



The lefteye flounder family Bothidae (Order Pleuronectiformes) of Taiwan

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Abstract

The family Bothidae in Taiwan is reviewed. A total of 15 genera and 42 species are recognized. Historical records are re-evaluated and five species are recorded in Taiwan for the first time: *Arnoglossus yamanakai* Fukui & Ozawa, 1988, *Crossorhombus valderostratus* (Alcock, 1890), *Parabothus polylepis* (Alcock, 1889), *Parabothus coarctatus* (Gilbert, 1905), and *Psettina variegata* (Fowler, 1933). *Laeops tongkongensis* Chen & Weng, 1965 is recognized as a junior synonym of *Laeops kitaharae* Smith & Pope, 1906. Keys to genera and species, diagnostic characters, distribution and photographs are provided.

Keywords: Taxonomy, Ichthyology, Actinopterygii, Teleostei, new record

Introduction

Members of the flatfish family Bothidae are widely distributed in the tropical to temperate waters of world. The Indo-West Pacific is the most species rich ocean in bothids. Bothids inhabit at the bottom from the shallow coastal to deep offshore waters. Norman's (1934) monograph of Pleuronectiformes of the world, including 13 genera and 82 species in the subfamily Bothinae, which he defined by sinistral eyes, asymmetrical pelvic fins in position and size. Amaoka (1969) upgraded the subfamily to family level on the basis of important osteological characters, such as presence of intermuscular bones in lateral body muscles, absence of a neural spine of the first vertebra, and no preorbital bone on the blind side. Currently, 20 genera and about 173 species are recognized as valid in the family around the world (KA, pers. data).

The history of the study of bothid fishes in Taiwan is short and simple. Chen (1954) listed 3 genera and 6 species in the subfamily Bothinae. Chen (1969) listed 7 genera and 25 species, including some name changes after Chen & Weng (1965) and provided a key to species. Shen (1984) listed 12 genera and 24 species and also provided a key to species. Chen & Yu (1986) listed 12 genera and 30 species. Subsequently, Shen in Shen *et al.* (1993) provided brief descriptions of 12 genera and 24 species, with a key to genera and species. Chen (2004) listed 7 genera 11 species from Penghu (Pescadores Islands).

Ho *et al.* (2009) documented the flatfishes in the collection of the Tunghai University (THUP) that were transferred to NMMB-P and gave brief descriptions of the type series of three species described by Chen & Weng (1965), as well as newly recorded species of Bothidae (3 spp.) and Citharidae (1 sp.). The taxonomy of Bothidae in Taiwan, however, had not been settled as a whole, mainly because the highly similar appearance and some genera exhibit remarkable morphological changes with growth and sexual differences, which lead to apparent misidentifications.

In a project dedicated to study the taxonomy of flatfishes in Taiwan, the team conducted several joint investigations. Amaoka & Ho (2018) reviewed the genus *Engyprosopon* and described 2 new species and 4 new records for Taiwan. In the present work, we review the species of the family Bothidae and present diagnostic characters, keys for all genera and species, and distribution and photographs for each species.

Methods and materials

Counts and measurements follow those of Hubbs & Lagler (1974) and Amaoka *et al.* (1993). Gender of scientific names follows Nakabo & Hirashima (2015). Proportional measurements are expressed as percentages of standard length (SL), or as proportions of SL and head length (HL). Specimens examined are showed each number with sex (if available) and follows body lengths as mm SL in parenthesis

Most specimens examined are housed in the fish collection of the National Museum of Marine Biology and Aquarium, Pingtung, Taiwan (NMMB-P), and a part of the specimens are kept in the Biodiversity Research Center, Academia Sinica, Taipei, Taiwan (ASIZP), the National Taiwan University Museum, Taipei, Taiwan (NTUM), and National Museum of Natural History, Smithsonian Institutions (USNM). New specimens were collected from various fish markets around Taiwan and preserved in 75% ethanol or 50% isopropyl alcohol after fixation in 5% Formalin. The number of vertebrae and features of the caudal skeleton were examined from radiographs taken by a digital X-ray machine (Dexela CMOS X-ray detector, Model 2315) set up in National Museum of Marine Biology & Aquarium, Taiwan. Comparative specimens were used when only one specimen from off Taiwan was available for examination. Data and characters of comparative specimens are shown in parenthesis.

Most pictures of specimens were taken from fresh fishes, before they have been fixed in formalin. Both sides of the body are shown for species with sexual dimorphism.

Abbreviations. SL=standard length; HL=head length; D=dorsal-fin rays; A=anal-fin rays; P=pectoral-fin rays on ocular side; C=caudal-fin rays (unbranched+branched+unbranched); LLS=lateral-line scales; GR=gill rakers on first gill arch (upper limb+lower limb); vert.=vertebrae, divided into precaudal vertebrae+caudal vertebrae (with urostyle counted as one).

Detailed information of collecting sites followed Ebert *et al.* (2013). Geographic distribution for is provided for where each species found in Taiwan, followed by the supplements of general range elsewhere.

Family Bothidae

鯪科

Diagnostic characters. Eyes on left side of body. Optic chiasma monotypic, right-eye nerve always dorsal. All fin rays unbranched except for middle rays of caudal fin. Pelvic fins asymmetrical, fin-base on ocular side longer than that on blind side, first ray on blind side opposite to second to fourth rays on ocular side. Pelvic-fin rays supported by cartilage of pelvic bone extending anteriorly beyond lower tip of cleithrum. Caudal-fin rays 17, middle 11–13 rays branched.

Lateral line on ocular side with a strong curve above pectoral fin, rudimental or none on blind side. Branchiostegal membranes of each side joined. Gill arch without any tubercles except for gill rakers. Five rows of intermuscular bones. Epipleurals, ribs and first neural spine absent. Urohyal fishhook-like in shape, pointed at tip (except for *Taeniopsetta* in truncate). Caudal skeleton (hypural plate) with four plates, their distal half separated by clefts or closely attached. No preorbital and 3–5 suborbital bones on blind side (Amaoka, 1969).

Key to genera of Bothidae in Taiwan

- 1A. First pelvic-fin ray on blind side opposite to second ray on ocular side; origin of pelvic fin on ocular side slightly behind tip of isthmus, their distance subequal to base length of pelvic fin on ocular side; lower part of urohyal truncate distally *Taeniopsetta* (1 species)
- 1B. First pelvic-fin ray on blind side opposite to third or fourth ray on ocular side; origin of pelvic fin on ocular side at or near tip of isthmus; lower part of urohyal pointed distally 2
- 2A. Mouth extremely large, maxillary length more than half of HL; end of upper jaw extend to or well behind posterior margin of eye. 3
- 2B. Mouth small to moderate large, maxillary length less than half of HL; end of upper jaw before posterior margin of eye 4
- 3A. Anterior tip of upper jaw extending beyond snout tip; pectoral-fin length on ocular side longer than HL *Kamoharaia* (1)
- 3B. Anterior tip of upper jaw not extending beyond snout tip; pectoral-fin length on ocular side shorter than HL *Chascanopsetta* (2)
- 4A. Eyes separated by a broad concave space; interorbital space wider in males than in females and in large specimens than small ones of same sex; rostral spine usually present in males 5

4B.	Eyes separated by a bony ridge or distinctly narrow anteriorly, no sexual dimorphism on interorbital space; no rostral spine	11
5A.	First dorsal-fin ray elongate, lure-like, longer than and free from the second ray; gill rakers palmate	<i>Asterorhombus</i> (2)
5B.	First dorsal-fin ray shorter than second, connected to each other by fin membrane; gill rakers not palmate in shape	6
6A.	Tip of isthmus below posterior margin of eye	7
6B.	Tip of isthmus below middle to anterior margin of eye	8
7A.	Body long elliptical, body depth < 46.2% SL	<i>Parabothus</i> (4)
7B.	Body ovoid, body depth > 50% SL	<i>Tosarhombus</i> (1)
8A.	LLs > 76	9
8B.	LLs < 61	10
9A.	Anterior dorsal-fin rays elongate; 3 clear ocelli on body	<i>Grammatobothus</i> (2)
9B.	Anterior dorsal-fin rays not elongate; no clear ocelli on body	<i>Bothus</i> (3)
10A.	Scales ctenoid, with long hair like spines on posterior margin; body dark brown, with a large dark blue blotch on blind side in males	<i>Crossorhombus</i> (4)
10B.	Scales ctenoid, with short spines on posterior margin; body greyish or greenish brown, light grayish on blind side in males	<i>Engyprosoyon</i> (9)
11A.	HL > 22% SL; vert. < 45	12
11B.	HL < 21% SL; vert. > 49	13
12A.	Upper-jaw length about equal to eye diameter; scales with long hair like spines on posterior margin	<i>Psettina</i> (4)
12B.	Upper-jaw length longer than eye diameter; scales cycloids or ctenoids with short spines on posterior margin	<i>Arnoglossus</i> (6)
13A.	Upper-jaw length 3.1–6.2% SL, lower-jaw length 5.6–7.8%, upper-eye diameter 4.8–6.2%; vert. 11–12+37–42=48–54.	14
13B.	Upper-jaw length 7.5–8.8% SL, lower-jaw length 10.2–11.5, upper-eye diameter 3.3–4.5; vert. 13+37–38=50–51	<i>Neolaeops</i> (1)
14A.	Teeth present on both jaws of ocular side; upper-jaw length about equal to eye diameter; HL 18.1–20.6% SL	<i>Japonolaeops</i> (1)
14B.	Teeth absent on both jaws of ocular side; upper-jaw length much shorter than eye diameter; HL 14.9–17.6% SL	<i>Laeops</i> (1)

Arnoglossus Bleeker, 1862

羊舌鮚屬

Arnoglossus Bleeker, 1862:427. Type species: *Pleuronectes arnoglossus* Schneider, 1801.

Diagnostic features. Body elongate, elliptical. Tip of isthmus below posterior margin of lower eye. Dorsal profile of head not changing in both sexes and with growth. Eyes separated by ridge or very narrow concave; interorbital width same in both sexes. No rostral, orbital and mandibular spines in both sexes.

Mouth middle to large in size; maxilla extending to anterior margin to middle of lower eye or slightly beyond that point. Teeth on both jaws small to moderately large, uniserial, sometimes enlarged canine-like anteriorly; teeth on lower jaw stronger, longer, and more widely-spaced than those on upper jaw. Gill rakers slender to stout, sometimes with spines along each inner margin.

Scales cycloid or ctenoid with row of feeble ctenii on posterior margin on ocular side; scales cycloid on blind side; lateral line on ocular side curved above pectoral fin; absent on blind side.

Dorsal-fin without branched rays, sometimes with elongate anterior rays in adult males and/or females. Pectoral fin on ocular side not filamentous. Pelvic fin on ocular side originating at tip of isthmus, first fin ray on blind side opposite to third or fourth fin ray on ocular side. Vent on blind side, just before anal-fin origin; urogenital pore on ocular side. Caudal skeleton with four plates, including parhypural and three hypurals, without deep clefts.

Remarks. *Arnoglossus* is closely related to *Japonolaeops*, and differs in the larger mouth, with the upper-jaw length more than 1/3 HL.

Key to species of *Arnoglossus* in Taiwan

1A.	First to fourth dorsal-fin rays filamentous (> 50 mm SL); a large black spot on rear end of dorsal- and anal-fin bases	<i>A. macrolophus</i>
1B.	Anterior four rays of dorsal fin not elongate, except for some anterior rays slightly elongate or only second ray elongate in males; no spots on same region	2
2A.	LLs > 60; D 99–114; A 77–92; gill rakers with serration along inner margin; upper-jaw length 8.3–12.8% SL	3

- 2B. LLs 51–58; D 89–96; A 68–78; gill rakers without serration along inner margin; upper-jaw length 6.7–8.3% SL *A. tenuis*
 3A. Upper limb of first gill arch with 1 raker; maxilla extends to anterior margin or anterior 1/3 of lower eye; uppermost and lowermost 2 caudal-fin rays unbranched; anterior few dorsal-fin rays more or less elongate in males *A. polyspilus*
 3B. No gill rakers on upper limb of first gill arch; maxilla extends to middle of lower eye, or slightly behind it; uppermost and lowermost 3 caudal-fin rays unbranched; second dorsal-fin ray elongate in males. 4
 4A. LLs 82–83; D 110–113; A 85–86; vert. 11+35–36=46–47; pectoral fin and pelvic fin with black blotches *A. oxyrhynchus*
 4B. LLs 60–72; D 99–108; A 77–84; vert. 10–12+33–34=43–45; pectoral and pelvic fins without black blotch. 5
 5A. Gill rakers short, somewhat palmate; cycloid scales on both sides; shortest distance between upper eye and dorsal margin of head nearly equal to half eye diameter; abdominal vertebrae 10. *A. japonicus*
 5B. Gill rakers slender, distal half of each gill raker with spines; scales weakly ctenoid on ocular side, cycloid on blind side; shortest distance between upper eye and dorsal margin of head about 1/3 of eye diameter; abdominal vertebrae 11–12
 *A. yamanakai*

Arnoglossus japonicus Hubbs, 1915

Japanese lefteye flounder; 日本羊舌鰈

Figures 1A–B; Tables 1–2

Arnoglossus japonicus Hubbs, 1915:454 (Type locality: south of Kyushu, Japan). Chen, 1969:214; Shen, 1984:450; Chen & Yu, 1986:817; Shen in Shen *et al.*, 1993:566; Shen & Wu, 2012:747.

Arnoglossus polyspilus (not of Günther): Shen in Shen *et al.*, 1993:567.

Arnoglossus elongatus (not of Weber): Chen & Weng, 1965:43; Chen & Yu, 1986:817.

Specimens examined. NMMB-P02249 (1 male, 1 female, 118.7–121.6), Taiwan, 20 Jun. 1983; NMMB-P22222 (1 male, 1 female, 90.3–109.4), Ke-tzu-liao, 11 Feb. 2015; NMMB-P23187 (2 males, 2 females, 100.2–121.0), Ke-tzu-liao, 18 Mar. 2016; NMMB-P23207 (1 female, 116.9), Dong-gang, 5 Mar. 2016; NMMB-P23315 (3 males, 2 females, 110.0–110.1), Ke-tzu-liao, 18 Mar. 2016; NMMB-P24852 (2, 112.5–145), Ke-tzu-liao, 4 Apr. 2015; NMMB-P25680 (1 female, 130.8), Ke-tzu-liao, 27 Jun. 2016; NMMB-P25707 (1 male, 115.1), Ke-tzu-liao, 2 Apr. 2015; NMMB-P25709 (1 male, 105), Ke-tzu-liao, 27 Feb. 2017. More specimens are deposited in NMMB-P.

Diagnostic features. D 100–108; A 77–84; P 12–14; C 3+11+3=17; LLs 66–72; GR 0+7–8=7–8; vert. 10+33–34=43–44.

Body elongated, greatest depth near anterior 1/3 part of body (33.9–41.1% SL). Head small, its length about 66–74% of body depth (24.3–28.5% SL); front of head with slight concavity in front of upper eye; head profile gentle, same in both sexes. Snout sharply protruding, snout length shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameter slightly longer than 1/2 of upper-jaw length; upper eye about half eye diameter away from dorsal margin of head. No orbital spines in both sexes. Interorbital space with narrow bony ridge extending from anterior margin of lower eye to posterior space between both eyes.

Mouth large, upper-jaw length on ocular side 9.9–12.8% SL; anterior tip of upper jaw on about same vertical line to anterior tip of lower jaw; maxilla extending to or slightly beyond middle part of lower eye. Teeth on both jaws uniserial, upper jaw with 2–4 canine-like teeth on ocular side, 4–5 on blind side anteriorly, posteriorly gradually getting smaller; lower jaw with 8–16 widely spaced canine-like teeth. Gill rakers on lower limb, short and strong bearing 2–5 sharp spines on inner margin; entirely absent on upper limb.

Scales rather large and deciduous, cycloid on both sides. Second dorsal-fin ray elongate in males (2.7–3.5 in HL); no elongate ray in females. Pectoral fin on ocular-side short and feeble, about half of head (13.1–16.5% SL); that of blind side very short. Caudal fin round, uppermost and lowermost 3 rays simple, and middle rays deeply branched.

Coloration. Ocular side of body uniformly pale brownish without distinct blotches or spots; dorsal and anal fins uniformly pale brownish sometimes with darkish spots; blind side of body uniformly milky white.

Size. Reaching 131 mm SL in Taiwan; up to 144 mm SL in southern Japan (Amaoka, 1969).

Distribution. Northeastern, western and southern Taiwan; Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. This species resembles *A. yamanakai* in having an elongate second dorsal-fin ray in males and similar counts of D and A, but differs in having cycloid scales on the ocular side, 10 abdominal vertebrae (vs. 11–12 in the latter), a long upper jaw (2.15–2.48 in HL, vs. 2.54–2.92), uniserial teeth on the upper jaw (vs. biserial), longer gill rakers, and no black margin of the anterior half of the dorsal fin.

TABLE 1. Frequency of dorsal- and anal- fin rays of *Arnoglossus* species in Taiwan.

		Dorsal-fin rays																									
n	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	
<i>A. japonicus</i>	21									1	1	1	5	3	2	5	1	2	1								
<i>A. macrolophus</i>	4	1	1	0	0	1	1																				
<i>A. oxyrhinchus</i>	2																										
<i>A. polyspilus</i>	19												1	0	2	4	0	6	1	2	1	2	1	1	0	1	
<i>A. tenuis</i>	20	1	1	3	7	4	1	1	2																		
<i>A. yamanakai</i>	20									2	0	0	3	2	4	3	4	2									
		Anal-fin rays																									
n	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	
<i>A. japonicus</i>	21									1	3	2	3	4	5	2	1										
<i>A. macrolophus</i>	3	1	0	0	1	0	1																				
<i>A. oxyrhinchus</i>	2																1	1									
<i>A. polyspilus</i>	23												1	1	1	7	1	5	1	1	1	1	0	3	1		
<i>A. tenuis</i>	20	2	2	3	3	2	4	0	3	0	0	1															
<i>A. yamanakai</i>	20									1	1	4	3	3	3	5											

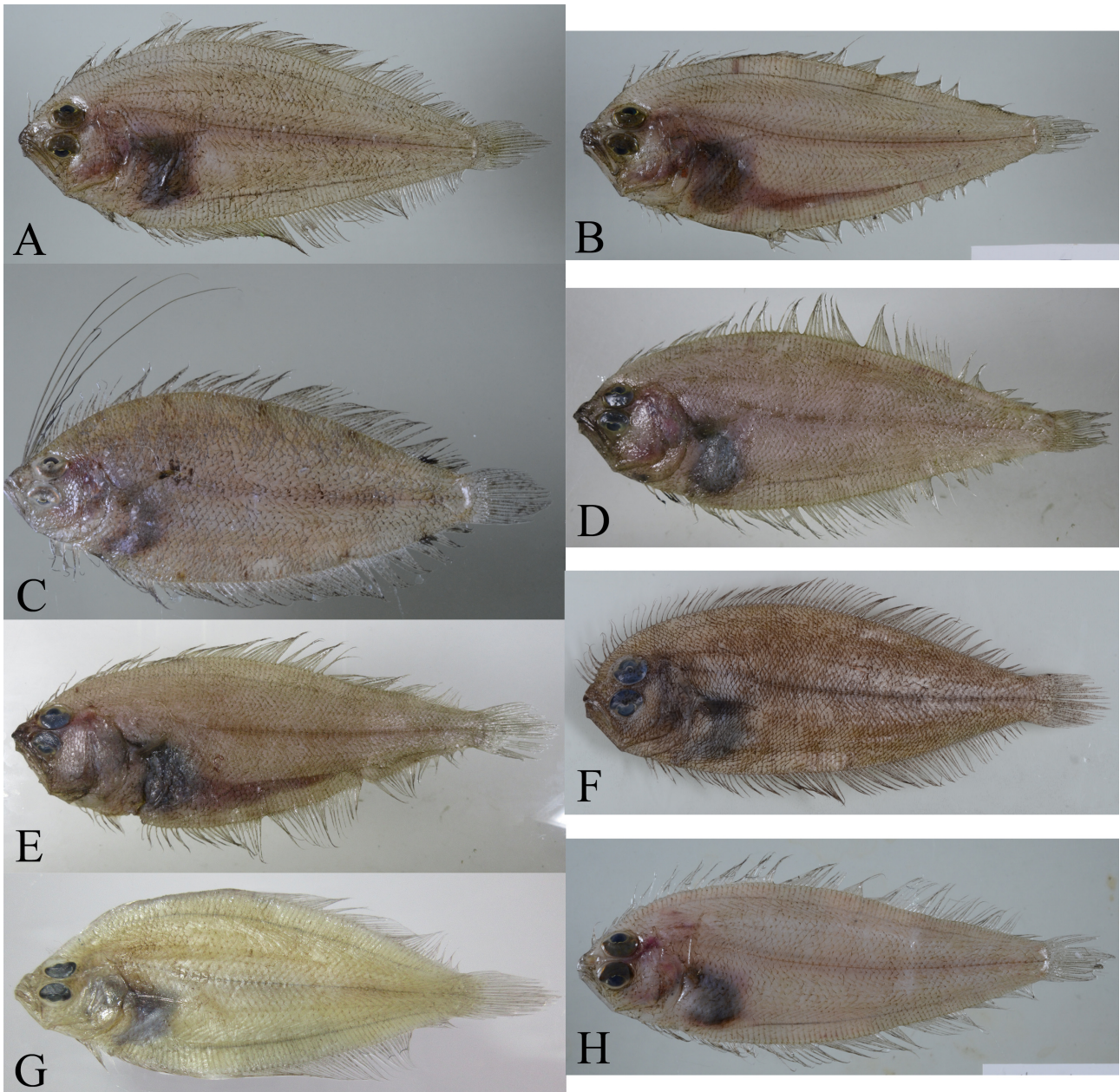


FIGURE 1. A–B. *Arnoglossus japonicus*, NMMB-P23187, male 121.0 mm SL (A) and female, 110.2 mm SL (B). C. *A. macrolophus*, NMMB-P 23204, male, 81.1 mm SL. D–E. *A. oxyrhynchus*, NMMB-P23317, male, 148.0 mm SL (D) and female, 171.1 mm SL (E). F. *A. polyspilus*, NMMB-P29041, 164 mm SL. G. *A. tenuis*, NMMB-P25684, 64.5 mm SL. H. *A. yamanakai*, NMMB-P25685, 95.0 mm SL.

Chen & Weng (1965) recognized two lots (THUP 2602, 2814) with 4 specimens of *A. elongatus*. The whereabouts of these specimens are unknown. However, Chen (1969) mentioned that their specimens were misidentification of the present species.

***Arnoglossus macrolophus* Alcock, 1889**

Largecrested lefteye flounder; 長冠羊舌鮚

Figure 1C; Tables 1–2

Arnoglossus macrolophus Alcock, 1889:280, pl. 18, fig. 2 (Type locality: south of Ganjam, Bay of Bengal). Arai & Amaoka, 1996:359; Shen & Wu, 2012:747.

Specimens examined. NMMB-P1786 (1 male, 59.8), Daxi, 9 Sep. 2003; NMMB-P8215 (1 female, 87.5), Donggang, 16 Jun. 2004; NMMB-P23204 (1 male, 81.1), Ke-tzu-liao, 31 Mar. 2016; NMMB-P29430 (1 male, 74.2), Ke-tzu-liao, 24 Apr. 2018

Diagnostic features. D 89–94; A 69–74; P 13–14; C 2+13+2=17; LLs 52–57; GR 0+10–12=10–12; vert. 10+30–32=40–42.

Body elliptical, greatest depth at about middle part of body (37.3–41.4% SL). Head small, its length about half of body depth (23.3–25.1% SL); front profile of head with slight concavity anterior of upper eye; head profile gentle, same in both sexes. Snout slightly shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameters distinctly shorter than upper jaw. No orbital spines in both sexes. Interorbital ridge low, extending from anterior margin of lower eye to posterior margin of upper eye.

Mouth moderately large, upper-jaw length on ocular side 8.8–10.1% SL; maxilla extending to or slightly behind anterior margin of lower eye; teeth on both jaws uniserial, closely set, without enlarged anterior teeth. Gill rakers only on lower limb of first arch, slender, pointed at tip and not serrate.

Scales on ocular side ctenoid with row of slender ctenii, cycloid on blind side. Anteriormost four to six dorsal-fin rays slender, filamentous, first ray longest, 32.9–64% SL in males, 28.7% SL in females. Pectoral fin on ocular-side shorter than head, 11–16% SL; that on blind-side small.

Coloration. Ocular side of body uniformly pale brownish, a dark blotch at junction of straight and curved portions of lateral line, two small blotches on middle of straight portion of lateral line; a series of five dark obscure blotches along dorsal margin and three along ventral margin of body; posterior parts of dorsal and anal fins with conspicuous black blotches basally. Blind side of body yellowish white.

Size. Reaching 88 mm SL in Taiwan; up to 130 mm total length elsewhere (Hensley & Amaoka, 2001).

Distribution. Northeastern and southwestern Taiwan; Indian and Western Pacific ocaens (Amaoka, 2016).

Remarks. This species is easily separated from other species of this genus in having four to six filamentous anteriormost rays of dorsal fin in males and a distinct blotch on the posterior parts of the dorsal and anal fins, respectively. The sexual dimorphism occurs in specimens larger than about 55 mm SL.

Arnoglossus oxyrhynchus Amaoka, 1969

Sharpsnout lefteye flounder; 尖吻羊舌鲆

Figures 1D–E; Tables 1–2

Arnoglossus oxyrhynchus Amaoka, 1969:135 (Type locality: Mimase, Kochi Prefecture, Japan). Ho *et al.*, 2009:5 (new record).

Specimens examined. NMMB-P23317 (1 male, 1 female, 148.0–171.1), Ke-tzu-liao, 22 Apr. 2016.

Diagnostic features. D 110–113; A 85–86; P 14; C 3+11+3=17; LLs 82–83; GR 0+8–9=8–9; vert. 11+35–36=46–47.

Body elongated, greatest depth near anterior 1/3 part of body (36.1–36.7% SL). Head small, its length about 65–70% body depth (24.6–26.2% SL); front of head with shallow concavity in front of upper eye; head profile gentle, same in both sexes. Snout sharply protruding, snout length slightly shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameter much shorter than upper-jaw length; upper eye extremely close to dorsal margin of head. No orbital spines in both sexes. Interorbital space high, with narrow bony ridge extending from anterior margin of lower eye to posterior space between both eyes.

Mouth large, upper-jaw length on ocular side 11.0–11.5% SL; anterior tip of upper jaw protruding beyond anterior tip of lower jaw; maxilla extending to slightly behind middle part of lower eye. Teeth on both jaws uniserial except for biserial on posterior half on blind side; 4 enlarged canines on upper jaw anteriorly, protruding beyond anterior tip of lower jaw; lateral teeth of lower jaw canine-like, stronger and more apart than those on upper jaw. Gill rakers only on lower limb, short and strong bearing 3 or 4 sharp spines on inner margin.

TABLE 2. Frequency of four meristic data of *Arnoglossus* species in Taiwan.

	Lateral-line scales																																				
	n	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83			
<i>A. japonicus</i>	20															2	3	5	2	2	3	3															
<i>A. macrolophus</i>	3	1	0	1	0	0	1																														
<i>A. oxyrhinchus</i>	2																																			1	1
<i>A. polyaspilus</i>	13																				3	3	2	3	2	0	4	1	0	1	0	1	0	1			
<i>A. tenuis</i>	20	2	4	4	5	3	0	1	1																												
<i>A. yamanakai</i>	19								1	1	1	7	1	5	1	1	1																				
		Gill rakers (upper + lower)																Vertebrae (precaudal +caudal)																			
	n	10	11	12	13	14	n	0	1	+	5	6	7	8	9	10	11	12	n	10	11	12	+	28	29	30	31	32	33	34	35	36					
<i>A. japonicus</i>	20	4	10	6	20	20	8	12											12	12															10	2	
<i>A. macrolophus</i>	4	3	1	4	4	4	1	1	2										4	4																	
<i>A. oxyrhinchus</i>	2	2	2	2	2	2	1	1	1										2	2																	
<i>A. polyaspilus</i>	20	1	8	11	7	1	6	3	4										20	20																	
<i>A. tenuis</i>	19	4	12	3	19	19	1	11	6	1									20	20																	
<i>A. yamanakai</i>	20	16	4	18	18	18	3	1	13	1									20	20																	

Scales small and deciduous, ctenoid on ocular side with row of short ctenii, cycloid on blind side. Anterior 1–3 rays of dorsal fin elongate in males, second ray longest, longer than 1/2 HL; no elongate rays in females. Pectoral fin of ocular-side short, about half of head length (10.7–12.9% SL); that of blind side very short. Caudal fin round, uppermost and lowermost 3 rays simple, and middle rays divided into 2 branches.

Coloration. Ocular side of body uniformly pale brownish without distinct blotches or spots, snout dark; dorsal and anal fins uniformly pale brownish with a row of darkish spots; posterior part of pectoral and pelvic fins on ocular side with dark blotch, darker in males than in females. Blind side of body uniformly milky white.

Size. Reaching 170 mm SL off Taiwan; up to about 194 mm SL in southern Japan (Amaoka, 1969).

Distribution. Southwestern Taiwan; Western Pacific Ocean (Amaoka, 2016).

Remarks. Ho *et al.* (2009) firstly reported 2 specimens from Taiwan. This species belongs to a group of *Arnoglossus* with many scales on the lateral line and spines on the inner margin of the gill rakers. It resembles *A. japonicus* in having an elongate second dorsal-fin ray in males and a sharply protruding snout, but differs in having ctenoid scales on the ocular side, more dorsal- and anal- fin rays, more lateral-line scales and vertebrae, and a black blotch on pectoral and pelvic fins.

***Arnoglossus polyspilus* (Günther, 1880)**

Manyspotted lefteye flounder; 多斑羊舌鲆

Figure 1F; Tables 1–2

Anticitharus polyspilus Günther, 1880:48 (Type locality: Kei Island, Arafura Sea, Indonesia).

Arnoglossus polyspilus: Norman, 1927:20; Chen & Weng, 1965:42; Shen & Wu, 2012:747.

Specimens examined. NMMB-P22241 (10, 116.8–168.7), NMMB-P22266 (3, 150.0–155.0), Ke-tzu-liao, 21 Jan. 2015; NMMB-P23271 (5, 142.9–171.9), Ke-tzu-liao, 28 Feb. 2016; NMMB 29041 (1 male, 164 mm), Ke-tzu-liao, 18 Mar. 2018.

Diagnostic features. D 103–114; A 81–92; P 11–13; C 2+13+2=17; LLs 71–82; GR 0–1+8–9=8–9; vert. 10+30–32=40–42.

Body elongated, greatest depth near middle part of body (36.7–42.1% SL). Head small, its length about 60–70% of body depth (25.3–27.6% SL); front of head with small concavity anterior of upper eye; head profile gentle, same in both sexes. Snout shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameter much shorter than upper-jaw length. No orbital spines in both sexes. Interorbital ridge very low, extending from anterior margin of lower eye to posterior margin of upper eye.

Mouth moderately large, upper-jaw length on ocular side 9.7–10.9% SL; maxilla extending to anterior margin of lower eye or slightly beyond it. Teeth on both jaws uniserial, several pairs enlarged anteriorly; lateral teeth on lower jaw stronger and wider spaced than those on upper jaw. Gill rakers on lower limb, long and serrated inner edge; 0 (rarely 1) gill raker on upper limb.

Scales moderately large, ctenoid with row of short ctenii; cycloid on blind side. Few anterior dorsal-fin rays more or less elongate, longer in males than in females. Pectoral fin of ocular-side small, slightly longer than half of head length, 13.1–14.8% SL; that of blind side very short. Caudal fin round, uppermost and lowermost 2 rays simple, and middle rays divided into more than 2 branches.

Coloration. Ocular side of body uniformly pale greenish brown without distinct blotches or spots, all fins uniformly pale brownish without spots. Blind side of body uniformly milky white.

Size. Reaching 172 mm SL in Taiwan; up to about 240 mm TL elsewhere (Hensley & Amaoka, 2001).

Distribution. Northeastern, western and southwestern Taiwan; Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. This species resembles *A. oxyrhynchus*, *A. japonicus* and *A. yamanakai* in having many scales on the lateral line and serration on the edge of the gill rakers. It differs however from the latter two species in having the maxilla not extended to below middle of lower eye, several anterior rays of dorsal fin elongated in males and the two uppermost and lowermost rays of the caudal fin unbranched.

Arnoglossus tenuis Günther, 1880

Dwarf lefteye flounder; 細羊舌鯧

Figure 1G; Tables 1–2

Arnoglossus tenuis Günther, 1880:55 (Type locality: Hong Kong, China). Shen, 1984:450; Chen & Yu, 1986:817; Shen in Shen *et al.*, 1993:567; Shen & Wu, 2012:748.

Arnoglossus aspiolos (not of Bleeker, 1851): ?Chen & Weng, 1965:41; ?Chen, 1969:214; ?Chen & Yu, 1986:817; ?Shen & Wu, 2012:747.

Arnoglossus thori (not of Kyle, 1913): ?Chen & Weng, 1965:40.

Specimens examined. NMMB-P23199 (9, 57.3–62.8), Ke-tzu-liao, 3 Apr. 2016; NMMB-P25682 (3, 59.9–65.4), Ke-tzu-liao, 27 Jun. 2016; NMMB-P25684 (8, 55.2–64.5), Dong-gang, 11 Oct. 2016. More specimens deposited in NMMB-P collection.

Diagnostic features. D 89–96; A 68–78; P 10–12; C 2+13+2=17; LLs 51–58; GR 0+5–8=5–8; vert. 10+28–30=38–40.

Body elongated, greatest depth slightly anterior of middle part of body (38.4–48.0% SL). Head small, its length about half of body depth (22.3–24.3% SL); front of head with distinct concavity in front of upper eye; head profile gentle, same in both sexes. Snout shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameter slightly shorter than upper jaw. No orbital spines in both sexes. Interorbital ridge low, extending from anterior margin of lower eye to posterior margin of upper eye.

Mouth very small, upper-jaw length on ocular side 7.3–8.3% SL; maxilla extending to or slightly behind anterior margin of lower eye. Teeth on both jaws uniserial, closely set, not enlarged anteriorly; lower jaw teeth on ocular side curved inward, teeth on blind side slightly longer and stronger than those on ocular side. Gill rakers only on lower limb, long and slender, pointed at tip and not serrate.

Scales large, deciduous, ctenoid with short ctenii on ocular side, cycloid on blind side. Pectoral fin on ocular side much shorter than head length (13.0–15.4% SL); that on blind side very short.

Coloration. Ocular side of body uniformly pale brown without distinct blotches or spots, all fins uniformly pale brownish without spots. Blind side of body uniformly milky white.

Size. Reaching 65 mm SL in Taiwan; up to about 120 mm total length elsewhere (Hensley & Amaoka, 2001).

Distribution. Northeastern and southwestern Taiwan; Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. This species resembles *A. aspiolos* in having small a mouth and fewer scales on the lateral line. It differs from the latter in having slightly more dorsal- and anal-fin rays and more lateral-line scales. Shen (1983) pointed out that the specimen identified as *A. aspiolos* by Chen & Weng (1965) is a misidentification (see above). Moreover, *A. tenuis* resembles *A. macrolophus* in body shape, small mouth, fewer dorsal- and anal-fin rays, but can be distinguished by lacking elongate anterior dorsal-fin rays and no black spots on the posterior portions of the dorsal- and anal-fin bases.

Arnoglossus yamanakai Fukui & Ozawa, 1988

Tokai lefteye flounder; 山中氏羊舌鯧

Figure 1H; Tables 1–2

Arnoglossus yamanakai Fukui & Ozawa, 1988:923 (Type locality: South China Sea). Fukui *et al.* (1990):215.

Arnoglossus japonicus Hubbs, 1915:454 (in part, paratype).

Arnoglossus sp. A: Ozawa & Fukui, 1986:384, 409 (larvae).

Specimens examined. NMMB-P22849 (2, 87.2–87.3), Ke-tzu-liao, 28 Mar. 2015; NMMB-P23270 (2 males, 86.2–97.9, 2 females, 82.7–88.9), Ke-tzu-liao, 28 Feb. 2016; NMMB-P23314 (1 male, 94.9), 18 Mar. 2016; NMMB-P25674 (3 males, 1 female, 92.7–95.4), Ke-tzu-liao, 27 Dec. 2016; NMMB-P25685 (5 males, 1 female, 89.5–95.7), 2 Apr. 2015; NMMB-P25696 (1 female, 84.7), 20 Jan. 2017; NMMB-P25715 (1 male, 1 female, 85.9–89.8), Ke-tzu-liao, 22 Apr. 2016

Diagnostic features. D 99–107; A 77–83; P 12–13; C 3+11+3=17; LLs 60–68; GR 0+7–8=6–9; vert. 11–12+33–34=44–45.

Body elongated, greatest depth near anterior 1/3 part of body (34.2–38.0% SL). Head small, its length about

67–76% body depth (23.8–27.0% SL); front of head with very slight concavity in front of upper eye; head profile gentle, same in both sexes. Snout rather round, snout length shorter than eye diameter. Rostral spine absent on tip of snout in both sexes. Eye diameter much shorter than upper jaw length; upper eye close to dorsal margin of head, its width about 1/3 of eye diameter. No orbital spines in both sexes. Interorbital space with narrow bony ridge extending from anterior margin of lower eye to posterior space between both eyes.

Mouth large, upper-jaw length on ocular side 8.3–10.5% SL; anterior tip of upper jaw on about same vertical line to anterior tip of lower jaw or slightly beyond; maxilla extending to or slightly behind anterior margin of lower eye. Teeth on both jaws biserial, outer row larger than inner row, 55–71 teeth on upper jaw of ocular side, 23–35 teeth on lower jaw of ocular side; numerous very small inner row teeth, covered by skin. Gill rakers only on lower limb, slender with spines on inner margin of distal half.

Scales rather large and very deciduous, weakly ctenoid on ocular side, cycloid on blind side. Second dorsal-fin ray elongate in males, about 1.8–3.6 in HL; no elongate ray in females. Pectoral fin on ocular side small, longer than half of head length (15.1–17.4% SL); that on blind side very short. Caudal fin pointed, upper 2–3 and lower 3 rays simple, and middle rays branched into 2.

Coloration. Ocular side of body uniformly pale brownish without distinct blotches or spots; distal margin of dorsal fin from posterior margin of head to middle part of body dark in males, not dark in females; blind side of body uniformly milky white.

Size. Reaching 98 mm SL in Taiwan; up to 123 mm SL in East China Sea (Fukui *et al.*, 1990).

Distribution. Southwestern Taiwan off Ke-tzu-liao, Kaohsiung, at depth not more than 100 m; Western Pacific Ocean (Amaoka, 2016)

Remarks. This species resembles *A. japonicus* in having an elongate second dorsal-fin ray in males and similar numbers of dorsal- and anal- fin rays, but differs by characters described in the remarks of *A. japonicus*. The adult size is smaller than *A. japonicus*. This is the first record of the species from Taiwan.

Asterorhombus Tanaka, 1915

Asterorhombus Tanaka, 1915:567. Type species: *Asterorhombus stellifer* Tanaka, 1905.

Diagnostic features. Body ovate. Tip of isthmus below posterior margin of lower eye. No orbital and rostral spines. Front margin of head same in both sexes. Interorbital space narrowly concave, width same in both sexes or slightly wider in males than in females and juveniles.

Mouth rather large in size, upper-jaw length on ocular side 9.6–12.9% SL. Maxilla extending to anterior margin of lower eye. Teeth on both jaws uniserial. Gill rakers short and palmate. Scales ctenoid on ocular side, cycloid on blind side; 46–67 scales in lateral line. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side.

Dorsal-fin origin on blind side in front of upper margin of lower eye, first ray elongate, separated from remaining rays. Anal-fin origin below anterior base of pectoral fin on ocular-side. Pectoral fin not elongate, without sexual dimorphism. Pelvic fin on ocular side originating at tip of isthmus, fourth or fifth ray opposite to first ray on blind side. Caudal skeleton with four plates including parhypural and three hypurals, all plates with deep clefts.

Remarks. *Asterorhombus* is closely related to *Engyprosopon* in having a concave interorbital space and all four plates of the caudal skeleton with deep clefts, but it differs from the latter in having palmate gill rakers and an elongate first dorsal-fin ray.

Key to species of *Asterorhombus* in Taiwan

- 1A. Body depth more than half of SL; first dorsal-fin ray with fin membrane only at distal part; interorbital width in males wider than in females when > 60 mm SL. *Asterorhombus cocosensis*
- 1B. Body depth less than half of SL; first dorsal-fin ray with fin membrane from base to tip; no sexual dimorphism in interorbital width in all stages *Asterorhombus intermedius*

***Asterorhombus cocosensis* (Bleeker, 1855)**

Angler flatfish, Cocos Island flounder; 可可羊舌鮨

Figures 2A–B; Table 3

Rhombus cocosensis Bleeker, 1855:179 (Type locality: Cocos Island, Australia).*Engyprosonon fijiensis* Norman, 1931a:508 (Type locality: Fiji Islands)*Asterorhombus fijiensis*: Hensley, 1986:941; Lin *et al.*, 1995:26.*Asterorhombus cocosensis*: Hensley, 2003:833; Shen & Wu, 2012:748.

Specimens examined. ASIZP 57101 (1 female, 98.1), Taiping Island (Itu Aba Island), South China Sea, 20 Apr. 1994. Other localities: RMNH 6730 (holotype of *Rhombus cocosensis*, 71.7), Cocos Island, Indian Ocean; BMNH 1879.5.14.89, (holotype of *Engyprosonon fijiensis*, 68.1), Levuka, Fiji, 8 Aug. 1983; WAM P 28028-013 (1 female, 62.5), Rowley Shoals, Cleeke Reef, Bedwell Island, 8 Aug. 1982; IOP 3303 (1 male, 109.9), Kerama Islands, Okinawa Prefecture, Japan, 21 Mar. 21, 1993.

Diagnostic features. D 82 (79–82 from other localities); A 62 (59–62); P 11 (11–13); C 2+13+2=17; LLs 55 (52–58); GR 0+9 (0+8–9); vert. 10+26=36 (10+25–26=35–36).

Body ovate, greatest depth at middle part of body 55.1 (53.3–54.1)% SL. Head longer than half of body depth 28.8 (27.9–30.2)% SL; upper profile of head with slight concavity in front of upper margin of lower eye; head profile relatively steep. Snout long, its length less than 1/3 HL. Eyes small, separated by deep and wide space, their width slightly wider in males than in females and juveniles; surface of upper eye rarely with 1–9 tentacles.

TABLE 3. Frequency of six meristic data of two *Asterorhombus* species; * indicates the value of specimens (one in each species) collected from Taiwan.

	Dorsal-fin rays								Anal-fin rays								
	n	79	80	81	82	83	84	85	n	58	59	60	61	62	63	64	65
<i>A. cocosensis</i>	5	1	0	1	3*				5		1	0	2	2*			
<i>A. intermedius</i>	33		2	2	9	14*	3	3	34	1	0	0	4	12	9*	6	2
	Lateral-line scales								Pectoral-fin rays								
	n	50	51	52	53	54	55	56	57	58	n	10	11	12	13		
<i>A. cocosensis</i>	5			1	0	2	1*	0	0	1	5		3*	1	1		
<i>A. intermedius</i>	31	2	4	5	8	2	5*	3	2	33	7*	24	2				
	Gill rakers (upper + lower)						Vertebrae (precaudal + caudal)										
	n	0	+	8	9	10	11	n	10	+	25	26	27	28			
<i>A. cocosensis</i>	5	5*		3	2*			5	5*		1	4*					
<i>A. intermedius</i>	33	33*		13*	15	4	1	31	31*		2	26	3*				

Mouth large, curved; upper-jaw length 11.5 (11.2–12.2)% SL; maxilla extending to anterior margin of lower eye; posterior half of ventral margin of lower jaw with some membranous flaps. Teeth on both jaws uniserial, upper jaw teeth small and short, somewhat enlarged anteriorly, smaller and more closely set posteriorly; teeth on lower jaw similar to anterior teeth on upper jaw. Gill rakers only on lower limb, short and palmate with 2–5 spines.

Scales on ocular side rather small, ctenoid with short ctenii; cycloid scales on blind side; snout, both jaws, pectoral fin and pelvic fin scaleless. First dorsal-fin ray elongate, separated from remaining rays, with large leaf-like membrane at tip; fin membranes of anterior second to fourth rays deeply incised. Pectoral-fin short on ocular side, a little longer than half of HL 15.8 (15–16.2)% SL.

Coloration. Ocular side of body uniformly yellowish brown, with many obtuse ocelli, larger than eye, and numerous small dark spots; all fins with many small dark spots except for pectoral fin; body, fins and membranous tip of first dorsal ray with red blotches in fresh specimens.

Size. Reaching 98.1 mm SL in Taiwan; up to 150 mm TL elsewhere (Hensley & Amaoka, 2001).

Distribution. The only record for Taiwan is from Taiping Island (Itu Aba Island), South China Sea; widespread in the Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. Lin *et al.* (1995) identified the same specimen examined herein as *Asterorhombus fijiensis*, which is a junior synonym of *A. cocosensis*. This species has a lure originated from the first dorsal-fin ray, which resembles a small crustacean in form and coloration. Divers observed the lure to repeatedly vibrate (Amaoka *et al.*, 1994).

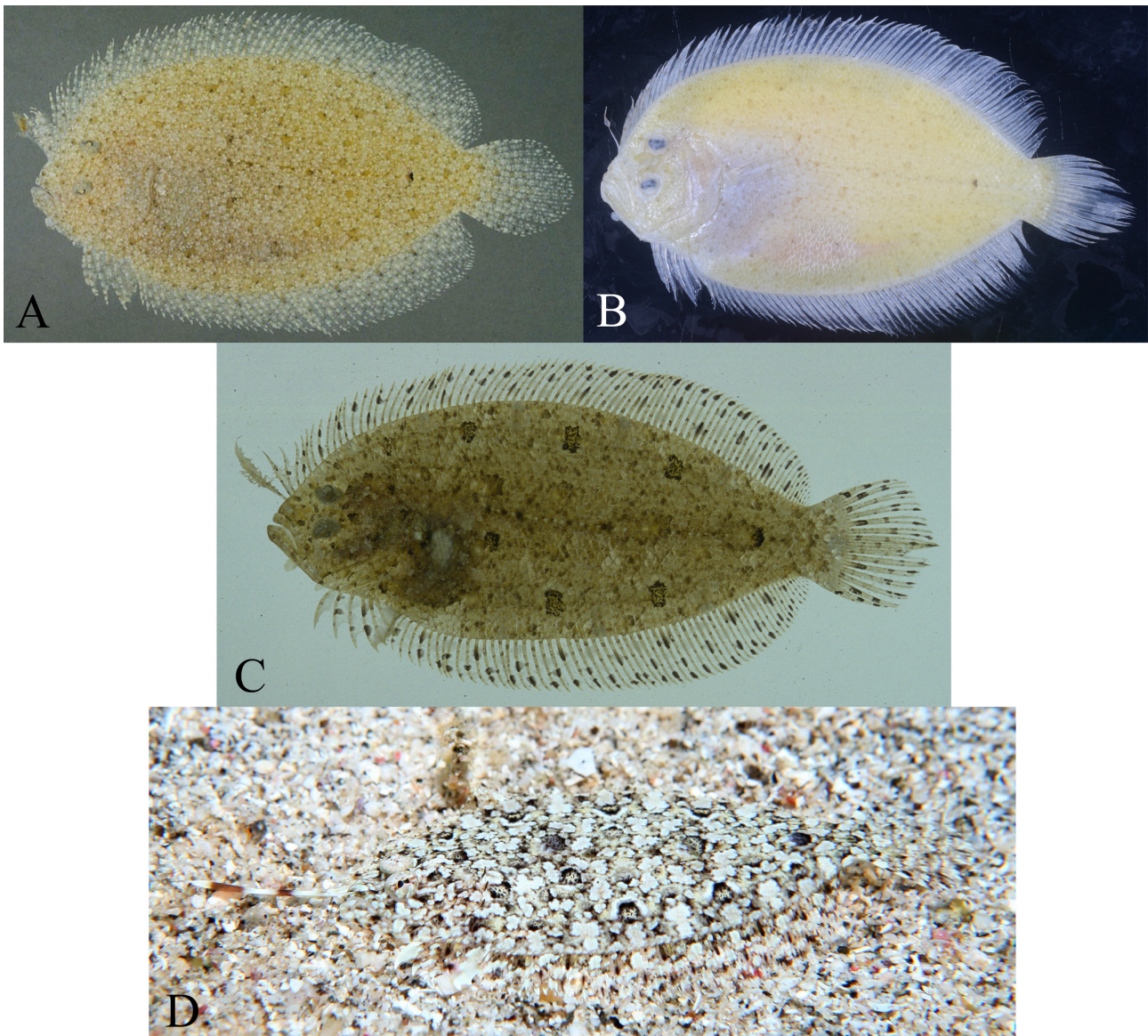


FIGURE 2. A–B. *Asterorhombus cocosensis*, ASIZP 57101, female, 98.1 mm SL fresh, photo by J.-P Chen (A), preserved (B). C–D. *A. intermedius*, ASIZP 57100, male, 87.7 mm SL, photo by J.-P Chen (C), underwater photo taken from Lang-dao, Orchid Island, photo by J.-P. Chen (D).

***Asterorhombus intermedius* (Bleeker, 1865)**

Intermediate flounder; 間星羊舌鯧

Figures 2C–D; Table 3

Platophrys (*Arnoglossus*) *intermedius* Bleeker, 1865:47 (Type locality: Surawesi, Celebes, Indonesia).

Asterorhombus intermedius: Amaoka, 1969:111; Lin *et al.*, 1995:27; Shen & Wu, 2012:748.

Specimens examined. ASIZP 57100 (1, 87.7), Dawulun, Keelung, northern Taiwan, 28 Apr. 1993. Other localities: BSKU 8376 (1 male, 122.0), Mimase, Kochi Prefecture, Japan, 1 Jul., 1958; FAKU 17541 (1 female, 103.5), Miya, Aichi Prefecture, Japan, 15 Mar. 1952; HUMZ 124783 (1 female, 108.8), Belep Island, New Caledonia, 24 Oct. 1989; HUMZ 142681–142682 and MNHN 1995-1174–1177 (3 males, 3 females, 54.8–101.7), Bellona

Plateau, Coral Sea, 25 Jul. 1984; MNHN 1995-1178 (1 female, 119.1), Fairway Ridge, Coral Sea, 15 Jul. 1984; MNHN 1995-1179 (1 female, 97.8), Belep Island, New Caledonia, 2 Jul. 1986; MNHN 1995-1180 (1 male, 76.8), New Caledonia, 20 Aug. 1985; MNHN 1995-1181 (1 female, 98.4), Chesterfield Plateau, Coral Sea, 24 Jul. 1988; HUMZ 142683–142684 and MNHN 1995-1185 (1 male, 2 females, 81.2–98.6), Chesterfield Plateau, 24 Jul. 1988; MNHN 1995-1186 (male, 95.0), Bellona Plateau, 22 Aug. 1988; MNHN 1995-1187 (1 male, 78.8), Chesterfield Plateau, 28 Jul. 1988; MNHN 1995-1188 (1 male, 91.7), New Caledonia, 22 Apr. 1988; MNHN 1995-1189 (1 female, 50.3), Chesterfield Plateau, 17 July 1984; MNHN 1995-1190 (1 female, 90.2), Chesterfield Plateau, 28 Jul. 1988; MNHN 1995-1191 (1 male, 57.6), Bellona Plateau, 24 Jul. 1984; MNHN 1995-1192 (1 male, 72.7), Chesterfield Plateau., 18 Jul. 1984; HUMZ 142685, MNHN 1995-1193, (1 male, 1 female, 47.0–82.5), Nereus Reef, 68–75 m, 22 Jul. 1988; HUMZ 142686, MNHN 1995-1194 (2 males, 43.0–65.1), New Caledonia, 23 Aug. 1984; MNHN 1995-1195 (1 female, 53.5), New Caledonia, 20 Aug. 1984; MNHN 1995-1196 (1 male, 50.5), New Caledonia, 21 Aug. 1984.

Diagnostic features. D 83 (80–85, from other localities); A 63 (58–65); P 10 (10–12); C 2+13+2=17(1–3+11+15+21–2=17); LLs 55 (50–57); GR 0+8 (0+8–11); vert. 10+28=38 (10+26–28=36–38).

Body ovate, greatest depth at middle part of body 44.7 (41.3–50.8)% SL. Head much longer than half of body depth 24.7 (26.2–29.7)% SL; upper profile of head with slight concavity in front of lower margin of upper eye; head profile moderately steep. Snout round and mounded, snout length about 1.5 times of eye diameter. Eyes small, separated by deep and narrow space; interorbital width about 1/3 of eye diameter.

Mouth large, curved; upper-jaw length 9.6 (10.7–12.9)% SL; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on both jaws uniserial, upper-jaw teeth small, somewhat enlarged anteriorly; teeth on lower jaw slightly larger than lateral teeth on upper jaw. Gill rakers only on lower limb, short and palmate with 5–8 spines.

Scales on ocular side rather small, ctenoid with short ctenii; cycloid scales on blind side; snout, both jaws and interorbital area scale-less. First dorsal-fin ray elongate 16.3 (8.4–19.5)% SL, and separated from remaining rays; pectoral fin short on ocular side 15.4 (13.0–17.8)% SL.

Coloration. Ocular side of body uniformly dark brownish, 2–3 dark (blue in fresh specimens) blotches, larger than eye, along dorsal and ventral edges of body, obtuse blotches on lateral line, and many scattered small blotches on head and body. All fins with many dark small blotches and spots except for pectoral fin; blind side of body uniformly whitish.

Size. Reaching 87.7 mm SL in Taiwan; up to 150 mm total length (Hensley & Amaoka, 2001).

Distribution. Northern Taiwan and an underwater photograph taken from around Orchid Island, southern Taiwan; widespread in the Western Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. *Asterorhombus intermedius* resembles *A. filifer* in the coloration of the body and body form, but it differs from *A. filifer* in having a short first dorsal-fin ray, a rough edge of the fin membrane of the first dorsal-fin ray and few scales along the lateral line (Hensley, 2005). *Asterorhombus filifer* is not reported from Taiwanese waters.

Bothus Rafinesque, 1810

Bothus Rafinesque, 1810:23. Type species: *Bothus rumulo* Rafinesque, 1810.

Diagnostic features. Body round to elliptical in larger specimens. Tip of isthmus below middle of lower eye or slightly behind. Head profile, head spines, interorbital width, and length of pectoral-fin rays subject to sexual dimorphism and changing with growth. Both eyes separated by broad, concave space; interorbital width wider in males than in females or juveniles. Rostral, orbital and mandibular spines present in males. Large flap(s) from surface or posterior margin of both eyes in larger males, and sometimes in larger females.

Mouth small to moderately large; maxilla extends to, or somewhat beyond, anterior margin of lower eye. Teeth on both jaws uniserial or biserial, no canine-like teeth. Gill rakers short to moderately long, not serrated. Scales small, ctenoid on ocular side with row of moderate ctenii on posterior margin or cycloid; scales cycloid on blind side. Lateral line on ocular side curved above pectoral fin, absent on blind side.

Dorsal- and anal- fin rays simple and not elongate. Pectoral fin filamentous on ocular side in males, and sometimes also in females. Pelvic fin on ocular side starting at tip of isthmus, first ray on blind side opposite to fourth

fin ray on ocular side. Vent on blind side, just before origin of anal fin, and urogenital pore on opposite side of vent. Caudal skeleton consisting of four plates including parhypural and three hypurals, without deep clefts. Four suborbital bones on blind side. First haemal spine distinctly enlarged; haemapophyses of abdominal vertebrae expanded, extending to neighboring haemapophysis at tip.

Remarks. *Bothus* closely resembles *Tosarhombus* in having a deep body and many scales on the lateral line. It differs from the latter in lacking yellowish white blotches along the head margin before both eyes, having the tip of the isthmus below the middle of the lower eye, four suborbital bones on the blind side, an enlarged first haemal spine and expanded haemapophyses in the abdominal vertebrae.

Key to species of *Bothus* in Taiwan

- 1A. Scales on ocular side cycloid, except for ctenoid on dorsal and ventral margins of body; length of lower jaw on ocular side less than 11% SL *B. myriaster*
- 1B. Scales on ocular side ctenoid; length of lower jaw more than 13% SL 2
- 2A. D 99–100; A 77–78; eyes small, eye diameter 4.6–5.3% SL; gill rakers on lower limb 9–11. *B. mancus*
- 2B. D 86–93; As 67–71; eyes large, eye diameter 6.1–7.3% SL; gill rakers on lower limb 6–9 *B. pantherinus*

Bothus mancus (Broussonet, 1782)

Tropical flounder; 蒙鯧

Figures 3A–B; Table 4

Pleuronectes mancus Broussonet, 1782: no pagination (Type locality: Ulietea, near Anamoka, Tahiti).

Bothus mancus: Norman, 1927:34; Chen & Weng, 1965:58; Shen, 1983:24; Shen in Shen *et al.*, 1993:567; Shen & Wu, 2012:749.

Specimens examined. NMMB-P00628 (female, 147.3), Taiwan, 7 Feb. 1985; NMMB-P04701 (male, 342.4), Hengchun, Pingtung, 15 Sep. 1965; NMMB-P05154 (female, 129.3), Wan-li-ton, Hengchun, Pingtung, 15 Sep. 1966; NMMB-P27812 (149.9), Hengchun, Pingtung, 17 Nov. 2017.

Diagnostic features. D 99–101; A 77–79; P 11–13; C 2+13+2=17; LLs 81–89; GR 0+8–11=9–11; vert. 10+30=40.

Body compressed; body shape changed ontogenetically, from round to elliptical, greatest depth at middle part of body (54.3–58.9% SL). Head length about equal to half of body depth (27.5–29.9% SL); upper profile of head with shallow, gentle concavity anterior of dorsal margin of upper eye, steep in both sexes. Snout much longer than eye diameter. Rostral spine present on tip of snout in males, absent in females and juveniles. Eye diameter less than half of upper jaw length. Males with 3–4 small orbital spines on anterior margin of upper eye and 1 strong spine on anterior margin of lower eye; both eyes in mature males with several flaps. Interorbital space shallow, wide and concave, its width wider in males than in females and juveniles.

Mouth large, upper-jaw length 9.1–10.1% SL; maxilla extending to or slightly beyond anterior margin of lower eye; large and obtuse knob on symphysis of lower jaw in males. Teeth on both jaws uniserial, somewhat enlarged anteriorly. Gill rakers only on lower limb, short and slender, pointed at tip, not serrate.

Scales on ocular side very small, ctenoid with moderate long ctenii on posterior margin, cycloid on blind side. Pectoral-fin rays on ocular side remarkably elongate in males, pectoral fin vary in length (20.9–65.7% SL).

Coloration. Ocular side of body uniformly darkish brown mottled with many dark spots; head and body with many small bluish spots and rings; a diffuse dark blotch above junction of curve and straight portions of lateral line; a darker blotch on middle of straight section of lateral line; a smaller blotch anterior to caudal peduncle; a series of dark blotches along bases of dorsal and anal fins; pectoral fin on ocular side with irregular dark brown cross-bars. Blind side of body yellowish white.

Size. Reaching 342 mm SL in Taiwan; up to about 460 mm SL elsewhere (Norman, 1934).

Distribution. Around Taiwan, including Penghu, Green and Orchid islands; widespread in the Indian and Pacific oceans (Amaoka, 2016).

TABLE 4. Frequency of six meristic data of three *Bothus* species in Taiwan.

	Dorsal-fin rays																					
	n	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101					
<i>B. mancus</i>	4													2	1	1						
<i>B. myriaster</i>	20				3	2	4	2	3	2	1	1	2									
<i>B. pantherinus</i>	20	1	0	4	3	4	3	4	1													
	Anal-fin rays																					
	n	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79						
<i>B. mancus</i>	3													1	1	1						
<i>B. myriaster</i>	19	2	0	2	7	2	1	1	2	0	1	0	0	1								
<i>B. pantherinus</i>	20			3	4	5	5	3														
	Pectoral-fin rays						Vertebrae (precaudal + caudal)															
	n	9	10	11	12	13	n	10	+	26	27	28	29	30								
<i>B. mancus</i>	4			1	1	1				3	3						3					
<i>B. myriaster</i>	20	12	7	1						20	20		1	2	15	2						
<i>B. pantherinus</i>	20		14	5	1					20	20			7	12	1						
	Lateral-line scales																					
	n	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	//	102	103	104	105
<i>B. mancus</i>	3					1	0	0	0	0	0	1	0	1								
<i>B. myriaster</i>	19			1	2	2	2	3	0	0	0	1	0	1	2	3	//	1	0	0	1	
<i>B. pantherinus</i>	20	2	1	3	3	4	0	2	3	0	2											
	Gill rakers (upper + lower)																					
	n	0	1	2	3	4	5	+	5	6	7	8	9	10	11							
<i>B. mancus</i>	3	3											1	1	1							
<i>B. myriaster</i>	20	1	1	1	8	8	1		2	9	8	1										
<i>B. pantherinus</i>	20	8	0	2	6	4				7	6	6	1									

Remarks. This species inhabits in similar habitats as *Bothus pantherinus*, but differs from the latter in having a notch at the frontal margin of the head and higher meristics. Its body form changes from a round to an elliptical shape with growth.

Specimens larger than 220 mm SL exhibit a distinct sexual dimorphism in the interorbital width, the pectoral-fin length on the ocular side, presence of rostral and orbital spines on both eyes, and orbital flaps on both eyes.

***Bothus myriaster* (Temminck & Schlegel, 1846)**

Oval flounder; 繁星鯧

Figures 3C–F; Table 4

Rhombus myriaster Temminck & Schlegel, 1846:181 (Type locality: Nagasaki Prefecture, Japan).

Bothus ovalis: Norman, 1927:32 (in part); Chen & Weng, 1965:56.

Bothus myriaster: Chabanaud, 1929:379; Chen & Weng, 1965:54; Shen, 1983:21; Shen in Shen *et al.*, 1993:567; Shen & Wu, 2012:749.

Bothus assimilis: ?Chen & Weng, 1965:57; ?Shen & Wu, 2012:749.

Specimens examined. NMMB-P02769 (1 male, 102.5), Chieh-din, Kaohsiung, 50 m, bottom trawl, 1 Nov. 2001; NMMB-P04164 (3 males, 170.6–177.3), Kaohsiung, 11 Oct. 1965; NMMB-P12210 (1 male, 154.0), Daxi, Yilan, 22 Jan. 2010; NMMB-P22243 (5, 73.4–123.9), Ke-tzu-liao, 9 Mar. 2015; NMMB-P23231 (4 males, 1 female, 103.5–113.8), Ke-tzu-liao, 31 Mar. 2016; NMMB-P23285 (1 male, 118.4), Ke-tzu-liao, 7 Apr. 2016; NMMB-P23286 (2 males, 121.9–123.4), Ke-tzu-liao, 7 Apr. 2016; NMMB-P24769 (1 male, 1 female, 106.1–106.4), Dong-gang, 31 Mar. 2016. More specimens deposited in NMMB-P.

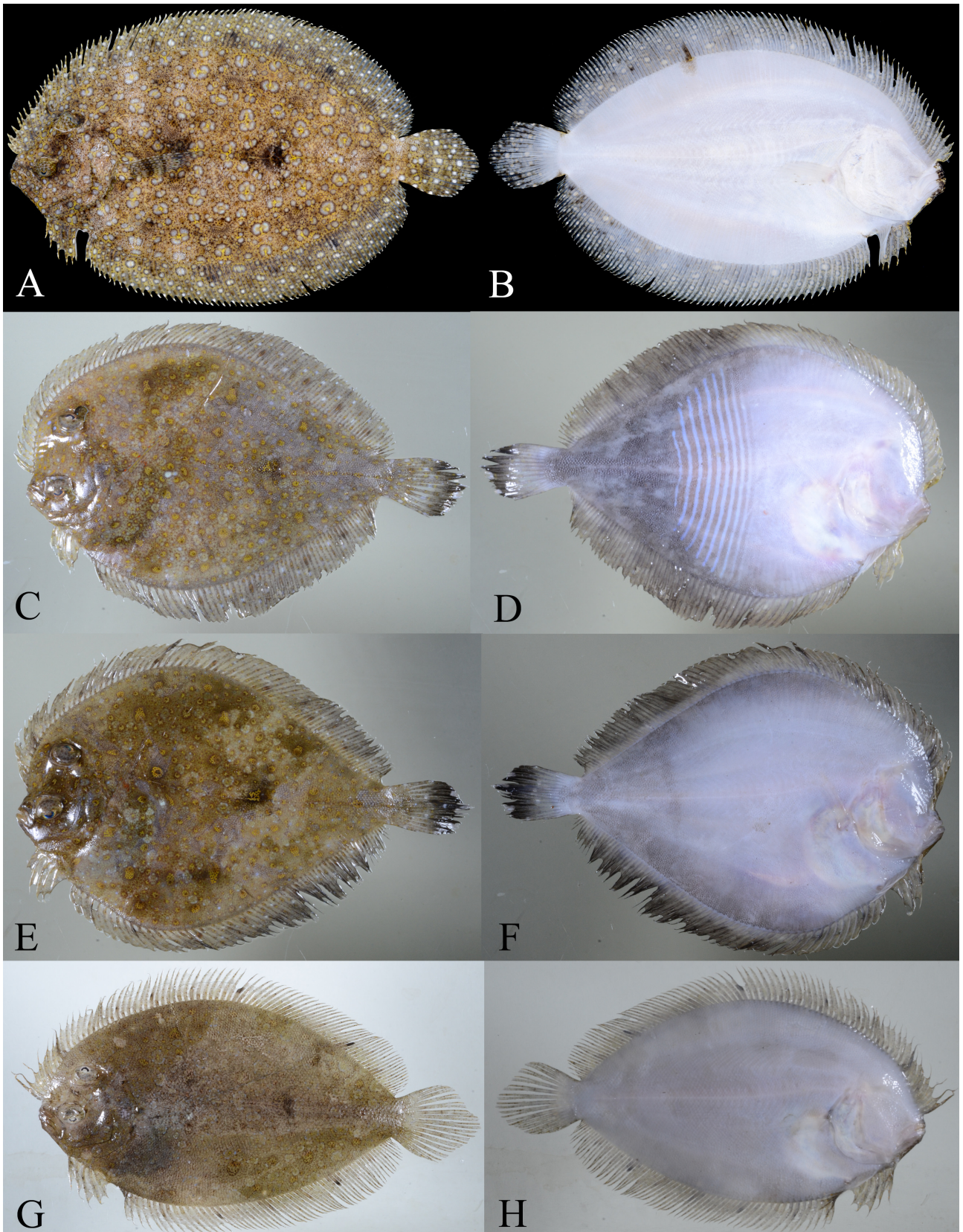


FIGURE 3. A–B. *Bothus mancus*, NMMB-27812, female, 149.9 mm SL. C–F. *B. myriaster*, NMMB-P23231, male, 103.5 mm SL (C–D) and female, 107.6 mm SL (E–F). G–H. *Bothus pantherinus*, NMMB-P23285, male, 116.5 mm SL. Left column, ocular side and right column, blind side.

Diagnostic Features. D 89–97; A 65–77; P 9–11; C 2–3+11–13+2–3=17; LLs 79–105; GR 0–5+5–8=9–11; vert. 10+26–29=36–39.

Body very compressed, and round to elliptical, changing ontogenetically, greatest depth at middle part of body (51.8–76.6% SL). Head much shorter than half of body depth (21.8–27.8% SL); upper profile of head with distinct concavity anterior of dorsal margin of upper eye, steep in both sexes. Snout much shorter than eye diameter. Rostral spine present on tip of snout in males, absent in females and juveniles. Eye diameter subequal to upper jaw. Small orbital spine at anterior margins of each eye in males, absent in females and juveniles; large males with broad flap at hind margins of eyes. Interorbital space with shallow and broad concavity, its width wider in males than in females and juveniles.

Mouth small, upper-jaw length 6.0–7.5% SL; maxilla extending to or slightly beyond anterior margin of lower eye; low and obtuse knob on symphysis of lower jaw in males. Teeth on upper jaw biserial, those on outer series stronger and more wide-spaced than those on inner series; teeth on lower jaw biserial in anterior section, uniserial in posterior section. Gill rakers on lower limb, short and slender, pointed at tip, not serrate; those on upper limb very small or rudimentary. Scales on ocular side very small, cycloid except for those on dorsal and ventral margins of body, cycloid on blind side. Pectoral-fin rays elongate on ocular side in both sexes, longest ray 42.1–65.7% SL.

Coloration. Ocular side of body uniformly darkish brown with many dark spots; a dark blotch above junction of curve and straight section of lateral line; a dark blotch on middle of straight section of lateral line; dorsal and anal fins with a series of dark spots; posterior 1/3 of caudal fin blackish. Blind side of body white on front half of body; darker on posterior half with several dark cross bars, clear and dark in males, faint or missing in juveniles and females.

Size. Reaching 201 mm SL in Taiwan; up to about 270 mm TL elsewhere (Hensley & Amaoka, 2001).

Distribution. Widespread around Taiwan; Indian to Western Pacific oceans (Amaoka, 2016).

Remarks. Body form changes from round to elliptical with growth (Amaoka, 1964). Specimens larger than 70 mm SL exhibit a distinct sexual dimorphism, including changes of the interorbital width, presence of rostral and orbital spines on the lower eye, orbital flaps at hind margins of eyes, and body coloration on the blind side.

***Bothus pantherinus* (Rüppell, 1830)**

Leopard flounder; 豹紋鯽

Figures 3G–H; Table 4

Rhombus pantherinus Rüppell, 1830:121 (Type locality: Mohila, Red Sea).

Bothus pantherinus: Regan, 1920:212; Chen & Weng, 1965:53; Shen, 1983:25; Shen in Shen *et al.*, 1993:568; Shen & Wu, 2012:749.

Grammatobothus krempfi: ? Shen in Shen *et al.*, 1993:569.

Specimens examined. NMMB-P01621 (1 male, 167.6), Hou-bi-hu, Hengchun, 10 Mar. 1994; NMMB-P04159 (1 male, 154.9), Penghu, 1 Aug. 1957; NMMB-P07591 (1, 86.6), Shan-hai, Hengchun, 29 Jun. 2004; NMMB-P09839 (92.1), Hai-ko, Checheng, 18 Aug. 2008; NMMB-P23285 (1 male, 116.5), Ke-tzu-liao, 7 Apr. 2016; NMMB-P24608 (1 male, 123.9), NMMB-P24609 (1 female, 116.8), Ke-tzu-liao, 5 Jul. 2016; NMMB-P24874 (4 females, 127.4–150.1), Ke-tzu-liao, 13 Jul. 2016; NMMB-P24875 (4 males, 122.3–145.3; 4 females, 105.0–114.0), Ke-tzu-liao, 27 Jun. 2016; more specimens in NMMB-P collection.

Diagnostic Features. D 86–93; A 67–71; P 10–12; C 2+13+2=17; LLs 77–86; GR 0–4+6–9=6–12; vert. 10+27–29=37–39.

Body compressed, ovoid, greatest depth at middle part of body (50.1–59.7% SL). Head length about equal to half of body depth (26.1–29.3% SL); upper profile of head without distinct concavity anterior of dorsal margin of upper eye, steep in both sexes. Snout length about equal to eye diameter. Rostral spine present on tip of snout in males, absent or low knob in females and juveniles. Eye diameter much shorter than upper jaw. Males with 1–4 small orbital spines at anterior margins of both eyes and one strong spine at anterior margin of lower eye in males, spines absent in females and juveniles; usually several tentacles on hind margins of both eyes in males. Interorbital space deep and wide concave, its width wider in males than females and juveniles.

Mouth large, upper-jaw length 9.0–10.2% SL; maxilla extending to, or slightly beyond anterior margin of lower eye. Teeth on upper jaw biserial anteriorly, uniserial posteriorly; teeth on lower jaw uniserial, anterior teeth larger than posterior ones. Gill rakers only on lower limb, short and slender, pointed at tip, not serrate.

Scales on ocular side small, ctenoid with moderate ctenii in length, cycloid on blind side. Pectoral-fin rays extremely elongate in males on ocular side, pectoral-fin length 45.8–106.0% SL in mature males, 17.1–51.4% SL in females or juveniles.

Coloration. Ocular side of body uniformly darkish brown mottled with numerous dark spots and rings of various size; a diffuse dark blotch above junction of curved and straight sections of lateral line; a darker and larger blotch on middle of straight section of lateral line; smaller blotch anterior of caudal peduncle; a series of dark blotches along bases of dorsal and anal fins; pectoral fin on ocular side with brownish spots and irregular dark brown cross-bars. Blind side of body yellowish white.

Size. Reaching 170 mm SL in Taiwan; up to about 300 mm SL elsewhere (Amaoka, 2016); a doubtful record of 45 cm TL in Hensley & Amaoka (2001).

Distribution. Around Taiwan, including Penghu, Green, Orchid and Dongsha islands; widely distributed in the tropical and subtropical waters of the Indian and Pacific oceans (Amaoka, 2016).

Remarks. This species is sometimes confused with *B. mancus* that inhabits in a similar habitat, but it differs from the latter in having a smooth head margin without concavity and fewer fin rays, gill rakers and vertebrae.

Specimens larger than 100 mm SL, exhibit a distinct sexual dimorphism in the pectoral-fin length on the ocular side, presence of rostral and orbital spines, and orbital tentacles hind margins of both eyes. It is notable that many specimens do not show a clear sexual dimorphism in the interorbital width and the length of the pectoral fin on the ocular side. This is probably related to intersexuality observed by Amaoka *et al.* (1974), and which suggests the occurrence of sexual reversal.

***Chascanopsetta* Alcock, 1894**

Chascanopsetta Alcock, 1894:128. Type species: *Chascanopsetta lugubris* Alcock, 1894.

Diagnostic features. Body elongate elliptical, rather soft and flabby. Tip of isthmus far behind posterior margin of lower eye. Dorsal profile of head not changing with sex and growth. Caudal peduncle narrow, its depth 4–5% SL. Both eyes separated by narrow flat space; interorbital width same in both sexes. No rostral, orbital and mandibular spines in both sexes.

Mouth extremely large; maxilla extending to posterior margin of lower eye or far beyond it; upper-jaw length more than half of HL. Tip of upper jaw not extending to tip of snout; tip of lower jaw extending slightly beyond tip of upper jaw. Teeth on both jaws small, uniserial, sometimes irregularly biserial in place, no canine teeth anteriorly; teeth on lower jaw curved inward, and depressible. Gill rakers absent or short and slender, not serrated.

Scales very small, deciduous, cycloid on both sides. Lateral line on ocular side short, curved above pectoral fin; lateral line present on blind side. Some anterior rays of dorsal fin slightly elongated and free from fin membrane distally. Pectoral fin on ocular side not elongate in both sexes. Pelvic fin on ocular side starting near tip of isthmus or behind it; first ray on blind side opposite to third ray on ocular side. Caudal skeleton with four plates including parhypural and three hypurals, without deep clefts. Four suborbital bones on blind side.

Remarks. *Chascanopsetta* is related to *Kamoharaia* in having an extremely large mouth, but it differs from the latter by the tip of upper jaw not extending beyond the tip of the snout, absence large canine teeth on the tip of the lower jaw, and the tip of vomer not projected into mouth.

Key to species of *Chascanopsetta* in Taiwan

- 1A. Tip of lower jaw reaching slightly beyond tip of upper jaw, lower-jaw length 19.6–20.1% SL, upper-jaw length 14.5–17.6% SL; vert. 17+38–40=55–57 *Chascanopsetta lugubris*
- 1B. Tip of lower jaw reaching extremely far beyond tip of upper jaw, lower-jaw length 20.9–25.2% SL, upper-jaw length 16.7–20.3% SL; vert. 17–18+41–43=59–60 *Chascanopsetta prognatha*

***Chascanopsetta lugubris* Alcock, 1894**

Pelican flounder; 大口長頰鯧

Figure 4A; Table 5

Chascanopsetta lugubris Alcock, 1894:129 (Type locality: Bay of Bengal, Indian Ocean). Chen & Weng, 1965:60; Chen, 1969:215; Shen, 1983:35; Shen, 1984:447; Chen & Yu, 1986:820; Shen in Shen *et al.*, 1993:568; Tongboonkua *et al.*, 2018:179.

Chascanopsetta lugubris lugubris: Amaoka & Yamamoto, 1984:209; Shen & Wu, 2012:749.

Specimens examined. NMMB-P001382 (4 of 10, 142.2–243.9), Dong-gang, no date; NMMB-P1985 (10, 135.3–186.0), Dong-gang, 13 Jun. 1983; NMMB-P5794 (2, 125.2–166.3), Dong-gang, 13 Mar. 2003; NMMB-P7386 (1, 144.7), Dong-gang, 3 Apr. 2004; NMMB-P8153 (4 of 5, 140.7–177.0), Dong-gang, 11 Jun. 2004; NMMB-P19174 (1 of 2, 202.0), Dong-gang, 3 Nov. 2011; NMMB-P22225 (2, 157.8–189.8), Dong-gang, 13 Mar. 2015; NMMB-P22260 (1, 73.8), Dong-gang, 11 Feb. 2015; NMMB-P25745 (1, 296.4), Dong-gang, 30 Mar. 2017; more specimens in NMMB-P collection.

Diagnostic Features. D 115–124; A 78–86; P 14–17; C 2+13+2=17; LLs 157–197; GR 0+1–3=1–3; vert. 17+38–40=55–57.

Body elongate elliptical, rather soft and flabby; greatest depth at posterior margin of abdominal cavity (24.9–30.5% SL). Caudal peduncle narrow, its depth about 14–19 % of body depth. Head relatively large (19.8–22.7% SL); upper profile of head with slight concavity anterior of dorsal margin of lower eye. Snout blunt and short, its length about 2/3 of eye diameter. Eyes separated by narrowly flat space, its width about 1/3 to 1/4 of eye diameter.

Mouth very large, upper-jaw length 14.5–17.6% SL; maxilla extending well beyond posterior margin of lower eye; tip of lower jaw reaching a little beyond tip of upper jaw. Teeth on both jaws uniserial, slender; upper-jaw teeth small on posterior half; lower-jaw teeth curved inward and depressible, posteriormost teeth smaller than others. Gill rakers on lower limb, rudimentary. Scales on both sides very small, cycloid. Anterior rays of dorsal fin somewhat elongated, free from fin membrane except for base. First ray of anal fin connected with last ray of pelvic fin by narrow membrane. Pectoral fin on both sides slender, length on ocular side 10.3–14.6% SL. Caudal fin slender, with round tip.

Coloration. Ocular side of body uniformly dark brownish with many small irregularly arranged dark blotches; light blue on peritoneum; median fins dark without marking; paired fins paler than body. Blind side of body light brownish except for light blue peritoneum.

Size. Reaching 296 mm SL in Taiwan; up to 380 mm SL elsewhere (Hensley & Amaoka, 2001).

Distribution. Widespread around Taiwan; Indian to Western Pacific oceans (Amaoka & Yamamoto, 1984).

Remarks. This species had been regarded as two subspecies, *C. lugubris lugubris* from Pacific Ocean and *C. lugubris danae* from Atlantic Ocean (Amaoka & Yamamoto (1984). But Munroe (2003) graded up to species based on clearly different counts of the gill rakers. Recently Tongboonkua *et al.* (2018) showed generic divergence between *C. lugubris* and *C. danae*. We followed their results, though it may be problematic in identification of species.

Caschanopsetta lugubris differs from *C. prognatha* in having the tip of the lower jaw slightly beyond the tip of the upper jaw and the lower-jaw length being shorter than HL (Amaoka, 2016).

***Chascanopsetta prognatha* Norman, 1939**

Longchin pelican flounder; 前長頰鯧

Figures 4B, C; Table 5

Chascanopsetta prognathus Norman, 1939:100 (Type locality: Maldives).

Chascanopsetts normani Kuronuma, 1940:40 (Type locality: Suruga Bay, Japan)

Chascanopsetta prognatha: Hensley & Smale, 1998:13

Specimens examined. NMMB-P30849 (8, 132.5–313.2), HUMZ 230193–230195 (3, 198.8–218.0), Dong-sha Islands (Pratas Islands), bottom trawl, ca. 300–400 m, 13 Feb. 2019.

Diagnostic features. D 121–135; A 82–93; P 14–17; C 2+13+2=17; LLs 176–208; GR 0+0–3; vert. 17–18+42–44=59–61.



FIGURE 4. A. *Chascanopsetta lugubris*, NMMB-P25745, 296.4 mm SL. B–C. *C. prognatha*, NMMB-P30849, 198 mm SL, fresh (B) and preserved (C).

Body elongate elliptical, rather soft and flabby; greatest depth 23.0–29.1% SL, at posterior margin of abdominal cavity. Caudal peduncle narrow, its depth about 4.0–5.7% SL of body depth. Head relatively small (18.4–21.6% SL); upper profile of head with slight concavity anterior of dorsal margin of lower eye. Snout blunt and short, its length about 2/3 of eye diameter. Eyes separated by narrow flat space, its width about 1/3 to 1/4 of eye diameter.

Mouth extremely large, upper-jaw length 16.7–20.3% SL (14.4% in young, 132.5 mm SL); maxilla extending far beyond posterior margin of lower eye; tip of lower jaw reaching much beyond tip of upper jaw, projecting length about equal to 1/5 of the whole length. Teeth on both jaws uniserial, slender, curved inward and depressible; teeth on lower jaw stronger than those on upper jaw. Gill rakers on lower limb, rudimentary, none on upper limb. Scales on both sides very small and deciduous, cycloid. Some anterior rays of dorsal fin slightly elongated, free from fin membrane except for base. First ray of anal fin connected with last ray of pelvic fin by narrow membrane. Pectoral fin on both sides slender, its length on ocular side about 11.5–16.6% SL. Caudal fin slender, rather long and with rounded tip.

TABLE 5. Frequency of six meristic data of two *Chascanopsetta* species in Taiwan.

	Dorsal-fin rays																																	
	n	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135												
<i>C. lugubris</i>	19	1	2	1	1	3	4	3	0	1	3																							
<i>C. prognatha</i>	16							1	0	0	2	3	2	2	2	1	1	0	0	1	0	1												
		Anal-fin rays																																
	n	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93																	
<i>C. lugubris</i>	20	2	1	1	2	2	4	4	3	1																								
<i>C. prognatha</i>	16					1	0	0	1	3	1	0	4	2	2	0	2																	
		Lateral-line scales																																
	n	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182							
<i>C. lugubris</i>	20	2	0	0	1	1	0	0	1	0	1	0	0	0	0	0	1	1	0	1	0	0	1	0	1	1	0							
<i>C. prognatha</i>	16																																	
		183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208							
		0	1	1	2	0	0	0	1	1	1	0	0	0	0	1																		
		0	0	1	1	0	1	0	1	0	1	0	1	1	1	1	0	0	0	0	0	1	0	1	0	0	1							
		Pectoral-fin rays										Gill rakers (upper+lower)										Vertebrae (precaudal+caudal)												
	n	14	15	16	17	n					0	+	0	1	2	3	n					17	18	+	38	39	40	41	42	43	44			
<i>C. lugubris</i>	20	5	11	3	1	16					16			1	3	12		21					21	21		7	12	2						
<i>C. prognatha</i>	16	4	6	4	2	16					16			4	3	4	5	4					4	3	1									

Coloration. Ocular side of body uniformly pale brownish or pale grayish without markings; peritoneum dark blue with narrow pale brownish bands; median fins and paired fins dusky, anterior dorsal-fin rays more or less pale. Blind side of body light brownish except for light blue peritoneum.

Size. Reaching 313.2 mm SL in Taiwan, also the largest known specimen.

Distribution. Dongsha Island, South China Sea; Indian to Western Pacific oceans.

Remarks. This species has been confused with *Chascanopsetta lugubris*. However, they are easily separable by the characters shown in the key of species. Ho *et al.* (2009) listed 10 specimens of *C. prognatha* (NMMB-P1985) which have been misidentified as *C. lugubris*. The presence of *C. prognatha* in Taiwan is confirmed based on specimens newly collected from Dongsha Island, South China Sea.

***Crossorhombus* Regan, 1920**

Crossorhombus Regan, 1920:211. Type species: *Platophrys dimorphus* Gilchrist, 1904.

Diagnostic features. Body deeply ovate. Tip of isthmus below middle of lower eye. Sexual dimorphism and ontogenetic changes evident on head profile, head spines, interorbital width, and length of pectoral-fin rays. Strong rostral spine in males, absent in females, and in juveniles of both sexes. Front margin of head steeper in mature males than females and juveniles. Interorbital space widely concave, becoming wider with growth, and wider in males than in females and juveniles.

Mouth rather small in size, upper-jaw length on ocular side 5.3–7.9% SL (3.0–4.5 in HL); maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on upper jaw uniserial or biserial anteriorly; uniserial on lower jaw. Scales ctenoid on ocular side with row of long ctenii along posterior margin; cycloid on blind side; 46–63 scales in lateral line. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side.

Dorsal-fin origin on blind side in front of upper margin of lower eye. Anal-fin origin below anterior base of pectoral fin on ocular side. Pelvic fin on ocular side originating at tip of isthmus, fourth or fifth fin ray opposite of first ray on blind side. Caudal skeleton with four plates including parhypural and three hypurals, all plates or only parhypural and uppermost hypural without deep clefts.

Remarks. *Crossorhombus* is closely related to *Engyprosopon* as evidenced by similar body shape, mouth size and presence of sexual dimorphism on rostral spine and interorbital width. *Crossorhombus* can be distinguished from *Engyprosopon* in having ctenoid scales with long ctenii, blind side of body stained with dark blue in male, and all four plates or uppermost and lowermost plates of caudal skeleton without deep clefts.

Key to species of *Crossorhombus* in Taiwan

- 1A. Pectoral fin shorter than HL; caudal fin with two dark bands at base and distal margin; males with pyriform dark blue blotch on blind side, its anterior margin away from dorsal margin of bodyq *C. azureus*
- 1B. Pectoral fin filamentous, longer than HL; dark bands on posterior part of caudal fin or not; males with dark blue blotch on blind side, its anterior margin close to dorsal and ventral margins of body 2
- 2A. Black margins on dorsal and anal fins; uppermost and lowermost 3 caudal-fin rays unbranched; anterior margin of blotch on blind side of males smooth or slightly notched *C. kobensis*
- 2B. No black margins on dorsal and anal fins; uppermost and lowermost 2 caudal-fin rays unbranched; anterior margin of blotch on blind side of males deeply notched, V-shaped 3
- 3A. Caudal fin with a dark band on posterior part; pectoral fin on ocular side filamentous, its length 32.6–41.9% SL in males *C. valderostratus*
- 3B. Caudal fin without any dark band; pectoral fin on ocular side not elongate, its length 27.8–31.8% SL *C. howensis*

***Crossorhombus azureus* (Alcock, 1889)**

Bluespotted flounder; 青纓鯧

Figures 5A–D; Table 6

Rhomboidichthys azureus Alcock, 1889:283 (Type locality: Bay of Bengal)

Crossorhombus azureus: Norman, 1927:30; Chen & Weng, 1965:51; Shen & Wu, 2012:750.

Crossorhombus kanekons: Amaoka, 1969:75; Shen, 1983:15; Shen in Shen *et al.*, 1993:568; Shen & Wu, 2012:750.

Specimens examined. NMMB-P3632 (1 male, 147.2), Taiwan, 1 Aug. 1957; NMMB-P8825 (1 male, 4 females, 86.1–136.7), Penghu, 32 m, 30 Aug. 2005; NMMB-P22232 (1 male, 2 females, 80.6–106.7), Ke-tzu-liao, 11 Mar. 2015; NMMB-P22299 (2 females, 94.7–127.2), Ke-tzu-liao, 28 Mar. 2015; NMMB-P23183 (2 males, 1 female, 88.0–121.7), Ke-tzu-liao, 6 Oct. 2015; NMMB-P23239 (1 male, 90.2), Ke-tzu-liao, 4 Feb. 2016; NMMB-P24270 (1 male, 2 females, 88.8–94.0), Ke-tzu-liao, 13 Jul. 2016; NMMB-P24367 (1, 100.6), Ke-tzu-liao, 27 Jun. 2016; more specimens deposited in NMMB-P collection.

Diagnostic features. D 86–92; A 66–73; P 12–13; C 2+13+2=17; LLs 52–63; GR 0–4+6–8=6–11; vert. 10+25–27=35–37.

Body deeply ovate, greatest at middle part of body (50.7–57.1% SL). Head much shorter than half of body depth (20.5–24.1% SL); upper profile of head with deep concavity in front of interorbital space; head profile steep in mature males, less so in females and juveniles. Snout much shorter than eye diameter. Rostral spine present on tip of snout in males, absent in females and juveniles. Eye diameters slightly shorter than upper jaw length. Some small orbital spines at anterior margin of lower eye in males, absent in females and juveniles. Interorbital space deeply and widely concave, its width wider in males than females and juveniles.

Mouth small, lipped; upper-jaw length 5.3–6.3% SL; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on upper jaw biserial, those on outer series larger and less closely set than those on inner series; teeth on lower jaw uniserial, closely set; teeth on ocular side larger than those on blind side. Gill rakers on lower limb, short and slender, pointed at tip, smooth; very small or absent on upper limb.

Scales on ocular side rather small, ctenoid with long ctenii along inner margin; scales on blind side cycloid. Pectoral-fin rays very short on ocular side, shorter than HL in both sexes (15.2–18.5% SL).

Coloration. Ocular side of body uniformly brownish red with 2–3 small dark blotches on lateral line and a series of dark spots arranged along dorsal and ventral margins of body; caudal fin with 2 distinct dark bands, one at basal and one at distal regions; blind side of body in males with distinct deep-bluish pyriform pattern, uniformly whitish in female.

Size. Reaching 147 mm SL in Taiwan; up to 180 mm SL in southern Japan (Amaoka, 1997).

Distribution. Western and southwestern Taiwan; widespread in the Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. This species exhibits a distinct sexual dimorphism in specimens larger than 60 mm SL in respect to the interorbital width, presence of rostral and orbital spines of the lower eye and body coloration on the blind side. *Crossorhombus kanekonis*, previously reported from Taiwan by Shen in Shen *et al.* (1993) and Shen & Wu (2012), is a synonym of *C. azureus* (Hensley & Randall, 1993).

***Crossorhombus howensis* Hensley & Randall, 1993**

Lord Howe Island flounder; 霍文纓鯧

Figures 5E–H; Table 6

Crossorhombus howensis Hensley & Randall, 1993:1120 (Type locality: Lord Howe Island). Shen & Wu, 2012:750.

Specimens examined. USNM 260394 (1 male, 103; 1 female, 60.0), paratypes, cut between large outstanding rock and Ch'uan-fan-shih, Hengchun, Pingtung, 0–6 m, 23 Apr. 1968.

Diagnostic features. D 87–88; A 67–69; P 11–12; C 2+13+2=17; LLs 53–54; GR 0+6=6; vert. 10+25=35.

Body short and deeply ovate, greatest depth slightly before middle part of body (59.4% SL). Head much shorter than half of body depth (23.1–23.9% SL); upper profile of head with deep concavity anterior of upper margin of lower eye; head profile steep, nearly vertical in mature males, less steep in females and juveniles. Snout much shorter than eye diameter. Rostral spine on tip of snout, sharp and strong in males, absent in females and juveniles. Eye diameter slightly shorter than upper-jaw length. Small orbital spines at anterior margins of either eyes in males, (absent in females and juveniles); flaps on posterior area of eyes in male. Interorbital space deeply and widely concave, wider in males than females and juveniles.

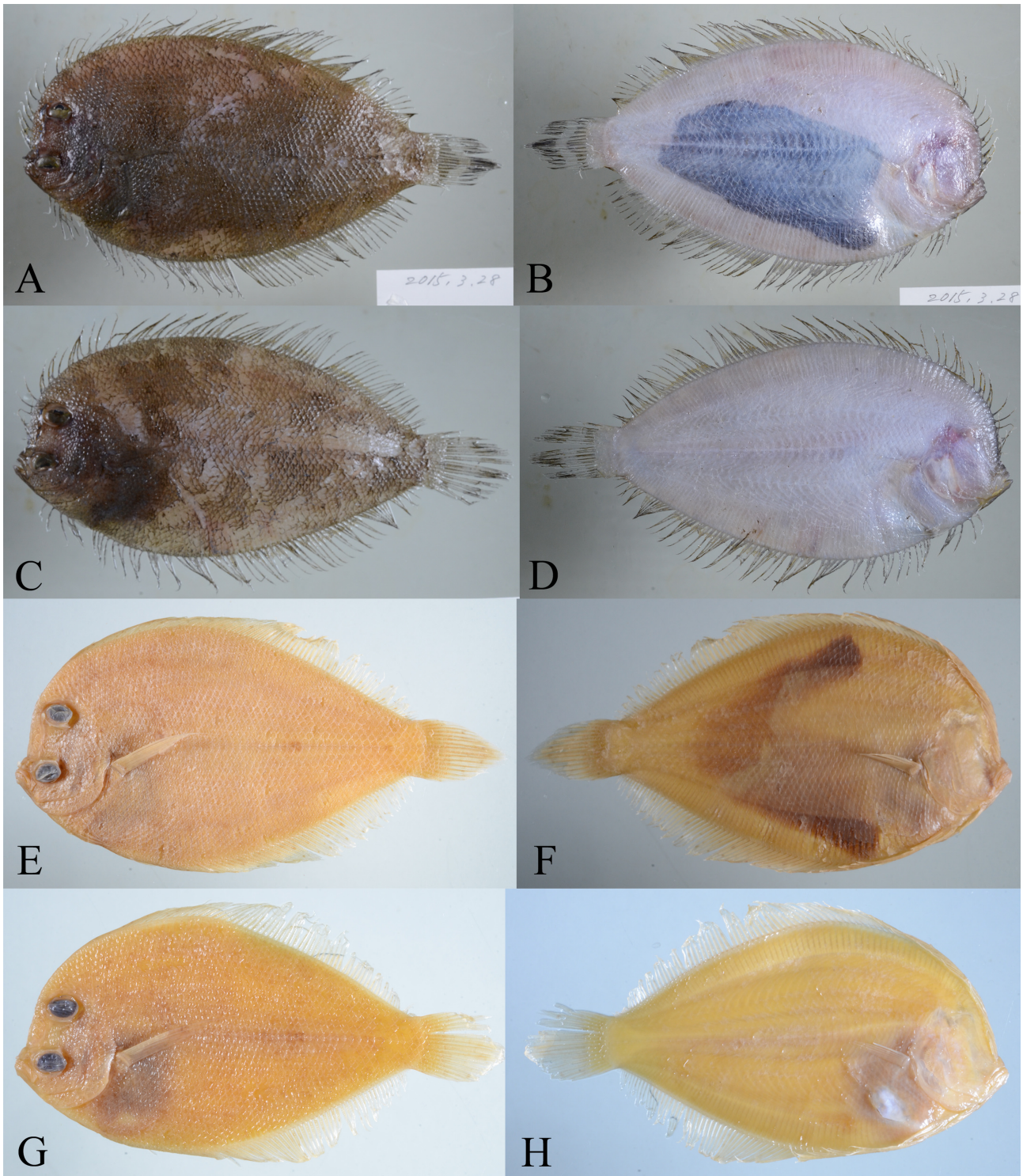


FIGURE 5. A–D. *Crossorhombus azureus*, NMMB-P22299, male, 113.3 mm SL (A–B) and female, 94.7 mm SL (C–D). E–H. *C. howensis*, USNM 260394, male, 103.0 mm SL (E–F) and female, 62.0 mm SL (G–H).

Mouth small and lipped, upper-jaw length 6.2–6.9% SL; maxilla extending to anterior margin of lower eye. Teeth on upper jaw biserial, those on outer series larger and more widely spaced than those on inner series; teeth on lower jaw uniserial, similar to inner teeth of upper jaw. Gill rakers on lower limb short and blunt, not serrate; absent on upper limb. Scales on ocular side small, ctenoid with long ctenii on posterior margin; scales on blind side cycloid. Pectoral-fin rays on ocular side about as long as head in males (27.8–31.8% SL) and shorter than head in females (ca. 20% SL).

Coloration. Ocular side of body yellowish brown with many dark spots and obtuse dark specks; a series of dark spots along dorsal and ventral margins of body; 4–5 spots along straight section of lateral line; dorsal, anal and caudal fins light with small dark specks; flaps on eyes with dark spots; blind side of body in males with distinct deep-bluish pattern in horizontal V-shape, uniformly whitish in female.

Size. Reaching 103 mm SL in Taiwan; up to 107 mm SL in Lord Howe Island (Hensley & Randall, 1993).

Distribution. Southern Taiwan off Hengchun, Pingtung; Lord Howe Island (Hensley and Randall, 1993).

Remarks. This species exhibits a distinct, sexual dimorphism in respect to the interorbital width, presence of rostral and orbital spines, flaps on eyes (rarely on one eye), pectoral-fin length on ocular side and body coloration on the blind side. *Crossorhombus howensis* closely resembles *C. valderostratus* in having a deep-bluish horizontal V-shaped pattern in males, but differs from latter in having a shorter pectoral fin on the ocular side in males (27.8–31.8% SL, vs. 32.6–41.9), and a caudal fin without any dark band at posterior margin. Two male paratypes were collected from Taiwan, but we were unable to obtain any further specimens. This species may be rare in Taiwan.

***Crossorhombus kobensis* (Jordan & Starks, 1906)**

Kobe flounder; 高本纓鯧

Figures 6A–B; Table 6

Scaeops kobensis Jordan & Starks, 1906:170 (Type locality: Kobe, Hyogo Prefecture, Japan).

Crossorhombus kobensis: Kuronuma, 1939:84; Shen, 1983:17 (in part); Shen in Shen *et al.*, 1993:568; Shen & Wu, 2012:750.

Specimens examined. NMMB-P22249 (1 male, 69.1), Taiwan (possibly Dong-gang), no other data. Other localities: FAKU15947 (1 female, 79.8), FAKU15973, 15980 (2 males, 67.1–99.0), Mimase, Kochi Prefecture, Japan 20 Feb. 1951; FAKU 25611 (1 male, 97.5), Yawatahama, Ehime Prefecture, Japan, 13 Mar. 1956; FAKU29821 (1 male, 103.5), Choshi, Chiba Prefecture, Japan 20 Jul. 1958; FAKU 29829–29830 (2 males, 79.3–81.2), FAKU29834, 29837–29838, 29849, 29851 (5 males, 50.5–74.0), Mimase, Kochi Prefecture, Japan, 23 May 1959; FAKU29866, FAKU29876, 29878, 29879, 29891–29892, 29894 (7 females, 49.2–70.8), Mimase, Kochi Prefecture, Japan 23 May 1959.

Diagnostic features. Description based on a single specimen collected from Taiwan, with additional information from other specimens. D 85 (80–86 from other localities); A 64 (60–67); P 11 (10–11); C 3+11+3=17; LLs 56 (50–55); GR 0+6=6 (0+6–7); vert. 10+25=35 (10+24–26=34–36).

Body ovate, strongly compressed, greatest depth at middle part of body 54.1% SL (49.3–56.8% SL, from other localities). Head much shorter than half of body depth 24.5% SL (23.1–27.3); upper profile of head with deep concavity anterior of upper margin of lower eye; head profile steep, almost vertical in mature males (less steep in females and juveniles, from other localities). Snout much shorter than eye diameter. Rostral spine on tip of snout, sharp and strong in males (absent in females and juveniles).

Eye diameter shorter than upper jaw. Some small orbital spines at anterior margin of both eyes in males, (absent in females and juveniles). Interorbital space deeply and widely concave, its width wider in males than females, 10.6% SL (5.9–12.3 in males, 2.0–5.5 in females). Mouth small, upper-jaw length 6.8% SL (6.8–8.6); maxilla extending to anterior margin of lower eye.

Teeth on upper jaw biserial, those on outer series larger and more widely spaced than those on inner series; teeth on lower jaw uniserial, closely set. Gill rakers on lower limb very short and slender, not serrate; absent on upper limb. Scales on ocular side small, ctenoid with long ctenii on posterior margin; scales on blind side cycloid. Pectoral-fin rays on ocular side filamentous, second ray longest, longer than head; pectoral-fin length 31.3% SL (30.8–57.2 in males, 22.2–36.1 in females).

Coloration. Ocular side of body uniformly dark brown with obtuse dark blotches on lateral line and a series of dark spots arranged along dorsal and ventral margins of body; many very tiny elliptical black spots arranged in front of eyes and interorbital space; margins of dorsal and anal fins dark; blind side of body in males stained distinctly deep bluish at posterior 2/3 portion, its anterior margin without concavity, uniformly whitish in females.

Size. Reaching 69 mm SL in Taiwan; up to 120 mm TL elsewhere (Hensley & Amaoka, 2001).

Distribution. Western and southwestern Taiwan; Southern Japan, South China Sea, East China Sea (Amaoka, 2016).

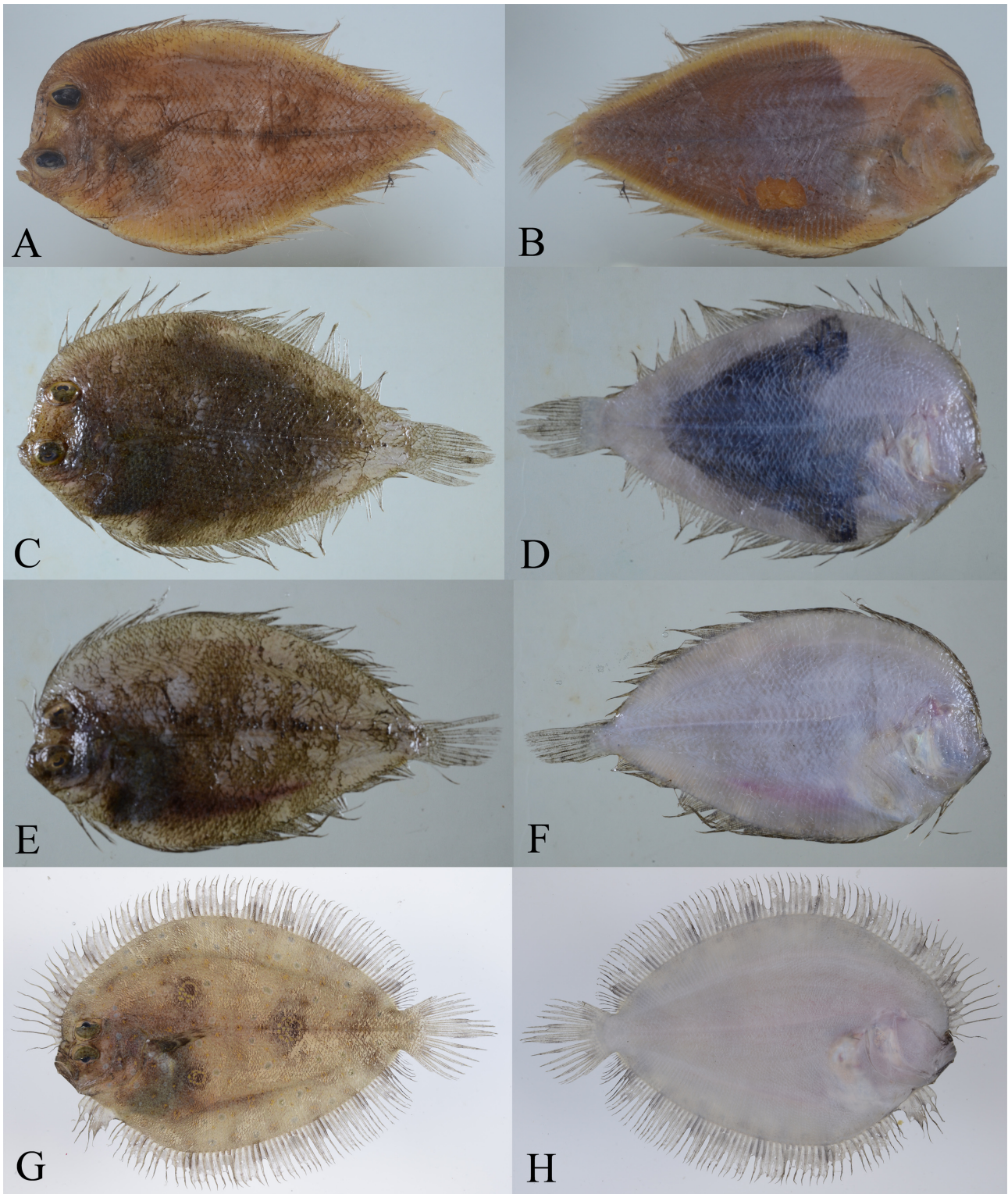


FIGURE 6. A–B. *Crossorhombus kobensis*, NMMB-P22249, male, 69.1 mm SL. C–F. *C. valderostratus*, NMMB-P22286, male, 70.7 mm SL (C–D) and female, 66.2 mm SL (E–F). G–H. *Grammatobothus polyophthalmus*, NMMBA 28527, 116.9 mm SL, photo by K. Koeda.

Remarks. Specimens larger than 50 mm SL exhibit a distinct sexual dimorphism expressed in the presence of rostral and orbital spines before both eyes and the coloration on the blind side.

Crossorhombus kobensis resembles *C. valderostratus* in having a large dark blue pattern on the blind side of the body in males, but it differs from the latter by a rather elliptical body, 3 unbranched upper and lower rays of the

caudal fin and no concavity at the anterior margin of the blue pattern on the blind side of the body in males. This species is rare in Taiwan, but rather common in Japan (Amaoka, 1969).

TABLE 6. Frequency of six meristic data of four *Crossorhombus* species in Taiwan. Data of *C. kobensis* are taken from other localities, except for one (marked by *) from Taiwan.

	Dorsal-fin rays													Pectoral-fin rays					
	n	80	81	82	83	84	85	86	87	88	89	90	91	92	n	10	11	12	13
<i>C. azureus</i>	42						3	4	5	3	2	2	1	16			6	10	
<i>C. howensis</i>	2							1	1					2		1	1		
<i>C. kobensis</i>	29	3	5	4	7	4	3*	3						27	10	17*			
<i>C. valderostratus</i>	20			2	4	4	5	4	0	1				20	1	9	10		
	Anal-fin rays																		
	n	60	61	62	63	64	65	66	67	68	69	70	71	72	73				
<i>C. azureus</i>	20						2	1	2	5	4	3	2	1					
<i>C. howensis</i>	2							1	0	1									
<i>C. kobensis</i>	28	2	3	7	6	4*	2	3	1										
<i>C. valderostratus</i>	20			3	1	0	7	5	1	3									
	Lateral-line scales																		
	n	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
<i>C. azureus</i>	20						1	0	0	1	0	5	2	2	6	2	0	1	
<i>C. howensis</i>	2							1	1										
<i>C. kobensis</i>	24					4	7	4	7	1	1	1*							
<i>C. valderostratus</i>	19	1	1	0	2	5	2	1	1	4	2								
	Gill rakers (upper+lower)									Vertebrae (precaudal+caudal)									
	n	0	1	2	3	4	+	6	7	8	n	10	+	23	24	25	26	27	
<i>C. azureus</i>	20	14		2	3	1		10	7	3	20	20				6	13	1	
<i>C. howensis</i>	2	2						2			2	2				2			
<i>C. kobensis</i>	27	27*						19*	8		16	16*			2	13*	1		
<i>C. valderostratus</i>	20	19	1					16	4		20	20		1	4	15			

Crossorhombus valderostratus (Alcock, 1890)

Victory bluespotted flounder; 寬額青纓鯧

Figures 6C–F; Table 6

Rhombichthys valde-rostratus Alcock, 1890:435 (Type locality: Sri Lanka).

Crossorhombus valde-rostratus: Norman, 1927:28.

Crossorhombus valderostratus: Hensley & Randall, 1993:1125.

Crossorhombus kobensis: Shen, 1983:18, fig. 23.

Specimens examined. NMMB-P22286 (5 males, 4 females, 51.3–70.7), Ke-tzu-liao, 28 Mar. 2015; NMMB-P25675 (6 females, 65.2–73.3), NMMB-P25712 (3 males, 60.1–70.5), Ke-tzu-liao, 27 Jun. 2016. More specimens deposited in NMMB-P.

Diagnostic features. D 82–88; A 62–68; P 10–12; C 2+13+2=17; LLs 46–55; GR 0(1)+6–7=6–7; vert. 10+23–25=33–35.

Body short and deeply ovate, greatest depth slightly before middle part of body (54.4–63.2% SL). Head much shorter than half of body depth (24.5–27.4% SL); upper profile of head with deep concavity anterior of upper margin of lower eye; head profile steep, almost vertical in mature males, less steep in females and juveniles. Snout much shorter than eye diameter. Rostral spine on tip of snout, sharp and strong in males, absent in females and juveniles. Eyes diameter slightly shorter than upper jaw. Small orbital spines at anterior margin of both eyes in males, absent

in females and juveniles. Interorbital space deeply and widely concave, its width wider in males than in females and juveniles.

Mouth small and lipped, upper-jaw length 6.8–7.9% SL; maxilla extending to slightly beyond anterior margin of lower eye. Teeth on upper jaw biserial, those on outer series larger and more widely spaced than those on inner series; teeth on lower jaw uniserial, similar to inner teeth of upper jaw. Gill rakers on lower limb short and blunt, not serrate; absent on upper limb. Scales on ocular side small, ctenoid with long ctenii on posterior margin; scales on blind side cycloid. Pectoral-fin rays on ocular side filamentous in males, pectoral-fin length 32.6–41.9% SL in males, 19.7–24.7% SL in females.

Coloration. Ocular side of body dark to light brown with many dark spots and obtuse dark blotches; faint large dark blotch on curve and middle of straight section of lateral line; surface of eyes with many dark spots; margins of dorsal and anal fins not dark; blind side of body in males with distinct deep-bluish pattern in horizontal V-shape, uniformly whitish in females.

Size. Reaching 104 mm SL in Taiwan, up to 121 mm SL known from Kenya (Hensley and Randall 1993).

Distribution. Southern Taiwan; widespread in Indian and West Pacific oceans (Amaoka, 2016).

Remarks. Specimens more than about 60 mm SL exhibit a distinct sexual dimorphism in respect to the interorbital width, presence of rostral and orbital spines at both eyes, the pectoral-fin length on the ocular side and body coloration on the blind side. *Crossorhombus valderostratus* very closely resembles *C. howensis* from Lord Howe Islands and Taiwan, but it differs from latter in having longer pectoral fins on the ocular side in males (32.6–41.9% SL, vs. 27.8–31.8), and a filamentous second ray of the pectoral fin. Also, *C. valderostratus* inhabits in deeper water than *C. howensis*.

Genus *Engyprosopon* Günther, 1862

Engyprosopon Günther, 1862:431. Type species: *Rhombus mogkii* Bleeker, 1854.

Diagnostic features. Body shallow to deeply ovate. Tip of isthmus below middle of lower eye. Usually sexual dimorphism and growth changes on head profile, head spines, interorbital width, and length of pectoral-fin rays. Rostral spine strong, or feeble (rarely absent) in males, feeble or absent in females and juveniles. Front margin of head steep in mature males, less steep in females and juveniles, or rarely with the same steepness in both sexes. Interorbital space narrow to very broad, concave to almost ridge-like, becoming wider with growth; the space wider in males than in females and juveniles.

Mouth usually moderate or occasionally large in size, upper-jaw length on ocular side 2.0–3.6 in HL. Teeth on upper jaw uniserial or biserial; uniserial on lower jaw. Scales ctenoid on ocular side with one row of feeble ctenii along posterior margin; cycloid on blind side; lateral line on ocular side curved above pectoral fin, with 36–61 scales; absent on blind side.

Dorsal fin originating on blind side, anterior to upper margin of lower eye. Anal fin originating below anterior base of pectoral fin on ocular side. Pelvic fin on ocular side originating at tip of isthmus, fourth or fifth fin ray of ocular side opposite to first ray of blind side. Vent on blind side, just before origin of anal fin, and urogenital pore on ocular side, opposite side of vent. Caudal skeleton with four plates, including parhypural and three hypurals, all plates with deep clefts.

Remarks. *Engyprosopon* is closely related to *Asterorhombus* in having cleft plates on the parhypural and three hypurals. But *Engyprosopon* is well distinguished from *Asterorhombus* in lacking a lure on the first dorsal-fin ray and palmate-like gill rakers.

Key to species of *Engyprosopon* of Taiwan

- 1A. Gill rakers without spinules on their inside edges; ocular-side lower jaw 9–13% SL (2.0–2.5 in HL) 2
- 1B. Gill rakers with spinules on their inside edges; ocular-side lower jaw 13–18% SL (1.5–2.0 in HL) 7
- 2A. Distal half of caudal fin with a pair of large blackish blotches 3
- 2B. Distal half of caudal fin without blackish blotches 5
- 3A. Gill rakers 16–18 on lower limb. *E. xystrias*
- 3B. Gill rakers 5–11 on lower limb. 4

- 4A. Body ovate, its depth more than half SL; ocular-side pectoral fin rays not filamentous, usually shorter than HL *E. grandisquama*
- 4B. Body rather elongate, its depth less than half SL; ocular-side pectoral fin rays filamentous, longer than HL ... *E. multisquama*
- 5A. Interorbital space narrow, 7.8–12.5 in HL; GR 0+6–8; LLs 50–55 *E. mogkii*
- 5B. Interorbital space wide, 1.7–3.9 in HL; GR 0–3+9–11; LLs 43–48. 6
- 6A. Both eyes away from head margin; eyes small, upper eye diameter 5.7–8.6% SL (3.0–4.0 in HL); caudal-peduncle depth 1.7–2.1 in HL; body depth 47.6–54.9% SL (1.8–2.1 in SL) *E. maldivense*
- 6B. Both eyes close to head margin; eyes large, upper eye diameter 9.2–10.0% SL (2.7–2.9 in HL); caudal-peduncle depth 2.2–2.3 in HL; body depth 57.6–59.8% SL (1.7 in SL) *E. brevifrontale*
- 7A. LLs 37–40; ocular-side pelvic fin filamentous in males, 14.1–16.2% SL; fin membrane of ocular-side pelvic fin with many black spots in males *E. longipelvis*
- 7B. LLs 46–52; ocular-side pelvic-fin rays not elongate in both sexes, 9.6–14.6% SL; fin membrane of ocular-side pelvic fin without spots in both sexes 8
- 8A. Eyes separated by a concave interorbital space in both sexes; eyes large, upper eye diameter 3.0–3.5 in HL; anterior teeth not enlarged; blind side of body dark in males. *E. mozambiquense*
- 8B. Eyes nearly contiguous, separated by extremely narrow interorbital space, almost filled entirely by a bony ridge in both sexes; eyes small, upper eye diameter 3.8–4.3 in HL; anterior teeth on upper jaw enlarged, canine-like; blind side of body not dark in both sexes *E. parvipectorale*

Engyprosopon brevifrontale Amaoka & Ho, 2018

Bigeyed flounder; 窄額短額鯆

Tables 7–8

Engyprosopon brevifrontale Amaoka & Ho, 2018:465, fig. 10–11 (Type locality: off Ke-tzu-liao, southwestern Taiwan).

Specimens examined. As listed in Amaoka & Ho (2018).

Diagnostic features. D 83–85; A 64–67; P 12; C broken; LLs 43; GR 0+9–10=9–10; vert. 10+25=35. A deep and short body, large eyes situated close to the margin of the head, 0+9–10 smooth gill rakers, strong rostral spine on ocular side, strong upper orbital spines, small rostral spine on blind side; pectoral-fin ray on ocular-side elongate in males (41–58% SL) and with a dark blue peritoneum.

Size. Reaching 94 mm SL.

Distribution. Known only from the type series collection from off Ke-tzu-liao, Kaohsiung, southwestern Taiwan.

Engyprosopon grandisquama (Temminck & Schlegel, 1846)

Largescaled flounder; 大鱗短額鯆

Tables 7–8

Rhombus grandisquama Temminck & Schlegel, 1846:183, figs. 3–4 (Type locality: southern Japan).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018). Also other specimens in NMMB-P collection.

Diagnostic features. D 81–87; A 61–65; P 10–12; C 3+11+3=17; LLs 40–45; GR 0+5–7=5–7; vert. 10+24=34. Body deeply ovoid; caudal fin with a pair of black blotches, arranged between the third and fourth fin rays from upper- and lowermost rays in the fin; pectoral fin on ocular side not elongate, and without sexual differences in its length; gill rakers very short, not serrate.

Size. Reaching 83 mm SL in Taiwan; up to 122 mm SL in southern Japan (Amaoka, 1969).

Distribution. Northeastern, western and southwestern Taiwan; widespread in Indian and Pacific oceans (Amaoka & Ho, 2018).

TABLE 7. Frequency of dorsal- and anal- fin rays of nine *Engyprosopon* species in Taiwan. Data of *E. xystrias* are taken from other localities, except for one (marked by *) from Taiwan.

	Dorsal-fin rays																						
	n	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	
<i>E. brevifrontale</i>	2						1	0	1														
<i>E. grandisquama</i>	10				3	1	2	1	1	1	1												
<i>E. longipelvis</i>	3	1	0	1	0	1																	
<i>E. maldivense</i>	13								1	0	1	2	2	3	2	1	0	1					
<i>E. mogkii</i>	2								1	0	1												
<i>E. mozambiquense</i>	14		2	5	1	2	2	2															
<i>E. multisquama</i>	10												1	0	0	1	2	2	3	0	0	1	
<i>E. parvipectorale</i>	6	1	0	1	0	2	1	1															
<i>E. xystrias</i>	10												1	0	0	1	2*	1	1	0	1	2	1

	Anal-fin rays																						
	n	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	
<i>E. brevifrontale</i>	2								1	0	0	1											
<i>E. grandisquama</i>	10					2	1	3	3	1													
<i>E. longipelvis</i>	3			1	2																		
<i>E. maldivense</i>	13								3	2	3	2	1	2									
<i>E. mogkii</i>	2							1	0	0	0	1											
<i>E. mozambiquense</i>	14	1	0	3	3	3	3	0	1														
<i>E. multisquama</i>	10												1	2	3	1	0	2	0	1			
<i>E. parvipectorale</i>	6		1	0	3	2																	
<i>E. xystrias</i>	10									2*	0	1	0	0	0	1	0	1	1	1	1	1	2

***Engyprosopon longipelvis* Amaoka, 1969**

Long-pelvic fin flounder; 長腹鰭短額鯧

Tables 7–8

Engyprosopon longipelvis Amaoka, 1969:93 (Type locality: Mimase, Kochi Prefecture, Japan).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018). Also other specimens in NMMB-P collection.

Diagnostic features. D 78–82; A 59–60; P 11–12; C 3+11–12+2–3; LLs 37–40; GR 0+7=7; vert. 10+24=34. Gill rakers slender with spines on inner margin; pelvic-fin rays on ocular side elongate in males, longest ray much longer than ocular-side pectoral fin in mature males, and its fin membrane with many black spots.

Size. Reaching 58 mm SL in Taiwan; up to 66 mm SL in Japan (Amaoka, 1969).

Distribution. Southwestern Taiwan; southern Japan (Amaoka & Ho, 2018).

***Engyprosopon maldivense* (Regan, 1908)**

Olive wideeyed flounder; 馬爾地夫短額鯧

Tables 7–8

Scaeops maldivensis Regan, 1908:234, pl. 25, fig. 1. (Type locality: Maldives).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018). Also other specimens in NMMB-P collection.

Diagnostic features. D 85–94; A 64–69; P 10–12; C 3+11+3=17; LLs 44–48; GR 0–3+9–11=11–13; vert.

10+25–26=35–36. Caudal fin without black blotches; pectoral fin on ocular side with very elongate filament in both sexes; Mouth large, upper-jaw length 8.3–9.8 % SL; gill rakers not serrate; upper-jaw teeth biserial.

Size. Reaching 181 mm SL (Amaoka & Ho, 2018).

Distribution. Northeastern and southwestern Taiwan; widespread in Indian and Western Pacific oceans (Amaoka 2016).

***Engyprosopon mogkii* (Bleeker, 1854)**

Mogki flounder; 黑斑短額鯧

Tables 7–8

Rhombus mogkii Bleeker, 1854:256 (Type locality: Sulawesi, Indonesia).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018).

Diagnostic features. D 85–87; A 63–67; P 11–12; C 3+11+3=17; LLs 50–51; GR 0+6–8=6–8; vert. 10+24–25=34–35. No concavity on head margin anterior to lower eye; gill rakers very slender, long and not serrate; narrow interorbital width; no sexual dimorphism in coloration on blind side of body; borders between each gill lamella stained with dark pigmentation.

Size. Reaching 91 mm SL in Taiwan; up to 110 mm SL in the eastern Indian Ocean (Hensley & Amaoka, 2001).

Distribution. Northeastern and southwestern Taiwan; Indian Ocean, Malay Peninsula and Archipelago, and Coral Sea (Amaoka & Ho, 2018).

***Engyprosopon mozambiquense* Hensley, 2003**

Mozambique flounder; 莫三比克短額鯧

Tables 7–8

Engyprosopon mozambiquensis Hensley, 2003:834 (Type locality: Mozambique).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018). Also other specimens in NMMB-P collection.

Diagnostic features. D 79–84; A 57–64; P 10–12; C 3+11+3; LLs 46–52; GR 0+6–7=6–7; vert. 10+24–25=34–35. Gill rakers with spines; mouth large, its length 14.4–16.4% SL; maxilla extending to vertical through anterior 1/3 to 1/2 of lower eye; interorbital width narrow in both sexes, width in males larger than that in females and juveniles; pectoral fin filamentous on ocular side, greatly elongate in males, with two dark cross bands; ventral margin of lower jaw on ocular side with 3 distinct black spots, the posteriormost especially distinct; caudal fin with irregularly scattered small dark spots and two large ones at upper and lower margins.

Size. Reaching 67 mm SL (Amaoka & Ho, 2018).

Distribution. Southwestern Taiwan; Philippines, Indian Ocean (India, Burma, Nicobar Islands and Cocos Islands) (Hensley, 2003) and Coral Sea (Amaoka, unpubl. data).

***Engyprosopon multisquama* Amaoka, 1963**

Manyscaled flounder; 多鱗短額鯧

Tables 7–8

Engyprosopon multisquama Amaoka, 1963b:111 (Type locality: Susaki, Kochi Prefecture, Japan).

Synonymy as shown in Amaoka & Ho (2018).

Specimens examined. As listed in Amaoka & Ho (2018). Also other specimens in NMMB-P collection.

TABLE 8. Frequency of four meristic data of nine *Engyprosopon* species in Taiwan. Data of *E. xystrius* are taken from other localities, except for one (marked by *) from Taiwan.

	Lateral-line scales																
	n	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
<i>E. brevifrontale</i>	2						2										
<i>E. grandisquama</i>	10				3	0	2	3	0	2							
<i>E. longipelvis</i>	3	1	0	0	2												
<i>E. maldivense</i>	9								1	2	4	1	1				
<i>E. mogkii</i>	2														1	1	
<i>E. mozambiquense</i>	12										1	1	1	3	2	3	1
<i>E. multisquama</i>	9									2	2	1	1	2	1		
<i>E. parvipectorale</i>	6													1	1	2	2
<i>E. xystrius</i>	10			1	2*	1	0	0	0	0	1	2	0	2	1		

	Gill rakers (upper + lower)																							
	n	0	1	2	3	4	5	6	+	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
<i>E. brevifrontale</i>	2	2													1	1								
<i>E. grandisquama</i>	10	10								1	8	1												
<i>E. longipelvis</i>	3	3										3												
<i>E. maldivense</i>	13	9	1	0	3									5	7	1								
<i>E. mogkii</i>	2	2									1	0	1											
<i>E. mozambiquense</i>	14	14									12	2												
<i>E. multisquama</i>	10	10									10													
<i>E. parvipectorale</i>	6	6									1	4	1											
<i>E. xystrius</i>	10	3*	0	0	3	2	1	1										3*	1	0	3	2	1	

	Pectoral-fin rays					Vertebrae (precaudal+caudal)							
	n	10	11	12	13	14	n	10	+	24	25	26	27
<i>E. brevifrontale</i>	2			2			2	2			2		
<i>E. grandisquama</i>	10	3	6	1			10	10		10			
<i>E. longipelvis</i>	3		2	1			3	3		3			
<i>E. maldivense</i>	13	2	6	5			13	13			8	5	
<i>E. mogkii</i>	2		1	1			2	2		1	1		
<i>E. mozambiquense</i>	14	4	9	1			14	14		3	11		
<i>E. multisquama</i>	10	4	5	1			9	9			2	7	
<i>E. parvipectorale</i>	6	1	4	0	0	1	3	3			2	1	
<i>E. xystrius</i>	10			7*	3		9	9*			1	4*	4

Diagnostic features. D 89–98; A 68–75; P 10–12; C 3+11+3=17; LLs 45–50; GR 0+6–7=6–7; vert. 10+25–26=35–36. Body narrowly ovate, greatest depth less than 53.5% SL; caudal fin with a pair of black blotches, arranged between the second and fourth fin rays from the uppermost and lowermost fin rays; pectoral fin on ocular-side with greatly elongate filament, longer in males than females; gill rakers not serrate.

Size. Reaching 105 cm SL in Taiwan; up to 137 mm SL in southern Japan (Amaoka, 1969).

Distribution. Northeastern, western and southwestern Taiwan; from southern Japan to possibly Mekong River (Amaoka, unpubl. data).

Engyprosopon parvipectorale Amaoka & Ho, 2018

Narroweyed flounder; 短胸鰭短額鯧

Tables 7–8

Engyprosopon parvipectorale Amaoka & Ho, 2018:474, fig. 16–18 (Type locality: Ke-tzu-liao, southwestern Taiwan).

Specimens examined. As listed in Amaoka & Ho (2018).

Diagnostic features. D 78–84; A 58–61; P 10–14; C 3+11+3; LLs 49–52; GR 0+6–8=6–8; vert. 10+25–26=35–36. Gill rakers serrate, each raker with 2–5 stout spines; head 29.1–32.1% SL; both-jaws teeth uniserial with anterior canines; extremely narrow or almost ridge-like interorbital in both sexes; pectoral fin on ocular side distinctly shorter than in other species (18.3–20.8% SL in both sexes); small scattered spots on caudal fin.

Size. Reaching 68.0 mm SL (Amaoka & Ho, 2018).

Distribution. Known only from off Ke-tzu-liao, Kaohsiung, southwestern Taiwan.

***Engyprosopon xystrias* Hubbs, 1915**

Smooth wideeyed flounder; 光短額鯧

Tables 7–8

Engyprosopon xystrias Hubbs, 1915:475 (Type locality: near Tanegashima Island, Kagoshima Prefecture).

As shown in synonym list in Amaoka & Ho (2018).

Specimen examined. As listed in Amaoka & Ho (2018).

Diagnostic features. D 92 (88–98, from other localities); A 65 (65–77); P 12 (12–13); C 3+11+3=17; LLs 40 (39–50); GR 0+13 (0–6+13–18); vert. 10+26=36 (10+25–27=35–37). Anterior margin of head anterior to both eyes with about 4–5 pale blotches margined by dark bands; scales on front margin of head more strongly ctenoid and non-deciduous compared to body scales.

Size. Reaching 89 mm in Taiwan; up to 102 mm in southern Japan (Hensley & Amaoka, 2001).

Distribution. Southwestern Taiwan; southern Japan, South China Sea, Coral Sea and Saya de Malha Bank (Amaoka & Ho 2018).

Genus *Grammatobothus* Norman, 1926

Grammatobothus Norman, 1926:253. Type species: *Platophrys polyophthalmus* Bleeker, 1865.

Diagnostic features. Body ovoid, compressed. Tip of isthmus below middle of lower eye. Dorsal profile of head similar in both sexes and growth. Both eyes separated by a narrow concave space. Sexual dimorphism in lengths of dorsal-fin rays and pectoral-fin rays. Interorbital width stable with sex and growth. No rostral, orbital and mandibular spines.

Mouth rather small; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth small, uniserial on both jaws, not enlarged anteriorly. Gill rakers short and smooth.

Scales small, not deciduous, ctenoid on ocular side with short ctenii along posterior margin; scales cycloid on blind side. Lateral line on ocular side curved above pectoral fin, obscure lateral line present on blind side.

Dorsal and anal fins without branched rays; 2nd to 10th rays of dorsal fin elongate in both sexes, but longer in males than in females. Pectoral fin on ocular side elongate with filamentous rays in males. Pelvic fin on ocular side starting at tip of isthmus; first ray on blind side opposite to third or fourth fin ray on ocular side. Caudal skeleton with four plates including parhypural and three hypurals, without deep clefts.

Remarks. *Grammatobothus* closely resembles *Bothus* in body shape, but differs in having a narrow interorbital width without sexual difference, elongate anterior dorsal-fin rays, three suborbital bones on blind side, abdominal vertebrae not expanded, and first interhaemal spine not enlarged.

Key to species of *Grammatobothus* of Taiwan

- 1A. D 75–84; A 65–67; body deeply ovate, its depth 61.8–66% SL (1.5–1.6 in SL); 2nd to 10th rays of dorsal fin elongate
..... *G. polyophthalmus*
- 1B. D 82; A 66; body ovate, its depth 52.1% SL (1.9 in SL); 2nd to 4th rays of dorsal fin elongate. *G. kremphi*

***Grammatobothus polyophthalmus* (Bleeker, 1865)**

Manyeeyed flounder, Threespot flounder; 眼斑雙線鯆

Figures 6G–H; Table 9

Platophrys polyophthalmus Bleeker, 1865:46 (Type locality: Sumatra, Indonesia).

Gramatobothus polyophthalmus: Norman, 1926:253; Ho *et al.*, 2009:6.

Specimens examined. NMMB-P04602 (1 male, 127.1), Yilan, 16 Jul. 1965; NMMB-P25740 (1, 75.7), Ke-tzu-liao, 27 Jun. 2016; NMMB-P28527 (1 male, 116.9), Ke-tzu-liao, 8 Feb. 2018.

Diagnostic features. D 75–84; A 64–67; P 15–16; C 2+13+2=17; LLs 71–80; GR 2–5+7–9=12–13; vert. 10+28=38.

Body deep ovate, deepest near middle part of body (61.8–66.0% SL). Head much shorter than half of body depth (26.6–27.8% SL); upper profile of head steep with distinct concavity in front of ventral margin of upper eye. Snout shorter than eye diameter. Rostral spine absent. Eye diameter slightly shorter than upper-jaw length. Interorbital space with a narrow concave space, its width about 1/3 of eye diameter.

Mouth small, upper-jaw length 8.5–8.8% SL; maxilla extending to or slightly beyond anterior margin of lower eye; several short and blunt prominent spines along upper jaw. Teeth on both jaws uniserial, upper-jaw teeth becoming gradually smaller backward; all teeth of lower jaw about same size, similar to anterior teeth of upper jaw. Gill rakers very small on upper limb and slender on lower limb, all not serrated.

Scales on ocular side very small, ctenoid with one row of short ctenii on posterior margin, cycloid on blind side. Second to tenth rays of dorsal fin prolonged, lengths in males longer than those in females; 4th or 5th rays longest, its length in males slightly longer than head; fin membranes behind prolonged rays deeply incised, and membrane on posterior surface of prolonged rays expanded, forming pinniform rays. Pectoral-fin rays on ocular side very long in males, length of pectoral fin 19.7–37.4% SL, not elongate in females.

Coloration. Ocular side of body pale brownish, with three large prominent dark ocelli, two anteriormost above and below pectoral fin, one posteriormost midway along straight portion of lateral line, and with many more or less regularly distributed small, distinct, dark spots (light blue in fresh); one or two distinct chromosome-shaped dark bars (deep blue in fresh) above upper eye in males; dorsal and anal fins with indistinct dark blotches; pectoral fin on ocular side with broad pale cross bars. Blind side of body yellowish white.

Size. Reaching 127 mm SL off Taiwan; up to about 170 mm total length elsewhere (Hensley & Amaoka, 2001).

Distribution. Northeastern and southwestern Taiwan; widespread in Indian and Western Pacific oceans (Amaoka, 2016).

Remarks. *Grammatobothus polyophthalmus* differs from *G. krempfi* and *G. pennatus* in having 2nd to 10th dorsal-fin rays elongate (vs. 2nd to 4th in latter) and a deeper body (1.5–1.8 vs. 1.8–2.0 in HL). Ho *et al.* (2009) reported this species from Taiwanese waters for the first time.

***Grammatobothus krempfi* Chabanaud, 1929**

Krempf's flounder; 克氏雙線鯆

Table 9

Grammatobothus krempfi Chabanaud, 1929:377 (Type locality: Poulo Condore, Vietnam). Shen, 1983:14; ?Shen & Wu, 2012:751.

Specimens examined. No specimen examined.

Diagnostic features. The following description is adapted from Shen (1983). D 81; A 66; P 14; C17; LLs 76; GR ?+8.

Body ovate, greatest at near middle part of body (52.1% SL); head large (29.4% SL); upper-jaw length 10.1% SL; pectoral fin moderately long (38.7% SL); second to fourth rays of dorsal fin prolonged and pinniform; pelvic-fin rays prolonged and pinniform.

Coloration. Ocular side of body brownish, with a series of darker blotches along dorsal and ventral margins; a large blotch at curved portion of lateral line, on middle of body and in front of caudal peduncle.

TABLE 9. Frequency of six meristic data of *Grammatobothus* species in Taiwan. Data of *G. kremphi* were adopted from Shen (1983).

	Dorsal-fin rays											Anal-fin rays				
	n	75	76	77	78	79	80	81	82	83	84	n	64	65	66	67
<i>G. kremphi</i>	1							1				1			1	
<i>G. polyophthalmus</i>	3	1	0	0	0	0	0	1	0	0	1	3	1	1	0	1
	Pectoral-fin rays					Lateral-line scales										
	n	14	15	16		n	71	72	73	74	75	76	77	78	79	80
<i>G. kremphi</i>	1	1					1					1				
<i>G. polyophthalmus</i>	3		1	2			3	1	0	0	0	1	0	0	0	1
	Gill rakers (upper + lower)								Vertebrae (precaudal + caudal)							
	n	2	3	4	5	+	7	8	9	n	10	+	28			
<i>G. kremphi</i>	1							1			0					
<i>G. polyophthalmus</i>	3	1	0	1	1		2	0	1		2	2		2		

Size. Reaching 99.0 mm SL off Taiwan; up to about 175 mm SL elsewhere (Chabanaud, 1929).

Distribution. Southern Taiwan (Shen, 1983); Vietnam (type locality).

Remarks. *Grammatobothus kremphi* was reported from Taiwan by Shen (1983). The specimen (NTUM 5502, sex unknown, 99.0, Tainan, 22 Oct. 1978) was identified as *G. kremphi* based on the ovate body shape and some anterior rays of the dorsal fin distinctly elongated. However, the specimen is not in the collection at present and therefore the identification is based on photographs. Shen in Shen *et al.* (1993) and Shen & Wu (2012) also reported *G. kremphi* from Taiwan, but no voucher specimens were provided. The picture shown by Shen in Shen *et al.* (1993) is clearly *Bothus pantherinus*, because of the absence of elongate anterior dorsal-fin rays. On the other hand, Shen & Wu (2012) showed an illustration of *G. kremphi* instead of providing any photo and no voucher of that illustration was mentioned.

Genus *Japonolaeops* Amaoka, 1969

Japonolaeops Amaoka, 1969:202. Type species: *Japonolaeops dentatus* Amaoka, 1969.

Diagnostic features. Body slender and elliptical, rather flatten. Tip of isthmus below posterior margin of lower eye. Dorsal profile of head constant with sex and growth. Caudal peduncle narrow, its depth about 5.9–6.3 % SL. Both eyes separated by very narrow concavity; interorbital width same in both sexes. No rostral, orbital and mandibular spines in both sexes.

Mouth very small in size; maxilla extending slightly beyond anterior margin of lower eye. Teeth on both jaws small, uniserial on upper jaw and uniserial or biserial (sometimes in narrow band) on lower jaw. Gill rakers slender, without spines along inner edge.

Scales very small, deciduous, cycloid on both sides. Lateral line on ocular side with small curve section above pectoral fin; lateral line absent on blind side. Dorsal and anal fins with simple rays throughout, not elongate. Pectoral fin on ocular side not elongate in both sexes. Pelvic fin on ocular side starting at tip of isthmus; first ray on blind side opposite to fourth ray on ocular side. Vent on blind side, just in front of origin of anal fin, and urogenital pore on ocular side, opposite of vent. Caudal skeleton with four plates including parhypural and three hypurals, without deep clefts.

Remarks. *Japonolaeops* is closely related to *Laeops* with a relatively elongate body, caudal skeleton without deep clefts, and no sexual dimorphism. The genus differs from *Laeops* in having teeth on both jaws, anterior rays of dorsal fin not elongate, and anterior two rays of dorsal fin connected to the following rays.

***Japonolaeops dentatus* Amaoka, 1969**

Lanceolate toothed flounder; 日本左鰽

Figure 7A; Table 10

Japonolaeops dentatus Amaoka, 1969:202 (Type locality: Mimase, Kochi Prefecture, Japan). Shen, 1983:31; Shen in Shen *et al.*, 1993:570; Shen & Wu, 2012:752.

Specimens examined. NMMB-P02173 (1, 153.9), Taiwan, no date; NMMB-P07140 (1 female, 137.1), Dong-gang, 26 Dec. 2003; NMMB-P11568, (2, 98.2–130.6), Taiwan, 13 Jun. 1983; NMMB-P12618 (3, 133.2–138.5), Dong-gang, 25 Mar. 2011; NMMB-P13769 (2 males, 133.3–133.5), Dong-gang, 26 Aug. 2011; NMMB-P21093 (2, 98.1–102.9), Dong-gang, 30 Mar. 2014; NMMB-P21130 (1 female, 139.3), Ke-tzu-liao, 2 Ari. 2014; NMMB-P21614 (1, 118.8), Dong-gang, 25 Feb. 2014; NMMB-P22109 (1, 143.4), Dong-gang, 22 Feb. 2014; NMMB-P23205 (1, 122.0), Dong-gang, 5 Mar. 2016; NMMB-P23279 (1 female, 139.8), Dong-gang, 3 Apr. 2015; NMMB-P23281 (1, 130.0), Dong-gang, 16 Apr. 2015; NMMB-P25676 (1, 146.6), Dong-gang, 8 Jan. 2017. More specimens deposited in NMMB-P.

Diagnostic features. D 111–118; A 93–97; P 14–15; C 3+10–11+3–4=17; LLs 94–105; GR 5–8+6–10=13–16; vert. 11+39–42=50–53.

Body elongated and strongly compressed, greatest at near anterior 1/3 part of body, its depth 31.1–36.8% SL. Caudal peduncle narrow. Head small, more than 1/2 of body depth (18.1–20.6% SL); front of head with deep concavity anterior of upper eye; head profile gently curved. Snout short, protruding, snout length much shorter than eye diameter. Eyes small, diameter slightly longer than upper jaw; upper eye extremely close to dorsal margin of head. Interorbital space low and narrow; inner margins of each eye with bony ridge extending from anterior margin of lower eye to posterior interorbital space.

Mouth small and asymmetrical, upper-jaw length on ocular side about 4.5–6.2% SL; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth present on both sides of both jaws; uniserial in upper jaw, teeth on blind side somewhat larger than those on ocular side; anterior teeth on lower jaw biserial, posterior teeth uniserial. Gill rakers on lower limb slender and pointed without inner serration; those on upper limb small. Scales very small and deciduous, cycloids on both sides.

Dorsal and anal fins very low anteriorly and posteriorly. Pectoral fin on ocular side very short, slightly longer than half of head (10.8–13.7% SL); that on blind side relatively short. Caudal fin round and slender.

Coloration. Ocular side of body uniformly dark yellowish without distinct blotches or spots; all fins uniformly pale dark without distinct spots and blotches; middle part of caudal fin black except for basal part. Blind side of body uniformly yellowish white.

Size. Reaching 153.9 mm SL in Taiwan; up to about 200 mm SL elsewhere (Hensley & Amaoka, 2001).

Distribution. Western and southwestern Taiwan; widespread in Indian and Western Pacific oceans, including South China Sea to southern Japan, and Coral Sea (Amaoka, 2016).

Remarks. This species resembles members of *Laeops* in the small mouth and general appearance, but can be easily separated in the presence of teeth on both jaws of both sides and the anterior two dorsal-fin rays not being separated from the remaining fin rays. Moreover, this species is closely related to *Laeops gracilis* Fowler, 1934, but it differs from the latter in having smaller head and deeper body (Amaoka, 2016).

Genus *Kamoharaia* Kuronuma, 1940

Kamoharaia Kuronuma, 1940:35. Type species: *Chascanopsetta megastoma* Kamohara, 1936.

Diagnostic features. Body long elliptical, strongly compressed. Tip of isthmus far behind posterior margin of lower eye, located above posterior end of lower jaw. Dorsal profile of head constant with sex and growth. Caudal peduncle narrow. Both eyes separated by ridge or a very narrow concave space; interorbital width same in both sexes. No rostral, orbital and mandibular spines in both sexes.

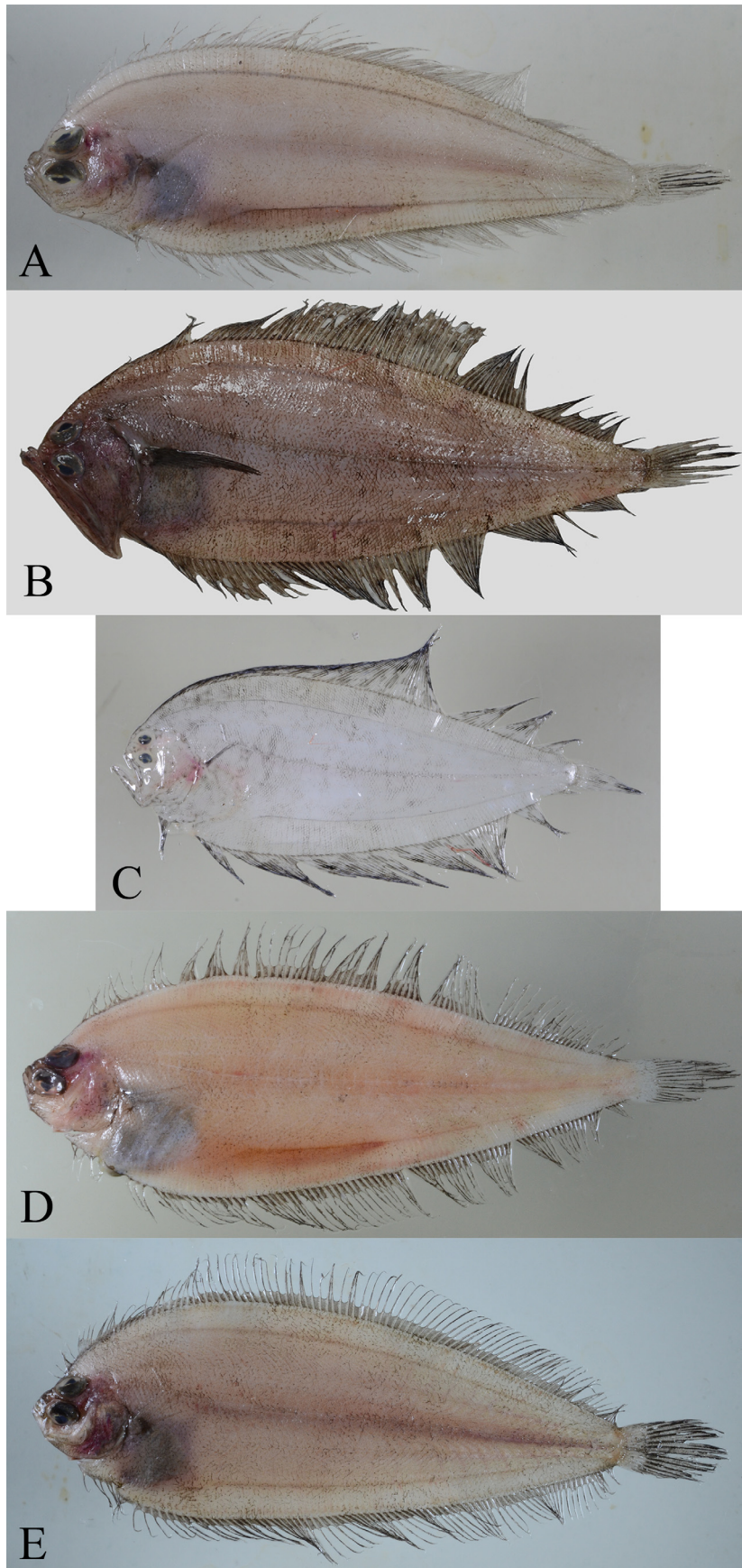


FIGURE 7. A. *Japonolaeops dentatus*, NMMB-P 23281, 130 mm SL. B–C. *Kamoharaia megastoma*, NMMB-P 17856, 186.6 mm SL(B) and NMMB-P21088, juvenile, 105 mm SL (C). D–E. *Laeops kitaharae*, NMMB-P21087, female, 130.8 mm SL (D) and NMMB-P22276, male, 150 mm SL (E).

Mouth extremely large; maxilla extending far beyond posterior margin of lower eye, tip of upper jaw projecting beyond tip of snout; upper-jaw length about equal to HL. Anterior half of upper jaw uniserial, with some enlarged teeth anteriorly, followed by tooth band on posterior half; teeth on lower jaw uniserial with 3 pairs of canines at anterior tip. Gill rakers small, without spines.

Scales small, cycloid on both sides. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side. First ray of dorsal fin slightly elongate. Pectoral fin on ocular side not elongate in both sexes. Pelvic fin on ocular side starting at tip of isthmus, with rather short base; first ray on blind side opposite to third fin ray on ocular side. Caudal skeleton consisting of four plates including parhypural and three hypurals, without deep clefts. Suborbital bones 3 on blind side. Tip of vomer projecting into mouth.

Remarks. *Kamoharaia* is closely related to *Chascanopsetta* with which it shares an extremely large mouth, but it can be distinguished from the latter by the tip of the upper jaw extending beyond the tip of the snout, the presence of large canine teeth at the tip of the lower jaw, and in the tip of the vomer projecting into the mouth.

***Kamoharaia megastoma* (Kamohara, 1936)**

Widemouthed flounder; 鱸口鯧

Figures 7B–C; Table 10

Chascanopsetta megastoma Kamohara, 1936:308 (Type locality: Kochi Prefecture, Japan). Chen & Weng, 1965:61.

Kamoharaia megastoma: Kuronuma, 1940:36; Shen, 1983:34; Shen in Shen *et al.*, 1993:570; Ho *et al.*, 2009:11; Shen & Wu, 2012:752.

Specimens examined. NMMB-P17856 (1, 186.6), Nan-fang-ao, 13 Oct. 2012; NMMB-P21088 (1, 109), Dong-gang, 30 Mar. 2014; NMMB-P22267 (1, 164.2), Dong-gang, 7 Nov. 2013; NMMB-P25330 (1, 95.0), Dong-gang, 26 May 2013; NMMB-P29037 (1, 95.4), Ke-tzu-liao, 18 Mar. 2018. More specimens deposited in NMMB-P.

Diagnostic features. D 109–112; A 84–88; P 12; C 3–5+7–11–5=17; LLs 126–132; GR 0–3+7–8; vert. 13+39–40=52–53.

Body elliptical, strongly compressed; greatest depth near tip of pectoral fin (34.1–38.3% SL). Caudal peduncle narrow, its depth 5.1–5.7% SL. Head small, its length 17.1–20.1% SL; upper profile of head deeply concave anterior of interorbital area, and more or less convex in front of upper eye. Snout much shorter than eye diameter. Eyes small, about 1/3 of upper jaw, separated by narrow flat ridge.

Mouth very large, upper-jaw length about 14.5–19.2% SL; maxilla extending well beyond posterior margin of lower eye; tip of upper jaw protruding beyond tip of snout by half eye diameter. Teeth on upper jaw uniserial, 3 or 4 pairs of larger teeth anteriorly, narrow tooth band on posterior half; lower jaw teeth uniserial, anteriorly 3 pairs of large inward curved canine teeth, posterior teeth becoming smaller. Tip of vomer projecting into mouth cavity. Gill rakers short and slender without serration on lower limb, rudimentary on upper limb.

Scales on both sides very small, cycloid. First ray of dorsal fin elongate, its length 2.5–2.8 in HL. Pectoral fin on ocular side about half of that on blind side. Caudal fin slender and round, with 3–5 unbranched rays dorsally and ventrally.

Coloration. Ocular side of body uniformly brownish with many irregular dark blotches; median fins and pectoral fin on ocular side dark except for basal portion. Blind side of body yellowish white.

Size. Reaching 187 mm SL in Taiwan; up to 220 mm SL elsewhere (Hensley & Amaoka, 2001).

Distribution. Northeastern and southwestern Taiwan; widespread in the Indo-Australian archipelago to southern Japan (Amaoka, 2016).

Remarks. This species resembles *Chascanopsetta lugubris* in having an extremely large mouth, but can be easily distinguished in having the tip of the maxilla strongly extending beyond the tip of the snout, in having 3 pairs of canine teeth on the tip of the lower jaw and in the tip of the vomer projecting into the mouth cavity. In juveniles of 100–120 mm SL, both jaws are not particularly protruding (Amaoka, 2016).

Genus *Laeops* Günther, 1880

左鯧屬

Laeops Günther, 1880:29. Type species: *Laeops parviceps* Günther, 1880.

Diagnostic features. Body elongate, elliptical, strongly compressed. Tip of isthmus below posterior margin of lower eye or slightly beyond. No sexual dimorphism of dorsal profile of head, interorbital width, head spines and pectoral fin. Caudal peduncle extremely narrow, its depth slightly less than half of HL. Interorbital space narrow. No rostral, orbital and mandibular spines in both sexes.

Mouth very small, asymmetrical, twisted to blind side; maxilla extending slightly beyond anterior margin of lower eye. Teeth present only on blind side of both jaws, small, uniserial or forming narrow band. Gill rakers slender and smooth. Scales very small, deciduous, cycloids on both sides. Lateral line on ocular side with small curved section above pectoral fin; lateral line absent on blind side.

Dorsal- and anal- fin rays simple and unbranched. Anterior two rays of dorsal fin separated from remainder rays, or anterior three rays elongate. Pectoral fin on ocular side not elongate. Pelvic fin on ocular side starting at tip of isthmus, first ray on blind side opposite to fourth fin ray on ocular side. Vent on blind side, just before origin of anal fin, and urogenital pore on ocular side, opposite to vent. Caudal skeleton with four plates, including parhypural and three hypurals, and lacking deep clefts.

Remarks. *Laeops* is closely related to *Japonolaeops* as evidenced by the elongate body, small mouth, caudal skeleton without deep clefts, and no sexual dimorphism. It differs from *Japonolaeops* in having teeth only on the blind side and in the anterior two dorsal fin rays not continuous with the following rays, or rarely the anterior three rays elongate.

Laeops kitaharae (Smith & Pope, 1906)

Kitahara's flounder; 北原氏左鯧

Figures 7D–E; Table 10

Lambdopsetta kitaharae Smith & Pope, 1906:496 (Type locality: Kagoshima Prefecture, Japan).

Laeops tongkongensis Chen & Weng, 1965 (type locality: Tungkang [Dong-gang] fish market, Taiwan). Shen, 1983:32; Shen in Shen *et al.*, 1993:571; Shen & Wu, 2012:752.

Laeops kitaharae: Chen & Weng, 1965:67; Shen, 1983:31; Shen in Shen *et al.*, 1993:570; Shen & Wu, 2012:752.

Laeops parviceps (not of Günther): Chen & Weng, 1965:62; Shen, 1983:33; Shen in Shen *et al.*, 1993:571; Shen & Wu, 2012:753.

Laeops guentheri (not of Alcock): Chen & Weng, 1965:66; Shen & Wu, 2012:752.

Laeops lanceolata (not of Franz): Chen & Weng, 1965:68.

Laeops variegata (not of Franz): Chen & Weng, 1965:69.

Laeops nigrescens (not of Lloyd): Chen & Weng, 1965:64.

Specimens examined. NMMB-P21087 (1, 130.8), Dong-gang, Mar. 30, 2014; NMMB-P22229 (1, 149.2), Dong-gang, 21 Jan. 2015; NMMB-P23185 (1, 125.5), Ke-tzu-liao, 22 Apr. 2014; NMMB-P23188 (1 female, 134.5), NMMB-P23268 (4, 121.2–130.7), 18 Mar. 2016; NMMB-P23269 (5, 120.3–139.9), Dong-gang, 28 Feb. 2016; NMMB-P23270 (1, 132.2), Ke-tzu-liao, 28 Feb. 2016; NMMB-P23280 (1, 120.0), Dong-gang, 16 Apr. 2016; NMMB-P23283 (4, 103.2–128.5), Ke-tzu-liao, 3 Apr. 2016; NMMB-P24846 (1, 148.3), Ke-tzu-liao, 2 Apr. 2015. Large among of specimens deposited in NMMB-P.

Diagnostic features. D 103–117; A 87–92; P 12–15; C 2–3+11–13+2–4=17; LLs 90–105; GR 0–5+5–8=6–12; ert. 11–12+39–42=50–53.

Body elongated and strongly compressed, greatest near anterior 1/4 part of body, its depth highly variable (28.5–36.9% SL). Caudal peduncle narrow, its depth 5.7–6.8% of SL. Head extremely small, head less than 1/2 of body depth (14.9–18.4% SL); front of head almost straight or with shallow concavity above middle of upper eye. Snout extremely short, snout length about half of eye diameter. Eyes small, diameter much larger than upper-jaw length; upper eye extremely close to dorsal margin of head. Interorbital space narrow; inner margins of eyes with high bony ridge extending from anterior margin of lower eye to posterior interorbital space.

TABLE 10. Frequency of six meristic data of *Japonolaeops dentatus*, *Kamoharaita megastoma*, *Laeops kitaharae*, and *Neolaeops microphthalmus* in Taiwan.

	Dorsal-fin rays											Vertebrae (precaudal+caudal)																		
	n	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	n	11	12	13	+	37	38	39	40	41	42		
<i>Japonolaeops dentatus</i>	16								2	1	0	3	3	1	3	3	20	20								1	2	16	1	
<i>Kamoharaita megastoma</i>	3						1	0	1	1							3	3			3					2	1			
<i>Laeops kitaharae</i>	20	1	0	0	0	3	0	4	3	6	0	2	0	0	0	1	20	19	1							1	6	11	2	
<i>Neolaeops microphthalmus</i>	20	1	1	1	3	0	4	3	5	1	2						20									20	5	15		
		Anal-fin rays											Pectoral-fin rays																	
<i>Japonolaeops dentatus</i>	15	n	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	96	97	n	12	13	14	15	16				
<i>Kamoharaita megastoma</i>	3					1	0	0	0	2							4	6	4	1	18					9				
<i>Laeops kitaharae</i>	20										2	2	6	5	3	2					3	3								
<i>Neolaeops microphthalmus</i>	20					1	1	1	2	3	4	3	2	0	2	0	1				20	4	10	4	2					
		Lateral-line scales											Gill rakers (upper + lower)																	
<i>Japonolaeops dentatus</i>	17	n	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	//	126	127	128	129	130	131	132				
<i>Kamoharaita megastoma</i>	3						1	1	0	1	0	1	4	4	1	1	2	1												
<i>Laeops kitaharae</i>	18	1	0	0	1	0	1	1	0	1	1	1	3	0	0	3	5	1		1	1	0	0	0	0	1				
<i>Neolaeops microphthalmus</i>	19					2	0	0	1	2	3	1	4	0	1	3	2													
<i>Japonolaeops dentatus</i>	18	n	0	1	2	3	4	5	6	7	8	+	5	6	7	8	9	10												
<i>Kamoharaita megastoma</i>	3																													
<i>Laeops kitaharae</i>	20	10	1	4	1	2	2						3	14	1	2														
<i>Neolaeops microphthalmus</i>	12					2	1	1	8																					

Mouth extremely small, asymmetrical, twisted to blind side, upper-jaw length on ocular side 3.1–3.9% SL; maxilla extending to anterior margin of lower eye; lower jaw extending beyond tip of upper jaw. Teeth absence on ocular side of both jaws, many small teeth on blind side curved inward, in narrow bands. Gill rakers on lower limb very small and pointed, smooth; none or some small rakers on upper limb.

Scales very small and deciduous, cycloid on both sides. Dorsal and anal fin rays slender, fin membranes very weak and easily broken except for basal parts; first two rays not detached from remainder of fin. Pectoral fin on ocular side very short, a little longer than half of head (9.2–12.3% SL); that of blind side relatively short. Caudal fin round and slender, its length about equal to HL.

Coloration. Ocular side of body uniformly pale brownish without distinct blotches or spots, snout dark; distal half of dorsal, anal and caudal fins, and of pelvic fin on ocular side black; blind side of body uniformly yellowish white.

Size. Reaching 149 mm SL in Taiwan; up to 164 mm SL in Japan (Amaoka 1969).

Distribution. Western and southwestern Taiwan; South China Sea to southern Japan, and Korea (Amaoka, 2016).

Remarks. *Laeops tongkongensis* Chen & Weng, 1965 is synonymized with *Laeops kitaharae* (Smith & Pope, 1906) based on the examination of the type specimens of both species for this study. We cannot separate *L. tongkongensis* from *L. kitaharae* based on the diagnosis of both species provided in the key of Chen & Weng (1965). The body depth of type series of *L. tongkongensis* are 28.3–29.8% SL versus 34.5% SL in holotype and 28.5–36.9% SL in Taiwanese specimens of *L. kitaharae*. The head length of type series of *L. tongkongensis* are 15.5–16.2% SL, versus 17.2% SL and 14.9–18.4% SL, respectively, of *Laeops kitaharae*. Moreover, both species could not be discriminated in counts and other morphometric characters. As a consequence, *L. tongkongensis* is recognized as a junior synonym of *L. kitaharae*.

In addition, eight species in the genus *Laeops* were reported from Taiwan (Chen & Weng, 1965). They probably also represent *Laeops kitaharae*, which is known for its broad morphological variations in proportional measurements (Amaoka, 1969). The pictures of *L. kitaharae* shown by Shen & Wu (2012) represent a reversal specimen of *Plagiopsetta glossa*.

Genus *Neolaeops* Amaoka, 1969

Neolaeops Amaoka, 1969:148. Type species: *Laeops microphthalmus* von Bonde, 1922.

Diagnostic features. Body elongate elliptical, strongly compressed. Tip of isthmus below posterior margin of lower eye. No sexual dimorphism in dorsal profile of head, interorbital width, and head spines. Caudal peduncle narrow. Both eyes separated by narrow ridge. No rostral, orbital and mandibular spines.

Mouth medium in size; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on both jaws small, uniserial; anterior teeth enlarged, canine-like. Gill rakers slender and smooth. Scales very small, deciduous, cycloid on both sides. Lateral line on ocular side with short curved section above pectoral fin; lateral line absent on blind side.

Dorsal- and anal- fin rays simple. Pectoral fin on ocular side not elongate, starting at tip of isthmus; first ray on blind side opposite to fourth ray on ocular side. Vent on blind side just in front of origin of anal fin, and urogenital pore on ocular side opposite to vent. Caudal skeleton composed of four plates including parhypural and three hypurals, without deep clefts.

Remarks. *Neolaeops* resembles *Laeops* and *Japonolaeops* in the elongate body, the caudal skeleton without deep clefts, no sexual dimorphism and very small scales. It differs from *Laeops* in the presence of teeth on both jaws on both sides of body and in the larger mouth, and from *Japonolaeops* in having uniserial teeth on both jaws, a larger mouth and more abdominal vertebrae.

Neolaeops microphthalmus (von Bonde, 1922)

Crosseyed flounder; 小眼新左鲆

Figure 8A; Table 10

Laeops microphthalmus von Bonde, 1922:11 (Type locality: coast of Natal, East Africa).

Arnoglossus microphthalmus: Norman, 1931:508; Chen & Weng, 1965:44.

Neolaeops microphthalmus: Amaoka, 1969:149; Shen, 1983:34; Shen in Shen *et al.*, 1993:571; Shen & Wu, 2012:753.

Specimen examined. NMMB-P04832 (4, 122.4–162.3), Dong-gang, 9 Oct. 1965; NMMB-P06242 (1, 166.0), Dong-gang, 6 Feb. 1966; NMMB-P08116 (1 male, 168.6), Dong-gang, 16 Apr. 2004; NMMB-P14234 (1, 101.2), Dong-gang, 6 Sep. 2011; NMMB-P15268 (1 female, 168.9), Dong-gang, 28 Oct. 2011; NMMB-P20986 (1 male, 110), Dong-gang, 12 Mar. 2014; NMMB-P21127 (1 male, 3 females, 148.4–168.7), Ke-tzu-liao, 2 Apr. 2014; NMMB-P22078 (2, 104–177), Dong-gang, 7 Nov. 2013; NMMB-P22227 (1, 128.5), Dong-gang, 22 Apr. 2014; NMMB-P25673 (1 male, 1 female, 152.3–167.4), Dong-gang, 20 Jan. 2016; NMMB-P25681 (1 male, 168.9), Fu-gang, Taitung, 12 Jan. 2017. More specimens deposited in NMMB-P.

Diagnostic features. D 104–112; A 81–92; P 13–16; C 2–4+10–12+2–4=17; LLs 93–104; GR 3–6+6–10=12–16; vert. 13+37–38=50–51.

Body elongated and strongly compressed, deepest near anterior 1/3 part of body (38.9–43.5% SL). Caudal peduncle narrow, its depth 6.0–6.9% SL. Head small, its length about half of body depth (19.5–21.5% SL); front of head with deep concavity anterior of upper eye; head profile round. Snout slightly protruding, snout length slightly longer than eye diameter. Eyes small, diameter about 1/2 of upper jaw length; upper eye extremely close to dorsal margin of head. Interorbital space narrow, bony ridge extending from anterior margin of lower eye to posterior interorbital space.

Mouth moderate and almost symmetrical, upper-jaw length on ocular side about 7.4–8.8% SL; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on both jaws uniserial, with enlarged and canine-like teeth anteriorly, small and close-set laterally on upper jaw, lateral teeth on lower jaw stronger and wider spaced than those on upper jaw. Gill rakers absent on upper limb, those on lower limb slender, pointed, and smooth. Scales very small and deciduous, cycloid on both sides. Pectoral fin on ocular side very short, about half of head length (10.0–11.9% SL); that on blind side shorter and more feeble. Caudal fin round and slender.

Coloration. Ocular side of body uniformly pale brownish without distinct blotches or spots, snout dark; dorsal and anal fins and pelvic fin on ocular side black; several middle rays of caudal fin black distally. Blind side of body uniformly milky white.

Size. Reaching 169 mm SL in Taiwan; up to about 210 mm SL elsewhere (Hensley & Amaoka, 2001).

Distribution. Western and southwestern Taiwan; widespread in Indian and Western Pacific oceans, including South China Sea, East China Sea, southern Japan, East Africa (Amaoka, 2016).

Remarks. This species superficially resembles members of *Japonolaeops* and *Laeops*, but is readily distinguished by its deeper body, larger mouth and smaller eyes.

Genus *Parabothus* Norman, 1931

Parabothus Norman, 1931b:600. Type species: *Arnoglossus polylepis* Alcock, 1889.

Diagnostic features. Body elliptical. Tip of isthmus below or slightly behind posterior margin of lower eye. Sexual dimorphism and ontogenetic changes of head profile, head spines and interorbital width. Front margin of head steeper in mature males than females and juveniles. Both eyes separated by wide concave space; interorbital width larger in males than in females and juveniles. Usually no rostral, orbital and mandibular spines in both sexes, except for occasional short obtuse rostral and mandibular spines in males.

Mouth large; maxilla extending to anterior margin of lower eye or somewhat beyond. Teeth on both jaws usually uniserial, rarely biserial in upper jaw; teeth slightly enlarged anteriorly. Gill rakers moderately long, usually not serrated, absent on upper limb.

Scales rather not deciduous, ctenoid on ocular side with row of moderately long ctenii along posterior margin; scales cycloid on blind side. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side. Dorsal and anal fins with simple rays. Pectoral fin on ocular side not elongated in both sexes. Pelvic fin starting at tip of isthmus; first ray on blind side opposite to third or fourth ray on ocular side. Vent on blind side, just in front of origin of anal fin, and urogenital pore on ocular side. Caudal skeleton with four plates, including parhypural and three hypurals; no deep clefts on distal margin.

Remarks. *Parabothus* closely resembles *Tosarhombus* in having ctenoid scales on the ocular side bearing moderately long spines, caudal plates lacking clefts, and sexual dimorphism of the interorbital width. It differs from *Tosarhombus* in having a narrower interorbital space, usually absence of a rostral spine in male, a more elongate body, and the anterior head margin lacking clear blotches.

Key to species of *Parabothus* of Taiwan

- 1A. D 83–89; A 63–67. *P. polylepis*
- 1B. D 98–117; A 77–95. 2
- 2A. LLs 61–67; upper jaw teeth biserial; sometimes obtuse rostral spine in male. *P. taiwanensis*
- 2B. LLs > 78; upper jaw teeth uniserial; no rostral spine in male 3
- 3A. LLs 78–83; upper eye diameter 3.0–3.5 in HL; no dark blotch at junction between curved and straight portion of lateral line; no dark spots along dorsal margin of upper eye *P. kiensis*
- 3B. LLs 87–95; upper eye diameter 3.5–3.9 in HL; two dark blotches at junction between curved and straight portion of lateral line; small dark spots along dorsal margin of upper eye *P. coarctatus*

Parabothus coarctatus (Gilbert, 1905)

Greenspotted flounder; 短腹擬鯆

Figures 8B–C; Table 11

Platophrys coarctatus Gilbert, 1905:686 (Type locality: Pailolo Channel, Hawaii Islands, U. S. A.).

Specimens examined. NMMB-P13149 (1, 188.9), NMMB-P13150 (1, 188.8), NMMB-P12151 (1, 188.5), Penghu Island, 31 Dec. 2010; NNMB-P17686 (1, 173.0), Daxi, Yilan, 12 Nov. 2012; NMMB-P22242 (1 male, 195, 1 female, 137.4), Ke-tzu-liao, 21 Jan. 2015.

Diagnostic features. D 110–117; A 89–95; P 12–14; C 2+13+2=17; LLs 87–95; GR 0+8–9=8–9; vert. 10+33=43.

Body elliptical, deepest slightly anterior of middle of body (38.6–42.3% SL). Head relatively small (26.2–26.8% SL); upper profile of head with slight concavity in front of interorbital space. Snout round, relatively long, its length shorter than eye diameter. Eye diameter smaller than upper jaw length. Interorbital space deeply concave, its width narrower than eye diameter, wider in males than females and juveniles, 3.0–3.4% SL in males, 1.4–2.0% SL in females or juveniles.

Mouth moderately large, upper-jaw length 9% SL; maxilla extending to slightly beyond anterior margin of lower eye. Prominent knob on mandibular symphysis. Teeth on both jaws small, uniserial, some pairs of anterior teeth enlarged, canine-like; lateral teeth on lower jaw somewhat larger than those on upper jaw. Gill rakers on lower limb of first arch, moderate in size, not serrate; absent on upper limb.

Scales small, ctenoid with moderate ctenii on ocular side; scales on blind side cycloid. Pectoral fin on ocular side short (14.3–15.2% SL).

Coloration. Ocular side of body grayish brown; a series of obtuse greenish yellow blotches with dark margins near dorsal and ventral margins of body; two dark small spots on junction between curve and straight portion of lateral line, two on middle and one on posterior portions; head with greenish yellow spots and dashes, each with dark margins; dorsal and anal fins with a regularly arranged series of dark blotches; body on blind side milky white.

Size. Reaching 189 mm SL in Taiwan; up to 225 mm SL in Japan (Amaoka, 1969)

Distribution. Northeastern, western and southwestern Taiwan; southern Japan to Coral Sea, Hawaii Islands (Amaoka *et al.*, 1997).

Remarks. This species resembles *Parabothus kiensis* in body shape, but differs in smaller eyes, smaller scales and the shape and abundance of blotches on the body. This species exhibits sexually dimorphism and ontogenetic changes of the interorbital width.

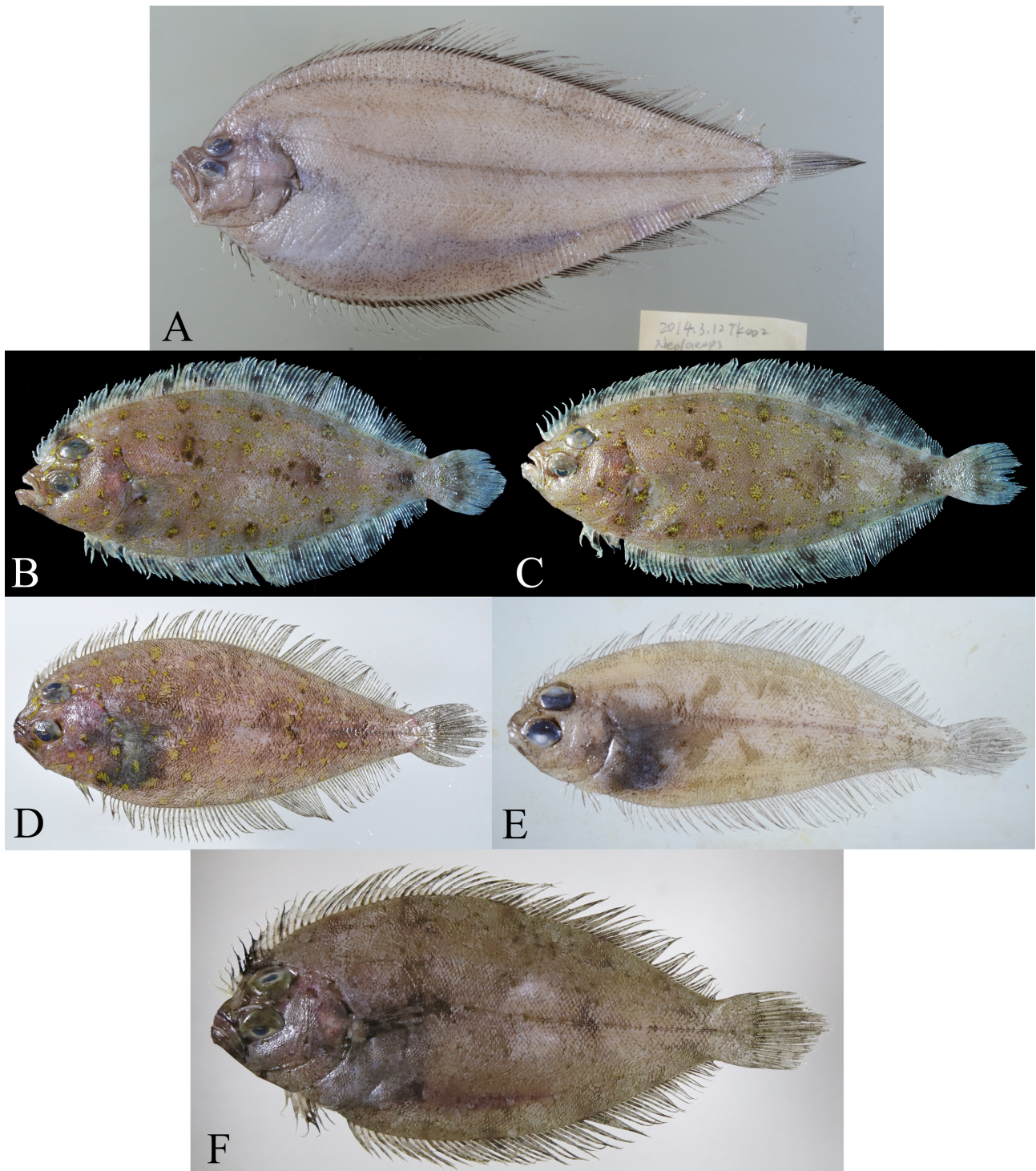


FIGURE 8. A. *Neolaeops microphthalmus*, NMMB-P20986, 110 mm SL. B–C. *Parabothus coarctatus*, NMMB-P13151, male, 188.5 mm SL (B) and NMMB-P13149, female, 188.9 mm SL (C). D–E. *Parabothus kiensis*, NMMB-P18021, male, 133.0 mm SL (D) and NMMB-P30894, female, 157 mm SL (E). F. *Parabothus polylepis*, NMMB-P26403, female, 119.7 mm SL.

***Parabothus kiensis* (Tanaka, 1918)**

Yellowspotted flounder; 少鱗擬鯡

Figures 8D–E; Table 11

Platophrys kiensis Tanaka, 1918:225 (Type locality: Tanabe, Wakayama Pref., Japan)

Parabothus kiensis: Okada & Matsubara, 1938:423; Shen & Wu, 2012:754.

Parabothus chlorospilus (not of Gilbert): Shen, 1983:13.

Specimens examined. NMMB-P12622 (1 male, 1 female, 153.0–168.7), Dong-gang, 25 Mar. 2011; NMMB-P18021 (1 male 133.0), Dong-gang, date unknown; NMMB-P22239 (1, 164.6), Dong-gang, 21 Jan. 2015; NMMB-P22265 (1 female, 118.3), Dong-gang, 11 Feb. 2015; NMMB-P25744 (1 female, 120.1), Dong-gang, 22 Mar. 2017; NMMB-P28992 (1 female 141.3), 18 Mar. 2018; NTUM 05402 (1, 126.3), Tungkong, 19 Nov. 1976.

Diagnostic features. D 100–114; A 84–89; P 12–13; C 2+13+2=17; LLs 78–83; GR 0+7–9=7–9; vert. 10+31–32=41–42.

Body elliptical, deepest slightly anterior of middle of body (38.0–42.2% SL). Head rather small (25.9–27.6% SL); upper profile of head with slight concavity anterior to interorbital space. Snout round, longer than half of eye diameter. Eye diameter about equal to upper-jaw length. Interorbital space deeply concave, its width narrower than eye diameter, wider in males than in females and juveniles, 4.1–4.9% SL in males, 1.0–2.0% in females.

Mouth moderately large, upper-jaw length 8.1–10.1% SL; maxilla extending to slightly beyond anterior margin of lower eye. Prominent knob on mandibular symphysis in males, feeble or absent in females and juveniles. Teeth on both jaws small, uniserial, some pairs of anterior teeth enlarged; lateral teeth on lower jaw somewhat stronger than those on upper jaw. Gill rakers on lower limb moderate in size, not serrate; absent on upper limb.

Scales on ocular side ctenoid with long ctenii; scales on blind side cycloid. Pectoral fin on ocular side moderately large, not elongated (13.7–16.5% SL).

Coloration. Ocular side of body grayish brown with indistinct dark spots and yellowish green blotches of irregular form; no distinct blotches on any fins; body on blind side milky white.

Size. Reaching 132 mm SL in Taiwan; up to 203 mm SL in southern Japan (Amaoka, 1969).

Distribution. Northeastern and southwestern Taiwan; widespread in Western Pacific Ocean off southern Japan to Indonesia, northern Australia and Coral Sea (Hensley & Amaoka, 2001).

Remarks. This species resembles *Parabothus coarctatus* in body shape, but it differs from the latter in having larger eye (3.0–3.5 vs. 3.5–3.9 in HL), fewer lateral-line scales (78–83 vs. 87–95), and lacking dark spots on lateral line and along upper margin of upper eye. The specimen identified by Shen (1983) as *Parabothus chlorospilus* is a female of *P. kiensis*.

Parabothus polylepis (Alcock, 1889)

Manyscaled flounder; 多鳞拟鲆

Figure 8F; Table 11

Arnoglossus polylepis Alcock, 1889:290 (Type locality: off Sri Lanka)

Parabothus polylepis: Norman, 1931:600.

Specimen examined. NMMB-P26403 (1 female, 119.7), Ke-tzu-liao, 27 Jun. 2017.

Diagnostic features. D 89; A 67; P 10; C 2+13+2=17; LLs 86; GR 0+8=8; vert. 10+27=37.

Body elliptical, deepest slightly anterior of middle of body (46.2% SL). Head longer than half of body depth (27.7% SL); front profile of head with shallow concavity anterior of ventral margin of lower eye. Snout much shorter than eye diameter. No rostral spine on snout tip. Eye diameter shorter than upper-jaw length. Orbital spine absent. Interorbital space narrow, deeply concave, its width narrower than eye diameter, 4% HL (based on one female only).

Mouth moderate large, upper-jaw length 9.7% SL; maxilla extending to slightly beyond anterior margin of lower eye. Teeth on both jaws uniserial, moderately conical, some pairs of anterior teeth enlarged; lateral teeth on lower jaw somewhat stronger than those on upper jaw. Gill rakers on lower limb moderate large in size, smooth; absent on upper limb.

Scales on ocular side ctenoid with moderately long ctenii; cycloid on blind side. Pectoral fin on ocular side moderate large, not elongate (16.6% SL).

Coloration. Ocular side of body dark brown with an obtuse, large dark blotch at junction of straight and curved sections of lateral line, and a dark obtuse blotch on middle section of straight lateral line; a conspicuous black blotch on dorsal fin above anterior margin of upper eye; a series of large faint rings along dorsal and ventral edges of body; vertical fins with faint dark spots at base; pectoral fin with three indistinct dark cross bars; pelvic fin with a black spot on membrane between third and fourth rays; body on blind side grayish white.

TABLE 11. Frequency of six meristic data of four *Parabothus* species in Taiwan.

	Dorsal-fin rays																											
	n	89	//	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117					
<i>P. coarctatus</i>	6														1	0	1	0	1	0	1	0	1	2				
<i>P. kiensis</i>	7				1	0	0	0	0	0	1	2	0	0	0	0	1	1	0	1								
<i>P. polylepsis</i>	1	1																										
<i>P. taiwanensis</i>	20			2	0	2	0	0	0	4	2	3	5	1	0	1												
Anal-fin rays																												
n	67	//	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95							
<i>P. coarctatus</i>	6														1	0	0	1	3	0	1							
<i>P. kiensis</i>	7									1	0	2	0	2	2													
<i>P. polylepsis</i>	1	1																										
<i>P. taiwanensis</i>	20			1	3	1	2	2	0	4	1	3	1	2														
Gill rakers (upper+lower)																												
n	10	11	12	13	14	n			0	+	7	8	9	n			10	+	27	28	29	30	31	32	33			
<i>P. coarctatus</i>	6		1	4	1	5	5		1	4				6	6											6		
<i>P. kiensis</i>	7		2	5		7	7		2	1	4			7	7											3	4	
<i>P. polylepsis</i>	1	1				1	1		1	1				1	1											1		
<i>P. taiwanensis</i>	20		2	7	9	2	20	20	15	5				20	20											1	9	10
Lateral-line scales																												
n	61	62	63	64	65	66	67	//	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95		
<i>P. coarctatus</i>	6																											
<i>P. kiensis</i>	7								1	0	2	3	0	1														
<i>P. polylepsis</i>	1																										1	
<i>P. taiwanensis</i>	20	5	3	3	2	3	1	3																				

Size. Reaching 120 mm SL in Taiwan; up to 130 mm SL in Sri Lanka (Norman, 1934).

Distribution. Southwestern Taiwan off Ke-tzu-liao at depths less than 100 m; Sri Lanka at depths 59–64 m (de Bruin *et al.*, 1995).

Remarks. This species was first recorded from Taiwan on the bases of a single female specimen. This species can be separated from the three other Taiwanese species of *Parabothus* in having fewer dorsal- and anal- fin rays and vertebrae. Currently, no male specimen was examined by the authors and the characters of males are unknown. This species may exhibit sexually dimorphism and ontogenetic changes on interorbital width and presence or absence of rostral spine as other congeners.

***Parabothus taiwanensis* Amaoka & Shen, 1993**

Taiwan flounder; 台灣擬鯆

Figures 9A–B; Table 11

Parabothus taiwanensis Amaoka & Shen, 1993:1042 (Type locality: Kaohsiung, Taiwan). Shen & Wu, 2012:754.

Parabothus chlorospilus (not of Gilbert, 1905): Shen, 1983:13.

Parabothus sp.: Shen, 1983:13; Shen in Shen *et al.*, 1993:571.

Crossorhombus sp.: Shen, 1983:19.

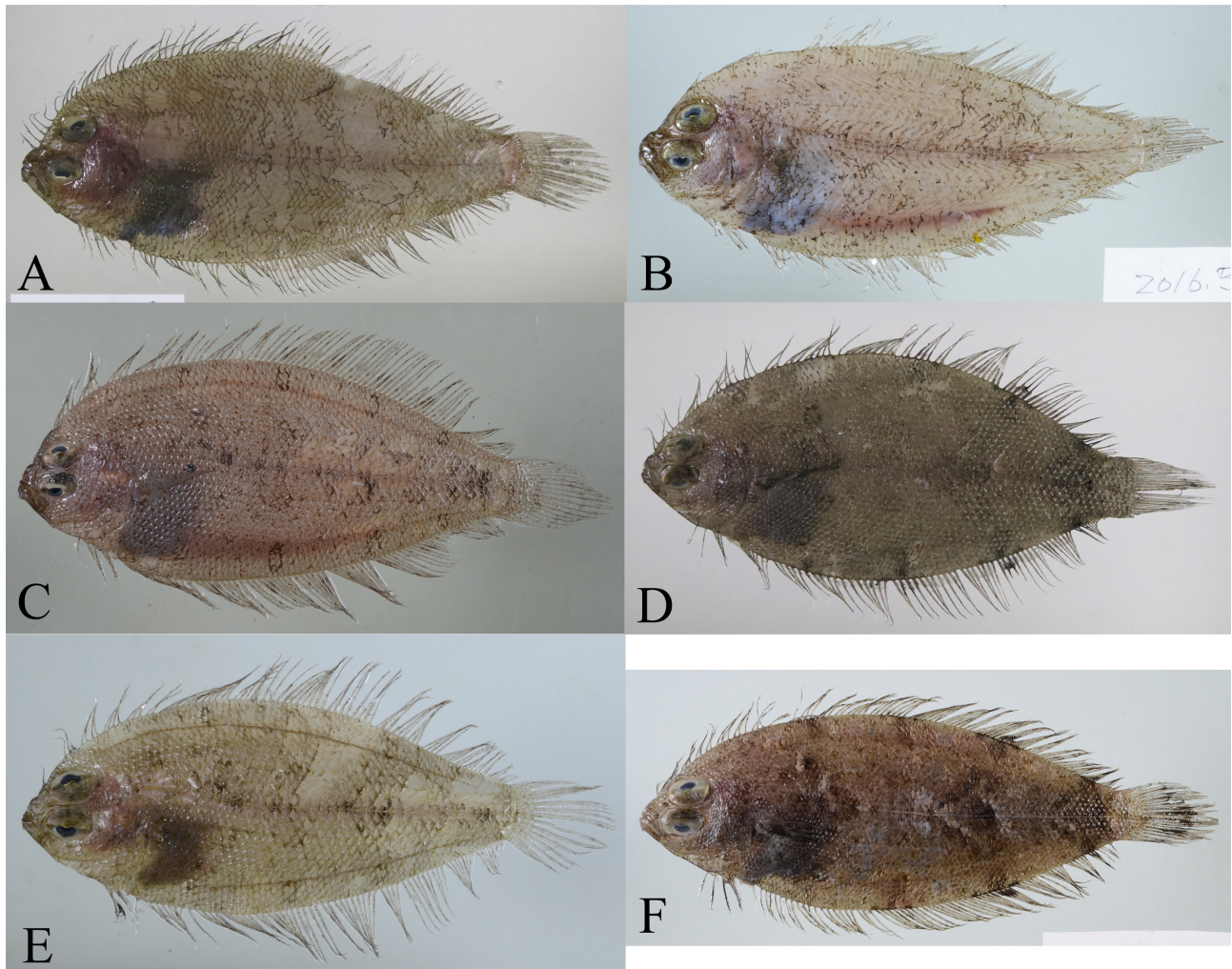


FIGURE 9. A–B. *Parabothus taiwanensis*, NMMB-P 25725, male, 122.3 mm SL (A) and NMMB-P 23214, female, 101.6 mm SL (B). C. *Psettina gigantea*, NMMB-P23236, 98.2 mm SL. D. *Psettina ijimae*, NMMB-P26402, 68.3 mm SL. E. *Psettina tosana*, NMMB-P 23211, 81.5 mm SL. F. *Psettina variegata*, NMMB-P23202, 121.9 mm SL.

Specimens examined. NMMB-P23214 (1 female, 101.6), Ke-tzu-liao, 17 Mar. 2016; NMMB-P23219 (2, 73.0–85.5), Ke-tzu-liao, 30 Apr. 2015; NMMB-P23232 (3 males, 1 female, 91.8–132.2), Ke-tzu-liao, 31 Mar. 2016; NMMB-P23272 (1 male, 1 female, 116.3–129.6), Ke-tzu-liao, 28 Feb. 2016; NMMB-P23305 (1 male, 1 female, 92.7–95.6), Ke-tzu-liao, 18 Mar. 2016; NMMB-P24854 (1 male, 1 female, 116.7–124.8), NMMB-P25710 (1 male, 117.6), NMMB-P25713 (2 males, 100.8–123.9), Ke-tzu-liao, 2 Apr. 2015; NMMB-P25725 (2 males, 98.8–122.3), Ke-tzu-liao, 11 Mar. 2017. More specimens deposited in NMMB-P.

Diagnostic features. D 98–110; A 77–87; P 11–14; C 2+13+2=17; LLs 61–67; GR 0+7–8=7–8; vert. 10+28–30=38–40.

Body elliptical, deepest at anterior 1/3 of body (36.8–45.6% SL). Head slightly longer than half of body depth (22.0–28.1% SL); upper profile of head with deep concavity in front of interorbital space. Snout much shorter than eye diameter. Rostral spine on snout tip blunt in males, absent in females and juveniles. Eye diameter slightly shorter than upper-jaw length. Orbital spine absent in either sex. Interorbital space narrow, deeply concave, its width narrower than eye diameter, wider in males than females and juveniles, 3.0–3.5% SL in males, 2.3–2.6% SL in females, 1.2–1.3% SL in juveniles.

Mouth moderate, upper-jaw length 7.4–12.7% SL; maxilla extending to slightly beyond anterior margin of lower eye. Prominent knob on mandibular symphysis in males, feeble or absent in females and juveniles. Teeth on upper jaw biserial, those in outer series stronger and more widely spaced than those in inner series; some anterior teeth canine-like; teeth on lower jaw uniserial, nearly equal in size and spacing to inner-row teeth of upper jaw. Gill rakers only on lower limb, moderate in size, not serrate.

Scales on ocular side ctenoid with long ctenii; scales on blind side cycloid. Pectoral fin on ocular side very short (13.5–22.3% SL).

Coloration. Ocular side of body grayish brown without any distinct color pattern (body pale purple when scales are removed); body on blind side grayish white. All fins on both sides uniformly grayish brown without any noticeable spots or blotches.

Size. Reaching 130 mm SL in Taiwan; up to 153 mm SL in East China Sea (Yamada *et al.*, 2007).

Distribution. Northeastern and southwestern Taiwan, at depth not deeper than 100 m (present study); East China Sea (Yamada *et al.*, 2007).

Remarks. This species can be easily separated from *P. polylepis* in having more dorsal- and anal-fin rays, and from *Parabothus kiensis* and *P. coarctatus* in having clearly fewer lateral-line scales. This species exhibits sexually dimorphism and ontogenetic changes of interorbital width and presence or absence of a rostral spine and mandibular knob. *Parabothus* sp. and *Crossorhombus* sp. reported by Shen (1983) may in fact represent the same species.

Genus *Psettina* Hubbs, 1915

Psettina Hubbs, 1915:456. Type species: *Engyprosopon ijimae* Jordan & Starks, 1904.

Diagnostic features. Body elliptical. Tip of isthmus below posterior margin of lower eye or slightly in front. No sexual or ontogenetic dimorphism of dorsal profile of head. Both eyes separated by a ridge or very narrow concavity; interorbital width same in both sexes. No rostral, orbital and mandibular spines, except rarely short obtuse rostral and mandibular spines in mature males.

Mouth small; maxilla extending to anterior margin of lower eye. Teeth on both jaws small, not enlarged anteriorly; teeth on upper jaw uniserial or biserial, those on lower jaw uniserial. Gill rakers few, small, slender and smooth. Scales small, not deciduous, ctenoid on ocular side with row of long ctenii along posterior margin; cycloid on blind side. Lateral line on ocular side curved above pectoral fin, absent on blind side.

Dorsal- and anal-fin rays simple, none elongated. Pectoral fin on ocular side not elongated in both sexes. Pelvic fin on ocular side starting at tip of isthmus; first ray on blind side opposite to fourth ray on ocular side. Caudal skeleton with four plates, including parhypural and three hypurals, without deep clefts.

Remarks. *Psettina* is recognized by its rather small and elliptical body, ctenoid scales with a row of long spines along posterior margin, caudal skeleton without deep clefts, no sexual differences in rostral and orbital spines, interorbital width, shape of dorsal profile of body and coloration.

There are currently 10 species recognized in *Psettina*, all restricted to the Indian and Western Pacific oceans; four species are recognized in Taiwan.

Key to species of *Psettina* in Taiwan

- 1A. Caudal fin without black blotch or band; dark blotches along dorsal and ventral margins of body not extending to bases of dorsal and anal fins; pectoral fin without dark blotch or band; no large blotch on lateral line; teeth biserial on upper jaw and uniserial on lower jaw 2
- 1B. Caudal fin with black blotch or band; a series of dark blotches along dorsal and ventral margins of body extending to dorsal and anal fin bases, respectively; pectoral fin with dark band or blotch; three obscure large dark blotches on lateral line; teeth on both jaws uniserial 3
- 2A. Snout tip and both jaws blackish; upper-jaw length 7.4–8.9% SL; LLs 56–63 *P. gigantea*
- 2B. Snout tip and both jaws pale brown; upper-jaw length 6.6–7.4% SL; LLs 46–51 *P. tosana*
- 3A. LLs 55–61; D 89–91; A 66–71; GR 2–4+5–6 *P. iijimae*
- 3B. LLs 75–77; D 101–107; A 78–82; GR 0+7–8 *P. variegata*

Psettina gigantea Amaoka, 1963

Combscaled flounder; 長鰈鯡

Figure 9C; Table 12–13

Psettina gigantea Amaoka, 1963a:56 (Type locality: Mimase, Kochi Prefecture, Japan). Shen, 1983:26; Shen in Shen *et al.*, 1993:572; Shen & Wu, 2012:754.

Psettina profunda (not of Weber): Kamohara, 1959:7; Chen & Weng, 1965:46.

Specimens examined. NMMB-P03187 (4, 102.1–106.1), Taichung, central western Taiwan, 6 Apr. 2002; NMMB-P23236 (11, 88.2–108.9), Dong-gang, 20 Feb. 2016; NMMB-P23284 (2, 112.8–112.9), Ke-tzu-liao, 3 Apr. 2016. More specimens deposited in NMMB-P.

Diagnostic features. D 92–102; A 74–82; P 11–13; C 2+13+2=17; LLs 56–63; GR 0+6–8=6–8; vert. 10+29–30=39–40.

Body compressed, elliptical, deepest at anterior 1/3 of body (44.1–47.4% SL). Head more than half of body depth (22.7–26.8% SL); front profile of head with slight concavity anterior of ventral margin of lower eye; head profile gently convex. Snout much shorter than eye diameter. Eye diameter subequal to upper jaw. Interorbital space very narrow, concave, sometimes with ridges on anterior and posterior portions.

Mouth rather large for this genus, upper-jaw length on ocular side 7.4–8.9% SL; maxilla extending to anterior margin of lower eye. Short knob at mandibular symphysis. Teeth on upper jaw regularly biserial; those in inner row larger than outer row, somewhat enlarged anteriorly; teeth on lower jaw uniserial. Gill rakers short, pointed at tip and not serrated on lower limb; absent on upper limb. Scales on ocular side small, ctenoid with row of long ctenii, cycloid on blind side. Pectoral fin on ocular side short (15.4–18.1% SL); that of blind side very short, about 2/3 of ocular side.

Coloration. Ocular side of body uniformly darkish brown with a row of indistinct dark ringed blotches along dorsal and ventral margins of body; snout and both jaws dark; blind side of body uniformly milky white.

Size. Reaching 110 mm SL in Taiwan; up to about 130 mm SL in southern Japan (Amaoka, 2016).

Distribution. Northeastern, western and southwestern Taiwan; southern Indonesia, northeastern Australia to southern Japan (Amaoka, 2016).

Remarks. This species differs from its congeners in lacking distinct blotches on body and fins. Small individuals were sometimes confused with *P. tosana*, but can be separated by having more lateral-line scales and a larger mouth.

Distribution. Northeastern, western and southwestern Taiwan; from Coral Sea throughout southern Indonesia, to southern Japan and southern Korea (Amaoka, 2016).

Remarks. This species resembles *P. brevirectus* and *P. variegatus* in body shape, coloration and position of blotches. It, however differs from the former in having many more scales in the lateral line, fewer gill rakers on the lower limb, and from the latter in having fewer scales in the lateral line and fewer gill rakers on the lower limb. Chen & Weng (1965) recorded 56 lateral-line scales for a specimen which they described as *P. brevirectus* but which actually belongs to *P. iijimae*.

***Psettina ijimae* (Jordan & Starks, 1904)**

Iijima flounder; 鰺鯧

Figure 9D; Table 12–13

Engyprosopon ijimae Jordan & Starks, 1904:626 (Type locality: Suruga Bay, Shizuoka Prefecture, Japan).

Psettina ijimae: Hubbs, 1915:456; Shen, 1983:25; Shen & Wu, 2012:754.

Psettina brevirectis (not of Alcock): Chen & Weng, 1965:45.

Specimens examined. NMMB-P01725 (1, 75.0), Hain-da, Kaohsiung, 3 Nov. 1983; NMMB-P05573 (3, 65.6–71.6), Anping, Tainan, 1 Oct. 1963; NMMB-P12221 (82.5), Daxi, 22 Jan. 2010; NMMB-P26402 (3, 66.9–74.7), Ke-tzu-liao, 27 Jun. 2017; NMMB-P29421 (1, 51.8), Ke-tzu-liao, 25 Apr. 2018.

Diagnostic features. D 89–91; A 66–71; P 11–13; C 2+13+2=17; LLs 55–61; GR 2–4+5–6=7–10; vert. 10+26–28=36–38.

Body compressed, elliptical, deepest at middle part of body (43.8–47.3% SL). Head small, about half of body depth (23.0–24.8% SL); front profile of head almost smooth, without distinct concavity anterior of eyes; head profile gentle curve. Snout shorter than 1/2 of eye diameter. Eye diameter longer than upper-jaw length. Interorbital ridge extending from anterior margin of lower eye to posterior margin of upper eye.

Mouth very small, upper-jaw length on ocular side 5.8–6.3% SL; maxilla extending to anterior margin of lower eye. Small mandibular knob at symphysis. Dentition on blind side more developed than on ocular side, teeth on both jaws uniserial, close-set, gradually becoming small posteriorly. Gill rakers short, slender, pointed at tip and not serrate; rakers on upper limb smaller than those on lower limb. Scales on ocular side small, ctenoid with one row of long hair-like ctenii; cycloid on blind side. Pectoral fin on ocular side much shorter than head (10.4–19.4% SL); that of blind side very short, about 2/3 of that of ocular side.

Coloration. Ocular side of body uniformly darkish brown with a row of 6 distinct dark blotches along dorsal margin of body and 5 along ventral margin of body, these blotches entering to dorsal and anal fins; large blackish blotch at junction between curved and straight section of lateral line, at middle straight section and near caudal peduncle on lateral line; distal part of pectoral fin and hind part of caudal fin with blackish band. Blind side of body uniformly milky white.

Size. Reaching 83 mm SL in Taiwan; up to 85 mm SL in southern Japan (Amaoka, 2016).

***Psettina tosana* Amaoka, 1963**

Tosa flounder; 土佐鰺鯧

Figure 9E; Table 12–13

Psettina tosana Amaoka, 1963a:56 (Type locality: Mimase, Kochi Prefecture, Japan). Shen, 1983:27; Shen in Shen *et al.*, 1993:572; Shen & Wu, 2012:755.

Specimens examined. NMMB-P23211 (1, 81.5), Ke-tzu-liao, 28 Feb. 2015; NMMB-P23234 (8, 63.0–80.1), Ke-tzu-liao, 31 Mar. 2016; NMMB-P23309 (7, 66.1–75.8), Ke-tzu-liao, 3 Apr. 2016; NMMB-P25706 (4, 69.3–79.9), Ke-tzu-liao, 2 Apr. 2015. More specimens deposited in NMMB-P.

Diagnostic features. D 90–98; A 71–80; P 10–12; C 2+13+2=17; LLs 46–51; GR 0+6–8=6–8; vert. 10+28–30=38–40.

Body compressed, elliptical, deepest at middle of body (40.2–46.5% SL). Head more than half of body depth (22.9–25.5% SL); front profile of head with slight concavity in front of ventral margin of upper eye; head profile smoothly convex. Snout much shorter than eye diameter. Eye diameter much shorter than upper-jaw length. Interorbital space with low ridge.

Mouth small, upper-jaw length on ocular side 6.6–7.4% SL; maxilla extending to anterior margin of lower eye. Mandibular knob very small at symphysis. Teeth on upper jaw regularly biserial; teeth on inner row larger than outer row; teeth on lower jaw uniserial. Gill rakers short, pointed at tip, not serrate on lower limb, absent on upper limb. Scales on ocular side rather large, ctenoid with row of long ctenii; cycloid on blind side. Pectoral fin on ocular side short (19.0–24.3% SL), subequal to head length; that of blind side about 2/3 of that on ocular side.

TABLE 12. Frequency of dorsal- and anal- fin rays of *Psettina* spp., *Taenioipsetta ocellata* and *Tosarhombus octoculatus* in Taiwan. Data of *T. octoculatus* are from other localities, except for one (marked by *) from Taiwan.

	n	Dorsal-fin rays																Anal-fin rays															
		82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107						
<i>Psettina gigantea</i>	17										1	2	2	1	1	3	3	2	1	0													
<i>Psettina ijimae</i>	7						2	3	2																								
<i>Psettina tosana</i>	20							3	0	4	3	5	3	1	0	1																	
<i>Psettina variegata</i>	4																			1	2	0	0	0	0	0	1						
<i>Taenioipsetta ocellata</i>	3					1	0	0	1	0	0	0	1																				
<i>Tosarhombus octoculatus</i>	24													1	0	0	3	2	8	6	3	1*											
<i>Psettina gigantea</i>	17										1	4	4	3	3	0	0	1	1														
<i>Psettina ijimae</i>	7				1	0	1	3	1	1																							
<i>Psettina tosana</i>	20								1	2	1	5	5	4	1	0	0	1															
<i>Psettina variegata</i>	4																																
<i>Taenioipsetta ocellata</i>	3										2	0	0	0	0	1																	
<i>Tosarhombus octoculatus</i>	29													1	5	6*	8	3	5	1													

Coloration. Ocular side of body uniformly brown, 7 dark rings along dorsal, and 6 along ventral margins of body, respectively; 4 dark rings above and 2 below lateral line, respectively. Scattered small dark blotches on body; snout and both jaws pale brown. All fins pale; median fins with faint dark blotches; blind side of body uniformly milky white.

Size. Reaching 82 mm SL in Taiwan; up to 120 mm SL in southern Japan (Amaoka, 2016).

Distribution. Northeastern and southwestern Taiwan; East China Sea and southern Japan (Amaoka, 2016).

Remarks. This species resembles small specimen of *P. gigantea*, but can be distinguished by fewer lateral-line scales and dorsal- and anal- fin rays. Otherwise, *P. tosana* is smaller in size and inhabits in shallower waters than *P. gigantea*.

***Psettina variegata* (Fowler, 1933)**

Variegated flounder; 多變鰈鯢

Figure 9F; Table 12–13

Bothus (Crossobothus) variegatus Fowler, 1934:335 (Type locality: the Philippines).

Psettina ijimae (not of Jordan & Starks): Shen in Shen *et al.*, 1993:570.

Parabothus chlorospilus (not of Gilbert): Shen in Shen *et al.*, 1993:571; Shen & Wu, 2012:753.

Specimens examined. NMMB-P23202 (1, 121.8), Ke-tzu-liao, 18 Mar. 2016; NMMB-P23203 (1, 115.7), Ke-tzu-liao, 3 Apr. 2016; NMMB-P26401 (2 of 4, 118.6–121.9), Ke-tzu-liao, 27 Jun. 2017.

Diagnostic features. D 101–107; A 78–82; P 12–13; C 2+13+2=17; LLs 75–77; GR 0+7–8=7–8; vert. 10+28–29=38–39.

Body compressed, oblong, deepest at middle part of body (38.8–43.3% SL). Head rather large, about half of body depth (24.1–27.4% SL); front profile of head with shallow concavity in front of upper eye. Snout longer than 1/2 of eye diameter. Eye diameter about equal to upper jaw. Interorbital ridge extending from anterior margin of lower eye to posterior margin of upper eye.

Mouth very small, upper-jaw length on ocular side 7.1–8.9% SL; maxilla extending to anterior margin of lower eye; maxillary head with obtuse knob, a tiny knob at mandibular symphysis. Teeth on both jaws uniserial, close-set, gradually becoming large and more widely spaced anteriorly. Gill rakers on lower limb, short, slender, pointed at tip and not serrate; absent on upper limb.

Scales on ocular side small, ctenoid with one row of long hair-like ctenii; cycloid on blind side. Pectoral fin on ocular side much shorter than head (16.9–18.8% SL); that of blind side very short, about 1/2 of that of ocular side.

Coloration. Ocular side of body uniformly darkish brown with 3 large dark blotches and small, obscure, irregularly shaped black spots; first blotch on junction between curved and straight sections of lateral line, second on middle of straight section of lateral line, and posteriormost blotch near caudal peduncle; a series of 5 dark obscure blotches along dorsal margin of body and 4 along ventral margin of body, extending to bases of dorsal and anal fins; caudal fin with large black blotch at its center; pectoral fin on ocular side with irregular shaped blackish bands; blind side of body milky white stained with dark in places.

Size. Reaching 122 mm SL in Taiwan, the largest known record.

Distribution. Southwestern Taiwan off Ke-tzu-liao, Kaohsiung, at depth not more than 100 m; the Philippines, Hong Kong, and Western Australia (Amaoka & Larson, 1999).

Remarks. This is the first record of the species in Taiwan. It resembles *P. brevirictus* and *P. ijimae* in body shape, coloration and position of blotches. However, it can be easily distinguished from the other two species in having more lateral-line scales and growing to a larger size.

The figures of *Parabothus chlorospilus* and *Psettina ijimae* provided by Shen in Shen *et al.* (1993) and the figure of *Parabothus chlorospilus* provided by Shen & Wu (2012) are here all identified as *Psettina vairegata* by us.

Genus *Taeniopsetta* Gilbert, 1905

Taeniopsetta Gilbert, 1905:680. Type species: *Taeniopsetta radula* Gilbert, 1905.

Diagnostic features. Body deeply ovoid. Tip of isthmus below posterior margin of lower eye. No sexual or ontogenetic dimorphism in dorsal head profile. Both eyes separated by ridge or very narrow concavity; interorbital width constant in both sexes and juveniles. Rostral, orbital and mandibular spines present in males, feeble or absent in females and juveniles.

Mouth small in size; maxilla extending to anterior margin of lower eye. Teeth on both jaws uniserial, not enlarged anteriorly. Gill rakers short, usually not serrated. Scales small, not deciduous, cycloid or ctenoid on ocular side, cycloid on blind side. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side.

Dorsal and anal fins with elongate rays in either sexes or males only; all rays simple. Pectoral fin on ocular side not elongate. Pelvic fin on ocular side starting behind tip of isthmus; first ray on blind side opposite to second ray on ocular side. Vent on blind side, just before origin of anal fin, and urogenital pore on ocular side, opposite side of vent. Caudal skeleton with four plates including parhypural and three hypurals, without deep clefts. Five suborbital bones on blind side.

Remarks. *Taeniopsetta* was assigned to the Paralichthyidae based on the position and asymmetrical degree of pelvic fins (Norman, 1934). Subsequently, it was assigned to the Bothidae because of the presence of intermuscular bones and lack of a first neural spine by Amaoka (1969). *Taeniopsetta* differs from other bothids in having a somewhat narrower base of the pelvic fin on the ocular side, its origin behind the tip of the isthmus, and many suborbital bones on blind side.

Taeniopsetta ocellata (Günther, 1880)

Indo-Pacific ocellated flounder; 眼斑線鰨
Figures 10A–C; Table 12–13

Pseudorhombus ocellatus Günther, 1880:56 (Type locality: Admiralty Islands, Papua New Guinea).

Taeniopsetta ocellata: Norman, 1927:17; Ho *et al.*, 2009:11.

Specimens examined. NMMB-P05155 (formerly THUP4171, 1 female, 107.7), Dong-gang, 21 Mar. 1979; NMMB-P11513 (1, 70.4), NMMB-P11514 (1, 66.5), Dong-gang, 27 May 2008; NMMB-P29264 (1, 65.7), Ke-tzu-liao, 3 Apr. 2018.

Diagnostic features. D 87–95; A 73–78; P 12–14; C 3+11+3=17; LLs 102–104; GR 0+5–6=5–6; vert. 10+31–32=41–42.

Body deeply ovate, deepest at middle of body (51.0–63.5% SL). Head slightly shorter than half of body depth (21.4–27.3% SL); front profile of head with slight concavity anterior to interorbital space. Snout length about half of eye diameter. Rostral spine on snout tip strong in males, absent or feeble in females and juveniles. Eye diameter longer than upper jaw. Strong orbital spines at anterior margin of eyes in males, none or feeble in females and juveniles. Interorbital space with low ridges separated by extremely narrow concavity.

Mouth small, upper-jaw length 5.7–8.0% SL, maxilla extending to or slightly beyond anterior margin of lower eye. Symphyseal knob strong on lower jaw. Teeth on both jaws small, uniserial. Gill rakers on lower limb, short and slender, smooth; absent on upper limb.

Scales on both sides cycloid, small, not deciduous. Twelfth to 20th rays of dorsal fin and first to 7th rays of anal fin extended in males, but not in females. Pectoral fin on ocular side not elongated. Pelvic-fin origin below posterior margin of lower eye, length of fin base and ray on ocular side slightly longer than those on blind side; first ray on blind side opposite to second ray on ocular side.

Coloration. Ocular side of body light brownish red with 4 and 3 U-shaped dark blotches along dorsal and ventral margins respectively; 3 smaller, blotches above and below middle of lateral line; median fins with many dark brownish spots and streaks. Posterior half of body on blind side dark brown in males, light brown in females.

Size. Reaches 108 mm SL in Taiwan; up to 190 mm SL elsewhere (Hensley & Amaoka, 2001).

Distribution. Southwestern Taiwan; Indian and Western Pacific oceans (southern Japan, Saya de Malha Bank, New Caledonia, Admiralty Islands) (Amaoka, 2016).

Remarks. This species exhibits a distinct sexual dimorphism in the presence or absence of a rostral spine, orbital spines in front of the both eyes, the symphyseal knob at the tip of the lower jaw, the length of the dorsal and anal fin rays and the body coloration of the blind side. Ho *et al.* (2009) listed this species for Taiwan based on a single specimen transferred from Tunghai University. We examined 3 additional juveniles from southern Taiwan.

TABLE 13. Frequency of four meristic data of *Psettina* species, *Taeniopsetta ocellata* and *Tosarhombus octoculatus* in Taiwan. Data of *T. octoculatus* are from other localities, except for one (marked by *) from Taiwan.

	Pectoral-fin rays													Gill rakers (upper + lower)													Vertebrae (precaudal + caudal)												
	n	10	11	12	13	14	n	0	1	2	3	4	5	6	7	8	9	n	10	11	+	26	27	28	29	30	31	32											
<i>Psettina gigantea</i>	17		7	9	1		17	17					5	9	3		17	17									15	2											
<i>Psettina ijimae</i>	8		2	5	1		8		2	2	4	5	3				8	8			1	6	1																
<i>Psettina tosana</i>	20	10	9	1			20	20				8	9	3			20	20					2	17	1														
<i>Psettina variegata</i>	4		3	1			4	4				1	3				4	3	1				2	2															
<i>Taeniopsetta ocellata</i>	3		1	1	1		3	3			1	2					3	3									2	1											
<i>Tosarhombus octoculatus</i>	26		13	13*			26	26*				2	16*	8			15	15*				1	13*	1															
		Lateral-line scales																																					
	n	46	47	48	49	50	51	//	55	56	57	58	59	60	61	62	63	64	65	66	//	75	76	77	//	102	103	104											
<i>Psettina gigantea</i>	17										1	4	2	4	2	2	1	1																					
<i>Psettina ijimae</i>	8								1	1	1	0	1	3	1																								
<i>Psettina tosana</i>	20	2	2	0	3	5	8																																
<i>Psettina variegata</i>	4																						1	2	1														
<i>Taeniopsetta ocellata</i>	3																									2	0	1											
<i>Tosarhombus octoculatus</i>	26											2	4	5	4	5	3	1	2*																				

Genus *Tosarhombus* Amaoka, 1969

土佐鯧屬

Tosarhombus Amaoka, 1969:64. Type species: *Tosarhombus octoculatus* Amaoka, 1969.

Diagnostic features. Body ovoid. Tip of isthmus below posterior margin of lower eye. Dorsal profile of head steeper in males than in females and juveniles. Both eyes separated by extremely wide concavity; interorbital width larger in males than in females or juveniles. Rostral, orbital and mandibular spines well developed in males.

Mouth large; maxilla extending to or slightly beyond anterior margin of lower eye. Teeth on upper jaw uniserial (rarely biserial); teeth on lower jaw uniserial, nearly same size on both sides. Gill rakers moderately long, usually not serrated, absent in upper limb.

Scales generally not deciduous, ctenoid on ocular side with one row of long ctenii along posterior margin; scales cycloid on blind side. Lateral line on ocular side curved above pectoral fin; lateral line absent on blind side. Pectoral fin rays on ocular side filamentous in males. Pelvic fin on ocular side starting at tip of isthmus, and on a vertical through posterior margin of lower eye; first ray on blind side opposite to third fin ray on ocular side. Vent on blind side, just before origin of anal fin, and urogenital pore on ocular side, opposite side of vent. Caudal skeleton with four plates including parhypural and three hypurals, without deep clefts on distal margins.

Remarks. *Tosarhombus* closely resembles *Parabothus* in having ctenoid scales with long spines on the ocular side, caudal plates lacking cleft, and sexual dimorphism in interorbital width. It differs from *Parabothus* in having a much wider interorbital space in males, a rostral spine present in males, a deeper body and a row of yellowish white blotches on the anterior margin of the head. It also resembles *Crossorhombus* in the deep body, the broad interorbital space in males, and ctenoid scales with long spines on the ocular side. It differs from *Crossorhombus* in the tip of the isthmus below the posterior margin of the lower eye, no blotch on the blind side of the body in both sexes and the first pelvic fin ray on the blind side opposite to the third ray on the ocular side.

Tosarhombus octoculatus Amaoka, 1969

Eighteyed flounder; 八斑土佐鯧

Figures 10D–E; Table 12–13

Tosarhombus octoculatus Amaoka, 1969:129, fig. 36 (Type locality: Urado, Kochi Prefecture, Japan). Ho *et al.*, 2009:7; Shen & Wu, 2012:755.

Specimens examined. NMMB-P02359 (1 male, 111.0), Taiwan, 30 May 1983. Other localities: FAKU29431 (holotype, male, 161.8), Urado, Kochi Prefecture, Japan 20 Nov., 1958; FAKU 29432–29438 (paratypes, 7 males 123.2–147.5), Urado, Kochi Prefecture, Japan, Nov. 20–24, 1958; FAKU 29439–29454, (paratypes, 6 females, 90.5–143.4), Urado, Kochi Prefecture, Japan, 20–24 Nov., 1958; FAKU 33830 (paratype, 1 female, 129.5), Urado, Kochi Prefecture, Japan, 12 Dec., 1959.

Diagnostic features. D 104 (96–104 from other localities); A 78 (76–82); P 13 (12–13); C 2+13+2=17 (2+13+2=17); LLs 66 (59–66); GR 0+7=7 (0+6–8=6–8); vert. 10+29=39 (10+28–30=38–40). Description based on a single specimen collected from Taiwan with additional information from other specimens shown in parentheses.

Body ovate, deepest at anterior 1/3 of body, its depth 50.0% SL (45.4–50.7% SL, from other localities). Caudal peduncle narrow, its depth about 10.4 (9.4–11.1)% SL. Head rather small 26.0 (25.1–27.8)% SL; upper profile of head with distinct concavity in front of dorsal margin of upper eye. Snout round, short, its length much shorter than eye diameter. Short obtuse rostral spine on tip of snout in males, (absent in females and juveniles from other localities). Eye diameter about equal to upper jaw length. Short and low orbital spine anterior of upper eye in males, (absent in females and juveniles). Interorbital space broad and shallow concave, its width about equal to eye diameter, 8.8% SL (9.1–12.9 in males, 4.2–8.3 in females), (wider in males than in females and juveniles).

Mouth large, upper-jaw length 7.9 (7.8–8.9)% SL; maxilla extending to middle of lower eye. Prominent knob on mandibular symphysis. Teeth on upper jaw small, biserial, those on outer row much shorter and widely spaced than those on inner row; teeth on lower jaw uniserial and close-set. Gill rakers only on lower limb, moderately long, pointed at tip, and not serrated, absent on upper limb. Scales small, ctenoid with long ctenii on ocular side; cycloid on blind side. Pectoral fin on ocular side moderately large, and elongate in males, its length 26.5% SL (22.4–31.4 in males, 18.5–20.4 in females and juveniles).

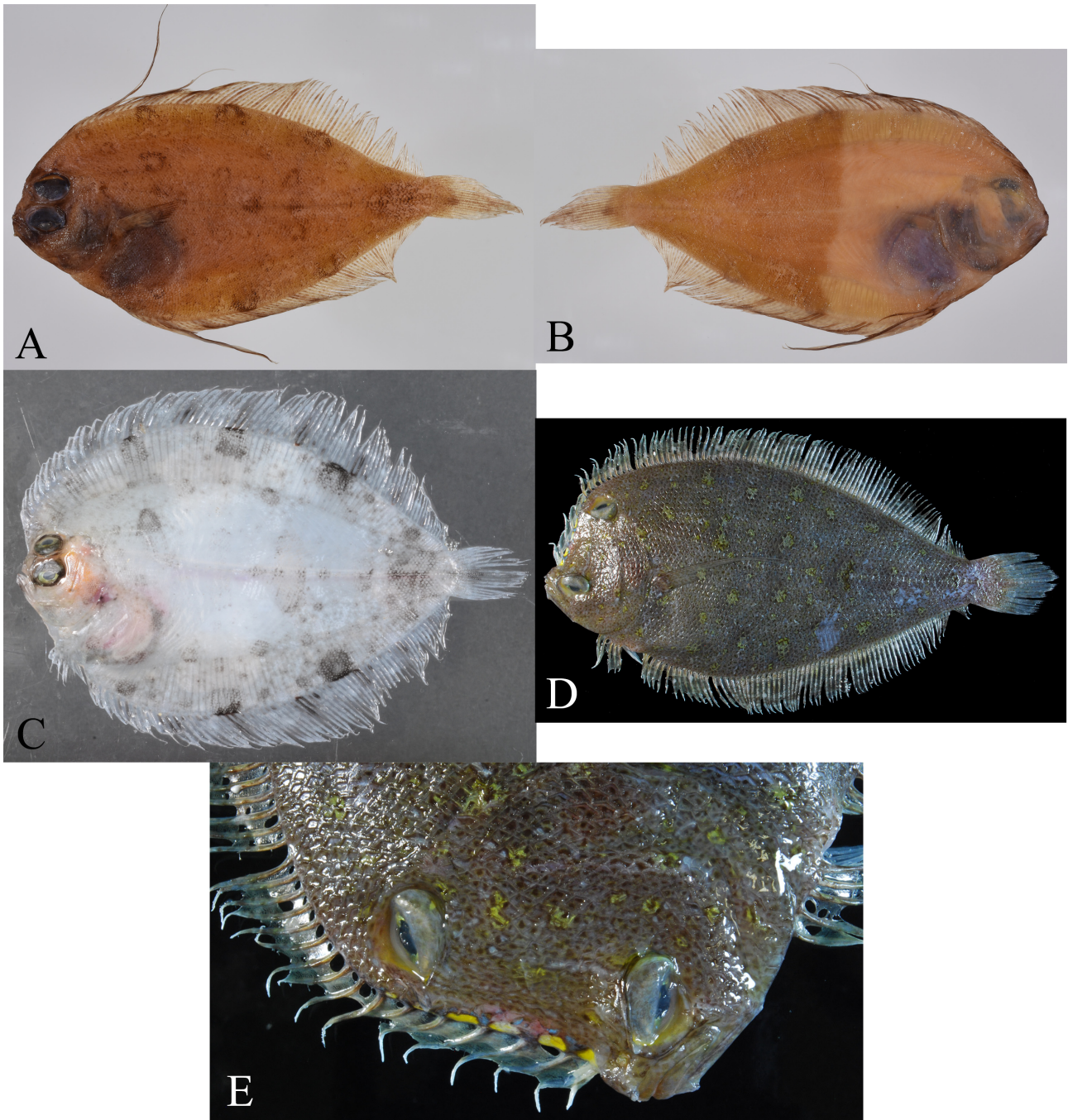


FIGURE 10. A–C. *Taeniopsetta ocellata*, FRIP01118, 160 mm SL, ocular side (A) and blind side (B), photo taken by S.-C. Chung; C. NMMB-P29264, 65.7 mm SL, juvenile. D–E. *Tosarhombus octoculatus*, ca. 200 mm SL, specimen not retained.

Coloration. Ocular side of body uniformly bluish purple; 6 yellowish white blotches with black rims on anterior margin of head; body on blind side milky white.

Size. Reaches 111.0 mm SL in Taiwan; up to 162 mm SL (Amaoka, 1969).

Distribution. Western Taiwan; southern Japan to Philippines (Amaoka, 2016).

Remarks. This species exhibits sexual dimorphism and ontogenetic changes of the interorbital width, the length of the pectoral fin on the ocular side, and the presence or absence of a rostral spine. Amaoka & Rivaton (1991) reported larvae of *T. octoculatus* from the Ryukyu Islands and eastern Taiwan. Ho *et al.* (2009) recorded a single adult male specimen from Taiwan. Photos of two large individuals collected from Penghu (Pescadores) Islands were also examined, but might now be lost.

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References

- Alcock, A.W. (1889) List of the Pleuronectidae obtained in the Bay of Bengal in 1888 and 1889, with descriptions of new and rare species. *Journal of the Asiatic Society of Bengal*, 58 (2), 279–295, pls. 16–18.
- Alcock, A.W. (1890) On some undescribed shore-fishes from the Bay of Bengal. *Annals and Magazine of Natural History*, Series 6, 6 (36), 425–443.
<https://doi.org/10.1080/00222939008694064>
- Alcock, A.W. (1894) An account of a recent collection of bathybial fishes from the Bay of Bengal & from the Laccadive Sea. *Journal of the Asiatic Society of Bengal*, 63 (2), 115–137, pls. 6–7.
- Amaoka, K. (1963a) A revision of the flatfish referable to the genus *Psettina* found in the waters around Japan. *Bulletin of the Misaki Marine Biological Institute, Kyoto University*, 4, 53–62.
- Amaoka, K. (1963b) A revision of the flatfish referable to the genus *Engyprosopon* found in the waters around Japan. *Bulletin of the Misaki Marine Biological Institute, Kyoto University*, 4, 107–121.
- Amaoka, K. (1964) Development & growth of the sinistral flounder, *Bothus myriaster* (Temminck & Schlegel) found in the Indian & Pacific Oceans. *Bulletin of the Misaki Marine Biological Institute, Kyoto University*, 5, 11–29.
- Amaoka, K. (1969) Studies on the sinistral flounders found in the waters around Japan. Taxonomy, anatomy & phylogeny. *Journal of the Shimonoseki University of Fisheries*, 18 (2), 65–340.
- Amaoka, K. (1997) Bothidae. In: Okamura, O. & Amaoka, K. (Eds.), *Sea fishes of Japan*. Yamatokeikoku-sha, Tokyo, 783 pp. [in Japanese]
- Amaoka, K. (2016) *Flatfishes of Japan (Citharidae, Paralichthyidae, Bothidae, Pleuronectidae, Poecilopsettidae, Samaridae)*. Tokai University Press, Hiratsuka, 229 pp. [in Japanese]
- Amaoka, K. & Ho, H.-C. (2018) Review of the genus *Engyprosopon* Günther, 1862 (Pleuronectiformes: Bothidae) from waters off Taiwan, with descriptions of two new species. *Zootaxa*, 4413 (3), 449–481.
<https://doi.org/10.11646/zootaxa.4413.3.2>
- Amaoka, K. & Larson, H.K. (1999) New species of *Psettina* (Pleuronectiformes: Bothidae) from off Western Australia, and record of a rare species. *Copeia*, 1999 (4), 1072–1078.
<https://doi.org/10.2307/1447981>
- Amaoka, K. & Rivaton, J. (1991) Pisces Pleuronectiformes: A review of genus *Tosarhombus* (Bothidae) with description of two new species from Saya de Malha Bank (Indian Ocean) & the Chesterfield Islands (Coral Sea). In: Crosnier, A. (Ed.), Résultats des Campagnes MUSORSTOM. Vol. 8. *Mémoires du Muséum National d'Histoire Naturelle, Série A, Zoologie*, 151, pp. 449–466.
- Amaoka, K. & Shen, S.C. (1993) A new bothid flatfish *Parabothus taiwanensis* collected from Taiwan (Pleuronectiformes: Bothidae). *Bulletin of Marine Science*, 53 (3), 1042–1047.
- Amaoka, K. & Yamamoto, E. (1984) Review of the genus *Chascanopsetta*, with the description of a new species. *Bulletin of the Faculty of Fisheries Hokkaido University*, 35 (4), 201–224.
- Amaoka, K., Mihara, E. & Rivaton, J. (1993) Pisces, Pleuronectiformes: Flatfishes from the waters around New Caledonia. A revision of the genus *Engyprosopon*. In: Crosnier, A. (Ed.), Résultats des Campagnes MUSORSTOM. Vol. 11. *Mémoires du Muséum National d'Histoire Naturelle, Paris, New Series, Série A, Zoologie*, 158, 377–426.
- Amaoka, K., Mihara, E. & Rivaton, J. (1997) Pisces, Pleuronectiformes: Flatfishes from the waters around New Caledonia. Six species of the bothid genera *Tosarhombus* and *Parabothus*. In: Séret, B. (Ed.) Résultats des Campagnes MUSORSTOM. Vol. 17. *Mémoires du Muséum National d'Histoire Naturelle, Paris, New Series, Série A, Zoologie*, 174, pp. 143–172.
- Amaoka, K., Nishikawa, S. & Tanaka, N. (1974) Sexual dimorphism & an abnormal intersexual specimen in the bothid flounder *Bothus pantherinus*. *Japanese Journal Ichthyology*, 21 (1), 16–20.
- Amaoka, K., Senou, H. & Ono, A. (1994) Record of the bothid flounder *Asterorhombus fijiensis* from the Western Pacific, with observations on the use of the first dorsal-fin ray as a lure. *Japanese Journal of Ichthyology*, 41 (1), 23–28.
- Arai, M. & Amaoka, K. (1996) *Arnoglossus macrolophus* Alcock (Pleuronectiformes: Bothidae), a valid species distinct from *A. tapeinosomus* (Bleeker). *Ichthyological Research*, 43 (4), 359–365.
<https://doi.org/10.1007/BF02347635>
- Bleeker, P. (1854) Vijfde bijdrage tot de kennis der ichthyologische faunavan Celebes. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 7 (2), 225–260.

- Bleeker, P. (1855) Derde bijdrage tot de kennis der ichthyologische fauna vande Kokos-eilanden. *Natuurkundig Tijdschrift voor Nederlandsch Indië*, 8 (1), 169–180.
- Bleeker, P. (1862) Sur quelques genres de la famille des Pleuronectoïdes. *Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen. Afdeling Natuurkunde*, 13, 422–429.
- Bleeker, P. (1865) Description de quelques espèces inédites des genres *Pseudorhombus* et *Platophrys* de l'Inde Archipélagique. *Nederlandsch Tijdschrift voor de Dierkunde*, 3, 43–50.
- Broussonet, P.M.A. (1782) *Ichthyologica sistens, piscium descriptiones et icons. Decas I.* apud P. Elmsly, London, 49 pp.
<https://doi.org/10.5962/bhl.title.5786>
- Chabanaud, P. (1929) Poissons Hétérosomates recueillis en Indo-Chine par M. le Dr. A. Krempf. *Bulletin du Muséum National d'Histoire Naturelle, Série 2*, 1 (6), 370–382.
- Chen, J.T.F. (1954) Fishes of Taiwan. *Taiwan Study Series*, 27, 1–126. [in Chinese]
- Chen, J.T.-F. (1969) *A synopsis of the vertebrates of Taiwan. Vol. 1.* Commercial Books Co., Taipei, 548 pp. [in Chinese]
- Chen, J.T.-F. & Weng, H.T.C. (1965) A review of the flatfishes of Taiwan. *Biological Bulletin Tunghai University, Ichthyology Series*, 5 (25 & 27), 1–103.
- Chen, J.T.-F. & Yu, M.-J. (1986) *A synopsis of the vertebrates of Taiwan, revised and enlarged edition.* Commercial Press, Taipei, 1092 pp. [in Chinese]
- Chen, C.-H. (2004) Checklist of fishes of Penghu. *FRI special publication*, 4, 1–175. [in Chinese]
- de Bruin, G.H.P., Russell, B.C. & Bogusch, A. (1995) *FAO species identification field guide for fishery purposes. The marine fishery resources of Sri Lanka.* FAO, Rome, 400 pp.
- Ebert, D.A., Ho, H.-C., White, W.T. & de Carvalho, M.R. (2013) Introduction of the systematics and biodiversity of sharks, rays, and chimaeras (Chondrichthyes) of Taiwan. *Zootaxa*, 3752 (1), 5–19.
<https://doi.org/10.11646/zootaxa.3752.1.3>
- Fowler, H.W. (1934) Description of new fishes obtained 1907 to 1910, chiefly in the Philippine Islands and adjacent seas. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 85, 233–367. [for 1933]
- Fricke, R., Eschmeyer, W.N. & Van der Laan, R. (Eds.) (2019) Eschmeyer's catalog of fishes: genera, species, references. Electronic Version. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 23 April 2019)
- Fukui, A. & Ozawa, T. (1988) *Arnoglossus yamanakai*. In: Masuda, H. (Ed.), *An atlas of the early stage of fishes in Japan.* Tokai University Press, Tokyo, pp. 923–924. [in Japanese]
- Fukui, A., Yamada, U. & Ozawa, T. (1990) Redescription of *Arnoglossus yamanakai* (Pleuronectiformes, Bothidae), with description of the adults. *Japanese Journal of Ichthyology*, 37 (3), 215–223.
- Gilbert, C.H. (1905) II. The deep-sea fishes of the Hawaiian Islands. In: The aquatic resources of the Hawaiian Islands. *Bulletin of the U. S. Fish Commission*, 23 (2), 577–713, pls. 66–101.
- Gilchrist, J.D.F. (1904) Descriptions of new South African fishes. *Marine Investigations in South Africa*, 3, 1–16, pls. 19–36.
- Günther, A. (1862) *Catalogue of the fishes in the British Museum. Catalogue of the Acanthopterygii Pharyngognathi & Anacanthini in the collection of the British Museum. Vol. 4.* British Museum, London, 534 pp.
- Günther, A. (1880) Report on the shore fishes procured during the voyage of H. M. S. “Challenger” in the years 1873–76. *Report on the scientific results of the voyage of H. M. S. Challenger during the years 1873–76, Zoology*, 1 (6), 1–82, pls. 1–32.
- Hensley, D.A. (1986) Current research on Indo-Pacific bothids. In: Uyeno, T., Arai, R., Taniuchi, T. & Matsuura, K. (Eds.), *Indo-Pacific Fish Biology. Proceedings of the Second International Conference on Indo-Pacific Fishes.* Ichthyological Society of Japan, Tokyo, p. 941.
- Hensley, D.A. (2003) On the status of *Rhombus cocosensis* Bleeker, and description of a new species of *Engyprosopon* based on misidentification of this species (Pleuronectiformes: Bothidae). *Copeia*, 2003 (4), 833–837.
<https://doi.org/10.1643/IA02-266.1>
- Hensley, D.A. (2005) Revision of the genus *Asterorhombus* (Pleuronectiformes: Bothidae). *Copeia*, 2005 (3), 445–460.
<https://doi.org/10.1643/CI-03-186R3>
- Hensley, D.A. & Amaoka, K. (2001) Bothidae, Lefteye flounders. In: Carpenter, K.E. & Niem, V.H. (Eds.), *Species identification guide for fishery purposes. The living marine resources of the western central Pacific. Vol. 6. Bony fishes part 4 (Labridae to Latimeriidae), estuarine crocodiles, sea turtles, sea snakes and marine mammals.* FAO, Rome, pp. 3799–3841.
- Hensley, D.A. & Randall, J.E. (1993) Description of a new flatfish of the Indo-Pacific genus *Crossorhombus* (Teleostei: Bothidae), with comments on congeners. *Copeia*, 1993 (4), 1119–1126.
<https://doi.org/10.2307/1447092>
- Hensley, D.A. & Smale, M.J. (1998) A new species of the flatfish genus *Chascanopsetta* (Pleuronectiformes: Bothidae), from the coasts of Kenya & Somalia with comments on *C. lugubris*. *The J.L.B Smith Institute of Ichthyology, Special Publication*, 59, 1–16.
- Ho, H.-C., Lin, C.-C., Ju, Y.-M., Wang, S.-I., Shao, K.-T. & Chang, C.-W. (2009) Specimen catalog of the National Museum of Marine Biology and Aquarium transferred from Tunghai University. (I) Order Pleuronectiformes. *Platax*, 6, 1–16.
- Hubbs, C.L. (1915) Flounders & soles from Japan collected by the United States Bureau of Fisheries steamer “Albatross” in 1906. *Proceedings of the United States National Museum*, 48 (2082), 449–496, pls. 25–27.
<https://doi.org/10.5479/si.00963801.48-2082.449>
- Hubbs, C.L. & Lagler, K.F. (1974) *Fishes of the Great Lakes region.* The University of Michigan Press, Ann Arbor, 213 pp., 44

pls.

- Jordan, S. & Starks, E.C. (1904) List of fishes dredged by the steamer "Albatross" off the coast of Japan in the summer of 1900, with descriptions of new species and a review of the Japanese Macrouridae. *Bulletin of the U. S. Fish Commission*, 22, 577–630, pls. 1–8.
- Jordan, S. & Starks, E.C. (1906) A review of the flounders and soles of Japan. *Proceedings of the United States National Museum*, 31 (1484), 161–246.
<https://doi.org/10.5479/si.00963801.31-1484.161>
- Kamohara, T. (1936) Supplementary notes on the fishes collected in the vicinity of Kochi-shi (IX). *Zoological Magazine Tokyo*, 48 (6), 306–311.
- Kamohara, T. (1959) New records of fishes from Kochi Prefecture, Japan. *Report of Usa Marine Biology Station*, 6 (2), 1–8.
- Kuronuma, K. (1939) The miscellaneous notes on the flatfishes preserved at the Kominato Marine Biological Station, Chiba Prefecture. *Suisan Kenkyushi*, 34, 83–86.
- Kuronuma, K. (1940) The heterosomate fishes collected in deep waters of Japan. I. *Bulletin of the Biogeographical Society of Japan*, 10 (3), 29–61.
- Lin, P.-L., Shao, K.-T. & Shen, S.-C. (1995) Records of the genus *Asterorhombus* (Family: Bothidae) and its two species from northern Taiwan and Taiping Island. *Acta Zoologica Taiwanica*, 6 (1), 25–32.
- Munroe, T.A. (2003) Family Bothidae. In: Carpenter, K.E. (Ed.), *The living marine resources of the Western Central Atlantic. Bony fishes Part 2. FAO species identification guide for fishery purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5. Food and Agriculture Organization of the United Nations*. FAO, Rome, pp. 1885–1895.
- Nakabo, T. & Hirashima, Y. (2015) *Scientific names of Japanese fishes: Etymology*. Tokai University Press, Kanagawa, 372 pp. [in Japanese]
- Norman, J.R. (1926) A report on the flatfishes (Heterosomata) collected by the F. I. S. "Endeavour", with a synopsis of the flatfishes of Australia & a revision of the subfamily Rhombosoleinae. *Biological Results of the Fishing Experiments carried on by the F. I. S. "Endeavour" 1909–1914*, 5 (5), 219–308.
- Norman, J.R. (1927) The flatfishes (Heterosomata) of India, with a list of the specimens in the Indian Museum. *Records of the Indian Museum, Calcutta*, 29 (1), 7–48.
- Norman, J.R. (1931a) Notes on flatfishes (Heterosomata)-I. Notes on flatfishes of the family Bothidae in the British Museum, with descriptions of three new species. *Annals and Magazine of Natural History*, Series 10, 8 (47), Art. 69, 507–510.
<https://doi.org/10.1080/00222933108673430>
- Norman, J.R. (1931b) Notes on flatfishes (Heterosomata)-III. Collection from China, Japan, & the Hawaiian Islands. *Annals and Magazine of Natural History*, Series 10, 8 (48), 597–604.
<https://doi.org/10.1080/00222933108673448>
- Norman, J.R. (1934) *A systematic monograph of the flatfishes (Heterosomata). Vol. 1. Psettodidae, Bothidae, Pleuronectidae*. British Museum (Natural History), London, viii + 459 pp.
<https://doi.org/10.5962/bhl.title.8585>
- Norman, J.R. (1939) Fishes. The John Murray Expedition 1933–34. *Scientific Reports, John Murray Expedition*, 7 (1), 1–116.
- Okada, Y. & Matsubara, K. (1938) *Keys to the fishes & fish-like animals of Japan, including Kurile Islands, southern Sakhalin, Bonin Islands, Ryukyu Islands, Korea and Formosa*. Sansendo, Tokyo, 584 pp., 113pls. [in Japanese]
- Ozawa, T. & Fukui, A. (1986) Studies on the development & distribution of the bothid larvae in the western North Pacific. In: Ozawa, T. (Ed.), *Studies on the oceanic ichthyoplankton in the western North Pacific*. Kyushu University Press, Fukuoka, pp. 322–420.
- Rafinesque, C.S. (1810) *Caratteri di alcuni nuovi generi e nuove specie di animali e piante della sicilia, con varie osservazioni sopra i medisimi. Part I*. Sanfilippo, Palermo, pp. 3–69.
<https://doi.org/10.5962/bhl.title.104418>
- Regan, C.T. (1908) Report on the marine fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean. *The Transactions of the Linnean Society of London, Second Series, Zoology*, 12 (3), 217–255, pls. 23–32.
<https://doi.org/10.1111/j.1096-3642.1908.tb00199.x>
- Regan, C.T. (1920) A revision of the flat-fishes (Heterosomata) of Natal. *Annals of the Durban Museum*, 2 (5), 205–222.
- Rüppell, W.P.E.S. (1830–31) *Atlas zu der Reise im nördlichen Afrika. Fische des Rothen Meers*. Heinrich Ludwig Brönnner, Frankfurt, 141 pp., 35 pls.
- Shen, S.-C. (1983) Study on the bothid fishes (Family Bothidae) from Taiwan. *Journal of Taiwan Museum*, 36 (1), 1–41.
- Shen, S.-C. (1984) *Synopsis of fishes of Taiwan*. Southern Materials Center, Taipei, Taiwan, 533 pp.
- Shen, S.-C. (1993) *Pleuronectiformes*. In: Shen, S.-C., Lee, S.-C., Shao, K.-T., Mok, H.-K., Chen, C.-T. & Chen, C.-H. (Eds.), *Fishes of Taiwan*. Department of Zoology, National Taiwan University, Taipei, pp. 565–574.
- Shen, S.-C. & Wu K.-Y. (2012) *Fishes of Taiwan*. National Museum of Marine Biology & Aquarium, Pingtung, 896 pp.
- Smith, H.M. & Pope, T.E.B. (1906) List of fishes collected in Japan in 1903, with descriptions of new genus and new species. *Proceedings of the United States National Museum*, 31 (1489), 459–499.
<https://doi.org/10.5479/si.00963801.31-1489.459>
- Tanaka, S. (1915) Ten new fishes found in the waters around Japan. *Zoological Magazine Tokyo*, 27 (325), 565–568. [in Japanese]

- Tanaka, S. (1918) Twelve new fishes found in the waters around Japan. *Zoological Magazine Tokyo*, 30 (356), 223–227. [in Japanese]
- Temminck, C.J. & Schlegel, H. (1842–50) Pisces. *Siebold's Fauna Japonica, Leiden*, 1842–1850, 1–323, 144 pls.
- Tongboonkua, P., Lee M.-Y. & Chen W.-J. (2018) A new species of sinistral flatfish of the genus *Chascanopsetta* (Teleostei: Bothidae) from off Papua New Guinea, western Pacific Ocean. *Zootaxa*, 4476 (1), 168–181.
<https://doi.org/10.11646/zootaxa.4476.1.16>
- von Bonde, C. (1922) The Heterosomata (flat fishes) collected by the S. S. “Pickle”. *Report Fisheries and Marine Biological Survey, Union of South Africa*, 2 (1), 1–29, pls. 1–6.
- Yamada, U., Tokimura, M., Horikawa, H. & Nakabo, T. (2007) *Fishes and fisheries of the East China and Yellow Seas*. Tokai University Press, Kanagawa, 1262 pp. [in Japanese]