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Two new Red Sea dwarfgobies (Teleostei, Gobiidae, *Eviota*)

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Abstract

Two new species in the dwarfgoby genus *Eviota*, *E. oculopiperita* and *E. geminata*, are described from Saudi Arabia in the Red Sea, bringing the total number of species of *Eviota* in the Red Sea to eight. *Eviota oculopiperita* is most similar to *E. shimadai*, but differs in coloration and the structure of the fourth pelvic-fin ray. *Eviota geminata* is most similar to *E. randalli* but differs in lacking the IT and SOT cephalic sensory pores and in details of coloration.

Key words: systematics, taxonomy, *geminata*, *oculopiperita*, *pseudostigma*, *randalli*, *shimadai*, new species, coral reef fishes.

Introduction

The gobiid genus *Eviota* comprises a group of tiny Indo-Pacific fishes known as dwarfgobies and is currently represented by 81 described valid species (Eschmeyer 2013), with many more species awaiting description. The first species from the Red Sea in the genus *Eviota* was described as *Eleotris prasinus* by Klunzinger (1871). Lachner and Karnella (1978) reviewed the dwarfgobies of the Red Sea, describing three new species and recording a total of six species: *E. distigma* Jordan & Seale 1906, *E. guttata* Lachner & Karnella 1978, *E. pardalota* Lachner &

Karnella 1978, *E. prasina* (Klunzinger 1871), *E. sebreei* Jordan & Seale 1906, and *E. zebrina* Lachner & Karnella 1978. Randall (1983) did not add to that number, nor did Herler and Hilger (2005). Of these, only *E. pardalota* was thought to be endemic; however, Randall *et al.* (1994) extended its range to the Arabian Gulf.

In June 2013, during a survey of Red Sea fishes off the coast of Saudi Arabia conducted by King Abdulaziz University and Senckenberg Research Institute and Natural History Museum as part of their Red Sea Biodiversity Project, the second author photographed and collected two different dwarf gobies that he did not recognize: one specimen at Al Wajh Bank and two specimens of a second species from an unnamed island at Duba, Saudi Arabia. These two species are described here as new, elevating the number of species of *Eviota* in the Red Sea to eight, and the total number of valid species of the genus to 83.

The new species fit the description typical of all species of *Eviota*: the pelvic fins are separate, and the 5th pelvic-fin ray, if present, is unbranched; the membrane joining the 5th pelvic-fin rays is rudimentary or absent; there are ctenoid scales on the body, but no scales on the head, nape or pectoral-fin base; the breast either lacks scales or may have a few embedded cycloid scales; the teeth in the upper jaw are in two or more rows; and there are 1–3 enlarged curved canine-like teeth in the innermost row of the lower jaw just behind the jaw symphysis.

Materials and Methods

Counts and measurements, descriptions of fin morphology and the cephalic sensory-canal pore patterns follow Lachner and Karnella (1980) and Jewett and Lachner (1983). Postanal 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 where they articulate with the caudal-fin ray bases; the additional smaller spot posterior to this is not counted. The membrane joining the 5th pelvic-fin rays is always short and weakly developed, and the fins lack a frenum. “The membranes joining the first four fin rays 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” (Lachner & Karnella 1980). Dorsal/anal fin-ray counts include only segmented rays.

Measurements were made to the nearest 0.1 mm using an ocular micrometer and 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 was used to make pores more obvious (Akihito *et al.* 1993, Saruwatari *et al.* 1997, Nakabo 2002) and an airjet was used to observe them. Measurements for the holotype are given first, followed by those for the paratype. The specimens of *E. geminata* n. sp. were damaged, so information on pectoral and pelvic-fin rays and scales is not complete.

Specimens have been deposited in the following museums: SMF – Senckenberg Museum, Frankfurt; KAUMM – King Abdulaziz University Marine Museum, Jeddah, Saudi Arabia (temporarily housed at SMF). Institutions housing other material examined include the Bishop Museum, Honolulu (BPBM); California Academy of Sciences, San Francisco (CAS); Osaka Museum of Natural History, Osaka, Japan (OMNH); and the Royal Ontario Museum, Ontario (ROM).

Eviota oculopiperita Greenfield & Bogorodsky, n. sp.

Pepperminteye Dwarfgoby

Figures 1A–C, 3 A & C.

Holotype. SMF 34955, 11.9 mm female, Al Wajh Bank, Saudi Arabia, 25°37'20.88" N, 36°50'27.24" E, sandy slope with small coral patches, depth 8–10 m, coll. S.V. Bogorodsky & T.J. Alpermann, 11 June 2013.

Diagnosis. The following combination of characters distinguishes *E. oculopiperita* from congeners: cephalic sensory-pore system pattern IV (lacking pores PITO and IT, and AITO enlarged); dorsal/anal fin-ray formula 8/8; pectoral-fin rays unbranched; 9 branches on 4th pelvic-fin ray; no black spot at caudal-fin base, no longitudinal dark stripes or bright yellow midlateral stripe, and eye white with radiating reddish bars out from the pupil.

Description. Dorsal-fin rays VI+I,8; anal-fin rays I,8; pectoral-fin rays 15, all unbranched; 5th pelvic-fin ray 24% of 4th; 9 branches on 4th ray; 2 segments between consecutive branches of 4th pelvic-fin ray; pelvic-fin membranes reduced; 11 branched and 17 segmented caudal-fin rays; 24 lateral scale rows; transverse scale rows 7; scales on ventral surface of abdomen, no scales on breast; first dorsal fin triangular in shape, not filamentous in female; genital papilla in female smooth, not fimbriate, with several short fingers on end; front of head sloping with an angle of about 60° from horizontal axis; mouth oblique, forming an angle of about 55° to horizontal axis of body, lower jaw projecting, maxilla extending to front of pupil; anterior tubular nares short and dark, reaching to posterior edge of upper lip; gill opening extending forward to posteroventral edge of preoperculum; cephalic sensory-pore system pattern Group IV with AITO pore enlarged, and papilla pattern not visible.

Measurements (holotype 11.9 mm female). Head length 28.6; origin of first dorsal fin 34.9, behind line through rear base of pectoral fin; origin of second dorsal fin 55.5, slightly in advance of anal-fin origin; origin of anal fin 58.0; caudal-peduncle length 22.7; caudal-peduncle of moderate depth 12.6; body relatively deep 26.0; eye diameter 10.9; snout length 4.2; pectoral-fin length 34.9; pelvic-fin length 35.7.

Color in preservative of holotype (Fig. 1A). Background color light cream with no bold markings on body or fins. A cluster of melanophores behind eye near its center and extending across head to behind other eye. A few chromatophores on top of snout in front of eyes. A single chromatophore between front of eye and anterior tubular nares, nares covered with scattered chromatophores. Remainder of head without pigment. A cluster of chromatophores angling down and back across pectoral-fin base from top to near center. Side of abdomen under pectoral fin with a large cluster of chromatophores. All fins immaculate.

Live color (Figs. 1B,C). Head and body translucent greenish with internal coloration visible, scales outlined with yellowish brown. A white line running along vertebral column from head to caudal-fin base, line interrupted by six dark brown streaks progressively shorter posteriorly, narrow yellow-brown bars extending posterodorsally from streaks above abdomen. Two large irregular reddish-brown blotches containing black chromatophores on side over the abdomen surrounded by white, below second and third brown streak along vertebral column. These blotches followed by a smaller blotch above anal-fin origin. Body behind this last blotch and onto caudal peduncle with a series of six chevron-shaped yellow-brown marks that are narrower above vertebral column. Body dorsally below dorsal fins flecked with irregular small brown marks and a few whitish speckles. Side of head with dark-brown blotch similar to those on abdomen, dark brown bar extends obliquely back from blotch beneath ventral portion of pectoral-fin base. White patch above dark mark on pectoral-fin base, extending onto pectoral fin. Nape white with scattered reddish brown marks. Two similar reddish brown marks extending forward from eyes down to snout, and area of anterior tubular nares also with reddish brown mark. Three horizontal yellow-brown lines under eye, first from center of eye back across cheek, second from center of eye anterior to end of jaws, and third from anteroventral part of eye anteriorly across both jaws. Pupil of eye black, iris white with short reddish brown or red bars radiating out from pupil like spokes of a wheel, similar to pattern of a red-and-white peppermint candy. Fin membranes clear and rays of median fins with yellow-brown markings.

Etymology. The specific epithet is an adjective combining the Latin *oculus* (eye) plus *piperita*, the specific name of the peppermint plant (*Mentha piperita*), in reference to the color of the eye that resembles a peppermint candy.

Distribution. Known only from the single specimen taken in the Red Sea at Al Wajh Bank, Saudi Arabia. Two specimens observed (one collected) from inner lagoon of a coral reef inside Al Wajh Bank, on a sandy slope with small coral patches, depth 8–10 m; specimens found on top of coral patch. Another specimen observed from the lagoon at Al Khoreiba, northern Saudi Arabia at a depth of 2 m.

Comparisons. *Eviota oculopiperita* is a member of the cephalic sensory-canal pore pattern Group IV of Lachner and Karnella (1980) that includes 9 other species: *E. bifasciata* Lachner & Karnella 1980, *E. dorsogilva* Greenfield & Randall 2011, *E. dorsopurpurea* Greenfield & Randall 2011, *E. lachdeberei* Giltay 1933, *E. nigriventris* Giltay 1933, *E. pamae* Allen, Brooks & Erdmann 2013, *E. partimacula* Randall 2008, *E. raja* Allen



A



B



C

Figure 1. *Eviota oculopiperita* n. sp. **A.** holotype, SMF 34955, 11.9 mm, preserved. **B.** non-collected individual. **C.** holotype, underwater photograph. Photos by D.W. Greenfield (A), S.V. Bogorodsky (B,C).



Figure 2. *Eviota shimadai*, underwater photograph (Fig. 10 from Greenfield & Randall 2010).

2001, and *E. shimadai* Greenfield & Randall 2010. All of these species lack the PITO and IT pores, and the AITO pore is enlarged or paired. Three of these species belong to the *E. nigriventris* complex, characterized by having a single broad ventral stripe that is equal to or greater than the eye diameter above the anal-fin base, lacking a black spot centered at the base of the caudal fin, and lacking small white spots: i.e. *E. nigriventris*, *E. dorsogilva*, and *E. dorsopurpurea* (all three markings are lacking in *E. oculopiperita*). *Eviota bifasciata* and *E. raja* have two dark stripes, one along the ventral surface, and the other along the dorsal surface of the sides (lacking in *E. oculopiperita*). *Eviota pamae* has a single more or less round, dark mark on the lower caudal-fin base and a bright yellow midlateral stripe (absent in *E. oculopiperita*). Both *E. lachdebereri* and *E. partimacula* have a dark mark at the caudal-fin base (absent in *E. oculopiperita*). *Eviota oculopiperita* is most similar to *E. shimadai* (Fig. 2), sharing most of its counts and measurements (Greenfield & Randall 2010), but differs in coloration and the structure of the fourth pelvic-fin ray. The most obvious color difference is seen in the eye, which is white with radiating reddish bars out from the pupil in *E. oculopiperita* (Fig. 3A), but is black in *E. shimadai* with a wide white stripe across the top of the iris and a narrow white stripe under the pupil (Fig. 3B). The white stripe at the top of the eye in *E. shimadai* extends posterior to the eye and then breaks into a series of white spots across the top of the abdomen (absent in *E. oculopiperita*). The large dark brown patches on the side of the abdomen that are present in *E. oculopiperita* are absent in *E. shimadai*. *Eviota oculopiperita* has many more branches on the fourth pelvic-fin ray than *E. shimadai* (9 vs. 2 or 3) (Fig. 3C).

Other material examined. *Eviota shimadai*, holotype, NSMT-P 94898; paratypes, OMNH-P34244, BPBM 35322, BPBM 38653, CAS 227275, & ROM 84584.



Figure 3. Close-up of eyes (from Figs. 1 & 2): **A.** *Eviota oculopiperita* n. sp. **B.** *Eviota shimadai*. Pelvic fin: **C.** *Eviota oculopiperita* n. sp., holotype, photo by D.W. Greenfield.

Eviota geminata Greenfield & Bogorodsky, n. sp.

Geminate Dwarfgoby

Figures 4A–C.

Holotype. SMF 34956, 12.3 mm, male, unnamed island, Duba, Saudi Arabia, 27°05'42.32" N, 35°46'42.39" E, isolated coral block, depth 12 m, coll. S.V. Bogorodsky, 19 June 2013.

Paratype. KAUMM 17, 13.9 mm, female, unnamed island, Duba, Saudi Arabia, 27°04'52.74" N, 35°46'25.92" E, fringing reef, depth 10–12 m, coll. S.V. Bogorodsky, 19 June 2013.

Diagnosis. The following combination of characters distinguishes *E. geminata* from congeners: lacking both the IT and SOT pores of the cephalic sensory-pore system; dorsal/anal fin-ray formula 8/8; 15 pectoral-fin rays, some branched; genital papilla not fimbriate; dorsal fin not filamentous in both sexes; three moderately broad internal bars posteriorly on body between anal-fin origin and caudal-fin base; a broad orange band extending from top of eye forward to ventral part of eye, continuing to chin as an oblique blackish bar.

Description. Dorsal-fin rays VI+I,8; anal-fin rays I,8; pectoral-fin rays 15, some branched; 5th pelvic-fin ray absent; 17 segmented caudal-fin rays; scales on ventral surface of abdomen, embedded cycloid scales on breast; first dorsal fin triangular in shape, not filamentous; genital papilla not fimbriate, papilla of male short and rounded at end, papilla of female bulbous with several short fingers on end; front of head sloping with an angle of about 65° from horizontal axis; mouth oblique forming an angle of about 45° to horizontal axis of body, lower jaw not projecting, maxilla extending to center of pupil; anterior tubular nares short and dark, not extending to upper lip; gill opening extending forward to posteroventral edge of preoperculum; cephalic sensory-pore system lacking IT and SOT pores, PITO variable, and papilla pattern not visible.

Measurements (holotype & paratype). Head length 33.2 (32.0); origin of first dorsal fin 37.2 (38.8), behind line through rear base of pectoral fin; origin of second dorsal fin 56.3 (57.6), slightly in advance of anal-fin origin; origin of anal fin 60.7 (61.9); caudal-peduncle length 23.5 (27.7); caudal-peduncle slender, the depth 10.1 (10.4); body slender, 20.2 (21.6); eye diameter 12.6 (12.2); snout length 4.0 (5.0).

Color in preservative of holotype (Fig. 4A). Background color cream, head and body peppered with small brown chromatophores, those on side of head larger. Body with five internal dark bars: first two over abdomen and extending from dorsal to ventral surface, first under first three dorsal-fin spines and expanded to a large blotch under pectoral fin, second under last spine; three bars between anal-fin origin and caudal-fin base, each extending ventrally from midline, third bar just posterior to anal-fin origin and fourth at end of anal fin; fifth bar on caudal peduncle. Dorsal surface with six small dark spots: first two part of first two internal bars, third above third bar, fourth between bars three and four, fifth above fifth bar, and sixth over fifth bar. Pectoral-fin base with dark blotch on lower half extending onto rays, upper half with scattering of brown chromatophores. Top of head peppered with small brown chromatophores extending onto nape and narrow broken line along top of head from behind eyes onto nape. A brown band extends anteriorly from anteroventral portion of eye across both jaws onto gular area. Another dark line under eye extending down behind jaws. Cheek with two dark spots on ventral portion, one a small spot at the bottom of preoperculum, second a larger vertical line at posterior edge of preoperculum. Snout lighter than rest of head with fewer scattered brown chromatophores. Pupil of eye black, iris gray. Pectoral and pelvic fins clear, anal and second dorsal fins peppered with dark chromatophores, first dorsal fin with light area across center of first four spines, remainder of fin peppered with dark chromatophores, caudal fin with light scattering of dark chromatophores.

Color of fresh holotype and paratype (Figs. 4B,C). Background color of head and body white. Dark pigment pattern in fresh specimens same as in preserved specimens except internal bars are black and more obvious,



Figure 4. *Eviota geminata* n. sp. **A.** holotype, SMF 34956, 12.3 mm, preserved. **B.** holotype, male, fresh. **C.** paratype, KAUMM 17, 13.9 mm, female, fresh. Photos by D.W. Greenfield (A), S.V. Bogorodsky (B,C).

especially ventrally; bars overlaid with yellow extending to the dorsal surface, first two bars extending basally onto first dorsal fin, third bar bifurcating dorsally and extending basally onto second dorsal fin. Broad yellow bar extending across nape to upper part of pectoral-fin base. Prepectoral area unspotted. Yellow spot containing chromatophores dorsally and ventrally at caudal-fin base. Head yellow, top directly behind the eyes dark yellow, densely covered with dark chromatophores. Pupil of eye black and iris light gray with orange mark posteriorly near center of eye, and a broad orange band extending anteriorly from top of eye forward to anteroventral part, continuing obliquely as diffuse black bar crossing jaws to chin. Pectoral and pelvic fins clear with slight yellowish tinge. Basal third of first three dorsal-fin spines black with yellow membranes, middle third clear, and distal third with clear membranes, distal half of first dorsal-fin spine white in male; remaining three spines with small dark chromatophores (more dense in male) and a wash of yellow on membranes, second internal dark bar reaching last dorsal spine. Second dorsal fin with three dark spots on base corresponding to internal dark bars of body, fin-rays dark and membranes with scattered dark chromatophores and a yellow wash. Anal-fin membranes with a reddish tinge and scattered dark chromatophores. Caudal fin with dark rays and a yellow wash on basal half of membranes.

Etymology. The specific epithet *geminata* is a noun in apposition based on the Latin word *geminus* meaning twin, in reference to its great similarity to *Eviota randalli* Greenfield 2009.

Distribution and Habitat. Presently known from two specimens collected from an unnamed island close to Duba, Saudi Arabia in the Red Sea, 25 km south of Duba, 3 km offshore. Specimens were collected from shelter in reef by ichthyocide (not seen before collection). The female was collected from the seaward side of the island from a shallow slope of a fringing reef with coral patches at its base at depths of 5–12 m, and the male specimen was collected at a depth of about 12 m from the opposite side of the island, characterized by a steep slope down to 30–40 m, with a reef wall and isolated coral blocks.

Comparisons. Usually species of the genus are compared to other species in the cephalic sensory-pore system to which they belong, but *E. geminata* does not fit any of the recognized groups; however, because of its distinctive color pattern, it appears most similar to *E. randalli* (type location Fiji) that Greenfield (2009) separated from *E. pseudostigma* Lachner & Karnella 1980, the species closest to *E. geminata* geographically in the Indian Ocean. *Eviota geminata* can be distinguished from both in having more obvious bars on the body (internal black bars overlaid with yellow), and the first dorsal fin in *E. geminata* with a clear area in the middle third of fin, whereas the first dorsal fin is unicolored in *E. pseudostigma* and *E. randalli*. *Eviota pseudostigma* has four distinct dark spots between the anal-fin origin and the caudal-fin base that connect to internal bars (Fig. 5), whereas *E. geminata* and *E. randalli* have only three (Fig. 6). There also is a difference in the branching pattern of the pectoral-fin rays between *E. pseudostigma* and *E. randalli*, but the rays are damaged in *E. geminata* so this character cannot be evaluated. *Eviota geminata* differs from *E. randalli* in having fewer pectoral-fin rays (15 vs. 16–18). The fresh colors of *E. geminata* differ from *E. randalli* in having much more yellow.

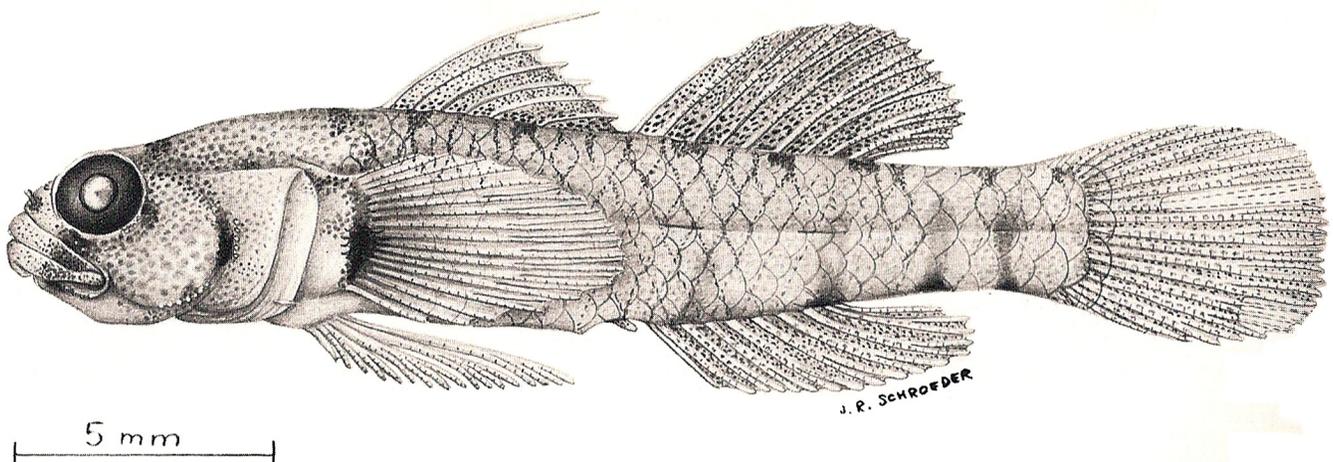


Figure 5. *Eviota pseudostigma*, holotype (Fig. 3 from Greenfield 2009).



Figure 6. *Eviota randalli*, holotype, Fiji (Fig. 1 from Greenfield 2009).

Whereas *E. randalli* and *E. pseudostigma* both belong to Group I (complete) of the cephalic sensory-pore system, *E. geminata* differs from both in lacking the IT pore. The SOT pore also is missing, and the PITO pore is absent in the paratype but present and very small in the holotype. There are other examples of *Eviota* species that are similar in color pattern to another species, but differ in the absence of a head pore, e.g. Greenfield and Randall (2010) for their *E. toshiyuki* and *E. zonura* Jordan & Seale 1906, and Greenfield and Erdmann (2013) for their *E. santanai* and *E. latifasciata* Jewett & Lachner 1983. Tornabene *et al.* (2013a) have demonstrated that the cephalic-sensory pore system groupings do not appear to reflect genetic relationships, and some species have lost all pores, i.e. *E. jewettae* Greenfield & Winterbottom 2012 and *E. diminuta* Tornabene *et al.* 2013. Another goby example of a pair of similar species also separated by details of the cephalic sensory-pore system was recently described from the Red Sea by Suzuki, Bogorodsky and Randall (2012) for *Bryaninops spongicolus* and *B. dianneae* Larson 1985. It thus appears that head pores may be lost during the process of isolation and speciation.

Remarks. All six previously described species known from the Red Sea, except *E. pardalota* which also occurs in the Arabian Gulf, have broad distributions from the Red Sea and east coast of Africa, east to the central Pacific. *Eviota oculopiperita* and *E. geminata* are the first new species to be added for the Red Sea since 1978 and at present both are known only from the Red Sea, but these tiny gobies are not easily seen and collected, thus they may occur elsewhere. If they are endemic, that means that 25% of the *Eviota* species are endemic compared to the overall total of 13.5% for Red Sea fishes.

Among Red Sea species of the genus, *Eviota geminata* has a distinctive color pattern of broad internal dark bars on the body that are overlaid with yellow and is unlikely to be confused with other species. *Eviota oculopiperita* might be confused in the field with *E. guttata* because it also possesses brown blotches on the abdomen, but it differs in eye color (large brown blotches on the top of the eye in *E. guttata*). *Eviota guttata* also has a single large red spot behind the eye that is lacking in both *E. geminata* and *E. oculopiperita*.

Other material examined. *Eviota pseudostigma*, 2 paratypes, Amirantes Islands, CAS 43545; Comoros, ROM 54949 (4). *Eviota randalli*, holotype, Fiji, CAS 228572; paratypes, Fiji, CAS 228573, CAS 228574, & CAS 219785.

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