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Careproctus rotundifrons, a New Snailfish (Scorpaeniformes: Liparidae) from Japan

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Abstract A new deep-sea liparid species, *Careproctus rotundifrons*, is described on the basis of 37 specimens collected from Sagami and Suruga bays, and off the Pacific coast of Fukushima Prefecture, Honshu Island, Japan (521–1100 m depth). This species resembles *C. aureomarginatus* from the South Atlantic and *C. cypselurus* from the North Pacific in general appearance but is distinguished by the following combination of characters: dorsal-fin rays 47–50; anal-fin rays 41–45; pectoral-fin rays 34–40; vertebrae 10–11+42–46=53–56; eye diameter 5.6–7.2% of standard length (SL); disk length 4.7–7.1% SL; interorbital width 9.9–13.5% SL; outer margin of pectoral-fin slightly notched; pectoral radials 4(3+1) lacking notches; ribs 2–3, scapula notch present; pyloric caeca 15–29; peritoneum dark brown; stomach, oral cavity, and pyloric caeca pale.
Key words : New species, Liparidae, *Careproctus*, Sagami Bay, Suruga Bay, Fukushima Prefecture.

The snailfishes (family Liparidae) are one of the most species-rich groups in the Southern Ocean, Antarctic and North Pacific, with a few additional deep water species known from the Indian Ocean (Nelson, 2006). Chernova *et al*. (2004) listed up the valid species, showing 334 species in 29 genera, but noted that "much work remains to be done with on the taxonomy and these numbers will continue to change."

The deep-sea snailfish genus *Careproctus* Krøyer, 1862 includes 113 species at least (Chernova *et al*., 2004; Chernova, 2005; Stein, 2006; Duhamel and King, 2007; Orr and Maslenikov, 2007). According to Burke (1930) and Kido (1988), the genus is diagnosed by the following characters: disk present, nostril single, pseudobranchiae absent, pectoral fin with fewer rays than anal fin. Kido (1988) recognized 18 species of *Careproctus* from Japanese waters, but subsequently Kido and Shinohara (1997) reported *Careproctus melanurus* Gilbert, 1892 as new to Japan and Imamura and Nobetsu (2002) described *Careproctus parvidiscus* as a new species. Although a total of 20 species are now recorded from Japan and adjacent waters, several (e.g., *Careproctus homopterus* Gilbert and Burke, 1912, *Careproctus segaliensis* Gilbert and Burke, 1912, *Careproctus sinensis* Gilbert and Burke, 1912, and *Careproctus bathycoetus* Gilbert and Burke, 1912; Fig. 1) are known only from holotypes and their taxonomic information is still poor (see Kido, 1988; Nakabo, 2002).

Tokyo Sea Life Park and the Marine Science Museum, Tokai University (MSM) have been capturing marine animals using bait traps in Sagami and Suruga bays since 1990 respectively. A number of unidentified *Careproctus* snailfishes were captured with other marine animals from both bays at depths of 730–1100 m. In addition, a single specimen of the same species was collected by an otter trawl conducted by the R/V *Wakataka-maru* at 521–567 m depth off the Pacific coast of Tohoku District, Honshu Island in 2002. These specimens provided the basis for the

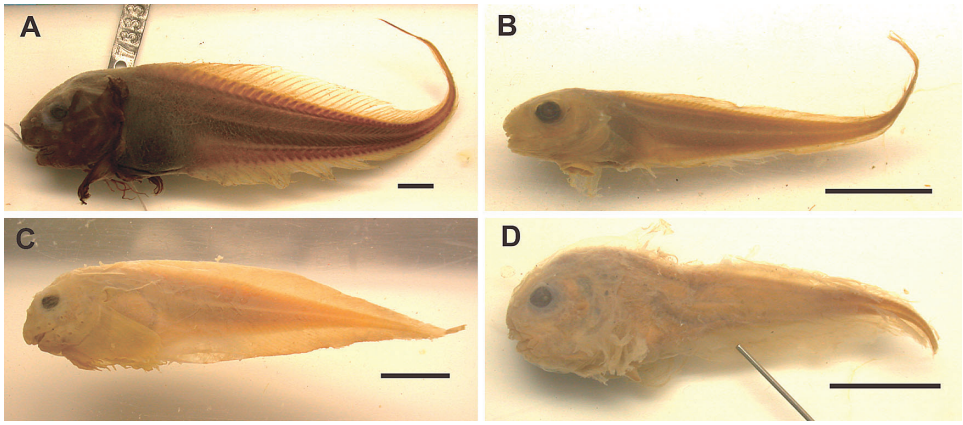

Fig. 1. Four rare species of *Careproctus* from Japan and adjacent waters. A: *Careproctus bathycoetus* (holotype, USNM 73337, Okhotsk Sea off Sakhalin); B: *C. homopterus* (holotype, USNM 73342, Okhotsk Sea off Sakhalin); C: *C. segaliensis* (holotype, USNM 73336, Okhotsk Sea off Sakhalin); D: *C. sinensis* (holotype, USNM 73339, Sea of Japan off Sado Island). Photographed by Gento Shinohara. Bars 10 mm.

new *Careproctus* species described herein.

Counts, measurements, and terminology follow Able and McAllister (1980), Andriashev and Stein (1998) and Stein *et al*. (2001), except that the number of fin rays on the pectoral-fin lower lobe was counted from the anteriormost ray to the longest ray and the lower lobe length of the pectoral fin was taken as that of the longest ray on the lobe (Kido, 1988). In addition, terminology of the intermuscular bones follows Patterson and Johnson (1995). Counts of unpaired fin rays, vertebrae, and accessory bones were based on radiographs. Osteological characters were observed on two specimens cleared and stained with both Alcian Blue and Alizarin Red S (see Dingerkus and Uhler, 1977). Standard length (SL) and head length (HL) are used throughout. Institutional abbreviations follow Leviton *et al*. (1985).

Careproctus rotundifrons sp. nov.

(New Japanese name: Hime-kon'nyakuuo)

(Figs. 2, 3)

Holotype. NSMT-P 76691, male, 97.9 mm SL, 35°13.55′N, 139°22.35′E (Sagami Bay off Chigasaki, Kanagawa Prefecture, Honshu I., Japan), 730–780 m, 13 Mar. 1996, coll. by H. Sakurai.

Paratypes. 36 specimens, 45.3–107.8 mm SL: NSMT-P 65560, 102.8 mm SL, 36°56.5′N, 141°36.7′E–36°59.9′N, 141°39.7′E (Pacific coast off Fukushima Prefecture, Honshu I.), 521–567 m depths, 23 Oct. 2002, R/V *Wakataka-maru*, coll. by G. Shinohara; HUMZ 201215, NSMT-P 76692–76693, 3 specimens, 63.1–91.4 mm SL, 35°12.65′N, 139°18.75′E (Sagami Bay off Ninomiya, Kanagawa Prefecture), 980–1100 m, 22 Jan. 1993, coll. by H. Arai; NSMT-P 76695, 76697, 76698, USNM 392619, 4, 48.4–66.7 mm SL, Sagami Bay off Ninomiya, 800–830 m, 8 Feb. 1995, coll. by H. Sakurai; HUMZ 201216, NSMT-P 76700, 76702, USNM 392620, 4, 45.3–75.0 mm SL, 35°13.42′N, 139°21.01′E (Sagami Bay off Chigasaki), 880–930 m, 21 Sep. 1995, coll. by H. Sakurai; NSMT-P 76707–76711, 5, 65.5–95.3 mm SL, 35°13.55′N, 139°22.35′E (Sagami Bay off Chigasaki), 730–780 m, 13 Mar. 1996, coll. by H. Sakurai (NSMT-P 76708 is cleared and stained); NSMT-P 76703–76706, 4, 73.5–107.0 mm SL, 35°14.30′N, 139°21.40′E (Sagami Bay off Hiratsuka), 730–760 m, 26 July 1996, coll. by H. Arai; NSMT-P 76712–76713, 2, 67.0–107.8 mm SL, Suruga Bay, 1000 m, 9 Mar. 1990, coll. by Y. Shiobara; NSMT-P 76715, 95.6 mm SL, Suruga Bay, depth unknown, 19 Dec. 1990, coll. by Y. Shiobara; NSMT-P 76714, 76716 , 2, 97.8–105.4 mm SL, Suruga Bay, depth unknown, 1990 (date unknown), coll. by Y. Shiobara (NSMT-P 76716 is cleared and stained); NSMT-P 76717–76726, 10, 69.6–104.4 mm SL, Suruga Bay, depth unknown, Nov. 1990–Mar. 1991, coll. by Y. Shiobara.

Diagnosis. A species of *Careproctus* with the following characters: dorsal-fin rays 47–50; anal-fin rays 41–45; pectoral-fin rays 34–40; vertebrae 10–11+42–46=53–56; eye diameter 5.6–

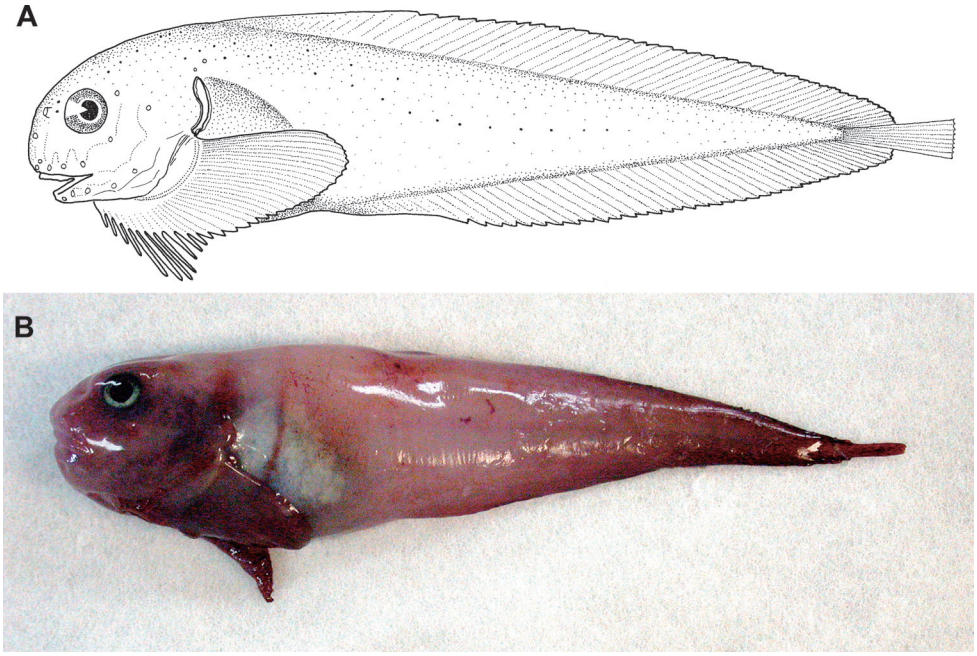

Fig. 2. *Careproctus rotundifrons* sp. nov. from Sagami Bay (A) and Pacific coast off Fukushima Prefecture (B). A: holotype, NSMT-P 76691, male, 97.9 mm SL; B: paratype, NSMT-P 65560, male, 102.8 mm SL.

7.2% SL; disk length 4.6–7.1% SL; interorbital width 9.9–13.5% SL; outer margin of pectoral fin slightly notched; pectoral radials 4 (3+1) lacking notches; ribs 2–3; scapula notch present; pyloric caeca 15–29; peritoneum dark brown; stomach, oral cavity, and pyloric caeca pale.

Description. Holotype condition is shown first, followed by paratype condition in parentheses if different.

Dorsal-fin rays 48 (47–50), anal-fin rays 42 (41–45), pectoral-fin rays 37 on both sides (35–40 on left/34–39 on right), caudal-fin rays 1+5/5+1=12 (1−2+5/5+1=12–13), vertebrae 10+43=53 (10–11+42–46=53–56), ribs 3(2–3), gill rakers 9 (8–10), pyloric caeca 18 (15–28), epural 1 (absent in NSMT-P 76714, probably abnormal condition).

Proportional measurements (%SL): head length 25.9 (24.2–30.1), head width 21.5 (13.8–24.7), body depth 24.0 (16.6–25.9), predorsal length 32.2 (29.1–37.0), preanal length 35.0 (34.7–43.1), snout length 10.1 (8.9–11.6), eye diameter 6.4 (5.6–7.2), interorbital width 11.7 (9.9–13.5), upper jaw length 10.5 (10.4–13.6), lower jaw length 10.2 (9.9–12.5), length of longest pectoral-fin ray in upper lobe 19.3 (16.7–21.7), length of longest pectoral-fin ray in lower lobe 14.0 (10.3–15.9), gill opening length 6.7 (6.1–7.5), distance between snout and disk 11.6 (10.8–15.1), distance between snout and anus 17.1 (17.1–22.7), distance between mandible and disk 9.4 (8.5–13.9), distance between mandible and anus 14.5 (14.5–20.6), distance between disk and anus 0.5 (0–3.6), disk length 4.9 (4.7–7.1), disk width 6.0 (5.2–7.0).

Head large, slightly compressed; its front rounded. Snout rounded. Mouth subterminal. Upper jaw reaching to below anterior margin of pupil. Lower jaw position terminal (*sensu* Stein *et al*., 2001). Teeth in both jaws small, conical, arranged in about 25 oblique rows in upper jaw (Fig. 3A: drawing); inner most teeth weakly trilobed (Fig. 3A: upper photo). Eye relatively large, pupil widely opened. Nostril short, tubular, located anterior to eye. Cephalic pores well developed; cephalic pore formula 2-6-7-2. Two

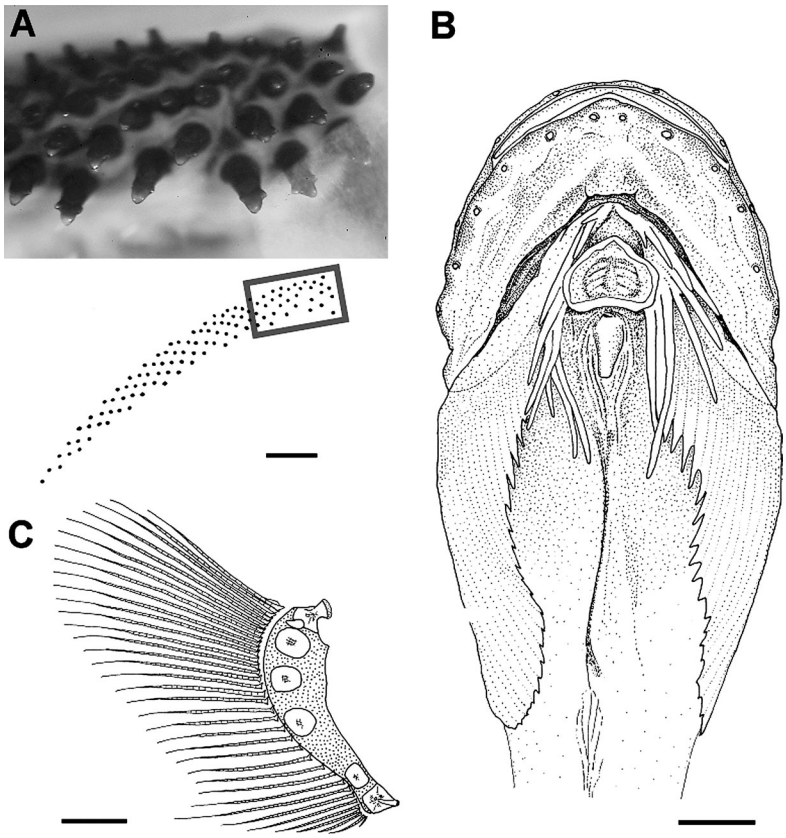

Fig. 3. Premaxillary teeth (A, ventral view), mandible and disk (B, ventral view), and pectoral girdle (C, lateral view) of *Careproctus rotundifrons* sp. nov. A and C: paratype, NSMT-P 76716, 97.8 mm SL; B: holotype, NSMT-P 76691, 97.9 mm SL. Bars 0.5 mm in A and 5 mm in B and C. Square on drawing in A indicates position of photograph.

chin pores present on ventral surface of lower jaw, opening directly on the skin surface, interspace of the 2 pores clearly exceeding the pore diameter (Fig. 3B). Gill opening above pectoral-fin base. Opercular flap weak, rounded. Gill rakers short, triangular, covered with fine spines.

Pectoral fin slightly notched posteroventrally, reaching to above anal-fin origin; rays shortened ventrally in lower lobe, the lowest one shortest, tiny, located below posterior end of eye.

Trunk compressed, tapering gradually to caudal fin. Dorsal-fin origin above gill opening. Interneural of dorsal ray 1 between neural spines 4 and 5 [rarely between 5 and 6 (NSMT-P 76692)]. A single free interneural present between neural spines 3 and 4 (present or absent). Disk small, almost rounded, its anterior margin just below pupil. Anus close to disk. A small genital papilla present posteriorlly to the anus (Fig. 3B) (females frequently having a minute genital papilla-like process). Ribs 3, on abdominal vertebrae 8–10 (2–3; 8–9, 7–9, or 8–10). Epineurals on abdominal vertebrae 3–16 (from 3–9 to 3–22). Anal-fin origin below vertebra 14 (13–14). Anterior rays of dorsal and anal fins buried in gelatinous subcutaneous layer. Caudal fin narrow, truncated, continuous with dorsal and anal fins anteriorly. Hypurals and parhypural fused in to a plate with a slit posteriorly.

Body without prickles. Gelatinous tissue layer beneath skin thin. Two free neuromasts (rudimentary pores sensu Burke, 1930) anterior

to eye. Three free neuromast rows on body: first between eye and dorsal-fin origin; second originating from immediately above the anterior suprabranchial pore and extending posteriorly, its length one fourth of SL; and third originating from immediately behind the posterior suprabranchial pore and extending posteriorly, its length half of SL (Fig. 2A). Pyloric caeca slender, pointed, on left side of body with stomach.

Osteology (based on NSMT-P 76708 and 76716). Basal cartilaginous lamina of pectoral girdle widest at dorsal one-third, narrowing ventrally (Fig. 3C). Pectoral radials 4 (3 dorsal+1 ventral), lacking notches; 3 dorsal radials round, ventral one small, squarish; 1 fenestra between scapula and radial. Scapula notched ventrally, with strong helve. Coracoid triangular with broad lamina.

Color when fresh. Head and body pale (pale to reddish). Margins of vertical and pectoral fins dusky. Dots, spots and bands absent on body. Stomach, pyloric caeca, and orobranchial cavity pale. Peritoneum dark brown.

Color in alcohol. Head and body uniformly pale (uniformly pale to reddish).

Maximum size of specimens. 107.8 mm SL (male) and 104.4 mm SL (female).

Distribution. Known from the continental slope off the Pacific coast of Fukushima Prefecture (521–567 m), Sagami Bay (730–1100 m), and Suruga Bay (1000 m).

Biological note. Both mature and immature specimens were captured by bait traps on the sea floor. Because individuals on display at Tokyo Sea Life Park were observed to swim searching for food fallen on the bottom and frequently to stay on the acrylic glass or walls of a tank using the ventral disk, the species is apparently benthic. A holosaurid (*Aldrovandia affinis* Günther, 1877), a psychrolutid (*Ebinania vermiculata* Sakamoto, 1932), and 2 zoarcids [*Ericandersonia sagamia* Shinohara and Sakurai, 2006 and *Japonolycodes abei* (Matsubara, 1936)] were captured together with this species in the same traps in Sagami Bay, indicating the likelihood of their sharing similar habitat.

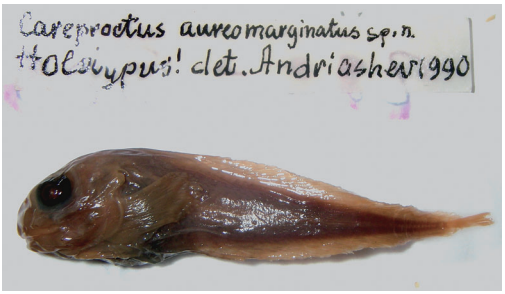

Fig. 4. Holotype of *Careproctus aureomarginatus* Andriashev, 1991, ZIN 49587, from Atlantic Ocean near Falkland Islands. Photographed by Hsuan-Ching Ho.

Females have an ovipositor in the abdominal cavity and it is everted to outside the body when the abdominal cavity is pressed.

Etymology. The name *rotundifrons* is derived from Latin *rotund* (rounded)+*frons* (front) in reference to the rounded forehead.

Comparison. This species resembles *Careproctus aureomarginatus* Andriashev, 1991 known only from the holotype (Fig. 4), taken from slightly south of the Falkland Islands, at 1660–1665 m depth. Counts of the dorsal-, anal-, and caudal-fin rays, vertebrae, ribs, and pectoral girdle radials of *C. aureomarginatus* are within the ranges of those of *C. rotundifrons*. Both species are similarly colored on the peritoneum (dark brown) and stomach (pale), and have a similar tooth pattern and shape (see Andriashev, 1991). However, *C. rotundifrons* is distinguished from *C. aureomarginatus* by the following characters: larger numbers of pyloric caeca (15–29 in *C. rotundifrons* vs. 10 in *C. aureomarginatus*) and gill rakers (8–10 vs. 7), fewer principal caudal-fin rays (5/5 vs. 5/6), shorter eye diameter [21.4–26.9% HL (5.6–7.2% SL) vs. 41.2% HL (13.2% SL)], shorter disk length [18.2–26.9% HL (4.6–7.1% SL) vs. 31.3% HL (10.0% SL)], and greater interorbital width [37.9–54.1% HL (9.9–13.5% SL) vs. 19.4% HL (6.2% SL)], the pectoral-fin outer margin is slightly notched in *C. rotundifrons* (vs. distinctly notched), a scapula notch is present (absent), and 2 chin pores separated, interspace clearly exceeding the pore diam-

eter (closely spaced, not exceeding one-half of the pore diameter) (see Andriashev, 1992). Eye diameter, disk length, and interorbital width are all significantly different (Fig. 5). Among species of *Careproctus* known from the North Pacific, *C. rotundifrons* resembles *Careproctus cypselurus* Jordan and Gilbert in Jordan and Evermann, 1898 in having a slightly notched pectoral fin, similar pectoral-fin ray counts (34–40 in *C. rotundifrons* vs. 32–40 in *C. cypselurus*), the gill opening wholly above the pectoral fin, the anus closely behind the disk, similar body color patterns in fresh specimens, a dark peritoneum, and pale stomach and pyloric caeca (Kido, 1988; Mecklenburg *et al*., 2002). However *C. rotundifrons* is distinguished from *C. cypselurus* by the following characters: fewer dorsal- and anal-fin rays and vertebrae counts (47–50, 41–45, and 53–56 in *C. rotundifrons* vs. 58–64, 52–58, and 64–70 in *C. cypselurus*, respectively) (see Mecklenburg *et al*., 2002), the disk rounded (vs. triangular), inner teeth trilobed (vs. all conical), uppermost fin ray of pectoral-fin level with lower margin of eye (vs. level with posterior corner of maxillary), lower lobe of pectoral fin reaching behind gill opening (vs. below gill opening), caudal fin truncated (vs. deeply forked), body varying from pale to reddish brown when fresh (vs. purplish-indigo), no additional pigmentation evident in alcohol (vs. scattered dark pigment), and the oral and branchial cavities pale (vs. dusky) (see Kido, 1988).

Comparative materials. *Careproctus aureomarginatus*, ZIN 49587, holotype, (only digital image taken by Hsuan-Ching Ho); *C. cypselurus*: NSMT-P 68796. 4 specimens, 300–320 mm SL, Sea of Okhotsk off eastern Hokkaido, Japan, 44°46.6′N, 144°20.4′E–44°43.1′N, 144°18.7′E, 450–477 m depth, 5 Nov. 2003, R/V *Hokkomaru.*

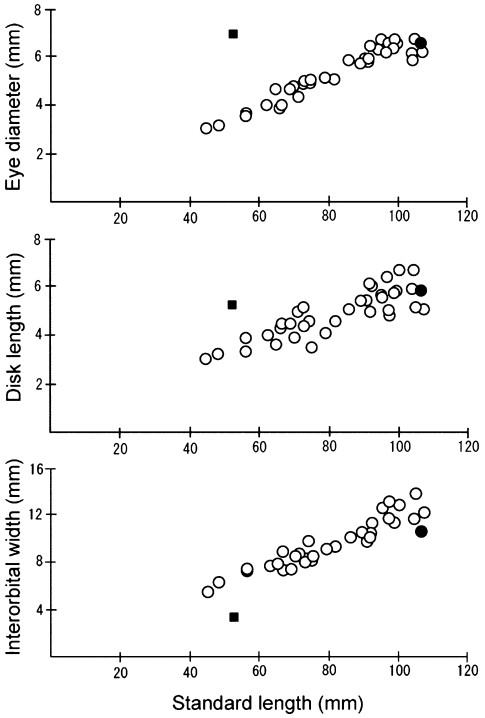

Fig. 5. Relationships of eye diameter, disk length, and interorbital width with standard length in *Careproctus rotundifrons* sp. nov. (circles) and *C. aureomarginatus* (square). Solid, holotype; open, paratypes.

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