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# *Eviota fluctiphila*, a new dwarfgoby from the western Pacific Ocean (Teleostei: Gobiidae)

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## Abstract

A new species of dwarfgoby, *Eviota fluctiphila*, n. sp., is described from West Papua in the western Pacific Ocean. It has a complete cephalic sensory-canal pore system (pattern 1), dorsal/anal-fin formula of usually 8/8, some pectoral-fin rays branched, the fifth pelvic-fin ray absent, the first dorsal fin not filamentous, no occipital or dark marks on the nape, the pectoral-fin base peppered with scattered melanophores, the first dorsal fin dark crossed by a pale band, two dark postanal spots above the anal-fin base, a dark internal blotch over the preural centrum on and above the midline, and a pear-shaped male urogenital papilla. *Eviota fluctiphila* occurs in shallow (0.2–2 m), high-energy reef habitats.

**Key words:** taxonomy, ichthyology, coral-reef fishes, gobies, West Papua, Raja Ampat, *E. algida*, *E. winterbottomi*

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## Introduction

The dwarfgobies (genus *Eviota* Jenkins, 1903) are represented by 129 species including the new species described herein, and thus is the second most speciose coral-reef teleost genus, and the fifth most speciose saltwater teleost genus (Greenfield 2021). These gobies are found throughout the Indo-Pacific Ocean, with the greatest diversity in the western Pacific in the area referred to as the 'Coral Triangle', which contains the world's greatest diversity of coral-reef fishes (Allen & Erdmann 2012). They also are relatively abundant. In the Hawaiian Islands, larval *Eviota* constitute the most abundant species in the plankton (Boehlert & Mundy 1996), and in a survey of fish assemblages across the Great Barrier Reef, three goby species accounted for 55.9% of all specimens, two of them being *Eviota* species (Goatley et al. 2016). Cryptobenthic fishes, such as *Eviota*, have been shown to be the main contributor to nutrient and energy import to reefs in tropical seas (Brandl et al. 2019). In spite of their diversity and abundance, they are not often seen because of their very small size: < 35.7 mm SL, but 43% ≤ 18 mm SL (Greenfield 2017). Recently, however, efforts to intensively search for cryptobenthic fishes and these goby species in particular, including obtaining diagnostic underwater color photographs before collecting individuals, have led to the rapid increase of described species. Prior to the recent reviews of the genus (Greenfield & Winterbottom 2016, Greenfield 2017, 2021), the last major review on the genus by Jewett & Lachner (1983) reported 40 species, with 89 species having been described since that time.

The new species described here was collected during assessments of the marine tourism potential (including surveys for new dive sites) of the Kawe region of the Raja Ampat Archipelago, West Papua, conducted by the second and third authors as part of their work with the Raja Ampat Regency government.

## Materials and Methods

The holotype is deposited at the Museum Zoologicum Bogoriense, Cibinong, Java (MZB) and the paratypes and non-type specimens are deposited at the California Academy of Sciences, San Francisco, CA, USA (CAS).

Descriptions of pelvic-fin morphology and cephalic sensory-canal pores follow Greenfield & Winterbottom (2016), as originally formulated by Lachner & Karnella (1980) and Jewett & Lachner (1983). Internal postanal ventral midline spots, running along the posterior ventral midline of the body, begin at the anal-fin origin and extend to a vertical line two or three scale rows anterior to the ends of the hypurals; the additional smaller spot posterior to this, if present, is not counted. We follow Lachner & Karnella (1980: 4) in describing the membranes joining the first 4 pelvic-fin rays, which "…are considered to be well developed when the membranes extend beyond the bases of the first branches; they are considered to be reduced when they are slightly developed, not extending to the bases of the first branches". The dorsal/anal fin-ray formula count (eg. 8/8) only includes segmented rays.

Measurements were made to the nearest 0.1 mm using an ocular micrometer or dial calipers (the latter only for standard length, body depth, and caudal-peduncle depth). 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); origin of the first dorsal fin is measured from the median anterior point of the upper lip to the anterior base of the first dorsal-fin spine; origin of the second dorsal-fin is measured from the median anterior point of the upper lip to the anterior base of its spine; origin of the anal fin is measured from the median anterior point of the upper lip to the anterior base of its spine; body depth is measured at the center of the first dorsal fin; head length is taken from the upper lip to the posterior end of the opercular membrane; 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 the straight-line distance from the anterior tip of the premaxilla to the end of the upper margin of the dentary where the maxilla joins behind it; caudal-peduncle depth is the least depth, and caudal-peduncle length is the horizontal distance between the verticals at the rear base of the anal fin and the caudal-fin base; pelvic-fin length is measured from the base of the pelvic-fin spine to the tip of the longest pelvic-fin soft ray.

Cyanine Blue 5R (acid blue 113) stain was used to make pores and scale outlines more obvious (Akihito et al. 1993, 2002, Saruwatari et al. 1997).

**Figure 1.** *Eviota fluctiphila*, fresh holotype, MZB 26095, 14.3 mm SL female, Batu Hitam, Raja Ampat, West Papua (M.V. Erdmann).

## *Eviota fluctiphila,* n. sp.

Surge Dwarfgoby

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Figures 1–4

**Holotype.** MZB 26095, 14.3 mm SL female, West Papua, Raja Ampat Archipelago, Batu Hitam, -0.0739°, 130.0867°, 0.3 m, field number MVE-17-036, vertical rocky wall exposed to strong surge, R. Mambrasar, clove oil and hand net, 18 November 2017.

**Paratypes.** CAS 247339, 2 males 11.5 & 14.5 mm SL, 2 females 11.8 & 12.2 mm.SL, taken with holotype; CAS 247339, 2 females 11.0 & 11.5 mm SL, immature 10.5 mm SL (DNA vouchers), taken with holotype.

**Non-type material.** CAS 241535, 13.0 mm SL male, taken at type location, R. Mambrasar & M.V. Erdmann, 28 August 2010.

**Diagnosis.** A species of *Eviota* distinguished from all congeners by a combination of a complete cephalic sensory-canal pore system (pattern 1), a dorsal/anal fin-ray formula usually 8/8 (2 with 8/7), some pectoral-fin rays branched, fifth pelvic-fin ray absent, first dorsal fin not filamentous, no dark occipital or nape markings, two dark postanal spots above anal-fin base, pectoral-fin base peppered with melanophores, dark internal blotch over the preural centrum on and above the midline, first dorsal fin dark crossed by a pale band about three-quarters way out, and a pear-shaped male urogenital papilla.

**Description.** Dorsal-fin elements VI+I,8 (one of 8 with I,7), none filamentous, first dorsal fin triangular; anal-fin elements I,8 (3 of 8 with I,7); pectoral-fin rays 16 (16 or 17), some rays branched, reaching to base of second soft dorsal-fin ray; fifth pelvic-fin ray absent, 5 (4–5) branches on fourth ray, 3 (2–3) segments between consecutive branches of fourth pelvic-fin ray, pelvic-fin membrane slightly developed, no basal membrane; caudal fin with 12 (11–14) branched and 17 segmented rays; front of head rounded with an angle of about 60° from horizontal axis; mouth slanted obliquely upwards, forming an angle of about 55° to horizontal axis of body, lower jaw not projecting; maxilla extending posterior to posterior margin of pupil; anterior tubular nares extending just past posterior margin of upper lip; gill opening extending forward just posterior to edge of preoperculum; complete cephalic sensory-canal pore system (pattern 1); lateral-line scales 24 (23–24); transverse scale rows 7; uppermost scale rows end at fourth spine of first dorsal fin; scales on body finely ctenoid, no scales on abdomen or

breast; male urogenital papilla smooth, pear-shaped, with finger-like extensions at end and melanophores at center (Fig. 2).

Measurements. Holotype (range of all types, mean of all types): Head length 31.3 (28.7–33.5, 31.2); origin of first dorsal fin 37.6 (35.6–39.1, 37.5), lying behind posterior margin of pectoral-fin base; origin of second dorsal fin 57.8 (56.8–60.4, 59.1), slightly in advance of anal-fin origin; origin of anal fin 60.6 (56.8–65.1, 61.6); caudal-peduncle length 26.5 (21.2–26.5, 23.9); caudal-peduncle depth 14.3 (14.3–16.9, 15.4); body depth 23.7 (21.6–24.9, 24.1); eye diameter 10.4 (9.1–12.3, 10.3); snout length 4.9 (3,2–5.2, 4.5); pectoral-fin length 31.7 (21.2–39.1, 34.4); pelvic-fin length 31.7 (24.1–34.3, 30.3).

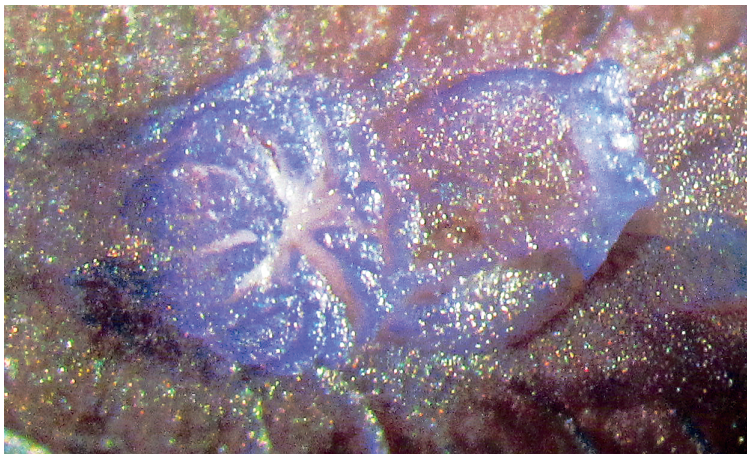

**Figure 2.** *Eviota fluctiphila*, male urogenital papilla, paratype, CAS 247339, 14.5 mm SL, Batu Hitam, Raja Ampat, West Papua (D.W. Greenfield).

**Color of fresh holotype.** (Fig. 1) Background color of head and body translucent gray, overlain with rust-colored patterns; body with concentrations of chromatophores aligned vertically under center of scales; ventral body with 8 distinctive yellow-gold spots: first two vertically aligned narrow bars under pectoral fin; third a spot just anterior to anal-fin origin; fourth over center of anal fin; fifth over end of anal fin; sixth to eigth along caudal peduncle; reddish-rust crescent along caudal-fin base; pectoral-fin base crossed by narrow white bar angling from top of operculum to base of fin, area above white bar reddish-rust, area below bar with scattered black melanophores; narrow translucent gray line behind eye from top of preoperculum extending back to below origin of first dorsal fin; nape with scattered rust blotches; 5 orange-rust blotches around eye: three small blotches above and behind upper half of eye; one larger blotch at 4 o'clock; fifth a bar at 6 o'clock angling down behind jaws; rust-brown bar aligned vertically on operculum; two smaller orange-rust spots on lower part of operculum; pupil of eye black, iris orange with spoke-like, narrow, white bars radiating from pupil; snout, tubular nares and jaws light rusty red; first dorsal fin reddish-rust with small distinct white spots along length of first spine and bases of next 4 spines angling across fin; distal third of fin crossed with wide white band, distal margin clear with scattered black melanophores; second dorsal fin reddish with 4 small white spots spaced along base of fin, distal margin clear with scattered black melanophores, peppering of small white spots on posterior third of fin; caudal fin with rows of red spots along rays on ventral half of fin; pectoral and pelvic fins clear.

**Color in life** (Fig. 3). Background color of top of head and back translucent yellow-green; sides and lower portion of head and body below midline translucent bluish gray, with 7 black bars crossing body: first narrowest

**Figure 3.** *Eviota fluctiphila*, underwater, CAS 241535, 13.0 mm SL, male, Batu Hitam, Raja Ampat, West Papua (M.V. Erdmann).

**Figure 4.** *Eviota fluctiphila*, preserved holotype, MZB 26095, 14.3 mm SL female, Batu Hitam, Raja Ampat, West Papua, (D.W. Greenfield).

extending from nape to top of operculum; second from just behind front of first dorsal fin down to pectoral-fin base; a distinct white line between second and third bar under pectoral fin; third from posterior first dorsal fin, a little wider and extending down under pectoral fin to ventral surface; fourth wider, running from front of second dorsal fin to midline, overlying a bluish gray area; fifth same width running from center of second dorsal fin to below midline; sixth widest at end of second dorsal fin, bifurcating below midline and extending to ventral surface; seventh crossing caudal peduncle; followed by a dark area just before caudal-fin base. Pupil of eye black surrounded by narrow yellow ring with spoke-like, small, narrow, white bands radiating out across reddish iris, two white lines crossing top of iris with some small yellowish spots. Jaws and side of head covered with irregular -shaped reddish spots about size of pupil or smaller; narrow white line running down length of center of snout; thin translucent green bands across top of head; small white spot at each posterior naris; jaws with several small white spots at front, largest at end of premaxilla and front of lower jaw. Area around opercular membrane grayish, contrasting with darker pectoral-fin base. Bases of spines of first dorsal fin reddish brown. Color of other fins not known.

**Color of holotype in preservative** (Fig. 4). Background color of head and body yellowish-cream. Body with concentrations of melanophores aligned vertically under center of scales. Top of head and behind eyes down to level of center of eye dark brown; nape with scattered circles of larger melanophores,surrounding areas peppered with small melanophores; scattered melanophores around eyes, grayish snout, and jaws; pupil of eye black, iris light yellow with spokes of dark brown blotches surrounding pupil; cheek with three blotches of larger melanophores, one at 3 to 5 o'clock, two at center of cheek; dark-brown bar aligned vertically on operculum; ventral surface of head heavily peppered with melanophores; pectoral-fin base covered with scattered larger melanophores; abdomen darker than sides of body, brown scale centers not as obvious; ventral portion of body with 5 post-anal dark-brown spots, two above anal fin, others along caudal peduncle; small dark-brown spot at center of caudal peduncle, larger subcutaneous bar visible underneath; first dorsal fin with light area on basal portion of first 5 spines, a dark-brown to black band crossing fin above, followed by narrow light band and a distal dark-brown to black margin; second dorsal fin heavily peppered with small brown melanophores, distal margin brown-black; anal fin dark brown, anterior rays with white sections along length; caudal fin with melanophores on basal portions of rays, remainder with scattered small brown melanophores; pectoral and pelvic fins clear.

**Etymology.** The specific epithet is from the Latin for ocean waves (*fluctus*) and loving (*philus*). The name is treated as a feminine compound adjective.

**Distribution and habitat.** The new species is currently known only from Batu Hitam in the Kawe Island group of the Raja Ampat Archipelago, West Papua, although presumably it is more widely distributed in the western Pacific region. The specimens were exclusively from shallow subtidal (0.2–2 m), wave-washed, volcanic rock exposed to near-constant surge conditions where they were observed sheltering in small cracks in the vertical rock faces covered to varying degrees with sponges, soft corals and ahermatypic hard corals. The species appears secretive: it was never observed fully exposed, making *in situ* photography nearly impossible.

**Figure 5.** *Eviota algida*, underwater photograph from the type locality at Nusa Penida, Indonesia (M.V. Erdmann).

**Comparisons.** Of the 42 species of *Eviota* with a complete cephalic sensory-canal pore system, 15 share a dorsal/anal fin-ray formula of 8/8 with the new species, 3 have 8/7 (*E. pardalota* from the Red Sea and Arabian Gulf, *E. rubriguttata* from the Ryukyu Islands, Japan, and *E. sodwanaensis* known only from South Africa), and *E. notata* (known only from the Indian Ocean) has 7/7. The remaining species in the group have higher counts, i.e. 9/8, 10/8, or 10/9 (Greenfield 2017). *Eviota notata* additionally differs by having the fifth pelvic-fin ray. *Eviota pardalota* differs also by having the fifth pelvic-fin ray as well as two prominent dark spots on the pectoral-fin base often with large dark spots on the head (vs. neither present on the new species). *Eviota rubriguttata* has distinct large red spots on the dorsal and anal fins, the spots on the first dorsal fin arranged in three rows crossing the fin (vs. no red spots in the new species which has a pale band across the fin) and the melanophores on the pectoral-fin base are limited to adjacent to the opercular membrane (vs. covering most of the base). *Eviota sodwanaensis* has a dark occipital spot and a black dorsal fin without a pale band (vs. neither in the new species).

Of the 15 species sharing the dorsal/anal formula of 8/8, *E. distigma* and *E. herrei* differ from the new species by having the fifth pelvic-fin ray (vs. absent); *E. monostigma* and *E. korechika* have three dark postanal spots above the anal-fin base (vs. two); *E. minuta* has a cup-shaped male urogenital papilla and *E. mimica* has one that is plate-like (vs. pear-shaped); *E. epistigmata*, *E. nebulosa*, *E. nigramembrana*, and *E. nigripinna* lack scattered melanophores on the pectoral-fin base (vs. covering the base); *E. pseudostigma* and *E. randalli* have a dark spot on the lower pectoral-fin base (vs. absent); *Eviota specca* has a dark bar angling across the upper portion of the pectoral-fin base, a heavy peppering of small melanophores on the fins, and two elongate dark bars under the eye (vs. absent).

*Eviota algida* Greenfield & Erdmann, 2014 (Fig. 5), *Eviota winterbottomi* Greenfield & Randall, 2010 (Fig. 6), and *Eviota flaviarma* Greenfield & Erdmann, 2021 (Fig. 7) share the pear-shaped male urogenital papilla with

**Figure 6.** *Eviota winterbottomi*, fresh holotype, ROM 73100, Hon Rua, Vietnam (R. Winterbottom).

**Figure 7.** *Eviota flaviarma*, fresh holotype, CAS 247274, Papua New Guinea (M.V. Erdmann).

the new species and appear to be the most similar congeners. *Eviota algida* has a filamentous first dorsal fin in males (vs. not filamentous) and a red eye with gold flecks (Fig. 5) (vs. an orange iris with spoke-like, narrow, white bars radiating out from the pupil (Fig. 8)). Note that Greenfield (2017) has discussed the importance of eye color in distinguishing different species of *Eviota*. *Eviota winterbottomi* has a full-depth, dark, internal bar on the caudal peduncle centered over the preural centrum (Fig. 6) (vs. a blotch on and above the preural centrum with a narrow postanal spot below, not forming a full-depth bar); subequal bands of red and white radiating out from the pupil (vs. spoke-like, narrow, white bars radiating out from the pupil (Fig. 8)); and a translucent grayish body with brown scale margins (vs. greenish red body). Unlike the new species, *E. winterbottomi* is usually found in deeper waters, 2–30 m. *Eviota flaviarma* shares basic morphology with the new species, but differs greatly in color pattern, particularly having yellow on the pectoral-fin base (Fig. 7) and the first dorsal fin black with a pale bar and some red extending partway up the spines from the base; the proximal second dorsal fin with red spots and the distal membranes dusky with a black margin; the anal fin all black; and obvious internal bars with a distinct spot on the caudal peduncle.

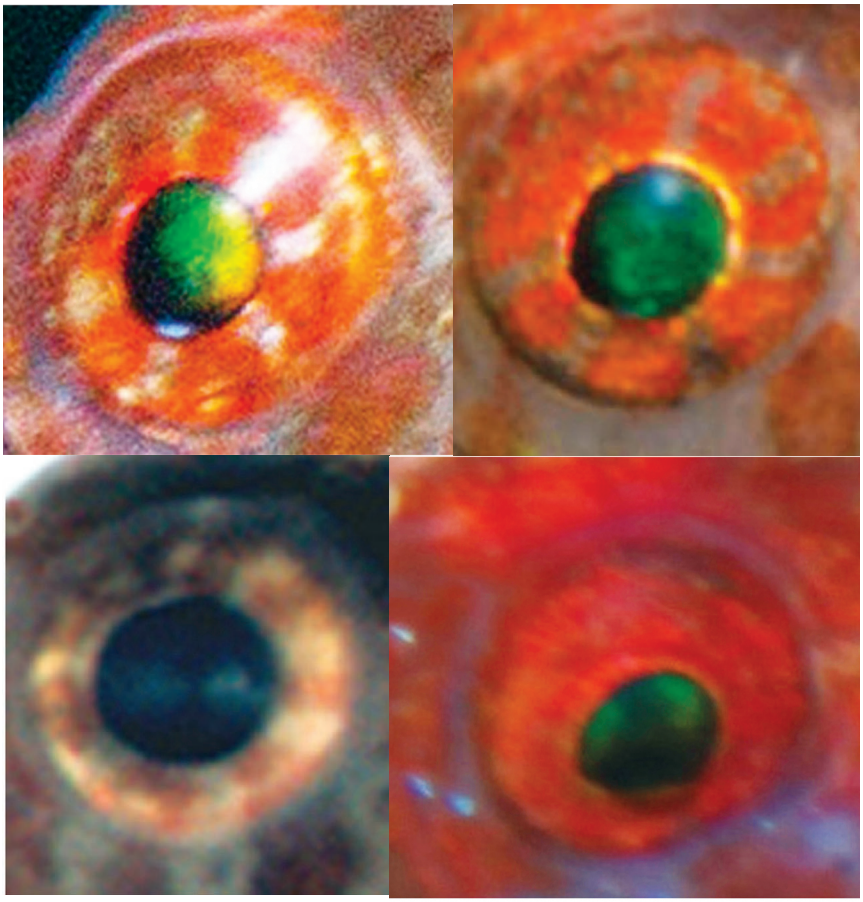

**Figure 8.** Eye color patterns of *Eviota* species sharing pear-shaped male urogenital papillae: upper left: *E. fluctiphila,* upper right: *E. flaviarma*, lower left: *E. winterbottomi*, lower right: *E. algida.*

In the key to *Eviota* species (Greenfield & Winterbottom 2016, Greenfield 2021), *E fluctiphila* would progress through the key to couplet 32a with a dorsal/anal formula of 8/7 leading to 33, or 32b, or with a formula of 8/8 leading to 34, but *E. fluctiphila* has both. Couplet 33 leads to two species, *E. pardalota* and *E. rubriguttata*. *Eviota pardalota* has a fifth pelvic-fin ray and two prominent dark spots on the pectoral-fin base (both absent in *E. fluctiphila*). From couplet 34, *E. fluctiphila* would progress to couplet 38. Here there is an error in the key noted in the errata in Greenfield (2021), 38a should lead to 39 and 38b should lead to 44. *Eviota fluctiphila* lacks distinct pectoral-fin

base markings and would proceed to 44 and 45 with the two species, *E. winterbottomi* and *E. algida*, which have been separated from *E. fluctiphila* in the discussion above.

The shared pear-shaped male papilla in *E. fluctiphila*, *E. flaviarma*, *E. algida*, and *E. winterbottomi* suggests a phylogenetic relationship, additional genetic analyses should should shed further light on this supposition.

**Comparative material.** *Eviota winterbottomi*: holotype ROM 73100, Hon Rua, Vietnam. *Eviota algida*: holotype CAS 237611, paratypes 237612, 237338, Nusa Penida, Indonesia; non-types CAS 243789 (6), Rinca, Komodo, Indonesia. *Eviota flaviarma*: holotype CAS 247274, paratypes CAS 247275 (3), 247278, 247277, Milne Bay, Papua New Guinea.

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