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Freshwater Gobies of the Genus *Rhinogobius* from the Mekong Basin in Thailand and Laos, with Descriptions of Three New Species

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I-Shiung Chen, Maurice Kottelat and Peter J. Miller (1999) Freshwater gobies of the genus *Rhinogobius* from the Mekong Basin in Thailand and Laos, with description of three new species. *Zoological Studies* **38**(1): 19-32. Four valid species of the genus *Rhinogobius* Gill, 1859 occur in the Mekong basin in Thailand and Laos: *R. mekongianus* (Pellegrin and Fang, 1940), and 3 new species, *R. albimaculatus*, *R. lineatus*, and *R. taenigena*. The 4 species can be distinguished by their color patterns and different meristic characters.

Key words: Gobiidae, Fish taxonomy, Laos, Thailand, *Rhinogobius*.

The Asiatic freshwater goby genus *Rhinogobius* Gill (1859) is widely distributed on islands of the West Pacific including Japan (Masuda et al. 1984, Akihito et al. 1993), Taiwan (Tzeng 1986, Aonuma and Chen 1996, Chen and Shao 1996, Lee and Chang 1996, Chen et al. 1998), Hainan (Wu and Ni 1985, Chen 1994), and the Philippines (Chen and Miller unpubl. data), as well as within continental Asia in China, Vietnam, Laos, Cambodia, and Thailand (Chu and Wu 1965, Kottelat 1989, Chen and Miller 1998, Chen and Miller unpubl. data). The life histories of species of *Rhinogobius* indicate that the genus includes both diadromous and landlocked species (Mizuno 1960, Mizuno and Goto 1987, Chen 1994). There are at least 50 *Rhinogobius* species in East and Southeast Asia (Chen and Miller unpubl. data).

The taxonomic status of *Rhinogobius* species from mainland Southeast Asia has not yet been revised. All nominal *Rhinogobius* species were usually misplaced (Chu and Wu 1965) and often placed in the genus *Ctenogobius* Gill, 1858 following Herre (1935a,b) and Smith (1945). In fact, the genus *Ctenogobius* is restricted merely to the Atlantic Ocean region (Robins and Lachner 1966, Miller 1981), and most of the west Pacific freshwater species usually referred to the genus *Ctenogobius* before should belong to *Rhinogobius* (Chen 1994).

The Mekong is the longest river of Southeast Asia, originating in Tibet (Xizang) and flowing through Yunnan in south China, northern Burma, Laos, Thailand, Cambodia, and Vietnam. The first nominal *Rhinogobius* species known from the Mekong basin is *R. mekongianus* (Pellegrin and Fang, 1940) originally described from Laos. Later, Smith (1945) described *Ctenogobius cephalopardus* which has already been treated as a junior synonym of *R. mekongianus* by Kottelat (1982 1989). Recent field work in the Mekong basin of Thailand and Laos (Fig. 1) yielded 4 species of *Rhinogobius*: *R. mekongianus*, and 3 new species described below: *R. albimaculatus*, *R. lineatus*, and *R. taenigena*.

'*Rhinogobius*' *ocellatus* (Fowler, 1937) is the most common and abundant goby in the middle Mekong basin (Kottelat 1998 and unpubl. data, Chen and Miller unpubl. data). Fowler (1937) in fact described it as a species of '*Tukagobius*', an obvious mispelling of *Tukugobius* Herre, 1927. Our

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unpublished data indicate that although '*R.*' *ocellatus* is much closer to *Rhinogobius* than any other gobiid genus, this species could be regarded as a distinct genus (Chen, Kottelat and Miller unpubl. data) from *Rhinogobius* and will be reported elsewhere.

MATERIALS AND METHODS

Morphometric methods follow Miller (1988) and meristic methods follow Chen and Shao (1996). Terminology of cephalic sensory canals and free neuromast organs (sensory papillae) is from Miller (1986) and Wongrat and Miller (1991), based on Sanzo (1910). 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 1st dorsal fin to upper pectoral origin; TR, transverse scale series; V, pelvic fin; and VC, vertebral count. The specimens are deposited in the Australian Museum, Sydney (AMS); the Museum of the Institute of Zoology, Academia Sinica, Taipei (ASIZP); the collection of M. Kottelat, Cornol (CMK); Muséum national d´Histoire naturelle, Paris (MNHN); the National Museum of Marine Biology/Aquarium, Pingtung (NMMBP); and the Zoological Reference Collection, National University, Singapore (ZRC).

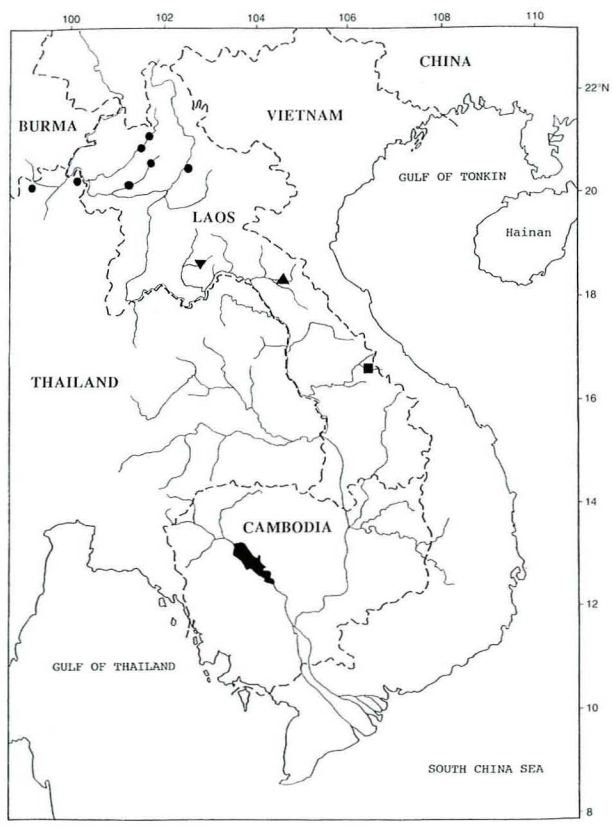

Fig. 1. Collection localities of four *Rhinogobius* species from the Mekong basin in Thailand and Laos. Circle: *R. mekongianus*; inverted triangle: *R. albimaculatus*; triangle: *R. lineatus*; and square: *R. taenigena*.

SYSTEMATICS

Rhinogobius Gill, 1859

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

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

Rhinogobius mekongianus (Pellegrin and Fang, 1940)

(Figs. 2, 3, 9, 13)

Gobius mekongianus Pellegrin and Fang, 1940: 122 (type locality: Ban Nam Kheung, Mekong basin, Laos).

Ctenogobius cephalopardus Smith, 1945: 546. (type locality: Doi Hua Mot in Huey Melao, a tributary of the Mekok, Mekong basin, Chiang Rai Prov., Thailand).

Ctenogobius mekongianus: Kottelat, 1982: 525.

Rhinogobius mekongianus: Kottelat, 1989: 19.

Materials: MNHN 39.261, 3 syntypes of *G. mekongianus*, 34.0 + 9.2-36.7 + 8.7 mm, Jan. 1939, Delacour, Greenway and Blanc, Ban Nam Kheung, Mekong basin, Laos. 20 specimens: 10 in CMK 4029, 21.4 + 5.1 - 38.0 + 10.5 mm, 24 March, 1983, Kottelat and Hobelman, Nam Mae Mao at Ban Huai Phak Phai, Mekong basin, Chiang Mai Prov., Thailand. 10 in ASIZP-057815-1, 32.0 + 8.7 mm; ASIZP-057815-2, 29.4 + 7.1 mm; ASIZP-057815-3, 29.6 + 6.4 mm; ASIZP-057815-4, 28.6 + 6.4 mm; ASIZP-057815-5, 28.8 + 6.5 mm; NMMBP-413-1, 28.0 + 6.5 mm; NMMBP-413-2, 27.0 + 6.5 mm; NMMBP-413-3, 24.2 + 5.4 mm; NMMBP-413-4, 22.6 + 5.4 mm; and NMMBP-413-5, 22.5 + 4.9 mm; all on 15 June 1996, I-S. Chen, a small hill tributary of the Mekong basin, 8 km SE of Chiang Khong, Chiang Rai Prov., Thailand.

Additional materials (not included in counts and measurements): AMS I.2973001, 3 specimens, 32.9 + 7.0-36.0 + 9.2 mm, data same as CMK 4029. CMK 14028, 19 specimens, 19.9 + 4.0-43.1 + 10.0 mm; 11 May 1997, gorges of Houay Houn, about 3 km upstream of Ban Houway Lek, Nam Ou watershed, Mekong basin, Loung Phabang Prov., Laos. CMK 14217, 9 specimens, 18.9 + 4.2-38.6 + 9.7 mm, 19 May 1997, Nam Beng about 3 km NNE

Nateuy, Nam Tha watershed, Mekong basin, Louang Nam Tha Prov., Laos. CMK 14255, 7 specimens, 15.8 + 3.7-34.7 + 8.5 mm, 21 May 1997, Nam Tha about 9 km SSE of Louang Nam Tha, Mekong basin, Louang Nam Tha Prov., Laos. CMK 14305, 8 specimens, 24.1 + 6.4-36.0 + 8.5 mm, 22 May 1997, Nam Luang about 1 km upstream of Ban Namlueng, Nam Tha watershed; Mekong baisn, Louang Nam Tha Prov., Laos.

Diagnosis: *Rhinogobius mekongianus* is distinguished by the combination of the following characters: 2nd dorsal fin rays modally I/8, anal fin rays modally I/7; and pectoral fin rays modally 16; vertebral count 11 + 17 = 28; body with 7 blackish-brown blotches and 5-6 longitudinal rows of black or brown spots; and male with about 40 rounded blackish-brown spots on cheek usually larger than half of pupil.

Description: Body cylindrical anteriorly and compressed posteriorly. Body proportions as in Table 1. Head moderately large, more depressed in male. Eye large, dorsolateral. Snout slightly pointed. Bony interorbital narrow. Cheek fleshy in male. Lips thick. Mouth oblique, its rear edge reaching the middle vertical of orbit in male, but just extending to the vertical line of anterior edge of pupil in female. Both jaws with 3-4 rows of conical teeth, and outer row enlarged. Tongue tip rounded, unnotched. Anterior nostril a short tube and posterior one a round hole. Gill-opening extending to the rear edge of preopercle. Isthmus broad. 11 + 17 = 28 vertebrae (in 10 specimens).

Fins. D1 VI-VII; D2 1/7-9; A I/6-8; P 15-17; V I/5 + I/5 (frequency as in Table 2). Fin bases and lengths as in Table 1. D1 II and III longest, with D1 rear tip reaching 1st branched rays of D2 base when depressed in male; but not reaching origin of

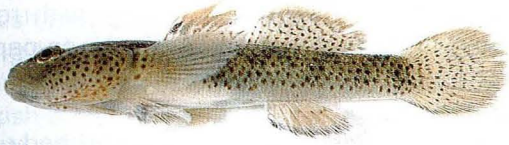

Fig. 2. *Rhinogobius mekongianus*, male, 38.4 mm SL, Thailand.

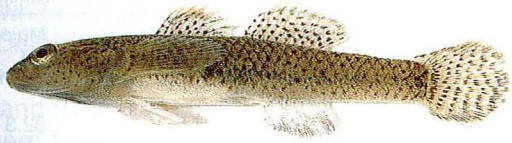

Fig. 3. *Rhinogobius mekongianus*, female, 36.2 mm SL, Thailand.

Fig. 4. *Rhinogobius albimaculatus*, male, CMK 13360-5, 42.2 mm SL, paratype, Laos.

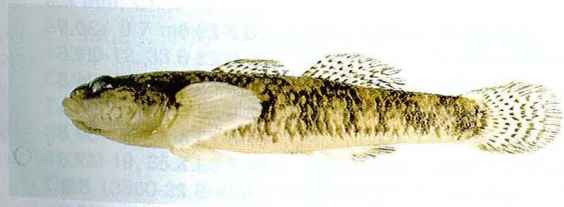

Fig. 5. *Rhinogobius albimaculatus*, female, ZRC 45289, 35.0 mm SL, paratype, Laos.

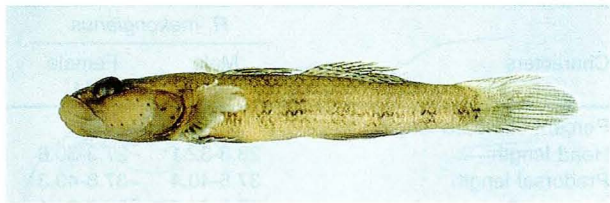

Fig. 6. *Rhinogobius lineatus*, male, ZRC 45290, 33.2 mm SL, holotype, Laos.

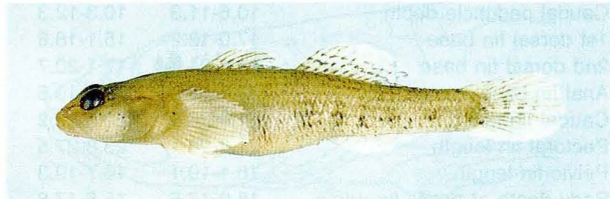

Fig. 7. *Rhinogobius lineatus*, female, CMK 12507-4, 36.7 mm SL, paratype, Laos.

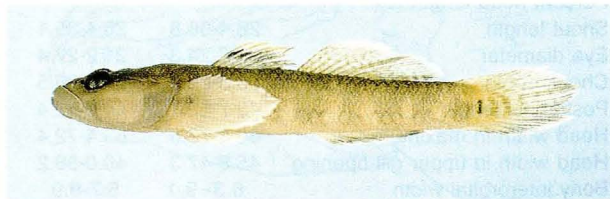

Fig. 8. *Rhinogobius taenigena*, male, ZRC 45293, 30.1 mm SL, holotype, Laos.

V I/5 + I/5 (frequency distribution as in Table 2). Fin bases and lengths as in Table 1. D1 II and III longest, with D1 rear tip reaching 1st branched rays of D2 base when depressed in male; but not reaching origin of D2 in female. D2 and A rear tips not reaching the procurrent rays of C. A origin inserted below 2nd branched rays of D2. P oblong, the rear tip extending to the vertical of anus in male but not reaching anus in female; and with 1st and last rays unbranched. V disc rounded, spinous rays with pointed membranous lobe. C elliptical, with round rear margin.

Scales. Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal region and belly cycloid; scales in longitudinal series 29-31; transverse series 8-9; predorsal median series 4-6; series between 1st dorsal and upper pectoral fin origin 6-7 (frequency distribution as in Table 3). Head including opercle, prepectoral, and prepelvic area naked. Predorsal squamation with somewhat truncate anterior edge, anterior tip of predorsal middle squamation reaching to the opposite above posterior oculoscapular canal.

Head lateral-line system. Canals: Nasal extension of anterior oculoscapular canal with terminal pores σ near the line of rear end of anterior nostril. Anterior interorbital region of oculoscapular canal not united, with paired pores λ. A single pore κ in posterior interorbital region. Pore ω present at posterodorsal edge of eye. Posteriorbital anterior oculoscapular canal with pore α, and terminal pore ρ but pore β lacking; posterior oculoscapular canal present (terminal pores θ and τ), the distance between pores θ and τ larger than that between interorbital pores λ. Preopercular canal present with pores γ, δ, and ε. Sensory papillae: Row *a* extending forward to the middle vertical of orbit. Length of row *b* about equal to orbit. Rows *c* and *d* long, with row *c* reaching vertical of pore α. A single *cp* papilla. Row *f* paired. Opercular rows *ot* and *oi* well separated. Other details as in Fig. 9.

Coloration when fresh: Head and body light

Table 1. Morphometry of four *Rhinogobius* species in the Mekong basin from Thailand and Laos

Characters	*R. mekongianus*		*R. albimaculatus*		*R. lineatus*		*R. taenigena*
	Male	Female	Male	Female	Male	Female	Male
	7	11	7	15	2	2	1
Percent standard length (%)							
Head length	28.3-32.1	27.3-30.8	29.7-32.6	26.7-29.3	29.6-30.8	24.6-26.4	32.3
Predorsal length	37.5-40.4	37.8-40.3	38.0-41.9	36.6-40.4	37.7-40.2	35.8-36.0	38.2
Snout to 2nd dorsal origin	57.0-64.5	56.8-61.1	56.9-61.4	57.7-61.1	57.7-59.2	57.2-58.3	63.0
Snout to anus	56.6-63.8	53.5-60.2	61.4-63.8	60.7-66.0	61.5-61.8	56.9-58.5	64.2
Snout to anal fin origin	61.1-68.0	60.3-66.0	56.2-57.4	54.9-60.2	57.0-57.9	63.5-64.6	60.6
Prepelvic length	29.2-32.8	26.5-31.1	29.6-32.2	26.0-28.5	30.1-31.0	25.5-27.0	31.5
Caudal peduncle length	23.1-26.5	21.5-29.6	23.9-26.1	21.6-26.8	26.1-26.6	26.9-27.0	25.0
Caudal peduncle depth	10.6-11.3	10.3-12.3	9.4-11.4	9.5-11.1	10.0-10.5	10.0-10.2	11.6
1st dorsal fin base	17.0-18.2	15.1-18.6	15.0-16.8	15.3-18.0	15.2-17.9	15.7-16.9	15.0
2nd dorsal fin base	18.3-21.5	17.1-20.7	19.7-21.8	16.8-21.2	19.3-20.1	17.8-19.1	22.3
Anal fin base	12.4-14.9	12.4-15.5	14.6-16.6	13.6-16.9	14.1-14.8	14.1-14.2	19.8
Caudal fin length	21.9-28.0	22.0-26.2	23.8-27.4	20.6-26.1	24.1-28.9	21.7-22.9	27.0
Pectoral fin length	21.9-28.1	23.8-27.5	24.1-29.0	22.2-28.4	22.9-25.4	21.3-22.9	25.7
Pelvic fin length	16.1-19.1	16.7-19.3	16.7-20.7	16.6-23.3	15.3-17.3	15.3-15.5	18.3
Body depth at pelvic fin origin	15.9-17.5	15.6-17.8	12.9-16.5	14.2-17.7	13.5-13.8	14.9-15.0	13.9
Body depth at anal fin origin	15.2-17.1	15.2-17.2	13.5-14.6	14.0-16.4	12.8-13.1	14.2-14.5	14.3
Body width at anal fin origin	10.9-12.5	10.9-12.9	8.6-11.3	9.9-12.9	9.5- 9.7	10.5-11.6	11.0
Pelvic fin origin to anus	26.3-32.4	26.3-33.9	25.8-30.0	28.5-33.9	25.3-28.8	32.0-33.0	29.3
Percent head length (%)							
Snout length	28.4-36.8	26.4-35.1	31.2-34.4	28.3-30.4	28.8-34.4	28.3-29.6	30.9
Eye diameter	21.2-24.3	21.2-27.4	16.9-22.9	21.6-24.3	20.0-20.6	22.5-23.6	21.6
Cheek depth	25.3-28.3	21.5-28.5	20.9-33.7	20.0-28.0	23.6-28.7	26.7-29.4	24.3
Postorbital length	45.7-52.1	44.0-52.4	48.0-56.7	44.8-52.8	43.5-51.6	52.0-58.0	50.1
Head width in maximum	60.5-72.8	63.4-72.4	58.3-76.5	59.2-74.2	63.8-71.1	67.8-72.5	57.8
Head width in upper gill-opening	45.8-47.3	49.0-58.2	43.3-50.4	46.7-56.4	44.7-47.1	51.7-53.7	47.3
Bony interorbital width	6.3- 9.1	5.7-9.9	6.2- 8.4	4.4- 8.0	6.0- 6.2	6.0- 6.2	8.9
Fleshy interorbital width	15.4-21.7	15.7-22.9	13.0-19.6	13.4-23.7	20.7-22.6	19.6-24.3	20.6
Lower jaw length	35.9-46.1	34.1-37.9	41.3-47.8	30.7-37.6	41.4-44.1	33.6-37.2	42.4

brown or brown; body usually with 7 vertical blackish-brown blotches, and some individuals with smaller blotches. Bands are usually wider than the interspaces. Dorsal side of body from nape to caudal peduncle with 5 blackish-brown blotches. Body scale pockets with brown margins, darker on dorsal half. Lateral body always with 5-6 longitudinal rows of blackish-brown round spots, but some females with fewer rows of them. Belly whitish. Cheek and opercle always with 35-45 blackish-brown round spots, most of them larger than 1/2 of eye diameter in male, and with fewer or smaller spots in female. Dorsal side of snout with paired reddish-brown lines on both sides from anterior margin of orbit via pore σ closely toward snout tip. D1 with black blotch on the middle of membrane in front of 2nd spinous rays, with few blackish-brown spots on posterior part in male; but having blackish-brown spots and blotch always absent in female. D2 with 4 horizontal rows of blackish-brown spots or stripes. C with vertical or slightly oblique rows of brown spots or lines. P base with two rows of brown spots or lines. P base with about 2 rows of black spots in adult male but fewer spots in female; and basal part of P with a light semi-circular mark. V disc dusky, pigmented with white margin in male, and whitish in female.

Distribution: This species was collected from several localities in the Mekong basin in northern Thailand (Chiang Mai and Chiang Rai Provs.) and northern Laos (Louang Nam Tha, Oudomxai, and Louang Phabang Provs.). It has been collected both in small streams and larger rivers, among stones and boulders, with moderate to swift current.

Rhinogobius albimaculatus **sp. nov.**

(Figs. 4, 5, 10, 14)

Holotype. ZRC 45288, 43.8 + 11.4 mm; 28 Feb. 1997, M. Kottelat et al., Houay Sala Yai, a tributary of Nam San, Mekong basin, Vientiane Prov., 18°35'17"N 103°05'00"E, Laos.

Paratypes. 21 specimens. ZRC 45289, 2 specimens, 35.0 + 8.0-47.5 + 11.5 mm; CMK 13360-4, 43.7 + 10.4 mm; CMK 13360-5, 42.2 + 11.3 mm; CMK 13360-6, 47.1 + 12.3 mm; CMK 13360-7, 36.1 + 8.2 mm; CMK 13360-8, 33.5 + 8.3 mm; CMK 13360-9, 35.1 + 9.7 mm; CMK 13360-10, 37.1 + 9.7 mm; CMK 13360-11, 35.0 + 7.8 mm; CMK 13360-12, 33.6 + 7.7 mm; CMK 13360-13, 34.1 + 8.2 mm; CMK 13360-14, 34.4 + 9.4 mm; CMK 13360-15, 35.3 + 7.6 mm; CMK 13360-16, 37.7 + 8.0 mm; CMK 13360-17, 33.9 + 7.7 mm; CMK 13360-18, 39.7 + 8.2 mm; CMK 13360-19, 35.2 + 7.9 mm; CMK 13360-20, 33.5 + 7.4 mm; CMK 13360-21, 34.6+8.3 mm; and CMK 13360-22, 31.4 + 7.1 mm; all data same as above.

Diagnosis: *Rhinogobius albimaculatus* is distinguished by the combination of characters: 2nd dorsal fin rays modally I/9, and anal fin rays I/7; and pectoral fin rays modally 15; vertebral count 10 + 18 = 28; body with 5 or 6 lateral blackish-brown blotches; and male with long filamentous rays in 1st dorsal fin and cheek with about 40 small rounded white spots.

Description: Body cylindrical anteriorly and compressed posteriorly. Body proportions as in Table 1. Head moderately large, and depressed in male. Eye large, dorsolateral. Snout longer in male than in female. Bony interorbital narrow. Cheek very fleshy in adult male. Lips thick, and especially in male with projecting lateral side of upper lip. Mouth oblique, and maxillary not extending beyond the middle vertical of orbit. Both jaws with 3-4 rows of conical teeth, and outer row enlarged. Tongue tip rounded, unnotched. Anterior nostril a short tube and posterior one a hole. Gill-opening extending near the rear vertical line of preopercle. Isthmus broad. 10 + 18 = 28 vertebrae (in 22 specimens).

Fins. D1 VI; D2 I/9-10; A I/7; P 15-16; V I/5 + I/5 (frequency distribution as in Table 2). Fin bases

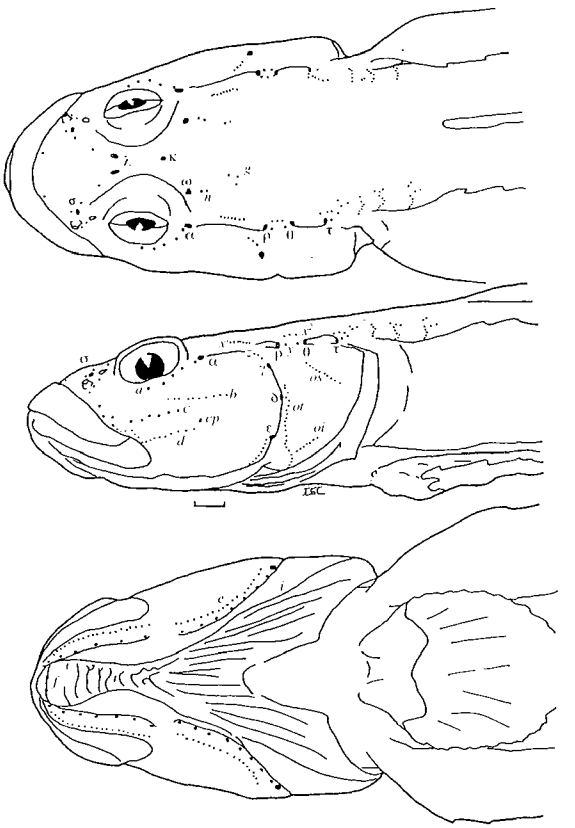

Fig. 9. Head lateral-line system of *Rhinogobius mekongianus*, 36.8 mm SL, Thailand.

and lengths as Table 1. D1 III and IV longest and filamentous, with D1 rear tip reaching beyond 3rd or 4nd branched rays of D2 when depressed in male, but not reaching D2 origin in female. The posterior 2 or 3 rays of D2 and A longest in male. D2 and A rear tips almost extending to or beyond the procurrent rays of C in adult male; but not reaching C base in female. A origin inserted below 2nd branched rays of D2. P oblong, the rear tip extending to the vertical of anus in male but not reaching the anus in female; 1st and last rays unbranched. V disc rounded, spinous rays with pointed membranous lobe. C elliptical with rounded rear edge.

Scales. Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal region and belly cycloid; scales in longitudinal series 29-31; transverse series 8-10; predorsal median series 6-11; series between 1st dorsal and upper pectoral fin origin 6-8 (frequency distribution as in Table 3). Head including opercle, prepectoral, and prepelvic area naked. Predorsal squamation always with truncate anterior edge, anterior tip of predorsal middle squamation reaching above and between pores θ and τ in male, but slightly beyond pore θ in female. Tips of lateral squamation not extending toward pore ρ.

Head lateral-line system. Canals: Nasal extension of anterior oculoscapular canal present, with terminal pores σ slightly in front of posterior nostril. Anterior interorbital part of oculoscapular canal not united, with paired pores λ. A single pore κ in posterior interorbital region. Pore ω present at posterodorsal edge of eye. Posteriorbital anterior oculoscapular canal with pore α, and terminal pore ρ but without pore β. Posterior oculoscapular canal present (terminal pores θ and τ), the distance between pores ρ and θ somewhat less than that between interorbital pores λ. Preopercular canal present with pores γ, δ, and ε. Sensory papillae: Row *a* extending to the middle vertical of eye. Row *b* short, about equal to orbit. Rows *c* and *d* long,

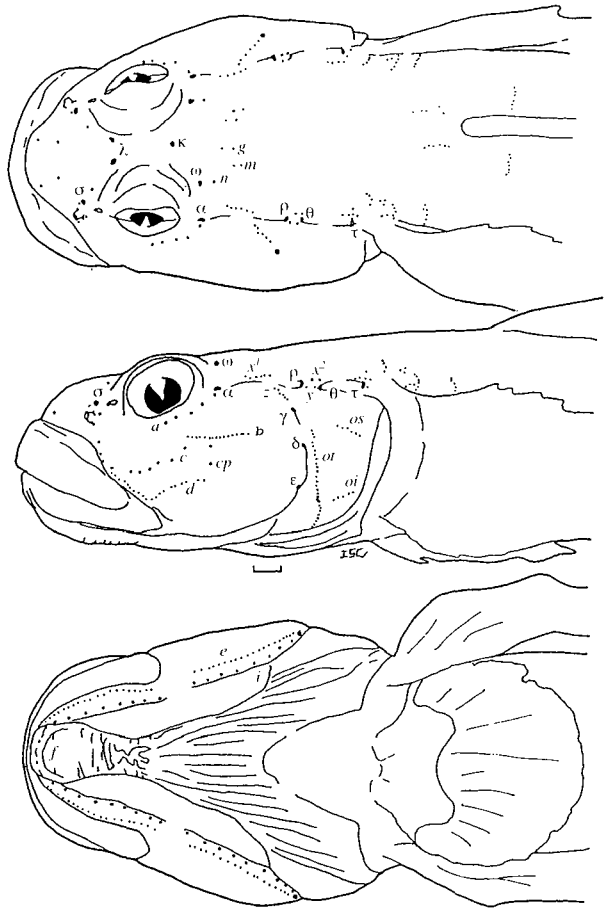

Fig. 10. Head lateral-line system of *Rhinogobius albimaculatus*, ZRC 45288, 43.8 mm SL, holotype.

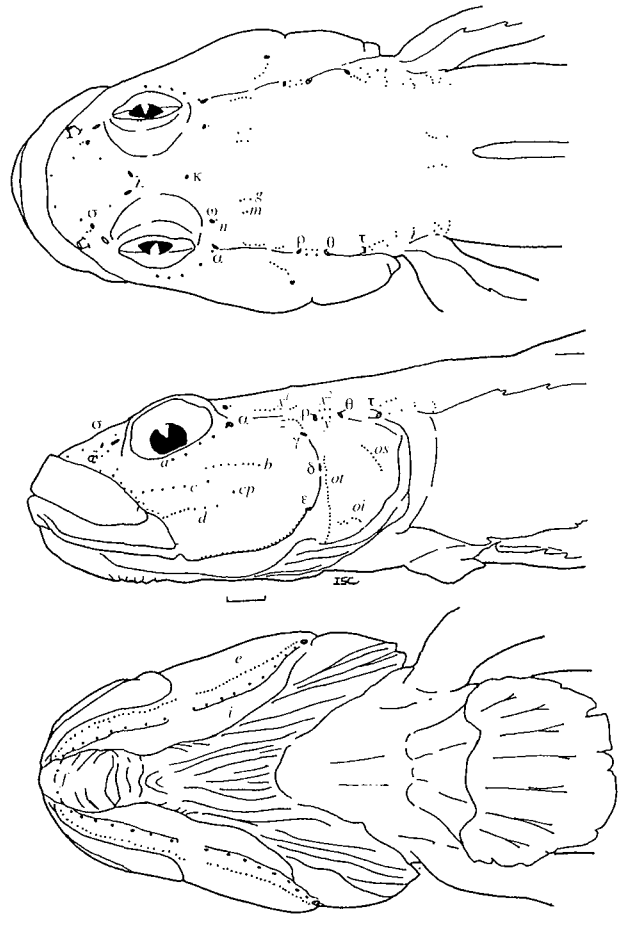

Fig. 11. Head lateral-line system of *Rhinogobius lineatus*, ZRC 45291, 33.2 mm SL, paratype.

but not reaching beyond the vertical of pore α. A single *cp* papilla. Row *f* paired. Opercular rows *ot* and *oi* separated. Other details as in Fig. 10.

Coloration when fresh: Observations from color slides taken of freshly preserved specimens. Head and body with yellowish-brown background. Scale pockets on lateral side with brown or dark brown margin. Body with 5 or 6 vertical blackish-brown blotches on lateral side. Dorsal side of body from nape to caudal peduncle with 5 dark brown blotches. Belly pale yellow. Coloration on cheek and opercle sexually dichromatic. In male, cheek and opercle with irregular deep-brown short bars or stripes on 1/3 and with 30-45 small milky-white round spots on dark brown background on ventral 2/3 and the round spots scattered downward across the branchiostegal membrane. In the female, cheek and opercle with irregular short blackish-brown lines or bars, some of them connected to others, and branchiostegal membrane unmarked. Snout with a pair of brown lines from anterior margin of eye through pore σ to snout tip. Snout below nostrils and upper cheek with 2 brown stripes, the former from anterior margin of orbit crossing toward upper lip and the latter, broader one along lower margin of eye to upper lip. D1 grayish brown with 2 elongate black blotches on middle of fin membranes from 1st to 3rd spinous rays in male, but with 2 rows of dark brown spots in female. D2 with 4 to 5 rows of dark brown spots in female. C with 5 to 7 rows of vertical blackish-brown stripes or spots. A dusky brown with a submarginal black band with white margin in male but A whitish in female. P with a light basal, semi-circular mark, and its base with several round spots on background of broad brown band in male; but with just small brown bar or spot in female. V disc dusky black pigmented in male, and whitish in female.

Distribution: This species has been collected only in the Nam San basin (a tributary of Nam Ngum Reservoir) in the Mekong basin of Laos. It was collected in headwaters with relatively fast water, in riffles, among large gravel.

Etymology: The specific name, '*albimaculatus*'

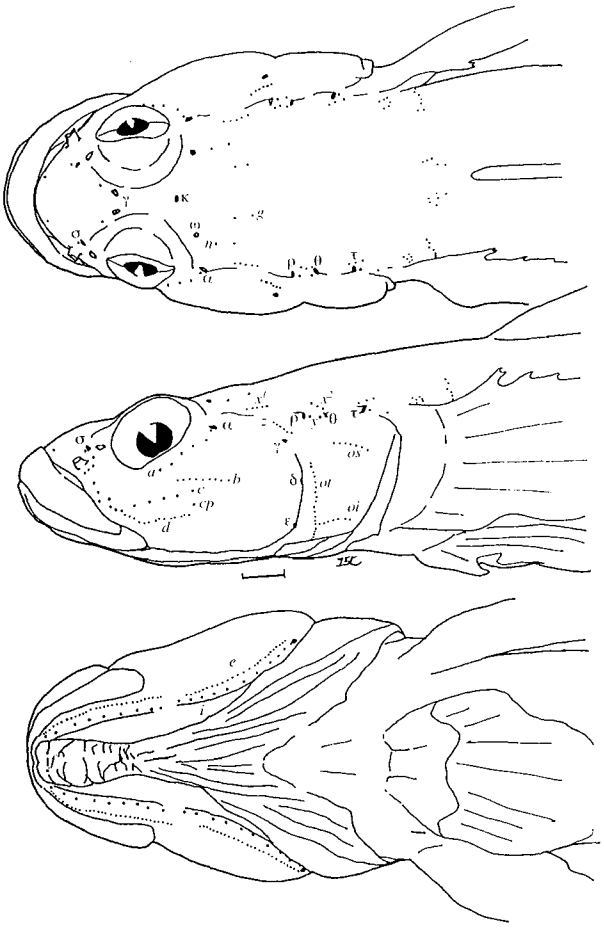

Fig. 12. Head lateral-line system of *Rhinogobius taenigena*, ZRC 45293, 30.1 mm SL, holotype.

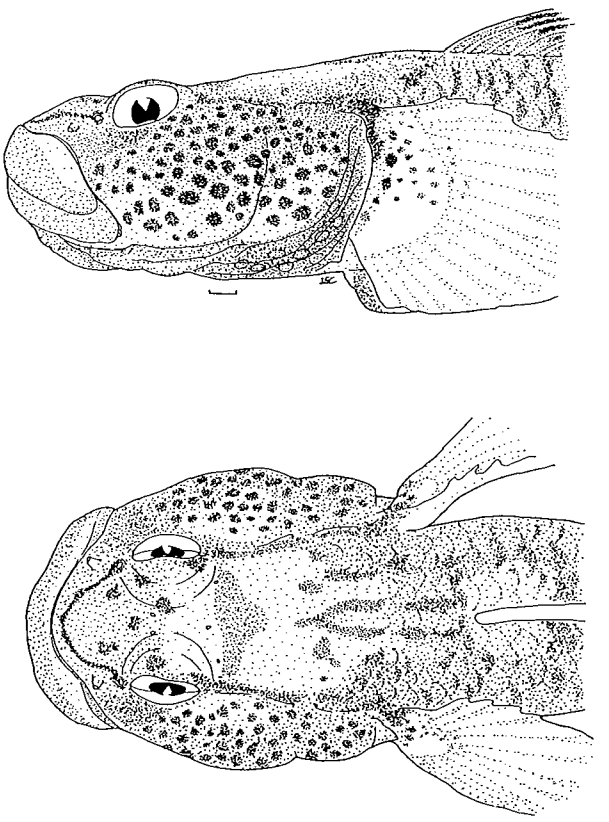

Fig. 13. Cephalic patterns of *Rhinogobius mekongianus*, male, CMK 4029, 37.5 mm SL.

is derived from the Latin *albus* (white) and *maculatus* (spotted)', a reference to the diagnostic white spots on the cheek of adult male. An adjective.

Remarks: Although this species shares similarity of color pattern on the cheek in females with that of *R. chiengmaiensis* Fowler, 1934 which occurs in the upper Chao Phraya basin, they can

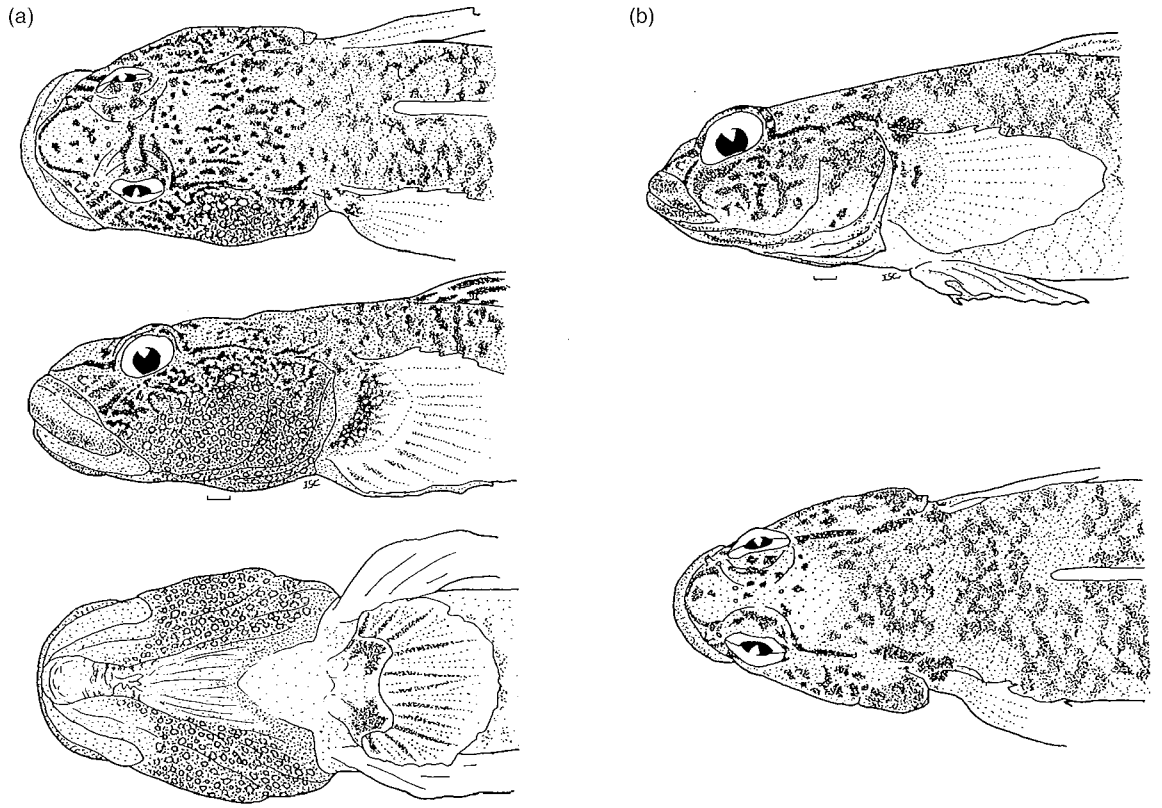

Fig. 14. Cephalic patterns of (a) male, ZRC 45288, 43.8 mm SL, holotype and (b) female, ZRC 45289, 47.5 mm SL, paratype of *Rhinogobius albimaculatus*.

Table 2. Frequency distribution of fin ray counts from four *Rhinogobius* species of the Mekong basin

	D1		D2				A			P		
	VI	VII	I/7	I/8	I/9	I/10	I/6	I/7	I/8	15	16	17
R. mekongianus	22	1	2	20	1	–	3	19	1	6	14	3
R. albimaculatus	22	–	–	–	18	4	–	22	–	15	7	–
R. lineatus	4	–	–	–	4	–	–	4	–	1	3	–
R. taenigena	2	–	–	1	1	–	–	–	2	1	1	–

Table 3. Frequency distribution of scale series from four *Rhinogobius* species of the Mekong basin

	LR				TR			PreD								SDP			
	29	30	31	32	8	9	10	4	5	6	7	8	9	10	11	5	6	7	8
R. mekongianus	11	10	2	–	12	11	–	1	16	6	–	–	–	–	–	–	20	3	–
R. albimaculatus	5	10	7	–	1	16	5	–	–	1	4	3	4	9	1	–	4	16	2
R. lineatus	1	1	–	2	–	1	3	–	–	3	1	–	–	–	–	–	3	1	–
R. taenigena	2	–	–	–	–	2	–	–	–	–	–	–	–	1	1	1	1	–	–

be easily distinguished by these characters in the male: (1) first dorsal fin rays: *R. albimaculatus* with filamentous rays vs. *R. chiengmaiensis* without filamentous rays; and (2) color pattern of cheek: *R. albomaculatus* with about 40 rounded white spots vs. *R. chiengmaiensis* with minute red spots.

***Rhinogobius lineatus* sp. nov.**
(Figs. 6, 7, 11, 15)

Rhinogobius mekongianus: Kottelat, 1998 (not Pellegrin and Fang): 115, fig. 18.

Holotype: ZRC 45290, 33.2 + 9.6 mm, 25 March 1996, M. Kottelat et al., rapids on the Nam Gnouang, a tributary entering the Nam Theun downriver of Ban Thabak, Nam Theun basin, Mekong basin, Bolikhamxai Prov., 18°16'50"N, 104°38'00"E, Laos.

Paratypes: 4 specimens. 3 in ZRC 45291, 35.8 + 8.6 mm; CMK 12507-3; 38.2 + 8.8 mm; CMK 12507-4; 36.7 + 8.0 mm; data same as above. 1 in CMK 12794, 25.4 + 6.1 mm, 24 March, 1996, M. Kottelat et al., rapids about 17 km upriver of Ban Thabak bridge, Nam Theun basin, Mekong basin, Khammouan Prov., Laos.

Diagnosis: *Rhinogobius lineatus* can be distinguished by the following combination of characters: 2nd dorsal fin rays modally I/9; anal fin rays I/7; pectoral fin rays modally 16; vertebral count 11 + 17 = 28; body with 5 or 6 lateral pale brown blotches and 6-7 brown longitudinal lines; and cheek with 10-14 tiny black dots.

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

Fins. D1 VI; D2 1/9; A I/7; P 15-16; V I/5+I/5 (frequency distribution as in Table 2). Fin bases and lengths as in Table 1. D1 III and IV longest, without any filamentous elongation, and its rear tip reaching origin of D2 base when depressed. D2 slightly higher than D1. D2 and A rear tips not reaching C base. A origin inserted below and between 2nd and 3rd branched rays of D2. P oblong, the rear tip reaching the vertical of anus in male, but not reaching the vertical in female; and its 1st and last rays unbranched. V disc rounded,

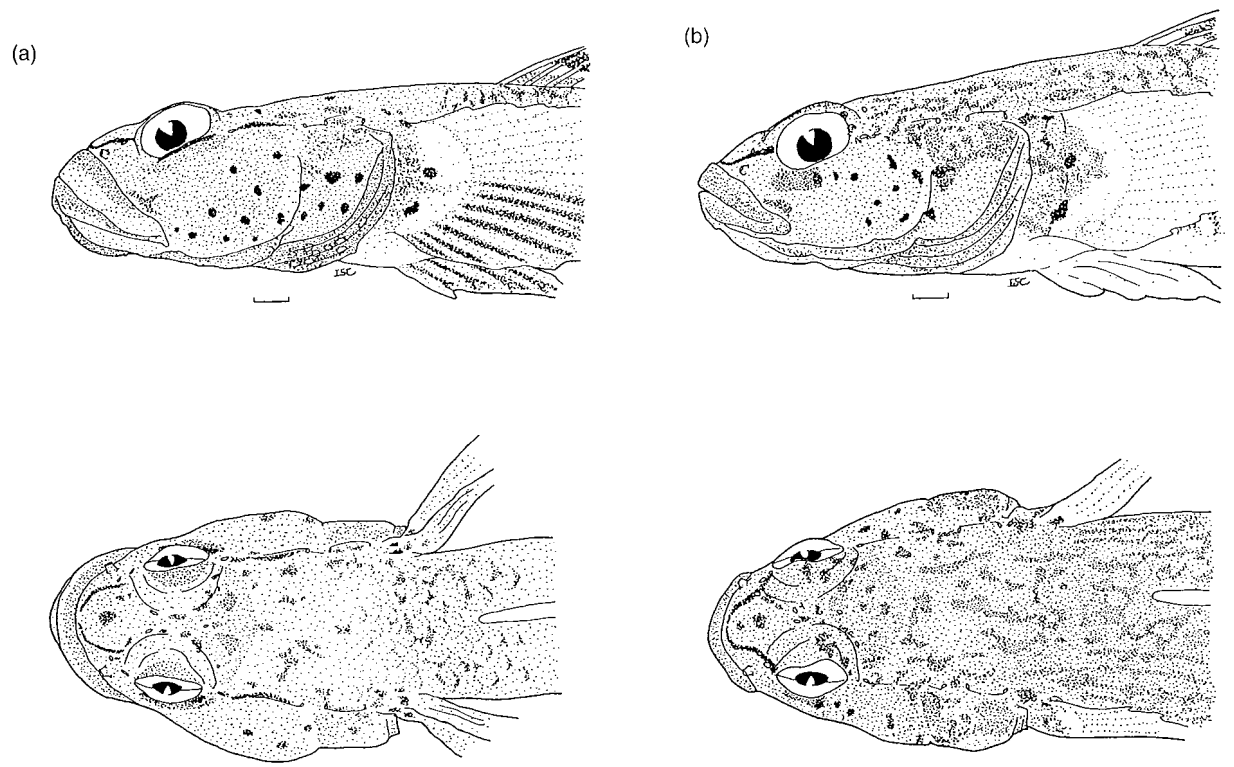

Fig. 15. Cephalic patterns of (a) male, ZRC 45291, 35.8 mm SL. paratype and (b) female, CMK 12507-3, 38.2 mm SL, paratype, of *Rhinogobius lineatus*.

spinous rays with pointed membranous lobe. C elliptical, rear margin rounded.

Scales. Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal area and belly cycloid; scales in longitudinal series 29-32; transverse series 9-10; predorsal median series 6-7; series between 1st dorsal and upper pectoral fin origin 6-7 (frequency distribution as in Table 3). Head including opercle, prepectoral and prepelvic areas naked. Predorsal squamation with bifurcate anterior edge, anterior tip of predorsal middle squamation not extending beyond or just to the opposite of pores τ; but tips of lateral squamation extending above the posterior oculoscapular canal.

Head lateral-line system. Canals: Nasal extension of anterior oculoscapular canal with terminal pores σ slightly in front of posterior nostril.

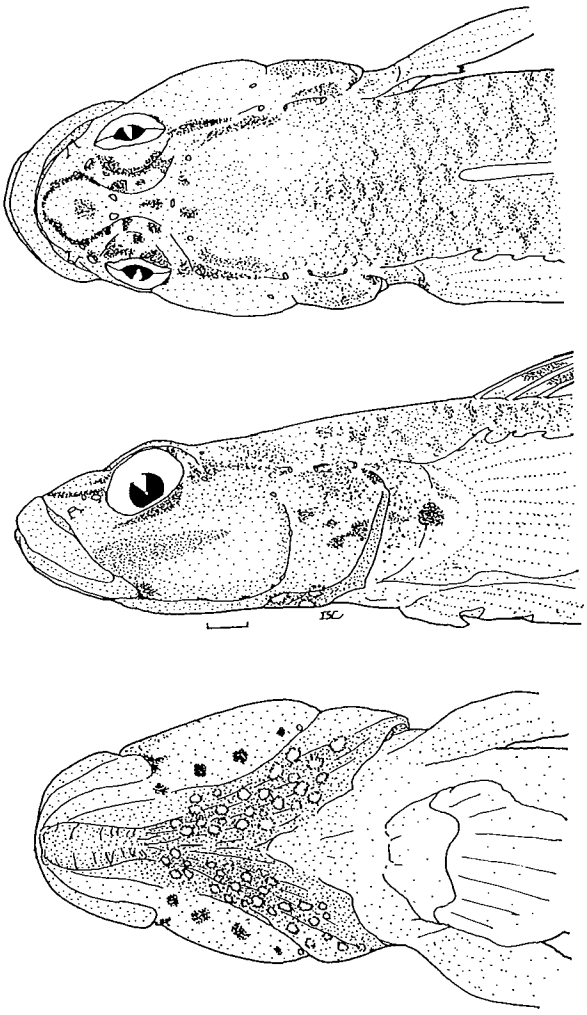

Fig. 16. Cehalic pattern of male *Rhinogobius taenigena*, ZRC 45293, 30.1 mm SL, holotype.

Anterior interorbital sections of oculoscapular canal separated, with paired pores λ. A single pore κ in posterior interorbital region. Pore ω present at posterodorsal edge of eye. Posteriorbital anterior oculoscapular canal with pore α, and terminal pore ρ but pore β lacking; posterior oculoscapular canal present (terminal pores θ and τ), the distance between pores ρ and θ about equal to that between interorbital pores λ. Preopercular canal present with pores γ, δ, and ε. Sensory papillae: Row *a* extending to the middle vertical of orbit. Row *b* slightly shorter than orbit. Rows *c*, *d* long, but not reaching to vertical of pore *α*. A single *cp* papilla. Row *f* paired. Opercular rows *ot* and *oi* slightly connected. Other details as in Fig. 11.

Coloration when fresh. Observation from color slides taken of freshly preserved specimens. Head and body light yellowish brown; body with 6 to 7 pale blackish-brown, and discontinuous longitudinal lines (somewhat indistinct in ventral part), and also 6 to 7 blackish brown lateral blotches. C base with 2 to 3 brown spots. Belly pale yellowish white. Cheek and opercle with 11 to 14 black round spots in both sexes, and female with a small square gray blotch beneath orbit. Snout with 2 dark brown lines from anterior margin of eye through posterior nostril toward snout tip. A distinct dark brown stripe ranging horizontally from pore α to pore ρ above cheek. Branchiostegal membrane unmarked. D1 with a broad blackish-brown band, and 2 or 3 blackish spots from 1st to 3rd or 4th spinous rays in male, but with 2 rows of brown spots in female. D2 with 3 rows of horizontal dark brown spots. C with 3 to 5 rows of brown vertical stripes or spots. A with a submarginal black band in male vs. whitish in female. P base with 2 deep-black spots and basal part of P with a milky-white basal, semi-circular mark in male, but pale brown in female. V disc membrane dusky black pigmented with white margin in male, but unmarked in female.

Distribution: This species has been collected only in the lower Nam Theun and in the Nam Gnouang, a tributary of the Nam Theun, in the Mekong basin of Laos. It was found among large gravel and rocks, in rapids.

Etymology: The specific name, '*lineatus*', from the Latin *lineatus* (lined, striped) refers to the diagnostic feature of the 6 or 7 longitudinal brown lines. An adjective.

Remarks: *Rhinogobius lineatus* is more similar to *R. mekongianus* than to other species based on the presence of dark brown or black spots on the cheek in both sexes. They can be distinguished by the following characters: (1) 2nd dorsal fin rays I/9

in *R. lineatus* vs. modally I/8 in *R. mekongianus*; (2) cheek with 10-14 loosely and widely arranged black spots vs. 35-45 densely-set larger black spots; and (3) body with 6-7 longitudinal brown lines vs. without longitudinal stripes.

Rhinogobius taenigena sp. nov.

(Figs. 8, 12, 16)

Holotype: ZRC 45293, 30.1 + 8.2 mm, 30 April 1997, M. Kottelat et al., Xe Pon between rapids upstream and downstream of Ban Fuang, Xe Bang Hiang basin, Mekong basin, Savannakhet Prov., 16°37'06"N, 106°33'30"E, Laos.

Paratype: CMK 13750, 18.2 mm, other data same as holotype.

Diagnosis: *Rhinogobius taenigena* is distinguished by the following combination of characters: 2nd dorsal fin rays I/8-9; and anal fin rays I/8; pectoral fin rays 15-16; vertebral count 10 + 17 = 27; body with 5 or 6 lateral pale brown square blotches; and male with a horizontal grayish stripe on cheek and 4 small blackish-brown spots on ventral edge of cheek.

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

Fins. D1 VI; D2 1/8-9; A I/8; P 15-16; V I/5 + I/5. Fin bases and lengths as in Table 1. D1 III and IV longest, with D1 rear tip reaching origin of D2 base when depressed. D2 slightly higher than D1. D2 and A rear tips not reaching C base. A origin inserted below 3rd branched rays of D2. P oblong, the rear tip extending to the vertical of anus with 1st and last rays unbranched. V disc rounded, spinous rays with pointed membranous lobe. C elliptical, rear margin rounded.

Scales. Body with moderately large ctenoid scales, anterior predorsal area naked; posterior predorsal region and belly cycloid; scales in longitudinal series 29; transverse series 9; predorsal median series 10-11; series between 1st dorsal and upper pectoral fin origin 5-6. Head including opercle, prepectoral and prepelvic areas naked. Predorsal squamation with trifurcate anterior edge, anterior tip of predorsal middle squamation reaching to the opposite pores θ; but tips of lateral squamation just above pore τ.

Head lateral-line system. Canals: Nasal extension of anterior oculoscapular canal with terminal pores σ slightly in front of posterior nostril. Anterior interorbital sections of oculoscapular canal not united, with paired pores λ. A single pore ω in posterior interorbit. Pore ω present at posterodorsal edge of eye. Posteriorbital anterior oculoscapular canal with pore α and terminal pore ρ, but pore β lacking; posterior oculoscapular canal present (terminal pores θ and τ), the distance between pores ρ and θ about equal to that between interorbital pores λ. Preopercular canal present with pores γ, δ, and ε. Sensory papillae: Row *a* extending forward to the middle vertical of orbit. Row *b* slightly shorter than orbit. Rows *c* and *d* long, but not reaching to vertical of pore α. A single *cp* papilla. Row *f* paired. Opercular rows *ot* and *oi* connected. Other details as in Fig. 12.

Coloration when fresh. Observations from the color slides taken of freshly preserved specimens. Head and body pale yellowish brown; body with 7 vertical blackish-brown, somewhat square bands. The bands wider than interspaces. Dorsal side of body uniformly dark brown, belly pale yellow. C base with short, vertically black bar. Cheek with a dark gray, elongate but somewhat triangular blotch; opercle with a gray horizontal line. Dorsal side of snout with a V-shaped, brown stripe. A horizontal, brown stripe extending from pore α to pore ρ. Ventral margin of cheek with 4 blackish-brown spots. Branchiostegal membrane with white, round spots which probably were originally orange or red in live male. D1 with 2 black spots on middle of fin membranes before 3rd spinous rays. D2 with 5 rows of dark brown spots. C with 4 pale brown vertical stripes. A with a submarginal black band. P with a light basal, semi-circular mark, and a deep-black rounded spot on middle of its base. V disc slightly grayish with white margin.

Distribution: This species is known from two specimens collected from the Xe Pon (a tributary of the Xe Bang Hiang) in the Mekong basin in Laos. Part of the Xe Pon basin is in Vietnam and as this species was collected only a few kilometer downstream of the Vietnamese border, the species is expected to occur in Vietnam too. The species is possibly endemic to the Xe Bang Hiang basin.

Etymology: The specific name '*taenigena*' is derived from the Latin *taenia* (band) and *gena* (cheek); it refers to the diagnostic horizontal band on the cheek. A noun in apposition.

Remarks: This species seems close to *R. duospilus* (Herre, 1935a) originally described from Hong Kong with which it shares the presence of a

horizontal brown or gray stripe on the cheek and at least 1 black spot on the pectoral fin base. However, they can be distinguished by the following characters: (1) cheek with 4 tiny ventral dark spots in male *R. taenigena* vs. 3 oblique black stripes downward posterioventrally in male *R. duospilus*; (2) pectoral fin with a single black spot vs. two distinct black spots; and (3) branchiostegal membrane with orange (white when preserved) spots in male vs. several orange-red lines.

Key to the *Rhinogobius* species of the Mekong basin in Thailand and Laos

1a. Predorsal scales modally 5; cheek with 35-50 rounded blackish brown spots in male; body with 5-6 longitudinal rows of blackish-brown spots ..... *R. mekongianus*

1b. Predorsal scales 6-11; color pattern different from above 2

2a. First dorsal fin with elongate filamentous rays; posterior rays of 2nd dorsal and anal fins reaching procurrent caudal fin rays; lower 2/3 of cheek with about 40 white round spots on a dark brown background in male .... *R. albimaculatus* sp. nov.

2b. First dorsal fin without filamentous rays; posterior rays of second dorsal and anal fins not reaching procurrent caudal fin rays 3

3a. Anal fin I/7; predorsal scales 6-7; 11 + 17 = 28 vertebrae; cheek with 10-14 small black dots in both sexes; body with 7 longitudinal brown stripes ..... *R. lineatus* sp. nov.

3b. Anal fin I/8; predorsal scales 10-11; 10 + 17 = 27 vertebrae; cheek with a horizontal gray stripe and no black spots on lateral side in male; body without longitudinal stripe ..... *R. taenigena* sp. nov.

DISCUSSION

The 4 *Rhinogobius* species from the middle Mekong basin have higher vertebral counts (27-28 vs. 26) and fewer pectoral fin rays (15-17 vs. 18-23) than those of most of the Japanese (including Ryukyus) and Taiwanese species (Akihito et al. 1993, Chen and Shao 1996). However, similar trend in the Mekong *Rhinogobius* species are also observed in the most of *Rhinogobius* species ocurring the river basins of southern China (Chen and Miller 1998 and unpubl.). On the other hand, the four Mekong *Rhinogobius* can be easily distinguished from so-called, '*Rhinogobius ocellatus*' by the following characters: (1) head pore: no pore σ1 in 4 Mekong *Rhinogobius* but pore σ1 present in '*R.*' *ocellatus*; (2) squamation: larger body scales (LR 29-32) in four Mekong *Rhinogobius* species vs. smaller ones (LR 40-46) in '*R. ocellatus*'; and (3) fin rays: fewer Prays (15-17) in four Mekong *Rhinogobius* species but more P rays (19-22) in '*R. ocellatus*'. Furthermore, '*Rhinogobius ocellatus*' does not belong to *Rhinogobius* Gill, 1859 because of the presence of the both features of head pore σ1 and tricuspid teeth in male. Although those 2 features can be observed in *Tridentiger* species, the infraorbital sensory papillae in '*Rhinogobius ocellatus*' with reduced, singular papilla row *cp* contrasts with longer row of 4 papillae in *Tridentiger* species (Akihito et al. 1993). Further comparison and discussion of '*Rhinogobius ocellatus* (Fowler)' will be published eslewhere (Chen et al., unpubl. data).

Regarding the *Rhinogobius* species from other geographical regions, there is only a single endemic landlocked species from each region like Taiwan (*R. rubromaculatus* Lee and Chang), Ryukyu Islands (*R.* sp. Iwata unpubl. data) and mainland Japan (*R. flumineus* (Mizuno)) respectively with higher vertebral count (27-28) (Mizuno 1960, Mizuno and Goto 1987, Lee and Chang 1996, Chen and Shao 1996, Iwata unpubl. data). Thus, at least the presence of a distinct dark spot is a common feature on 1st dorsal fin membrane in the male always observed from the 4 Mekong *Rhinogobius* as well as the most landlocked species from southern China, and also Taiwanese *R. rubromaculatus*, but it had never been noted in the Japanese *Rhinogobius* (Chen 1994, Lee and Chang 1996, Chen and Shao 1996). It might be suggested that the landlocked species from the Mekong and southern China, and Taiwan probably share a common ancestor. It seems that the landlocked species with high vertebral counts have colonized more continental hydrographic systems successfully and gave rise to numerous landlocked species in the continental Asia and also in Taiwan. Thus, it might also be suggested that the landlocked Japanese *R. flumineus* (Mizuno) without such feature has probably convergently evolved higher vertebral counts and fewer pectoral fin rays from the Japanese diadromous *Rhinogobius* species (Yoshinobori) (Chen et al., in preparation). The research for testing the hypothsis by molecular approach is in progress (Chen et al. 1998 and unpubl. data).

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泰國及寮國湄公河流域之淡水鰕虎：吻鰕虎屬 (*Rhinogobius*) 魚類之分類，並記述該屬之三新種

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本文係報告泰國及寮國境內的湄公河流域產之淡水鰕虎：吻鰕虎屬 (*Rhinogobius* Gill, 1859) 魚類的分類研究，共計發現四種吻鰕虎魚類，包括有已知的湄公河吻鰕虎 *R. mekongianus* (Pellegrin and Fang, 1940)，以及本文將描述發表的三種新種：白斑吻鰕虎 *R. albimaculatus* n. sp.，線紋吻鰕虎 *R. lineatus* n. sp.，以及帶頰吻鰕虎 *R. taenigena* n. sp.。這四種吻鰕虎魚類，能以色斑特徵與計數形質予以區分。文中並提供該屬魚類的檢索表與各種之彩色照片，以供參考。

關鍵詞：鰕虎科，魚類分類，泰國，寮國，吻鰕虎。

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