Bull. Kitakyushu Mus. Nat. Hist. Hum. Hist., Ser. A, **8**: 9-17, March 31, 2010

New record of an ectoparasitic isopod, *Zonophryxus retrodens* RICHARDSON, 1903 (Crustacea: Dajidae) from Japan

Michitaka SHIMOMURA[1], Susumu OHTSUKA[2] & Jun HASHIMOTO[3]

[1]*Kitakyushu Museum of Natural History & Human History, Kitakyushu 805-0071, Japan.*
[2]*Takehara Marine Science Station, Graduate School of Biosphere Science, Hiroshima University, 5-8-1 Minato-machi, Takehara, Hiroshima 725-0024, Japan*
[3]*Faculty of Fisheries Marine Biology and Dynamics, Nagasaki University, 1-14 Bunkyo, Nagasaki 852-8521, Japan*

(Received January 13, 2010; accepted February 12, 2010)

ABSTRACT — The ectoparasitic isopod, *Zonophryxus retrodens* RICHARDSON, 1903, is recorded for the first time from Japan. This species is distinguished from other congeners mainly in the following combination of characters: elongate oval body, 5 dorsal traces of segmentations on pereon, 3 pairs of notches on lateral margins of anterior half of the body in female, broad ventral flange in female; and ovoid pleotelson without uropods in male. This study provides additional information on this species, including a description, host, coloration, and scanning electron micrographs.

KEY WORDS: dajid, host, Isopoda, parasite, taxonomy

INTRODUCTION

Ectoparasitic isopods of the genus *Zonophryxus* RICHARDSON, 1903 comprise six species, which infect deep-sea shrimps Pandalidae and Nematocarcinidae from tropical, temperate and Antarctic waters. These are *Z. retrodens* RICHARDSON, 1903 (type species), *Z. grimaldii* KOEHLER, 1911, *Z. trilobus* RICHARDSON, 1910, *Z. quinquedens* BARNARD, 1913, *Z. similis* RICHARDSON, 1914 and *Z. dodecapus* HOLTHUIS, 1949 (BRANDT & JANSSEN, 1994). The host-parasite relationships are introduced in Table 1. During our recent coastal survey in the East China Sea, southern Japan, specimens of dajid isopod were found on the dorsal surface of carapace of the pandalid shrimp *Plesionika semilaevis* BATE, 1888. Based on these materials, we report in this paper *Zonophryxus retrodens* RICHARDSON, 1903 from Japanese water for the first time.

MATERIALS AND METHODS

The gear used for the collection was a beam trawl of 3 m span opening on board TS Nagasaki-Maru (Nagasaki University, Japan). The appendages of specimens were dissected, mounted in a glycerin and ethanol solution and drawn with a camera lucida under a light compound microscope (Nikon E600). One female and male were dehydrated through an alcohol series, freeze-dried, sputter-coated with platinum, and observed with a scanning electron microscope (Hitachi S-3000N). Terminology follows SHIMOMURA *et al.* (2005) and BRANDT & JANSSEN (1994). The specimens are deposited in the Kitakyushu Museum of Natural History & Human History (KMNH IvR).

TAXONOMY

Genus *Zonophryxus* RICHARDSON, 1903

Type species. *Zonophryxus retrodens* RICHARDSON, 1903.

Other species. *Z. grimaldii* KOEHLER, 1911; *Z. trilobus* RICHARDSON, 1910; *Z. quinquedens* BARNARD, 1913; *Z. similis* RICHARDSON, 1914; *Z. dodecapus* HOLTHUIS, 1919.

Zonophryxus retrodens RICHARDSON, 1903

Zonophryxus retrodens RICHARDSON, 1903, 823–824, figs. 4, 5.
(Figs. 1–7)

Material examined. Female (KMNH IvR 500,483), 12.4 mm, male (KMNH IvR 500,484), 3.3 mm, obtained from dorsal surface of the carapace of *Plesionika semilaevis* BATE, 1888 (identified by J. HASHIMOTO), St. A-2, 32˚09.015′N, 129˚30.259′E –32˚09.034′N, 129˚31.725′E, 499–496 m deep, female (KMNH IvR 500,485), 12.0 mm, male (KMNH IvR 500,486), 3.0 mm, obtained from dorsal surface of the carapace of *P. semilaevis*

Table 1. Previous records of *Zonophryxus*

Parasite	Hosts and depths	Localities	References
Z. retrodens Richardson, 1903	Unknown	Hawaii (type locality)	Richardson, 1903
Z. grimaldii Koehler, 1911	*Heterocarpus grimaldii* A. Milne-Edwards & Bouvier, 1900 (1401 m)	Spain	Koehler, 1911
Z. trilobus Richardson, 1910	*Heterocarpus gibbosus* Bate, 1888 (503–570 m)	Philippines (type locality), Indonesia	Richardson, 1910; Kensley, 1979
Z. quinquedens Barnard, 1913	*Nematocarcinus* sp. (860–1281 m), *N. longirostris* Bate, 1888 (665 m)	South Africa (type locality), Antarctic Ocean	Barnard, 1913; Brandt & Janssen, 1994
Z. similis Richardson, 1914	Unknown (1063 m)	Hudson Bay	Richardson, 1914
Z. dodecapus Holthuis, 1949	*Parapandalus narval* (Fabricius, 1787) (210 m), *Heterocarpus ensifer* A. Milne-Edwards, 1881 (900 m)	Canary Islands (type locality), Guam	Holthuis, 1949; Danforth, 1976

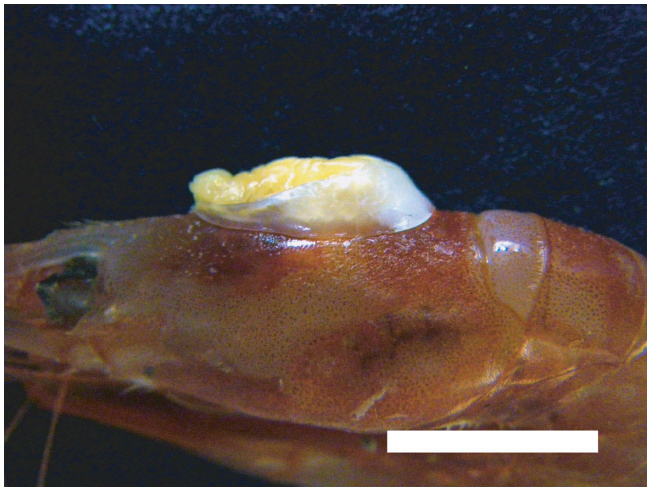

Fig. 1. *Zonophryxus retrodens* Richardson, 1903, female (KMNH IvR 500,483) attached on the host *Plesionika semilaevis*. Scale = 10 mm.

(identified by Dr. T. Komai), St. O, 32˚12.504′N, 128˚56.631′E–32˚12.682′N, 128˚59.150′E, 386–380 m deep, beam trawl, by TS Nagasaki-Maru, N295 cruise, 22 November 2009.

Description of female. –Body (Figs. 1, 2A–C) elongate ovate, approximately 1.8 times as long as maximum width, vaulted dorsally, rounded posteriorly, with five pairs of oostegites ventrally; lateral margins 4 lobed by 3 notches; caudal end with 10 serrations. Cephalon (Fig. 2A, B) without eyes: anterior margin nearly straight; posterior border imperfectly defined. Pereomeres (Fig. 2B) indistinctly defined in dorsal view, with 5 traces of segmentation.

Antenna 1 (Fig. 2C; see Fig. 6A) formed broad lamella, surrounding oral cone. Antenna 2 (Fig. 2C; see Fig. 6A, D) simple digitiform. Oral cone (Fig. 2C; see Fig. 6A) conical, surpassing cephalon ventrally. Maxilliped (Fig. 2C, D) unilobed, with deep slit posteromedially.

Oostegite 1 (Fig. 2A, C, E) bilobed, covering ventral side of maxilliped, larger than oostegites 2 and 3. Oostegite 2 (Fig. 2A, C) unilobed, smallest. Oostegite 3 (Fig. 2A, C) unilobed, lanceolate. Oostegite 4 (Fig. 2A, C) unilobed, extends lower to upper part of oostegite 5. Oostegite 5 (Fig. 2A, C) bilobed, broadest; medial margin serrated.

Pereopods 1–5 (Figs. 2A, 3A–C, 4A, B) subsimilar in shape and size: bases swollen dorsally; ischia slightly longer than basis, with many small setules ventrally; meri fused with carpi, triangular in outline, ventrally with 1–4 branched, 0–4 simple and many small setules; propodi broad oval, ventrally with 1–3 branched and 1–3 simple setae; dactyli hook-like, with 2 long, short branched setae ventrally and short simple seta ventrolaterally, and with strong claw apically.

Description of male. –Body (Fig. 4C; see Fig.7A) dorsoventrally flattened, approximately 2.4 times as long as maximum width. Cephalon (Fig. 4C) without eyes, fused with first pereomere, narrower than pereomere 2, with fine setae laterally; dorsal surface slightly concave. Pereomeres 2–7 (Fig. 4) with fine setae laterally: pereomeres 2 and 3 curved posteriorly; pereomeres 4 and 5 subequal in width; pereomere 6 longest; pereomere 7 narrowest. Pleotelson (Fig. 4C; see Fig. 7A) ovoid, approximately 1.5 times as long as wide, partly hidden under pereomere 7, without uropods and setae.

Pereopod 1 (Fig. 4D) shorter than pereopods 2–6, longer than pereopod 7: bases broadest and longest article, without setae; ischium about half as long as basis, without setae; merus subtriangular, ventrally with branched seta; carpus subtriangular, ventrally with 2 branched setae; propodus broad oval, ventrally with 2 branched setae and some simple scales; dactylus hook-like, with branched seta ventrally. Pereopod 2 (Fig. 4E): carpus

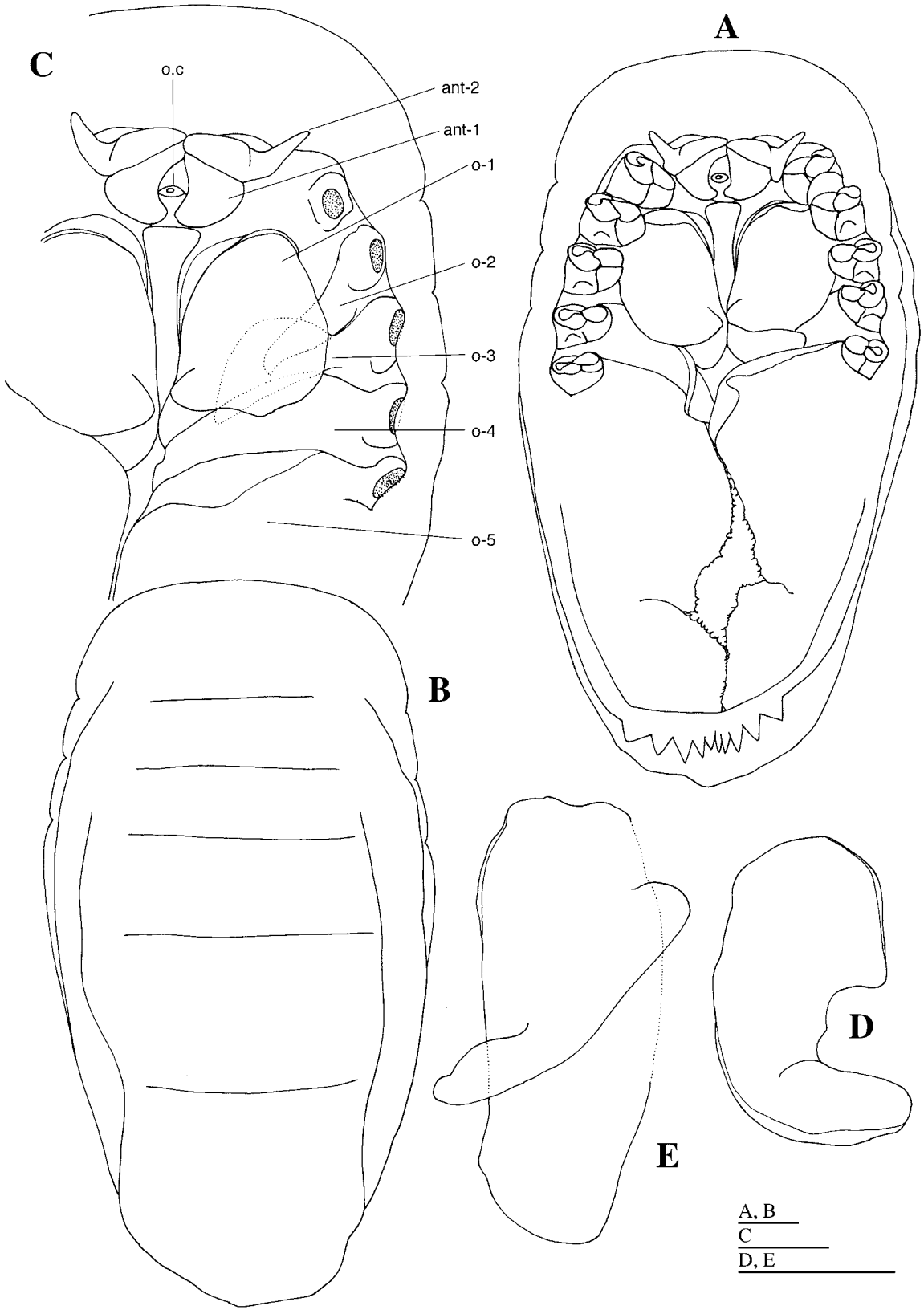

Fig. 2. *Zonophryxus retrodens* RICHARDSON, 1903, female (KMNH IvR 500,483): A, habitus, ventral; B, habitus, dorsal; C, antenna 1, 2 and oostegites, ventral, pereopods removed; D, left maxilliped, ventral; E, left oostegite 1, ventral. Appendages numbered: o. c, oral cone; ant-1–2, antenna 1–2; o-1–5, oostegites 1–5. Scales = 1 mm.

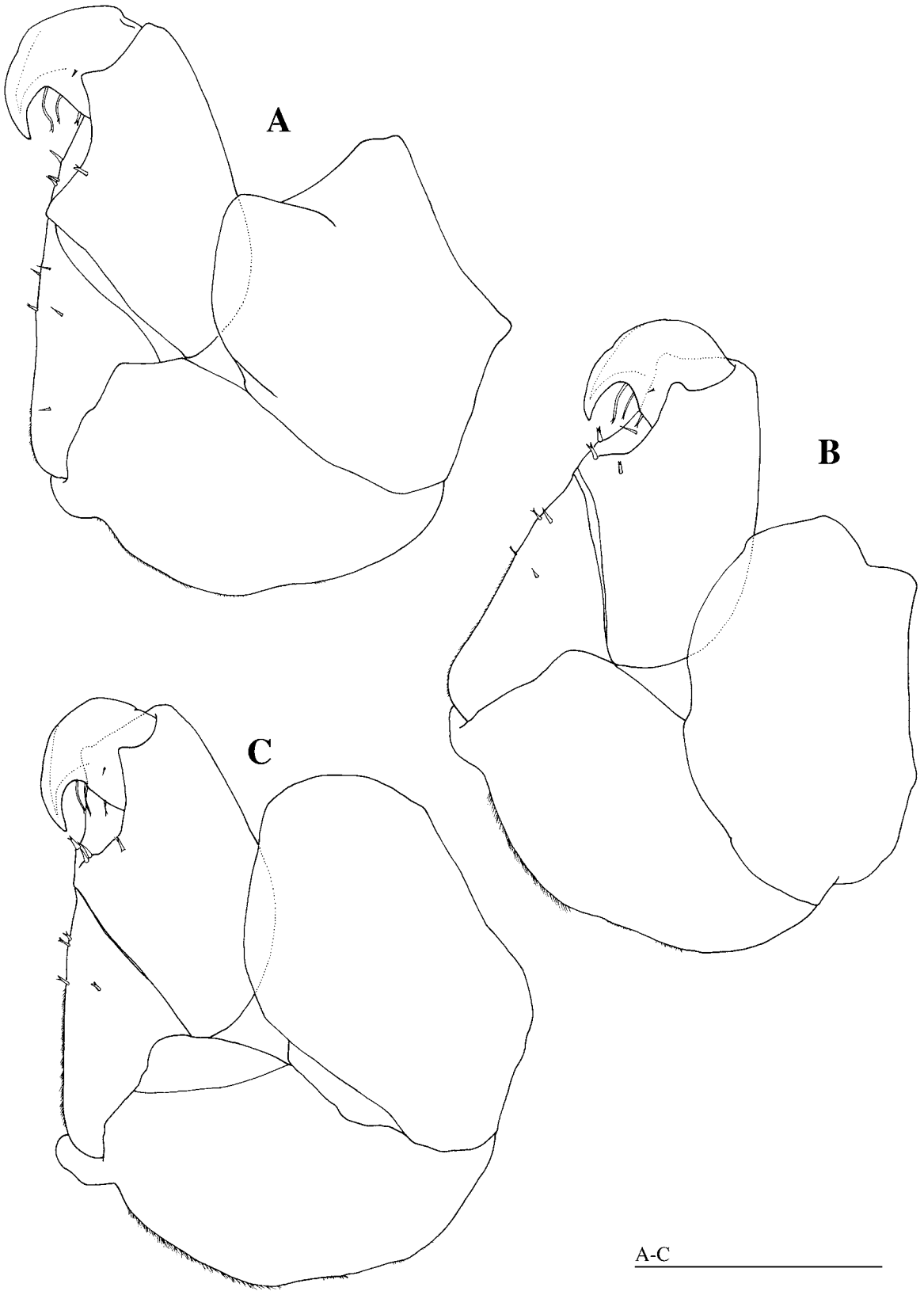

Fig. 3. *Zonophryxus retrodens* RICHARDSON, 1903, female (KMNH IvR 500,483): A, left pereopod 1, lateral; B, left pereopod 2, lateral; C, left pereopod 3, lateral. Scale = 0.5 mm.

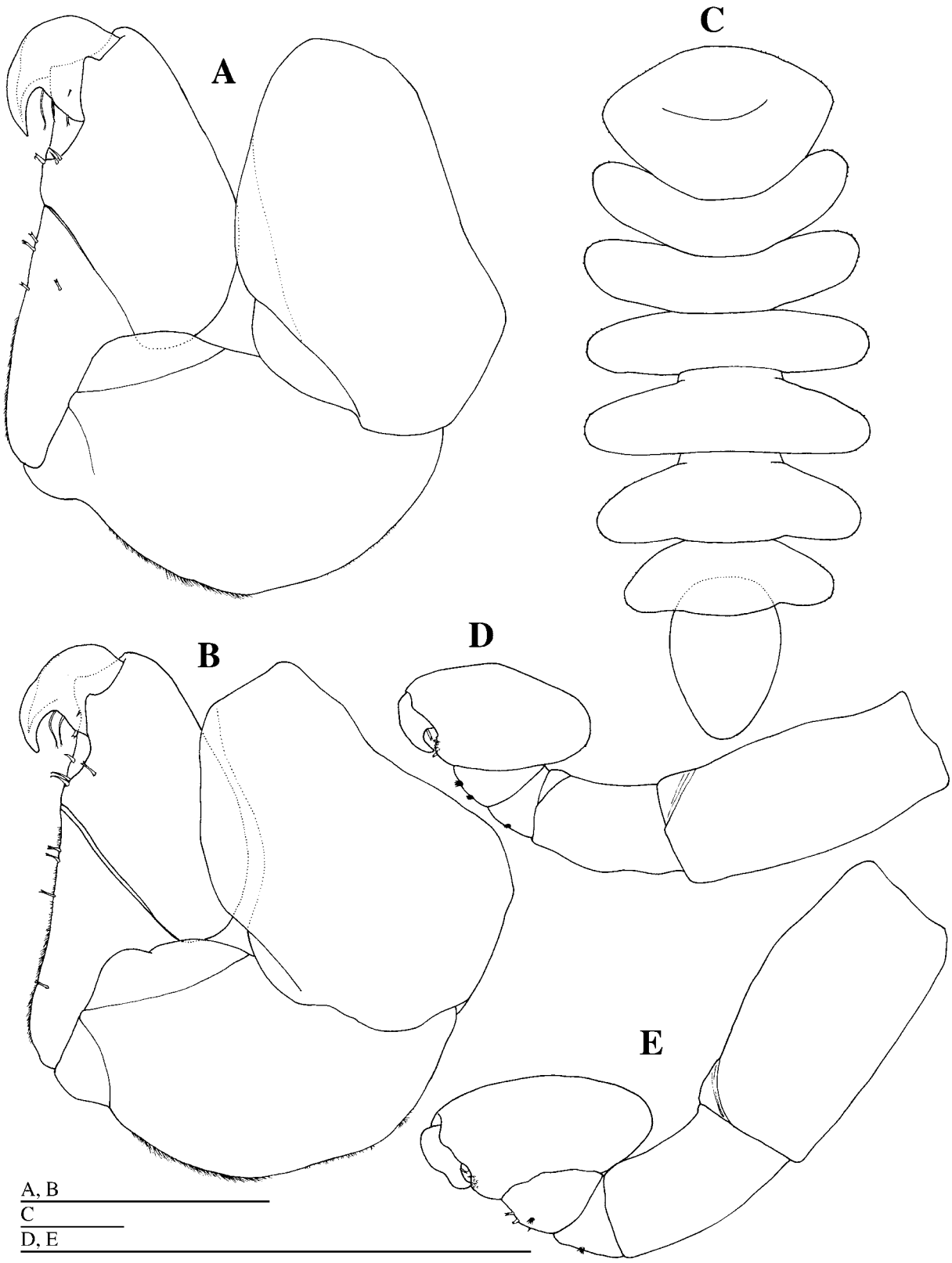

Fig. 4. *Zonophryxus retrodens* RICHARDSON, 1903, A, B, female (KMNH IvR 500,483), C–E, male (KMNH IvR 500,484): A, left pereopod 4, lateral; B, left pereopod 5, lateral; C, habitus, dorsal; D, left pereopod 1, lateral; E, left pereopod 2, lateral. Scales = 0.5 mm.

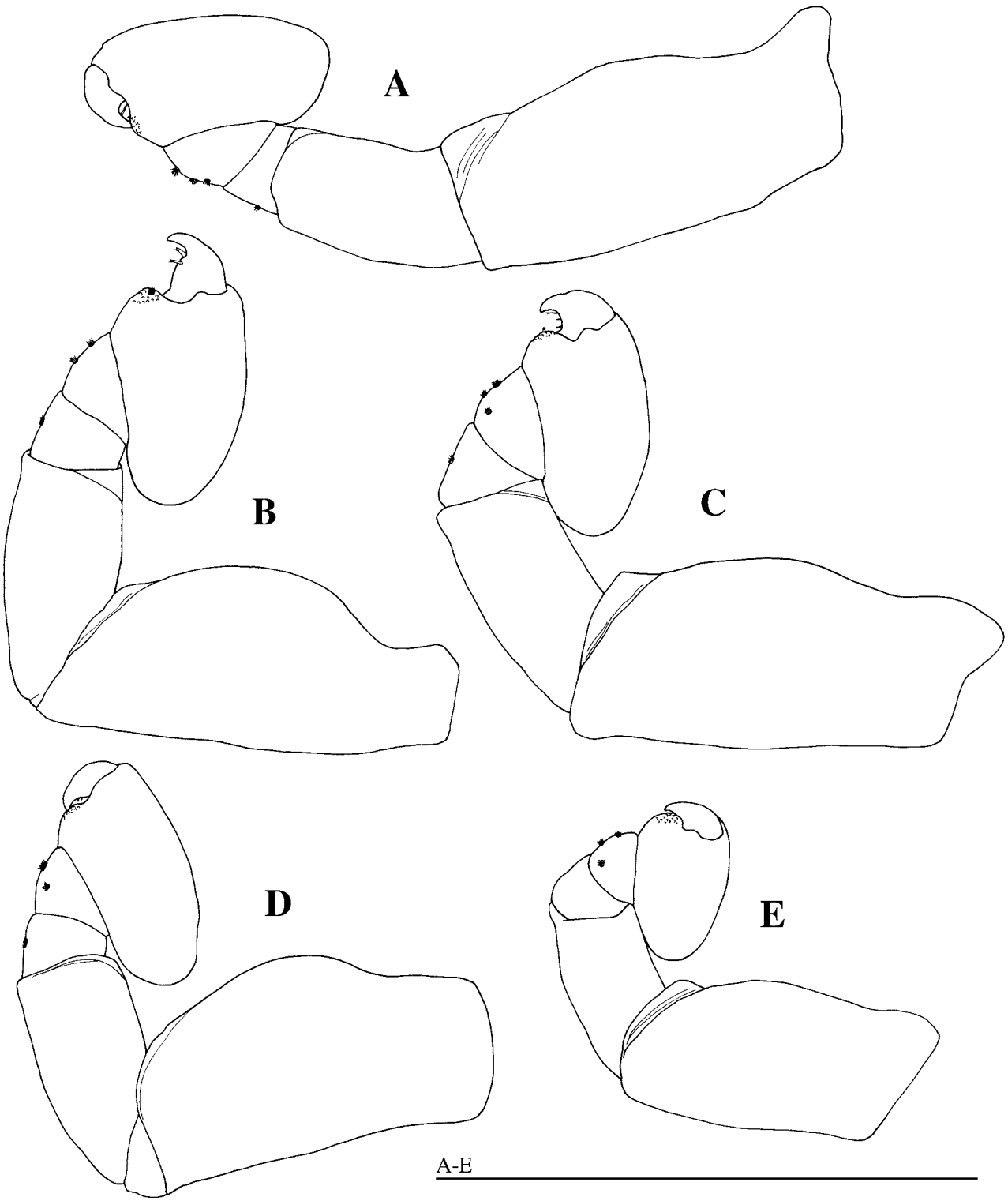

Fig. 5. *Zonophryxus retrodens* RICHARDSON, 1903, male (KMNH IvR 500,484): A, left pereopod 3, lateral; B, left pereopod 4, lateral; C, left pereopod 5, lateral; D, left pereopod 6, lateral; E, left pereopod 7, lateral. Scale = 0.5 mm.

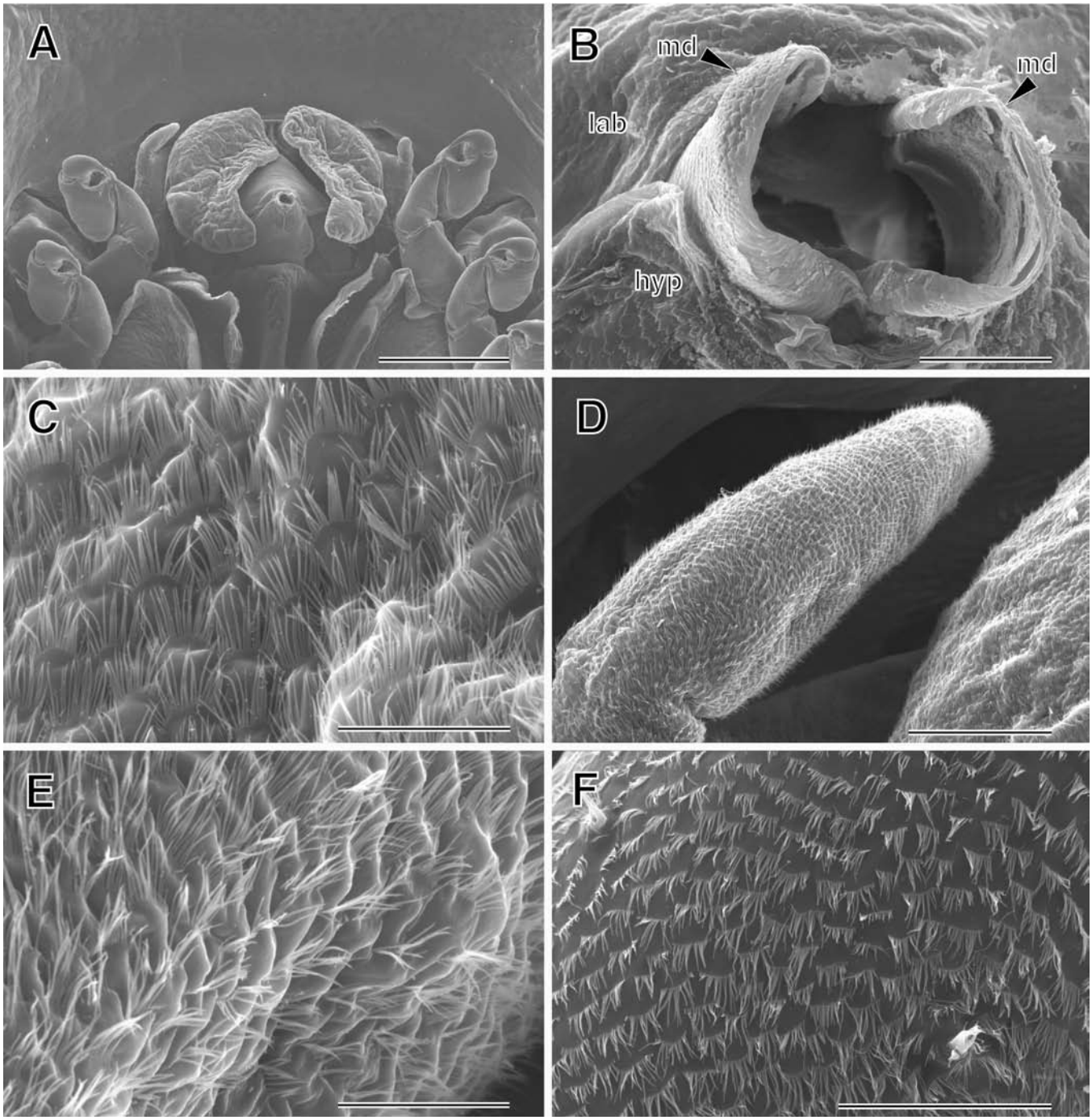

Fig. 6. *Zonophryxus retrodens* Richardson, 1903, female (KMNH IvR 500,485): A, cephalon and anterior part of pereon, ventral; B, tip of oral cone (appendages numbered: lab, labrum; hyp, hypopharynx); C, setules on antenna 1; C, right antenna 2, ventral; D, setules on antenna 2; F, setules on propodus of left pereopod 1. Scales = A, 1000 μm; B, F, 50 μm; C, 100 μm; D, E, 20 μm.

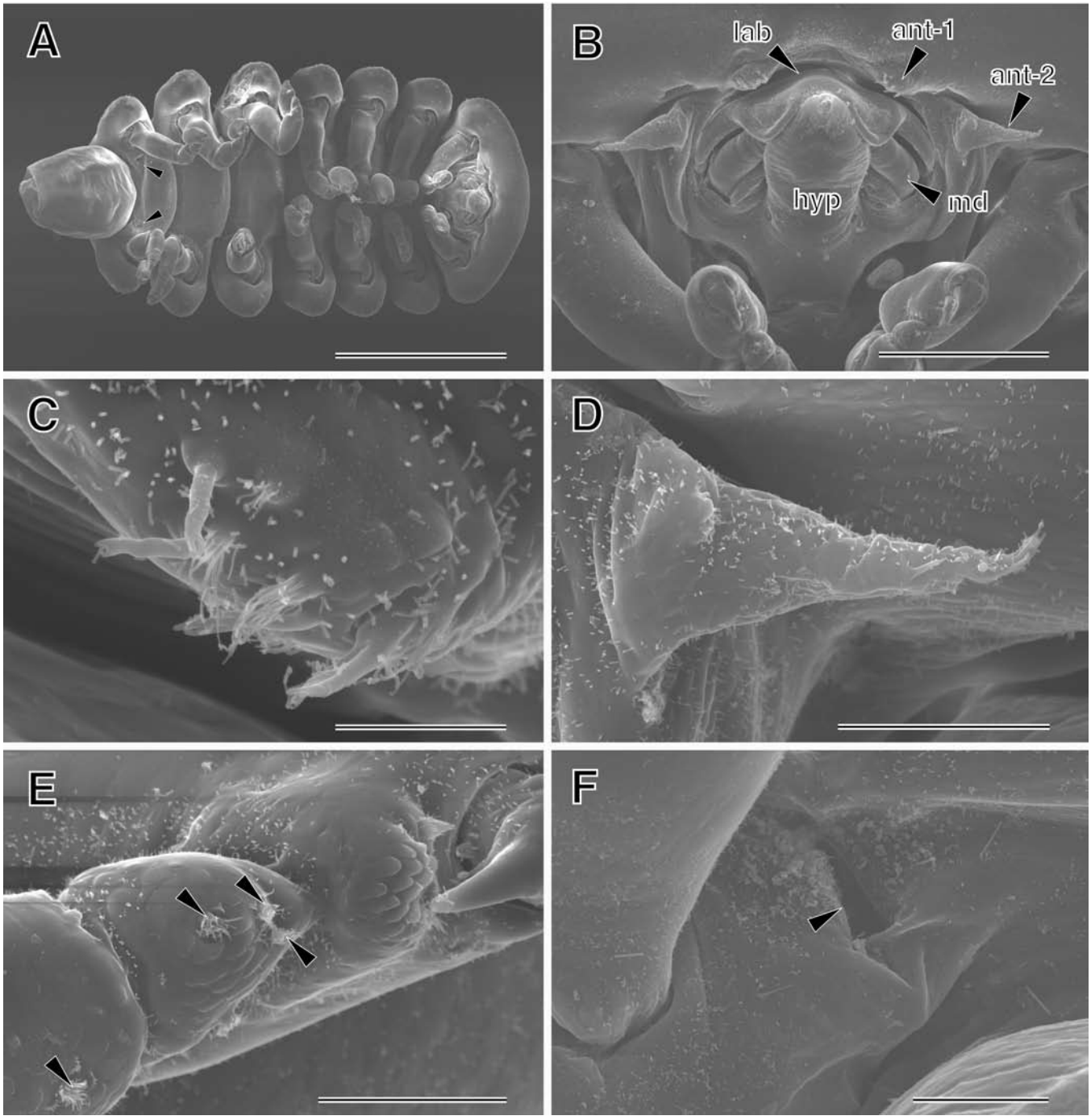

Fig. 7. *Zonophryxus retrodens* Richardson, 1903, male (KMNH IvR 500,486): A, habitus, ventral (arrowheads indicate gonopores); B, cephalon and anterior part of pereon, ventral (appendages numbered: ant-1–2, antenna 1–2; md, mandible; lab, labrum; hyp, hypopharynx); C, left antenna 1, ventral; D, left antenna 2, ventral; E, left pereopod 3, ventral (arrowheads indicate branched setae); F, ventral surface of pereomere 7 (arrowhead indicates right gonopore). Scales = A, 1000 µm; B, 200 µm; C, 20 µm; D, E, 50 µm; F, 50 µm.

with 3 branched and simple setae ventrally. Pereopods 3–6 similar in size and chaetotaxy. Pereopod 7 shortest.

SEM observation. –One female and one male were also examined with SEM (Figs. 6, 7). Because most SEM micrographs complement the above description, only selected points are mentioned here.

Female (Fig. 6). Mandibles (Fig. 6A, B) dorsally bordered by labrum and ventrally by hypopharynx, covered with many teeth. Integument of antenna 1 and 2 (Fig. 6C–E) covered with many setules. Lateral surface of ischia to propodi of pereopods (Fig. 6F) with many setules.

Male (Fig. 7). Gonopore (Fig. 7A, F, arrowed) opening near base of pereopod 7. Antenna 1 (Fig. 7B, C) unilobed, rudimentary, with some branched setae, and with many minute setae. Antenna 2 (Fig. 7B, D) subtriangular, unisegmented, with some simple setae and many minute setae. Mandibles (Fig. 7B) dorsally bordered by labrum and ventrally by hypopharynx; basal part of mandibles exposed laterally. Pereopods (Fig. 7E) with some branched, many fine setae and simple scales.

Color of female in life. –Dorsum (Fig. 1) yellowish white, translucent white marginally.

Remarks. –The present specimens were identified as *Zonophryxus retrodens* RICHARDSON, 1903, only known from Oahu Island, Hawaii, the North Pacific. The identification was based on 5 dorsal traces of segmentation on pereon in females and the ovoid pleotelson in males. *Zonophryxus retrodens* is similar to *Z. trilobus* RICHARDSON, 1910 from Philippines (type locality) and Indonesia (KENSLEY, 1979) and *Z. dodecapus* HOLTHUIS, 1949 from Canary Islands (type locality) and Guam Island (DANFORTH, 1976), in having the elongate ovate body. The species is distinguished from *Z. trilobus* by the following features (those of *Z. trilobus* in parentheses): 3 pairs of notches on lateral margins of anterior half of the body in female (4 pairs of notches); broad ventral flange in female (narrow posteriorly); and ovoid pleotelson without uropods in male (pyriform pleotelson with pair of uropods). *Z. retrodens* differs from *Z. dodecapus* in having the following features (those of *Z. dodecapus* in parentheses): rounded posterior end of the body in female (truncate); and ovoid pleotelson in male (elongate triangular).

ACKNOWLEDGMENTS

We express our thanks to the captain and crew of TS Nagasaki-Maru, Nagasaki University, for their cooperation at sea. We thank for Dr. J. C. MARKHAM of the Arch Cape Marine Laboratory and Dr. T. KATO of the Shirahama Aquarium, Kyoto University for their comments on the manuscript. We are also grateful to Dr. T. KOMAI of the Natural History Museum and Institute, Chiba, for his identification of the pandalid host. This study was partly supported by grants from the Ministry of Education, Science, Sports and Culture to MS (No. 21770100) and the Japan Society of the Promotion of Sciences to SO (No. 20380110).

REFERENCES

BARNARD, K. H. 1913. Contributions to the Crustacean Fauna of South Africa. *Annals of the South African Museum*, **10**: 197–240.

BRANDT, A. & JANSSEN, H. H. 1994. Redescription of *Zonophryxus quinquedens* Barnard, 1913 (Crustacea, Isopoda, Dajidae) from the Weddell Sea, Antarctica, with notes on its biology and zoogeography. *Polar Biology*, **14**: 343–350.

DANFORTH, C. G. 1976. Epicaridea (Isopoda) of Guam. *Crustaceana,* **31**(1): 78–80.

HOLTHUIS, L. B. 1949. *Zonophryxus dodecapus* nov. spec., a remarkable species of the family Dajidae (Crustacea Isopoda) from the Canary Islands. *Proceedings of the Koninklijke Nederlandse Academie van Wetenschappen*, **52**: 208–213.

KENSLEY, B. 1979. Redescription of *Zonophryxus trilobus* RICHARDSON, with notes on the male and developmental stages (Crustacea: Isopoda: Dajidae). *Proceedings of the Biological Society of Washington*, **92**: 665–670.

KOEHLER, R. 1911. Isopodes nouveaux de la famille Dajides provenant des campagnes de la "Princesse-Alice". *Bulletin de l'Institut Oceanographique*, **196**: 1–34.

RICHARDSON, H. 1903. Isopods collected at the Hawaiian Islands by the U. S. Fish Commission steamer Albatross. *U. S. Fish Commission Bulletin*, **2**(3): 817–826.

RICHARDSON, H. 1910. Marine isopods collected in the Philippines by the US Fisheries Commission Steamer "Albatross" in 1907–1908. *Bureau of Fisheries*, **736**: 1–44.

RICHARDSON, H. 1914. Report on the scientific results of the expedition to the tropical Pacific in charge of Alexander AGASSIZ, on the U.S. Fish Commissions Steamer Albatross, from August 1899, to March, 1900, Commander Jefferson F. MOSTER, U. S. N., Commanding XVII. Reports on the scientific results of the expedition to the eastern tropical Pacific in charge of Alexander AGASSIZ, by the U.S. Fish Commission Steamer Albatross from October 1904 to March 1905, Liet. Commander L. M. GARRETT, U. S. N., Commanding XXVII. *Bulletin of the Museum Comparative Zoölogy, at Harvard College in Cambridge*, **58**: 361–372 (Figs. 1–16).

SHIMOMURA, M., OHTSUKA, S. & NAITO, K. 2005. *Prodajus curviabdominalis* n. sp. (Isopoda: Epicaridea: Dajidae), an ectoparasite of mysids, with notes on morphological changes, behavior and life-cycle. *Systematic Parasitology*, **60**: 39–57.