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Engyprosopon keliaoense, a new lefteye flounder (Teleostei: Bothidae) from Taiwan

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Abstract

A new bothid flounder, *Engyprosopon keliaoense* **sp. nov.**, is described on the basis of 4 specimens collected from off southwestern Taiwan. The new species belongs to these congeners with a pair of black botches on the caudal fin and is most similar to *E. grandisquama* (Temminck & Schlegel). It can be separated from the latter by having smaller upper and lower eyes, narrower interorbital width, shorter pectoral fin on the ocular side, and more scales in the lateral line. Investigation on *Rhombus grandisquama* and its junior synonyms revealed that *Rhombodoichthys spilurus* Günther and *Rhombus poecilurus* Bleeker are retained as junior synonyms of *E. grandisquama*, whereas *Rhombodoichthys spiniceps* Macleay and *Scaeops orbicularis* Jordan & Seale are now excluded from the synonymy of *E. grandisquama.*

Key words: Taxonomy, ichthyology, bothid flounder, Pleuronectiformes, Taiwan

Introduction

Within a frame of reviewing the taxonomy of the lefteye flounder family Bothidae in Taiwan undertaking from 2014, four specimens (each two males and females) were collected from Ke-tzu-liao fish market at Kaohsiung, southwestern Taiwan, northern South China Sea. They were caught at depths of about 10–30 meters by bottom trawl. These specimens, characterized by having ovoid body, both eyes separated by a concaved space, feeble ctenoid scales on ocular-side of body, deeply clefted parhypural and hypural plates, and dark color pattern on the blind side in males, are clearly a member of the genus *Engyprosopon* Günther, 1862.

Engyprosopon is the most speciose genus within Bothidae, with about 30 valid species currently recognized, which live in shallow waters from tropical to temperature waters of the Indo-west and central Pacific oceans (Amaoka *et al.* 1993, Amaoka & Ho 2018). Amaoka & Ho (2018) reviewed genus *Engyprosopon* from Taiwan and recognized nine species, including two newly described species. Subsequently, Amaoka & Ho (2019) reviewed the family Bothidae and provided same species of Amaoka & Ho (2018).

The present specimens were initially identified as *Engyprosopon grandisquama* (Temminck & Schlegel, 1846) in having a pair of black blotches on the caudal fin and other morphological characters. However, with a relatively deep body about symmetrical dorsal and ventral outlines, shelving of anterior outline of head in male, small eyes, narrow interorbital width in both sexes and short pectoral fin, the newly collected specimens were regarded as a distinct species.

We investigated the type series of *Rhombus grandisquama* and its synonyms, including *Rhombus poecilurus* Bleeker, 1852, *Rhomboidichthys spilurus* Günther, 1880 and *Rhomboidichthys spiniceps* Macleay, 1881, as well as the original description of *Scaeops orbicularis* Jordan & Seale, 1907. As a result, our specimens differ from all these junior synonyms and are thus recognized as an undescribed species. Herein we describe and name this lefteye flounder as new to science. The status of four junior synonyms of *E. grandisquama* was discussed.

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Materials and methods

Type specimens and comparative materials examined in this study are deposited in fish collections of the National Museum of Marine Biology and Aquarium (NMMB-P), the Hokkaido University Museum (HUMZ) and National Taiwan University (NTUM). Other type materials deposited at Natural History Museum, London (BMNH), Australian Museum, Sydney (AMS) and Nationaal Natuurhistorisch Museum, Leiden (RMNH), with their images and radiographs taken by colleagues, are examined and used for comparison.

Counts and proportional measurements follow those of Hubbs & Lagler (1958) and Amaoka *et al.* (1993). Standard length (SL) and head length (HL) are used throughout. All measurements were made to the nearest 0.1 mm with calipers. The numbers of dorsal and anal fin rays and vertebrae, and features of the caudal skeleton were examined from digital radiographs taken in each museum. Measurements of some type materials were measured from the high resolution images by using ImageJ© program for public.

Results

Family Bothidae

***Engyprosopon keliaoense* sp. nov.**
New English: Keliao lefteye flounder
Figures 1A–D, 5A–C; Tables 1–3

Holotype. NMMB-P25662, male, 67.7 mm SL, off Ke-tzu-liao, Kaohsiung, southwestern Taiwan, bottom trawl, 10–30 m, 26 Jun. 2016.

Paratypes. HUMZ 232504 (formerly NMMB-P25663), female, 66.7 mm SL and NMMB-P25686, female, 72.4 mm SL, collected with the holotype; NTUM 17310, male, 69.0 mm SL, field no. WJC 9802, off Ke-tzu-liao, Kaohsiung, 23 May 2020, coll. Pakorn Tongboonkua.

Etymology. The specific name is derived from Chinese 蚵寮(Ke Liao), meaning oyster hut. Named for the type locality, a small village that raised oysters and collected fishes for living since century ago.

Diagnosis. A species of *Engyprosopon* characterized by having a pair of black spots on the caudal fin, small upper and lower eyes (3.48–3.77 in HL), narrow interorbital width in both sexes (5.96–9.78 in HL), and short pectoral fin on the ocular side (1.25–1.43 in HL).

Description. Proportional data (as in SL and HL) for the holotype are provided first, followed by those of paratypes in parentheses. Morphological (as percentages of SL) and meristic data are provided in Tables 1–2.

Dorsal-fin rays 81 (81–84), anal-fin rays 59 (62–63), ocular-side pectoral-fin rays 11 (11–12), blind-side pectoral-fin rays 9 (9–10), caudal-fin rays 3+10+4 (3+11+3), ocular-side pelvic-fin rays 6 (6), blind-side pelvic fin rays 6 (6), scales in lateral line 47 (46–51), gill rakers 0+6 (0+5–7), vertebrae 10+24 (10+24).

Proportions in SL: HL 4.05 (4.02–4.09), body depth 1.8 (1.82–1.85). Proportions in HL: snout 5.06 (4.74–4.97), upper eye diameter 3.55 (3.66–3.77), lower eye diameter 3.48 (3.56–3.75), interorbital width 5.96 (6.48 in male, 7.90–9.78 in females), ocular-side upper jaw 3.09 (2.96–3.16), blind-side upper jaw 3.09 (3.13–3.23), ocular-side lower jaw 2.11 (2.13–2.20), blind-side lower jaw 1.96 (1.98–2.08), caudal peduncle depth 1.92 (1.83–1.95), ocular-side pectoral fin 1.25 (1.30–1.43), blind-side pectoral fin 1.74 (1.95–2.07), ocular-side pelvic fin 1.59 (1.94–2.08), blind-side pelvic fin 2.17 (2.16–2.35), base of ocular-side pelvic fin 2.20 (2.38–2.59), base of blind-side pelvic fin 6.42 (7.55–8.98), longest dorsal-fin ray 1.78 (2.02–2.13), longest anal-fin ray 1.80 (1.89–2.10), middle caudal-fin ray 1.09 (1.17–1.22).

Body deeply ovate, deepest about middle of body, body depth slightly deeper than half of body length; dorsal and ventral profiles of body almost symmetrically convex in both sexes. Head small, a little shorter than 1/4 of SL; anterior profile of head not steep in male, and a slight concavity anterior to middle of interorbital space. Snout short, much shorter than eye diameter. Short and obtuse small rostral spine in male and no spine in female.

Eyes small, eye diameter shorter than length of maxilla length; lower eye slightly in advance of upper eye. No orbital spine in each sex. Interorbital space very narrow, male slightly wider than female or almost equal. Ocular-side nostrils anterior to interorbital region, anterior nostril a short tube with small round flap posteriorly, posterior nostril without flap; blind side nostrils rudimental or absent, closely set below origin of dorsal fin.

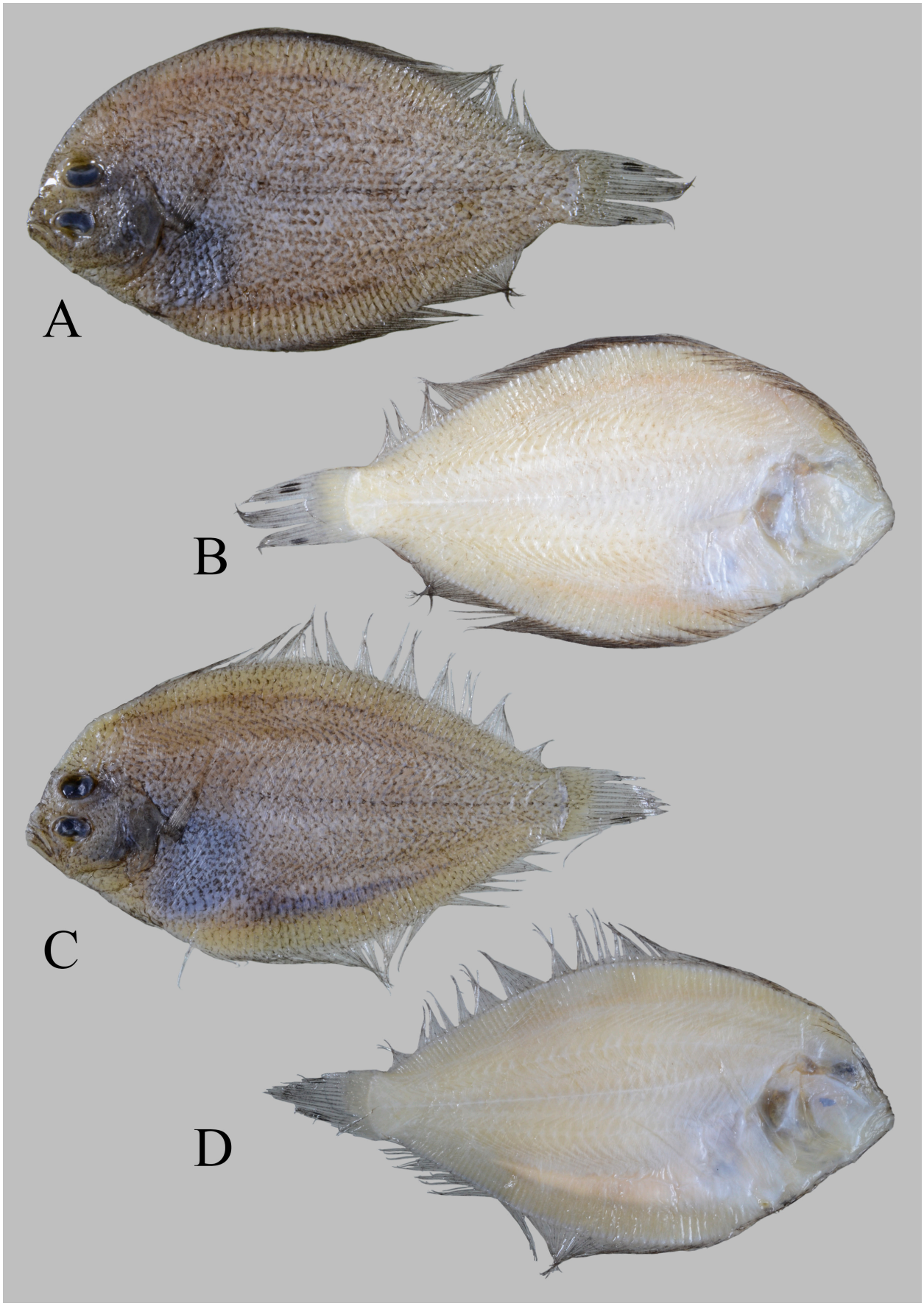

FIGURE 1. *Engyprosopon keliaoense* **sp. nov.** A, B. Holotype, NMMB-P 25662, male, 67.7 mm SL. C, D. Paratype, HUMZ 232504, female, 72.4 mm SL. A, C. Ocular sides. B, D. Blind sides.

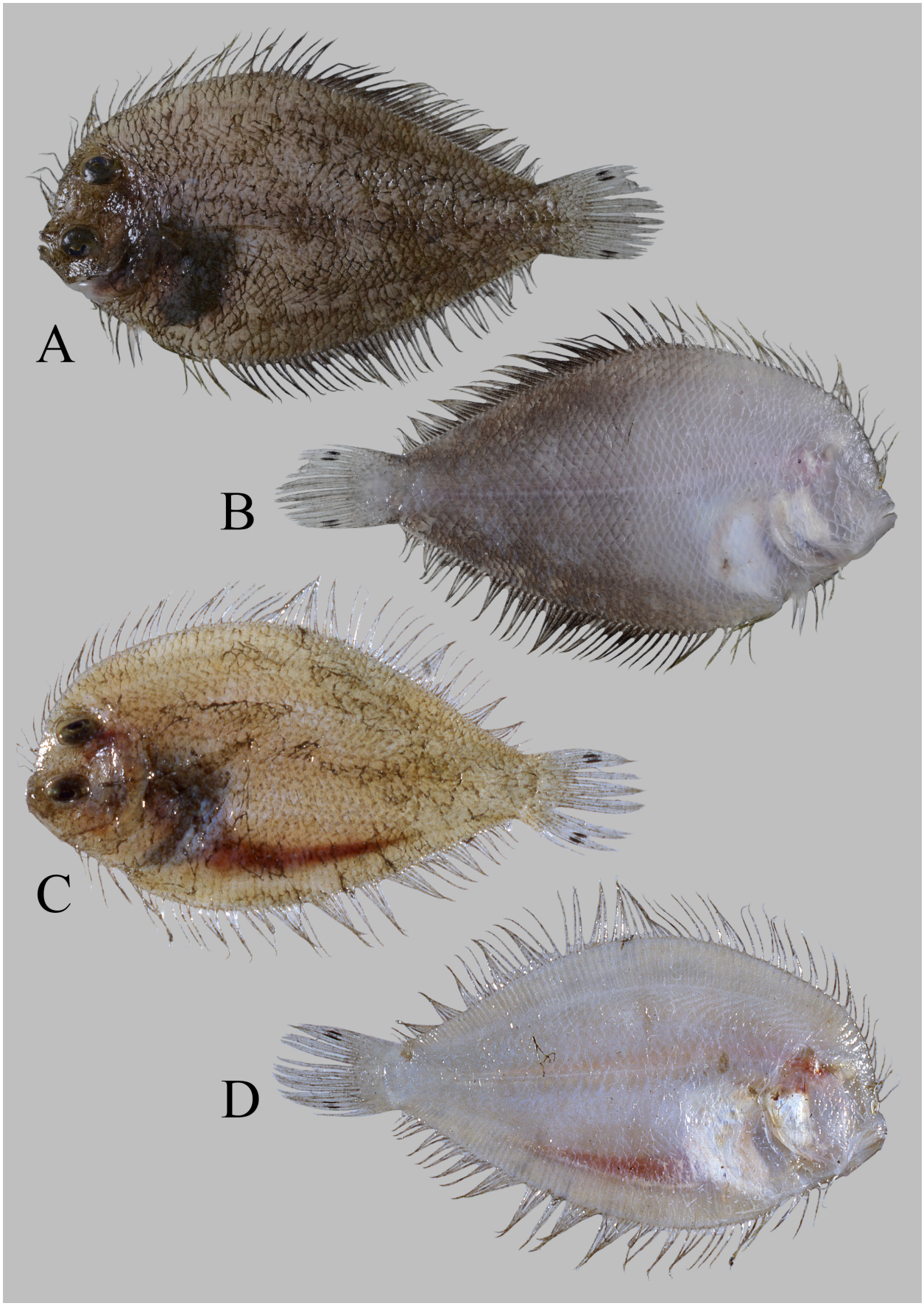

FIGURE 2. *Engyprosopon grandisquama*, A, B. Male, NMMB-P22235, 74.7 mm SL. C, D. Female, NMMB-P22302, 72.6 mm SL. A, C. Ocular sides. B, D, Blind sides.

TABLE 1. Morphometric data of *Engyprosopon keliaoense* **sp. nov.**, and *E. grandisquama* and its junior synonyms. M= Male, F= Female, O= Ocular side, B= Blind side. HT= Holotype, PT= Paratype(s), LT= Lectotype, PLT= Paralectotypes, NT= Non-types.

Taxon	*E. keliaoense* **sp. nov.**	*E. grandisquama*		*Rhombus grandisquama*	*Rhombus poecilurus*	*Rhombodoichthys spilurus*
	HT (PT)	NT (Japan)	NT (Taiwan)	LT (PLT)	HT (PT)	HT
SL (mm), n, sex	67.7/M (66.7–72.4/1M, 2F)	70.3–79.5/10M, 63.5–89.2/10F	59.8–82.5/27M, 51.1–74.1/14F	78.3/M (57.0–70.7/3M)	67.6/F (68.3/F)	81.4/M
% SL		Mean (Range)	Mean (Range)			
Head length	24.7 (24.4–24.9)	26.3 (25.0–27.5)	25.1 (22.3–27.4)	25.0 (25.4–26.2)	25.4 (24.5)	25.1
Body depth	55.5 (54.0–55.0)	53.9 (51.1–57.3)	56.5 (51.8–61.3)	53.4 (51.9–56.2)	52.7 (49.8)	57.1
Snout length	4.9 (5.0–5.2)	5.3 (4.2–6.3)	5.1 (4.6–5.8)	5.0 (5.1–5.4)	4.9 (5.2)	5.0
Upper eye diameter	**6.9 (6.6–6.7)**	7.9 (7.3–8.6)	8.2 (7.0–9.3)	7.3 (7.9–8.1)	7.4 (7.6)	7.4
Lower eye diameter	**7.1 (6.6–6.9)**	8.3 (7.5–9.2)	8.0 (7.0–8.9)	- (7.4–8.4)	7.4 (7.4)	7.4
Interorbital width (M)	**4.1 (3.8)**	9.1 (8.1–9.9)	9.0 (7.4–10.2)	7.2 (6.5–8.4)	-	5.1
Interorbital width (F)	**(2.5–3.1)**	5.0 (3.9–6.7)	4.8 (3.9–5.8)	-	3.6 (3.0)	-
Upper jaw length (O)	8 (7.7–8.4)	8.4 (7.5–9.4)	7.6 (6.3–8.3)	7.6 (8.4–8.6)	7.7 (8.1)	8.3
Upper jaw length (B)	8 (7.7–7.9)	8.4 (7.6–9.1)	7.5 (7.0–8.2)	7.9 (8.2–9.1)	~7.5	-
Lower jaw length (O)	11.7 (11.1–11.6)	11.5 (10.2–12.3)	11.0 (9.9–11.7)	10.7 (10.8–11.9)	11.5(11.4)	11.0
Lower jaw length (B)	12.6 (11.8–12.6)	12.5 (9.9–13.5)	11.6 (10.3–12.5)	-	-	-
Depth of caudal peduncle	12.9 (12.6–13.6)	12.9 (11.7–13.7)	12.8 (11.4–13.9)	13.0 (12.5–13.0)	13.3 (12.6)	13.1
Pectoral fin length (O) (M)	**19.8 (18.2)**	23.8 (21.1–25.7)	23.1 (20.4–24.9)	23.2 (20.5–26.2)	-	20.4
Pectoral fin length (O) (F)	**(17.1–19.2)**	24.7 (23.4–26.2)	22.4 (19.3–24.8)	-	22.0 (19.0)	-
Pectoral fin length (B)	14.2 (12.0–12.7)	13.4 (11.8–14.8)	12.9 (11.4–14.1)	12.1 (12.7–13.8)	13.6 (-)	-
Pelvic fin length (O)	15.5 (11.9-12.6)	12.2 (10.5–13.8)	10.5 (8.9–12.6)	-	-	-
Pelvic fin length (B)	11.4 (10.4–11.5)	12.4 (11.2–13.7)	10.8 (8.3–12.2)	-	-	-
Base of pelvic fin (O)	11.2 (9.6–10.4)	11.0 (10.2–11.9)	10.5 (9.4–11.3)	-	-	-
Base of pelvic fin (B)	3.8 (2.7–3.3)	4.9 (3.9–5.6)	3.8 (3.0–4.4)	-	-	-
Longest dorsal fin ray	13.9 (11.7–12.3)	13.3 (11.3–15.1)	12.6 (10.0–15.4)	12.7 (11.4–11.9)	11.8 (-)	-
Longest anal fin ray	13.7 (11.9–13.2)	13.6 (11.8–15.5)	12.8 (10.3–14.2)	12.5 (12.0)	11.3 (11.1)	-
Middle caudal fin ray	22.6 (20.4–20.9)	-	22.7 (19.6–23.8)	(19.3–21.1)	20.5 (18.4)	-

FIGURE 3. A–B. Lectotype of *Rhombus grandisquama*, RMNH 3533, male, 78.3 mm SL. C–D. Holotype of *Rhombus poecilurus*, RMNH 6738, female, 67.6 mm SL. A, C. Ocular sides. B, D, Blind sides. Photos by Esther Dondorp.

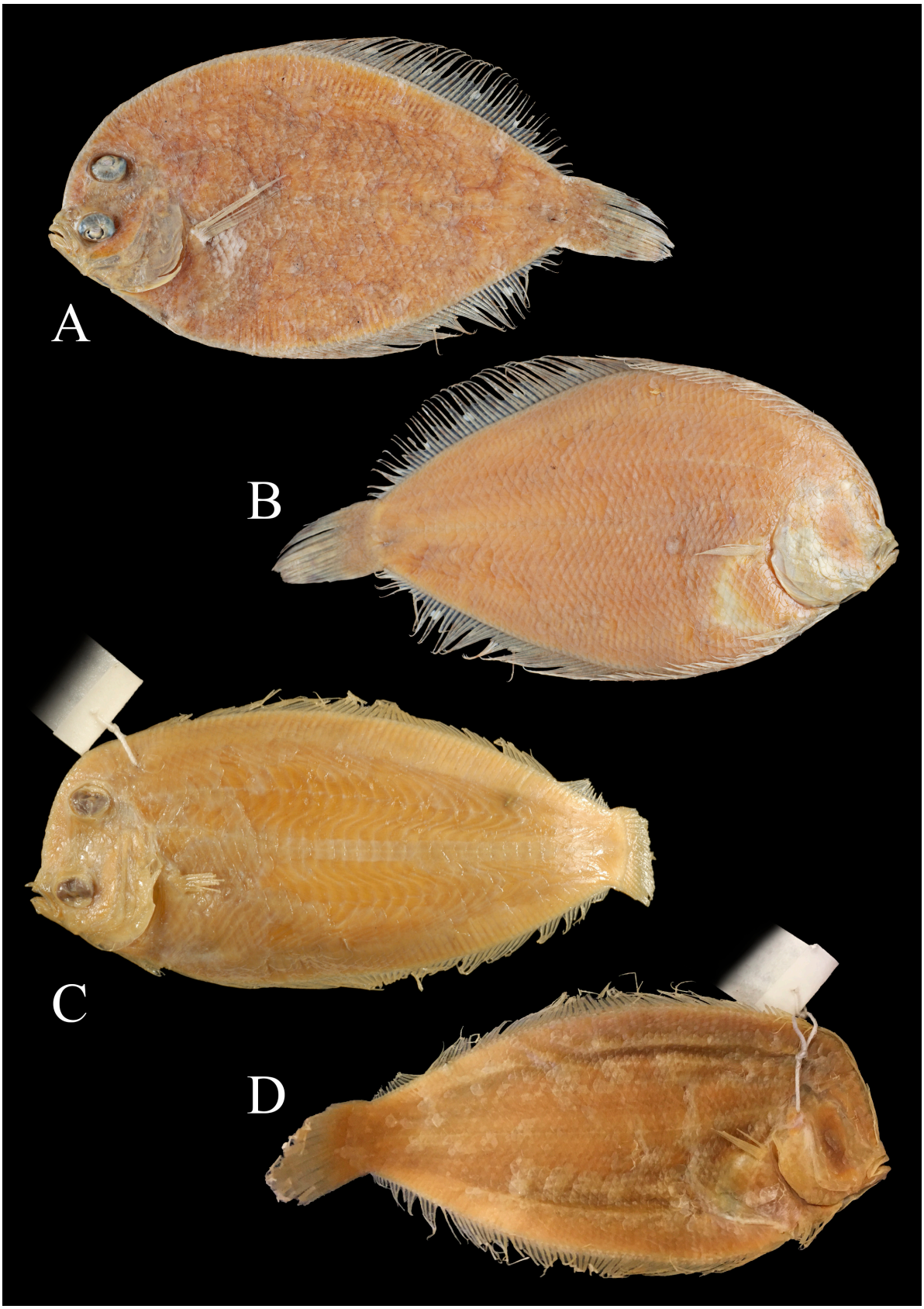

FIGURE 4. A–B. Holotype of *Rhombodoichthys spilurus*, BMNH 1875.5.14.88, male, 81.4 mm SL. C–D. Holotype of *Rombodoichthys spiniceps*, AMS I.16274-001, male, 94.6 mm SL. A, C. Ocular sides. B, D, Blind sides. Photos by James Maclaine (A–B), Anthony Gill (C), and Yi-Kai Tea (D).

Mouth large, oblique; maxilla extending to below near anterior 1/3 of lower eye; anterior tip of upper jaw about same vertical line to tip of lower jaw. Teeth on upper jaw biserial at anterior half, those in outer series stouter and sparse; lower jaw teeth uniserial, about similar to anterior teeth in inner row of upper jaw in size and space. Gill rakers on first arch short, not serrate, absent on upper limb. Ocular-side scales ctenoid with short ctenii, very small and deciduous, both jaws and snout naked; blind-side scales cycloid.

Dorsal fin originating before middle of interorbital space, no elongate rays, longest ray at near middle of body. Anal fin origin below base of pectoral fin, subsymmetrical to dorsal fin of posterior half of body in shape. Ocular-side pectoral fin very short, distinctly shorter than head length in both sexes. Ocular-side pelvic fin origin at tip of isthmus, fifth ray of ocular side opposite to first ray of blind side. Tip of isthmus below middle of lower eye. Caudal fin rays branched, except for three uppermost and four (three) lowermost simple rays.

Coloration. When preserved, ocular-side body uniformly greyish light brown. All fins greyish; caudal fin with a pair of large prominent black blotches, each extending between third and fifth rays from dorsal and ventral margins of the fin, respectively. On blind-side, posterior half of body with faintly black pigmentation in males and uniformly white in females (Fig. 1B, D).

Sexual dimorphism. This species shows sexual dimorphism, of which males have snout spine, broader interorbital width, longer pectoral fin and faintly black pigmentation on the blind side of body, but these are not especially prominence (Table 1; Figs. 1, 5).

Distribution. Known from the type series collected from off Ke-tzu-liao, Kaohsiung, southwestern Taiwan, at depth 10–30 meters.

Discussion

Of the congeners, *E. keliaoense* is similar to *E. grandisquama*, *E. multisquama* Amaoka, 1963 and *E. xystrias* Hubbs, 1915, which share a distinct character of a pair of prominent black spots on the upper and lower margins of caudal fin and can be separated from other congeners easily (e.g. without such a pair of black spots on the fin). The new species can be distinguished from *E. xystrias* by having 0+5–7 gill rakers on the first gill arch (vs. 0+12) and 10+24 vertebrae (vs. 10+26); and from *E. multisquama* by having 81–84 dorsal-fin rays and 59–63 anal-fin rays (vs. 89–98 and 68–75, respectively) and relatively short ocular-side pectoral fin, 1.25–1.37 in HL in males and 1.30–1.43 in females (vs. 0.48–0.72 and 0.95–1.11, respectively) (data from Amaoka & Ho 2018).

Among them, *E. keliaoense* is closely resembles *E. grandisquama* co-occurred in Taiwanese waters in having almost identical counts of most meristic characters (except for relatively more lateral-line scales).

Based on previous literatures (Norman,1934; Amaoka *et al.* 1993; Amaoka & Ho 2018, 2019), four names have been included in the synonymy of *E. grandisquama*: *Rhombus poecilurus* Bleeker, 1852 (type locality: Indonesia), *Rhomboidichthys spilurus* Günther, 1880 (type locality: New Guinea), *Rhomboidichthys spiniceps* Macleay, 1882 (type locality: Australia), and *Scaeops orbicularis* Jordan and Seale, 1907 (type locality: Philippines).

Examination on the lectotype (Fig. 3A–B) and 3 paralectotypes (RMNH 3533, 4 males) of *Rhombus grandisquama* Temminck and Schlegel, 1846 (type locality: Japan) revealed that the most common morphological form of *E. grandisquama* founded in Taiwanese and Japanese waters is identical to these types (Tables 1–2). In addition, we also examined the type series of *Rhombus poecilurus* (2 females; Fig. 3C–D), *Rhomboidichthys spilurus* (1 male; Fig. 4A–B), and *Rhomboidichthys spiniceps* (1 male; Fig. 4C–D), as well as the original description of *Scaeops orbicularis*.

Both type series of *Rhomboidichthys spilurus* and *Rhombus poecilurus* possess consistent morphology which falls within the range of that of *Rhombus grandisquama* and additional specimens examined by us (Tables 1–2) and are thus recognized as junior synonyms of *E. grandisquama*, as suggested by previous authors. However, *Rhomboidichthys spiniceps* is not the same with *E. grandisquama* because it has spinules on surface of each gill raker, whereas the gill rakers of *Engyprosopon grandisquama* are completely smooth. We suggest that a further investigation is needed.

Although Jordan & Seale (1907) provided Bleeker [Pieter Bleeker] as author of *Scaeops orbicularis*, Bleeker has never described such a name. Based on the brief description, this species is still questionable. However, *E. keliaoens*e can easily discriminate from *S. orbicularis* in having only 46–51 lateral-line scales (vs. 34 scales in lateral line). In addition, all *Engyprosopon* in Taiwan process relatively high lateral-line scale count (37–52, see Amaoka & Ho, 2019; Table 3). This name is recognized as a nomen dubium in *Engyprosopon* and is waiting for further investigation.

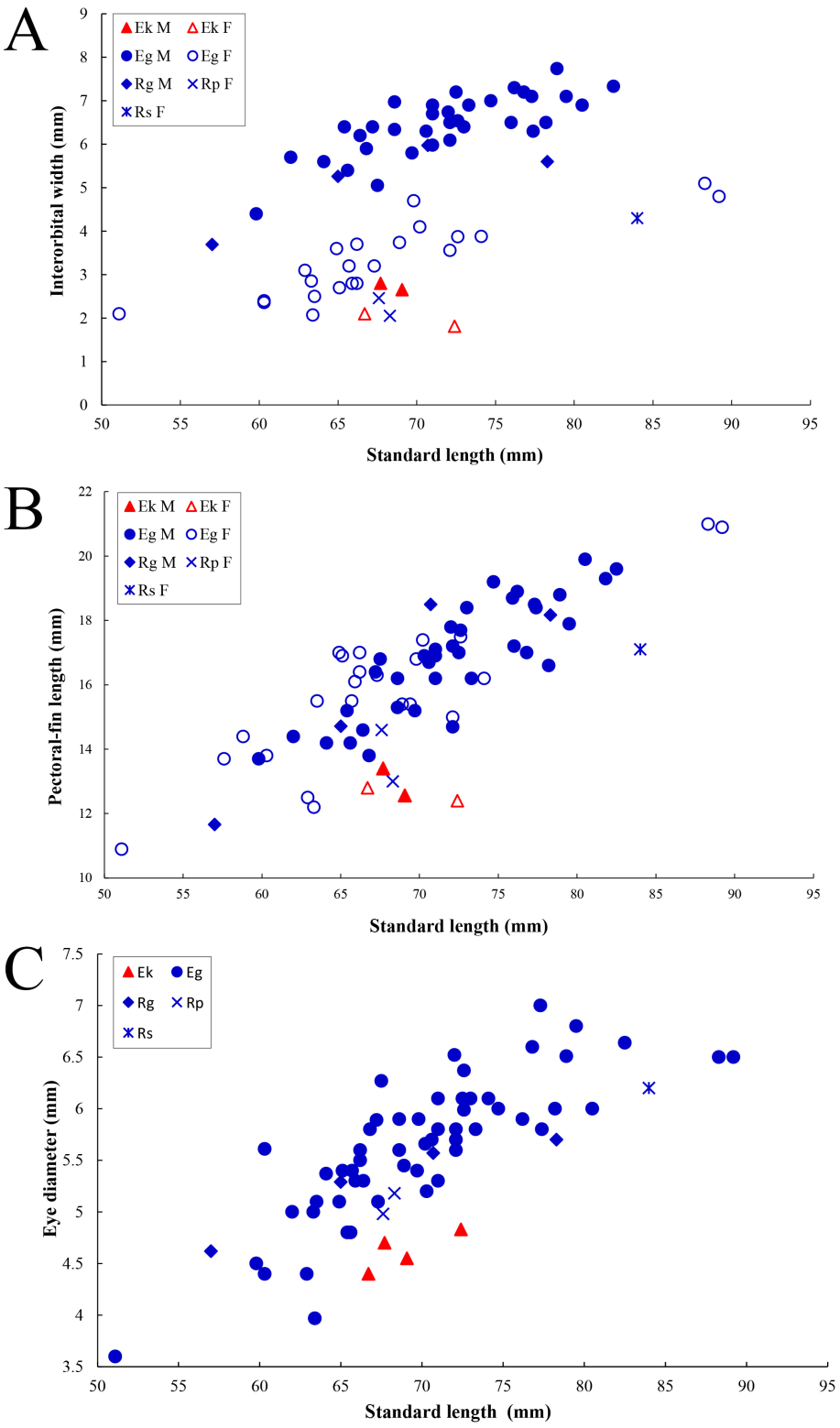

FIGURE 5. Relationships of interorbital width (A), ocular-side pectoral-fin length (B), and upper eye diameter (C) versus standard length in E. keliaoense (Ek) and *E. grandisquama* (Eg), including types of *Rhombus grandisquama* (Rg), *Rhombus poecilurus* (Rp), *Rhomboidichthys spilurus* (Rs). M=male(s), F=female(s).

TABLE 2. Morphometric data of *Engyprosopon keliaoense* **sp. nov.**, and *E. grandisquama* and its junior synonyms. See Table 1 for abbreviations.

Taxon	*E. keliaoense* **sp. nov.**	*E. grandisquama*		*Rhombus grandisquama*	*Rhombus poecilurus*	*Rhombodoichthys spilurus*
	HT (PT)	NT (Japan)	NT (Taiwan)	LT (PLT)	HT (PT)	HT
Dorsal fin rays	81 (81–84)	80–86	81–89	84 (81–84)	81 (88)	90
Anal fin rays	59 (62–63)	59–65	61–67	62 (60–64)	61 (66)	67
Pectoral fin rays (O)	11 (11–12)	11–12	10–12	12 (11–12)	11 (11)	11
Pectoral fin rays (B)	9 (9–10)	9–10	8–10	-	-	-
Scales in lateral line	**47 (46–51)**	37–42	40–45	ca. 43 (ca. 45)	44 (45)	45
Gill rakers	0+6 (0+5–7)	0+6	0+5–7	-	-	0+6
Vertebrae	10+24 (10+24)	10+23–25	10+23–24	10+24 (10+23–24)	10+24 (10+24)	10+24

TABLE 3. Frequency of lateral-line scales of *Engyprosopon keliaoense* **sp. nov.**, *E. grandisquama* and four junior synonyms previously referred to *E. grandisquama*. * values of primary types. ** from Jordan & Seale (1907).

	n	34	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
E. keliaoense **sp. nov.**	4											2	1*	0	0	0	1
E. grandisquqama (Taiwan)	29					5	3	9	5	3	4						
E. grandisquqama (Japan)	20		2	1	3	5	5	2	2								
Rhombus grandisquama	4								1*	0	3						
Rhombus poecilurus	2									1*	1						
Rhombodoichthys spilurus	1										1*						
Rhombodoichthys spiniceps	1										1*						
Scaeops orbicularis	1	1**															

In summary, *E. keliaoense* **sp. nov.** differs from *E. grandisquama* in having more lateral-line scales (46–51, vs. 37–45 in *E. grandisquama*), smaller upper eye diameter (6.6–6.9% SL, vs. 7.0–9.3%) and lower eye diameter (6.6–7.1% SL, vs. 7.0–9.2%), narrower interorbital width in males (3.8–4.1% SL, vs. 7.4–10.2%) and females (2.5–3.1% SL, vs. 3.9–6.7%), short ocular-side pectoral fin in males (18.2–19.8% SL, vs. 20.4–25.7%) and females (17.1–19.2% SL, vs. 19.3–26.2%) (Tables 1–2).

Comparative materials. *Rhombus grandisquama*: RMNH 3533, lectotype, male, 78.3 mm SL, and paralectotypes, 3 males, 57.0–70.3 mm SL, Nagasaki, Japan. *Rhombus poecilurus*: RMNH 6738, syntypes, 2 females, 67.6–68.3 mm SL, Ambon Island, Molucca Islands, Indonesia. *Rhomboidichthys spiniceps*: AMS I.16274-001 [ex MAMU F211], holotype, male, 94.6 mm SL, Port Jackson, New South Wales, Australia. *Rhomboidichthys spilurus*: BMNH 1875.5.14.88, holotype, male, 81.4 mm SL, South of New Guinea, Zebu, Challenger station 188, 28 fathoms [51.2 m]. Non-types of *E. grandisquama* (* with data taken): Taiwan: *NMMB-P22233, 1 male, 82.5 mm SL, 11 Mar. 2015; *NMMB-P22298, 1 male, 72.0 mm SL, and 1 female, 70.2 mm SL, 28 Mar. 2015; NMMB-P22235, 4 males, 67.5–78.9 mm SL, 11 Feb, 2015; *NMMB-P22302, 3 females, 65.7–72.6 mm SL, 28 Mar. 2015; *NMMB-P22245, 1 female, 60.3 mm SL, 11 Feb. 2015; *NMMB-P23228, 2 males (2 of 7), 75.9–81.8 mm SL, 31 Jun. 2016; *NMMB-P23248, 3 females (3 of 19), 57.6–69.4 mm SL, 6 Oct. 2015; *NMMB-P23302, 9 males, 64.1–71.0 mm SL, and 3 females, 65.7–72.6 mm SL, 3 Apr. 2016; *NMMB-P24466, 1 male (1 of 8), 76.0 mm SL, 13 Jul. 2016; NMMB-P25670, 6, 53.8–64.0 mm SL, 27 Jun. 2016; NMMB-P25683, 12, 50.0–70.8 mm SL, 11 Oct. 2016; NMMB-P25689, 2, 46.1–74.3 mm SL, 22 Apr. 2016; NMMB-P25711, 7, 68.9–78.6 mm SL, 27 Jun. 2016; NMMB-P25722, 1, 79.6 mm SL, 6 Oct. 2016; NMMB-P25724, 4, 71.4–73.4 mm SL, 5 May 2016; NMMB-P25729, 21, 55.5–75.7 mm SL, 11 Mar. 2017; NMMB-P33945, 17, 44.0–75.0 mm SL, 6 Mar. 2017; *NMMB-P33960, 9, 50.0–76.0 mm SL, 29 Mar. 2017; all collected from off Ke-tzu-liao, Kaohsiung, southwestern Taiwan, bottom trawl, ca. 10–30 m. Japan: *FAKU 28883, 28887, 28895, 28902, 28906, 28911, 28912, 28916, 28917, 28923, 10 males, 70.3–80.5 mm SL, and *FAKU 28933, 28934, 28942, 28946, 28948, 28949, 28950, 28952, 28953, 28954, 10 females, 63.5–89.2 mm SL, all collected from Mimase and Susaki, Kochi Prefecture, 20 June–10 July, 1958.

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