Deep-sea Fauna and Pollutants off Pacific Coast of Northern Japan, edited by T. Fujita, National Museum of Nature and Science Monographs, No. 39, pp. 447-466, 2009

New and Rare Species of the Deep-sea Gammaridea (Crustacea: Amphipoda) off Pacific Coast of Northern Honshu, Japan

Ko Tomikawa[1] and Hironori Komatsu[2]

[1] Graduate School of Education, Hiroshima University,
1-1-1 Kagamiyama, Higashi-Hiroshima, 739-8524 Japan
E-mail: tomikawa@hiroshima-u.ac.jp
[2] Department of Zoology, National Museum of Nature and Science,
3-23-1 Hyakunin-cho, Shinjuku-ku, Tokyo, 169-0073 Japan
E-mail: h-komatu@kahkau.go.jp

Abstract: A new species of Trischizostomatidae and two rare species of Epimeriidae and Melitidae were collected from the deep sea off Pacific coast of northern Honshu, Japan: *Trischizostoma tohokuense* sp. nov., *Uschakoviella echinophora* Gurjanova, 1955, and *Megaceradocus gigas* Mukai, 1979. The genera *Trischizostoma* and *Uschakoviella* are recorded from Japan for the first time. *Trischizostoma tohokuense* differs from the known species of the genus by the combination of the following features: the accessory flagellum of the antenna 1 reaches the end of the article 3 of the primary flagellum; the palp of the maxilliped is developed, longer than the outer plate; the length of the propodus of the gnathopod 1 is almost same as the breadth; the ventral margin of the merus of the gnathopod 2 without setae; and the telson is entire, apically rounded.

Key words: Amphipoda, Gammaridea, deep sea, *Trischizostoma tohokuense*, *Uschakoviella echinophora*, *Megaceradocus gigas*, taxonomy, Japan.

Introduction

As a part of the research project entitled "Study on Deep-Sea Fauna and Conservation of Deep-Sea Ecosystem" by the National Museum of Nature and Science, Tokyo, one of the authors (HK) had joined in the trawling and dredging research at the deep sea off Pacific coast of northern Honshu, Japan, in 2005–2008. During the research, a lot of collections of amphipod crustaceans were made. Parts of these samples contained a new species of Trischizostomatidae and two rare species of Epimeriidae and Melitidae. The present paper deals with the new species and two rare species of deep-sea benthic gammarids.

Materials and Methods

Amphipods were fixed with 80% ethanol or 10% formalin immediately after collection and preserved in 75% ethanol. Appendages were dissected and embedded in gum-chloral medium on glass slides. Specimens were examined using a light microscope, and illustrated with the aid of a camera lucida. The body length from the tip of the rostrum to the base of the telson was measured to the nearest 0.1 mm. The specimens are deposited in the National Museum of Nature and Science, Tokyo (NSMT).

Systematics

Trischizostomatidae Lilljeborg, 1865
[New Japanese name: Sakate-yokoebi-ka]

Trischizostoma Boeck, 1861
[New Japanese name: Sakate-yokoebi-zoku]

Trischizostoma tohokuense sp. nov.
[New Japanse name: Tohoku-sakate-yokoebi]
(Figs. 1–6)

Material examined. Holotype: ovigerous female (27.5 mm), NSMT-Cr 19002, R/V *Wakataka-maru*, trawl, collected at St. WA-06-G450 (off Onahama, the Tohoku District, 36˚51.52´N, 141˚28.64´E to 36˚52.70´N, 141˚30.04´E, depth 454 m), 27 October 2006. Paratypes: 3 ovigerous females (22.5–26.0 mm), NSMT-Cr 19003, data same as holotype; 1 ovigerous female (32.4 mm), NSMT-Cr 19004, R/V *Wakataka-maru*, trawl, collected at St. WA-06-G425 (off Onahama, the Tohoku District, 36˚53.19´N, 141˚29.24´E to 36˚52.05´N, 141˚27.59´E, depth 420–428 m), 27 October 2006; 1 female (30.0 mm) and 1 ovigerous female (33.8 mm), NSMT-Cr 19005, R/V *Wakataka-maru*, trawl, collected at St. WA-06-G350 (off Onahama, the Tohoku District, 36˚56.17´N, 141˚30.80´E to 36˚57.90´N, 141˚31.47´E, depth 355–373 m), 27 October 2006; 1 female (26.4 mm) and 1 ovigerous female (26.8 mm), NSMT-Cr 19006, R/V *Wakataka-maru*, trawl, collected at St. WA-05-G350 (off Onahama, the Tohoku District, 36˚56.30´N, 141˚30.90´E to 36˚58.00´N, 141˚31.50´E, depth 356–373 m), 3 November 2005; 2 ovigerous females (30.0–30.8 mm), NSMT-Cr 19007, R/V *Wakataka-maru*, trawl, collected at St. WA-05-H310 (off Nakaminato, the Tohoku District, 36˚29.00´N, 141˚59.50´E to 36˚30.50´N, 141˚00.04´E, depth 306–311 m), 30 October 2005. All materials are collected by H. Saito and H. Komatsu.

Description. Female [NSMT-Cr 19002, 27.5 mm]. Head (Fig. 2A) deeper than long; lateral cephalic lobe absent; rostrum large, rounded; eyes covering most of head, expanded dorsally and ventrally. Dorsal margins of pereonites 1–7 and pleonites 1–3 smooth (Fig. 1). Posteroventral corner of epimeral plate 2 (Fig. 6D) roundly pointed. Anteroventral corner of epimeral plate 3 (Fig. 6E) broadly rounded. Urosomite 1 with anterodorsal notch (Fig. 1). Urosomites 2 and 3 dorsally smooth (Fig. 1).

Antenna 1 (Fig. 2B) short, 0.15 times as long as body; peduncular article 1 length 0.86 times of breadth; peduncular articles 2 and 3 short, 0.38 and 0.51 times as long as peduncular article 1, respectively; accessory flagellum 5-articulate, 0.57 times as long as primary flagellum, article 1 long, broad, 6.6 times as long as article 2; primary flagellum 10-articulate, articles 2 and 4 each with 1 long seta (seta on article 2 incomplete), calceoli absent in female. Antenna 2 (Fig. 2C) length 1.5 times as long as antenna 1; peduncular article 3 short, 0.38 times as long as article 4, article 4 1.1 times as long as article 5, with posteromarginal plumose setae; flagellum 25-articulate, calceoli absent in female.

Upper lip (Fig. 3A) narrowing distally, ventral margin slightly concave. Lower lip (Fig. 3B) subtriangular, inner lobes present, shoulders of outer lobes bluntly pointed. Mandibles (Fig. 3C) with incisors symmetrical; lacinia mobilis, accessory setal row, and molar absent; palp article 3 length 0.8 times as long as article 2, with many facial setae. Maxilla 1 (Fig. 3D) with inner plate narrow lacking setae; outer plate (Fig. 3E) narrow with 5 large and 3 small teeth; palp (Fig. 3F) small, 1-articulate, with 2 terminal setae. Maxilla 2 (Fig. 3G–H) with inner and outer plates narrow, each with 3 setae. Maxilliped (Fig. 3I) with inner plate (Fig. 3J) narrow; outer plate (Fig. 3K) with

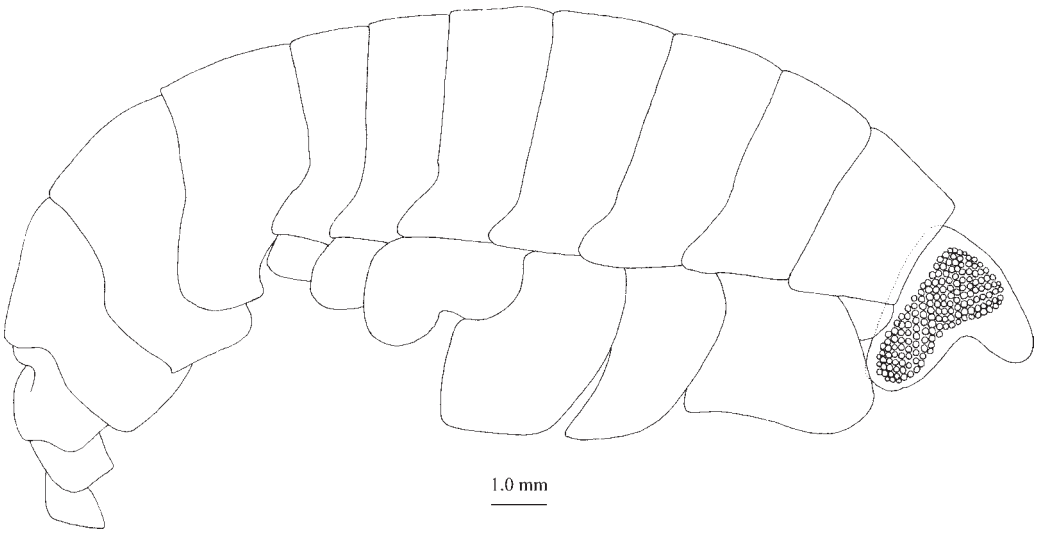

Fig. 1. *Trischizostoma tohokuense* sp. nov., holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama. Habitus, lateral view.

small submarginal setae; palp developed, 4-articulate, geniculate between articles 2 and 3; article 2 with 1 seta.

Gnathopod 1 (Fig. 4A–C) subchelate; coxa without marginal setae; basis long, slender, both anterior and posterior margins smooth; merus and carpus rotated, propodus and dactylus inverted; propodus subcircular, length 0.9 times breadth, palmar margin (Fig. 3B) with 12 robust setae, anterodistal corner with 2 medial robust setae; both anterior and posterior margins of dactylus smooth. Gnathopod 2 (Fig. 4D–E) minutely subchelate; coxa large, anteroventral corner rounded, ventral margin slightly concave; basis long, slender, anterodistal corner with 4 short setae; merus without marginal setae; both anterior and posterior margins of carpus with numerous setae; propodus subtriangular, palmar robust setae absent; dactylus (Fig. 4E) short, marginally smooth. Pereopod 3 (Fig. 5A) with large coxa, posterodistal corner pointed, without marginal setae; posterior margin of propodus lined with minute triangular scales (Fig. 5B). Pereopod 4 (Fig. 5C) with large coxa, posterodistal corner almost rectangular, posteroporximal margin with concavity, without marginal setae; posterior margin of propodus lined with minute triangular scales. Pereopod 5 (Fig. 5D) with bilobed coxa, marginally smooth; posterior margin of basis bare, posterodistal lobe expanded; posterior margin of merus with 2 setae; anterior margins of propodus and dactylus lined with minute triangular scales. Pereopod 6 (Fig. 5E) with small coxa, posteriorly weakly lobate, marginally smooth; posterior margin of basis bare, posterodistal lobe expanded; posterior margin of merus with 8 setae; anterior margins of propodus and dactylus lined with minute triangular scales. Pereopod 7 (Fig. 5F) with small coxa, rectangular, marginally bare; posterior margin of basis smooth, posterodistal lobe expanded; posterior margin of merus with 13 setae; anterior margins of propodus and dactylus lined with minute triangular scales.

Brood plates (oostegites) from gnathopod 2 to pereopod 5. Coxal gills from gnathopod 2 to pereopod 7.

Pleopods (Fig. 6A) with retinacula of peduncles paired (Fig. 6B), faces of peduncle lacking setae; medial margin of inner ramus with clothes-pin setae (Fig. 6C).

Uropod 1 (Fig. 6F) with 9 robust setae on dorsomedial margin of peduncle, length of peduncle 0.81 times as long as inner ramus; inner ramus 1.1 times as long as outer ramus, medial margin of inner ramus with 5 robust setae and minute triangular scales, lateral margin with minute

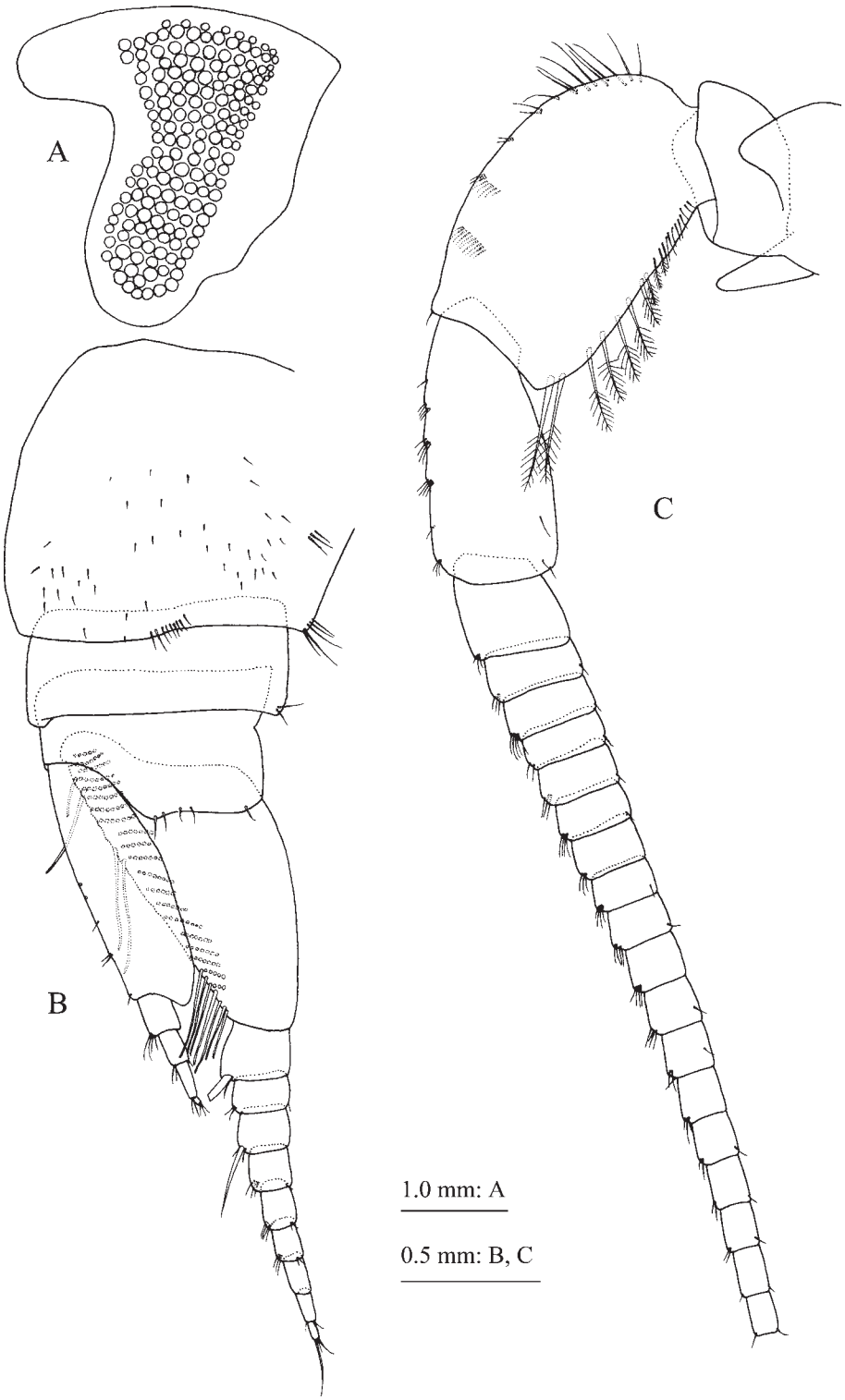

Fig. 2. *Trischizostoma tohokuense* sp. nov., holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama. A, Head, lateral view; B, Antenna 1, medial view; C, Peduncular articles 2–5 and flagellar articles 1–18 of antenna 2, medial view.

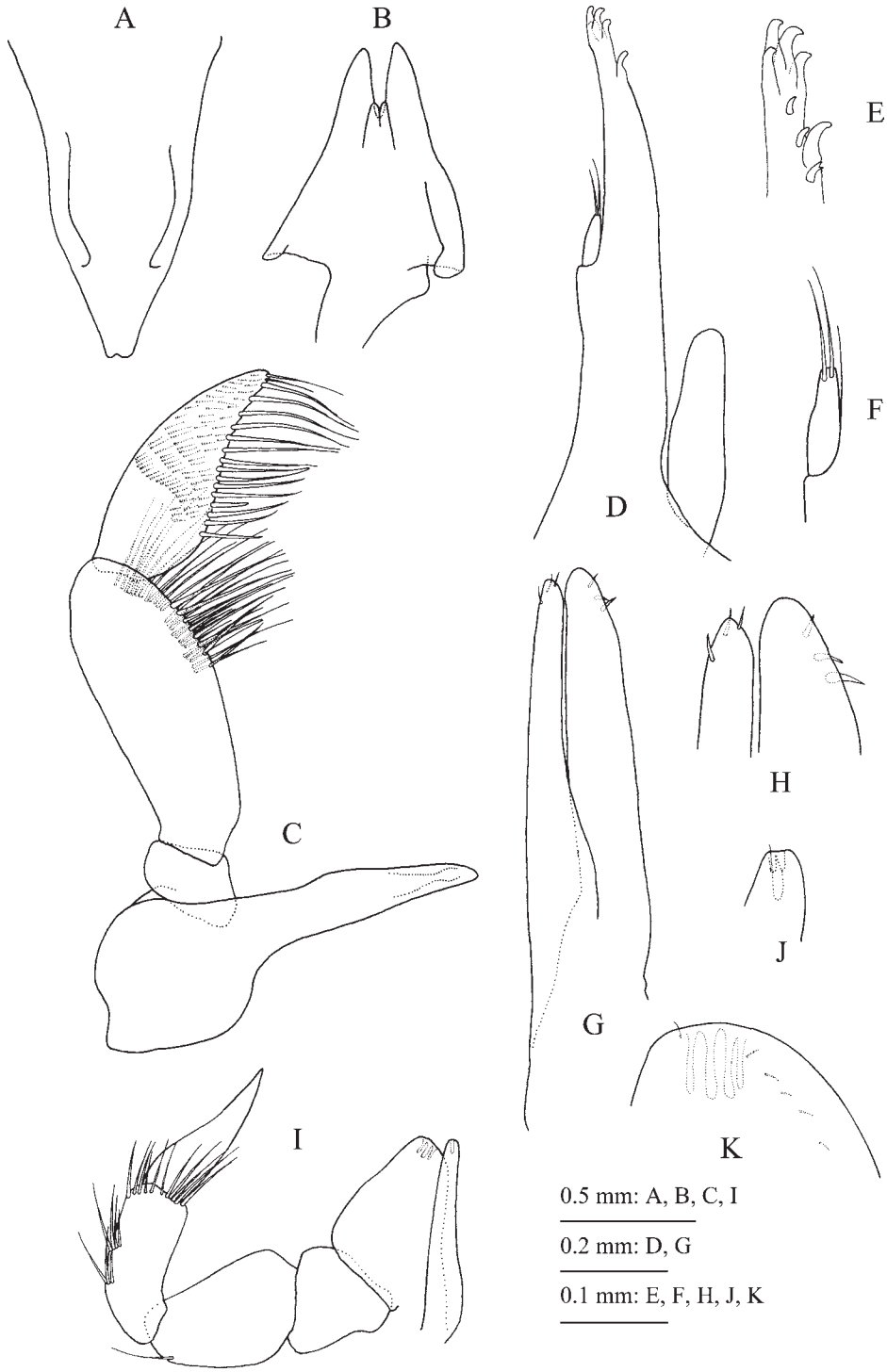

Fig. 3. *Trischizostoma tohokuense* sp. nov., holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama. A, Upper lip, anterior view; B, Lower lip, ventral view; C, Mandible, medial view; D, Maxilla 1, dorsal view; E, Outer plate of maxilla 1, dorsal view; F, Palp of maxilla 1, dorsal view; G, Maxilla 2, dorsal view; H, Terminal parts of inner and outer plates of maxilla 2, dorsal view; I, Maxilliped, dorsal view; J, Inner plate of maxilliped, dorsal view; K, Outer plate of maxilliped, dorsal view.

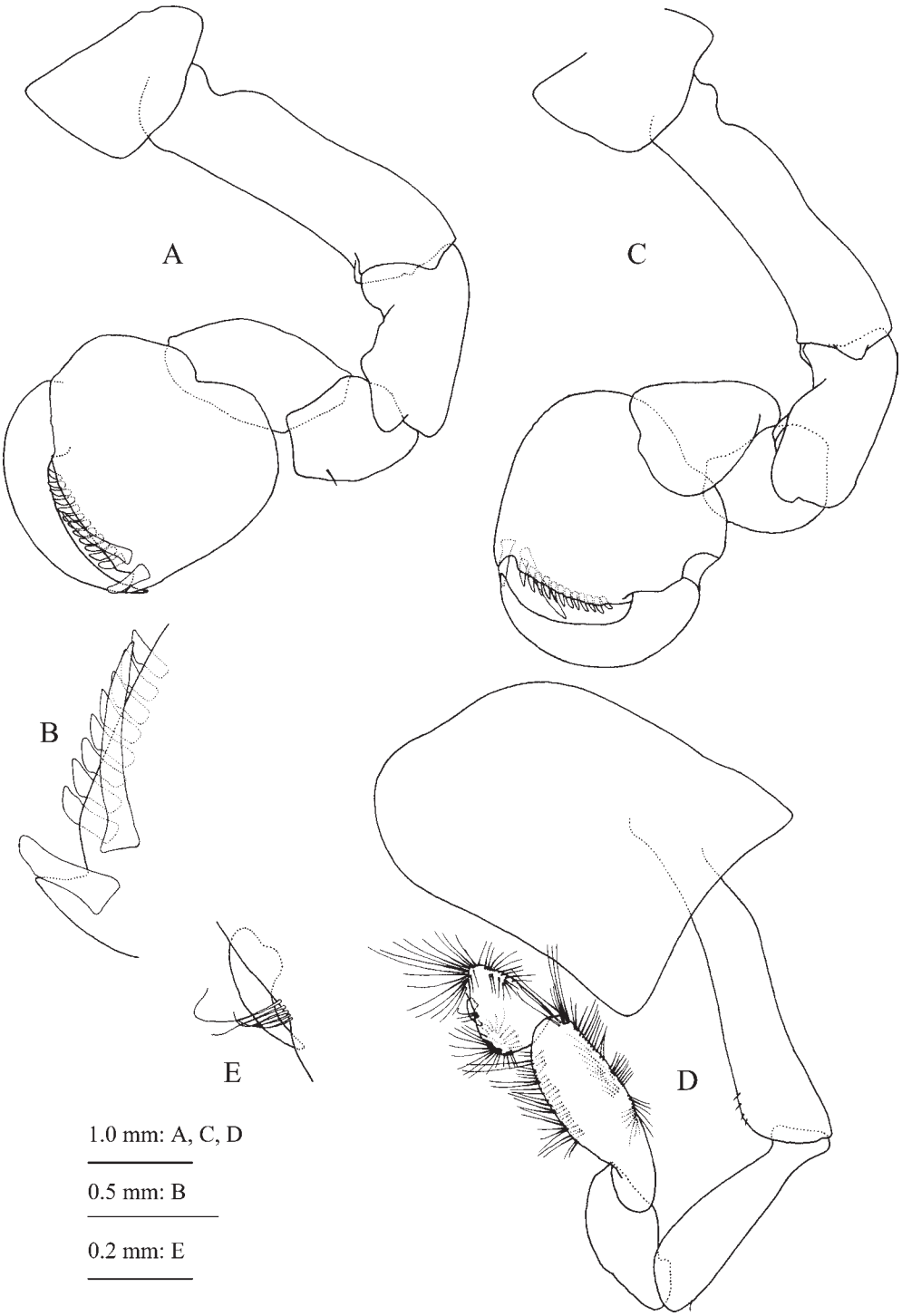

Fig. 4. *Trischizostoma tohokuense* sp. nov., A, B, D, E, holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama; C, paratype, female (22.5 mm), NSMT-Cr 19003, off Onahama. A, Gnathopod 1 (propodus and dactylus rotated due to preparation), lateral view; B, Palmar margin of gnathopod 1, lateral view; C, Gnathopod 1, lateral views; D, Gnathopod 2, lateral view; E, Palmar margin of propodus and dactylus of gnathopod 2, lateral view.

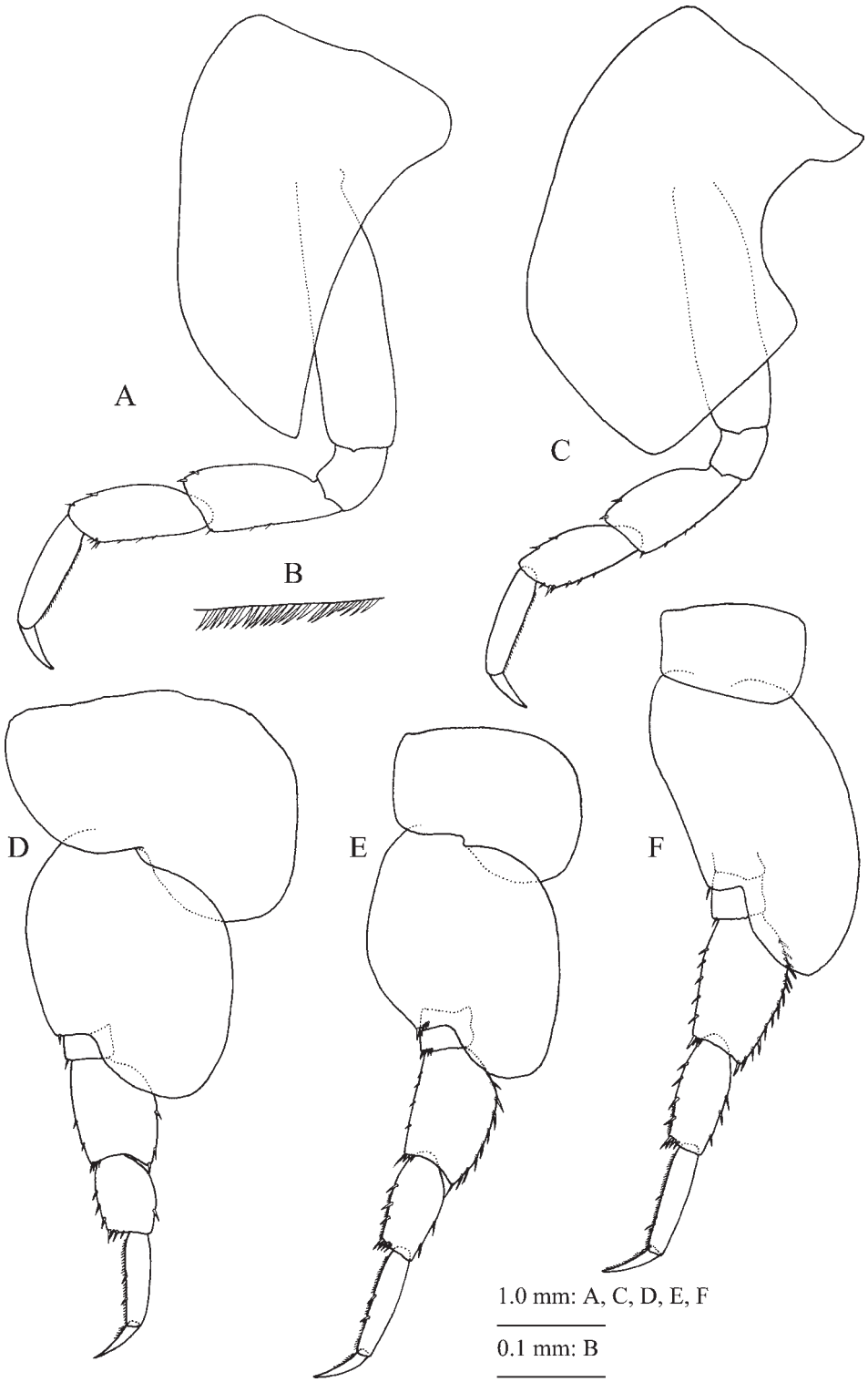

Fig. 5. *Trischizostoma tohokuense* sp. nov., holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama. A, Pereopod 3, lateral view; B, Posterior margin of propodus of pereopod 3; C–F, Pereopods 4–7, respectively, lateral view.

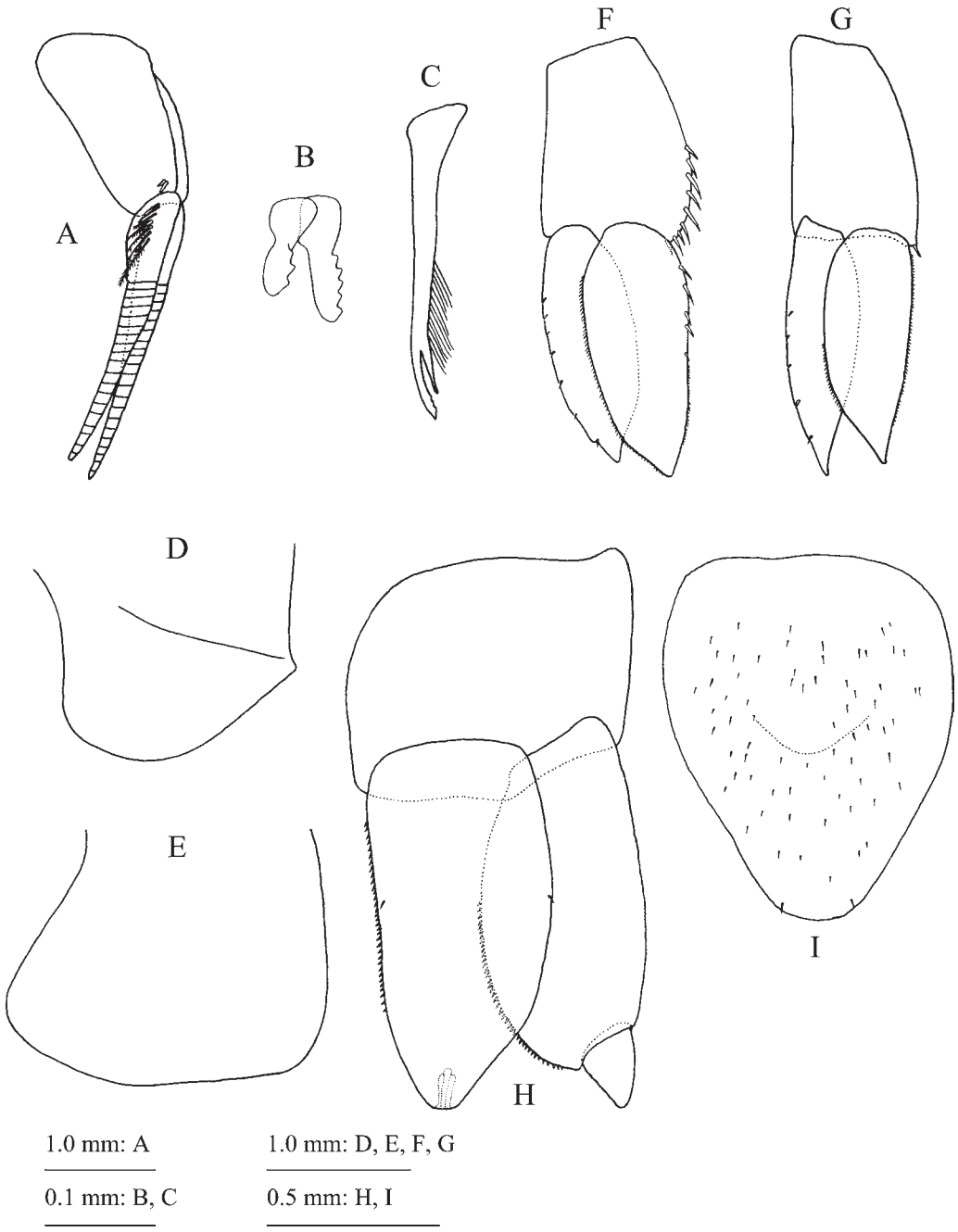

Fig. 6. *Trischizostoma tohokuense* sp. nov., holotype, female (27.5 mm), NSMT-Cr 19002, off Onahama. A, Pleopod 1 (some setae on rami omitted), medial view; B, Retinacula on peduncle of peleopod 1, medial view; C, Clothes-pin seta on inner basal margin of inner ramus of pleopod 1, medial view; D–E, Left epimeral plates 2–3, respectively, lateral view; F–H, Uropods 1–3, respectively, dorsal view; I, Telson, dorsal view.

triangular scales; outer ramus with 7 lateral setae. Uropod 2 (Fig. 6G) with 1 apicomedial seta on peduncle, length of peduncle 0.89 times as long as inner ramus; inner ramus 0.9 times as long as outer ramus, both medial and lateral margins of inner ramus lined with minute triangular scales; outer ramus with 5 lateral setae. Uropod 3 (Fig. 6H) with subrectangular peduncle, length 0.85

times breadth, marginally bare; inner ramus 0.93 times as long as outer ramus, medial margin of inner ramus with 1 seta and minute triangular scales, lateral margin with 1 seta; outer ramus 2-articulate, medial margin of article 1 lined with minute triangular scales, article 2 short, length 0.23 times as long as article 1. Telson (Fig. 6I) longer than broad, length 1.3 times breadth, entire, with many dorsal and subapical short setae, apically rounded, without marginal penicillate setae.

Etymology. The species is named for the type locality, the Tohoku District.

Distribution. North-west Pacific, off Onahama and Nakaminato, the Tohoku District, in 306–454 m depth.

Remarks. The genus *Trischizostoma* contains pelagic or deep-water amphipods, and occurs from 22–3655 m (Barnard and Karaman, 1991; Freire and Serejo, 2004). Some species of *Trischizostoma* are ectoparasites on fishes. It currently contains 16 species from the world oceans: *T. nicaeense* (Costa, 1851); *T. raschi* Boeck, 1861; *T. remipes* Stebbing, 1908; *T. paucispinosum* K. H. Barnard, 1916; *T. longirostre* Chevreux, 1919; *T. serratum* K. H. Barnard, 1926; *T. circulare* Barnard, 1961; *T. denticulatum* Ledoyer, 1978; *T. barnardi* Vinogradov, 1990; *T. cristochelata* Vinogradov, 1990; *T. macrochela* Vinogradov, 1990; *T. nascaensis* Vinogradov, 1990; *T. tanjae* Vinogradov, 1991; *T. crosnieri* Lowry and Stoddart, 1993; *T. richeri* Lowry and Stoddart, 1994; and *T. costai* Freire and Serejo, 2004. *Trischizostoma tohokuense* differs from the known species of the genus by the combination of the following features: the accessory flagellum of the antenna 1 reaches the end of the article 3 of the primary flagellum; the palp of the maxilliped is developed, longer than the outer plate; the length of the propodus of the gnathopod 1 is almost same as the breadth; the ventral margin of the merus of the gnathopod 2 without setae; and the telson is entire, apically rounded.

As mentioned above, species of *Trischizostoma* occur in pelagic or deep-water habitats. *Trischizostoma tohokuense* were collected by a trawl at the sea bottom, and thus it is suggested that the new species might be a demersal. The specimens of the species contain oil droplets in the body. It might be adaptation of the species to the deep-water environment. Females ovigerous in October through to November. This is the first record of Trischizostomatidae from Japan.

Epimeriidae Boeck, 1871
[Japanese name: Yoroi-yokoebi-ka]

Uschakoviella Gurjanova, 1955
[Japanese name: Igaguri-yokoebi-zoku]

Uschakoviella echinophora Gurjanova, 1955
[Japanese name: Igaguri-yokoebi]
(Figs. 7–10)

Uschakoviella echinophora Gurjanova, 1955: 200, figs. 14–15; Shoemaker, 1964: 417, fig. 12; Watling and Holman, 1981: 217, fig. 23; Barnard and Karaman, 1991: 401, fig. 75.

Material examined. Female (12.7 mm), NSMT-Cr 19008, R/V *Tansei-maru*, collected at St. KT-07-29-M2 (off Miyako, the Tohoku District, 39˚16.20´N, 142˚41.07´E to 39˚18.62´N, 142˚43.73´E, depth 1528 m), 5 November 2007; male (12.4 mm), NSMT-Cr 19009, R/V *Tansei-maru*, collected at St. KT-07-29-M3-1 (off Miyako, the Tohoku District, 39˚20.04´N, 142˚50.99´E to 39˚21.75´N, 142˚51.90´E, depth 1728 m), 5 November 2007. All materials were collected by T. Akiyama and H. Komatsu.

Remarks. This is the first record of this monotypic genus in Japan, having been recorded from

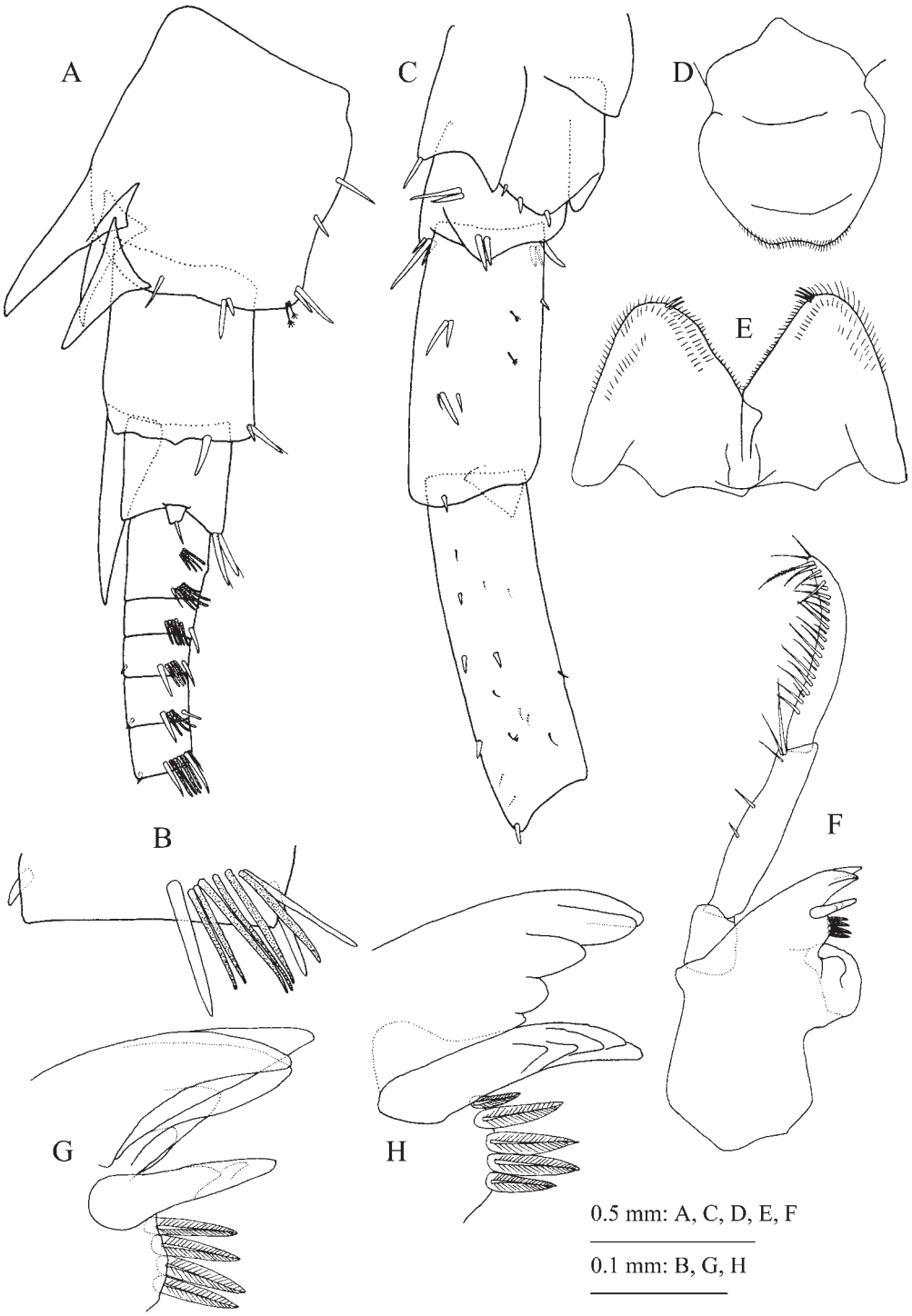

Fig. 7. *Uschakoviella echinophora* Gurjanova, 1955, male (12.7 mm), NSMT-Cr 19008, off Miyako. A, Peducular articles 1–3 and flagellar articles 1–5 of antenna 1, medial view; B, Flagellar article of antenna 1 (aesthetascs stippled), medial view; C, Peduncular articles 1–5 of antenna 2, medial view; D, Upper lip, anterior view; E, Lower lip, ventral view; F, Mandible, medial view; G and H, Incisors, lacinia mobilis, and accessory setal row of right and left mandibles, respectively, lateral and medial view, respectively.

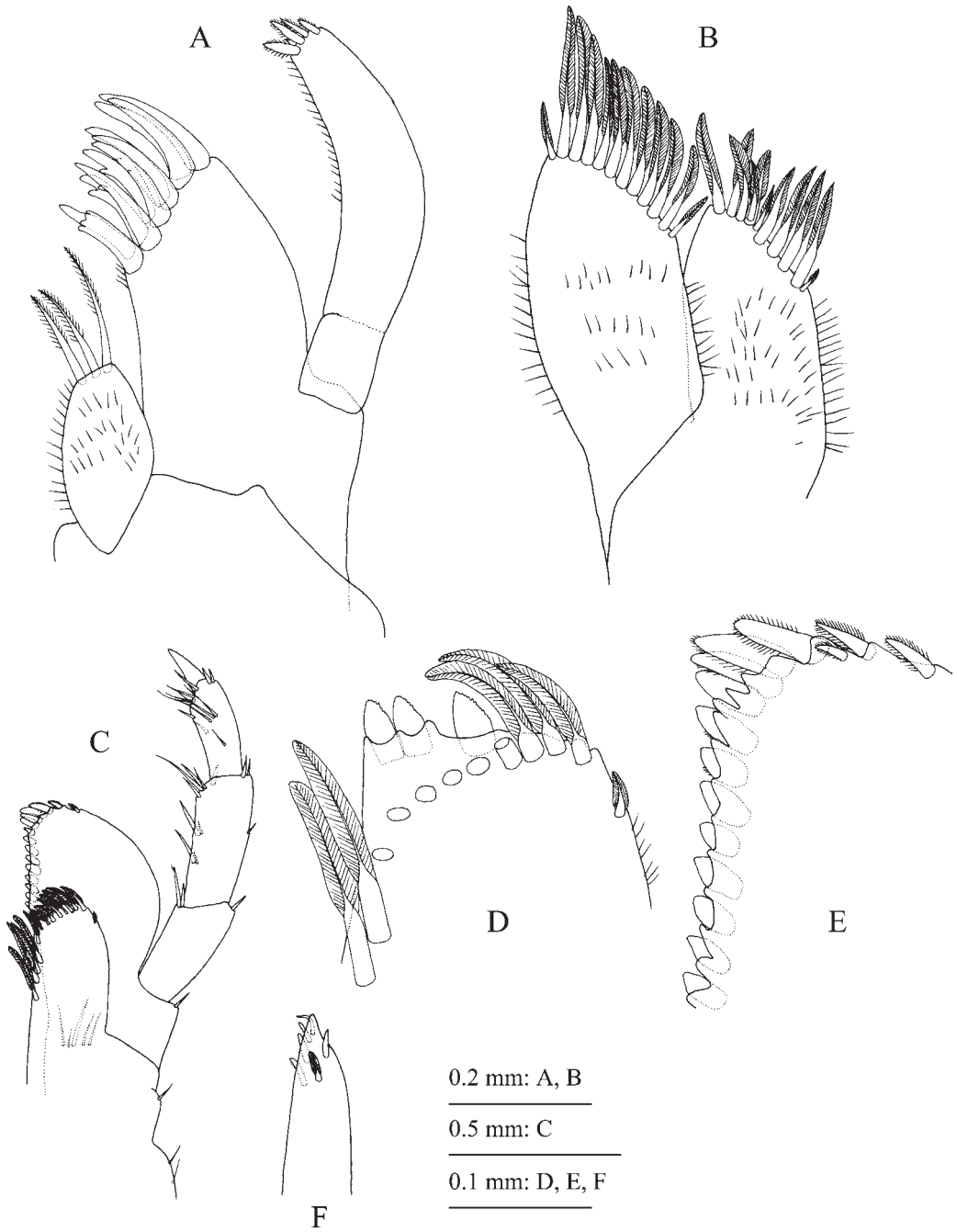

Fig. 8. *Uschakoviella echinophora* Gurjanova, 1955, male (12.7 mm), NSMT-Cr 19008, off Miyako. A, Maxilla 1, dorsal view; B, Maxilla 2, dorsal view; C, Maxilliped, dorsal view; D–F, Inner, outer plates, and palp article 4 of maxilliped, respectively, dorsal view.

the Okhotsk-Bering region (Gurjanova, 1955; Shoemaker, 1964; Watling and Holman, 1981). It is only forth reported collection of the genus and species. The present specimens agree well with Gurjanova's original description, and Shoemaker's, and Watling and Holman's redescriptions. However, the present specimens differ from those of the earlier studies in the following features:

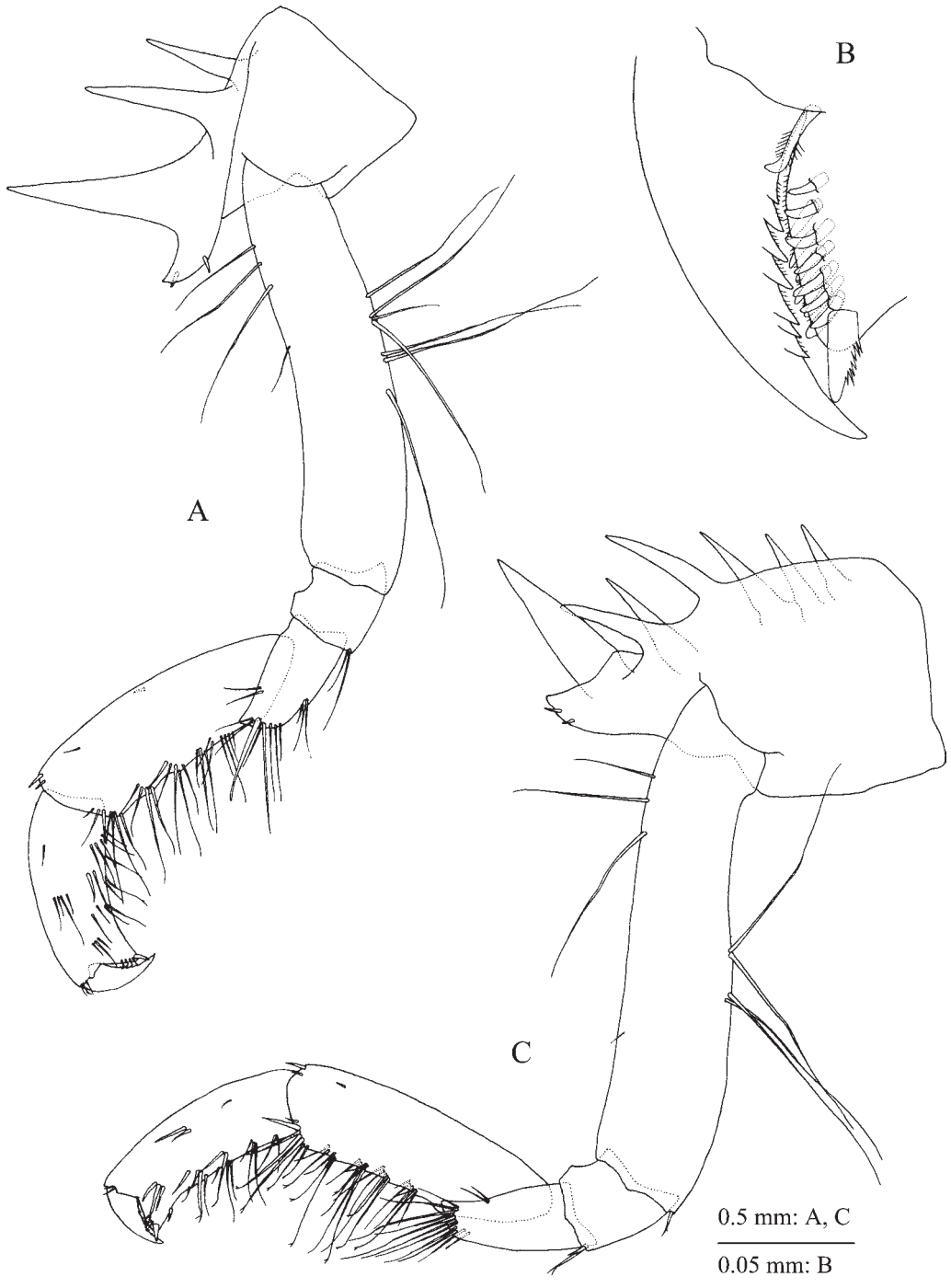

Fig. 9. *Uschakoviella echinophora* Gurjanova, 1955, male (12.7 mm), NSMT-Cr 19008, off Miyako. A and C, Gnathopods 1 and 2, respectively, medial view; B, Palmar margin of propodus and dactylus of gnathopod 1, medial view.

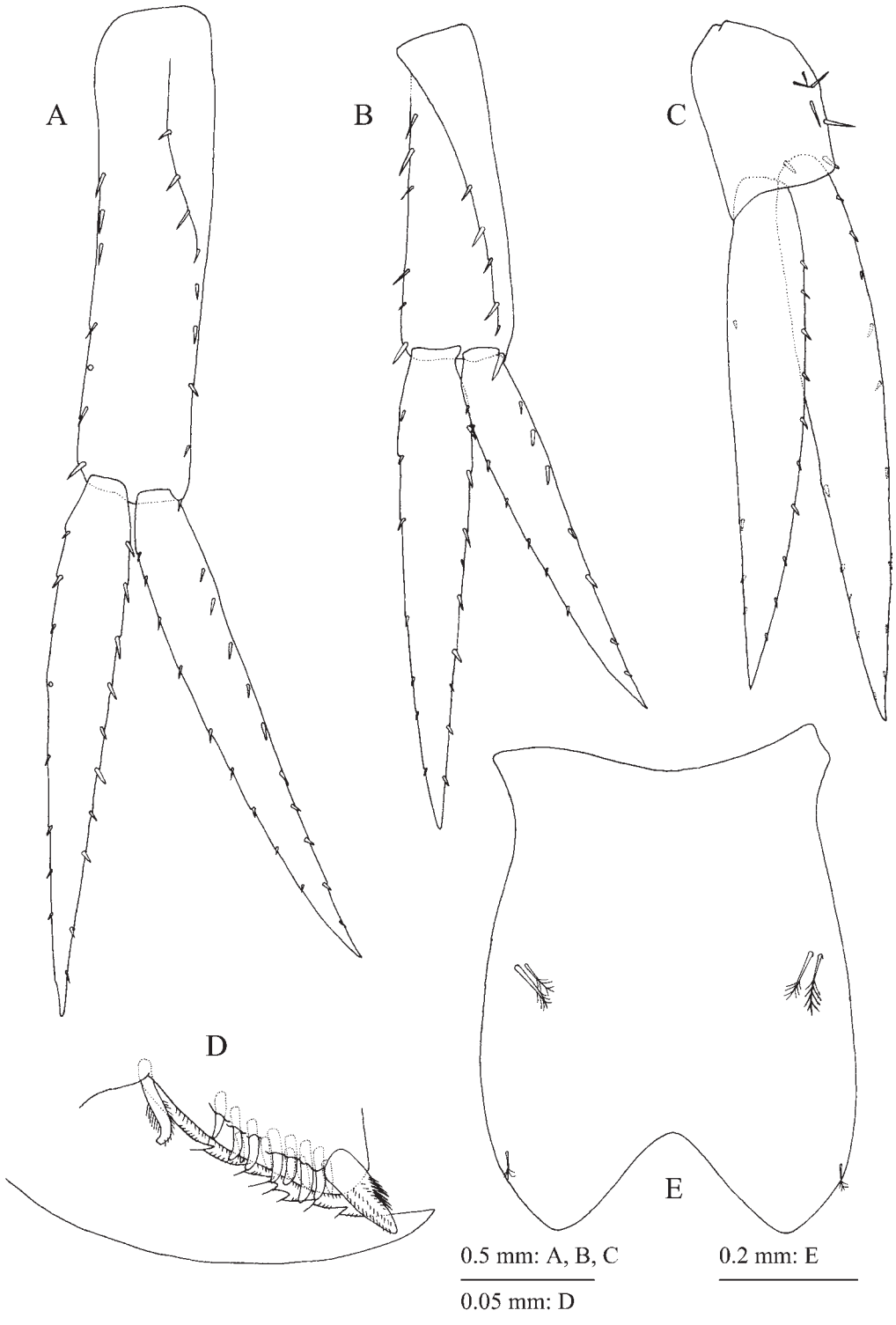

Fig. 10. *Uschakoviella echinophora* Gurjanova, 1955, male (12.7 mm), NSMT-Cr 19008, off Miyako. A–C, Uropods 1–3, respectively, dorsal view; D, Palmar margin of propodus and dactylus of gnathopod 2, medial view; E, Telson, dorsal view.

dense plumose setae are absent on the posterior margins of the propodi of the gnathopods 1 and 2 (present in Gurjanova's original description but not clearly described in Shoemaker's and Watling and Holman's redescriptions); the telson lacks marginal robust setae (bearing small robust setae in the descriptions of the above authors except Watling and Holman's redescription); and the telson lacks the dorsal projections (present in Watling and Holman's redescription, but absent in the Gurjanova's original description and Shoemaker's redescription). As mentioned in Watling and Holman (1981), this species has been reported in the limited numbers of papers. Additional material is needed to clarify the taxonomic position of the Japanese population.

Melitidae Bousfield, 1973
[Japanese name: Merita-yokoebi-ka]

Megaceradocus Mukai, 1979
[Japanese name: Oni-nokogiri-yokoebi-zoku]

Megaceradocus gigas Mukai, 1979
[Japanese name: Oni-nokogiri-yokoebi]
(Figs. 11–15)

Megaceradocus gigas Mukai, 1979: 177, figs. 1–20.

Material examined. Male (27.0 mm), NSMT-Cr 19010, female (36.0 mm), NSMT-Cr 19011, R/V *Wakataka-maru*, dredge, collected at St. WA-06-GH480D (off Hitachi, the Tohoku District, 36˚40.01´N, 141˚20.25´E to 36˚39.82´N, 141˚19.98´E, depth 478–483 m), 18 November 2006; female (38.6 mm), NSMT-Cr 19012, R/V *Wakataka-maru*, dredge, collected at St. WA-05-FG510D (off Naraha, the Tohoku District, 37˚16.90´N, 141˚50.00´E, depth 515–516 m), 15 November 2005; female (37.1 mm), NSMT-Cr 19013, R/V *Wakataka-maru*, dredge, collected at St. WA-05-GH380D (off Hitachi, the Tohoku District, 36˚39.00´N, 141˚14.30´E, depth 373–378 m), 12 November 2005. All materials were collected by H. Saito.

Remarks. The genus *Megaceradocus* was erected by Mukai (1979) to accommodate his new species *M. gigas*. Later, Krapp-Schickel and Jarrett (2000) transferred *Ceradocus baffini* Stephensen, 1933 to *Megaceradocus*.

Megaceradocus gigas was originally described by Mukai (1979) based on female specimens found in gut contents of a skate from the Sea of Japan. This is the first male specimens of this rarely collected species to be reported, and only the second record of the species. The present specimens agree well with the original description. However, the following slight differences were noted between the present specimens and Mukai's original description (the features of the original description are in parentheses): the peduncular article 1 of the antenna 1 with a posterodistal robust seta (absent); the ventral margin of the upper lip is rounded with fine setae (subacute without marginal setae); and the inner plate of the maxilla 2 is subquadrate (suboval).

There is a little sexual dimorphism in this species. The number of robust setae on the posterior margin of the antenna 1 of the male is less than that of female (one in male and three in female). The rami of the uropod 3 of the male are slightly narrower than the female (width of outer ramus is 0.26 times as long as its length in male and 0.3 times in female). The number of robust setae along the lateral margin of the telson is less than the female (one in male and three in female). The female has setose brood plates.

Mukai and Takeda (1987) recorded the fossil specimens of the species of the genus, *Megaceradocus* sp. cf. *gigas* from the Miocene Morozaki Group in the Chita Peninsula, central Japan.

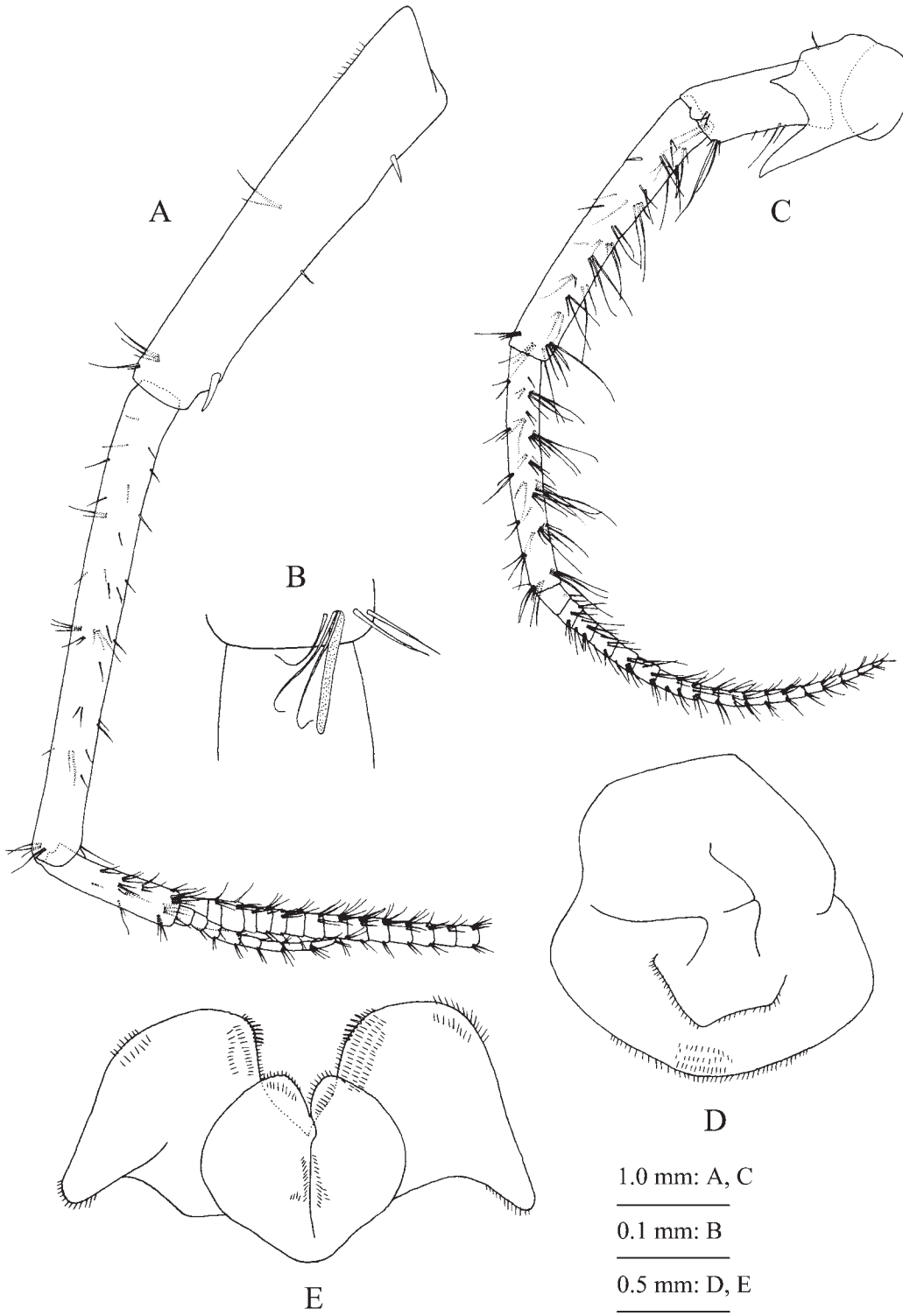

Fig. 11. *Megaceradocus gigas* Mukai, 1979, male (27.0 mm), NSMT-Cr 19010, off Hitachi. A, Peduncular articles 1–3 and flagellar articles 1–15 of antenna 1, medial view; B, Flagellar article of antenna 1 (aesthetascs stippled), medial view; C, Antenna 2, medial view; D, Upper lip, anterior view; E, Lower lip, ventral view.

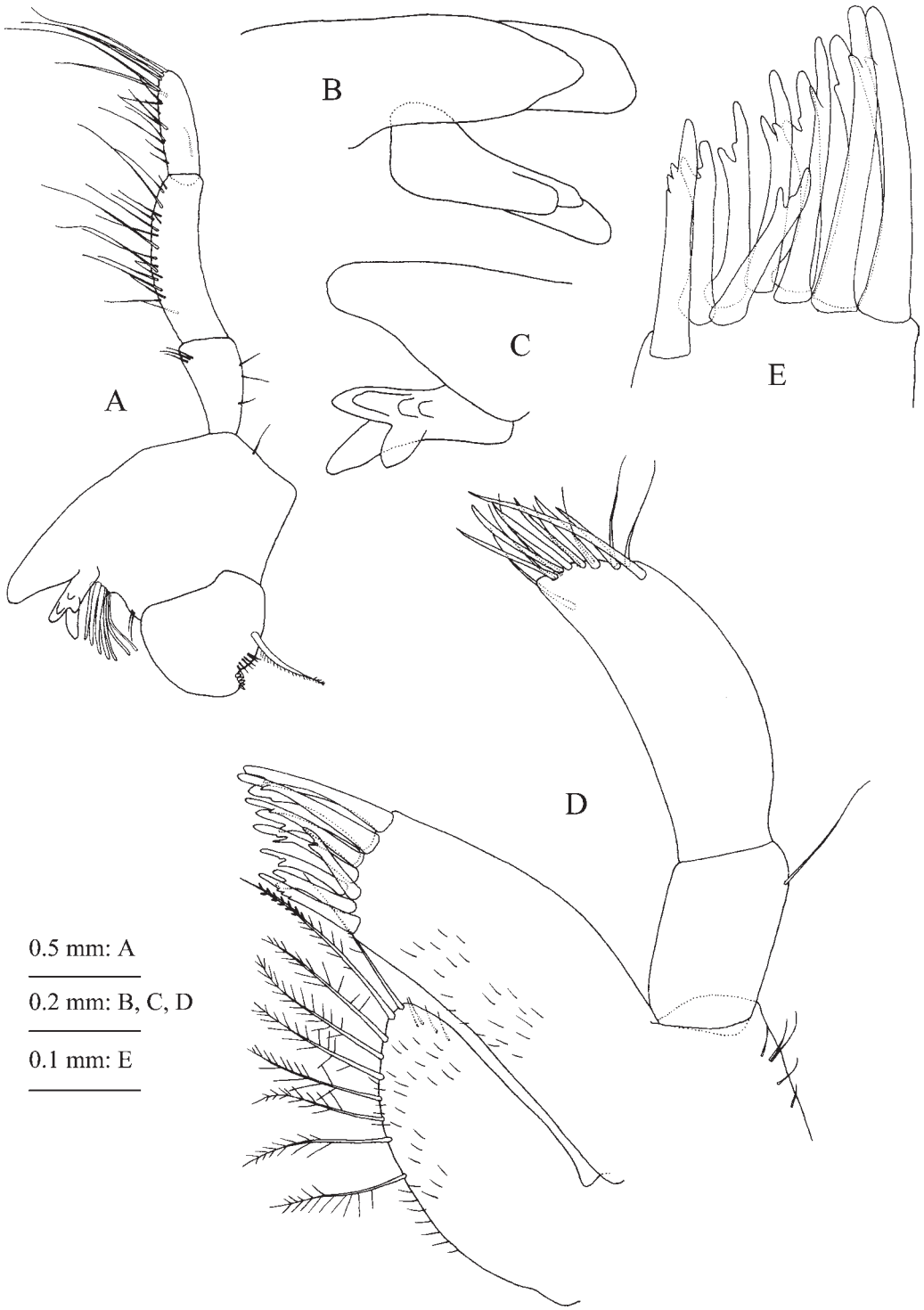

Fig. 12. *Megaceradocus gigas* Mukai, 1979, male (27.0 mm), NSMT-Cr 19010, off Hitachi. A, Mandible, medial view; B and C, Incisors and lacinia mobilis of left and right mandibles, respectively, medial view; D, Maxilla 1, dorsal view; E, Outer plate of maxilla 1, dorsal view.

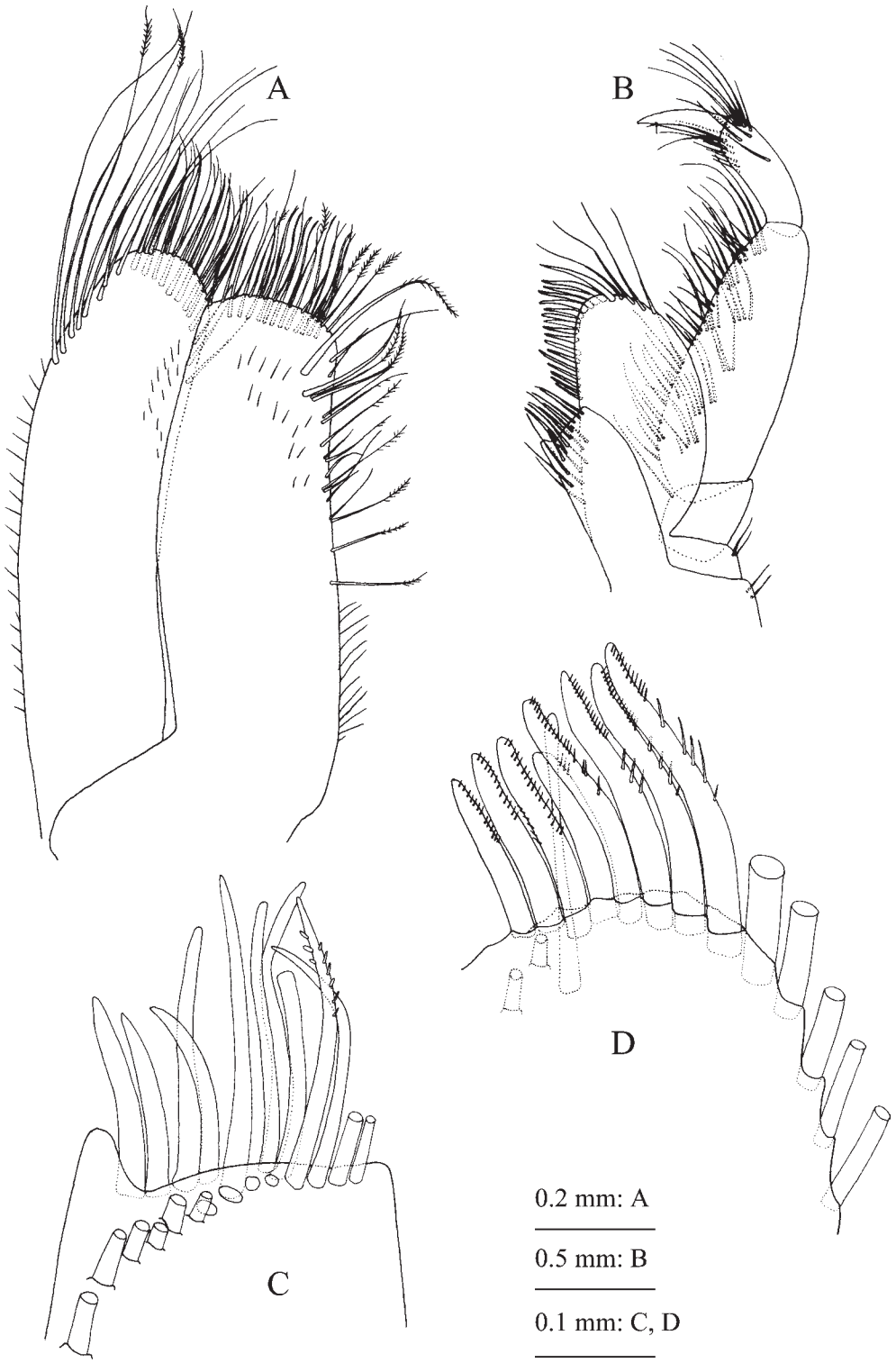

Fig. 13. *Megaceradocus gigas* Mukai, 1979, male (27.0 mm), NSMT-Cr 19010, off Hitachi. A, Maxilla 2, dorsal view; B, Maxilliped, dorsal view; C, Inner plate of maxilliped, dorsal view; D, Outer plate of maxilliped, dorsal view.

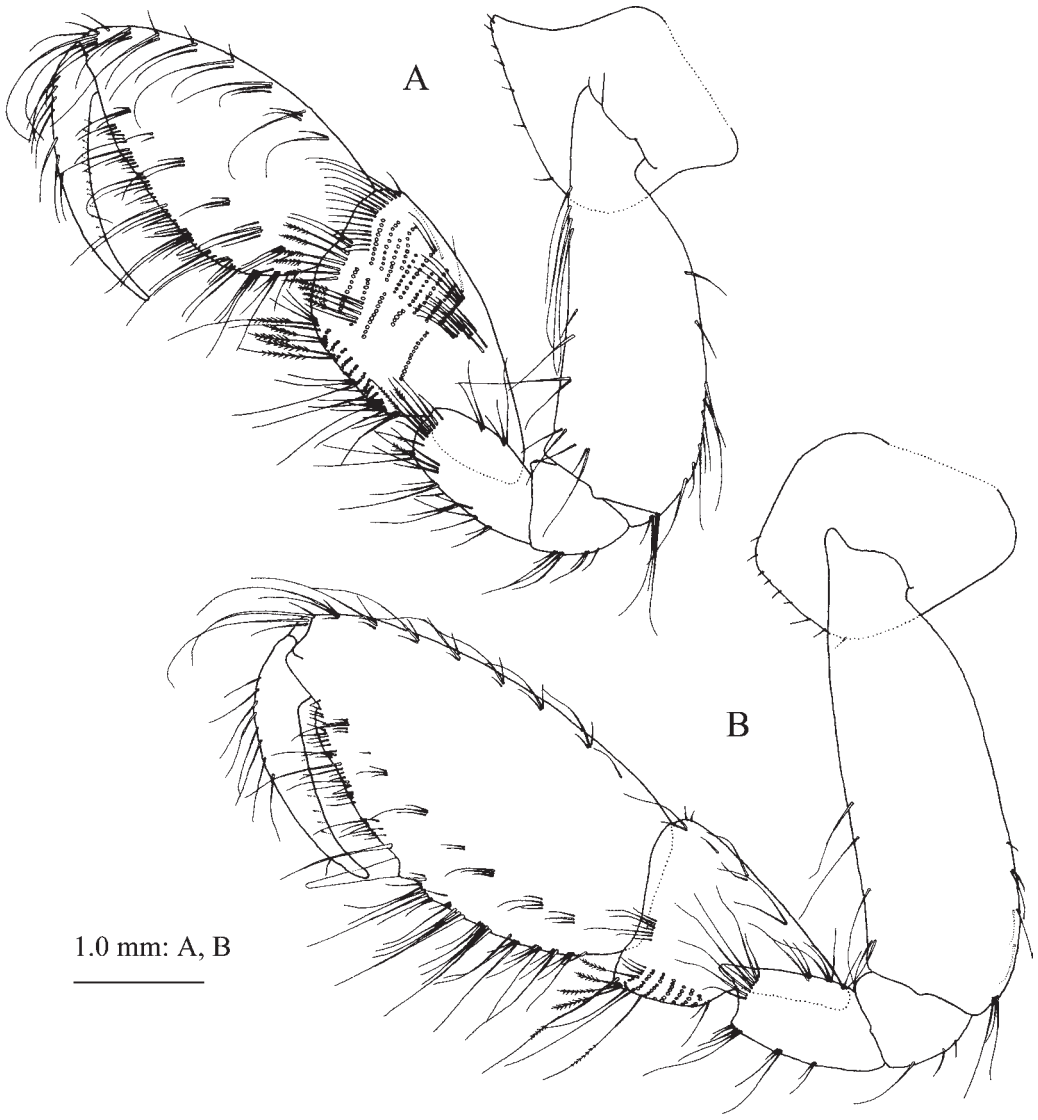

Fig. 14. *Megaceradocus gigas* Mukai, 1979, male (27.0 mm), NSMT-Cr 19010, off Hitachi. A and B, Gnathopods 1 and 2, respectively, medial views.

The fossil *Megaceradocus* sp. cf. *gigas* is morphologically similar to the modern *M. gigas*. The former is slightly different from the latter in the straight or concave posterior margin of the basis of the pereopods 5–7 (convex in the fossil specimens).

Acknowledgements

We wish to express our cordial thanks to Dr. H. Saito of the NSMT and Dr. T. Akiyama of the Okayama University for sampling and sorting the specimens, the captain and staffs of the R/V *Wakataka-maru* of the Fisheries Research Agency and the R/V *Tansei-maru* of the Japan Agency for Marine-Earth Science and Technology for their kind cooperation to collect the samples on board. Our sincere thanks also due to Dr. W. Vader who is professor emeritus at Tromsø Museum

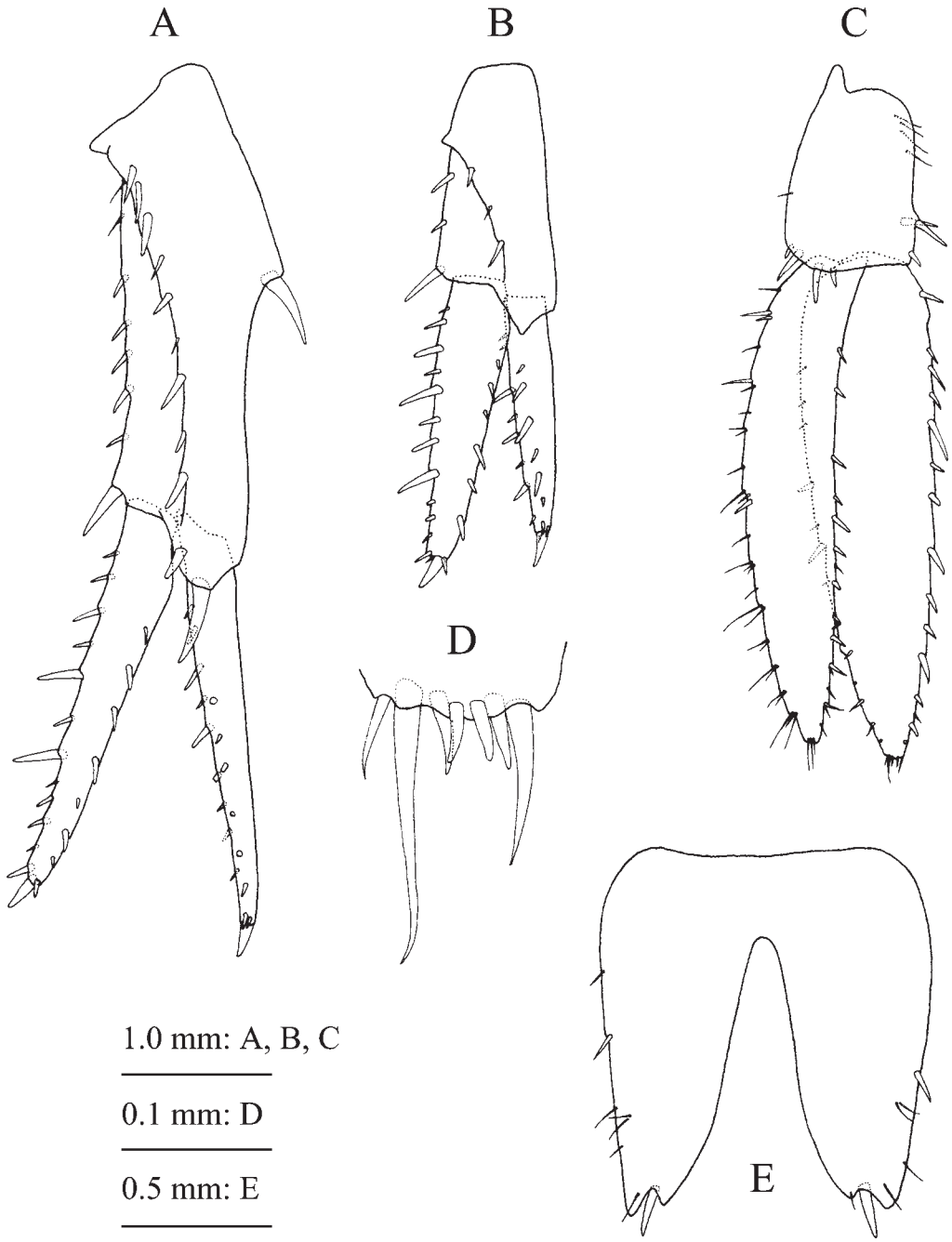

Fig. 15. *Megaceradocus gigas* Mukai, 1979, male (27.0 mm), NSMT-Cr 19010, off Hitachi. A–C, Uropods 1–3, respectively, dorsal view; D, Distal part of outer ramus of uropod 3, dorsal view; E, Telson, dorsal view.

for his critical reading and valuable comments on the manuscript.

References

Barnard, J. L. and G. S. Karaman, 1991. Families and genera of marine gammaridean Amphipoda (except marine gammaroids). *Records of the Australian Museum,* Supplement, **13**: 1–866.

Freire, P. R. and C. S. Serejo, 2004. The genus *Trischizostoma* (Crustacea: Amphipoda: Trischizostomidae) from the southwest Atlantic, collected by the REVIZEE Program. *Zootaxa*, **645**: 1–15.

Gurjanova, E. F., 1955. New species of gammarideans (Amphipoda, Gammaridea) from the northern part of the Pacific Ocean. *Trudy Zoologicheskogo Instituta,* **18**: 166–218. (In Russian.)

Krapp-Schickel, T. and N. E. Jarrett, 2000. The amphipod family Melitidae on the Pacific coast of North America. Part II. The *Maera-Ceradocus* complex. *Amphipacifica,* **2**: 23–61.

Mukai, H., 1979. A new giant amphipod belonging to a new genus, *Megaceradocus*, found in the Japan Sea. *Bulletin of the National Science Museum*, Series A (Zoology), **5**: 175–181.

Mukai, H. and M. Takeda, 1987. A giant amphipod Crustacea from the Miocene Morozaki Group in the Chita Peninsula, central Japan. *Bulletin of the National Science Museum,* Series C (Geology and Paleontology), **13**: 35–39.

Shoemaker, C., 1964. Seven new amphipods from the west coast of North America with notes on some unusual species. *Proceedings of the United States National Museum*, **115**: 391–429.

Watling, L. and H. Holman, 1981. Additional acanthonotozomatid, paramphithoid, and stegocephalid Amphipoda from the Southern Ocean. *Proceedings of the Biological Society of Washington*, **94**: 181–227.