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Discovery of a second juvenile of the rare flatfish *Plagiopsetta glossa* (Pleuronectiformes: Samaridae) from the East China Sea

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Abstract

The morphology and coloration of a juvenile of the tongue flatfish *Plagiopsetta glossa* Franz, 1910 are described in detail herein based on a single specimen of 22.0 mm standard length (SL) collected at 45 m in the East China Sea off Kerama Islands, Japan. The coloration of the late stage juvenile differs from that of a previously reported early stage juvenile of 10.0 mm SL. We also found differences in morphology and coloration between this juvenile and adults; namely, the ocular-side scales are far less ctenoid in the juvenile. Additionally, the body is less prominently pigmented on the ocular side in the juvenile, and yellow spots are only present on the unpaired fins of the juvenile. Finally, this juvenile lack pectoral fin banding on the ocular side, whereas adults are characterized by some dark cross bands. These observations suggest that scale morphology and coloration of *P. glossa* change during the transition from the late juvenile to the adult stage.

Keywords: Actinopterygii, biodiversity, Kerama Islands, lateral line, taxonomy

Introduction

The tongue flatfish *Plagiopsetta glossa* Franz, 1910, which belongs to the family Samaridae, is known from depths of 65–220 m in tropical to temperate waters off southern Japan, South Korea, Taiwan, southern China, Philippines, and off the east coast of Australia (e.g., Shen, 1982; Cooper et al., 1994; Nakabo, 2002; Park et al., 2007; Yamada et al., 2007; Jeong, 2017). Larval (Sasaki & Uyeda, 2002) and adult stages (e.g., Franz, 1910; Kuronuma, 1940; Shen, 1982; Cooper et al., 1994; Mihara & Amaoka, 1995) have been described in detail. However, only limited knowledge exists on juveniles (Minami, 1988, 2014).

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In 2019 a single specimen of a juvenile *P. glossa* was collected at 45 m from the East China Sea off Kerama Islands, Okinawa Prefecture, Japan. We describe its morphology and coloration in detail herein and compare these features with those of another juvenile, as well as adult specimens.

Materials and methods

The present specimen is deposited in the Department of Zoology, National Museum of Nature and Science, Tsukuba, Japan (NSMT); comparative specimens have been curated in the fish collection of the Hokkaido University Museum, Hakodate, Japan (HUMZ).

Counts and proportional measurements follow Hubbs and Lagler (1958) except that all dorsal, anal and caudal-fin rays were counted individually, snout length was measured from the anterior margin of the orbit of the non-migrated eye to the anterior tip of the upper jaw, and the length of the middle caudal-fin ray was measured from the ray's base to its distal tip. Vertebral counts were determined from a radiograph and are expressed as abdominal + caudal vertebrae. All measurements were made to the nearest 0.1 mm with digital calipers and a divider. Standard length and head length are abbreviated as SL and HL, respectively. Terminology of sensory pores on the head follows Voronina (2009). The definition for "juvenile stage" of Kendall et al. (1984) was adopted.

Results

Plagiopsetta glossa Franz, 1910
舌形斜鎧鰈
(Fig. 1; Table. 1)

Material examined. NSMT-P 134468, 22.0 mm SL, sex unknown, East China Sea, specifically off the southern coast of Nagannu Island, Kerama Islands, Ryukyu Islands, Okinawa Prefecture, Japan (26°14.60′N 127°32.41′E to 26°14.69′N 127°32.40′E), 45 m depth, 26 May 2019, dredge, R/V *Toyoshio-maru* (Hiroshima University).

Comparative materials. HUMZ 37129, 51.7 mm SL, male, Mimase fish market, Kochi Prefecture, Japan, date unknown; HUMZ 48065, 121.6 mm SL, male, Mimase fish market, Kochi Prefecture, Japan, 11 Oct. 1972; HUMZ 58700, 102.3 mm SL, male, Mimase fish market, Kochi Prefecture, Japan, 24 Oct. 1976; HUMZ 79911, 143.2 mm SL, male, off Owase, Mie Prefecture, Japan, 85 m depth, 11 Dec. 1978.

Description of the 22 mm SL juvenile (NSMT-P 134468).

Meristic data. Dorsal-fin rays 71; anal-fin rays 50; pectoral-fin rays 8;

Tab. 1. Comparison of select morphological features and coloration of juveniles and adults of *Plagiopsetta glossa*.

	Juveniles		Adults
	NSMT-P 134468	Minami (1988, 2014)	Previous[a-n] and present studies
SL (mm)	22.0	10.0	44.5–172
Morphology			
Scales on ocular side of head	Weakly ctenoid	–	Ctenoid
Scales on ocular side of body	Weakly ctenoid	–	Ctenoid
Scales on blind side of head	Cycloid and weakly ctenoid	–	Weakly ctenoid
Scales on blind side of body	Cycloid	–	Weakly ctenoid
Middle of body on both sides	Scaleless	–	Scaly
Ocular-side lateral line	Incomplete	–	Complete
Blind-side lateral line	Absent	–	Absent or incomplete
Coloration			
Ocular side of snout	Unpigmented	Unpigmented	Unpigmented or feebly pigmented
Ocular side of body	Partially pigmented	Slightly pigmented	Whole pigmented
Vertical band ventral to pectoral-fin base	Present	Absent	–
Large blotch on middle of body	Present	Absent	–
Small, faint blotch on posterior body	Present	Present	–
Vertical band on caudal peduncle	Present	Absent	–
Blind side of body	Unpigmented	–	Pigmented
Yellow spots on unpaired fins (when fresh)	Present	–	Absent
Bands on pectoral fin	Absent	Absent	Present
Ocular-side pelvic fin	Unpigmented	Unpigmented	Pigmented
Blind-side pelvic fin	Unpigmented	Unpigmented	Unpigmented

– No data; [a]Franz (1910), [b]Kuronuma (1940), [c-d]Shen (1982, 1984), [e]Sakamoto (1984a), [f]Cooper et al. (1994), [g]Mihara and Amaoka (1995), [h]Park et al. (2007), [i-j]Yamada et al. (2007, 2009), [k]Liu et al. (2014), [l]Ikeda and Nakabo (2015), [m]Jeong (2017), and [n]Amaoka (2020).

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pelvic-fin rays 5 in both ocular- and blind-side fins; caudal-fin rays 16; lateral line scales on ocular side unquantifiable due to incompleteness of lateral line; vertebrae 11+28.

Measurements (% SL). HL 26.7 on ocular side, 29.3 on blind side; body depth 39.2; snout length 5.6; upper eye diameter 10.4; lower eye diameter 9.7; upper jaw length 8.8 on ocular side and 8.6 on blind side; lower jaw length 13.4 on ocular side and 12.5 on blind side; pectoral fin length 21.5; pelvic fin length 14.7 on ocular side and 14.3 on blind side; pelvic fin base length 5.6 on ocular side and 5.4 on blind side; caudal peduncle length 8.8; caudal peduncle depth 13.0; middle caudal-fin ray 26.2.

Additional measurements (in SL or HL). HL on ocular side 3.7 in SL and 3.4 on blind side; body depth 2.6 in SL; snout length 4.8 in HL; upper eye diameter 2.6 in HL; lower eye diameter 2.7 in HL; interorbital width 30.8 in HL; upper jaw length on ocular side 3.0 in HL and 3.4 on blind side; lower jaw length on ocular side 2.0 in HL and 2.3 on blind side; pectoral-fin length 4.7 in SL; pelvic-fin length on ocular side 6.8 in SL and 7.0 on blind side; pelvic-fin base length on ocular side 18.0 in SL and 18.6 on blind side; caudal peduncle length 11.4 in SL; caudal peduncle depth 7.7 in SL; middle caudal-fin ray 3.8 in SL.

Body laterally compressed, elliptical, and deepest at midpoint (Fig. 1). Head small, the dorsal profile gently sloping anteriorly; head length on ocular side slightly smaller than on blind side. Dextral eye large, not covered by scales, and separated from its counterpart by a narrow, scaleless bony ridge; dorsal margin of upper orbit almost reaching dorsal profile of head; anterior margins of both eyes nearly on same vertical line; sizes of both eyes almost equal. Two nostrils on ocular side; anterior nostril a long tube with its anterior tip reaching maxilla when depressed antero-ventrally; posterior nostril a shorter tube, situated just anterior to interorbital bony ridge. Two nostrils on blind side: minute and without tubes; both nostrils situated at same horizontal level. Two supraorbital canal pores on ocular side (absent on blind side). Mouth oblique; anterior tip of premaxilla anterior to upper margin of lower orbit; maxilla extending below anterior margin of lower eye, not reaching below middle of lower eye; teeth biserial anteriorly and uniserial posteriorly on all jaws; minute conical teeth in outer rows, moderate to minute conical teeth in inner rows on all jaws. Vomer and palatine toothless. Gill rakers on first arch rudimentary on both limbs of both sides. Gill membranes connected with one another. Scales weakly ctenoid on ocular side (albeit cycloid on basal caudal fin);

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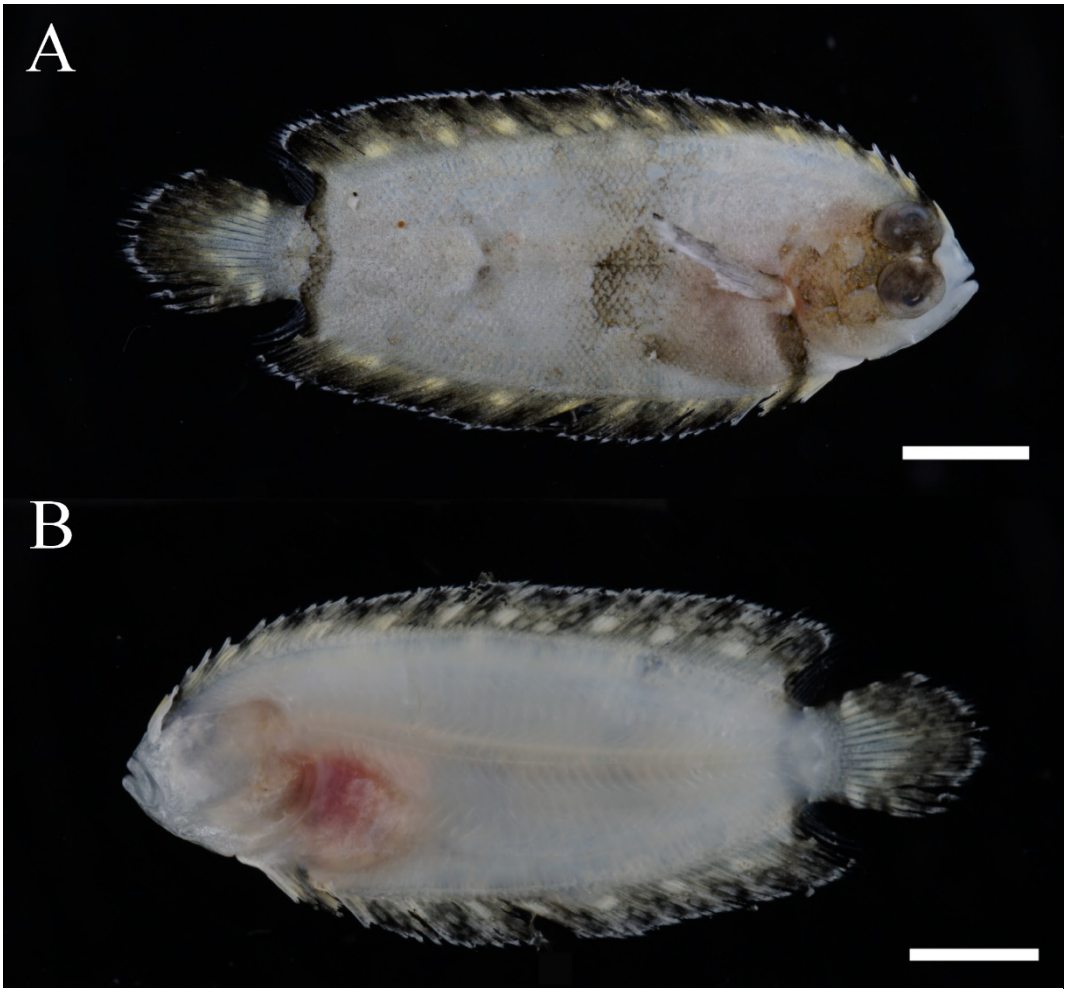

Fig. 1. Ocular side (A) and blind side (B) of a fresh juvenile of *Plagiopsetta glossa*. NSMT-P 134468, 22.0 mm SL, East China Sea off Kerama Islands, Okinawa Prefecture, Japan. Scale bars indicate 5 mm. Photographs taken by G. Shinohara.

cycloid on blind side except for single weakly ctenoid scale on cheek; snout, jaws, mid-part of body, and fins (except for basal caudal fin) scaleless on both sides. Lateral line on ocular side incomplete, without pored scales on middle of body; lateral line absent on blind side.

Dorsal-fin origin anterior to upper orbit on ocular side; dorsal-fin origin dorsal to premaxilla on blind side and anterior to vertical line through anterior nostril; dorsal-fin membrane originating on blind side behind upper jaw and not covering nostrils. Anal-fin origin slightly posterior to anus; anal-fin membrane not connected to pelvic-fin membranes.

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Pectoral fin on ocular side moderate in size, not reaching middle of body; dorsal-most ray longest and eighth ray shortest on ocular side; no pectoral fin on blind side. Pelvic fins small and sub-symmetrical; first ray on ocular-side pelvic fin slightly anterior to first ray of blind-side fin; third ray longest in both pelvic fins. All dorsal-, anal-, pectoral-, and pelvic-fin rays simple and unbranched. Caudal fin short and rounded; all caudal-fin rays bifurcated except for upper- and lower-most two (i.e., simple rays). Anus on midventral line between pelvic and anal fins.

Coloration of fresh specimen (based on photograph; Fig. 1). Body pigmented partially on ocular side and unpigmented on blind side; body white on ocular side, with single vertical black band ventral to pectoral-fin base; single, large, black blotch on middle of body; single, faint, small, black blotch on posterior part of body; single, vertical, black band on caudal peduncle; blind side of body white. Eyes blackish gray; anterior rim of both orbits black. Snout, upper and lower jaws, and isthmus white. Cheek yellowish-brown on ocular side and white on blind side. Pectoral fin grayish white, with single black dot distally. Pelvic fin yellow with single, vertical, black band on ocular side; blind-side pelvic fin white. Ocular side of dorsal fin black with white margin and featuring 11 yellow spots along base; blind side of dorsal fin marbled with 11 white spots along base. Ocular side of anal fin black with white margin and seven yellow spots along base; blind side of anal fin marbled, with seven white spots along base. Ocular side of caudal fin black except for gray base and white margin (with single, faint, yellow, V-shaped line); blind side of caudal fin gray anteriorly and marbled posteriorly (with white margin); upper- and lower-most areas of caudal fin (behind blind side caudal-fin base) with two white spots.

Coloration in alcohol. Head grayish white on ocular side; pelvic fin black on ocular side; yellow bands or spots absent on dorsal, anal, and caudal fins. Coloration of other parts similar to that of fresh specimen.

Remarks. Minami (1988: 953, 954) presented a single-line illustration (drawn by Muneo Okiyama) with a brief description of a 10.0 mm SL juvenile under the name of *Poecilopsetta plinthus*. However, Uyeda and Sasaki (2001) determined that this specimen was incorrectly identified and should instead be *P. glossa*. We agree with this correction, and, in fact, Minami's (1988) specimen is very similar to the present juvenile in possessing the following features: longer nasal tube present in the anterior nostril, dorsal-fin origin anterior to upper orbit, and a single, faint, small blotch present on

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the posterior part of the body (unnumbered fig. in Minami, 1988: 954; unnumbered fig. in Minami, 2014: 1479; Table 1). On the other hand, the present specimen is different from Minami's juvenile in its coloration: 1) a single, vertical band present ventral to the pectoral-fin base in the present juvenile vs. no band (and only a few melanophores present ventral to the base of the pectoral fin) in Minami's juvenile; 2) a single, large blotch present on the middle of the present juvenile's body (neither blotches nor melanophores were seen on the Minami's juvenile); 3) a single, vertical band on the former's caudal peduncle (vs. no band in the Minami's juvenile, which instead presented a patch of melanophores on the dorsal and ventral margins of the caudal peduncle); and 4) pigmented dorsal and anal fins (those of Minami's juvenile unpigmented, except for dark blotches along a horizontal line on each fin; Table 1). These differences seem to be related to age: the present juvenile and Minami's juvenile are possibly at the late and early juvenile stages, respectively, judging from their sizes (22.0 vs. 10.0 mm SL).

Comparison of juvenile and adults. Characters of this juvenile are almost consistent with those of the original description of *P. glossa* (Franz, 1910) and in the descriptions of *P. glossa* provided in subsequent studies (e.g., Kuronuma, 1940; Cooper et al., 1994; Mihara & Amaoka,1995). Accordingly, we identified this juvenile as *P. glossa*.

We found the following morphological differences between the present juvenile and adult specimens (Table 1; Franz, 1910; Kuronuma, 1940; Cooper et al., 1994; Mihara & Amaoka, 1995): 1) scales weakly ctenoid on ocular side and mostly cycloid on blind side in the present juvenile (vs. ctenoid on ocular side and mostly weakly ctenoid on blind side in adults); and 2) middle of body and middle of both sides of caudal fin scaleless (vs. scaly). Additionally, the coloration of the present juvenile when fresh is also different from that of adult specimens, judging from the figures in the previous studies (pl. 318-F in Sakamoto, 1984a; figs. 438-24a, c & 440-5 in Shen, 1984; fig. 2B in Park et al., 2007; pl. 48-3 in Yamada et al., 2007; pl. 539 in Yamada et al., 2009; fig. 176 in Liu et al., 2014; pl. 236-6 in Ikeda & Nakabo, 2015; unnumbered fig. in Jeong, 2017; unnumbered fig. in Amaoka, 2020): 1) body partially pigmented without ocelli on ocular side in the present juvenile (vs. entire ocular side pigmented with or without some ocelli along dorsal and anal-fin bases in adults); 2) body unpigmented on blind side (vs. partially or whole pigmented); 3) dorsal, anal, and caudal fins with some yellow spots (vs. no such yellow spots); pectoral fin without

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bands (vs. some dark cross bands); and 4) pelvic fin on ocular side unpigmented (vs. partially pigmented). These differences suggest that scale morphology and coloration of *P. glossa* change ontogenetically, especially during the transition from the late juvenile stage to the adult stage.

Distribution. *Plagiopsetta glossa* is known from the western Pacific: southern Japan, South Korea, Taiwan, southern China, Philippines, and eastern Australia at depths of 65–220 m (adults) and 45 m (present juvenile; e.g., Franz, 1910; Fowler, 1934; Shen, 1982, 1993; Cooper et al., 1994; Shinohara et al., 2005; Park et al., 2007; Yamada et al., 2007, 2009; Ohashi & Motomura, 2011; Shen & Wu, 2011; Liu et al., 2014; Ikeda & Nakabo, 2015; Jeong, 2017; Amaoka, 2020; Tashiro, 2022).

Additional comments. The genus *Plagiopsetta* Franz, 1910 comprises four valid species: *P. glossa*, *Plagiopsetta gracilis* Mihara & Amaoka, 2004, *Plagiopsetta stigmosa* Mihara & Amaoka, 2004 and *Plagiopsetta biocellata* Fricke, Golani, & Appelbaum-Golani, 2019. *Plagiopsetta glossa* is easily distinguished from its congeners in having 64–75 dorsal-fin rays (vs. 82 in *P. gracilis*, 71–78 in *P. stigmosa*, and 61 in *P. biocellata*,), 45–68 lateral line scales on the ocular side (vs. 97, 70–86, and 74, respectively), and 26–28 caudal vertebrae (vs. 34, 29–30, and 31, respectively; Mihara & Amaoka, 2004; Fricke et al., 2019; present study). *Plagiopsetta glossa* is also distinct from *P. gracilis* in having 50–57 anal fin rays (vs. 66) and from *P. stigmosa* and *P. biocellata* in its absence of a jet-black blotch on the pectoral fin (vs. present; Mihara & Amaoka, 2004; Fricke et al., 2019).

We also reviewed the existence of a lateral line on the blind side as a potential species-level character, as originally proposed by Mihara and Amaoka (2004) and Fricke et al. (2019). The lateral line is absent on the blind side in *P. glossa* and *P. gracilis* vs. complete and incomplete in *P. stigmosa* and *P. biocellata*, respectively. This is one reason why we deemed our specimen to be *P. glossa*. However, the original description of *P. glossa* (Franz, 1910) and the description by Cooper et al. (1994) indicate that this species has an incomplete lateral line on the blind side. We also found that the four additional adult specimens of *P. glossa* examined herein have incomplete lateral lines on their blind sides consisting of 3–10 pored scales. This suggests that *P. glossa* demonstrates intraspecific variation in this character. Therefore, this character cannot separate *P. glossa* from either *P. gracilis* or *P. biocellata*.

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