

## The New Crustacean Amphipod Genus *Kapalana* from Australian Waters (Senticaudata, Ischyroceridae, Ischyrocerinae, Cerapodini)

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**ABSTRACT.** *Kapalana* g. nov. is proposed and described for seven new species of Australian cerapodid amphipods: *K. amelga* sp. nov.; *K. durraween* sp. nov.; *K. kimbla* sp. nov.; *K. maia* sp. nov.; *K. michaelmas* sp. nov.; *K. stebbingi* sp. nov. and *K. wadei* sp. nov. In all of these species the females show a form of parental care in that the juveniles build their initial tubes in a ring around the tube of the adult female. *Cerapus flindersi* Stebbing, 1888 is tentatively assigned to the new genus *Kapalana*.

**KEYWORDS.** Crustacea; Amphipoda; Ischyroceridae; Cerapodini; *Kapalana*; Australia; new genus; new species; taxonomy; parental care.

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Just (2017) established the tribe Cerapodini Smith, 1880 within the ischyrocerine subfamily based on clades described by Lowry & Berents (1996). The tribe comprised five genera (*Bathypoma* Lowry & Berents, 1996; *Cerapus* Say, 1817; *Notopoma* Lowry & Berents, 1996; *Paracerapus* Budnikova, 1989; *Runanga* J. L. Barnard, 1961) and was confirmed by Souza-Filho & Serejo (2014).

The Cerapodini is currently represented in Australian waters by five species of *Cerapus*, the deep water species *Bathypoma enigma* Lowry & Berents, 1995 from off the Tasmanian coast, *Notopoma stoddartae* Lowry & Berents, 1996 from Elizabeth and Middleton Reefs and *Runanga coxalis* J. L. Barnard, 1961 in the Tasman Sea.

A group of eight species in the Cerapodini, also found in Australian waters, is described here in the new genus *Kapalana* defined by: (a) the posterior margin of peduncular article 1 modified into a strong projection; (b) the peduncles

of antennae 1 and 2 covered in scales; and (c) juveniles attach their initial tubes to tubes of the female parent (Figs 4, 12) forming a ring which encircles the tube. There may be at least two generations attached to a female parent tube at any one time.

Apomorphic character states, common in some genera, such as the tiny scales on the peduncles of the antennae in the apparently endemic Australian genus *Kapalana*, are reported in one species of *Notopoma* (*N. argentina*) living in southern South America, and the presence of a holdfast on the tube in one species of *Kapalana* (*K. michaelmas*) is also known in the South African species *Notopoma africana*, indicating the possibility of a common ancestor for *Kapalana* and *Notopoma*. Therefore, there appears to be an ancient connection between *Kapalana* and *Notopoma*. *Notopoma* is a diverse, widespread genus mainly defined by the peduncle of antenna 1 which folds into a neat operculum. The genus

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does not occur on the Australian plate, if the hidden continent Zelandia is accepted (Mortimer *et al.*, 2017). The rather unspecialized genus *Bathypoma*, however, which occurs off the coast of Tasmania, shares the operculum (see Lowry & Berents, 1996: 77) with *Notopoma*, a further example of shared apomorphic character states among taxa in the Cerapodini *Cerapus* clade.

## Material and methods

The generic diagnostic description and the species descriptions were generated from a DELTA database (Dallwitz, 2010) to the *Cerapus* group species of the world. The **bolded** text distinguishes the genus in at least two

characteristics from every other cerapodini taxon. Material is lodged in the Australian Museum, Sydney (AM), Museum Victoria (MV) and the South Australian Museum (SAM). The following abbreviations are used on the plates: **A**, antenna; **EP**, epimeron; **G**, gnathopod; **H**, head; **IP**, inner plate of maxilliped; **LL**, lower lip; **MD**, mandible; **MP**, maxilliped; **MX**, maxilla; **OP**, outer plate of maxilliped; **p**, palp; **P**, pereopod; **PL**, pleopod; **U**, uropod; **UR**, urosome; **l**, left; **r**, right. The terminology for cuticular structures follows Watling (1989).

Mouthparts do not provide useful diagnostic characters for species in the genus *Kapalana* and are therefore illustrated for *K. wadei* only. Locality data presented in *Material examined* includes museum station data codes (e.g. NSW 2034, MI NSW 3369, BSS 112, WPNPA).

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### Checklist and distribution of the Cerapodini Smith, 1880; 6 genera, 48 species.

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taxon	general distribution
<i>Bathypoma enigma</i> Lowry & Berents, 1996	Australia: Tasmania
<i>Cerapus alquirta</i> (Barnard & Drummond, 1981)	Australia: Victoria
<i>Cerapus benthophilus</i> Thomas & Heard, 1979	Gulf of Mexico
<i>Cerapus bundegi</i> Lowry & Berents, 2005	Australia: Western Australia
<i>Cerapus calamicola</i> (Giles, 1885)	India: Gulf of Mannar
<i>Cerapus chaomai</i> Lowry & Berents, 2002	Thailand: Trang
<i>Cerapus cudjoe</i> Lowry & Thomas, 1991	USA: Florida
<i>Cerapus erae</i> Bulycheva, 1952	Japan: Russia
<i>Cerapus jonsoni</i> Valério-Berardo, Souza & Rodrigues, 2008	Brazil: Santos Continental Shelf
<i>Cerapus longirostris</i> Shen, 1936	China: Shantung Peninsula; Japan: Uematsu
<i>Cerapus maculanigra</i> Zeina & Asakura, 2017	Red Sea
<i>Cerapus micronesicus</i> Myers, 1995	Micronesia: Kosrae
<i>Cerapus murrayae</i> Lowry & Berents, 2005	Australia: New South Wales
<i>Cerapus nudus</i> Just, 2009	Australia: Queensland
<i>Cerapus oceanicus</i> Lowry, 1985	Western Samoa: Upolu
<i>Cerapus ortei</i> Ortiz & Thomas, 2007	Costa Rica
<i>Cerapus pacificus</i> Lowry, 1985	Fiji: Viti Levu
<i>Cerapus thomasi</i> Ortiz & Lemaitre, 1997	Colombia: Gulf of Morrosquillo
<i>Cerapus tubularis</i> Say, 1817	USA: north-east coast
<i>Cerapus volucola</i> Lowry & Berents, 2005	Australia: Queensland; Papua New Guinea, Madang Lagoon
<i>Cerapus yuyatalay</i> Lowry & Berents, 2002	Thailand, Sikao district
<i>Kapalana amelga</i> sp. nov.	Australia: New South Wales
<i>Kapalana durraween</i> sp. nov.	Australia: New South Wales
<i>Kapalana flindersi</i> (Stebbing, 1888)	Australia: Queensland
<i>Kapalana kimbla</i> sp. nov.	Australia: Victoria; South Australia
<i>Kapalana maia</i> sp. nov.	Australia: Victoria; Tasmania
<i>Kapalana michaelmas</i> sp. nov.	Australia: South Australia; Western Australia
<i>Kapalana stebbingi</i> sp. nov.	Australia: New South Wales; Victoria
<i>Kapalana wadei</i> sp. nov.	Australia: New South Wales
<i>Notopoma africana</i> Lowry & Berents, 1996	South Africa: south-east of St Lucia
<i>Notopoma argentina</i> Alonso de Pina, 2005	Argentina
<i>Notopoma cidaridis</i> Berge, Vader & Lockhart, 2004	Antarctica: north of Elephant Island
<i>Notopoma crassicornis</i> (Spence Bate, 1855)	United Kingdom: England; Northumberland
<i>Notopoma fallohidea</i> (Lowry, 1981)	New Zealand: Kaikoura
<i>Notopoma fluminense</i> Valério-Berardo, <i>et al.</i> , 2008	Brazil: Campos Basin
<i>Notopoma harfoota</i> (Lowry, 1981)	New Zealand: Kaikoura; Wellington
<i>Notopoma lowryi</i> Souza-Filho & Serejo, 2014	Brazil
<i>Notopoma lukini</i> (Tzvetkova, 1992)	Russia: Kurile Islands
<i>Notopoma moorea</i> Lowry & Berents, 1996	Society Islands: Moorea
<i>Notopoma opposita</i> (K. H. Barnard, 1932)	Antarctica: South Georgia; Palmer Archipelago
<i>Notopoma sismithi</i> (Stebbing, 1888)	Subantarctic: Kerguelen Islands; Macquarie Island
<i>Notopoma stoddartae</i> Lowry & Berents, 1996	Australia: Elizabeth and Middleton Reefs, Tasman Sea
<i>Notopoma stoora</i> (Lowry, 1981)	New Zealand: Kaikoura
<i>Notopoma teresae</i> Souza-Filho & Serejo, 2014	Brazil
<i>Paracerapus comparativus</i> (Kudrjaschov, 1975)	Russia: Kurile Islands
<i>Paracerapus polutovi</i> (Gurjanova, 1951)	Russia: East Kamchatka, Bering Sea
<i>Runanga coxalis</i> J. L. Barnard, 1961	Tasman Sea
<i>Runanga wairoa</i> McCain, 1969	New Zealand: East of Dunedin

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## Key to genera of Cerapodini

- 1 Antenna 1 peduncular article 3 forming an opercular cap ..... 2  
 — Antenna 1 peduncular article 3 not forming an opercular cap ..... 3
- 2 Gnathopod 2 male subchelate ..... *Bathypoma* Lowry & Berents, 1996  
 — Gnathopod 2 male carpochele ..... *Notopoma* Lowry & Berents, 1996
- 3 Antenna 1 with vestigial accessory flagellum ..... *Runanga* J. L. Barnard, 1961  
 — Antenna 1 without vestigial accessory flagellum ..... 4
- 4 Pereopods 5–7 directed posteriorly ..... 5  
 — Pereopods 5 directed posteriorly, pereopods 6–7 directed anteriorly  
 ..... *Paracerapus* Budnikova, 1989
- 5 Antenna 1 peduncular article 1 posterior margin without strong  
 posterior projection ..... *Cerapus* Say, 1817  
 — Antenna 1 peduncular article 1 posterior margin with strong  
 posterior projection ..... *Kapalana* g. nov.

Suborder Senticaudata Lowry & Myers, 2013

Infraorder Corophiida Leach, 1814

Parvorder Caprellidira Leach, 1814

Superfamily Photoidea Boeck, 1872

Family Ischyroceridae Stebbing, 1899

Subfamily Ischyrocerinae Stebbing, 1899

Tribe Cerapodini Smith, 1880

[Further information on higher classification given in  
 Lowry & Myers (2013) and Just (2017)]

### *Kapalana* g. nov.

**Type species.** *Kapalana durraween* sp. nov., present designation.

**Included species.** *Kapalana* includes 8 species: *K. amelga* sp. nov.; *K. durraween* sp. nov.; *K. flindersi* (Stebbing, 1888) comb. nov.; *K. kimbla* sp. nov.; *K. maia* sp. nov.; *K. michaelmas* sp. nov.; *K. stebbingi* sp. nov.; *K. wadei* sp. nov.

**Etymology.** Named for the retired New South Wales Fisheries vessel FRV *Kapala*, the source of many Australian Museum fish and invertebrate collections from 1971 to 1997. The name is feminine in gender.

**Diagnostic description.** Head with eyes present, rostrum long to very long. **Antenna 1** without accessory flagellum; peduncular article 1 not produced anterodistally and anteromedially into an opercular cap, **posterior margin with strong subquadrate or acute posterior projection**. Antennae 1–2 peduncular articles 1–3 covered in scales [except *K. amelga*, *K. maia* and *K. flindersi*]. Gnathopod 2 carpochele in male. Pereopod 5 propodus inserted on posterior concave side of carpus. Pereopods 5–7 directed posteriorly. Pereopods 6–7 similar, much longer than pereopod 5. Uropod 1, peduncle with distoventral fan of robust setae. Uropod 2–3 uniramous. **Tubes of juveniles attached in a ring, circling the tube of adult female** (not known for *K. flindersi*).

**Remarks.** *Kapalana* has the strongest similarities to *Runanga* J. L. Barnard, 1961, *Cerapus* and *Paracerapus* Budnikova, 1989. *Kapalana* differs from these genera in having a projection on the posterior margin of the first article of antenna 1 and in *Kapalana*, the juveniles attach their initial tubes to the mother tube.

The species known as *Cerapus flindersi* Stebbing, 1888 is based on a female from Flinders Passage in Torres Strait, northern Queensland. It has never been re-collected and the tube is not known. The specimen is held in The Natural History Museum, London (BMNH 89.5.15.147) and consists of four microscope slides. Based on the morphology of antenna 1 peduncular article 1, we tentatively move it to the genus *Kapalana*.

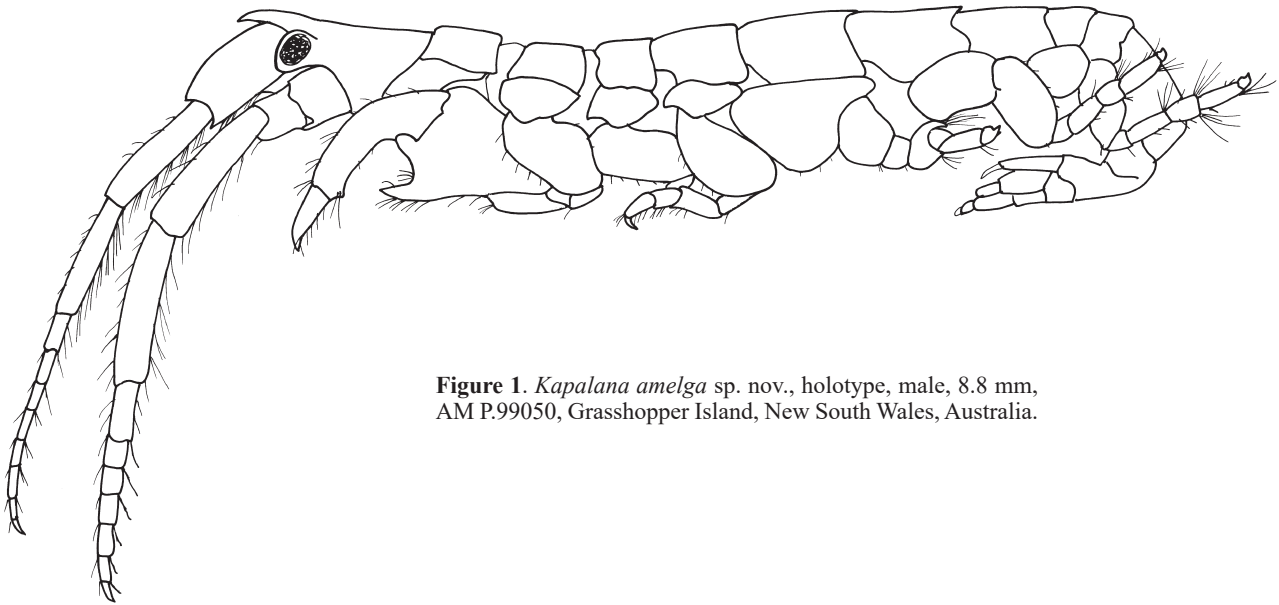
Walker & Scott (1903) reported a female from Abd al Kuri, in the Gulf of Aden that they called *Cerapus flindersi* and Chilton (1892) reported a male *Cerapus flindersi* from Port Jackson, Australia, but in both cases the species identification is dubious. Walker & Scott's specimen is poorly illustrated. Chilton's specimen lacks a projection on the posterior margin of the first article of antenna 1 and represents an undescribed species of *Cerapus*.

### *Kapalana amelga* sp. nov.

Figs 1–3

**Holotype**, male, 8.8 mm, AM P.99050, south-west side of Grasshopper Island, New South Wales, Australia (35°38'01"S 150°19'51"E), hand collected on scuba, in the red alga *Peyssonnelia novaehollandiae*, 11 m, P. B. Berents, J. Eu, A. J. Millar & G. D. F. Wilson on RV *Baragula*, 10 February 2003, Hermon Slade Batemans Bay Expedition, NSW 2038. **Paratype** female, 6.5 mm, AM P.99051, type locality, hand collected on scuba in the red alga *Amphiroa anceps*, 13 m, P. B. Berents, J. Eu, A. J. Millar & G. D. F. Wilson on RV *Baragula*, Hermon Slade Batemans Bay Expedition, 9 February 2003, NSW 2034.

**Additional material examined.** One female, 3 juveniles, AM P.99052, type locality, hand collected on scuba in red alga *Peyssonnelia novaehollandiae*, 11 m, P. B. Berents, J. Eu, A. J. Millar & G. D. F. Wilson on RV *Baragula*, 10 February 2003, Hermon Slade Batemans Bay Expedition,



**Figure 1.** *Kapalana amelga* sp. nov., holotype, male, 8.8 mm, AM P.99050, Grasshopper Island, New South Wales, Australia.

NSW 2038; 1 male, 1 female, 8 juveniles, AM P.99053, type locality, hand collected on scuba in red alga *Amphiroa anceps*, 13 m, P. B. Berents, J. Eu, A. J. Millar & G. D. F. Wilson on RV *Baragula*, 9 February 2003, Hermon Slade Batemans Bay Expedition, NSW 2034; 2 males, 3 females, 1 juvenile, AM P.99054, type locality, hand collected on scuba in red alga *Amphiroa anceps*, 13 m, P. B. Berents, J. Eu, A. J. Millar & G. D. F. Wilson on RV *Baragula*, 9 February 2003, Hermon Slade Batemans Bay Expedition, NSW 2034.

**Type locality.** South-west side of Grasshopper Island, New South Wales, Australia (35°38'01"S 150°19'51"E).

**Etymology.** From the Spanish word *amelga*, meaning a ridge between two furrows and referring to the ridged posterior margin on the propodus of gnathopod 2.

**Description.** Based on Holotype, male, 8.8 mm, AM P.99050.

**Head.** Rostrum long, length  $0.4 \times$  head, evenly tapered, apically acute; lateral cephalic lobe with ventral corner subacute, subocular margin deeply recessed, reaching beyond eye, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1* long, length  $0.5 \times$  body length; peduncle with scales; peduncular article 1 longer than article 3, length  $1.2 \times$  peduncular article 3, not produced anterodistally and anteromedially, with strong sub-quadrate projection along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 8-articulate; article 1 short. *Antenna 2* length equal to antenna 1; flagellum 7-articulate.

*Epistome and upper lip* fused, produced, broad base, apically subquadrate.

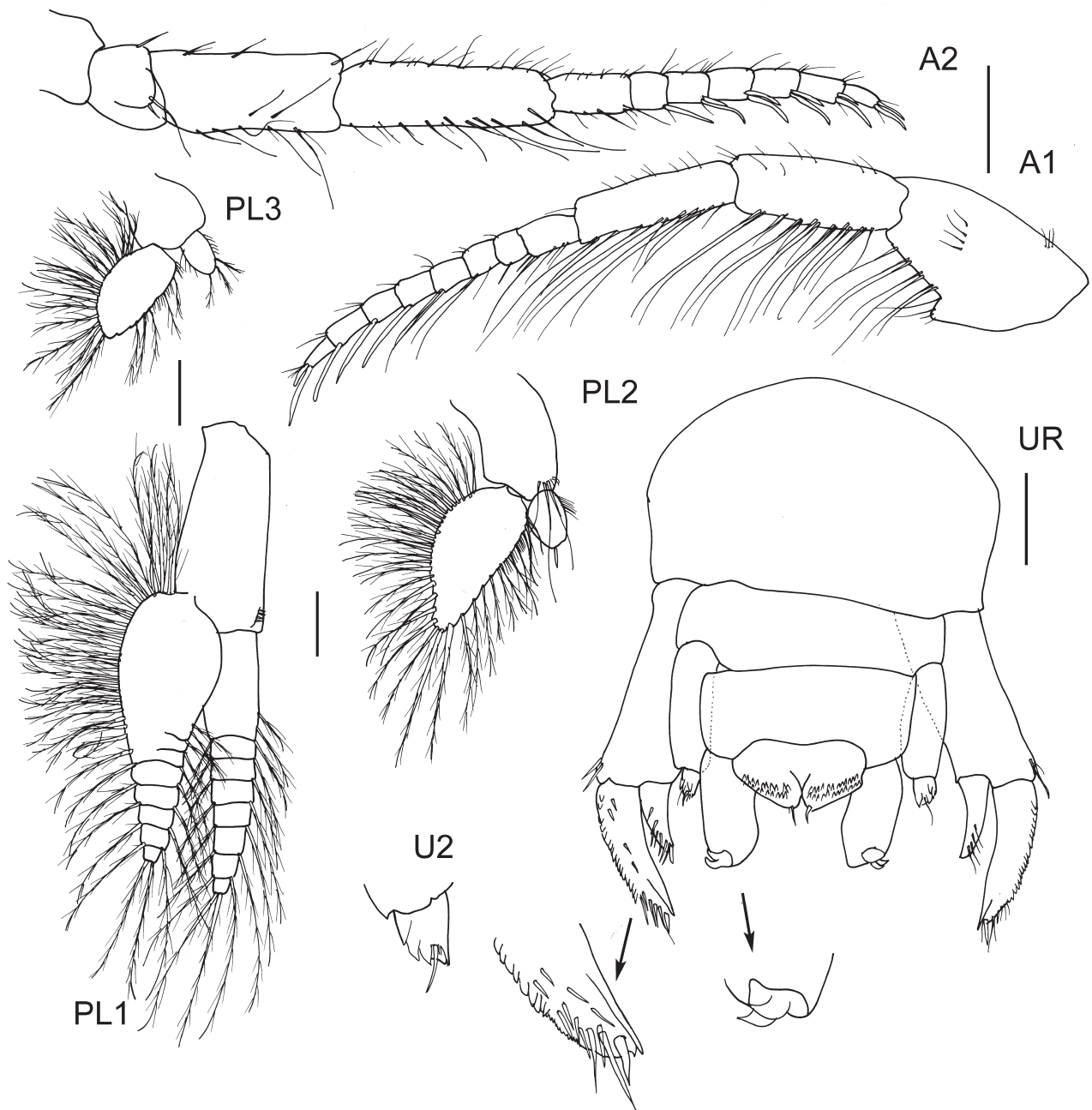
**Pereon.** *Pereonite 1* with lateral keel, without sternal keel. *Pereonites 2–3* with sternal keel. *Pereonite 5* length  $1.6 \times$  depth.

*Gnathopod 1* coxa not fused to pereonite 1, length  $1.1 \times$  depth, without anteroventral lobe; basis length  $2.5 \times$  depth; carpus broad, length  $1.4 \times$  depth with setose posterior lobe; propodus palm acute, robust setae absent. *Gnathopod 2* carpochebate; coxa not fused to pereonite 2, length  $1.6 \times$

depth, without anteroventral lobe or cusp; basis short, broad, length  $1.9 \times$  breadth, without anteroproximal group of long slender setae; carpus long, length  $1.3 \times$  breadth, broad, posterior margin with row of small spines, palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium length, length  $1.1 \times$  width; propodus slender, curved, length  $4.5 \times$  width, without tooth on posterior margin, posterodistal corner smooth, with 1 tooth; dactylus length  $0.5 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3; basis length  $2.2 \times$  breadth, evenly rounded, with simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $2.2 \times$  breadth; merus length  $1.1 \times$  breadth; short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, with anterior lobe separated from an anteroventral lobe; basis length  $1.6 \times$  breadth, with simple setae along entire anterior margin; ischium long, length  $2.4 \times$  breadth; merus long, length  $1.6 \times$  breadth. *Pereopod 5* coxa length  $1.5 \times$  depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 5 plumose setae; propodus with 2 setae along posterior margin; dactylus short, unciniate with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis with patch of small setae near anterior margin; merus length  $1.6 \times$  breadth; dactylus short, unciniate, with 2 accessory hooks. *Pereopod 7* coxa without posterodorsal lobe, without patch of small setae; merus length  $1.4 \times$  breadth; dactylus short, unciniate, with 2 accessory hooks.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 8-articulate; outer ramus 6-articulate, article 1 evenly swollen; *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad 1-articulate. *Uropod 1* biramous; peduncle, length  $1.1 \times$  outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 5 lateral setae, with large apical robust seta, without smaller slender setae; inner ramus length  $0.5 \times$  outer ramus, with 4–5 medial and no lateral setae, with large



**Figure 2.** *Kapalana amelga* sp. nov., holotype, male, 8.8 mm, AM P.99050, Grasshopper Island, New South Wales, Australia. A1 and A2 scales, represent 0.5 mm; pleopods and urosome, scales represent 0.2 mm.

apical robust seta. *Uropod 2* uniramous, peduncle, length  $2.6 \times$  breadth,  $3.8 \times$  length of ramus; ramus small with 3 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.9 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.5 \times$  breadth, weakly cleft (28%), each lobe with 22–24 anteriorly directed hooks in 2 rows.

**Female** (sexually dimorphic characters). Based on paratype female, 6.5 mm, AM P.99051. *Antenna 1* peduncle without scales; flagellum 6-articulate. *Antenna 2* flagellum 6-articulate. *Pereonite 1* without lateral keel. *Pereonite 2–3* without sternal keel. *Pereonite 5*, length  $2.2 \times$  depth. *Gnathopod 1* coxa, length  $1.3 \times$  depth; basis, length  $2.6 \times$  depth; carpus length  $1.6 \times$  depth with setose posterior lobe. *Gnathopod 2* subchelate; palm extremely acute. *Pereopod*

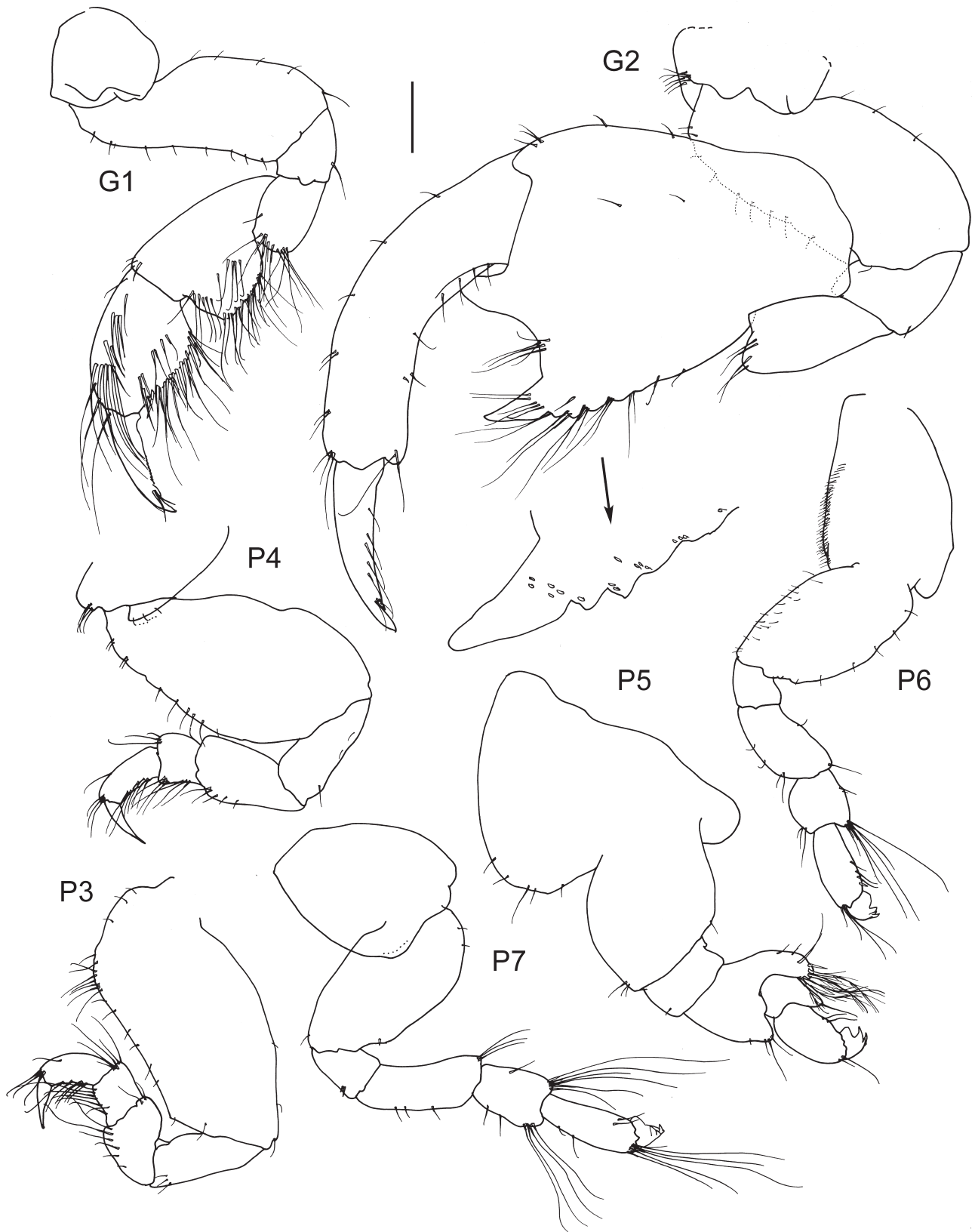
*5* coxa, length  $1.3 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube.** Encrusted with detritus; tubes of juveniles attached in a ring, circling the tube of adult female.

**Habitat.** Sublittoral (11–13 m depth).

**Remarks.** *Kapalana amelga*, like *K. flindersi* and *K. maia*, lacks scales on the peduncles of antennae 1 and 2. It differs from other species in the genus in having the posterior margin of the gnathopod 2 carpus with a row of small spines and three apical denticles on the ramus of uropod 2.

**Distribution.** Australia. *New South Wales*: Grasshopper Island.



**Figure 3.** *Kapalana amelga* sp. nov., holotype, male, 8.8 mm, AM P.99050, Grasshopper Island, New South Wales, Australia. Scales represent 0.2 mm.

*Kapalana durraween* sp. nov.

Figs 4–6

**Holotype**, male, 9.4 mm, AMP.21868, off Disaster Bay, New South Wales, Australia (37°16'S 150°5'E), 91 m, K. Moller, May 1930. **Paratypes**: 1 male, 6.9 mm, AM P.10721, off Twofold Bay, New South Wales, Australia (37°5'S 150°9'E), 82 m, K. Moller on *Durraween*, August 1929; 1 male, 8.2 mm, AM P.76108; 1 female, 7.0 mm, AM P.76109; 4 males, 1 female, AM P.10719, off Twofold Bay, New South Wales, Australia (37°5'S 150°7'E), 82 m, K. Moller on *Durraween*, July 1929.

**Additional material examined**. 10 specimens, AMP.21867, 35 km east of Port Jackson, New South Wales, Australia (33°50'S 151°40'E), 366 m, 27 March 1905; 1 female, AM P.10720, west-south-west of Gabo Island, Victoria, Australia (37°34'S 149°55'E), 128 m, K. Moller on *Durraween*, December 1929; 1 female, 2 juveniles, AM P.76107, off Disaster Bay, New South Wales, Australia (37°16'S 150°5'E), 91 m K. Moller, May 1930.

**Etymology**. Named for the trawler *Durraween*, whose Master, Captain K. Moller, contributed many natural history specimens to the Australian Museum. Used as a noun in apposition.

**Description**. Based on Holotype, male 9.4 mm, AMP.21868.

**Head**. Rostrum long, length  $0.3 \times$  head, evenly tapered, apically acute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner rounded, ventral margin horizontal, posterior margin sloping. *Antenna 1* very long, length  $0.8 \times$  body length; peduncle with scales; peduncular article 1 shorter than article 3, length  $0.7 \times$  peduncular article 3, not produced anterodistally and anteromedially, with strong sub-quadrate projection along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner with distal projection flagellum 10-articulate; article 1 short. *Antenna 2* length equal to antenna 1; flagellum 9-articulate.

*Epistome and upper lip* fused, produced, broad base, apically acute.

**Pereon**. *Pereonite 1* with lateral keel, without sternal keel. *Pereonites 2–3* with sternal keel. *Pereonite 5* length  $1.4 \times$  depth.

*Gnathopod 1* subchelate; coxa not fused to pereonite 1, without anteroventral lobe; basis length  $2.1 \times$  depth; carpus broad, length  $1.5 \times$  depth with setose posterior lobe, propodus palm acute, robust setae absent. *Gnathopod 2* carpochele; coxa not fused to pereonite 2, length  $1.6 \times$  depth, without anteroventral lobe or cusp; basis short, broad, length  $1.4 \times$  breadth, basis without anteroproximal group of long slender setae, basis without anteroproximal bulge; carpus long, length  $1.2 \times$  breadth, broad, palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium length, length  $1.2 \times$  width; propodus broad, curved, length  $4.5 \times$  width, without tooth on posterior margin, posterodistal corner smooth, without spines; dactylus length  $0.4 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, with broad anteroventral lobe, length  $1.9 \times$  depth; basis, length  $1.9 \times$  breadth, with proximal, subquadrate anterodorsal corner,

with plumose setal group and simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $2 \times$  breadth; merus length  $1.1 \times$  breadth; short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2.1 \times$  depth, with anteroventral lobe; basis length  $1.7 \times$  breadth, with plumose setal group midway along anterior margin or with simple setae along entire anterior margin; ischium long, length  $2.5 \times$  breadth; merus long, length  $1.4 \times$  breadth. *Pereopod 5* coxa length  $1.2 \times$  depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 6 plumose setae; propodus with 4 setae along posterior margin; dactylus short, uncinately with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis without patch of small setae near anterior margin; merus length  $1.6 \times$  breadth; dactylus short, uncinately, with 2 accessory hooks. *Pereopod 7* coxa without posterodorsal lobe; merus length  $2.1 \times$  breadth; dactylus short, uncinately, with 2 accessory hooks.

**Pleon**. *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 9-articulate; outer ramus 9-articulate, article 1 evenly swollen. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length  $1.4 \times$  outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 14 lateral setae, with large apical robust seta and smaller slender setae; inner ramus length  $0.5 \times$  outer ramus, with 1 medial, and 3 lateral setae, without large apical robust seta. *Uropod 2* uniramous, peduncle, length  $2.8 \times$  breadth,  $4.4 \times$  length of ramus; ramus small with 7 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.5 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.6 \times$  breadth, moderately cleft (58%), each lobe with 26–30 anteriorly directed hooks in 2 rows.

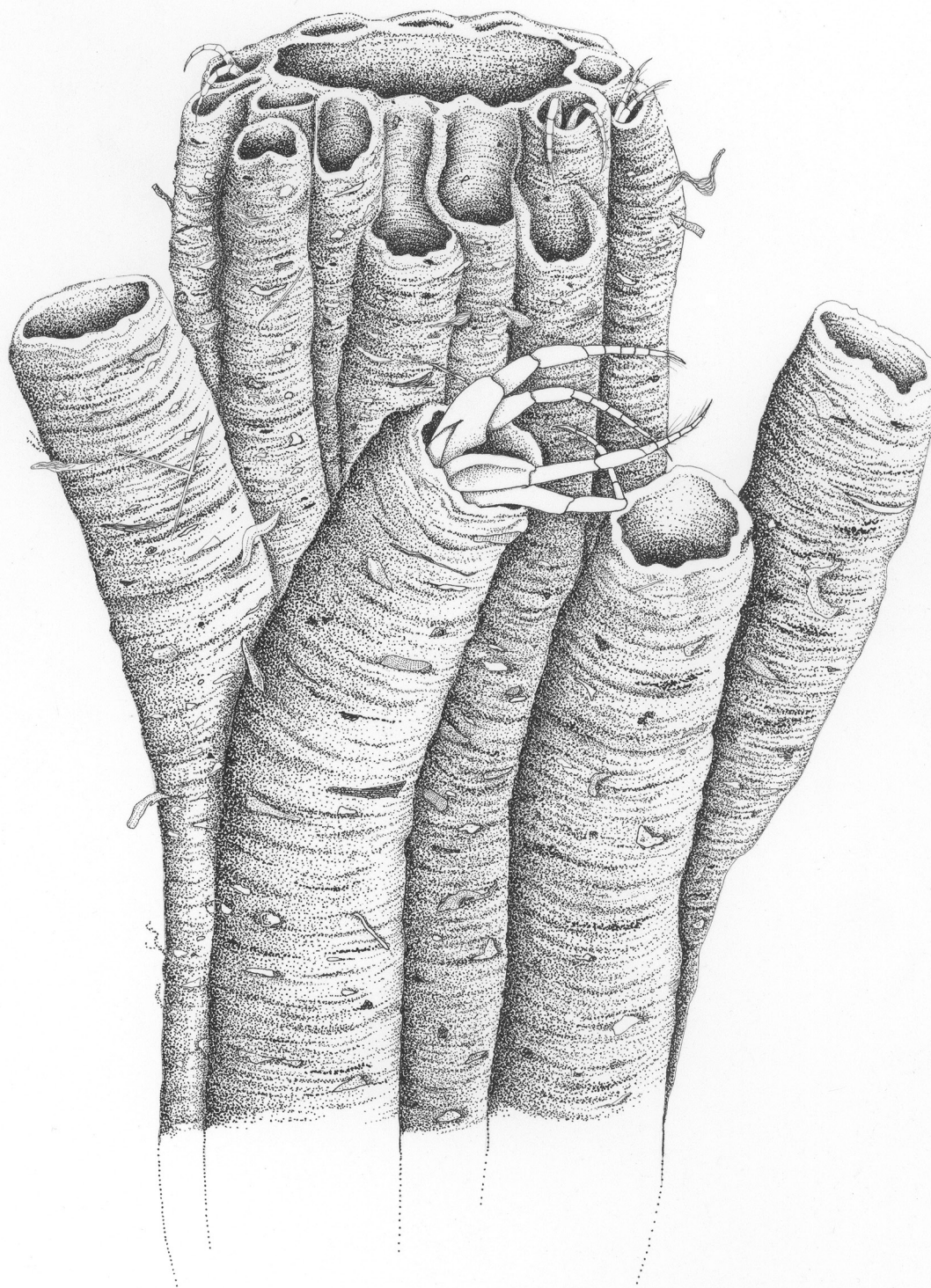
**Female** (sexually dimorphic characters). Based on paratype female 7.0 mm, AM P.76109. *Antenna 1* flagellum 9-articulate. *Pereonite 1* without lateral keel. *Pereonites 2–3* without sternal keel. *Pereonite 5*, length  $1.9 \times$  depth. *Gnathopod 1* coxa, length  $1.1 \times$  depth; basis, length  $2 \times$  depth; carpus length  $1.3 \times$  depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa, length  $1.7 \times$  depth; basis, length  $2.2 \times$  breadth. *Pereopod 5*, coxa, length  $1.4 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube**. Tubes of juveniles attached in a ring, circling the tube of adult female.

**Habitat**. Continental shelf and slope (82–366 m depth).

**Remarks**. The shape of gnathopod 2 propodus and carpus changes as males grow, with the carpus becoming longer than wide and the propodus becoming curved and slender in large males. In males less than 7 mm, the length and breadth of the carpus are equal and the propodus is less than three times as long as wide

Three species, *K. amelga*, *K. durraween* and *K. maia*, have an evenly tapered rostrum. Neither *Kapalana durraween* nor *K. maia* have a large apical seta on the inner ramus of uropod 1. *Kapalana durraween* differs from *K. maia* in having scales on the peduncle of antenna 1, a lateral keel on pereonite 1 and a sternal keel on pereonite 3.



**Figure 4.** *Kapalana durraween* sp. nov., AM P.21867, central maternal tube with encircling juvenile tubes, 35 km east of Port Jackson, New South Wales, Australia (diameter of central tube = 2mm).

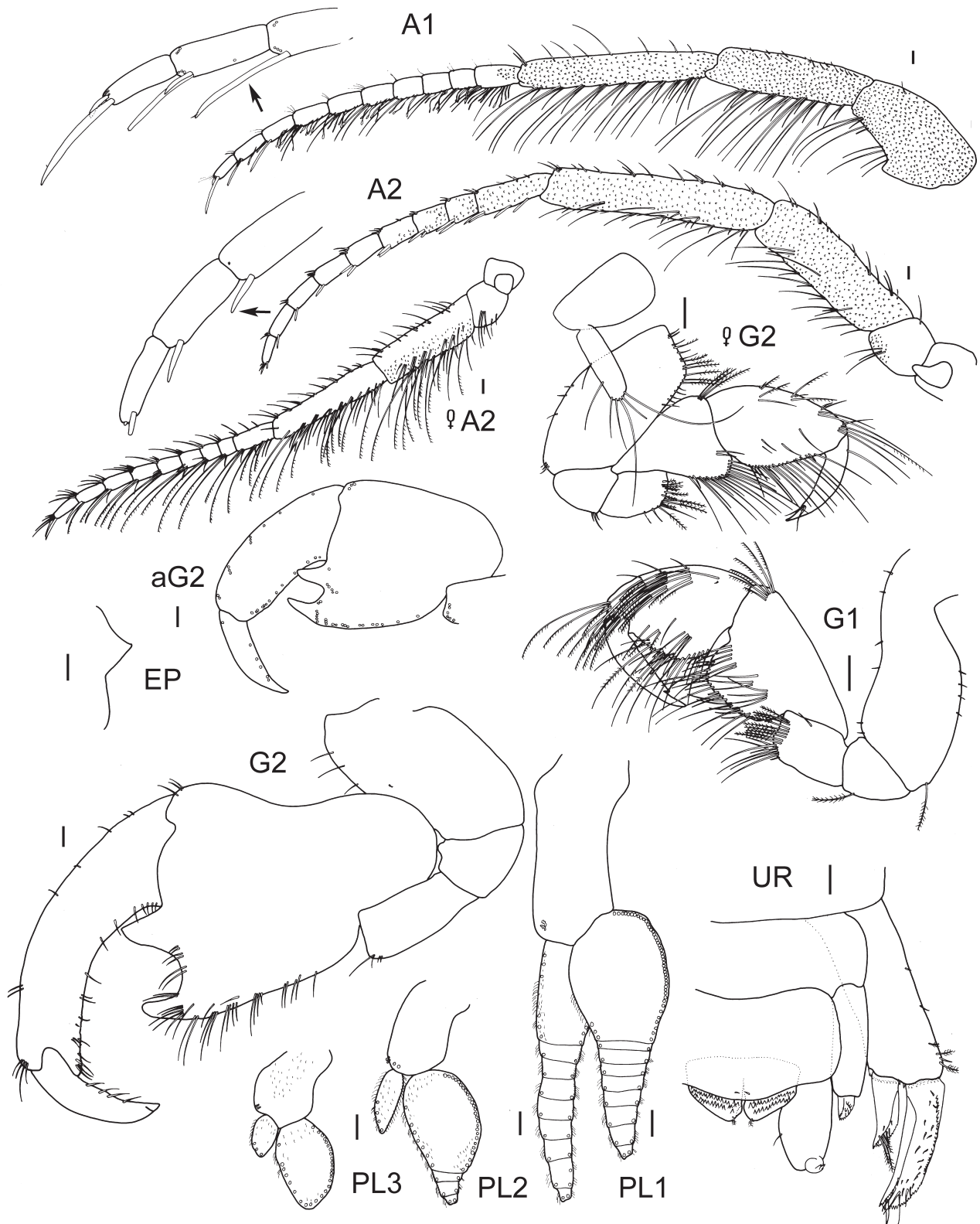
**Distribution.** Australia. *New South Wales*: east of Port Jackson; off Twofold Bay; off Disaster Bay. *Victoria*: west south west of Gabo Island.

***Kapalana kimbla* sp. nov.**

Figs 7, 8

**Holotype**, male, 9.4 mm, MV J70496, 26 km south-west of Cape Otway, Bass Strait, Victoria, Australia (39°01'00"S 143°22'06"E), 84 m, M. F. Gomon, 31 January 1981, MV Bass Strait Survey, BSS 120 S. **Paratypes**, ovigerous female, 9.6 mm, MV J70497; male, 6.8 mm, MV J70498; male, 7.4 mm, MV J70499; male, 5.7 mm, MV J70500; male, 4.6

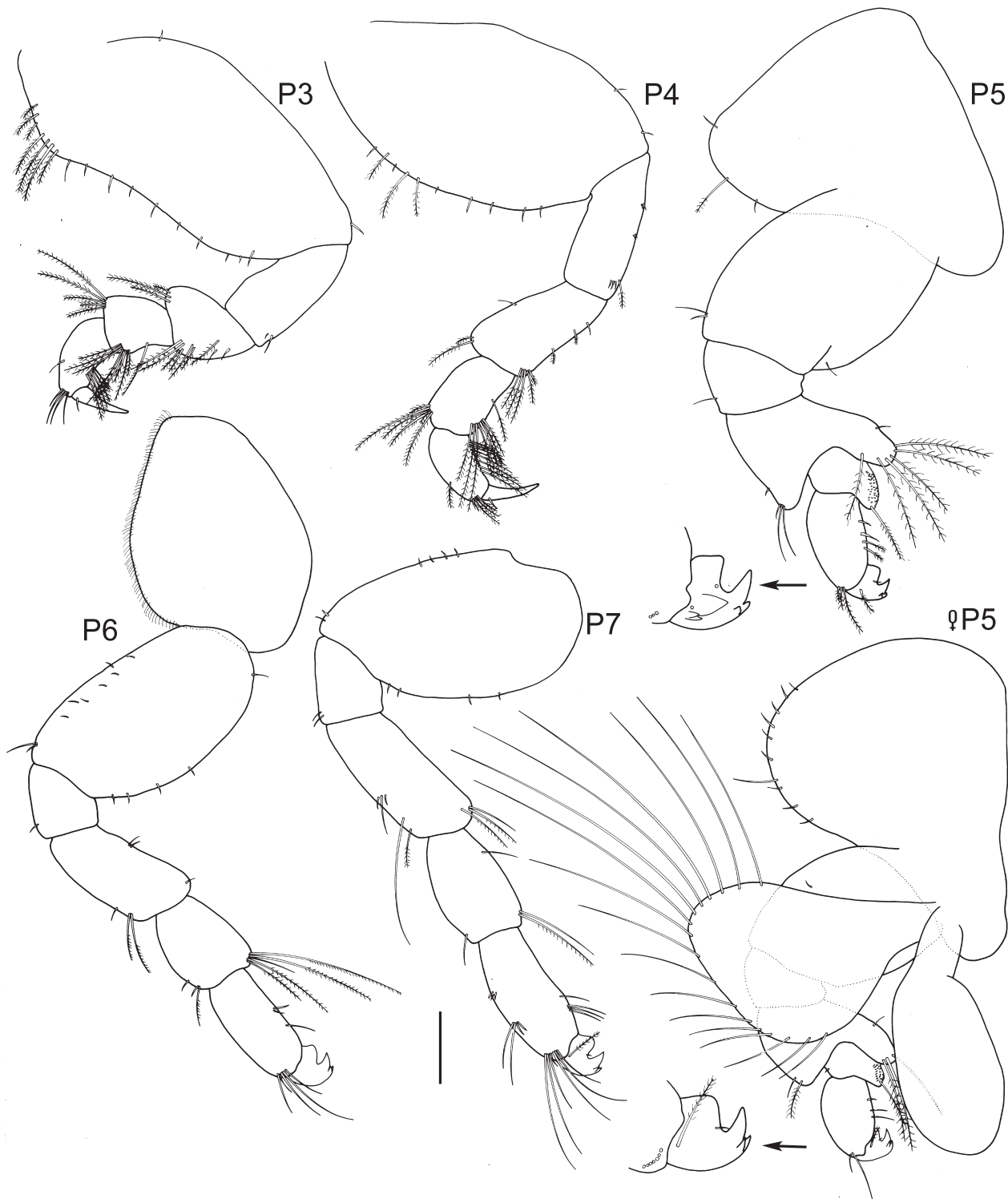




**Figure 5.** *Kapalana durraween* sp. nov., holotype, male, 9.4 mm, AM P.21868; paratype, female, 6.96 mm, AM P.76109; paratype male "a", 6.9 mm, AM P.10721; Disaster Bay, New South Wales, Australia. Gnathopod 2 male "a" and pleopods 1–3 insertion points of setae are indicated by small circles. Scales represent 0.1 mm.

mm, MV J70501; male, 3.9 mm, MV J70502; same data as holotype. One female, 1 male, MV J11259, cove on south shore Leonard Point, Wilsons Promontory, Victoria, Australia, (39°01'30"S 146°17'30"E), 3 February 1982, WPNPA. One male, 1 juvenile, MV J11295, north east end Vancouver

Peninsula, Western Australia, Australia, (39°03'24"S 117°56'012"E), 7 m, 8 April 1984, SWA 18. Many specimens, AM P.99049, off Venus Bay township, Venus Bay, South Australia, Australia, (33°13'48"S 134°40'06"E), sand in channel, 3 m, G. C. B. Poore, 23 April 1985, SA 85.



**Figure 6.** *Kapalana durraween* sp. nov., holotype, male, 9.4 mm, AM P.21868; paratype, female, 6.9 mm, AM P.76109; Disaster Bay, New South Wales, Australia. Scales represent 0.1 mm.

**Additional material examined.** Many specimens, MV J11297, type locality, M. F. Gomon, 31 January 1981, MV Bass Strait Survey, BSS 120 S.

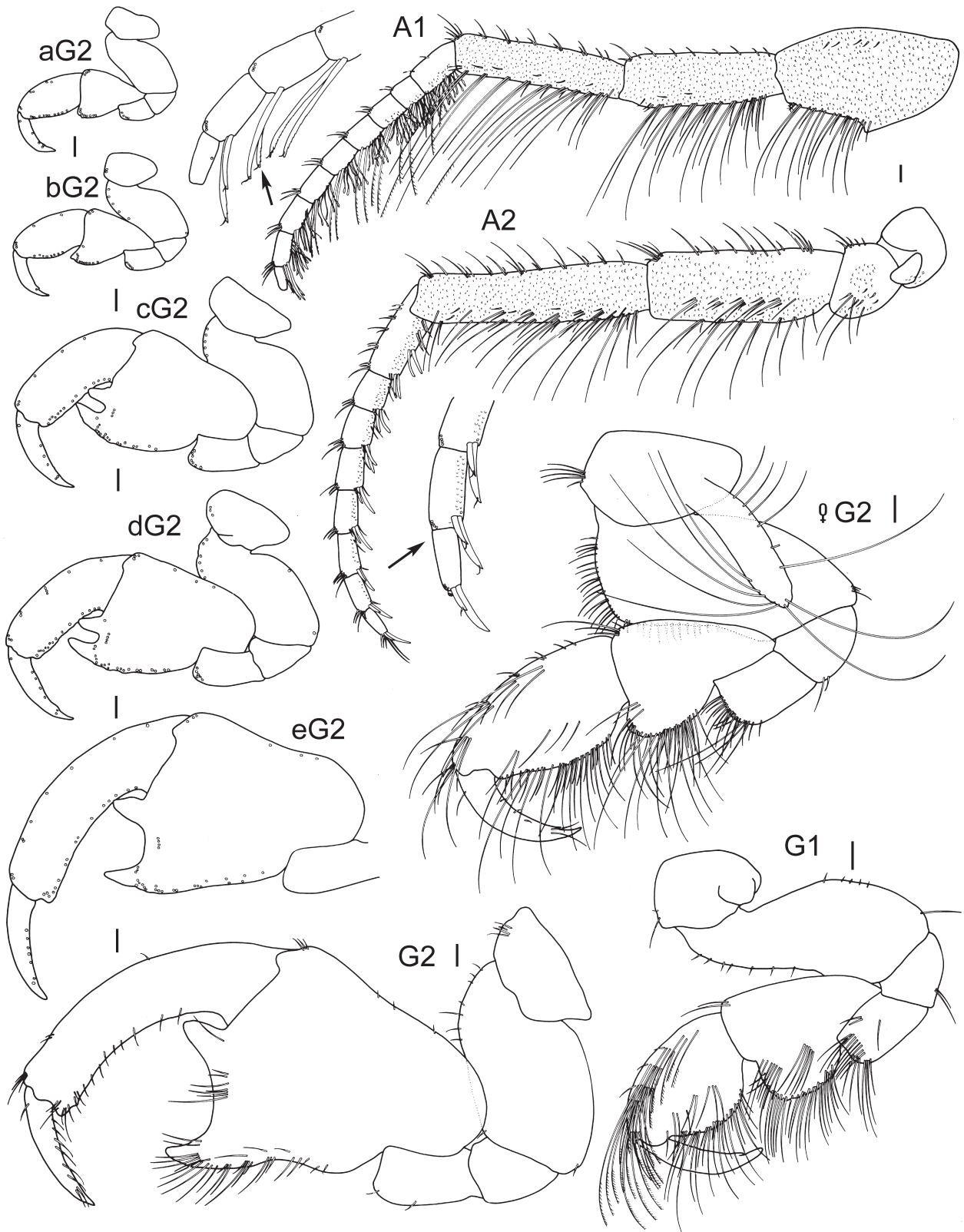
**Type locality.** 26 km south-west of Cape Otway, Bass Strait, Victoria, Australia (39°01'00"S 143°22'06"E).

**Etymology.** Named for HMAS *Kimbla* in recognition of many collections made for museums in Australia by this

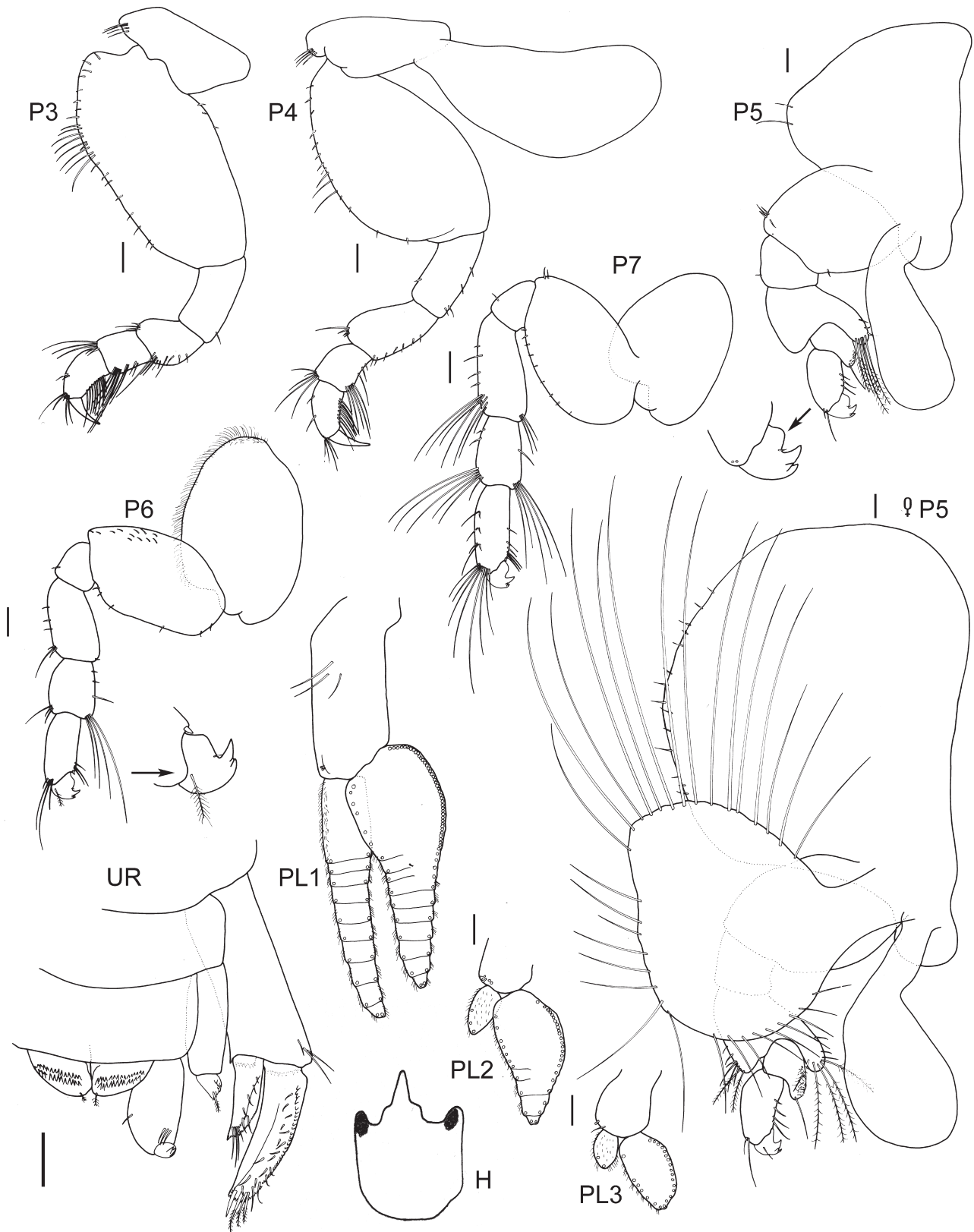
ship. Used as a noun in apposition.

**Description.** Based on Holotype, male, 9.4 mm, MV J70496.

**Head.** Rostrum long, length 0.5 × head, forming a basal shoulder, apically acute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner subquadrate, ventral margin horizontal, posterior margin vertical. *Antenna 1* long, length



**Figure 7.** *Kapalana kimbla* sp. nov., holotype, male, 9.4 mm, MV J70496; paratype male “a”, 3.9 mm, MV J70502; paratype, male “b”, 4.6mm, MV J70501; paratype, male “c”, 5.7 mm, MV J70500; paratype, male “d”, 6.8 mm, MV J70498; paratype, male “e”, 7.4 mm, MV J70499; paratype female, 9.6 mm, MV J70497; Bass Strait, Victoria, Australia. Gnathopod 2 males “a”, “b”, “c”, “d”, “e” insertion points of setae are indicated by small circles. Scales represent 0.1 mm.



**Figure 8.** *Kapalana kimbla* sp. nov., holotype, male, 9.4 mm, MV J70496; paratype, female, 9.6 mm, MV J70497; Bass Strait, Victoria, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scales represent 0.1 mm.

0.6 × body length; peduncle with scales; peduncular article 1 subequal to article 3, length 1.1 × peduncular article 3, not produced anterodistally and anteromedially, with strong sub-quadrate projection along posterior margin, posterodistal

corner not produced; peduncular article 2 anterodistal corner without distal projection; flagellum 9-articulate; article 1 short. *Antenna 2* length 1.1 × antenna 1; flagellum 9-articulate.

*Epistome and upper lip* fused, produced, broad base, apically subquadrate.

**Pereon.** *Pereonite 1* with lateral keel. *Pereonites 1–3* with sternal keel. *Pereonite 5* length  $2 \times$  depth. *Gnathopod 1* coxa not fused to pereonite 1, length  $1.4 \times$  depth, without anteroventral lobe; basis length  $2.2 \times$  depth; carpus broad, length  $1.4 \times$  depth with setose posterior lobe, propodus palm acute, robust setae absent. *Gnathopod 2* carpochebate; coxa not fused to pereonite 2, length  $1.8 \times$  depth, without anteroventral lobe or cusp; basis short, broad, length  $1.4 \times$  breadth, without anteroproximal group of long slender setae; carpus long, length  $1.1 \times$  breadth, broad, with smooth posterior margin; palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium length, length equal to width; propodus slender, curved, length  $4.9 \times$  width, without tooth on posterior margin, posterodistal corner smooth with 1 tooth; dactylus length  $0.4 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, without anteroventral lobe, length  $1.6 \times$  depth; basis, length  $1.9 \times$  breadth, with proximal rounded anterodorsal corner, with simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $2 \times$  breadth; merus length  $1.1 \times$  breadth, short, without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2.3 \times$  depth, with anterior lobe separated from several small anteroventral lobes; basis, length  $1.6 \times$  breadth, with simple setal group midway along anterior margin; ischium long, length  $2.4 \times$  breadth; merus long, length  $1.5 \times$  breadth. *Pereopod 5* coxa, length  $1.4 \times$  depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe not extending beyond anterior margin of carpus posterior lobe with 5 plumose setae; propodus with 3 setae along posterior margin; dactylus short, uncinuate with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis with patch of small setae near anterior margin; merus length  $1.7 \times$  breadth; dactylus short, uncinuate, with 2 accessory hooks. *Pereopod 7* coxa with posterodorsal lobe, without patch of small setae; merus length  $2 \times$  breadth; dactylus short, uncinuate, with 2 accessory hooks.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 10-articulate; outer ramus 7-articulate, article 1 evenly swollen. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus broad, 3-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle length  $1.3 \times$  outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial and lateral setae, with large apical robust seta and smaller slender setae; inner ramus, length  $0.6 \times$  outer ramus, without medial setae, with 4 lateral setae. *Uropod 2* uniramous, peduncle length  $2.5 \times$  breadth,  $5 \times$  length of ramus; ramus small with 5 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.7 \times$  breadth; ramus with 3 curved hooks. *Telson* length  $0.6 \times$  breadth, weakly cleft (25%), each lobe with 26–27 anteriorly directed hooks in 2 rows.

**Female** (sexually dimorphic characters). Based on female 9.6 mm, MV J.11297. *Antenna 1* flagellum 10-articulate. *Antenna 2* flagellum 10-articulate. *Pereonite 1* without lateral keel. *Pereonites 1–3* without sternal keel. *Pereonite 5* length

$1.5 \times$  depth. *Gnathopod 1* basis, length  $2.2 \times$  depth; carpus length  $0.7 \times$  depth with setose posterior lobe. *Gnathopod 2* subchelate; coxa, length  $1.6 \times$  depth; basis, length  $1.9 \times$  breadth. *Pereopod 5* coxa, length  $1.4 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube.** Granular, fine or coarse grained, tubes of juveniles attached in a ring, circling the tube of adult female.

**Habitat.** Sub-littoral (3–84 m depth).

**Remarks.** The shape of gnathopod 2 propodus and carpus changes as males grow, with the propodus becoming curved and slender in large males. In males less than 5 mm in length, gnathopod 2 is subchelate and the carpus has a straight posterior margin. In males longer than 5 mm, gnathopod 2 becomes carpochebate and the carpus develops an excavate posterior margin with the excavate margin becoming shallower and wider in large males longer than 9 mm.

*Kapalana kimbla* and *K. amelga* both have a strong subquadrate projection along the posterior margin of peduncular article 1 of antenna 1, a large apical robust seta on the inner ramus of uropod 1 and a shallow excavate palm on gnathopod 2. They differ in a number of characters including the posterior margin of the carpus of gnathopod 2 which is smooth in *K. kimbla*, but has a row of small spines in *K. amelga*. *Kapalana kimbla* is the only species with 3 curved hooks on uropod 3.

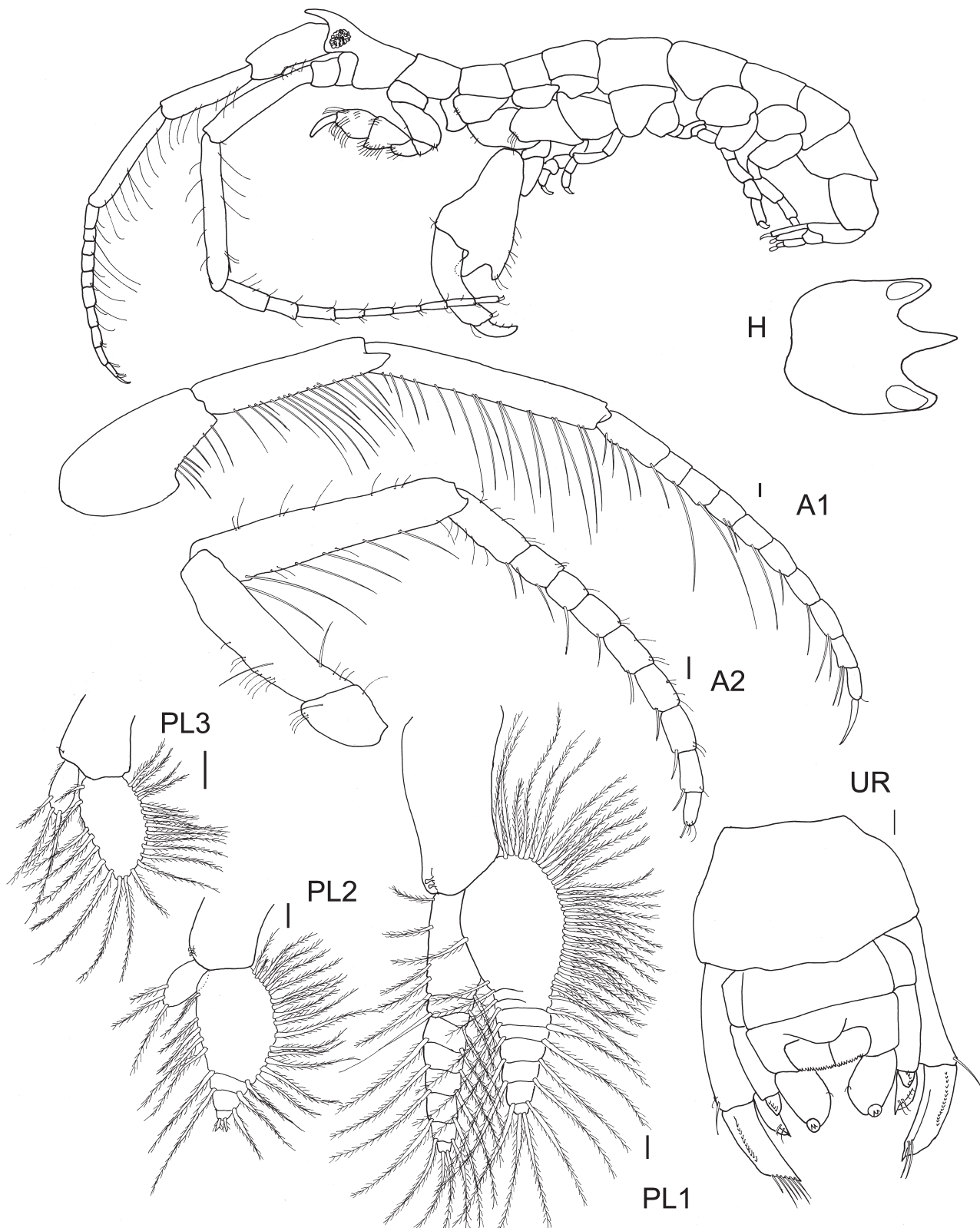
**Distribution.** Australia. *Victoria*: Bass Strait; Wilsons Promontory. *South Australia*: Venus Bay.

### *Kapalana maia* sp. nov.

Figs 9–11

**Holotype**, male, 10.0 mm, MV J70540, 60 km east of North Point, Flinders Island, Bass Strait, (39°41'42"S 148°39'30"E), naturalist's dredge, 115 m, 27 March 1979, G. C. B. Poore on HMAS *Kimbla*, BSS 32. **Paratypes**, female, 12.5 mm, MV J70541; 2 males, 3 females, 2 juveniles, MV J13712, same data as holotype. 1 male, 1 female, MV J11270, 63 km east of North Point, Flinders Island, Bass Strait, (39°44'48"S 148°40'36"E), WHOI epibenthic sled, 124 m, 14 November 1981, R.S. Wilson, BSS 167 S; 2 females, 2 juveniles, MV J1705, 25 km south of Cape Otway, Bass Strait, (39°06'00"S 143°35'48"E), grab, sled and trawl, 95 m, M.F. Gomon, 31 January 1981, BSS 118.

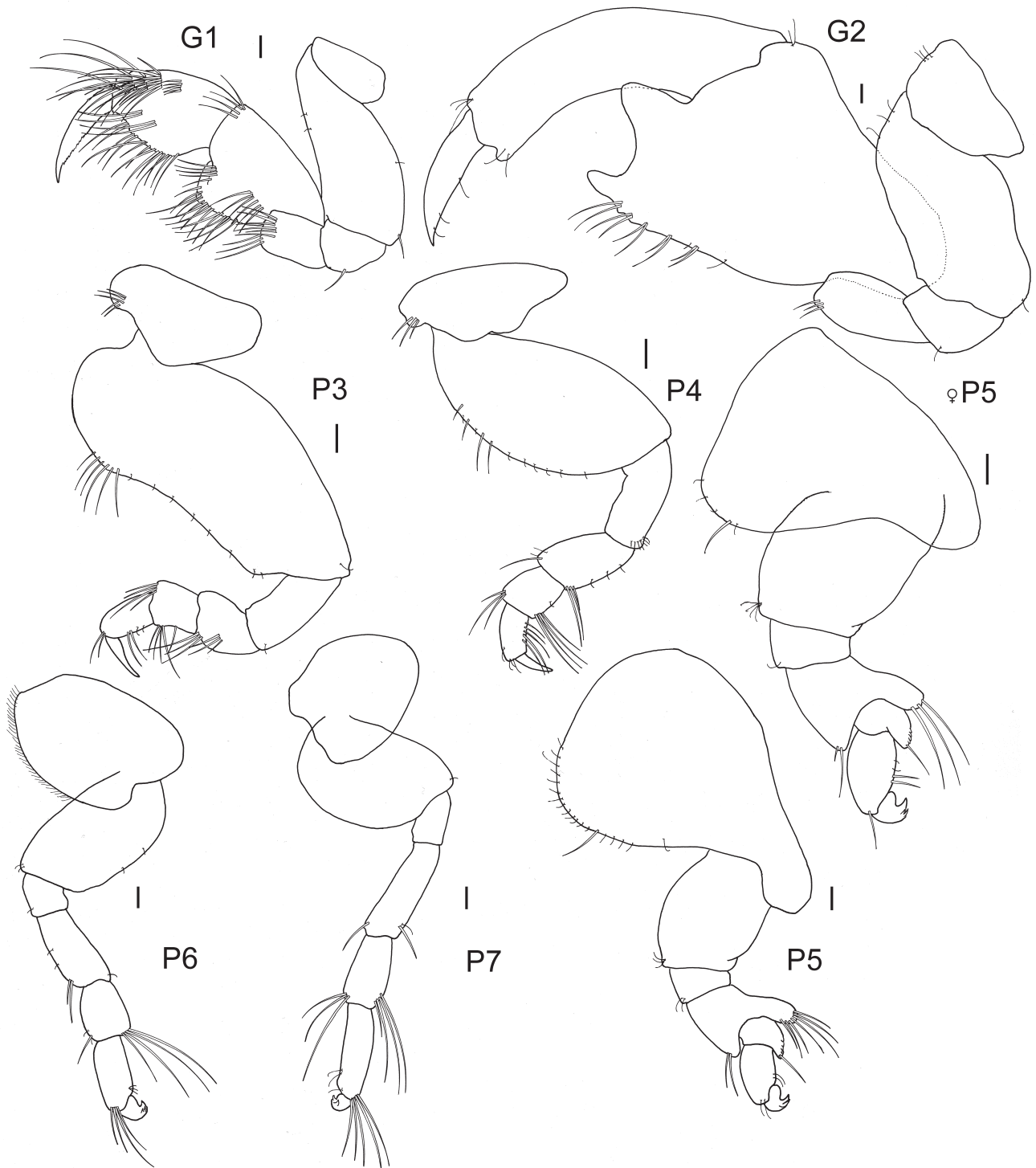
**Additional material examined.** One female, MV J1706, 25 km south of Cape Otway, Bass Strait, (39°06'00"S 143°35'48"E), grab, sled and trawl, 95 m, M.F. Gomon, 31 January 1981, BSS 118; 1 male, MV J11264 and 1 male, 2 females, 4 juveniles, MV J11257, 75 km south-south east of Port Fairy, Bass Strait, (39°01'S 142°35'E), Smith-McIntyre grab/pipe dredge, 90 m, G.C.B. Poore, 9 October 1980, BSS 63; 1 female, MV J11258, 46 km south west of Lakes Entrance, Bass Strait, (38°17'S 147°29'E), otter trawl, 29–31 m, M.F. Gomon and R.S. Wilson, 31 July 1983, BSS 211 T; 1 female, MV J11260, 52 km west north-west of Cape Farewell, King Island, Bass Strait, (39°25'S 143°23'E), Smith-McIntyre grab/pipe dredge, 103 m, G.C.B. Poore, 10 October 1980, BSS 80; 20 specimens, MV J11265, 44 km NE of Cape Wickham, King Island, Bass Strait, (39°22'00"S 144°18'18"E), grab, sled and trawl, 60 m, R.S. Wilson, 23 November 1981, BSS 203; 1 female, MV J11267, 80 km west south-west of Cape



**Figure 9.** *Kapalana maia* sp. nov., holotype, male, 10.0 mm, MV J70540, Bass Strait, Victoria, Australia. Scales represent 0.1 mm.

Otway, Bass Strait, (39°59'S 142°37'E), Smith-McIntyre grab/pipe dredge, 94 m, G.C.B. Poore, 9 October 1980, BSS 62; 1 male, MV J11291, 79 km south south-east of Port Fairy, Bass Strait, (39°02'S 142°38'E), Smith-McIntyre grab/pipe dredge, 119m, G.C.B. Poore, 9 October 1980, BSS 64; 1 male, 2 females, MV J11292, 15 km south of Cape

Wellington, Wilsons Promontory, Bass Strait (39°03'12"S 146°39'30"E), 55 m, WHOI epibenthic sled, R.S. Wilson, 18 November 1981, BSS 179 S; 1 male, MV J11519, off Crib Point, Western Port, Victoria (38°20'56"S 145°13'20"E), Smith-McIntyre grab, 8 m, A.J. Gilmour, 29 March 1965, CPBS-N; 6 specimens, MV J13710, 60 km east of North

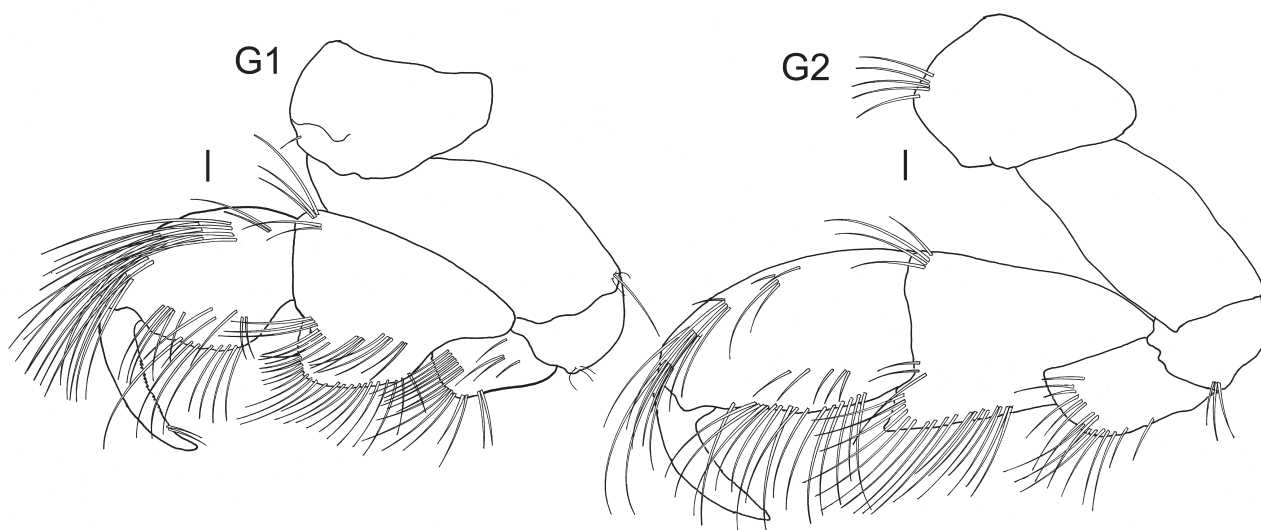


**Figure 10.** *Kapalana maia* sp. nov., holotype, male, 10.0 mm, MV J70540; paratype, female, 12.5 mm, MV J70541; Bass Strait, Victoria, Australia. Scales represent 0.1 mm.

Point, Flinders Island, Bass Strait, (39°41'42"S 148°39'30"E), naturalist's dredge, 115 m, G.C.B. Poore, 27 March 1979, BSS 32; 1 female, 200 m west of Kinghorne Point, Woodbridge, Tasmania, (43°10'00"S 147°17'00"E), pipe dredge, 27 m, R.S. Wilson, 17 April 1985, TAS 5; 1 female, MV J70505, 30 km north of North Point, Flinders Island, Bass Strait, (39°26'18"S 144°18'18"E), grab, sled and trawl, 49 m, R.S. Wilson, 17 November 1981, BSS 173; 1 female, AM P.99055, south east of Lakes Entrance, Bass Strait, (38°08'50"S 148°35'00"E), sandy clay, 146 m, C. Phipps on *Esso Gipps*, 5–7 May 1969,

Stn. 9; 3 males, AM P.99056, 65 km south of Cape Schanck, Bass Strait (39°08'18"S 144°43'54"E), coarse sand, 66 m, R.S. Wilson on RV *Tangaroa*, 23 November 1981, BSS 201; 2 males, 1 female, 1 juvenile, AM P.99057, 23 km east of Cape Rochon, Three Hummock Island, Bass Strait (40°22'12"S 145°17'00"E), sand, epibenthic sled, 40 m, M.F. Gomon and G.C.B. Poore on RV *Sarda*, 3 November 1980, BSS 112.

**Type locality.** 60 km east of North Point, Flinders Island, Bass Strait, (39°41'42"S 148°39'30"E).



**Figure 11.** *Kapalana maia* sp. nov., paratype, female, 12.5 mm, MV J70541; Bass Strait, Victoria, Australia. Scales represent 0.1 mm.

**Etymology.** The species name is derived from the Greek *maia*, meaning “good mother”, in reference to the juveniles living in tubes which are attached to the female tube.

**Description.** Based on Holotype, male, 10.0 mm, MV J70540. **Head.** Rostrum long, length  $0.4 \times$  head, evenly tapered, apically acute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner rounded, ventral margin sloping. *Antenna 1* very long, length  $0.8 \times$  body length; peduncle without scales; peduncular article 1 shorter than peduncular article 3, length  $0.7 \times$  peduncular article 3; peduncular article 2 with medial triangular projection; flagellum 10-articulate; article 1 long. *Antenna 2* length equal to antenna 1; flagellum 9-articulate.

*Epistome and upper lip* fused, produced, broad base, apically acute.

**Pereon.** *Pereonite 1* without lateral keel or sternal keel. *Pereonite 2* with sternal keel. *Pereonite 3* without sternal keel. *Pereonite 5* length  $1.3 \times$  depth.

*Gnathopod 1* coxa not fused to pereonite 1, length  $2.2 \times$  depth, without anteroventral lobe; basis, length  $2.3 \times$  depth; carpus broad, length  $1.4 \times$  depth with setose posterior lobe; propodus palm acute, robust setae absent. *Gnathopod 2* carpochele; coxa not fused to pereonite 2, length  $1.5 \times$  depth, without anteroventral lobe or cusp; basis short, broad, length  $1.6 \times$  breadth; carpus long, length  $1.2 \times$  breadth, broad, palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium length, length  $1.1 \times$  width; propodus broad, curved, length  $4 \times$  width, without tooth on posterior margin, posterodistal corner smooth, with 1 tooth; dactylus length  $0.4 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, with broad anteroventral lobe, length  $1.8 \times$  depth; basis, length  $1.8 \times$  breadth, evenly rounded, with simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $2.3 \times$  breadth; merus length  $1.1 \times$  breadth, short, without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2.4 \times$  depth, with anterior lobe separated from an anteroventral lobe; basis, length  $1.9 \times$  breadth, with simple

setal group midway along anterior margin; ischium long, length  $2.5 \times$  breadth; merus long, length  $1.3 \times$  breadth. *Pereopod 5* coxa, length  $1.3 \times$  depth, without patches of small setae; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 3 plumose setae; propodus with 2 setae along posterior margin; dactylus short, uncinuate with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis without patch of small setae near anterior margin; merus length  $2 \times$  breadth; dactylus short, uncinuate, with 2 accessory hooks. *Pereopod 7* coxa without posterodorsal lobe, without patch of small setae; merus length  $2.5 \times$  breadth; dactylus short, uncinuate, with 2 accessory hooks.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 9-articulate; outer ramus 8-articulate, article 1 evenly swollen. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus broad, 4-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length  $1.5 \times$  outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, with 2 medial setae, lateral setae absent, with large apical robust seta and smaller slender setae; inner ramus, length  $0.5 \times$  outer ramus, with 6 medial, and 5 lateral setae, without large apical robust seta. *Uropod 2* uniramous, peduncle, length  $3 \times$  breadth,  $5.1 \times$  length of ramus; ramus small with 7 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.8 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.7 \times$  breadth, weakly cleft (27%), each lobe with 28–29 anteriorly directed hooks in 2 rows.

**Female** (sexually dimorphic characters). Based on paratype female 12.5 mm, MV J.70541. *Antenna 1* flagellum 11-articulate. *Antenna 2* flagellum 10-articulate. *Pereonite 2* without sternal keel. *Gnathopod 1* carpus length  $1.3 \times$  depth with setose posterior lobe. *Gnathopod 2* subchele, basis, length  $1.8 \times$  breadth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube.** Encrusted with fine sediment; tubes of juveniles attached in a ring, circling the tube of adult female.



**Remarks.** *Kapalana maia* belongs to the species group with a subquadrate projection along the posterior margin of peduncular article 1 of antenna 1. It shares with *K. durraween*, *K. michaelmas* and *K. wadei* a lack of apical robust seta on the inner ramus of uropod 1. It shares with *K. durraween* and *K. wadei* an anterodistal projection on peduncular article 2, but in *K. maia* the projection is triangular and more pronounced. It has an evenly tapered rostrum similar to *K. durraween*. *Kapalana maia* has no lateral keel on pereonite 1 or sternal keel on pereonite 3 (both present in *K. durraween*). The tubes of *K. maia* are encrusted with fine sediment (encrusted with sand grains and pieces of shell in *K. durraween*).

**Distribution.** Australia. *Victoria*: Bass Strait; Wilsons Promontory. *Tasmania*: Bass Strait; King Island; Flinders Island; Woodbridge.

### *Kapalana michaelmas* sp. nov.

Figs 12–15

**Holotype**, male, 10.3 mm, AM P.75528, off south-east corner of Michaelmas Island, King George Sound, Western Australia, Australia (35°3'S 118°E), sand, 27 m, J. K. Lowry, 17 December 1983, WA 187. **Paratypes**: 1 female, 10.0 mm, AM P.75529; 1 male, 5.7 mm, AM P.75530; 1 male, 5.4 mm, AM P.75531; 1 male, 6.5 mm, AM P.75532; 1 male, 7.5 mm, AM P.75533; 1 male, 8.9 mm, AM P.75534; many specimens, AM P.75535; 1 specimen, AM P.75538; collection data same as holotype.

**Additional material examined.** One female, AM P.75536, near Mistaken Island, Vancouver Peninsula, King George Sound, Western Australia (35°4'S 117°56'E), seagrass, 6 m, R. T. Springthorpe, 13 December 1983, WA 121; 2 females, AM P.75537, near Mistaken Island, Vancouver Peninsula, King George Sound, Western Australia (25°4'S 117°56'E), seagrass, 3 m, J. K. Lowry, 13 December 1983, WA 112; 1 male, 6.2 mm, 1 female, 8.3 mm, 1 male, 20 females, SAM C1755, 6 miles off Semaphore, South Australia (34.837°S 138.484°E), 5 fathoms, H.M. Hale, 12 December 1925; 2 females, SAM C6341, 2 nautical miles south west of Point AVOID, Price Island, Eyre Peninsula, South Australia (35°42'S 135°19'E), shale gutters and algae, 17 m, L. Hobbs on MRV *Ngerin*, 28 September 1989; females & juveniles, SAM C6342, West Island, South Australia (35°37'S 138°35'E), 5 m, S. A. Shepherd, 20 June 1989; many specimens, AM P.99047, Cape Donington, Spencer Gulf, South Australia, (34° 44'S 135°59'E), rough bottom, 15 m, N. Coleman, 21 December 1970; 1 male, 1 female, 1 juvenile, AM P.99048, reef front, south of Tantabiddy, Ningaloo Reef, Western Australia, (21°54'36"S 113°55'42"E), coral heads, 9 m, N. L. Bruce and M. Blazewicz-Paszkowycz, 12 June 2008, NIN 10c.

**Type locality.** Off south-east corner of Michaelmas Island, King George Sound, Western Australia, Australia (35°3'S 118°E).

**Etymology.** Named for Michaelmas Island, the type locality. Used as a noun in apposition.

**Description.** Based on Holotype, male, 10.3 mm, AM P.75528.

**Head.** Rostrum long, length  $0.5 \times$  head, forming a basal shoulder, apically acute; lateral cephalic lobe with ventral corner subacute, subocular margin deeply recessed, reaching beyond eye, anteroventral corner rounded, ventral margin sloping, posterior margin sloping. *Antenna 1* long, length  $0.5 \times$  body length; peduncle with scales; peduncular article 1 subequal in length to peduncular article 3, length  $1.1 \times$  peduncular article 3, with well-developed subquadrate projection along posterior margin; peduncular article 2 with distal projection; article 2 anterodistal corner without distal projection; flagellum 9-articulate; article 1 short. *Antenna 2* length  $0.9 \times$  antenna 1; flagellum 10-articulate.

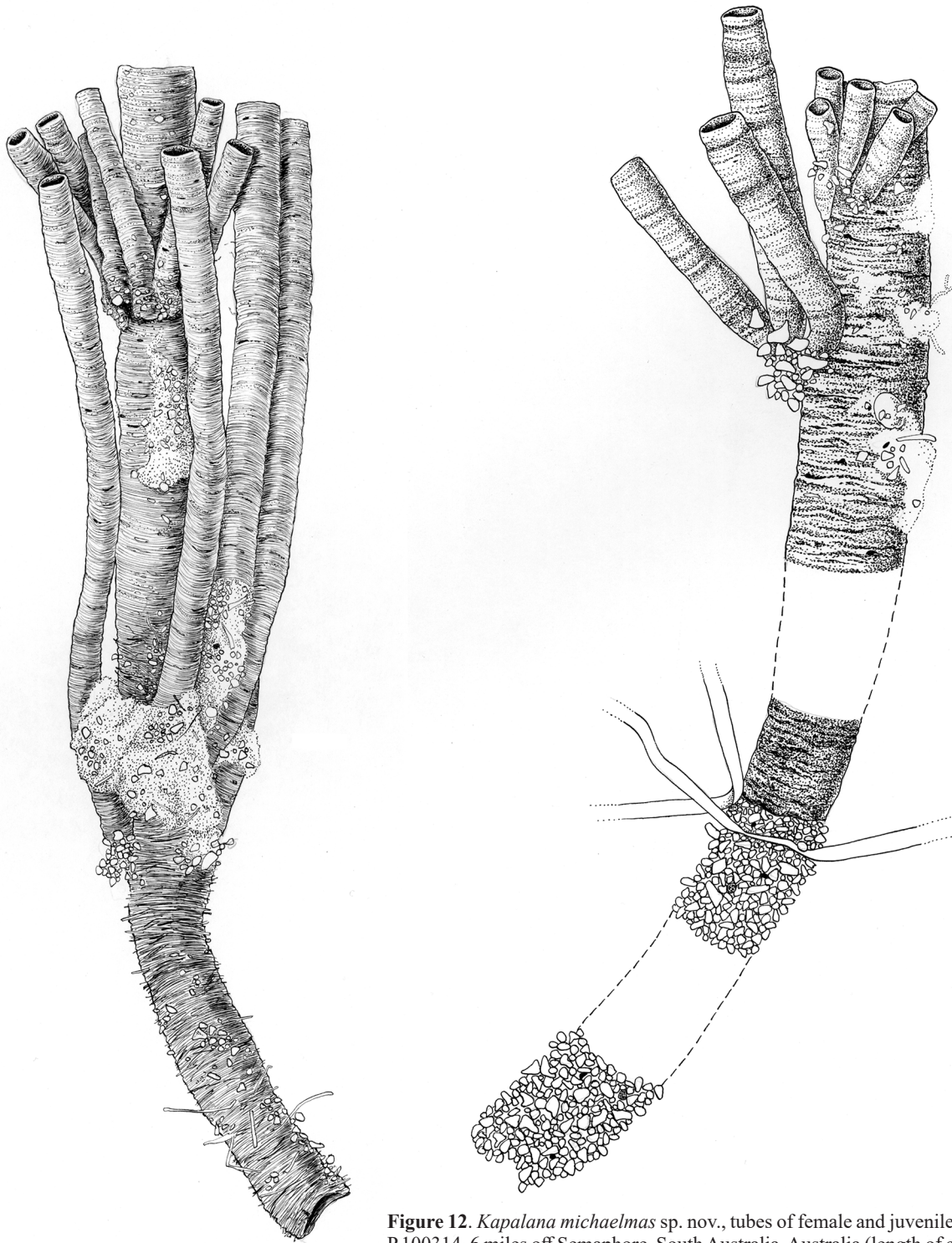
*Epistome and upper lip* fused, produced, broad base, apically acute. *Mandible* palp article 2 long and slender (more than  $2.5 \times$  as long as broad); palp article 3 slender, blade-like.

**Pereon.** *Pereonite 1* with lateral keel, without sternal keel. *Pereonites 2–3* without sternal keel. *Pereonite 5* length equal to depth.

*Gnathopod 1* subchelate; coxa not fused to pereonite 1, length  $1.2 \times$  depth, without anteroventral lobe; basis length  $2.3 \times$  depth; carpus broad, length  $1.5 \times$  depth with setose posterior lobe, propodus palm acute, robust setae absent. *Gnathopod 2* carpochele; coxa not fused to pereonite 2, length  $1.6 \times$  depth, without anteroventral lobe or cusp; basis short, broad, length  $1.8 \times$  breadth; carpus long, length  $1.3 \times$  breadth, broad, palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, medium length, length  $0.9 \times$  width; propodus slender, curved, length  $4.8 \times$  width, without tooth on posterior margin, posterodistal corner smooth, without spines; dactylus length  $0.5 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, without anteroventral lobe, length  $2.3 \times$  depth; basis, length  $2.1 \times$  breadth, with proximal, subquadrate anterodorsal corner, with plumose setal group and simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $2.3 \times$  breadth; merus length equal to breadth, short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2 \times$  depth, with anterior lobe separated from an anteroventral lobe; basis length  $1.7 \times$  breadth, with simple setae along entire anterior margin; ischium long, length  $2.9 \times$  breadth; merus very long, length  $1.5 \times$  breadth. *Pereopod 5* coxa, length  $1.3 \times$  depth, without patches of small setae, with setae along ventral margin few or absent; merus with anterior lobe not extending beyond anterior margin of carpus, posterior lobe with 2 plumose setae; propodus with 4 setae along posterior margin; dactylus short, uncinately with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis with patch of small setae near anterior margin; merus length  $2 \times$  breadth; dactylus short, uncinately, with 2 accessory hooks. *Pereopod 7* coxa without posterodorsal lobe, without patch of small setae; merus length  $2.4 \times$  breadth; dactylus short, uncinately, with 2 accessory hooks.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 9-articulate; outer ramus 6-articulate, article 1 evenly swollen. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 3-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle, length  $1.4 \times$  outer ramus; rami with distoventral fan of robust setae;

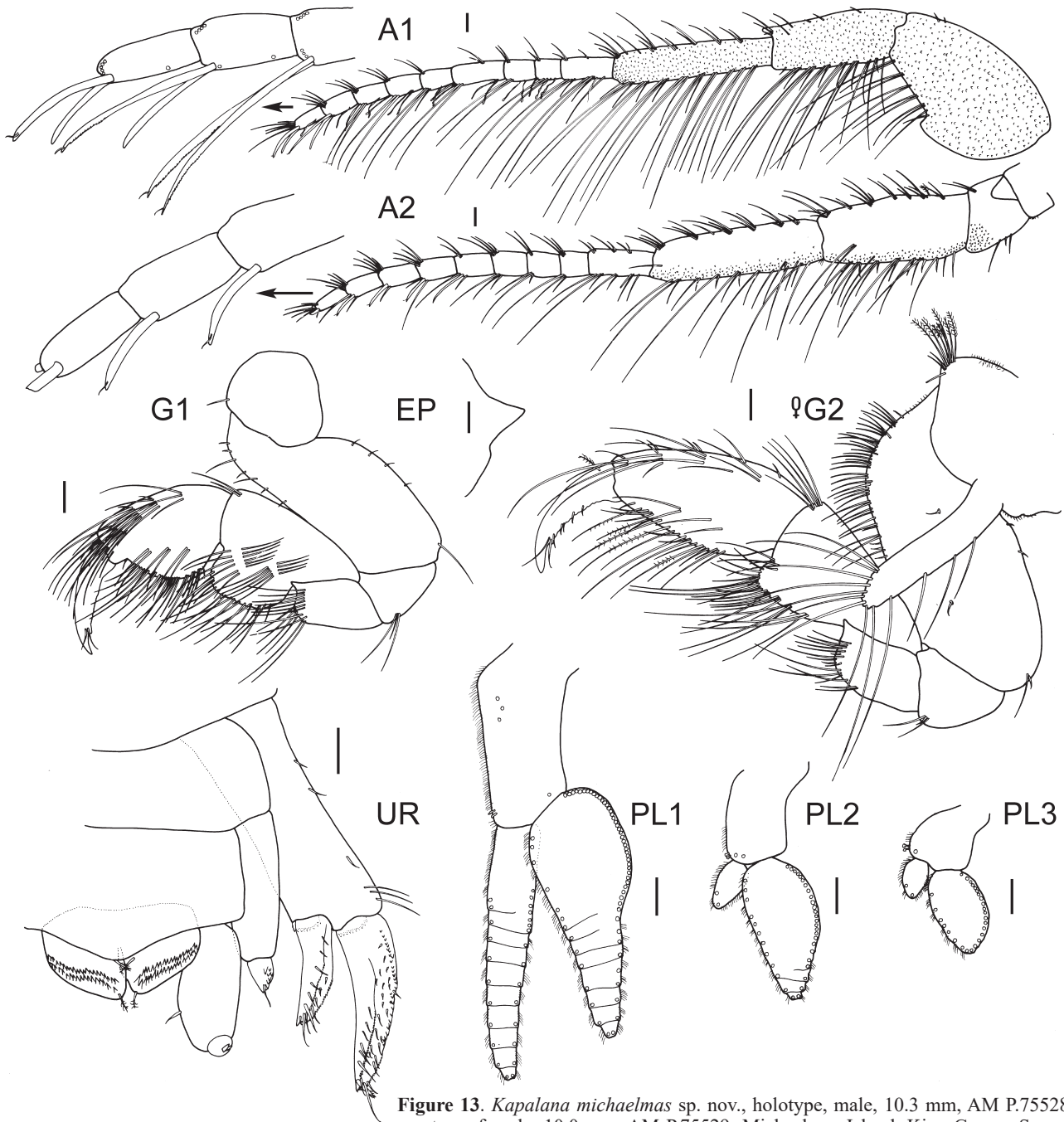


**Figure 12.** *Kapalana michaelmas* sp. nov., tubes of female and juveniles; left, AM P.100314, 6 miles off Semaphore, South Australia, Australia (length of central tube = 30 mm); right, AM P.75535, Michaelmas Island, King George Sound, Western Australia, Australia (length of tube = 70 mm).

outer ramus with lateral row of denticles, with 6 medial setae and 18 lateral setae, with large apical robust seta and smaller slender setae; inner ramus, length  $0.6 \times$  outer ramus, with 6 medial, and 4 lateral setae, without large apical robust seta. *Uropod 2* uniramous, peduncle, length  $2.9 \times$  breadth,  $3.7 \times$  length of ramus; ramus small with 7 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.9 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.6 \times$  breadth, moderately cleft (21%), each lobe with 38–39 anteriorly directed hooks in 2 rows.

**Female** (sexually dimorphic characters). Based on female, 10.0 mm, AM P.75529. *Antenna 1* flagellum 10-articulate. *Antenna 2* flagellum 7-articulate. *Pereonite 1* without lateral keel. *Gnathopod 1* coxa, length  $1.4 \times$  depth; basis, length  $2.6 \times$  depth, carpus length  $0.7 \times$  depth with setose posterior lobe. *Gnathopod 2* simple; basis, broad, length  $1.9 \times$  breadth, carpus length  $1.7 \times$  breadth. *Pereopod 5* coxa, length  $1.4 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube.** Tubes of adult males encrusted with fine and coarse organic matter. Tubes of adult females in two parts, the



**Figure 13.** *Kapalana michaelmas* sp. nov., holotype, male, 10.3 mm, AM P.75528; paratype, female, 10.0 mm, AM P.75529; Michaelmas Island, King George Sound, Western Australia, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scales represent 0.1 mm

anterior end encrusted with fine and coarse organic matter, the posterior end encrusted with large sand grains. Tubes of juveniles attached in a ring, circling the tube of adult female.

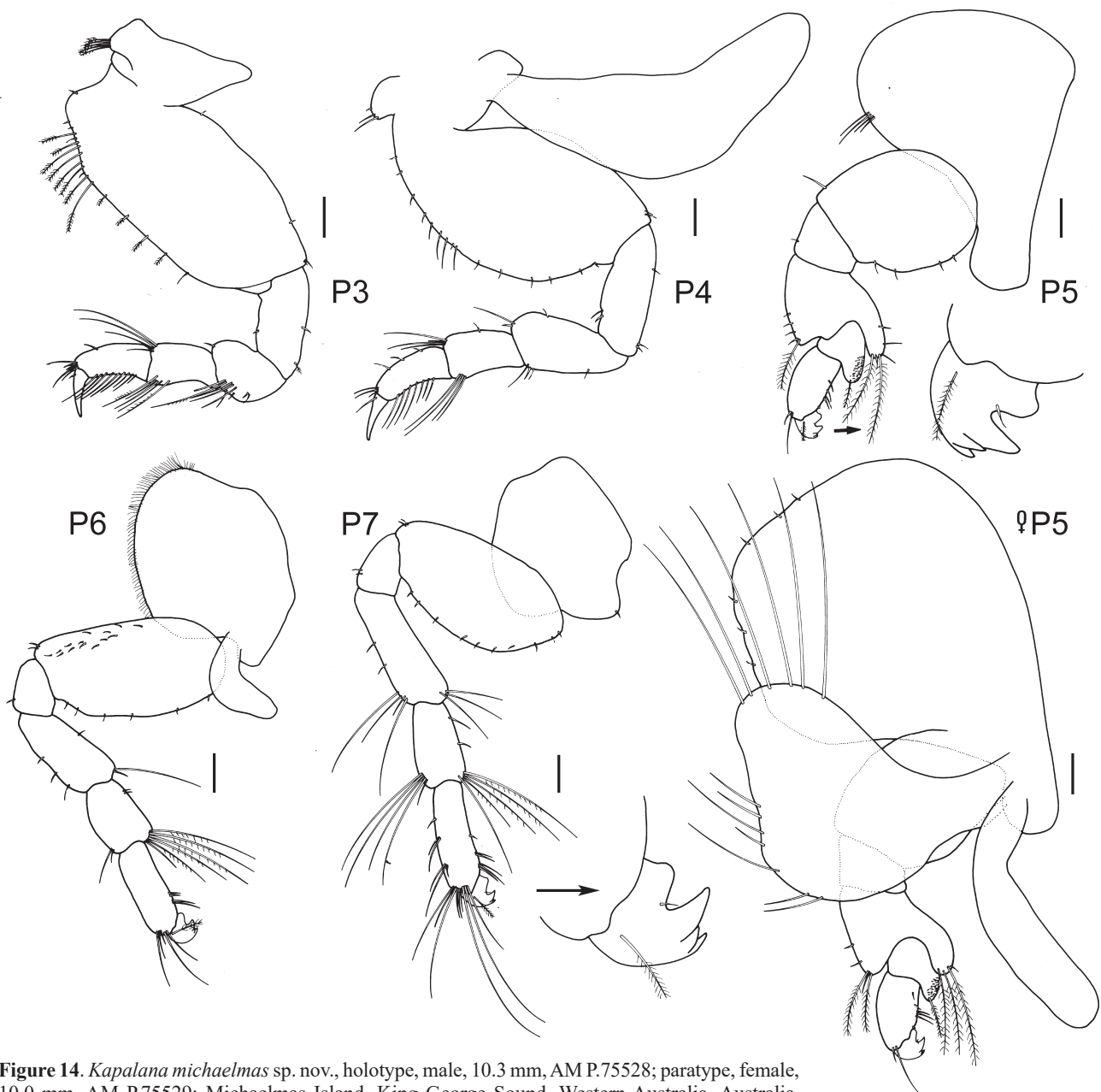
**Habitat.** Sublittoral (3–27 m depth).

**Remarks.** The shape of gnathopod 2 propodus and carpus changes as males grow, with the propodus becoming curved and slender in large males. In males less than 6 mm in length, gnathopod 2 is subchelate with a small anterodistal and posterodistal tooth. In males longer than 6 mm, gnathopod 2 becomes carpochele, and the carpus develops an excavate posterior margin.

*Kapalana michaelmas* shares with *K. durraween*, *K.*

*maia* and *K. wadei* a lack of apical robust seta on the inner ramus of uropod 1. The rostrum has a basal shoulder (a character shared with *K. kimbla* and *K. wadei*) but the rostrum is not as long as *K. wadei* (the rostrum is very long in *K. wadei*). Gnathopod 1 coxa is not fused to pereonite 1 in *K. michaelmas* (fused in *K. wadei*). In *K. michaelmas* the posterior lobe of the carpus of pereopod 5 bears 2 plumose setae and *K. wadei* bears 6 plumose setae.

**Distribution.** Australia. *Western Australia:* King George Sound; Ningaloo Reef. *South Australia:* off Semaphore; Price Island, Eyre Peninsula; West Island; Cape Donington, Spencer Gulf.



**Figure 14.** *Kapalana michaelmas* sp. nov., holotype, male, 10.3 mm, AM P.75528; paratype, female, 10.0 mm, AM P.75529; Michaelmas Island, King George Sound, Western Australia, Australia. Scales represent 0.1 mm

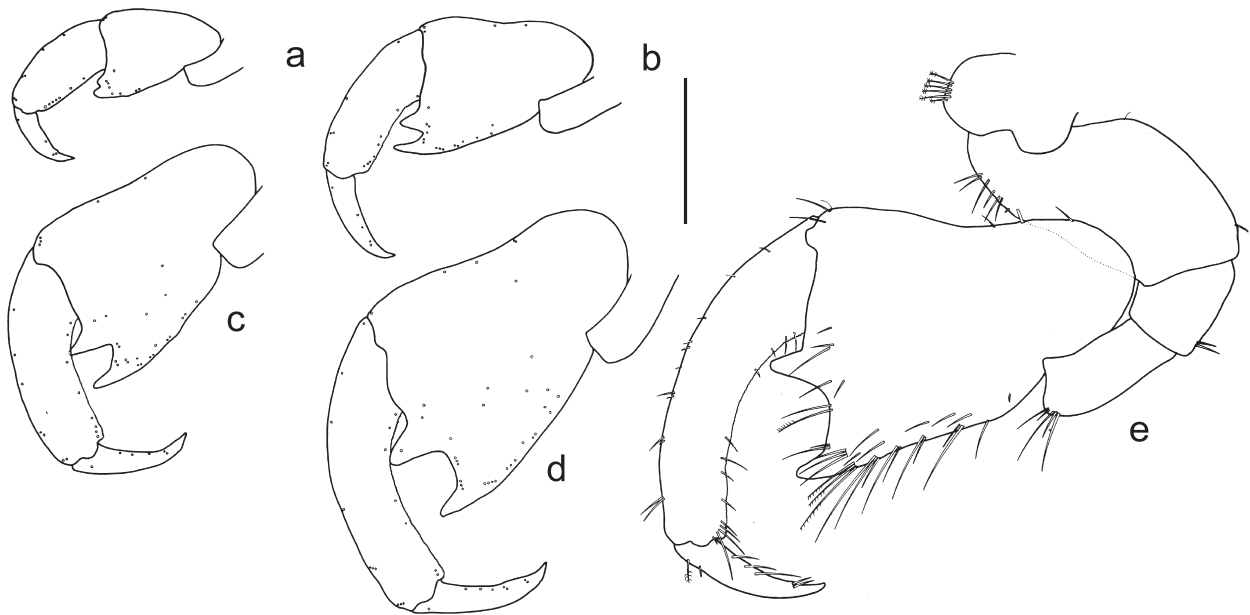
***Kapalana stebbingi* sp. nov.**

Figs 16–19

*Cerapus abditus*.—Stebbing, 1910: 616, pl. 5a.

**Holotype**, male, 8.9 mm, AM P.51210, east of Port Jackson, New South Wales, Australia (33°52'S 151°23'E), mud, 80 m, FRV *Kapala*, 27 October 1980, stn K-80-20-11. **Paratypes**: 1 female, ovigerous, 6.4 mm, AM P.51211; 1 male, 6.5 mm, AM P.99058; 1 male, 5.7 mm, AM P.99059; 1 male, 4.9 mm, AM P.99060; many specimens, AM P.99061; all same data as holotype. Many specimens, AM P.99062, south-east of Broken Bay, New South Wales, Australia, (33°36'S 151°30'E), trawl, 71–75 m, FRV *Kapala*, 10 February 1986, K86-01-02; 1 male, 1 female, MV J17211, south of Point Hicks, Victoria, Australia (38°14'48"S 149°09'18"E), WHOI epibenthic sled, 200 m, M.F. Gomon, 24 July 1986, Slope 41.

**Additional material.** Many specimens, AM P.99063, south-east of Broken Bay, New South Wales, Australia, (33°36'S 151°30'E), trawl, 71–75 m, FRV *Kapala*, 10 February 1986; 1 female, AM P.2526; 1 male, 1 female, AM P.2527; 3–4 km off Botany Bay, New South Wales, Australia, (34°05'S 151°15'E), mud, 91–95 m, E.R. Waite on HMCS *Thetis*, 11 March 1898, stn 37. 1 male, AM P.2528, 9–12 km off Cape Three Points, New South Wales, Australia, (33°32'S 151°32'30"E), trawl, sticky mud and shell, 75–91 m, E.R. Waite on HMCS *Thetis*, 25 February 1898, stn 13; 1 male, AM P.99064, east of Broken Bay, New South Wales, Australia, (33°35'S 151°41'E), 135 m, FRV *Kapala*, 10 February 1986, K86-01-03; 2 specimens, AM P.99065, east of Long Reef Point, New South Wales, Australia, (33°46'S 151°43'E), dredge, 176 m, FRV *Kapala*, 5 December 1977, K77-23-01.



**Figure 15.** *Kapalana michaelmas* sp. nov., holotype, male “e”, 10.3 mm, AM P.75528, Paratype, male “a”, 5.7 mm, AM P.75530; paratype, male “b”, 6.5 mm, AM P.75532; paratype, male “c”, 7.5 mm, AM P.75533; paratype, male “d”, 8.9 mm, AM P.75534; Michaelmas Island, King George Sound, Western Australia, Australia. Gnathopod 2 males “a”, “b”, “c”, “d” insertion points of setae are indicated by small circles. Scale represents 0.1 mm.

**Type locality.** East of Port Jackson, New South Wales, Australia (33°52'S 151°23'E).

**Etymology.** Named for T.R.R. Stebbing, who first illustrated this species.

**Description.** Based on holotype male, 8.9 mm, AM P.51210.

**Head.** Rostrum long, length  $0.3 \times$  head, evenly tapered, apically acute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, ventral margin sloping, posterior margin sloping. *Antenna 1* long, length  $0.6 \times$  body length; peduncle with scales; peduncular article 1 shorter than article 3, length  $0.6 \times$  peduncular article 3, not produced anterodistally and anteromedially, with strong acute projection along posterior margin, posterodistal corner produced; peduncular article 2 anterodistal corner without distal projection; flagellum 9-articulate; article 1 long. *Antenna 2* length  $1.1 \times$  antenna 1; flagellum 7-articulate.

*Epistome and upper lip* fused, produced, broad base, apically acute.

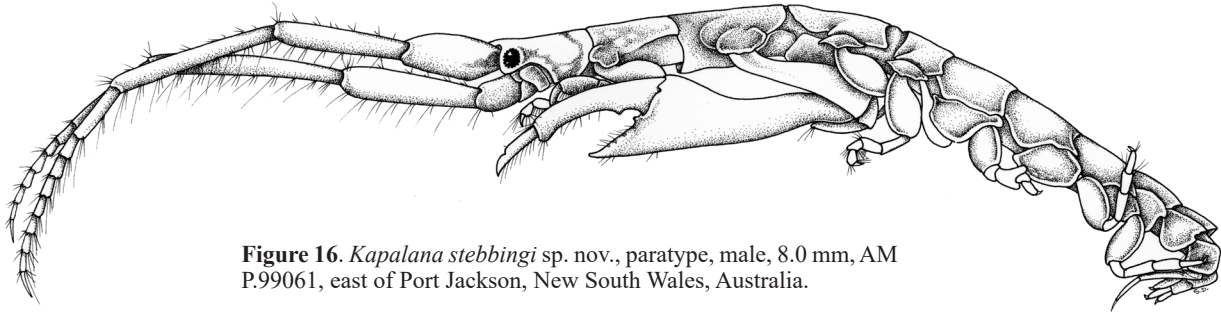
**Pereon.** *Pereonite 1* with lateral keel, without sternal keel. *Pereonites 2–3* without sternal keel. *Pereonite 5* length  $1.8 \times$  depth.

*Gnathopod 1* simple; coxa fused to pereonite 1, without anteroventral lobe; basis length  $2.2 \times$  depth; carpus very broad, length  $2.2 \times$  depth with setose posterior lobe, propodus palm extremely acute. *Gnathopod 2* carpochebate; coxa fused to pereonite 2, length  $1.3 \times$  depth, without anteroventral lobe or cusp; basis long, slender, length  $3 \times$  breadth, basis without anteroproximal group of long slender setae, basis without anteroproximal bulge; carpus very long, length  $1.9 \times$  breadth, slender, palm straight, anterodistal tooth small, located near articulation with propodus, posterodistal tooth poorly defined; propodus slender, slightly curved, length

$5.5 \times$  width, with proximal tooth on posterior margin, posterodistal corner minutely rugose with 1 tooth; dactylus length  $0.5 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, without anteroventral lobe, length  $1.7 \times$  depth; basis, length  $2.4 \times$  breadth, with proximal, subquadrate anterodorsal corner, with plumose setal group and simple setae along anterior margin, without denticles along anterior margin; ischium long, length  $3.9 \times$  breadth; merus length  $1.1 \times$  breadth; short; without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2.3 \times$  depth, with anterior lobe separated from an anteroventral lobe; basis length  $1.8 \times$  breadth, with plumose setae along entire anterior margin; ischium long, length  $2.5 \times$  breadth. *Pereopod 5* coxa, length  $1.5 \times$  depth, with patches of small setae, with setae along ventral margin; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 1 simple seta; propodus with 2 setae along posterior margin; dactylus short, unciniate with 1 accessory hook. *Pereopod 6* coxa with setal fringe ventrally, with patch of small setae near posterior margin; basis with patch of small setae near anterior margin; merus length  $2.2 \times$  breadth; dactylus short, unciniate, with 1 accessory hook. *Pereopod 7* coxa with posterodorsal lobe, with patch of small setae; merus length  $2.5 \times$  breadth; dactylus short, unciniate, with 1 accessory hook.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 7-articulate; outer ramus 4-articulate, article 1 with straight medial margin. *Pleopod 2* inner ramus reduced, 1-articulate; outer ramus, broad, 1-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; peduncle length  $1.4 \times$  outer ramus; rami with distoventral fan of robust setae; outer ramus with lateral row of denticles, without medial setae, with 8 lateral setae, with large apical robust seta and smaller slender setae; inner



**Figure 16.** *Kapalana stebbingi* sp. nov., paratype, male, 8.0 mm, AM P.99061, east of Port Jackson, New South Wales, Australia.

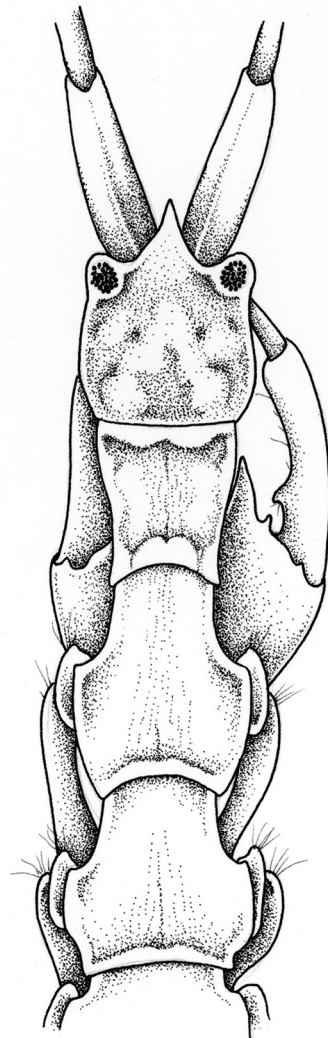
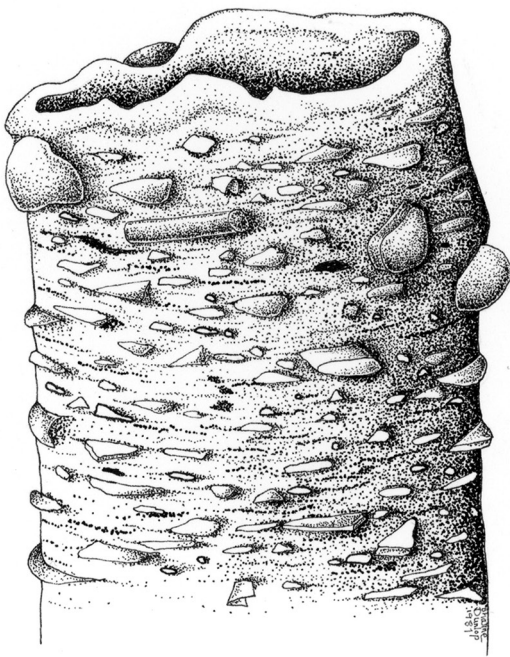
ramus, length  $0.6 \times$  outer ramus, without medial setae, with 4 lateral setae. *Uropod 2* uniramous, peduncle, length  $2.8 \times$  breadth,  $4.4 \times$  length of ramus; ramus small with 4 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.8 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.5 \times$  breadth, moderately cleft (54%), each lobe with 20–23 anteriorly directed hooks in 2 rows.

**Female** (sexually dimorphic characters). Based on paratype female, 6.4 mm, AM P.51211. *Antenna 1* flagellum 6-articulate. *Pereonite 1* without lateral keel. *Gnathopod 1* coxa not fused to pereonite 1, coxa, length  $1.6 \times$  depth; carpus broad, length equal to depth with setose posterior lobe. *Gnathopod 2* simple; coxa not fused to pereonite 2, length  $1.6 \times$  depth; basis short, broad, length  $1.8 \times$  breadth, carpus long, length  $1.6 \times$  breadth. *Pereopod 5* coxa, length  $1.5 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

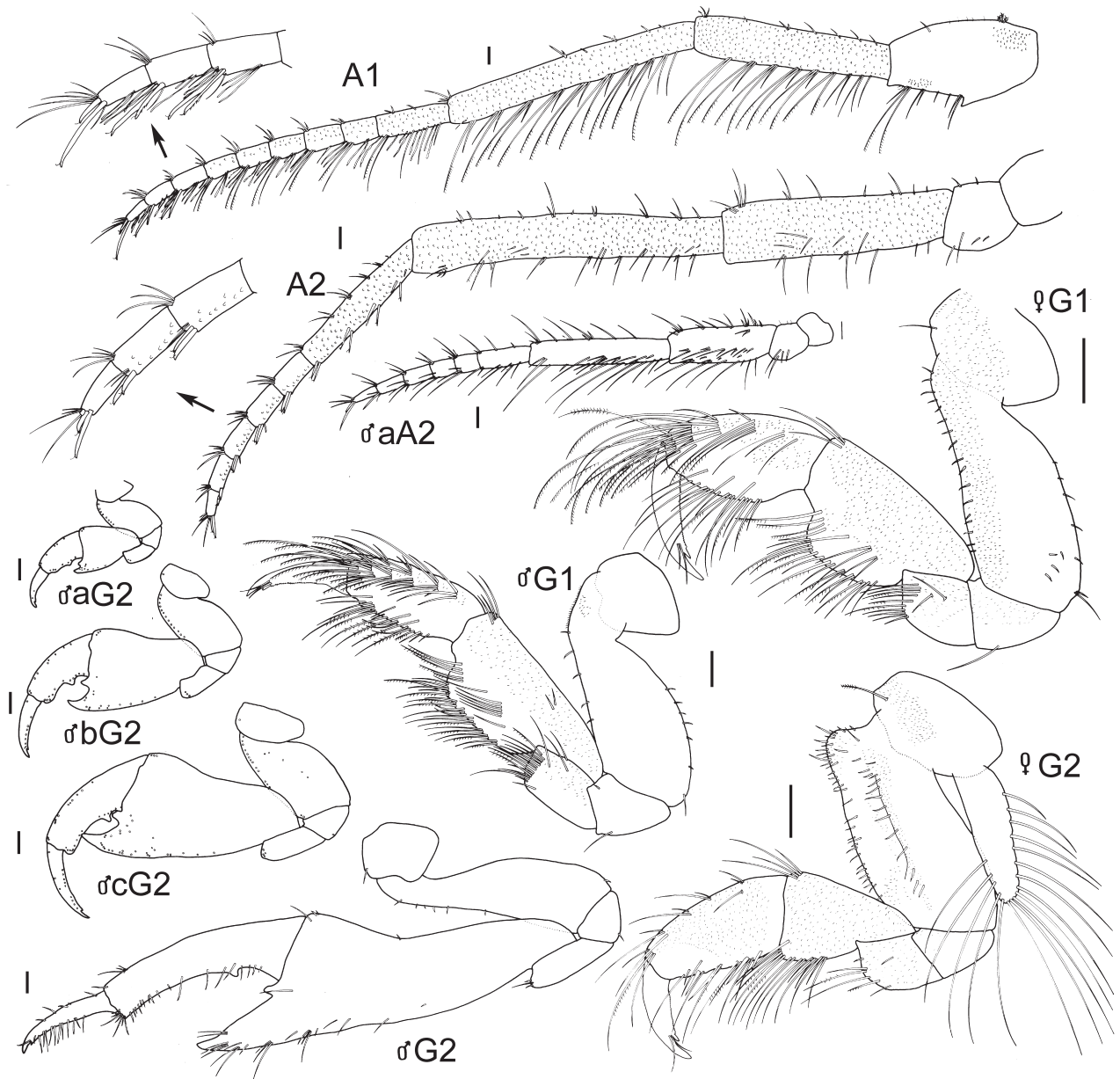
**Tube.** Encrusted with sand grains and pieces of shell. Tubes of juveniles attached in a ring, circling the tube of adult female.

**Habitat.** Sublittoral and continental shelf (71–200 m depth).

**Remarks.** The shape of gnathopod 2 basis, propodus and carpus changes as males grow, with the propodus becoming slender and the basis carpus becoming much longer than wide in males larger than 7 mm. In males less than 5 mm



**Figure 17.** *Kapalana stebbingi* sp. nov., left, tube, AM P.2528, 9–12 km off Cape Three Points, New South Wales, Australia, (tube diameter = 1 mm); right, Paratype, male, 8.0 mm, AM P.99061, dorsal view of head and pereonites 1–3, east of Port Jackson, New South Wales, Australia.



**Figure 18.** *Kapalana stebbingi* sp. nov., holotype, male, 8.9 mm, AM P.51210; paratype, male “a”, 4.9 mm, AM P.99060; paratype, male “b”, 5.7 mm, AM P.99059; paratype, male “c”, 6.5 mm, AM P.99058; paratype, female, 6.4 mm, AM P.51211; east of Port Jackson, New South Wales, Australia. Gnathopod 2 males “a”, “b”, “c” insertion points of setae are indicated by small circles. Scales represent 0.1 mm.

gnathopod 2 is subchelate. The proximal tooth on posterior margin is not prominent in males smaller than 5 mm. The carpus posterior margin is excavate in males 5.5 to 7 mm.

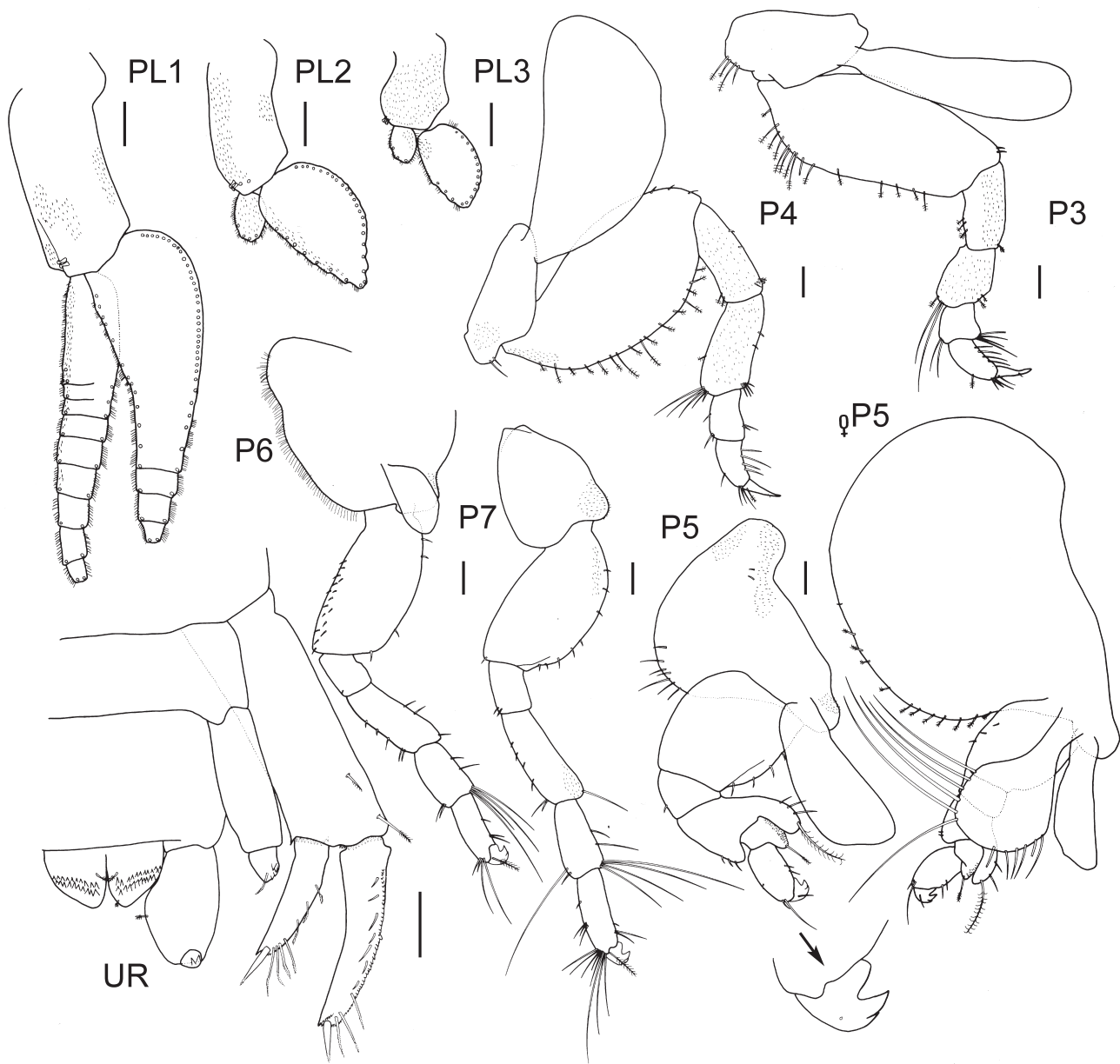
*Kapalana stebbingi* is the only species in the species group with antenna 1 peduncular article 1 with a strong subacute projection along the posterior margin, gnathopod 1 simple, the dactylus of pereopods 5–7 bearing 1 accessory hook, gnathopod 2 with a very long and slender carpus, the posterior margin of the propodus bearing a proximal tooth and a straight palm (all other species have an excavate palm).

**Distribution.** Australia. *New South Wales:* off Cape Three Points; off Botany Bay (Stebbing, 1910); east of Port Jackson; east of Long Reef; off Broken Bay. *Victoria:* south of Point Hicks.

### *Kapalana wadei* sp. nov.

Figs 20–24

**Holotype**, male, 10.9 mm, AM P.78347, just beyond beach flats, off Bagnalls Beach, Port Stephens, New South Wales, Australia (32°43'17"S 152°07'17"E), benthic sledge, W. F. Ponder & S. J. Hall, 25 October 1980, NSW 191. **Paratypes:** 11 males, 2 females, 3 juveniles, AM P.78348; 1 male, AM P.78349; 1 male, 8.3 mm, AM P.78350; 1 male, 11.2 mm, AM P.78351; 1 female, 9.3 mm, AM P.78352; 1 male, 15.5 mm, AM P.78353; all with same data as holotype. Many specimens, AM P.78354, northern cove of Boondelbah Island, Port Stephens, New South Wales, Australia, (32°42'17"S 152°13'28"E), red algae and *Kapalana* tubes,



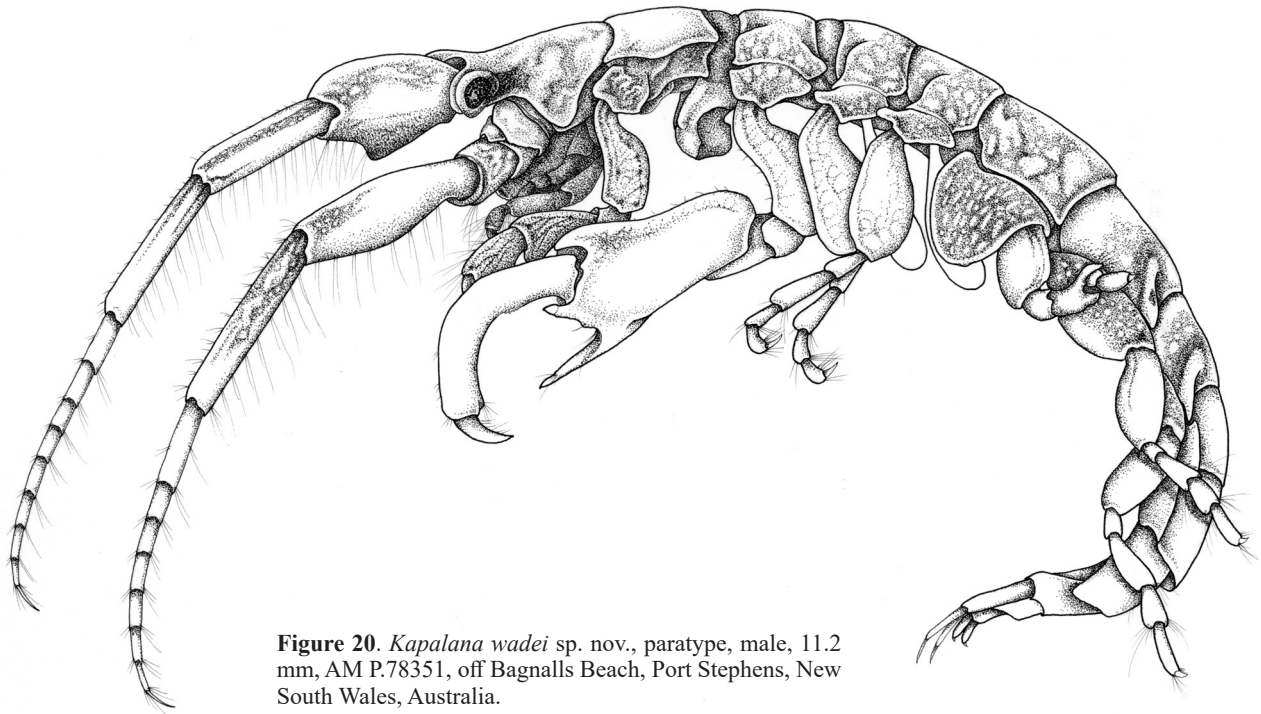
**Figure 19.** *Kapalana stebbingi* sp. nov., holotype, male, 8.9 mm, AM P.51210; paratype, female, 6.4 mm, AM P.51211; east of Port Jackson, New South Wales, Australia. Pleopods 1–3 insertion points of setae are indicated by small circles. Scales represent 0.1 mm.

hand collected on scuba, 17.1 m, P. B. Berents, 28 May 1998, NSW 1405; many specimens, AM P.78355, north-west side of Little Island, east of Port Stephens entrance, New South Wales, Australia (32°42'07"S 152°14'16"E), *Kapalana* tubes on large rocks, hand collected on scuba, 21.7 m, P. B. Berents, 30 May 1998, NSW 1454.

**Additional material examined.** 8 specimens, AM P.78356, Port Kembla, New South Wales, Australia, (34°29'S 150°55'E), low lying reef, 18 m, J. E. Watson; 4 specimens, AM P.78357, Gibbon Head, New South Wales, Australia, (34°04'S 151°10'E), on weed on reef, 23 m, J.E. Watson; 1 female, AM P.78358, north-west side of Little Island, east of Port Stephens entrance, New South Wales, Australia (32°42'07"S 152°14'16"E), brown-purple multi-siphoned low sponge in sediment and attached to rock, hand collected on scuba, 21.8 m, S. J. Keable, 30 May 1998, NSW 1443; 1 female, AM P.78359, north-west side of Little Island, east

of Port Stephens entrance, New South Wales, Australia, (32°42'07"S 152°14'16"E), orange finger sponge from rock, hand collected on scuba, 21.6 m, S. J. Keable, 30 May 1998, NSW 1444; several specimens, AM P.78360, north-west side of Little Island, east of Port Stephens entrance, New South Wales, Australia, (32°42'07"S 152°14'16"E), on lacy bryozoan cf. *Triphyllozoon* sp. on boulder, hand collected on scuba, 21.6 m, A. Murray, 30 May 1998, NSW 1446; 2 specimens, AM P.78361, north-west side of Little Island, east of Port Stephens entrance, New South Wales, Australia (32°42'07"S 152°14'16"E), on orange feathery bryozoan, hand collected on scuba, 20.1 m, A. Murray, 30 May 1998, NSW 1453; 2 females, AM P.78362, north-west side of Little Island, east of Port Stephens entrance, New South Wales, Australia (32°42'07"S 152°14'16"E), on gelatinous ascidians on rocks, hand collected on scuba, 21.6 m, A. Murray, 30 May 1998, NSW 1455; 1 ovigerous female, AM P.78363,





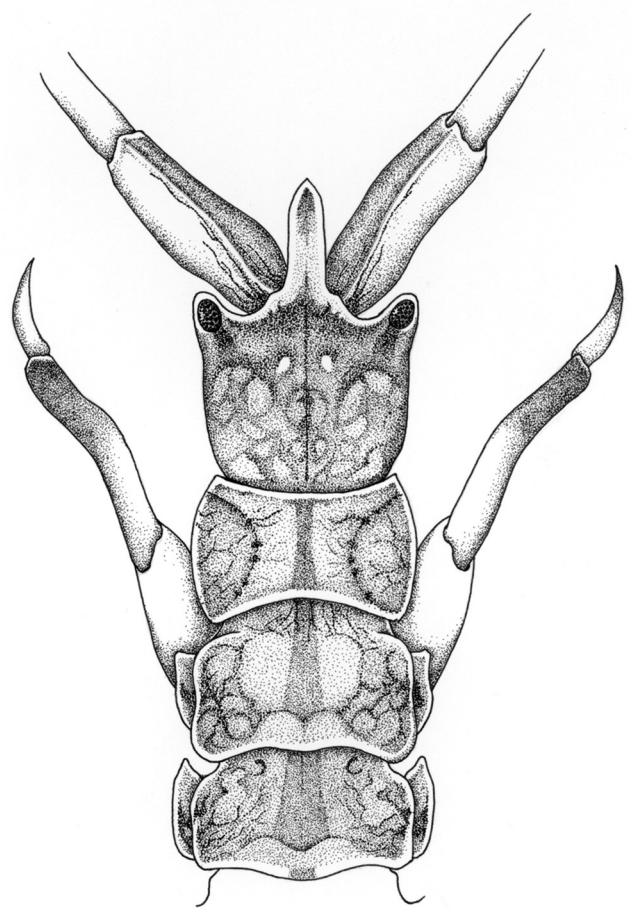
**Figure 20.** *Kapalana wadei* sp. nov., paratype, male, 11.2 mm, AM P.78351, off Bagnalls Beach, Port Stephens, New South Wales, Australia.

east of Red Head, New South Wales, Australia, (32°03'17"S 152°33'14"E), encrusted rock surface with sediment and worm tubes, airlift, 12.3 m, P. B. Berents, R. T. Johnson, S. J. Keable, A. Murray & R. T. Springthorpe on RV *Baragula*, 22 March 2003, NSW 2265; 2 males, AM P.78588, Jolong Reef, approximately 700 metres north east of Cape Banks, New South Wales, Australia, (33°59'47"S 151°15'13"E), turfing algae, hand collected on scuba, 21 m, A. Murray on RV *Baragula*, 10 November 2008, MI NSW 3369; many specimens, AM P.75506, Park Beach Bommie, east of Coffs Harbour, New South Wales, Australia (30°17'42"S 153°12'E), green alga *Halimeda* sp., hand collected on scuba, R. T. Springthorpe on RV *Baragula*, 3 May 2005, NSW 2828; 1 specimen, AM P.73743, east of Red Head, New South Wales, Australia (32°03'17"S 152°33'14"E), small sandy tubes from rock, hand collected on scuba, 12 m, Australian Museum Party, RV *Baragula*, 22 March 2003, NSW 2246; 1 male, AM P.74098, northern cove of Boondelbah Island, Port Stephens, New South Wales, Australia (32°42'17"S 152°13'28"E), red algae and *Kapalana* tubes, hand collected on scuba, 17.1 m, P. B. Berents, 28 May 1998, NSW 1405; many specimens, AM P.99316, Home Bommie, south east of Sullivan's Reef, east of Ulladulla, New South Wales, Australia (35°21'40"S 150°29'36"E), brown and red algae and lacy bryozoans scrapings on rock wall, by hand on scuba, 21.5 m, A. Murray on RV *Baragula*, 13 May 2013, MI NSW 4201.

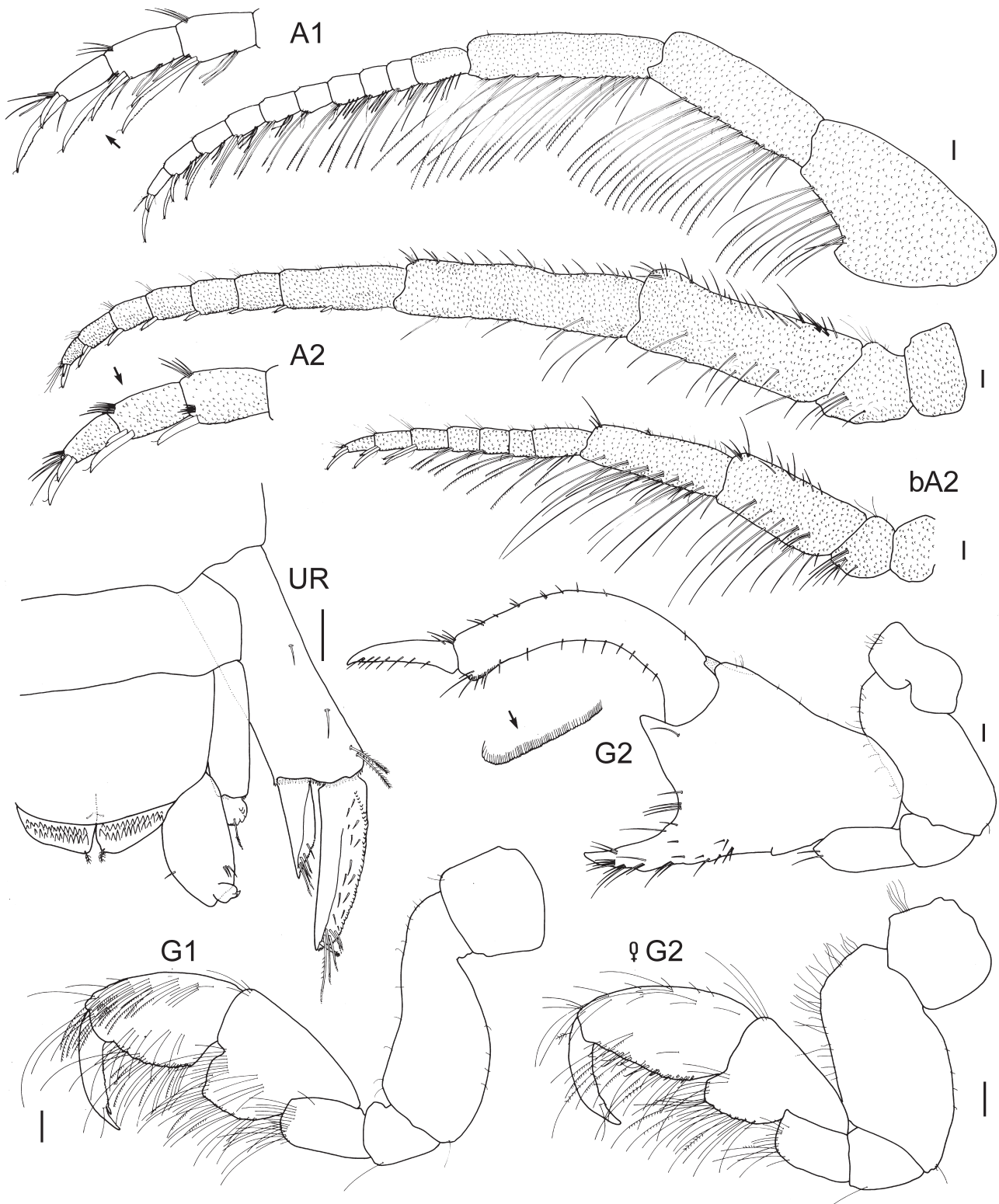
**Type locality.** Off Bagnalls Beach, Port Stephens, New South Wales, Australia (32°43'17"S 152°07'17"E).

**Etymology.** Named for Dr Denis Wade AM, Former Foundation Professor, Clinical Pharmacology at The University of New South Wales.

**Description.** Based on holotype, male, 10.9 mm, AM P.78347.



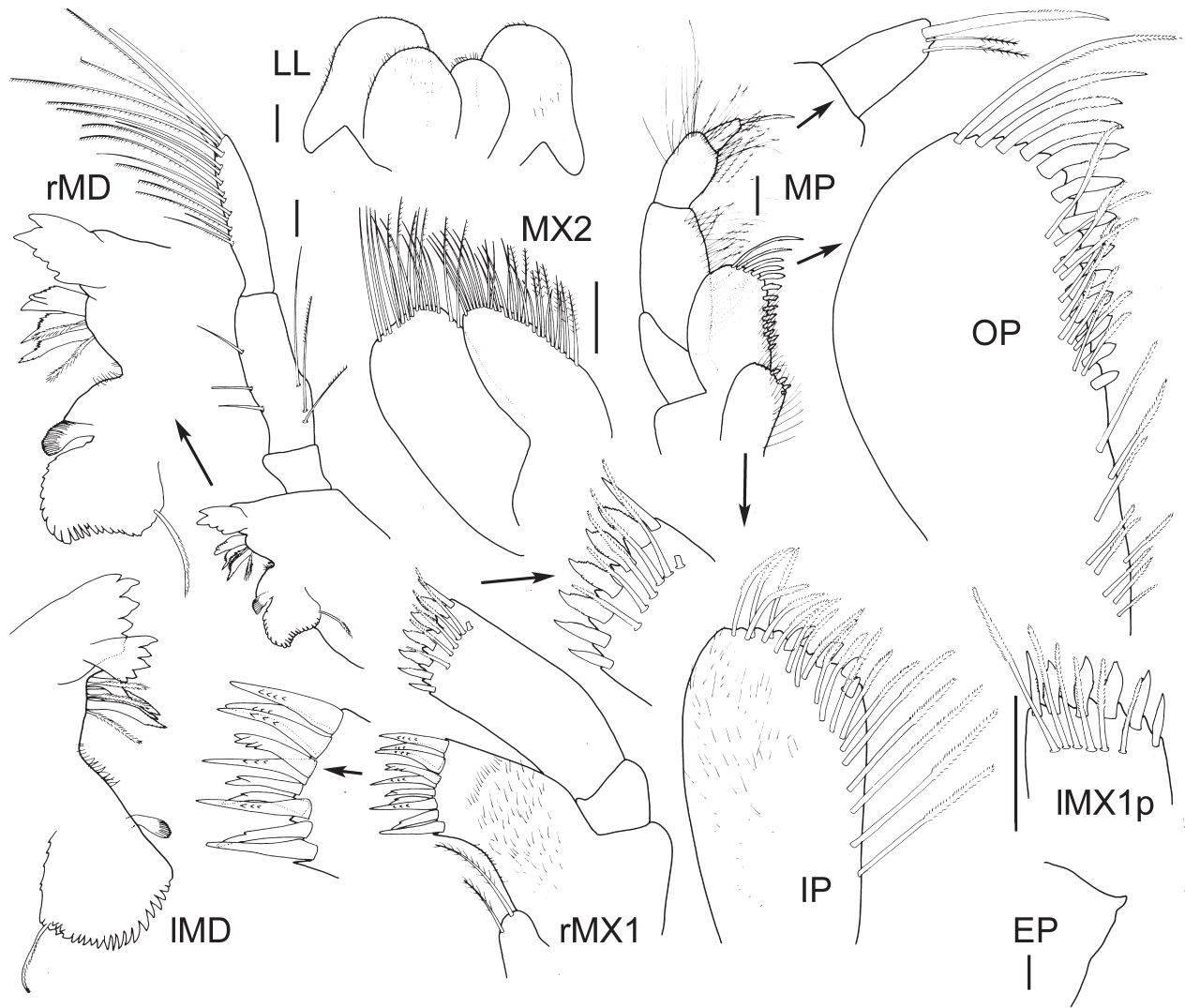
**Figure 21.** *Kapalana wadei* sp. nov., paratype, male, 11.2 mm, AM P.78351, dorsal view of head and pereonites 1–3, off Bagnalls Beach, Port Stephens, New South Wales, Australia.



**Figure 22.** *Kapalana wadei* sp. nov., holotype, male, 10.9 mm, AM P.78347; paratype male “b”, 8.3 mm, AM P.78350; paratype, female, 9.3 mm, AM P.78352; off Bagnalls Beach, Port Stephens, New South Wales, Australia. Scales represent 0.1 mm.

**Head.** Rostrum very long, length  $0.6 \times$  head, forming a basal shoulder, apically acute; lateral cephalic lobe with ventral corner rounded, subocular margin deeply recessed, reaching beyond eye, anteroventral corner rounded, ventral margin sloping, posterior margin sloping. *Antenna 1* long, length  $0.5 \times$  body length; peduncle with scales; peduncular article

1 subequal to article 3, length  $1.1 \times$  peduncular article 3, not produced anterodistally and anteromedially, with strong sub-quadrate projection along posterior margin, posterodistal corner not produced; peduncular article 2 anterodistal corner with distal projection flagellum 10-articulate; article 1 short. *Antenna 2* length  $1.1 \times$  antenna 1; flagellum 7-articulate.



**Figure 23.** *Kapalana wadei* sp. nov., holotype, male, 10.9 mm, AM P.78347; off Bagnalls Beach, Port Stephens, New South Wales, Australia. Scales represent 0.1 mm.

*Epistome* and upper lip fused, produced, broad base, apically acute. *Mandible*, palp article 2 long and slender,  $2.5 \times$  as long as broad, subequal in length to article 3; palp article 3 slender, blade-like, length  $5.2 \times$  breadth.

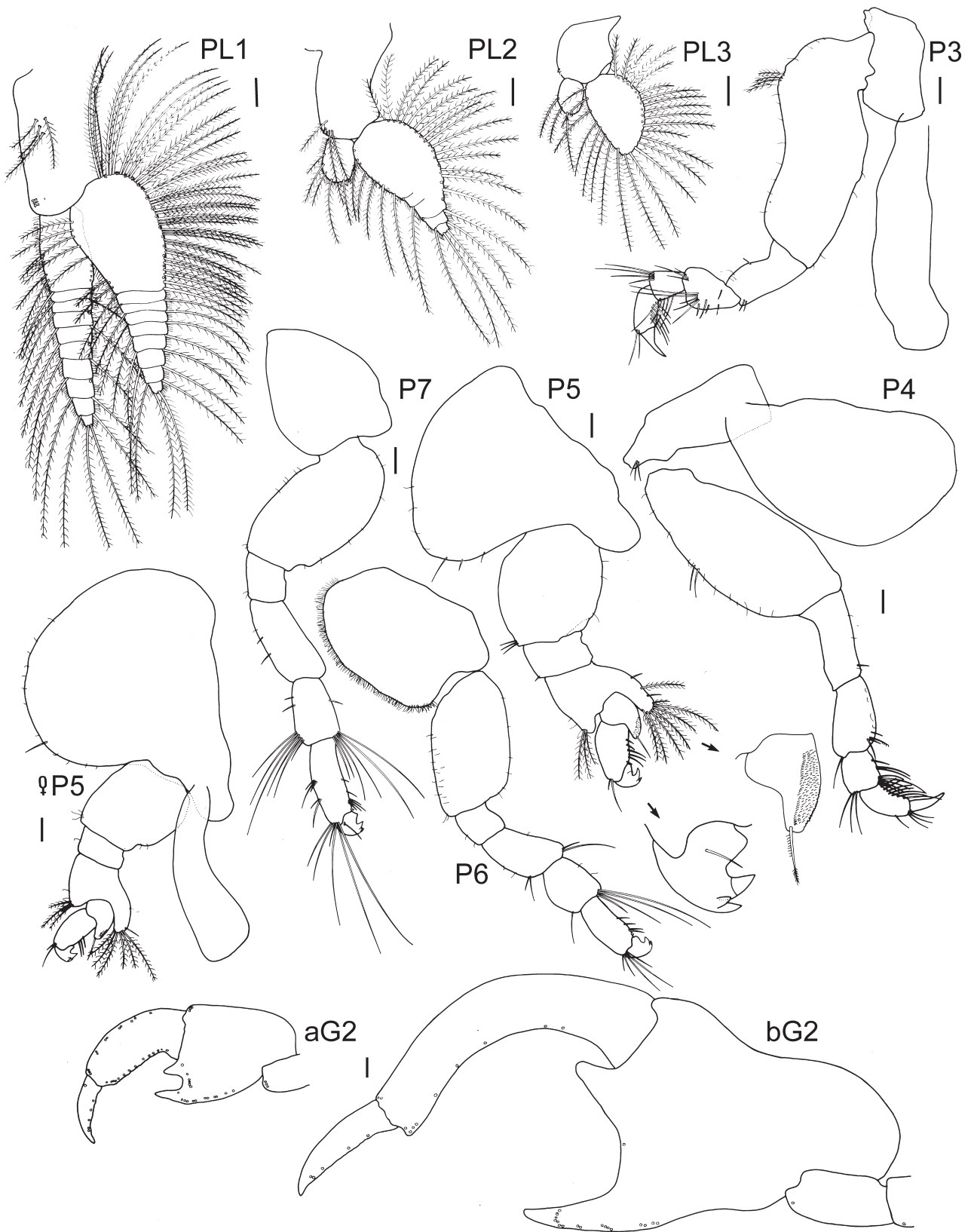
**Pereon.** *Pereonite 1* with lateral keel and sternal keel. *Pereonites 2–3* without sternal keel. *Pereonite 5* length  $1.5 \times$  depth.

*Gnathopod 1* subchelate; coxa fused to pereonite 1, without anteroventral lobe; basis length  $2.2 \times$  depth; carpus broad, length  $1.4 \times$  depth with setose posterior lobe, propodus palm acute, robust setae absent. *Gnathopod 2* carpochele; coxa not fused to pereonite 2, length  $1.9 \times$  depth, without anteroventral lobe or cusp; basis short, broad, length  $1.5 \times$  breadth; carpus long, length  $1.1 \times$  breadth, broad, palm shallowly excavate, anterodistal tooth large, located near articulation with propodus, posterodistal tooth well defined, long, length  $2.1 \times$  width; propodus slender, strongly curved, length  $5.1 \times$  width, without tooth on posterior margin, posterodistal corner rugose, without spines; dactylus length  $0.4 \times$  propodus.

*Pereopod 3* coxa not fused to pereonite 3, without anteroventral lobe, length  $1.8 \times$  depth; basis, length  $2.3 \times$

breadth, with proximal rounded anterodorsal corner, with plumose setal group and simple setae along anterior margin, without denticles along anterior margin; length  $1.9 \times$  breadth; merus length  $1.2 \times$  breadth, short, without ridges. *Pereopod 4* coxa not fused to pereonite 4, length  $2.3 \times$  depth, with anteroventral lobe; basis, length  $2 \times$  breadth, with simple setal group midway along anterior margin; ischium long, length  $2.6 \times$  breadth; merus long, length  $1.4 \times$  breadth. *Pereopod 5* coxa, length  $0.8 \times$  depth, without patches of small setae, with setae along ventral margin; merus with anterior lobe extending beyond anterior margin of carpus, posterior lobe with 6 plumose setae; propodus with 5 setae along posterior margin; dactylus short, uncinuate with 2 accessory hooks. *Pereopod 6* coxa with setal fringe ventrally, without patches of small setae near margins; basis with patch of small setae near anterior margin; dactylus short, uncinuate, with 2 accessory hooks. *Pereopod 7* coxa without posterodorsal lobe, without patch of small setae; dactylus short, uncinuate, with 2 accessory hooks.

**Pleon.** *Pleopods 1–3* biramous, decreasing in size anteroposteriorly. *Pleopod 1* inner ramus 10-articulate; outer ramus 9-articulate, article 1 evenly swollen. *Pleopod 2* inner



**Figure 24.** *Kapalana wadei* sp. nov., holotype, male, 10.9 mm, AM P.78347; paratype male “a”, 8.3 mm, AM P.78350; paratype, male “b”, 15.5 mm, AM P.78353; paratype, female, 9.3 mm, AM P.78352; off Bagnalls Beach, Port Stephens, New South Wales, Australia. Gnathopod 2 insertion points of setae are indicated by small circles. Scales represent 0.1 mm.

**Key to species of *Kapalana* g. nov.**

- 1      Rostrum very long, more than half as long as head ..... *Kapalana wadei* sp. nov.  
 —    Rostrum less than half as long as head ..... 2
- 2      Gnathopod 2 propodus with tooth on posterior margin ..... *Kapalana stebbingi* sp. nov.  
 —    Gnathopod 2 propodus without tooth on posterior margin ..... 3
- 3      Gnathopod 2 carpus with row of small spines on posterior margin  
        ..... *Kapalana amelga* sp. nov.  
 —    Gnathopod 2 carpus without row of small spines on posterior  
        margin ..... 4
- 4      Antenna 1 peduncular article 2 with medial triangular projection  
        on posterodistal corner ..... *Kapalana maia* sp. nov.  
 —    Antenna 1 peduncular article 2 without medial triangular pro-  
        jection on posterodistal corner ..... 5
- 5      Rostrum evenly tapered ..... *Kapalana durraween* sp. nov.  
 —    Rostrum forming a basal shoulder ..... 6
- 6      Pereopod 5 merus posterior lobe with 2 plumose setae ..... *Kapalana michaelmas* sp. nov.  
 —    Pereopod 5 merus posterior lobe with 5 plumose setae ..... *Kapalana kimbla* sp. nov.

ramus reduced, 1-articulate; outer ramus broad, 3-articulate. *Pleopod 3* inner ramus reduced, 1-articulate; outer ramus broad, 1-articulate. *Uropod 1* biramous; outer ramus with lateral row of denticles, without medial setae, with 13 lateral setae, with large apical robust seta and smaller slender setae; inner ramus, length  $0.7 \times$  outer ramus, without medial setae, with 1 lateral seta, without large apical robust seta. *Uropod 2* uniramous, peduncle, length  $2.8 \times$  breadth,  $4.2 \times$  length of ramus; ramus small with 6 denticles and 1 slender apical seta. *Uropod 3* uniramous, peduncle length  $1.7 \times$  breadth; ramus with 2 curved hooks. *Telson* length  $0.5 \times$  breadth, moderately cleft (31 %), each lobe with 26–27 anteriorly directed hooks, in 2 rows.

**Female** (sexually dimorphic characters). Based on paratype female, 9.3 mm, AM P.78352. *Antenna 1* flagellum 8-articulate. *Antenna 2* flagellum 10-articulate. *Pereonite 1* without lateral keel, without sternal keel. *Gnathopod 1* coxa not fused to pereonite 1, length  $1.2 \times$  depth; carpus length  $0.6 \times$  depth with setose posterior lobe. *Gnathopod 2* simple; coxa, length equal to depth; carpus length  $1.3 \times$  breadth. *Pereopod 5* coxa, length  $1.3 \times$  depth. *Oostegites* from gnathopod 2 to pereopod 5.

**Tube.** Encrusted with sand grains and pieces of shell; tubes of juveniles attached in a ring, circling the tube of adult female.

**Habitat.** Sublittoral (12–22 m depth).

**Remarks.** The shape of gnathopod 2 propodus and carpus changes as males grow, with the propodus becoming curved and slender. In males smaller than 8.5 mm the carpus posterior margin is more deeply excavate than in larger males.

*Kapalana wadei* is the only species with very long rostrum (greater than 50% the length of the head). The rostrum has a basal shoulder, which is a character shared with both *K. michaelmas* and *K. kimbla*. It shares with *K. durraween*, *K.*

*michaelmas* and *K. maia* a lack of apical robust seta on the inner ramus of uropod 1.

**Distribution.** Australia. *New South Wales*: Coffs Harbour to Ulladulla.

**Discussion**

Within the Cerapodini the unusual process by which juveniles attach their tubes to adult females appears to be unique to *Kapalana*. Extended parental care has been reported in amphipods and may take the form of juveniles remaining in the female marsupium (Shillaker & Moore, 1987; Kobayashi *et al.*, 2002; Thiel, 2003), juveniles on the female body (Aoki, 1999) and juveniles sharing the parental dwelling (Thiel, 2000b, 2003). Myers (1971) reported that the young of another corophiid, *Microdeutopus gryllotalpa* Costa, 1853, constructed tubes on the inside and outside of the parental tube.

Thiel (2003) suggests that the benefits of parental care include provision of a microhabitat for juveniles, assistance with feeding or grooming of juveniles and active defence or guarding. Thiel (1999) noted that when females carry their offspring, a second brood is not usually produced while carrying one brood, but in examples when the female guards the juveniles, a second brood may be produced while caring for the first, as seen in *Kapalana* (Fig. 4).

Although nothing is known about possible interactions between parent and juveniles in *Kapalana*, the fact that up to two generations of juveniles may attach to the mother tube indicates at least passive protection (Shillaker & Moore, 1987; Thiel, 1999, 2000a). It is not known how long juveniles of *Kapalana* remain in the tube attached to the female tube. Thiel (1999) found the duration of extended parental care in tube dwelling species to be variable but may be long lasting (exceeding 20 days).

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