[Research article]

Four species of *Mesanthura* (Crustacea: Isopoda: Anthuroidea) from Japan, including the description of a new species

Shoki Shiraki[1] and Keiichi Kakui[2]

[1]Department of Natural History Sciences, Graduate School of Science, Hokkaido University, Sapporo, Hokkaido 060-0810, Japan

[2]Department of Biological Sciences, Faculty of Science, Hokkaido University, Sapporo, Hokkaido 060-0810, Japan

Corresponding author: Shoki Shiraki; white-tree0703@eis.hokudai.ac.jp; https://orcid.org/0000-0002-8221-0532

Running head: *Mesanthura* isopods from Japan

Abstract

Anthuroid isopods in the genus *Mesanthura* (52 valid species) typically have a body with conspicuous dorsal pigmentation, with differences in the female pigmentation pattern being one of the main characters used to distinguish species. Five *Mesanthura* species have been reported to date from Japan. Here we describe *Mesanthura sol* **sp. nov.** from Irabu Island and Okinawa main island, Okinawa, Japan, and illustrate its sexual dimorphism in color pattern, with conspecificity between males and females confirmed with molecular data. We provide a description of *Mesanthura miyakoensis* based on specimens collected from Kochi, Shikoku, Japan. We present the first records of *Mesanthura cinctula* and *Mesanthura nigrodorsalis*

following their original descriptions. Finally, we provide partial sequences of the 16S rRNA gene for these four species and present a phylogenetic tree based on the sequences.

Zoobank (To the Editor: we will register this manuscript and the ZooBank ID if and when the manuscript is accepted.)

Keywords: Anthuridae; color; Cymothoida; pigmentation; taxonomy

Introduction

With 52 valid species (Boyko *et al*., 2025), *Mesanthura* Barnard, 1914 in the isopod family Anthuridae is characterized by having a body with conspicuous dorsal pigmentation (the chief character; Poore, 2001), the tri-articulate maxillipedal palp with the terminal article at least one-third as long as the penultimate article, the pereopod 1 with stepped palm and the carpus not fused with the propodus, the upper margin on the carpus of pereopods 4–7 shorter than the lower margin, the pereopods 4–7 with ventrodistal spiniform seta, and the leaf-like uropodal exopod (Poore 2001; Chew et al. 2014). Within species, the pigmentation pattern is roughly similar in females across ontogenetic stages from post-manca to ovigerous (Shiraki & Kakui, 2024) and is the primary taxonomic character (Wägele, 1984a). Although some studies have used the male pigmentation pattern in species discrimination, the pattern in males generally differs from that in females (Müller, 1993); this was confirmed with molecular evidence in *Mesanthura miyakoensis* Nunomura, 1979 (Shiraki & Kakui, 2024). *Mesanthura* isopods commonly occur in shallow waters in tropical or temperate seas (Müller, 1993).

To date, five *Mesanthura* species have been reported from Japan (Figure 1). *Mesanthura nigrodorsalis* Nunomura, 1977, with females almost completely pigmented, was described from shallow water at Amakusa, Kumamoto (Nunomura, 1977). *Mesanthura miyakoensis*, with females having a roughly square zone of black pigmentation dorsally on each pereonite, was described from a depth of 3 m off Miyako Island, Okinawa (Nunomura, 1979) and was subsequently reported from Tatsukushi, Kochi (Shiraki & Kakui, 2024); in addition, Nunomura (1992) reported *M*. sp. aff. *miyakoensis* from Kuroshima, Yaeyama Islands, Okinawa. *Mesanthura atrata* Nunomura, 1985, for which information on female pigmentation is lacking, was described from a single male from a rocky shore at a depth of 1 m in Toyama (Nunomura, 1985). *Mesanthura cinctula* Nunomura, 2006, in which females have a dark square zone dorsally on each pereonite, was described from depths of 247–269 m in Sagami Bay (Nunomura, 2006). Finally, *Mesanthura saikaiensis* Nunomura, 2016, for which the original description did not mention the female pigmentation pattern in detail, was described from the subtidal zone in Shijiki Bay, Nagasaki (Nunomura, 2016); an illustration in Nunomura (2016) shows the female to have a single large pigmented patch on pereonite 1 and a pair of patches on each of pereonites 2–7.

Here we describe a new species of *Mesanthura* having orange pigmentation, collected from coral rubble at 10–15 m depth on the north reef of Irabu Island, Miyako Islands, Okinawa, Japan and at 1 m depth of Onna Village, Okinawa main island, Okinawa, and present a description of *M. miyakoensis* based on specimens collected from Tatsukushi, Kochi, Shikoku, Japan. We also provide the first records for *M. cinctula* and *M. nigrodorsalis* after their original descriptions. For four of the species mentioned above, we present partial sequences of the 16S rRNA gene (16S) and a phylogenetic tree based on them.

Materials and Methods

Mesanthura individuals were collected around Japan from 2018 to 2023: intertidally by hand, from subtidally by free or SCUBA diving, and from deeper water by biological dredge (Figure 1; Table 1). Animals were photographed alive to record the pigmentation pattern and then fixed and preserved in 70–99% ethanol. The ontogenetic stage of each specimen was determined according to Shiraki & Kakui (2024). Some specimens were dissected, mounted on glass slides, and drawn as described in Shiraki *et al*. (2021). Appendages were mounted on slides, observed with an Olympus BX53 microscope, and sealed with Canada balsam. Body length was measured from the tip of the anterolateral lobe of the head to the tip of the telson, and body width at the widest portion of pereonite 5. Telson length was measured from the posterior tip to the narrowest point in the anterior half. Measurements were made axially from digital images by using Adobe Illustrator CC or ImageJ (Schneider *et al*., 2012). The specimens examined are deposited in the Invertebrate Collection of the Hokkaido University

Museum (ICHUM), Sapporo, Japan.

DNA was extracted from a pereopod of selected specimens by using a NucleoSpin Tissue XS Kit (Macherey-Nagel, Germany). Primers Copepod16S_F and Copepod16S_R (Kakui *et al*., 2023) were used for PCR amplification and cycle sequencing. Amplification conditions for 16S from *M*. *cinctula* with TaKaRa Ex Taq DNA polymerase (TaKaRa Bio, Japan) were 94°C for 1 min; 35 cycles of 98°C for 10 s, 45°C for 30 s, and 72°C for 50 s; and 72°C for 2 min, and those for 16S from the remaining three species (*M*. *miyakoensis*, *M*. *nigrodorsalis*, and our new *Mesanthura* species) with KOD One (Toyobo, Japan) were as described by Kakui *et al*. (2023). Nucleotide sequences were determined with a BigDye Terminator Kit ver. 3.1 and a 3730 DNA Analyzer (Life Technologies, USA). Sequences obtained were deposited in the International Nucleotide Sequence Database (INSD) through the DNA Data Bank of Japan (DDBJ).

Our 16S dataset for phylogenetic analysis (Table 1) comprised eight new sequences from four *Mesanthura* species, three sequences from *M*. *miyakoensis* (accession numbers LC787697, LC787698, LC795631; Shiraki & Kakui, 2024), and one sequence from the paranthurid *Paranthura japonica* Richardson, 1909 as an outgroup taxon (accession number GQ302694; unpublished). Sequences ranged in length from 421 to 439 bp. The sequences were aligned by using the MAFFT online platform version 7 (Katoh & Standley, 2013; Katoh *et al*., 2019) with the "Q-INS-i" strategy (Katoh & Toh, 2008), and ambiguous sites were removed with Gblocks version 0.91b (Castresana, 2000); the final alignment was 396 bp long. The optimal phylogenetic tree was determined with the maximum likelihood (ML) method implemented in IQtree version 2.1.2 (Minh *et al*., 2020), with nodal support values obtained through 1000 Shimodaira-Hasegawa-like approximate likelihood ratio tests (SH-aLRT; Guindon *et al*., 2010) and analysis of 1000 ultrafast bootstrap (UFBoot; Hoang *et al*., 2018) pseudoreplicates. Clades with SH-aLRT ≥ 80 and UFBoot ≥ 95 were considered to be well supported. The optimal substitution model determined under the corrected AIC (Akaike information criterion) option in ModelFinder (Kalyaanamoorthy *et al*., 2017) was TIM2 + F + G4. The resulting phylogenetic tree was drawn with FigTree software version 1.4.4 (https://github.com/rambaut/figtree/releases/tag/v1.4.4) and edited with Adobe Illustrator CC. P-distances and Kimura (1980) 2-parameter (K2P) distances among the eleven aligned *Mesanthura* sequences were calculated with MEGA7 (Kumar *et al*., 2016).

Results and Discussion

Systematics

Superfamily **Anthuroidea** Leach, 1814

Family **Anthuridae** Leach, 1814

Genus ***Mesanthura*** Barnard, 1914

Diagnosis

See Poore (2001).

Remarks

Mesanthura atrata and *Mesanthura javensis* Wägele, 1984 were described from only a single male specimen each and are distinguished from congeners mainly by differences in pigmentation pattern (Wägele, 1984b; Nunomura, 1985). As species in *Mesanthura* show sexual dimorphism in pigmentation pattern, the male pattern in one species cannot be compared to the female pattern in other species (e.g., Shiraki & Kakui, 2024; this study). Morphological information of their females that are molecularly linked to the males are needed to fix their taxonomic status.

Among the five *Mesanthura* species known from Japan, *M. saikaiensis* may not be a true member of the genus because it shows the following characters which contradict Poore's (2001) generic diagnosis: short article 3 of maxillipedal palp; pereopod-1 palm not stepped;

and the carpus of pereopods 4–7 without ventrodistal spiniform seta. In this study, however, we refrain from transferring the species to another genus because we did not observe *M. saikaiensis* specimens in this study.

Mesanthura cinctula Nunomura, 2006

(Japanese name: *Futairo-uminanafushi*)

(Figure 2)

Mesanthura cinctula Nunomura, 2006, p. 14, figure 4.

Material examined

Female lacking oostegites (ICHUM8940, 1 vial), body length 10.78 mm; sandy mud bottom, 321–224 m depth off Jogashima (35°07'13.0"N 139°33'46.0"E to 35°07'35.9"N 139°33'07.7"E), Kanagawa, Japan, 23 May 2018, collected by Hisanori Kohtsuka. Manca (ICHUM8941, 1 vial), body length 5.71 mm; 109–144 m depth off Jogashima (35°08'30.3"N 139°32'56.9"E to 35°08'34.3"N 139°32'43.1"E), Kanagawa, Japan, 22 February 2019, collected by Keiichi Kakui; LC849816 (16S).

Distribution

Mesanthura cinctula is known from Sagami Bay, Japan, at depths of 109–321 m (Nunomura, 2006; this study) (Figure 1).

Remarks

We assigned our specimens to *M. cinctula* based on (1) the square or rectangular pigmentation zone occupying half or more of each pereonite and located posteriorly in pereonites 4–6 and (2) the pleonites 1–5 dorsally fused but laterally articulated (Figure 2A–C, F; Nunomura, 2006). In the original description, the pigmentation zones on *M. cinctula* were simply described as "dark" (Nunomura, 2006: p. 14), with no mention of the hue. We observed the pigmentation to be reddish orange in both fresh and ethanol-preserved specimens. This species is unique in its depth of occurrence (200 m or deeper); all other *Mesanthura* species are known only from much shallower depths (Poore, 2001).

Mesanthura miyakoensis Nunomura, 1979

(Japanese name: *Moyou-uminanafushi*)

(Figures 3–7)

Mesanthura miyakoensis Nunomura, 1979, p. 31, figures 1, 2; Shiraki & Kakui, 2024, p. 3, figures 2, 3, 5, 6.

Mesanthura sp. (*aff miyakoensis*, Nunomura, 1979): Nunomura, 1992, p. 53, figure 4.

Material examined

Post-manca (ICHUM8942, 1 vial), body length 2.75 mm; coral rubble, 10–15 m depth, north reef of Irabu Island (24°51'55.5"N 125°08'39.6"E), Miyako Islands, Okinawa, Japan, 24 April 2022, collected by Shoki Shiraki; LC849817 (16S). Post-manca (ICHUM8943, 1 vial), body length 3.21 mm; same collection data as for ICHUM8942. Female lacking oostegites (ICHUM8944, 10 slides and 1 vial), body length 3.76 mm; coral rubble, intertidal zone, Tatsukushi (32°47'09.3"N 132°51'22.2"E), Kochi, Shikoku, Japan, 26 July 2021, collected by Yuki Oya. Subadult male (ICHUM8945, 6 slides and 1 vial), body length 3.79 mm; same locality as for ICHUM8944, 13 June 2021, collected by Yuki Oya; LC787697 (16S; Shiraki & Kakui, 2024). Female lacking oostegites (see the footnote for Table 1) (ICHUM8946, 1 vial), body length 4.59 mm; coral rubble, 1 m depth, same locality as for ICHUM8944, 10 October 2022, collected by Shoki Shiraki; LC795631 (16S; Shiraki & Kakui, 2024). Post-manca (ICHUM8947, 1 vial), body length 2.92 mm; same collection data as for ICHUM8946; LC787698 (16S; Shiraki & Kakui, 2024).

Description of female lacking oostegites based on ICHUM8944

Body (Figures 3A, 4A–D) length 12.49 times body width, slender. Dark brown pigmentation pattern as shown in Figure 4A–D, 6D, F. Head (Figure 4A) length 1.21 times head width, with several lateral simple setae; rostrum protruding, slightly shorter than anterolateral lobes; eyes dorsolateral, relatively large, length 0.19 times head length. Pereonites 1–7 (Figure 4A–D) with length ratio 1.17 : 1.15 : 1.05 : 1.21 : 1.49 : 1.32 : 0.84 : 0.90 relative to head length; each pereonite with several lateral simple setae. Pleonites 1–5 (Figure 4C, D) completely fused, 0.08 times body length, with several simple setae. Pleonite 6 free from pleonites 1–5, fused dorsally to telson. Telson (Figure 6F) linguliform, length 2.11 times width; with two indentations in apical edge comprising three protrusions, two posterior plumose sensory setae, one pair of posterior short, 28 dorsal short, and two pairs of posterior long simple setae, patches of dark brown pigmentation, and two statocysts anterioly. Pigmentation pattern as described by Shiraki & Kakui (2024).

Antennula (Figure 4E) with three peduncular articles and three flagellar articles. Peduncular article 1 longest, with plumose sensory seta, two simple setae, and seta (tip broken); article 2 with two plumose sensory setae; article 3 with four simple setae. Flagellar article 1 with plumose sensory seta; article 2 naked; article 3 with three aesthetascs and six simple setae.

Antenna (Figure 4F, G) with five peduncular articles and five flagellar articles. Peduncular article 1 with outer simple seta; article 2 with one outer and two distal simple setae, and inner seta (tip broken); article 3 with three inner simple setae; article 4 with two distal plumose sensory setae, four simple setae, and two inner setae (each tip broken); article 5 with four distal plumose sensory setae and eleven simple setae. Flagellar articles 1–5 with numerous distal simple setae.

Mandible (Figure 4H) with tri-articulate palp. Palp article 1 with distal simple seta;

article 2 longest, without simple setae; article 3 with six spiniform setae. Incisor with three-toothed cusp and two-toothed cusp. Lamina dentata with three denticles. Molar process rounded.

Maxilla (Figure 4I) bent inward, with six distal teeth.

Maxilliped (Figure 4J) with tri-articulate palp. Palp article 1 with two inner simple setae; article 2 with three distal simple setae; article 3 nearly as long as broad, 0.63 times as long as article 2, with two inner plumose setae and three inner distal simple setae. Endite lacking. Epipod oval.

Pereopod 1 (Figure 5A) subchelate. Basis with one dorsal and one ventrodistal simple setae. Ischium with ventrodistal simple seta. Merus with two dorsal and two ventral simple setae. Carpus triangular, with three membranous processes and four ventral simple setae. Propodus oval, with one dorsodistal and one outer simple setae. Palm with middle rounded process, several transparent membranous processes, and nine simple setae. Dactylus with ventral transparent membranous process and one ventral, three ventrodistal, and four inner simple setae. Unguis as long as dactylus, naked.

Pereopod 2 (Figure 5B) narrower than pereopod 1. Basis with three dorsal plumose sensory setae, and two dorsal and one ventrodistal simple setae. Ischium with two dorsal simple setae. Merus with two dorsal and four ventral simple setae. Carpus triangular, narrower than merus, with three ventral simple setae. Propodus rectangular, with ventrodistal transparent membranous process, ventrodistal spiniform seta with sensory bristle sensu Negoescu (1994), dorsal plumose sensory seta, and two dorsodistal and six ventral simple setae. Dactylus with ventrodistal spiniform seta, two ventrodistal plumose sensory setae, and one ventral, two ventrodistal, and three inner simple setae. Unguis about half length of dactylus.

Pereopod 3 (Figure 5C) similar to pereopod 2 except in number of plumose sensory setae and simple setae.

Pereopod 4 (Figure 5D) nearly as narrow as pereopods 2 and 3. Basis with four dorsal plumose sensory setae and five simple setae. Ischium with one dorsal and two ventral simple setae. Merus with two dorsal and two ventral simple setae. Carpus trapezoidal, with ventrodistal spiniform seta having sensory bristle, dorsal plumose sensory seta, and one dorsal and two ventral simple setae. Propodus rectangular, with ventrodistal spiniform seta having sensory bristle, dorsodistal plumose sensory seta, and two dorsodistal and five ventral simple setae. Dactylus with ventrodistal spiniform seta and one mid-ventral, four ventrodistal, and four outer simple setae. Unguis about half length of dactylus, naked.

Pereopods 5–7 (Figure 5E–G) similar to pereopod 4, except in numbers of spiniform setae, plumose sensory setae on basis, and simple setae. Propodus of pereopod 7 with two ventrodistal trifurcate spiniform setae in addition to ventrodistal spiniform seta with sensory bristle.

Pleopod 1 (Figure 6A) protopod with three inner spiniform setae. Exopod operculiform, with twelve plumose setae and seven short simple setae on surface near distal margin. Endopod shorter than exopod, with three plumose setae.

Pleopods 2 and 3 (Figure 6B, C) with protopod bearing one and two simple setae, respectively. Exopods with six distal plumose setae and two short outer simple setae. Endopods with four plumose setae.

Uropodal (Figure 6D, E) protopod shaped like triangular prism, with network of stellate patches of dark brown pigmentation and eight plumose setae. Endopod (Figure 6D) rounded, pigmented similarly to protopod, with two distal plumose sensory setae, five plumose setae, and 31 simple setae. Exopod (Figure 6E) finely sinuate along dorsodistal margin, with 13 plumose sensory setae, 12 simple setae, and four setae (each tip broken).

Description of subadult male ICHUM8945

Body (Figures 3C, 7A) slender. Head length 1.59 times head width; rostrum overlapping anterolateral lobes; dorsolateral eyes large, 0.35 times as long as head. Pleonites 1–5 (Figure 7A) completely fused, 0.10 times body length. Pleonite 6 free from pleonites 1–5, fused dorsally to telson. Telson linguliform, similar to that in females, with two indentations in apical edge comprising three protrusions; with two statocysts anteriorly. Pigmentation pattern as described by Shiraki & Kakui (2024).

Antennula (Figure 7B) swollen, with three peduncular articles and eleven flagellar articles. Peduncular articles 1–3 naked. Flagellar article 1 with three inner simple setae; articles 2–10 naked; article 11 with four distal simple setae.

Antenna similar to that in females, with five peduncular articles and five flagellar articles.

Mandible (Figure 7C) with tri-articulate palp. Palp article 1 naked; article 2 longest, with zero (right) or one (left) simple seta; article 3 with six spiniform setae on both mandibles. Incisor, lamina dentata, and molar process reduced.

Maxilliped (Figure 7D) similar to that in females, with tri-articulate palp. Palp article 1 with inner simple seta; article 2 with three distal simple setae; article 3 nearly as long as broad, with two inner plumose setae and two inner simple setae. Endite lacking.

Pereopod 1 (Figure 7E) subchelate, slightly slenderer than and similar to that in females. Basis with one dorsal and two ventral simple setae. Ischium with one dorsal and one ventral simple setae. Merus with two dorsal and two ventral simple setae. Carpus triangular, with four ventral simple setae. Propodus oval, with inner distal spiniform seta and one dorsal, two dorsodistal, and one inner simple setae. Palm with middle weak rounded process and ten simple setae. Dactylus with one ventral, two ventrodisal, and five inner distal simple setae. Unguis slightly shorter than dactylus, naked.

Pereopods 3 and 7 slightly slenderer than and similar to those in females.

Pleopod 1 similar to that in females. Exopod operculiform, with 19 (right) or 17 (left) plumose setae. Endopod shorter than exopod, with six (right) or five (left) plumose setae.

Pleopod-2 (Figure 7F) exopod with six distal plumose setae and outer simple seta. Endopod with four plumose setae and appendix masculina. Appendix masculina 0.83 times as long as endopod, slightly curved inward.

Uropodal exopod and endopod similar to those in females.

Distribution

Mesanthura miyakoensis is widely distributed in southwestern Japan (Figure 1). It has been reported from Tatsukushi, Kochi, at a depth of 1 m (Shiraki & Kakui, 2024; this study); Miyako Island, Miyako Islands, Okinawa, at a depth of 3 m (type locality; Nunomura, 1979); Irabu Island, Miyako Islands, Okinawa, at a depth of 10–15 m (this study); and Kuroshima, Yaeyama Islands, Okinawa, depth unknown (Nunomura, 1992).

Remarks

We identified non-male (i.e., post-manca to ovigerous female) specimens from Irabu and Tatsukushi as *M. miyakoensis* by their having a pigmentation pattern (Figures 3A, B, 4A–D) identical to that described by Nunomura (1979). However, some differences in morphological characters are evident between our description and the original description (character state of the latter in parentheses). Our specimens have the pereopod-2 carpus narrower than the merus (as wide as the merus), one spiniform seta on the pereopod-3 propodus (two), a rounded uropodal endopod (weakly tapering; this apparent difference might be due to having drawn the uropod at a different angle), and two pairs of long simple setae on the posterior edge of the telson (one pair).

The pigmentation pattern in *M. miyakoensis* males differs from that in conspecific non-males (Shiraki & Kakui, 2024). Other sexually dimorphic characters in this species are typical for *Mesanthura*: males have larger eyes; longer, swollen antennulae; longer pereopods; an appendix masculina; and a longer pleon.

We concluded that *Mesanthura* sp. aff. *miyakoensis* sensu Nunomura (1992) is conspecific with *M*. *miyakoensis*. Although Nunomura (1992) listed four morphological differences between the two, we judged none of these to be interspecific differences: (1) The eyes (= dark pigmentation of the ommatidia) being scattered or not is likely an effect of fixation in alcohol; pigmentation has been reported to shrink after ethanol fixation (e.g., Shiraki & Kakui, 2024). (2,3) Differences in the number of articles in the antennule and antenna; these numbers can vary among conspecific specimens in anthuroids (e.g., Shiraki *et al*., 2021: table 1). (4) The longer pereopodal merus in *M*. sp. aff. *miyakoensis*: only pereopod-1 merus looks longer in *M*. sp. aff. *miyakoensis* than in *M. miyakoensis* sensu stricto, but by measuring from the illustrations, the length ratio of the merus relative to the carpus was almost same in *M*. sp. aff. *miyakoensis* and *M. miyakoensis* sensu stricto, both 0.79 (Nunomura, 1979, 1992).

Mesanthura nigrodorsalis Nunomura, 1977

(Japanese name: *Seguro-uminanafushi*)

(Figure 8)

Mesanthura nigrodorsalis Nunomura, 1977, p. 77, figures 5, 6.

Material examined

Female lacking oostegites (ICHUM8948, 1 vial), body length 6.74 mm; sea algae, 0.2 m depth, Nagamatsu Beach (34°19'51.4"N 135°09'10.4"E), Osaka, Japan, 10 September 2022, collected by Shoki Shiraki. Female lacking oostegites (ICHUM8949, 1 vial), body length 3.91 mm; calcareous algae, 1 m depth, Araihama (35°09'37.4"N 139°36'38.9"E), Kanagawa, Japan, 25 July 2021, collected by Hisanori Kohtsuka and Aoi Tsuyuki; LC849812 (16S). Female lacking oostegites (ICHUM8950, 1 vial), body length 5.19 mm; sea algae, 1 m depth, Jogashima (35°08′11.4″N 139°36′39.3″E), Kanagawa, Japan, 12 July 2022, collected by

Shoki Shiraki; LC849811 (16S).

Distribution

Mesanthura nigrodorsalis is known in the middle Japan (Figure 1): from Araihama and Jogashima, Kanagawa, at a depth of 1 m (this study); Nagamatsu Kaigan, Osaka, at a depth of 0.2 m (this study); and Amakusa, Kumamoto, in shallow water (type locality; Nunomura, 1977).

Remarks

We assigned our females lacking oostegites to *M. nigrodorsalis* due to their body entirely chestnut-colored dorsally (Figure 8; Nunomura, 1977), which likely acts as concealing coloration, as we collected *M. nigrodorsalis* from brown (*Sargassum* sp.) and calcareous algae that were similar in color. Another dark-bodied species, *M. nigra* Müller, 1993, was also reported from *Sargassum* sp. (Müller, 1993).

Mesanthura sol **sp. nov.**

(New Japanese name: *Taiyo-uminanafushi*)

(Figures 9–14)

Zoobank (To the Editor: we will register this manuscript and the ZooBank ID upon acceptance of the manuscript.)

Material examined

Holotype. Ovigerous female (ICHUM8951, 14 slides and 1 vial), body length 5.53 mm; coral rubble, 10–15 m depth, north reef of Irabu Island (24°51'55.5"N 125°08'39.6"E), Miyako Islands, Okinawa, Japan, 24 April 2022, collected by Shoki Shiraki; LC849814 (16S).

Paratypes. All from coral rubble, 1 m depth, Onna Village (26°29'57.4"N 127°50'30.8"E), Okinawa main island, Okinawa, Japan, 23 April 2023, collected by Shoki Shiraki. Female lacking oostegites (ICHUM8952, 1 vial), body length 5.39 mm; LC849810 (16S). Female lacking oostegites (ICHUM8953, 1 vial), body length 4.21 mm. Adult male (ICHUM8954, 1 vial), body length 6.09 mm; LC849815 (16S). Adult male (ICHUM8955, 6 slides and 1 vial), body length 4.54 mm; LC849813 (16S).

Etymology

The specific name is a noun in apposition derived from the Latin noun *sōl* (sun) referring to the orange color of the species.

Diagnosis

Female. Head with hollowed-out rectangular zone of pigmentation composed of distinct patches of orange. Pereonites and fused pleonites with distinct patches of orange pigmentation along margins, with non-pigmented elliptical "window" located mid-segment and occupying almost half zone of each segment. Telson 2.28 times as long as wide. Uropodal exopod oval, sinuous along dorsodistal margin. *Male.* Telson with two indentations at apical edge. Uropodal exopod tapering.

Description of holotype ovigerous female

Body (Figures 9A, B, 10A–C) length 12.52 times body width, slender. Head (Figure 10A) length 1.31 times head width, with hollowed-out rectangular pattern composed of distinct patches of orange pigmentation; rostrum protruding, as long as anterolateral lobes; dorsolateral eyes relatively large, 0.20 times head length. Pereonites 1–7 (Figure 10A–C) with length ratio 1.48 : 1.32 : 1.19 : 1.51 : 1.47 : 1.33 : 0.94 relative to head length; each pereonite with several lateral simple setae, distinct patches of orange pigmentation along the margin of each pereonite, with pigmentation lacking in oval-shaped "window" in middle;

yellow pigmentation along anterior margin of pereonite 1 and posterior part of other pereonites evident only in living animals. Pleonites 1–5 (Figure 10B, C) completely fused, 0.08 times body length, with trapezoidal pattern of distinct patches of orange pigmentation but without pigmentation in oval-shaped "window" in the middle. Pleonite 6 (Figure 10B) free from pleonites 1–5, fused dorsally to telson, with yellow pigmentation along posterior margin only in living animal. Telson (Figure 12H) linguliform, length 2.28 times width, with two posterior plumose setae and 36 simple setae; pigmentation weak; with two statocysts anteriorly.

Antennula (Figure 10D) with three peduncular and two flagellar articles. Peduncular article 1 longest, with three outer plumose sensory setae; article 2 with four distal plumose sensory setae and outer seta (tip broken); article 3 slightly shorter than article 1, with outer distal plumose sensory seta and four outer distal simple setae. Flagellar article 1 naked; article 2 with three distal aesthetascs and seven distal simple setae.

Antenna (Figure 10E) with five peduncular and four flagellar articles. Peduncular article 1 triangular, with two outer simple setae; article 2 with one outer and two distal simple setae; article 3 with two inner simple setae and inner seta (tip broken); article 4 with two distal plumose sensory setae and one inner and four distal simple setae; article 5 with four distal plumose sensory setae, nine distal simple setae, and inner seta (tip broken). Flagellar articles 1–4 with numerous distal simple setae.

Mandible (Figure 10F) with tri-articulate palp. Palp article 1 with distal simple seta; article 2 longest, with two simple setae; article 3 slightly shorter than article 1, with nine spiniform setae. Incisor with two three-toothed cusps. Lamina dentata with five denticles. Molar process weakly rounded.

Maxilla (Figure 10G) bent inward, with six distal teeth.

Maxilliped (Figure 10H) with tri-articulate palp. Palp article 1 with inner simple seta; article 2 with four inner and one outer simple setae; article 3 nearly as long as broad, length

0.68 times that of article 2, with two inner plumose setae and two inner simple setae. Endite lacking. Epipod oval.

Pereopod 1 (Figure 11A) subchelate. Basis with three dorsal plumose sensory setae and four simple setae. Ischium with one dorsodistal and two ventral simple setae and ventrodistal seta (tip broken). Merus with one dorsal and two ventral simple setae. Carpus triangular, with one inner, one outer, and three distal simple setae, and two setae (each tip broken). Propodus oval, with two dorsal, two dorsodistal, one inner, and 13 outer simple setae. Palm denticulate, with middle rounded process bearing seven simple setae and three distal simple setae. Dactylus with one ventral, five ventrodistal, and three inner simple setae. Unguis as long as dactylus, naked.

Pereopod 2 (Figure 11B) narrower than pereopod 1. Basis with dorsal plumose sensory seta, two dorsal and two ventral simple setae, and two setae (each tip broken). Ischium with two dorsal and three ventral simple setae. Merus with two dorsal and three ventral simple setae and ventral seta (tip broken). Carpus triangular, with six simple setae. Propodus rectangular, with ventro-subdistal transparent membranous process, ventrodistal spiniform seta with sensory bristle sensu Negoescu (1994), dorsal plumose sensory seta, and four dorsal and ten ventral simple setae. Dactylus with ventrodistal spiniform seta and one ventral, five ventrodistal, and five inner simple setae. Unguis about half as long as dactylus.

Pereopod 3 (Figure 11C) similar to pereopod 2 except in numbers of plumose sensory setae on basis and simple setae.

Pereopod 4 (Figure 11D) slightly narrower than pereopods 2 and 3. Basis with four dorsal plumose sensory setae and seven simple setae. Ischium with two dorsal and three ventral simple setae. Merus with two dorsal and four ventral simple setae. Carpus trapezoidal, with ventral triangular transparent membranous process, ventrodistal spiniform seta with sensory bristle, dorsal plumose sensory seta, and one dorsal and five ventral simple setae. Propodus slightly narrower than pereopods 2 and 3, with six ventral triangular transparent membranous processes, ventrodistal spiniform seta with sensory bristle, dorsodistal plumose sensory seta, and five dorsal and 10 ventral simple setae. Dactylus with ventrodistal spiniform seta and one mid-ventral, four ventrodistal, and five outer simple setae. Unguis about two-fifths as long as dactylus.

Pereopods 5–7 (Figure 11E–G) similar to pereopod 4, except for numbers of triangular transparent membranous processes, spiniform setae, plumose sensory setae, and simple setae. Propodus of pereopod 7 with two ventrodistal spiniform setae with sensory bristle.

Pleopod 1 (Figure 12A) protopod with outer spiniform seta. Exopod operculiform, with 20 plumose setae and ten simple setae on surface near distal margin. Endopod slightly shorter than exopod, with five plumose setae.

Pleopod 2 (Figure 12B) protopod with two inner spiniform setae and outer simple seta. Exopod with seven distal and one short outer plumose setae, and outer simple seta. Endopod with five plumose setae.

Pleopod 3 (Figure 12C) protopod with outer plumose sensory seta and two inner simple setae. Exopod with slight slit in the middle, with eight distal and one short outer plumose setae. Endopod with five plumose setae.

Pleopod 4 (Figure 12D) protopod with outer plumose sensory seta. Exopod with slit in middle, with seven plumose setae and two outer and one proximal simple setae. Endopod with five plumose setae.

Pleopod 5 (Figure 12E) protopod with outer plumose sensory seta and two inner simple setae. Exopod with slit in middle, with seven plumose setae (or eight, one possibly lost by damage to exopod) and outer simple seta. Endopod with three plumose setae.

Uropodal (Figure 12F, G) protopod shaped like triangular prism, with seven plumose setae and two simple setae. Exopod (Figure 12F) oval, sinuous along dorsodistal margin, with 21 plumose setae, 35 simple setae, and six setae (each tip broken). Endopod (Figure 12G) rounded, length 1.41 times width, with four plumose sensory setae, eight plumose setae, and numerous simple setae.

Description of adult male ICHUM8955

Body (Figures 9F, 13A–E) slender, length 14.28 times width. Head (Figure 13A) length 1.70 times head width, entirely pigmented reddish brown dorsally; rostrum overlapping anterolateral lobes; dorsolateral eyes large, 0.33 times as long as head. Pereonites 1–7 (Figure 13A–D) with length ratio 0.84 : 0.91 : 0.92 : 1.04 : 1.10 : 0.89 : 0.68 relative to head length; each pereonite with brown pigmentation around margin but lacking pigmentation in oval-shaped “window” in center. Pleonites 1–5 (Figure 13D) completely fused, 0.10 times body length, with segment in posterior half of pleon outlined with marginal pigmentation, leaving paired, circular or oval unpigmented “windows” medially and laterally. Pleonite 6 (Figure 13D) free from pleonites 1–5, fused dorsally to telson. Telson (Figure 14I) linguliform, length 2.19 times width, with two indentations in apical edge comprising three protrusions, with two posterior plumose setae, 41 simple setae, and two setae (each tip broken); pigmented primarily in anterior half; with two statocysts anteriorly.

Antennula (Figure 13F) swollen, with three peduncular and ten flagellar articles. Peduncular article 1 naked; article 2 with two plumose sensory setae; article 3 with three inner distal simple setae. Flagellar articles 1–10 with numerous aesthetascs on distal edge.

Antenna (Figure 13G) with five peduncular and five flagellar articles. Peduncular article 1 triangular, naked; article 2 with two simple setae; article 3 with three simple setae; article 4 with two distal plumose sensory setae and 12 simple setae; article 5 with three distal plumose sensory setae and 13 simple setae. Flagellar articles 1–5 with numerous distal simple setae; article 5 tiny.

Mandible (Figure 13H, I) with tri-articulate palp. Palp article 1 with distal simple seta; article 2 longest, with simple seta; article 3 naked (right) or with seven spiniform setae (left).

Incisor, lamina dentata, and molar process reduced.

Maxilliped (Figure 13J) with tri-articulate palp. Palp article 1 with inner simple seta; article 2 with two inner and one outer simple setae; article 3 nearly as long as broad, length 0.65 times that of article 2, with three inner plumose and two inner simple setae. Endite lacking. Epipod oval.

Pereopod 1 (Figure 14A) subchelate, slenderer than in females. Basis with three plumose sensory setae and two simple setae. Ischium with four simple setae. Merus with two dorsal and two ventral simple setae. Carpus triangular, with five simple setae. Propodus narrow, with 27 inner spiniform setae and four dorsal, two dorsodistal, and three outer simple setae. Palm denticulate, with slight process in middle, with three outer distal and five ventral simple setae. Dactylus with ventral membranous process, ventrodistal spiniform seta, and one ventral and eight distal simple setae. Unguis as long as dactylus, naked.

Pereopod 2 (Figure 14B) narrower than pereopod 1. Basis with two dorsal plumose sensory setae, two dorsal and three ventral simple setae, and seta (tip broken). Ischium with one dorsal and three ventral simple setae. Merus with two dorsal and five ventral simple setae. Carpus triangular, with four simple setae. Propodus rectangular, with ventrodistal spiniform seta with sensory bristle, dorsal plumose sensory seta, and two dorsal and eight ventral simple setae. Dactylus with ventral membranous process, ventrodistal spiniform seta, and nine simple setae. Unguis about half length of dactylus.

Pereopod 7 (Figure 14C) slightly narrower than pereopod 2. Basis with five dorsal plumose sensory setae and five simple setae. Ischium with one dorsal and three ventral simple setae. Merus with ventral plumose seta, and two dorsodistal and two ventral simple setae. Carpus trapezoidal, with two ventral triangular transparent membranous processes, ventrodistal spiniform seta with sensory bristle, dorsal plumose sensory seta, and one dorsal and three ventral simple setae. Propodus slightly narrower than pereopod 2, with three ventral triangular transparent membranous processes, three ventrodistal spiniform setae with sensory bristle, dorsodistal plumose sensory seta, and four dorsal and four ventral simple setae. Dactylus with ventral membranous process, ventrodistal spiniform seta, and eight distal simple setae. Unguis about two-fifths as long as dactylus.

Pleopod 1 (Figure 14D) protopod with four inner spiniform setae and outer plumose seta. Exopod operculiform, with 15 plumose and seven simple setae. Endopod with six plumose setae and distal simple seta.

Pleopod 2 (Figure 14E) protopod with two inner spiniform setae and outer simple seta. Exopod with nine distal and one short outer plumose setae, and outer simple seta. Endopod with three plumose setae and appendix masculina bearing six small triangular processes. Appendix masculina (Figure 14E, F) 1.04 times as long as endopod, slightly curved inward.

Uropodal (Figure 14G, H) protopod triangular-prism-shaped, with three plumose setae. Exopod (Figure 14G) narrower than in female, tapering, not sinuous along dorsodistal margin, with 15 plumose and 21 simple setae. Endopod (Figure 14H) rounded, 1.81 times as long as wide, with five plumose sensory setae, four plumose setae, and numerous simple setae.

Distribution

Mesanthura sol **sp. nov.** is known from Onna Village, Okinawa main island, Okinawa, Japan, at a depth of 1 m, and Irabu Island, Miyako Islands, Okinawa, Japan, at a depth of 10–15 m (type locality; this study).

Remarks

We determined the 16S sequences (LC849810, LC849813–LC849815) for two adult males and one female lacking oostegites from Onna Village and one ovigerous female from Irabu. The three sequences from Onna specimens were identical but were 3.2% divergent (p-distance) from the sequence from Irabu. Based on the low p-distance and the identical pigmentation pattern between Onna and Irabu females, we concluded that our males and females from the two sites are conspecific.

In *M. sol* **sp. nov.**, the pigmentation pattern is identical between ovigerous females (Figures 9A, B, 10A, B) and females lacking oostegites (Figure 9C, D). The pigmentation pattern in males and females is similar for the pereonites, but differs in the head and pleon. Males have the head entirely pigmented (Figures 9E, F, 13A), and a rectangular zone of pigmentation occupying the posterior half of the pleon and showing median and laterally paired unpigmented "windows" (Figures 9E, F, 13D), while females have only the anterior two-thirds of the head pigmented (Figures 9A–D, 10A), and only a large, elliptical non-pigmented "window" medially (Figures 9A–D, 10B). Yellow pigmentation was evident along anterior margin of pereonite 1 and posterior part of the other pereonites and pleonite 6 in females but absent in males. It should be noted that, in *M. miyakoensis*, the yellow pigmentation is present in adult males just after the molt but gradually faded and disappeared eventually (Shiraki & Kakui, 2024: fig. 5B–E).

The female pigmentation pattern differentiates *M. sol* **sp. nov.** from all the other *Mesanthura* species for which the female pattern is known. The female pattern is unknown for *Mesanthura crucis* (Barnard, 1925); Barnard (1925) did not describe it, and Kensley (1987: p. 114) mentioned only that the female syntypes had "lost all pigmentation." However, female *M. sol* **sp. nov.** differs from female *M. crucis* in the shape of the telson (length 2.28 times width in *M. sol* **sp. nov.**; 1.62 times in *M. crucis*) and the uropodal exopod (sinuous along dorsodistal margin; not sinuous) (Kensley, 1987).

Males in *M. sol* **sp. nov.** differ from the two species *M. atrata* and *M. javensis* in which only a male is known: from *M. atrata* in the shape of the uropodal exopod (tapering in *M. sol* **sp. nov.**; rounded in *M. atrata*) and from *M. javensis* in the number of indentations at the apical edge of the telson (two in *M. sol* **sp. nov.**; one in *M. javensis*) (Wägele, 1984b;

Nunomura, 1985).

In addition to the pigmentation pattern, the following characters were sexually dimorphic in *M. sol* **sp. nov.**: males have larger eyes; swollen and longer antennulae; longer pereopods; an appendix masculina, a longer pleon; reduced incisor, lamina dentata, and molar process (toothed incisor, denticulate lamina dentata, and weakly rounded molar process in females); an oval pereopod-1 propodus with the palm lacking spiniform setae (narrow propodus with the palm bearing 27 spiniform setae in females); and oval uropodal exopods with a sinuous dorsodistal margin (narrower and tapering exopods with a smooth dorsodistal margin in females).

Molecular phylogeny

In our phylogenetic tree (Figure 15), *M. sol* **sp. nov.** forms a clade with *M. miyakoensis*, with high nodal support (SH-aLRT = 95.6% and UFBoot = 95%). The relationship between *M. cinctula* and the other taxa included is unclear due to low support values.

Genetic distances (Table 2) among the four species were 16.7–30.8% (p-distance) and 19.5–40.2% (K2P). These high values suggest that 16S may be evolving too rapidly for reliable inference of interspecific relationships in *Mesanthura*; sequencing more slowly evolving genes such as 18S rRNA or 28S rRNA may be necessary. Intraspecific distances were much lower, ranging from 0.0–5.1% (p-distance) or 0.0–5.4% (K2P), and were lower for single localities (0.2–0.7% for *M. miyakoensis* at Tatsukushi; 0.0% for *M. sol* **sp. nov.** at Onna) than between localities (*M. miyakoensis*, 4.4–5.1% p-distance, 4.6–5.4% K2P; *M. sol* **sp. nov.**, both distances 3.2%). These inter-population values fall within the “gray zone” (Riehl *et al*., 2018) of 3–10% in p-distance, which can encompass both intraspecific and interspecific variation in Isopoda.

Data availability. The data supporting this study are available in the article and INSD.

Acknowledgements. We thank the following people for assistance. Hisanori Kohtsuka (The University of Tokyo); Yuki Oya (J. F. Oberlin University); Aoi Tsuyuki (University of the Ryukyus); Naohiro Hasegawa (Hiroshima Shudo University); Yuki Kita, Hiroki Matsushita, Kentaro Ageishi, Yoshinobu Matsushima, Maho Matsushita, and Shogo Sekiguchi (Hokkaido University); the staff at the Usa Marine Biological Institute (Kochi University); and Yosuke Kamata, Junko Watanabe, and Manami Kimura (Miyakojima diving shop 'AQUA STAR') helped in sampling. Hiroshi Kajihara and Kevin Wakeman (Hokkaido University) commented on our results. Hisanori Kohtsuka, Yuki Oya, and Aoi Tsuyuki provided photos of living specimens. The staffs of the Miyako, Ikema, and Irabu fisheries cooperative associations permitted sampling in the Miyako Islands. Takashi Akamine, Reijiro Haga, and Hidetaka Shibao (Okinawa Prefecture) handled the documentation necessary for permission to collect coral rubble. Matthew H. Dick (Hokkaido University) reviewed the manuscript and edited the English.

Authors' contributions. SS conceived and designed the study, conducted the faunal survey, made morphological observations and did the molecular work, wrote a first draft, and reviewed and edited the draft. KK supervised the study and critically reviewed and edited the draft.

Financial support. This study was supported by the Research Institute of Marine Invertebrates (KO2022-04) and a Grant-in-Aid for JSPS Fellows (JP23KJ0063) from the Japan Society for the Promotion of Science (JSPS).

Competing interests. The authors declare none.

Ethical standards. Not applicable.

References

Barnard KH (1914) Contributions to the crustacean fauna of South Africa. 3. Additions to the marine Isopoda, with notes on some previously incompletely known species. *Annals of the South African Museum* **10**, 325a–358a, 359–440.

Barnard KH (1925) A revision of the family Anthuridae (Crustacea Isopoda), with remarks on certain morphological peculiarities. *Zoological Journal of the Linnean Society* **36**, 109–160.

Boyko CB, Bruce NL, Hadfield KA, Merrin KL, Ota Y and Poore GCB (Eds) (2025) World marine, freshwater and terrestrial isopod crustaceans database. *Mesanthura* Barnard, 1914. https://www.marinespecies.org/aphia.php?p=taxdetails&id=205305 on 2025-03-20… accessed online 20 March 2025.

Castelló J (2017) New and little-known species of isopods (Crustacea, Isopoda) from the eastern Mediterranean. *Zootaxa* **4311**, 151–182.

Castresana J (2000) Selection of conserved blocks from multiple alignments for their use in phylogenetic analysis. *Molecular Biology and Evolution* **17**, 540–552.

Chew M, Abdul Rahim A and Haji Ross OB (2014) *Tinggianthura alba*: a new genus and species of Anthuridae (Isopoda, Cymothoida, Anthuroidea) from Pulau Tinggi, Johor, Malaysia with an updated key to the genera of Anthuridae. *PLoS One* **9**, e99072.

Guindon S, Dufayard JF, Lefort V, Anisimova M, Hordijk W and Gascuel O (2010) New algorithms and methods to estimate maximum-likelihood phylogenies: assessing the performance of PhyML 3.0. *Systematic Biology* **59**, 307–321.

Hoang DT, Chernomor O, von Haeseler A, Minh BQ and Vinh LS (2018) UFBoot2: improving the ultrafast bootstrap approximation. *Molecular Biology and Evolution* **35**, 518–522.

Kakui K, Fukuchi J and Ohta M (2023) *Diexanthema hakuhomaruae* sp. nov. (Copepoda: Siphonostomatoida: Nicothoidae) from the hadal zone in the northwestern Pacific, with an 18S molecular phylogeny. *Acta Parasitologica* **68**, 413–419.

Kalyaanamoorthy S, Minh BQ, Wong TKF, von Haeseler A and Jermiin LS (2017) ModelFinder: fast model selection for accurate phylogenetic estimates. *Nature Methods* **14**, 587–589.

Katoh K and Standley DM (2013) MAFFT multiple sequence alignment software version 7: improvements in performance and usability. *Molecular Biology and Evolution* **30**, 772–780.

Katoh K and Toh H (2008) Recent developments in the MAFFT multiple sequence alignment program. *Briefings in Bioinformatics* **9**, 286–298.

Katoh K, Rozewicki J and Yamada KD (2019) MAFFT online service: multiple sequence alignment, interactive sequence choice and visualization. *Briefings in Bioinformatics* **20**, 1160–1166.

Kensley B (1987) A re-evaluation of the systematics of K. H. Barnard's review of anthuridean isopods. *Steenstrupia* **13**, 101–139.

Kimura M (1980) A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences. *Journal of Molecular Evolution* **16**, 111–120.

Kumar S, Stecher G and Tamura K (2016) MEGA7: Molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution* **33**, 1870–1874.

Leach WE (1814) Crustaceology. In Brewster D (ed) *The Edinburgh Encyclopædia*. *Vol*. *7*. Edinburgh: William Blackwood, pp. 383–437.

Minh BQ, Schmidt HA, Chernomor O, Schrempf D, Woodhams MD, von Haeseler A and Lanfear R (2020) IQ-TREE 2: new models and efficient methods for phylogenetic inference in the genomic era. *Molecular Biology and Evolution* **37**, 1530–1534.

Müller HG (1993) The genus *Mesanthura* Barnard, 1914 from coral reefs in Kenya and Malaysia, with descriptions of three new species (Crustacea: Isopoda: Anthuridae). *Mittelungen aus dem Zoologischer Museum in Berlin* **69**, 19–44.

Negoescu I (1994) Isopoda Anthuridea (Crustacea: Peracarida) from New Caledonia and Loyalty Islands (South-western Pacific Ocean), I. *Travaux du Muséum d'Histoire Naturelle "Grigore Antipa"* **34**, 147–225.

Nunomura N (1977) Marine Isopoda from Amakusa, Kyushu (1). *Publications from the Amakusa Marine Biological Laboratory* **4**, 71–90.

Nunomura N (1979) *Mesanthura miyakoensis*, a new anthurid isopod form Miyakojima Island, Ryukyu Islands, Japan. *Bulletin of the Toyama Science Museum* **1**, 31–35.

Nunomura N (1985) Marine isopod crustaceans in the coast of Toyama Bay. *Memoirs of the Natural Science Museum, Tokyo* **18**, 121–139.

Nunomura N (1992) Anthuridea (Crustacea: Isopoda) from the Ryukyu Archipelago. *Bulletin of the Toyama Science Museum* **15**, 47–56.

Nunomura N (2006) Marine isopod crustaceans in the Sagami Sea, Central Japan. *Contributions from Toyama Science Museum* **318,** 7–42.

Nunomura N (2016) Marine isopod crustaceans collected from Shijiki Bay, western Japan (3) Anthuroidea. *Bulletin of the Toyama Science Museum* **40**, 19–36.

Poore GCB (2001) Families and genera of Isopoda Anthuridea. *Crustacean Issues* **13**, 63–173.

Riehl T, Lins L and Brandt A (2018) The effects of depth, distance, and the Mid-Atlantic Ridge on genetic differentiation of abyssal and hadal isopods (Macrostylidae). *Deep Sea Research Part II: Topical Studies in Oceanography* **148**, 74–90.

Schneider C, Rasband W and Eliceiri K (2012) NIH Image to ImageJ: 25 years of image analysis. *Nature Methods* **9**, 671–675.

Shiraki S and Kakui K (2024) Ontogenetic changes in pigmentation pattern in *Mesanthura miyakoensis* (Crustacea: Isopoda: Anthuridae). *Zoological Science* **41**, 323–328.

Shiraki S, Shimomura M and Kakui K (2021) A new species of *Expanathura* (Crustacea: Isopoda: Anthuroidea) from Iriomote Island, Japan, with a note on male polymorphism. *Zootaxa* **5047**, 377–390.

Wägele JW (1984a) Redescription of K. H. Barnard's three species of *Mesanthura* (Crustacea: Isopoda: Anthuridea). *Journal of Natural History* **18**, 389–403.

Wägele JW (1984b) On a small collection of littoral Crustacea Isopoda Anthuridea (family Anthuridae) from the Far East. *Journal of Natural History* **18**, 739–757.

Figure legends

Figure 1. Distribution of six *Mesanthura* species in Japan: (A) map of Japan; (B) map of Sagami Bay; (C) map of southwestern Japan. Symbols: purple circles, *M. nigrodorsalis*; blue hexagons, *M. miyakoensis*; pink triangle, *M. atrata*; red squares, *M. cinctula*; green diamond, *M. saikaiensis*; orange stars, *M. sol* **sp. nov.**; solid symbols, type locality; open symbols, locality reported after original description.

Figure 2. *Mesanthura cinctula* Nunomura, 2006, female lacking oostegites, living individual (A) and fixed specimen (B–F; ICHUM8940): (A) dorsal view (photographed by Hisanori Kohtsuka; no museum deposition), scale unavailable; (B, C) lateral and dorsal views; (D–F) head in dorsal and lateral views and pleon in lateral view. Scale bars: 1 mm.

Figure 3. *Mesanthura miyakoensis* Nunomura, 1979, dorsal views of living individuals: (A) female lacking oostegites (ICHUM8944) from Tatsukushi (photographed by Yuki Oya); (B) female lacking oostegites (ICHUM8943) from Irabu Island; (C) subadult male (ICHUM8945) from Tatsukushi (photographed by Yuki Oya). Scale bar: 1 mm.

Figure 4. *Mesanthura miyakoensis* Nunomura, 1979, female lacking oostegites (ICHUM8944): (A) head and pereonite 1, dorsal view; (B) pereonites 2–4, dorsal view; (C) pereonites 5–7 and pleon, dorsal view; (D) body, lateral view; (E) left antennula; (F) right antenna; (G) flagellum of right antenna; (H) left mandible; (I) left maxilla; (J) maxilliped. Scale bars: A–D, 1mm; E–J, 100 µm.

Figure 5. *Mesanthura miyakoensis* Nunomura, 1979, female lacking oostegites (ICHUM8944): (A–G) left pereopods 1–7. Scale bar: 100 µm.

Figure 6. *Mesanthura miyakoensis* Nunomura, 1979, female lacking oostegites (ICHUM8944): (A–C) left pleopods 1–3; (D) right uropodal endopod; (E) right uropodal exopod; (F) telson. Scale bar: 100 µm.

Figure 7. *Mesanthura miyakoensis* Nunomura, 1979, subadult male (ICHUM8945): (A) lateral view; (B) left antennula; (C) right mandible; (D) right maxilliped; (E) right pereopod 1; (F) right pleopod 2. Scale bars: A, 1 mm; B–F, 100 µm.

Figure 8. *Mesanthura nigrodorsalis* Nunomura, 1977, females lacking oostegites, living individual (A; ICHUM8949) and fixed specimen (B–E; ICHUM8948): (A) dorsal view of individual from Araihama (photographed by Aoi Tsuyuki); (B) lateral view; (C) head, dorsal view; (D, E) pleon, dorsal and lateral views. Scale bars: A, B, 1 mm; C–E, 500 µm.

Figure 9. *Mesanthura sol* **sp. nov.**, living individuals: (A, B) dorsal and lateral views of holotype ovigerous female from Irabu (ICHUM8951); (C, D) dorsal views of paratype females lacking oostegites from Onna Village (ICHUM8952 and ICHUM8953, respectively); (F, F) dorsal views of paratype adult males from Onna Village (ICHUM8954 and ICHUM8955, respectively). Scale bars: 1 mm.

Figure 10. *Mesanthura sol* **sp. nov.**, holotype ovigerous female from Irabu (ICHUM8951): (A) head and pereonites 1, 2, dorsal view; (B) pereonites 3–7 and pleon, dorsal view; (C) lateral view; (D) left antennula; (E) right antenna; (F) left mandible; (G) maxilla; (H) maxilliped. Scale bars: A–C, 1 mm; D–H, 100 µm.

Figure 11. *Mesanthura sol* **sp. nov.**, holotype ovigerous female from Irabu (ICHUM8951): (A–C, E–G) left pereopods 1–3 and 5–7; (D) right pereopod 4. Scale bar: 100 µm.

Figure 12. *Mesanthura sol* **sp. nov.**, holotype ovigerous female from Irabu (ICHUM8951): (A–E) right pleopods 1–5; (F) left uropodal exopod, pigmentation omitted; (G) right uropodal endopod, pigmentation omitted; (H) telson, pigmentation omitted. Scale bars: 100 μm.

Figure 13. *Mesanthura sol* **sp. nov.**, paratype adult male (ICHUM8955) from Onna Village: (A) head and pereonite 1, dorsal view; (B) pereonites 2, 3, dorsal view; (C) pereonites 4–6, dorsal view; (D) pereonite 7 and pleon, dorsal view; (E) lateral view, (F) left antennula, (G) right antenna; (H) right mandible; (I) left mandibular palp; (J) maxilliped. Scale bars: A–E, 1 mm; F–J,100 μm.

Figure 14. *Mesanthura sol* **sp. nov.**, paratype adult male (ICHUM8955) from Onna Village: (A) left pereopod 1; (B) right pereopod 2; (C) left pereopod 7; (D, E) right pleopods 1, 2; (F) tip of appendix masculina on right pleopod 2; (G) right uropodal exopod; (H) right uropodal endopod; (I) telson. Scale bars: A–E, G–I = 100 μm; F = 50 μm.

Figure 15. Maximum likelihood tree for *Mesanthura* species based on 16S rRNA gene sequences (396 bp), with the information on their depth range (deep or shallow) and substrate (sandy mud, sea algae, or coral rubble). Numbers near nodes are SH-aLRT/UFBoot support values (clades having SH-aLRT ≥80% and UFBoot ≥95% were considered to be well supported).

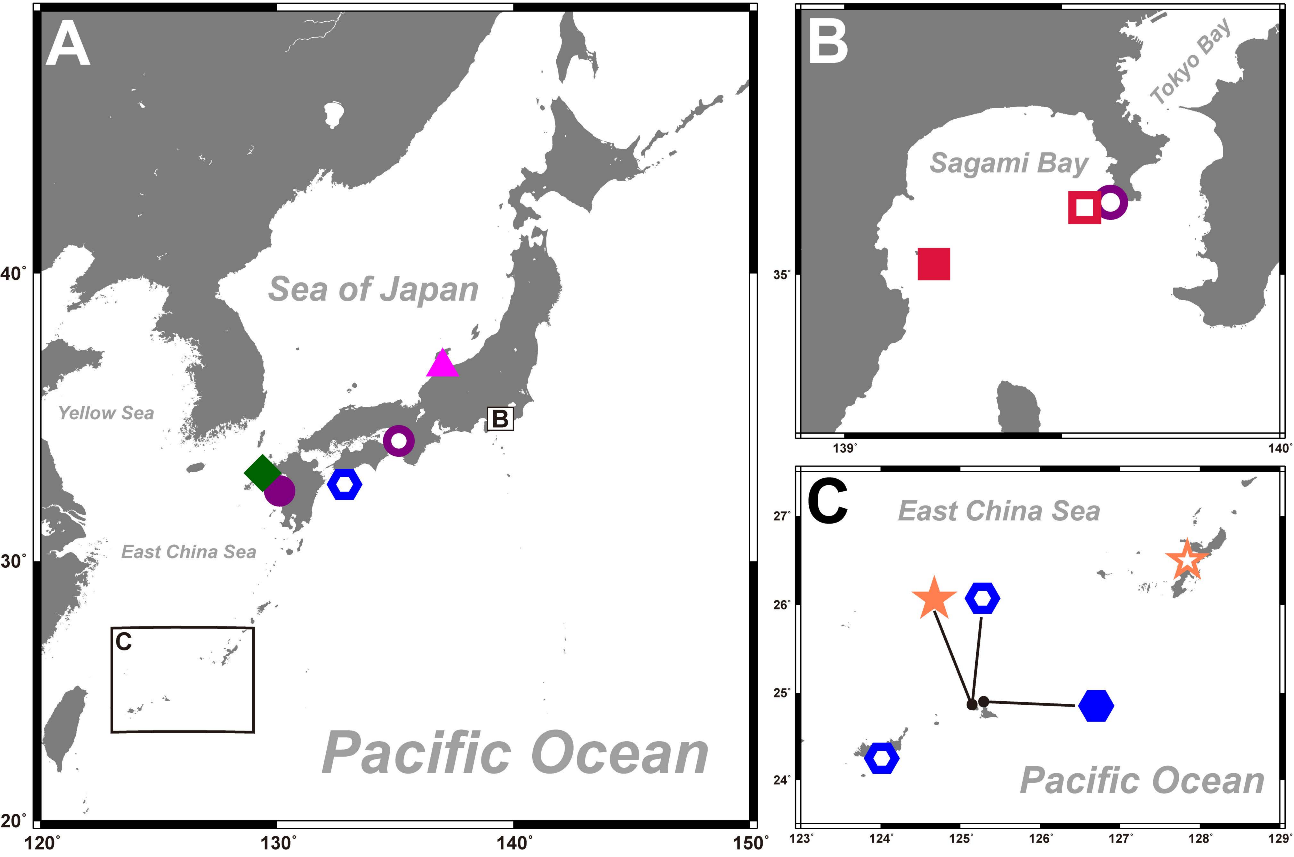
Table 1. Specimens used in this study and accession numbers for DNA sequence data; bold font, novel sequences obtained in this study; *, sequences from Shiraki & Kakui (2024).

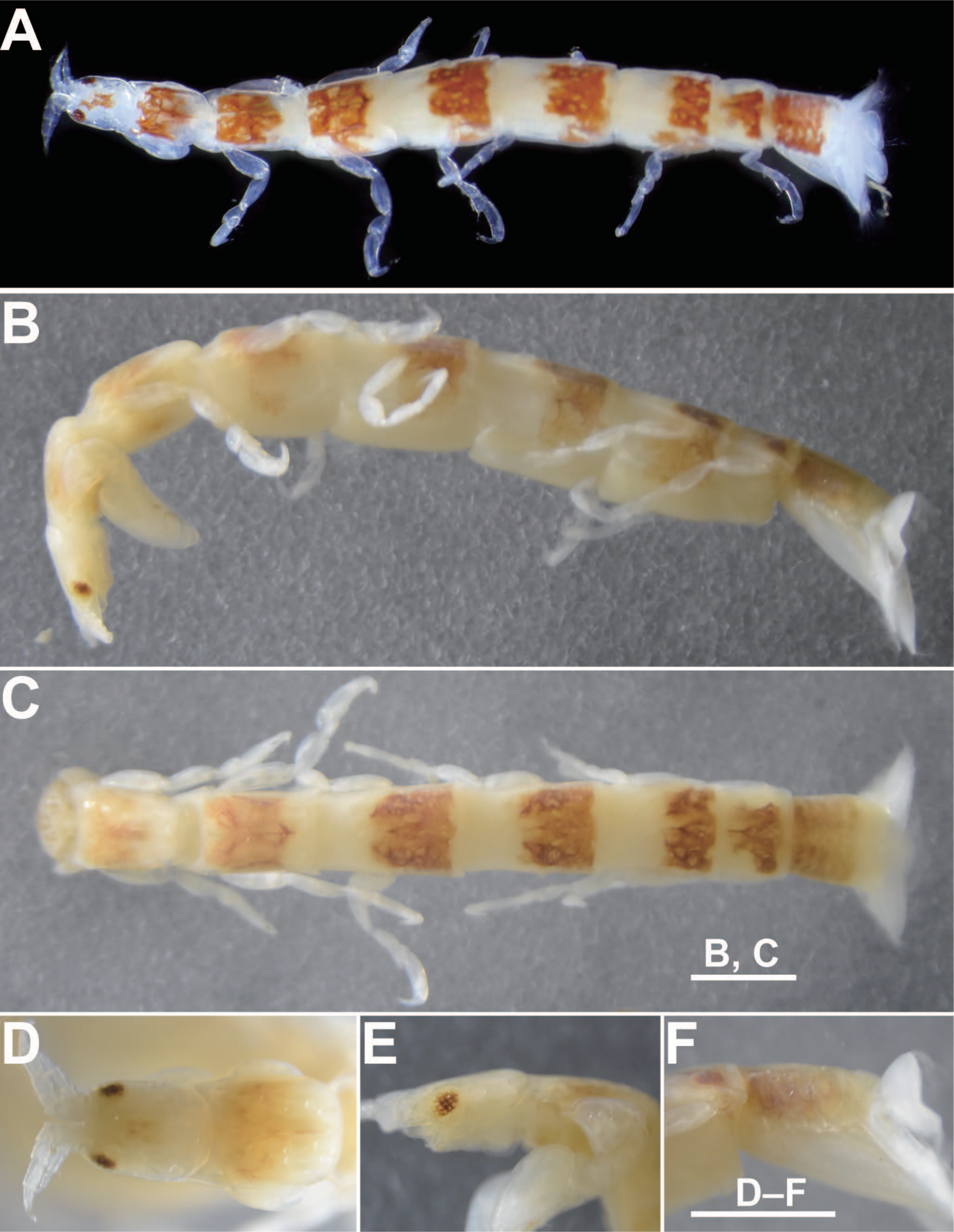
Species	Specimen No.	Sampling locality in Japan	Coll. date	Ontogenetic stage	Accession No.
M. cinctula	ICHUM8940	Off Jogashima, Kanagawa	23 May 2018	Female lacking oostegites	-
	ICHUM8941	Off Jogashima, Kanagawa	22 Feb. 2019	Manca	**LC849816**
M. miyakoensis	ICHUM8942	Irabu Island, Okinawa	24 Apr. 2022	Post-manca	**LC849817**
	ICHUM8943	Irabu Island, Okinawa	24 Apr. 2022	Post-manca	-
	ICHUM8944	Tatsukushi, Kochi, Shikoku	26 July 2021	Female lacking oostegites	-
	ICHUM8945	Tatsukushi, Kochi, Shikoku	13 June 2021	Subadult male	LC787697*
	ICHUM8946	Tatsukushi, Kochi, Shikoku	10 Oct. 2022	Female lacking oostegites[1]	LC795631*
	ICHUM8947	Tatsukushi, Kochi, Shikoku	10 Oct. 2022	Post-manca	LC787698*
M. nigrodorsalis	ICHUM8948	Nagamatsu Beach, Osaka	10 Sep. 2022	Female lacking oostegites	-
	ICHUM8949	Araihama, Kanagawa	25 July 2021	Female lacking oostegites	**LC849812**
	ICHUM8950	Jogashima, Kanagawa	12 July 2022	Female lacking oostegites	**LC849811**
M. sol **sp. nov.**	ICHUM8951	Irabu Island, Okinawa	24 Apr. 2022	Ovigerous female	**LC849814**
	ICHUM8952	Onna Village, Okinawa	23 Apr. 2023	Female lacking oostegites	**LC849810**
	ICHUM8953	Onna Village, Okinawa	23 Apr. 2023	Female lacking oostegites	-
	ICHUM8954	Onna Village, Okinawa	23 Apr. 2023	Adult male	**LC849815**
	ICHUM8955	Onna Village, Okinawa	23 Apr. 2023	Adult male	**LC849813**

[1] Specimen ICHUM8946 was an ovigerous female when collected but molted and became a female lacking oostegites through rearing; in this study, we treated it as a female lacking oostegites, whereas Shiraki & Kakui (2024: p. 324, right column, lines 31–32) treated it as an ovigerous female.

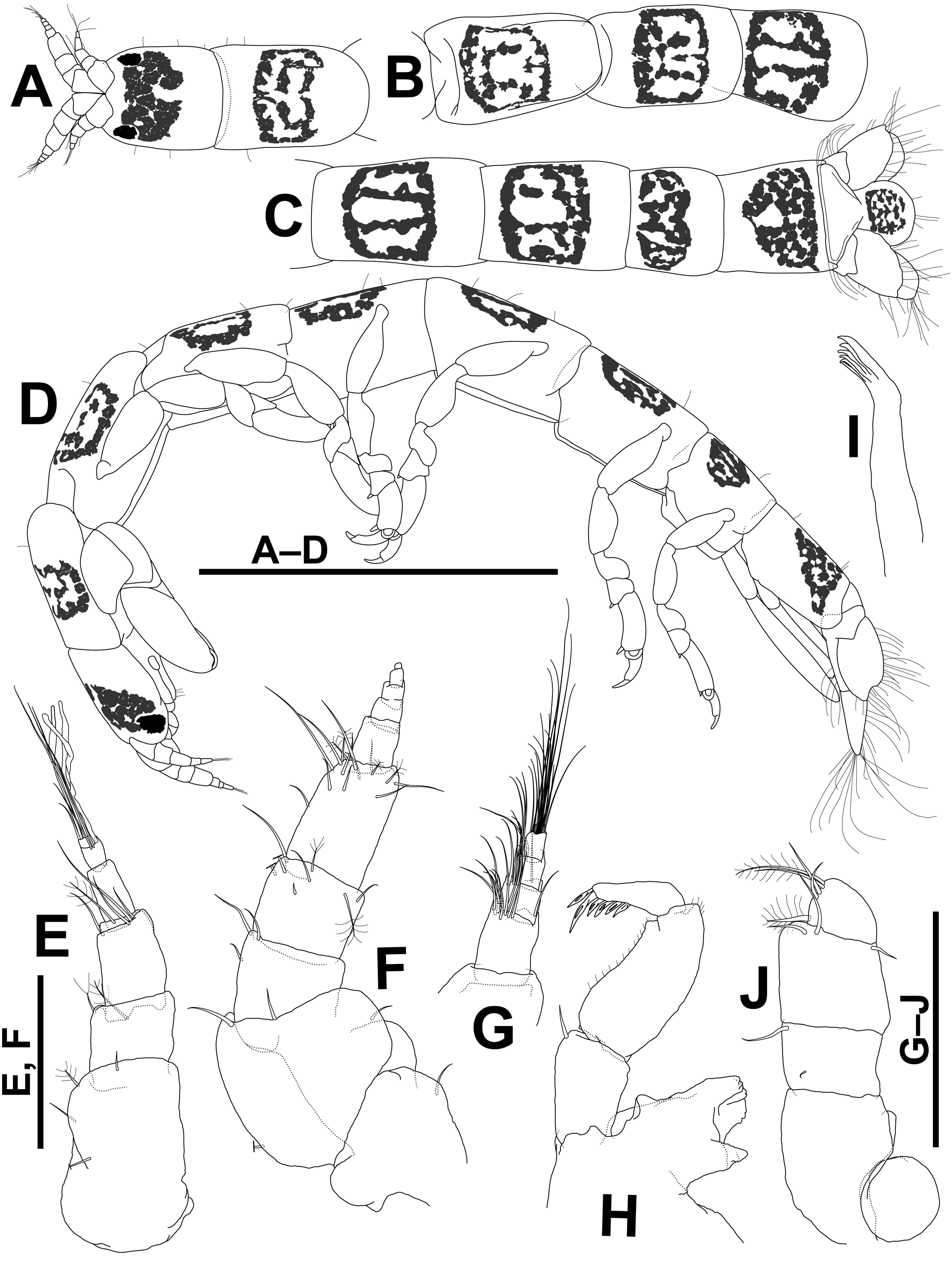
Table 2. Genetic distances (as percentages) among partial 16S rRNA sequences from *Mesanthura* specimens; above diagonal, K2P distances; below diagonal, p-distances; intraspecific distances are in bold font.

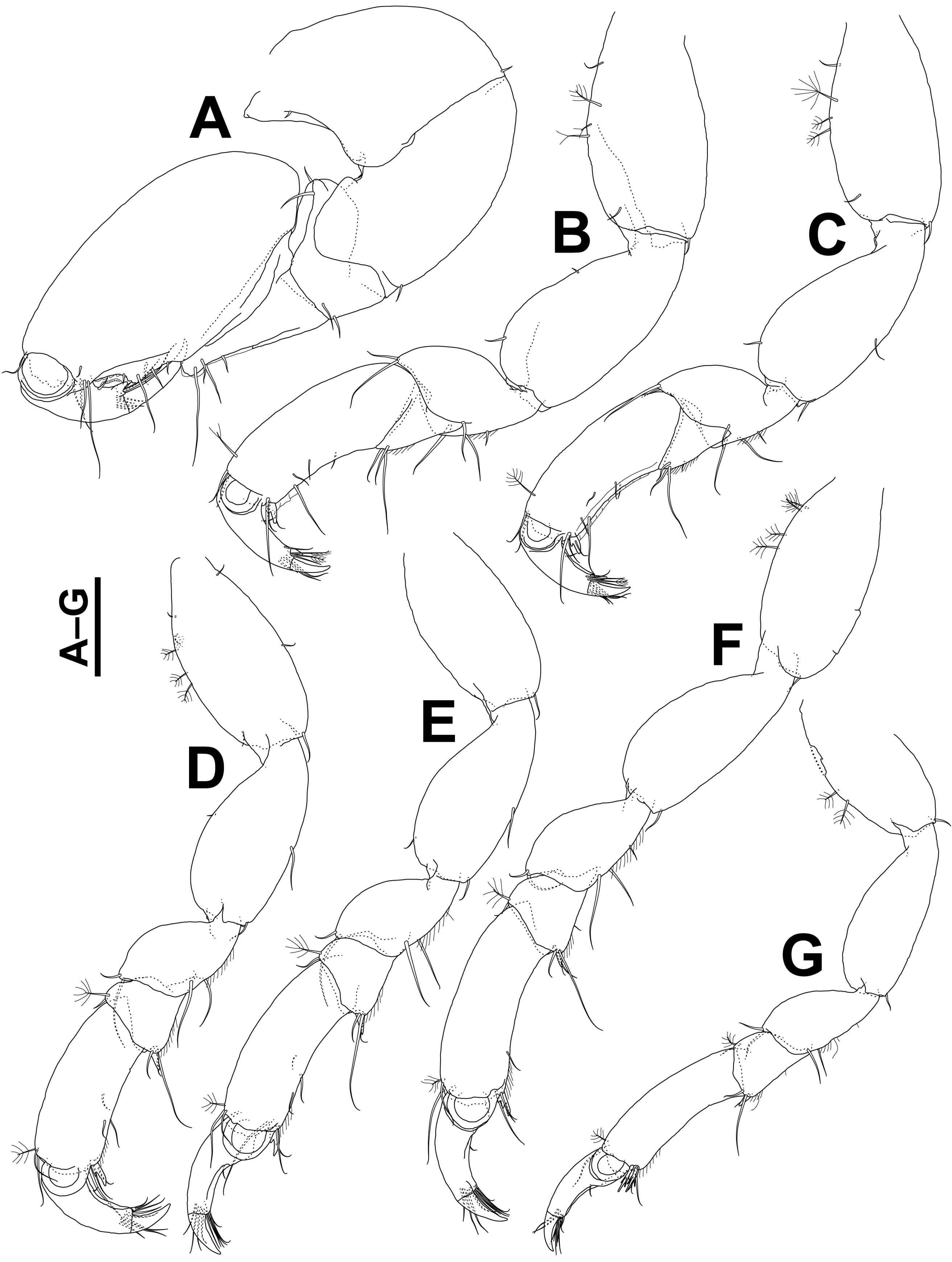
	1	2	3	4	5	6	7	8	9	10	11
1. *M. cinctula* (LC849816)		41.0	37.5	37.0	37.5	38.5	37.6	40.2	38.7	38.7	38.7
2. *M. miyakoensis* Irabu (LC849817)	30.8		**4.6**	**4.8**	**5.4**	26.3	26.2	20.5	20.8	20.8	20.8
3. *M. miyakoensis* Tatsukushi (LC787697)	28.9	**4.4**		**0.2**	**0.7**	27.5	27.4	19.8	19.5	19.5	19.5
4. *M. miyakoensis* Tatsukushi (LC787698)	28.6	**4.6**	**0.2**		**1.0**	27.9	27.8	20.1	19.8	19.8	19.8
5. *M. miyakoensis* Tatsukushi (LC795631)	28.9	**5.1**	**0.7**	**1.0**		27.9	27.8	19.8	19.5	19.5	19.5
6. *M. nigrodorsalis* Araihama (LC849812)	29.4	21.4	22.1	22.3	22.3		**0.7**	27.7	27.0	27.0	27.0
7. *M. nigrodorsalis* Jogashima (LC849811)	28.9	21.4	22.1	22.3	22.3	**0.7**		27.7	26.9	26.9	26.9
8. *M. sol* **sp. nov.** Irabu (LC849814)	30.6	17.5	17.0	17.2	17.0	22.6	22.6		**3.2**	**3.2**	**3.2**
9. *M. sol* **sp. nov.** Onna (LC849813)	29.9	17.7	16.7	17.0	16.7	22.1	22.1	**3.2**		**0.0**	**0.0**
10. *M. sol* **sp. nov.** Onna (LC849815)	29.9	17.7	16.7	17.0	16.7	22.1	22.1	**3.2**	**0.0**		**0.0**
11. *M. sol* **sp. nov.** Onna (LC849810)	29.9	17.7	16.7	17.0	16.7	22.1	22.1	**3.2**	**0.0**	**0.0**	

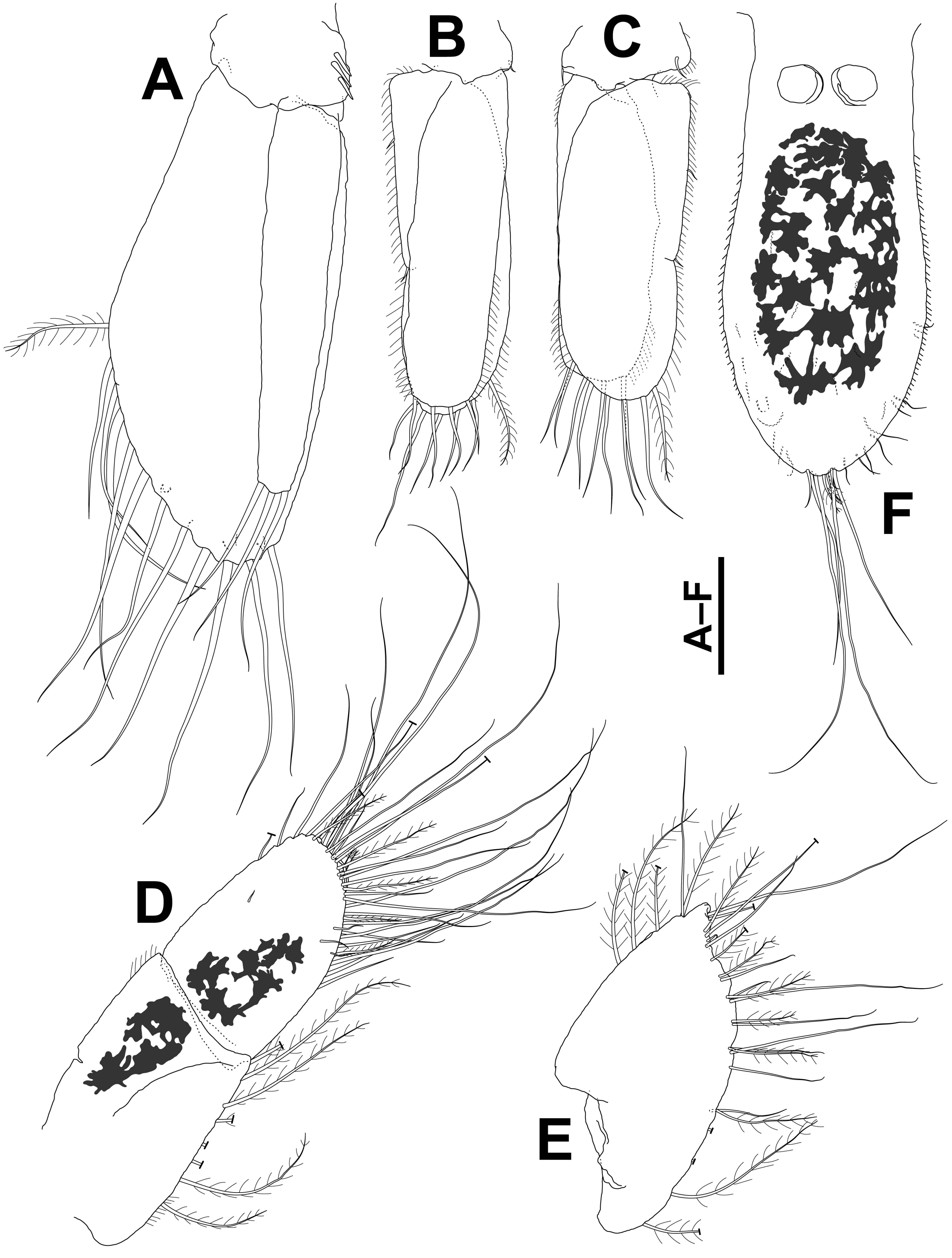

A
Sea of Japan
Yellow Sea
East China Sea
Pacific Ocean
B
C
40°
30°
20°
120°
130°
140°
150°
B
Sagami Bay
Tokyo Bay
35°
139°
140°
C
East China Sea
Pacific Ocean
27°
26°
25°
24°
123°
124°
125°
126°
127°
128°
129°

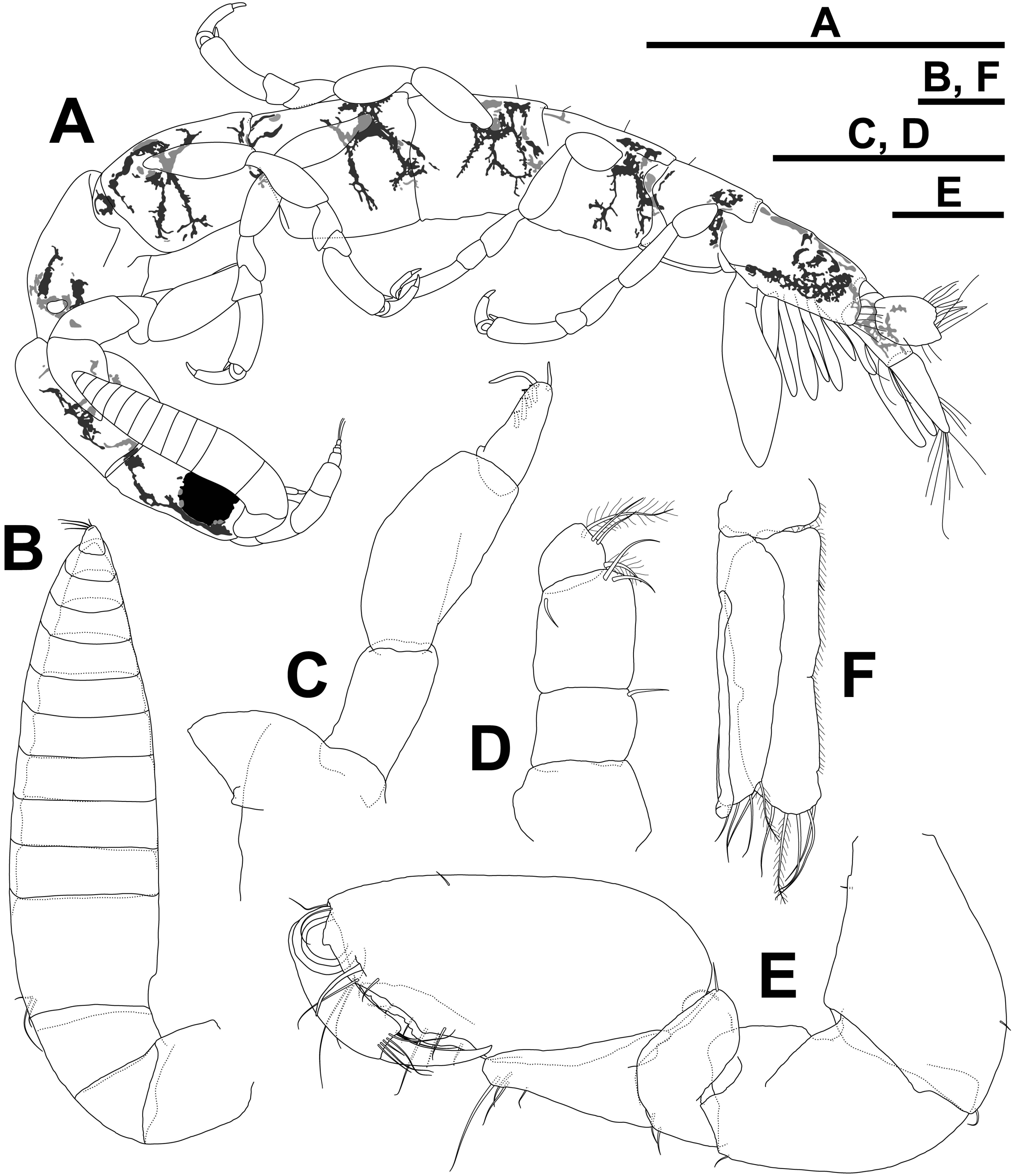

A
B
C
B, C
D
E
F
D–F


A
B
C
A–C

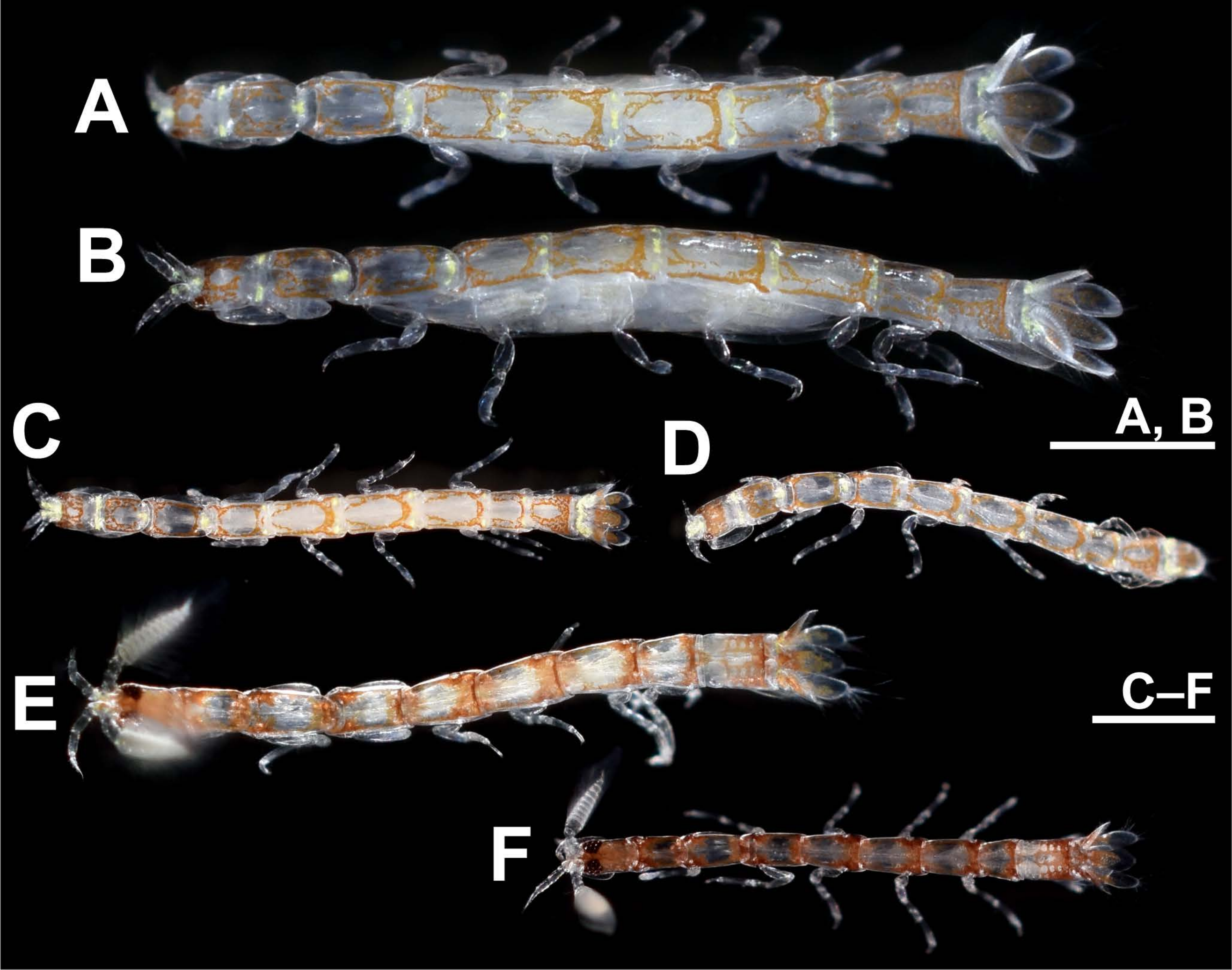

A
B
C
D
I
A–D
E
F
G
H
J
E, F
G–J


A
B
C
D
E
F
G
A–G

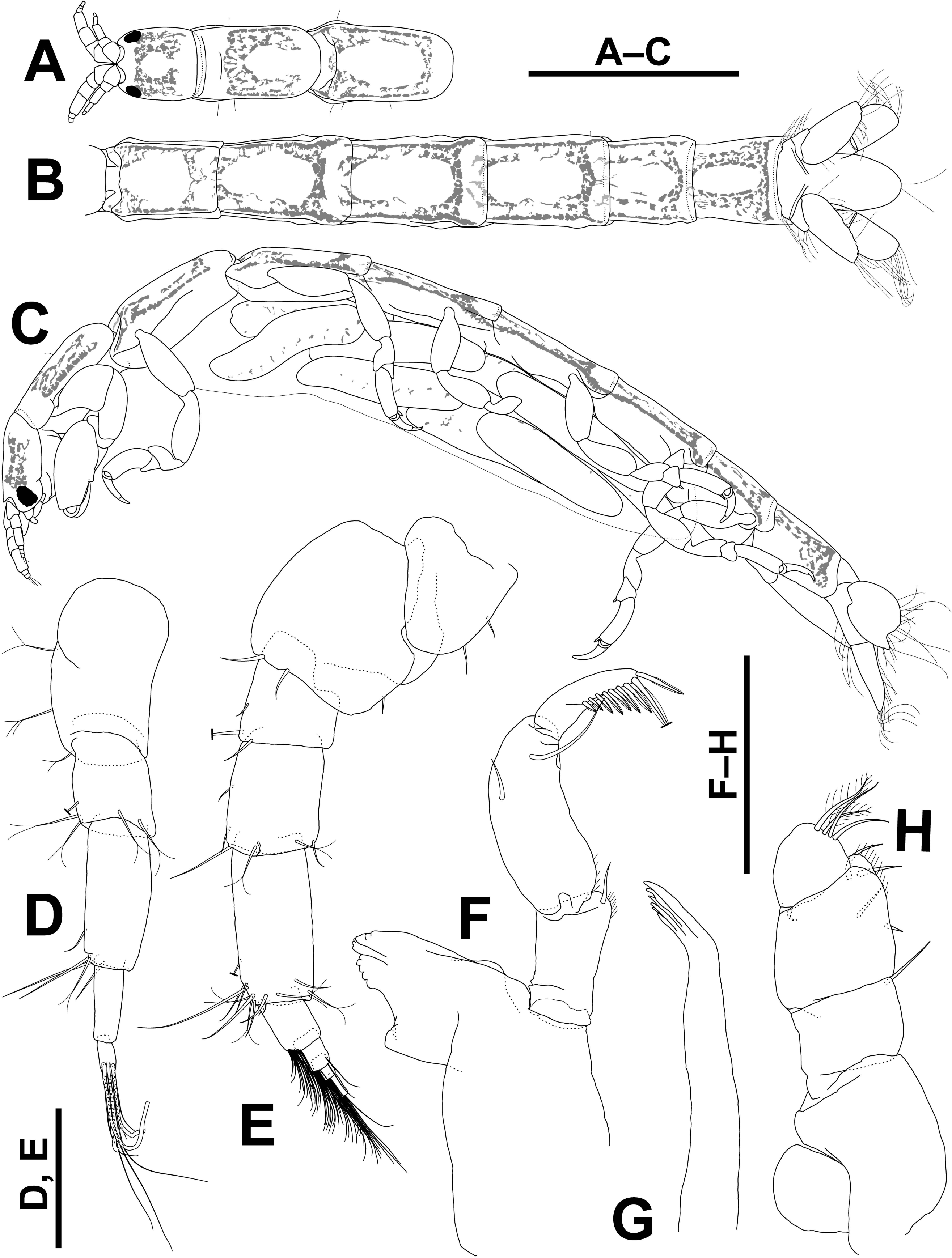

A
B
C
D
E
F
A–F

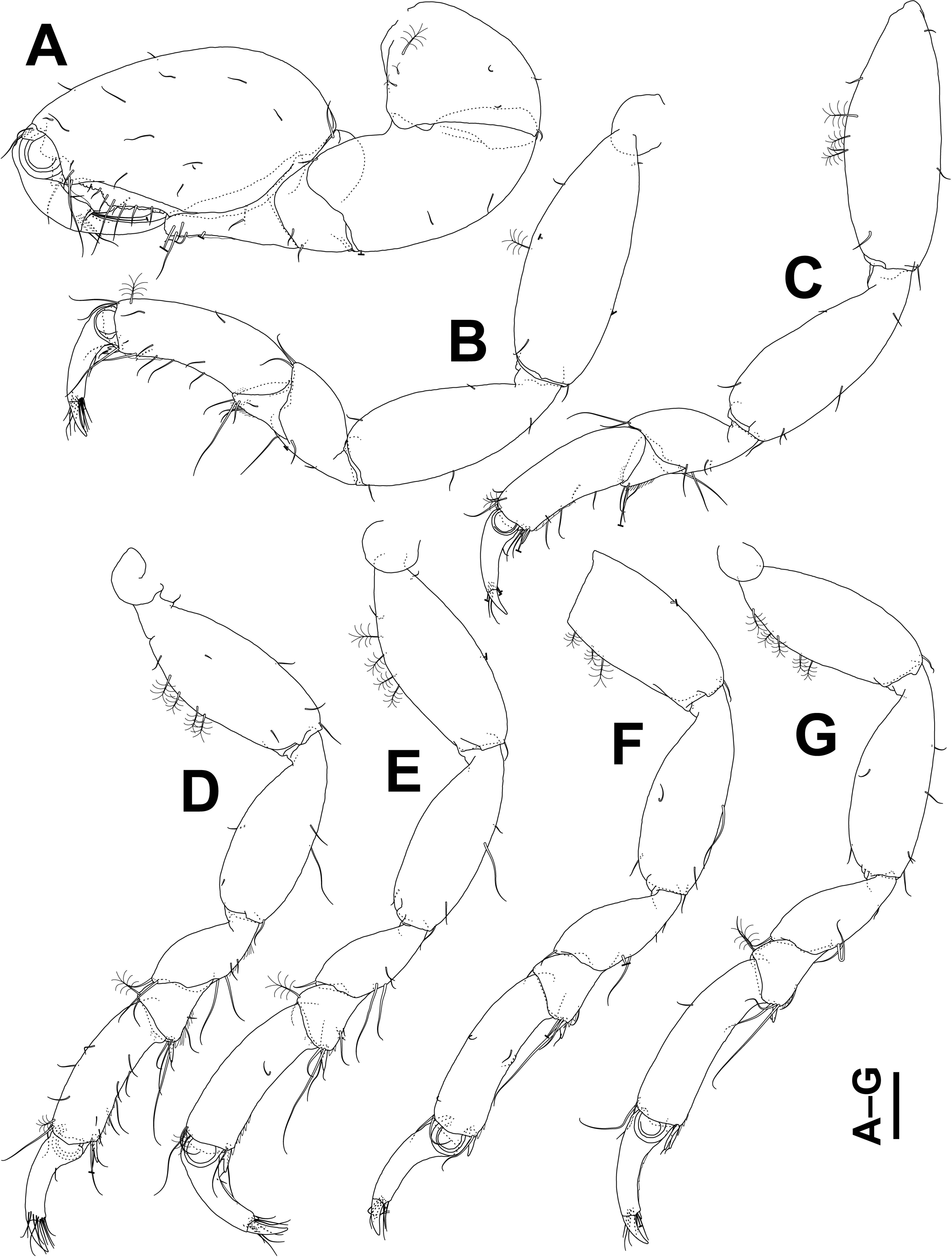

A
B, F
C, D
E
A
B
C
D
E
F

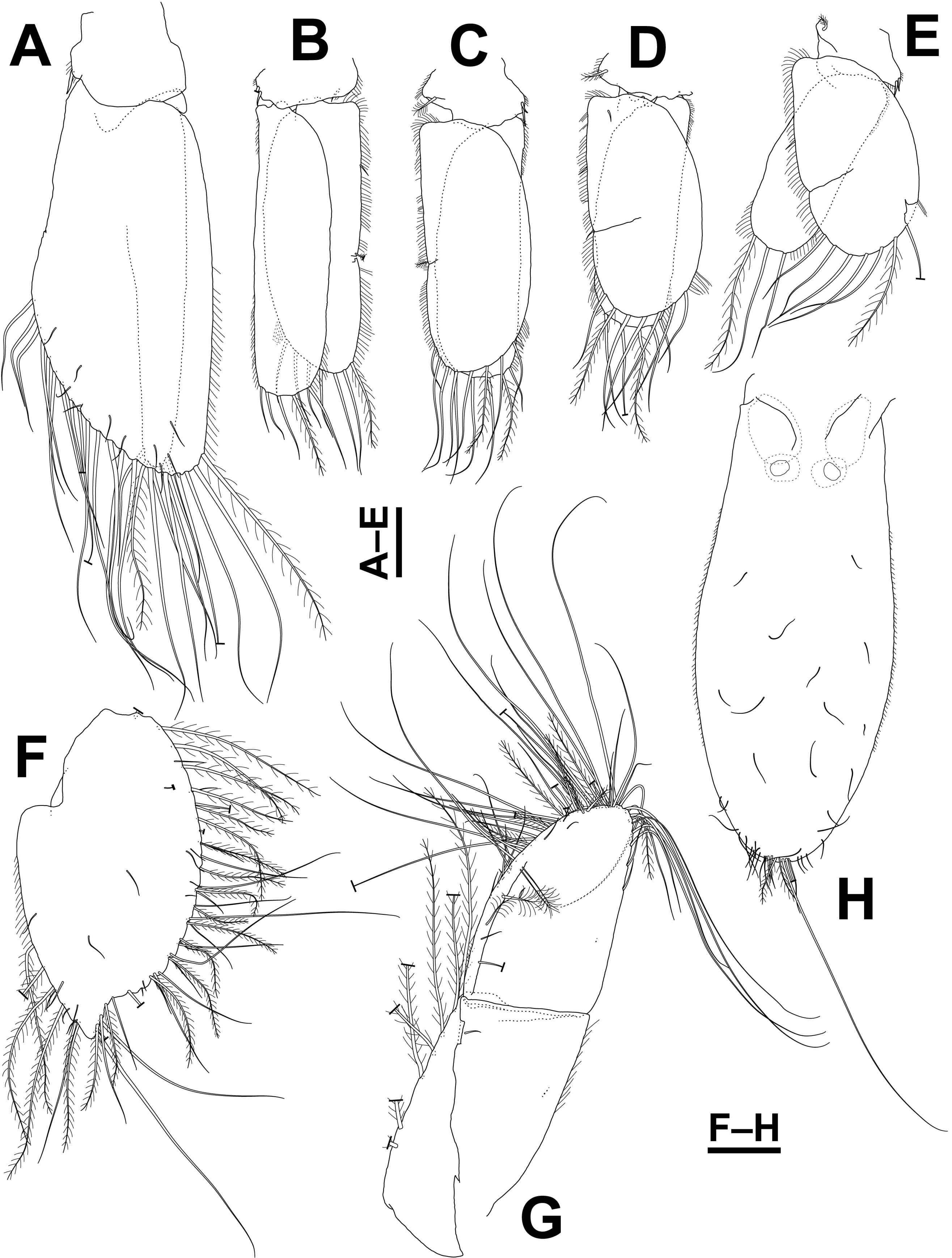

A
A
B
B
C
C
D
E
D, E

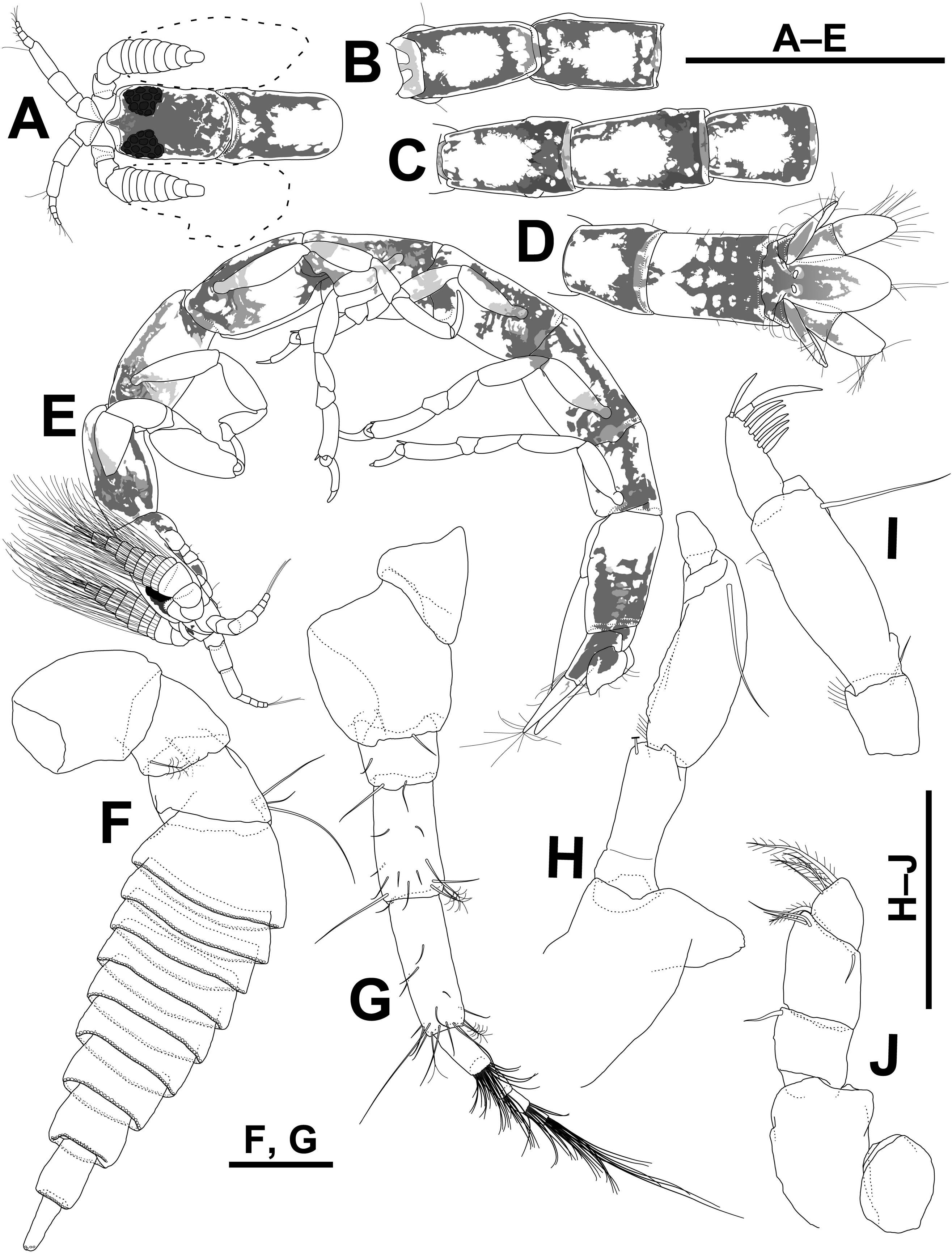


A
B
A, B
C
D
E
C–F
F

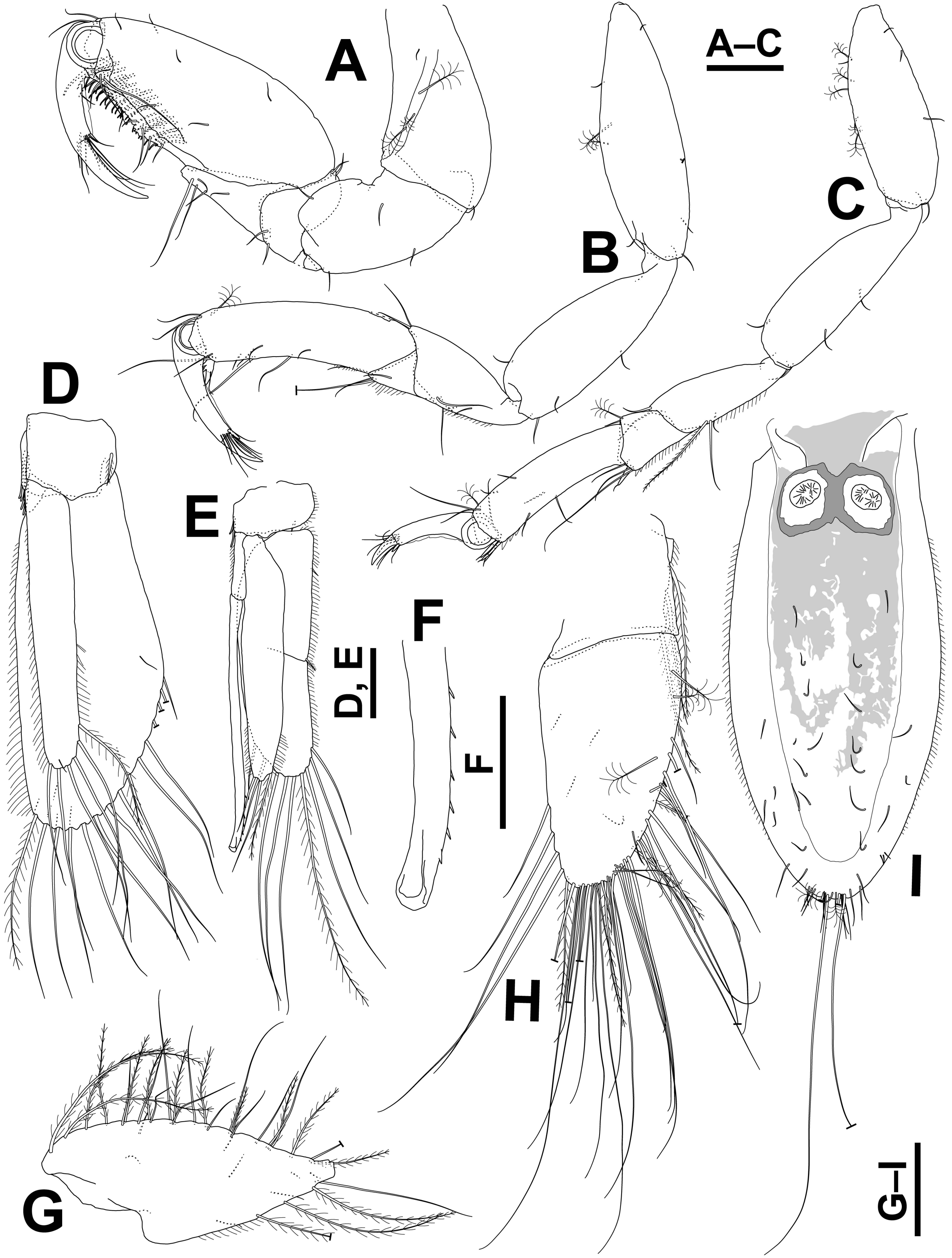

A
A–C
B
C
D
E
F
G
H
D, E
F–H

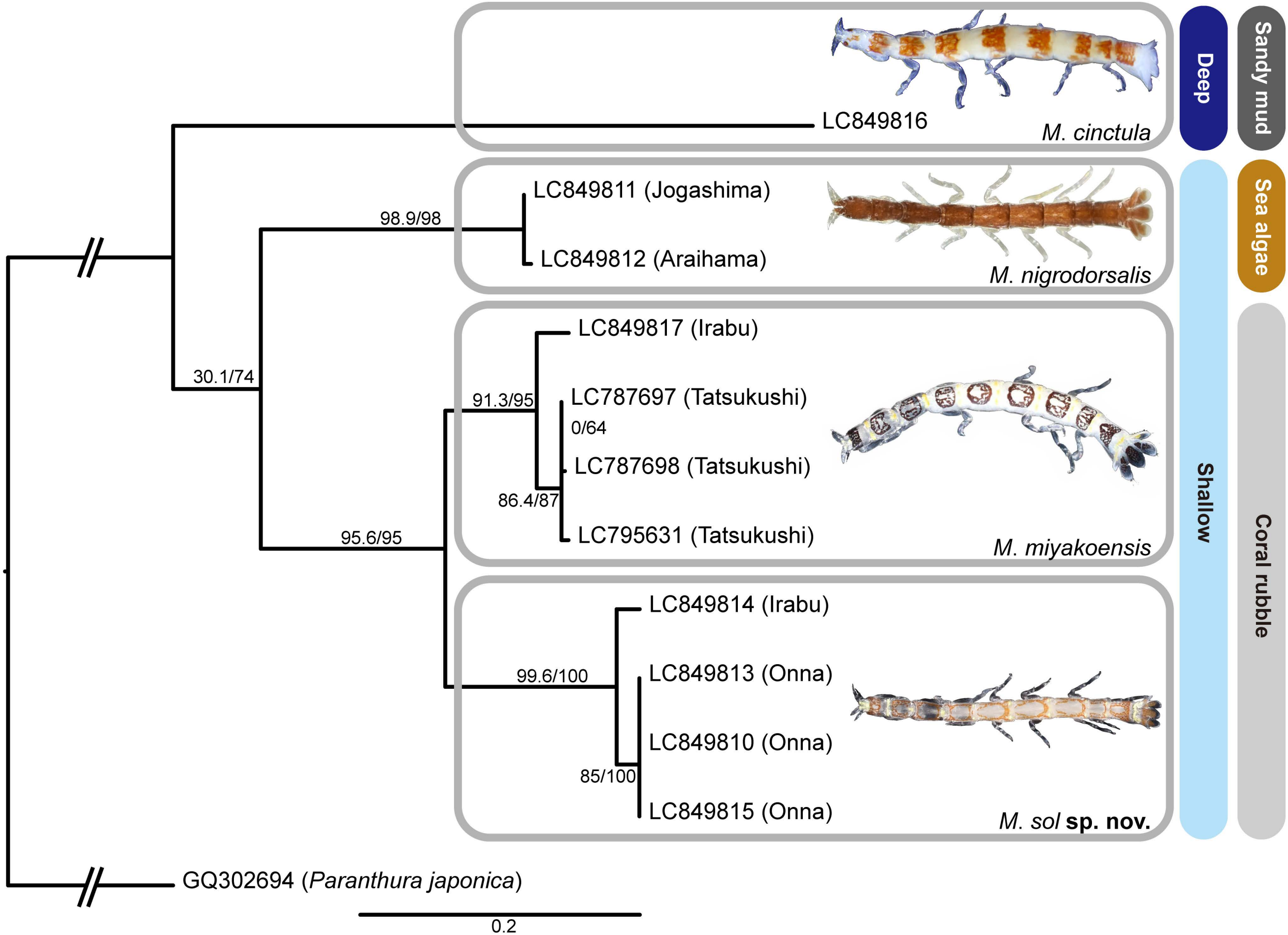

A
B
C
D
E
F
G
A–G


A
B
C
D
E
A–E
F
G
H
F–H



A–E
A
B
C
D
E
I
F
G
H
H–J
J
F, G


A
A–C
B
C
D
E
D, E
F
F
H
I
G
G–I



LC849816
M. cinctula
Deep
Sandy mud
98.9/98
LC849811 (Jogashima)
LC849812 (Araihama)
M. nigrodorsalis
Sea algae
30.1/74
LC849817 (Irabu)
91.3/95
LC787697 (Tatsukushi)
0/64
LC787698 (Tatsukushi)
86.4/87
95.6/95
LC795631 (Tatsukushi)
M. miyakoensis
Shallow
Coral rubble
LC849814 (Irabu)
99.6/100
LC849813 (Onna)
LC849810 (Onna)
85/100
LC849815 (Onna)
M. sol sp. nov.
GQ302694 (Paranthura japonica)
0.2