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A New Genus and Two New Species of Caprellidae (Crustacea: Amphipoda) from Mesophotic and Deep-sea Waters of Australia

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Abstract. Caprellids from mesophotic and deep-sea waters from Australia have been scarcely studied. A new genus *Pseudoliropus* gen. nov., and two new species *Pseudoliropus keablei* and *Pseudoprotella australiensis* sp. nov. are described based on material collected from 56 to 1125 m deep during surveys on board the vessels RV *Sprightly* (1973), FRV *Kapala* (1977–1986) and RV *Southern Surveyor* (2005) along the coast of the Northern Territory, Queensland, New South Wales, Victoria and Tasmania. *Pseudoliropus* is superficially very close to *Liropus* but can be readily distinguished by the absence of a mandibular molar (present in *Liropus*) and 2-articulate mandibular palp (3-articulate in *Liropus*). *Pseudoprotella australiensis* can be differentiated from all the remaining species of *Pseudoprotella* mainly on the basis of the unique body ornamentation (acute projection on the head, pereonites with abundant tiny tubercles scattered over the surface, and rows of lateral tubercles on the proximal end of pereonites 2–4). Further collections in deep ecosystems are mandatory to properly understand global amphipod diversity in Australian waters.

Introduction

The least known ocean regions occur below depths accessible to SCUBA diving and include mesophotic ecosystems and the deep sea (Woodall *et al.*, 2018).

The past several decades have seen interest in characterizing the biodiversity and ecology of mesophotic ecosystems, and in particular, mesophotic coral ecosystems (MCEs) (Bell *et al.*, 2018). These are communities of corals, sponges, algae, associated invertebrates and fishes that occur in the transition zone between well-lit surface waters and dark deeper waters, usually from 30–40 to 150 m deep (Abesamis *et al.*, 2018). The lower limit of the mesophotic corresponds to the maximum depth at which there is sunlight penetration to support photosynthesis and, hence, the growth of zooxanthellate coral reefs (Hinderstein *et al.*, 2010). Some coral biologists divide the mesophotic into upper and lower portions, with a faunal transition of species around 60 m (see Baldwin *et al.*, 2018 and references therein). Unlike isolated lower mesophotic reefs (60–150 m), which contain many endemic species, upper mesophotic reefs (30–60 m) are inhabited by numerous shallow reef organisms threatened by local and global stressors, which find refugia in MCEs (Weinstein *et al.*, 2014). The increasing availability of remotely operated vehicles (ROV) and autonomous underwater vehicles (AUV) (e.g., Englebert *et al.*, 2017;

Keywords: mesophotic; deep-sea; Amphipoda; Caprellidae; new taxa; Australia
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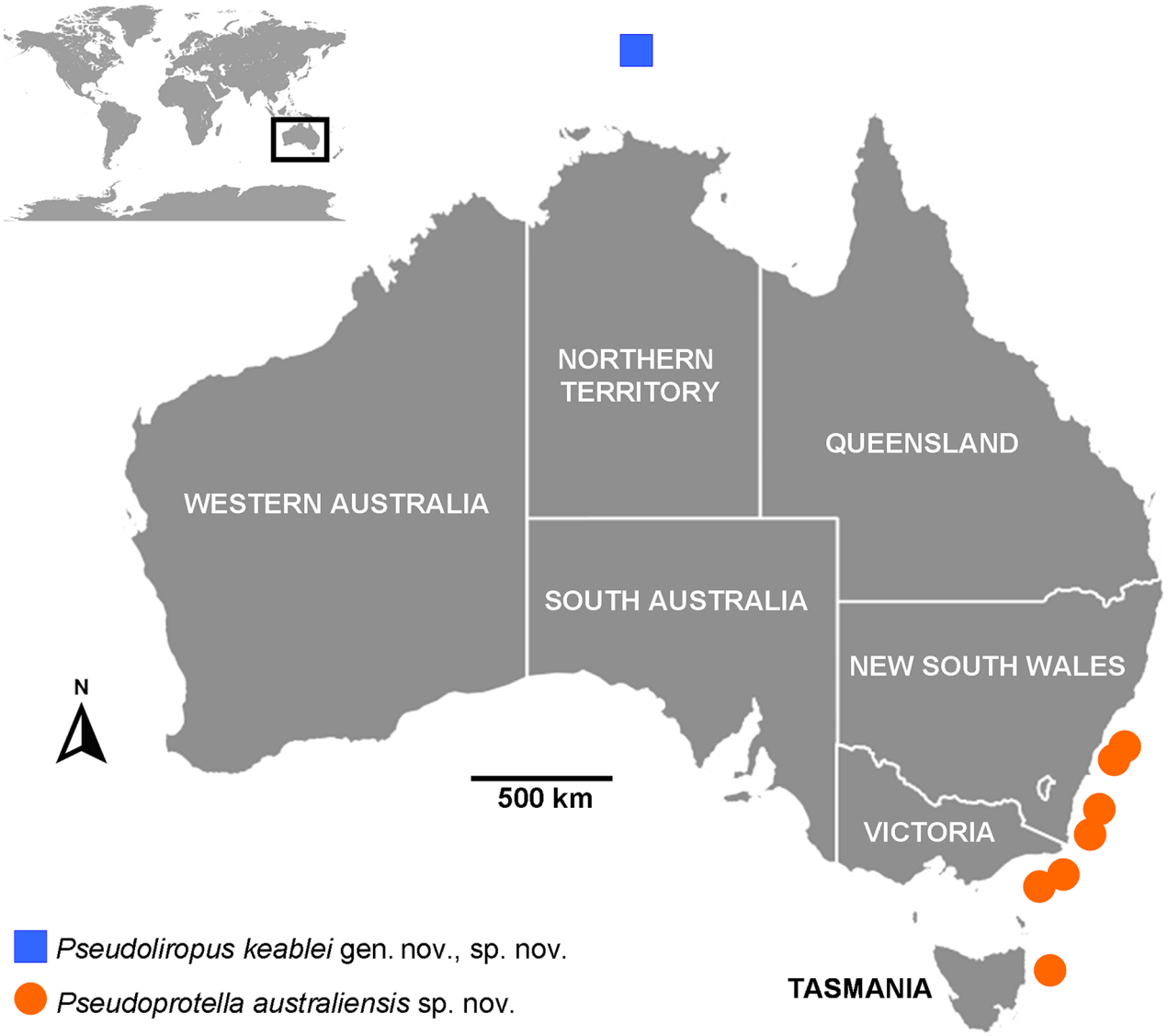

Figure 1. Localities at which the new genus and the new species were found.

Turner *et al.*, 2018), together with new diving technologies that combine Tri-Mix Diving and Rebreathers (e.g., Guerra-García *et al.*, 2015) are contributing to a better knowledge of these ecosystems complementing the traditional use of grabs or trawls. Despite this, however, there are still some highly diverse geographic areas where mesophotic ecosystems have yet to be explored and characterized (Bell *et al.*, 2018) and taxonomical and ecological studies are still lacking in the equatorial Indo-West Pacific region where the most species-rich coral reefs in the world are highly threatened by human activities and climate change (see Abesamis *et al.*, 2018 and references therein). Further, most published studies focus on sessile flora and fauna, but the small epibiont, vagile organisms are often overlooked. Indeed, sporadic sampling in mesophotic ecosystems often reveal the presence of novel genera and species of associated macrofauna, such as small peracarids (e.g., Petrescu *et al*., 2012; Senna *et al*., 2014).

The deep sea is considered to start at about 200 meters depth, at the shelf break, where a clear change of fauna from shallow to deep water is observed (Thistle, 2003). The waters deeper than 200 m form the largest environment on Earth with a volume of 1368 x10^6 km^3 covering an area of 360 million km^2, equivalent to about 50% of the surface of the Earth with an average depth of 3,800 m and a maximum depth of 10,924 m in the Mariana Trench (Ramirez-Llodra *et al.*, 2011). Nevertheless, as with mesophotic ecosystems, most deep-sea habitats still remain unexplored. For example, deep-sea surveys that include amphipods usually reveal that most of the caprellids collected are new to science (see e.g., Laubitz, 1972; Laubitz & Mills, 1972; Guerra-García, 2003, 2004; Takeuchi *et al*., 2016; Zettler *et al*., 2018).

In Australian waters, there is an increasing interest in characterizing mesophotic communities (see e.g., Turner *et al*., 2018. in Ningaloo Marine Park, Western Australia) and the fauna of deep-sea ecosystems (e.g., Horowitz *et al*., 2018; Tanner *et al*., 2018; Williams *et al*., 2018; MacIntosh *et al*., 2018; Farrelly & Ahyong, 2019). However, most studies are mainly focused on larger and most conspicuous organisms and there is a lack of knowledge dealing with the taxonomy of small epibiont organisms (e.g., Lowry & Stoddart, 2010). The present study deals with the description of new amphipod taxa found during sampling surveys focused on mesophotic ecosystems and deep sea of Australia (Fig. 1). A new genus and two new species of Caprellidae are fully described and illustrated.

Material and methods

Caprellids were collected by RV *Sprightly* in 1973, FRV *Kapala* in 1977–1986 and RV *Southern Surveyor* in May 2005 (see Wilson, 2005, for details). Specimens of the new species were dissected in 80% ethanol and slides were made using Aquatex® mounting medium (Merck Millipore Ltd). Figure plates were made following Takeuchi (2015) and Guerra-García *et al*. (2020). Firstly, original sketches of lateral view, antennae, gnathopods, pereopods and mouthparts were drawn using a Leica compound microscope equipped with a camera lucida. Figures were inked using Rotring pens based on the reduced copies of the original sketches organized in plates. Finally, with Photoshop 6, drawings were improved, cleaned and final plates arranged. Body length was measured from the anterior end of the head to the posterior end of pereonite 7. The symbols used in the present work are: *A1, 2* = Antenna 1, 2; *UL* = Upper lip; *LL* = Lower lip; *LMd* = Left mandible; *RMd* = Right mandible; *Mx 1, 2* = Maxilla 1, 2; *Mxp* = Maxilliped; *Gn 1, 2* = Gnathopod 1, 2; *P5–7* = Pereopod 5–7; *Ab* = Abdomen. In the descriptions, the term "spine" is used for stout, inflexible articulated structures, "seta" for slender, flexible articulated structures and "setule" for very short setae. Systematic classification was based on Lowry & Myers (2013, 2017). Specimens of the new genus and species are deposited in the Australian Museum (AM).

Taxonomic account

Superfamily Caprelloidea Leach, 1814

Family Caprellidae Leach, 1814

Subfamily Caprellinae Leach, 1814

Pseudoliropus gen. nov.

http://zoobank.org/NomenclaturalActs/904A1ABE-2698-40DE-A5B4-CC26549DF905

Diagnosis. Antenna 1 flagellum with more than 2 articles. Antenna 2 flagellum 2-articulate, swimming setae absent. Pereonites 3 and 4 with gills. Pereopods 3 and 4 uni-articulate. Pereopod 5 3-articulate. Pereopods 6 and 7 6-articulate. Mandible molar absent; mandible palp 2-articulate. Abdomen without appendages.

Type species. *Pseudoliropus keablei* sp. nov.

Etymology. The new genus superficially resembles the genus *Liropus*. The name is, therefore, composed of *Pseudo-* (=not genuine) and *Liropus*. Gender: masculine.

Pseudoliropus keablei sp. nov.

http://zoobank.org/NomenclaturalActs/B6A4E2C2-C597-413E-A0B6-19DF72908CB6

Figs 2–5

Holotype: AM P.79076, mature male (vial + 3 slides) (mouthparts dissected, used for description, figured), Arafura Sea, Area C South, Northern Territory, Australia, 9°10'32"S 133°29'40"E, 136 m depth, RV *Southern Surveyor*, "Southern Surveyor Arafura Sea Cruise May 2005", Smith-McIntyre Grab, calcareous muddy gravel with mostly shell fragments coral, fixed in 5% formalin, preserved 80% ethanol, coll. G.D.F. Wilson, 21 May 2005. **Paratypes** (collected together with holotype): AM P.101357, *paratype "a"*, mature female (vial + 1 slide) (mouthparts dissected, used for description, figured); AM P.101358, 2 premature females (not dissected).

Etymology. This species is dedicated to our friend and colleague Dr Stephen Keable. JMGG is very grateful to him for his continuous support, help and friendship during visits to the Australian Museum.

Diagnosis. Eyes present, although with few ommatidia. Body of male covered by abundant tiny dorsal tubercles from pereonite 2–5 and basis of gnathopod 2; pereonite 2 with small acute anterolateral projections; pereonites 3 and 4 with small, serrate, anterolateral projections. Body of female smooth. Maxilliped palp article 3 without distal projection. Mandibular molar absent; palp with 2 apical setae. Gnathopod 2 basis shorter than pereonite 2. Pereopods 3 and 4 1-articulate. Pereopod 5 3-articulate. Abdomen without appendages.

Description. *Holotype male* AM P.79076 (3.3 mm)

Lateral view (Fig. 2). Body dorsally covered by tiny dorsal tubercles on pereonites 2–5 and basis of gnathopod 2. Eyes with few ommatidia. Pereonite 1 fused with head, suture present. Small, acute anterolateral projections on pereonite 2 and small serrate anterolateral projections on pereonites 3–4. Pereonite 5 longest. Pereonite 7 shortest.

Gills (Fig. 2). Present at middle of pereonites 3–4, small, oval, length about 1.5 × width.

Mouthparts (Fig. 3). (Maxilliped and mandibles figured and described from holotype male; maxilla 1 and 2, upper and lower lips figured and described from paratype "a" female). Mouthparts remarkably small (ca. 0.05 mm; 0.015 × body length). Mandibular molar absent; palp 2-articulate, distal article the longest, with 2 apical setae; left mandible with incisor and lacinia mobilis 5-dentate, accessory blades not clearly distinguished; incisor of right mandible 5-dentate, lacinia mobilis blade-like, followed by 2 more blades; no trace of molar flake. Upper lip without setae. Lower lip without setae, inner lobes apparently fused. Maxilla 1 outer lobe with 5 spines; palp 2-articulate, distal article with 3 apical spines and medial seta. Maxilla 2 inner and outer lobe of similar size, small, each with 3 distal setae. Maxilliped inner plate small, length about 1/4 outer plate length, with 2 apical setae; outer plate elongate, with 4 or 5 setae; palp 4-articulate, article 2 with distal seta, article 3 with 2 apical setae, article 4 with few setulae.

Antennae (Figs 2, 4). Antenna 1 ca. 1/5 body length; flagellum 4-articulate. Antenna 2 about 1/2 length of antenna 1; proximal peduncular article with acute gland cone distally; swimming setae absent; flagellum 2-articulate.

Gnathopods (Figs 2, 4). Gnathopod 1 basis as long as ischium, merus and carpus combined; occlusal margin of propodus smooth, with row of fine setulae; 2 proximal grasping spines, dactylus bifid distally and with row of setulae. Gnathopod 2 inserted on anterior half of pereonite 2; coxa with distal projection (see detail in Fig. 2); basis about 2/3 length of pereonite 2, with tiny tubercles similar to

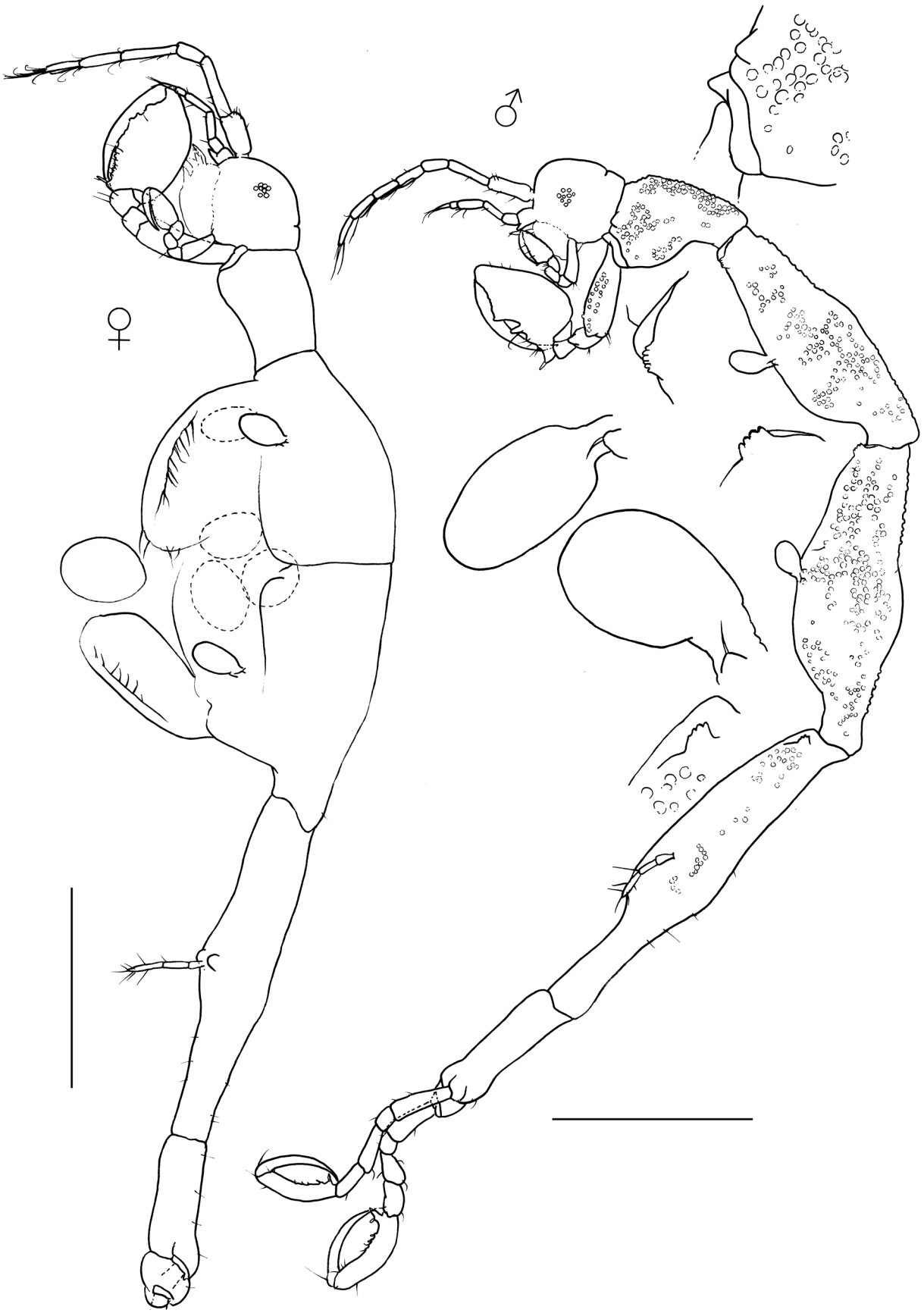

Figure 2. *Pseudoliropus keablei* sp. nov. Lateral view of holotype male AM P.79076 and paratype "a" female AM P.101357. Scale bars: 0.5 mm.

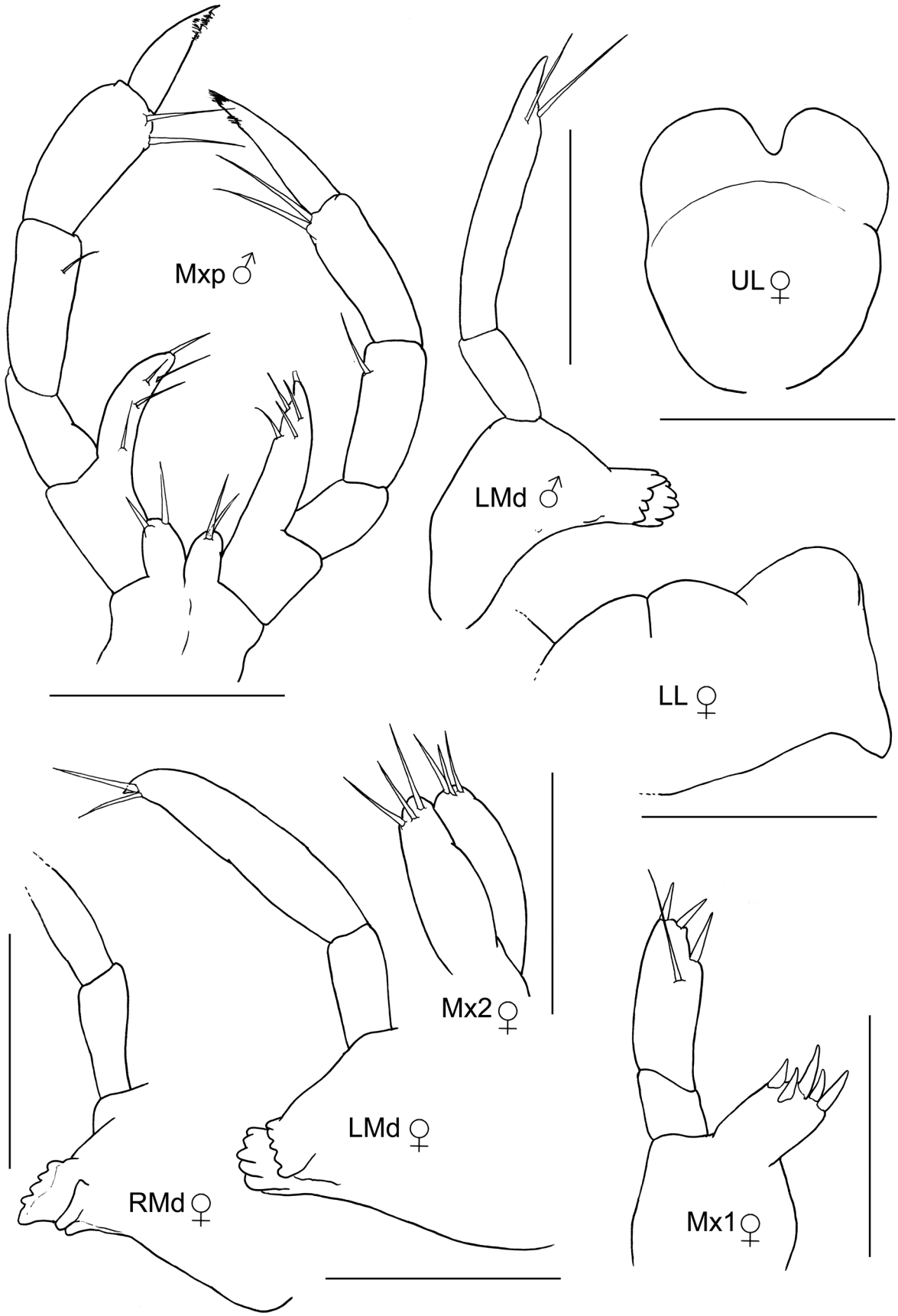

Figure 3. *Pseudoliropus keablei* sp. nov. Mouthparts. Maxilliped and left mandible of holotype male AM P.79076; maxilla 1, maxilla 2, upper lip, lower lip and mandibles of paratype "a" female AM P.101357. Scale bars: 0.05 mm.

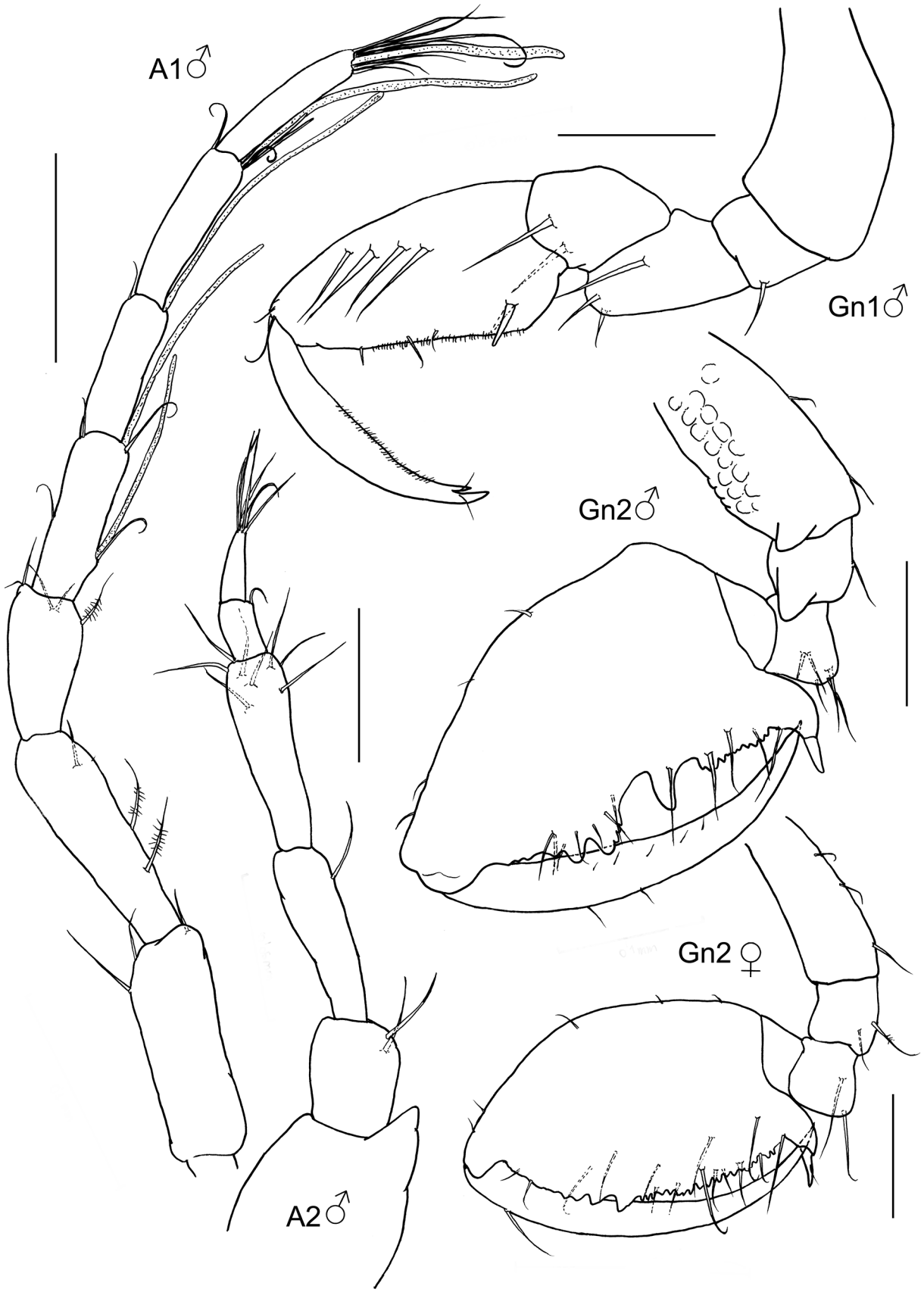

Figure 4. *Pseudoliropus keablei* sp. nov. Antenna 1, antenna 2, gnathopod 1 and gnathopod 2 of holotype male AM P.79076; gnathopod 2 of paratype "a" female AM P.101357. Scale bars: 0.1 mm (A1, Gn2), 0.05 (A2, Gn1).

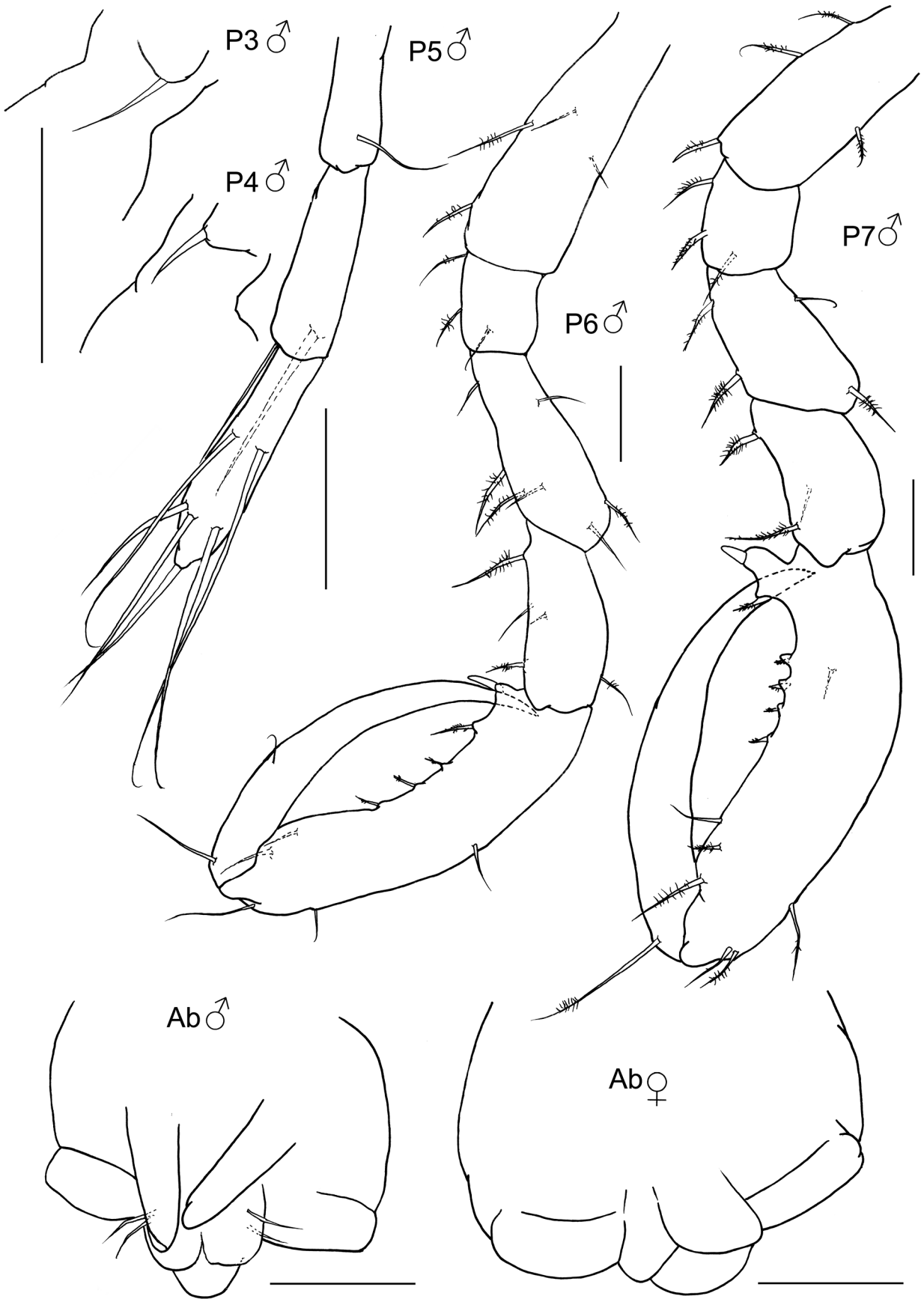

Figure 5. *Pseudoliropus keablei* sp. nov. Pereopods 3, 4, 5, 6 and 7 and abdomen of holotype male; abdomen of paratype "a" female AM P.101357. Scale bars: 0.05 mm.

those on pereonites; ischium rectangular; basis and ischium with distal projection laterally; merus rounded; carpus short, triangular; propodus palm with proximal projection with large grasping spine, serrated area, medial projection, and 2 more projections distally (Fig. 4); dactylus smooth and elongate, with very fine setulae only.

Pereopods (Figs 2, 5). Pereopods 3 and 4 tiny (ca. 0.01 mm, 0.003 × body length), 1-articulate, with distal seta. Pereopod 5 3-articulate, inserted at middle of pereonite 5, proximal and medial article with seta, distal article with 5 lateral setae and distal seta. Pereopods 6 and 7 6-articulate, with plumose setae; propodus of pereopod 6 proximal projection with proximal grasping spine; proximal projection of propodus of pereopod 7 larger, with grasping spine and plumose setae; dactylus curved.

Penes (Fig. 5) large, situated laterally, distinctive, elongate, length ca. 3× width.

Abdomen (Fig. 5) lacking appendages; pair of lobes with 2 setae, and single dorsal lobe.

Paratype female "a" AM P.101357 (3.1 mm) (Figs 2–5). Similar to male except as follows: body smooth, lacking tiny tubercles or anterolateral projections; pereonites 3 and 4 with oostegites; antenna 1 flagellum 3-articulate; gnathopod 2 basis without tiny tubercles, basis and ischium lacking distal projection, palm of propodus with proximal projection provided with grasping spine and margin serrated ventrally, medial projection absent. Abdomen lacking setae.

Remarks. The genus *Liropus* was established by Mayer (1890) and currently includes 14 species (Guerra-García *et al*., 2018). A morphological comparison among species of *Liropus* species is provided by Guerra-García & Hendrycks (2013), Mauro & Serejo (2015) and Sánchez-Moyano *et al*. (2015), and an illustrated key to the species was given by Guerra-García & Hendrycks (2013). The new genus *Pseudoliropus* is superficially very close to most species of *Liropus*, sharing short antennae, pereonite 5 elongate in males, and reduced pereopods 3–5. The two genera differ primarily in the mouthparts: (i) mandibular molar is present in *Liropus* but absent in *Pseudoliropus*; and (ii) the mandibular palp is 3-articulate in *Liropus* but 2-articulate in *Pseudoliropus*.

The specimens of *Pseudoliropus keablei* gen. nov, sp. nov. were collected from the Arafura Sea. The Arafura Sea is a continental shelf basin between northern Australia and Indonesian land masses, overlying part of the Sahul Shelf that straddles the Indian Ocean-Australian continental plates (Wilson, 2005). Area C South, the zone from which the specimens were collected, is on the southern flank of Pillar Bank, with depths ranging from 136–182 m. The shallower stations were higher on the bank and consisted of coarser sediments with several grab and rock dredge samples that collected oyster shells, coral and bryozoan fragments. The deeper sites consisted of soft bioturbated sediments with few epifauna (Wilson, 2005). The water temperatures were 14–16°C in the deeper regions of Area C (depth 230 m). Although these temperatures are not typical deep-sea temperatures (typically below 8°C), some deep-water faunal elements, such as stalked crinoids, hexactinellid sponges and deep-water pedunculate barnacles were observed (see Wilson, 2005 for details).

Pseudoprotella Mayer, 1890

Pseudoprotella australiensis sp. nov.

http://zoobank.org/NomenclaturalActs/439B99F5-7E80-4219-9104-AE62535658D6

Figs 6–12

Holotype: AM P.101359, mature male (vial + 2 slides) (mouthparts dissected, used for description, figured), south-east of Broken Bay, New South Wales, Australia, 33°36'S 151°30'E to 33°37'S 151°29'E, 71–75 m, FRV *Kapala*, beam trawl, fixed in formalin, preserved in 80% ethanol, 10 February 1986. **Paratypes**: (same collection data as the holotype): AM P.101360, *paratype "a"*, mature female (vial + 2 slides) (mouthparts dissected, used for description, figured); AM P.101361, *paratype "b"*, mature female (vial, no slides) (mouthparts not dissected); AM P.101362, *paratype "c"*, mature female (vial + 2 slides) (mouthparts dissected); AM P.101363, *paratype "d"* , mature male (vial, no slides) (mouthparts not dissected); AM P.101364, *paratype "e"*, juvenile male (vial, no slides) (mouthparts not dissected, figured); AM P.101365, *paratype "f"*, premature female (vial, no slides) (mouthparts not dissected, figured); AM P.101366, 25 mature males, 11 mature females, 3 premature females (vial containing all these specimens, no slides).

Other material examined. New South Wales, Australia: AM P.101367, 1 mature male, east of Long Reef Point, 33°46'S 151°43'E, 176 m, FRV *Kapala*, dredge, 5 December 1977; AM P.101368, 1 mature female, south-east of Broken Bay, 33°41'S 152°01'E, 1125 m, FRV *Kapala*, 11 December 1978; AM P.101369, 1 mature male, east of Long Reef, 33°46'S 151°48'E, 403 m, FRV *Kapala*, 3 December 1979; AM P.101370, 2 mature males, 2 mature females, 2 juveniles, east of Port Jackson, 33°52'S 151°23'E, 80 m, FRV *Kapala*, epibenthic sled, coll. R.T. Springthorpe, 11 December 1980; AM P.101371, 1 mature male, 1 mature female, east of Port Jackson, 33°50'S 151°32'E to 33°50'S 151°34'E, 132–135 m, FRV *Kapala*, trawl, 18 December 1985; AM P.101372, 3 mature females, east of Long Reef, 33°44'S 151°53'E to 33°43'S 151°54'E, 494–518 m, FRV *Kapala*, trawl, 18 December 1985; AM P.101373, 2 mature females, east of Long Reef, 33°43'S 151°46'E to 33°44'S 151°46'E, 174 m, FRV *Kapala*, epibenthic sled, coll. J. K. Lowry, R. T. Springthorpe, 20 December 1985; AM P.101374, 3 mature males, 1 premature female, 1 mature female, east of Barrenjoey Headland, 33°36'S 151°26'E to 33°36'S 151°27'E, 56 m, FRV *Kapala*, trawl, 10 February 1986; AM P.101378, 1 mature male, south-east of Disaster Bay, 37°23'54"S 150°17'54"E, 161–184 m, RV *Southern Surveyor*, benthic sled, coll. P. B. Berents, 1 September 1994; AM P.101379, 3 mature males, 1 premature female, 1 juvenile, east of Disaster Bay, 37°19'24"S 150°11'18"E, 107–110 m, RV *Southern Surveyor*, benthic sled, coll. P. B. Berents, 1 September 1994; AM P.101380, 1 mature male, east of Disaster Bay, 37°18'36"S 150°03'54"E, 81–82 m, RV *Southern Surveyor*, benthic sled, sediment, coll. P. B. Berents, 2 September 1994; AM P.101381, 2 mature females east of Disaster Bay, 37°18'42"S 150°00'48"E, 42–44 m, RV *Southern Surveyor*, benthic sled, coll. P. B. Berents, 2 September 1994; AM P.101382, 1 mature male east of Merimbula, 36°55'48"S 149°58'06"E, 43–44 m, RV *Southern Surveyor*, benthic sled, coll. P. B. Berents, 3 September 1994; AM P.101383, 1 mature female, east of Bermagui,

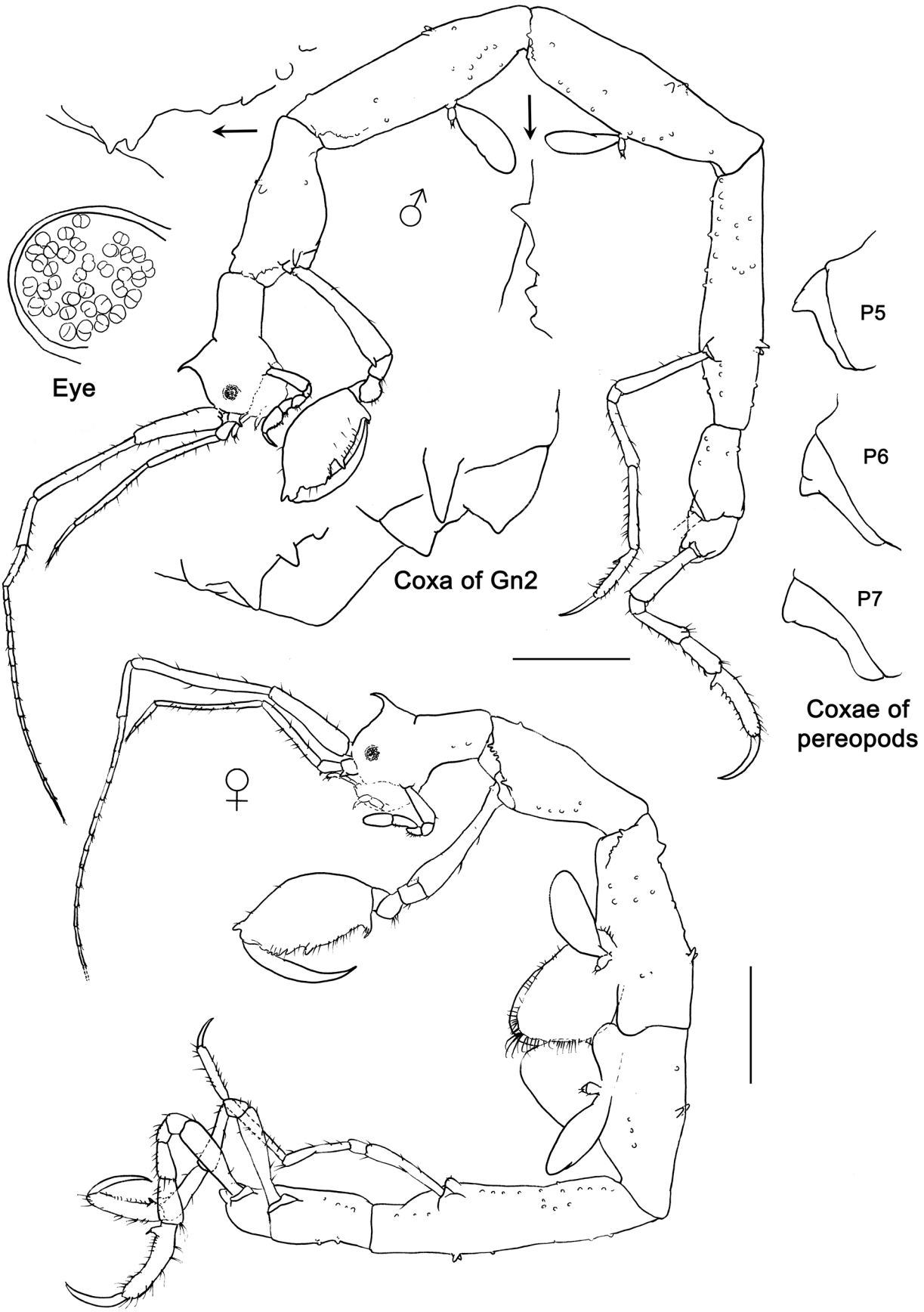

Figure 6. *Pseudoprotella australiensis* sp. nov. Lateral view of holotype male AM P.101359 and paratype "a" female AM P.101360. Details of eye, coxae of gnathopod 2 and pereopods and body tubercles ornamentation of the male are also included. Scale bars: 1 mm.

Figure 7. *Pseudoprotella australiensis* sp. nov. Mandibles of holotype male AM P.101359. Scale bars: 0.05 mm.

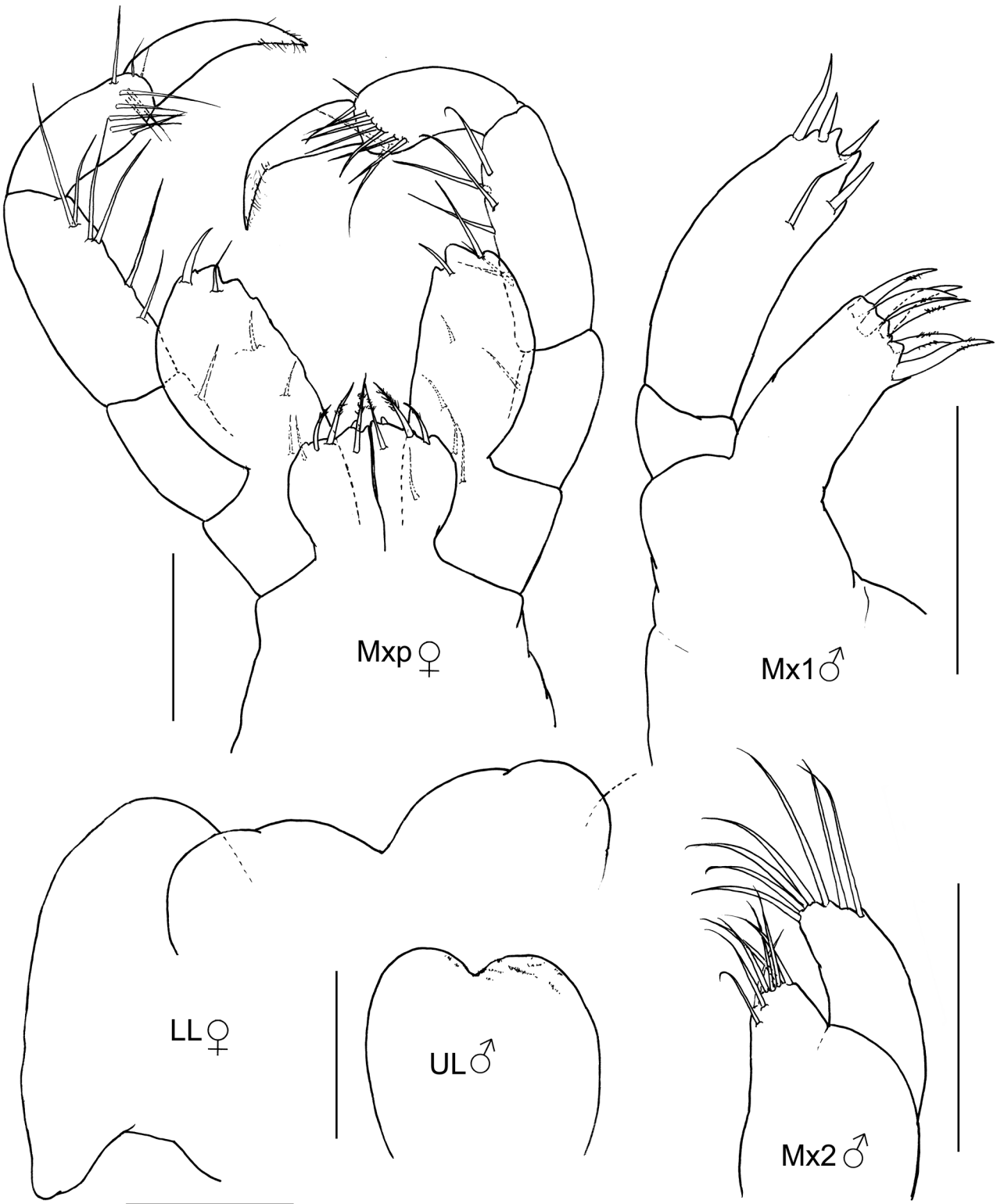

Figure 8. *Pseudoprotella australiensis* sp. nov. Maxilla 1, maxilla 2, upper lip of holotype male AM P.101359; maxilliped and lower lip of paratype "a" female AM P.101360. Scale bars: 0.1 mm.

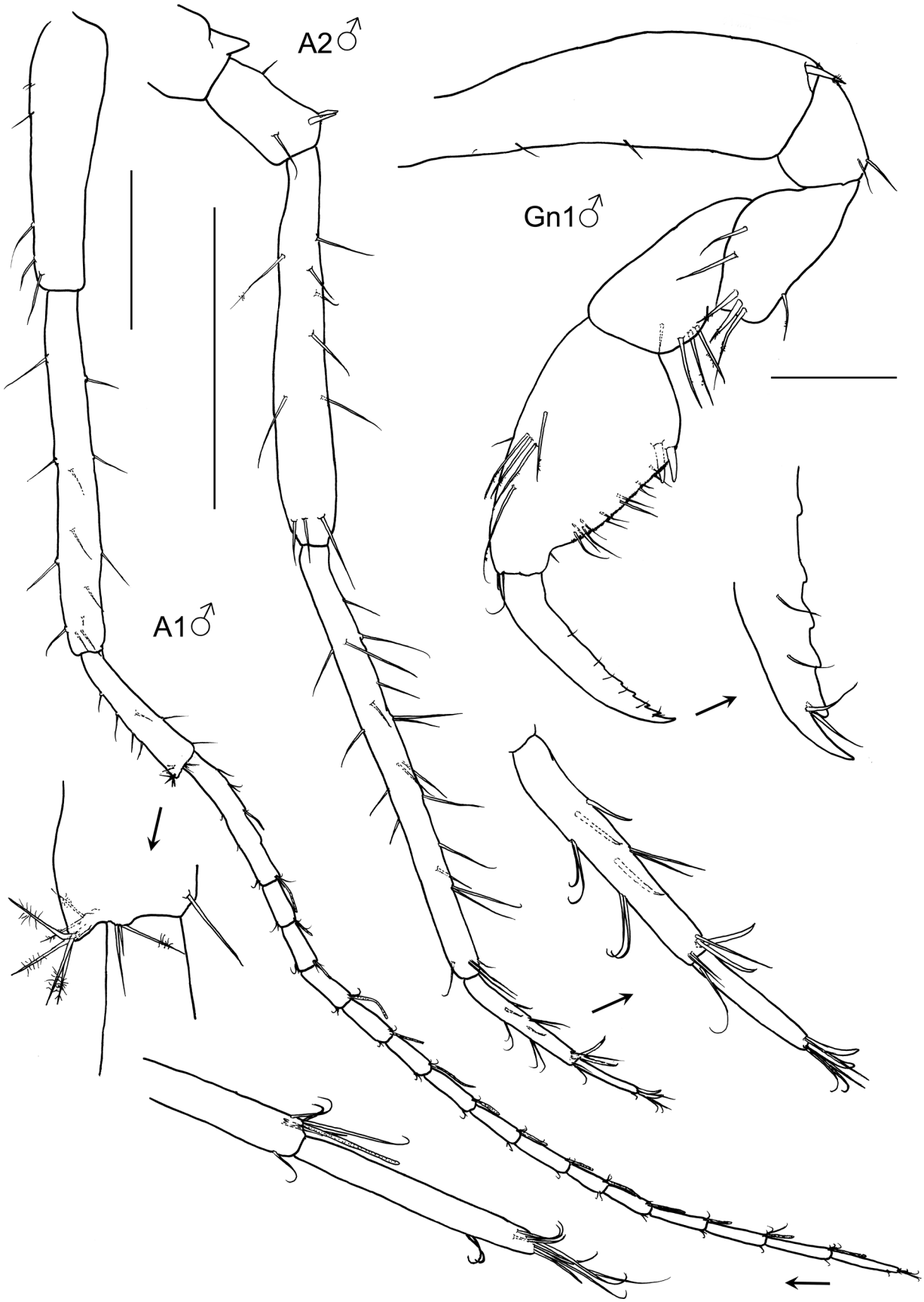

Figure 9. *Pseudoprotella australiensis* sp. nov. Antenna 1, antenna 2 and gnathopod 1 of holotype male AM P.101359. Scale bars: 1 mm (A1, A2), 0.1 mm (Gn1).

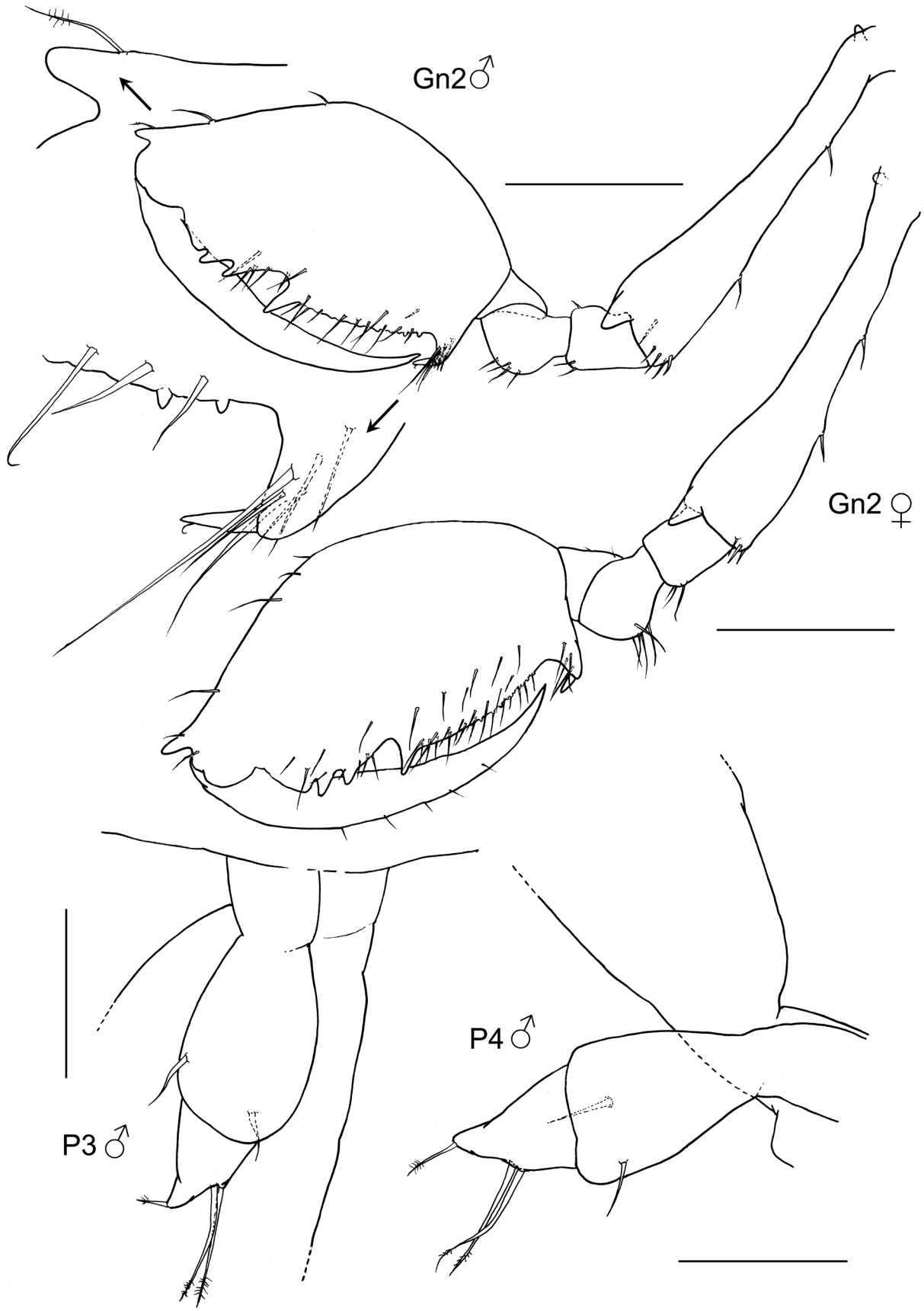

Figure 10. *Pseudoprotella australiensis* sp. nov. Gnathopod 2 and pereopods 3 and 4 of holotype male AM P.101359; gnathopod 2 of paratype "a" female AM P.101360. Scale bars: 0.5 mm (Gn2), 0.1 mm (P3, P4).

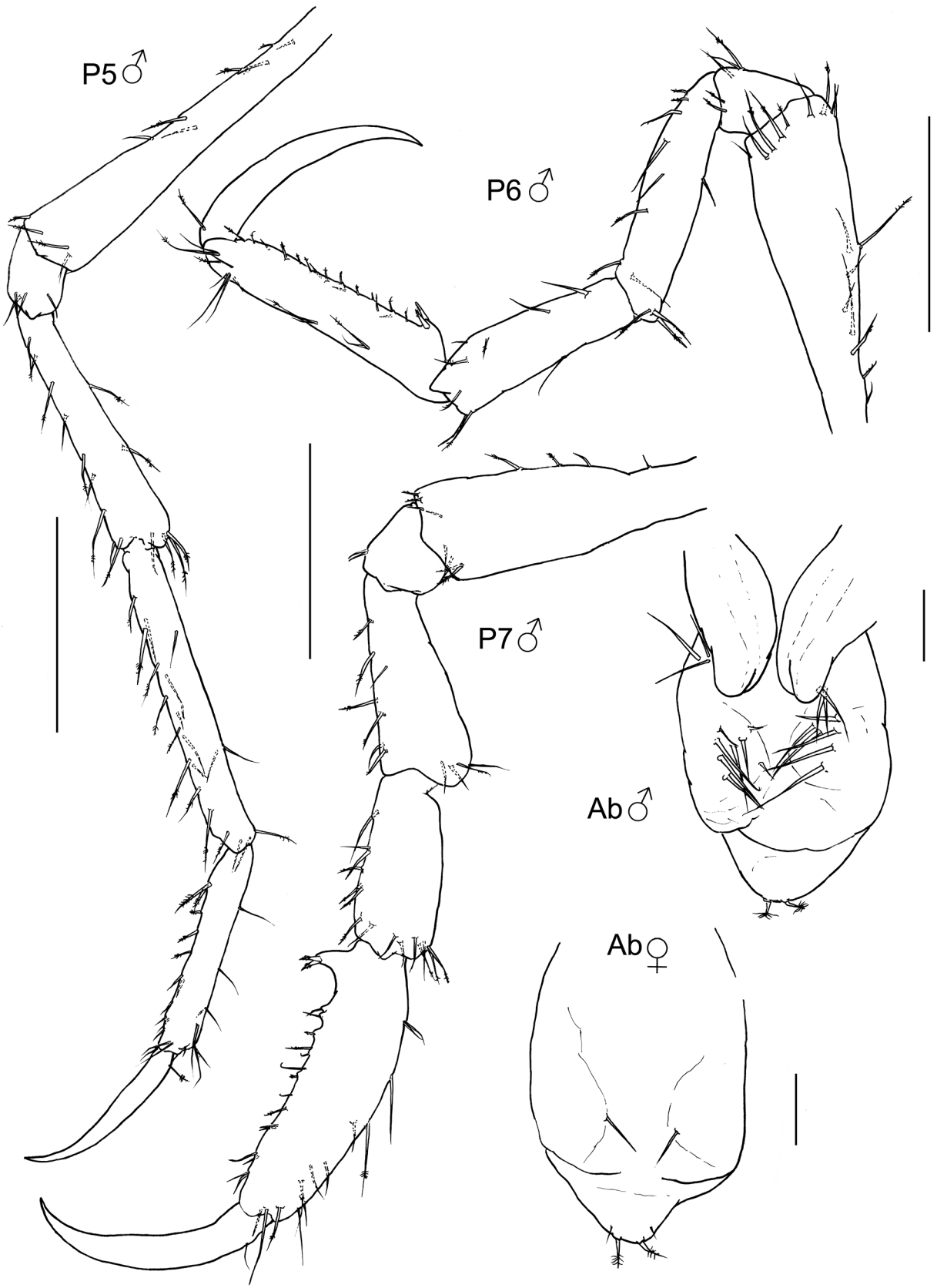

Figure 11. *Pseudoprotella australiensis* sp. nov. Pereopods 5, 6 and 7 and abdomen of holotype male AM P.101359; abdomen of paratype "a" female AM P.101360. Scale bars: 0.05 mm.

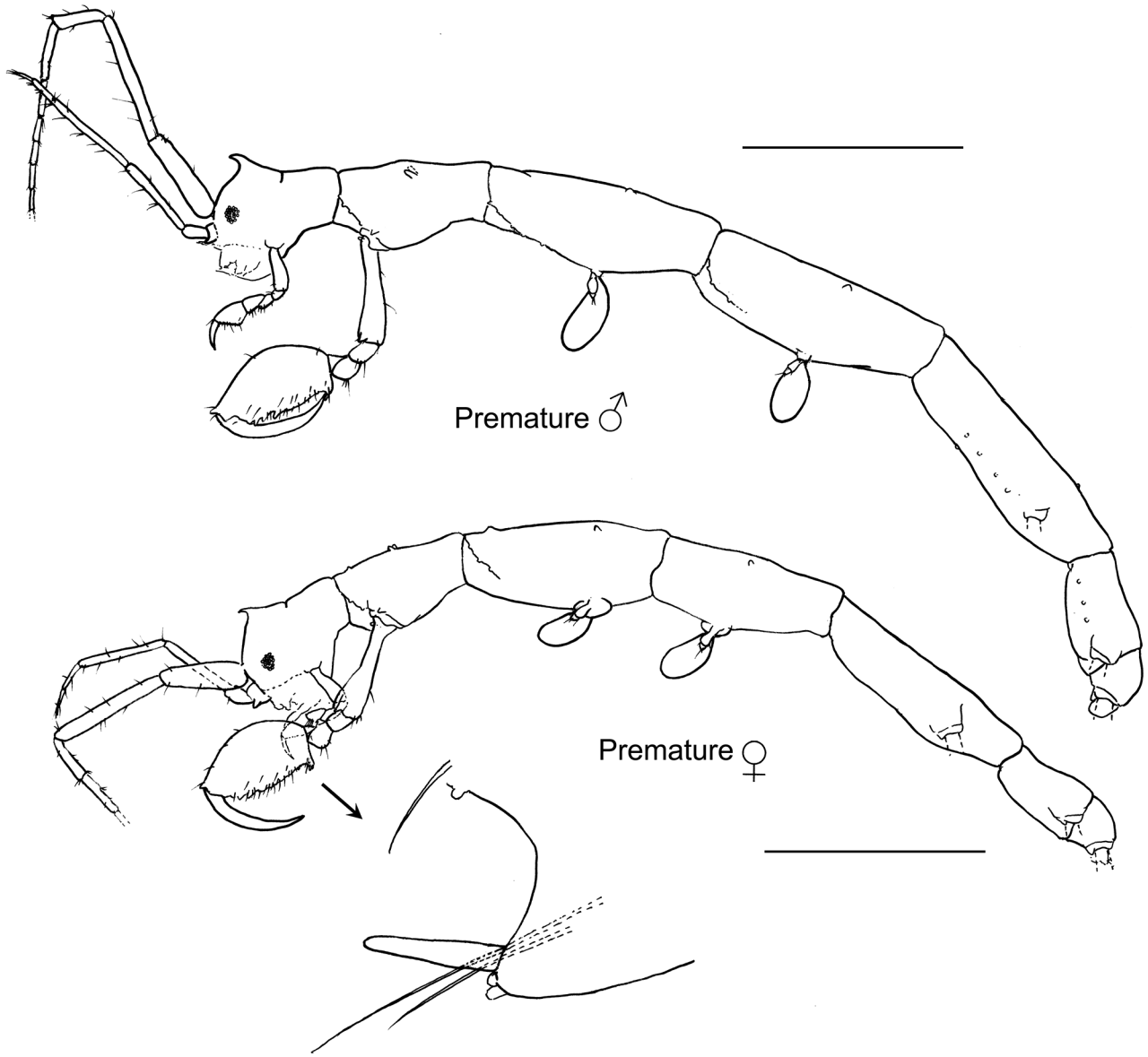

Figure 12. *Pseudoprotella australiensis* sp. nov. Lateral view of immature specimens: paratype "e" juvenile male AM P.101364 and paratype "f" premature female AM P.101365. Scale bars: 1 mm.

36°23'18"S 150°10'36"E, 76–79 m, RV *Southern Surveyor*, benthic sled, sediment, coll. P. B. Berents, 5 September 1994; AM P.101384, 2 mature females, east of Bermagui, 36°22'00"S 150°06'42"E, 26 m, RV *Southern Surveyor*, benthic sled, pebbles and coarse gravel, coll. P. B. Berents, 6 September 1994; AM P.101385, 1 mature female, east of Bermagui, 36°25'12"S 150°18'30"E, 220 m, RV *Southern Surveyor*, benthic sled, coll. P. B. Berents, 5 September 1994.

Victoria, Australia: AM P.101376, 1 mature male Bass Strait, east of Seal Islands, 38°59'06"S 148°31'36"E, 125 m, RV *Southern Surveyor*, benthic sled, 27 August 1994, coll. P. B. Berents; AM P.101377, 1 mature female, south of Gabo Island, 37°51'06"S 149°50'42"E, 130–131 m, RV *Southern Surveyor*, benthic sled, sponge, 31 August 1994, coll. P. B. Berents.

Tasmania, Australia: AM P.101375, 1 mature male, off St. Helens Point, 41°20'36"S 148°30'00"E, 110 m, RV *Sprightly*, fine clayey sand, preserved 80% ethanol, 25 March 1973, coll. P. H. Colman.

Etymology. The specific epithet "australiensis" alludes to the continent from which the species has been found, Australia.

Diagnosis. Eyes with distinctive ommatidia. Head with an anteriorly curved dorsal acute projection. Pereonites 2–6 with tiny tubercles scattered on the surface. Maxilliped palp article 3 without distal projection. Mandibular palp 3-articulate, with the setal formula 2-x-1, with x = 11; molar triturative, molar flake present. Maxilla 1 outer lobe with 6 distal spines. Gnathopod 2 basis shorter than pereonite 2. Pereopods 3 and 4 2-articulate; proximal article larger than distal article; distal article conical. Pereopods 5–7 6-articulate. Abdomen without appendages (no distinctive pleopods).

Description. *Holotype male* AM P.101359 (11.3 mm)

Lateral view (Fig. 6). Head with an anteriorly curved dorsal acute projection. Eyes with distinctive ommatidia. Pereonite 1 fused with head, suture present. Pereonites 2–6 with tiny tubercles scattered on surface. Pereonites 2–5 dorsal surface also with pair of rounded medial tubercles, slightly larger than those scattered on body surface. Pereonites 2 and 3 also with small proximal projection dorsally and row of small rounded projections laterally from head to coxa, and acute projection medially near coxa (see detail in Fig. 6). Pereonites 3 and 4 also ornamented with anterolateral row of small projections. Pereonite 5 the longest. Pereonite 7 smooth, the shortest.

Gills (Fig. 6). Present at middle of pereonites 3 and 4, elongate, length about 3 × width.

Mouthparts (Figs 7, 8). (Maxilla 1, maxilla 2, upper lip and mandibles figured and described from holotype male; maxilliped and lower lip figured and described from paratype "a" female). Mandibles with strong and triturative molar; palp 3-articulate; setal formula 2-x-1 with x=11, row of tubercles present near the base of setae (see details in Fig. 7); left mandible with incisor and lacinia mobilis 5-dentate, followed by 3 accessory blades; right mandible incisor 5-dentate, lacinia mobilis blade-like, followed by 2 more blades; molar flake present. Upper lip with very fine setulae. Lower lip without setae; inner lobes apparently with medial cleft but not clearly marked. Maxilla 1 outer lobe carrying 6 spines, palp 2-articulate, distal article with medial seta and 4 setae distally, together with 3 small distal teeth. Maxilla 2 inner lobe triangular, small; outer lobe rectangular, twice as large as inner lobe. Maxilliped inner plate small, length about 1/3 outer plate length, with 3 plumose setae and small tooth; outer plate with 3 setae; palp 4-articulate, article 4 curved distally and with row of tiny setulae.

Antennae (Figs 6, 9). Antenna 1 about 1/2 body length; flagellum 15-articulate, basal article 1, 3× length of article 2. Antenna 2 about 1/2 length of antenna 1; proximal peduncular article with acute gland cone distally; article 2 with 2 spines distally instead of setae; swimming setae absent; flagellum 2-articulate.

Gnathopods (Figs 6, 9, 10). Gnathopod 1 longer than ischium, merus and carpus combined; occlusal margin of propodus minutely serrated; 2 proximal grasping spines, dactylus bifid distally and provided with row of setulae. Gnathopod 2 inserted on anterior half of pereonite 2; coxa well developed (see detail in Fig. 6); basis about 2/3 length of pereonite 2, provided with small proximal internal projection near coxa and distal projection laterally; ischium rectangular; merus rounded; carpus short and triangular; propodus with distal projection dorsally together with plumose seta; palm with proximal projection provided with large grasping spine, serrated area, medial projection, and 2 more projections distally (see Fig. 9); dactylus smooth, slightly curved.

Pereopods (Figs 6, 10, 11). Pereopod 3 and 4 2-articulate; basal article with 2 setae, distal article conical with 2 lateral plumose setae and distal seta. Pereopods 5–7 with well-developed coxae (see details of Fig. 6). Pereopod 5 inserted on distal end of pereonite 5, elongate, provided with abundant plumose setae and lacking defined grasping spines. Pereopods 6 and 7 more robust than pereopod 5, with plumose setae, palm of propodus with pair of stronger plumose setae appearing as grasping spines (on pereopod 7 these 2 setae are inserted on a proximal projection).

Penes (Fig. 11) large, situated laterally, cleft distally, elongate, length about 3× width.

Abdomen (Fig. 11) lacking appendages, a pair of lobes with cluster of setae, and single dorsal lobe with 2 plumose setae.

Paratype female "a" AM P.101359 (9.7 mm) (Figs 6, 8, 10, 11). Very similar to male apart from the presence of setose oostegites on pereonites 3 and 4, lack of penes, and lateral lobes of abdomen provided with single seta instead of a cluster of setae.

Intraspecific variation and ontogenetic development. Most of the morphological characters of the species are rather constant in all the specimens examined. Body dorsal tuberculation is similar in all the specimens, with the formula: Head+P1 (1), P2 (1+2), P3 (1+2), P4 (2), P5 (2), P6 (0), P7 (0) (number of tubercles in parentheses, except for Head+P1 where the number indicates acute projection). In some females, pereonite 2 lacks medial dorsal projections, and in some males, pereonite 4 also has a proximal projection as in pereonite 3. In connection with the mouthparts, the maxilla 1 outer lobe is always provided with six spines and the distal article of the palp carries four distal and one medial spine. Each lobe of maxilla 2 is provided with six to eight setae. The maxilliped inner plate is always provided with three setae, the inner two always being plumose, and the third, external, plumose in some specimens and not plumose in others. This inner plate can have 1 or 2 small teeth, and the outer plate has 2 or 3 distal setae. The setal formula of mandibular palp is 2-x-1 (with x = 11 in all specimens examined), although some specimens have an additional long seta proximally which could be considered as 3-x-1.

Regarding ontogenetic development (Fig. 12), the flagellum of antenna 2 is always 2-articulate. The number of articles of the flagellum of antennae 1 increases with development. Pereonite 2 of immature males and females lacks the small proximal dorsal round projection, and dorsal tubercles of peronites 2–5 are less developed than in mature specimens. The number of tiny tubercles scattered on the body surface is also lower in immature individuals and the lateral ornamentation on the proximal part of pereonites 2, 3 and 4 is less developed. The gnathopod 2, rather similar in males and females, does not change significantly during development; the distal dorsal projection of the propodus is already present in immature specimens. In adults of both sexes, gills of pereonites 3 and 4 are of the same length. In some larger males gills 3 become larger than gills 4.

Remarks. Four species of *Pseudoprotella* have been described so far: *Pseudoprotella phasma* (Montagu, 1804), *Pseudoprotella inermis* Chevreux, 1927 (redescribed by Guerra-García & Takeuchi, 2000), *Pseudoprotella soela* Guerra-García, 2004b and *Pseudoprotella bogisa* (Mayer, 1903), which was recently transferred from the genus *Noculacia* to *Pseudoprotella* mainly on the basis of the presence of a well developed molar, the structure of pereopods 3 and 4 and the setal formula of the mandibular palp being 2-x-1 (see Guerra-García, 2002). A comparison of *Pseudoprotella* spp. is provided by Guerra-García (2002). *Pseudoprotella inermis* is restricted to the Strait of Gibraltar area and North Atlantic coast of Morocco (Guerra-García & Takeuchi, 2000; Guerra-García *et al.*, 2014) and it is characterized by the total absence of dorsal body projections.

Pseudoprotella bogisa has been collected so far only from Thai waters (McCain & Steinberg, 1970; Guerra-García, 2002), and *Pseudoprotella soela* from Western Australia (Guerra-García, 2004b). *Pseudoprotella phasma sensu lato* is distributed in the Mediterranean Sea and Atlantic Ocean, and includes several forms (f. *typica*, f. *minor*, f. *quadrispinis* and f. *bispinis*) described by Mayer (1890, 1903) and two additional ones collected from deep-sea areas of the northwestern Iberian Peninsula and figured by Guerra-García *et al.* (2018). Hence, *P. phasma*, as presently understood, probably includes at least six different species, which are still awaiting proper description and/or new appraisal of species ranking. A full revision of *Pseudoprotella* with detailed morphological and molecular data is, therefore, mandatory to clarify the taxonomical status of *P. phasma sensu lato* from shallow waters of the Mediterranean and Atlantic (Guerra-García *et al.*, 2018).

The new species, *P. australiensis*, can be differentiated from all the remaining species of *Pseudoprotella* mainly on the basis of the unique body ornamentation (acute projection on the head, pereonites with abundant tiny tubercles scattered on the surface, and rows of lateral tubercles on the proximal end of pereonites 2–4). The new species is closer to *P. bogisa* than to remaining species, mainly on the basis of the following characters: (i) distal article of pereopods 3 and 4 is conical and smaller than proximal one in *P. australiensis* and *P. bogisa* while it is not conical in *P. soela* and it is oval-rectangular and larger than the proximal one in *P. phasma* and *P. inermis*; (ii) maxilla 1 outer lobe is provided with 6 strong spines in *P. bogisa* and *P. australiensis*, while the remaining species have only 5 strong spines. A female of *Pseudoprotella* found in deep-sea water of Azores and figured by Guerra-García (2004a: 25, fig. 17) shows a combination of maxilla 1 with six strong spines and pereopods 3 and 4 with distal articles larger than proximal ones. This, together with the presence of two undescribed forms found in deep-sea Galician waters of the northwestern Iberian Peninsula indicates that a detailed study of *P. phasma sensu lato* from deep-sea waters of the Mediterranean and Atlantic Ocean is necessary to clarify the taxonomical status of the species of *Pseudoprotella*.

The new species, *P. australiensis*, seems to be abundant in mesophotic and deep-sea waters of southeastern Australia including New South Wales, Victoria and Tasmania from 56 to 1125 m depth. Although there are no ecological data accompanying most of the samples, the species has been collected mainly from sediments (fine clayey sand, pebbles and coarse gravel) and sponges.

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References

Abesamis, R. A., T. Langlois, M. Birt, E. Thillainath, A. A. Bucol, H. O. Arceo, and G. R. Russ. 2018. Benthic habitat and fish assemblage structure from shallow to mesophotic depths in a storm-impacted marine protected area. *Coral Reefs* 37(1): 81–97. https://doi.org/10.1007/s00338-017-1635-0

Baldwin, C. C., L. Tornabene, and D. R. Robertson. 2018. Below the mesophotic. *Scientific reports* 8(1) : 4920. https://doi.org/10.1038/s41598-018-23067-1

Bell, J. J., J. Jompa, A. Haris, S. Werorilangi, M. Shaffer, and C. Mortimer. 2018. Domination of mesophotic ecosystems in the Wakatobi Marine National Park (Indonesia) by sponges, soft corals and other non-hard coral species. *Journal of the Marine Biological Association of the United Kingdom* 99(4): 771–775. https://doi.org/10.1017/S0025315418000917

Englebert, N., P. Bongaerts, P. R. Muir, K. B. Hay, M. Pichon, and O. Hoegh-Guldberg. 2017. Lower mesophotic coral communities (60–125 m depth) of the northern Great Barrier Reef and Coral Sea. *PLoS ONE* 12: e0170336. https://doi.org/10.1371/journal.pone.0170336

Farrelly, C. A., and S. T. Ahyong. 2019. Deepwater decapod, stomatopod and lophogastrid Crustacea from Eastern Australia and the Great Australian Bight collected in 2015–2017: preliminary identifications of 191 species. *Museum Victoria Science Reports* 21: 1–97. https://doi.org/10.24199/j.mvsr.2019.21

Guerra-García, J. M. 2002. Revision of the genus *Noculacia* Mayer, 1903 (Crustacea: Amphipoda: Caprellidea) with the description of two new species. *Organisms Diversity & Evolution* 2(4): 351–352. https://doi.org/10.1078/1439-6092-00055

Guerra-García, J. M. 2003. Two new species of deep-water caprellids (Crustacea: Amphipoda) from northeastern Brazil. *Cahiers de Biologie Marine* 44: 171–184.

Guerra-García, J. M. 2004a. Deep-sea Caprellidea (Crustacea: Amphipoda) from Azores with the description of three newspecies. *Zoosystema* 26(2): 235–262.

Guerra-García, J. M. 2004b. The Caprellidea (Crustacea, Amphipoda) from Western Australia and Northern Territory, Australia. *Hydrobiologia* 522: 1–74. https://doi.org/10.1023/B:HYDR.0000029929.07691.a7

Guerra-García, J. M., T. Chatterjee, and N. V. Schizas. 2015. New genus and new species of Caprellidae (Crustacea: Peracarida: Amphipoda) from the mesophotic coral ecosystems of Puerto Rico and St. Croix, Caribbean Sea. *Zootaxa* 4018(1): 80–96. https://doi.org/10.11646/zootaxa.4018.1.4

Guerra-García, J. M., and E. A. Hendrycks. 2013. A new species of *Liropus* (Crustacea, Amphipoda, Caprellidae) from California, USA, with an illustrated key of the genus. *Zootaxa* 3718: 467–476. https://doi.org/10.11646/zootaxa.3718.5.3

Guerra-García, J. M., B. Iazaa, and C. Megina. 2014. Vertical distribution of caprellids (Crustacea: Amphipoda) associated to hydroids, with the first record of *Pseudoprotella inermis* for Morocco. *Zoologica Baetica* 25: 65–73.

Guerra-García, J. M., S. J. Keable, and S. T. Ahyong. 2020. A new species of *Paraproto* (Crustacea: Amphipoda) from southern New South Wales, Australia. *Zootaxa* 4755: 271–293. https://doi.org/10.11646/zootaxa.4755.2.4

Guerra-García, J. M., and I. Takeuchi. 2000. Redescription of *Pseudoprotella inermis* Chevreux, 1927, a rare species of caprellidean amphipod (Crustacea) from Ceuta, North Africa. *Proceedings of the Biological Society of Washington* 113: 980–988.

Guerra-García, J. M., R. Tato, and J. Moreira. 2018. Caprellidae (Crustacea: Peracarida: Amphipoda) from deep-sea waters off Galicia (NW Iberian Peninsula) with the description of a new genus and three new species. *Zootaxa* 4532(2): 151–202. https://doi.org/10.11646/zootaxa.4532.2.1

Hinderstein, L., J. Marr, F. Martinez, M. Dowgiallo, K. Puglise, R. Pyle, D. Zawada, and R. Appeldoorn. 2010. Theme section on "Mesophotic Coral Ecosystems: Characterization, Ecology, and Management." *Coral Reefs* 29: 247–251.
https://doi.org/10.1007/s00338-010-0614-5

Horowitz, J., D. M. Opresko, and T. Bridge. 2018. Black corals (Anthozoa: Antipatharia) from the deep (916 m–2542 m) Coral Sea, north-eastern Australia. *Zootaxa* 4472(2): 307–326.
https://doi.org/10.11646/zootaxa.4472.2.5

Laubitz, D. R. 1972. *The Caprellidae (Crustacea, Amphipoda) of Atlantic and Arctic Canada*. Ottawa: National Museum of Natural Sciences Publications in Biological Oceanography, 82 pp.

Laubitz, D. R., and E. L. Mills. 1972. Deep-sea Amphipoda from the western North Atlantic Ocean. Caprellidea. *Canadian Journal of Zoology* 50: 371–383.
https://doi.org/10.1139/z72-054

Lowry, J. K., and A. A. Myers. 2013. A phylogeny and classification of the Senticaudata subord. nov. (Crustacea: Amphipoda). *Zootaxa* 3610: 1–80.
https://doi.org/10.11646/zootaxa.3610.1.1

Lowry, J. K., and A. A. Myers. 2017. A phylogeny and classification of the Amphipoda with the establishment of the new order Ingolfiellida (Crustacea: Peracarida). *Zootaxa* 4265: 1–89.
https://doi.org/10.11646/zootaxa.4265.1.1

Lowry, J. K., and H. E. Stoddart. 2010. The deep-sea scavenging genus *Hirondellea* (Crustacea: Amphipoda: Lysianassoidea: Hirondelleidae fam. nov.) in Australian waters. *Zootaxa* 2329(1): 37–55.
https://doi.org/10.11646/zootaxa.2329.1.3

MacIntosh, H., F. Althaus, A. Williams, J. E. Tanner, P. Alderslade, S. T. Ahyong, N. J. Bax, F. Criscione, A. L. Crowther, C. A. Farrelly, J. K. Finn, L. Goudie, K. L. Gowlett-Holmes, A. M. Hosie, E. K. Kupriyanova, C. Mah, A. W. McCallum, K. L. Merrin, A. Miskelly, M. L. Mitchell, T. Molodtsova, A. Murray, T. D. O'Hara, P. M. O'Loughlin, H. Paxton, A. L. Reid, S. J. Sorokin, D. A. Staples, G. Walker-Smith, E. Whitfield, and R. S. Wilson. 2018. Invertebrate diversity in the deep Great Australian Bight (200–5000 m). *Marine Biodiversity Records* 22: 23.
https://doi.org/10.1186/s41200-018-0158-x

Mauro, F. D. M., and C. S. Serejo. 2015. The family Caprellidae (Amphipoda: Caprelloidea: Caprellidae) from Campos Basin, southwestern Atlantic, with a key of species occurring in Brazil. *Zootaxa* 4006(1): 103–127.
https://doi.org/10.11646/zootaxa.4006.1.5

Mayer, P. 1890. Die Caprelliden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *Nachtrag zur Monographie derselben. Fauna und Flora des Golfes von Neapel* 17: 1–157.
https://doi.org/10.5962/bhl.title.53624

Mayer, P. 1903. Die Caprellidae der Siboga-Expedition. *Siboga-Expeditie* 34: 1–160.
https://doi.org/10.5962/bhl.title.53742

McCain, J. C., and J. E. Steinberg. 1970. *Crustaceorum Catalogus: Amphipoda I, Caprellidea I, Family Caprellidae*. Den Haag: Dr W. Junk N.V., 78 pp.

Petrescu, I., T. Chatterjee, and N. V. Schizas. 2012. New genus and new species of Cumacea (Crustacea: Peracarida) from the mesophotic coral ecosystem of SW Puerto Rico, Caribbean Sea. *Zootaxa* 3476: 55–61.
https://doi.org/10.11646/zootaxa.3476.1.2

Ramirez-Llodra, E., P. A. Tyler, M. C. Baker, O. A. Bergstad, M. R. Clark, E. Escobar, L. Levin, L. Menot, A. A. Rowden, C. R. Smith, and C. L. Van Dover. 2011. Man and the last great wilderness: human impact on the deep sea. *PLoS ONE* 6(8): e22588.
https://doi.org/10.1371/journal.pone.0022588

Sánchez-Moyano, J. E., I. García-Asencio, and J. M. Guerra-García. 2015. Littoral caprellids (Crustacea: Amphipoda) from the Mexican Central Pacific coast, with the description of four new species. *Journal of Natural History* 49: 77–127.
https://doi.org/10.1080/00222933.2014.937366

Senna, A. R., R. Sorrentino, T. Chatterjee, and N. V. Schizas. 2014. A new species of *Boca* Lowry & Stoddart, 1997 (Amphipoda: Lysianassoidea: Aristiidae) from a mesophotic coral ecosystem off Puerto Rico, Caribbean Sea. *Zootaxa* 3884(5): 429–436.
https://doi.org/10.11646/zootaxa.3884.5.3

Takeuchi, I. 2015. A new species of *Paraproto* (Crustacea: Amphipoda: Phtisicidae) collected from the South Shetland Islands, Antarctica. *Polar Science* 9: 368–373.
https://doi.org/10.1016/j.polar.2015.08.002

Takeuchi, I., K. Tomikawa, and D. Lindsay. 2016. A new genus and species of Phtisicidae (Crustacea: Amphipoda) from abyssal depths in the Japan Trench, with special reference to similarities with Southern Ocean Genera. *Journal of Crustacean Biology* 36: 495–506.
https://doi.org/10.1163/1937240X-00002457

Tanner, J. E., F. Althaus, S. J. Sorokin, and A. Williams. 2018. Benthic biogeographic patterns in the southern Australian deep sea: Do historical museum records accord with recent systematic, but spatially limited, survey data? *Ecology and Evolution* 8(23): 11423–11433.
https://doi.org/10.1002/ece3.4565

Thistle, D. 2003. The deep-sea floor: an overview. In *Ecosystems of the World*, volume 28, pp. 5–39, of *Ecosystems of the Deep Ocean*, ed. P. A. Tyler. Amsterdam: Elsevier.

Turner, J. A., R. C. Babcock, R. Hovey, and G. A. Kendrick. 2018. AUV-based classification of benthic communities of the Ningaloo shelf and mesophotic areas. *Coral Reefs* 37(3): 763–778.
https://doi.org/10.1007/s00338-018-1700-3

Weinstein, D. K., T. B. Smith, and J. S. Klaus. 2014. Mesophotic bioerosion: variability and structural impact on US Virgin Island deep reefs. *Geomorphology* 222: 14–24.
https://doi.org/10.1016/j.geomorph.2014.03.005

Williams, A., F. Althaus, H. MacIntosh, M. Loo, K. Gowlett-Holmes, J. E. Tanner, and M. Green. 2018. Characterising the invertebrate megafaunal assemblages of a deep-sea (200–3000 m) frontier region for oil and gas exploration: the Great Australian Bight, Australia. *Deep Sea Research Part II: Topical Studies in Oceanography* 157: 78–91.
https://doi.org/10.1016/j.dsr2.2018.07.015

Wilson, G. D. F. 2005. *Arafura Sea Biological Survey. Report on RV Southern Surveyor Expedition 05/2005*. Unpublished voyage summary (prepared for the Department of the Environment and Heritage-National Oceans Office by the Australian Museum, 17 pp.

Woodall, L. C., D. A. Andradi-Brown, A. S. Brierley, M. R. Clark, D. Connelly, R. A. Hall, K. L. Howell, V. A. I. Huvenne, K. Linse, R. E. Ross, P. Snelgrove, P. V. Stefanoudis, T. T. Sutton, M. Taylor, T. F. Thornton, and A. D. Rogers. 2018. A multidisciplinary approach for generating globally consistent data on mesophotic, deep-pelagic, and bathyal biological communities. *Oceanography* 31(3): 76–89.
https://doi.org/10.5670/oceanog.2018.301

Zettler, M. L., A. Freiwald, and J. M. Guerra-García. 2018. Cold-water corals off Angola as refuge for a new *Aeginella* species (Crustacea: Amphipoda: Caprellidae). *Zootaxa* 4462(4): 535–546.
https://doi.org/10.11646/zootaxa.4462.4.6