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Eviota flaviarma, a new dwarfgoby from Papua New Guinea (Teleostei: Gobiidae)

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Abstract

A new species of dwarfgoby, *Eviota flaviarma*, n. sp., is described from Milne Bay, Papua New Guinea and also occurs in the Solomon Islands. The new species is characterized by a complete cephalic sensory-canal pattern (pattern 1), a dorsal/anal fin-ray formula of 8/8, 3–5 branched pectoral-fin rays, no fifth pelvic-fin ray, the first dorsal fin not filamentous, a pear-shaped male urogenital papillae, no dark occipital or nape markings, two dark postanal spots above the anal-fin base, a yellow spot on the upper pectoral-fin base with the entire base peppered with melanophores, a dark internal spot on the caudal peduncle over the preural centrum centered on and above the vertebral column, a black first dorsal fin divided by a thin pale band, and a dark or black anal fin. The new species is closely allied to *E. winterbottomi* and *E. algida*.

Key words: taxonomy, ichthyology, coral-reef fishes, gobies, Pacific Ocean, *E. algida*, *E. winterbottomi*

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Introduction

The dwarfgobies (genus *Eviota* Jenkins, 1903) are a diverse group of tiny coral-reef fishes (usually <18 mm SL) found throughout most of the Indo-Pacific Ocean. The description of the new species below brings the total number of valid described species of *Eviota* to 124, making them the second most speciose coral-reef genus and the fifth most speciose saltwater teleost genus (Greenfield & Winterbottom 2016, 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). The dwarfgobies can be relatively abundant on coral reefs, although their small size makes them difficult to observe (Greenfield 2017); nevertheless, tiny cryptobenthic fishes, including the dwarfgobies, can have a major effect on ecosystem functioning, providing for much of the biomass flux in the trophodynamics of the coral reef (Brandl et al. 2019). Recent developments of underwater macrophotography and intensive searching for cryptobenthics have resulted in the discovery of many undescribed species in recent years.

The new species was discovered on an expedition to Milne Bay in Papua New Guinea, when the second author was searching for additional specimens of a new species of *Trimma* pygmygoby, *Trimma wangunui* (Winterbottom & Erdmann 2019). While dispensing clove-oil solution into a coral crevice containing suspected *T. wangunui* specimens, several individuals of an *Eviota* dwarfgoby with a distinctive yellow patch at the base of the pectoral fin emerged and were captured. In total, 5 specimens, now the type series of *E. flaviarma*, were from that dive. Subsequent collections at the type locality and in the Solomon Islands have resulted in several additional specimens.

Materials and Methods

The holotype and paratypes 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). Postanal ventral midline spots, 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 flaviarma*, fresh holotype, CAS 247274, 14.5 mm SL male, anesthetized and underwater, Milne Bay, Papua New Guinea (M.V. Erdmann).

***Eviota flaviarma*, n. sp.**

Yellow-shoulder Dwarfsgoby

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Figures 1–5.

Holotype. CAS 247274, 14.5 mm SL, male, Papua New Guinea, Milne Bay, Little China, -10.2649°, 150.7697°, 10 m, field number MVE-16-085, M.V. Erdmann, 25 December 2016.

Paratypes. CAS 247275, 13.9 mm SL male, 14.2 mm SL female & 11.0 mm SL immature, taken with holotype; CAS 247278, 11.4 mm SL, male, taken with holotype; CAS 247277, 13.5 mm SL male, same location as holotype, 10–14 m, field number MVE-18-035, M.V. Erdmann, 8 May 2018;

Non-type material. CAS 247276, 15.1 mm SL, male, Solomon Islands, Florida Group, Bayldon Shoals, -9.1332°, 160.1331°, 10 m, field number MVE-16-063, M.V. Erdmann, 10 October 2016.

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 of 8/8, 3–5 pectoral-fin rays branched, fifth pelvic-fin ray absent, first dorsal fin not filamentous, a pear-shaped male urogenital papillae; no dark occipital or nape markings, two dark postanal spots above anal-fin base, upper pectoral-fin base yellow and entire base peppered with melanophores, a dark internal mark on caudal peduncle over preural centrum centered on and above vertebral column, anal fin all black, and first dorsal fin black, divided by a thin pale band 3/4 way out, and some reddish orange extending onto base from body.

Description. Dorsal-fin elements VI+I,8, first dorsal fin rounded, spines not filamentous, second spine longest, not extending to end of first dorsal fin when adpressed; last ray of second dorsal fin branched to base; anal-fin elements I,8, last ray branched to base; pectoral-fin rays 15 (15–17, 2 of 4 paratypes with 16), 3–5 rays branched, reaching to below second ray of second dorsal-fin; fifth pelvic-fin ray absent, fourth with 5 branches, 3 segments between consecutive branches, pelvic-fin membranes reduced between rays 1 to 4 with no basal membrane; caudal fin with 17 segmented rays, 12 branched; lateral-line scales 23; transverse scale rows 7; front of head rounded with an angle of about 60° from horizontal axis; mouth slanted obliquely upwards, forming

an angle of about 65° to horizontal axis of body, lower jaw slightly projecting; maxilla extending posteriorly to below center of pupil; anterior tubular nares short, just reaching margin of upper lip; gill opening extending forward to below posteroventral edge of preoperculum. Cephalic sensory-canal pore system complete (pattern 1); urogenital papilla of male smoothly pear-shaped with melanophores and fringed at posterior margin (Fig. 2), urogenital papilla of female bulbous, with several short distal finger-like projections.

Measurements for holotype and three paratypes 11.0–14.5 mm SL (i.e. holotype (range of all types, mean of all types)): head length 30.3 (29.5–34.0, 30.9); origin of first dorsal fin 34.5 (34.5–38.6, 36.1), lying behind posterior margin of pectoral-fin base; origin of second dorsal fin 59.3 (56.3–60.4, 58.4), slightly in advance of anal-fin origin; origin of anal fin 60.0 (58.3–62.0, 59.7); caudal-peduncle length 24.5 (21.8–24.5, 23.3); caudal-peduncle depth 14.1 (13.4–14.1, 13.7); body moderate depth 22.8 (22.7–25.2, 23.6); eye diameter 10.3 (9.1–10.4, 9.8); snout length 4.5 (4.5–5.6, 5.0); pectoral-fin length 31.0 (28.0–40.9, 32.6); pelvic-fin length 31.0 (28.9–33.6, 31.0), reaching to anal-fin origin.

Color of fresh holotype. (Fig. 1) Background color of head and body gray-white, surface markings burnt orange including irregular oval spots at 4 o'clock position behind upper eye, below eye and behind upper jaw, and at end of jaws, several smaller irregular spots between upper jaw and anteroventral part of eye and small spots along upper and lower jaws; top of head and nape with irregular spots about pupil size; narial tubes burnt orange with black tips; jaws and lower half of head peppered with small melanophores. Iris with orange spokes radiating from pupil. Pectoral-fin base white with peppering of small melanophores, upper portion of pectoral fin with bright yellow on base of rays and membranes. Body crossed by 6 darker burnt-orange bars: first at origin of first dorsal fin and under pectoral fin; second widest, at center of first dorsal fin; third at origin of second dorsal fin; fourth at center of second dorsal fin; fifth on caudal peduncle just posterior to end of dorsal fin; sixth on caudal peduncle. A dark internal spot larger than pupil over end of vertebral column; 5 internal black spots along ventral surface of body at ventral ends of body bars, two over anal-fin base, three on caudal peduncle; scale pockets burnt orange, edged with melanophores, contrasting strongly with bluish white background; a scattering of small blue-white spots on body near dorsal-fin bases. First dorsal fin black divided by a thin pale band about 3/4 way out,

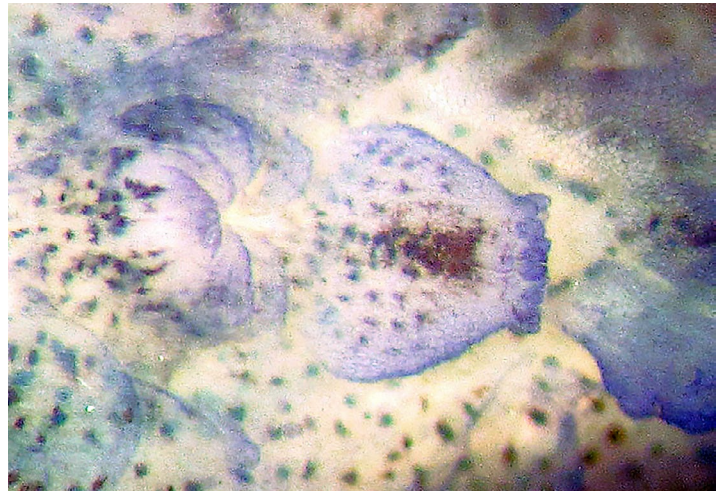


Figure 2. *Eviota flaviarma*, male urogenital papilla, paratype, CAS 247275, 13.9 mm SL, Milne Bay, Papua New Guinea (D.W. Greenfield).



Figure 3. *Eviota flaviarma*, fresh specimen, CAS 247276, 15.1 mm SL, male, anesthetized and underwater, Bayldon Shoals, Florida Group, Solomon Islands (M.V. Erdmann).

some reddish orange extending up from body along base of fin; second dorsal fin mostly dark with some reddish orange extending onto base and scattered small reddish-orange spots on membranes; anal fin dark, with scattered small blue spots; caudal-fin base with thin reddish bar at base, fin rays purplish, membranes clear; pelvic fins clear. A paratype from Solomon Islands shows a similar color pattern and is illustrated in Fig. 3.

Color in preservative. (Fig. 4) Background color of head and body pale yellow; scale pockets heavily outlined with melanophores; pectoral-fin base, abdomen, and lower half of body peppered with small melanophores; 5 black spots along ventral surface of body, two over anal-fin base, remainder on caudal peduncle; front and sides

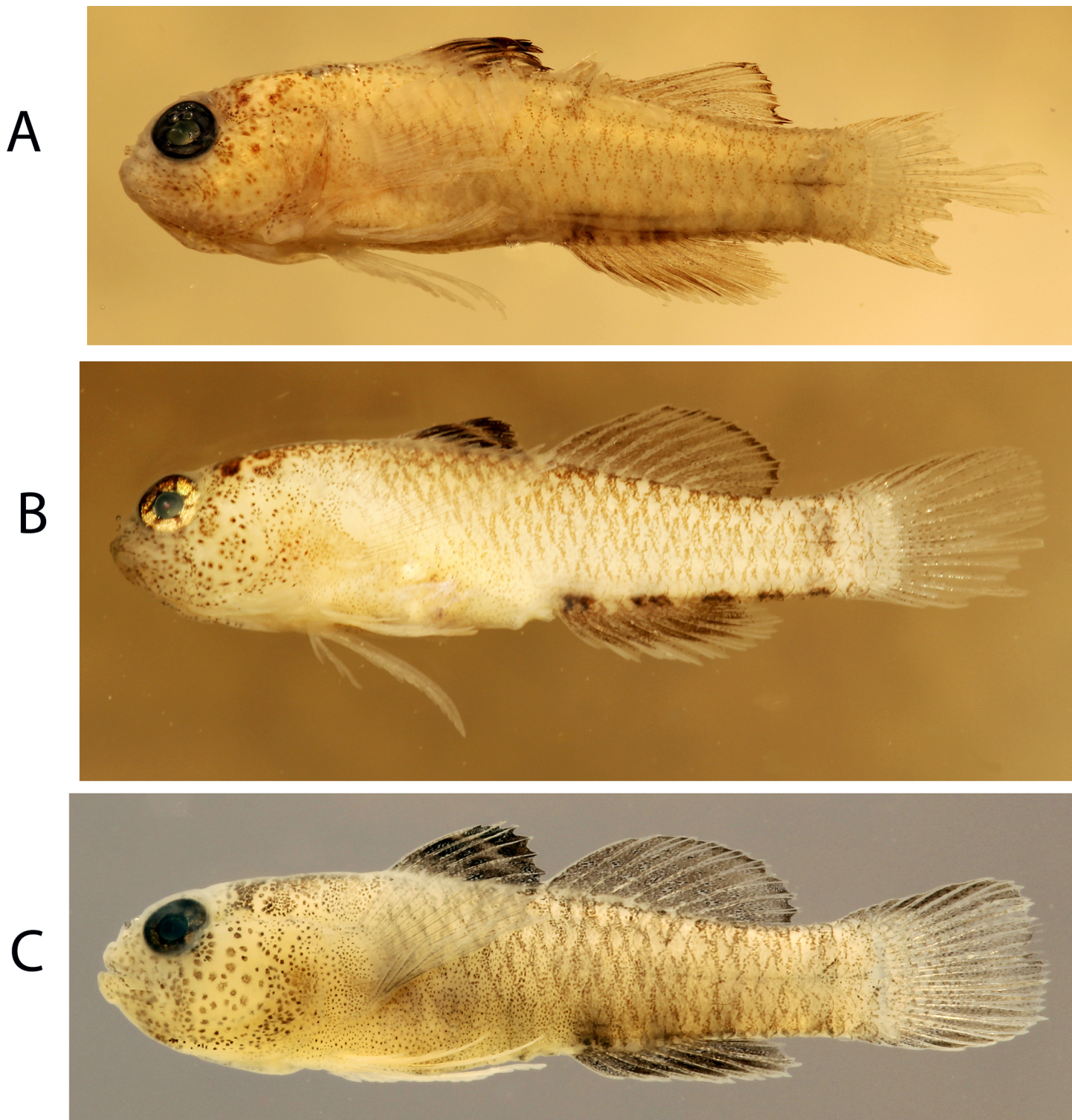


Figure 4. *Eviota flaviarma*, preserved types, A) holotype, CAS 247274, 14.5 mm SL male; B) paratype, CAS 247275, 14.2 mm SL female; C) CAS 247275, 13.9 mm SL male; Milne Bay, Papua New Guinea (D.W. Greenfield).

of head with small rounded black spots; top of head and nape crossed by three black bands. Iris gray. Caudal peduncle with an internal dark spot centered over and above vertebral column. First dorsal fin black divided by a pale band about 3/4 way out; second dorsal fin dark to black; anal fin dark to black, distal margin pale; dark edging along dorsal and ventral caudal-fin margins, remainder speckled with melanophores; pelvic fins clear; pectoral-fin membranes clear, rays lined with tiny melanophores; pelvic fins unmarked.

Etymology. The specific epithet is from the Latin for yellow (*flavus*) and shoulder (*armus*). The name is treated as a feminine compound adjective-noun combination.

Distribution. The new species is currently known with certainty only from Milne Bay, Papua New Guinea and the Florida Island Group, Solomon Islands. Surveys suggest the species is also found at least as far east as Cendrawasih Bay on the northern coast of West Papua (Luke Tornabene, pers. comm.). Individuals were collected on offshore patch reefs exposed to clear water and good current flow, in depths from 10–14 m from coral overhangs and crevices on healthy, live coral reefs.

Comparisons. Of the 41 species of *Eviota* with a complete sensory-canal pore system (pattern 1), only 14 share the dorsal/anal fin-ray formula of 8/8 with the new species, while an additional three have 8/7 (*E. pardalota* from the Red Sea and Arabian Gulf, *E. rubriguttata* from the Ryukyu Islands of Japan, and *E. sodwanaensis* known only from Southern Africa), and one has 7/7 (*E. notata* from the Indian Ocean only). All remaining species in the group have higher counts of 9/8, 10/8, or 10/9 (Greenfield 2017).

In addition to the ray formulae, *E. flaviarma* is distinguished from *E. notata* by having no fifth pelvic-fin ray (vs. 10% the length of the fourth pelvic-fin ray). It differs from *E. pardalota* by lacking its two dark prominent spots on the pectoral-fin base and many large dark spots on the head, and by having no fifth pelvic-fin ray (vs. present). It differs from *E. rubriguttata* by lacking its large red spots on the dorsal and anal fins, by having most of the pectoral-fin base peppered with melanophores (vs. melanophores limited to area adjacent to the opercular membrane). The new species differs from *E. sodwanaensis* by lacking its dark occipital spot and having the black dorsal fin divided by a thin pale band (vs. no pale band).

Of the 14 species sharing the dorsal/anal formula of 8/8, *E. distigma* and *E. herrei* are distinguished from *E. flaviarma* by having a 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 plate-like (vs. pear-shaped). Four species (*E. epistigmata*, *E. nebulosa*, *E. nigramembrana*, and *E. nigripinna*) have an unmarked pectoral-fin base (vs. heavily peppered with melanophores) and *E. nebulosa* also has a dark first dorsal fin not divided by a light band (vs. band present). *Eviota pseudostigma* and *E. randalli* have a dark spot on the lower pectoral-fin base (vs. none); *E. specca* has a dark bar angling across the upper portion of the pectoral-fin base and two dark bars under the eye (vs. absent); *E. algida* has a filamentous first dorsal fin in males (vs. not filamentous) and a red iris with a few gold flecks vs. orange spokes radiating out from the pupil in *E. flaviarma* (Fig. 5). Greenfield (2017) has discussed the utility of eye color in distinguishing different species of *Eviota*.

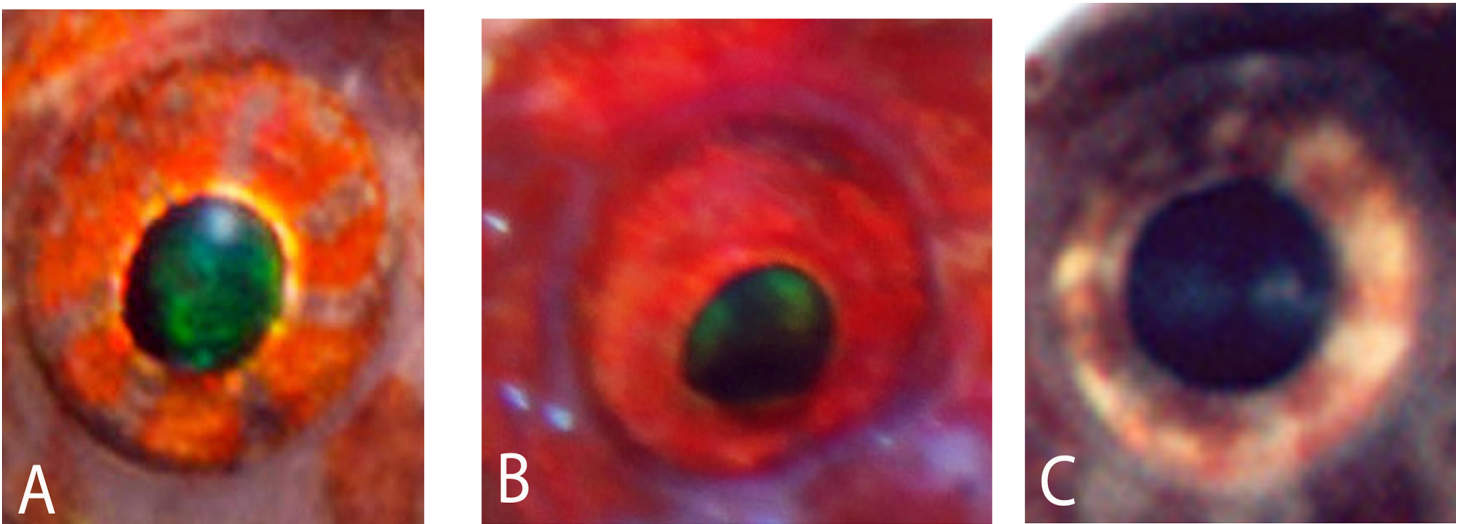


Figure 5. Eye color comparisons: A) *Eviota flaviarma*; B) *E. algida*; C) *E. winterbottomi* (M.V. Erdmann).



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

Three of the above species can also have a yellow spot on the pectoral-fin base, but, reiterating the differences: *E. nebulosa* lacks the peppering of melanophores on the pectoral-fin base and has a different first dorsal-fin color; *E. notata* has a dorsal/anal formula of 7/7 vs. 8/8; and *E. algida* (only sometimes with the yellow spot) has a filamentous first dorsal fin vs. not filamentous.

The remaining (14th) species, *Eviota winterbottomi*, Greenfield & Randall, 2010 appears to be closest to *E. flaviarma*. However, *E. winterbottomi* has a full-depth internal dark bar on the caudal peduncle over the preural centrum (Fig. 6), compared to a dark internal mark centered on and above the preural centrum with the postanal spot below it narrow, i.e. not forming a full-depth bar, in the new species. Additionally, *E. winterbottomi* does not have the diagnostic yellow pectoral-fin base of *E. flaviarma*. The iris of *E. winterbottomi* has subequal bands of red and white radiating out from the pupil (Fig. 5) vs. narrow white spokes; and lastly, *E. winterbottomi* is translucent grayish with brown scale margins., not the greenish red of the new species.

The new species would key to couplet 45 in the key to all *Eviota* by Greenfield & Winterbottom (2016), as a third alternative along with *E. winterbottomi* and *E. algida*. The three species share a complete cephalic sensory-pore system (pattern 1), a dorsal/anal formula of usually 8/8, branched pectoral-fin rays, an absent fifth pelvic-fin ray, and a pear-shaped male urogenital papilla, suggesting that they may represent a closely related species complex.

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