

## A taxonomic study on the Phtisicidae (Crustacea: Amphipoda) of New South Wales, Australia

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### ABSTRACT

The present study reviews the taxonomy of the Phtisicidae (Crustacea: Amphipoda) from the coast of New South Wales, Australia. The following seven species are described; *Dodecas decacentrum* Stebbing, 1910b, *Dodecas hexacentrum* Mayer, 1903, *Hircella cornigera* (Haswell, 1879b), *Metaproto novaehollandiae* (Haswell, 1879a), *Notoprotomima smithi* gen. nov., sp. nov., *Paraproto* sp. and *Perotripus* sp. Generic diagnoses of *Notoprotomima* gen. nov., *Dodecas*, *Hircella* and *Metaproto* are provided based on the present materials. *Notoprotomima smithi* is fully described as a new species of the new genus. *Dodecas decacentrum* differs from *Dodecas hexacentrum* by the presence of paired dorsodistal projections on pereonite 2, paired mid-dorsal projections on pereonites 3 and 4 and shorter gill length on pereonites 2 and 3. *Hircella cornigera* and *Metaproto novaehollandiae* are described in detail. The larger mature males of *M. novaehollandiae* possess the unusual massive type of the propodus of gnathopod 2. The extended distribution of *Perotripus* to the New South Wales coast is noted. A key for these phtisicid amphipods from New South Wales, Australia is provided.

### ARTICLE HISTORY

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### KEYWORDS

Amphipoda; Phtisicidae; new genus; new species; New South Wales, Australia

### Introduction

The Phtisicidae (Crustacea: Amphipoda) are one of the dominant groups of caprellid amphipods called “skeleton shrimps” inhabiting mainly shallow water ecosystems, especially in the tropical to temperate regions of the northern hemisphere and all over the southern hemisphere including Antarctica (see McCain and Steinberg 1970; Takeuchi 1993; De Broyer et al. 2004). The Phtisicidae of New South Wales, Australia were first recorded in two papers published by Haswell (1879a, 1879b). He reported *Hircella cornigera* (Haswell, 1879b) and *Metaproto novaehollandiae* (Haswell, 1879a) from Port Jackson, an inner bay situated in the Greater Sydney area. Mayer (1903) reported *Dodecas hexacentrum* Mayer, 1903 from off Watsons Bay, Port Jackson in

his monographic work that covered the Caprellidae of the world. Stebbing (1910b) reported *Dodecas decacentrum* Stebbing, 1910b from Botany Bay and off Wattamolla. Hence, four species have been recorded from New South Wales from the late nineteenth century to the beginning of the twentieth century. The type specimens of the Phtisicidae species deposited in the Australian Museum were listed by Springthorpe and Lowry (1994). However, modern taxonomic descriptions have not been published on the Phtisicidae of this area for nearly a century, leading to the unclear status of each species of the Phtisicidae. In the present study, we report the results of our taxonomic study on representatives of the family Phtisicidae in New South Wales, Australia including detailed descriptions of seven species: *Dodecas decacentrum* Stebbing, 1910b; *Dodecas hexacentrum* Mayer, 1903; *Hircella cornigera* (Haswell, 1879b); *Metaproteo novaehollandiae* (Haswell, 1879a); *Notoprotomima smithi* gen. nov., sp. nov.; *Paraproteo* sp. and *Perotripus* sp. A key for these species of the Phtisicidae is provided.

## Material and methods

The materials used in the present study, are based mainly on two sources. One is the type and additional specimens of the Phtisicidae which have been accumulated by the Australian Museum and by Dr S.D.S. Smith's laboratory, then of the University of New England, through various taxonomic, ecological and environmental surveys. The other specimens were obtained from field surveys during the 1995/96 austral summer along the coasts of New South Wales, from Jervis Bay and adjacent areas to the Solitary Islands. Mouthparts, gnathopod 1 and pereopods 5 to 7 of described individuals were dissected and mounted on slides in polyvinyl-lactophenol. The lateral body view of somites, antennae, respective appendages and mouthparts were drawn under a microscope equipped with a camera lucida. All descriptive text was generated from a DELTA database (Dallwitz 2005) to the world genera and Australian species of caprellid and phtisicid amphipods. The setal formulae (1-x-y-1 or 1-x-1) for the setae on mandibular palp article 3 are used for descriptions, as described by McCain (1968). All material is lodged in the Australian Museum, Sydney (AM). Standard abbreviations on the plates are: A, antenna; ABD, abdomen; F, female; G, gnathopod; LL, lower lip; M, male; MD, mandible; MX, maxilla; MXP, maxilliped; P, pereopod; UL, upper lip; LT, lateral; V, ventral; L, left; R, right.

Takeuchi (1993) showed 12 coded generic diagnostic characters based on a literature survey of the Phtisicidae, Caprellidae, Paracercopidae and Caprogammaridae. These characters were expanded to include several new characters, especially features of the head with pereonite 1, features of the mandible, features of the maxillipedal palp including the size of the inner plate (basal endite) to the outer plate (ischial endite) and a feature of pereonite 4. The fundamentally same generic diagnosis was also used for the genera of the Caprellidae in Takeuchi and Lowry (2007), Lim and Takeuchi (2012) and Takeuchi et al. (2014) and that for Phtisicidae in Lim et al. (2012). The familial classification of the present study follows Takeuchi (1993, 1999), Guerra-García and Takeuchi (2003, 2004), Lim et al. (2012) and Takeuchi (forthcoming 2015).

## Taxonomy

Order **AMPHIPODA** Latreille, 1816  
 Family **PHTISICIDAE** Vassilenko, 1968  
 Genus ***Dodecas*** Stebbing, 1883

### Diagnosis

Head fused with pereonite 1. Antenna 1 well developed; flagellum with more than two articles; accessory flagellum absent. Antenna 2 well developed; flagellum with more than three articles. Mandible well developed; molar absent; palp 3-articulate; palp setal formula 1–x–1. Maxilliped well developed; inner plate (basal endite) larger than outer plate (ischial endite); outer plate (ischial endite) well developed; palp article 3 without distal projection; palp article 4 well developed. Pereonite 4 clavate appendage absent. Pereonites 6 and 7 not fused. Pereopod 3 well developed, with seven articles. Pereopod 4 absent. Pereopod 5 reduced with four articles. Pereopods 6 and 7 well developed, with seven articles. Gills on pereonites 2 to 4. Pleopods present, one pair, tiny. Uropods two pairs; uropod 1, uniramous; uropod 2, uniramous. Telson (dorsal lobe) present.

### Type species

*Dodecas elongata* Stebbing, 1883, monotypy.

### Included species

*Dodecas* includes seven species: *Dodecas decacentrum* Stebbing, 1910b; *Dodecas elongata* Stebbing, 1883; ? *Dodecas eltaninae* McCain and Gray, 1971; *Dodecas grandimanus* Guiler, 1954; *Dodecas hexacentrum* Mayer, 1903; *Dodecas reducta* K.H. Barnard, 1932; *Dodecas tasmaniensis* Guiler, 1954.

### Remarks

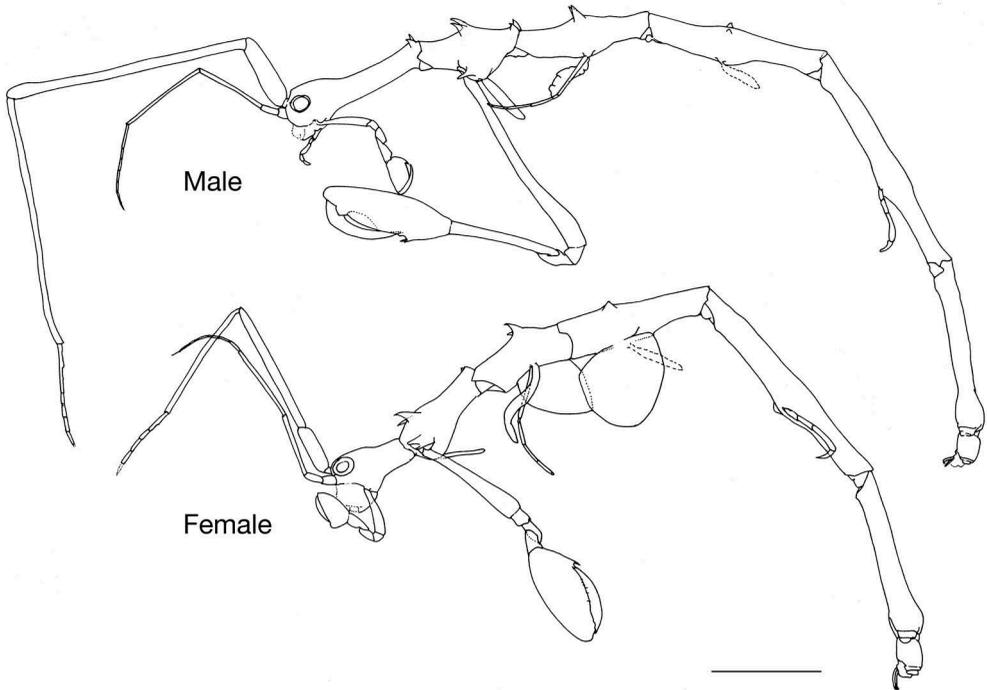
The genus *Dodecas* was established specifically for *D. elongata* Stebbing, 1883 by Stebbing (1883). The generic diagnosis of the present genus is provided based on the present description of *D. decacentrum* Stebbing, 1910b and *D. hexacentrum* Mayer, 1903.

### ***Dodecas decacentrum*** Stebbing, 1910b (Figures 1–3)

*Dodecas decacentrum* Stebbing, 1910b: 629–631, 652, pl. 60. – Briggs, 1914: 77–78. – Guiler, 1952: 31. – Guiler, 1954: 541. – McCain and Steinberg: 1970: 49. – Lowry and Stoddart, 2003: 35.

### Type material

Syntypes. 232 individuals, AM P2546, 34°03.5'S, 151°12.5'E, 2–3 km off Port Hacking, New South Wales, 69 m depth, sandy, 10 March 1898, Stn 35; 1 male, AM P2547, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales, 91–95 m depth, mud, 11 March 1898, Stn 37; 1 male, AM P3383, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales, 91–95 m



**Figure 1.** *Dodecas decacentrum* Stebbing, 1910b from 3–4 km off Botany Bay, New South Wales. Male, syntype, 18.98 mm, AM P2547; female, syntype, 16.67 mm, AM P46941. Bar indicates 2.0 mm.

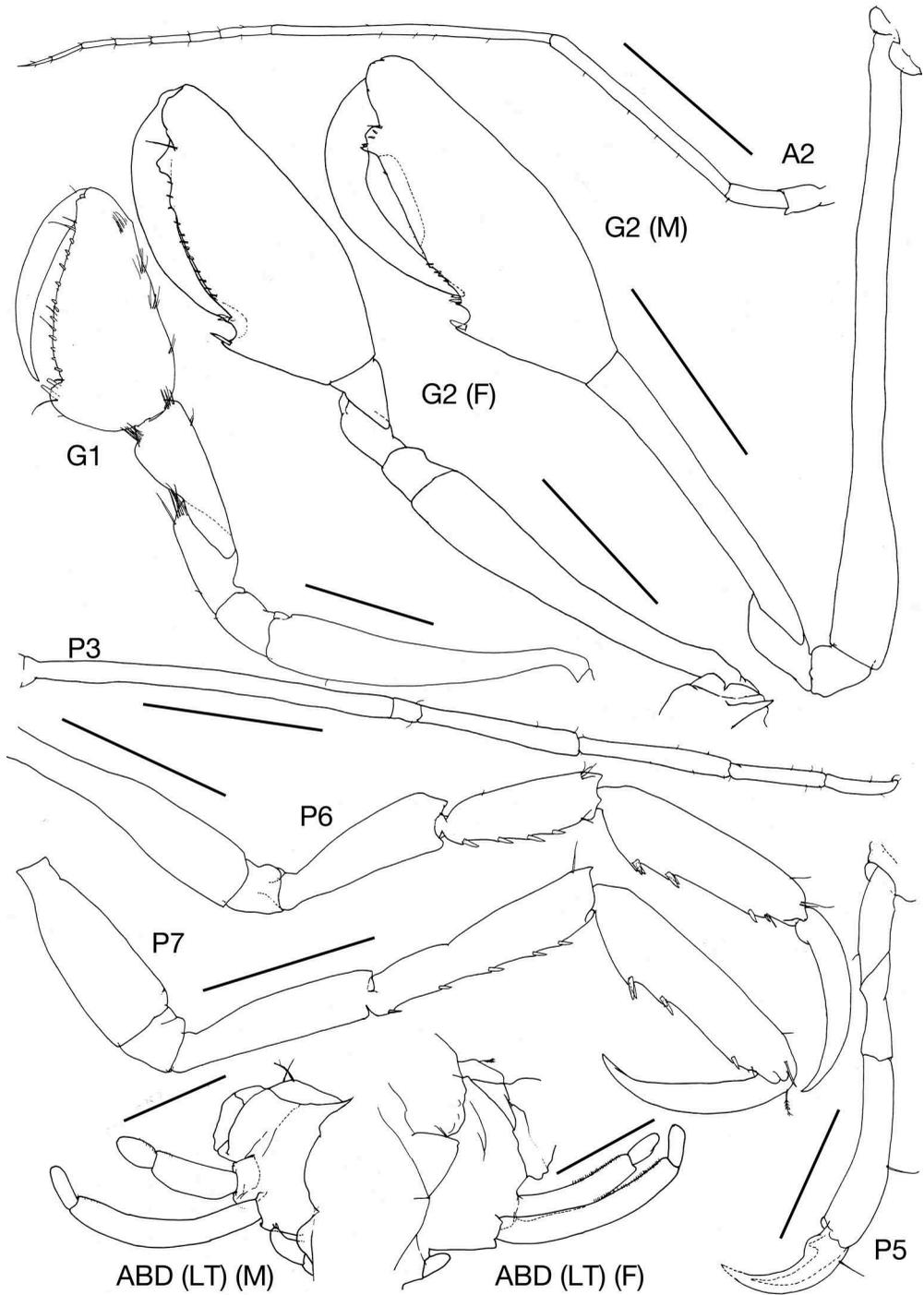
depth, mud, 11 March 1898, Stn 37; 220 individuals, AM P46931, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales 91–95 m depth, mud, 11 March 1898, Stn 37; 36 individuals (17 males, 18 mature females and 1 juvenile), AM P46917, 34°10'S, 151°11'E, 5.5–6.5 km off Wattamolla, New South Wales, 99–108 m depth, mud, 2 March 1898, Stn 57; 1 female, AM P46941, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales, 91–95 m depth, mud, 11 March 1898, Stn 37; 53 individuals (24 males, 25 mature and 4 immature females), AM P46942, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales, 91–95 m depth, mud, 11 March 1898, Stn 37; 1 male, AM P46943, 34°05'S, 151°15'E, 3–4 km off Botany Bay, New South Wales, 91–95 m depth, mud, 11 March 1898, Stn 37.

#### ***Additional material examined***

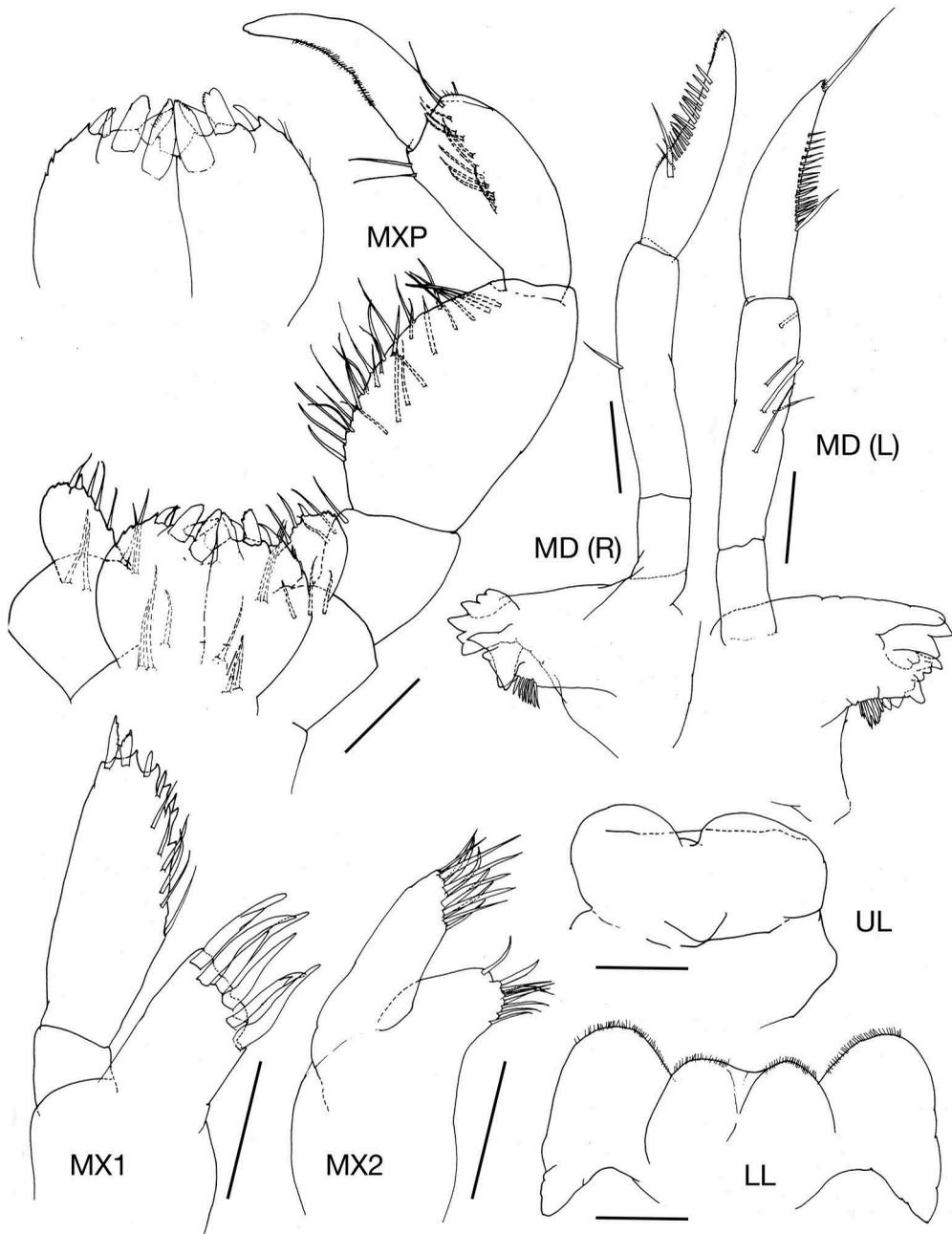
AM P46929, 5 males, 43°15'S, 147°16'E, D'Entrecasteaux Channel, Tasmania, 3.5–20 m depth, on the hydrozoan *Sertularia operculata*.

#### ***Type locality***

Botany Bay and off Wattamolla, New South Wales, Australia, 69–108 m depth.



**Figure 2.** *Dodecas decacentrum* Stebbing, 1910b from 3–4 km off Botany Bay, New South Wales. Male, syntype, 18.98 mm, AM P2547, A2, G1, G2, P3, P5, ABD (LT); male, syntype, 13.35 mm, AM P3383, P6, P7; female, syntype, 16.67 mm, AM P46941, G2, ABD (LT). Bars in ABD (LT) (F) and ABD (LT) (M) indicate 0.20 mm, those in G1, P3, P5, P6 and P7 indicate 0.50 mm and those in G2 (M) and G2 (F) indicate 1.0 mm.



**Figure 3.** *Dodecas decacentrum* Stebbing, 1910b from 3–4 km off Botany Bay, New South Wales. Male, syntype, 18.98 mm, AM P2547. Bars indicate 0.10 mm.

**Description**

Based on syntype, male, body length 18.98 mm, AM P2547 and male, 13.35 mm, AM P3383, for pereopods 6 and 7. *Head and pereonite 1* combined length 2.71 mm; *pereonite*

2, 1.91 mm; pereonite 3, 2.49 mm; pereonite 4, 3.42 mm; pereonite 5, 4.58 mm; pereonite 6, 3.33 mm; pereonite 7, 0.53 mm.

*Head and pereonites* slender. *Head* smooth, rounded dorsally; eye large, distinctive; *head/pereonite 1* concave along dorsal margin; *pereonite 1* with paired dorsodistal projections.

*Antenna 1* slender;  $0.67 \times$  body length; peduncle articles 2 and 3 subequal in length; peduncular article 3 straight; flagellum  $0.17 \times$  peduncular length, with more than five articles; proximal article result of fusion of 3–4 articles. *Antenna 2* slender;  $0.33 \times$  antenna 1 length; peduncle with several feeble setae; flagellum  $0.33 \times$  peduncular length, with seven articles.

*Upper lip* notched, forming rounded quadrilateral projections. *Mandible* right side incisor with six teeth; lacinia mobilis a reverse trapezoid plate followed by one smaller plate; accessory setal row with 10 setae; palp article 2 with one lateral seta; palp article 3 setal formula 1–16–1; left side incisor with five teeth; left side lacinia mobilis with five teeth, followed by one trapezoid plate; left side accessory setal row with one bundled seta and 10 setae; palp article 2 with five lateral setae; palp article 3 setal formula 1–17–1. *Lower lip* finely setose on inner and outer lobes. *Maxilla 1* outer plate with six stout apical setal-teeth; palp distal margin with six triangular projections, each with one slender or robust seta, with a row of slender setae. *Maxilla 2* inner plate triangular with nine apical robust setae; outer plate elongate with 12 apical setae. *Maxilliped* inner plate (basal endite) oval, with three stout serriform setae on expanded inner half of distal margin, with one or two setae on outer half; outer plate (ischial endite) oval,  $0.5 \times$  length of inner plate (basal endite), inner margin smooth, with four setae on inner margin; palp article 2 setose on inner margin; palp article 3 with moderately dense distal setae; palp article 4 weakly falcate.

**Pereon.** *Pereonite 2* with anterolateral triangular projection, with midlateral projection, with paired anteriorly curved mid-dorsal projections, with paired anteriorly curved dorsodistal projections. *Pereonite 3* with paired mid-dorsal projections. *Pereonite 4* with paired small mid-dorsal projections. *Pereonite 5* longest.

*Gnathopod 1* propodus triangular, with four rows of submarginal setae near dorsal margin; palm begins about  $1/4$  along posterior margin, smooth, with two robust setae near corner of palm; dactylus curved. *Gnathopod 2* situated near middle of pereonite 2; gill length about  $4.5 \times$  width,  $1/2 \times$  pereonite length; coxa vestigial; basis  $2.2 \times$  length of pereonite 2; carpus  $0.55 \times$  basis length; propodus elongate, subrectangular, large, length  $2.6 \times$  width, anterodistal margin straight; palm proximal projection with three robust (one large and two small) setae, palm margin straight, smooth, with narrow well-developed distal shelf with two small triangular projections distally.

*Pereopod 3* very slender; gill length about  $1/2 \times$  corresponding pereonite, curved anteriorly; basis to carpus straight and cylindrical; basis longer than other pereopod articles,  $2/5 \times$  the pereopod length; propodus without distal palm and robust setae; dactylus spatulate. *Gill 4* length about  $1/4 \times$  corresponding pereonite. *Pereopod 5* broad; articulation between articles 1 and 2 oblique; dactylus medium length, falcate. *Pereopod 6* basis longer than propodus; carpus with four robust setae and one slender seta on anterior margin; propodus with two pairs of robust setae on proximal margin and one robust and one slender seta; dactylus curved, not setose. *Pereopod 7* basis shorter than propodus; merus subequal in length to basis; carpus longer than basis with five robust setae; propodus and dactylus similar to those of pereopod 6.

**Pleon.** *Pleopod* one pair, tiny. *Uropod 1*; peduncle elongate, about 6–8 × width; ramus 0.2 × peduncular length. *Uropod 2*; peduncle about 5–6 × width, shorter than uropod 1; ramus 0.5 × peduncular length.

*Female* (sexually dimorphic characters). Based on female syntype, body length 16.67 mm, AM P 46941. *Antenna 1* about 0.5 × body length; flagellum 0.25 × peduncular length. Length of *head and pereonite 1* combined length 1.47 mm, and each length of *pereonites 2–7*, 1.91 mm, 1.82 mm, 2.98 mm, 4.58 mm, 3.24 mm and 0.67 mm, respectively. *Gnathopod 2* situated near anterior end of pereonite 2; palm margin of propodus convex, with one small triangular projection distally. *Gill 3* length about as long as corresponding pereonite, distal part curved posteriorly. *Gill 4* length about 1/3 × corresponding pereonite.

### Remarks

Of the seven species of *Dodecas*, two species, *D. decacentrum* Stebbing, 1910b and *D. hexacentrum* Mayer, 1903, have been reported along the coasts of New South Wales and redescribed in the present study. Guiler (1954) synonymized *D. decacentrum* with *D. hexacentrum* based on the Tasmanian specimens.

*Dodecas decacentrum* is, however, easily distinguished from *D. hexacentrum*, which coexists along the New South Wales coasts by the following diagnosis: (1) in *D. decacentrum* pereonite 2 possesses a pair of dorsodistal projections in addition to mid-dorsal projections on pereonite 2, while in *D. hexacentrum* the pereonite 2 lacks the dorsodistal ones; (2) in *D. decacentrum* pereonites 3–4 possess a pair of mid-dorsal projections, while in *D. hexacentrum* pereonites 3–4 lack these projections; (3) gills on pereonites 2 and 3 of male *D. decacentrum* are half the length of the corresponding pereonites, whereas those of male *D. hexacentrum* are longer than the corresponding pereonites; (4) in *D. decacentrum* the carpus of pereopods 6 and 7 are elongated with four or five spines along the anterior margin, while in *D. hexacentrum* the carpus of pereopods 6 and 7 lacks anterior spines.

The other five species have been reported so far from Tasmania and sub-Antarctic and Antarctic regions. Especially, *D. grandimanus* Guiler, 1954 and *D. tasmaniensis* Guiler, 1954 were established based on specimens which were collected from off Mountain Creek, Tasmania by Guiler (1954). Guerra-García and Takeuchi (2004) showed the lateral view of a male and a mature female of *D. tasmaniensis* Guiler, 1954 from Tasmania. The male, 9.41 mm in body length, is a little smaller than a mature female, 9.47 mm in body length, in both Guerra-García and Takeuchi (2004). The figure of the male indicates the presence of paired posterodorsal projections on pereonite 1, midlateral projection, paired anteriorly curved mid-dorsal projections, and anteriorly curved dorsodistal projection on pereonite 2 and paired mid-dorsal projections on pereonite 3 (see Guerra-García and Takeuchi 2004, fig. 3A). These characteristics show the close relationship of *D. tasmaniensis* to *D. decacentrum* (Guerra-García and Takeuchi 2004). However, the male specimen of *D. tasmaniensis* might not be a fully grown male, which fits precisely the species diagnosis of the present study, since in *D. decacentrum* and *D. hexacentrum* males grow larger than females (see Figures 1 and 4) similar to *Caprella* (see Takeuchi and Hirano 1991; Nakajima and Takeuchi 2008). Moreover, the lateral figure of a mature female of *D. tasmaniensis* lacks the posterodorsal projections on pereonite 1 and paired

anteriorly curved mid-dorsal projections on pereonite 2 (see Guerra-García and Takeuchi 2004, fig. 3B), while an immature female, 5.22 mm in body length, collected from King George Sound, Western Australia possessed paired anteriorly curved mid-dorsal projections and anteriorly curved dorsodistal projection on pereonite 2, paired mid-dorsal projections and shallow dorsodistal projection on pereonite 3, a mid-dorsal projection on pereonite 4 and a shallow mid-dorsal projection on pereonite 5 (see Guerra-García 2004a, fig. 7). These differences indicate that it is necessary to find fully adult males to clarify the species diagnosis of "*D. tasmaniensis*" collected from off Mountain Creek, Tasmania.

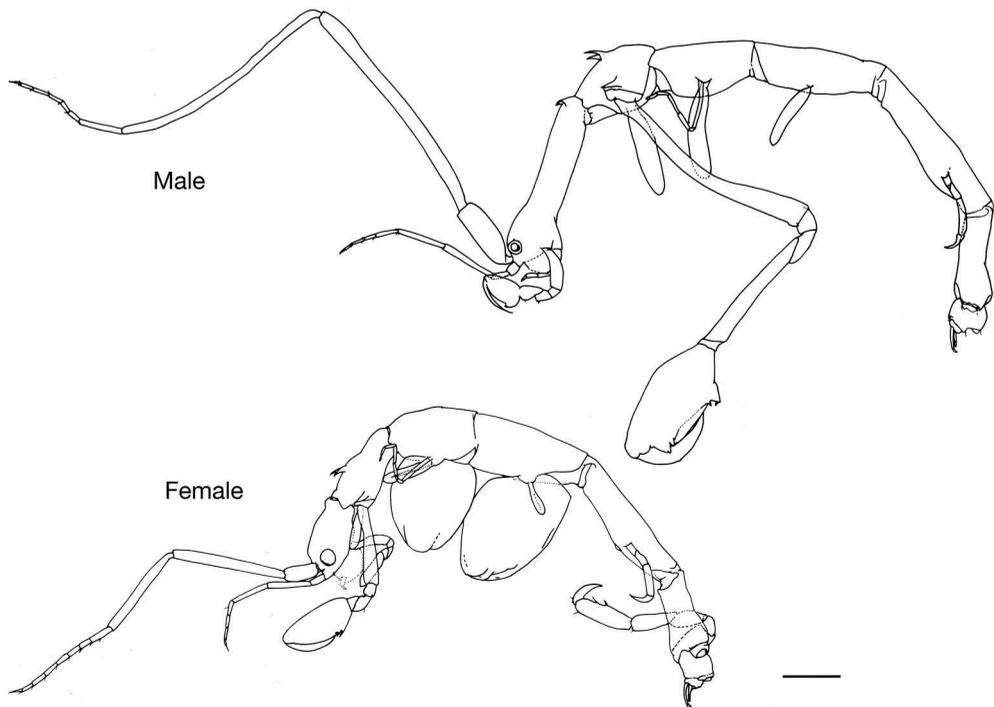
### *Dodecas hexacentrum* Mayer, 1903

(Figures 4–6)

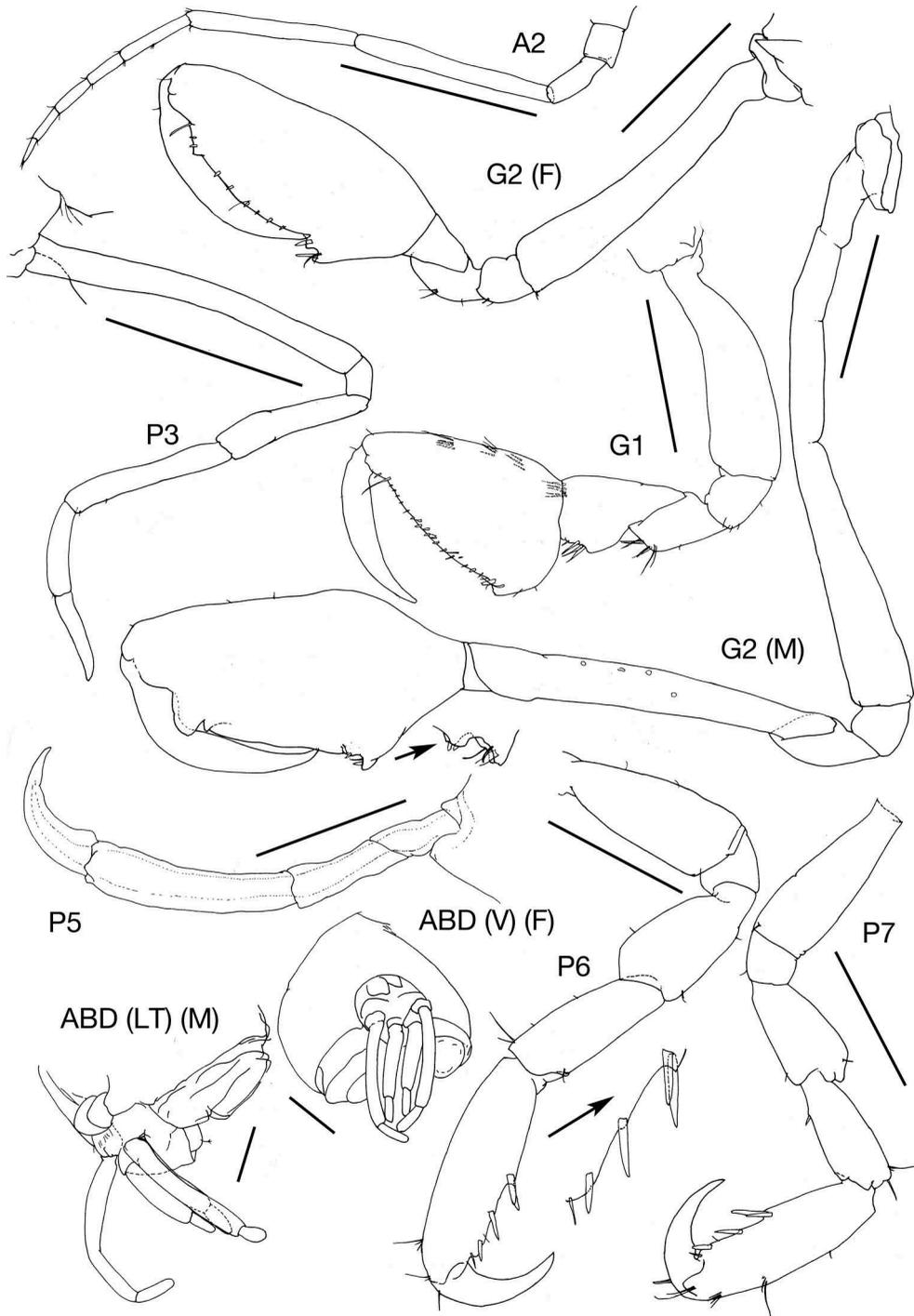
*Dodecas hexacentrum* Mayer, 1903: 29–30, pl. 1, figs 14–15, pl. 6 figs 33–34. – Stebbing, 1910b: 652. – K.H. Barnard, 1932: 306, fig. 169a. – Guiler, 1954: 539–542, figs 8–9. – McCain and Steinberg, 1970: 49. – Lowry and Stoddart, 2003: 35.

#### *Type material*

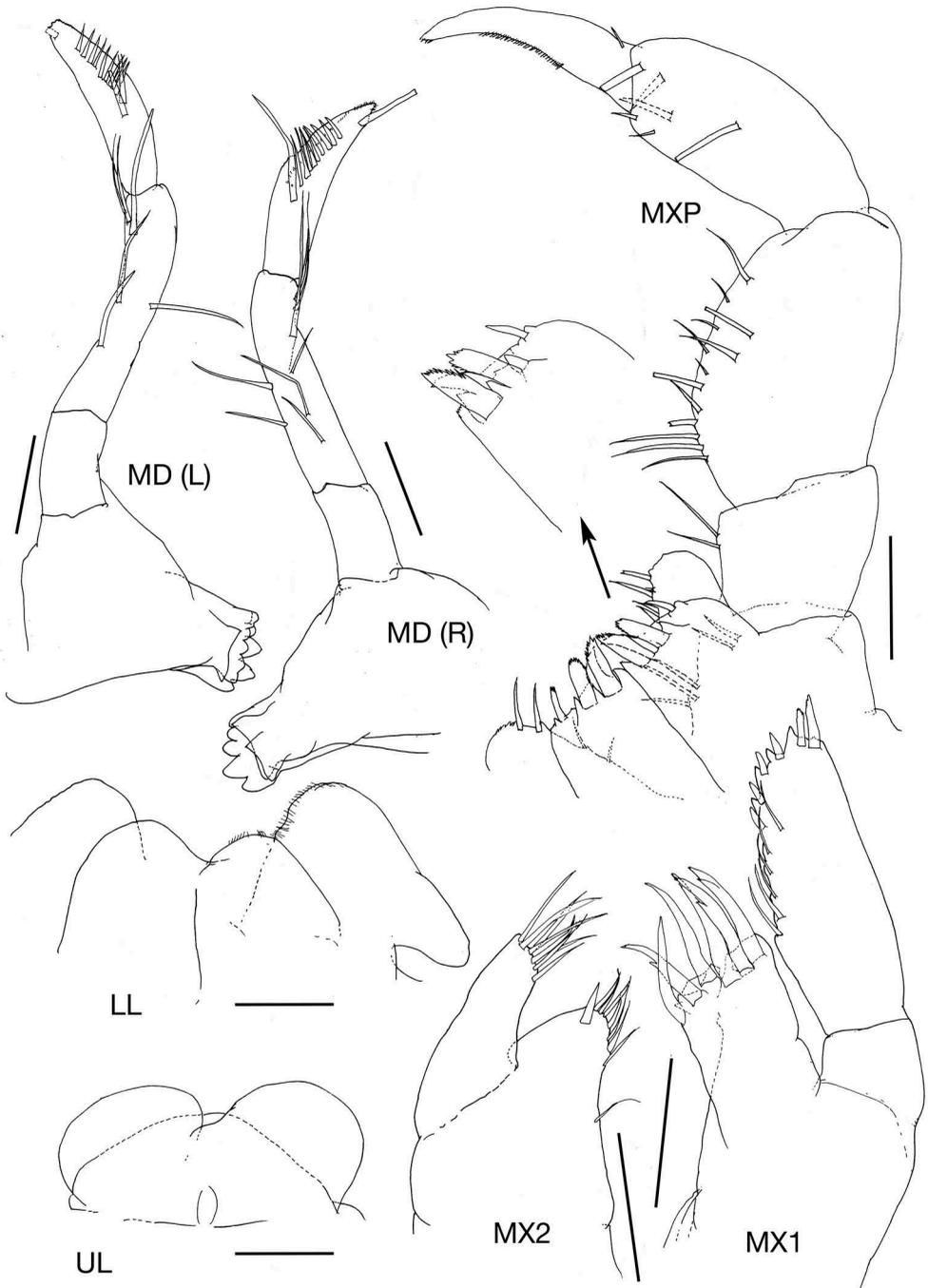
Syntypes. Male "a", AM G2555, 33°50.8'S, 151°60.7'E, off Watsons Bay, Port Jackson, New South Wales, May 1887, host sponge: *Thalassodendrum rubens* Lendenfeld; 2



**Figure 4.** *Dodecas hexacentrum* Mayer, 1903 from Watsons Bay, Port Jackson, New South Wales. Male, syntype, 14.01 mm, AM G2555; B, female, syntype 'b', 10.90 mm, AM P46932. Bar indicates 1.0 mm.



**Figure 5.** *Dodecas hexacentrum* Mayer, 1903 from Watsons Bay, Port Jackson, New South Wales. Male, syntype, 14.01 mm, AM G2555, A2; G1, P3, P5, ABD (LT); female 'b', syntype, 10.90 mm, AM P46932, G2, P6, ABD (V); female 'c', syntype, 5.03 mm, AM P46932, P7. Bars in P7, ABD (LT) (M) and ABD (V) (F) indicate 0.20 mm, those in G1, G2 (M), G2 (F), P3, P5, P6 and P7 indicate 0.50 mm and that in A2 indicates 1.0 mm.



**Figure 6.** *Dodecas hexacentrum* Mayer, 1903 from Watsons Bay, Port Jackson, New South Wales. Male, syntype, 14.01 mm, AM G2555. Bars indicate 0.10 mm.

mature females "b" and "c", AM P46932, 33°50.8'S, 151°60.7'E, off Watsons Bay, Port Jackson, New South Wales, May 1887, host sponge: *Thalassodendrum rubens* Lendenfeld; 7 males, 7 mature females, 1 immature female and 4 juveniles, AM P46933, 33°50.8'S, 151°60.7'E, off Watsons Bay, Port Jackson, New South Wales, May 1887, host sponge: *Thalassodendrum rubens* Lendenfeld; Many individuals, AM P46934, off Watsons Bay, Port Jackson, New South Wales, May 1887, host sponge: *Thalassodendrum rubens* Lendenfeld; 140 individuals, AM P46935, 33°51'S, 151°16'E, off Watsons Bay, Port Jackson, New South Wales, May 1887, host sponge: *Thalassodendrum rubens* Lendenfeld.

### **Additional material examined**

1 mature female, AM G2564, 38°32'S, 145°22'E, Griffiths Point, Victoria; 1 male and 1 female, AM P22827, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 19.8 m depth, 19 February 1973, host sponge: cf. *Teichonella labrinthica*, Australian Museum Shelf Benthic Survey (=AMSBS); 7 males and 9 mature females, AM P22828, 33°49'S, 151°21'E, east of North Head, Port Jackson, New South Wales, 19.8 m depth, 19 February 1973, host sponge: *Holopsamma flavus*, AMSBS; 1 mature female, AM P22829, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 19.8 m depth, 19 February 1973, host: *Chalinissa elegans*; 6 individuals, AM P22831, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 21.3 m depth, 20 February 1973, host: *Polymastrea craticia*, AMSBS; 3 males and 1 mature female, AM P22832, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 21.3 m depth, host: *Chalinissa elegans*, AMSBS; 2 males and 5 juveniles, AM P22833, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 25.9 m depth, 26 February 1973, host sponge: *Polymastrea craticia*, AMSBS; 643 individuals, AM P22834, 33°49'S, 151°20'E, east of North Head, Port Jackson, New South Wales, 25.9 m depth, 26 February 1973, host sponge: *Holopsamma flavus*, AMSBS; 1 male and 1 juvenile, AM P22835, 33°49'S, 151°21'E, east of North Head, Port Jackson, New South Wales, 32.9 m depth, 23 May 1973; 1 male and 1 juvenile, AM P22836, 33°49'S, 151°21'E, east of North Head, Port Jackson, New South Wales, 30.4 m depth, 25 May 1973, AMSBS; 2 males and 2 mature females, AM P22837, 33°50'S, 151°18'E, east of South Head, Port Jackson, New South Wales, 21 m depth, February 1974, host sponge: *Holopsamma flavus*, AMSBS; 1 individual, AM P22838, 33°44'S, 151°20'E, east of Long Reef, New South Wales, 15.2 m depth, 28 April 1972, AMSBS; 2 individuals, AM P22843, 33°49'S, 151°18'E, east of North Head, Port Jackson, New South Wales, 25.9 m depth, 26 February 1974, AMSBS; 1 male, AM P24371, 33°44'S, 151°22'E, east of Long Reef, Sydney, New South Wales, 32 m depth, 28 April 1972, AMSBS; 139 individuals, AM P46944, 33°50'S, 151°18'E, east of South Head, Port Jackson, New South Wales, 21 m depth, February 1974, host sponge: *Holopsamma flavus*, AMSBS.

### **Type locality**

Off Watsons Bay, Port Jackson, New South Wales.

## Other records

New South Wales: East of North Head and east of South Head, Port Jackson, east of Long Reef. Victoria: Griffiths Point.

## Description

Based on male, syntype "a", body length 14.04 mm, AM G2555. *Head and pereonite 1* combined length 3.02 mm; *pereonite 2*, 1.60 mm; *pereonite 3*, 1.78 mm; *pereonite 4*, 2.40 mm; *pereonite 5*, 3.02 mm; *pereonite 6*, 1.78 mm; *pereonite 7*, 0.44 mm.

*Head and pereonites* robust *Head* smooth, rounded dorsally; eye large, protruding; *head/pereonite 1* dorsal margin slightly convex; with anteriorly pointed paired dorsodistal projections.

*Antenna 1* slender; slightly shorter than body length; peduncle articles 2 and 3 subequal in length; peduncular article 3 concave along anterior margin; flagellum  $0.25 \times$  peduncular length, with seven articles; proximal article result of fusion of three articles. *Antenna 2* slender;  $0.33 \times$  antenna 1 length; peduncle without setae; flagellum about  $0.5 \times$  peduncular length, with five articles.

*Upper lip* notched, forming shallow quadrilateral projections. *Mandible* right side incisor with five teeth; lacinia mobilis a reverse trapezoid plate followed by a smaller plate; palp article 2 with eight lateral setae; palp article 3 setal formula 1–9–1; left side incisor with five teeth; lacinia mobilis with five teeth, followed by a trapezoid plate; palp article 2 with six lateral setae; palp article 3 setal formula 1–10–1. *Lower lip* finely setose on inner and outer lobes. *Maxilla 1* outer plate with six stout apical setal-teeth; palp distal margin with five triangular projections, each with one robust seta, with a row of slender setae. *Maxilla 2* inner plate triangular with one apical robust and eight slender setae; outer plate elongate with eight apical setae. *Maxilliped* inner plate (basal endite) quadrilateral, with three stout serriform setae on expanded inner half of distal margin, with one seta on outer half; outer plate (ischial endite) oval,  $0.25 \times$  length of inner plate (basal endite), inner margin smooth, with three or four setae on inner margin; palp article 2 setose on inner margin; palp article 3 not expanded, with six lateral to distal setae; palp article 4 weakly falcate.

**Pereon.** *Pereonite 2* with small anterolateral triangular projection, with midlateral projection, with paired anteriorly curved mid dorsal projections. *Pereonite 5* longest. *Gnathopod 1* propodus triangular, with three rows of submarginal setae near dorsal margin; palm begins  $1/4$  along posterior margin, smooth, with two robust setae (one large and one small) near corner of palm; dactylus curved. *Gnathopod 2* situated in middle of pereonite 2; gill elongate, about  $4 \times$  width,  $1.2 \times$  pereonite length; coxa vestigial; basis  $2.5 \times$  length of pereonite 2; carpus  $1.1 \times$  propodus length; propodus elongate (subrectangular), large, length  $2 \times$  width, anterodistal margin straight; palm proximal projection with three robust (one large and two small) setae, palm margin straight, smooth, with broad well developed distal shelf, with one large and one small projections, without sinus.

*Pereopod 3* very slender; gill length about as long as corresponding pereonite, straight; basis to carpus straight, cylindrical; basis shorter than other pereopod articles; propodus without distal palm and robust setae; dactylus spatulate, not setose. *Pereopod 4* absent. *Gill 4* length about  $1/2 \times$  corresponding pereonite, straight. *Pereopod 5* broad; articulation between articles 1 and 2 oblique; dactylus medium length, falcate, without setae.

**Pleon.** *Pleopod* one pair, tiny. *Uropod* 1; peduncle elongate, about 6–8 × width; ramus about 4–5 × width; ramus 0.35 × peduncular length.

*Female* (sexually dimorphic characters and pereopods 6 and 7). Based on syntype “b”, body length 10.90 mm, AM P46932 and “c”, body length 5.03 mm, AM P46932, for pereopods 6 and 7. Length of *head and pereonite 1* combined 1.20 mm, and each length of *pereonites 2–7*, 1.50 mm, 1.55 mm, 2.10 mm, 2.30 mm, 1.50 mm and 0.55 mm, respectively. Pereonite 1 lacking paired dorsodistal projections. Posterior end of pereonite 1 slightly convex. Pereonite 2 with anterolateral triangular projection, with anteriorly lateral projection, with anteriorly pointed paired mid-dorsal projections. Antenna 1 2/5 × body length. Basis of gnathopod 2 subequal to pereonite 2 length. Propodus oblong, with convex palm. Pereopod 6 with vestigial coxa; basis shorter than propodus; propodus with one pair of robust setae on proximal margin, with two robust setae along palm; dactylus falcate, not setose. *Pereopod* 7 similar to pereopod 6; merus shorter than basis.

### Remarks

See remarks of *Dodecas decacentrum*.

## Genus *Hircella* Mayer, 1882

### Diagnosis

Head fused with pereonite 1. Antenna 1 well developed, flagellum with more than two articles; accessory flagellum absent. Antenna 2 well developed; flagellum with two or three articles. Mandible well developed; molar absent; palp 3-articulate; palp setal formula 0–x–1. Maxilliped well developed; inner plate (basal endite) larger than outer plate (ischial endite); palp article 3 without distal projection; palp article 4 well developed. Pereonite 4 clavate appendage absent. Pereonites 6 and 7 not fused. Pereopod 3 absent. Pereopod 4 absent. Pereopod 5 present with one article. Pereopods 6 and 7 well developed, with seven articles. Gills on pereonites 2 to 4. Pleopods absent. Uropods 2 pairs; uropod 1, uniramous; uropod 2, uniramous. Telson (dorsal lobe) present.

### Type species

*Caprella cornigera* Haswell, 1879b, monotypy.

### Included species

*Hircella* includes three species: *Hircella berentsae* Guerra-García, 2006; *Hircella cornigera* (Haswell, 1879b); *Hircella inermis* Guerra-García and Takeuchi, 2004.

### Remarks

The genus *Hircella* was established specifically for *H. cornigera* (Haswell, 1879b) by Mayer (1903). Recently, Guerra-García and Takeuchi (2004) described the second species of *Hircella*, *H. inermis* Guerra-García and Takeuchi, 2004 from the Tasmanian coast. Mayer (1903) mentioned that pereopod 5 of *Hircella* was completely degenerate, and the diagnosis of Takeuchi (1993) followed his conclusion. Since the type specimen deposited in the Australian Museum is lost (Springthorpe and Lowry 1994), this new diagnosis is

based on recently collected specimens from the Solitary Islands, New South Wales. Observation revealed that pereopod 5 is composed of one tiny article and the number of articles in the flagellum of antenna 2 increases from two to three during growth (see [Figure 10](#)). Hence, the generic diagnosis of the present genus is revised as above.

***Hircella cornigera*** (Haswell, 1879b)  
(Figures 7–10)

*Caprella cornigera* Haswell, 1879b: 4, 347–348, pl. 23, fig. 5. – Haswell, 1882: 313–314.  
*Hircella cornigera*. – Haswell, 1885a: 999. – Mayer, 1890: 16–17, pl. 5, figs 10–11. – Mayer, 1903: 31–32. – Stebbing, 1910b: 652. – McCain and Steinberg, 1970: 51–52. – Lowry and Stoddart, 2003: 35. – Guerra-Garcia, 2006: 425, fig. 12.

**Material examined**

1 male, AM P48627, 30°14.5'S, 153°10.73'E, rocks and coral zone, Split Solitary Island, New South Wales, 8 m depth, hydroids, 5 February 1996; 1 male, AM P48647, 30°19.05'S, 153°09.25'E, Korffs Islet, Solitary Islands, New South Wales, 16 m depth, hydroids, 6 February 1996; 1 male and 1 mature female, AM P48648, 30°19.05'S, 153°09.25'E, Korffs Islet, Solitary Islands, New South Wales, 16 m depth, hydroids, 6 February 1996; 4 males, 3 mature females, 1 premature female, 5 immature females and 2 juveniles, AM P48649, 30°19.05'S, 153°09.25'E, Korffs Islet, Solitary Islands, New South Wales, 16 m depth, hydroids, 6 February 1996; 1 mature female, AM P48654, 30°19.05'S, 153°09.25'E, Korffs Islet, Solitary Islands, New South Wales, 8 m depth, hydroids, 6 February 1996; 2 males and 2 mature females, AM P48660, 29°55.5'S, 153°23.23'E, The Canyons, off North Solitary Island, New South Wales, 6 m depth, hydroids on top of rocks, 8 February 1996; 1 male, AM P48676, 30°18'S, 153°09'E, Corambirra Point, Coffs Harbour, New South Wales, 6 m depth, *Ecklonia radiata* holdfasts, 11 July 1989; 1 male, AM 48742, 35°08.84'S, 150°45.71'E, the base of vertical wall, 1 nautical mile south of Governor Head, out of Jervis Bay, New South Wales, hydroid, 17 m, coll. I. Takeuchi, A. Murray and R.T. Johnson, 28 February 1996; 1 mature female, 1 premature female and 1 juvenile, AM P87329, 30°19.05'S, 153°09.25'E, Korffs Islet, Solitary Islands, New South Wales, 8 m depth, hydroids, 6 February 1996.

**Type locality**

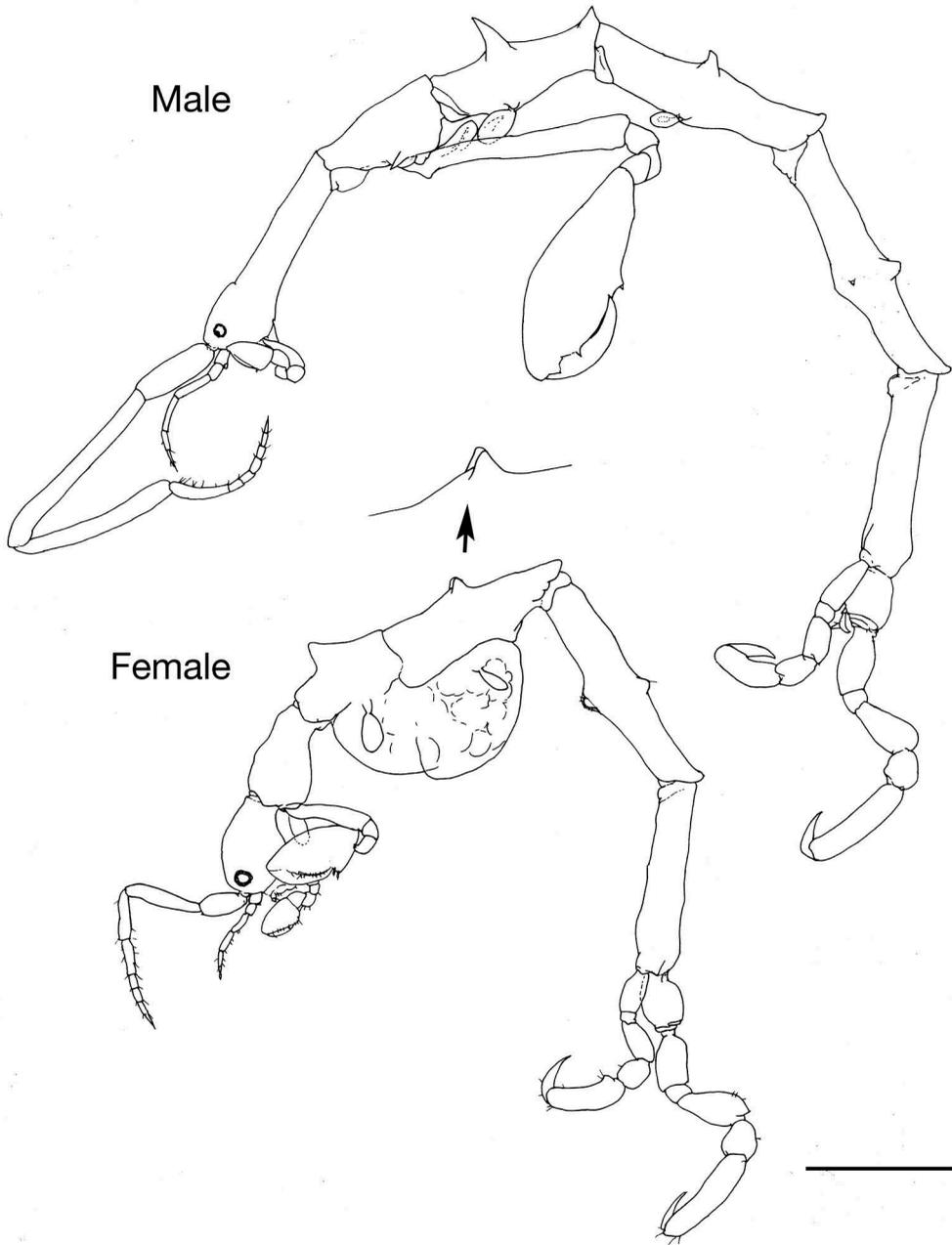
Clark Island, Port Jackson, New South Wales.

**Other records**

New South Wales: Split Solitary Island, Korffs Islet and The Canyons, off North Solitary Island, Solitary Islands, Corambirra Point, Coffs Harbour, and 1 nautical mile south of Governor Head, out of Jervis Bay (this study).

**Description**

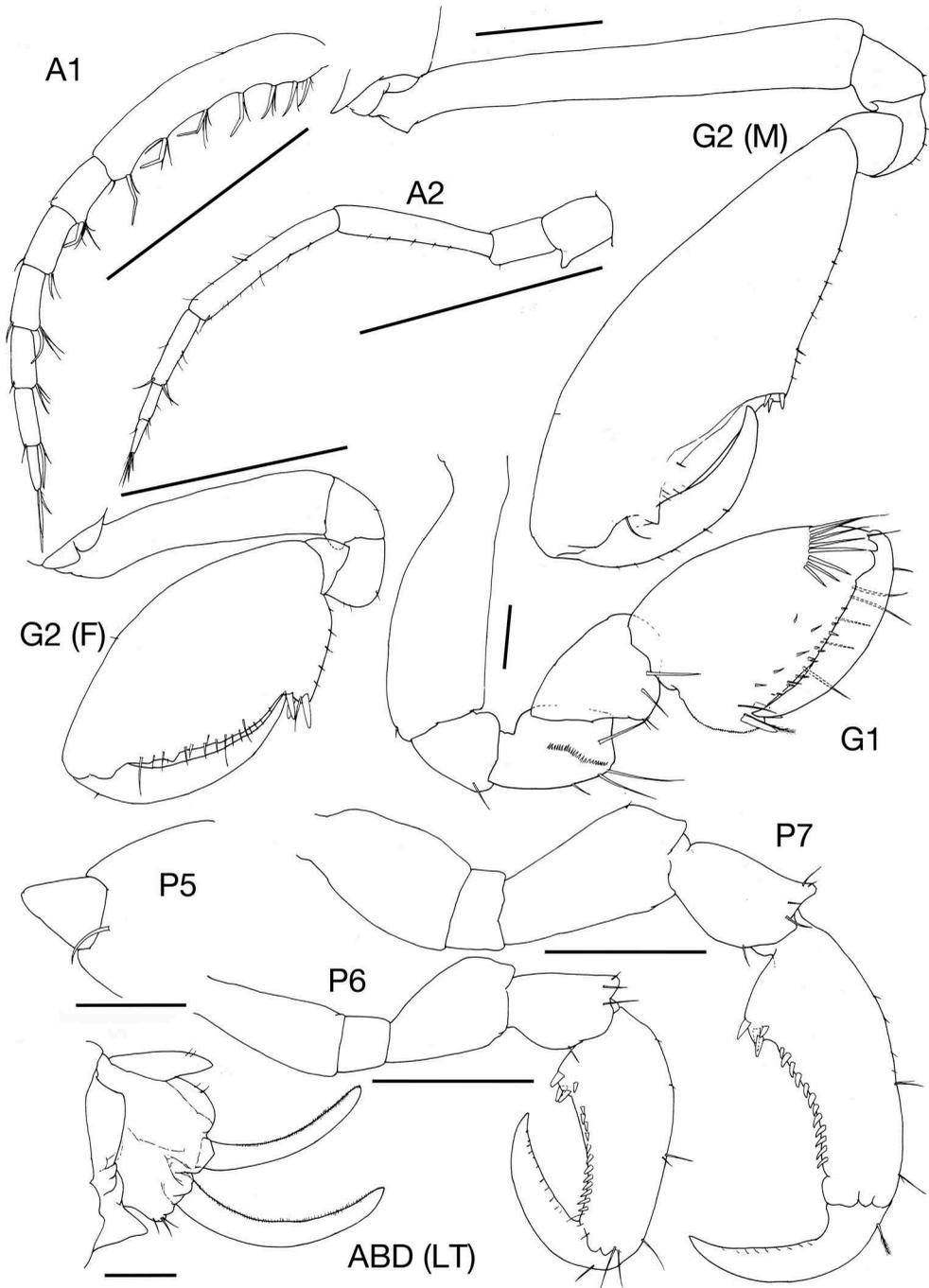
Based on male, body length 11.56 mm, AM P48647. *Head and pereonite 1* combined length 1.97 mm; *pereonite 2*, 1.18 mm; *pereonite 3*, 1.56 mm; *pereonite 4*, 2.18 mm; *pereonite 5*, 2.44 mm; *pereonite 6*, 1.77 mm; *pereonite 7*, 0.46 mm.



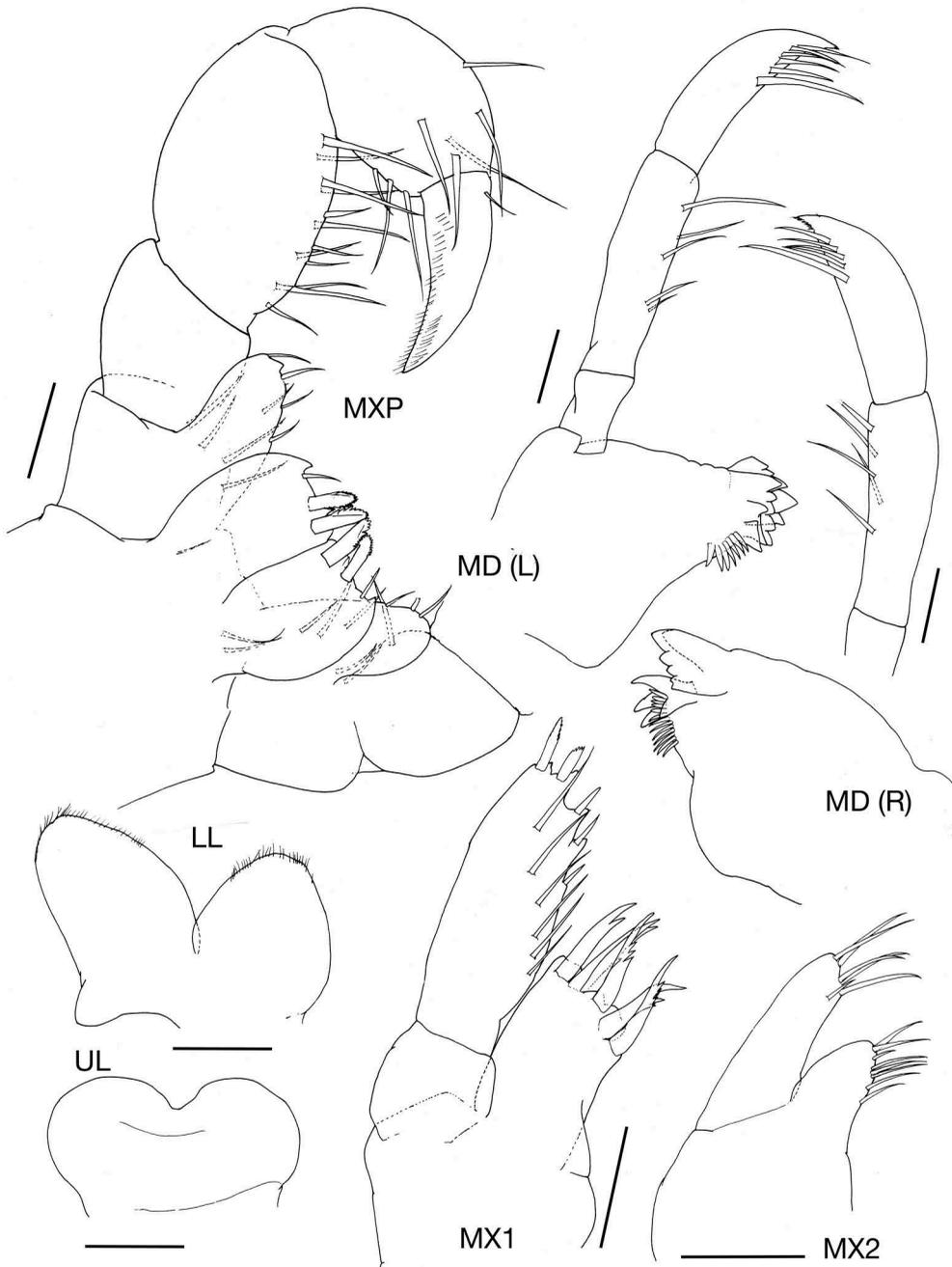
**Figure 7.** *Hircella cornigera* (Haswell, 1879b) from Korffs Islet, Solitary Islands, New South Wales. Male, 11.56 mm, AM P48647; female, 7.07 mm, AM P48654. Bar indicates 1.0 mm.

Head and pereonites slender. Head smooth, rounded dorsally; eye large, distinctive; head/pereonite 1 dorsal margin slightly convex.

*Antenna 1* slender; about  $0.5 \times$  body length; peduncle article 2 longest; peduncular article 3 slightly concave along anterior margin; flagellum  $0.33 \times$  peduncular length, with

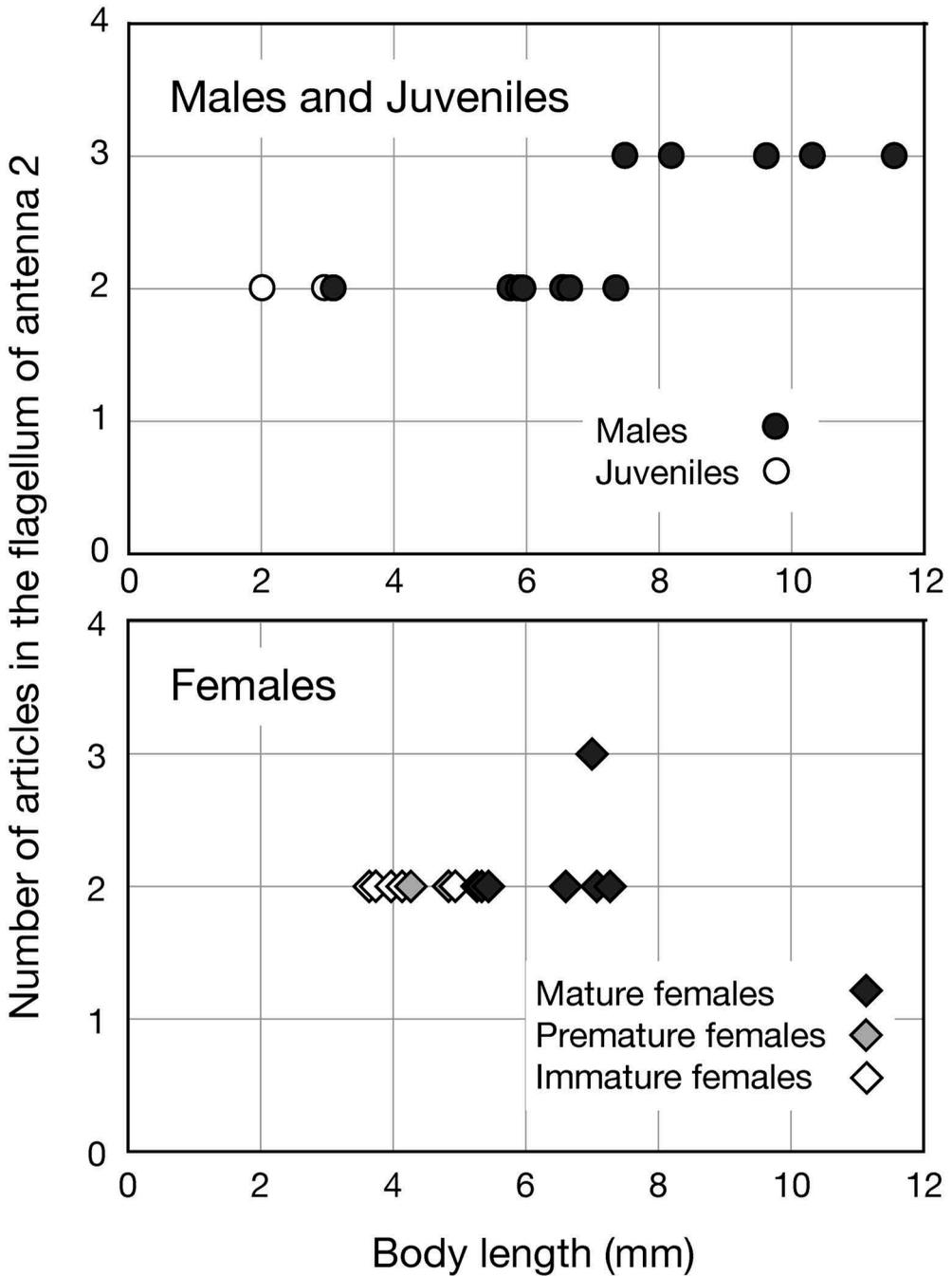


**Figure 8.** *Hircella cornigera* (Haswell, 1879b) from Korffs Islet, Solitary Islands, New South Wales. Male, 11.56 mm, AM P48647, A1, A2, G1, G2, P5, P6, P7, ABD (LT); female, 7.07 mm, AM P48654, G2. Bars in G1, P5 and ABD (LT) indicate 0.10 mm, those in G2 (M), G2 (F), P6 and P7 indicate 0.50 mm.



**Figure 9.** *Hircella cornigera* (Haswell, 1879b) from Korffs Islet, Solitary Islands, New South Wales. Male, 11.56 mm, AM P48647. Bars indicate 0.05 mm.

seven articles; proximal article result of fusion of 5+ articles. *Antenna 2* slender,  $0.25 \times$  antenna 1 length; peduncle with several feeble setae; flagellum  $0.4 \times$  peduncular length, with three articles.



**Figure 10.** *Hircella cornigera* (Haswell, 1879b) from Solitary Islands, Coffs Harbour, and out of Jervis Bay, New South Wales. Number of articles in the flagellum of antenna 2 against the body length.

*Upper lip* notched, forming rounded quadrilateral projections. *Mandible* right side incisor with five teeth; lacinia mobilis with four large teeth followed by accessory setal row with 13 setae; palp article 2 with five distolateral setae; article 3 setal formula 0–4–1; left side incisor with five teeth; lacinia mobilis with five teeth followed by two trapezoid plates; accessory setal row with seven setae; palp article 2 with five distolateral setae; palp article 3 setal formula 0–5–1. *Lower lip* finely setose on inner and outer lobes. *Maxilla 1* outer plate with six stout apical setal-teeth; palp distal margin with five triangular projections, each with one slender or robust seta, a row of slender lateral setae. *Maxilla 2* inner plate triangular with eight apical setae; outer plate elongate with six apical setae. *Maxilliped* inner plate (basal endite) oval, with two stout serriform setae on inner half of distal margin, with one seta on outer half of distal margin; outer plate (ischial endite) oval,  $0.67 \times$  length of inner plate (basal endite), inner margin smooth, with four setae on inner margin; palp article 2 setose on inner margin; palp article 3 with eight distal setae; palp article 4 weakly falcate.

**Pereon.** *Pereonite 2* with small antero-lateral projection, with mid-lateral projection. *Pereonite 3* with small antero-lateral projection, with paired mid-dorsal projections, with triangular dorsodistal projection. *Pereonite 4* with paired small mid-dorsal projections, with small dorsodistal projection. *Pereonite 5* longest, with paired mid-dorsal to dorso-distal projections, with small dorsodistal projection.

*Gnathopod 1* propodus triangular, with a row of submarginal setae on distal part (near anterior margin); palm begins about  $1/3$  along posterior margin, smooth, with two robust setae (one large and one small) near corner of palm; dactylus curved. *Gnathopod 2* situated in middle of pereonite 2; gill length about  $3 \times$  width, about  $1/2 \times$  pereonite length; coxa vestigial; basis  $1.5 \times$  length of pereonite 2, with small projection near proximal margin; carpus  $0.13 \times$  propodus length; propodus elongate (subrectangular), large, length  $3 \times$  width, anterodistal margin convex; palm proximal projection with three robust (one large and two small) setae, palm margin almost straight, smooth, with narrow well developed distal shelf.

*Gill 3* length about  $1/4 \times$  corresponding pereonite, straight. *Gill 4* length about  $1/8 \times$  corresponding pereonite, straight. *Pereopod 5* tiny, conical. *Pereopod 6* basis shorter than propodus; carpus with four setae on anterior margin; propodus with four robust setae on posterior margin, with 12 robust setae along palm; dactylus curved, not setose. *Pereopod 7* similar to pereopod 6; merus subequal in length to basis.

**Pleon.** *Uropod 1* uniaarticulate, uniramous; peduncle fused to abdomen; ramus length about  $6\text{--}8 \times$  width. *Uropod 2* similar to uropod 1.

*Female* (sexually dimorphic characters). Based on female, body length 7.07 mm, AM P 48654. Length of *head and pereonite 1* combined 0.69 mm, and *pereonites 2–7*, 0.82 mm, 0.78 mm, 1.46 mm, 1.62 mm, 1.39 mm and 0.31 mm, respectively. Head/ pereonite 1 dorsal margin straight. *Antenna 1*  $0.33 \times$  body length; flagellum  $0.5 \times$  peduncular length, with five articles. *Antenna 2*, flagellum with two articles. Basis of *gnathopod 2*  $0.8 \times$  pereonite 2 length; propodus oblong, with convex palm. *Pereonite 3* with anterolateral projections and paired mid-dorsal projections. *Gill 3* length about  $1/3 \times$  corresponding pereonite. *Gill 4* length about  $1/5 \times$  corresponding pereonite. Pereopod 5 lacking.

## Remarks

Mayer (1882) established the genus *Hircella* based on the single species, *Caprella cornigera* Haswell, 1879b, which was collected from Clark Island, situated in the middle of Port Jackson. The type specimens are lost (Springthorpe and Lowry 1994). The field survey during 1995/96 as well as the survey of the deposited specimens at the Australian Museum failed to find *H. cornigera* from Port Jackson. However, *H. cornigera* was found from Split Solitary Island, Korff's Islet, and North Solitary Island, the Solitary Islands, Corambirra Point, Coffs Harbour, and south of Governor Head, out of Jervis Bay, New South Wales. In addition to the coast of New South Wales, *H. cornigera* was recorded from North Stradbroke Island, which is situated near the southern border of Queensland (Guerra-García 2006). These indicate that *H. cornigera* is still distributed widely along the east coast from Jervis Bay, the New South Wales to North Stradbroke Island, Queensland facing the Pacific Ocean, while the species seems to have disappeared from Port Jackson and the inner parts of Jervis Bay. Hence, in the present study, a mature male and a mature female collected from the Solitary Islands have been described in detail.

Close observation of the present specimens shows that article numbers in the flagellum of antenna 2 increase from two to three during growth (Figure 10). Of the 11 males measured, all males larger than 7.4 mm in body length possess a 3-articulate flagellum. Of females, most have two articles in the flagellum, but the third largest mature female has three articles in the flagellum.

In addition to *H. cornigera*, two additional species of *Hircella* have been recorded recently; *H. inermis* Guerra-García and Takeuchi, 2004 from Tasmania and Western Australia (Guerra-García and Takeuchi 2004; Guerra-García 2004a) and *H. berentsae* Guerra-García, 2006 from North Stradbroke Island, Queensland (Guerra-García 2006). The present species, *H. cornigera*, is clearly distinguished from *H. inermis* and *H. berentsae* by the projections on pereonites 2 to 5. *Hircella cornigera* possesses mid-lateral projection on pereonite 2, mid-dorsal projections on pereonites 3 to 5 and dorsodistal projection on pereonites 3 and 5. Both *H. inermis* and *H. berentsae* lack projections on the corresponding pereonites.

## Genus *Metaproto* Mayer, 1903

### Diagnosis

Head fused with pereonite 1. Antenna 1 well developed; flagellum with more than two articles; accessory flagellum absent. Antenna 2 well developed; flagellum with more than three articles. Mandible well developed; molar absent; palp 3-articulate; palp setal formula 1-x-y-1. Maxilliped well developed; inner plate (basal endite) subequal to outer plate (ischial endite); outer plate (ischial endite) well developed; palp article 3 not expanded; palp article 4 well developed. Pereonite 4 clavate appendage absent. Pereonites 6 and 7 not fused. Pereopod 3 well developed, with seven articles. Pereopod 4 well developed, with seven articles. Pereopod 5 present, with five articles. Pereopods 6 and 7 well developed, with seven articles. Gills on pereonites 2 to 4. Pleopods absent. Uropods 1 pairs; uropod 1, uniramous. Telson (dorsal lobe) present.

### Included species

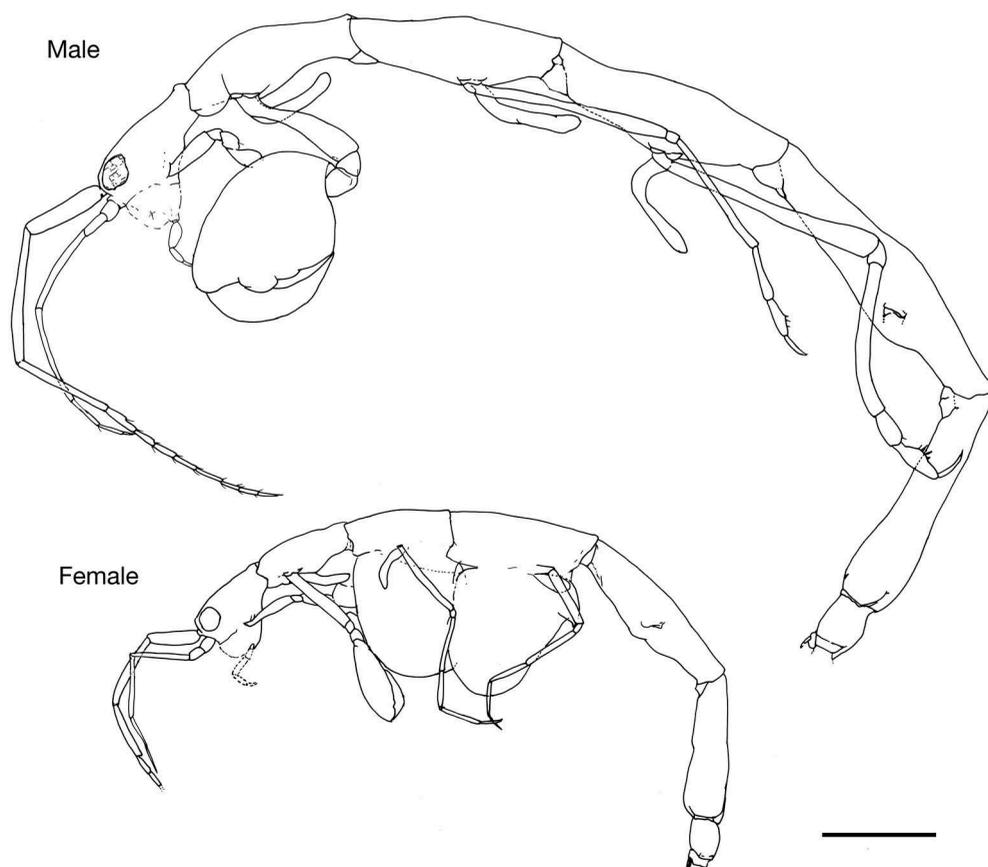
*Metaproto* includes one species: *Metaproto novaehollandiae* (Haswell, 1879a).

### Remarks

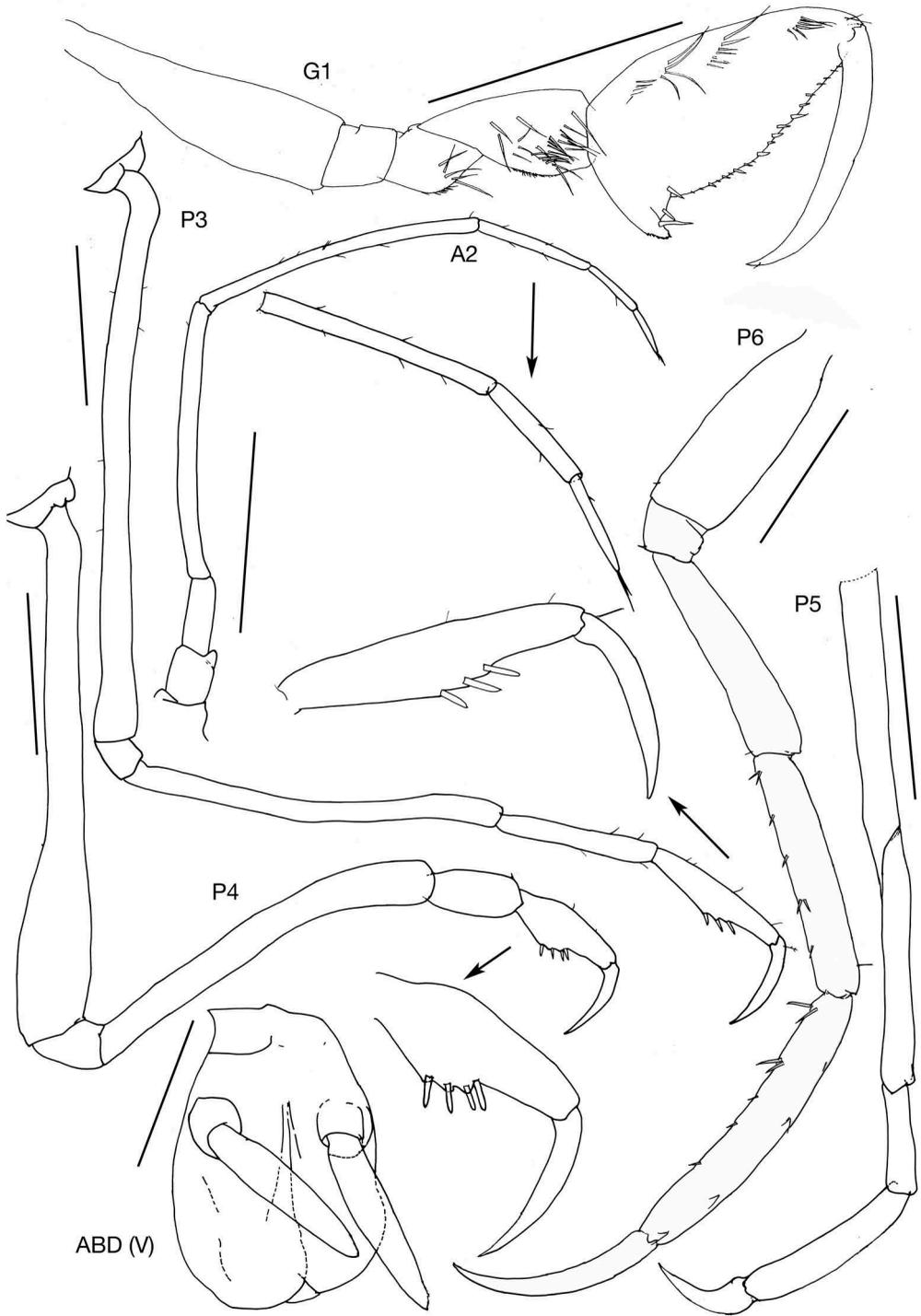
The genus *Metaproto* was established specifically for *M. novaehollandiae* (Haswell, 1879a) by Mayer (1903). The generic diagnosis of the present genus is provided based on the present description of *M. novaehollandiae* (Haswell, 1879a).

### *Metaproto novaehollandiae* (Haswell, 1879a) (Figures 11–16)

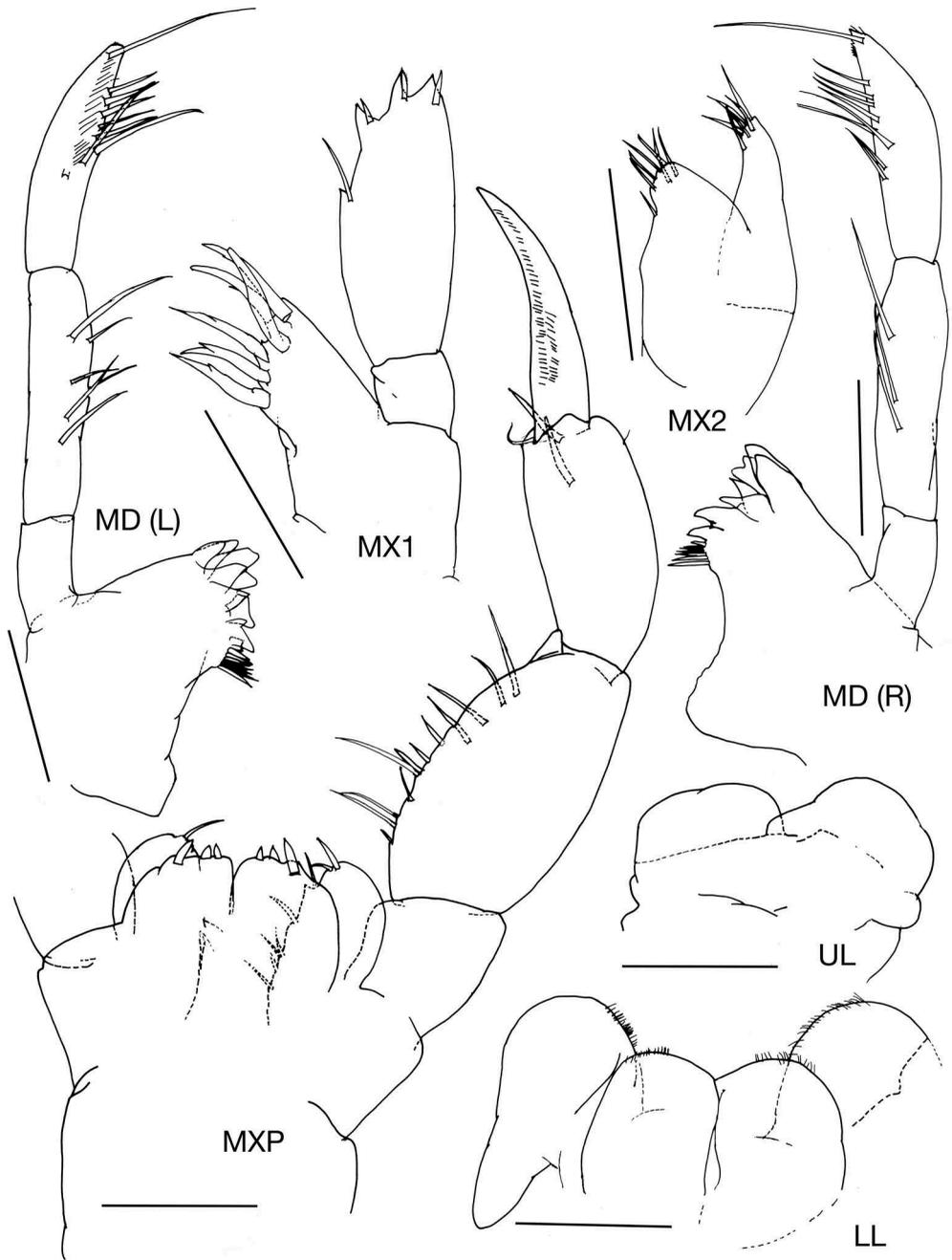
*Proto Novae-Hollandiae* Haswell, 1879a: 275–276, pl. 12 fig. 3. – Haswell, 1882: 310–311. – Mayer, 1882: 26. – Haswell, 1885b: 111–112, pl. 18, figs 13–16. – Mayer, 1890: 14–15. *Proto novae-hollandiae*. – Stebbing, 1888: 1230–1232. – Stebbing, 1910a: 470. – Stebbing, 1910b: 651–652.



**Figure 11.** *Metaproto novaehollandiae* (Haswell, 1879a) from Port Jackson, New South Wales. Male, syntype, 10.68 mm, AM P46915; female, syntype, 6.06 mm, AM P87331. Bar indicates 1.0 mm.

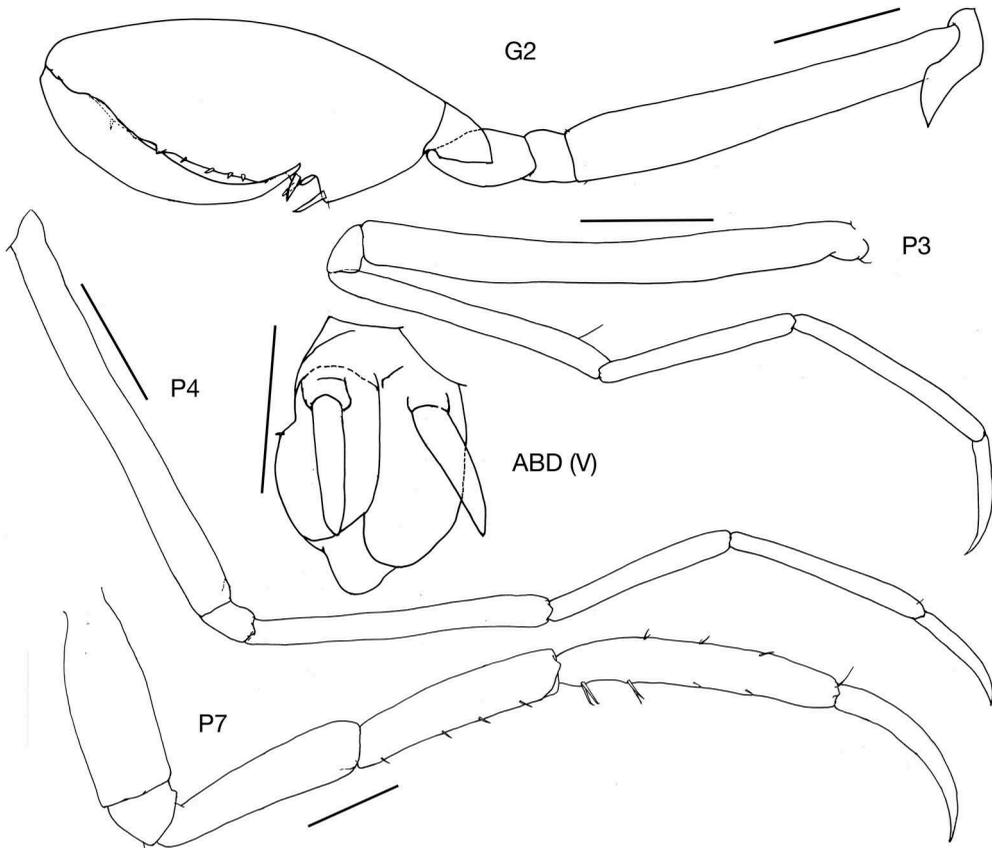


**Figure 12.** *Metaproto novaehollandiae* (Haswell, 1879a) from Port Jackson and Botany Bay, New South Wales. Male, syntype, 10.68 mm, AM P46915, A2, P3, P4, P5, ABD (V); male, 9.12 mm, AM P85982, P6. Bar in ABD (V) indicates 0.10 mm and those in A2, P3, P4, P5 and P6 indicate 0.50 mm.



**Figure 13.** *Metaproto novaehollandiae* (Haswell, 1879a) from Port Jackson, New South Wales. Male, syntype, 10.68 mm, P 46915. Bars indicate 0.10 mm.

*Metaproto Novae-Hollandiae*. – Mayer, 1903: 26–28, pl. 1 figs 11–12, pl. 6 figs 24–28, pl. 9 figs 3, 50.



**Figure 14.** *Metaprote novaehollandiae* (Haswell, 1879a) from Port Jackson and Botany Bay, New South Wales. Female, syntype, 6.06 mm, AM P87331, G2, P3, P4, ABD (V); female, 4.83 mm, AM P85984, P7. Bar in ABD (V) indicates 0.10 mm and those in G2, P3, P4 and P7 indicate 0.20 mm.

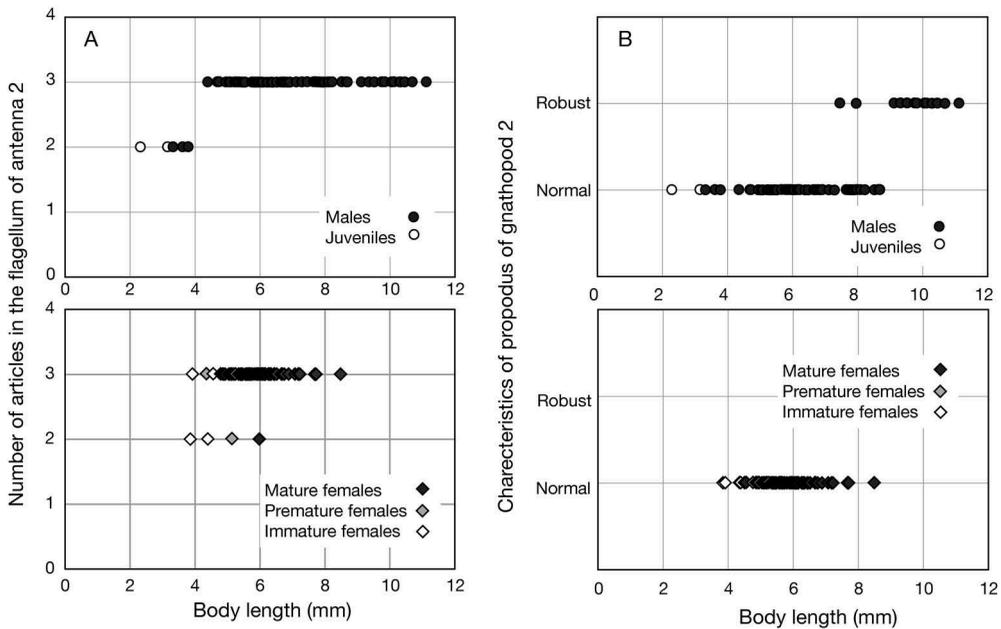
*Metaprote novaehollandiae*. – McCain and Steinberg, 1970: 56. – Lowry and Stoddart, 2003: 36 (in part).

### **Type material**

Syntypes: 1 male, AM G2566, 33°51'S, 151°16'E, Port Jackson, New South Wales; 1 male, AM P3387, 33°51'S, 151°16'E, Port Jackson, New South Wales; about 20 specimens, AM P3388, 33°51'S, 151°16'E, Port Jackson, New South Wales; 1 male, AM P46915, 33°51'S, 151°16'E, Port Jackson, New South Wales; 1 mature female, AM P87331, 33°51'S, 151°16'E, Port Jackson, New South Wales.

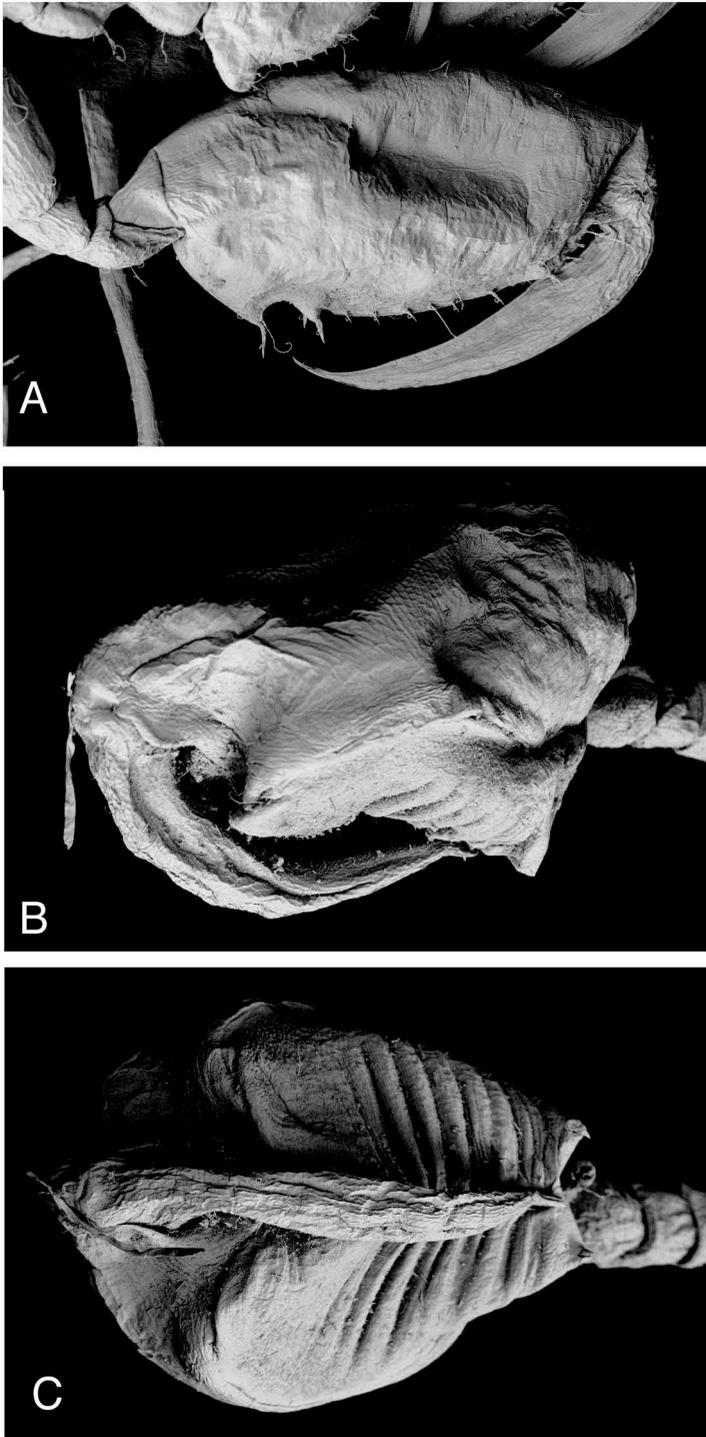
### **Additional material examined**

1 male, AM G930, 35°03'S, 150°44'E, Jervis Bay, New South Wales; 17 males and 5 females, AM P46914, 33°51'S, 151°16'E, Port Jackson, New South Wales; 2 males and 1 immature female, AM P47835, 33°58.27'S, 151°09.91'E, northwest Botany Bay, New South Wales, Stn 13, 3.4 m depth, sand (11–20%), 22 November 1976, NSW State Pollution



**Figure 15.** *Metaprote novaehollandiae* (Haswell, 1879a) from Botany Bay, New South Wales. (A) Number of articles in the flagellum of antenna 2 against the body length. (B) Ontogenetic change of propodus of gnathopod 2, i.e., normal type to robust type (see Figure 16) against the body length.

Control Commission (NSWSPCC); 1 premature female, AM P47836, 33°57.80'S, 151°09.51'E, northeast Botany Bay, New South Wales, Stn 24, 3.0 m depth, slightly muddy sand (11–20%), 3 December 1976, NSWSPCC; 1 immature female, AM P47837, 33°58.34'S, 151°10.23'E, northeast Botany Bay, New South Wales, Stn 26, 7.0 m depth, slightly muddy sand (51–70%), 3 December 1976, NSWSPCC; 6 males, 3 mature females, 1 premature females, 2 immature females and 1 juvenile, AM P47838, 33°58.64'S, 151°12.47'E, northeast Botany Bay, New South Wales, Stn 28, 7.5 m depth, mud (51–70%), 7 December 1976, NSWSPCC; 11 males, 2 mature females and 1 immature female, AM P47839, 33°58.64'S, 151°12.47'E, northeast Botany Bay, New South Wales, Stn 28, 7.5 m depth, slightly muddy sand (51–70%), 7 December 1976, NSWSPCC; 12 males, 5 mature females and 2 premature females, AM P47840, 33°58.65'S, 151°12.36'E, northeast Botany Bay, New South Wales, Stn 29, 7.5 m depth, mud (51–70%), 7 December 1976, NSWSPCC; 8 males, 9 mature females and 1 immature female, 33°58.74'S, 151°12.50'E, AM P47841, northeast Botany Bay, New South Wales, Stn 35, 7.5 m depth, mud (21–30%), 12 December 1976, NSWSPCC; 23 males, 15 mature females and 2 premature females, AM P47842, northeast Botany Bay, New South Wales, 33°58.86'S, 151°12.38'E, Stn 36, 7.6 m depth, mud (51–70%), 13 December 1976, NSWSPCC; 3 mature females, AM P47843, 33°58.78'S, 151°12.27'E, northeast Botany Bay, New South Wales, Stn 37, 8.0 m depth, mud (31–50%), 13 December 1976, NSWSPCC; 1 male, AM P47844, 33°58.41'S, 151°11.9'E, northeast Botany Bay, New South Wales, Stn 40, 7.0 m depth, muddy sand (31–50%), 13 December 1976, NSWSPCC; 6 males, 3 mature females and 2 immature females, AM P47845, 33°58.95'S, 151°12.30'E, northeast Botany Bay, New South Wales, Stn



**Figure 16.** Scanning electron microscopy (SEM) observation on ontogenetic change of gnathopod 2 in *Metaproteo novaehollandiae* (Haswell, 1879a) from Botany Bay, New South Wales. (A) Normal type of propodus of gnathopod 2 of a male, 5.06 mm, AM P84634. (B) and (C) Robust type of propodus of gnathopod 2 of a male, 9.57 mm, AM P84638. Since the SEM photos were taken at the Australian Museum after 36 years from the collection, lateral parts of propodus and dactylus of both individuals might be shrunken.

41, 8.0 m depth, mud (51–70%), 20 December 1976, NSWSPCC; 6 males, 7 mature females and 1 juvenile, AM P47846, 33°58.98'S, 151°12.44'E, northeast Botany Bay, New South Wales, Stn 42, 8.0 m depth, mud (51–70%), 20 December 1976, NSWSPCC; 1 mature female, AM P47847, 33°58.45'S 151°10.33'E, northwest Botany Bay, New South Wales, Stn 46, 6.7 m depth, mud (51–70%), 6 January 1971, NSWSPCC; 1 male, AM P47848, 33°58.37'S, 151°10.79'E, northeast Botany Bay, New South Wales, Stn 47, 5.0 m depth, sand (0–10%), 11 January 1977, NSWSPCC; 1 male, AM P47849, 33°59.15'S, 151°09.27'E, east of Ramgate, Botany Bay, New South Wales, Stn 48, 4.5 m depth, mud (71–90%), 11 January 1977, NSWSPCC; 5 males, 7 mature females, AM P47851, 34°00.11'S, 151°12.85'E, east Botany Bay, New South Wales, Stn 65, 5.0 m, depth, muddy sand (31–50% mud), 24 February 1977, NSWSPCC; 4 males and 10 mature females, AM P47852, 33°59.30'S, 151°2.64'E, east Botany Bay, New South Wales, Stn 81, 19.2 m, depth, muddy sand (31–50% mud), 2 February 1977, NSWSPCC; 1 male, AM P47854, 33°59.99'S, 151°12.02'E, east Botany Bay, New South Wales, Stn 84, 4.5 m, depth, sand (0–10% mud), 2 February 1977, NSWSPCC; 2 males, 2 mature females, 3 premature females, 1 immature female and 2 juveniles, AM P47855, 34°00.03'S, 151°12.30'E, east Botany Bay, New South Wales, Stn 85, 5.0 m, depth, sand (0–10% mud), 2 February 1977, NSWSPCC; 2 males and 1 mature female, AM P47856, 33°59.58'S, 151°12.93'E, east Botany Bay, New South Wales, Stn 86, 19.2 m, depth, muddy sand (21–30% mud), 4 February 1977, NSWSPCC; 4 males, AM P47857, 33°59.37'S, 151°12.75'E, east Botany Bay, New South Wales, Stn 88, 19.2 m, depth, muddy sand (31–50% mud), 4 February 1977, NSWSPCC; 2 males and 1 mature female, AM P47858, 33°59.52'S, 151°12.55'E, east Botany Bay, New South Wales, Stn 96, 12.8 m, depth, muddy sand (31–50% mud), 10 March 1977, NSWSPCC; 1 male, P84635 (SEM pin MI354), 33°58.64'S, 151°12.47'E, northeast Botany Bay, New South Wales, Stn 28, 7.5 m depth, slightly muddy sand (51–70%), 7 December 1976, NSWSPCC; 1 male P84636 (SEM pin MI355), 33°58.64'S, 151°12.47'E, northeast Botany Bay, New South Wales, Stn 28, 7.5 m depth, slightly muddy sand (51–70%), 7 December 1976, NSWSPCC; 1 male, P84637 (SEM pin MI353), 33°58.65'S, 151°12.36'E, northeast Botany Bay, New South Wales, Stn 29, 7.5 m depth, mud (51–70%), 7 December 1976, NSWSPCC; 1 male, P84638 (SEM pins MI357 and MI358), 33°58.65'S, 151°12.36'E, northeast Botany Bay, New South Wales, Stn 29, 7.5 m depth, mud (51–70%), 7 December 1976, NSWSPCC; 1 mature female, AM P84639 (SEM pin MI356), 33°58.65'S, 151°12.36'E, northeast Botany Bay, New South Wales, Stn 29, 7.5 m depth, mud (51–70%), 7 December 1976, NSWSPCC; 1 male, P85982, 33°59.30'S, 151°2.64'E, east Botany Bay, New South Wales, Stn 81, 19.2 m, depth, muddy sand (31–50% mud), 2 February 1977, NSWSPCC; 3 males, P85983, 33°59.30'S, 151°2.64'E, east Botany Bay, New South Wales, Stn 81, 19.2 m, depth, muddy sand (31–50% mud), 2 February 1977, NSWSPCC; 1 mature female, P85985, 33°59.30'S, 151°2.64'E, east Botany Bay, New South Wales, Stn 81, 19.2 m, depth, muddy sand (31–50% mud), 2 February 1977, NSWSPCC.

### *Type locality*

Port Jackson, New South Wales (33°51'S, 151°16'E).

## Other records

New South Wales: Jervis Bay and Botany Bay, New South Wales. Queensland: North Stradbroke Island (Guerra-García 2006).

## Description

Based on male, body length 10.68 mm, AM P46915 and male, 9.12 mm, AM P85982, for pereopod 6. *Head and pereonite 1* combined length 1.00 mm; *pereonite 2*, 1.35 mm; *pereonite 3*, 1.65 mm; *pereonite 4*, 1.88 mm; *pereonite 5*, 2.44 mm; *pereonite 6*, 1.91 mm; *pereonite 7*, 0.44 mm.

*Head and pereonites* slender. *Head* smooth, not rounded dorsally; eye large, distinctive; head/pereonite 1 slightly concave along dorsal margin; with weak dorsodistal projection.

*Antenna 1* slender;  $0.4 \times$  body length; peduncle article 2 longest; peduncular article 3 straight; flagellum  $0.4 \times$  peduncular length, with eight articles; proximal article result of fusion of two articles. *Antenna 2* slender;  $0.5 \times$  antenna 1 length; peduncle with several feeble setae; flagellum about  $0.25 \times$  peduncular length, with three articles.

*Upper lip* notched, forming shallow quadrilateral projections. *Mandible* right side incisor with five teeth; lacinia mobilis with four large teeth; accessory setal row with seven setae; palp article 2 with three setae; palp article 3 setal formula 1–7–1–0; left side incisor with six teeth; lacinia mobilis with two reverse-trapezoid plates; accessory setal row with one bundled seta and seven setae; palp article 2 with six lateral setae; palp article 3 setal formula 1–5–1–1. *Lower lip* finely setose on inner and outer lobes. *Maxilla 1* outer plate with six stout apical setal-teeth; palp distal margin with four triangular projections, each with one slender seta. *Maxilla 2* inner plate triangular with seven apical robust setae; outer plate elongate with five apical setae. *Maxilliped* inner plate (basal endite) round, with one large and two small nodular setae; outer plate (ischial endite) oval, subequal to inner plate (basal endite), with seven setae on inner margin; palp article 2 scarcely setose on inner margin; palp article 3 not expanded, four distal setae; palp article 4 falcate.

**Pereon.** *Pereonite 2* with weak anterior lateral projection; *pereonite 5* longest.

*Gnathopod 1* carpus and propodus setose; propodus triangular, with four rows of submarginal setae distally; palm begins about  $1/3$  along posterior margin, smooth, with three robust setae (one large and two small) near corner of palm; dactylus curved. *Gnathopod 2* begins  $0.3$  along anterior margin; gill elongate, about  $6 \times$  width, about  $2/3 \times$  pereonite length; coxa vestigial; basis  $0.7 \times$  pereonite length; carpus  $0.1 \times$  propodus length; propodus subovate, massive, length  $1.5 \times$  width, anterodistal margin convex; palm proximal projection with three robust (one large and two small) setae, palm margin convex, crumpled, with broad well developed distal shelf.

*Pereopod 3* very slender; gill length about  $2/3 \times$  corresponding pereonite, basal part curved posteriorly; basis to carpus straight, cylindrical; basis longer than other pereopod articles,  $2/5 \times$  pereopod length; propodus with well developed distal palm; palm with three robust setae near palmar corner; dactylus falcate. *Pereopod 4* very slender; shorter than pereopod 3; gill length about  $1/2 \times$  pereonite length, middle part curved posteriorly; basis slightly expanded distally; merus posterior margin concave; propodus palm expanded  $1/3$  from the proximal end; palm with four robust setae guarding corner.

*Pereopod 5* slender; articulation between articles 1 and 2 oblique; dactylus medium length, falcate, without setae. *Pereopod 6* propodus longest followed by basis, merus and carpus; carpus setose on inner margin; propodus with two pairs of setae on posterior margin, with three robust setae along palm; dactylus falcate.

**Pleon.** *Uropod 1*, peduncle, very short, about 2/3 width; ramus length about 4–5 × width, 4 × peduncular length.

*Female* (sexually dimorphic characters). Based on female, body length, 6.06 mm, AM P87331 and female, 4.83 mm, AM P85984, for pereopod 7. Length of *head and pereonite 1* combined length 0.67 mm, and *pereonites 2–7*, 0.73 mm, 0.64 mm, 1.15 mm, 1.42 mm, 1.12 mm and 0.32 mm, respectively. *Gnathopod 2* carpus 0.14 × propodus length; propodus elongate (subrectangular), 2.6 × width; palm margin straight, smooth, without distal shelf, with one small triangular projection distally, with tiny midpalmar projection. *Pereopods 3–4* propodus without distal palm and robust setae. *Pereopod 7* similar to male pereopod 7.

### Remarks

The syntypes of the present species deposited in the Australian Museum consisted of three samples, registered as P3387, P3388 and G2556. Although the sample registered as P3388 contains about 20 specimens, all specimens except for two dissected ones, were once dried up. A male and a mature female from the sample registered as P3387 were redescribed and illustrated for the present study under the new register numbers of AM P46915 and AM P87331.

The morphology of gnathopod 2 of larger males is unique within the Phtisicidae. The macrobenthic infaunal survey of Botany Bay by NSWSPCC during 1976 to 1977 contained about 200 individuals of *M. novaehollandiae* which were originally identified as "*Metaproto haswelliana*" in the catalogue of the Australian Museum and this named species was listed in the project studying effects of dredging on the macrobenthic infauna of Botany Bay (Jones and Candy 1981). Close examination of these individuals from Botany Bay shows the morphological development of gnathopod 2 during growth (Figures 15 and 16). In males smaller than 9.0 mm in body length and in the females of all stages, the characteristics of the propodus are typical of the family. In smaller males, the palm between the grasping robust setae followed by two smaller subgrasping robust setae and the distal end is slightly convex with no crumpled parts near the palm (Figure 16). The features of the propodus in females are similar to those of smaller males, but in mature males larger than around 8.0 mm body length, the propodus of the gnathopod 2 becomes massive. The widest part of the palm is about 2/3 the length of the palm; the lateral part of the propodus is extended into a curving edge covering about 2/3 of the lateral side of the palm and the lateral part between the curving edge and the palm forms several crumpled lines (Figure 16). The morphology of the propodus of gnathopod 2 is likely to change largely in just one moult.

In addition to this unique sexual dimorphism in gnathopod 2, in males, the propodus of pereopods 3 and 4 carries three to four robust setae on the middle of the shallow convex palm, while females have a straight palmar face on the propodus of the pereopods.

As in *Hircella cornigera* (Haswell, 1879b), article numbers in the flagellum of antenna 2 increase from two to three during growth (Figure 15). In males collected from Botany Bay by NSWSPCC, all males larger than 4.0 mm in body length possess a 3-articulate flagellum, while in females article numbers increase from two to three at around 4–6 mm in body length.

In addition to New South Wales, Australia, *Metaproto novaehollandiae* has been reported from tropical areas of the Indo-Pacific: Banda Sea (Mayer 1903), Philippines (Guerra-García 2002), Phuket, Thailand (Guerra-García 2004b), New Caledonia (Laubitz 1991), Papua New Guinea (Guerra-García 2003), Northern Territory and northern coast of Western Australia, Australia (Guerra-García 2004a) and Queensland, Australia (Guerra-García 2006; Guerra-García and Lowry 2009).

Close observation of NSWSPCC specimens shows that the numbers of articles in the flagellum of antenna 2 are restricted to two to three even in the larger mature males having the massive type propodus of gnathopod 2 (Figure 15). Mayer (1903) reported five articles in the flagellum on the male from Banda Sea. The lateral view of *M. novaehollandiae* from the tropical Indo-Pacific area in Guerra-García (2002, 2003, 2004a, 2004b, 2006, García and Lowry 2009) shows article numbers ranging from 2 to 4 (or 5).

The propodus of gnathopod 2 figured in Laubitz (1991) and Guerra-García (2002, 2003, 2004a, 2004b, 2006) is rather elongated as in typical species of Phtisicidae. However, as far as we know, there are no taxonomic descriptions on *M. novaehollandiae* from tropical areas of Indo-Pacific referring to the massive propodus of gnathopod 2.

The morphological diversity in antenna 2 and in the propodus of gnathopod 2 of *M. novaehollandiae* from tropical areas of the Indo-Pacific indicates the presence of multiple species differing from the *M. novaehollandiae* of New South Wales. In our opinion *M. novaehollandiae* reported from areas outside New South Wales, especially tropical waters, needs to be reanalysed. Hence, we do not include the records of *M. novaehollandiae* in the tropical region of the Indo-Pacific ((Mayer 1903; Laubitz 1991, Guerra-García 2002, 2003, 2004a, 2004b, 2006; Guerra-García and Lowry 2009) in the synonym list. Recently, Takeuchi and Oyamada (2013) studied in detail *Caprella californica* Stimpson, 1857 [sensu lato] which is widely distributed on both sides of the North Pacific as a common species, and reported that the differences of Japanese *C. californica* [sensu lato] from California ones are at species level. In their opinion the Japanese species identified as *C. californica* [sensu lato] is actually *Caprella scauroides* Mayer, 1903.

### Genus *Notoprotomima* gen. nov.

#### *Diagnosis*

Head fused with pereonite 1. Antenna 1 well developed; flagellum with more than two articles; accessory flagellum absent. Antenna 2 well developed; flagellum with two articles. Mandible well developed; molar absent; palp 3-articulate; article 3 with two or three large distal marginal setae. Maxilliped well developed; inner plate (basal endite) larger than outer plate (ischial endite); outer plate (ischial endite) well developed; palp article 3 without distal projection; palp article 4 well developed. Pereonite 4 clavate

appendage absent. Pereonites 6 and 7 not fused. Pereopod 3 well developed, with seven articles. Pereopod 4 well developed, with seven articles. Pereopod 5 well developed, with seven articles, with well developed dactylus. Gills on pereonites 2 to 4. Pleopods absent. Uropods two pairs; uropod 1, uniramous; uropod 2, uniramous. Telson (dorsal lobe) present.

### **Gender**

Feminine.

### **Type species**

*Notoprotomima smithi* sp. nov.

### **Etymology**

"*Notoprotomima*" is derived from "Noto-" meaning south (from notos = southerly), and *protomima*.

### **Included species**

*Notoprotomima* includes two species: *Notoprotomima grandimana* (Guerra-García, 2004a); *Notoprotomima smithi* sp. nov.

### **Remarks**

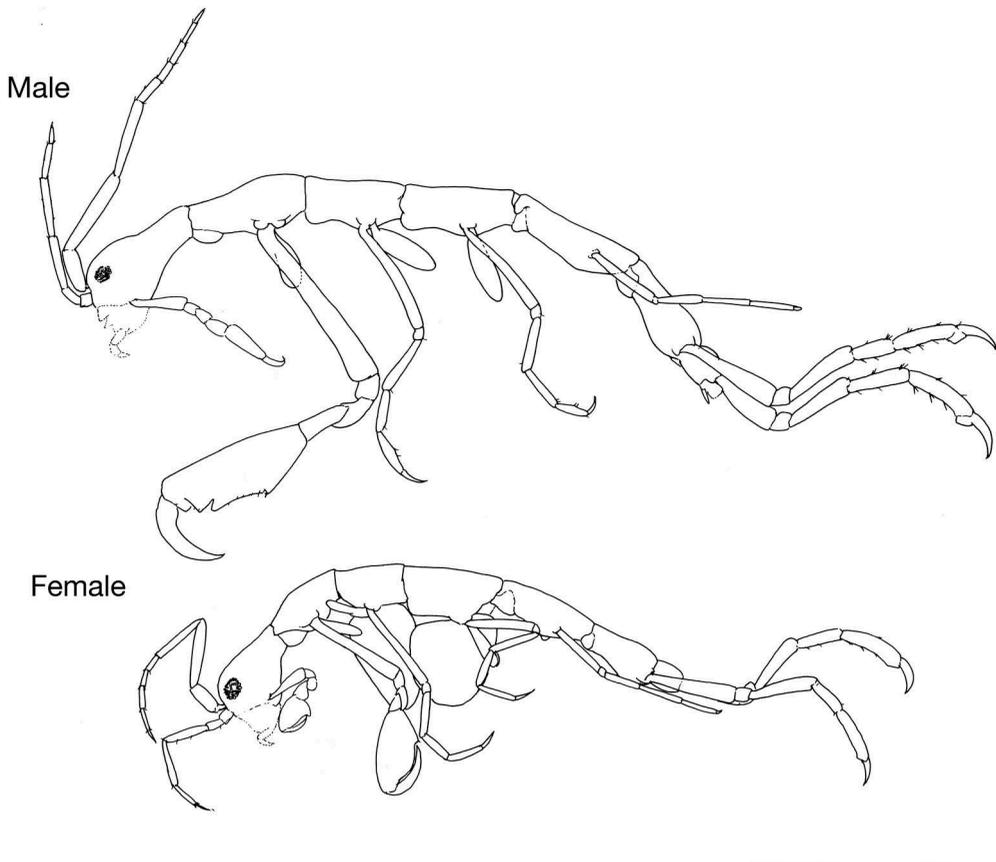
This new genus, *Notoprotomima*, is most closely related to *Pseudoprotomima* McCain, 1969 and *Symmetrella* Laubitz, 1995.

Three species have been reported so far (McCain 1969; McCain and Gray 1971; Guerra-García 2004a) from *Pseudoprotomima*; *P. hurleyi* McCain, 1969 from 788 to 1609 m depth near New Zealand, *P. hedgpethi* McCain and Gray, 1971 from 71 to 110 m depth in the South Indian Ocean and *P. grandimana* Guerra-García, 2004a from less than 18 m depth along the coast of Western Australia.

The present new genus, *Notoprotomima*, differs from *Pseudoprotomima* (see McCain and Gray 1971; Takeuchi 1993) in the following generic characters: (1) the flagellum of antenna 2 in *Notoprotomima* is restricted to two articles even in mature males, while that in *Pseudoprotomima* varies from two to four articles; and (2) in *Notoprotomima* the third article of the mandibular palp has two to three large distal setae, while in *Pseudoprotomima* the setal formula is 1-x-1.

The genus *Symmetrella* was established for *Symmetrella arnaudi* Laubitz, 1995 collected from bathyal depths, 2200 m, from the southern Indian Ocean (Laubitz 1995). The present new genus, *Notoprotomima*, differs from *Symmetrella* (see Laubitz 1995) in the following generic characters: (1) in *Notoprotomima* the third article of mandibular palp has two to three large distal setae, while in *Symmetrella* the setal formula is 1-x-1; (2) in *Notoprotomima* pereopod 4 is composed of seven articles, while *Symmetrella* lacks pereopod 4; and (3) in *Notoprotomima* the abdomen lacks pleopods, while in *Symmetrella* the abdomen possesses a pair of tiny pleopods.

Hence, we establish the new genus, *Notoprotomima*, based on the present species. The description and figures for *P. grandimana* Guerra-García, 2004a (Guerra-García



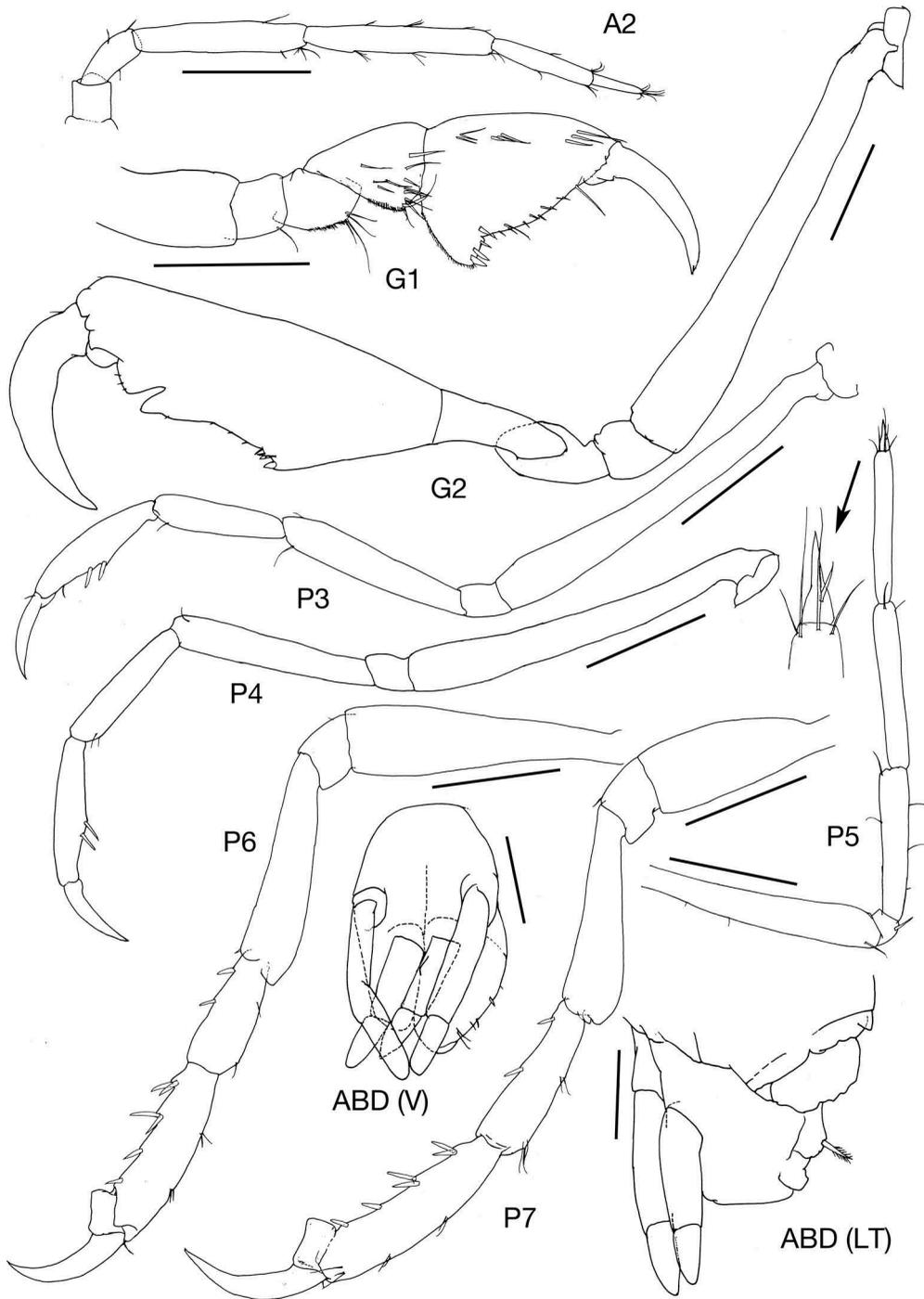
**Figure 17.** *Notoprotomima smithi* gen. nov., sp. nov. from east of North Head, Port Jackson, New South Wales. Male, holotype, 3.82 mm, AM P47831; b, female, paratype, 2.82 mm, AM P87330. Bar indicates 1.0 mm.

2004a) agree well with the present species in the above generic diagnosis of *Notoprotomima* and *P. grandimana* is here moved to *Notoprotomima*.

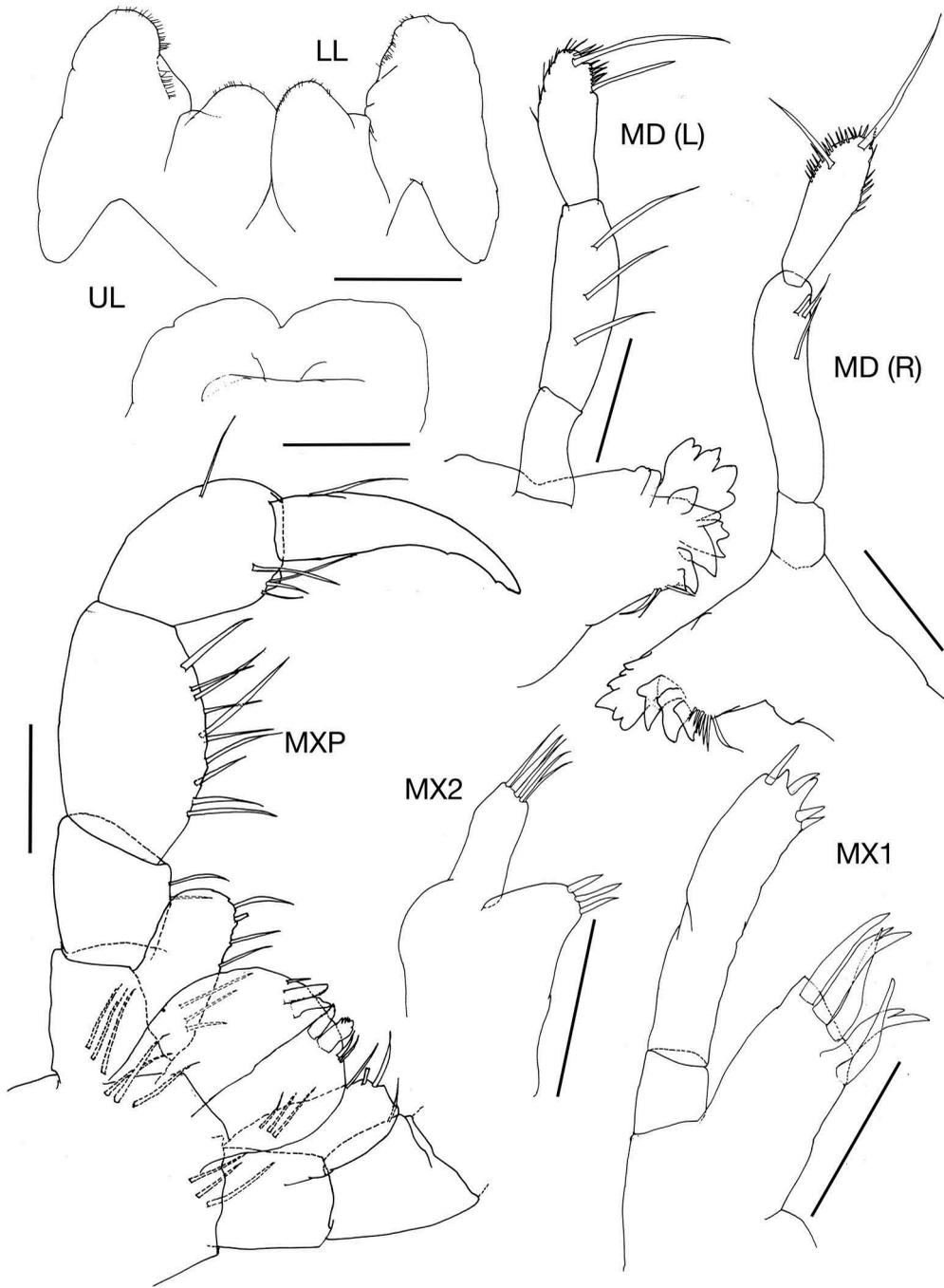
***Notoprotomima smithi* sp. nov.**  
(Figures 17–20)

***Type material***

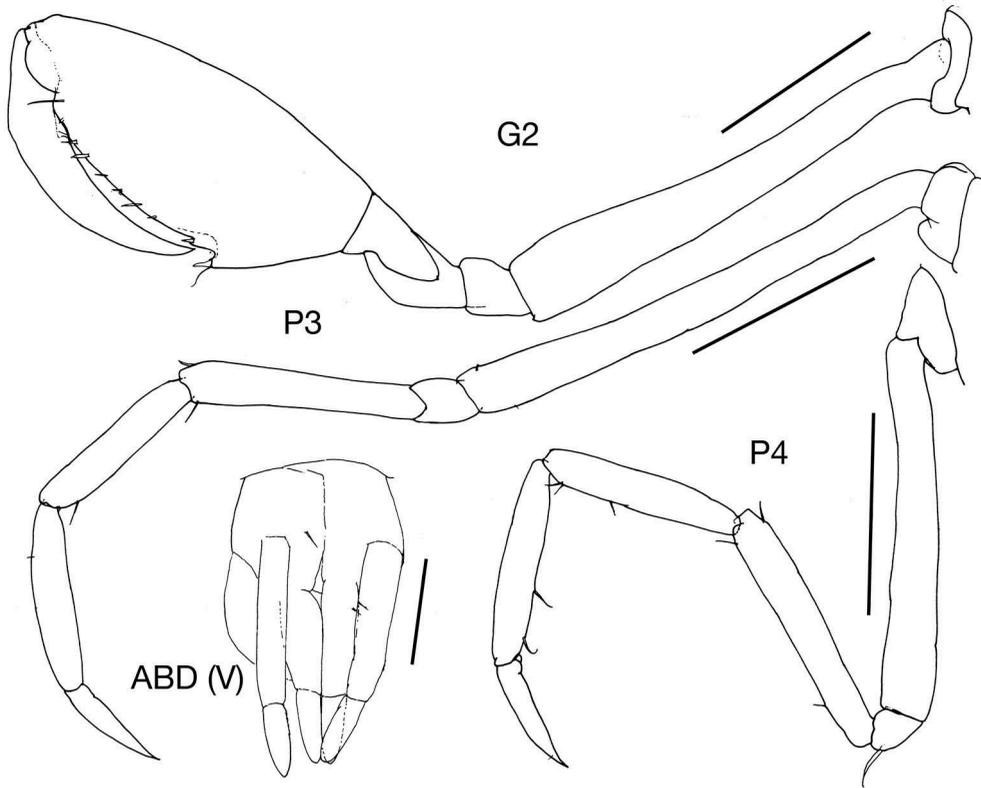
Holotype, male, AM P47831, 33°49'S, 151°18'E, east of North Head, Port Jackson, New South Wales, 32 m depth, 23 May 1972, AMSBS. Paratypes, 1 mature female, AM P47827, 33°49'S, 151°18'E, east of North Head, Port Jackson, New South Wales, 19.8 m depth, 19 February 1973, AMSBS; 3 males, 5 mature females and 1 juvenile, AM 33°49'S, 151°18'E, east of North Head, Port Jackson, New South Wales, 32 m depth, 23 May 1972, AMSBS; 1 male, P 47832, east of Long Reef, New South Wales, 33°44'S, 151°19'E, 15.2 m depth, 28 April 1972, AMSBS; 1 mature female, AM P87330, 33°49'S, 151°18'E, east of North Head, Port Jackson, New South Wales, 32 m depth, 23 May 1972, AMSBS.



**Figure 18.** *Notoprotomima smithi* gen. nov., sp. nov. from east of North Head, Port Jackson, New South Wales. Male, holotype, 3.82 mm, AM P47831. Bars in ABD (LT) and ABD (V) indicate 0.05 mm and those in A2, G1, G2, P3, P4, P5, P6 and P7 indicate 0.20 mm.



**Figure 19.** *Notoprotomima smithi* gen. nov., sp. nov. from east of North Head, Port Jackson, New South Wales. Male, holotype, 3.82 mm, AM P47831. Bars indicate 0.05 mm.



**Figure 20.** *Notoprotomima smithi* gen. nov., sp. nov. from east of North Head, Port Jackson, New South Wales. Female, paratype, 2.82 mm, AM P87330. Bar in ABD (V) indicates 0.05 mm and those in G2, P3 and P4 indicate 0.20 mm.

#### **Additional material examined**

2 males and 1 mature female, AM P48681, 30°10'S, 153°11'E, Rocky Bluff, Coffs Harbour, New South Wales, 23 August 1987, 6 m depth, *Ecklonia radiata* holdfasts, coll. S.D.A. Smith; 8 males and 2 mature females, AM P48682, 30°10'S, 153°11'E, Rocky Bluff, Coffs Harbour, New South Wales, 23 August 1987, 6 m depth, *Ecklonia radiata* holdfasts, coll. S.D.A. Smith; 2 males and 5 mature females, P 47834, 30°07'S, 153°12'E, Woolgoolga Headland, New South Wales, 5 m depth, *Ecklonia radiata* holdfast, 5 August 1991, coll. S.D.A. Smith; 5 males, 4 mature females and 1 premature female, AM P48685, 30°06'S, 153°12'E, Woolgoolga Headland, New South Wales, 31 March 1995, 6 m depth, *Ecklonia radiata* holdfast, coll. S.D.A. Smith.

#### **Type locality**

East of North Head, Port Jackson and east of Long Reef, New South Wales.

#### **Other localities**

New South Wales: Rocky Bluff, Coffs Harbour and Woolgoolga Headland.

## Description

Male, body length, 3.82 mm, AM P47831. *Head and pereonite 1* combined length 0.68 mm; *pereonite 2*, 0.62 mm; *pereonite 3*, 0.52 mm; *pereonite 4*, 0.54 mm; *pereonite 5*, 0.71 mm; *pereonite 6*, 0.56 mm; *pereonite 7*, 0.2 mm.

Head round dorsally, completely fused with pereonite 1.

*Antenna 1* slender, shorter than 1/2 of the body length; peduncular article 2 longest; flagellum 1/2 × peduncular length, with five articles; proximal article, result of fusion of two articles. *Antenna 2*, 3/5 × antenna 1 length; peduncular articles with several feeble setae; flagellum 1/4 × peduncular length, with two articles.

*Upper lip* notched, forming shallow quadrilateral projections. *Mandible* right incisor with six teeth, lacinia mobilis with two teeth, with two trapezoid plates decreasing in size, accessory setal row with seven setae; palp article 3 with two long apical setae and distal marginal fringing setae; left incisor with five teeth, lacinia mobilis with two teeth, with three trapezoid plates decreasing in size, accessory setal row with three setae; palp article 3 with two long apical setae and distal marginal fringing setae. *Lower lip* finely setose on inner and outer lobes. *Maxilla 1* outer plate with five stout apical setal-teeth; palp distal margin with two triangular projections and four robust seta. *Maxilla 2* inner plate triangular with three apical robust setae; outer plate elongate with five apical setae. *Maxilliped* inner plate (basal endite) round, with two stout serriform setae on inner half of distal margin, with two setae on outer end; outer plate (ischial endite) oval, 0.8 × length of inner plate (basal endite), inner margin smooth, with three or four setae on inner margin; palp article 2 setose on inner margin; palp article 3 with five distal setae; palp article 4 weakly falcate.

**Pereon.** *Pereonite 5* longest.

*Gnathopod 1* carpus and propodus setose; propodus triangular, with three rows of submarginal setae on distal part near anterior margin; palm begins 1/4 along posterior margin, smooth; dactylus curved. *Gnathopod 2* begins 2/5 along posterior margin; gill elongate, about 3 × width, about 1/2 × pereonite length; basis about 2 × length of pereonite 2; propodus elongate, subrectangular, large, length 2.6 × width; palm proximal projection with three robust (one large and two small) setae, palm margin concave, smooth, with two triangular projections distally.

*Pereopod 3* very slender; gill similar to gill 2; basis to carpus cylindrical; basis longer than other pereopod articles, 2/5 × pereopod length; propodus with distal palm, delimited by two robust setae. *Pereopod 4* very slender; shorter than pereopod 3; gill similar to gill 2; propodus with distal palm, delimited by two robust setae. *Pereopod 5* slender; dactylus short, straight, with one seta in the middle. *Pereopod 6* basis longest followed by merus; carpus with two setae on posterior margin; propodus with two pairs of robust setae on posterior margin, with two robust setae along palm, with trapezoid comb on distal part of palm; dactylus falcate. *Pereopod 7* similar to pereopod 6; merus longer than basis.

*Uropod 1*, peduncle, elongate, about 4 × width; ramus about 3–4 × width, 0.45 × peduncular length. *Uropod 2*, peduncle, elongate, about 3 × width; ramus about 2–3 × width, 0.4 × peduncular length.

*Female* (sexually dimorphic characters). Based on female body length 2.82 mm, AM P87330. *Antenna 1*, 0.6 × body length. Length of *Head/pereonite 1* combined 0.45 mm, and *pereonites 2–7*, 0.44 mm, 0.37 mm, 0.51 mm, 0.52 mm, 0.37 mm and 0.16 mm,

respectively. *Pereonite 2* with anterolateral triangular projection. *Gnathopod 2* propodus palm margin convex. *Pereopod 3* propodus without distal palm and robust setae.

### Etymology

This species is named in honour of Dr S.D.A. Smith, who first found the present species and enthusiastically supported the present study.

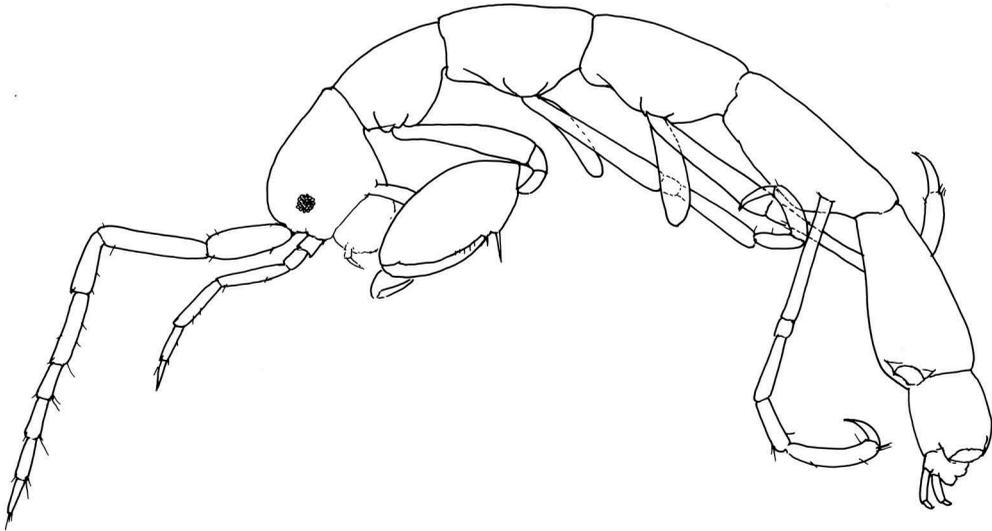
### Remarks

The present species, *N. smithi* sp. nov., differs from *N. grandimana* (Guerra-García, 2004a), which was recorded from shallow waters of Western Australia, in the following ways: (1) in *N. smithi*, antenna 1 is shorter than the body length, while in *N. grandimana*, antenna 1 is about half of the body length; (2) in *N. smithi*, gills are about half of the corresponding pereonite length, while in *N. grandimana*, gills are 1/3 to 1/2 of the body length; (3) in *N. smithi*, there are two triangular projections situated near distal end of palm of gnathopod 2, while in *N. grandimana*, the middle projection on the palm is rectangular (based on Guerra-García 2004a: 19, Figure 16); (4) in pereopods 6 and 7 of *N. smithi*, the trapezoid comb is present on the distal part of the palm of the propodus, while in *N. grandimana*, the propodus of pereopods 6 and 7 lack the comb; (5) in *N. smithi*, the third article of the mandibular palp has two large setae, while in *N. grandimana* the third article has three large setae.

### Genus *Paraproto* Mayer, 1903

#### *Paraproto* sp.

(Figure 21)



**Figure 21.** *Paraproto* sp. from south of Governor Head, out of Jervis Bay, New South Wales. ? Male, 2.74 mm, AM P87328. Bar indicates 0.50 mm.

### Material examined

AM P87328, ? 1 male, 35°08.84'S, 150°45.71'E, near the bottom end of vertical wall, 1 nautical mile south of Governor Head, out of Jervis Bay, New South Wales, brown algae (like *Sporochnus*), 20 m, 28 February 1996, coll. I. Takeuchi, A. Murray and R.T. Johnson.

### Locality

New South Wales: 1 nautical mile south of Governor Head, out of Jervis Bay (this study).

### Description

? Male, body length, 2.74 mm, AM P87328. *Body* slender, cylindrical with vestigial pleosome. *Head/pereonite 1* combined length 0.38 mm; *pereonite 2*, 0.33 mm; *pereonite 3*, 0.41 mm; *pereonite 4*, 0.43 mm; *pereonite 5*, 0.54 mm; *pereonite 6*, 0.42 mm; *pereonite 7*, 0.23 mm.

*Head/pereonite 1* without projections or humps.

*Antenna 1*  $1\frac{1}{2}$  × body length; peduncle article 2 longest; flagellum 0.9 × peduncular length; with five articles. *Antenna 2* 0.4 × antenna 1 length; flagellum 0.4 × peduncular length; with two articles.

**Pereon.** *Pereonites 2–7* without projections or humps; *pereonite 5* longest.

*Gnathopod 2* basis without anterodistal projection; carpus 0.1 × propodus length; propodus large, subovate, 2 × width; palm smooth.

*Pereonite 3 gill* elongate, cylindrical, 0.8 × corresponding pereonite. *Pereopod 3* slender; basis to carpus cylindrical; basis longer than other pereopod articles,  $\frac{2}{5}$  × the pereopod length; propodus without distal palm and robust setae; dactylus falcate/curved. *Pereonite 4 gill* length about  $\frac{3}{4}$  × corresponding pereonite. *Pereopod 4* similar to pereopod 3. *Pereopod 5* slender; propodus concave; dactylus medium length, curved, without setae.

**Pleon.** *Uropod 1*, peduncle, elongate, about 5 × width; ramus about 0.3 × peduncular length. *Uropod 2*, peduncle, elongate, about 4 × width; ramus about 0.2 × peduncular length.

### Habitat

Marine, littoral.

### Remarks

Four species of *Paraproto* have been recorded from the Australian coasts before the present study: *P. condylata* (Haswell, 1885a) from Australia, *P. gabrieli* Stebbing, 1914 from Victoria, *P. spinosa* (Haswell, 1885a) from Victoria and *P. tasmaniensis* Guerra-García and Takeuchi, 2004. Of the four species of *Paraproto*, *P. condylata* and *P. tasmaniensis* have the body smooth, as in the present species. However, because of the lack of a modern description of *P. condylata* from Australia we hesitate to identify this small individual.

*Paraproto condylata* was first reported by Haswell (1885a) as *Proto condylata* Haswell, 1885a. He never noted the specific locality for this species in Australia unlike the record for *P. spinosa* (Haswell, 1885a) that was recorded as “only in one locality-Port Western, Victoria.” Dr William A. Haswell served the University of Sydney around that period (Morison 1983). If *P. condylata* was collected from Victoria or other states, there is a high possibility that he would have recorded the locality as for *P. spinosa* (Haswell, 1885a). Hence, *P. condylata* might

have been collected from Sydney or adjacent areas along the coasts of New South Wales, Australia. Mayer (1903) also noted "*Paraproto condylata*?" in the species list of "Sydney (Port Jackson and Broken Bay)". The type material of *P. condylata* described by Haswell (1885a) is missing (Springthorpe and Lowry 1994). McCain and Gray (1971) reported the occurrence of "*P. condylata*" from South Shetland Islands, Antarctica with several illustrations. Guerra-Garcia and Coleman (2001) redescribed and figured "*P. condylata*" based on the specimens collected by the Polarstern cruise ANT XIV/2 from South Shetland Islands. Their description and figures in general agree with the description by McCain and Gray (1971). De Broyer et al. (2004) identified Antarctic "*P. condylata*" as *Paraproto* sp. due to several morphological differences between the Australian and Antarctic specimens. Based on Antarctic "*P. condylata*" a new species is proposed (Takeuchi, forthcoming 2015).

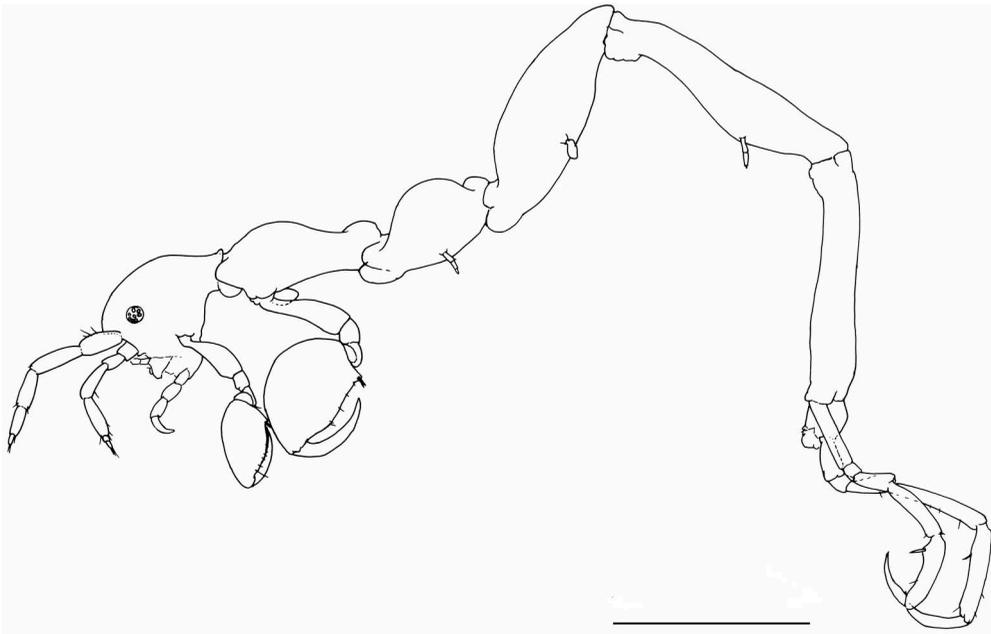
Genus *Perotripus* Dougherty and Steinberg, 1953

*Perotripus* sp.

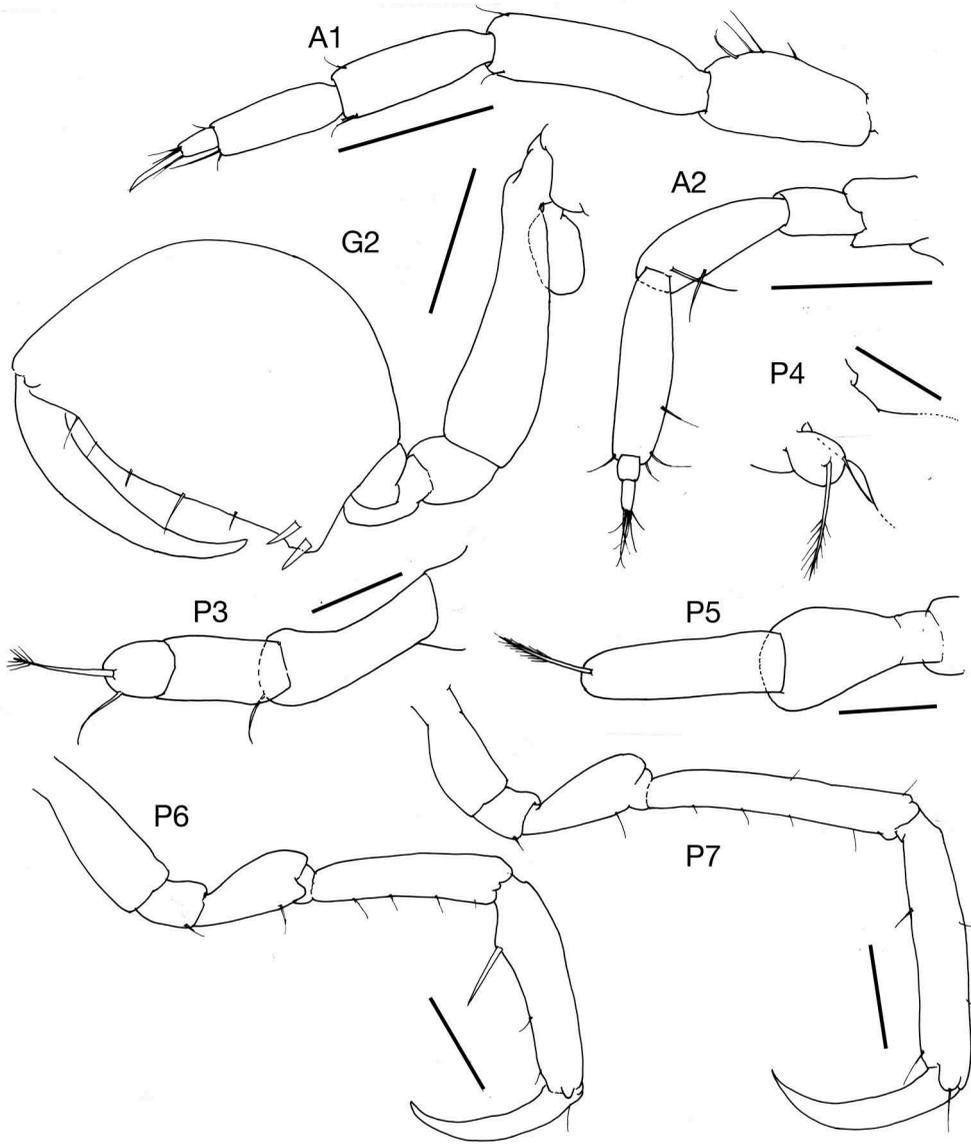
(Figures 22 and 23)

*Material examined*

1 ? male, AM P49034, 33°45'S, 151°19'E, Long Reef, New South Wales, 18 February 1996, attached to sipunculid; ? 1 premature female, AM P49035, 33°45'S, 151°19'E, Long Reef, New South Wales, 18 February 1996, attached to a sipunculid.



**Figure 22.** *Perotripus* sp. from east of Long Reef, New South Wales, Australia. ? Male, 3.04 mm, AM P49034. Bar indicates 0.50 mm.



**Figure 23.** *Perotripus* sp. from east of Long Reef, New South Wales, Australia. ? Male, 2.74 mm, AM P49034. Bars in A1, A2, G2, P6 and P7 indicate 0.10 mm and those in P3, P4 and P5 indicate 0.02 mm.

### Locality

New South Wales: Long Reef (this study).

? Male, body length 3.04 mm, AM P49034. *Head/pereonite 1* combined length 0.34 mm; *pereonite 2*, 0.40 mm; *pereonite 3*, 0.31 mm; *pereonite 4*, 0.55 mm; *pereonite 5*, 0.69 mm; *pereonite 6*, 0.64 mm; *pereonite 7*, 0.10 mm.

Eyes large, distinctive.

*Antenna 1* 0.15 × body length; peduncle article 2 longest; flagellum 0.33 × peduncular length, with two articles. *Antenna 2* 0.8 × antenna 1 length; flagellum 0.12 × peduncular length, with two articles.

**Pereon.** *Pereonite 2* with anterolateral rounded projection, with dorsodistal hump. *Pereonite 3* with rounded anterolateral projection, with dorsodistal hump. *Pereonite 4* with anterolateral projection, with broad dorsal hump. *Pereonite 5* longest. *Gnathopod 2* gill small, subovate; coxa vestigial; basis without anterodistal projection; carpus 0.1 × propodus length; propodus large; length 1.3 × width; propodus anterodistal margin convex; palm proximal projection with two robust (grasping) setae; propodus palm smooth, slightly convex. *Pereopod 3* slender, 3-articulate; gill missing in this specimen. *Pereopod 4* shorter than pereopod 3; gill small, subovate; length about 1.2 × width. *Pereopod 5* slender. *Pereopod 6* basis slightly shorter than propodus; carpus subequal to basis; propodus with one robust seta on posterior margin; dactylus falcate. *Pereopod 7* similar to pereopod 6; merus subequal in length to basis.

### Remarks

The genus *Perotripus* was established based on the single species, *P. brevis* (La Follette, 1915), which is distributed along the Californian to Alaskan coasts of the northeastern Pacific (Dougherty and Steinberg 1953; Laubitz 1970). Two additional species, *P. keablei* Guerra-García, 2006 and *P. koreanus* Lee and Hong, 2010 have so far been reported (Guerra-García 2006; Guerra-García and Lowry 2009; Lee and Hong 2010).

Of them, the present species, *Perotripus* sp., differs from *P. brevis* in the following distinctive characters: pereonite 2 is longer than pereonite 3 in *Perotripus* sp. from New South Wales, while pereonite 3 is longer than pereonite 2 in *P. brevis*. However, we have not described the present specimens as a new species because the specimens collected from New South Wales are only two small individuals. This indicates the possibility that these are juveniles, which have not developed specific diagnostic characters.

*Perotripus keablei* was recorded from Lizard Island, on the northern part of the Great Barrier Reef, Queensland. Unlike *P. brevis*, *P. koreanus* and *Perotripus* sp. in the present study, pereopod 3 of *P. keablei* has one tiny article with two apical setae, which is very similar to that of pereopod 4. Recently, Lim et al. (2012) established the genus *Microtripus* which differs from *Perotripus* by 3-articulate flagellum of antenna 1 with three articles and pereopod 3 with one article. While *P. brevis* and *P. koreanus* have pereopod 3 with three articles, corresponding pereopod of *P. keablei* with one article. Hence, this indicates that *P. keablei* possibly belongs to a different new genus from *Perotripus*.

In addition to these three species of *Perotripus* and *Perotripus* sp. reported in the current study, an undescribed species of *Perotripus* was recorded in the ecological and phylogenetic studies and checklist from the Pacific coasts of central Japan (Takeuchi et al. 1987; Takeuchi and Hirano 1995; Takeuchi 1999; Aoki and Takeda 2006).

## Key for the species of the Phtisicidae from New South Wales

The species key provided here is based on the characteristics that could be observed without dissection of the mouthparts using binocular microscope.

1. Pereopod 3 well developed, with seven articles ..... 2
  - Pereopod 3 vestigial, fewer than three articles ..... 5
2. Pereopod 4 well developed, with seven articles ..... 3
  - Pereopod 4 degenerated ..... 6
3. Gills on pereonites 2 to 4 ..... 4
  - Gills on pereonites 3 and 4 ..... *Paraproto* sp.
4. Basis of gnathopod 2 about 2 × length of pereonite 2 .....
  - ..... *Notoprotomima smithi* sp. nov.
  - Basis of gnathopod 2 shorter than length of pereonite .....
    - ..... *Metaproto novaehollandiae* (Haswell, 1879a)
5. Flagellum of antenna 1 with more than two articles .....
  - ..... *Hircella cornigera* (Haswell, 1879b)
  - Flagellum of antenna 1 with two articles ..... *Perotripus* sp.
6. Pereonites 3 and 4 with pair of mid-dorsal projections .....
  - ..... *Dodecas decacentrum* Stebbing, 1910b
  - Pereonites 3 and 4 lacking mid-dorsal projections .....
    - ..... *Dodecas hexacentrum* Mayer, 1903

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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