

# AUSTRALIAN MUSEUM SCIENTIFIC PUBLICATIONS

Hughes, L. E., 2013. Podoceridae of tropical Australia (Peracarida: Amphipoda). *Records of the Australian Museum* 65(1): 1–37. [Published in print and online 12 June 2013].

<http://dx.doi.org/10.3853/j.2201-4349.65.2013.1592>

ISSN 0067-1975 (print), ISSN 2201-4349 (online)

Published by the Australian Museum, Sydney

nature culture **discover**

Australian Museum science is freely accessible online at  
[www.australianmuseum.net.au/Scientific-Publications](http://www.australianmuseum.net.au/Scientific-Publications)  
6 College Street, Sydney NSW 2010, Australia



## Podoceridae of Tropical Australia (Peracarida: Amphipoda)

L. E. HUGHES

Australian Museum, 6 College Street, Sydney New South Wales 2010, Australia  
[lauren.hughes@austmus.gov.au](mailto:lauren.hughes@austmus.gov.au)

**ABSTRACT.** Thirteen taxa in the family Podoceridae are reported from tropical Australia, including six new species and four new records. *Podocerus hanapepe* J. L. Barnard, 1970, *P. talegus lawai* J. L. Barnard, 1970, *P. walkeri* Rabindranath, 1972 and *P. zeylanicus* (Walker, 1904) are reported from Australia for the first time. New distribution records are provided for *P. crenulatus* Myers, 1985, *P. lobatus* (Haswell, 1885) and *Laetmatophilus dabberi* Barnard & Drummond, 1981. The six new species *Podocerus clavicularius* sp. nov., *P. ferreus* sp. nov., *P. miscix* sp. nov., *P. orontes* sp. nov., *P. rockingham* sp. nov., and *L. triceratops* sp. nov. are described.

HUGHES, L. E. 2013. Podoceridae of tropical Australia (Peracarida: Amphipoda). *Records of the Australian Museum* 65(1): 1–37.

Podocerids are benthic filter-feeding amphipods common in shallow-water marine systems, occurring on algae, bryozoans, floating debris and are often part of the fouling community associated with artificial structures. In podocerids, morphological variation with growth stages and/or sexual dimorphism, causes difficulty in defining species groups. Tropical podocerids in particular exhibit much larger distribution ranges in comparison to temperate podocerid species. As such, tropical podocerid are the subject of much confusion within the literature, with many early workers recognizing the occurrence of such variation, and documenting their observations and apprehensiveness about defining intra- and inter-specific variation (Pirlot, 1938; Rabindranath, 1972; Ledoyer, 1979a; J. L. Barnard, 1971).

This study has benefited greatly from the high abundance of podocerids in samples examined. The opportunity to observe juvenile, male and female specimens has confirmed intra-specific variation for several species. The presence of dorsal carinae and gnathopod 2 propodus palmar teeth are known to vary with growth stage and gender. Important species level characters which remain consistent with growth

stage include: the gnathopod 1 coxal shape; fusion of carpus and propodus; carpus and propodus form; as well as presence of the uropod 1 and 2 ventromedial spine.

### Materials and methods

Material examined for this study were amphipod holdings predominantly from shallow-water (0–50 m) samples in various collections of the Australian Museum (AM), Museum and Art Gallery of the Northern Territory (MAGNT), Western Australian Museum (WAM), and Bernice P. Bishop Museum, Hawaii (BPBM). Material was dissected in 80% ethanol. Permanent slides were made using AQUATEX™ mounting medium. Specimens were prepared for electron microscopy as follows: preserving solution was sequentially advanced in 5% increments from 80% to 100% ethanol; critical point dried; mounted individually on pins and gold sputter coated. Images were captured using on a Zeiss EVO LS15 Scanning Electron Microscope with Robinson Backscatter Detector (SEM). Abbreviations for parts are as follows: *A*—antenna; *F*—accessory flagellum; *G*—gnathopod; *Md*—mandible;

*Mx1*—maxilla 1; *p*—palp; *P*—pereopod; *T*—telson; *U*—uropod and *Ur*—urosome. Material examined is presented in the format: location (GPS), depth, habitat, date of collection, collector(s) (expedition station number). Terminology of structures include: *setae*, articulating extrusions of the cuticle, and *tooth* or *spine*, non-articulating extrusions of the cuticle. In particular reference to head, pereonite and

pleonite non-articulating extrusions of the cuticle: *carina(e)*, extrusions along the dorsal margin; *lateral projections*, extrusions between the dorsal and ventral margins; and *ventral projections*, extrusions near the ventral margin. Descriptions were generated from a DELTA database of the Podoceridae containing all species in the genus *Laetmatophilus* and Indo-Pacific species of *Podocerus*.

## Systematic section

### Corophiidea Leach, 1814

Caprelloidea Leach, 1814

Podoceridae Leach, 1814

Podocerinae Leach, 1814

### *Laetmatophilus* Bruzelius, 1859

*Laetmatophilus* Bruzelius, 1859:10.—Stebbing, 1906: 695.—J. L. Barnard, 1969: 430.—Laubitz, 1984:79.—Ledoyer, 1986: 920.—Barnard & Karaman, 1991: 660–661.

**Diagnosis.** Pereon depressed, segments 5–7 fused; urosome of 2 segments. Accessory flagellum absent; epistome produced; maxilla 1 inner plate greatly reduced, non-setose, outer plate with 9 spines; maxilla 2 without facial setae; maxilliped palp 4 blunt; gnathopod 2 of female nearly as large as that of male; brood plates on pereopods 2–4; uropod 2 without rami, uropod 3 absent.

**Remarks.** Fusion of the cuticle segments of posterior pereonites 5 to 7 is inconsistent within the genus (Laubitz, 1984). *Laetmatophilus triceratops* sp. nov. has clearly fused pereonites 5 to 7 which can be readily observed from the SEM images (Fig. 2A,B).

### *Laetmatophilus dabberi* Barnard & Drummond, 1981

#### Fig. 1

*Laetmatophilus dabberi* Barnard & Drummond, 1981: 31–41, figs 4, 5.—Lowry & Stoddart, 2003: 245 (catalogue).

**Type locality.** Western Port, Victoria, Australia.

**Material examined.** Male, 4.0 mm, dissected, 1 slide, AM P.79826, off south-east corner of Michaelmas Island, King George Sound (35°03'S 118°00'E), 18 m, orange/red gorgonacean, 17 December 1983, coll. R. Springthorpe (WA 198); female, 2.0 mm, dissected, 1 slide, AM P.87608, off south-east corner of Michaelmas Island, King George Sound (35°03'S 118°00'E), 18 m, orange/red gorgonacean, 17 December 1983, coll. R. Springthorpe (WA 198).

**Remarks.** This is the first record of *L. dabberi* since its original description from Western Port, Victoria in southeastern Australia. Material cited here extends the distribution of *L. dabberi* to southwestern Australia.

**Distribution.** Australia. Victoria. Western Port (Barnard & Drummond, 1981); Western Australia: King George Sound (current study).

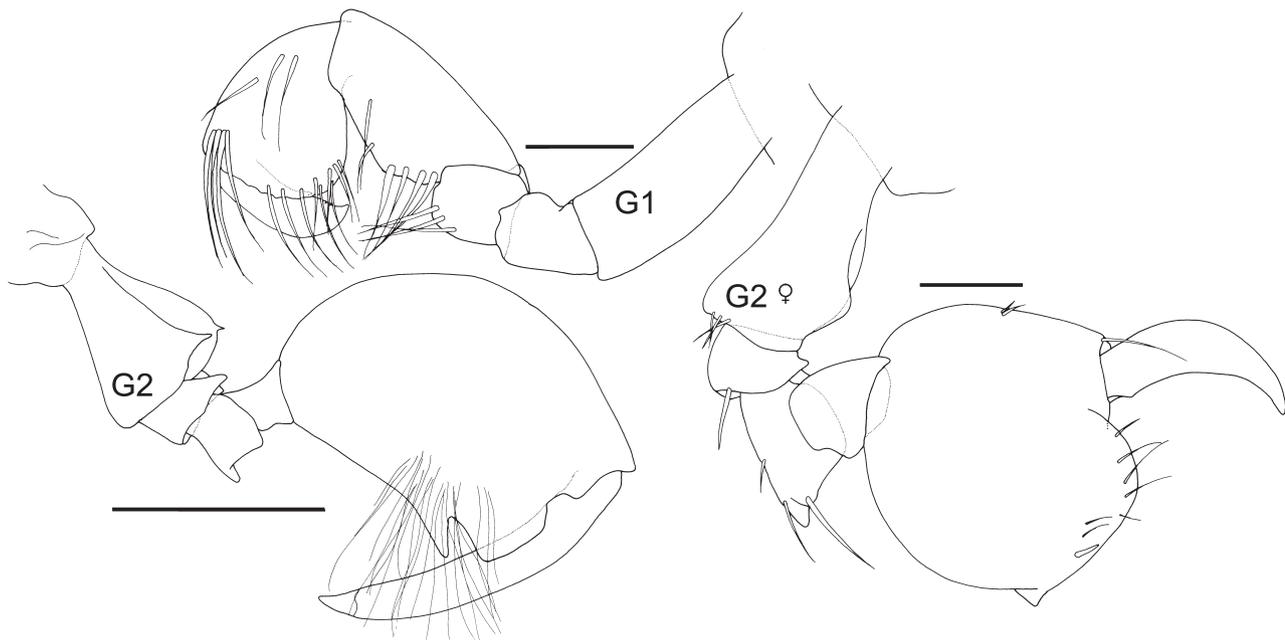


Figure 1. *Laetmatophilus dabberi* Barnard & Drummond, 1981, male, 4.0 mm, AM P.79826, and female, 2.0 mm, AM P.87608, King George Sound, Western Australia (scale 0.1 mm).

***Laetmatophilus triceratops* sp. nov.**

Figs 2–5

**Type material.** Holotype male, 4.3 mm, SEM pin mount and 2 slide, AM P. 87032, Area C Centre, Arafura Sea (9°22'52"S 133°39'53"E), 112 m, muddy sand, Smith McIntyre grab, 13 May 2005, coll. G. D. F. Wilson, Southern Surveyor Arafura Sea Cruise (SS05/2005/027/GR047); paratype female, 3.8 mm, dissected, 1 slide, AM P.87609, Area C Centre, Arafura Sea (9°22'52"S 133°39'53"E), 112 m, muddy sand, Smith McIntyre grab, 13 May 2005, coll. G. D. F. Wilson, Southern Surveyor Arafura Sea Cruise (SS05/2005/027/GR047); paratypes 2 juvenile specimens, AM P.79146, Area C Centre, Arafura Sea (9°22'52"S 133°39'53"E), 112 m, muddy sand, Smith McIntyre grab, 13 May 2005, coll. G. D. F. Wilson, Southern Surveyor Arafura Sea Cruise (SS05/2005/027/GR047).

**Additional material examined.** Male (immature), 2.8 mm, dissected, AM P.87610, Carnarvon shelf (23°52'55"S 113°27'33"E), 37 m, 5 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group (SOL097GR02); female, 3.5 mm, dissected, AM P.87611, Carnarvon shelf (23°52'55"S 113°27'33"E), 37 m, 5 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group (SOL097GR02); male, SEM pin mount (poor condition), AM P.85674, Carnarvon shelf (23°52'55"S 113°27'33"E), 37 m, Smith McIntyre grab, 5 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group (SOL097GR02); 5 specimen (various growth stages 2 gravid females and 3 juveniles), AM P.84678, Carnarvon shelf (23°52'55"S 113°27'33"E), 37 m, Smith McIntyre grab, 5 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group (SOL097GR02); female specimen, AM P.84677, Carnarvon shelf (23°46'17"S 113°20'36"E), 44 m, Smith McIntyre grab, 7 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group (SOL105GR02); female gravid specimen (no carina), AM P.84679, Carnarvon shelf (23°46'18"S 113°20'37"E), 44 m, Smith McIntyre grab, 7 August 2008, coll. Geosciences Australia: Marine and Coastal Environment Group 2008 (SOL105GR02).

**Type locality.** Arafura Sea (9°22'52"S 133°39'53"E).

**Etymology.** Named for the three carinae on the top of the head.

**Diagnosis.** *Head* with 3 carinae, projecting anteriorly, apically acute in triangle formation; rostrum well developed, elongate, about half the length of the head; eyes greatly bulging. *Pereonite 1* with single broad dorsal carina, produced dorsally, with pair of lateral and ventral projections. *Gnathopod 1* carpus rectilinear, 2.5 times as long as broad; propodus subovate, corner of palm with 4 robust setae. *Pereonite 2* dorsal carina broad, produced evenly, subtriangular, apically rounded. *Gnathopod 2* propodus medial surface with dense cluster of plumose setae, palm  $\frac{1}{3}$  the length of the propodus. *Pereonite 3* dorsal carina broad, produced evenly, subtriangular, apically rounded, with ventral projections. *Pereonite 4* dorsal carina broad, produced evenly, with ventral projections. *Pereonites 5–7* fused. *Pereonites 5–6* dorsal carina broad, evenly rounded. *Pereonite 7* dorsal carina broad, produced posteriorly, apically subacute. *Pleonite 1*

dorsal carina narrow, produced anteriorly, subtriangular, apically subacute. *Pleonite 2* dorsal carina narrow, produced evenly, subtriangular, apically subacute.

**Description.** Based on holotype male, AM P.87032, 4.3 mm. *Body* cuticle with dorsal projections. *Head* with 3 carinae, projecting anteriorly, apically acute in triangle formation; rostrum well developed, elongate, about half the length of the head; eyes greatly bulging; lateral cephalic lobe produced acute; anteroventral corner produced acute, posterior ventral corner produced acute. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 4 robust setae

*Pereonite 1* with single broad dorsal carina, produced dorsally, with pair of lateral and ventral projections. *Gnathopod 1* coxa subequal to coxa 2, broader than long, anteroventral corner not produced, apically rounded; basis 3.5 times as long as broad, without anterodistal setae; carpus rectilinear, 2.5 times as long as broad; propodus subovate, anterior margin with sparse slender setae, palm margin minutely crenulate, corner of palm with 4 robust setae; dactylus posterior margin with slender setae. *Pereonite 2* dorsal carina broad, produced evenly, extending the entire length of the pereonite, subtriangular, apically rounded. *Gnathopod 2* basis 2.8 times as long as broad, with medial acute projection, anterodistal corner with acute produced lobes, corner without setae; merus posterior margin narrow with produced lobe, lobe as long as broad, apically acute, without short robust setae; carpus free, distinct from propodus; propodus elongate subovoid, length twice width, anterior margin with 1 slender seta, medial surface with dense cluster of plumose setae, palm subacute,  $\frac{1}{3}$  the length of the propodus, with broad distal shelf, shelf margin strongly crenulate, palm with 2 proximal rounded teeth, palm defined by corner, without setae; dactylus extending beyond palm. *Pereonite 3* dorsal carina broad, produced evenly, subtriangular, apically rounded, with ventral projections. *Pereonite 4* dorsal carina broad, produced evenly, with ventral projections. *Pereonites 5–7* fused. *Pereonites 5–6* dorsal carina broad, evenly rounded. *Pereonite 7* dorsal carina broad, produced posteriorly, apically subacute. *Pleonite 1* dorsal carina narrow, produced anteriorly, subtriangular, apically subacute. *Pleonite 2* dorsal carina narrow, produced evenly, subtriangular, apically subacute. *Epimera 1–3* posteroventral corner rounded. *Urosome* with 2 pairs of uropods. *Urosomite 1* length 1.5 times as long as broad. *Uropod 1* peduncle 2.5 times as long as broad, ventromedial spine absent; inner ramus 1.9 times peduncle length; outer ramus about half the length of inner ramus. *Uropod 2* absent. *Uropod 3* uniramus; rami with row of slender setae. *Telson* dorsal lobe absent, apically rounded with single robust seta.

Female (sexually dimorphic characters) based on paratype female, 3.8 mm. AM P.87609.

*Gnathopod 1* basis 4.5 times as long as broad, with anterodistal robust seta; propodus subtriangular, produced distally, anterior margin with clusters of long slender setae, palm with 6 robust setae near corner. *Gnathopod 2* basis 4.4 times as long as broad; merus anterior margin with 2 robust setae; propodus subovate, length 1.6 times width, anterior margin with a few robust setae, posterior margin lined with robust setae, palm convex, 0.4 times length of the propodus, without distal shelf or teeth, palm defined by 2 robust setae; dactylus closing along palm.

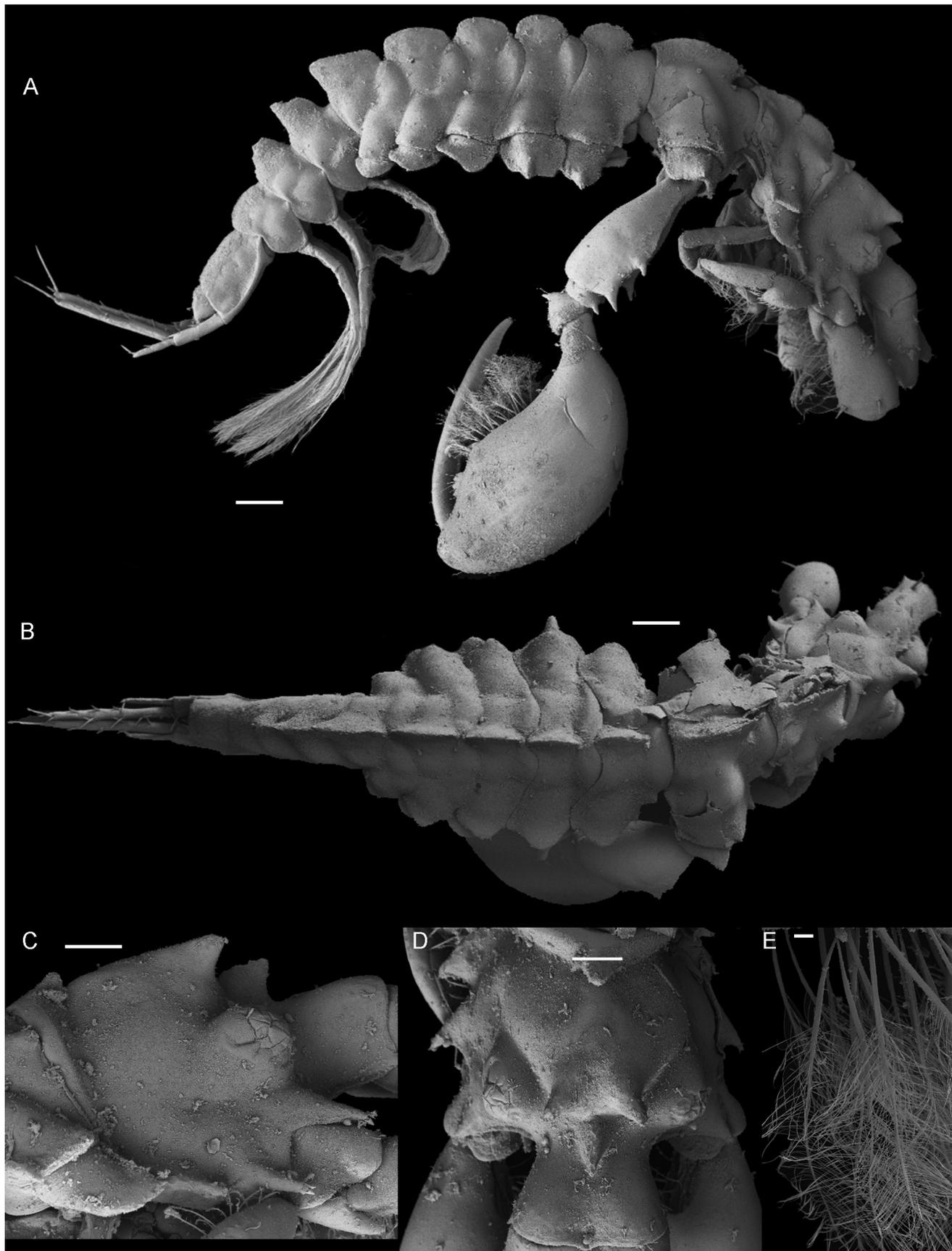


Figure 2. *Laetmatophilus triceratops* sp. nov., holotype male, 4.3 mm, AM P. 87032, Arafura Sea. SEM photographs: (A) whole animal lateral view (scale 200 μm); (B) whole animal dorsal view (scale 200 μm); (C) head lateral view (scale 100 μm); (D) head dorsal view (scale 100 μm) and (E) gnathopod 2 propodus palm plumose setae (scale 20 μm).

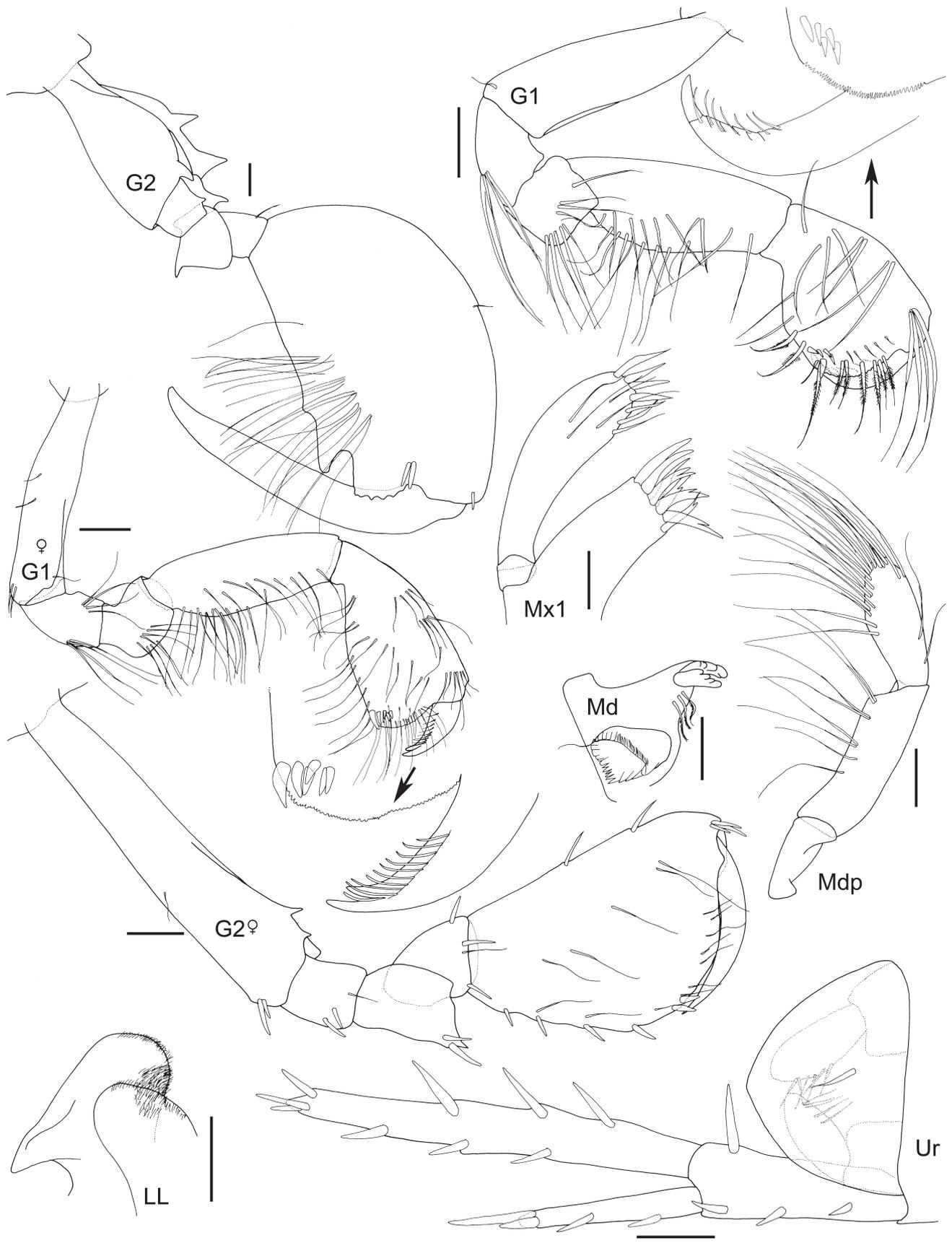


Figure 3. *Laetmatophilus triceratops* sp. nov., holotype male, 4.3 mm, AM P.87032, and paratype female, 3.8 mm, AM P.87609, Arafura Sea (scale 0.1 mm).

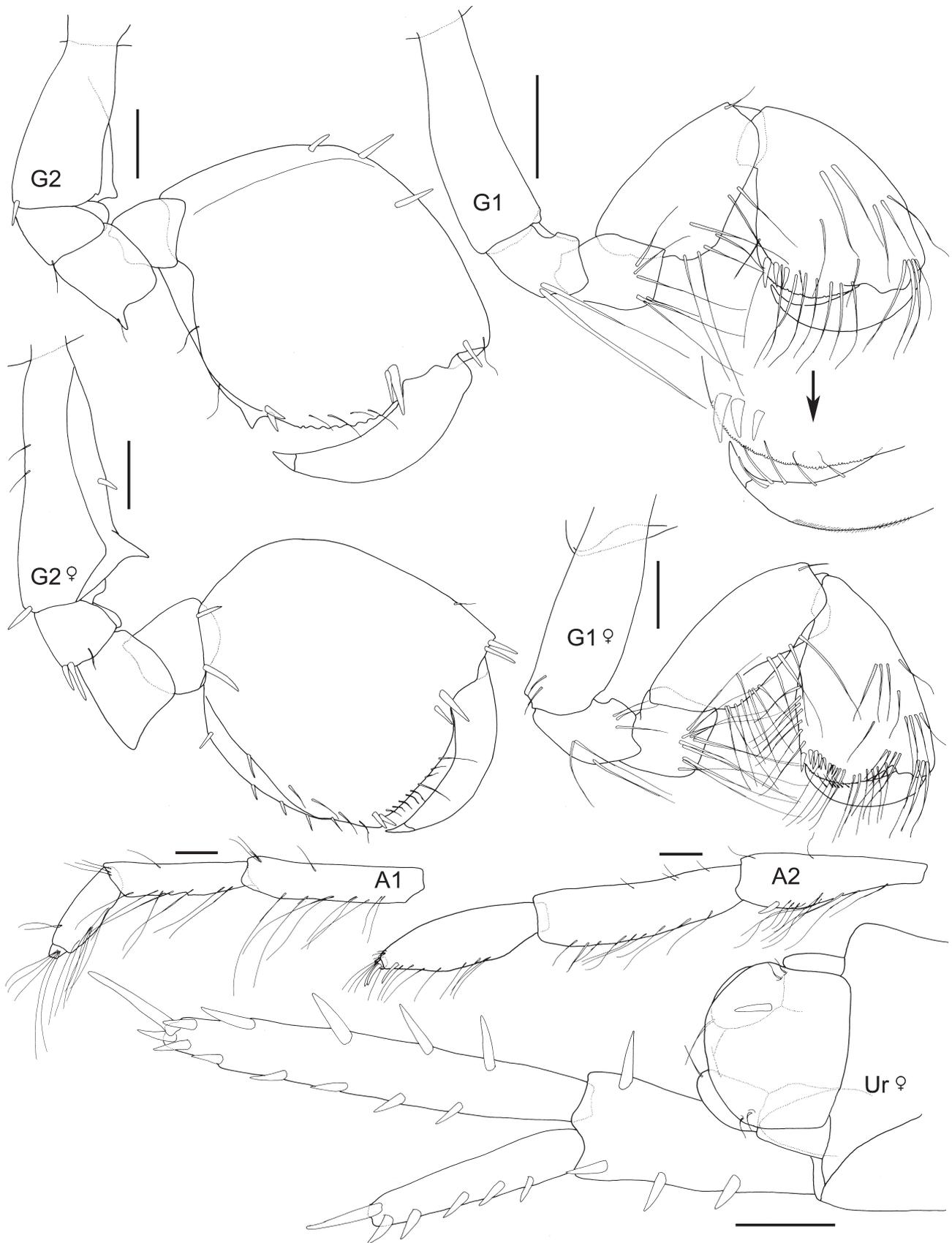


Figure 4. *Laetmatophilus triceratops* sp. nov., juvenile male, 2.8 mm, AM P.87610, and juvenile female, 3.5 mm, AM P.87611, Carnarvon Shelf, Western Australia (scale 0.1 mm).

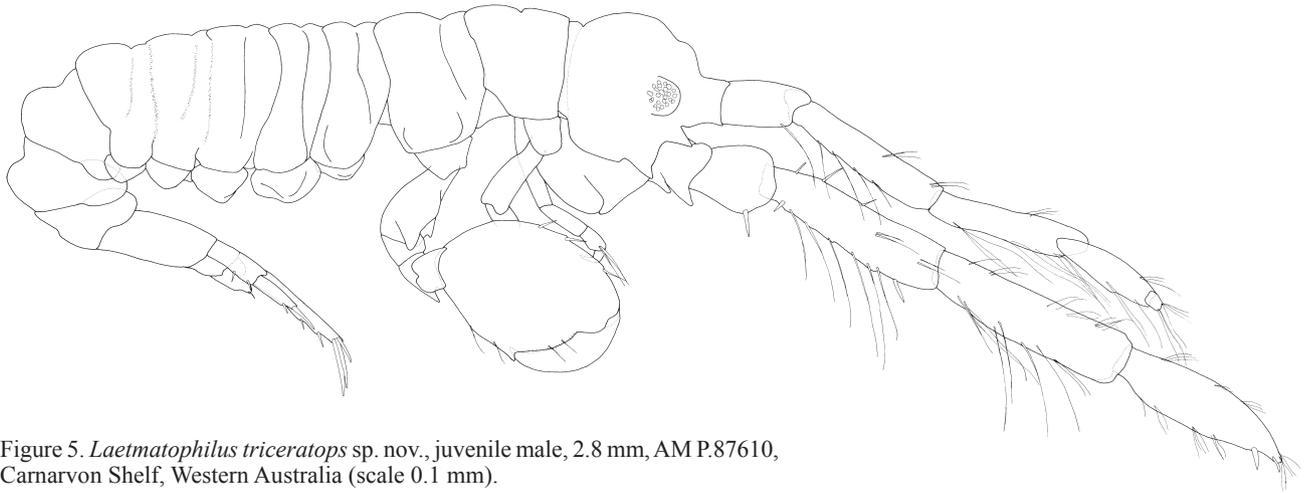


Figure 5. *Laetmatophilus triceratops* sp. nov., juvenile male, 2.8 mm, AM P.87610, Carnarvon Shelf, Western Australia (scale 0.1 mm).

**Variation.** Juveniles (c. 2.8 mm) have a smooth dorsum that develops into broad evenly rounded carina with acute carinae on the head and pleonites. The carination on the dorsal surface of the head transitions from a smooth hump in juveniles to three anterior projecting carinae in adults. The first acute body processes to develop are the head lateral cephalic lobes and anteroventral corner, and carinae on pleonites 1 and 2. In penultimate gravid females the carina on the head are apically rounded and appear cleaved, while the final adult female has acute carinae.

**Remarks.** In *Laetmatophilus triceratops* sp. nov., the body form develops from a smooth dorsum to having posterior carinae between juvenile and adult growth stage. A similar growth pattern has also been noted for *L. hala* J. L. Barnard, 1970. The shape of the dorsal carinae separates adult *L. triceratops* sp. nov., and *L. hala* from *L. acuticephalus* Ledoyer, 1978; *L. armatus* (Norman, 1869); *L. hystrix* Haswell, 1880; *L. ledoyeri* Ruffo, 1987; *L. leptochair* K. H. Barnard, 1937 and *L. tuberculatus* Bruzelius, 1859, which have dorsal, lateral and/or ventral projections along the body cuticle. A smooth body form distinguishes *L. dabberi* Barnard & Drummond, 1981; *L. durbanensis* K. H. Barnard, 1916; *L. intermedius* Ledoyer, 1979a; *L. paradurbanensis* Bano & Kazmi, 2004; *L. purus* Stebbing, 1888 and *L. tridens* K. H. Barnard, 1916.

The adult male gnathopod 2 in *Laetmatophilus triceratops* sp. nov. and *L. hala*, along with *L. dabberi* all have a distinct sickle-shape propodus with mainly distal setae. *Laetmatophilus triceratops* sp. nov. can be distinguished from *L. hala* by the formation of carinae on the head (3 acute carinae in triangle formation) and the absence of lateral ridging on the body.

*Laetmatophilus triceratops* sp. nov. juvenile specimens that have not developed dorsal carinae are very similar to *L. dabberi* known from southern Australia. However *L. triceratops* sp. nov. juveniles have a more developed head bump in comparison to the smooth form of *L. dabberi*. The adult specimens of *L. triceratops* sp. nov. have well developed carina, gnathopod 1 carpus and propodus more elongate, propodus palm with many robust setae and the male gnathopod 2 basis with acute medial processes, which are not present in *L. dabberi*.

**Distribution.** Australia. Western Australia: Arafura Sea; Carnarvon Shelf (current study).

### *Podocerus* Leach 1814

*Podocerus* Leach, 1814: 433.—Stebbing, 1906: 700.—J. L. Barnard, 1970: 237.—Lincoln, 1979: 570.—Barnard & Karaman, 1991: 664. (Type species *Podocerus variegatus* Leach, 1814 by monotypy).  
*Platophium* Dana, 1852: 309.—Dana, 1853: 837 (type species *Platophium brasiliense* Dana, 1853 by monotypy).  
*Dexiocerella* Haswell, 1885: 107 (type species *Cyrtophium dentatum* Haswell, 1879 subsequent selection of Barnard & Karaman, 1991).

**Diagnosis.** Following Hughes (2012): Pereon depressed, with 5–7 segments; urosome of 3 segments. Antennae 1 accessory flagellum present; maxilla 1 inner plate reduced and non-setose or absent, outer plate with 9 spines; maxilla 2 without facial setae; maxilliped palp 4 blunt; brood plates on pereopods 2–4 or 2–5; uropod 2 uniramus or biramus; uropod 3 without rami.

### *Podocerus clavicularius* sp. nov.

Fig. 6

**Type material.** Holotype male, 4.0 mm, dissected, 2 slides, WAM C51370, Tish Point, Rosemary Island, Dampier Archipelago (20°29'40"S 116°35'53"E), 0.5 m, on brown algae *Sargassum* sp., 30 August 1999, coll. R. A. Peart (WA 683); paratype male, AM P.90229, Tish Point, Rosemary Island, Dampier Archipelago (20°29'40"S 116°35'53"E), 0.5 m, on brown algae *Sargassum* sp., 30 August 1999, coll. R. A. Peart (WA 683).

**Type locality.** Tish Point, Rosemary Island, Dampier Archipelago, Western Australia (20°29'40"S 116°35'53"E).

**Etymology.** The name is a reference to the male gnathopod 2 resembling a key, *clavicularius* is Latin for key maker, locksmith.

**Diagnosis.** *Body* cuticle dorsally smooth. *Gnathopod 1* coxa larger than coxa 2, as broad as long, anteroventral corner weakly produced ventrally, apically subacute. *Gnathopod 2* basis 0.9 times as long as broad; carpus free, distinct from propodus; propodus subovate, length 1.3 times width, medial surface with a few sparse plumose setae, palm half the length of the propodus with 1 tooth, defined by corner with 2 robust setae; dactylus closing short of palm end.

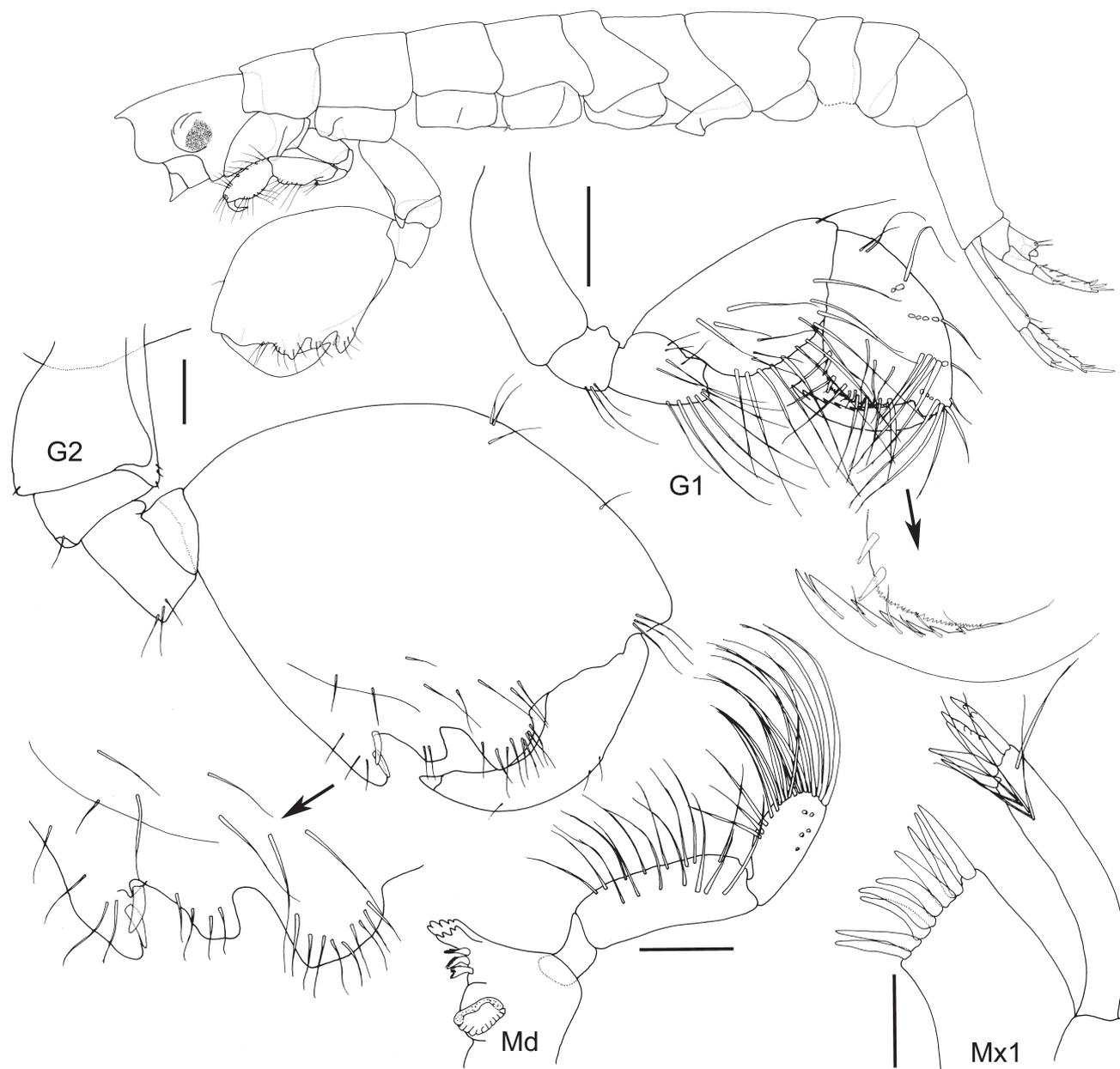


Figure 6. *Podocerus clavicularius* sp. nov., holotype male, 4.0 mm, WAM C51370, Dampier Archipelago, Western Australia (scale 0.1 mm).

**Description.** Based on holotype male, 4.0 mm. WAM C51370. *Body* cuticle dorsally smooth. *Head* dorsally smooth; rostrum short, one tenth of head length; eyes greatly bulging; lateral cephalic lobe rounded; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 5 robust setae, 2 cuspidate.

*Gnathopod 1* coxa larger than coxa 2, as broad as long, anteroventral corner weakly produced ventrally, apically subacute; basis 3 times as long as broad, without anterodistal setae; carpus rectilinear, twice as long as broad with truncate lobe; propodus subtriangular, produced distally, anterior margin with clusters of long slender setae, palm margin minutely crenulate, with 2 robust setae near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface with raised serrations. *Gnathopod 2* basis 0.9 times as long as broad; anterodistal corner with subacute produced lobes,

with long slender setae; carpus free, distinct from propodus; propodus subovate, length 1.3 times width, anterior margin with a few long slender setae, medial surface with a few sparse plumose setae, palm subacute, half the length of the propodus, with broad, well developed distal shelf, shelf margin smooth, palm with 1 tooth, defined by corner with 2 robust setae; dactylus closing short of palm end.

*Epimera 2–3* posteroventral corner rounded. *Urosomite 1* length 2.2 times as long as broad. *Uropod 1* peduncle 3 times as long as broad, ventromedial spine absent; inner ramus 0.8 times peduncle length; outer ramus 0.7 times length of inner ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus 0.33 times length of inner ramus. *Uropod 3* uniramous; ramus without setae. *Telson* dorsal lobe with 2 apical setae, lower margin without lateral or apical setae.

**Remarks.** *Podocerus clavicarius* sp. nov. has a spheroid propodus on male gnathopod 2 with the dactylus closing short of the palm. This combination of characters is unique within the genus *Podocerus*. See also remarks for *P. miscix* sp. nov.

**Distribution.** Australia. Western Australia: Dampier Archipelago.

### *Podocerus* cf. *crenulatus* Myers, 1985

Fig. 7

*Podocerus crenulatus* Myers, 1985: 60, fig. 44.—Kilgallen, 2009: 850–853, figs 6, 7.

**Type locality.** Momi Bay, Viti Levu, Fiji.

**Material examined.** Australia. Male, 3.0 mm, dissected, 2 slides, MAGNT Cr017401, south end of lagoon, Scott Reef, Indian Ocean (14°01'S 121°47'E), intertidal pools, dead coral rubble and sand, 18 September 1984, coll: B. Russell. Fiji. Holotype male, 2.7 mm, AM P.35190, Momi Bay, Viti Levu, 7 September 1979, coll. A. A. Myers.

**Diagnosis.** *Body* laterally rugose. *Head* with weak hump. *Gnathopod 2* propodus medial surface with sparse setae,  $\frac{3}{4}$  the length of the propodus, palm with one distal subtriangular tooth, palm defined by 2 robust seta without corner or tooth. *Pereonite 7* with lateral hump. *Pleonite 1* dorsal carina narrow, produced posteriorly, subtriangular, apically rounded, with lateral hump. *Pleonite 2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded, with lateral hump. *Uropod 1* with well-developed ventromedial spine, spine twice as long as broad.

**Description.** Based on male, 3.0 mm, Cr017401. *Body* cuticle with posterior dorsal carinae, laterally rugose. *Head* with weak hump; rostrum short, about 1 tenth of head length; eyes greatly bulging; lateral cephalic lobe rounded; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 6 robust setae.

*Gnathopod 1* coxa damaged; basis 3 times as long as broad, without anterodistal setae; carpus rectilinear, 2.1 times as long as broad with truncate lobe; propodus subrectangular, anterior margin with sparse slender setae, palm margin minutely crenulate, without robust seta at corner of palm; dactylus posterior margin with serrate teeth, cuticle surface with raised serrations. *Gnathopod 2* basis twice long as broad; anterodistal corner with produced subacute lobes, with long slender setae; merus posterior margin with narrow produced lobe, lobe twice as long as broad, posterior margin apically rounded, with 2 short robust setae; carpus free, distinct from propodus; propodus elongate subovoid, length 2.1 times width, anterior margin with clusters of long slender setae, medial surface with sparse setae, palm acute, straight,  $\frac{3}{4}$  the length of the propodus, with broad, well developed distal shelf, shelf margin smooth, palm with one distal subtriangular tooth, palm defined by 2 robust seta without corner or tooth; dactylus closing along palm. *Pereonite 6* dorsal carina narrow, produced posteriorly, subtriangular, apically rounded. *Pereonite 7* dorsal carina broad, produced posteriorly, subtriangular, apically rounded, with lateral hump.

*Pleonite 1* dorsal carina narrow, produced posteriorly, subtriangular, apically rounded, with lateral hump. *Pleonite 2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded, with lateral hump. *Epimera 1–3* posteroventral corner rounded. *Urosomite 1* twice as long as broad. *Uropod 1* peduncle 3 times as long as broad, with well-developed ventromedial spine, spine twice as long as broad; inner ramus 1.3 times peduncle length; outer ramus about  $\frac{3}{4}$  the length of the inner ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus about half the length of inner ramus. *Uropod 3* uniramous; rami without setae. *Telson* dorsal lobe with 2 apical setae, lower margin without lateral or apical setae.

**Remarks.** This single male specimen from Scott Reef is attributed to *P. crenulatus* Myers, 1985 originally described from Viti Levu, Fiji. The Scott Reef specimen has a more elongate pereonite 6 and has a smooth, not crenulate, palm of gnathopod 2. The Scott Reef specimen is larger 3.0 mm than those figured from Fiji, 2.7 mm (Myers, 1985) and Queensland, 2.0 mm (Kilgallen, 2009). The gnathopod crenulations may not persist in larger adult male forms, or the single specimens here may be an aberration. The male specimens from Fiji have an extra robust setae on the gnathopod 2 propodus between the distal shelf and first palmar tooth, not seen in this specimen.

**Distribution.** Australia. Indian Ocean: Scott Reef (current study). Queensland: Lizard Island (Kilgallen, 2009). Fiji: Viti Levu (Myers, 1985).

### *Podocerus ferreus* sp. nov.

Figs 8–9

**Type locality.** Iron Ore Wharf, Darwin Harbour, Northern Territory, Australia (12.4725'S 130.8428'E).

**Etymology.** Ferreus is Latin for “of iron”, in reference to the type locality.

**Type material.** Holotype male, 4.4 mm, dissected, 2 slides, MAGNT Cr017407, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scrapings, 16 August 1998, coll: MAGNT/CSIRO Survey Team; paratype female, 4.7 mm, dissected, 1 slide, MAGNT Cr017408, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scrapings, 16 August 1998, coll: MAGNT/CSIRO Survey Team; paratype male, 4.8 mm, SEM pin mount, AM P.85670, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scrapings, 16 August 1998, coll: MAGNT/CSIRO Survey Team; paratypes 10+ specimens, MAGNT Cr015652, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scraping, 16 August 1998, coll: MAGNT/CSIRO Survey Team; paratypes 2 specimens, MAGNT Cr015540, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scrapings, 28 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 5 specimens, MAGNT Cr015584, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scraping, 28 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 6 specimens, MAGNT Cr015589, Iron Ore Wharf, Darwin Harbour (12.4725'S 130.8428'E), wharf pylon scrapings, 28 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 3 specimens, MAGNT Cr015605, Iron Ore Wharf, Darwin

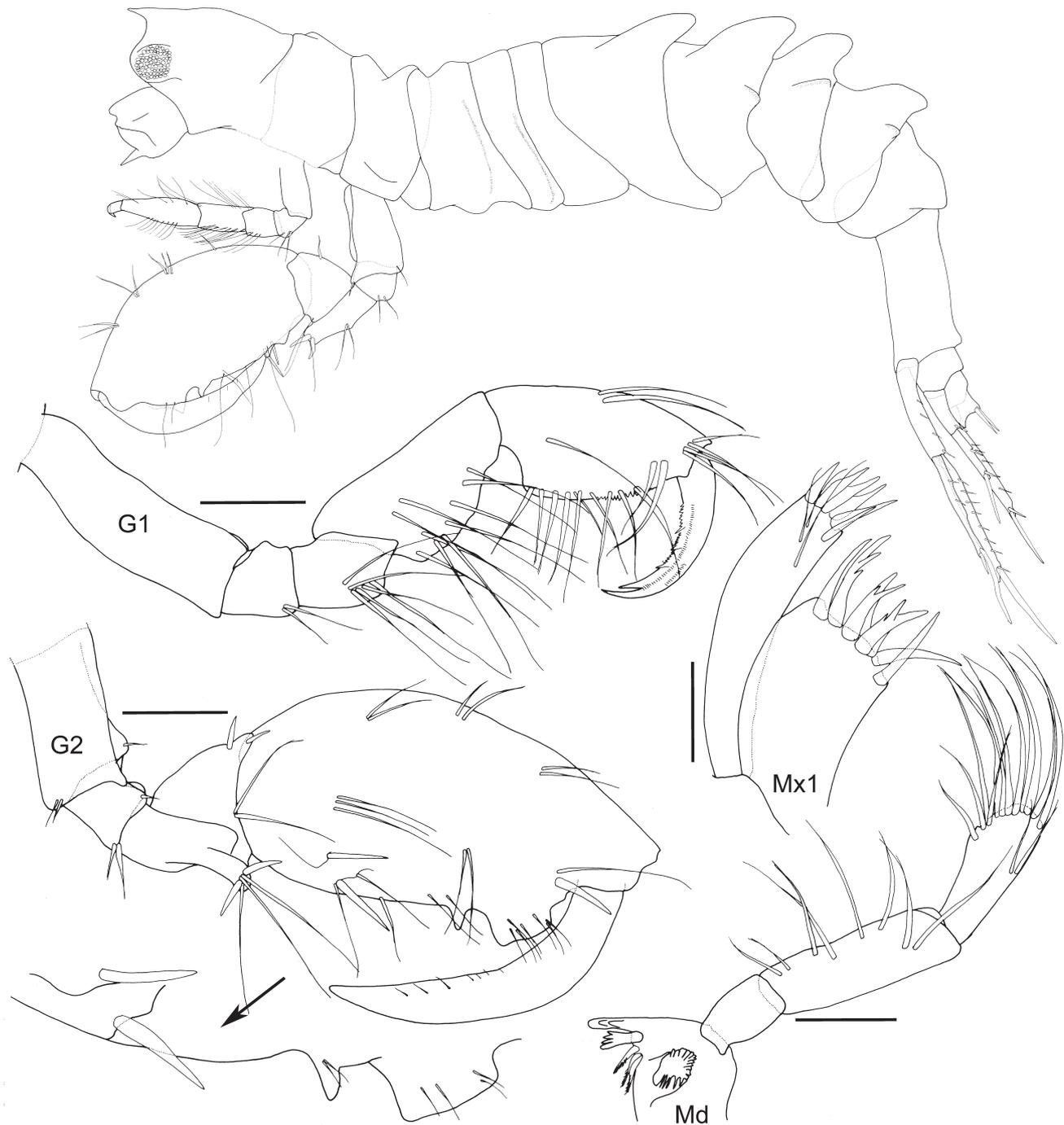


Figure 7. *Podocerus cf. crenulatus*, Myers, 1985, male, 3.0 mm, MAGNT Cr017401, Scott Reef, Indian Ocean (scale 0.1 mm).

Harbour (12.4725°S 130.8428°E), wharf pylon scraping, 28 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 5 specimens, MAGNT Cr015623, Fort Hill Wharf, Darwin Harbour (12.4715°S 130.8467°E), wharf pylon scrapings, 27 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 4 specimens, MAGNT Cr015634, Fort Hill Wharf, Darwin Harbour (12.4715°S 130.8467°E), wharf pylon scrapings, 27 March 1999, coll: MAGNT/CSIRO Survey Team; paratypes 4 specimens, MAGNT Cr015667, Iron Ore Wharf, Darwin Harbour (12.4725°S 130.8428°E), wharf pylon scrapings, 28 March 1999, coll: MAGNT/CSIRO Survey Team.

**Additional material examined.** 3 specimens, MAGNT Cr015552, Fort Hill Wharf, Darwin Harbour (12.4715°S

130.8467°E), wharf pylon scrapings, 27 March 1999 coll: MAGNT/CSIRO Survey Team; 14 specimens, MAGNT Cr015683, East Arm Port, Darwin Harbour (12.4918°S 130.8831°E), wharf pylon scrapings, 20 August 1998, coll: MAGNT/CSIRO Survey Team; 2 specimens, MAGNT Cr015693, Near Stokes Hill Wharf, Darwin Harbour (12.47°S 130.8483°E), wharf pylon scrapings, 18 August 1998, coll: MAGNT/CSIRO Survey Team; 3 specimens, MAGNT Cr015918, Channel Island, Middle Arm, Darwin Harbour (12.55°S 130.8667°E), intertidal algae and rubble, 14 November 1985, coll: C. Watson; 11 specimens, AM P.78313, west end of East Point, north end of Fannie Bay, Darwin (11°24'00"S 130°48'30"E), 8–10 m, on Gorgonian *Echinogorgia* sp., 26 October 1982, coll: J. K. Lowry (NT

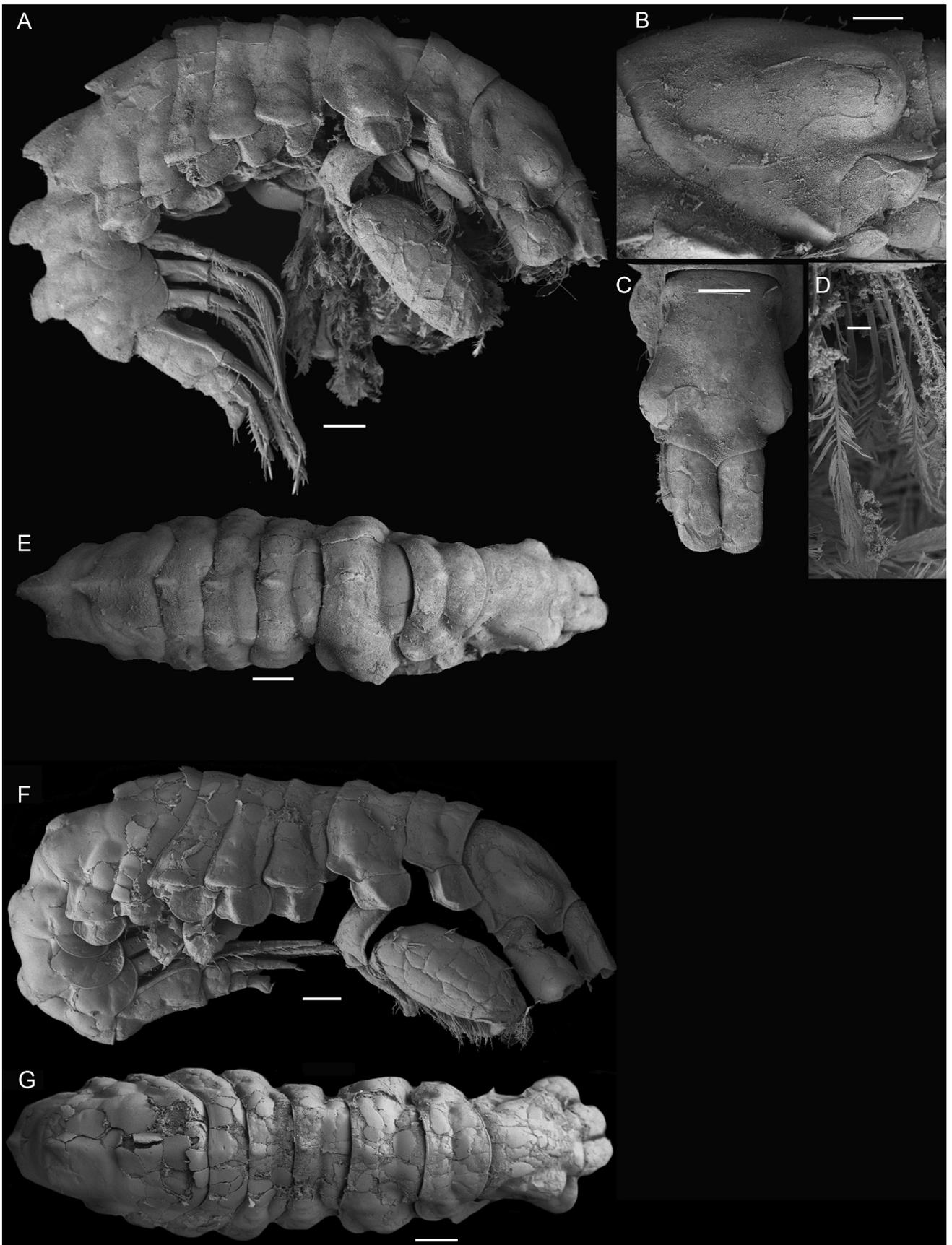


Figure 8. *Podocerus ferreus* sp. nov. paratype male, 4.8 mm, AM P.85670, Darwin Harbour, Northern Territory. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) head lateral view (scale 100  $\mu$ m); (C) head dorsal view (scale 200  $\mu$ m) (D) gnathopod 2 propodus palm plumose setae (scale 20  $\mu$ m) and (E) whole animal dorsal view (scale 200  $\mu$ m). Male, 5.2 mm, AM P.87035, (F) whole animal lateral view (scale 200  $\mu$ m); and (G) whole animal dorsal view (scale 200  $\mu$ m).

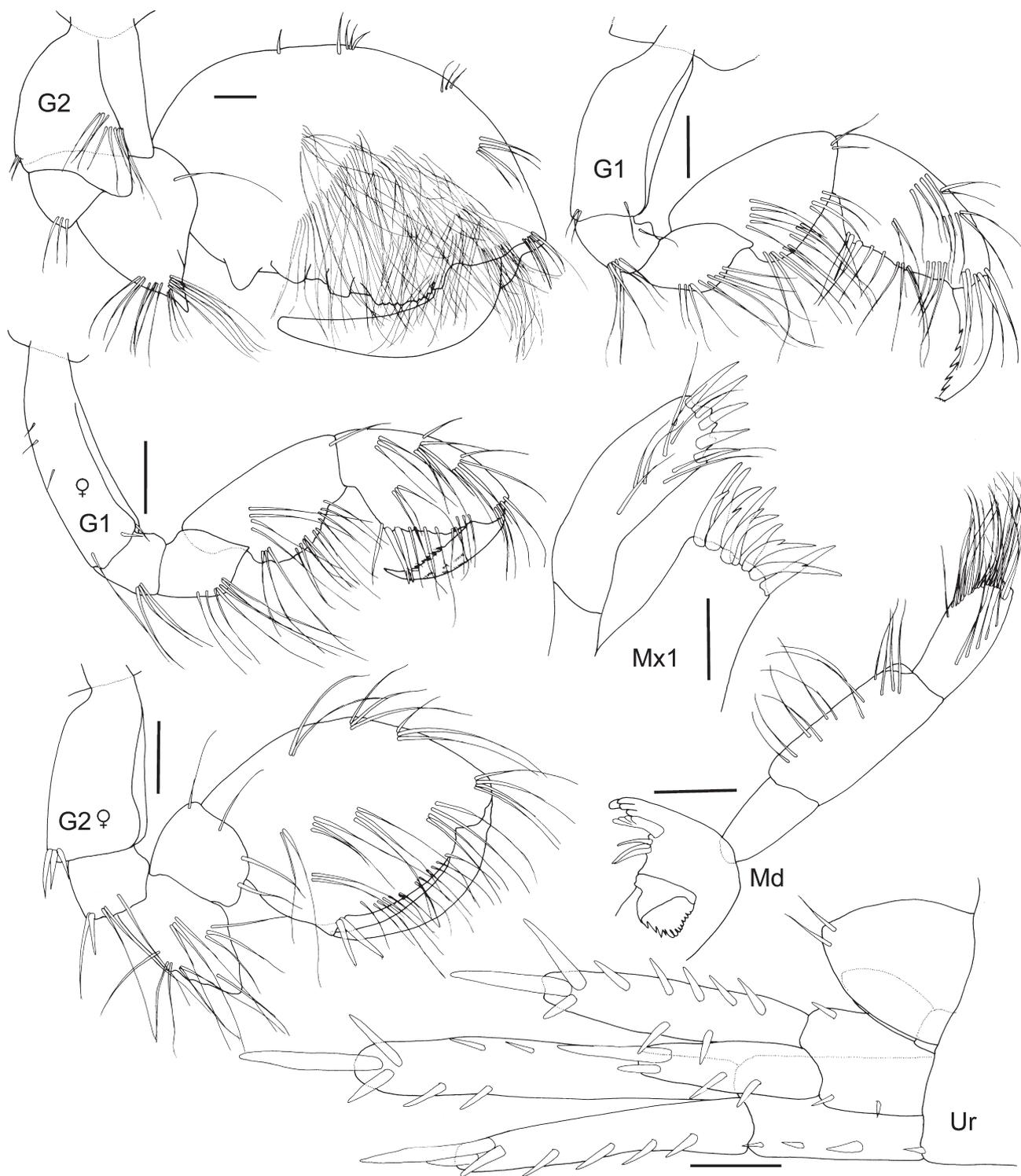


Figure 9. *Podocerus ferreus* sp. nov. holotype male, 4.4 mm, MAGNT Cr017407, and paratype female, 4.7 mm, MAGNT Cr017408, Darwin Harbour, Northern Territory (scale 0.1 mm).

92); 1 male, 6.2 mm, dissected, 4 slides, MAGNT Cr017410, Port Essington (11.3333'S 132.1667'E), March 1984. coll: NT Fisheries; 1 female, 4.7 mm, dissected, 1 slide, MAGNT Cr017409, Port Essington (11.3333'S 132.1667'E), March 1984, coll: NT Fisheries; 1 male, SEM pin mount, AM P.85667, Port Essington (11.3333'S 132.1667'E); 1 male, 5.2 mm, SEM pin mount, AM P. 87035, Port Essington (11.3333'S 132.1667'E); 8 specimens (1 male, 5 female and 2 juvenile), Cr015841, Port Essington (11.3333'S

132.1667'E), March 1984, coll: NT Fisheries; 7 specimens (1 male and 6 female), Cr015855, Port Essington (11.3333'S 132.1667'E); 4 female specimens, MAGNT Cr015837, Perkins Wharf, Gove Harbour, Gulf of Carpentaria (12.1938'S 136.72'E), 0.5 m, 7 June 2001, coll. K. Neil & party (JCU/CRC Reef) (A571 GB7); 1 specimen, MAGNT Cr015825, Cargo Wharf, Gove Harbour, Gulf of Carpentaria (12.2042'S 136.6808'E), 8 June 2001 coll. K. Neil & party (JCU/CRC Reef) (A695 GD0).

**Diagnosis.** *Head* with weak hump; lateral cephalic lobe subquadrate. *Gnathopod 1* coxa smaller than coxa 2, as broad as long, anteroventral corner produced anteriorly, apically subacute. *Gnathopod 2* basis 1.5 times as long as broad, with long slender setae; carpus indistinct, fused with propodus; propodus subovate, palm  $\frac{3}{4}$  the length of the propodus, palm with 2 teeth, defined by tooth, without robust setae; dactylus closing short of palm end. *Pereonite 3* dorsal carina narrow, produced evenly, subtriangular, apically subacute. *Pereonite 4* dorsal carina narrow, produced evenly, subtriangular, apically rounded. *Pereonite 5* dorsal carina narrow, produced evenly, subtriangular, apically subacute. *Pereonite 6* dorsal carina broad, produced posteriorly, subtriangular, apically acute. *Pereonite 7* dorsal carina broad, produced posteriorly, subtriangular, apically rounded. *Pleonite 1* dorsal carina broad, produced posteriorly, subtriangular, apically subacute. *Pleonite 2* dorsal carina broad, produced posteriorly, broadly rounded.

**Description.** Based on holotype male, 4.4 mm. MAGNT Cr017407. *Body* cuticle dorsally smooth, with posterior dorsal carina, laterally smooth. *Head* with weak hump; rostrum short, about one tenth of head length; eyes greatly bulging; lateral cephalic lobe subquadrate; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 5 robust setae.

*Gnathopod 1* coxa smaller than coxa 2, as broad as long, anteroventral corner produced anteriorly, apically subacute; basis 2.5 times as long as broad, without anterodistal setae; carpus subtriangular, 1.8 times as long as broad; propodus subtriangular, anterior margin with clusters of long slender setae, palm margin smooth with 2 long robust setae near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface with raised serrations. *Gnathopod 2* basis 1.5 times as long as broad, anterodistal corner with produced subacute lobes with long slender setae; merus posterior margin with narrow produced lobe, lobe as long as broad, posterior margin apically acute; carpus indistinct, fused with propodus; propodus subovate, length 1.9 times width, anterior margin with clusters of short robust setae, medial surface with dense plumose setae, palm acute, straight,  $\frac{3}{4}$  the length of the propodus, with broad, well developed distal shelf, shelf margin strongly crenulate, palm with 2 teeth, defined by tooth, without robust setae; dactylus closing short of palm end. *Pereonite 3* dorsal carina narrow, produced evenly, subtriangular, apically subacute. *Pereonite 4* dorsal carina narrow, produced evenly, subtriangular, apically rounded. *Pereonite 5* dorsal carina narrow, produced evenly, subtriangular, apically subacute. *Pereonite 6* dorsal carina broad, produced posteriorly, subtriangular, apically acute. *Pereonite 7* dorsal carina broad, produced posteriorly, subtriangular, apically rounded.

*Pleonite 1* dorsal carina broad, produced posteriorly, subtriangular, apically subacute; *epimeron 1* posteroventral corner rounded. *Pleonite 2* dorsal carina broad, produced posteriorly, broadly rounded; *epimera 2–3* posteroventral corner subquadrate. *Urosomite 1* length twice as long as broad. *Uropod 1* biramus, peduncle ventromedial spine absent; inner ramus 1.2 times peduncle length. *Uropod 2* biramus, peduncle ventromedial spine absent; outer ramus about half the length of inner ramus. *Uropod 3* uniramus; rami without setae. *Telson* dorsal lobe with 2 apical setae, lower margin without lateral or apical setae.

Female (sexually dimorphic characters) based on paratype

female, 4.7 mm. MAGNT Cr014708. *Gnathopod 2* basis 2 times long as broad; anterodistal corner subquadrate, without setae; merus posterior margin with broad lobe, lobe 0.9 times as long as broad, with a few slender setae; carpus free, distinct from propodus; propodus length 1.2 times width, anterior margin with clusters of long slender setae, palm convex without distal shelf, defined by corner with 2 robust setae.

**Variation.** *Podocerus ferreus* sp. nov. has variable dorsal carinae with either well or poorly developed processes seen for both male and female specimens. The development of carina is not related to growth stage. Both carina forms are recorded in the same sample from numerous locations.

**Remarks.** The variable dorsal carina in *Podocerus ferreus* sp. nov. is similar to the intra-specific variation known for *P. oronotes* sp. nov. and *P. lobatus* (of Pirlot, 1938) where individuals are known with either acute or rounded carina.

*Podocerus ferreus* sp. nov. has the male gnathopod 2 propodus palm with a well-developed shelf and three teeth, similar to *P. tategus levuensis* Myers, 1985, *P. ulreungensis* Kim & Kim, 1991 and *P. wanganui* J. L. Barnard, 1972. However, uropod 1 is without a ventromedial spur in *P. ferreus* sp. nov., differentiating it from *P. wanganui*. In *P. ferreus* sp. nov. the cephalic lobe is subquadrate while in *P. ulreungensis* it is acute. The dorsum overall appearance is smooth in *P. ferreus* sp. nov. and with slight ridging in *P. ulreungensis*. In *P. ferreus* sp. nov. gnathopod 1 propodus is recotilinear in shape while spheroid and subtriangular in *P. tategus levuensis* and *P. wanganui*, respectively.

**Distribution.** Australia. Northern Territory: Port Essington, Darwin Harbour, Gove Harbour (currently study).

### *Podocerus hanapepe* J. L. Barnard 1970

Figs 10–11

*Podocerus hanapepe* J. L. Barnard, 1970: 240, Figs 158, 159.—Ledoyer, 1972: 266, pl. 73.—Myers, 1985: 60, Figs 45, 46.—Myers, 1986: 1391.—Ledoyer, 1986: 930–932, fig. 366.—Myers, 1990: 149–157.—Horton, 2008: 846–847.

**Type locality.** Waikiki Beach, Oahu, Hawaii.

**Material examined.** *Hawaii.* Many specimens, BPBM 12518, Channel wreck, Kalihi, Honolulu Harbour, Oahu, 11 December 1997, coll. R. C. DeFelice & Co. (HH Station 16); 6 specimens, BPBM 12540 Keehi Lagoon, Airport Rescue Dock, Honolulu, Oahu, 11 December 1997, coll. R. C. DeFelice & Co. (HH Station 17); 1 specimen BPBM 12624 Kewalo Basin, Marine Mammal Laboratory, Honolulu, Oahu, 8 July 1998, Coll. R. C. DeFelice & Co. (HH Station 22); many specimens, BPBM 12760 Hilton Lagoon discharge pipe, Ala Wai Harbour, Honolulu, Oahu, 30 July 1998, coll. R. C. DeFelice & Co. (HH Station 29).

*Australia. Northern Territory.* Male, 3.9 mm, dissected, 4 slides, AM P.87612, bommies at north-west end of McCluer Island (11°02'S 132°58'E), 8 m, yellow hydroid, 16 October 1982, coll. J. K. Lowry, (NT 45); female, 4.8 mm, dissected, 1 slide, AM P.87613, bommies at north-west end of McCluer Island (11°02'S 132°58'E), 8 m, yellow hydroid, 16 October 1982, coll. J. K. Lowry, (NT 45); male, 4.0 mm, dissected, 1 slide, AM P.87614, bommies at

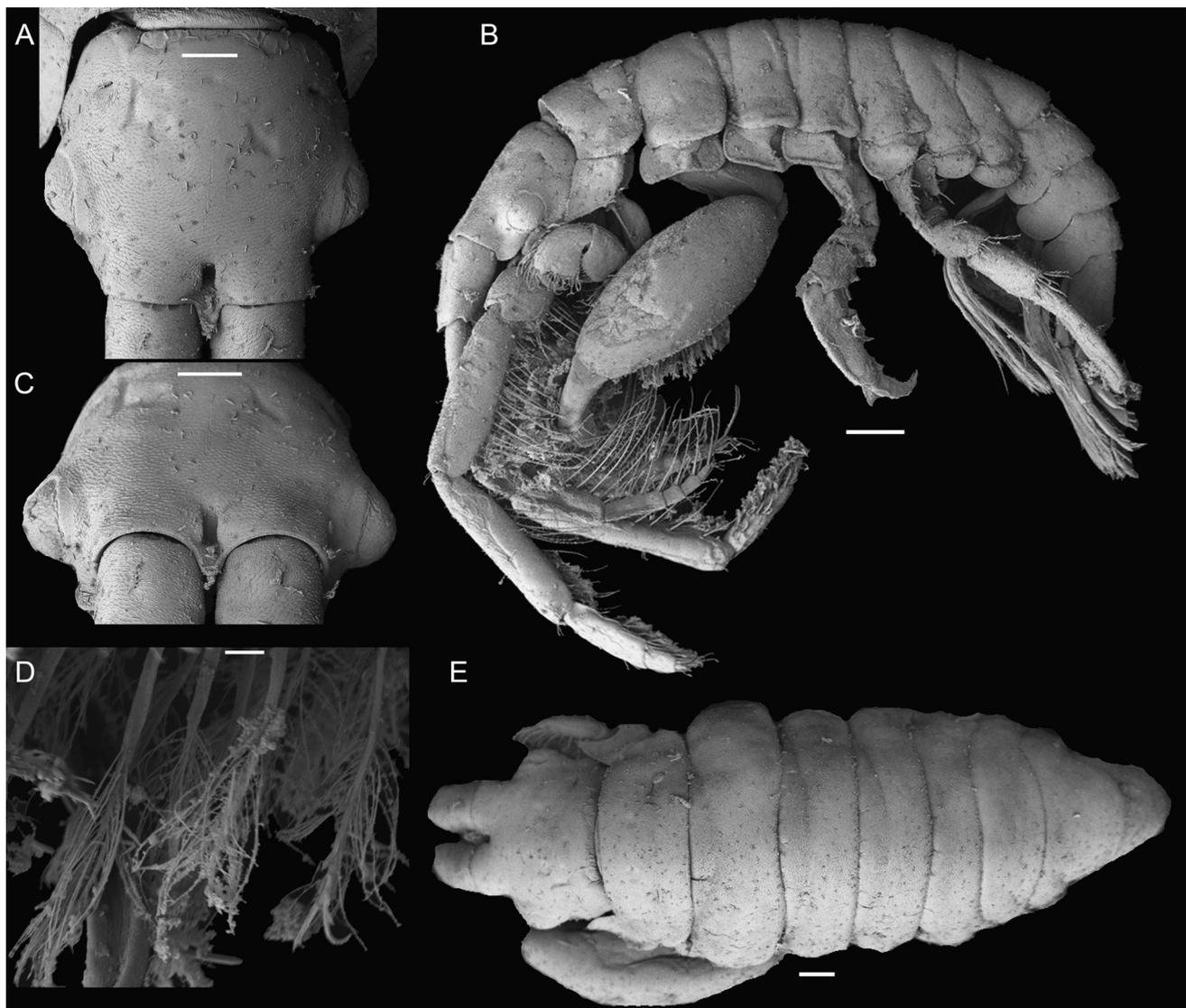


Figure 10. *Podocerus hanapepe* J. L. Barnard, 1970, male, 3.4 mm, AM P. 85671, McCluer Island, Northern Territory. SEM photographs: (A) head dorsal view (scale 100  $\mu$ m); (B) whole animal lateral view (scale 200  $\mu$ m); (C) head frontal view (scale 100  $\mu$ m); (D) gnathopod 2 propodus palm plumose setae (scale 10  $\mu$ m) and (E) whole animal dorsal view (scale 200  $\mu$ m).

north-west end of McCluer Island (11°02'S 132°58'E), 8 m, yellow hydroid, 16 October 1982, coll. J. K. Lowry, (NT 45); male, 3.4 mm, SEM pin mount, AM P.85671, bommies at north-west end of McCluer Island (11°02'S 132°58'E), 8 m, yellow hydroid, 16 October 1982, coll. J. K. Lowry, (NT 45); many specimens, AM P.77904, bommies at north-west end of McCluer Island (11°02'S 132°58'E), 8 m, yellow hydroid, 16 October 1982, coll. J. K. Lowry, (NT 45); many specimens, AM P.78309, bommies, north-west end, McCluer Island (11°02'S 132°58'E), 6 m, brown algae, top of reef, 16 October 1982, coll. J. K. Lowry (NT 48); 4 specimens AM P.78307, bommies, north-west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); 1 male specimen, dissected, 1 slide, AM P.87615, bommies, north-west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); 1 male specimen, SEM pin mount, AM P.85673, bommies, north-west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); 3 small specimens, AM P.78311, south end, McCluer Island

(11°06'S 133°00'E), 8 m, red algae, 17 October 1982 coll. J. K. Lowry (NT 58).

*Queensland.* 13 specimens, AM P.77413, 200 m off the beach on the southern side of Thursday Island, Torres Strait (10°35'18"S 142°12'58 E), 2 m, low turfing brown algae on mooring rope, 30 September 2006, coll. J. K. Lowry & M. Capa (MI QLD 1894); 1 specimen, AM P.77414, 200 m off the beach on the southern side of Thursday Island, Torres Strait (10°35'18"S 142°12'58"E), 2 m, low turfing brown algae on mooring rope, 30 September 2006, coll. J. K. Lowry & M. Capa (MI QLD 1894); 1 specimen, AM P.77415, 200 m off the beach on the southern side of Thursday Island, Torres Strait (10°35'18"S 142°12'58"E), 2 m, low turfing brown algae on mooring rope, 30 September 2006, coll. J. K. Lowry & M. Capa (MI QLD 1894); 75 specimens, AM P.77408, Number One Reef, Katai Nab, North of Horn Island, Torres Strait (10°32'30"S 142°10'16"E), 6 m, submerged rope fibre caught on reef, encrusted with red epiphytic algae on tips, 28 September 2006, coll. J. K. Lowry (MI QLD 1846); 8 specimens, AM P.77409, Number One Reef, Katai Nab, North of Horn Island, Torres Strait (10°32'30"S

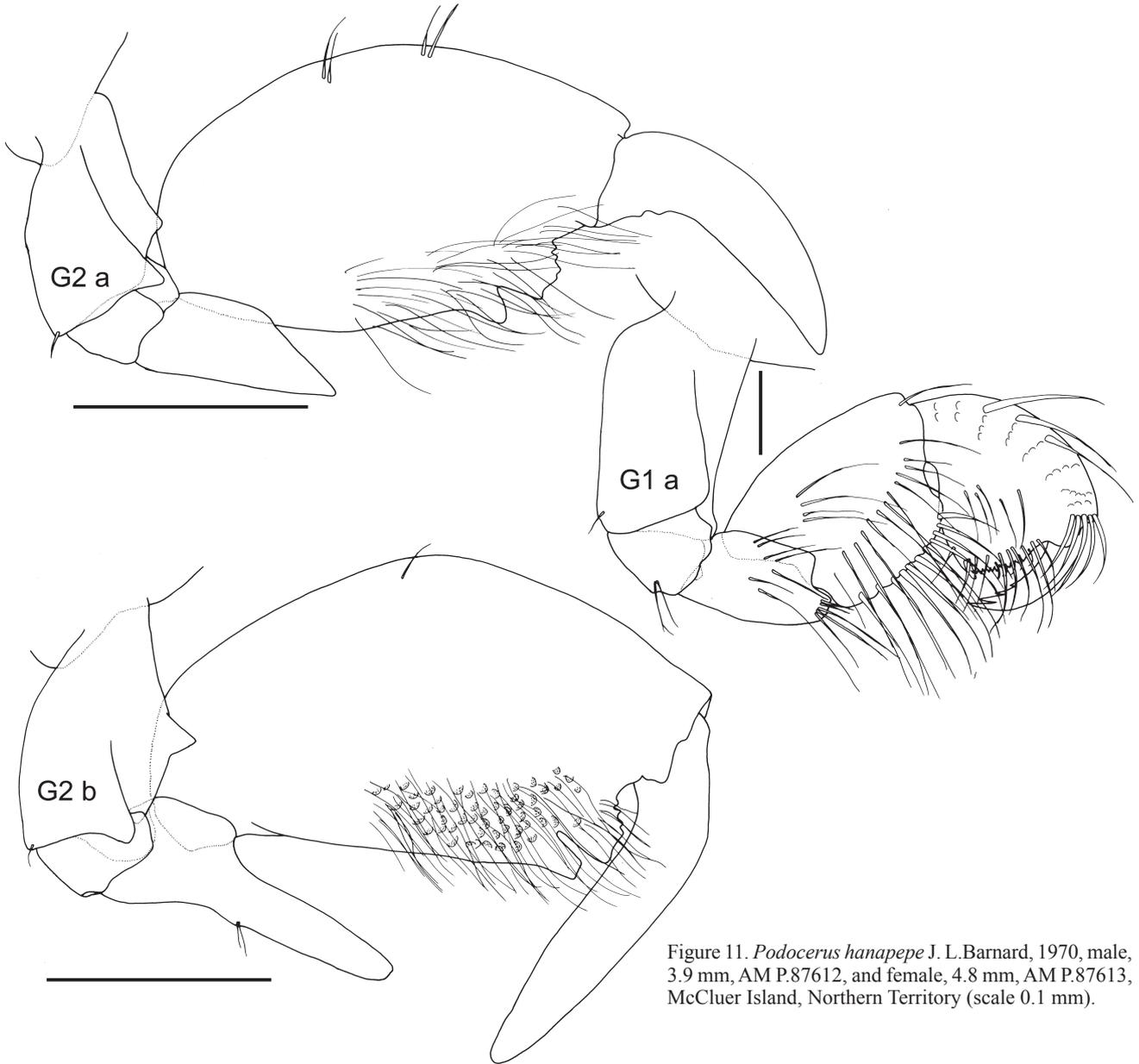


Figure 11. *Podocerus hanapepe* J. L. Barnard, 1970, male, 3.9 mm, AM P.87612, and female, 4.8 mm, AM P.87613, McCluer Island, Northern Territory (scale 0.1 mm).

142°10'16"E), 0.5 m, turtle skeleton old and bleached, amphipod living in pores of bones, 28 September 2006, coll. J. K. Lowry & M. Capa (MI QLD 1847); 1 specimen, AM P.77410, Number One Reef, Katai Nab, North of Horn Island, Torres Strait (10°32'30"S 142°10'16"E), 5.6 m, coarse coral rubble, 28 September 2006, coll. L. E. Hughes (MI QLD 1849); 3 specimens, AM P.77411, Number One Reef, Katai Nab, North of Horn Island, Torres Strait (10°32'30"S 142°10'16"E), 8 m, large brick covered in fine sediment, epiphytes, brown algae *Padina* sp., low turfing algae, 28 September 2006, coll. J. K. Lowry & L. E. Hughes (MI QLD 1850); 1 specimen, AM P.77412, Number One Reef, Katai Nab, North of Horn Island, Torres Strait (10°32'30"S 142°10'16"E), 8 m, large brick covered in fine sediment, epiphytes, brown algae *Padina* sp., low turfing algae, 28 September 2006, coll. J. K. Lowry & L. E. Hughes (MI QLD 1851).

*Cocos (Keeling) Islands*. 5 specimens (4 males and 1 female), AM P.82180, between Direction Island and Prison Island (12°06'S 96°53'E), 4 m, coral head with encrusted algae in channel in rubble, 8 October 1979, coll. F. H. Talbot.

*Papua New Guinea*. Male, dissected, 2 slides, AM P.87616, east side of Pig Island, Madang Lagoon (5°09'S 145°49'E), subtidal pools, red coralline algae *Amphiroa* sp. and other seaweeds, 1 May 1991, coll. J. D. Thomas (JDT/PNG-82); many specimens, AM P.76404, east side of Pig Island, Madang Lagoon (5°09'S 145°49'E), subtidal pools, red coralline algae *Amphiroa* sp. and other seaweeds, 1 May 1991, coll. J. D. Thomas (JDT/PNG-82).

*Fiji*. Male, dissected, 2 slides, AM P.87617, Nukumbutho Reef, Viti Levu, Fiji (18°11'S 178°29'E), no depth, mixed red algae from reef crest, 8 August 1979, coll. A. A. Myers (Stn 8); 24 specimens, AM P.35312, Nukumbutho Reef, Viti Levu, Fiji (18°11'S 178°29'E), no depth, mixed red algae from reef crest, 8 August 1979, coll. A. A. Myers (Stn 8); 41 specimens, AM P.35317, Votualailai, Viti Levu, Fiji (18°10'S 177°32'E), no depth, brown algae *Sargassum cristaefolium* on reef crest, 9 August 1979, coll. A. A. Myers (Stn 12).

*Cook Islands*. 1 specimen, AM P.39381, 2.5 km south of Aorangi village, Raratonga (21°15'06"S 159°43'54"E), 1 m, coral rubble from reef crest, 12 November 1986, coll. A. A. Myers (Stn 2); 6 specimens, AM P.39380, 2.5 km south of

Aorangi village, Raratonga (21°15'06"S 159°43'54"E), 1 m, brown algae *Turbinaria* sp. from reef crest, 12 November 1986, coll. A. A. Myers (Stn 1).

**Remarks.** *Podocerus hanapepe* is recorded from Australia for the first time. Material examined from McCluer Island in the Northern Territory, Torres Strait in Queensland, Cocos (Keeling) Islands in the Indian Ocean and additionally Papua New Guinea. With a distribution range from Hawaii, Fiji, Hong Kong and Madagascar, the new Australian and Papua New Guinea records provide an addition location within this geographic range. Several specimens in the collection from Australian waters differ slightly from that figured for Hawaii in having a 4-articulate antenna 1.

Material examined here from all locations also confirms the presence of studs on the palm medial surface on the male gnathopod 2, as illustrated by Ledoyer, 1986. This character is best observed with the palmar plumose setae removed. SEM images revealed a second unusual character, a discreet indentation or hole in the head above the rostrum, the function of this unique feature is unknown (Fig. 10A,C).

**Distribution.** Australia. Northern Territory, McCluer Island (current study). Cocos (Keeling) Islands. Prison Island (current study). Hawaii: Oahu (J. L. Barnard, 1970). Tonga (Myers, 1990). Fiji. (Myers, 1985). Niue Island (Myers, 1986). Hong Kong (Horton, 2008). Papua New Guinea: Madang Lagoon (current study). Madagascar (Ledoyer, 1986).

### *Podocerus lobatus* (Haswell, 1885)

*Dexiocerella lobata* Haswell, 1885: 110, pl. 18, Figs f6–8.

*Cyrtophium lobatum*.—Chevreux & de Guerne, 1888: 627.

*Platophium l.*—Stebbing, 1888: 1184.

*Platophium orientale*.—Della Valle: 333.

*Podocerus lobatus*.—Stebbing, 1899: 239.—Pirlot, 1938: 358, fig. 161.—Springthorpe & Lowry, 1994: 128.—Lowry & Stoddart, 2003: 246.—Hughes, 2012: 91–98, Figs 18–20.

*Podocerus brasiliensis*.—Kilgallen, 2009: 842–844, Figs 1, 2.

**Type locality.** East of South Head, Port Jackson, New South Wales, Australia (33°50'S 151°18'E).

**Material examined.** *Queensland*. Male, dissected, 2 slides, AM P.87927, North of Third Lagoon, outer reef, One Tree Island (23°29'04"S 152°04'07"E), 18 m, red tufts of algae, 27 October 2006, coll. I. Takeuchi & J. K. Lowry (MI QLD 1980).

**Remarks.** Material examined here was originally cited in Kilgallen, 2009 under *P. brasiliensis*. Close examination and slide preparation of One Tree Island material confirms the re-identification.

**Distribution.** *New South Wales*. Port Stephens (Haswell, 1885); Port Jackson; Clovelly (Hughes, 2012). *Western Australia*. Fremantle; Dongara (Hughes, 2012). *Queensland*. One Tree Island (Kilgallen, 2009). *?Sulawesi*: Aru Islands (Pirlot, 1938).

### *Podocerus miscix* sp. nov.

Figs 12–13

**Type material.** Holotype, male, 2.7 mm, dissected, 2 slides, MAGNT Cr017403, Bedout Island, Western Australia (19°35'S 119°05'E), 3 m, reef flat, 4 June 1985, coll. B. C. Russell (BCR85-9). Paratypes: 1 female, 3.0 mm, dissected, 1 slide, MAGNT Cr017404, Bedout Island, Western Australia (19°35'S 119°05'E), 3 m, reef flat, 4 June 1985, coll. B. C. Russell (BCR85-9); 1 male, 3.2 mm, dissected, 1 slide, MAGNT Cr017405, Bedout Island, Western Australia (19°35'S 119°05'E), 3 m, reef flat, 4 June 1985, coll. B. C. Russell (BCR85-9); 2 specimens (1 hyperadult male, 1 male) MAGNT Cr017406, Bedout Island, Western Australia (19°35'S 119°05'E), 3 m, reef flat, 4 June 1985, coll. B. C. Russell (BCR85-9).

**Type locality.** Bedout Island, Western Australia (19°35'S 119°05'E).

**Etymology.** From the Latin *miscix* meaning changeable, inconstant, in reference to the male gnathopod 2 development with growth stage.

**Diagnosis.** *Gnathopod 1* coxa subequal to coxa 2, longer than broad, anteroventral corner produced anteriorly, apically rounded; carpus rectilinear with truncate lobe; propodus subtriangular, produced distally, palm margin minutely crenulate. *Gnathopod 2* carpus partially fused with propodus; propodus subovate, medial surface without setae, palm subacute, convex, palm with 3 teeth, defined by tooth with 1 robust seta; dactylus posterior margin crenulate with proximal tooth. *Uropod 1* biramus; peduncle with well-developed ventromedial spine, spine 3 times as long as broad.

Hyperadult male. *Gnathopod 2* basis with medial acute projection; propodus subtriangular distal shelf, propodus palm with 1 subtriangular tooth.

Female *Gnathopod 2* propodus, palm with 3 teeth, defined by tooth, with 2 robust setae.

**Description.** Based on holotype male, 2.7 mm, MAGNT Cr017403. *Body* cuticle dorsally and laterally smooth. *Head* dorsally smooth, rostrum short, one tenth of head length; eyes weakly bulging; lateral cephalic lobe rounded; anteroventral corner rounded.

*Gnathopod 1* coxa subequal to coxa 2, longer than broad, anteroventral corner produced anteriorly, apically rounded; basis 3 times as long as broad, without anterodistal setae; carpus rectilinear with truncate lobe, 1.5 times as long as broad; propodus subtriangular, produced distally, anterior margin with clusters of long slender setae, palm margin minutely crenulate, with 1 robust seta near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface smooth. *Gnathopod 2* basis 1.5 times as long as broad, anterodistal corner with produced subacute lobes without setae; merus posterior margin with narrow produced lobe, lobe as long as broad, posterior margin apically subacute, anterior margin without short robust setae; carpus partially fused with propodus; propodus subovate, length 1.6 times width, anterior margin with a few long slender setae, medial surface without setae, palm subacute, convex,  $\frac{3}{4}$  the length of the propodus, with broad, well developed distal shelf, shelf margin strongly crenulate, palm with 3 teeth, defined by tooth with 1 robust seta; dactylus posterior margin smooth with proximal tooth, closing along palm.

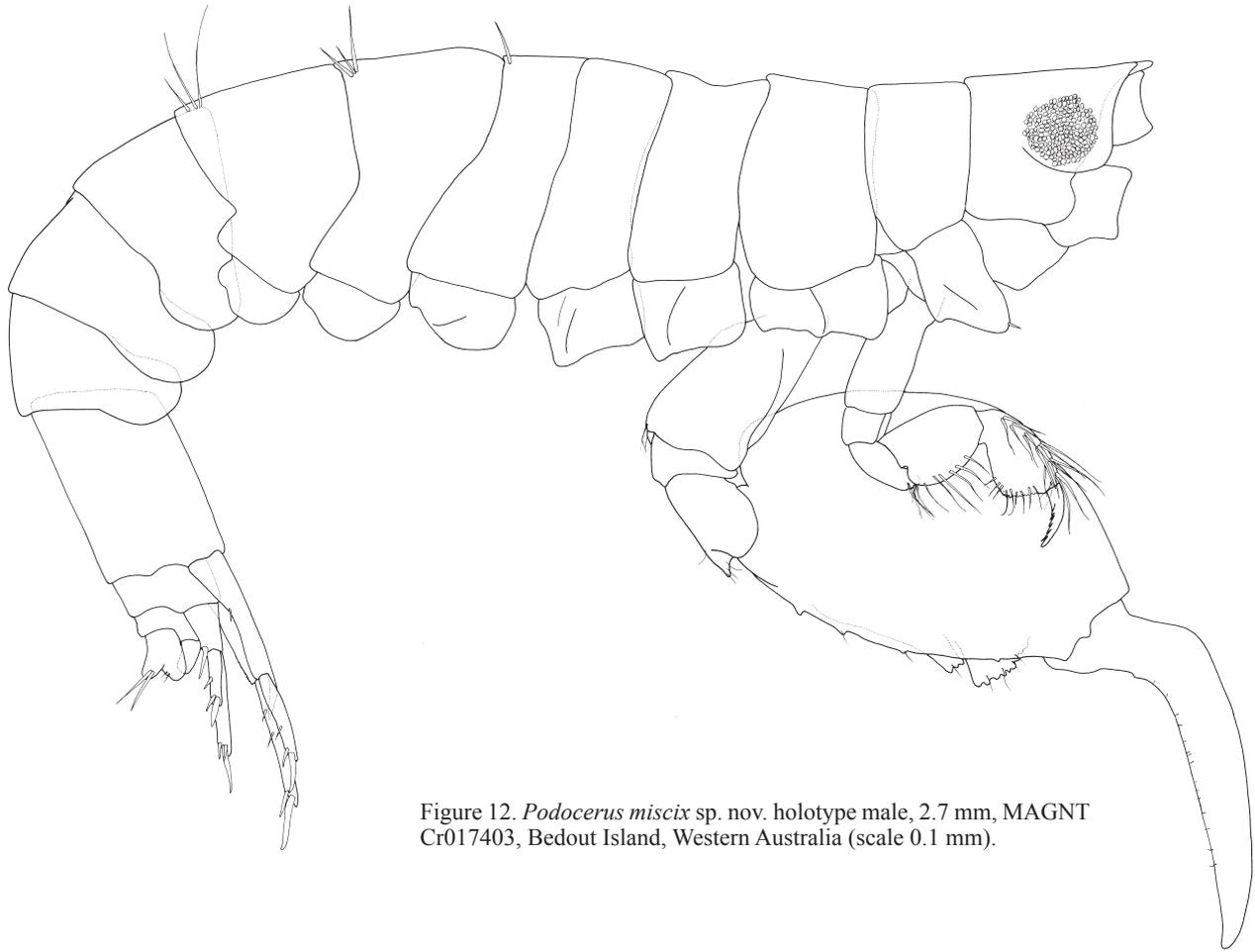


Figure 12. *Podocerus miscix* sp. nov. holotype male, 2.7 mm, MAGNT Cr017403, Bedout Island, Western Australia (scale 0.1 mm).

*Epimera* 1–3 posteroventral corner rounded. *Urosomite* 1 length 1.5 times as long as broad. *Uropod* 1 biramus; peduncle 3 times as long as broad, with well-developed ventromedial spine, spine 3 times as long as broad; inner ramus length subequal to peduncle; outer ramus more than half the length of inner ramus. *Uropod* 2 biramous; peduncle ventromedial spine absent; outer ramus about half the length of inner ramus. *Uropod* 3 uniramus; ramus without setae. *Telson* dorsal lobe with 2 apical setae, lower margin with 2 pair of long slender lateral setae.

Male hyperadult (dimorphic characters) based on paratype male, 3.2 mm. MAGNT Cr017405. *Gnathopod* 2 basis with medial acute projection, anterodistal corner with produced rounded lobes without setae; merus posterior margin with narrow produced lobe, lobe as long as broad, posterior margin apically subacute without setae; propodus subovate, length twice width, palm with well-developed subtriangular distal shelf, propodus palm with 1 subtriangular tooth; dactylus posterior margin weakly denticulate with proximal subquadrate tooth, apically falcate.

Female (sexually dimorphic characters) based on paratype female, 3.0 mm. MAGNT Cr017404. *Gnathopod* 2 basis 3 times long as broad; anterodistal corner subquadrate, with short robust setae; merus posterior margin with broad lobe, lobe 1.3 times as long as broad, with 5 short robust setae; carpus free, distinct from propodus; propodus length 1.5 times width, anterior margin with a few robust setae, palm convex, with poorly developed distal shelf, shelf margin weakly crenulate, palm with 3 teeth, defined by tooth, with 2 robust setae.

**Remarks.** Material figured here of juvenile male, adult male and female share the same carina formulae and gnathopod 1 carpus, propodus and dactylus form, with all specimens from the same sample. The transition from the juvenile male to hyperadult male includes a variation in the number of gnathopod 2 propodus teeth and tooth size. The gnathopod 2 basis in the hyperadult male specimen has 2 anterior projections. The falcate dactylus and posterior margin crenulation indicate the male b specimen is a hyperadult and therefore it seems best to couple it to the other males in the sample with other similarities. The slight elongation of the gnathopod 1 carpus and propodus, and also the gnathopod 2 propodus are typical with increasing specimen size.

The *P. miscix* sp. nov. female gnathopod 2 propodus is relatively large compared to that of other female podocerids. Gravid females with enlarged and sexually dimorphic gnathopods are also known for *P. orontes* sp. nov.

*Podocerus miscix* sp. nov. is similar to *P. clavicarius* sp. nov. and *P. tulearensis* Ledoyer 1986 with a smooth dorsum and large spheroid gnathopod 2. The male gnathopod 2 dactylus extends along or beyond the propodus palm in *P. miscix* sp. nov. and *P. tulearensis*, while it closes short of the palm in *P. clavicarius* sp. nov. *Podocerus tulearensis* is known from a single male specimen where the gnathopod 2 palm has a distal shelf and no teeth (or sinus with weakly developed tooth) and the dactylus is straight, compared with *P. miscix* sp. nov. where the palm has 1 to 4 teeth and a recurved dactylus.

**Distribution.** Western Australia: Bedout Island (current study).

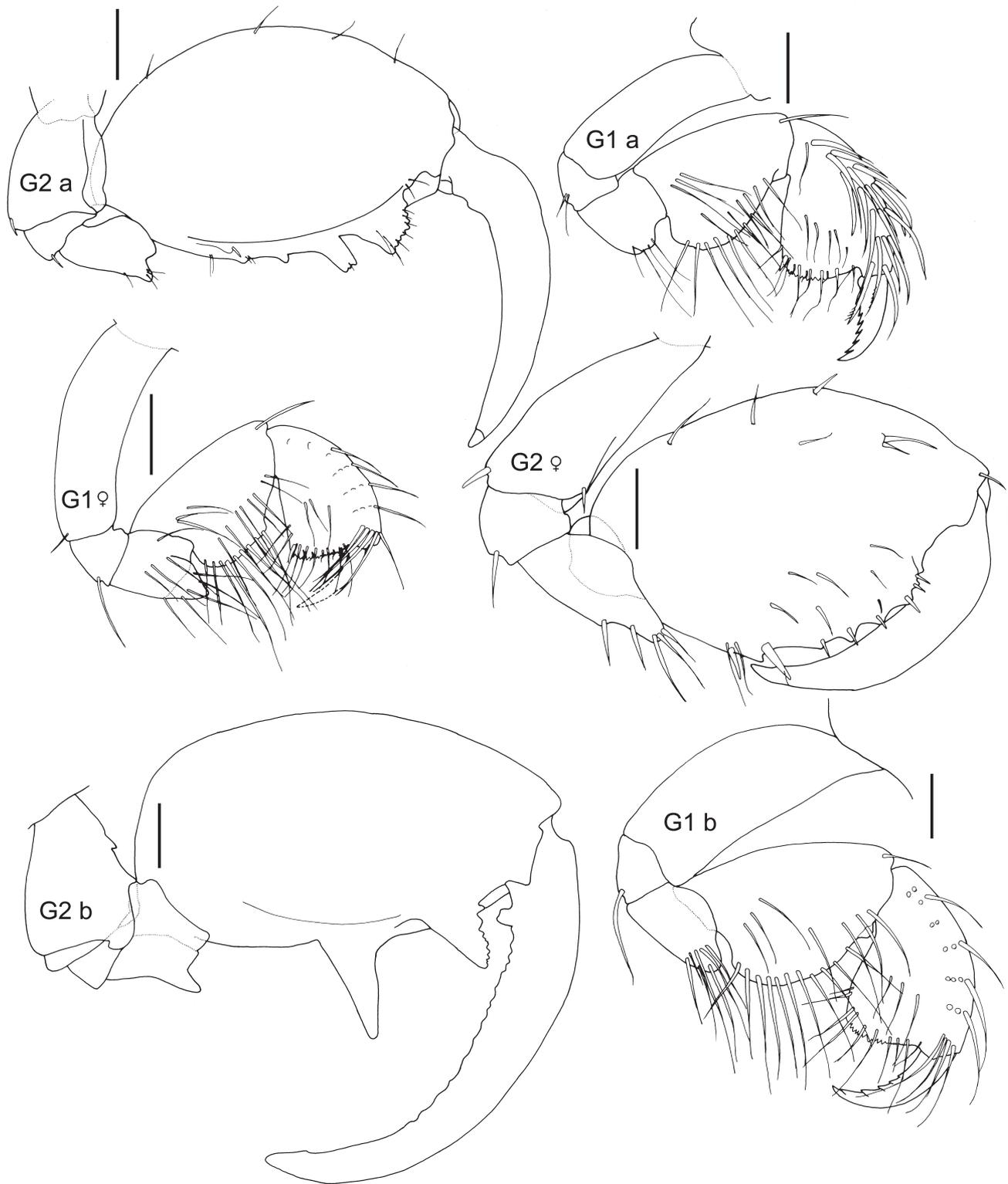


Figure 13. *Podocerus miscix* sp. nov. holotype male, 2.7 mm, MAGNT Cr017403, male b, 3.2 mm, MAGNT Cr017405, and female, 3.0 mm, MAGNT Cr017404, Bedout Island, Western Australia (scale 0.1 mm).

*Podocerus orontes* sp. nov.

Figs 14–17

**Type material.** Holotype male, 7.4 mm, dissected, 3 slides, MAGNT Cr017399, Orontes Reef, Port Essington, Cobourg Peninsula (11°0.4'S 132°4.75'E), 10.15 m, 19 September 1985, coll. C. Hood, L. Vail and R. Williams; paratype female, dissected, 5.9 mm, 1 slide, MAGNT Cr017400, Orontes Reef, Port Essington, Cobourg Peninsula (11°0.4'S 132°4.75'E), 10.15 m, 19 September 1985, coll. C. Hood, L. Vail and R. Williams; paratype male, SEM pin mount, AM P.85669, Orontes Reef, Port Essington, Cobourg Peninsula (11°0.4'S 132°4.75'E), 19 September 1985; paratypes 10 + specimens, MAGNT Cr004975, Orontes Reef, Port Essington, Cobourg Peninsula (11°0.4'S 132°4.75'E), 10.15 m, 19 September 1985, coll. C. Hood, L. Vail and R. Williams; 1 male, 6.2 mm, SEM pin mount, AM P. 87034, Orontes Reef, Port Essington, Cobourg Peninsula (11°0.4'S 132°4.75'E), 19 September 1985; 10+ specimens, MAGNT Cr011685, north of North West Vernon Island, Beagle Gulf (12°1.02'S 131°1.86'E), 38 m, shale and gravel, 11 October 1993, coll. K. E. Coombes.

**Type locality.** Orontes Reef, Port Essington, Cobourg Peninsula, Northern Territory (11°0.4'S 132°4.75'E).

**Etymology.** Named from the type locality, applied as a noun in apposition.

**Additional material examined.** *Northern Territory.* 2 specimens (1 male, 1 female), MAGNT Cr012180, west of North Peron Island, Timor Sea (13°10.26'S 129°55.62'E), 15 m, coarse sand and shale, 3 October 1993, coll. R. Williams; 1 male specimens, MAGNT Cr015891, northwest of Middle Point, Darwin Harbour (12.5'S 130.85'E), 3–4 m, sand, silt weed and sponges, 30 May 1989, coll. K. Coombes & R. Williams; female, 7.8 mm, SEM pin mount carcass and dissection, 1 slide, AM P.87031, Area C East, Arafura Sea (9°22'59"S 134°09'47"E), 108 m, several large rocks, bioclastic gravel and sand, Smith-McIntyre grab, 11 May 2005, coll. G. D. F. Wilson (SS05/2005/019/GR033); 3 specimens, AM P.79144, Area C East, Arafura Sea (9°22'59"S 134°09'47"E), 108 m, several large rocks, bioclastic gravel and sand, Smith-McIntyre grab, 11 May 2005, coll. G. D. F. Wilson (SS05/2005/019/GR033); female, dissection, 1 slide, AM P.87623, Area C East, Arafura Sea (9°22'59"S 134°09'47"E), 108 m, several large rocks, bioclastic gravel and sand, Smith-McIntyre grab, 11 May 2005, coll. G. D. F. Wilson (SS05/2005/019/GR033).

*Western Australia.* Female gravid, 9.2 mm, dissected, AM P.87629, Van Diemen Rise, eastern Joseph Bonaparte Gulf, Timor Sea (11°08'21"S 129°55'00"E), 31 m, Smith-McIntyre grab, 4 September 2009, Geoscience Australia, RV *Solander* (SOL 21GR29); male, 6.4 mm, dissected, AM P.87630, Van Diemen Rise, eastern Joseph Bonaparte Gulf, Timor Sea (11°37'21"S 129°50'07"E), 34 m, Smith-McIntyre grab, 17 September 2009, Geoscience Australia, RV *Solander* (SOL41GR77); male (damaged), AM P.87631, Van Diemen Rise, eastern Joseph Bonaparte Gulf, Timor Sea (12°24'14"S 129°58'10"E), 40 m, Smith-McIntyre grab, 19 September 2009, Geoscience Australia, RV *Solander* (SOL 48GR91); very small male, AM P.84680, Carnarvon Shelf (23°46'18"S 113°20'37"E), 44 m, Smith-McIntyre grab, 7 August 2008, coll. Geoscience Australia: Marine and Coastal Environment Group (SOL 105GR02).

**Diagnosis.** *Head* rostrum weakly developed, almost absent; eyes not protruding from head. *Gnathopod 1* coxa larger than coxa 2, as broad as long, anteroventral corner not produced, apically rounded; carpus rectilinear, 2.5 times as long as broad; propodus subtriangular. *Gnathopod 2* merus posterior margin lined with dense brush of setae; propodus elongate subovoid, length 2.3 times width, palm with one proximal subtriangular and one small distal tooth, palm poorly defined. *Pereonite 6* dorsal carina broad, produced posteriorly, subtriangular, apically subacute. *Pereonite 7* dorsal carina produced posteriorly, subtriangular, apically rounded. *Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded. *Epimera 1–3* posteroventral corner rounded. *Uropod 1* with well-developed ventromedial spine, spine twice as long as broad. *Uropod 2* biramous, ventromedial spine as long as broad. *Telson* dorsal lobe with 2 long and 2 short apical setae.

Female. *Gnathopod 2* merus with 2 apical robust setae; propodus length 2.1 times width, propodus palm with large crenulate medial tooth, palm defined by corner with tooth and 1 robust seta; dactylus closing short of palm end.

**Description.** Based on holotype male, 7.4 mm. MAGNT Cr17399. *Body* cuticle with posterior dorsal carinae, laterally smooth. *Head* dorsally smooth; rostrum weakly developed, almost absent; eyes not protruding from head; lateral cephalic lobe subquadrate; anteroventral corner rounded. *Antenna 1* (based on paratype female MAGNT Cr017400) subequal to body; peduncle article 2 subequal to article 3; primary flagellum 0.7 peduncle length; accessory flagellum 1-articulate, 5 times as long as broad. *Antenna 2* distinctly longer than antenna 1, 1.5 times body length with dense concentration of long slender setae along posterior margin; article 4 subequal to article 5; flagellum about 0.25 times peduncle length. *Antennae 2* flagellum posterior margin with line of short robust setae. *Mandible* accessory setal row with 2 setae. *Maxilla 1* palp distal margin with 5 robust setae.

*Gnathopod 1* coxa larger than coxa 2, as broad as long, anteroventral corner not produced, apically rounded; basis 3 times as long as broad, without anterodistal setae; carpus rectilinear, 2.5 times as long as broad; propodus subtriangular, anterior margin with clusters of long slender setae, palm margin smooth with 6 robust setae near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface serrate. *Gnathopod 2* basis 2.1 times as long as broad, anterodistal corner produced, rounded lobes with robust setae; merus posterior margin lined with dense brush of setae, with broad produced lobe, lobe 1.1 times as broad as long, apically rounded, without robust setae; carpus free, distinct from propodus; propodus elongate subovoid, length 2.3 times width, anterior margin with clusters of short robust setae, medial surface with dense plumose setae, palm straight, lined with dense bunch of plumose setae, with broad, well developed distal shelf, shelf margin smooth, propodus palm with one proximal subtriangular and one small distal tooth, palm poorly defined; dactylus extending the length of palm. *Pereonite 6* dorsal carina broad, produced posteriorly, subtriangular, apically subacute. *Pereonite 7* dorsal carina produced posteriorly, subtriangular, apically rounded.

*Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded. *Epimera 1–3* posteroventral corner rounded. *Uropod 1* biramous; peduncle 4 times as long as broad, with well-developed ventromedial spine, spine twice as long as broad; inner ramus 1.3 times peduncle

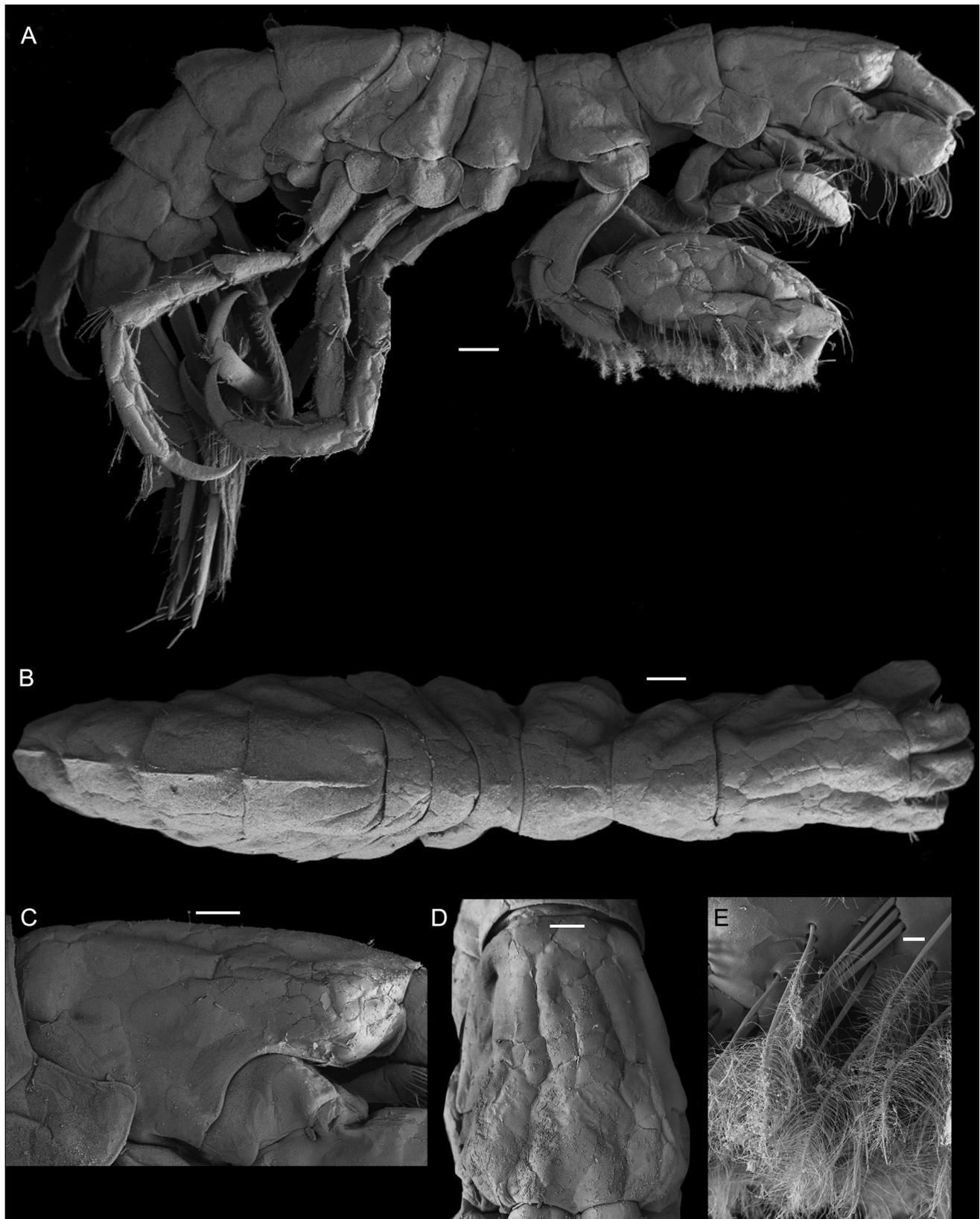


Figure 14. *Podocerus ornontes* sp. nov. male, 6.2 mm, AM P.87034, Cobourg Peninsula, Northern Territory. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) whole animal dorsal view (scale 200  $\mu$ m); (C) head lateral view (scale 100  $\mu$ m); (D) head dorsal view (scale 100  $\mu$ m) and (E) gnathopod 2 propodus palm plumose setae (scale 20  $\mu$ m).

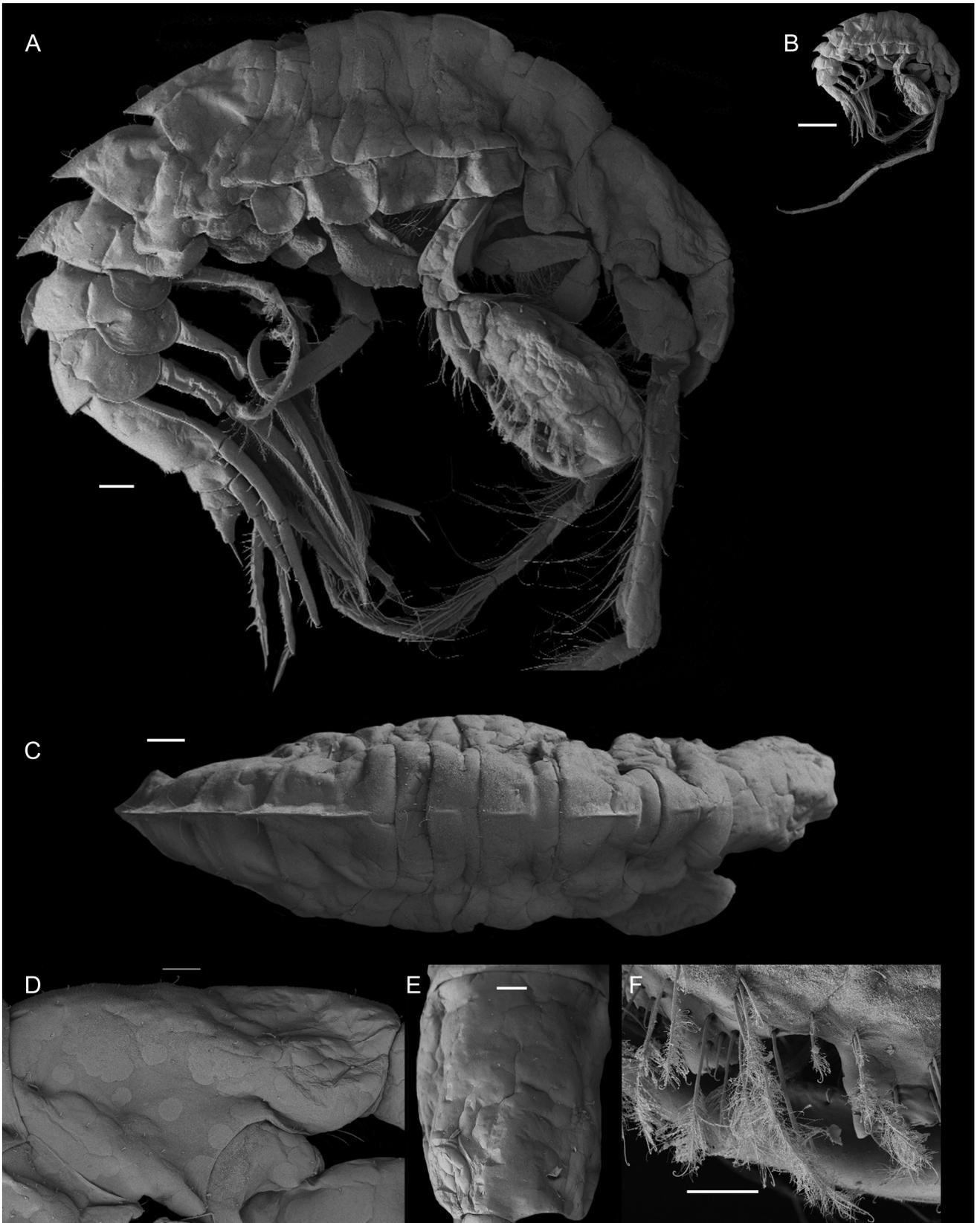


Figure 15. *Podocerus ornontes* sp. nov. female, 7.8 mm, AM P.87031, Cobourg Peninsula, Northern Territory. SEM photographs: (A) whole animal lateral view (scale 200  $\mu\text{m}$ ); (B) whole animal dorsal view whole animal lateral view with antennae (scale 1 mm); (C) whole animal dorsal view (scale 200  $\mu\text{m}$ ) (D) head lateral view (scale 100  $\mu\text{m}$ ); (E) head dorsal view (scale 100  $\mu\text{m}$ ); and (F) gnathopod 2 propodus palm plumose setae (scale 100  $\mu\text{m}$ ).

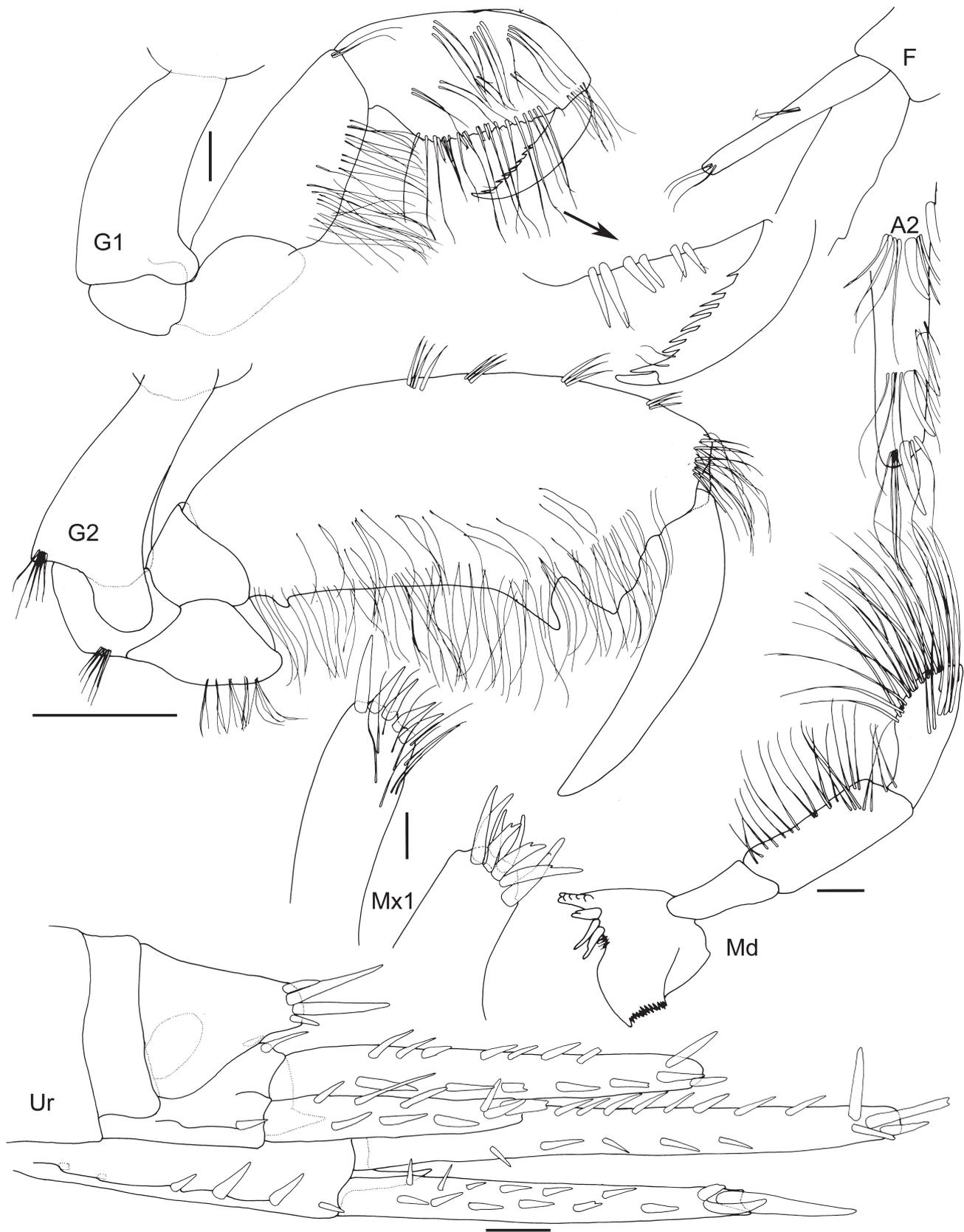


Figure 16. *Podocerus ornontes* sp. nov. holotype male, 7.4 mm, MAGNT Cr17399, Orontes Reef, Northern Territory, scale 0.1 mm.

length; outer ramus 0.75 times length of the inner ramus. *Uropod 2* biramous, ventromedial spine as long as broad; outer ramus 0.5 times length of inner ramus. *Uropod 3* uniramous; ramus without setae. *Telson* dorsal lobe with 2

long and 2 short apical setae, lower margin without lateral or apical setae.

Female (sexually dimorphic characters) based on paratype female, 5.9 mm. MAGNT Cr17400.

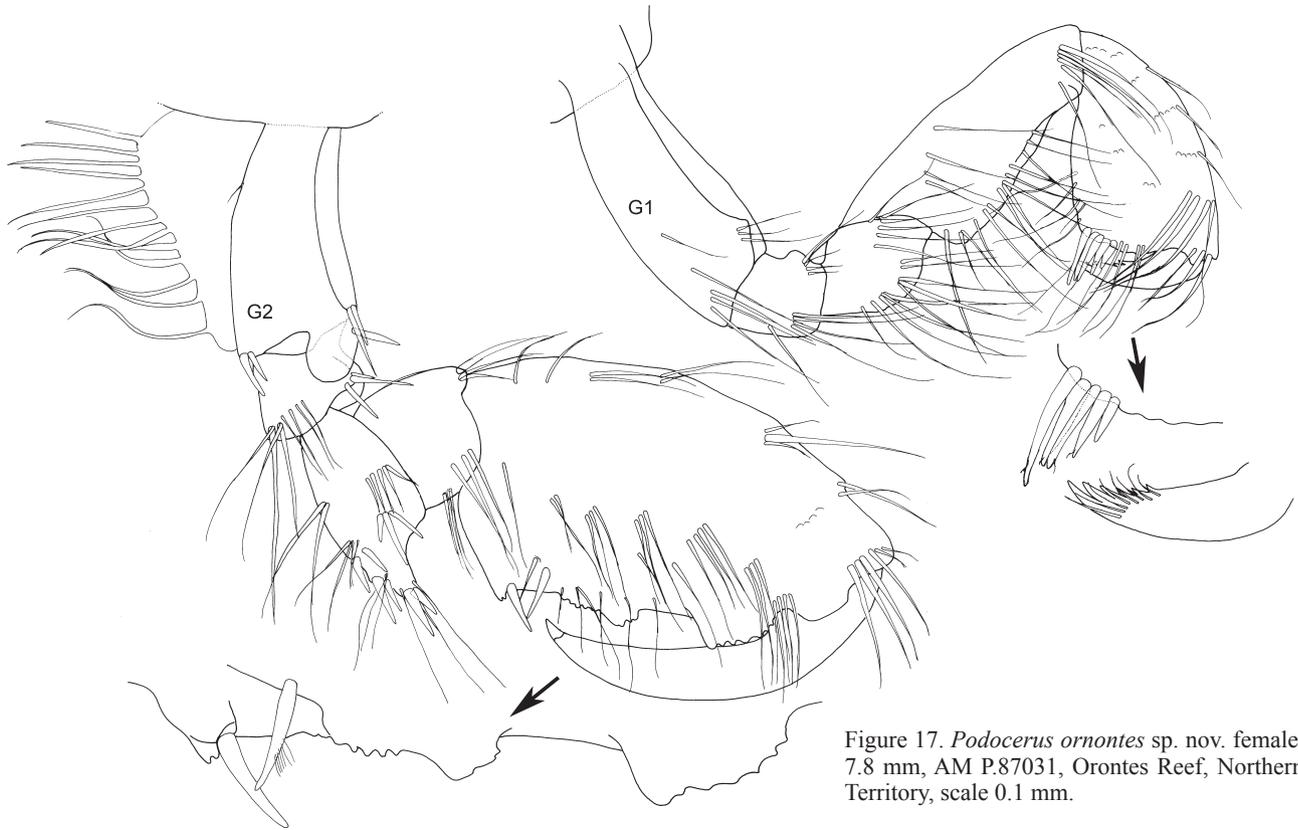


Figure 17. *Podocerus orontes* sp. nov. female, 7.8 mm, AM P.87031, Orontes Reef, Northern Territory, scale 0.1 mm.

*Gnathopod 2* basis twice as long as broad, anterodistal corner with long robust setae; merus posterior margin narrow, lobes as long as broad, apically subacute with 2 apical robust setae; propodus length 2.1 times width, palm acute, straight,  $\frac{2}{3}$  the length of the propodus with well-developed shelf, shelf margin strongly crenulate, propodus palm with large crenulate medial tooth, palm defined by corner with tooth and 1 robust seta; dactylus closing short of palm end.

**Variation.** In male and female adult specimens the pereonites 6–7 and pleonites 1–2 carina may be rounded, subacute or acute. This variation was not related to the gender or growth stage of specimens and was observed in material from several locations.

**Remarks.** The enlarged female gnathopod 2 in *P. orontes* sp. nov. is a more extreme example of sexual dimorphism than previous reported within the Podoceridae. The dorsal carina formula, form of gnathopod 1 and the consistent presence of the male and female morphotypes in samples from multiple locations over 100 km apart supports the idea that individuals are conspecific (as opposed to mismatched sexes). In both male and females the rounded and acute apical carina forms, not related to gender or growth stage, have been noted for *P. ferreus* sp. nov.

The combination of four carina on the dorsum is known for *P. fulanus* Barnard, 1970 (males and females) and *P. ferreus* sp. nov. *Podocerus orontes* sp. nov. males can be separated from all other podoceric species by the combination of the male gnathopod 2 propodus palm with distal shelf and 1 large distal tooth, as well as the uropod 1 and 2 with ventromedial spine. The distal shelf and tooth of gnathopod 2 are similar in *P. gloriosae* Ledoyer, 1986 from

Madagascar but this species has additional dorsal carina and no uropod ventromedial spines.

The female gnathopod 2 propodus palm with several broad multidentate teeth is currently unique compared to other male and female podocerids. A further distinguishing feature of *P. orontes* sp. nov. in both sexes is the gnathopod 1 elongate carpus (length 2.5 times breadth).

**Distribution.** Australia. Northern Territory: Port Essington, Timor Sea, Beagle Gulf, Darwin Harbour, North West Shelf (current study).

### *Podocerus rockingham* sp. nov.

Figs 18–19

**Type material.** Holotype male, 3.8 mm, dissected, 3 slides, WAM C.51669, reef west of groyne, 2 km south of Cape Peron (32°16'S 115°41'E), 3 m, brown algae in deep channels in limestone reef, 26 December 1983, coll. R. Springthorpe (WA 310); paratype female, 3.2 mm, dissected, 1 slide (poor condition), AM P.87619, reef west of groyne, 2 km south of Cape Peron (32°16'S 115°41'E), 3 m, brown algae in deep channels in limestone reef, 26 December 1983, coll. R. Springthorpe (WA 310); paratype male, 3.6 mm, SEM pin mount, AM P.85666, reef west of groyne, 2 km south of Cape Peron (32°16'S 115°41'E), 3 m, brown algae in deep channels in limestone reef, 26 December 1983, coll. R. Springthorpe (WA 310); paratypes many specimens, AM P.79830, reef west of groyne, 2 km south of Cape Peron (32°16'S 115°41'E), 3 m, brown algae in deep channels in limestone reef, 26 December 1983, coll. R. Springthorpe (WA 310).

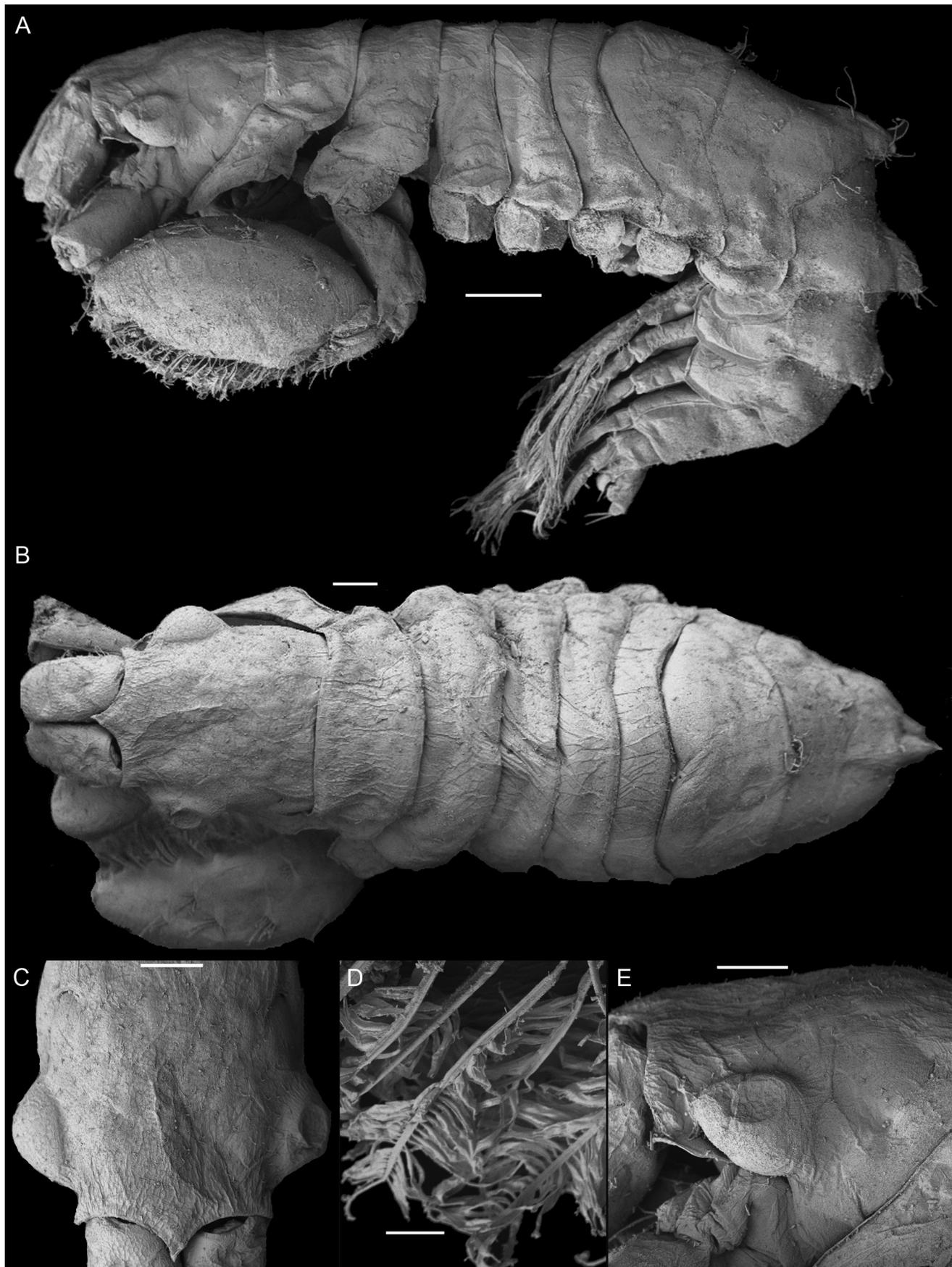


Figure 18. *Podocerus rockingham* sp. nov. paratype male, 3.6 mm, AM P.85666, Cape Peron, Western Australia. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) whole animal dorsal view (scale 100  $\mu$ m); (C) head dorsal view (scale 100  $\mu$ m); (D) gnatopod 2 propodus palm plumose setae (scale 20  $\mu$ m) and (E) head lateral view (scale 100  $\mu$ m).

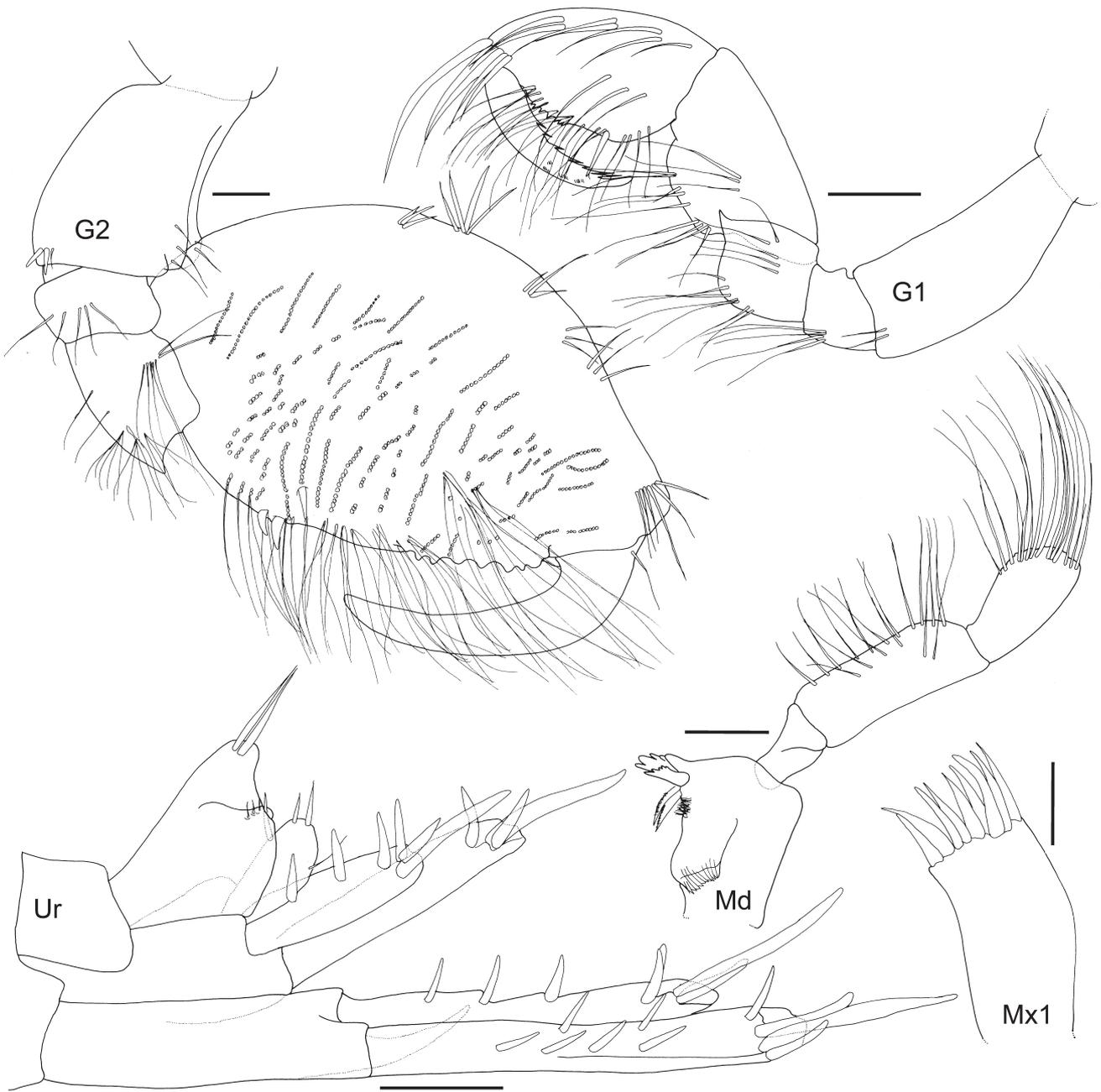


Figure 19. *Podocerus rockingham* sp. nov. holotype male, 3.8 mm, AM P.87618, Cape Peron, Western Australia (scale 0.1 mm).

**Type locality.** Cape Peron, Western Australia (32°16'S 115°41'E).

**Etymology.** Named after the town of Rockingham, a settlement near the type locality. Applied as a noun in apposition.

**Additional material examined.** Male, AM P.79489, rocks near shore, Canal Rocks, south of Yallingup (33°40'16"S 114°59'40"E), 0.5 m, on narrow-leaved brown alga *Sargassum* sp., 6 December 2000, coll. R. A. Peart (WA 745); male, AM P.79491, rocks near shore, Canal Rocks, south of Yallingup (33°40'16"S 114°59'40"E), 0.5 m, on broad-leaved brown alga *Sargassum* sp., 6 December 2000, coll. R. A. Peart (WA 741).

**Diagnosis.** Body cuticle with sparse slender setae. *Gnathopod 1* as broad as long, anteroventral corner greatly produced ventrally, apically subacute. *Gnathopod 2* carpus

indistinct, fused with propodus; propodus subovate, with weakly developed distal shelf, shelf margin strongly crenulate, palm without teeth or sinus, defined by 3 robust setae; dactylus closing short of palm end. *Pereonite 7* dorsal carina broad, produced posteriorly, subtriangular, apically rounded. *Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded; *epimeron 1* posteroventral corner rounded. *Urosomite 1* length 1.5 times as long as broad. *Uropod 1* peduncle 2 with well-developed ventromedial spine, spine 3 times as long as broad.

**Description.** Based on holotype male, 3.8 mm. WAM C51669J. *Body* cuticle with posterior dorsal carinae, laterally smooth with sparse slender setae.

*Head* dorsally smooth; rostrum short, one tenth of head length; eyes greatly bulging; lateral cephalic lobe subacute; anteroventral corner subquadrate. Mouthparts. *Mandible*

accessory setal row with 5 setae. *Maxilla 1* palp distal margin with 2 robust setae.

*Gnathopod 1* coxa larger than coxa 2, as broad as long, anteroventral corner greatly produced ventrally, apically subacute; basis 2.5 times as long as broad, without anterodistal setae; carpus rectilinear with truncate lobe, lobe twice as long as broad; propodus subrectangular, anterior margin with clusters of long slender setae, palm margin minutely crenulate, with 1 robust seta near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface with raised serrations. *Gnathopod 2* basis 1.5 times long as broad; anterodistal corner subquadrate without lobes with long slender setae; merus posterior margin with rows of slender setae and narrow produced lobe, lobe as long as broad, apically acute, without robust setae; carpus indistinct, fused with propodus; propodus subovate, length 1.8 times width, anterior margin with clusters of long robust setae, medial surface with dense plumose setae, palm acute, straight,  $\frac{2}{3}$  the length of the propodus with weakly developed distal shelf, shelf margin strongly crenulate, palm without teeth or sinus, defined by 3 robust setae; dactylus closing short of palm end. *Pereonite 7* dorsal carina broad, produced posteriorly, subtriangular, apically rounded.

*Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically rounded; *epimeron 1* posteroventral corner rounded. *Epimera 2–3* posteroventral corner subquadrate. *Urosomite 1* length 1.5 times as long as broad. *Uropod 1* biramus; peduncle 2.5 times as long as broad, with well-developed ventromedial spine, spine 3 times as long as broad; inner ramus 1.3 times peduncle length; outer ramus  $\frac{3}{4}$  the length of the inner ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus  $\frac{3}{4}$  length of inner ramus. *Uropod 3* uniramous; ramus with apical setae. *Telson* dorsal lobe with 2 apical setae, lower margin with pair of slender apical setae.

**Remarks.** The male gnathopod 2 propodus in *P. rockingham* sp. nov. and *P. akanthius* Hughes, 2012, from South Australia, have a weakly developed distal shelf and crenulate palmar margin without teeth, similar to *P. karu* J. L. Barnard, 1972 from New Zealand and *P. manawatu* J. L. Barnard, 1972, recorded in New Zealand and southern Australia. *Podocerus rockingham* sp. nov. and *P. akanthius* have three dorsal carinae and uropod 2 without a ventromedial spine, separating them from the dorsally smooth *P. karu* and *P. manawatu* which have a ventromedial spine on uropod 2.

The relationship between *P. rockingham* sp. nov. and *P. akanthius* is very close with regard to the three dorsal carinae, the distinctive gnathopod 1 coxa greatly attenuated and projecting ventrally, and the gnathopod 1 propodus shape. *Podocerus rockingham* sp. nov. can be distinguished by the apically rounded dorsal carina, the more subovate gnathopod 2 propodus, medial surface with dense setae and palm crenulate along only part of the margin. The apically rounded carinae are consistent in *P. rockingham* sp. nov. from juveniles, as small as 2.0 mm, to adult specimens. In *P. akanthius* the dorsal carinae have acute apices and the gnathopod 2 is slightly longer, less setose and with the palm weakly crenulate along the entire margin.

Interestingly, the gnathopod 2 propodus palm as either partially crenulate or fully crenulate is a relationship noted between the New Zealand species *P. karu* and *P. manawatu* by Barnard 1970, respectively.

**Distribution.** Western Australia: Cape Peron, Yallingup.

## *Podocerus talegus lawai* J. L. Barnard, 1970

Figs 20–21

*Podocerus talegus lawai* J. L. Barnard, 1970: 241–243, Figs 160, 161.—Myers, 1990: 149–157.

**Type locality.** Off Ewa Beach, Oahu, Hawaii.

**Material examined.** Male, 3.8 mm, dissected, 2 slides, AM P.87620, bommies, north west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); 10 specimens, AM P.78306, bommies, north west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); female, 3.2 mm, dissected, 1 slide, AM P.87621, bommies, north west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); male, SEM pin mount, 3.3 mm, AM P.85668, bommies, north west end, McCluer Island (11°02'S 132°58'E), 8 m, branching brown algae, 16 October 1982, coll. G. C. B. Poore (NT 32); 7 specimens, AM P.78305, reef, north side of New Year Island (10°54'S 133°02'E), 2 m, red algae, 13 October 1982, coll. G. C. B. Poore, (NT 1); many specimens, AM P.78312, south end, McCluer Island (11°06'S 133°00'E), 8 m, coral base *Acropora* sp., 17 October 1982, coll. P. Horner, (NT 59); 3 specimens, AM P.78310 south end, McCluer Island, (11°06'S 133°00'E), 8 m, red algae, 17 October 1982 coll. J. K. Lowry (NT 58).

**Diagnosis.** *Body* cuticle dorsally and laterally smooth with sparse slender setae. *Gnathopod 2* carpus indistinct, fused with propodus; propodus palm with one rectangular and one subtriangular tooth, palm poorly defined without corner, tooth or robust setae; dactylus extending length of propodus.

**Description.** Based on male, 3.8 mm. AM P.87620. *Body* cuticle dorsally and laterally smooth with sparse slender setae. *Head* dorsally smooth; rostrum short, one tenth of head length; eyes greatly bulging; lateral cephalic lobe subquadrate; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 robust setae. *Maxilla 1* palp distal margin with 5 robust setae.

*Gnathopod 1* coxa subequal to coxa 2, as broad as long, anteroventral corner produced anteriorly, apically subacute; basis 3 times as long as broad, basis with a few long slender anterodistal setae; carpus rectilinear, twice as long as broad; propodus subtriangular, anterior margin with clusters of long slender setae, propodus palm margin minutely crenulate, with 1 robust seta near corner of palm; dactylus posterior margin with serrate teeth. *Gnathopod 2* basis twice long as broad, anterodistal corner lobe subacute with a few long slender setae; merus posterior margin with rows of slender setae, with narrow produced lobe, lobe as long as broad, apically acute, without robust setae; carpus indistinct, fused with propodus; propodus elongate subovoid, length twice width, anterior margin with clusters of short slender setae, medial surface with dense plumose setae, palm acute, convex, with broad, well developed distal shelf, shelf margin smooth, palm with one rectangular and one subtriangular tooth, palm poorly defined without corner, tooth or robust setae; dactylus extending length of propodus.

*Epimera 1–3* posteroventral corner rounded. *Urosomite 1* length 1.2 times as long as broad. *Uropod 1* biramus; peduncle 3 times as long as broad with well-developed

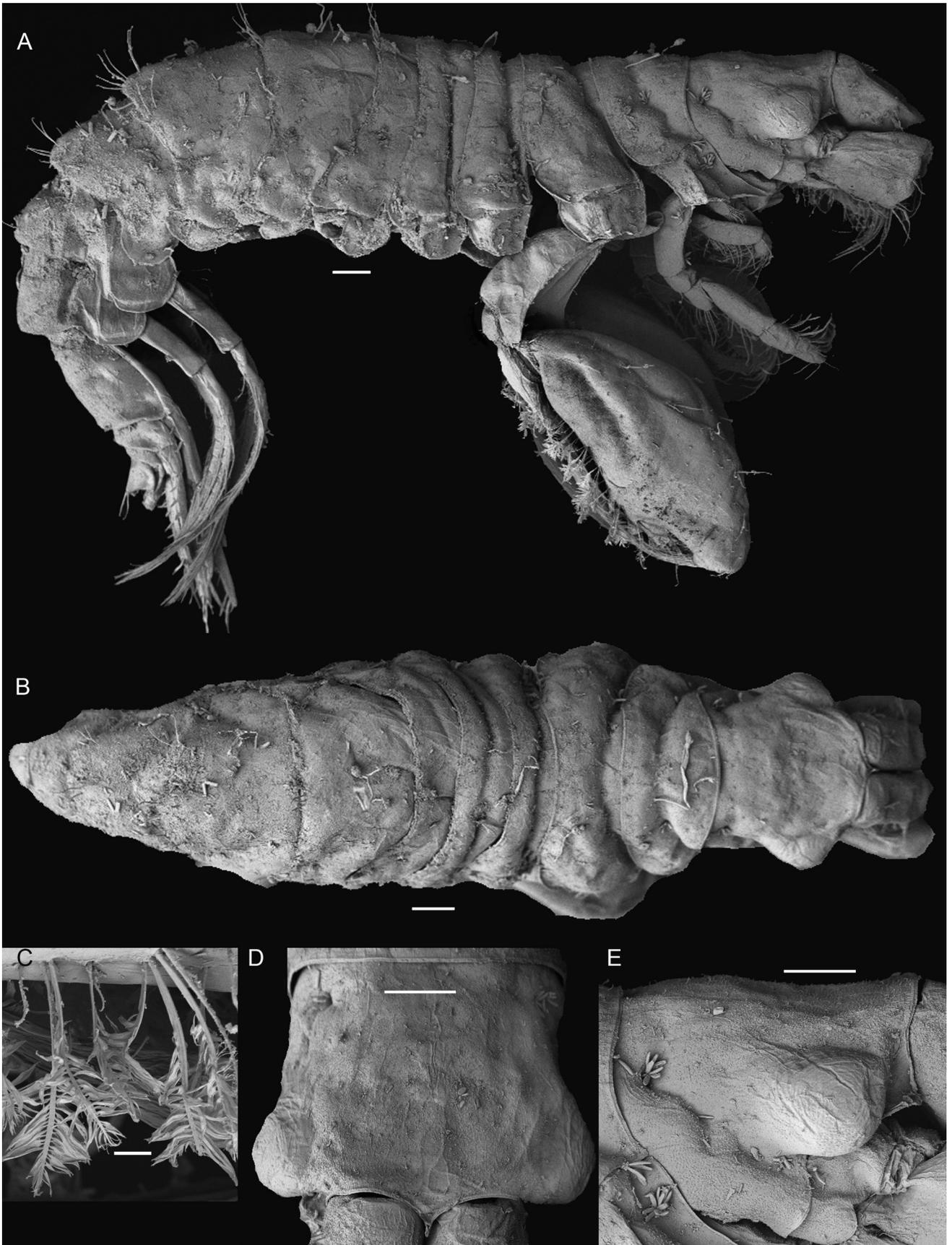


Figure 20. *Podocerus talegus lawai* Barnard, 1970, male, 3.3 mm, AM P.85668, McCluer Island, Northern Territory. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) whole animal dorsal view (scale 200  $\mu$ m); (C) gnathopod 2 propodus palm plumose setae (scale 20  $\mu$ m); (D) head dorsal view (scale 100  $\mu$ m) and (E) head lateral view (scale 100  $\mu$ m).

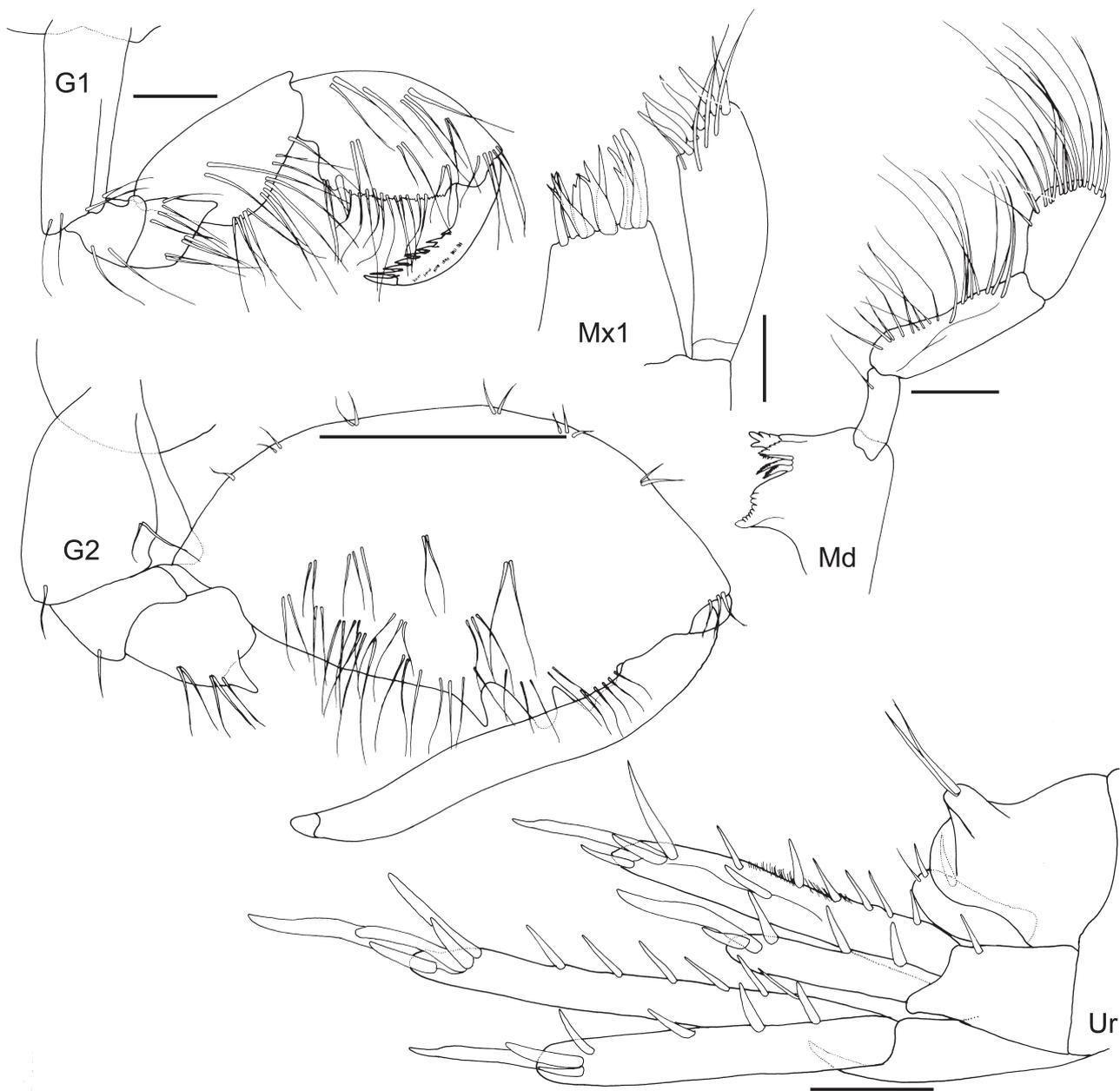


Figure 21. *Podocerus talegus lawai* Barnard, 1970, male, 3.8 mm, AM P.87620, McCluer Island, Northern Territory, scale 0.1 mm.

ventromedial spine, spine 4 times as long as broad; inner ramus 1.8 times peduncle length; outer ramus about  $\frac{3}{4}$  the length of the inner ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus about half the length of inner ramus. *Uropod 3* uniramous; ramus with 3 apical setae. *Telson* dorsal lobe with 2 apical setae, lower margin without apical and lateral setae.

**Remarks.** This report of *P. talegus lawai* in the Northern Territory is a significant range extension, with its original description from Hawaii (J. L. Barnard, 1970) and subsequent report from Tonga (Myers, 1990). Despite the large geographic distance there is little morphological variation in the material reported. The male gnathopod 2 propodus teeth are more developed and the dactylus more

stout in the material figured from the Northern Territory in comparison to other locations, however these features are associated with growth stages.

The male gnathopod 2 propodus palm acute and elongate dactylus define *P. talegus lawai*, *P. gloriosae* Ledoyer, 1986, *P. madagascarensis* Ledoyer, 1986 and *P. orontes* sp. nov. Both *P. talegus lawai* and *P. madagascarensis* have two teeth along the palm separating it from this species group. The shape of the gnathopod 1 coxa best distinguishes, *P. talegus lawai* where the anterior corner is not produced while well produced in *P. madagascarensis*.

**Distribution.** Australia. Northern Territory, McCluer Island, New Year Island (current study). Hawaii. Oahu (J. L. Barnard, 1970). Tonga (Myers, 1990).

***Podocerus walkeri* Rabindranath, 1972**

Figs 22–23

- Platophium laeve* Walker, 1904: 295–296, pl. 7, fig. 51.  
*Podocerus walkeri* Rabindranath, 1972: 299–302, fig. 1.—  
 Ledoyer, 1979b: 172, fig. 16.  
*Podocerus* sp. Ortiz & Lalana, 1997: 29–113 (in part).  
*Podocerus sandroruffoi* Ortiz & Lalana, 2003: 61–66, figs  
 1, 2.  
*Podocerus andamanensis*.—Wongkamhaeng, Darakrai &  
 Pholpunthin, 2009: 16–19, figs 16, 17.

**Type locality.** Pamban Coast, Gulf of Mannar, India.

**Material examined.** Australia. *Western Australia.* Male, dissected, 4.8 mm, 4 slides, AM P.83810, Jackson Island, Cape Leveque (16°25'19"S 123°05'19"E), 7 m, brown algae *Sargassum* sp., 27 May 2010, coll. J. K. Lowry (MI WA 1141); female, 4.2 mm, dissected, 1 slide, AM P.87623, Jackson Island, Cape Leveque (16°25'19"S 123°05'19"E), 7 m, brown algae *Sargassum* sp., 27 May 2010, coll. J. K. Lowry (MI WA 1141); male, dissected, 1 slide, AM P.87622, south of Nelson Rocks, Dampier Archipelago (20°26'31"S 116°40'14"E), 5 m, on brown algae *Dictyopteris* sp., 7 September 1999, coll. P. Morrison (WA 715); male, 4.1 mm, SEM pin mount, AM P.87033, south of Nelson Rocks, Dampier Archipelago (20°26'31"S 116°40'14"E), 5 m, on brown algae *Dictyopteris* sp., 7 September 1999, coll. P. Morrison (WA 715); 14 specimens, WAM C51670, south of Nelson Rocks, Dampier Archipelago (20°26'31"S 116°40'14"E), 5 m, on brown algae *Dictyopteris* sp., 7 September 1999, coll. P. Morrison (WA 715); 2 specimens, AM P.79831, 500 m offshore at Bush Bay, 30 km south of Carnarvon (25°10'S 113°39'E), 0.5 m, branching sea grass, 6 January 1984, coll. J. K. Lowry and R. T. Springthorpe (WA 426); 7 specimens, AM P.79833, 500 m offshore at Bush Bay, 30 km south of Carnarvon (25°10'S 113°39'E), 2 m, airlift, seagrass detritus, 6 January 1984, coll. J. K. Lowry and R. T. Springthorpe (WA 431).

*Northern Territory.* 5 specimens (3 males and 2 females), AM P.87624, bommies, north west end, McCluer Island (11°02'S 132°58'E), 6 m, brown algae, top of reef, 16 October 1982, coll. J. K. Lowry (NT 48); 2 male specimens, MAGNT Cr017402, Black Point, Port Essington, Cobourg Peninsula (11°09.0'S 132°08.2'E), 1–2 m, brown algae *Sargassum* sp. washings, 18 July 1981, coll. A. J. Bruce and J. N. A. Hooper (CP 10).

*Queensland.* Male, dissected, 1 slide, AM P.87625, Cockle Bay, Magnetic Island (19°11'S 146°49'E), depth unknown, seagrass: *Cymodocea serrulata*, *Halodule uninervis* and *Halophila ovalis*, coll. D. W. Klumpp & S. N. Kwak, 17 February 1999 to 16 August 2000; many specimens, AM P.80580, Cockle Bay, Magnetic Island (19°11'S 146°49'E), depth unknown, seagrass: *Cymodocea serrulata*, *Halodule uninervis* and *Halophila ovalis*, coll. D. W. Klumpp & S. N. Kwak, 17 February 1999 to 16 August 2000.

*New South Wales.* Male, dissected, 3 slides, AM P.87626, Carols Wharf, Scotland Island, Broken Bay (33°38'39.66"S 151°17'29.17"E), 0–1 m, fouling material on boat (including brown algae *Padina* sp., calcareous bryozoans, solitary and colonial ascidians, black sponge), 14 January 2011, coll. L. E. Hughes (MI NSW 4012); male specimen, AM P.87931, end of sand spit, Kurnell, Botany Bay (34°24"S 151°11'E), 10 May 1972, coll. NSW Fisheries.

**Diagnosis.** *Gnathopod 1* coxa subequal to coxa 2. *Gnathopod 2* articles lined with clusters of robust setae; propodus palm distal shelf poorly developed, palm lined with two rows of short robust setae, without teeth or sinus. *Pereonites 6–7* dorsal carina broad, produced posteriorly, subtriangular, apically subacute. *Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically subacute.

**Description.** Based on male, 4.8 mm. AM P.83810. *Body* cuticle with posterior dorsal carinae, laterally smooth. *Head* dorsally smooth; rostrum weakly developed, as broad as long; eyes weakly bulging; lateral cephalic lobe subquadrate; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 6 robust setae.

*Gnathopod 1* coxa subequal to coxa 2, as broad as long, anteroventral corner produced anteriorly, apically subacute; basis 3 times as long as broad, without anterodistal setae; carpus rectilinear, twice as long as broad; propodus subovate, anterior margin with sparse slender setae, palm margin minutely crenulate with 3 robust setae near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface with raised serrations. *Gnathopod 2* articles lined with clusters of robust setae; basis twice as long as broad; anterodistal corner with rounded produced lobe with short robust setae; merus posterior margin lined with a few slender and robust setae, with broad produced lobe, lobe as long as broad, apically rounded, with 2 short robust setae; carpus free, distinct from propodus; propodus subovate, length 1.8 times width, anterior margin with clusters of short robust and slender setae, palm acute, weakly convex,  $\frac{5}{8}$  the length of the propodus, distal shelf poorly developed, shelf margin strongly crenulate, palm lined with two rows of short robust setae, without teeth or sinus, palm defining corner with 3 short robust setae; dactylus closing along palm. *Pereonites 6–7* dorsal carina broad, produced posteriorly, subtriangular, apically subacute.

*Pleonites 1–2* dorsal carina broad, produced posteriorly, subtriangular, apically subacute. *Epimera 1–3* posteroventral corner rounded. *Urosomite 1* short, twice as long as broad. *Uropod 1* biramous; peduncle twice as long as broad, ventromedial spine absent; inner ramus 1.7 times peduncle length, inner ramus  $\frac{3}{4}$  than outer ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus  $\frac{3}{4}$  length of inner ramus. *Uropod 3* uniramous; rami without setae. *Telson* dorsal lobe with 2 apical setae, lower margin without lateral or apical setae.

**Remarks.** Material drawn from Indonesia as *P. sandroruffoi* Ortiz & Lalana, 2003 is placed as a junior synonymy of *P. walkeri*. Ortiz & Lalana, 2003 provided exhaustive remarks comparing known *Podocerus* species with their material, however they did not cite Rabindranath, 1972 who described *P. walkeri* from the Gulf of Mannar or Ledoyer, 1979b, the first reviewer for the species, with material collected in Indonesia. Material illustrated by Wongkamhaeng *et al.*, 2009 as *P. andamanensis* (Giles, 1890) from Thailand, is also placed in synonymy. Their illustrations agree with *P. walkeri*. It is important to note the original description and illustrations for *P. andamanensis* are too limited for this species to be considered identifiable.

It is possible that *P. andamanensis* is a senior synonym of *P. walkeri*, as Giles's illustrations indicate a male specimen

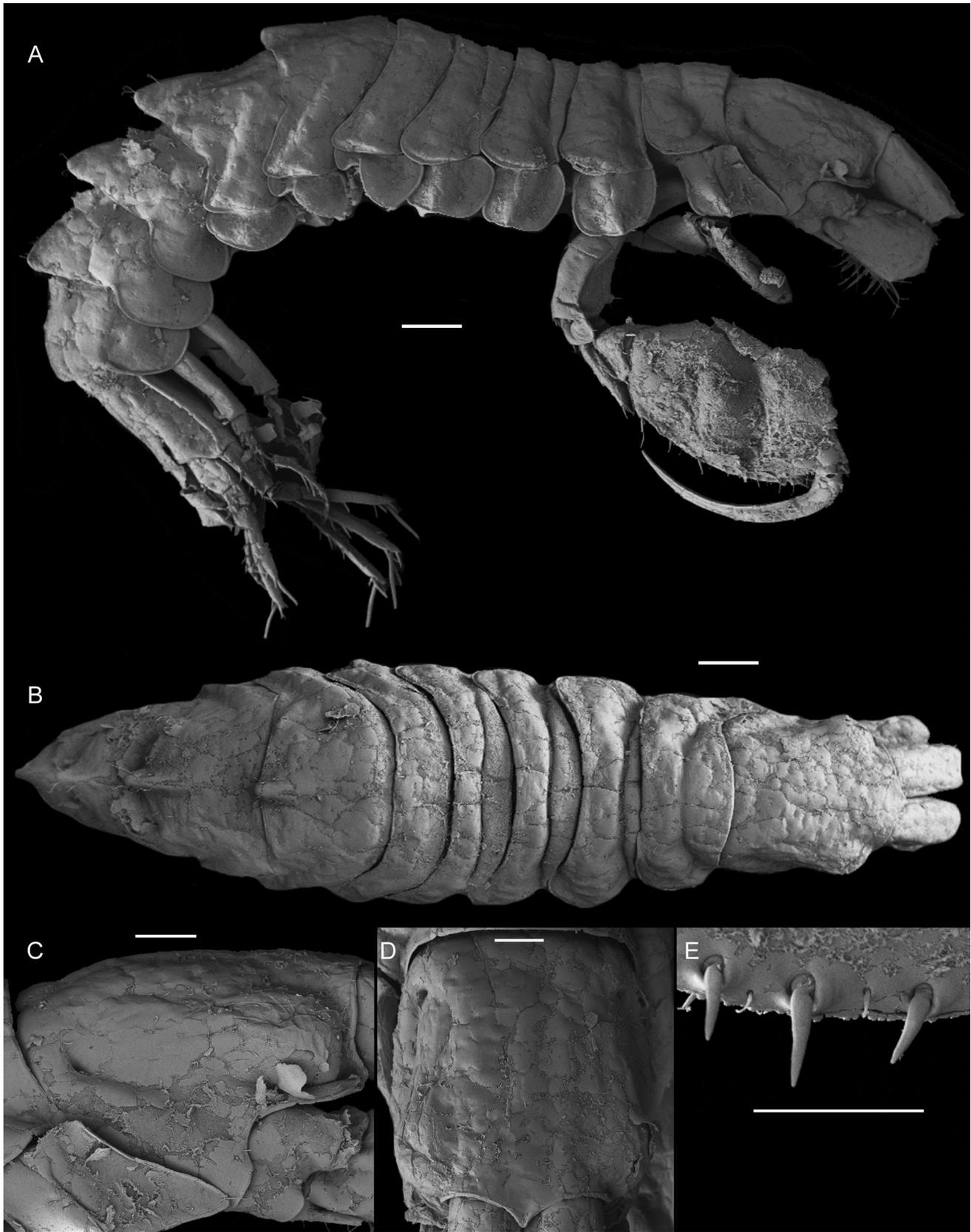


Figure 22. *Podocerus walkeri* Rabindranth 1972, male, 4.1 mm, AM P.87033, Jackson Island, Western Australia. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) whole animal dorsal view (scale 200  $\mu$ m); (C) head lateral view (scale 100  $\mu$ m); (D) head dorsal view (scale 100  $\mu$ m) and (E) gnathopod 2 propodus palm robust setae (scale 100  $\mu$ m).

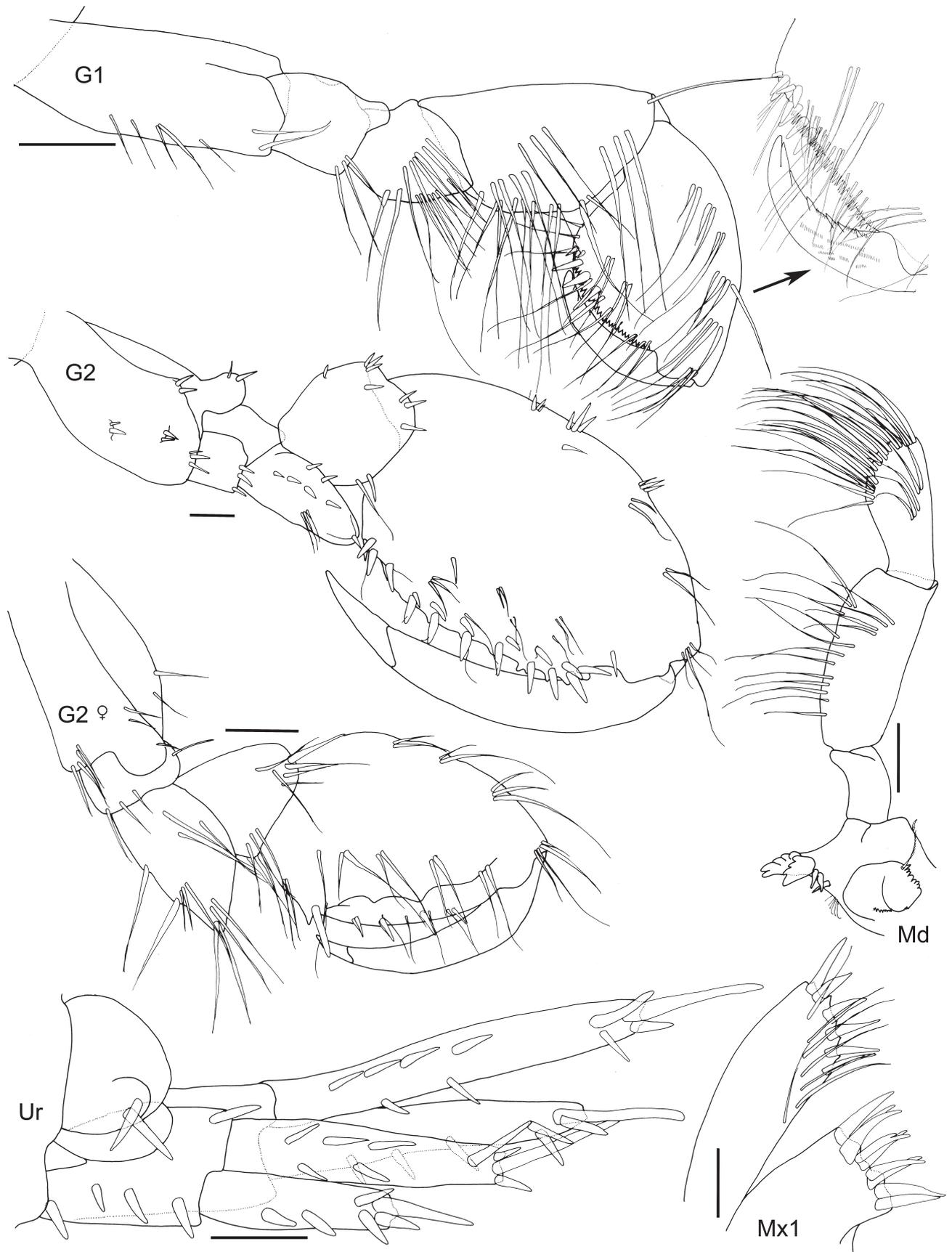


Figure 23. *Podocerus walkeri* Rabindranth 1972, male, 4.8 mm, AM P.83810, and female, 4.2 mm, AM P.87623, Jackson Island, Western Australia (scale 0.1 mm).

with the gnathopod 2 propodus without plumose setae however a redescription of the type material is needed to assess this situation adequately.

The male gnathopod 2 propodus palm lined with short robust setae and without plumose setae is distinct within the genus. *Podocerus walkeri* can be separated from the subspecies *P. walkeri pedunculata* as the latter species lacks the uropod 1 and 2 peduncle ventromedial spine, and the dorsal carina appear to be less developed in mature specimens.

There is no significant variation between the original description of *P. walkeri* and material figured from Australia, Indonesia (Ortiz & Lalana, 2003) and Thailand (Wongkamhaeng *et al.*, 2009). Material reported here includes specimens from several sites in Western Australia, Northern Territory; Magnetic Island on the Great Barrier Reef, Queensland and 2 specimens from New South Wales in southeastern Australia (see discussion).

**Distribution.** Australia. Western Australia: Dampier Archipelago, Carnarvon, Cape Leveque. Northern Territory: McCluer Island, Port Essington. Queensland: Magnetic Island. New South Wales: Broken Bay, Botany Bay. Sri Lanka: (Walker, 1904). India: Gulf of Mannar (Rabindranath, 1972). Indonesia: Misool Island, Banda Naira, Bunaken Island, Sulawesi Island, Maluku Island, Strait of Sunda (Ledoyer, 1979b; Ortiz & Lalana, 1997; 2003). Thailand: Tarai Island, Tan Island, Rab Island (Wongkamhaeng *et al.*, 2009).

### *Podocerus zeylanicus* (Walker, 1904)

Figs 24–26

*Platophium zeylanicum* Walker, 1904: 297, pl. 8 (53).

*Podocerus mangarevae* Chevreux, 1908: 521: figs 33–35.

*Podocerus zeylanicus*.—Ruffo, 1969: 71, fig. 24.—Ledoyer, 1986: 940–942, fig. 371.

**Type locality.** Cheval Paar, Sri Lanka.

**Material examined.** *Western Australia.* Male, 4.8 mm, dissected, 3 slides, AM P.87627, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque (16°29.728'S 123°1.768'E), floating brown alga *Sargassum* sp., 23 May 2010, coll. K. B. Attwood (MI WA 1096); female, 4.3 mm, dissected, 1 slide, AM P.87628, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque (16°29.728'S 123°1.768'E), floating brown alga *Sargassum* sp., 23 May 2010, coll. K. B. Attwood (MI WA 1096); male, 4.6 mm, SEM pin mount, AM P.85665, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque (16°29.728'S 123°1.768'E), floating brown alga *Sargassum* sp., 23 May 2010, coll. K. B. Attwood (MI WA 1096); 12 specimens AM P.83813, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque (16°29.728'S 123°1.768'E), floating brown alga *Sargassum* sp., 23 May 2010, coll. K. B. Attwood (MI WA 1096). 1 specimen, AM P.83811, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque, Buccaneer Archipelago (16°29.728'S 123°1.768'E), 2 m, 26 May 2010, coll. L. E. Hughes (MI WA 1139); many specimens, AM P.83812, Cygnet Bay Pearl Farm inside lines, Cygnet Bay, Cape Leveque, Buccaneer Archipelago (16°29.728'S 123°1.768'E), 0 m, 26 May 2010, coll. K. B. Attwood (MI WA 1140); many specimens, AM P.83914, Cygnet Bay Pearl Farm outside lines, Cygnet Bay, Cape Leveque (16°28.831'S

123°2.264'E), 2 m, 23 May 2010, coll. J. K. Lowry and K. B. Attwood (MI WA 1094); many specimens, AM P.80990, Cygnet Bay, Cape Leveque, Buccaneer Archipelago (16°28'40"S 123°02'06"E), 2 m, off floating rope line, 10 April 2008; many specimens, AM P.80992, Cygnet Bay, Cape Leveque, Buccaneer Archipelago (16°28'39"S 123°02'46"E), 3 m, off pearl shell in panel, 10 April 2008; 2 specimens, AM P.80994, Cygnet Bay, Cape Leveque, Buccaneer Archipelago (16°28'26"S 123°01'42"E), 3 m, off pearl shell in panel, 11 April 2008; many specimens, AM P.80986, Port George IV, Bonaparte Archipelago (15°23'30"S 124°40'54"E), 3 m, off pearl shell in panel, 15 April 2008; 2 specimens (female and juvenile), WAM C49155, Henderson (32°10'S 115°47'E), ship hull scraping, 6 October 2011 (MV *Armoured 3*, operating between Henderson and Barrow Island); many specimens, WAM C49230, draft marks, Flying Foam Passage, Dampier Archipelago (20°28'S 116°50'E), ship hull scraping, 4 November 2011, coll. T. Corkill, S. Cameron, & R. Wilks (IMSS: West Sea 3005, Sample O).

**Diagnosis.** *Body* cuticle dorsally and laterally smooth, with sparse slender setae. *Gnathopod 1* coxa subequal to coxa 2, longer than broad, anteroventral corner weakly produced, apically rounded; propodus subovate, with 11 robust setae near corner of palm; carpus indistinct, fused with propodus; propodus palm with one proximal subtriangular tooth, with palm defining tooth and robust seta; dactylus closing short of palm end.

**Description.** Based on male, 4.8 mm. AM P.87627. *Body* cuticle dorsally and laterally smooth, with sparse slender setae. *Head* dorsally smooth; rostrum short, about 1 tenth of head length; eyes greatly bulging; lateral cephalic lobe rounded; anteroventral corner subquadrate. *Mandible* accessory setal row with 3 setae. *Maxilla 1* palp distal margin with 5 robust setae.

*Gnathopod 1* coxa subequal to coxa 2, longer than broad, anteroventral corner weakly produced, apically rounded; basis 2.1 times as long as broad, without anterodistal setae; carpus subtriangular, 1.1 times as long as broad; propodus subovate, anterior margin with clusters of long slender setae, palm margin smooth, with 11 robust setae near corner of palm; dactylus posterior margin with serrate teeth, cuticle surface smooth. *Gnathopod 2* basis 2.1 times as long as broad, anterodistal corner subquadrate, without setae; merus posterior margin with a few slender setae, distally rounded, without lobe; carpus indistinct, fused with propodus; propodus subovate, length 1.9 times width, anterior margin with clusters of short slender setae, medial surface with dense plumose setae, palm subacute, straight,  $\frac{2}{3}$  the length of propodus, with broad, well developed distal shelf, shelf margin strongly crenulate, palm with one proximal subtriangular tooth, with palm defining tooth and robust seta; dactylus closing short of palm end. *Pereopods 5–7* similar in size.

*Epimera 1–3* rounded. *Uropod 1* biramus; peduncle 3 times as long as broad, ventromedial spine absent; inner ramus subequal in length to peduncle; outer ramus about  $\frac{3}{4}$  the length of the inner ramus. *Uropod 2* biramous; peduncle ventromedial spine absent; outer ramus  $\frac{3}{4}$  length of inner ramus. *Uropod 3* uniramus; ramus with 3 apical setae. *Telson* dorsal lobe with 2 long and 2 short apical setae, lower margin without lateral or apical setae.

Female (sexually dimorphic characters) based on female,

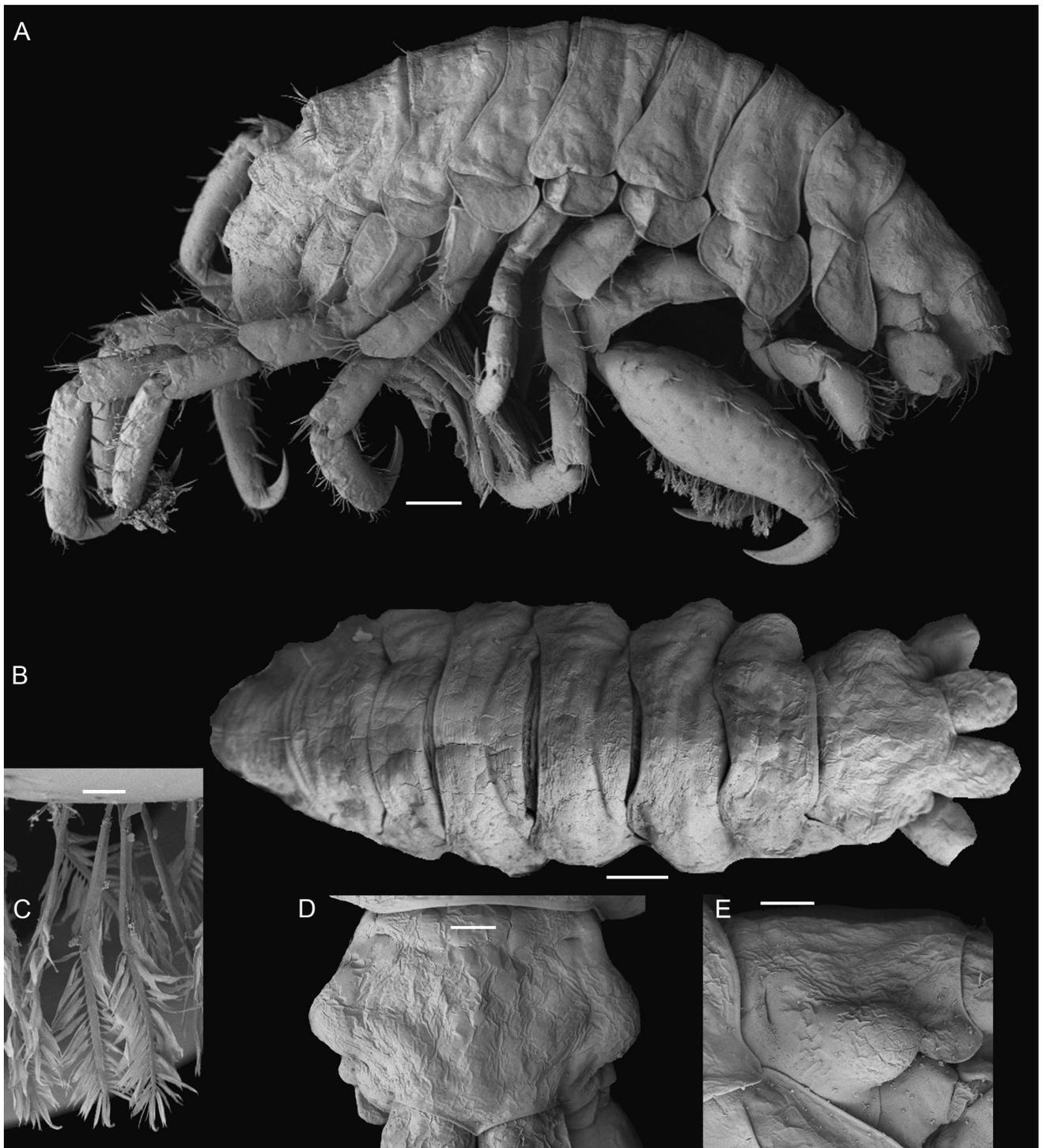


Figure 24. *Podocerus zeylanicus* (Walker, 1904), male, 4.6 mm, AM P.85665, Cygnet Bay, Western Australia. SEM photographs: (A) whole animal lateral view (scale 200  $\mu$ m); (B) whole animal dorsal view (scale 200  $\mu$ m); (C) gnathopod 2 propodus palm plumose setae (scale 20  $\mu$ m); (D) head dorsal view (scale 100  $\mu$ m) and (E) head lateral view (scale 100  $\mu$ m).

4.3 mm. AM P.87621. *Gnathopod 1* propodus subtriangular to subrectangular, with 2 robust setae near corner of palm. *Gnathopod 2* basis 1.6 times long as broad; anterodistal corner with long robust setae; merus posterior margin with broad produced lobe, lobe 1.1 times as broad as long, apically rounded; carpus free, distinct from propodus; propodus length 1.2 times width, palm weakly convex, without distal shelf or teeth, palm defined by corner with 6 robust setae; dactylus closing along palm.

**Remarks.** *Podocerus zeylanicus* (Walker, 1904) was described from Cheval Paar, Sri Lanka. The species has been cited from French Polynesia (Chevreux, 1907 as *P. mangarevae*) and tentatively from Madagascar (*P. ?zeylanicus* Ledoyer, 1986). Material drawn here agrees with the limited illustrations provided by Walker, where the gnathopod 1 has a distinct coxa shape, the propodus is subovate and setose, the gnathopod 2 has a fused carpus and propodus palm, with 2 weak teeth and the uropod 1

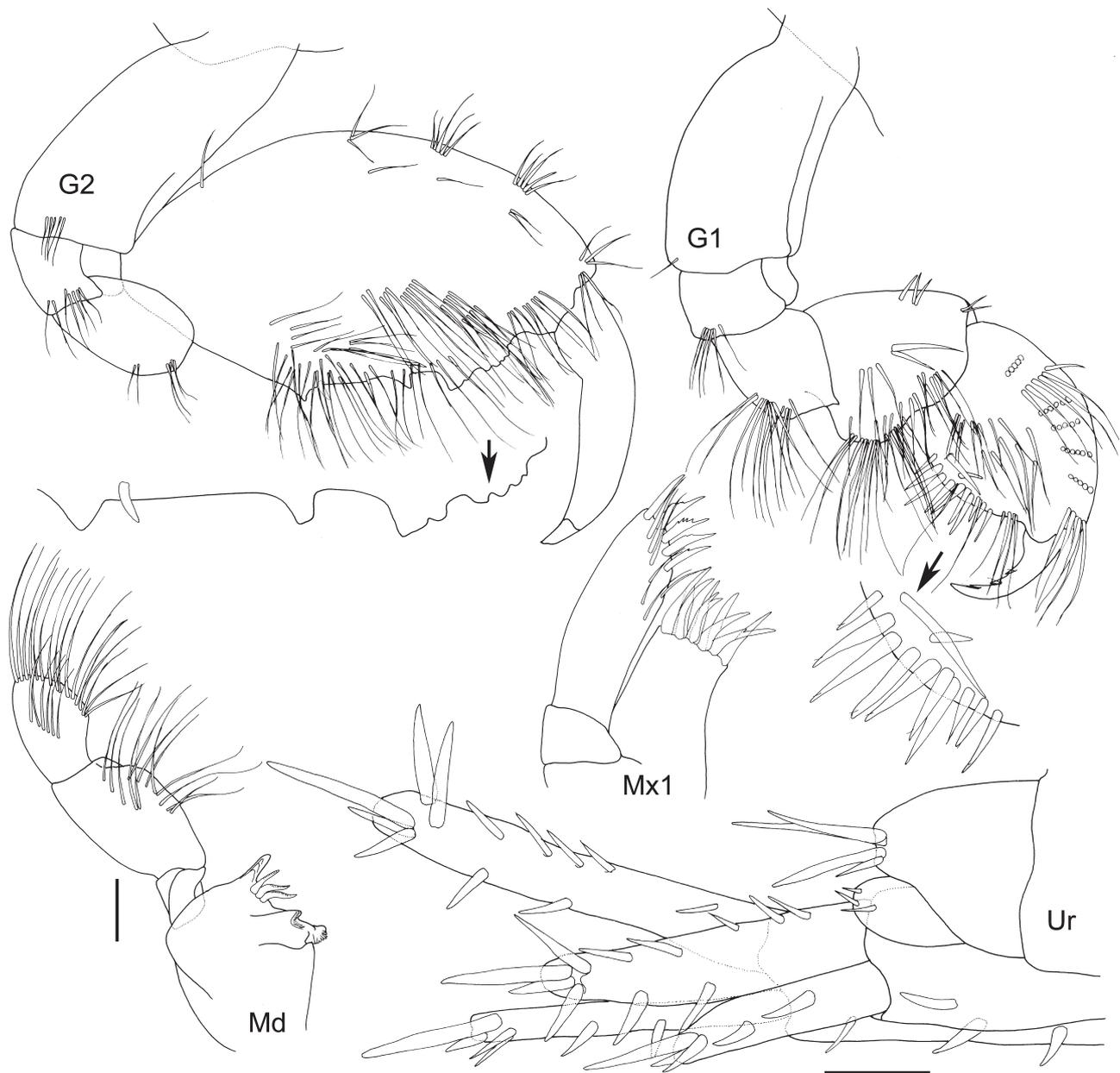


Figure 25. *Podocerus zeylanicus* (Walker, 1904), male, 4.8 mm, AM P.87627, Cygnet Bay, Western Australia (scale 0.1 mm).

outer ramus is  $\frac{3}{4}$  the length of the inner ramus. The Western Australian material differs in the telson apical lobe that has four setae, while five, two and three setae are figured French Polynesia, Madagascar and Sri Lanka, respectively. This variation in telsonic setation is minor when considered against the consistency in all other species level characters and the wide geographic distribution of material. Material examined from Cape Leveque, Western Australia in 2008 was collected between pearl farming lines, the same habitat as the first documented collection in 1902 from Sri Lanka.

*Podocerus zeylanicus* has a male gnathopod 2 propodus palm tooth formula common throughout the genus *Podocerus*, a broad distal shelf with one proximal and

one distal tooth, is also known for *P. cuspidatus* Horton, 2008, juvenile *P. hanapepe* J. L. Barnard, 1970, *P. lobatus* (Haswell, 1885) and *P. palinuroides* Ledoyer, 1986.

A smooth dorsum separates *P. zeylanicus*, *P. hanapepe* and *P. lobatus* from *P. cuspidatus*, *P. lobatus* (of Pirlot, 1938) and *P. palinuroides*. *Podocerus zeylanicus*, *P. cuspidatus* and *P. hanapepe* are without the cluster of plumose setae on the gnathopod 2 basis seen on *P. lobatus* (including Pirlot, 1938) and *P. palinuroides*. *Podocerus zeylanicus* can be separated from *P. hanapepe*, *P. lobatus* and *P. cuspidatus* by the lateral cephalic lobe rounded and the male gnathopod 2 basis more elongate. In *P. zeylanicus* the gnathopod 1 coxa is distinct in shape, as broad as long

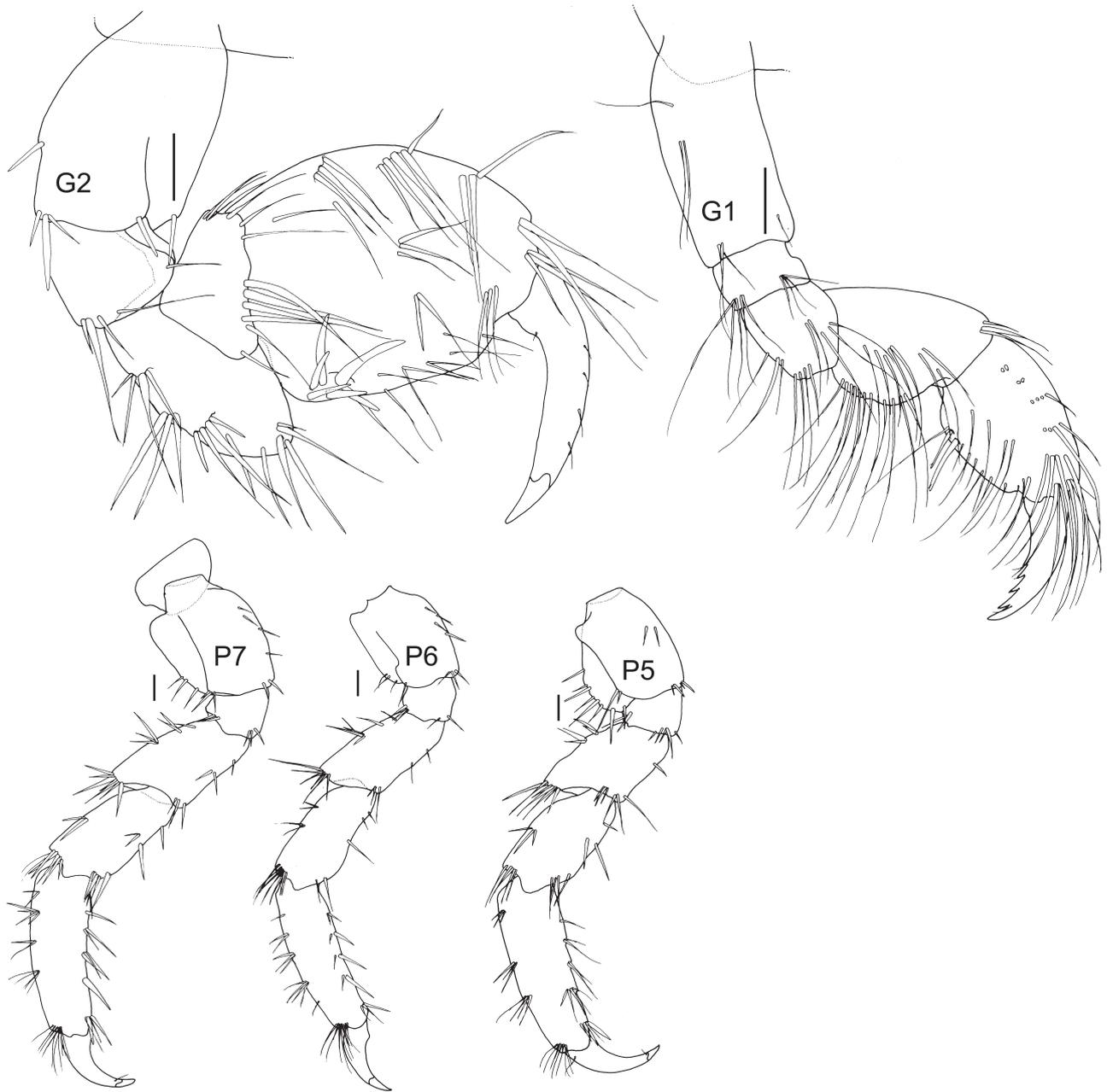


Figure 26. *Podocerus zeylanicus* (Walker, 1904), male, 4.8 mm, AM P.87627, and female, 4.3 mm, AM P.87628, Cygnet Bay, Western Australia (scale 0.1 mm).

with the anteroventral corner weakly produced, and the gnathopod 2 propodus palm has numerous, nine or more, robust setae, separating it from other taxa.

Female *P. zeylanicus* are similar to *P. uncinatus* Kilgallen, 2009 from the Great Barrier Reef (known only from female specimens). However the coxa in *P. zeylanicus* are contiguous, with coxa 2 more subquadrate compared with the small discontinuous coxa in *P. uncinatus*.

**Distribution.** Sri Lanka. East Cheval Parr (Walker, 1904). Red Sea: Cundabulu Island (Ruffo, 1969). French Polynesia. Gambier Archipelago: Magnareva Island. Australia (Chevreux, 1908). Western Australia: Henderson, Dampier Archipelago, Cape Leveque, Port George IV (current study).

## Discussion

This study expands the known distribution ranges of *P. hanapepe*, *P. talegus lawai*, *P. walkeri* and *P. zeylanicus* further throughout the Indo-Pacific. As filter feeders and common fouling organisms, podocerids will cling to floating material including algae, float lines, moorings, bottoms of boats and turtles which provide a high dispersal potential for these species (LazoWazem *et al.*, 2011; Hughes, 2012; Kilgallen, 2009; Walker, 1904).

*Podocerus walkeri* originally described from the Gulf of Mannar, India, is recorded throughout the tropical Indo-Pacific (Sri Lanka—Walker, 1904; India—Rabindranath, 1972; Indonesia—Ledoyer, 1979b; Indonesia—Ortiz &

Lalana, 1997; 2003; Thailand—Wongkamhaeng et al., 2009). The new records of *P. walkeri* include the Northern Territory and Great Barrier Reef in tropical Australia. Two male specimens collected separately, one from the bottom of a small motor vessel in Broken Bay in 2011 and one from an unknown habitat in the major shipping center of Port Botany in 1972, are the most southern temperate records for this species. *Podocerus walkeri* has not previously been listed as an invasive species, these records, either alien or native, warrant closer attention. For organisms predisposed to fouling, such as podocerids, anthropogenic movement will provide a broader opportunity to disperse (Molnar, et al., 2008). However, invasive records need to be carefully assessed against natural distributions, with attention to natural and artificial habitat collection (Carlton, 2011). The East Australian Current, recreational and commercial shipping are potential vectors for *P. walkeri*.

Finally, confirmation of extreme morphological variation, with growth stages and sexual dimorphism, across several new species described here does little to resolve the difficulties for those identifying tropical species of podocerid. Enigmatic features such as the carina and propodus palm sculpturing must be applied cautiously as species level diagnostic characters. Characters associated with the gnathopod 1 coxa, carpus and propodus shape and the uropods 1 and 2 peduncle anteroventral spine are less changeable with growth stage and of greater use for identifying podocerid species.

ACKNOWLEDGMENTS. *Podocerus hanapepe* from Queensland and Papua New Guinea was originally identified by Niamh Kilgallen and James Darwin Thomas, respectively. I am grateful to Sue Lindsay for SEM preparation and images. I thank Gavin Dally and Sue Horner (MAGNT), Stephen Keable (AM), Andrew Hosie (WAM) and Holly Bollick (BPBM) for loan and curation of material. I am thankful for the constructive comments made by Dr T. Horton and an anonymous reviewer. The study was funded by an ABRS grant no.RF210-19.

## References

- Bano, H., and Q. B. Kazmi. 2004. *Laetmatophilus paradurbanensis*, New Species (Crustacea: Amphipoda: Podoceridae) From Pakistan Coast (Northern Arabian Sea). *Pakistan Journal of Marine Sciences* 13(1,2): 35–40.
- Barnard, J. L. 1969. The families and genera of marine gammaridean Amphipoda. *Bulletin of the United States National Museum* 271: 1–535.  
<http://dx.doi.org/10.5479/si.03629236.258.1>
- Barnard, J. L. 1970. Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithsonian Contributions to Zoology* 34: 1–286.  
<http://dx.doi.org/10.5479/si.00810282.34>
- Barnard, J. L. 1972. The marine fauna of New Zealand: algae-living littoral Gammaridea (Crustacea Amphipoda). *New Zealand Oceanographic Institute Memoir* 62: 1–216.
- Barnard, J. L., and M. M. Drummond. 1981. Three corophioids (Crustacea: Amphipoda) from Western Port, Victoria. *Proceedings of the Royal Society of Victoria* 93: 31–41.
- Barnard, J. L., and G. S. Karaman. 1991. The families and genera of marine gammaridean Amphipoda (except marine gammaroids). *Records of the Australian Museum, Supplement* 13: 1–866.
- Barnard, K. H. 1916. Contributions to the crustacean fauna of South Africa. 5. The Amphipoda. *Annals of the South African Museum* 15: 105–302, pls 26–28.
- Barnard, K. H. 1937. Amphipoda. *Scientific Reports of the John Murray Expedition* 4, 6: 131–201.
- Bruzelius, R. M. 1859. Bidrag till kannedomen om Skandinaviens Amphipoda Gammaridea. *Kungliga Svenska Vetenskapsakademiens Handlingar*, Series 2, 3(1): 1–104, pls 1–4.
- Carlton, J. T. 2011. The global dispersal of marine and estuarine crustaceans. In *In the Wrong Place—Alien Marine Crustaceans: Distribution, Biology and Impacts, Invading Nature*, ed. B. S. Galil, P. F. Clark, and J. T. Carlton. *Invasion Ecology* 6: 3–23.  
<http://dx.doi.org/10.1007/978-94-007-0591-3>
- Chevreaux, E. 1908. Amphipodes recueillis dans les possessions françaises de l'Océanie par M. le Dr. Seurat, directeur du laboratoire de recherches biologiques de Rikitea (îles Gambier), 1902–1904. *Mémoires de la Société Zoologique de France* 20: 470–527.
- Chevreaux, E., and J. de Guerne. 1888. Sur un amphipode nouveau (*Cyrtophium chelonophilum*), commensal de *Thalassocaretta* L. *Comptes Rendus de l'Académie des Sciences*, Paris 88: 4 pp.
- Dana, J. D. 1852. On the classification of the Crustacea Choristopoda or Tetradecapoda. *American Journal of Science and Arts*, Series 2, 14: 297–316.
- Dana, J. D. 1853. Crustacea. Part II. *United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, U.S.N.* 14: 689–1618.
- Della Valle, A. 1893. Gammarini del Golfo di Napoli. *Fauna und Flora des Golfes von Neapel* 20: 1–948, pls 1–61.
- Haswell, W. A. 1880. On some new amphipods from Australia and Tasmania. *Proceedings of the Linnean Society of New South Wales* 5(1): 97–105, pls 5–7.

- Haswell, W. A. 1885. Notes on the Australian Amphipoda. *Proceedings of the Linnean Society of New South Wales* 10(1): 95–114, pls 10–18.
- Haswell, W. A. 1879. On some additional new genera and species of amphipodous crustaceans. *Proceedings of the Linnean Society of New South Wales* 4(4): 319–50, pls 18–24.
- Horton, T. 2008. Amphipoda from Marine Caves of Hong Kong Island. *Journal of Natural History* 42 (9–12): 825–854.  
<http://dx.doi.org/10.1080/00222930701860124>
- Hughes, L. E. 2012. New and little-known Podoceridae (Peracarida: Amphipoda) from Southern Australia. *Records of the Australian Museum* 64(1): 71–120.  
<http://dx.doi.org/10.3853/j.0067-1975.64.2012.1588>
- Kilgallen, N. M. 2009. Podoceridae. In *Benthic Amphipoda (Crustacea: Peracarida) of the Great Barrier Reef, Australia*, ed. J. K. Lowry and A. A. Myers. *Zootaxa* 2260: 841–860.
- Kim, W., and C. B. Kim. 1991. The marine amphipod crustaceans of Ulreung Island, Korea: Part 1. *Korean Journal of Zoology* 34: 232–252.
- Laubitz, D. R. 1984. A revision of the family Podoceridae (Amphipoda: Gammaridea). *Australian Museum Memoir* 18: 77–86.  
<http://dx.doi.org/10.3853/j.0067-1967.18.1984.373>
- Lazo-Wasem, E. A., T. Pinou, A. Peña de Niz and A. Feuerstein. 2011. Epibionts associated with the nesting marine turtles *Lepidochelys olivacea* and *Chelonia mydas* in Jalisco, Mexico: a review and field guide. *Bulletin of the Peabody Museum of Natural History* 52(2): 221–240.  
<http://dx.doi.org/10.3374/014.052.0203>
- Leach, W. E. 1814. Crustaceology. *The Edinburgh Encyclopaedia* 7: 383–429.
- Ledoyer, M. 1972. Amphipodes gammariens vivant dans les alvéoles des constrictions organogènes récifales intertidales de la région de Tuléar (Madagascar). Etude systématique et écologique. *Téthys Supplement* 3: 165–285.
- Ledoyer, M. 1978. Amphipodes gammariens (Crustacea) des biotopes cavitaires organogènes récifaux de l'île Maurice (Océan Indien). *The Mauritius Institute Bulletin* 8(3): 197–332.
- Ledoyer, M. 1979a. Les gammariens de la pente externe du Grand Récif de Tuléar (Madagascar) (Crustacea Amphipoda). *Memorie del Museo Civico di Storia Naturale, Verona, Series 2, Sezione Science della Vita*, 2: 1–150.
- Ledoyer, M. 1979b. Expédition Rumphius II (1975) Crustacés parasites, commensaux, etc. (Th. Monod et R. Serene, ed.) VI. Crustacés Amphipodes Gammariens. *Bulletin du Muséum National d'Histoire Naturelle, Paris, Series 4, Section A*, 1: 137–181.
- Ledoyer, M. 1986. Crustacés Amphipodes Gammariens. Familles des Haustoriidae à Vitjazianidae. *Faune de Madagascar* 59: 599–1112.
- Lincoln, R. J., ed. 1979. *British Marine Amphipoda: Gammaridea*. London, British Museum (Natural History), i–v, 1–658.
- Lowry, J. K., and H. E. Stoddart. 2003. *Crustacea: Malacostraca: Peracarida: Amphipoda, Cumacea, Mysidacea*. CSIRO Publishing: Melbourne, Australia.
- Molnar, J. L., R. L. Gamboa, C. Revenga, and M. D. Spalding. 2008. Assessing the global threat of invasive species to marine biodiversity. *Frontiers in ecology and the environment* 6(9): 485–492.  
<http://dx.doi.org/10.1890/070064>
- Myers, A. A. 1985. Shallow-water, coral reef and mangrove Amphipoda (Gammaridea) of Fiji. *Records of the Australian Museum, Supplement* 5: 1–143.  
<http://dx.doi.org/10.3853/j.0812-7387.5.1985.99>
- Myers, A. A. 1986. Amphipoda from the South Pacific: Niue Island. *Journal of Natural History* 20: 1381–1392.  
<http://dx.doi.org/10.1080/00222938600770921>
- Myers, A. A. 1990. Amphipoda from the South Pacific: the Cook Islands. *Records of the Australian Museum* 42(2): 149–157.  
<http://dx.doi.org/10.3853/j.0067-1975.42.1990.112>
- Norman, A. M. 1869. Shetland final dredging report. Part II. On the Crustacea, Tunicata, Polyzoa, Echinodermata, Actinozoa, Hydrozoa, and Porifera. *Report of the British Association for the Advancement of Science* 38: 247–336.
- Ortiz, M., and R. Lalana. 1997. Amphipoda. Results of the Zoological Expedition Organized by Grigore Antipa Museum in the Indonesian Archipelago (1991). 1. Peracarida (Crustacea) *Travaux du Muséum National d'Histoire Naturelle Grigore Antipa. M. Gutu*. 38: 29–113.
- Ortiz, M., and R. Lalana. 2003. On a New species of Podocerus (Amphipoda: Gammaridea: Podoceridae) from the Indonesian Archipelago. *Travaux du Muséum National d'Histoire Naturelle Grigore Antipa. M. Gutu*. 45: 61–66.
- Pirlot, J. M. 1938. Les amphipodes de l'expédition du Siboga. Deuxième partie. Les amphipodes gammariens III.—Les amphipodes littoraux. 2. Familles des Dexaminidae, Talitridae, Aoridae, Photidae, Ampithoidae, Corophiidae, Jassidae, Cheluridae et Podoceridae. Première partie (addendum). Les amphipodes hypérides. Familles des Lanceolidae, Cystisomatidae et Oxycephalidae. La sexualité chez Cystisoma Guérin Méneville. *Siboga-Expeditie, Monographie* 33f: 329–388.
- Rabindranath, P. 1972. A New Species of *Podocerus* Leach (Amphipoda) with a Redescription of *Podocerus brasiliensis* (Dana, 1853). *Crustaceana, Supplement* 3: 299–307.
- Ruffo, S. 1969. Studi sui crostacei anfipodi. LXVII. Terzo contributo alla conoscenza degli anfipodi del Mar Rosso. *Memorie del Museo Civico di Storia Naturale, Verona* 17: 1–77.
- Ruffo, S. 1987. Contributo alla conoscenza dei Podoceridae Mediterranei (Crustacea, Amphipoda) (studi sui crostacei anfipodi. CVIII). *Bollettino del Museo Civico di Storia Naturale di Verona* 13: 1–12.
- Springthorpe, R. T., and J. K. Lowry. 1994. Catalogue of crustacean type specimens in the Australian Museum: Malacostraca. *Technical Reports of the Australian Museum* 11: 1–134.  
<http://dx.doi.org/10.3853/j.1031-8062.11.1994.68>
- Stebbing, T. R. R. 1888. Report on the Amphipoda collected by H.M.S. Challenger during the years 1873–1876. *Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873–76, Zoology* 29: 1–1737, pls 1731–1210.
- Stebbing, T. R. R. 1899. On the true *Podocerus* and some new genera of amphipods. *Annals and Magazine of Natural History, Series 7*, 3: 237–241.  
<http://dx.doi.org/10.1080/00222939908678113>
- Stebbing, T. R. R. 1906. Amphipoda. I. Gammaridea. *Das Tierreich* 21: 1–806.
- Walker, A. O. 1904. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries 1904, Supplementary Reports* 17: 229–300, pls 1–8.
- Wongkamhaeng, K., A. Darakrai, and P. Pholpunthin. 2009. New Species of *Tehtygeneia* (Eusiridae: Amphipoda) and New Record of Algae-Living Gammarid Amphipods in South Sea Island Marine National Park, Nakhon Si Thammarat Province, Thailand. *The Nagisa World Congress*: 1–2.

