

Review of the cheek-spine goby genus *Gladiogobius* (Actinopterygii, Perciformes, Gobiidae), with descriptions of two new species from the Indo-West Pacific

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Abstract The Indo-West Pacific cheek-spine goby genus *Gladiogobius* Herre is reviewed. The genus contains three species, *G. brevispinis* sp. nov., *G. ensifer* Herre, 1933 and *G. rex* sp. nov., which are distinguished from other gobiine genera in having the following combination of characters: a single long, posteriorly-directed, spur-like spinous projection at rear margin of preopercle; low cutaneous ridge along predorsal midline; no scales on head and nape; distinct transverse pattern of sensory-papilla rows on cheek. *Gladiogobius brevispinis* is described on the basis of 11 specimens (12.5–42.6 mm SL) from Japan (Ryukyu Islands), China (Hainan Island) and Indonesia (Sulawesi and Bali). It differs from congeners in having a short preopercular spine (clearly shorter than length of preopercular canal) and no filamentous dorsal-fin spines. *Gladiogobius rex* is described on the basis of 20 specimens (17.5–38.9 mm SL) from Phuket, Thailand, but also occurs widely in the Indian Ocean and the Red Sea. It is readily distinguished from congeners in having a very long preopercular spine (extending well beyond opercular margin). A redescription is also provided for *G. ensifer* based on 17 specimens (24.3–34.0 mm SL) from scattered localities in the West Pacific. We also include a key to the species of *Gladiogobius*.

Key words: Gobiidae, *Gladiogobius brevispinis* sp. nov., *Gladiogobius rex* sp. nov., *Gladiogobius ensifer*, Indo-West Pacific.

Three Indo-west Pacific genera within the gobiid subfamily Gobiinae (*sensu* Pezold, 1993) possess one or more posteriorly-directed, preopercular or cheek spines: *Asterropteryx* Rüppell, 1830; *Gladiogobius* Herre, 1933; *Oplopomus* Valenciennes *in* Cuvier and Valenciennes, 1837. *Gladiogobius* was described by Herre (1933), based on his new species, *Gladiogobius ensifer*, from Waigeo Island, western New Guinea (Raja Ampat Islands, Irian Jaya Barat Province, Indonesia) and Culion Island in the Calamianes Group, Philippines. The genus has been considered monotypic since its original description.

During February 1999 the second author (GRA) had a rare opportunity to dive in the inner estuary at Gilimanuk, off the western end of Bali, Indonesia. Estuary diving is usually mediocre at

best, due to a greatly diminished fish fauna compared to that of coral reefs and silty conditions that cause poor underwater visibility. However, on this occasion there was good tidal flushing with an influx of clear water. Consequently, a number of interesting fishes were observed and several were captured using a small multiprong spear. The collection included two specimens of an unfamiliar goby subsequently identified as an undescribed species of *Gladiogobius*.

After the discovery of the Bali fish, GRA learned that the first author was in the process of revising *Gladiogobius*, based on research involving collections housed in several institutions in Japan. We therefore decided to collaborate on a review of this genus, which now contains three species, including two new taxa described herein.

Materials and Methods

Institutional abbreviations follow Leviton *et al.* (1985), except for NCIP (Pusat Penelitian dan Pengembangan Oseanologi, Jakarta, Indonesia). Species accounts are presented in alphabetical order.

The methods for measurements followed those of Hubbs and Lagler (1958), with exceptions given below (the snout tip refers to the mid-anterior-most point of the upper lip): interorbital width was the least width between the innermost rims of the right and left eyes; jaw length was measured between the snout tip and the posterior-most point of the lips; length of cheek spine was the least distance between the anterior bony ridge of the preopercular canal support (clearly visible from external view) and tip of the spine; width of nape was measured between the uppermost ends of the gill openings; body depth was measured at the anal-fin origin; preanal and prepelvic lengths were measured from the snout tip to the origin of each fin; pectoral-fin length was measured from the base to the tip of the longest ray; pelvic-fin length was measured between the base of the pelvic-fin spine and the distal tip of the longest (4th) segmented ray; height of pelvic-fin connecting membrane was measured at the lowest point of the membrane (usually measured from mid-point between the right and left sides of the innermost ray to the mid-posterior edge of the connecting membrane); caudal-fin length was measured from the base to the tip of the middle caudal-fin ray (not including elongate filamentous part). Measurements were made with calipers under a dissecting microscope to the nearest 0.01 mm. The methods of counts followed Akihito *et al.* (1984), except for the following: longitudinal scale count was the number of oblique rows starting from just above the dorsalmost attachment of the opercular membrane and proceeding posteriorly to the mid-base of the caudal fin; three types of transverse scale count were taken (see descriptive accounts); circumpeduncular scale count was the number of zigzag rows along a vertical line around the narrowest point of the caudal peduncle; preventral scale

count was the number of scales on the ventral midline of the preventral area (scales are typically embedded); gill rakers, including all rudiments, were counted on the outer side of first arch; counts of the pseudobranchial filaments included all rudiments. Scales (except for predorsal and circumpeduncular scales) and paired-fin rays were counted on both sides, but gill rakers and pseudobranchial filaments were counted on the right side only. Meristic counts of the holotype are indicated with an asterisk in the species descriptions. The number of paratypes having a particular count appears in parentheses. Osteological features were observed from radiographs and cleared and stained specimens, following the method of Potthoff (1984). The methods of Akihito *et al.* (1984) were used in describing the pattern of the interdigitation of the dorsal-fin pterygiophores between the neural spines ("P-V"). Cephalic sensory canals and papillae were observed on specimens stained with cyanine blue, and abbreviations for these followed Akihito *et al.* (1984) and Miller (1986), respectively.

Genus *Gladiogobius* Herre, 1933

[Japanese name: Togenaga-haze zoku]

Gladiogobius Herre, 1933:23 (type species: *Gladiogobius ensifer* Herre, 1933, by monotypy).

Diagnosis. *Gladiogobius* is distinguished from all other gobiid genera in having the following combination of characters: a single distinct, posteriorly-directed spur-like bony spinous projection at rear margin of preopercle; low cutaneous ridge along predorsal midline; no scales on head and nape; distinct transverse pattern of sensory-papilla rows on cheek.

Description. Dorsal-fin rays VI-I, 9–10 (usually VI-I, 10); anal-fin rays I, 8–9 (usually I, 9–10); pectoral-fin rays 16–18; pelvic-fin rays I, 5; segmented caudal-fin rays 9+8, including 6–7+6–7 branched rays; dorsal unsegmented caudal-fin rays 5–8; ventral unsegmented caudal-fin rays 3–8 (usually 5 or more); longitudinal scales 23–26; transverse scales from anal-fin origin upward and forward to base of first dorsal fin

9–13; transverse scales from anal-fin origin upward and backward to base of second dorsal fin 8–12; transverse scales from second dorsal-fin origin downward and backward to base of anal fin 7–11; predorsal scales 0; prepelvic scales 0–5; circumpeduncular scales 12; gill rakers 3–5+8–10; pseudobranchial filaments 4–8.

Body moderately elongate and compressed. Head compressed, its width 72.2–95.3% of depth. Snout short, its length subequal or usually slightly shorter than eye diameter (snout length 71.7–113.4% of eye diameter); snout does not protrude beyond upper lip. Eye dorsolateral, large, its diameter 22.1–31.1% of head length; interorbital space narrow, its width narrower than pupil diameter and 2.4–6.0% of head length. Distinct, low cutaneous ridge along predorsal midline, extending forward beyond a vertical through preopercular margin (but not reaching to eyes). Gape oblique, forming an angle of about 25–40 degrees with body axis. Lower jaw subequal to upper jaw; posterior end of jaws reach to below pupil; jaw length 29.0–36.8% of head length. Anterior nasal opening a short tube, slightly protruding over upper lip; no fleshy flap at tip of anterior naris; posterior nasal opening a simple pore with only a slightly elevated anterior margin, located closer to eye than anterior naris. Tip of tongue nearly truncate, free from floor of mouth. Posteroventral margin of lower lip interrupted at symphysis. Mental flap on chin undeveloped. Gill opening moderately narrow, not extending anteriorly to a vertical line through preopercular margin; gill membranes attach to isthmus. No fleshy projections on lateral wing of shoulder girdle. A distinct, posteriorly-directed, spur-like spinous bony projection at posterior margin of preopercle. Gill rakers on outer surface of ventral arm of first arch well developed, long and thin (i.e. blade-like); rakers on outer surface of dorsal arm of first arch well developed, but distinctly shorter than neighbor rakers on ventral arm; first gill slit well developed. Caudal peduncle moderately slender, its depth 50.7–67.4% of caudal-peduncle length. First dorsal fin (excluding filamentous parts) subequal or slightly higher

than second dorsal fin; first dorsal fin close to, but not connected to, second dorsal fin by membrane; fourth (or, occasionally, fifth) spine of first dorsal fin longest (127.4% of preceding spine in length), elongate, filamentous (if fifth spine longest, the fourth spine also long and filamentous and only slightly shorter than fifth spine) except in *G. brevispinis*; all dorsal-fin spines slender and flexible; all segmented rays of second dorsal fin branched; eighth or ninth segmented ray of second dorsal fin longest, its distal end not extending to, or beyond, a vertical through base of caudal fin when adpressed. Origin of anal fin on a vertical with base of second segmented ray of second dorsal fin; height of anal fin slightly lower than second dorsal fin; anal-fin spine slender and flexible; all segmented anal-fin rays branched; eighth (in *G. ensifer* and *G. rex*) or ninth (in *G. brevispinis*) segmented ray of anal fin longest, its distal end not extending to, or slightly beyond, a vertical through base of caudal fin when adpressed. Caudal fin rounded or nearly truncate; tenth (and, occasionally, eighth and ninth) segmented ray slightly elongate and filamentous. Pectoral fin nearly lanceolate, reaching posteriorly to a vertical line through base of first, second or third segmented ray of second dorsal fin; all pectoral-fin rays branched, excluding simple uppermost 1–2 and, sometimes, ventralmost ray. Origin of pelvic fin below or only a slightly anterior to a vertical line through origin of first dorsal fin; pelvic fins almost separated, fused medially via very low connecting membrane (its height 11.2–28.6% length of fifth segmented pelvic-fin ray) between innermost rays; no pelvic-fin frenum; all segmented pelvic-fin rays branched; fourth segmented ray longest; fifth segmented ray 61.6–87.7% of preceding (fourth) ray in length; pelvic fin reaching posteriorly to base of spine or first or second segmented rays of anal fin when adpressed.

Most of body and caudal-fin base covered by ctenoid scales with peripheral cteni, except belly, pectoral-fin base, and prepelvic region with cycloid scales (pectoral-fin base naked in one species); head and nape naked.

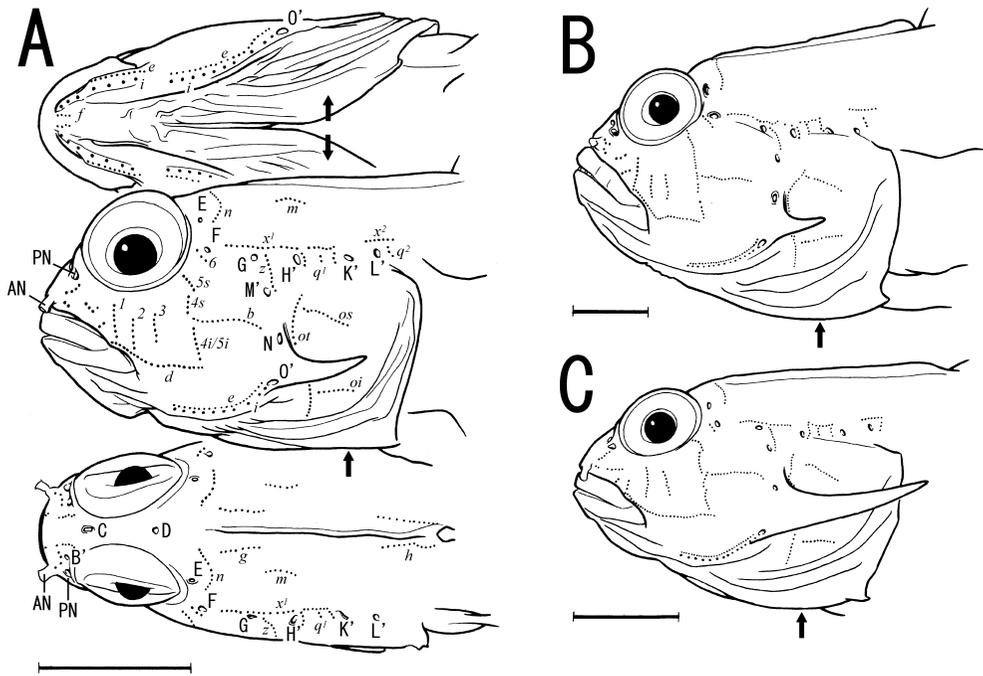


Fig. 1. Heads of three species of *Gladiogobius*, showing cephalic sensory-canal pores (indicated by uppercase letters, except for AN and PN) and sensory papillae (indicated by lowercase letters). A) *Gladiogobius ensifer*, NSMT-P 61522, male, 24.8 mm SL; B) *Gladiogobius brevispinis*, NCIP 6186, holotype, male, 42.6 mm SL; C) *Gladiogobius rex*, NSMT-P 44892, paratype, male, 31.6 mm SL. AN and PN, anterior and posterior nares, respectively. Arrows show the position where the gill membrane is attached to the isthmus. Bars indicate 3 mm. Drawn by K. Shibukawa.

Teeth in both jaws slender, unicuspid; each jaw with 3–5 rows of teeth anteriorly, narrowing to single row posteriorly; teeth on outermost row slightly enlarged, larger than those of inner rows; no stout canine-like teeth on jaws; no teeth on vomer or palatine.

Cephalic sensory systems are illustrated in Fig. 1. Anterior oculoscapular-canal pores B', C (unpaired), D (unpaired), E, F, G and H'; posterior oculoscapular-canal pores K' and L'; preopercular-canal pores M', N and O'; right and left sides of anterior oculoscapular canals fused medially in interorbital space. All cephalic sensory-papillae rows uniserial or comprising a single papilla, not forming multiple lines or aggregations; distinct transverse pattern of sensory papillae rows on cheek; six short transverse rows of sensory papillae (rows 1–6) below eye; rows 4 and 5 sometimes continuous, forming a single

vertical row; row *b* relatively short, not extending below eye; rows *e* and *i* broadly interrupted in middle section; a pair of short longitudinal rows of sensory papillae just behind chin (=row *f*); row *n* a short transverse row; row *s*² a short longitudinal row comprising 1–3 papillae. Sensory papillae on midlateral body forming uniserial vertical rows, each restricted to a single scale; three radiating rows of sensory papillae on caudal fin along the sixth, ninth and twelfth (or eleventh) segmented caudal-fin rays.

Selected osteology. Vertebrae 10+16=26; each epineural not fused to relevant pleural; P-V 3/II II I I 0/9; anal-fin pterygiophores anterior to first haemal spine 2; single epural; first and second pterygiophores of second dorsal fin lacking autogenous middle radials; ossified scapula moderately developed, encircling scapular foramen dorsally; 4 pectoral radials; dorsalmost pectoral

radial abuts dorsal part of cleithrum; short rib-like ventral postcleithra present; lower hypural plate (hypurals 1+2) articulates with urostyle + dorsal hypural plate (hypurals 3+4); dorsal and ventral procurrent cartilages moderately short, extending anteriorly to a little beyond distal tips of neural and haemal spines of 14th caudal vertebra, respectively; 5 branchiostegal rays; gill rakers on outer side of first arch slender, short and filamentous; other gill rakers short and stout, each bearing short distal spines; no gill rakers on inner and outer sides of first and second arches, respectively; basihyal triangular, its anterior margin not concave; infrapharyngobranchial 1 absent; interarcual cartilage relatively long corn-like; basibranchial 1 cartilaginous; basibranchial 3 moderately long, approaching basibranchial 4 posteriorly; rostral cartilaginous; ascending process of premaxilla long, well differentiated from articular process; mesopterygoid absent; posteroventral portion of preopercle with a flattened, stout, blade-like, posteriorly-directed spinous projection; bony canal support developed throughout vertical portion of preopercle; anterior margin of middle of preopercle without a dorsally directed bony projection; anterior margin of vomer rounded; posterior laminar portion of mesethmoid well ossified, forming interorbital septum anteriorly; frontals not fused medially; a low mid-dorsal bony crest on posterior part of supraoccipital.

Sexual dimorphism. Male genital papilla narrow and pointed, broad and rounded in female.

Remarks. As noted above, three Indo-Pacific gobiine genera possess one or more posteriorly-directed preopercular spines, i.e., *Asterropteryx*, *Gladiogobius*, and *Oplopomus*. *Gladiogobius* is readily distinguished from the other two genera in having a low cutaneous ridge along the predorsal midline and a pair of conspicuous black spots just behind the isthmus. In addition, *Asterropteryx* differs in having scales on cheek, operculum and nape (vs. head and nape naked in *Gladiogobius*), and *Oplopomus* has multiple longitudinal pattern of sensory-papillae rows on cheek (vs. transverse pattern in *Gladiogobius*),

rigid and pungent first spine of first and second dorsal fins (vs. flexible), and entirely united pelvic fins (vs. largely separated).

The species of *Gladiogobius* are small bottom-dwellers (largest specimen examined, 42.6 mm SL), typically found in shallow sheltered bays and lagoons with sandy-mud bottoms.

Included species. *Gladiogobius* comprises three species: *G. brevispinis* sp. nov., *G. ensifer*, and *G. rex* sp. nov.

Key to the species of *Gladiogobius*

- 1a. Cheek spine very long, extending posteriorly to well beyond posterior margin of opercular membrane (Fig. 1C), its length about twice eye diameter; several distinct, minute black (dark brown when alive) dots across cheek from posterior end of jaws to base of cheek spine (Red Sea, Indian Ocean, Andaman Sea and northwestern Java, Indonesia) *G. rex* sp. nov.
- 1b. Cheek spine not extending posteriorly to posterior margin of opercular membrane (Figs. 1A & 1B), its length subequal or less than eye diameter; no distinct minute black dots across cheek (usually single or some faint, small dusky blotches present just behind posterior end of jaws). 2
- 2a. Cheek spine relatively long, its length 21.3–26.7% of head length and usually subequal to distance between preopercular canal pores M' and O' (Fig. 1A); typically nine segmented anal-fin rays; fourth spine of first dorsal fin greatly elongate, filamentous, longer than preceding spine; base of pectoral fin broadly covered by embedded cycloid scales; dusky marking just above dorsal end of gill opening ovoid, distinctly deeper than preceding dusky marking (Ryukyu Islands of Japan, Palau, Solomon Islands, Philippines, Indonesia, Gulf of Thailand, and northern Australia)..... *G. ensifer*
- 2b. Cheek spine short, its length 12.4–17.9% of head length and distinctly shorter than dis-

tance between preopercular-canal pores M' and O' (Fig. 1B); typically 10 segmented anal-fin rays; no elongated and filamentous spines on first dorsal fin (some middle spines may be weakly filamentous, but fourth spine always subequal in length to preceding spine); no scales on pectoral-fin base, except some embedded, small cycloid scales on at ventral part; dusky marking just above dorsal end of gill opening usually narrow, dash-like, subequal in depth to preceding dusky marking (Ryukyu Islands of Japan, Hainan Island, Yap, and Indonesia)*G. brevispinis* sp. nov.

***Gladiogobius brevispinis* sp. nov.**

(Figs. 1B, 2A, 3A)

[New Japanese name: Kotoge-haze]

[New English name: Short-spined Goby]

Gladiogobius ensifer (non Herre); Masuda and Kobayashi, 1994: 329, fig. 1 (Yaeyama Islands); Akihito *et al.*, 1993: 1012 (line drawing of whole body); Akihito *et al.*, 2000: 1238 (line drawing of whole body); Akihito *et al.*, 2002: 1238 (line drawing of whole body); Kuitert and Tonzuka, 2001: 676, fig. A (Java, Indonesia).

Gladiogobius sp. 1; Senou *et al.*, 2004: 391 (Iriomote-jima Island, Yaeyama Islands of Ryukyu Archipelago, Japan).

Holotype. NICP 6186, male, 42.6 mm SL, Gilimanuk, Bali, Indonesia (08°12'S, 114°27'E), inner lagoon next to mangrove, 1.0–1.5 m depth, 7 Feb. 1999 (coll. by G. R. Allen).

Paratypes. Nine specimens, 12.5–41.9 mm SL : NSMT-P 55899, 2 specimens (2 males, including 1 cleared and stained), 26.7–28.1 mm SL, Luhuitou Bay, Hainan Island, China, 3 Dec. 1997 (collected by G. Shinohara); URM-P 4123, 2 specimens (male and female), 24.1–26.9 mm SL, Yonada-gawa River, Iriomote-jima Island, Ryukyu Islands, Japan, 16 Aug. 1982 (collected by Yamamura and Totani); URM-P 31223, 1 specimen (female), 29.3 mm SL, Miyako-jima Island, Ryukyu Islands, Japan, 11–12 June 1993 (collected by Kanashiro); URM-P 36312, 2 specimens (female and juvenile), 12.5–24.6 mm SL,

Nobaru-zaki Point, Iriomote-jima Island, Ryukyu Islands, Japan, 14 Aug. 1996 (collected by H. Yoshigou); WAM-P.31531.004, 1 specimen (female), 41.9 mm SL, collected with holotype.

Non-type material. NSMT-P 76626, 1 specimen (juvenile), 14.5 mm SL, Sendakan, west coast of Lembeh Island, off Sulawesi, Indonesia, 1 m depth, 17 July 2000 (collected by K. Shibukawa).

Diagnosis. *Gladiogobius brevispinis* is distinguished from other congeners in having: a short cheek spine (its length 3.7–5.7% and 12.4–17.9% in SL and head length, respectively, vs. 6.5–16.4% and 21.3–53.1% in SL and head length, respectively, in other congeners); typically 10 segmented anal-fin rays (vs. typically 9); no elongate, filamentous spines on first dorsal fin (except tip of middle spines occasionally filamentous, but fourth spine subequal in length to preceding spine vs. at least fourth spine well elongate, filamentous, longer than preceding spine); no scales on pectoral-fin base, except some embedded, small cycloid scales on ventral part (vs. largely covered by embedded cycloid scales); dusky marking just above dorsal gill attachment usually narrow, dash-like, subequal in depth to preceding dusky marking (vs. ovoid, distinctly deeper than preceding dusky blotch).

Description. The following description is based on the type series. Dorsal-fin rays VI-I, 10* (9); anal-fin rays I, 9 (1) or I, 10* (8); pectoral-fin rays 16* (6) or 17* (12); pelvic-fin rays I, 5* (18); segmented caudal-fin rays 9+8* (7), including 6+6 (1), 6+7* (4) or 7+7 (2) branched rays; dorsal unsegmented caudal-fin rays 5 (1), 6 (1) or 7* (3); ventral unsegmented caudal-fin rays 5 (2), 6* (1) or 7 (2); longitudinal scales 24 (4), 25* (6) or 26 (4); transverse scales from anal-fin origin upward and forward to base of first dorsal fin 12* (7) or 13 (7); transverse scales from anal-fin origin upward and backward to base of second dorsal fin 9* (3) or 10* (11); transverse scales from second dorsal-fin origin downward and backward to base of anal fin 8* (1), 9* (10) or 11 (2); predorsal scales 0* (7); prepelvic scales 0* (2), 1 (2) or 2 (3); circumpe-

Table 1. Proportional measurements of three species of *Gladiogobius*

	<i>Gladiogobius brevispinis</i> sp. nov.				<i>Gladiogobius ensifer</i>				<i>Gladiogobius rex</i> sp. nov.			
	Holotype		Holotype + 7 paratypes		Non-type specimens		Holotype		Holotype + 18 paratypes			
	Male	Males ^a	Females	4 specimens	Males	Females	5 specimens	PMBC 16650	Males	Female ^a		
Standard length (mm)	42.6	26.7–42.6	24.1–41.9	24.1–41.9	24.8–31.1	24.3–34.0	33.1	30.8–38.4	17.5–38.9			
In % of standard length												
Head length	30.7	30.7–33.2	29.4–33.0	29.4–33.0	30.2–32.1	30.0–31.7	30.9	29.1–30.6	29.5–32.0			
Snout length	7.0	6.6–7.0	6.2–7.2	6.2–7.2	6.9–8.2	6.8–7.6	6.7	6.5–7.3	6.4–7.9			
Eye diameter	6.8	6.8–8.0	7.2–8.4	7.2–8.4	7.1–8.1	7.2–8.2	7.6	6.7–7.0	6.5–8.6			
Interorbital width	1.8	1.6–1.8	0.8–1.7	0.8–1.7	1.0–1.4	1.0–1.5	1.3	1.0–1.5	1.0–1.6			
Jaw length	11.3	11.2–11.3	10.0–11.4	10.0–11.4	9.5–10.6	9.6–10.1	10.0	8.9–9.8	9.0–10.0			
Head depth	18.9	18.9–19.5	18.4–20.1	18.4–20.1	17.8–20.1	18.3–20.0	19.5	17.8–18.8	16.6–20.0			
Head width	15.6	15.6–16.0	14.3–16.2	14.3–16.2	14.1–17.0	14.8–16.3	14.9	14.8–16.9	14.9–18.1			
Nape width	12.5	11.9–12.5	11.4–13.1	11.4–13.1	11.6–13.5	12.0–12.9	12.7	10.5–13.0	12.0–13.8			
Body depth	22.1	19.1–22.1	19.4–21.1	19.4–21.1	18.5–20.8	18.6–20.2	20.7	19.2–20.2	16.6–20.7			
Body width	14.5	12.5–14.5	12.2–15.1	12.2–15.1	11.1–13.5	10.8–14.0	12.8	11.9–13.6	11.3–14.3			
Predorsal length	32.0	32.0–34.1	34.4–36.1	34.4–36.1	33.1–34.3	33.9–35.7	34.1	33.9–34.8	34.1–36.8			
Prepelvic length	36.9	36.9–38.0	35.5–40.5	35.5–40.5	33.0–35.7	33.6–35.5	32.8	31.6–35.2	32.2–36.1			
Preanal length	60.0	60.0–60.2	59.8–63.2	59.8–63.2	58.0–59.9	60.5–63.1	61.7	58.5–62.2	57.8–63.2			
Caudal–peduncle length	22.4	22.0–22.4	20.9–22.3	20.9–22.3	23.0–24.9	22.6–23.3	20.7	21.9–23.4	20.6–23.9			
Length of D ₁ base	15.1	12.1–15.1	12.4–13.8	12.4–13.8	12.9–13.9	12.4–13.8	13.0	12.3–13.5	12.2–13.9			
Length of D ₂ base	24.0	20.9–24.0	20.2–23.8	20.2–23.8	22.7–24.1	22.5–24.7	25.1	23.5–25.1	21.2–25.1			
Length of A base	25.0	22.8–25.0	21.5–23.7	21.5–23.7	23.7–24.8	22.1–25.5	24.9	23.8–25.4	23.2–25.2			
Length of P ₁ length	22.0	20.4–22.0	19.1–20.5	19.1–20.5	18.2–20.4	18.0–19.0	19.3	17.5–19.9	17.4–20.1			
P ₁ length	29.8	29.8–30.7	28.0–32.3	28.0–32.3	29.3–34.1	29.3–30.5	31.2	27.8–34.5	27.2–32.1			
P ₂ length	28.9	28.9–29.8	26.5–29.7	26.5–29.7	28.8–34.1	28.9–31.2	32.1	27.9–30.9	26.7–32.1			
Length of 4th P ₂ ray	27.9	27.5–27.9	25.2–28.1	25.2–28.1	27.2–32.8	27.7–29.8	29.6	27.5–28.6	25.7–30.1			
Length of 5th P ₂ ray	23.9	22.8–23.9	21.2–22.8	21.2–22.8	20.2–26.2	21.3–23.4	23.9	17.3–23.8	20.6–24.4			
C length	28.2	27.7–28.2	25.8–28.3	25.8–28.3	25.3–31.2	24.3–27.6	27.2	24.4–28.5	24.5–29.2			
Length of cheek spine ^b	5.2/5.5	4.2–5.7	3.7–5.5	3.7–5.5	6.8–8.6	6.5–7.5	15.1/15.0	13.5–15.9	13.2–16.4			

^a Including holotype.^b Measured bilaterally.^c Values of left and right sides of cheek spine in holotype by a slash, the first value representing the left one.Abbreviations: A, anal fin; C, caudal fin; D₁, first dorsal fin; D₂, second dorsal fin; P₁, pectoral fin; P₂, pelvic fin.

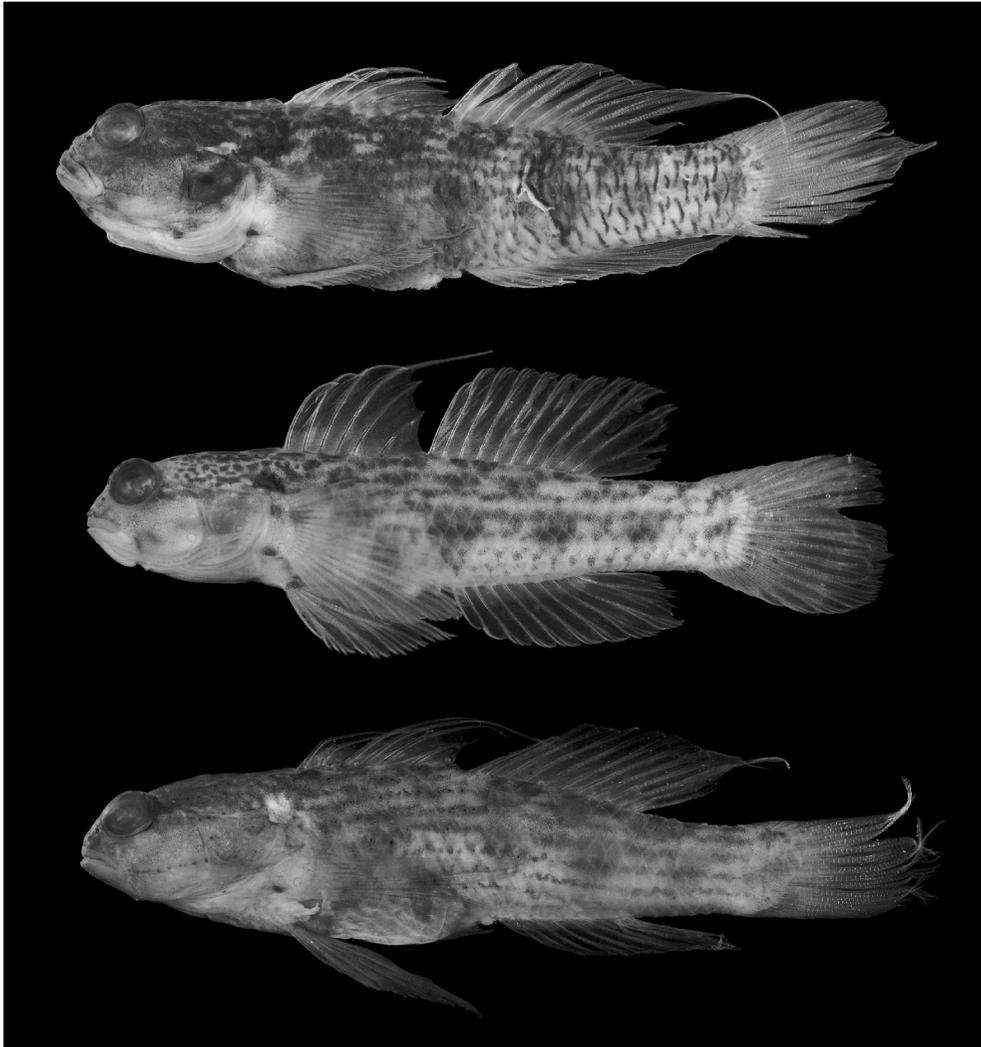


Fig. 2. Three species of *Gladiogobius*. A) *G. brevispinis*, WAM-P.31531.004, paratype, female, 41.9 mm SL; B) *G. ensifer*, NSMT-P 61522, male, 24.8 mm SL; C) *G. rex*, PMBC 16650, holotype, female, 33.1 mm SL. Photographed by K. Shibukawa.

duncular scales 12* (7); gill rakers 3+9 (1), 4+9 (1), 4+10 (3) or 5+9 (1); pseudobranchial filaments 6 (1), 7 (3) or 8 (2).

Color when alive. The following description is based on underwater photographs taken by K. Yano from Iriomote-jima Island, Ryukyu Archipelago, Japan (Senou *et al.*, 2004: 391): ground color of head light bluish gray dorsally, pale beige ventrally; several minute pale sky spots scattered on cheek and operculum, as well as a short oblique, pale blue line below eye; two

short, parallel horizontal dark brownish gray stripes from posteroventral margin of eye to a vertical line through posterior margin of preopercle; a single, slightly oblique, dark brownish gray irregular stripe (tinged with orange) from posterior corner of jaws to posterior margin of operculum; ground color of eyes light gray dorsally, dark gray ventrally; short blackish transverse lines or mottles on dorsal surface of eye; pupil encircled by reddish yellow; two short, parallel, dash-like oblique black lines just above opercu-

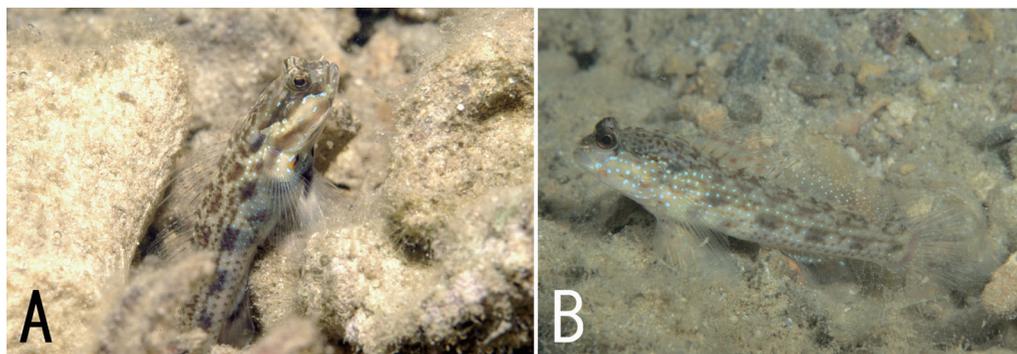


Fig. 3. Underwater photographs of two species of *Gladiogobius*. A) *Gladiogobius brevispinis*, Yap Island, Micronesia (photographed by G. R. Allen); B) *Gladiogobius ensifer*, Tatsugo, Amami-oshima Island, Ryukyu Islands, Japan, 2 m depth (photographed by H. Kanehara). *Note*.—In the photo specimen of *G. brevispinis* (A), fourth spine of first dorsal fin is elongate and filamentous, but subequal in length to preceding spine.

lum and pectoral-fin base; occipital region and nape with numerous dense, small irregular-shaped, dark brownish gray spots; ground color of body light bluish gray, except for pale beige belly; a series of five horizontally elongate, dusky blotches on mid-lateral body, also a pair of similar colored blotches on side of belly; 5–6 horizontal series of minute brownish spots on side of body; numerous minute pale blue dots scattered on body (those on belly especially conspicuous and enlarged); fins nearly transparent, with numerous enlarged white chromatophores (pectoral and pelvic fins slightly tinged with yellow); middle of caudal fin with ca. 4–5 indistinct vertical or arched reddish gray lines. Coloration of live specimen from Java, Indonesia (Kuitert and Tonzuka, 2001: 676, photo A of “*Gladiogobius ensifer*”), is similar to the Japanese specimens described above, except the ground color of the head and body is paler.

Color in alcohol. Similar to live coloration except the blue spots and lines on the head and body are faded as well as the white and/or yellow chromatophores on the fins.

Distribution and habitat. Type specimens of *Gladiogobius brevispinis* was collected from three widely separated localities including the Ryukyu Islands of Japan, Hainan Island in the South China Sea, and Indonesia. The species is certainly more widely distributed and more

records are expected to result from further estuarine collections, especially in areas adjacent to the Indo-Australian Archipelago. GRA encountered about 15 individuals (including holotype and a single paratype) at Bali, Indonesia in depths of 1.0–1.5 m near the mangrove fringe of a large enclosed estuary with the bottom consisting of fine sand and silt. Solitary fish or pairs were present at the mouth of burrows that were excavated under small, rocky outcrops. He also observed several individuals associated with an unidentified alpheid shrimp that shared the same burrow. Moreover, GRA recently photographed the species well to the east of the known distribution at Yap Island in Micronesia, where it was living in coralline areas adjacent to coastal mangroves (Fig. 3A). Senou *et al.* (2004) reported this species from the Yaeyama Group, Ryukyu Islands (Ishiagki-jima Island and Iriomote-jima Island) where it was found solitary in estuaries and inner reef areas with sand-mud bottoms and dead-coral rubble in less than 2 m depth.

Remarks. Akihito *et al.* (1993, 2000, 2002) included *Gladiogobius ensifer* in the key to species of Japanese gobies. However, their “*G. ensifer*” appears to comprise three species. The specimen upon which their head illustration was based (Akihito *et al.*, 1993: 1012; 2000: 1238; 2002: 1238) was correctly identified as *G. ensifer*, but the specimen used in the line drawing

of the entire body (Akihito *et al.*, 1993: 1012, 2000: 1238; 2002: 1238) is actually *G. brevispinis*, judging from the pigmented pattern of the head and body, short cheek spine, and the lack of elongate spines on the first dorsal fin. They also noted that *G. ensifer* is distributed in the Red Sea and Indo-West Pacific region, which suggests that their "*G. ensifer*" also contained *G. rex*, the only known species of the genus found in the Red Sea and Indian Ocean (see also "Remarks" for *G. rex*).

The typical fleshy crest on the nape is not developed in the smallest specimen that was examined (one of URM-P 36312, 12.5 mm SL).

Etymology. The new species is named *brevispinis* (Latin, meaning "short-spine") in reference to the distinctive preopercle spine, which is the shortest for the genus. The new Japanese vernacular is a combination of the Japanese words "ko" (meaning "small"), "toge" (meaning "spine") and "haze" (meaning "goby").

***Gladiogobius ensifer* Herre, 1933**

(Figs. 1A, 2B, 3B, 4)

[Japanese name: Togenaga-haze]

[English name: Bandit goby]

Gladiogobius ensifer Herre, 1933: 23 [original description, type locality: near entrance to Majalibit Inlet, Waigiu (=Waigeo Island), Indonesia]; Koumans, 1940: 147 [notes on paratypes and cotypes]; Koumans, 1953: 32–33 [part: his line drawing of this species in fig. 6 was based on *G. rex* (see also remarks under *G. rex*, below)]; Hayashi *et al.*, 1981: 5, pl. 1, fig. 100 (Ishigaki-jima Island, Ryukyu Islands, Japan); Akihito *et al.*, 1984: 233 (part), pl. 353, fig. D; Akihito *et al.*, 1993: 1093 (head illustration showing cephalic sensory systems), 2000: 1302 (head illustration showing cephalic sensory systems), 2002: 1302 (head illustration showing cephalic sensory systems); Masuda and Kobayashi, 1994: 328, fig. 8 (Yaeyama Group of Ryukyu Islands); Myers, 1999: 255, pl. 161, fig. C (Palau, Micronesia); Kuitert and Tonzuka, 2001: 676, figs. B and C (Bali, Indonesia); Shibukawa *et al.*, 2003: 184 (Bitung of Sulawesi Island, Indonesia).

Materials examined. Sixteen specimens, 24.3–34.0 mm SL: AMS I.24830-001, 2 specimens, 28.8–32.5 mm SL, Palau Islands; NSMT-P

23337, 1 specimen (female), 25.0 mm SL, east coast of Makabo Island, Florida Islands, Solomon Islands, 0.5 m depth, 24 Aug. 1984 (collected by K. Matsuura); NSMT-P 61522, 1 specimen (male), 24.8 mm SL, Tanjung Lampu, west coast of Lembah Island, eastern off Bitung of Sulawesi, Indonesia, 1 m depth, 13 July 2000 (collected by K. Shibukawa); NSMT-P 76627, 1 specimen (female), 34.0 mm SL, Iwayama Bay, Palau Islands, 1.0 m depth, 16 June 1980 (collected by K. Shibukawa); NSMT-P 76628, 3 specimens (1 males and 2 females, including 1 female cleared and stained), 24.3–26.0 mm SL, Sendakan, west coast of Lembah Island, eastern off Bitung of Sulawesi, Indonesia, 17 July 2000 (collected by K. Shibukawa); URM-P 24400, 2 specimens (2 females), 26.3–29.6 mm SL, Ngth-an, Babeldaub, Palau Islands, 29 Aug. 1990 (collected by T. Yoshino); WAM 32242-001, 2 specimens, 30.5–34.9 mm SL, Misool Island, Indonesia (collected by G. R. Allen); YCM-P 26084, 2 specimens (1 male and 1 female), 30.1–33.3 mm SL, off Atetsu, Setouchi-cho, Oshima-gun, Amami-oshima Island, Kagoshima Prefecture, Japan, 26 Aug. 1991 (collected by Sagami-bay Marine Biological-research Club); YCM-P 28509, 1 specimen (male), 30.0 mm SL, off Atetsu, Setouchi-cho, Oshima-gun, Amami-oshima Island, Kagoshima Prefecture, Japan, 31 Aug. 1992 (collected by Sagami-bay Marine Biological-research Club); YCM-P 28555, 1 specimen (male), 31.1 mm SL, collecting data same with YCM-P 28509. In addition, the digital image and x-ray of holotype of *Gladiogobius ensifer* (FMNH 17412, 32.5 mm SL, Fig. 4) were examined (see remarks section, below).

Diagnosis. *Gladiogobius ensifer* is distinguished from other congeners in having the following combination of characters: cheek spine moderately long (its length 21.3–26.7% in head length), but not reaching posteriorly to posterior margin of opercular membrane; I, 8–9 (typically I, 9) anal-fin rays; fourth spine of first dorsal fin greatly elongate, filamentous, longer than preceding spine; 10–12 (typically 10 or 11) transverse scales from anal-fin origin upward and forward



Fig. 4. Holotype of *Gladiogobius ensifer*, FMNH 17412, 32.5 mm SL. Photographed by P. Willink. © The Field Museum of Natural History, Chicago.

to base of first dorsal fin; base of pectoral fin broadly covered by embedded cycloid scales.

Description. Dorsal-fin rays VI-I, 10 (10); anal-fin rays I, 8 (1) or I, 9 (9); pectoral-fin rays 16 (4) or 17 (16); pelvic-fin rays I, 5 (20); segmented caudal-fin rays 9+8 (10), including 6+6 (5), 6+7 (4) or 7+7 (1) branched rays; dorsal unsegmented caudal-fin rays 6 (1), 7 (8) or 8 (1); ventral unsegmented caudal-fin rays 5 (2), 6 (6) or 7 (2); longitudinal scales 23 (14), 24 (5) or 25 (1); transverse scales from anal-fin origin upward and forward to base of first dorsal fin 9 (2), 10 (7), 11 (10) or 12 (1); transverse scales from anal-fin origin upward and backward to base of second dorsal fin 8 (1), 9 (16) or 10 (3); transverse scales from second dorsal-fin origin downward and backward to base of anal fin 7 (1), 8 (6) or 9 (13); predorsal scales 0 (10); preopercular scales 3 (1), 4 (7) or 5 (2); circumpeduncular scales 12 (10); gill rakers 3+9 (2) or 4+9 (4); pseudobranchial filaments 6 (3) or 7 (3).

Color when alive. The following description is based on an underwater photograph taken at Bali Island, Indonesia (Kuitert and Tonozuka, 2001: 676, figs. B and C): ground color of head and body light gray or light bluish gray dorsally, pale beige or yellowish white ventrally; two short, parallel horizontal dark gray or grayish brown stripes from posteroventral margin of eye to a vertical line through posterior margin of preopercle, upper one of which continuous with a horizontal dusky line along upper margin of operculum; a series of dusky vague blotches (tinged with red or brown) from posterior corner of jaws to posterior margin of operculum; several minute pale blue spots scattered on cheek and opercu-

lum; ground color of eye light gray or dark gray; 4–5 short transverse lines on dorsal surface of eye; pupil encircled by pale yellow or reddish yellow; a conspicuous blackish, ovoid spot (slightly smaller than eye), tinged with blue, just above pectoral-fin base; a series of five horizontally elongate dusky blotches on mid-lateral body, and pair of similar colored blotches on side of belly; occipital region and nape with numerous close-set, small irregular shaped, dark reddish gray spots; 5–6 horizontal series of minute brownish gray dots on side of body; numerous minute pale blue dots scattered on body (those on belly conspicuous and enlarged); ground color of fins nearly transparent; dorsal and caudal fins with reddish lines and/or dots.

Color when fresh. The following description is based on a color photograph of a freshly collected specimen from Sulawesi, Indonesia (NSMT-P 61522; Shibukawa *et al.*, 2003: 184): ground color of head and body pale gray brown dorsally, becoming paler ventrally; minute sky blue spots scattered on cheek, operculum, pectoral-fin base, and anterior half of body; ventral surface of head and belly brilliant white; two short, obliquely elongate, dusky spots tinged with red on cheek just behind end of jaws; similar colored vague blotches on middle of cheek and operculum; black and reddish brown longitudinal irregular lines from posterior and ventral margin of eye, respectively; dark gray spot, slightly larger than pupil just above dorsal end of gill opening; small, dense dark brownish-gray spots on nape and occipital region; a series of five dark brownish-gray spots on mid-lateral body, as well as two similar colored blotches on side of belly; ground color of dorsal fins whitish, tinged with yellow; numerous minute reddish orange and pale blue spots scattered on dorsal fins; broad white band along base of anal fin; a reddish vertical bar, interrupted in middle section, slightly behind midlateral dusky spot on caudal-fin base; radiating red lines along caudal-fin rays.

Color in alcohol. Similar to live coloration except the blue spots and lines on the head and body are faded as well as the white and/or yellow

chromatophores on the fins.

Distribution and habitat. *Gladiogobius ensifer* is known from the Philippines, Indonesia, Palau, and the Ryukyu Islands, Japan. KS observed several individuals on a sand-mud bottom with silty rubble and seaweeds in a shallow coastal area (ca. 1 m depth) of a protected bay in Sulawesi, Indonesia. The specimens were found solitary around or under the rubble, and not associated symbiotically with any other organisms.

Remarks. P. Willink of FMNH provided images (including soft-x ray negatives) and the following morphological data of the holotype of *Gladiogobius ensifer* (FMNH 17412, Fig. 4): dorsal-fin rays VI-I, 10; anal-fin rays I, 9; pectoral-fin rays 17/17 (+1 additional ray anterior to the plane of all other rays); fourth and fifth dorsal spines elongate and filamentous; head length 29.5% of SL; eye diameter 7.2% of SL, and 24.4% of head length; length of left cheek spine 6.8% of SL, 23.1% of head length, and 94.4% of eye diameter.

Hayashi *et al.* (1981) recorded *Gladiogobius ensifer* from Ishigaki-jima Island, Yaeyama Group of the Ryukyu Islands, Japan, with the new Japanese vernacular name "Togenaga-haze" (meaning "long-spine goby"). They noted that their specimen (YCM-P 6138, 23.7 mm SL) had a very long preopercular spine, much longer than that of *Asterropteryx ensifera*. Judging from this statement and the black and white photograph (Hayashi *et al.*, 1981: pl. 1, fig. 100), the specimen was possibly identical with *G. ensifer*. Unfortunately, KS could not find out their specimen when he recently arrived at the YCM.

***Gladiogobius rex* sp. nov.**

[Figs. 1C, 2C; Tables 1]

[New English name: King Goby]

Gladiogobius ensifer (non Herre). Koumans, 1940: 181 [Haarlem Island, Batavia (=Jakarta)]; Koumans, 1953: 32–33 (in part); Smith, 1959: 189, pl. 11, fig. J (Ibo, Aldabra and Mahe, Seychells); Goren, 1979: 40 (Red Sea); Kuitert, 1998: 203 (Maldives); Satapoomin, 1999: 20, Pl. 2, Fig. E (Cape Panwa Reef, Phuket, Thailand).

Holotype. PMBC 16650, female, 33.1 mm SL, Laem Phanwa, southern Phuket, Thailand (7°47'55"N, 98°42'35"E), 1 m depth, 15 Nov. 2001 (collected by U. Satapoomin).

Paratypes. Total 17 specimens, 17.5–38.9 mm SL: NSMT-P 44892, 6 specimens (3 males and 3 females, including 1 male cleared and stained), 31.6–38.9 mm SL, Phuket, Thailand, 0.3 m depth, 1 Nov. 1986 (collected by R. Arai and K. Matsuura); PMBC 13918, 1 specimen (female), 26.9 mm SL, Laem Phanwa, southern Phuket, Thailand, 0 m depth, 12 Aug. 1995 (collected by U. Satapoomin); PMBC 13919, 3 specimens (1 male and 2 females), 30.4–31.2 mm SL, Laem Phanwa, southern Phuket, Thailand, 4 m depth, 13 Mar. 1997 (collected by U. Satapoomin); PMBC 13920, 4 specimens (1 male and 3 females), 17.5–34.5 mm SL, Laem Phanwa, southern Phuket, Thailand, 0 m depth, 11 Dec. 1997 (collected by U. Satapoomin); URM-P 12800, 2 specimens (2 females), 26.4–30.1 mm SL, Phuket, Thailand, 28 Oct. 1983 (collected by H. Senou); URM-P 14784, 1 specimen (female), 29.8 mm SL, Phuket, Thailand (collected by H. Senou).

Non-type specimens. RMNH 16732, 2 specimens, Haarlem Island, Bay of Batavia (=Jakarta), Indonesia, 13 Aug. 1938.

Diagnosis. *Gladiogobius rex* is distinguished from other congeners in having: cheek spine very long, extending posteriorly to beyond posterior margin of opercular membrane, its length about twice eye diameter; several distinct, minute black (dark brown when alive) dots across cheek from posterior end of jaws to base of cheek spine.

Description. The following description is based on the type series. Dorsal-fin rays VI-I, 9 (3) or VI-I, 10* (14); anal-fin rays I, 9* (17); pectoral-fin rays 17* (21) or 18 (13); pelvic-fin rays I, 5* (17); segmented caudal-fin rays 9+8* (17), including 6+6 (10), 6+7* (4) or 7+7 (1) branched rays; dorsal unsegmented caudal-fin rays 6 (2), 7* (8) or 8 (5); ventral unsegmented caudal-fin rays 3 (1), 6* (5), 7 (6) or 8 (3); longitudinal scales 23 (12), 24* (19) or 25* (3); transverse scales from anal-fin origin upward and for-

ward to base of first dorsal fin 9 (1), 10 (8), 11* (24) or 12 (3); transverse scales from anal-fin origin upward and backward to base of second dorsal fin 8 (3), 9* (18) or 10* (15); transverse scales from second dorsal-fin origin downward and backward to base of anal fin 8 (7), 9* (27) or 10 (2); predorsal scales absent (18); prepelvic scales 3 (1), 4 (9) or 5* (7); circumpeduncular scales 12* (18); gill rakers 3+8 (2), 3+9 (1), 4+8 (1), 4+9 (1), 5+8 (2), 5+9 (1) or 5+10 (1); pseudobranchial filaments 4 (2), 5 (4) or 6 (3).

Color when alive. The following description is based on the color photograph by Kuitert (1998: 203, as *Gladiogobius ensifer*): ground color of head and body pale gray dorsally, whitish ventrally; minute sky blue spots scattered on cheek, operculum, pectoral-fin base, and anterior half of body; several distinct, minute dark brown dots across cheek from posterior end of jaws to base of cheek spine; iris silvery white, with a black oblique cross band through pupil; a short, vague dusky longitudinal stripe behind eye, with a black dot at the anteroventral corner; a faint dusky blotch, as large as pupil, just above dorsal end of gill opening; minute black dots sparsely scattered on operculum, nape, pectoral-fin base and anterior part of body; a series of four dark brownish-gray spots on mid-lateral body, and pair of similar colored blotches on side of belly; fins translucent.

Color when fresh [based on a color photograph by Satapoomin (1999, as *Gladiogobius ensifer*)]. Similar to coloration when alive, except as follows: dorsal and caudal fins with many black dots or short lines; iris entirely dusky; cheek and pectoral-fin base tinged with orange.

Color in alcohol. Similar to live coloration except the blue spots on the head and body are faded as well as the orange colour on the operculum and pectoral-fin base.

Distribution and habitat. *Gladiogobius rex* is described herein on the basis of specimens from the Andaman Sea at Phuket, Thailand, although it appears to range widely in the Indian Ocean and Red Sea. "*Gladiogobius ensifer*" of Smith

(1959), Goren (1979) and Kuitert (1998) are referable to *G. rex*, judging from their accounts and illustrations. According to U. Satapoomin (personal communication), the PMBC specimens (i.e. PMBC 13918, 13919, 13920 and 16650) were collected from intertidal flat or reef slope at depths of 0–4 m.

Remarks. Koumans (1940: 181) noted that two specimens from Haarlem Island (near Jakarta, northwestern Java, Indonesia) possessed a spur-like spine at the preopercle extending beyond the opercle to the base of pectoral fin. These two specimens (RMNH 16732) were examined by KS, and confirmed as *Gladiogobius rex*. Although the pigmentation on the head and body were slightly faded, these specimens have a very long preopercular spine (as noted by Koumans). This record is currently the only known location of *G. rex* from outside the Indian Ocean/Andaman Sea; the second author has encountered numerous Indian Ocean reef fishes in this part of northwestern Java (including the Seribu Islands). Koumans (1953: 32, fig. 6) provided a line drawing of "*Gladiogobius ensifer*," which judging from the long preopercular spine and is obviously *G. rex*. Koumans' drawing agrees with the smallest of the two RMNH specimens examined by the first author, although the third dorsal spine is illustrated slightly too long (i.e. third spine 74.5% vs. ca. 89.0% of fourth spine in drawing).

Akihito *et al.* (1984) provided a brief account, line drawing of head (showing cephalic sensory systems and other head details), and a black and white photograph of "*G. ensifer*." Although the photographed specimen (plate 353, fig. D) appears to be the same as the Japanese specimen of *G. ensifer* that illustrated by Hayashi *et al.* (1981), the specimen in the line drawing of the head (p. 242, fig. 54) has a very long cheek spine extending well beyond posterior margin of operculum, indicative of *G. rex*. According to T. Yoshino (personal communication), this head illustration was probably based on the Phuket specimen of the URM (one of URM-P12800).

Etymology. The species is named *rex* (Latin,

meaning “king”) in reference to its brave appearance with armature consisting of a very long, sword-like preopercle spine.

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