

Note on color variations of inner surface of pectoral fins in *Lepidotrigla microptera* Günther, 1873 (Actinopterygii: Triglidae) from Mutsu Bay, Japan

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ABSTRACT

Color variations of inner surface of pectoral fin in a searobin *Lepidotrigla microptera* Günther, 1873 are presented with color photographs for the first time based on 49 specimens collected from Mutsu Bay, Aomori, Japan by the T/S Ushio-maru. Examples of some of these color variations are red, dusky red, red with distal bluish black, red with bluish black rays and posterior part, blueish black, and mosaic with red and bluish black. Also, the specimens show variations of blotches and spots on inner surface of pectoral fin that include lacking either, having single blackish bar-like blotch without spots on the mid-basal area, single blackish bar-like blotch with bluish gray or white spots on the mid-basal area, only black or bluish gray spots on the mid-basal area, and two blackish bar-like blotches without spots on the upper basal area.

Keywords: searobin, gurnard, T/S Ushio-maru, intraspecific variation.

INTRODUCTION

Lepidotrigla microptera Günther, 1873 (Actinopterygii: Triglidae) is characterized by having 15–18 dorsal- and 15–18 anal-fin soft rays, 61–68 lateral-line scales, 3 to 7 rostral spines, length of the longest rostral spine more than 3.0 in eye diameter, serrate first dorsal spine, and usually red inner surface of pectoral fin (P1 hereafter) without blotches and spots, and in lacking a postorbital groove and scales on breast (Matsubara and Hiyama, 1932; Yamada, 1986; Ochiai and Yatou, 1988; Richards, 1992; Yamada *et al.*, 2007; Yamada and Yagishita, 2013). The species is known from South and East China Seas, and all coasts around Japan (*e.g.*, Ochiai and Yatou, 1988; Yamada and Yagishita, 2013; Amaoka *et al.*, 2020). The coloration of the inner surface of the P1 has been useful for species identification of the genus *Lepidotrigla*. The inner surface of the P1 of *Lepidotrigla microptera* is uniformly black to red, except for the milky white color of the lower 3 or 4 rays, and usually lacks any patterns, *viz.* blotches or spots (*e.g.*, Günther, 1873; Shindo, 1951; Yamada *et al.*, 2007; Yamada and Yagishita, 2013). Some color variations of the inner surface of the P1 have been previously reported in this species, including orange vertical lines on fin membranes and a blackish blotch without or with 3 to 4 blueish spots on the mid-basal area (Ochiai and Yatou, 1988; Yamada *et al.*, 2007). However, any color drawings and photographs

of those variations have not been published. In 2018 and 2019, 49 specimens of *L. microptera* with several color variations were collected from Mutsu Bay, Aomori, Japan (Fig. 1) by T/S Ushio-maru, School of Fisheries Sciences, Hokkaido University. We describe these color variations in detail accompanied by photographs based on the specimens.

MATERIALS AND METHODS

Counts and proportional measurements follow Hubbs and Lagler (1958), except for the following: counts of scale rows below and above the lateral line of Richards and Saksena (1977); head depth, lengths of cleithral spine, P1, three free pectoral rays and pelvic fin of del Cerro and Lloris (1997a, b); counts of predorsal scales and dorsal-fin bucklers, and measurements of caudal peduncle length (dorsal) and caudal peduncle length (ventral) of Gomon and Psomadakis (2018). All measurements were made to the nearest 0.1 mm with calipers. Terminology of cranial spines follows Teague (1951). Descriptions are based on 49 specimens collected from Mutsu Bay by the T/S Ushio-maru. The presented specimens and comparative materials were deposited at the Hokkaido University Museum, Hakodate, Hokkaido, Japan (HUMZ). Lengths of specimens are standard lengths (SL) enclosed by parentheses immediately after registration numbers.

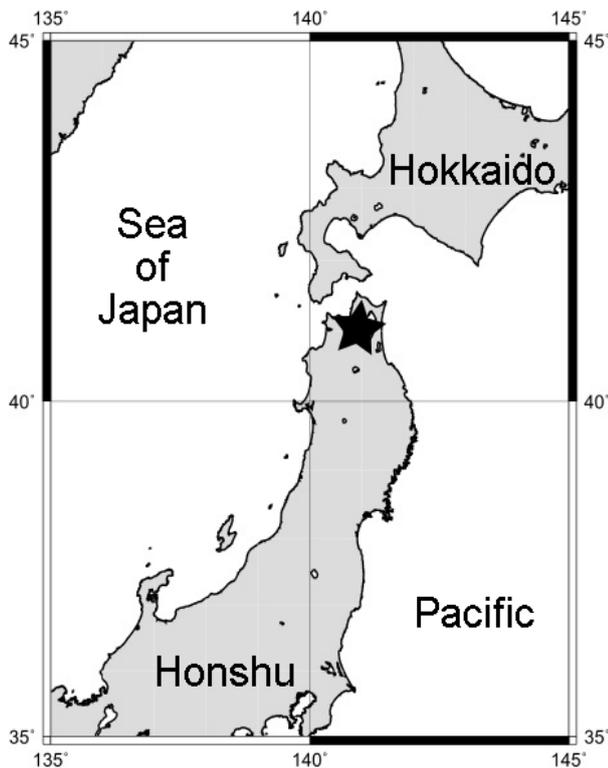


Figure 1. Sampling site in northern Japan for fresh material examined.

***Lepidotrigla microptera* Günther, 1873**
(Figs. 2–4)

Materials examined. HUMZ 231243 (216 mm, female), 231244 (211, female), 231245 (153, female), 231246 (162, male), 231248 (175, female), 231249 (200, female), 231283 (148, male), 231284 (172, male), 231285 (189, female), 231286 (175, male), 231287 (188, male), 231288 (201, female), 231289 (207, female), 40°57.736'N, 140°45.155'E to 40°56.036'N, 140°45.509'E, 44–51 m depth, trawl, 8 Nov. 2019; HUMZ 231253 (150, female), 231255 (188, female), 231256 (187, female), 231257 (191, female), 231258 (209, female), 231259 (189, unknown), 231260 (197, male), 231262 (200, male), 231290 (208, male), 231291 (178, male), 231292 (185, male), 231293 (162, male), 231294 (192, female), 231295 (183, male), 231296 (178, female), 231297 (185, male), 231298 (215, female), 41°04.815'N, 140°02.056'E to 41°04.915'N, 140°59.725'E, 46–51 m depth, trawl, 7 Nov. 2019; HUMZ 231299 (186, female), 41°04.8'N, 141°00.8'E, 48 m depth, trawl, 24 Sep. 2018; HUMZ 231311 (201, female), 231313 (213, female), 231317 (183, female), 231410 (174, female), 231411 (203, female), 231412 (197, male), 231413 (207, female), 231414 (185, female), 231415 (188, female), 231416 (190, female), 231417 (168, female), 231418 (189, female), 231419 (173, female), 231421 (183, female), 41°04.075'N, 141°02.562'E to 41°04.199'N,

141°00.328'E, 46–47 m depth, trawl, 26 Sep. 2019; HUMZ 231465 (190, male), 231466 (148, female), 231468 (169, male), 231469 (183, male), 40°56.740'N, 140°45.380'E to 40°58.279'N, 140°45.532'E, 46–51 m depth, trawl, 25 Sep. 2019.

Description. Counts and proportional measurements are listed in Table 1.

Color of inner surface of P1 when fresh (Fig. 3). Area among the lower 3 or 4 rays milky white color without any blotches and spots. Posterior margin of the remaining area bluish black. The remaining area except for the posterior margin red (Fig. 3A, F), dusky red (Fig. 3B, G), red with bluish black distally (Fig. 3C, J, O), red with bluish black rays and posterior part (Fig. 3D, H, K, L, N), bluish black (Fig. 3E, I, M), or mosaic of red and bluish black (Fig. 3P). Blotches and spots lacking (Fig. 3A–D), having single blackish bar-like blotch without spots on the mid-basal area (Fig. 3E, N), single blackish bar-like blotch with bluish gray (Fig. 3F, G) or white (Fig. 3H, I) spots mid-basally, only black (Fig. 3J, K, M) or bluish gray (Fig. 3L) spots on the mid-basal area, or two blackish bar-like blotches without spots on upper basal area (Fig. 3O).

Color of inner surface of P1 in 50% isopropyl alcohol after fixation by 10% formalin (Fig. 4). Area among the lower 3 or 4 rays almost the same when fresh. The remaining area faded to pale brown to black. Blotches and spots almost unclear.

Discussion. Various color variations of the inner surface of P1 were observed in this study (Figs. 3, 4). In addition to previous descriptions of the color variations of the entire fin except for the area among the lower 3 or 4 rays (black to red: *e.g.*, Günther, 1873; Shindo, 1951; Yamada *et al.*, 2007; Yamada and Yagishita, 2013), the mosaic pattern (Fig. 3P) is a new observation. Although specimens having a single blotch with or without gray spots on the mid-basal area of P1 (Fig. 3F, G, N) have been reported (Ochiai and Yatou, 1988; Yamada *et al.*, 2007), the following color variations are newly observed in this study, *i.e.* single blotch with white spots on the mid-basal area (Fig. 3H, I), only black (Fig. 3J, K, M) or gray (Fig. 3L) spots on the mid-basal area, and two blotches on the upper basal area (Fig. 3O). The orange vertical lines on fin membranes of Yamada *et al.* (2007) corresponds with bluish black rays and posterior part lacking blotches and spots (Fig. 3D). Because the colors continuously differ, ranging from red to bluish black, defining the color as a characteristic is clearly impossible. After fixation by 10% formalin and preservation in 50% isopropyl alcohol of the specimens,



Figure 2. Lateral view of *Lepidotrigla microptera*. HUMZ 231244, 211 mm SL.

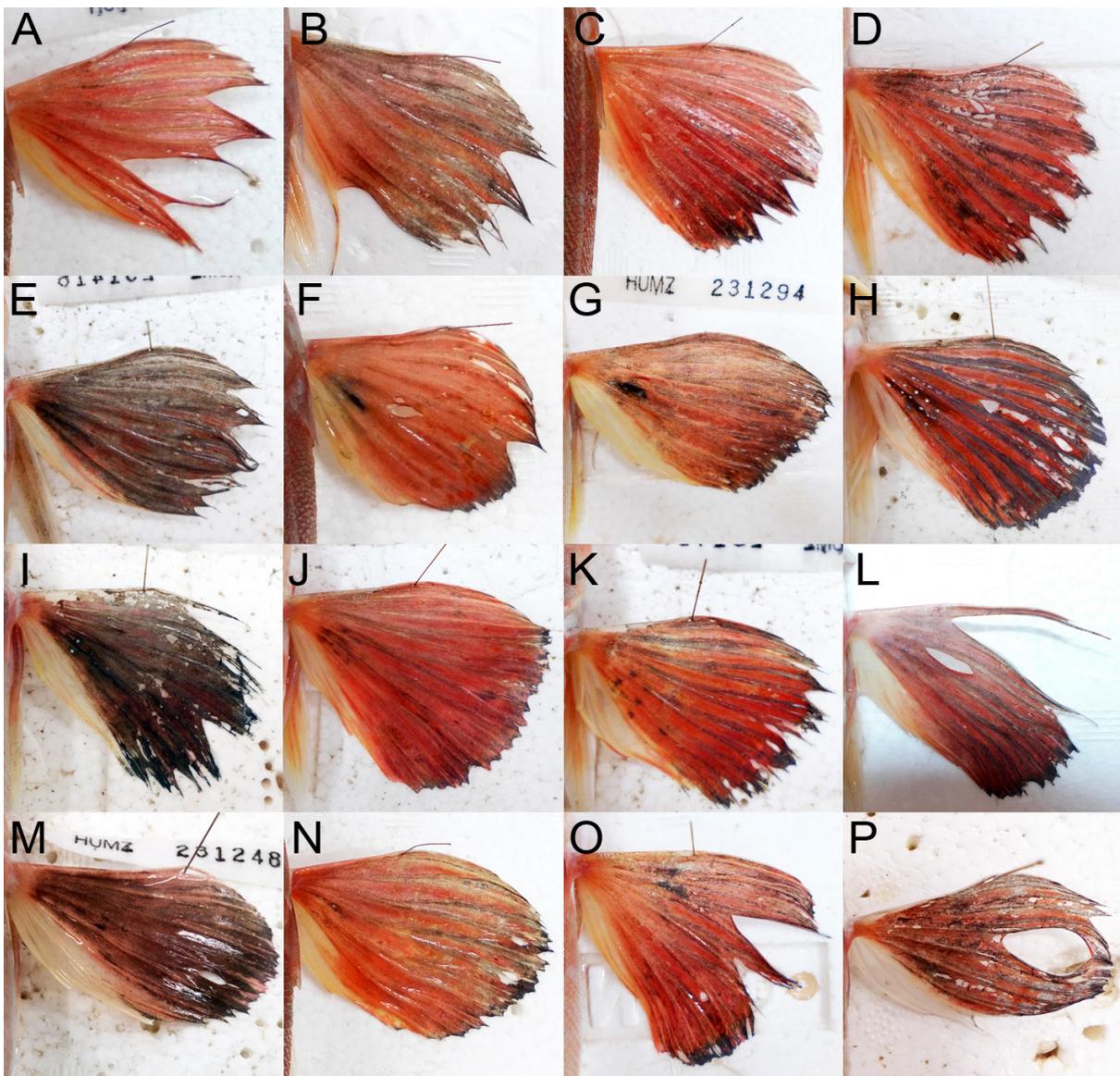


Figure 3. Dorsal views of inner surface of pectoral fin in *Lepidotrigla microptera* before preservation. A, HUMZ 231287; B, HUMZ 231258; C, HUMZ 231243; D, HUMZ 231291; E, HUMZ 231416; F, HUMZ 231283; G, HUMZ 231294; H, HUMZ 231295; I, HUMZ 231419; J, HUMZ 231412; K, HUMZ 231417; L, HUMZ 231284; M, HUMZ 231248; N, HUMZ 231288; O, HUMZ 231297; P, HUMZ 231466. E, H–L, O and P miller image.



Figure 4. Dorsal views of inner surface of pectoral fin in *Lepidotrigla microptera* after fixation of the same specimens in the same order as Figure 3. A, HUMZ 231287; B, HUMZ 231258; C, HUMZ 231243; D, HUMZ 231291; E, HUMZ 231416; F, HUMZ 231283; G, HUMZ 231294; H, HUMZ 231295; I, HUMZ 231419; J, HUMZ 231412; K, HUMZ 231417; L, HUMZ 231284; M, HUMZ 231248; N, HUMZ 231288; O, HUMZ 231297; P, HUMZ 231466. E, H–L, O and P miller image.

in 5 of 7 specimens having a blotch and spots on the mid-basal area (Fig. 3F–I), those spots disappeared (Fig. 4F–I). Therefore, it is difficult to separate specimens having only a blotch (Fig. 4E, N). Of our observations of 92 comparative specimens already deposited at the museum, 65 specimens lack blotches and spots, 20 have only a blotch, 6 have only spots, and 1 has both a blotch and spots. Based on our observations of fresh material that has then been preserved, it is possible that the preserved specimens examined having only a blotch may have had both a blotch and spots when fresh. Also, sexual dimorphisms of the species was not observed in both color and pigment patterns.

As mentioned above, it is important to record the inner surface color of the P1 when fresh for identification of *Lepidotrigla*. Despite this, a lot of color variations were found in *L. microptera* in this study, even though color is important for species identification of the genus. Although this species resembles *Lepidotrigla kishinouyei* Snyder, 1911 in having a short first free pectoral ray and many rostral spines, the two are easily separated by the presence of a blotch and spots on the inner surface of the P1 in *L. kishinouyei* that is absent in *L. microptera* (Yamada and Yagishita, 2013; Amaoka *et al.*, 2020). The distributions of the two are also very close, with *L. kishinouyei* occurring from the East China Sea to

Table 1. Counts and proportional measurements of *Lepidotrigla microptera*

	Present study From Mutsu Bay <i>n</i> =49	Comparative materials <i>n</i> =92
Standard length (mm)	148–216	104–243
Counts		
Dorsal fin	VIII–X-16–18	VIII–IX-15–17
Anal fin	16–18	15–19
Pectoral fin	11–15	13–15
Pelvic fin	I,5	I,5
Lateral-line scales	62–66	61–67
Scales above lateral line	3–4	3–6
Scales below lateral line	16–20	16–22
Predorsal scales	6–9	5–10
Dorsal-fin bucklers	23–26	23–25
Preocular spines	1–3	0–3
Postocular spines	0–1	0–1
Precaudal vertebrae	11–12 (<i>n</i> =8)	11–12 (<i>n</i> =22)
Caudal vertebrae	21–22 (<i>n</i> =8)	20–22 (<i>n</i> =22)
Total vertebrae	32–34 (<i>n</i> =8)	32–34 (<i>n</i> =22)
Total gill rakers	11–14	10–14
Measurements (% SL)		
Body depth	19.8–23.6	19.6–26.2
Predorsal length	31.2–34.8	30.0–35.1
Head length	30.6–33.5	29.1–34.2
Head depth	18.0–20.3	17.6–22.1
Head width	15.7–18.6	14.8–20.8
Snout length	13.0–15.1	12.3–15.8
Orbital diameter	6.9–8.7	6.6–10.0
Interorbital width	7.3–9.1	7.4–9.7
Suborbital width	8.0–9.7	8.0–10.1
Postorbital length of head	10.6–11.9	9.8–11.8
Height of cheek	10.7–12.2	9.3–12.1
Length of cleithral spine	5.5–10.0	5.4–10.6
Upper jaw length	11.1–13.0	10.3–13.1

Table 1. Counts and proportional measurements of *Lepidotrigla microptera* (continued)

	Present study	Comparative materials
	From Mutsu Bay	
	<i>n</i> =49	<i>n</i> =92
Lower jaw length	10.2–12.3	9.2–12.6
Caudal peduncle length (dorsal)	12.5–17.0	12.9–17.7
Caudal peduncle length (ventral)	13.1–17.2	13.2–17.4
Caudal peduncle depth	4.8–5.9	4.8–6.0
Length of 1st dorsal-fin base	17.7–23.7	16.1–23.2
Length of 2nd dorsal-fin base	31.7–36.7	31.4–37.5
Length of anal-fin base	31.7–36.7	30.7–38.2
Length of 1st dorsal-fin spine	14.2–18.9	12.9–18.8
Length of 2nd dorsal-fin spine	16.8–21.4	15.0–21.8
Length of 3rd dorsal-fin spine	16.7–21.3	14.8–21.4
Length of pectoral fin	27.3–32.8	24.3–33.6
Length of 1st free pectoral ray	18.1–22.8	16.5–22.8
Length of 2nd free pectoral ray	15.9–19.4	13.9–19.4
Length of 3rd free pectoral ray	12.8–16.1	10.4–15.9
Length of pelvic fin	16.8–21.1	16.1–20.6

southern Hokkaido, Japan and *L. microptera* ranging from the South and East China Seas to Hokkaido, Japan (Yamada and Yagishita, 2013; Amaoka *et al.*, 2020). The following diagnostic characters are useful for the identification of the two species, *i.e.* length of the longest rostral spine (short, more than 3.0 in eye diameter in *L. microptera* and less in *L. kishinouyei*), number of anal-fin rays (15–18 vs. 14–16), and head length (short, 3.2–3.4 in SL vs. long, 2.9–3.0) (Yamada *et al.*, 2007; Yamada and Yagishita, 2013).

Comparative materials *Lepidotrigla microptera* (92 specimens, 104–243 mm SL). HUMZ 39527 (140 mm), Kochi, 7 Aug. 1973; HUMZ 40902 (182), Hakodate, Hokkaido, set net, 3 May 1975; HUMZ 42202 (163), Otaru, Hokkaido; HUMZ 42278 (154), 42279 (169), 42280 (190), 42281 (156), 42282 (201), 42284 (164), 42285 (182), 42286 (151), 42287 (182), 42288 (173), 42290 (186), 42291 (157), 42292 (198), Hakodate, Hokkaido, set net, 27 May 1975; HUMZ 42939 (153), Ishinomaki, Miyagi, Dec. 1920; HUMZ 43651 (196), Yamagata, date unknown; HUMZ 43659 (197), Tsuruoka, Yamagata, Aug. 1912; HUMZ 47621 (130), Mimase Fishing Port, Kochi, 6 Oct. 1972; HUMZ 48943

(156), 48944 (152), 48945 (148), Ofunato, Iwate, set net, 30 Oct. 1975; HUMZ 48975 (143), Ofunato, Iwate, set net, 31 Oct. 1975; HUMZ 49400 (105), Mimase Fishing Port, Kochi, 15 Nov. 1975; HUMZ 49980 (177), Hakodate, Hokkaido, set net, 12 Nov. 1975; HUMZ 49985 (170), Hakodate, Hokkaido, set net, 17 Dec. 1975; HUMZ 51889 (192), 51891 (172), 51893 (171), 51898 (202), Sado, Niigata, set net, 24 Mar. 1976; HUMZ 51946 (117), Awa, Niigata, trawl, Mar. 1976; HUMZ 51956 (168), 51957 (170), Sado, Niigata, set net, 23 Jan. 1976; HUMZ 52598 (181), 52599 (188), 52600 (179), 52601 (149), 52602 (175), Sado, Niigata, date unknown; HUMZ 52802 (184), 52803 (169), Sado, Niigata, 25 Mar. 1976; HUMZ 52864 (181), 52865 (197), Setana, Hokkaido, set net, 10 May 1976; HUMZ 58817 (163), 62137 (167), Odawara, Kanagawa, 6 Nov. 1976; HUMZ 64850 (185), Hakodate, Hokkaido, set net, 21 June 1977; HUMZ 65588 (207), 66039 (187), 66040 (135), off Ishikawa (36°19.5'N 138°08'E), 75–82 m depth, 1 June 1977; HUMZ 66376 (191), Hakodate, Hokkaido, set net, 9 July 1977; HUMZ 87638 (176), Hakodate, Hokkaido, set net, 24 June 1980; HUMZ 90751 (211), Hakodate, Hokkaido, set net, 8 July 1981; HUMZ 95336 (161), Hakodate, Hokkaido, set net, 24

June 1982; HUMZ 96445 (194), Ishikari Bay, Hokkaido (43°12.2'N 141°03.4'E), 22–24 m depth, trawl, 14 Sep. 1982; HUMZ 96455 (175), 96794 (194), 96795 (175), 96796 (177), 96797 (163), 96798 (178), 96952 (130), 96954 (121), Ishikari Bay, Hokkaido (43°16.2'N 140°44.8'E), 37–62 m depth, trawl, 10 Sep. 1982; HUMZ 96992 (174), 96994 (165), 96995 (160), Ishikari Bay, Hokkaido (43°25.4'N 140°58.5'E), 80–84 m depth, trawl, 9 Sep. 1982; HUMZ 97529 (196), Ishikari Bay, Hokkaido (43°12.4'N 141°08.5'E), 22 m depth, trawl, 11 May 1983; HUMZ 97537 (176), 97559 (212), set net, 25 May 1983; HUMZ 103149 (179), Toyoura Hokkaido, gill net, 31 July 1984; HUMZ 105055 (184), 105056 (180), Hakodate, Hokkaido, set net, 2 July 1985; HUMZ 109410 (203), Setana, Hokkaido, set net, 12 June 1986; HUMZ 110250 (175), 110251 (159), Hakodate, Hokkaido, date unknown; HUMZ 124723 (199), Otaru, Hokkaido, 7 May 1959; HUMZ 138815 (107), Kamo, Yamagata, 120 m depth, trawl, 11 Oct. 1994; HUMZ 192470 (181), off Miyagi (37°57.24'N 141°10.97'E to 37°55.06'N 141°12.60'E), 40.5–46.5 m depth, 29 June 2004; HUMZ 192655 (112), off Hachinohe, Aomori (40°35.63'N 141°35.17'E to 40°37.21'N 141°32.85'E), 45.0–50.5 m depth, 4 July 2004; HUMZ 192810 (154), data unknown; HUMZ 205269 (193), 205270 (177), 205340 (243), 205341 (172), off the Pacific coast of the Tohoku region, trawl, 18 June 2009; HUMZ 208515 (104), off Miyagi (37°56.28'N 141°11.42'E to 37°55.93'N 141°12.33'E), 48.7–51.0 m depth, 21 June 2010; HUMZ 209372 (182), Hakodate or Funka Bay, hook and line, Sep. 2010; HUMZ 214488 (140), off Iwate (40°16.17'N 142°06.02'E to 40°13.45'N 142°07.09'E), 149–157 m depth, 10 Oct. 2010; HUMZ 214500 (133), 214501 (138), 214502 (128), off Hachinohe, Aomori (40°46.46'N 141°51.86'E to 40°48.24'N 141°48.30'E), 142–157 m depth, 12 Oct. 2011; HUMZ 219288 (163), off Misawa, Aomori (40°52.65'N 141°29.71'E to 40°48.24'N 141°48.30'E), 142–157 m depth, 14 June 2013; HUMZ 220584 (162), Hakodate, Hokkaido, set net, 30 Oct. 2013.

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REFERENCES

- Amaoka, K., K. Nakaya and M. Yabe. 2020. *Pictorial Guide to the Fishes of Hokkaido*. Hokkaido Shimbun Press, Sapporo. 590 pp. (in Japanese)
- del Cerro, L. and D. Lloris. 1997a. A new species of *Lepidotrigla* (Scorpaeniformes, Triglidae) from the waters off Queensland (Australia). *Scientia Marina* 61(1): 45–52.
- del Cerro, L. and D. Lloris. 1997b. Gurnard fishes (Scorpaeniformes, Triglidae) from off New Caledonia, with description of five new species. In: B. Séret (ed.) *Résultats des Campagnes MUSORSTOM, volume 17. Mémoires du Muséum National d'Histoire Naturelle* 174: 91–124.
- Gomon, M.F. and P.N. Psomadakis. 2018. Review of the *Lepidotrigla gurnards* (Teleostei: Scorpaeniformes: Triglidae) in the Bay of Bengal and Andaman Sea off Myanmar with a description of a new species. *Raffles Bulletin of Zoology* 66: 66–77.
- Günther, A. 1873. Report on a collection of fishes from China. *The Annals and Magazine of Natural History, Including Zoology, Botany, and Geology (Series 4)* 12(69): 239–250.
- Hubbs, C. L. and K.F. Lagler. 1958. *Fishes of the Great Lakes Region*. Cranbrook Institute of Science *Bulletin No. 26*. Cranbrook Institute of Science, Bloomfield Hills, Michigan. xi + 213 pp.
- Matsubara, K. and Y. Hiyama. 1932. A review of Triglidae, a family of mail-cheeked fishes, found in the waters around Japan. *Journal of the Imperial Fisheries Institute* 28(1): 3–67.
- Ochiai, A. and T. Yatou. 1988. Triglidae. In: H. Masuda, K. Amaoka, C. Araga, T. Uyeno and T. Yoshino (eds.), *The Fishes of the Japanese Archipelago. Second edition*. Tokai University Press, Tokyo, 2 Vols. pp. 318–320. (in Japanese)
- Richards, W.J. 1992. Comments on the genus *Lepidotrigla* (Pisces: Triglidae) with descriptions of two new species from the Indian and Pacific oceans. *Bulletin of Marine Science* 51(1): 45–65.
- Richards, W.J. and V.P. Saksena. 1977. Systematics of the gurnards, genus *Lepidotrigla* (Pisces, Triglidae), from the Indian Ocean. *Bulletin of Marine Science* 27(2): 208–222.
- Shindo, S. 1951. Studies on the stock of *Lepidotrigla* of the Eastern Sea (I) on the specific characteristics. *Bulletin of the Japanese Society of Scientific Fisheries* 17(3): 83–90. (in Japanese with English abstract)
- Teague, G.W. 1951. The sea-robins of America, a review of the triglid fishes of the genus *Prionotus*. *Comunicaciones Zoológicas del Museo de Historia Natural de Montevideo* 3(61): 1–59.
- Yamada, U. 1986. *Lepidotrigla microptera* Günther. In:

- O. Okamura (ed.), *Fishes of the East China Sea and the Yellow Sea*. Seikai Regional Fisheries Research Laboratory, Nagasaki, pp. 350–351. (in Japanese)
- Yamada, U, M. Tokimura, H. Horikawa and T. Nakabo. 2007. *Fishes and Fisheries of the East China and Yellow Seas*. Tokai University Press, Hadano. lxxiii + 1262 pp. (in Japanese)
- Yamada, U. and N. Yagishita. 2013. Triglidae. In: T. Nakabo (ed.), *Fishes of Japan with Pictorial Keys to the Species. Third Edition*. Tokai University Press, Hadano, pp. 720–726. (in Japanese)

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