**Taxonomic status of *Hoplichthys regani* Jordan 1908 (Scorpaeniformes: Hoplichthyidae), with comments on its authorship**

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**Abstract** Validity of a ghost flathead, *Hoplichthys regani* Jordan 1908, which was sometimes regarded as a junior synonym of *Hoplichthys gilberti* Jordan and Richardson 1908, was evaluated. We conclude that *H. regani* is a valid species from comparison of specimens of both species, including the name bearing types. *Hoplichthys regani* can be distinguished from *H. gilberti* by the length of the longest free pectoral fin ray and length of each dorsal fin spine in males. We also redescribe *H. regani* and discuss its authorship, following the International Code of Zoological Nomenclature.

**Keywords** *Hoplichthys regani* · Hoplichthyidae · Validity · Authorship · redescription

## Introduction

A ghost flathead, *Hoplichthys regani*, was originally established by Jordan (1908) based on the description of misidentified *Hoplichthys langsdorfii* Cuvier *in* Cuvier and Valenciennes 1829 by Jordan and Richardson (1908) (see discussion under "Authorship of *Hoplichthys regani*"). Some researchers regarded *H. regani* as a junior synonym of *Hoplichthys gilberti* Jordan and Richardson 1908, because both species commonly possess a short snout, large eyes, a narrow interorbit and a single developed spine on each lateral scute (e.g., Matsubara and Ochiai 1950a, c; Kamohara 1958, 1964). In contrast, others distinguished *H. regani* from *H. gilberti* by the length of pelvic fin and lower free pectoral fin rays, counts of anal fin rays, and width between the rows of spines on the infraorbital (e.g., Matsubara and Ochiai 1950b; McGrouther 1999; Nakabo 2002). After morphological examination of the holotype of *H. regani* (Fig. 1) and comparison with its congeners, including *H. gilberti*, it was revealed that *H. regani* is valid. Purposes of the present study are to verify the validity of *H. regani* and to redescribe this species. We also discuss its authorship, because some researchers considered Jordan (1908) to be its author, while others regarded Jordan and Richardson (1908) as the authors.

## Materials and methods

Counts and proportional measurements mainly followed Hubbs and Lagler (1958), except for body depth measured at the origin of the first dorsal fin, head depth at the center of the parietal spines on both sides, head width 1 at anterior margin of eye, head width 2 at inner base of preopercular spine, head width 3 at outer base of preopercular spine, snout length from the anterior tip of the snout to the anterior edge of the eye and length of dorsal and anal fin bases from the base of the first ray to the base of the last ray, not including the fin membrane. Body width was measured at the origin of the second dorsal fin. Gill rakers were counted on the first gill arch of the right side. Vertebrae and caudal fin rays were counted from radiographs. Sex was determined by microscope examination of gonads (no sectioning of gonads was undertaken). Measurements were made with calipers and dividers to the nearest 0.1 mm. Standard and head lengths are abbreviated as SL and HL, respectively. Counts of spines on the head are shown as "right side/left side". Count of pectoral fin rays is shown as "joined pectoral fin rays + free pectoral fin rays = total pectoral fin rays". Terminology for spines on the head is shown in Figure 2, following Jordan and Thompson (1913), Matsubara (1955b) and Imamura (1996). Institutional abbreviations follow Eschmeyer (1998), except for Hokkaido University Museum, Hakodate (HUMZ), Kagoshima University Museum, Kagoshima (KAUM) and National Museum of Nature and Science, Tsukuba (NSMT).

### ***Hoplichthys regani*** **Jordan 1908**

(Figs. 1, 2, 4a)

*Hoplichthys langsdorfii* (not of Cuvier 1829): Jordan and Richardson 1908: 645, fig. 5 (description; Kagoshima Prefecture).

*Hoplichthys regani* Jordan 1908: 800 (original description; type locality: off Sakurajima, Kagoshima Prefecture, Japan); Jordan and Thompson 1913: 69, fig. 2 (key and description); Eschmeyer et al. 1998: 1434 (list and synonymy); McGrouther 1999: 2424 (key; western Central Pacific).

*Hoplichthys regani* Jordan and Richardson 1908 (authorship misidentified): Jordan 1908: 800; Jordan et al. 1913: 288, fig. 237 (synonymy); Okada and Matsubara 1938: 335 (key;

southern Japan); Matsubara and Ochiai 1950c: 149 (synonymy and description); Böhlke 1953: 126 (list); Matsubara 1955a: 1123 (key and description; Kagoshima Prefecture, Sombrero Island, Balayan Bay and Verde Island); Ochiai 1984: 322, pl. 361-B (short description; Kagoshima Prefecture); Lindberg and Krasyukova 1987: 163, fig. 100 (key and description; Kagoshima); Nakabo 1993: 540 (pictorial key; Kagoshima Prefecture); Shao and Chen 1994: 261 (key and short description; Taiwan); McGrouther 2000: 608 (list; South China Sea); Nakabo 2000: 621 (pictorial key; Kagoshima Prefecture); Nakabo 2002: 621 (pictorial key; Kagoshima Prefecture).

*Hoplichthys regani* (authorship not shown): Matsubara and Ochiai 1950b: 88 (key; southern Japan); Yamada 1986: 337 (key and description).

**Material examined.** SU 22390, holotype, male, 144.6 mm SL, off Sakurajima, Kagoshima Prefecture, Japan.

**Diagnosis.** A species of *Hoplichthys* with a short snout (31.1% HL), large eye (26.0% HL), a narrow interorbit (4.4% HL), developed spines on the lower side of the lower jaw, a single developed spine on each lateral scute, long free pectoral fin ray (23.2% SL) and slightly rounded caudal fin.

**Description.** Counts and proportional measurements are shown in Table 1.

Head extremely flattened, depth 3.2 in width at outer base of preopercular spine. Body elongate, slightly depressed, naked, except for lateral scutes on lateral side of body; depth 1.4 in body width at origin of second dorsal fin. Snout paddle like, slightly longer than eye diameter; preoptic length 1.5 in postorbital length. Anterior nostril located medial to central part of lachrymal; posterior nostril located medial to posterior edge of lachrymal; both nostrils of same size, possessing a short tube. Upper jaw long, length almost equal to snout length; posterior edge of maxilla reaching anterior margin of eye. Teeth villiform, forming narrow tooth bands on jaws, vomer and palatines. Eye relatively large; its diameter 1.2 in snout length. Interorbit narrow and concave; interorbital width 6.0 in vertical eye diameter. Posterior margin of opercle relatively rounded. Lower margin of branchiostegal membrane fused with isthmus. Gill rakers relatively long and club-shape; their tip over base of anterior raker. Many spines and finely serrated ridges on dorsal surface of head (Fig. 2). Single pair of serrated ridges situated lateral to mid-line on snout and interorbit; these ridges ending at posterior margin of orbit. Dorsal surface of lachrymal possessing sparsely scattered small spines. A single row of developed spines on lateral side of lachrymal; anteriormost spine large, directed forward; second to fourth spines small, directed backward; fifth to ninth spines directed laterally; posteriormost spine largest. Two rows of spines on the first infraorbital, inner row on dorsal side directed upward and outer row on lateral side directed laterally; spines on outer row larger than these on inner row, progressively becoming larger posteriorly. Two rows of spines on the second infraorbital, inner row on dorsal surface and outer row on lateral side; inner row directed upward, accompanied by sparse small spines posteriorly and medially; spines on outer row same in size, directed laterally. Outer rows on first and second infraorbitals distinctly separated. Small spines densely scattered on dorsal surface of third infraorbital. A single row of preopercular spines on lateral side of preopercle; two posterior spines well developed, directed backward; posteriormost spine largest, but not beyond posterior margin of opercle; the other anterior spines small, directed laterally. A single opercular spine weakly pointing upward, beyond posterior margin of opercle. Finely serrated ridges radially directed posteriorly from anterodorsal corner of opercle; a single ridge accompanied by opercular spine especially developed. Two pairs of parietal spines on occiput, with serrated ridges radiating from them. Four (right side) and two (left) posttemporal spines present anterior to spine on first lateral scute; serrated ridges radially directed forward from posttemporal spines. Spines on ventral surface of lower jaw developed, located posterior to maxilla, directing forward and downward. A single humeral spine located posterior to opercle, with two (right) and one (left) small spines on its anterior margin. Single row of lateral scutes on lateral side of body, reaching base of caudal fin; a single developed spine directed upward and backward on central part of each lateral scute, with a single small spine directed backward on its base. One to two serrated ridges on upper part of each lateral scute directed anteromedially. First dorsal fin high, originating from area above junction between second and third lateral scutes; length of first dorsal fin base 3.8 in HL; second spine longest, tip of adpressed spine reaching beyond origin of second dorsal fin. Second dorsal fin originating from area above junction between ninth and tenth lateral scutes, and ending beyond area between 23rd and 24th lateral scutes; length of second dorsal fin base 1.1 in length of anal fin base; first to 11th dorsal fin soft rays progressively becoming longer posteriorly; 12th to 15th dorsal fin soft rays becoming shorter posteriorly. Pectoral fin originating from posterior edge of opercle, reaching 12th lateral scute; fourth ray longest, length 1.4 in HL. Lower three rays of pectoral fin thick and free, longer than remaining joined pectoral fin rays; first free pectoral fin ray (= 14th pectoral fin ray) longest, reaching to beyond anus; its length 1.2 in HL. Base of pelvic fin situated anterior to base of pectoral fin; distal edge of pelvic fin reaching area under seventh lateral scute. Anal fin lower than second dorsal fin, originating from area below junction between eighth and ninth lateral scutes, ending below 24th lateral scute; first anal fin ray especially short, its length 1.7 in last anal fin ray. Caudal fin slightly rounded; depth of caudal peduncle 8.1 in caudal fin length. Anus slightly anterior to origin of anal fin.

*Color*.—Color in alcohol now mostly faded; body, dorsal surface of head and fins light brown, ventral side of head paler. According to Jordan and Richardson (1908), color when fresh, body yellowish brown, back crossed with four obscure cross-bars of dusky, with many fine punctulations in small, vaguely outlined clusters; belly pale; spinous dorsal with obscure spots of dusky, forming rows across both rays and membranes; soft dorsal mottled, light color in roundish spots between rays; caudal and pectorals with rays specked and with membranes clouded with dusky; and anal fin pale except for narrow distal edge blackish.

**Distribution.** A reliable record from off Sakurajima, Kagoshima Prefecture, Japan (Jordan and Richardson 1908; this study).

## Discussion

**Validity of *Hoplichthys regani*.** *Hoplichthys regani* resembles *Hoplichthys gilberti*, which is frequently collected from Japan (e.g., Matsubara and Ochiai 1950b; Ochiai 1984), in having a short snout, large eyes, a narrow interorbit and a single developed spine on each lateral scute. However, *H. regani* has been regarded as separable from *H. gilberti* in having long free pectoral fin rays that extend beyond the posterior edge of the joined pectoral fin rays (vs. short free pectoral fin rays not reaching posterior edge of joined pectoral fin rays in *H. gilberti*) (e.g., Matsubara and Ochiai 1950b; Nakabo 2002). In addition, *H. regani* has been considered to be distinguishable from *H. gilberti* in having a wide space between the outer rows of spines on the first and second infraorbital (vs. space narrow in *H. gilberti*) and a long pelvic fin (1.8 in HL vs. more than 2 in HL) (Jordan and Thompson 1913; Matsubara and Ochiai 1950b; McGrouther 1999). Jordan and Thompson (1913) and Matsubara and Ochiai (1950b) also distinguished *H. regani* from *H. gilberti* by the count of anal fin rays (16 in *H. regani* vs. 17 in *H. gilberti*). In contrast, Matsubara and Ochiai (1950a), Kamohara (1958, 1964) and Tsuda (1990) suggested the possibility of *H. regani* being a junior synonym of *H. gilberti*, although they did not show concrete evidence for the suggestion.

We compared the characters above between the holotype of *H. regani*, and the holotype, nine paratypes and 40 non-types of *H. gilberti*. The ratios of HL to pelvic fin length were 2.4 in *H. regani* and 2.4–3.2 in *H. gilberti* (Fig. 3). The count of anal fin rays of *H. regani* is different in the description and drawing of the holotype by Jordan and Richardson (1908); it is 16 in the description, but 18 in the drawing. As a result of our observation, it was revealed that the holotype of *H. regani* indeed possesses 17 anal fin rays (Table 1). Because *H. gilberti* has 16–18 (mode: 17) anal fin rays, the counts of anal fin rays are not different between the species. The outer rows of spines on the first and second infraorbital were widely separated in the holotype of *H. regani* (Fig. 4A). In contrast, the space between the rows of spines on the infraorbital was observed to be variable in *H. gilberti* (Fig. 4B, C). Therefore, the species cannot be distinguished using these three characters.

In contrast, the longest free pectoral fin ray was long (23.2% SL), and its posterior tip reaches over the posterior tip of the joined pectoral fin rays in *H. regani*. On the other hand, the ray was short (10.5–18.3% SL) and its posterior tip did not reach the posterior tip of the joined pectoral fin rays in *H. gilberti* (Fig. 5). In addition, after comparing the length of each dorsal fin spine in males of both species, it was clear that all dorsal fin spines, except for a broken third spine, were longer in *H. regani* than those in *H. gilberti* (first dorsal fin spine 15.9% SL in *H. regani* vs. 8.0–14.8% SL in *H. gilberti*; second 17.3% SL vs. 8.1–15.4% SL; fourth 16.1% SL vs. 5.5–13.8% SL; fifth 14.0% SL vs. 3.6–11.1% SL; sixth 9.3% SL vs. 2.2–6.4% SL) (Fig. 6). Therefore, the characters recognized in the free pectoral fin rays and dorsal fin spines are valuable to distinguish the two species.

Of about eight valid species in the Hoplichthyidae, *H. regani* is also similar to *Hoplichthys citrinus* Gilbert 1905 in possessing a short snout (31.1% HL in *H. regani* vs. 30.4–35.3% HL in *H. citrinus*) and a narrow interorbit (4.4% HL vs. 3.1–4.0% HL), but is distinguished from the latter by a shorter first dorsal fin spine in males (vs. elongate, filament-like in males of *H. citrinus*) (this study). *Hoplichthys regani* differs from *H. langsdorfii* and *Hoplichthys ogilbyi* McCulloch 1914 in having a longer first dorsal fin, and posterior tip of adpressed fin reaching the origin of the second dorsal fin (vs. shorter and posterior tip not reaching origin of second dorsal fin in *H. langsdorfii* and *H. ogilbyi*), and caudal fin slightly rounded (vs. double truncated and especially long in middle portion) (McCulloch 1914; this study). In addition, *H. regani* is distinguished from *Hoplichthys platophrys* Gilbert 1905, *Hoplichthys haswelli*

McCulloch 1907, *Hoplichthys fasciatus* Matsubara 1937, *Hoplichthys pectoralis* (Fowler 1943) and *Hoplichthys filamentosus* Matsubara and Ochiai 1950c by having a narrow interorbit (interorbital width 4.4% HL in *H. regani* vs. more than 6.0 % HL in latters) (Gilbert 1905; McCulloch 1914; Fowler 1943; this study). Therefore, *H. regani* is distinguished from all valid hoplichthyid species, and we conclude *H. regani* is valid. This conclusion supports previous studies such as Matsubara and Ochiai (1950b), McGrouther (1999) and Nakabo (2002).

**Authorship of *Hoplichthys regani*.** Jordan and Richardson (1908) listed *H. langsdorfii* in their review of mail-cheeked fishes of the waters of Japan based on a single specimen collected from Kagoshima Prefecture, Japan. Subsequently Jordan (1908) reported that the specimen identified as *H. langsdorfii* by Jordan and Richardson (1908) was an undescribed species following a personal communication from C. T. Regan. Jordan (1908) gave a new scientific name, *Hoplichthys regani*, to this undescribed species without any description and considered Jordan and Richardson (1908) to be the authors of this species. Although some authors considered Jordan (1908) to be the author of *H. regani* (e.g., Eschmeyer et al. 1998; McGrouther 1999), others regarded Jordan and Richardson (1908) as its authors (e.g., Matsubara and Ochiai 1950a, c; Nakabo 2002).

According to ICZN (1999: Art. 12.1) for availability of scientific names, the names published before 1931 must satisfy the requirements of Art. 11 (i.e., being published after 1757, mandatory use of Latin alphabet, consistent application of binominal nomenclature, names to be used as valid when proposed) and must be accompanied by an indication of the taxon that it denotes. The name *Hoplichthys regani* completely satisfies requirements of ICZN (1999: Art. 11). Jordan (1908) clearly indicated that the new scientific name *Hoplichthys regani* was given to the specimen described as *H. langsdorfii* by Jordan and Richardson (1908), thus Jordan's (1908) taxonomic action satisfies the indication of ICZN (1999: Art. 12.2). Therefore, *H. regani* is considered to be available.

According to ICZN (1999: Art. 50.1), the author of a name is the person who first publishes it in a way that satisfies the criteria of availability. Jordan (1908), who published the new scientific name first and correlated it to the description of the holotype (Jordan and Richardson 1908), satisfies this article. We conclude that the author of *H. regani* is Jordan (1908), following studies such as Eschmeyer et al. (1998) and McGrouther (1999).

**Distribution.** After the description of *H. regani* based on the holotype, no records of this species have been reported from Japan. Shao and Chen (1994) gave a short description of this species from Taiwan with only a simplified illustration based on the original drawing. *Hoplichthys regani* is also reported from Sombrero Island (apparently a misspelling of Scobrero Island), Balayan Bay and Verde Island (Matsubara 1955a), and the South China Sea (McGrouther 2000), with only the scientific name in a key to species. Matsubara (1955a) did not provide the catalog numbers of specimens or a detailed description. Other records listed in the synonymy were not represented by specimens from specific localities, were without descriptions, were based on the holotype, or were probably misidentifications. Examination of hoplichthyid specimens in Japanese and Taiwanese museums revealed no other specimens of *H. regani* were deposited in these institutions. It is possible that *H. regani* is more widespread, but at this time we can report its occurrence only in Japan with certainty.

Gloerfelt-Tarp and Kailola (1984) and Allen (1997) reported *H. regani* from southern Indonesia and northwestern Australia, providing a short description, and a photograph or an illustration. Paxton et al. (2006) included this species in the Australian ichthyofauna based on Allen (1997). These specimens have a concave caudal fin, an elongate caudal fin filament on the posterior edge of the upper and lower lobes of the caudal fin and are yellow or orange (see Gloerfelt-Tarp and Kailola 1984; Allen 1997). Because the combination of these characters is not found in *H. regani* and all other valid species of the Hoplichthyidae, we regard these specimens to be an undescribed species. Therefore we do not include southern

Indonesia and northwestern Australia in the distribution of *H. regani* (a conclusion also reached by M. McGrouther, pers. comm.).

**Comparative materials.** *Hoplichthys langsdorfii* (10 specimens, 44.7–182.6 mm SL): BSKU 52274, BSKU 59794, BSKU 66610, BSKU 97068, BSKU 97519, HUMZ 110881, HUMZ 142836, HUMZ 204809, Japan; HUMZ 170917, HUMZ 170919, Taiwan. *Hoplichthys citrinus* (7 specimens, 135.0–184.6 mm SL): USNM 51610 (holotype, 152.1 mm SL, male), USNM 51670 (paratype), USNM 51704 (5 paratypes), Hawaii. *Hoplichthys platophrys*: USNM 51620 (holotype, 60.9 mm SL), Hawaii. *Hoplichthys gilberti* (50 specimens, 47.1–222.6 mm SL): USNM 51271 (holotype, 127.0 mm SL, female), SU 20229 (2 paratypes), USNM 398507 (7 paratypes), Suruga Bay, Japan; BSKU 119, BSKU 59164, BSKU 59526, BSKU 72535, BSKU 92589, BSKU 94340, BSKU 95246, BSKU 95739, BSKU 96187, BSKU 96191, BSKU 96300, BSKU 97066, HUMZ 79234, HUMZ 80241, HUMZ 80302, HUMZ 80424, HUMZ 205034, HUMZ 205087, HUMZ 205724, KAUM-I 15642, Japan; BSKU 16909, Timor Sea; BSKU 17659, BSKU 17660, BSKU 17661, BSKU 17667, South China Sea; BSKU 97922, HUMZ 193714, HUMZ 193715, HUMZ 193716, HUMZ 193997, Indonesia; HUMZ 185337, New Caledonia; HUMZ 186095, HUMZ 186096, Taiwan; HUMZ 188688, HUMZ 188693, HUMZ 188698, HUMZ 199846, HUMZ 200035, KAUM-I 7182, East China Sea; NSMT-P 92804, western Indian Ocean. *Hoplichthys fasciatus* (10 specimens, 43.4–63.6 mm SL): FAKU 1891 (holotype, 63.6 mm SL), off Mie Prefecture, Japan; BSKU 8896, BSKU 9512, BSKU 9513, BSKU 11376, BSKU 45862, BSKU 72726, BSKU 80757, BSKU 94893, FAKU 1816, Japan. *Hoplichthys pectoralis*: USNM 99503 (holotype, 61.1 mm SL), west cost of Luzon, Philippine Islands. *Hoplichthys filamentosus* (10 specimens, 110.5–306.5 mm SL): FAKU 11918 (holotype, 110.5 mm SL), off Shizuoka Prefecture, Japan; BSKU 93, BSKU 161, BSKU 28615, BSKU 28642, BSKU 39697, BSKU 40052, BSKU 40053, BSKU 94698, Japan; HUMZ 190264, Indonesia.

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Legend to figures:

**Fig. 1** Dorsal (**a**) and ventral (**b**) views of *Hoplichthys regani*, SU 22390, holotype, male, 144.6 mm SL, off Sakurajima, Japan

**Fig. 2** Dorsal (**a**) and ventral (**b**) illustrations of head of *Hoplichthys regani*, showing series of spines and ridges. *1* row of spines on lachrymal; *2* inner row of spines on the first infraorbital; *3* outer row of spines on the first infraorbital; *4* inner row of spines on the second infraorbital; *5* outer row of spines on the second infraorbital; *6* preopercular spines; *7* opercular spine; *8* parietal spines; *9* posttemporal spines; *10* spines on lateral scutes; *11* humeral spine; *12* spines on ventral surface of lower jaw; *scale bars* 10 mm

**Fig. 3** Relationship of ratio of head length/pelvic fin length versus standard length. *Solid symbol* holotype; *open symbol* paratypes and non-types; *triangle Hoplichthys regani*; *circle H. gilberti*

**Fig. 4** Lateral spines on head of *Hoplichthys regani* and *H. gilberti*. **a** *H. regani* (SU 22390); **b** *H. gilberti* (HUMZ 80423); **c** *H. gilberti* (HUMZ 205019). *Solid arrows* point to space between outer rows of spines on the first and second infraorbital; *bars* 5.0 mm

**Fig. 5** Relationship of free pectoral fin length versus standard length. *Solid symbol* holotype; *open symbol* paratypes and non-types; *triangle Hoplichthys regani*; *circle H. gilberti*

**Fig. 6** Relationships of dorsal fin spine length versus standard length. *Solid triangle Hoplichthys regani*; *open circle H. gilberti* in male

**Table 1** Counts and proportional measurements of *Hoplichthys regani* and *H. gilberti*

| | *H. regani* | *H. gilberti* | | |
|---|---|---|---|---|
| | Holotype | Holotype | Males[a] | Females and youngs[b] |
| | Male | Female | (*n* = 23) | (*n* = 26) |
| SL (mm) | 144.6 | 127.0 | 93.0–222.6 | 47.1–208.1 |
| Counts | | | | |
| First dorsal fin rays | VI | VI | V–VI | VI |
| Second dorsal fin rays | 15 | 15 | 14–15 | 14–16 |
| Anal fin rays | 17 | 17 | 16–17 | 16–18 |
| Caudal fin rays | 7 + 6 = 13 | 7 + 7 = 14 | 7–8 + 6–7 = 13–14 | 6–7 + 6–7 = 12–14 |
| Pectoral fin rays | 13 + 3 = 16 | 13 + 3 = 16 | 12–13 + 3–4 = 16–17 | 12–13 + 3–4 = 15–17 |
| Pelvic fin rays | I, 5 | I, 5 | I, 5 | I, 5 |
| Gill rakers | 2 + 12 = 14 | 2 + 12 = 14 | 2 + 11–14 = 13–16 | 2 + 11–13 = 13–15 |
| Branchiostegals | 7 | 7 | 7 | 7 |
| Vertebrae | 26 | 26 | 26 | 26 |
| Lateral scutes | 27 | 27 | 26–28 | 27–28 |
| Head spines | | | | |
| Spines on lachrymal | 9/9 | 10/D | 6–12/8–11 | 7–11/8–10 |
| Inner row spines on first infraorbital | 13/13 | D/D | 9–20/9–21 | 4–17/4–17 |
| Outer row spines on first infraorbital | 8/9 | 8/D | 6–18/6–15 | 5–14/5–15 |
| Inner row spines on second infraorbital | 18/20 | 17/D | 7–23/8–25 | 2–21/3–22 |
| Outer row spines on second infraorbital | 11/10 | 12/D | 9–22/10–25 | 8–22/8–20 |
| Preopercular spines | 6/8 | 6/7 | 5–11/5–11 | 4–11/4–9 |
| Spines on ventral surface of lower jaw | 6/6 | 6/5 | 2–8/2–9 | 1–8/1–9 |
| Proportional measurements (% SL) | | | | |
| HL | 28.4 | 30.1 | 27.9–34.8 | 29.2–36.6 |
| Body depth | 7.5 | 5.9 | 5.0–9.1 | 4.2–9.2 |
| Body width | 10.5 | 9.6 | 6.8–11.5 | 7.5–11.3 |
| Pre-first dorsal length | 27.9 | 29.4 | Unmeasured | Unmeasured |
| Length of first dorsal fin base | 7.4 | 7.3 | 5.5–8.8 | 6.5–8.6 |
| Length of first dorsal fin spine | 15.9 | 8.2 | 8.0–14.8 | 5.7–13.9 |
| Length of second dorsal fin spine | 17.3 | D | 8.1–15.4 | 7.7–12.6 |
| Length of third dorsal fin spine | D | 8.5 | 7.8–16.1 | 7.1–12.7 |
| Length of fourth dorsal fin spine | 16.1 | 9.0 | 5.5–13.8 | 6.2–11.7 |
| Length of fifth dorsal fin spine | 14.0 | 7.9 | 3.6–11.1 | 4.2–8.9 |
| Length of sixth dorsal fin spine | 9.3 | 3.9 | 2.2–6.4 | 1.7–5.9 |
| Pre-second dorsal length | 41.8 | 44.0 | Unmeasured | Unmeasured |

| | | | | |
|---|---|---|---|---|
| Length of second dorsal fin base | 47.6 | 45.5 | 44.9–48.5 | 41.2–46.5 |
| Length of first dorsal fin soft ray | 15.1 | D | 9.1–14.3 | 10.9–13.5 |
| Length of second dorsal fin soft ray | 15.7 | 12.3 | 11.0–16.5 | 9.8–14.6 |
| Length of third dorsal fin soft ray | 17.0 | 12.3 | 9.7–30.9 | 11.2–15.1 |
| Length of fourth dorsal fin soft ray | 18.7 | 12.0 | 11.3–41.5 | 11.0–15.6 |
| Length of fifth dorsal fin soft ray | 19.3 | 12.2 | 10.8–41.7 | 10.7–15.8 |
| Length of sixth dorsal fin soft ray | 20.2 | 11.7 | 10.5–39.7 | 9.9–15.2 |
| Length of seventh dorsal fin soft ray | 20.6 | 11.9 | 8.3–41.8 | 10.3–16.0 |
| Length of eighth dorsal fin soft ray | 20.3 | 11.2 | 10.1–40.5 | 9.2–17.8 |
| Length of ninth dorsal fin soft ray | 19.4 | 10.7 | 8.7–31.2 | 9.0–15.8 |
| Length of 10th dorsal fin soft ray | 20.8 | 10.6 | 8.8–19.7 | 8.9–14.4 |
| Length of 11th dorsal fin soft ray | 20.9 | 7.9 | 9.5–19.7 | 7.7–16.6 |
| Length of 12th dorsal fin soft ray | 20.1 | D | 8.4–20.2 | 8.0–15.4 |
| Length of 13th dorsal fin soft ray | 19.4 | 8.1 | 8.4–20.3 | 7.2–12.4 |
| Length of 14th dorsal fin soft ray | 15.8 | D | 7.2–19.4 | 5.8–9.6 |
| Length of 15th dorsal fin soft ray | 12.3 | D | 5.7–14.3 | 4.5–7.5 |
| Pre-anal length | 39.7 | 39.7 | Unmeasured | Unmeasured |
| Length of anal fin base | 53.5 | 50.4 | 48.0–53.7 | 45.9–52.1 |
| Length of first anal fin ray | 5.1 | 4.0 | 2.6–5.4 | 2.2–5.4 |
| Length of 17th anal fin ray | 8.9 | 5.7 | Unmeasured | Unmeasured |
| Pectoral fin length | 20.8 | 19.1 | 16.0–22.6 | 17.5–22.9 |
| Length of longest free pectoral fin ray | 23.2 | 16.1 | 12.2–17.6 | 10.5–18.3 |
| Pelvic fin length | 12.0 | 11.1 | 9.5–11.9 | 10.1–14.1 |
| Caudal peduncle depth | 2.2 | 1.9 | Unmeasured | Unmeasured |
| Length of upper caudal peduncle | 12.0 | 11.3 | 10.0–12.9 | 9.8–14.7 |
| Length of lower caudal peduncle | 9.1 | 8.4 | 6.5–9.5 | 7.7–9.5 |
| Caudal fin length | 17.7 | 14.7 | 12.5–20.8 | 10.6–16.6 |
| Proportional measurements (% HL) | | | | |
| Head depth | 23.9 | 25.1 | Unmeasured | Unmeasured |
| Head width 1 | 46.0 | D | 37.5–46.4 | 37.2–46.3 |
| Head width 2 | 61.3 | D | 47.0–59.4 | 46.0–59.7 |
| Head width 3 | 77.1 | D | Unmeasured | Unmeasured |
| Snout length | 31.1 | 28.2 | 28.1–32.3 | 27.9–33.4 |
| Orbital diameter | 37.2 | 37.8 | 34.1–40.7 | 32.7–39.5 |
| Vertical eye diameter | 26.0 | 25.4 | 23.4–28.7 | 24.4–29.3 |
| Horizontal eye diameter | 18.6 | 18.4 | 15.9–22.6 | 15.3–21.4 |
| Interorbital width | 4.4 | 3.6 | 1.8–4.2 | 2.2–7.3 |
| Postorbital length | 45.4 | 44.5 | Unmeasured | Unmeasured |
| Upper jaw length | 30.2 | 28.9 | 30.1–35.8 | 29.4–37.7 |

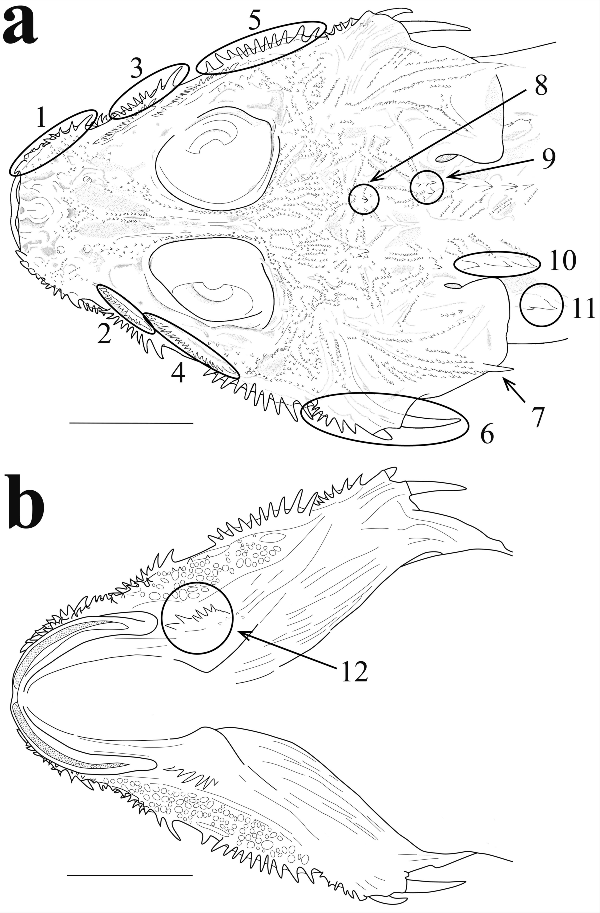
| | | | | |
|---|---|---|---|---|
| Lower jaw length | 29.3 | D | 28.2–35.0 | 27.8–37.3 |

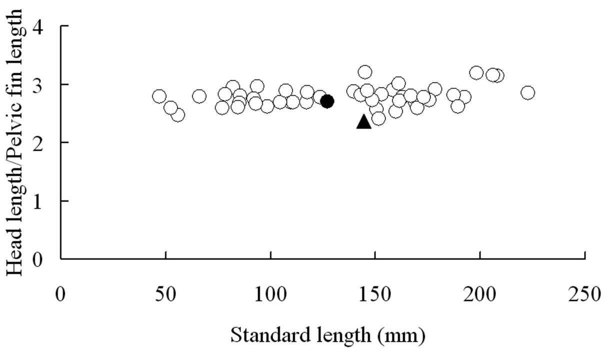
[a] Including one paratype

[b] Including eight paratypes

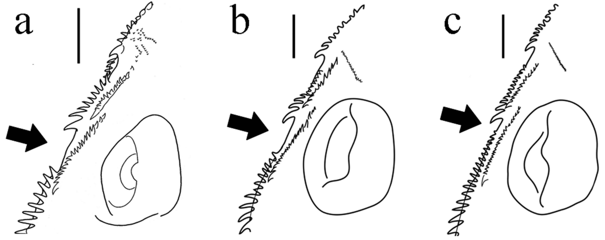
D indicating uncountable or unmeasurable data owing to damage

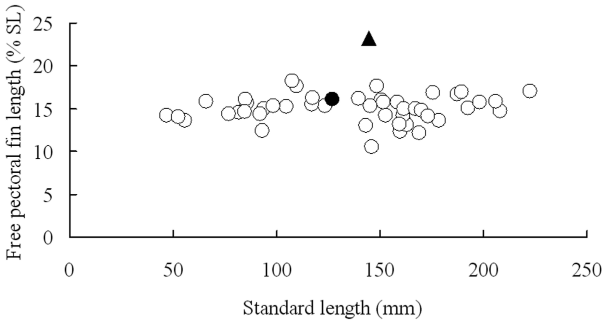

a
b


a
1
2
3
4
5
6
7
8
9
10
11
b
12

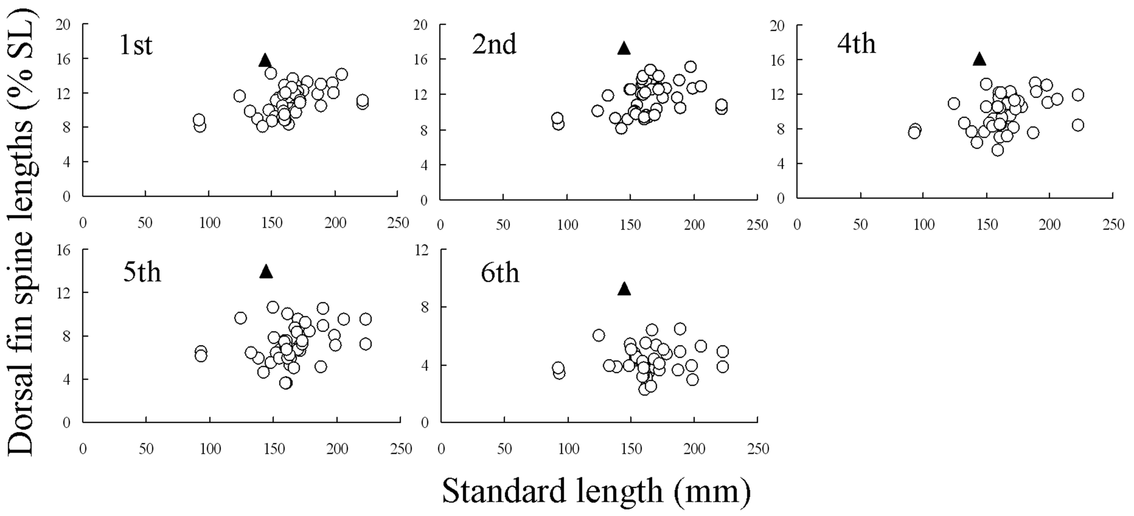


Head length/Pelvic fin length
4
3
2
1
0
0
50
100
150
200
250
Standard length (mm)


a
b
c



Free pectoral fin length (% SL)
25
20
15
10
5
0
0
50
100
150
200
250
Standard length (mm)


1st
2nd
4th
5th
6th
Dorsal fin spine lengths (% SL)
Standard length (mm)
0
50
100
150
200
250
0
4
8
12
16
20