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Eviota imitata, a new dwarfgoby from Raja Ampat, Indonesia (Teleostei: Gobiidae)

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Abstract

A new species of dwarfgoby, *Eviota imitata* n. sp., is described from Raja Ampat, West Papua, Indonesia, based on the holotype and 8 paratypes. The new species is distinguished by a cephalic sensory-canal pore system lacking only the IT pore (pattern 2), a dorsal/anal fin-ray formula usually 8/7, pectoral-fin rays unbranched, the 5th pelvic-fin ray absent, a narrow dark-red line extending down from under the eye to the jaws, three ventral postanal spots, a dark irregular blotch at the caudal-fin base, and no distinctive black crescent-shaped marks underneath the pectoral fin. It is most similar to *E. flebilis* Greenfield, Suzuki & Shibukawa, 2014 and *E. bilunula* Greenfield & Suzuki, 2016. A phylogenetic tree shows the new species belongs to the unbranched pectoral-fin ray clade of *Eviota*.

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

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Introduction

While conducting a biodiversity survey for the Raja Ampat Regency government in West Papua, Indonesia, the third author photographed and collected specimens of *Eviota* that had the distinctive narrow dark-red line under the eye typical of *E. flebilis* Greenfield, Suzuki & Shibukawa, 2014 from the Ryukyu Islands, Japan, and *E. bilunula* Greenfield & Suzuki, 2016 from Fiji. The Raja Ampat species, however, differs from both of these species and is described here as new.

Materials and Methods

Counts and measurements, descriptions of fin morphology and the cephalic sensory-canal pore patterns follow 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 drawn 2 to 3 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, p. 4) in describing the membranes joining the first four 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". Dorsal/anal fin-ray formula counts (eg. 9/8) only include segmented rays. Measurements were made to the nearest 0.1 mm using an ocular micrometer or dial calipers, and are presented as percentage of standard length (SL). All specimen lengths are SL in mm. Cyanine Blue 5R (acid blue 113) stain and an airjet were used to make the cephalic sensory-canal pores more obvious (Akihito *et al*. 1993, 2002, Saruwatari *et al*. 1997). For measurements, values for the holotype are given first, followed by the range for all specimens and the mean in parentheses.

We sequenced a segment of the mitochondrial gene cytochrome c oxidase subunit I (COI) and the nuclear gene protease III (Ptr) for three individuals of the new species (GenBank accession numbers for paratypes CAS 243777: tissues FB1, FB2, & FB3 for Ptr, MF049069, MF049070, MF049071, and for COI, MF049072, MF049073, MF049074). In addition, for comparison we sequenced a single specimen of a similar goby from Rote Island, Lesser Sundas, Indonesia (GenBank accession numbers for FB4, MVE-15-046, for COI, MF134414 and for Ptr, MF134415). The primers used for COI were GOBYH7468 and GOBYL6896 from Thacker (2003), and the Ptr primers were PtrF2 and PtrR2 from Yamada *et al*. (2009). These sequences were combined with the COI and Ptr alignments from Tornabene *et al*. (2016), and a phylogeny was inferred using Bayesian methods in the software MrBayes ver. 3.2 (Ronquist *et al*. 2012). Outgroups included the gobiids *Asterropteryx semipunctata*, *Bryaninops ridens*, and *Gobiodon unicolor*. For each analysis, two parallel Metropolis-coupled Markov Chain Monte Carlo runs were generated for 10,000,000 iterations with a sampling frequency of 1000 iterations. Following Tornabene *et al*. 2013, the branch length prior in MrBayes was set to an unconstrained-exponential prior with a mean of 0.01 (default mean in MrBayes is 0.1) to remedy the issue of analyses frequently converging on local optima consisting of trees with unrealistically long branches (Brown *et al*. 2010, Marshall 2010). Stationarity, mixing, and convergence of each MCMC run was assessed using the program Tracer ver. 1.5 (Rambaut & Drummond 2007), visually inspecting the topologies of each run, and by verifying that the standard deviation of split frequency statistic in MrBayes was less than 0.05.

Eviota imitata, n. sp.

Mimic Dwarfgoby

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Figures 1–5.

Holotype. MZB 23844, 13.9 mm SL, male, Indonesia, Raja Ampat, Kawe, Eagle Rock, 00°8.356' S, 130°7.388' E, 10 m, clove oil and hand net, field number MVE-15-046, M.V. Erdmann, 3 October 2015.

Paratypes. All taken with holotype: CAS 243778, 2 males (12.4 mm & 13.4 mm SL), 4 females (9.8–12.5 mm SL), 2 immature (9.6 & 9.9 mm SL). CAS 243777, 95% ethanol-fixed specimens for DNA, male, 10.1 mm SL, (tissue FB2), 2 immature (7.9 mm SL [tissue FB1] & 9.5 mm SL [tissue FB3]).

Diagnosis. A species of *Eviota* with the following combination of characters: cephalic sensory-canal pore system lacking only IT pore (pattern 2); dorsal/anal fin-ray formula 7–9/7–8, usually 8/7; pectoral-fin rays unbranched; 5th pelvic-fin ray absent; a dark blotch at caudal-fin base, often with a portion extending onto lower portion of caudal fin; very dark-red line extending almost vertically down from under anterior margin of pupil to posterior end of maxilla; usually three ventral postanal spots from subcutaneous bars (four in one paratype); no distinctive black crescent-shaped marks underneath pectoral fin.

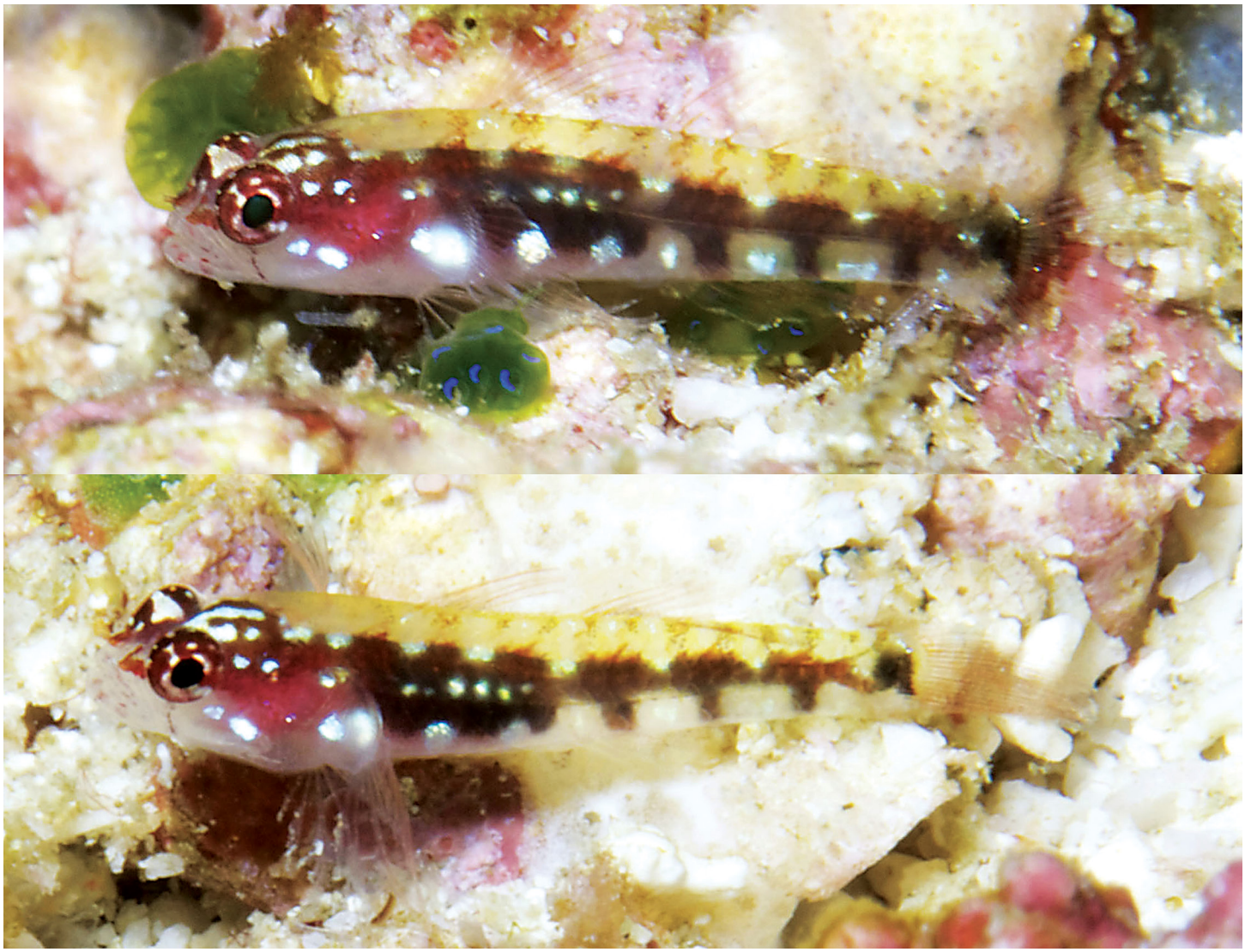

Figure 1. *Eviota imitata*, underwater photographs of type specimen series, Raja Ampat, Indonesia (M.V. Erdmann).

Description. Dorsal-fin elements VI–I,8 (VI–I,7–9), usually I,8; anal-fin elements I,7 (I,7–I,8), usually I,7; dorsal- and anal-fin soft rays branched except first, last ray branched to base; pectoral-fin rays 15, all unbranched, fin reaching to second anal-fin-ray base; pelvic fins joined by membrane only at extreme base, pelvic-fin membrane between rays absent, pelvic-fin rays I,4 (5th ray absent), 5 (3–5) branches on 4th pelvic-fin ray; 3 (2–3) segments between consecutive branches of 4th pelvic-fin ray, pelvic fin reaching to base of first anal-fin ray; 11 (10–11) branched and 17 (16–17) segmented caudal-fin rays; lateral scale rows 22, transverse scale rows 5, no scales on head, nape, breast, pectoral-fin base, midline of belly, and wide areas along bases of dorsal fins; first dorsal-fin spine may be filamentous in large males, extending back to end of second dorsal fin of male holotype, not filamentous in small male or female paratypes; cephalic sensory-canal pore system lacking only the IT pore (pattern 2); lower jaw slightly projecting, maxilla extending beyond a vertical at posterior margin of pupil; body slender, front of head rounded with an angle of about 70° from horizontal axis; mouth oblique, forming an angle of about 55° to horizontal axis of body; anterior naris tube extending forward just past posterior edge of upper jaw; gill opening extending forward to a vertical just behind the back of eye; male urogenital papilla smooth with a curved tip with a horn on each side, reaching to base of second soft anal-fin ray; female urogenital papilla bulbous with short fingers distally. General body shape shown in Fig. 2.

Measurements (percentage of SL; based on holotype and 8 paratypes 9.6–13.9 mm SL): head length 32.4 (30.3–32.8, 31.6); origin of first dorsal fin 34.2 (34.2–37.4, 36.0); origin of second dorsal fin 54.3 (52.1–59.3, 55.5); origin of anal fin 57.9 (57.9–62.8, 60.0); caudal-peduncle length 22.3 (20.7–28.2, 23.8); caudal-peduncle depth 12.2 (11.1–13.6, 12.2); body depth 20.9 (16.8–20.9, 19.7); eye diameter 9.3 (8.0–11.2, 10.0); snout length 4.7 (3.8–6.2, 5.2); upper-jaw length 13.3 (10.0–13.4, 11.1); pectoral-fin length 32.0 (27.9–33.5, 30.1); pelvic-fin length 30.9 (29.7–41.3, 34.4).

Color of fresh holotype. (Fig. 1) Body translucent with silver-white, red, and dark-brown markings. Background color of body translucent yellow on dorsal half, translucent gray on ventral half. Dorsal two-thirds of head red, ventral one-third translucent gray with exception of a very thin, very dark-red vertical line extending ventrally from center of eye, and very small scattered red areas on lower jaw. Three horizontally paired sets of iridescent white spots on head, one pair on center of cheek in line with ventral margin of eye, second pair behind eye in line with dorsal margin of pupil, third pair on nape immediately behind eye. Snout and tubular naris reddish. Pupil of eye black, iris reddish brown with several small silver-white spots. Lateral midline of body with internal dark reddish-brown band running from behind eye, where it is more reddish, to caudal-fin base. Behind pectoral-fin base, dark-brown lateral stripe is expanded to a large dark section extending below lateral midline. Three or four internal dark-brown post-anal bars extending ventrally from reddish lateral stripe. A series of 6 evenly spaced, iridescent, white spots or dashes along dorsal half of dark-brown lateral stripe, with first spot located beneath origin of first dorsal fin and last spot located over middle of caudal peduncle. A similar series of seven iridescent white spots or dashes below lateral midline; first spot largest and located on ventral half of pectoral-fin base, and last four spots located in-between red post-anal bars. Several smaller iridescent white spots located on trunk behind pectoral fin. Dorsal surface of body with twelve light-brown spots with yellow tinges, spaced from first dorsal fin to caudal-fin base. Caudal peduncle with a distinct, irregular, dark blotch over posterior margin, extending slightly onto base of ventral caudal-fin rays. Dorsal-, anal-, caudal-, and pectoral-fin rays tinged with light red.

Color of preserved male holotype. (Fig. 2A) Background color of head and body light yellow. Body with sprinkling of melanophores from nape and across anterior half of body. Series of twelve dark-brown spots spaced along dorsum from front of first dorsal fin to caudal-fin base. Narrow black line running along vertebral column on anterior half of body. Three black ventral postanal spots, two over anal fin, third on caudal peduncle followed by small black spot at caudal-fin base. A few melanophores in line under eye extending down to end of upper jaw where dark line is in life. A few scattered melanophores on jaws and snout. Cluster of melanophores on center of isthmus in line with center of eye. Pupil of eye translucent, iris black. Caudal-fin base with large dark brown to black scalene triangle, longest arm extending onto lower portion of caudal fin. Caudal fin crossed by four black bands, anteriormost band more curved than others, remainder of fin peppered with melanophores. First and second filamentous spines of first dorsal fin with evenly spaced small black spots, twelve in first spine.

Figure 2. *Eviota imitata*, preserved: A) holotype, MZB 23844, 13.9 mm SL, male; B) paratype, CAS 243778, 11.3 mm SL, female (D.W. Greenfield).

Lower third of first dorsal fin with horizontal band of melanophores. Pectoral fin with scattered melanophores on membranes. Pelvic fins immaculate.

Color of preserved female paratype. (Fig. 2B) Background color of head and body light yellow. Head with brown blotch behind eye at one to two o'clock position, almost as large as eye. Brown bar running from front of eye to narial tube. Distinctive narrow black line below eye extending down behind jaws. Black spot on isthmus. Dusky area over operculum. Abdomen under pectoral fin dark brown with scattered melanophores. Black line extending along vertebral column with three faint postanal bars extending down to ventral surface. Black blotch at caudal-fin base, longest arm extending towards lower part of caudal fin, with scattered small melanophores on fin rays. First dorsal fin with row of small melanophores along membranes near base. Second dorsal fin with band of small melanophores along distal margin. Other fins immaculate.

Etymology. The specific epithet is a feminine adjective from the Latin verb *imitor* (to mimic or imitate), in reference to its similarity to *Eviota flebilis*.

Distribution and habitat. The new species is currently known only from Raja Ampat, Indonesia. The species was observed and collected from a current-swept rubble field ranging from 8–12 m deep. Individuals were typically perched on small 5–10 cm long pieces of coralline-algae-encrusted coral rubble, and would quickly retreat under the rubble when approached.

Comparisons. The new species *Eviota imitata* belongs to the cephalic sensory-canal pore pattern-2 group of Lachner & Karnella (1980), lacking only the IT pore. The group contains 40 described species, including *E. imitata*. The new species differs from other species in this group as follows: the following species have branched pectoral-fin rays (vs. unbranched in *E. imitata*), i.e. *E. afelei*, *E. bimaculata*, *E. dorsimaculata*, *E. erdmanni*,

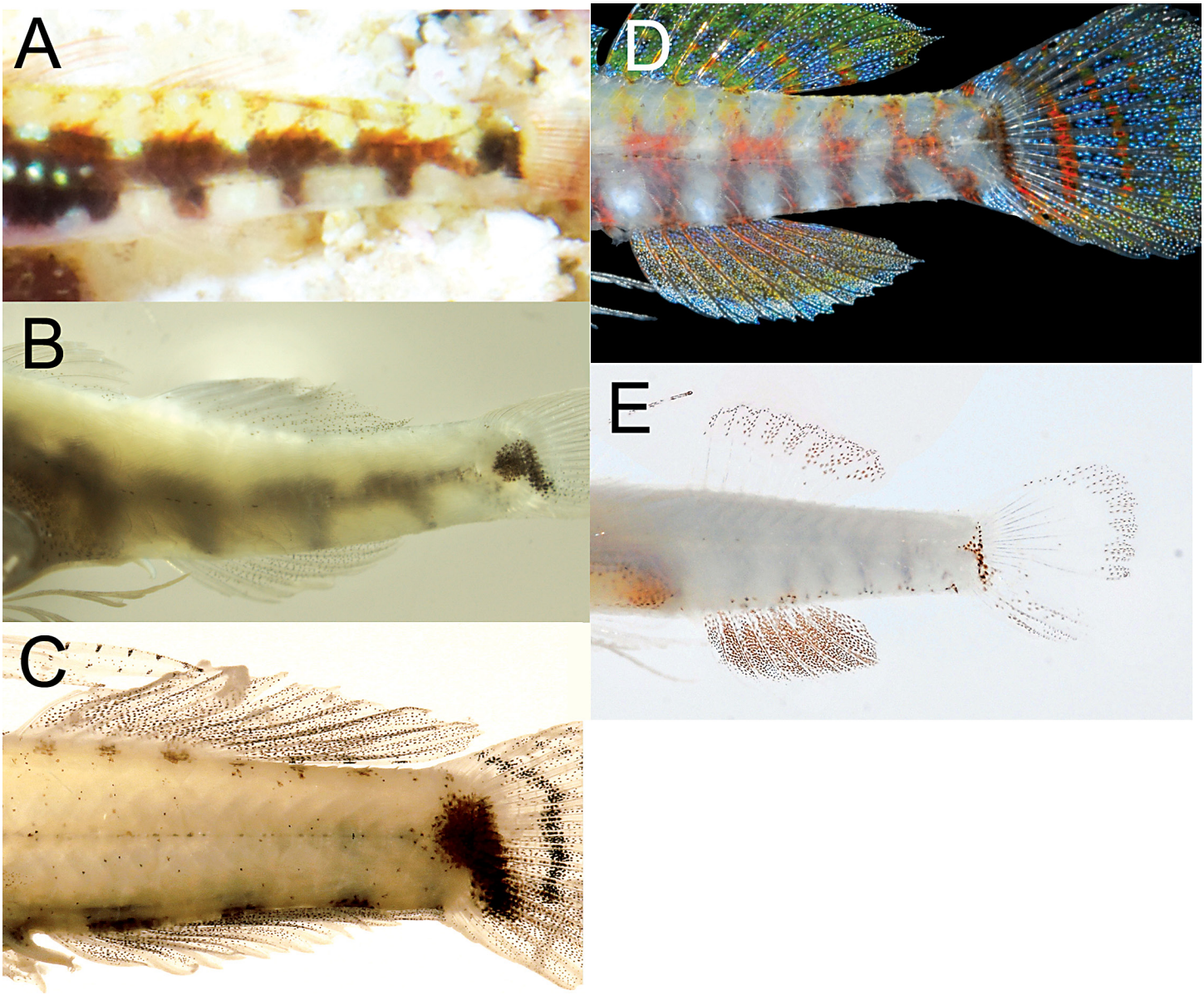

Figure 3. Comparison of ventral post-anal bars and spots: A) *E. imitata*, live; B) *E. imitata*, 95% ethanol fixed, CAS 243777 (FB3); C) *E. imitata*, holotype, formalin-fixed; D) *E. flebilis*, holotype, fresh; E) *E. flebilis*, holotype, formalin-fixed. The pattern for *E. bilunula* is identical to that of *E. flebilis*.

E. hinanoae, *E. hoesei*, *E. indica*, *E. japonica*, *E. latifasciata*, *E. lacrimosa*, *E. melanosphena*, *E. pellucida*, *E. piperata*, *E. prasina*, *E. punctulata*, *E. queenslandica*, *E. rubra*, *E. saipanensis*, *E. tigrina*, *E. variola*, and *E. zonura*. *Eviota imitata* differs from the remaining species that have unbranched pectoral-fin rays by having a dorsal/anal fin-ray formula of 8/7 or 7/7 (vs. 9/8 or 9/7 in *E. sigillata*, *E. spilota*, and *E. zebrina* or 9/8 or 8/7 in *E. cometa*), and further differs from *E. cometa* by lacking the obvious double black spots with yellow before the caudal fin. Seven species within the cephalic sensory-canal pore pattern-2 group share the dorsal/anal fin-ray formula of 8/7 as found in *E. imitata*: *E. ancora*, *E. bilunula*, *E. flebilis*, *E. pellucida*, *E. prasites*, *E. springeri*, and *E. storthynx*. These species can be distinguished as follows: *E. imitata* lacks a 5th pelvic-fin ray (vs. present in *E. pellucida*, *E. prasites*, and *E. springeri*), lacks the dark occipital spots of *E. storthynx*, lacks the large rounded spot medially at the end of the caudal peduncle of *E. springeri*, and lacks the hook-shaped orange marking on the side of the head of *E. ancora.*

Eviota imitata is most similar to *E. flebilis* and *E. bilunula*, but both of those species have a very narrow dark bar at the caudal-fin base and five dark ventral postanal spots (vs. an irregular dark blotch and only three (four in one specimen) dark ventral postanal spots in *E. imitata* [Fig. 3]). In addition, *E. bilunula* has two distinctive black crescent-shaped marks underneath the pectoral fin that are lacking in *E. imitata*.

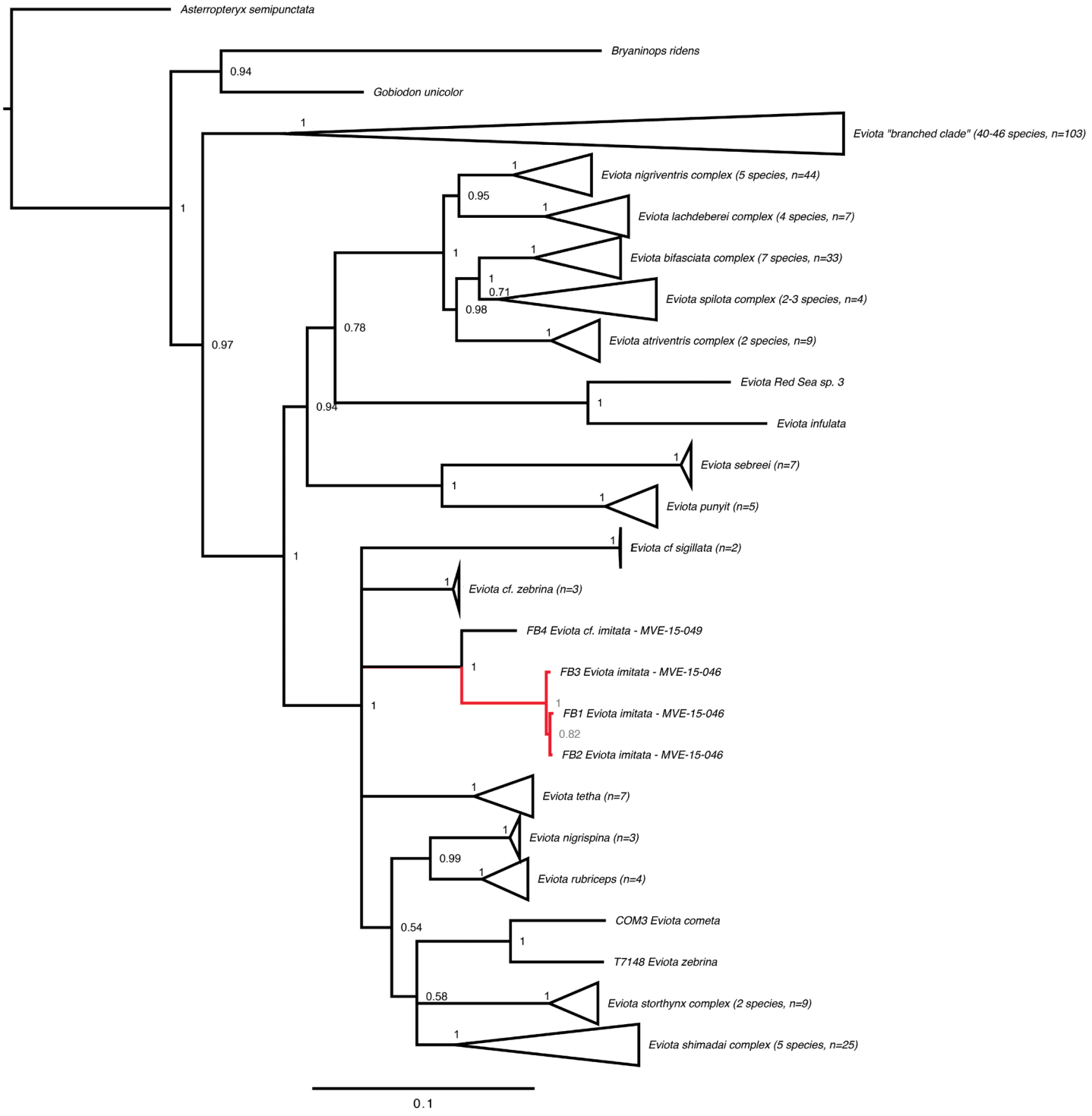

Figure 4. Molecular phylogeny from mitochondrial COI and nuclear Ptr genes. Support values at nodes are Bayesian posterior probabilities. Nodes with less than 0.50 support are shown as polytomies. *Eviota* "branched clade" refers to a monophyletic group containing species with branched pectoral-fin rays, *sensu* Tornabene *et al*. (2013). Scale bar indicates expected number of substitutions per site. For species or species complexes collapsed into triangles, the length of the triangle equals the total internal-branch length of the most recent common ancestor of that group. For collapsed clades, n= number of specimens sequenced in that clade.

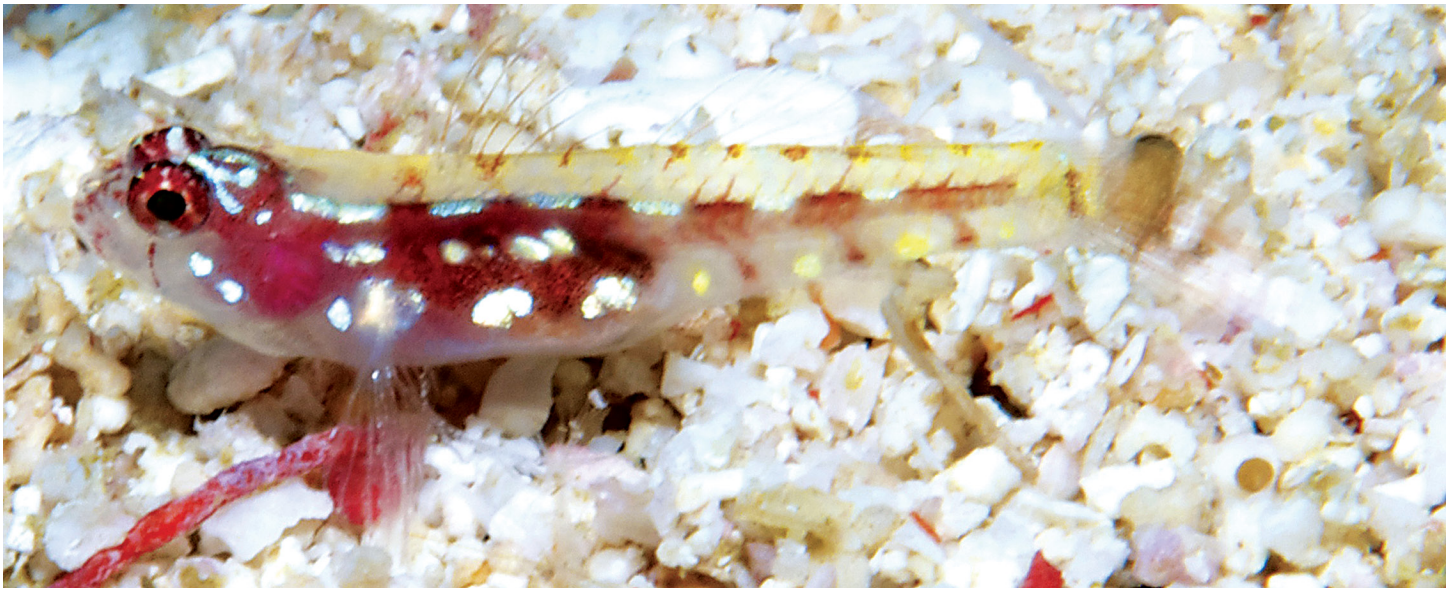

Figure 5. *Eviota* cf. *imitata*, Rote Island, Indonesia; sample FB4 in molecular phylogeny (M.V. Erdmann).

In the comprehensive key to *Eviota* by Greenfield & Winterbottom (2016), *E. imitata* would end at couplet 56a with *E. springeri*, because of the dark blotch at the caudal-fin base. Nevertheless, *E. springeri* from the Indian Ocean can be distinguished by a dark spot on the anterior base of the first dorsal fin (vs. none), a 5th pelvic-fin ray (vs. absent), 5 mid-ventral postanal spots (vs. 3), and the dark blotch at the caudal-fin base in *E. springeri* is more rounded.

Genetics analysis. A molecular phylogeny based on both nuclear and mitochondrial markers (Fig. 4) shows *E. imitata* in a clade with other species of *Eviota* with unbranched pectoral-fin rays. Specifically, the three specimens of *E. imitata* sequenced here are closely related to a specimen that resembles this species from SE Rote Island, Lesser Sunda Islands, Indonesia. That individual, along with others collected and photographed at Rote Island, as well as at Kwato Island, Milne Bay, Papua New Guinea, agree with *E. imitata* in preserved coloration as well as in counts and measurements. However, they differ in live coloration, exhibiting gold spots spaced along the lower half of the body that are white in *E. imitata*, and they have narrower dark bars extending ventrally from the vertebral column (Fig. 5).

It is possible that these two color forms represent recently diverged species, and that, together with *E. flebilis* and *E. bilunula*, they collectively form a species complex similar to those seen in other groups within the unbranched pectoral-fin ray clade of *Eviota* (e.g. Greenfield & Tornabene 2014, Tornabene *et al*. 2015, Tornabene *et al*. 2016). However, with limited genetic data from only a single specimen from Rote (and no genetic data from *E. flebilis* or *E. bilunula*), it may be premature to make this distinction. The average genetic distance between the specimen from Rote Island and *E. imitata* is ~11% for COI (69 substitutions, 630 total bp), and ~0.7% in the conserved nuclear gene Ptr (4–5 substitutions, 632 total bp). The average within-species divergence for *E. imitata* is 0.8% and 0.15% for COI and Ptr, respectively. These levels of intra/interspecific divergence are typical for recently diverged species of *Eviota*.

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