

SPONGICOLOIDES IHEYAENSIS, A NEW SPECIES OF DEEP-SEA
SPONGE-ASSOCIATED SHRIMP FROM THE IHEYA RIDGE, RYUKYU ISLANDS,
SOUTHERN JAPAN (DECAPODA: STENOPODIDEA: SPONGICOLIDAE)

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A B S T R A C T

A new species of the deep-sea sponge-associated shrimp genus *Spongiocoloides* Hansen, 1908, *S. iheyaensis*, is described and illustrated on the basis of 6 specimens (3 sexual pairs) collected from the North Knoll of the Iheya Ridge at depths of 988–1051 m, Ryukyu Islands, southern Japan. This is the fourth species of the genus known from the Pacific Ocean. The new species is similar to *S. hawaiiensis* from Hawaii and *S. novaezealandiae* from New Zealand, but is distinguished by the differences in spination of carapace, sixth pleonal somite, and third pereopod. It is suggested that the egg number of the new species is greater than that of other congeneric species. Sexually dimorphic characters are discussed. A key to the Pacific species of *Spongiocoloides* is provided.

INTRODUCTION

At present, five genera are recognized in the family Spongiicolidae (see Holthuis, 1993): *Microprosthem*a Stimpson, 1860; *Paraspongiicola* de Saint Laurent and Cléva, 1981; *Spongiicola* de Haan, 1844; *Spongiocoloides* Hansen, 1908 and *Spongiocaris* Bruce and Baba, 1973. The genus *Microprosthem*a is distributed in shallow coral reefs, while the other genera are associated with deep-sea hexactinellid sponges, living as sexual pairs entrapped within the atrium. *Spongiocoloides* is represented by following seven species from the Pacific and Atlantic, all known from deep water at depths of about 700–2400 m: *S. evolutus* (Bouvier, 1905); *S. galapagensis* Goy, 1980; *S. hawaiiensis* Baba, 1983; *S. inermis* (Bouvier, 1905); *S. koehleri* (Caulery, 1896); *S. novaezealandiae* Baba, 1979 and *S. profundus* Hansen, 1908. All species are rare, represented only by a few specimens.

After the discovery of hydrothermal vents in the North Knoll of the Iheya Ridge, located at the north-set about 100 km away from the Okinawa Island, Ryukyu Islands (Fig. 1), survey cruises for chemosynthetic community were carried out by one of the authors using the R/V “Natsushima” and the submersible “Shinkai 2000” since 1997 (Yamamoto et al., 1999). During the cruises, specimens of spongiicolid shrimp were collected inhabiting the cavities of unidentified hexactinellid sponges settling on rock far from a vent opening (Fig. 2). These specimens were found to represent an undescribed species of *Spongiocoloides*, named here as *S. iheyaensis*. The new species is similar to *S. hawaiiensis* and *S. novaezealandiae*, but spination of the carapace, sixth pleonal somite and third pereopod differentiates the new species from the latter two. The new species is the first of the genus known from Japan, as well as the fourth from the Pacific.

MATERIALS AND METHODS

Specimens of the new species in this study were collected from the North Knoll of the Iheya Ridge during dives of the DS “Shinkai 2000”, and deposited in the National Science Museum, Tokyo (NSMT) and Japan Agency for Marine-Earth Science and Technology Center (JAMSTEC). Counts of teeth on the lateral margins of the antennal scale and the uropods include the terminal tooth. Marginal spines of the telson are counted as: spines on lateral margin; spine on posterolateral angle, where the dorsolateral carina terminates; spines on posterior margin. Postorbital carapace length and maximum pleonal width are abbreviated as CL and PW in the text. Drawings were made with the aid of drawing tube mounted on a LEICA MZ95 stereomicroscope. For comparison, the following specimens were examined.

Spongiocoloides novaezealandiae Baba, 1979. Holotype male, CL 12.7 mm (Museum of New Zealand Te Papa Tongarewa, NMNZ-Cr 1889), Chatham Rise, New Zealand, 990–1110 m depth, R/V “Kaiyo-Marū”, St. 36, 44°44.0'S, 175°42.0'E, 16 July 1968; 2 males, CL 7.7–10.2 mm, 1 ovigerous female, CL 9.4 mm (National Museum of Natural History, Smithsonian Institution, USNM 256953), Fiji.

SYSTEMATICS

Genus *Spongiocoloides* Hansen, 1908
Spongiocoloides iheyaensis new species
Figs. 3–8

Material Examined.—Holotype: ovigerous female, CL 15.1 mm (NSMT-Cr 15109), the North Knoll of the Iheya Ridge, Ryukyu Islands, 988 m depth, “Shinkai 2000”, #1195 dive, 27°47.17'N, 126°53.91'E, 22 June 2000.

Paratypes: 1 male, CL 9.0 mm (NSMT-Cr 15110), paired with holotype female; 1 male, CL 12.3 mm (JAMSTEC #006425), 1 female, CL 15.7 mm (JAMSTEC #006426), 998 m depth, “Shinkai 2000” #979 dive, 27°47.36'N, 126°53.99'E, 26 Sep. 1997; 1 male, CL 9.9 mm (JAMSTEC #015833), 1 female, CL 10.5 mm (JAMSTEC #015834), 1051 m depth, “Shinkai 2000” #1094 dive, 27°47.17'N, 126°54.07'E, 8 May 1999. All specimens inhabited cavities of hexactinellid sponges in heterosexual pairs.

Diagnosis.—A large-sized spongicolid shrimp with sub-cylindrical body form, body surface generally glabrous. Dorsal margin of rostrum armed with 7-11 small teeth; ventral margin with 1-3 small teeth; each ventrolateral ridge unarmed or armed with 1-2 small teeth. Carapace with single row of spines on postorbital region and scattered small spines at anterolateral region; cervical, hepatic and branchial grooves present. Sixth pleonal somite with 1 or longitudinal row of 2-4 small spines on midline and often with 1-2 small lateral spines on either side. Telson quadrangular, with 2 dorsolateral carinae each bearing 7-13 spines; lateral margin with 6-10 spines; posterolateral angle with 1 spine; posterior margin rounded, with 3-8 small spines. Antennal scale subquadrangular; lateral margin with 7-11 teeth. Eye with cornea globular, unfaceted, devoid of dark pigment. First maxilliped with 2 or 3-segmented palp; distal segment with 1 prominent spine in females. Fixed finger of third pereopod armed with short row of 3-9 teeth on distoventral margin; ischium unarmed. Uropodal exopod broader than endopod, lateral margin with 11-15 teeth.

Description of Holotype Female.—Rostrum (Figs. 3A, 4A, C) 0.34 times as long as carapace, straight or slightly upturned, reaching to distal margin of second segment of antennular peduncle; dorsal margin armed with 11 small teeth, all anterior to orbital margin; ventral margin armed with 2 small teeth on distal half; rostral base triangular in dorsal view, each ventrolateral ridge armed with 2 small teeth on distal half.

Carapace (Figs. 3A, 4A, C) thin texture, glabrous. Cervical groove distinct, bearing cincture of numerous small spines on posterior border. Epigastric region armed with numerous scattered small spines. Gastric region with numerous scattered spines, decreasing in size posteriorly. Branchial region with shallow groove, and a few small branchial spines. Hepatic region with shallow groove. Post-orbital region armed with a longitudinal row of 5 spines. Orbital margin concave, inferior orbital angle produced in rounded lobe. Branchiostegal margin convex, with a few marginal spines. Pterygostomial angle with numerous spines, decreasing in size posteriorly.

Sixth and seventh thoracic sternites (Fig. 4D) with paired triangular plates, ventral surface concave, ventrolateral and posterior margins setose. Eighth sternites with paired narrow plate, anteroventral surface concave.

Pleonal somites (Figs. 3A, 4F) glabrous. First to fourth pleura broadly rounded and setose on ventral margin, those of second to fourth somites each with articular knob. First somite (Fig. 4F) short, divided in 2 sections by distinct transverse carina; posterior section of pleuron rounded. Second somite anteriorly with transverse groove ending at base of pleuron. Third somite longest with shallow transverse groove on tergum. Pleuron of fifth somite rounded, armed with 1-2 ventral teeth. Sixth somite (Fig. 4H) with longitudinal row of 4 small spines on midline and with 2 small lateral spines on either side; ventrolateral margin ending in sharp tooth; posterior margin smooth. Telson (Fig. 4H) elongate, quadrangular, 2.3 times longer than broad; dorsal surface grooved medially; dorsolateral carinae conspicuous, each with 10 spines; lateral margin slightly constricted near base, armed with 1 small subproximal spine and with

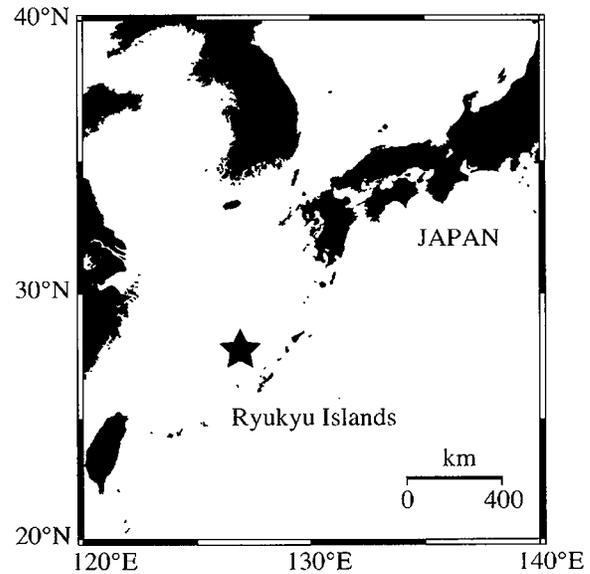


Fig. 1. Locality of the sampling site (★) for *Spongicoloides iheyaensis* n. sp. in the North Knoll of the Iheya Ridge.

10 spines; posterolateral angle with 1 spine; posterior margin broadly rounded, with 8 spines.

Pleonal sternites unarmed.

Eye (Fig. 5A) well developed, moderately large; cornea globular, shorter than eyestalk, devoid of dark pigment, corneal surface not faceted; eyestalk armed with 1 tiny middorsal and 2 mesial spines.

Antennular peduncle (Fig. 5B) reaching to proximal one-third of scaphocerite; first segment without statocyst, about twice length of second segment, mesial margin straight; lateral margin slightly expanded proximally; stylocerite greatly reduced to tiny spine reaching to one-third length of first segment; second segment longer than distal segment, bearing 2 small spines on mesial margin; distal segment unarmed. Flagella slender, about 3 times as long as peduncle.

Antenna (Figs. 4A, 5C) with stout basicerite, bearing large spine at distolateral angle and additional 1 small spine on ventrodorsal margin and 1 spine on ventral surface proximally. Antennal scale broad, subquadrangular, about 2.4 times as long as wide; lateral margin slightly concave, armed with 10 (left) or 9 (right); dorsal surface with 2 distinct longitudinal carinae. Carpocerite short, reaching second segment of antennular peduncle, with 1 small spine distomesially; flagellum about 3.3 times of CL.

Mandible (Fig. 5D) with 3-segmented palp; distal segment oval, subequal in length to intermediate segment; molar and incisor processes separated. Maxillule (Fig. 5E) with simple palp bearing 1 short terminal seta; distal endite broad, its mesial margin truncate; proximal endite suboval, tapering distally. Maxilla (Fig. 5F) with palp slender, tapering distally; distal and proximal endites both deeply bilobed; scaphognathite well developed. First maxilliped (Fig. 5G) with 2-segmented palp; distal segment with 1 prominent spine; proximal segment broad, 2.0 times of distal segment in length; distal endite large, rounded anteriorly; proximal endite bilobed; exopod with well developed flagellum; epipod large, subequally bilobed. Second maxilliped (Fig. 5I)

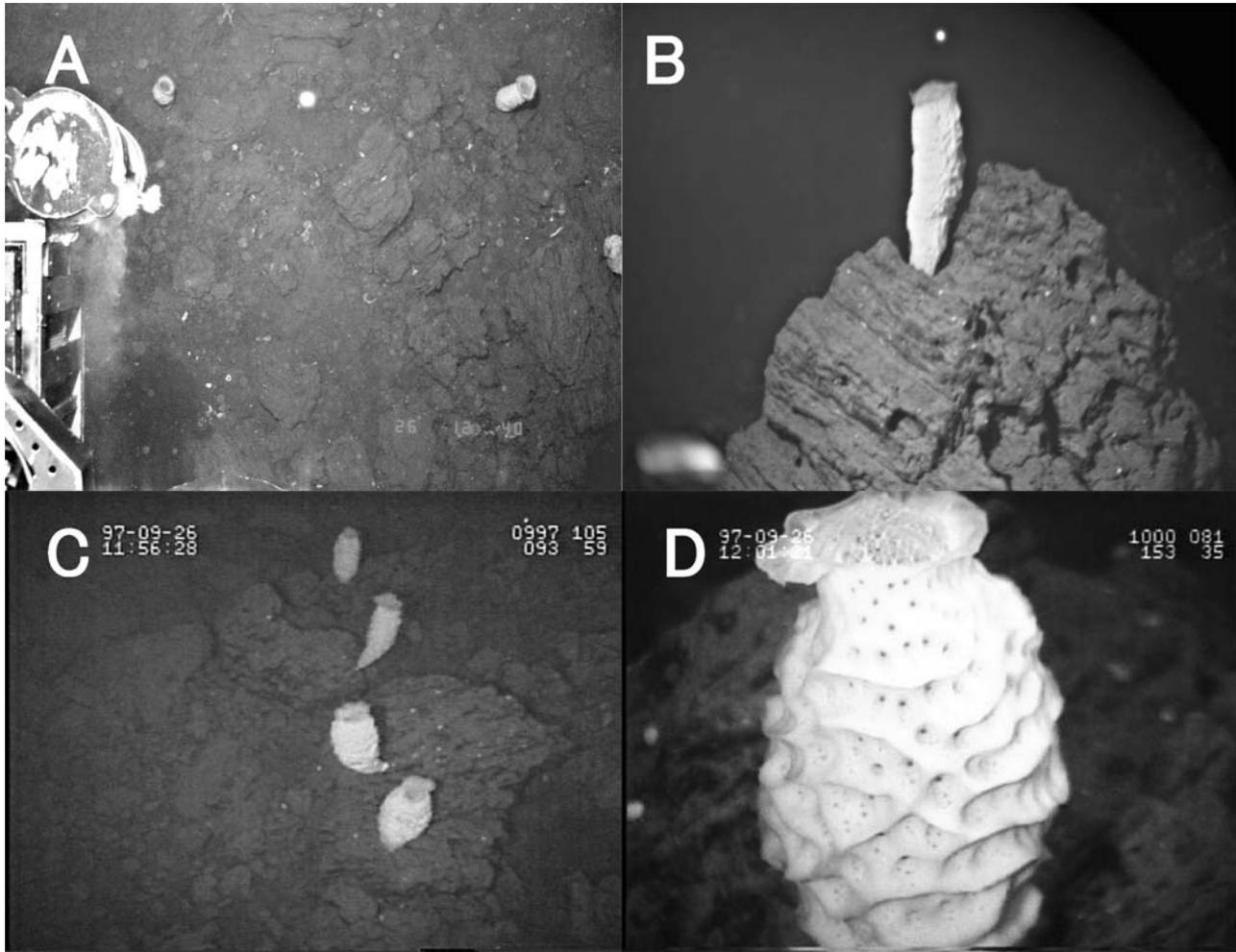


Fig. 2. A-D, landscape of host sponge *Euplectella* sp. standing on the deep-sea floor at the sampling sites.

with endopod composed of 7 segments; dactylus triangular, about twice as long as broad; propodus subquadrate, about 1.2 times of dactylus in length; carpus short, widened distally, about 0.6 times of propodus; merus long, 3.2 times of carpus; ischium not fused with basis, 0.3 times of merus; epipod oval, with a podobranch; exopod absent. Third maxilliped (Fig. 5J) with 7-segmented endopod, slender, overreaching distal margin of scaphocerite by length of dactylus; dactylus tapering distally; propodus 1.8 times as long as dactylus, without grooming setae; carpus 1.1 times of propodal length; merus 1.5 times of carpal length; ischium subequal to merus; basis shortest, 0.2 times of ischium; coxa with small epipod; exopod absent.

Branchial formula summarized in Table 1.

First pereiopod (Fig. 6A, B) overreaching tip of antennal scale by length of chela; dactylus 0.5 times of palm; palm subcylindrical, without grooming setae; carpus longest, about 2.7 times as long as palm; merus 0.7 times as long as carpus; ischium 0.6 times of merus; coxa and basis short, unarmed.

Second pereiopod (Fig. 6C) generally similar to first pereiopod, but longer, overreaching tip of antennal scale by length of chela and half of carpus; dactylus 0.4 times of

palm; carpus 1.8 times of palm; merus 0.8 times of carpus; ischium 0.5 times of carpus; coxa and basis short, unarmed.

Third pereiopod (Fig. 6D, E) largest, overreaching tip of antennal scale by length of chela and carpus. Fingers each terminating in strongly curved, corneous claw; dactylus 0.6 times of palm length, cutting edge formed by chitinous ridge bearing 1 low, rounded tooth at about midlength; fixed finger (Fig. 6E) with short row of 4 (left) or 9 (right) small teeth on distoventral margin; palm longer than other segments, subcylindrical; carpus widened distally, about 0.5 times of palm; merus slightly shorter than palm, unarmed; ischium almost equal to carpus in length, unarmed, distodorsal angle not produced; basis and coxa short, unarmed.

Fourth and fifth pereiopods similar, moderately long and slender. Fourth pereiopod (Fig. 7A) overreaching tip of antennal scale by length of dactylus, propodus and 0.3 of carpus; dactylus compressed laterally, biunguiculate, ventral unguis shorter than dorsal unguis, both clearly demarcated, sometimes bearing much smaller accessory tooth on ventral margin arising just proximal to base of ventral unguis; propodus about 0.4 times of carpus, armed with single row of movable spines on flexor margin; carpus longest, sometimes with 1 small spine at distoventral angle; merus

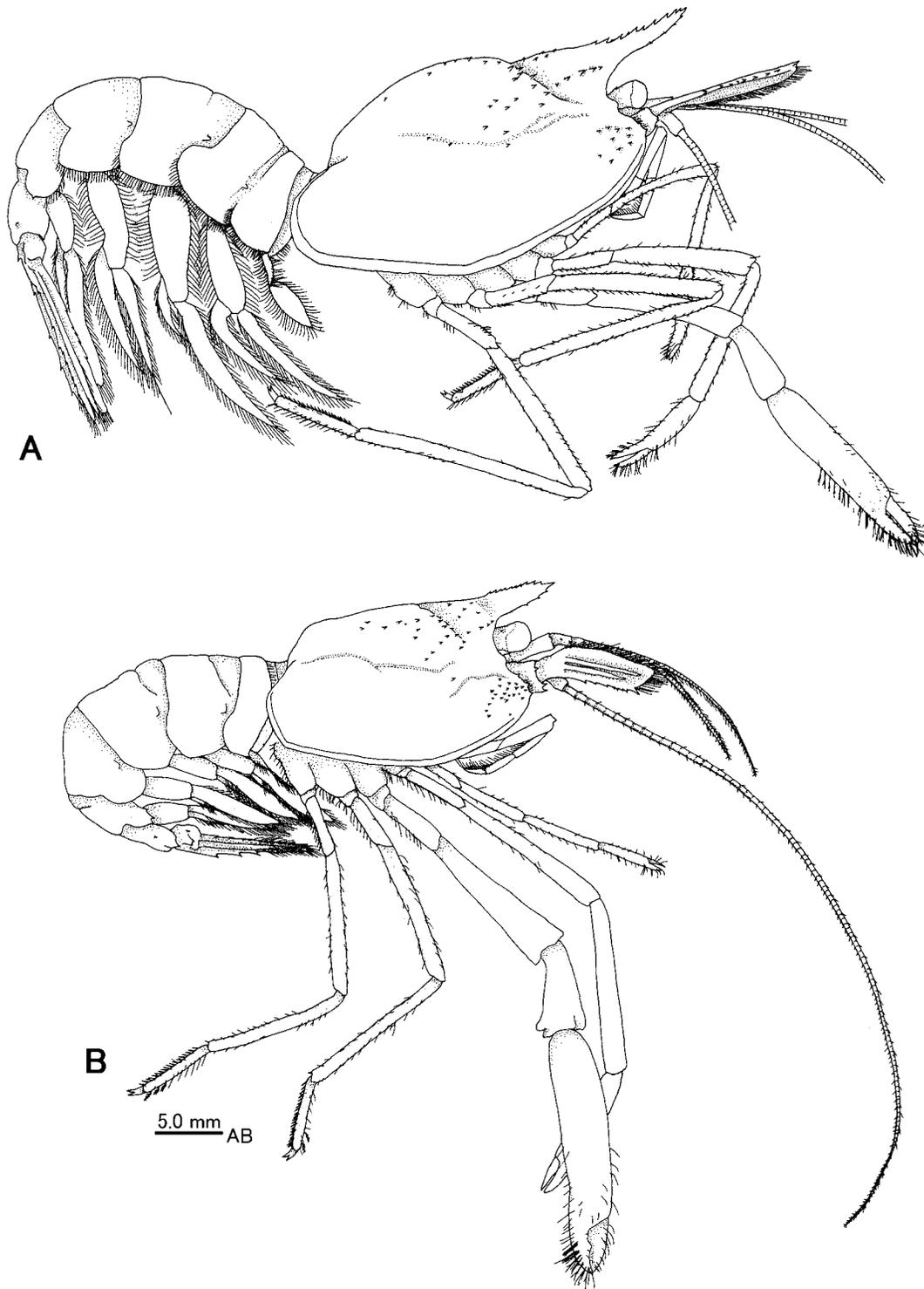


Fig. 3. *Spongicoloides iheyaensis* n. sp. A, holotype female (NSMT-Cr 15109); B, paratype male (JAMSTEC #006425). A, whole animal, 15.1 mm CL; B, same, 12.3 mm CL.

0.8 times of carpus; ischium half length of merus, unarmed; coxa and basis short and stout.

Fifth pereopod (Fig. 7B, C) overreaching tip of antennal scale by length of dactylus, propodus, and half of carpus; propodus 0.4 times of carpus, armed with single row of

movable spines on flexor margin; merus 0.7 times of carpus; ischium 0.4 times of merus, unarmed.

First pleopod (Fig. 7E) smallest, uniramous. Second to fifth pleopods biramous. Second pleopod (Fig. 7F) with propod distinctly shorter than rami, bearing breeding setae

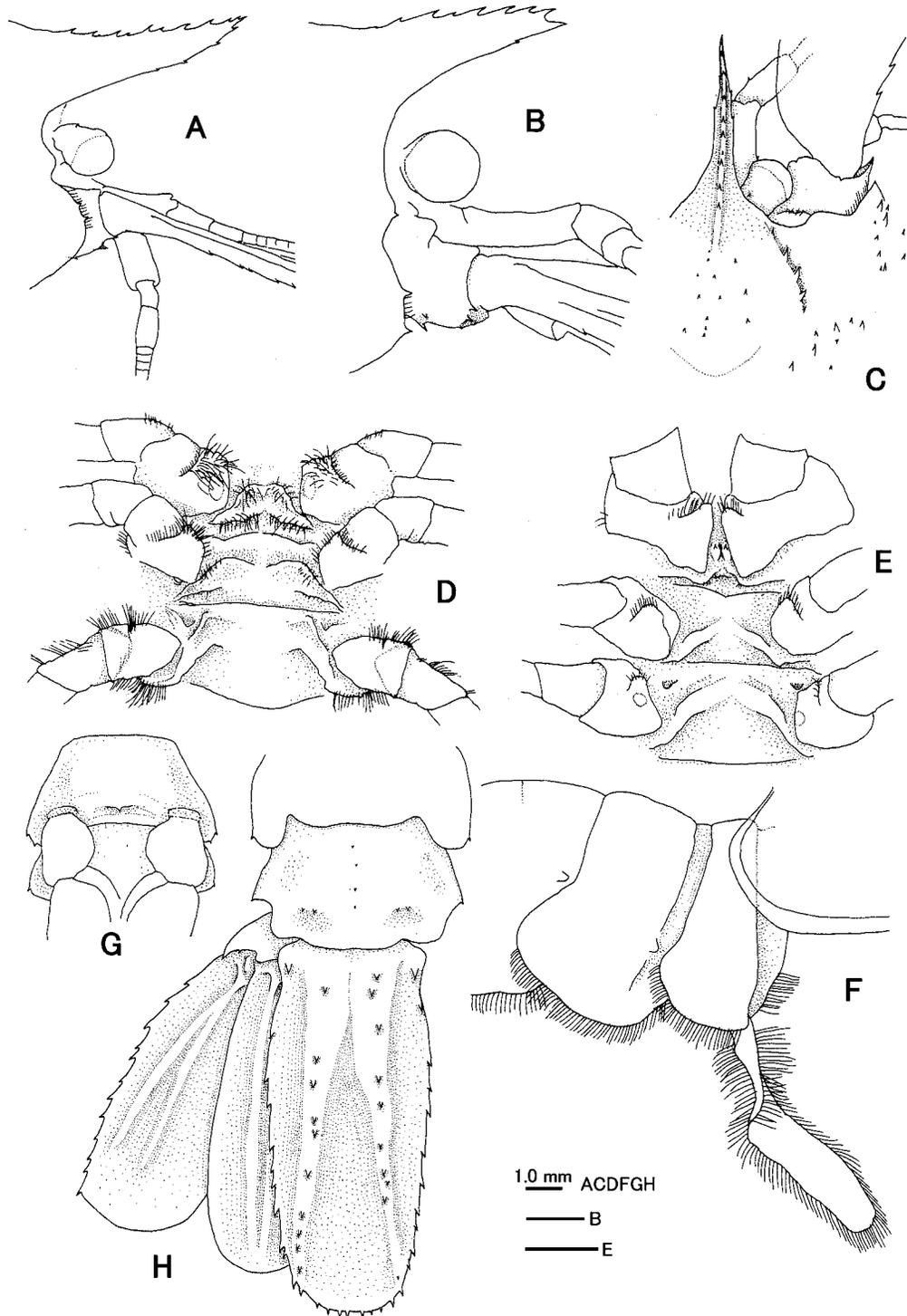


Fig. 4. *Spongiocoloides iheyaensis* n. sp. A, C, D, F, H, holotype female (NSMT-Cr 15109); B, E, paratype male (NSMT-Cr 15110); G, paratype male (JAMSTEC #6425). A, B, anterior region of carapace, lateral view; C, same, dorsal view; D, E, thoracic sternites; F, first and second pleonal somites; G, fifth pleonal somite, ventral view; H, sixth pleonal somite, telson and uropods, dorsal view, marginal setae omitted.

on dorsal and ventral margins; mesial surface with ridge bearing longer ovipositing setae. Third to fifth pleopods generally similar, but decreasing in size posteriorly; fourth and fifth pleopods lacking ovipositing setae.

Uropod (Fig. 4H) with protopod stout, lateral margin terminating in spine and with smaller spine somewhat

mesial to distolateral spine. Exopod broader, but shorter than endopod; lateral margin slightly convex with row of 12 (left) or 13 (right) acute teeth; dorsal surface with 2 smooth longitudinal carinae. Endopod ovate, falling short of posterior margin of telson; dorsal surface with median and submedian longitudinal carinae.

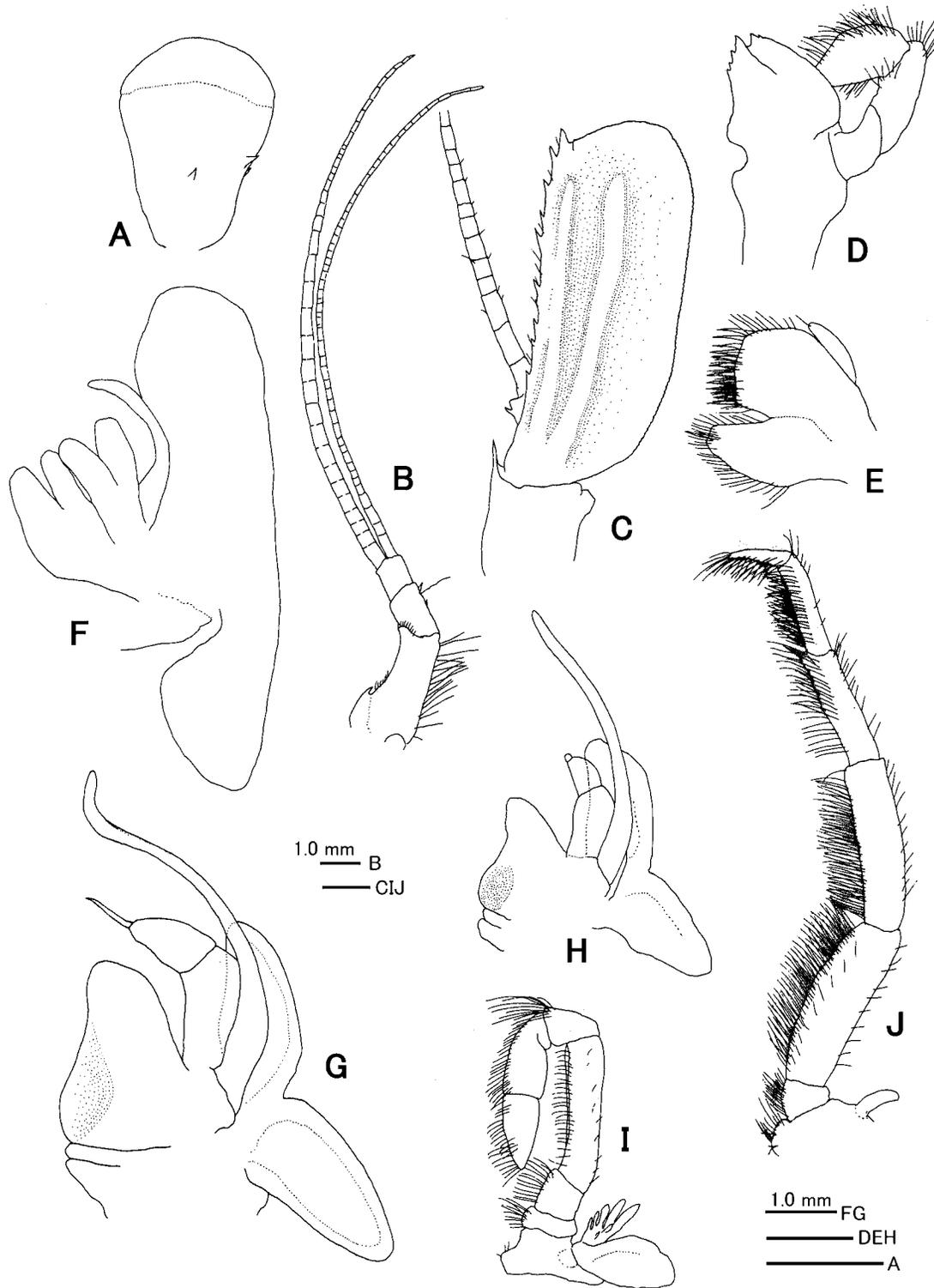


Fig. 5. *Spongicoloides iheyaensis* n. sp. A-G, I, J, holotype female (NSMT-Cr 15109); H, paratype male (NSMT-Cr 15110). A, eye; B, antennule; C, antenna; D, mandible; E, maxillule; F, maxilla; G, H, first maxillipeds; I, second maxilliped; J, third maxilliped. C, F, G, H, setae omitted.

Variation in Paratype Females.—Rostrum 0.38-0.45 times as long as carapace; dorsal margin armed with 9-10 small teeth; ventral margin with 1-2 small teeth; each ventrolateral ridge unarmed or armed with 1 small tooth. Postorbital region of carapace armed with a longitudinal row of 3-4

spines. Small antennal spine absent or present. Sixth pleonal somite armed with 1 small spine on midline, and without or with 1 small lateral spine on either side. Telson with dorsolateral carinae each bearing 7-13 spines; lateral margin armed with 6-8 spines; posterior margin with 3-4 spines.

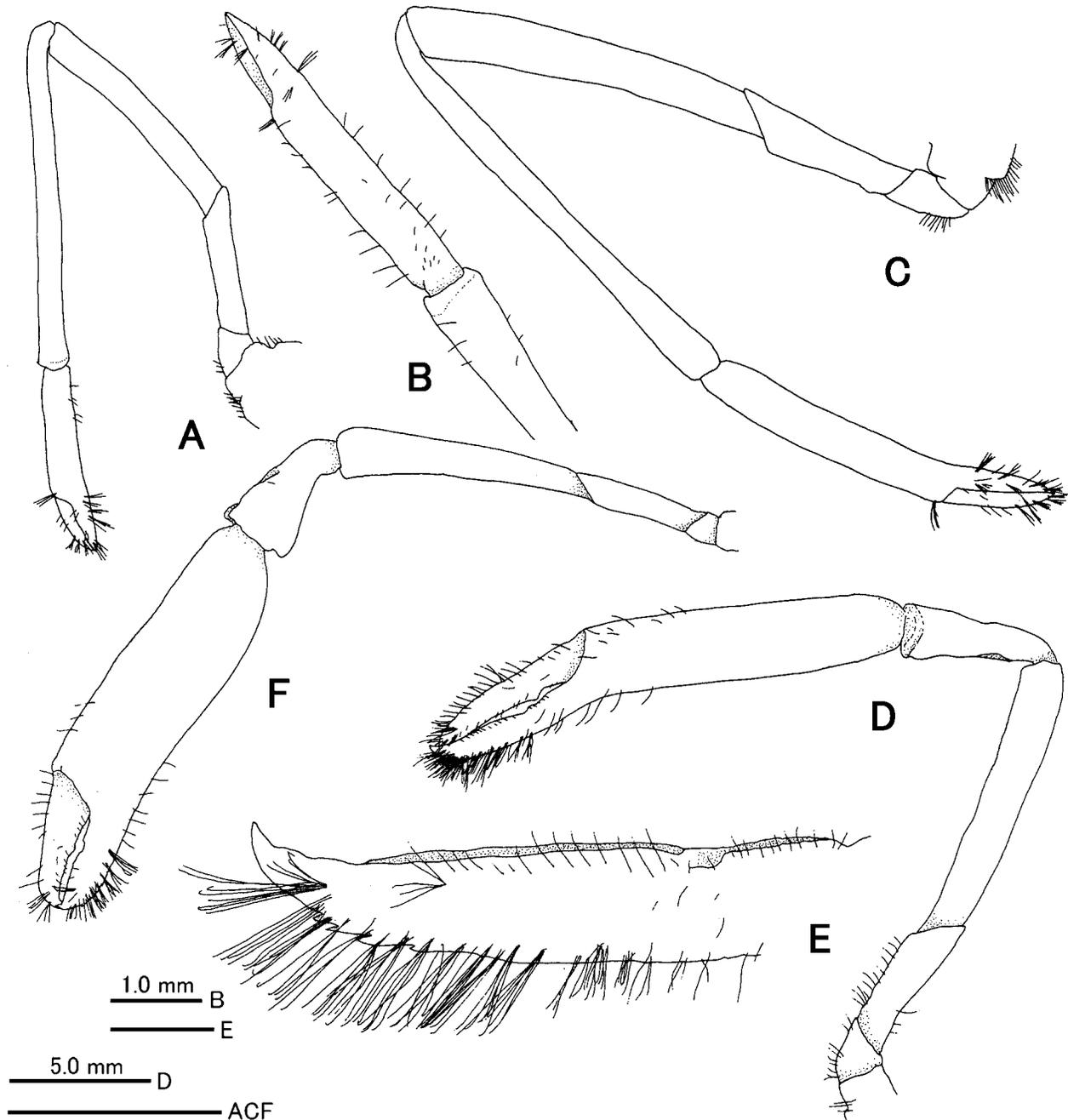


Fig. 6. *Spongiocoloides iheyaensis* n. sp. A-E, holotype female (NSMT-Cr 15109); F, paratype male (NSMT-Cr 15110). A, first pereiopod; B, same, propodus and carpus, ventral view; C, second pereiopod; D, third pereiopod; E, same, distal part; F, same.

Eyestalk unarmed. Lateral margin of antennal scale armed with 7-11 teeth. Fixed finger of third pereiopod with short row of 3-5 small teeth on distoventral margin. Lateral margin of uropodal exopod with 11-13 acute teeth.

Male Characteristics.—Main sexually dimorphic characters of *Spongiocoloides iheyaensis* are related to ovipositing, which generally follow to the cases of other spongiocolids such as *Spongiocola japonica* reported by Saito (2002). Carapace up to 12.3 mm long. Sixth thoracic sternite (Fig. 4E) with paired anteromesial spines. Fifth pleonal

sternite (Fig. 4G) with 1 spine on posteroventral surface. PW/CL = 0.6-0.8 for females, but 0.5 for males. Fingers of third pereiopod (Fig. 6F) elongate 0.4 times of propodal length in females, but 0.3 times in males. Chela width/length = 0.15 for females, but 0.23 for males. Dactyli of fourth and fifth pereiopods (Fig. 7D) biunguiculate, sometimes bearing much smaller accessory tooth on ventral margin arising just proximal to base of ventral unguis. It is most characteristic that males have no prominent spine on the distal segment of first maxilliped palp (Fig. 5H).

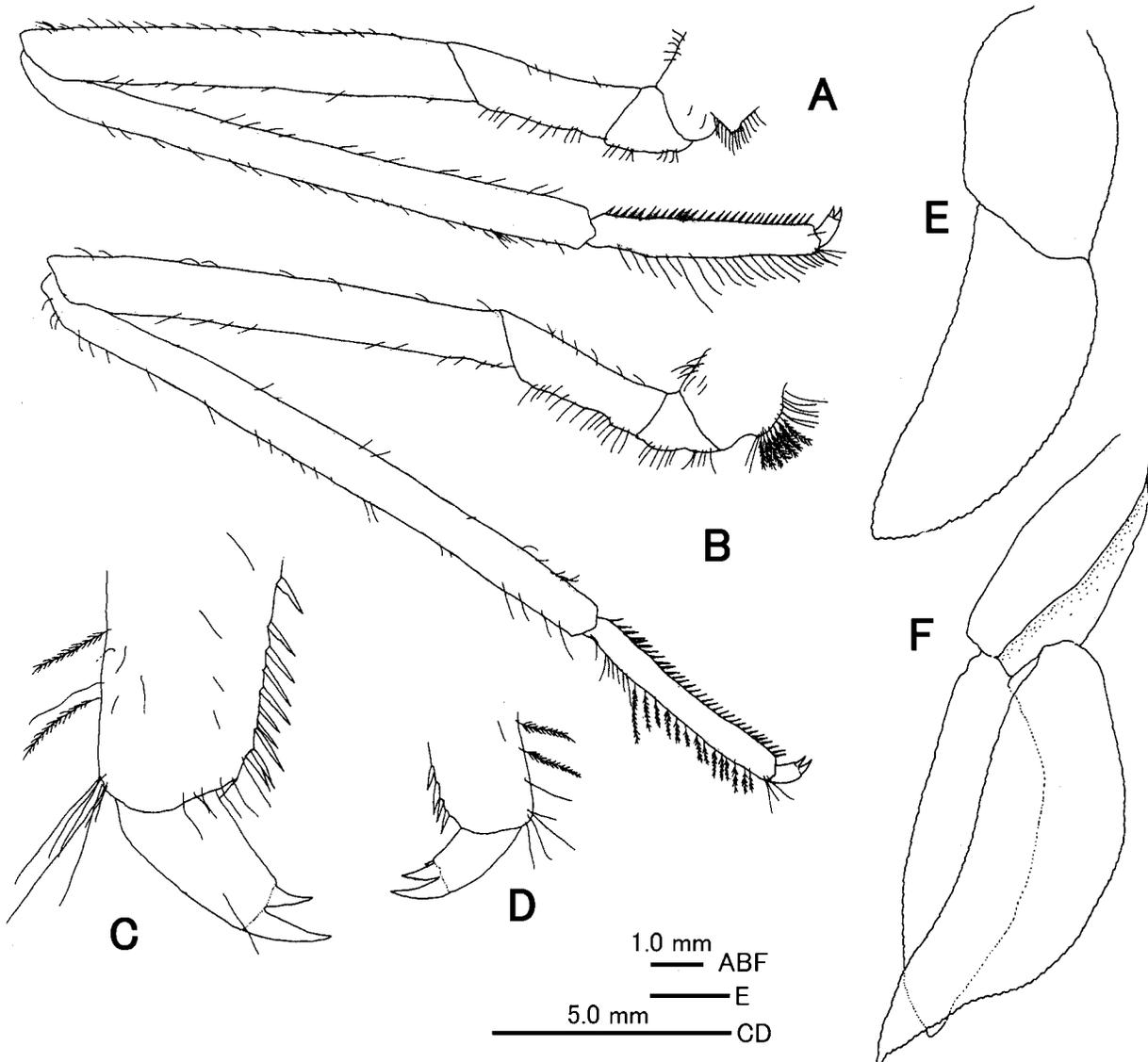


Fig. 7. *Spongiocoloides iheyaensis* n. sp. A-C, E, F, holotype female (NSMT-Cr 15109); D, paratype male (NSMT-Cr 15110); G, paratype male (JAMSTEC #015833); H, paratype female (JAMSTEC #006426). A, B, fourth and fifth pereopods; C, fifth pereopod, distal part; D, same; E, first pleopod; F, second pleopod.

Etymology.—The specific name, *iheyaensis*, refers to the type locality, the Iheya Ridge, Ryukyu Islands, southern Japan.

Remarks.—Holotype female carries 229 eggs (1.7×1.3 mm).

Third pereopods are equal in all but one specimen (holotype). In the holotype, the third pereopods are unequal; the length of the left chela is 17.5 mm, while that of the right is 11.6 mm.

Two paratype specimens (JAMSTEC#015833, #006426) are infested by bopyrid parasites attached to the ventral surface of the thorax and the anterior part of the pleonal cavity (Fig. 8A, B). This is the first record of bopyrid parasites in the family Spongiocolidae.

DISCUSSION

The new species is similar to the two western Pacific congeners *Spongiocoloides hawaiiensis* and *S. novaezelandiae*.

The three share the following features that separate them from the Atlantic and eastern Pacific congeners of the genus. 1) The three western Pacific species have a single arthrobranch on the first and second maxillipeds. However, *S. inermis* lacks one on the first maxilliped. *Spongiocoloides profundus* has both arthrobranches but in rudimentary form, while *S. galapagensis* lacks both. 2) These three have paired arthrobranches on the third maxilliped through fourth pereopods, while *S. galapagensis*, *S. inermis* and *S. profundus* have a single arthrobranch on there. In *S. inermis*, the rear-most one is rudimentary. *Spongiocoloides evolutus* is distinguished in having a single arthrobranch on the third maxilliped. 3) These three have epipods on the first through third maxilliped, while *S. koehleri* has ones on the first maxilliped through fourth pereopod. 4) These three but *S. hawaiiensis* possess a normal podobranch on the second maxilliped. However, the latter species, *S. inermis* and

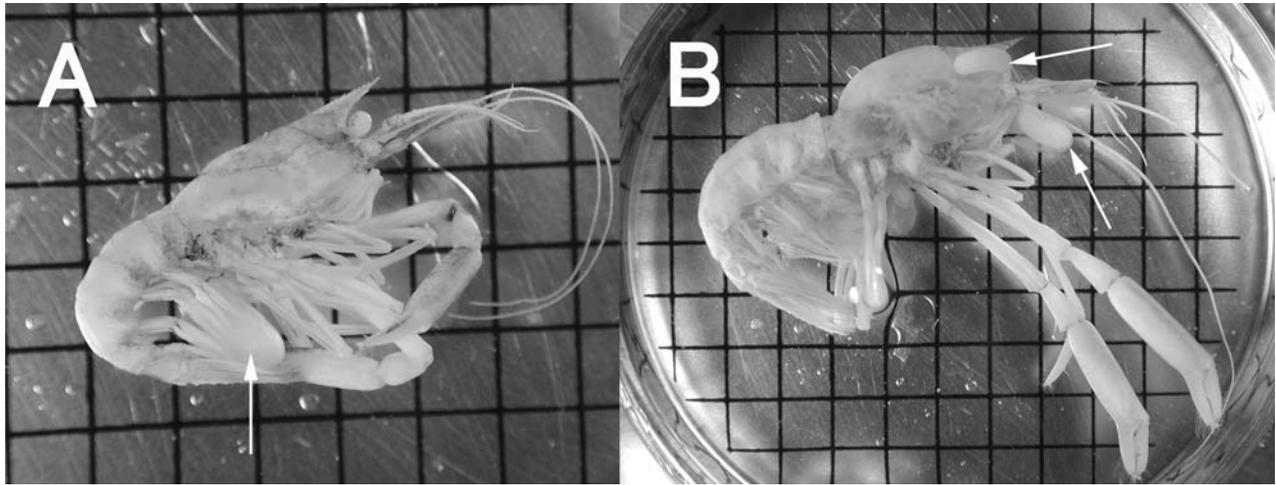


Fig. 8. *Spongiocoloides iheyaensis* n. sp. A, paratype male (JAMSTEC #015833) carrying a bopyrid parasite (arrow) in the pleonal chamber; B, paratype female (JAMSTEC #006426) carrying a few bopyrid parasites (arrows) on the cephalothorax.

S. profundus differ in the possession of a rudimentary podobranch on the second maxilliped, which is one of the distinguishing characters in the three western Pacific species.

Nevertheless, *S. iheyaensis* appears unique within the genus in that the sixth pleonal somite is armed with 1 or longitudinal row of small spines on the midline, with small lateral spines on the surface, and the possession of three to nine teeth on the distoventral margin of the fixed finger of the third pereiopod. Furthermore, the carapace with a hepatic groove and postorbital spines distinguishes the new species from *S. hawaiiensis* and *S. novaezelandiae*, in which the carapace lacks a hepatic groove and postorbital spines.

Species of *Spongiocoloides* generally have relatively few, large sized eggs hatching as postlarva or later stage. For example, the female of *S. galapagensis* has 20 eggs, 2.0 mm in long diameter (Goy, 1980), and the female of *S. novaezelandiae* has 23 eggs, 2.2-2.4 mm in long diameter (Baba, 1979). Each of these species is endemic to a specific region without overlapping in geographical ranges. However, the holotype female of *S. iheyaensis* bears 229 eggs, about 1.7 × 1.3 mm. The egg size is smaller and the number of eggs is larger in *S. iheyaensis* when compared to the other members of *Spongiocoloides*.

Members of *Spongiocoloides* are the deepest living genus of the family, being collected from cavities of hexactinellid sponges inhabiting hard bottom of the deep sea at depths of about 700-2400 m, where dredge or trawl are difficult to operate. To date, original descriptions of the previously known species of *Spongiocoloides* are based only on the insufficient type descriptions and a few subsequent reports,

more or less damaged, so that morphological variations of species are poorly understood. The new species is so far known only from off Iheya Ridge, southern Japan, but it remains uncertain whether this species is endemic to that area. The specimens of the present study were made available in good condition using manned deep-sea submersibles, which is advantageous and essential for studying animal diversity in deep-sea, as it will make it possible to observe the habitat directly and collect even more effectively specimens of commensal animals.

KEY TO THE PACIFIC SPECIES OF *SPONGICOLOIDES*

1. Third maxilliped and first to fourth pereiopods each with single arthrobranch. Propodus and ischium of third maxilliped armed with spines on mesial margins. Uropodal endopod with 1 spine on median dorsal carina *S. galapagensis* Goy, 1980 (Galapagos Islands, eastern Pacific, 717 m)
 - Third maxilliped and first to fourth pereiopods each with two arthrobranches. Propodus and ischium of third maxilliped unarmed on mesial margins. Uropodal endopod unarmed on dorsal carinae 2
2. Carapace with hepatic groove and postorbital spines. Sixth pleonal somite armed with 1 or longitudinal row of small spines on midline. Fixed finger of third pereiopod armed with 3-9 teeth on distoventral margin *S. iheyaensis* new species (Ryukyu Islands, western Pacific, 988-1051 m)
 - Carapace without hepatic groove and postorbital spines. Sixth pleonal somite unarmed on midline. Fixed finger of third pereiopod unarmed on distoventral margin 3
3. Carapace without branchial groove and scattered small spines on anterolateral region. Second maxilliped with rudimentary podobranch. Ischium of third pereiopod without process on distoventral margin . . . *S. hawaiiensis* Baba, 1983 (Hawaiian Islands, western Pacific, 640 m)
 - Carapace with branchial groove and scattered small spines on anterolateral region. Second maxilliped with normal podobranch. Ischium of third pereiopod

Table 1. Branchial formula of *Spongiocoloides iheyaensis* n. sp.

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranchs	—	—	1	1	1	1	1	1
Arthrobranchs	1	1	2	2	2	2	2	—
Podobranch	—	1	—	—	—	—	—	—
Epipods	1	1	1	—	—	—	—	—
Exopods	1	—	—	—	—	—	—	—

with prominent process on distoventral margin *S. novaezealandiae* Baba, 1979 (New Zealand, Fiji, western Pacific, 990–1110, 2380 m)

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