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Two new dwarfgobies from the Ryukyu Islands, Japan: *Eviota shibukawai* and *Eviota filamentosa* (Teleostei: Gobiidae)

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Abstract

Two new species of dwarfgoby are described from the Ryukyu Islands, Japan. *Eviota shibukawai* n. sp. is characterized by cephalic sensory-pore system Pattern 2 (lacking only the G (IT) pore); a dorsal/anal fin-ray formula of 9/8 or 8/8; branched pectoral-fin rays; a dark, roundish spot on the caudal peduncle centered on the preural centrum region; six dark, narrow, internal postanal bars; and the body is heavily peppered with dark chromatophores. It lacks distinct dark spots on the pectoral-fin base and a postocular spot, and the genital papilla is neither fimbriate nor cup-like. *Eviota filamentosa* n. sp. is characterized by a unique cephalic sensory-pore system pattern (lacking the F' (AOT), G (IT) and preopercular-canal pores N' & O' (POP) pores); a dorsal/anal formula of 8/8; unbranched pectoral-fin rays; the 5th pelvic-fin ray absent; 19–21 lateral scales; and the genital papilla neither fimbriate nor cup-like.

Key words: taxonomy, gobies, new species, Indo-Pacific, Pacific Ocean, Ryukyu, Japan, coral-reef fishes.

Introduction

In his surveys of the fishes of the Ryukyu Islands, Japan, the first author has recognized and collected many gobies in the genus *Eviota* that were new to science (Greenfield & Suzuki 2010, 2011, 2013, Greenfield, Suzuki & Shibukawa 2014, Greenfield, Winterbottom & Suzuki 2014). In this paper, we describe two more species from the Ryukyu Islands recently collected by the first author. The new species conform to the general characteristics of the genus *Eviota*, i.e. 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; the pelvic-fin rays are multi-branched, often fringe-like; 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; and the teeth in the upper jaw are in two or more rows with 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) and Akihito *et al.* (1993). 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 membranes joining the first four [pelvic] 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, p. 4). Dorsal/anal fin-ray counts only include segmented rays.

Measurements were made to the nearest 0.1 mm using an ocular micrometer, and are presented as percentage of Standard Length (SL). Cyanine Blue 5R (acid blue 113) stain was used to make pores more obvious (Akihito *et al.* 1993, Saruwatari *et al.* 1997, Akihito *et al.* 2002), and an airjet was used to observe them. Counts and measurements are presented for the holotype first, followed by the paratype in parentheses, if different. Type materials have been deposited at KAUM (Kagoshima University Museum, Kagoshima, Japan) and NSMT (National Museum of Nature and Science, Tsukuba, Japan).



Figure 1. *Eviota shibukawai*, preserved holotype, NSMT-P 114946. Photograph by Koichi Shibukawa.

Eviota shibukawai n. sp.

Shibukawa's Dwarfgoby

New Japanese name: Akabana-Isohaze

Figures 1–3.

Holotype. NSMT-P 114946, 9.9 mm, female, Nakana, Iriomote-jima Island, the Ryukyu Islands, Japan, 24°.4341' N, 123° .7905' E, 5–8 m depth, field number S-18748, Toshiyuki Suzuki, Koichi Shibukawa, Masatomi Suzuki & Akira Kawai, 14 August 2010.

Paratype. NSMT-P 114947, 9.2 mm, juvenile, field number S-18749, taken with holotype.

Diagnosis. A species of *Eviota* with cephalic sensory-pore system Pattern 2 (lacking only G (IT) pore); dorsal/anal fin-ray formula 9/8 or 8/8; pectoral-fin rays branched; 5th pelvic-fin ray less than 10% of 4th or rudimentary; a dark, roundish spot on caudal peduncle centered on preural centrum region; six dark, narrow, internal postanal



Figure 2. *Eviota shibukawai*, freshly collected holotype, NSMT-P 114946. Photograph by Toshiyuki Suzuki.

bars; body heavily peppered with dark chromatophores; genital papilla neither fimbriate nor cup-like; no distinct dark spots on the pectoral-fin base; and no postocular spot.

Description. Dorsal-fin elements VI+I,9 (I,8); anal-fin elements I,8; all dorsal and anal-fin soft rays branched except first, last ray split to base; pectoral-fin rays 16 (15), 11–15th (10–15th) branched, fin reaching to 2nd (4th) anal-fin ray base; pelvic fins joined by membrane only at extreme base, no pelvic frenum, pelvic-fin membrane reduced, pelvic-fin rays I,5, 4th pelvic-fin ray with 6 branches, 1 segment between branches, 5th segmented pelvic-fin ray less than 10% of 4th ray or rudimentary, pelvic fins reaching to third anal-fin ray base; 12 (11) branched caudal-fin rays, segmented caudal-fin rays 16 (17); lateral scale rows 27 (25), transverse scale rows 6, scales on body finely ctenoid, those on belly cycloid, no scales on head, nape, breast, pectoral-fin base, and narrow bare areas along base of first dorsal fin; vertebrae 10 + 17 = 27 (10 + 16 = 26); dorsal-fin spines not filamentous; cephalic sensory-pore system Pattern 2 lacking only the G (IT) pore: anterior oculoscapular canal with pores B' (NA), single C (AIOT), single D (PIT0), E (SOT), F' (AITO), and two preopercular-canal pores, N' and O' (POP); female genital papilla reaching to anal-fin origin, neither fimbriate nor cup-like, bulbous, with 2 finger-like and 7 nub-like projections; front of head rounded with an angle of about 60° to horizontal axis of body; mouth slanted obliquely upwards, forming an angle of about 55–60° to horizontal axis of body, both jaws equal, maxilla extending posterior to a vertical at center of pupil; anterior tubular nares short, not extending to upper lip, light in color; gill opening extending forward to below posteroventral edge of preoperculum; gill membranes attached anteriorly to isthmus, without a free fold.

Measurements. Holotype 9.9 mm SL, paratype 9.2 mm SL; head length 30.3 (32.1); origin of first dorsal fin 37.5 (38.3), above posterior end of pectoral-fin base; origin of second dorsal fin 56.7 (58.0); origin of anal fin 60.6 (61.1), below a vertical through 2nd (1st) soft ray of second dorsal fin; caudal-peduncle length 23.1 (24.9); caudal peduncle of moderate depth 13.5 (13.5); body slender, depth 21.2 (20.7); eye diameter 9.1 (9.8); snout length 5.3 (5.2); upper-jaw length 11.3 (9.3); pectoral-fin length 33.7 (25.4); pelvic-fin length 32.7 (broken).

Color in preservative of holotype (Fig. 1). Head and body translucent white with six internal, dark, postanal bars showing through on ventral half of body. Small dark roundish spot centered on midline over preural centrum. Head and body peppered with brown chromatophores, more dense on anterior half of body with a heavy concentration behind eye. Side of head with scattered clusters of brown chromatophores, line of these chromatophores extending from posteroventral edge of eye anteriorly to jaws. Interorbital area, snout, and jaws with few chromatophores. Eye black. Anal fin darker than other fins, distal three-quarters of membranes densely covered with brown and black chromatophores. Distal margin of first dorsal fin edged with dark brown chromatophores, upper half of fin with scattered lighter-brown chromatophores, center of fin with a narrow darker



Figure 3. *Eviota shibukawai*, freshly collected paratype, NSMT-P 114947. Photograph by Koichi Shibukawa.

band of chromatophores, lower half lighter with a few scattered larger, dark chromatophores. Distal half of second dorsal fin densely peppered with brown chromatophores, lower half with fewer, larger, brown chromatophores. Dorsal, ventral, and distal margins of caudal fin edged with dark brown chromatophores, center portion with larger dark chromatophores on rays. Pelvic and pectoral fins with dark chromatophores along rays.

Color of fresh holotype (Fig. 2). Body translucent light yellow, peppered uniformly with dark chromatophores. Series of orange bars crossing body, first three cross top of head and nape, then two under first dorsal fin, sixth between first and second dorsal fins, split ventrally into a Y with one branch at anus and other around anal-fin origin, followed by five postanal bars; posteriormost bar has a black roundish spot centered on midline over preural centrum; postanal bars each split into a Y dorsally. A small orange spot at top and bottom of caudal-fin base and a narrow orange line over end of hypural plate. Abdomen darker than rest of body. Head and pectoral-fin base generally redder than body, covered with irregular-shaped red-orange bars overlaid with clusters of black chromatophores. Pupil of eye black, iris red with scattered dark markings. Anal fin darker than other fins, distal three-quarters of membranes black, first three orange postanal bars extend onto base of fin. Distal margin of first dorsal fin with a bright yellow band, edged with black, central area clear with scattered black chromatophores, lower half of fin with irregular-shaped orange patterns over clear membrane. Second dorsal fin similar to first but colors less intense. Dorsal, ventral and distal margins of caudal fin edged with black, central area with a wash of orange basally, black chromatophores lining rays. Pelvic and pectoral fins with dark chromatophores along rays. Color of paratype (Fig. 3) similar to holotype, but posterior half of body not as yellowish.

Distribution. Known only from the type specimens from Iriomote-jima Island, the Ryukyu Islands, Japan.

Etymology. The new species is named for Koichi Shibukawa, who collected and photographed the types of the new species, in honor of his great contribution to our knowledge of the systematics of the Gobioidi.

Comparisons. Sixteen described species of *Eviota* share three basic characteristics of *E. shibukawai*: the cephalic sensory-canal pore pattern 2 (lacking only the G [IT] pore), branched pectoral-fin rays, and a dorsal/anal formula of either 8/8 or 9/8 (Greenfield & Winterbottom 2014, Table 1). Six of these species can be distinguished by the absence of a dark spot on the caudal peduncle on the preural centrum region: *E. afelei*, *E. bimaculata*, *E. japonica*, *E. piperata*, *E. punctulata*, and *E. rubra*. Four more species have distinct dark spots on the pectoral-fin base that are not present on *E. shibukawai*, i.e. *E. hoesei*, *E. lacrimosa*, *E. prasina*, and *E. queenslandica*. The remaining six species can be distinguished from *E. shibukawai* by the following individual characteristics: *E. dorsimaculata* has the dark caudal-peduncle spot centered above the lateral midline and has four broad dark internal bars between the anal-fin origin and the caudal-fin base (vs. the dark spot centered on midline and six narrow internal postanal bars); *E. hinanoae* has five postanal internal bars, the body not heavily peppered with dark chromatophores, and a cup-like genital papilla (vs. six bars, body with heavy peppering of dark chromatophores,

and genital papilla not cup-like); *E. indica* has a caudal peduncle spot that is higher than wide (vs. round); *E. latifasciata* has a postocular spot, four broad, dark, postanal internal bars, and no markings under the eye (vs. no postocular spot, six postanal bars, and markings under the eye); *E. saipanensis* has four postanal internal bars and a cup-like genital papilla (vs. six bars and genital papilla not cup-like); and *E. zonura* has five postanal internal bars and the genital papilla is fimbriate (vs. six bars and genital papilla not fimbriate).



Figure 4. *Eviota filamentosa*, preserved and stained holotype, KAUM-I. 50855. Photograph by Toshiyuki Suzuki.

***Eviota filamentosa* n. sp.**

Threadfin Dwarfgoby

New Japanese name: Itohiki-Isohaze

Figures 4–7.

Eviota sp. 2. Suzuki 2014: 516 (Yoron-jima Island, the Ryukyu Islands, Japan)

Holotype. KAUM-I. 50855, 10.9 mm, male, off Chabana Fishing Port, Yoron-jima Island, the Ryukyu Islands, Japan, 27°03'40" N, 128°25'02" E, 15–17 m depth, KAUM Fish Team, 21 Aug. 2012.

Paratype. OMNH-P 34246, 9.8 mm, juvenile, “Barasu Higasi”, Iriomote-jima Island, the Ryukyu Islands, Japan, 24°26'04.6" N 123°49'26.4" E, 7 m depth, field number S-17084, Toshiyuki Suzuki, Masatomi Suzuki & Akira Kawai, 8 August 2008.

Diagnosis. A species of *Eviota* with a unique cephalic sensory-pore system pattern, lacking F' (AOT), G (IT) and preopercular-canal pores N' & O' (POP) pores; genital papilla neither fimbriate nor cup-shaped; dorsal/anal formula of 8/8; 5th pelvic-fin ray absent; pectoral-fin rays unbranched; and 19–21 lateral scales.

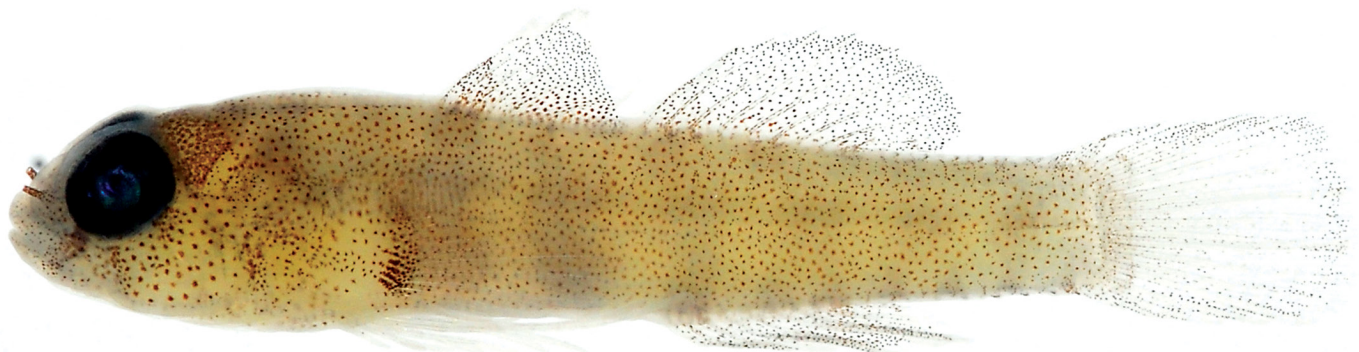


Figure 5. *Eviota filamentosa*, preserved paratype, OMNH-P 34246. Photograph by Toshiyuki Suzuki.



Figure 6. *Eviota filamentosa*, fresh paratype, OMNH-P 34246. Photograph by Toshiyuki Suzuki.

Description. Dorsal-fin elements VI+I,8; anal-fin rays I,8; all dorsal and anal-fin soft rays branched except first and second, last ray split to base; pectoral-fin rays 15 (16), all rays not branched, pectoral fin reaching to fourth anal-fin ray base (third anal-fin ray base); pelvic fins joined by membrane only at extreme base, no pelvic frenum, pelvic-fin membrane reduced, pelvic-fin rays I,4, 4th pelvic-fin ray with 2 branches, 5th pelvic-fin ray absent, pelvic fins reaching to third anal-fin ray base (second); 12 branched caudal-fin rays, 17 segmented caudal-fin rays; lateral scale rows 21 (right side) (19), transverse scale rows 5, scales on body finely ctenoid, no scales on head, nape, breast, pectoral-fin base, belly, and wide areas naked along bases of dorsal fins; vertebrae 10+16=26; first dorsal-fin spine filamentous, extending back to base of last soft ray of second dorsal fin (not filamentous in paratype); unique cephalic sensory-pore system: anterior oculoscapular canal with pores B' (NA), single C (AITO), single D (PITO) and E (SOT), no F' (AOT), G (IT) or preopercular-canal (N' and O' - POP) pores; male genital papilla neither fimbriate nor cup-shaped, reaching beyond anal-fin origin (not developed in paratype); front of head sloping at angle of about 55° to horizontal axis of body; mouth slanted obliquely upwards, forming an angle of about 50° to horizontal axis of body, lower jaw slightly projecting (equal), maxilla extending posterior to vertical at middle of pupil (anterior half); anterior tubular nares long, extending to upper lip and slightly dark in color; gill opening extending forward to below posteroventral edge of preoperculum; gill membranes attached just below end of gill opening.

Measurements. Holotype 10.9 mm SL, paratype 9.8 mm SL; head length 33.9 (31.6); origin of first dorsal fin 42.6 (39.8), above posterior end of pectoral-fin base; origin of second dorsal fin 62.6 (58.3); origin of anal fin 60.9 (61.2), at a vertical through 2nd soft ray of second dorsal fin (1st); caudal-peduncle length 25.2 (23.3); caudal peduncle of moderate depth 13.0 (13.6); body slender, depth 20.9 (21.4); eye diameter 10.9 (9.7); snout length 6.5 (4.9); upper-jaw length 12.8 (7.8); pectoral-fin length 38.3 (32.0); pelvic-fin length 36.5 (31.6).

Color in preservative of holotype and paratype (Figs. 4 & 5). Head and body translucent white with six internal, dark, postanal bars showing through on ventral half of body. Small dark roundish spot centered on midline over preural centrum. Head and body peppered with brown chromatophores, more dense on anterior half of body with a heavy concentration behind eye. Side of head with scattered clusters of brown chromatophores, line of these chromatophores extending from posteroventral edge of eye anteriorly to jaws. Interorbital area, snout, and jaws with a few chromatophores. Eye black. Anal fin darker than other fins, distal three-quarters of membranes densely covered with brown and black chromatophores. Distal margin of first dorsal fin edged with dark brown chromatophores, upper half of fin with scattered lighter brown chromatophores, narrow darker band of chromatophores running across center of fin, lower half lighter with a few scattered larger, dark chromatophores. Distal half of second dorsal fin densely peppered with brown chromatophores, lower half with fewer larger brown chromatophores. Dorsal, ventral and distal margins of caudal fin edged with dark brown chromatophores, center portion with larger dark chromatophores along rays. Pelvic and pectoral fins with dark chromatophores along rays.

Color of fresh paratype (Fig. 6). Basic color pattern as in preserved holotype and paratype, additional heavy peppering of reddish-orange chromatophores of same size as dark chromatophores, forming orangish hue on head and body. Internal bars dark brown to black. Pectoral-fin base anterior to black crescent is whitish, crossed by band



Figure 7. *Eviota filamentosa*, fresh holotype in breeding color, KAUM-I. 50855. Photograph by KAUM Fish Team.

of dark chromatophores overlaid with orange. Operculum red-orange. Triangular wedge of dark chromatophores behind eye red, with three small white spots dorsally. Pupil of eye black, iris gold with red spokes radiating out from pupil, dorsal portion of iris black. First four spines of first dorsal fin with basal third orange, central third clear, distal third with orange spines and peppering of melanophores, remainder of fin with basal third orange, upper two-thirds with orange spines and a peppering of melanophores. Second dorsal fin with orange extensions of body bars onto base of fin, remainder of fin with orange rays and clear membranes lightly peppered with melanophores. Caudal fin as in preserved holotype but light orange rays. Anal fin with orange extensions of body bars at base, remainder clear with a peppering of melanophores. Pelvic fins dusky. Lower four rays of pectoral fin dusky, remaining rays orange.

Color of fresh holotype (Fig. 7). Underlying dark color pattern as in fresh paratype, but body washed with yellow, obscuring other colors except for reddish areas on operculum and iris. Nape behind posterior margin of operculum white. Dorsal, anal, and caudal fins yellow.

Distribution. Yoron-jima Island and Iriomote-jima Island, the Ryukyu Islands, Japan (Suzuki 2014 and this study).

Etymology. The specific epithet is a feminine singular adjective in the nominative case derived from the Latin *filum*, (thread), referring to the thread-like first dorsal-fin spine.

Comparisons. *Eviota filamentosa* differs from all other described species of *Eviota* by lacking all of the following pores: F' (AOT), G (IT), and N' & O' (POP). Six other described species of *Eviota* lack G (IT) and N' & O' (POP) pores, but have the F' (AOT) pore; they comprise *E. lacrimae*, *E. ocellifer*, *E. pinocchioii*, *E. piperata*, *E. sparsa*, and *E. susanae*. In addition, *Eviota susanae* differs by having a fimbriate genital papillae (vs. non-fimbriate); *E. pinocchioii* has a dorsal/anal formula of 9/8 and very long tubular nares (vs. 8/8, short nares); *E. sparsa* has a dorsal/anal count of 9/8 and a long 5th pelvic-fin ray, 60-80% of the 4th pelvic-fin ray (vs. 8/8 and absent); *E. ocellifer* has branched pectoral-fin rays and a conspicuous semi-ocellated spot at front of first dorsal fin (vs. rays unbranched and no dorsal spot); *E. piperata* has branched pectoral-fin rays and five postanal midline spots (vs. unbranched and six spots). *Eviota filamentosa* is most similar to *E. lacrimae* (Sunobe 1988), but *E. lacrimae* has 23 lateral scales (vs. 19–21), the first elongated dorsal spine white (vs. not white), lateral scales beginning at the upper part of axilla (vs. farther back below anterior part of first dorsal fin), and the gill membrane attached to the isthmus anterior to the pelvic fin (vs. attached at the lower end of the pectoral-fin base).

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References

- 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 [In Japanese], pp. 1088–1116.
- Akihito, Sakamoto, K., Ikeda, Y. & Sugiyama, K. (2002) Gobioidae. *In*: Nakabo, T. (Ed), *Fishes of Japan with pictorial keys to the species. English edition. Vol. II*, Tokai University Press, Tokyo, pp. 1139–1310, 1596–1619.
- Greenfield, D.W. & Suzuki, T. (2010) *Eviota nigrispina*, a new goby from the Ryukyu Islands, Japan (Teleostei: Gobiidae). *Zootaxa*, 2655, 57–62.
- Greenfield, D.W. & Suzuki, T. (2011) Two new goby species of the genus *Eviota* from the Ryukyu Islands, Japan (Teleostei: Gobiidae). *Zootaxa*, 2812, 63–68.
- Greenfield, D.W. & Suzuki, T. (2013) *Eviota nigramembrana*, a new dwarfgoby from the Western Pacific (Teleostei: Gobiidae). *Zootaxa*, 3637, 169–175.
- Greenfield, D.W., Suzuki, T. & Shibukawa, K. (2014) Two new dwarfgobies of the genus *Eviota* from the Ryukyu Islands, Japan (Teleostei: Gobiidae). *Zootaxa* 3774, 481–488.
- Greenfield, D.W. & Winterbottom, R. (2014) *Eviota piperata*, a new gobiid species from Palau (Teleostei: Gobiidae). *Zootaxa*, 3755, 295–300.
- Greenfield, D.W., Winterbottom, R. & Suzuki, T. (2014) *Eviota occasa*, a new species of dwarfgoby from Palau and the Ryukyu Islands, Japan (Teleostei: Gobiidae). *Journal of the Ocean Science Foundation*, 10, 11–19.
- Jewett, S.L. & Lachner, E.A. (1983) Seven new species of the Indo-Pacific genus *Eviota* (Pisces: Gobiidae). *Proceedings of the Biological Society of Washington*, 96(4), 780–806.
- Lachner, E.A. & Karnella, J.S. (1980) Fishes of the Indo-Pacific genus *Eviota* with descriptions of eight new species (Teleostei: Gobiidae). *Smithsonian Contributions to Zoology*, 315, 1–127.
- Saruwatari, T., Lopez, J.A. & Pietsch, T.W. (1997) Cyanine blue: a versatile and harmless stain for specimen observations. *Copeia*, 1997(4), 840–841.
- Sunobe, T. (1988) A new gobiid fish of the genus *Eviota* from Cape Sata, Japan. *Japanese Journal of Ichthyology*, 35 (3), 278–282.
- Suzuki, T. (2014) *Eviota* sp. 2, p. 516. *In*: Motomura, H. & Matsuura, K. (Eds), *Field guide to fishes of Yoron Island in the middle of the Ryukyu Islands, Japan*. Asahi Press, Kagoshima, Japan [In Japanese], 646 pp.