



## A new species of *Tomiyamichthys shrimpgoby* (Pisces: Gobiidae) from Papua New Guinea

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### Abstract

A new species of gobiid fish, *Tomiyamichthys stuarti*, is described from Milne Bay Province, eastern Papua New Guinea, on the basis of three male specimens, 20.4–23.5 mm SL. Diagnostic features include 11 segmented dorsal-fin and anal-fin rays, 15 pectoral-fin rays, 51–56 lateral and 11 transverse scales, no preopercular pores (no M', N, and O'), no pores above the operculum (no K' and L'), no prepelvic or prepectoral scales, ctenoid posterior body scales, and color pattern. The markings on the new species consist of 5 large brown blotches on the side of the body with about 9 brown saddles on the upper back, orange spots on the dorsal fins and upper caudal fin, and yellow pelvic and anal fins. Type specimens were collected from a flat mud bottom in 30 m depth.

**Key words:** taxonomy, systematics, ichthyology, coral-reef fishes, gobies, Indo-Pacific Ocean, Nuakata Shrimp-goby.

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## Introduction

The Indo-Pacific gobiid fishes of the genus *Tomiyamichthys* Smith, 1956 inhabit sand bottoms where they live symbiotically with alpheid snapping shrimps. There are 15 currently recognized species (Eschmeyer *et al.* 2018): *T. alleni* Iwata, Ohnishi & Hirata, 2000 from the Western Pacific Ocean (Japan and Bali to Fiji); *T. dorsostigma* Bogorodsky, Kovačič & Randall, 2011 from the Red Sea; *T. fourmanoiri* (Smith, 1956) from the Western Indian Ocean; *T. gomezi* Allen & Erdmann, 2012 from Philippines and Indonesia; *T. lanceolatus* (Yanagisawa, 1978) from the Western Pacific Ocean (Japan, Philippines, Indonesia, New Guinea, and Guam); *T. latruncularius* (Klausewitz, 1974) from the Red Sea to Western Pacific Ocean (Indonesia, New Guinea, and Great Barrier Reef); *T. levisquama* Hoese, Shibukawa & Johnson, 2016 from northern Australia; *T. nudus* Allen & Erdmann, 2012 from Brunei, Malaysia, Indonesia, and New Guinea; *T. oni* (Tomiyama, 1936) from the Western Pacific (Japan to Andaman Sea and eastward to Fiji); *T. praealta* (Lachner & McKinny, 1980) from Seychelles; *T. reticulatus* Greenfield, 2017 from Fiji; *T. russus* (Cantor, 1849) from the Eastern Indian and Western Pacific Oceans; *T. smithi* Chen & Fang, 2003 from Japan, Taiwan, Sabah, and Papua New Guinea; *T. tanyspilus* Randall & Chen, 2007 from Indonesia and New Guinea; and *T. zonatus* Allen, 2015 from Papua New Guinea. Eleven species from the East Indian region (Andaman Sea to Solomon Islands), including two undescribed species, were diagnosed and illustrated in color by Allen & Erdmann (2012). Hoese *et al.* (2016) provided valuable data for differentiating the various species on the basis of fin-ray counts, cephalic-sensory-canal-pore patterns, and scalation. The present paper describes a new species that was collected by the authors at Nuakata Island in Milne Bay Province of Papua New Guinea during May 2018.

## Materials and Methods

The holotype and paratype specimens are deposited at the Western Australian Museum, Perth, Australia (WAM).

Lengths are given as standard length (SL), measured from the median anterior point of the upper lip to the base of the caudal fin (the posterior end of the hypural plate); body depth is measured at both the origin of pelvic fins and the origin of the anal fin, and body width at the origin of the pectoral fins; head length 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 is from the same anterior point to the posterior end of the maxilla; cheek depth is the least distance between the ventral edge of the preoperculum and the lower edge of the eye; 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-fin and pectoral-fin lengths are the length of the longest ray; pelvic-fin length is measured from the base of the pelvic-fin spine to the tip of the longest pelvic-fin soft ray.

Terminology and abbreviations for cephalic sensory-canal pores follow those presented by Akihito (1984). Cyanine Blue 5R (Acid Blue 113) stain was used to make pores, papillae, and scale outlines more obvious (Akihito *et al.* 1993; Saruwatari *et al.* 1997).

The count of scales in longitudinal series is made from above the dorsal end of the gill opening to the base of the caudal fin; scales in transverse series are counted from the origin of the anal fin upwards and backwards to the base of the first dorsal fin; gill rakers are counted on the first gill arch, those on the upper limb listed first; rudiments are included in the counts.

The range of counts and proportional measurements for paratypes are indicated in parentheses when different from the value for the holotype.

*Tomiyamichthys stuarti*, n. sp.

Nuakata Shrimpgoby

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Figures 1–3, Tables 1–3.

**Holotype.** WAM P.34854-014, male, 23.5 mm SL, Papua New Guinea, Milne Bay Province, Nuakata Island, Duduwali Bay, -10.2892°, 151.0056°, 30 m, rotenone, G.R. Allen, M.V. Erdmann, and W.M. Brooks, 6 May 2018.

**Paratypes.** WAM P.34854-040, 2 males, 20.4–20.9 mm SL, collected with holotype.

**Diagnosis.** Dorsal-fin elements VI–I,11; anal-fin elements I,11; pectoral-fin rays 15; scales in longitudinal series 51–56; scales absent on cheek, opercle, predorsal, prepelvic, and pectoral-fin base; scales weakly ctenoid except cycloid on anterodorsal portion of body and belly; gill opening extending slightly forward of level of posterior margin of preopercle; dorsal fin without elongate spines, longest spine 1.9–2.8 in HL; caudal fin long and pointed, 2.1–2.2 in SL; reduced pattern of cephalic sensory-canal pores consisting of only B', C, D, E, F and G pores (i.e. no preopercular pores M', N, and O' and no pores K' and L' above the operculum); gill rakers poorly developed, 0 + 4–5; largest specimen, male holotype, 23.5 mm SL.

**Description.** Dorsal-fin elements VI–I,11; anal-fin elements I,11, all segmented dorsal- and anal-fin rays branched, last to base; pectoral-fin rays 15, all rays branched except uppermost; pelvic-fin rays I,5, all soft rays with two branch points, except innermost with three branch points; pelvic fins joined medially with membrane, frenum well-developed; caudal fin with 14 (13) branched and 17 segmented rays and 5 (4–5) upper and 6 (4–5) lower procurrent rays; longitudinal scales 51 (51–56); transverse scale rows 11; predorsal and prepelvic scales absent; circumpeduncular scales 12; gill rakers poorly developed, 0+5 (0 + 4–5); vertebrae 26.



**Figure 1.** *Tomiyamichthys stuarti*, holotype fresh (above) and preserved (below), WAM P.34854-014, male, 23.5 mm SL, Nuakata Island, Milne Bay Province, Papua New Guinea (G.R. Allen).

Body elongate, depth at pelvic-fin origin 5.8 (5.7–5.9) in SL; body compressed, width at pectoral-fin origin 1.5 (1.4) in body depth; head length 3.8 (3.6) in SL; head compressed, width 1.3 (1.1–1.2) in body depth at pelvic-fin origin; snout short, length 6.9 (6.6–6.4) in head length; orbit diameter 3.1 (3.2–3.3) in head length; interorbital space extremely narrow, eyes nearly in contact with each other; caudal-peduncle depth 2.8 (2.9–3.1) in head length; caudal-peduncle length 1.6 (1.7) in head length.

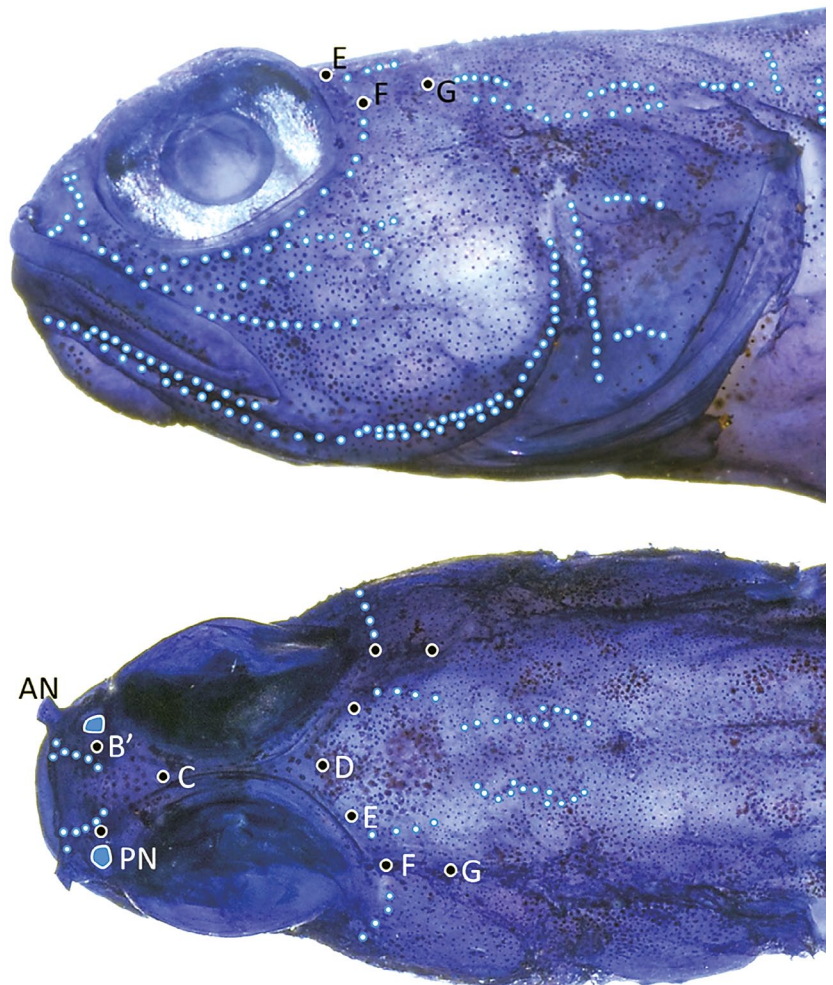
Mouth terminal, oblique, and large, forming angle of about 38° to horizontal axis of maxilla, reaching vertical near posterior edge of pupil, upper-jaw length 2.3 (2.1–2.2) in head length; upper jaw with 12–14 slender, slightly incurved teeth on each side, progressively larger towards front of jaw; also inner row of about 10–12 slender teeth and a pair of large, retrorse canines at front of upper jaw; front of lower jaw with 2–3 rows of incurved teeth nearly as large as those of upper jaw, ending in a pair of large, recurved, well-spaced canines about one-third back in jaw; remainder of jaw with single row of small incurved teeth; no teeth on vomer or palatines; edge of lips smooth; tongue tip broadly triangular; no distinct mental flap.

Gill opening broad, extending slightly forward of vertical at posterior edge of preopercle; gill membranes attached only anteriorly to isthmus, with no free fold; gill rakers poorly developed, first arch with only 4–5 rakers confined to lower limb.

Posterior naris a large, nearly round aperture in front of center of eye at fleshy edge of orbit; anterior naris a short membranous tube, anteroventral to posterior naris just above edge of upper lip. Cephalic sensory-canal pores and papillae rows (Fig. 2) well developed, but reduced pattern of pores consisting of: large pore (B') immediately adjacent to each posterior naris, two unpaired pores (C and D) at anterior and posterior interorbital, a pore (E), behind rear upper corner of orbit, and two postocular pores (F and G); no preopercular pores and none above operculum. A single transverse row of papillae across chin (Fig. 3).

Scales on body progressively larger posteriorly, scale rows irregular, especially anteriorly; scales weakly ctenoid, except cycloid on anterodorsal portion of body and belly; scales absent on cheek, opercle, predorsal, prepelvic, and pectoral-fin base; no scales on fins except about three rows at base of caudal fin, smaller than last row on caudal peduncle.

Origin of first dorsal fin slightly behind rear base of pelvic fins, predorsal length 3.0 (2.9) in SL; dorsal-fin spines slender and flexible, none filamentous; first dorsal-fin spine 1.6 (1.5) in HL; third dorsal-fin spine longest, 1.3 (1.2–1.3) in HL; last membrane of first dorsal fin nearly joined to origin of second dorsal-fin base; spine of second dorsal fin 2.7 in HL; penultimate dorsal-fin soft ray longest, 1.5 (1.4–1.5) in HL; origin of anal fin below base of first or second dorsal-fin soft ray, preanal length 1.8 (1.7–1.8) in SL; anal-fin spine 3.9 (3.6) in HL; penultimate anal-fin soft ray longest, 1.4 in HL; caudal fin long and pointed (lanceolate), 2.2 (2.1) in SL; pectoral fins pointed, tenth ray longest, reaching to level of anal-fin origin, 3.5 (3.2–3.3) in SL; prepelvic length 3.4 (3.2–3.3) in SL; pelvic fin tips falling well short of anal-fin origin, length of pelvic fin 4.5 (3.9–4.2) in SL; pelvic-fin



**Figure 2.** *Tomiyamichthys stuarti*, holotype, lateral and dorsal view of head showing sensory papillae (white dots) and pores (white-edged black spots). AN=anterior naris, PN=posterior naris (G.R. Allen).



**Figure 3.** *Tomiyamichthys stuarti*, preserved holotype, WAM P.34854-014, male, 23.5 mm SL, ventral view of head, showing transverse row of sensory papillae (black-edged white dots) and throat pigmentation (G.R. Allen).

spine about one-third length of longest pelvic-fin ray; pelvic frenum thin, membrane nearly reaching tip of pelvic-fin spines.

**Color when fresh.** (Fig. 1) Generally bluish gray except pale yellow behind eye and reddish brown on snout; opercle with irregular red-brown markings; abdominal region pale yellow; series of 5 large (> width of eye), brown blotches on middle of side, more or less surrounded by halo of light blue to chalk white; series of brown saddle-like markings on dorsal head and upper back, consisting of three on predorsal region, one below middle of spinous dorsal fin, one below dorsal-fin junction and three below second dorsal fin; pattern on side of body superimposed with about 20–23 narrow, chevron-shaped bands, widely spaced below first dorsal fin, but closer spaced posteriorly, terminating at caudal-fin base; first dorsal fin with 2 or 3 dark brown spots on basal portion of anterior edge of fin, remainder of fin and second dorsal fin translucent bluish with 4–6 longitudinal rows of orange spots; caudal fin with blue and yellow longitudinal streaks on membranes of entire fin, also 5 or 6 transverse rows of orange spots on upper third of fin; anal fin and pelvic fins yellow; pectoral fins translucent yellowish with small dark-brown spot on upper base.

**Color in alcohol.** (Figs. 1 & 3) Overall pale gray with 5 diffuse black blotches on middle of side and smaller diffuse saddle-like blotches on dorsal surface of head and upper back; head pale gray with dense covering of tiny melanophores and blackish streak covering most of upper lip; ventral surface of head (Fig. 3) with cluster of small melanophores on tip of chin and cluster of larger melanophores on throat; fins translucent whitish with dense covering of microscopic melanophores; first dorsal fin with a pair of black spots on basal portion of anterior edge; first and second dorsal fins with longitudinal rows of faint, dark-edged spots; small blackish spot on uppermost fleshy portion of pectoral-fin base.

**Etymology.** The new species is named for Stuart Mathews Brooks, the third author's son.

**Distribution and habitat.** The species is currently known only from the type locality at Nuakata Island in Milne Bay Province of Papua New Guinea. The habitat consists of a flat muddy bottom in 30 m depth in a sheltered bay with a mangrove shoreline. Although not observed alive, we presume the new species lives in burrows and, like other members of the genus, is associated with snapping shrimps of the genus *Alpheus*.

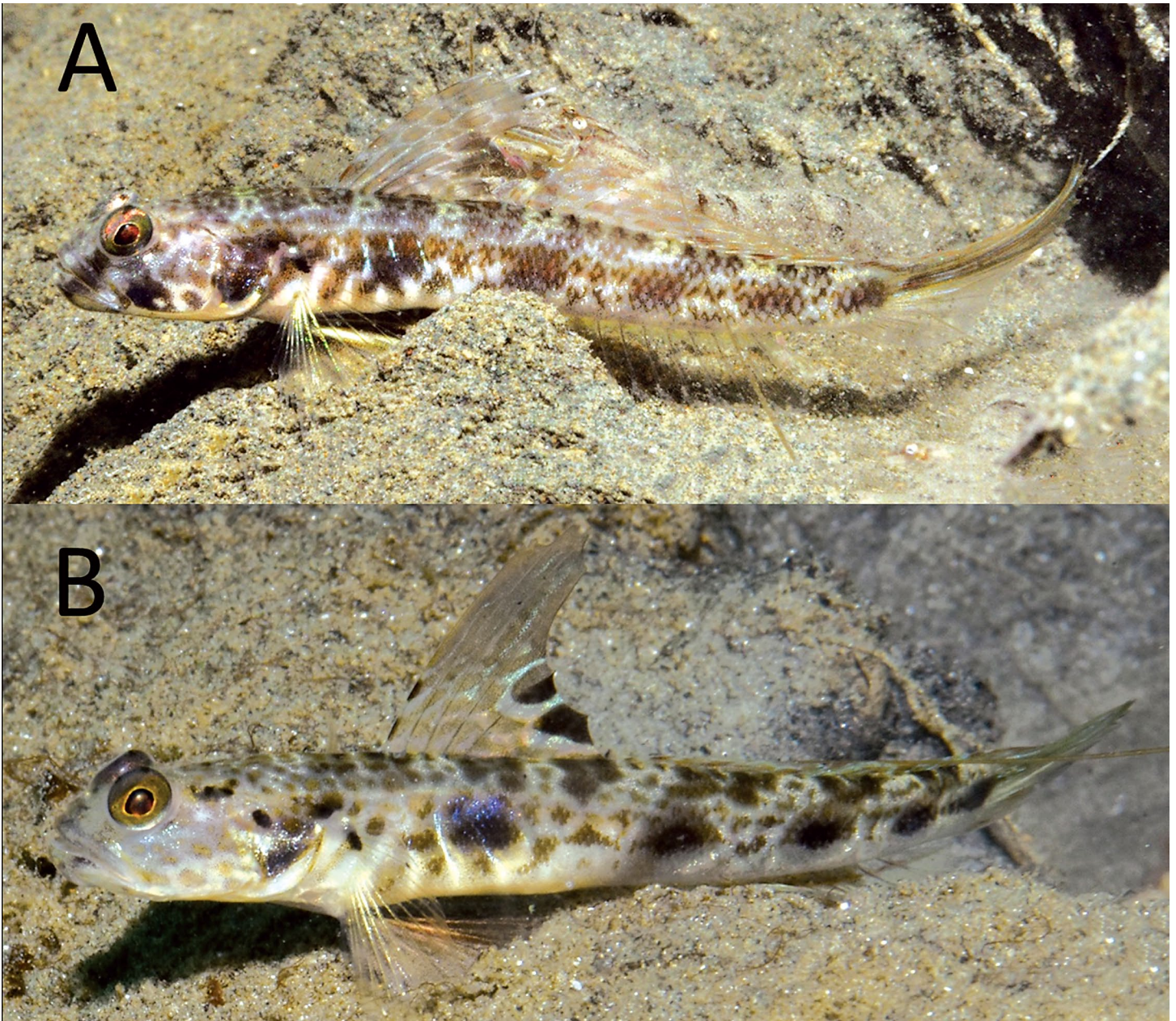
**Comparisons.** Hoese *et al.* (2016) provided comparisons of salient head-pore and scalation features for the known species of *Tomiyamichthys*. These data are also included here, with the addition of the new taxon, in Tables 2 and 3.

The new species differs from all congeners, including the 9 described species reported by Allen & Erdmann (2012) from the East Indian region, in having the combination of 11 segmented dorsal-fin and anal-fin rays, 15 pectoral-fin rays, 51–56 lateral and 11 transverse scales, no preopercular pores (i.e. no M', N, and O'), no pores K'

TABLE 1

Proportional measurements of type specimens of  
*Tomiyamichthys stuarti*, n. sp. as percentages of the standard length

	holotype	paratypes	
	WAM P.34854 -014	WAM P.34854 -040	WAM P.34854 -040
	male	male	male
Standard length (mm)	23.5	21.0	20.8
Body depth (P2 origin)	17.1	17.0	17.4
Body depth (A origin)	12.8	14.0	13.0
Body width	11.4	12.0	12.7
Head length	26.3	28.0	27.8
Head width	13.2	14.6	15.2
Snout length	3.2	4.4	4.2
Orbit diameter	8.5	8.4	8.6
Interorbital width	0.0	0.0	0.0
Cheek depth	8.8	8.9	9.8
Upper-jaw length	11.3	12.5	13.2
Caudal-peduncle depth	9.2	9.5	9.0
Caudal-peduncle length	16.5	16.6	16.6
Predorsal length	32.9	34.6	34.8
Preanal length	56.6	56.2	58.2
Prepelvic length	29.5	30.3	31.3
Base of dorsal fins	56.7	57.9	55.1
First dorsal-fin spine	16.8	18.5	18.9
Third dorsal-fin spine	20.6	22.5	21.0
Fifth dorsal-fin spine	11.4	10.6	11.0
Spine of second dorsal fin	9.8	10.3	10.3
Longest dorsal-fin ray	17.7	19.6	18.9
Base of anal fin	33.2	31.8	27.5
Anal-fin spine	6.8	7.9	7.6
Longest anal-fin ray	18.8	19.9	20.1
Caudal-fin length	46.4	47.3	47.4
Pectoral-fin length	28.9	31.2	30.1
Pelvic-spine length	7.4	6.8	6.7
Pelvic-fin length	22.0	25.6	24.1



**Figure 4.** *Tomiyamichthys lanceolatus* (A) and *T. tanyspilus* (B), approximately 35 mm SL, underwater photographs, Milne Bay, Papua New Guinea (G.R. Allen).

and L' above the operculum, no prepelvic or prepectoral scales, and ctenoid posterior-body scales. Only two other species, *T. oni* and *T. zonatus*, share 11 dorsal-fin and anal-fin rays, but *T. oni* differs in having 17–18 pectoral-fin rays, and about 83 lateral and 20–22 transverse scales, whereas *T. zonatus* differs in having 17 pectoral-fin rays and 13–14 transverse scales. The new species also differs from most members of the genus in having a low number (15) of pectoral-fin rays compared to usual counts of more than 17. Only *T. gomezi* and *T. nudus* have regular counts of 15 rays, but they are clearly separable on the basis of 10 dorsal-fin and anal-fin rays, a pair of preopercular pores, and the complete lack of scales in *T. nudus*. Although *T. alleni* sometimes has 15 pectoral-fin rays, it differs in having 10 dorsal-fin and anal-fin rays, as well as having cycloid scales on the posterior body. The color pattern of the new species, consisting of a lateral row of 5 large dark blotches and a secondary row of slightly smaller dark saddles along the back, is perhaps most similar to that of *T. lanceolatus* (Fig. 4A) and *T. tanyspilus* (Fig. 4B), both of which co-occur with *T. stuarti* in Milne Bay Province. Although both species share 5 large dark blotches laterally on the body, the dorsal saddles are not as well defined (and are interspersed with numerous smaller brown spots) as those of *T. stuarti*, and they also differ in having a pair of dark spots on the rear margin of the first dorsal fin.

TABLE 2

Fin-ray and Scale counts for Species of *Tomiyamichthys*  
(adapted from Hoese *et al.* 2016)

Species	Second dorsal fin	Anal fin	Pectoral fin	Lateral scales	Transverse scales
<i>T. alleni</i>	I,10	I,10	15–17	25–50	7–10
<i>T. dorsostigma</i>	I,12	I,12	17	120–125	27
<i>T. fourmanoiri</i>	I,12	I,12	16	77	24
<i>T. gomezi</i>	I,10	I,10	15	47–56	12–13
<i>T. lanceolatus</i>	I,12	I,12	16–18	54–58	16–18
<i>T. latruncularius</i>	I,9	I,9	17–18	47–49	18
<i>T. levisqama</i>	I,10	I,10	18–19	50–70	22–25
<i>T. nudus</i>	I,10	I,10	14–15	0	0
<i>T. oni</i>	I,11	I,11	17–18	83	20–22
<i>T. praealtus</i>	I,10	I,10	18	54	24
<i>T. reticulatus</i>	I,12	I,13	21	57	13
<i>T. russus</i>	I,10	I,10	17	74–95	24–27
<i>T. smithi</i>	I,12	I,12	18	93–96	25
<i>T. stuarti</i>	I,11	I,11	15	51–56	11
<i>T. tanyspilus</i>	I,12	I,12	17–18	78–80	22
<i>T. zonatus</i>	I,11	I,11	17	52–54	13–14

TABLE 3

Head pores, Prepelvic scales, and Posterior body scales in *Tomiyamichthys* Species

number of pores given for preopercular (POP) and for other categories present (+) or absent (-); LC tube = separate tube above operculum or pores K' and L'; LC1 = lateral canal pore above preoperculum or pore G; PO = postorbital or pore E; n=naked, ps=partly scaled (adapted from Hoese *et al.* 2016)

Species	POP	LC tube	LC1	PO pores	Prepelvic scales	Posterior scales
<i>T. alleni</i>	0	-	-	-	n	cycloid
<i>T. dorsostigma</i>	3	+	+	+	n	cycloid
<i>T. fourmanoiri</i>	3	+	+	+	n	cycloid
<i>T. gomezi</i>	2	-	+	+	ps	ctenoid
<i>T. lanceolatus</i>	0	-	+	+	n	ctenoid
<i>T. latruncularius</i>	3	-	-	+	n	ctenoid
<i>T. levisqama</i>	3	-	+	+	ps	cycloid
<i>T. nudus</i>	2	-	+	+/-	n	none
<i>T. oni</i>	0	-	-	+	ps	cycloid
<i>T. praealtus</i>	3	-	+	+	n	cycloid
<i>T. reticulatus</i>	0	-	-	+	n	ctenoid
<i>T. russus</i>	2–3	-	+	+	ps	ctenoid
<i>T. smithi</i>	3	+	+	+	n	cycloid
<i>T. stuarti</i>	0	-	+	+	n	ctenoid
<i>T. tanyspilus</i>	0	-	+	+	ps	cycloid
<i>T. zonatus</i>	0	-	+	-	n	ctenoid



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