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Coloration of a small Nozawa's prickleback, *Stichaeus nozawae* Jordan and Snyder, 1902 (Zoarcoidei : Stichaeidae)

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Abstract

The coloration of small individuals of Nozawa's prickleback, *Stichaeus nozawae* is presented for the first time, based on a specimen (112 mm SL) collected by T/S *Ushio-maru* from the Funka Bay, Hokkaido. The specimen has obscure bands on dorsal, anal, caudal and pectoral fins. Although specimens of comparable sizes (57.4–168 mm SL) have obscure bands on these fins, most larger specimens (252–361 mm SL) have no bands on the caudal and pectoral fins. Most descriptions or images in previous studies, including the original description, were based on large specimens (220–450 mm SL), which have no bands on these fins. Thus, bands on caudal and pectoral fins of *S. nozawae* tend to disappear with growth.

Key words : Funka Bay, Hokkaido, Band, Color variation, T/S *Ushio-maru*

Introduction

The stichaeid Nozawa's prickleback or mottled shanny, *Stichaeus nozawae* Jordan and Snyder, 1902, which lives in coastal waters at depths from 6.5–500 m, has been recorded in the Sea of Japan from the Niigata Prefecture to the west coast of Sakhalin, in the Okhotsk Sea from northeast of Hokkaido to south of Kuril Islands, and the Pacific coast of the Japanese Archipelago north from the Aomori Prefecture (e.g., Hikita, 1951 ; Oshima, 1957 ; Amaoka et al., 1989 ; Mecklenberg and Sheiko, 2004 ; Hatooka, 2013 ; Tohkairin et al., 2015). In the original description by Jordan and Snyder (1902), the description of the coloration and drawing of this species was based on the holotype, 255 mm body length, collected from Otaru in the Sea of Japan off Hokkaido. Although many subsequent studies also described the coloration of this species and included drawings or photographs (e.g., Kamohara, 1961 ; Amaoka et al., 1983, 1995 ; Amaoka and Miki, 1984 ; Kamohara and Okamura, 1985 ; Abe, 1989 ; Tsuda, 1990 ; Miki, 2000 ; Taki et al., 2005 ; Hatooka, 2013 ; Tohkairin et al., 2015 ; Kai, 2018), all were based only on large specimens [220–450 mm SL (standard length)]. Thus, the coloration of small specimens of this species has never been described.

Recently, a single small specimen (112 mm SL) of *S. nozawae* was collected by T/S *Ushio-maru* from the Funka Bay, Hokkaido. Its coloration differs from that of large specimens. In this study, we describe the coloration of the specimen when it was fresh and after it was preserved. In addition, we briefly review the color variation of *S. nozawae* based on preserved specimens and images of fresh specimens.

Materials and Methods

The specimens examined in this study are deposited at the Hokkaido University Museum, Hakodate (HUMZ).

Methods for counting and measuring are those of Hubbs and Lagler (1958), except for counts of dorsal- and anal-fin rays and vertebrae and measurements of body depth and length of paired fins, which follow Miki and Maruyama (1986), and caudal-fin ray counts, which follow Yatsu (1981). Measurements were made to the nearest 0.1 mm with dial and digital calipers. Unpaired-fin rays and vertebrae were counted from a radiograph.

Stichaeus nozawae Jordan and Snyder, 1902
(Standard Japanese name : Taue-gaji)
(Figs. 1, 2 ; Tables 1, 2)

Stichaeus nozawae Jordan and Snyder, 1902 : 496–497, fig. 26 (original description ; type locality : Otaru, Sea of Japan off Hokkaido) ; Sato, 1937 : 31 ; Okada and Matsubara, 1943 : 403 ; Hikita, 1951 : 311 ; Oshima, 1957 : 6 ; Makushok, 1958 : 19, 49, 79–80, figs. 7Б, 30Б, 51Б ;

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Uyeno, 1971 : 85 ; Amaoka et al., 1983 : 73, fig. 115 ; Lindberg and Krasyukova, 1989 : 54, 63–68, figs. 42, 43B ; Tsuda, 1990 : 292–293, unnumbered fig. ; Amaoka et al., 1995 : 260, pl. 441 ; Sokolovskaya et al., 1998 : 12 ; Mecklenburg and Sheiko, 2004 : 5 ; Taki et al., 2005 : 757, fig. 3026 ; Pitruk et al., 2011 : 461–462, figs. 1–2 ; Shinohara et al., 2012 : 196 ; Hatooka, 2013 : 1242, unnumbered fig. ; Shinohara et al., 2014 : 269 ; Tohkairin et al., 2015 : 13, pl. IX, fig. 6 ; Moreva et al., 2016 : 471–478 ; Dyldin et al., 2018 : 9 ; Kai, 2018 : 364, unnumbered fig. ; Turanov et al., 2019 : 1792–1793 ; Amaoka et al., 2020 : 419, fig. 649.

Stichaeus nozawai : Matsubara, 1955 : 766 ; Kato, 1956 : 322 ; Kamohara, 1961 : 66 ; Ouchi, 1963 : 130 ; Amaoka and Miki, 1984 : 302, pl. 271–H ; Kamohara and Okamura, 1985 : 37, fig. 108 ; Miki and Maruyama, 1986 : 402–404, fig. 3B, tables 1–5 ; Abe, 1989 : 178, fig. 532 ; Amaoka et al., 1989 : 271 ; Hatooka, 1993 : 917 ; Hatooka, 2000 : 1048 ; Miki, 2000 : 545, fig. 12 ; Hatooka, 2002 : 1048 ; Shinohara et al., 2009 : 725 ; Amaoka et al., 2011 : 336, fig. 509.

Diagnosis

Dorsal–fin rays XLIX–LI ; anal–fin soft rays 35–38 ; pectoral–fin rays 15–16 ; caudal vertebrae 37–39 ; maxilla extending to vertical through posterior margin of eye ; double rows of pores in a lateral line canal ; 2nd pelvic–fin soft ray longer than 3rd soft ray ; oblique bands present on dorsal fin.

Material

HUMZ 230899, 112 mm SL, 42°19.715'N, 140°23.038'E, Funka Bay, Hokkaido, 52 m depth, 29 September 2019.

Description

Counts are listed in Table 1. Measurements (% SL) : Head length 23.3 ; body depth 11.2 ; snout length 3.6 ; orbital diameter 5.2 ; eye diameter 4.5 ; interorbital width 2.1 ; post orbital length 15.0 ; upper jaw length 7.3 ; lower jaw length 10.3 ; caudal–fin length 15.1 ; pectoral–fin length 17.8 ; pelvic–fin length 7.4 ; dorsal–fin base length 76.4 ; anal–fin base length 57.9 ; predorsal length 21.8 ; preanal length 42.3 ; depth of caudal peduncle 5.3.

Color when fresh based on photograph (Fig. 1). Body light brown. Dorsal surface of head brown. Snout white, except for black line running from pupil to anterior edge of orbit. Edges of sensory pores on head black. Two brown bands extending from orbit, one downward and other directed obliquely from posterior edge to cheek. Upper jaw not pigmented except for brown maxillary base. Lower jaw with four vertical black bands, anterior most faint and posterior most wider. Isthmus brown. Lower opercular region yellowish. Anterior opercular region brown. Skin covering branchiostegal rays brown. Black blotch above base of pectoral fin. Eight faint brown bands on body dorsally extending ventrally from base of dorsal fin, anterior most directed downward over lateral line, but others not reaching below lateral line. Irregular brown blotches on anterior part of sides behind pectoral–fin base. Ventral region between pelvic and anal fins white. Small white spots scattered ventrally. Caudal peduncle brown. Anterior half of dorsal fin light brown with black blotch on anterior most part, followed by seven faint oblique black bands. Posterior part of dorsal fin yellowish. Anal fin yellowish, with six broad black bands and black vertical line between second and third bands. Caudal fin yellowish with three obscure vertical black bands. Pectoral fin semitransparent with three obscure oblique black bands, anterior most obscurest and broadest. Pelvic fin brown basally, semitransparent distally.

Color in alcohol. Similar to fresh condition, except dorsal, anal, pectoral and caudal fins semitransparent and light brown.

Remarks

Genus *Stichaeus* Reinhardt, 1836 comprises 5 valid species : *Stichaeus fuscus* Miki and Maruyama, 1986, *S. grigorjewi* Herzenstein, 1890, *S. nozawae* Jordan and Snyder, 1902, *S. ochriamkini* Taranetz, 1935 and *S. punctatus* (Fabricius, 1780) (Miki and Maruyama, 1986 ; Mecklenberg and Sheiko, 2004 ; Pitruk et al., 2011 ; Fricke et al., 2020). *Stichaeus nozawae* is easily distinguishable from its congeners in having the 2nd pelvic–fin soft ray longer than the 3rd ray, 15–16 pectoral–fin rays and 37–39 caudal vertebrae (vs.

Fig. 1. Fresh coloration of present specimen (HUMZ 230899, 112 mm SL). Scale bar indicates 50 mm.

the 3rd pelvic-fin soft ray longer than the 2nd soft ray, 12-14 and 33-34, respectively, in *S. fuscus*), 49-51 dorsal spines and 35-38 anal-fin soft rays (vs. 52-56 and 42-45, respectively, in *S. grigorjewi*), dorsal fin with oblique dark bands but no dark spots on dorsal fin (vs. oblique dark bands absent but 3-4 rounded dark spots present on dorsal fin in *S. ochriamkini*), and double rows of pores in body lateral line canal (vs. a single row in *S. punctatus*) (Miki and Maruyama, 1986 ; Lindberg and Krasyukova, 1989 ; Pitruk et al., 2011). Characters of the present specimen are consistent with those in the original description of *S. nozawae* provided by Jordan and Snyder (1902) and the description provided by Miki and Maruyama (1986) (Table 1). Thus, we identify the specimen as *S. nozawae*.

The coloration of the caudal and pectoral fins in the present specimen (three obscure bands on both fins) differs from previous descriptions (no bands on both fins or one to three faint bands on pectoral fin), which were based on larger specimens (220-450 mm SL) (e.g., Jordan and Snyder, 1902 ; Amaoka et al., 1983, 1995 ; Tohkairin et al., 2015). On the other hand, the coloration of the present specimen is consistent with the colorations of other small specimens we have examined (57.4-168 mm SL) (Fig. 2a, b) and the colorations in previous descriptions is consistent with the colorations of large specimens examined (252-361 mm SL) (Fig. 2c-e). These observations suggest that bands on the caudal and pectoral fins tend to disappear with growth (Table 2). We have also seen obscure bands on both fins in images of some previous studies based on large specimens (400-450 mm SL) (Tsuda, 1990 ; Kai, 2018) (Table 2) and this also suggests that the disappearance of bands on both fins with growth is just a tendency with a few exceptions.

The coloration of the dorsal, anal and pelvic fins of the present specimen and others examined at large and small sizes is in accordance with the coloration of previous descriptions (i.e., oblique dark bands on dorsal fin, single horizontal dark line or vertical dark bands or blotches on anal fin, and no bands on pelvic fin ; Jordan and Snyder, 1902 ; Amaoka et al., 1983, 1995 ; Tohkairin et al., 2015 ; present study ; Figs. 1, 2). No significant differences in coloration of these fins were observed in specimens at different sizes. Hence, we propose that there is no ontogenetic change in coloration in the dorsal, anal and pelvic fins (Table 2).

Comparative materials

Large specimens (11, 252-361 mm SL). HUMZ 75759, 327 mm SL, Pacific off Muroran, Hokkaido, 1 June 1978 ; HUMZ 78631, 313 mm SL, 44°11.6'N, 145°03'E, Kitami-Yamato Bank, Okhotsk Sea, Hokkaido, 400-450 m depth, 14 September 1978 ; HUMZ 86603, 288 mm SL, Pacific off Muroran, Hokkaido, 17 January 1980 ; HUMZ 90703, 342 mm SL, Kitami-Yamato Bank, Okhotsk Sea, Hokkaido, 150-500 m depth, 8 May 1981 ; HUMZ 90975, 308 mm SL, HUMZ 90976, 252 mm SL, Kitami-Yamato Bank, Okhotsk Sea, Hokkaido, 150-500 m depth, 1 July 1981 ; HUMZ 92029, 283 mm SL, a fish market of Kushiro, Hokkaido, 17 July 1981 ; HUMZ 97550, 339 mm SL, 43°12.4'N, 141°08.5'E, Ishikari Bay, Sea of Japan, Hokkaido, 22 m depth, 11 May 1983 ; HUMZ 103611, 361 mm SL, Pacific off Muroran, Hokkaido, 16 November 1984 ; HUMZ 123998, 356 mm SL, 44°46.5'N, 144°01.3'E, 189 m depth, Kitami-Yamato Bank, Okhotsk Sea, Hokkaido, 19 July

Table 2. Presence or absence of bands (or blotches) on each fin in small and large specimens.

Sizes (mm SL)	57.4-200	200-450
Dorsal fin	Present	Present
Anal fin	Present	Present or absent
Caudal fin	Present	Usually absent
Pectoral fin	Present	Usually absent
Pelvic fin	Absent	Absent

Table 1. Selected characters of *Stichaeus nozawae*.

	Present specimen HUMZ 230899	Jordan and Snyder (1902) Holotype	Miki and Maruyama (1986) *n* = 37
SL (mm)	112	255	41.8-346
Counts			
Dorsal-fin rays	L	LI	XLIX-LI
Anal-fin rays	I, 36	I, 37	I, 35-38
Pectoral-fin rays	15	15*	15-16
Pelvic-fin rays	I, 3	-	I, 3
Caudal-fin rays	3 + 6 + 6 + 3	-	-
Vertebrae	16 + 38	-	15-17 + 37-39
Rows of pores in lateral line canals	2	2	2
Oblique bands on dorsal fin	Present	Present	Present

*Counted from the drawing of holotype (fig. 26 in Jordan and Snyder, 1902).

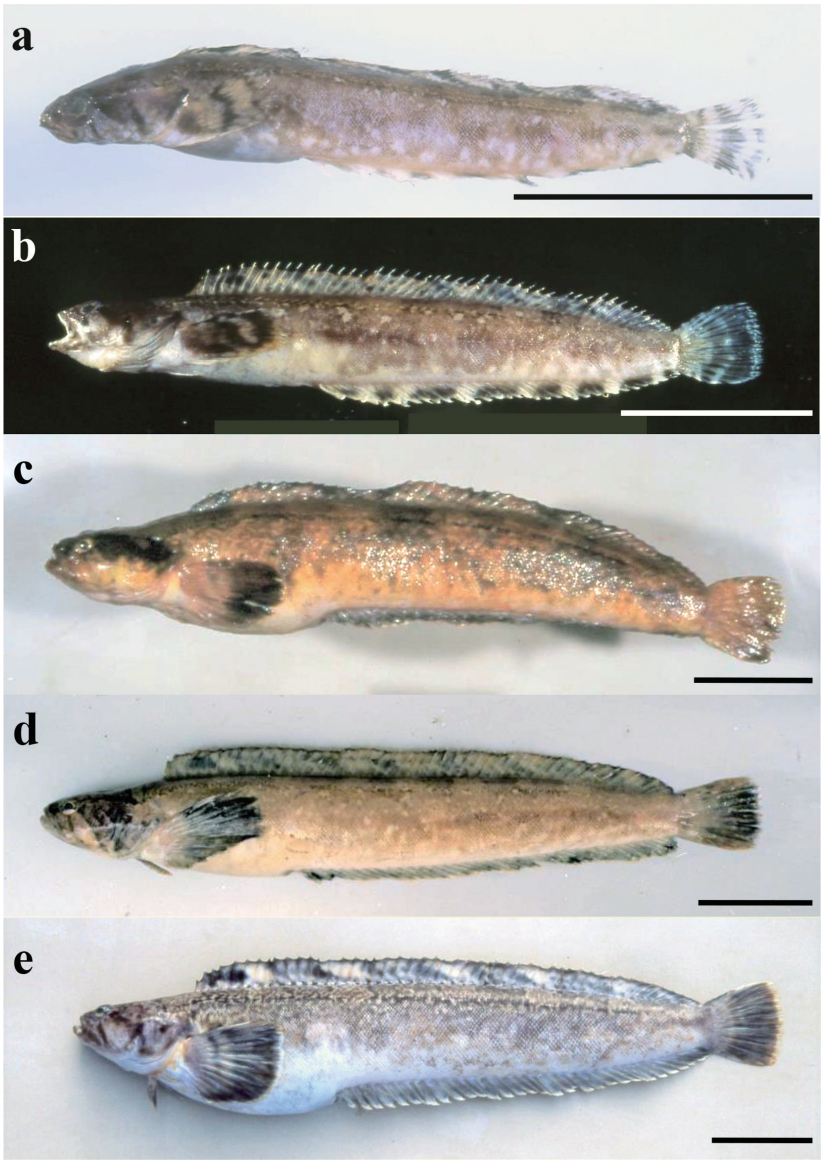

Fig. 2. Fresh coloration in *S. nozawae*. (a) HUMZ 166708, 119 mm SL, (b) HUMZ 164852, 168 mm SL, (c) HUMZ 132477, 277 mm SL, (d) HUMZ 92029, 283 mm SL and (e) HUMZ 123998, 356 mm SL. Scale bars indicate 50 mm.

1992 ; HUMZ 132477, 277 mm SL, Okhotsk Sea off Shiretoko Peninsula, Hokkaido, 16 May 1995.

Small specimens (17, 57.4–168 mm SL). HUMZ 36973, 117 mm SL, Pacific off Kushiro Harbor, Hokkaido, 80 m depth, 5 September 1974 ; HUMZ 45476, 168 mm SL, 42°32'N, 143°48'E, Pacific off east of Erimo, Hokkaido, 87 m depth, 6 September 1975 ; HUMZ 64829, 57.4 mm SL, HUMZ 64832, 61.1 mm SL, Sawaki, coast of Okhotsk Sea, Hokkaido, 85 m depth, 24 August 1977 ; HUMZ 91976, 63.0 mm SL, Okhotsk Sea off Omu, Hokkaido, 50 m depth, 11 July 1981 ; HUMZ 93028, 132 mm SL, Pacific off Riruran, Akkeshi, Hokkaido, 50 m depth, 18 August 1981 ; HUMZ 93047, 93.5 mm SL, Pacific off Oshamappu, Kushiro, Hokkaido, 43 m depth, 19 August 1981 ; HUMZ 94024, 118 mm SL, 44°43'N, 143°00'E, Okhotsk Sea off Omu, Hokkaido, 60 m depth, 2 July 1980 ; HUMZ 94025, 76.7 mm SL, 44°23'N, 143°41'E, 50 m depth, Okhotsk Sea off Yubetsu, Hokkaido, 28 June 1980 ; HUMZ 94027, 80.7 mm SL, 44°23'N, 143°41'E, 100 m depth, Okhotsk Sea off Yubetsu, Hokkaido, 28 June 1980 ; HUMZ 97155, 149 mm SL, 43°25.4'N, 140°58.5'E, Ishikari Bay, Sea of Japan, Hokkaido, 80 m depth, 9 September 1982 ; HUMZ 98389, 136 mm SL, Okhotsk Sea off Gunkai, Hokkaido, 95 m depth, 24 August 1977 ; HUMZ 164852, 168 mm SL, Pacific off Otsu, Hokkaido, 29 July 1999 ; HUMZ 166708, 119 mm SL, 44°27.5'N, 143°42.5'E, Okhotsk Sea off Yubetsu, Hokkaido, 108–150 m depth, 8 August 1999 ; HUMZ 166850, 118 mm SL, 44°42.5'N, 144°07.5'E, Okhotsk Sea off Kitami, Hokkaido, 150–200 m depth, 15 August 1999 ; HUMZ 166853, 150 mm SL, HUMZ 166855, 135 mm SL, 44°32.5'N, 144°02.5'E,

Okhotsk Sea off Kitami, Hokkaido, 150–200 m depth, 16 August 1999.

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