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# *Tomiyamichthys elliotensis*, a new species of shrimpgoby (Teleostei: Gobiidae) from Lady Elliot Island, Queensland, Australia

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## Abstract

A new species of gobiid fish, *Tomiyamichthys elliotensis*, is described from Lady Elliot Island at the southern end of Australia's Great Barrier Reef, on the basis of 6 specimens, 32.6–52.7 mm SL. Diagnostic features include a sail-like first dorsal fin without filamentous elements; 10 segmented dorsal and anal-fin rays; 17 or 18 pectoral-fin rays; scales all cycloid, 78–84 lateral and 18–24 transverse scale rows, no prepectoral scales; and a cephalic sensory-canal pore system containing pores B', C, D, E, F, G, H', M', N and O'. The fish is overall whitish with a midlateral row of 4 large, ovate, brown spots; diagonal yellow-orange bands on the first dorsal fin; a brown stripe along the mid-second-dorsal fin; several yellow-orange stripes along the anal fin; and bluish pelvic fins with yellow fin rays. Among the 6 species of *Tomiyamichthys* that have mtDNA COI sequences, interspecific divergences range from 14.4% to 21.5% and the new species is 18.3% different in COI sequence from its putative nearest relative *Tomiyamichthys oni*. The habitat of the new species consists of relatively flat, sandy bottoms exposed to periodic strong tidal currents in 15–24 m depths.

**Key words:** taxonomy, ichthyology, coral-reef fishes, gobies, western Pacific Ocean, DNA barcoding, *T. oni*.

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## Introduction

The Indo-Pacific gobiid fishes of the genus *Tomiyamichthys* Smith, 1956 dwell symbiotically with alpheid snapping shrimps, occurring on sand-rubble bottoms in the vicinity of coral reefs. There are 18 currently recognized species (Fricke et al. 2023): *T. alleni* Iwata, Ohnishi & Hirata, 2000 from the Western Pacific (Japan and Bali to Fiji); *T. dorsostigma* Bogorodsky, Kovačič & Randall, 2011 from the Red Sea; *T. emilyae* Allen, Erdmann & Utama, 2019 from Japan, Philippines, and Indonesia; *T. eyreae* Allen, Erdmann & Mongdong, 2020 from West Papua, Indonesia; *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 (Japan, Philippines, Indonesia, New Guinea, and Guam); *T. latruncularius* (Klausewitz, 1974) from the Red Sea to Western Pacific (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 New Caledonia); *T. praealtus* (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. stuarti* Allen, Erdmann & Brooks, 2018 from Papua New Guinea; *T. tanyspilus* Randall & Chen, 2007 from Indonesia and New Guinea; and *T. zonatus* Allen, 2015 from Papua New Guinea. Allen & Erdmann (2012) diagnosed and illustrated in color 11 species from the East Indian region (Andaman Sea to Solomon Islands), including two undescribed taxa. 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 nineteenth member of the genus that was recently collected by the authors at Lady Elliot Island, located within the Capricorn Bunker Group and one of the southernmost reefs of Australia's Great Barrier Reef.

## Materials and Methods

Type specimens are deposited at the Queensland Museum, Brisbane (QM) and the Western Australian Museum, Perth (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 (posterior end of the hypural plate); 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 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; caudal 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 segmented ray.

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 second dorsal fin; gill rakers are counted on the first gill arch, those on the upper limb listed first; rudiments are included in the counts. Papillae rows in Fig. 3 are diagrammatic for location and extent and dots do not map individual papillae.

Counts and measurements are given for the holotype followed in parentheses by the paratypes and the mean value for all types. Proportional measurements expressed as percentage of the standard length in Table 1.

Terminology and abbreviations for cephalic sensory-canal pores follow 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).

DNA was extracted from fin clips using a QIAGEN Blood and Tissue DNeasy Kit following manufacturer's recommendations. The COI gene was amplified using COI-1-FF2d and COI-1-FR1d primers and thermocycling conditions as per Ivanova et al. (2007). ExoSAP-IT from USB (Cleveland, Ohio) was used to purify the PCR products. The cleaned products were quantified with a QubitTM dsDNA BS assay Kit on a Qubit 3 Fluorometer (Thermo Fischer Scientific) and sequenced in both directions by the Genetics Research Services team at the University of Queensland using Applied Biosystems BigDye Terminator v3.1 reagents and the Applied Biosystems 3730 DNA analyzer. Additional sequences for the congeners *T. russus* (OQ385634, OQ387379) and *T. lanceolatus* (HQ536662) were obtained from GenBank. Sequences of *T. oni*, *T. tanyspilus*, and *T. latruncularius* were obtained from samples collected by MVE. The COI sequence for *Stonogobiops xanthorhinica* (HQ536655), from another genus of shrimpgobies was used as an outgroup.

Sequences were aligned and edited using Geneious Prime 2023.1.1 (https://www.geneious.com) and trimmed for downstream analysis (fragment size of 535 bp). Genetic analyses were conducted in MEGA11: Molecular Evolutionary Genetics Analysis version 11 (Tamura et al. 2021). Pairwise genetic distances were computed as p-distance. A neighbor-joining tree using p-distance substitution rates and equal rates among sites was generated for visualization.

## ***Tomiyamichthys elliotensis*, n. sp.**

### Lady Elliot Shrimpgoby

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Figures 1–7; Tables 1–3

**Holotype.** QM I.41296, female, 52.7 mm SL, Australia, Queensland, Lady Elliot Island, Lighthouse Bommie, -24.1156°, 152.708°, 19 m, clove oil & hand net, M.V. Erdmann & C.L. Gudgeon, 15 February 2023.

**Paratypes.** QM I.41297, 2 males, 34.5 & 37.9 mm SL, collected with holotype; WAM P. 35516-001, female, 51.8 and 2 males, 32.6–38.6 mm SL, collected with holotype

**Diagnosis.** Dorsal-fin elements VI-I,10, no dorsal-fin spine elongated, longest spine 1.0–1.3 in HL; anal-fin elements I,10; pectoral-fin rays 17–18 (usually17); lateral scale series 78–84; scales entirely cycloid; scales absent on cheek, opercle, predorsal, and pectoral-fin base; gill opening extending to about level of posterior edge

**Figure 1.** *Tomiyamichthys elliotensis,* freshly captured female holotype, 52.7 mm SL, Lady Elliot Island, Queensland, Australia (M.V. Erdmann).

**Figure 2.** *Tomiyamichthys elliotensis,* underwater photograph, approx. 50 mm SL, Lady Elliot Island, Queensland, Australia (M.V. Erdmann).

of preopercle; caudal fin rounded, about equal to head length or 3.2–3.6 in SL; pattern of cephalic sensory-canal pores consisting of B', C, D, E, F, G, H', M', N and O' pores; gill rakers poorly developed, 2 + 4–6; color in life overall whitish with midlateral row of 4 large, ovate, brown spots, 5 or 6 diagonal yellow-orange bands on first dorsal fin, brown stripe along middle of second dorsal fin, several yellow-orange stripes along anal fin, and bluish pelvic fins with yellow fin rays; largest specimen, female holotype, 52.7 mm SL.

**Description.** Dorsal-fin elements VI-I,10; anal-fin elements I,10, all segmented dorsal-fin and anal-fin rays branched, last to base; pectoral-fin rays 18 (17 except one with 18 on one side), all branched; pelvic-fin elements I,5, all segmented rays branched with 2 or 3 branch points, the fifth rays joined medially with membrane; segmented caudal-fin rays 17 (with 14 branched), plus 5 upper and 4 (4 or 5) lower rays unsegmented; lateral scale series 82 (78–84; 81); transverse scale rows 20 (18–24; 21); predorsal scales absent; males types with no prepelvic scales and female types with several embedded prepelvic scales; circumpeduncular scales 28 (20–27; 25); gill rakers poorly developed 2+4 (2+4–6); vertebrae 26.

Body elongate, depth at pelvic-fin origin 7.3 (6.8–7.5; 7.1) in SL; body compressed, width at pectoral-fin origin 1.3 (1.1–1.2; 1.2) in body depth; head length 3.6 (3.5–3.8; 3.6) in SL; head compressed, width 1.0 (0.9–1.0; 1.0) in body depth; snout short, length 5.6 (4.8–6.3; 5.6) in HL; orbit diameter 4.2 (3.6–3.9; 3.9) in HL; interorbital space very narrow, eyes nearly in contact; caudal-peduncle depth 3.1 (2.8–3.3; 3.0) in HL; caudal-peduncle length 1.7 (1.5–1.7; 1.7) in HL.

Mouth terminal, oblique, and large, forming angle of about 25–30° to horizontal axis of body, reaching vertical near posterior edge of eye; upper-jaw length 2.7 (2.2–2.7; 2.5) in HL; several rows of small, slender, conical teeth in both jaws, those in outer row of upper jaw increasingly larger and more widely spaced anteriorly; front of lower jaw with 4 or 5 enlarged teeth on each side; no teeth on vomer or palatines; inner edge of lips papillose; tongue broadly triangular with rounded tip; gill opening broad, extending to about level of posterior edge of preopercle; gill membranes attached only anteriorly to isthmus, with no free fold; gill rakers poorly developed with pair of tiny rakers on upper limb, 4–6 rakers on lower limb, and 9 or 10 elements on outer face of first arch.

Posterior nostril a large, nearly round aperture in front of center of eye at fleshy edge of orbit; anterior nostril a short membranous tube, anteroventral to posterior nostril just above and in contact with edge of upper lip.

Cephalic pores and longitudinal pattern of papillae rows as shown in Fig. 3, pores include a large pore (B') immediately adjacent to each posterior nostril; two unpaired pores (C and D) at anterior and posterior interobital; a pore (E), behind rear, upper corner of orbit; three postocular pores (F, G, and H'), and three preopercular pores (M', N, and O'). A single tranverse row of 6 or 7 papillae across ventral chin, just behind lower lip (Fig 3B).

Scales entirely cycloid, gradually larger posteriorly; scales absent on head, pectoral-fin base, and prepelvic area of male; tiny embedded scales present on prepelvic area of female; no scales on fins except about three rows at base of caudal fin, smaller than last row on caudal peduncle.

First dorsal fin moderately large and sail-like without filamentous rays, its origin slightly behind rear base of pelvic fins and membrane behind last spine confluent with base of second dorsal fin; predorsal length 2.9 (2.9–3.1; 3.0) in SL; dorsal spines slender and flexible, first 4 spines subequal, first spine, 4.6 (3.5–4.8; 4.1) in SL; third spine 4.9 (3.9–4.8; 4.4) in SL; fourth spine 5.0 (4.0–4.9; 4.6) in SL; spine of second dorsal fin 2.9 (2.6–3.0; 2.8) in HL; penultimate segmented dorsal-fin ray longest, 5.6 (4.9–5.7; 5.3) in SL; origin of anal fin below base of second segmented dorsal-fin ray; preanal length 1.6 (1.7–1.8; 1.7) in SL; anal-fin spine 4.4 (4.0–5.3; 4.6) in HL; penultimate segmented anal-fin ray longest, 6.1 (5.0–5.7; 5.5) in SL; caudal fin rounded, about equal to HL, 3.6 (3.2–3.5; 3.4) in SL; pectoral fins rounded when spread, middle rays longest, reaching to level of base of first segmented dorsal-fin ray, 3.9 (3.3–3.7; 3.6) in SL; prepelvic length 3.6 (3.1–3.6; 3.4) in SL; adpressed pelvic fins tips falling well short of anal opening, length of pelvic fin 5.4 (3.9–5.5; 4.7) in SL; pelvic-fin spine length 34% (25–33%; 29%) of longest pelvic ray; pelvic frenum moderately thickened, membrane reaching tips of pelvic-fin spines.

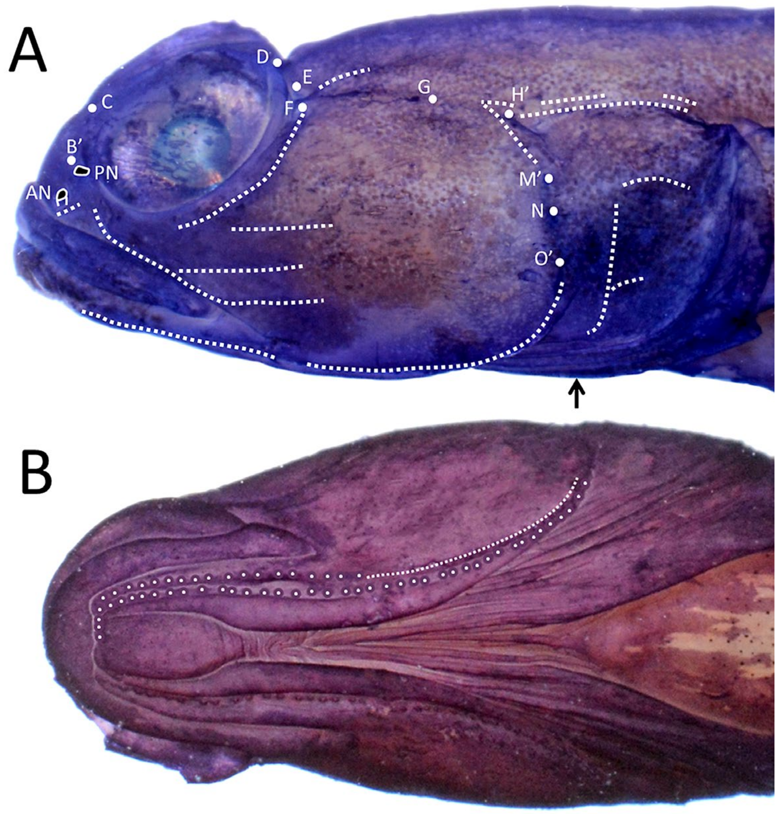


**Figure 3.** *Tomiyamichthys elliotensis*, preserved male paratype WAM P. 35516-001, 38.6 mm SL, cyanine blue stain; A: lateral, white circles with letters are sensory pores, papillae rows are broken white lines; B: ventral, papillae are both-sized dots (papillae rows are diagrammatic for location and extent and dots do not map individual papillae) AN & PN=anterior and posterior nostrils; arrow is level of gill attachment (G.R. Allen).

**Figure 4.** *Tomiyamichthys elliotensis,* preserved female holotype, 52.7 mm SL, Lady Elliot Island, Queensland, Australia (G.R. Allen).

**Color in life.** (Figs. 1, 2, 5–7) Generally pale gray to whitish with 4 large, brown, oblong spots along middle of side, decreasing in size posteriorly, the anteriormost sometimes greatly expanded to form a broad dark-brown bar that extends dorsally onto first dorsal fin (Fig. 5A); 4 diffuse clusters of small, irregular, brown spots along base of dorsal fin at level of each large mid-lateral spot; head with variable brown to orange markings, including diagonal band from lower margin of eye across cheek, dark spot in contact with posterior extent of jaws, several spots on upper part of cheek and opercle, and a cluster of close-set spots on predorsal portion of nape; some individuals with greatly expanded brown markings on cheek and opercle (Figs. 1 & 5A); iris white, often with a hint of a brown bar across middle of upper portion; first dorsal fin with 5 or 6 diagonal brown bands or rows of orange spots on a pale gray to brownish background, a brown outer margin, and alternating brown and white bands on first spine; second dorsal fin whitish with widely spaced small orange spots, a brown stripe on middle portion and a narrow yellow outer margin; anal fin bluish with narrow orange stripes except pale yellowish on basal third; caudal fin semitranslucent and whitish; pelvic fin yellow with blue rays; pectoral fin translucent with bright white area basally that extends onto fleshy base, upper half of fleshy base sometimes with brown stripe and orange-yellow spots. A few individuals are very pale and exhibit faded patterns with diffuse markings (Fig. 7).

**Color of fresh holotype.** (Fig. 1) Similar to color in life except yellow on lower basal portion of pectoral fin and a large brown spot enclosing narrow orange bands on upper half of fleshy portion of base; a diffuse brown blotch with numerous small orange spots covering most of opercle; pair of brown to orange spots, about one-third pupil size, posteriorly on cheek, a large brown blotch on anterior cheek, an oblong brown blotch adjacent to and extending slightly posterior to rear extent of upper jaw, and dusky brown lips; fins as in life except outer edge of first dorsal fin orange, dark blotches on distal membrane between first and second plus third and fourth spines; lower third of caudal fin slightly dusky brownish.

**Color in alcohol.** (Fig. 4) Body yellowish white on sides with 4 large, brown oblong spots along middle of side, each merging with a slightly lighter brown saddle on dorsal half of body, anteriormost sometimes expanded to form a broad dark-brown bar extending dorsally onto first dorsal fin; head mainly brown except yellowish tan on rear portion of cheek and whitish on lips; oblong brown blotch adjacent to and extending slightly posterior to rear extent of upper jaw and a pair of brown spots, about one-third pupil size, posteriorly on cheek; first dorsal fin mainly dusky brown; second dorsal fin translucent or slightly dusky with brown stripe across middle portion; anal fin translucent on basal third and outer third with alternating translucent and brown stripes; caudal fin translucent, slightly dusky on lower third; pelvic fins slightly dusky; pectoral fins translucent whitish with brown spot on upper two-thirds of fleshy base and smaller brown spot on lowermost portion of base.

**Sexual dimorphism.** Judging from underwater photographs and preserved specimens there are no detectable differences between sexes other than those related to the shape of the urogenital papilla and prepelvic scalation. Adult females have a relatively large, rounded, barrel-shaped, urogenital papilla compared with a smaller, more flattened, triangular papilla of males. Females have several small, embedded prepelvic scales, not found on males.

**Etymology.** The new species is named for the type location, Lady Elliot Island on the Great Barrier Reef.

**Distribution and habitat.** The new species is currently known only from Lady Elliot Island at the southern end of the Great Barrier Reef (GBR), although it is likely to be present throughout the Capricorn-Bunker Reefs and potentially could be widespread throughout the GBR. The type specimens and numerous other individuals were observed on relatively flat sandy bottoms exposed to periodic strong tidal currents in 15–24 m depth. Temperatures at this site range from 20–28° C across the year. Most individuals observed appeared to be solitary, while about 20% of burrows encountered had a pair of shrimpgobies guarding the entrance. Interestingly, observations during peak tidal currents revealed that nearly all shrimpgoby burrows were completely covered by shifting sands; only during slack tides would the alpheid shrimp reopen the burrow entrances. Numerous other species of shrimpgoby were commonly observed within 1 or 2 m of burrows of the new species, including *Amblyeleotris diagonalis*, *A. novaecaledoniae*, *A. ogasawarensis*, *A. rubrimarginata, A. steinitzi*, *A. wheeleri*, *Ctenogobiops mitodes*, *C. pomastictus,* and *Stonogobiops xanthorhinica*.

**Comparisons.** Salient features to diagnose the species of *Tomiyamichthys* are summarized in Tables 2 & 3. The new taxon appears most similar in morphology and color pattern to *T. oni*, originally described from Japan, but subsequently recorded from mainly western Pacific localities including Indonesia (Sumatra to West Papua), Brunei, Philippines, Palau, Papua New Guinea, Solomon Islands, and New Caledonia. The two species

# TABLE 1

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

| | holotype | paratypes | | | | |
|---|---|---|---|---|---|---|
| | QM I.41296 | WAM P.35516-001 | WAM P.35516-001 | QM I.41296 | QM I.41296 | WAM P.35516-001 |
| Sex | female | female | male | male | male | male |
| Standard length (mm) | 52.7 | 51.8 | 38.6 | 37.4 | 34.5 | 32.6 |
| Body depth at pelvic-fin origin | 13.7 | 13.3 | 14.6 | 13.5 | 14.5 | 14.8 |
| Body depth at anal-fin origin | 12.3 | 12.4 | 12.7 | 12.4 | 11.6 | 13.8 |
| Body width | 10.8 | 11.6 | 11.8 | 11.9 | 11.9 | 12.3 |
| Head length | 28.1 | 26.1 | 28.1 | 28.0 | 28.3 | 28.9 |
| Head width | 14.1 | 14.2 | 14.8 | 13.9 | 16.5 | 14.3 |
| Snout length | 5.0 | 5.5 | 4.7 | 5.1 | 5.4 | 4.6 |
| Orbit diameter | 6.6 | 6.8 | 7.5 | 7.3 | 7.9 | 7.4 |
| Cheek depth | 7.6 | 8.2 | 7.8 | 8.1 | 7.8 | 7.7 |
| Upper-jaw length | 10.5 | 10.7 | 11.0 | 10.3 | 12.1 | 12.9 |
| Caudal-peduncle depth | 9.1 | 9.5 | 9.7 | 9.5 | 8.6 | 9.4 |
| Caudal-peduncle length | 16.1 | 15.9 | 18.3 | 16.1 | 17.0 | 17.9 |
| Predorsal length | 34.3 | 32.9 | 32.3 | 33.1 | 34.8 | 33.6 |
| Preanal length | 61.2 | 58.9 | 59.0 | 56.9 | 56.9 | 60.2 |
| Prepelvic length | 27.9 | 27.9 | 29.6 | 28.1 | 31.9 | 31.5 |
| Base-of-dorsal-fin length | 53.5 | 55.3 | 52.0 | 53.8 | 51.5 | 54.6 |
| First dorsal-fin spine | 21.9 | 20.8 | 23.4 | 25.2 | 26.7 | 28.5 |
| Third dorsal-fin spine | 20.4 | 20.9 | 22.2 | 23.4 | 23.5 | 25.8 |
| Fourth dorsal-fin spine | 19.8 | 20.3 | 20.9 | 22.7 | 22.2 | 25.2 |
| Spine of second dorsal fin | 9.8 | 9.5 | 9.4 | 9.9 | 10.0 | 11.0 |
| Longest dorsal-fin ray | 18.0 | 20.5 | 18.8 | 18.2 | 19.7 | 17.5 |
| Base of anal-fin fin | 25.3 | 24.2 | 26.5 | 26.4 | 25.0 | 27.3 |
| Anal-fin spine | 6.5 | 6.4 | 5.9 | 5.3 | 7.0 | 5.9 |
| Longest anal-fin ray | 16.5 | 17.4 | 18.2 | 20.1 | 19.5 | 18.0 |
| Caudal-fin length | 27.5 | 28.4 | 31.1 | 28.4 | 29.8 | 29.4 |
| Pectoral-fin length | 25.7 | 27.4 | 27.7 | 29.3 | 27.8 | 30.7 |
| Pelvic-fin-spine length | 6.4 | 6.4 | 5.6 | 6.0 | 6.3 | 6.1 |
| Pelvic-fin length | 18.7 | 22.1 | 22.2 | 22.7 | 25.4 | 18.2 |

## TABLE 2

## Head pores, prepelvic scales, posterior body scales, fin-ray and scale counts in *Tomiyamichthys* species (adapted from Hoese et al. (2016) & Allen et al. (2019))

# of preopercular pores (POP); present (+) or absent (-); LC tube= separate tube above operculum or pores K' & L'; LC1= lateral-canal pore above preoperculum or pore G; PO= postorbital or pore E; n= naked, ps= partly scaled

| Species | POP | LC tube | LCI | PO pores | Prepelvic scales | Posterior body scales |
|---|---|---|---|---|---|---|
| *T. alleni* | 0 | - | - | - | n | cycloid |
| *T. dorsostigma* | 3 | + | + | + | n | cycloid |
| *T. fourmanoiri* | 3 | + | + | + | n | cycloid |
| **T. elliotensis** | **3** | **-** | **+** | **+** | **ps (♀ only)** | **cycloid** |
| *T. emilyae* | 2 | - | + | + | n | cycloid |
| *T. eyreae* | 3 | - | + | + | ps | ctenoid |
| *T. gomezi* | 2 | - | + | + | ps | ctenoid |
| *T. lanceolatus* | 0 | - | + | + | n | ctenoid |
| *T. latruncularius* | 3 | - | - | + | n | ctenoid |
| *T. levisquama* | 3 | - | + | + | ps | cycloid |
| *T. nudus* | 2 | - | + | +/- | n | none |
| *T. oni* | 2 | - | - | + | ps | cycloid |
| *T. praealtus* | 3 | - | + | + | n | cycloid |
| *T. reticulatus* | 0 | - | - | + | n | ctenoid |
| *T. russus* | 2-3 | - | + | + | ps | ctenoid |
| *T. smithi* | 3 | + | + | + | n | cycloid |
| *T. stuarti* | 0 | - | + | + | n | ctenoid |
| *T. tanyspilus* | 0 | - | + | + | ps | cycloid |
| *T. zonatus* | 0 | - | + | - | n | ctenoid |

| Species | Second dorsal fin | Anal fin | Pectoral fin | Lateral scales | Transverse scales |
|---|---|---|---|---|---|
| *T. alleni* | I,10 | I,10 | 15-17 | 25-50 | 7-10 |
| *T. dorsostigma* | I,12 | I,12 | 17 | 120-125 | 27 |
| *T. fourmanoiri* | I,12 | I,12 | 16 | 77 | 24 |
| **T. elliotensis** | **I,10** | **I,10** | **17-18** | **78-84** | **18-24** |
| *T. emilyae* | I,10 | I,10 | 15-17 | 66-72 | 19-21 |
| *T. eyreae* | I,9 | I,9 | 17 | 55-56 | 14 |
| *T. gomezi* | I,10 | I,10 | 15 | 47-56 | 12-13 |
| *T. lanceolatus* | I,12 | I,12 | 16-18 | 54-58 | 16-18 |
| *T. latruncularius* | I,9 | I,9 | 17-18 | 47-49 | 18 |
| *T. levisquama* | I,10 | I,10 | 18-19 | 50-70 | 22-25 |
| *T. nudus* | I,10 | I,10 | 14-15 | 0 | 0 |
| *T. oni* | I,11 | I,11 | 17-19 | 74-91 | 20-22 |
| *T. praealtus* | I,10 | I,10 | 18 | 54 | 24 |
| *T. reticulatus* | I,12 | I,13 | 21 | 57 | 13 |
| *T. russus* | I,10 | I,10 | 17 | 74-95 | 24-27 |
| *T. smithi* | I,12 | I,12 | 18 | 93-96 | 25 |
| *T. stuarti* | I,11 | I,11 | 15 | 51-56 | 11 |
| *T. tanyspilus* | I,12 | I,12 | 17-18 | 78-80 | 22 |
| *T. zonatus* | I,11 | I,11 | 17 | 52-54 | 13-14 |

TABLE 3

Comparison of color pattern features of *Tomiyamichthys elliotensis* and *T. oni*

| **Color pattern features** | ***Tomiyamichthys elliotensis*** | ***Tomiyamichthys oni*** |
|---|---|---|
| Midlateral spots | Ovate | Round |
| Profuse freckling on side | Absent | Present |
| Eye band | Diagonal and no contact with jaws | Vertical and contacts rear extent of jaws |
| Black spot on first dorsal fin* | Absent | Present |
| First dorsal-fin markings | 5 or 6 yellow-orange bands | Broad brown bar/band |
| Anal-fin markings | Yellow-orange stripes | No stripes |
| Pectoral fins | Translucent | Small brown spots |
| Pelvic fins | Yellow with blue fin rays | Dusky brown with blue fin rays |

*distal edge of membrane between third and fourth dorsal spines

share similar meristic and morphological features, including lateral and transverse scale counts and most fin-ray counts, with the exception of segmented dorsal and anal-fin rays (10 for *T. elliotensis* vs. 11 for *T. oni*). The head-pore pattern of the two species differs slightly, with *T. elliotensis* having the G pore above the middle of the preoperculum and the O' pore on the preopercular margin, both absent in *T. oni*. Moreover, color patterns are diagnostically different (Figs. 5 & 6, Table 3). The body of *T. elliotensis* is relatively immaculate with minimal freckling or spotting, other than the large ovate markings along the sides, vs. profuse freckling and spotting and round lateral markings in *T. oni.*

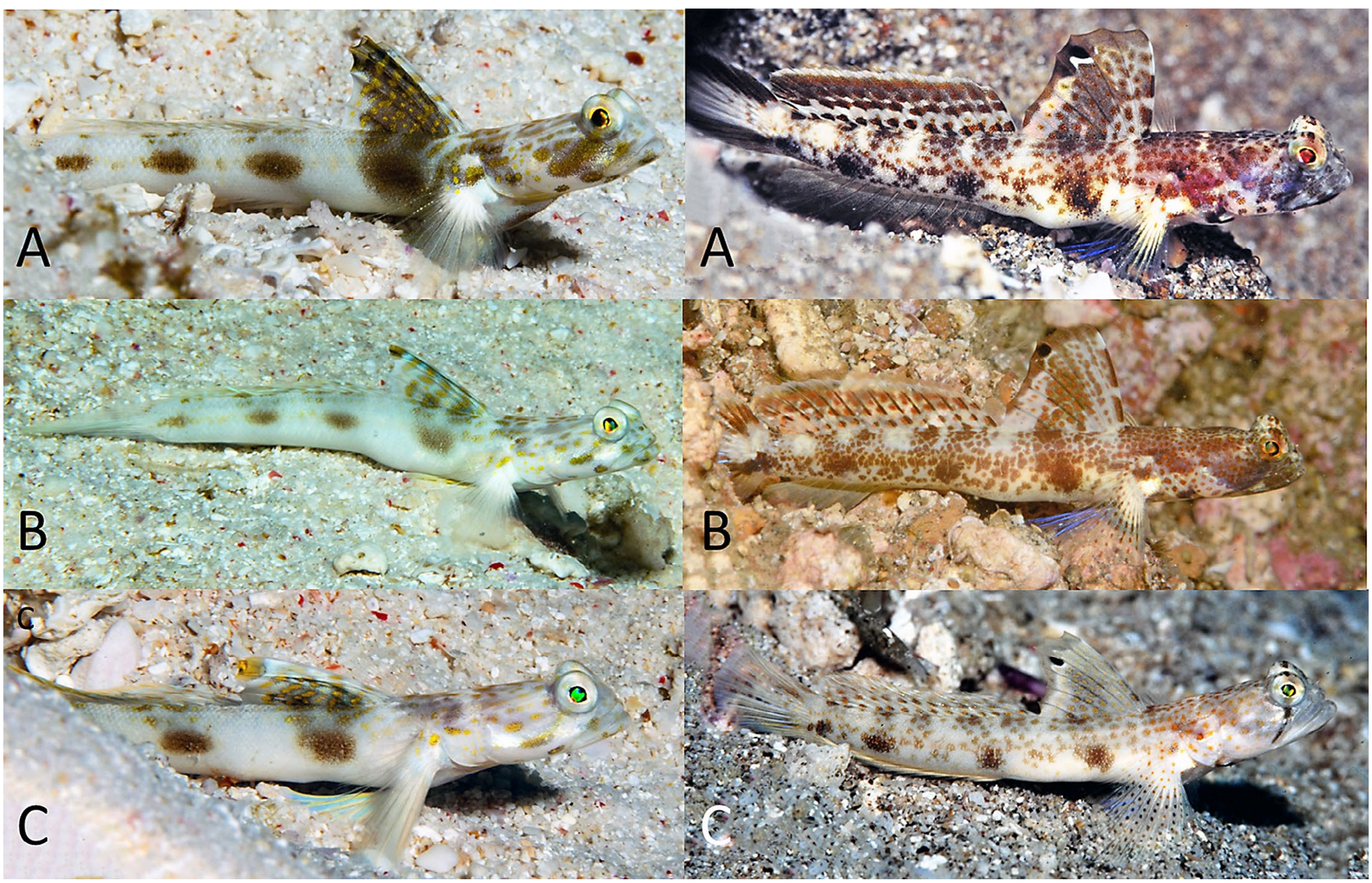


**Figure 5.** Adults underwater, about 50 mm SL; *Tomiyamichthys elliotensis,* at left A, B & C (M.V. Erdmann); *Tomiyamichthys oni*, at right A & B are males & C is female (G.R. Allen).

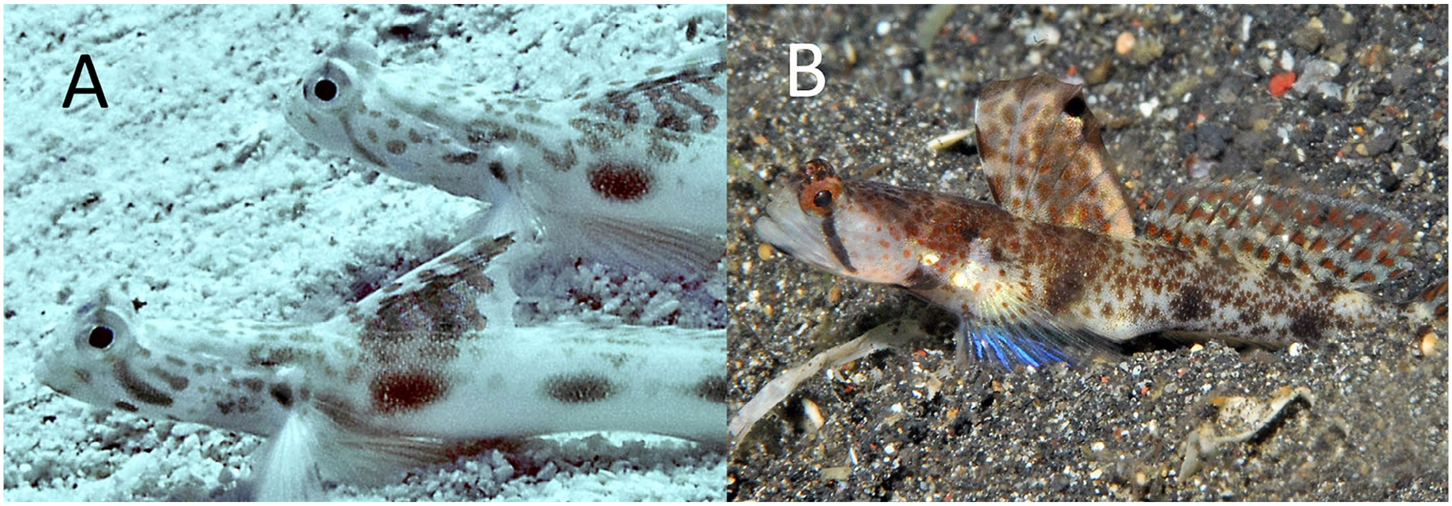


**Figure 6.** Adults underwater, about 50 mm SL, comparison of bar below eye; A: *Tomiyamichthys elliotensis,* B: *Tomiyamichthys oni* (G.R. Allen).

Particular useful are dorsal-fin markings: the first dorsal fin of T. *elliotensis* has 5 or 6 yellow-orange bands or rows of large spots vs. a single broad brown band occupying most of the fin in *T. oni*, and the second dorsal fin of T. *elliotensis* has a prominent, although relatively narrow, middle dark stripe and a narrow yellow outer margin, differing markedly from *T. oni*, where males have a broad brown stripe on the upper fin with a narrow white margin and females have 3 or 4 rows of brown spots. Another useful feature is the dark band originating on the lower edge of the eye. Although frequently inconspicuous in the new species, it is more horizontally oriented and does not make contact with the posterior extent of the jaws vs. more vertically positioned and in contact with the jaws in *T. oni* (Fig. 6). The color patterns of both species, although distinctive, are highly variable depending on substrate and behavior. As in several other *Tomiyamichthys*, they are capable of altering the intensity of the basic pattern, especially the brown markings on the head, body, and fins. For example, an unusually pale form of the new species was occasionally observed (Fig. 7).

The genetic analysis showed clear support for species delineation of *T. elliotensis*. The three *T. elliotensis* samples formed a monophyletic clade in the neighbor-joining tree. Although only 6 *Tomiyamichthys* species were included in the COI analysis, there was clear and deep separation between *T. elliotensis* and all other species including *T. oni* (Fig. 8). The mtDNA COI sequences within the group were very different from each other, interspecific distances range from 14.4% to 21.5%, with intraspecific differences on the order of 0 to 1.7%.

**Figure 7.** *Tomiyamichthys elliotensis,* underwater pale form of adult, about 45 mm SL, Lady Elliot Island, Queensland, Australia (M.V. Erdmann).

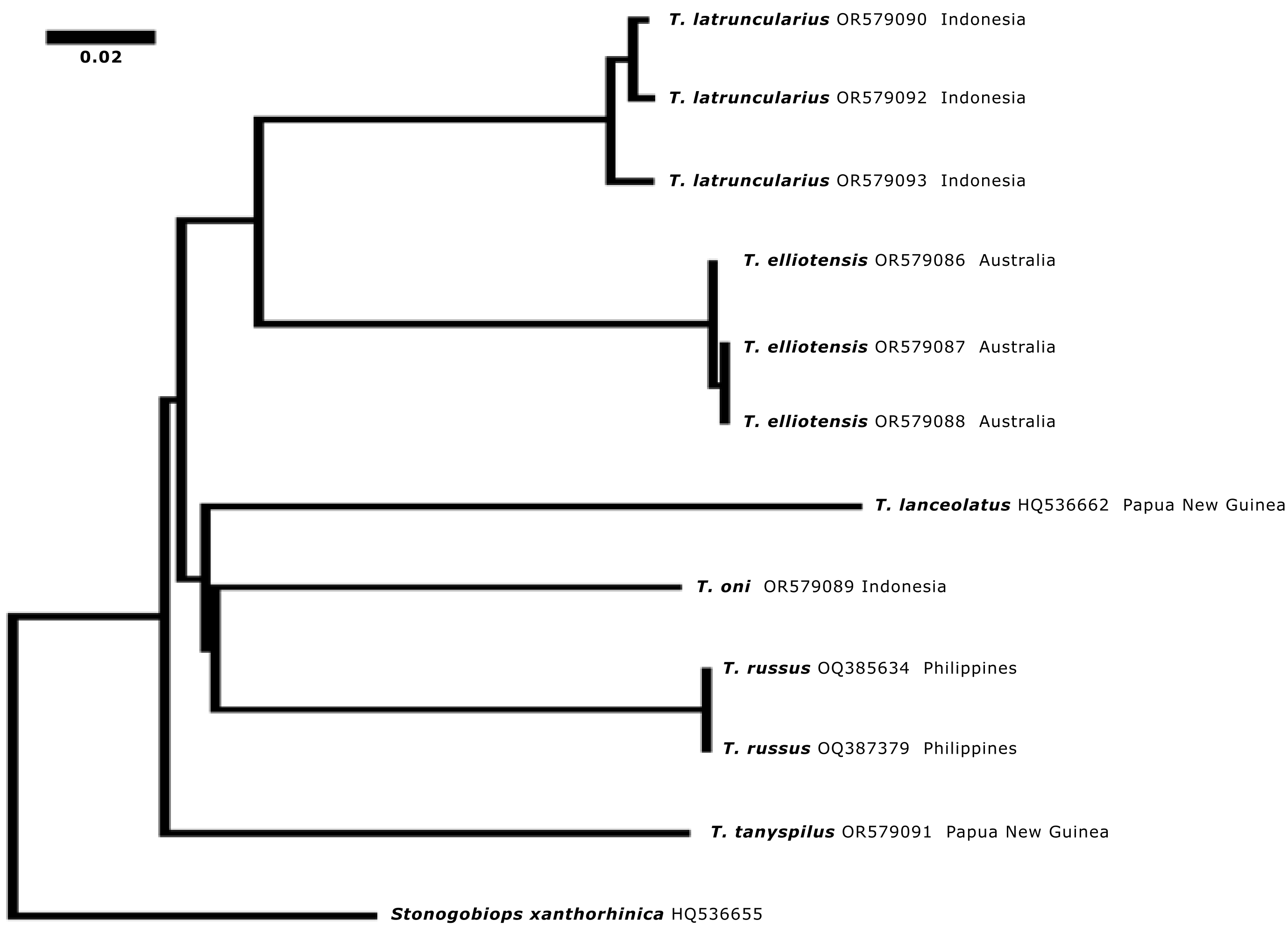


**Figure 8.** The neighbor-joining tree for mtDNA COI sequences of *Tomiyamichthys* species, based on p-distances with uniform rates among sites. *Stonogobiops xanthorhinica* is used as an outgroup. Location of collection and GenBank accession number are indicated.

The sequence difference between the new species and its putative closest relative *T. oni* is 18.3%. The large interspecific distances are a result of highly variable sequences of COI, such that other genera of gobies are less different from *T. elliotensis* than is *T. oni*. This indicates that more conservative genes and much more extensive sampling is needed for any robust phylogenetic inferences of relationships within *Tomiyamichthys*.

## Other material examined:

*Tomiyamichthys oni*: WAM P.34322-002, 48 mm SL, Kwato Island, Milne Bay, Papua New Guinea; WAM P.39471-001, 38 mm SL, Fakfak Peninsula, West Papua, Indonesia; WAM P. 35013-001, 41 mm SL, Lembeh Strait, North Sulawesi, Indonesia.

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## References

Akihito (1984) Suborder Gobiodei. *In*: Masuda, H., Amaoka, K., Araga, C., Uyeno, T. & Yoshino, T. (Eds.) *Fishes of the Japanese Archipelago*. Tokai University Press, Tokyo, Japan [English text], pp. 236–238.

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) Descriptions of two new species of shrimpgobies (Gobiidae: *Cryptocentrus* and *Tomiyamichthys*) from Papua New Guinea. *Journal of the Ocean Science Foundation*, 16, 67–81. https://doi.org/10.5281/zenodo.1021435.

Allen, G.R. & Erdmann, M.V. (2012) *Reef Fishes of the East Indies. Volumes I–III.* Tropical Reef Research, Perth, Australia, x+1260 pp.

Allen, G.R., Erdmann, M.V. & Brooks, W.M. (2018) A new species of *Tomiyamichthys* (Pisces: Gobiidae) from Papua New Guinea. *Journal of the Ocean Science Foundation*, 31, 38–46. https://doi.org/10.5281/zenodo.1458266.

Allen, G.R., Erdmann, M.V. & Mongdong, M.U. (2019) *Vanderhorstia dawnarnallae*, a new species of shrimpgoby (Pisces: Gobiidae) from West Papua, Indonesia. *Journal of the Ocean Science Foundation*, 33, 89–98. https://doi.org/10.5281/zenodo.3519384

Allen, G.R., Erdmann, M.V. & Utama, I.V. (2019) *Tomiyamichthys emilyae*, a new species of shrimpgoby (Gobiidae) from North Sulawesi, Indonesia. *Journal of the Ocean Science Foundation*, 33, 53–64. https://doi.org/10.5281/zenodo.3473511.

Bogorodsky, S.V., Kovačić, M. & Randall, J.E. (2011) A new species and three new records of gobiid fishes from the Red Sea. *Cybium*, 35 (3), 213–222. https://doi.org/10.26028/cybium/2011-353-005

Cantor, T.E. (1849) Catalogue of Malayan fishes. *Journal of the Asiatic Society of Bengal*, 18 (2), 983–1443.

Chen, I-S. & Fang, L.-S. (2003) A new marine goby of genus *Flabelligobius* (Teleostei: Gobiidae) from Taiwan. *Ichthyological Research*, 50 (4), 333–338.

Fricke, R., Eschmeyer, W.N. & Van der Laan, R. (Eds.) (2023) *Eschmeyer's Catalog of Fishes: Genera, Species, References, electronic version ( 8 August 2023)*, San Francisco, CA, USA. Available at http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (last accessed 8August 2023).

Greenfield, D.W. (2017) *Tomiyamichthys reticulatus*, a new species of shrimpgoby from Fiji (Teleostei: Gobiidae). *Journal of the Ocean Science Foundation*, 28, 47–51. https://doi.org/10.5281/zenodo.996850

Hoese, D.F., K. Shibukawa, K. & Johnson, J.W. (2016) Description of a new species of *Tomiyamichthys* from Australia with a discussion of the generic name. *Zootaxa*, 4079 (5), 582–594. https://doi.org/10.11646/zootaxa.4079.5.5

Ivanova, N.V., Zemlak, T.S., Hanner, R.H. & Hebert, P.D. (2007) Universal primer cocktails for fish DNA barcoding. *Molecular Ecology Notes*, 7 (4), 544–548. https://doi.org/10.1111/j.1471-8286.2007.01748.x

Iwata, A., Ohnishi, N. & Hirata, T. (2000) *Tomiyamichthys alleni*: a new species of Gobiidae from Japan and Indonesia. *Copeia*, 2000 (3), 771–776.

Klausewitz, W. (1974) Fische aus dem Roten Meer. 14. *Eilatia latruncularia* n. gen. n. sp. und *Vanderhorstia mertensi* n. sp. vom Golf von Aqaba (Pisces: Gobiidae: Gobiinae). *Senckenbergiana Biologica*, 55 (4/6), 205–212.

Lachner, E.A. & McKinney, J.F. (1981) A new fish species of the genus *Vanderhorstia* (Teleostei: Gobiidae) from the Amirante Islands, Indian Ocean. *Proceedings of the Biological Society of Washington*, 93 (4) (for 1980), 963–970.

Randall, J.E. & Chen, I-S. (2007) *Tomiyamichthys tanyspilus*, a new species of gobiid fish from Indonesia. *Zoological Studies*, 46 (6), 651–655.

Smith, J.L.B. (1956) An interesting new gobioid fish from Madagascar, with a note on *Cryptocentrus oni* Tomiyama, 1936. *Annals and Magazine of Natural History*, (Series 12) 9, (104) (art. 67), 553–556.

Saruwatari, T., Lopez, J.A. & Pietsch, T.W. (1997) Cyanine blue: a versatile and harmless stain for specimen observations. *Copeia*, 1997 (4), 840–841. https://doi.org/10.2307/1447302

Tamura, K., Stecher, G. & Kumar, S. (2021) MEGA11: Molecular Evolutionary Genetics Analysis version 11. *Molecular Biology and Evolution*, 38, 3022–3027. https://doi.org/10.1093/molbev/msab120

Tomiyama, I. (1936) Gobiidae of Japan. *Japanese Journal of Zoology*, 7 (1), 37–112.

Yanagisawa, Y. (1978) Studies on the interspecific relationship between gobiid fishes and snapping shrimp. I. Gobiid fishes associated with snapping shrimps in Japan. *Publications of the Seto Marine Biological Laboratory*, 24 (4/6), 269–325.