



***Lubricogobius tunicatus*, a new species of goby (Pisces: Gobiidae) from Papua New Guinea and the first record of *L. ornatus* from the East Indies**

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Abstract

A new species of goby, *Lubricogobius tunicatus*, is described from Milne Bay Province, eastern Papua New Guinea, on the basis of 10 adult specimens, 9.1–11.5 mm SL. Diagnostic features include 9 (rarely 10) segmented dorsal-fin rays, 6–7 segmented anal-fin rays, the presence of both anterior and posterior nostrils, the greatest body depth 3.1–3.7 in SL, overall coloration typically pale yellow to whitish (rarely brown), and an exceptionally small maximum size of about 11.5 mm SL. *Lubricogobius tunicatus* is most similar in appearance to *L. nanus* Allen, 2015, another diminutive species from Papua New Guinea that differs in having 10–11 dorsal-fin rays and 8–9 anal-fin rays. The new species is apparently invariably associated with a species of tunicate (*Polycarpa* sp.) on silty-sand bottoms in depths of about 20–28 m. In addition, *L. ornatus* Fourmanoir, 1966, originally described from Vietnam and also recorded from the Ryukyu Islands in Japan, northern Australia, and New Caledonia, is reported for the first time from the East Indies, based on two specimens collected at Lembeh Strait, North Sulawesi, Indonesia.

Key words: ichthyology, taxonomy, systematics, coral-reef fishes, Indo-Pacific Ocean

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Introduction

The gobiid genus *Lubricogobius* Tanaka, 1915 contains very small (less than about 35 mm SL), inconspicuous (although sometimes brightly-colored) gobies that inhabit coral reefs and adjacent sand and silt-bottom habitats in the western Pacific Ocean and northwestern Australia. They frequently shelter in tunicates and sponges, as well as among dead bivalves, worm tubes, and discarded bottles. The genus is characterized by an absence of scales and sensory pores, pelvic fins united by a well-developed frenum, relatively elongate shape (depth 2.9–3.7 in SL), a gill opening that is not restricted to the pectoral-fin base, and general yellowish coloration. The genus was reviewed by Randall & Senou (2001), who recognized three species including *L. dinah* Randall & Senou, 2001; *L. exiguus* Tanaka, 1915; and *L. ornatus* Fourmanoir, 1966. Additionally, *L. tre* Prokofiev, 2009 was described on the basis of a single trawled specimen from Vietnam and *L. nanus* Allen, 2015 was described from a mud-slope habitat in Milne Bay Province of eastern Papua New Guinea. The latter description also provided additional diagnostic information for the various members of the genus and an overall distribution map.

In this paper, we describe a new species of *Lubricogobius* that we collected adjacent to Bunama Village on the southeastern coast of Normanby Island, in the D'Entrecasteaux Islands of Milne Bay Province, eastern Papua New Guinea, during May 2016. We made repeated scuba dives on a moderately sloping, silt-sand bottom with numerous small brown tunicates and 30-cm-high tubeworms that were heavily encrusted with a variety of sessile invertebrates. Closer inspection revealed that many of the tunicates and tubeworms were populated by tiny gobies, which appeared to be obligate commensals. These were collected and later identified as new species of both *Lubricogobius* and *Sueviota* Winterbottom & Hoese, 1988, associated respectively with the tunicate and tubeworm hosts (the *Sueviota* sp. will be described in a separate publication).

Materials and Methods

Lengths are given as standard length (SL), measured from the median anterior point of the upper lip to the base of the caudal fin (posterior end of the hypural plate) or total length (TL); body depth is measured at both the origin of the pelvic fins and the origin of the anal fin, and body width at the origin of the pectoral fins; head length (HL) is taken from the upper lip to the posterior end of the opercular membrane, and head width over the posterior margin of the preopercle; orbit diameter is the greatest fleshy diameter; snout length is measured from the median anterior point of the upper lip to the nearest fleshy edge of the orbit; upper-jaw length from the same anterior point to the posterior end of the maxilla; caudal-peduncle depth is the least depth, and caudal-peduncle length the horizontal distance between verticals at the rear base of the anal fin and the caudal-fin base; lengths of spines and rays are measured to their extreme bases; caudal- and pectoral-fin lengths are the length of the longest ray; pelvic-fin length is measured from the base of the pelvic spine to the tip of the longest pelvic-fin soft ray. Gill rakers are counted on the first gill arch, those on the upper limb listed first; rudiments are included in the counts.

Cyanine Blue 5R (acid blue 113) stain was used to make papillae more obvious (Saruwatari *et al.* 1997, Akihito *et al.* 2003), and closer observation was assisted by the use of an airjet.

Morphometric data presented as percentages of the standard length are included in Table 1. The range of counts and measurements for paratypes is indicated in parentheses, if different from the holotype. Type specimens are deposited at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM) and the Western Australian Museum, Perth (WAM).

***Lubricogobius tunicatus*, n. sp.**

Tunicate Goby

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Figures 1–5; Table 1.

Holotype. WAM P. 34558-001, male, 10.9 mm SL, 10°08.696' S, 151°09.235' E, Bunama Village, Normanby Island, D'Entrecasteaux Islands, Milne Bay Province, Papua New Guinea, 23–28 m, clove oil and hand net, M.V. Erdmann, 27 May 2016.

Paratypes. USNM 432518, 4 specimens, 9.1–11.3 mm SL; WAM 34558-007, 5 specimens, 9.6–11.5 mm SL; all collected with holotype.

Diagnosis. Dorsal-fin rays VI–I,9–10 (rarely 10); anal-fin rays I,6–7; pectoral-fin rays 17–19 (rarely 17 or 19); both anterior and posterior nostrils present; scales absent; pelvic disc with conspicuous frenum; greatest body depth 3.1–3.7 in SL; head length 2.7–3.2 in SL; head compressed, width 1.0–1.3 in head depth; caudal fin rounded, 2.6–3.5 in SL; color in life either semi-translucent dull yellowish or semi-translucent whitish, both varieties with pigment along vertebral column, as alternating long, dark, dash-like marks with intervening shorter white sections; head and body covered in a uniform scattering of fine melanophores.

Description. Dorsal-fin rays VI–I,9 (one paratype with VI–I,10); anal-fin rays I,7 (4 paratypes with I,6); dorsal and anal-fin soft rays branched except first 1–2 usually unbranched; last dorsal and anal-fin soft rays



Figure 1. *Lubricogobius tunicatus*, holotype, WAM P. 34558-001, male, 9.7 mm SL, alcohol preserved (upper), stained with Cyanine Blue (lower), Normanby Island, D'Entrecasteaux Islands, Milne Bay Province, Papua New Guinea (G.R. Allen).

branched at base; pectoral-fin rays 18/19 (18, except two with 17 on one side), rays branched except uppermost and lowermost two rays unbranched; pelvic rays I,5, all segmented rays branched and frenum well developed; branched caudal rays 12 (13, except 11 in 3 paratypes and 12 in one); segmented caudal rays 16 (16–17); upper procurent unsegmented caudal rays 6; lower procurent unsegmented caudal rays 5 (5–6); gill rakers 4+11, including rudiments; total vertebrae 24 (4 specimens).

Greatest body depth 3.4 (3.1–3.7) in SL; body depth at origin of anal fin 4.4 (4.3–5.4) in SL; body compressed, width 2.1 (1.6–2.3) in greatest body depth; head length 2.7 (2.8–3.2) in SL; head compressed, width at posterior preopercular margin 1.0 (1.1–1.3) in depth at preopercular margin; snout short, 5.8 (4.6–6.6) in HL; eye moderately large, fleshy orbit diameter 2.9 (2.4–3.0) in HL; interorbital space narrow, least bony width 5.5 (3.3–5.0) in HL; caudal-peduncle depth 2.5 (2.2–2.9) in HL; caudal-peduncle length 1.7 (1.3–1.6) in HL; dorsal and ventral edges of caudal peduncle with low, inconspicuous fleshy keel.

Mouth moderately large and strongly oblique with lower jaw projecting, gape forming angle of about 53° to horizontal axis of head and body; maxilla ending at vertical at or slightly posterior to anterior edge of pupil, upper-jaw length 2.3 (2.0–2.5) in HL. Upper jaw with outer row of slender, recurved, well-spaced canine teeth and inner band of 2–3 irregular rows of small conical teeth anteriorly in jaw, narrowing to single row posteriorly; front of lower jaw with outer row of 5–6 slender incurved canines on each side and two inner rows of small conical teeth, narrowing to a single row on side of jaw, except where interrupted by two large recurved canines on each side. Tongue truncate anteriorly with broadly rounded corners. Gill opening ending below posterior border of preopercle.

Head and body naked; head, body, and fins covered with coat of finely granular mucus. Anterior nostrils present; posterior nostrils large, with fleshy rim, in anterior interorbital space at edge of orbit. No open sensory pores on head. Mid-lateral row of widely-spaced and inconspicuous sensory papillae on side of body, each forming transverse row of 1–3 papillae; similar tiny papillae in either transverse rows or clusters, scattered on back and upper half of caudal peduncle; row of 3 papillae below and just behind pectoral-fin base and similar short rows on lower side just before anus; small papillae also evident on caudal fin, including transverse row of 4 larger papillae at base and tracks of smaller papillae along length of fin rays; pattern of cephalic sensory papillae as illustrated in Fig. 2.

Origin of first dorsal fin about level with base of pectoral fins, predorsal length 2.3 (2.2–2.5) in SL; no filamentous dorsal spines; first dorsal spine 4.7 (2.4–3.7) in HL; fifth dorsal spine longest, 1.7 (1.5–1.9) in HL; last interspinous membrane of first dorsal fin joined to spine of second dorsal fin near its base; spine of second dorsal fin 2.3 (2.0–2.8) in HL; penultimate dorsal-fin soft ray longest, 1.7 (1.6–1.8) in HL; origin of anal fin below base of third dorsal-fin soft ray, preanal length 1.5 (1.4–1.5) in SL; anal-fin spine 3.9 (2.3–4.1) in HL; penultimate anal-fin soft ray longest, 1.7 (1.5–2.1) in HL; caudal fin rounded, 3.1 (2.6–3.5) in SL; pectoral fins reaching to about level of anus, middle rays longest, 3.1 (2.6–3.5) in SL; prepelvic length 2.9 (2.7–3.3) in SL; pelvic fins joined to form pointed disc, nearly reaching anus, 3.6 (3.0–3.8) in SL.



Figure 2. *Lubricogobius tunicatus*, WAM P. 34558-001, male, 9.7 mm SL, pattern of cephalic sensory papillae (black-edged white dots). Anterior and posterior nostrils as AN and PN, respectively. The arrow indicates anterior extent of gill opening (G.R. Allen).

Color in life. (Figs. 3–5) Two common, possibly gender-related, color phases: body either semi-translucent dull yellowish or semi-translucent whitish, both varieties with pigment along vertebral column, as alternating long, dark, dash-like marks with intervening shorter white sections. Head and body covered in a uniform scattering of fine melanophores; opercle region pinkish due to underlying red gill filaments; eye with greenish pupil; iris pale yellow with numerous tiny brown spots on dorsal half, pale grey on lower half; fins generally translucent.

Color in alcohol. (Fig. 1) Pale tan with uniform scattering of tiny melanophores; fins generally translucent with dense peppering of melanophores on inter-radial membranes.

Etymology. The new species is named *tunicatus* (Latinized adjective from tunicate) referring to its commensal host. The specific epithet is a masculine singular adjective in the genitive case.

TABLE 1

Proportional measurements (as percentage of SL) for type specimens
of *Lubricogobius tunicatus*

	holo- type	paratypes								
	WAM P.34558	USNM 432518	WAM P.34558	WAM P.34558	USNM 432518	WAM P.34558	WAM P.34558	WAM P.34558	WAM P.34558	WAM P.34558
Sex	male	male	male	male	male	female	female	female	female	female
Standard length (mm)	10.9	10.9	10.8	10.5	9.1	11.5	11.3	11.1	10.2	9.6
Greatest body depth	29.6	28.8	28.2	27.9	29.3	27.2	30.0	31.8	32.1	29.2
Depth at anal-fin origin	22.5	18.4	20.5	21.0	21.7	20.2	20.7	20.2	21.8	23.3
Body width	14.4	15.8	13.5	16.9	12.8	16.7	17.6	18.9	18.2	14.2
Head length	37.2	33.0	33.7	35.4	35.5	31.5	33.7	34.2	34.6	34.8
Head depth	22.6	27.1	26.3	26.5	27.4	24.4	25.8	27.5	27.1	26.8
Head width	22.9	21.0	20.7	23.2	21.7	19.7	21.3	23.3	22.4	22.2
Snout length	6.4	7.1	5.3	6.0	5.4	5.1	6.4	5.4	7.0	7.6
Orbit diameter	13.0	11.4	11.8	14.6	11.7	11.4	13.3	13.6	13.6	12.4
Interorbital width	6.8	7.7	6.7	8.8	8.6	8.7	10.2	8.7	7.5	9.1
Upper-jaw length	16.5	13.6	14.1	17.8	16.2	12.6	14.2	13.9	13.9	15.7
Caudal-peduncle depth	15.0	12.5	13.5	12.3	13.6	12.2	13.0	13.4	13.0	15.5
Caudal-peduncle length	22.5	24.9	24.3	26.6	23.9	23.6	20.9	24.4	23.8	22.2
Predorsal length	43.2	41.5	43.1	42.7	45.1	40.3	39.8	43.8	43.6	45.1
Preanal length	67.7	67.6	66.9	69.9	67.7	69.2	67.0	68.3	65.1	66.6
Prepelvic length	34.7	35.9	36.1	35.4	37.5	33.4	33.1	35.7	32.1	30.3
First dorsal-fin spine	7.9	10.3	11.0	12.3	9.7	13.0	12.3	10.6	11.7	12.4
Longest dorsal-fin spine	14.0	15.9	15.4	17.8	16.7	16.1	17.8	15.9	15.9	14.9
Spine of second dorsal fin	16.3	12.0	16.7	17.9	15.8	14.7	15.2	15.5	12.5	15.8
Longest dorsal-fin soft ray	22.1	17.1	21.4	23.3	19.3	21.4	22.2	20.9	23.0	18.1
Anal-fin spine	9.4	10.0	9.9	11.3	11.6	11.4	10.3	14.7	8.5	13.2
Longest anal-fin soft ray	22.4	18.8	16.3	23.2	18.8	18.1	18.8	20.8	20.5	18.9
Caudal-fin length	31.8	30.1	29.6	38.3	37.7	28.8	32.4	30.7	30.7	35.3
Pectoral-fin length	29.8	28.9	30.7	30.4	32.4	31.5	29.4	32.2	31.3	33.2
Pelvic-fin length	28.0	26.2	27.4	29.5	33.7	26.3	27.9	26.9	27.7	28.5



Figure 3. *Lubricogobius tunicatus*, approximately 9–11 mm SL, underwater photographs taken at the type locality, Normanby Island, Milne Bay Province, Papua New Guinea (G.R. Allen & M.V. Erdmann).

Distribution and habitat. The new species is currently known only from the type locality, adjacent to Bunama Village on southeastern Normanby Island in the D’Entrecasteaux Islands of Milne Bay Province, eastern Papua New Guinea. The type specimens were all obtained within a 50 m radius on a gently sloping to nearly flat, silty-sand bottom in depths of about 20–28 m. They were apparently invariably associated with an unidentified tunicate, likely belonging to the genus *Polycarpa* (Fig. 5), which was common between about 13–30 m, but only populated by fishes below a depth of about 20 m. We estimated about a third of the tunicates below 20 m were occupied by fish, which were found alone or in pairs. The fish were usually observed while perched on the lip of the tunicate’s oral or incurrent siphon, retreating quickly inside when disturbed. They also made brief forays on the exterior part of the tunicate and around its base.

Comparisons. The new species is most similar in overall appearance to *L. nanus* (Fig. 4B). Both species reach a tiny maximum size (to about 11.5 mm SL) and are characterized by a variable, usually yellowish, overall color with a dense uniform covering of single melanophores on the head and body. However, the two species are clearly differentiated by fin-ray counts: *L. tunicatus* have 9 (rarely 10) dorsal-fin rays and 6–7 anal-fin rays vs. higher counts of 10–11 dorsal-fin rays and 8–9 anal-fin rays for *L. nanus*. The new species is easily distinguished from *L. exiguus* (Fig. 4C) which has modally one more pectoral-fin ray (19 vs. 18), lacks the scattering of melanophores (thus much brighter yellow in life), has a rounded second dorsal fin (vs. straight in *L. tunicatus*), and reaches a significantly greater maximum size, to at least 29.2 mm SL (Randall & Senou 2001). Apparently *L. tunicatus* is found exclusively with its host tunicate in contrast to *L. exiguus*, which is sometimes found with tunicates, but also frequently resides in other hollow objects such as dead bivalves, worm tubes, and discarded bottles.

The six known species of *Lubricogobius* occur widely in the far western Pacific and off northwestern Australia. Although they appear to have mainly allopatric distributions, two or more species are reported from a few locations (Fig. 6). The following key will further serve to differentiate the species of the genus.

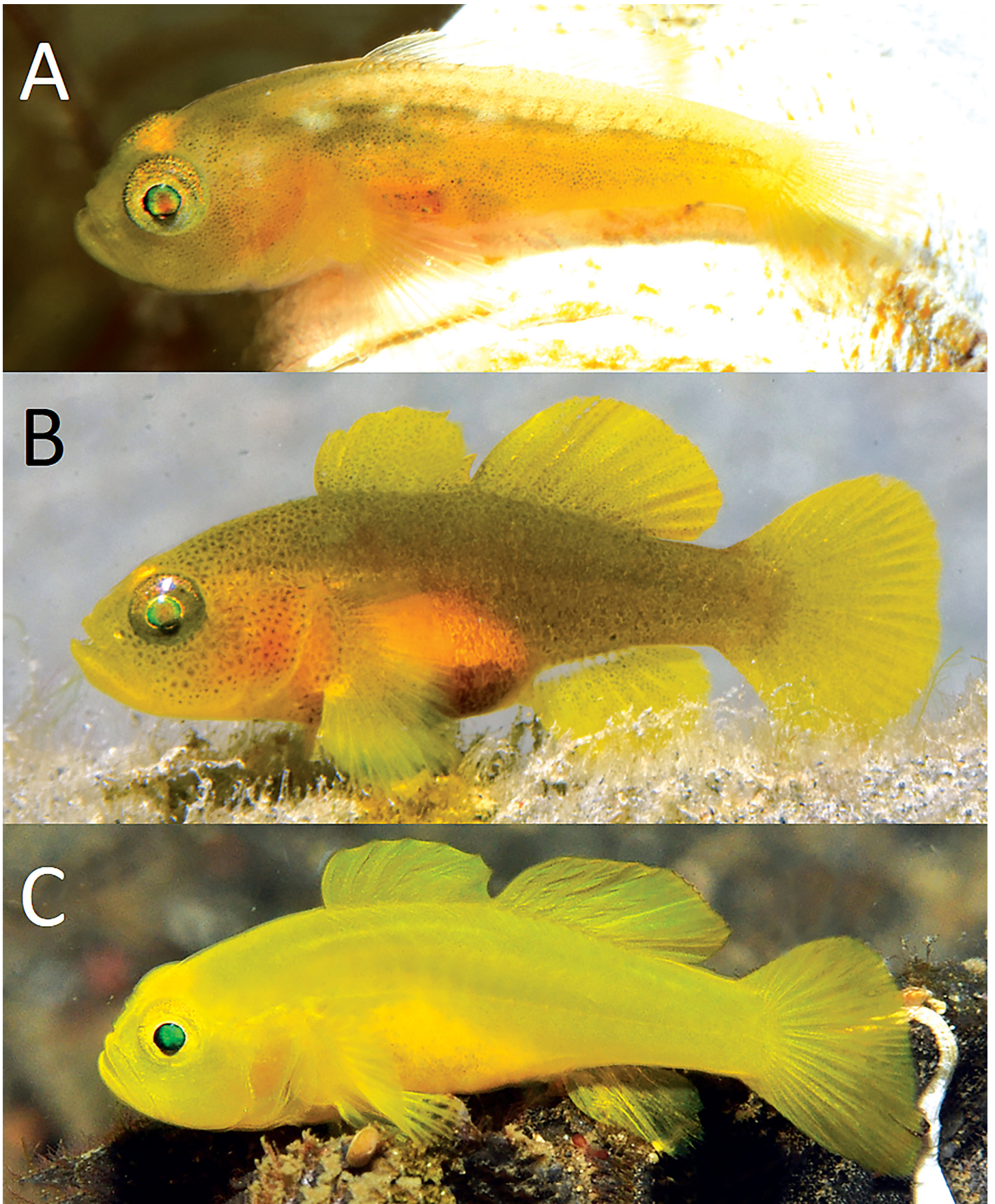


Figure 4. Comparison of *Lubricogobius* species: A) *L. tunicatus*, approx. 10 mm SL, Normanby Island, Papua New Guinea; B) *L. nanus*, approx. 10 mm SL, Alotau, Papua New Guinea; C) *L. exiguus*, approx. 20 mm SL, Lembah Strait, North Sulawesi Province, Indonesia (all G.R. Allen).

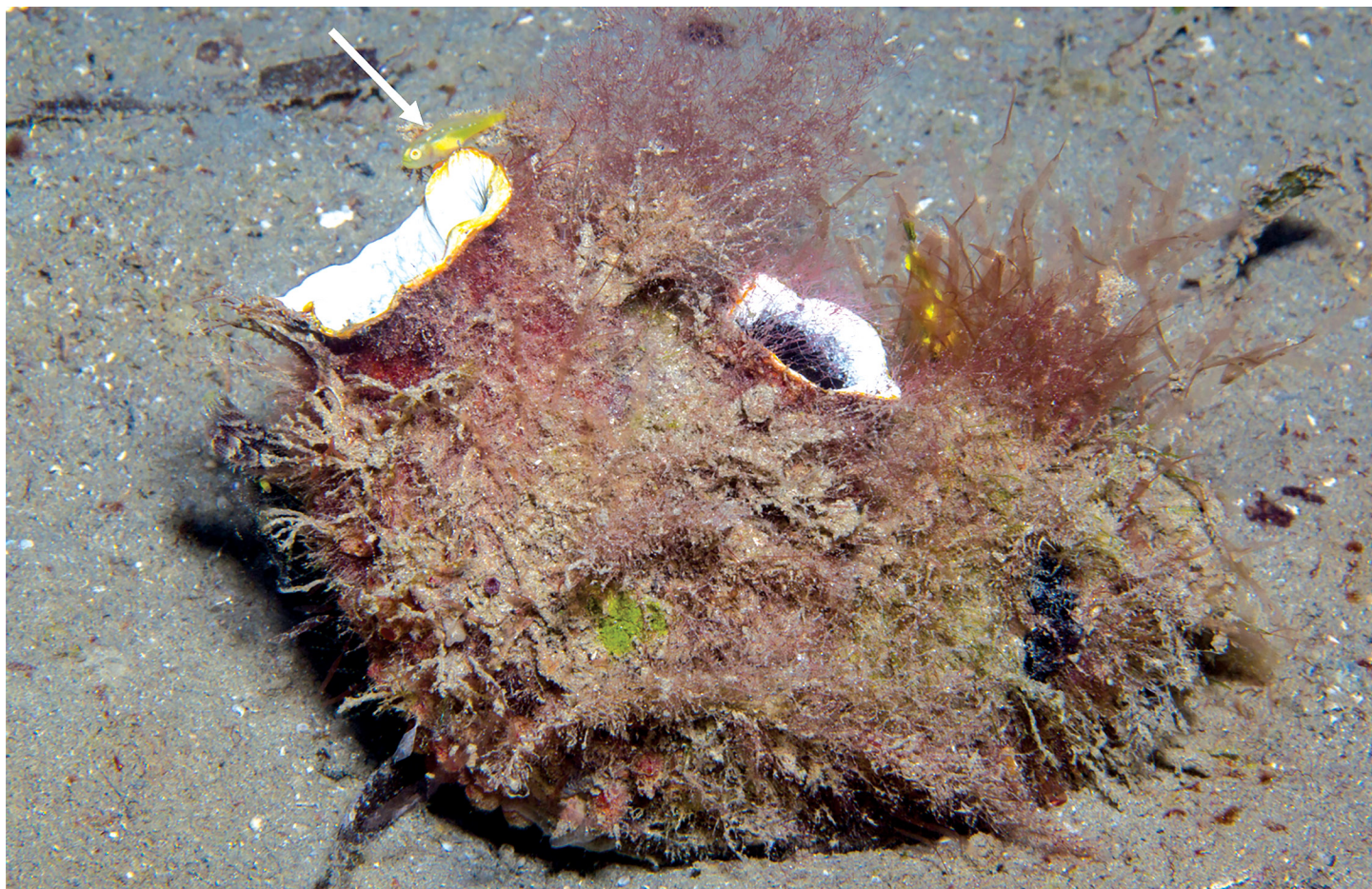


Figure 5. *Lubricogobius tunicatus*, underwater photograph of the new species (arrow) on its tunicate host (*Polycarpa* sp.) at the type locality, Normanby Island, Milne Bay Province, Papua New Guinea (M.V. Erdmann).

Key to the species of *Lubricogobius*, modified from Randall & Senou (2001)

- 1a. Anterior nostrils present (rarely absent on one side in *L. exiguus*); color in life variable but uniform, either yellow, orange, brown, or whitish2
- 1b. Anterior nostrils absent; color in life white dorsally, abruptly orange ventrally (Ryukyu Islands, Japan; Indonesia; and Papua New Guinea)*L. dinah*
- 2a. Anal-fin soft rays 8–93
- 2a. Anal-fin soft rays 5–74
- 3a. Greatest body depth 3.0 in SL; median fins red-orange in life; sensory papillae on body restricted to area below front of first dorsal fin and above pectoral-fin base (Vietnam)*L. tre*
- 3b. Greatest body depth 3.2–3.4 in SL; median fins yellow or brown in life; sensory papillae on body includes midlateral row of widely-spaced papillae (Papua New Guinea)*L. nanus*

- 4a. Dorsal and ventral midline of caudal peduncle keeled with ridge of tissue; no lines radiating from eye or on operculum5
- 4b. Dorsal and ventral midline of caudal peduncle not keeled with ridge of tissue; bluish lines (dark in preservative) radiating from eye and two on operculum joining at dorsal midline on nape (Ryukyu Islands, Japan; Vietnam; northern Sulawesi, Indonesia; northern Australia; and New Caledonia) *L. ornatus*
- 5a. Profile of second dorsal fin mostly straight with angular posterior corner; color in life semi-translucent pale yellow to whitish, rarely brown; head and body covered with tiny melanophores; pectoral-fin rays modally 18 (Papua New Guinea) *L. tunicatus*, n. sp.
- 5b. Profile of second dorsal fin, including posterior corner, rounded; color in life bright yellow; head and body not covered with tiny melanophores; pectoral-fin rays modally 19 (southern Japan to Indonesia) *L. exiguus*

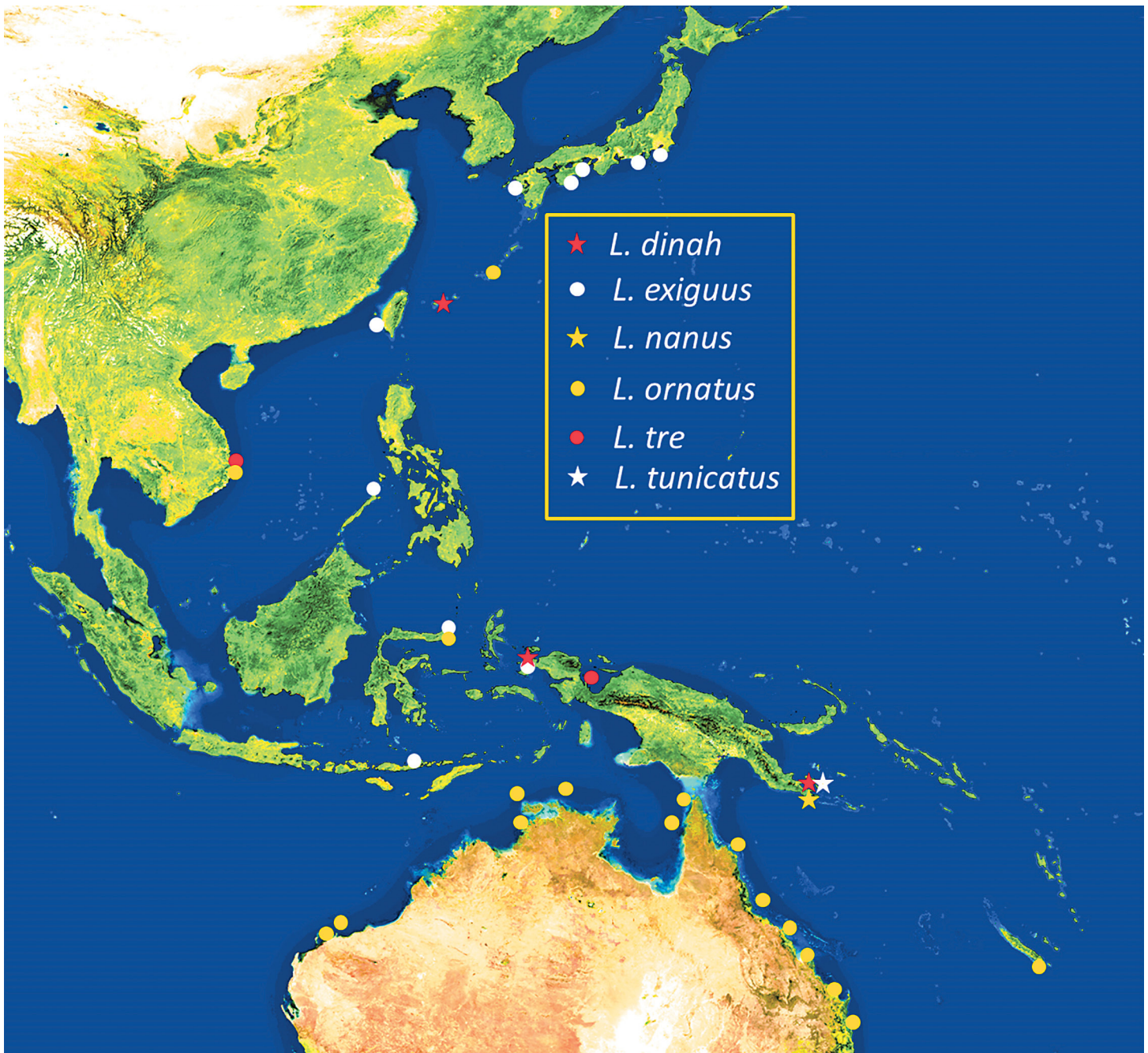


Figure 6. Distribution of species of *Lubricogobius* based on museum specimens and underwater photographs.



Figure 7. *Lubricogobius ornatus*, underwater photograph, 22–24 mm SL, Lembah Strait, northern Sulawesi, Indonesia (M.V. Erdmann).

New record for *Lubricogobius ornatus*. Several previous visits by the authors to Lembeh Strait, near the northern tip of Sulawesi, Indonesia between 2012 and 2015 resulted in numerous sightings and two collections of *L. exiguus* (photograph incorrectly labeled as *L. ornatus* by Allen & Erdmann [2012]: 926). However, both *L. exiguus* and *L. ornatus* were collected and photographed by the second author during a visit to this locality in July 2016. This collection represents the first record of *L. ornatus* for the East Indies; it was previously reported from the Ryukyu Islands of Japan, Vietnam (type locality), off northwestern and northeastern Australia, and New Caledonia (Randall & Senou 2001, Allen 2015). The live color of this species was illustrated by Randall & Senou 2001, and also reported by Allen 2015, as overall bright yellow. The Lembeh specimens (WAM P.34625-001), however, were reddish orange (Fig. 7). The two specimens were collected on a rubble bottom in 10 m depth.

Comparative material examined. *Lubricogobius ornatus*: WAM P.34625-001, 2: 22–24 mm SL, Lembeh Strait, N. Sulawesi, Indonesia. *Lubricogobius exiguus*: WAM P.33953-008, 13 mm SL, Lembeh Strait, N. Sulawesi, Indonesia; WAM P.34625-002, 4: 8–15 mm SL, Lembeh Strait, N. Sulawesi, Indonesia. *Lubricogobius nanus*: WAM P.34428-001 (holotype), 9.7 mm SL, Alotau, Papua New Guinea; WAM P.34319-006 (paratypes), 2 specimens, 10.8 and 10.9 mm SL, Alotau, Papua New Guinea; WAM P.34428-002, 9.5 mm SL, Alotau, Papua New Guinea.

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References

- Akihito, Sakamoto, K., Iwata, A. & Ikeda, Y. (1993) Cephalic sensory organs of the gobioid fishes. *In*: Nakabo, T. (Ed.), *Fishes of Japan with pictorial keys to the species*. Tokai University Press, Tokyo, Japan, pp. 1088–1116. [In Japanese]
- Allen, G.R. (2015) *Lubricogobius nanus*, a new species of goby (Pisces: Gobiidae) from eastern Papua New Guinea. *Journal of the Ocean Science Foundation*, 17, 1–11.
- Allen, G.R. & Erdmann, M.V. (2012) *Reef fishes of the East Indies. Vol. III*. Tropical Reef Research, Perth, Australia, pp. 856–1292.
- Fourmanoir, P. (1966) Trois nouvelles espèces de poissons du Vietnam: *Sicyodon albus* nov. gen., nov. sp., et *Lubricogobius ornatus* nov. sp. (Gobiidae), et *Parupeneus aurantius* nov. sp. (Mullidae). *Bulletin du Museum national d'Histoire naturelle, Paris, Series 2*, 37, 956–961.
- Prokofiev, A.M. (2009) A new species of *Lubricogobius* (Perciformes: Gobiidae) from Nha Trang Bay, Vietnam. *Journal of Ichthyology*, 49 (5), 416–419.
- Randall, J.E. & Senou, H. (2001) Review of the Indo-Pacific gobiid fish genus *Lubricogobius*, with description of a new species and a new genus for *L. pumilus*. *Ichthyological Research*, 48, 3–12.
- Saruwatari, T., Lopez, J.A. & Pietsch, T.W. (1997) Cyanine blue: a versatile and harmless stain for specimen observations. *Copeia*, 1997(4), 840–841.
- Tanaka, S. (1915) Ten new species of Japanese fishes. *Dobutsugaku Zasshi (Zoological Magazine)*, Tokyo, 27, 565–568. [in Japanese]
- Winterbottom, R. & Hoese, D.F. (1988) A new genus and four new species of fishes from the Indo-West Pacific (Pisces; Perciformes; Gobiidae), with comments on relationships. *Royal Ontario Museum, Life Sciences Occasional Paper*, 37, 1–17.