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# The Shallow-water Tanaidacea (Arthropoda: Malacostraca: Peracarida) of the Bass Strait, Victoria, Australia (other than the Tanaidae)

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**Abstract**

Błażewicz-Paszkowycz, M. and Bamber, R.N. 2012. The Shallow-water Tanaidacea (Arthropoda: Malacostraca: Peracarida) of the Bass Strait, Victoria, Australia (other than the Tanaidae). *Memoirs of Museum Victoria* 69: 1–235.

All of the shallow-water tanaidacean taxa (except for species of the family Tanaidae) from material collected between 1964 and 1999 within the Bass Strait, Victoria, Australia, have been analyzed. The material had been collected predominantly by staff from the Museum Victoria, Melbourne. The species treated here are those occurring at depths <200 m; substrata were predominantly sands. A total of 65 species in 43 genera is discussed, of which 44 species, five genera and one subgenus are described as new, although two of the species are not named owing to inadequacy of the material. Only nine of the species are known from elsewhere in Australia, and none from outside Australia. In addition, after examination of more material of its type- (and only) species, the genus *Annexos* is synonymized with *Apseudes*, as is *Xanthapseudes*; *Apseudes tuski* is moved to *Apseudopsis*; subgenera of *Bunakenia* are rejected; the "tribes" Parapseudini and Pakistanapseudini are raised to Subfamily rank; *Magniaculeus* is synonymized with *Saltipedis*; intraspecific variation in *Kalliapseudes obtusifrons* is discussed; the genera of the Pagurapseudinae are resolved, and *Pagurapseudes abrucei* is transferred to *Macrolabrum*; the first male for the genus *Bathytanais* is described; the validity of the genus *Araphuroides* is discussed, and *A. io* is returned to *Araphura*; *Protanaissus makrotrichos*, *P. alvesi* and *P. floridensis* are moved to new genera; the family Tanaopsidae is erected to accommodate the genus *Tanaopsis* (at least).

**Keywords** Tanaidacea; Apseudomorpha; Tanaidomorpha; Australia; Tasman Sea; Bass Strait

## Introduction

The Tanaidacea is a group of generally small, mainly marine, peracarid crustaceans found in benthic habitats from the shore to the deep sea. A comprehensive review of their biology and ecology has been presented by Larsen (2005). As a rule, they are outnumbered in these habitats by the two dominant peracarid groups, the Amphipoda (in shallower waters) and the Isopoda (in deeper waters), although they appear to be a dominant macrofaunal group on abyssal plains where they potentially rival polychaetes in ecological importance (Błażewicz-Paszkowycz *et al.* 2012).

Despite this, the group has been understudied historically. Most species are small in the size-spectrum of macrofauna (commonly only a few mm long, and less than 1 mm wide); they also have a hydrophobic cuticle, which results in their adhering to surface water-films during sample-collection. As a result, they have been undersampled in general macrofaunal collection, and their identification even to genus has posed problems for the non-specialist. Fortunately, an increase in the number of specialists studying the Tanaidacea since the 1980s, coinciding with more rigorous investigations of the smaller taxa in the deep sea, the tropics and the Antarctic, has begun to improve the understanding of, and the availability of identification texts for, the group. Valuable baselines now exist regionally (e.g. Bird & Holdich, 1989; Guţu, 1997; Poore, 2002, 2005; Larsen, 2005; Larsen & Shimomura, 2007b; Bamber, 2008; Edgar, 2008) and globally (e.g. Sieg, 1980b; Sieg, 1983a; Blazewicz-Paszkowycz, 2007; Drumm *et al*., 2008).

In shallow waters (<500 m), the regions where studies on the Tanaidacea have been most comprehensive have been the northeast Atlantic (Europe) and eastern coasts of the USA, simply because of the history of effort in these areas. There has also been a long history of study in the Mediterranean, although over the last century that has concentrated on apseudomorph species (e.g. Guţu, 2002), and more recently in the Antarctic (e.g. Blazewicz-Paszkowycz & Sekulska-Nalewajko, 2004; Jóźwiak & Błażewicz-Paszkowycz, 2007).

As a general rule, the more comprehensive studies have found that in shallow waters tanaidaceans are less diverse, but the species have denser populations, when compared with deep waters where diversity can be surprisingly high, but species are often represented by only a few (or one) individuals. It was therefore entirely unexpected when Bamber (2005), surveying the shallow-water (0 to 40 m depth) tanaidacean fauna of one bay in southwestern Australia over three weeks, found 26 species in 21 genera; further, that in quantitative sandy-beach samples of an admittedly low-diversity community, the tanaidaceans were the dominant peracarid group, representing 80% of the peracarid fauna numerically.

Most recent studies in Australian waters (Larsen, 2001; Guţu, 2006; Błażewicz-Paszkowycz & Bamber, 2007a, b; Bamber, 2008; Edgar, 2008) have found an extraordinary shallow-water diversity and dominance of the Tanaidacea when compared with other parts of the world. For example, Holdich & Jones (1983), listed 28 species in 16 genera for the long-studied British waters, this total having risen only to 33 as a result of subsequent publications (Bird & Holdich, 1989; Bird, 2002, 2004; Bamber, 2011); Larsen (2005) listed a total of 58 shallow-water (undefined) species from the Gulf of Mexico/ western Caribbean Sea. Furthermore, the large majority of the taxa found in Australian waters was new to science, and showed both high local diversity and high regional distinctness. Bamber (2005) listed 28 species in 21 genera recorded from Australian waters previously to that study (although two species were missed from that list); a short time later, Bamber (2008) listed a new total of 113 species in 61 genera from Australian waters. Of this impressive number, only six species have also been recorded outside Australia (and four of those are recorded as "cf." in Australian waters, and may yet prove to be distinct). Seventeen genera are currently endemic to Australia. One entire family, the Whiteleggiidae Guţu, 1972, is also endemic [Błażewicz-Paszkowycz & Bamber (2007b) showed that the only other record, of *Whiteleggia multicarinata* (Whitelegge, 1901) off South Africa, was in fact a *lapsus calami*]. At the regional level, Bamber (2008) found that, of 29 species discovered in Moreton Bay, Queensland, only six species also occurred elsewhere in Australia.

The present paper brings together the results of four decades of sampling in the Bass Strait, southeastern Australia. This region lies between the Great Australian Bight to the west and the Tasman Sea to the east, and between Victoria in the north and Tasmania in the south, extending for some 400 km east-to-west and 250 to 300 km north to south (Fig. 1). It is the widest area of continental shelf of temperate Australia (Wilson & Poore, 1987), and forms part of the Southeast Australia Large Marine Ecosystem (LME), considered notable for its biodiversity (e.g. Morgan, 1989). The prevailing strong current runs from east to west. Most of the Strait is around 50 m depth, and the substrata are predominantly sands.

This work describes all the shallow-water tanaidacean taxa analysed from material collected between 1964 and 1999 within the Bass Strait (see Poore, 1986; Wilson and Poore, 1987), except for taxa in the Family Tanaidae Dana, 1849, which are being treated elsewhere. Species analyzed are those occurring at depths <200 m (although some of these extend to greater depths). Species occurring in adjacent waters exclusively below 200 m will also be treated elsewhere.

From the foregoing, it is perhaps now no surprise that analysis of the hundreds of samples collected over that period revealed a total of 65 species in 43 genera, of which 57 species and eight genera were new to science. Some of this material has already been described (Błażewicz-Paszkowycz & Bamber, 2007a, b). The following description of all taxa from the Bass Strait describes 44 new species, five new genera, one new subgenus and designates one new family. The material is held in the collections of Museum Victoria, Melbourne.

## Methods

A map of the Bass Strait region, showing principal sampling areas mentioned in the text, is given as Figure 1.

Sampling techniques, including trawls, dredges, epibenthic sled and Smith-McIntyre grab, are listed in Poore (1986) and Wilson & Poore (1987); these papers also give sample-station details, including sediments where known. Techniques for more recent samples are not known, but none are treated herein as quantitative.

The type material and other studied materials are deposited at Museum Victoria (Melbourne, Australia). In the case of very numerous species, not all the material is listed below even when studied for confirmation of identification; in these cases, primary types are only those specimens designated as such herein. In addition, some previously described material held at the Museum was re-examined to resolve issues of identity, and in one case to designate new type material (neotype).

Dissected material was stained with chlorazol black and mounted in glycerine for microscopic examination. Drawings were done with the aid of a *camera lucida*. Measurements are made axially, dorsally on the body and antennae, laterally on pereopods. Body-proportions are based on length (from anterior of rostrum to tip of telson) versus width of pereonite 2. Morphological terminology is as in Błażewicz-Paszkowycz and Bamber (2007b).

## Systematics

Order **Tanaidacea** Dana, 1849

Suborder **Apseudomorpha** Sieg, 1980

Superfamily **Apseudoidea** Leach, 1814

Family **Apseudidae** Leach, 1814

Subfamily **Apseudinae** Leach, 1814

Genus ***Apseudes*** Leach, 1814

*Xanthapseudes* Guţu, 2008, new synonymy.

***Apseudes abditospina*** (Błażewicz-Paszkowycz & Bamber, 2007) comb. nov.

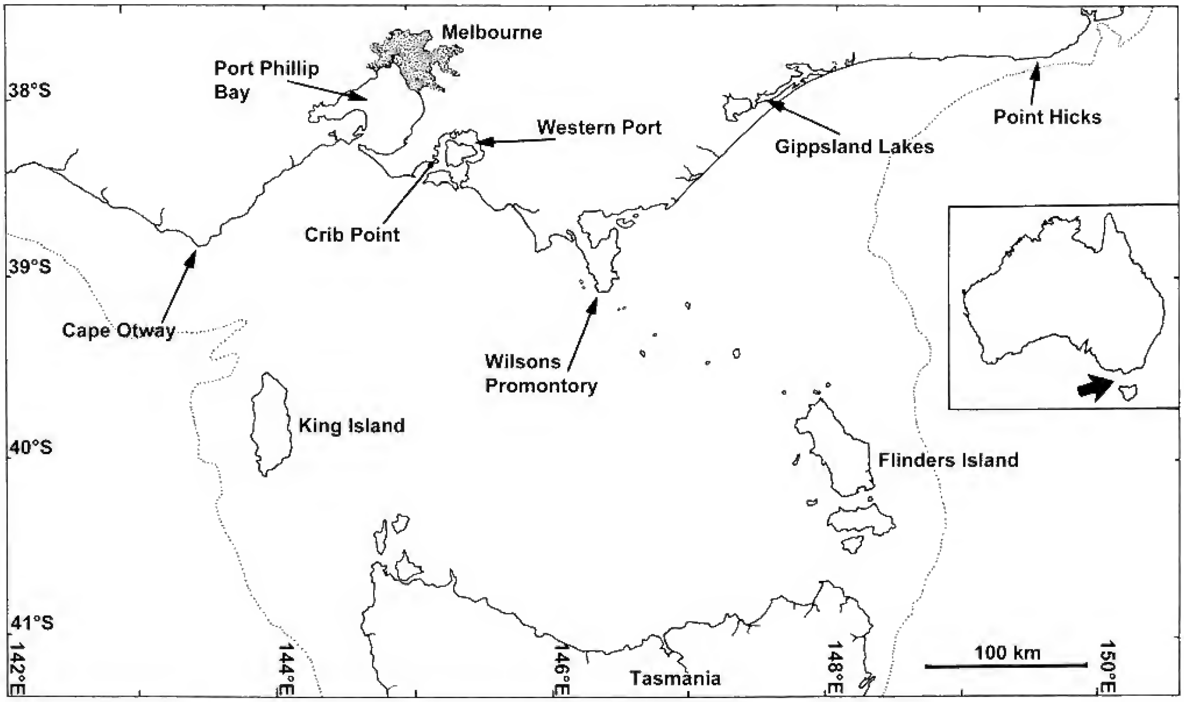


Fig. 1. Map of the Bass Strait, showing main place names mentioned in the text and 100 m depth contour (dotted line) (partly redrawn after Wilson & Poore, 1987).

Figure 2

*Annexos abditospina* Błażewicz-Paszkowycz & Bamber, 2007b, 111–116, figs 1–3.

*Remarks.* On its original description, *Annexos abditospina* was attributed to a new genus of the Apseudinae owing to its not having exopodites on the cheliped nor on pereopod 1. Re-examination of paratypes of this species has found that it does indeed have exopodites on both of these appendages (Fig. 2), although they readily break off. Both are of three articles, that on the cheliped has seven marginal plumose setae on the distal article, while the exopodite on pereopod 1 has five.

The species is therefore transferred to the genus *Apseudes*, of which *Annexos* becomes a junior synonym. *A. abditospina* was compared with, and distinguished from, other Australian species of *Apseudes* during its original description (Błażewicz-Paszkowycz & Bamber, 2007b). With the discovery of exopodites on the cheliped and pereopod 1, *A. abditospina* sits comfortably with that group of typical *Apseudes* which includes the generotype, *A. talpa* (Montagu, 1808).

There are distinct proximal hook-like apophyses on the bases of the first three pereopods of this species, a feature known elsewhere only in *A. atuini* (Bamber 2005), from Western Australia, although in that species they are also present on the posterior pereopods. Like *Apseudes poorei* (Błażewicz-Paszkowycz & Bamber, 2007) (see below), this species has distinct articulated inner-distal spines on the first and second maxilliped palp articles. For discussion of the relevance of this feature to Guţu's (2008a) suggested genus *Xanthapseudes* see under remarks for *A. poorei* below.

This species was found throughout the Bass Strait, between 38°43' and 40°22'S and 144°18' and 148°24'E, and from 22 to 79 m depth on sandy to coarse shell substrata.

**Apseudes poorei** Błażewicz-Paszkowycz & Bamber, 2007

*A. poorei* Błażewicz-Paszkowycz & Bamber, 2007b, 120–125, figs 7–9.

*Xanthapseudes poorei* Guţu, 2008a, 39.

*Remarks. Apseudes poorei* is very similar to *A. bucospinosus* Guţu, 2006, a species from Heron Island on the Great Barrier Reef (depth not recorded), although the pereopods of the latter species are not fully described. An unusual distinguishing feature of *A. poorei* is the presence of plumose setae on the bases of pereopods 2 and 4; the two species are distinguished further on the setation of the mouthparts and the morphology of the cheliped, *inter alia*. *A. bucospinosus* has strong inner-distal "spiniform processes" rather than spines on the first and second maxilliped palp articles. Guţu (2008a) assigned these


Fig. 2. *Apseudes abditospina* comb. nov. A, cheliped; B, pereopod 1. Scale = 0.1 mm.

two species to a new genus, *Xanthapseudes*, on the basis of an assumed similarity in the character of spines or spine-like apophyses on the proximal maxilliped palp articles. In fact, in this character, *A. poorei* is much closer to *A. abditospina*, yet quite distinct on a number of other characters (for example, the anterolateral spiniform apophyses on the pereonites and the hook-like apophyses on the anterior pereopod bases of the latter species). It is therefore evident that this character of one article of the maxilliped palp alone is not a sufficient basis on which to distinguish a separate genus.

*Apseudes poorei* was found throughout the Bass Strait, between 38°00' and 40°23'S and 144°05' and 148°37'E, and from 13 to 82 m depth on sandy substrata.

***Apseudes quasimodo*** sp. nov.

Figures 3–5

*Material examined.* 1 ♀ with oostegites (Registration no, J58462), holotype, Eastern Bass Strait, Stn MSL-EG 95, 37°51.70'S 148°14.60'E, 37 m depth, February 1991, coarse sand, coll. N. Coleman, Smith-McIntyre grab; 2 ♀♀ with oostegites, 6 subadults, 1 juvenile (J28515), paratypes, same sample as Holotype. 1 ♀ with oostegites and penial tubercle, 3 juveniles (J28513), paratypes, Stn MSL-EG 69, 37°51.70'S 148°14.6'E, 37 m depth, 4 June 1991, coarse sand; 2 ♀♀ with oostegites, 3 brooding ♀♀, 23 juveniles (J28514), paratypes, Stn MSL-EG 77, 37°49.89'S 148°30.13'E, 27 m depth, 4 June 1991, coarse sand; 3 subadults (J28512), paratypes, Stn MSL-EG 44, 37°53.18'S 148°28.96'E, 45 m depth, 26 September 1990, sand and shell; 1 brooding ♀, 8 subadults

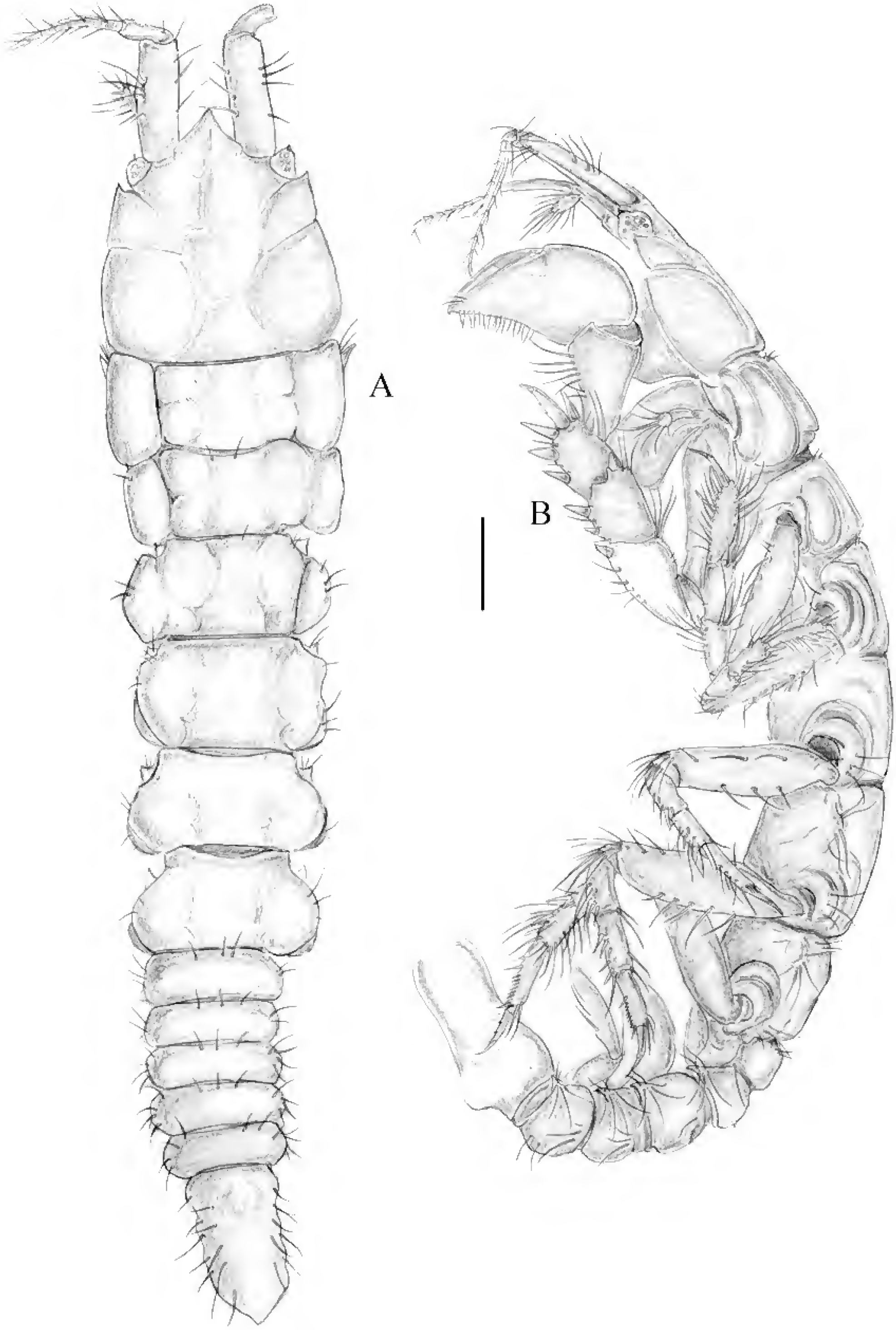


Fig. 3. *Apseudes quasimodo* sp. nov., holotype female. A, dorsal view; B, lateral view. Scale = 1 mm.

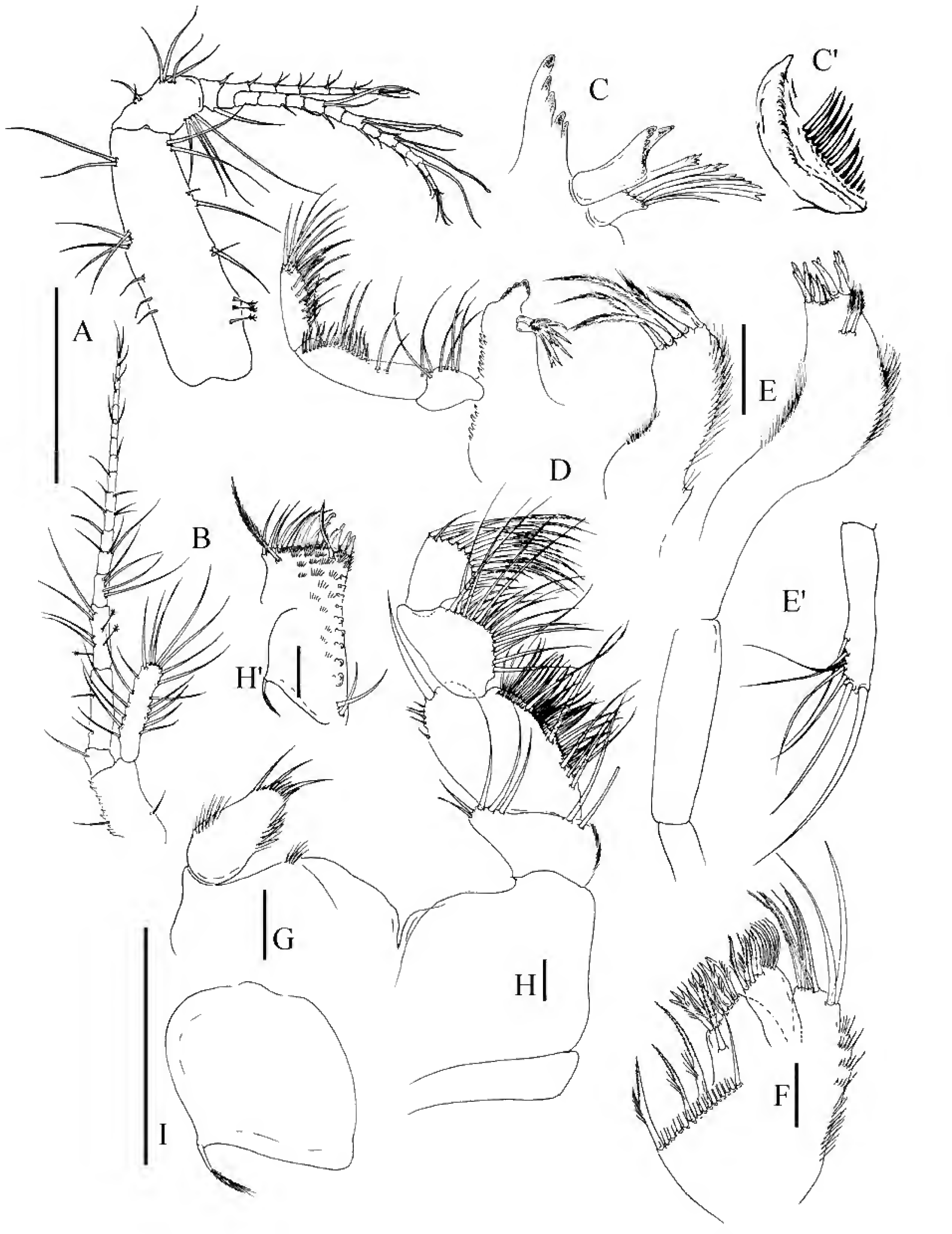


Fig. 4. *Apseudes quasimodo* sp. nov., female paratype (J56389). A, antennule; B, antenna; C, left mandible; C', mandible molar; D, right mandible; E, maxillule; E', maxillule palp; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath. Scale: A = 0.6 mm; B, I = 1 mm; C-H = 0.1 mm.

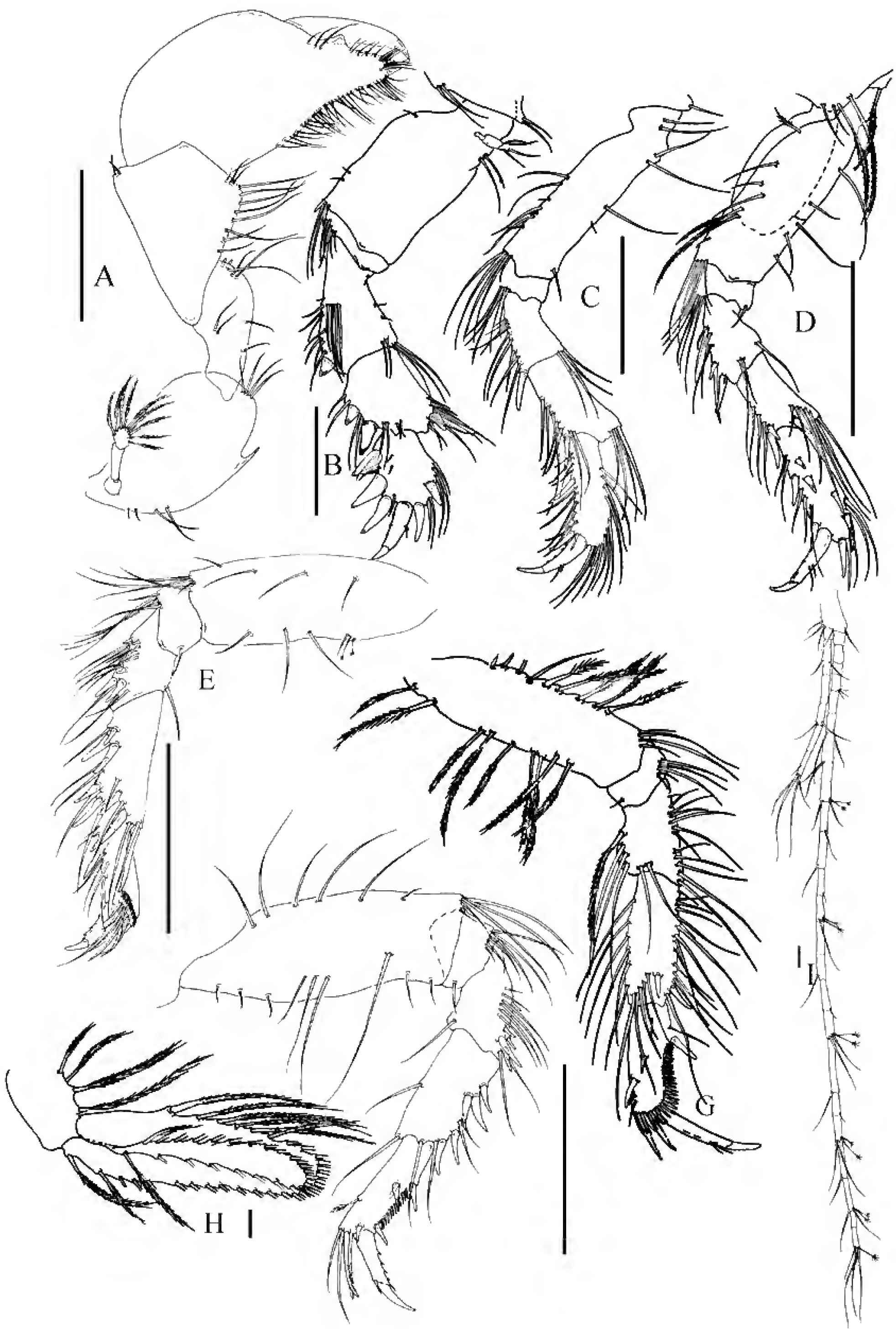


Fig. 5. *Apseudes quasimodo* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

(J28516), paratypes, Stn MSL-EG 96, 37°51.70'S 148°14.60'E, 37 m depth, February 1991, coarse sand; 6 ♀♀ with oostegites, 8 subadults, 7 juveniles (J28517), paratypes, Stn MSL-EG 99, 37°53.39'S 148°15.40'E, 43 m depth, February 1991, coarse sand; 1 subadult (J28518), paratypes, Stn MSL-EG 103, 37°49.89'S 148°30.13'E, 27 m depth, February 1991, coarse sand; 1 subadult (J28519), paratypes, Stn MSL-EG 104, 37°49.89'S 148°30.13'E, 27 m depth, February 1991, coarse sand; 2 ♀♀ with oostegites (J28520), paratypes, Stn MSL-EG 30, 37°51.77'S 148°13.63'E, 40 m depth, 25 September 1990, sand with shell; 1 ♀ with oostegites (J28521), paratypes, Stn MSL-EG 44, 37°53.18'S 148°28.96'E, 45 m depth, 26 September 1990, sand with shell; 1 ♀ with oostegites (J28522), paratypes, Stn MSL-EG 55, 37°50.63'S 148°43.47'E, 49 m depth, 28 September 1990, sand with shell; 1 ♀ with oostegites (J51300), paratypes, Stn MSL-EG VC-41-C3, 37°32.95'S 148°03.78'E, 40 m depth, May 1998; all Eastern Bass Strait, coll. N. Coleman, Smith-McIntyre grab. 1 ♀ with oostegites (J56335), paratypes, steel wharf Stn MSL ref C27 grab nr4, 12 m depth, 5 March 1997; 1 ♀ with oostegites (J57555), paratypes, Western Bass Strait, Stn CR 89-K-5 Stn 52, 38°57'S 143°27'E, 49 m depth, 08 October 1980, coarse sand, Smith-McIntyre grab. 2 juveniles (J57644), 1 ♀ with oostegites, 1 juvenile (J57665), 1 ♀ with oostegites (J57671), paratypes, Stn CPBS 23N, 38°20.29'S 145°14.18'E, 10 m depth, 10 March 1965, sandy gravel; 3 ♀♀, 2 subadults (J57668), paratypes, Stn CPBS 33S, 38°22.06'S 145°14.10'E, 13 m depth, 5 March 1965, reef, sponge; 2 ♀♀ with oostegites (J57680), paratypes, CPBS 23S/1 1973, ca 38°21'S 145°14'E, 10 m depth; all Crib Point Benthic Survey, Western Port, Smith-McIntyre grab.

*Description of female/hermaphrodite*. Body (Fig. 3), dorsoventrally flattened, holotype 12.7 mm long, 5.6 times as long as wide, narrower posteriorly. Cephalothorax subrectangular, as long as wide, anterior margin with conspicuous pointed rostrum with "shoulders" at base. Eyes present, eyelobes with small spine-like apophyses directed anteriorly; lateral spiniform apophyses at anterior margin of branchial chambers. Pereonites 1, 3, 5 and 6 subequal, about 0.4 times as long as cephalothorax, pereonite 2 just shorter, pereonite 4 longest, half length of cephalothorax; lateral margins of pereonites 1 and 2 uniformly convex, pereonites 3 to 6 with small anterolateral spine-like apophyses and expanded posterolaterally at attachment of coxae (all pereonites respectively 2.6, 2.8, 2.1, 1.6, 2.0 and 1.9 times as wide as long); ventral pointed, forwardly-curved hyposphenia on pereonites 2, 4 and 5, but variable - rarely also on pereonite 1, sometimes absent on pereonites 2 and 4; penial tubercle mid-ventrally on pereonite 6. Pleon just longer than last three pereonites together, with five free subequal pleonites bearing pleopods; pleonites dorsally convex, over three times as wide as long, not bearing lateral spiniform apophyses. Pleotelson less than half-length of whole pleon, twice as long as wide, with conspicuous lateral setae, and with pronounced mid-dorsal boss towards anterior margin.

Antennule (Fig. 4A). Peduncle proximal article three times as long as wide, inner margin without rugosity, with three shorter setae in proximal half and mid-length and subdistal tufts of four and two simple setae, outer margin with three proximal penicillate setae and three pairs of simple setae as figured; second article slightly longer than wide, 0.25 times as long as article 1, with four outer distal setae, four inner distal setae and two inner proximal setae; third article about half as long as wide, 0.25 times as long as second, with single inner and outer distal setae; fourth article as long as third, with single inner distal seta. Main flagellum of 12 segments, segments 6, 8, 10 and 12 each bearing 1 aesthetasc; accessory flagellum of five segments.

Antenna (Fig. 4B). Proximal peduncle article simple; article 2 with inner rugosity, single outer and inner setae at mid-length, and bearing elongate squama with 18 simple marginal setae; peduncle article 3 as long as wide, with one seta; article 4 0.8 times as long as article 2, with two inner setae; article 5 0.8 times as long as article 4, with three penicillate setae and four longer outer simple setae. Flagellum of 13 segments.

Labrum (not figured) rounded, distally finely setulose; sharp epistome present. Left mandible (Fig. 4C) outer margin rugose, bearing strong, denticulate pars incisiva, robust, denticulate lacinia mobilis, setiferous lobe with two trifurcate, three bifurcate and one simple setae, pars molaris (Fig. 4C') robust, distally concave, with fine marginal spinules. Right mandible (Fig. 4D) as left but without lacinia mobilis; mandibular palp of three articles, proximal article longer than wide with five inner setae, article 2 twice as long as article 1 with three longer proximal setae, two longer distal setae, and row of about 14 shorter setae in distal half; article 3 two-thirds length of article 2, densely setose along inner margin and distally. Labium (Fig. 4G) with small mid-distal tuft of setules, palp with fine lateral setules and three simple distal setae. Maxillule (Fig. 4E, E') inner endite with finely setose outer margin and five finely setulate distal setae; outer endite with eleven distal spines and two subdistal setae, outer and inner margins finely setose; palp of two articles, distally with six setae increasing in length towards tip of article. Maxilla (Fig. 4F) with smooth outer margin; outer lobe of moveable endite with two finely plumose subdistal setae and six distally-denticulate distal setae; inner lobe of moveable endite with three distally-denticulate setae, four simple setae and two subdistal setulose setae; outer lobe of inner endite with three stout trifurcate distal spines, and three distal and one subdistal setulose setae; inner lobe of fixed endite with rostral row of over 40 setae guarding seven longer finely denticulate setae. Maxilliped (Fig. 4H) basis naked; palp article 1 with two inner distal setae and five setae on slight outer-distal apophysis; palp article 2 longer than wide, with dense rows of numerous filtering setae on inner margin, outer margin with one slender distal spine and adjacent subdistal short, simple setae; palp article 3 longer than wide, with six shorter and thirteen longer simple setae in two rows along expanded inner margin; palp article 4 with twelve distal setae. Endite (Fig. 4H') with simple inner caudodistal seta, plumose outer subdistal seta, outer fine distal setae and inner rod-like distal spines. Epignath (Fig. 4I) large, cup-shaped, with distally-plumose distal seta.

Cheliped (Fig. 5A) robust. Basis 1.8 times as long as wide, dorsally naked, ventrally with two smaller and two longer proximal seta, mid-ventral spine-like apophysis and tuft of four distal setae; exopodite present, 3-articled, second article naked, elongate, distal article with nine plumose setae. Merus narrowing proximally, with three longer simple setae and paired short spines on ventrodistal "shoulder". Carpus subtriangular, widest distally (here 0.7 times as wide as carpus length), with row of simple setae along entire free ventral margin, dorsodistal and ventrodistal shorter setae. Chela stout, propodus 1.3 times as long as wide, fixed finger; dense row of setae along majority of ventral margin; cutting edge of fixed finger with row of fine setules and proximal tooth-like apophysis; dactylus with fine setae but no apophyses on cutting edge, distal claw pointed, meeting claw of fixed finger.

Pereopod 1 (Fig. 5B) with coxal spine-like apophysis pronounced. Basis stout, 1.9 times as long as wide, with two proximal dorsal setae, sparse small ventral setae, small ventrodistal spine and adjacent setae; exopodite present, 3-articled, article 3 with four distal plumose setae. Ischium with dense tuft of ventrodistal setae. Merus widening distally, 0.56 times as long as basis, with row of longer mesial setae, ventral marginal setae in distal half, stout ventrodistal spine, five dorsodistal simple setae but no dorsodistal spine. Carpus three-quarters as long as merus, with dorsodistal stout spine surrounded by tuft of setae, two ventral stout spines. Propodus just shorter than carpus and articulating slightly ventral of carpus midline, with three ventral stout spines, two dorsal stout spines surrounded by setae. Dactylus stout, with mid-dorsal fine seta and fine inner denticulation, unguis short, both together 0.85 times as long as propodus.

Pereopod 2 (Fig. 5C) more slender. Coxa without apophysis. Basis 4.1 times as long as wide with longer dorsal setae in the proximal half and tufts of ventral setae. Merus 0.7 times as long as carpus, with ventrodistal slender spine. Carpus elongate, with ventrodistal slender spine. Propodus articulating subdistally on ventrodistal corner of carpus, just longer than carpus, densely setose on both margins, with mid-ventral and ventrodistal spines. Dactylus with paired mid-dorsal setae and fine ventral denticulation, unguis short, the two together 0.63 times as long as propodus. Pereopod 3 (Fig. 5D) similar to pereopod 2, but propodus with outer mesial and subdistal dorsal spines.

Pereopod 4 (Fig. 5E) similar to pereopod 2 but basis with plumose sensory setae, merus only half length of carpus and with two ventral spines, carpus with four ventral, two distal and one slender dorsodistal spines; propodus as long as carpus, with dorsodistal tuft of four short and two long finely denticulate setae, and adjacent spinulation; dactylus plus claw 0.6 times as long as propodus and shorter than longest dorsodistal propodal setae. Pereopod 5 (Fig. 5F) similar to but larger than pereopod 4, carpus without dorsodistal spine, propodus with two long, lender and one short dorsodistal spines, and with ventral row of 12 short spinules bounded proximally, distally and mesially by small spines; dactylus ventrally denticulate, together with claw almost as long as propodus. Pereopod 6 (Fig. 5G) basis with both dorsal and ventral marginal plumose setae, merus with one plumose and three simple setae all longer than article. carpus densely setose on all margins, with subdistal and ventrodistal spines, propodus with tapering row of fine spines along most of ventral margin and around distal margin; dactylus together with claw almost as long as propodus.

Pleopods (Fig. 5H) all alike. Basis elongate, with four inner but no outer plumose setae. Endopod and exopod subequal, linguiform, each with about 30 plumose setae.

Uropod (Fig. 5I) biramous, both rami filiform, multi-segmented. Basis with five setae distally; exopod one-quarter as long as endopod, with five segments; endopod elongate, with about 22 segments.

*Description of younger stages*. Juveniles with slender cheliped, exopodite with only 5 setae; hyposphenia sparse, one on pereonite 6; subadults with robust cheliped similar to that of adult, fewer hyposphenia than adult, one on pereonite 6; no oostegites.

*Etymology*. Named after Quasimodo, a central character from French author Victor Hugo's 1831 novel *Notre Dame de Paris*, who also had a distinctive dorsal hump.

*Remarks. Apseudes quasimodo* sp. nov. is unique amongst the Apseudidae in having a pronounced mid-dorsal boss towards the anterior margin of the pleotelson, as well as the anaxial articulation of the propodus on the anterior pereopods. In the presence of a row of small spinules on the ventral margin of the propodus of pereopod 5 (as well as of pereopod 6), it resembles only *Apseudes sensu stricto* and *Paradoxapseudes* (see below) in the Apseudidae, but in the conformation of the cheliped, the pereonites, and with spine-like apophyses at the anterior margin of branchial chambers, *inter alia*, shows similarities with *Spinosapseudes* and *Tuberapseudes*, as well as such taxa as *Apseudes grossimanus* (which also has suggestions of an anaxial articulation of the pereopod propodus) and *A. tenuimanus*.

*Apseudes quasimodo* was found in Western Port at 10–13 m depth, and in the Eastern Bass Strait off the Metung to Marlo coast (to the east of Gippsland Lakes) from 27 to 49 m depth on coarse sandy substrata.

Genus ***Apseudopsis*** Norman, 1899

***Apseudopsis tuski*** (Błażewicz-Paszkowycz & Bamber, 2007) comb. nov.

*Apseudes tuski* Błażewicz-Paszkowycz & Bamber, 2007b, 116–120, figs 4–6.

*Remarks.* This species lacks anterolateral spiniform apophyses on the pereonites, a comb of spinules on the pereopod 5 propodus, and a dorsodistal spine on the merus of pereopod 1, so is clearly a member of *Apseudopsis* Norman 1899 *sensu* Guţu (2006), indeed close in overall morphology to *A. latreilli* (Milne-Edwards, 1828). *Apseudopsis tuski* also has unusual spination on the maxilliped palp, as is the case for two of the species of *Apseudes* discussed above, but in this case there are three spines on the outer margin of the second article, the most distal of which is large and robust.

This species was found throughout the Bass Strait, between 37°50' and 40°07'S and 143°14' and 148°30'E, and from 18 to 84 m depth on sandy to coarse shell substrata.

Genus ***Spinosapseudes*** Guţu, 1996

***Spinosapseudes colobus*** Błażewicz-Paszkowycz & Bamber, 2007

*S. colobus* Błażewicz-Paszkowycz & Bamber, 2007b, 126–127, figs 10–13.

*Remarks. Spinosapseudes colobus* was the second species of the genus to be described after *S. setosus* (Lang, 1968), recorded from the other side of the Tasman Sea off New Zealand at 610 m depth. *S. colobus* is a species more compact in its pereopods, and of a shallower distribution. This species was found throughout the Bass Strait, between 38°39' and 40°23'S and 144°18' and 148°40'E, and from 22 to 124 m depth.

Genus ***Bunakenia*** Guţu, 1995

***Bunakenia labanticheiros*** sp. nov.

Figures 6–9

*Material examined.* 1 brooding ♀ (J50813), holotype, Central Bass Strait Stn VC 31 C2, 39°02.52'S 146°10.47'E, 40 m depth, 14 May 1999, coll. N. Coleman; 1 ♂, 7 ♀♀, 2 juveniles (J50814), paratypes, Eastern Bass Strait Stn VC 31 C1, 38°18.3'S 147°15.25'E, 40 m depth, 10 May 1998, coll. N. Coleman; 115 specimens (J23633), paratypes, East Gippsland Survey Stn MSL-EG 32, 37°54.07'S 148°12.09'E, 42 m depth, 25 September 1990, sand with shell; 27 specimens (J23634), paratypes, East Gippsland Survey Stn MSL-EG 33, 37°53.42'S 148°11.87'E, 43 m depth, 25 September 1990, sand with shell; 20 ♀♀, 5 ♂♂ (J23637), paratypes, East Gippsland Survey Stn MSL-EG55, 37°50.63'S 148°43.47'E, 49 m depth, 28 September 1990, sand with shell; 3 ♀♀, 1 ♂ (J23639), paratypes, East Gippsland Survey Stn MSL-EG57, 37°51.29'S 148°43.73'E, 50 m depth, 28 September 1990, sand with shell; 27 specimens (J29174), paratypes, East Gippsland Survey Stn MSL-EG71, 37°53.39'S 148°15.40'E, 43 m depth, 4 June 1991, coarse sand; 45 specimens (J28619), paratypes, East Gippsland Survey Stn MSL-EG97, 37°53.39'S 148°15.40'E, 43 m depth, February 1991, coarse sand.

*Description of female.* Body (Fig. 6) dorsoventrally flattened, slender, holotype 2.4 mm long, 5.6 times as long as wide, tapering towards posterior, glabrous. Cephalothorax subrectangular, as long as wide, with uniform triangular rostrum; eyelobes and eyes present. Six free subequal pereonites, each glabrous and without lateral apophyses; pereonite 1 trapezoidal, wider anteriorly, just less than half as long as cephalothorax; pereonites 2 and 6 subequal, subrectangular, half as long as cephalothorax; pereonites 3 and 5 subequal, subrectangular, two-thirds as long as cephalothorax; pereonite 4 longest, 0.8 times as long as cephalothorax (all pereonites respectively 2.3, 2.0, 1.5, 1.25, 1.5 and 1.8 times as wide as long), lateral margins smooth, without apophyses. Pleon 2.4 times as long as pereonite 6, tapering posteriorly, of five free subequal pleonites bearing pleopods plus pleotelson; each pleonite about five times as wide as long, without dorsolateral rows of plumose setae. Pleotelson subrectangular, 0.7 times as long as all pleonites together, as long as wide.

Antennule (Fig. 7A) proximal peduncle article 3.2 times as long as wide, outer margin with numerous penicillate setae and one subdistal and two distal simple setae, inner margin centrally rugose, one simple proximal seta and five plumose setae; second peduncle article 1.5 times as long as wide, 0.3 times as long as first, with penicillate outer seta and numerous simple inner setae; third article half length of second, 1.5 times as long as wide, distally with inner and outer setae, the former longer than article; fourth peduncle article about half length of third. Main flagellum of 9 segments, single aesthetascs present on fifth, eighth and ninth segments; accessory flagellum of three segments.

Antenna (Fig. 7B), proximal peduncle article without apophysis. Second article with linguiform squama bearing 11 marginal setae, two setae next to base of squama. Third peduncle article twice as long as wide and two-thirds as long as second, fourth article as long as second, fifth article half length of fourth. Flagellum of five segments.

Labrum rounded, simple, distally setose. Right mandible (Fig. 7C) with strong, crenulate pars incisiva, setiferous lobe with six forked setae, outer margin finely spinose. Left mandible (Fig. 7D) similar but with crenulate lacinia mobilis. Pars molaris robust, with posterodistal denticulation; palp of three articles, proximal article with five simple setae, second article longest with two medial simple setae and, distal to these, three rows of two, three and four simple, third article with ten setae in a single row. Labium (Fig. 7G) with denticulate outer margin, palp with fine lateral setules and three simple distal setae. Maxillule (Fig. 7E) inner endite with outer apophysis, finely setose outer margin and five setulose distal setae, outer endite with eleven distal spines and two subdistal setae (not seen on figure), outer and inner margins finely setose, palp of two articles, distally with three setae. Maxilla (Fig. 7F) typical of the genus, with a rostral row of 25 setae, compound setae on the fixed endite and serrate sickle-like setae on the moveable endite inside five compound outer setae on the outer lobe. Maxilliped (Fig. 7H) basis with medial inner seta; first palp article with one very long inner setae and small, naked outer apophysis; second palp article just longer than wide, with one row of inner simple setae, parallel row of shorter setulose setae, and outer distal spine; third palp article wider than long with inner distal group of thirteen simple setae; fourth palp article mounted anaxially, with eight distal setae. Endites (Fig. 7H') with three coupling hooks, distally with four outer setae and numerous inner slender, blunt spines.

Cheliped (Fig. 8A) slender, smaller than pereopod 1, basis twice as long as wide, ventrally with long proximal seta, central sharp spine and distal group of four simple setae; three-articled exopodite present, slender, distal article with three plumose setae. Merus subtriangular, twice as long as wide, ventral margin with eight setae; carpus 4.7 times as long as wide, with longer ventral marginal setae and shorter dorsal marginal setae. Chela slender, fixed finger just shorter than palm with dense distal setation; dactylus and claw slightly overreaching fixed finger, both fingers without apophyses on cutting edge.

Pereopod 1 (Fig. 8B) with conspicuous sharp setose apophysis on coxa; stout basis less than twice as long as wide, dorsal margin bearing only simple setae in proximal half, single ventrodistal spine; exopodite large, three-articled, distal article with six plumose setae. Ischium with simple ventrodistal setae. Merus widening distally, with single dorsodistal and ventrodistal spines and associated simple setae. Carpus compact, wider than long, with fan of dorsodistal setae, one dorsodistal and two ventrodistal blunt spines. Propodus with two dorsodistal spines and four ventral blunt spines interspersed with single fine setae. Dactylus slender, with paired mid-dorsal and ventral fine setae; claw slender, finely denticulate.

Pereopods 2 and 3 (Fig. 8C, D) basis 3.2 times as long as wide with sparse penicillate setae, one (pereopod 2) or two (pereopod 3) ventromedial setae and tuft of longer ventrodistal setae; ischium half as long as wide; merus as long as carpus, widening distally and with long ventral setae and single

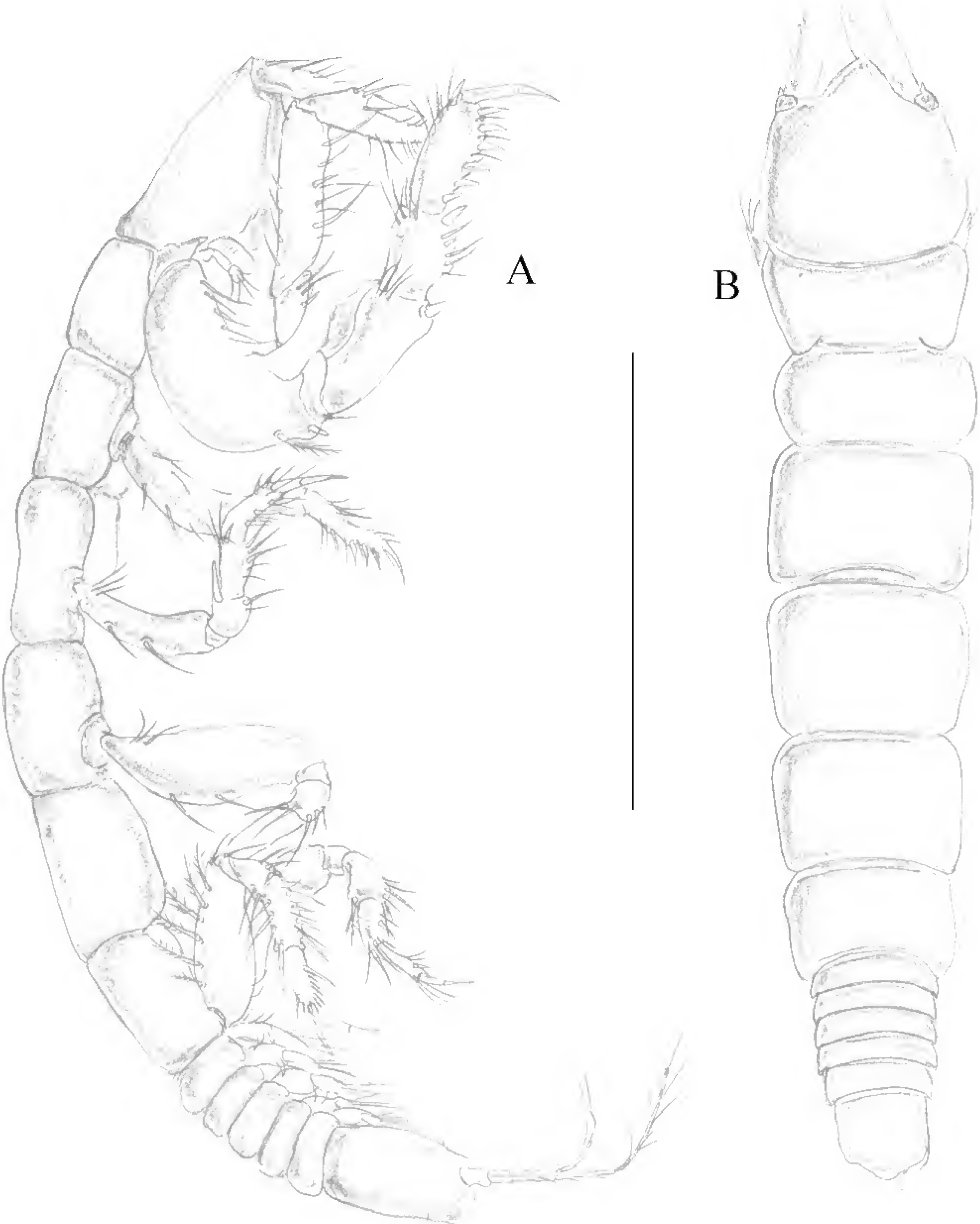


Fig. 6. *Bunakenia labanticheiros* sp. nov., holotype female. A, lateral view; B, dorsal view. Scale = 1 mm.


Fig. 7. *Bunakenia labanticheiros* sp. nov., female paratype. A, antennule; B, antenna; C, right mandible; D, left mandible; E, maxillule; E', maxillule palp; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite. Scale: A, B = 0.1 mm; C-H = 0.01 mm.

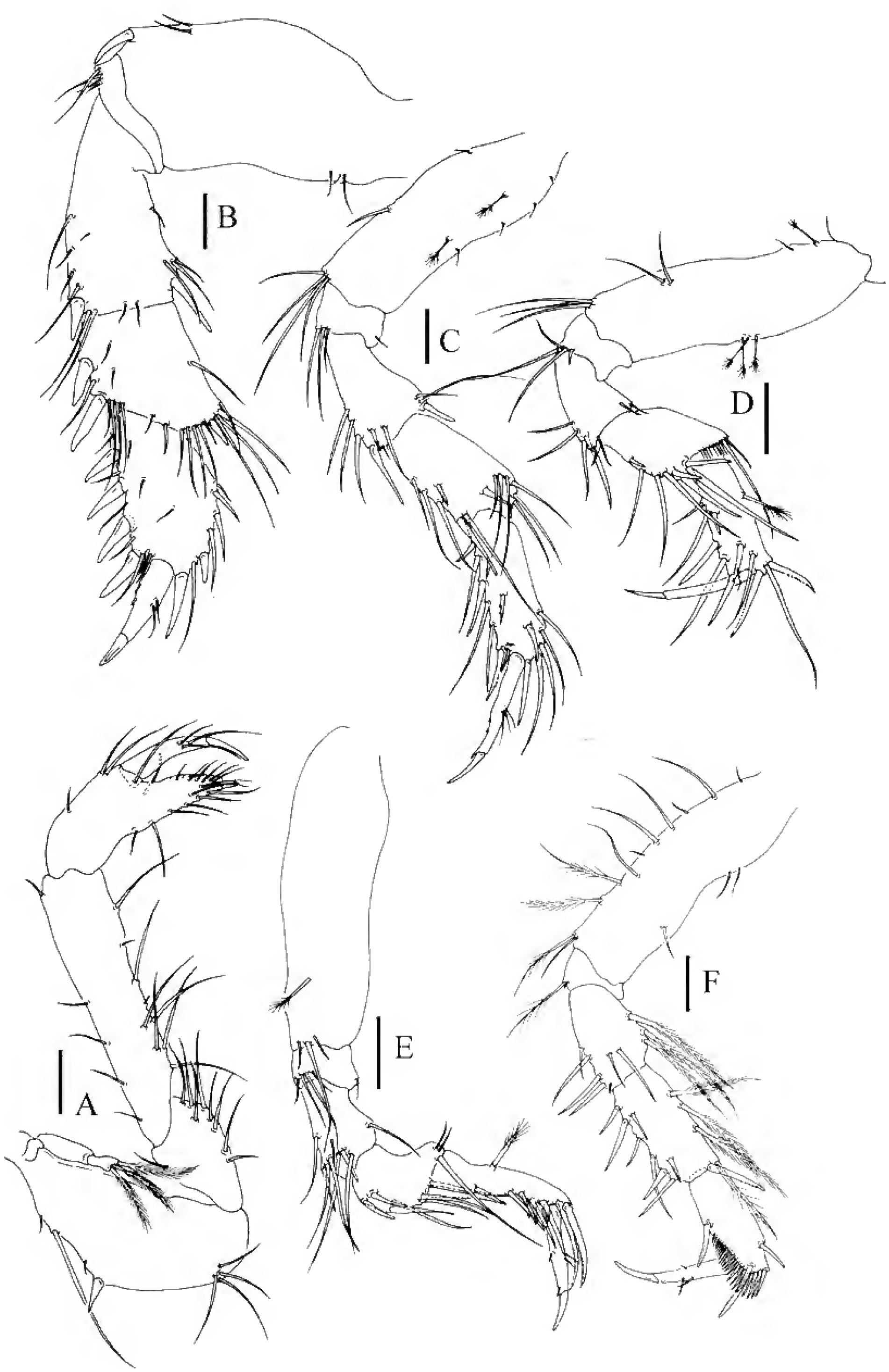


Fig. 8. *Bunakenia labanticheiros* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6. Scale = 0. 1 mm.

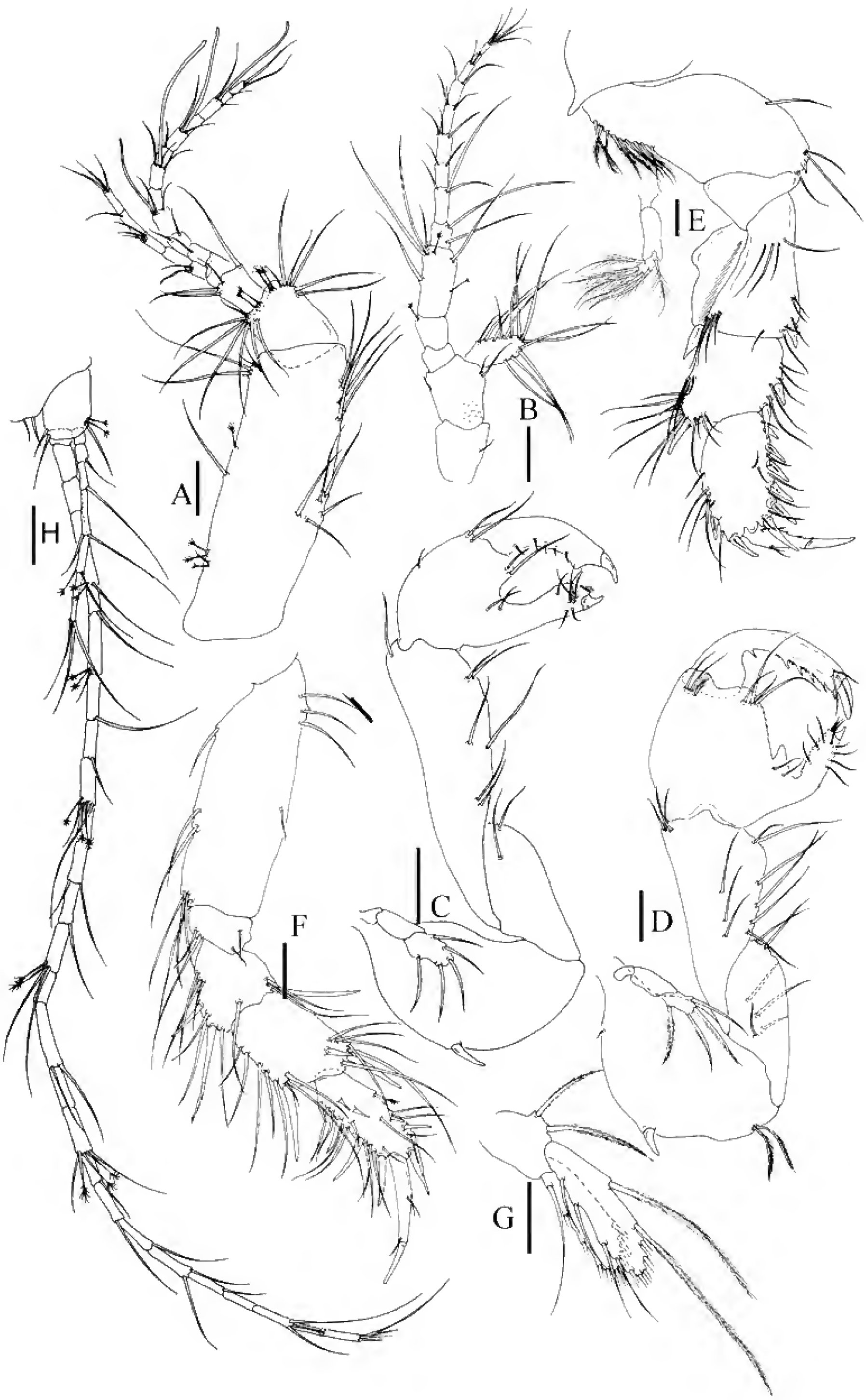


Fig. 9. *Bunakenia labanticheiros* sp. nov., male. A, antennule; B, antenna; C, juvenile male cheliped; D, adult male cheliped; E, pereopod 1; F, pereopod 2; G, pleopod; H, uropod. Scale = 0.1mm.

ventrodistal slender spine; carpus with slender ventrodistal spine I tuft of simple setae and crown of dorsodistal simple setae; propodus with two or three ventral and one dorsodistal slender spines; dactylus slender, claw not denticulate.

Pereopods 4 (Fig. 8E) and 5 with slender basis with penicillate seta and fine ventrodistal simple setae; carpus slightly longer than merus; propodus of pereopod 4 with mid-dorsal penicillate seta; dactylus and claw less slender than those of anterior pereopods.

Pereopod 6 (Fig. 8F) proportionately as pereopod 5, but basis with ventral marginal row of five simple and three plumose setae; merus shorter than carpus and with three dorsal plumose setae; carpus with four dorsal plumose setae; propodus with 20 small compound spines ventrally and distally on each side in tapering row; dactylus plus claw slender, simple.

Pleopods as those of male (Fig. 9G) all alike, basis with two inner but no outer plumose setae, endopod and exopod subequal, slender, each with 11 plumose setae.

Uropod (Fig. 9H) biramous, basis with three distal simple and two penicillate setae; exopod just less than three times as long as basis and of six segments; endopod elongate, filiform, multisegmented.

*Description of male.* generally similar to female. Antennule (Fig. 9A) main flagellum of 11 segments with single aesthetascs on segments 3, 5, 7 and 9, accessory flagellum of 5 segments. Antenna (Fig. 9B) flagellum of eight segments.

Conspicuous dimorphism of cheliped (Fig. 9D): basis 1.5 times as long as wide, ventrally with central spine and paired distal plumose setae; three-articled exopodite present, stout, distal article with four plumose setae. Carpus stouter, widening distally, twice as long as wide. Chela robust, highly modified, fixed finger flexed back along distal margin of propodus (palm), distal tip truncate with rugose cutting edge, tooth-like apophysis in angle between fixed finger and palm; dactylus narrowing rapidly from base, distally truncate, with five spines but no apophysis on cutting edge. Chela of subadult male (Fig. 9C) intermediate between that of mature male and that of female, carpus slender, fixed finger longer than palm, but not reflexed.

Pereopod 1 (Fig. 9E) with stout basis twice as long as wide, dorsal margin bearing nine plumose setae in proximal half. Ischium dorsally wide. Merus dorsal margin with flattened, flange-like apophysis and dorsodistal spine. Pereopods 2 (Fig. 9F) and 3, merus shorter than carpus.

*Etymology.* From the Greek – *labe* – something for grasping, and *anticheiros* – thumb, in reference to the extra tooth on the fixed finger of the chela of the male.

*Remarks.* Guţu (1996c) described two subgenera of *Bunakenia.* The nominate *B. (Bunakenia)*, distinguished only by having rows of plumose setae on the basis of pereopod 1, includes three species, *B. (B.) indonesiana* Guţu, (1995a) from Sulawesi, at 4–5 m depth, *B. (B.) tanzaniana* Guţu, 1996(d) from the Indian Ocean coast of Africa at 20 m depth, and *B. (B.) salzella* Bamber, 2005 from the littoral to 30 m depth in southwestern Australia. The subgenus *B. (Extensibasella)*, without plumose setae on the basis of pereopod 1, includes *B. (E.) sudvestatlantica* Guţu, 1996(c) from Brazil at 31 m depth, *B. (E.) aspalieus* Bamber, Bird and Angsupanich, 2003, from Thailand in littoral-infralittoral seagrass beds, *B. (E.) kadazan* Bamber and Sheader, 2005 from Sabah in sand at 23–35 m depth, and *B. (E.) anomala* Guţu, 2006 from Moreton Bay, Australia (depth unspecified).

The present species has plumose setae on the basis of pereopod 1 in the male, but not in the female, and thus falls quite between the two subgenera; Bamber & Sheader (2005) questioned the validity of the subgenera, their species *B. kadazan* showing little affinity to *B. (E.) sudvestatlantica*, and the zoogeography of these two "groups" is inconsistent. We therefore choose to dispense with those subgenera.

In the conformation of the male chela, with extreme reflexion of the fixed finger, *Bunakenia labanticheiros* sp. nov. is similar only to the other Australian species, *B. salzella*, from which it can be distinguished by the presence of the tooth-like apophysis in the angle between the fixed finger and the palm of the male chela (absent in *B. salzella*), the absence of plumose setae on the basis of pereopod 1 in the female (present in *B. salzella*), the mid-ventral spine on the basis of the cheliped (a plumose seta in *B. salzella*), fewer ventral spines on the propodus of pereopod 1, fewer plumose setae on the basis of pereopod 6, and details of the setation of the mouthparts and pleopods, *inter alia*.

Unlike the present species, *B. kadazan* has a thin, pointed rostrum; *B. sudvestatlantica* has a more elaborate cheliped basis in the male, and is without the tooth-like apophysis in angle between fixed finger and palm of the male chela, as also are *B. tanzaniana* and *B. anomala*; *B. aspalieus* (male unknown) has posterolateral hook-like apophyses on the pereonites; all four have plumose setae on both margins of the pleopod; *B. indonesiana* has only one basis seta on the pleopod, but dense rows of plumose setae on the pereopod 1 basis of both genders, and a more pronounced rostrum. All of these species have an inner apophysis on the proximal peduncle article of the antenna, unlike *Bunakenia labanticheiros.*

All specimens were taken from sandy substrata at between 40 and 50 m depth in the Central and Eastern Bass Strait.

Genus ***Paradoxapseudes*** Guţu, 1991

***Gollumudes*** Guţu, 1991

*Remarks.* in a reanalysis of material from Cuba, the type locality for the then monotypic genus *Paradoxapseudes*, Guţu (2008a) revised the morphology of the type species, *P. cubensis* Guţu 1991, and realised that *Gollumudes* Bamber 2000 is a junior synonym of *Paradoxapseudes*. As a result, he was able to assign 12 species to the genus, which now showed a worldwide distribution. The genus is partly characterized by the row of leaf-like propodal spines on pereopod 5, as well as the row on pereopod 6 found in other apseudomorphs (but see also *Apseudes*). Owing to this new resource of information on the morphological variation within *Paradoxapseudes* (including *Gollumudes*), the Bass-Strait material, including that attributed to "*G.*" *larakia* Edgar (1997) by Błażewicz-Paszkowycz & Bamber (2007b) was re-examined, and found to be of two distinct species, which are described below.

During the analysis of the morphology of all the taxa now included in *Paradoxapseudes*, it also became apparent that the material from Tanzania mentioned by Guţu (2007), and from the Strait of Malacca and the South China Sea mentioned by Guţu (2008a), all attributed to the Japanese species *P. littoralis* (Shiino, 1952), was in fact not of that species (unlike *P. littoralis*, they have serrations on the antennule peduncle article 1, significantly more segments in the main flagellum of the antennule, and plumose, not simple, dorsal setae on the basis of pereopod 1, and the last two have far fewer leaf-like spines on the propodus of pereopod 5, *inter alia*). It is certainly quite unlikely that the material from Tanzania would be conspecific with a species from Japan. This material is considered to represent at least two further taxa, for which more detailed description is required before diagnosis and naming.

***Paradoxapseudes paneacis*** sp. nov.

Figures 10–12

*Gollumudes larakia* Błażewicz-Paszkowycz & Bamber, 2007b (partim – shallow water specimens), non-*Apseudes larakia* Edgar, 1997.

*Material examined.* 1 ♀ (J58580), holotype, 1 ♂ (J58581), allotype, 155 further specimens (J57662), paratypes, Crib Point Benthic Survey Stn CPBS 33S/2, Western Port, 38°21.60'S 145°13.67'E, 13 m depth, 12 March 1965, muddy sand, Smith McIntyre Grab. 21 specimens (J57649), Stn CPBS 33S, same data as holotype; 1 ♀ with oostegites (J55880), 3 specimens (J57659), paratypes, Stn CPBS 23N, 38°20.29'S 145°14.18'E, 10 m depth, 10 March 1965, sandy gravel; 7 specimens (J57672), paratypes, Stn CPBS 23S, 38°21.69'S 145°13.51'E, 11 m depth, 9 March 1965, muddy sand; 1 brooding ♀ (J56169), 20 specimens including ♂♂ and brooding ♀♀, 1 brooding ♀ (J57674), paratypes, Stn CPBS 41N, 38°20.81'S 145°13.85'E, 13 m depth, 30 March 1965, gravel and sand; all Western Port, Crib Point Benthic Survey, Smith McIntyre Grab. 1 ♀ (J56292), paratype, Western Port, "sublittoral", 25 November 1971.

*Other material (as in Błażewicz-Paszkowycz & Bamber, 2007b).* 1 individual (J53143), 50 m south of Twin Reefs, Venus Bay (38°41'S, 145°39'E), 9 m, 07 March 1982, coll. M. McDonald; 1 individual (J55759), 50 m east of Petrel Rock, Venus Bay (38°39'S, 145°42'E), 8 m, 05 March 1982, (CPA 1) coll. M. McDonald and M.F. Gomon; 5 individuals (J55761), 1 km east of Harmers Haven, 500 m offshore (38°34'S, 145°40'E), 11 m, 06 March 1982, (CPA 14), coll. C. Larsen and G. Barber; 1 individual (J55762), 1 km east of Harmers Haven, 300 m offshore (38°34'S, 145°40'E), 6 m, 06 March 1982 (CPA 15), coll. R.S. Wilson and C. Larsen; 1 individual (J55763), east side of Cape Paterson (38°41'S, 145°36'E), 6 m, 05 March 1982, (CPA 12), coll. R.S. Wilson, G. Barber, *et al.*; 1 individual (J55765) Bennison Channel 1.0 km south of Granite Island (38°49'S, 146°23'E), 6.0 m, 23 November 1983, (CIN 28), coll. G.J. Morgan.

*Description of female.* Body (Fig. 10) dorsoventrally flattened, holotype 2.9 mm long, 5.8 times as long as wide, tapering towards posterior. Cephalothorax subrectangular, 1.4 times as long as wide, with large triangular rostrum; eyelobes and eyes present. Pereonites 1 and 2 subequal in length, 0.28 times as long as cephalothorax, with convex lateral margins, paired anterodorsal setae and posterolateral plumose setae; pereonite 3 longest, 1.5 times as long as pereonite 2, with anterolateral pointed apophysis, midlateral invagination and posterolateral rounded apophysis above pereopod attachment, and with lateral plumose setae and paired anterodorsal setae; pereonites 4 to 6 similar to, but progressively shorter than, pereonite 3, pereonite 6 being 1.26 times as long as pereonite 2 (all pereonites respectively 2.7, 2.5, 1.7, 1.8, 1.9 and 1.9 times as wide as long). Pleon three times as long as pereonite 6, narrower than pereon, with five free subequal pleonites bearing pleopods; each pleonite about three times as wide as long and extended laterally into sharp, triangular apophysis bearing plumose setae. Pleotelson subpentangular, with two rounded apophyses bearing plumose setae on each side, as long as last three pleonites together, just longer than wide.

Antennule (Fig. 11A) proximal peduncle article 3.6 times as long as wide, outer margin with penicillate setae and sparse simple setae in distal half, inner margin with sparse simple setae and proximal serration; second peduncle article wider distally, 1.5 times as long as wide, 0.3 times as long as first, with three penicillate and five simple distal setae; third article 0.7 times length of second, about twice as long as wide; fourth peduncle article slender, half length of third. Main flagellum of 7 segments, aesthetascs present on second, third and fifth segments, seventh segment anaxial on sixth; accessory flagellum of three segments.

Antenna (Fig. 11B), proximal peduncle article with subrectangular inner apophysis bearing two plumose setae. Second peduncle article twice as long as first, twice as long as wide, margins sinuous, with medial and distal simple setae on outer margin, medial and distal tooth-like apophyses on inner margin, the former with an adjacent plumose seta; elongate linguiform squama bearing two longer distal and two shorter subdistal setae. Third peduncle article as long as wide and one-quarter as long as second, with inner-distal spine-like apophysis; fourth and fifth articles 0.7 times as long as second. Flagellum of four segments.

Labrum (not figured) rounded, distally finely setulose. Left mandible (Fig. 11C) with strong, crenulate pars incisiva, robust lacinia mobilis with three distal crenulations, setiferous lobe with two compound and three simple setae; outer margin finely denticulate; pars molaris (Fig. 11C") robust, with radial rows of distal rugosity; palp (Fig. 11C') of three articles, proximal article shortest with five simple setae, second article longest with single row of two longer and eight shorter finely setulose setae along distal half of ventral margin, third article with 11 finely setulose setae, distal setae much longer than more proximal setae; right mandible (Fig. 11D) similar but without lacinia mobilis. Maxillule (Fig. 11E) inner endite with slight outer apophysis, finely setose outer margin and four setulose distal setae, outer endite with eleven distal spines and two subdistal setae, outer margin finely setose, palp (Fig. 11E') of two articles, distally with four setae. Maxilla (Fig. 11F) outer lobe of moveable endite with two subdistal setulose sickle-like setae and five distal setulose setae, inner lobe with eight simple curved setae and five stouter plumose setae; outer lobe of fixed endite with six compound distal spines and subdistal biserrate spine, inner lobe with three stout, proximally setulose setae and rostral row of 26 setae. Labium (Fig. 11G) with setulose outer margin, palp with dense tufts of fine lateral setules and three simple distal seta. Maxilliped (Fig. 11H) basis naked; first palp article with one very long plumose inner seta and adjacent fine simple seta, and

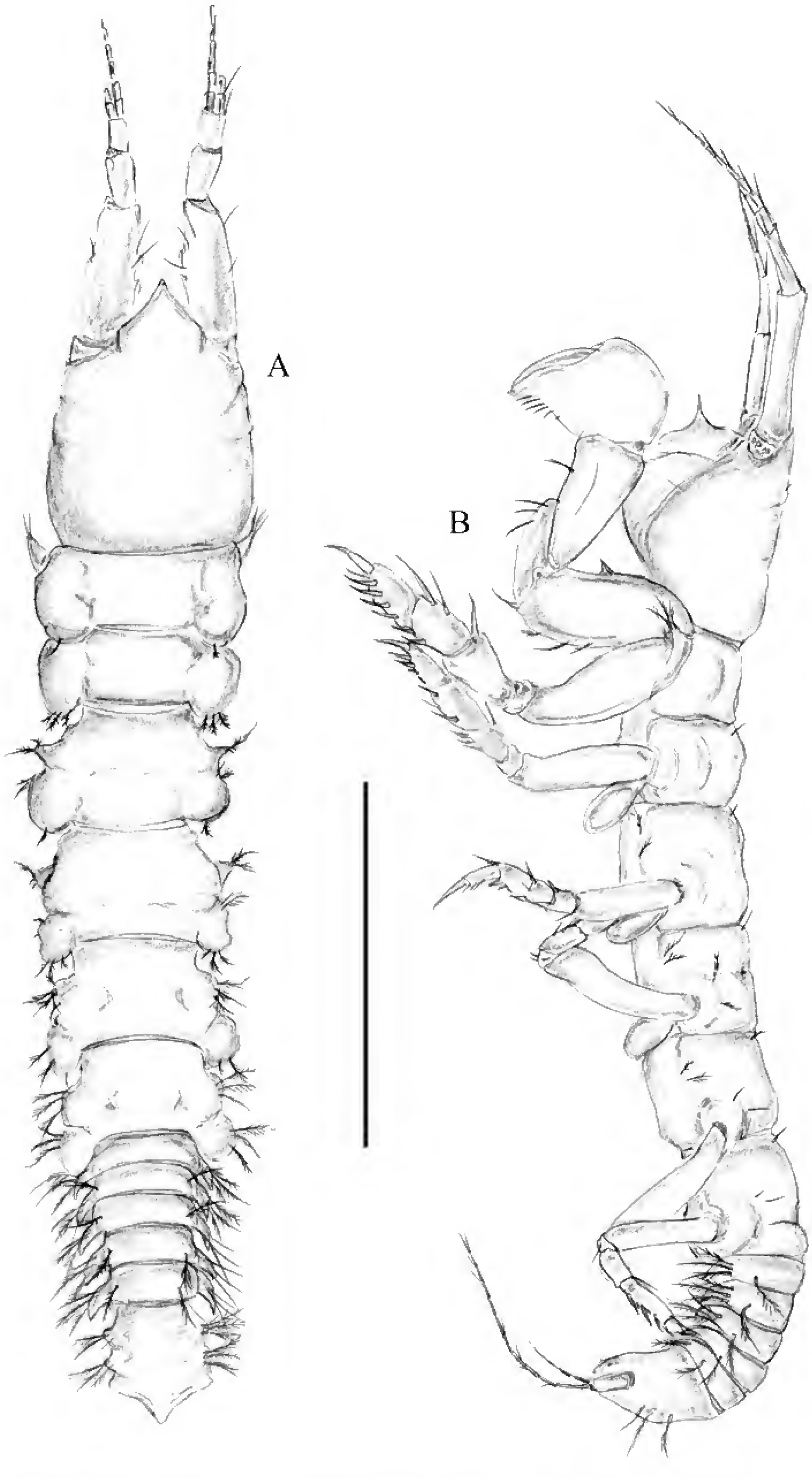


Fig. 10. *Paradoxapseudes paneacis* sp. nov., holotype, adult female. A, dorsal view; B, lateral view. Scale = 0.1 mm.

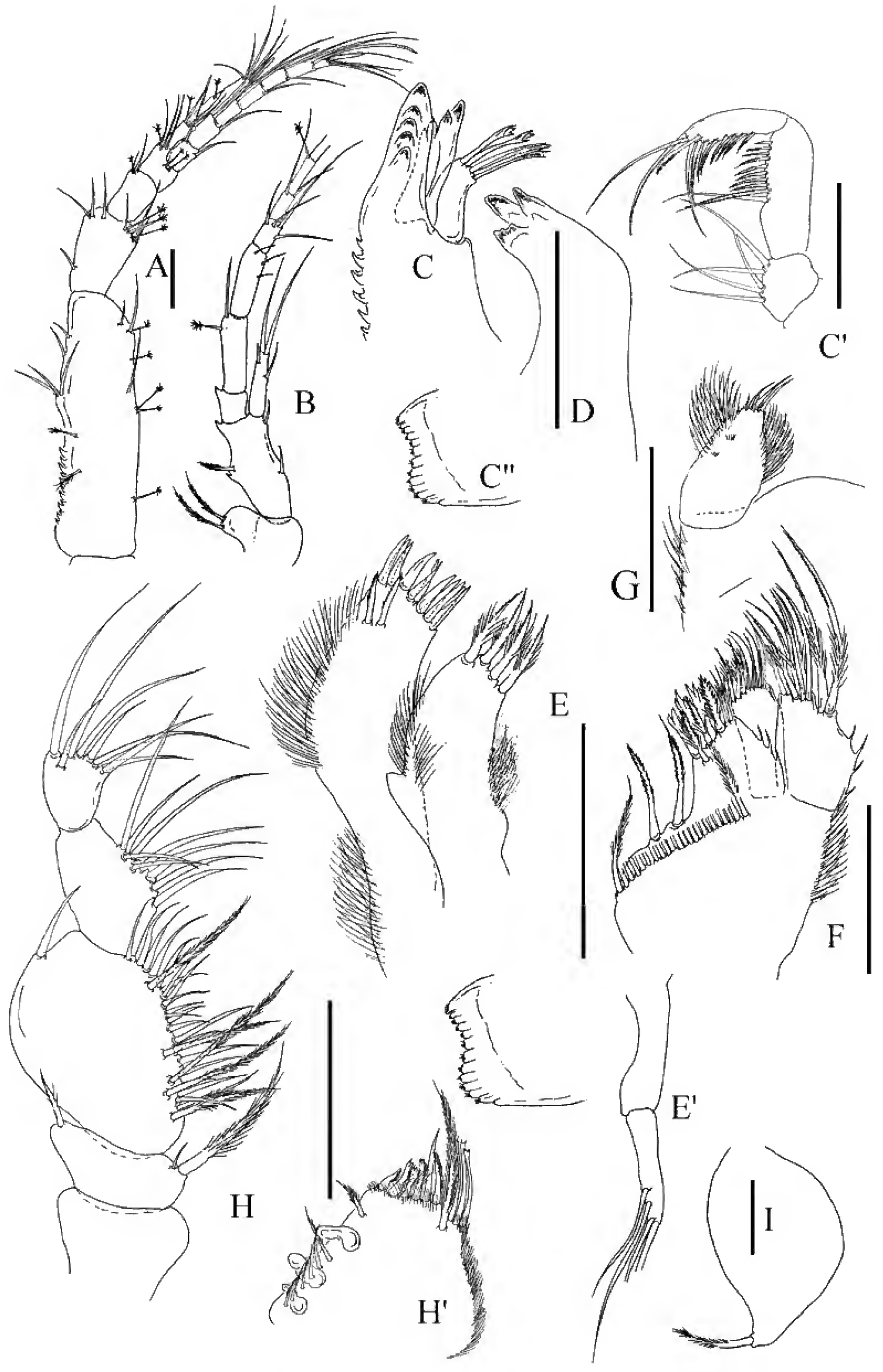


Fig. 11. *Paradoxapseudes paneacis* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; C', mandible palp; C”, mandibular molar; D, right mandible; E, maxillule, with E', detail of palp; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath. Scale: A, B = 0.1 mm; C-I = 0.01 mm.

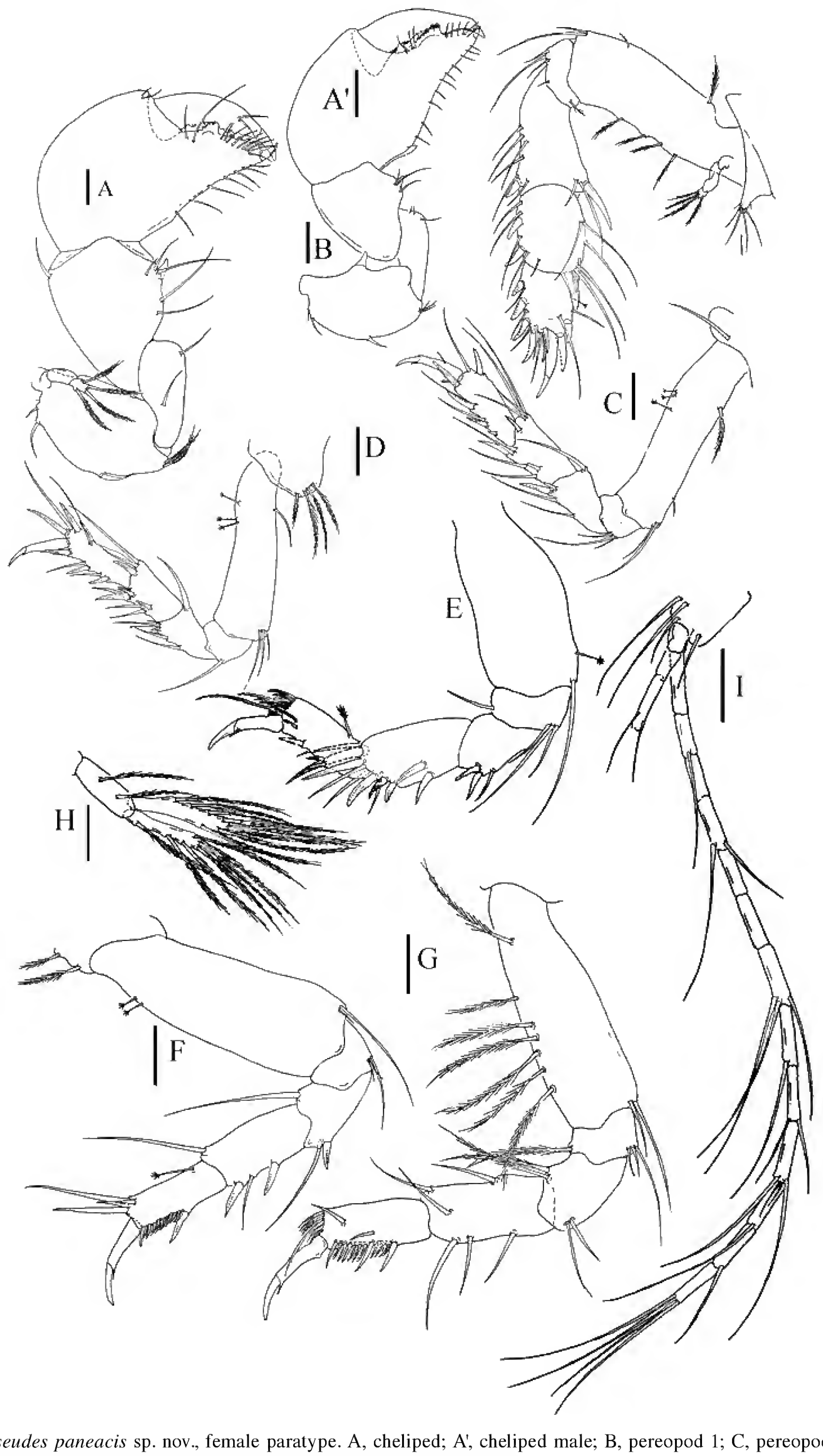


Fig. 12. *Paradoxapseudes paneacis* sp. nov., female paratype. A, cheliped; A', cheliped male; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

small plumose outer seta; second palp article longer than wide, with inner rows of five ventral plumose setae and numerous distally-curved simple; third palp article nearly twice as long as wide, with inner group of nine simple curved setae; fourth palp article with one subdistal and seven distal simple setae. Endites (Fig. 11H') with three coupling hooks, outer margin densely setulose, distally with one simple seta and numerous slender, blunt, bifurcate spines, outer subdistal plumose seta. Epignath (Fig. 11I) oval, with setulose distal spine.

Cheliped (Fig. 12A') basis 1.6 times as long as wide, with two ventroproximal setae on small tubercles, mid-ventral curved spine, two ventrodistal plumose setae; exopodite present, distal article with 4 plumose setae (as on male, Fig. 12A); merus with one longer and two shorter setae on ventrodistal shoulder; carpus widening distally, subpentangular, with stout, curved spine and three simple setae mid-ventrally; chela robust, palm of propodus just longer than wide, fixed finger two-thirds length of palm, ventral margin regularly setose, cutting edge of fixed finger with crenulations and central rugose tooth-like apophysis, numerous submarginal setae; dactylus stout, with crenulated cutting edge.

Pereopod 1 (Fig. 12B) with conspicuous setose apophysis on coxa; basis 2.9 times as long as wide, dorsal margin bearing four plumose setae in proximal half, ventral margin with single proximal plumose seta, single mid-ventral and paired distal simple setae; exopodite three-articled, distal article with four plumose setae. Ischium with three simple ventrodistal setae. Merus widening distally, with ventrodistal row of simple marginal setae, and single long dorsodistal and shorter ventrodistal finely denticulate spines. Carpus just shorter than merus, with setose margins including paired dorsodistal setae longer than propodus, one dorsodistal and two ventrodistal finely denticulate spines. Propodus 0.6 times as long as carpus, with two dorsodistal and four ventral finely denticulate spines interspersed with single fine setae. Dactylus slender, claw short, together longer than propodus.

Pereopods 2 and 3 (Fig. 12C, D) coxa with rounded, setose apophysis, basis four times as long as wide, sparsely setose, ventrodistal seta reaching past half length of merus; ischium half as long as wide, with fine dorsal seta, one short ventral seta and one ventral seta longer than merus; merus shorter than carpus, with two to four ventral setae, pair of ventrodistal spines, one very short, and single strong dorsodistal seta; carpus with ventrodistal spine with adjacent simple setae, smaller submarginal ventral spines, inner distal finely-denticulate spine and long dorsodistal simple setae exceeding tip of propodus; propodus longer than carpus, with three or four finely-denticulate ventral spines, one (P2) or two (P3) dorsodistal finely-denticulate spines, dorsodistal setae exceeding tip of claw; dactylus with ventrodistal seta, dactylus and claw curved, together as long as carpus.

Pereopod 4 (Fig. 12E) basis three times as long as wide, ventrodistal seta reaching past half length of merus; ischium half as long as wide, with fine dorsal seta, two shorter ventral setae and one ventral seta longer than merus; merus 0.6 times as long as carpus, with one ventral seta and pair of ventrodistal finely-denticulate spines; carpus with paired mid-distal spines and ventrodistal row of five finely denticulate spines interspersed with simple setae; propodus 0.8 times as long as carpus, with two finely-denticulate ventral spines and group of numerous finely-setulose dorsodistal setae and single dorsodistal seta exceeding tip of claw; dactylus with ventrodistal seta, dactylus and claw curved, together just shorter than propodus.

Pereopod 5 (Fig. 12F) similar to pereopod 4, but merus with single ventral spine, long dorsodistal and ventrodistal setae reaching or exceeding tip of carpus, carpus with two ventral spines and dorsodistal seta exceeding tip of propodus, propodus with one short and two longer setae, one of which longer than dactylus plus claw, and with ventral comb of 10 leaf-like spines in the distal half.

Pereopod 6 (Fig. 12G) proportionately similar to pereopod 5, basis with seven plumose dorsal setae; ischium with single dorsal plumose seta; merus with two dorsal plumose setae; carpus with dorsal and ventral simple setae; propodus with small leaf-like spines ventrally and distally; dactylus plus claw slender, curved, together as long as propodus

Pleopods typical for genus (Fig. 12H), basis with two inner but no outer plumose setae, endopod with eight plumose marginal setae, exopod shorter with seven plumose marginal setae.

Uropod (Fig. 12I) biramous, basis with four distal simple setae; exopod broken, of at least four segments; endopod elongate, filiform, with about 14 segments.

*Description of male*. Generally similar to female, but with dimorphic cheliped (Fig. 12A), basis stout, 1.5 times as long as wide, with ventroproximal setae on small tubercles, mid-ventral curved spine, ventrodistal plumose setae; exopodite present, distal article with 4 plumose setae; merus sparsely setose; carpus stouter than that of female, widening distally, almost triangular, with stout, curved ventral spine; chela robust, stouter than that of female, palm of propodus as long as wide, fixed finger almost half length of palm, ventral margin regularly setose, cutting edge of fixed finger with crenulations and sub-proximal rugose tooth-like apophysis, numerous submarginal setae; dactylus stout, with crenulated cutting edge. Setae on most articles longer than those of female.

*Etymology*. Named after Crib Point, the type locality, contrived from the Greek *pahnee* – a crib, and *akis* – a point.

*Remarks*. The shallow-water material described as *Gollumudes larakia* in Błażewicz-Paszkowycz & Bamber (2007) is in fact of this species, to which are added numerous further specimens, principally collected during the Crib Point Benthic Survey (see Poore, 1986). *Paradoxapseudes paneacis* sp. nov. is unusual in the genus in having long ventrodistal and dorsodistal setae on merus, carpus, ischium and basis of each pereopod. It is the only Australian species with a spine on the cheliped carpus, a feature also present in *P. littoralis* (from Japan), *P. garthi* (Menzies, 1956) from the Gulf of California, *P. heroae* (Sieg, 1986) from the Subantarctic, and *P. intermedius* (Hansen, 1895) from the Mediterranean. *P. paneacis* is also the only Australian species to have inner proximal serration on the antennule peduncle (like only *P. intermedius* of the four species listed above); as well as the long distal setae on the pereopod article, the present species differs from *P. intermedius* in having more mandibular palp setae, fewer basis setae on pereopods 1 and 6, and in the conformation of the rostrum, *inter alia*.

All specimens were collected in Western Port on shallow sands at depths between 6 and 13 m.

***Paradoxapseudes attenuata*** sp. nov.

Figures 13–15

*Gollumudes larakia* Błażewicz-Paszkowycz & Bamber, 2007b (partim – deeper-water specimens), non-*Apseudes larakia* Edgar, 1997.

*Material*: 1 ♀ (J47130), holotype, Stn BSS109, Central Bass Strait, 40°30.9'S 144°56'E, 27 m depth, 2 November 1980, very coarse sand, coll. M. Gomon & G.C.B. Poore; 2 ♀♀ with oostegites (J55843), paratypes, Stn BSS117, Central Bass Strait, 40°38.0'S 145°23'E, 36 m depth, 4 November 1980, muddy shell and grit, coll. M. Gomon & G.C.B. Poore; 1 ♀ (J58464), paratype, Stn BSS161, Central Bass Strait, 39°48.3'S 147°19.2'E, 60 m depth, 14 November 1981, muddy sand, coll. R. Wilson.

*Other material*: 2 ♀♀ (J55842), Stn BSS119, western Bass Strait, 39°06.7'S 143°28.7'E, 92 m depth, 31 January 1981, fine sand, coll. M. Gomon *et al.*; 1 ♀ (J57559), Stn VC 18 C2, Central Bass Strait, 38°30.2'S 144°15.0'E, 40 m depth, 30 May 1998, coll. N. Coleman, Smith McIntyre grab. *Material in Błażewicz-Paszkowycz & Bamber (2007b)*: 4 individuals (J47131), Australia, Tasmania, eastern Bass Strait, 37 km NNE of Eddystone Point (40°43.48'S, 148°37.12'E), 67 m, 14/11/1981, (BSS 164), coll. R.S. Wilson; 1 individual (J55756), western Bass Strait, 30 km SSW of Warrnambool (38°38.12'S, 142 35.00'E), 59 m, 20/11/1981, (BSS 188), coll. R.S. Wilson; 3 individuals (J55757), western Bass Strait, 15 km S of Port Fairy (38°32.00'S, 142 28.36'E), 52 m, 20/11/1981, (BSS 187), coll. R.S. Wilson; 1 individual (J55760), western Bass Strait, 15 km south of Port Fairy (38°32.00'S, 142 28.36'E), 52 m, 20/11/1981, (BSS 187), coll. R.S. Wilson; 2 individuals (J55766), Victoria, western Bass Strait, 5 km south of Point Reginald (38°48.00'S, 143°14.30'E), 47 m, 20/11/1981, (BSS 185), coll. R.S. Wilson; 1 individual (J55758), western Bass Strait, 5 km southwest of Bluff Point (40°48.06'S, 144°38.00'E), 42 m, 02/02/1981, (BSS 126 G), coll. M.F. Gomon.

*Description of female with oostegites*. Body (Fig. 13) dorsoventrally flattened, elongate, holotype 2.75 mm long, seven times as long as wide, tapering towards posterior. Cephalothorax subrectangular, 1.5 times as long as wide, with triangular rostrum; eyelobes and eyes present. Pereonite 1 laterally convex, 0.23 times as long as cephalothorax; pereonite 2 1.2 times as long as pereonite 1, with slight anterolateral apophysis bearing plumose seta, smaller posterolateral plumose seta; pereonites 3 to 6 with anterolateral pointed apophyses and posterolateral rounded apophyses, each bearing plumose setae, pereonites 3 and 5 subequal, 1.8 times as long as pereonite 1, pereonite 4 longest, twice as long as pereonite 1, pereonite 6 as long as pereonite 2 (all pereonites respectively 2.9, 2.3, 1.5, 1.2, 1.4 and 1.9 times as wide as long). Pleon narrower than pereon, just longer than cephalothorax, tapering posteriorly, with five free subequal pleonites bearing pleopods; each pleonite about 3.3 times as wide as long and extended laterally into sharp, triangular apophysis bearing plumose setae. Elongate pleotelson subpentangular, with two rounded apophyses bearing plumose setae on each side, as long as last four pleonites together, 1.75 times as long as wide.

Antennule (Fig. 14A) proximal peduncle article 4.2 times as long as wide, outer margin with slight proximal rounded apophysis, three penicillate setae and three simple setae in distal half, inner margin with sparse simple setae, no proximal corrugation; second peduncle article twice as long as wide, 0.4 times as long as first, with two penicillate and five simple distal setae; third article half length of second, about twice as long as wide; fourth peduncle article slender, slightly shorter than third. Main flagellum of 7 segments, single aesthetasc present on sixth segments, seventh segment anaxial on sixth; accessory flagellum of three segments.

Antenna (Fig. 14B), proximal peduncle article with inner apophysis bearing small seta and two teeth. Second peduncle article twice as long as first, twice as long as wide, margins sinuous with mid-inner setae on apophysis, with elongate linguiform squama bearing 6 marginal setae. Third peduncle article as long as wide and one-quarter as long as second, fourth article 0.8 times as long as second, fifth article half length of second. Flagellum of five segments.

Labrum (Fig. 14C) rounded, simple, distally with rows of setules. Left mandible (Fig. 14D) with strong, crenulate pars incisiva, robust lacinia mobilis with five distal crenulations, setiferous lobe with four slender setae; pars molaris robust, with radial rows of distal rugosity; palp (Fig. 14D') of three articles, proximal article shortest with six simple setae, second article longest with four distomedial simple setae, third article with six distal setae. Right mandible (Fig. 14E) similar but without lacinia mobilis. Labium (Fig. 14H) with denticulate outer margin, setulose distal margin, palp with fine lateral setules and one simple distal seta. Maxillule (Fig. 14F) inner endite with slight outer apophysis, finely setose outer margin and four setulose distal setae, outer endite with eleven distal spines and two subdistal setae, outer and inner margins finely setose, palp of two articles, distally with one short and one longer setae. Maxilla (Fig. 14G) outer lobe of moveable endite with two simple subdistal sickle-like setae and five distal setulose setae, inner lobe with eight simple curved setae and five stouter plumose setae; outer lobe of fixed endite with six compound distal spines and subdistal biserrate spine, inner lobe with three stout, serrate and proximally setulose setae and rostral row of 15 setae. Maxilliped (Fig. 14I) basis naked; first palp article with one very long plumose inner seta and small outer seta; second palp article with artefactual suggestion of proximal articulation, longer than wide, with four proximal inner plumose setae and rows of inner curved setae in distal half, mostly plumose; third palp article nearly twice as long as wide, with inner group of six simple curved setae; fourth palp article with one subdistal and seven distal simple setae. Endites (Fig. 14I') with two coupling hooks, outer margin densely setulose, distally with one simple seta and numerous slender, blunt, bifurcate spines. Epignath (Fig. 14J) oval, with setose distal spine.

Cheliped (Fig. 15A) basis twice as long as wide, ventrally with central sharp seta and distal pair of simple setae; three-articled exopodite present, slender, distal article with four plumose setae. Merus with small spine and two simple setae on ventrodistal "shoulder"; carpus 2.4 times as long as wide, with ventral marginal setae and single dorsodistal seta. Chela stout, fixed finger as long as palm with six ventral setae, cutting edge setose and with proximal tooth-like apophysis; dactylus and claw slightly overreaching fixed finger, with fine setules on cutting edge.

Pereopod 1 (Fig. 15B) with conspicuous setose apophysis on coxa; basis three times as long as wide, dorsal margin bearing four simple setae in proximal half, ventral margin with single proximal, single mid-ventral and paired distal simple setae; exopodite three-articled, distal article with four plumose setae. Ischium with three simple ventrodistal setae. Merus widening distally, with ventroproximal row of simple setae, and single long dorsodistal and shorter ventrodistal finely-denticulate spines and associated simple setae. Carpus shorter than merus, with setose margins including paired dorsodistal setae longer than propodus, one dorsodistal and two ventrodistal finely-denticulate spines. Propodus just shorter than carpus, with two dorsodistal and four ventral finely-denticulate spines interspersed with single fine setae. Dactylus slender, claw short.

Pereopods 2 and 3 (Fig. 15C, D) basis four times as long as wide, sparsely setose, ventrodistal setae reaching to half length of merus; ischium half as long as wide, with fine dorsal seta, one short ventral seta and one ventral seta longer than merus; merus shorter than carpus, with four ventral setae and single dorsodistal seta; carpus with slender ventrodistal spine with adjacent simple setae and long dorsodistal simple setae as long as article; propodus longer than carpus, with two or three slender ventral spines, dorsodistal setae as long as article; dactylus with ventrodistal seta, dactylus and claw slender, curved, together as long as propodus.

Pereopod 4 (Fig. 15E) similar to pereopod 3 but with stouter basis just less than 3 times as long as wide, with penicillate seta and fine ventrodistal simple seta as long as ischium and merus combined; dactylus and claw less curved than those of anterior pereopods, one of dorsodistal setae longer than dactylus and claw combined.

Pereopod 5 (Fig. 15G) similar to pereopod 4, but basis with three penicillate setae and three ventrodistal simple setae, propodus with one longer seta shorter than dactylus plus claw, and with ventral comb of 11 leaf-like spines in the distal half.

Pereopod 6 (Fig. 15F) basis with four plumose dorsal setae; merus shorter than carpus but proportionately longer than on pereopod 5, with two dorsal plumose setae; carpus with one dorsal plumose seta; propodus with small leaf-like spines ventrally and distally; dactylus plus claw slender, curved, together as long as propodus

Pleopods typical for genus (Fig. 15H), basis with two inner but no outer plumose setae, endopod with 12 plumose marginal setae, exopod shorter with eight plumose marginal setae.

Uropod (Fig. 15I) biramous, basis with five distal simple setae; exopod about twice as long as basis and of four segments; endopod elongate, filiform, with about 17 segments.

Male unknown.

*Etymology*. From the Latin – *attenuatus*: long, drawn out, thin.

*Remarks*. *Paradoxapseudes attenuata* sp. nov. is one of only three species of the genus without plumose setae on the basis of pereopod 1 or proximal serration on the antennal peduncle,

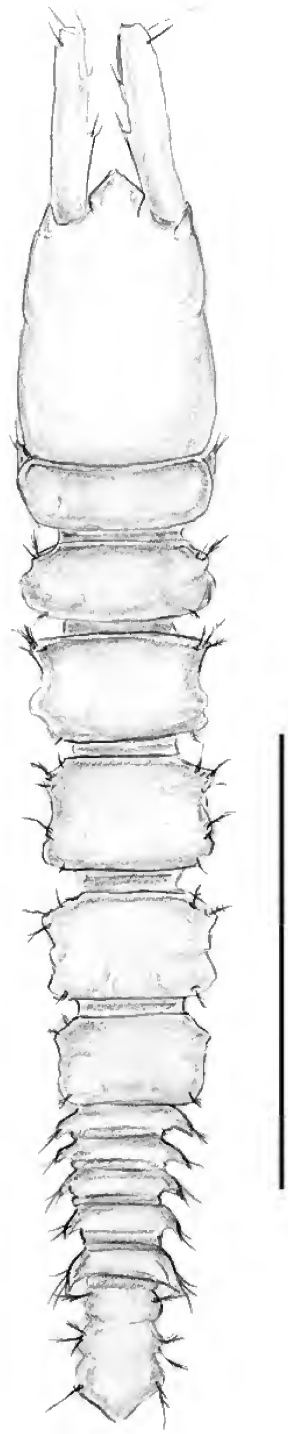

Fig. 13. *Paradoxapseudes attenuata* sp. nov., holotype, adult female, dorsal view. Scale = 1 mm.


Fig. 14. *Paradoxapseudes attenuata* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; D' mandible palp; E, right mandible; F, maxillule; G, maxilla; H, labium; I, maxilliped; I', maxilliped endite; J, epignath Scale: A, B, J = 0.1 mm; C-I = 0.01 mm.

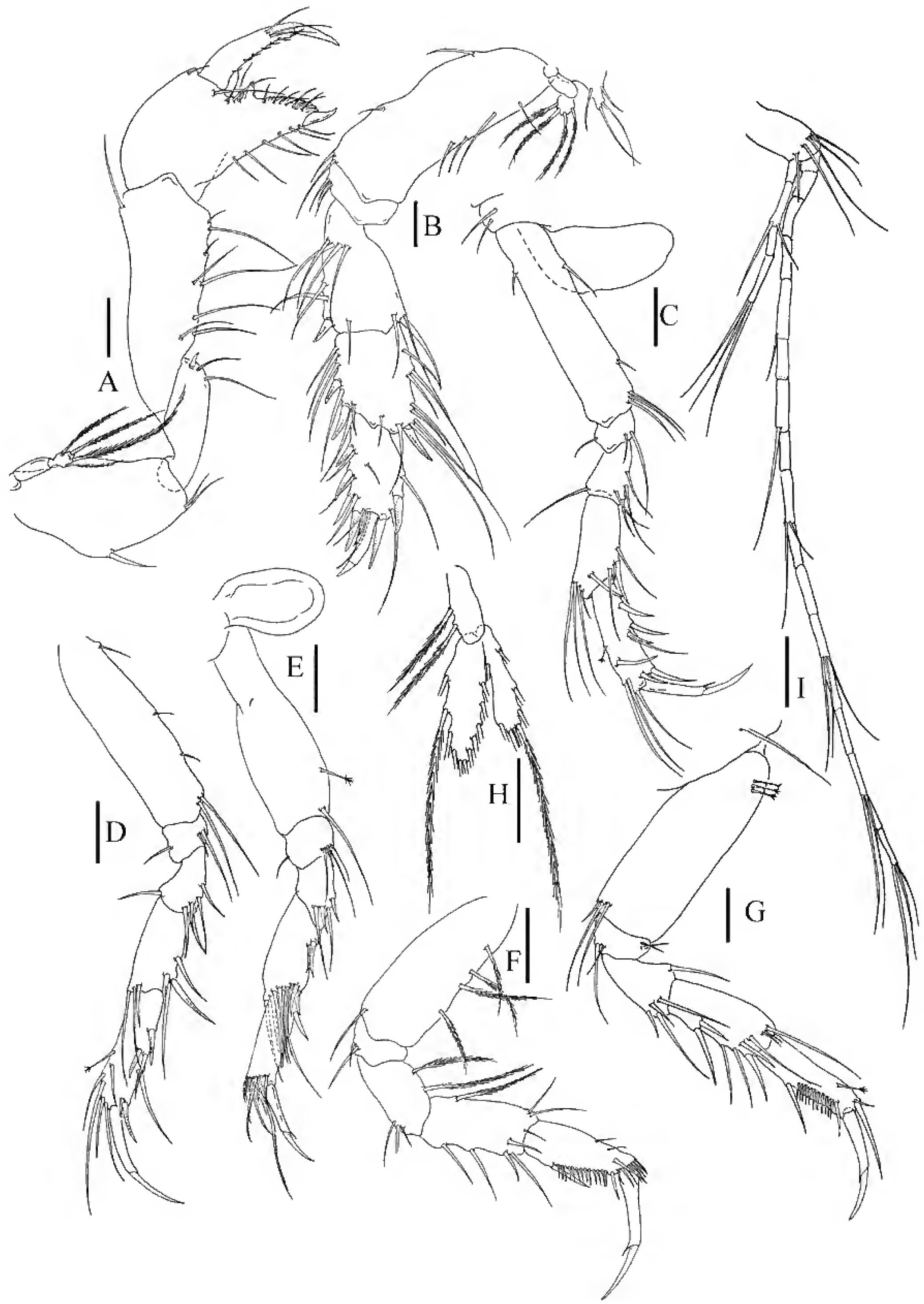


Fig. 15. *Paradoxapseudes attenuata* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

and with only two maxillule palp setae; of the other two, *P. littoralis* is distinct in having only two segments in the accessory flagellum and four in the main flagellum of the antennule (three and seven respectively in the other two), while *P. mortoni* (Bamber, 1997) has one fewer ventral propodus spine on pereopod 1, one fewer setae on the pleopod basis, one more distal seta on the labial palp, fewer setae on the proximal mandibular palp article, and ventral tubercles on the carpus of the female cheliped. The second antennal-peduncle article in the present species is unusual in widening at its midpoint where the setae attach, and in only having four ventral setae on the second article of the mandibular palp, all other species having at least 6. *P. attenuata* is one of the most elongate species in the genus, particularly in the proportions of its cephalothorax.

*Paradoxapseudes attenuata* was collected throughout the Bass Strait on sandy substrata at depths between 27 and 92 m.

Subfamily **Pugiodactylinae** Guţu, 1995

Genus ***Pugiodactylus*** Guţu, 1995

***Pugiodactylus syntomos*** Błażewicz-Paszkowycz & Bamber, 2007
*P. syntomos* Błażewicz-Paszkowycz & Bamber, 2007b, 131–132, figs 14–16.

*Material examined.* 1 brooding ♀ (J57921), Slope Stn. 49, 41°56.50'S 148°37.90'E, coarse bryozoan mud, 200 m depth, 27 July 1986, coll. M. Gomon *et al.*, WHOI Epibenthic sled.

*Remarks. P. syntomos* is distinct from the other four species, which have been described in this genus owing to its rounded rostrum, short cheliped carpus and more compact antenna, *inter alia*. It was distributed sparsely throughout the Bass Strait at between 9 and 200 m depth (the present specimen extending the deeper end of the range marginally), on muddy to coarse sand substrata and once on a predominantly rocky bottom. The genus is found from the Antarctic through Australia (Victoria and Queensland) to Malaysia and the South Pacific, usually in shallow waters.

Family **Whiteleggiidae** Guţu, 1972

Genus ***Whiteleggia*** Lang, 1972

***Whiteleggia multicarinata*** (Whitelegge, 1901)
*W. multicarinata*, Lang, 1970, 605–615, figs 3–8; – Błażewicz-Paszkowycz & Bamber, 2007, 132 (Bass Strait material).

*Additional material examined*. 2 specimens, Stn. BSS 206, Eastern Bass Strait, 19 km E of Lake Tyers Entrance, 37°50.5'S, 148°16.0'E, 26 m depth, coarse sand, 30 July 1983, coll. M. Gomon & R. Wilson, FV Silver Gull.

*Remarks*. This endemic south-east-Australian species occurred across the Bass Strait, on heterogeneous sandy substrata from depths between 26 and 124 m. Previous records were of the type material, off New South Wales, Australia, at 37 to 108 m depth, and further specimens in 1914 on sand and mud in depths of 70 to 100 m off Merimbula, New South Wales (not off South Africa – see Błażewicz-Paszkowycz & Bamber, 2007, p. 132).

Genus ***Pseudowhiteleggia*** Lang, 1970

***Pseudowhiteleggia typica*** Lang, 1970

*P. typica*, Lang, 1970, 616–626, figs 9–15; – Błażewicz-Paszkowycz & Bamber, 2007, 132–136 (Bass Strait material).

*Remarks*. Also endemic to southeast Australia, this species occurred in the Central and Western Bass Strait at depths between 39 and 84 m, on coarse to heterogeneous sands, commonly sympatric with *Whiteleggia multicarinata*. The only previous record was of the types at 50 m depth off northern New South Wales, Australia.

Family **Kalliapseudidae** Lang, 1956

Subfamily **Kalliapseudinae** Guţu, 1972

Genus ***Kalliapseudes*** Stebbing, 1910

***Kalliapseudes obtusifrons*** (Haswell, 1882)

Figures 16–21

*Apseudes obstusifrons* Haswell, 1882; – *Kalliapseudes obtusifrons* Drumm & Heard, 2006, 29–38, figs 1–4 (redescription, literature).

*Material examined*. A total of 684 individuals were examined from 65 samples, including 361 females (71 with oostegites, 75 with brood pouches), 141 males, 100 juveniles and 82 mancae. Samples were from West of Cape Otway to Port Philip Bay (depths from 9 to 124 m), Port Phillip Bay itself (15 to 20 m), Western Port (2 to 19 m), East of Wilson's Promontory (11 to 40 m), and the Gippsland coast (22 to 29 m), thus ranging from 142.03°E to 148.7°E, and variously between 38.24°S to 40.4°S. Substrata included mud, but mainly fine to coarse sands, to sandy gravel and shell. Numbers per sample ranged from 1 to 141 specimens. A selection of the samples examined is listed in Appendix 1. Numerous further samples held in the collections of Museum Victoria and confirmed as this species were not examined in detail.

*Remarks. Kalliapseudes obtusifrons* was originally known from Port Jackson, New South Wales (33.85°S 151.27°E), and the species remained somewhat enigmatic until Drumm & Heard (2006) rediscovered a syntype (designating it the lectotype) and valuably redescribed a further specimen – an ovigerous female collected from Cabbage Tree Island, New South Wales (31.95°S 152.59°E) (these authors also gave an identification key to the Australian species of *Kalliapseudes*). These had been the only known specimens of this species. It was therefore of some surprise to find *K. obtusifrons* common throughout the Bass Strait.

The large amount of material available has enabled us to confirm the description of the female given by Drumm & Heard (2006) and to supplement that description where their material was damaged, to describe the dimorphism of the male, and to examine intraspecific variation in some meristic characters across the width of the Bass Strait.

*Supplementary description of female* (Fig. 16). Antennule (Fig. 17A) main flagellum with 7 to 10 segments, accessory flagellum with 3 or 4 segments, both with three distal setae; antenna (Fig. 17B) first article with large apophysis with 4 to 6 plumose setae,

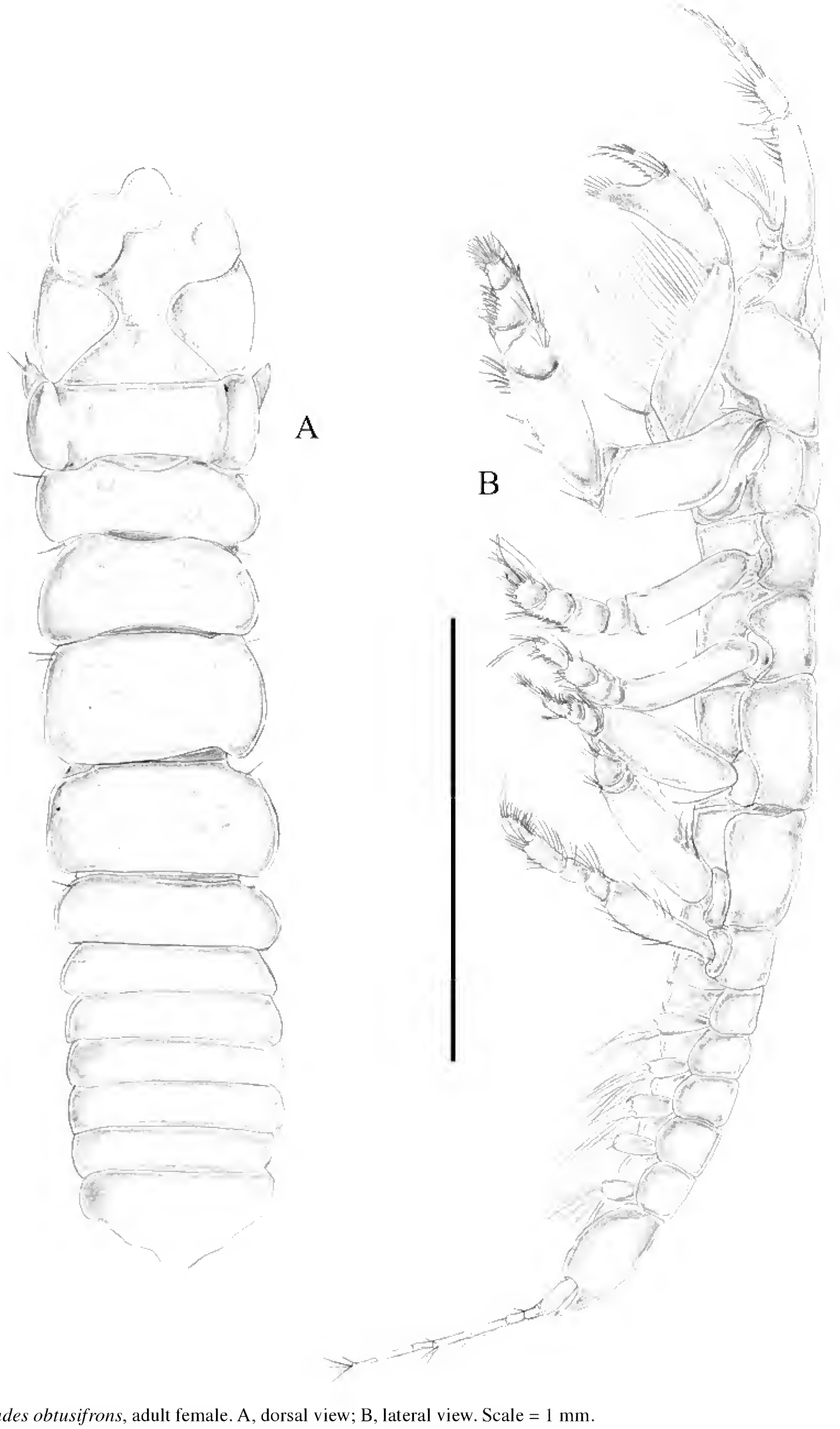


Fig. 16. *Kalliapseudes obtusifrons*, adult female. A, dorsal view; B, lateral view. Scale = 1 mm.


Fig. 17. *Kalliapseudes obtusifrons*, female. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; G, maxilla; H, labium; I, maxilliped; J, maxilliped endite.

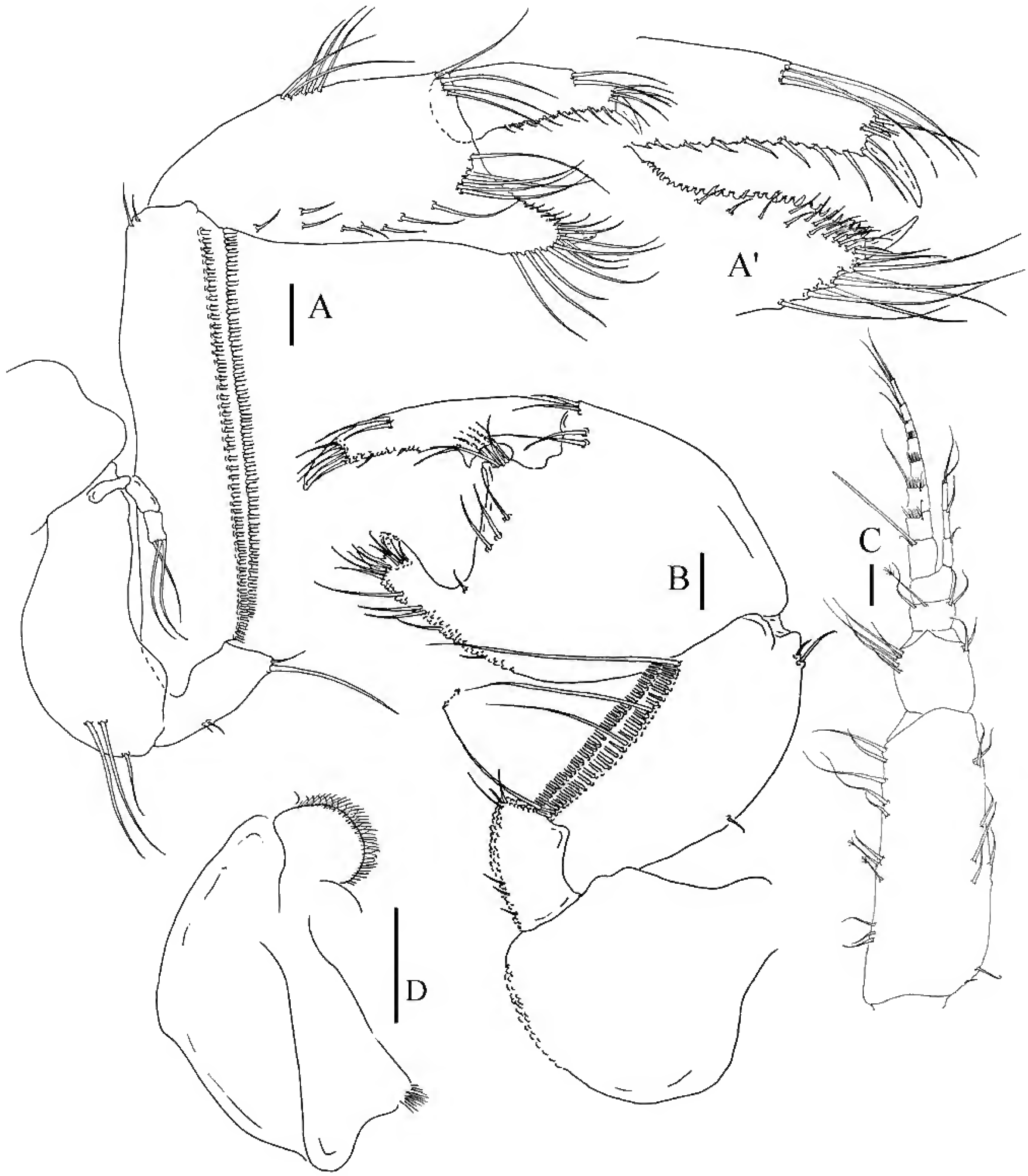


Fig. 18. *Kalliapseudes obtusifrons*. A, female cheliped; A', female cheliped, details; B, male cheliped; C, male antennule; D, epignath. Scale = 0.1 mm.


Fig. 19. *Kalliapseudes obtusifrons*. A, pereopod 1, female; B, details of pereopod 1, female; C, details of pereopod 1, male; D, details of pereopod 1, brooding female; E, details of pereopod 1, manca. Scale: A = 0.2 mm; B-E = 0.1 mm.

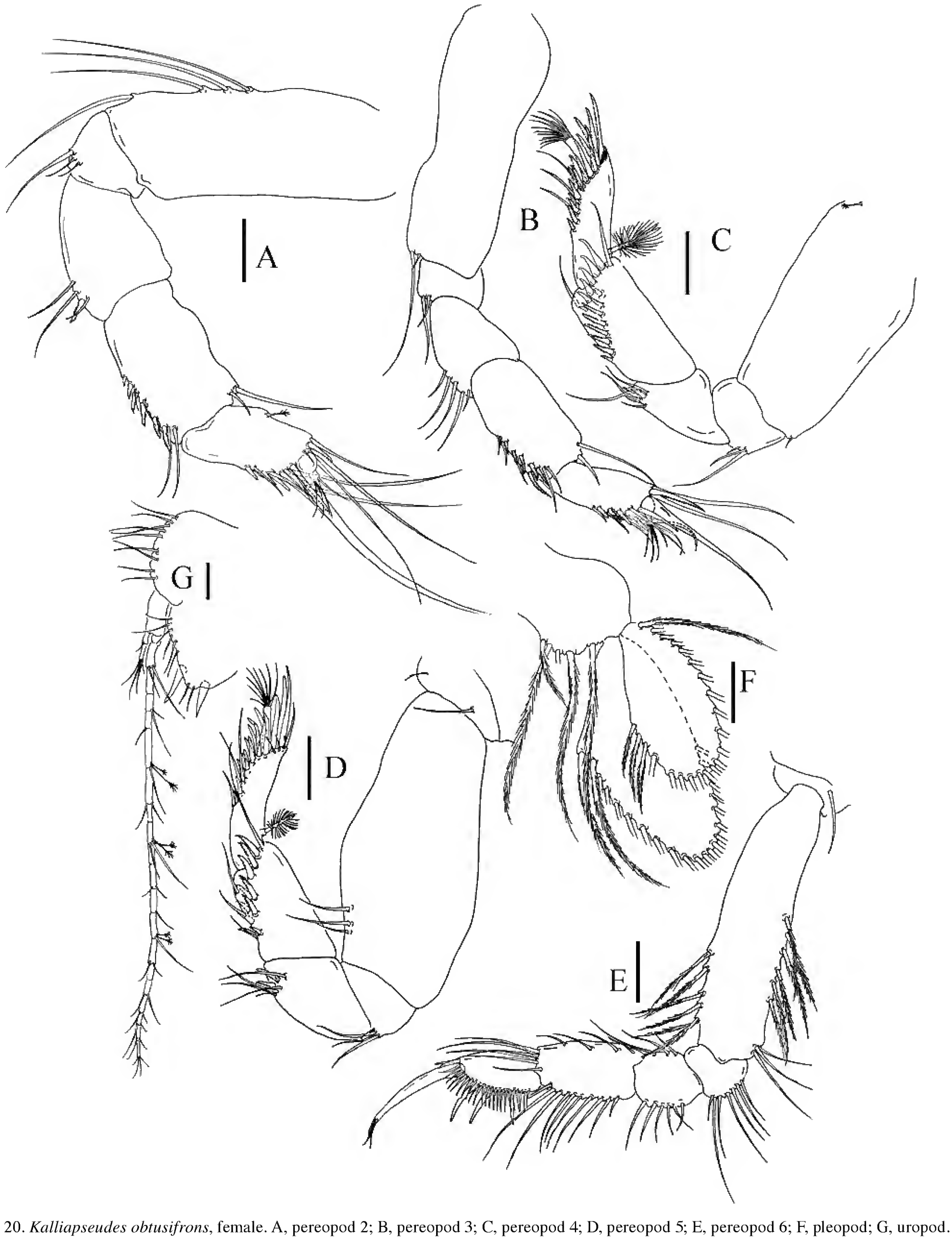


Fig. 20. *Kalliapseudes obtusifrons*, female. A, pereopod 2; B, pereopod 3; C, pereopod 4; D, pereopod 5; E, pereopod 6; F, pleopod; G, uropod. Scale = 0.1 mm.

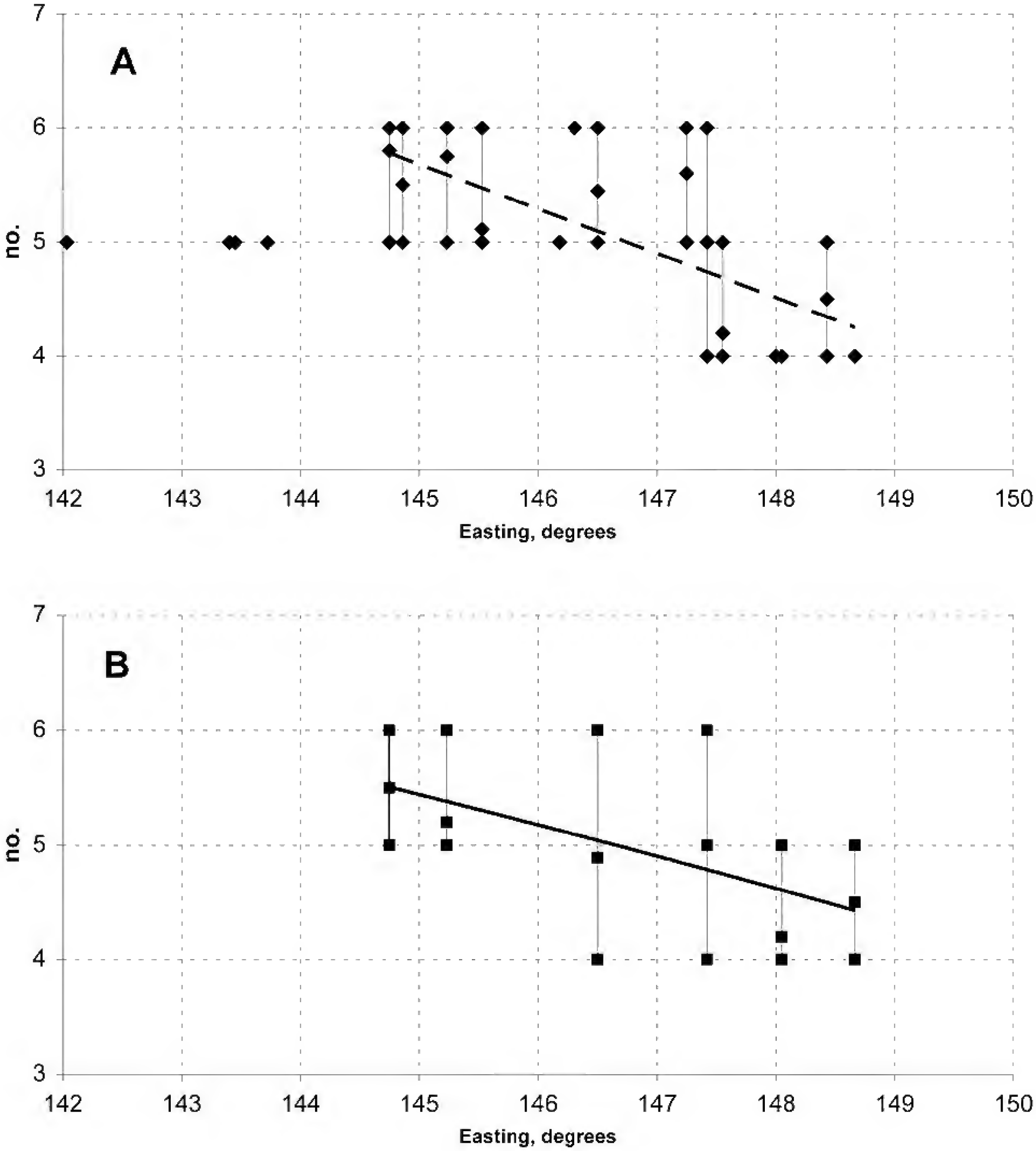


Fig. 21. *Kalliapseudes obtusifrons*: graphs of A, number of ventral spines on the propodus of pereopod 1 and B, number of squama setae, both against longitude across the Bass Strait (means and ranges where available), with linear trend-lines.

squama with 4 to 7 simple setae, third article with two inner plumose setae, fourth article fused to fifth; flagellum of 6 segments, distal segment with four distal setae.

Cheliped (Fig. 18A) basis with two longer and one shorter ventrodistal setae. Pereopod 1 (Fig. 19) basis with group of ventrodistal simple setae, exopodite with three distal setae; ischium with ventral seta; propodus with 4 to 6 ventral propodal spines. Pereopod 2 (Fig. 20A) with group of long subdistal ventral setae on basis. Pereopod 6 (Fig. 20E) basis with 4 to 6 plumose setae on ventral margin.

Pleopod (Fig. 20F) basis with 3 to 5 plumose seta on outer margin. Uropod endopod filiform, 2.7 times as long as pleotelson, of about 19 segments.

*Dimorphism of male*. Antennule (Fig. 18C) peduncle article 3 and 4 shorter than wide, main flagellum with 8 segments, segments 2 to 5 each bearing distal row of four or five aesthetascs. Cheliped (Fig. 18B) basis swollen, as long as wide, with corrugated ventrodistal margin; merus with ventral and distal margins corrugated; carpus twice as long as wide, with parallel ventral rows of filtering setae increasing in length distally; propodus robust, ventral margin corrugated in distal two-thirds, palm of chela as long as wide, with row of five plumose filtering setae as long as width of palm. Fixed finger about half length of palm, cutting edge with corrugated triangular distal apophysis and smooth triangular tooth-like proximal apophysis; dactylus cutting edge with proximal triangular tooth-like apophysis, distally corrugated.

*Note*: Drumm & Heard (2006) describe a "distinct line of fusion" on the cheliped carpus; this would be a stress line in the cuticle related to the internal proximal attachment of the caudal carpus muscle, as seen elsewhere in *Apseudes bruneinigma* Bamber, 1998 (q.v.) and *Pakistanapseudes goofi* Bamber & Sheader, 2003 (Bamber & Sheader, 2003, fig. 4A). It was not observed in any of the Bass Strait *K. obtusifrons* material.

*Morphometric variation*. As mentioned above, the large amount of material from the Bass Strait has allowed observation of variation in certain meristic characters. Variations were found in the numbers of segments in the antennule flagella (the NSW specimen of Drumm & Heard, 2006, had 10 segments in the main flagellum, 4 in the accessory flagellum; Fig. 17A shows an example of a main flagellum of 7, accessory flagellum of 3), in the number of squama setae (the NSW specimen had 7, the example in Fig. 17B shows 6), in the number of pereopod 1 propodus ventral spines (Fig. 19 shows an adult range of 4 to 6, and a manca with 3), in the number of pereopod 1 exopodite setae (the NSW specimen had 2, most Bass Strait specimens had 3, as in Fig. 19A), and in the number of pleopod basis setae (the NSW specimen had 4, Bass Strait juveniles had 1 to 2, Bass Strait adults had 3 to 4 or once 5, e.g. Fig. 20F).

When those features with sufficient variation are plotted across the east-west range of the Bass Strait material, a distinct trend is revealed: the number of ventral propodal spines in adults (Fig. 21A) and the number of squama setae (Fig. 21B) show either a decline from east to west, or a step somewhere around 147°E (east of Wilson's Promontory). An identical trend is shown in the number of ventral propodal spines in juveniles (not figured). A step change around 147°E may represent a general separation of two populations, possibly partially isolated by hydrographic conditions, as has been shown in other crustaceans with intraspecific meristic variation between populations (e.g. Henderson *et al*., 1990); there would then be no reason why the New South Wales specimens should continue this trend directly, as they would again be a semi-isolated population. Intraspecific ranges in meristics in other species of *Kalliapseudes* were discussed by Bamber *et al*. (2003), who found increases in the number of accessory flagellum segments and the number of squama setae in *Kalliapseudes makrothrix* Stebbing, 1910, *K. gobinae* Bamber, 1999 and *K. tomiokaensis* Shiino, 1966, but in relation to size (larger in larger individuals), and based on much smaller samples. The patterns found here for *K. obtusifrons* are not size-related.

The adult female to male sex ratio of all the material examined was 2.6:1.

Family **Metapseudidae** Lang, 1970

Subfamily **Metapseudinae** Lang, 1970

Genus ***Cyclopoapseudes*** Menzies, 1953

Subgenus ***Exopoapseudes*** subgen. nov.

*Diagnosis*. *Cyclopoapseudes* with exopodites on cheliped and pereopod 1.

*Type species*. *Cyclopoapseudes diceneon* Gardiner, 1973. Other species *C. (E.) plumosa* sp. nov.

*Etymology*. Combined from *Exo* – from "exopod", and "*-poapseudes*" from the last part of the name of the genus *Cyclopoapseudes* (female).

*Remarks*. With the following new species, there are now four species of *Cyclopoapseudes* known. The Pacific species *C. indecorus* Menzies, 1953 (the generotype), from Ecuador, and the Indian Ocean species *C. estafricana* Băcescu, 1975 (Tanzania) are both without exopodites on the cheliped and pereopod 1, while *C. diceneon* Gardiner, 1973 (New Zealand) and the new species described below from the Bass Strait, both from Antipodean waters, have these exopodites. In other apseudomorph taxa, this difference has been considered sufficient to distinguish separate genera (rightly or wrongly); here we distinguish two subgenera, the nominate *Cyclopoapseudes* and the presently Antipodean *Exopoapseudes*, the latter being the more plesiomorphic.

***Cyclopoapseudes (Exopoapseudes) plumosa*** sp. nov.

Figures 22–25

*Material examined*. 1 ♀ (J60994), holotype, 1 ♂ (3.5 mm long) (J60993), allotype, 2 females with empty brood pouch (3 mm long), 1 brooding ♀ (3 mm long), 7 ♂♂, 8 subadult ♂♂ (1 dissected), 47 other specimens (J57560), paratypes, CPBS 33S, Western Port off Crib Point, 38°22.06'S 145°14.10'E, 13 m depth, reef with sponges, 5 March 1965, coll. A.J. Gilmour.

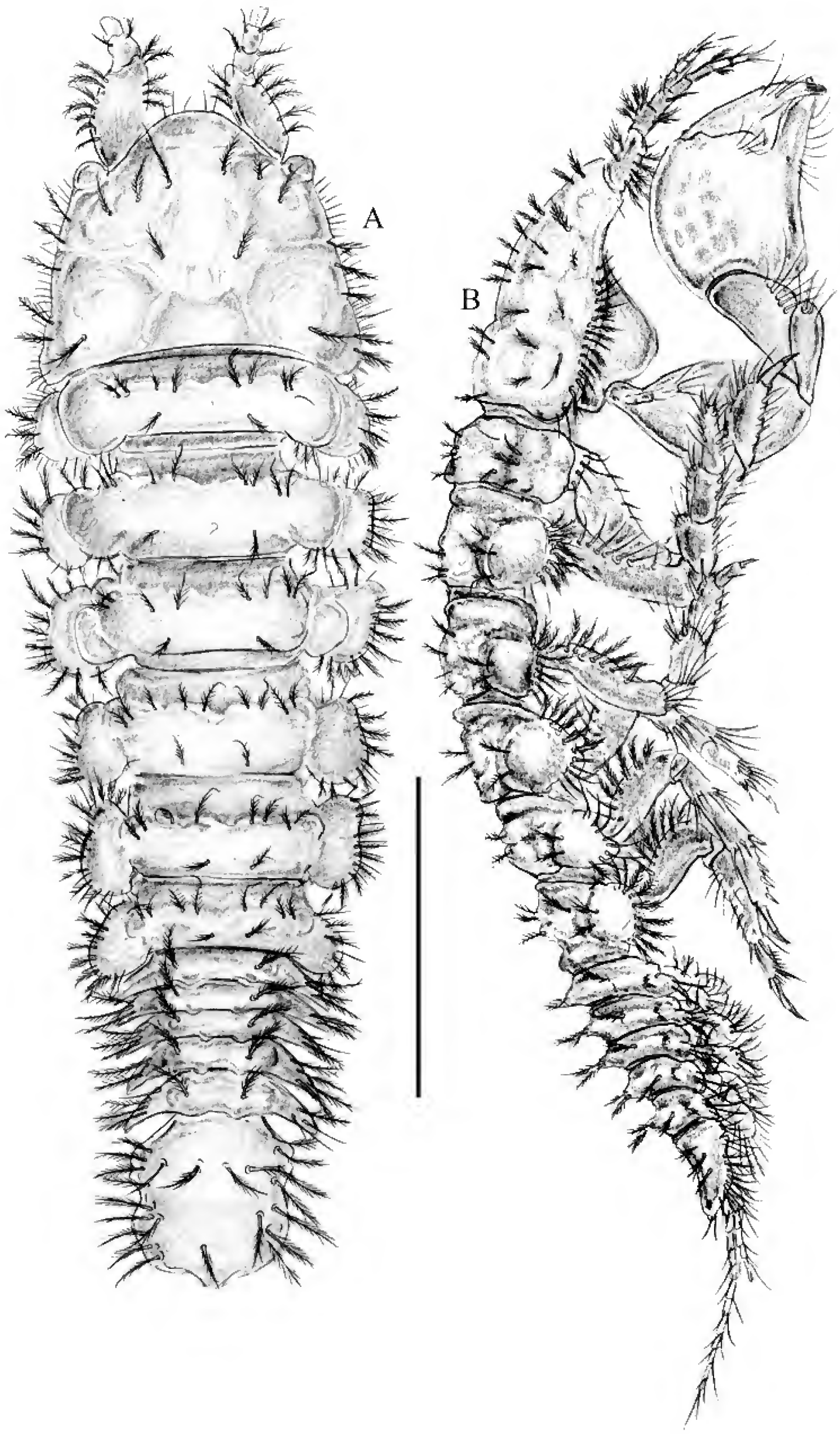


Fig. 22. *Cyclopoapseudes (Exopoapseudes) plumosa* sp. nov. A, holotype female dorsal view; B, male lateral view. Scale = 1 mm.


Fig. 23. *Cyclopoapseudes (Exopoapseudes) plumosa* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; D, right mandible D', mandibular molar; E, maxillule; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath Scale: A–D, G, I = 0.1 mm; E-F, H = 0.01 mm.

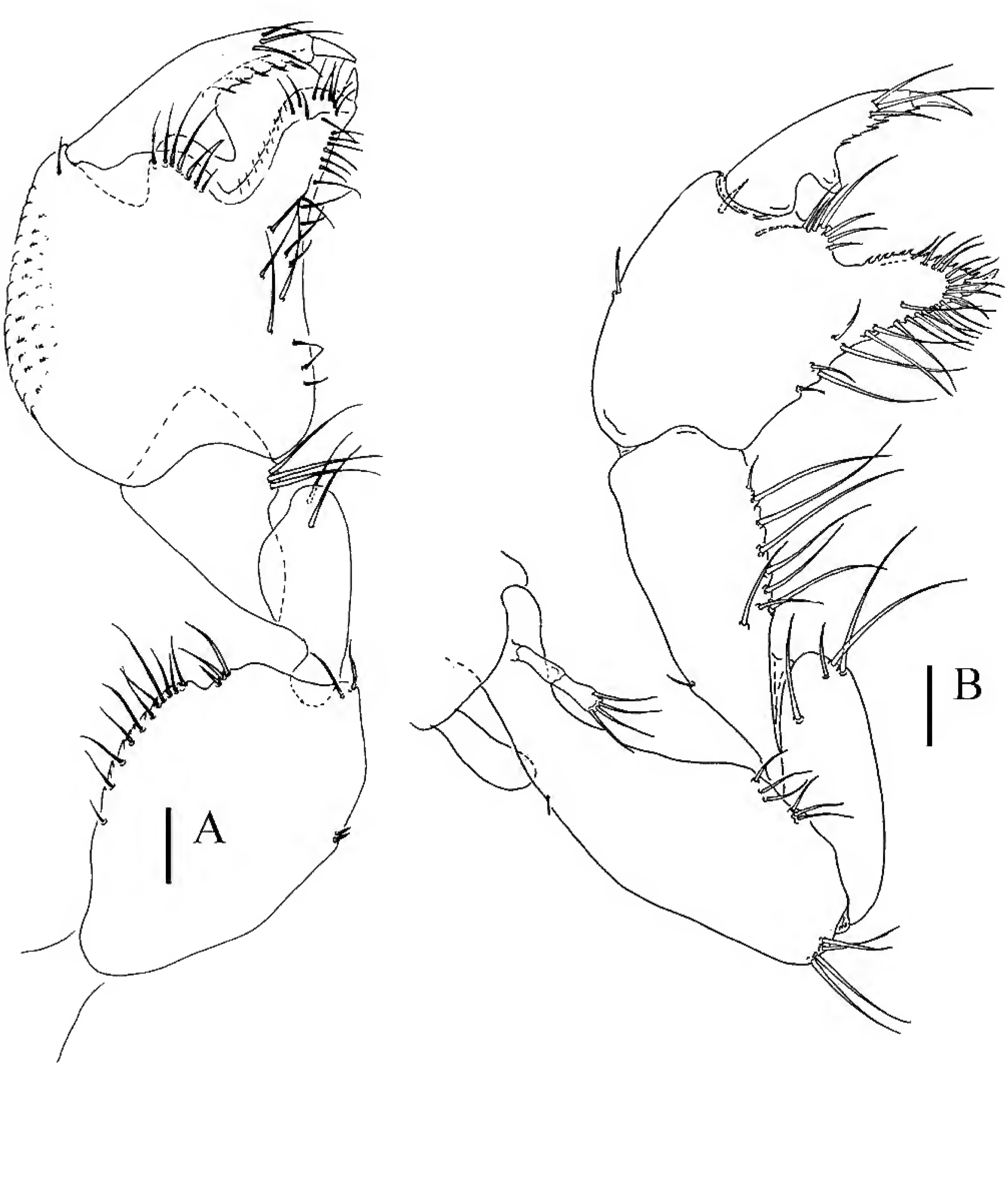


Fig. 24. *Cyclopoapseudes (Exopoapseudes) plumosa* sp. nov. A, cheliped male; B, cheliped female. Scale = 0.1 mm.

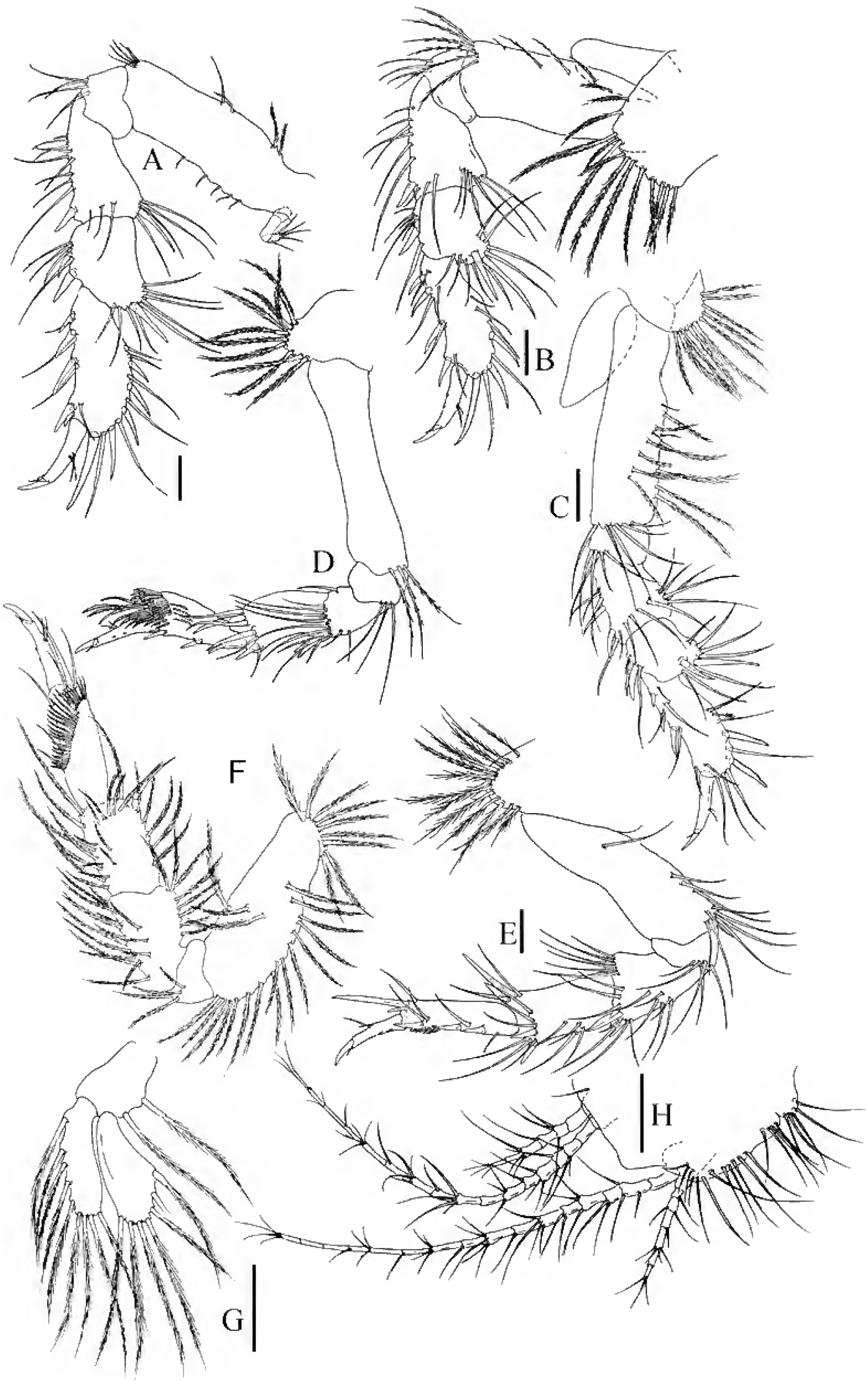


Fig. 25. *Cyclopoapseudes (Exopoapseudes) plumosa* sp. nov., female paratype. A, pereopod 1; B, pereopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

*Description of female with oostegites*. Body (Fig. 22A) compact, grossly similar to that of *C. diceneon*, holotype 3.7 mm long (tip of rostrum to posterior of pleotelson), 3.5 times as long as wide, narrower posteriorly. Cephalothorax subrectangular, wider than long (1.5 times as wide as long without rostrum), anterior margin with conspicuous rounded rostrum with smooth anterior margin. Eyes present on robust eyelobes; paired dorsal plumose setae, lateral plumose and simple setae as figured. Pereonites all with lateral margins expanded and uniformly convex, each with anterior row of 6 to 8 plumose setae, posterior pair of plumose setae, and numerous lateral marginal plumose and simple setae; pereonites 1 to 5 subequal in length (pereonite 1 just shortest), about 0.4 times as long as cephalothorax; pereonite 6 shortest, 0.6 times as long as pereonite 2 (all pereonites respectively 3.25, 3.0, 3.0, 2.6, 2.6 and 3.8 times as wide as long). Pleon three times as long as pereonite 2, of five free subequal pleonites bearing pleopods; pleonites dorsally with paired low posterior tubercles, about seven times as wide as long, with paired mid-dorsal plumose setae, laterally expanded by spiniform apophyses each bearing three or four plumose setae. Pleotelson distally with truncated protuberance, slightly longer than wide and half as long as whole pleon, with midlateral indentation; antero-dorsal row of four plumose setae, postero-dorsal triad of plumose setae, laterally with seven marginal plumose setae.

Antennule (Fig. 23A). Peduncle proximal article compact, twice as long as wide, inner margin with paired mesial and three subdistal plumose setae, outer margin with entire row of plumose setae; second article one-third as long as first, with inner and distal groups of plumose setae; third article two-thirds length of second, with outer distal seta and inner marginal plumose setae; fourth just shorter than third, with distal simple setae. Main flagellum of 7 segments, segments 2, 3 and 5 each bearing single aesthetasc; accessory flagellum of 4 segments.

Antenna (Fig. 23B). Proximal peduncle article with inner distal pair of plumose setae; article 2 just longer than article 1, inner margin bearing pair of plumose setae and sub-proximal rounded apophysis, outer margin with three plumose setae and subdistal squama with seven simple marginal setae; peduncle article 3 shorter than wide, one-quarter the length of article 2, with one simple and one plumose inner setae; article 4 twice as long as article 3, with inner distal pairs of simple and penicillate setae; article 5 slightly longer than article 4, with inner and outer distal simple setae and paired inner penicillate setae. Flagellum of seven segments.

Labrum (not figured) rounded, distally finely setulose. Left mandible (Fig. 23D) bearing strong, pointed and crenulated pars incisiva, lacinia mobilis slender with fine denticulations, setiferous lobe with one stout and five finer compound setae, pars molaris (Fig. 23D') robust, blunt, margin with row of rounded tubercles and fine teeth; mandibular palp of three articles, proximal article with single subdistal seta, article 2 more than half as long as whole palp with four simple distal setae, article 3 shorter than article 1 with four subdistal and two distal simple setae. Right mandible (Fig. 23C) as left, but lacinia mobilis with more robust dentition, setiferous lobe with one simple and seven compound setae. Maxillule (Fig. 23E) inner endite with five finely setulate distal setae, inner margin finely setulose; outer endite with nine distal spines and two subdistal setulose setae, outer margin finely setose, inner margin with fine rows of setules. Palp of two articles, distal article with distal row of five simple setae Maxilla (Fig. 23F) with naked outer margin; outer lobe of moveable endite with two simple subdistal setae and eight simple distal setae; inner lobe of moveable endite with four simple and two setulose setae; outer lobe of inner endite with six outer simple setae interspersed with two bidenticulate spines, inner half with two bidenticulate spines and three distally compound spines; inner lobe of fixed endite with rostral row of 19 setae guarding five longer setulose setae. Labium (Fig. 23G) with smooth outer margin, palp with fine lateral setules and two simple distal spines. Maxilliped (Fig. 23H) basis with finely setose outer margin, no distal setae; palp article 1 with outer distal simple seta and inner distal finely setulose seta; palp article 2 longer than wide, inner margin with rows of numerous short setae, and two simple and two setulose longer setae in proximal half, outer margin finely denticulate with slender distal spine reaching tip of third article; palp article 3 with 10 simple setae along inner margin; palp article 4 with eleven setae along broad distal margin. Endite (Fig. 23H') with paired, slender, simple inner caudodistal setae, linguiform inner distal spines and simple outer distal setae, setulose outer margin, two coupling-hooks. Epignath (Fig. 23I) slender, linguiform, with distally setulose distal spine.

Cheliped (Fig. 24B) basis 2.8 times as long as wide, narrow proximally, with short dorsodistal simple setae and four longer ventrodistal setae; exopodite with four plumose setae. Merus subrectangular, with four distal simple setae. Carpus 2.5 times as long as wide, with row of long simple setae along ventral margin. Chela stout, palm just longer than wide and fixed finger 0.6 times as long as palm, ventral margin densely setose; slight setose apophysis between fixed finger and articulation of dactylus; cutting edge of fixed finger serrated, distal claw stout; dactylus with proximal tooth-like apophysis on cutting edge, distal claw pointed.

Pereopod 1 (Fig. 25A) basis three times as long as wide, dorsal margin with five simple setae on a slightly convoluted margin, ventral margin with paired proximal plumose setae, two mid-ventral setae and four ventrodistal setae; exopodite present, 3-articled, article 3 with five distal plumose setae. Ischium with four simple ventrodistal setae. Merus just under half as long as basis, expanded distally, with numerous ventral simple setae, ventrodistal spine, and curved, slender dorsodistal spine with longer adjacent simple setae. Carpus 0.8 times as long as merus, with two ventral spines and intervening simple setae, and single dorsodistal spine amongst tuft of longer setae. Propodus slightly anaxial on carpus, longer than merus, with four ventral spines alternating with simple setae, one ventrodistal spine adjacent to dactylus, and five dorsal spines alternating with simple setae. Dactylus more than half as long as propodus, with mid-dorsal fine setae, ventrodistal seta; unguis mounted subdistally, short.

Pereopod 2 (Fig. 25B) more slender but similar to pereopod 1. Coxa with plumose setae. Basis three times as long as wide with ventral and ventrodistal plumose setae. Merus 1.1 times as long as carpus, with ventrodistal spine but no dorsodistal spine. Propodus with four ventral and three dorsal spines with interspersed setae. Pereopod 3 (Fig. 25C) similar to pereopod 2, but basis with longer and dorsal plumose seta, merus with two ventral spines, carpus with two dorsodistal spines, propodus with two dorsal spines.

Pereopod 4 (Fig. 25D) basis 5 times as long as wide, naked other than three ventrodistal plumose setae; merus with two ventrodistal spines and inner-distal group of setae as long as carpus; carpus twice as long as merus, distally with slender, curved spines and simple setae; propodus as long as carpus, articulated anaxially on carpus, widening distally to square end, with dense group of finely denticulate shorter and longer setae; dactylus plus unguis as long as propodus. Pereopod 5 (Fig. 25E) similar to pereopod 2, basis with ventral simple setae; merus shorter than carpus, with two ventrodistal spines; carpus with two ventrodistal and one dorsodistal spines; propodus with three ventral and two dorsodistal spines.

Pereopod 6 (Fig. 25F) basis arrayed with proximal, dorsal subdistal, and ventral plumose setae as figured; ischium with four ventrodistal plumose setae; merus and carpus with plumose setae along dorsal and ventral margins, carpus with single dorsodistal spine; propodus with comb of fine leaf-like spines along distal half of ventral margin and around dactylus, dactylus with adjacent slender, curved spine.

Pleopods (Fig. 25G) all alike. Basis with two dorsal plumose setae, ventral margin naked. Endopod shorter than exopod, linguiform, with nine ventral and distal plumose setae; exopod subovate, with seven plumose setae around distal margin.

Uropod (Fig. 25H) biramous, exopod just shorter than pleotelson, of six segments, endopod 3.75 times as long as exopod, of fifteen segments.

*Distinctions of male*. Sexual dimorphism minimal (Fig. 22B), cheliped (Fig. 24A) more robust, dorsal margin of basis expanded and bearing row of 11 simple setae; merus narrow proximally, with two distal setae; carpus only 1.7 times as long as wide, with three mid-ventral setae; propodus as long as wide, with dorsal marginal rows of microtrichia, chela fingers as those of female but more robust.

*Etymology*. named for the plumose dorsal setae on the carapace.

*Remarks*. The morphology of the body of the present species is typical for the genus, as are the conformation of the mandible palp, and of the fourth pereopod, both being unusual features characteristic of the genus. As commented above, *Cyclopoapseudes (Exopoapseudes) plumosa* sp. nov. shares the possession of exopodites on the cheliped and pereopod 1 only with *C. (E.) diceneon*. It is distinguished from that species particularly in the form of the pleotelson, that of the present species being almost square in outline (although with mid-lateral indentation), that of *C. (E.) diceneon* narrowing at half its length to give a T-shape when viewed dorsally, with a conical posterior protuberance bearing long paired distal setae. In addition, *C. (E.) plumosa* has plumose setae dorsally on the carapace (that of *C. (E.) diceneon* being naked), a somewhat more slender and more setose antennule, more setose pereopods, *inter alia*.

Gardiner (1973) distinguished brooding females and subadult males (with a presumed male genital cone "anlage"), and only the latter had a cheliped with a stout propodus and a tooth-like apophysis on the cutting edge of the dactylus. The cheliped of the female figured here (Fig. 24B) is even more robust than that of Gardiner's male, but has an oostegite, contrary to Gardiner's (ibid.) contention that all metapseudids are without an oostegites on the cheliped. The male cheliped of the present species also demonstrates sexual dimorphism. Menzies (1953) based *C. indecorus* on what he referred to as a male (without specifying why), and his relatively incomplete description shows a chela without tooth-like apophysis; with only one specimen, no sexual dimorphism is known for this species. Finally, Băcescu (1975) gave an even less complete description of *C. estafricana*, but based on a brooding female and a juvenile, so again no information is available on dimorphism or hermaphroditism. This genus unfortunately is generally of sparse occurrence.

Genus ***Labraxeudes*** Błażewicz-Paszkowycz & Bamber, 2007

***Labraxeudes heliodiscus*** Błażewicz-Paszkowycz & Bamber, 2007

Figure 26

*L. heliodiscus* Błażewicz-Paszkowycz & Bamber, 2007b, 136–141, figs 17–19.

*Material examined*. 6 ♀♀ (3 brooding, 3 with oostegites), 3 juveniles (J55848), Stn WBES 1746, Western Port, 38°29.78'S 145°06.28'E, sand, 24 m depth, 25 November 1974, Smith-McIntyre Grab; 14 ♀♀ (6 with oostegites, 5 brooding), 2 juveniles (J56346), Stn CRUST 21, Whaleback Rock, 0.5 km south of Point Hicks, 37°48.30'S 149°16.48'E, ca 30 m depth; 22 ♀♀ (5 brooding, 15 with oostegites) (J57612), Stn CPBS 33S, Crib Point, Western Port, 38°22.04'S 145°14.06'E, "reef/ sponge", 13 m depth, 5 March 1965; 7 ♀♀ (1 brooding, 3 with oostegites) (J57679), Stn CPBS 23N, Crib Point, Western Port, 38°20.17'S 145°14.11'E, sandy gravel, 10 m depth, 10 March 1965.

*Remarks*. the types (four females) of this species were described from a sample off Phillip Island, at the mouth of Western Port. Examination of the further material listed above has allowed description of some ontogenic variation, and the correction of some misinterpretations of the type material.

Contrary to the type description, all setae on the cephalothorax, pereonites, pleonites and pleotelson are plumose. The pleotelson has a rounded posterior protuberance bearing plumose setae (Fig. 26F).

The uropods of the figured type now appear to be from a damaged specimen: large-adult uropods (Fig. 26F) have 7 segments in the endopod and 5 segments in the exopod. The juveniles (post-manca) have shorter uropods (Fig. 26D), but already 7 articles in the endopod and 4 in the exopod, as do brooding females with a simple cheliped (Fig. 26E); the juveniles also have a simpler, semicircular rostrum (Fig. 26C). The chelipeds show progressive development: those of juveniles (Fig. 26A) are simple, smaller versions of those of the smaller brooding females (Fig. 26B): these have a basis twice as long as wide, with one proximal and two distal ventral setae and a mid-ventral spine; exopodite as in the type; merus with mesial and subdistal setae and two ventrodistal spines; carpus 2.25 times as long as wide, with paired proximodorsal

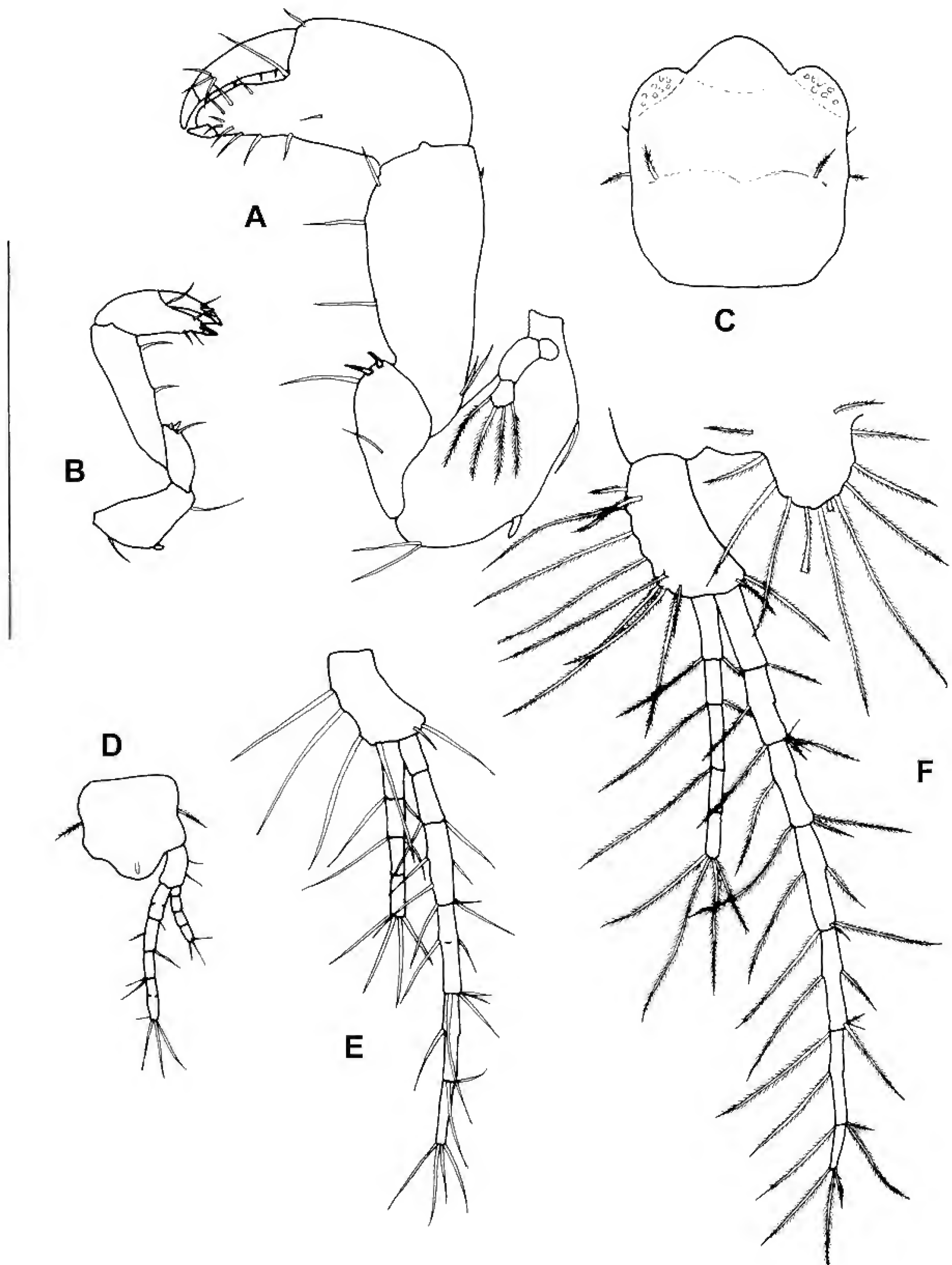


Fig. 26. *Labraxeudes heliodiscus*. A, cheliped of 2.53 mm brooding female; B, cheliped of 1.2 mm juvenile; C, cephalothorax of 1.2 mm juvenile; D, pleotelson and right uropod of 1.2 mm juvenile (plumose nature of uropod setae not shown); E, left uropod of 2.53 mm brooding female (plumose nature of all setae not shown); F, left uropod of 3.74 mm female with oostegites. Scale line = 0.5 mm.

setae and three ventral setae; chela palm 1.4 times as long as wide, fixed finger with three ventral setae, dactylus with no tooth-like apophysis on the cutting edge. The larger specimens have the cheliped as shown for the type (Błażewicz-Paszkowycz & Bamber, 2007b, fig. 19A), showing a dimorphism suggestive of a male, yet these specimens also have oostegites, and no penial tubercle was found on any specimen. This may imply progynous, or later simultaneous, hermaphroditism in this species, but until a specimen with a penial tubercle is discovered, no conclusion can be drawn about this.

All the known material of this species was collected in Western Port except for the specimens from off Point Hicks, at depths from between 10 and 30 m and on a range of substrata.

Genus ***Metapseudes*** Stephensen, 1927

***Metapseudes wilsoni*** Błażewicz-Paszkowycz & Bamber, 2007

*M. wilsoni* Błażewicz-Paszkowycz & Bamber, 2007b, 141–146, figs 20–23.

*Material examined*. 1 specimen, Stn. BSS 198, Western Bass Strait, 36 km SSW of Stokes Point, King Island, 40°26.7'S, 143°41.4'E, 85 m depth, medium sand, 22 November 1981, coll. R. Wilson, RV Tangaroa; 1 brooding ♀, Stn. BSS 203, Central Bass Strait, 44 km NE of Cape Wickham, King Island, 39°22.0'S, 144°18.3'E, 60 m depth, coarse sand, 23 November 1981, coll. R. Wilson, RV Tangaroa. 1 ♀ (J57543), Stn SA62, Flinders Island, "The Hotspot" reef, 5 n miles W of N end of Flinders Island, South Australia, 33°40.30'S 132°22.00'E, 17 m depth, tufted bryozoans on rock face, exposed, 19 April 1985, SCUBA, coll. G.C.B. Poore.

*Remarks*. The large type collection of this species was taken in the Eastern Bass Strait at 32 m depth; the present specimens extend the range through the Bass Strait, as well as to South Australia, and to a depth of 85 m. This, the second species of the genus, is most easily distinguished from the generally similar generotype, *M. aucklandiae* Stephensen, 1927, described from New Zealand in shallow waters (Stephensen, 1927, Gardiner, 1973) (depth range 0–113 m), by the more slender antennules and antennae, and the distinct form of the rostrum, inter alia.

Family **Parapseudidae** Guţu, 1981

Subfamily **Pakistanapseudinae** Guţu, 2008 new rank

*Remarks*. Guţu (2008b) separated the family Parapseudidae into two groups, separating the species of the *Pakistanapseudes*-group discussed by Błażewicz-Paszkowycz & Bamber (2007a) from the remaining parapseudids. Guţu (ibid.) erected two tribes (Parapseudini and Pakistanapseudini), but it is entirely more appropriate to consider these as subfamilies, so we have given them that new rank herein.

Genus ***Pakistanapseudes*** Băcescu, 1978

*Remarks*. in describing his new genus, Băcescu (1978) did not designate a type-species. By inference, and as stated by Bamber & Sheader (2003), it should be *Pakistanapseudes leptochelatus* Băcescu 1978, herein so designated (not *Pakistanapseudes leptodactylus* Băcescu 1978 as cited by Guţu, 2008, a *lapsus calami*). It should be noted that members of this genus have a great propensity for autotomizing their appendages on fixation unless relaxed first, so in many species not all of the pereopods, chelipeds, antennules or uropods are known. In both of the new species described below, chelipeds and first pereonites were so rare that no complete exopodite was found.

***Pakistanapseudes bassi*** Błażewicz-Paszkowycz & Bamber, 2007

*P. bassi* Błażewicz-Paszkowycz & Bamber, 2007a, 14–19, figs 7–9.

*Remarks*. This species was described originally from numerous specimens collected throughout the Bass Strait, on sandy substrata from depths between 60 and 293 m. Numerous further samples of this species exist in the collections of Museum Victoria, including some from water as shallow as 2 m (Port Phillip Bay), over 100 specimens having been examined in the course of this study in addition to the type-collection, and it appears clearly to be the commonest *Pakistanapseudes* species in the Bass Strait region. It is morphologically similar to *P. perulpa* (rounded rostrum, no bifurcate claws), but unlike that species it has no ventral setae on the pleopod basis, and pereonites 5 and 6 are wide than long (longer than wide in *P. perulpa*).

***Pakistanapseudes lucifer*** sp. nov.

Figures 27–29

*Material examined*. 1 ovigerous ♀ (J28617), holotype, Stn MSL-EG 117, Eastern Bass Strait, 37°52.65'S 148°42.15'E, 49 m depth, February 1991, coarse sand; 4 ♀♀ (J28627), paratypes, Stn MSL-EG 78, Eastern Bass Strait, 37°43.89'S 148°30.13'E, 27 m depth, 4 June 1991, coarse sand; 1 brooding ♀, 2 ♀♀ with oostegites (J28611), paratypes, Stn MSL-EG 99, Eastern Bass Strait, 37°53.29'S 148°15.40'E, 43 m depth, February 1991, coarse sand; 1 ♂ (J28630), paratype, Stn MSL-EG 108, Eastern Bass Strait, 37°53.14'S 148°28.94'E, 45 m depth, February 1991, medium sand; 1 ♀ (J28627), paratype, Stn MSL-EG 72, Eastern Bass Strait, 37°53.39'S 148°15.40'E, 43 m depth, 4 June 1991, coarse sand; 3 ♂♂, 1 brooding ♀ (J28629), paratypes, Stn MSL-EG 104, Eastern Bass Strait, 37°49.89'S 148°30.13'E, 27 m depth, February 1991, coarse sand; 2 ♀♀ (J57574), paratypes, Stn BSS170, Eastern Bass Strait, 39°51.8'S 148°26.5'E, 130 m depth, 15 November 1981, fine sand, coll. R.S. Wilson; 1 ♂ (J57574), paratype, Stn BSS169, Eastern Bass Strait, 39°02.4'S 148°30.6'E, 120 m depth, 15 November 1981, muddy sand, coll. R.S. Wilson; 1 ♀ (J57574), paratype, Stn BSS188, Western Bass Strait, 38°38.2'S 142°35.0'E, 59 m depth, 20 November 1981, coll. R.S. Wilson; 1 ♀ (J51790), paratype, Stn VC 27 C1, Western Bass Strait, 38°23.92'S 145°18.43'E, 40 m depth, 11 May 1998, fine sand; 2 ♀♀ (J51317), paratypes, Stn VC 18 C3, Western Bass Strait, 38°30.2'S 144°15.00E, 40 m depth, 13 May 1998; 2 brooding ♀♀ (J57655), 1 ♀ with oostegites (J57646), 1 brooding ♀ (J57653), 1 ♂ (J57654), paratypes, Stn CPBS 41N, Western Port, 38°20.81'S 145°13.85'E, 13 m depth, 30March 1965, gravel and sand; 1 ♀ (J55925), 12 March 1965, 1 ♀ (J55902), 20 March 1967, 2 ♂♂ and 4 ♀♀ (1 with oostegites, 2 brooding) (J55885), paratypes, Stn CPBS 32S, Western Port, 38°22.06'S 145°14.10'E, 13 m depth, reef with sponge.

*Description of female*. Body (Fig. 27A), dorsoventrally flattened, elongate, holotype 3.2 mm long (tip of rostrum to posterior of pleotelson), six times as long as wide, tapering towards posterior. Cephalothorax subrectangular, just longer than wide, with pronounced pointed rostrum curving downward, laterally

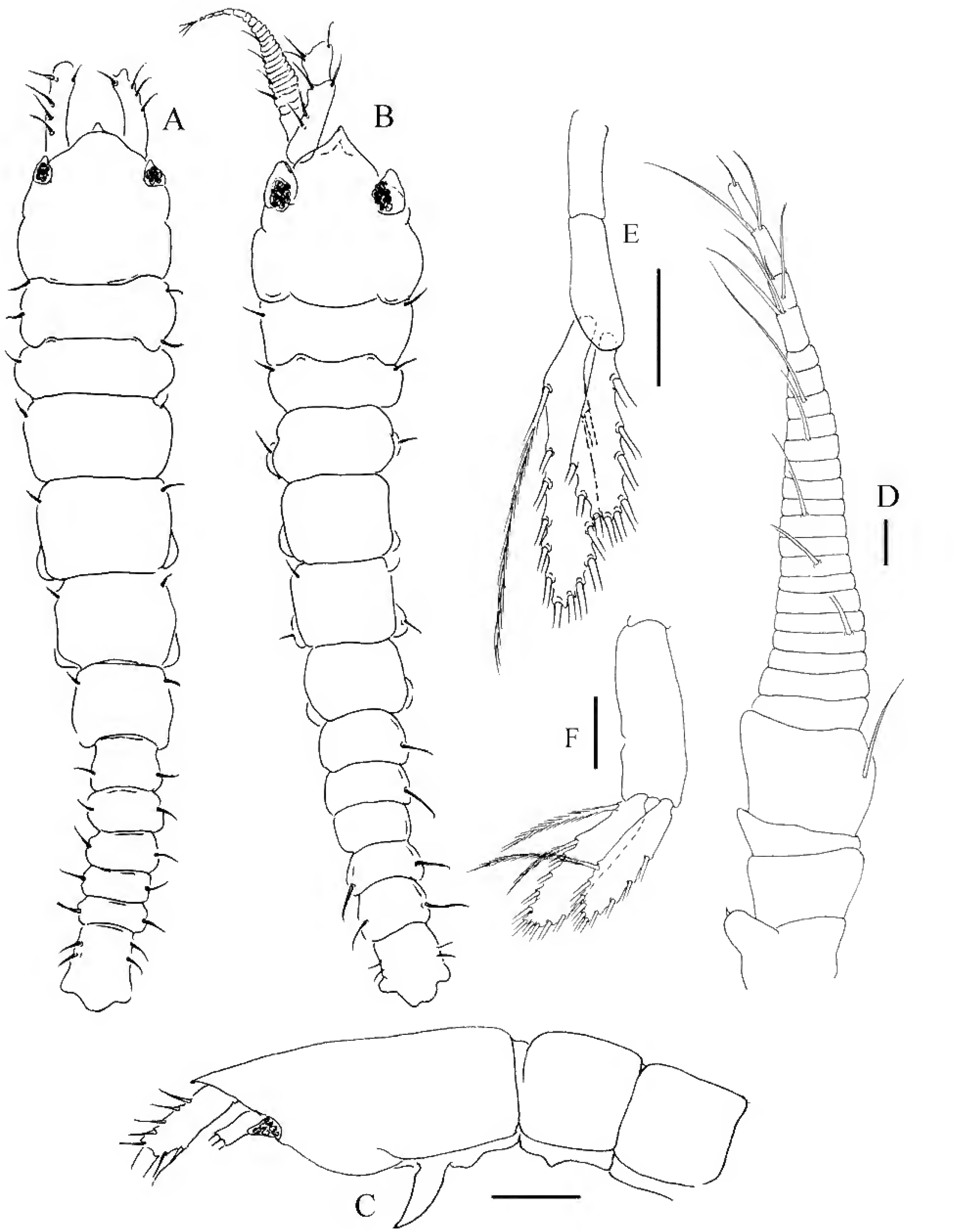


Fig. 27. *Pakistanapseudes lucifer* sp. nov. A, holotype ovigerous female, dorsal. B, male, dorsal; C, cephalothorax of female, lateral; D, male antennule; E, male pleopod; F, female pleopod. Scale = 0.1 mm.


Fig. 28. *Pakistanapseudes lucifer* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; D, right mandible; E, mandibular molar; E', mandibular palp; F, maxillule;.; F', maxillule palp; G, maxilla; H, labium; I, maxilliped; J, maxilliped endite. Scale A, B = 0.1 mm; C – I = 0.01 mm.

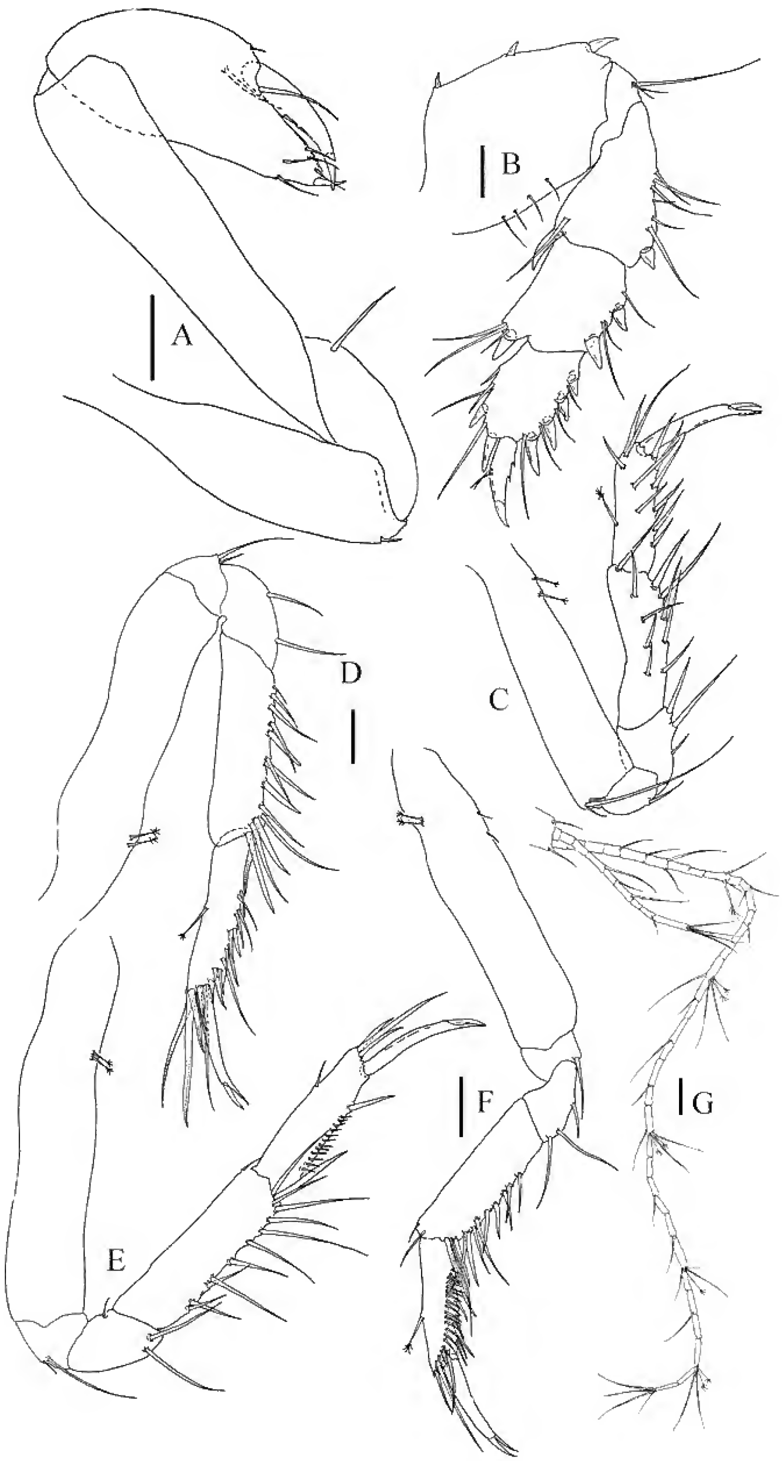


Fig. 29. *Pakistanapseudes lucifer* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, uropod. Scale = 0.1 mm.

indented at anterior of branchial chambers; eyelobes distinct, dark ocelli present. Conspicuous forward-pointing spine-like hyposphenium mid-ventrally between chelipeds (Fig. 27C). Each pereonite laterally convex, with anterolateral seta (posterolateral seta on pereonite 1); pereonites 1 and 2 subequal, shortest, about 0.35 times as long as cephalothorax; pereonite 3 one-and-a-half times length of pereonite 1; pereonite 4 longest, nearly twice as long as pereonite 1, pereonite 5 just shorter than pereonite 4, pereonite 6 just shorter than pereonite 3 and narrowest (all pereonites respectively 2.7, 2.7, 1.8, 1.3, 1.3 and 1.3 times as wide as long). Pleon three times as long as pereonite 5, with five free pleonites bearing pleopods; pleonites with single midlateral seta on each side; pleonite 1- 0.8 times as long as wide, posterior pleonites progressively shorter. Pleotelson rectangular, wider posteriorly, 0.3 times length of pleon, 1.4 times as long as wide, with paired lateral setae.

Antennule (Fig. 28A) proximal peduncle article 2.7 times as long as wide, with inner and outer subdistal tufts of setae and midlateral outer group of three penicillate setae and single simple seta. Article 2 about 1.4 times as long as wide, 0.34 times length of first, with inner and outer distal setae exceeding distal edge of third article, single outer distal penicillate seta. Article 3 just under half-length of article 2, as long as wide. Peduncle article 4 half-length of article 3, wider than long. Main flagellum sparsely setose, of twelve segments, three aesthetascs present on segment 4, four on segment 6, one on each of segments 8 and 10; accessory flagellum of five segments.

Antenna (Fig. 28B) with naked proximal peduncle article (not figured) expanded on inner margin. Article 2 longer than first, with two simple setae adjacent to elongate squama bearing seven inner marginal and distal setae. Peduncle article 3 shorter than wide with inner seta. Article 4 half as long as second with inner penicillate setae; article 5 twice as long as article 4. Flagellum of six segments, first and second segments with setae longer than three flagellar segments.

Labrum rounded, simple, naked; epistome not obvious. Right mandible (Fig. 28D) with five cusps on pars incisiva; setiferous lobe with three trifurcate, two bifurcate and one simple setae, pars molaris (Fig. 28E) stout, blunt with distal rugosity and denticulate margin; palp (Fig. 28E') of three articles, proximal article with one distal seta, second article twice as long as first and naked, third article just longer than second and with two longer stout distal setae and one shorter subdistal seta. Left mandible (Fig. 28C) as right but with dentate lacinia mobilis; outer margin finely denticulate. Labium with outer serrations, distally finely setose, palp (Fig. 28H) with inner and outer fine lateral setules and two longer and two shorter distal spines, and conspicuous rounded inner apophysis. Maxillule (Fig. 28F) inner endite with outer apophysis and finely-setose distal margin, and five plumose distal setae; outer endite with ten distal spines and three distally denticulate subdistal setae, outer margin finely setose; palp of two articles, distally with three setae graduated in length. Maxilla (Fig. 28G) typical of genus, outer margin finely setose; moveable endite outer lobe with two subdistal and five distal finely denticulate setae, inner lobe with six plumose/denticulate setae; fixed endite outer lobe with simple, trifurcate and bilaterally denticulate distal spines, inner lobe with five longer plumose setae and rostral row of 24 setae. Maxilliped (Fig. 28I) with simple setae; first palp article with short outer seta and long inner distal seta; second palp article with inner margin bearing proximal serrations and numerous setae largely in two rows, longest inner seta not reaching distal margin of article, single outer distal setae; third palp article with nine recurved inner setae; fourth palp article with eleven setae around distal margin. Endite (Fig. 28J) distal margin with outer simple setae and inner blunt compound spines, two coupling hooks. Epignath not recovered.

Cheliped (Fig. 29A) slender. Basis four times as long as wide, ventrally without spine but with single ventrodistal seta. Exopodite damaged. Merus with single ventrodistal seta. Carpus slender, four times as long as wide, naked. Chela not slender, palm (propodus) 1.6 times as long as wide with single inner and outer distal setae at base of dactylus and small dorsodistal seta; ventral margin of fixed finger with two setae; cutting edge of fixed finger without apophyses but with three setae. Dactylus shorter than palm, naked, with no apophyses on cutting edge.

Pereopod 1 (Fig. 29B) generally bearing simple (not tapering) longer setae. Basis stout, 1.4 times as long as wide, with small ventroproximal and mid-ventral spine and larger ventrodistal spine, dorsal margin with four simple, fine setae. Exopodite damaged. Ischium with two shorter and one longer ventrodistal setae. Merus more than half length of basis, wider distally, with single dorsodistal seta and curved dorsodistal spine, row of mid-ventral setae, stout ventrodistal spine without adjacent setae. Carpus compact, as long as merus, 1.2 times as long as wide, with two short ventral and one longer dorsodistal blunt spines, sparse ventral and dorsodistal setae as figured. Propodus shorter than carpus, with four ventral blunt spines increasing in length towards distal margin interspersed with single, simple setae, two dorsodistal slender blunt spines and few setae along dorsal margin. Dactylus stout, with two ventral denticulations and two dorsal setae. Unguis distinct, pointed.

Pereopods 2 (Fig. 29C) and 3 similar to each other. Basis four times as long as wide, with two dorsoproximal penicillate setae and two shorter and one elongate ventrodistal setae, longest seta exceeding tip of merus. Ischium as long as wide with one ventrodistal seta; merus short, 0.2 times as long as basis, much shorter than carpus, with three ventral setae, dorsal margin naked. Carpus elongate, three times as long as merus, with inner and ventral rows of setae, single dorsodistal seta. Propodus 0.8 times as long as carpus, with row of elongate, simple ventral setae, paired mesial setae, dorsoproximal penicillate seta and three dorsodistal setae. Dactylus slender, as long as propodus, with subdistal unguis forming bifurcate tip.

Pereopod 4 (Fig. 29D) slender, similar to pereopod 2, basis 4.7 times as long as wide, without ventrodistal setae. Carpus 3.2 times as long as merus. Propodus with dorsodistal group of one short spine, and one longer slender spine and two setae all as long as dactylus; dactylus elongate, 0.8 times as long as propodus, bifurcate as pereopod 2. Pereopod 5 (Fig. 29E) similar to pereopod 4 but propodus with ventral row of fine spinules and three dorsodistal setae; dactylus with subdistal unguis forming bifurcate tip. Pereopod 6 (Fig. 29F) similar to pereopod 5 but propodus ventral and distal margin with row of some 19 small leaf-like spinules, dorsodistal group of four spines and single seta. Dactylus with subdistal unguis forming bifurcate tip.

Pleopods (Fig. 27F) all alike. Basis naked; rami linguiform. Endopod longer than exopod, respectively with 12 and 10 marginal plumose setae.

Uropod (Fig. 29G) biramous, basis with single inner and outer distal setae; exopod of nine segments; endopod over four times as long as exopod, 0.6 times as long as body length, of about 35 segments.

*Description of male*. similar to female (figured male 3.7 mm long, Fig. 27B), cephalothorax proportionately slightly larger, rostrum more pronounced. Antennule and antenna (Fig. 27D) with multisegmented flagella bearing dense aesthetascs; squama of antenna fused to second peduncle article, with small distal spinule, fourth peduncle article short, fifth article with two simple distal setae. Cheliped not recovered. Pleopods with more elongate basis, with articulation (Fig. 27E).

*Etymology*. named after the Devil, owing to its having bifurcated claws ("cloven hooves") on all pereopods other than pereopod 1.

*Remarks*. bifurcation of the pereopod claws (used in this context to mean the combination of dactylus and unguis, whether fused or not) in *Pakistanapseudes* is a variable feature, ranging from no bifurcation (e.g. *P. leptochelatus*, *P. bassi*), to a bifurcation resulting from the subdistal attachment of the unguis on the dactylus on pereopods 2 and 3, as, for example, in *P. goofi* Bamber & Sheader, 2003, and finally to a subdistal fusion of the unguis to the dactylus on pereopods 2 and 3 as, for example, in *P. tenuicorporeus* (Shiino, 1963); apart from the present species, the only other species of the Pakistanapseudinae to have bifurcating claws (with an unfused dactylus) on pereopods 5 and 6 as well as 2 and 3 is *Swireapseudes birdi* Guţu & Iliffe, 2008, but in that species the claw of pereopod 4 is not bifurcate, whereas the claw of pereopod 4 in *P. lucifer* sp. nov. is bifurcate, identical to those of the other pereopods.

Other distinctions of *P. lucifer* include the complete absence of setae on the basis of the pleopod: many other species lack outer (ventral) setae, but all appear to have inner (dorsal) setae, although the setation of the basis in *P. leptochelatus* is unclear. In addition, the basis of pereopod 1 is surprisingly short compared with other species, and all other species show some modification of the dactylus and unguis of pereopod 4 (where known), normally a marked reduction in size compared with the other pereopods (although it is larger in *P. perulpa* Błażewicz-Paszkowycz & Bamber, 2007 and *P. ridculli* Bamber, 2005): in the present species, it shows no difference.

In the very sparse setation of the mandibular palp, only *P. brasiliensis* Guţu 1996, from Brazil, approaches *P. lucifer*, but that species has a naked proximal article and eight distal/subdistal setae on the distal article. The sparsity of setation on the cheliped and pereopods is more extreme than any other pakistanapseudid, while the presence of a ventral row of fine spinules on the propodus of pereopod 5 is unique in this group, and the presence of three subdistal setae on the outer endite of the maxillule is unknown in the Apseudomorpha, as far as we are aware, all other species having two when they are present.

With regard to the identification key to Australian *Pakistanapseudes* species given by Błażewicz-Paszkowycz & Bamber (2007), the only other Australian species with a pointed rostrum is *P. australianus* Guţu, 2006, from Queensland, but that species has two setae on the pleopod basis, far more segments in the antennular and antennal flagella, and is without bifurcated claws on pereopods 2, 4, 5 and 6 (pereopod 3 has not been described).

*Pakistanapseudes lucifer* occurred throughout the Bass Strait, at depths from 13 to 130 m on sandy substrata.

### ***Pakistanapseudes perulpa*** Błażewicz-Paszkowycz & Bamber, 2007

*P. perulpa* Błażewicz-Paszkowycz & Bamber, 2007a, 3–8, figs 1–3.

*Material examined.* 1 ♀ with oostegites, 1 subadult (J30441), La Trobe Valley Ocean Outfall Survey Stn MSL LV 4 T5, Eastern Bass Strait, 1 km off Delray Beach, Victoria, 38°14'S 147°22'E, 15–16 m depth, 24 October 1989; 2 ♀♀ (1 with oostegites) (J30444), La Trobe Valley Ocean Outfall Survey Stn MSL LV 6 T8, Eastern Bass Strait, 1 km off Delray Beach, Victoria, 38°14'S 147°22'E, 15–16 m depth, 29 August 1990; 4 ♀♀ (2 with oostegites) (J30405), La Trobe Valley Ocean Outfall Survey Stn MSL LV 6 S1, Eastern Bass Strait, 1 km off The Honeysuckles, Victoria, 38°22'S 147°12'E, 15–16 m depth, 28 August 1990; 6 ♀♀ (5 with oostegites) (J30409), La Trobe Valley Ocean Outfall Survey Stn MSL LV 6 S4, Eastern Bass Strait, 1 km off The Honeysuckles, Victoria, 38°22'S 147°12'E, 15–16 m depth, 28 August 1990, SCUBA Airlift, coll. EPA & Marine Science Laboratory.

*Remarks*: this species was described originally from Moreton Bay, Queensland, from clean sandy substrata at depths between 7 and 28 m. The present material is within this depth range, but extends the distribution much further south. It has a rounded rostrum, setae on both margins of the pleopod basis, an overlong dactylus to pereopod 4, and is without bifurcating claws.

### ***Pakistanapseudes taylorae*** sp. nov.

Figures 30–32

*Material examined.* 1 ♀ with oostegites (J57588), holotype, Stn BSS76, Western Bass Strait, 39°19'S 143°38'E, 95 m depth, 10 October 1980, coarse sand, carbonate, coll. G C B Poore; 1 juvenile without appendages (J57596), paratype, Stn BSS112, Central Bass Strait, 40°22.2'S 145°17'E, 40 m depth, 3 November 1980, mainly sand, coll. M.F. Gomon and G C B Poore; 3 ♂♂, 3 ♀♀ (J55840), paratypes, Stn BSS180, Central Bass Strait, 39°12.9'S 146°27.3'E, 65 m depth, 18 November 1981, medium sand, coll. R.S. Wilson; 1 brooding ♀ (J55865), paratype, Stn CPBS 32N, Western Port, 38°20.83'S 145°13.49'E, 13 m depth, 21 February 1969, sandy gravel. 1 ♀ (not registered), Stn BSS209, Eastern Bass Strait, 38°18.0'S 147°37.0'E, 55 m depth, 31 July 1983, muddy with fine shell, coll. M. Gomon & R.S. Wilson.

*Description of female*. Body (Fig. 30A), dorsoventrally flattened, elongate, holotype 4 mm long (tip of rostrum to posterior of pleotelson), 6.5 times as long as wide, tapering towards posterior. Cephalothorax subrectangular, just wider than long, with pronounced apparently rounded rostrum but with small distal point (Fig. 31C), single lateral setae in front of branchial chamber on each side; eyelobes distinct, dark ocelli present. Forward or backward pointing hyposphenium mid-ventrally between chelipeds. Pereonite 1 naked, pereonites 2

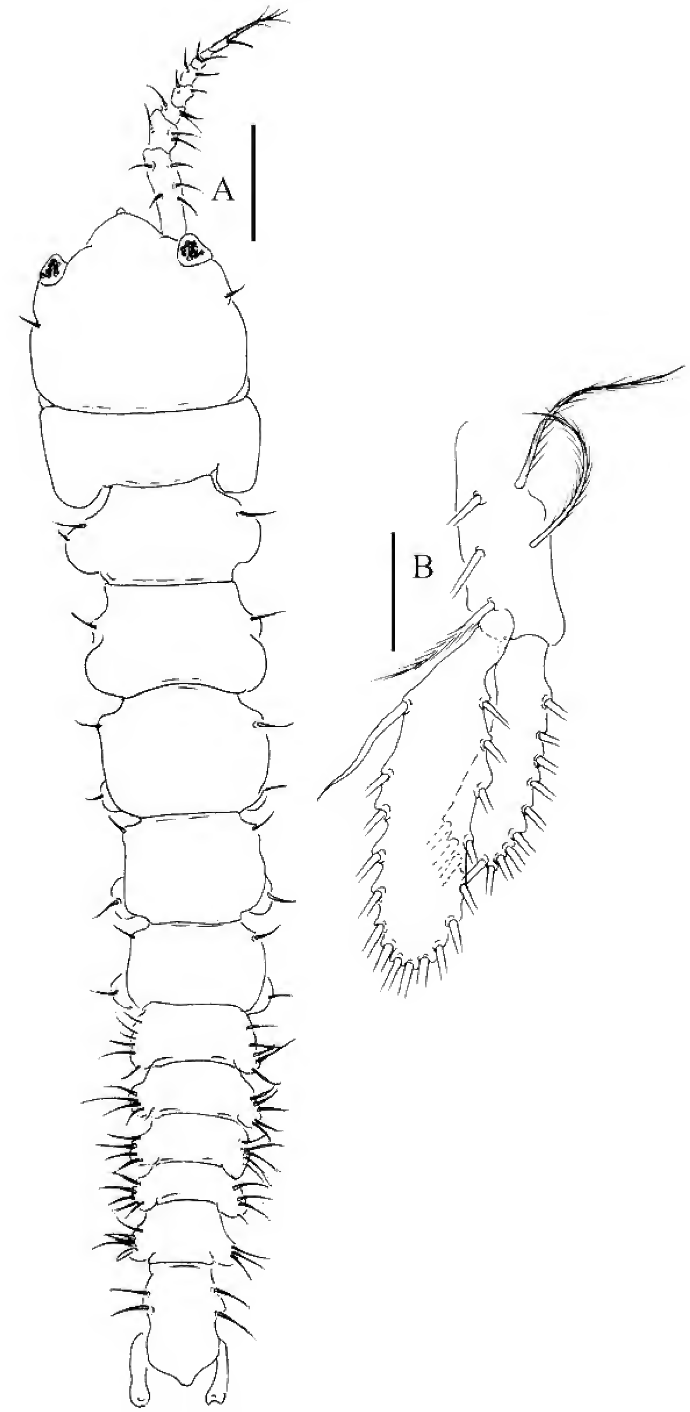


Fig. 30. *Pakistanapseudes taylorae* sp. nov., holotype female. A, dorsal view; B, pleopod. Scale = 0.1 mm.

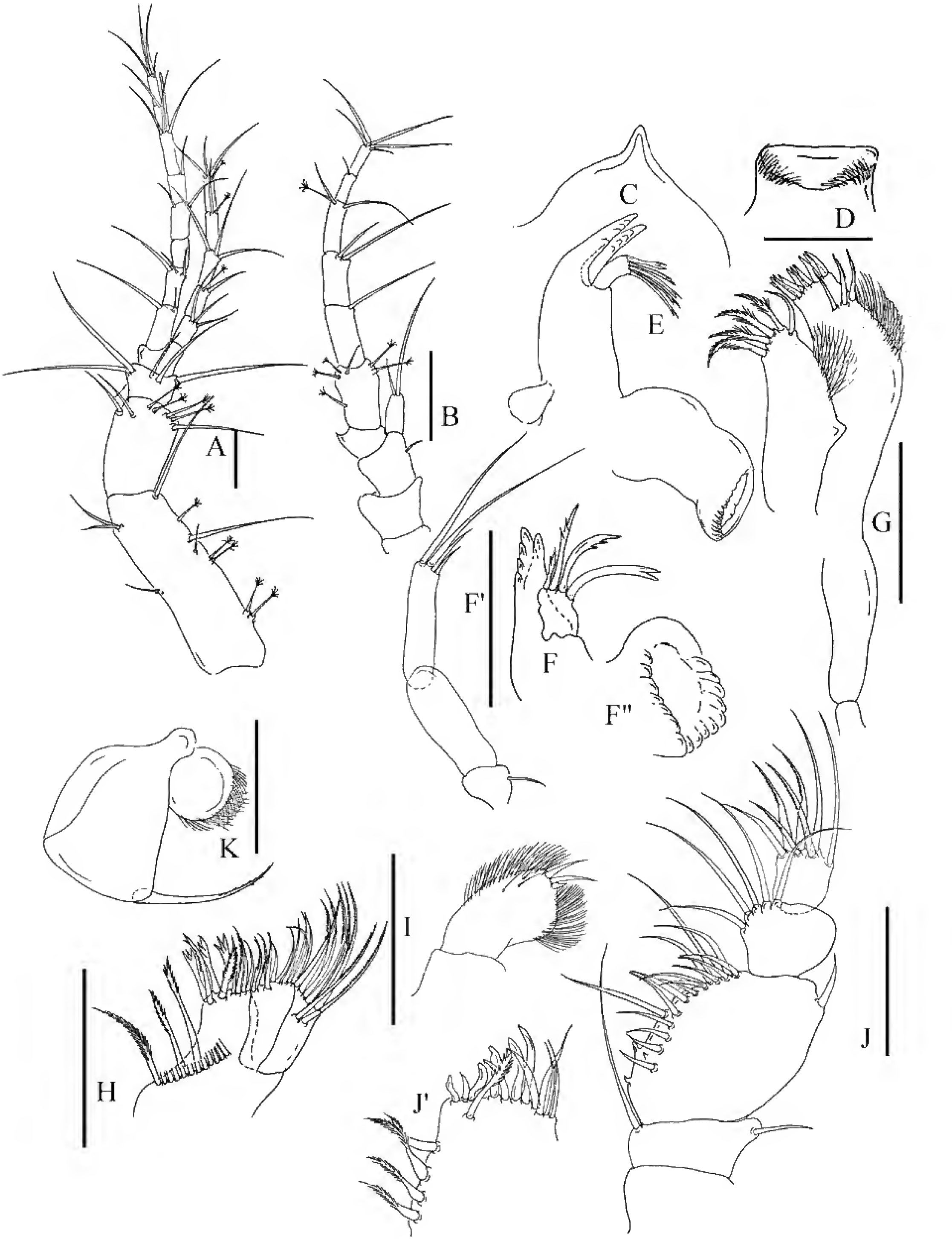


Fig. 31. *Pakistanapseudes taylorae* sp. nov., female paratype. A, antennule; B, antenna; C, rostrum; D, labrum; E, left mandible; F, right mandible; F' mandible palp; G, maxillule; H, maxilla; I, labium; J, maxilliped; J', maxilliped endite; K, epignath. Scale A, B, D = 0.1 mm; C, E-K= 0.01 mm.


Fig. 32. *Pakistanapseudes taylorae* sp. nov. A, antennule, male; B, cheliped (fragment), female; C-H, pereopods 1–6 respectively, female. Scale = 0.1 mm.

and 3 with anterolateral seta, pereonites 4 to 6 with anterolateral seta and posterolateral seta; pereonite 1 shortest, about 0.4 times as long as cephalothorax, pereonites 2 and 3 subequal, half length of cephalothorax; pereonite 4 longest, 1.3 times as long as pereonite 1, pereonite 5 just shorter than pereonite 4, pereonite 6 just longer than pereonite 1 (all pereonites respectively 2.6, 1.8, 1.7, 1.1, 1.2 and 1.7 times as wide as long); pereonites 1 and 2 with or without hyposphenia. Pleon three times as long as pereonite 4, with five free pleonites bearing pleopods; pleonite 1- 0.4 times as long as wide, posterior pleonites progressively shorter, each with four or five lateral setae. Pleotelson rectangular, one-third length of pleon, twice as long as wide, with paired lateral setae.

Antennule (Fig. 31A) proximal peduncle article 3.2 times as long as wide, outer margin with few shorter simple setae, inner margin with numerous penicillate setae and more sparse longer simple setae, longest seta reaching distal edge of second peduncle article. Second article 1.5 times as long as wide, half length of first, with distal crown of simple and penicillate setae. Article 3 about 0.2 times length of article 2, half as long as wide, with long distal setae all round. Peduncle article 4 as long as article 3, wider than long. Main flagellum regularly setose, of eight segments, single aesthetascs present on segments 6 and 8; accessory flagellum of five segments.

Antenna (Fig. 31B) with naked proximal peduncle article expanded on inner margin. Article 2 just longer than first, with one simple seta adjacent to elongate squama bearing two distal setae. Peduncle article 3 shorter than wide with inner spine-like apophysis. Article 4 one-and-a-half times as long as second with crown of penicillate setae; article 5 just longer than article 4, with single distal seta. Flagellum of four segments.

Labrum (Fig. 31D) truncate, simple, marginally setose. Pointed epistome obvious. Right mandible (Fig. 31F) with five rounded "teeth" on pars incisiva; setiferous lobe with one bifurcate and three trifurcate setae, pars molaris (Fig. 31F") stout, blunt with crenulate distal margin; palp (Fig. 31F') of three articles, proximal article with one inner seta; second article nearly three times as long as first, naked; third article as long as second, with two longer and two shorter simple distal setae. Left mandible (Fig. 31E) as right but with dentate lacinia mobilis and five setae on setiferous lobe. Labium (Fig. 31I) without serrations, not setose, palp with inner and outer fine lateral setules and two longer and one minute simple distal setae, and widely rounded inner apophysis. Maxillule (Fig. 31G) inner endite with outer finely-setose margin distal of apophysis, and four plumose and one simple distal setae; outer endite with ten distal spines and three subdistal setae, outer margin finely setose; palp of two articles. Maxilla (Fig. 31H) typical of genus, outer margin naked, outer lobe of moveable endite with two subdistal and seven distal finely denticulate setae, inner lobe with nine plumose/denticulate setae; fixed endite outer lobe with simple, trifurcate, plumose and bilaterally denticulate distal spines, inner lobe with two longer plumose setae and rostral row of 13 setae. Maxilliped (Fig. 31J) mostly with simple setae; first palp article with short outer distal seta and longer inner distal seta almost reaching tip of article 2; second palp article with outer distal spine, inner margin bearing 16 setae largely in two rows, longest inner seta reaching fourth article, inner proximal margin with about three thorn-like apophyses; third palp article with five recurved inner setae; fourth palp article with seven setae around distal margin, inner five with finely denticulate inner margins. Endite (Fig. 31J') distal margin with outer simple setae and gradation of inner blunt spines, caudal seta leaf-like. Epignath (Fig. 31K) large, cup-shaped, with large, setose proximal lobe and distally setulose distal spine.

Cheliped (Fig. 32B) only one available on one specimen, damaged; basis slender, 2.6 times as long as wide, ventrally with small proximal and longer distal setae, without spine. Exopodite damaged. Merus with three ventrodistal setae. Carpus slender, 3.3 times as long as wide, with one mid-ventral and two ventrodistal setae. Chela badly damaged, fixed finger with 3 ventral setae, and tuft of distal curled setae, and row of spatulate setae on cutting edge.

Pereopod 1 (Fig. 32C) basis three times as long as wide, with small ventroproximal and mid-ventral spine and seta between these two, longer, pointed ventrodistal spine with adjacent seta exceeding distal margin of ischium, dorsal margin with two proximal simple setae and two mid-dorsal penicillate setae. Exopodite damaged. Ischium with three ventrodistal setae. Merus half as long as basis, wider distally, with slender dorsodistal spine and long dorsodistal seta as long as carpus, row of five ventral setae and ventrodistal spine. Carpus just shorter than merus, with three ventral spines interspersed with three setae, and one elongate dorsodistal spine with adjacent row of four setae. Propodus with five ventral spines increasing in length towards distal margin interspersed with single simple setae, two dorsodistal slender blunt spines and row of setae along dorsal margin. Dactylus stout, with three ventral denticulations, two small mid-dorsal setae. Unguis distinct, pointed.

Pereopod 2 (Fig. 32D) basis 2.7 times as long as wide, with single mid-ventral spine and three elongate ventrodistal setae. Ischium as long as wide with row of three ventrodistal setae; merus shorter than carpus, with single long, slender dorsodistal and ventrodistal spines. Ventral margin with row of six setae, one ventrodistal seta. Carpus 1.5 times as long as merus, with row of three slender spines interspersed with single setae along ventral margin, and diagonal row across inner face of two spines and six setae, one longer, slender dorsodistal spine; propodus just longer than carpus, ventrodistal margin with four slender spines interspersed with single simple setae, dorsally with three slender spines and five setae in distal half. Dactylus slender, together with distinct unguis 0.8 times as long as propodus, not bifurcate. All spines with fine denticulation in distal half.

Pereopod 3 (Fig. 32E) similar to pereopod 2, but basis more slender, merus with only one ventral spine and without dorsal spine, carpus and propodus with fewer spines and setae, dactylus 1.24 times as long as propodus, very small unguis subdistal, giving bifurcation.

Pereopod 4 (Fig. 32F) basis 4.3 times as long as wide, with ventrodistal and dorsoproximal penicillate setae and single, long ventrodistal simple seta exceeding tip of merus. Ischium with single ventrodistal seta. Merus with three ventral setae. Carpus 1.5 times as long as merus, ventrally with four slender, blunt, finely denticulate spines interspersed with nine setae. Propodus with distal crown of ten setae, single dorsal penicillate seta in proximal half; dactylus elongate, sinuous, pointed, 1.6 times as long as propodus.

Pereopod 5 (Fig. 32B) similar to pereopod 4 but basis without ventrodistal seta, ventral setae on ischium and merus shorter, unguis attached subdistally, shorter than extension of dactylus, giving bifurcation.

Pereopod 6 (Fig. 32H) basis naked, ischium with two ventrodistal setae and single smaller dorsodistal seta. Carpus with eight setae and five denticulate spines ventrally. Propodus ventral and distal margin with row of some 26 small leaf-like spines, ventrally with slender subdistal spine, dorsodistal group of two setae. Dactylus as long as propodus, unguis attached subdistally, shorter than extension of dactylus, giving bifurcation.

Pleopods (Fig. 30B) all alike. Basis with two outer plumose setae and three inner plumose setae; rami linguiform. Endopod longer than exopod, respectively with 17 and 13 marginal plumose setae.

Uropods missing on all specimens.

*Description of male.* Generally similar to female, available specimens missing most appendages (cheliped unknown); antennule missing, antenna (Fig. 32A) with multisegmented flagellum with array of aesthetascs over whole surface; squama with three distal setae.

*Etymology.* named after Dr Joanne Taylor, Collection Manager at Museum Victoria, in gratitude for all her diligent efforts and her tolerance of our interference with her collections.

*Remarks. Pakistanapseudes taylorae* sp. nov. is the seventh species of this genus recorded from Australian waters (see Błażewicz-Paszkowycz & Bamber, 2007, and above). The only other species to have a pointed rostrum and bifurcate claws is *P. lucifer* (described above); the present species is distinguished from *P. lucifer* by having basal setae on the pleopod, a very short third peduncle article on the antennule, a non-bifurcate claw on pereopods 2 and 4, far more and longer setae and spines on the cheliped and pereopods, fewer segments in the flagellum of the antenna and the main flagellum of the antennule, fewer setae on the distal maxilliped palp article, and the thorn-like apophyses on the second palp article, *inter alia*. Interestingly, both of these species have the unusual attribute of three subdistal setae on the outer endite of the maxillule.

Elsewhere, the only other species of the Pakistanapseudinae with a pointed (if only slightly) rostrum, eyes, and bifurcate pereopod claws is *Swireapseudes birdi* from the Bahamas, but that species has far more segments in the antennular and antennal flagella, far fewer spines on its much more slender pereopod 1, a proportionately longer third peduncle article on the antennule, and distinct setation of its mouthparts.

*P. taylorae* is particularly unusual in the Pakistanapseudinae in the reduced setation of the antennal squama: only the deep-sea species *Leptolicoa thokozele* (Bamber & Sheader, 2003), very distinct from the present species in a number of features, has as few as two squama setae.

*P. taylorae* was collected sparsely throughout Bass Strait, on coarse to medium sands, and in depths between 13 and 95 m.

***Pakistanapseudes* C sp. nov.**

*Material examined.* 1 damaged female (J58891), Stn MSL EG 49, Eastern Bass Strait, 15.1 km WSW OF Pt Ricardo, 37°51.38'S 148°28.14'E, 34 m depth, 26 September 1990, Smith-McIntyre Grab.

*Remarks.* The body of this taxon is very elongate, much more so than, and thus quite different from, all the other described Australian species of *Pakistanapseudes*. Unfortunately, the single specimen is in very poor condition, with the only appendages being the cheliped and pereopods 1 and 2, and the pleon in particular is substantially damaged, so it does not warrant a proper description, nor naming, despite its being clearly a distinct and new species.

Subfamily **Parapseudinae** Guţu, 1981 new rank

Genus ***Parapseudes*** Sars, 1882

***Parapseudes blandowskii*** sp. nov.

Figures 33–36

*Material examined.* 1 brooding ♀, holotype (J24152), Stn CRUST 153, Cappers Camp, west end of Nelson Bay, off rock platform, 38°24'S 141°34'E, 5 m depth, 29 February 1992, coll. B.F. Cohen & R.S. Wilson, SCUBA airlift. 4 ♂♂, 22 ♀♀ (10 brooding, 7 with oostegites), 5 subadults (J57615), 1 ♀ (J57795), 1 ♂ (J58574), paratypes, Stn CPBS 41N, Western Port, 38°20.81'S 145°13.85'E, 13 m depth, 30 March 1965, sandy gravel; 2 ♂♂, 8 ♀♀ (6 brooding) (J57634), paratypes, Stn CPBS 23S, Western Port, 38°21.69'S 145°13.51'E, 11 m depth, 9 March 1965, muddy sand; 1 subadult (J57630), paratype, Stn CPBS 23N, Western Port, 38°20.29'S 145°14.18'E, 10 m depth, 10 March 1965, sandy gravel; 33 specimens (including ♂♂ and brooding ♀♀) (J57622), paratypes, Stn CPBS 33S, Western Port, 38°22.06'S 145°14.10'E, 13 m depth, 5 March 1965, reef with sponges; 3 ♀♀ (2 brooding, 1 with oostegites) (J56359), paratypes, Stn CPBS 41N, Western Port, 38°20.81'S 145°13.85'E, 13 m depth, 30 March 1965, sandy gravel; 1 ♀ (J56199), paratype, Stn CPBS 32N, Western Port, 38°19.71'S 145°13.82'E, 14 m depth, 25 Agust 1966, sand; 2 ♂♂, 4 ♀♀ (1 brooding) (J57627), paratypes, Stn CPBS 33S, Western Port, 38°22.06'S 145°14.10'E, 13 m depth, 5 March 1965, reef with sponges; 32 specimens (including ♂♂ and brooding ♀♀) (J57645), paratypes, Stn CPBS 41N, Western Port, 38°20.81'S 145°13.85'E, 13 m depth, 30 March 1965, sandy gravel, coll. A.J. Gilmour; 4 ♀♀ (3 brooding), 1 subadult (J56363), paratypes, Red Rock Point Island, sublittoral, 23 July 1974; 1 ♂, 1 ♀ (J56361), paratypes, Cruise 81-T-1 Stn BSS 185, Western Bass Strait, 38°48.0'S 143°14.5'E, 47 m depth, 20 November 1981, rocky bottom, coll, R. Wilson; 1 ♂, 1 brooding ♀ (J56291), paratypes, Western Port sublittoral, 25 November 1971, coll J E Verse, H F Seed.

*Description of female.* Body (Fig. 33) typical of the genus, holotype 4.0 mm long (tip of rostrum to posterior of pleotelson), five times as long as wide, narrower posteriorly. Cephalothorax pentangular, as long as wide including rostrum, anterior margin produced into convex, triangular rostrum with smooth anterior margin; lateral indentation anterior to branchial chambers. Eyes present on rounded eyelobes. All pereonites with lateral margins uniformly convex, appearing as posterolateral rounded apophyses on pereonites 3 to 6 owing to anterior (3 and 4) or posterior (5 and 6) lateral indentations, each with two to four conspicuous simple lateral setae; pereonite 1 shortest, about one-quarter as long as cephalothorax; pereonites 2 to 5 progressively longer, pereonite 6 as long as pereonite 3 (all pereonites respectively 3.5, 2.8, 1.7, 1.6, 1.5 and 1.7 times as wide as long). Pleon twice as long as pereonite 5, of five free subequal pleonites, the first four only bearing pleopods, and rectangular pleotelson; pleonites more than four times as wide as long, laterally expanded by spiniform apophyses each bearing two or three simple setae distally, pleonite 1 with dorsal row of setae. Pleotelson distally extended and rounded, half as long as whole pleon, 1.3 times as wide as long, bearing lateral and dorsal simple setae.

Antennule (Fig. 34A). Peduncle proximal article compact, widest at mid-length, 2.3 times as long as wide, inner margin with row of four simple setae just distal of mid-length and subdistal seta, outer margin with penicillate setae in proximal third and four simple setae in distal two-thirds; second article one-third as long as article 1, 1.5 times as long as wide, with outer and inner subdistal tufts of three simple setae; third article 0.4 times as long as second and wider than long; fourth article just shorter than third, naked. Main flagellum of 10 segments, segments 6 and 8 each bearing single aesthetasc; accessory flagellum of 4 segments.

Antenna (Fig. 34B). Proximal peduncle article with outer rounded apophysis, naked; article 2 0.8 times as long as article 1, outer margin with one simple marginal seta, linguiform squama with six simple setae around distal margin; peduncle article 3 shorter than wide, one-third as long as article 2, with one distal seta; article 4 as long as article 1, with one distal seta; article 5 one-third as long as article 4, with one distal seta. Flagellum of five segments.

Labrum (Fig. 34C) rounded, distally finely setulose. Left mandible (Fig. 34D) bearing strong, crenulated pars incisiva, lacinia mobilis robust with five strong denticulations, setiferous lobe with three trifurcate and one bifurcate setae, pars molaris robust, blunt, margin with anterodistal row of finely denticulate teeth (as shown for right mandible, Fig. 34E); mandibular palp of three articles, proximal article longer than wide with four setae on inner margin, article 2 twice as long as article 1 with two longer and three shorter setae in distal half, article 3 0.8 times as long as article 2 with eight inner finely denticulate setae in distal two-thirds and six longer subdistal to distal curved simple setae. Right mandible (Fig. 34E) as left but without lacinia mobilis. Maxillule (Fig. 34F) inner endite with five setulate distal setae, inner and outer margins setulose; outer endite with ten distal spines and two subdistal setae, outer margin finely setulose; palp of two articles, distally with four setae. Maxilla (Fig. 34G) with sparse fine setae on outer margin; outer lobe of moveable endite with three simple subdistal setae and seven simple distal setae; inner lobe of moveable endite with five simple and seven setulose distal setae, inner margin with three subdistal simple setae; outer lobe of inner endite distally with four outer simple setae, one distally-bilaterally-setulose spine, two mid-distal simple spines, three stout trifurcate spines, and one inner stout spine distally setulose on outer margin, subdistally with one distally-bilaterally-setulose spine; inner lobe of fixed endite with rostral row of 18 setae guarding six longer finely-denticulate setae, inner margin finely denticulate. Labium (Fig. 34I) with microtrichia along outer margin, palp with fine lateral setules and three simple distal spines. Maxilliped (Fig. 34H) basis

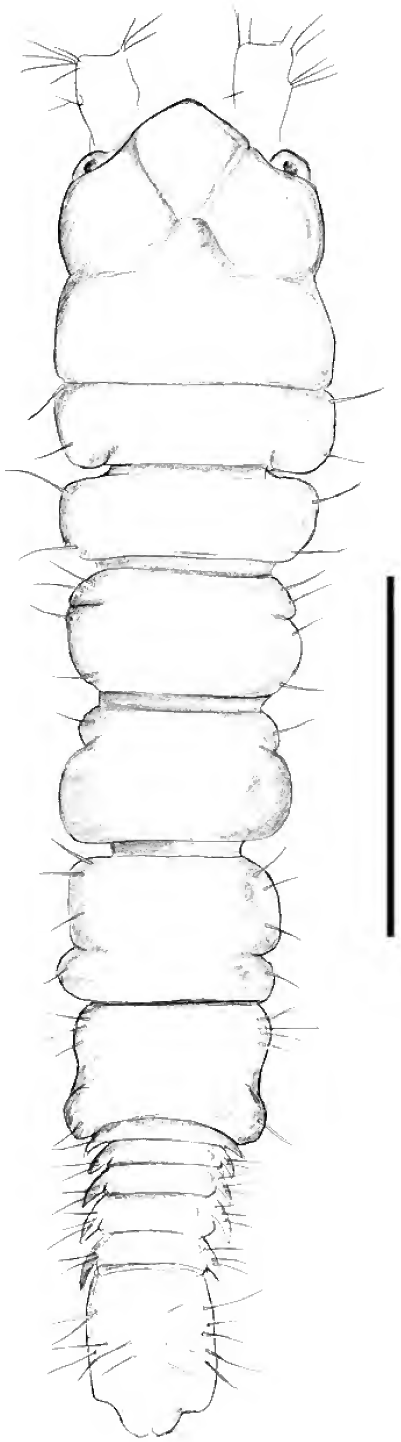

Fig. 33. *Parapseudes blandowskii* sp. nov., holotype female, dorsal view. Scale = 1 mm.


Fig. 34. *Parapseudes blandowskii* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; F', maxillule palp; G, maxilla; H, maxilliped; H', maxilliped endite; I, labium. Scale = 0.1 mm.


Fig. 35. *Parapseudes blandowskii* sp. nov. A, female cheliped; B, male cheliped (exopodite not shown); C, uropod. Scale = 0.1 mm.

naked; palp article 1 with single fine distal spine on outer margin and three fine simple inner proximal setae; palp article 2 longer than wide, with rows of numerous short setae and two longer simple setae along inner margin, outer margin with four distal setae; palp article 3 as long as wide, with 14 simple setae along inner margin, in two rows; palp article 4 with seven distal setae and one subdistal seta. Endite (Fig. 34H') with bilaterally-setulose inner caudodistal seta, distal margin with simple outer setae and inner half bearing slender, distally rugose spines.

Cheliped (Fig. 35A) slender, basis 2.7 times as long as wide, dorsally naked, ventrally with one subdistal and paired distal fine setae; exopodite present, 3-articled, distal article with four plumose setae. Merus lozenge-shaped, with five ventrodistal simple setae. Carpus 2.6 times as long as wide, with two mid-ventral and two ventrodistal setae. Chela palm (propodus) longer than wide, with ventral submarginal group of three setae, dorsal submarginal row of three shorter setae, comb of four longer setae adjacent to dactylus articulation. Chela fingers shorter than palm, ventral margin of fixed finger with five setae; two setae near inner base of fixed finger; cutting edge with fine spinules and row of eight setae but no apophyses, distal claw slender, curved; dactylus with three subdistal setae, row of stout setae along cutting edge, distal claw pointed.

Pereopod 1 (Fig. 36A, B) basis 3.7 times as long as wide, dorsally with two proximal spines and adjacent seta, and one subdistal spine, ventrally with proximal and mid-ventral setae, ventrodistally with small spine and tuft or two shorter and three longer setae; exopodite present, 3-articled, distal article with six plumose setae. Ischium with single dorsodistal and tuft of longer ventrodistal setae. Merus half as long as basis, expanded distally, with entire row of ventral simple setae, submarginal spinules, and ventrodistal spine, dorsally with slender, curved dorsodistal spine and long adjacent simple setae almost as long as carpus.


Fig. 36. *Parapseudes blandowskii* sp. nov. A, pereopod 1; B, pereopod 1 basis details; C, pereopod 2; D, pereopod 3; E, pereopod 4; E', distal articles of pereopod 4; F, pereopod 5; G, pereopod 6. H, pleopod. Scale = 0.1 mm.

Carpus as long as merus, with six or seven ventral spines and intervening simple seta, dorsal margin with numerous simple setae and slender, curved dorsodistal spine. Propodus as long as carpus, with nine ventral spines alternating with simple setae, four ventral submarginal spinules, two distal spinules, simple dorsal setae in proximal half and two dorsodistal spines. Dactylus half as long as propodus, with mid-dorsal fine setae; unguis half length of dactylus.

Pereopod 2 (Fig. 36C) more slender. Basis 3.7 times as long as wide with small dorsal spine in distal half and ventrodistal tuft of setae mostly twice as long as ischium. Ischium with ventrodistal tuft of setae as long as merus. Merus 0.7 times as long as carpus, with curved dorsodistal spine, row of ventral simple marginal setae and straight ventrodistal spine. Carpus with five ventral spines interspersed with setae, groups of inner mesial and dorsodistal simple setae, and one shorter straight subdistal spine and one longer curved dorsodistal spine. Propodus articulating anaxially on merus, just longer than merus, with five ventral and two dorsodistal spines with interspersed setae. Dactylus curved, with fine mid-dorsal seta, unguis slender, together 0.8 times as long as propodus. Pereopod 3 (Fig. 36D) similar to pereopod 2, but basis with dorsal seta rather than spine, merus with two ventrodistal spines, carpus with longer marginal and shorter submarginal ventral spines and three dorsodistal spines, propodus with dorsal penicillate seta.

Pereopod 4 (Fig. 36E) similar to pereopod 3 but basis stouter, twice as long as wide; merus with six ventral and one dorsodistal setae; carpus with numerous ventral and distal setae; propodus with dorsoproximal penicillate seta; dactylus with claw (Fig. 36E') half length of adjacent setae, half length of propodus. Pereopod 5 (Fig. 36F) similar to pereopod 4, but basis with fine dorsoproximal setae; carpus with curved dorsodistal spine, ventral margin densely setose and spinose; dactylus plus unguis 0.8 times as long as propodus. Pereopod 6 (Fig. 36G) similar to pereopod 5 but basis with plumose setae along entire dorsal and ventral margins, two ventrodistal setae plumose; merus with single long dorsal plumose seta; carpus with three dorsal plumose setae in proximal half; propodus with ventrodistal submarginal row of 30 spinules, fine distal compound spinules, dactylus plus unguis 0.8 times as long as propodus.

Pleopods (Fig. 36H) in four pairs all alike. Basis elongate, with four dorsal and three ventral plumose setae. Endopod shorter than exopod without proximal articulation; both rami slender, with 12 to 14 marginal plumose setae.

Uropod (Fig. 35C) biramous; basis with distal crown of about 12 simple and two penicillate setae; exopod 2.75 times as long as basis with seven elongate segments; endopod nearly five times as long as exopod, with about 27 segments.

*Distinctions of male*. Penial tubercle conspicuous. Flagella of antennule and antenna with numerous aesthetascs.

Cheliped (Fig. 35B) robust and highly dimorphic; basis 2.4 times as long as wide, dorsally with conspicuous paired tooth-like apophyses in proximal half, ventrally with mid-ventral spine and two fine distal setae; exopodite present, 3-articled, distal article with four plumose setae. Merus stout with ventrodistal shoulder bearing five setae. Carpus as long as wide, with paired mid-dorsal setae, dorsal subdistal tooth-like apophysis, ventroproximal hooked apophysis with three adjacent setae, ventrodistal corner finely rugose with row of five setae. Chela palm (propodus) as long as wide with mid-distal triangular apophysis with tuft of numerous setae; fixed finger distally squared with conspicuous proximal invagination, ventral margin with five longer setae and distal comb of seven shorter setae; cutting edge with small apophyses; dactylus with two larger apophyses on cutting edge, distal claw overreaching fixed finger.

Basis of pereopod 1 (Fig. 36B) dorsally with two proximal spines and adjacent seta, and one subdistal spine as female.

*Etymology.* named after Wilhelm Blandowski (1822–1878), a founder of the Geological Society of Victoria, and the first scientist appointed to the then new Victorian Museum, Melbourne, on 1 April 1854.

*Remarks*: Lang (1965) synonymized all *Parapseudes* material worldwide into *P. latifrons* (Grube, 1864), with a putative distribution from the Yugoslavian Adriatic (type locality), the Mediterranean, the Atlantic Ocean, the Caribbean, Pacific Central and South America through Hawaii to Japan. His decision was based on observing variation in the number of uropod segments, the number of ventral spines on the distal articles of pereopod 1, and the number of segments in the antennule flagella, all characters on which earlier species had been distinguished. From our present knowledge of sibling species in Tanaidacea, such a synonymy is no longer tenable. Both Guţu (1998a), in his preliminary reassessment of the genus, and Larsen & Shimomura (2008) in their sensible discussion of *Parapseudes*, point out that the many described species require detailed re-examination in order to determine their validity, and indeed to understand the world-wide diversity of this genus.

Guţu (1998a; 1998b; 2001) distinguished four species in the genus based, *inter alia*, on the number of dorsal proximal spines on the basis of pereopod 1. To extend this concept, *P. latifrons sensu* Sars (1882) (Mediterranean), *P. algicola* (Shiino, 1952) (Japan) and *P. francispori* (Băcescu, 1980) (Mediterranean) have one proximal spine, *P. latifrons sensu* Guţu (1998b) (Tanzania) and *P. latifrons sensu* Lang (1965) (Japan) (both non *Rhoëa latifrons* Grube, 1864) have two proximal spines, and *P. inermis* (Silva Brum, 1974) (Brazil) and *P. trispinosus* Guţu, 1998(a) (Indonesia) have three; none of these have a subdistal spine. *P. pedispinis* (Boone, 1923) (California) has one proximal spine and one subdistal spine on the pereopod 1 basis. *P. neglectus* Miller, 1940 (Hawaii), *P. similis* Vanhöffen, 1914 (Cape Verde) and *P. spongicola* Brown, 1958 (South Africa) apparently have no such spines, although the original (and only) descriptions of these three species are somewhat wanting. *P. arenamans* Larsen & Shimomura, 2008 (Japan) definitely has no such spines.

These last authors suggested that the appearance of such spines may be an artefact based on setae embedded in mucus: this is not the case for the present material, nor for that of *P. latifrons* agg. *sensu* Bamber (2005) from S.W. Australia (see below). The spination of the pereopod 1 basis in *P. goodei* Richardson, 1905 (Bermuda) and *P. hirsutus* Stebbing, 1910 (Chagos) is not known.

*Parapseudes blandowskii* sp. nov. has two proximal spines on the basis preceded by a seta and one subdistal spine dorsally on the basis of pereopod 1. This basis spination most closely resembles that of *P. latifrons* agg. of Bamber (2005), from Esperance, southwest Australia, (based only on females) which has three proximal and one subdistal basis spines, and of *P. pedispinis*, redescribed from California by Menzies (1953), although that species has only one proximal spine and is without the adjacent seta. Further, the male cheliped of *P. pedispinis* (as that of all other described males) is without the dorsal and ventral tooth-like apophyses on the carpus shown by *P. blandowskii*. The Esperance species, currently being redescribed elsewhere, has a distinctly different dactylus on pereopod 4.

From species where the spination of the pereopod 1 basis is unknown, *P. blandowskii* differs in the ventral spination of the merus, carpus and propodus of pereopod 1, in the number of segments in the antennule flagella (notwithstanding the variation inferred by Lang, 1965), in the proportions of the pereonites, the plumose setation of pereopod 6, and particularly in the conformation of the male cheliped carpus, *inter alia*.

Both Larsen & Shimomura (2008) and Guţu (1998a; 1998b) found in their species and in *P. francispori* (see Guţu, 2001) that the dactylus of pereopod 4 was reduced to a small tubercle-like structure with the unguis reduced to a seta, and both speculated that this might be the norm in the genus. The present species shows a normal (although reduced in size) dactylus plus unguis on pereopod 4 (Fig. 36E, detail). A normal dactylus and unguis were also shown by Sars (1886) for what must be taken as *P. latifrons sensu stricto*, and by Shiino (1952) in *P. algicola*, while that of *P. latifrons* agg. from Esperance has a reduced but not tubercle-like dactylus and unguis.

*Parapseudes blandowskii* is only the second *Parapseudes* species presently known from Australasia, and occurred on sandy substrata at depths of 10 to 15 m in Western Port, occasionally deeper outside that embayment. *P. latifrons* agg. of Bamber (2005) was found on sandy substrata with rhodoliths and on the red alga *Osmundaria prolifera* at depths from 18 to 40 m in Esperance Bay, southwest Australia.

Guţu (1998a) gave a revised diagnosis for the genus, but failed to include therein two significant characterizing features, viz the dorsal row of setae on pleonite 1 and the presence of only four pairs of pleopods. This last characteristic is particularly diagnostic for *Parapseudes*.

## Genus ***Saltipedis*** Guţu, 1995

### ***Saltipedis nugoris*** Błażewicz-Paszkowycz & Bamber, 2007

Figure 37

*S. nugoris* Błażewicz-Paszkowycz & Bamber, 2007a, 26–31, figs 13–15.

*Magniaculeus nugoris* Guţu, 2008, p. 58.

*Description of male cheliped* (Fig. 37). Much more robust than that of female. Basis stout, twice as long as wide, with dorsoproximal two-humped apophysis and dorsodistal expansion into which proximal part of merus fits; with mid-ventral spine and ventrodistal seta. Exopodite with three articles, distal article with six marginal plumose setae. Merus almost rectangular, with mid-ventral seta and tuft of eight simple distal setae. Carpus stout, 1.5 times as long as wide, with paired small dorsodistal setae, ventrally with three submarginal and two marginal setae. Chela stout, propodus with tufts of setae dorsodistally and on mid-distal apophysis, fixed finger with array of distal setae as figured, conspicuous tooth-like apophysis on cutting edge; dactylus cutting edge with fine crenulation and setules distally, tooth-like apophysis proximally.

*Remarks*. This species was described originally from numerous specimens collected throughout the Bass Strait, on muddy- to coarse sandy substrata from depths between 12 and 293 m. Numerous further samples of this species exist in the collections of Museum Victoria, over 100 specimens having been examined in the course of this study in addition to the type-collection, and conforming to the same habitat range as the type collection.

This re-examination of material has enabled us to expand on the original description, to include the dimorphic male cheliped. While this species was originally confused with *Saltipedis forex* Bamber, 2005, until the distinctions from morphological detail were determined, the male cheliped reinforces the differences: that of *S. forex* is without the proximal apophysis on the basis, has a spine rather than a seta mid-ventrally on the basis (as does the female), no mid-ventral seta on the merus, and a truncated fixed finger to the chela (thus without tooth-like apophysis), more reminiscent of the male chela of the unrelated apseudid *Mendamanus ailurostoma* Bamber, 1999.

### ***Saltipedis floccus*** sp. nov.

Figures 38–40

*Material examined*. 1 brooding ♀ (J55832), holotype, Stn BSS159, Central Bass Strait, 39°43.5'S 146°18.8'E, 80 m depth, 13 November 1981, muddy shell, coll. R. Wilson; 1 ♀ (J57600), paratype, Stn BSS155, Central Bass Strait, 38°55.5'S 145°17.0'E, 70 m depth, 12 November 1981, fine sand, coll. R. Wilson. 2 ♀♀ (J57731), paratypes, Stn BSS117, Central Bass Strait, 40°38.0'S 145°23'E, 36 m depth, 4 November 1980, muddy shell with grit, coll. M. Gomon & G C B Poore. 1 ♀ (J57721), paratype, Stn BSS68, Western Bass Strait, 39°27'S 142°55'E, 180 m depth, 10 October 1980, coarse sand, carbonate, coll. G C B Poore. 1 ♂, 6 subadults (J57718), paratypes, Stn BSS 133T, Central Bass Strait, 30 km N of Wynyard, Tasmania, 40°33.07'S 145°44.68'E to 40°36.22'S 145°48.68'E, 68 m depth, mud, 04 February 1981, coll. M.F. Gomon *et al*., 20 m otter trawl. 3 ♀♀ (J57737), paratypes, Stn BSS 158, Central Bass Strait, 66 km S of Rodondo Island, Victoria, 39°48.36'S 146°18.48'E, 82 m depth, sand with silt and mud, 13 November 1981, coll. R.S. Wilson. 1 ♀ (J57725), paratype, Stn BSS158, Central Bass Strait, 39°49.5'S 146°18.5'E, 82 m depth, 13 November 1981, sand-silt-mud, coll. R. Wilson. 1 ♀ (J57725), paratype, Stn BSS158, Central Bass Strait, 39°49.5'S 146°18.5'E, 82 m depth, 13 November 1981, sand-silt-mud, coll. R. Wilson. 1 ♂ without cephalothorax (J55850), paratype, Stn WBES 1746, Western Port, 38°29.47'S 145°06.17'E, 79 m depth, 25 November 1974, Smith-McIntyre grab, coll. N. Coleman. 1 ♀ (J55864), paratype, Stn HP BES 1747/2, Western Port, Victoria, 38°27.32'S 145°08.35'E, 18 m depth, 25 November 1974, Smith-McIntyre grab, coll. N. Coleman. 1 ♀ (J55900), paratype, Stn CPBS 100, Western Port, 38°21.15'S 145°13.23'E, 4 m depth, 24 March 1965, mud and *Zostera*; 2 ♀♀ (J57663), paratype, Stn CPBS 01S, Western Port, 38°21.73'S 145°13.23'E, 3 m depth, 1 April 1965. 1 ♀ (J17162), 1 ♀ (J46538), paratypes, Stn MSL EG6, Eastern Bass Strait, 19 km S of Lakes Entrance, Victoria, 38°04'S 148°00'E, 92 m depth, 12 August 1989, Smith-McIntyre grab, coll. G.D. Parry.

Fig. 37. *Saltipedis nugoris*, male cheliped. Scale = 0.1 mm.

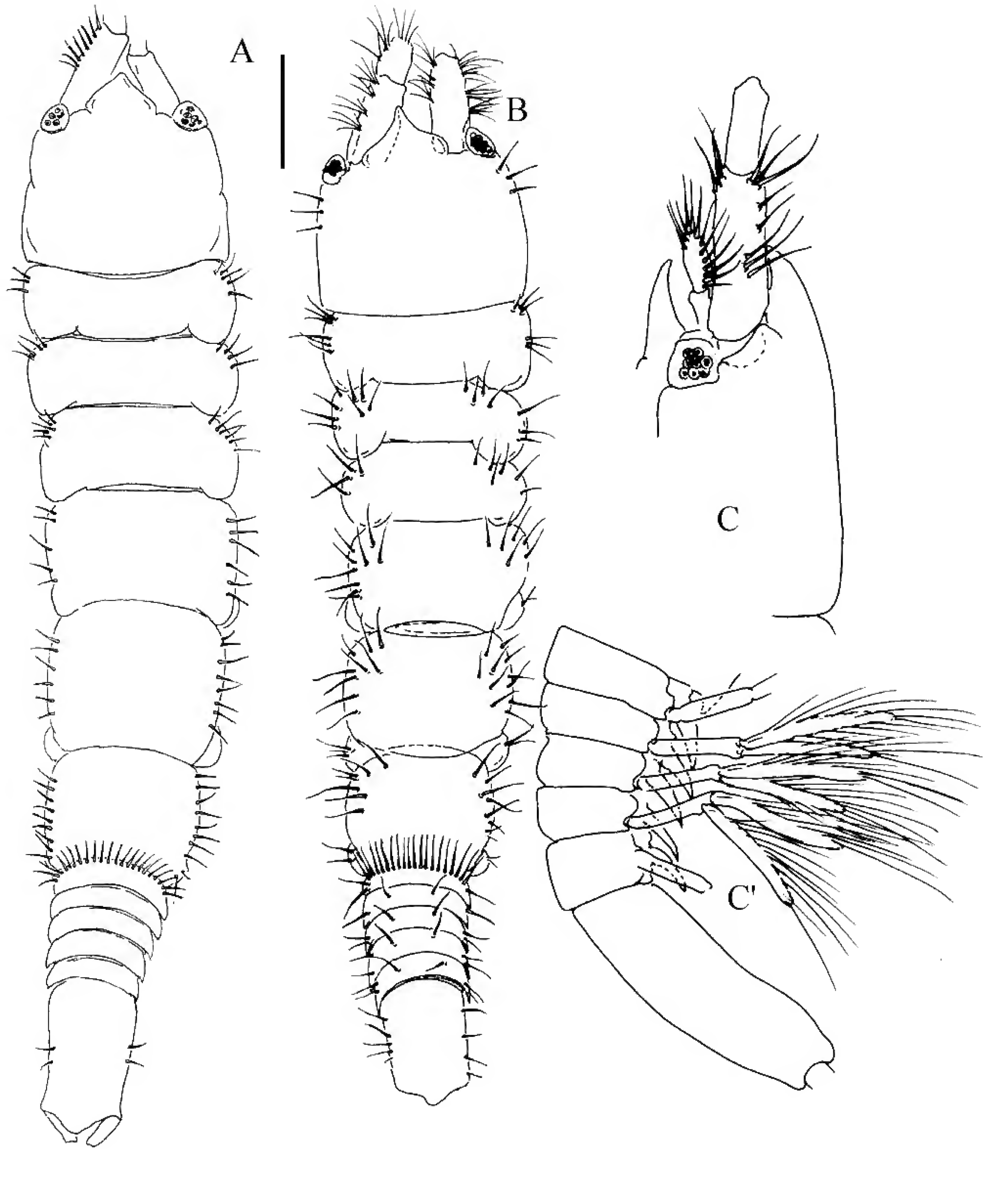


Fig. 38. *Saltipedis floccus* sp. nov. A, holotype female, dorsal; B, male, dorsal; C, cephalothorax, lateral; C', pleon, lateral. Scale = 1.0 mm.


Fig. 39. *Saltipedis floccus* sp. nov., female. A, proximal articles of antennular peduncle; B, antenna; C, right mandible incisor; D, left mandible incisor; D', mandible molar; D'', mandible palp; E, maxillule; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath. Scale A, B = 0.1 mm; C–I = 0.01 mm.


Fig. 40. *Saltipedis floccus* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = A-F= 0.1 mm.

*Description of female*. Body (Fig. 38A) dorsoventrally flattened, holotype 9.2 mm long (tip of rostrum to posterior of pleotelson), five times as long as wide, tapering towards posterior. Cephalothorax subrectangular, as long as wide, with pronounced triangular rostrum; eyelobes distinct, dark ocelli present. Spine-like hyposphenium present mid-ventrally between chelipeds, but no hyposphenium on pereonite 2. Pereonites 1 to 3 with tufts of four to six anterolateral setae, pereonites 4 to 6 with setae dispersed along lateral margins; pereonites 1 and 2 subequal, shortest, about one-third as long as cephalothorax, pereonite 3 1.2 times as long as pereonite 2; pereonites 4 and 6 subequal, 1.7 times length of pereonite 2; pereonite 5 longest, 2.3 times as long as pereonite 2 (all pereonites respectively 3.3, 3.2, 2.6, 1.8, 1.2 and 1.4 times as wide as long). Pleon one-quarter as long as whole body, with five free, pleonites bearing pleopods and backwardly-directed hyposphenia (Fig. 38C'); pleonite 1 with row of setae around anterior margin, posterior pleonites naked; pleonites 4.7 times as wide as long. Pleotelson (Fig. 1B) rectangular, more than half-length of pleon, twice as long as wide, with sparse lateral setae.

Antennule: only basal peduncle articles present on any specimen (Fig. 39A); proximal peduncle article 1.7 times as long as wide, inner margin with row of five setae at mid-length and distal tuft of 7 or 8 setae, outer margin with four groups of setae, a proximal row of penicillate setae, a subproximal tuft of simple and penicillate setae, a subdistal row of simple setae and a distal tuft of six simple setae. Second article 1.5 times as long as wide, 0.5 times length of first, with simple inner distal setae, simple outer proximal setae and an outer distal tuft of simple and penicillate setae.

Antenna (Fig. 39B) with proximal peduncle article expanded on inner margin as a rounded apophysis with three spinules. Article 2 as long as first, with four simple setae adjacent to elongate squama bearing seventeen marginal setae. Peduncle article 3 shorter than wide with inner seta. Fourth article just longer than third, as long as wide, with two inner setae; fifth article twice as long as third, with long inner seta. Flagellum of thirteen segments, mostly with setae longer than two flagellar segments.

Epistome conspicuous (Fig. 38C). Labrum rounded, distally setulose. Right mandible (Fig. 39C) with three rounded "teeth" on pars incisiva; setiferous lobe with four trifurcate and one simple setae; left mandible (Fig. 39D) as right but with dentate lacinia mobilis, and six trifurcate setae on setiferous lobe; pars molaris (Fig. 39D') stout, blunt with distal rugosity; palp (Fig. 39D") of three articles, proximal article with field of twelve inner setae; second article twice as long as first with three shorter and one longer simple inner setae at mid-length; third article as long as first, with eleven shorter inner subdistal setae, two longer distal setae and three shorter submarginal dorsal setae. Labium (Fig. 39G) with outer rows of microtrichia, inner distal margin finely setose, palp with inner fine lateral setules, three simple distal setae, outer proximal microtrichia and small, rounded, setose inner apophysis. Maxillule (Fig. 39E) inner endite with outer apophysis, and four compound distal setae; outer endite with twelve distal spines and two subdistal setae, inner and outer margins finely setose; palp of two articles, distally with six graduated setae. Maxilla (Fig. 39F) typical of genus, outer margin denticulate, moveable endite outer lobe with two subdistal and five distal finely denticulate setae, inner lobe with twelve plumose/denticulate setae; fixed endite outer lobe with simple, trifurcate, plumose and bilaterally denticulate distal spines, inner lobe with nine longer plumose setae and rostral row of 37 setae. Maxilliped (Fig. 39H) with simple setae; basis with inner and outer simple setae and outer distal spine-like apophysis; first palp article with paired inner and outer setae and outer distal spine-like apophysis; second palp article with inner margin bearing numerous setae largely in two rows, longest two inner setae exceeding fourth article, and tuft of nine outer distal setae; third palp article with about 13 recurved inner setae; fourth palp article with seven setae around distal margin and one outer subdistal seta. Endite (Fig. 39H') distal margin with outer simple setae, central rod-pike setae and inner blunt spines, inner margin with plumose setae and four coupling hooks. Epignath (Fig. 39I) large, cup-shaped, with setose outer margin and finely plumose distal spine.

Cheliped (Fig. 40A) slender. Basis 2.7 times as long as wide, with mid-ventral spine and two subdistal penicillate setae; dorsally naked. Exopodite 3-articled; article naked, article 3 with four plumose setae. Merus subrectangular, with ventroproximal, mesial and ventrodistal groups of setae. Carpus very slender, four times as long as wide, two simple setae along ventral margin, five setae along inner midline, and tufts of shorter dorsodistal and ventrodistal setae. Chela slender, palm (propodus) 1.2 times as long as wide with numerous setae on inner face; ventral margin setose along fixed finger; cutting edge of fixed finger without apophyses but with small curved setae. Dactylus longer than palm, with no apophyses on cutting edge.

Pereopod 1 (Fig. 40B) basis 2.35 times as long as wide, with small ventral spinules, ventrodistal spine and long ventrodistal setae exceeding distal margin of ischium, dorsal margin with four setae in proximal half. Exopodite conspicuous, 3-articled, article 2 with one seta, article 3 with five plumose setae. Ischium with three ventrodistal setae. Merus wider distally, with slender dorsodistal spine and shorter, stouter ventrodistal spine, tufts of simple setae ventrally, mesially and dorsodistally. Carpus compact, as long as merus, with two elongate dorsodistal spines, two shorter ventrodistal spines, setae along entire dorsal margin, dorsodistal, ventral and ventrodistal tufts of setae. Propodus as long as carpus, with six ventral spines increasing in length towards distal margin interspersed with setae, two dorsodistal slender spines and row of setae along dorsal margin, mesial field of sparse setules. Dactylus stout, with two ventral denticulations and dorsal seta, unguis distinct, pointed, both together 0.8 times as long as propodus.

Pereopod 2 (Fig. 40C) basis 1.6 times as long as wide, with three ventral spinules, and tuft of long ventrodistal setae exceeding distal margin of ischium. Ischium shorter than wide with tuft of seven ventrodistal setae; merus shorter than carpus, with dense field of ventral setae, two ventrodistal slender spines, dorsal margin naked. Carpus with diagonal row of setae along inner face, two dorsodistal slender spines, ventral margin with five fine spines interspersed with setae;

propodus just longer than carpus, ventrodistal margin with five fine spines interspersed with setae, dorsally with three fine spines interspersed with setae. Dactylus compact, unguis shorter, distinct, both together 0.6 times as long as propodus.

Pereopod 3 (Fig. 40D) similar to pereopod 2, but basis armed only with one mid-ventral and three dorsoproximal penicillate setae.

Pereopod 4 (Fig. 40E) basis slender, with sparse ventral spinules and tuft of ventrodistal setae. Ischium with ventrodistal row of six setae. Merus with numerous ventral setae and one ventrodistal slender spine. Carpus 1.3 times as long as merus, ventrally with five fine spines interspersed with long setae, diagonal row of setae along inner face distally including five fine spines. Propodus just longer than carpus, with dorsoproximal penicillate seta, ventrally with five fine spines interspersed with long setae, diagonal row of setae along inner face distally including two fine spines; dactylus and claw elongate, 0.75 times as long as propodus.

Pereopod 5 (Fig. 40F) basis stouter with single ventrodistal seta, ischium with slender dorsodistal spine, spines on merus, carpus and propodus longer than those on pereopod 4, distal propodal spines finely denticulate.

Pereopod 6 (Fig. 40G) similar to pereopod 5 but basis without complete dorsal marginal row of plumose setae, five ventral plumose setae in distal half; ischium with two dorsodistal spines; propodus ventral and distal margin with row of some 26 small leaf-like spines.

Pleopods (Fig. 40H) all alike. Basis with five ventral (inner) plumose setae and six dorsal (outer) plumose setae; rami linguiform. Endopod longer than exopod, respectively with 24 and 22 marginal plumose setae.

Uropod (Fig. 40I) biramous. Basis with two tufts each of four distal setae. Exopod five times as long as basis and of about ten poorly-distinguished segments; endopod damaged on all specimens, but at least twice as long as exopod.

*Description of male*. Only one male found (Fig. 38B), with damaged antennae and antennules, without chelipeds. Body similar to that of female, but pereonites 4 and 5 proportionately shorter; cephalothorax with three lateral setae posterior to each eyelobe; all pereonites and pleonites with more dorsal setae.

*Etymology*. From the Latin, *floccus*, a tuft or lock of hair, with reference to the distinctive tufts of setae on the lateral margins of the pereonites.

*Remarks*. *Saltipedis floccus* sp. nov. is the fourth species of the genus to be described from Australian waters after *S. forex*, *S. incognita* Bamber, 2005 (both from southwestern Australia), and *S. nugoris* from the Bass Strait (see above). All four are generally similar in their habitus (as are all species of the genus other than *S. achondroplasia* Bamber, Bird & Angsupanich, 2003), and they share the unusual feature, not found in any other species of the genus, of outer spine-like apophyses on the maxilliped basis and palp-article-1. They are, however, readily distinguished: *S, nugoris* and *S. forex* are without an epistome, and have a triangular or blunt rostrum respectively, while *S. floccus* and *S. incognita* have a conspicuous epistome and a pointed rostrum, but no hyposphenia on pereonites 1 or 2 (present in *S, nugoris*); *S. forex* is the only one of these species without a cephalothoracic hyposphenium between the chelipeds, or a dorsodistal spine on the merus of pereopod 1.

*S. forex* is notably different from the other Australian species owing to the tufts of setae on the lateral margins of its pereonites; the mouthparts are also much more densely setose (notably the mandibular and maxilliped palps), and the present species is the only one to have ventral (as well as dorsal) plumose setae on the basis of pereopod 6.

Despite all of these differences, the four Australian species do broadly seem to be closely related. Guţu (2008b) moved the previously-described three species into a separate genus, *Magniaculeus*, simply on the feature of the spine-like maxilliped apophyses, ignoring the numerous features by which they differ. In fact, the present species disagrees with a number of the diagnostic characters of *Magniaculeus* (many of which were vague or not distinct to the newly-described genus), e.g. the labial palp is not ovate, and the propodus of pereopod 1 is not longer than the carpus. Both features are in fact more like that of another genus – *Brachylicoa* – which Guţu (2006) also somewhat tenuously separated from *Saltipedis*. Equally, the fine spines on the basis of pereopod 1 in *S, nugoris* and *S. forex* are diagnostic features of another of Guţu's (2006) new genera derived from *Saltipedis*, *Podictenius*. Until a more comprehensive and rational analysis of the genus *Saltipedis* (including *Brachylicoa*, *Magniaculeus* and *Podictenius)* is undertaken, separating these four species into a separate genus is premature.

*Saltipedis floccus* was collected throughout the Bass Strait, at depths between 3 and 180 m, normally on heterogeneous substrata, and it was often sympatric with *S, nugoris*.

Genus ***Remexudes*** Błażewicz-Paszkowycz & Bamber, 2007

***Remexudes toompani*** Błażewicz-Paszkowycz & Bamber, 2007

*R. toompani* Błażewicz-Paszkowycz & Bamber, 2007a, 19–25, figs 10–12.

*Remarks*. The presently monotypic genus *Remexudes* shows affinities to both *Saltipedis* and *Pakistanapseudes*, but is quite distinct owing to the elongate pereopod 1 propodus and the flattened distal articles of pereopod 2 which are of the fossorial form more typical of first pereopods in the Apseudomorpha. With a dorsal row of plumose setae on pleonite 1, it accords with the Parapseudinae. The outer spine-like apophysis on the basis of the maxilliped is also found in Australian species of *Saltipedis*, although they also have a similar apophysis on the first palp article.

*Remexudes toompani* occured throughout the Bass Strait, on sandy substrata from depths of 11 to 630 m.

Family **Pagurapseudidae** Lang, 1970

Subfamily **Hodometricinae** Guţu, 1981

Genus ***Indoapseudes*** Băcescu, 1976

***Indopaseudes macabre*** Bamber, 2005

*I. macabre* Bamber, 2005, 650–654, figs 17–18.

*Material examined.* 1 ♀ with oostegites, 1 brooding ♀ (J46401), Cruise 81-T-1 Stn 196 DP, Western Bass Strait, 6km W of Currie, King Island, 38°54.7'S 143°43.4'E, 49 m depth, coarse sand, 21 November 1981, coll. R.S. Wilson, Smith McIntyre grab, RV *Tangaroa*.

*Remarks*. Of the three described species of *Indoapseudes*, *I. macabre* is the only species found in Australia (so far). The type (and only other) material was of 11 specimens collected in Esperance, southwestern Australia, in association with macroalgae, from 18 to 26 m depth: the present specimens extend the distribution to southeastern Australia, and the lower end of the depth range to 49 m.

Genus ***Similipedia*** Guţu, 1989

***Similipedia diarris*** Błażewicz-Paszkowycz & Bamber, 2007

*S. diarris* Błażewicz-Paszkowycz & Bamber, 2007b, 146–147, figs 24–26.

*Material examined.* 5 specimens, Stn. BSS 158, Central Bass Strait, 66 km S of Rodondo Island, 39°49.5'S, 146°18.5'E, 82 m depth, "sand-silt-mud", 13 November 1981, coll. R. Wilson, RV Tangaroa.

*Remark. Similipedia diarris* was originally described from 45 specimens collected off Wilson's Promontory at 65 m depth. The present specimens are from slightly further south, and slightly deeper water. The only other species of the genus, *S. eminescui* Guţu, 1989, was recorded from the north-east Mozambique Channel.

Subfamily **Pagurapseudinae** Lang, 1970

The Pagurapseudinae incorporates species which are obligately adapted to living within gastropod shells, and show extreme morphological adaptations, often convergent with those of pagurid decapods. In particular, the pereon and pleon are twisted, the pleotelson consequently asymmetrical, the number of pleopods is usually reduced, the chelipeds are robust and often asymmetrical, the first pereopods are proportionately large (long), and the second to sixth pereopods bear rows of short, cylindrical spines or tubercles on the merus, carpus and propodus, used for gripping the inside of the empty snail-shell.

There are three genera described within this subfamily, *Pagurapseudes* Whitelegge 1901, *Pagurotanais* Bouvier, 1918, and *Macrolabrum* Băcescu, 1976(b), but, as more species have been discovered over the years, there has been some confusion over the features which distinguish or characterize them (see Guţu, 1996b; Bamber, 2007; 2008). *Pagurotanais* is distinguished in having an exopodite present on the cheliped (absent in one species) but absent on pereopod 1 (these being respectively absent and present in the other two genera). *Macrolabrum* was distinguished by, and named for, an unusually long epistome exceeding the tip of the rostrum (anterior margin of the carapace) when viewed from above. In comparison with *Pagurapseudes*, this genus usually also has pronounced cheliped dimorphism in the male and robust distal setae or spines on the uropod endopod; other features which have been cited are the basis of pereopod 1 being conspicuously wider than subsequent articles, and the presence of large plumose setae on the maxilliped palp. However, some of these features are subjective, and some overlap these two genera as defined by the other characters.

A further character, disregarded before but confirmed in the present material, which does serve to distinguish these genera consistently is the conformation of the pleopods. These are best developed in *Pagurapseudes* species, with two equal linguiform rami, each as long as the basis (protopod) and with a few setae on all margins (e.g. Fig. 44H), and present on at least 1 and up to 5 pereonites (juveniles have fewer pairs). In *Macrolabrum* species, the pleopods are present as only two pairs in adults, again well developed and biramous, but, while the exopod is similar to that of *Pagurapseudes* species, the endopod is characteristically shorter and almost circular (e.g. Fig. 50H). In *Pagurotanais* species, the pleopods are either absent entirely (including the generotype, see Bouvier, 1918), or present as a single pair, in the male only in one species, and of highly reduced form with the rami bearing 1 to 3 setae, and shorter than the basis. (e.g. McSweeney, 1982, figs 4G, 6C, unfortunately described as *Pagurapseudes*).

As the other features have not been found to be entirely consistent (e.g. the epistome of *Macrolabrum distonyx* Bamber, 2007 does not exceed the anterior margin of the carapace), this pleopod character is most stable in distinguishing the genera. As a result, *Pagurapseudes abrucei* Băcescu 1981, incidentally a species with a notably wide basis to pereopod 1 (less than twice as long as wide), is moved to *Macrolabrum*. The three genera may thus be keyed out as follows:

1. Pereopod 1 without exopodite; pleopods in the adult absent, or present as a single pair with reduced, unequal rami shorter than basis and bearing 3 or fewer setae; epistome not exceeding anterior margin of carapace ... *Pagurotanais*

   Pereopod 1 with conspicuous exopodite; pleopods present in the adult, with well-developed rami, at least one of which is linguiform and subequal in length to the basis ... 2

2. Rami of pleopods subequal in length, linguiform; epistome not exceeding anterior margin of carapace ... *Pagurapseudes*

   Endopod of pleopods circular and shorter than exopod; epistome usually (but not always) exceeding anterior margin of carapace ... *Macrolabrum.*

The original material of the generotype *Pagurapseudes spinipes*, from New South Wales, probably included more than one species. The type-description clearly accords with a *Pagurapseudes*, and is good enough to recognize as a species. Those specimens which Whitelegge (1901) mentions as females having no pleopods may well have been *Pagurotanais koonungai* Bamber, 2008 (recorded from Brisbane), while his other specimens with less than three pleopods were possibly juveniles or other species.

Five distinct species of the Pagurapseudinae were found in the Bass Strait material, all new, doubling the species complement for this subfamily in Australia.

Genus ***Pagurapseudes*** Whitelegge, 1901

***Pagurapseudes victoriae*** sp.nov.

Figures 41–44

*Material examined.* 1 brooding ♀ (J57789), holotype, Stn CPBS 03N, Western Port, 38°20.56'S 145°15.08'E, 2 m depth, 5 April 1965; 3 ♀♀ (1 brooding), 1 ♂ (J57790), paratypes, same sample as holotype; 2 ♀♀ (J48009), paratypes, Stn CPBS 25S, Western Port, 38°21.63'S 145°15.08'E, 9 m depth, 23 February 1965, sand; 1 ♀ with oostegites, 2 ♂♂ (J48004), paratypes, Stn CPBS 11S, Western Port, 38°22.00'S 145°13.38'E, 3 m depth, 17 March 1965, shelly gravel; 3 ♀♀ (J56614) , 2 ♀♀ (56612), paratypes, 95 further specimens (unregistered), Stn PPBES 985, Port Phillip Bay, 38°21.00'S 144°41.5'E, 9 m depth, 9 December 1971, sand; 3 ♀♀ (J43098), paratypes, Port Phillip Bay "wet sandy region", 38°10.51'S 144°43.9'E, 7.5 m depth, 17 October 1994, sand (labelled "*P. spinipes*"); 2 ♀♀ (J56618), paratypes, 1 ♂, 4 ♀♀ (unregistered), Stn BSS180, Central Bass Strait, 39°12.9'S 146°27.3'E, 65 m depth, 18 November 1981, medium sand, coll. R.S. Wilson; 5 ♀♀ (J56617), paratypes, 10 ♀♀ (unregistered), Stn BSS170, Eastern Bass Strait, 31°51.8S 148°26.5'E, 130 m depth, 15 November 1981, fine sand, coll. R.S. Wilson; 1 brooding ♀, 1 ♂ (J56613), paratypes, Stn BSS209, Eastern Bass Strait, 38°18.0'S 147°37.0'E, 55 m depth, 31 July 1983, muddy fine shell, coll. M. Gomon & R.S. Wilson.

*Other material.* A further 447 specimens from the Tasmanian Coast, Flinders Island, Western Port, Port Phillip Bay and throughout the Bass Strait, at depths from 5 to 69 m.

*Description of female.* Body (Fig. 41A) typical of a pagurapseudid, pleon skewed to the right and curved under pereon; small, holotype about 5 mm long. Cephalothorax (Fig. 41B) subrectangular, as long as wide, rostrum variable (Fig. 42): often trilobed, anterior margin either smooth (Fig. 42A), or with fine (Fig. 42B) or coarse (Fig. 42C) denticulation, this variation irrespective of gender or maturity; lateral margins of branchial chamber with 8 or 9 plumose setae, sparse plumose setae scattered over dorsal surface of branchial chambers. Eyelobes distinguished with anterior pointed apophysis, eyes present as group of black-pigmented ocelli. Epistome not visible dorsally. Each pleonite with anterolateral and posterolateral tufts of plumose setae; pereonite 1 shortest, 0.3 times as long as cephalothorax; pereonite 2 1.4 times as long as pereonite 1; pereonite 3 longer, pereonite 4 longest, nearly twice as long as pereonite 1; pereonites 5 and 6 progressively shorter, pereonite 6 just longer than pereonite 2 (all pereonites respectively 3.0, 2.0, 1.4, 1.3, 1.4 and 1.5 times as wide as long). Pleon with five free subequal, asymmetrical pleonites, each pleonite about one-third as long as pereonite 6, with sparse lateral and occasional dorsal plumose setae. Pleonites 1 to 3 only bearing pleopods. Pleotelson almost semicircular, longer than last two pleonites together, just shorter than wide, with sparse plumose lateral setae and simple distal setae.

Antennule (Fig. 43A) proximal peduncle article 3.25 times as long as wide, with conspicuous inner-distal tridentate apophysis and inner-medial expansion bearing tooth-like apophyses and two plumose setae; outer margin also denticulate, each "tooth" with an adjacent plumose seta. Second peduncle article 0.3 times as long as first, expanded distally to 1.5 times as long as wide, with plumose distal setae; third article as long as second, fourth article one-third length of third. Main flagellum of five (rarely six) segments, with single aesthetascs on each segment; accessory flagellum of two (rarely three) segments, distally not quite reaching distal edge of third segment of main flagellum.

Antenna (Fig. 43B) with two basal articles fused into wide proximal peduncle article inner margin bearing denticulation and distal apophysis and two plumose and three penicillate setae, outer margin with blunt apophysis; third article as long as wide, 0.4 times as long as fused basal articles, with single simple seta; fourth peduncle article half as long as fused basal articles, naked; fifth article just longer than fourth, with one simple and four penicillate distal setae. Flagellum of two segments, distal segment with three distal setae.

Labrum (Fig. 43D) bilobed, rounded, sparsely setose, small pointed epistome present (Fig. 43C). Left mandible (Fig. 43E) with finely denticulate outer margin, quadricuspid pars incisiva, tricuspid lacinia mobilis, setiferous lobe with simple and bifurcate setae, pars molaris round, blunt, with ventrodistal spinules on grinding surface; palp of three articles, proximal article with robust, plumose inner seta, second article longest, twice as long as proximal article, with 13 inner distally-denticulate setae in distal half; third article two-thirds as long as second, with nine progressively longer distally-denticulate setae along inner margin, distal seta longer than article. Right mandible as left but without lacinia mobilis (Fig. 43F). Labium (Fig. 43I) typically marginally setose, palp with two strong distal setae, fine outer setules and longer inner setae. Maxillule (Fig. 43G) inner endite with five plumose distal setae outer apophysis and row of simple setae, inner margin with fine setules; outer endite with ten distal spines, inner and outer margins setose; palp (Fig. 43G') of two articles with distinct articulation, distally with three setae each bearing rounded setulose tips. Maxilla (Fig. 43H) outer margin setulose, outer lobe of moveable endite with two subdistal and seven distal finely setulose setae, inner lobe with four simple and four setulose setae; fixed endite outer lobe with two bifurcate, two trifurcate, two setulose and three bilaterally denticulate distal spines, inner lobe with four longer plumose setae and rostral row of 20 setae. Maxilliped (Fig. 43K) basis with seven distal plumose setae, inner margin with two rows of denticulation and plumose seta; proximal palp article with simple outer margin with one plumose and one simple setae, and short spine, inner margin naked; second article with coarsely denticulate inner and outer margins, three plumose seta on outer margin, two shorter simple setae and five plumose setae along inner margin; third article widening distally, with coarsely denticulate outer margin, six inner simple setae; fourth article with ten distal and outer sub-distal setae each with fine denticulation in distal half; endite (not figured) with finely setose outer margin, simple distal spines, three coupling-hooks. Epignath (Fig. 43J) large, inner lobes conspicuous, distal spine proximally setose.

Chelipeds (Fig. 44A) showing no conspicuous dimorphism. Compact basis 1.3 times as long as wide, with complex proximal surface denticulations dorsally and ventrally, three mid-ventral simple setae, one simple and two plumose subdistal ventral setae; exopodite absent. Merus quadrate, distal half of ventral margin with coarse denticulation, three inner and one ventral subdistal plumose setae and four mid-

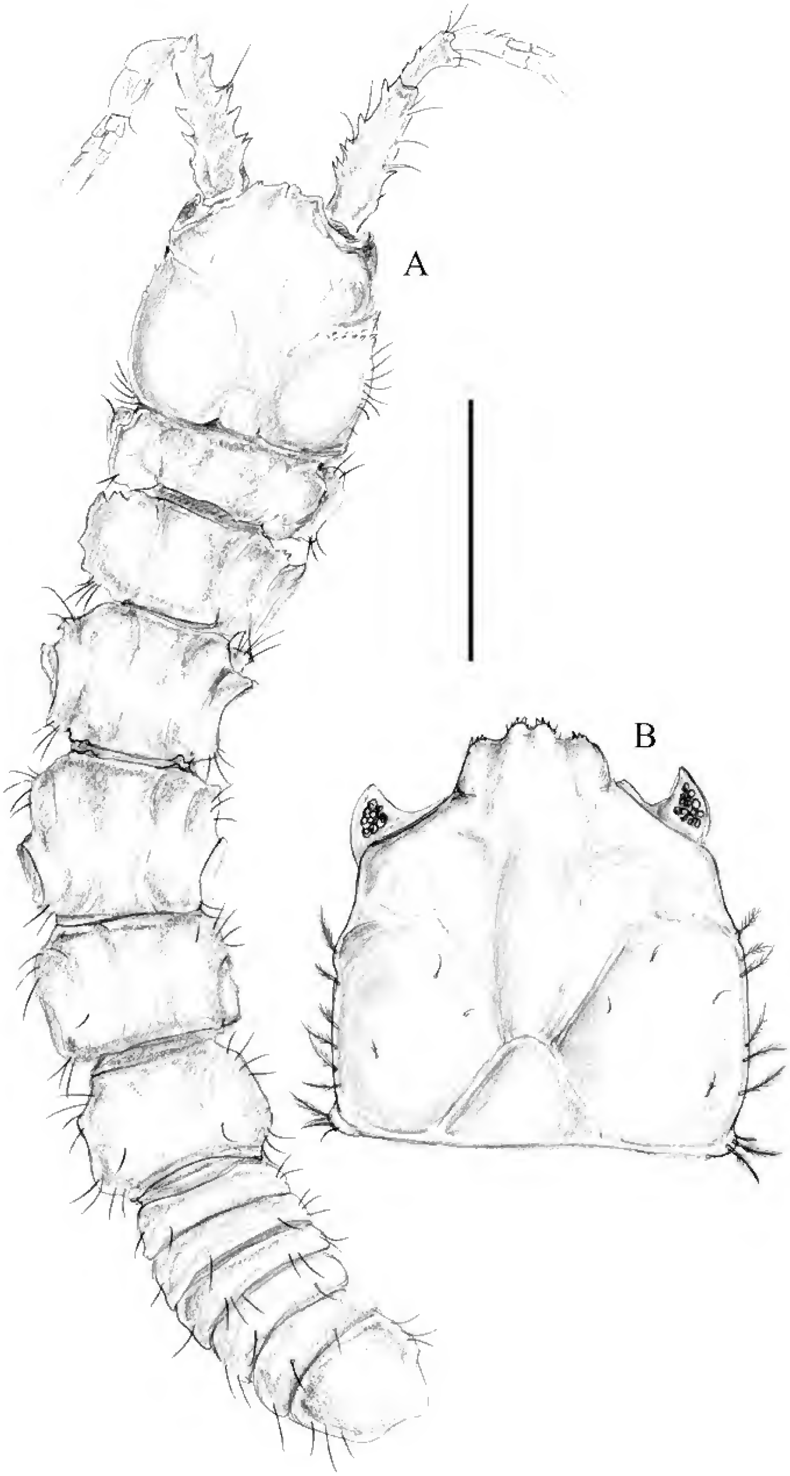


Fig. 41. *Pagurapseudes victoriae* sp. nov., female. A, dorsal; B, cephalothorax. Scale = 1 mm.

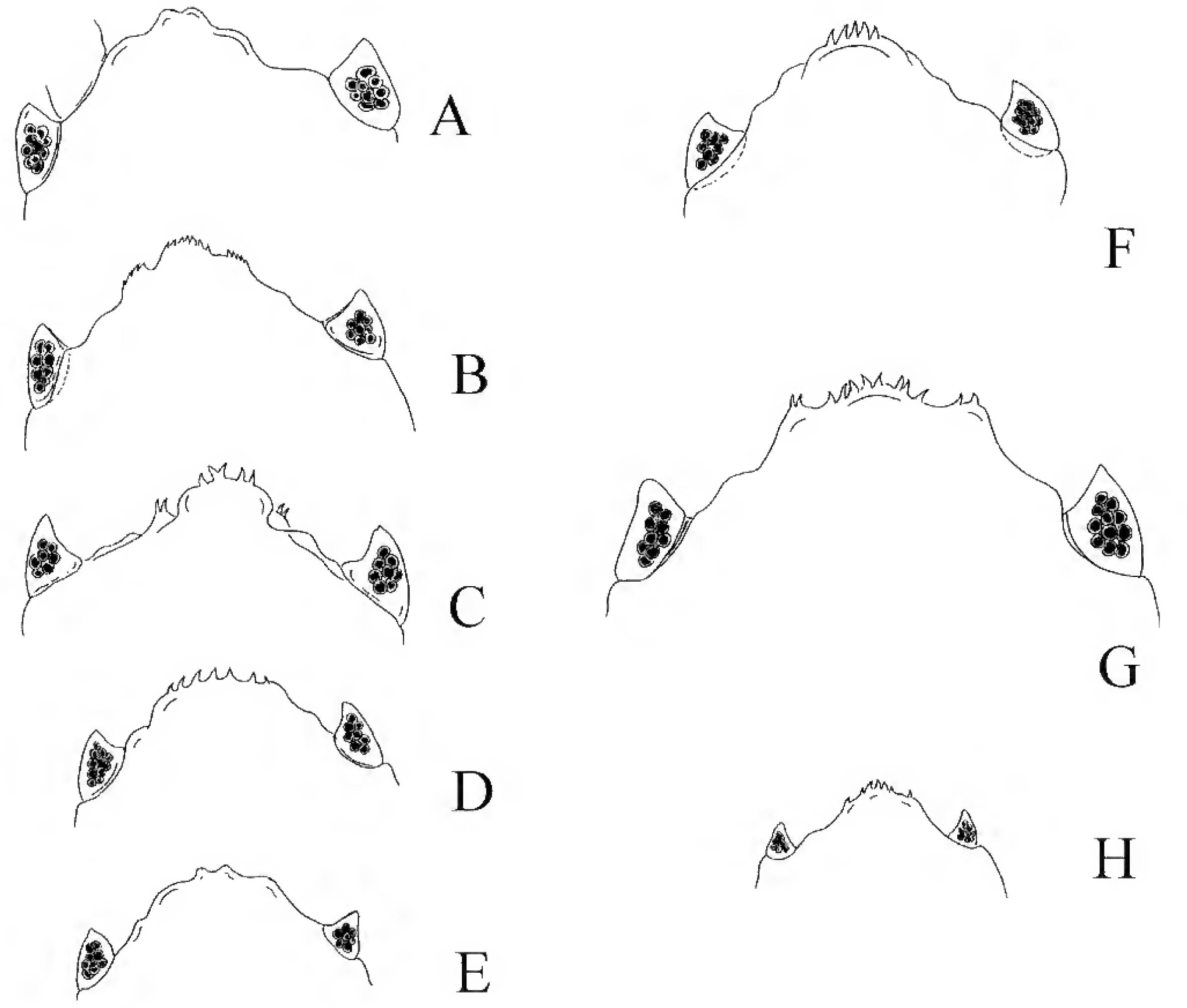


Fig. 42. *Pagurapseudes victoriae* sp. nov., anterior of carapace of A-E, females (lengths of carapaces 1.2 mm – 0.9 mm); F, ovigerous female (length of carapace 1.3 mm); G, ovigerous female (length of carapace 1.7 mm); H, manca.

ventral simple setae. Carpus elongate, twice as long as wide, widening distally, with denticulate inner margin, sparse dorsal and ventral marginal fine setae, two plumose and one simple inner proximal setae. Propodus elongate, 2.1 times as long as wide, with few ventral setae; fixed finger with four ventral setae, three setae adjacent to cutting edge, saw-like row of small tooth-like spines distally on cutting edge (Fig. 44A'); dactylus curved, cutting-edge with fine denticulations and three distal tooth-like spines (Fig. 44A').

Pereopod 1 (Fig. 44B) longest pereopod, coxa with slight apophysis having denticulate margin and one simple and one plumose setae; basis 2.3 times as long as wide, dorsal margin bearing seven plumose setae interspersed amongst triangular tooth-like apophyses with further four submarginal plumose setae, ventral margin with four ventral and one distal plumose setae, two simple ventrodistal setae; exopodite present (Fig. 44B'), large, distal article with seventeen plumose setae. Ischium one-quarter as long as basis, with mid-dorsal simple seta, ventrally with one plumose and two simple distal setae. Merus 0.8 times as long as basis, dorsally with two distal setae, ventral margin with plumose setae and distal spine. Carpus shorter than merus, with four ventral spines, each with crenulate anterior face, interspersed with setae. Propodus 1.4 times as long as carpus, with five ventral spines. Dactylus curved, 0.8 times as long as propodus, with fine ventral setae, unguis slender, sharp, 0.4 times as long as dactylus.

Pereopods 2 to 6 similar to each other, each about one-half to one-third as long as pereopod 1. Pereopod 2 (Fig. 44C)

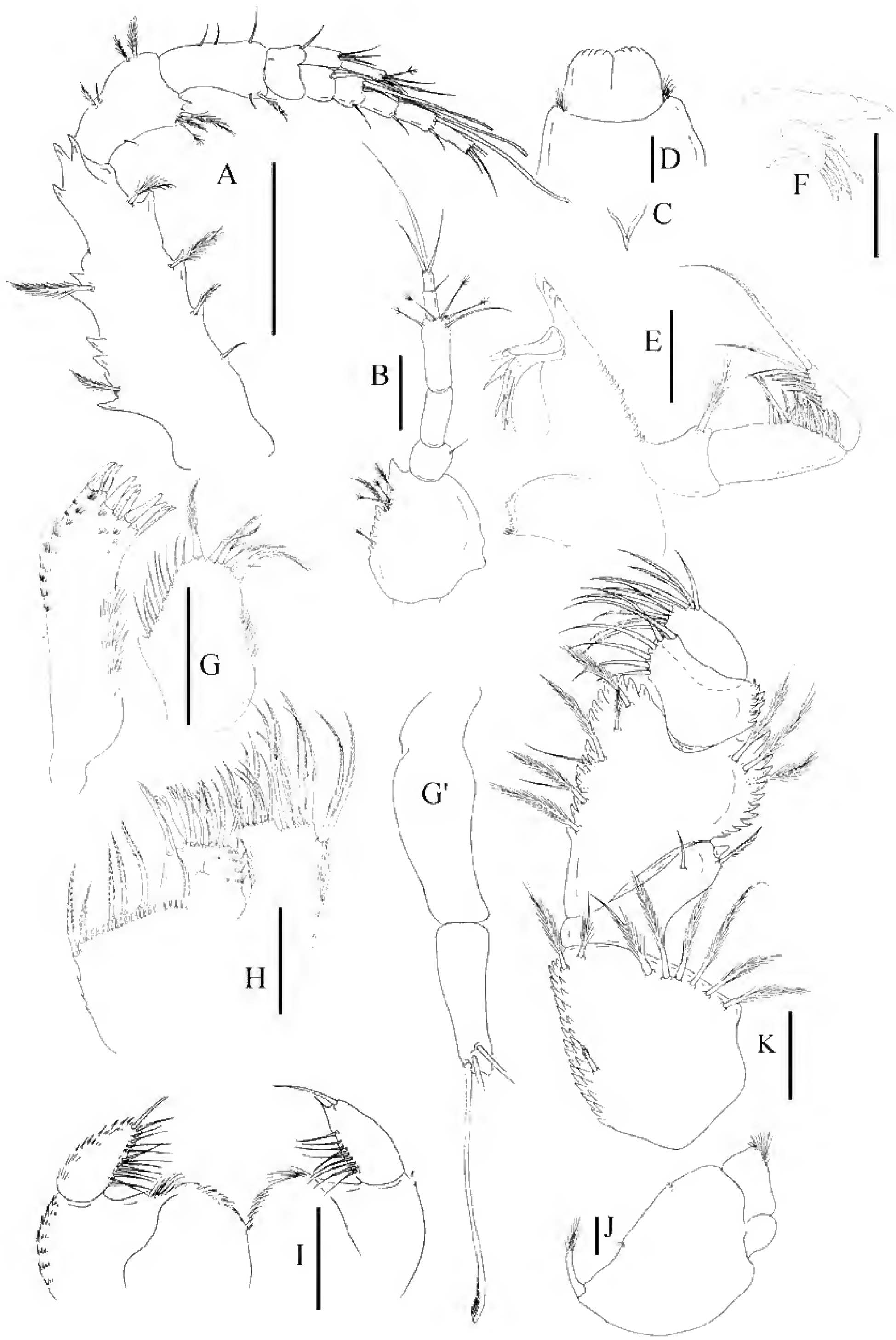


Fig. 43. *Pagurapseudes victoriae* sp. nov., female paratype. A, antennule; B, antenna; C, epistome; D, labrum; E, left mandible; F, right mandible; G, maxillule endites; G', maxillule palp; H, maxilla; I, labium; J, epignath; K, maxilliped. Scale A-B = 0.1 mm; C-K = 0.01 mm.

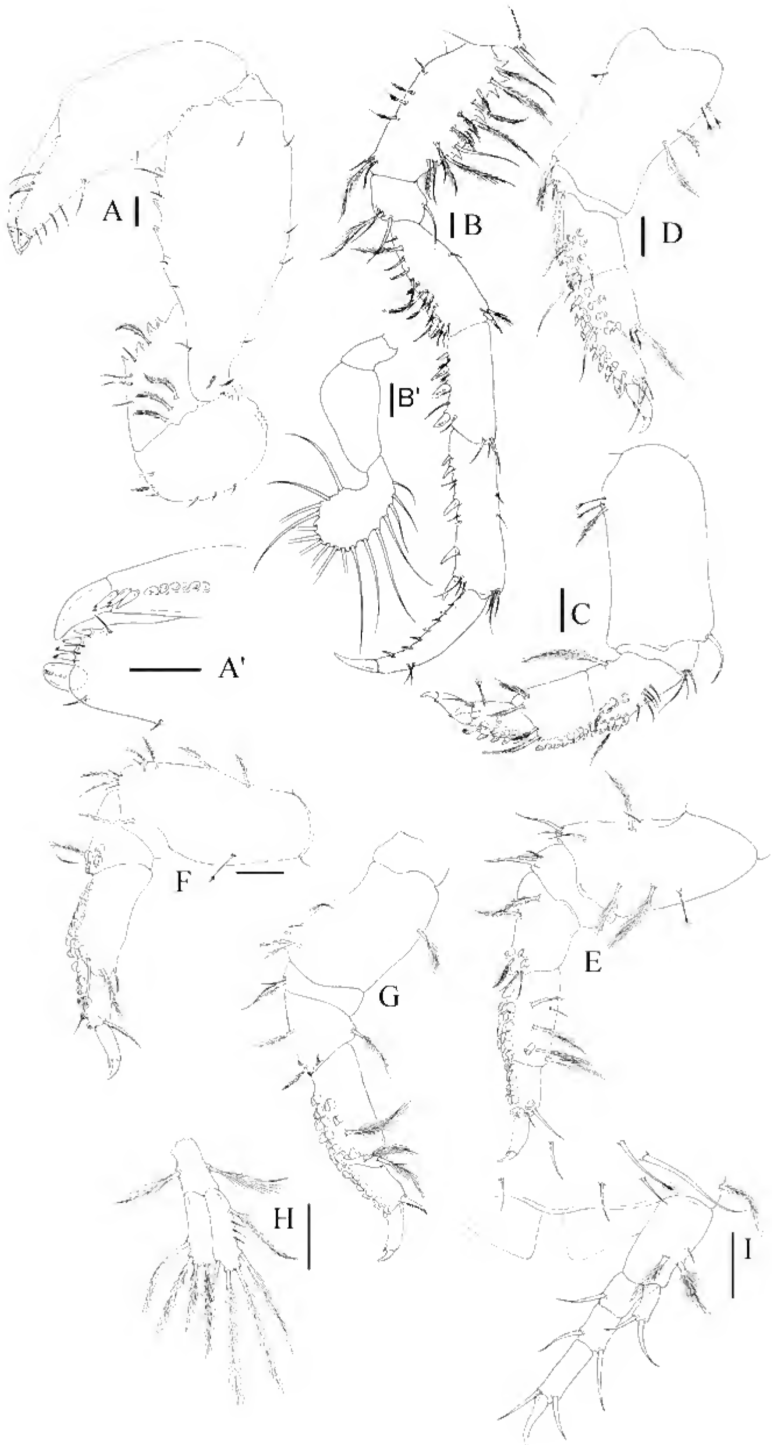


Fig. 44. *Pagurapseudes victoriae* sp. nov., female paratype. A, cheliped; A', detail of chela; ; B, pereopod 1; B', exopod; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

basis stout, 2.2 times as long as wide, with one plumose and two penicillate dorsoproximal setae, simple ventrodistal seta; ischium with three ventrodistal setae. Merus, carpus and propodus bearing "sucker-like" spines, generally in two ventral rows, and plumose setae as figured. Merus longer than carpus; propodus 0.8 times as long as carpus, distal propodal spine simple, stout; dactylus and unguis not fused into hook-like claw, dactylus with minute inner distal spine. Pereopod 3 (Fig. 44D) with more plumose setae on basis, no dorsal seta on merus. Pereopod 4(Fig. 44E) basis stouter, 1.7 times as long as wide, fewer "sucker-like" spines on merus, without stout distal propodal spine. Pereopod 5 (Fig. 44F) as pereopod 4. Pereopod 6 (Fig. 44G) basis with only one plumose dorsal seta, propodus with distal denticulate spine adjacent to dactylus.

Pleopods (Fig. 44H) only present on pleonites 1 to 3, biramous, reduced; basis with single dorsal and ventral plumose setae; exopod with outer proximal and three distal plumose setae, endopod with four distal plumose setae, inner margin with three simple setae and proximal plumose seta.

Uropod (Fig. 44I) biramous, basis with two plumose distal setae; endopod longer than basis, of three segments increasing in length, second segment distally with two setae, third segment twice as long as first with one stout and two more slender distal setae; exopod of one segment, just shorter than proximal endopod segment, with two distal setae.

*Description of male*. Male closely similar to female, chelipeds not significantly dimorphic, but antennule with main flagellum of six segments. Penial tubercle conspicuous ventrally on pereonite 6.

*Etymology*. Named after the State of Victoria (and thus indirectly Queen Victoria), off which this species is by far the commonest pagurapseudid.

*Remarks*. *P. inquilinus* Bamber 2007, from 440–450 m depth off New Caledonia, is the only previously-described species of *Pagurapseudes* to have two segments in the accessory flagellum of the antennule (all others having only one), and shows many similarities to the present species in the morphology of the antennule, antenna and pereopods, but has seven segments in the main flagellum (in both sexes). *P. victoriae* sp. nov. is also distinguished in having the complex denticulation on the maxilliped basis and palp (absent in *P. inquilinus*), and only three setae on the maxillule palp (six in *P. inquilinus*); conversely, the New Caledonia species has ventral spine-like apophyses rather than simple setae on the basis of the cheliped, and simple spines rather than plumose setae proximally on the cheliped carpus, and is without the dorsal denticulations on the basis of pereopod 1, has fewer lateral but more dorsal plumose setae on the carapace, and the uropod exopod is longer than the proximal endopod segment (shorter in *P. victoriae*, indeed, notably small for the genus).

The only species of *Macrolabrum* to have two segments in the accessory flagellum of the antennule are *M. aenigmaticus* Guţu, 1997, (from Bali), *M. boeri* Băcescu 1981 and *M. abrucei* (Băcescu, 1981) comb. nov. (both from the Great Barrier Reef), but those species have only four segments in the main flagellum (the distal segment being comparatively minute in all three), and no complex apophyses on the proximal article of the antennule peduncle (as well as typical *Macrolabrum* pleopods).

The variation in the numbers of antennular flagella articles, although consistent in their distinction from other species, and the variation in denticulation of the rostrum in the present species are notable, as these characters have been used (albeit not in isolation) in distinguishing between other pagurapseudid species, which are rarely taken in such profusion as was *P. victoriae*.

*Pagurapseudes victoriae* was collected throughout the Bass Strait, at depths from 2 to 130 m, on sandy substrata.

## ***Pagurapseudes kimbla*** sp. nov.

Figures 45–47

*Material examined*. 1 ♀ with oostegites (56368), holotype, Stn BSS185, Western Bass Strait, 38°48.0'S 143°14.5'E, 47 m depth, 20 November 1981, hard rock, coll. R.S. Wilson; 1 juvenile (J56613), paratype, Stn BSS68, Western Bass Strait, 39°27'S 142°55'E, 183 m depth, 10 October 1980, bryozoan mud, coll. G C B Poore; 1 ♀ (J56370), paratype, Stn BSS171, Eastern Bass Strait, 38°53.7'S 147°55.2'E, 71 m depth, 18 November 1981, medium sand, coll. R.S. Wilson; 1 ♀ with oostegites (J55834), paratype, Stn BSS162, Central Bass Strait, 40°09.2'S 147°31.9'E, 51 m depth, 14 November 1981, shelly sand, coll. R.S. Wilson; 1 ♀ (J56369), paratype, Stn BSS203, Central Bass Strait, 39°22.0'S 144°18.3'E, 60 m depth, 23 November 1981, coarse sand, coll. R.S. Wilson; 1 subadult (J29171), paratype, Stn MSL EG88, Eastern Bass Strait, 37°52.65'S 148°42.15'E, 49 m depth, 4 June 1991, coarse sand, coll. N Coleman; 1 ♀ (J29172), paratype, Stn MSL EG115, Eastern Bass Strait, 37°52.65'S 148°42.15'E, 49 m depth, February 1991, coarse sand, coll. N Coleman; 1 brooding ♀ (J29173), paratype, Stn MSL EG111, Eastern Bass Strait, 37°52.65'S 148°42.15'E, 49 m depth, February 1991, coarse sand, coll. N Coleman; 1 subadult (J51377), paratype, Stn VC 27 C1, Central Bass Strait, 36°23.92'S 145°18.43'E, 40 m depth, 11 May 1998, fine sand, coll. N Coleman.

*Description of female*. Body (Fig. 45A) typical of a pagurapseudid, small, holotype about 1.7 mm long. Cephalothorax (Fig. 45B) slightly rounded, just longer than wide, with convex anterior margin, rostrum a finely-denticulate semicircle; lateral carapace without denticulations, sparse, irregular plumose setae. Eyelobes rounded, eyes present as group of black-pigmented ocelli. Epistome not apparent. Pereonites 1 and 3 subequal, two-thirds as long as cephalothorax, pereonite 1 with paired anterolateral plumose or simple setae and single posterolateral simple setae; pereonite 2 shortest, 0.6 times as long as cephalothorax; pereonites 4 to 6 subequal, 0.9 times as long as cephalothorax; pereonite 5 longest, as long as cephalothorax. Pleon of five free subequal pleonites, each pleonite about half as long as cephalothorax. Pleonites 1, 2 and 3 only bearing pleopods. Pleotelson semicircular, 1.5 times as long as last pleonites, with plumose lateral seta on each side, paired longer and single shorter simple setae above uropod attachment, and two small posterior spines (Fig. 47I).

Antennule (Fig. 46A) proximal peduncle article 3.3 times as long as wide, with three larger and one smaller inner spine-like apophyses accompanied by plumose setae, no distal apophysis; outer margin with two proximal tooth-like apophyses and numerous penicillate and fewer plumose setae. Second peduncle article 0.35 times as long as first, with array

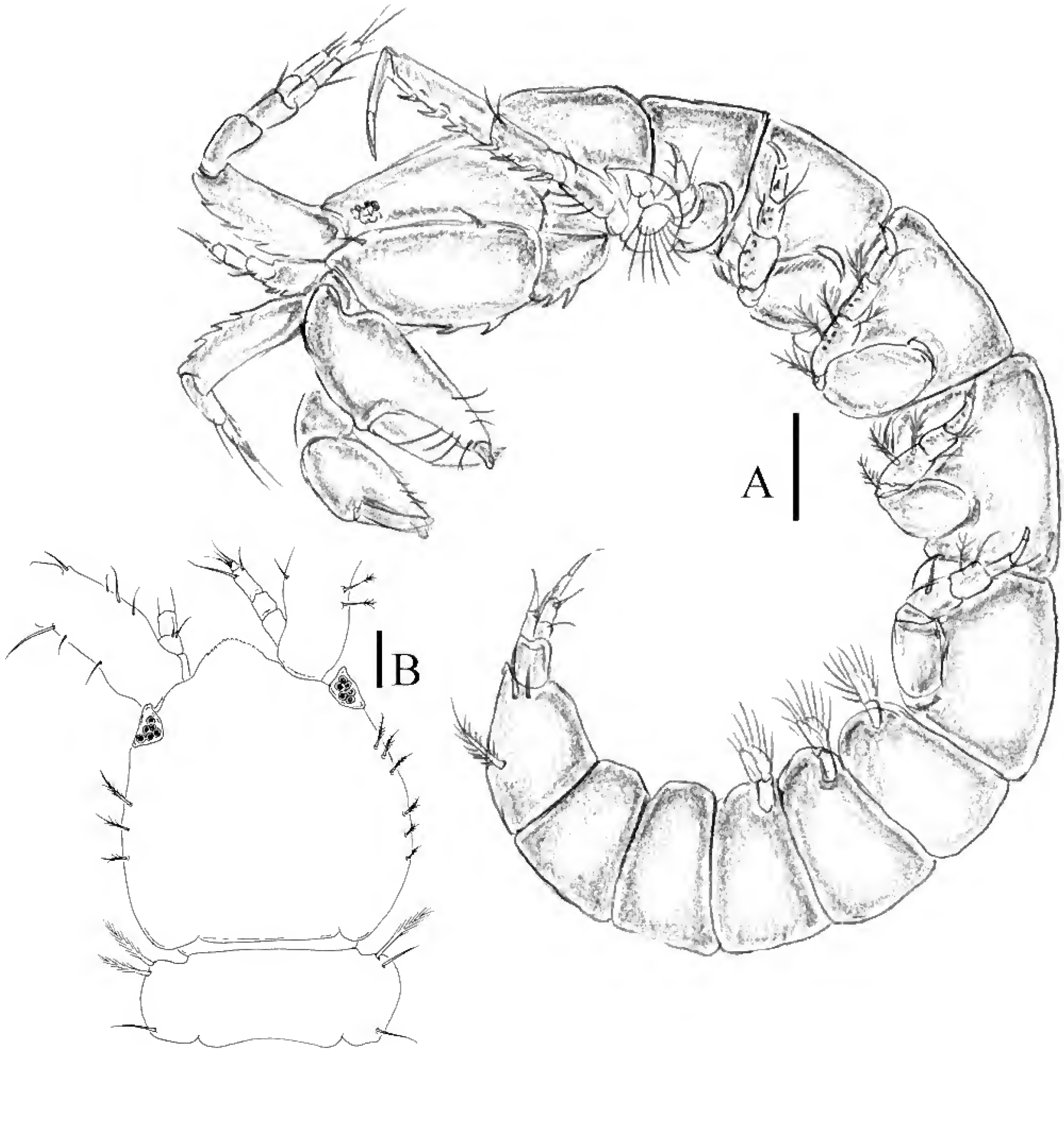


Fig. 45. *Pagurapseudes kimbla* sp. nov., holotype female. A, lateral view; B, cephalothorax. Scale = 0.1 mm.

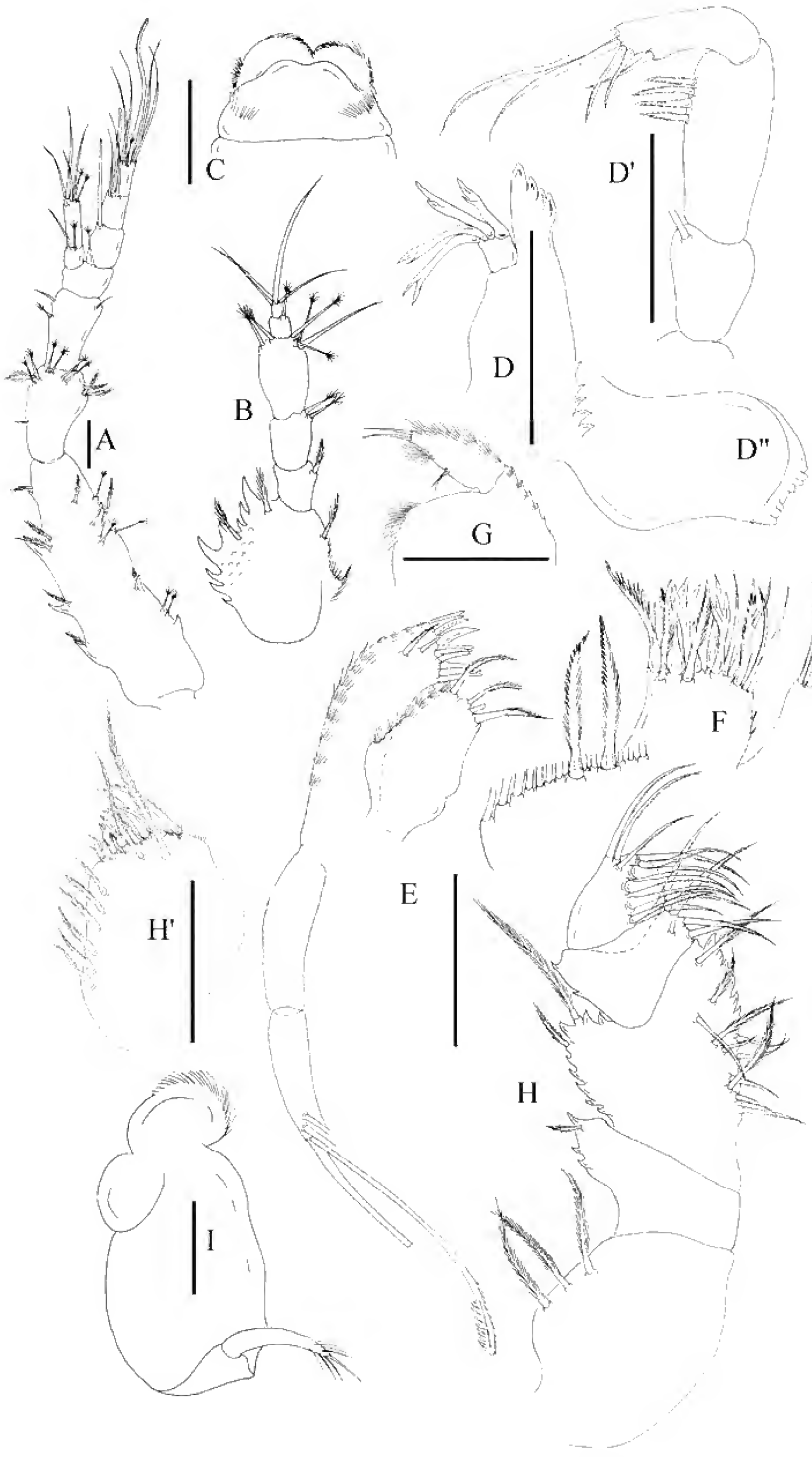


Fig. 46. *Pagurapseudes kimbla* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; D', mandible palp; D" mandible molar; E, maxillule; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath. Scale = 0.1 mm.

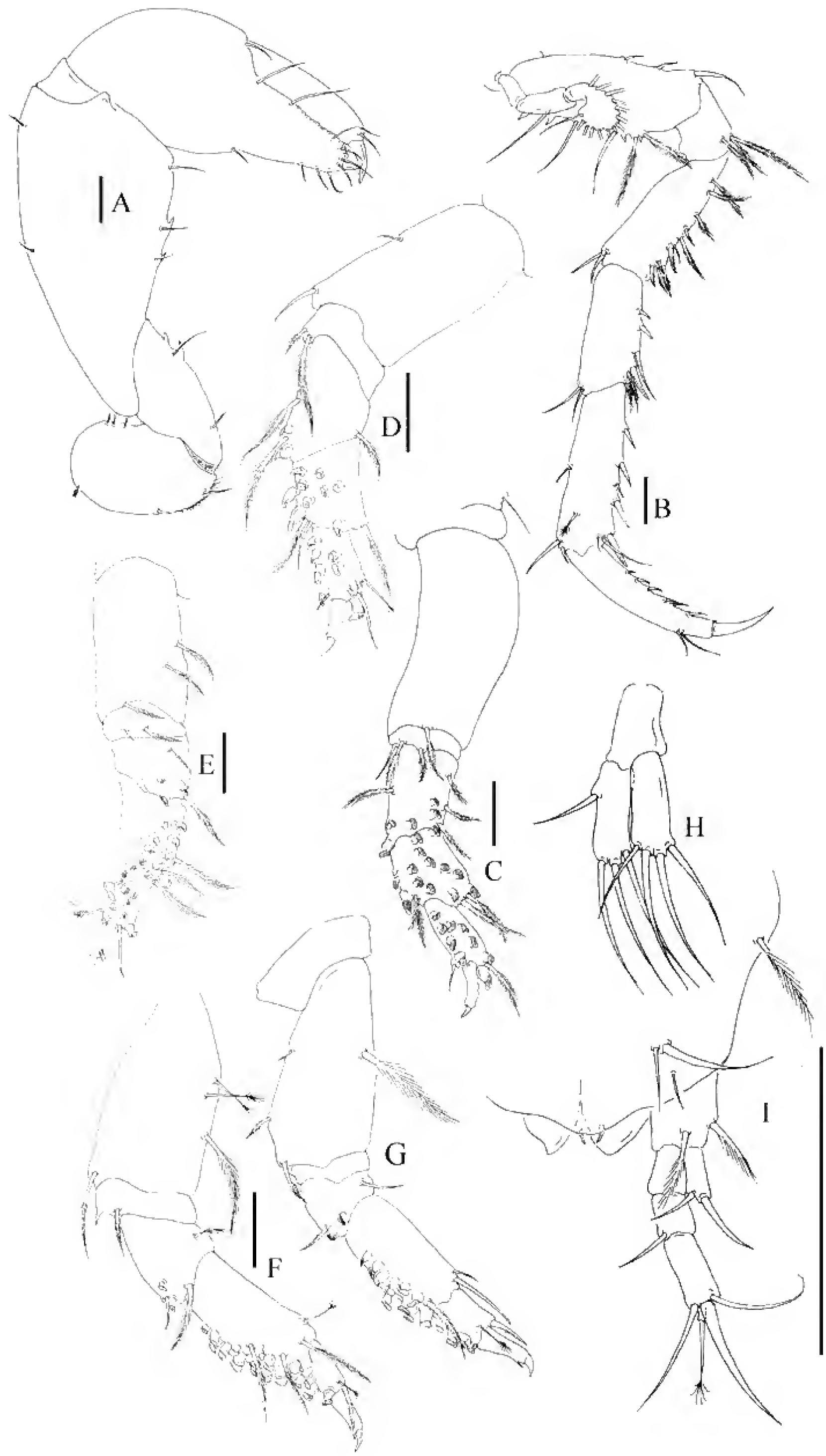


Fig. 47. *Pagurapseudes kimbla* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

of plumose and penicillate distal setae; third article 0.9 times as long as second, fourth article 0.4 times as long as third. Main flagellum of three segments, with single aesthetascs on each segment; accessory flagellum of two segments, distally not quite reaching distal edge of second segment of main flagellum.

Antenna (Fig. 46B) with two basal articles fused into wide proximal peduncle article with complex inner denticulation, outer tooth-like apophysis and paired inner and single outer plumose setae; third article 1.3 times as long as wide with outer plumose seta; fourth peduncle article just longer than third, with two outer penicillate setae; fifth article twice as long as third with distal array of penicillate setae and one simple seta. Flagellum of two segments, distal segment with four distal setae.

Labrum (Fig. 46C) bilobed, rounded, sparsely setose. Right mandible (Fig. 46D) outer margin denticulate, with quadricuspid pars incisiva, setiferous lobe with four bifurcate setae, pars molaris (Fig. 46D') round, blunt, with marginal crenulations; palp (Fig. 46D") of three articles, proximal article with single long, plumose inner seta (broken on figure), second article longest, 1.8 times as long as proximal article, with four inner distally setulose setae in distal half; third article 0.8 times as long as second, with five progressively longer distally setulose setae in distal third, distal seta longer than article. Left mandible as right but with narrow, tricuspid lacinia mobilis (not figured). Labium (Fig. 46G) outer margin denticulate, palp with two distal setae and setulose margins. Maxillule (Fig. 46E) inner endite with four plumose distal setae (one broken on figure), outer apophysis and setulose margin; outer endite with 10 distal spines, outer margin finely setose; palp of two articles with distinct articulation, distally with four simple setae with rounded setulose tips. Maxilla (Fig. 46F) moveable endite damaged in preparation; fixed endite outer lobe with four simple, one sabre-like, three trifurcate, one setulose and three bilaterally denticulate distal spines, inner lobe with two longer plumose setae and rostral row of 13 setae. Maxilliped (Fig. 46H) basis with three outer plumose setae; proximal palp article with tridenticulate outer margin with one plumose seta, inner margin naked; second article with coarse denticulations along inner and outer margins, one long and one short plumose setae on outer margin, seven setulose setae and four plumose setae along inner margin; third article with bidenticulate outer margin, six inner marginal simple setae each with fine denticulation in distal half; distal article with seven inner-marginal and three distal setae, each with fine denticulation in distal half; endite (Fig. 46H') with naked outer margin, seven compound distal spines decreasing in size inwards and two subdistal plumose setae. Epignath (Fig. 46I) large, inner lobes conspicuous, distal spine with setae surrounding tip.

Chelipeds (Fig. 47A) showing no conspicuous dimorphism. Compact basis 1.6 times as long as wide, with three dorsoproximal setae, ventroproximal penicillate seta, mid-ventral spine and ventrodistal seta, ventrodistal margin densely setulose; exopodite absent. Merus quadrangular, two ventral simple setae and two tooth-like apophyses on ventrodistal margin. Carpus elongate, twice as long as wide, widening distally, with sparse dorsal and ventral fine setae and two tooth-like apophyses on mid-ventral margin. Propodus robust, as long as wide, fixed finger with three ventral, three distal and three dorsal setae, row of small rounded teeth along cutting edge; moveable finger stout, curved, with two distal setae.

Pereopod 1 (Fig. 47B) longest pereopod, with basis slender, 4.7 times as long as wide, dorsal margin bearing five plumose setae interspersed amongst six triangular tooth-like apophyses, ventral margin with two spines in distal half and distal simple seta; exopodite present, large, distal article with thirteen plumose setae. Ischium one-quarter as long as basis, with naked dorsal margin, three ventrodistal plumose setae. Merus 0.6 times as long as basis, with two simple dorsodistal setae, ventral margin with nine plumose setae and two subdistal spines. Carpus shorter than merus, with one ventral simple and two ventrodistal plumose setae and three ventral spines. Propodus 1.3 times as long as carpus, with four slender ventral spines. Dactylus curved, as long as propodus, with fine ventral setae, unguis slender, sharp, 0.4 times as long as dactylus.

Pereopods 2 to 6 similar to each other, each about one-half to one-third as long as pereopod 1. Pereopod 2 (Fig. 47C) basis stout, twice as long as wide, with plumose ventrodistal seta; ischium with paired ventrodistal setae. Merus, carpus and propodus bearing "sucker-like" spines, generally in two ventral rows, and plumose setae as figured. Merus 1.2 times as long as carpus; propodus 1.1 times as long as carpus, without distal spine; dactylus and unguis not fused, with minute inner seta. Pereopod 3 (Fig. 47D) similar but carpus as long as propodus. Pereopod 4 (Fig. 47E) slightly more compact, basis 1.7 times as long as wide, fewer "sucker-like" spines on merus, carpus longer than merus or propodus. Pereopod 5 (Fig. 47F) as pereopod 4. Pereopod 6 (Fig. 47G) propodus with dorsodistal denticulate spine.

Pleopods (Fig. 47H) only present on pleonites 1, 2 and 3, biramous, reduced; basis naked; exopod with outer proximal and three distal plumose setae, endopod with four distal plumose setae. Uropod (Fig. 47I) biramous, basis with two plumose distal setae; endopod longer than basis, of three segments, first distally naked, second segment as long as first with simple distal seta, third segment with three distal setae and one penicillate seta; exopod of one segment, subequal in length to proximal endopod segment, with two distal setae.

*Male*. Unknown.

*Etymology*. The HMAS *Kimbla* was one of the vessels used on the Bass Strait Survey between 1979 and 1984 (noun in apposition).

*Remarks*. *Pagurapseudes kimbla* sp. nov. is the only species of the genus to have two segments in the accessory flagellum and three in the main flagellum of the antennule. Equally, no previously described species of the related genus *Macrolabrum* has this combination of antennular flagellar segments. The present species is also unusual in having the propodus of pereopod 2 longer than the carpus (in other species it is conspicuously shorter). The only other species of *Pagurapseudes* to have only two segments in the antennular accessory flagellum are *P. inquilinus* Bamber (2007) from 440–450 m depth off New Caledonia, which has seven segments in the main flagellum (Bamber, 2007), and *P. victoriae* (see above) which has 5 or 6 segments in the main flagellum. Both of those species have one dorsal and one ventral seta on the pleopod basis, whereas *P. kimbla* has none.

*Pagurapseudes kimbla* was taken only occasionally, from throughout the Bass Strait at depths from 40 to 183 m, and on varied substrata.

Genus ***Macrolabrum*** Băcescu, 1976

***Macrolabrum tangaroa*** sp. nov.

Figures 48–50

*Material examined.* 1 ♂ (J56366), holotype, Stn BSS202, Western Bass Strait, 39°00.2'S 144°33.9'E, 74 m depth, 23 November 1981, sandy shell, coll. R.S. Wilson.

*Description of male (limited by dissection of half of only available specimen).* Body (Fig. 48A) typical of a pagurapseudid, small, holotype about 1.85 mm long. Cephalothorax apparently naked, rostrum (Fig. 49A) convex, smooth. Eyelobes distinguished with anterior pointed apophysis, eyes present as group of black-pigmented ocelli. Epistome not visible dorsally. Pereonites 1, 3 and 5 subequal, about 0.6 times as long as cephalothorax; pereonites 2 and 4 subequal, 1.15 times as long as pereonite 3; pereonite 6 longest, 1.45 times as long as pereonite 3. Pleon with five free subequal pleonites, each pleonite about half as long as pereonite 6. Pleonites 1 and 2 only bearing pleopods. Pleotelson semicircular, about as long as last two pleonites together, with plumose lateral seta and simple posterior seta on each side (Fig. 50I).

Antennule (Fig. 49B) proximal peduncle article 2.25 times as long as wide, margins without denticulation or apophyses inner margin with simple setae, outer margin with simple setae and two penicillate setae in distal half; second peduncle article 0.44 times as long as first with simple mesial and distal setae; third article 0.6 times as long as second, fourth article half length of second. Main flagellum of two segments, with single aesthetascs on each segment; accessory flagellum of one segment, distally just reaching distal edge of second segment of main flagellum.

Antenna (Fig. 49C) with two basal articles fused into wide proximal peduncle article with complex inner denticulation and single inner and outer-distal plumose setae; second article not as long as wide, with small inner distal spine; third peduncle article 1.5 times as long as second, fourth 2.5 times as long as second, both with distal penicillate setae. Flagellum of two very short segments, distal segment with one short and one very long distal setae, longer seta 1.5 times as long as distal three peduncle articles together.

Labrum (not figured) bilobed, rounded, sparsely setose, epistome present, not reaching anterior margin of carapace. Left mandible (Fig. 49D) with quadricuspid pars incisiva, narrow, bicuspid lacinia mobilis, setiferous lobe with four variously crenulate setae, pars molaris round, blunt, with distal marginal crenulations; palp (Fig. 49D') of three articles, basal article with single ventrodistal plumose seta, second article with five ventral plumose setae in distal half, third article with six plumose setae in distal third, these setae progressively longer distally such that proximal seta half length of article, distal seta more than twice as long as article; right mandible not seen. Labium (Fig. 49G) typically marginally setose, palp with two distal setae. Maxillule (Fig. 49E) inner endite with four distally-setulose distal setae, no outer apophysis; outer endite with 9 distal spines, outer and inner margins densely setose; palp (Fig. 49E') of two articles with distinct articulation, distally with four simple setae. Maxilla (Fig. 49F) outer margin naked, outer lobe of moveable endite with two subdistal and five distal simple setae, inner lobe with five simple setae; fixed endite outer lobe with five simple, one sabre-like, one trifurcate and two bilaterally denticulate distal spines and subdistal bilaterally denticulate spine, inner lobe with two longer distally denticulate setae and rostral row of 15 setae; one large inner distally denticulate seta. Maxilliped (Fig. 49H) basis with two inner plumose setae, three inner marginal denticulations, outer margin with small setose apophysis and two fine setae; proximal palp article with coarsely denticulate inner and outer margins and with one inner and one outer plumose seta; second article with coarsely denticulate inner and outer margins extended into large teeth inner-distally, and with six submarginal plumose setae and four plumose setae along inner margin, single outer plumose seta; third article with four setae on slight inner apophysis, each with fine denticulation in distal half; fourth article with six distal and two outer subdistal simple setae, each with fine denticulation in distal half; endite not seen. Epignath (Fig. 49I) large, marginally densely setose, inner lobes inconspicuous, distal spine setose.

Cheliped (Fig. 50A) with compact basis 1.2 times as long as wide, dorsally naked, ventrally with proximal seta, mud-ventral spine and six distal setae; exopodite absent. Merus subtriangular, with ventral plumose setae and ventrodistal denticulate triangular apophysis. Carpus unusually wide, 1.8 times as long as wide, widening distally to form cuff into which reflexed propodus could sit, cuff lined with crenulations; dorsally with sparse proximal plumose and simple setae, ventrally with sparse simple setae. Propodus robust, as long as wide with four ventral setae; fixed finger only half length of body of propodus ("palm"), with three ventrodistal and five dorsal setae, saw-like row of small teeth distally on cutting edge; moveable finger stout, curved, with three distal setae and one seta on cutting edge.

Pereopod 1 (Fig. 50B) longest pereopod, with stout basis 2.2 times as long as wide, dorsal margin bearing nine plumose setae but no apophyses, two subdistal submarginal outer plumose setae, ventral margin with three simple setae and plumose ventrodistal seta; exopodite present, large, distal article with fifteen plumose setae. Ischium 0.2 times as long as basis, with naked dorsal margin, simple ventral seta and single ventrodistal plumose seta. Merus 0.6 times as long as basis, naked, ventral margin with six plumose setae and nine shorter denticulate setae. Carpus just shorter than merus, with two ventral and three ventrodistal denticulate setae and longer ventrodistal simple seta, dorsodistally with two simple and two denticulate setae. Propodus as long as merus, with three ventral spines and two ventrodistal spines with adjacent simple setae. Dactylus curved, longer than propodus, with fine ventral setae, unguis slender, sharp, 0.6 times as long as dactylus.

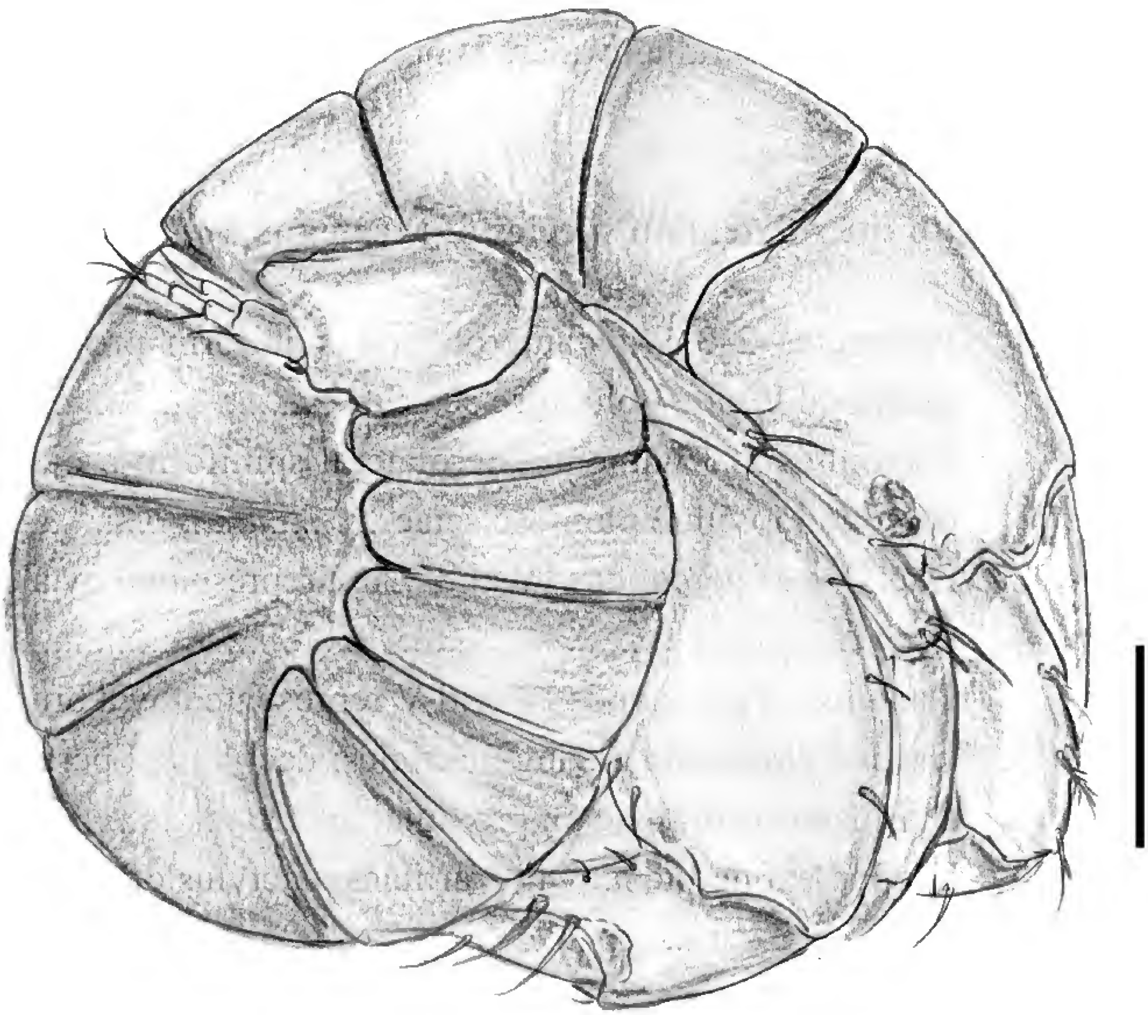

Fig. 48. *Macrolabrum tangaroa* sp. nov., holotype female. A, lateral view. Scale = 0.1 mm.

Pereopods 2 to 6 similar to each other, each about one-half as long as pereopod 1. Pereopod 2 (Fig. 50C) basis stout, 1.75 times as long as wide, with two plumose ventral seta; ischium with four plumose ventrodistal setae. Merus, carpus and propodus bearing "sucker-like" spines, generally in three ventral rows, and plumose setae as figured. Merus just shorter than carpus; propodus 0.3 times as long as carpus, with minutely denticulate distal spine; dactylus and unguis not fused, together longer than propodus. Pereopod 3 (Fig. 50D) with more setae on basis, only three plumose setae on ischium, carpus proportionately longer. Pereopod 4 (Fig. 50E) with only two plumose setae on ischium, carpus shorter than merus. Pereopod 5 (Fig. 50F) similar to pereopod 3, fewer sucker-like spines on merus. Pereopod 6 (Fig. 50G) with only one plumose seta on ischium.

Pleopods (Fig. 50H) only present on pleonites 1 and 2, biramous, reduced; basis with two dorsal but no ventral plumose setae; exopod with five distal plumose setae, endopod almost circular, with nine distal and inner plumose setae. Uropod (Fig. 50I) biramous, basis with one simple and one plumose distal setae; endopod longer than basis, of two segments, first segment shorter than basis, naked, second segment with three robust distal setae and one penicillate seta; exopod of two segments, first segment shorter than proximal endopod segment, second segment reaching half length of distal endopod segment, with two distal setae.

*Female*. Unknown.

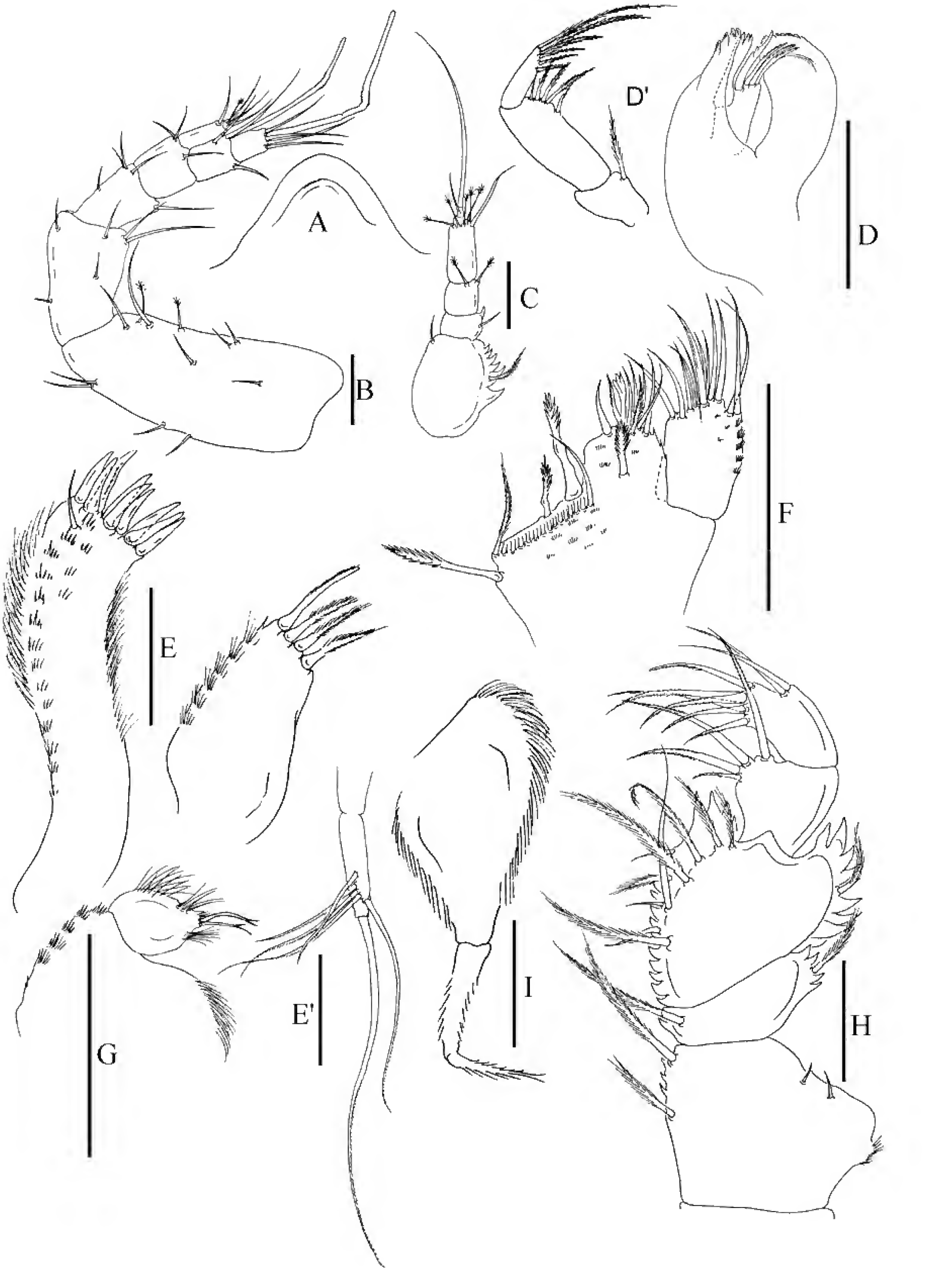


Fig. 49. *Macrolabrum tangaroa* sp. nov., female paratype. A, rostrum; B, antennule; C, antenna; D, left mandible; D', mandible palp; E, maxillule; E', maxillule palp; F, maxilla; G, labium; H, maxilliped; I, epignath. Scale = 0.1 mm.

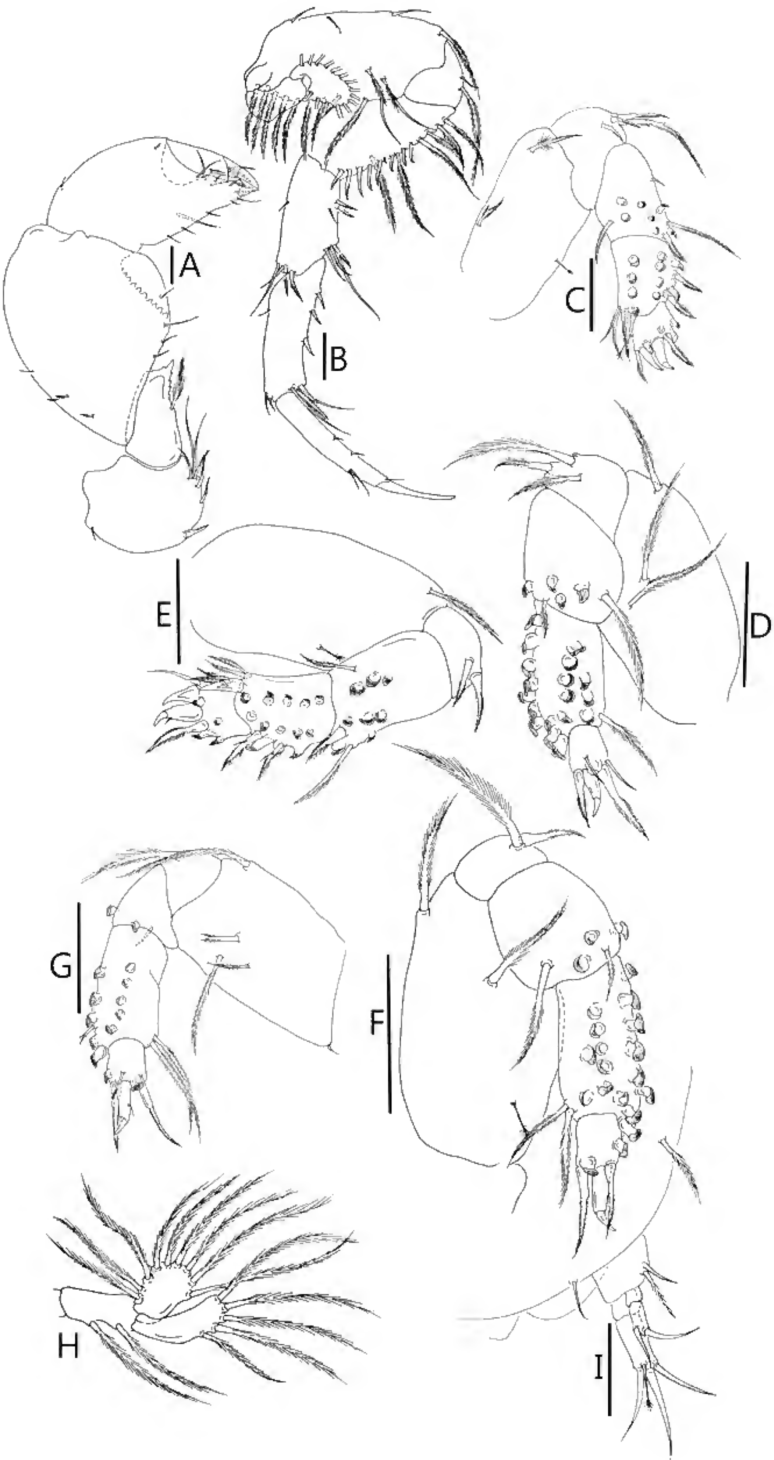


Fig. 50. *Macrolabrum tangaroa* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

*Etymology*. The RV *Tangaroa* was one of the vessels used on the Bass Strait Survey between 1979 and 1984 (noun in apposition).

*Remarks*. Unusually for a *Macrolabrum* species, the epistome of *M. tangaroa* sp. nov. does not exceed the anterior margin of the carapace (a condition also found in *M. distonyx*, a species with a three-segmented uropod endopod). The only other *Macrolabrum* species to have two segments in both uropod rami is *M. aenigmaticus* (known only from a juvenile), but that species differs from *M. tangaroa* in having a four-segmented main flagellum and a two-segmented accessory flagellum on the antennule, a propodus on pereopod 2 not shorter than the carpus, and distinct setation on the pereopod 1 basis, *inter alia*. The extremely wide, almost oval, cheliped carpus of *M. tangaroa* appears to be unique in the genus, but may represent a sexual dimorphism (males are not known for all species). The very short propodus on pereopod 2 is also an unusual and characterizing feature of this species.

The single specimen of *Macrolabrum tangaroa* was taken at 74 m depth in the western Bass Strait.

***Macrolabrum sarda*** sp. nov.

Figures 51–54

*Material examined*. 1 ♀ (J57788), holotype, Stn SA63, Flinders Island, South Australia, "The Hotspot" reef, 5 n miles W of N end of Flinders Island, 33°40.30'S 134°22.00'E, 17 m depth, 19 April 1995, SCUBA, coll. G.C.B. Poore; 1 ♀, 1 ♂ (J56372), paratypes, same sample as Holotype; 1 ♀ (J56373), paratype, Stn SA59, Flinders Island, South Australia, bay on NW coast of Flinders Island, 33°41.42'S 134°28.30'E, 3 m depth, 23 November 1981, hand dredge, coll. G.C.B. Poore; 1 ♀ (J56366), paratype, Stn BSS180, Central Bass Strait, 8 km south of South East Point, Wilsons Promontory, Victoria, 39°12.9'S 146°27.3'E, 65 m depth, 18 November 1981, medium sand, coll. R.S. Wilson.

*Description of female*. Body (Fig. 51A) typical of a pagurapseudid, small, holotype about 3.5 mm long. Cephalothorax (Fig. 51A, B) subrectangular, slightly narrower anteriorly, almost as long as wide, with denticulate rostrum; paired plumose setae behind ocular lobe, lateral margins with six hooked spine-like apophyses and seven plumose setae. Eyelobes distinct, eyes present as group of black-pigmented ocelli. Epistome conspicuous, exceeding anterior margin of carapace, visible dorsally. Pereonite 1 with undulating anterior and posterior margins, 0.4 times as long as cephalothorax and 2.8 times as wide as long, laterally with seven or eight plumose setae on each side; pereonite 2 similar to but just longer than pereonite 1, twice as wide as long, laterally with two plumose setae on each side; pereonites 3 to 6 naked. Pleon 0.4 times as long as whole body, with five free subequal pleonites, each pleonite nearly as long as pereonite 6 and slightly wider than long; pleonites 1 and 2 only bearing pleopods. Pleotelson subrectangular, about twice as long as last pleonite, 1.5 times as long as wide, with three lateral setae on each side.

Antennule (Fig. 52A) proximal peduncle article 3.5 times as long as wide, inner margin with four proximal spine-like apophyses accompanied by simple setae, further simple setae in distal half, outer margin with proximal penicillate setae, distal simple setae and distal spine; second peduncle article 0.5 times as long as first, inner spine-like apophysis at mid-length, both margins with single mid-length plumose seta and tuft of distal plumose setae; third article 0.85 times as long as second, with short inner and outer plumose setae; fourth article one-third length of third. Main flagellum of four segments including minute distal segment, first, second and third segments with 3, 2 and 1 aesthetascs respectively; accessory flagellum of three segments, first segment short, second segment longest and distally exceeding distal edge of first segment of main flagellum, third segment minute.

Antenna (Fig. 52B) with two basal articles fused into wide proximal peduncle article bearing complex denticulation along inner margin, one plumose and one simple inner setae; third article one-third length of fused proximal articles, as long as wide with inner distal spine-like apophysis and outer distal spine and adjacent simple seta; fourth peduncle article twice as long as third with inner distal spine-like apophysis and outer distal penicillate seta; fifth article 2.5 times as long as third with distal crown of penicillate setae and long outer simple seta. Flagellum of two unequal segments, distal segment with three distal setae.

Labrum (not figured) bilobed rounded, sparsely setose, epistome large, exceeding rostrum. Left mandible (Fig. 52C) with heavily denticulate outer margin, quadricuspid pars incisiva, tricuspid lacinia mobilis, setiferous lobe with four distally denticulate setae, pars molaris round, blunt, crushing face with marginal crenulations; palp of three articles, proximal article with inner distal crenulations and long, plumose inner seta, second article longest, 1.7 times as long as proximal article, inner margin with five plumose and two simple marginal setae, and 23 shorter simple setae essentially in two rows; third article half as long as second, with six progressively-longer inner setae and two outer setulose subdistal setae. Right mandible (Fig. 52D) as left but without lacinia mobilis. Labium (Fig. 52G) with hook-like denticulation on outer margin, palp elongate, setose, with two distal setae. Maxillule (Fig. 52E) inner endite with four distally-denticulate distal setae and outer apophysis below setose margin, outer endite with 9 distal spines, outer margin setose; palp of two articles with indistinct articulation, distally with six setae each minutely denticulate in its distal half. Maxilla (Fig. 52F) outer margin setulose, outer lobe of moveable endite with two subdistal and five distal simple setae, inner lobe with seven simple setae and one plumose seta; fixed endite outer lobe with fpur simple, three trifurcate and one bilaterally denticulate distal spines, inner lobe with one longer distally denticulate seta and rostral row of 16 setae. Maxilliped (Fig. 52H) basis with two inner and three distal setae and small outer setulose apophysis; proximal palp article with denticulate inner and outer margins, and one inner and one outer plumose setae; second article with denticulate inner and outer margins, outer margin with one distal and three marginal plumose setae, inner margin with two distal plumose setae and two more in proximal half, and sparse simple setae; third article with five simple and four finely-denticulate inner marginal setae; distal article with six finely-denticulate inner-marginal and distal setae, paired outer subdistal plumose setae; endite (Fig. 52H') with finely setose outer margin, distally with two plumose setae and five bi- or trifurcate spines progressively smaller towards inner

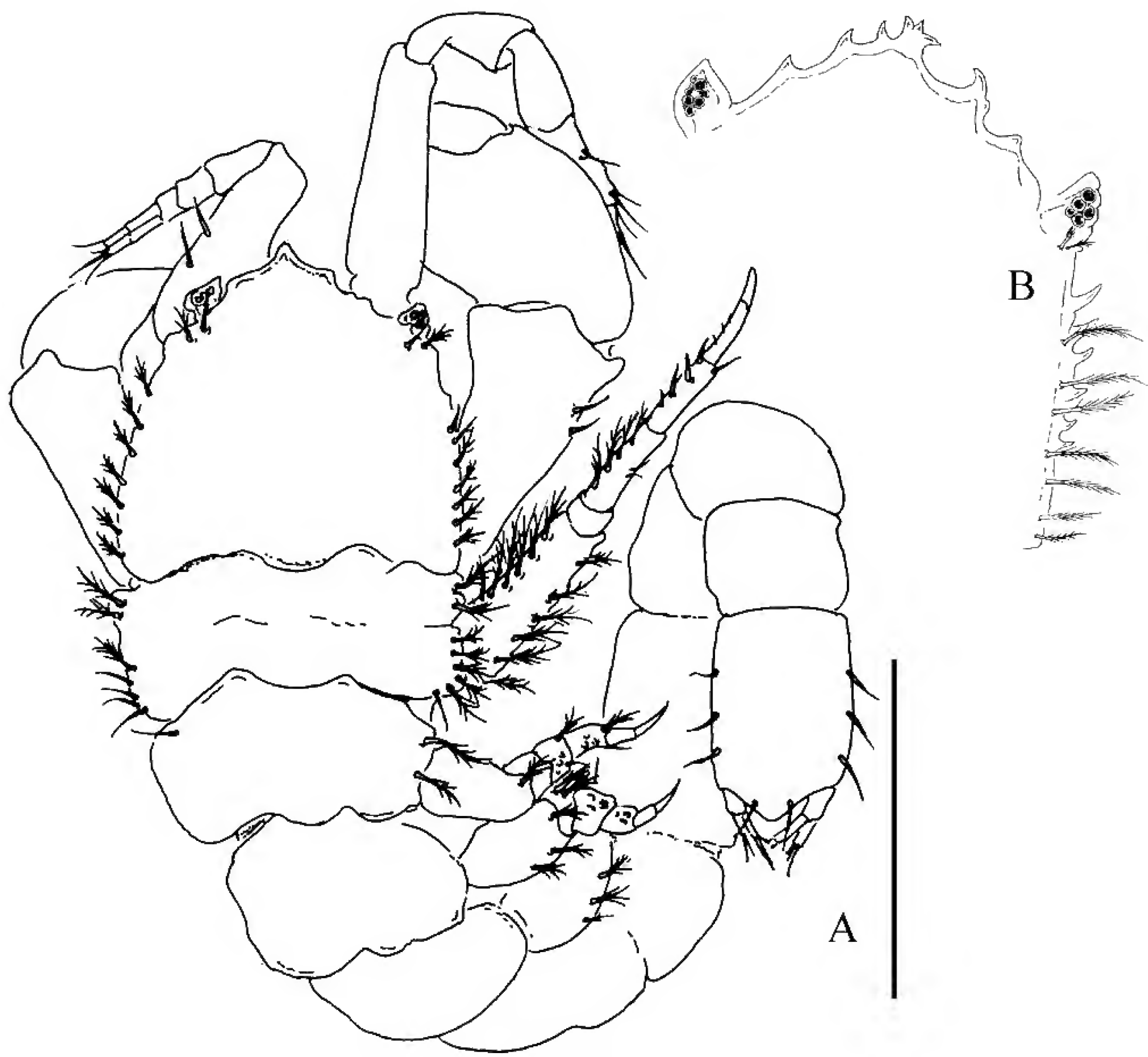


Fig. 51. *Macrolabrum sarda* sp. nov. A, adult female, dorsal view; B, cephalothorax. Scale = 1 mm.

margin, and two subdistal plumose setae; three coupling-hooks. Epignath (Fig. 52I) large, oval, distal spine coarsely setose.

Chelipeds showing dimorphism. Right cheliped (Fig. 53B) with compact basis 1.3 times as long as wide, with three dorsal setae on slight apophysis, mid-ventral finely-denticulate spine, two ventrodistal finely-denticulate spines and ventrodistal plumose seta; exopodite absent. Merus subtriangular with pronounced distal triangular extension, five simple and three plumose ventral setae. Carpus elongate, 2.3 times as long as wide, dorsally with sparse fine setae and mid-dorsal hook-like apophysis, ventrally with denticulate margin in distal half, four simple and one plumose marginal setae. Propodus robust, 1.35 times as long as wide, with three ventral and one dorsoproximal short setae; fixed finger wide, blunt, distally rounded, claw nor evident, with row of crenulations distally and tuft of three proximal setae on cutting edge, two ventral setae; moveable finger stout, strongly curved, cutting edge with rounded crenulations. Left chela (not figured) more slender, fixed finger pointed with distal claw.

Pereopod 1 (Fig. 54A) longest pereopod, coxa with triangular apophysis bearing two plumose setae; basis stout, 2.3 times as long as wide, with mid-proximal spine, dorsal margin expanded, expansion incomplete distally, bearing 19 plumose setae interspersed with eleven triangular spinules, ventral margin with three proximal simple setae, three central plumose setae and one distal plumose seta; exopodite present (Fig. 54A'), large, second

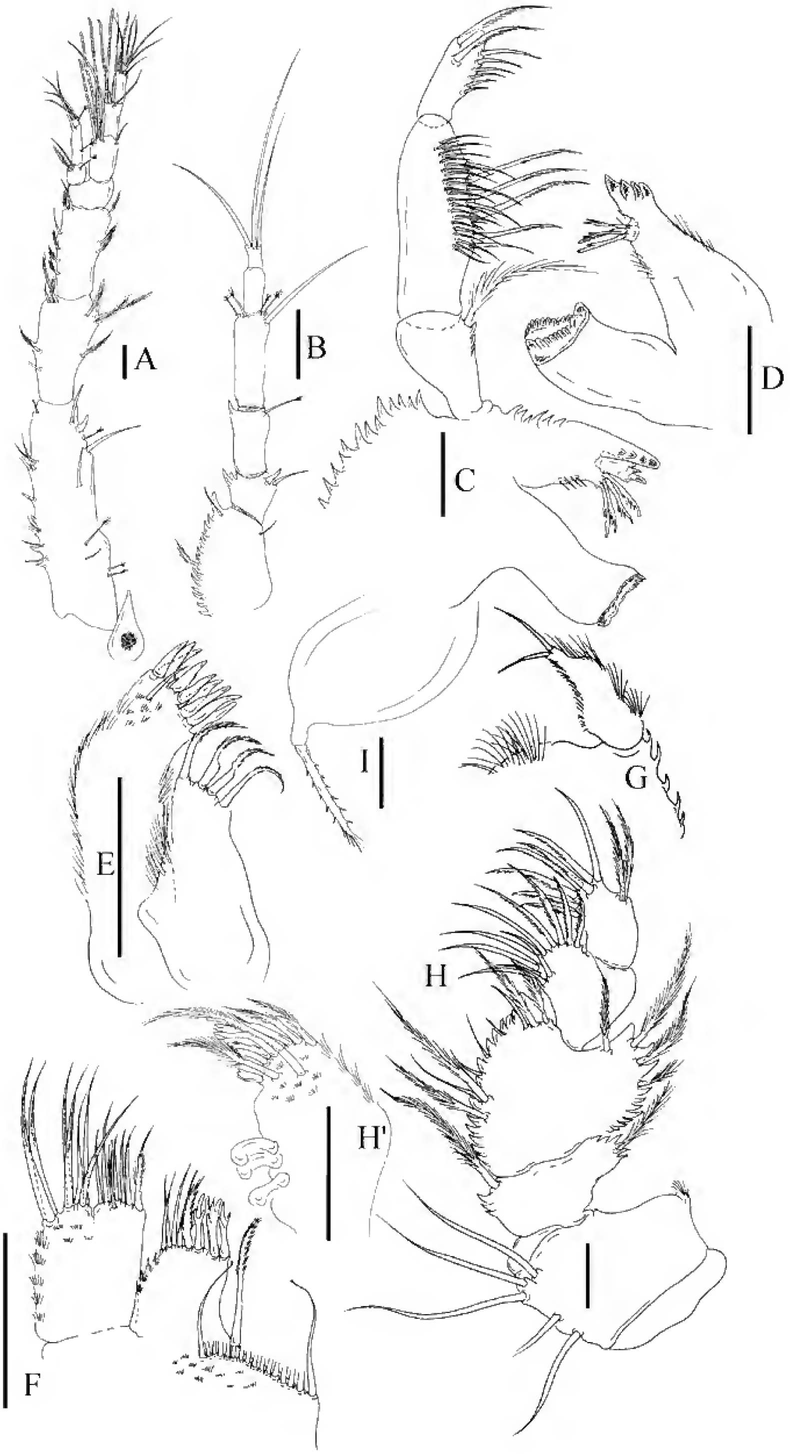


Fig. 52. *Macrolabrum sarda* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; D, right mandible; E, maxillule; F, maxilla; G, labium; H, maxilliped; H', maxilliped endite; I, epignath. Scale = 0.1 mm.

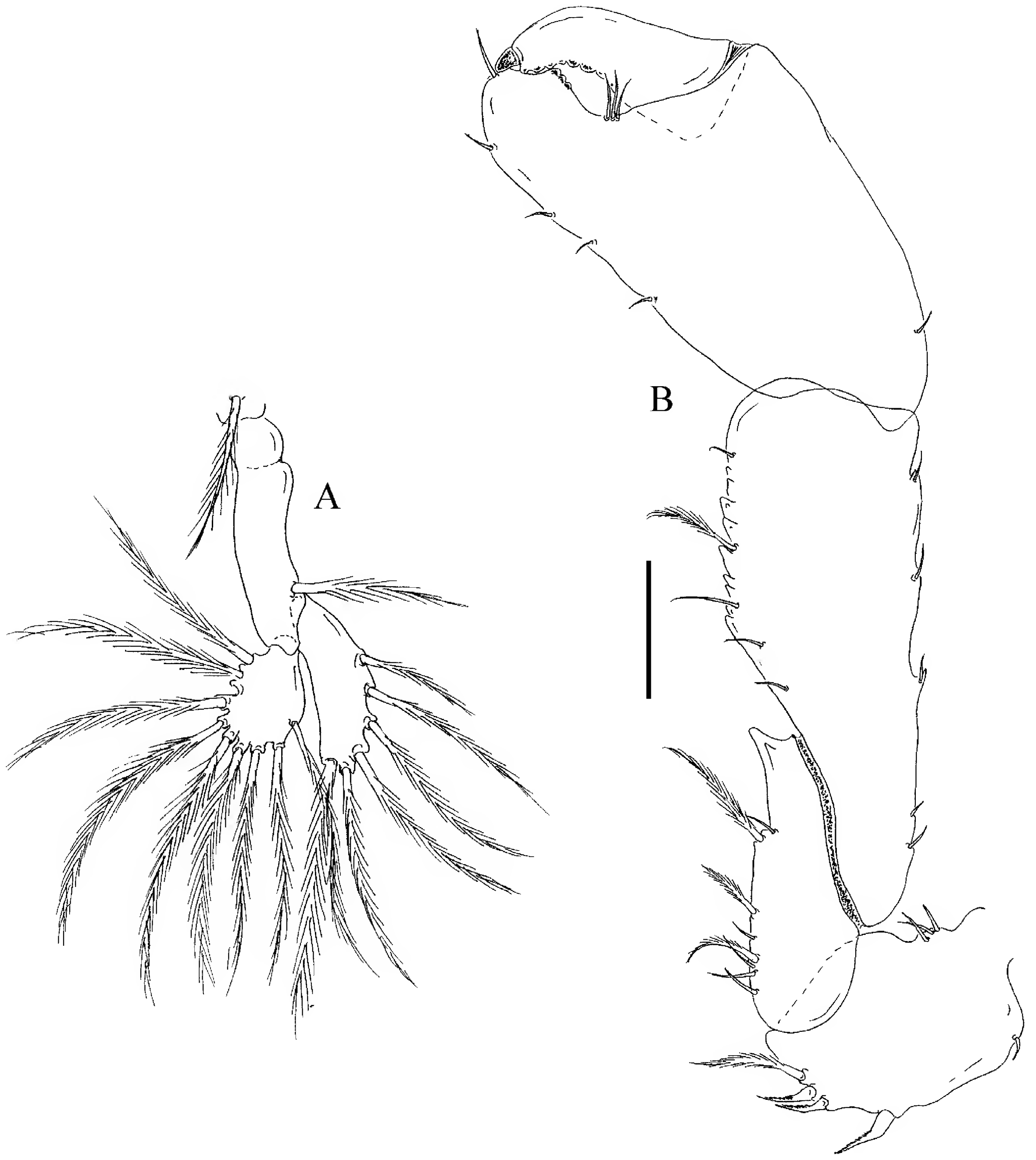


Fig. 53. *Macrolabrum sarda* sp. nov. A, pleopod; B, cheliped, female. Scale = 0.1mm.

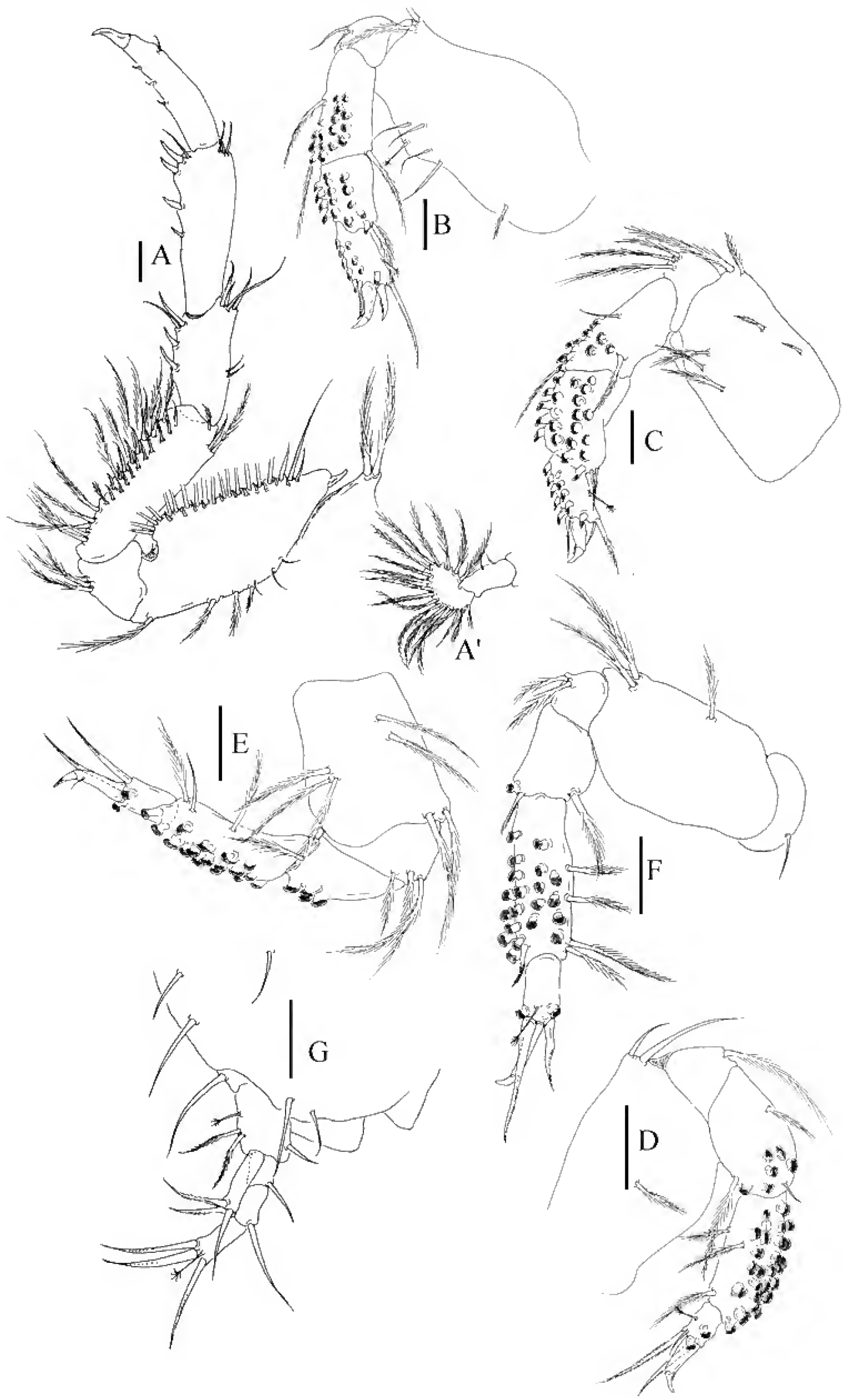


Fig. 54. *Macrolabrum sarda* sp. nov., male paratype. A, pereopod 1; A', pereopod 1, exopod; B, pereopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, uropod. Scale = 0.1 mm.

article with two dorsal setules, distal article with 18 plumose setae. Ischium as long as wide, with naked dorsal margin, three plumose ventral setae. Merus 0.8 times as long as basis, dorsally with two plumose and one simple distal setae, ventrally with 10 marginal plumose setae, 17 submarginal denticulate setae in two rows. Carpus short, half length of merus, ventrally with three spines and subdistal simple setae, and with two mid dorsal simple setae and dorsodistal tuft of three simple setae and one spine. Propodus 1.7 times as long as carpus, with four ventral spines in distal half and sparse distal setae. Dactylus stout, curved, 0.8 times as long as propodus, with three ventral and one dorsal setae, unguis slender, sharp, 0.3 times as long as dactylus.

Pereopods 2 to 6 similar to each other, each about one-half to one-third as long as pereopod 1. Pereopod 2 (Fig. 54B) coxa with simple seta; basis stout, 1.9 times as long as wide, dorsally with plumose proximal seta and four simple and one penicillate setae in distal half, ventrally with two distal plumose setae; ischium with paired ventrodistal setae. Merus, carpus and propodus bearing "sucker-like" spines, generally in three ventral rows, and sparse plumose setae as figured. Merus 1.5 times as long as basis; carpus 0.7 times as long as merus; propodus 0.75 times as long as carpus; dactylus and unguis not fused, with minute inner seta, together 0.8 times as long as propodus; adjacent distal propodal, spine simple but with inner distal fine denticulation. Pereopod 3 (Fig. 54C) with only plumose setae on basis, three ventrodistal plumose setae on ischium, dorsal penicillate seta on propodus. Pereopod 4 (Fig. 54D) slightly more compact, basis 1.5 times as long as wide; fewer sucker-like spines on merus; carpus just longer than merus; propodus short, 0.3 times as long as carpus, with two denticulate distal spines; dactylus plus unguis 1.5 times as long as propodus. Pereopod 5 (Fig. 54E) as pereopod 4 but with more plumose setae on basis and ischium. Pereopod 6 (Fig. 54F) carpus twice as long as merus, only one sucker-like spine on merus.

Pleopods (Fig. 53A) only present on pleonites 1 and 2, biramous, reduced; basis with single dorsal and no ventral plumose seta, and suggestion of proximal articulation; exopod with six outer and distal plumose setae, endopod almost circular, with eight marginal plumose setae.

Uropod (Fig. 54G) biramous, basis outer margin with two plumose and one penicillate setae, inner margin with one subdistal simple seta; endopod longer than basis, of three segments increasing in length, first and second segments each with inner distal simple seta, third segment with three stout distal setae each with fine serrations in distal half and one penicillate seta; exopod of one segment, subequal in length to proximal two endopod segments together, with three distal setae each with fine serrations in distal half.

*Male*. Closely similar to female, chelipeds not significantly sexually-dimorphic.

*Etymology*. The SV *Sarda* was one of the vessels used on the Bass Strait Survey between 1979 and 1984 (noun in apposition).

*Remarks*. The only other species of Macrolabrum to show minute distal segments on both flagella of the antennule are *M. aenigmaticus*, *M. boeri* and *M. abrucei*, but these have only two segments in the accessory flagellum; further, *M. aenigmaticus* has no pleopod basis setae and only two uropod endopod segments, while the other two have only one uropod exopod segment, and *M. boeri* has six ventral setae on the pleopod basis.

In fact, the only other species of the Pagurapseudinae to have a three-segmented accessory flagellum on the antennule is *Pagurapseudes victoriae* (see above), and then only in rare, larger individuals, while the complex setation of the basis and merus of pereopod 1 and of the second mandible palp article are unique to *Macrolabrum sarda* sp. nov..

*Macrolabrum sarda* sp. nov. was recorded from the Central Bass Strait, at 65 m on medium sand, as well as from South Australia at 3 to 17 m depth.

### *Macrolabrum haikung* sp. nov.

Figures 55–57

*Material examined.* 1 brooding ♀ (J57787), holotype, Stn CRUST 23, "The Whaleback", Bommie, 0.5 km S of Point Hicks, Victoria, 37°48.30'S 149°16.48'E, 13 m depth, 08 April 1989, SCUBA, coll. G.C.B. Poore; 14 ♀♀ (J56374), paratypes, same sample as Holotype; 1 ♀ (27697), paratype, Stn BSS175, Eastern Bass Strait, 40 km north of Deal Island, Tasmania, 39°05.8'S 147°26.2'E, 59 m depth, 18 November 1981, medium sand, coll. R.S. Wilson.

*Description of female*. Body (Fig. 55A) typical of a pagurapseudid, pleon skewed to the right and curved under pereon; small, holotype about 2.4 mm long. Cephalothorax slightly longer than wide, rostrum rounded, finely denticulate (Fig. 55B). Eyelobes distinguished with anterior pointed apophysis, eyes present as group of black-pigmented ocelli. Epistome not conspicuous. Pereonites 1, 2 and 3, 4 subequal, 0.3 times as long as cephalothorax; pereonites 4 and 5 subequal, 1.4 times as long as pereonite 1; pereonite 6 longest, 1.7 times as long as pereonite 1. Pleon of five free subequal pleonites, each pleonite about 0.7 times as long as pereonite 6; pleonites 1 and 2 only bearing pleopods. Pleotelson (Fig. 57I) subrectangular, about as long as last pleonite, 1.4 times as wide as long, with single plumose lateral seta on each side, and paired simple posterior setae.

Antennule (Fig. 56A) compact, proximal peduncle article 2.2 times as long as wide, without apophyses, inner margin sparsely setose, inner margin with three penicillate and one simple setae distally; second peduncle article 0.4 times as long as first with simple distal setae; third article 0.7 times as long as second, with simple distal setae; fourth article half length of second, with two simple and one penicillate distal setae. Main flagellum of two segments, with simple setae and single aesthetasc on each segment; accessory flagellum of one segment, distally exceeding distal edge of first segment of main flagellum.

Antenna (Fig. 56B) with two basal articles fused into wide proximal peduncle article bearing inner denticulation and plumose seta, outer margin expanded into a flange with two simple setae; third article shorter than wide, one-fifth length of combined proximal articles, with simple inner seta; fourth peduncle article 1.7 times as long as third, with inner penicillate seta; fifth article three-times as long as third, with penicillate and simple distal setae. Flagellum of two minute segments, proximal segment with penicillate seta, distal segment with two distal setae.


Fig. 55. *Macrolabrum haikung* sp. nov., holotype female. A, lateral view; B, rostrum. Scale = 0.1 mm.

Labrum (not figured) bilobed, rounded, sparsely setose. Right mandible (Fig. 56C) with tricuspid pars incisiva, setiferous lobe with three trifid setae, pars molaris slender, round, blunt, simple; palp of three articles, proximal article with long, plumose inner seta, second article longest, twice as long as first article, naked; third article as long as first, with four progressively longer distal setae and one outer subdistal seta, each seta finely denticulate. Left mandible (not figured) as right but with narrow, bicuspid lacinia mobilis. Labium typically marginally setose, palp (Fig. 56F) with setulose margins and two distal setae. Maxillule (Fig. 56D) inner endite with four finely serrate distal setae, margins naked, no outer apophysis; outer endite with 9 serrate distal spines, outer margin setose; palp of two articles, distally with outer setules and three simple setae. Maxilla (Fig. 56E) outer margin naked, outer lobe of moveable endite with two subdistal and four distal simple setae, inner lobe with six simple setae; fixed endite outer lobe with three simple, three trifurcate and one bilaterally denticulate distal spines, inner lobe with one longer distally denticulate seta and rostral row of 10 setae. Maxilliped (Fig. 56G) basis with two inner plumose setae, outer margin denticulate and with one short plumose seta; proximal palp article with two denticulations and one plumose seta on inner and outer margins; second article with denticulate inner and outer margins, outer margin with two plumose setae, inner margin with four plumose and two simple setae; third article with three inner marginal simple setae; distal article with seven finely-denticulate and one simple distal setae, paired outer subdistal setae each with setules at mid-length and finely-denticulate distal half; endite (Fig. 56G') with naked outer margin, five bifurcate distal spines, and two coupling-hooks. Epignath (Fig. 56H) narrow, inner lobes conspicuous, distal spine with short marginal setules in distal half.

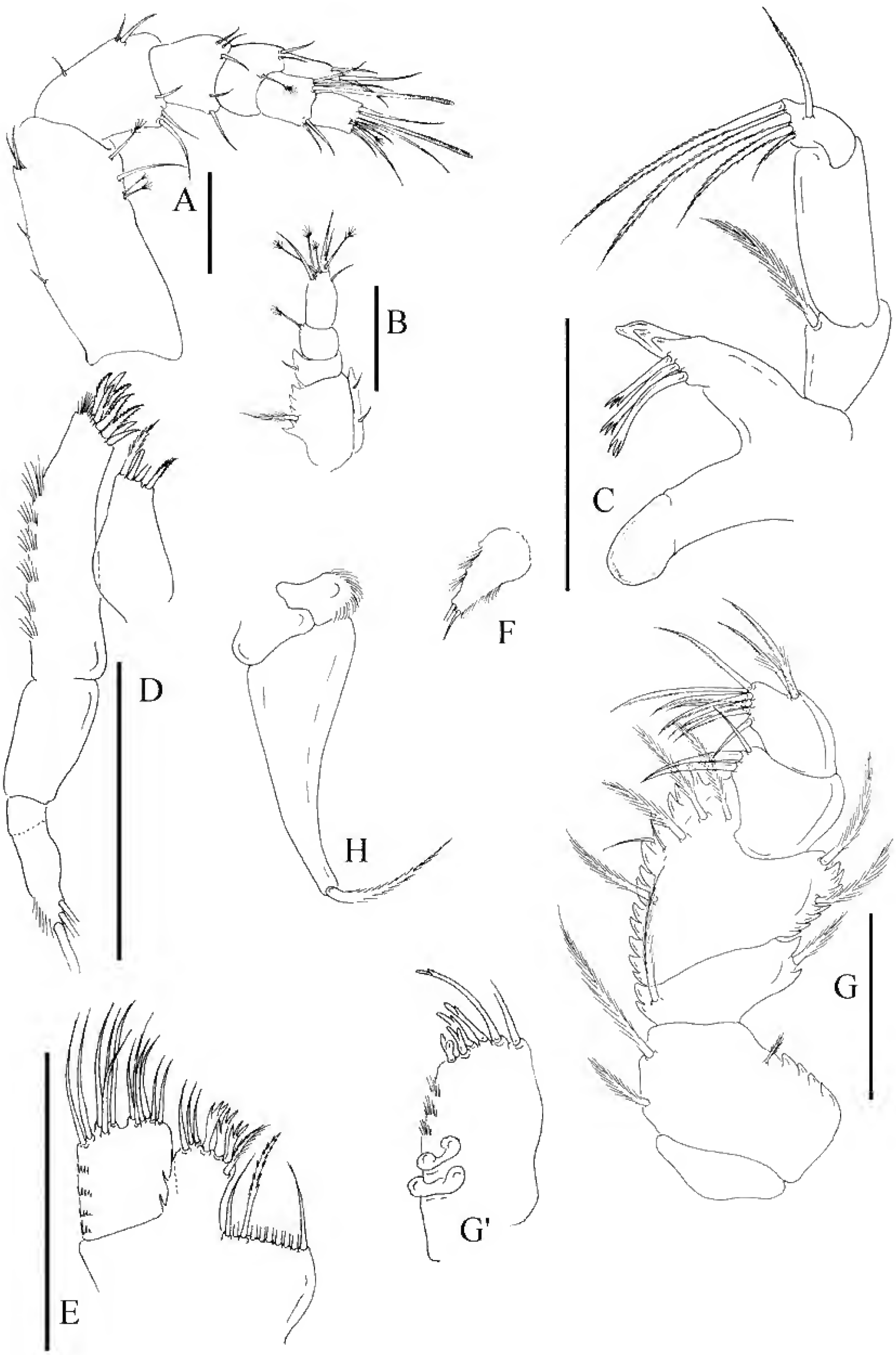


Fig. 56. *Macrolabrum haikung* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; D, maxillule; E, maxilla; F, labial palp; G, maxilliped; G', maxilliped endite; H, epignath. Scale = 0.1 mm.

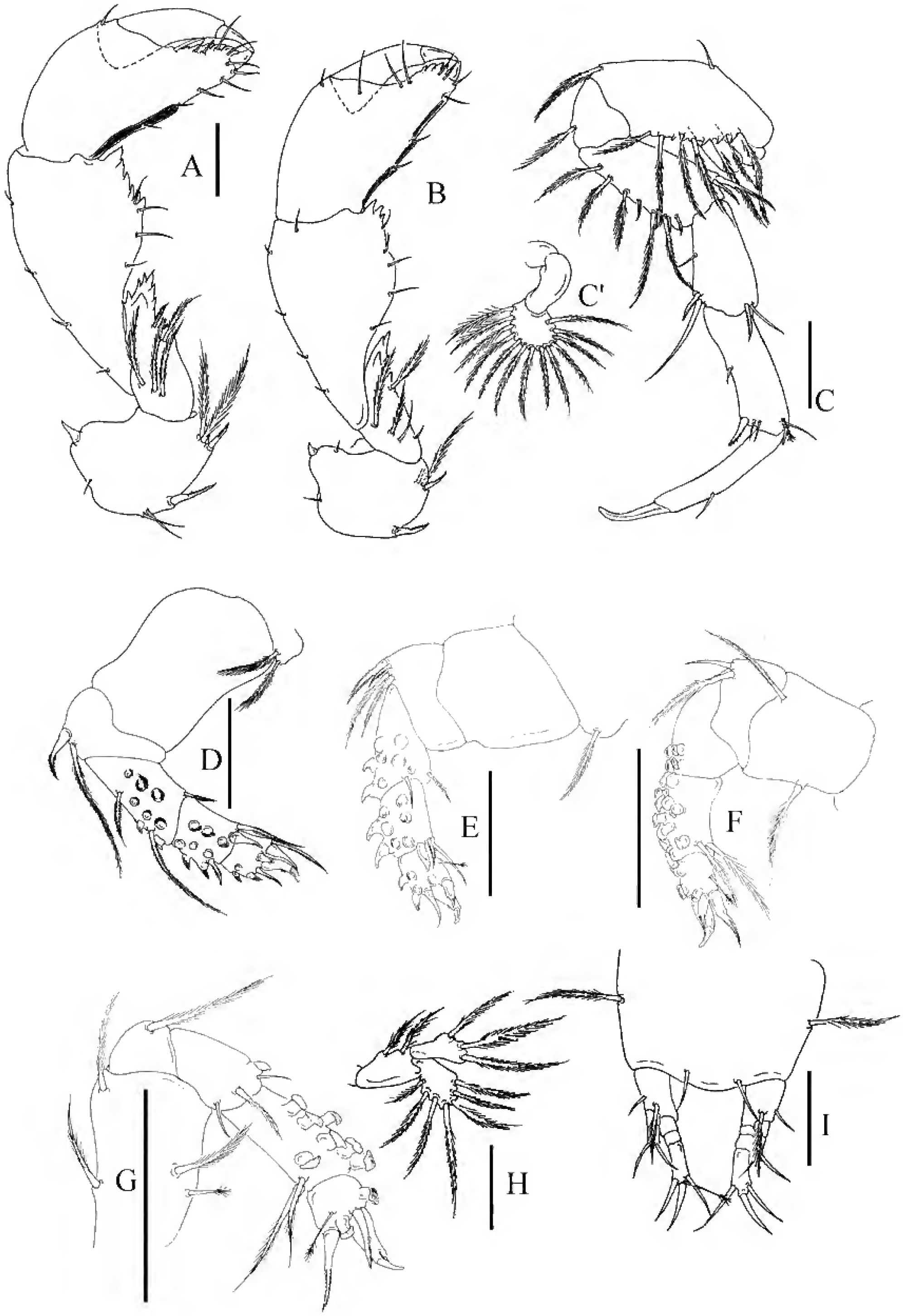


Fig. 57. *Macrolabrum haikung* sp. nov., female paratype. A, right cheliped; B, left cheliped; C, pereopod 1; C', exopod; D, pereopod 2; E, pereopod 3; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

Chelipeds showing slight dimorphism. Right cheliped (Fig. 57A) with compact basis 1.1 times as long as wide, with mid-ventral spine, two simple setae proximal to this, and two plumose setae and one spine ventrodistally; stout proximal spine dorsally; exopodite absent. Merus subtriangular, with complex, denticulate triangular distal apophysis, two mid-ventral, two inner-proximal and three outer-proximal plumose setae. Carpus elongate, 1.65 times as long as wide, widening distally, with six teeth in ventrodistal denticulation, four ventral and four dorsal simple setae. Propodus 1.3 times as long as wide, single dorsodistal seta, ventrally with two simple setae and expanded into thin flange; fixed finger with three ventral, one distal and five dorsal marginal setae, crenulate cutting edge; moveable finger stout, curved, naked. Left cheliped (Fig. 57B) similar, ventral denticulations on carpus limited to three on distal apophysis, chela slightly more slender (propodus 1.2 times as long as wide), with fewer setae and denticulation restricted to distal half of cutting edge of fixed finger.

Pereopod 1 (Fig. 57C) longest pereopod, with stout basis twice as long as wide, dorsal margin bearing seven plumose setae interspersed amongst triangular tooth-like apophyses, and three rounded paddle-like apophyses proximally; ventral margin with simple proximal seta and distal plumose seta; exopodite present (Fig. 57C'), large, second article naked, distal article with thirteen plumose setae. Ischium 0.3 times as long as basis, with single ventral plumose seta. Merus relatively compact for the genus, twice as long as wide, 0.75 times as long as basis, with two denticulate dorsodistal setae, ventral margin with five longer plumose setae and four shorter denticulate spines. Carpus shorter than merus, with denticulate spine and simple seta dorsodistally and ventrodistally. Propodus as long as merus, with dorsodistal group of one simple seta, one penicillate seta and one curved spine, ventrodistally with two simple setae and one denticulate spine. Dactylus almost straight, just longer then propodus, with single dorsal but no ventral setae, unguis slender, curved, blunt, half as long as dactylus.

Pereopods 2 to 6 similar to each other, each about one-half to one-third as long as pereopod 1. Pereopod 2 (Fig. 57D) basis stout, 1.7 times as long as wide, naked; ischium with one shorter and one longer ventrodistal setae. Merus, carpus and propodus bearing "sucker-like" spines, generally in three ventral rows, and sparse plumose setae as figured. Merus longer carpus; propodus 0.6 times as long as carpus, both with stout, finely denticulate distal spine; dactylus and unguis not fused, with minute inner seta. Pereopod 3 (Fig. 57E) with very short basis, shorter than wide, ischium with three ventrodistal plumose setae, merus with fewer sucker-like spines, merus and carpus subequal in length, carpus and propodus both with stout, finely denticulate distal spine. Pereopod 4 as pereopod 5. Pereopod 5 (Fig. 57F) with one dorsal and one ventrodistal setae on basis, one longer and one shorter ventrodistal setae on ischium, merus without setae, shorter than carpus; stout, finely denticulate distal spine on propodus only. Pereopod 6 (Fig. 57G) basis with two plumose dorsal setae, mid-ventrally with plumose seta and penicillate seta; ischium with one ventrodistal seta; merus with only one sucker-like spine; unguis mounted subdistally on dactylus.

Pleopods (Fig. 57H) only present on pleonites 1 and 2, biramous, reduced; basis with two ventral plumose setae; exopod with three distal plumose setae, endopod almost circular with seven marginal plumose setae. Uropod (Fig. 57I) biramous, basis with one simple and one plumose distal setae; endopod longer than basis, of three segments, first and second segments subequal, distally naked, third segment longer than first two together, with three stout distal setae and one penicillate seta; exopod of two segments, together subequal in length to proximal two endopod segments together, with two distal setae.

*Male*. Unknown.

*Etymology*. The FRV *Hai Kung* was one of the vessels used on the Bass Strait Survey between 1979 and 1984 (noun in apposition).

*Remarks*. The only other species of *Macrolabrum* with three and two segments in the uropod endopod and exopod respectively, and two and one segments in the antennular main and accessory flagellum respectively is *M. distonyx*, from New Caledonia (see Bamber, 2007), which also has a proximal spine on the cheliped basis like *M. haikung* sp. nov. and an epistome not exceeding the anterior margin of the carapace, but that species has a far more elongate antennule with denticulation on the proximal peduncle article, a triangular, denticulate rostrum, four spines on the mandible palp second article, more slender pereopod bases, and a huge chela on the right cheliped, *inter alia*.

Indeed, the present species is unique in its extremely compact pereopod bases, the relatively short articles of pereopod 1 with

Table 1. Numbers of segments in the antennule flagella and uropod rami, for all described Australian species of Pagurapseudinae.

| Species | Main flagellum | Accessory flagellum | Uropod exopod | Uropod endopod |
|---|---|---|---|---|
| *Pagurotanais koonungai* Bamber, 2008 | 3 | 1 | 1 | 2 |
| *Macrolabrum abrucei* (Băcescu 1981) | 4 | 2 | 1 | 3 |
| *Macrolabrum boeri* Băcescu 1981 | 4 | 2 | 1 | 3 |
| *Macrolabrum impedimenta* Bamber, 2005 | 2 | 1 | 1 | 2 |
| *Macrolabrum tangaroa* sp. nov. | 2 | 1 | 2 | 2 |
| *Macrolabrum sarda* sp. nov. | 4 | 3 | 1 | 3 |
| *Macrolabrum haikung* sp. nov. | 2 | 1 | 2 | 3 |
| *Pagurapseudes spinipes* Whitelegge 1901 | 4 | 1 | 1 | 3 |
| *Pagurapseudes victoriae* sp. nov. | 5 (6) | 2 (3) | 1 | 3 |
| *Pagurapseudes kimbla* sp. nov. | 3 | 2 | 1 | 3 |

their sparse setation, the lack of ventral setae on the dactylus of pereopod 1, the subdistal attachment of the unguis on pereopod 6, the serration of the distal spines on the maxillule outer endite, and in particular the inner flange on the antenna proximal article and the ventral flange on the cheliped propodus.

*Macrolabrum haikung* was taken from the Eastern Bass Strait at 13 to 59 m depth on medium sand.

Comment on the Pagurapseudinae of Australia

The known Pagurapseudinae of Australia are largely easily distinguishable by the numbers of segments in the antennule flagella and in the uropod rami, as shown in Table 1.

Suborder **Tanaidomorpha** Sieg, 1980

Superfamily **Paratanaoidea** Lang, 1949

Family **Paratanaidae** Lang, 1949

Subfamily **Paratanaidinae** Lang, 1949

Genus ***Paratanais*** Dana, 1952

***Paratanais malignus*** Larsen, 2001

Figures 58–59

*Paratanais malignus* Larsen, 2001, 368–372, figs 11–13, 17.

*Material examined.* 1 ♀ (J56667), Stn BUN2, off Honeysuckle Hill, Bunurong, Victoria, 38°40.32'S 145°37.47'E, 10 to 11 m depth, 1 April 1997, SCUBA, coll. T,D. O'Hara. 2 ♀♀ (J56668), 1 ♀ (J56669), Stn WV11, Beware Reef, near Cape Conran, Victoria, 37°49.21'S 148°47.23'E, 5 to 6 m depth, 15 April 1998, SCUBA, coll. T,D. O'Hara. 3 ♀♀ (J56670), Stn WV13, Sailor's Grave, off East Cape Conran, Victoria, 37°48.13'S 148°44.41'E, 4 to 5 m depth, 15 April 1998, SCUBA, coll. T,D. O'Hara. 1 ♀ (J56671), Stn WV5, Cheviot Beach, Point Nepean, Victoria, 38°18'S 144°40'E, 1.9 to 3.5 m depth, 31 March 1998, SCUBA, coll. T,D. O'Hara. 1 ♀ (J56694), Stn BSS 213T, Eastern Bass Strait, 24 km SW of Lakes Entrance, Victoria, 38°03'S 147°50'E, 45 m depth, 01 October 1983, otter trawl, coll. M. Gomon & R.S. Wilson. 1 ♀ (J56734), Stn BSS 181S, Central Bass Strait, 26 km SE of Aireys Inlet, Victoria, 38°39.48'S 144°18.12'E, 79 m depth, very fine sand, 19 November 1981, WHOI epibenthic sledge, coll. R.S. Wilson. 1 ♀ (J56738), Stn BSS 188, Western Bass Strait, 30 km SSW of Warrnambool, Victoria, 38°38.12'S 142°35.00'E, 59 m depth, 20 November 1981, coll. R.S. Wilson. 1 ♀ (J56766), Stn PPBES 1218, Port Phillip Bay, off Brighton, Victoria, 37°54.45'S 144°58.30'E, 4 m depth, coll. Department of Fisheries & Wildlife Marine Pollution Studies. 3 juveniles (J57546), Stn BSS 158, Central Bass Strait, 66 km S of Rodondo Island, Victoria, 39°48.36'S 146°18.48'E, 82 m depth, sand with silt and mud, 13 November 1981, coll. R.S. Wilson. Numerous other lots in the collections of Museum Victoria.

This species is particularly recognizable owing to its having a leaf-shaped spine at junction of the chela fingers; other characterizing features are the rugose lacinia mobilis of the left mandible, and the dorsal field of marginal setules on article 2 of the antenna peduncle. The additional material found here allows some additions to the type-description of Larsen (2001). The original type-material included only females and mancae; the present material also includes the male, which is described below.

*Supplementary description of female.* Body-length up to 3.7 mm. Distal spine on article three of antennal peduncle often not showing articulation; labrum densely setose (Fig. 58A). Pars molaris of left mandible with elaborate distal spination (Fig. 58B). Maxilla (Fig. 58C) subtriangular, naked. Maxilliped (Fig. 58D) endites with anteromedial seta (originally described as absent in the more limited type-material), second palp article with long simple seta in addition to serrated spine and finely shorter setulose seta.

Cheliped (Fig. 58E) carpus with long inner seta; fixed finger of propodus with two ventral setae. Pereopods 1 to 3 (Figs 58F, G) with seta on coxa.

*Description of male.* Body (Fig. 59A) shorter than that of female, 2.6 mm long, 4.8 times as long as wide. Cephalothorax subtriangular, as long as wide, longer than pereonites 1 to 3 together; large eyes present, with large pigmented ocelli. Pereonite 1 shortest, pereonites 2 and 3 progressively longer, pereonite 3 twice as long as pereonite 1, pereonites 4 to 6 equal in length, 2.7 times as long as pereonite 1. Pleon with five free subequal pleonites bearing pleopods.

Antennule (Fig. 59B) of seven articles, proximal article 1.2 times as long as wide, with inner tuft of penicillate setae; second article 0.7 times as long as wide, about half length of first, with inner seta longer than article width; third article less than half length of second with longer inner and shorter outer distal setae. Flagellum of four segments; first segment very short, with proximal and distal rows of aesthetascs; second segment 2.5 times as long as wide, with distal row of aesthetascs; third segment as long as second, with simple distal seta; fourth segment shorter than third, distally with two penicillate and five simple setae, and single aesthetasc.

Antenna similar to that of female.

Mouthparts (Fig. 59C) largely reduced. Maxilliped basis with single distal seta, endites naked, palp with simple setae longer than those of female.

Cheliped (Fig. 59D) compact, more robust than that of female; carpus just longer than wide, with longer ventral and shorter dorsal single setae; propodus with inner comb-row of 14 setae; fixed finger with numerous fine spinules ("teeth") along cutting edge; dactylus strongly curved, with two setae on inner margin.

Pereopods (Fig. 59E, F, G) more slender than those of female, pereopods 2 and 3 similar to pereopod 1; posterior pereopods with bases about 2.5 times as long as wide, propodi nearly five times as long as wide and as long as carpus and merus together.

Pleopods (Fig. 59H) similar to those of female, but setae longer.

Uropod (Fig. 59I) rami more slender than those of female; exopod almost as long as proximal endopod segment; proximal endopod segment with additional array of penicillate setae in proximal half.

*Remarks.* The type material of *Paratanais malignus* was collected in kelp epifauna at 4 to 4.5 m depth in Botany Bay, New South Wales. The present material extends the known distribution to throughout the Bass Strait in depths from 2 to 82 m on sandy to muddy substrata.


Fig. 58. *Paratanais malignus*, female. A, labrum; B, left mandible; C, maxilla and maxillule endite; D, maxilliped; E, cheliped with detail of chela fingers; F, pereopod 1; G, pereopod 3; H, pleopod. Scale = 0.01 mm for A to D, 0.1 mm for E to H.

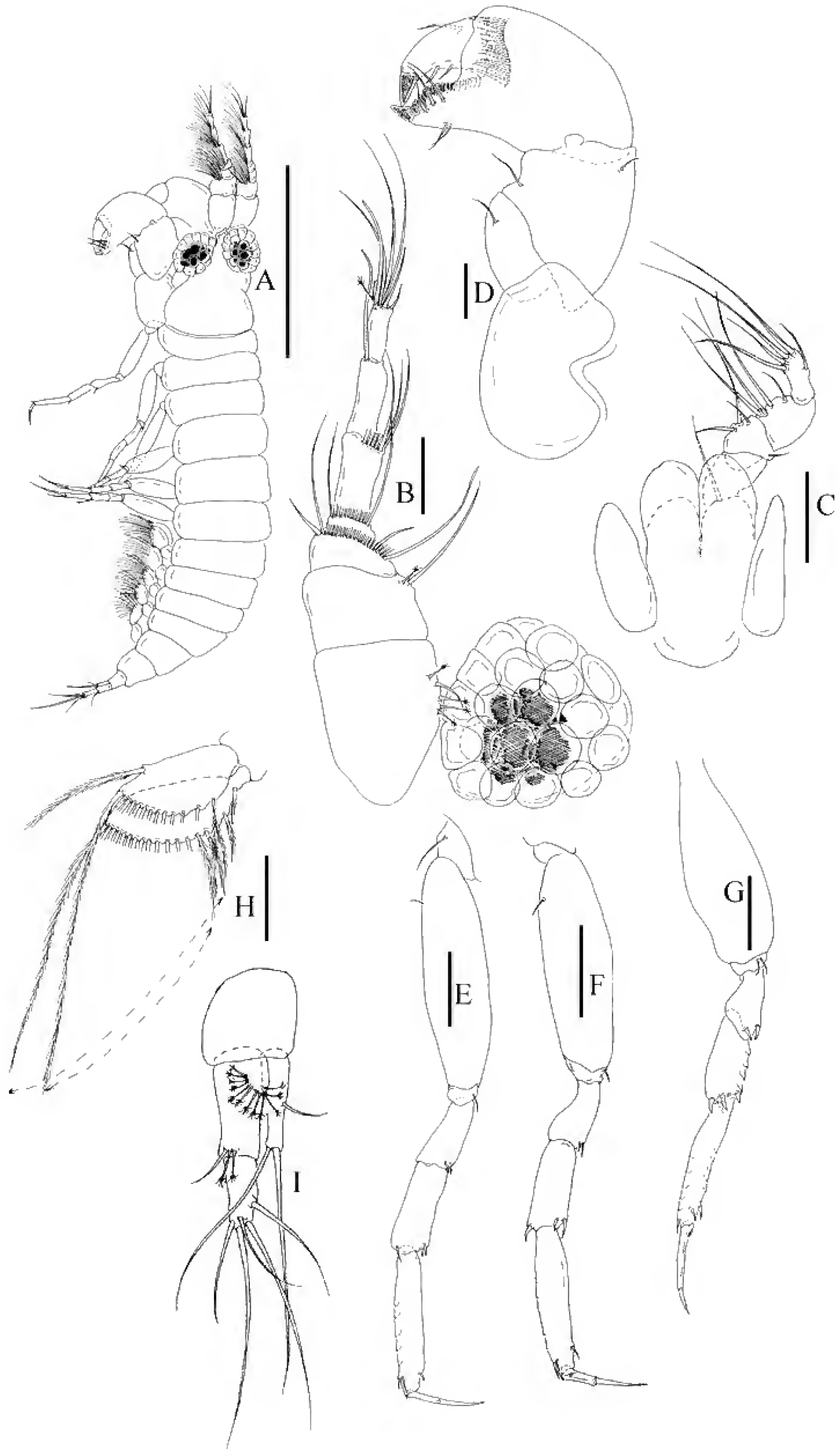


Fig. 59. *Paratanais malignus*, male. A, dorsal; B, antennule; C, mouthparts; D, cheliped; E, pereopod 1; F, pereopod 2; G, pereopod 4; H, pleopod; I, uropod. Scale = 1 mm for A, 0.1 mm for B to I

***Paratanais tanyherpes*** sp. nov.

Figures 60–62

*Material examined.* 1 ♀ (J56762), holotype, Stn CPBS-N 32, Western Port, off Crib Point, 30°20.83'S 145°13.48'E, 13 m depth, sandy gravel, 23 March 1965, coll. A.J. Gilmour, Smith-McIntyre Grab. 1 ♀ (J56763), paratype, Stn CPBS-A 4, Western Port, off Crib Point, 38°21'S 145°14'E, 9 m depth, sand, 12 October 1964, coll. A.J. Gilmour, Smith-McIntyre Grab. 4 ♀♀ (J56755), paratypes, Stn CPBS-N 31, Western Port, off Crib Point, 38°20.93'S 145°13.62'E, 15 m depth, fine sand and mud, 29 March 1965, coll. A.J. Gilmour, Smith-McIntyre Grab. 1 ♀ (J56757), paratype, Stn CPA 22, Cape Paterson, Victoria, 38°41'S 145°36'E, 0 m depth, 07 March 1982, coll. R.S. Wilson & H.M. Lew-Ton. 2 ♀♀ (J56754), paratypes, Stn BSS 174 S, Eastern Bass Strait, 25 km NE of Deal Island, Tasmania, 39°16.8'S 147°33.2'E, 57 m depth, medium sand, 18 November 1981, coll. R.S. Wilson, WHOI epibenthic sled. 2 ♀♀ (J56761), paratypes, Stn BSS 155, Central Bass Strait, 38 km SW of Cape Paterson, 38°55.5'S 147°17.0'E, 70 m depth, fine sand, 12 October 1964, coll. R.S. Wilson. 1 ♀ (J57533), paratype, Stn BSS 203, Central Bass Strait, 44 km NE of Cape Wickham, King Island, 39°22'S 144°18.3'E, 60 m depth, coarse sand, 23 November 1981, coll. R.S. Wilson. 1 ♀ (J56689), paratype, Stn BSS 199, Western Bass Strait, 20 km SSW of Stokes Point, King Island, 40°19.5'S 143°48.8'E, 71 m depth, fine mud, 22 November 1981, coll. R.S. Wilson. 3 ♀♀ (J56722), paratypes, Stn BSS 192 DRC, Western Bass Strait, 44 km SW of Cape Otway, 39°06.7'S 143°07.4'E, 81 m depth, medium sand, 21 November 1981, coll. R.S. Wilson. 4 ♀♀ (J56705), paratypes, Stn BSS 209, Eastern Bass Strait, 40 km SSW of Lakes Entrance, 38°18.0'S 147°37.0'E, 55 m depth, muddy fine shell, 31 July 1983, coll. M.F. Gomon & R.S. Wilson. 3 ♀♀ (J56764), paratypes, Stn BSS 173, Eastern Bass Strait, 30 km north of North Point Flinders Island, 39°26.3'S 147°48.7'E, 49 m depth, medium sand, 17 November 1981, coll. R.S. Wilson. 1 ♀ (J56756), paratype, Stn CPBS-S 32, Western Port, off Crib Point, 38°21.6'S 145°13.7'E, 13 m depth, muddy sand, 12 March 1965, coll. A.J. Gilmour. 1 ♀ (J56765), 2 ♀♀ (J56758), 1 ♀ (J56759), paratypes, Stn CPBS-N 32, Western Port, off Crib Point, 38°20.83'S 145°13.48'E, 13 m depth, sandy gravel, 23 March 1965, coll. A.J. Gilmour, Smith-McIntyre Grab. 1 ♀ (J57542), paratype, Stn CPBS-S 26, Western Port, off Crib Point, 38°22.18'S 145°15.22'E, 10 m depth, sand, 26 February 1965, coll. A.J. Gilmour, Smith-McIntyre Grab. 1 ♀ (J57563), paratype, Stn SPPS 5, Southern Port Phillip Bay, 38°17.3'S 144°41.4'E to 38°16.4'S 144°41.8'E, 7 m depth, coll. Marine Research Group of Victoria, dredge.

*Description of female.* Body (Fig. 60A) elongate, 8.7 times as long as wide, holotype 3 mm long. Cephalothorax subrectangular, 1.4 times as long as wide, twice as long as pereonite 1, with slight triangular rostrum, naked. Pereonite 1 shortest, pereonites 2 and 3 about 1.5 times as long as pereonite 1; pereonite 4 longest, 1.9 times as long as pereonite 1; pereonites 5 just shorter than pereonite 4, pereonite 6 just shorter than pereonite 2 (all pereonites respectively 1.5, 1.1, 1.0, 0.9, 0.9 and 1.1 times as wide as long). Pleonites 3.6 times as wide as long, pleonites 1 to 4 with one plumose, articulating lateral seta on each side. Pleotelson semicircular, short, twice as long as pleonite 5, 1.7 times as wide as long, distally with four posterolateral setae, marginal single simple setae either side of each uropod attachment, and marginal penicillate seta distal of uropod attachment (Fig. 62I).

Antennule (Fig. 61A) of five articles, shorter than cephalothorax; proximal article 1.6 times as long as wide, with inner tufts of penicillate setae and short outer-distal simple seta; second article wider than long, about one-third length of first, with inner distal tuft of penicillate setae and simple seta longer than article width; third article two-thirds length of second with inner and outer distal setae; fourth article slender, tapering, almost as long as second and third articles together, with one distal seta; distal article minute, with four distal setae and single aesthetasc.

Antenna (Fig. 61B) proximal article compact, naked; second article just shorter than wide, ventral margin produced, without distal apophyses, with mid-ventral seta, shorter laterodistal and dorsodistal seta, dorsal margin densely setulose; third article two-thirds as long as wide, shorter than second article, dorsal margin convex, with stout dorsodistal spine; fourth article just longer than second, with two distal simple setae and mesial and distal penicillate setae; fifth article half as long as fourth with one distal seta; sixth article minute with one very short and four longer distal setae.

Labrum (Fig. 61C) hood-shaped, apically rounded, setose. Left mandible (Fig. 61D) with wide, crenulate lacinia mobilis, right mandible (Fig. 61E) pars incisiva bilobate; left pars molaris (Fig. 61D') robust distally with both sharp, slender and short, rounded "teeth". Labium (Fig. 61G) simple, densely and finely setose, without palp. Maxillule (Fig. 61F) with nine distal spines, rows of outer and inner setae on endite, palp not retrieved. Maxilla (Fig. 61F) linguiform, naked. Maxilliped (Fig. 61H) endites characteristic of genus, with denticulate outer margin, two ovate spines and long single inner seta; palp first article with outer-distal seta; second article with two simple setae and one shorter denticulate, reflexed spine, distal rows of microtrichia; third article with three marginal and one submarginal inner, finely denticulate setae; fourth article with five distal finely-denticulate setae and fine inner setules; single distal seta on basis comfortably exceeding distal margin of first palp article but not exceeding distal margin of endites.

Cheliped (Fig. 62A) compact, basis 2.1 times as long as wide, with dorsodistal seta; merus triangular, occupying almost all of ventral margin of carpus, with single mid-ventral seta; carpus 1.75 times as long as wide, with proximal and distal dorsal setae and two longer ventrodistal setae; propodus 1.25 times as long as wide, fixed finger short, half as long as body of propodus ("palm"), with two ventral setae and three setae alongside cutting edge; with lamellate apophyses on cutting edge, terminal spine robust; dactylus with outer margin smooth, two proximal simple setae on cutting edge.

Pereopod 1 (Fig. 62B) longer than others, coxa simple with long seta; basis slender, arcuate, 4.15 times as long as wide, with dorsal seta in proximal third; ischium compact with single seta; merus slender, with single ventrodistal seta; carpus 0.8 times as long as merus, with one longer and two shorter dorsodistal setae; propodus 1.75 times as long as carpus, with two subdistal setae and fine dorsodistal sharp apophysis; dactylus with dorsoproximal seta exceeding tip of dactylus; unguis slender, curved, twice as long as dactylus, both together 1.1 times as long as propodus. Pereopod 2 (Fig. 62C) more compact than pereopod 1, basis 2.9 times as long as wide; merus 0.7 times as long as carpus, merus with two ventrodistal setae; carpus with one dorsodistal seta, and one dorsodistal and two ventrodistal curved, finely denticulate spines; propodus twice as long as carpus, and just longer than dactylus plus unguis. Pereopod 3 (Fig. 62D) similar to pereopod 2.

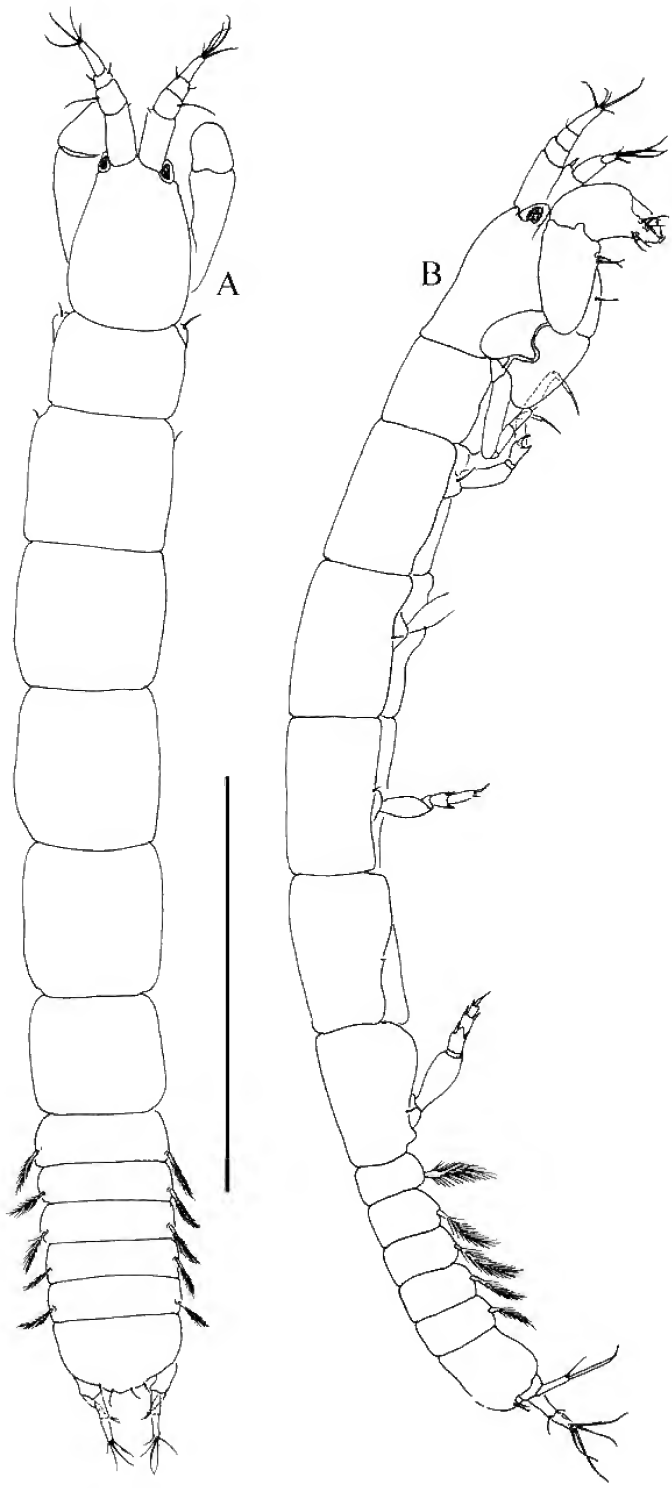


Fig. 60. *Paratanais tanyherpes* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.

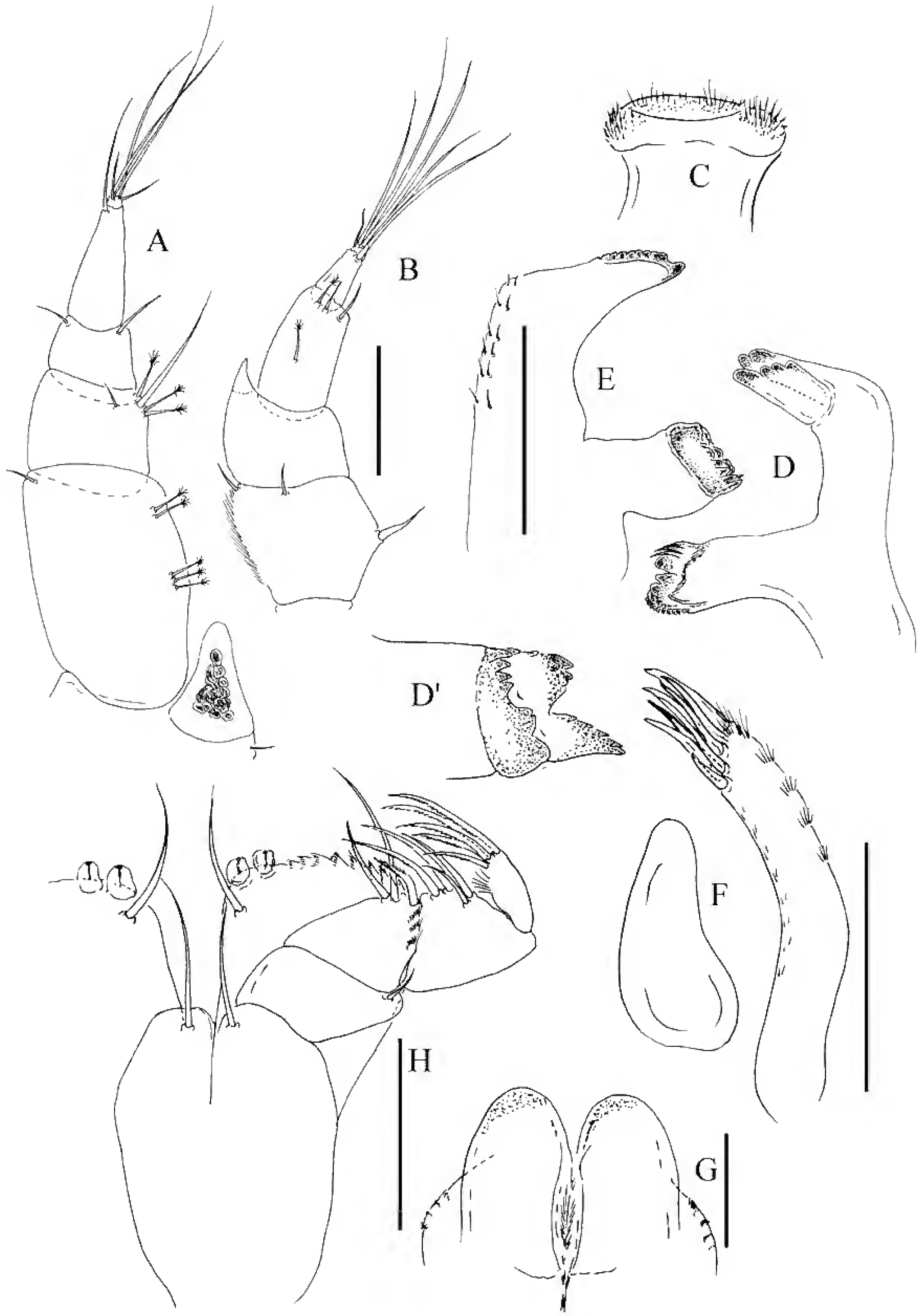


Fig. 61. *Paratanais tanyherpes* sp. nov., female paratype. A, antennule; B, antenna (proximal article not shown); C, labrum; D, left mandible, with D', detail of molar process; E, right mandible; F, maxillule endite and maxilla; G, labium; H, maxilliped. Scale = 0.2 mm.


Fig. 62. *Paratanais tanyherpes* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

Pereopod 4 (Fig. 62E) slightly more robust than anterior pereopods, basis 2.8 times as long as wide with two mid-ventral penicillate setae; merus and carpus subequal in length, each with two ventrodistal curved, finely-denticulate spines, carpus also with two dorsodistal curved, finely-denticulate spines, ventrodistal surface of carpus with rows of microtrichia; propodus 1.4 times as long as carpus, with simple dorsodistal seta, mid-dorsal penicillate seta, two ventrodistal curved, finely-denticulate spines, and row of fine setules along distal margin; dactylus stout, with microtrichia; unguis distinct, curved, with minute ventrodistal denticulation, half length of dactylus, both together 0.6 times as long as propodus. Pereopod 5 (Fig. 62F) as pereopod 4. Pereopod 6 (Fig. 62G) as pereopod 4, but propodus with three dorsodistal serrate spines and no dorsal penicillate seta.

Pleopods (Fig. 62H) all alike, with naked basis, endopod with single inner subdistal plumose seta; exopod without setae on inner margin, proximal seta on outer margin of both rami separated from remaining setae.

Uropod (Fig. 62I) basis naked, exopod of one segment, over half as long as endopod, with one mesial and two unequal distal setae; endopod of one segment, with mesial and distal tufts of penicillate and simple setae; rami slender.

*Male*. Unknown.

*Etymology*. From the Greek *tanaos* – long and *herpes* – a creeping thing, the present species being the most elongate yet known in the genus.

*Remarks*. There are only two described species of *Paratanais* with a single-segmented uropod endopod, viz. *P. intermedius* Dojiri & Sieg, 1997 (q.v.) from 98 to 591 m depth in the Santa Maria Basin, California, and *P. wanga* Bamber, 2008 from 4 to 26 m in Moreton Bay, Queensland. Although the description and figures of *P. intermedius* are poor, it is distinct from *Paratanais tanyherpes* sp. nov. in having a more elongate antenna (peduncle articles 2 and 3 clearly longer than wide), the distal seta on the maxilliped basis not reaching the distal margin of first palp article, the merus of the cheliped covering only some 75% of the ventral margin of the carpus, the merus on pereopod 1 shorter than the carpus, and the uropod rami much less elongate. *P. wanga* is distinct from *P. tanyherpes* in having the second antennal peduncle article 1.4 times as long as wide, and again the uropod rami much less elongate. In many respects, *P. tanyherpes* is very close in morphology to the New Zealand species *P. tara* Bird, 2011, with which it shares the proportions of the antennule, the setation/spination of the antennule, of many details of the maxilliped, but that species differs in having a two-articled uropod endopod (*inter alia*).

*Paratanais tanyherpes* is further distinguished from these three species, and indeed all others in the genus, in being very elongate, the body being nearly nine times as long as wide ("about 6" times in *P. intermedius*; 6.4 times in *P. wanga*; up to 7.5 times in *P. tara*; eight times as long as wide in the previously most-elongate species, *P. martinsi* Bamber & Costa, 2009, q.v.). *P. tanyherpes* was found throughout the Bass Strait, including in Western Port and Port Phillip Bay, at depths between 0 to 81 m.

***Paratanais vetinari*** Bamber, 2005

Figures 63–64

*Paratanais vetinari* Bamber, 2005, 712–716, figs 51–52.

*Material examined*. 1 ♂ (J58466), 5 ♀♀ (J56735), Stn 190, 81-T-1, Western Bass Strait, 50 km SSW of Warrnambool, Victoria, 38°49.5'S 142°35.4'E, 89 m depth, coarse sand, 21 November 1981, coll. R.S. Wilson. 1 ♀ (J56666), Stn WV5, Cheviot Beach, Point Nepean, Victoria, 38°18'S 144°40'E, 3.5 to 5 m depth, 31 March 1998, SCUBA, coll. T,D. O'Hara. 1 ♀ (J56663), Stn BUN4, East of Eagles Nest, Victoria, 38°40.46'S 145°39.14'E, 5 to 11 m depth, 01 April 1997, SCUBA, coll. coll. T,D. O'Hara *et al*.. 1 ♀ (J46369), Stn WV2, Schomberg Reef, near Peterborough, Victoria, 38°36.49'S 142°53.19'E, 3.5 to 5 m depth, 19 May 1998, SCUBA, coll. T,D. O'Hara. 3 ♀♀ (J51620), Stn VC 08 C1, Western Bass Strait, 38°14.36'S 142°10.11'E, 40 m depth, 14 May 1998, Smith-McIntyre Grab, coll. N. Coleman. 1 ♀ (J46370), Stn CRUST 21, "The Whaleback", bommie 0.5 km S of Point Hicks, 37°48.30'S 149°16.48'E, 13 m depth, 08 April 1989, SCUBA, coll. G.C.B. Poore. 1 ♀ (J56665), 1 ♀ (J56662), Stn WV13, Sailor's Grave, off East Cape Conran, Victoria, 37°48.13'S 148°44.41'E, 4 to 5 m depth, 15 April 1998, SCUBA, coll. T,D. O'Hara. 1 ♀ (J56664), Stn WV8, Nepean Bay, Point Nepean, Victoria, 38°18.24'S 144°39.28'E, 5 to 6 m depth, 08 April 1998, SCUBA, coll. T.D. O'Hara. Numerous other lots in the collections of Museum Victoria.

*Paratanais vetinari* was described initially from Esperance, southern Western Australia, based on four females. The present females seem to agree with the type-description; the presence of the male in the Bass Strait material allows its first description.

*Description of male*. Body (Fig. 63A, B) smaller and more compact than that of female, 1.8 mm long, 5 times as long as wide. Cephalothorax narrow in anterior half, 1.15 times as long as wide, longer than pereonites 1, 2 and 3 together, with conspicuous triangular rostrum; eyes present, large, pigmented. Six free dorsoventrally-flattened pereonites; pereonite 1 shortest, pereonites 2 just longer than pereonite 1, both short and with single anterolateral seta on each side; pereonites 3 to 6 subequal in length (all pereonites respectively 4.4, 3.7, 2.4, 2.4, 2.2 and 2.1 times as wide as long). Pleon laterally convex, with five free subequal pleonites bearing pleopods; pleonites 4.6 times as wide as long. Pleotelson semicircular, short, les than twice as long as pleonite 5, 2.2 times as wide as long.

Antennule (Fig. 63C) peduncle of three articles, proximal article twice as long as wide, second article 0.6 times as long as wide, about one-third length of first, with inner simple seta longer than article width; third article half length of second with inner and outer distal setae; flagellum of seven segments, segments progressively longer distally, segments 1 to 6 with subdistal rows of 8 or 9 aesthetascs, distal segment with one penicillate and four simple distal setae.

Antenna (Fig. 63D) of six articles, proximal article compact, naked; second article shorter than wide with single simple distal and mesial setae; third article as long as wide, about half as long as second article, naked; fourth article 1.25 times as long as second; fifth article longer than fourth, slender, tapering; sixth article minute with five distal setae.

Mouthparts largely atrophied; maxilla (Fig. 63F) subtriangular, naked; maxilliped (Fig. 63E) endites narrow, with single distal seta, basis with long distal seta, palp with

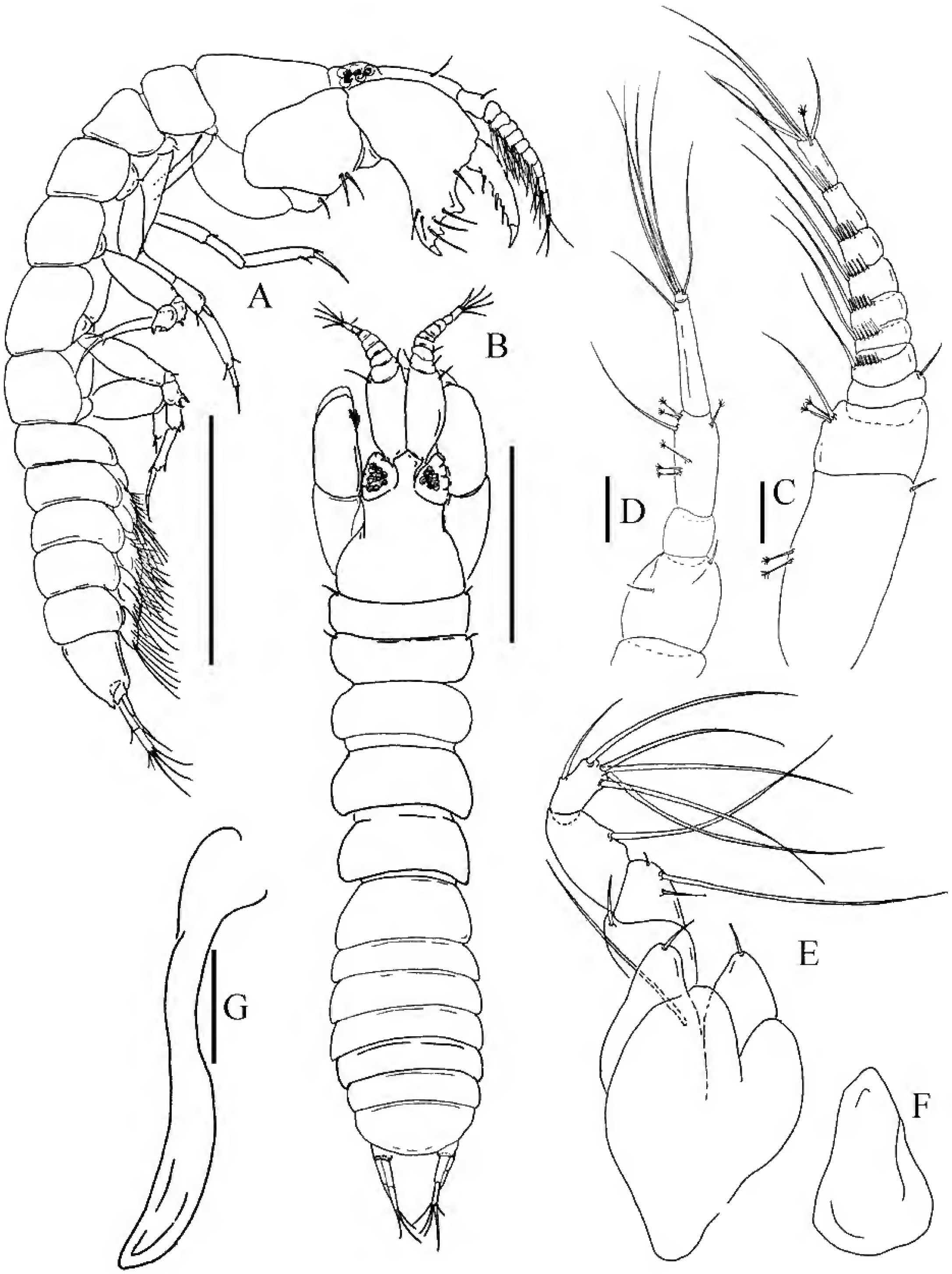


Fig. 63. *Paratanais vetinari*, male. A, lateral view; B, dorsal view; C, antennule; D, antenna; E, maxilliped; F, maxilla; G, epignath. Scale A-B = 0.5 mm; C-G = 0.1 mm.

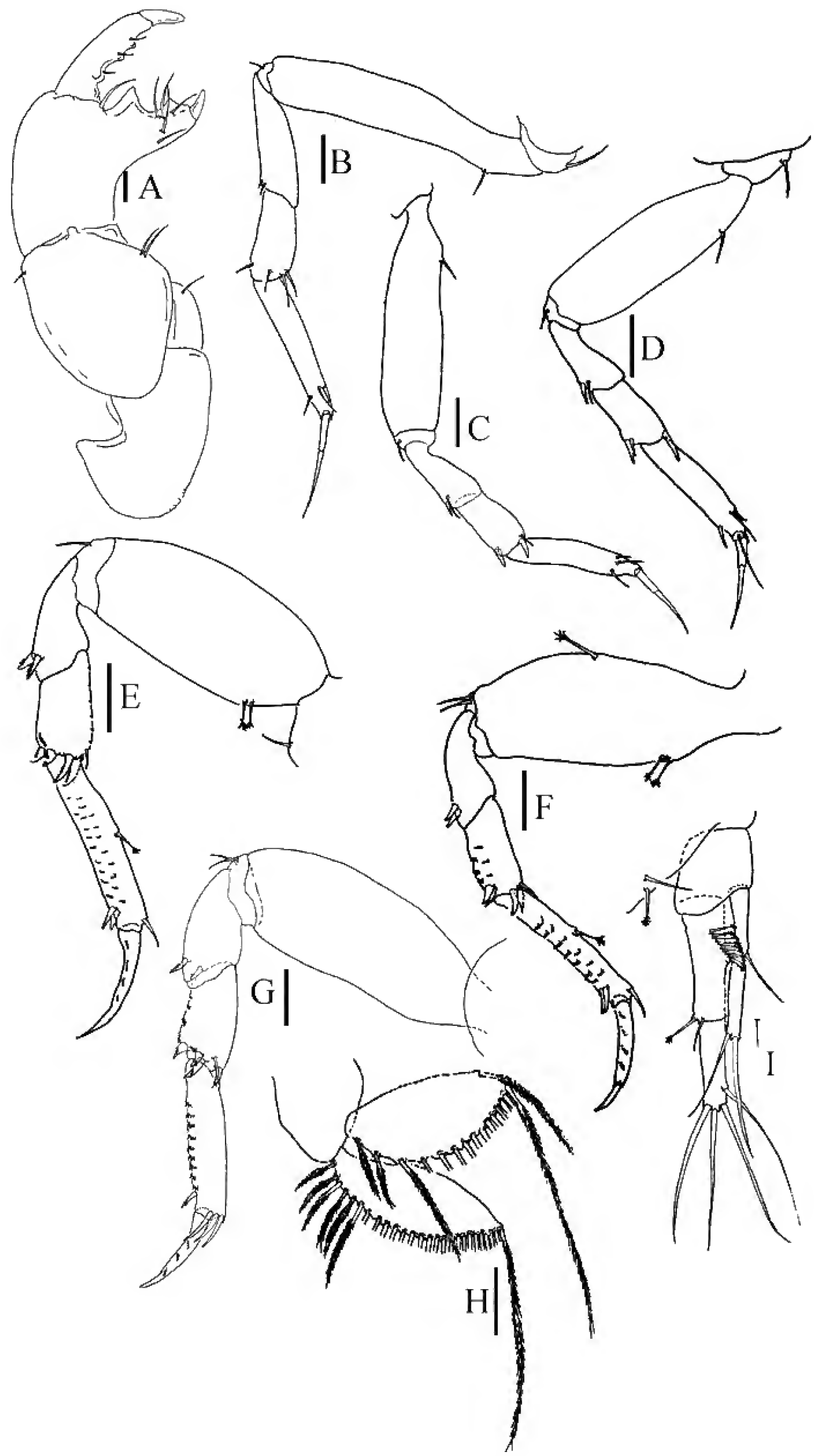


Fig. 64. *Paratanais vetinari*, male. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

simple setae much longer than those of female; epignath (Fig. 63G) narrow, linguiform.

Cheliped (Fig. 64A) similar to that of female, merus shorter, carpus 1.3 times as long as wide; propodus proportionately longer, fixed finger with triangular tooth-like apophysis proximally on cutting edge; dactylus with three simple setae on cutting edge.

Pereopods 1 to 3 (Fig. 64B, C, D) similar to those of female, merus of pereopod 1 1.3 times as long as carpus, distal spines on carpi of pereopods 2 and 3 simple and more slender.

Pereopods 4 to 6 (Fig. 64E, F, G) proximally similar to those of female, but propodus 6 times as long as wide with dense ventral fields of microtrichia, dactylus and unguis two-thirds as long as propodus, articulation between the two indistinct, dactylus with fields of microtrichia.

Pleopods (Fig. 64H) all alike, similar to those of female but setae proportionately longer.

Uropod (Fig. 64I) similar to but more elongate than that of female, distal exopod segment longer than proximal segment; proximal endopod segment with inner array of penicillate setae.

*Remarks*. Of the seven previously-described species of *Paratanais* from Australasia (including *P. tanyherpes* above), only *P. vetinari* and *P. maleficus* Larsen, 2001 have a two-segmented uropod exopod. Females of these two are most easily distinguished by the uropod segments being more than twice as long as wide in *P. vetinari*, but less than 1.5 times as long as wide in *P. maleficus*. Most features of the appendages of the male of *P. maleficus* as described and figured by Larsen (2001) are different from those shown here. Another characteristic feature of the present species is the subdistal ventral seta on the propodus of pereopods 2 and 3 being longer than the dactylus (shorter in *P. maleficus*). The only other species described with a two-segmented uropod exopod is *P. hessleri* Kudinova-Pasternak, 1985 (q.v.), but, despite the relatively poor description, that species has the subdistal ventral propodus seta on pereopods 2 and 3 shorter than the dactylus, and it clearly has a more elongate body, antennules and antennae, *inter alia*.

The type-collection of *Paratanais vetinari* was from 20 to 30 m depth on gravelly sand with rhodoliths and sparse macroalgae. In the Bass Strait, this species was collected from between 3.5 and 89 m depth on sandy substrata, including sympatrically with *P. malignus*.

Subfamily **Bathytanaidinae** Larsen & Heard, 2001

Genus ***Bathytanais*** Beddard, 1886

***Bathytanais bathybrotes*** (Beddard, 1886)

Figures 65–67

*Paratanais bathybrotes* Beddard, 1886(a), 119 – *Bathytanais bathybrotes* Bamber, 2008, 175–176, literature.

*Material examined*. 12 specimens (including 2 brooding ♀♀) (J56271), 1 ♂ (J56272), from sand wall at front of Pope's Eye, Port Philip Bay, 7 m depth, 28 February 1982, coll. R Lipson.

The female of this species was comprehensively redescribed by Lang (1972); however, the male was previously unknown – indeed, no male of any *Bathytanais* species has been recorded before, making the following description particularly important.

*Description of male*. Body (Fig. 65A, B) with typical gross appearance of a *Paratanais* male, 2.1 mm long, 5.3 times as long as wide. Cephalothorax subrectangular, as long as wide, as long as pereonites 1 to 3 together, with conspicuous subtriangular rostrum; eyes large, one-third as long as cephalothorax, with black ommatidia. Pereonite 1 shortest, pereonites 2, and 3 subequal in length, 1.4 times as long as pereonite 1, pereonites 4 and 5 subequal, 1.8 times as long as pereonite 1, pereonite 6 just shorter than pereonite 5 (all pereonites respectively 3.6, 2.7, 2.8, 2, 2 and 2.3 times as wide as long). Pleon of five free subequal pleonites bearing pleopods, ventrally with blunt keel; pleonites 2.7 times as wide as long and 1.2 times as long as pereonite 1. Pleotelson (Fig. 47K) semicircular, as long as pereonite 6, 1.5 times as wide as long.

Antennule (Fig. 66A) of three peduncular and four flagellar articles, proximal peduncle article 1.9 times as long as wide, with outer mesial tufts of penicillate setae, inner distal simple seta; second article just shorter than wide, 0.4 times as long as first article, with outer-distal tuft of penicillate setae; third article one-third length of second, with two simple distal setae; first flagellar article half as long as third peduncle article, with proximal and distal rows of six or seven aesthetascs and outer-distal simple seta; second and third flagellar articles subequal in length, four times as long as first, with distal rows of six aesthetascs; fourth flagellar article just shorter than third, distally with four simple setae, one penicillate seta and one aesthetasc.

Antenna (Fig. 66B) of six articles, proximal article compact, naked; second article with ventrodistal tuft of three penicillate setae and one ventrodistal and one dorsodistal simple setae; third article as long as wide, 0.6 times as long as second article, with dorsodistal seta; fourth article twice as long as third, with one mid-dorsal and three dorsodistal penicillate setae, single dorsal and ventral subdistal simple setae; fifth article 0.9 times as long as fourth with one dorsal subdistal seta; sixth article minute with five simple and one penicillate distal setae.

Mouth parts underdeveloped in comparison with those of female. Labrum (Fig. 66C) apically rounded, naked. Mandibles absent. Maxillule (Fig. 66D) with naked endite and simple palp bearing distal setule; maxilla (Fig. 66D) ovoid, naked. Maxilliped (Fig. 66E) endites relatively wide, with two minute ovate tubercles and single inner seta; palp first article with outer-distal seta; second article with three inner-distal simple setae; third article with three inner setae in proximal half; fourth article with five inner to distal setae and one outer subdistal seta; single inner seta on basis not reaching distal margin of endites.

Cheliped (Fig. 66F) compact, basis twice as long as wide, naked; merus subtriangular, ventrally convex, with one mid-ventral seta; carpus 1.3 times as long as wide with two mid-ventral setae, one dorsoproximal and one dorsodistal fine setae; propodus as long as wide, with inner comb-row of 12 setae; fixed finger just shorter than palm, with two ventral setae, three setae adjacent to cutting edge; dactylus with dorsoproximal seta, two proximal setae on cutting edge.

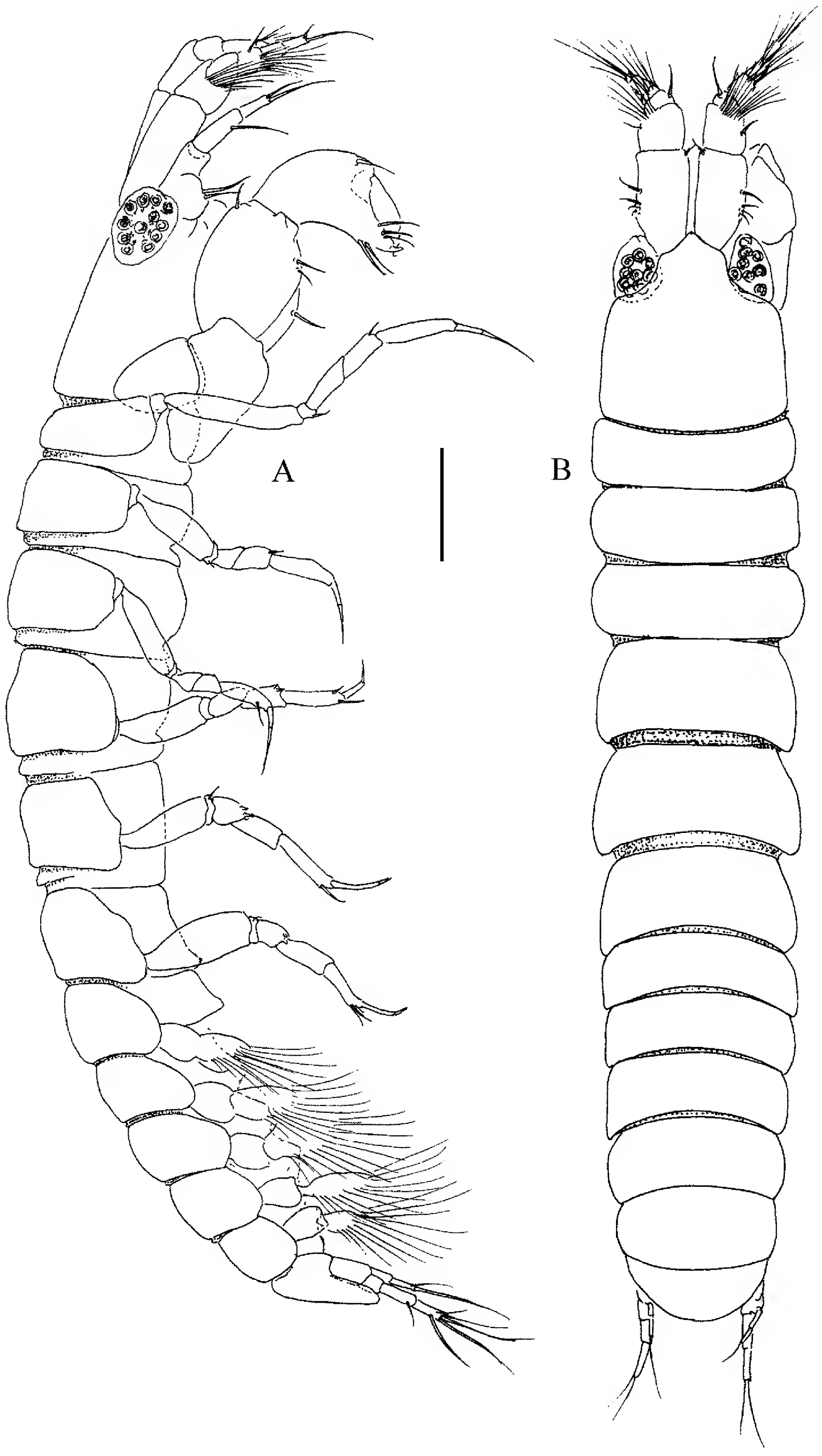


Fig. 65. *Bathytanais bathybrotes*, male. A, lateral; B, dorsal. Scale = 0.2 mm.

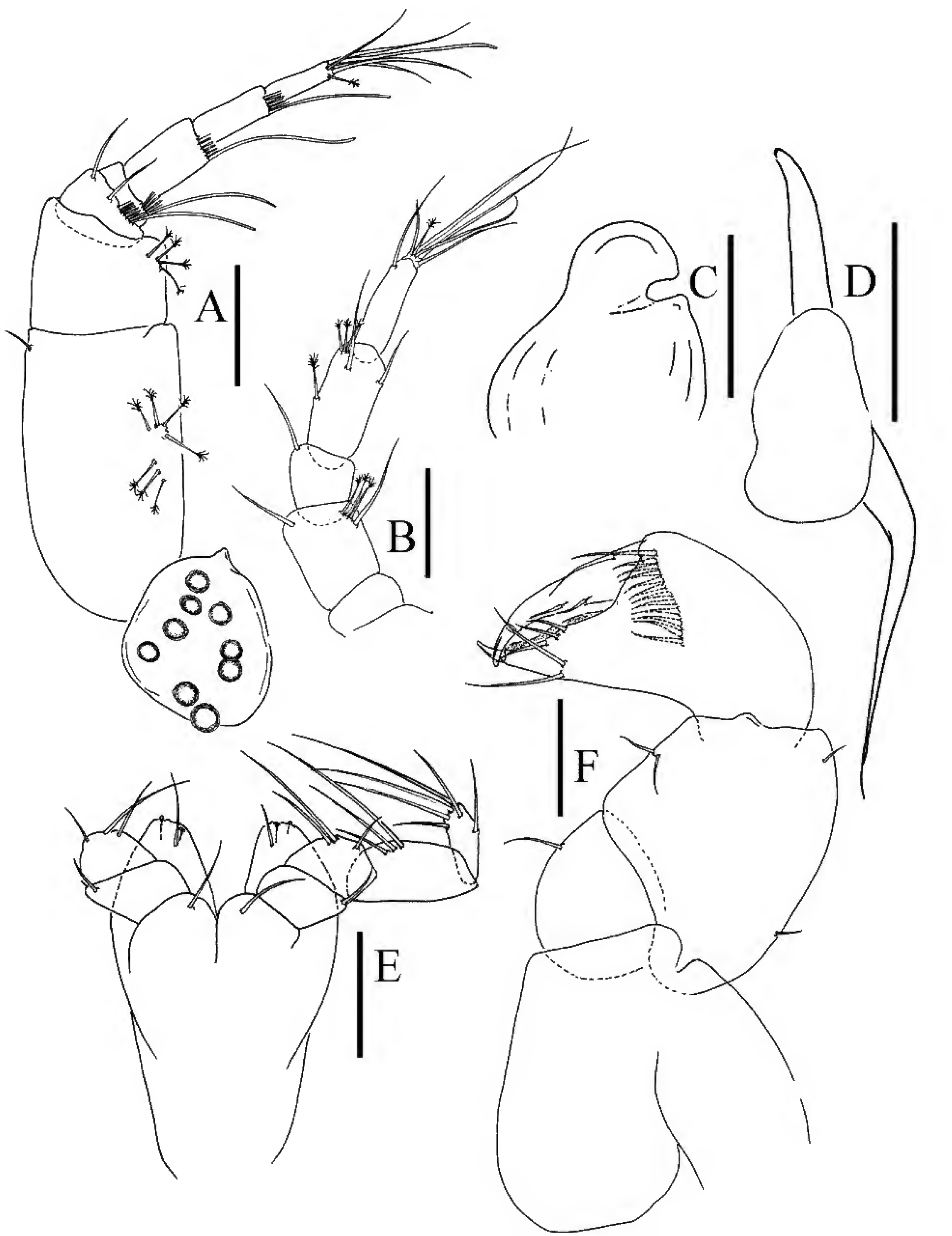


Fig. 66. *Bathytanais bathybrotes*, male. A, antennule; B, antenna; C, labrum; D, maxillule and maxilla; E, maxilliped; F, cheliped. Scale = 0.1 mm.

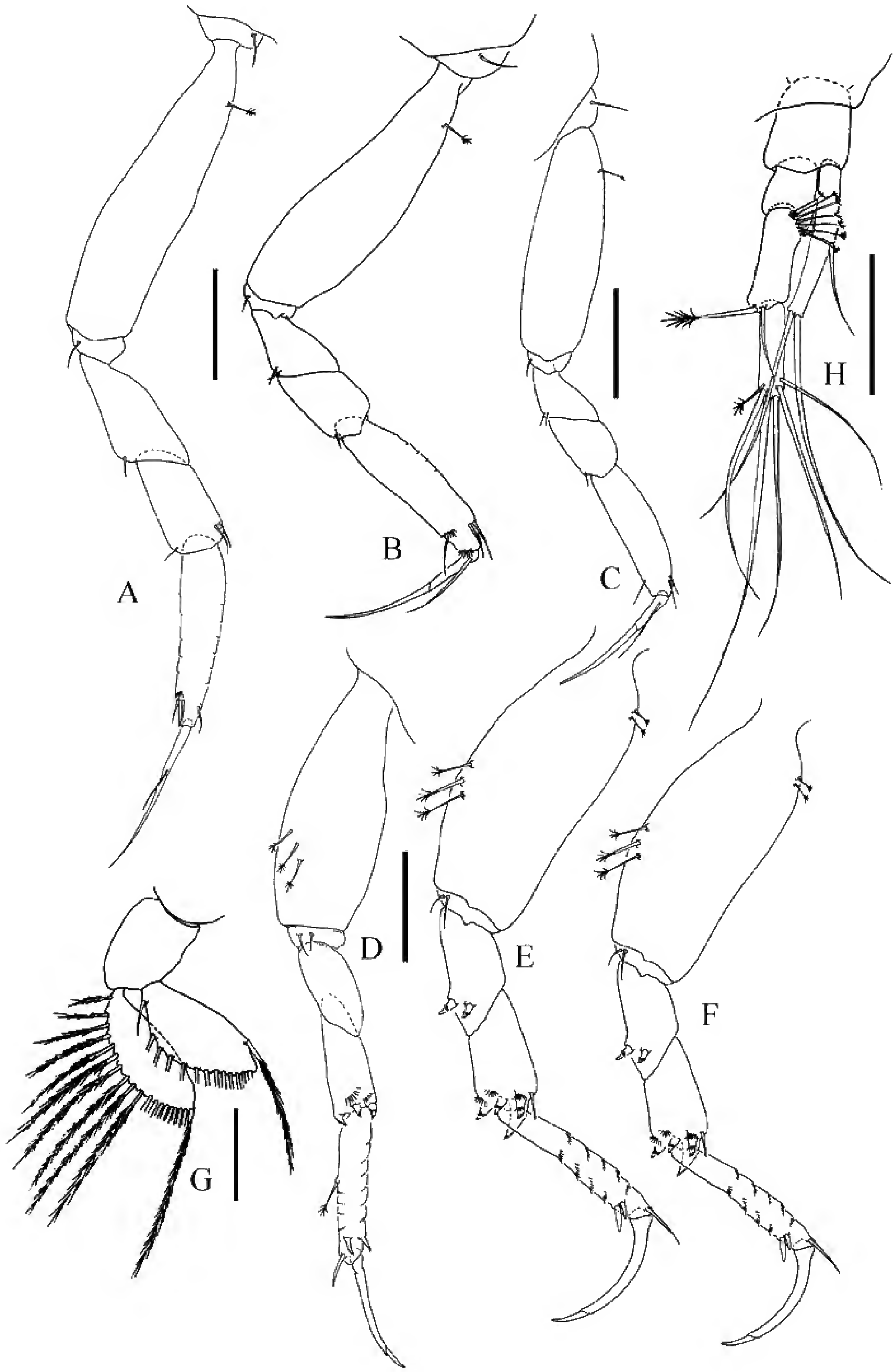


Fig. 67. *Bathytanais bathybrotes*, male. A, pereopod 1; B, pereopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

Pereopod 1 (Fig. 67A) longer than others, coxa simple with seta; basis slender, 4.25 times as long as wide with dorsoproximal penicillate seta; ischium compact with single seta; merus one-third as long as basis, with fine ventrodistal seta; carpus 0.9 times as long as merus, with fine ventrodistal seta and two dorsodistal setae; propodus 1.8 times as long as carpus, with one dorsal and two ventral subdistal setae, and dorsal and ventral marginal microtrichia; dactylus half as long as slender unguis and with distal seta, dactylus and unguis together 0.9 times as long as propodus. Pereopod 2 (Fig. 67B) similar to pereopod 1, but more compact, basis 3.4 times as long as wide; merus and carpus equal in length, carpus without dorsodistal setae; propodus with two dorsal and one ventral subdistal setae, dactylus with proximal seta. Pereopod 3 (Fig. 67C) similar to pereopod 2.

Pereopod 4 (Fig. 67D) basis stout, 2.6 times as long as wide, with three ventral subdistal penicillate setae; ischium with two ventral setae; merus one-third as long as basis, naked; carpus as long as merus, with two ventrodistal and one dorsodistal tooth-like spines; propodus 1.7 times as long as carpus with dorsodistal seta, two ventrodistal spines, mid-distal penicillate seta and marginal rows of penicillate setae; dactylus long and slender, four times as long as distinct unguis, both together 0.8 times as long as propodus. Pereopod 5 (Fig. 67E) similar to pereopod 4, but basis with dorsoproximal pair of penicillate setae, merus with two ventrodistal tooth-like spines, carpus with additional larger outer distal spine and dorsodistal seta, dactylus and unguis distinctly more curved. Pereopod 6 (Fig. 67F) as pereopod 5.

Pleopods (Fig. 67G) all alike, with naked basis, rami subequal; endopod with inner subdistal plumose seta and 13 plumose setae around outer margin; exopod without setae on inner margin, 19 plumose setae around outer margin.

Uropod (Fig. 67H) basis naked; exopod of two subequal segments, together more than half as long as endopod, first segment with simple outer-distal seta, second segment with two unequal distal simple setae; endopod of three segments, proximal segment short, naked, second segment twice as long as first, with proximal array of seven penicillate setae, distally with one simple and one penicillate setae; third segment as long as second, distally with five simple and one penicillate setae.

*Remarks*. The history of this species was discussed by Bamber (2008), from which we may disregard the type-locality as being a *lapsus calami*. *Bathytanais bathybrotes* was previously known from New South Wales at depths of 6 to 50 m depth (Beddard, 1886b; Lang, 1972) and from Moreton Bay, Queensland at depths between 8 and 42 m (Bamber, 2008) on clean sand. The present material extends its distribution further west to Victoria.

The *Bathytanais* male is very similar to males of *Paratanais* species, and does not show the expanded antenna peduncle articles of the females, but appears to differ in the presence of a proximal seta on the dactyli of pereopods 2 and 3. Discovery of the males of other species is necessary to confirm this as a generic character.

### *Bathytanais fragilis* Larsen & Heard, 2001

*Bathytanais fragilis* Larsen & Heard, 2001, 13–16, figs 5–7 (partim: deeper-water specimens only).

*Material examined*. 1 ♀ (J37854), holotype, Slope 21, 36°57.40'S 150°18.80'E, 220 m depth, muddy shell, 20 July 1986. 3 ♀♀ (J58583), paratypes ("other material" in Larsen & Heard, 2001), same data as holotype. 1 ♀ (J39282), idiotype, Slope 32, 38°21.90'S 149°20.00'E, 1000 m depth, fine mud, 23 July 1986. All coll. G.C. Poore *et al.*, WHOI suprabenthic sled, R.V. *Franklin*.

*Remarks*. In the light of other *Bathytanais* material found in the collections, the type-material of *B. fragilis* was re-examined, and some specimens (from shallower samples) were separated as belonging to a distinct species, described below. Significantly, we were able to confirm the shape and, in particular, the transparency of the ventral expansion on the second article of the antenna peduncle in *B. fragilis*, as well as other features of its morphology.

*Bathytanais fragilis* is recorded from the Eastern Bass Strait, from depths between 200 and 1000 m, mainly on muddy substrata.

### *Bathytanais parageios* sp. nov.

Figures 68–70

*Bathytanais fragilis* Larsen & Heard, 2001 partim (shallow-water specimens only).

*Material examined*. 1 ♀ (J58584), holotype, MAFRI-H28 GI, Long Island Hastings, 38°19'S 145°14'E, 17 m depth, 4 March 1997; 6 ♀♀ (J66538), paratypes, MAFRI-H27 G4, Crib Point, 38°21'S 145°14'E, 12 m depth, 4 March 1997; 4 ♀♀ (J66579), paratypes, MAFRI-H28 GI, Long Island Hastings, 38°19'S 145°14'E, 17 m depth, 4 March 1997; all coll. DPI Victoria, Smith McIntyre grab. 1 ♀ (J56781), paratype, WBES stn 1723, Western Port, 38°17.07'S 145°14.86'E, 14 m depth, sand, 22 November 1973, coll. Marine Studies group, Smith McIntyre grab. 3 ♀♀ (J51621), paratypes, VC-34-C1, 38°32.42'S 146°29.68'E, 40 m depth, fine mud, 11 May 1998, coll. N Coleman, Smith McIntyre grab. 22 specimens (incl. 1 brooding ♀), MSL-EG 70, 37°53.39'S 148°15.40'E, 43 m, coarse sand, 4 June 1991, coll. N Coleman, Smith McIntyre grab (cited as paratypes of *B. fragilis* under a different registration no. in Larsen & Heard, 2001). 1 ♀ (J58465), paratype (dissected and figured), CR 81-T-1 stn 155, 38°55.5'S 145°17.0'E, 70 m depth, fine sand, 12 November 1981, coll. R.S. Wilson, Smith McIntyre grab. 1 ♀ (J55908), paratype, CPBS 31N/3, Crib Point, 38°20.94'S 145°13.62'E, 15 m depth, fine sand and mud, 29 March 1965, coll. Marine Studies group, Smith McIntyre grab. 2 ♀♀ (J56676), paratype, CPBS 31N/4, same data as previous. 3 ♀♀ (J23557), paratypes, MSL-EG 58, Eastern Bass Strait, 37°51.19'S 148°38.53'E, 51 m depth, mud and shell, 29 September 1990, coll. Marine Studies group, Smith McIntyre grab, RV *Sarda*. 1 ♀ (J17283) and 1 ♀ (J17281), paratypes, MSL-EG 16, Eastern Bass Strait, 38°04'S 148°25.7'E, 28 m depth, sand and shell, 12 August 1989, coll. G Parry, Smith McIntyre grab, RV *Sarda*.

*Description of female*. Body (Fig. 68) elongate, holotype 3.8 mm long, eight times as long as wide. Cephalothorax subrectangular, as long as wide, shorter than pereonites 1 and 2 together, with rounded triangular rostrum, naked; eyes present, pigmented. Pereonites cylindrical; pereonite 1 shortest, half length of cephalothorax; pereonite 2 longer, 0.75 times as long as cephalothorax; pereonite 3 longest, as long as cephalothorax; pereonites 4 and 5 subequal, longer than pereonite 2, pereonite 6 just shorter than pereonite 2 (all pereonites respectively 1.9, 1.1, 0.8, 1.0, 0.9 and 1.1 times as wide as long). Pleon of five free subequal pleonites bearing

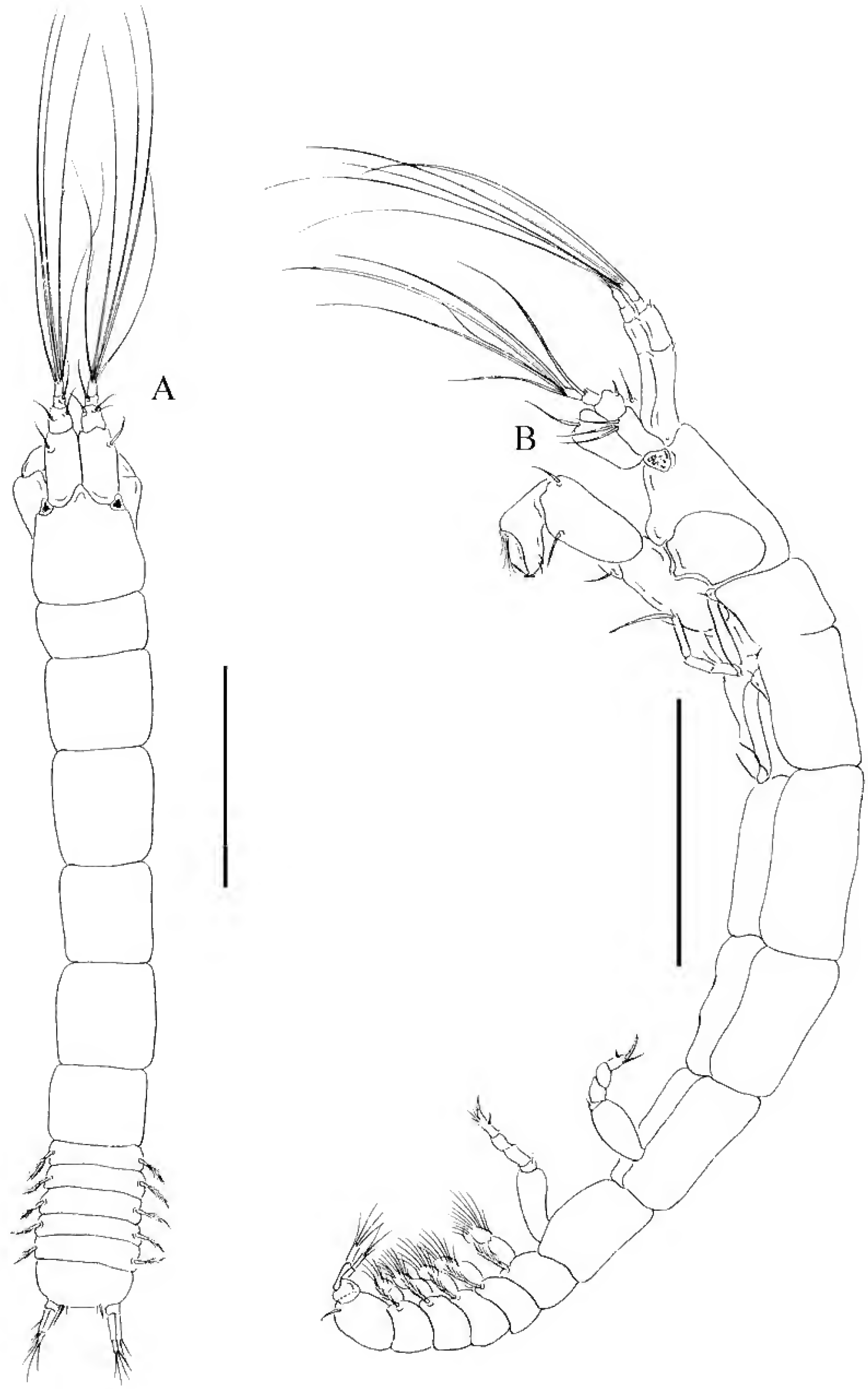


Fig. 68. *Bathytanais parageios* sp. nov., holotype female. A, dorsal view; B, lateral view. Scale = 0.1 mm.

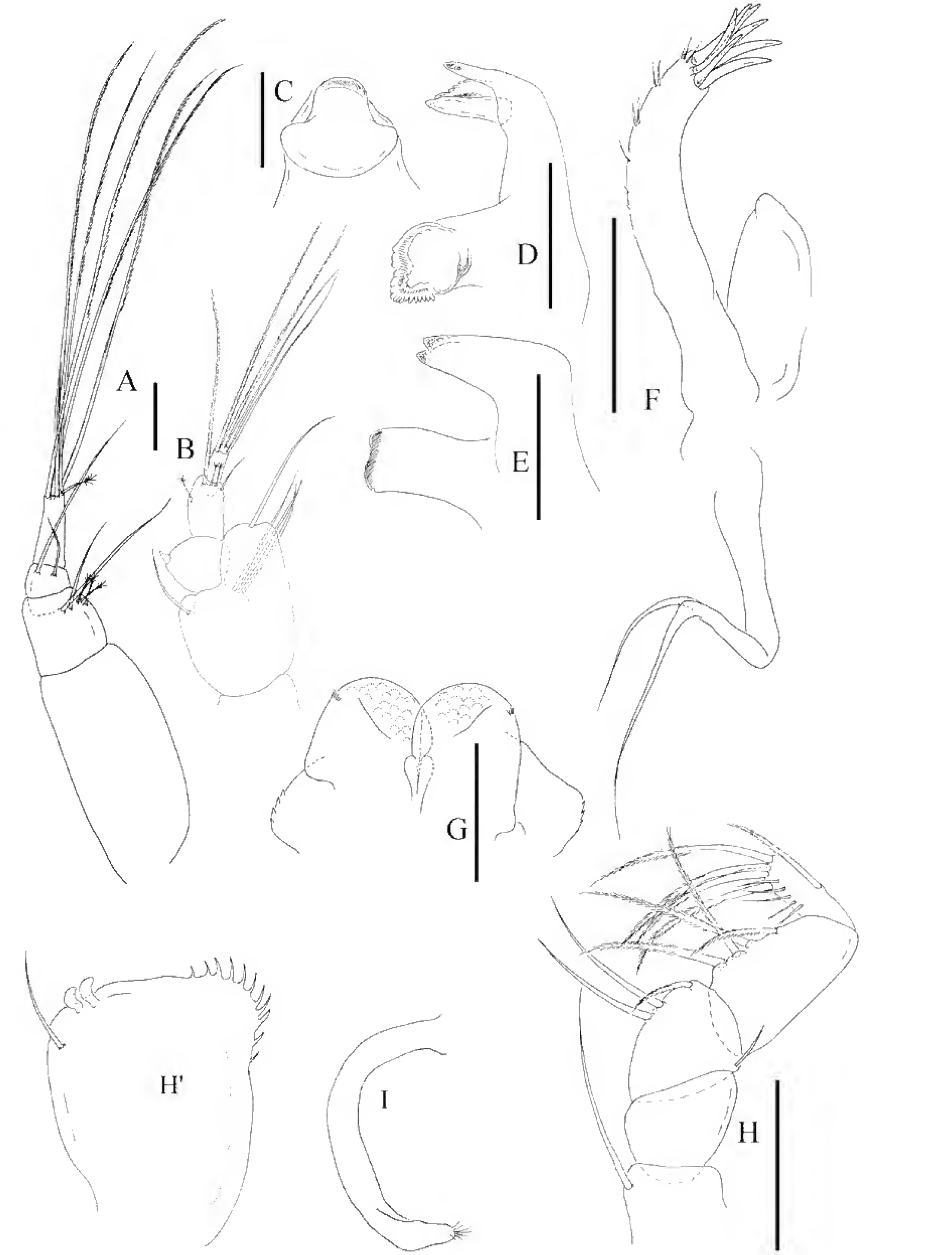


Fig. 69. *Bathytanais parageios* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule and maxilla G, maxilliped; G', maxilliped endite. Scale A-C = 0.1 mm; D-H= 0.01 mm.

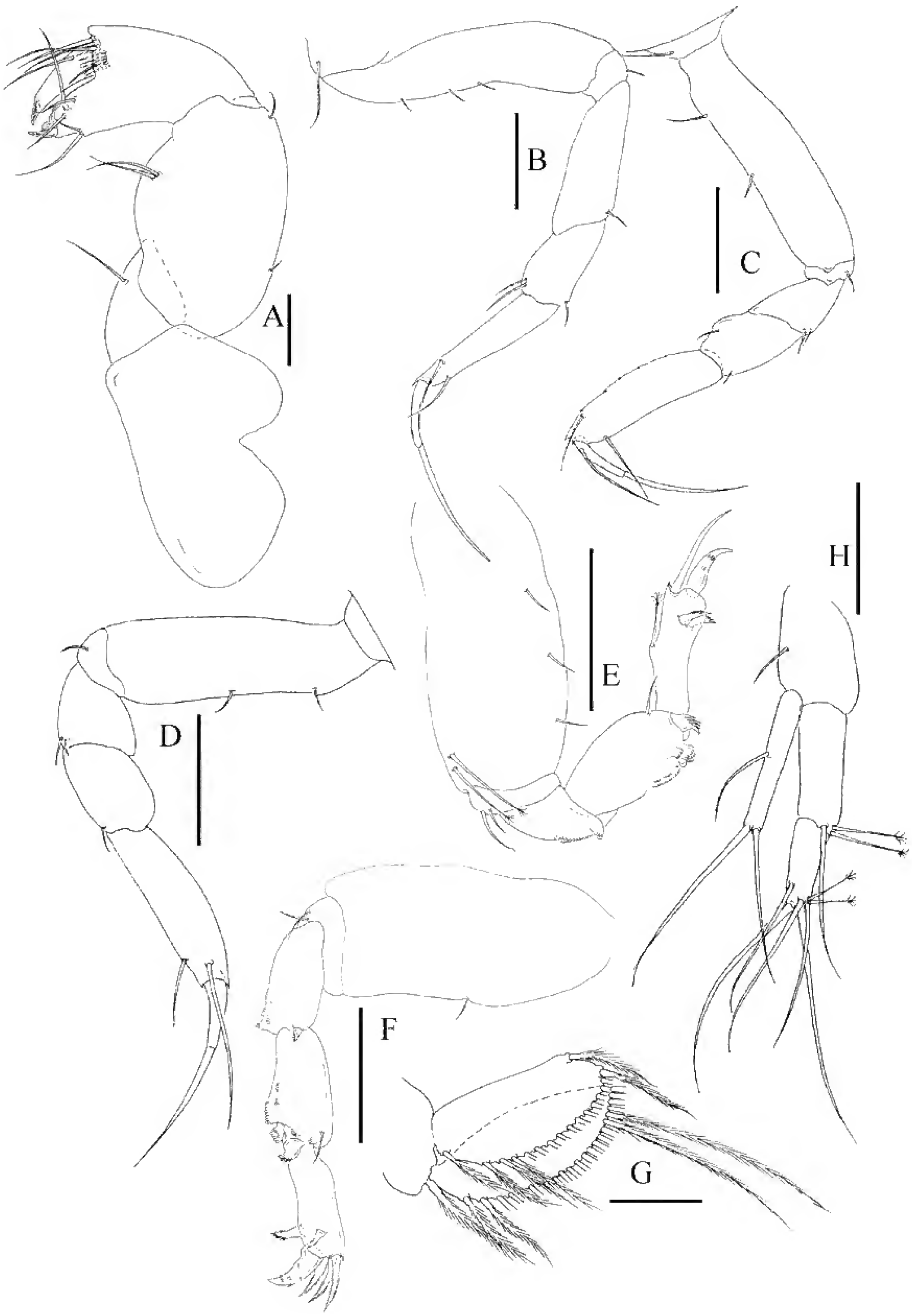


Fig. 70. *Bathytanais parageios* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

pleopods plus pleotelson, the whole shorter than pereonites 5 and 6 together; pleonites 5 times as wide as long; each pleonite with one plumose, articulating lateral seta on each side. Pleotelson semicircular, short, 1.6 times as long as pleonite 5, twice as wide as long, distally with two posterolateral simple setae on each side.

Antennule (Fig. 69A) of four articles, proximal article twice as long as wide, naked; second article as long as wide, about one-third length of first, distally with two simple and three penicillate setae; third article two-thirds length of second with two simple distal setae; fourth article slender, as long as second article, with five setulose distal setae, longest three longer than cephalothorax and antennule together, but without aesthetasc (possibly a generic character: G Bird, pers. comm.).

Antenna (Fig. 69B) of six articles, proximal article compact, naked; second article dorsally with slight flange-like expansion bearing single simple distal seta, ventral margin with three distal setae and laminar apophysis (flange) exceeding distal edge of third peduncle article, distally rounded, not transparent, with long mid-distal seta; third article just shorter than wide, half as long as second article, expanded mid-dorsally with mid-distal spine; fourth article half as long as second, distally with one simple seta, two penicillate setae and long dorsal setulose seta 3.5 times as long as article; fifth article half as long as fourth with two long setulose distal setae; sixth article minute with two long setulose distal setae.

Labrum (Fig. 69C) apically rounded, setose. Left mandible (Fig. 69D) with wide, curved, crenulate lacinia mobilis, right mandible (Fig. 69E) without lacinia mobilis; pars incisiva bilobate, pars molaris robust, distally flat with marginal rugosity extended as short, rounded "teeth" ventrally. Labium (Fig. 47G) rounded, finely setose with microtrichia on inner face, outer margins finely denticulate. Maxillule (Fig. 69F) with seven distal spines and sparse outer setules, palp slender with two distal setae. Maxilla (Fig. 69F) oval, naked. Maxilliped (Fig. 69H) with single inner spine on basis reaching distal margin of second palp article; palp first article naked, second article with two simple setae and shorter denticulate seta on inner margin, outer margin with one simple seta; third article with three denticulate setae on inner margin; fourth article with five submarginal simple ventral setae, four distal denticulate setae and one mid-dorsal denticulate seta; endites (Fig. 69H') characteristic of genus, wider than maxilliped bases, with denticulate outer corner, two elongate ovate spines and single inner slender spine. Epignath (Fig. 69I) slender, curved, distally setose.

Cheliped (Fig. 70A) basis 1.8 times as long as wide, naked; merus with one mid-ventral seta; carpus 1.6 times as long as wide, ventral margin convex with two mid-ventral setae, dorsally with proximal and distal simple setae; propodus longer than wide, distally with comb of five shorter setae on inner face and three longer setulose setae, fixed finger short with lamellate apophyses on cutting edge, one longer and one shorter ventral setae, one longer and two shorter simple setae distally below cutting edge; dactylus with outer margin smooth and bearing one setulose seta.

Pereopod 1 (Fig. 70B) longer than others, coxa simple with seta; basis slender, arcuate, 4.4 times as long as wide with three dorsal setae in proximal half; ischium compact with single seta; merus just over half length of basis, with ventrodistal seta; carpus 0.6 times as long as merus with one ventrodistal and two dorsodistal setae; propodus as long as merus, with two distal setae; dactylus curved, half as long as propodus, unguis slender, twice as long as dactylus. Pereopod 2 (Fig. 70C) more compact, basis 4 times as long as wide; merus 0.8 times as long as basis, with two ventrodistal setae; carpus 1.3 times as long as merus, with slight dorsal expansion and single dorsal and ventral distal setae; propodus twice as long as carpus, with two distal setae; dactylus with long dorsoproximal seta, one-third length of propodus and half length of slender, curved unguis. Pereopod 3 (Fig. 70D) similar to pereopod 2, but dactylus without dorsal seta.

Pereopod 4 (Fig. 70E) coxa not evident; basis stouter, 2.3 times as long as wide, with three simple dorsal setae and two ventrodistal penicillate setae; ischium with two ventrodistal setae; merus half as long as carpus, each with ventrodistal microtrichia and rugosity and molar spines, carpus with dorsodistal seta; propodus as long as carpus, with mid-dorsal penicillate seta, dorsodistal spine exceeding claw, inner and outer ventrodistal molar spines; dactylus and claw fused into unguis, curved, bearing microtrichia, half as long as propodus. Pereopod 5 (not figured) as pereopod 4 but without dorsal penicillate seta on propodus. Pereopod 6 (Fig. 70F) similar to pereopod 4, but basis without penicillate setae, merus with triangular dorsodistal spine, propodus with three distal serrate spines adjacent to unguis.

Pleopods (Fig. 70G) all alike, with naked basis; endopod shorter than exopod, with single inner-subdistal plumose seta, exopod without setae on inner margin; outer margins of endopod and exopod with 16 and 23 plumose setae respectively, on both rami proximal seta on outer margin separated from remaining setae.

Uropod (Fig. 70H) basis with one outer simple seta. Rami slender, exopod of one segment exceeding proximal segment of endopod, with one mesial and two distal simple setae, endopod of two segments, proximal segment with two penicillate and one simple distal setae, distal segment with two penicillate and five simple distal setae.

*Male*. Unknown.

*Etymology*. From the Greek *parageios* – pertaining to shallow water.

*Remarks. Bathytanais parageios* sp. nov. is close in morphology and locality to *B. fragilis*, but there are consistent differences. *B. fragilis* is characterized, *inter alia*, by the expansion on the second peduncle article of the antenna being transparent (confirmed in the examination of the types, see above), and somewhat wider proximally than distally, with two medial setae and no dorsal seta on the article; in the present species, this article has a slight dorsal expansion with a seta, and the ventral expansion is of uniform width throughout, with three medial setae, and quite opaque. The second peduncle article is also subtly different, that of *B. fragilis* having a forward-pointing spine-like apophysis bearing a seta, while that of *B. parageios* has a stout spine. Further, the third article of the antennule of *B. fragilis* has a seta some five times as long as the fourth antennular article, this seta being less than twice as long in *B. parageios*.

While these differences are sufficiently subtle to suggest variability with depth in one species, other notable differences are found in the uropod segmentation, *B. fragilis* having a one-segmented endopod some three times as long as wide, while that of *B. parageios* is two-segmented, and conspicuously more slender (as is the exopod) at five times as long as wide. Further differences are found in the spination of the posterior pereopods (especially pereopod 6), the setation of the maxilliped basis and endite, the proportionately shorter second and third articles of the antennular peduncle, the proportionately shorter fifth article of the peduncle of the antenna (half as long as the fourth in *B. parageios*, subequal in length in *B. fragilis*), and the more numerous plumose setae on the rami of the pleopods, and the more gracile posterior pereopods in *B. parageios*. No variation between these morphologies was observed within the material examined.

These two taxa are thus considered sibling species, close in morphology but showing a number of distinctions, and separated by depth and habitat (*B. parageios* on shallower sandy sediments, *B. fragilis* on deeper muds), this niche-specificity presumably having lead to allopatric speciation. Their antennal morphology distinguishes them entirely from all other described *Bathytanais* species.

*Bathytanais parageios* was collected from throughout the Bass Strait, from depths between 12 and 70 m, mainly on sandy substrata.

Family **Leptocheliidae** Lang, 1973

Genus ***Leptochelia*** Dana, 1849

***Leptochelia billambi*** sp. nov.

Figures 71–74

*Material examined.* 1 ♀ (J58472), holotype, 1 ♂ (J58474), allotype, 162 ♀♀ (J58473), paratypes, sample Stn CPBS 000/4, 38°21.17'S 145°13.15'E, 2 m depth, sandy mud, 6 April 1965, coll. MSG, Smith McIntyre grab.

Portland Exotic Species survey material: 31 ♀♀ (J66139) at 3 m depth, 9 ♀ (J66142) at 0.5 m depth, 16 specimens (J66139) at 7 m depth, paratypes, MAFRI-P17 SCR, Portland No. 6 berth, 38°21'S 147°37'E, 3 May 1996. 2 ♀♀ (J66126) at 7 m depth, 4 ♀♀ (J66123) at 3 m depth, paratypes, MAFRI-P16 SCR, Portland No. 2 berth, 38°20'S 147°37'E, 3 May 1996. 1 ♀ (J66094) at 3 m depth, paratypes, MAFRI-P15 SCR, Portland SL Pattersons Berth, 38°21'S 147°37'E, 2 May 1996. 3 ♀♀ (J66156) at 3 m depth, 2 ♀♀ (J66158) at 0.5 m depth, paratypes, MAFRI-P18 SCR, Portland No. 1 berth, 38°21'S 147°37'E, 4 May 1996. 1 ♂ (J66386), paratype, MAFRI-M47-G47, Port of Melbourne, 37°50'S 144°53'E, 14 m depth, 7 December 1999.

*Other material examined.* A further 521 idiotypic individuals from the Bass Strait, Western Port and Port Philip Bay, many without registration numbers, and including 303 ♀♀ (9 brooding), 3 ♂♂ and 38 juveniles. Numerous further specimens exist in the collections of Museum Victoria.

*Description of female.* Body (Fig. 71A, B) slender, holotype 2.4 mm long, 6.4 times as long as wide. Cephalothorax subrectangular, tapering towards anterior, 1.4 times as long as wide, longer than pereonites 1 and 2 together, with slight rostrum, eyelobes rounded, eyes present and black, single setae at posterior of eyelobes and mid-laterally. Pereonites 1 and 6 subequal and shortest, pereonites 2 to 5 subequal, progressively longer, pereonite 5 longest and 1.4 times as long as pereonite 1 (all pereonites respectively 1.9, 1.7, 1.5, 1.5, 1.4 and 1.9 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite about 5.6 times as wide as long, with 2 or 3 lateral setae. Pleotelson pentangular, as long as last two pleonites together, twice as wide as long, with one anterolateral and posterolateral seta on each side and two distal setae.

Antennule (Fig. 72A) of three longer and one minute distal articles, proximal article 4 times as long as wide, 1.6 times as long as distal three articles together, with proximal, mesial and distal inner groups of penicillate setae, inner and outer simple mesial setae and one long inner distal seta longer than second article; second article twice as long as wide, one-third as long as first article, distal seta just longer than article; third article just shorter than second, with one distal seta; fourth article minute, with three distal setae and one aesthetasc.

Antenna (Fig. 72B) of six articles, proximal article compact, with fine distal seta; second article as long as wide, with single inner distal and dorsodistal slender spines; third article just longer than wide, with dorsodistal slender spine; fourth article longest, 3.2 times as long as wide and twice as long as third, with mid-length seta reaching two-thirds of length to distal margin, and distal tufts of penicillate and simple setae; fifth article 0.6 times as long as fourth; sixth article minute, with four simple and one penicillate distal setae.

Labrum (Fig. 72C) hood-shaped, setose, typical of genus. Left mandible (Fig. 72D) with crenulate lacinia mobilis wider than distal end of mandible, distal crenulation on pars incisiva, pars molaris with strong rugosity; right mandible (Fig. 72E) similar but without lacinia mobilis, pars incisiva distally bifurcate. Labium (Fig. 72G) wide, bilobed, distally finely setose, without palp. Maxillule (Fig. 72F) with ten distal spines and setose margins, rows of setules on inner distal face; palp distinct, with two distal setae. Maxilliped (Fig. 72H) palp first article naked, second article with finely setose inner margin, and with one outer, one ventral and three inner setae, distal-most inner seta not reaching distal margin of third palp article; third article with nine inner marginal and one distal submarginal finely denticulate setae; fourth article with nine inner/distal finely denticulate setae and one outer subdistal seta; basis with five long setae extending to third palp article; endites distally with fine outer setules and three robust spatulate spines, inner spine shorter than others.

Cheliped (Fig. 73A) with rounded, comparatively slender basis 2.3 times as long as wide; merus triangular with three ungrouped ventral setae; carpus twice as long as wide, with two midventral setae and two shorter marginal dorsal setae; propodus slightly longer than wide, with inner distal comb of seven setae and longer seta at base of dactylus; fixed finger with four ventral and three inner setae, cutting edge crenulate; dactylus naked.

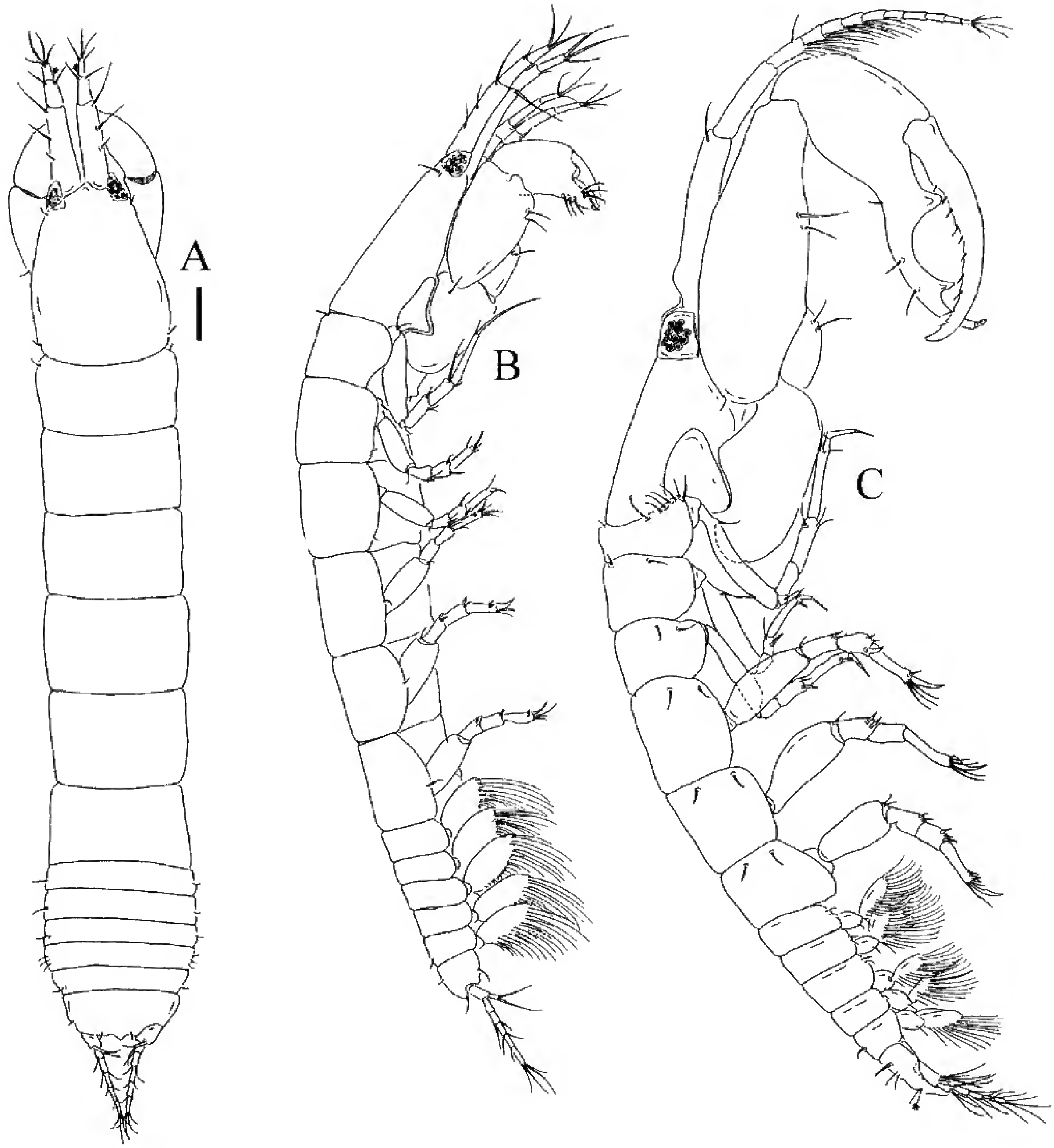


Fig. 71. *Leptochelia billambi* sp. nov., female holotype. A, dorsal view; B, lateral view; C, male lateral view. Scale = 0.2 mm.

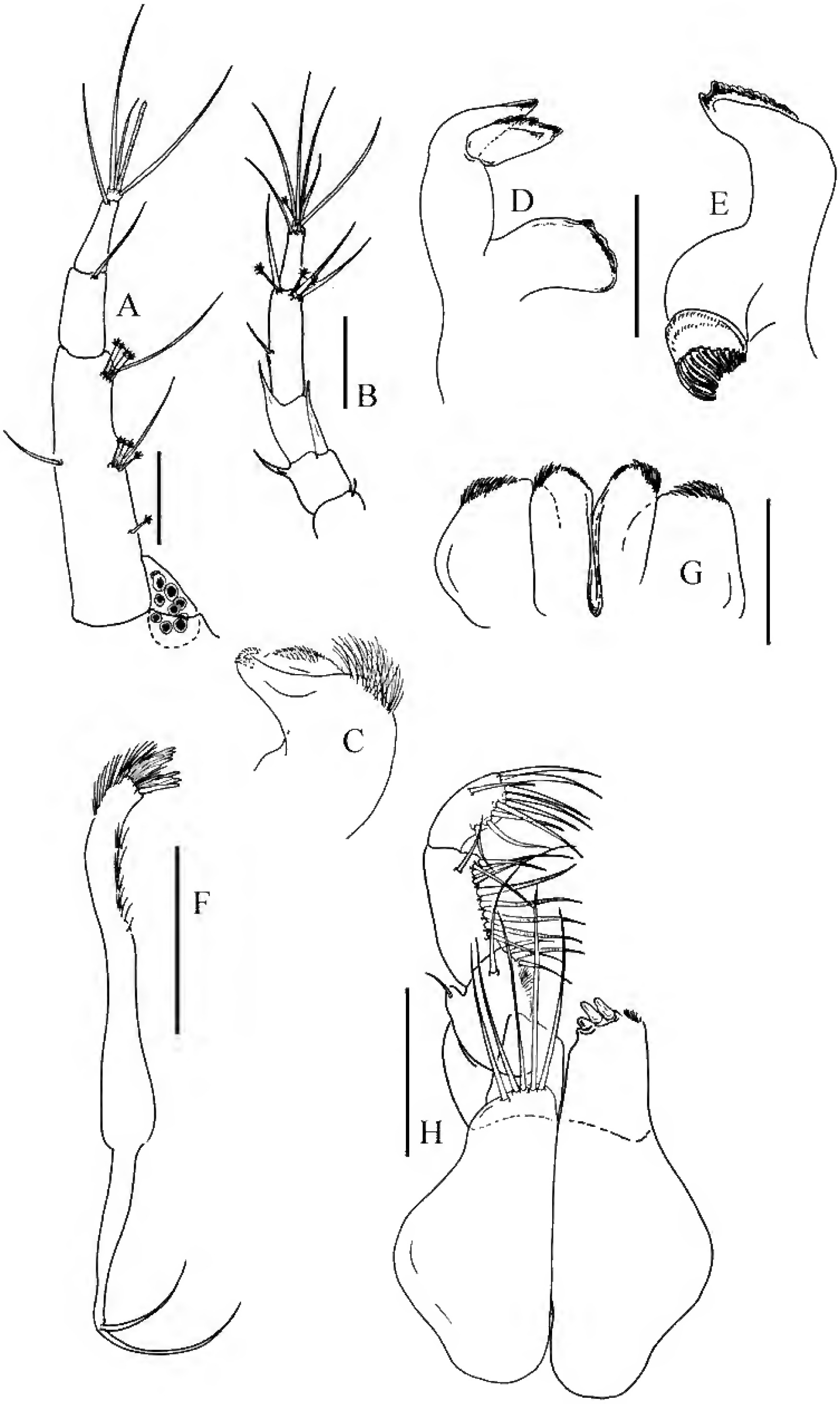


Fig. 72. *Leptochelia billambi* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; G, labium; H, maxilliped. Scale = 0.2 mm.


Fig. 73. *Leptochelia billambi* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.2 mm.

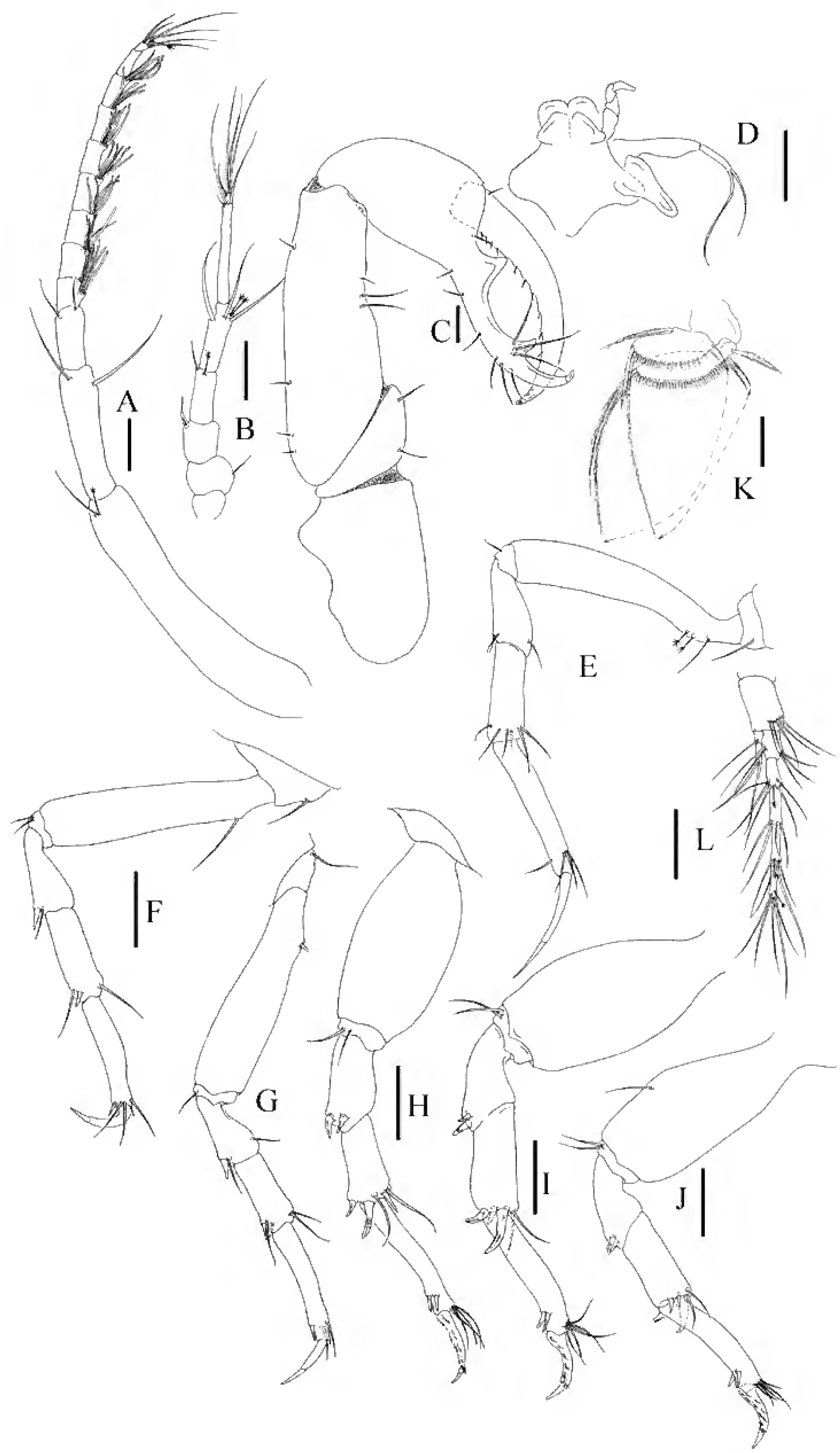


Fig. 74. *Leptochelia billambi* sp. nov., male paratype. A, antennule; B, antenna; C, cheliped; D, mouth parts; E, pereopod 1; F, pereopod 2; G, pereopod 3; H, pereopod 4; I, pereopod 5; J, pereopod 6; K, pleopod; L, uropod. Scale = 0.2 mm.

Pereopod 1 (Fig. 73B) longer than other pereopods, coxa with seta; basis slender, 4.4 times as long as wide, with single dorsoproximal simple and penicillate setae; ischium compact with one ventral seta; merus as long as carpus, with one dorsodistal and two ventrodistal setae; carpus with two ventrodistal setae, one medial distal seta and three dorsodistal setae, longest of which is half length of propodus; propodus 1.8 times as long as carpus, with three setae on subdistal dorsal mound and one subdistal ventral seta; dactylus slender, extending into shorter slender unguis 0.7 times as long as dactylus, the two together as long as propodus. Pereopod 2 (Fig. 73C) more compact than pereopod 1; coxa with longer seta; basis 3.1 times as long as wide; ischium with 2 setae; merus as long as carpus and 1.5 times as long as wide, with strong ventrodistal spine and ventral rows of microtrichia; carpus with single dorsodistal and ventrodistal setae and two ventrodistal spines, and ventral rows of microtrichia; propodus 1.6 times as long as carpus, with three distal setae and ventral rows of microtrichia; dactylus and short unguis curved, together 0.7 times as long as propodus. Pereopod 3 (Fig. 73D) similar to pereopod 2, but carpus shorter than merus and with two dorsodistal setae.

Pereopod 4 (Fig. 73E) basis stout, 2.23 times as long as wide with two ventroproximal penicillate setae; ischium with two ventrodistal setae; merus with paired ventrodistal spines and ventral rows of microtrichia; carpus just shorter than merus, with outer, ventral and inner distal spines each with fine subdistal setules, and ventral rows of microtrichia; propodus 1.2 times as long as carpus, with two ventrodistal spines, five dorsodistal setae mostly as long as dactylus, and ventral rows of microtrichia; dactylus and distinct unguis curved, 0.6 times as long as propodus. Pereopod 5 (Fig. 73F) as pereopod 4, but carpus with additional simple distal seta, propodus as long as carpus. Pereopod 6 (Fig. 73G) as pereopod 5, but propodus with seven finely denticulate and one simple distal setae.

Pleopods (Fig. 73H) all alike, typical for the genus but basis naked, endopod with single inner plumose seta and proximal outer seta separated from remainder.

Uropod (Fig. 73I) biramous, basis naked; exopod of one segment, 0.8 times as long as proximal endopod segment, outer distal seta longer than inner distal seta; endopod of five segments, distal segments slender.

*Description of male*. Larger than female (allotype length 4.2 mm), body (Fig. 71C) more compact, cephalon as long as pereonites 2 to 4 together, with large eyelobes bearing large black eyes; pereonite 1 shortest, pereonites 2, 3 and 6 subequal, twice as long as pereonite 1, pereonite 4 longest, three times as long as pereonite 1, pereonite 5 just shorter than pereonite 4. Five free pleonites, subequal in length, each as long as pereonite 1, pleotelson as long as pleonites 5 and 6 together.

Antennule (Fig. 74A) elongate, first peduncle article 6.4 times as long as wide, curved, with single dorsodistal penicillate and simple setae; second article 0.43 times as long as first with single ventral and dorsal distal simple setae; third article half as long as second and twice as long as wide with single ventral and dorsal distal simple setae; flagellum of 9 segments, segments 1 to 7 bearing proximal row of 6 or 7 aesthetascs, segment 8 naked, segment 9 minute, distally with six simple and one penicillate setae.

Antenna (Fig. 74B) proximal article compact; second article as long as wide, with single ventrodistal seta; third article longer than second, twice as long as wide, with single simple dorsodistal seta; fourth article 3.3 times as long as third, with incipient secondary articulation at mid-length bearing single simple and penicillate setae, distally ventral pairs of penicillate and simple setae, and stronger dorsal seta reaching half length of fifth article; fifth article 0.9 times as long as fourth with two longer and one shorter distal setae; sixth article minute, with four simple distal setae.

Mouthparts (Fig. 74D) atrophied, naked maxilliped and maxillule palp with two distal setae distinguishable.

Cheliped (Fig. 74C) larger and more slender than that of female; basis 1.7 times as long as wide; merus short, with two ventral setae; carpus three times as long as wide, with three midventral setae and four dorsal marginal setae; propodus 1.4 times as long as wide, fixed finger 1.25 times as long as palm, with six ventral setae, three setae adjacent to cutting edge, two inner tooth-like apophyses on cutting edge; dactylus slender, curved, with proximal seta and row of 13 setae along cutting edge.

Pereopods (Fig. 74E to J) similar to but more slender than those of female, merus shorter than carpus on pereopods 1 to 3; on pereopods 4 to 6 propodus much longer than carpus, distal carpal spines more elongate than those of female, microtrichia restricted to dactylus, dactylus proportionately longer than in female.

Pleopods (Fig. 74K) with longer setae than on those of female. Uropod (Fig. 74L) basis with inner distal row of setae; exopod two-segmented, longer than proximal endopod segment; endopod of five segments, more heavily setose than that of female.

*Etymology*. Named after William Lamb, 2nd Viscount Melbourne, after whom the city of Melbourne was named in 1837 (the original Melbourne being a village in Derbyshire, England).

*Remarks*. Bamber (2008) gave an identification key to the species of the Leptocheliidae then known from Australian waters, through which the present species would key out to *Leptochelia opteros* Bamber, 2008, the commonest species in Moreton Bay, Queensland: it is indeed close to that species, and shares with it a distal seta on the proximal article of the antenna; however, *L. billambi* sp. nov. is a larger species, its cheliped and antennule are more elongate than those of *L. opteros*, the fixed finger of the chela has 4, not 3, ventral setae, the chela comb-row has more setae, and the maxilliped basis has 5 distal setae (4 in *L. opteros*). The male appears generally as a larger version of that of *L. opteros*, but that male is characterized by having a dorsodistal flange on the basis of pereopod 6, absent in the present species. Finally, *L. billambi* was recorded on sandy mud substrata, while *L. opteros* lives amongst sublittoral algae and epifaunal communities. The incipient secondary articulation of the fourth antennal peduncle article in the male is so far unique to this species in the Leptocheliidae.

A range of morphometric and meristic characters in females has been analyzed for some 22 taxa attributable to the *Leptochelia savignyi* (Krøyer, 1842)-complex (see Bamber, 2008; Bamber, 2010), with which the present species has been compared. The only other species which has the proximal article of the antennule approaching as slender as 4 times as long as wide is *L. savignyi sensu stricto*, ranging from 3.5 to 3.8 times as long as wide (Bamber, 2010), while in the figure of *L. savignyi sensu* Sars (1886) from the Mediterranean this article is 4 times as long as wide. However, that species has only 4 maxilliped-basis setae (five in *L. billambi*) and a proportionately shorter cheliped basis and carpus in the adult, while the distal seta on article 2 of the antennule is not longer than the article itself (longer in *L. billambi*), the uropod exopod is only just longer than half of the proximal endopod-segment length (0.8 times as long in *L. billambi*), and the dactylus plus unguis of pereopod 1 are shorter than the propodus (equal in length in *L. billambi*); further, the male of *L. savignyi sensu stricto* also has a dorsodistal flange on the basis of pereopod 6 (Bamber, 2010), unlike that of *L. billambi.* Other than the present species, there are only four described species which have the distal seta on article 2 of the antennule as long as or longer than the article itself (*L. itoi* Ishimaru 1985, *L. daggi* Bamber, 2005, *L. opteros* Bamber, 2008 and *L. guduroo* Bamber, 2008), but all of these have the first peduncle article of the antennule less than three times as long as wide.

*Leptochelia billambi* was recorded commonly at between 0 and 14 m depth in Port Phillip Bay and Western Port, Victoria.

Genus ***Araleptochelia*** gen. nov.

*Diagnosis.* Female with 4-articled antennule, third article longer than second; antenna 6-articled, articles 2 and 3 with slender distal spines, article 2 without ventral spine; maxilliped basis with four long setae extending to half length of second palp article, endites distally with single seta and three slender spatulate spines; cheliped relatively slender, merus covering less than half of ventral margin of carpus, propodus (palm of chela) nearly twice as long as wide; dactylus plus unguis on first pereopod 1.5 times as long as propodus; merus of pereopods 2 and 3 with ventrodistal spine about two-thirds as long as carpus; pleopod without inner plumose seta on the pleopod endopod; uropod exopod 1-segmented, endopod 5-segmented, with all segments elongate (more than four times as long as wide). Otherwise typical of the family. Male showing dimorphism in the antennule with secondary segmentation of the flagellum to more than 17 segments, proximal flagellum segment bearing large dorsodistal spine almost as long as flagellum; cheliped slender, sinuous; posterior pereopods without flange on basis. Sub-adult male with five-articled antennule.

*Type species: Araleptochelia macrostonyx* sp. nov. by monotypy,

*Etymology.* from the Greek *araeos* – thin, as is the chela of the female (and the proximal uropod endopod segments) – and "*Leptochelia*", to which genus it is closest (female).

*Remarks.* Ostensibly, the species described below has the gross appearance of a typical *Leptochelia*; females of that genus are remarkably conservative in their morphology, a factor which in the past has lead to over-synonymization. The present species has a sufficient number of distinguishing characters, notably the slender chela (somewhat reminiscent of that of a typhlotanaid); the very slender distal spines on the second and third peduncle articles of the antenna; the proportionately very long dactylus and unguis of pereopod 1; the long ventrodistal spines on the merus of pereopods 2 and 3; the lack of an inner plumose seta on the pleopod endopod; and the elongate proximal uropod segments, that it warrants separation into a distinct genus.

The spination/setation of the antennal peduncle articles is more typical of such genera as *Konarus* Bamber, 2006, *Pseudonototanais* Lang, 1973 and *Parakonarus* Bird, 2011 rather than of *Leptochelia*, while the proportions of the dactylus and unguis of pereopod 1 are more typical of *Leptochelia.*

The mouthparts are typical of *Leptochelia*, *inter alia*, and while the maxilliped basis has four distal setae in the only known species (thus distinguishing it from such other leptocheliid genera as *Heterotanais* and *Pseudoleptochelia*), the number of these setae is known to be variable in, for example, *Leptochelia* (e.g. Bamber, 2008), so cannot as yet be regarded as diagnostic. While the chela of the male may be regarded as somewhat intermediate between that of the *L. savignyi*-type and that of the *L. minuta*-type, the extreme secondary segmentation of the antennule flagellum, with an extraordinarily long spine on the first flagellum segment, reinforces the difference between this taxon and species of *Leptochelia.*

***Araleptochelia macrostonyx*** **sp. nov.**

Figures 75–78

*Material examined.* 1 brooding ♀ (J58470), holotype, 11 ♀♀ (J56622), paratypes, Stn 81-HK-1 134, 40°56.0'S 146°05.40'E, 68 m depth, mud, 4 February 1981, coll. MF Gamon *et al.*, FRV *Hai Kung*, pipe-dredge. 3 ♀♀ (J56629), paratypes, Stn 80-Sa-1 113, 40°23.8'S 146°32'E, 65 m depth, muddy sand, 3 November 1980, coll. MF Gamon *et al.*, FRV *Sarda*. 14 ♀♀ (J56630), paratypes, Stn 83-SG-1 209, 38°18.0'S 147°37.0'E, 55 m depth, muddy fine shell, 31 July 1983, coll. MF Gamon *et al.*, FV *Silver Gull.*

13 ♀♀, 2 ♂♂ (J56636), 5 ♀♀, 1 juvenile (J56635), paratypes, Stn 81-T-1 158, 39°49.5'S 146°18.5'E, 82 m depth, sand-silt-mud, 13 November 1981. 1 ♀ (J56634), paratype, Stn 81-HK-1 189, 38°42.8'S 142°35.6'E, 69 m depth, coarse sand, 20 November 1981. 1 ♀ (J56626), paratype, Stn 81-HK-1 201, 39°08.3'S 144°43.9'E, 66 m depth, coarse sand, 23 November 1981. 9 ♀♀, 1 ♂ (J56627), 1 preparatory ♂ (J56639), 8 preparatory ♂♂ (J56640), paratypes, Stn 81-HK-1 159, 39°43.5'S 146°18.8'E, 80 m depth, muddy shell, 13 November 1981. 1 ♀ (J56631), 1 ♀ (J56633), 1 preparatory ♂ (J56638), paratypes, Stn 81-HK-1 161, 39°48.3'S 147°19.2'E, 60 m depth, muddy sand, 14 November 1981. 1 ♀ (J56624), paratype, Stn 81-HK-1 173, 39°26.3'S 147°48.7'E, 49 m depth, medium sand, 17 November 1981. 2 ♀♀ (J56628), paratypes, Stn 81-T-1 169, 39°02.4'S 148°30.6'E, 120 m depth, muddy sand, 15 November 1981. All coll. R.S. Wilson, RV *Tangaroa.*

1 preparatory ♂ (J56637), paratype, Stn 83-SG-1 209, 38°18.0'S 147°37.0'E, 55 m depth, muddy fine shell, 31 July 1983, coll. M.F. Gomon & R.S. Wilson, FV *Silver Gull.*

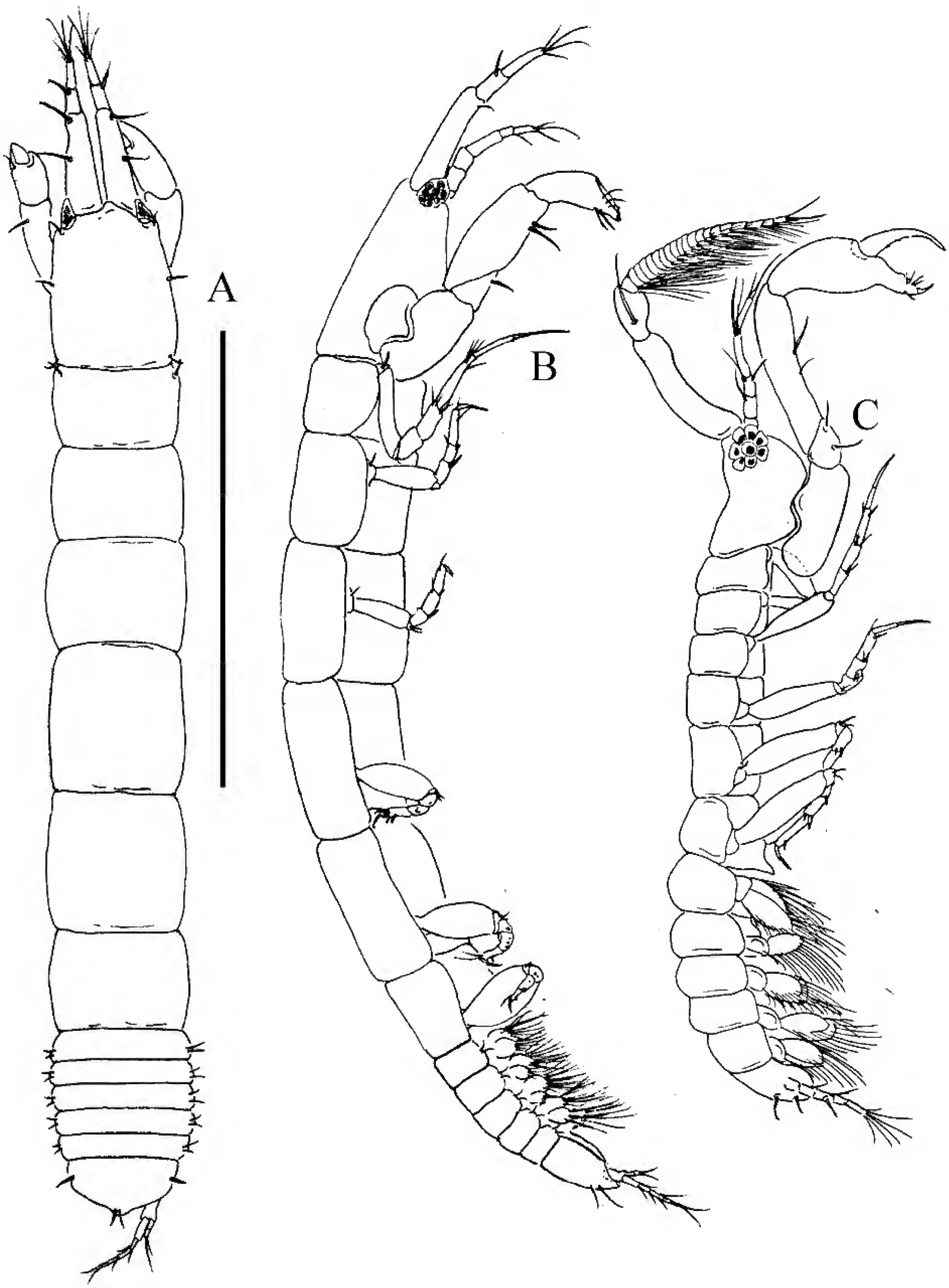


Fig. 75. *Araleptochelia macrostonyx* sp. nov., female holotype. A, dorsal view; B, lateral view; C, male lateral view. Scale = 1 mm.

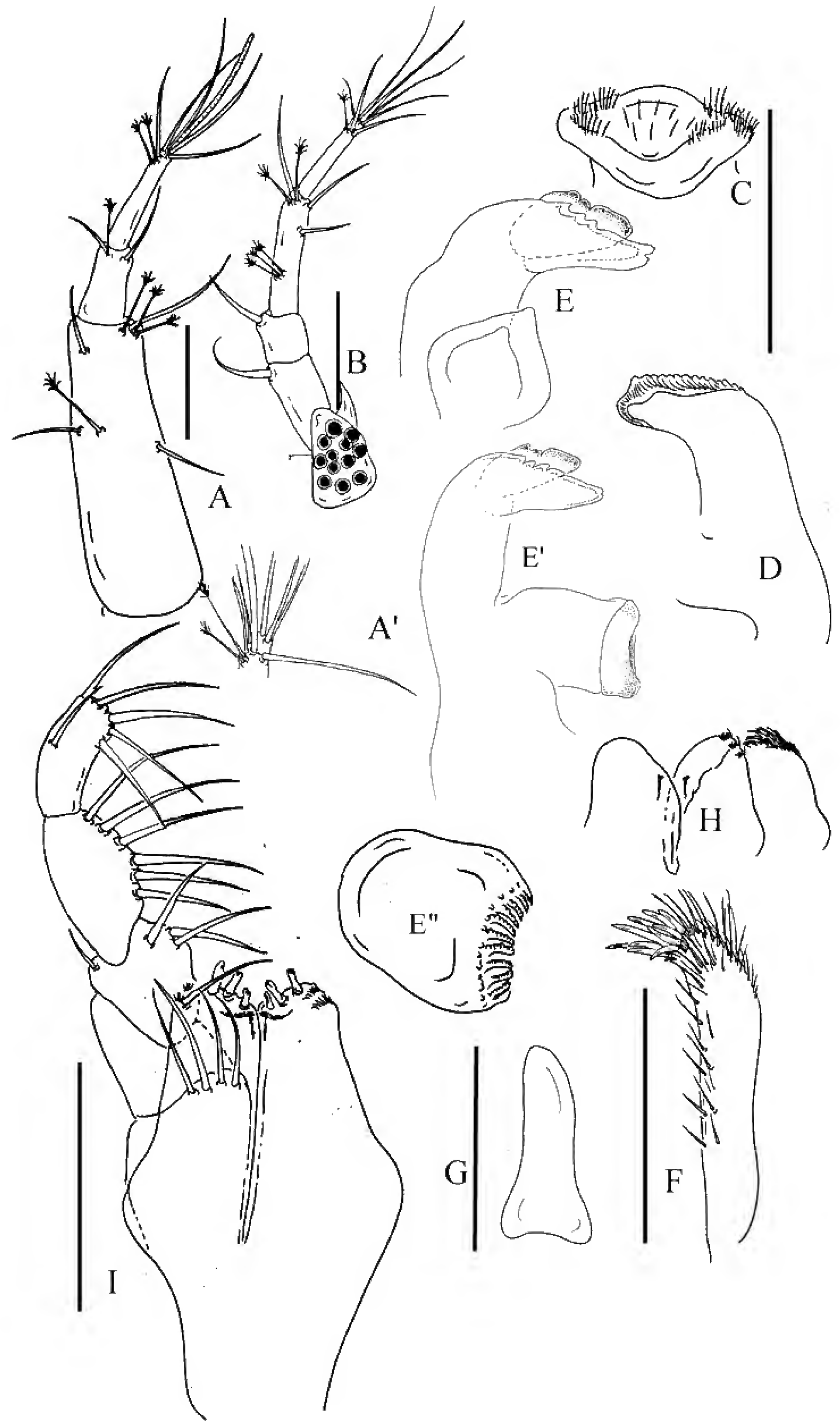


Fig. 76. *Araleptochelia macrostonyx* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, right mandible; E, E' left mandible; F, maxillule endite; G, maxilla; H, labium; I, maxilliped. Scale = 0.1 mm.

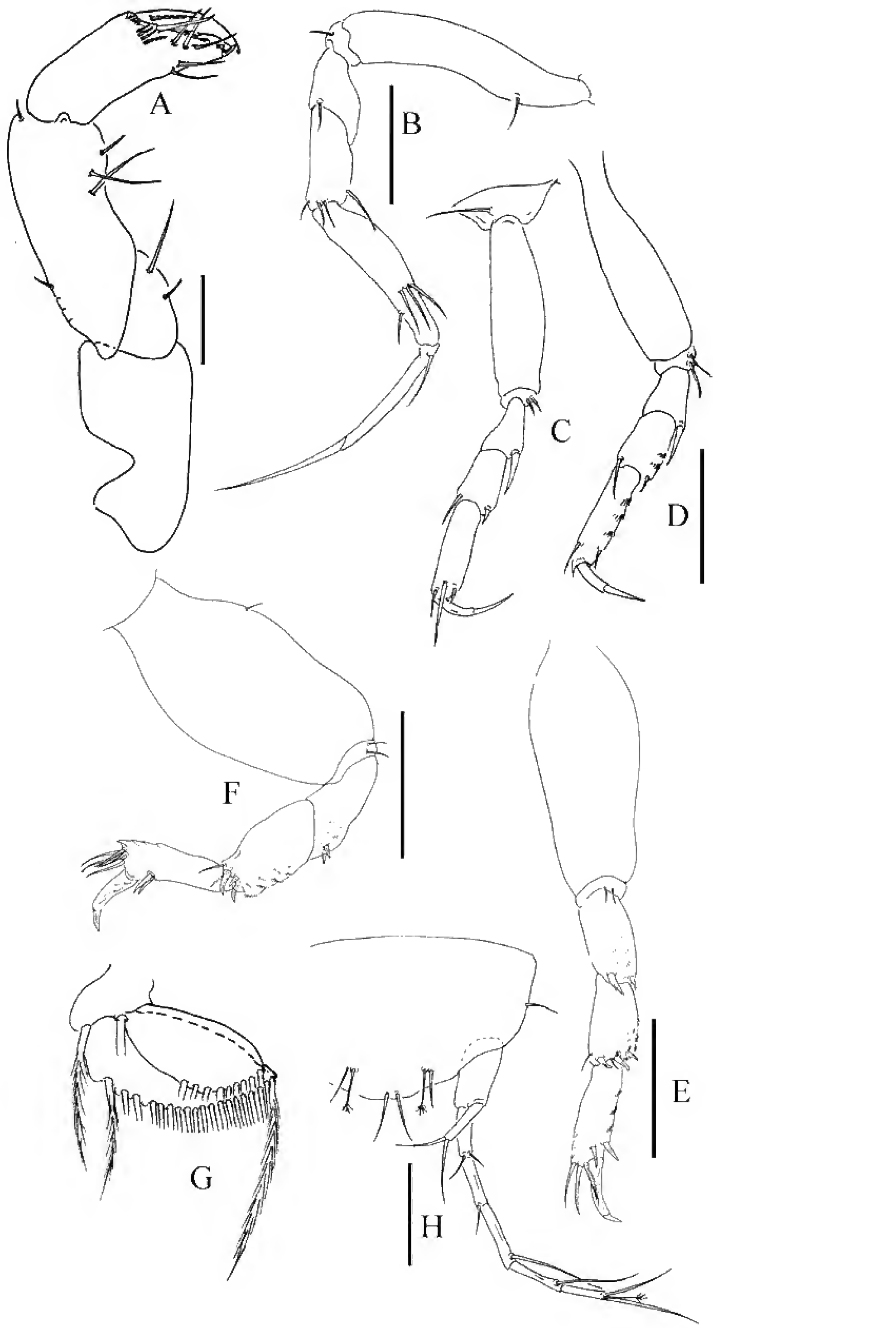


Fig. 77. *Araleptochelia macrostonyx* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

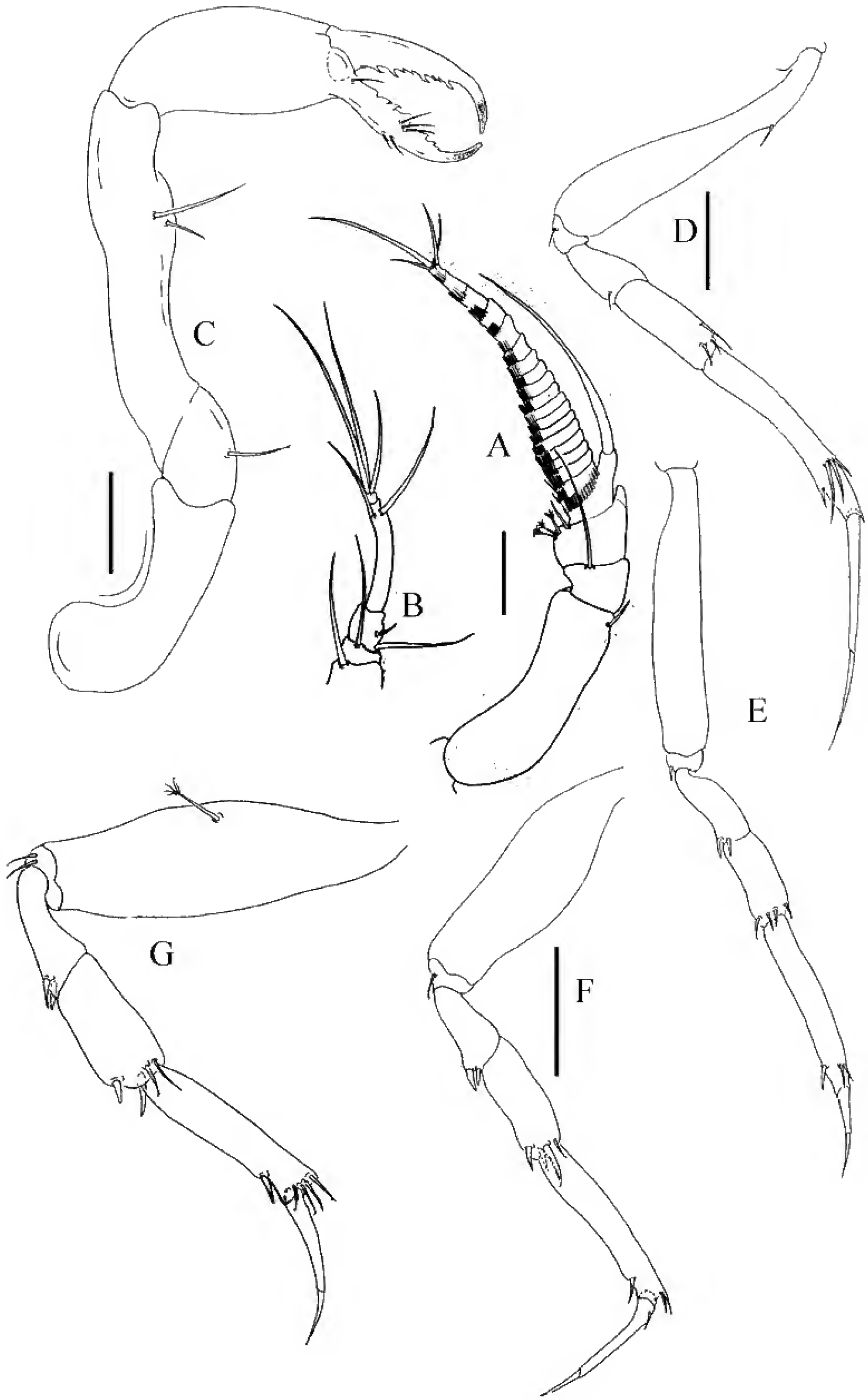


Fig. 78. *Araleptochelia macrostonyx* sp. nov., male. A, antennule; B, antenna; C, cheliped; D, pereopod 1; E, pereopod 2; F, pereopod 3; G, pereopod 6. Scale = 0. 1 mm.

*Description of female.* Body (Fig. 75A, B) slender, holotype 2.3 mm long, 7.4 times as long as wide. Cephalothorax subrectangular, 1.3 times as long as wide, as long as pereonites 1 and 2 together, with slight rostrum, eyelobes and black eyes present, single setae at posterior of eyelobes, midlaterally and posterolaterally. Pereonites 1 and 2 subequal, shortest; pereonites 3 and 6 subequal, slightly longer than pereonite 1; pereonites 4 and 5 subequal, longest and almost twice as long as pereonite 1 (all pereonites respectively 1.5, 1.6, 1.5, 0.9, 0.9 and 1.4 times as wide as long). Pleon with five free subequal pleonites bearing pleopods, each pleonite about 6 times as wide as long, with paired lateral setae. Pleotelson semicircular, longer than last two pleonites together, 1.7 times as wide as long, on each side bearing one posterolateral seta and a pair of one simple and one penicillate setae posterior to uropod attachment, and two distal setae.

Antennule (Fig. 76A) of four tapering articles, as long as cephalothorax, proximal article 3.1 times as long as wide; second article almost twice as long as wide, one-quarter as long as first article, longest distal outer only just longer than article; third article 1.3 times as long as second; fourth article minute, eccentric, with four distal setae and one aesthetasc.

Antenna (Fig. 76B) of six articles, proximal three articles subequal in length; proximal article naked; second article with single dorsodistal slender spine; third article as long as wide, with slender dorsodistal spine; fourth article longest, 2.7 times as long as third article and nearly 5 times as long as wide; fifth article 0.75 times as long as fourth; sixth article minute.

Labrum (Fig. 76C) hood-shaped, setose, typical of genus. Left mandible (Fig. 35E, E') with crenulate lacinia mobilis narrower than distal end of mandible, proximal crenulation on pars incisiva, pars molaris (Fig. 76E) robust; right mandible (Fig. 76D) similar but without lacinia mobilis. Labium (Fig. 76H) wide, bilobed, distally finely setose, without palp. Maxillule (Fig. 76F) with ten distal spines and setose margins, setules on inner distal face paired. Maxilla (Fig. 76G) simple, linguiform, naked. Maxilliped (Fig. 76I) palp first article naked, second article with one outer and three inner setae in distal half, distal-most inner seta only half as long as third palp article; third and fourth articles with filtering rows of six and five setae respectively, fourth article with outer seta; basis with four long setae extending to half length of second palp article; endites distally with single seta and three slender spatulate spines.

Cheliped (Fig. 77A) basis nearly twice as long as wide; merus subtriangular with two ventral setae; carpus 2.8 times as long as wide, with three ventral setae in distal half, one proximal and one distal dorsal setae; propodus elongate for the genus, palm 1.8 times as long as wide, fixed finger 0.45 times as long as palm with two ventral and three inner setae alongside cutting edge, cutting edge crenulate, comb-row at base of dactylus of four setae with adjacent microtrichia; dactylus with outer proximal seta.

Pereopod 1 (Fig. 77B) longer than other pereopods, coxa with seta; basis slender, five times as long as wide; ischium compact with one ventral seta; merus 0.6 times as long as carpus, with single distal seta; merus-carpus articulation strongly oblique; carpus with one dorsal and three ventral distal setae, longest of which is less than one-third as long as propodus; propodus twice as long as carpus, with three setae on subdistal dorsal mound and one subdistal ventral seta; dactylus slender, with proximal seta, extending into slightly longer slender unguis, the two together 1.5 times as long as propodus. Pereopod 2 (Fig. 77C) more compact than pereopod 1; basis 3.3 times as long as wide; ischium with 2 setae; merus as long as carpus, with slender ventrodistal spine more than half as long as carpus; carpus with dorsodistal seta and short ventrodistal spine; propodus 1.75 times as long as carpus, with two dorsodistal and one ventrodistal setae, and dorsodistal sharp apophysis; curved dactylus and slightly longer unguis together 0.7 times as long as propodus. Pereopod 3 (Fig. 77D) similar to pereopod 2, but dactylus and unguis subequal.

Pereopod 4 (Fig. 77E) basis stouter than those of anterior pereopods, twice as long as wide; ischium with two seta; merus and carpus subequal, merus with two short, ventrodistal spines and microtrichia, carpus with one outer, one ventral and one inner distal spines each with serrate ventral margin, single inner and outer simple dorsodistal setae and ventral microtrichia; propodus 1.2 times as long as carpus, with ventral microtrichia, two ventrodistal serrate spines, and three dorsodistal finely-denticulate setae almost as long as dactylus; dactylus and short unguis distinct, curved, together two-thirds as long as propodus. Pereopod 5 as pereopod 4. Pereopod 6 (Fig. 77F) similar to but stouter than pereopod 4, but distal carpal spines larger, propodus with two pectinate and three finely-denticulate distal setae.

Pleopods (Fig. 77G) all alike, with no inner plumose seta on endopod; proximal outer seta separated from others on both rami.

Uropod (Fig. 77H) biramous, basis naked; exopod of one slender segment as long as proximal endopod segment, outer distal seta longer than inner distal seta; endopod of five elongate segments.

*Description of male.* Typical primary male, smaller than female (allotype length 1.6 mm), body (Fig. 75C) more compact, cephalon as long as pereonites 1 to 3, with large eyelobes bearing large black eyes; pereonite 5 longest, other pereonites subequal in length. Five free pleonites, subequal in length and about as long as pereonite 1, pleotelson nearly twice as long as pleonite 5. Sexual dimorphism as follows.

Antennule (Fig. 78A) elongate, first peduncle article curved, 2.8 times as long as wide with one dorsodistal seta; second article compact, 0.25 times as long as first with long outer distal seta; third article compact with dorsodistal spine and ventrodistal penicillate and simple setae; flagellum of 19 segments, first 18 each bearing distal row of aesthetascs, proximal flagellum article with extraordinarily-long dorsodistal spine extending almost full length of flagellum; distal article short and with four simple setae. Antenna (Fig. 78B) with slender distal setae rather than spines on articles 2 and 3, articles 4 and 5 apparently fused. Mouthparts atrophied.

Cheliped (Fig. 78C) very slender, three-quarters as long as body; basis arcuate, about 3 times as long as wide; carpus slender and sinuous, about 5 times as long as wide with two ventral setae in proximal half; palm of propodus twice as long as wide, fingers of chela 0.8 times length of palm; fixed finger longer than palm, with two ventral and three inner setae alongside cutting edge, cutting edge with sharp denticulations but no large tooth-like apophyses, distal spine rugose; dactylus with sharp tooth-like denticulations along cutting edge, unguis rugose.

Pereopods (Fig. 78D to G) more elongate than those of female; unguis of pereopod 1 shorter than dactylus; on pereopods 4 to 6 carpal spines more slender, distal articles without dense fields of microtrichia, unguis longer and more slender, together with dactylus >0.8 times as long as propodus.

*Preparatory male*. As female, but antennule with four longer articles as well as minute distal article, from division of third peduncle article of neuter.

*Etymology*. From the Greek *macro* – long and *stonyx* – a sharp point, in reference to both the extremely long dactylus and unguis on pereopod 1, the ventrodistal spine on the merus of pereopods 2 and 3, and the spine on the fourth antennal article of the male, all characterizing features of this species.

*Remarks*. The numerous distinctions of this species from those most similar, i.e. species of *Leptochelia*, are described under the remarks for the genus. *Araleptochelia macrostonyx* sp. nov. contributes further to the great diversity of the Leptocheliidae in Australian waters and is readily distinguished from other species without dissection owing to its unique cheliped morphology and the extremely long dactylus plus unguis on pereopod 1. The antennular morphology of four longer segments in the subadult male was demonstrated for the related *Leptochelia savignyi* (Krøyer, 1842) by Bamber (2010).

*A. macrostonyx* was found on muddy to coarse sand substrata at depths from 49 to 120 m right across the northern half of the Bass Strait.

### Genus *Pseudoleptochelia* Lang, 1973

### *Pseudoleptochelia occiporta* sp. nov.

Figures 79–82

*Material examined.* 1 ♀ (J58467), holotype, 1 ♂ (J58468), allotype, 48 ♀♀, 2 juveniles (J55820), paratypes, Stn 81-T-1 162, 40°09.2'S 147°31.9'E, 51 m depth, shelly sand, 14 November 1981, coll. R.S. Wilson, RV *Tangaroa*. 4 ♀♀, 2 juveniles (J50804), paratypes, Stn VC 23 C1, 38°19.18'S 144°37.62E, 40 m deep, reef, 12 May 1998. 10 specimens (J48183), paratypes, CPBS 01S/4, 38°21.73'S 145°13.23'E, 3 m depth, 1 April 1965. 6 specimens, (J48188), paratypes, CPBS 03S/2, 38°21.65'S 145°15.21'E, 2 m depth, sandy-mud, 13 April 1965. 25 specimens, (J48175), paratypes, CPBS 11N/4, 38°23.23'S 145°13.28'E, 5 m depth, fine sand, 21 March 1965. 10 specimens, (J48178), paratypes, CPBS 11S/2, 1 specimen, (J48751), paratypes, CPBS 11S/4, both 38°22.00'S 145°13.38'E, 3 m depth, shelly gravel, 17 March 1965. 5 specimens, (J48755), paratypes, CPBS 22N/4, 38°20.60'S 145°13.46'E, 13 m depth, shelly sand, 18 March 1965. 66 ♀♀, 26 juveniles, (J48967), paratypes, CPBS 32N/367, 38°20.83'S 145°13.49'E, 13 m depth, sandy gravel, 20 March 1967. 1 ♀ (J48972), 3 specimens (J48970), paratypes, CPBS 32N/769, 38°20.83'S 145°13.49'E, 13 m depth, sandy gravel, 15 July 1969. 12 specimens, (J48971), paratypes, CPBS 32N/870, 38°20.83'S 145°13.49'E, 13 m depth, sandy gravel, 12 August 1970. 20 ♀♀, 10 juveniles, (J48980), paratypes, CPBS 32S/770, 38°21.60'S 145°13.67'E, 13 m depth, muddy sand, 6 July 1970. 8 specimens, (J48974), paratypes, CPBS 32S/866, 38°21.60'S 145°13.67'E, 13 m depth, muddy sand, 26 August 1966. 1 ♀, (J48955), paratypes, CPBS 40O/3, 38°21.17'S 145°14.00'E, 15 m depth, sand, 1 April 1965. 3 specimens, (J48958), paratypes, CPBS 41N/2, 38°20.81'S 145°13.85'E, 13 m depth, gravelly sand, 30 March 1965.

*Description of female*. Body (Fig. 79A, B, C, D) relatively small for the genus, holotype 2.7 mm long, 6.3 times as long as wide. Cephalothorax subrectangular, tapering towards anterior, 1.4 times as long as wide, 1.5 times as long as pereonites 1 and 2 together, with slight rostrum, eyelobes rounded, eyes present and black, paired setae at posterior of eyelobes and single setae midlaterally. Pereonite 1 shortest, pereonite 2 and 6 subequal and 1.5 times as long as pereonite 1, pereonites 3 to 5 subequal and 1.9 times as long as pereonite 1 (all pereonites respectively 2.6, 1.8, 1.4, 1.4, 1.5 and 1.7 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite about 5.3 times as wide as long, with single midlateral setae. Pleotelson pentangular, as long as last two pleonites together, 1.6 times as wide as long, with one anterolateral and two posterolateral setae on each side and two distal setae.

Antennule (Fig. 80A) of three longer and one minute distal articles, proximal article 3.5 times as long as wide, 1.5 times as long as distal three articles together, with proximal, mesial and distal inner groups of penicillate setae, inner simple mesial seta, and one outer and one long inner distal seta longer than second article; second article twice as long as wide, one-third as long as first article, longer distal seta just longer than article; third article just shorter than second, distally with one simple and one penicillate seta; fourth article minute, distally with three simples and two penicillate setae and one aesthetasc.

Antenna (Fig. 80B) of six articles, proximal article compact, naked; second article as long as wide, with single inner distal and dorsodistal slender spines; third article as long as second and just longer than wide, with dorsodistal stouter spine (Fig. 80b'); fourth article longest, 3.8 times as long as wide and twice as long as third, with short mesial setae and distal tufts of penicillate and simple setae; fifth article 0.7 times as long as fourth; sixth article minute with six distal setae.

Labrum (Fig. 80C) hood-shaped, setose. Left mandible (Fig. 80D) with crenulate lacinia mobilis wider than distal end of mandible, distal crenulation on pars incisiva, pars molaris with strong rugosity; right mandible (Fig. 80E) similar but without lacinia mobilis, crenulation of pars incisiva extending down inner margin. Labium (Fig. 80G) wide, bilobed, distally finely setose, without palp. Maxillule (Fig. 80F) with nine distally bifurcate spines and setose margins, rows of setules on inner distal face; palp distinct, with two distal setae. Maxilliped (Fig. 80H) palp first article naked, second article with finely setose inner margin, and with one outer and two inner setae, distal-most inner seta not reaching distal margin of third palp article; third and fourth articles with 11 inner marginal setae in two rows of 7 (dorsal) and 4 (ventrodistal); fourth article with one outer subdistal seta; basis with 4 to 6 long setae (sometimes asymmetrical – Fig. 80H') extending to distal edge of second palp article; endites (Fig. 80H") distally with fine outer setules, long outer seta and three robust spatulate spines, with additional subdistal pair of spatulate spines.

Cheliped (Fig. 81A) with rounded, comparatively stout basis 1.6 times as long as wide, with subdistal dorsal seta; merus triangular with three ventral setae; carpus 1.7 times as

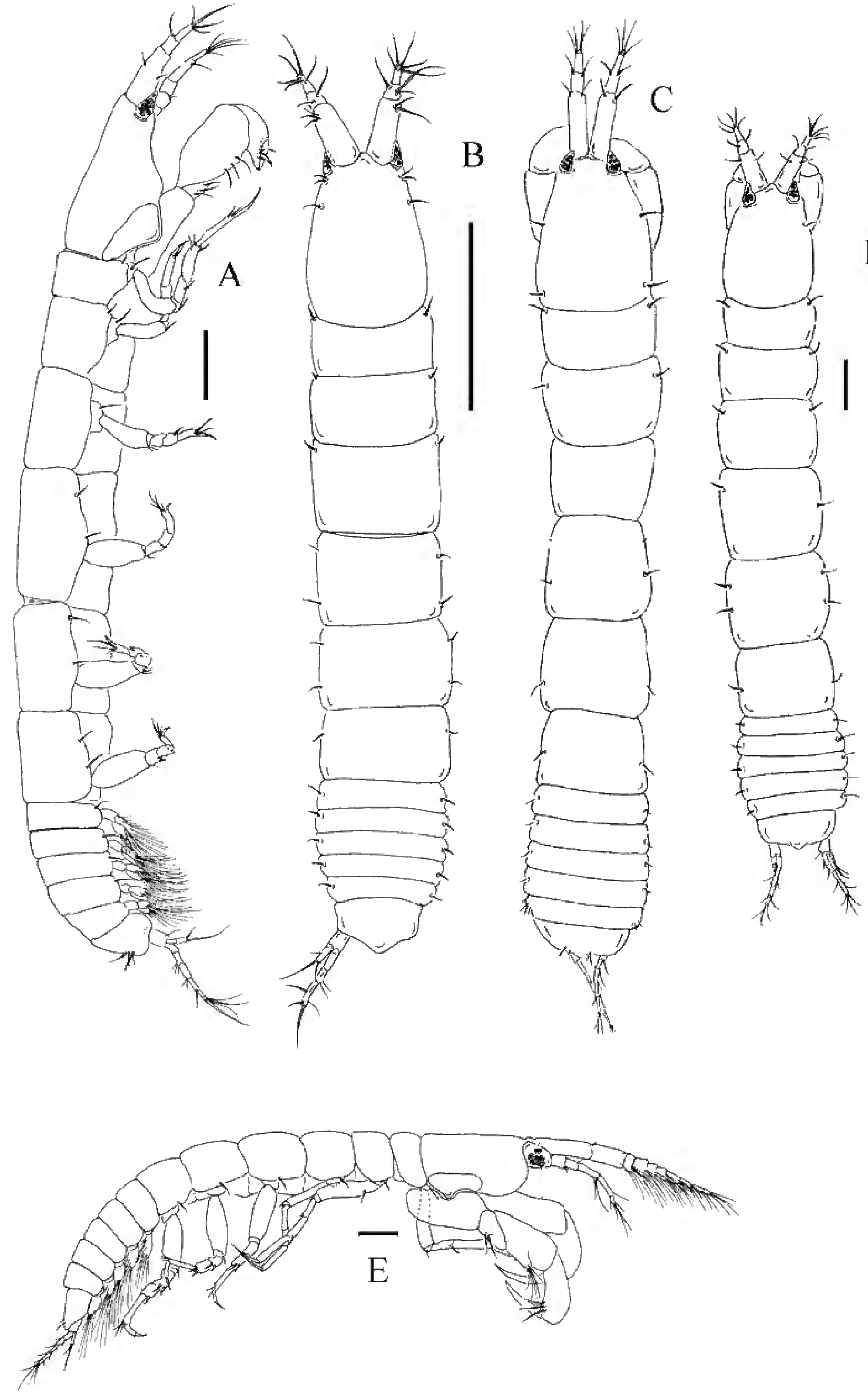


Fig. 79. *Pseudoleptochelia occiporta* sp. nov., holotype female. A, lateral view; B, manca, dorsal view; C, 4 mm female paratype; D, 3 mm female paratype; E, male lateral. Scale: A, B, D = 0.2 mm; E = 0.1 mm (scale for C as for D).

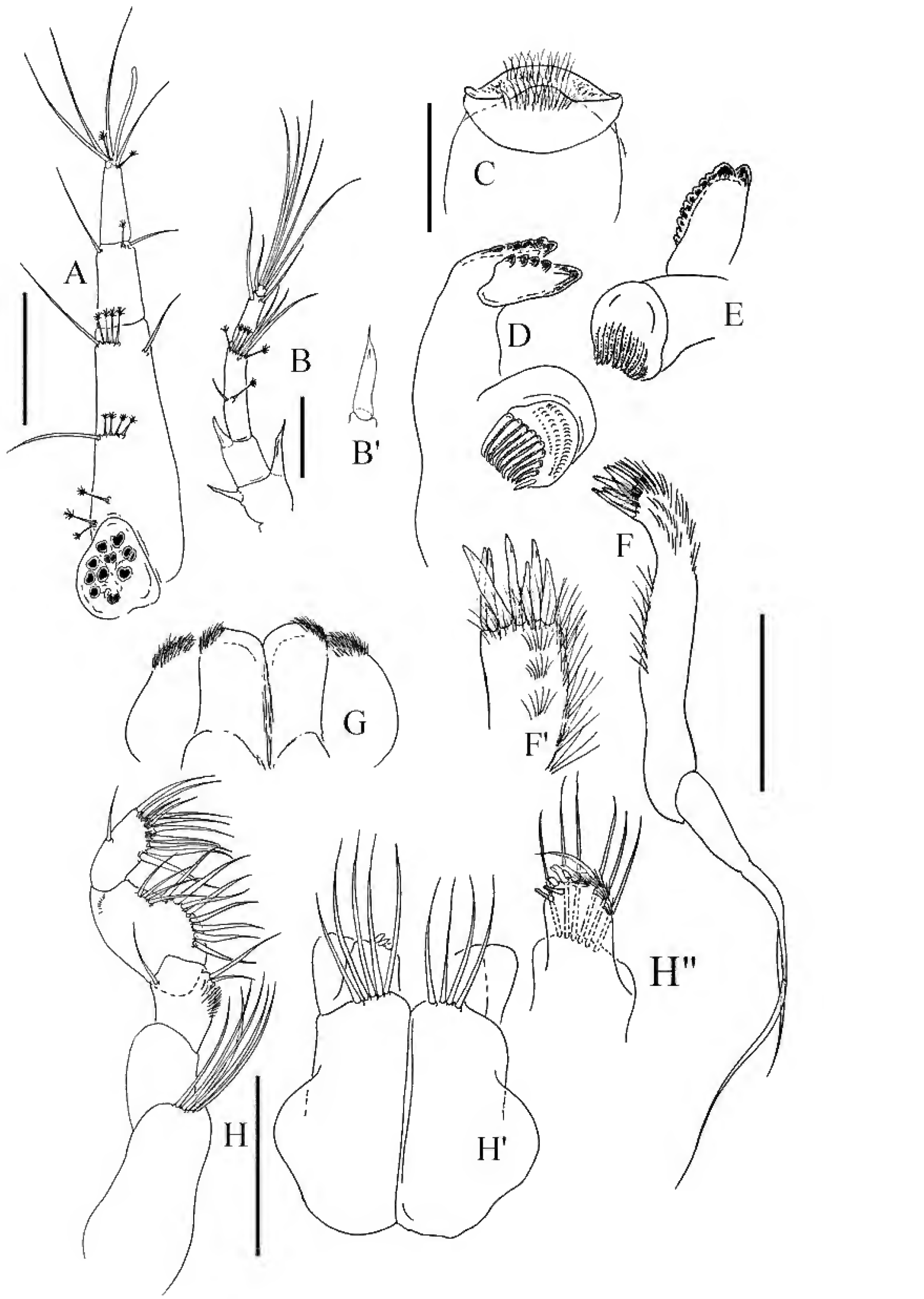


Fig. 80. *Pseudoleptochelia occiporta* sp. nov., female paratype. A, antennule; B, antenna (proximal article not shown); B', spine on antennal article 3; C, labrum; D, left mandible; E, right mandible; F, maxillule; F', maxillule endite details; G, labium; H, maxilliped; H', maxilliped bases of smaller female; H", endite of H. Scale = 0.2 mm.

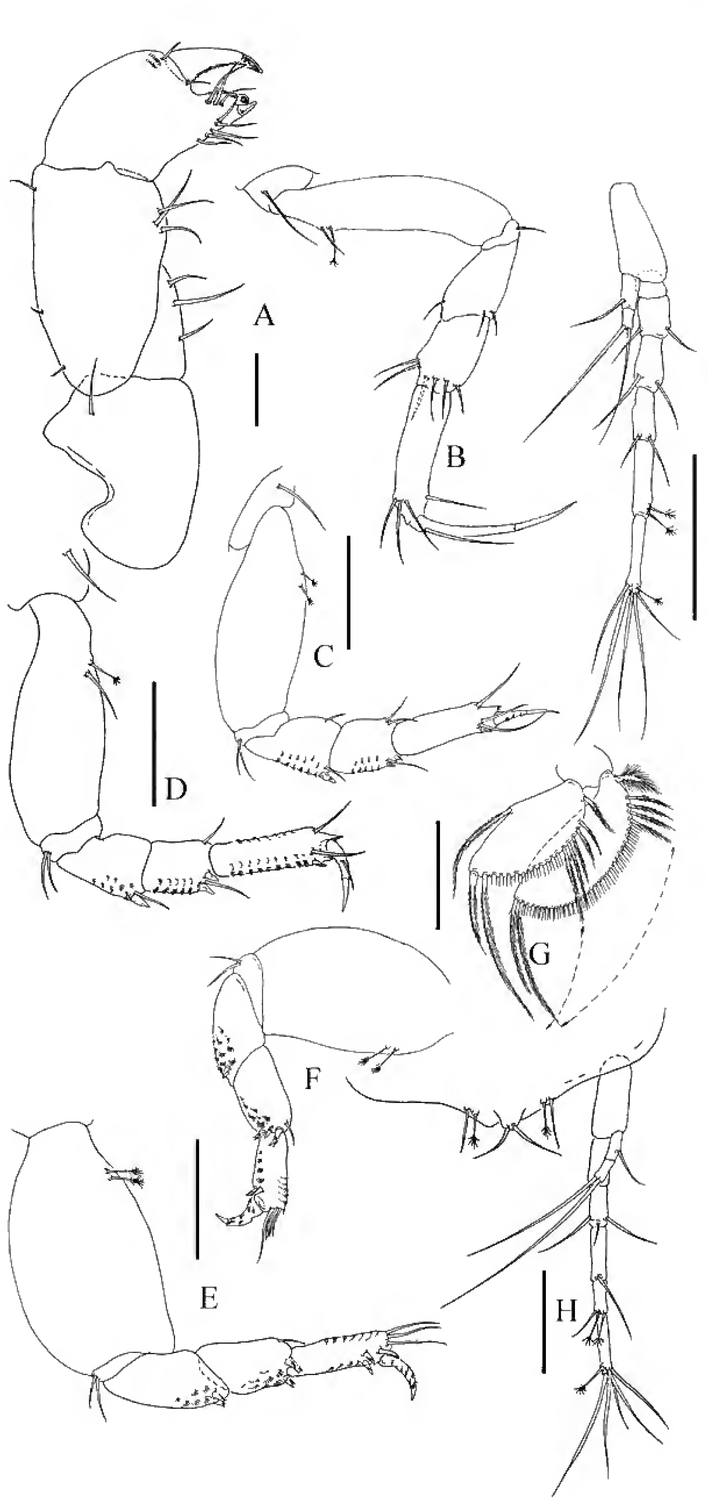


Fig. 81. *Pseudoleptochelia occiporta* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod H', uropod details. Scale = 0. 2 mm.

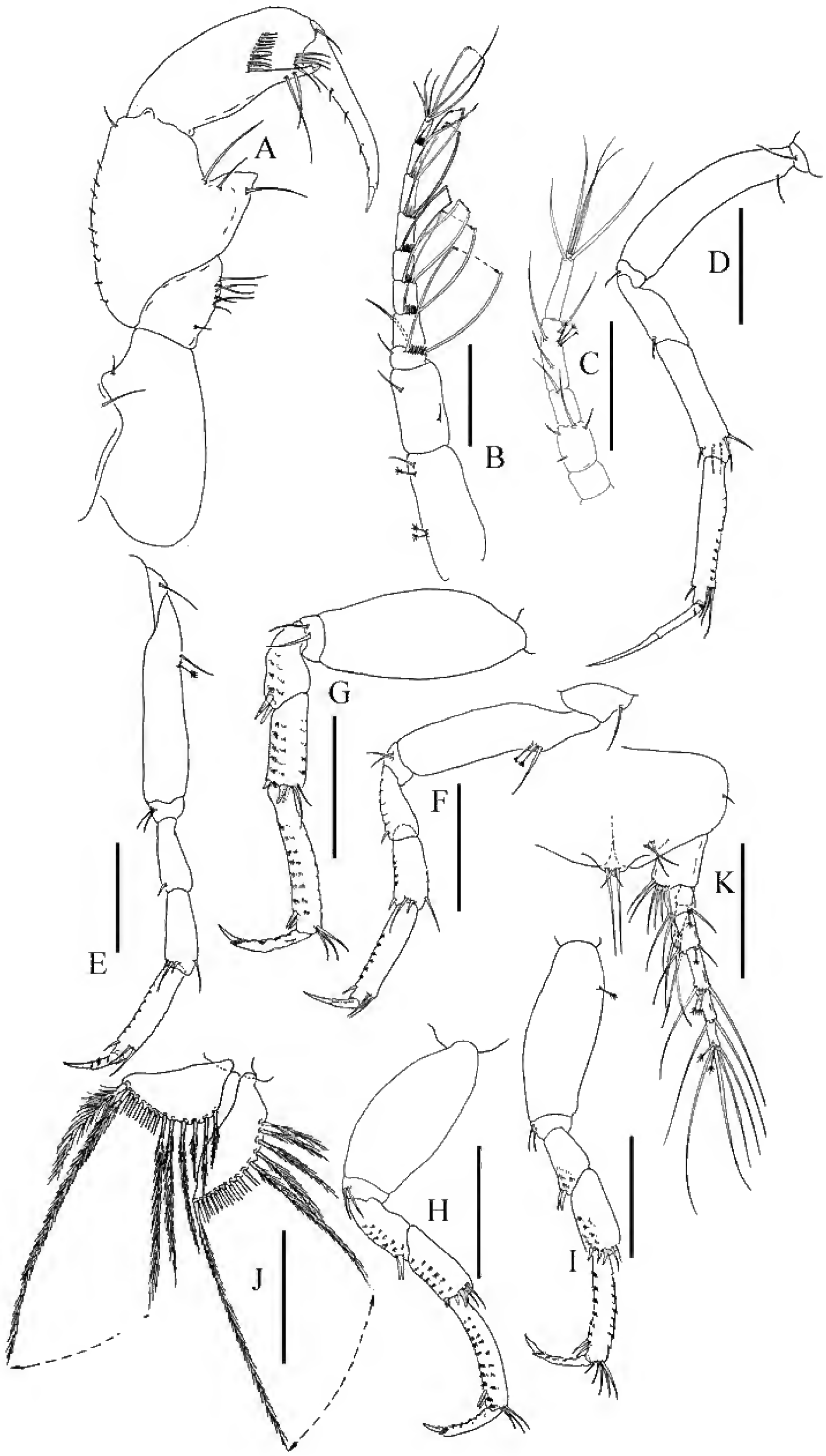


Fig. 82. *Pseudoleptochelia occiporta* sp. nov., male. A, cheliped; B, antennule; C, antenna; D, pereopod 1; E, pereopod 2; F, pereopod 3; G, pereopod 4; H, pereopod 5; I, pereopod 6; J, pleopod; K, uropod. Scale = 0. 1 mm.

long as wide, with three midventral setae and three shorter dorsal marginal setae; propodus as long as wide, with dorsodistal seta and one seta at base of dactylus; fixed finger with five ventral and three inner setae, cutting edge crenulate, subdistal claw; dactylus with finely-crenulate cutting edge.

Pereopod 1 (Fig. 81B) longer than other pereopods, coxa with long seta; basis slender, 4.4 times as long as wide, with single dorsoproximal simple and penicillate setae; ischium compact with one ventral seta; merus 0.9 times as long as carpus, with one dorsodistal and two ventrodistal setae; carpus with distal crown of two dorsodistal, one inner and two outer medial, and one ventrodistal setae, longest of which is much less than half length of propodus; propodus 1.5 times as long as carpus, with three setae on subdistal dorsal mound and one subdistal ventral seta; dactylus slender, curved, extending into shorter slender unguis 0.7 times as long as dactylus, the two together some 1.4 times as long as propodus. Pereopod 2 (Fig. 81C) more compact than pereopod 1; basis 2.45 times as long as wide; ischium with 2 setae; merus just longer than carpus and 1.1 times as long as wide, with single dorsodistal and ventrodistal setae and tooth-like ventrodistal spine and ventral rows of microtrichia; carpus with two dorsodistal and single ventrodistal setae and two small ventrodistal spines, and ventral rows of microtrichia; propodus 1.9 times as long as carpus, with three distal setae and dorsodistal sharp apophysis; dactylus and shorter unguis curved, together 0.6 times as long as propodus. Pereopod 3 (Fig. 81D) similar to pereopod 2, but merus and carpus with no and one dorsodistal setae, propodus with two distal setae.

Pereopod 4 (Fig. 81E) basis stout, 1.7 times as long as wide with two ventroproximal penicillate setae; ischium with two ventrodistal setae; merus with paired ventrodistal spines and ventral rows of microtrichia; carpus just shorter than merus, with one dorsodistal seta, outer, ventral and inner distal spines each with fine subdistal setules, and ventral rows of microtrichia; propodus 1.1 times as long as carpus, with two ventrodistal spines, three dorsodistal setae mostly as long as dactylus, serrated spines adjacent to dactylus articulation, and ventral rows of microtrichia; dactylus and distinct unguis curved, 0.6 times as long as propodus, dactylus with microtrichia. Pereopod 5 as pereopod 4. Pereopod 6 (Fig. 81F) as pereopod 4, but propodus with four shorter and one longer distal setae.

Pleopods (Fig. 81G) all alike, typical for the genus, basis naked, endopod with single inner plumose seta and proximal outer seta separated from remainder.

Uropod (Fig. 81H) biramous, basis naked; exopod of two segments, as long as proximal endopod segment, outer distal seta longer than inner distal seta; endopod of five or six segments, distal segments slender.

*Description of male*. Smaller than female (allotype length 1.5 mm), body (Fig. 79E) more compact, cephalon 1.25 times as long as pereonites 1 to 3 together, with large eyelobes bearing large black eyes; pereonite 1 shortest, pereonite 2 just longer, pereonites 3 and 6 subequal, 1.8 times as long as pereonite 1, pereonites 4 and 5 twice as long as pereonite 1. Five free pleonites, subequal in length, as long as pereonite 1, pleotelson as long as pleonites 4 and 5 together. Pleotelson with much longer distal setal pair (Fig. 82K).

Antennule (Fig. 82B) first peduncle article 2.4 times as long as wide, with paired dorsomedial penicillate setae and single dorsodistal penicillate and simple setae; second article 0.65 times as long as first with single ventroproximal and dorsal subdistal simple setae; third article 0.3 times as long as second with single ventrodistal simple seta; flagellum of 8 segments, segment 1 with proximal and distal rows of aesthetascs, segments 2 to 7 bearing distal row of 5 or 6 aesthetascs, segment 8 minute, distally with four simple setae.

Antenna (Fig. 82C) of six articles, proximal article compact, naked; second article longer than wide, longer than first article, with single dorsoproximal and three distal seta; third article shorter than second, 1.6 times as long as wide, with single simple distal seta; fourth article nearly twice as long as third, with mesial seta and distal tufts of penicillate and simple setae; fifth article as long as fourth with two long distal setae; sixth article minute, with three simple distal setae.

Mouthparts atrophied.

Cheliped (Fig. 82A) with subchelate chela; basis twice as long as wide; merus short, with seven ventral setae; carpus 1.9 times as long as wide but with large subtriangular ventral apophysis bearing the three midventral setae, dorsal margin with continuous row of nine setae; propodus twice as long as wide with dorsodistal seta, fixed finger reduced to small apophysis with claw, with three ventral setae, three setae adjacent to remains of cutting edge, inner diagonal comb-row of ten shorter and one longer setae; dactylus slender, curved, as long as propodus, with row of four setae along cutting edge.

Pereopods (Fig. 82D to I) similar to but more slender than those of female, with in particular more elongate propodi; merus shorter than carpus on pereopods 1 to 3; on pereopods 4 to 6 propodus much longer than carpus, ventrodistal merus spines more elongate than those of female, dactylus proportionately longer than in female.

Pleopods (Fig. 82J) with longer setae than on those of female. Uropod (Fig. 82K) basis with inner distal row of setae; exopod two-segmented, longer than proximal endopod segment; endopod of five segments, less-elongate and more heavily setose than that of female.

*Distinctions of manca*. Smaller than female (Fig. 79B), similar in morphology and proportions, uropod exopod of one segment.

*Etymology*. From the Latin *occidentalis* – western, and *portus* – a port, the species mainly occurring in, and common in, Western Port, Victoria.

*Remarks*. The genus *Pseudoleptochelia* is in need of review. Bird & Bamber (2000) listed twelve species in the genus, since when three further species have been described, *P. fairgo* Bamber, 2005, and *P. straddi* Bamber, 2008, both from Australia, and *P. bulbus* Bamber, 2006 from New Caledonia. However, the male of *P. bulbus*, and *P. straddi* (known only from the male) are currently suspected to be species of a different genus (Bamber, in prep.). Many of these *Pseudoleptochelia* species are poorly described, particularly their females and their mouthparts, some being known only from males.

Lang (1973) diagnosed the genus *Pseudoleptochelia* as having stout posterior pereopod bases, with spines on the second and third antennal peduncle articles (as in *Leptochelia*), the uropod exopod with one or two segments, the endopod with at least three segments, and the maxilliped bases with two distal setae. Unfortunately, Lang (*ibid*.) based his genus on *Heterotanais anomalus* Sars, 1882, the female of which is not fully described, and on his own new species, *Pseudoleptochelia mortenseni*, which, judging from his figure 16, is clearly a chimaera, as the antennule of "a small female" (Lang, 1873: fig. 16g) is typical of a species of *Konarus* Bamber, 2006 or *Parakonarus* Bird, 2011, and not *Pseudoleptochelia sens. auctt*., casting doubt on with which female his subchelate male should be associated (see Bird, 2011). In practice, the maxilliped-basis setation and female antennal spination are unknown in at least half of the *Pseudoleptochelia* species.

*Pseudoleptochelia occiporta* sp. nov. is consistent with the generic diagnosis of Lang (loc. cit.) except for its having 4 to 6 maxilliped-basis setae, a feature of three other leptocheliid genera, *Leptochelia*, *Konarus* and *Parakonarus*. It shares this feature, as well as the five distal spatulate spines on the maxilliped endite, with *P. bulbus* Bamber, 2006 from New Caledonia, a species differing owing to its one-segmented uropod exopod and distinct setation of the pereopod 1 carpus, *inter alia*.

The genera *Konarus* and *Parakonarus* both have setae rather than spines on the second and third antennal peduncle articles, and an unguis distinctly longer than the dactylus on pereopod 1, unlike the present species. We therefore choose to place the present species in *Pseudoleptochelia* until the genus has been properly resolved.

The only currently accepted species of *Pseudoleptochelia* recorded previously from Australia is *P. fairgo*, known from Esperance, Western Australia, and Brisbane, Queensland (Bamber, 2005; 2008). The female of *P. fairgo*, which also has four maxilliped-basis setae, is unique in the genus in having setose tubercles on the merus of pereopods 4 to 6, and a tuft of elongate setae on the cheliped carpus pointing proximally in life, neither feature being present in *P. occiporta*.

The male of the present species has a rounded apophysis on the carpus of the cheliped like *Pseudoleptochelia fairgo*, but differs from that species in that *P. fairgo* has a ventrodistal apophysis on the propodus of the cheliped which is wider and rounded (slender and pointed in *P. occiporta*) and a strong dorsodistal seta on the third antennular peduncle article as long as the proximal four flagellum segments (only a very small dorsodistal seta in *P. occiporta*). In *P. occiporta* the uropod exopod is two-segmented in both sexes, but the exopod in *P. fairgo* is one-segmented with only an incipient fusion line. Of the four *Pseudoleptochelia* species having a two-segmented uropod exopod, none have a ventral carpal apophysis on the male cheliped as found in *P. occiporta*.

*Pseudoleptochelia occiporta* was taken at depths between 3 and 51 m, on gravelly to muddy sands, mainly in Western Port.

## Genus ***Bassoleptochelia*** gen. nov.

*Diagnosis*. Female with 4-articled antennule, third article longer than second; antenna with setae rather than spines on articles 2 and 3; mandibles with relatively simple lacinia mobilis and pars molaris, maxilliped with three basal setae, elongate distal spatulate spines on endites, setae on palp article 2 simple; cheliped very slender, merus covering less than half of ventral margin of carpus and with ventral tuft of numerous long setae, propodus (palm of chela) longer than wide, fixed finger with two ventral setae; pereopod 1 with elongate merus and distal crown of setae on carpus, dactylus longer than unguis; merus, carpus, propodus and dactylus of pereopods 4 to 6 with fields of microtrichia, carpus of pereopod 6 with dense brush of microtrichia (prickly tubercle); uropod exopod 1-segmented, endopod 4-segmented. Otherwise typical of the family. Male showing dimorphism in the antennule with secondary segmentation of the flagellum to more than 5 segments; cheliped slender, chela almost subchelate, fixed finger one-third as long as dactylus, distal edge of propodus with triangular tooth-like apophysis, comb-row vertical; pereopods more slender than those of female, posterior pereopods ambulatory.

*Type species*. *Bassoleptochelia verro* sp. nov. by monotypy.

*Etymology*. Named for the Bass Strait, plus –*Leptochelia* (female).

*Remarks*. The species described below has the gross appearance of a typical leptocheliid, but the tufts of microtrichia on the posterior pereopods are not found in any other species of the family (being more like those found on some typhlotanaid species – see Błażewicz-Paszkowycz, 2007). Among Australian leptocheliids, the "brush" of long setae on the cheliped merus is also found in *Pseudoleptochelia fairgo*, although in that species they point proximally in life. Equally, the male is unusual for the family in having ambulatory posterior pereopods, which must develop secondarily from those of the subadult form which are like those of the female, and in the unique cheliped chela, which falls somewhere between the normal chelate form of most genera and the subchelate form found in some species of *Pseudoleptochelia* and *Parakonarus*. The mouthparts are also atypical of the family, in having simple inner setae on the second palp article of the maxilliped, while the mandibular lacinia mobilis and pars molaris are both simple, rather than crenulate or rugose, respectively.

### ***Bassoleptochelia verro*** sp. nov.

Figures 83–86

*Material examined*. 1 ♀ (J58469), holotype, 5 ♀♀ (J55822), paratypes, Stn 81-T-1 177, 38°53.7'S 147°06.5'E, 58 m depth, coarse shell, 18 November 1981. 1 ♂ (J58471), allotype, 1 ♀ (J56650), paratype, Stn 81-T-1 199, 40°19.5'S 143°48.8'E, 71 m depth, sandy shell, 22 November 1981. 4 ♀♀ (J56657), 1 ♀ (J56652), paratypes, Stn 81-T-1 203, 39°22.0'S 144°18.3'E, 60 m depth, coarse sand, 23 November 1981. 13 ♀♀ (J56646), paratypes, Stn 81-T-1 180, 39°12.9'S 146°27.3'E, 65 m depth, medium sand, 18 November 1981. 1 ♀ (J56643), paratype, Stn 81-T-1 187, 38°32.0'S 147°28.6'E, 52 m depth, medium sand, 20 November 1981. All coll. R.S. Wilson, RV *Tangaroa*. 8 ♀♀, 1 ♂ (J56651), paratypes, Stn 81-Sa-1 116, 40°32.0'S 145°23'E, 43 m depth, muddy shell and grit, 4 November 1980, coll. M.F. Gomon & G.C.B. Poore, FRV *Sarda*.

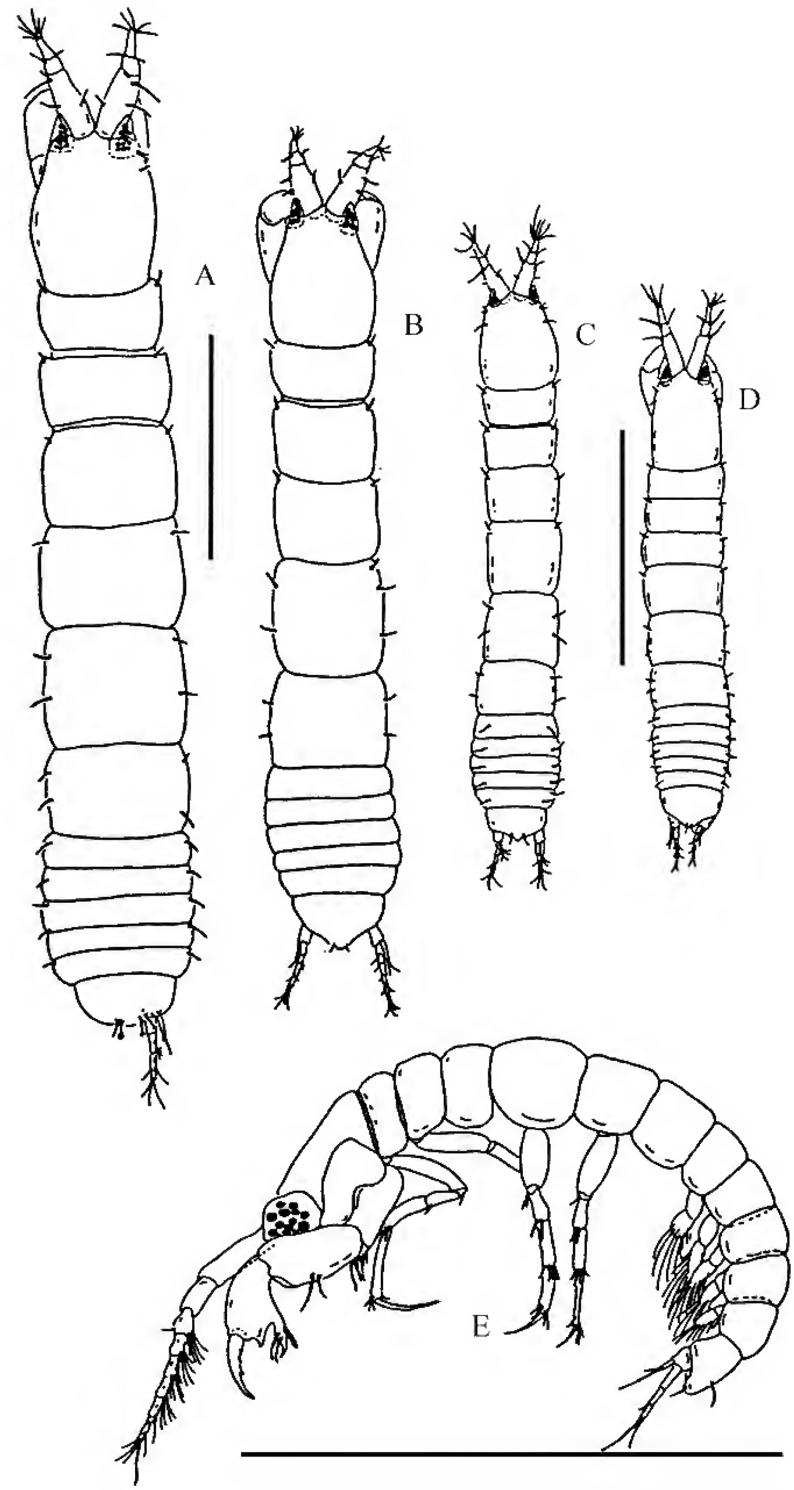


Fig. 83. *Bassoleptochelia verro* sp. nov. A, female holotype, dorsal; B, neuter; C, juvenile; D, manca II; E, male, lateral. Scale = 1mm.


Fig. 84. *Bassoleptochelia verro* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, right mandible; E, incisor and E', molar of left mandible; F, maxillule; G, labium; H, maxilliped and H' endite. Scale = 0.1mm.


Fig. 85. *Bassoleptochelia verro* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6 with F' distal detail; G, pleopod; H, uropod. Scale = 0.1mm.

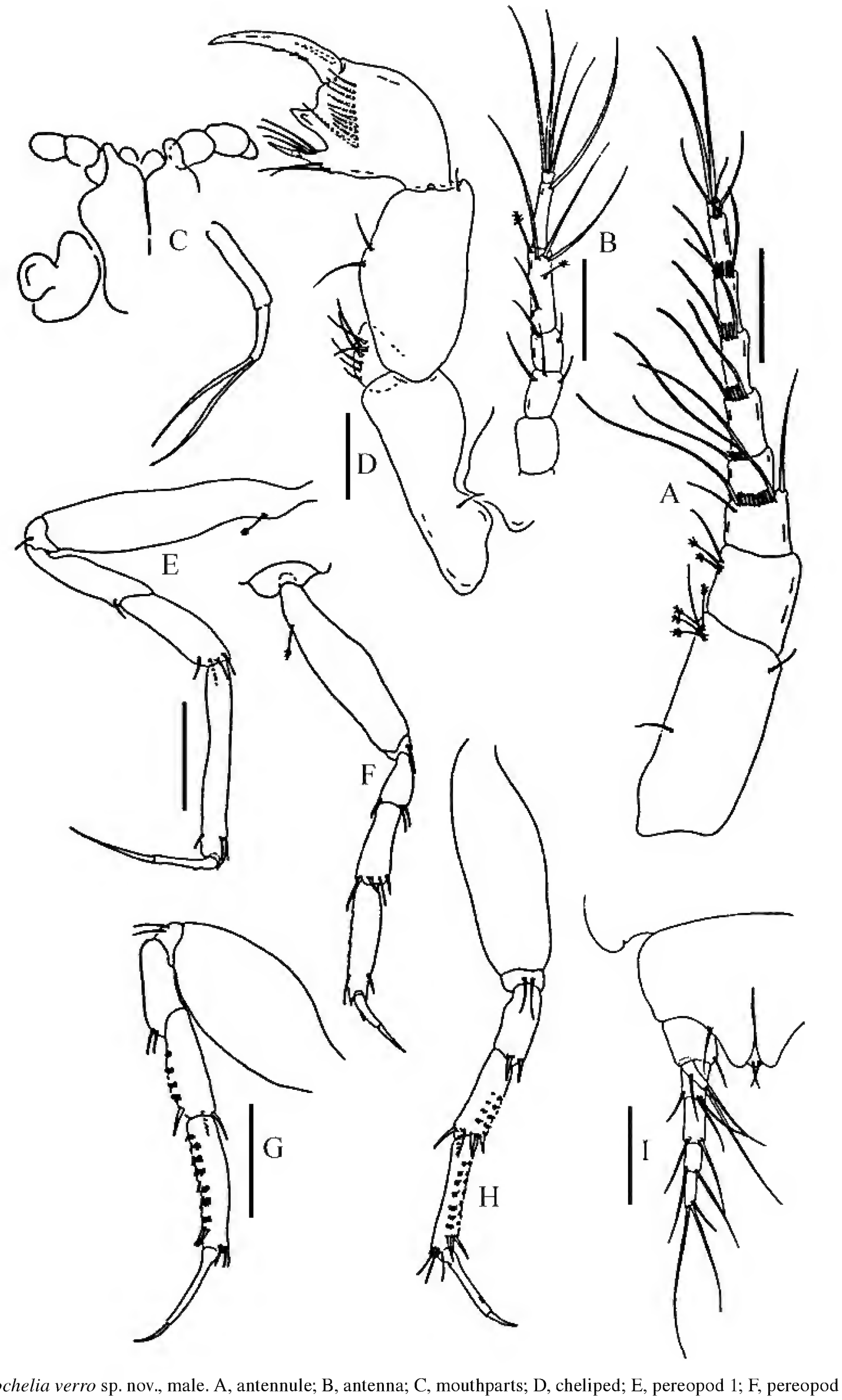


Fig. 86. *Bassoleptochelia verro* sp. nov., male. A, antennule; B, antenna; C, mouthparts; D, cheliped; E, pereopod 1; F, pereopod 2; G, pereopod 4; H, pereopod 5; I, uropod. Scale = 0.1mm.

*Description of female*. Body (Fig. 83A) narrowing anteriorly, holotype 3.8 mm long, 6.4 times as long as wide. Cephalothorax subrectangular, laterally convex, tapering towards anterior, 1.4 times as long as wide, longer than pereonites 1 and 2 together, with slight triangular rostrum, eyelobes extended into spine-like apophysis (Fig. 84A), eyes present and black, single setae at posterior of eyelobes. Pereonites 1 to 4 with single anterolateral setae, pereonites 5 and 6 with paired lateral setae on each side; pereonites 1 and 2 subequal and shortest, pereonites 3, 4 and 6 subequal, 1.6 times as long as pereonite 1, pereonite 5 longest and twice as long as pereonite 1 (all pereonites respectively 2.0, 2.0, 1.3, 1.5, 1.2 and 1.5 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite about 5.3 times as wide as long, with single midlateral seta. Pleotelson pentangular, as long as last two pleonites together, twice as wide as long, with one simple and one penicillate posterolateral seta on each side and two distal setae.

Antennule (Fig. 84A) of three longer and one minute distal articles, proximal article 2.4 times as long as wide, 1.6 times as long as distal three articles together, with mesial and distal inner groups of penicillate setae, inner and outer simple mesial setae, outer distal seta and one long inner distal seta longer than tip of antennule, outer margin of article finely setulose in proximal half; second article as long as wide, one-quarter as long as first article, inner and outer distal setae three times as long as article; third article 1.3 times as long as second, with two distal setae; fourth article minute, distally with three simple setae, one penicillate seta and one aesthetasc.

Antenna (Fig. 84B) of six articles, proximal article longer than wide, naked; second article as long as wide, with single inner distal and dorsodistal strong setae; third article half as long as wide, one-third as long as second article, with dorsodistal slender seta; fourth article longest, 3.2 times as long as wide and 4.5 times as long as third, with distal crown of penicillate and simple setae; fifth article 0.6 times as long as fourth; sixth article minute, with three simple distal setae.

Labrum (Fig. 84C) hood-shaped, finely setose. Left mandible (Fig. 84E) with simple subrectangular lacinia mobilis, pars incisiva distally bilobed with crenulation on proximal inner margin, pars molaris narrow with slight marginal crenulation distally; right mandible (Fig. 84D) similar but without lacinia mobilis, pars incisiva distally crenulate. Labium (Fig. 84G) wide, bilobed, distally finely setose, outer lobe with single outer distal seta, without palp. Maxillule (Fig. 84F) with eight distal spines, outer distal tuft of setules, rows of setules on inner face; palp with distinct articulation, with two distal setae. Maxilla not recovered. Maxilliped (Fig. 84H) palp first article elongate, naked; second article with four simple inner setae; third article with five inner marginal finely-denticulate setae; fourth article with six longer and one shorter distal finely denticulate setae and one outer subdistal seta; basis with three long setae extending to third palp article; endites distally with fine outer setules and three elongate spatulate spines and long inner simple seta. Epignath not recovered.

Cheliped (Fig. 85A) with elongate slender basis 3.5 times as long as wide; merus subtriangular with brush of nine ventral setae and one outer dorsoproximal seta; carpus twice as long as wide, with three midventral setae on slightly flattened edge and four shorter dorsal marginal setae, dorsoproximal margin of carpus slightly crenulate; propodus relatively slender, 1.3 times as long as wide, with inner distal comb of three setae and longer seta at base of dactylus; fixed finger with two ventral and three inner setae, cutting edge crenulate; dactylus with proximal seta, cutting edge simple.

Pereopod 1 (Fig. 85B) slender, longer than other pereopods, coxa with seta; basis 3.5 times as long as wide, with single dorsoproximal simple seta; ischium compact with one ventral seta; merus slender, six times as long as wide and as long as carpus, with one dorsodistal seta; carpus widening distally, with single ventrodistal, inner and outer distal and dorsodistal setae, longest of which is less than half length of propodus; propodus 1.5 times as long as carpus, with three setae on subdistal dorsal mound and one subdistal ventral seta; dactylus slender, extending into longer slender unguis 1.4 times as long as dactylus, the two together 0.85 times as long as propodus. Pereopod 2 (Fig. 85C) more compact than pereopod 1; basis 2.2 times as long as wide, with dorsoproximal penicillate seta; ischium with two ventral setae; merus as long as carpus and as long as wide, with small ventrodistal spine, ventrodistal seta and ventral rows of microtrichia; carpus with single dorsodistal and two ventrodistal setae and ventral rows of microtrichia; propodus 1.6 times as long as carpus, with two distal setae, dorsodistal sharp apophysis and ventral rows of microtrichia; dactylus and subequal unguis only slightly curved, together 0.9 times as long as propodus, proximal seta on dactylus. Pereopod 3 (Fig. 85D) similar to pereopod 2, but basis with fields of microtrichia, merus without ventrodistal spine.

Pereopod 4 (Fig. 85E) basis stout, twice as long as wide with midventral penicillate seta; ischium with two ventrodistal setae; merus with paired ventrodistal slender spines and ventral rows of microtrichia; carpus just longer than merus, with dorsodistal seta and ventral rows of microtrichia; propodus as long as carpus, with two ventrodistal spines, three dorsodistal setae longer than dactylus, and ventral rows of microtrichia; dactylus and distinct, short unguis curved, 0.9 times as long as propodus, with lateral rows of microtrichia. Pereopod 5 as pereopod 4. Pereopod 6 (Fig. 85F) as pereopod 4, but carpus with dense field of microtrichia, propodus with four distal setae.

Pleopods (Fig. 85G) all alike, typical for the genus, basis naked, endopod with single inner plumose seta and proximal outer seta separated from remainder.

Uropod (Fig. 85H) biramous, basis with outer distal seta; exopod of one segment, as long as proximal endopod segment, outer distal seta longer than inner distal seta; endopod of four segments, distal segment slender.

*Subadults*. Neuter, juvenile and manca essentially smaller versions of adult female (Figs 83B, C, D).

*Description of male*. Smaller than female (allotype length 1.5 mm), body (Fig. 83E) more compact, cephalon as long as pereonites 1 to 3 together, with large eyelobes bearing large black eyes; pereonite 1 shortest, pereonites 2 and 3 respectively 1.3 and 1.5 times as long as pereonite 1, pereonite 4 longest, 2.7 times as long as pereonite 1, pereonites 5 and 6 progressively shorter, respectively 2.2 and 1.8 times as long as pereonite 1. Five free pleonites, subequal in length, each as long as pereonite 2, pleotelson 1.4 times as long as pleonite 5.

Antennule (Fig. 86A) peduncle compact, first peduncle article twice as long as wide, with ventrodistal tuft of penicillate and simple setae; second article 0.4 times as long as first and as long as wide, with ventrodistal tuft of penicillate and simple setae; third article 0.25 times as long as first and slightly shorter than wide with single ventral and long dorsal distal simple setae; flagellum of 6 segments, segment 1 with proximal and distal rows of aesthetascs, segments 2 to 5 bearing distal row of 3 to 5 aesthetascs, segment 6 with four distal setae.

Antenna (Fig. 86B) of six articles, proximal article longer than wide, naked; second article as long as first, with three distal setae; third article shorter than second, with two distal setae; fourth article longest, 1.6 times as long as second and 4 times as long as wide, with mesial simple and penicillate setae and distally one penicillate and three long simple setae; fifth article 0.8 times as long as fourth; sixth article minute, with four simple distal setae.

Mouthparts (Fig. 86C) atrophied, naked maxilliped and maxillule palp with two distal setae distinguishable.

Cheliped (Fig. 86D) proportionately larger than that of female; basis three times as long as wide; merus short, with brush of seven ventral setae; carpus 1.8 times as long as wide, with twp midventral setae. Propodus almost square, 1.3 times as long as wide, fixed finger short with slender distal claw, with two ventral setae and three setae adjacent to naked, simple cutting edge; large, triangular tooth-like apophyses on distal face of propodus, and inner vertical comb-row of 8 shorter and one longer setae; dactylus slender, curved, nearly three times as long as propodal fixed finger, with proximal seta and three spinules on cutting edge, articulation of unguis obscure.

Pereopod 1 (Fig. 86E) similar to that of female but propodus proportionately longer (1.8 times as long as carpus) and more elongate; pereopods 2 (Fig. 86F) and 3 similar to but shorter than pereopod 1, carpus with distal crown of setae. Pereopods 4 to 6 (e.g. Fig. 86G, H) ambulatory, merus, carpus and propodus slender, all distal spines more elongate than those of female but distal setae proportionately shorter, microtrichia restricted to carpus and propodus without dense brush on pereopod 6, dactylus long and slender, naked, 0.7 times as long as propodus, unguis just less than half as long as dactylus.

Pleopods with longer setae than on those of female. Uropod (Fig. 86I) similar to that of female.

*Etymology*. From the Latin – *verro* – a brush, in reference to the tuft of setae on the cheliped merus and the dense fields of microtrichia on the posterior pereopods, especially the carpus of pereopod 6, analogous to the "prickly tubercles" found in some typhlotanaids (noun in apposition).

*Remarks*. The numerous distinctions of this species from other leptocheliids are described under the remarks for the genus, and again it contributes to the great diversity of the Leptocheliidae in Australian waters. *Bassoleptochelia verro* sp. nov. was found on coarser sandy substrata at depths from 43 to 71 m right across the Bass Strait.

## Family **Tanaellidae** Larsen & Wilson, 2002

*Remarks*. The family Tanaellidae was erected to include four genera, *Araphura* Bird & Holdich, 1984; *Araphuroides* Sieg, 1986(a); *Arthrura* Kudinova-Pasternak, 1966, and *Tanaella* Norman & Stebbing, 1886.

In particular, *Araphuroides* was split from *Araphura* by Sieg (1096a) for two species, *Araphura brevispina* Bird & Holdich, 1984 and *Araphuroides parabreviremis* Sieg, 1986. Features distinguishing these two genera have been discussed subsequently and inconsistently (e.g. Sieg & Dojiri, 1989; Larsen, 2005; Larsen et al., 2009). The tanaellid taxa described herein confound this issue further, and their generic attribution is discussed below after their description.

### Genus ***Araphura*** Bird & Holdich, 1984

#### ***Araphura pygmothymos*** sp. nov.

Figures 87–89

*Material examined*. 1 ♀ (J58833), holotype, Central Bass Strait, 66 km S of Rodondo Island, Stn BSS 158, 39°48.6'S 146°18.8'E, 82 m depth, sand with silt and mud, 13 November 1981; 1 ♀ (J58834), paratype, same data as holotype; 1 ♀ (J56692), paratype, Central Bass Strait, 100 km SSE of Cape Liptrap, Victoria, Stn BSS 156, 39°45.90'S 145°33.3'E, 74 m depth, muddy fine sand, 13 November 1981; 1 ♀ (J58835), paratype, Central Bass Strait, 38 km SW of Cape Paterson, Stn BSS 155, 38°55.5'S 145°17.00'E, 70 m depth, fine sand, 12 November 1981; all coll. R.S. Wilson.

*Description of female*. Body (Fig. 87A, B) slender, holotype 2 mm long, 9.7 times as long as wide. Cephalothorax subrectangular, narrowing anteriorly with slight triangular rostrum, 1.6 times as long as wide, twice as long as pereonite 1, naked, eyes absent. Pereonites all naked and rectangular; pereonites 1 and 5 subequal in length; pereonites 2 to 4 subequal, 1.2 times as long as pereonite 1; pereonite 6 shortest, 0.8 times as long as pereonite 5 (all pereonites respectively 1.3, 0.9, 0.9, 0.9, 1.0 and 1.3 times as wide as long). Pleon of five free subequal pleonites bearing pleopods plus pleotelson; each pleonite 4.2 times as wide as long. Pleotelson subrectangular, as long as all pleonites together, 1.25 times as long as wide.

Antennule (Fig. 88A) of four articles, proximal article nearly 2.6 times as long as wide, as long as distal three articles together, with single outer distal simple seta surrounded by four penicillate setae; second article longer than wide, 0.43 times as long as first article, with three outer distal penicillate setae; third article compact, 0.6 times as long as second article, naked; fourth article tapering, with six simple and one penicillate distal setae, and one aesthetasc.

Antenna (Fig. 88B) of six articles, proximal article compact, fused to cephalothorax; second article 1.3 times as long as wide, with dorsodistal seta; third article as long as wide, 0.8 times as long as second article, with dorsodistal seta; fourth article longest, 4.5 times as long as wide, nearly three times as long as second article, with penicillate seta in proximal half and crown of one simple and four penicillate distal setae; fifth article half as long as second, with one distal simple seta; sixth article minute with four distal setae.

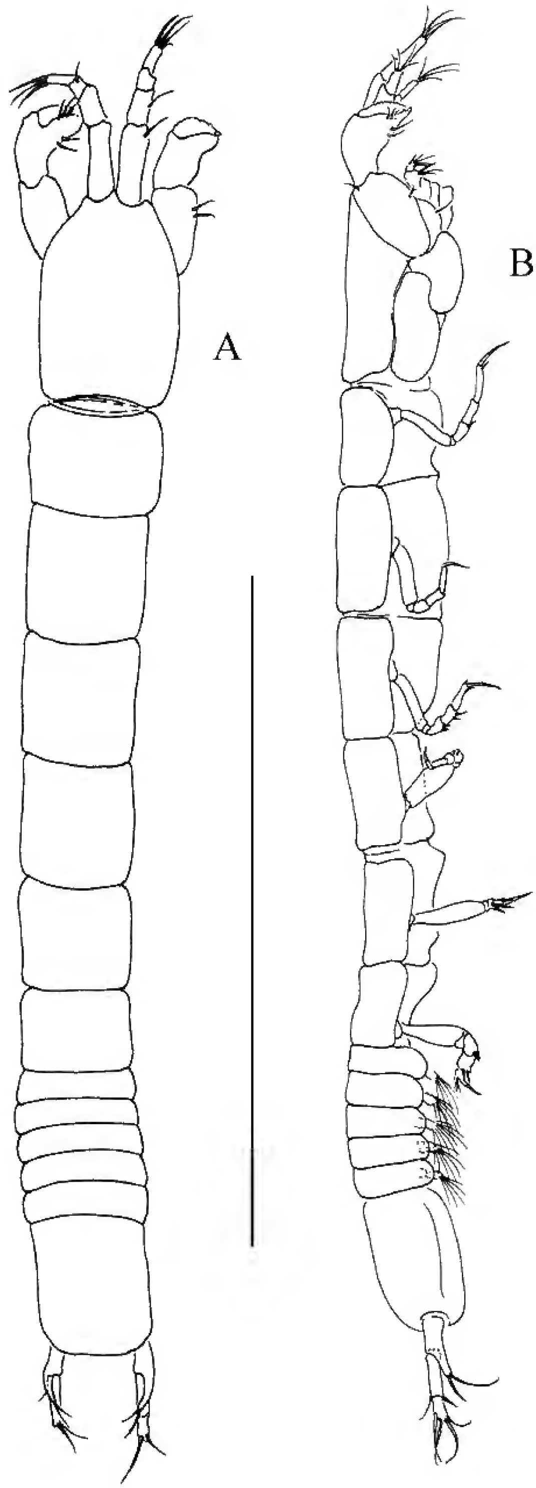


Fig. 87. *Araphura pygmothymos* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1.0 mm.

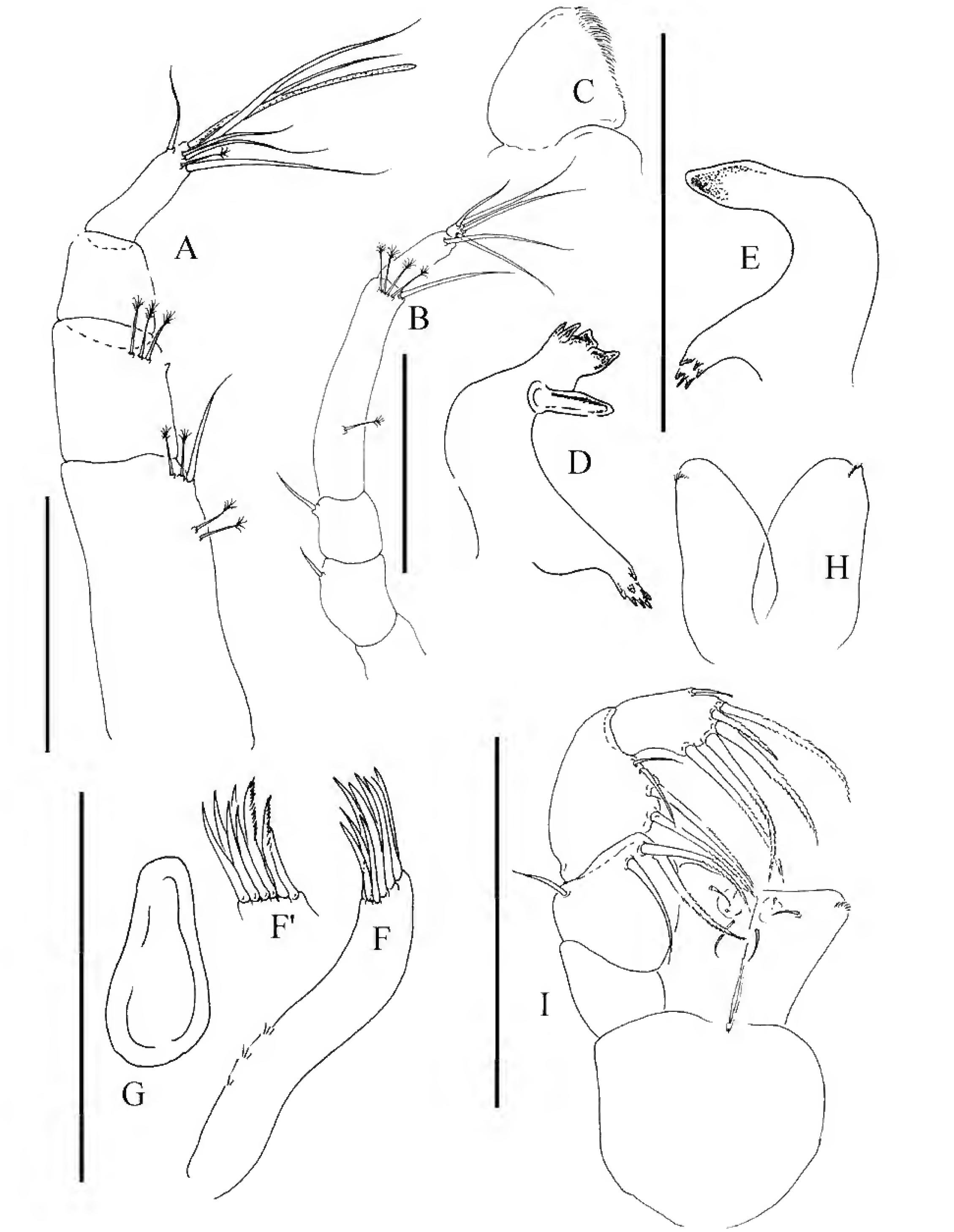


Fig. 88. *Araphura pygmothymos* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; F' maxillule endite spines; G, maxilla; H, labium; I, maxilliped. Scale = 0.1 mm.

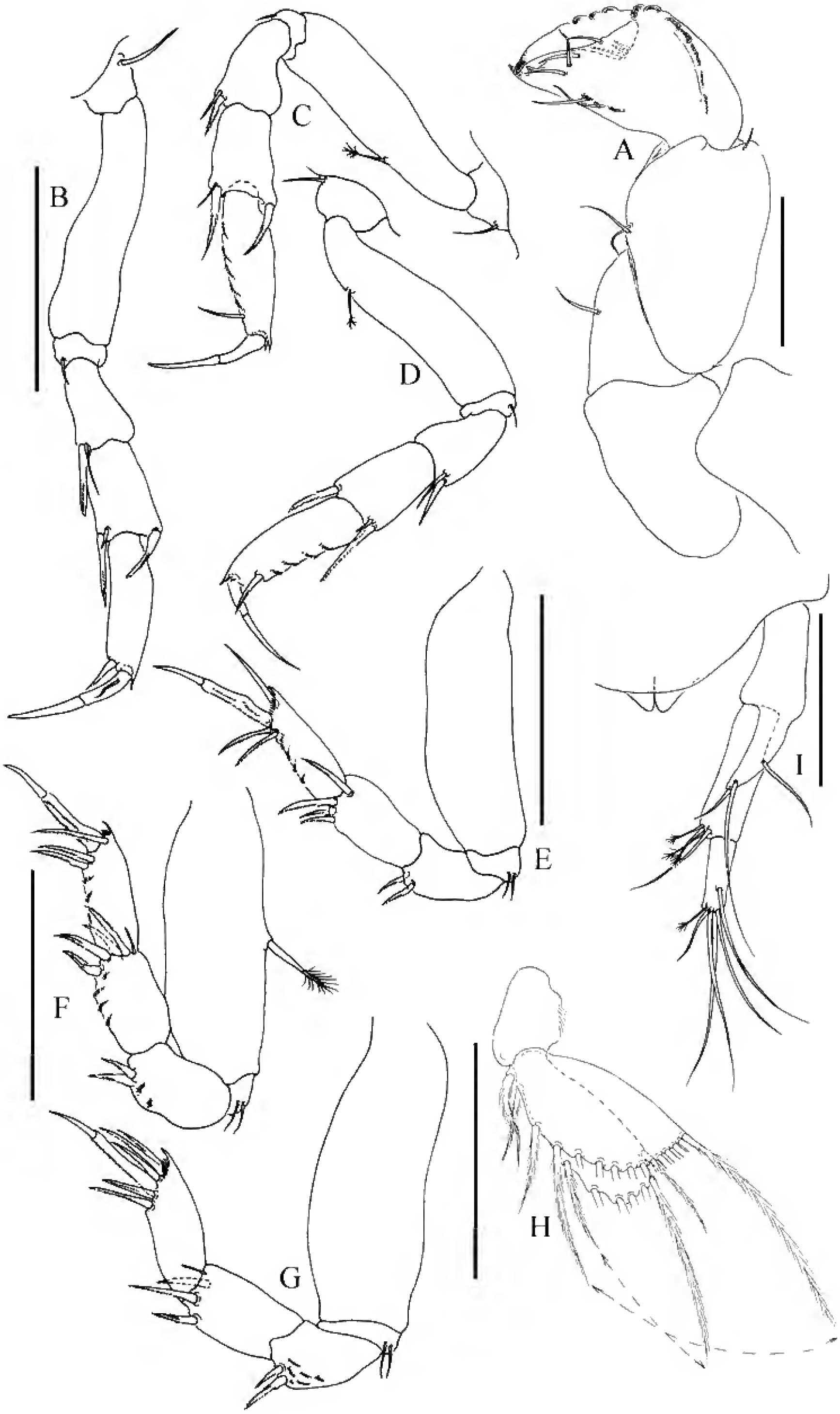


Fig. 89. *Araphura pygmothymos* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

Labrum (Fig. 88C) rounded, hood-shaped, setose. Left mandible (Fig. 88D) with wide, spade-like crenulate pars incisiva and linguiform lacinia mobilis, right mandible (Fig. 88E) with lanceolate pars incisiva and without lacinia mobilis; pars molaris of both mandibles tapering, with fine distal denticulations. Labium (Fig. 88H) simple, outer distal corner with unarticulated setose palp-like projection. Maxillule (Fig. 88F) with nine finely-denticulate distal spines. Maxilla (Fig. 88G) simple, linguiform, naked. Maxilliped (Fig. 88I) palp first article naked, second article with one outer and three distal inner setae, third article with two longer mesial and two shorter distal inner setae, fourth article with four longer and one shorter distal setae and one small subdistal outer seta; basis naked; endites distally naked, with outer-distal microtrichia and paired inner setae.

Cheliped (Fig. 89A) with rounded, naked basis 1.5 times as long as wide, merus subtriangular with single ventral seta shorter than width of merus, and covering about half of ventral margin of carpus; carpus 1.7 times as long as wide, with two midventral setae, one dorsodistal seta; propodus 1.2 times as long as wide, with two ventral setae, outer face with curving ridge of rounded tubercles from mid proximal to dorsodistal, inner comb-row of two setae; fixed finger with three setae below cutting edge; dactylus with dorsal rounded tubercles in proximal half.

Pereopod 1 (Fig. 89B) longer than others, coxa without apophysis, with seta; basis slender, 4.2 times as long as wide; ischium compact, with one ventrodistal seta; merus just shorter than carpus, ventrodistally with seta and longer distally-denticulate spine exceeding half length of carpus; carpus distally with ventral seta and single distally-denticulate spines dorsally and ventrally; propodus 1.5 times as long as carpus, with ventrodistal spine and dorsodistal spinous apophysis; dactylus with proximal seta, unguis 1.4 times as long as dactylus, both together 0.9 times as long as propodus. Pereopod 2 (Fig. 89C) similar to pereopod 1, basis 3.5 times as long as wide with dorsal penicillate seta; merus longer than carpus; propodus 1.8 times as long as carpus and with ventral fields of microtrichia; dactylus and unguis together 0.8 times as long as propodus. Pereopod 3 (Fig. 89D) similar to pereopod 2.

Pereopod 4 (Fig. 89E) somewhat more compact, basis 3.25 times as long as wide; ischium with two ventrodistal setae; merus 0.7 times as long as carpus, with two ventrodistal spines; carpus with four ventrodistal spines; propodus just longer than carpus, with ventral fields of microtrichia, two ventrodistal spines and one dorsodistal spine; dactylus about twice as long as unguis, and with fields of microtrichia, dactylus and unguis not fused into a claw, the two together 1.2 times as long as propodus. Pereopod 5 (Fig. 89F) as pereopod 4, but with ventral penicillate seta on basis, carpus with dorsodistal seta. Pereopod 6 (Fig. 89G) as pereopod 5, but propodus with two ventral and three dorsal distal spines.

Pleopods (Fig. 89H) all alike, with naked basis, endopod and exopod without setae on inner margin, outer margins with respectively 8 and 12 plumose setae.

Uropod (Fig. 89I) basis naked, exopod 0.6 times as long as proximal endopod segment, with one mesial and two distal setae; endopod of two segments, distal segment 0.6 times as long as proximal segment, setose as figured.

*Male*. Unknown.

*Etymology*. From the Greek *pygme* – a fist, and *thymos* – a warty excrescence, referring to the tubercles on the chela (noun in apposition).

*Remarks*. The characteristics of the genus *Araphura* and its distinctions from the closely related genera *Araphuroides* Sieg, 1886 and *Tanaella* Norman & Stebbing, 1886 are discussed by Sieg (1986a) and Larsen *et al*. (2009) (but see below): the latter give a key to the genus *Araphura*, in which the present species keys out to *A. parabrevimanus*. That species, found at >3200 m off Panama (the record from 720 m in the Subantarctic by Kudinova-Pasternak, 1975, is highly unlikely), is well figured by Lang (1968), from which the distinctions of the present shallow-water Antipodean species, although subtle, can be seen clearly.

In particular, in *A. parabrevimanus* the dorsal surfaces of the propodus and dactylus of the chela are smooth, ornamented with rows of microtrichia, while in *A. pygmothymos* sp. nov. these surfaces are highly tuberculate, the line of tubercles on the propodus extending across the dorsal outer face. Recently, Bird (2011) has described *Araphura whakarakaia* from New Zealand. Also a species with tubercles on the cheliped propodus and dactylus; as well as the different orientation of this tuberculation, *A. pygmothymos* differs from the New Zealand species in lacking a crenulate cheliped carpus, in its more elongate pleotelson, and in having stout spines on the merus of pereopods 1 to 3, *inter alia*. Other differences characterizing the present species are the more compact antennule peduncle articles, the lack of a pseudoarticulation-line on the fourth article of the antenna, the stronger distal spines on the merus and carpus of the pereopods, and the less-elongate uropodal exopod-process.

*Araphura pygmothymos* was found in the Central Bass Strait at depths of 70 to 82 m on fine to muddy sands.

***Araphura yarra*** sp. nov.

Figures 90–92

*Material examined*. 1 ♀ (J58836), holotype, Stn BSS 155, Central Bass Strait, 38 km SW of Cape Paterson, 38°55.5'S 145°17.00'E, 70 m depth, fine sand, 12 November 1981; coll. R.S. Wilson; 1 ♀ (J58845), paratype, Stn VC 31 C1, Central Bass Strait, 38°02.52'S 146°10.47'E, 40 m depth, 14 May 1999; coll. N. Coleman; 1 ♀ (J56681), paratype, Stn VC 18 C2, Central Bass Strait, 38°30.2'S 144°15.00'E, 40 m depth, 13 May 1998; coll. N. Coleman. 1 ♀ (J28487), paratype, Stn MSL-EG 118, Eastern Bass Strait, 10.8 km E of eastern edge of Lake Tyers, 37°50.92'S 148°12.83'E, 25 September 1990, coll. N. Coleman (depth not available). 1 ♀ (J58837), paratype, Stn BSS 197, Western Bass Strait, 4 km SSW of Currie, King Island, 40°00.7'S 143°49.9'E, 46 m, 21 November 1981, coll. R.S. Wilson,Smith-McIntyre Grab.

*Description of female*. Body (Fig. 90A, B) slender, holotype 1.9 mm long, 8.8 times as long as wide. Cephalothorax subrectangular, narrowing anteriorly with slight rounded rostrum, 1.6 times as long as wide, 2.5 times as long as pereonite 1, naked, eyes absent. Pereonites all naked and rectangular; pereonites 1 and 6 subequal in length; pereonites 2 to 5 subequal, 1.5 times as long as pereonite 1 (all pereonites respectively 1.6, 1.0, 1.2, 1.0, 0.9 and 1.3 times as wide as long).

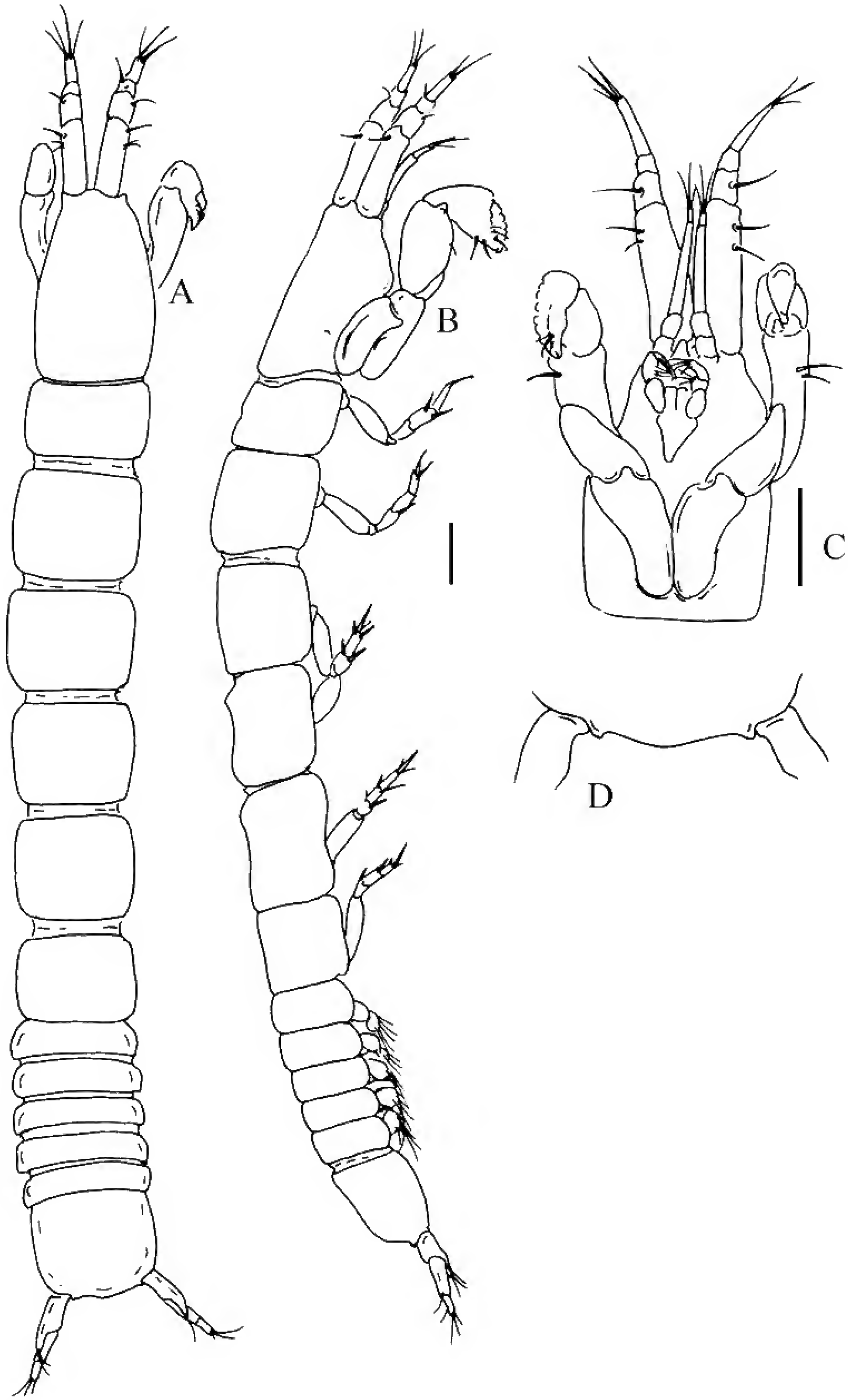


Fig. 90. *Araphura yarra* sp. nov., female holotype. A, dorsal; B, lateral; C, cephalothorax, ventral; D, posterior of pleotelson with attachment of uropods, ventral, showing adjacent tubercles. Scale = 0.1 mm.


Fig. 91. *Araphura yarra* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; G, maxilliped; H, labium; I, epignath. Scale = 0.1 mm.

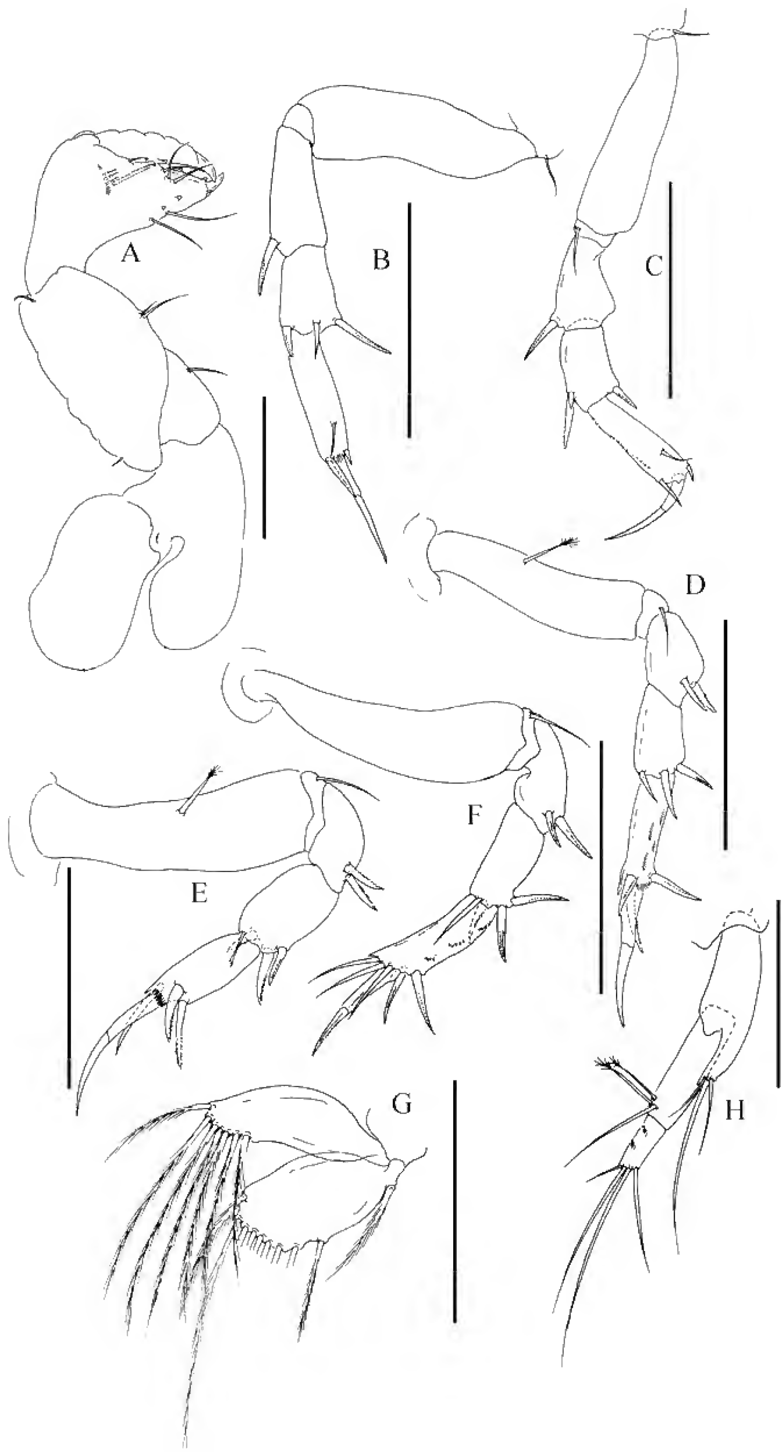

Fig. 92. *Araphura yarra* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

Pleon of five free subequal pleonites bearing pleopods, plus pleotelson; each pleonite 3.6 times as wide as long. Pleotelson subrectangular, as long as last three pleonites together, 1.2 times as wide as long, without mid-distal process, but with disto-marginal tubercle adjacent to attachment of each uropod (Fig. 90D).

Antennule (Fig. 91A) of four articles, proximal article 2.8 times as long as wide, longer than distal three articles together, with single outer distal simple and penicillate setae; second article longer than wide, 0.35 times as long as first article, outer distal margin with one penicillate and one longer simple setae, latter longer than article; third article as long as wide, 0.6 times as long as second article, with two simple mesial setae; fourth article tapering, 1.3 times as long as third, with five simple distal setae.

Antenna (Fig. 91B) of six articles, proximal article compact, fused to cephalothorax; second article 1.3 times as long as wide, with two dorsodistal setae; third article as long as wide, just shorter than second article, with single simple dorsodistal seta; fourth article longest, 3.6 times as long as wide, nearly three times as long as third article, with single distal simple and penicillate seta setae; fifth article as long as second, with one distal simple seta; sixth article minute with five distal setae.

Labrum (Fig. 91C) rounded, hood-shaped, naked. Left mandible (Fig. 91D) with bilobed pars incisiva and tridentate linguiform lacinia mobilis, right mandible (Fig. 91E) with tridentate pars incisiva and without lacinia mobilis; pars molaris of both mandibles stout, with fine distal denticulations, ventralmost longest. Labium (Fig. 91H) simple, outer distal corner slightly setose. Maxillule (Fig. 91F) with eight finely-denticulate distal spines, palp with two relatively short distal setae. Maxilla not recovered. Maxilliped (Fig. 91G) palp first article naked, second article with one outer and three distal inner setae, third article with two longer mesial and two shorter distal inner setae, fourth article with four distal setae and one small subdistal outer seta, ventral microtrichia; basis naked; endites distally with single inner setae but no tubercles. Epignath (Fig. 91I) ribbon-like, naked.

Cheliped (Fig. 92A) sclerite with triangular insertion into basis; rounded, naked basis 2.2 times as long as wide, with conspicuous proximal extension but not reaching to pereonite 1 ventrally (Fig. 90C); merus subtriangular with single ventral seta shorter than width of merus, and covering about one-third of ventral margin of carpus; carpus nearly twice as long as wide, dorsal margin convoluted, with one longer and one shorter midventral setae, one dorsodistal seta and one dorsoproximal seta; propodus 1.2 times as long as wide, with two ventral setae, outer face with two submarginal tooth-like tubercles, inner comb-row of three setae; fixed finger with three setae below cutting edge, cutting edge with rounded crenulations; dactylus with dorsal rounded tubercles.

Pereopod 1 (Fig. 92B) not longer than others, coxa without apophysis, with seta; basis 3.4 times as long as wide, naked; ischium compact, without seta; merus 1.4 times as long as carpus, ventrodistally with distally-denticulate spine exceeding half length of carpus; carpus distally with single distally-denticulate spines dorsally, mesially and ventrally; propodus 1.4 times as long as carpus, with subdistal seta, ventrodistal spine, distal microtrichia and dorsodistal spinous apophysis; dactylus naked, unguis 1.8 times as long as dactylus, both together as long as propodus. Pereopod 2 (Fig. 92C) similar to pereopod 1, basis 3.8 times as long as wide; ischium with seta; merus 1.2 times as long as carpus; propodus 1.5 times as long as carpus and with ventral fields of microtrichia; dactylus and unguis together 0.9 times as long as propodus. Pereopod 3 (not figured) similar to pereopod 2.

Pereopod 4 (Fig. 92D) coxa naked, basis 3.6 times as long as wide with midventral penicillate seta; ischium with ventral seta; merus as long as carpus, with two ventrodistal distally-denticulate spines; carpus with three distal distally-denticulate spines; propodus 1.3 times as long as carpus, with ventral fields of microtrichia, three distal distally-denticulate spines, distal microtrichia and dorsodistal spinous apophysis; dactylus 0.8 times as long as unguis, dactylus and unguis not fused into a claw, the two together 1.2 times as long as propodus. Pereopod 5 (Fig. 92E) as pereopod 4, but basis somewhat stouter, propodus only just longer than carpus. Pereopod 6 (Fig. 92F) as pereopod 5, but basis without penicillate seta, propodus with two ventral and three dorsal distal spines.

Pleopods (Fig. 92G) all alike, with naked basis, endopod and exopod without setae on inner margin, outer-distal margins with respectively 7 and 9 plumose setae, exopod with additional separated proximal plumose seta.

Uropod (Fig. 92H) basis naked, exopod process half as long as proximal endopod segment, with three distal setae; endopod of two segments, distal segment half as long as proximal segment, setose as figured.

*Male* .Unknown.

*Etymology*. Named after the Yarra River which runs through Melbourne (noun in apposition).

*Remarks*. Like *Araphura pygmothymos* (se above), *Araphura yarra* sp. nov. keys out to *A. brevimanus* in the key presented by Larsen *et al*. (2009), but is distinguished from that species for similar reasons, such as the tuberculate dorsal margin of the cheliped dactylus, the more compact antennule peduncle articles, the lack of a line of pseudoarticulation on the fourth article of the antenna, and the stronger distal spines on the merus and carpus of the pereopods. The present species is distinguished from the New Zealand species *A. whakarakaia* by its different tuberculation of the cheliped, and distinct spinulation of the pereopods (as in *A. pygmothymos*). It is distinguished from *A. pygmothymos* by the shorter pereonites, the more slender cephalothorax, the absence of outer rows of tubercles on the cheliped propodus, the absence of a seta on the ischium of pereopod 1, in having only three (rather than four) spines on the carpi of pereopods 4 to 6, and in the setation of the uropodal exopod process, *inter alia*.

*Araphura yarra* was found in the Central Bass Strait at depths of 40 to 70 m on fine sand.

### *Araphura doutagalla* sp. nov.

Figures 93–95

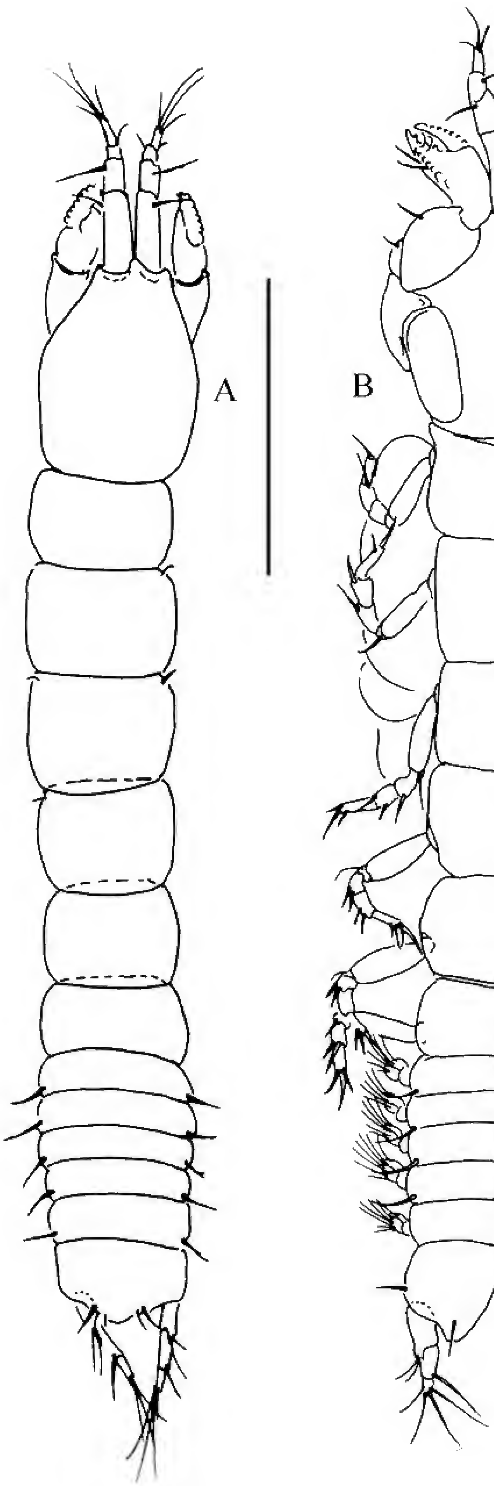


Fig. 93. *Araphura doutagalla* sp. nov., female holotype. A, dorsal; B, lateral. Scale = 0.5 mm.

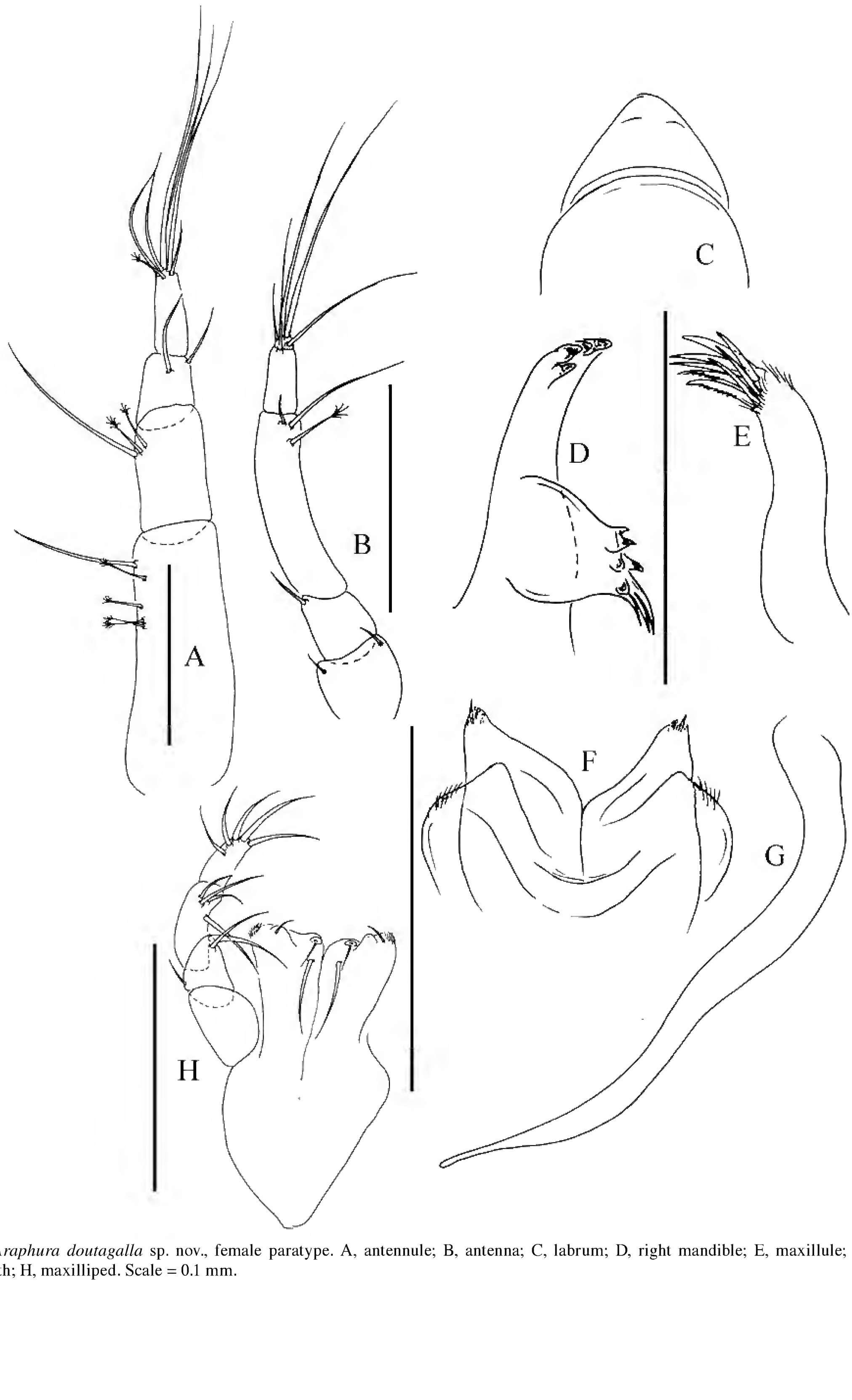


Fig. 94. *Araphura doutagalla* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, right mandible; E, maxillule; F, labium; G, epignath; H, maxilliped. Scale = 0.1 mm.


Fig. 95. *Araphura doutagalla* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

*Material examined.* 1 ♀ (J58838), holotype, 1 ♀ (J58848), paratype, Central Bass Strait, 28 km E of Cape Farewell, King Island, Stn BSS 107, 39°32.8'S 144°16.00'E, 18 m depth, fine sand, 1 November 1980; coll. M.F. Gomon & G.C.B. Poore.

*Description of female.* Body (Fig. 93A, B) slender, holotype 1.8 mm long, 7.4 times as long as wide. Cephalothorax pear-shaped, widest centrally, with distinct rounded rostrum, 1.4 times as long as wide, 2.6 times as long as pereonite 1, naked, eyes absent. Pereonites rectangular, although pereonites 1, 5 and 6 with convex lateral margins, bearing single anterolateral setae; pereonite 1 short; pereonites 2 to 4 subequal in length, 1.2 times as long as pereonite 1; pereonite 5 shorter, 1.1 times as long as pereonite 1; pereonite 6 shortest, 0.7 times as long as pereonite 1 (all pereonites respectively 1.6, 1.4, 1.3, 1.3, 1.4 and 2.3 times as wide as long). Pleon of five free subequal pleonites bearing pleopods plus pleotelson; each pleonite four times as wide as long, with single epimeral seta on each side. Pleotelson subpentangular, twice as long as each pleonite, 1.6 times as wide as long, with two laterodistal simple and one penicillate setae on each side of slight rounded mid-distal process (Fig. 95I).

Antennule (Fig. 94A) of four articles, proximal article 2.9 times as long as wide, as long as distal three articles together, with single outer distal simple seta preceded by four penicillate setae; second article longer than wide, half as long as first article, with two outer distal penicillate setae and adjacent simple seta 1.4 times as long as article; third article compact, half as long as second article, with two simple distal setae; fourth article tapering, with six simple and one penicillate distal setae.

Antenna (Fig. 94B) of six articles, proximal article compact, fused to cephalothorax; second article as long as wide, with single dorsodistal and ventrodistal setae; third article as long as wide, 0.85 times as long as second article, with dorsodistal seta; fourth article longest, 4.4 times as long as wide, three times as long as third article, with penicillate seta and two simple setae distally; fifth article as long as third, with one distal simple seta; sixth article minute with four distal setae.

Labrum (Fig. 94C) rounded, hood-shaped, naked. Left mandible not recovered; right mandible (Fig. 94D) with four rounded "teeth" on pars incisiva, pars molaris stout with fine distal denticulations, ventral ones elongate. Labium (Fig. 94F) simple, outer distal corner of both lobes setulate. Maxillule (Fig. 94E) with eight finely-denticulate distal spines and distal setules, palp not recovered. Maxilla not recovered. Maxilliped (Fig. 94H) palp first article naked, second article with one outer and two distal inner setae, third article with one longer mesial and three shorter distal inner setae, fourth article with five distal setae; basis naked; endites distally each with rounded tubercle and two fine setae, and with outer-distal microtrichia and longer inner seta. Epignath (Fig. 94G) long, tapering, ribbon-shaped, naked.

Cheliped (Fig. 95A) sclerite with triangular insertion into basis, rounded basis 1.6 times as long as wide, with simple dorsal seta, and with conspicuous proximal extension but not reaching to pereonite 1 ventrally; merus subtriangular with single ventral seta longer than width of merus, and covering about half of ventral margin of carpus; carpus 1.5 times as long as wide, with two midventral setae, one dorsodistal seta and one dorsoproximal seta, dorsal margin smooth; propodus 1.2 times as long as wide, with two ventral setae, outer face with curving ridge of rounded tubercles along fixed finger and three such tubercles dorsodistally, inner comb-row of three setae; fixed finger with three setae below cutting edge, cutting edge with three "teeth"; dactylus with dorsal rounded tubercles and two fine spinules on cutting edge.

Pereopod 1 (Fig. 95B) not longer than others, coxa without apophysis, with seta; basis three times as long as wide; ischium compact, with one ventrodistal seta; merus as long as carpus, ventrodistally with seta as long as carpus and shorter distally-denticulate spine exceeding half length of carpus; carpus distally with mesial seta, distally-denticulate dorsodistal spine as long as carpus, and shorter simple ventrodistal spine; propodus 1.3 times as long as carpus, with simple ventrodistal spine; dactylus naked, unguis 1.8 times as long as dactylus, both together 1.2 times as long as propodus. Pereopod 2 (Fig. 95C) similar to pereopod 1, basis 3.5 times as long as wide; carpus with additional distally-denticulate ventrodistal spine; dactylus and unguis together 0.9 times as long as propodus. Pereopod 3 (Fig. 95D) similar to pereopod 2.

Pereopod 4 (Fig. 95E) slightly more compact, basis 2.7 times as long as wide; ischium with two ventrodistal setae; merus as long as carpus, with two ventrodistal distally-denticulate spines; carpus with four distally-denticulate distal spines; propodus 1.4 times as long as carpus, with ventral fields of microtrichia, two ventrodistal distally-denticulate spines and one dorsodistal distally-denticulate spine; dactylus 1.3 times as long as unguis, dactylus and unguis not fused into a claw, the two together just shorter than propodus. Pereopod 5 (Fig. 95F) as pereopod 4, but carpus with additional dorsodistal simple seta, ventrodistal microtrichia evident on merus and carpus. Pereopod 6 (Fig. 95G) as pereopod 5, but propodus distally with two ventral and two dorsal distally-denticulate spines.

Pleopods (Fig. 95H) all alike, with naked basis, endopod and exopod without setae on inner margin, outer-distal margins with respectively 7 and 8 plumose setae, exopod with additional separated proximal plumose seta.

Uropod (Fig. 95I) longer than pleotelson, basis naked, exopod process 0.4 times as long as proximal endopod segment, with two distal setae; endopod of two segments, distal segment 0.6 times as long as proximal segment, setose as figured.

*Male.* Unknown.

*Etymology.* "Doutagalla" was used by the European settlers at Melbourne as one of the early names for the colony: it may have been a mistranslation of the name of a prominent tribal elder, but is also said to translate as "treeless plain" (noun in apposition).

*Remarks. Araphura doutagalla* sp. nov., like the previous two species, is generally of the *A. brevimanus* form, but is also distinguished from that species and from *A. whakarakaia* as are those two taxa, and again has tuberculation on the chela. The patterns of this tuberculation are distinct from those of both *A. pygmothymos* and *A. yarra*; in addition, *A. doutagalla* has a more robust body form (7.4 times as long as wide, compared with 9.7 or 8.8 times in the other two respectively), and conspicuously the uropodal exopod process is less than half the length of the proximal segment of the endopod (longer than or as long as half the length respectively). Its relatively stout mandibular molar process is similar to that of *A. yarra* (and not those of *A, pygmothymos*), while the proportions of the merus and carpus of pereopod 1 are like those of *A. pygmothymos* (and not those of *A, yarra*).

*Araphura doutagalla* was found in the Central Bass Strait north of Tasmania at a depth of 18 m on fine sand.

## Genus *Araphuroides* Sieg, 1886

### *Araphuroides stabastris* sp. nov.

Figures 96–99

*Material examined.* 1 ♀ (J58536), holotype, Central Bass Strait, 33 km S of Deal Island, Stn BSS 161, 39°48.3'S 147°19.2'E, 60 m depth, muddy sand, 14 November 1981; coll. R.S. Wilson; 1 ♂ (J58544), allotype, Central Bass Strait, 35 km NNE of Cape Wickham, King Island, Tasmania, Stn BSS 204 DRC, 39°16.0'S 144°05.4'E, 82 m depth, sandy shell, 23 November 1981; coll. R.S. Wilson; 2 ♀♀ (J58537), paratypes, Central Bass Strait, 33 km S of Deal Island, Stn BSS 161, 39°48.3'S 147°19.2'E, 60 m depth, muddy sand, 14 November 1981; coll. R.S. Wilson; 5 ♀♀ (J58538), paratypes, Central Bass Strait, 44 km NE of Cape Wickham, King Island, Stn BSS 203, 39°22.0'S 144°18.3'E, 60 m depth, coarse sand, 23 November 1981; coll. R.S. Wilson; 1 ♀ (J58541), paratype, Central Bass Strait, 38 km SW of Cape Paterson, Stn BSS 155, 38°55.5'S 145°17.00'E, 70 m depth, fine sand, 12 November 1981; coll. R.S. Wilson; 1 ♀ (J58540), paratype, Eastern Bass Strait, 24 km NNE of Eddystone Point, Stn BSS 163G, 40°43.9'S 148°32.5'E, 56 m depth, muddy sand, 14 November 1981; coll. R.S. Wilson; 2 ♀♀ (J58543), paratypes, Central Bass Strait, 65 km ENE of Cape Rochon, Three Hummock Island, Stn BSS 157, 40°10.9'S 145°44.3'E, 75 m depth, shelly sand, 13 November 1981; coll. R.S. Wilson; 1 ♀ (J58546), paratype, Eastern Bass Strait, 100 km NE of North Point, Flinders Island, Stn BSS 170, 38°52.6'S 148°25.2'E, 130 m depth, fine sand, 15 November 1981; coll. R.S. Wilson; 1 ♀ (J58548), paratype, Eastern Bass Strait, 28 km SSW of Marlo, Stn BSS 207, 37°59.0'S 148°27.0'E, 51 m depth, muddy sand and fine shell, 30 July 1983; coll. M.F. Gomon; 1 ♀ (J58539), paratype, Central Bass Strait, 25 km SW of Cape Frankland, Flinders Island, Stn BSS 162, 40°09.4'S 147°32.7'E, 51 m depth, shelly sand, 14 November 1981; coll. R.S. Wilson; 2 ♀♀ (J58542), paratypes, Western Bass Strait, 40 km SSW of Warrnambool, Victoria, Stn BSS 189, 38°42.8'S 142°35.6'E, 69 m depth, coarse sand, 20 November 1981; coll. R.S. Wilson; 2 ♀♀ (J58561), paratypes, Central Bass Strait, 99 km WSW of Cape Liptrap, Stn BSS 131T, 39°45.55'S 145°33.82'E to 39°48.03'S 145°32.58'E, 78.7 m depth, very fine sand, 03 February 1981; coll. M.F. Gomon, G.C.B. Poore & C.-C. Lu.

*Description of female.* Body (Fig. 96A, B) slender, holotype 2.35 mm long, 7 times as long as wide. Cephalothorax subrectangular, tapering anteriorly with slight triangular rostrum, 1.3 times as long as wide, longer than pereonites 1 and 2 together, naked, eyes absent. Pereonite 1 shortest, 0.4 times as long as cephalothorax; pereonites 2 to 6 subequal, half as long as cephalothorax, with rounded lateral margins and wider than long (all pereonites respectively 2.0, 1.6, 1.4, 1.3, 1.3 and 1.4 times as wide as long). Pleon of five free subequal pleonites without pleopods plus pleotelson; each pleonite 3.2 times as wide as long. Pleotelson pentangular, as long as last pereonite, with paired posterior setae on each side.

Antennule (Fig. 97A) of four articles, proximal article 1.6 times as long as wide, 1.3 times as long as distal three articles together, with single outer distal simple seta surrounded by four penicillate setae; second article just longer than wide, 0.3 times as long as first article, with outer distal tuft of one simple and two penicillate setae; third article two-thirds as long as second, distally with outer simple seta and inner pair of one simple and one penicillate setae; fourth article tapering, just longer than second article, with six distal setae and one aesthetasc.

Antenna (Fig. 97B) of six articles, proximal article compact, fused to cephalothorax; second and third articles as long as wide, each with dorsodistal seta; fourth article longest, as long as three proximal articles together and 4.3 times as long as wide, with two simple and two penicillate distal setae; fifth article as long as third, with one distal seta; sixth article minute with four distal setae.

Labrum (Fig. 97C) rounded, hood-shaped, setose. Left mandible (Fig. 97D) with irregularly denticulate pars incisiva and triangular, crenulate lacinia mobilis, right mandible (Fig. 97E) with bilobed pars incisiva and without lacinia mobilis; pars molaris apically tuberculate. Labium (Fig. 97G) simple, finely setose at outer distal corners, without palp. Maxillule (Fig. 97F) with eight distal spines, each distally finely-denticulate, palp (Fig. 97F') with two distal setae. Maxilla (Fig. 97H) simple, naked. Maxilliped palp (Fig. 97I) first article with single outer distal seta; second article with three inner setae, two of these distally finely serrated; third article with two longer and two shorter inner setae; fourth article with five distal setae, each distally finely serrated, and one outer subdistal seta; basis with single, long seta almost reaching distal margin of endites; endites distally with two setae and rounded tubercle.

Cheliped (Fig. 98A) with rounded, naked basis about twice as long as wide; merus subtriangular with single ventral seta and covering more than half of ventral margin of carpus; carpus 1.5 times as long as wide, with two midventral setae, one dorsodistal seta; propodus as long as wide, comb-row of three setae, fixed finger with two ventral and three setae below cutting edge; dactylus naked.

Pereopod 1 (Fig. 98B) coxa without apophysis, with seta; basis slender, five times as long as wide, naked; ischium compact with one ventral seta; merus one-quarter as long as basis, with slender ventrodistal spine; carpus 1.75 times as long as merus, distally with inner seta and single distally-denticulate spine dorsally and two ventrally; propodus 1.25 times as long as carpus, with ventrodistal seta and distal tuft of setules; dactylus 0.42 times as long as unguis, both together 1.3 times as long as propodus. Pereopod 2 (Fig. 98C) similar to pereopod 1 although articles proportionately shorter, basis four times as long as wide with two mid-dorsal penicillate setae. Pereopod 3 (Fig. 98D) similar to pereopod 2.

Pereopod 4 (Fig. 98E) basis stouter, 3.6 times as long as wide, with two mid-ventral penicillate setae; ischium with two ventral setae; merus two-thirds as long as carpus and with two ventrodistal spines; carpus with three distal spines; propodus 1.14 times as long as carpus, with dorsal penicillate seta and three distal spines, each with fine serrations; dactylus longer than distinct unguis, both together just longer than propodus.

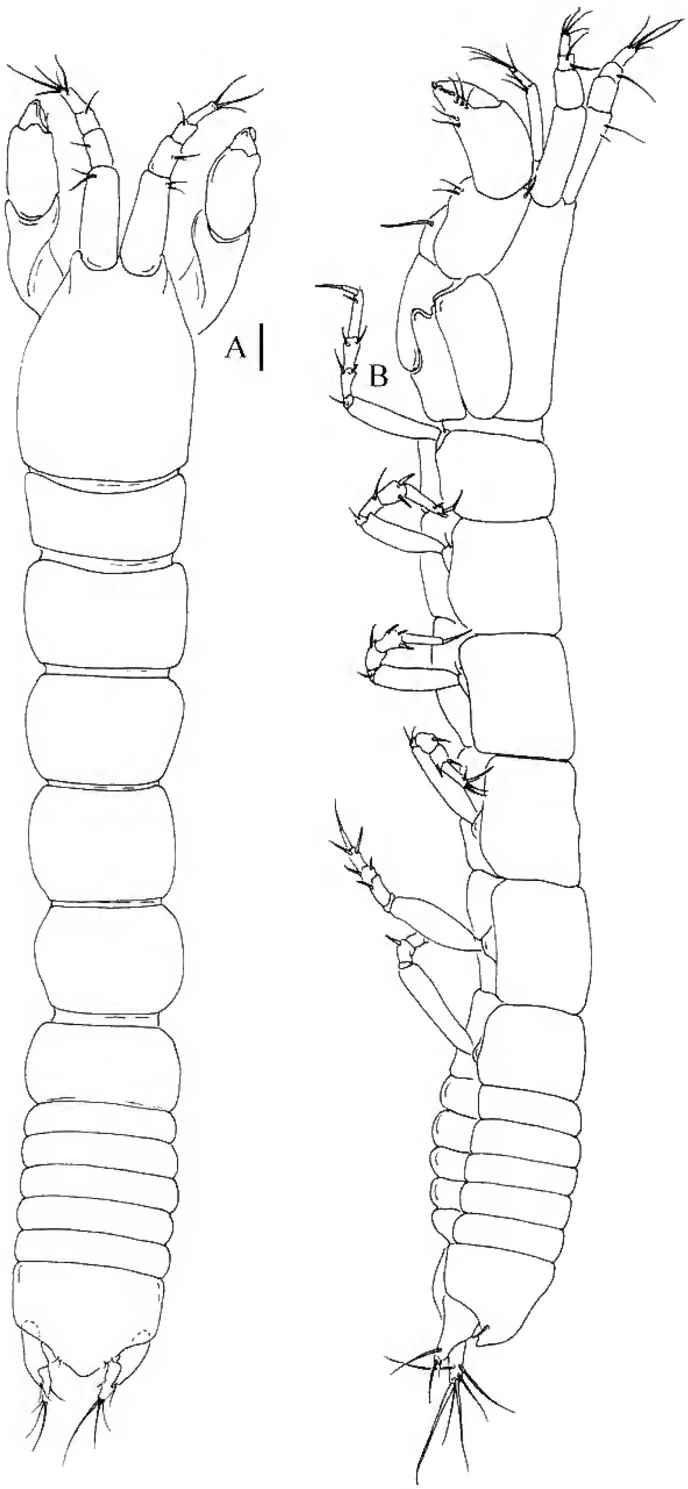


Fig. 96. *Araphuroides stabastris* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 0.1 mm.

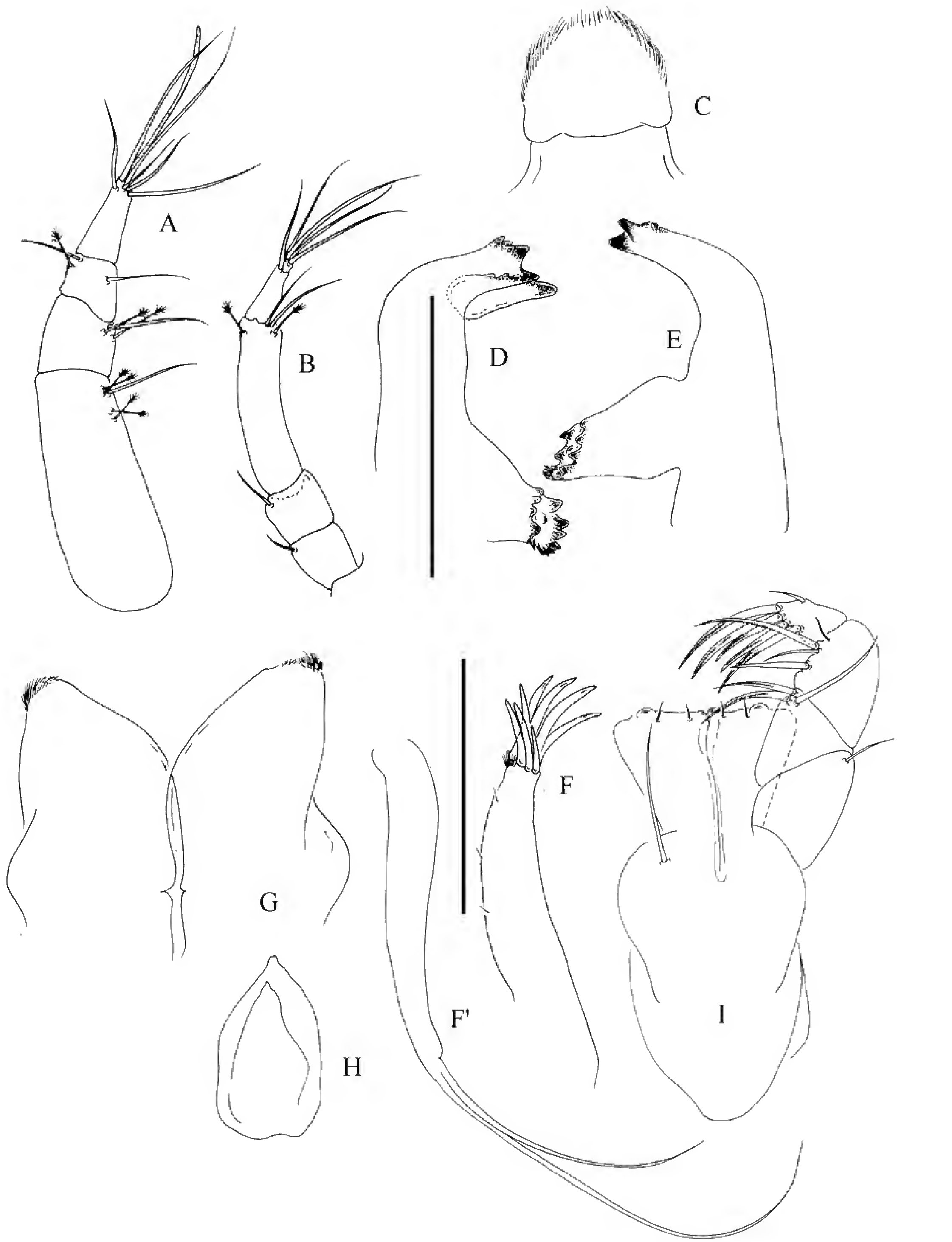


Fig. 97. *Araphuroides stabastris* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; F' maxillule palp; G, labium; H, maxilla; I, maxilliped. Scale = 0.2 mm.

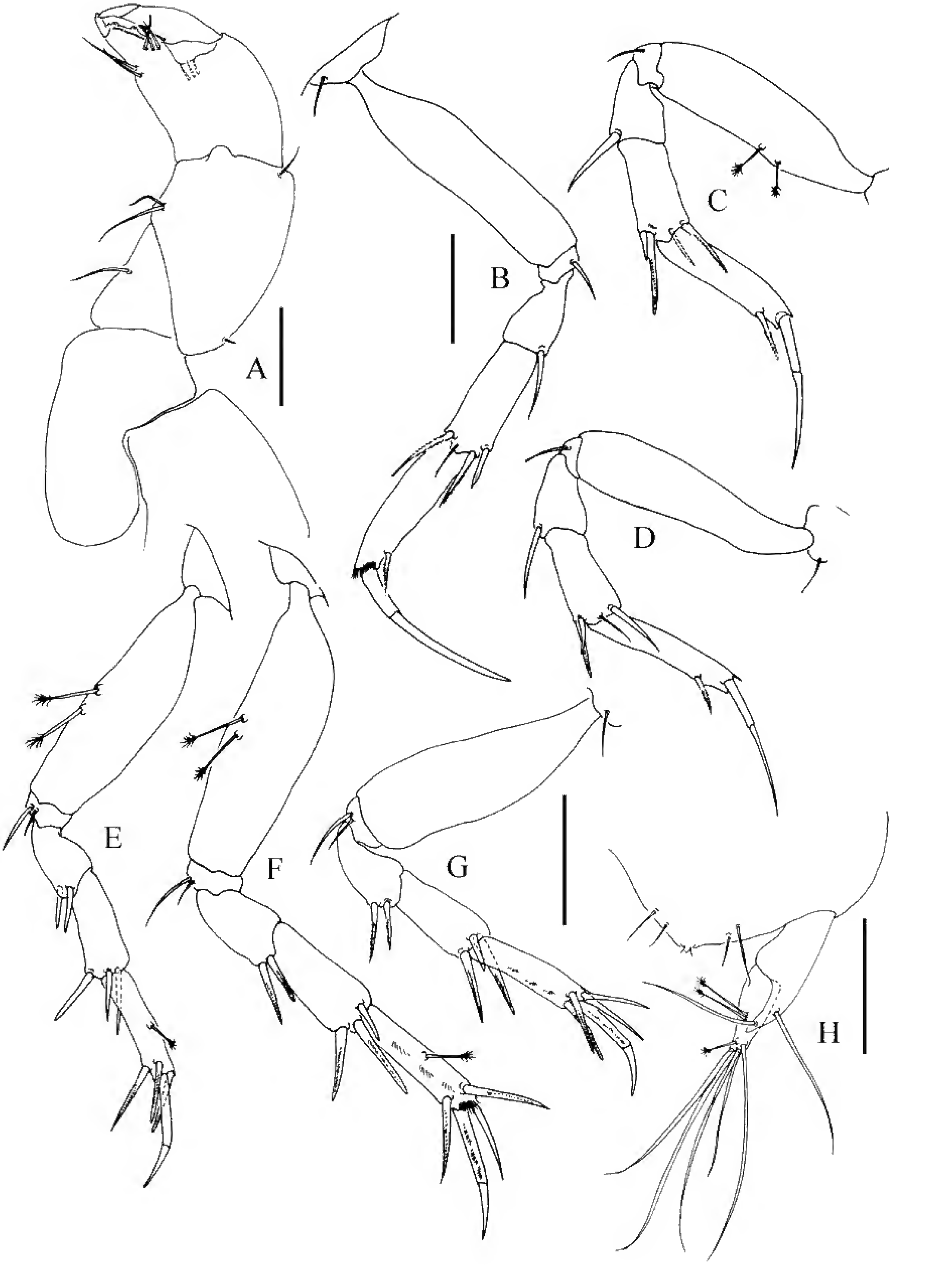


Fig. 98. *Araphuroides stabastris* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, uropod. Scale = 0.2 mm.

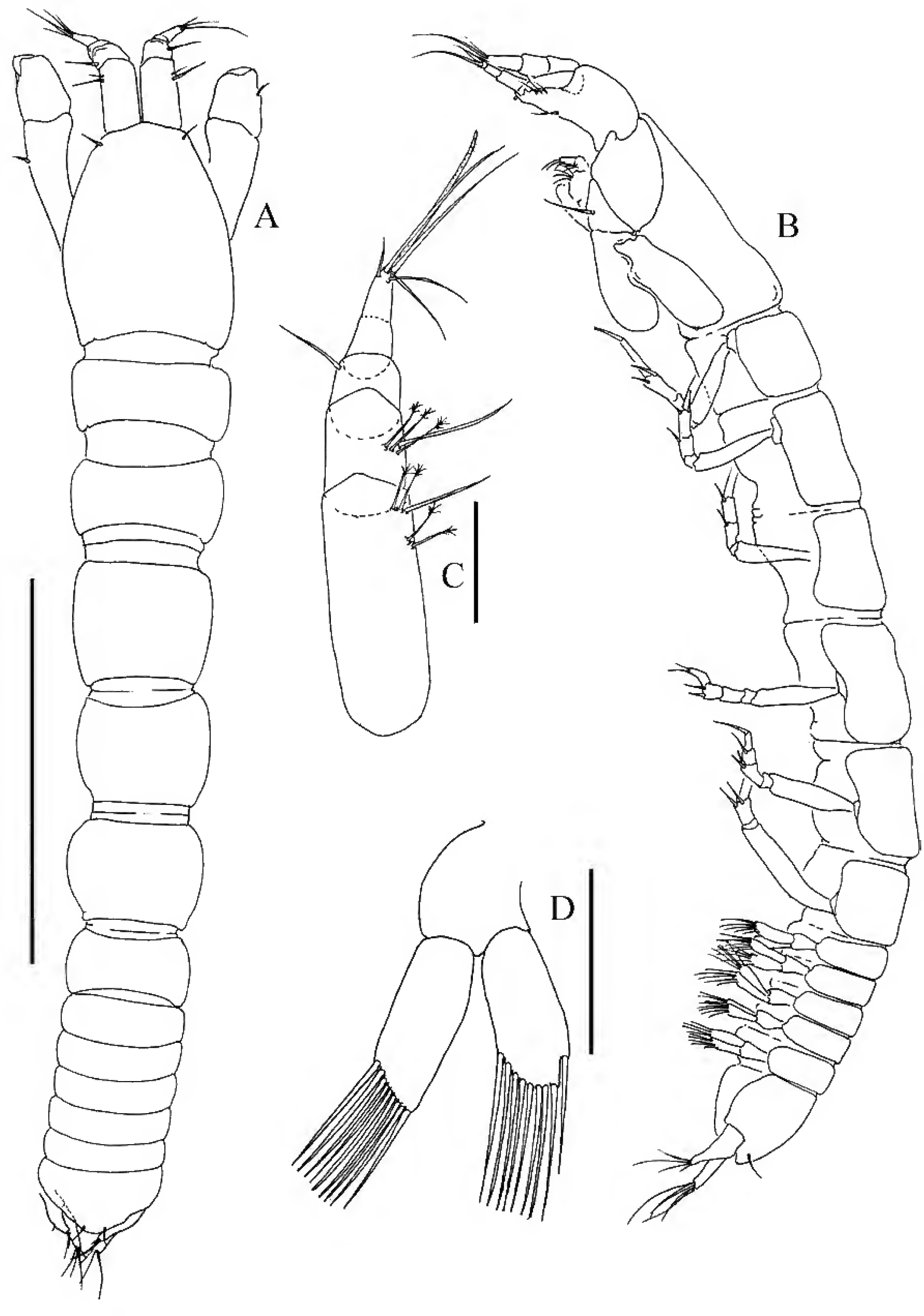


Fig. 99. *Araphuroides stabastris* sp. nov., male allotype. A, dorsal view ; B, lateral view ; C, antennule ; D, pleopod. Scale = 1 mm for A (and B), 0.1 mm for C and D.

Pereopod 5 (Fig. 98F) as pereopod 4, but all spines showing fine serrations, microtrichia present on propodus and dactylus. Pereopod 6 (Fig. 98G) as pereopod 5, but propodus with four distal spines, and basis without penicillate setae.

Pleopods absent.

Uropod (Fig. 98H) basis naked, exopod process 0.7 times as long as endopod, with one mesial and one distal setae; endopod of one segment, with subdistal tuft of two penicillate setae and distal group of five simple and one penicillate setae.

*Distinctions of male* (Fig. 99). Generally similar to female, allotype body length 2.9 mm; pereonite 2 only half as long as wide. Antennule with incipient articulation of distal article. Five pairs of pleopods present, rami subequal in length, exopod with nine distal setae, endopod with eight distal and one inner subdistal setae.

*Etymology. Stabastris* is an anagram of Bass Strait.

*Remarks.* The genus *Araphuroides* is distinguished from *Araphura* and *Tanaella* in having pereonites laterally rounded and wider than long (unlike *Araphura*), with a distinct uropodal exopod-process (unlike *Tanaella*), but see discussion below. Larsen (2005) re-diagnosed the genus and gave a key to the four species then known, in which *A. stabastris* sp. nov. is not resolved. Since that paper, *A. io* (Bamber, 2005) was transferred to this genus from *Araphura* by Larsen *et al.* (2009), and the present species is indeed closest to *A. io*, a species recorded from south-western Western Australia at depths from 23 to 40 m.

*Araphuroides stabastris* is distinguished from *A. io* in having a shorter cephalothorax; a cheliped with two ventral carpal setae, and only three setae in the chela comb-row; pereopod 1 with a more elongate basis (five times as long as wide, only three times in *A. io*), a carpus approaching twice as long as the merus (subequal in *A. io*), and a proportionately longer unguis (2.4 times as long as dactylus, only 1.3 times in *A. io*); all pereopods with a proportionately longer dactylus plus unguis, proportionately longer carpus, and longer distal spines on the merus and carpus. In addition, *A. io* has pleopods in the female. Both species are without a line of pseudo-articulation on the fourth antennal article found in all other species apart from *A. bombus* Larsen, 2005.

*Araphuroides stabastris* was found at 31 to 71 m depth on muddy to shelly sands throughout the Bass Strait.

***Araphuroides batmania*** sp. nov.

Figures 100–101

*Material examined.* 1 ♀ (J58572), holotype, 4 ♀♀ (J58904), paratypes, Central Bass Strait, 28 km E of Cape Farewell, King Island, Stn BSS 107S, 39°32.8'S 144°16.0'E, 18 m depth, fine sand, 1 November 1980; 25 ♀♀ (J58571), paratypes, Central Bass Strait, 35 km E of Cape Farewell, King Island, Stn BSS 108G, 39°32.8'S 144°21.0'E, 27 m depth, fine sand, 01 November 1980; all coll. M.F. Gomon & G.C.B. Poore.

*Description of female.* Body (Fig. 100A, B) slender, holotype 3.2 mm long, 6.6 times as long as wide. Cephalothorax subrectangular, 1.3 times as long as wide, shorter than pereonites 1 and 2 together, with single anterolateral seta on each side, eyes absent. Pereonites rectangular, mostly with convex lateral margins; pereonite 1 longest, 0.6 times as long as cephalothorax; pereonites 2 to 5 subequal, half as long as cephalothorax; pereonite 6 shortest, half as long as pereonite 1 (all pereonites respectively 1.25, 1.5, 1.6, 1.5, 1.5 and 2.4 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite 4.8 times as wide as long. Pleotelson semicircular, as long as last two pleonites together, with one posterolateral seta on each side.

Antennule (Fig. 100C) of four articles, proximal article 2.7 times as long as wide, just longer than distal three articles together; second article 1.5 times as long as wide, 0.4 times as long as first article; third article shorter than wide, 0.4 times as long as second article; fourth article tapering, twice as long as third article, with four distal setae and one aesthetasc.

Antenna (Fig. 100D) of six articles, proximal article compact, fused to cephalothorax; second article longer than wide, with dorsodistal seta; third article as long as wide, with dorsodistal seta; fourth article longest, 4.7 times as long as wide, with midventral and ventrodistal penicillate setae and ventrodistal simple seta; fifth article 0.4 times as long as fourth with one distal seta; sixth article minute with four distal setae.

Labrum (Fig. 100E) hood-shaped, naked. Left mandible (Fig. 100F) with narrow, crenulate lacinia mobilis, cutting-edge angled; pars incisiva truncate with prominent crenulations. Right mandible (Fig. 100G) without lacinia mobilis, pars incisiva pointed with inner crenulations; pars molaris of both mandibles distally with strong, rounded tooth-like protrusions. Labium not recovered. Maxillule (Fig. 100H, H') with nine distal spines, at least some of these finely denticulate, and fine distal setules, palp with two distal setae. Maxilla (Fig. 100H) ovoid, simple, naked. Maxilliped palp (Fig. 100I) first article with simple outer seta, second and third articles with three inner setae, fourth article with four distal, finely denticulate spines and one outer subdistal seta; basis naked; endites distally with single seta, outer group of setules and slight inner tubercle.

Cheliped (Fig. 101A) naked basis attached to substantial sclerite; merus subtriangular with single ventral seta; carpus 1.5 times as long as wide, with two midventral and one dorsodistal setae; propodus with row of rounded tubercles along outer ventral margin including fixed finger, with two ventral setae, three setae on crenulate cutting edge; dactylus dorsal margin with rounded tuberculation.

Pereopod 1 (Fig. 101B) coxa with seta; basis 3.9 times as long as wide, naked; ischium compact with ventral seta as long as merus; merus just longer than carpus, with fine dorsodistal seta, ventrodistally with slender spine denticulate in distal two-thirds and simple seta; carpus distally with strong dorsodistal spine, smaller ventrodistal spine and mid-distal seta; propodus 1.4 times as long as carpus, with short ventrodistal spine; dactylus half as long as slender unguis, both together as long as propodus. Pereopod 2 (Fig. 101C) similar to pereopod 1, but basis with proximal seta, merus with stouter ventrodistal spine but without dorsodistal seta, carpus with longer ventrodistal spine, propodus with dorsodistal seta. Pereopod 3 (Fig. 101D) similar to pereopod 2, but basis naked.

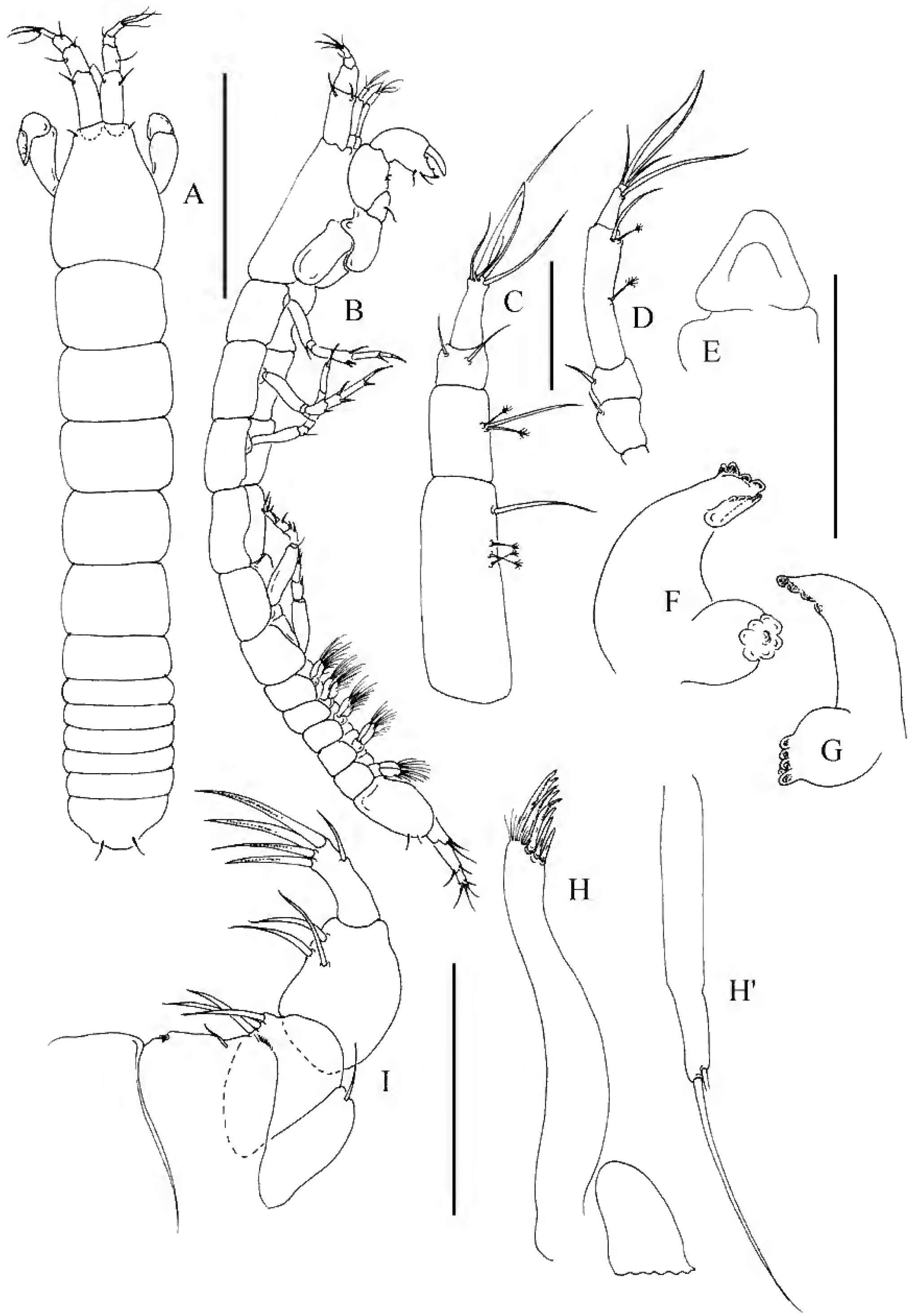


Fig. 100. *Araphuroides batmania* sp. nov. A, holotype female dorsal; B, holotype female lateral; C, antennule; D, antenna; E, labrum; F, left mandible; G, right mandible; H, maxillule and maxilla; H', maxillule palp; I, maxilliped. Scale: A-B = 1 mm, C-H = 0.1 mm.

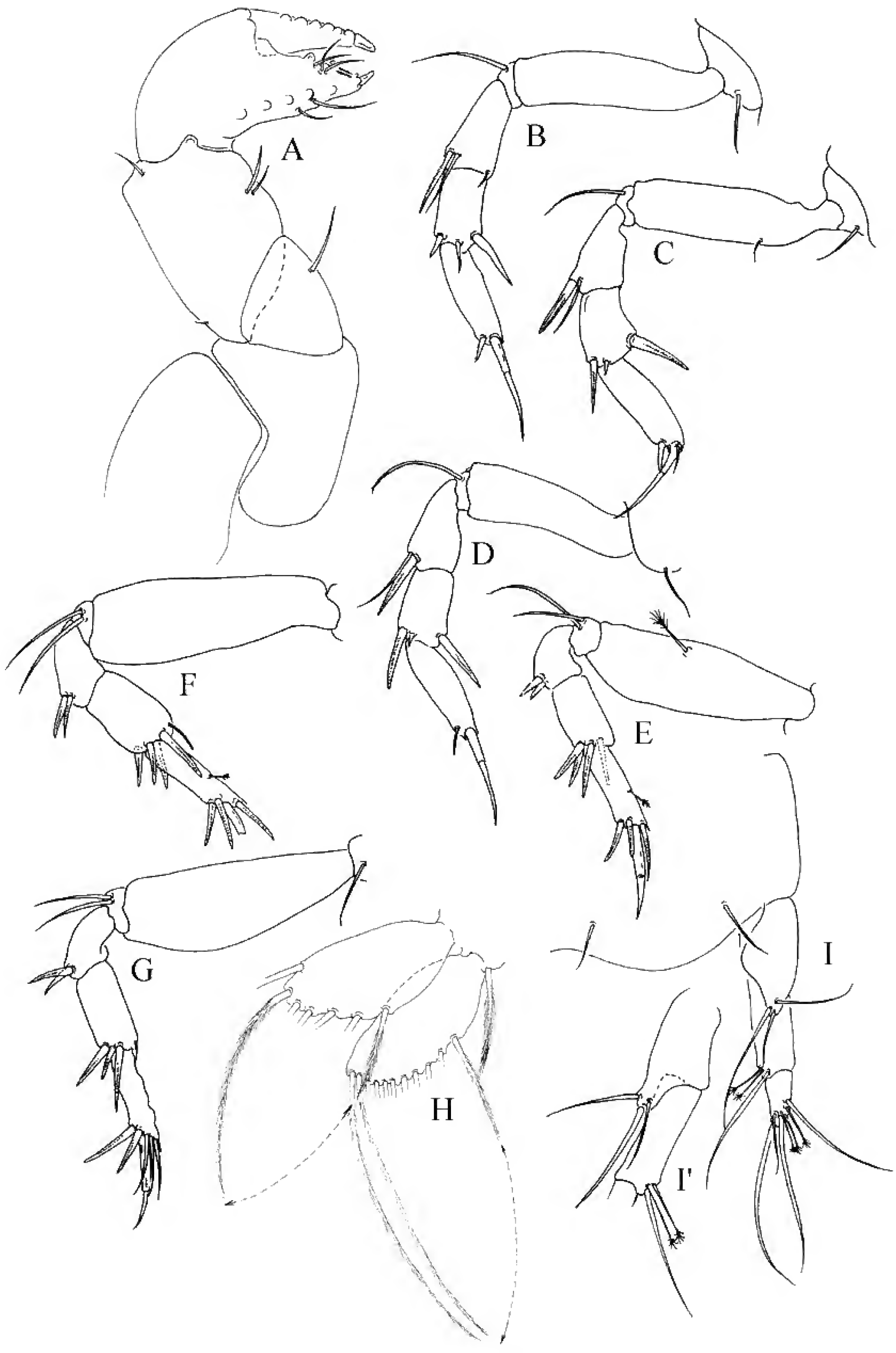


Fig. 101. *Araphuroides batmania* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod; I', uropod basis, lateral.

Pereopod 4 (Fig. 101E) basis stouter than those of anterior pereopods, 3.2 times as long as wide, with ventral penicillate seta; ischium with two ventral setae; merus and carpus subequal, merus 0.6 times as long as carpus and with two ventrodistal spines, carpus with distal crown of four denticulate spines; propodus 1.3 times as long as carpus, with mid-dorsal penicillate seta, one dorsodistal and two ventrodistal spines; dactylus longer than unguis. Pereopod 5 (Fig. 101F) as pereopod 4, but basis naked. Pereopod 6 (Fig. 101G) as pereopod 5, but propodus with three dorsodistal setae.

Pleopods (Fig. 101H) all alike, with naked basis, endopod and exopod without setae on inner margin, outer distal margins with respectively 7 and 12 plumose setae, additional proximal exopod seta separated from others.

Uropod (Fig. 101I) exopod process 0.4 times as long as proximal endopod segment, with three distal setae; endopod of two segments, proximal segment with one simple and two penicillate distal setae, distal segment half as long as proximal segment and with four simple and three penicillate distal setae.

*Male*. Unknown.

*Etymology*. Batmania was one of the names of the early settlement at Melbourne (ca. 1835), named after John Batman, a leading member of the Tasmanian Port Phillip Association.

*Remarks*. For reasons given above under *Araphuroides stabastris*, the present species is again closest only to *A. io*; unlike the previous species, *A. batmania* sp. nov. also has on pereopod 1 the shorter carpus, shorter distal merus and carpus setae, and proportionately shorter dactylus plus claw of *A. io*, and again shares the absence of a line of pseudo-articulation on the fourth antennal article. Like *A. io*, but unlike *A. stabastris*, the female of the present species has pleopods.

*Araphuroides batmania* is distinguished from *A. io* by its longer first pereonite on a generally stouter body, fewer setae on the maxilliped palp, and a mandible with more complex crenulation on the pars incisiva and rounded distal tubercles on the pars molaris, and is distinguished from *A. io*, and all other described species in the genus, in having rounded tubercles on both fingers of the chela.

*Araphuroides batmania* was taken in the Central Bass strait east of Cape Farewell, King Island at depths of 18 to 27 m in fine sand.

### *Araphuroides sala* sp. nov.

Figures 102–104

*Material examined*. 1 ♀ (J58841), holotype, Western Port, off Crib Point, Stn CPBS-N 52/272, 38°19.92'S 145°13.95'E, 19 m depth, sand and gravel, 31 March 1965; coll. A.J. Gilmour. 1 ♀ (J58843), paratype, Western Port, off Crib Point, Stn CPBS-N 25/1, 38°20.25'S 145°14.68'E, 11 m depth, sand, 10 March 1965; coll. A.J. Gilmour. 1 ♀ (J58839), Stn CPBS-N 32/1, 1 ♀ (J58840), Stn CPBS-N 32/2, and 4 ♀♀ (J58842), Stn CPBS-N 32/3, paratypes, all Western Port, off Crib Point, 38°20.83'S 145°13.48'E, 13 m depth, sandy gravel, 23 March 1965; coll. A.J. Gilmour. 2 ♀♀ (J58534, J58535), paratypes, Eastern Bass Strait, 63 km E of North Point, Flinders Island, Stn BSS 167, 39°44.8'S 148°40.6'E, 124 m depth, muddy sand, 14 November 1981, coll. R.S. Wilson.

*Description of female*. Body (Fig. 102A, B) slender, holotype 1.4 mm long, 8.1 times as long as wide. Cephalothorax pear-shaped, widest centrally, with distinct rounded rostrum, 1.6 times as long as wide, 2.7 times as long as pereonite 1, naked, eyes absent. Pereonites all naked, lateral margins convex; pereonite 1 short, 0.4 times as long as cephalothorax; pereonites 2 to 5 subequal, 1.25 times as long as pereonite 1; pereonite 6 shortest, 0.8 times as long as pereonite 1 (all pereonites respectively 1.5, 1.25, 1.25, 1.5, 1.3 and 2.0 times as wide as long). Pleon of five free subequal pleonites bearing pleopods plus pleotelson; each pleonite 4.4 times as wide as long, with single lateral epimeral seta on each side. Pleotelson subpentangular, 0.4 times as long as whole pleon, as long as wide, paired laterodistal setae either side of rounded mid-distal margin.

Antennule (Fig. 103A) of four articles, proximal article 3.6 times as long as wide, longer than distal three articles together, distally with two tufts of penicillate setae and single outer simple seta; second article longer than wide, 0.4 times as long as first article, with four inner distal penicillate setae and one outer simple seta; third article compact, half as long as second article, with two simple distal setae; fourth article tapering, 1.4 times as long as third article, with six simple and one penicillate distal setae.

Antenna (Fig. 103B) of six articles, proximal article compact, shorter than wide, fused to cephalothorax; second article as long as wide, with two distal setae; third article shorter than wide, 0.7 times as long as second article, with dorsodistal seta; fourth article longest, five times as long as wide, more than three times as long as second article, with penicillate seta in proximal half, crown of one simple and five penicillate distal setae and dorsal rows of microtrichia; fifth article as long as second, with one distal simple seta; sixth article minute with four distal setae.

Labrum (Fig. 103C) rounded, hood-shaped, distally setose. Left mandible (Fig. 103D) with wide, spade-like crenulate pars incisiva and triangular, crenulate lacinia mobilis, right mandible (Fig. 103E) with crenulate and distally bifid pars incisiva and without lacinia mobilis; pars molaris of both mandibles stout, with fine, elongate distal denticulations. Labium (Fig. 103H) simple, outer distal corner of both lobes setulose. Maxillule (Fig. 103F) with nine finely-denticulate distal spines and few distal setules, palp with two distal setae. Maxilla (Fig. 103G) simple, triangular, naked. Maxilliped (Fig. 103I) palp first article naked, second article with one outer and three distal inner setae, two of these finely denticulate; third article with two longer mesial and two shorter distal inner setae, one of each of these finely denticulate; fourth article with four longer and one shorter distal finely-denticulate setae and one small subdistal outer seta; basis naked; endites distally each with two rounded tubercles, with outer-distal microtrichia and inner seta. Epignath (Fig. 103J) slender, ribbon-like, distally pointed, naked.

Cheliped (Fig. 103K) with rounded, naked basis 2.3 times as long as wide, merus subtriangular with single ventral seta, and covering about half of ventral margin of carpus; carpus 1.5 times as long as wide, with one longer and one much shorter midventral setae, one dorsodistal seta and one dorsoproximal seta, dorsal margin smooth; propodus just longer than wide,

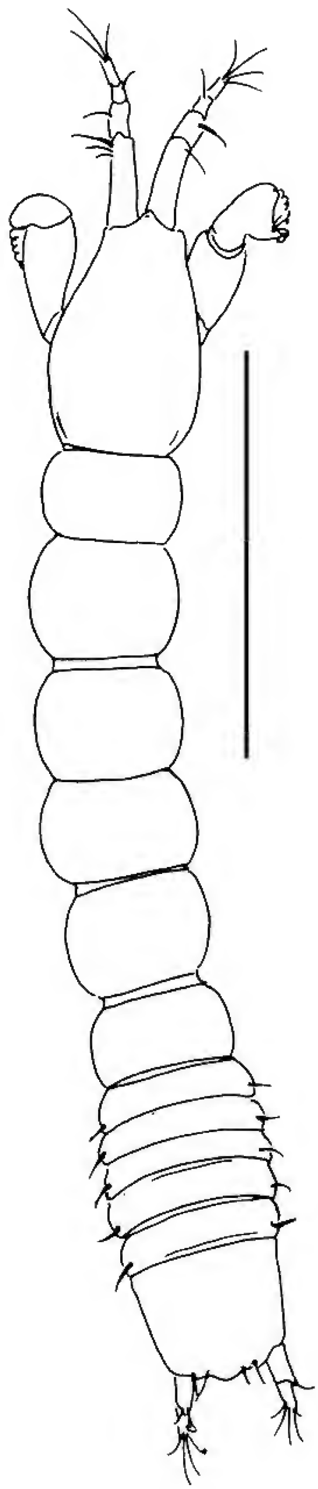

Fig. 102. *Araphuroides sala* sp. nov., female holotype, dorsal. Scale = 0.5 mm.

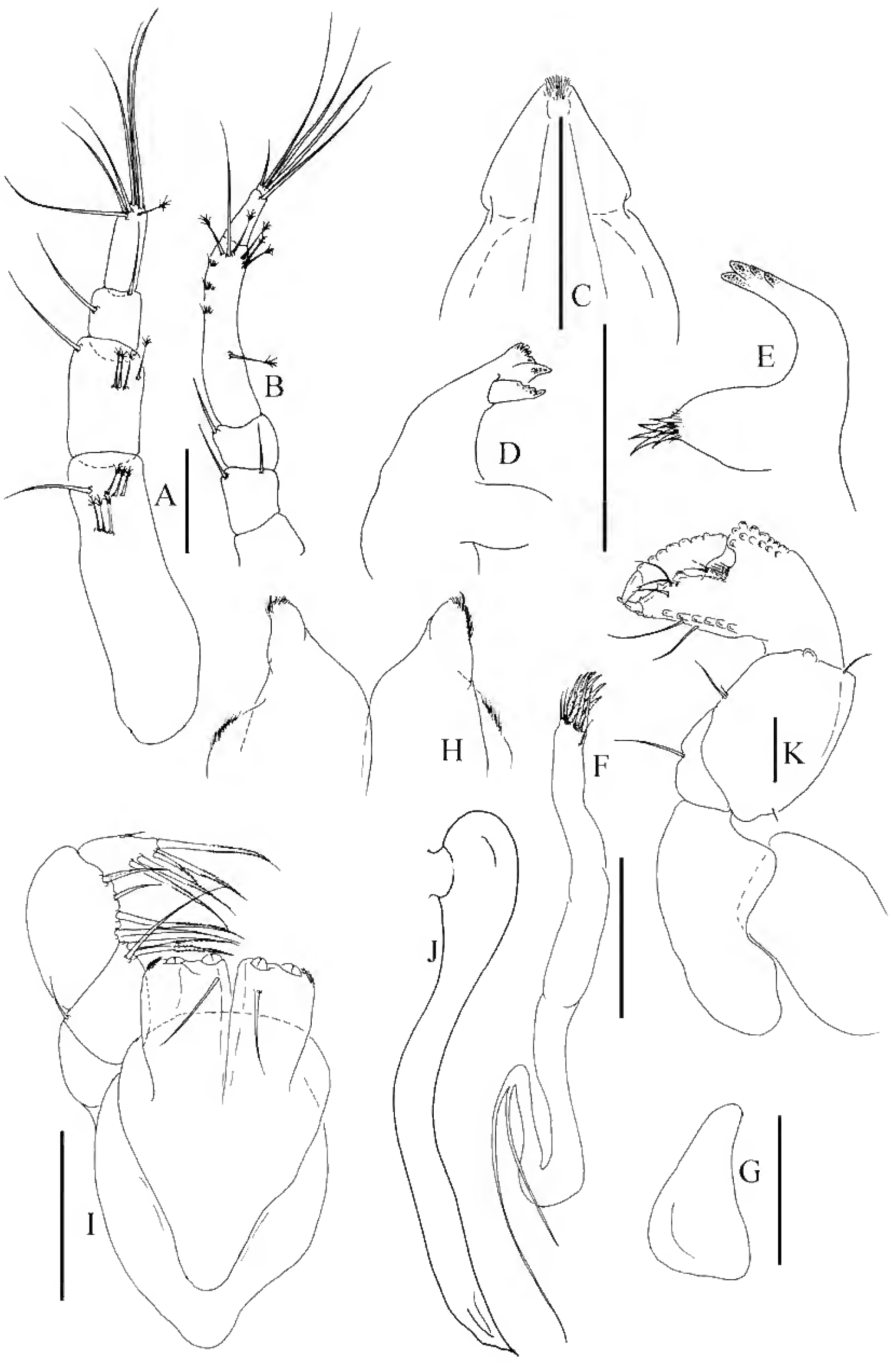


Fig. 103. *Araphuroides sala* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; G, maxilla; H, labium; I, maxilliped; J, epignath; K, cheliped. Scale = 0.1 mm.

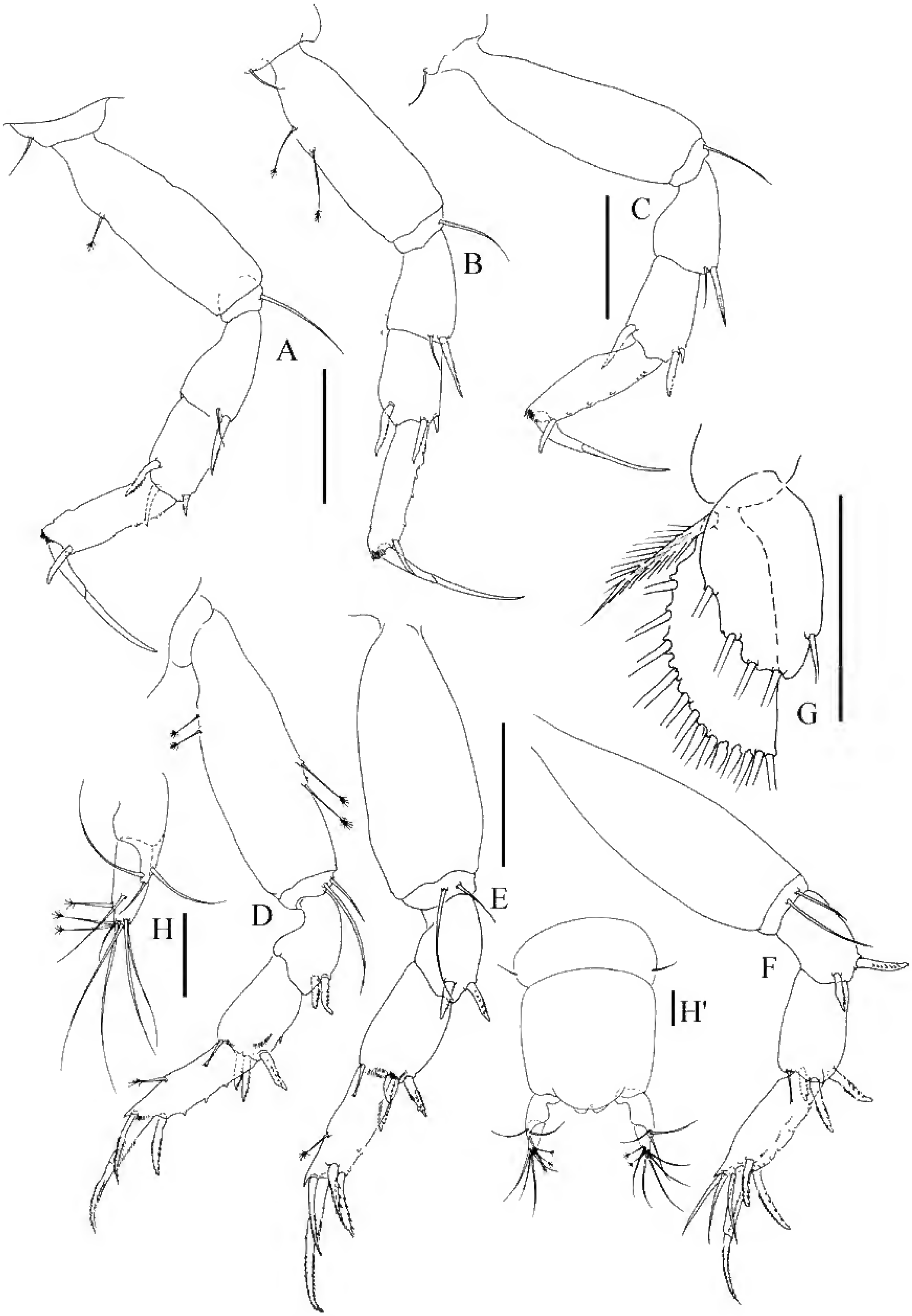


Fig. 104. *Araphuroides sala* sp. nov., female paratype. A to F, pereopods 1 to 6 respectively; G, pleopod; H, uropod; H' pleotelson, dorsal (distal setae not shown). Scale = 0.1 mm.

with two ventral setae, dorsally with two rows of rounded tubercles in distal half, outer face with row of rounded tubercles along ventral margin of fixed finger, inner comb-row of four setae; fixed finger with three setae below cutting edge and two or three small tooth-like apophyses on cutting edge; dactylus with rounded tubercles along dorsal margin.

Pereopod 1 (Fig. 104A) not longer than others, coxa without apophysis, with seta; basis 2.9 times as long as wide, with dorsoproximal penicillate seta; ischium compact, with one ventrodistal seta almost as long as merus; merus 1.2 times as long as carpus, ventrodistally with seta and longer distally-denticulate spine just exceeding half length of carpus; carpus distally with shorter ventral spine and single distally-denticulate dorsodistal spines anteriorly and posteriorly; propodus 1.25 times as long as carpus, with ventrodistal spine and dorsodistal and ventral microtrichia; dactylus naked, unguis 1.5 times as long as dactylus, both together 1.4 times as long as propodus. Pereopod 2 (Fig. 104B), similar to pereopod 1, basis with two dorsoproximal penicillate setae; merus and carpus subequal in length; propodus 1.5 times as long as carpus; dactylus and unguis together 1.2 times as long as propodus. Pereopod 3 (Fig. 104C) similar to pereopod 2.

Pereopod 4 (Fig. 104D) not more compact, coxa naked, basis three times as long as wide, with two dorsoproximal and two midventral penicillate setae; ischium with one shorter and one longer ventrodistal setae, latter as long as merus; merus just shorter than carpus, with two finely-denticulate ventrodistal spines; carpus with single dorsodistal and ventrodistal setae and three finely-denticulate ventrodistal spines, distally with microtrichia; propodus 1.2 times as long as carpus, with ventral fields of microtrichia, dorsal penicillate seta, two ventrodistal and one dorsodistal finely-denticulate spines; dactylus 0.8 times as long as unguis, both with fields of microtrichia, dactylus and unguis not fused into a claw, the two together 1.1 times as long as propodus. Pereopod 5 (Fig. 104E) as pereopod 4, but basis without penicillate setae. Pereopod 6 (Fig. 104F) as pereopod 5, but propodus with two ventral and three dorsal distal spines.

Pleopods (Fig. 104G) all alike, with naked basis, endopod with subdistal inner plumose seta, exopod without setae on inner margin, outer margins with respectively 5 and 12 plumose setae, additional proximal exopod seta separated from others.

Uropod (Fig. 104H, H') half as long as pleotelson, basis naked, exopod process half as long as endopod, with three distal setae; endopod of one segment, setose as figured.

*Male.* Unknown.

*Etymology.* Named after the English journalist George Augustus Henry Sala who, during a visit to Victoria in 1885, coined the phrase "Marvellous Melbourne", which stuck long into the twentieth century and is apparently still used today by Melburnians (noun in apposition).

*Remarks.* Within the genus *Araphuroides*, only the three species described herein and *A. bombus* Larsen, 2005 are without a pseudo-articulation line on the fourth antennal article, and only the present species and *A. batmania* have rounded tubercles on the chela; these two also share the elongate setae on the ischia of the pereopods. *A. batmania* differs from *A. sala* sp. nov. in being without the dorsodistal tubercles on the chela, as well as in having only rounded distal tubercles on the mandibular molar process, and in having a uropod with a longer exopod process and a two-segmented endopod.

*Araphuroides sala* was found in Western Port and off Flinders Island in coarse to muddy sands at depths between 11 and 124 m.

*Discussion of the genera* Araphura *and* Araphuroides.

Sieg (1986a) originally distinguished *Araphuroides* from *Araphura* by their "body shape", the pereonites of *Araphura* having parallel margins while those of the two species he attributed to *Araphuroides* (see above) having "gently rounded" margins; additionally, pereonite 2 in *Araphura* is "normally" as long as wide or slightly wider than long, while it is "distinctly broader than long" in *Araphuroides*; further, he maintained that the merus on pereopod 1 is short, "only slightly longer than broad", in *Araphura*, but "distinctly longer than broad" in *Araphuroides*. Finally, the pars molaris of the mandible is broad, with "at least one longer and several small toothlike processes" in *Araphuroides*, but is pointed "ending in three or four tiny tips" in *Araphura*.

Sieg & Dojiri (1989) expanded on these distinctions, citing pereonite 2 as being "at least as long as broad, but mostly longer than broad" in *Araphura*; strangely, these authors showed the features of the ratio of length to width of pereonite 2, and of parallel- or convex-sided pereonites to be ontogenically variable. Larsen (2005) and Larsen *et al.* (2009) added the body length to width proportions as distinguishing these two genera (*Araphura* 9 to 13 times as long as wide, *Araphuroides* less than nine times), even though this feature was not cited by Sieg (locc. cit.).

These various features for the Australian species of these two genera are shown in Table 2. None of the species has a pereopod 1 merus "only slightly longer than broad". Other than this, it is apparent that the only species agreeing wholly with Sieg's concept of *Araphura* is *A. pygmothymus*, and it is the only one with a "pointed" mandibular molar process. Yet, from their remaining morphology, *A. yarra* is clearly a species close to *A. pygmothymus*. Indeed, a number of these species appear to be siblings. Considering Larsen's (2005) concept of body length to width, these Australian species show a gradation suggesting that any such distinction is entirely arbitrary.

Indeed, it is apparent that the "characters" diagnosing these genera according to Sieg (locc. cit.) are not consistent, and consideration of the features shown in table 2 as being diagnostic is to fall into the error or classifying characters rather than animals. To quote Linnaeus, "Characters come from the genus, not the genus from the characters. Characters are not there so that there should be a genus but in order that the genus should be recognized." (Linné, 1751; see also Mayr, 1969). One might be as justified in using the tuberculation on the chela found here (and in *A. whakarakaia*) in all three species named in *Araphura* plus two of the *Araphuroides* species; however, this can hardly be a generic character, as it is also present in another and quite distinct tanaellid genus, described below, as well as some species of the unrelated genera *Chauliopleona* Dojiri & Sieg, 1997 and *Akanthophoreus* Sieg, 1986.

Table 2. Characters of the Australian species of *Araphura* and *Araphuroides*, together with those defined as characterizing the genera by Sieg & Dojiri (1989). *data from Larsen (2005), who further distinguished these genera on body proportion, but note that Sieg (1986a) and Sieg & Dojiri (1989) did not.

| | **Body length: width** | **pereonite 2 width: length** | **pereopod 1 merus length: width** | **pereopod 1 merus: carpus** | **mandible molar process** | **mandibular molar ventrodistal slender spines** | **lateral borders of pereonites** | **Tuberculation on the chela** |
|---|---|---|---|---|---|---|---|---|
| *Araphura pygmothymus* | 9.7 | 0.9 | 1.7 | ~1.0 | tapering | absent | parallel | present |
| *Araphura yarra* | 8.8 | 1 | 2.1 | 1.4 | stout | present | ~ parallel | present |
| *Araphura doutagalla* | 7.4 | 1.4 | 1.7 | ~1.0 | stout | present | ~ parallel | present |
| *Araphuroides stabastris* | 7 | 1.6 | 1.3 | 0.6 | stout | absent | convex | absent |
| *Araphuroides batmania* | 6.6 | 1.5 | 1.7 | ~1.0 | stout | absent | ~ convex | present |
| *Araphuroides sala* | 8.1 | 1.25 | 1.7 | 1.2 | stout | present | convex | present |
| *Araphura io* Bamber, 2005 | 7.3 | 1.5 | 1.6 | ~1.0 | stout | present | ~ parallel | absent |
| *Araphura sensu* Sieg & Dojiri, 1989 | 9 to 13* | ≤ 1.0 | ~1.0 | ~1.0 | tapering | absent | parallel | |
| *Araphuroides sensu* Sieg & Dojiri, 1989 | < 9.0* | >1.0 | >1.0 | >1.0 | stout | present | convex | |

The right conclusion is probably to dismiss *Araphuroides* as a distinct genus, but that must necessitate a reanalysis of all 24 species attributed to these two genera (including those described herein). At present, the three species above attributed to *Araphuroides* are distinguished simply on their convex (or relatively convex) lateral pereonite margins. On that basis, despite its being apparently close to the *Araphuroides* species described above, *Araphura io* is returned to its original genus.

Genus ***Inconnivus*** gen. nov.

*Diagnosis, female.* Tanaellid with cephalothorax showing lateral concavity towards anterior. Eyelobes present. Antennule with four articles, antenna with six articles, proximal article fused to cephalothorax; second and third articles with slender dorsodistal spines. Mandibular pars molaris longer than pars incisiva, with distal ring or spines, longer ventrally. Pereopods, chelipeds, maxillipeds with microtrichia; merus and carpus of all pereopods with spines. Dactylus and unguis of pereopods distinct, as long as or longer than propodus; distal propodal spine of pereopods 2 and 3 coaxial with dactylus. Pleopods present. Uropods stout, exopod present as small process fused to basis; endopods short, the two not configured in the form of "pincers".

*Type species. Inconnivus billibunteri* sp. nov. by monotypy.

*Etymology.* from the Latin "that does not close the eyes", alluding to the presence of distinct eyelobes in a taxon otherwise hardly distinct from the eyelobe-less genus *Tanaella* Norman and Stebbing, 1886; noun derived from the adjective, male.

*Remarks.* With the anterolateral concavity to the cephalothorax, the conformation of the antennules, antennae, pereopods, pleopods, uropods and mouthparts, the species described below shows a very close affinity to *Tanaella*. The uropods are very short for a *Tanaella*, and clearly not "pincer-like" (see diagnosis of *Tanaella* by Larsen & Heard, 2004b), although this configuration is also approached by, for example, *T. kroyeri* Larsen *et al*., 2009. However, the present species takes this reduction in the uropods much further, and, most distinctly, has evident eyelobes, although no ocelli were observed in the preserved material: Larsen and Heard (2004b) included a lack of eyelobes in their generic diagnosis for *Tanaella*, and Larsen (2005) considered it one diagnostic feature of the Tanaellidae.

The species below shows some superficial similarities to the Cryptocopinae, but the conformation of the uropods, antennae, maxilliped endites and chelipeds, and the pereopod spination all suggest otherwise.

This species is therefore attributed to a separate genus, closely related to *Tanaella*, but with the presence of eyelobes, probably more plesiomorphic. It is not possible at present to say whether the additional features of the tuberculate rugosity on the cheliped or the microtrichia on the pereopods are generic or specific characters.

***Inconnivus billibunteri*** sp. nov.

Figures 105–107

*Material examined.* 1 ♀ (J37873), holotype, off Nowra, New South Wales, Stn SLOPE 1, 34°59.52'S 151°05.93'E, 204 m depth, 14 July 1986; coll. G.C.B. Poore; 1 ♀ (J58564), paratype, Central Bass Strait, 25 km SW of Cape Frankland, Flinders Island, Stn BSS 162, 40°09.4'S 147°32.6'E, 51 m depth, shelly sand, 14 November 1981; coll. R.S. Wilson; 1 ♀ (J58903), paratype, Eastern Bass Strait, 100 km NE of North Point, Flinders Island, Stn BSS 170, 38°52.6'S 148°25.2'E, 130 m depth, fine sand, 15 November 1981; coll. R.S. Wilson.

*Description of female.* Body (Fig. 105) compact, holotype 2.9 mm long, 4.8 times as long as wide. Cephalothorax narrowing towards anterior, as long as wide, about as long as pereonites 1 to

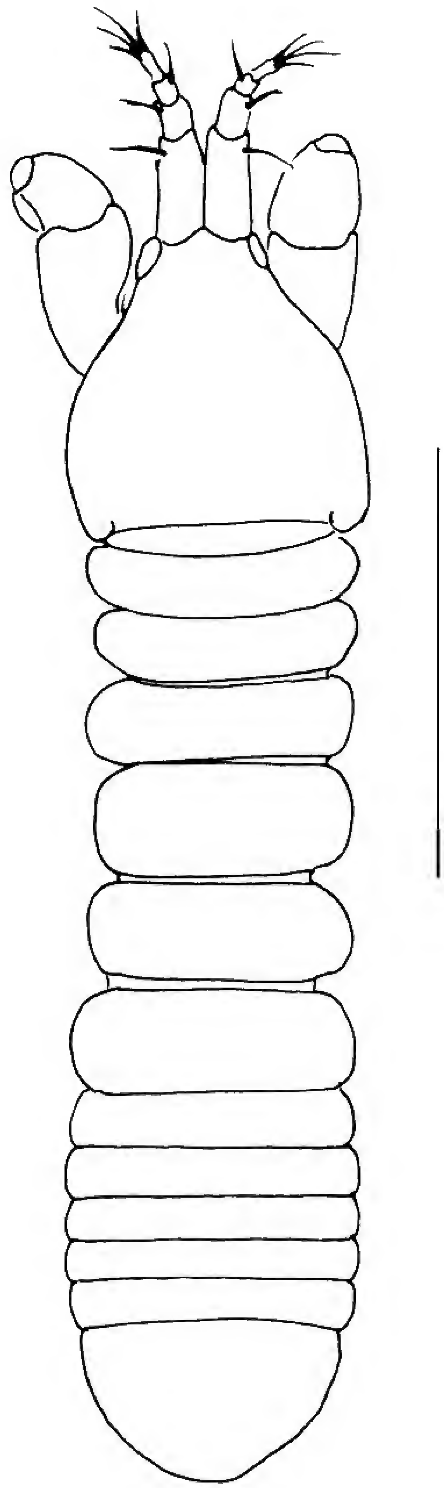

Fig. 105. *Inconnivus billibunteri* sp. nov. A, holotype female dorsal view. Scale = 1 mm.

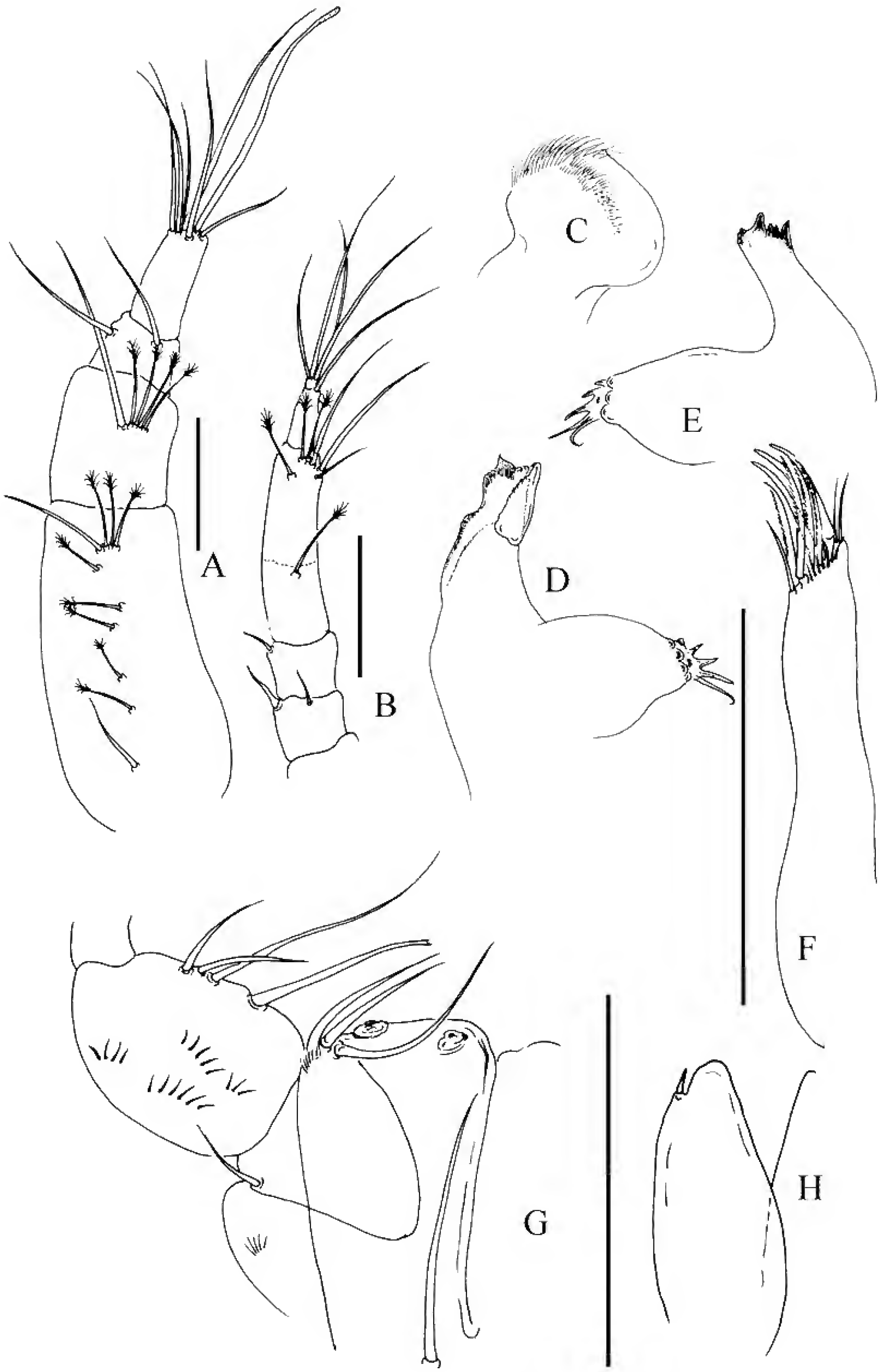


Fig. 106. *Inconnivus billibunteri* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule endite; G, maxilliped (distal palp article damaged); H, labium. Scale = 0.1 mm.


Fig. 107. *Inconnivus billibunteri* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

4 together, naked; eyelobes present, eyes absent. All pereonites laterally convex; pereonites 1 to 3 subequal in length, narrow, less than one-quarter as long as cephalothorax; pereonite 4 longest, 1.5 times as long as pereonite 3; pereonites 5 and 6 subequal, 0.9 times as long as pereonite 4 (all pereonites respectively 4, 4.4, 3.8, 2.3, 2.7 and 2.9 times as wide as long). Five free subequal pleonites bearing pleopods; each pleonite 6.4 times as wide as long. Pleotelson semicircular, as long as maximum width, longer than last three pleonites together, naked.

Antennule (Fig. 106A) of four articles, proximal article 2.4 times as long as wide, 1.3 times as long as distal three articles together, with mid-dorsal row of two simple and about eight penicillate setae; second article slightly longer than wide, one-third as long as first article, with distal tuft of one simple and four penicillate setae; third article compact, one-third as long as second article, with two simple distal setae; fourth article 2.5 times as long as third with six simple distal setae and one aesthetasc.

Antenna (Fig. 106B) proximal article compact, fused to cephalothorax; second article as long as wide, with distal seta and dorsodistal spinule; third article as long as wide, with dorsodistal seta; fourth article longest, 3.9 times as long as wide, with suggestion of secondary articulation just proximal of mid-length, and with one penicillate seta just proximal of mid-length and group of three simple and three penicillate distal setae; fifth article 0.3 times as long as fourth with one simple distal seta; sixth article minute with four distal setae.

Labrum (Fig. 106C) rounded, distally setose. Left mandible (Fig. 106D) with narrow, irregularly-crenulate pars incisiva, lacinia mobilis triangular with fine outer denticulations, right mandible (Fig. 106E) as left but without lacinia mobilis; pars molaris of both mandibles robust with slender ventrodistal spines. Labium (Fig. 106H) simple, elongate, with outer-distal spinule. Maxillule (Fig. 106F) with nine distal spines, six of these slender, scythe-like with fine denticulations; palp not recovered. Maxilliped palp (Fig. 106G) with groups of microtrichia; first article naked; second article with outer distal seta and three longer inner-distal setae; third article with four inner setae, longest seta much longer than article; fourth article damaged in preparation; basis with single, long seta not reaching distal margin of endites; endites distally with two oval tubercles. Epignath not recovered.

Cheliped (Fig. 107A) sclerite with triangular attachment to basis; basis just longer than wide and bearing microtrichia; merus subtriangular with single ventral seta; carpus rounded, compact, 1.1 times as long as wide, with two midventral setae, one dorsoproximal and one dorsodistal setae; propodus as long as carpus, with comb-row of four setae, fixed finger with two ventral and one inner setae, three setae on cutting edge, cutting edge crenulate; dactylus with robust row of rounded crenulations along outer dorsal margin, cutting edge with three coarser crenulations.

Pereopod 1 (Fig. 107B) coxa naked; basis slender, 4.5 times as long as wide, with mid-ventral microtrichia and ventrodistal seta; ischium compact with long ventral seta 0.85 times as long as merus; merus, carpus and propodus subequal in length; merus with midventral microtrichia and ventrodistal spine; carpus with microtrichia, ventrodistal spine, two inner-distal setae and long dorsodistal spine, 0.75 times as long as propodus and with inner denticulation; propodus with ventral microtrichia, subdistal dorsal seta and ventrodistal spine longer than dactylus; dactylus and claw subequal in length, both together 1.15 times as long as propodus. Pereopod 2 (Fig. 107C) similar to pereopod 1, basis four times as long as wide, without ventrodistal seta; carpus with two ventrodistal spines, dorsodistal spine half as long as propodus; propodus 1.3 times as long as carpus, without dorsal seta; dactylus with proximal seta. Pereopod 3 (Fig. 107D) similar to pereopod 2 but carpus and propodus subequal in length and 1.4 times as long as merus.

Pereopod 4 (Fig. 107E) basis stout, 2.5 times as long as wide, with two penicillate setae; ischium with ventrodistal seta as long as merus; merus shorter than carpus, with two finely-denticulate ventrodistal spines; carpus with three finely-denticulate ventrodistal spines and slender dorsodistal blunt spine; propodus 1.2 times as long as carpus, with dorsal penicillate seta, ventral rows of microtrichia, and three distal spines almost as long as dactylus; dactylus and claw subequal in length, curved, both together 1.3 times as long as propodus. Pereopod 5 (Fig. 107F) as pereopod 4, but seta on ischium longer than merus, merus and carpus subequal in length, distal setae on propodus longer than dactylus. Pereopod 6 (Fig. 107G) as pereopod 4, but basis more slender (3.25 times as long as wide), propodus with four distal finely-denticulate spines and one simple seta.

Pleopods (Fig. 107H) all alike, with naked basis, endopod shorter than exopod, both without setae on inner margin, outer margins with respectively 7 and 14 plumose setae.

Uropod (Fig. 107I) short; basis naked and with minute rounded exopodal process bearing two long and one short distal setae; endopod of one segment just longer than basis, with two penicillate setae at mid-length and array of five simple distal setae.

*Male.* Unknown.

*Etymology.* named after William George ("Billy") Bunter, a proportionately-fat schoolboy character in books written by Charles Hamilton using the pen-name Frank Richards.

*Remarks.* The characterizing features of this species, which distinguish it from the related genus *Tanaella*, particularly the presence of eyelobes, are described above under the generic remarks. Further, it is much less slender than species of *Tanaella*. In comparison with those species, *Inconnivus billibunteri* sp. nov. would key out to *T. mclellandi* Larsen and Heard, 2004b, in the key to the genus given by Guerrero-Kommritz & Blazewicz-Paszkowycz (2004) but the antennule is distinct, the uropods too short, the chela smaller, the propodi of pereopods 1 and 2 proportionately shorter, and pleopods are present.

Since that publication, two further species of *Tanaella* have been described. *T. kommritzia* Larsen & Shimomura, 2007(a) has much longer (and incurved) uropods, *inter alia*, and is distinctly more slender. The only species of *Tanaella* recorded from Australia, *T. dongo* Bamber, 2005, is the slenderest of the genus, and has a 2-segmented uropod. Neither, of course, has eyelobes.

*Inconnivus billibunteri* was collected sporadically at depths from 51 to 204 m on shelly to fine sand substrata.

Family **Mirandotanaidae** Błażewicz-Paszkowycz & Bamber, 2009

Genus ***Pooreotanais*** Błażewicz-Paszkowycz & Bamber, 2009

***Pooreotanais gari*** Błażewicz-Paszkowycz & Bamber, 2009

*Pooreotanais gari* Błażewicz-Paszkowycz & Bamber, 2009, 7–11, figs 1–3.

*Remarks. Pooreotanais gari* was described from a male and a number of females and subadults collected from Western Port, Victoria, at depths between 13 and 18 m on a variety of substrata. The genus, and indeed the family Mirandotanaidae, is characterized by having a grossly inflated posterior half (or more) of the body, including the pleon and at least pereonite 6 (pereonites 4 to 6 in the present species). The function of this inflated posterior is unknown, but is unlikely to be related to reproduction as it is also shown by the male.

The only other species of *Pooreotanais*, *P. ningaloo*, is from Western Australia, and is distinct in having only pereonite 6 inflated, and the pleotelson longer than any pleonites (shorter in *P. gari*), *inter alia*.

Family **Typhlotanaidae** Sieg, 1984

Genus ***Typhlotanais*** Sars, 1882 *sensu lato*

***Typhlotanais herthio*** sp. nov.

Figures 108–110

*Material examined.* 1 ♀ (J58514), holotype, Eastern Bass Strait, 60 km E of North Point, Flinders Island, Stn BSS 32, 39°41.7'S 148°39.5'E, 115 m depth, muddy sand, 27 March 1979; coll. G.C.B. Poore; 45 ♀♀ and neuters (J58515), paratypes, Central Bass Strait, 32 km SE of Cape Otway, Stn BSS 48DN, 39°01'S 143°49'E, 81 m depth, coarse sand, 07 October 1980; coll. G.C.B. Poore; 41 ♀♀ and neuters (J58518), paratypes, Central Bass Strait, 66 km S of Rodondo Island, Stn BSS 158S, 39°48.6'S 146°18.8'E, 82 m depth, sand with silt and mud, 13 November 1981; coll. R.S. Wilson.

*Description of female.* Body (Fig. 108A, B) slender, holotype 2.7 mm long, 6.4 times as long as wide. Cephalothorax subrectangular, tapering towards anterior with slight triangular rostrum, 1.2 times as long as wide, about as long as pereonites 1 and 2 together, naked, eyes absent. Pereonite margins parallel, pereonite 1 shortest, 0.4 times as long as cephalothorax; pereonites 2 to 5 subequal, 0.8 times as long as cephalothorax, pereonite 6 shorter, 0.6 times as long as pereonite 5 (all pereonites respectively 2.4, 1.4, 1.4, 1.3, 1.4 and 1.7 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite 5.8 times as wide as long. Pleotelson pentangular, one-third length of pleon and twice as wide as long, with four small distal setae (Fig. 110I).

Antennule (Fig. 109A) of three articles, proximal article 5.2 times as long as wide, 1.8 times as long as distal two articles together, with row of three strong inner-dorsal setae, outer margin with tufts of one simple and two or three penicillate setae at mid-length and distally; second article nearly twice as long as wide, 0.4 times as long as third article, with single inner distal penicillate and longer simple setae; third article tapering, 0.4 times as long as first article, with five simple and one penicillate distal setae.

Antenna (Fig. 109B) of six articles, proximal article compact, naked; second article stout, as long as wide, with dorsodistal seta longer than article; third article shorter than wide, with fine dorsodistal seta; fourth article longest, ten times as long as wide, curved, with one simple and one penicillate distal setae; fifth article one-quarter as long as fourth with one distal seta; sixth article minute with four distal setae.

Labrum (Fig. 109C) rounded, hood-shaped, distally setose. Left mandible (Fig. 109D) with subtriangular pars incisiva and wide, crenulate lacinia mobilis, right mandible (Fig. 109E) without lacinia mobilis; pars molaris of both mandibles with strong, rounded tooth-like protrusions around distal margin. Labium (Fig. 109H) simple, finely setose on outer margins. Maxillule (Fig. 109F) with eight distal spines, palp (Fig. 109F') with two distal setae. Maxilla (Fig. 109G) ovoid, naked. Maxilliped palp (Fig. 109I) first article naked, second article with one outer and three inner setae, distal of these finely denticulate in distal half; third article with four inner setae in distal half of article, two of these finely denticulate in distal half; fourth article with five inner to distal setae, four of these finely denticulate in distal half, and one outer subdistal seta; basis with single, long seta reaching distal margin of endites; endites distally with two setae and two slight tubercles, outer distal margin slightly denticulate. Epignath (Fig. 109J) elongate, linguiform, naked.

Cheliped (Fig. 110A) with rounded basis reaching pereonite 1 ventrally, 1.2 times as long as wide, with single dorsodistal seta; merus subtriangular with single ventral seta; carpus elongate, three times as long as wide, with two midventral setae of markedly unequal length, one fine ventrodistal seta, and row of eight setae along dorsal margin; propodus slender, curved, twice as long as wide, fixed finger 0.73 times as long as palm, with two ventral setae, three setae on cutting edge; dactylus with fine proximal seta.

Pereopod 1 (Fig. 110B) longer than others, coxal apophysis large, triangular, pointed, with seta; basis arcuate, slender, nearly six times as long as wide, with six simple setae along dorsal margin; ischium compact, with ventral seta two-thirds as long as merus; merus 0.4 times as long as basis, with three simple distal setae; carpus just shorter than merus with distal crown of eight simple setae; propodus 1.5 times as long as carpus, with three dorsal subdistal setae, longer ventral subdistal seta; short, stout dactylus with proximal seta longer than dactylus, slender unguis 2.6 times as long as dactylus, both together 0.9 times as long as propodus. Pereopod 2 (Fig. 110C), coxa similar to that of pereopod 1, basis 3.3 times as long as wide, with midventral seta and eight setae along dorsal margin; ischium with seta only half as long as merus; merus 0.25 times as long as basis, with single dorsal and two ventral distal simple setae, and dense field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds; carpus 1.4 times as long as merus, with distal crown of eight setae and dense field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds; propodus 1.6 times as long as carpus, with two dorsal subdistal setae, longer ventral subdistal

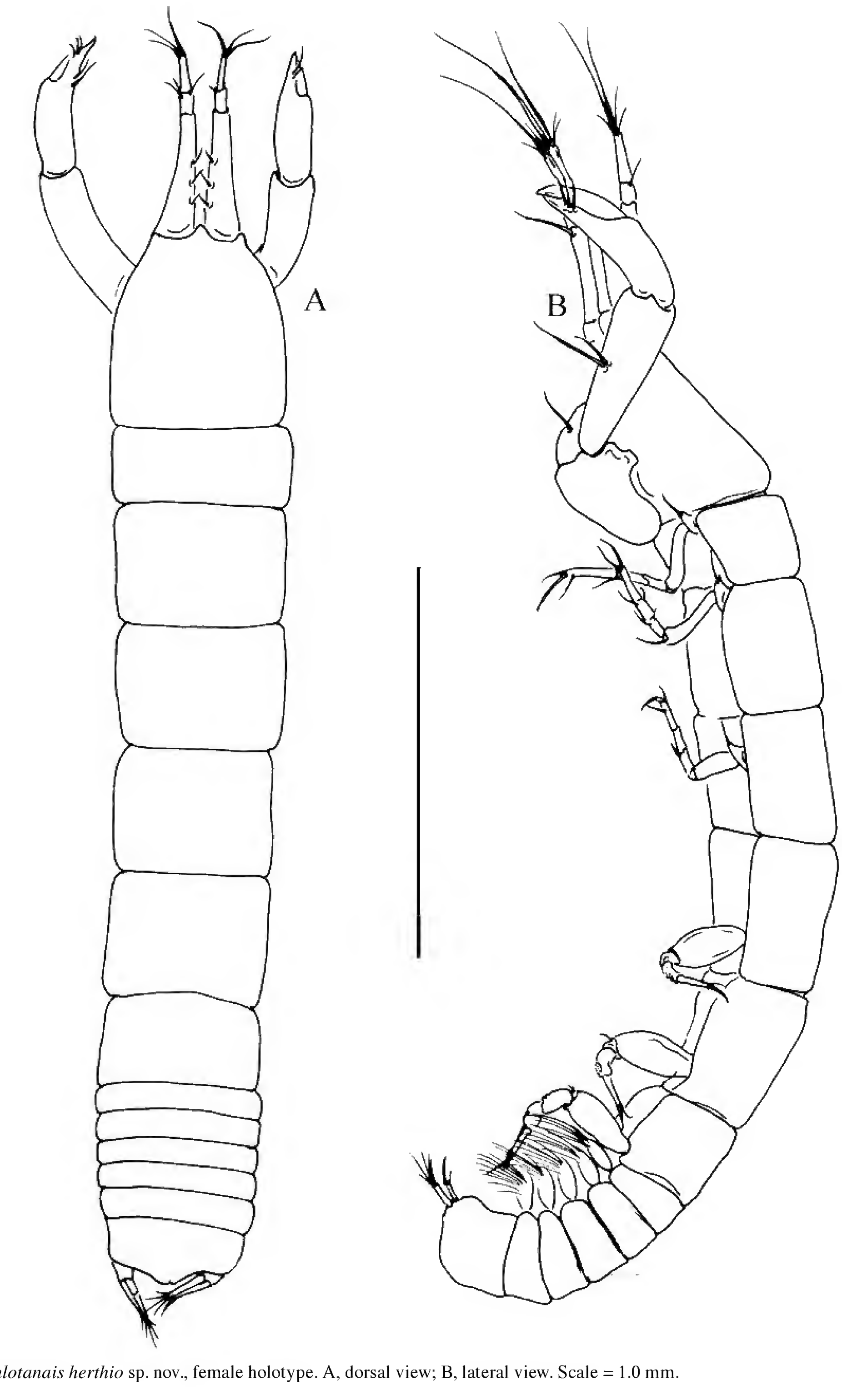


Fig. 108. *Typhlotanais herthio* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1.0 mm.


Fig. 109. *Typhlotanais herthio* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule endite; F' maxillule palp; G, maxilla; H, labium; I, maxilliped; J, epignath. Scale = 0.1 mm.

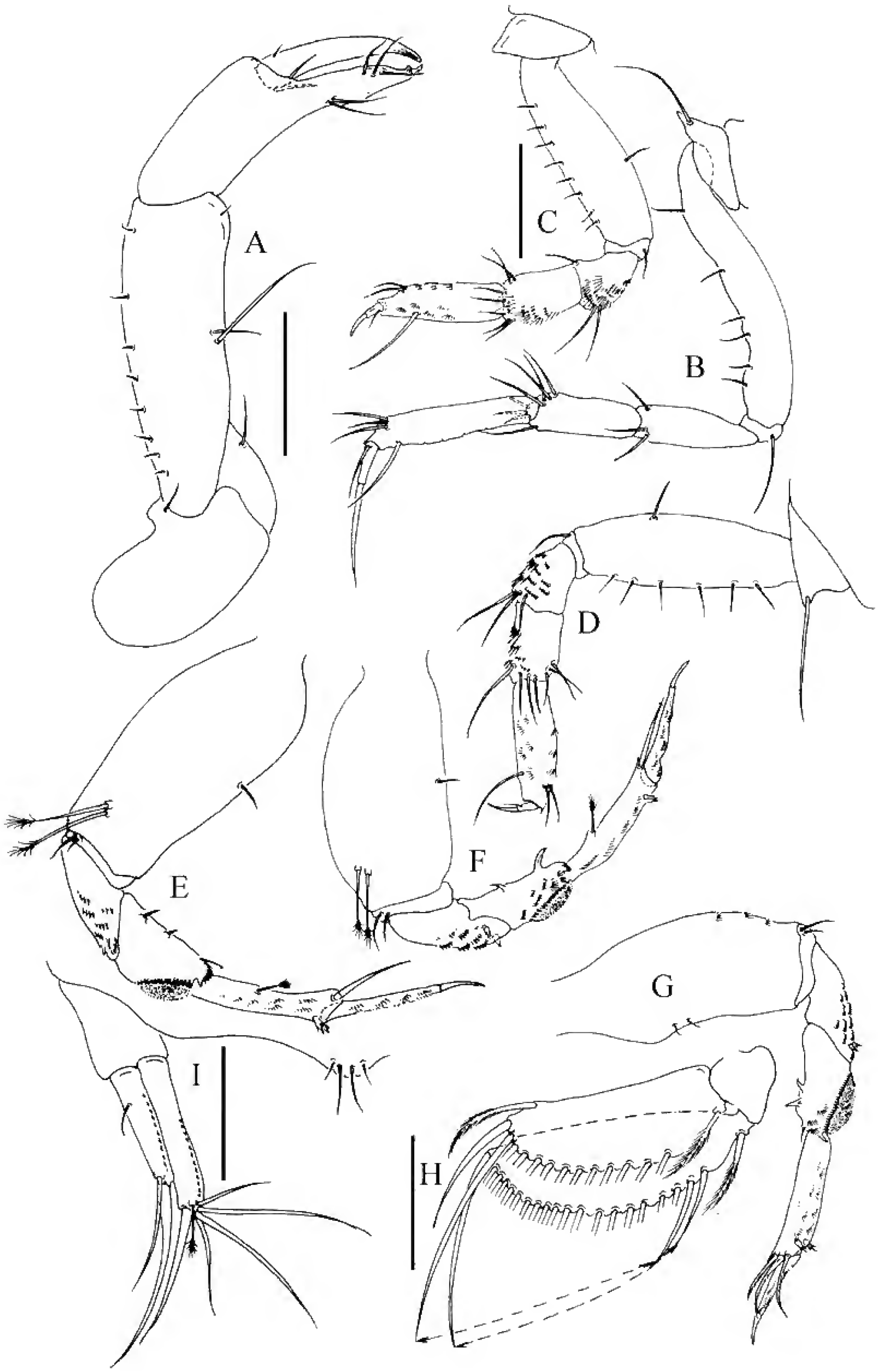


Fig. 110. *Typhlotanais herthio* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod-6. Scale = 0.1 mm.

seta, and fields of microtrichia; short, stout dactylus with proximal seta longer than dactylus, slender unguis longer than dactylus, both together 0.4 times as long as propodus. Pereopod 3 compact (Fig. 110D), similar to pereopod 2, basis with six dorsal marginal setae; merus with three ventrodistal setae.

Pereopod 4 (Fig. 110E) basis stout, 2.1 times as long as wide, with simple mid-dorsal seta and two penicillate setae near ventrodistal corner; ischium with two ventrodistal setae; merus 0.8 times as long as carpus, with field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds, and two small ventrodistal spines; carpus with robust distal molar spine, two simple mid-dorsal and one dorsodistal setae, and "prickly tubercle" (*sensu* Błażewicz-Paszkowycz, 2007) surrounded by minute spines in ventrodistal half; propodus 1.5 times as long as carpus, with fields of microtrichia, mid-dorsal penicillate seta, strong dorsodistal seta, and two ventrodistal dentiform spines; dactylus slender, with fields of microtrichia, three times as long as curved unguis, both together longer than propodus. Pereopod 5 (Fig. 110F) as pereopod 4, but carpus with mid-dorsal and dorsodistal spines. Pereopod 6 (Fig. 110G) as pereopod 5, but basis without penicillate setae, propodus with three dorsodistal setae.

Pleopods (Fig. 110H) all alike, with naked basis, exopod shorter than endopod; endopod and exopod without setae on inner margin, outer margins with respectively 15 and 21 plumose setae, proximal seta on both rami separated from others.

Uropod (Fig. 110I) biramous, basis naked; exopod and endopod of one segment, exopod shorter than endopod, with one fine proximal, one slender and one stouter distal setae; endopod with four slender, one stouter and one penicillate distal setae.

*Male.* Unknown.

*Etymology.* From the Anglo-Saxon *haer* – hairy, and *thioh* – the thigh, alluding to the density of dorsal marginal setae on the bases of the anterior pereopods, which distinguish this species most evidently from the other species of the *greenwichensis*-group of *Typhlotanais sensu lato*; noun in apposition

*Remarks.* With the pronounced coxal spurs on the anterior pereopods, the curving carpus-propodus and the dorsal marginal spines on the carpus of the cheliped, and the prickly tubercles on the posterior carpi, this species fits into the "*greenwichensis*-group" of Błażewicz-Paszkowycz (2007). The two described species of this group are *T. greenwichensis* Shiino, 1970, from the Antarctic-Subantarctic, and *T. messinensis* Sars, 1882 from the Mediterranean.

*Typhlotanais greenwichensis* differs from *T. herthio* sp. nov. in being more elongate (nearly seven times as long as wide), with a less-slender proximal article to the antennule (four times as long as wide), and, most obviously, has only a few dorsal marginal setae on the pereopods 1 to 3 (4, 4 and 3 respectively). *T. messinensis* is quite distinct in having a more compact proximal peduncle article to the antennule (three times as long as wide), and two-segmented rami on the uropods.

*Typhlotanais herthio* was collected sporadically through the Bass Strait, from sandy substrata at depths between 81 and 115 m.

Genus ***Antiplotanais*** Bamber, 2008

***Antiplotanais actuarius*** sp. nov.

Figures 111–113

*Material examined.* 1 ♀ (J58529), holotype, Western Bass Strait, 26 km SW of Cape Otway, Stn BSS 120, 39°01.0'S 143°22.1'E, 84 m depth, medium sand, 31 January 1981; coll. M.F. Gomon; 1 ♀ (J56616), paratype, Southern Port Phillip Bay, Stn PPBES 985, 38°21.0'S 144°51.5'E, 9 m depth, sand, 09 December 1971; coll. G.C.B. Poore & S.F. Rainer.

*Description of female.* Body (Fig. 111A, B) compact, holotype 1.7 mm long, 4.5 times as long as wide. Cephalothorax subrectangular, tapering towards anterior with slight triangular rostrum, as long as wide, longer than pereonites 1 to 3 together, naked, eyes absent. Pereonite 1 shortest, 0.2 times as long as cephalothorax; pereonites 2 to 5 progressively longer, pereonite 2 being 1.4 times as long as pereonite 1, pereonite 5 being twice as long as pereonite 1; pereonite 6 as long as pereonite 4 (all pereonites respectively 4.5, 3.3, 2.8, 2.5, 2.1 and 2.4 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite 3.7 times as wide as long. Pleotelson pentangular, one-third length of pleon and 1.6 times as wide as long, with four small dorso-distal setae.

Antennule (Fig. 112A) of three articles, proximal article 1.9 times as long as wide, 2.4 times as long as distal two articles together, with row of five inner setae, outer margin with proximal and mid-length tufts penicillate setae, one simple seta at mid-length and two distally; second article nearly twice as wide as long, 0.6 times as long as third article, with single inner distal penicillate and longer simple setae and outer distal simple seta; third article tapering, 0.25 times as long as first article, with six simple and one penicillate distal setae.

Antenna (Fig. 112B) of six articles, proximal article compact, naked; second article stout, as long as wide, with dorsodistal seta much shorter than article; third article shorter than wide, with fine dorsodistal seta; fourth article longest, nearly five times as long as wide, with one simple and three penicillate distal setae; fifth article 0.4 times as long as fourth with one distal seta; sixth article minute with five distal setae.

Labrum (not figured) rounded, hood-shaped, distally setose. Left mandible (Fig. 112C) with subtriangular pars incisiva and linguiform, crenulate lacinia mobilis, right mandible (Fig. 112D) without lacinia mobilis but with wider, rounded pars incisiva; pars molaris of both mandibles stout with few (two or three) large, pointed, tooth-like protrusions on distal margin. Labium (Fig. 112G) simple, finely setose on outer and distal margins. Maxillule (Fig. 112E) with eight distal spines, palp with two distal setae. Maxilla not recovered. Maxilliped palp (Fig. 112F) first article naked, second article with one outer and three inner setae, at least one of these finely denticulate in distal half; third article with four inner setae in distal half of article, two of these finely denticulate in distal half; fourth article with five inner to distal setae, four of these finely denticulate in distal half, and one outer subdistal seta; basis with single, long seta exceeding distal margin of endites; endites distally with two setae and two distinct tubercles, and microtrichia. Epignath (Fig. 112H) elongate, linguiform, naked.

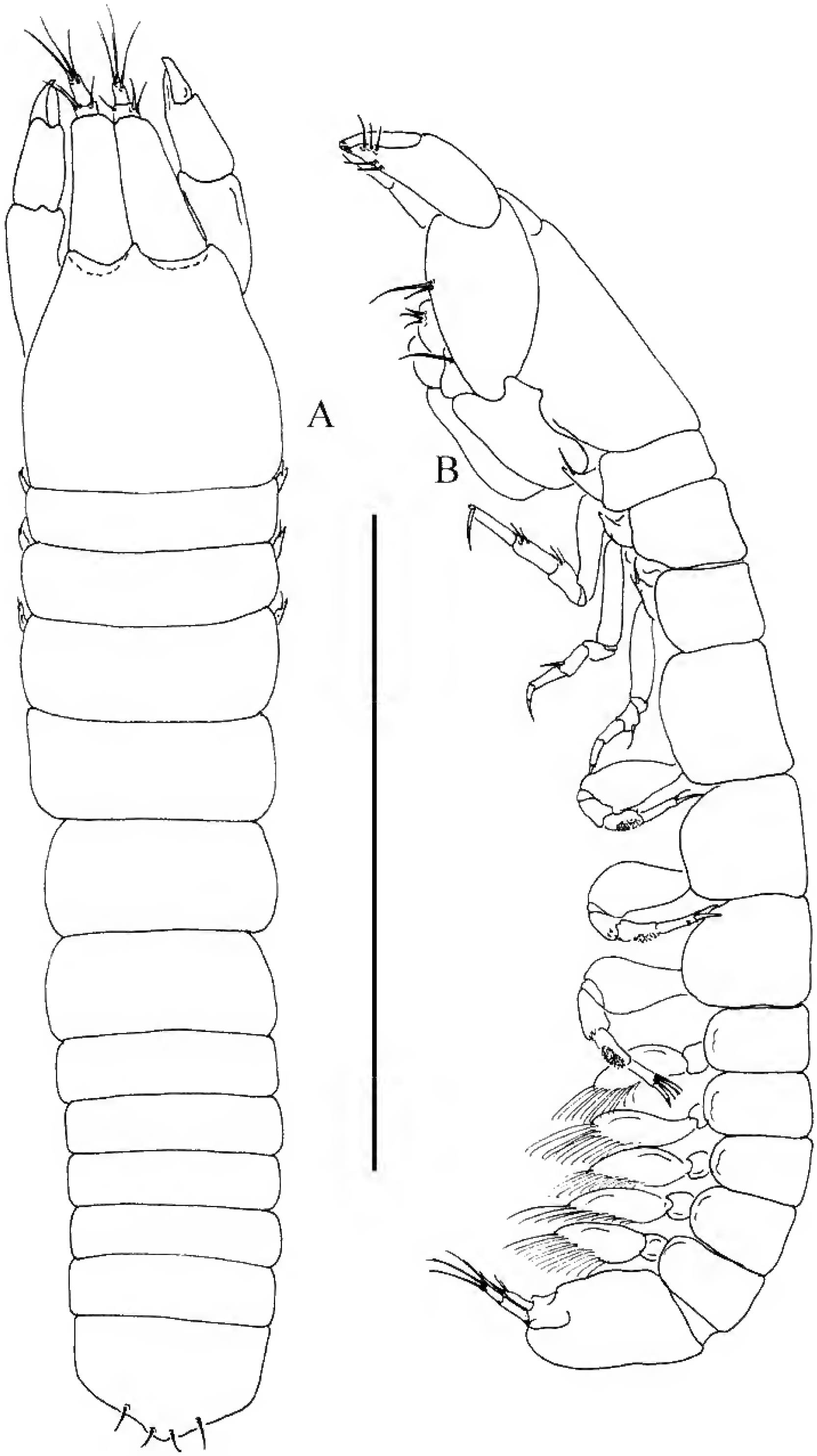


Fig. 111. *Antiplotanais actuarius* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.

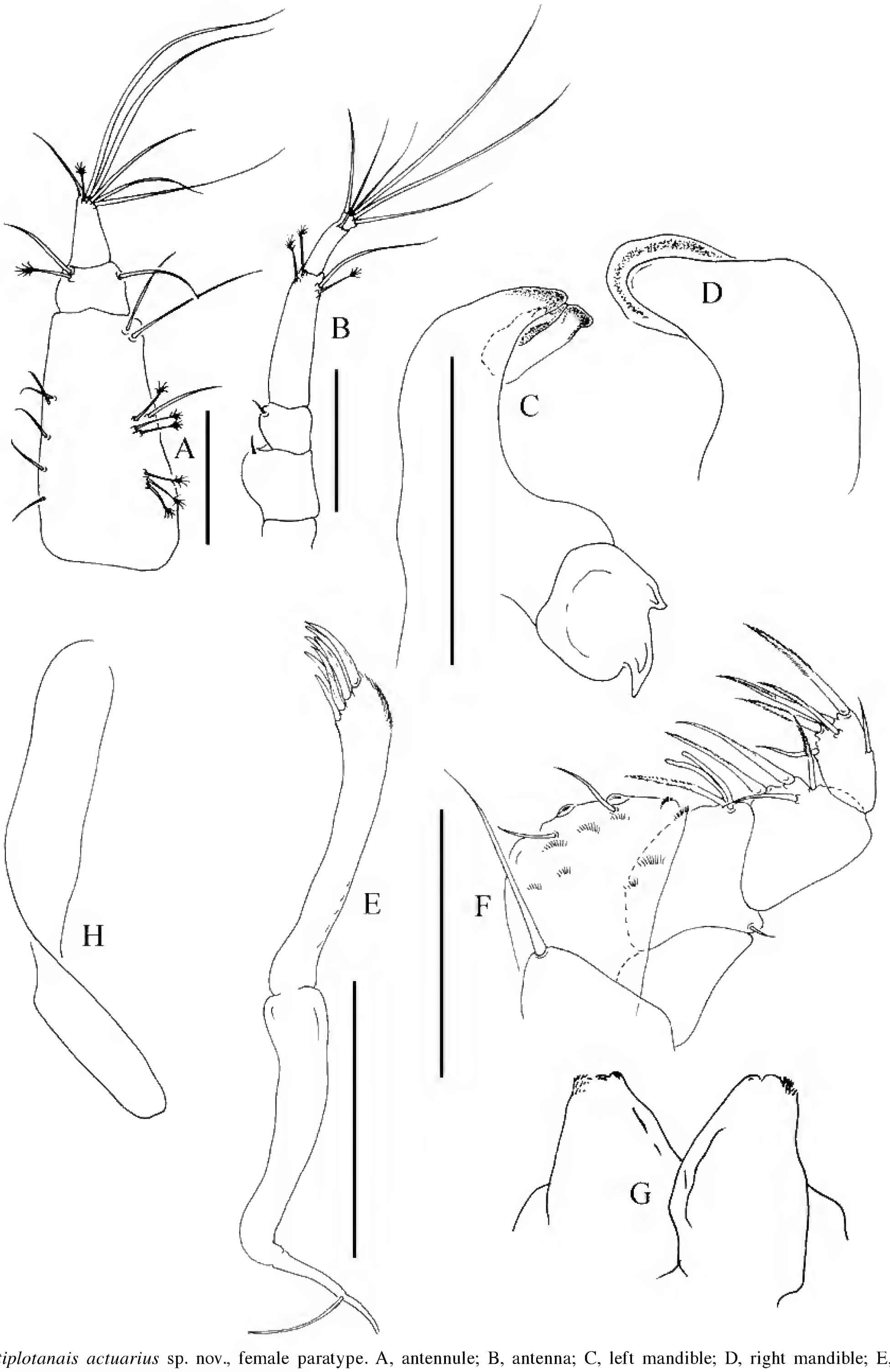


Fig. 112. *Antiplotanais actuarius* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible; D, right mandible; E, maxillule; F, maxilliped; G, labium; H, epignath. Scale = 0.1 mm.

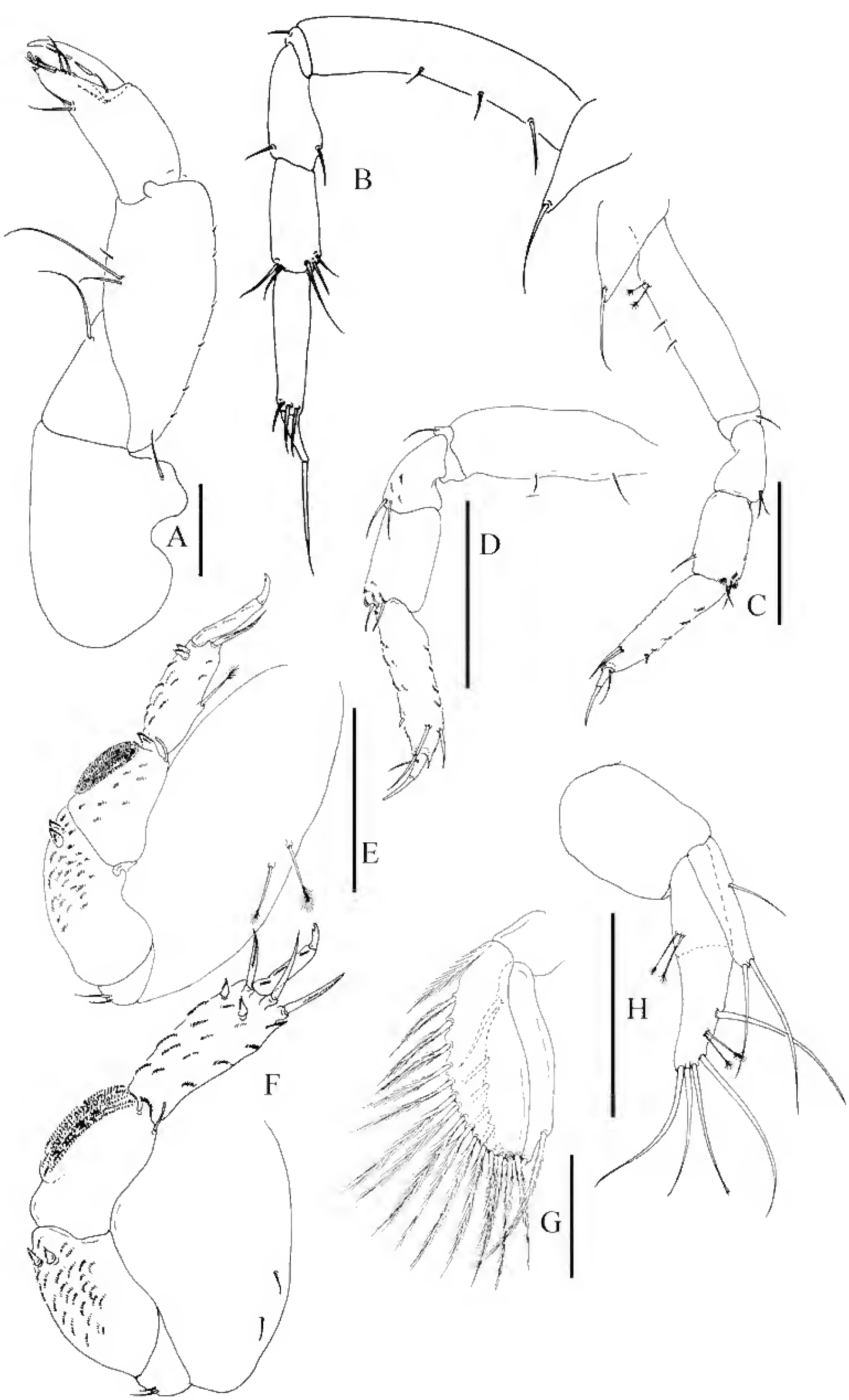


Fig. 113. *Antiplotanais actuarius* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

Cheliped (Fig. 113A) with rounded basis reaching pereonite 1 ventrally, 1.65 times as long as wide, with single dorsodistal seta; merus subtriangular with single ventral seta; carpus elongate, 2.5 times as long as wide, with three midventral setae very unequal in length, and row of six minute setae along dorsal margin; propodus slender, curved, 1.5 times as long as wide, fixed finger 0.7 times as long as palm, with two ventral setae, three setae on cutting edge; dactylus naked.

Pereopod 1 (Fig. 110B) longer than others, coxal apophysis large (evident dorsally on whole animal, see Fig. 108A), triangular, pointed, with seta; basis curved, 4.6 times as long as wide, with three simple setae along dorsal margin; ischium compact, with short ventral seta; merus 0.4 times as long as basis, with one dorsal and one ventral simple distal setae; carpus as long as merus with three dorsal and two ventral simple distal setae; propodus 1.4 times as long as carpus, with three distal setae; short, naked dactylus half as long as slender unguis, both together 1.2 times as long as propodus. Pereopod 2 (Fig. 113C), coxa similar to that of pereopod 1, basis 3.7 times as long as wide, with two setae on dorsal margin; ischium with single seta; merus 0.4 times as long as basis, ventrodistally with two simple setae; carpus 1.1 times as long as merus, with one dorsodistal seta, ventrodistally with two simple setae and field of microtrichia; propodus 1.6 times as long as carpus, with two dorsal subdistal setae, shorter ventral subdistal seta, and fields of microtrichia; short, stout dactylus with proximal seta longer than dactylus, slender unguis longer than dactylus, both together 0.4 times as long as propodus. Pereopod 3 compact (Fig. 113D), similar to pereopod 2, basis with two simple setae on dorsal margin; ischium with single seta; merus ventrodistally with two simple setae and field of microtrichia; carpus ventrodistally with two simple setae and field of microtrichia; propodus with two dorsal subdistal setae, shorter ventral subdistal seta, and fields of microtrichia; short, stout dactylus with proximal seta longer than dactylus, slender unguis longer than dactylus.

Pereopod 4 (Fig. 113E) basis stout, 2.2 times as long as wide, with two penicillate setae mid-ventrally; ischium with two ventrodistal setae; merus 1.1 times as long as carpus, with field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds, and two small ventrodistal spines; carpus with robust distal molar spine, one dorsodistal blunt seta, and "prickly tubercles" (*sensu* Błażewicz-Paszkowycz, 2007) surrounded by minute spines in ventrodistal half; propodus as long as carpus, with fields of microtrichia, mid-dorsal penicillate seta, simple dorsodistal seta, and two small ventrodistal spines; dactylus slender, with fields of microtrichia, three times as long as curved unguis, both together 0.9 times as long as propodus. Pereopod 5 (not figured) as pereopod 4. Pereopod 6 (Fig. 113F) as pereopod 4, but basis with simple setae, propodus with three dorsodistal setae finely denticulate in their distal half.

Pleopods (Fig. 113G) all alike, with naked basis, exopod shorter than endopod; endopod and exopod without setae on inner margin, outer margins with respectively 9 and 16 plumose setae, proximal seta on both rami separated from others.

Uropod (Fig. 113H) biramous, basis naked; exopod half as long as endopod, with one fine proximal, one shorter and one longer distal setae; endopod with residual (atrophied) articulation line, with two penicillate setae just proximal to this line, one subdistal and four distal simple setae and two subdistal penicillate.

*Male*. Unknown.

*Etymology*. From the Latin *actuarius* – a shorthand writer, a pun referring to the shorter chela ("hand") in proportion to the cheliped carpus in this species when compared with the other two described species of *Antiplotanais*.

*Remarks*. The genus *Antiplotanais* shares with the *Typhlotanais greenwichensis*-group (see above) the conspicuous coxal apophyses on the anterior pereopods, and prickly tubercles on the carpi of the posterior pereopods. It differs in the much more compact antennule and antenna, the proportionately shorter habitus (all less than 6 times as long as wide with all pereonites at least twice as wide as long), the relatively long pleonites, the presence of dorsal or dorsodistal setae on the pleotelson, the stouter dactyli on the posterior pereopods and the presence of distal lobes on the mandibular pars molaris.

There were two described species of *Antiplotanais*, *A. coochimudlo* Bamber, 2008, from off Brisbane, Queensland, and *A. lutze* (Bamber, 2005), from Esperance Bay, Western Australia. *Antiplotanais actuarius* sp. nov. differs from the other two particularly in the presence of dorsal setae on the bases of the anterior pereopods, in the cephalothorax being no longer than wide, and in the proportionately-shorter cheliped propodus (including the fixed-finger), being 0.64 times as long as the carpus compared with 0.85 times in *A. coochimudlo* and the same length in *A. lutze*. All three species are from sandy substrata in shallow waters off Australia.

Bamber (2008) remarked that the dactyli and ungues of the posterior pereopods appeared to be fused; it is evident from the present material that this is not the case. The posterior ungues are distinct but very short, and confirmed by re-examination of paratypic material of *A. lutze*, so evidently missed in the examination of the previous material of this genus of very small animals.

*Antiplotanais actuarius* was recorded only twice, from Port Phillip Bay and the Western Bass Strait at 9 and 24 m respectively, on sandy substrata.

Genus ***Hamatipeda*** Błażewicz-Paszkowycz, 2007

***Hamatipeda sima*** sp. nov.

Figures 114–116

*Material examined.* 1 ♀ (J58901), holotype, 4 ♀♀ (J58902), paratypes, Eastern Bass Strait, 85 km NE of North Point, Flinders Island, Stn BSS 169S, 39°02.4'S 148°30.6'E, 120 m depth, sandy-mud, 15 November 1981; coll. R.S. Wilson.

*Description of female.* Body (Fig. 114A, B) elongate, slender, holotype 3.9 mm long, 13 times as long as wide. Cephalothorax subrectangular, tapering towards anterior with slight triangular rostrum, 1.4 times as long as wide, naked, eyes absent. All pereonites with parallel sides, all but the sixth longer than wide: pereonite 1 as long as cephalothorax; pereonites 2 and 4 subequal, 1.5 times as long as cephalothorax; pereonite 3 longest,

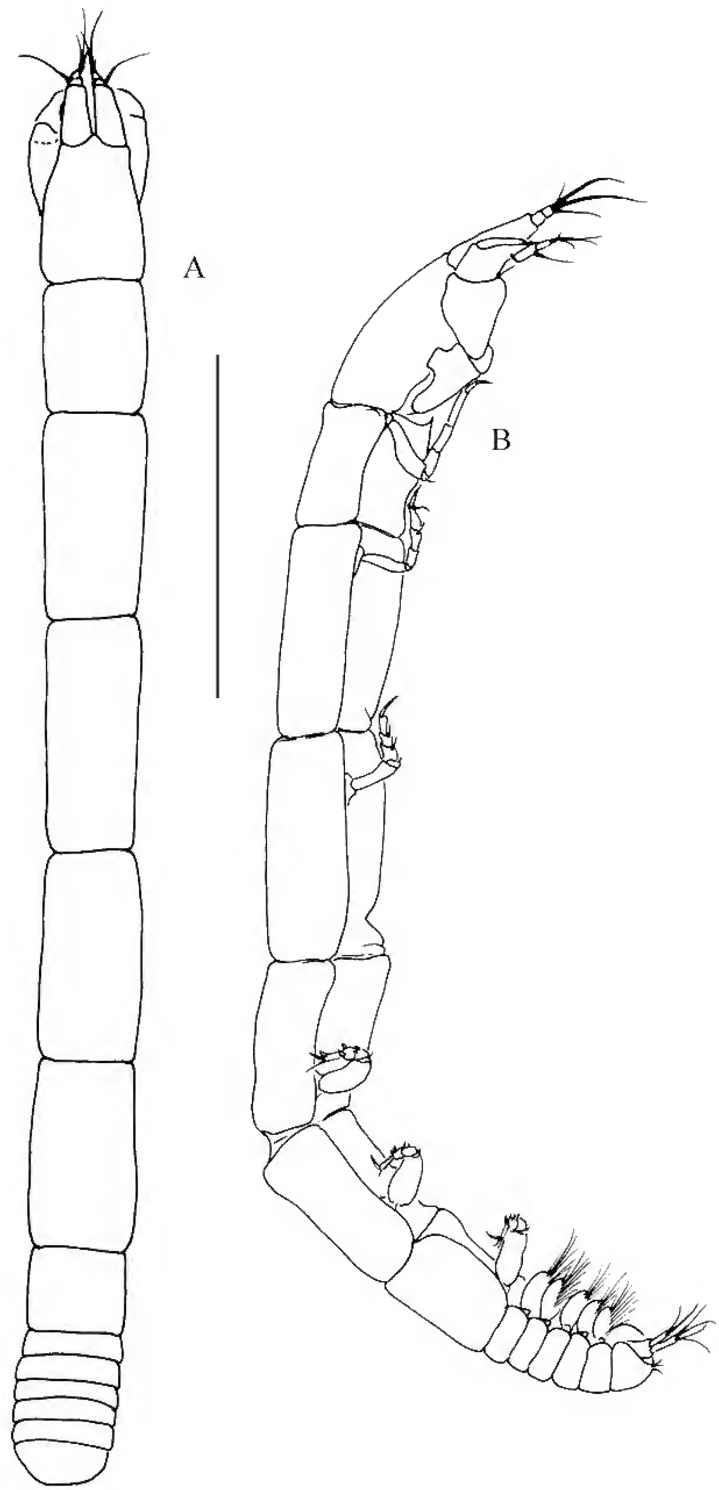


Fig. 114. *Hamatipeda sima* sp. nov. female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.


Fig. 115. *Hamatipeda sima* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule; G, maxilla; H, maxilliped; I, labium; J, epignath. Scale = 0.1 mm.

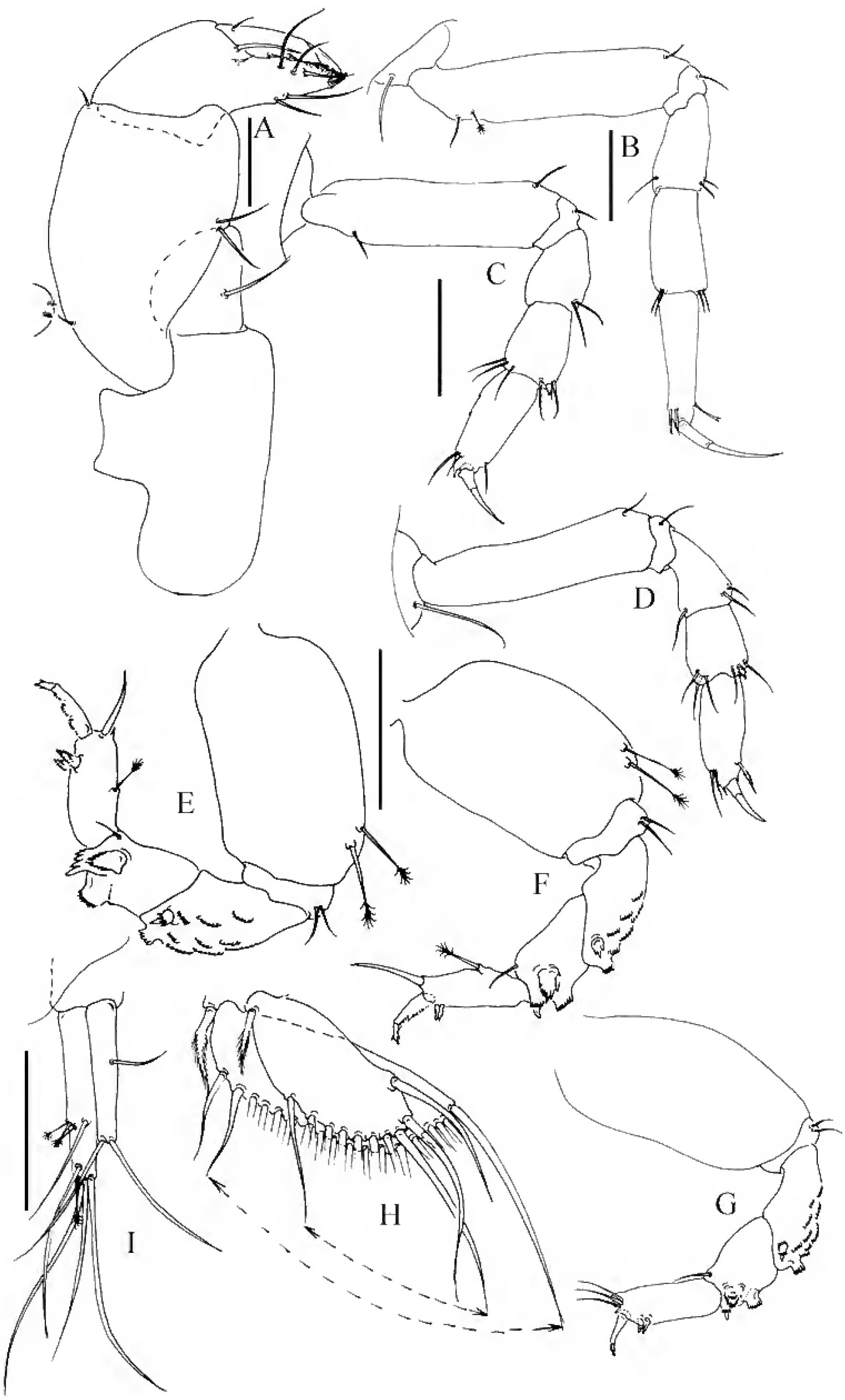


Fig. 116. *Hamatipeda sima* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

1.75 times as long as cephalothorax; pereonite 5 shorter than pereonite 4, 1.4 times as long as cephalothorax; pereonite 6 shortest, 0.6 times as long as cephalothorax (all pereonites respectively 0.8, 0.5, 0.4, 0.5, 0.6 and 1.1 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite 4.8 times as wide as long. Pleotelson semicircular, twice as long as each pleonite and 1.9 times as wide as long, with four small distal setae.

Antennule (Fig. 115A) of three articles, proximal article stout, 2.7 times as long as wide, five times as long as distal two articles together, with one simple inner seta, outer margin with tufts of two or three penicillate setae proximally, at mid-length and distally, the last two tufts also with one simple seta; second article nearly as long as wide, attached within invagination of proximal article but as long as third article, with single outer and inner simple setae; third article tapering, 1.4 times as long as wide, with six simple and one penicillate distal setae.

Antenna (Fig. 115B) of six articles, proximal article compact, naked; second article twice as long as wide and twice as long as first article, with dorsodistal seta; third article as long as wide, as long as first article, with dorsodistal seta and ventral microtrichia; fourth article longest, five times as long as wide, with fields of microtrichia, and distal crown of three simple and three penicillate setae; fifth article one-quarter as long as fourth with one distal seta; sixth article minute with four distal setae.

Labrum (Fig. 115C) rounded, hood-shaped, distally very-finely setose. Left mandible (Fig. 115D) with subtriangular pars incisiva and linguiform, bilobed lacinia mobilis, right mandible (Fig. 115E) without lacinia mobilis but with longer cutting edge on pars incisiva; pars molaris of both mandibles with strong, smooth distal margin. Labium (Fig. 115I) simple, finely setose on outer margins. Maxillule (Fig. 115F) with eight distal spines, rows of microtrichia on outer margin of endite, palp with two distal setae. Maxilla (Fig. 115G) ovoid, naked. Maxilliped palp (Fig. 115H) first article naked, second article with one outer and three inner setae; third article with one robust and three shorter inner setae, all finely denticulate in distal two-thirds; fourth article with five inner to distal setae, proximal of these finely denticulate in distal half, and one outer subdistal seta; basis with single, long seta not reaching distal margin of endites; endites distally with two setae and non-articulate tubercle. Epignath (Fig. 115J) elongate, linguiform, naked.

Cheliped (Fig. 116A) with rounded basis not reaching pereonite 1 ventrally, twice as long as wide; merus subtriangular with single ventral seta; carpus stout, 1.5 times as long as wide, with two midventral setae, one fine dorsoproximal seta, and one dorsodistal seta; propodus palm just longer than wide, fixed finger 0.85 times as long as palm, with two ventral setae, three setae on cutting edge, cutting edge finely denticulate; dactylus with fine proximal seta.

Pereopod 1 (Fig. 116B) longer than others, coxal without apophysis, with seta; basis straight, 4.3 times as long as wide, with one simple and one penicillate dorsoproximal setae and one ventrodistal seta; ischium compact, with ventral seta; merus one-third as long as basis, with two ventrodistal and one dorsodistal simple setae; carpus just longer than merus with two ventrodistal and two dorsodistal simple setae; propodus 1.3 times as long as carpus, with two dorsal subdistal setae and one ventral subdistal seta; dactylus half as long as slender unguis, both together 0.9 times as long as propodus. Pereopod 2 (Fig. 116C), coxa similar to pereopod 1, basis 4.1 times as long as wide without dorsoproximal penicillate seta; merus 0.25 times as long as basis, without dorsodistal seta; carpus with three dorsodistal and three ventrodistal setae and small ventrodistal spine; propodus 1.5 times as long as carpus, with two dorsal subdistal setae and one ventral subdistal seta; short, stout dactylus half as long as unguis, both together 0.7 times as long as propodus. Pereopod 3 compact (Fig. 116D), similar to pereopod 2, merus with dorsodistal seta.

Pereopod 4 (Fig. 116E) basis stout, 1.8 times as long as wide, with two penicillate setae near ventrodistal corner; ischium with two ventrodistal setae; merus 1.4 times as long as carpus, with field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds, and two dentiform ventrodistal spines; carpus with three dentiform hook-like ventrodistal spines and dorsodistal seta; propodus 1.25 times as long as carpus, with mid-dorsal penicillate seta, strong dorsodistal seta, and two ventrodistal dentiform spines; dactylus slender, with fields of microtrichia, four times as long as curved unguis, unguis distally trifurcate, both together 0.65 times as long as propodus. Pereopod 5 (Fig. 116F) as pereopod 4. Pereopod 6 (Fig. 116G) as pereopod 4, but basis without penicillate setae, propodus with three dorsodistal setae.

Pleopods (Fig. 116H) all alike, with naked basis, exopod shorter than endopod; endopod and exopod without setae on inner margin, outer margins with respectively 11 and 20 plumose setae, proximal seta on both rami separated from others.

Uropod (Fig. 116I) biramous, basis naked; exopod and endopod of one segment, exopod shorter than endopod, with one fine proximal and two distal setae; endopod with one simple and two penicillate setae just distal of mid-length, distally with four simple and one penicillate setae.

*Male.* Unknown.

*Etymology.* From the Greek *simos*, meaning "snub-nosed", alluding to the characteristic very short distal antennular articles of the present species.

*Remarks.* The distinctive genus *Hamatipeda* is characterized by the very elongate body, with pereonites 1 to 5 longer than wide and as long as (pereonite 1) or longer than the cephalothorax, and the specialized dentiform hook-like spines on the carpus of the posterior pereopods, *inter alia*. *H. sima* sp. nov. is entirely typical of the genus.

Of the two previously described species, *Hamatipedia trapezoida* Błażewicz-Paszkowycz, 2007, is distinct in having trapezoidal pereonites which are narrower posteriorly than anteriorly, while *H. longa* (Kudinova-Pasternak, 1975) is distinct in having a two-segmented uropod endopod. Both have a more slender cheliped carpus, more slender posterior pereopod bases, lack distinctive tubercles on the maxilliped endites, and have a much longer distal antennule article than the present species, more than twice (*H. trapezoida*) or three times (*H. longa*) as long as wide, compared with less than 1.5 times as long as wide in *H. sima*.

*Hamatipeda sima* is known only from the type-locality off Tasmania (see above).

Genus ***Paratyphlotanais*** Kudinova-Pasternak & Pasternak, 1978

***Paratyphlotanais colouros*** sp. nov.

Figures 117–119

*Material examined.* 1 ♀ (J58551), holotype, 3 ♀♀ (J58552), paratypes, Eastern Bass Strait, 82 km ENE of North Point, Flinders Island, Stn BSS36, 39°27.7'S 148°51.4'E, 293 m depth, coarse sand, 28 March 1979; coll. G.C.B. Poore; 1 ♀ (J58553), paratype, Eastern Bass Strait, 67 km ENE of North Point, Flinders Island, Stn BSS38, 39°22.4'S 148°38.7'E, 73 m depth, coarse sand, 29 March 1979; coll. G.C.B. Poore; 2 ♀♀ (J58554), paratypes, Central Bass Strait, 44 km NE of Cape Wickham, King Island, Stn BSS203, 39°22.0'S 144°18.3'E, 60 m depth, coarse sand, 23 November 1981; coll. R.S. Wilson.

*Description of female.* Body (Fig. 117A, B) relatively slender, holotype 1.6 mm long, 6.4 times as long as wide. Cephalothorax subrectangular, tapering towards anterior with slight triangular rostrum, 1.5 times as long as wide, naked, eyes absent. Pereonites wider than long, ventrally with anteriorly-pointed hyposphenia on pereonites 1 to 3; pereonite 1 shortest, 0.12 times as long as cephalothorax; pereonite 2 parallel-sided, 2.4 times as long as pereonite 1; pereonite 3 with convex margins, 1.3 times as long as pereonite 2; pereonites 4 and 5 subequal, twice as long as pereonite 2; pereonite 6 as long as pereonite 3 (all pereonites respectively 5.8, 2.5, 1.9, 1.3, 1.3 and 1.7 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite four times as wide as long. Pleotelson pentangular, as long as last two pleonites together and 1.6 times as wide as long, with four small distal setae.

Antennule (Fig. 118A) stout, proximal article 1.7 times as long as wide, 1.2 times as long as distal two articles together, with four simple setae along inner margin, outer margin with one simple seta at mid-length and two penicillate and one simple setae distally; second article shorter than wide, one-quarter as long as first article, with one outer simple seta and single inner penicillate and longer simple distal setae; third article tapering, 2.5 times as long as second article, with five simple and one penicillate subdistal setae adjacent to apical spur *sensu* Bird (2004).

Antenna (Fig. 118B) of six articles, proximal article compact, naked; second article as long as wide, with dorsodistal seta; third article shorter than wide, 0.6 times as long as second article, with dorsodistal seta; fourth article longest, four times as long as third article and four times as long as wide, curved, with three simple and one penicillate distal setae; fifth article half as long as fourth article with one distal seta; sixth article minute with four distal setae.

Labrum (Fig. 118C) rounded, hood-shaped, marginally setose. Left mandible (Fig. 118D) with bilobed, crenulate pars incisiva and wide, crenulate lacinia mobilis, right mandible (Fig. 118E) similar but without lacinia mobilis; pars molaris of both mandibles with strong, rounded marginal tubercles. Labium (Fig. 118H) simple, finely setose on outer and inner-distal margins. Maxillule (Fig. 118F) with eight distal spines, palp not recovered. Maxilla not recovered. Maxilliped palp (Fig. 118G) first article naked, second article with one outer and three inner setae; third article with four inner setae in distal half of article; fourth article with five inner to distal setae and one outer subdistal seta; basis with single, long seta reaching past distal margin of endites; endites distally with one seta and slight tubercle, outer distal margin denticulate. Epignath (Fig. 118I) elongate, linguiform, naked.

Cheliped (Fig. 119A) basis not reaching back to anterior of pereonite 1 ventrally, 1.7 times as long as wide, with single dorsodistal seta; merus subtriangular with three ventral setae; carpus 2.2 times as long as wide, with two longer and one shorter mid-ventral setae, one mid-dorsal and one dorsodistal setae; propodus slender, palm 1.25 times as long as wide, fixed finger as long as palm, with two ventral setae, three setae on cutting edge; dactylus with fine proximal seta.

Pereopod 1 (Fig. 119B) longer than others, coxa without apophysis, with seta; basis straight, slender, 4.5 times as long as wide, with two dorsal and one ventral simple setae in proximal third; ischium compact, with ventral seta; merus 0.3 times as long as basis, with two ventral and one dorsal simple distal setae; carpus 1.5 times as long as merus with distal crown of six simple setae; propodus 1.4 times as long as carpus, with two dorsal subdistal setae, shorter ventral subdistal seta; slender dactylus with proximal seta exceeding tip of dactylus, slender unguis 1.6 times as long as dactylus, both together as long as propodus. Pereopod 2 (Fig. 119C) similar to pereopod 1, basis 4.8 times as long as wide, with three dorsal but no ventral setae; ischium with seta; merus with single dorsal and ventral distal simple setae, and ventrodistal spine; carpus 1.1 times as long as merus, with dorsodistal and mesiodistal simple setae, and two unequal ventrodistal spines, longer spine denticulate; propodus with one dorsal subdistal seta; dactylus and unguis together 0.9 times as long as propodus. Pereopod 3 (Fig. 119D) similar to pereopod 2, basis with two dorsal and one ventral setae; carpus with dorsodistal spine half as long as carpus.

Pereopod 4 (Fig. 119E) basis stouter than that of anterior pereopods, three times as long as wide; ischium with two ventrodistal setae; merus as long as carpus, with one denticulate slender ventrodistal spine and one seta; carpus with one dorsodistal setae and four ventrodistal denticulate spines; propodus 1.3 times as long as carpus, with one dorsodistal and two ventral subdistal denticulate spines; dactylus twice as long as curved unguis, both together 0.6 times as long as propodus. Pereopod 5 (not figured) as pereopod 4, but basis with ventral penicillate seta. Pereopod 6 (Fig. 119F) basis stout, 2.4 times as long as wide; ischium with two ventrodistal setae; merus 0.9 times as long as carpus, with two denticulate slender ventrodistal spines; carpus with one dorsodistal setae and apparently three ventrodistal slender denticulate spines; propodus as long as carpus, with three dorsodistal setae and two ventral subdistal slender spines; dactylus slender, with ventral microtrichia, twice as long as curved unguis, both together 0.7 times as long as propodus.

Pleopods (Fig. 119G) all alike, with naked basis, exopod shorter than endopod; endopod with subdistal inner seta, exopod without setae on inner margin, outer margins with respectively 10 and 15 plumose setae, proximal seta on both rami separated from others.

Uropod (Fig. 119H) biramous, basis naked; exopod of one segment, less than half as long as proximal endopod segment,

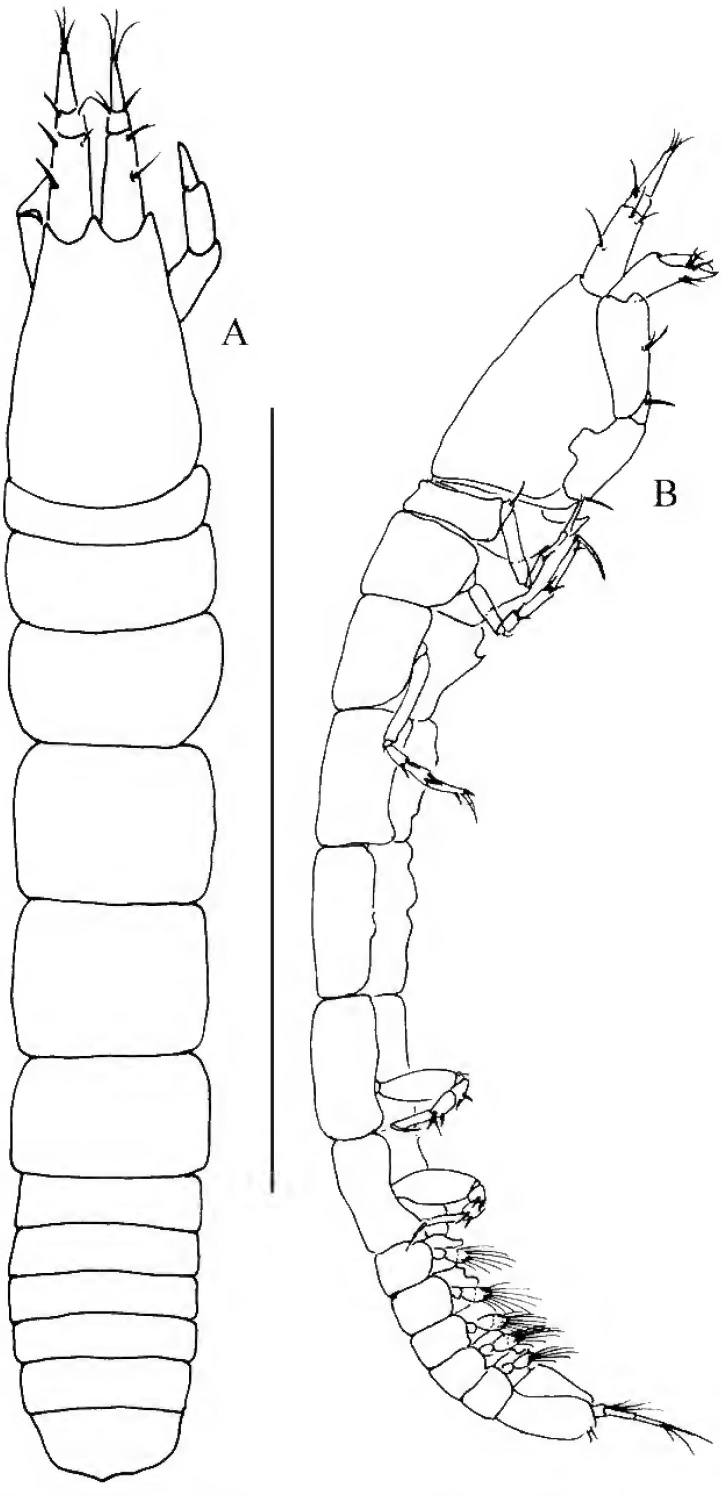


Fig. 117. *Paratyphlotanais colouros* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.


Fig. 118. *Paratyphlotanais colouros* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule endite; G, maxilliped; H, labium; I, epignath. Scale = 0.1 mm.

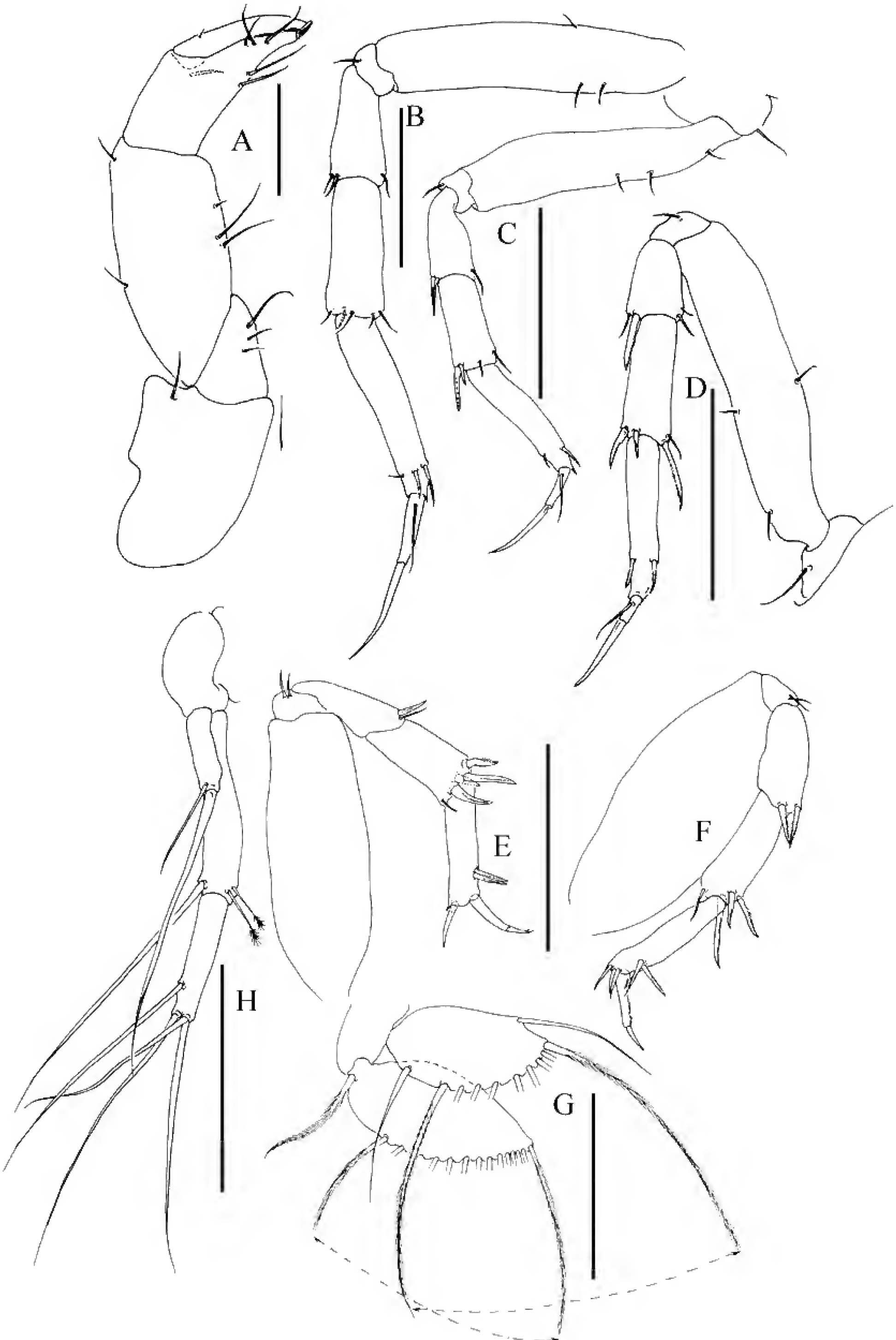


Fig. 119. *Paratyphlotanais colouros* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

with one shorter and one longer distal setae; endopod of two segments, distal segment 0.6 times as long as proximal segment; proximal segment with one simple and two penicillate distal setae, distal segment with one subdistal and three distal simple setae.

*Male.* Unknown.

*Etymology.* From the Greek *kolouros* – "bobtailed", alluding to the characterizing short uropod exopod of this species.

*Remarks.* The present species, with its pereopod spination, elongate and tapering cephalothorax, hyposphenia (sternal spurs) on the anterior pereonites and apical spur on the antennule, accords comfortably with the genus *Paratyphlotanais*, as most recently competently analyzed by Bird (2004), since when only one further species, *P. alveolus* Błażewicz-Paszkowycz, 2007, has been described. *P. colouros* sp. nov. has a unique conformation for the genus being without coxal apophyses (spurs) and with a narrow pereonite 1 (less than half the length of pereonite 2). Of the nine species previously attributed to this genus (see Błażewicz-Paszkowycz, 2007) only *P. gracilipes* (Hansen 1913) from the Northeast Atlantic south of Iceland, *P. pectinatus* Bird, 2004, from the Northeast Atlantic Margin and *P. armatus* (Vanhöffen, 1914) from the Antarctic share the short pereonite 1, but the first two have coxal spurs, while the last has a cephalothorax shorter than pereonites 1 to 3 together.

Furthermore, none of those species has such a short uropod exopod in proportion to the endopod, being much longer than half the length of the proximal segment of the endopod compared with 0.4 times that length in *P. colouros* (note that the endopod of *P. pectinatus* is only known from the proximal segment, but the exopod is much longer than that segment and two-segmented: see Bird, 2004, fig.7f).

*P. colouros* was collected from the Central and Eastern Bass Strait at 60 to 293 m in coarse sand.

## Genus ***Peraeospinosus*** Sieg, 1986

### ***Peraeospinosus tanytrix*** sp. nov.

Figures 120–122

*Material examined.* 1 ♀ (J58534), holotype, and 107 ♀♀, 36 neuters (J58535), paratypes, Eastern Bass Strait, 63 km E of North Point, Flinders Island, Stn BSS 167, 39°44.8'S 148°40.6'E, 124 m depth, fine sand and mud, 14 November 1981; coll. R.S. Wilson; 5 ♀♀ and 1 neuter (J58896), paratypes, Stn BSS 167G, 1 ♀ (J58898), paratype, Stn BSS 167S, same data as holotype; 1 ♀ (J58895), 7 ♀♀ in tubes with numerous mancae (J58897), paratypes, Eastern Bass Strait, 60 km E of North Point, Flinders Island, Stn BSS 32, 39°41.7'S 148°39.5'E, 115 m depth, muddy sand, 27 March 1979; coll. G.C.B. Poore; 1 ♀ (J58899), paratype, Eastern Bass Strait, 100 km NE of North Point, Flinders Island, Stn BSS 170, 38°52.6'S 148°25.2'E, 130m depth, fine sand, 15 November 1981; coll. R.S. Wilson; 1 ♀ (J58900), paratype, Eastern Bass Strait, 28 km SSW of Marlo, Stn BSS 207, 37°59'S 148°27'E, 51 m depth, muddy sand and fine shell, 30 July 1983; coll. M.F. Gomon; 4 ♀♀ in tubes with mancae (J57817), paratypes, off Nowra, New South Wales, Stn SLOPE 1, 34°59.52'S 151°05.93'E, 204 m depth, 14 July 1986; coll. G.C.B. Poore; 7 ♀♀ with tubes (J37858), paratypes, off Nowra, New South Wales, Stn SLOPE 2, 34°57.9'S 151°08.0'E, 503 m depth, 14 July 1986; coll. G.C.B. Poore; 2 ♀♀ (J37883), paratypes, off Nowra, New South Wales, Stn SLOPE 7, 34°52.28'S 151°15.02'E to 34°51.13'S 151°15.13'E, 1096 m depth, 15 July 1986; coll. G.C.B. Poore & C.-C. Lu.

*Description of female.* Body (Fig. 120A, B) slender, holotype 4.7 mm long, seven times as long as wide. Cephalothorax rounded but tapering towards anterior with triangular rostrum, as long as wide, naked, eyes absent. Pereonite 1 wider anteriorly, just over half as long as cephalothorax; pereonites 2 and 3 narrowed at mid-length, subequal in length, 1.6 times as long as pereonite 1; pereonites 4 and 5 subrectangular, subequal in length, 1.1 times as long as pereonite 1; pereonite 6 with mid-lateral creases, shortest, 0.8 times as long as pereonite 1 (all pereonites respectively 1.7, 0.9, 0.8, 1.2, 1.2 and 1.5 times as wide as long). Pleon with five free subequal pleonites bearing pleopods; each pleonite six times as wide as long. Pleotelson semicircular, one-third length of pleon and twice as wide as long, with two small distal setae (Fig. 122H).

Antennule (Fig. 121A) of three articles, proximal article clavate, twice as wide proximally as distally, 3.3 times as long as wide, 1.6 times as long as distal two articles together, with row of three fine inner-dorsal setae, outer margin with tufts of three, four and three penicillate setae proximally, at mid-length and distally, last two tufts with accompanying simple seta; second article 1.3 times as long as wide, one-third as long as third article, with two unequal dorsodistal simple setae; third article tapering, almost half as long as first article, with five simple distal setae.

Antenna (Fig. 121B) of six articles, proximal article compact, as long as second article, with ventral microtrichia; second article swollen, as long as wide, with ventral microtrichia; third article shorter than wide, 0.7 times as long as second article, with fine dorsodistal seta; fourth article longest, 8.4 times as long as wide, four times as long as second article, curved, with two simple and two penicillate distal setae; fifth article half as long as fourth with one distal seta; sixth article minute with five distal setae.

Labrum (Fig. 121C) rounded, hood-shaped, distally setose. Left mandible (Fig. 121D) with subtriangular, crenulate pars incisiva and wide, crenulate lacinia mobilis, right mandible (Fig. 121E) with rounded, smooth cutting edge on pars incisiva, without lacinia mobilis; pars molaris of both mandibles with fine denticulations around distal margin. Labium (Fig. 121H) simple, finely setose on distal margin and with rows of microtrichia on outer margins. Maxillule (Fig. 121F) with nine distal spines and sparse microtrichia, palp not recovered. Maxilla (Fig. 121G) ovoid, naked. Maxilliped (Fig. 121I) palp first article naked, remaining articles with microtrichia; second article with one outer simple seta and three inner setae finely denticulate in distal half; third article with four inner setae in distal half of article, two of these finely denticulate in distal half; fourth with five inner to distal setae finely denticulate in distal half; basis with single seta about half as long as endites; endites distally with two setae. Epignath not recovered.

Cheliped (Fig. 122A) basis not quite reaching anterior margin of pereonite 1 ventrally, 1.4 times as long as wide, with single dorsodistal seta; merus subtriangular with single ventral seta; carpus 1.5 times as long as wide, with two midventral setae, one fine dorsodistal seta, and row of five setae along

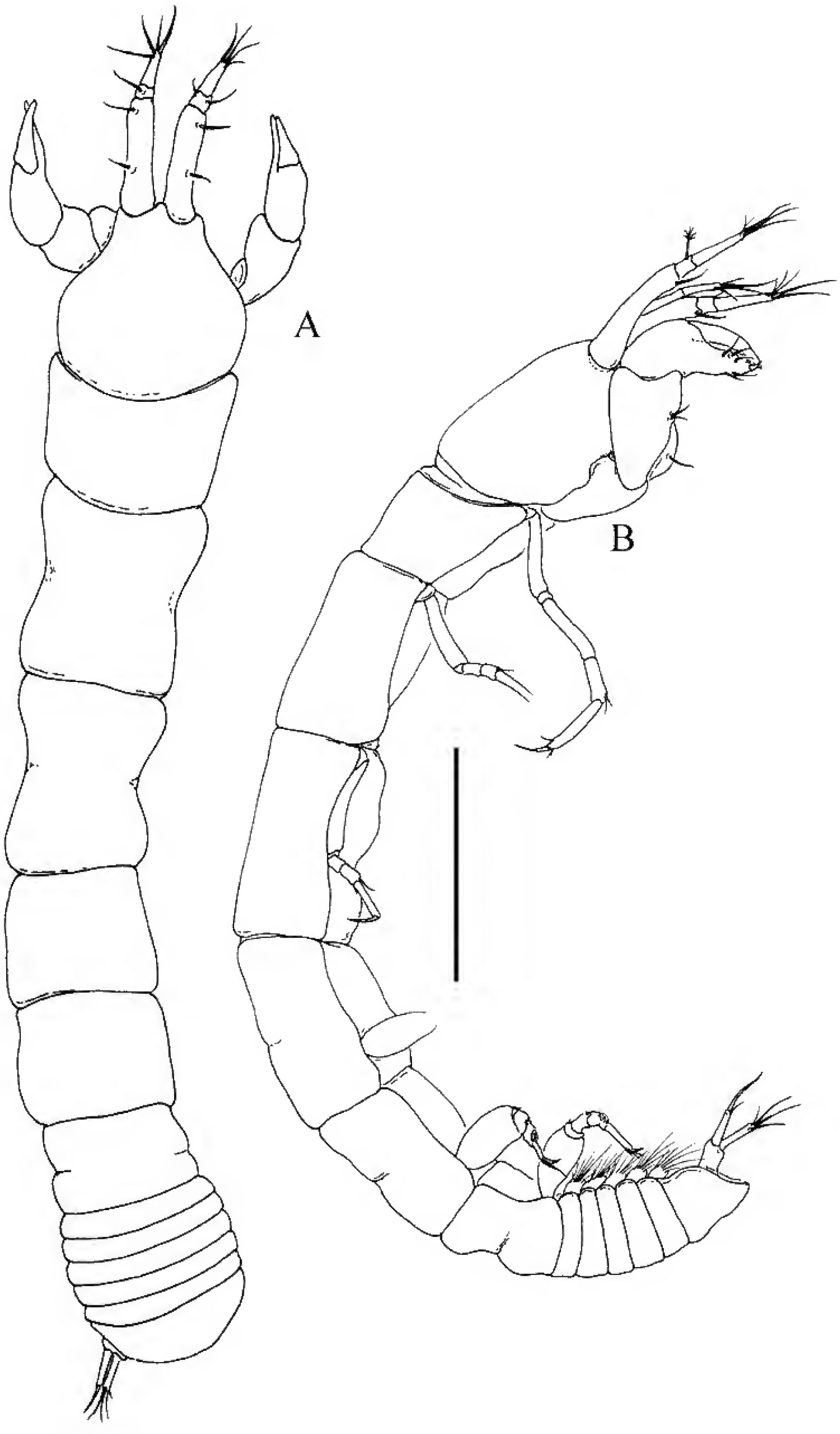


Fig. 120. *Peraeospinosus tanytrix* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.

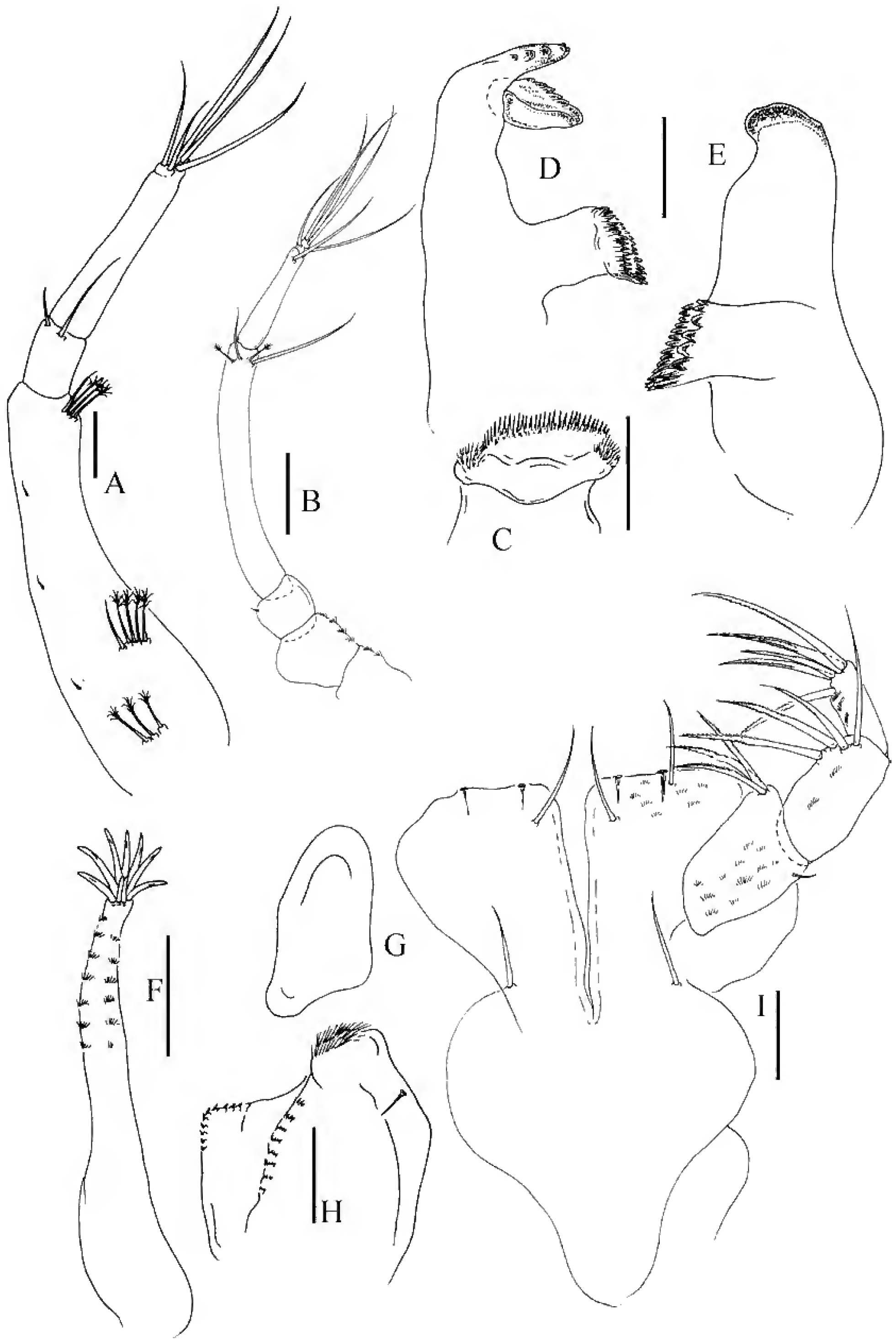


Fig. 121. *Peraeospinosus tanytrix* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; E, right mandible; F, maxillule endite; G, maxilla; H, labium; I, maxilliped. Scale = 0.1 mm.

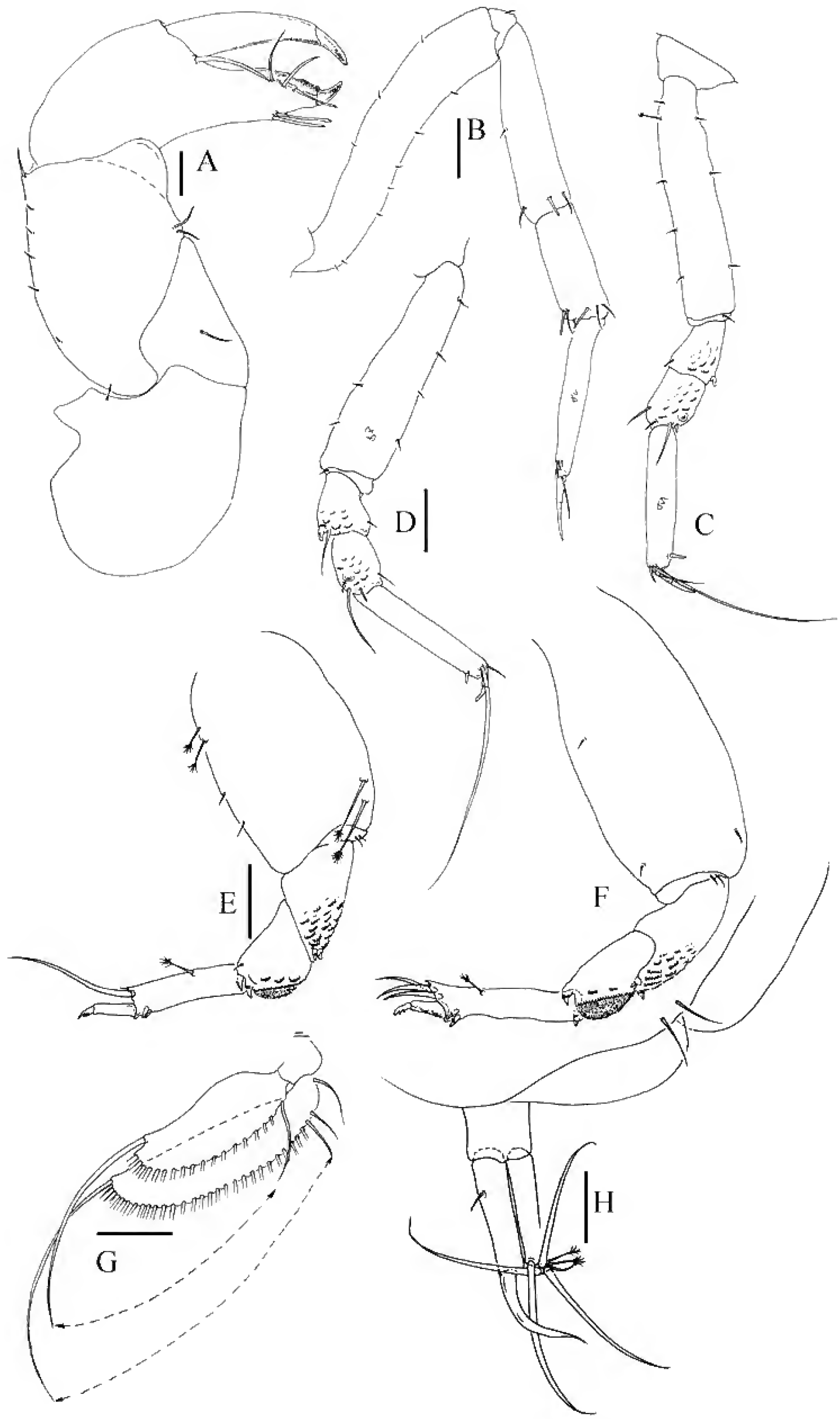


Fig. 122. *Peraeospinosus tanytrix* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

dorsal margin, ventral margin distally invaginated to accommodate propodus on reflexion; propodus about as long as wide, fixed finger as long as palm, with two ventral setae, three setae on cutting edge; dactylus naked.

Pereopod 1 (Fig. 122B) coxa without apophysis, naked; basis arcuate, slender, 5.7 times as long as wide, with seven fine setae along dorsal margin and three more along ventral margin; ischium compact, with fine ventral seta; merus elongate, 0.6 times as long as basis and 4.7 times as long as wide, with mid-dorsal fine seta and three simple distal setae; carpus 0.6 times as long as merus, 2.5 times as long as wide, with distal crown of five simple setae; propodus 1.5 times as long as carpus, six times as long as wide, with two dorsal subdistal setae; short, stout dactylus with proximal seta longer than dactylus, slender unguis 1.4 times as long as dactylus, both together 0.4 times as long as propodus. Pereopod 2 (Fig. 122C), coxa similar to that of pereopod 1, basis 4.9 times as long as wide, with one penicillate and four fine simple setae along dorsal margin and three simple setae along ventral margin; ischium with ventral seta; merus 0.25 times as long as basis, with single dorsodistal seta, short ventrodistal spine, and dense field of microtrichia across ventral and ventrolateral surfaces in distal two-thirds; carpus 0.9 times as long as merus, with dorsal, mesial and ventral distal setae, short ventrodistal spine, and dense field of microtrichia across ventral and ventrolateral surfaces; propodus 2.6 times as long as carpus, with ventral subdistal seta, one shorter dorsodistal seta, one very long dorsodistal seta 1.3 times as long as propodus; short, stout dactylus with proximal seta exceeding tip of subequal slender unguis, both together one-third as long as propodus. Pereopod 3 (Fig. 122D) similar to pereopod 2, basis without penicillate seta; merus with additional ventrodistal seta; dactylus and unguis together 0.2 times as long as propodus, long distal seta 1.6 times as long as propodus.

Pereopod 4 (Fig. 122E) basis stout, 1.5 times as long as wide, with two simple mid-dorsal seta and two dorsoproximal and two ventrodistal penicillate setae; ischium with two ventrodistal setae; merus 1.2 times as long as carpus, with field of microtrichia across ventral and ventrolateral surfaces in distal half, and two small ventrodistal spines; carpus with two hooked distal spines, fine dorsodistal seta, and prickly tubercle surrounded by minute spines and microtrichia in ventrodistal half; propodus 1.3 times as long as carpus, with mid-dorsal penicillate seta, strong dorsodistal seta, and two short ventrodistal spines; dactylus slender, nearly three times as long as denticulate unguis, both together half as long as propodus. Pereopod 5 (not figured) as pereopod 4. Pereopod 6 (Fig. 122F) similar to pereopod 4, but basis without penicillate setae, propodus with three dorsodistal setae.

Pleopods (Fig. 122G) all alike, with naked basis, exopod shorter than endopod; endopod and exopod without setae on inner margin, outer margins with respectively 19 and 31 plumose setae, proximal seta on both rami slightly separated from others.

Uropod (Fig. 122H) biramous, basis naked; exopod and endopod of one segment, subequal in length; exopod with one fine proximal, one stout distal setae; endopod with four simple and three penicillate distal setae.

*Male*. Unknown.

*Etymology*. From the Greek *tany* – long, and *thrix* – a hair, with reference to the exceedingly long distal seta on the propodi of pereopods 2 and 3.

*Remarks*. The genus *Peraeospinosus* was reviewed most recently by Błażewicz-Paszkowycz (2005), who presented an identification key to the ten species then described; in that key, *P. tanytrix* sp. nov. identifies as *P. emergensis* Błażewicz-Paszkowycz, 2005, sharing the rounded cephalothorax not longer than wide and the elongate pereonites 1 to 3, but does not share with that species the elongate merus, carpus and propodus of pereopod 2, nor the elongate dorso-distal "rod-seta" on the carpus of pereopod 1. The only other species described since that key is *P. acruxi* Błażewicz-Paszkowycz, 2007, which shares with *P. emergensis* the pereopod 1 rod seta and elongate anterior pereonites, but has a cephalothorax longer than wide. Most distinctively, none of the eleven previously described species have such an extraordinarily long distal seta on the propodi of pereopods 2 and 3 as found in *P. tanytrix*, although this condition is approached in some species of *Torquella* Błażewicz-Paszkowycz, 2007.

*Peraeospinosus tanytrix* was collected from Eastern Bass Strait at depths between 51 and 1096 m. The tubes, apparently used for brooding, were of agglomerated sediment particles and fibrous material.

## Genus *Meromonakantha* Sieg, 1986

### *Meromonakantha anarsios* sp. nov.

Figures 123–125

*Material examined*. 1 ♀ (J62058), holotype; 1 ♀ (J62059), paratype, Stn BSS 36 (CR 79-K-1), Eastern Bass Strait, 82 km ENE of North Point, Flinders Island, 293 m, 28 March 1979, 39°27.7'S 148°41.4'E, 293 m depth, coarse sand, 28 March 1979, coll. G.C.B. Poore.

*Description of female*. Body (Fig. 123A, B) slender, holotype 1.4 mm long, 7.5 times as long as wide. Cephalothorax subrectangular, narrowing anteriorly (conical) with slight triangular rostrum, 1.2 times as long as wide, twice as long as pereonite 1, naked, eyes absent. Pereonites all naked and rectangular; pereonites 1 and 6 subequal in length; pereonites 2 and 3 subequal, 1.3 times as long as pereonite 1; pereonites 4 and 5 subequal, 1.5 times as long as pereonite 1 (all pereonites respectively 1.6, 1.2, 1.1, 1.0, 1.0 and 1.3 times as wide as long). Pleon of five free subequal pleonites bearing pleopods plus pleotelson; each pleonite 4.2 times as wide as long. Pleotelson subpentangular, as long as last two pleonites together, 1.75 times as wide as long.

Antennule (Fig. 124A) of three articles, proximal article three times as long as wide, 1.7 times as long as distal two articles together, outer margin with three pairs of penicillate setae, one central and one distal simple setae each as long as distal two articles together; second article longer than wide, 0.25 times as long as first article, with two distal simple setae; third article tapering, 1.4 times as long as second article, with five simple and one penicillate distal setae.

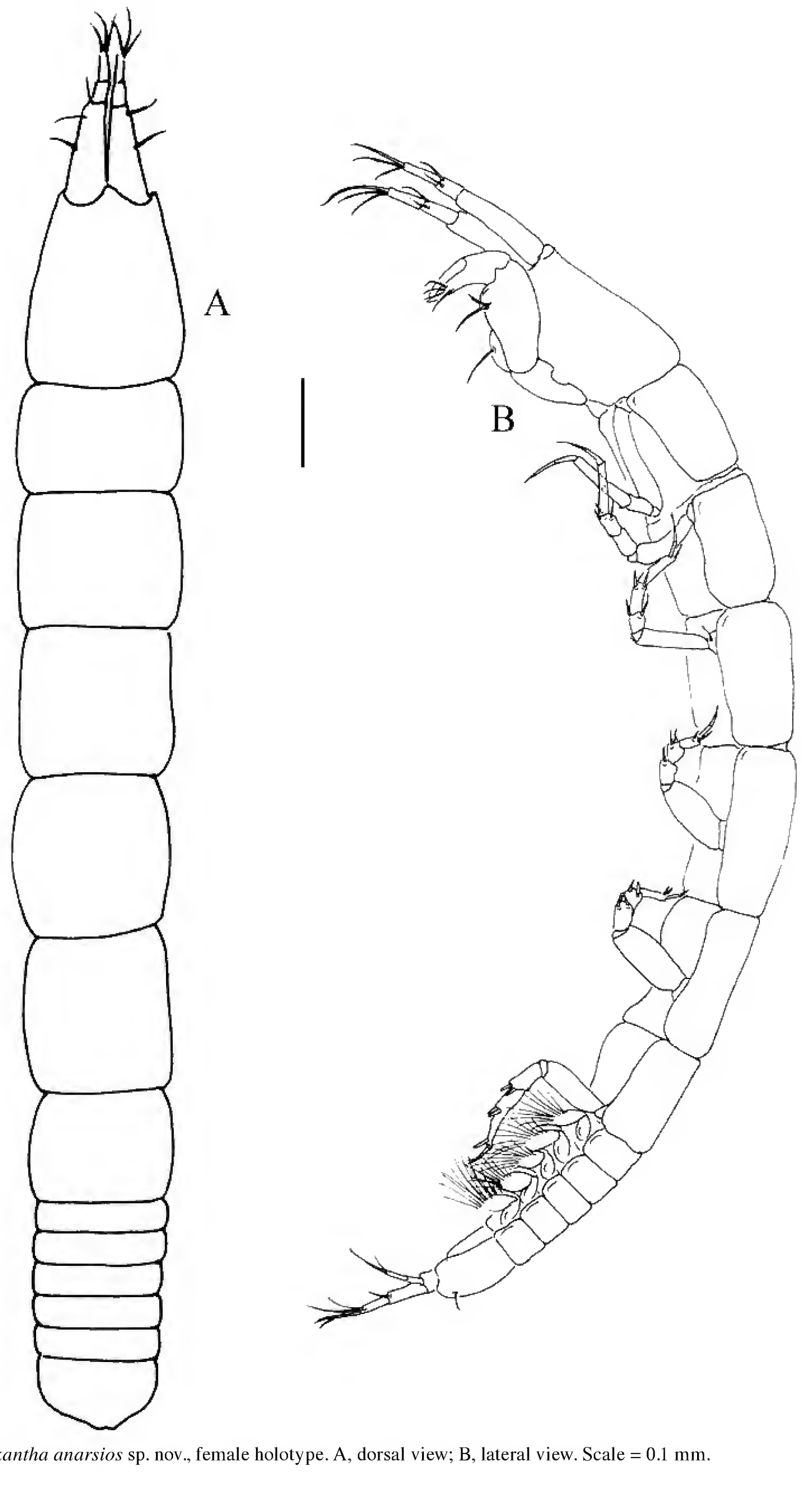


Fig. 123. *Meromonakantha anarsios* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 0.1 mm.


Fig. 124. *Meromonakantha anarsios* sp. nov., female paratype. A, antennule; B, antenna; C, right mandible; D, maxillule endite; E, maxilla; F, labium; G, maxilliped; H, epignath; I, cheliped. Scale = 0.1 mm.

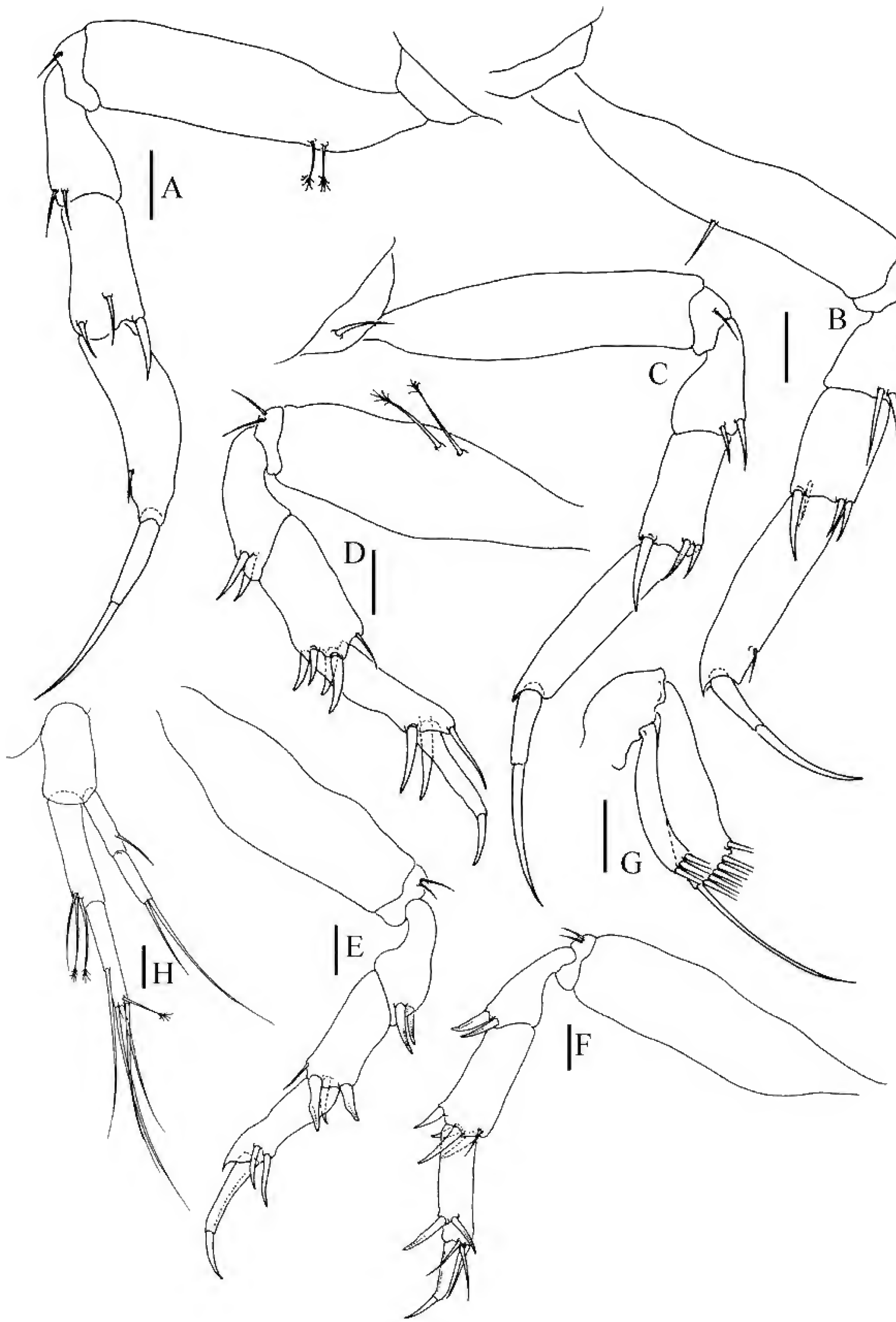


Fig. 125. *Meromonakantha anarsios* sp. nov., female paratype. A to F, pereopods 1 to 6 respectively; G, pleopod; H, uropod. Scale = 0.1 mm.

Antenna (Fig. 124B) of six articles, proximal article compact, fused to cephalothorax; second article just longer than wide, with dorsodistal seta; third article as long as wide and as long as second article, with strong dorsodistal seta; fourth article longest, four times as long as wide, 3.6 times as long as third article, with three simple and two penicillate distal setae; fifth article 1.5 times as long as third, with one distal simple seta; sixth article minute with four distal setae.

Labrum and left mandible not recovered. Right mandible (Fig. 124C) with wide, spade-like pars incisiva bearing upper and lower marginal rounded "teeth" and submarginal denticulations; pars molaris stout, blunt, with rounded distal tubercles. Labium (Fig. 124F) simple, outer distal corner with unarticulated setulose projection. Maxillule (Fig. 124D) with eight distal spines and small seta. Maxilla (Fig. 124E) simple, linguiform, naked. Maxilliped (Fig. 124G) palp first article naked, second article with one outer and three distal inner setae, one of inner setae finely plumose; third article with three longer and one shorter distal inner setae, fourth article elongate, with four distal setae and one subdistal outer seta; basis naked; endites distally naked, with outer-distal microtrichia and paired inner setae. Epignath (Fig. 124H) elongate, ribbon-like, distally pointed.

Cheliped (Fig. 124I) sclerite dorsally inserted, basis not reaching anterior of pereonite 1 ventrally, 1.6 times as long as wide with outer dorsodistal seta; merus subtriangular with single ventral seta, and covering about half of ventral margin of carpus; carpus 1.9 times as long as wide, with two midventral setae, one dorsodistal seta; propodus elongate, 1.5 times as long as wide, with two ventral setae, inner comb-row of three setae; fixed finger slender, two-thirds as long as palm, with three setae below cutting edge; dactylus with proximal seta.

Pereopod 1 (Fig. 125A) coxa without apophysis; basis slender, 3.8 times as long as wide, with two dorsal penicillate setae in proximal half; ischium compact, with one ventrodistal seta; merus 0.7 times as long as carpus, ventrodistally with two slender spines; carpus distally with slender spines dorsally, mesially and ventrally; propodus slightly curved, 1.3 times as long as carpus, with ventral subdistal seta; dactylus naked, unguis 1.4 times as long as dactylus, both together 1.2 times as long as propodus. Pereopod 2 (Fig. 125B), similar to pereopod 1, basis with mid-dorsal simple seta but no penicillate setae; carpus with additional distal seta; propodus straight, 1.9 times as long as carpus; dactylus and unguis together 0.9 times as long as propodus. Pereopod 3 (Fig. 125C) similar to pereopod 2, basis naked.

Pereopod 4 (Fig. 125D) somewhat more compact, basis three times as long as wide with two penicillate setae; ischium with two ventrodistal setae; merus as long as carpus, with two stout ventrodistal spines; carpus with four curved distal spines and dorsodistal seta; propodus 1.2 times as long as carpus, with two curved ventrodistal spines and one dorsodistal seta; dactylus with fine ventral denticulation, about twice as long as unguis, the two together as long as propodus. Pereopod 5 (Fig. 125E) as pereopod 4, but without penicillate seta on basis, propodus with dorsodistal spine-like apophysis but no seta. Pereopod 6 (Fig. 125F) as pereopod 5, but propodus with three dorsodistal setae.

Pleopods (Fig. 125G) all alike, with naked basis, endopod and exopod elongate, linguiform, without setae on inner or outer margins, exopod wider and slightly longer than endopod, each respectively with seven and three distal plumose setae.

Uropod (Fig. 125H) basis naked, twice as long as wide; exopod of two subequal segments, just longer than proximal endopod segment; endopod of two subequal segments, setose as figured.

*Male.* Unknown.

*Etymology.* From the Greek *anarsios* – strange, incongruous, as this species diverges on a number of characters from the current diagnosis for the genus (see below).

*Remarks.* With the long seta on the third article of the antenna, the simple setation/spination of the pereopods (lacking fields of microtrichia or prickly-tubercles), the conformation of the cephalothorax, of the mandibular molar process and of the uropods, *inter alia*, the present species accords with *Meromonakantha* rather than any other typhlotanaid genus. It diverges from the diagnosis given by Błażewicz-Paszkowycz (2007) in that neither the cephalothorax nor the pleon are wider than the pereon, and the dactyli and ungues of the posterior pereopods are not "semi-fused".

Although, as pointed out by Błażewicz-Paszkowycz (2007), the genus is in need of revision once sufficient material of a number of its less-well described species becomes available, *Meromonakantha anarsios* sp. nov. is also distinguished from all of the other species in having relatively long curved spines on the posterior pereopods, a more slender proximal article to the antennule, and the pereonites mostly parallel-sided.

While these differences may be considered sufficient to distinguish *Meromonakantha anarsios* as a separate genus, we choose at present to maintain its affiliation with other members of *Meromonakantha* rather than erect a monotypic genus.

Family **Tanaissuidae** Bird & Larsen, 2009

Genus ***Tanaissus*** Norman & Scott, 1906

***Tanaissus giraffa*** sp. nov.

Figures 126–129

*Material examined.* 1 ♀ (J58475), holotype; 1 ♀ (J23599), paratype, stn MSL-EG 45, Eastern Bass Strait, 13.5 km E of eastern edge of Lake Tyers, 37°51.74'S 148°14.77'E, 37 m depth, sand-shell, 25 September 1990, R.V. Sarda, Smith-McIntyre Grab. 1 ♂ (J28482), dissected, stn MSL-EG 67, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, 37°51.42'S 148°14.36'E, 37 m depth, sand-shell, 4 June 1991, coll. N. Coleman, Smith-McIntyre Grab.

*Description of female.* Body (Fig. 126A, B) slender, ten times as long as wide, 1.4 mm long. Cephalothorax as long as pereonites 2 and 3 combined, twice as long as wide, rostral half much narrower than posterior, with finely-rugose rounded rostral margin (Fig. 127A). Pereonites all rectangular, pereonite1 shortest, 0.2 times as long as cephalothorax; pereonite 2 twice as long as pereonite 1; pereonites 3 to 6

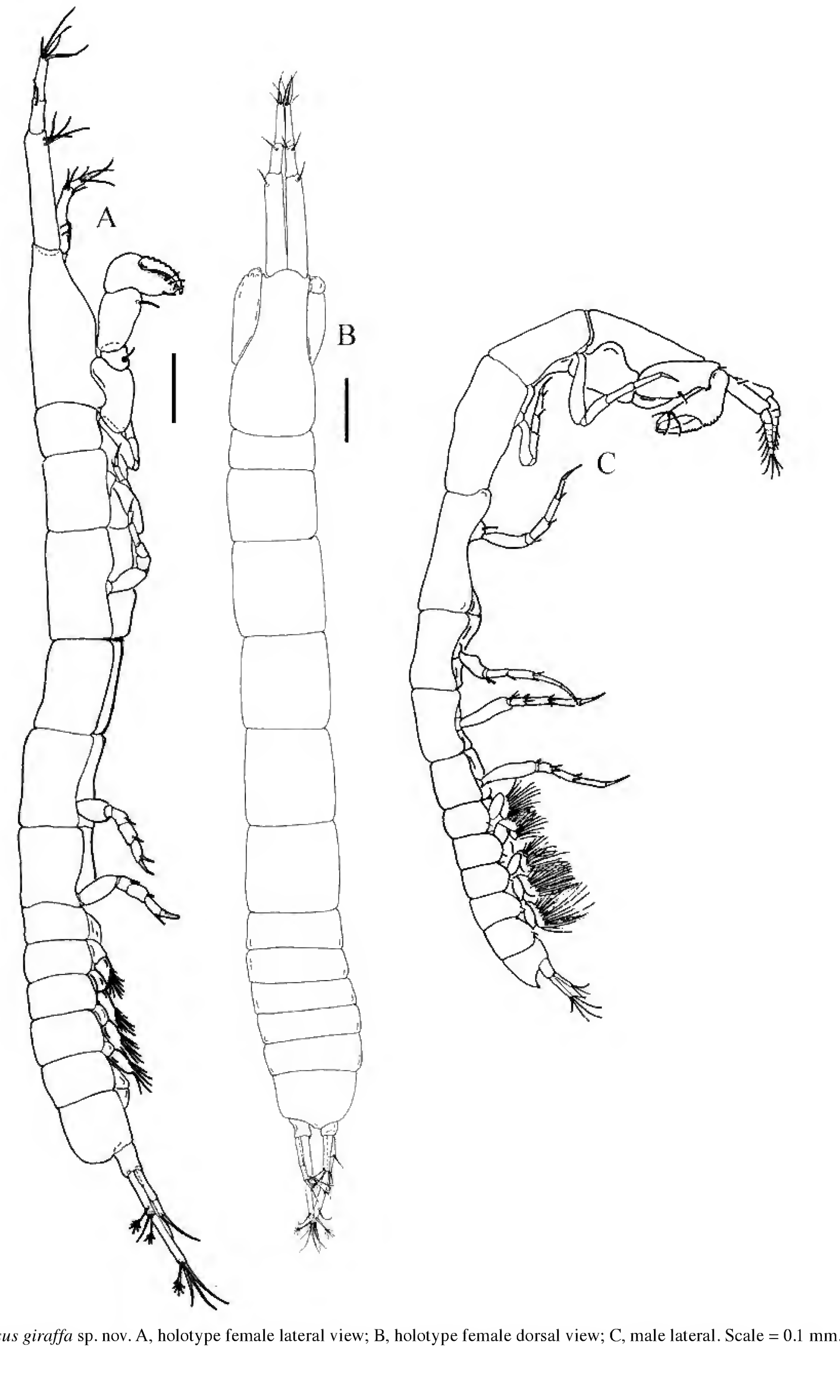


Fig. 126. *Tanaissus giraffa* sp. nov. A, holotype female lateral view; B, holotype female dorsal view; C, male lateral. Scale = 0.1 mm.

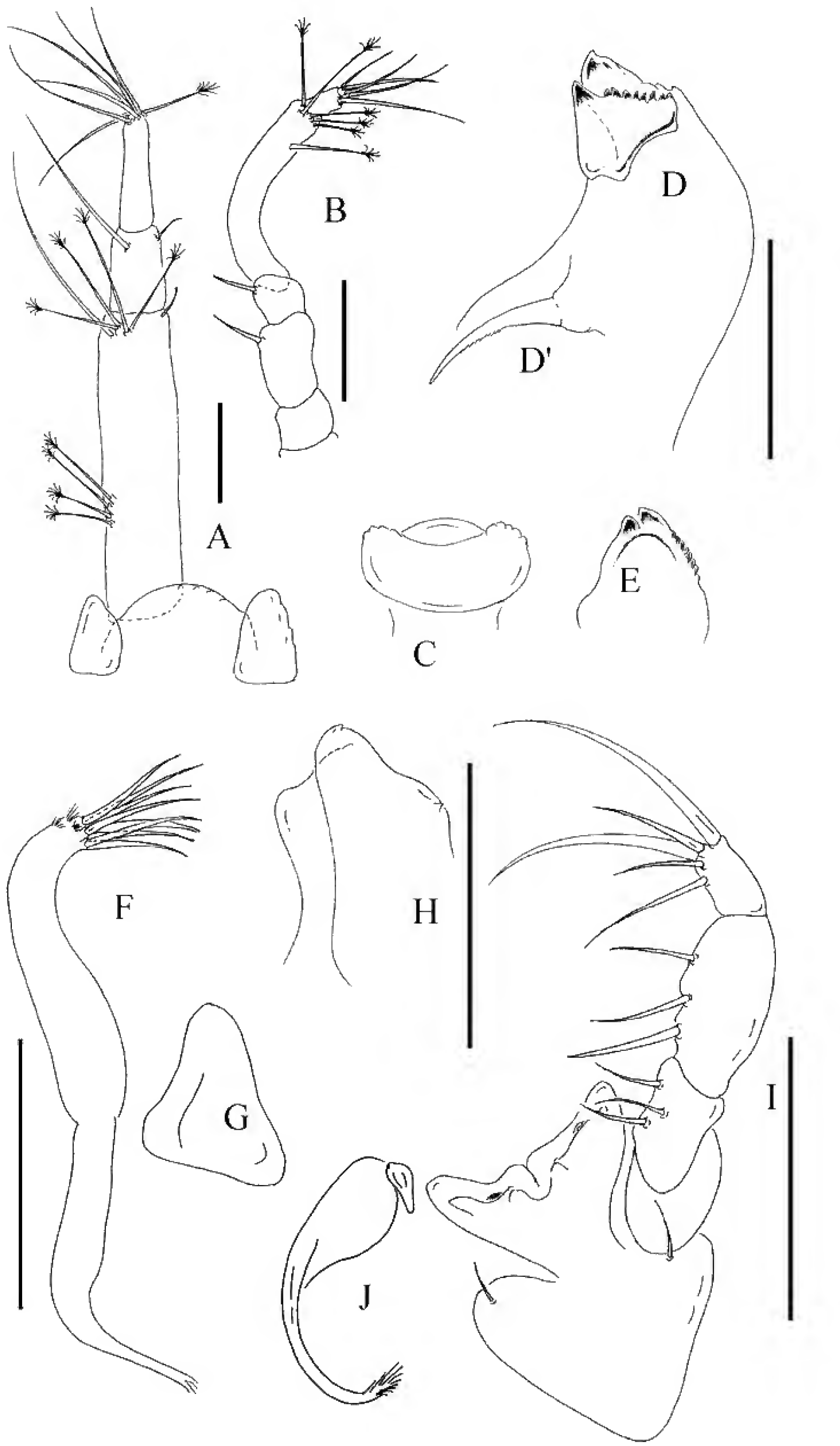


Fig. 127. *Tanaissus giraffa* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, left mandible; D', mandible molar; E, right mandible; F, maxillule; G, maxilla; H, labium; I, maxilliped; J, epignath. Scale = 0.1 mm.

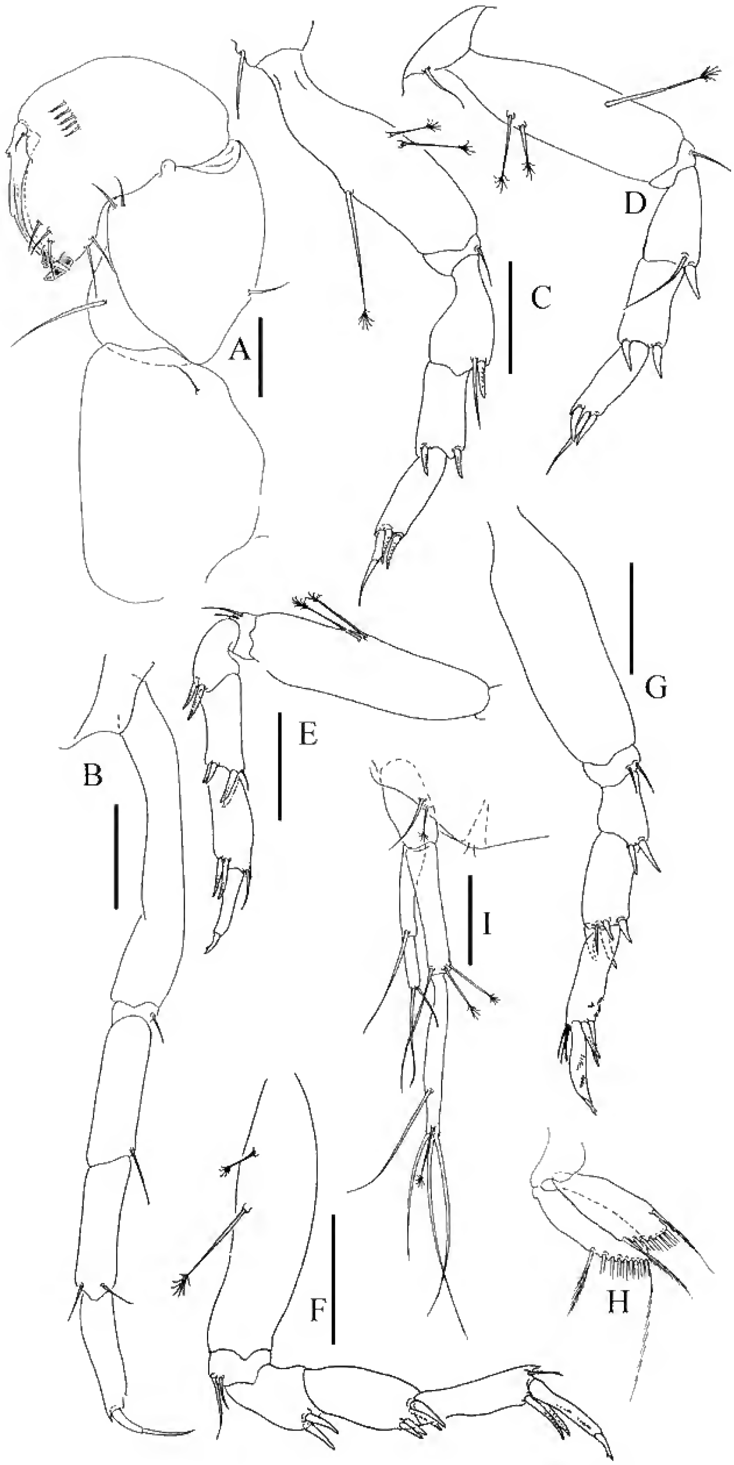


Fig. 128. *Tanaissus giraffa* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G. pereopod 6; H, pleopod; I, uropod. Scale = 0. 1 mm.

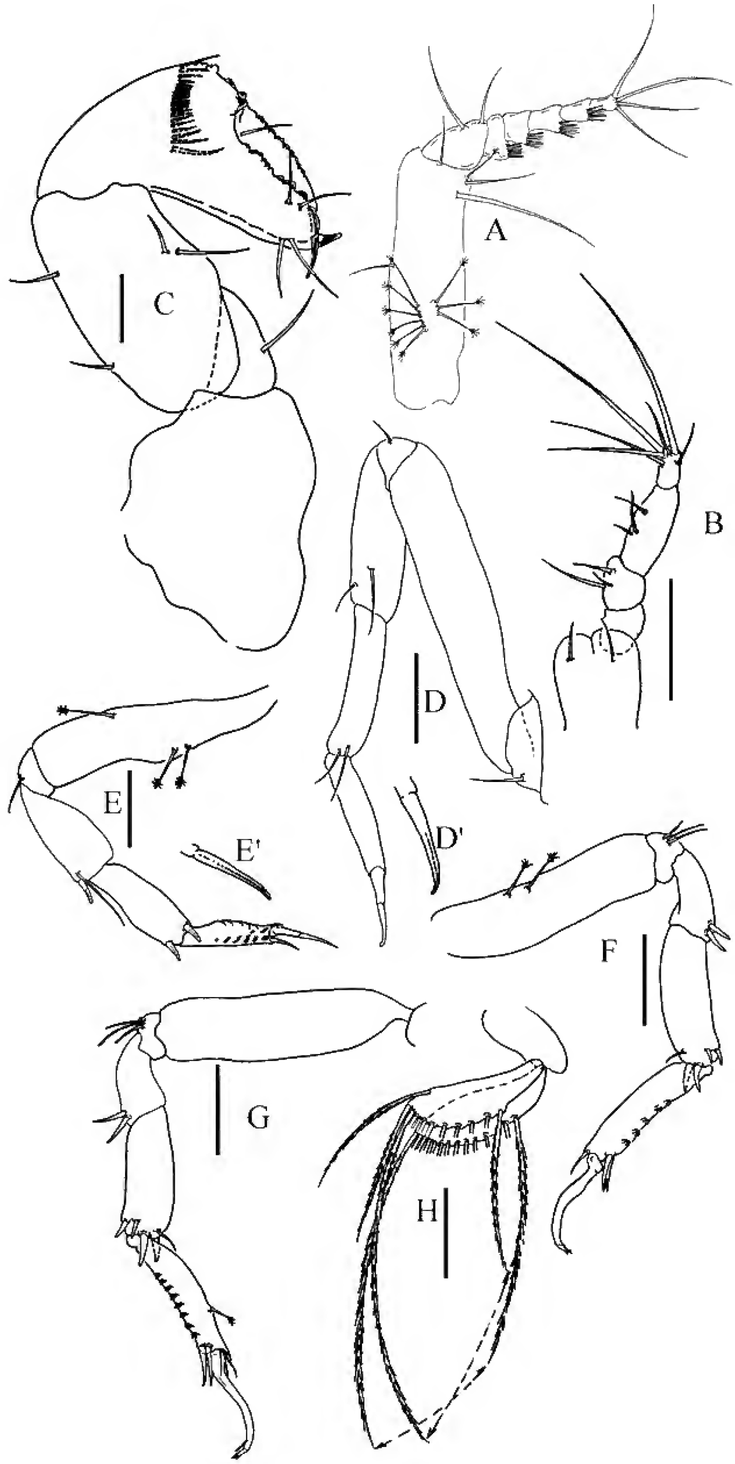


Fig. 129. *Tanaissus giraffa* sp. nov., male. A, antennule; B, antenna; C, cheliped; D, pereopod 1; D' pereopod 1 dactylus; E, pereopod 2; E', pereopod 2 dactylus; F, pereopod 4; G, pereopod 6; H, pleopod. Scale = 0.1 mm.

subequal, 2.8 times as long as pereonite 1 (all pereonites respectively 2.5, 1.2, 0.9, 0.9, 0.9 and 1.0 times as wide as long). Pleon nearly twice as long as pereonite 6; pleonites subequal in length, three times as wide as long, all bearing pleopods; pleotelson subrectangular, as long as two preceding pleonites, 1.4 times as wide as long, with two setae above each uropod attachment and two fine distal setae.

Antennule (Fig. 127A) slender, as long as cephalothorax, three–articled; article 1 four times as long as wide, 1.6 times as long as articles 2 and 3 combined, with proximal and distal outer clusters of four penicillate setae, and single inner and outer simple distal setae; article 2 longer than wide with single inner and outer simple distal setae; article 3 three times as long as wide, 1.5 times as long as article 2, with six simple distal setae and one penicillate seta.

Antenna (Fig. 127B) six–articled, article 1 short and annular, article 2 twice as long as article 1, 1.5 times as long as wide, with dorsal seta; article 3 as long as article 1, with dorsal seta; article 4 longer than articles 1 to 3 combined, five times as long as wide, curved, with six distal and subdistal penicillate setae; article 5 as long as article 1, with long seta; article 6 very small, with four setae.

Labrum (Fig. 127C) rounded, hood-shaped, naked. Mandibles stout; left mandible (Fig. 127D) with triangular incisor and broader denticulate lacinia mobilis, molar gently curved, weak and acutely pointed; right mandible (Fig. 127E) with finely denticulate distal margin and bifid incisor; molar as on left mandible. Labium (Fig. 127H) two-lobed with slightly notched distal processes. Maxillule (Fig. 127F) endite sigmoid, with two distal setae and eight terminal spines; palp with two distal setae. Maxilla (Fig. 127G) triangular, naked. Maxilliped (Fig. 127I) basis with short seta near articulation with palp; palp article 1 naked, article 2 with three inner weak setae, article3 with three unequal inner setae, and article 4 with two longer and three shorter simple setae; endites almost-completely fused. Epignath (Fig. 127J) with distinct basal lobe, distally slender and finely setulose.

Cheliped (Fig. 128A) attachment posterior on cephalothorax, basis extending past anterior margin of pereonite 1 ventrally, with rounded posterior free margin, 1.4 times as long as wide, with small laterodistal seta; merus subtriangular, with ventral seta; carpus 1.3 times as long as broad, with one dorsal and two ventral setae; chela 1.4 times as long as carpus, propodus without bifid dorsodistal crest, anterior comb-row of five dendritic setae; fixed finger robust, with convex cutting edge, two ventral setae and three setae near cutting edge; dactylus narrow, curved and acute, with several dorsal nodules and one small anterior seta.

Pereopod 1 (Fig. 128B) longer and more slender than pereopods 2–3; coxa with seta; basis 7.3 times as long as wide; ischium with small seta; merus three times as long as wide, half as long as basis, with ventrodistal seta; carpus as long as merus, with two distal setae, both much shorter than propodus; propodus 0.8 times as long as carpus, with small dorsodistal spine-like apophysis; dactylus half as long as unguis , both together 0.7 times as long as propodus. Pereopod 2 (Fig. 128C) stouter than pereopod 1, coxa with seta; basis narrow proximally, 3.5 times as long as wide, with one mid-dorsal and two ventral penicillate setae; ischium with one small seta; merus distally expanded, 0.4 times as long as basis, with one seta and one spine ventrodistally; carpus 0.7 times as long as merus, rectangular, with one dorsodistal and one ventrodistal spines; propodus 1.2 times as long as carpus, with two ventrodistal spines; dactylus and unguis together 0.8 times as long as propodus. Pereopod 3 (Fig. 128D) similar to pereopod 2.

Pereopod 4 (Fig. 128E) basis 3.8 times as long as wide with two mid-ventral penicillate setae; ischium with two setae; merus 0.8 times as long as carpus, with two ventrodistal spines; carpus nearly three times as long as wide, with outer and inner dorsal spines longer than outer and inner ventral spines, simple dorsodistal seta; propodus 1.25 times as long as carpus, 2.4 times as long as wide, with one dorsodistal seta and two ventrodistal spines; dactylus and very short bifurcate unguis apparently distinct, together 0.9 times as long as propodus. Pereopod 5 (Fig. 128F) similar to pereopod 4, dactylus with microtrichia, together with unguis as long as propodus. Pereopod 6 (Fig. 128G) similar to pereopods 4 and 5 but basis without penicillate setae, propodus with three dorsodistal setae, dactylus plus unguis shorter than propodus.

Pleopods all similar (Fig. 128H), with basal article about as long as wide, naked; endopod and exopod rami similar, but endopod somewhat wider, with eight terminal setae, exopod with nine terminal setae; all setae plumose and longest barely as long as rami.

Uropod (Fig. 128I) slender, twice as long as pleotelson; basal article twice as long as wide, naked; exopod two-segmented, just longer than proximal article of endopod, with one distal seta on longer proximal segment, two unequal distal setae on distal segment; endopod two–segmented, proximal segment shorter and with one simple and two penicillate distal setae, distal article with one subdistal and three distal simple setae and one distal penicillate seta.

*Distinctions of male*. Body (Fig. 126C) slightly larger than female, length 1.5 mm. Cephalothorax similar to that of female. Pereonites more or less rectangular, or with slightly concave lateral margins; pereonite 1 not shortest, 0.7 times as long as each of cephalothorax and pereonite 2; pereonites 2 and 3 subequal, pereonites 4 to 6 progressively shorter, pereonite 6 half as long as pereonite 1. Pleon as long as pereonites 4 to 6 inclusive.

Antennule (Fig. 129A) seven–articled, shorter than cephalothorax; peduncle article 1 stout, 3.3 times as long as wide, with array of nine dorsal penicillate setae in proximal half, mid-inner simple seta, one longer and one shorter outer distal simple setae with adjacent penicillate seta, and one dorsodistal seta; peduncle article 2 compact, 0.2 times as long as article 1, with two inner setae; flagellum of five segments, proximal four segments with group of five or six outer distal aesthetascs; distal segment with four simple distal setae.

Mouthparts absent apart from large maxillipeds. Maxilliped (Fig. 129B) basis with seta near articulation with palp; palp articles 1 and 2 similar in length, article 2 with two small and one long setae; article 3 longer than articles 1 and 2 combined, with three inner setae; article 4 small, with two short, tow medium and two very long terminal setae.

Cheliped (Fig. 129C) similar to that of female, but carpus more slender, 1.7 times as long as wide, chela more slender and longer than carpus, fixed finger narrower; comb-row of 20 setae.

Pereopods (Fig. 129D to G) generally similar to those of female; pereopod 2 (Fig. 129E) propodus with microtrichia; pereopods 4 to 6 (Fig. 129F, G) with more slender propodi (about 5 times as long as wide), dactyli slender and severely curved.

Pleopods all similar (Fig. 129H), proportionately larger than in female and rami more elongate; endopod with one distal and eleven outer plumose setae, exopod with fourteen plumose setae, longest setae more than twice as long as rami.

Uropod similar to that of female.

*Etymology*. With reference to the unusually long pereonite 1 of the male, *Giraffa* (from the Arabic – *zirafah*) is the genus of the African camelopard ruminant with an extraordinarily long neck (noun in apposition).

*Remarks*. There are four described species of *Tanaissus* (see Bird, 2002: Bamber *et al*., 2009), all from the Northern Hemisphere, three from the North Atlantic and one from the Mediterranean. Bamber *et al*. (2009) give a key to three of these, in which the female of *T. giraffa* sp. nov. fails at couplet 2, owing to its having a single-pointed, acuminate molar process on the mandible but no bifid dorsal crest on the chela; the male of the present species fails at couplet 4 owing to its having a pleon longer than pereonites 4 and 5 together, but no ventral apophysis on the cheliped carpus; in addition, its antennular segmentation is distinct from all of these species, as is the very long pereonite 1. The fourth species, *T. psammophilous* (Wallace, 1919, q.v.), known only from the female, is incompletely described, but differs from *T. giraffa* in being less elongate (about 7 times as long as wide), in the proportions of the pereonites and of the antennule, and in the structure of the chela.

*Tanaissus giraffa* was recorded from the Eastern Bass Strait on shelly sand at 37 m depth.

## Genus *Protanaissus* Sieg, 1983

*Diagnosis* (after Shiino, 1970 and Sieg, 1983b). Antennule of three articles; antenna of six articles. Labrum naked. Mandible molar process tapering to a point, without grinding surface; incisor process of right mandible triangular, notched, and serrated on anterior border; incisor process of left mandible triangular, serrated on anterior border, lacinia mobilis of similar shape. Labium simple. Maxillule apically curved inwards. Maxilliped bases fused; endites flared, short and broad, fused proximally, not fused distally; palp article 1 naked; article 2 with three distal/inner setae, longest of which exceeds tip of palp. Chela of cheliped rugose; fixed finger cutting-edge serrated. Pereopod 1 dactylus plus unguis as long as or longer than propodus, each of these longer than merus and carpus combined. Pereopods 2 and 3 carpus with slender ventrodistal spines; pereopods 4 to 6 with three spines and one seta on carpus, and short, stout dactylus armed with small unguis, propodi with dorsodistal seta/setae exceeding length of dactylus. Pleopods with subequal rami, endopod with subdistal inner plumose seta. Uropod biramous, both rami with two segments, exopod shorter than endopod, endopod proximal segment with conspicuous distal penicillate setae.

*Type species. Typhlotanais longidactylus* Shiino, 1970 by monotypy.

*Remarks*. Sieg (1983b) erected the genus *Protanaissus* for *Typhlotanais longidactylus* Shiino, 1970, a species from the Antarctic, recognizing both that this species was not a typhlotanaid, and that it had affinities with the genus *Tanaissus*. As the diagnosis given by Sieg (ibid.) was very brief, this has been expanded above, based also on the original description of the type species by Shiino (1970). Particular characterizing features, especially as cited by Shiino (ibid.) are the elongate propodus and dactylus-plus-unguis of pereopod 1, and the wide maxilliped endites, while the longer inner seta on maxilliped palp article 2, the spination of the merus of pereopods 2 and 3, and the long distal propodal seta of pereopods 4 to 6 are further features distinguishing *Protanaissus* from *Tanaissus*.

Subsequent species attributed to this genus are discussed below, after the description of a new species of *Protanaissus* from the Bass Strait.

### ***Protanaissus huberti*** sp. nov.

Figures 130–132

*Material examined*. 1 ♀ (J50812), holotype, Stn VC 41 C3, Eastern Bass Strait, 37°32.95'S 148°03.78'E, 40 m depth, 08 May 1998, coll. N. Coleman, Smith-McIntyre Grab. 1 ♀ (J51796), paratype dissected, Stn VC 40 C1, Eastern Bass Strait, 37°35.42'S 147°31.88'E, 40 m depth, 08 May 1998, coll. N. Coleman, Smith-McIntyre Grab. 1 ♀ (J48971), paratype, CPBS 32N/810, Western Port off Crib Point, 38°20.83'S 145°13.49'E, 13 m depth, sandy gravel, 12 August 1970, coll. A.J. Gilmour. 1 ♀ (J55829), paratype dissected, Stn VC 18 C2, Central Bass Strait, 38°30.2'S 144°15.0'E, 40 m depth, 13 May 1998, coll. N. Coleman, Smith-McIntyre Grab. 1 ♀ (J48980), paratype, CPBS 32S/770, Western Port off Crib Point, 38°21.6'S 145°13.67'E, 13 m depth, muddy sand, 06 July 1970; coll. A.J. Gilmour. 1 ♀ (J48919), paratype, CPBS 300/770, Western Port off Crib Point, 38°21.15'S 145°13.51'E, 15 m depth, fine sand with mud, 06 July 1970, coll. A.J. Gilmour.

*Description of female*. Body (Fig. 130) slender, parallel-sided, seven times as long as wide, holotype 1.3 mm long. Cephalothorax longer than pereonites 2 and 3 combined, 1.3 times as long as wide, rostral half narrower than posterior. Pereonites all rectangular with convex lateral margins, pereonite1 shortest, 0.25 times as long as cephalothorax; pereonites 2, 3 and 6 subequal, 1.7 times as long as pereonite 1; pereonites 4 and 5 subequal, 2.4 times as long as pereonite 1 (all pereonites respectively 2.5, 1.5, 1.5, 1.1, 1.1 and 1.6 times as wide as long). Pleon 2.5 times as long as pereonite 6; pleonites subequal in length, four times as wide as long, all bearing pleopods; pleotelson semicircular, as long as two preceding pleonites, 1.8 times as wide as long.

Antennule (Fig. 131A) slender, as long as cephalothorax, three–articled; article 1 four times as long as wide, 1.5 times as long as articles 2 and 3 combined, with mid-dorsal and dorsodistal tufts of penicillate setae, and single mid-length and distal simple inner setae; article 2 twice as long as wide, 0.4 times a slong as article 1, with single inner and outer simple distal setae; article 3 twice as long as wide, 0.7 times as long as article 2, with five simple distal setae and one aesthetasc.

Antenna (Fig. 131B) six–articled, article 1 short and annular, article 2 more than twice as long as article 1, 1.5 times as long as wide, with dorsal seta; article 3 half as long as article 2, with dorsal seta; article 4 longer than articles 1 to 3 combined, 5.6 times as long as wide, curved, with two simple and three penicillate distal setae; article 5 as long as article 1, 1.5 times as long as wide, with long distal seta; article 6 very small, with two setae.

Labrum (Fig. 131C) rounded, hood-shaped, naked. Left mandible (Fig. 131D) with triangular incisor serrated on anterior border, and broader denticulate lacinia mobilis, molar gently curved, tapering to narrow tip with spinules but no grinding surface; right mandible (Fig. 131E) with finely denticulate distal margin and bifid incisor; molar as on left mandible. Labium not recovered. Maxillule (Fig. 131F) endite sigmoid, with two distal setules and six longer and two shorter terminal spines; palp not recovered. Maxilla (Fig. 131G) wide, rounded, naked. Maxilliped (Fig. 131G) basis fused, with long seta near articulation with palp almost reaching distal margin of palp article 3; palp setae simple, article 1 naked; article 2 with outer distal seta, three inner-distal setae, longest of which exceeds tip of palp; article 3 with four unequal inner distal setae; article 4 with two subdistal and four distal setae; endites basally fused, distally wide, inner distal margin with one short and one linguiform tubercles. Epignath not recovered.

Cheliped (Fig. 131H) basis with rounded posterior free margin, 1.6 times as long as wide, with small laterodistal seta; merus subtriangular, with ventral seta; carpus 1.8 times as long as broad, with one dorsoproximal, one dorsodistal and two mid-ventral setae; chela about as long as carpus, stout, resembling that of *Tanaissus* spp., propodus wider than long with dorsodistal rugosity; fixed finger robust, proximally wide, with convex denticulate cutting edge, one ventral seta and three setae near cutting edge; dactylus with dorsal rugosity in proximal half.

Pereopod 1 (Fig. 132A) longer and more slender than pereopods 2–3; coxa without seta; basis five times as long as wide, sinuous; ischium with small seta; merus 0.3 times as long as basis, naked; carpus 1.7 times as long as merus, naked; propodus 1.2 times as long as merus and carpus combined, with small dorsodistal spine-like apophysis and fine ventral subdistal seta; curved dactylus 0.8 times as long as curved unguis, both together as long as propodus. Pereopod 2 (Fig. 132B) stouter than pereopod 1, coxa with fine seta; basis 3.6 times as long as wide, with one dorsoproximal simple seta; ischium with one seta; merus distally wider, one-quarter as long as basis, with one slender ventrodistal spine; carpus 1.8 times as long as merus, with one slender ventrodistal spine; propodus as long as carpus, with one ventrodistal seta; dactylus shorter than unguis, both together as long as propodus. Pereopod 3 (Fig. 132C) similar to pereopod 2, but coxal seta longer, basis naked, ventrodistal spine on carpus larger (more than half as long as carpus), propodus with some distal microtrichia.

Pereopod 4 (Fig. 132D) basis 2.9 times as long as wide; ischium with two setae; merus 0.4 times as long as basis, with

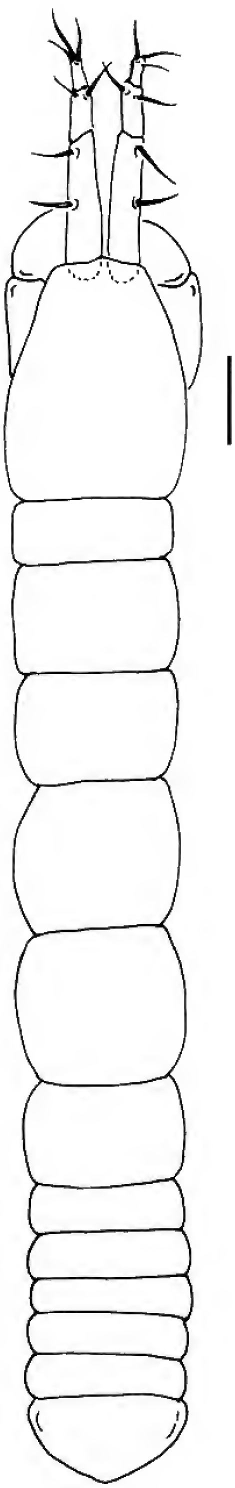

Fig. 130. *Protanaissus huberti* sp. nov. female holotype. Scale = 0.1 mm.


Fig. 131. *Protanaissus huberti* sp. nov. A, antennule; B, antenna; C, labrum; D, left mandible ; E, right mandible; F, maxillule ; G, maxilliped and maxilla ; H, cheliped. Scale = 0.01 mm.

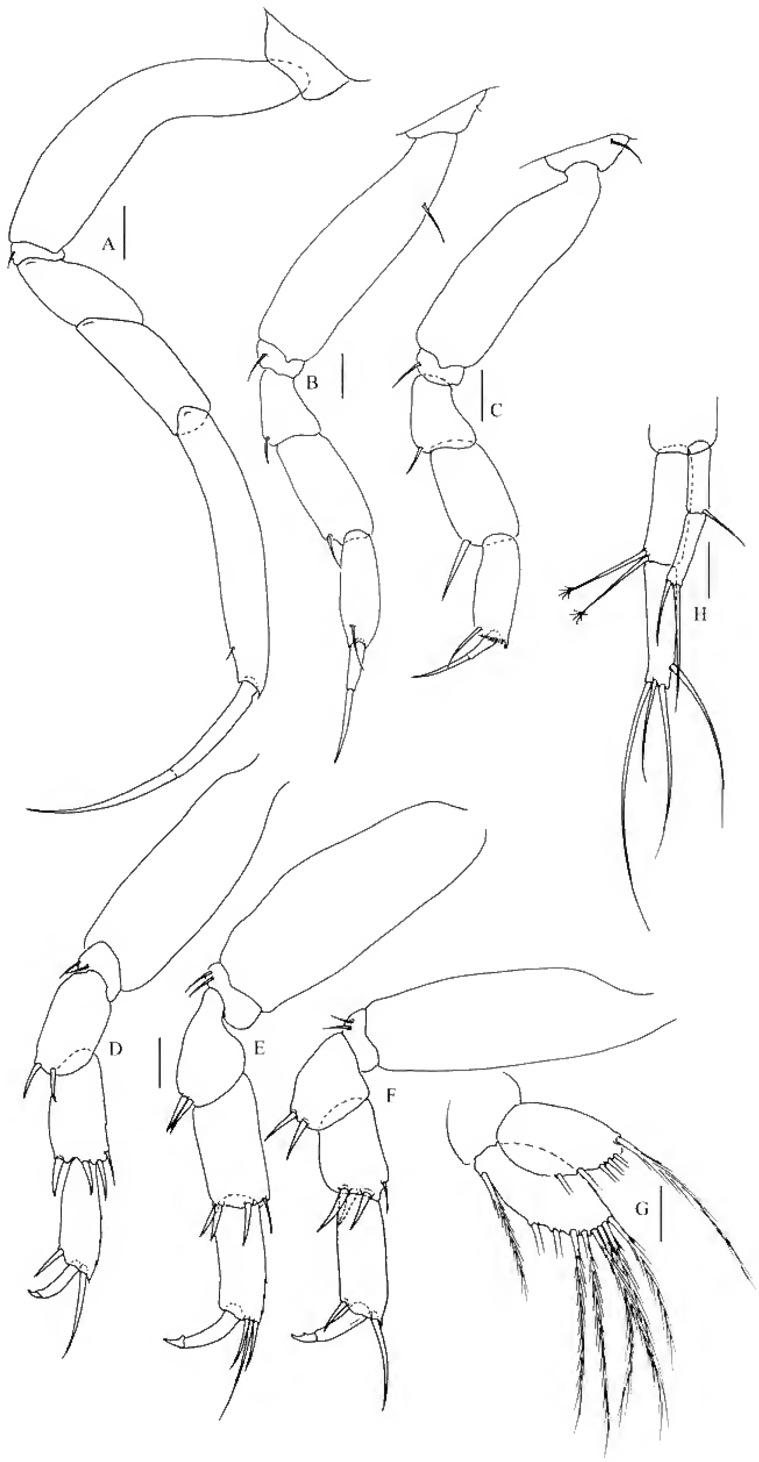


Fig. 132. *Protanaissus huberti* sp. nov. A, pereopod 1; B, pereopod 2; C, pereopod 3; D, pereopod 4; E, pereopod 5; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.01 mm.

two ventrodistal spines; carpus as long as merus, with single ventral, outer and inner distal spines and dorsodistal spinule; propodus 1.1 times as long as carpus, with dorsal microtrichia in distal half, one dorsodistal seta exceeding length of dactylus plus unguis, and ventrodistal spine almost as long as dactylus; dactylus and very short bifurcate unguis together half as long as propodus. Pereopod 5 (Fig. 132E) similar to pereopod 4, merus somewhat shorter. Pereopod 6 (Fig. 132F) similar to pereopods 4 and 5 but propodus with two shorter and one longer dorsodistal setae, no ventrodistal seta or spine.

Pleopods all similar (Fig. 132G), basal article about as long as wide, naked; endopod and exopod rami similar, but endopod somewhat shorter, with five outer-distal and one inner-subdistal plumose setae; exopod with seven outer-distal and one separated outer proximal plumose setae.

Uropod (Fig. 132H) slender; basal article naked; exopod two-segmented, just longer than proximal article of endopod, segments subequal in length, with one distal seta on proximal segment, two unequal distal setae on distal segment; endopod two–segmented, segments subequal in length, proximal segment with two inner penicillate distal setae, distal article with one subdistal and three distal simple setae.

*Male*. Unknown.

*Etymology*. This species is dedicated to the first author's son and the second author's good friend, Hubert.

*Remarks*. *Protanaissus huberti* sp. nov. shows many similarities to *P. longidactylus*, including the elongate distal articles of pereopod 1, the rugose cheliped, the conformation of the mouthparts, particularly the wide maxilliped endites, and the long dorsodistal setae on the propodi of the posterior pereopods. It is distinguished from *P. longidactylus* in having the distal antennular article shorter than the second article (approaching twice as long in *P. longidactylus*), the more compact fifth article of the antenna, the presence of distal spinules on the mandibular molar process, the presence of linguiform distal tubercles on the maxilliped endites, in having only one ventrodistal spines on the merus and carpus of pereopods 2 and 3, only one ventral seta on the cheliped propodus (two in *P. longidactylus*), serrations along the whole cutting edge of the fixed finger of the cheliped propodus (only distally serrate in *P. longidactylus*) and in having only one ventrodistal seta on the propodus of the posterior three pairs of pereopods (or none on pereopod 6) compared with two in *P. longidactylus.*

*Protanaissus huberti* was taken occasionally throughout the eastern and central Bass Strait at depths between 13 and 40 m.

The second species to have been attributed to *Protanaissus* was *P. makrotrichos* Sieg 1986, from the shelf off Argentina, which showed many similarities to *P. longidactylus*, but had a distal grinding ("triturating") surface on the mandibular molar process, no rugosity on the cheliped, and a maxilliped endite distally folded to fuse with the basis giving the appearance of two narrow lobes; rather than having a long dorsodistal seta on the propodus of pereopod 6, *P. makrotrichos* has a long ventrodistal seta. Guţu (1996c) described *P. alvesi* from Brazil, which, while again similar to *P. longidactylus*, also had a distal grinding surface on a stout (not tapering) mandibular molar process, no rugosity on the cheliped, no very long seta on maxilliped palp article 2, a maxilliped endite apparently distally narrow, and a long ventrodistal seta on the propodus of pereopod 6, thus more similar to *P. makrotrichos*. Finally, Larsen and Heard (2004a) described *P. floridensis* from Florida, a species with a uniformly narrow mandibular molar process, rugosity on the cheliped, and distally narrow (but not infolded or fused) maxilliped endites, as well as a one-segmented uropod exopod, a uropod endopod without conspicuous pair of penicillate setae on the proximal segment, no very long seta on maxilliped palp article 2, the dactylus plus unguis of pereopods 4 to 6 fused into a claw, no long distal seta on the propodus of pereopod 6, and a quite distinct pereopod 1, with the propodus shorter than the merus and carpus combined, and a dactylus-plus-claw about half as long as the propodus.

That these three additional species have a distally-narrowed maxilliped endite, that two of them have a grinding mandibular molar and no cheliped rugosity, while the third has a quite distinct pereopod 1 and apparently fused claws on pereopods 4 to 6, *inter alia*, puts them in conflict with the generic diagnosis given above. Conversely, the new Australian species, *Protanaissus huberti*, described above agrees with the generic diagnosis in all respects.

We therefore remove *Protanaissus makrotrichos* and *P. alvesi* to a separate genus, clearly close to *Protanaissus*, while *P. floridensis* is moved to yet another distinct genus, no closer to *Protanaissus* than it is to *Tanaissus*. These genera are defined below.

## Genus ***Molotanaissus*** gen. nov.

*Diagnosis of female*. Antennule of three articles; antenna of six articles. Labrum naked. Mandible molar process with distal grinding or crushing surface; incisor process of right mandible triangular, notched, and serrated on anterior border; incisor process of left mandible triangular, serrated on anterior border, lacinia mobilis of similar shape. Maxillule apically curved inwards. Maxilliped bases fused, endites short and distally narrowed and infolded, fused proximally; palp article 1 naked; article 2 with three distal/inner setae, longest of which does not exceed tip of palp. Chela of cheliped not rugose; fixed finger cutting-edge not serrated. Pereopod 1 dactylus plus unguis as long as or longer than propodus, each of these longer than merus and carpus combined. Pereopods 2 and 3 carpus with or without seta and with relatively stout ventrodistal spine; pereopods 4 to 6 with four distal spines on carpus, and with short, stout dactylus armed with small unguis, propodi with long ventrodistal seta exceeding length of dactylus. Pleopods with subequal rami, endopod with subdistal inner plumose seta. Uropod biramous, both rami with two segments, exopod shorter than endopod, endopod proximal segment with conspicuous distal penicillate setae.

*Male.* Unknown.

*Etymology*. From the Latin *molo* – "grind", pertaining to the grinding surface on the molar processes of the mandible (unlike the condition found in *Tanaissus* or *Protanaissus*), and *Tanaissus*; masculine.

*Type species. Protanaissus makrotrichos* Sieg, 1986 by original designation.

*Species included*: *Molotanaissus makrotrichos* (Sieg, 1986) comb. nov.; *M. alvesi* (Guţu, 1996) comb. nov. (see Guţu, 1996c, for distinctions between these two species).

*Distribution*. Patagonian Shelf off Argentina (20–50 m depth) and off Brazil (58=60 m).

Genus ***Unitanaissus*** gen. nov.

*Diagnosis of female*. Antennule of three articles; antenna of six articles. Labrum naked. Mandible molar process uniformly narrow, with distal bifurcation but no grinding surface; incisor process of left mandible triangular, serrated on anterior border, slightly notched, lacinia mobilis narrower with three rounded distal crenulations. Maxillule apically curved inwards. Maxilliped bases fused, endites short, parallel-sided and entirely narrowed; palp article 1 naked; article 2 with three distal/inner setae, longest of which does not exceed tip of article 3. Sclerite triangular, inserted dorsally to cheliped basis. Chela of cheliped rugose; fixed finger cutting-edge slightly serrated distally. Pereopod 1 dactylus plus unguis half as long as propodus, each of these shorter than merus and carpus combined. Pereopods 2 and 3 carpus with relatively stout ventrodistal spine; pereopods 4 to 6 with dactylus and unguis fused into short, stout claw, propodi without long distal seta. Pleopods with subequal rami, endopod with subdistal inner plumose seta. Uropod biramous, exopod with one segment and shorter than endopod, endopod with two segments, proximal segment without conspicuous distal penicillate setae.

*Male*. Unknown.

*Etymology*. From the Latin *unus* – "one", and *Tanaissus*, alluding to the single-segmented uropod exopod, a condition unlike that found in *Tanaissus*, *Protanaissus* or *Molotanaissus*; masculine.

*Type species. Protanaissus floridensis* Larsen & Heard, 2004 by monotypy.

*Species included*: *Unitanaissus floridensis* (Larsen & Heard, 2004) comb. nov.

*Distribution*. Atlantic coast of Florida, 7 m depth.

Family **Agathotanaidae** Lang, 1971

Genus ***Paragathotanais*** Lang, 1971

***Paragathotanais wurundjeri*** sp. nov.

Figures 133–134

*Material examined*. 1♀ (J58566), holotype, Eastern Bass Strait, 60 km E of North Point, Flinders Island, Stn BSS 32, 39°41.7'S 148°39.5'E, 115 m depth, muddy sand, 27 March 1979, coll. G.C.B. Poore; 1♀ (J58567), paratype, Eastern Bass Strait, 24 km NNE of Eddystone Point, Stn BSS 163, 40°43.9'S 148°32.5'E, 56 m depth, muddy sand, 14 November 1981; coll. R.S. Wilson; 1♀ (J58568), paratype, Eastern Bass Strait, 85 km NE of North Point, Flinders Island, Stn BSS 169, 39°02.4'S 148°30.6'E, 120 m depth, muddy sand, 15 November 1981; coll. R.S. Wilson.

*Description of female*. Body (Fig. 133A) slender, holotype 3.7 mm long, 8.5 times as long as wide. Cephalothorax pear-shaped, widest and laterally-rounded posteriorly, tapering towards anterior with slight rounded rostrum, 1.5 times as long as wide, as long as pereonites 1 and 2 together, naked; eyelobes and eyes absent. Pereonites hexagonal, pereonites 1 to 3 widest anteriorly, pereonites 4 to 6 centrally; pereonites 1 and 6 subequal in length, shortest, half as long as cephalothorax; pereonite 2 just longer than pereonite 1; pereonites 3 to 5 subequal in length, longer than wide and about 1.25 times as long as pereonite 1 (all pereonites respectively 1.4, 1.1, 0.9, 0.8, 0.9 and 1.0 times as wide as long). Pleon narrower than pereon, pleonites without pleopods, each five times as wide as long. Pleotelson pentangular (Fig. 134H), one-half length of pleon and 1.4 times as wide as long.

Antennule (Fig. 133B) of four articles, proximal article 2.9 times as long as wide, as long as distal three articles together, outer margin with four penicillate setae in distal half, and simple seta distally as long as second peduncle article; second article twice as long as wide, 0.4 times as long as first article, with two outer distal penicillate and single longer simple setae, one inner distal seta; third article 0.3 times as long as second article, with single inner and outer distal setae; fourth article as long as second, with five simple and one penicillate distal setae.

Antenna (Fig. 133C) of six articles, proximal article compact, naked; second article nearly twice as long as wide, naked; third article just shorter than wide, half as long as second article, with fine dorsodistal seta; fourth article longest, twice as long as second article and four times as long as wide, with penicillate seta in proximal half and one simple and two penicillate distal setae; fifth article half as long as fourth with one distal seta; sixth article minute with five distal setae.

Labrum not recovered. Left mandible (Fig. 133D) with rounded "teeth" on pars incisiva, slender hook-like lacinia mobilis, pars molaris flaccid, lanceolate, directed proximally. Labium (Fig. 133H) with prominent setose mediodistal processes. Maxillule (Fig. 133E) with ten distal spines and proximal tufts of setae, palp not recovered. Maxilla (Fig. 133F) linguiform, naked. Maxilliped palp (Fig. 133G) first article naked, second article with three inner distal setae; third article with three inner setae; fourth article distally with two shorter and two longer setae, longer setae finely denticulate in distal half; basis naked; endites distally with two setae and outer rounded tubercle. Epignath (Fig. 133I) elongate, distally pointed, naked.

Cheliped (Fig. 134A) basis compact, 0.7 times as long as wide, naked; merus subtriangular with single ventral seta; carpus 1.5 times as long as wide, with two unequal midventral setae, one fine dorsodistal seta and one fine mid-dorsal seta; propodus as long as wide, fixed finger 0.9 times as long as palm, with one ventral seta, three setae adjacent to cutting edge, tooth-like apophyses centrally and distally on cutting edge; dactylus stout, naked.

Pereopod 1 (Fig. 134B) coxa with seta; basis slightly arcuate, slender, 5.2 times as long as wide, naked; ischium compact, with ventral seta; merus 0.4 times as long as basis,

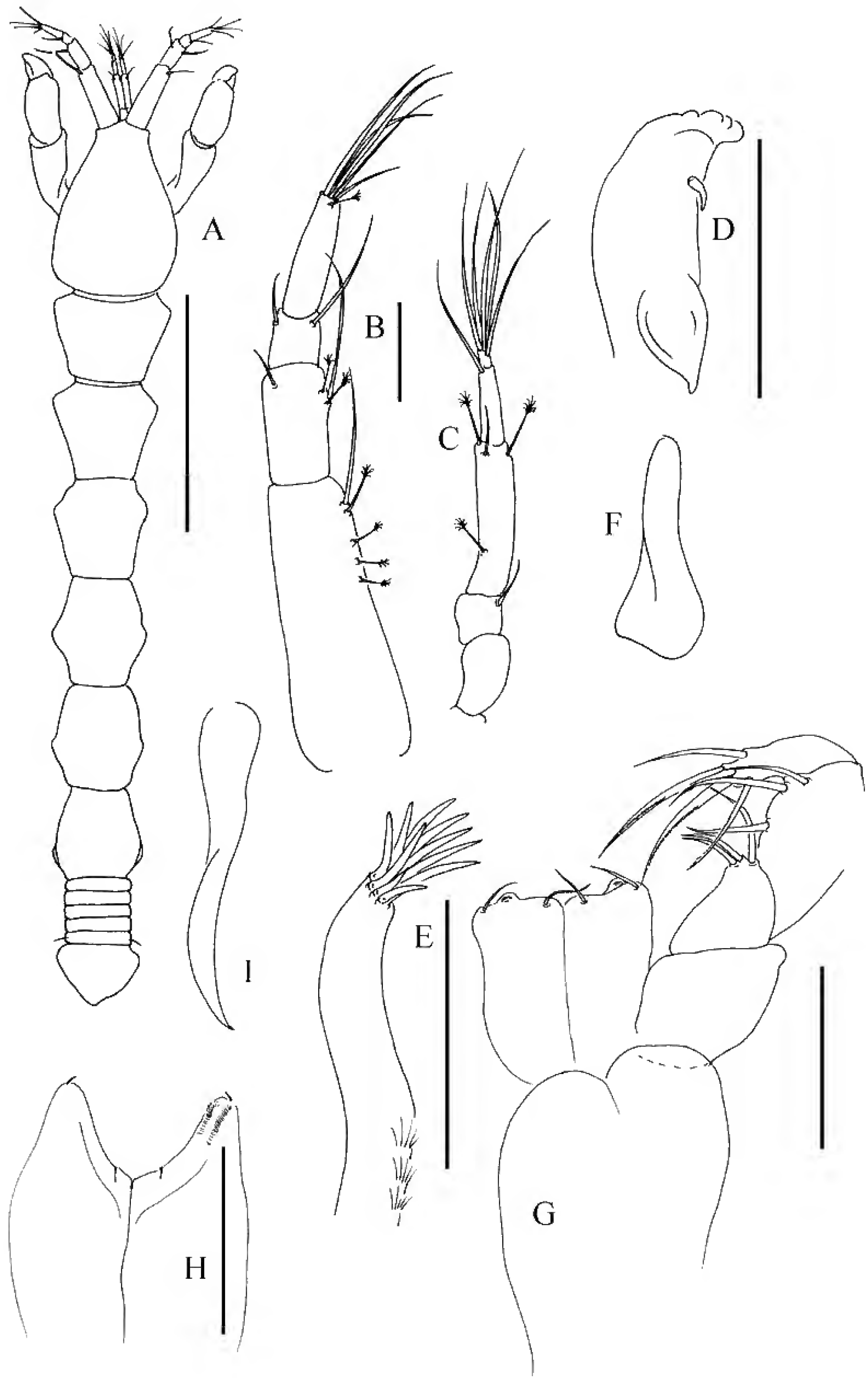


Fig. 133. *Paragathotanais wurundjeri* sp. nov., female paratype. A, whole body dorsally; B, antennule; C, antenna; D, left mandible; E, maxillule endite; F, maxilla; G, maxilliped; H, labium; I, epignath. Scale A = 1 mm, B-I = 0.1 mm.

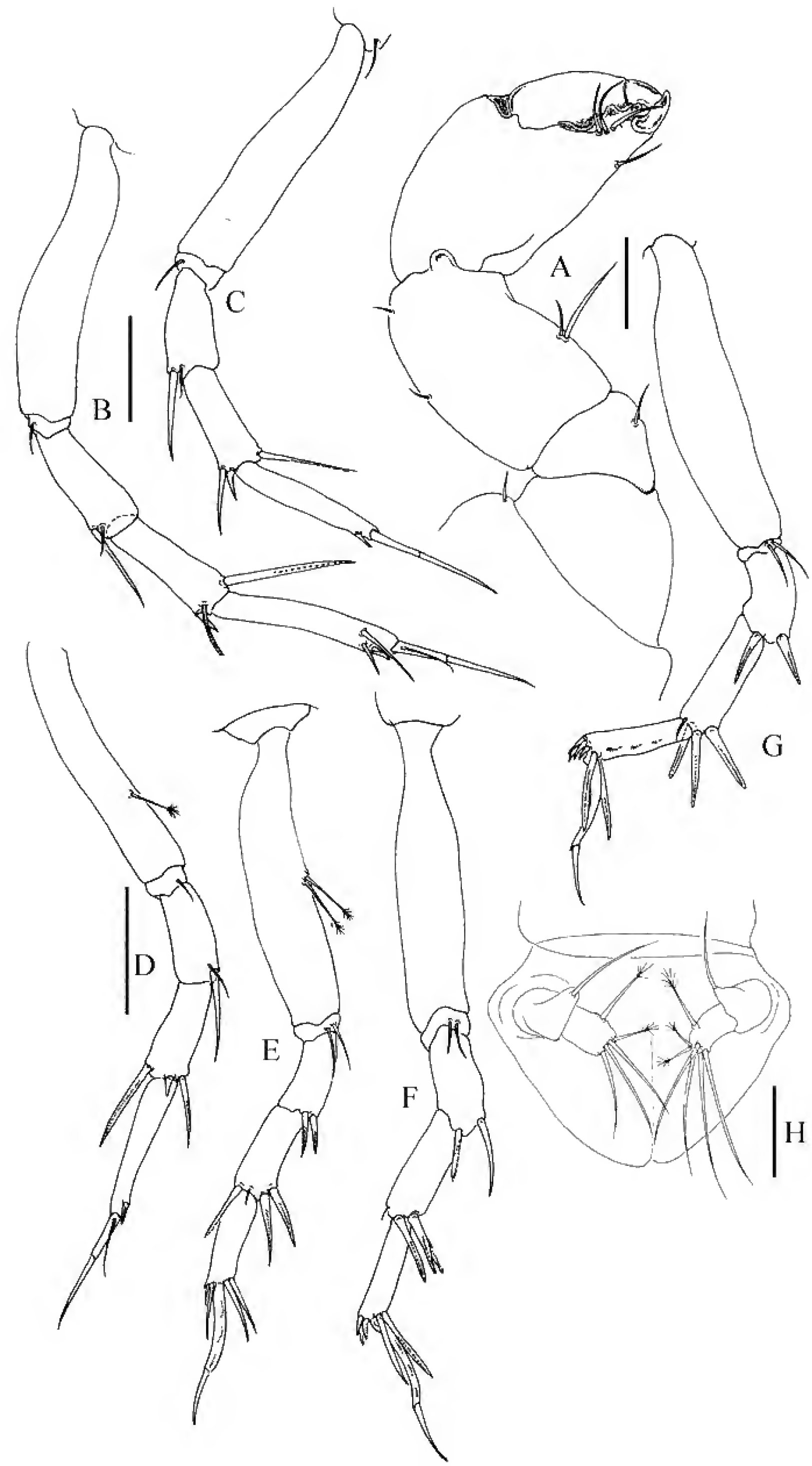


Fig. 134. *Paragathotanais wurundjeri* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleotelson and uropods, ventral. Scale = 0.1 mm.

ventrodistally with seta and elongate slender spine 0.6 times as long as merus; carpus as long as merus, distally with dorsal finely-denticulate spine longer than carpus and one simple shorter and one finely-denticulate longer ventral spines; propodus 1.6 times as long as carpus, with two subdistal setae, shorter ventral spine; dactylus with proximal seta, slender unguis 1.8 times as long as dactylus, both together 0.8 times as long as propodus. Pereopod 2 (Fig. 134C) similar to pereopod 1, but merus 0.85 times as long as carpus, propodus without subdistal setae. Pereopod 3 compact (Fig. 134D), similar to pereopod 2, basis with ventral penicillate seta.

Pereopod 4 (Fig. 134E) coxa naked; basis slightly stouter than those of anterior pereopods, 4.7 times as long as wide, with two midventral penicillate setae; ischium with two ventrodistal setae; merus one-quarter as long as basis, with two finely-denticulate ventrodistal spines; carpus 1.2 times as long as merus, distally with two ventral and one dorsal finely-denticulate spines and fine mesial seta; propodus as long as carpus, distally with two ventral finely-denticulate spines. and one longer and one shorter dorsal setae; dactylus sinuous, with fields of microtrichia, 1.6 times as long as curved unguis, both together 1.5 times as long as propodus. Pereopod 5 (Fig. 134F) as pereopod 4, but carpus with lateral rather than dorsodistal spine; propodus with three short dorsodistal spines and no setae. Pereopod 6 (Fig. 134G) as pereopod 5, but propodus with microtrichia and four dorsodistal spines.

Pleopods absent.

Uropods (Fig. 134H) held ventrally beneath anterior of pleotelson; basis naked; exopodal process shorter than endopod, with one distal seta; endopod of one segment, with one subdistal penicillate seta, four simple and one or two penicillate distal setae.

*Male.* Unknown.

*Etymology.* The Wurundjeri were one of the indigenous hunter-gatherer tribes of the Melbourne region, from whom John Batman, in 1835, negotiated a "purchase" of 2,400 km$^2$ of land which became the site of the original settlement which developed into the city of Melbourne (noun in apposition).

*Remarks.* Larsen (2005) gave a key to the females of *Paragathotanais*, in which the present species fails at couplet 5 in having a relatively stout cheliped, but "shoulders" (super-coxal processes) on the pereonites. In addition to the species listed that publication, Guerrero-Kommritz (2003) described *P. insolitus* from the Angola basin, but that species is distinct in having only four articles in the antenna, and very reduced spination of the anterior pereopods; *P. abyssorum* Larsen, 2007 is distinguished from *P. wurundjeri* sp. nov. by the much more compact antennule, the more slender cheliped and the smaller spines on the anterior pereopods, *inter alia* (Larsen, 2007); *P. vikingus* Bird, 2010 has far more compact pereonites, a characteristically elongate and parallel-sided cephalothorax, and a distinct mandibular morphology (Bird, 2010); *P. zevinae* (Kudinova-Pasternak, 1970), moved to this genus from *Paranarthrura* by Larsen (2007), has a more compact antennule and a more slender cheliped (Kudinova-Pasternak, 1970). All of these species have a smaller exopodal process on the uropod. Finally, *P. ipy* Jóźwiak & Błażewicz-Paszkowycz, 2011, differs from *P. wurundjeri* in having no ventrodistal spine on the merus of pereopods 1 to 3.

*Paragathotanais wurundjeri* is the shallowest-recorded species of the genus discovered so far, having been collected on muddy sand at 56 to 120 m depth in the Eastern Bass Strait. All of the other species occur at depths greater than 200 m, and mostly at depths greater than 2000 m.

Genus ***Ozagathus*** gen. nov.

*Diagnosis.* Agathotanaid with three-articled antennule, apparent five-articled antenna; pereonites wider medially, pleon slightly narrower than pereon; mandibular molar membranous and directed proximally, lacinia mobilis reduced to apophysis; labium with prominent rounded mediodistal processes; maxilliped bases and endites naked; cheliped without pseudocoxa; pereopod coxae unfused; anterior pereopods with carpal spines; dactyli and ungues of posterior pereopods not fused, their carpi with two spines; uropod exopod a fused process on basis, endopod one-segmented, uropods held beneath pleotelson. Female without pleopods. Male with slightly more robust antennule and with poorly-developed pleopods.

*Type species. Ozagathus watharongus* sp. nov. by monotypy.

*Etymology.* From "Oz", colloquial slang for "Australia", and "agathus" derived from the prefix to the Family name (male).

*Remarks.* The new species described below shows all the general features of an agathonataid, but is somewhat intermediate between the previously recognized genera, having the three-articled antennule and reduced uropods typical of *Agathotanais* Hansen, 1913, but an apparently five-articled antenna more typical of *Paragathotanais*. The mouthparts are generally within the range of morphology shown by the Family, although the setulose rounded distal processes on the labium are presently characteristic of *Ozagathus* gen. nov. Whether the tuberculation of the cheliped, a feature not previously described for an agathotanaid, is a generic character is impossible to say at present, particularly in the light of the variable presence of this feature in some genera of the Tanaellidae (see above).

***Ozagathus watharongus*** sp. nov.

Figures 135–137

*Material examined.* 1 ♀ (J58854), holotype, MSL EG120, Eastern Bass Strait, 11.7 km W of Pt Ricardo, 37°49.54'S 148°30.01'E, 29 m depth, 28 September 1990, coll. Marine Science Laboratories. 1 ♀ (J56381), paratype, MSL-EG 68, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, 37°51.42'S 148°14.36'E, 121 m depth, 04 June 1991, coll. N. Coleman; 1 ♀ (J23653), paratype, MSL-EG 41, Eastern Bass Strait, 11.7 km W of Pt Ricardo, 37°49.54'S 148°30.01'E, 29 m depth, sand and shell, 28 September 1990, Smith-McIntyre Grab, coll. Marine Science Laboratories. 1 ♀ (J50793), paratype, VC 48 C1, Eastern Bass Strait, 37°21.43'S 149°29.57'E, 40 m depth, 09 May 1998, coll. N. Coleman, Smith-McIntyre Grab. 1 ♀ (J28426), paratype, MSL-EG 121, Eastern Bass Strait, 11.7 km W of Pt Ricardo, 37°49.54'S 148°30.01'E, 29 m depth, sand and shell, 28 September 1990, Smith-McIntyre Grab, coll. Marine Science Laboratories. 17 ♀♀ (J28413), paratypes, MSL-EG 86,

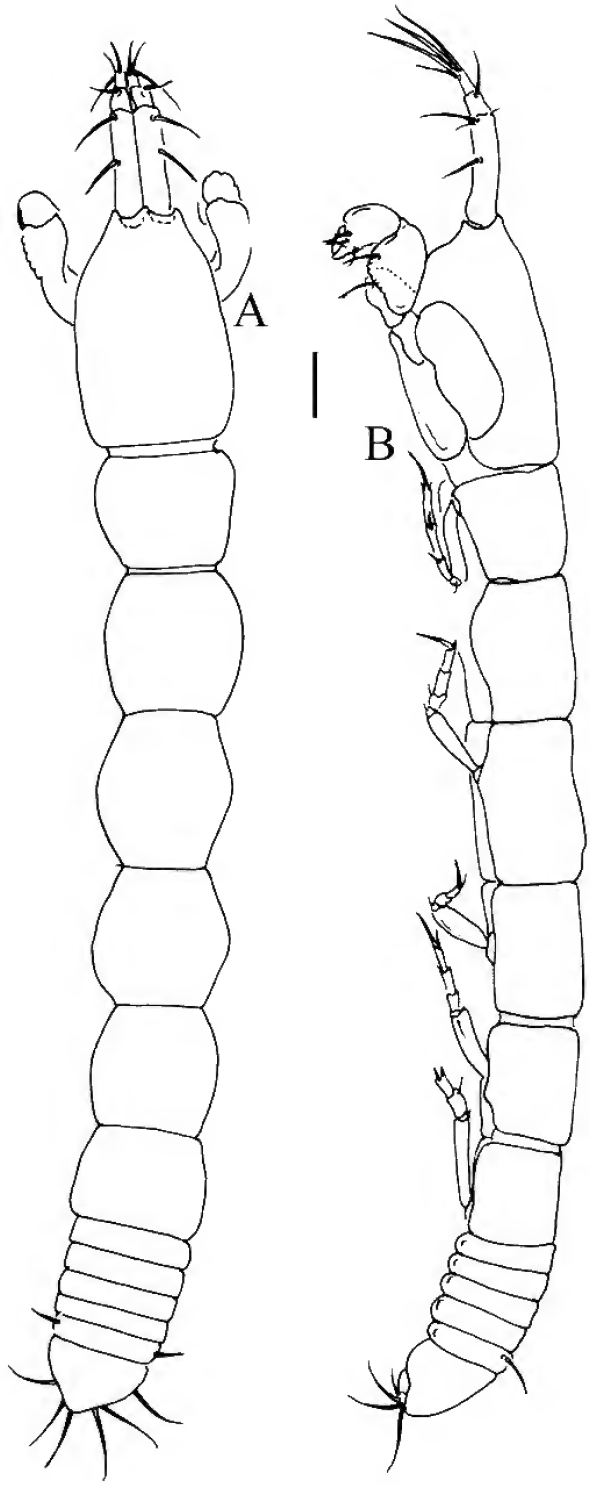


Fig. 135. *Ozagathus watharongus* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 0.1 mm.

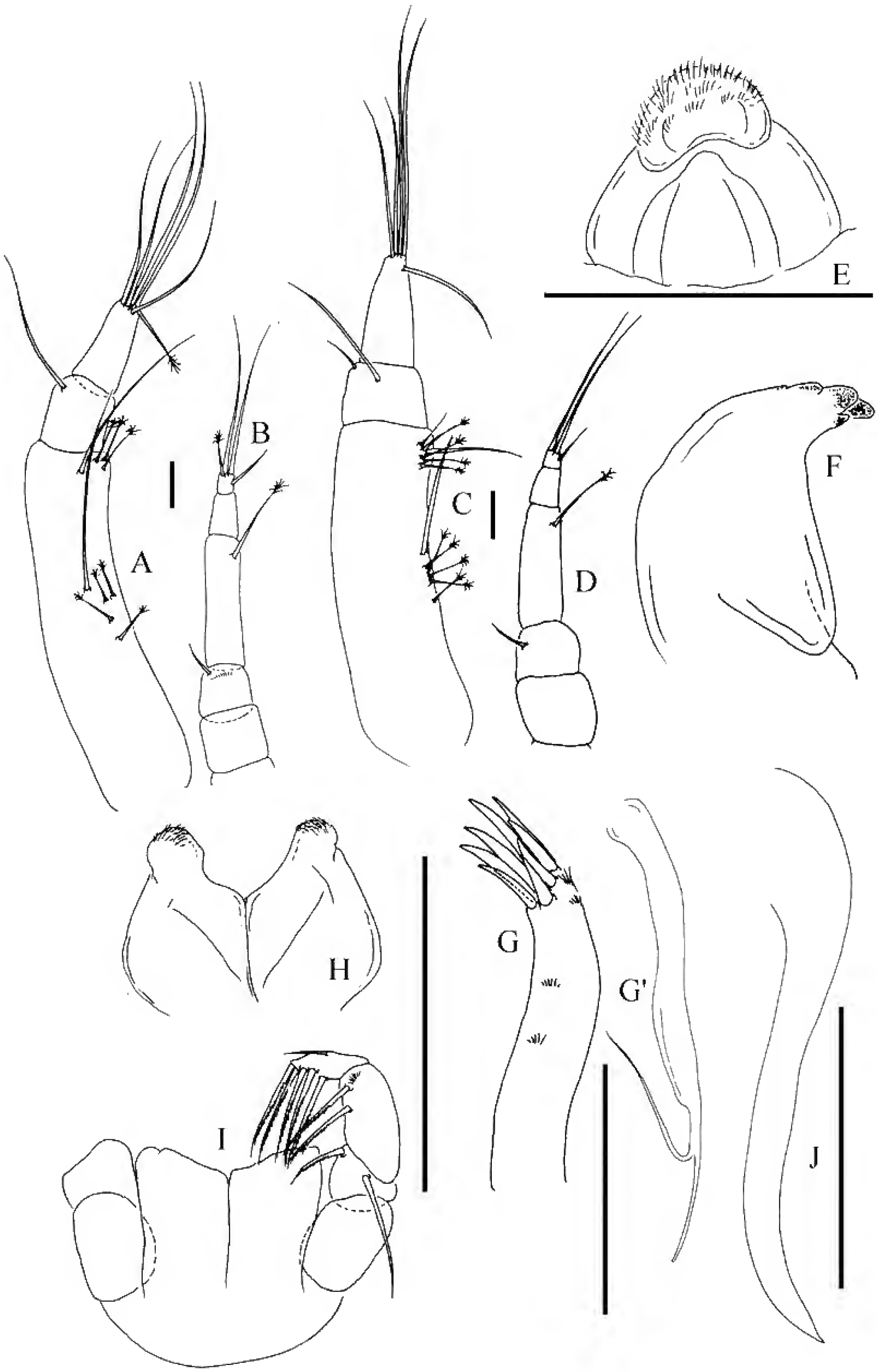


Fig. 136. *Ozagathus watharongus* sp. nov. A, female antennule; B, female antenna; C, male antennule; D, male antenna; E, labrum; F, left mandible; G, maxillule; G', maxillule palp; H, labium; I, maxilliped; J, epignath. Scale = 0.01 mm.

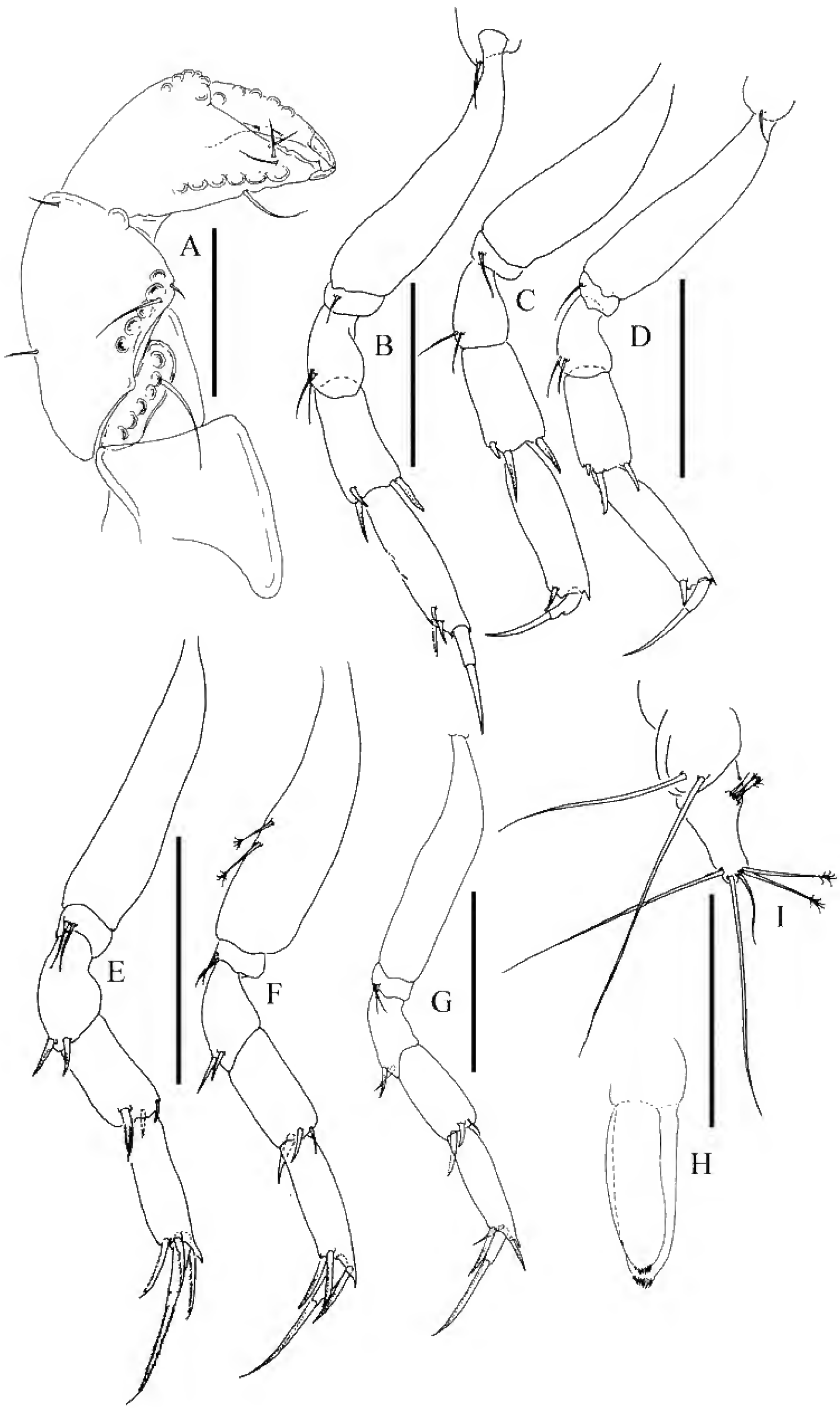


Fig. 137. *Ozagathus watharongus* sp. nov. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, male pleopod; I, uropod. Scale = 0.1 mm.

Eastern Bass Strait, 2.9 km SE of Cape Conran, 37°50.00'S 148°38.54'E, 95 m depth, coarse sand, 04 June 1991, Smith-McIntyre grab, coll. N. Coleman. 30 ♀♀ (J28416), paratypes, MSL-EG 90, Eastern Bass Strait, 7.3 km SSW of Cape Conran, 37°52.39'S 148°42.09'E, 161 m depth, coarse sand, 04 June 1991, Smith-McIntyre grab, coll. N. Coleman. 2 ♀♀ (J50792), paratypes, Stn VC 37 C1, Eastern Bass Strait, 38°18.3'S 147°15.25'E, 40 m depth, 10 May 1999, Smith-McIntyre grab, coll. N. Coleman. 19 ♀♀ (J28420), paratypes, MSL-EG 114, Eastern Bass Strait, 2.9 km SE of Cape Conran, 37°50.00'S 148°38.54'E, 29 m depth, coarse sand, February 1991, Smith-McIntyre grab, coll. N. Coleman. 4 ♀♀ (J23525), paratypes, MSL-EG 45, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, 37°51.44'S 148°14.46'E, 37 m depth, sand and shell, 25 September 1990, Smith-McIntyre grab, coll. Marine Science Laboratories. 22 ♀♀ (J23532), paratypes, MSL-EG 59, Eastern Bass Strait, 9.5 km SW of Cape Conran, 37°52.53'S 148°39.29'E, 48 m depth, sand and shell, 28 September 1990, Smith-McIntyre grab, coll. Marine Science Laboratories.

*Description of female.* Body (Fig. 135A, B) slender, holotype 1.9 mm long, 8.7 times as long as wide. Cephalothorax subrectangular, tapering in anterior third with slight triangular rostrum, 1.6 times as long as wide, almost as long as pereonites 1 and 2 together, wider than pereon, naked; eyelobes and eyes absent. Pereonites almost barrel-shaped, pereonite 1 widest anteriorly, pereonites 2 to 5 centrally, pereonite 6 posteriorly; pereonites 1 and 5 subequal in length, half as long as cephalothorax; pereonites 2 and 4 just longer than pereonite 1; pereonite 3 longest, 1.3 times as long as pereonite 1; pereonite 6 shortest, 0.8 times as long as pereonite 1 (all pereonites respectively 1.2, 1.0, 0.9, 1.0, 1.1 and 1.3 times as wide as long). Pleon just narrower than pereon, pleonites without pleopods, each 4.5 times as wide as long; pleonite 5 with conspicuous midlateral seta on each side. Pleotelson subpentangular, 0.4 times length of pleon and as wide as long.

Antennule (Fig. 136A) of three articles, proximal article 4.2 times as long as wide, 1.35 times as long as distal two articles together, outer margin with mid-length and distal tufts of four penicillate and one simple setae, mid-length seta exceeding tip of proximal article, distal seta exceeding tip of antennule; second article as long as wide, 0.2 times as long as first article, with simple outer distal seta; third article 1.2 times as long as second article, with five simple and one penicillate distal setae.

Antenna (Fig. 136B) of five apparent articles, proximal article totally fused to carapace; second article as long as wide, naked; third article just longer than wide, as long as second article, with fine dorsodistal seta; fourth article longest, 2.2 times as long as second article and nearly four times as long as wide, with subdistal ventral penicillate seta; fifth article one-third as long as fourth, naked; sixth article half as long as fifth, distally with three simple and one penicillate setae.

Labrum (Fig. 136E), compact, rounded, distally setulose. Left mandible (Fig. 136F) with three rounded lobe-like "teeth" on pars incisiva, lacinia mobilis reduced to a similar rounded subdistal tubercle, pars molaris flaccid, blunt, directed proximally. Labium (Fig. 136H) with prominent setose, rounded mediodistal processes. Maxillule (Fig. 136G) with eight distal spines and sparse groups of microtrichia, palp (Fig. 136G') with two distal setae. Maxilla not recovered. Maxilliped (Fig. 136I) palp first article naked, second article with two inner distal setae; third article with two inner setae in distal half; fourth article tapering, with five setae along inner margin to tip, single outer subdistal seta; all palp setae other than the last distally finely denticulate; bases fused, naked; endites distally with rudiment of outer rounded tubercle. Epignath (Fig. 136J) elongate, distally pointed, naked.

Cheliped (Fig. 137A) basis compact, 0.85 times as long as wide, naked; merus subtriangular, outer face with strip of six rounded tubercles and single seta along dorsodistal margin; carpus 1.6 times as long as wide, with two unequal midventral setae, one fine dorsodistal seta and one fine mid-dorsal seta, and strip of five rounded tubercles along ventral margin of outer face; propodus longer than wide with ventral submarginal strip of six rounded tubercles and group of smaller tubercles dorsodistally, fixed finger 0.8 times as long as palm, with one ventral seta, three setae adjacent to cutting edge, small "teeth" centrally and distally on cutting edge; dactylus with rounded tubercles along dorsal margin and proximally on inner face, two blunt tubercles on cutting edge.

Pereopod 1 (Fig. 137B) coxa with seta; basis slightly arcuate, slender, five times as long as wide, naked; ischium compact, with ventral seta; merus 0.3 times as long as basis, ventrodistally with two setae; carpus 1.3 times as long as merus, distally with one dorsal, and one shorter and one longer ventral finely-denticulate spines; propodus 1.5 times as long as carpus, ventrally with subdistal spine and seta; dactylus short and robust, tapering unguis 1.7 times as long as dactylus, both together 0.7 times as long as propodus. Pereopod 2 (Fig. 137C) similar to but somewhat stouter than pereopod 1, basis 3.7 times as long as wide, propodus without subdistal seta but with dorsodistal spine-like apophysis. Pereopod 3 (Fig. 137D), similar to pereopod 2.

Pereopod 4 (Fig. 137E) basis 4.2 times as long as wide; ischium with two ventrodistal setae; merus 0.4 times as long as basis, with two finely-denticulate ventrodistal spines; carpus as long as merus, distally with outer and inner finely-denticulate spines and fine dorsal seta; propodus 1.3 times as long as carpus, distally with three finely-denticulate spines and dorsodistal spine-like apophysis; dactylus about half as long as curved unguis, unguis slender, finely denticulate, both together 1.3 times as long as propodus. Pereopod 5 (Fig. 137F) as pereopod 4, but basis with two penicillate setae. Pereopod 6 (Fig. 137G) as pereopod 4, but basis naked.

Pleopods absent.

Uropods (Fig. 137I) held ventrally beneath pleotelson; basis naked but with slight fused exopod with two distal setae exceeding tip of endopod and visually conspicuous in dorsal view of animal (Fig. 135); endopod of one segment, widest proximally, with one simple and two penicillate setae in proximal half, three simple and two penicillate setae distally.

*Distinctions of male.* Of similar overall appearance to female; antennule (Fig. 136C) stouter, proximal two articles respectively 3.5 and 0.7 times as long as wide; antenna (Fig. 136D) also slightly stouter, second and third articles shorter than wide, fourth article three times as long as wide; pleopods present (Fig. 137H), somewhat rudimentary, biramous, rami with incomplete articulation with naked basis, each with distal tuft of fine setules.

*Etymology*. The Wathaurong were another of the indigenous hunter-gatherer tribes of the Melbourne region in the mid-nineteenth century (see under *Paragathotanais wurundjeri* above) (noun in apposition).

*Remarks*. See above under *Remarks* for the genus. *Ozagathus watharongus* sp. nov. was collected frequently in the Eastern Bass Strait, at depths from 29 to 161 m on coarse or shelly sands.

Family **Akanthophoreidae** Sieg, 1986

Genus ***Gejavis*** gen. nov.

*Diagnosis of female*. Similar to *Akanthophoreus*, uropods biramous, endopod and exopod two-segmented; molar process tapering with several terminal spines; maxillule endite with nine distal spines; maxilliped basis naked; maxilliped palp article 2 with three inner plumose setae, outer margin naked, article 3 with three plumose and one simple inner setae; cheliped carpus without ventral shield but with rugose dorsla margin, propodus with coarse rugosity; pereopod 1 merus ventrodistally with one seta and one slender spine, carpus with dorsodistal seta, ventrodistally naked; dactyli without groove or small spines; pereopods 4 to 6, unguis of anterior pereopods much longer than dactylus; pereopods 4 to 6, carpus with three spines and one seta. Pleonites with long setae.

*Type species. Gejavis corsotos* sp. nov. by monotypy.

*Etymology*. Named cryptically after Dr Graham Gird (G J being his initials, and avis being Latin for a bird) for his invaluable contributions to tanaidacean taxonomy and phylogeny (female).

*Remarks*. The new species described below shows close affinities to *Akanthophoreus* Sieg, 1986 (see Bird, 2007, for diagnosis and discussion of that genus) and *Chauliopleona* Dojiri and Sieg, 1997, but is distinguished in the comparatively reduced spination of the merus and carpus of pereopod 1, in the simpler conformation of the dactyli of all pereopods, in having the uropod exopod longer than the proximal endopod segment, in the absence of a seta on the maxilliped basis and in the maxilliped palp setation. The new genus differs from *Paraleptognathia* Kudinova-Pasternak, 1981 in that the cheliped is rugose trather than setulose, and is without a ventrodistal carpal shield, pereopod 1 is without the complex spinulation of that genus, and again the conformation of the pereopod dactyli and the uropod rami are distinct. There remain some species currently assigned to *Leptognathia* Sars, 1882 with two-segmented uropod exopods which will presumably be reallocated once the confounded classification of this group of tanaidaceans is resolved better (*Leptognathia sensu stricto* is currently regarded as having a one-segmented uropod exopod, e.g. Larsen & Shimomura, 2007a); again, *Gejavis* gen. nov. is largely distinguished from those species by its pereopod 1 spination and uropod exopod conformation.

The rugosity of the cheliped in the present genus is also distinct from those of other akanthophoreids, although it is not possible at this stage to say whether this feature is a generic or specific characteristic.

Błażewicz-Paszkowycz and Bamber (2011) elevated Sieg's (1986a) subfamily Akanthophoreinae to familial rank to accommodate the genus *Akanthophoreus* (at least), as, despite this genus having its own higher taxon, being the type genus of that subfamily, it had been left unclassified ("Family *incertae sedis*") in a number of recent phylogenetic and taxonomic works on the genus (e.g. Larsen & Wilson, 2002; Bird, 2007). The new genus described here is clearly close to *Akanthophoreus*, and so is placed within the same Family.

***Gejavis corsotos*** sp. nov.

Figures 138–140

*Material examined*. 1 ♀ (J58562), holotype, CPBS 03S, Western Port off Crib Point, 38°21.65'S 145°15.21'E, 2 m depth, sandy-mud, 13 April 1965, Smith-McIntyre grab, coll. A. J. Gilmour; 1 ♀ (J23596), paratype, Stn MSL-EG 40, Eastern Bass Strait, 11.7 km W. of Pt Ricardo, 37°49.90'S 148°30.01'E, 29 m depth, sand-shell, 28 September 1990, R.V. Sarda, Smith-McIntyre Grab. 1 ♀ (J62057), paratype, Stn. BSS 31, Eastern Bass Strait, 22 km NNE of North Point, Flinders Island, 39°34.3'S 148°04.0'E, 37 m depth, coarse sand, 26 March 1979, dredge, coll. G.C.B. Poore. 1 ♀ (J56376), paratype (dissected), Stn MSL-EG 69, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, 37°51.7'S 148°14.6'E, 37 m depth, 04 June 1991, coll. N. Coleman, Smith-McIntyre Grab.

*Description of female*. Body (Fig. 138A, B) elongate, slender, 2.4 mm long, nine times as long as wide. Cephalothorax subrectangular, tapering from mid-length towards anterior, 1.4 times as long as wide, with slight rounded rostrum, naked; eyes absent. Six free cylindrical pereonites; pereonites 1 to 5 about as long as wide, subequal in length and 0.6 to 0.7 times as long as cephalothorax; pereonite 6 shortest, less than half as long as cephalothorax and 1.3 times as wide as long. All pleonites bearing pleopods, each pleonite with one midlateral seta on each side. Pleotelson rounded, almost three times as long as pleonite 5, 1.3 times as wide as long, with paired distal and laterodistal setae.

Antennule (Fig. 139A) of four articles, proximal article 1.9 times as long as wide, 0.6 times as long as last three articles together, with mesial and distal outer tufts of penicillate setae and single inner and outer simple distal setae; second article 1.6 times as long as wide, 0.7 times as long as first article, with one outer distal penicillate seta and single inner and outer simple distal setae; third article half length of second with one outer distal penicillate seta and single inner and outer simple distal setae; distal article more slender, 1.6 times as long as third article, with three simple and one penicillate distal setae and single aesthetasc.

Antenna (Fig. 139B) of six articles, proximal article naked; second article slightly inflated with one small dorsodistal seta; third article half length of second article, with single dorsodistal seta three-times as long as article; fourth article longest, as long as articles 1 to 3 together and 3.5 times as long as wide, with four distal penicillate setae and single simple distal seta exceeding tip of antennule; fifth article 0.4 times as long as fourth, with one distal seta; sixth article 0.25 times as long as fifth, with four distal setae.

Labrum (Fig. 139C) apically blunt, finely setose. Left mandible not recovered; right mandible (Fig. 139D) with bilobed pars incisiva, pars molaris basally stout, tapering, with

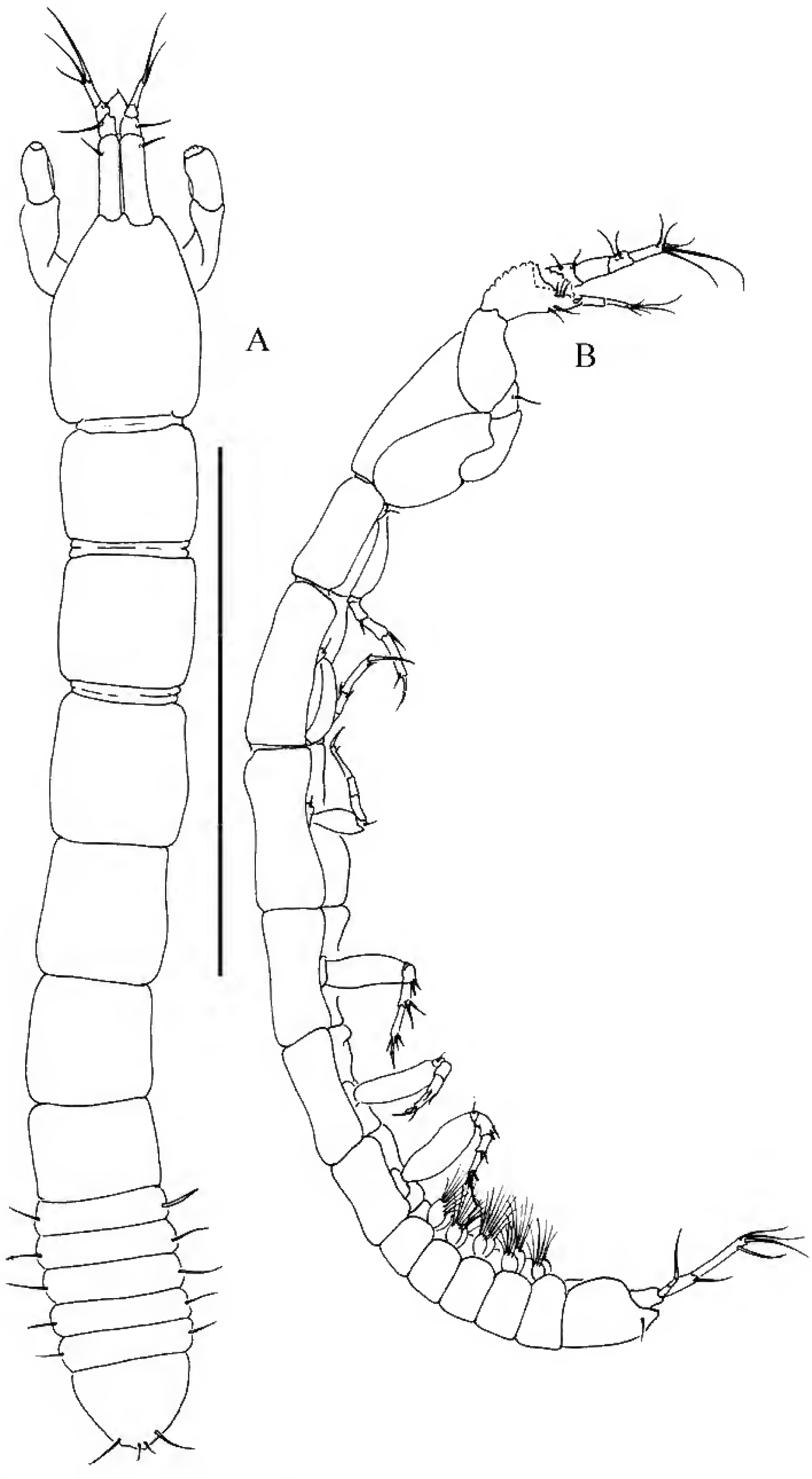


Fig. 138. *Gejavis corsotos* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.

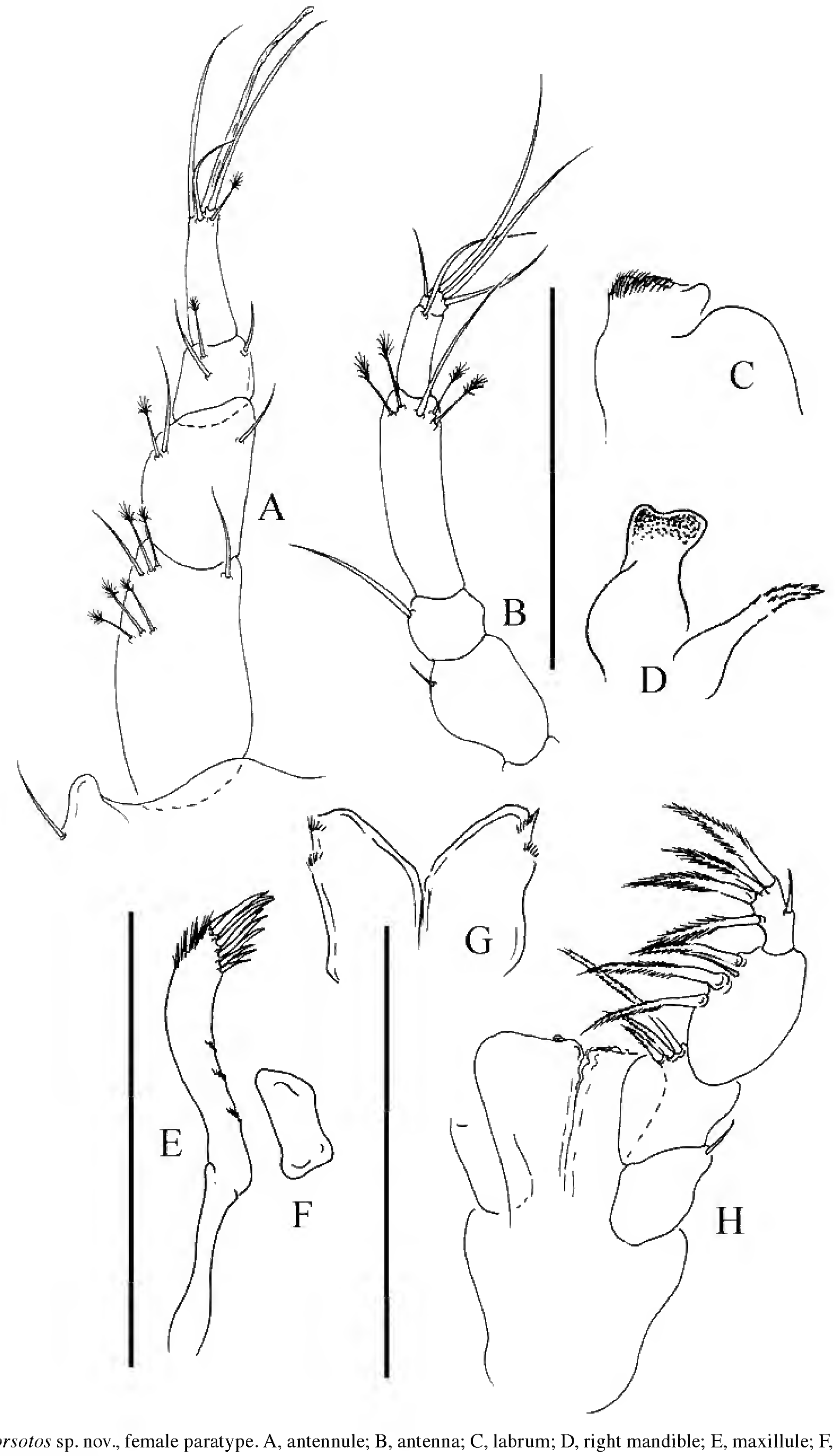


Fig. 139. *Gejavis corsotos* sp. nov., female paratype. A, antennule; B, antenna; C, labrum; D, right mandible; E, maxillule; F, maxilla; G, labium; H, maxilliped. Scale = 0.1 mm.

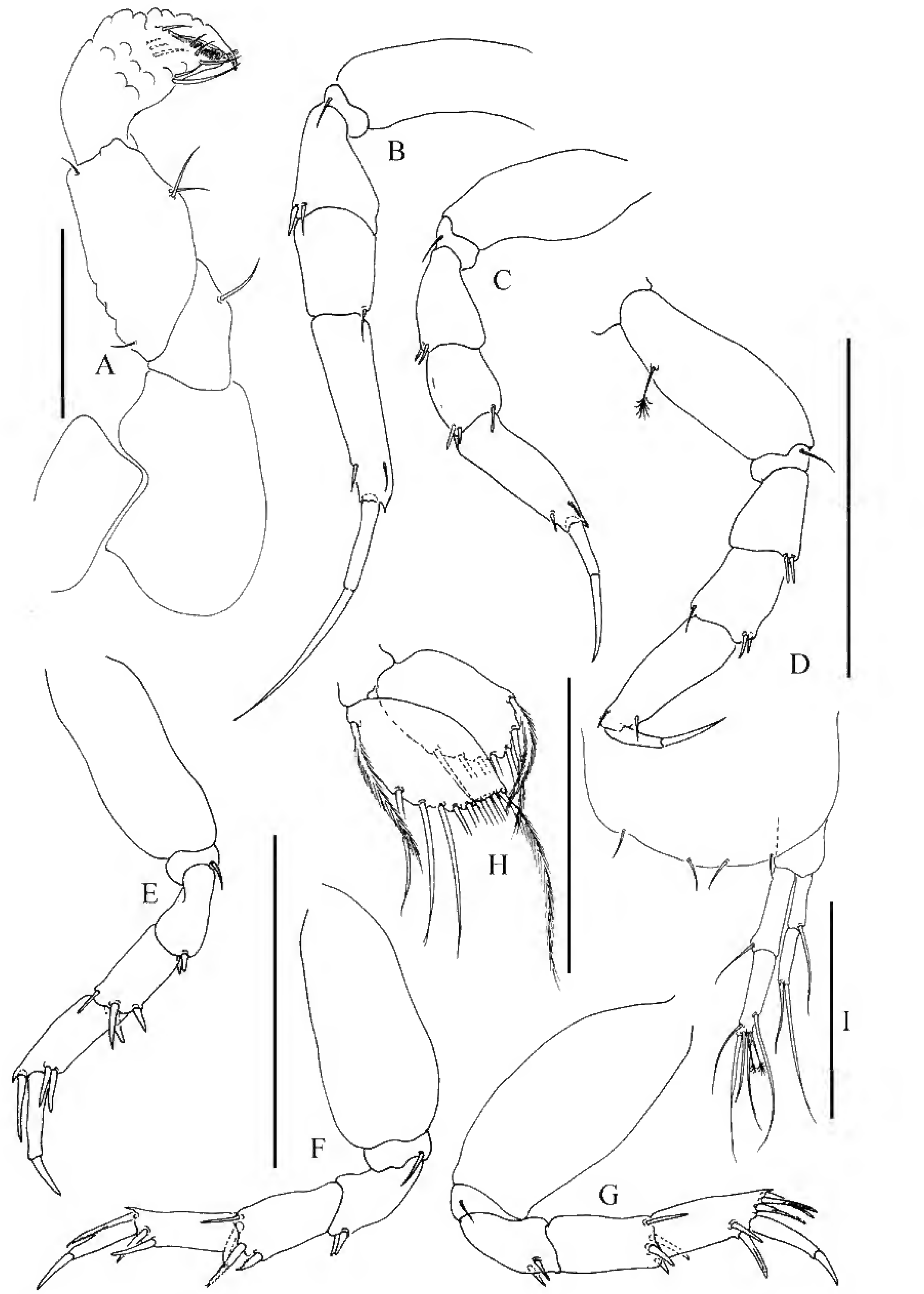


Fig. 140. *Gejavis corsotos* sp. nov., female paratype. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

several distal spinules. Labium (Fig. 139G) with outer distal and subdistal microtrichia. Maxillule (Fig. 139E) with nine distal spines and outer brush of setules, palp damaged. Maxilla (Fig. 139F) quadrangular, simple, naked. Maxilliped (Fig. 139H) endites each with inner-distal rounded tubercle and slightly crenulated distal margin; palp first article with outer distal seta, second and third articles with three inner plumose setae, third article with additional inner simple seta; fourth article with one inner and three distal plumose setae and one outer simple seta; basis naked. Epignath not recovered.

Cheliped (Fig. 140A) basis with large posterior lobe, wider proximally and extended past anterior margin of pereonite 1 ventrally, about 1.8 times as long as wide; merus subtriangular with one mid-ventral seta; carpus twice as long as wide with paired mid-ventral setae and no shield, proximal and distal single dorsal setae, proximal half of dorsal margin coarsely rugose; propodus longer than wide, with coarse rugosity over outer face and along dorsal margin; inner comb-row of three setae; fixed finger short with lamellate cutting edge, two ventral and three inner setae; dactylus with dorsal margin coarsely rugose, cutting edge naked.

Pereopod 1 (Fig. 140B) basis damaged in preparation, curved, about 3.5 times as long as wide; ischium compact with single seta; merus just shorter than carpus with single ventrodistal seta and spine; carpus with dorsodistal seta; propodus 1.9 times as long as carpus, with single dorsal and ventral subdistal setae; dactylus half as long as slender unguis, both together 1.4 times as long as propodus. Pereopod 2 (Fig. 140C) similar to but shorter than pereopod 1; basis 2.5 times as long as wide; merus as long as carpus and with two ventrodistal spines; carpus with one dorsal and two ventral distal spines; unguis 1.7 times as long as dactylus, both together 0.7 times as long as propodus. Pereopod 3 (Fig. 140D) as pereopod 2, but basis with dorsoproximal penicillate seta.

Pereopod 4 (Fig. 140E) basis 2.8 times as long as wide; ischium with one ventral seta; merus wider distally, 0.4 times as long as basis, with two ventrodistal spines; carpus 0.9 times as long as merus, with fine dorsodistal spines and three stouter mid- and ventrodistal spines; propodus with one longer dorsodistal and two shorter ventrodistal spines, all shorter than dactylus; dactylus twice as long as unguis, both together 1.4 times as long as propodus. Pereopod 5 (Fig. 140F) as pereopod 4, but basis broader, 2.4 times as long as wide, and dorsodistal spine on [propodus as long as dactylus. Pereopod 6 (Fig. 140G) as pereopod 5, but propodus with three dorsodistal spines.

Pleopods (Fig. 140H) all alike, with naked basis; endopod shorter than exopod and with seven mainly distal plumose setae; exopod with ten distal and outer plumose setae, proximal seta on ventral margin well-separated from remaining setae, most setae about as long as rami.

Uropod (Fig. 140I) basis naked; exopod of two subequal segments, longer than proximal endopod segment, proximal segment with one distal seta, distal segment with two unequal distal setae; endopod of two subequal segments, proximal segment with one seta, distal segment with one subdistal and four distal simple setae and two distal penicillate setae.

*Male.* Unknown.

*Etymology.* From the Greek *korsotos* – “shorn”, referring to the relative lack of spines or setae on pereopod 1 of the present species.

*Remarks.* See above under *Remarks* for the genus. *Gejavis corsotos* sp. nov. was taken from sandy substrata at 2 to 37 m depth, in Western Port and the Eastern Bass Strait.

Family **Tanaopsidae** fam. nov.

*Diagnosis.* Generally leptognathioid (*sensu lato*) facies, pleon laterally convex and wider than pereon, antennule in female of four longer articles with or without minute distal article, in male with multisegmented flagellum; mandible pars incisiva distally rounded with adjacent serrated incisive margin, molar process either slender and pointed or absent; maxillule endite reflexed through about 90° and with five or six distal spines, one significantly more robust than the others; maxilliped endite flared. Cheliped with triangular, dorsally-inserted sclerite, fixed finger with two ventral setae, bifid terminal spine and bifid or trifid distal denticle on incisive margin. Pereopods 1 to 3 with setae, unguis longer than slender dactylus, both together about as long as or longer than propodus, dactylus with proximal seta; pereopods 4 to 6 with spines on merus, carpus (three in number) and propodus. Pleopods with plumose seta along entire outer margin of exopod, but restricted to distal half of outer margin of endopod; uropods biramous, rami with one or two segments.

*Type genus*: *Tanaopsis* Sars, 1896

*Remarks.* The present suprageneric classification of the Paratanaoidea is in a state of flux, owing to recent attempts at phylogenetic resolution involving cladistics, based on meristics and morphometrics (Larsen & Wilson, 2002; Błażewicz-Paszkowycz & Poore, 2008; Bird & Larsen, 2009). The only of these studies to consider the genus *Tanaopsis* were Larsen & Wilson (2002) and Błażewicz-Paszkowycz & Poore (2008), but they were unable to resolve it to a family as defined by their generated clades.

The diagnostic features listed above taken together distinguish members of the genus *Tanaopsis* from all other paratanaoid genera of the leptognathioid *sensu lato* facies; that said, they constitute a diagnosis of the genus itself. Equally, exclusion of the unique features of the cheliped fixed finger does not allow inclusion of any other genera. Further detailed cladistic analyses may associate other genera, which would then require qualifying the familial diagnosis above, removing characters not consistent across all associated genera into the diagnosis of the genus *Tanaopsis*. Bird (2011) suggests possible affinities with *Cristatotanais* Kudinova-Pasternak, 1990 (including *Spinitanaopsis* Larsen, 2005).

It is further the case that *Tanaopsis* itself may not be monophyletic. There appear to be two groups of species, one with a pointed mandibular molar process and two-segmented uropod rami (*T. antarcticus* Lang, 1967; *T. cadieni* Sieg & Dojiri, 1991; *T. curtus* Kudinova-Pasternak 1984; *T. gallardoi* (Shiino, 1970); *T. profunda* Lang, 1967; *T. canaipa* Bamber, 2008 and one of the two species described below), the other without a molar process and with one-segmented uropod rami

(*T. chotkarakde* Bird & Bamber, 2000; *T. kerguelenensis* Shiino, 1979 [mandible unknown]; and one of the two species described below); the latter group also tend to have a more slender antennule. That said, *T. laticaudata* Sars, 1882 is described as being without a mandibular molar (Sars, 1896), but has two-segmented uropod rami. It is at present not possible to distinguish such groups as separate genera, as the type species of *Tanaopsis sensu stricto*, *T. graciloides* (Lilljeborg, 1864) needs proper redescription based on material from the northwest Atlantic (see Bamber *et al*., 2009).

Genus ***Tanaopsis*** Sars, 1896

***Tanaopsis boonwurrungi*** sp. nov.

Figures 141–143

*Material examined*. 1 ♀ (J57793), holotype, 1 ♀ (J58563), paratype, dissected, Western Port, off Crib Point, Stn CPBS-N 03, 38°20.57'S 145°15.08'E, 2 m depth, fine sand, 05 April 1965; 1 ♀ (J57792), paratype, Western Port, off Crib Point, Stn CPBS 31N, 38°20.93'S 145°13.62'E, 15 m depth, fine sand with mud, 29 March 1965; all coll. A.J. Gilmour.

*Description of female*. Body (Fig. 141) slender with widened pleon, holotype 3 mm long, 8.7 times as long as wide. Cephalothorax pear-shaped, widest and laterally-rounded posteriorly, tapering towards anterior with slight rounded rostrum, as long as maximum width, shorter than pereonites 1 and 2 together, naked; eyelobes present, eyes apparently absent in preserved material. Pereonite 1 shortest, 0.4 times as long as cephalothorax, laterally convex; pereonite 2 nearly twice as long as pereonite 1, laterally convex; pereonite 3 (and subsequent pereonites) with parallel sides, 2.5 times as long as pereonite 1; pereonite 4 longest, longer than wide and 3.2 times as long as pereonite 1; pereonite 5 just shorter than pereonite 4, pereonite 6 just longer than pereonite 2 (all pereonites respectively 2.3, 1.4, 1.0, 0.8, 0.9 and 1.2 times as wide as long). Pleon with five free pleonites bearing pleopods; first pleonite trapezoidal, longest, as long as pereonite 1 and 2.7 times as long as wide; each remaining pleonite 0.8 times as long as first pleonite and 3.9 times as wide as long. Pleotelson pentangular, one-quarter length of pleon and 1.7 times as wide as long, with two slender distal spines.

Antennule (Fig. 142A) of five articles (four longer articles plus minute distal article), proximal article 2.1 times as long as wide, just shorter than distal four articles together, outer margin with tufts of three penicillate setae at mid-length and two penicillate and one simple setae distally; second article as long as wide, 0.35 times as long as first article, distally with single inner and outer simple setae and three penicillate setae; third article compact, 0.7 times as long as second article, distally with single inner and outer simple setae; fourth article tapering, nearly twice as long as third article, with single simple distal seta; fifth article (Fig. 142A') minute, with aesthetasc and four simple and one penicillate distal setae.

Antenna (Fig. 142B) of six articles, proximal two articles not recovered; third article longer than wide, with fine dorsodistal seta longer than article and distal microtrichia; fourth article longest, 2.7 times as long as third article, 4.5 times as long as wide, slightly curved, with three simple and three penicillate distal setae; fifth article as long as third with one distal seta; sixth article minute with five distal setae.

Labrum not recovered. Mandibles (Fig. 142C) without lacinia mobilis or pars molaris, pars incisiva with saw-like row of denticulations and rounded distal apophysis, larger on right mandible. Labium (Fig. 142F) with prominent, finely setulose mediodistal processes. Maxillule (Fig. 142D) with five finely-denticulate distal spines, one stouter than the others, and outer tufts of setules, palp not recovered. Maxilla (Fig. 142E) linguiform but basally cupped, with fine marginal setules. Maxilliped palp (Fig. 142G) first article naked, second article with one outer and one inner distal setae; third article with four slender and curved inner setae; fourth with five distal setae and one outer subdistal seta; basis with single seta reaching distal margin of proximal palp article; endite distally naked. Epignath (Fig. 142H) elongate, linguiform, naked.

Cheliped (Fig. 143A) basis 1.6 times as long as wide, naked; merus subtriangular with single ventral seta; carpus stout, 1.2 times as long as wide, with two midventral setae, one mid-dorsal and one dorsodistal setae; propodus stout, as long as wide, fixed finger 0.6 times as long as palm, with two ventral setae, three setae on cutting edge, distal claw with typical inner and outer bifurcate apophyses; dactylus dorsally finely crenulate, with slender spinules along cutting edge and fine proximal seta.

Pereopod 1 (Fig. 143B) longer than others, coxal apophysis (Fig. 143B') large, pointed, with seta; basis slender, 5.7 times as long as wide, naked; ischium compact, naked; merus 0.7 times as long as carpus, wider distally, naked; carpus with single dorsal and ventral distal setae; propodus 1.7 times as long as carpus, with three dorsal subdistal setae, one ventral subdistal seta; dactylus half as long as unguis, unguis slender and as long as propodus. Pereopod 2 (Fig. 143C), coxa rounded with seta; basis 4.3 times as long as wide; ischium with seta; merus 0.7 times as long as carpus, with single ventrodistal seta; carpus with two dorsal and one ventral distal setae; propodus 2.2 times as long as carpus, with two dorsal subdistal setae, one ventral subdistal seta; slender unguis longer than dactylus, both together 1.2 times as long as propodus. Pereopod 3 (Fig. 143D) similar to pereopod 2.

Pereopod 4 (Fig. 143E) basis stout, 2.1 times as long as wide, naked; ischium with two ventrodistal setae; merus as long as carpus, with ventral field of microtrichia and two small distally-denticulate ventrodistal spines; carpus with one dorsodistal seta and three small distally-denticulate ventrodistal spines; propodus 1.6 times as long as carpus, with fields of microtrichia, mid-dorsal penicillate seta, one dorsodistal and two ventrodistal spines all distally finely denticulate; dactylus slender, with fields of microtrichia, 1.5 times as long as unguis, both together 0.9 times as long as propodus. Pereopod 5 (Fig. 143F) as pereopod 4, but basis with two ventral penicillate setae. Pereopod 6 (Fig. 143G) as pereopod 4, but propodus with three dorsodistal spines.

Pleopods (Fig. 143H) all alike, with naked basis, endopod shorter than exopod and with rounded proximal apophysis on inner margin; endopod with inner subdistal plumose seta and 14 plumose setae along the distal half of the outer margin, exopod without setae on inner margin, outer margin with 27 plumose setae, proximal setae on rami not separated from others.

Uropod (Fig. 143I) biramous, basis naked; exopod and endopod each of one segment, exopod shorter than endopod, with one fine proximal, one shorter and one longer distal setae; endopod with distal penicillate seta on first segment and five simple and one penicillate distal setae on second segment.

*Male.* Unknown.

*Etymology.* The Boonwurrung were another of the indigenous hunter-gatherer tribes of the (now) Melbourne region in the mid-nineteenth century (see under *Paragathotanais wurundjeri* above).

*Remarks.* Sieg and Dojiri (1991) gave a key to the genus *Tanaopsis* for the species then known, in which the present species keys out to the generotype, *T. graciloides* with which they included *T. laticaudata* as a synonym (as had most previous authors). Bamber *et al.* (2009) cast doubt on this synonymy, maintaining the distinction of Sars' Mediterranean species from Lilljeborg's Northeast Atlantic-Subarctic species until a proper redescription of the latter was undertaken; all descriptions and figures referred to in the recent literature for *T. graciloides*, including by Sieg and Dojiri (1991) are from Sars (1882). Bird & Bamber (2000), while describing as new *T. chotkarakde*, also added *T. gallardoi* to the genus. Since then, the only new *Tanaopsis* species that have been described are *T. canaipa* from Queensland and *T. rawhitia* Bird, 2011 from New Zealand.

*Tanaopsis boonwurrungi* sp. nov. shares the lack of a molar process on the mandible only with *T. graciloides/ laticaudata* and *T. chotkarakde*, and possibly *T. kerguelenensis* (mandible not described, but a species also with one-segmented uropodal rami). *T. boonwurrungi* is immediately distinguished from all of these taxa by its distinctly more slender habitus, with pereonites 4 and 5 longer than wide, and a much more slender cheliped, while *T. chotkarakde* has a lacinia mobilis on the left mandible, and the two European taxa have a two-segmented uropod exopod.

The small distal article on the antennule has only been reported before for a *Tanaopsis* species by Bird (2011), who noted its presence in *T. rawhitia*. While such an article does not appear to have been present in some other more recently or better-described species, viz. *T. kerguelenensis*, *T. cadieni*, *T. chotkarakde* or *T. canaipa*, the possibility of its having been overlooked in some of the earlier descriptions cannot be dismissed.

*Tanaopsis boonwurrungi* was taken only in Western Port at 2 to 15 m depth on fine sand.

***Tanaopsis oios*** sp. nov.

Figures 144–145

*Material examined.* 1 ♀ (J58547), holotype (on microscope slide), 1 further ♀ (lost), Eastern Bass Strait, 28 km SSW of Marlo, Stn BSS 207, 37°59'S 148°27'E, 51 m depth, muddy sand and fine shell, 30 July 1983; coll. M.F. Gomon & R.S. Wilson.

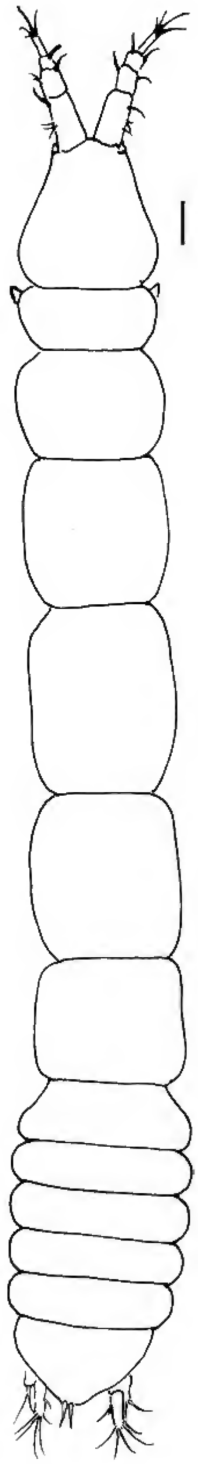

Fig. 141. *Tanaopsis boonwurrungi* sp. nov., female holotype, dorsal view. Scale = 0.1 mm.

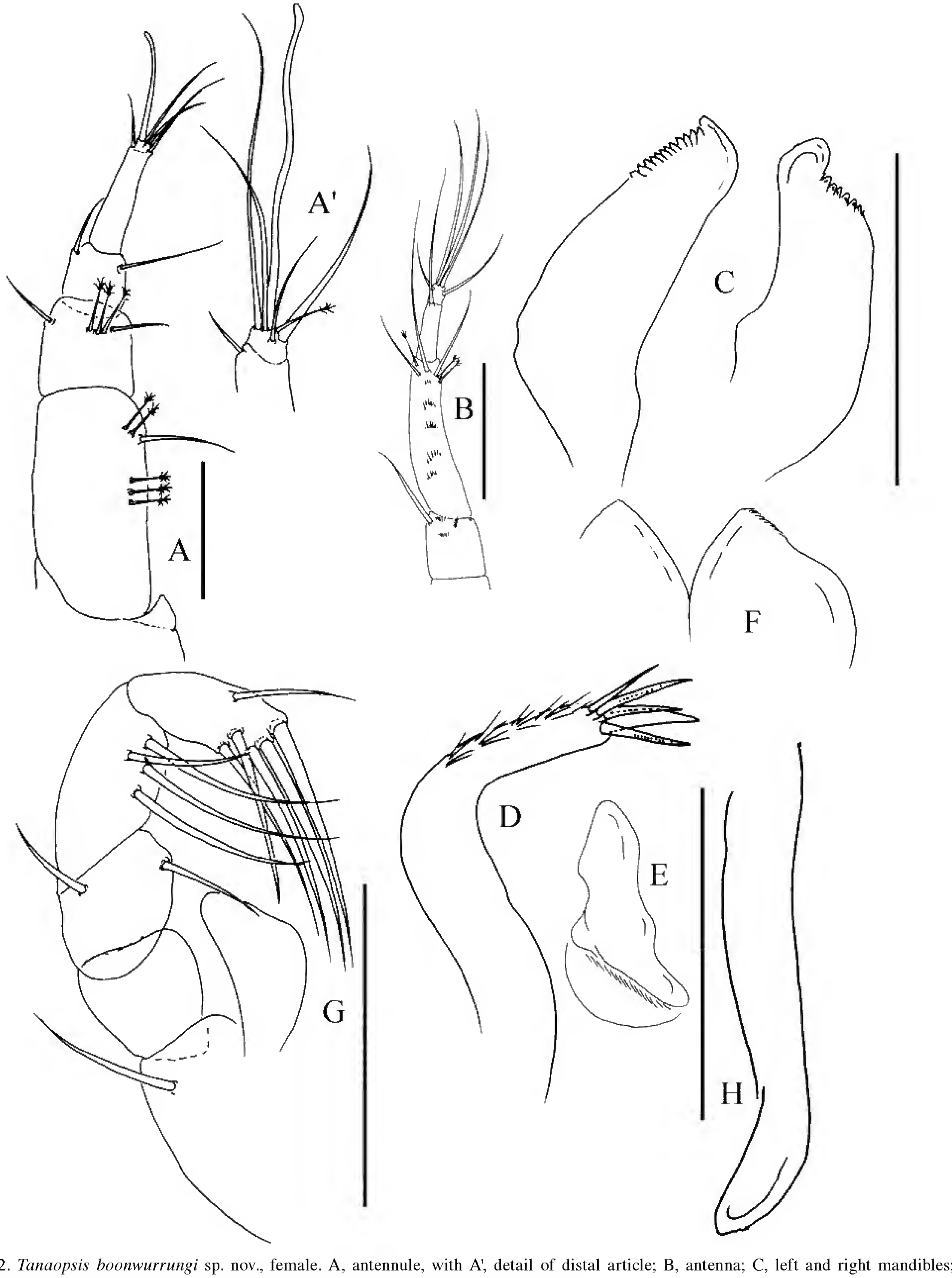


Fig. 142. *Tanaopsis boonwurrungi* sp. nov., female. A, antennule, with A', detail of distal article; B, antenna; C, left and right mandibles; D, maxillule endite; E, maxilla; F, labium; G, maxilliped; H, epignath. Scale line = 0.1 mm.

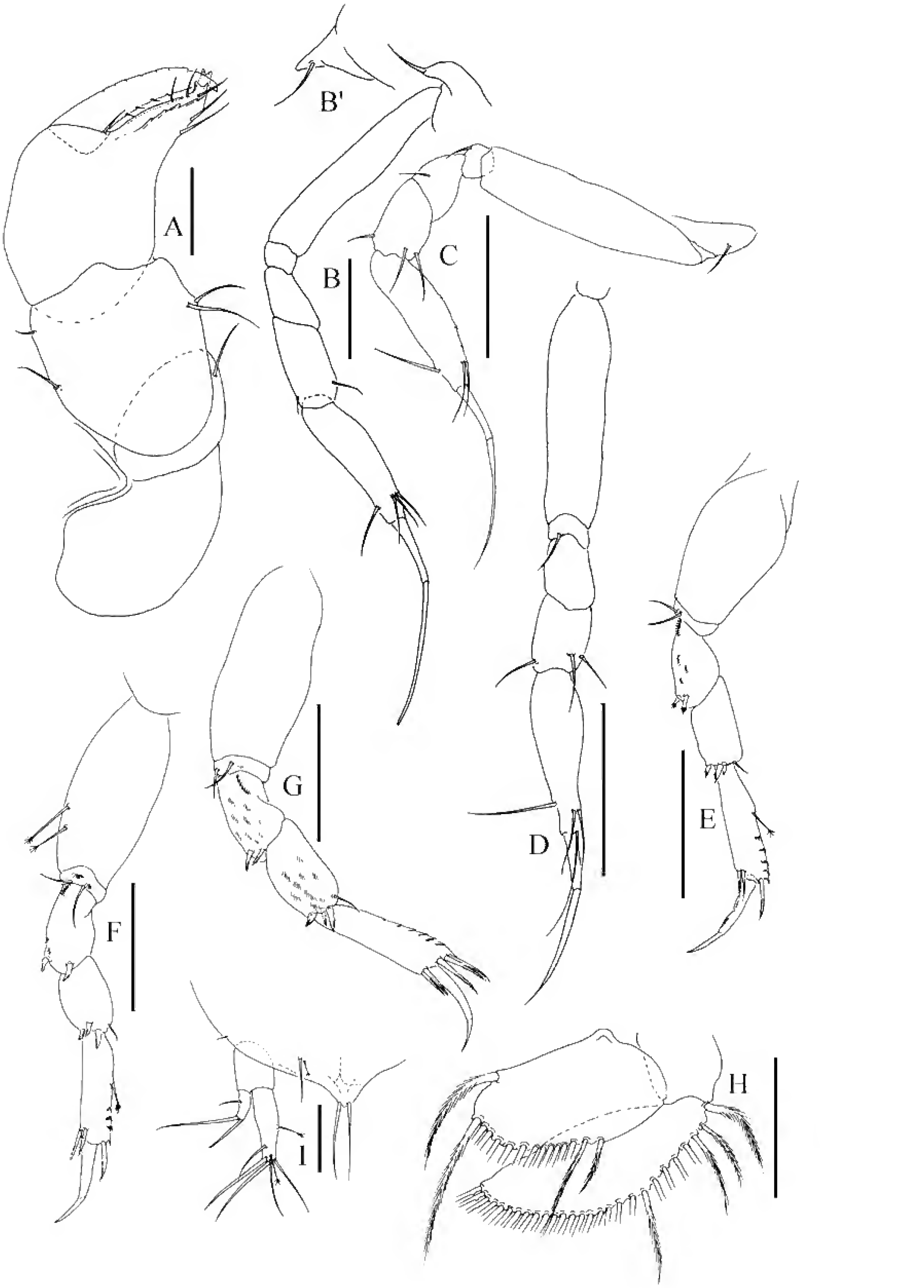


Fig. 143. *Tanaopsis boonwurrungi* sp. nov., female. A, cheliped; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4; F, pereopod 5; G, pereopod 6; H, pleopod; I, uropod. Scale = 0.1 mm.

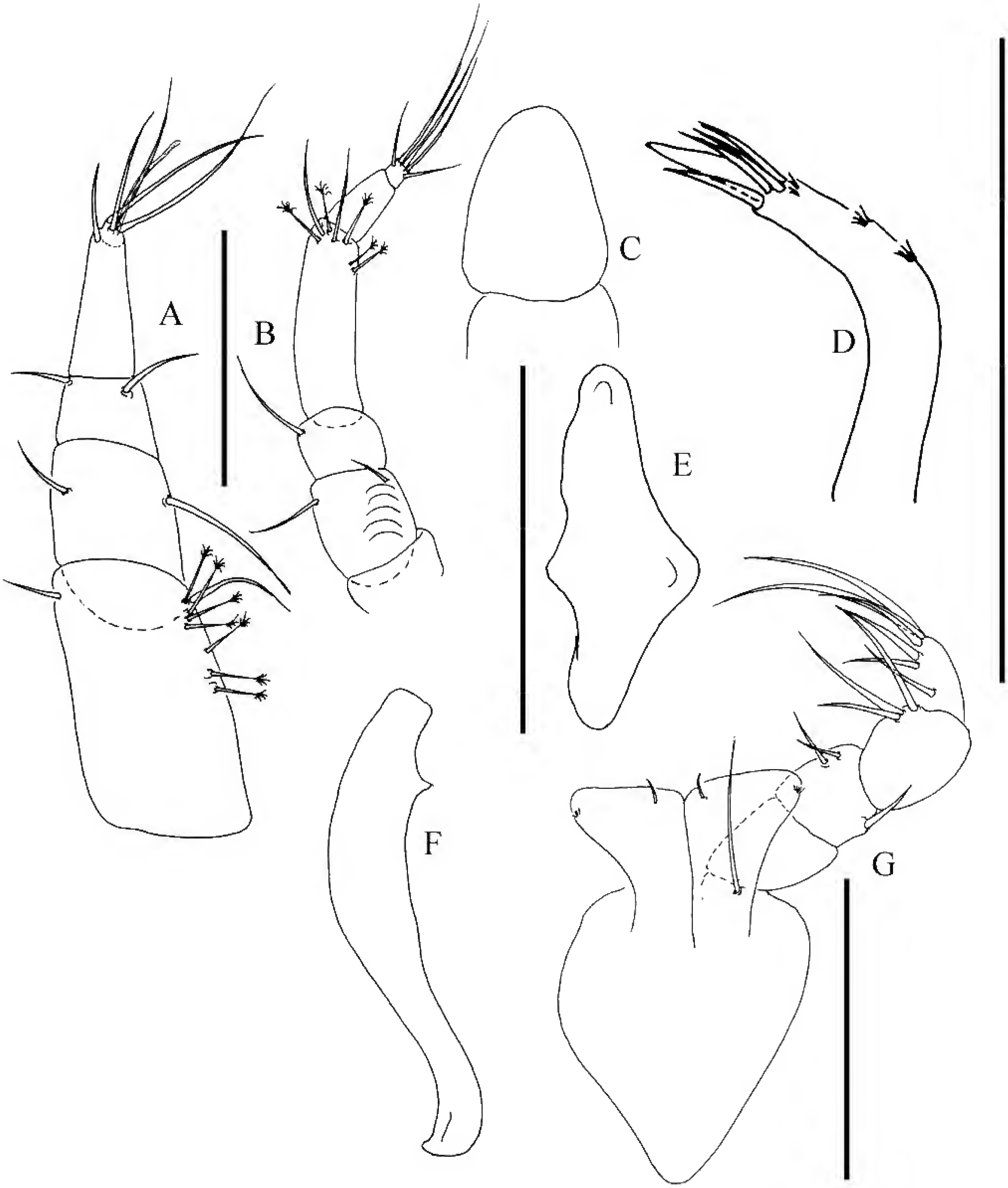


Fig. 144. *Tanaopsis oios* sp.nov. A, antennule; B, antenna; C, labrum; D, maxillule endite; E, maxilla; F, epignath; G, maxilliped. Scale = 0.1 mm.

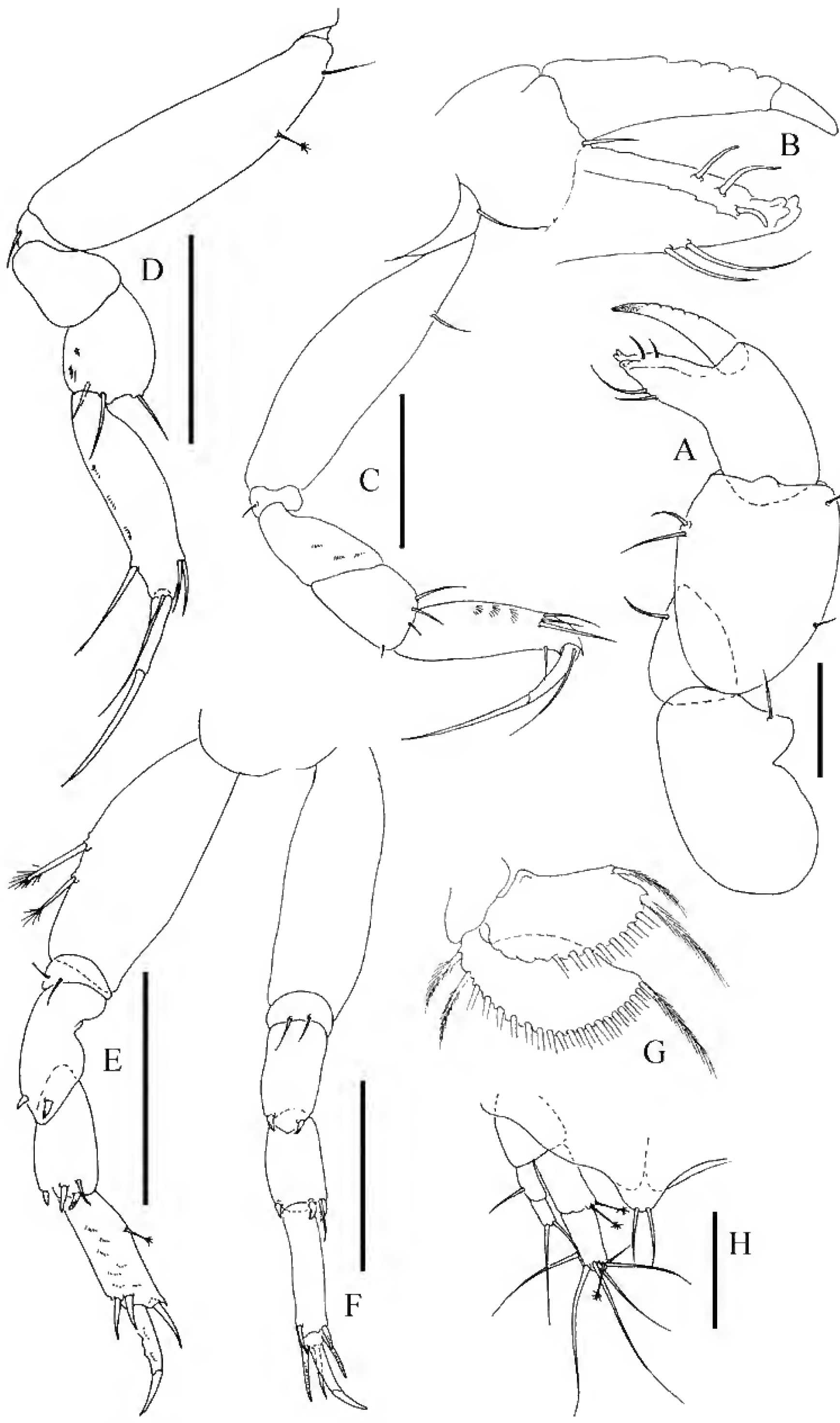


Fig. 145. *Tanaopsis oios* sp.nov. A, cheliped; B, detail of chela; C, pereopod 1; D, pereopod 2; E, pereopod 5; F, pereopod 6; G, pleopod; H, uropod. Scale = 0.1 mm.

*Description of female*. Body slender with widened pleon, typical for the genus but damaged (not figured).

Antennule (Fig. 144A) of four longer articles but with incipient articulation of minute distal article, proximal article 1.9 times as long as wide, three-quarters as long as distal three articles together, outer margin with tufts of three penicillate setae at mid-length and four penicillate and one simple setae distally, inner margin with simple distal seta; second article 1.25 times as long as wide, 0.6 times as long as first article, subdistally with single inner and outer simple setae; third article compact, 0.4 times as long as second article, distally with single inner and outer simple setae; fourth article tapering, 2.4 times as long as third article, with single simple subdistal seta and four simple distal setae.

Antenna (Fig. 144B) of six articles, proximal article compact, naked; second article as long as wide, 2.5 times as long as first article, with single dorsodistal and ventrodistal setae and microtrichia; third article shorter than wide, 0.6 times as long as second article, with fine dorsodistal seta longer than article; fourth article longest, three times as long as third article, three times as long as wide, slightly curved, with two simple and five penicillate distal setae; fifth article just longer than third, naked; sixth article minute with five distal setae.

Labrum (Fig. 144C) acorn-shaped, naked. Mandibles and labium not recovered. Maxillule (Fig. 144D) with five distal spines, one stouter than the others, and outer tufts of setules, palp not recovered. Maxilla (Fig. 144E) linguiform but medially expanded, naked. Maxilliped palp (Fig. 144F) first article naked, second article with one outer and two inner distal setae; third article with three inner distal setae; fourth with six inner to distal setae, distal two much longer than the others; basis seta not seen; endite distally with inner seta and setules below outer corner. Epignath (Fig. 144G) elongate, linguiform, distally hooked, naked.

Cheliped (Fig. 145A) with rounded basis 1.9 times as long as wide, single dorsodistal seta; merus subtriangular with single ventral seta; carpus stout, 1.4 times as long as wide, with two midventral setae, one mid-dorsal and one dorsodistal setae; propodus stout, 1.5 times as long as wide, fixed finger 0.7 times as long as palm, with two ventral setae, three setae on cutting edge, distal claw with typical inner and outer bifurcate rounded apophyses (Fig. 145B); dactylus dorsally coarsely crenulate.

Pereopod 1 (Fig. 145C) without coxal apophysis, coxa with seta; basis 3.6 times as long as wide, with dorsoproximal simple seta; ischium compact, with ventral seta; merus one-third as long as basis, wider distally, with sparse microtrichia; carpus 0.9 times as long as merus, with three dorsal and single ventral distal setae; propodus 1.9 times as long as carpus, with three dorsal subdistal setae, one ventral subdistal seta, sparse dorsal microtrichia and dorsodistal spine-like apophysis; dactylus with longer proximal seta, half as long as slender unguis, both together 1.3 times as long as propodus. Pereopod 2 (Fig. 145D) basis 3.5 times as long as wide, dorsally with one simple seta and one penicillate seta in proximal half; ischium with seta; merus as long as carpus, naked; carpus with two dorsal and one ventral distal setae and sparse microtrichia; propodus 2.4 times as long as carpus, with two dorsal subdistal setae, one longer ventral subdistal seta exceeding tip of dactylus, and sparse microtrichia; dactylus with longer proximal seta, slender unguis 1.7 times as long as dactylus, both together as long as propodus. Pereopod 3 (not figured) similar to pereopod 2.

Pereopod 4 similar to pereopod 5, but basis without penicillate setae. Pereopod 5 (Fig. 145E) basis relatively stout, 2.3 times as long as wide, with two midventral penicillate setae; ischium with two ventrodistal setae; merus, carpus and propodus subequal in length; merus with two small distally-denticulate ventrodistal spines; carpus with one inner distal seta and three small distally-denticulate ventrodistal spines; propodus with fields of microtrichia, mid-dorsal penicillate seta, one dorsodistal and two ventrodistal spines finely denticulate in distal half; dactylus with fields of microtrichia, 1.5 times as long as unguis, both together 0.9 times as long as propodus. Pereopod 6 (Fig. 145F) as pereopod 5, but basis without penicillate setae, propodus with three dorsodistal spines.

Pleopods (Fig. 145G) all alike, with naked basis, endopod shorter than exopod and with rounded proximal apophysis on inner margin; endopod with inner subdistal plumose seta and nine outer plumose setae in distal half; exopod without setae on inner margin, outer margins with 21 plumose setae, proximal seta not separated from others.

Uropod (Fig. 145H) biramous, basis naked; exopod and endopod each of two subequal segments; exopod distinctly longer than proximal endopod segment, proximal segment with one and distal segment with one shorter and one longer distal setae; endopod with two distal penicillate setae on first segment and five simple and one penicillate distal setae on second segment.

*Male*. Unknown.

*Etymology*. From the Greek *oios* – alone, singular, as only one specimen from a remote part of the Bass Strait remains.

*Remarks*. Of the previously-described species of *Tanaopsis* with two clear segments in both uropod rami, only three have the uropod exopod exceeding the length of the proximal endopod segment. In comparison with *T. oios* sp. nov., *T. graciloides sensu* Lang, 1967 has a much less slender cheliped basis, the rugosity on the cheliped dactylus not restricted to the distal half; a more slender antennal article 4, and fewer distal setae on anterior pereopod carpi. *T. laticaudata* has a more compact cheliped carpus, the rugosity of the cheliped dactylus more extensive, fewer distal setae on anterior pereopod carpi, and is without the long ventral seta on the propodus of pereopod 2. *T. cadieni* has a more slender antennal article 4, has a triangular coxal apophysis on pereopod 1, and is without the long ventral seta on P2 propodus.

*T. oios* was only found in the Eastern Bass Strait to the east of the Gippsland Lakes, at 51 m depth on shelly muddy sand.

Family **Colletteidae** Larsen & Wilson, 2002

Genus ***Parafilitanais*** Kudinova-Pasternak, 1989

***Parafilitanais vadosus*** sp. nov.

Figures 146–148

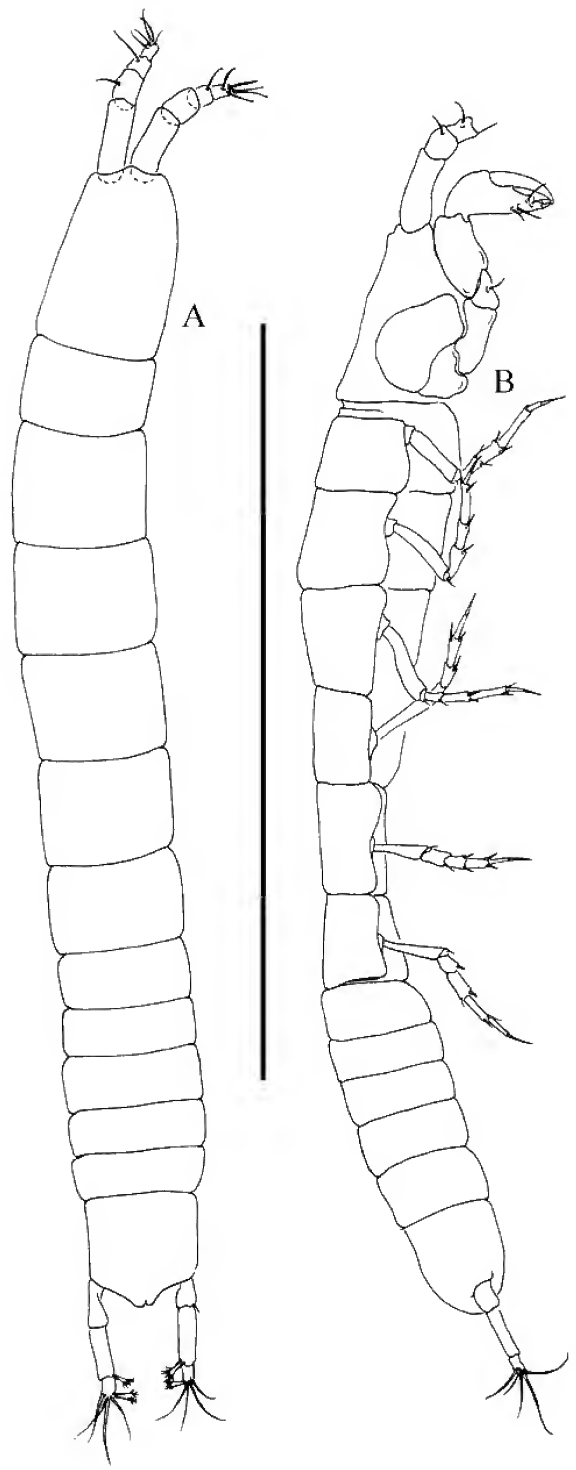


Fig. 146. *Parafilitanais vadosus* sp. nov., female holotype. A, dorsal view; B, lateral view. Scale = 1 mm.

*Material examined.* 1 ♀ (J56378), holotype, Stn MSL-EG 41, Eastern Bass Strait, 11.7 km W of Pt Ricardo, 37°49.90'S 148°30.02'E, 29 m depth, 28 September 1990, coll. Marine Sciences Laboratory. Smith-McIntyre grab. 1 ♂ (J28486), paratype dissected, Stn MSL-EG 113, Eastern Bass Strait, 2.9 km SE. of Cape Conran, 37°50.00'S 148°36.90'E, 29 m depth, coarse sand, February 1991, coll. N. Coleman, Smith-McIntyre grab. 1 ♀ (J56375), paratype, Stn MSL-EG 29, Eastern Bass Strait, 10.4 km ESE of eastern edge of Lake Tyers, 37°52.52'S 148°12.55'E, 38 m depth, 25 September 1990, coll. Marine Sciences Laboratory. Smith-McIntyre grab.

*Description of female* (Fig. 146A, B). Body slender, holotype 1.45 mm long, nearly nine times as long as wide. Cephalothorax subrectangular, slightly narrower anteriorly with slight triangular rostrum, as long as wide, about as long as pereonites 1 and 2 together, naked, eyes absent. Pereonites 1 and 6 shortest, 0.43 times as long as cephalothorax; pereonites 2 to 5 subequal, pereonite 2 slightly longest, 1.4 times as long as cephalothorax, (all pereonites respectively 1.6, 1.2, 1.3, 1.3, 1.3 and 1.6 times as wide as long). Pleon with five free subequal cylindrical pleonites without pleopods; each pleonite 2.7 times as wide as long. Pleotelson pentangular, one-third length of pleon and as wide as long, with blunt distal apex.

Antennule (Fig. 147A) of four articles, proximal article just over twice as long as wide, just shorter than distal three articles together, with simple distal seta; second article about 1.3 times as long as third article, with one simple and two penicillate outer distal setae; third article with two simple inner distal setae; fourth article 1.4 times as long as third, with five simple and two penicillate distal setae.

Antenna (Fig. 147B) of six articles, proximal article compact, naked, fused to cephalothorax; second article stout, as long as wide, with dorsodistal seta; third longer than wide, with fine dorsodistal seta; fourth article longest, three times as long as third article, 5.4 times as long as wide, curved, with two simple and four penicillate distal setae; fifth article 0.3 times as long as fourth with one distal seta; sixth article minute with four distal setae.

Labrum not recovered. Left mandible (Fig. 147C) with subtriangular, crenulate pars incisiva and linguiform, crenulate lacinia mobilis, right mandible (Fig. 147D) without lacinia mobilis; pars molaris of both mandibles tapering abruptly with fine tooth-like protrusions around distal margin. Labium (Fig. 147F) simple, distally slender, naked. Maxillule (Fig. 147E) with nine finely-denticulate distal spines, palp not recovered. Maxilla not recovered. Maxilliped (Fig. 147G) palp first and second articles with microtrichia on outer margin, second article with two shorter and one stout longer inner setae; third article with two inner setae in distal half of article; fourth with four inner to distal setae, and one outer subdistal seta; bases fused, naked; endites distally with outer microtrichia and inner rounded tubercle. Epignath not recovered.

Cheliped (Fig. 147H) basis twice as long as wide, naked, posterior lobe small, sclerite large; merus with one ventral seta; carpus rounded, 1.2 times as long as wide, wider proximally, with one dorsodistal and two mid-ventral setae; propodus elongate, 1.4 times as long as wide, with two ventral setae, one inner and one outer mid-distal setae adjacent to dactylus articulation; fixed finger with three setae alongside

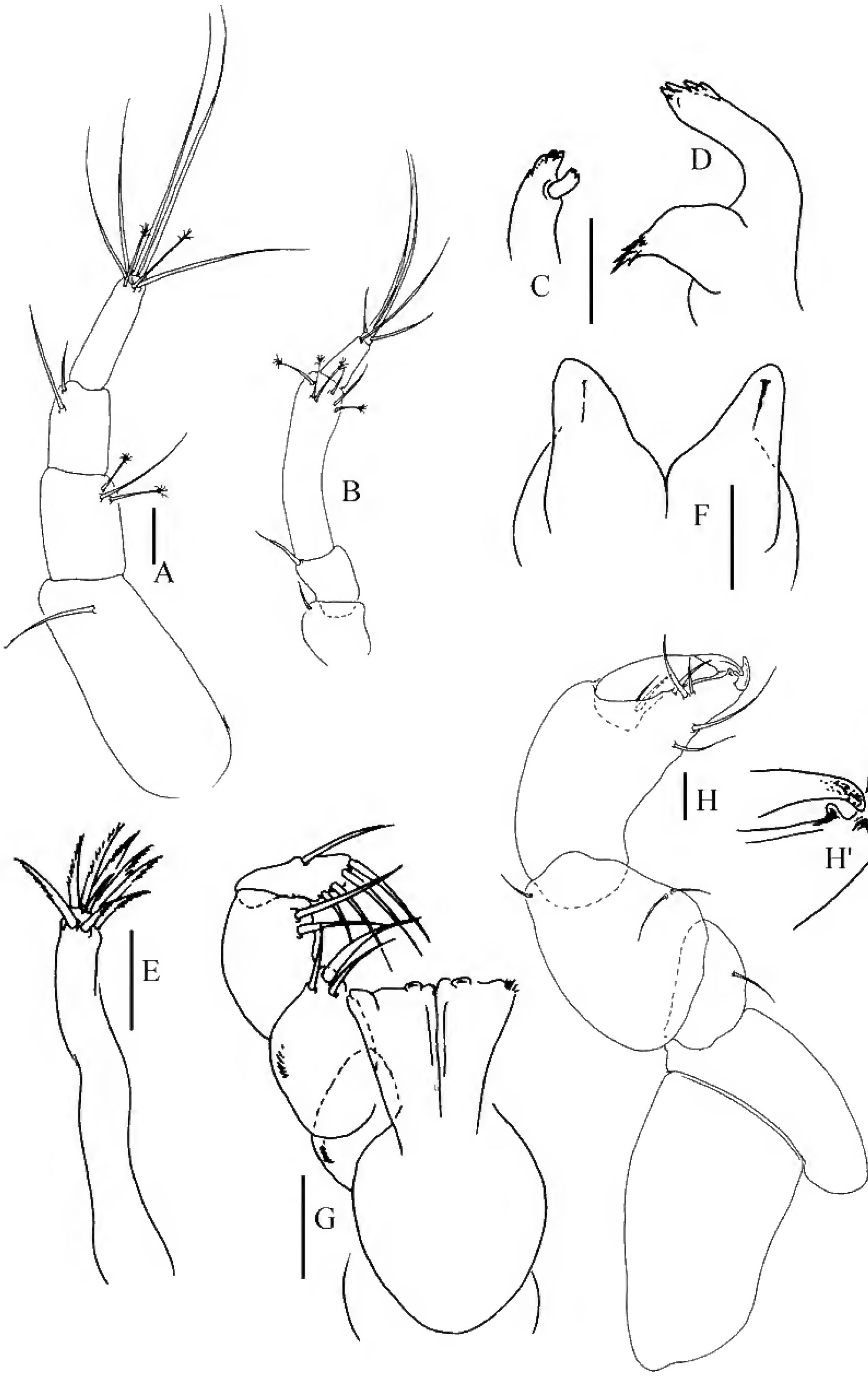


Fig. 147. *Parafilitanais vadosus* sp. nov., female paratype. A, antennule; B, antenna; C, left mandible, distal; D, right mandible; E, maxillule endite; F, labium; G, maxilliped; H, cheliped with H', detail of tips of chela fingers. Scale = 0.1 mm.

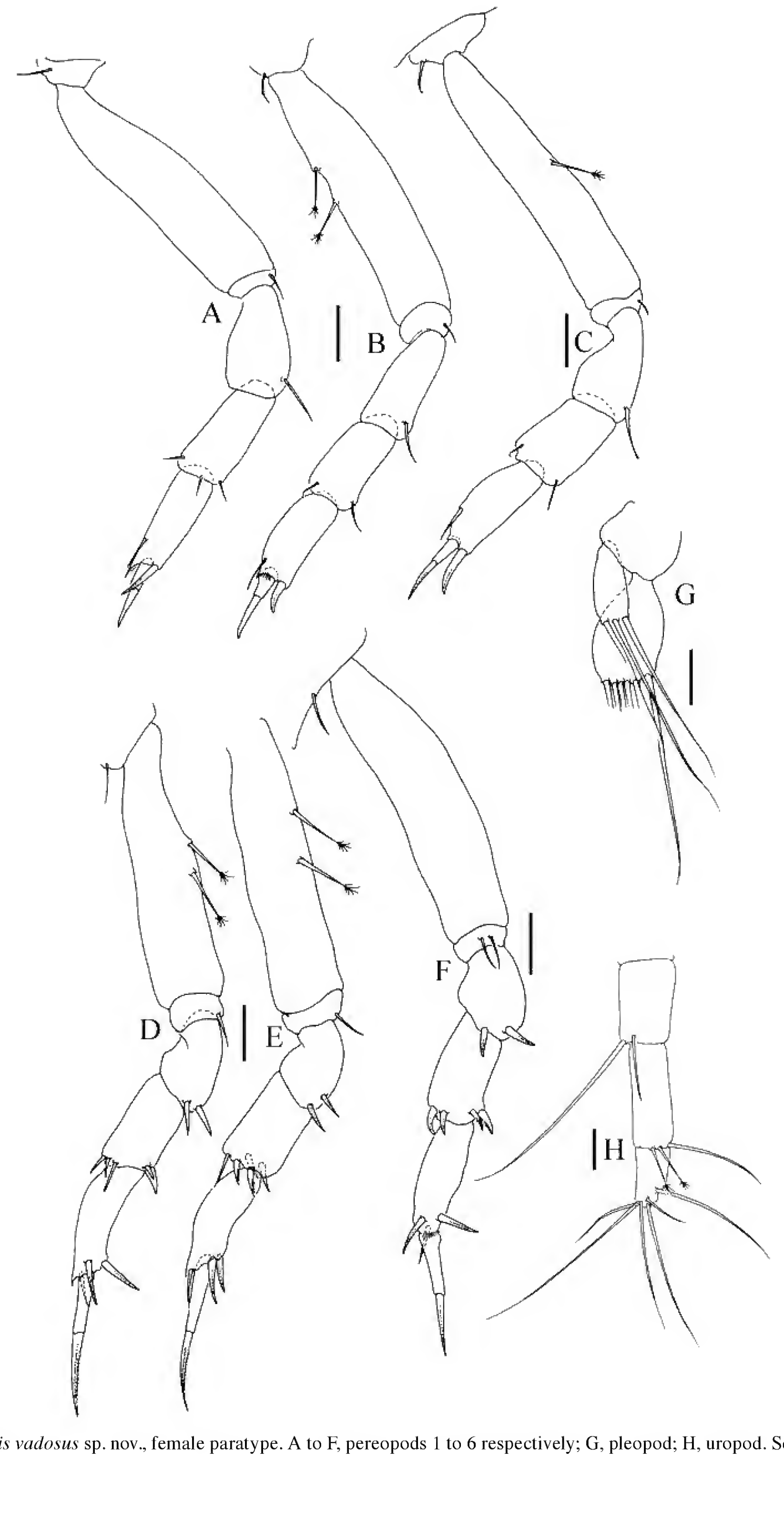


Fig. 148. *Parafilitanais vadosus* sp. nov., female paratype. A to F, pereopods 1 to 6 respectively; G, pleopod; H, uropod. Scale = 0.1 mm.

cutting edge, distal spine with two adjacent tooth-like tubercles (Fig. 147H'); dactylus naked, shorter than fixed finger.

Pereopod 1 (Fig. 148A) coxa with simple seta; basis four times as long as wide, naked; ischium compact with one ventral seta; merus, carpus and propodus subequal in length, merus with one slender ventrodistal spine, carpus with three fine distal setae, propodus with subdistal dorsal seta, dorsodistal spine-like apophysis, distal microtrichia and distal spine with denticulations in distal half; dactylus shorter than unguis, both together two-thirds as long as propodus. Pereopods 2 (Fig. 148B) similar to pereopod 1, but basis with two dorsal penicillate setae, merus just longer than carpus; pereopod 3 (Fig. 148C) similar to pereopod 2, basis with one penicillate seta.

Pereopod 4 (Fig. 148D) coxa with seta, basis four times as long as wide with two penicillate setae; ischium with one ventral seta; merus just shorter than carpus, with two ventrodistal distally-denticulate spines; carpus with two fine dorsodistal setae, and one dorsodistal and two ventrodistal short, curved spines; propodus 1.3 times as long as carpus, with dorsodistal seta and spine-like apophysis, and two ventrodistal distally-denticulate spines; dactylus half as long as laterally-denticulate unguis, both together 1.2 times as long as propodus. Pereopod 5 (Fig. 148E) as pereopod 4, but carpus with four distal spines and one dorsodistal seta; pereopod 6 (Fig. 148F) as pereopod 5, but ischium with two setae, unguis as long as dactylus.

Pleopods absent.

Uropod (Fig. 148H) uniramous, basis 1.5 times as long as wide, with one shorter and one longer outer distal ("exopodal") setae, longer seta exceeding distal tip of endopod; proximal segment of endopod about twice as long as basis, 2.5 times as long as wide, with one simple and two penicillate distal setae; distal segment half as long as proximal segment, with one subdistal and five distal setae.

Male similar to female, but with pleopods: pleopod (Fig. 148G) basis naked, endopod half as long as exopod, rami with four and seven distal setae respectively.

*Etymology*. From the Latin *vadosus* – shallow, this species being by far the shallowest recorded for the genus.

*Remarks*. The morphology of this species accords entirely with the diagnosis of the genus *Parafilitanais* as given by Larsen (2002), including the proportions of the cheliped and the pereopods, and the structure of the uropod, but excepting his statement that the fourth to sixth pereopod are without a coxa: coxae are present and unfused in this genus, as shown by the present specimen and by Larsen's (loc. cit.) figures 1A and 1L.

Of the three previously-described species of the genus (see Larsen, 2005), *Parafilitanais vadosus* sp. nov. has a proportionately shorter pereonite 1 than does *P. caudatus* Kudinova-Pasternak, 1989, a proportionately longer pleon than does *P. similis* Kudinova-Pasternak, 1990, and is without the distally-flattened pleotelson and the extended cheliped dactylus of *P. mexicana* Larsen, 2002. In addition, the present species is distinct from all of the other three in having the distal segment of the uropod endopod about half as long as the proximal segment (>0.7 times in the others), and in the proportionately shorter dactylus and unguis of the anterior pereopods.

*Parafilitanais vadosus* was taken at 29 to 38 m depth in the Eastern Bass Strait. The previous species were all recorded in deep waters, *P. caudatus* at 3660 m in the Indian Ocean, *P. similis* at 750 m in the Pacific Ocean, and *P. mexicana* at 625–2030 m in the Gulf of Mexico.

Genus ***Bascestus*** gen. nov.

*Diagnosis*. Female of leptognathioid (*sensu lato*) facies, elongate. Cephalothorax longer than wide, eyelobes and eyes absent. Pleonite epimera each with long seta. Antennule four-articled; antenna six-articled, fourth article longest, curved, without secondary articulation. Mandibular molar proximally broad, tapering, distally with numerous fine teeth; right mandible incisor not crenulate, but distally concave with adjacent stout teeth; left incisor with few distal crenulations, lacinia mobilis narrow, linguiform. Maxilliped bases fused, naked, endites not fused, distally with single rounded tubercle and small inner seta. Cheliped attached by distally rectangular sclerite, basis narrower posterior to this attachment; propodus with two ventral setae. Pereopods 1 to 3 with one seta on ischium; pereopods 2 to 6 with compound (denticulate in their distal half) spines on merus, carpus and propodus; pereopods 2 and 3 merus ventrodistally with one seta and one compound spine, pereopods 4 to 6 carpus with three spines and one seta. Ungues of anterior pereopods longer than dactyli; ungues of posterior pereopods distinct, shorter than dactyli, both articles with fine ventral denticulation. Pleopods present, functional; rami rounded, with plumose setae extending along outer margin. Uropod biramous, basis without distal apophyses, rami slender, endopod and exopod of two segments.

Male much less elongate than female, antennule of five articles; other appendages similar to those of female, mouthparts functional.

*Etymology*. From "Bass" as in Bass Strait, and the Greek (but with Latin pronunciation) *cestus* – a reinforced boxing glove, alluding to the nodulose chela of at least the type-species of this genus (male).

*Type species*: *Bascestus melmackenziae* sp. nov.

*Remarks*. The species described below shows morphological affinities with such genera as *Leptognathiella* Hansen, 1913, *Leptognathioides* Bird & Holdich, 1984, *Stenotanais* Bird & Holdich, 1984, and *Kanikipa* Bird, 2011, without conforming to any single one of these. Thus the mandibular structure, particularly the right incisor and the tapering molar, resemble those of the first three of these three genera, the last two of which also show some ventrodistal carpal expansion to accommodate the reflexion of the chela; the linguiform lacinia mobilis of the left mandible is also consistent with most species of these four genera, while the molar dentition resembles that of *Leptognathiella* and *Stenotanais*. The presence on the merus of the anterior pereopods of a ventrodistal seta and a ventrodistal spine is consistent with *Leptognathioides* and *Kanikipa* (but also the nototanaid genus *Tanaissus* and the agathotanaid genus *Paragathotanais*), while denticulation of the posterior dactyli accords with *Stenotanais* and *Akanthophoreus inter alia* (the latter also having a similar mandibular molar morphology).

Thus, there is no particular characteristic of *Bascestus* gen. nov. that distinguishes it from a number of others once allocated to the Leptognathiidae *sensu* Sieg, 1976b, but their combination in the present taxon is unique and excludes it from any of those genera. In having sexual dimorphism possibly limited to the antennular structure and habitus proportions, the present genus is further distinct from many other "leptognathiid" genera (in a number of which males remain unknown).

Since the insightful work of Bird and Holdich (1984), which highlighted the distinctions of a number of these genera previously subsumed into *Leptognathia* Sars, 1882, and sensibly discussed the relative merits of different characters for distinguishing different taxon levels, these taxa have been moved variously into such families as the Anarthruridae Lang, 1971, thence to the Colletteidae (*Leptognathiella* and *Leptognathioides*), the Akanthophoreidae (*Akanthophoreus*) or currently *incertae sedis sensu* Larsen and Wilson (2002) (*Stenotanais*, *Kanikipa*). Owing to its apparent affinities as described above, we choose at present to place *Bascestus* in the Colletteidae *sensu* Larsen and Wilson (2002).

***Bascestus melmackenziae*** sp. nov.

Figures 149–151

*Material.* 1 ♀ (J23600), holotype, Eastern Bass Strait, 3.2 km S of Cape Conran, Stn MSL-EG 55, 37°50.38'S 148°43.28'E, 49 m depth, sand and shell, 28 September 1990, coll. Marine Science Laboratories, Smith-McIntyre Grab. 2 ♀♀ (J56380), paratypes, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, Stn MSL-EG 68, 37°51.42'S 148°14.36'E, 37 m depth, 04 June 1991, coll. N. Coleman, Smith-McIntyre Grab. 1 ♂ (J28484), allotype, Eastern Bass Strait, 13.3 km E of eastern edge of Lake Tyers, Stn MSL-EG 69, 37°51.42'S 148°14.36'E, 37 m depth, 04 June 1991, coll. N. Coleman, Smith-McIntyre Grab.

*Description of female.* Body (Fig. 149C) slender, 12 times as long as wide, holotype 2 mm long. Cephalothorax parallel-sided in posterior half, narrowing anteriorly, 1.8times as long as wide, with slight rounded rostrum; eyelobes and eyes absent. Pereonites all rectangular, pereonite1 half as long as cephalothorax, as long as wide; pereonites 2 to 5 subequal in length, 1.4 times as long as pereonite 1, longer than wide; pereonite 6 shortest, 0.9 times as long as pereonite 1 (all pereonites respectively 1.0, 0.7, 0.8, 0.8, 0.7 and 1.1 times as wide as long). Pleon over three as long as pereonite 6; pleonites subequal in length, 2.8 times as wide as long, all bearing pleopods and single mid-lateral setae; pleotelson subpentangular, longer than two preceding pleonites, as wide as long, with single midlateral setae and two pairs of distal setae.

Antennule (Fig. 150A) shorter than cephalothorax, four–articled; article 1 nearly three times as long as wide, 0.9 times as long as articles 2 to 4 combined, with subdistal outer pair of penicillate setae, and single outer simple distal seta; article 2 slightly overlapping proximal part of article 3, twice as long as wide, less than half as long as article 1, with single inner and outer simple subdistal setae and tuft of five dorsodistal setae; article 3 slightly overlapping proximal part of article 4, 1.7 times as long as wide, 0.6 times as long as article 2, with single inner and outer simple subdistal setae; article 4 as long as article 2, five times as long as wide, with three simple and two penicillate subdistal setae and two longer simple distal setae.

Antenna (Fig. 150C), six–articled, article 1 short and annular, naked; article 2 about as long as wide, distally with single shorter dorsal and longer lateral setae; article 3 just shorter than article 2, with dorsodistal seta; article 4 twice as long as articles 2 and 3 combined, 4.5 times as long as wide, curved, distally with two simple and three penicillate setae; article 5 one-third as long as article 4, with long distal seta; article 6 very small, with five distal setae.

Labrum (Fig. 150D) rounded, hood-shaped, distally setose. Mandibles stout; left mandible (Fig. 150E) with distally-crenulate incisor and narrow, simple lacinia mobilis, molar proximally stout, tapering, tip with six or seven slender spine-like teeth; right mandible (Fig. 150F) incisor distally concave with few stout teeth; molar as on left mandible. Labium (Fig. 150H) simple, each side with single subdistal spinule. Maxillule (Fig. 150G) endite slightly sigmoid, with one distal seta and five terminal and two subterminal spines; palp and maxilla not recovered. Maxilliped (Fig. 150I) bases rounded, fused, naked; palp article 1 naked, article 2 with two inner distal setae and one outer distal seta; article 3 with three stout inner setae; article 4 with five distal and one outer subdistal setae; endites not fused, distally with rounded tubercle and inner seta. Epignath not recovered.

Cheliped (Fig. 149D, 151A) basis *in situ* proximally well-anterior of anterior margin of pereonite 1 ventrally, attached by distally rectangular sclerite; basis narrower posterior to this attachment, with rounded posterior free margin, twice as long as wide, with small dorso-subdistal seta; merus subtriangular, with ventral seta; carpus twice as long as wide, with three dorsoproximal and two mid-ventral setae, ventrodistally with slight expansion of margins into which chela can reflect; propodus longer than wide, with two ventral setae and comb-row of four simple setae, dorsal margin and mid-lateral face with rows of rounded nodules in distal half, and with inner ventral submarginal crenulate ridge; fixed finger cutting edge with three proximal denticulations and three adjacent setae; dactylus with several dorsal nodules and one small proximal seta.

Pereopod 1 (Fig. 151B) basis relatively stout, 2.5 times as long as wide, with one mid-dorsal simple seta; ischium with one seta about half as long as merus; merus distally expanded, 0.4 times as long as basis, 1.4 times as long as distal width, ventrodistally with one shorter seta and one compound spine almost as long as carpus; carpus 1.1 times as long as merus, rectangular, with two short ventrodistal spinules and inner and outer compound distal spines; propodus 1.5 times as long as carpus, with one compound ventrodistal spine, one distal seta as long as dactylus, and dorsodistal spinulation; dactylus half as long as unguis, both together as long as propodus. Pereopod 2 as pereopod 3. Pereopod 3 (Fig. 151C) similar to pereopod 1, but basis with mid-dorsal penicillate seta, carpus with single ventral, inner and outer compound distal spines.

Pereopod 4 (Fig. 151D) basis 2.4 times as long as wide; ischium with two setae; merus 0.3 times as long as basis, with two ventrodistal compound spines; carpus 1.3 times as long as merus, with with single ventral, inner and outer compound distal spines and simple dorsodistal seta; propodus 1.1 times as long as carpus, with one dorsodistal seta and two ventrodistal

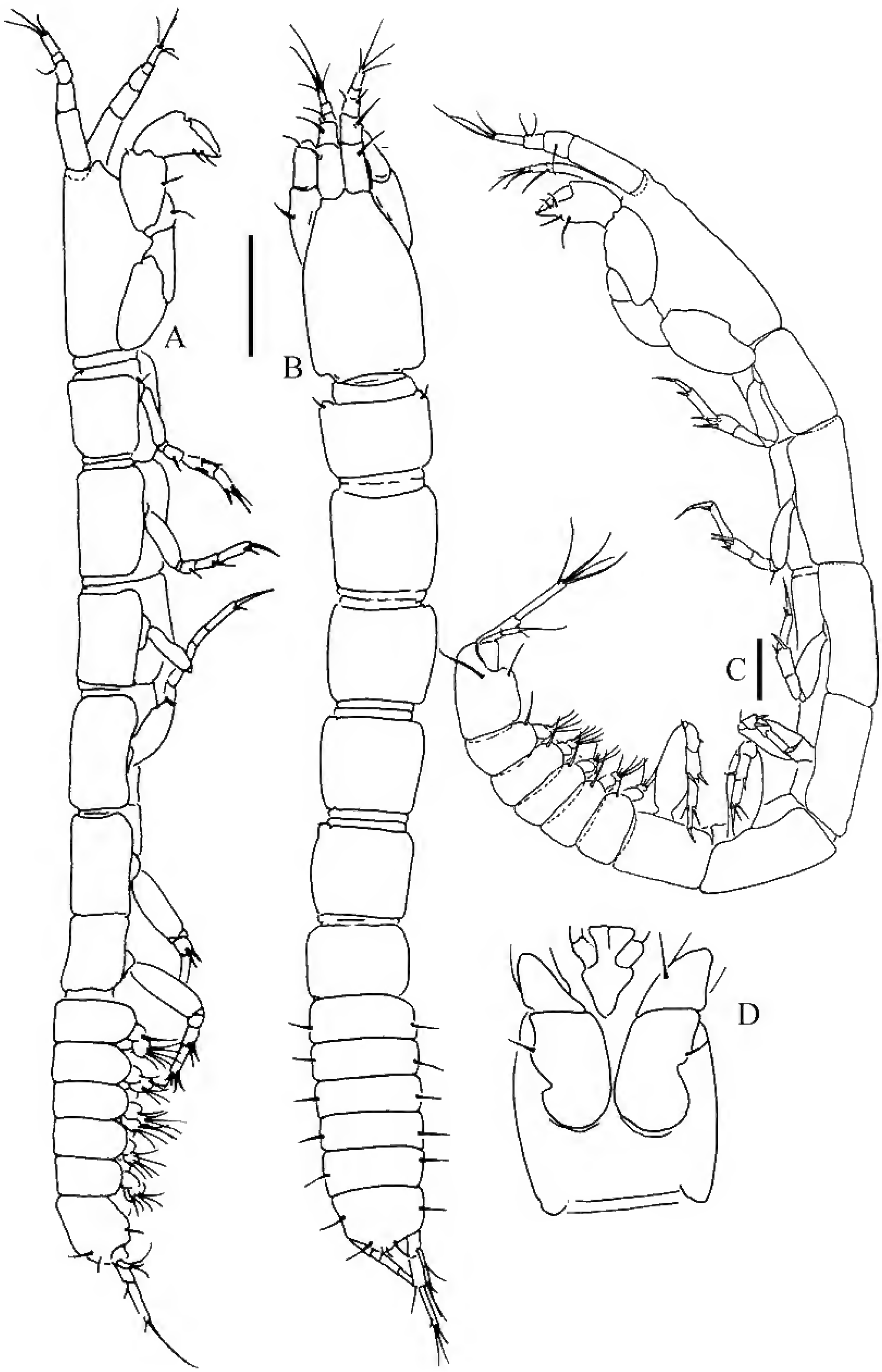


Fig 149. *Bascestus melmackenziae* sp. nov. A, male, lateral; B, male, dorsal; C, holotype female, lateral; D, cephalothorax, ventral, showing attachment of chelipeds. Scale = 0.1 mm.

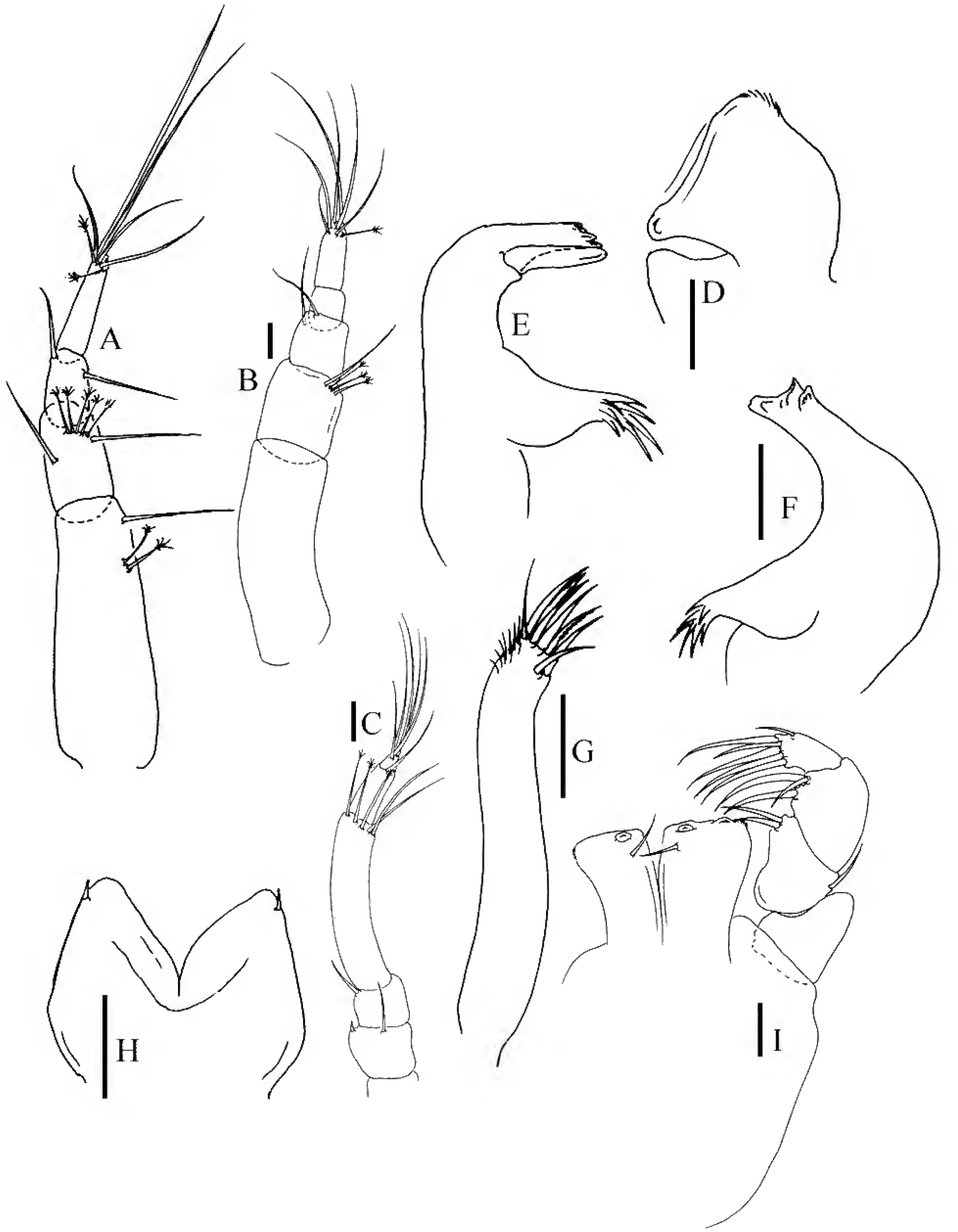


Fig 150. *Bascestus melmackenziae* sp. nov. A, female antennule; B, male antennule; C, antenna; D, labrum; E, left mandible; F, right mandible; G, maxillule endite; H, labium; I, maxilliped. Scale = 0.01 mm.

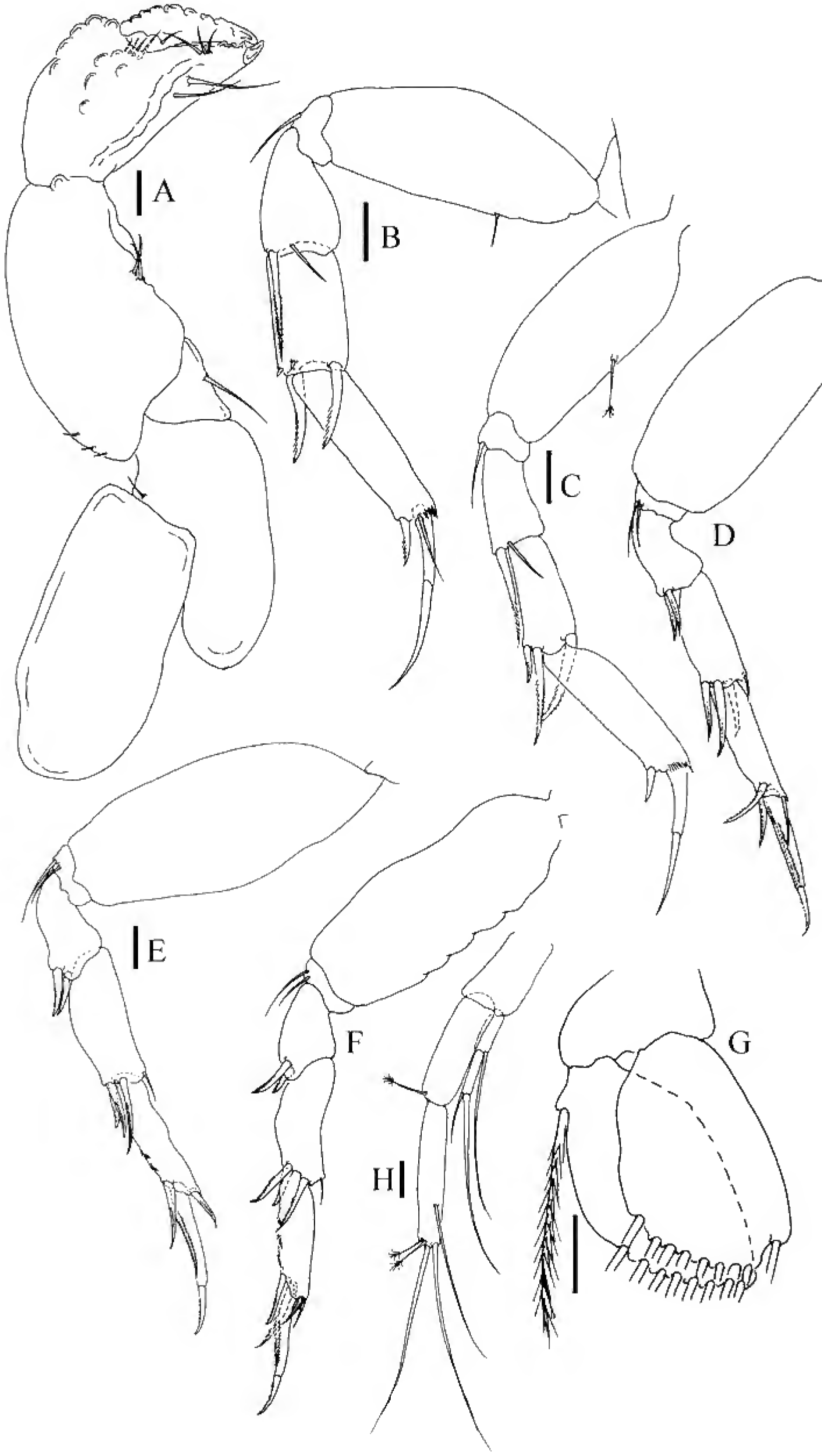


Fig 151. *Bascestus melmackenziae* sp. nov. A, cheliped ; B, pereopod 1 ; C, pereopod 3; D, pereopod 4 ; E, pereopod 5 ; F, pereopod 6 ; G, pleopod ; H, uropod. Scale = 0.01 mm.

compound spines; dactylus semicircular in cross-section, ventral edges finely denticulate; unguis half as long as dactylus, ventrally finely denticulate, dactylus and unguis together 1.2 times as long as propodus. Pereopod 5 (Fig. 151E) similar to pereopod 4, propodus with microtrichia. Pereopod 6 (Fig. 151F) similar to pereopods 4 and 5 but basis with dorsal undulation, propodus with two dorsodistal setae.

Pleopods all similar (Fig. 151G), basal article naked; endopod and exopod rami rounded, all setae plumose; endopod with eight outer to distal setae and one inner subdistal seta, proximal outer margin naked; exopod with eight outer to distal setae and separated outer proximal seta.

Uropod (Fig. 151H) slender, nearly twice as long as pleotelson; basal article twice as long as wide, naked, without distal apophyses; exopod two-segmented, shorter than proximal article of endopod, segments subequal in length, with one distal seta on proximal segment, two unequal distal setae on distal segment; endopod two–segmented, proximal segment shorter and with one penicillate distal seta, distal article with one subdistal and two distal simple setae and two distal penicillate setae.

*Distinctions of male*. Body (Fig. 149A, B) smaller and less elongate than that of female, length 0.9 mm, 10 times as long as wide. Cephalothorax similar to that of female, 1.7 times as long as wide, tapering anteriorly. Pereonites more or less rectangular; pereonite 1 half as long as cephalothorax; pereonites 2 to 5 subequal in length although progressively shorter, about 1.2 times as long as pereonite 1, not longer than wide; pereonite 6 shortest, 0.9 times as long as pereonite 1; pereonites respectively 1.3, 1.0, 1.1, 1.0, 1.1 and 1.4 times as wide as long. Pleon as long as pereonites 4 to 6 inclusive, pleonites 2.8 times as wide as long.

Antennule (Fig. 150B) five–articled, shorter than cephalothorax; peduncle article 1 stout, three times as long as wide, naked; peduncle article 2 compact, 0.4 times as long as article 1, 1.3 times as long as wide, with three penicillate and one simple ventrodistal setae; article 3 as long as wide, 0.6 times as long as article 2, with two dorsodistal simple setae; flagellum of two segments, proximal segment just longer than wide, 0.75 times as long as peduncle article 3, naked; second segment twice as long as wide, as long as peduncle article 3, with four simple and one penicillate subdistal setae and two simple distal setae.

Mouthparts, chelipeds, pereopods, pleopods and uropods similar to those of female.

*Etymology*. Named after Melanie Mackenzie of the Museum Victoria in gratitude for her diligent and uncomplaining assistance with the material and data of the collections.

*Remarks*. The characters of this species are discussed above under the generic remarks. The rugose tuberculation of the cheliped may be a specific rather than generic character as it is known to show intrageneric variation in other paratanaoid taxa (see discusison under *Araphura*). *Bascestus melmackenziae* sp. nov. was taken from depths of 37 to 49 m in the Eastern Bass Strait.

**Tanaidomorpha** *incertae sedis*

### Species 33

Figure 152

*Material examined.* 6 mancae (manca 1) (J51791), Stn VC30 C1, Victoria, Central Bass Strait, 38°35.53'S, 146°07.51'E, 40 m depth, 11th May 1998, Smith-McIntyre grab, coll. N. Coleman.

*Description*. Body (Fig. 152) glabrous, small, eight times as long as wide, length of all specimens 1.4 mm. Cephalothorax subrectangular, wider than long, with branchial chambers expanded as lateral rounded flanges over cheliped attachment; rostrum straight, smooth, with anterior margin of carapace protruding either side of rostrum as rounded lobes. Pereonite 1 trapezoidal, 0.8 times as long as cephalothorax, anteriorly 1.4 times as wide as pereonite length, posteriorly 0.8 times as wide as pereonite length; pereonites 2 and 3 rectangular, 0.75 times as wide as long, pereonite 2 almost as long as cephalothorax, pereonite 3 just shorter than pereonite 1; pereonites 4 and 5 hexagonal, pereonite 4 as wide as long and as long as pereonite 3, pereonite 5 about 1.5 times as wide as long and about half length of cephalothorax; pereonite 6 short, one-quarter as long as pereonite 5 and four times as wide as long. Pleon laterally convex, first four pleonites 5.2 times as wide as long, fifth pleonite as long as pereonite 6 and four times as wide as long. Pleotelson semicircular, twice as long as each anterior pleonite and twice as wide as long.

Antennule apparently of three articles. Posterior pereopods with prickly tubercles on carpus. Uropods biramous, each ramus of one segment.

*Remarks*. These specimens are all at the manca 1 stage, with a highly reduced pereonite 6, hardly longer than pleonite 1, and no pereopod 6. Their morphology shows no similarity to any known genus; in particular, the lobate structure of the cephalothorax is highly unusual, yet appears unlikely to be a juvenile character. The presence of prickly tubercles on the posterior pereopods suggests that this taxon may belong in the Typhlotanaidae (but see *Bassoleptochelia* above). Without knowledge of the adult, it is at present not possible to assign this taxon to any category lower than Suborder, and it may well represent a distinct Family. "Species 33" is a Museum Victoria collection reference number.

### Discussion

While the Bass Strait has been the subject of unusually extensive and intensive sampling, from which the collections analyzed here have arisen, it remains remarkable that we now know of 65 species in 43 genera from this area (Appendix 2), of which 57 species and eight genera have proven to be new to science (and at present are all endemic except for *Remexudes toompani*). The extraordinarily high diversity of this assemblage is the more remarkable because the habitats are not very diverse, being predominantly sandy substrata and thus with limited niche diversity. That the Bass Strait is not unique in this respect (although Australia may be) is demonstrated by the comparatively similarly high levels of tanaidacean diversity discovered from much briefer surveys elsewhere in Australia, such as Esperance

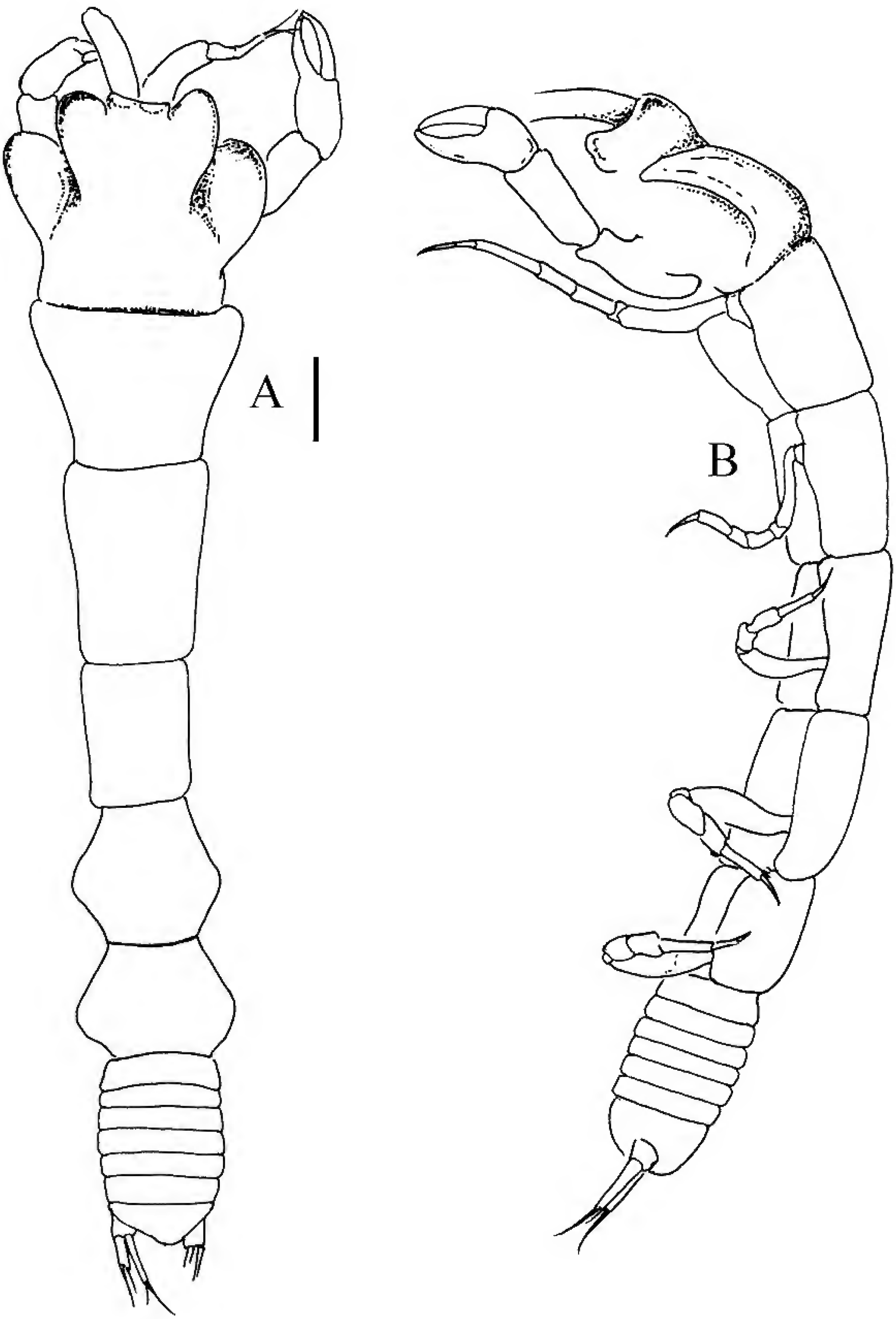


Fig. 152. Tanaidomorpha *incertae sedis* Species 33, manca. A, dorsal view ; B, lateral view. Scale line = 0.1 mm.

(Bamber, 2005) and Moreton Bay (Bamber, 2008), again both areas with predominantly sandy substrata.

Of those nine species from the Bass Strait known from elsewhere in Australia, two, *Indoapseudes macabre* and *Paratanais vetinari*, are also known from southwestern Australia, somewhat consistent with the predominant current flow coming from the west. All but one of the remainder are also found in the adjacent territory of New South Wales, and two extend as far as Brisbane (Queensland).

At the generic level, those described as new for the Bass Strait are currently endemic (other than *Remexudes*). *Whiteleggia* and *Pseudowhiteleggia*, both with a fairly long history in the literature, and *Remexudes* are so far restricted to the southeastern corner of Australia. The typhlotanaid genus *Antiplotanais* now contains three species, all from Australia, from southern Western Australia, Victoria and southern Queensland. The at-present more-numerous genus *Bathytanais* is almost exclusively Australian, being represented by seven species in Australian waters (from all coasts) but also, enigmatically, one species in Hong Kong.

On a somewhat more widespread basis, the genera *Spinosapseudes* and *Metapseudes* are now both known from two species only, with some zoogeographic consistency, one of each genus being from the Bass Strait and the other from New Zealand waters. A similar distributional association appears to be shown within *Araphura* (and *Araphuroides*?): while overall these genera are relatively widespread in their distribution, the morphology of the species from the Bass Strait, with nodulose chelipeds, is also found only in species from New Zealand and the sub-Antarctic South Shetland Islands. A similar Antarctic/sub-Antarctic link is to be found in the Mirandotanaidae.

The two pagurapseudid genera recorded above, both well-represented in the eastern half of Australia, show diversity and similar distributions throughout Australasia to Micronesia and also with one (*Macrolabrum*) or five (*Pagurapseudes*) species in the western Indian Ocean. A similar distribution is shown by the four known species of *Indoapseudes*, and by the genus *Pakistanapseudes*, five species of which have now been found in the Bass Strait, which contributes to a surprisingly high diversity in Australia, (belying the derivation of the generic name) with some nine of the 18 species recorded globally in the Pakistanapseudinae coming from Australian waters.

There are thus some consistent trends within the zoogeography of the Bass Strait taxa, at both regional and wider scales.

However, the origins of this Australian diversity are not easy to explain. A process of original evolution and subsequent radiation is occasionally suggested as a source of high diversity. An early stage in such a process may be exhibited by the presently Australian-endemic family Whiteleggiidae. Yet speculation over associations with the tanaidacean faunas of other parts of what was Gondwana must await better study of the faunas of South Africa and India, for examples. Interestingly, there appears little association with the tanaidacean fauna of Antarctica, where such families as the Leptocheliidae appear to be absent. The converse hypothesis of colonization and subsequent allopatric speciation and radiation is equally well-supported by the distributions of such taxa as the Pakistanapseudinae and the Pagurapseudidae with their links through Australasia and the Indian Ocean together with an apparent greatest diversity in Australia itself.

It remains the case that such hypotheses will remain speculative until more is known about the tanaidacean faunas from other, as yet understudied (or at least unpublished) regions of Australia, such as the tropical waters of northern Queensland, the Gulf of Carpentaria and the north coast of Australia, and northern Western Australia, with their extensive coral-reef habitats, as well as the Great Australian Bight in the south. Fortunately, information on the tanaidaceans of neighbouring regions is, in some cases, improving markedly, with valuable recent work from New Zealand waters by Bird (2008; 2011) and some from Micronesia (Bamber, 2009 and references therein).

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**Appendix 1. Sample registration numbers for *Kalliapseudes obtusifrons* material examined.**

Crib Point, Western Port, Victoria

J48195 8♀(2 brooding), 6♂, 1 juvenile
J48207 15♀(6 brooding), 4♂, 2 juveniles
J48219 5♀(1 brooding, 2 with oostegites), 1♂
J48228 6♀(1 brooding), 2 juveniles
J48375 1♀ with oostegites, 1♂
J48383 1♂
J48388 7♀(4 brooding), 2♂, 16 juveniles
J48389 5 brooding ♀, 10 juveniles
J48393 3♀(2 brooding), 2♂, 1 juvenile
J48398 2 brooding ♀, 1♂, 5 juveniles
J48399 2 brooding ♀, 3 juveniles
J48402 4♀(1 brooding), 2 juveniles
J48409 1 brooding ♀, 2 juveniles
J48416 4♀(2 brooding, 1 with oostegites), 4♂, 2 juveniles
J48418 1♀, 1♂

Hastings, Western Port, Victoria

J66425 79♀(24 brooding, 28 with oostegites), 41♂, 21 juveniles
J66520 1 brooding ♀
J66665 9♀, 2♂, 2 juveniles
J66918 1♀
J67235 3♀, 1♂
J67281 1♀, 1♂

Port Phillip Bay, Victoria

J43615 1♀
J43616 1 brooding ♀, 1 juvenile
J43617 1♀
J43618 1 brooding ♀, 1♂
J43619 1♀, 1♂
J43620 1 brooding ♀
J43621 1♀
J43623 1♂
J43624 1♀, 1♂
J43662 3♀, 2♂, 13 juveniles
J43076 1♂
J43080 1♀, 1♂
J43081 1♂

Gippsland, E. Bass Strait

J28079 9♀(3 with oostegites), 5♂, 7 juveniles
J28114 18♀(4 brooding, 7 with oostegites), 6♂
J28102 8♀(2 brooding), 6♂, 2 juveniles
J28110 28♀(4 with oostegites), 3♂
J28098 1♀ with oostegites

East of Wilson's Promontory

J50781 2♀(1 brooding), 1♂
J50782 2 juveniles
J50783 1♀, 4 juveniles
J50784 1♀, 1 juvenile
J50785 44♀(6 brooding), 9♂, 6 juveniles
J50786 3♀, 2♂
J50787 9♀(2 brooding, 2 with oostegites), 4♂, 3 juveniles
J50788 2♀(1 brooding), 1♂
J50789 9♀, 4♂, 1 juvenile
J50790 13♀, 3 juveniles
J50791 3♀

**Appendix 2. Full species list of Tanaidacea from Bass Strait, with provenance elsewhere in Australia, if any.**

**ORDER TANAIDACEA DANA, 1849**

**Suborder Apseudomorpha Sieg, 1980**(a)
Superfamily Apseudoidea Leach 1814

**Family Apseudidae Leach 1814**

Subfamily Apseudinae Leach 1814
Genus *Apseudes* Leach 1814
*Apseudes abditospina* (Błażewicz-Paszkowycz & Bamber, 2007) **comb. nov.**
*Apseudes poorei* Błażewicz-Paszkowycz & Bamber, 2007
***Apseudes quasimodo*** **sp. nov.**
Genus *Apseudopsis* Norman 1899
*Apseudopsis tuski* (Błażewicz-Paszkowycz & Bamber, 2007) **comb. nov.**
Genus *Spinosapseudes* Guţu 1996(a)
*Spinosapseudes colobus* Błażewicz-Paszkowycz & Bamber, 2007
Genus *Bunakenia* Guţu 1995(a)
***Bunakenia labanticheiros*** **sp. nov.**
Genus *Paradoxapseudes* Guţu 1991
***Paradoxapseudes paneacis*** **sp. nov.**
***Paradoxapseudes attenuata*** **sp. nov.**

Subfamily Pugiodactylinae Guţu 1995(b)
Genus *Pugiodactylus* Guţu 1995(b)
*Pugiodactylus syntomos* Błażewicz-Paszkowycz & Bamber, 2007

**Family Whiteleggiidae Guţu 1972**
Genus *Whiteleggia* Lang 1970
*Whiteleggia multicarinata* (Whitelegge, 1901) [also New South Wales[1]]
Genus *Pseudowhiteleggia* Lang, 1970
*Pseudowhiteleggia typica* Lang, 1970 [also New South Wales[1]]

**Family Kalliapseudidae Lang 1956(b)**

Subfamily Kalliapseudinae Guţu 1972
Genus *Kalliapseudes* Stebbing 1910
*Kalliapseudes obtusifrons* (Haswell 1882) [also New South Wales[2]]

**Family Metapseudidae Lang 1970**

Subfamily Metapseudinae Lang 1970
Genus *Cyclopoapseudes* Menzies, 1953
Subgenus *Exopoapseudes* **subgen. nov.**
***Cyclopoapseudes (Exopoapseudes) plumosa*** **sp. nov.**
Genus *Labraxeudes* Błażewicz-Paszkowycz & Bamber, 2007(b)
*Labraxeudes heliodiscus* Błażewicz-Paszkowycz & Bamber, 2007
Genus *Metapseudes* Stephensen 1927
*Metapseudes wilsoni* Błażewicz-Paszkowycz & Bamber, 2007

**Family Parapseudidae Guţu 1981**

Subfamily Pakistanapseudinae Guţu 2008 **new rank**
Genus *Pakistanapseudes* Băcescu 1978
*Pakistanapseudes bassi* Błażewicz-Paszkowycz & Bamber, 2007
***Pakistanapseudes lucifer*** **sp. nov.**
*Pakistanapseudes perulpa* Błażewicz-Paszkowycz & Bamber, 2007 [also Queensland[7]]
***Pakistanapseudes taylorae*** **sp. nov.**
***Pakistanapseudes*** **sp. nov. C**

Subfamily Parapseudinae Guţu 1981 **new rank**
Genus *Parapseudes* Sars, 1882
***Parapseudes blandowskii*** **sp. nov.**
Genus *Saltipedis* Guţu 1995(b)
*Saltipedis nugoris* Błażewicz-Paszkowycz & Bamber, 2007
***Saltipedis floccus*** **sp. nov.**
Genus *Remexudes* Błażewicz-Paszkowycz & Bamber, 2007
*Remexudes toompani* Błażewicz-Paszkowycz & Bamber, 2007 [also Queensland[7]]

**Family Pagurapseudidae Lang 1970**

Subfamily Hodometricinae Guţu 1981
Genus *Indoapseudes* Băcescu 1976(a)
*Indoapseudes macabre* Bamber, 2005 [also south-western Australia[3]]
Genus *Similipedia* Guţu 1989
*Similipedia diarris* Błażewicz-Paszkowycz & Bamber, 2007

Subfamily Pagurapseudinae Lang, 1970
Genus *Pagurapseudes* Whitelegge 1901
***Pagurapseudes victoriae*** **sp. nov.**
***Pagurapseudes kimbla*** **sp. nov.**
Genus *Macrolabrum* Băcescu, 1976(b)
***Macrolabrum tangaroa*** **sp. nov.**
***Macrolabrum sarda*** **sp. nov.**
***Macrolabrum haikung*** **sp. nov.**

**Suborder Tanaidomorpha Sieg, 1980(a)**
Superfamily Paratanaoidea Lang, 1949

**Family Paratanaidae Lang, 1949**

Subfamily Paratanaidinae Lang, 1949
Genus *Paratanais* Dana, 1952
*Paratanais malignus* Larsen, 2001 [also New South Wales[4]]
***Paratanais tanyherpes*** **sp. nov.**
*Paratanais vetinari* Bamber, 2005 [also south-western Australia[3]]

Subfamily Bathytanaidinae Larsen & Heard, 2001
Genus *Bathytanais* Beddard, 1886
*Bathytanais bathybrotes* (Beddard, 1886(a)) [also south-western Australia[5] and Queensland[6]]
*Bathytanais fragilis* Larsen & Heard, 2001
***Bathytanais parageios*** **sp. nov.**

**Family Leptocheliidae Lang, 1973**
Genus *Leptochelia* Dana, 1849
***Leptochelia billambi* sp. nov.**
**Genus *Araleptochelia* gen. nov.**
***Araleptochelia macrostonyx* sp. nov.**
Genus *Pseudoleptochelia* Lang, 1973
***Pseudoleptochelia occiporta* sp. nov.**
**Genus *Bassoleptochelia* gen. nov.**
***Bassoleptochelia verro* sp. nov.**

**Family Tanaellidae Larsen & Wilson, 2002**
Genus *Araphura* Bird & Holdich, 1984
***Araphura pygmothymos* sp. nov.**
***Araphura yarra* sp. nov.**
***Araphura doutagalla* sp. nov.**
Genus *Araphuroides* Sieg, 1886
***Araphuroides stabastris* sp. nov.**
***Araphuroides batmania* sp. nov.**
***Araphuroides sala* sp. nov.**
**Genus *Inconnivus* gen. nov.**
***Inconnivus billibunteri* sp. nov.**

**Family Mirandotanaidae Błażewicz-Paszkowycz & Bamber, 2009**
Genus *Pooreotanais* Błażewicz-Paszkowycz & Bamber, 2009
**Pooreotanais gari *Błażewicz-Paszkowycz* & Bamber, 2009**

**Family Typhlotanaidae Sieg, 1984**
Genus *Typhlotanais* Sars, 1882 *sensu lato*
***Typhlotanais herthio* sp. nov.**
Genus *Antiplotanais* Bamber, 2008
***Antiplotanais actuarius* sp. nov.**
Genus *Hamatipeda* Błażewicz-Paszkowycz, 2007
***Hamatipeda sima* sp. nov.**
Genus *Paratyphlotanais* Kudinova-Pasternak & Pasternak, 1978
***Paratyphlotanais colouros* sp. nov.**
Genus *Peraeospinosus* Sieg, 1986
***Peraeospinosus tanytrix* sp. nov.**
Genus *Meromonakantha* Sieg, 1986
***Meromonakantha anarsios* sp. nov.**

**Family Nototanaidae Sieg 1976**

Subfamily Nototanainae Sieg 1976
Genus *Tanaissus* Norman & Scott, 1906
***Tanaissus giraffa* sp. nov.**
Genus *Protanaissus* Sieg, 1983
***Protanaissus huberti* sp. nov.**

**Family Agathotanaidae Lang 1971**
Genus *Paragathotanais* Lang, 1971
***Paragathotanais wurundjeri* sp. nov.**
**Genus *Ozagathus* gen. nov.**
***Ozagathus watharongus* sp. nov.**

**Family Akanthophoreidae Sieg, 1986**
**Genus *Gejavis* gen. nov.**
***Gejavis corsotos* sp. nov.**

**Family Tanaopsidae fam. nov.**
Genus *Tanaopsis* Sars, 1896
***Tanaopsis boonwurrungi* sp. nov.**
***Tanaopsis oios* sp. nov.**

**Family Colletteidae Larsen & Wilson, 2002**
Genus *Parafilitanais* Kudinova-Pasternak, 1989
***Parafilitanais vadosus* sp. nov.**
**Genus *Bascestus* gen. nov.**
***Bascestus melmackenziae* sp. nov.**

**Family *incertae sedis***
**"Species 33"**

[1] Lang, 1970
[2] Drumm & Heard, 2006
[3] Bamber, 2005
[4] Larsen, 2001
[5] Lang, 1972
[6] Bamber, 2008
[7] Błażewicz-Paszkowycz & Bamber, 2007

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# *Synidotea poorei*, a new isopod from the fouling community in Singapore waters (Valvifera, Idoteidae)

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**Abstract**

Cai, Y. and Teo, S.L.M. 2012. *Synidotea poorei*, a new isopod from the fouling community of Singapore (Valvifera, Idoteidae). *Memoirs of Museum Victoria* 69: 237–243.

*Synidotea poorei* new species (Idoteidae) is described from fouling community on navigational buoys and jetties in Singapore waters. It belongs to the *S. hirtipes* species group. The new species is characterized by a smooth uropodal peduncle, sub-parallel pleotelson lateral margins and a moderately excavate pleotelson posterior margin. It represents a new record for the genus in Southeast Asia.

**Keywords** Fouling, *Synidotea*, new species, marine isopod, Singapore

## Introduction

Knowledge of the marine isopod fauna from Southeast Asia is relatively poor, and that of Singapore is even less so. Ten species, represent ten genera in eight families have been reported from Singapore waters. Most of these consist of records within larger works (e.g. Schioedte and Meinert, 1879; Barnard, 1925; Monod, 1926; Menzies and Barnard, 1951; Stock, 1960; Bruce 1986a). A new species of wood-borer, *Limnoria cristata* Cookson and Cragg, 1991, was described from intertidal driftwood in a mangrove forest, and two new species of branchial parasitic isopods have been described from hermit crabs collected in Singapore (Williams and Schuelein, 2005). In 2002, during a survey of the fouling community on the navigational buoys and jetties in Singapore coastal waters, four species of marine isopods, belonging to three families were found in the epifauna and epiflora on the surface of the navigational buoys. *Sphaeroma walkeri* Stebbing, 1905 (Sphaeromatidae) and *Cirolana willeyi* Stebbing, 1904 (Cirolanidae) are reported here for the first time from Singapore. *Sphaeroma walkeri*, originally described from Sri Lanka, has been reported to be a widely distributed introduced species found in various fouling communities (Miller, 1968; Carlton and Iverson, 1981; Mak and Morton, 1985) but it may not necessarily have been introduced to Singapore. *Cirolana willeyi*, also described from Sri Lanka, has been subsequently reported from estuarine and mangrove habitats from East Africa to Australia (Bruce, 1981, 1986b). A third species, of the genus *Cilicaea* (Sphaeromatidae) was also found. The fourth is a new species of *Synidotea* (Idoteidae) described here. Specimens examined have been deposited in Raffles Museum of Biodiversity Research, National University of Singapore, Singapore (ZRC) and Museum Victoria, Melbourne (NMV). Terminology follows that of Poore and Lew Ton (1993).

**Idoteidae** Samouelle, 1819

***Synidotea*** Harger, 1878

***Synidotea poorei*** sp. nov.

Figures 1-4

*Material examined.* Holotype: male, tl 11.4 mm, ZRC.2005.0118, North Pandan Buoy, 1°15'48.12" N, 103°45'10.81" E, Terumbu Pandan, Singapore, coll. Y. Cai, S. L. M. Teo, K. S. Tan and T. M. Sin, 11 Apr. 2002. Paratypes: 25 males, tl 4.6–12.2 mm, 15 females, tl 5.6-8.1 mm, ZRC.2005.0119, data same as holotype: 2 females, 7.4. 10.2 mm; 4 ovigerous females, tl 6.9-8.6 mm; 4 males, tl 10.2-12.9 mm, NVM J62812, data same as holotype. Other specimens: 4 males, tl 6.0-9.1 mm, 2 females, tl 7.0-7.4 mm, ZRC.2005.0120, North West Sudong Buoy, 1°13'07.22" N, 103°42'59.10" E, near Pulau Sudong, Singapore, 19 Jul. 2002; 1 female, tl 8.4 mm, ZRC.2005.0121, Perimbi Buoy. 1°25'45.11" N, 103°53'14.75" E, East Johor Strait, Singapore, coll. Y. Cai. 21 May 2002; 1 male, tl 12.0 mm, ZRC.2005.0122, Retan-D Buoy, 1°17'35.63" N, 103°45'25.48" E, off Sungei Pandan, West Coast, Singapore, coll. Y. Cai, K. S. Tan & S. C. Lim, 17 Oct. 2003; 1 female, tl 5.9 mm, ZRC.2005.0123, Sirdhana Buoy. 1°14'43.00" N, 103°52'55.02" E, off Marina Bay, Singapore, coll. Y. Cai, K. S. Tan, T. M. Sin & S. L. M Teo, 5 Jun. 2002; 6 males, tl 6.2-10.8 mm, 1 female, tl 7.0 mm, ZRC.2005.0124, Mooring Buoys at Marina Bay, Singapore, 1°17'06.26" N, 103°51'20.09" E, coll.

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Fouling, *Synidotea*, new species, marine isopod, Singapore

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K. S. Tan & S. C. Lim, 14 Jul. 2003; 84 males, tl 6.8-13.2 mm, 54 females, tl 7.3-10.0 mm, ZRC.2005.0125, CAAS2 Buoy, 1°23'38.65" N, 103°59'37.13" E, off Changi Beach, Singapore, coll. Y. Cai, S. L. M. Teo & T. M. Sin, 23 Apr. 2002; 3 males, tl 4.8-10.3 mm, 1 female, tl 8.0 mm, ZRC.2005.0126, Jetty of St John's Island, 1°13'20.95" N, 103°50'56.33" E, Singapore, coll. Y. Cai, 22 Mar. 2004.

*Description of male.* Maximum size: 11.4 x 4.0 mm (holotype). Body 2.9–3.1 times as long as wide; depressed and smooth, without tubercles or carina, lateral margin smooth. Colour brownish with darker spots. Cephalon frontal margin almost straight, with indistinct median excavation, dorsal surface with anterior and posterior transverse grooves and longitudinal lateral grooves. Eyes bulge outward, forming part of contour of lateral margin of head. Ratio of post-orbital head width to width of pereonite 3 (widest pereonite) 0.56.

Antenna 1 flagellum uniarticulate, with 10 pairs of jointed aesthetascs. Antenna 2 0.6 body length; article 4 2.4 times as long as wide; article 5 3.6 times as long as wide; flagellum with 16-22 articles, 1.2 length of peduncle.

Dorsum of each pereonite smooth, margin slightly arched; dorsomarginal areas of pereonites 2–7 slightly enlarged, distinctly depressed, lateral margins slightly upturned, marginal areas becoming progressively less depressed, and sloping gently on posterior pereonites; lunettes on pereonites 2–4 with posterior margin subtriangular or rounded; distolateral angle of pereonites 1–4 rounded, those of pereonites 5–7 subrectangular.

Pleotelson about 1.4 times as long as wide, dorsum smooth, evenly convex, lateral margin sub- parallel over anterior two-thirds, then tapering beyond curved margin to rounded posterior margin, with a shallow medial excavation.

Mandible incisor with 4 strong, unequal cusps. Lacinia mobilis stout, 4-cusped, with additional large serrate spine-like process. Molar process large, truncate, surrounded by short spines, bearing laterally 3 stiff setulose setae and many denticles along distal end.

Mesial lobe of maxilla 1 with 2 stout distally serrated robust apical setae with mesial setules; outer lobe with 9 robust tooth-like serrated setae.

Maxilla 2 3-lobed, with plumose, simple and comb setae on endopod as figured; mesial lobe of exopod lined with comb setae, Outer lobe enlarged, recurved laterally, fringed with extremely long plumose setae.

Endite of maxilliped with 1 recurved coupling hook, lined with 7-10 apical moderately slender plumose setae. Palp 3-articulate, last article expanded and fringed with 6-10 long setae. Epipod laminar, distal margin rounded, outer and distal margin fringed with fine setae.

Pereopod 1 carpus triangular, flexor margin densely lined with simple setae and denticles ; propodus 1.9 times as long as greatest depth, tapering and curving distally, flexor margin with long simple setae; dactylus elongated, with simple setae.

Pereopods 2-7 similar in form and size, slightly longer than pereopod 1; carpus subrectangular; flexor margins of ischium to propodus densely fringed with simple setae and pubescence; extensor margins of carpus and merus armed with 1 or 2 simple setae; dactylus more elongate and straighter than that of pereopod 1. Pereopod 2 propodus as long as merus and carpus together, 2.8 times as long as wide. Pereopod 4 propodus 2.4 times as long as wide. Pereopod 7 propodus 3.5 times as long as wide.

Penes fused along entire length, 1.6 times as long as wide, swollen distally, with notched lateral and distal margins.

Pleopods 1 and 2 with plumose marginal setae on endopods and exopods, both rami without sutures. Pleopods 1-3 with about 11, 5 and 3 coupling hooks on inner margin of peduncles respectively. Pleopod 2 with appendix masculina elongated, reaching beyond distal margin of endopod by one-sixth of its length, mostly straight, distal quarter slightly curving medisally, with numerous spinules distally. Pleopods 3-5 with few and short simple marginal setae, incomplete transverse suture present from near middle of the outer margin of exopod.

Uropod 2.9 times as long as distal peduncle width, with short, simple setae, no oblique ridges on peduncle, distolateral angle with 3 plumose setae; endopod 0.3 length of peduncle, mesial length 0.7 proximal suture length, suture at 75° to long axis, distal margin truncate, at 75° to long axis, lateral margin gently convex between lateral and distal margins

*Female.* Maximum size, 7.6 x 3.1 mm (one of paratypes). Body stouter than male, 2.3-2.6 times as long as wide; pleotelson 1.2 times as long as wide; pereonal margins more evenly curved than in male. Antenna 2 with 13-15 articled flagellum. Maxilla 2 3-lobed, with plumose, simple and comb setae on endopod as figured; both inner and outer lobes of exopod lined with comb setae; no dense pubescence on pereopods 2-7. Oostegites lamellar on pereonites 1-4.

*Etymology.* The new species is named after Gary C. B. Poore, who has contributed significantly to our understanding of marine isopods in the Indo-Pacific region.

*Habitats.* The new species was most commonly found in association with macroalgae and hydroids in the fouling community of Singapore waters.

*Remarks.* Currently, 14 species of the genus *Synidotea* belong to the '*S. hirtipes* group', which was defined as a group of similar species characterized by a smooth body, entire or slightly excavate front of the head, and excavated pleotelson apex (Monod, 1931; Menzies and Miller, 1972; Poore, 1996). The group contains: *S. hirtipes* (Milne Edwards, 1840), *S. laevidorsalis* (Miers, 1881), *S. laticauda* Benedict, 1879, *S. harfordi* Benedict, 1879, *S. variegata*, Collinge, 1917, *S. marplatensis* Giambiagi, 1922, *S. fluviatilis* Pillai, 1954, *S. worlinensis* Joshi and Bal, 1959, *S. brunnea* Pires and Moreira, 1975, *S. hunumantharoei* Kumari and Shyamasundari, 1984, *S. keablei* Poore and Lew Ton, 1993, *S. grisea* Poore and Lew Ton, 1993, *S. oahu* Moore, 2004, and *S. fosteri* Schotte and Heard, 2004. Two more species, *S. innatans* and *S. karumba* from Australia, were just described and added into the group (Poore, 2012).

*Synidotea poorei* sp. nov. can be separated from *S. hirtipes* easily by its smooth uropodal peduncle (vs. two ridges in *S. hirtipes*). The new species is superficially similar to *S. lavidorsalis*, *S. laticauda*, *S. grisea* and *S. keablei*, but it can be separated from these species by the sub-parallel lateral margin of the pleotelson. It also differs from *S. laevidorsalis*

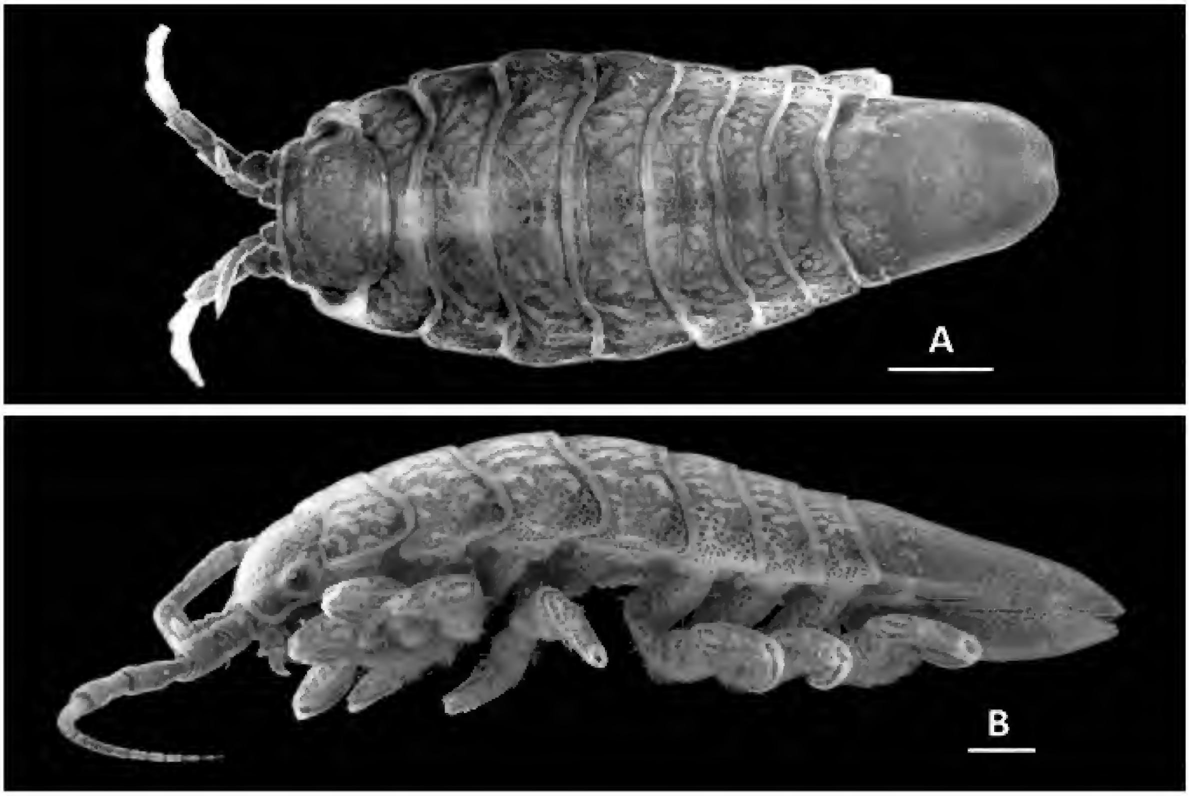


Figure 1. Photographs of *Synidotea poorei*, sp. nov. A. female, tl 7.4 mm, B. male, tl 12.9 mm, NMV. Scale bar = 1 mm.

by the shape of uropodal endopod (fig. 3G vs. fig. 1f in Poore, 1996) and the fused penial plates (fig. 3H vs. fig. 1k in Poore, 1996); from S. *laticauda* by the less excavated posterior end of the pleotelson; and from *S. keablei* by sexual dimorphism of the maxilla 2, and the elongated pleotelson. *Synidotea poorei* sp. nov. can be distinguished from *S. harfordi* by the shape of the lunette on the pereonites 2-4 (rounded vs. triangular) and the overall body form, which is more slender in the latter. *Synidotea poorei* is also similar to *S. brunnea* from which it can be separated by the more elongated antennae 1 and 2, and the shape of uropodal endopod (fig 3G vs. fig. 38 in Pires & Moreira, 1975). *Synidotea poorei*, also resembles *S. variegata* (cf. Collinge, 1917; Pillai, 1963) from which it differs by the more stout peduncle of antenna 2 (fig 3 in Collinge, 1917 vs. fig. 2C), stouter pleotelson (1.3 times as long as wide in female and 1.5 times in male of *S. poorei* vs. 1.7 times in *S. variegata*); and the shallower pleonal suture. With respect to the body form, the cephalon and the pleotelson, *S. poorei* is very similar to the Argentinean species *S. marplatensis*. It can be separated by the much longer appendix masculina (Fig. 3C, D vs. Fig. 4 in Giambiagi, 1922); and the smooth uropodal peduncle (vs. with an oblique ridge). *Synidotea poorei* can also be easily separated from the two recently described species, *S. fosteri* and *S. oahu* by its much longer antenna 2, and the smooth uropodal endopod.

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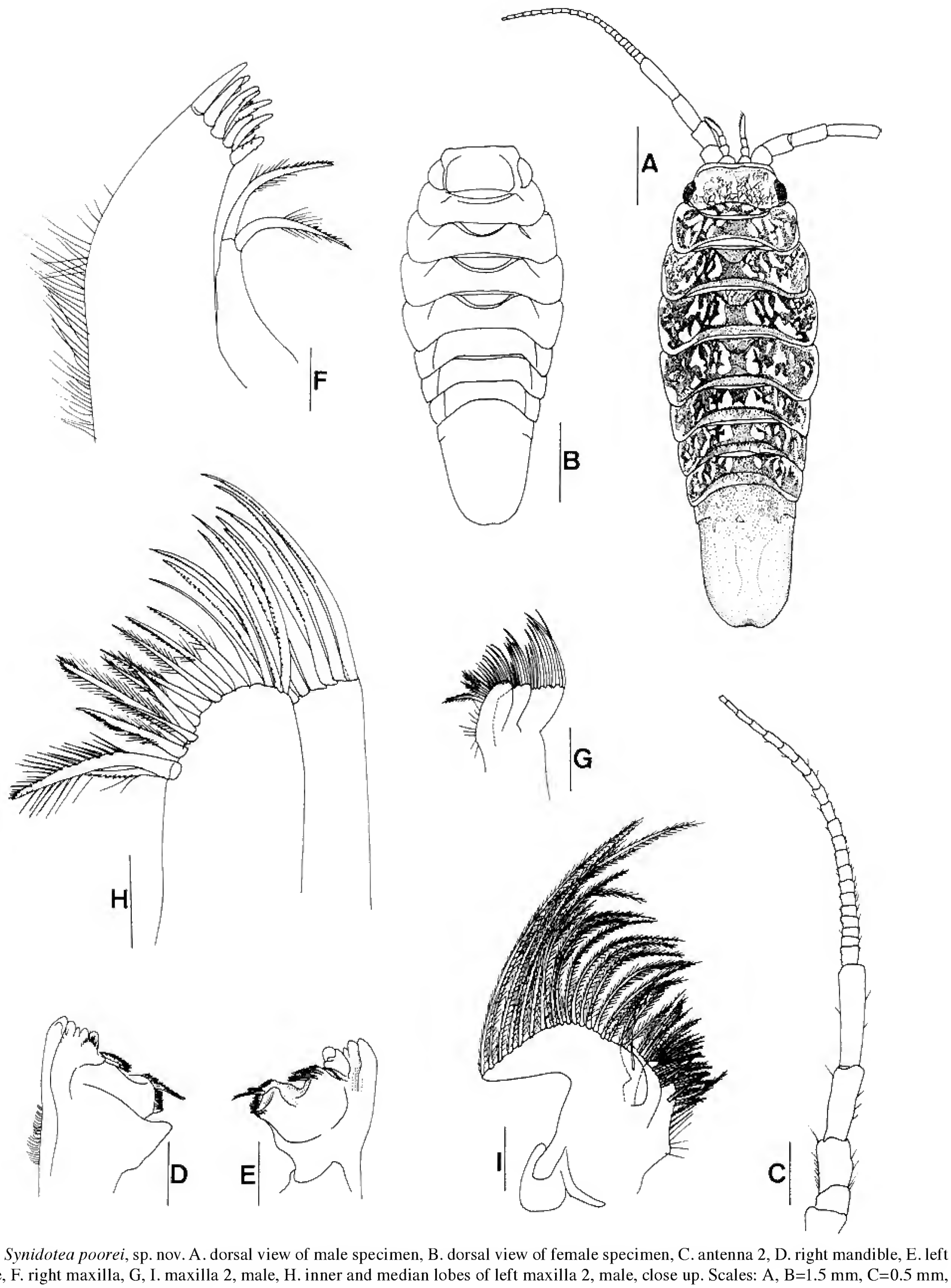


Figure 2. *Synidotea poorei*, sp. nov. A. dorsal view of male specimen, B. dorsal view of female specimen, C. antenna 2, D. right mandible, E. left mandible, F. right maxilla, G, I. maxilla 2, male, H. inner and median lobes of left maxilla 2, male, close up. Scales: A, B=1.5 mm, C=0.5 mm, D, E=0.2 mm, F, H=0.1 mm, G=2 mm.

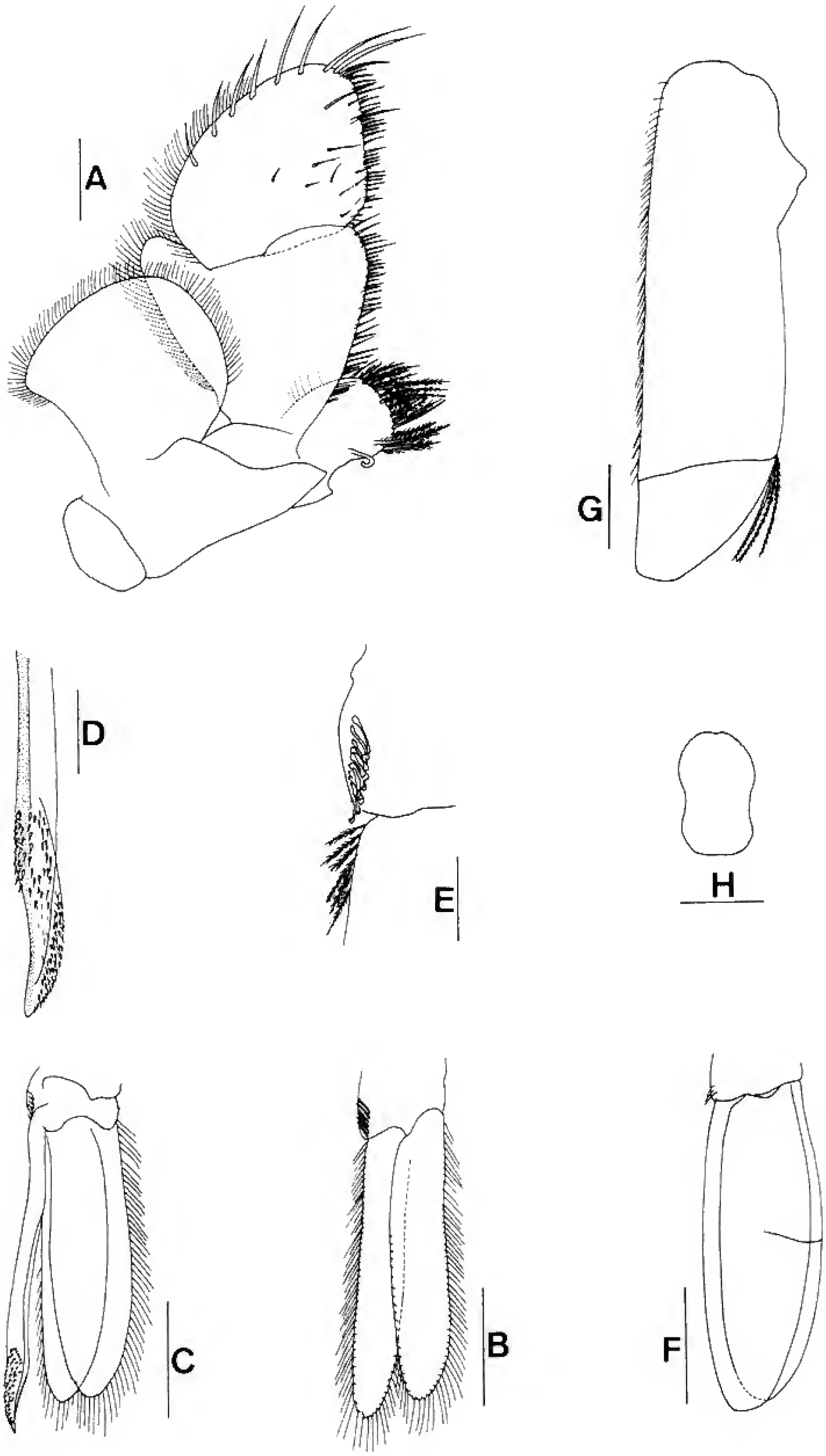


Figure 3. *Synidotea poorei*, sp. nov. A. left maxilliped, B. pleopod 1, male, C. pleopod 2, male, D. appendix masculina of pleopod 2, E. base of pleopod 1, F. pleopod 3, G. right uropod, H. penial papilla. Scales: A, D, E, G, H=0.2 mm, B, C, F=0.6 mm.

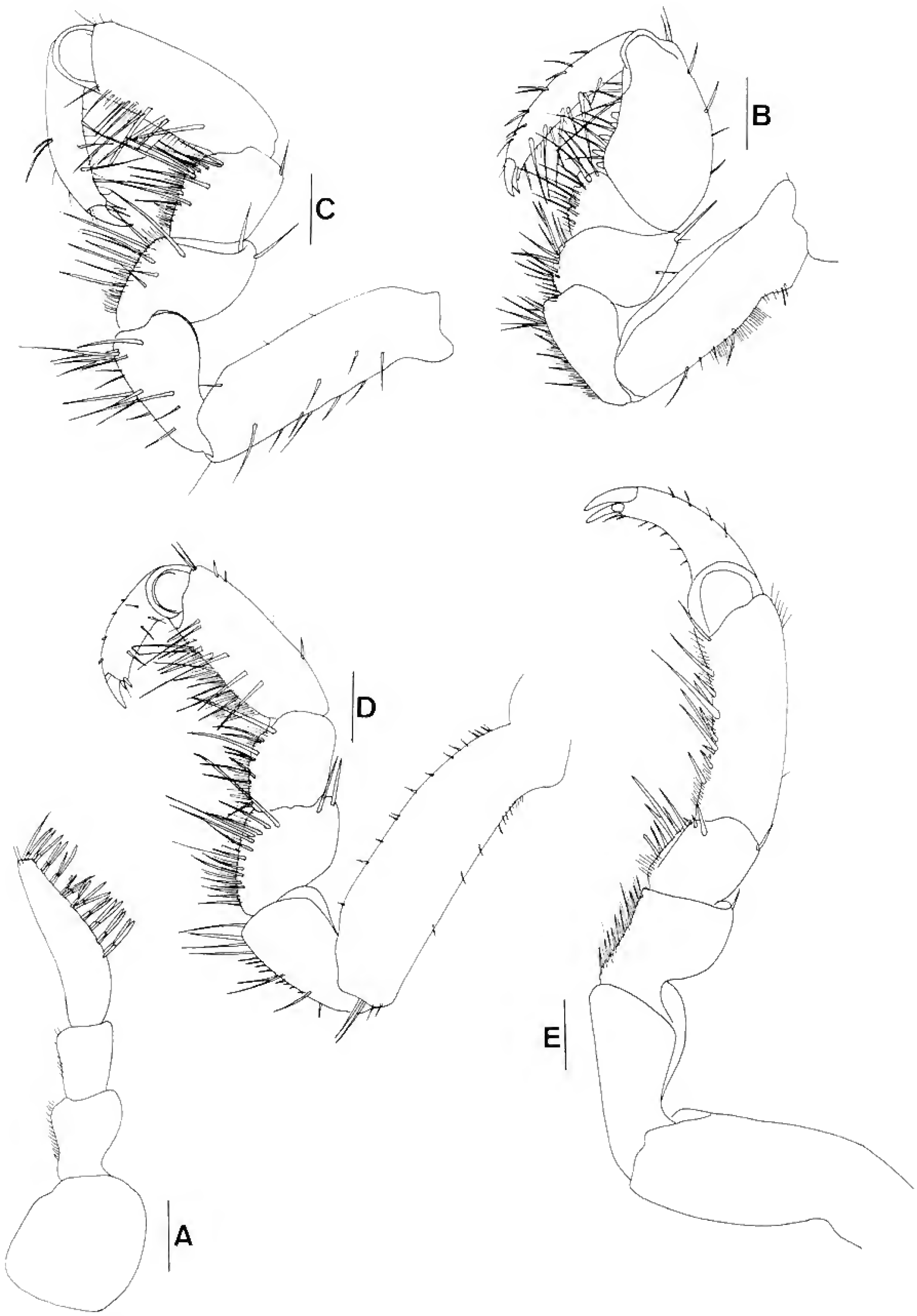


Figure 4. *Synidotea poorei*, sp. nov. A. left antenna 1, B. left pereopod 1, C. left pereopod 2, D. left pereopod 4, E. left pereopod 7. Scales: A-E=0.2 mm.

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# Two further species groups and new species among Australian *Hydrobiosella* Tillyard: new species from south-eastern Australia (Trichoptera: Philopotamidae)

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**Abstract** Cartwright, D.I. 2012. Two further species groups and new species among Australian *Hydrobiosella* Tillyard: new species from south-eastern Australia (Trichoptera: Philopotamidae). *Memoirs of Museum Victoria* 69: 245–258.

Eleven philopotamid caddisfly species in the genus *Hydrobiosella* Tillyard are newly described from Australia, based on small differences in features of the male genitalia. These species are placed in two new species groups, one based on *H. letti* Korboot, the other on *H. bandabanda* sp. nov.

The five species of the *Hydrobiosella bandabanda* group, all newly described here: *H. bandabanda*, *H. jibboor*, *H. jirrima*, *H. tarrong* and *H. tiarka*, share features of phallus with two or more embedded spines subapically and both preanal appendages and parameres absent. Females of four of these species are also figured in part. All five species are endemic to the eastern half of Victoria, mainland Australia.

The *H. letti* species group comprises seven species: *Hydrobiosella bifurca*, *H. bos*, *H. excilatas*, *H. fibra*, *H. incisura*, *H. letti* Korboot and *H. tenuitas*, united in having features such as elongate, nearly straight parameres arising near middle to base of phallus, no obvious spines in phallus and presence of preanal appendages. Females of two of these species are also partly figured. These seven species are all are endemic to eastern coastal mainland Australia, from north-eastern Victoria to eastern Queensland.

**Keywords** Trichoptera, caddisflies, Philopotamidae, *Hydrobiosella*, Australia.

## Introduction

The recent history of the genus *Hydrobiosella* Tillyard in Australia is revised and summarized by Cartwright (2010, 2012a, 2012b). In brief, the first Australian species in the genus were described in 1953 by Mosely (in Mosely and Kimmins, 1953). Further species were added by Korboot (1964); Jacquemart (1965); (Neboiss, 1977, 1982, 2003) and Cartwright (2010, 2012a, 2012b). A total of 53 species of *Hydrobiosella* are known worldwide: from Australia (43 species — Cartwright 2012b), New Zealand (4 species — Morse 1999) and New Caledonia (6 species — Espeland and Johannson 2007).

Groups were first recognized among Australian *Hydrobiosella* by Neboiss (1977) for Tasmanian species). He *diagnosed* three groups based primarily on male genitalia and these, the *H. bispina*, *H. eminentia* and *H. waddama* species groups were detailed more recently and included in an updated key to the Australian species and species group (Cartwright 2010, 2012a, 2012b). Two further species groups are diagnosed here and include 11 newly described species which bring to 54 the total number of Australian species of *Hydrobiosella*. Australian mainland species in the *H. waddama* group have recently been reviewed (Cartwright 2012b).

In this study of the newly recognised *Hydrobiosella bandabanda* group, 60 male and 10 female specimens were examined, determined to be referable to five very similar species. The more common species in the group were, *H. tiarka* comprising about 41% of specimens, *H. bandabanda* 30%, *H. jirrama* 17%, and *H.tarrong* with about 10% of specimens. One species, *H. jibboor*, is known from only one specimen. No differentiation of female genitalia has been established as yet. All five species were collected from south-eastern Australia, within the Bassian region, a distribution suggestive of a 'southern' origin.

This revision of the Australian '*Hydrobiosella letti*' group is based on some 37 male and 36 female specimens, referred to seven species. The most common species, *H. bifurca*, contributed about 79% of all *H. letti* species group specimens. All six other species are known from fewer than five specimens. The seven species of this group, including the six new species were collected from eastern Australia, north-eastern Victoria, central-eastern New South Wales and eastern Queensland. Three of the seven species are from north-eastern Queensland, so southern or northern Australia origins could be postulated equally for the group.

## Methods and abbreviations

Among species in this genus, size, and body and wing colour can be useful distinguishing characters, but are often variable. Wing and body colour can be most useful in freshly preserved material but the colour often fades with time in alcohol. Most of the material studied has been preserved in alcohol for many years and was on loan from Museum Victoria, made available by the late Dr Arturs Neboiss. Depositories for specimens are abbreviated as follows: Museum Victoria, Melbourne (NMV), Australian National Insect Collection, Canberra (ANIC), the Natural History Museum, London (BMNH) and the Queensland Museum, Brisbane (QM). All specimens, including types, mentioned in the text are lodged in the NMV unless stated otherwise.

Males of each species are most easily distinguished by genitalic features, but usually require clearing of the abdomen in potassium hydroxide. Females were paired with respective males on the basis of similarities in size and coloration, and on wing venation and locality.

Figured specimens are identified by the notebook numbers of Dr Arturs Neboiss (NMV), prefix PT-; or the author; prefix CT-. Terminology used generally follows that of Neboiss (1977, 1982), Blahnik (1998, 2005) and Holzenthal et al. (2007). Terminology used for genitalic parts are indicated on selected figures for each genus and additionally where necessary. Typically, setae or spines are illustrated only on the right side of the figure (as viewed) to enable a better view of the underlying structures. Length/width measurements generally mean maximum length divided by maximum width.

## Descriptions

### *Hydrobiosella* Tillyard **1924**

*Hydrobiosella* Tillyard 1924: 288; Mosely and Kimmins 1953: 387; Neboiss 1977: 45; Neboiss 2003: 55.

*Type species*. *Hydrobiosella stenocerca* **Tillyard by monotypy.**

Generic descriptions are given by Tillyard (1924: 288); Mosely and Kimmins (1953: 387) and Neboiss (1977: 45).

### Key to males of known Australian groups (or ungrouped species) of *Hydrobiosella* Tillyard (after Cartwright 2010, 2012)

1. Phallus without pair of parameres (Figs 2, 3, 5, 6; Cartwright 2012a, figs 2, 3; Neboiss 1986, figs pp. 99, *H. amblyopia*; 101, *H. tasmanica*; 102, *H. corinna*) ........ 2

\- Phallus with pair of parameres (Cartwright 2010, figs 2, 3, 5, 6; Neboiss 1986, figs pp. 99, *H. michaelseni*, *H. waddama*; 101, *H. letti*; 102, *H.bispina*; 103, *H. arcuata*) ........ 6

2. Preanal appendages present, usually small (Cartwright2012a, figs 2, 3; Neboiss 1977, figs 204, 205, 216, 217; Neboiss 1986, figs pp. 101, *H. tasmanica*; 102, *H. corinna*; Neboiss 2003, figs 8a–h) ........ 3

\- Preanal appendages absent (Figs 2, 3, 18, 19; Neboiss 1986, figs pp. 99, *H. amblyopia*; 101, *H. tasmanica*) ........ 4

3. Preanal appendages relatively slender, elongate and 'unattached' to segment IX (Cartwright 2012a, figs 2, 3, 5); NE-Qld ........ *Hydrobiosella eminentia* group

\- Preanal appendages often short and bulbous or 'attached' to segment IX (Neboiss, 1977, figs 204-211; Neboiss 1986, figs p. 102, *H. corinna*; Neboiss, 2003, figs 8A-H); Tas ........ *Hydrobiosella corinna* group

4. Phallus apically with downward projecting spine(s) (Neboiss 1977, figs 216-221, 225, 226; Neboiss 1986, figs p. 101, *H. armata*, *H. tasmanica*; Neboiss 2003, figs 10A-G, 11A-G, 12A-F); Tas ........ *H. tasmanica* group

\- Phallus apically without downward projecting spine(s) (Figs 2, 3; Neboiss 1982, fig. 12; Neboiss 1986, figs p. 99 *H. amblyopia*) ........ 5

5. Segment IX with a large disto-lateral projection (Neboiss 1982, fig. 12; Neboiss 1986, figs p. 99 *H. amblyopia*); S-WA ........ *H. amblyopia* (ungrouped)

\- Segment IX without a large disto-lateral projection (Figs 2, 3, 5, 6); C and NE Vic ........ *H. bandabanda* group

6. Inferior appendages with harpago with dark row of setae forming fringe along ventral margin (Cartwright 2010, figs 3, 6; Neboiss 1986, figs pp. 102, *H.bispina*; 103, *H. arcuata*); E-Vic, E-NSW, E-Qld ........ *Hydrobiosella bispina* group

\- Inferior appendages with harpago without dark row of setae forming fringe along ventral margin (Figs 18, 19; Neboiss 1986, figs pp. 99, *H. michaelseni*, *H. waddama*) ........ 7

7. Parameres elongate and sinusoidal, attached ventrally to base of phallus (Cartwright 2012b, figs 2, 3, 5, 6; Neboiss 1977, fig. 233; Neboiss 1986, figs p. 99, *H. waddama*); Tas, SE Aust. ........ *Hydrobiosella waddama* group

– Parameres not elongate and sinusoidal, not attached ventrally to base of phallus (Figs 18, 19; Neboiss 1982, figs 9, 10; Neboiss 1986, figs pp. 99, *H. michaelseni*; 101, *H. letti*) ........ 8

8. Parameres curved strongly and crossed (Neboiss 1982, figs 9, 10; Neboiss 1986, figs p. 99; *H. michaelseni*); S-WA ... *Hydrobiosella michaelseni* (Ulmer) (unplaced to group)

\- Parameres not curved strongly and crossed (Figs 18, 19; Neboiss 1986, figs p. 101, *H. letti*); NE-Vic, CE-NSW, E-Qld ........ *Hydrobiosella letti* group

### *Hydrobiosella bandabanda* group

*Diagnosis*. Key characters of males in the group are phallus without parameres but with two or more embedded spines subapically and preanal appendages absent.

*Description*. Head and nota dorsally brown to dark brown with pale setal warts and scutellum, abdomen brownish dorsally and ventrally, paler laterally; wings light brown to brown. Medium-sized adults. Forewing length about 2.8–3.1 times maximum width, males: 5.9–9.8 mm; females: 6.1–10.8 mm; wing venation (Fig. 1), similar to the type species *H. stenocerca* (Mosely and Kimmins 1953, fig. 265a), *H. bispina* (Cartwright, 2010, fig. 1) and *H. waddama* (Mosely and

Kimmins 1953, fig. 269a), R1 simple, forks 1, 2, 3, 4 and 5 present; forks 1 and 2 sessile; fork 2 with nygma present, length about 1.3–1.4 times length fork 1; fork 3 shorter, length 0.7 times length fork 2, fork 3 length ranging from between 1.8–1.9 times length footstalk, cross-veins r-m and m contiguous at fork 3; fork 4 similar length to fork 3, fork length about 7 times length footstalk; fork 5 very long, length between 1.6–1.7 times length fork 4; discoidal cell closed, length between 3.7–3.8 times maximum width. Hind wing length about 2.4–2.5 times maximum width; forks 1, 2, 3 and 5 present; forks 1 and 2 sessile; fork 2 with nygma, length fork 2 between 1.4–1.5 times length fork 1; fork 3 shorter, length about 0.6 times length fork 2, fork 3 slightly longer than footstalk, length fork ranging between 1.3–1.4 times length footstalk; fork 5 very long, length between 1.8–1.9 times length fork 3; discoidal cell closed, length between 4.0–4.1 times maximum width; with three longer anal veins (Fig. 1).

*Male*. Segment IX with a shallow, wide V notch medially on distal margin (Figs 4, 7, 10). Preanal appendages absent. Segment X mainly sclerotised, dorso-ventrally compressed; in dorsal view, with a 'tongue-shaped' process, tapered distally, rows of fine hairs meso-laterally and usually a pair of small knobs baso-laterally (Figs 2, 5). Phallus generally robust, tube-like, with a pair of spines sub-apically, sometimes with one or two spines more basally (Figs 2, 3, 5, 6). Inferior appendages with two segments, in lateral view, basal segment usually more robust and longer than harpago. Harpago has a small field of dark spines meso-distally (Figs 3, 6).

*Female*. Genitalia typical of genus with a small projection on sternite IX mesodistally (Figs 38-41).

*Larva*. Confirmed larvae are known for *H. bandabanda*. These larvae match *Hydrobiosella* sp. AV2 (Cartwright, 1997). The diagnostic features are head wide and angular laterally, and forecoxa with two sclerotised processes on anterior margin, one longer than the other (Cartwright, 1997, fig. 1.3). *Hydrobiosella* sp. AV2 larvae are recorded mainly from riffle habitats of very small to medium-sized streams between 0.4-8 m wide at moderate to high altitudes between 800-1460 m (Suter et al. 2006).

**Key to males of species of the *Hydrobiosella bandabanda* group from Australia**

1. Segment X dorsally with a central ridge bearing pair of acute lateral processes (Figs 2, 2a); EC-Vic ........ *H. bandabanda*
- Segment X without a central dorsal ridge (Figs 5, 8) ........ 2
2. Segment X with sub-apical spine (Fig. 6); E-Vic ........ *H. tiarka*
- Segment X without apical spine (Figs 9, 12) ........ 3
3. Segment X in lateral view with apical half slender, not dilated apically; inferior appendages with terminal segment dilated slightly in apical half (Fig. 9); NE-Vic ........ *H. tarrong*
- Segment X in lateral view with apical half robust, dilated apically; inferior appendages with terminal segment not dilated in apical half (Figs 12, 15) ........ 4
4. Segment X with a dorsal 'bump' subapically (Fig. 12); NE-Vic ........ *H. jibboor*
- Segment X without a dorsal 'bump' subapically (Fig. 15); NE-Vic ........ *H. jirrima*

***Hydrobiosella bandabanda*** sp. nov.

Figures 1, 2, 2a, 3, 3a, 4, 4a, 38, 38a

Holotype. Male. Victoria, Toorongo Falls, 7 km NE of Noojee, (about 37°51'S, 146°00'E), 27 Nov 1981, J. Morse & A. Neboiss (NMV, T- 21392).

Paratypes. Victoria. 4 males (specimen CT-593 figured), 1 female (specimen CT-594 figured), collected with holotype; 7 males (specimen PT-581 figured), 2 females (specimen CT-612 figured), Newlands Ck, Upper Thomson R. (about 37°37'S, 146°10'E), 26 Feb 1978, TR Survey (NMV).

*Other material examined*. Victoria. 2 males, Falls Ck Ski Village, 26 Mar 1957, A. Neboiss; 1 male, Cumberland Falls, SE of Marysville, 7 Jan 1971, A. Neboiss; 1 male, Baw Baw Ski Village, 4900 ft, 8 Jun 1974, J.C.; 1 male, Cement Ck, Mt Donna Buang Rd, 3 Mar 1980, J. Dean?; 1 male, small ck 1 km N Rum Ck, 9 Nov 1983, D. Cartwright (NMV).

*Diagnosis*. Males of *Hydrobiosella bandabanda* can be distinguished from those of other species in the group by a central dorsal ridge or groove with a pair of lateral acute processes on segment X.

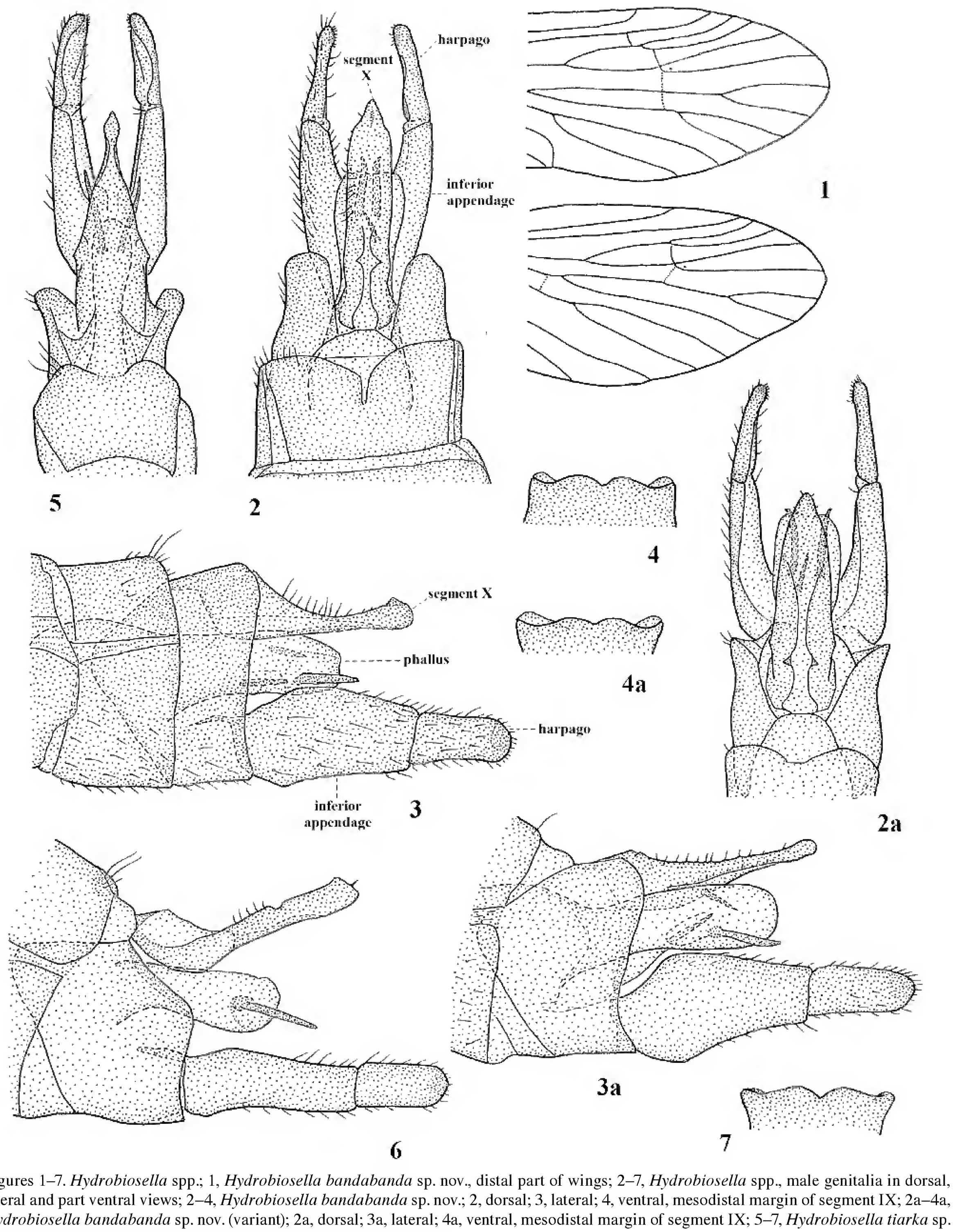
*Description*. Wings typical of the genus (Fig. 1), similar to those of *H. bispina* (Cartwright, 2010, fig. 1). Length of forewing; male 6.7–9.1 mm, female 7.2–9.3 mm.

*Male*. Segment IX with a shallow, wide V-shaped notch medially on distal margin (Figs 4, 4a). Segment X in dorsal view, a 'tongue-shaped' process, with sides almost parallel, a pair of small knobs baso-laterally, tapered distally and with a central dorsal ridge or groove bearing a pair of lateral acute processes (Figs 2, 2a), length about 3-3.5 times width; in lateral view broad-based, slightly curved (Fig. 3), or straight (Fig. 3a) slender in middle, usually slightly dilated distally with a sub-apical 'knob' (Fig. 3), sometimes without 'knob' (Fig. 3a). Phallus generally tube-like, robust, with a pair of sub-apical spines and two smaller spines basally (Figs 2, 2a, 3, 3a). Inferior appendages in lateral view, with basal segment broadest near middle, length about twice maximum width; harpago shorter, length about half length basal segment, more slender, length about twice maximum width, apex broadly rounded (Figs 3, 3a).

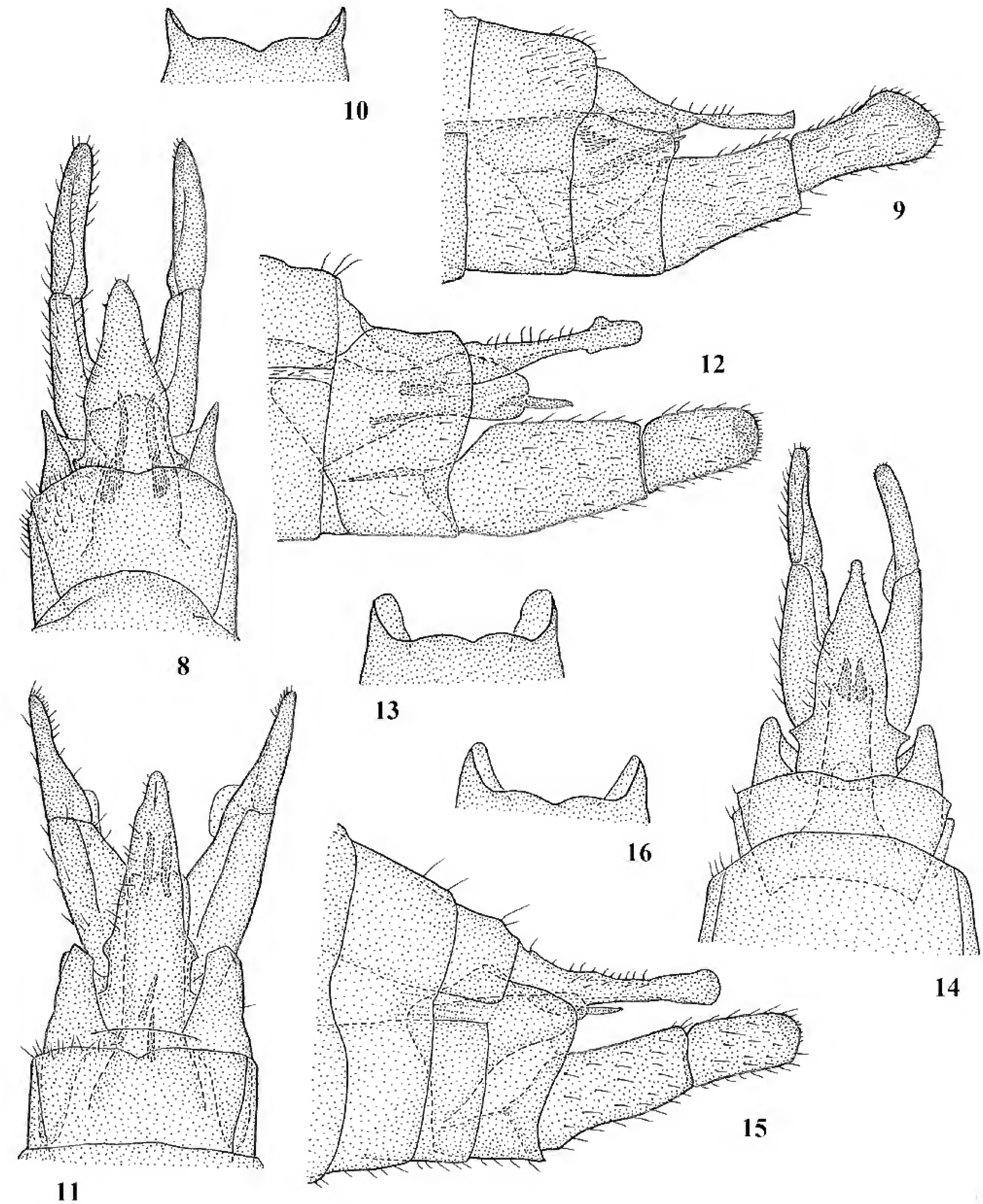
*Female*. Genitalia typical of genus, with a small acute projection on sternite IX meso-distally (Figs 38, 38a).

*Etymology*. *Bandabanda* – Australian aboriginal word for split or broken open (dorsal groove on segment X).

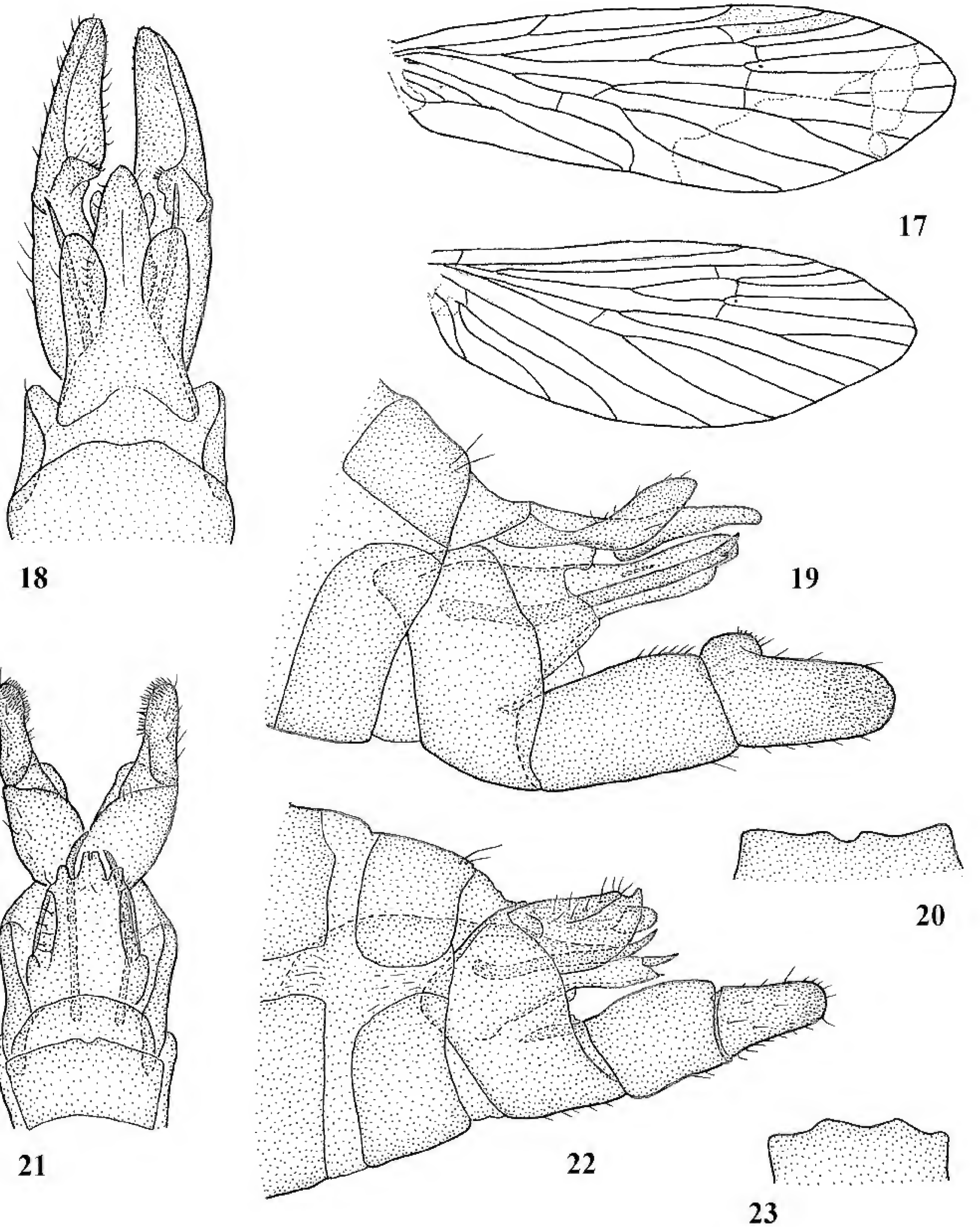
*Remarks*. *Hydrobiosella bandabanda* shows slight variation among the 21 specimens collected from 7 localities in eastern-central and north-eastern Victoria (latitudinal range 36°52'–37°51'S).



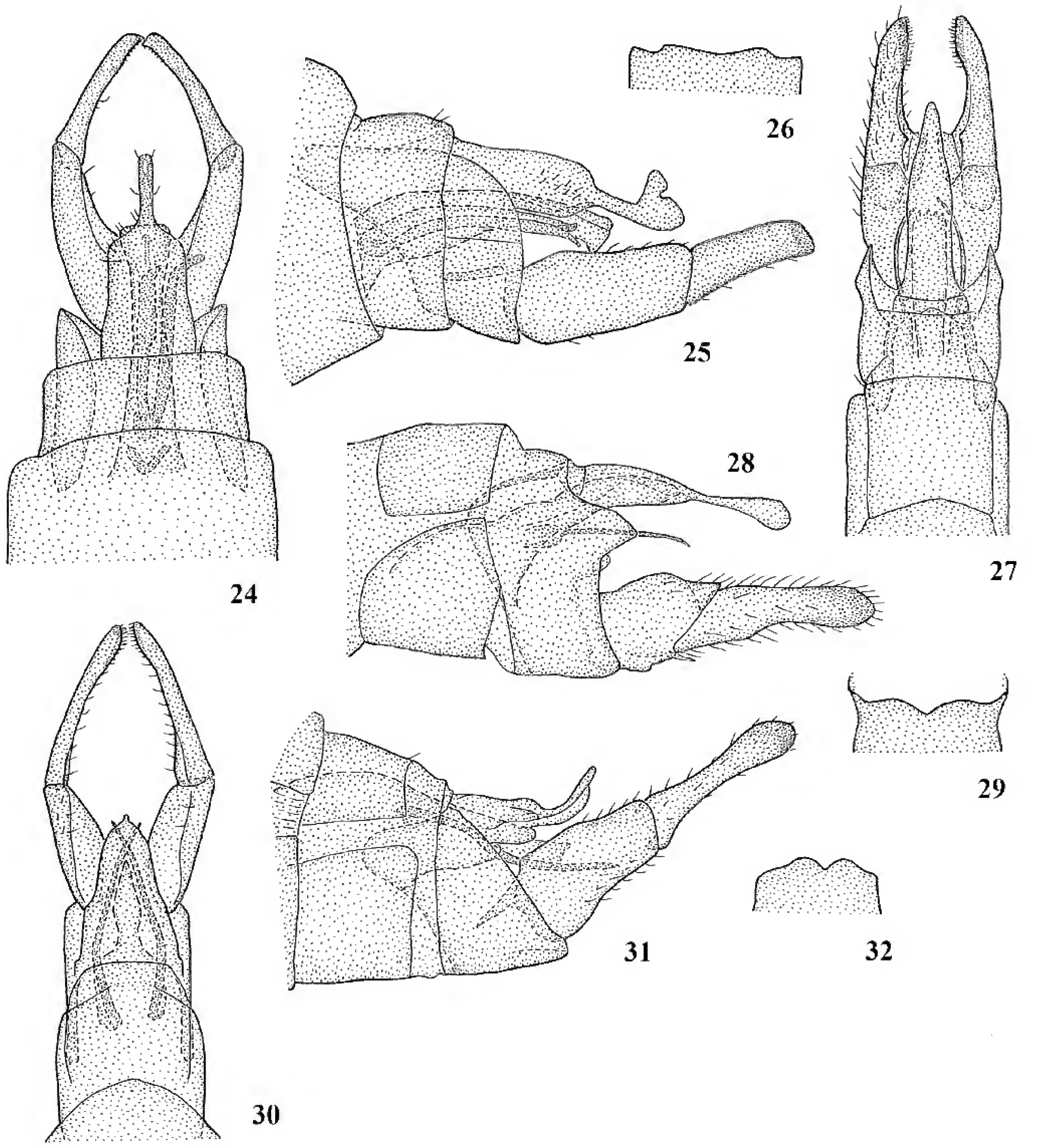

Figures 1–7. *Hydrobiosella* spp.; 1, *Hydrobiosella bandabanda* sp. nov., distal part of wings; 2–7, *Hydrobiosella* spp., male genitalia in dorsal, lateral and part ventral views; 2–4, *Hydrobiosella bandabanda* sp. nov.; 2, dorsal; 3, lateral; 4, ventral, mesodistal margin of segment IX; 2a–4a, *Hydrobiosella bandabanda* sp. nov. (variant); 2a, dorsal; 3a, lateral; 4a, ventral, mesodistal margin of segment IX; 5–7, *Hydrobiosella tiarka* sp. nov.; 5, dorsal. 6, lateral; 7, ventral, mesodistal margin of segment IX.



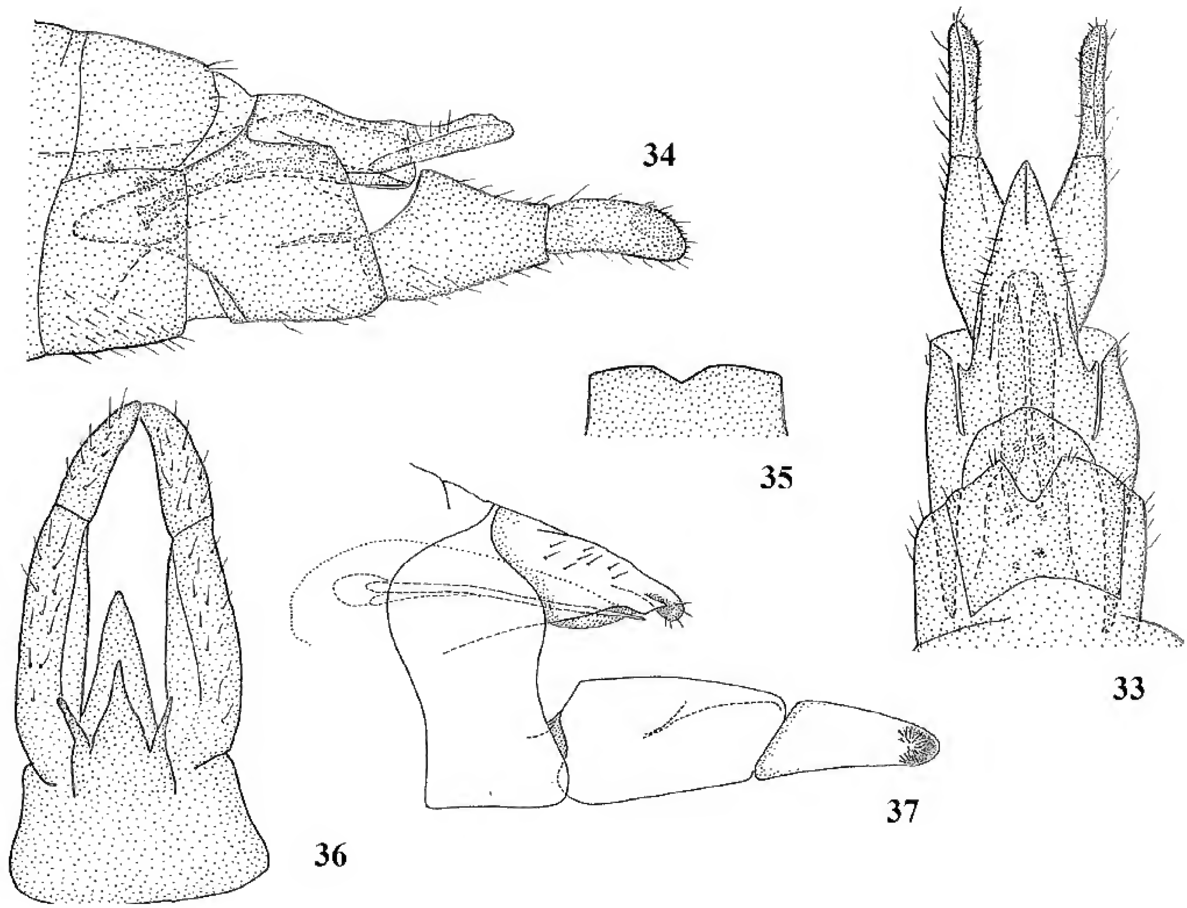

Figures 8–16. *Hydrobiosella* spp.; male genitalia in dorsal, lateral and part ventral views; 8–10, *Hydrobiosella tarrong* sp. nov.; 8, dorsal, 9, lateral, 10, ventral, mesodistal margin of segment IX; 11–13, *Hydrobiosella jibbor* sp. nov.; 11, dorsal; 12, lateral; 13, ventral, mesodistal margin of segment IX; 14–16, *Hydrobiosella jirrima* sp. nov.; 14, dorsal; 15, lateral; 16, ventral, mesodistal margin of segment IX.




Figures 17–23. *Hydrobiosella* spp.; 17, *Hydrobiosella letti* Korboot., wings. 18–23, Hydrobiosella spp., male genitalia in dorsal, lateral and part ventral views; 18–20, *Hydrobiosella fibra* sp. nov.; 18, dorsal; 19, lateral; 20, ventral, mesodistal margin of segment IX; 21–23, *Hydrobiosella bifurca* sp. nov.; 21, dorsal; 22, lateral; 23, ventral, mesodistal margin of segment IX.



Figures 24–32. *Hydrobiosella* spp.; male genitalia in dorsal, lateral and part ventral views; 24–26, *Hydrobiosella incisura* sp. nov.; 24, dorsal; 25, lateral; 26, ventral, mesodistal margin of segment IX; 27–29, *Hydrobiosella tenuitas* sp. nov.; 27, dorsal; 28, lateral; 29, ventral, mesodistal margin of segment IX; 30–32, *Hydrobiosella exilatis* sp. nov.; 30, dorsal; 31, lateral; 32, ventral, mesodistal margin of segment IX.




Figures 33–37. *Hydrobiosella* spp.; male genitalia; 33–35, *Hydrobiosella bos* sp. nov.; male genitalia in dorsal, lateral and part ventral views; 33, dorsal; 34, lateral; 35, ventral, mesodistal margin of segment IX; 36–37, *Hydrobiosella letti* Korboot; male genitalia in dorsal and lateral views; 36, dorsal; 37, lateral.

***Hydrobiosella tiarka*** sp. nov.

Figures 5–7, 39

Holotype. Male. Victoria. Cement Ck nr Warburton (about 37°43'S, 145°43'E), 8 Dec. 1970, A. Neboiss (NMV, T-21407).

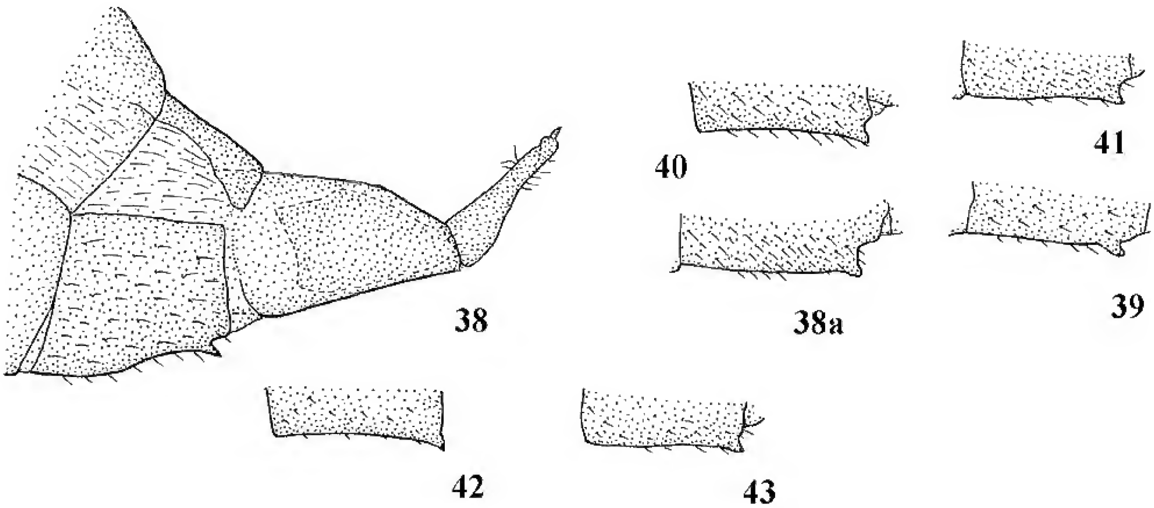
Paratypes. Victoria. 7 males, collected with holotype; 4 males (specimen PT-584 figured), same loc. and coll., 27 Mar 1972; 1 male, same loc., 29 Sep 1990, B. Armitage; 1 male, Cement Ck, 5 Feb 1955, A. Neboiss; 1 male, same loc. and coll., 19 Nov 1955; 1 female (specimen CT-614 figured), Cement Ck, Mt Donna Buang, 8 Apr 1976, Cartwright; 1 male, same loc. and coll., 1 Dec 1976 (NMV).

*Other material examined*. Victoria. 3 males, Cement Ck Mt Donna Buang-Warburton Rd, 23 Feb 2012, D. Cartwright; 1 male, Erica, 29 Jan 1960, A. Neboiss; 1 male, 1 female, Toorongo Falls, NE Noojee, 17 Dec 1970, A. Neboiss; 1 male, Brittania Ck, 6km S of Warburton, 27 Feb 1976, A. Neboiss; 3 males, 1 female, Ada R. on Ada River Rd, 37°50.8'S 145°52'E, 19 Jan 1979, Latrobe C Survey; 1 male, same loc. and coll., 10 Feb 1980 (NMV).

*Diagnosis*. Males of *Hydrobiosella tiarka* can be separated from those of other species in the group by the small apical spine and slightly bulbous apex on segment X.

*Description*. Wings similar to those of *H. bandabanda* (Fig. 1); length of forewing, male 6.7–9.8 mm; female 8.2–10.8 mm.

*Male*. Segment IX with a shallow, wide V-shaped notch medially on distal margin (Fig. 7). Segment X in dorsal view, a 'tongue-shaped' process, with almost parallel sides in basal half, with a pair of very small knobs meso-laterally, tapered strongly distally to a small apical, slightly bulbous knob, length about 2.9 times width, without a central dorsal ridge or groove (Fig. 5); in lateral view broad-based, narrowed at basal third, slender with almost parallel sides in distal two thirds, with short apical spine (Fig. 6). Phallus generally tube-like, robust, with a pair of slightly divergent sub-apical spines (Figs 5, 6). Inferior appendages in lateral view, slender, with basal segment sub-rectangular, length




Figures 38–43. *Hydrobiosella* spp. Female genitalia (part segment VIII) in lateral view; 38, *Hydrobiosella bandabanda* sp. nov.; lateral; 38a, *Hydrobiosella bandabanda* sp. nov. (variant) lateral; 39, *Hydrobiosella tiarka* sp. nov.; lateral; 40, *Hydrobiosella tarrong* sp. nov.; lateral; 41 *Hydrobiosella jirrima* sp. nov.; lateral; 42, *Hydrobiosella bifurca* sp. nov.; lateral; 43, *Hydrobiosella bos* sp. nov

about 2.8 times maximum width; harpago shorter, length about half length basal segment, length about 2.1 times maximum width, with broad rounded apex (Fig. 6).

*Female*. Genitalia typical of genus, with a small projection on sternite IX meso-distally (Fig. 39).

*Etymology*. *Tiarka* – Australian Aboriginal word for toothpick or sharp (apical spine on tergum X).

*Remarks*. Twenty-six male and three female specimens of *Hydrobiosella tiarka* have been collected from six localities in eastern-central Victoria (latitudinal range 37°43'-37°58' S).

***Hydrobiosella tarrong*** sp. nov.

Figures 8–10, 40

Holotype. Male. Victoria, Cement Ck nr Warburton (about 37°43'S, 145°43'E), 26 Mar 1958, A. Neboiss (NMV, T-21425).

Paratypes. Victoria. 2 males (specimen CT-609 figured), 3 females (specimen CT-610 figured), collected with holotype; 1 male, same loc. and coll., 27 Mar 1972 (NMV).

*Diagnosis*. Males of *Hydrobiosella tarrong* can be separated from those of other species in the group by the slender apical half of segment X, in lateral view and the inferior appendages with harpago dilated slightly in apical half.

*Description*. Wings similar to those of *H. bandabanda* (Fig. 1); length of forewing: male 7.8–9.0 mm, female 8.5–9.0 mm.

*Male*. Segment IX with a shallow, wide notch medially on distal margin (Fig. 10). Segment X in dorsal view, a 'tongue-shaped' process, with sides almost parallel in basal half, with a pair of very small knobs baso-laterally, tapered distally to a slightly rounded apex, without a central dorsal ridge or groove (Fig. 8); length about 1.7 times width; in lateral view broad-based, narrowed strongly at midpoint, slender with almost parallel sides in distal half (Fig. 9). Phallus generally tube-like, robust, slightly truncate, with a pair of sub-apical spines and two groups of chitinous spines basally (Figs 8, 9). Inferior appendages in lateral view, robust, with basal segment sub-rectangular, slightly angular meso-dorsally, length about 1.8-1.9 times maximum width; harpago shorter, length about 0.8 times length basal segment, length about 1.9 times maximum width, with slightly dilated, broadly rounded apex (Fig. 9).

*Female*. Genitalia typical of genus, with a small projection on sternite IX meso-distally (Fig. 40).

*Etymology*. *Tarrong* – Australian aboriginal word for teeth (pair of 'chitinous spines' in middle of phallus).

*Remarks*. Four male and three female specimens of *Hydrobiosella tarrong* have been collected from the type locality in eastern-central Victoria (latitude 37°43'S).

***Hydrobiosella jibboor*** sp. nov.

Figures 11–13

Holotype. Male (specimen CT-611 figured). Victoria, Mt Buller, headwaters Chalet Ck, 1400 m (about 37°10'S, 146°25'E), 19 Mar. 1993, I. Campbell (NMV, T- 21437).

*Diagnosis*. Males of *Hydrobiosella jibboor* can be separated from those of other species in the group by the dorsal 'raised ridge' sub-apically on segment X and rounded apex and segment IX with almost straight distal margin.

*Description*. Wings similar to those of *H. bandabanda* (Fig. 1), length of forewing: male 6.9 mm.

*Male*. Segment IX with a weak notch in meso-ventral margin (Fig. 13), and with an almost straight distal margin (Fig. 12). Segment X in dorsal view, a 'tongue-shaped' process, with almost parallel sides in basal third, with a pair of very small knobs baso-laterally, tapered distally to a rounded apex, length about 2.3 times width, without a central dorsal ridge or groove (Fig. 11); in lateral view tapered slightly in basal two thirds, slightly bulbous sub-apically with a small dorsal 'raised ridge' (Fig. 12). Phallus generally tube-like, robust, with a pair of narrowly separated sub-apical spines, with two more spines basally (Figs 11, 12). Inferior appendages in lateral view, robust, with basal segment sub-rectangular, length about twice maximum width; harpago shorter, length about half length basal segment, length about 1.6–1.7 times maximum width, with broad rounded apex (Fig. 12).

*Female*. Unknown.

*Etymology*. *Jibboor* – Victorian Aboriginal word for mountain (type locality — Mt Buller).

*Remarks*. A single male specimen of *Hydrobiosella jibboor* has been collected from the type locality in north-eastern Victoria (latitude 37°10'S).

### *Hydrobiosella jirrima* sp. nov.

Figures 14–16, 41

Holotype. Male. Victoria, McKay Ck, Sassafras Gap (about 36°37'S, 147°47'E), 2 Feb. 1974, A. Neboiss (NMV, T- 21438).

Paratypes. Victoria. 3 males (specimen CT-586 figured), collected with holotype; 5 males, 1 female (specimen CT-613 figured), Sassafras Gap, 13 Feb 1963, A. Neboiss; 1 male, Gibbo R., S of Donovan Ck jn, 3 Feb 1974, A. Neboiss; 1 male, roadside trickles, 1.2km N Sassafras Gap, lt tr., 11 Feb 2010, R. StClair and D. Cartwright (NMV).

*Diagnosis*. Males of *Hydrobiosella jirrima* can be distinguished from those of other species in the group by the absence of a short dorsal 'raised ridge' subapically and slender apex on segment X.

*Description*. Wings similar to those of *H. bandabanda* (Fig. 1); length of forewing, male 6.6–7.8 mm, female 6.6 mm.

*Male*. Segment IX with a weak wide notch in meso-ventral margin (Fig. 16), and an almost rounded distal margin (Fig. 15). Segment X in dorsal view, a 'tongue-shaped' process, with almost parallel sides in basal quarter, with a pair of very small acute knobs baso-laterally, tapered distally to a narrow apex, without a central dorsal ridge or groove (Fig. 14); length about 1.9 times width; in lateral view weakly broad-based, tapered slightly in basal two thirds, very slightly bulbous apically (Fig. 15). Phallus generally tube-like, robust, with a pair of narrowly separated sub-apical spines (Figs 14, 15). Inferior appendages in lateral view, robust, with basal segment sub-rectangular, length about 2.3 times maximum width; harpago shorter, length about 0.6 times length basal segment, length about twice maximum width, with broad rounded apex (Fig. 15).

*Female*. Genitalia typical of genus, with a small projection on sternite IX meso-distally (Fig. 41).

*Etymology*. *Jirrima* – Australian aboriginal word for a mountain (type locality Sassafras Gap).

*Remarks*. Eleven males and one female of *Hydrobiosella jirrima* have been collected from three sites near the type locality in north-eastern Victoria (latitudinal range 36°37'-36°39'S).

### *Hydrobiosella letti* group

Diagnosis. Key characters of males in the group are parameres elongate and straight or slightly curved, arising near base or middle of phallus, and preanal appendages absent.

*Description*. Head and body generally brown; wings light brown to brown. Medium sized adults. Forewing length, males: 4.5-8.0 mm; females: 5.8-9.4 mm; forewing length about 2.9-3.0 times maximum width, wing venation (Fig. 17), similar to *H. stenocerca* (Mosely and Kimmins 1953, fig 265a), *H. bispina* (Cartwright, 2010, fig. 1) and *H. waddama* (Mosely and Kimmins 1953, fig. 269a), R1 simple, forks 1, 2, 3, 4 and 5 present; forks 1 and 2 sessile; fork 2 with nygma, about 1.3-1.4 times length fork 1; fork 3 shorter, length about two-thirds length fork 2, fork 3 length ranging from between 1.6-1.7 times length footstalk, cross-veins r-m and m contiguous at fork 3; fork 4 similar length to fork 3, fork length about 2.0-2.2 times length footstalk; fork 5 very long, length between 1.9-2.0 times length fork 4; discoidal cell closed, length between 3.7-3.9 times maximum width. Hind wing length about 2.6-2.7 times maximum width, with forks 1, 2, 3 and 5 present; forks 1 and 2 sessile; fork 2 with nygma present, fork 2 length between 1.6-1.7 times length fork 1; fork 3 shorter, length about two-thirds length fork 2, fork 3 longer than footstalk, length fork ranging between 1.9-2.1 times length footstalk; fork 5 very long, length between 1.6-1.7 times length fork 3; discoidal cell closed, length between 4.1-4.3 times maximum width; with three longer anal veins (Fig. 17).

*Male*. Segment IX in lateral view, length between 1.2-1.9 times width, usually sub-rectangular (Figs 19, 37), occasionally projecting and tapered basally (Fig. 25) with a shallow, wide V notch (Figs 29, 32) or wide, shallow concavity medially on distal margin (Figs 23, 26). Segment X mainly sclerotised dorsally, membranous ventrally, usually broadbased, tapered distally; in dorsal view, with a 'tongue-shaped' process (Figs 18, 21, 24). Phallus generally tube-like, parameres slender, elongate and straight or slightly curved, arising near base of phallus (Figs 19, 22, 28). Inferior appendages with two segments, in lateral view, basal segment usually more robust than harpago. Harpago has a small field of dark spines meso-distally (Figs 19, 22, 31).

*Female* Genitalia typical of genus (Figs 42, 43).

*Larva*. No confirmed larvae are known for this group.

***Remarks***. The seven species in this group are known from NE-Victoria, eastern New South Wales and eastern Queensland. Females of only two species have been associated.

### Key to males of species of the *Hydrobiosella letti* group from Australia

1. Segment X with pair of baso-lateral lobes (Figs 18, 19); SE-Qld ........ *H. fibra*
- Segment X without pair of baso-lateral lobes (Figs 21, 22, 24, 25) ........ 2

2. Segment X in dorsal view, with pair of small apico-lateral projections (Fig. 22); NE-Qld ........ *H. bifurca*
- Segment X in dorsal view, without pair of small apico-lateral projections (Figs 25, 28) ........ 3
3. Segment X laterally compressed apically, with distinctive notch (Figs 24, 25); SE-Qld ........ *H. incisura*
- Segment X not laterally compressed apically, without distinctive notch (figs 27, 28) ........ 4
4. Inferior appendages in lateral view with harpago length > 3.5 times width (Figs 28, 31) ........ 5
- Inferior appendages in lateral view with harpago length < 2.5 times width (Figs 34, 37) ........ 6
5. Segment X in lateral view, slightly dilated apically (Fig. 28); in dorsal view, slender; length about 2.8 times maximum width (Fig. 27); NE-Qld ........ *H. tenuitas*
- Segment X in lateral view, not dilated apically, instead slender and upturned (Fig. 31); in dorsal view, not slender; length about 1.4 times maximum width (Fig. 30); NE-Qld ........ *H. exilatis*
6. Inferior appendages with basal segment angled dorso-mesally (Fig. 34); NE-Vic ........ *H. bos*
- Inferior appendages with basal segment not angled dorso-mesally (Fig. 37); CE-NSW ........ *H. letti*

***Hydrobiosella fibra*** sp. nov.

Figures 18–20

Holotype. Male. Queensland, Kenilworth rainforest (about 26°36'S, 152°44'E), 7 Apr. 1967, N. Dobrotworsky (NMV, T- 21450).

Paratypes. Queensland. 2 males, collected with holotype (specimen PT-578 figured) (NMV).

*Diagnosis*. Males of *Hydrobiosella fibra* can be separated from other species in the group by the presence of a pair of stout baso-lateral lobes on tergum X.

*Description*. Wings similar to *H. letti* (Fig. 17); length of forewing, male 6.3-6.6 mm.

*Male*. Segment IX in lateral view, sub-quadrate, length about 1.8-1.9 times width, projecting slightly basally (Fig. 6.3), with a shallow rounded notch medially on distal margin (Fig. 20). Segment X with a pair of large sub-ovate baso-lateral lobes (Figs 18, 19); in dorsal view, 'tongue-shaped (fig. 18); in lateral view slender, slightly tapered distally (Fig. 19). Phallus generally tube-like, with a pair of straight, slender lateral 'parameres' arising basally (Figs 18, 19). Inferior appendages in lateral view, with basal segment sub-rectangular, length about 1.7-1.8 times maximum width; harpago slightly shorter, length about 1.6 times maximum width; bulbous dorso-basally, tapered slightly distally, broadly rounded apically (Fig. 19).

*Female*. Unknown.

*Etymology*. *Fibra* – Latin for lobe (on tergum X).

*Remarks*. Three male specimens of *Hydrobiosella fibra* have been collected from the type locality in south-eastern Queensland (latitude 26°36'S).

***Hydrobiosella bifurca*** sp. nov.

Figures 21–23, 42

Holotype. Male. Queensland, unnamed Ck, Paluma Dam Rd, Mt Spec State Forest, 18°57'S, 146°10'E, 860m, 24 Feb 1994, A.L. Sheldon (NMV, T- 21453).

Paratypes. Queensland. 2 males, 3 females, same site and collector, 17 Jan 1994; 2 females, same site and collector, 6 Jul 1994, A.L.S.; 2 males, 5 females, unnamed Ck, 'cascade' on Paluma Dam Rd, 840m, 6 July 1994, A.L.S.; 1 female (specimen CT-656 figured), same site and collector, 31 Oct 1993; 1 male, Camp Ck trib., Mt Spec State Forest, 18°57'S, 146°10'E, 760m, 22 Feb 1994, A.L.S.; 1 female, same site and collector, 23 Apr 1994; 4 females, same site and collector, 6 Jul 1994; 1 male, 1 female, Birthday Ck, below falls, Mt Spec State Forest, 18°57'S, 146°10'E, 760m, 29 Mar 1994, A.L.S.; 1 male (specimen PT-1768 figured), Cairns, Lake Morris Rd, 16 Nov 1988, K. Walker (NMV).

*Other material examined*. Queensland. 1 male, Barron Falls, Kuranda, 16 Jun 1971, E.F. Riek (ANIC); 1 female, U Freshwater Ck, Whitfield Range, Cairns, 24 Aug 1974, M.S. Moulds; 1 male, 1 female, Lock-Davies Ck Rd, Lamb Ra, Mareeba Dist. 10 Nov 1974, M.S. Moulds; 2 males, Fishery Falls, 17°11S, 145°52E, 10-11 Nov 2007, A. Cairns, A. Wells, W. Cairns (ANIC); 1 male, small waterfall on Kirrama Range Rd, 9.2km from Nat. Pk sign, -18.20°, 145.83°, 9 May 2011, M. Shackleton and J. Mynott; 1 male, 1 female, 1 km N of Tully Falls, 8 Jan 1976, A. Walford-Huggins; 1 male, Tully Falls, S of Ravenshoe, 11 Jan 1977, Moulds; 1 male, same locality and date, M.S. and B.J. Moulds; 1 male, Birthday Ck, 3.5 km WNN Paluma, 18°59'S, 146°10'E, 7 Apr 1990, R. StClair; 1 male, 1 female, same site and collector, 23 Dec 1989; 1 female, same site and collector, 19 Jan 1990; 1 female, Birthday Ck, above weir, Mt Spec State Forest, 18°57'S, 146°10'E, 820m, 22 Oct 1993, A.L.S.; 1 female, same site and collector, 6 Nov 1993; 1 female, same site and collector, 23 Apr 1994; 1 female, Birthday Ck, below falls, Mt Spec State Forest, 18°57'S, 146°10'E, 760m, 17 Mar 1994, A.L.S.; 1 female, same site and collector, 6 Jul 1994; 2 females, Birthday Ck, Iron Cabin, Mt Spec State Forest, 18°57'S, 146°10'E, 790m, 23 Apr 1994, A.L.S.; 1 female, Camp Ck trib., Mt Spec State Forest, 18°57'S, 146°10'E, 760m, 15 May 1994, A.L.S.; 1 female, same site and collector, 15 Mar 1994; 1 female, unnamed Ck, Paluma Dam Rd, Mt Spec State Forest, 18°57'S, 146°10'E, 860m, 11 Jun 1994, A.L. Sheldon; 1 female, Goodard Ck, Kirrama State For., 18°06'S, 145°41'E, Apr 1993, G. Theischinger; 8 males, 2 females, river on L. Morris Rd, 16.94°S, 145.72°E, M. Shackleton and J. Mynott (NMV).

*Diagnosis*. Males of *Hydrobiosella bifurca* can be separated from those of other species in the group by the pair of small apico-lateral projections on segment X.

*Description*. Wings similar to *H.letti* (Fig. 17); length of forewing, male 5.4-6.6mm, female 5.8-7.5 mm.

*Male*. Segment IX in lateral view, sub-quadrate, length about 1.5 times width, projecting slightly basally (Fig. 22), with a very shallow, wide concavity medially on distal margin (Fig. 23). Segment X robust, in dorsal view, sub-quadrate, length about 1.1-1.2 times width, with a pair of small apico-lateral projections (Fig. 21); in lateral view slightly tapered distally, with a slightly upturned apex (Fig. 22). Phallus generally tube-like; with a pair of straight, slender lateral 'parameres' arising from the phallus near middle (Figs 21, 22). Inferior appendages in lateral view, with basal segment sub-rectangular, length about 1.3 times maximum width; harpago slightly shorter, more slender, length about 1.5 times maximum width, tapered slightly distally, broadly rounded apically (Fig. 22).

*Female*. Genitalia typical of genus (Fig. 42).

*Etymology*. *Bifurca* – Latin for having two prongs or forks (apico-lateral projections on tergum X).

*Remarks*. Some 24 male and 34 female specimens of *Hydrobiosella bifurca* have been collected from at least twelve sites in north-eastern Queensland (latitudinal range 16°49'-18°59'S). *Hydrobiosella bifurca* was cited in a checklist (Walker et al., 1995) as *Hydrobiosella* sp. nov. PT-1768.

### *Hydrobiosella incisura* sp. nov.

Figures 24–26

Holotype. Male (specimen CT-557 figured), Queensland, National Park (about 28°14'S, 153°09'E), 5 Jun. 1955, collector? (NMV, T-21478).

*Diagnosis*. Males of *Hydrobiosella incisura* can be separated from those of other species in the group by the laterally compressed apex on segment X with distinctive notch.

*Description*. Wings similar to *H. letti* (Fig. 17), length of forewing: male 6.5 mm.

*Male*. Segment IX in lateral view, length about 1.3 times width, projecting and tapered basally (Fig. 25), with a very shallow, wide concavity medially on distal margin (Fig. 26). Segment X robust in basal two-thirds, narrowed in apical third (Figs 24, 25), in dorsal view, slender in apical third (Fig. 24); in lateral view, narrowed subapically, dilated apically with distinctive notch (Fig. 25). Phallus generally tube-like; with a pair of straight, slender lateral 'parameres' arising from the phallus near base (Figs 24, 25). Inferior appendages in lateral view, with basal segment sub-rectangular, length about 2.1 times maximum width; harpago shorter, length about 0.7 times length basal segment, more slender, length about 2.5 times maximum width, tapered slightly distally, broadly rounded apically (Fig. 25).

*Female*. Unknown.

*Etymology*. *Incisura* – Latin for notch (apex of segment X).

*Remarks*. The single male specimen of *Hydrobiosella incisura* was collected from the type locality in south-eastern Queensland (latitude 28°14'S).

### *Hydrobiosella tenuitas* sp. nov.

Figures 27–29

Holotype. Male (specimen PT-1038 figured), Queensland, Bellenden Ker Range, summit TV stn, 1560m (about 17°16'S, 145°54'E), 1-7 Nov 1981, Earthwatch-Qld Mus. (NMV, T-21479).

*Diagnosis*. Males of *Hydrobiosella tenuitas* can be separated from those of other species in the group by the slender segment X, also slightly dilated apically in lateral view, and the long and slender harpago of the inferior appendages.

*Description*. Wings similar to *H. letti* (Fig. 17), length of forewing: male 7.6 mm.

*Male*. Segment IX in lateral view, length about 1.2 times width, sub-rectangular, not projecting and tapered basally, projecting slightly distally (Fig. 28), with a shallow, wide V-shaped notch medially on distal margin (Fig. 29). Segment X slender, almost parallel sided in basal two-thirds, length about 2.8-2.9 times width, narrowed in apical third (Figs 27, 28), in dorsal view, narrow 'tongue-shaped, tapered slightly in distal third, narrowly rounded apex (Fig. 27); in lateral view, narrowed at about apical third, dilated slightly distally with bulbous apex (Fig. 28). Phallus generally tube-like; with a pair of slightly curved, slender lateral 'parameres' arising from the phallus near middle (Figs 27, 28). Inferior appendages in lateral view, with basal segment sub-trapezoidal, length about 1.4 times maximum width; harpago longer, length about 1.6 times length basal segment, more slender, length about 3.8-3.9 times maximum width, tapered slightly distally, broadly rounded apically (Fig. 28).

*Female*. Unknown.

*Etymology*. *Tenuitas* – Latin for slender (segment X and harpago of inferior appendages).

*Remarks*. The single male specimen of *Hydrobiosella tenuitas* was collected from north-eastern Queensland (latitude 17°16'S). *Hydrobiosella tenuitas* was cited in a checklist (Walker et al., 1995) as *Hydrobiosella* sp. nov. PT-1038.

### *Hydrobiosella exilatis* sp. nov.

Figures 30–32

Holotype. Male: Queensland, Bellenden Ker Range, cable tower 3, 1054m (about 17°16'S, 145°54'E), 25-31 Oct 1981, Earthwatch-Qld Mus. (NMV, T-21480).

Paratypes. 3 males (specimen PT-1037 figured), Mt Bartle Frere, 0.5 km N of South Peak, 1500m, 6-8 Nov 1981, Earthwatch-Qld Mus. (NMV).

*Diagnosis*. In lateral view, males of *Hydrobiosella exilatis* can be distinguished from those of other species in the group by the slender and upturned distal half of segment X; in dorsal view, very flat and appearing broad, length about 1.4 times maximum width, and long and slender harpago of the inferior appendages.

*Description*. Wings similar to *H. letti* (Fig. 17), length of forewing: male 6.4-7.4 mm.

*Male*. Segment IX in lateral view, length about 1.3-1.4 times width, sub-rectangular, slightly projecting basally (Fig. 31), with a shallow, wide V-shaped notch medially on distal margin (Fig. 32). Segment X length about 1.3-1.4 times width, in dorsal view, 'tongue-shaped', broad-based, tapered distally (Figs 30, 31), apex broadly rounded (Fig. 30); in lateral view, narrowed near middle, dilated slightly distally with bulbous apex (Fig. 31). Phallus generally tube-like; with a pair of long, slender, slightly curved, lateral 'parameres' arising from the phallus near middle (Figs 30, 31). Inferior appendages in lateral view, with basal segment sub-rectangular, length about 1.8-1.9 times maximum width, harpago slightly longer, length about 1.1

times length basal segment, more slender, length about 3.5 times maximum width, 'dumb bell- shaped', narrowed near middle, broadly rounded apically (Fig. 31).

*Female*. Unknown.

*Etymology*. *Exilatis* – Latin for slender (harpago of inferior appendages).

*Remarks*. Four male specimens of *Hydrobiosella exilatis* have been collected from two adjacent localities in north-eastern Queensland (latitudinal range 17°16'- 17°24'S). *Hydrobiosella excilatas* was cited in a checklist (Walker et al., 1995) as *Hydrobiosella* sp. nov. PT-1037.

### *Hydrobiosella bos* sp. nov.

Figures 33–35, 43

Holotype. Male. Victoria, Eurobin Falls, Mt Buffalo Rd (about 36°42'S, 146°50'E), 3 Dec. 1982, A. Neboiss (NMV, T- 21484).

Paratype. Victoria. 1 male (specimen CT-553 figured), 2 females (specimen CT-554 figured), collected with holotype (NMV).

*Diagnosis*. Males of *Hydrobiosella bos* can be distinguished from those of other species in the group by the dorso-mesally angled basal segment on the inferior appendages.

*Description*. Wings similar to *H. letti* (Fig. 17), length of forewing: male 7.6-8.0 mm, female 8.9-9.4 mm.

*Male*. Segment IX robust, in lateral view, length about 1.4 times width, projecting and tapered basally (fig. 34), with a shallow, wide concavity medially on distal margin (Fig. 35). Segment X broad-based, tapered distally (Figs 33, 34), in dorsal view, 'tongue-shaped', length about 1.8-1.9 times width, broadly rounded apex (Fig. 33); in lateral view, straight, with slightly bulbous apex (Fig. 34). Phallus generally tube-like; with a pair of long, slightly curved, 'parameres' arising from the phallus near base (Figs 33, 34). Inferior appendages in lateral view, with basal segment sub-pentangular, length about 1.4 times maximum width, harpago shorter, length about 0.7 times length basal segment, more slender, length about 2.6 times maximum width, sub-ovate, broadly rounded apically (Fig. 34).

*Female*. Genitalia typical of genus with a small acute projection on sternite IX meso-distally (Fig. 43).

*Etymology*. *Bos* – Latin for buffalo (type locality-Mt Buffalo).

*Remarks*. Two males and two female specimens of *Hydrobiosella bos* have been collected from the type locality in north-eastern Victoria (latitude 36°42'S).

### *Hydrobiosella letti* Korboot

Figures 17, 36, 37

*Hydrobiosella letti* **Korboot, 1964: 36, figs 40-57. – Neboiss, 1987: 132, figs 7, 8. – Neboiss, 1986: 101.**

Holotype. Male (not seen): New South Wales, Lett R. near Lithgow, 25 Sep 1962, K. Korboot, T-6182 (QM).

*Other material examined*. Queensland, 1 male (CT-655), Morans Ck above Morans Falls, Lamington Nat. Pk, 28.23°S 153.13°E, 16 Nov 2011, J. Mynott & M. Shackleton.

*Diagnosis*. *Hydrobiosella letti* can be distinguished from other species in the group, especially H. bos, by the basal segment of the inferior appendages not angled dorso-mesally and harpago sub-triangular in lateral view.

*Description*. (Revised after Korboot, 1964; Neboiss, 1987). Wings (Fig. 17), length of forewing: male 4.5 mm.

*Male*. Segment IX robust, in lateral view, length about 1.4 times width, projecting and tapered basally (Fig. 37). Segment X broad-based, tapered distally (Figs 36, 37), in dorsal view, 'tongue-shaped', length about 1.8-1.9 times width, broadly rounded apex (Fig. 36); in lateral view, straight, with slightly bulbous apex (Fig. 37). Phallus generally tube-like; with a pair of long, slightly curved, 'parameres' arising from the phallus near base (Figs 36, 37). Inferior appendages in lateral view, with basal segment sub-pentangular, length about 1.4 times maximum width, harpago shorter, length about 0.7 times length basal segment, more slender, length about 2.6 times maximum width, sub-triangular, tapered to broadly rounded apex (Fig. 37).

*Female*. Unknown.

*Remarks*. A single male specimen of *Hydrobiosella letti* is known from the type locality in central-eastern New South Wales (latitude 33°24'S). Korboot's (1963, fig. 45) and Neboiss's (1987, figs 7, 8) figures have been redrawn to allow direct comparisons and to accompany the description that is revised in light of new interpretations of *Hydrobiosella* genitalic and wing structures. Neboiss (1987) commented on the condition of the type specimen and errors in Korboot's original description and that the vial containing the remaining body parts had two locality labels: Lett River via Lithgow and Montville, Queensland. The recently collected male specimen from Lamington National Park in south-eastern Queensland is here referred to *H. letti*, although there are several minute differences in the genitalia (latitude 28°14'S).

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# Two new species of *Photonectes* (Teleostei: Stomiidae) from the Indo-Pacific, and a re-examination of *P. achirus*

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**Abstract**

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Two new species of the mesopelagic fish genus *Photonectes* (family Stomiidae) from the Indo-Pacific are described. Both are referred to the subgenus *Photonectes* because they lack pectoral fins, have no fleshy tissue on their dorsal- and anal-fin rays, have a pelvic-fin insertion closer to the caudal-fin base than the snout, and have IP photophores located on the isthmus at a position midway along the mandible, posterior to the mandibular symphysis. *Photonectes waitti* sp. nov., known from the tropical western and central Pacific Ocean, northwestern Coral Sea and north Indian Ocean, is most similar to *P. coffea*, differing from it by the number of PV photophores (24—25 vs. 29—31), gill filaments reduced (vs. greatly elongate), jaw teeth long and short canines (vs. short canines only), and barbel length less than (vs. equal to or greater than) head length. *Photonectes paxtoni* sp. nov., known from the tropical western Pacific Ocean, off Papua New Guinea, has a short barbel, less than head length, ending in a very large bulb without any terminal filaments or appendages, and different photophore numbers compared to other members of the subgenus: VAV 15—16 (vs. 10—15), AC 13 (vs. 9—12), and IV 29 (vs. 30—46). *Photonectes achirus* is re-examined with respect to previously unreported dark pigment on the head.

**Keywords** *Photonectes*, Stomiidae, new species, Indo-Pacific

## Introduction

The Stomiidae is a very speciose family of midwater fishes, currently comprising approximately 280 species in 27 genera (Nelson, 2006; Eschmeyer, 2011; Froese and Pauly, 2011). The genus *Photonectes* has 25 nominal species, 16 of which are regarded as valid species (Eschmeyer, 2011; Froese and Pauly, 2011).

In 2009, 21 specimens of an apparently undescribed species of *Photonectes* were collected from the equatorial western Pacific Ocean, in the vicinity of Howland and Baker islands. In 2010, an additional specimen was collected in the Coral Sea off Cairns, Australia. The examination of material from museum collections revealed two more specimens, extending the range of the species into Hawaiian waters and the Gulf of Aden. The search for additional material resulted in the discovery of another undescribed species collected in 1969 by the Australian Museum off Papua New Guinea. Both species are members of the subgenus *Photonectes* based on the lack of pectoral fins, their dorsal and anal fins not enveloped with fleshy tissue, their pelvic-fin insertion located closer to caudal-fin base than to the snout tip, and their IP photophores located on the isthmus at a position midway along the mandible, posterior to the mandibular symphysis (Regan and Trewavas, 1930; Morrow and Gibbs, 1964; Klepadlo, 2011). Descriptions of these two species are provided herein.

Besides photophores and barbels, other dermal features that aid in identification of species of *Photonectes* include the presence or absence of white luminous tissue patches on the head and body and the presence or absence of ventro-lateral blue luminous tissue markings on the body, along the isthmus and inside the mouth.

Specimens of *P. achirus* were collected along with specimens of the former undescribed species in the equatorial western Pacific Ocean in the vicinity of Howland and Baker islands. While examining museum specimens of *P. achirus*, patches of dark pigment were observed on the head that were previously unreported (e.g., in Regan and Trewavas, 1930; Beebe and Crane, 1939; Morrow and Gibbs, 1964; Klepadlo, 2011). The patches of dark pigment were only observed on faded museum specimens, usually rusty-brown in colour, that had been preserved for a long period of time. The dark pigment was not detectable in freshly-caught specimens that were usually black or black-brown in color. Faded museum specimens of other *Photonectes* species were examined, but these markings were found only on specimens of *P. achirus*. A re-examination of *P. achirus* is provided on the basis of this new finding.

## Methods

Values for selected morphometric and meristic features in the new species are given in Table 1. Measurements were made with vernier calipers to the nearest 0.1 mm and include: standard length (SL), head length (HL), barbel length, and lengths from snout to pelvic fin (Sn-V), from pelvic fin to vent (V-vent), and from vent to base of caudal fin (vent-C). Percent of SL (% SL) was calculated for *P. waitti* and *P. paxtoni* and % SL values for *P. achirus* were derived from Morrow and Gibbs (1964) and Froese and Pauly (2011). Descriptions of teeth are given and these were separated as premaxillary, maxillary, mandibular, vomerine, palatine and basibranchial; maxillary teeth are further divided into "erect" (anterior canines) and "oblique" (posterior series of very small inclined teeth). Photophore terminology (Figure 1) follows Morrow and Gibbs (1964), Harold (2003), and Klepadlo (2011). In addition to diagnostic counts of the primary photophores, descriptions are given of small secondary photophores that occur as clusters or form lateral bars in the genus *Photonectes*. Further, descriptions are made of two opercular (OP) photophores: the pre-opercular photophore (PRO) at the posteriodorsal margin of the operculum and the subopercular photophore (SO) located in a cup-like depression ventral to the PRO (notation follows Weitzman, 1974: Table 1).

Gill-filament length (Klepadlo, 2011: Fig. 2) on first branchial arch is defined as "1st reduced" (less than one-half arch depth), "normal" (longer than arch depth but not extending beyond opercular opening) or "very long" (much greater than depth or arch and extending beyond opercular opening).

Most specimens were collected with a neuston net. Other collection methods included Isaacs-Kidd midwater trawl (IKMT), IKMT modified to collect plankton (IKPT) (Williamson and McGowan, 2009), rectangular midwater trawl (RMT) and a bottom trawl. Collection depths are given in meters (m), fathoms (fm) or meters-wire-out (mwo). Time of collection listed for *P. waitti* sp. nov. is given in UTC/GMT. Notes on the color (under visible light) of fresh specimens of *P. waitti* are based on observations made by the first author in the field.

Material examined is in the collections of the Australian Museum (AMS), Museum of Victoria (NMV), Scripps Institution of Oceanography (SIO) and Smithsonian Institution (USNM).

### ***Photonectes waitti*** new species

Figures 2a,b, 5; Table 1

Holotype: NMV A 30913-001 (71.4 mm SL), 0°34.836'—35.329'N, 176°56.432'—49.956'W, neuston net, 0—0.5 m depth, R/V Seward Johnson, Catalyst II expedition, 06 March 2009, 14:04—15:05.

Paratypes: AMS I.49494-010 (48.7 mm SL), 16°34.25'S, 147°08.01'E, 11 December 2010, 19:43—20:43, RMT8 trawl, 330 m depth; NMV A 30908-001/-002 (2: 22.5—32.6 mm SL), 0°21.243'-21.257'N, 176°50.117'-49.575'W, 23 February 2009, 12:17—13:17, neuston, 0—0.5 m depth; NMV A 30915-001 (1: 32.1 mm SL) and SIO 11-301/-302 (2: both 48.5 mm SL), 0°27.568'—27.658'N, 176°51.848'—50.574'W, 28 February 2009, 12:32—13:32, neuston, 0—0.5 m depth; NMV A 30906-001/-002/-003/-004/-005 (5: 31.6—51.0 mm SL), collected with holotype; NMV A 30908-001/-002 (2: 22.5—32.6 mm SL), 0°21.243'—21.257'N, 176°50.117'—49.575'W, 23 February 2009, 12:17—13:17, neuston, 0—0.5 m depth; NMV A 30907-001/-002/-003/-004 (4: 25.2—30.7 mm SL), 0°54.289'N, 177°09.476'W, 02 May 2009, neuston net, 0—0.5 m depth; SIO 11-300 (37.6 mm SL), 0°13.518'—13.212'N, 176°46.428'—45.634'W, 19 February 2009, 07:43—08:43, neuston, 0—0.5 m depth; SIO 11-303 (2: 25.4—41.5 mm SL), 0°53.000'—50.586'N, 176°57.332'—56.657'W, 20 March 2009, 12:59—13:57, neuston net, 0—0.5 m depth; USNM 402774 (32.3 mm SL), 01°19.045'—18.335'N, 176°47.913'—47.673'W, 19 April 2009, RMT trawl M205, 1200 m depth; USNM 300149 (23.4 mm SL), 12°40'N, 51°13'E, 1 m plankton net, captured at surface, R/V *Anton Bruun* Cr. 5, sta. 287A, IIOE Expedition, 3 February 1964; USNM 300199 (26 mm SL), 21°20'—30'N, 158°20'—30'W, 26 September 1973, 3 m IKMT, 0—110 m depth, T. Clarke 73-9-33; USNM 300201 (24.8 mm SL), 21°20'—30'N, 158°20'—30'W, 30 August 1973, 03:18—05:15, 3 m IKMT 0—350 m depth, T. Clarke 73-8-31.

*Diagnosis:* Differs from other species in the subgenus *Photonectes* in the following combination of characters: dorsal-fin rays 11—14, anal-fin rays 12—16; IV photophores 38—39, PV photophores 24—25; absence of blue luminous tissue; length of gill filaments on first branchial arch reduced, less than depth of gill arch; and barbel with two large bulbs in series. Few species of *Photonectes* have more than one large bulb or luminous area on the barbel (secondary photophores excluded). Above the main bulb in *P. mirabilis* are small bulbs on the stem and a tiny terminal bulb. *P. phyllopogon* has a single bulb and a terminal luminous appendage (Morrow and Gibbs, 1964). *P. barnetti* has a large pale area along the stem below the bulb (luminescent colour uncertain) (Klepadlo, 2011). *P. coffea* has two bulbs in series without any terminal bulb (Klepadlo, 2011). For *P. waitti* there are two large bulbs in series and a tiny bulb at the end of the filament. *Photonectes waitti* differs from *P. mirabilis* and *P. phyllopogon* in having 11—14 dorsal-fin rays (*vs.* 16—17 and 20—23, respectively), 12—16 anal-fin rays (*vs.* 19—20 and 22—25, respectively), and 38—39 IV photophores (*vs.* 33—34 and 30—31, respectively). It differs from *P. coffea* in having gill filaments on first gill arch reduced (*vs.* very long, extending beyond gill opening), and PV photophores 24—25 (*vs.* 29—31). It differs from *P. achirus*, *P. caerulescens*, and *P. mirabilis* in lacking blue luminous tissue.

*Description:* Body elongate, 20.9—71.4 mm SL; depth about eight times into length. HL 3.2—8.7 mm (11.0—18.1% SL, mean 15.3%); Sn-V 13.3—47.9 mm (58.5—67.4% SL, mean 62.1%); V-vent 3.4—10.5 mm (13.9—21.4% SL, mean 18.2%); vent-C 4.3—13.0 mm (15.6—23.4% SL, mean 19.9%) (see Table 1). Eye 0.8—1.9 mm (17.2—29.3% HL, mean 23.5%). Opercle concave dorsally and lobate posteriorly. Gill filaments on first branchial arch reduced, length less than arch depth; tips of filaments dark. Color of body in life dark brown to black. On fresh specimens or undamaged preserved specimens, narrow black lateral bands in line with PV, VAV and AC photophores. On freshly caught specimens, these lateral bands could be seen to harbor minute secondary photophores and luminous patches (described further below).

Dorsal-fin rays 12 (11—14, rarely 15—16); anal-fin rays 14 (12—16, rarely 17—19); pelvic-fin rays 7 (rarely 6); pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin. Pelvic fins inserted closer to caudal fin than to snout (33.1—42.4% SL *vs.* 58.6—67.4% SL); longest ray extending at least to anus (tips broken). Caudal fin forked and elongate; ventral lobe longer than dorsal lobe. All fin-rays covered with melanophores extending halfway along the length; membranes clear.

Photophores: IV 38—39, rarely 35—37 (IP 12, rarely 11 or 13; PV 24—25, rarely 22, 23 or 26); VAV 13—14, rarely 12 or 15; AC 11—12, rarely 13; OA 38—39, rarely 35—37 (OV 24—26, rarely 23; VAL 12—13, rarely 14—15), last 1 to 2 photophores over anal-fin base; BR-7, rarely 6. IP series beginning about halfway along isthmus length, approximately opposite BR-7; space between IP-8 and IP-9 about twice space between IP-1 and IP-2 making series 8 + 4. Anterior end of AC series raised, approximately even with last VAL photophore, tapering downward over anal fin base and ending along ventro-lateral caudal peduncle. Secondary photophores on head and body, mainly concentrated in vertical lines from dorsum to each PV, VAV and AC photophore; also between IV and OA series and along ventrum in rather horizontal lines; no secondary photophores on any fin-ray. Postorbital organ ovoid, 0.7—0.9 mm (12.3—18.8% HL, mean = 14.6%; skin flap over posterior end in NMV A.30907-003. One ovoid PRO photophore; one smaller circular SO photophore. SO photophore directed ventrally and placed in a cup-like structure. PRO and SO photophores of fresh specimens reddish pink under visible light. Blue luminous tissue and dark markings absent.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 5—8; 4—8 maxillary teeth erect and 4—10 oblique; mandibular teeth 11—25; vomerine teeth in 2 to 3 pairs, lateral teeth longest; palatine teeth in 2 pairs, about equal length; basibranchial teeth in 2 to 4 pairs (anterior and posterior pairs separated by gap, 1 to 2 pairs followed by 1 to 2 pairs; posterior tooth in each group longest).

Barbel shorter than head, 2.3-5.5 mm (59.0—85.4% HL, mean 74.0%), with two main bulbs and a fine terminal filament. One specimen (SIO 11-304) with very tiny bulb at distal end of terminal filament. Stem pigmented, no secondary photophores; first segment (~45% of barbel length) tapering into first bulb with pigment cup-like around bulb base. First bulb ovoid (~18% of barbel length), width about three times stem width, tapering into short segment of stem (~9% of barbel length) followed by second bulb. Section of stem between bulbs with melanophores increasing in concentration distally. Second bulb elongate (~18% of barbel length), narrow, about twice stem width, and with melanophore-line from stem extending length of bulb onto short terminal filament (~9% of barbel length). In freshly-caught specimens bulbs lavender to pink under white light.

*Distribution:* Known from tropical western and central Pacific Ocean, northwestern Coral Sea and Indian Ocean (Gulf of Aden) at depths of 0—1200 m.

*Etymology:* Named in recognition of Theodore (Ted) Waitt, the founder of the Waitt Family Foundation and the Waitt Institute. The Waitt Institute sponsored and directed the expedition of the R/V *Seward Johnson* to the equatorial western Pacific Ocean (Catalyst II expedition) during which this species was collected.

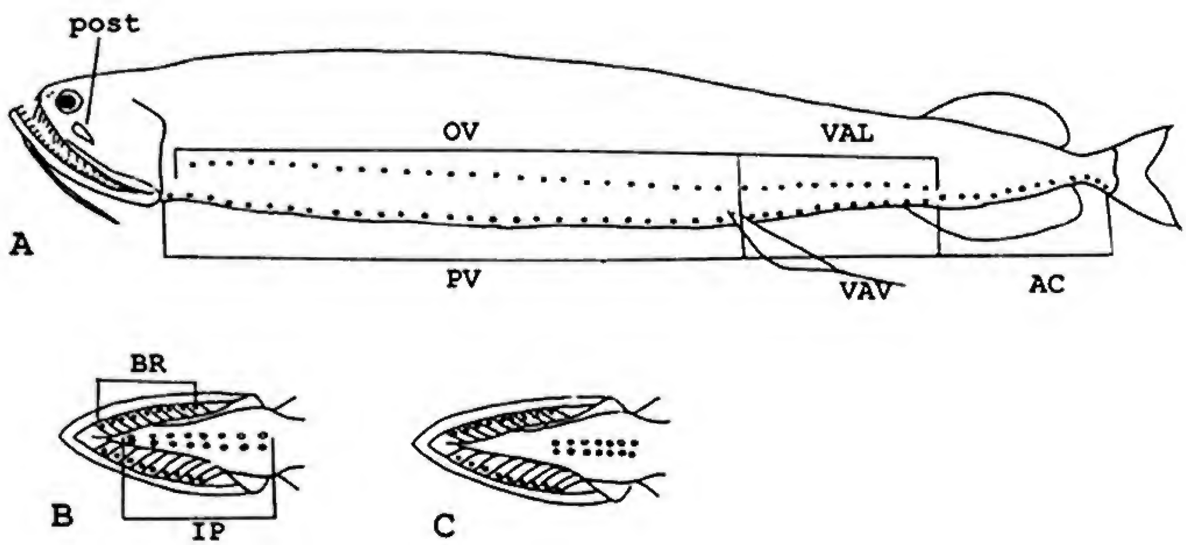


Figure 1. (A) Photophore notation: post – postorbital organ; VAV – ventrally, from pelvic fin base to anal fin origin; AC - from anal fin origin to caudal fin base; OV – laterally, from pectoral fin origin to pelvic fin origin; VAL – laterally, from pelvic fin origin to anal fin origin or slightly beyond; (B) and (C) IP – along isthmus to pectoral fin base commencing at mandibular symphysis or posteriorly halfway along isthmus length, respectively.

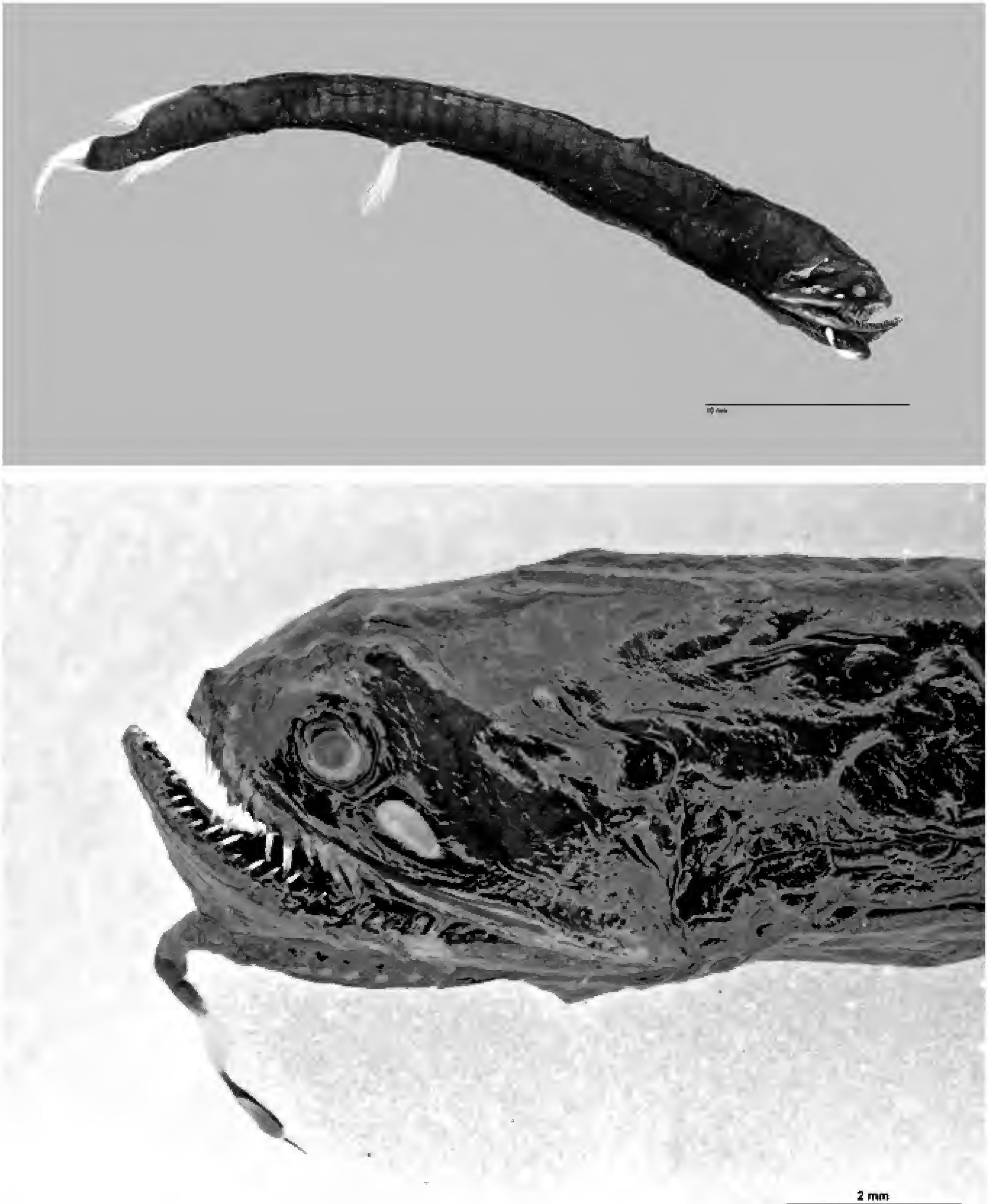


Figure 2. *Photonectes waitti* new species **a)** NMV A.30906-005, 51.0 mm, paratype; **b)** lateral view of head and barbel, NMV A.30913-001, 71.4 mm, holotype. Photograph by NMV.


Figure 3. *Photonectes paxtoni* new species, holotype, AMS I.1972043, 23.4 mm SL. Photograph by NMW.

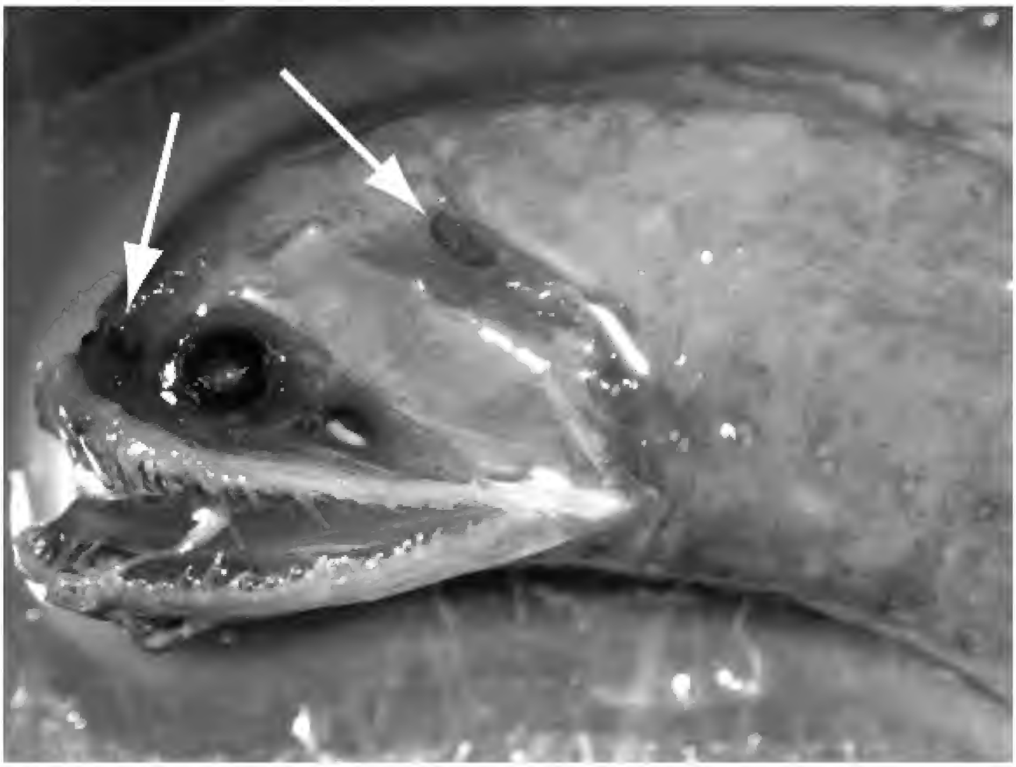

Figure 4. *Photonectes achirus*, AMS I.19739-018, 32.3 mm, lateral view of head of showing dark marking at upper operculum (Photograph by C. Klepadlo).

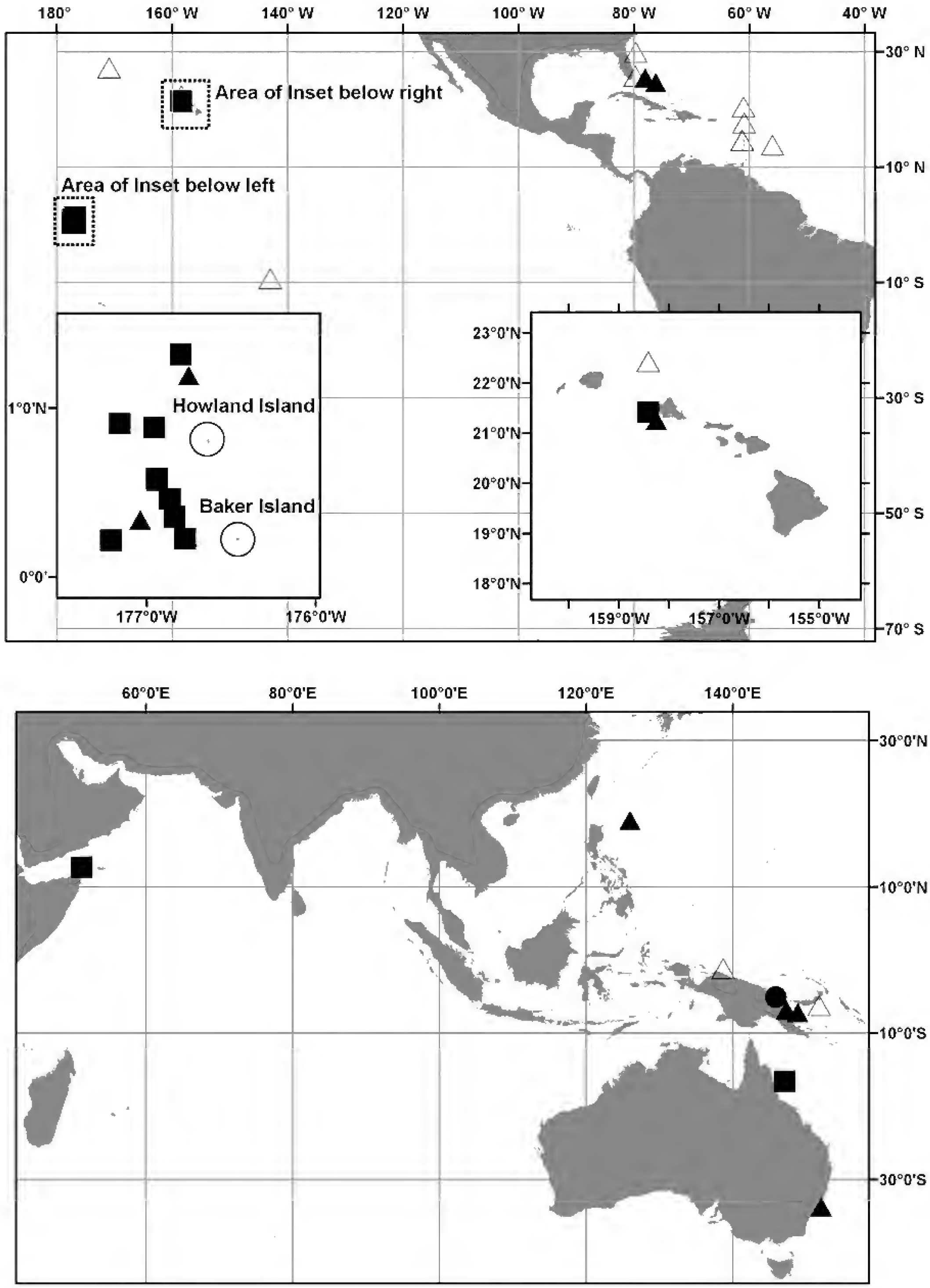


Figure 5. Distribution of *Photonectes waitti* (black square), *P. paxtoni* (black circle), *P. achirus* (black triangle; white triangle = literature records). Symbols may represent more than one record

Table 1. Selected meristics and morphometrics of *Photonectes waitti*, *P. paxtoni*, and *P. achirus*. Values for holotypes followed by range for paratypes in parentheses where they vary from the holotype. Values for *P. achirus* from Morrow and Gibbs (1964) and Froese and Pauly (2011).

| Character | *Photonectes waitti* (n=24) | *Photonectes paxtoni* (n=2) | *Photonectes achirus* |
|---|---|---|---|
| Standard Length (mm) | 71.4 (20.9-74.0) | 23.4 (22.4) | 20.0-87.0 |
| Fin Rays: | | | |
| Dorsal | 12 (11-16) | 16 (18) | 14-16 |
| Anal | 14 (11-19) | 18 (18) | 14-19 |
| Pelvic | 7 (6-7) | 7 | 7 |
| Photophores: | | | |
| IP | 12 (11-13) | 8 | 8-11 |
| PV | 23 (22-26) | 21 | 22-28 |
| VAV | 14 (12-15) | 16 (15) | 11-13 |
| AC | 11 (10-13) | 13 | 10-11 |
| OV | 26 (21-26) | 20 | 19-22 |
| VAL | 13 (12-15) | 14 | 11-12 |
| BR | 7 (6-8) | 8 | 6-8 |
| %SL: | | | |
| Head | 12.9 (12.1-18.9) | 17.1 (15.6) | 15.4-18.7 |
| Sn-V | 66.9 (58.5-67.4) | 61.1 (61.6) | 58.2-73.2 |
| V-vent | 14.7 (14.9-21.3) | 15.4 (15.2) | 8.7-21.1 |
| Vent-C | 18.2 (15.6-23.4) | 23.5 (23.2) | 15.6-22.8 |

*Remarks: Photonectes waitti* is a widespread tropical open-ocean species. Twenty-one specimens were collected in 2009 from the equatorial western Pacific Ocean. One specimen was collected in 2010 from Australian waters in the Coral Sea. While examining older (40+ years) museum specimens labeled *Photonectes* sp., three additional specimens were found that extended the distribution of *P. waitti* into the Central Pacific, in the vicinity of Hawaii, and the northwestern Indian Ocean (Gulf of Aden).

**_Photonectes paxtoni_** new species

Figures 3, 5; Table 1

Holotype: AMS I.1970-243 (23.4 mm SL), 05°05'S, 145°56'E, off Madang, Papua New Guinea, 27 October 1969, 2 m IKMWT, 135 m depth.

Paratype: AMS I.19727-023 (22.4 mm SL), 05°05'S, 145°54'E, off Madang, Papua New Guinea, 27 October 1969, 2 m IKMWT, 130 m depth.

*Diagnosis: Photonectes paxtoni* differs from other members of the subgenus *Photonectes* in the following combination of characters: barbel short, with a very enlarged ovoid terminal bulb lacking terminal appendages; absence of blue luminous tissue; length of gill filaments on first branchial arch reduced, less than arch depth; and VAV photophores 15—16 (*vs.* 10—15), AC photophores 13 (*vs.* 9—12) and IV photophores 29 (*vs.* 30—46). The bulb is remarkably large and plain (without filaments). The enlarged bulb is similar to *P. ovibarba* (synonym of *P. braueri*). However, *P. paxtoni* has no pectoral fins (*vs.* present, with 2 rays each), IV photophores 29 (*vs.* 32—33), AC photophores 13 (*vs.* 10—12), and the bulb lacks any terminal appendage (*vs.* bearing a small ovoid appendage). Another species with a large bulb, *P. fimbria* (synonym of *P. parvimanus*), can also be eliminated based on the following: IV photophores 43—49 (*vs. P. paxtoni* with 29), IP photophores insert near mandibular symphysis or no gap (*vs.* insert halfway along the isthmus, or with gap), thick skin over dorsal- and anal-fin rays (*vs.* thick skin absent), and bulb with terminal flap increasing with growth (*vs.* no flap or terminal appendage; growth change unknown).

*Description:* Body elongate, 22.4—23.4 mm SL; depth about seven times into length. HL 3.5—4.0 mm (15.6—17.1% SL); Sn-V 13.8—14.3 mm (61.1—61.6% SL); V-vent 3.4—3.6 mm (15.2—15.4% SL); vent-C 5.2—5.5 mm (23.2—23.5% SL) (see Table 1). Eye 1.0—1.1 mm (25.0—27.5% HL). Opercle lobate, slightly concave dorsally. Gill filaments on first branchial arch reduced, length less than arch depth; tips of gill filaments unpigmented. Color of body rusty-brown in preservative, assumed black in life.

Dorsal-fin rays 16—18; anal-fin rays 18; pelvic-fin rays 7; pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin; fin-rays covered with minute white luminous spots; membranes clear. Pelvic fins inserted closer to caudal fin than to snout tip (38.4—38.9% SL *vs.* 61.1—61.6% SL); longest ray extending to anal-fin origin. Caudal-fin rays broken; fin assumed forked.

Photophores: IV 29 (IP 8; PV 21); VAV 15—16 (last 2 to 3 over anal-fin base); AC 13; OA 34 (OV 20; VAL 14, last two photophores over anal-fin base); BR 8. IP series beginning posteriorly about halfway along isthmus length, opposite BR-8; photophores evenly spaced. Anterior end of AC series beginning on same level as last VAV. Secondary photophores scattered over head and body, in clusters along dorsum, tapering ventrally to between each OA photophore, continuing ventrally between each IV photophore, and in clusters along ventral surface; none on any fin rays. Postorbital organ ovoid, elongate, about equal to eye diameter. One PRO and one SO photophore on operculum, and one postorbital photophore. Specimen AMS I.1927-023 with a pair of white luminous spots on snout between nostrils. Blue luminous tissue and dark markings absent.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 4; 5—7 maxillary teeth erect and 8 oblique; mandibular teeth 12—15; vomerine teeth one pair; palatine teeth absent; basibranchial teeth 4 (one pair anteriorly and two single teeth midlength). Vomerine teeth long, length equal to longest premaxillary tooth.

Barbel short, 1.5—1.8 mm (42.9—45.0% HL), with very large ovoid bulb. Stem short, ~1.0 mm (~25% HL), pigment tapering anteriorly onto base of bulb in a small V-shape; no secondary photophores on stem. Bulb large and simple, with no appendages or terminal filaments; width ~1.0 mm. Color of bulb in life unknown.

*Distribution:* Known only from type locality off Madang, Papua New Guinea; depth 130—135 m.

*Etymology:* The name recognises Dr. John Paxton for his many contributions to the study of mesopelagic fishes and for his encouragement to the authors.

*Remarks: Photonectes paxtoni* is currently known from two specimens from shallow collections (depth 130—135 m). They were located among 46-year-old museum specimens labeled *Photonectes* sp.

***Photonectes achirus*** Regan and Trewavas, 1930

Figures 4, 5; Table 1

*Material examined:* AMS I.19739-018 (32.3 mm SL), 07°09.0'S, 148°52.0'E (western Solomon Sea), 110 m depth, 7 November 1969; AMS I.19753-037 (2: 25.3—30.9 mm SL), 05°51.0'S, 147°20.0'E (Papua New Guinea, Vitiaz Straits), IKMT, 0—110 m depth, 4 November 1969; AMS I.24859-002 (78.0 mm SL), 33°43.0'—40.0'S, 152°03.0'—05.0'E (Australia, off Sydney, NSW), bottom trawl, 0—1135 m depth, 16 October 1984; NMV A 30906-006 (46.4 mm SL), 0°34.836'—35.329'N, 176°56.432'—49.956'W, neuston net, 0—0.5 m depth, 6 March 2009; NMV A 30917-001 (46.7 mm SL), 0°14.213'—14.354'N, 176°45.843'—45.641'W, neuston net, 0—0.5m depth, 19 February 2009; SIO 11-305 (72.2 mm SL), 01°11.503'—10.113'N, 176°45.152'—46.050'W, RMT, 600 m depth, 26 April 2009; SIO 11-306 (83.5 mm SL), 0°20.264'—18.657'N, 177°02.297'—00.516'W, RMT, 600 m depth, 9 May 2009; SIO 70-333 (33.5 mm SL), 19°11.0'—04.8'N, 125°12.7'45.0'E, 10 ft IKMT, 0—2000 m depth, 13 September 1970; SIO 88-194 (21.4 mm SL), 24°40.5'N, 76.16'W (Exuma Sound), IKMT, 200 m depth, 14 July 1986; SIO 88-197 (23.0 mm SL), 25°28.0'N, 78°07.3'W (Tongue-of-the-Ocean), IKMT, 200 m depth, 8 January 1987; USNM 300205 (36.7 mm SL), 21°10'N, 158°10'W, IKMT, 0—775 m depth, 8 November 1974, 12:35—17:12, T. Clarke 74-11-4.

*Diagnosis: Photonectes achirus* differs from other species in the subgenus *Photonectes* in the following combination of characters: presence of blue luminous tissue in a band extending from pectoral region to pelvic fins, with short transverse streaks between OV photophores, and in patches on sides of isthmus, under lower jaw and above end of maxillary; length of gill filaments very long, extend beyond opercular opening; and barbel shorter than head length, with small bulb ending in a terminal appendage with a tiny bulb at tip.

*Re-Examination:* Body elongate, largest recorded specimen 87.0 mm SL. Morphometric and meristic values for four specimens collected from waters around Howland and Baker islands were in agreement with Morrow and Gibbs (1964): body depth 11.8—16.7% SL; head 15.4—18.7% SL (mean 14.8%); Sn-V 58.2—73.0% SL (mean 65.6%); V-vent 8.7—21.1% SL (mean 14.4%); vent-C 15.6—22.8% SL (mean 20.1%). Eye 7.7—28.8% HL (mean 20.7%). Opercle slightly concave dorsally. Gill filament very long, feathery; extending slightly beyond gill cover; tips of filaments uncolored. Color of body black, fading to rusty brown in preservative.

Dorsal-fin rays 14—16; anal-fin rays 14—19; pelvic-fin rays 7; pectoral fins absent. Dorsal and anal fins not covered with black fleshy skin. Pelvic fins inserted closer to caudal fin than to snout tip; longest ray extending posteriorly to vent. Caudal fin forked; ventral lobe longer than dorsal lobe. All fin rays covered with melanophores along full length; membranes clear.

Photophores: IV 31-36 (IP 8—11 + PV 22—28); VAV 11—13; AC 10—11; OA 30—35 (OV 19—22; [rarely 23] + VAL 11—12 [rarely 9—10 or 13—15], last two photophores over anal-fin base); BR 6—8. IP series begins about halfway along isthmus length, approximately opposite posterior most BR; IP photophores noticeably smaller than body photophores. Anterior end of AC series raised, about one photophore diameter above last VAV, gently tapering to ventral profile. Secondary photophores very small, scattered over head and body; most densely clustered along dorsum; no secondary photophores on any fin-ray. Postorbital organ ovoid, with dark cap of melanophores along dorsal margin or with cluster of melanophores at anterior margin; length up to 30% HL.

Clusters of small white luminous spots on opercle. Blue luminous patch under OV-1 to OV-2; two patches along isthmus from symphysis to BR-1; pair of spots between eyes and small spots dorsal to occipito-vertebral articulation ("nape"); one pair anteriorly inside mouth; midventral stripe from below pectoral fins to pelvic fins, with short transverse streaks alternating with serial photophores.

Teeth caniniform, long and short; premaxillary teeth longest, needle-like. Premaxillary teeth 7—12; 6—8 maxillary teeth erect and 7—10 oblique; mandibular teeth 17—22; vomerine teeth 1 or 2 pairs; palatine teeth 1 pair; basibranchial teeth 4 pairs (anterior and posterior pairs separated by gap: 1 or 2 pairs followed by 2 or 3 pairs).

Barbel shorter than head length (70.0—80.0% HL). Stem covered with melanophores, terminating in a small bulb, slightly wider than stem width, with a long slender terminal appendage ending in a small bulb at tip.

***Comment on Pigmentation:*** In older, faded museum specimens small to large dark semi-circular patches on snout and upper opercle (Fig. 4; see Discussion). The dark patches were observed on older faded specimens of *P. achirus* (AMS I.19739-018, SIO 70-333, SIO 88-194, SIO 88-197) on the snout between the nostrils and on the upper opercle (see Fig. 4). They are circular to slightly ovoid in shape, contain darker spots and are bordered by heavy pigment. Examination of more recently collected (unfaded) specimens of *P. achirus* (SIO 11-305, SIO 11-306) did not reveal the colouration observed in older (faded) specimens. Several specimens did have clusters of secondary photophores at the upper opercular margin that are probably associated with the dark spots. However, other areas on the body with secondary photophores were not surrounded by any dark patches. One specimen of *P. achirus* (USNM 300205) had noticeable clusters of white luminous tissue on the nape and along the opercular margin with no dark patches surrounding the clusters; snout tissue was damaged. The skin on the head of *P.* cf. *gracilis* (USNM 300157) is in very good condition with both secondary photophores and a large cluster of white luminous tissue at the upper opercular margin; there is no indication of dark patches. Other faded *Photonectes* were examined for dark patches: *P. albipennis* (AMS I.221809-030, SIO 73-149), *P. braueri* (AMS I.20305-013), *P. caerulescens* (SIO 76-6), *P. margarita* (SIO 69-354), *P. mirabilis* (AMS I.19739-018), *P. parvimanus* (SIO 10-177), *P. paxtoni* (AMS I.19727-023, AMS I. 19702-043), *P. waiiti* (USNM 300149, USNM 300201); none showed any trace. The significance of the tissue is unknown; it is not noticeable in fresh specimens nor is it reflective or photogenic. In reviews of dragonfishes ascribed to the family Melanostomiatidae by Beebe and Crane (1939) and Morrow and Gibbs (1964), neither work mentions these dark patches. Whether it occurs only on *P. achirus* is unknown at this time.

*Distribution:* Known from western Atlantic and Caribbean, north Pacific near Hawaii and Tasman Sea at depths of 75—1400 m (Clarke, 1974; Froese and Paul, 2011; Morrow and Gibbs, 1964; Sutton and Hopkins, 1996) and now recorded from the equatorial western Pacific Ocean in the vicinity of Howland and Baker islands.

Comparative material examined
*Photonectes albipennis* (AMS I.22809-030, SIO 73-149).
*Photonectes braueri* (AMS I.20305013).
*Photonectes caerulescens* (SIO 76-6, USNM 256901).
*Photonectes* cf. *gracilis* (AMS I.20941-010, USNM 300157).
*Photonectes margarita* (SIO 69-354).
*Photonectes mirabilis* (AMS I.19739-018) [re-identified as *P. achirus*].
*Photonectes parvimanus* (SIO 10-177).

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# The phyllophorid sea cucumbers of southern Australia (Echinodermata: Holothuroidea: Dendrochirotida: Phyllophoridae)

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**Abstract**

O'Loughlin, P. M., Barmos S. and VandenSpiegel D. 2012. The phyllophorid sea cucumbers of southern Australia (Echinodermata: Holothuroidea: Dendrochirotida: Phyllophoridae). *Memoirs of Museum Victoria* 69: 269–308.

A new monotypic Phyllophoridae (Phyllophorinae) genus *Phyllostauros*, with author O'Loughlin, is erected for *Thyone vercoi* Joshua and Creed. We raise *Phyllophorella* Heding and Panning (subgenus of *Phyllophorus* Grube) to generic rank. The holotype and three paratypes of *Phyllophorus ventripes* Joshua and Creed are conspecific with *Thyone vercoi* Joshua and Creed. We make *Phyllophorus ventripes* Joshua and Creed a subjective junior synonym of *Thyone vercoi* Joshua and Creed. One paratype of *Phyllophorus ventripes* Joshua and Creed is conspecific with *Phyllophorus thyonoides* H. L. Clark. We reject the synonymy of *Thyone okeni* Bell with *Thyone venusta* Selenka. Twelve new species of Phyllophoridae are described for southern Australia, with author O'Loughlin: *Lipotrapeza eichleri*, *Lipotrapeza litusi*, *Massinium melanieae*, *Massinium vimsi*, *Massinium watsonae*, *Phyllophorella notialis*, *Thyone flindersi*, *Thyone joshuai*, *Thyone kerkosa*, *Thyone spenceri*, *Thyone tourvillei*, *Thyonidiella kungi*. Phyllophoridae species reported previously for southern Australia are reviewed: *Lipotrapeza ventripes* (Joshua and Creed); *Lipotrapeza vestiens* (Joshua); *Neothyonidium dearmatum* (Dendy and Hindle); *Phyrella thyonoides* (H. L. Clark); *Thyone nigra* Joshua and Creed; *Thyone okeni* Bell; *Thyone vercoi* Joshua and Creed. Species *Phyrella thyonoides* (H. L. Clark) is re-assigned to genus *Phyllophorella* Heding and Panning. A key is provided for the southern Australian species of Phyllophoridae. We acknowledge the rejection for nomenclatorial purposes by the ICZN (Opinion 417) of the publication by Oken 1815, and hence the current invalid status of genus *Thyone* Oken. A petition has been sent to the ICZN for re-validation of *Thyone* Oken and we retain the use of *Thyone* Oken provisionally. The petition includes a similar request for re-validation of *Psolus* Oken.

**Keywords**

Sea cucumber, Dendrochirotida, Phyllophoridae, *Lipotrapeza*, *Massinium*, *Neothyonidium*, *Phyllophorella*, *Phyrella*, *Psolus*, *Thyone*, *Thyonidiella*, new genus, new species, synonymies, Australia, key, ICZN.

## Introduction

The first phyllophorid species described for southern Australia (Victoria) was *Phyllophorus vestiens* Joshua, 1914. This species subsequently became the type species for *Lipotrapeza* H. L. Clark, 1938. The following year species *Phyllophorus ventripes* Joshua and Creed, 1915 and *Thyone nigra* Joshua and Creed, 1915 were erected for South Australia. *Phyrella thyonoides* H. L. Clark, 1938 was erected for southwest Australian specimens. A second *Thyone* Oken, 1815 species occurring in the rocky shallows of southern Australia has been mistakenly identified as the New South Wales (Port Jackson) species *Thyone okeni* Bell, 1884. And Joshua (1914) and Hickman (1978) mistakenly identified specimens from southeast Australia as the New Zealand species *Neothyonidium dearmatum* (Dendy and Hindle, 1907). Thus at the time of writing six phyllophorid species have been reported for southern Australian waters, two with mistaken identities. We review the systematic status of these species.

During 1981 the former Victorian Institute of Marine Sciences conducted a survey of the benthic fauna of eastern Bass Strait using the Taiwanese FRV *Hai Kung* and the then New Zealand Oceanographic Institute RV *Tangaroa*. Collecting and sorting yielded specimens as small as a few millimeters in length. Many small phyllophorid specimens were collected, representing four new phyllophorid species. We describe the new species in this work. The Museum Victoria south-east Australia continental slope survey on RV *Franklin* yielded a small phyllophorid from off the Freychinet Peninsula in eastern Tasmania that is described here. During 1986 and 1987 the South Australian Department of Fisheries collected many small phyllophorid specimens from the upper Spencer Gulf that are lodged in the South Australia Museum and were available for this study. We describe two new species from this collection. And we examined relevant collections of southern Australian phyllophorid specimens from the Australian Museum, South Australian Museum, Western Australian Museum and Tasmanian Museum and Art Gallery.

Recently the new phyllophorid genus *Massinium* Samyn and Thandar, 2003 was erected for some former *Neothyonidium* Deichmann, 1938 species. We have found three new species of *Massinium* in southern Australian waters. There has been considerable uncertainty about the systematic status of the two species *Phyllophorus ventripes* Joshua and Creed , 1915 and *Thyone vercoi* Joshua and Creed, 1915 and we have attempted to resolve the issues.

We are attempting a comprehensive review of southern Australian phyllophorid species and have therefore described new species based in some cases on limited and damaged specimens that nonetheless have distinguishing morphological characters. We have recognized and noted some cases of what we consider to be inappropriate species assignments to higher taxa such as species to genera and genera to sub-families, but we have generally refrained from altering current assignments until more comprehensive revisions are possible with the aid of emerging genetic data. One such current revision that we are aware of is a review by François Michonneau and Gustav Paulay (University of Florida) of genus *Phyrella* Heding and Panning, 1954.

We have noticed throughout this work that for a particular species the number of polian vesicles and the form of the calcareous ring may vary considerably for individual specimens. These realities are significant for attempts to distinguish species systematically.

We acknowledge the rejection for nomenclatorial purposes by the ICZN (Opinion 417, 42 pp., 1956) of the publication by Oken 1815, and hence the current invalid status of genus *Thyone* Oken, 1815. Pawson and Miller 1981 consequently referred *Thyone* to author Jaeger 1833 with type species *Holothuria fusus* Müller, 1776 (following Jaeger 1833). This maintained the type species of Oken for *Thyone*. But the first author after Oken to use genus *Thyone* validly was Lesson 1830, not Jaeger 1833. Lesson 1830 used *Thyone* as a sub-genus in *Holothuria* for one new Aspidochirotida species (*Holothuria* (*Thyone*, Oken) *edulis*) and for a new Echiura (spoon-worm) species (*Holothuria* (*Thyone*, Oken) *eaouari*). Neither species would be satisfactory as a type species for *Thyone*. Rowe (in Rowe and Gates 1995) retained Oken 1815 as author of *Thyone* as a *nomen conservandum*, following H. L. Clark 1946. This retention has not been validated by the ICZN. On the grounds of anticipating considerable uncertainty and instability in holothuroid literature if *Thyone* Oken remains invalid and has to be replaced, a petition has been sent by Gustav Paulay and Mark O'Loughlin (July 2012) to the ICZN for validation of *Thyone* Oken, 1815. Reasons have been given in this petition for the re-validation also of *Psolus* Oken, 1815. We retain the use of *Thyone* Oken provisionally.

## Methods

Scanning electron microscope (SEM) images were taken by Didier VandenSpiegel after clearing the ossicles of associated soft tissue in commercial bleach, air-drying, mounting on aluminum stubs, and coating with gold. Observations were made using a JEOL JSM-6480LV SEM. Measurements were made with Smile view software. Photos of the preserved specimens were taken by Shari Barmos with a Nikon 300s DSLR camera, using a Nikkor 105 mm lens and 2x adaptor / teleconverter. The photo of a live juvenile specimen of *Lipotrapeza vestiens* was taken by Leon Altoff and Audrey Falconer using a Pentax K10D with bellows mounted Olympus 38mm lens and dual flashes. The photo of a live specimen of *Thyone nigra* was taken by John Eichler using a Pentax W30.

## Abbreviations

| | |
|---|---|
| AM | Australian Museum (registration number prefix J). |
| ICZN | Appropriately the International Commission on Zoological Nomenclature, or the International Code of Zoological Nomenclature. |
| MRG | Marine Research Group of the Field Naturalists Club of Victoria. |
| NMV | Museum Victoria (registration number prefix F). |
| NIWA | New Zealand National Institute of Water and Atmospheric Research (est. 1992). |
| PPS | Port Phillip Survey (1957–1963). |
| SAM | South Australian Museum (registration number prefix K, photo index number prefix PK). |
| TMAG | Tasmanian Museum and Art Gallery (registration number prefix H). |
| VIMS | Victorian Institute of Marine Sciences (1974–1998). |
| WAM | Western Australian Museum (registration number prefix Z). |

Numbers in brackets after registrations refer to numbers of specimens in lots.

Order **Dendrochirotida Grube**, 1840

Family **Phyllophoridae** Öestergren, 1907 (sensu Pawson and Fell 1965)

*Diagnosis (after Pawson and Fell 1965).* Dendrochirotida with calcareous ring composite with posterior extensions to the plates, the extensions composed of small pieces.

*Remarks.* Pawson and Fell 1965 abandoned tentacle number as the principal diagnostic criterion for family Phyllophoridae, and based their new diagnosis on the presence of a composite calcareous ring as described in the diagnosis above.

### Key to southern Australian species of Phyllophoridae (sensu Pawson and Fell 1965)

1. Tentacles 20 or 15 ........ **2**

— Tentacles 10, 8 large, 2 small ventral ........ genus *Thyone* Oken ........ **11**

2. Tentacles 15, 5 outer pairs large, 5 single small inner ones ........ ***Thyonidiella kungi*** O'Loughlin sp. nov. (Bass Strait offshore)

— Tentacles 20 ........ genera *Lipotrapeza* H. L. Clark, *Massinium* Samyn and Thandar, *Phyllophorella* Heding and Panning, *Phyllostauros* O'Loughlin gen. nov. ........ **3**

3. Outer tentacles 15, variable sizes, 5 single small inner ones ........ genus *Phyllophorella* Heding and Panning ........ **4**

— Tentacles 5 pairs large, 5 pairs small . genera *Lipotrapeza* H.L. Clark, *Massinium* Samyn and Thandar, *Phyllostauros* O'Loughlin gen. nov. ........ **5**

4. Table ossicle discs regular, never incomplete; tube foot support ossicles sometimes tables with curved discs, never dumbbell-shaped rods ........ ***Phyllophorella notialis*** O'Loughlin sp. nov. (south New South Wales)

— Table ossicle discs frequently irregular, frequently incomplete; tube foot support ossicles frequently dumbbell-shaped rods ........ ***Phyllophorella thyonoides*** (H. L. Clark) (South Australia and south Western Australia)

5. Calcareous ring composite, long, tubular, plates joined posteriorly by continuous calcareous band of small plates creating posterior inter-radial oblong non-calcareous spaces ........ *Massinium* Samyn and Thandar ........ **6**

— Calcareous ring with posterior prolongations not joined by continuous band of small plates; not long, not tubular; posterior composite extensions short, free ........ genera *Lipotrapeza* H. L. Clark, *Phyllostauros* O'Loughlin gen. nov. ........ **8**

6. Large and small tube feet uniformly distributed; 4 polian vesicles; anal body wall with table ossicles ........ ***Massinium melanieae*** O'Loughlin sp. nov. (Great Australian Bight)

— Tube feet not uniformly distributed; fewer than 4 polian vesicles; anal body wall lacking table ossicles ........ **7**

7. Body wall soft; tube feet scattered dorsally, concentrated ventrally; peri-oral table discs with up to 20 perforations; tentacles with rods and some rosettes; endplate support ossicles perforate rods ........ ***Massinium vimsi*** O'Loughlin sp. nov. (Bass Strait offshore)

— Body wall thin, firm; tube feet more concentrated along longitudinal muscles; peri-oral table discs with up to 40 perforations; tentacles with rare fine rods, lacking rosettes; endplate support ossicles rare ........ ***Massinium watsonae*** O'Loughlin sp. nov. (SE Tasmania)

8. Adult mid-body wall ossicles lacking . genus *Lipotrapeza* H. L. Clark ........ **9**

— Mid-body wall ossicles crosses ........ ***Phyllostauros vercoi*** (Joshua and Creed) (South Australia)

9. Tube feet ossicles include abundant rosettes intergrading with few small plates ........ ***Lipotrapeza litusi*** O'Loughlin sp. nov. (SW Australia)

— Tube feet never with rosette ossicles ........ **10**

10. Body reddish-brown; tube feet usually concentrated ventrally, scattered dorsally; tube foot endplate support ossicles and tentacle ossicles predominantly dumbbell-shaped ........ ***Lipotrapeza eichleri*** O'Loughlin sp. nov. (SE Australia)

— Body pale brown / flesh-pink; tube feet usually evenly distributed around body; tentacle ossicles predominantly rods with small distal widening; tube foot endplate support ossicles irregular narrow perforated plates ........ ***Lipotrapeza vestiens*** (Joshua) (across southern Australia)

11. Adult body wall with table ossicles ........ **12**

— Adult mid-body wall lacking table ossicles ........ **16**

12. Table ossicles with spires comprising 2 pillars; anterior third at least of calcareous ring tubular ........ **13**

— Table ossicles with predominantly single pillar spires; none of calcareous ring tubular ........ ***Thyone tourvillei*** O'Loughlin sp. nov. (eastern Tasmania, Bass Strait)

13. No adult body wall table discs with more than 30 perforations ........ **14**

— Many adult body table discs with more than 30 perforations ........ **15**

14. Tentacles with rod and rosettes ossicles; adult body wall table discs with predominantly 4 and often 8 perforations, discs typically about 56 $\mu$m long ........ ***Thyone joshuai*** O'Loughlin sp. nov. (South Australia, SE Australia)

— Tentacles with rosette ossicles only; adult body wall table discs rarely with 4 perforations, discs frequently about 88 $\mu$m long ........ ***Thyone nigra*** Joshua and Creed (SE to SW southern Australia)

15. Adult body wall table discs small to large, large discs sometimes narrow with solid distal extensions, spires long with long splayed distal ends ........ ***Thyone kerkosa*** O'Loughlin sp. nov. (Recherche Archipelago)

— Adult body wall table discs round to oval, uniform size, spires short ........ ***Thyone spenceri*** O'Loughlin sp. nov. (Upper Spencer Gulf)

16. Peri-oral table ossicles with irregular discs, up to 72 $\mu$m long, fewer than 40 perforations, spires with 2 pillars; tentacles branches with thin rods, distally with fine branches or few perforations, some rods with sigmoid form, some straight, rods up to 88 $\mu$m long ........ ***Thyone flindersi*** O'Loughlin sp. nov. (southern Australia)

— Peri-oral table ossicles with regular discs, up to 192 $\mu$m diameter/length, up to more than 60 small perforations, table spires thick short columnar mesh; tentacle branches with stout rods, some dumbbell-shaped, rods up to 320 $\mu$m long ........ ***Thyone okeni*** Bell (New South Wales)

Subfamily **Phyllophorinae** Heding and Panning, 1954

*Diagnosis*. Radial plates of the calcareous ring with posterior prolongations composed of a few large pieces, prolongations sometimes arising jointly from radial and inter-radial plates; inter-radial plates frequently lacking any posterior prolongation; ring not tubular.

*Southern Australia genera*. *Lipotrapeza* H. L. Clark, 1938; *Phyllophorella* Heding and Panning, 1954; *Phyllostauros* O'Loughlin gen. nov. (below); *Thyonidiella* Heding and Panning, 1954.

*Remarks*. We raise subgenus *Phyllophorella* Heding and Panning, 1854 (subgenus of *Phyllophorus* Grube, 1840) to generic rank.

***Lipotrapeza*** H. L. Clark, 1938

*Lipotrapeza* H. L. Clark, 1938: 494–495.—H. L. Clark 1946: 411.—Heding and Panning, 1954:173–175.

*Diagnosis*. Dendrochirote holothuroids with 20 tentacles, 5 pairs large, 5 pairs small; tube feet around body, not radial, sometimes concentrated ventrally and scattered dorsally; calcareous ring stout with paired short tapered posterior composite prolongations arising from radial (early development) or jointly from radial and inter-radial plates (later development); mid-body wall of adults lacking ossicles; mid-body wall of juveniles with tables, spires with 4 pillars; tube feet with endplates and endplate supporting ossicles, sometimes with rosettes and small plates.

*Type species*. *Phyllophorus vestiens* Joshua, 1914 (original designation).

*Other species*. *Lipotrapeza ambigua* Cherbonnier, 1988 (Madagascar); *L. capilla* Cherbonnier, 1958 (Sierra-Leone); *L. eichleri* O'Loughlin sp. nov. (SE Australia); *L. incurva* Cherbonnier, 1988 (Madagascar); *L. japonica* Heding and Panning, 1954 (Japan); *L. litusi* O'Loughlin sp. nov. (SW Australia).

*Remarks*. We make *Lipotrapeza ventripes* (Joshua and Creed, 1915) a subjective junior synonym of *Phyllostauros vercoi* (Joshua and Creed, 1915) (see below). Cherbonnier 1988 referred five small specimens (up to 20 mm long) from Madagascar to *Lipotrapeza ventripes* (Joshua and Creed, 1915). This referral is discussed under *Lipotrapeza vestiens* (below).

*Lipotrapeza ambigua* Cherbonnier, 1988, erected for 12 specimens from Madagascar, is described as having 10 large outer tentacles and two inner circles of five small ones, a calcareous ring with paired composite radial posterior prolongations and composite inter-radial posterior prolongations, and some tables in the adult anal body wall. We judge that the species does not fit the diagnostic characters of *Lipotrapeza* H. L. Clark, 1938.

*Lipotrapeza capilla* Cherbonnier, 1958, erected for two specimens from Sierra-Leone, is described as having a tentacle arrangement of 15 outer tentacles comprising five pairs of large with a very small tentacle between each pair, and five inner tentacles. There are rosette and plate ossicles in the mid-body wall, and long paired composite posterior radial elongation of the calcareous ring. We judge that the species does not fit the diagnostic characters of *Lipotrapeza* H. L. Clark, 1938.

*Lipotrapeza incurva* Cherbonnier, 1988, erected for eight specimens from Madagascar, is described as having 10 large outer tentacles and 10 very small ones in two inner circles. On this character we judge that the species does not fit the diagnostic characters of *Lipotrapeza* H. L. Clark, 1938, although for most characters it does.

We also query the inclusion of the northern *Lipotrapeza japonica* Heding and Panning, 1954, specifically for the presence of three series of tentacles (10 + 5 + 5) and the form of the calcareous ring with discrete paired posterior radial prolongations (as illustrated by Heding and Panning 1954).

The current referrals of species to *Lipotrapeza* H. L. Clark, 1938 suggest to us that from a morphological viewpoint the genus is currently polyphyletic and requiring review.

***Lipotrapeza eichleri*** **O'Loughlin sp. nov.**

Figures 1a, b, 2

*Material examined*. Holotype. Victoria, Phillip I., Kitty Miller Bay, rocky shallows, M. O'Loughlin and J. Monagle, 20 Apr 1987, NMV F174906.

Paratypes. Type locality and date, NMV F161502 (4); Westernport Bay, Phillip I., McHaffie Reef, sea-grass beds, J. Eichler and V. Stajsic, 1 Mar 2008, NMV F157403 (1).

*Other material*. Cape Paterson, 4 m, 13 Mar 2001, NMV F97432 (2); Westernport Bay, Shoreham, 16 Feb 1972, NMV F45265 (1); Honeysuckle reef, 21 Mar 1976, NMV F161493 (1); Port Phillip Bay, Point Lonsdale, J. Kershaw, Jan 1902, NMV F76558 (3); Portland, Anderson Point, 23 Feb 2007, NMV F125359 (1 juvenile).

*Diagnosis*. Up to 75 mm long, up to 25 mm diameter (preserved, tentacles withdrawn), cylindrical body, narrow rounded oral and anal ends, thin firm body wall minutely papillate; external anal scales not detected; 20 tentacles, 5 large pairs, alternating with 5 small pairs; complete cover of tube feet, crowded ventrally, scattered dorsally, diameter about 0.5 mm; calcareous ring with 10 posterior composite tapering projections arising from both radial and inter-radial plates, posterior ends free thin tails, ring not tubular, length of plates with anterior projections sub-equal with posterior composite prolongations, form of the plates and composite components variable; short stone canal, madreporite close to vascular ring; 1–3 tubular polian vesicles, variable lengths; longitudinal muscles flat, lacking longitudinal indentation centrally; gonad tubules arise in series along gonoduct on each side of dorsal mesentery, tubules not branched.

Adult mid-body wall lacking ossicles; tube foot ossicles endplates and support rods only; endplates with denticulate margin, irregular perforations similar size, diameters up to 480 $\mu$m; tube foot support ossicles predominantly dumbbell-shaped, enlarged distally, perforate, denticulate margin, up to 192 $\mu$m long; peri-oral region with abundant rosettes about 40 $\mu$m long; tentacles with rods and rosettes, larger rods dumbbell-shaped with small perforations and denticulate margin distally, up to 208 $\mu$m long, few small rosettes up to 40 $\mu$m long; anal ossicles tube foot endplates and support rods, tentacle-like rods, rosettes, some large up to 64 $\mu$m long.

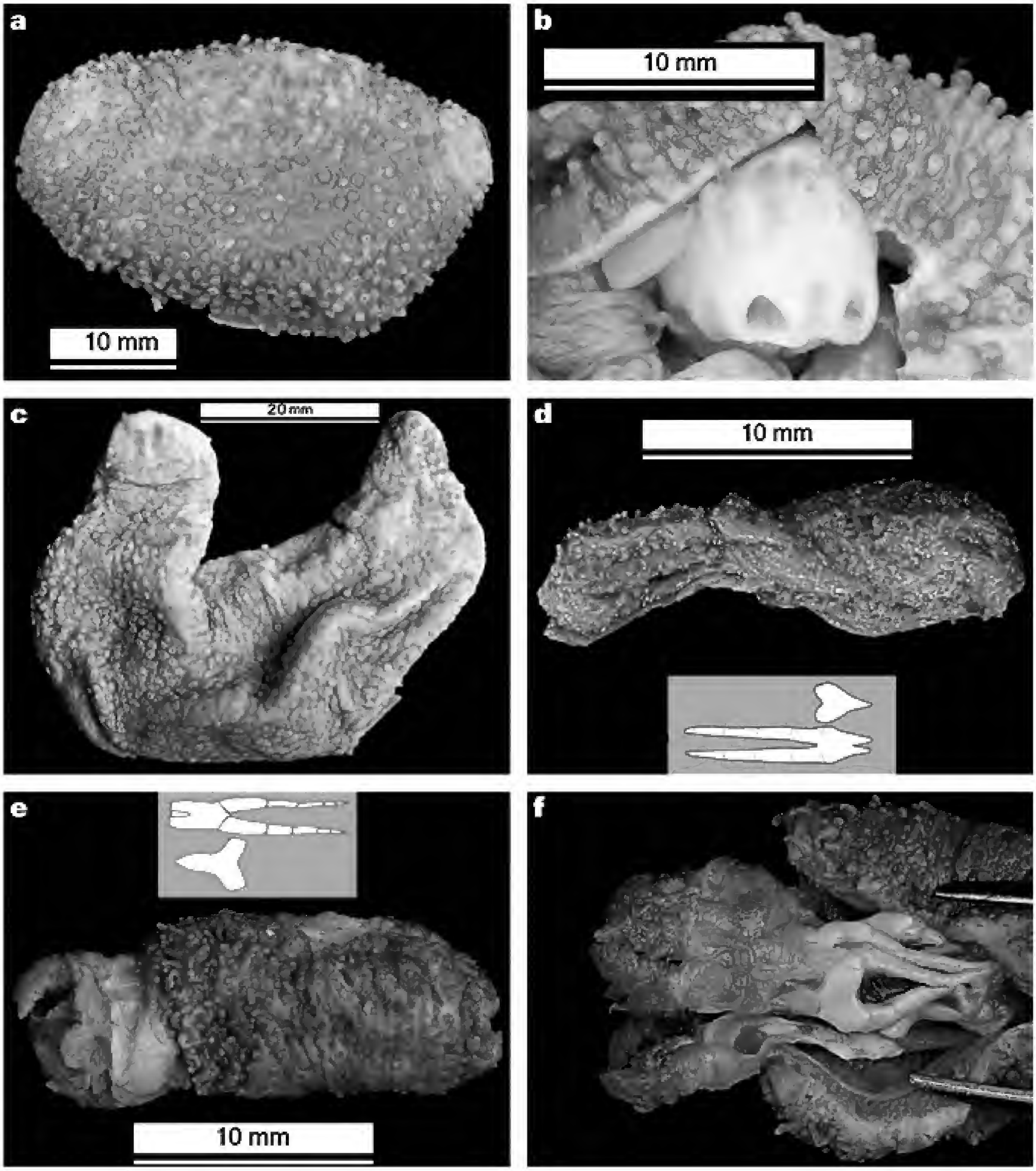


Figure 1. Photos of preserved type specimens. a, *Lipotrapeza eichleri* O'Loughlin sp. nov. (holotype NMV F174906); b, *Lipotrapeza eichleri* calcareous ring (paratype NMV F161502); c, *Lipotrapeza litusi* O'Loughlin sp. nov. (holotype WAM Z13475); d, *Thyonidiella kungi* O'Loughlin sp. nov. (holotype NMV F76637) (insert: form of the calcareous ring plates); e, *Phyllophorella notialis* O'Loughlin sp. nov. (holotype NMV F132691) (insert: form of the calcareous ring plates); f, *Phyllophorella notialis* calcareous ring (holotype).

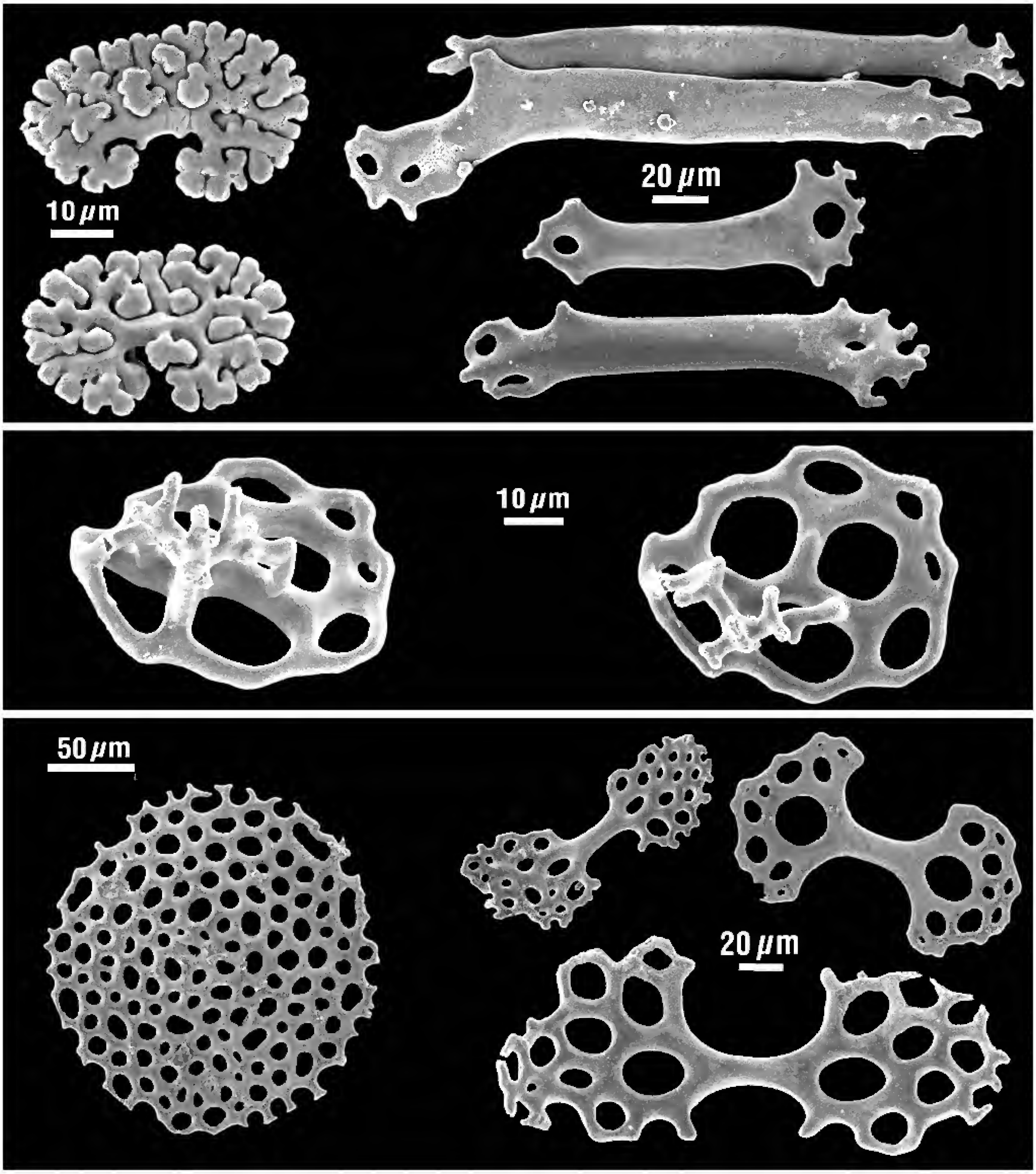


Figure 2. SEM images of ossicles from specimens of *Lipotrapeza eichleri* O'Loughlin sp. nov. Top, rods and rosettes from tentacles (holotype NMV F174906); middle, tables from juvenile (NMV F161502, 5 mm long); bottom, endplate and dumbbell-shaped endplate support ossicles from same juvenile (NMV F161502).

Juvenile (5 mm long) with mid-body wall tables and tube foot endplates and support rods; tables with irregular discs up to 60 $\mu$m long, short irregular 4-pillared spires; endplates up to 180 $\mu$m diameter, dumbbell-shaped endplate support rods up to 240 $\mu$m long.

*Colour (preserved).* Body dark brown to grey-brown with variable red colouration, dark grey-brown oral end, white anal end; many tube feet red; tentacles pale brown.

*Distribution.* South-east Australia, Victoria, Cape Paterson to Portland, rocky shallows and sea-grass, 0–4 m.

*Etymology.* Named for John Eichler, with appreciation of his contribution to Museum Victoria through the MRG, and his discovery and field photograph of a paratype of this new species.

*Remarks.* We note that unlike the other two species of *Lipotrapeza* H. L. Clark, 1938 the large and small pairs of tentacles in *Lipotrapeza eichleri* O'Loughlin sp. nov. alternate in one series, not inner and outer series. *Lipotrapeza eichleri* is distinguished from other *Lipotrapeza* species in the key (above).

### *Lipotrapeza litusi* O'Loughlin sp. nov.

Figures 1c, 3

*Material examined.* Holotype. Western Australia, Cottesloe Beach, 32°00'S 115°45'E, beach washed, L. M. Marsh, Aug 1990, WAM Z13475.

*Diagnosis.* Up to 70 mm long, 22 mm diameter (preserved, tentacles withdrawn); form cylindrical, upturned oral and anal rounded tapers; 20 tentacles, 5 outer pairs large, 5 inner pairs small; tube feet all around body, scattered dorsally, close ventrally, across introvert, diameters up to 0.7 mm; calcareous ring stout, irregular, with some short posterior composite projections arising jointly from radial and inter-radial plates, not tubular, lacking thin radial composite posterior elongations; short stone canal, madreporite close to vascular ring; single polian vesicles; thin branched gonad tubules arise in series along gonoduct on each side of dorsal mesentery.

Mid-body wall lacking ossicles; tube feet with endplates, support rods, abundant rosettes, few small plates; endplate diameters up to 536 $\mu$m; support rods stout, distally enlarged and perforate, up to 144 $\mu$m long; rosettes oval, up to 48 $\mu$m long, intergrade with small plates; small plates irregular, perforate, denticulate margin, up to 104 $\mu$m long; tentacles with rods and rosettes, rods stout, distally enlarged and perforate, up to 200 $\mu$m long, abundant rosettes up to 64 $\mu$m long.

*Colour (preserved).* Body off-white, body and tube feet with some residual red; tentacle trunks white, branches pale brown.

*Distribution.* Southwest Australia, Cottesloe beach, off-shore sediments.

*Etymology.* Named from the Latin *litus* (beach) with reference to the beach-washed source of the type specimen.

*Remarks. Lipotrapeza litusi* O'Loughlin sp. nov. is distinguished from other *Lipotrapeza* species in the key (above). The single specimen that this species is based on was found on a beach and the species presumably lives in off-shore sediments.

### *Lipotrapeza vestiens* (Joshua, 1914)

Figures 4, 5a, 6

*Phyllophorus vestiens* Joshua, 1914: 5, pl. 1 fig. 2a–f.

*Lipotrapeza vestiens*.—H. L. Clark, 1938: 496–497.—H. L. Clark, 1946: 412.—Heding and Panning, 1954: 176, fig. 84 (from Joshua 1914).—Rowe, 1982: 462, pl. 31.2.—Rowe and Gates, 1995: 311.—Edgar, 1997: 369.—Gowlett-Holmes, 2008: 263.

*Material examined.* Holotype. Victoria, Torquay, NMV F45144.

Paratypes. Torquay, NMV F45145 (1); slide of body wall, NMV F45146 (mounted body wall, 33 mm long, 20 mm wide, not from either type specimen, endplates and support rods only).

*Other material (selection).* Victoria, Cape Conran, 2 Oct 1988, NMV F73832 (1); Walkerville south, Bear Gully, 7 Mar 1982, NMV F73838 (1); Cape Paterson Survey (CPA), 1982, Petrel Rock, NMV F73823 (1); Shack Bay, NMV F73824 (1); Cape Paterson, NMV F73825 (1); Harmers Haven, NMV F73822 (1); Westernport Bay Survey by MRG, 1969–71, Merricks, NMV F45239 (3); 29 Oct 1980, NMV F75976 (many); 28 Jan 1983, NMV F73831 (2); Shoreham, NMV F73854 (1); Flinders, 26 Feb 1977, NMV F74235 (5); 10 Mar 1980, NMV F73830 (many); Port Phillip Bay, Beaumaris, Ricketts Point, 25 Apr 2008, NMV F157402 (1); Cheltenham beach after storm, 20 Jul 1891, NMV F73856 (6); Mordialloc beach, May 1897, NMV F73857 (4); Sandringham, Jul 25 1891, NMV F73858 (4; no. 60642–5; det. by Joshua 1914; det. as *Phyllophorus ventripes* by F. W. E. Rowe 1976); Kennett River, 29 Dec 1982, NMV F73827 (2); Marengo, 26 Mar 1977, NMV F73850 (2); Portland, MRG, 23 Feb 2007, NMV F125356 (1).

Tasmania. Bass Strait, Lulworth, 22 Nov 1982, NMV F174904 (13); North Head, mouth of Tamar River, 28 Aug 1978, NMV F97070 (1).

South Australia. Gulf St Vincent, Willunga Reef, 23 Nov 1976, SAM K2583 (1); Cape Jervis, 3–5 m, 22 Apr 2005, SAM K2590 (1, PK0296); S side of Kangaroo I., Hanson Bay, rocky shallows, 6 Mar 1978, AM J12559 (3); Whittlebee Point, 1 Mar 1975, SAM K2591 (4); Baird Bay, 27 Feb 1975, SAM K2596 (3).

Western Australia, Two Peoples Bay, 5 Dec 1968, WAM Z31964 (1); Cape Naturaliste, 31 Dec 1971, WAM Z31971 (1); Yanchep, 31°33'S 115°41'E, reef flat, 1959, WAM Z8994 (1).

*Diagnosis.* Up to 175 mm long, up to 35 mm diameter (preserved, tentacles withdrawn, largest WAM Z8994), cylindrical body with slight anal taper, thick soft body wall; external anal scales not detected; 20 tentacles, 5 outer pairs large, 5 inner pairs small; complete cover of close tube feet, not contiguous, sometimes more concentrated ventrally than dorsally, diameter about 0.7 mm, radial to scattered tube feet cross introvert; calcareous ring with 10 posterior composite tapering projections arising predominantly from radial plates but sometimes jointly from both radial and inter-radial plates, posterior ends free thin tails comprising small elongate plates, ring not tubular, posterior projections shorter than combined height of plates and anterior projections, form of plates and composite components variable; short stone canal, madreporite multi-lobed, close to vascular ring; up to 5 polian vesicles, variable sizes, frequently one; longitudinal muscles flat, longitudinal indentation along centre of muscle; gonad tubules arise in series along gonoduct on each side of dorsal mesentery, tubules not branched.

Mid-body wall lacking ossicles; tube foot ossicles endplates and support rods and narrow plates only; endplates with denticulate or smooth margin, irregular perforations similar size, endplate diameters up to 480 $\mu$m; endplate support rods

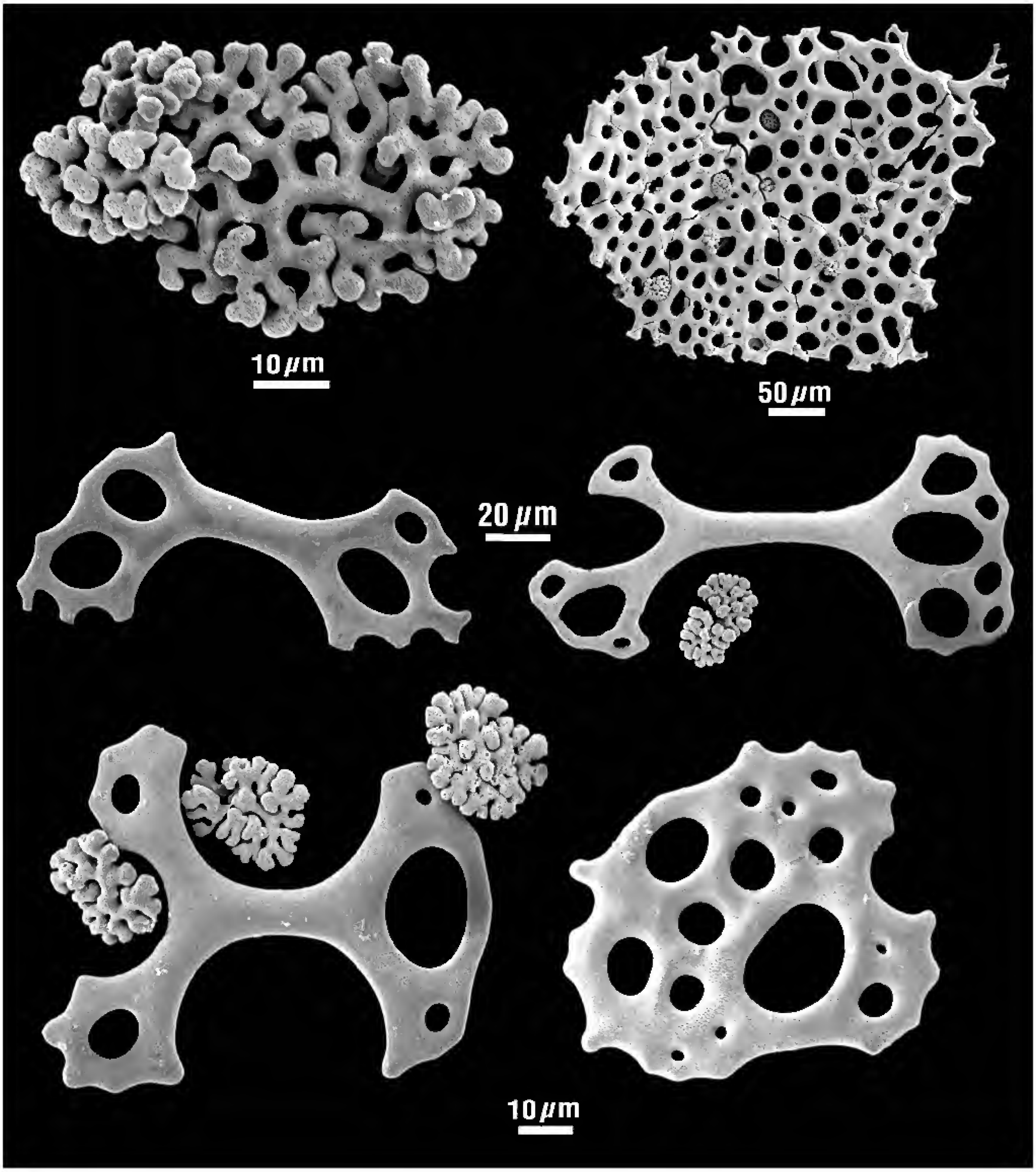


Figure 3. SEM images of ossicles from holotype of *Lipotrapeza litusi* O'Loughlin sp. nov. (WAM Z13475). Tube foot endplate (top right), rosettes, endplate support rods, rare perforated plate (bottom right).

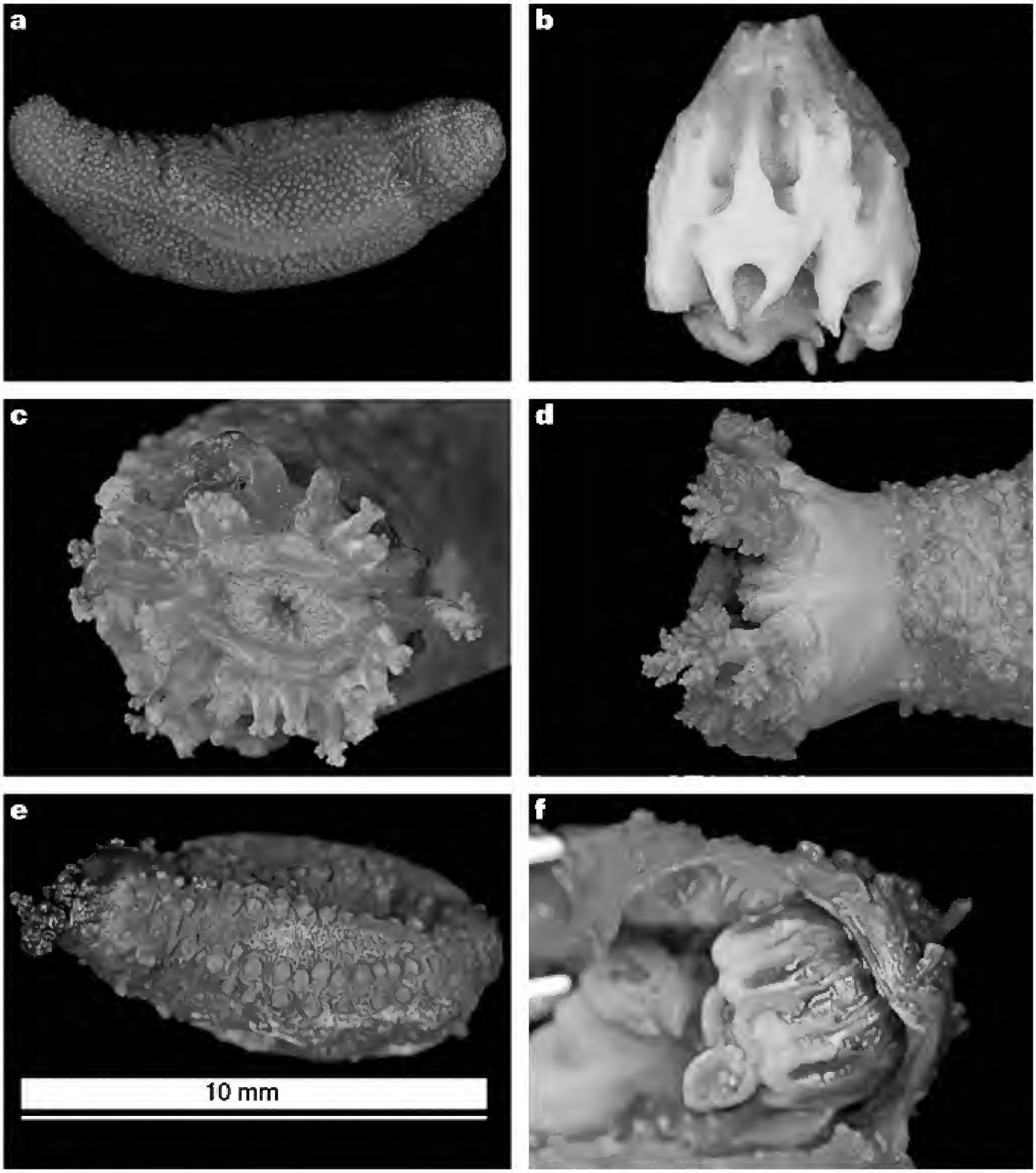


Figure 4. Photos of preserved specimens of *Lipotrapeza vestiens* (Joshua, 1914). a, adult specimen with tentacles withdrawn, close cover of tube feet, paired series of tube feet along interior longitudinal muscle attachment (NMV F73830, 80 mm long); b, calcareous ring with posterior prolongations arising from both radial and inter-radial plates (NMV F73830); c, oral view of tentacle crown with inner and outer rings of 5 paired small and 5 paired large tentacles (NMV F75976); d, lateral view of bare introvert and tentacle crown showing outer paired large and inner paired small tentacles (NMV F73830); e, juvenile with radial paired series of tube feet (NMV F75976); f, juvenile cucumariid-like calcareous ring lacking posterior prolongations (NMV F75976).

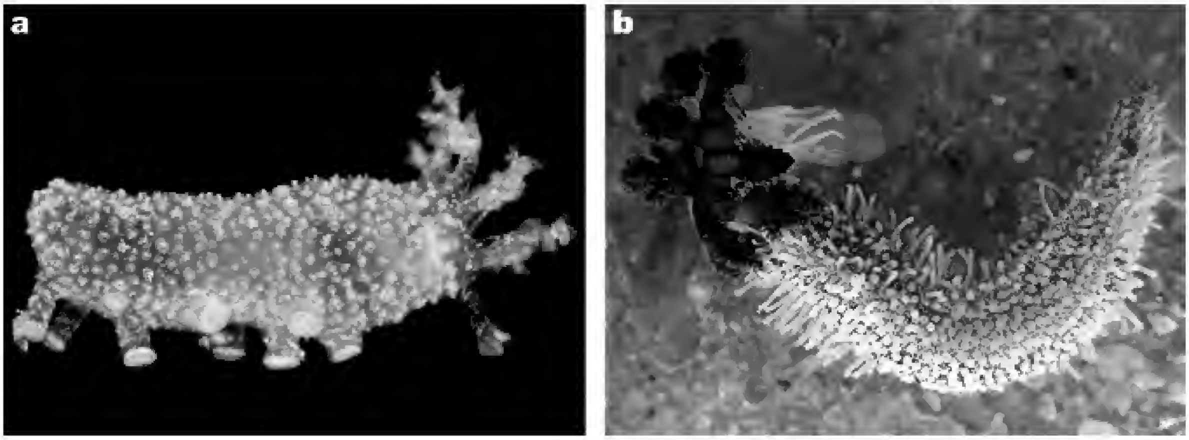

Figure 5. Photos of live specimens. a juvenile of *Lipotrapeza vestiens* (Joshua, 1914) from Eagles Nest, coast of Victoria, with body wall tables and ventral tube feet only (3 mm long; photo by Leon Altoff); b, specimen of *Thyone nigra* Joshua and Creed, 1915 from McHaffie Reef, Westernport Bay, with calcareous ring eviscerated (NMV F151855, photo by John Eichler).

and narrow plates straight to curved, larger ossicles perforate and denticulate, up to 200 $\mu$m long; tentacles with rods and rosettes, larger rods branched and denticulate distally, sometimes with small perforations, up to 160 $\mu$m long, rosettes oval to irregular, up to 80 $\mu$m long; peri-oral region with tentacle-like rods and rosettes; introvert with rosettes, fine rods up to 80 $\mu$m long; anal ossicles tube foot endplates and support rods, tentacle-like rods, rosettes, 5 scales with base up to 320 $\mu$m wide and digitiform column up to 360 $\mu$m long, base and column comprising massed short branched rods.

Juveniles. For specimen 20 mm long tentacles 20; for specimen 10 mm long tube feet radial only; for specimen 15 mm long calcareous ring cucumariid-like, lacking posterior projections, not composite; for specimens 7 mm long and smaller, tables present in mid-body wall, discs regular and irregular with frequently 8 perforations, lobed margin, discs typically 72 $\mu$m long, spires with 4 pillars, spires up to 64 $\mu$m long.

*Colour (preserved).* Body pink-brown, dark brown orally and anally; tube feet off-white; large tentacle branches dark brown, trunks off-white, small tentacles off-white.

*Distribution.* Southern Australia, from E Victoria, Cape Conran, west to S Western Australia (Yanchep); rocky shallows, 0–5 m.

*Remarks.* Cherbonnier 1988 referred five small specimens (up to 20 mm long) from Madagascar to *Lipotrapeza ventripes* (Joshua and Creed, 1915). As noted above and discussed below we make *Lipotrapeza ventripes* (Joshua and Creed, 1915) a subjective junior synonym of *Phyllostauros vercoi* (Joshua and Creed, 1915). In his observations Cherbonnier 1988 based his referral of these specimens to *Lipotrapeza ventripes* on Clark 1938. We judge from their descriptive remarks that both authors are referring to *Lipotrapeza vestiens* (Joshua, 1914). The Madagascar specimens have the diagnostic characters of the presence of tentacle rods, the form of the calcareous ring, presence of tube foot endplates and support rods, and absence of ossicles in the mid-body wall that characterize *Lipotrapeza vestiens*. But *Lipotrapeza vestiens* specimens attain a much larger size (up to 175 mm long), have five distinct pairs of inner small tentacles (not two circles of five), do not normally have fewer dorsal than ventral tube feet, and lack the "pseudo-plates" referred to by Cherbonnier 1988. We judge that the Madagascar specimens are not *Lipotrapeza vestiens*. *Lipotrapeza vestiens* (Joshua, 1914) is distinguished from the other species of *Lipotrapeza* in the key (above).

***Phyllophorella*** Heding and Panning, 1954

*Diagnosis (after Heding and Panning 1954).* Dendrochirote holothuroids with 20 tentacles in 2 series of 15 variably large outer and 5 small inner; body covered with tube feet; calcareous ring with 5 paired short composite tapering posterior extensions, arising principally from the radial plates but sometimes jointly from the radial and inter-radial plates; body wall ossicles tables with 4-pillared spires.

*Type species. Phyllophorus* (*Phyllophorella*) *robusta* Heding and Panning, 1954 (original designation; locality Thailand).

*Other species. P. contractura* Cherbonnier, 1988; *P. drachi* Cherbonnier and Guille, 1968; *P. dubius* Cherbonnier, 1961; *P. kohkutiensis* Heding and Panning, 1954; *P. liuwutiensis* (Yang, 1937); *P. longipeda* (Semper, 1867); *P. notialis* O'Loughlin sp. nov.; *P. perforata* (H. L. Clark, 1932); *P. purpureopunctata* (Sluiter, 1901); *P. rosetta* Thandar, 1994; *P. roseus* Cherbonnier and Féral, 1981; *P. spiculata* (Chang, 1935); *P. thyonoides* (H. L. Clark, 1938).

*Remarks.* We re-assign species *Phyllophorus thyonoides* H. L. Clark, 1938 from *Phyrella* Heding and Panning, 1954 to *Phyllophorella* Heding and Panning, 1954 on the basis of having 15 variably large outer tentacles and 5 small inner ones, and frequent cases of the posterior prolongations of the

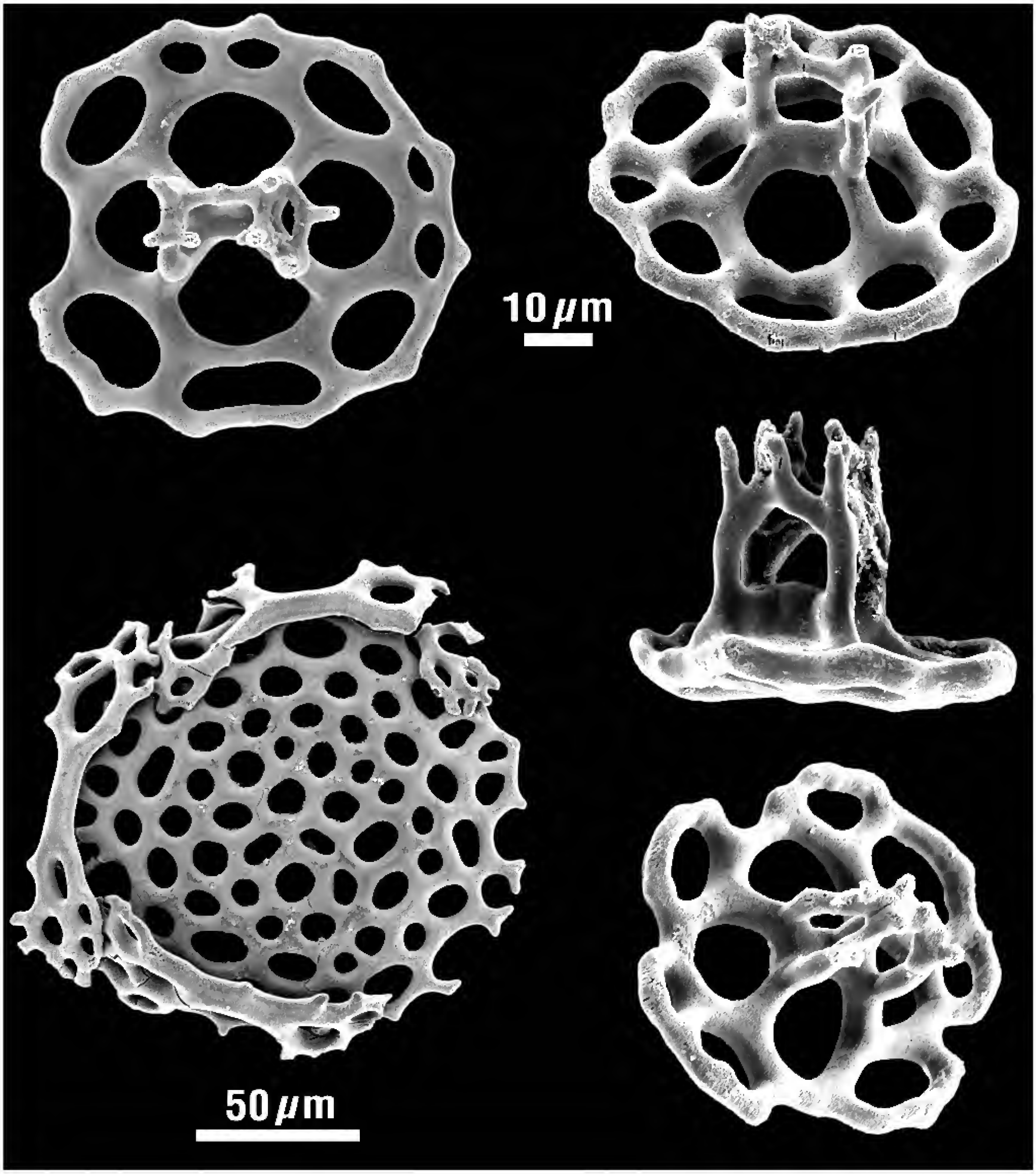


Figure 6. SEM images of ossicles from juvenile of *Lipotrapeza vestiens* (Joshua, 1914). Mid-body wall tables with 4-pillared spires, irregular discs with about 12 perforations, endplate with support rods (5 mm long, NMV F125356).

calcareous ring arising from both radial and inter-radial plates (as illustrated by Heding and Panning 1954 for most *Phyllophorella* species). We note that Rowe (in Rowe and Gates 1995) made *Phyllophorus parvipedes* H. L. Clark, 1938 (type locality Broome in NW Australia) a subjective junior synonym of *Phyllophorus spiculata* Chang 1935 (type locality China).

***Phyllophorella notialis*** O'Loughlin sp. nov.

Figures 1e, f, 7

*Material examined*. Holotype. SE Australia, New South Wales, Disaster Bay, RV *Southern Surveyor* SS0404 stn 102, 37°17.22'S 150°4.15'E, 79 m, 28 April 2004, NMV F132691.

*Description*. Body 20 mm long, diameter up to 7 mm (preserved, tentacles slightly extended, part of posterior body missing); 20 tentacles in 2 series, 15 outer variable sizes from large to medium, 5 inner very small; complete cover of tube feet, diameter about 0.3 mm; calcareous ring not tubular, radial plates with paired composite tapering tails; inter-radial plates not composite, lacking posterior extensions, truncate, less than half total length of radial plates; single polian vesicle; lacking gonad tubules.

Mid-body ossicles tables only, table discs variably round to oval, margins smooth and slightly lobed, disc lengths variable from 64 $\mu$m to 192 $\mu$m, frequently 96 $\mu$m, table spires short, about 24 $\mu$m long, predominantly 4 pillars, rarely 5, blunt apical spines; endplates up to 144 $\mu$m diameter, endplate support ossicles tables with curved discs, discs up to 136 $\mu$m long; tentacle ossicles abundant small, fine rods, intergrading with stout rods with swollen multi-perforate and bluntly denticulate ends, each end with a large and up to 10 small marginal perforations, rods up to 176 $\mu$m long.

*Colour*. Body grey-brown, introvert white, tentacles pale brown with some dark brown markings.

*Distribution*. Australia, south coast of New South Wales, Disaster Bay, 79 m.

*Etymology*. Named from the Latin *notialis* (southern), for the research vessel *Southern Surveyor*.

*Remarks*. *Phyllophorella notialis* O'Loughlin sp. nov. is distinguished from other southern Australian species of Phyllophoridae in the key (above).

***Phyllophorella thyonoides*** (H. L. Clark, 1938)

Figures 9, 10, 13f

*Phyllophorus thyonoides* H. L. Clark, 1938: 492–494, fig. 48.—H. L. Clark, 1946: 409.

*Phyllophorus ventripes* Joshua and Creed, 1915: 19, pl. 2 fig. 1, pl. 3 fig. 5. (part).

*Lipotrapeza ventripes*.—H. L. Clark, 1938: 495–496.—H. L. Clark, 1946: 412.—Heding and Panning, 1954: 175, fig. 83 (from Joshua and Creed 1915).—Smith, 1970: 94.—Rowe, 1982: 464.—Rowe and Gates, 1995: 311. (part).

*Phyrella thyonoides*.—Heding and Panning, 1954: 183–184, fig. 88 (from H. L. Clark 1938).—Rowe and Gates, 1995: 313–314.

*Material examined*. *Phyllophorus ventripes* Joshua and Creed, 1915. Paratype. South Australia, J. C. Verco, SAM K1375 (1; earliest label "type material"; recent label "type"; judged here to be a paratype; determined as *Phyrella thyonoides* by F. W. E. Rowe 1977; confirmed here).

Other material. South Australia, J. C. Verco, SAM K2597 (1; determined as *Phyllophorus (Phyllophorella) thyonoides* by F. W. E. Rowe 1977; confirmed here).

Western Australia, Garden I., Careening Bay, intertidal sand flats, 26 Nov 1961, WAM Z31837 (1); sand flats, 20 Dec 1969, WAM Z31962 (1); Cockburn Sound, Woodman's Point, seagrass bank, 1 Dec 1957, WAM Z31834 (2); 1 m, 18 Mar 1972, WAM Z31975 (1); 100 km S of Geraldton, Cliff Head, seagrass rhizomes, 2 m, 2 Sep 1985, WAM Z21214 (2); 3 Jun 1986, AM J21716 (4).

*Diagnosis*. Up to 60 mm long, up to 25 mm diameter (preserved, tentacles withdrawn), curved cylindrical body tapered to rounded upturned ends orally and anally, variably with ventral belly, thick firm body wall; external anal scales not detected; 20 tentacles, 15 variably large outer, 5 inner small; complete spaced cover of large and small tube feet, larger and more numerous ventrally, disc ends up to 0.7 mm diameter, smaller dorsally, orally, anally, radial to scattered tube feet cross introvert, spaced paired posterior radial series; calcareous ring with 10 posterior composite tapering projections arising from radial plates only (smaller specimens) or jointly from both radial and inter-radial plates (larger specimens), ring not tubular, posterior ends free tapering tails generally sub-equal with anterior plates and projections, spaces between posterior prolongations extending anteriorly to similar extents radially and inter-radially, form of plates and composite components variable; short stone canal, multi-lobed madreporite close to vascular ring; 1–3 polian vesicles; gonad tubules arise in series along gonoduct on each side of dorsal mesentery, tubules not branched.

Mid-body wall with scattered tables, discs regular to irregular in form, some with appearance of being incomplete, rounded quadrangular to oval, commonly 96 $\mu$m long, frequently up to 112 $\mu$m long, rarely up to 144 $\mu$m long, margin lobed, lobes smooth or denticulate, commonly central and about 8 outer perforations, sometimes many perforations anally, spires frequently with 4 pillars up to 48 $\mu$m high, rarely 3, 5, 6 pillars; tube foot ossicles endplates and endplate support ossicles only; endplates with denticulate margin, irregular perforations similar size, diameters up to 600 $\mu$m; endplate support ossicles up to 184 $\mu$m long, dumbbell-shaped rods with rounded ends with large and small perforations and denticulate margin, and narrow multi-perforate plates with denticulate margin; tentacles with rods and rosettes, larger rods dumbbell-shaped, widened and perforate distally with denticulate margin, up to 320 $\mu$m long, rosettes up to 104 $\mu$m long; introvert with some rosettes up to 48 $\mu$m long; peri-oral region with tentacle-like rods and rosettes; anal ossicles tube foot endplates and support rods, tentacle-like rods, rosettes, 5 scales comprising base up to 320 $\mu$m wide with digitiform column up to 360 $\mu$m long, base and column comprising massed short branched rods.

Specimen 4 mm long with radial tube feet; cucumariid ring lacking posterior prolongations; mid-body ossicles typical solid 4-pillared tables, some margins closely denticulate, rare larger irregular tables with discs up to 120 $\mu$m wide.

*Colour (preserved)*. Body off-white with close grey-brown/ black flecking creating dark grey/black appearance, body

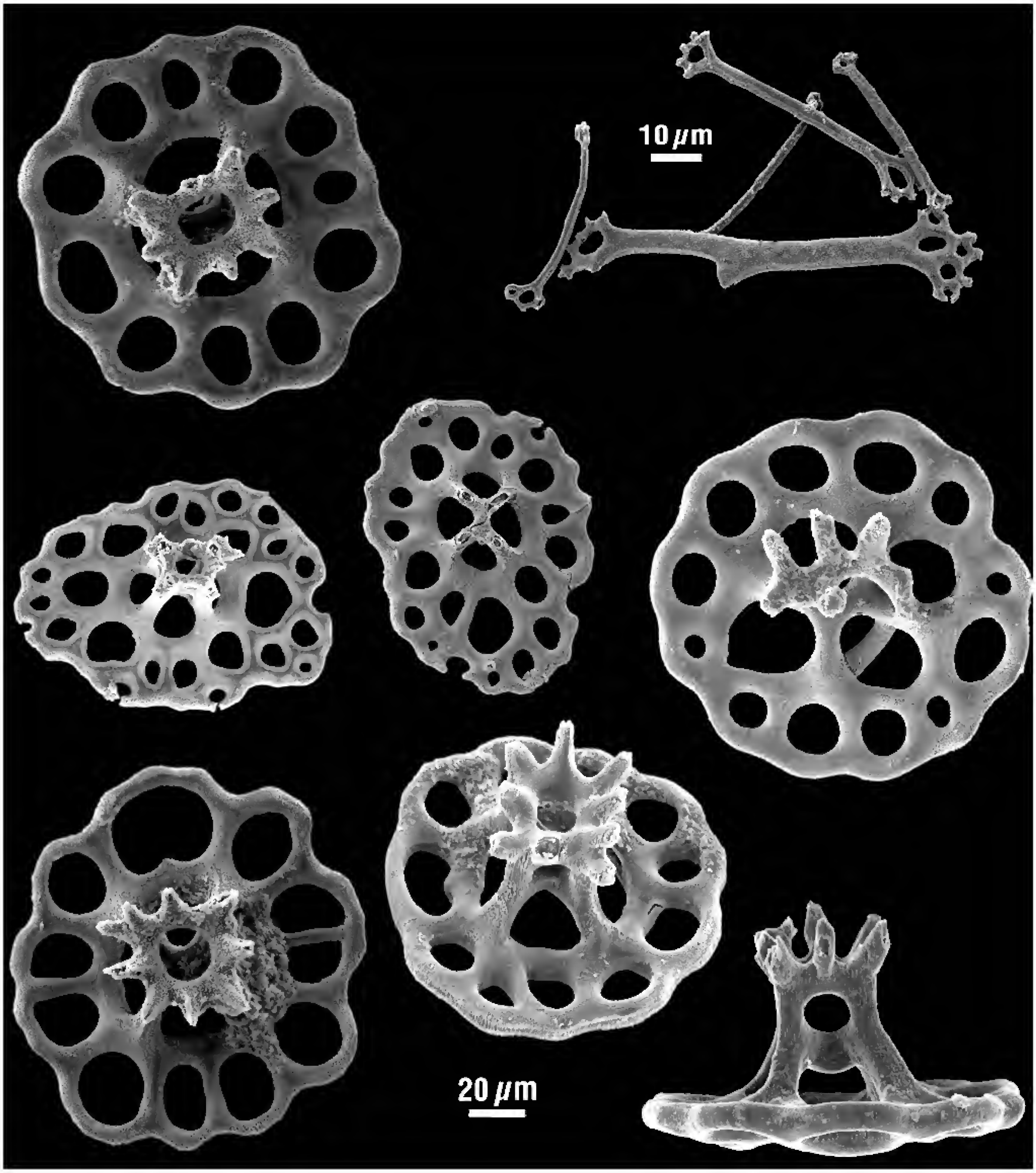


Figure 7. SEM images of ossicles from holotype of *Phyllophorella notialis* O'Loughlin sp. nov. (NMV F132691). Tentacle rods (top right) and 4-pillared tables from the body wall.

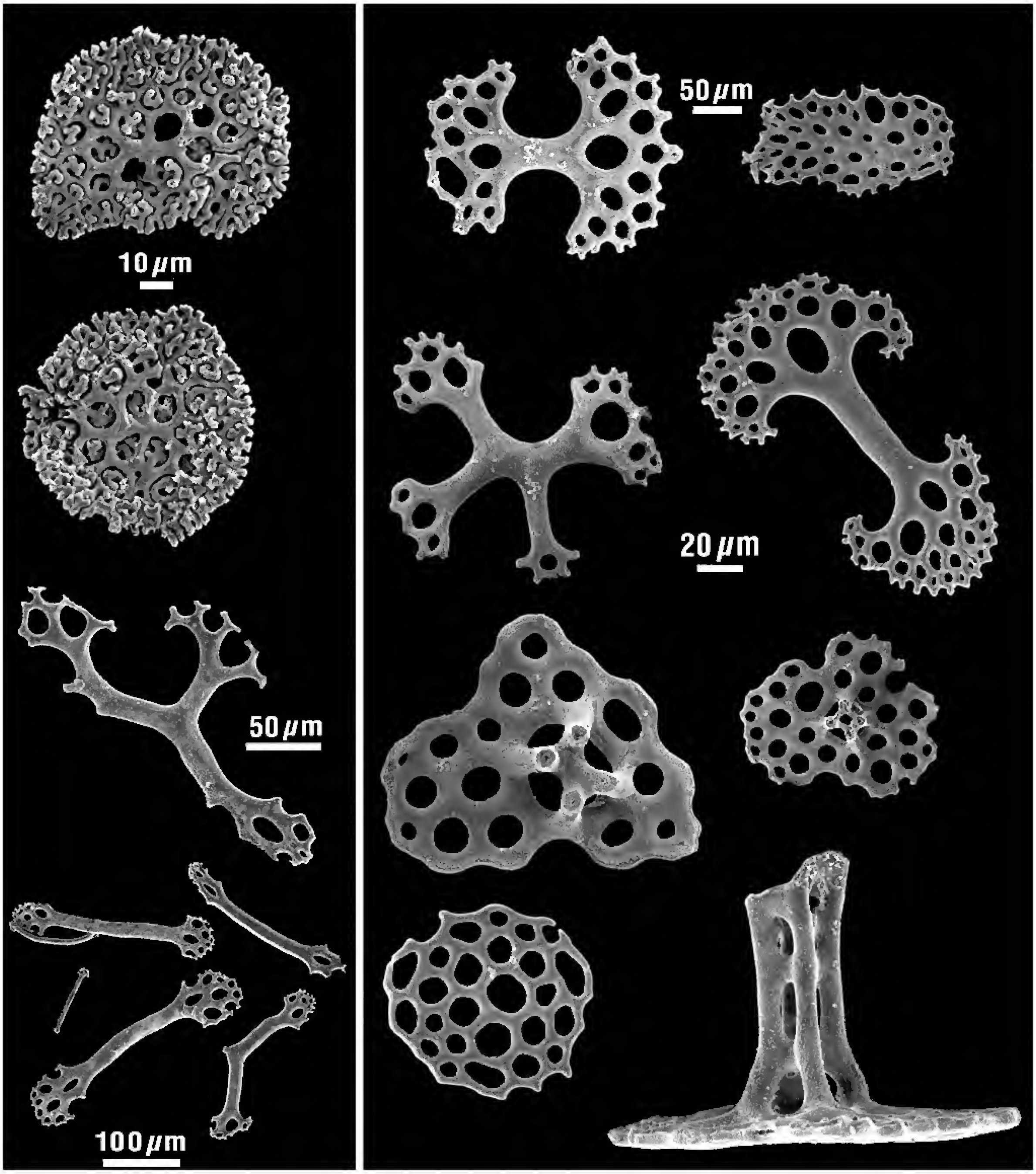


Figure 8. SEM images of ossicles from specimens of *Thyonidiella kungi* O'Loughlin sp. nov. Tentacle rosettes and rods (left; holotype NMV F76637); endplate, dumbbell-shaped endplate support ossicles, and 4-pillared tables, from body wall of a juvenile (3 mm long; NMV F76639).

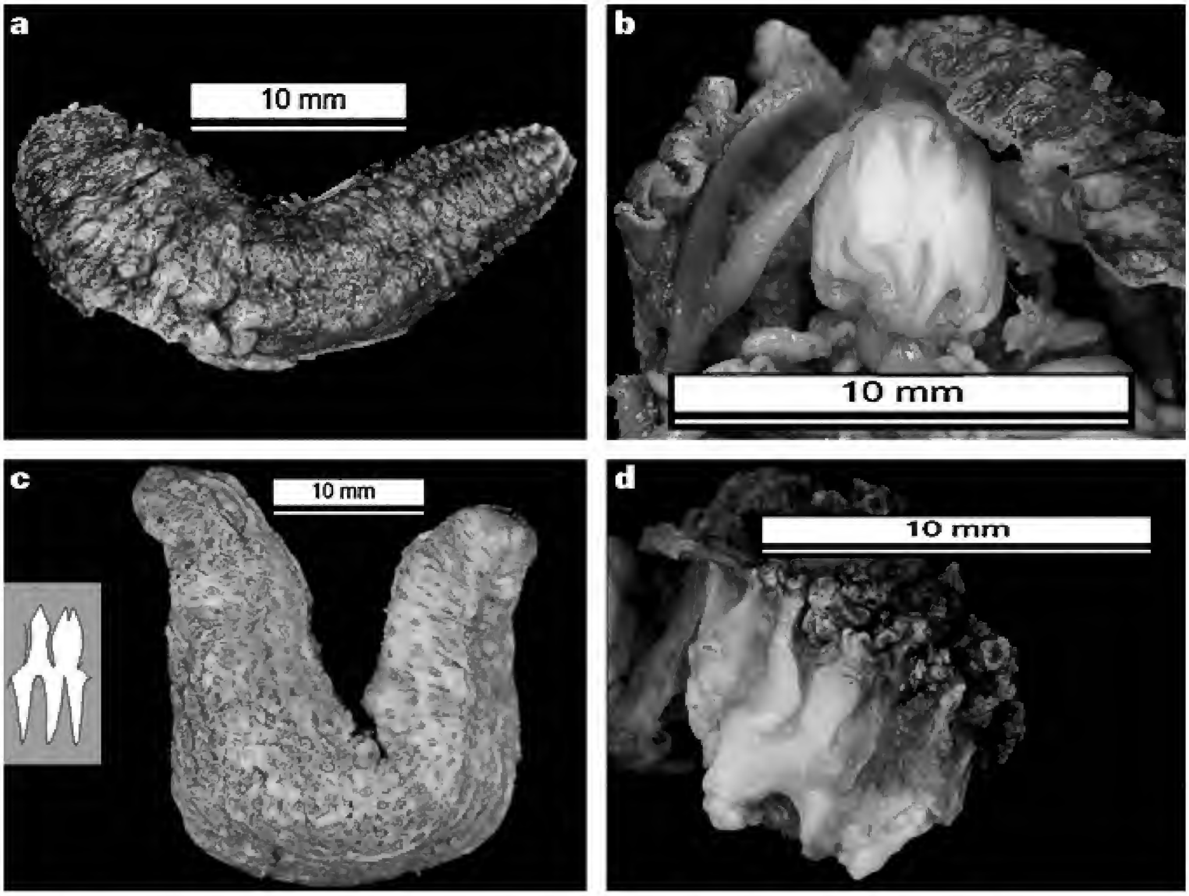


Figure 9. Photos of preserved specimens of *Phyllophorella thyonoides* (H. L. Clark, 1938). a, specimen from Western Australia (AM J21716); b, calcareous ring with posterior prolongations from radial plate only (AM J21716); c, specimen from South Australia (SAM K2597); d, calcareous ring with posterior prolongations jointly from radial and inter-radial plates (paratype of *Phyllophorus ventripes* Joshua and Creed, 1915, SAM K1375).

sometime red-brown to orange, not darker orally and anally; tube feet off-white, sometimes red; tentacle branches dark brown, white lumps (rosette ossicle clusters) on trunks.

*Distribution*. St. Vincent Gulf (South Australia) to Cliff Head (100 km S of Geraldton) (Western Australia), intertidal and offshore sediments, seagrass beds, 0–2 m.

*Remarks*. Specimen SAM K1374 is judged here (and so reported by Rowe and Gates 1995) to be the holotype for *Phyllophorus ventripes* Joshua and Creed, 1915. Thus specimens of *Phyllophorus ventripes* SAM K1375 (labelled "type material") and NMV F45143 (3 specimens labelled "syntypes", and so reported by Smith 1970) are judged here to be paratypes. Rowe and Gates 1995 listed four paratype specimens of *Phyllophorus ventripes* in lot SAM K1375. We found only one specimen in this lot. The three missing specimens may be those registered as syntypes (NMV F45143). We examined these SAM and NMV type specimens. The holotype of *Phyllophorus ventripes* Joshua and Creed, 1915 and the three NMV paratypes are conspecific with *Thyone vercoi* Joshua and Creed, 1915, described in the same paper and based on a single specimen (see below under *Phyllostauros vercoi*). The remaining SAM K1375 paratype of *Phyllophorus ventripes* is conspecific with *Phyllophorus thyonoides* H. L. Clark, 1938.

There are no labels or other records of where and when Dr. J. C. Verco collected the specimens for which *Thyone vercoi* and *Phyllophorus ventripes* were erected as new species. However H. L. Clark 1938 records Le Fevre Peninsula (sandy shallows 15 km NW of Adelaide in Gulf St. Vincent) as the precise locality for the collection of two loan specimens of *Thyone vercoi* (information presumably *pers. comm.*). Apart from the original specimens collected by Dr. Verco there are no other SAM specimens of either of these two species. WAM specimens of *P. thyonoides* collected from sea grass beds and

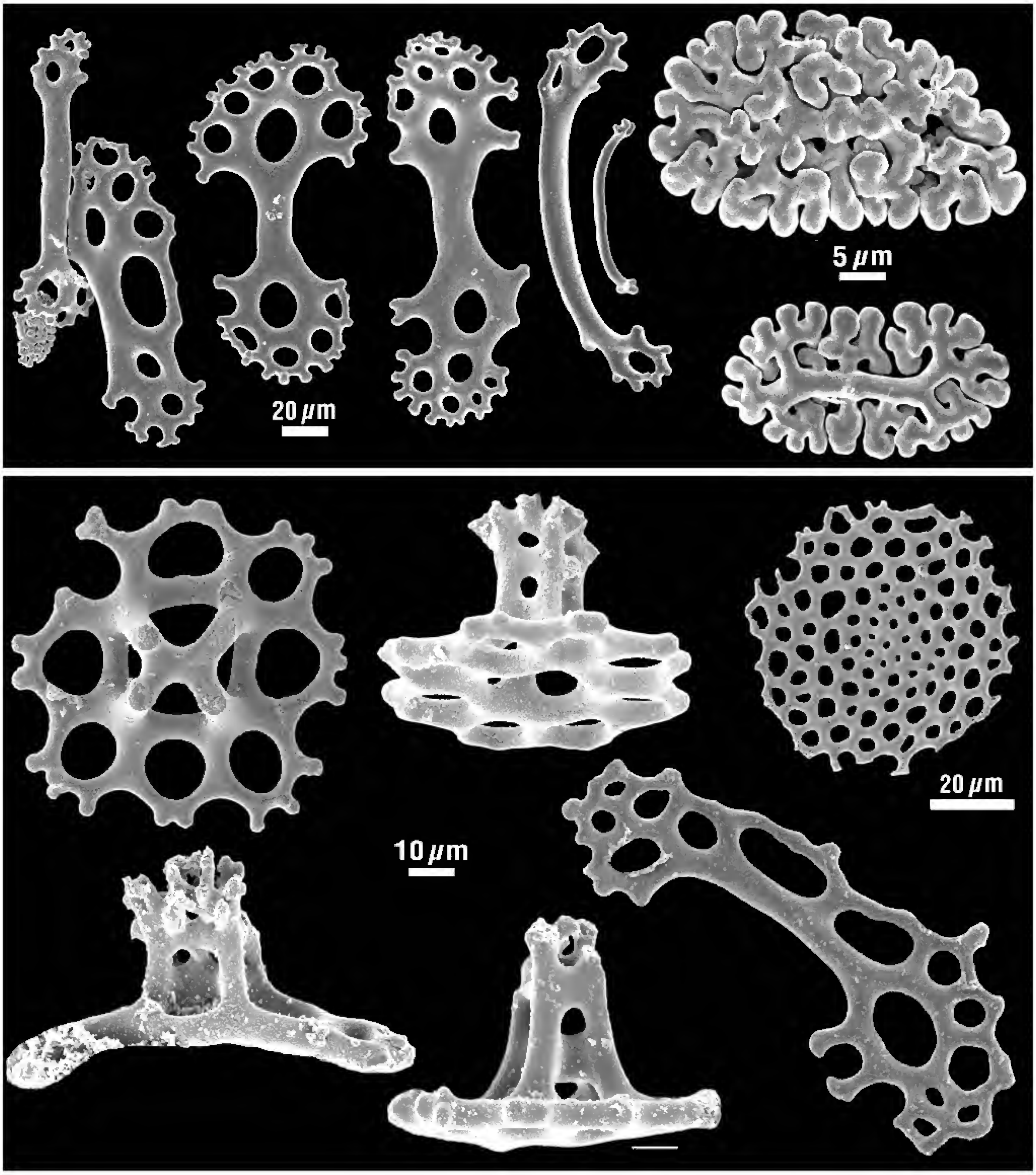


Figure 10. SEM images of ossicles from specimen of *Phyllophorella thyonoides* (H. L. Clark, 1938) (AM J21716). Tentacle rods, some dumbbell-shaped, and rosettes (top); mid-body wall tables and tube foot endplate and support plate ossicle (bottom).

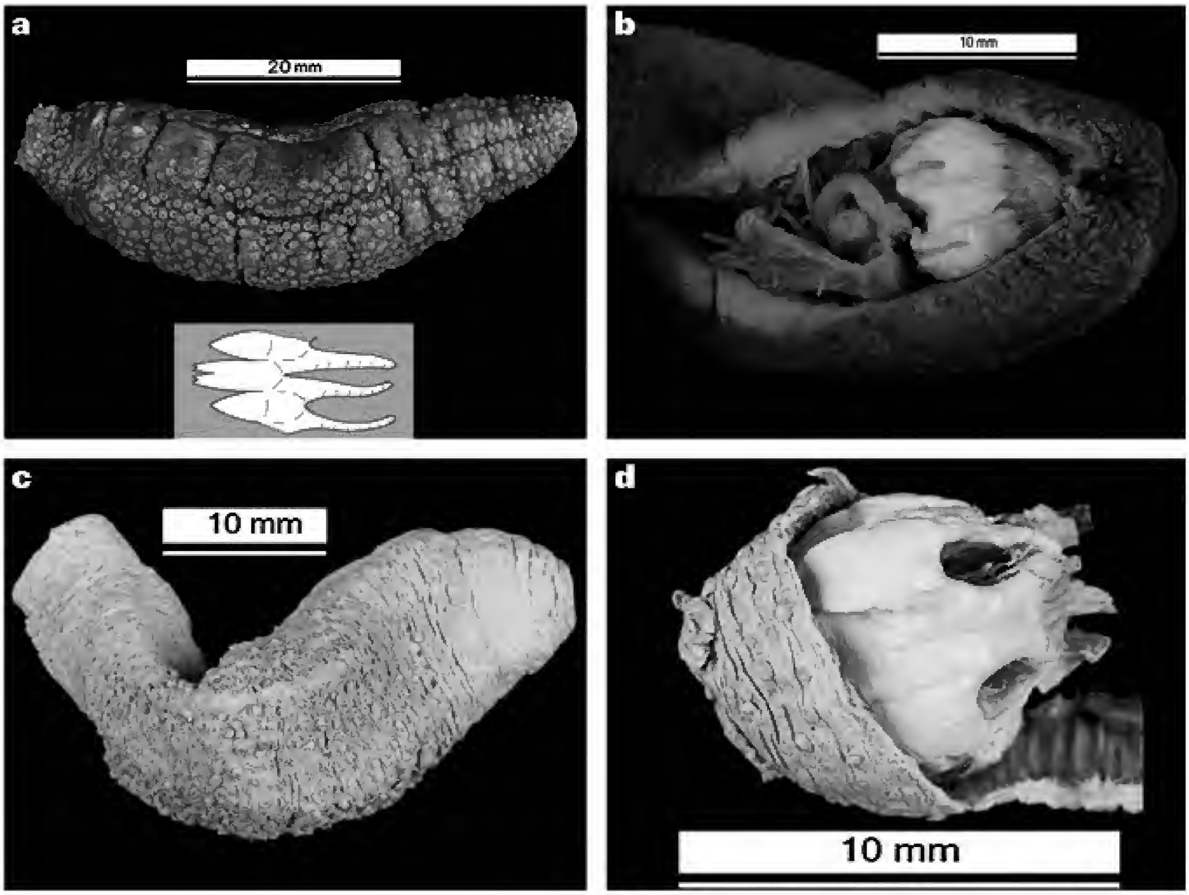


Figure 11. Photos of preserved specimens of *Phyllostauros vercoi* (Joshua and Creed, 1915). a, lateral view showing tube feet close ventrally and ventro-laterally, and sparse dorsally (paratype of *Phyllophorus ventripes* Joshua and Creed, 1915; NMV F45143) (insert: form of the calcareous ring plates); b, calcareous ring (NMV F45143); c, ventro-lateral view (holotype of *Phyllophorus ventripes* Joshua and Creed, 1915, dry, oral end detached, SAM K1374); d, calcareous ring (SAM K1374).

the sandy Le Fevre Peninsula provide evidence of the eco-niche for both *P. thyonoides* and *P. vercoi*.

The drawing of the calcareous ring for *Phyllophorus ventripes* Joshua and Creed, 1915 (*P. thyonoides* and *P. vercoi* here) is somewhat misleading as it shows posterior prolongations arising from the radial plates only, whereas in many specimens they arise jointly from radial and inter-radial plates. H. L. Clark 1938 noted for *Phyllophorus thyonoides* “obviously the lines of division between radial and inter-radial pieces of the calcareous ring are indefinite and arbitrary”. We agree. We noted that in one specimen of *Phyllophorella thyonoides* (WAM Z31975, illustrated in fig. 13f) the posterior prolongations of the calcareous ring are joined as in genus *Massinium* Samyn and Thandar, 2003 species (see below).

The dorsal tube feet are deeply buried in pits for *Phyllophorus ventripes* paratype SAM K1375 (*P. thyonoides* here), and this presumably led the original authors to describe the species as lacking tube feet dorsally.

***Phyllostauros*** O’Loughlin gen. nov.

*Diagnosis*. Dendrochirote holothuroids with 20 tentacles, 5 large pairs alternating and 5 small pairs; body covered with tube feet; calcareous ring with 5 paired composite posterior tapering prolongations, arising jointly from the radial and inter-radial plates; body wall ossicles crosses with bifurcate ends, 1 or 2 surface spines near the ends.

*Type species*. *Thyone vercoi* Joshua and Creed, 1915 (monotypic).

*Distribution*. Central southern Australia.

*Etymology*. From the first part *Phyllo* of the relevant family name Phyllophoridae, with *stauros* (Greek for cross) referring to the body wall ossicle form.

*Remarks*. *Thyone vercoi* Joshua and Creed, 1915 was erected for one specimen that is now dry and in poor condition (holotype, SAM K1374). The authors made three permanent

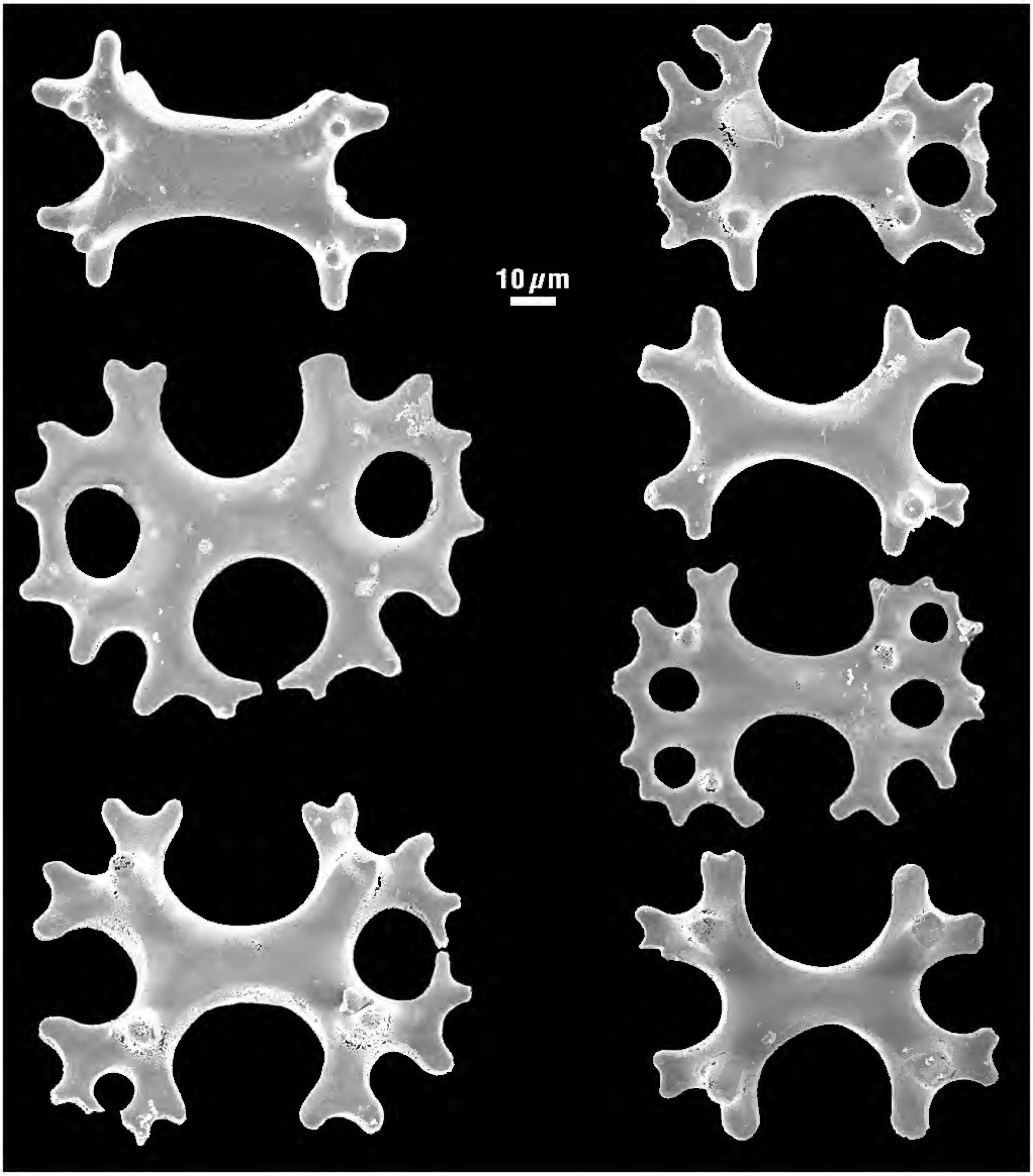


Figure 12. SEM images of ossicles of specimen of *Phyllostauros vercoi* (Joshua and Creed, 1915) (from paratype of *Phyllophorus ventripes* Joshua and Creed, 1915; NMV F45143). Surface-knobbed crosses from the body wall.

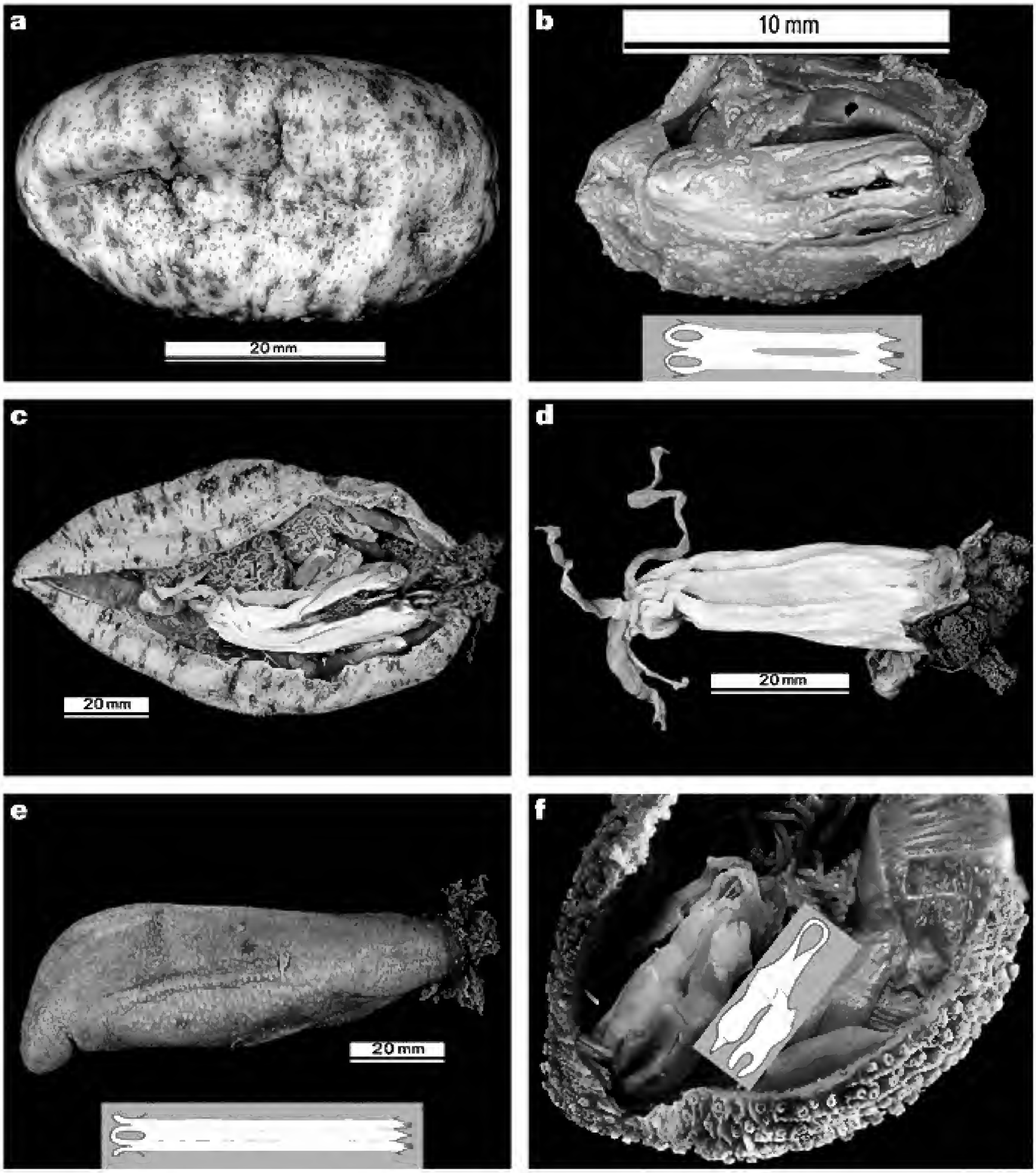


Figure 13. Photos of preserved specimens. a, *Massinium melanieae* O'Loughlin sp. nov. (holotype NMV F174897); b, *Massinium vimsi* O'Loughlin sp. nov. (holotype, NMV F76629) (insert: form of the calcareous ring plates); c, *Massinium watsonae* O'Loughlin sp. nov. (holotype, NMV F97435); d, calcareous ring, stone canal (along alimentary canal) and madreporite, and 2 polian vesicles (top left corner) of *Massinium watsonae* (TMAG H1988); e, colour morph of *Massinium watsonae* (NMV F174899) (insert: form of the calcareous ring plates); f, exceptional calcareous ring from specimen of *Phyllophorella thyonoides* (H. L. Clark, 1938) with posterior prolongations joined as in *Massinium* species (WAM Z31975) (insert: form of the calcareous ring plates).

microscope slides from parts of the dorsal body wall, pharynx and a tentacle. These slides are in good condition, and held by SAM. H. L. Clark 1946 refers to additional slides held in MCZ. The tentacle crown is damaged, but there are more than the 10 tentacles reported originally, and close to 20. The calcareous ring is composite with posterior prolongations, but is not tubular as in southern Australian *Thyone* Oken, 1815 species.

Based on the cross ossicles in the body wall H. L. Clark 1946 referred *Thyone vercoi* to *Staurothyone* H. L. Clark, 1938, but with reservations. He noted that Deichmann thought that the species was identical with *Lipotrapeza vestiens* (Joshua, 1914). Genus *Staurothyone* is in family Cucumariidae. *Thyone vercoi* has close to 20 tentacles, composite posterior extensions to the plates of the calcareous ring, and tube feet all over the body (close ventrally, scattered and sparse dorsally). *Thyone vercoi* belongs in family Phyllophoridae, not Cucumariidae, and cannot be retained in *Staurothyone*. *Thyone vercoi* is unique amongst Phyllophoridae species for the presence of body wall cross ossicles and absence of table ossicles. Rowe 1982, and Rowe in Rowe and Gates 1995, anticipated the need for a new genus. *Phyllostauros* O'Loughlin gen. nov. is erected here as a monotypic genus, and is referred to family Phyllophoridae and sub-family Phyllophorinae with reservations because of the unique cross ossicles in the body wall.

***Phyllostauros vercoi*** (Joshua and Creed, 1915)

Figures 11, 12

*Thyone vercoi* Joshua and Creed, 1915: 19–20, pl. 2 figs 2–4, pl. 3 fig. 1, pl. 4.—H. L. Clark, 1938: 463–464.

*Phyllophorus ventripes* Joshua and Creed, 1915: 19, pl. 2 fig. 1, pl. 3 fig. 5. (part).

*Lipotrapeza ventripes*.—H. L. Clark, 1938: 495–496.—H. L. Clark, 1946: 412.—Heding and Panning, 1954: 175, fig. 83 (from Joshua and Creed 1915).—Rowe, 1982: 464.—Rowe and Gates, 1995: 311. (part).

*Staurothyone vercoi*.—H. L. Clark, 1946: 397–398.—A. M. Clark, 1966: 345.—Rowe and Gates, 1995: 281.

*'Staurothyone' vercoi*.—Rowe, 1982: 464, fig, 10.29b.

*Material examined*. Holotype. South Australia, SAM K517 (with microscope slides of "skin", tentacle, and pharynx; specimen strongly contracted, dry).

*Phyllophorus ventripes* Joshua and Creed, 1915. Holotype. South Australia coast, SAM K1374 (specimen dry; oldest labels "type M.S.S.", "*Phyllophorus* sp. n. type", "holotype"; determined as "*Sturothyone*" *vercoi* by F. W. E. Rowe 1977). Paratypes. South Australia coast, 18 Sep 1913, NMV F45143 (3; no. 60676–8; labelled syntypes; determined by Joshua and Creed in 1914; from SAM "in exchange" 19 Sep 1919; AM label "*Staurothyone*" *vercoi*; judged here to be paratypes).

*Diagnosis*. Up to 50 mm long, up to 15 mm diameter (preserved, tentacles withdrawn), cylindrical body tapered to rounded slightly upturned ends orally and anally, distinct ventral surface, thick firm body wall; external anal scales not detected; 20 tentacles, 5 large pairs alternating with 5 small pairs; complete cover of tube feet, larger and concentrated ventrally, disc ends about 0.7 mm diameter, smaller and scattered dorsally, orally, anally, disc ends about 0.4 mm diameter; tube feet cross introvert; calcareous ring with 10 posterior composite digitiform projections arising jointly from both radial and inter-radial plates, projections each comprise about 6 end-to-end plates, projections close radially creating long narrow gap extending higher anteriorly into the radial plates than the wide inter-radial gap, ring not tubular, posterior prolongations sub-equal in length with plates and anterior projections, form of plates and composite components variable; short stone canal, multi-lobed madreporite close to vascular ring; 1 tubular polian vesicle; longitudinal muscles with mid-muscle groove; gonad tubules in series along gonoduct on each side of dorsal mesentery, not branched.

Mid-body wall with abundant crosses, typically 64 $\mu$m long, some with 1 or 2 blunt surface spines near bifurcate ends, rare large crosses 88 $\mu$m long with bifurcations joined to create large perforations; tube foot ossicles endplates and support rods only, endplates with denticulate margin, irregular perforations similar size, diameters up to 320 $\mu$m, endplate support ossicles predominantly dumbbell-shaped, up to 104 $\mu$m long, rounded ends with large and small perforations and denticulate margin; tentacles with rods and rosettes, larger rods dumbbell-shaped, widened and perforate distally with denticulate margin, up to 240 $\mu$m long, rosettes up to 40 $\mu$m long; pharynx with abundant rosettes, typically 32 $\mu$m long.

*Colour*. Body red-brown, rusty, not darker orally and anally; tube feet disc ends off-white; tentacles with white lumps (rosettes), trunks white, branches pale brown.

*Distribution*. South Australia, Gulf St. Vincent, intertidal and offshore sediments.

*Remarks*. The new generic referral and unique diagnostic characters of *Phyllostauros vercoi* (Joshua and Creed, 1915) are discussed above under the new genus *Phyllostauros* O'Loughlin.

As the basis of their erection of this new species Joshua and Creed 1915 refer specifically to a single specimen collected by Dr. J. C. Verco, "considerably contracted" and 36 mm long (SAM K517). H. L. Clark 1938 refers to a loan of two specimens of *Thyone vercoi*, 50 and 14 mm long. He further notes that both came from Le Fevre Peninsula (15 km NW of Adelaide in Gulf St. Vincent), and thus from sandy shallows. Curiously H. L. Clark 1946 makes no mention of these two specimens in discussing *Staurothyone vercoi*.

The two oldest labels with the holotype specimen of *Phyllophorus ventripes* (SAM K1374) record "type M.S.S" and "type, SA coast, Dr. Verco". Other recent labels indicate "holotype". Rowe and Gates 1995 record "holotype". We accept that this specimen is the holotype. A determination by F. W. E. Rowe in 1977 indicates *'Staurothyone' vercoi*. We agree with this species determination and synonymy. Although the specimen is dry it is still possible to extract cross ossicles from the body wall.

Furthermore we have found that the three paratypes of *Phyllophorus ventripes* Joshua and Creed 1915 (NMV F45143) are conspecific with *Thyone vercoi* (type status of paratypes discussed above under *Lipotrapeza thyonoides*).

The holotype specimen of *Thyone vercoi* is dry and in poor condition but there is an excellent set of slides from the type available. The species itself has unique characters within Phyllophoridae, has never been uncertain in terms of type status, has not been erroneously reported in the literature, and has received considerable attention in the literature (see above under *Phyllostauros*). On the other hand, for *Phyllophorus ventripes*, considerable confusion has surrounded the history of the status and identity and description of the type specimens, and subsequent determination of other material. Thus as "first revisers" (see ICZN Article 24.2.2) we give name precedence to *Thyone vercoi* over *Phyllophorus ventripes* in Joshua and Creed 1915. *Phyllophorus ventripes* is a subjective junior synonym of *Thyone vercoi*.

***Thyonidiella*** Heding and Panning, 1954

*Diagnosis (after Heding and Panning 1954).* Dendrochirote holothuroids with 15 tentacles in 2 series, 10 large outer and 5 small inner; body covered with tube feet; calcareous ring with composite tapering posterior extensions comprising discrete single series of plates, arising principally from radial plates but sometimes also joined with inter-radial plate posterior extensions; body wall ossicles tables with 4-pillared spires, sometimes only present in juveniles; endplates with support plates, not support tables.

*Type species. Thyonidiella tenera* (Ludwig, 1875) (senior synonym of original type species *Thyonidiella oceana* Heding and Panning, 1954).

*Other species. T. cherbonnieri* Rowe and Richmond, 2004; *T. drozdovi* (Levin and Stepanov, 1999); *T. exigua* Cherbonnier, 1988; *T. kungi* O'Loughlin sp. nov.

*Remarks.* Rowe and Richmond (2004) commented in detail on genus *Thyonidiella* Heding and Panning, 1954. They noted that *Thyonidiella oceana* Heding and Panning, 1954 is a junior synonym of *Thyonidiella tenera* (Ludwig, 1875), and that *Semperiella* Heding and Panning, 1954 is a junior synonym of *Thyonidiella* Heding and Panning, 1954. They further judged that *Thyonidiella exigua* was probably based on a juvenile specimen of *Selenkiella paradoxa* Cherbonnier, 1970.

***Thyonidiella kungi*** O'Loughlin sp. nov.

Figures 1d, 8

*Material examined.* Holotype. Australia, Bass Strait, VIMS 81–T–1, NZOI RV *Tangaroa* stn 176, 38°54.3'S, 147°13.4'E, 58 m, coarse shell, 18 Nov 1981, NMV F76637.

Paratypes. Type locality and date, NMV F174910 (1); VIMS 81–T–1 stn 171, 38°53.7'S, 147°55.2'E, 71 m, shelly sand, 17 Nov 1981, NMV F76635 (3); VIMS 81–T–1 stn 177, 38°53.7'S, 147°06.5'E, 58 m, coarse shell, 18 Nov 1981, NMV F76638 (5).

*Other material.* VIMS 81–T–1 stn 161, 39°47.3'S, 147°19.3'E, 60 m, muddy shell, 14 Nov 1981, NMV F76636 (1); VIMS 81–T–1 stn 174, 39°14.8'S, 147°31.5'E, 57 m, muddy shell, 18 Nov 1981, NMV F76639 (5, very small).

*Diagnosis.* Up to 16 mm long, up to 5 mm diameter (preserved, tentacles withdrawn), cylindrical body, rounded end orally, tapered to rounded end anally, thick soft body wall; external anal scales not detected; 15 tentacles in 2 series, 5 outer pairs large, 5 single inner small; complete spaced cover of tube feet, diameter up to about 0.2 mm; calcareous ring with 10 posterior composite tapering projections arising in pairs from radial plates only, posterior projections free thin tails each comprising about 5 elongate plates, ring not tubular, anterior radial plate narrowing slightly with deep central split, lacking lateral small notches, interradial plates not composite; single polian vesicle; longitudinal muscles flat, not divided.

Mid-body dorsal wall lacking ossicles; tube foot ossicles endplates and support ossicles only, endplates with denticulate margin, irregular sub-equal perforations, diameters up to 184 $\mu$m, endplate support ossicles dumbbell-shaped, distally perforate with denticulate margin, up to 120 $\mu$m long; tentacles with rods and rosettes, larger rods dumbbell-shaped, widened and perforate distally with denticulate margin, up to 304 $\mu$m long, rosettes up to 88 $\mu$m long; anal ossicles tube foot endplates and support rods, tentacle-like rods, rosettes, 5 scales comprising base up to 320 $\mu$m wide with digitiform column up to 240 $\mu$m long, base and column comprising massed short branched rods.

Specimen 3 mm long with radial tube feet; cucumariid ring lacking posterior prolongations; mid-body ossicles solid 4-pillared tables, irregular multi-perforate discs up to 184 $\mu$m long, high spires with 4 cross connections, up to 136 $\mu$m high; mid-body tube feet with endplates up to 152 $\mu$m diameter, perforations small centrally, large peripherally, margin denticulate, endplate support rods dumbbell-shaped, up to184 $\mu$m long.

*Colour (preserved).* Body pale brown.

*Etymology.* Named for the Taiwanese FRV *Hai Kung* that conducted part of the survey of the benthic marine fauna of eastern Bass Strait for the former Victorian Institute of Marine Sciences.

*Distribution.* Eastern Bass Strait, 38–40°S, 147–148°E, 58–71 m, coarse shell, mud and sand.

*Remarks. Thyonidiella kungi* O'Loughlin sp. nov. is distinguished from other southern Australia Phyllophoridae species in the key (above).

Subfamily ***Semperiellinae*** Heding and Panning, 1954

*Diagnosis.* Calcareous ring tubular with long posterior prolongations, both ring and projections made up of a mosaic of small pieces; tentacles 20; body wall ossicles tables, each with a spire of 2 or 4 pillars.

*Genera. Cladolella* Heding and Panning, 1954; *Massinium* Samyn and Thandar, 2003; *Neopentadactyla* Deichmann, 1944; *Neothyonidium* Deichmann 1938; *Pentadactyla* Hutton, 1879; *Phyrella* Heding and Panning, 1954.

*Remarks.* We note that Rowe and Richmond (2004) judged that *Semperiella* Heding and Panning, 1954 (family Semperiellinae Heding and Panning, 1954) is a junior synonym of *Thyonidiella* Heding and Panning, 1954 (family Phyllophorinae). This refines the diagnosis for genera of subfamily Semperiellinae, removing the inclusion of genera with 15 tentacles. We query the inclusion in Semperiellinae of genus *Phyrella* Heding and Panning, 1954 with its calcareous ring that is not tubular and is similar to that in genera of Phyllophorinae. We note that *Cladolella* Heding and Panning, 1954 has a *Massinium*-like calcareous ring (see illustration in Heding and Panning 1954), 20 tentacles, and tables with 2-pillar spires, and might be considered to be a senior synomym of *Massinium* Samyn and Thandar, 2003 with its variety of body wall ossicles, although the tube feet are radial in *Cladolella*.

***Massinium*** Samyn and Thandar, 2003

*Massinium* Samyn and Thandar, 2003: 136.—Samyn et al., 2010: 2.

*Material examined*. *Massinium granulosum* Samyn and Thandar, 2010. Holotype and paratype. Queensland, Moreton Bay, Stradbroke I., intertidal seagrass, 14 Nov 1977, AM J13578 (2); Queensland, 32 km NNE of Double Island, AM J2093 (1).

*Massinium magnum* (Ludwig, 1882). Queensland, Heron I., 10 m, sandy rubble, 21 Nov 1974, AM J9490 (1).

*Diagnosis (Samyn et al. 2010)*. Dendrochirotid holothuroids with 20 tentacles arranged in two circles of 10 + 10; anus usually encircled by calcareous teeth; calcareous ring elongate, tubular, with both radial and interradial plates fragmented into a mosaic of small pieces and prolonged posteriorly, with the posterior processes distally linked to processes of neighbouring plates forming a loop beneath the water vascular ring; polian vesicles elongate, usually 4; ossicles of mid-body wall comprise granuliform rods, and/or rosette-shaped deposits; tables present in juveniles or occasionally in adults as scarce reduced deposits.

*Type species*. *Massinium maculosum* Samyn and Thandar, 2003 (original designation).

*Other species*. *Massinium albicans* Samyn et al. 2010; *M. arthroprocessum* (Thandar, 1889); *M. dissimilis* (Cherbonnier, 1988); *M. granulosum* Samyn et al., 2010; *M. magnum* (Ludwig, 1882); *M. melanieae* O'Loughlin sp. nov.; *M. vimsi* O'Loughlin sp. nov.; *M. watsonae* O'Loughlin sp. nov.

*Remarks*. We have not further emended the generic diagnosis in Samyn et al. 2010 but note the possibly polyphyletic nature of *Massinium* Samyn and Thandar, 2003, with the variety of body wall ossicle forms in the assigned species that include tables with 2-pillar spires, pseudobuttons, and thick granuliform rods.

***Massinium melanieae*** O'Loughlin sp. nov.

Figures 13a, 14

*Material examined*. Holotype. Southern Australia, Great Australian Bight, *Southern Surveyor* cruise SS01/00 stn 378, 31°50'S 130°46'E, 55 m, 13/14 May 2000, NMV F174897.

*Diagnosis*. *Massinium* species up to 42 mm long, up to 24 mm diameter (preserved, tentacles withdrawn), slight oral to anal taper, thin firm body wall; exterior anal scales not detected; 20 tentacles, 5 pairs of large, 5 pairs of small; complete uniform cover of small and large tube feet, diameter up to 0.4 mm; white tubular composite calcareous ring 25 mm long; radials up to 3 mm wide, anterior taper with apical notch; inter-radials up to 2 mm wide, taper to anterior point, distal indentation closed by narrow calcareous posterior bridge creating oblong non-calcareous section; 4 polian vesicles, shorter than calcareous ring; stone canal extending from end of calcareous ring with madreporite free in coelom (dissected condition); cylindrical longitudinal muscles, not divided; gonad tubules thin, branched.

Lacking mid-body wall ossicles; tube feet with endplates only, diameter up to 320 µm, irregular perforations, small central, larger peripheral; tube feet lacking support ossicles; peri-oral region with abundant regular tables, discs oval to rounded rectangular, up to 96 µm long, 4 large central and numerous small peripheral perforations, spires up to 24 µm long, 2 pillars each with up to 5 blunt apical spines, some bifid; tentacle branches with thin rods, knobbed or finely perforate distally, up to 104 µm long; tentacle trunks lacking ossicles; inner wall of tubular calcareous ring with rods up to 104 µm long, widened and rounded distally, each end with up to 8 perforations; anal ossicles scales, endplates, tables; scales single-layered, thick, irregular, perforated; endplates about 160 µm diameter; tables irregular, frequently about 16 disc perforations, 3 or 4 large central, small peripheral, 2 pillars, each with blunt apical spines, most discs up to 72 µm long, pillars about 40 µm high.

*Colour (preserved)*. Body off-white with grey-brown irregular patches; tentacle trunks grey, branches grey-brown.

*Type locality*. Southern Australia, Great Australian Bight, 55 m.

*Etymology*. Named for Melanie Mackenzie, collection curator in the Department of Marine Biology in Museum Victoria, and valued colleague in echinoderm systematic research.

*Remarks*. *Massinium melanieae* O'Loughlin sp. nov. is erected for a single specimen in good condition. The type locality is unlikely to be sampled again in the foreseeable future and we judge that it is important to erect this species. The distinguishing combination of diagnostic characters for *Massinium melanieae* O'Loughlin is given in the key (above).

***Massinium vimsi*** O'Loughlin sp. nov.

Figures 13b, 15

*Material examined*. Holotype. Australia, eastern Bass Strait, VIMS, NZOI RV *Tangaroa* 81–T–1 stn 174, 39°16.8'S 147°32.2'E, 57 m, mud / shell, 18 Nov 1981, NMV F76629.

*Diagnosis*. *Massinium* species 12 mm long, 5 mm diameter (preserved, tentacles withdrawn), form cylindrical with rounded ends, soft body wall; exterior anal scales not detected; 20 tentacles, 5 pairs of large, 5 pairs of very small; complete cover of tube feet, more prominent ventrally, up to 0.2 mm diameter; tubular composite calcareous ring 9 mm long, plates up to 1 mm wide, posterior radial notch, posterior deep inter-radial indentation closed posteriorly by continuous band of small plates to create elongate non-calcareous space; radials tapered anteriorly with anterior notch; inter-radials tapered to anterior point; single tubular polian vesicle; stone canal and madreporite lying anteriorly on calcareous ring; cylindrical longitudinal muscles, not divided; lacking gonad tubules.

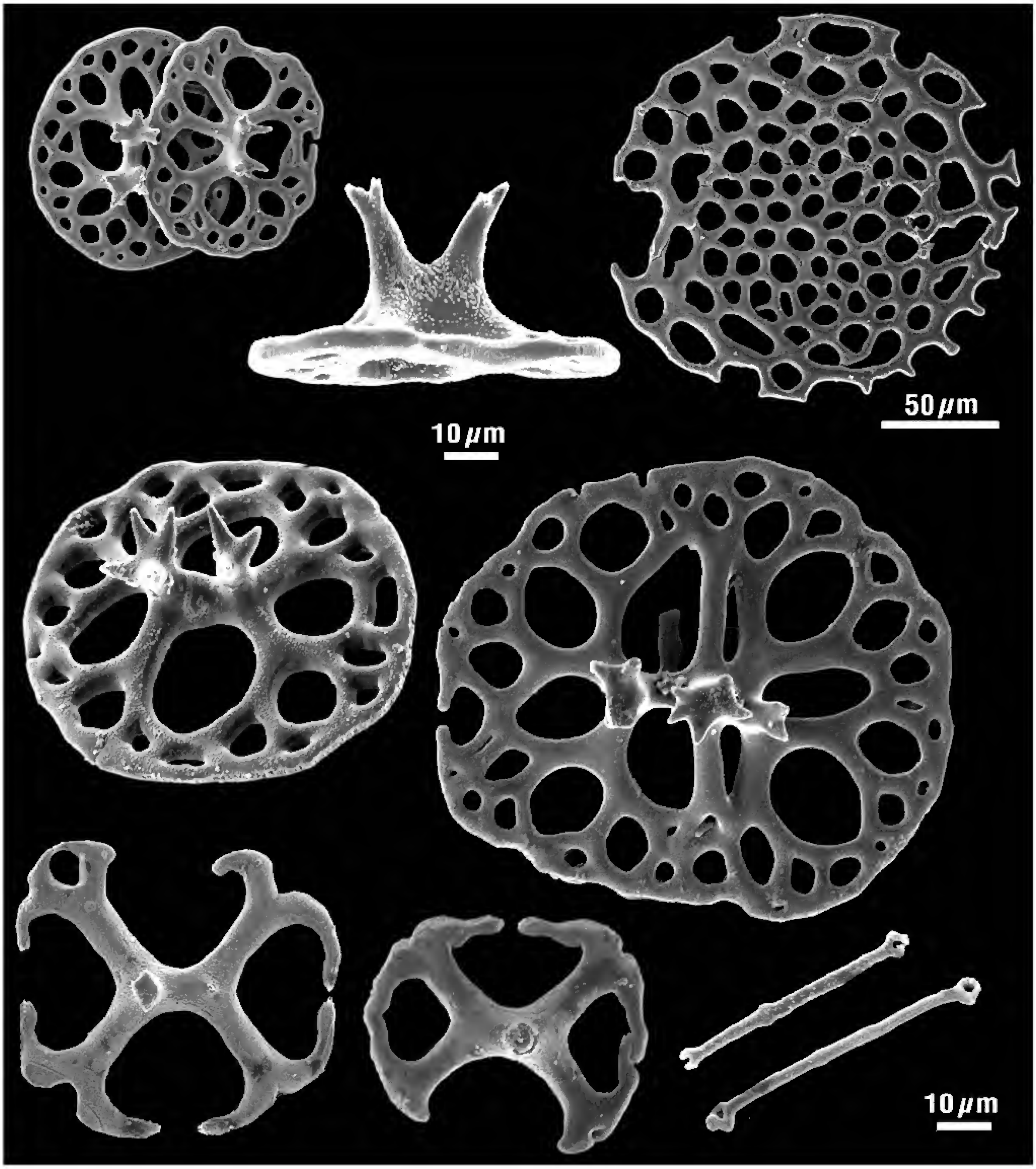


Figure 14. SEM images of ossicles from holotype of *Massinium melanieae* O'Loughlin sp. nov. (NMV F174897). Regular tables from peri-oral body wall (top left); mid-body tube foot endplate (top right); large irregular table from anal region (central right); thin rods from tentacle branches (bottom right).

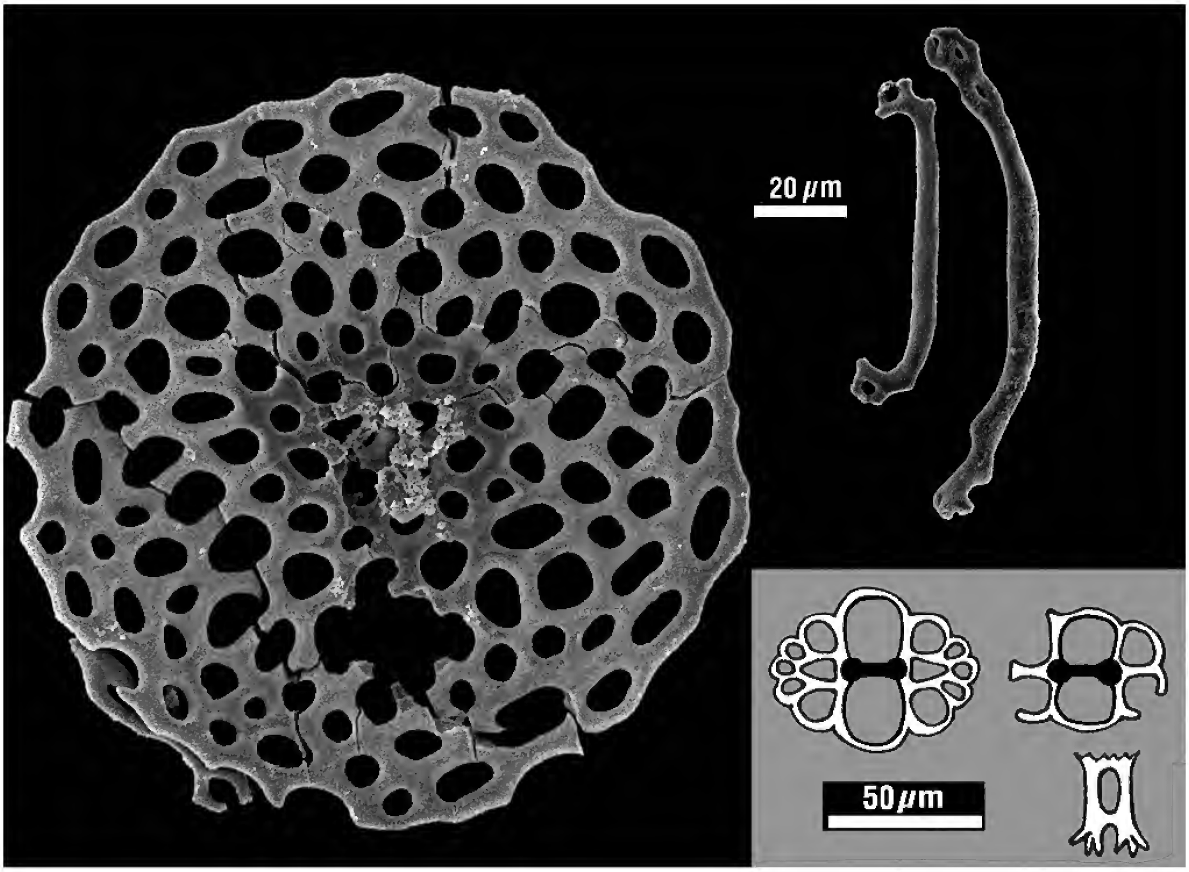


Figure 15. SEM images of ossicles from holotype of *Massinium vimsi* O'Loughlin sp. nov. (NMV F76629). Tube foot endplate (left); tentacle rods (right); (insert: drawings of table disc, developing disc, and table spire from peri-oral body wall table ossicles).

Lacking mid-body wall ossicles; tube feet endplates up to 184 µm diameter with irregular small perforations and slightly undulating to denticulate margin, rod-like support plates around margin of endplates, narrow, curved, perforations distally, sometimes along rod, large central, small distal, rods up to 96 µm long; peri-oral region with tables, discs up to 72 µm long, lobed margin, up to about 18 perforations, spires about 32 µm long, 2 pillars each with 2–3 sometimes bifid spines distally, single cross-bridge; introvert ossicles endplates, endplate support rods and rosettes, endplates up to 136 µm diameter with irregular small perforations, rods up to 80 µm long, straight to slightly bracket-shaped, slightly swollen distally with 1–2 terminal perforations, rosettes rare; tentacles ossicles rods and rare rosettes, rods up to 96 µm long, curved, ends of rods swollen, smooth or denticulate, 1–2 distal perforations; anal ossicles endplates and endplate support rods, anal endplates up to 144 µm diameter, undulating margin, some with slightly larger peripheral perforations, support rods perforated as in tube feet, up to 80 µm long.

*Colour (preserved).* Body pale brown; tentacles dark brown.

*Type locality and distribution.* Southeast Australia, eastern Bass Strait, 57 m.

*Etymology.* Named for the former Victorian Institute of Marine Sciences (VIMS), with appreciation of the thoroughness of the 1981 benthic survey of eastern Bass Strait with a significant contribution of specimens to this study.

*Remarks. Massinium vimsi* O'Loughlin sp. nov. is erected for a single specimen in good condition. The small specimen size and absence of gonad tubules suggest that it is probably a juvenile. The type locality is unlikely to be sampled again in the foreseeable future and we judge that it is important to erect this species. The distinguishing combination of diagnostic characters for *Massinium vimsi* O'Loughlin is given in the key (above).

***Massinium watsonae*** O'Loughlin sp. nov.

Figures 13c, d, e, 16

*Lipotrapeza dearmatus*.—H. L. Clark, 1938: 494.—H. L. Clark, 1946: 411–412. (part; Australian material non *Phyllophorus dearmatus* Dendy and Hindle, 1907).

*Neothyonidium dearmatum*.—Heding and Panning, 1954: 191–192 (part; Australian material non *Phyllophorus dearmatus* Dendy and Hindle).—Hickman, 1978: 32, pl. 1, figs 15–24 (non *Phyllophorus dearmatus* Dendy and Hindle).

*Neothyonidium* sp.—Rowe, 1982: 466, pls 31.5, 31.6.

*Neothyonidium ? dearmatum*.—Edgar, 1997: 369 (with photo of tentacles).

*Material examined*. Holotype. Southeast Tasmania, Bruny Island, Simpsons Bay, 43°17'S 147°18'E, 11 m, 15 Feb 1972, J. E. Watson, NMV F97435.

Paratypes. Type locality and date, NMV F174898 (1); NMV F174899 (1); off Bruny Island, D'Entrecasteaux Channel, 12 m, Feb 1972, J. E. Watson, NMV F97420 (2).

Other material. D'Entrecasteaux Channel, off Green Island, 56 m, D. F. Turner, 21–25 July 1948, TMAG H169 (1; det. F. W. E. Rowe 1974 as *Neothyonidium dearmatum*); Derwent River, Blackmans Bay, on beach after storm, E. Turner, 12 Jun 1988, TMAG H1988 (1, tentacle crown and ring only); Kettering, 43°08'S 147°15'E, 10 m, A. J. Dartnall and T. Sward, 29 Mar 1977, AM J12385 (1; as *Lipotrapeza dearmatus*; ring damaged posteriorly prohibiting type status); slides for AM J12385 specimen prepared by V. V. Hickman, tentacles and body wall TMAG H2089, introvert TMAG H2090, dorsal body wall TMAG H2091, mid-body wall TMAG H2092, anal TMAG H2093, posterior TMAG H2094, anal papilla TMAG H2095, cloaca TMAG H2096; Eastern Tasmania, Great Oyster Bay, no other data, AM J1538 (1). "New South Wales", no other data, AM J18132 (1; presumed locality error, SE Tasmania distribution).

*Neothyonidium dearmatum* (Dendy and Hindle, 1907). New Zealand, near Cook Strait, 40°S 174°E, 67 m, NIWA 4187 (2); 55 m, NIWA 73992 (1); off Christchurch, 43°S 173°E, 59 m, NIWA 28443 (1); 44°S 173°E, 54 m, NIWA 76793 (1); 64 m, NIWA 73987 (4); off Stewart I., 47°S 168°E, 33 m, NIWA 45522 (2).

*Diagnosis*. *Massinium* species up to 110 mm long, up to 40 mm diameter (preserved, tentacles withdrawn), wide orally, tapered to rounded end anally, thin firm body wall; exterior anal scales not detected; 20 tentacles, 5 outer pairs large, 5 inner pairs small; complete cover of tube feet, single series of close tube feet on each side of longitudinal muscle interior attachment, scattered inter-radially, across introvert in irregular paired radial series, diameters up to 0.4 mm; white leathery tubular composite calcareous ring up to 50 mm long; radials with anterior taper and notch, posterior notch; inter-radials tapered to anterior point, posterior inter-radial indentation closed by continuous band of small plates to create oblong non-calcareous space; 1–2 tubular polian vesicles, as long and longer than calcareous ring; long thin stone canal with globular madreporite attached by mesentery to pharynx; cylindrical longitudinal muscles, not divided; gonad tubules long thin.

Ossicles disappear with age / size; per-oral tables only in 110 mm long holotype; eroded ossicle remnants only in 70 mm long paratype (NMV F97420); in specimen 65 mm long (AM J12385), mid-body wall lacking ossicles; tube feet with few endplates up to 216 μm diameter, irregular small perforations, larger peripherally, rare curved support rods up to 80 μm long around endplate margin; peri-oral region with tables, sometimes rosettes, table discs oval to rounded, irregular, up to 144 μm long, up to about 40 perforations, spires with 2 pillars, distal cross-bar sometimes perforated, pillars with few blunt spines apically; introvert ossicles tables with oval to rounded rectangular discs, sometimes rosettes, table discs up to 96 μm long, up to 24 perforations, 4 large central perforations, many smaller surrounding ones, spires up to 48 μm long, 2 (rarely 1) pillars with 2–3 blunt spines apically; larger specimens tentacles lacking ossicles in trunks and branches, 50 mm long specimen with rare rods, up to 80 μm long, few distal perforations; posterior/anal body with tube foot endplates up to 192 μm diameter, rare curved endplate support rods up to 80 μm long; anal papilla with anal scale fragments, tube foot endplates, rods and rosettes; anal scales comprising multi-layered base with digitiform calcareous papilla about 800 μm long comprising mass of thick linear, X, Y, H shaped rods; anal tube foot endplates up to 152 μm diameter; numerous short irregular anal rods intergrading with rosettes, up to 48 μm long.

*Colour (preserved)*. Variable, body pale pinkish-brown with dark brown patches to uniform pale brown, tentacle trunks brown to dark brown, branches dark brown to grey-brown.

*Type locality*. Tasmania, Bruny Island, Simpsons Bay, 11 m.

*Distribution*. Southeast Tasmania, D'Entrecasteaux Channel to Derwent Estuary; 11–56 m.

*Etymology*. Named for Jan E. Watson, Honorary Associate of Museum Victoria, hydroid systematist, significant contributor to the marine invertebrate collections of Museum Victoria, and collector of the types of this species.

*Remarks*. The diagnostic description of ossicles is based principally on the comprehensive set of V. V. Hickman slides (see Material examined) of a smaller Kettering specimen (65 mm long, up to 15 mm diameter) registered to the Australian Museum (AM J12385). The presence and form of tables in the introvert and absence of ossicles in the tentacles are consistent with the Blackmans Bay part-specimen, except that there are also rosettes in the introvert. The presence or absence of rosettes is judged to be variable in specimens of some phyllophorid species.

H. L. Clark 1938 referred *Phyllophorus dearmatus* Dendy and Hindle, 1907 to his new genus *Lipotrapeza* with considerable reservation, based on the entirely different calcareous ring. In the same year Deichmann erected the genus *Neothyonidium* to which Heding and Panning 1954 subsequently referred *Phyllophorus dearmatus*. No specimen of *Neothyonidum dearmatum* (Dendy and Hindle, 1907) has been found in Australian waters. Material determined by Joshua (1914) to be *Phyllophorus dearmatus* has been examined and found to represent our new species *Thyone flindersi* O'Loughlin sp. nov. (below). Deichmann (in H. L. Clark 1946) correctly judged that the Joshua specimens should be referred to *Thyone*.

Hickman (1978) reported a specimen of *Neothyonidium dearmatum* from Kettering on the D'Entrecasteaux Channel in southeast Tasmania, but noted some differences from the descriptions of this New Zealand species. The specimen is not

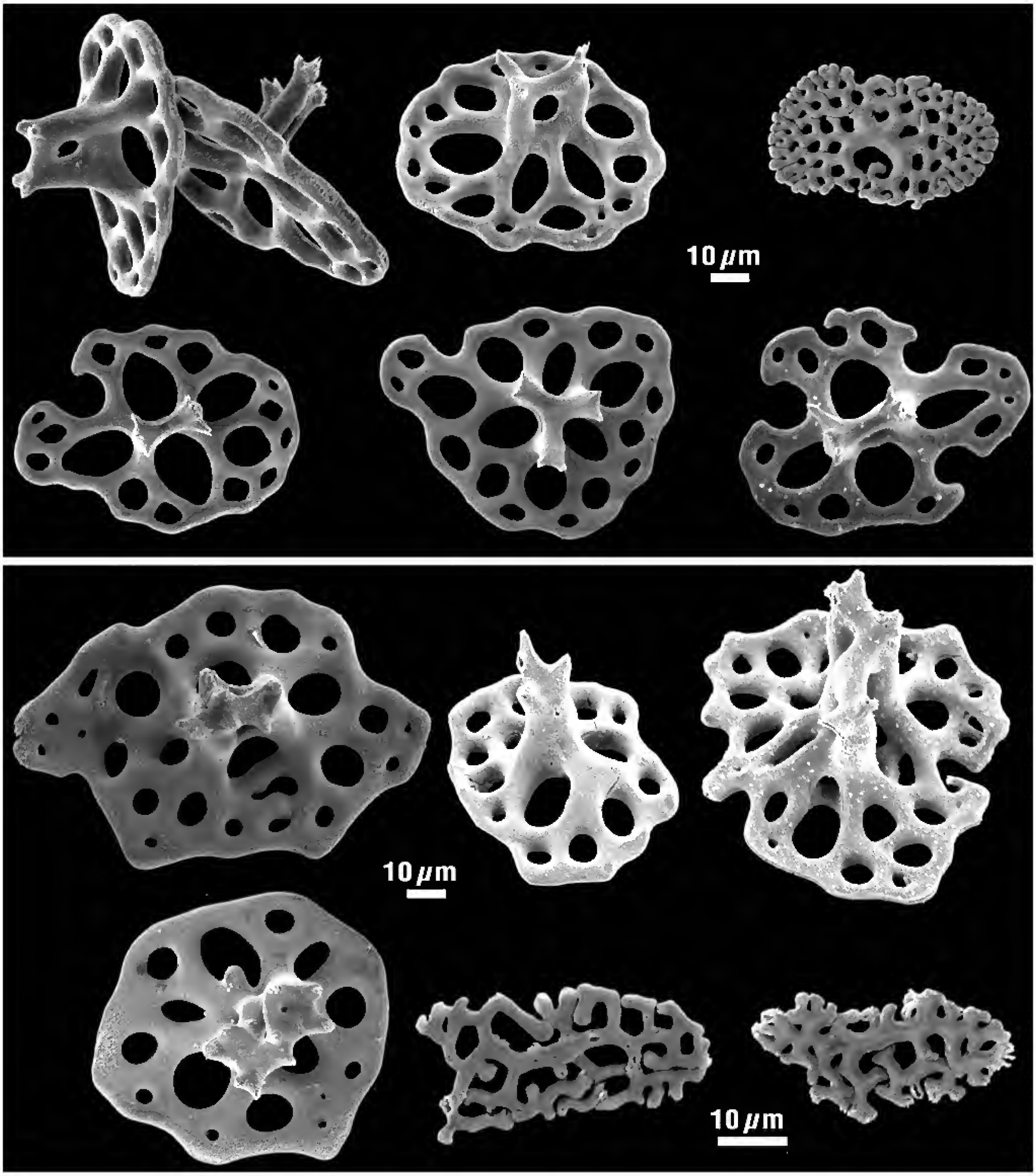


Figure 16. SEM images of ossicles from specimen of *Massinium watsonae* O'Loughlin sp. nov. (TMAG H1988). Tables and rosette from introvert (top); tables and rosettes from peri-oral body wall (bottom).

held in the TMAG but ossicle slides prepared by Hickman are available and were examined by us. The specimen is now held by the AM and has been examined here. Based on the description by Hickman (1978) and the ossicle slides, the Kettering specimen is conspecific with specimens referred here to our new species *Massinium watsonae* O'Loughlin sp. nov. (above). Rowe (1982) referred to the Kettering specimen as *Neothyonidium* sp.

Based on the descriptions by Dendy and Hindle (1907), Mortensen (1925), and Pawson (1970) and our observations the diagnostic characters that distinguish *Neothyonidium dearmatum* (Dendy and Hindle) from *Massinium watsonae* O'Loughlin sp. nov. (characters in bracket) are: size up to 65 mm long (up to 110 mm); tentacle rod ossicles present (lacking tentacle ossicles); inter-radial plates of calcareous ring divided for most of their length by non-calcareous space (short distal closed oblong non-calcareous space); distal end of each inter-radial plate with two narrowing tails that may be contiguous but not joined by small plates (distal end of calcareous ring a continuous collar of small plates, the generic diagnostic character for *Massinium* Samyn and Thandar, 2003); single polian vesicle (2 polian vesicles); if present tables in anterior and posterior body wall (in introvert only); table disc lengths average 75 µm (average about 90 µm); perforations in table discs usually 8 (up to 24). The combination of unique diagnostic characters of *Massinium watsonae* O'Loughlin sp. nov. is given in the key (above).

Subfamily **Thyoninae** Panning, 1949

***Thyone*** Oken, 1815

*Diagnosis (emended from Pawson and Miller 1981).* Tentacles 10; tube feet scattered on body wall, never restricted to radii; calcareous ring tubular with long posterior prolongations comprising a mosaic of small pieces; body wall ossicles tables with a spire of one or two pillars.

*Type species. Holothuria fusus* Müller, 1776 (monotypy).

*Southern Australian species. Thyone flindersi* O'Loughlin sp. nov.; *Thyone joshuai* O'Loughlin, sp. nov.; *Thyone kerkosa* O'Loughlin sp. nov.; *Thyone nigra* Joshua and Creed, 1915; *Thyone okeni* Bell, 1884; *Thyone spenceri* O'Loughlin sp. nov.; *Thyone tourvillei* O'Loughlin sp. nov.

*Remarks*. We acknowledge the current invalid status of *Thyone* Oken, 1815 and our provisional retention is discussed in the Introduction. We emend the diagnosis of *Thyone* Oken to include tables with one pillar in the spire to accommodate a new species described in this work. Pawson and Miller 1981 remarked on the need for a revision of the "supergenus" *Thyone*. This need continues for what will be a major undertaking. The revision should await further supportive evidence from emerging genetic data.

***Thyone flindersi*** O'Loughlin sp. nov.

Figures 17a, 18

*Phyllophorus dearmatus*.—Joshua, 1914: 4–5 (non *Phyllophorus dearmatus* Dendy and Hindle, 1907).

*Thyone* sp. —Joshua and Creed, 1915: 20.

*Thyone okeni*.—Rowe, 1982: 462 ("provisional referral"; Port Phillip and Westernport Bays specimens non *Thyone okeni* Bell, 1884).—Rowe and Gates, 1995: 316 (southern coast specimens non *Thyone okeni* Bell, 1884).—Gowlett-Holmes, 2008: 263 (southern coast specimens non *Thyone okeni* Bell, 1884).

*Material examined*. Holotype. Victoria, Flinders ocean platform, intertidal rocky shallows, 17 Feb 2008, M. O'Loughlin and E. Whitfield, NMV F151847.

Paratypes. Westernport Bay, McHaffie Reef, 38°28'S 145°10'E, MRG, 16 Feb 2008, NMV F151848 (1); Shoreham, Honeysuckle Point, sieved from root of *Amphibolus*, A. Falconer (MRG), 12 May 2012, NMV F174912 (1); MRG, 12 Apr 2012, NMV F174909 (1); Flinders, Mushroom Reef, 17 Feb 1990, NMV F73805 (1).

*Other material (selection)*. Westernport Bay, Merricks, rocky shallows, 27 May 1989, NMV F73804 (1); Westernport Bay Survey, stn 57/02/69, Merricks, 22 Feb 1969, NMV F45261 (1; determined by D. Pawson 1974 as *Thyone okeni* Bell, 1884); Shoreham, rocky shallows, Jun 1979, NMV F73806 (1); San Remo, 28 Jan 1909, NMV F73819 (1) (no. 60641; determined in Joshua 1914 as *Phyllophorus dearmatus* Dendy and Hindle, 1907).

Tasmania, Bass Strait, Waterhouse Passage, 40°49'S 147°38'E, rocky shallows, 23 Nov 1982, NMV F97430 (1).

South Australia, J. C. Verco, Jan 1914, NMV F97433 (1; as *Thyone* sp. by Joshua and Creed 1915); Gulf St Vincent, off Adelaide, between North Haven and Largs Bay, seagrass, 1 Dec 1980, SAM K2585 (2); Willunga Reef, 23 Nov 1976, SAM K2582 (1); Aldinga Reef, 22 Nov 1979, SAM K2584 (3); Yorke Peninsula, Port Giles jetty, 15 m, Jan 1983, SAM K2595 (1); Wool Bay, 4 m, sand, AM J16647 (2); Edithburgh Jetty, 3–4 m, in sand, 14 Mar 1994, SAM K2600 (1), SAM PK0072; Kangaroo Island, Kingscote Jetty, 3–4 m, in sand, 1 May 1999, SAM K2598 (1), SAM PK0191; 3 May 1999, SAM K2599 (2), SAM PK0183; Sir Joseph Banks Group, Smith Rocks, 28 Jan 1986, SAM K2607 (3); Waterloo Bay, seagrass, 5 m, 1980, SAM K2586 (2); Great Australian Bight, Point Westall, near Streaky Bay, 15 Jan 1991, NMV F97427 (1); near Ceduna, Cape Vivonne, 32°12'S 133°41'E, rocky shallows, 16 Jan 1991, NMV F97428 (1).

Western Australia, Albany, 35°03'S 117°92'E, 2 m, Jan 1988, AM J24966 (2); Bunbury, 13 Apr 1963, WAM Z31974 (1); Cockburn Sound, rubble and muddy sand, 29 Apr 1989, WAM Z31977 (1); Jervoise Groyne, 1 Jan 1958, 3 m, WAM Z31969 (1); Garden I., 29 Apr 1989, WAM Z31984 (1); Mangles Bay, 31 Jul 1988, WAM Z31961 (2); Woodman's Point, WAM Z31982 (2).

*Diagnosis*. *Thyone* species up to 100 mm long, up to 15 mm diameter (relaxed, preserved, excluding tentacles, introvert; WAM Z31984), wide mid-body, tapered to upturned rounded oral and anal ends, thick firm body wall; external anal scales not detected; 10 tentacles, 8 large, 2 much smaller ventrally; complete cover of spaced tube feet, contiguous paired series on each side of longitudinal muscle interior attachments, more scattered inter-radially, more abundant ventrally than dorsally, diameter about 0.2–0.3 mm; tubular composite calcareous ring, posterior ends of composite radial plates not joined; radials tapered anterior with terminal split, divided posterior into paired narrowing composite tails, tails sometimes split; inter-radials tapered to anterior point, posterior ends truncate at a point anterior to the division of each radial; short stone canal and globular split-pea-like madreporite lie on the calcareous ring; single elongate thin polian vesicle; longitudinal muscles cylindrical to flat, undivided; gonad tubules unbranched.

Mid-body wall lacking ossicles; tube feet with endplates only, endplates with irregular perforations, distinctly larger peripherally,

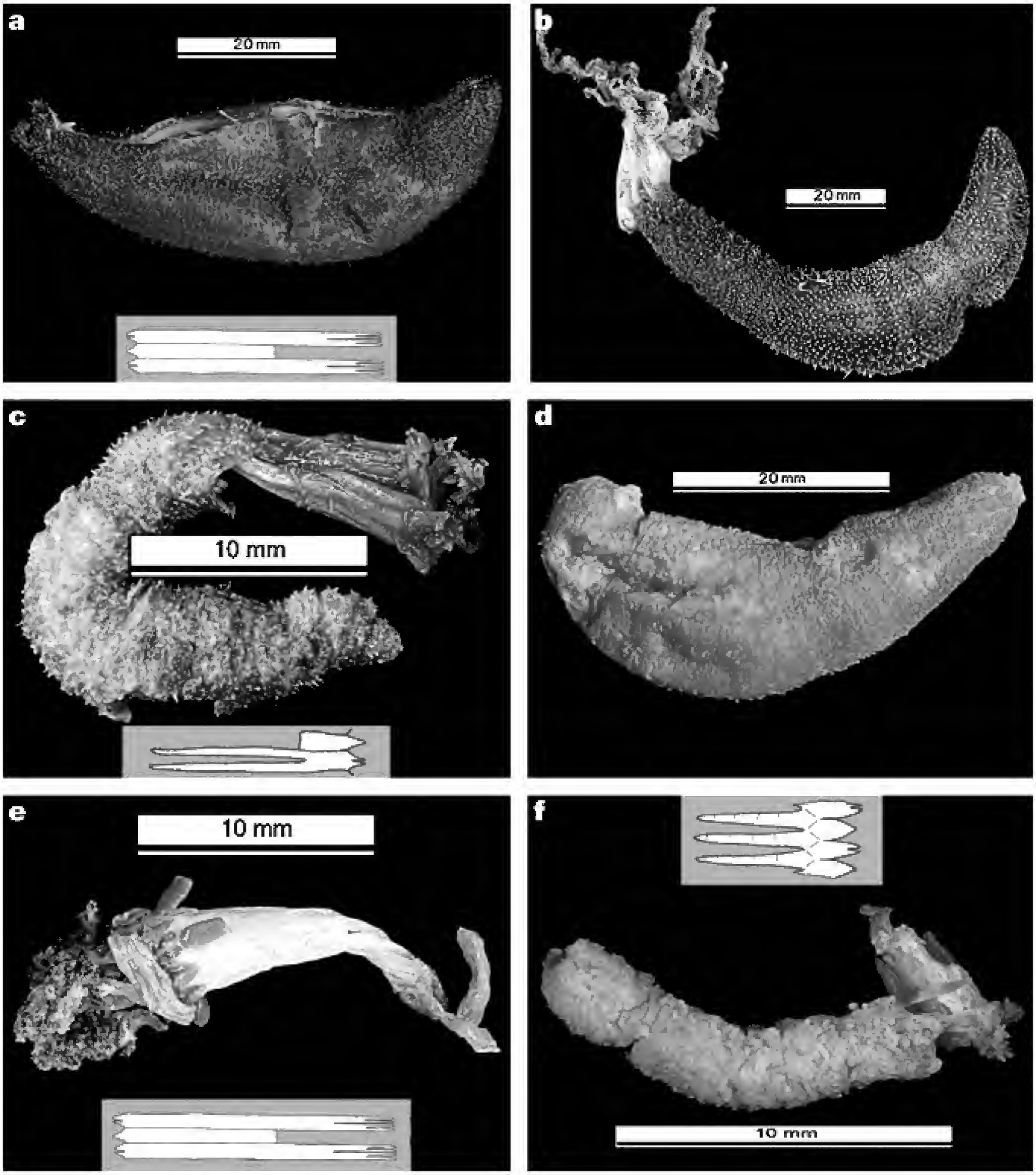


Figure 17. Photos of preserved specimens. a, holotype of *Thyone flindersi* O'Loughlin sp. nov. (NMV F151847) (insert: form of the calcareous ring plates); b, specimen of *Thyone okeni* Bell, 1884 (AM J10868); c, holotype of *Thyone joshuai* O'Loughlin sp. nov. (SAM K2566) (insert: form of the calcareous ring plates); d, holotype of *Thyone kerkosa* O'Loughlin sp. nov. (WAM Z31838); e, holotype of *Thyone spenceri* O'Loughlin sp. nov. (SAM K2562) (insert: form of the calcareous ring plates); f, holotype of *Thyone tourvillei* O'Loughlin sp. nov. (NMV F174902) (insert: form of the calcareous ring plates).

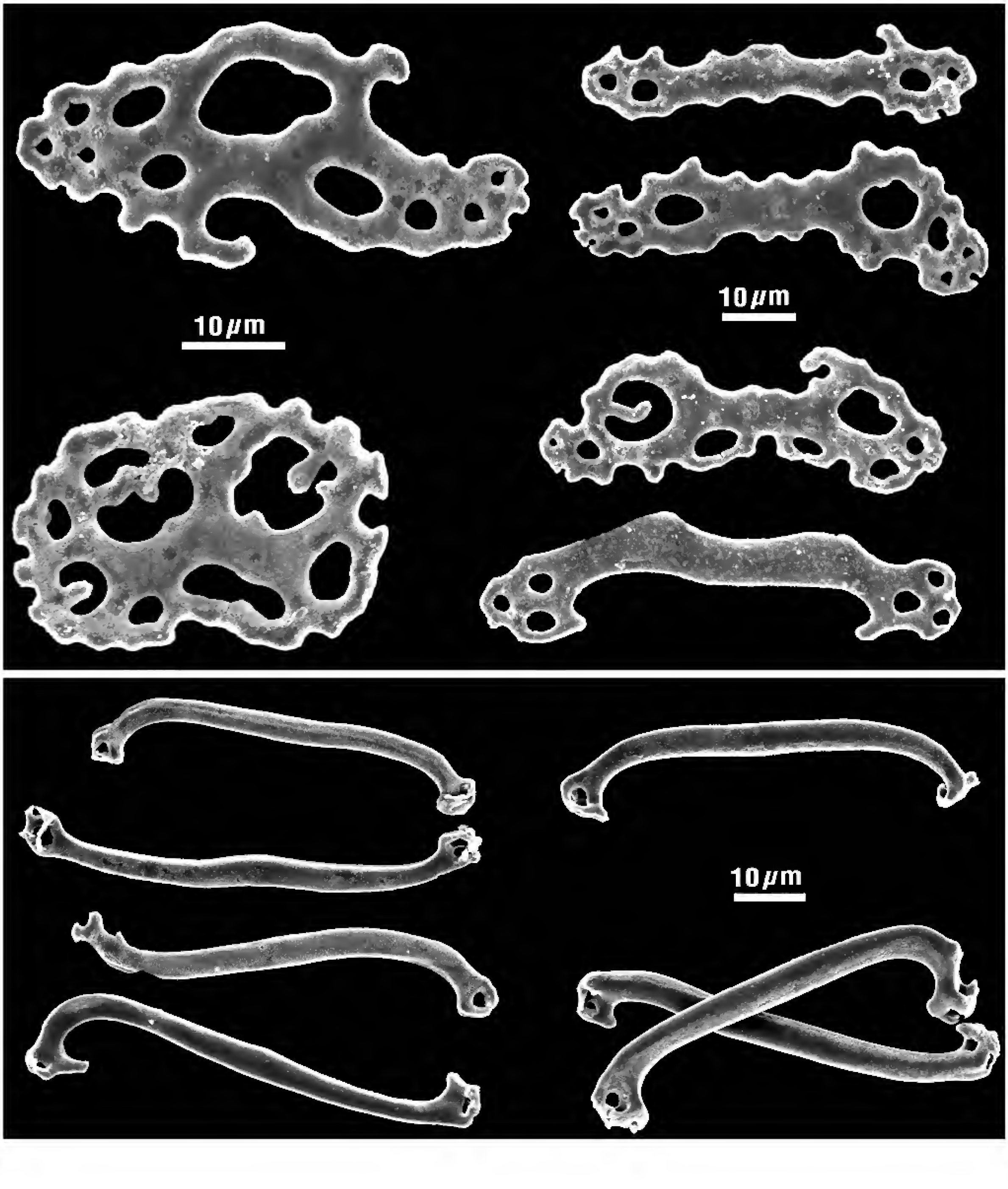


Figure 18. SEM images of ossicles from paratype of *Thyone flindersi* O'Loughlin sp. nov. (NMV F174909). Ossicles from peri-oral body wall (top); rods from tentacles (bottom).

diameters up to 160 μm; lacking endplate support rods or plates or tables; per-oral body wall with tables and sometimes rosettes, table discs irregular, rounded rectangular to oval to rounded triangular, up to 35 perforations, discs up to 72 μm long, spires with 2 pillars, single cross connection, blunt spines distally, spires up to 32 μm high, rosettes predominantly oval up to 40 μm long; anal ossicles scales with spires, tube foot endplates, rosettes, rods, sometimes tables; scales thick, single-layered with lace-like thickening, fragment 440 μm long, multilayered spire 424 μm long, anal endplate diameters up to 136 μm, rosettes up to 48 μm long, rods with finely perforated ends, some with short branching distally, up to 96 μm long, table discs up to 56 μm long, up to > 8 perforations, spires with 2 pillars; tentacles branches with rods predominantly bracket-shaped, distally with lumps or fine branches or few perforations, some rods with sigmoid form, some straight, rods up to 88 μm long, tentacle trunks sometimes with rosettes, round to oval to rod-like, up to 56 μm long.

*Colour (live and preserved).* Body brown to dark reddish brown, body frequently dark grey orally and anally, introvert brown; tube feet red to dark brownish red, off-white orally and anally; tentacle trunks brown, lacking white spots (rosette clusters), tentacle branches dark grey.

*Distribution.* Southern Australia, east to San Remo (Westernport Bay), northern Tasmania (Bass Strait), west to Cockburn Sound (Western Australia near Perth), rocky shallows, seagrass; 0–15 m.

*Etymology.* Named for the type locality, Flinders, in Victoria, in turn named for the English explorer Matthew Flinders who first charted the coastline of Victoria.

*Remarks.* The specimen reported in Joshua and Creed 1915 as *Thyone* sp. is registered to Museum Victoria and determined as *Thyone flindersi* O'Loughlin sp. nov. A specimen from San Remo collected in 1909 and reported in Joshua 1914 as *Phyllophorus dearmatus* Dendy and Hindle, 1907 was examined and determined as *Thyone flindersi*. Rowe 1982 "provisionally" referred Port Phillip and Westernport Bay specimens to *Thyone okeni* Bell. *Thyone flindersi* is distinguished from other southern Australia *Thyone* species in the key (above).

### *Thyone joshuai* O'Loughlin sp. nov.

Figures 17c, 19

*Material examined.* Holotype. South Australia, Upper Spencer Gulf, Whyalla, 33°02'S 137°40'E, 12 m, E. Oks, Sep 1987, SAM K2566.

Paratypes. South Australia, Upper Spencer Gulf, SA Department of Fisheries, Backy Point W, 18 m, Sep 1987, SAM K2560 (1); Feb 1986, SAM K2563 (1); East Shoal NE, 8 m, Feb 1986, SAM K2569 (3); Lowly Point W, 24 m, Sep 1987, SAM K2571 (4); Feb 1987, SAM K2572 (2); False Bay, 10 m, Sep 1987, SAM K2573 (1); Cockle Spit W, 7 m, Aug 1976, SAM K2574 (1); Ward Spit S, 9 m, Feb 1987, SAM K2576 (1); Douglas Bank NE, 11 m, Feb 1987, SAM K2578 (1); Fairway Bank W, 13 m, Sep 1987, SAM K2580 (1); Whyalla, 12 m, Sep 1987, SAM K2581 (1); Port Bonython, 15 m, Sep 1987, SAM K2622 (1).

Other material. Victoria, Eastern Bass Strait, 38–40°S 143–149°E; VIMS, FRV *Hai-Kung* 81–HK–1, stn 119, 92 m, 31 Jan 1981, NMV F76632 (2); stn 120, 84 m, sand, 31 Jan 1981, NMV F76630 (4); VIMS, NZOI RV *Tangaroa* 81–T–1 stn 162, 51 m, shell, 14 Nov 1981, NMV F76631 (1); 81–T–1 stn 167, 124 m, mud/fine sand, 14 Nov 1981, NMV F76633 (1; 2.5 mm long); stn 170, 140 m, muddy sand, 15 Nov 1981, NMV F76624 (3; up to 5 mm long); 81–T–1 stn 174, 57 m, mud/shell, 18 Nov 1981, NMV F76628 (1); stn 174, 57 m, mud/shell, 18 Nov 1981, NMV F76634 (1; 3 mm long); stn 180, 65 m, mud/sand, 18 Nov 1981, NMV F76626 (1; 1.5 mm long); stn 200, 48 m, sand/shell, 22 Nov 1981, NMV F76625 (1; 2 mm long).

New South Wales, Disaster Bay, RV *Southern Surveyor* SS0404 stn 102, 37°17.22'S 150°04.15'E, 79 m, 28 Apr 2004, NMV F132693 (1); Port Hacking, Jibbon Head, 34.0708°S 151.1306°E, 23 m, Sep 1976, AM J22366 (1).

*Diagnosis. Thyone* species up to 21 mm long, up to 8 mm diameter (preserved, tentacle withdrawn), body fusiform, tapered to rounded end orally and anally, short tail anally, soft thin body wall; external anal scales not detected; 10 tentacles, 8 large, 2 ventral small; tube feet in close single paired series on radii, scattered inter-radially, diameter about 0.15 mm; composite calcareous ring, anterior third tubular, posterior ends of composite radial plates not joined, radials tapered anteriorly with terminal split, deep posterior division more than half composite plate length, paired composite ends thin, narrow, free; inter-radials tapered to anterior point, truncate posteriorly about where the radial plates split, inter-radial composite plates about one third the length of the radial plates; gonad tubules unbranched; long stone canal, globular madreporite; single polian vesicle, elongate, tubular; longitudinal muscles sub-cylindrical.

Mid-body wall ossicles scattered tables, discs regular, oval, margin slightly lobed, perforations typically 4 large central, frequently 4 small corner, discs 56–64 μm long, spires with 2 pillars, distally spinous, single distal cross connection, spires up to 32 μm long; tube feet with endplates, variably with and lacking tube foot support tables, endplates with distinct outer ring of large perforations, small central perforations, endplate diameters up to 160 μm, if present tube foot support tables with curved narrow discs up to 112 μm long; tentacles ossicles stout and fine rods and rosettes, rods irregular, up to 200 μm long, frequently with 1 or 2 side branches bluntly spinous distally, widened perforated ends, rosettes up to 64 μm long, some intergrade with rods; anal ossicles tables and scales, tables as in mid-body wall, scales single and multi-layered.

Small specimens (10 mm long): abundant mid-body tables, discs with typically 4 perforations, regular, lobed margin, 40 μm long; tube feet with endplates, ring of outer large perforations, 88 μm diameter, tube foot support tables with narrow curved discs, 72 μm long; anal tables as in larger specimen mid-body.

Smallest specimens (1.5–3 mm long): mid-body tables regular with 8 perforations and irregular with many more than 8 perforations, discs up to 128 μm long, spires up to 48 μm long; tube feet table discs curved and narrow with more than 8 perforations, discs up to 112 μm long, large mesh endplates, 112 μm diameter.

*Colour(preserved).* Body off-white, sometimes fine brown flecking; tentacles brown to pale brown.

*Distribution.* Off-shore sediments, Victoria, eastern Bass Strait, 39–40°S 143–149°E, 48–140 m; New South Wales, Disaster Bay, Port Hacking, 34–37°S 150–151°E, 23–79 m; South Australia, Upper Spencer Gulf, 32–33°S 137°E, 7–24 m.

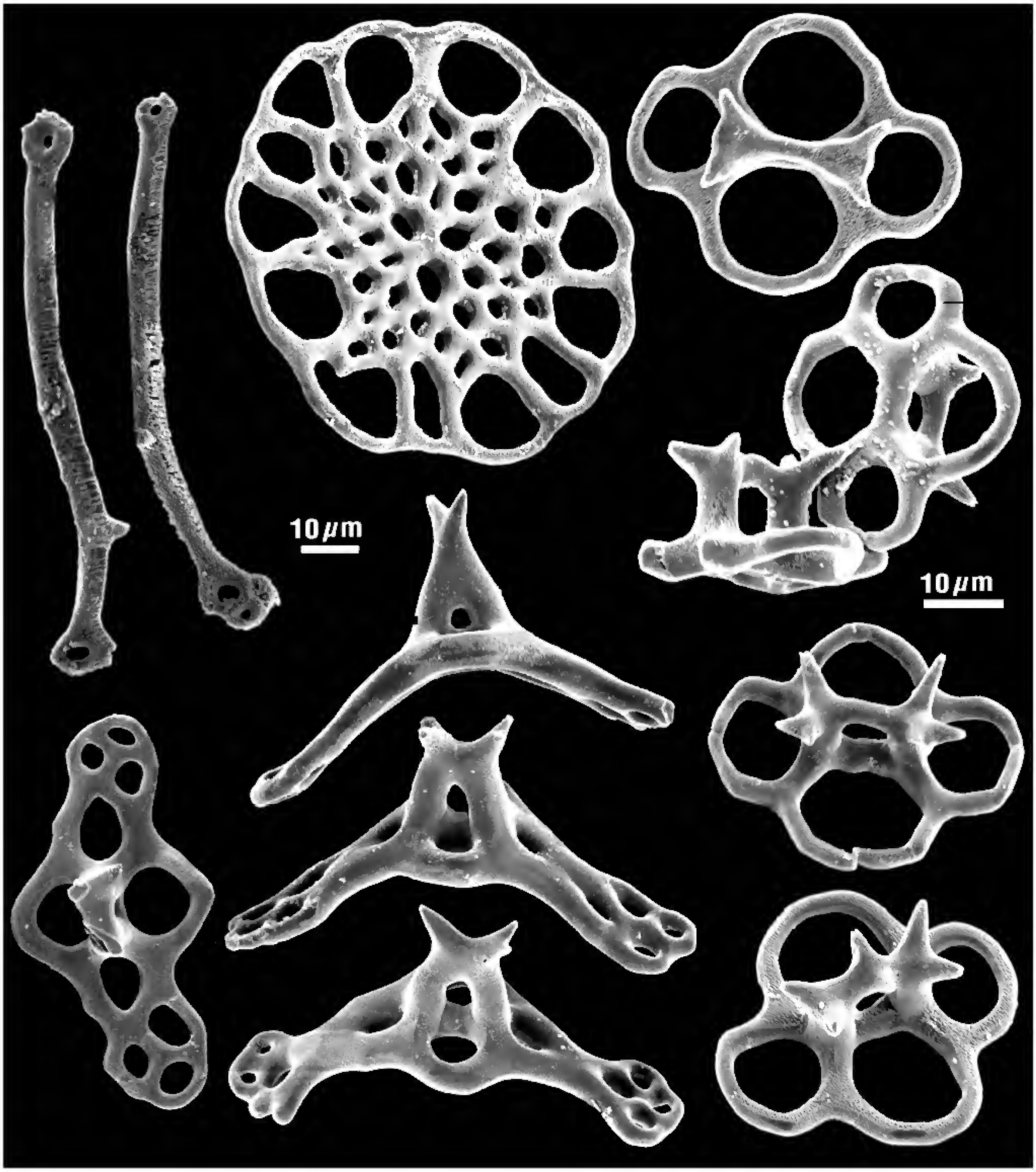


Figure 19. SEM images of ossicles from specimens of *Thyone joshuai* O'Loughlin sp. nov. Tables from mid-body wall (right), tube foot endplate (top), and tube foot support tables (central and left bottom) (from holotype, SAM K2566); rods from tentacles (top left) (specimen NMV F76631).

*Etymology*. Named for E. C. Joshua, who described the first phyllophorid species on the coast of southern Australia.

*Remarks*. Significant changes with age/size in body wall and tube foot ossicle forms are recorded in the diagnosis (above). Notable changes are the increase in size and number of perforations in tables with decreasing size of specimen, the mesh-like form of endplates with decrease in specimen size, and the loss of tube foot support tables with increasing specimen size. The morphological characters that distinguish *Thyone joshuai* O'Loughlin sp. nov. from other southern Australian *Thyone* species are given in the key (above).

***Thyone kerkosa*** O'Loughlin sp. nov.

Figures 17d, 20

*Material examined*. Holotype. Southern Australia, Recherche Archipelago, Sandy Hook Island, 34°02'S 122°00'E, *Scallop Trawl Survey* 1986, L.F.B.E. *Triumph*, D. Richards et al., 26 July 1986, WAM Z31838 (body with tentacles and ring eviscerated and lost).

*Diagnosis*. Body 45 mm long (preserved), up to 15 mm diameter, cylindrical, tapered to rounded oral and anal ends, body wall soft, thick; external anal scales not detected; tentacles lost; complete close cover of small tube feet, diameter 0.3 mm; calcareous ring lost.

Body wall with table ossicles only, tables range greatly in form and inter-grade; numerous small tables with discs rounded rectangular with smooth lobed margins, smallest with typically 8 perforations, discs 48–56 $\mu$m long, spires with 2 pillars, short blunt pointed spines apically, spires 16 $\mu$m long; medium-sized tables with elongate oval discs, sometimes bi-lobed, up to about 40 small perforations, no perforations between disc margin and 2 large central perforations adjacent to spire, discs up to 144 $\mu$m long, spires with 2 pillars, up to 3 cross-connections, spires up to 64 $\mu$m long; large tables with irregular narrow tapered discs, 2 large central perforations, up to about 30 small perforations, ends of disc sometimes extended into solid non-perforate 'tail', sometimes solid digitiform side branches off discs, discs and tails up to 124 $\mu$m long, spires with 2 pillars, solid, up to 3 small perforations, 2 long laterally extended apical points together as wide as disc length, pillars 48 $\mu$m long; tube feet with endplates and table support ossicles; endplates up to 120 $\mu$m diameter; tables with curved discs; anal ossicles tables, single and multi-layered scales.

*Colour (preserved)*. Body pale brown.

*Distribution*. SW Australia, Recherche Archipelago.

*Etymology*. Named from the Greek *kerkos* (tail), with reference to the elongate tail-like extensions on some narrow table discs and some table spires apically.

*Remarks*. We are conscious of the limited morphological data available for the single damaged specimen on which we are erecting *Thyone kerkosa* O'Loughlin sp. nov. But we judge that it is important to establish this distinctive species in a work that is attempting a comprehensive treatment of southern Australian phyllophorid species. We are confident that the species belongs to genus *Thyone* Oken because of the distribution and size of tube feet, and similarity of the tables to those of another new *Thyone* species from the Upper Spencer Gulf that has a characteristic *Thyone* ring and tentacles (see below). *Thyone kerkosa* is distinguished from other southern Australian *Thyone* species in the key (above).

***Thyone nigra*** Joshua and Creed, 1915

Figures 5b, 21

*Thyone nigra* Joshua and Creed, 1915: 20–21, pl. 3 figs 3a–e, 4.—H. L. Clark, 1946: 401.—A. M. Clark, 1966: 347–348, figs 10b, c.—Rowe, 1982: 462, fig. 10.29a.—Rowe and Gates, 1995: 316.

*Material examined*. Holotype. South Australia, Dr. Verco, SAM K1376 (specimen and slide).

Other material. Victoria, Westernport Bay, McHaffie Reef, 16 Feb 2008, NMV F151855 (1; photo live); Port Phillip Bay, Corio Bay, PPS, Area 26 stn 300–301, 6 m, 16 May 1963, NMV F73807 (2); PPS, Corio Bay, Area 27 stn 41, 3 m, 16 Feb 1958, NMV F73808 (1).

Tasmania, Bass Strait, Waterhouse Passage, 40°49'S 147°38'E, rocky shallows, 23 Nov 1982, NMV F97425 (2); 26 Feb 1991, NMV F174901 (1).

South Australia, Upper Spencer Gulf, Backy Point, 18 m, Sep 1987, SAM K2561 (1); Ward Spit, 9 m, Feb 1986, SAM K1799 (1); Eyre Peninsula, Elliston, 33°39'S 134°53'E, rocky shallows, 18 Jan 1991, NMV F97426 (1); Point Westall (near Streaky Bay), 32°55'S 134°04'E, 0 m, 15 Jan 1991, NMV F97427 (1); Great Australian Bight, Point Sinclair, 32°06'S 132°59'E, 10 May 1973, NMV F97424 (3).

Western Australia, Busselton, 1 Mar 1962, WAM Z31985 (1); Cockburn Sound, Woodman's Point, 13 Feb 1972, WAM Z31983 (4); 1 m, 25 Aug 1971, WAM Z31963 (2); Jervoise Groyne, 2 m, 1 Nov 1959, WAM Z31835 (1); Perth, Ocean Reef boat harbour, 10–14 m, May 1990, WAM Z31981 (1).

*Diagnosis*. *Thyone* species up to 35 mm long, up to 11 mm diameter (preserved; NMV F151855 specimen 42 mm long live, 17 mm long preserved), body fusiform, tapered to rounded end orally and anally, sometimes oral and anal ends upturned, thick firm body wall; external anal scales not detected; 10 tentacles, 8 large, 2 ventral small; complete cover of spaced tube feet, paired to multiple series of contiguous tube feet radially, scattered inter-radially, diameter about 0.2 mm; tubular composite calcareous ring, posterior ends of composite plates not joined; radials tapered anteriorly with terminal split, deep posterior division about half composite plate length, paired composite ends narrow, free; inter-radials tapered to anterior point, truncate posteriorly, inter-radial composite plate extending about half the length of the radial plate; stone canal attached to side of calcareous ring, split pea madreporite form; single polian vesicle, elongate, tubular; longitudinal muscles cylindrical; gonad tubules unbranched.

Mid-body wall ossicles tables, discs irregularly oval to rounded rectangular with 4 central large perforations, 4 and up to about 26 outer smaller perforations, small table discs typically 80 $\mu$m long, large table discs up to 120 $\mu$m long, tables inter-grade with endplate support tables with narrow curved discs up to 136 $\mu$m long, table spires with 2 pillars, single cross-bar, spinous distally, spire height up to 32 $\mu$m; tube feet with endplates, endplate support tables (above); endplates with irregular perforations, small centrally, large marginally, up to about 160 $\mu$m diameter; peri-oral body wall

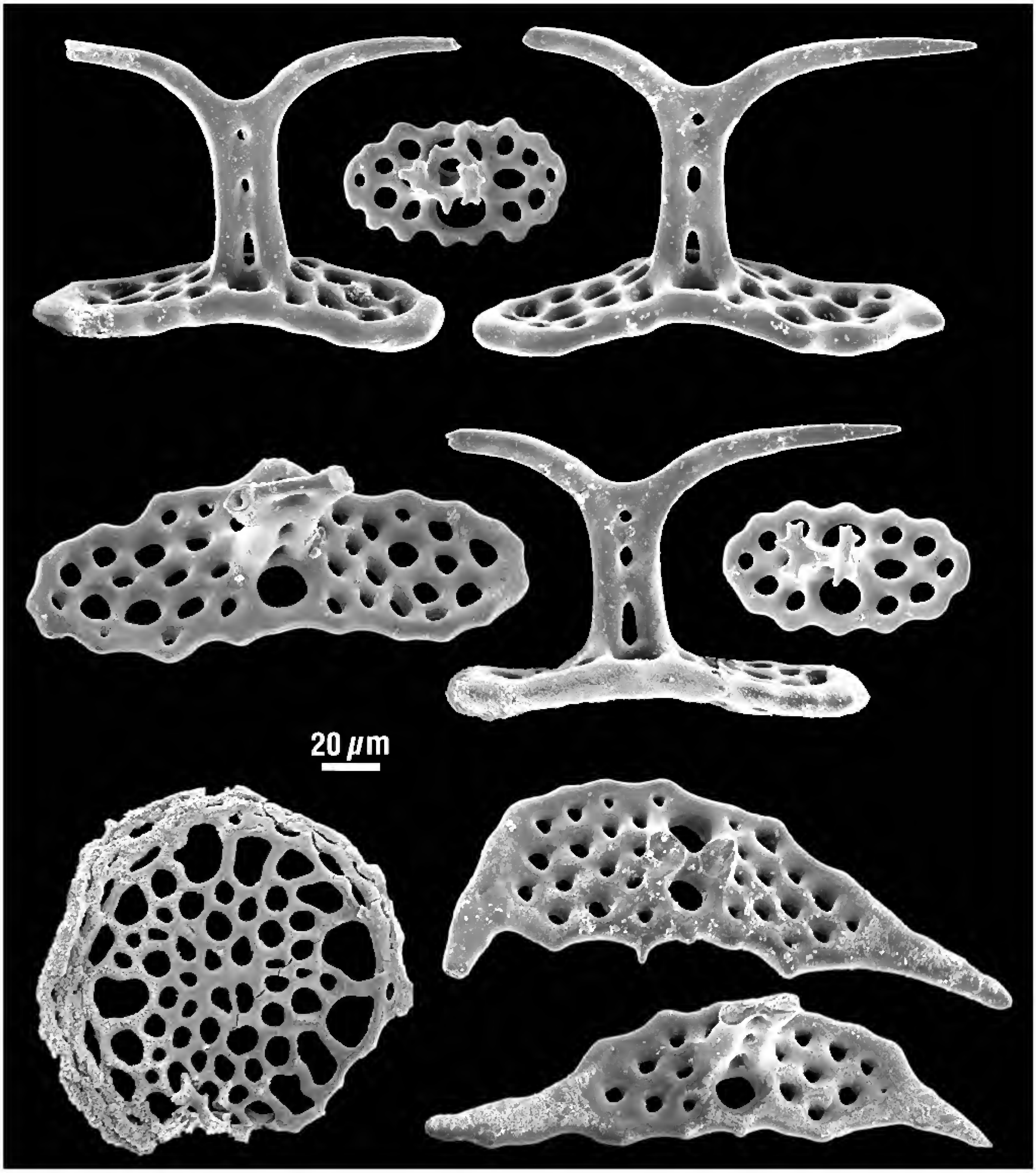


Figure 20. SEM images of ossicles from holotype of *Thyone kerkosa* O'Loughlin sp. nov. (WAM Z31838). Mid-body wall tables small and large tables with attenuated discs and distal spires, and tube foot endplate (bottom left).

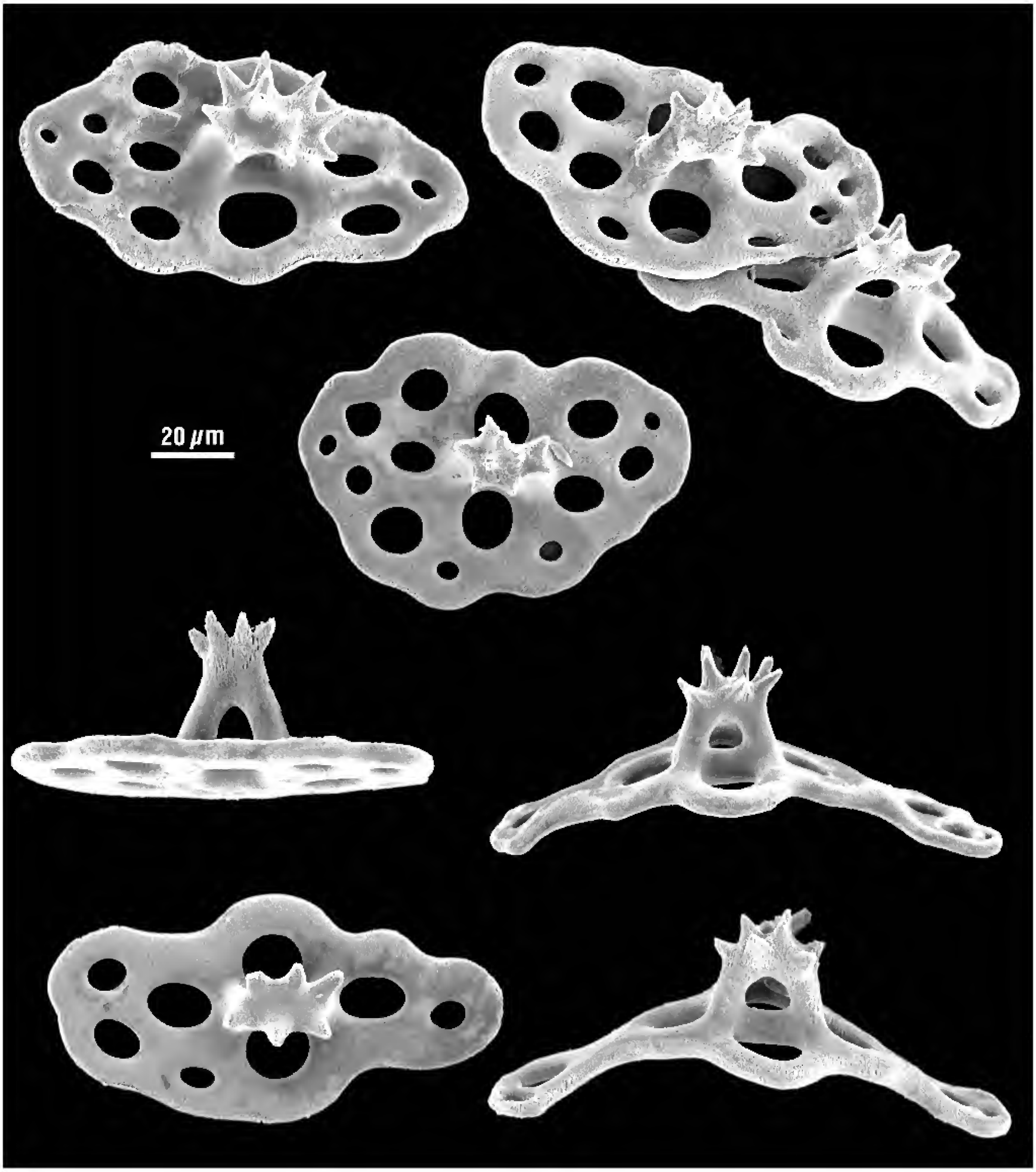


Figure 21. SEM images of ossicles from specimen of *Thyone nigra* Joshua and Creed, 1915 (NMV F151855). Mid-body wall tables and tube foot support tables with narrow curved discs.

ossicles tables, rosettes, tables irregularly oval to elongate, 2 pillars, up to 30 disc perforations, discs up to 90 $\mu$m long, rosettes oval to bi-lobed, up to 50 $\mu$m long; tentacles rarely with rods, perforated ends, predominantly straight and curved more than bracket-shaped, up to 72 $\mu$m long, rods inter-grade with rosettes, rosettes abundant, many linear.

*Colour (preserved).* Body white with dark brown flecking/ blotching, darker to black orally and anally, tube feet white with rare dark brown flecks; tentacle trunks brown with white spots (clusters of rosettes), tentacle branches dark grey.

*Type locality.* South Australia (precise collecting locality not recorded by collector Dr J. C. Verco).

*Distribution.* Southern Australia, east to Westernport Bay, north Tasmania (Bass Strait), west to Perth (Western Australia), rocky shallows and offshore sediments, 0–18 m.

*Remarks. Thyone nigra* Joshua and Creed, 1915 is distinguished from other southern Australia *Thyone* species in the key (above).

### *Thyone okeni* Bell, 1884

Figures 17b, 22

*Thyone okeni* Bell, 1884: 149–150, pl. 9D.—H. L. Clark, 1921: 167.—H. L. Clark, 1946: 402.—Rowe, 1982: 462 (non specimens from Port Phillip and Westernport in Victoria).—Rowe and Gates, 1995: 316 (non specimens from southern Australia).

*Material examined.* Australia, New South Wales, Port Jackson, AM J16905 (1); Vaucluse, Bottle and Glass Rock, under boulders, 21 Nov 1968, AM J7731 (1); 5 m, 29 Aug 1977, AM J10868 (2); mid-tide rock pools, 23 Oct 1968, NMV F174900 (1); off Nielsen Park, dredged, 21 Jan 1951, AM J16869 (1); Newcastle, Swansea Channel, 5 m, 21 May 1987, AM J20267 (1).

*Diagnosis. Thyone* species up to 75 mm long, up to 20 mm diameter (preserved, tentacle withdrawn; 85 mm long by Bell 1884); body cylindrical, oral and anal ends tapered, upturned; typically 10 tentacles, 8 large, 2 small ventral; body closely covered with tube feet, about 0.3–0.4 mm diameter, not more concentrated radially; no external evidence of anal scales or papillae; calcareous ring composite, tubular, no evidence of discrete plates for most of length, posterior composite tails not joined distally; radial plates with split anterior point, posterior end divided into two thin composite tails posterior to the end of the inter-radial plates; inter-radial plates tapered to anterior point, truncate posteriorly, about two thirds the length of radial plates; single long tubular polian vesicle; stone canal and madreporite lie anteriorly from attachment along calcareous ring; longitudinal muscles cylindrical, distinctly divided by deep groove mid-body.

Mid-body wall lacking ossicles; tube feet with endplates only, up to 240 $\mu$m diameter lacking any support rods or tables or plates, endplate with irregular perforations, large marginally small centrally, slightly denticulate margin; peri-oral body wall with numerous tables, discs round to slightly oval, up to 192 $\mu$m diameter/length, up to > 100 small perforations, spires thick short columnar mesh; tentacles branches with stout dumbbell-shaped ossicles, few to about 12 distal perforations, rods up to 320 $\mu$m long, tentacle trunks lacking ossicles, no rosettes seen; introvert ossicles rosettes; anal ossicles rods as in tentacles, rosettes as in introvert, single and multi-layered scale fragments, tube foot endplate diameters up to 200 $\mu$m.

*Colour (preserved).* Body brown to dark brown to grey-brown; tube feet off-white to grey to speckled to red; tentacle trunks off-white with brown patches, branches dark brown.

*Type locality.* New South Wales, Port Jackson.

*Distribution.* New South Wales, Port Jackson to Newcastle; 0–5 m.

*Remarks.* The distribution extensions of *Thyone okeni* Bell, 1884 to Thursday Island off Cape York in northern Queensland (H. L. Clark 1921) and to Guam in the eastern Pacific (Rowe and Doty 1977) are not confirmed. Thandar 1990 followed the comment by Rowe and Doty 1977 that *Thyone okeni* Bell was "probably distributed throughout the western Pacific area", and without examining specimens was "inclined to think that *T. venusta* Selenka, 1868 and *Thyone okeni* were conspecific" and then formally relegated *Thyone okeni* Bell, 1884 to junior synonymy with *Thyone venusta* Selenka, 1868 (type locality the Red Sea). In the key in his paper Thandar (1990) described the body of *Thyone venusta* Selenka, 1868 as being violet at both ends, and the tube feet as lacking ossicles. Neither character is true of *Thyone okeni* Bell, 1884. There are distinctive dumbbell-shaped endplate support rods in the tube feet of *Thyone okeni* Bell. We reject this synonymy on the basis of inadequate systematic evidence for these two species with widely separated type localities. *Thyone okeni* Bell, 1884 is distinguished from other southern Australia *Thyone* species in the key (above).

### *Thyone spenceri* O'Loughlin sp. nov.

Figures 17e, 23

*Material examined.* Holotype. South Australia, Upper Spencer Gulf, Backy Point – West, 32°50'S 137°50.52'E, 18 m, SA Fisheries Department, Sep 1987, SAM K2562 (ring, tentacle crown, anterior part of body wall).

Paratype. Upper Spencer Gulf, Port Bonython, 33°01'S 137°45'E, 15 m, SA Fisheries Department, Sep 1987, SAM K2565 (1, ring, tentacle crown, anterior part of body wall).

*Diagnosis.* Anterior body and calcareous ring 13 mm long (preserved), body wall soft; 10 tentacles, 8 large 2 ventral small; complete close cover of small tube feet; calcareous ring composite, tubular, posterior ends of composite plates not joined; radial plates tapered anterior with terminal split, long paired composite posterior prolongations separated for most of length, narrowing and further divided distally for about a quarter of total plate length, not joined; inter-radial plates composite, tapered to anterior point, truncate posteriorly; stone canal attached to alimentary canal mesentery, 'split-pea' madreporite form; single polian vesicle.

Anterior body wall with abundant tables, tables regular, discs round to oval to triangular, up to 96 $\mu$m long, 2 large central perforations, smaller perforations nearer margin, predominantly 40–50 small perforations, spires with 2 pillars, 24 $\mu$m long, 2 tapered ends distally; some table discs rosette-like; some table discs curved for tube foot support; tentacles

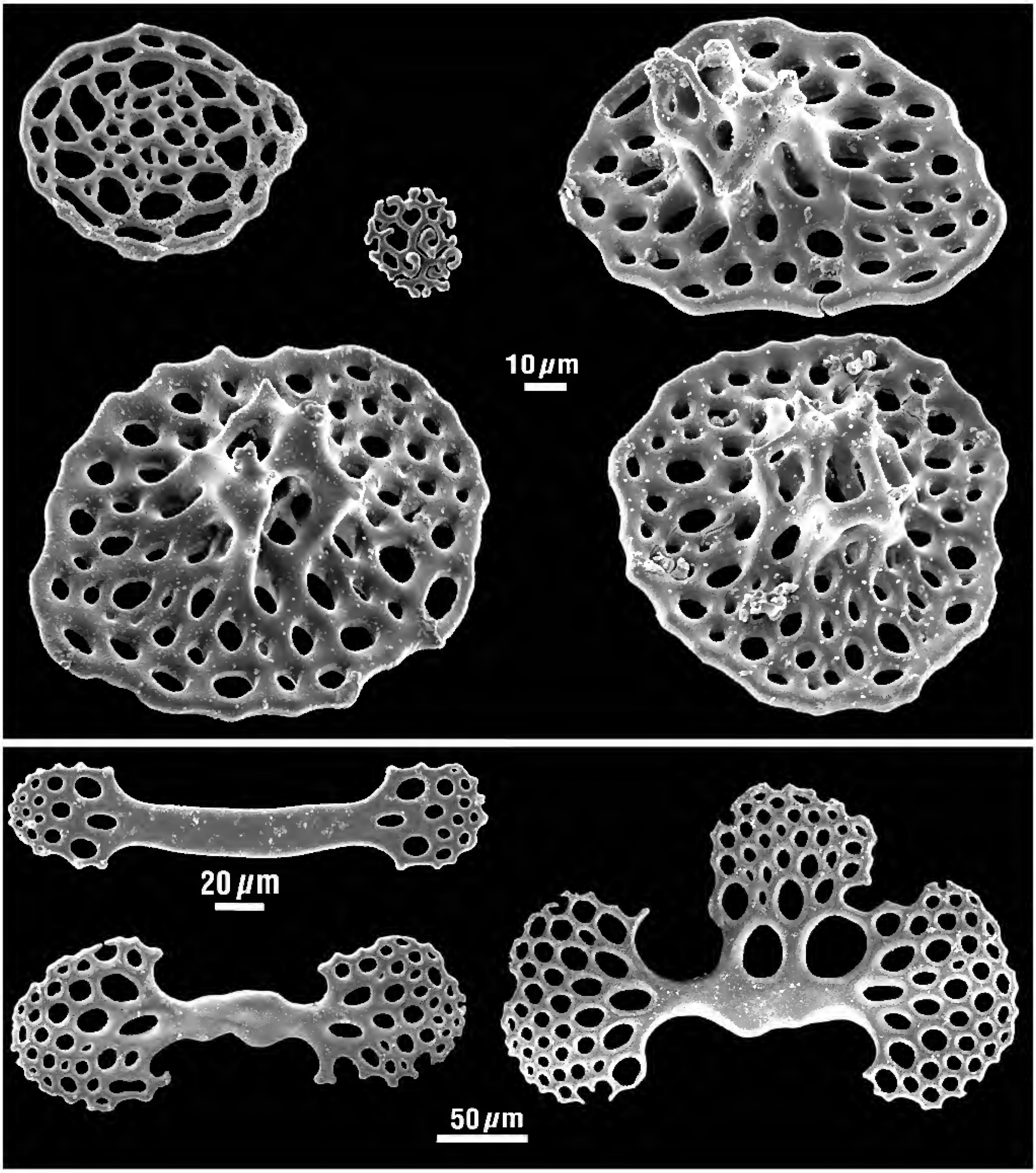


Figure 22. SEM images of ossicles from specimen of *Thyone okeni* Bell, 1884 (AM J7731). Peri-oral body wall rosette and tables with multi-branched spires (top); dumbbell-shaped ossicles from tentacles (bottom).

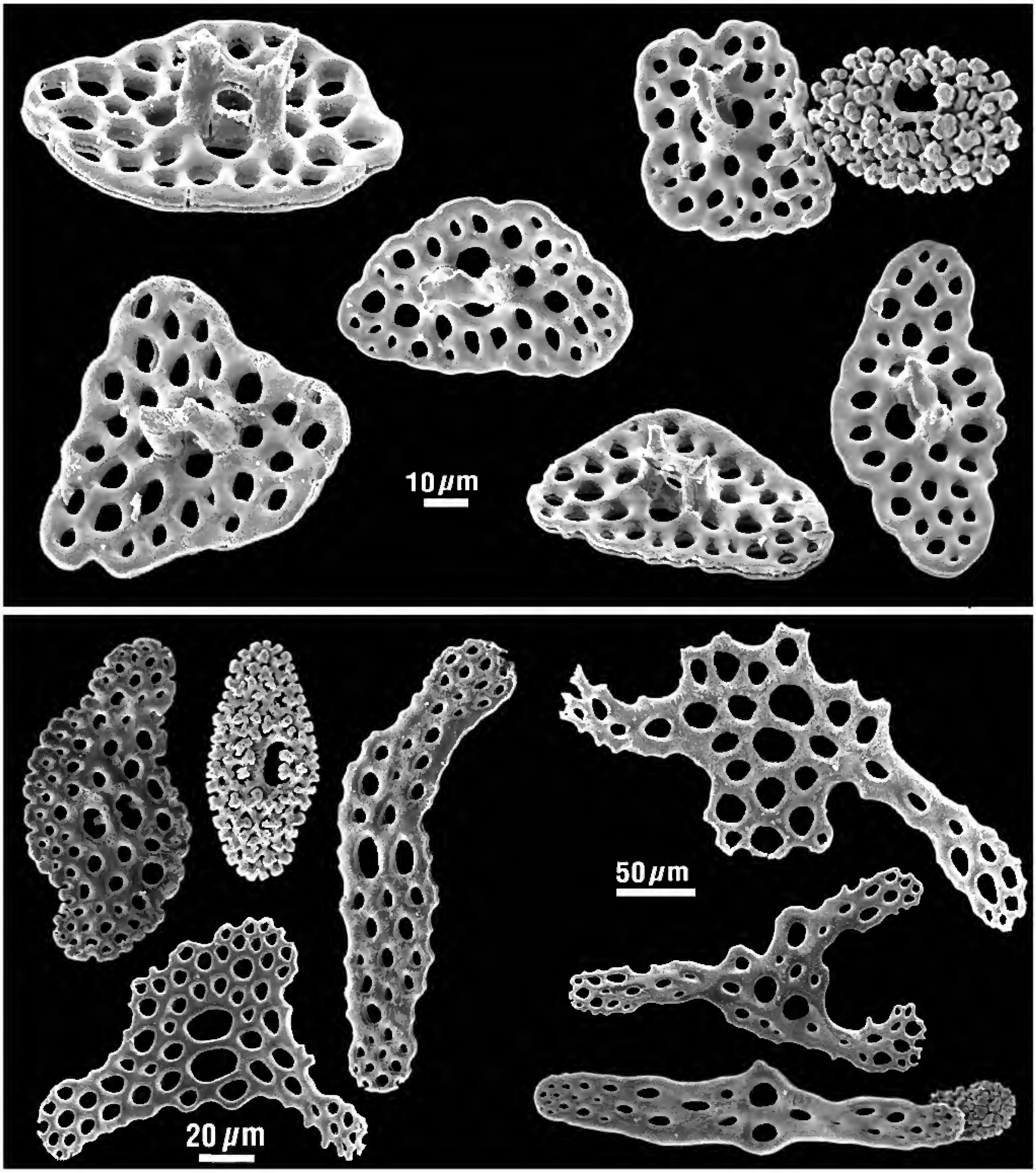


Figure 23. SEM images of ossicles from paratype of *Thyone spenceri* O'Loughlin sp. nov. (SAM K2565). Tables from anterior body wall (top); plates and rosettes from tentacles (bottom).

with abundant perforated plates, rosettes; plates variable in shape, some plates narrow, elongate with large perforations and distal blunt teeth, sometimes small branches along margin of plate, plates up to 280 $\mu$m long, some plates cross-shaped with perforate arms, some plates oval with four large central perforations, smaller surrounding ones and distal blunt teeth, plates up to 160 $\mu$m long, some plates curved with denticulate margin and numerous small perforations, plates up to 120 $\mu$m long; rosettes oval, up to 88 $\mu$m long; peri-oral body wall with tables and rods; tables with 2 spires, discs with 2 central large perforations, small perforations between central large ones and disc margin, each disc with up to more than 30 small perforations, discs about 104 $\mu$m long; peri-oral ossicles irregular wide perforated rods, up to 272 $\mu$m long, sometimes crosses.

*Colour (preserved).* Body off-white; tentacles brown with dark brown to black markings.

*Distribution.* South Australia, Upper Spencer Gulf, 15–18 m.

*Etymology.* Named with reference to Spencer Gulf in South Australia where the type specimens were collected.

*Remarks.* Both the holotype and paratype of *Thyone spenceri* O'Loughlin sp. nov. are damaged and most of the body wall has been lost. But there are good morphological systematic characters for the erection of this new *Thyone* Oken species. *Thyone spenceri* is distinguished from other southern Australian *Thyone* species in the key (above).

***Thyone tourvillei*** O'Loughlin sp. nov.

Figures 17f, 24

*Material examined.* Holotype. Eastern Tasmania, 37 km NE of Cape Tourville, RV *Franklin* stn SLOPE 85, 41°56'S 148°35'E, upper continental slope, 124 m, G. C. B. Poore et al., 30 Oct 1988, NMV F174902 (1, small, damaged, 15 mm long).

Paratype. Eastern Bass Strait, VIMS, RV *Tangaroa,* 81–T–1 stn 170, 38°52.6'S 148°25.2'E, 140 m, mud / sand, 15 Nov 1981, NMV F76627 (1, small, damaged, 6 mm long).

*Diagnosis.* *Thyone* species 15 mm long (preserved body and partly extended tentacles), up to 3 mm diameter, body cylindrical, rounded ends, body wall soft; external anal scales not detected; 11 tentacles (some lost in holotype), large pairs, small singly; complete close cover of tube feet, single contiguous series on each side of longitudinal muscle interior attachments, more scattered inter-radially, diameter about 0.2 mm; composite calcareous ring; radial plates tapered anteriorly with terminal split, long paired composite posterior prolongations, narrowing distally; inter-radial plates tapered to anterior point, not composite, lacking posterior extensions, contiguous postero-laterally with composite radial posterior extensions; stone canal and madreporite lie on calcareous ring; single polian vesicle.

Mid-body wall with tables, regular, discs oval, up to 64 $\mu$m long, 4 narrow perforations in cross formation centrally, 4 larger corner perforations, single pillar spire with apical spines, spire 24 $\mu$m long; tube feet with endplates and endplate support tables and plates; endplates with small central perforations, transversely elongate perforations marginally, marginal denticulations, diameters up to 144 $\mu$m; tube foot support tables with curved narrow disc, frequently 4 central perforations, 2 distally, discs up to 88 $\mu$m long, single pillar spire 24 $\mu$m long; tube foot support plates, slightly curved, sub-rectangular, larger perforations centrally, smaller distally, digitiform projections on one edge, up to 160 $\mu$m wide; tentacles with rods, tables, rosettes; rods up to 280 $\mu$m long, up to 4 distal perforations, up to 2 spines along shaft; rosettes up to 80 $\mu$m long.

*Colour (preserved).* Body and tube feet off-white, tentacles pale brown.

*Type locality.* Eastern Tasmania, off Cape Tourville, 124 m.

*Distribution.* Eastern Bass Strait and Tasmania, 124–140 m.

*Etymology.* Named for the type locality, Cape Tourville, in eastern Tasmania; in turn named for the French naval commander Comte de Tourville by the explorer Nicolas Baudin.

*Remarks.* Both the holotype and paratype of *Thyone tourvillei* O'Loughlin sp. nov. are damaged, but calcareous components are well-preserved and the specimens sufficiently intact to provide distinctive diagnostic characters for the new species. The diagnostic characters of this new species are not those of any current phyllophorid genus.

Thandar 1989 erected subfamily Sclerothyoninae Thandar, 1989 with two monotypic genera *Sclerothyone* Thandar, 1989 and *Temparena* Thandar, 1989 to accommodate two previously erected species. In both genera the calcareous ring is not tubular and is similar to that in the new species *Thyone tourvillei*. But in both Thandar genera the tube foot distribution is radial only, there are eight large and two small tentacles, and the tables have spires with two pillars. Neither genus is suitable for referral of the new species.

We refer this new species to *Thyone* Oken on the basis of tube feet and ossicle characters, but with considerable reservation because of the single pillar spire tables, Sclerothyoninae-like calcareous ring, and uncertain tentacle state. We are reluctant to erect a new genus on damaged and very small specimens, with uncertainty about tentacle characters, and with a major revision needed of genus *Thyone*. *Thyone tourvillei* is distinguished from other southern Australian *Thyone* species in the key (above).

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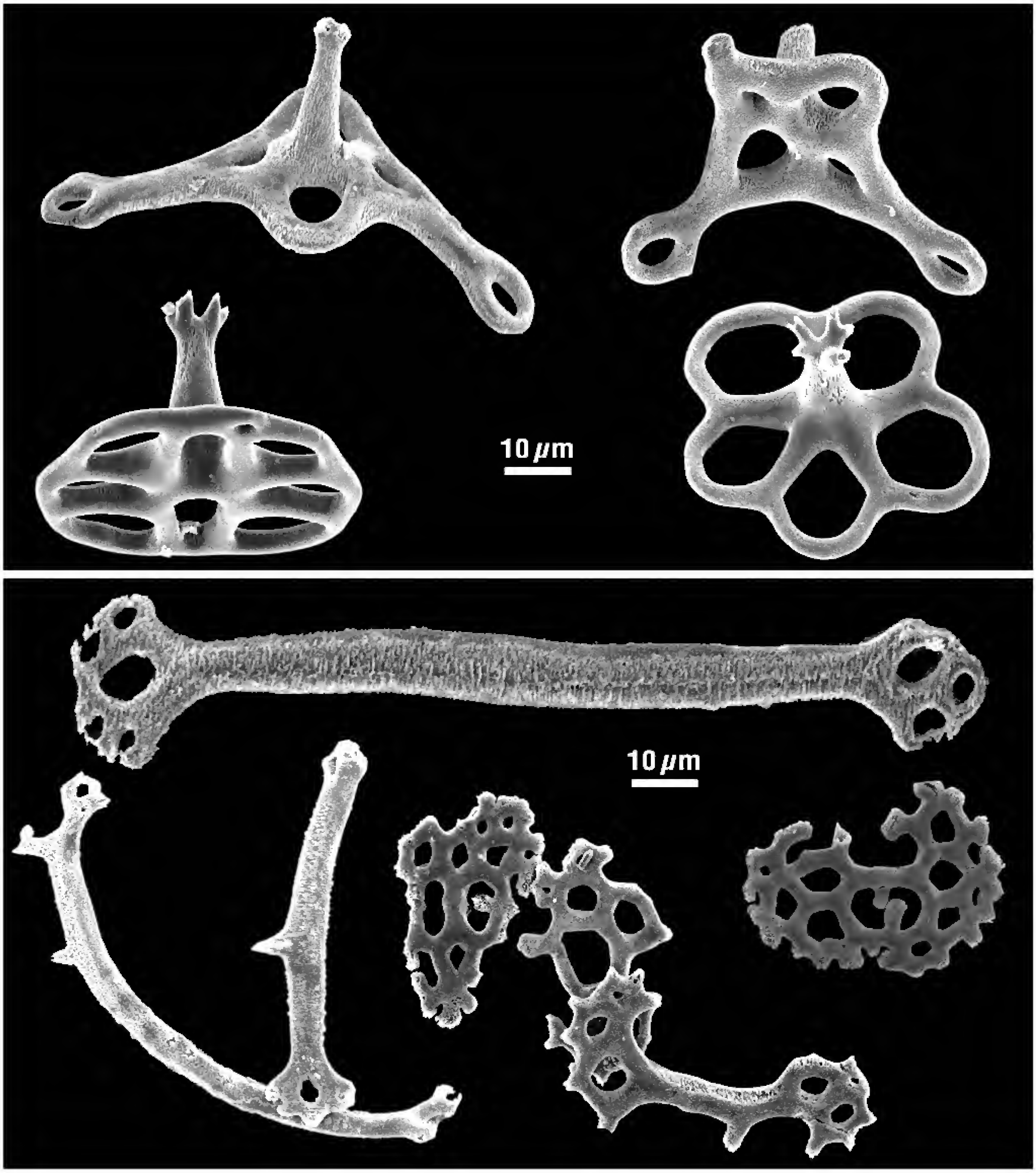


Figure 24. SEM images of ossicles from holotype of *Thyone tourvillei* O'Loughlin sp. nov. (NMV F174902). Mid-body wall tables with single pillar spires (top); rods and rosettes from tentacles (bottom).

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# A review of Australian fossil penguins (Aves: Sphenisciformes)

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**Abstract**

Park, T. and Fitzgerald, E.M.G. 2012. A review of Australian fossil penguins (Aves: Sphenisciformes). *Memoirs of Museum Victoria* 69: 309–325.

Australian fossil penguins (Sphenisciformes) are reviewed as a basis for future primary research. The five named species are based on type specimens of Eocene, Miocene—Pliocene and Holocene age collected from South Australia, Victoria and Tasmania. The phylogenetic affinities of these taxa remain unresolved. Only one type specimen is represented by clearly associated elements of a skeleton; the rest are single bones (isolated partial humeri and a pelvis). Further research is required to establish the taxonomic status of *Pachydyptes simpsoni*, *Anthropodyptes gilli*, *Pseudaptenodyes macraei*, *?Pseudaptenodytes* minor and *Tasidyptes hunteri*. Additional described specimens include isolated postcranial elements from the Late Oligocene of South Australia and Late Miocene—Early Pliocene of Victoria. Other Miocene and Pliocene specimens are housed in Museum Victoria. These specimens have the potential to shed light on the Neogene palaeobiogeography and diversification of crown group penguins.

**Keywords** South Australia, Tasmania, Victoria, Cenozoic, evolution, bird

## Introduction

The published fossil record of penguins (Sphenisciformes) in Australia, although limited compared to that of Antarctica, New Zealand and South America, spans some 40 million years from the late Eocene to Recent (Ksepka and Ando, 2011). The majority of previous work has been produced by one author (Simpson, 1957, 1959, 1965, 1970) with the last primary research conducted by Van Tets and O'Connor (1983). Since then, several summaries have been published (Jenkins, 1985; Fordyce & Jones, 1990; Vickers-Rich, 1991). Current work underway by the authors indicates that many undescribed diagnostic specimens reside in museum collections. The aim of this work is to introduce the Sphenisciformes, summarise current knowledge of Australian fossil penguins, discuss implications for penguin evolution, and outline both gaps in knowledge and opportunities for future research.

## Definitions and Terminology

This review follows the traditional classification of penguins where Sphenisciformes is the Order to which the single family, Spheniscidae, belongs. Spheniscidae contains all known species of penguin, fossil and extant. The terms Sphenisciformes and Spheniscidae are therefore used interchangeably throughout this paper. Osteological terminology and terms of orientation follows that of Baumel and Witmer (1993).

## Institutional Abbreviations

ANWC, Australian National Wildlife Collection, CSIRO Division of Wildlife and Rangelands Research, Canberra, Australia; NMV P, Museum Victoria Palaeontology Collection, Melbourne, Australia; SAM P, South Australian Museum Palaeontology Collection, Adelaide, Australia.

## The Sphenisciformes

Sphenisciformes (penguins) are a group of flightless marine birds confined to the southern hemisphere. Contrary to popular stereotype, not all species reside in Antarctica, with the highest species diversity found in New Zealand (Ksepka et al., 2012) and one species (the Galapagos penguin, *Spheniscus mendiculus* Sundevall, 1871 actually living at the equator (Vargas et al., 2005; Jadwiszczak, 2009). Fossil species are found in the same regions as extant species (Simpson, 1975), with Antarctica, Australia, New Zealand, South Africa, and South America all possessing both fossil and extant assemblages. Present regional species diversities roughly correspond to past levels, with areas such as New Zealand and Antarctica well represented by numerous fossil and living species, despite the fossil record not being continuous throughout the Cenozoic (Ksepka & Ando, 2011; Ksepka et al., 2012)(Fig. 1). One of the most specialised avian groups (Kaiser, 2007), the morphology of living penguins is well known (Pycraft, 1898; Lowe, 1933; Marples, 1952) and they have evolved a range of adaptations to an aquatic lifestyle including: small and scale-like feathers; increased underwater visual acuity (Sivak & Millodot, 1977; Bowmaker & Martin, 1985); several retia mirabilia systems for efficient thermoregulation (Frost et al., 1975; Thomas & Fordyce, 2007, 2012); stiffening of wing joints (Raikow et al., 1998); relative shortening of the wing; hydrodynamic flattening of wing elements; and shortening of the tarsometatarsus. The Sphenisciformes differ from most avian groups in that total diversity was greater in the past than present, with 19 extant species (sensu Ksepka & Ando, 2011), and 53 recognised fossil species (Fig. 2). This is testament to their aquatic lifestyle and the fact that particular penguin bones (e.g. humerus, tarsometatarsus) are more likely to fossilise than their equivalents in other avian groups due to their pachyostotic histology (Meister, 1962). Extant species feed on small fish, cephalopods, crustaceans and plankton, and show little interspecific postcranial morphological variation (Olson, 1985). Interspecific differences in cranial morphology are minimal; the differences that do occur probably reflect disparate feeding ecology (Zusi, 1975).

## Origin of Sphenisciformes

The fossil record of penguins is one of the longest and relatively complete of any of the neornithine groups, potentially allowing scientists to test hypotheses regarding the physical drivers of vertebrate evolution e.g. climate change, palaeoceanography (Baker et al., 2006; Ksepka & Thomas, 2012), biogeography (Clarke et al., 2007), secondary adaptation to water (Thomas & Fordyce, 2007), and stratigraphic calibration of molecular divergence estimates (Slack et al., 2006). Thus the penguin fossil record informs broader issues in macroevolution.

The oldest known penguin, *Waimanu manneringi* Jones, Ando and Fordyce, 2006, is from the early Paleocene (60.5 – 61.6 Ma) of New Zealand (Slack et al., 2006). Although archaic, it is clearly a penguin and already flightless. Simpson (1946) summarised previous theories of penguin evolution (e.g. Lowe, 1933) and concluded that penguins evolved directly from a volant ancestor, with no intermediate terrestrial stage. Molecular data estimate the divergence of Sphenisciformes from their sister taxon, Procellariiformes, about 71 Ma during the Cretaceous (Baker et al., 2006; Brown et al., 2008). Slack et al., (2006) wrote that the origins of Sphenisciformes took place 90–100 Ma as part of the Late Cretaceous neornithine radiation. It has been proposed that once the loss of aerial flight had occurred the adaptation of penguins to an aquatic lifestyle occurred rapidly due to the opening of ecological niches left by the extinction of most marine reptiles at the end of the Cretaceous and the intensive selection pressures of entering a new "adaptive zone" (Fordyce & Jones, 1990).

Some fossil species reached giant sizes (e.g. *Anthropornis nordenskjoeldi* Wiman, 1905, *Pachydyptes ponderosus* Oliver, 1930) of 1.5 – 1.6 m in standing height (Jadwiszczak, 2001), far exceeding that of today's largest species *Aptenodytes forsteri* Gray, 1844 (emperor penguin), which rarely exceeds 1.0 m (Friedmann, 1945; Stonehouse, 1975; Ksepka et al., 2012). Nonetheless, estimated heights of giant taxa may be overestimates following the first discovery of body proportions in a nearly complete stem penguin (Ksepka et al., 2012). These giant species (and potentially all stem species) are thought to have fed on fish, using their slender bills to spear large prey (Olson, 1985; Myrcha et al., 1990, 2002; Ksepka et al., 2008), This contrasts with extant species, which tend to have shorter beaks (*Aptenodytes* is an exception) and feed on smaller fish (Zusi, 1975). This trophic specialisation is thought to have occurred relatively late in penguin evolution (Ksepka & Bertelli, 2006), with elongate, narrow beaks representing the ancestral condition (Clarke et al., 2007). Fossil feathers are known from *Inkayacu paracasensis* Clarke et al., 2010, a species from the Eocene of Peru. These show not only that the key features of penguin wing feathers had evolved early in penguin evolution, but that this particular species was reddish-brown and grey, considerably different from the iconic black and white colouration of extant penguins (Clarke et al., 2010).

Considerable effort over the last two decades has been aimed at resolving penguin phylogeny including extinct taxa (Sibley & Ahlquist, 1990; Baker et al., 2006; Gianni & Bertelli, 2004; Bertelli & Gianni, 2005; Bertelli et al., 2006; Ksepka et al., 2006; Slack et al., 2006; Walsh & Suarez, 2006; Clarke et al., 2007; Acosta Hospitaleche et al., 2007, 2008). There is a general consensus between morphological and molecular data (Fig. 2), apart from the issues of where the phylogenies are rooted (Livezey, 1989), and the timing of the divergence of the crown Spheniscidae (Clarke et al., 2007). Basal penguins form a paraphyletic group, with higher morphological disparity compared to crown Spheniscidae (Davis and Renner, 2003). This is most likely due to the relatively recent common ancestry and broadly similar feeding ecology of the crown Spheniscidae (Zusi, 1975). The timing of the crown clade's divergence from stem Sphenisciformes is still unresolved, as molecular and morphological data give different estimates of ca. 41 Ma (Middle Eocene) and 11–13 Ma (Middle-Late Miocene), respectively (Baker et al., 2006; Göhlich, 2007). All pre-Miocene taxa are stem Sphenisciformes (Ksepka & Clarke, 2010), rendering the fossil record incongruent with the ancient divergence estimated from molecular data.

## Australian fossil Sphenisciformes

The record of Sphenisciformes in Australia is less extensive than that of New Zealand, South America and Antarctica, with a chronologically scattered distribution and the majority of fossils being fragmentary. This limited record probably reflects a lack of systematic field exploration, collecting and research, rather than real rarity of fossils. Until now, the majority of fossil penguin discoveries have been fortuitous in nature. Despite this relatively meagre record, penguins are known from ten localities limited to southeast Australia in every geologic epoch from the Eocene onwards (Figs. 1 and 3; Table 1).

*Eocene.* Six specimens in total have been described from this epoch (Finlayson, 1938; Glaessner, 1955; Simpson, 1957; Jenkins, 1974), including the partial skeleton (SAM P14157) of an indeterminate form resembling the Antarctic genus *Anthropornis* (Jenkins, 1974; Jenkins, 1985) (Fig. 4; Table 2). Found at Blanche Point, South Australia and originally named as *Pachydyptes simpsoni*, it is the most complete fossil penguin yet discovered in Australia. Other specimens referred to this *Anthropornis*-like form include a partial right humerus (SAM P14158a) (Fig. 5;

Table 1. Summary of Australian fossil penguin localities. Abbreviations: E, east; NNW, north northwest; S, south; SSW, south southwest;

| Locality | Geographic Location | Coordinates | Age (Ma) | Stratigraphic position | Reference(s) |
|---|---|---|---|---|---|
| **Blanche Point** | 37 km SSW of Adelaide, South Australia. | 35°14'S, 138°27'E | Late Eocene (36.5–38.0) | Blanche Point Formation | Alley et al., 1995; Jenkins et al., 1982; James and Bone, 2000 |
| **Witton Bluff** | South end of Christie's Beach, about 26 km SSW of Adelaide, South Australia. | 35°09'S, 138°28'E | Late Eocene (36.5–38.0) | " | " |
| **Mount Gambier** | Pritchard Brothers' building stone quarry, about 11 km west of Mount Gambier, South Australia. | 37°49'S, 140°38'E | Early–Late Oligocene (23.0–30.0) | Gambier Limestone | Alley et al., 1995; Li et al., 2000; Fitzgerald, 2004 |
| **Devil's Den** | On east bank of Glenelg River, about 17 km NNW of Dartmoor, Victoria. Site is marked "Bw" on the map published by Singleton (1941, p. 46). | 37°46'S, 141°14'E | Early Miocene (17.6–21.0) | Gellibrand Marl | Gill, 1959a; Jenkins, 1974; Abele et al., 1988; Dickinson et al., 2002 |
| **Batesford Quarry** | Australian Cement Company quarry south of Batesford, on the western bank of the Moorabool River, west of Geelong. | 38°06'S, 144°17'E | Early–Middle Miocene (15.9–17.6) | Batesford Limestone | Abele et al., 1988; Gourley and Gallagher, 2004 |
| | | | Middle Miocene (13.7–15.9) | Fyansford Formation | Abele et al., 1988; Gourley and Gallagher, 2004 |
| **Portland** | Beach on western side of Portland Bay, at Portland, Victoria. | 38°20'S, 141°36'E | Late Miocene (6.0–9.8) | Port Campbell Limestone | Mallett, 1977; Abele et al., 1988; Dickinson et al., 2002 |
| **Spring Creek** | Northeast of Minhamite, 41 km southeast of Hamilton, Victoria. | 37°58'S, 142°23'E | Late Miocene-Early Pliocene (5.0–6.0) | Goodwood Formation | Gill, 1964; Simpson, 1970; Abele et al., 1988; Holdgate and Gallagher, 2003 |
| **Beaumaris** | East of Rickett's Point on west shore of Beaumaris Bay, on northeast shore of Port Phillip Bay. | 37°59'S, 145°03'E | Late Miocene-Early Pliocene (5.0–6.2) | Black Rock Sandstone | Abele et al., 1988; Dickinson and Wallace, 2009 |
| **Red Bluff** | About 3.5 km southwest of Lake Tyers, east of Lakes Entrance, East Gippsland, Victoria. | 37°52'S, 148°03'E | Late Pliocene (2.5–3.5) | Jemmy's Point Formation | Abele et al., 1988; Wallace et al., 2005 |
| **Amphitheatre Cave** | Approximately 6 km north of Nelson, south-western Victoria. | 38°03'S, 141°01'E | Holocene | Cave pitfall assemblage | Baird, 1992 |
| **Hunter Island** | Stockyard Site, Hunter Island, 5 km north of Tasmania. | 40°32'S, 144°45'E | Holocene | Aboriginal midden | Van Tets and O'Connor, 1983 |

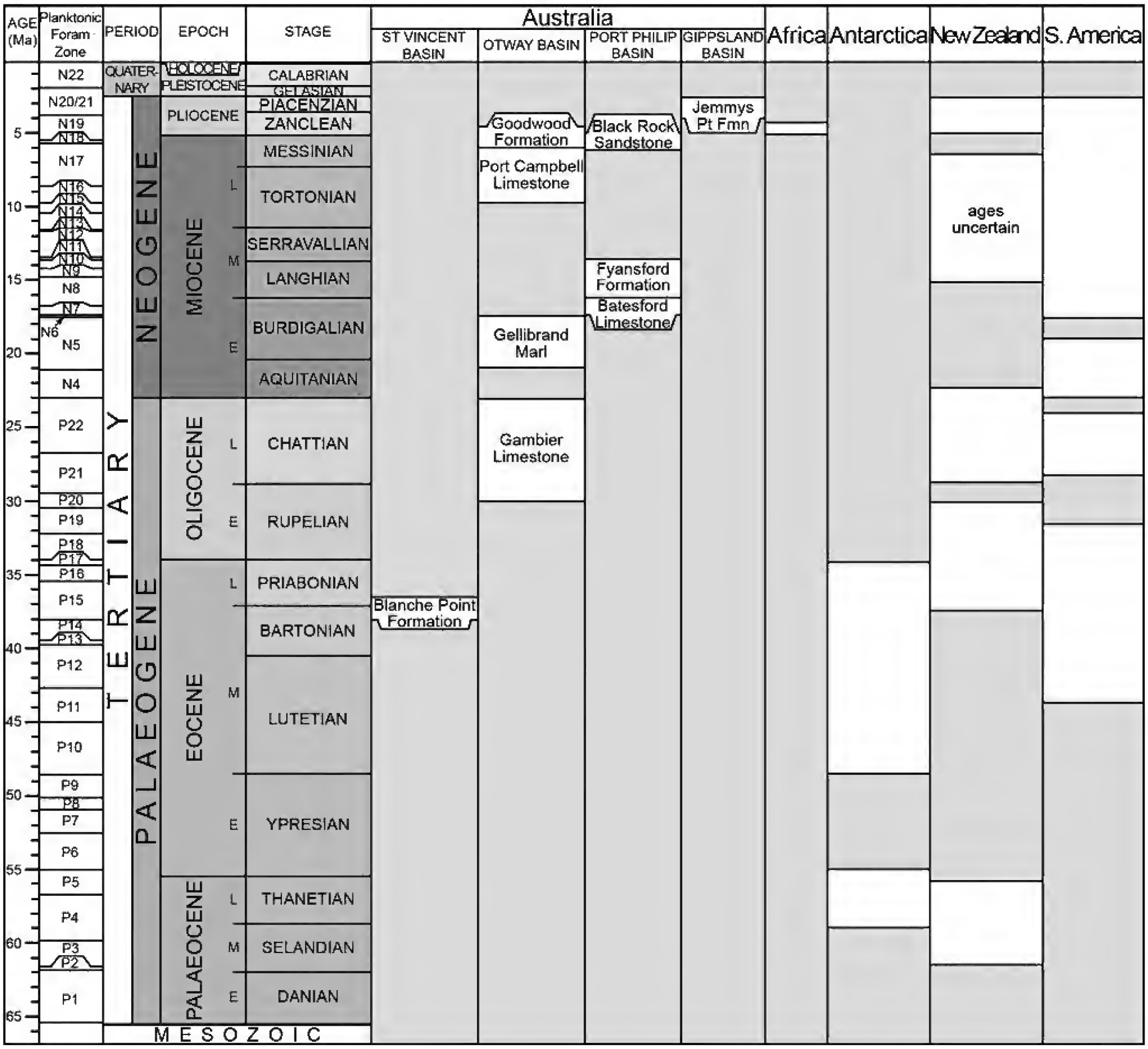


Figure 1. Chronostratigraphy and correlation of Australian fossil penguin-bearing units, compared with the fossil record of Sphenisciformes on other continents. Note that the vertical ranges of stratigraphic units represent estimates of geologic age maxima and minima for penguin-bearing horizons, not necessarily discrete time-spans of deposition. Geologic timescale is after Gradstein et al. (2004) with updates from Walker and Geissman (2009). See Table 1 for references to ages of Australian units. Ages of African units: Hendey (1981); Roberts et al. (2011); Ksepka and Thomas (2012). Ages of Antarctic units: Dingle and Lavelle (2000); Jadwiszczak (2006); Marenssi et al. (2012). Ages of New Zealand units: White and Waterhouse (1993); Cooper (2004); Slack et al. (2006); Ksepka et al. (2012). Ages of South American units: Devries (1998); Scasso et al. (2001); Celma and Cantalamessa (2007); Achurra et al. (2009); Malumián and Náñez (2011); Uhen et al. (2011).

Table 2), a partial right radius (SAM P14158b) (Fig. 5; Table 2), and a partial rib (SAM P17913; Table 2). A second form originally thought to be closely related to *Palaeeudyptes* was described by Finlayson (1938), who reported a left humerus (SAM P7158) (Fig. 6; Table 2) from Witton Bluff, South Australia. A right tibiotarsus (SAM P10862) (Fig. 7; Table 2), also from Witton Bluff was noted by Glaessner (1955), described by Simpson (1957), and also referred to this form. Simpson (1971) subsequently reassigned this material to Sphenisciformes, indeterminate. A third form, intermediate in size between the *Palaeeudyptes* and *Anthropornis* forms is known from two bones, one allegedly found at Blanche Point and the other from late Eocene rocks near Browns Creek, Otway Peninsula, Victoria (Jenkins, 1985; Vickers-Rich, 1991). These two specimens have not been described, and recent efforts by one of us (EMGF) to locate them in the SAM and MV collections have failed.

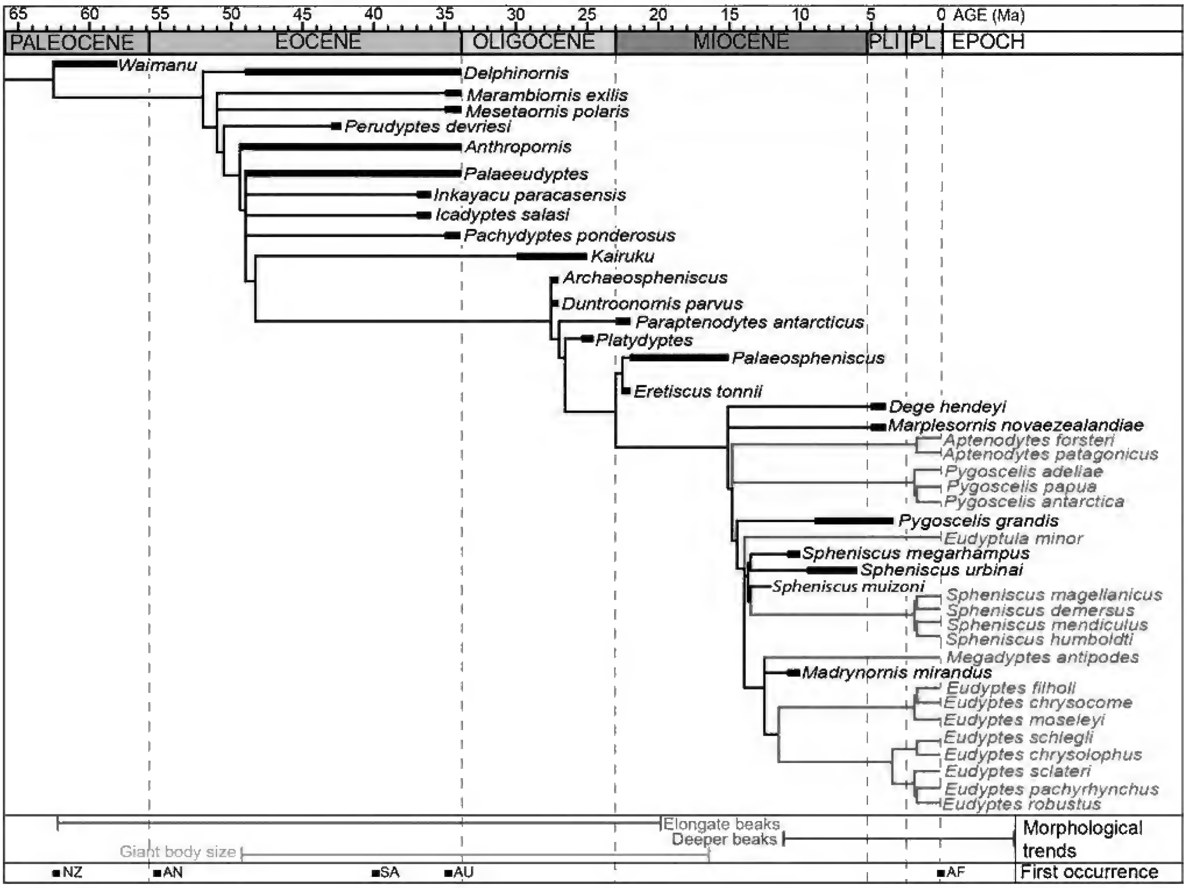


Figure 2. Temporally-calibrated phylogeny of Sphenisciformes modified from Ksepka and Ando (2011) and Ksepka et al. (2012), showing major trends in Sphenisciform evolution and the first occurrence of Sphenisciformes in each region with extant species. Stem sphenisciform branches are shown in black and crown clade Spheniscidae branches are shown in blue. Thick horizontal bars on branches indicate stratigraphic range maxima and minima. Abbreviations: AF, Africa; AN, Antarctica; AU, Australia; Ma, million years ago; SA, South America.

*Oligocene*. Only two fossil penguin specimens are known from the Oligocene of Australia. Both of them were derived from the Camelback Member of the Gambier Limestone, which has been correlated to the P21/22 planktonic foram zone (Lower–Upper Oligocene) (Li et al., 2000). Both specimens, a partial right humerus (SAM P10863) (Fig. 8; Table 2) and a partial left femur (SAM P10870) (Fig. 9; Table 2), were first noted by Glaessner (1955) and later described by Simpson (1957). Neither of the specimens has been assigned to a genus or species, but they are considered to be separate taxa (Simpson, 1957).

*Early–Middle Miocene*. Fossil penguin specimens have been described from the Early–Late Miocene of Australia. A single specimen was found as float on the banks of the Glenelg River at Devil's Den, Victoria (Gill, 1959a; Simpson, 1959). The large right humerus (NMV P17167) was named as *Anthropodyptes gilli* by Simpson (1959) (Fig. 10; Table 2). From the Early Miocene (Gill, 1959a; Jenkins, 1974; Dickinson et al., 2002), it is the latest surviving giant stem Spheniscid known, although some extinct crown Spheniscid taxa (e.g. *Spheniscus megaramphus*) would have been larger than *Aptenodytes forsteri* (Ksepka & Clarke, 2010; Stucchi, 2003). As yet undescribed material has also been collected from the Lower–Middle Miocene Batesford Limestone at Batesford, near Geelong, Victoria including: a partial right femur (NMV P222904), a partial left femur (NMV P201867), and a partial left coracoid (NMV P231933). A partial left tibiotarsus (NMV P231836) and a partial right femur (NMV P201856) have also been collected from the Middle Miocene Fyansford Clay at the same locality.

*Late Miocene–Pliocene*. Mio-Pliocene penguins have been described from two localities: Spring Creek, near Minhamite, and Beaumaris, Victoria. Simpson (1965, 1970), described a total of 21 penguin specimens from these localities. From Spring Creek an incomplete left humerus (NMV P26668, holotype of *Pseudaptenodytes macraei* Simpson, 1970) (Fig. 11; Table 2),

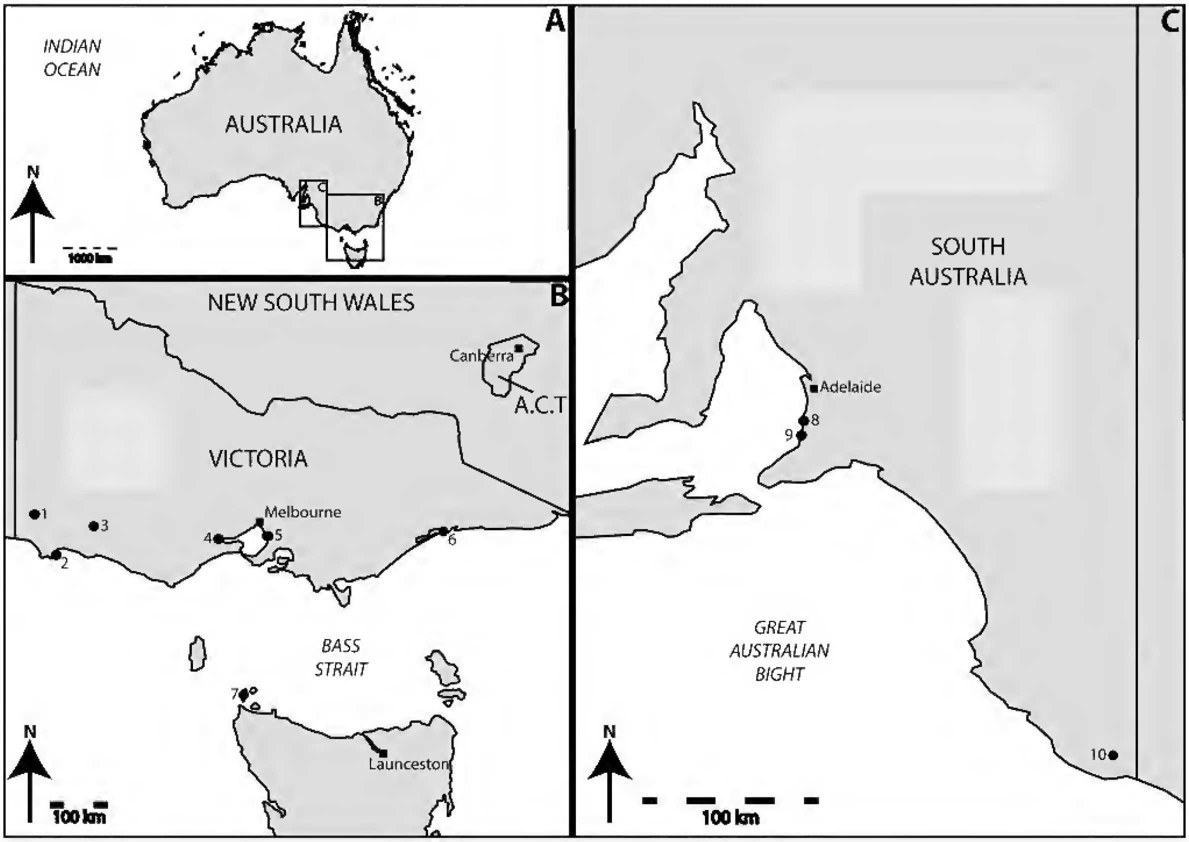


Figure 3. Fossil spheniscifom localities in Australia. 1 = Devil's Den; 2 = Portland; 3 = Spring Creek; 4 = Batesford Quarry; 5 = Beaumaris; 6 = Red Bluff; 7 = Hunter Island; 8 = Witton Bluff; 9 = Blanche Point; 10 = Mount Gambier

and from Beaumaris: a partial left coracoid (NMV P24065) (Simpson, 1965) (Fig. 12; Table 2); three partial left humeri (NMV P26671, NMV P26676, NMV P27059) (Fig. 13; Table 2); four partial right humeri (NMV P26669, NMV P26677, NMV P27057, NMV P26670) including the holotype of ?*Pseudaptenodytes minor* Simpson, 1970 (NMV P26669) (Figs. 13 and 14; Table 2); four partial carpometacarpi (NMV P27055, NMV P27056, NMV P27058, NMV P26903) (Figs. 13 and 15; Table 2); and eight isolated fragments (registration numbers unspecified by Simpson, 1970). The *P. macraei* humerus is the larger of the two species, being similar in size to the humerus of a king penguin (*Aptenodytes patagonicus* Miller, 1778), whereas the ?*P. minor* humerus approaches that of the gentoo penguin (*Pygoscelis papua* Forster, 1781) in size. ?*Pseudaptenodytes minor* was referred to Sphenisciformes indet. by Ksepka and Ando (2011: 159). The Upper Miocene Port Campbell Limestone at Portland, Victoria, has yielded a nearly complete left humerus (NMV P221273) and a partial left humerus (NMV P232062). One definitively Pliocene specimen is known from Australia, an undescribed partial right femur (NMV P41738) from the Pliocene Jemmys Point Formation at Red Bluff, west of Lake Tyers, Victoria.

*Holocene*. Van Tets and O'Connor (1983) described penguin remains from a ca. 760 year-old aboriginal midden on Hunter Island, Tasmania and described these as a new genus and species, *Tasidyptes hunteri*. Other workers (Fordyce and Jones, 1990; Ksepka and Clarke, 2010) have doubted this identification due to the fragmentary nature of the fossils: the coracoid (ANWC BS2669) (Table 2) and tarsometatarsus (ANWC BS2668) (Table 2) are indistinguishable from *Eudyptes*; and the four specimens comprising the hypodigm (ANWC BS2667, ANWC BS2668, ANWC BS2669, ANWC BS2670) (Table 2) come from three different horizons within the midden (Van Tets and O'Connor, 1983; Fordyce and Jones 1990; Ksepka and Clarke, 2010). Baird (1992) reported little penguin (*Eudyptula minor* Forster 1781) material from a pitfall assemblage in Amphitheatre Cave, Victoria which has been dated to ca. 4670 ybp (Table 2). However, this *Eudyptula* material is unlikely to be from the original pitfall assemblage due its differential preservation (Baird, 1992: 31–32).

Table 2. Described fossil penguin specimens from Australia. Abbreviations: ANWC, Australian National Wildlife Collection; indet., indeterminate; Ma, million years ago; NMV P, Museum Victoria Palaeontology Collection; SA, South Australia; SAM P, South Australian Museum Palaeontology Collection; TAS, Tasmania; VIC, Victoria.

| Specimen | Taxon (previous assignment) | Material | Locality (Formation) | Age (Ma) | Reference(s) |
|---|---|---|---|---|---|
| **SAM P7158** | Sphenisciformes indet. (cf. *Palaeeudyptes*) | left humerus | Witton Bluff, SA (Blanche Point Formation, Tuketja Member) | Late Eocene (36.5–38.0) | Finlayson, 1938; Simpson, 1957 |
| **SAM P10862** | " | right tibiotarsus | Witton Bluff, SA (Blanche Point Formation, Gull Rock Member) | " | Glaessner, 1955; Simpson, 1957 |
| **SAM P14157 (a-g)** | Sphenisciformes indet. (*Pachydyptes simpsoni*) | partial skeleton | Blanche Point, SA (Blanche Point Formation, Gull Rock Member) | " | Jenkins, 1974 |
| **SAM P14158a** | " | partial right humerus | Blanche Point, SA (Blanche Point Formation, Tuketja Member) | " | " |
| **SAM P14158b** | " | partial right radius | " | " | " |
| **SAM P17913** | " | partial rib | " | " | " |
| **SAM P10863** | Sphenisciformes indet. | partial right humerus | Mt. Gambier, SA (Gambier Limestone) | Early–Late Oligocene (~23.0–30.0) | Glaessner, 1955; Simpson, 1957 |
| **SAM P10870** | " | partial left femur | Mt. Gambier, SA (Gambier Limestone) | Early–Late Oligocene (~23.0–30.0) | Simpson, 1957 |
| **NMV P17167** | *Anthropodyptes gilli* | right humerus | Glenelg River, Devil's Den, VIC (Gellibrand Marl) | Early Miocene (17.6-21.0) | Simpson, 1959; Gill, 1959a |
| **NMV P24065** | Sphenisciformes indet. | partial left coracoid | Beaumaris, VIC (Black Rock Sandstone) | Late Miocene-Early Pliocene (5.0-6.0) | Simpson, 1965 |
| **NMV P26668** | *Pseudaptenodytes macraei* | partial left humerus | Spring Creek, Minhamite, VIC (Goodwood Formation) | Late Miocene-Early Pliocene (5.0-6.0) | Gill, 1964; Simpson, 1970 |
| **NMV P27055** | cf. *Pseudaptenodytes macraei* | partial right carpometacarpus | Beaumaris, VIC (Black Rock Sandstone) | Late Miocene-Early Pliocene (5.0-6.0) | Simpson, 1970 |
| **NMV P27056** | cf. *Pseudaptenodytes macraei* | partial left carpometacarpus | " | " | " |
| **NMV P26669** | Sphenisciformes indet. (?*Pseudaptenodytes minor*) | partial right humerus | " | " | " |
| **NMV P26677** | " | " | " | " | " |
| **NMV P26670** | " | " | " | " | " |
| **NMV P27057** | " | " | " | " | " |
| **NMV P26671** | " | partial left humerus | " | " | " |
| **NMV P26676** | " | " | " | " | " |
| **NMV P27058** | " | partial right carpometacarpus | " | " | " |
| **NMV P26903** | " | right carpometacarpus | " | " | " |
| **NMV P27059** | Sphenisciformes indet. | partial left humerus | " | " | " |
| **N/A** | " | isolated fragments (8) | " | " | " |
| **ANWC BS2667** | Sphenisciformes indet. (*Tasidyptes hunteri*) | juvenile synsacrum | Hunter Island, TAS (Aboriginal midden) | Holocene (ca. 760 ybp) | Van Tets and O'Connor, 1983 |
| **ANWC BS2668** | *Eudyptes* sp. (*Tasidyptes hunteri*) | left tarsometatarsus | " | " | " |
| **ANWC BS2669** | " | left coracoid | " | " | " |
| **ANWC BS2670** | Sphenisciformes indet. (*Tasidyptes hunteri*) | pelvis | " | " | " |
| **NMV P178677** | *Eudyptula minor* | proximal pelvis | Amphitheatre Cave, VIC (pitfall assemblage) | Holocene (ca. 760 ybp) | Baird, 1992 |
| **NMV P178678** | *Eudyptula minor* | right femur | " | " | " |
| **NMV P178679** | *Eudyptula minor* | left femur | " | " | " |
| **NMV P178680** | *Eudyptula minor* | partial left tibiotarsus | " | " | " |
| **NMV P178681** | *Eudyptula minor* | partial left tarsometatarsus | " | " | " |

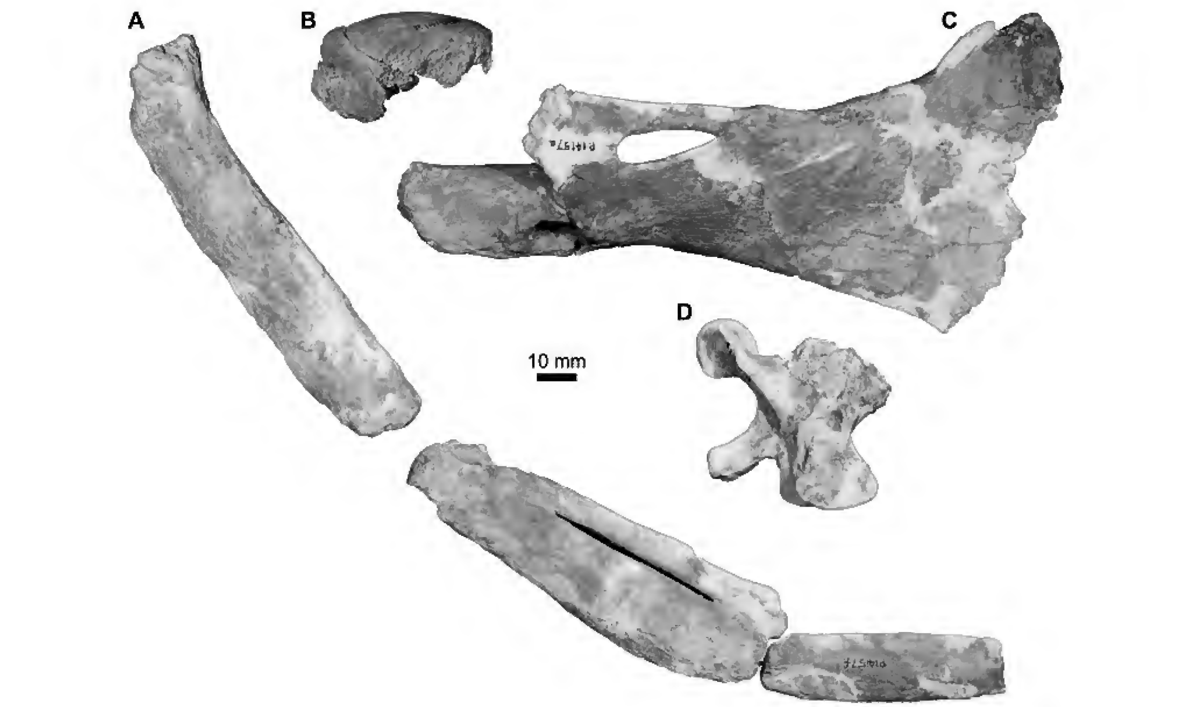


Figure 4. *Pachydyptes simpsoni* holotype, SAM P14157: A, right radius in ventral view, left carpometacarpus and left phalanx II-1 in dorsal view; B, head of right humerus in dorsal view; C, left coracoid in dorsal view; D, ?twelfth cervical vertebra in ventral view.

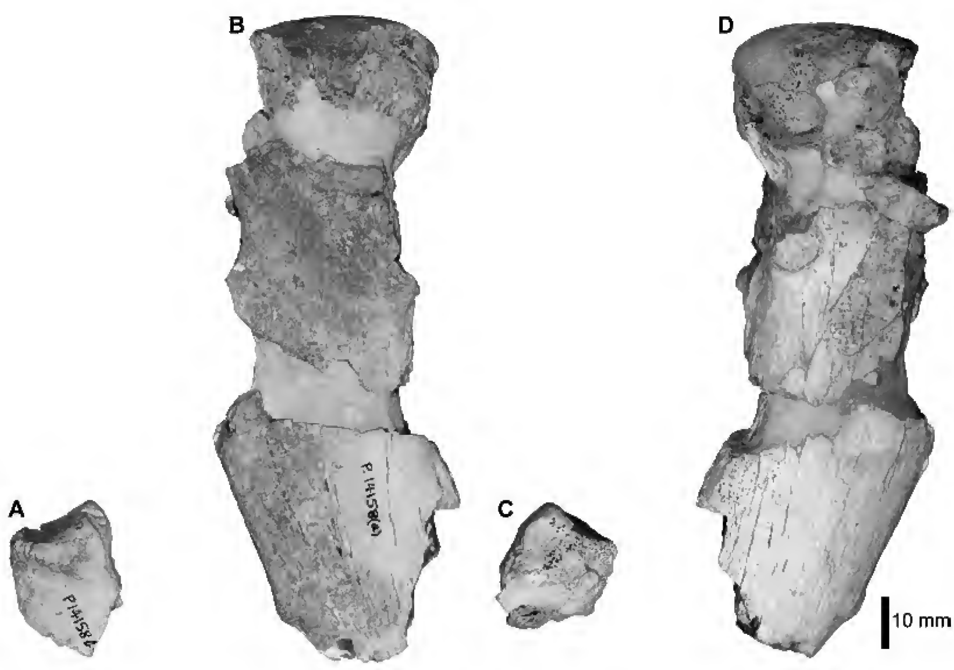


Figure 5. *Pachydyptes simpsoni* paratype, SAM P14158: proximal end of right radius in (A) ventral view and (C) dorsal view; partial right humerus in (B) ventral and (D) dorsal views.

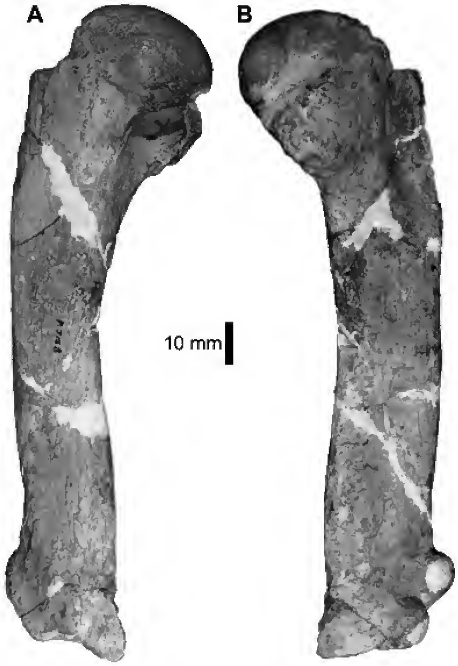


Figure 6. Sphenisciformes indet. left humerus, SAM P7158: A, dorsal view; B, ventral view.

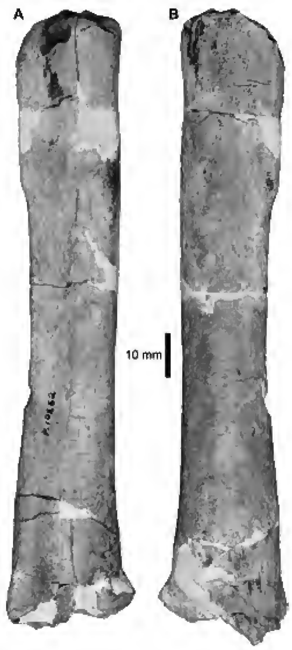


Figure 7. Sphenisciformes indet. partial right tibiotarsus, SAM P10862: A, cranial view; B, caudal view.

## Systematic Palaeontology

A total of five species of fossil penguin have been named from Australia. Only one taxon is based on a type specimen consisting of associated remains. The remaining four species are established on isolated elements. Only two of these five species are currently considered taxonomically distinct (*Anthropodyptes gilli* and *Pseudaptenodytes macraei*).

**Aves** Linnaeus, 1758

**Sphenisciformes** Sharpe, 1891

**Spheniscidae** Bonaparte, 1831

***Pachydyptes*** Oliver, 1930

***Pachydyptes simpsoni*** Jenkins, 1974

*Holotype.* Partial skeleton (SAM P14157) consisting of: a partial left coracoid; partial right humerus; partial left humerus; a right radius; a partial left carpometacarpus; a left phalanx II-1; and a partial vertebra. (Fig. 4; Table 2).

*Type locality.* Blanche Point, 37 km SSW of Adelaide, South Australia (35°14'S, 138°27'E).

*Horizon and age.* Occurs in the Gull Rock Member and the Tuketja Member of the Blanche Point Formation. The Gull Rock Member consists of green and grey, glauconitic and fossiliferous calcareous mudstone with a few limestone lenses; the Tuketja Member consists of alternating bands of tough, dark grey chert and friable clays, silts and calcareous clays (Jenkins et al., 1982). Both members are in the P15 foraminiferal zone; Late Eocene (Bartonian–Priabonian), 36.5–38.0 Ma (James and Bone, 2000).

*Referred material.* A partial right humerus (SAM P14158a) (Fig. 5), a partial right radius (SAM P14158b) (Fig. 5) and a rib fragment (SAM P17913). (Table 2)

*Diagnosis.* Following Marples (1952), the generic diagnosis of *Pachydyptes* is as follows : humerus relatively wide; m. deltoideus minor insertion (referred to as the 'external tuberosity' by Marples, 1952) projects distally; articular surface flattened; fossa pneumotricipitalis undivided; m. supracoracoideus insertion slightly oblique, almost parallel to long axis of shaft and widely separated from the m. latissimus dorsi insertion; shaft has slight sigmoid curve and slight angulation of the cranial border; angle between long axis of shaft and tangent of condylus dorsalis and condylus ventralis is acute; shelf adjacent to condylus ventralis approximately the same width as condylus ventralis; and coracoid convex at base. Following Jenkins (1974), *Pachydyptes simpsoni* differs from *Pachydyptes ponderosus* Oliver, 1930 by having: more concave medial margin of the coracoid; more pronounced angulation of the cranial margin of the humerus (referred to as the "preaxial

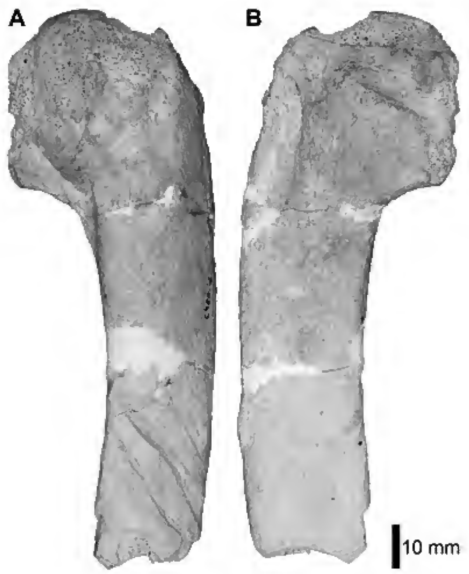


Figure 8. Sphenisciformes indet. partial right humerus, SAM P10863: A, dorsal view; B, ventral view.

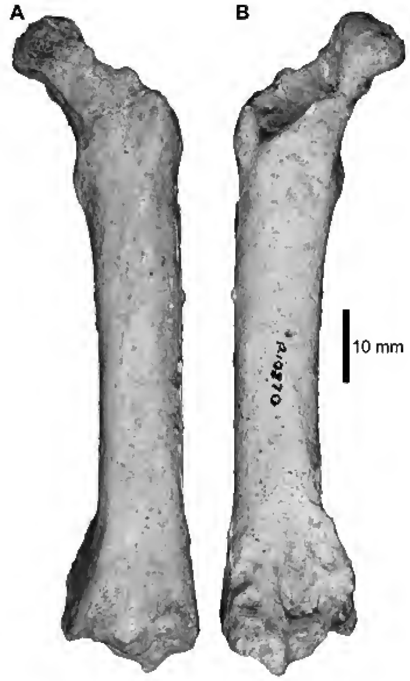


Figure 9. Sphenisciformes indet. partial left femur, SAM P10870: A, dorsal view; B, ventral view.

tuberosity on the shaft at the proximal limit of attachment of brachialis internus" by Jenkins, 1974); more widely separated insertions of the musculi supracoracoideus and the musculi coracobrachialis caudalis (referred to as the pectoralis secundus and pectoralis tertius respectively by Jenkins, 1974); metacarpal III extends further distally than metacarpal II; and the bones are generally less robust.

*Remarks.* The referred humerus (SAM P14158a) is similar to *Pachydyptes ponderosus* with its large head, expanded muscle attachments and wide shaft. The skeleton however is overall less robust than *P. ponderosus* and the overall morphology of the coracoid, radius and carpometacarpus shows similarities to *Anthropornis* and *Palaeeudyptes* (Jenkins, 1974). The coracoid has a broadly flared base and an oval foramen nervi supracoracoidei. On the radius, the insertion site of the m. brachialis is hollowed, forming a distinct notch similar to that of *Paraptenodytes robustus* Ameghino, 1905, although the bone itself resembles that of *Palaeeudyptes* and *Anthropornis* (Jenkins, 1974). Systematic revisions of *Pachydyptes simpsoni* have seen it first synonymised with *Anthropornis nordenskjoeldi* (Jenkins, 1985), and most recently considered as Sphenisciformes indet. (Ksepka and Clarke, 2010). The latter authors concluded that it occupied a more crownward position than Antarctic *A. nordenskjoeldi* specimens. We therefore consider the systematics of *P. simpsoni* to be unresolved.

***Anthropodyptes*** Simpson, 1959

***Anthropodyptes gilli*** Simpson, 1959

*Holotype.* Right humerus (NMV P17167). (Fig. 10; Table 2).

*Type locality.* Specimen was found as float on top of Miocene marl on east bank of Glenelg River at Devil's Den, about 17 km NNW of Dartmoor, Victoria. Site is marked "Bw" on the map published by Singleton (1941: 46) (37°46'S, 141°14'E).

*Horizon and age.* Gill (1959a) determined that NMV P17167 was derived from the Gellibrand Marl, which at this locality represents planktonic foram zones N5–N6, Early Miocene (Aquitanian–Burdigalian), 17.6–21.0 Ma (Jenkins, 1974: 292; Abele et al., 1988:285; Dickinson et al., 2002).

*Diagnosis.* Simpson (1957: 118) notes that *Anthropodyptes* does not share any diagnostic characters with any previously named genus. Generic characteristics as follows: humerus slender and elongate; shaft slightly sigmoid, with moderate angulation of the cranial margin; the proximal part of the shaft is narrower than the distal part; fossa pneumotricipitalis undivided and large proximo-distally; m. supracoracoideus insertion wide and slightly oblique, almost parallel to long axis of the shaft; angle between long axis of shaft and tangent of condylus dorsalis and condylus ventralis is about 42°; the condylus ventralis is only slightly ventral to the condylus dorsalis; shelf adjacent to condylus ventralis smaller than condylus ventralis.


Figure 10. *Anthropodyptes gilli* holotype right humerus, NMV P17167: A, dorsal view; B, ventral view.

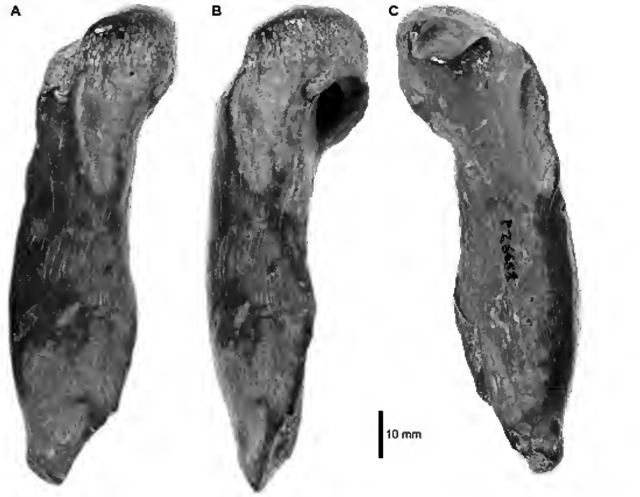


Figure 11. *Pseudaptenodytes macraei* holotype left humerus, NMV P26668: A, dorsal view; B, dorso-caudal view; C, ventral view.

*Remarks.* This species is apparently most similar to *Archaeospheniscus* (Gill, 1959b; Simpson, 1959: 118), a Late Oligocene New Zealand form. Based on synapomorphies, *Anthropodyptes gilli* has a most exclusive placement of clade 8 in the phylogenetic analysis of Ksepka and Clarke (2010: Fig. 21), giving it a more crown-ward position than earlier 'giant' forms from the late Eocene, but a similar phylogenetic position to late Oligocene giant forms such as *Kairuku* and *Archaeospheniscus. Anthropodyptes gilli* bears the distinction of being the latest surviving giant stem penguin, all other 'giant' stem taxa having a Palaeogene age (Ksepka and Clarke, 2010: 45). Comparisons of body proportions with other giant taxa are not possible until more complete material is found.

***Pseudaptenodytes*** Simpson, 1970

***Pseudaptenodytes macraei*** Simpson, 1970

*Holotype.* Partial left humerus (NMV P26668). (Fig. 11; Table 2).

*Type locality.* Spring Creek near Minhamite, 41 km southeast of Hamilton, Victoria (37°58'S, 142°23'E).

*Horizon and age.* The holotype is derived from the Goodwood Formation, a green-grey marly fine sand with abundant pebbles (Gill, 1964:332). The macroinvertebrate assemblage is similar to that of the Upper Miocene–Lower Pliocene Black Rock Sandstone (Gill, 1964; Simpson, 1970), and the Goodwood Formation is possibly laterally equivalent to the Upper Miocene–Lower Pliocene Grange Burn Formation (Fitzgerald, 2004).

*Referred material.* A partial right carpometacarpus (NMV P27055) and a partial left carpometacarpus (NMV P27056) were tentatively referred to this species (Simpson, 1970) (Fig. 15; Table 2). Both specimens were derived from the Upper Miocene–Lower Pliocene Black Rock Sandstone at Beaumaris.

*Diagnosis.* Simpson (1970) noted the very close similarity of *Pseudaptenodytes macraei* to *Aptenodytes patagonicus*, both in terms of size and the features of the proximal end of the humerus. Nevertheless, *P. macraei* differs from *Aptenodytes* by having a humerus with: a more sigmoid shaft; a smaller volume of the fossa pneumotricipitalis; a distinctly oval opening of the internal division of the fossa pneumotricipitalis; and a rounded cranial margin lacking a distinct 'preaxial angle' (Acosta Hospitaleche et al., 2008: Fig. 5, char. 11). It further differs from *A. forsteri* by lacking the pit for ligament insertion on the proximal surface adjacent to the head (Ksepka et al., 2006: Fig. 8). In *A. patagonicus* this feature is variable (Ksepka et al., 2006).

*Remarks.* Despite the similarities of the type specimen to *Aptenodytes patagonicus*, *Pseudaptenodytes macraei* is not ancestral to it or any of the modern species (Simpson, 1970:


Figure 12. Sphenisciformes indet. partial left coracoid, NMV P24065: A, dorsal view; B, ventral view.

20). Although similar, the autapomorphies of NMV P26668 preclude this specimen from referral to *Aptenodytes* or any extant genera. We consider *P. macraei* to be a distinct taxon established on the basis of a diagnostic type specimen.

***?Pseudaptenodytes minor*** Simpson, 1970

*Holotype.* Partial right humerus (NMV P26669). (Fig. 14; Table 2).

*Type locality.* East of Rickett's Point on the western shore of Beaumaris Bay, northeast shore of Port Phillip Bay, Victoria (37°59'S, 145°03'E).

*Horizon and age.* Black Rock Sandstone, which consists of a basal layer of phosphatic and ferruginous intraclasts overlain by calcareous sandstone (Dickinson and Wallace, 2009). Planktonic foram and molluscan biostratigraphy indicate a Late Miocene–Early Pliocene age range, which is corroborated by Sr dates of 5.0–6.2 Ma (Dickinson and Wallace, 2009).

*Referred material.* Distal end of right humerus (NMV P26677), proximal end of left humerus, (NMV P26671), proximal end of left humerus (NMV P26676), right humerus (NMV P26670), right humerus (NMV P27057), partial right carpometacarpus (NMV P27058), right carpometacarpus (NMV P26903) (Fig. 13; Table 2). All referred material was collected from the Upper Miocene–Lower Pliocene Black Rock Sandstone at Beaumaris.

*Diagnosis.* Differs from *Pseudaptenodytes macraei* by having: a more slender and less sigmoid shaft; and a less expanded distal section (Simpson, 1970). It also differs by having a distinct angle on the cranial margin, although this angulation is still less than that of any modern penguin (Simpson, 1970).

*Remarks.* Simpson (1970) notes the similarities between ?*Pseudaptenodytes minor* and *Paraptenodytes robustus* yet the holotype of ?*P. minor* is too incomplete to permit meaningful comparisons. The lack of diagnostic morphology in the type specimen of ?*P. minor* has resulted in Ksepka and Clarke (2010) referring this taxon to Sphenisciformes indet. More completely preserved material is required to confirm or reject the placement of this species in *Pseudaptenodytes*. The additional material referred by Simpson (1970) to ?*P. minor* displays little overlap in morphology with the holotype (NMV P26669). Furthermore, it is only on the basis of the referred material that the holotype was designated a species of *Pseudaptenodytes*. We therefore recommend restricting the concept of ?*P. minor* to the holotype. All referred material should be considered Sphenisciformes indet. pending further study.

***Tasidyptes*** Van Tets and O'Connor, 1983

***Tasidyptes hunteri*** Van Tets and O'Connor, 1983

*Holotype.* Pelvis in three parts (ANWC BS2670) (Table 2).

*Type locality.* Stockyard Site, Hunter Island, 5 km north of Tasmania (40°32'S, 144°45'E).

*Horizon and age.* Material found in an aboriginal midden. Carbon dating resulted in an age of 760 ± 70 ybp (Holocene).

*Referred material.* The paratype specimen is a left tarsometatarsus (ANWC BS2668). Also referred to the species are a juvenile synsacrum (ANWC BS2667) and a left coracoid (ANWC BS2669). (Table 2)

*Diagnosis.* Differs from *Eudyptula* and *Megadyptes* by having: a caudal part of the synsacrum with relatively broader fused vertebrae and long slender lateral processes; and the lateral foramen vasculare proximale situated more distal than the medial foramen vasculare proximale on the plantar surface of the tarsometatarsus. However, this character is not clear from the figure in Van Tets and O'Connor (1983: Fig. 4).

*Remarks.* This taxon is no longer considered valid due to the fragmentary nature of the fossils, the fact that the coracoid and tarsometatarsus are indistinguishable from *Eudyptes* and the fact that the four specimens come from three different stratigraphic layers of the midden (Van Tets and O'Connor, 1983; Fordyce and Jones, 1990; Ksepka and Clarke, 2010). However, Ksepka and Clarke (2010) note that due to the young age of the specimens, DNA testing to confirm their identity may well be possible. Ksepka and Ando (2011: 178) also draw attention to the synsacrum stating that the long slender lateral processes may be "a possible diagnostic character, certainly in need of quantitative evaluation".

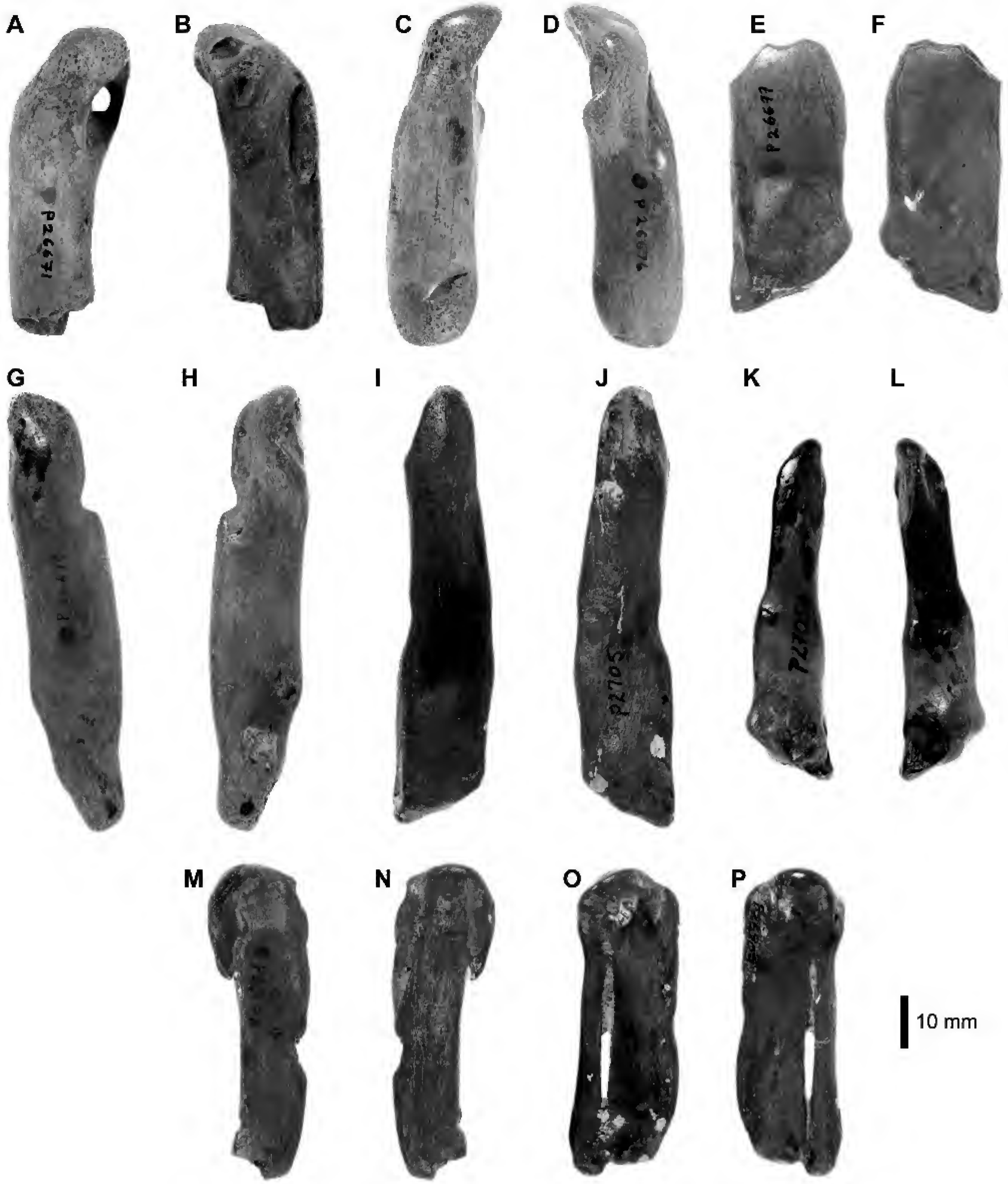


Figure 13. Sphenisciformes from the Upper Miocene–Lower Pliocene Black Rock Sandstone, Victoria. A–J and M–P, specimens referred to ?*Pseudaptenodytes minor*: partial left humerus, NMV P 26671, in (A) dorsal and (B) ventral views; partial left humerus, NMV P26676, in (C) dorsal and (D) ventral views; partial right humerus, NMV P26677, in (E) dorsal and (F) ventral views; partial right humerus, NMV P26670, in (G) dorsal and (H) ventral views; partial right humerus, NMV P27057, in (I) dorsal and (J) ventral views; partial right carpometacarpus, NMV P27058, in (M) dorsal and (N) ventral views; partial right carpometacarpus, NMV P26903, in (O) dorsal and (P) ventral views. Sphenisciformes indet. partial left humerus, NMV P27059: K, dorsal view; L, ventral view.


Figure 14. ?*Pseudaptenodytes minor* holotype partial right humerus, NMV P26669: A, dorsal view; B, ventral view.

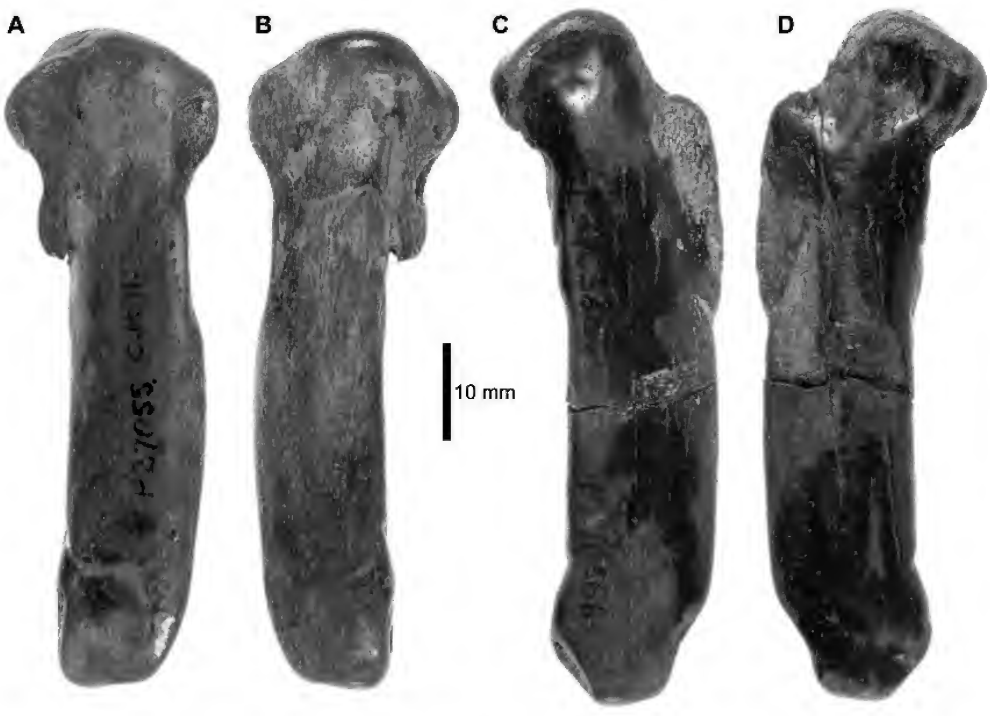


Figure 15. Specimens referred to *Pseudaptenodytes macraei*: partial right carpometacarpus, NMV P27055, in (A) dorsal and (B) ventral views; partial left carpometacarpus, NMV P27056, in (C) ventral and (D) dorsal views.

## Discussion

The Australian penguin record has thus far played a minor role in the interpretation of sphenisciform evolutionary history. Despite there being general summaries (Jenkins, 1985; Fordyce and Jones, 1990; Vickers-Rich, 1991), no primary systematic research has been conducted since 1983.

With this limited quantity of described material, what patterns may be deduced from the fossil record of penguins in Australia? As shown above, the record has a scattered chronologic distribution and is based on fragmentary fossils. Nonetheless, the vast majority of all fossil penguin specimens ever found are isolated and often incomplete elements (see Acosta Hospitaleche et al., 2007; Ksepka et al., 2008, 2012 for exceptions). Second, there is a disparity between past and present taxonomic diversity. During the Eocene, Oligocene and Miocene there were more than one species of penguin inhabiting Australia. All these species were larger than the sole extant species, *Eudyptula minor* Forster, 1781 (little penguin), although body sizes have yet to be estimated using established regression equations (e.g. Simpson, 1946; Jadwiszczak, 2001). This higher taxonomic diversity and morphological disparity relative to the present remains unexplained. A possible causal factor promoting higher diversity is the former increased availability of suitable breeding grounds due to higher sea levels forming numerous small offshore islands. An example of this is known from the Pliocene of Africa (Ksepka and Thomas, 2012).

The Australian record includes penguin material from the Early through late Miocene. This interval is inadequately sampled worldwide (Ksepka and Ando, 2011: 157–163), and thus Australian fossils may provide insights into this pivotal period in penguin history, including the diversification of crown Spheniscidae.

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# Four new valviferan isopods from diverse tropical Australian habitats (Crustacea: Isopoda: Holognathidae and Idoteidae)

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**Abstract**

Poore, G.C.B. 2012. Four new valviferan isopods from diverse tropical Australian habitats (Crustacea: Isopoda: Holognathidae and Idoteidae). *Memoirs of Museum Victoria* 69: 327–340.

Two new isopods of the family Holognathidae are described from tropical Australia: *Cleantioides carpentaria* sp. nov. from shallow seagrass sediments in the Gulf of Carpentaria and an eastern Queensland port; and *Zenobianopsis cidaris* sp. nov. from 500 m depth in the Coral Sea. The latter is the third in its genus. Two new species of *Synidotea* (Idoteidae), *S. innatans* sp. nov. and *S. karumba* sp. nov. are described. Both are distinguished from others of the *S. hirtipes*-group of species, on the basis of subtle differences in colour and proportions of the body and limbs. The material of *S. innatans* was taken from flotsam in the Timor Sea and is potentially an obligate rafting species. *Synidotea karumba* is from shallow sedimentary environments in the Gulf of Carpentaria.

**Keywords** Crustacea, Isopoda, Valvifera, Holognathidae, Idoteidae, *Cleantioides*, *Zenobianopsis*, *Synidotea*, new species, Australia

## Introduction

Two valviferan families of isopods are characterised by having more or less flattened body shape and slight differentiation of body segments, Holognathidae Thomson, 1904 and Idoteidae Samouelle, 1819. The Holognathidae comprise 21 species in five genera, four reviewed by Poore and Lew Ton (1990) and a fifth added by Liu et al. (2010). Three genera inhabit temperate shallow sediments in both hemispheres and two occur only in the deep South Pacific and Southern oceans. Three species occur in shallow temperate southern Australia (Poore and Lew Ton, 1993). The Idoteidae on the other hand are found circum-globally in shallow algal and seagrass habitats, mainly at temperate latitudes. The family comprises 23 species in Australia confined, with one exception, to temperate coasts (Poore and Lew Ton, 1993). No new species have been reported since the date of their review.

The only tropical species in Australia is the doubtful *Idotea brevicorna* Milne Edwards, 1840. Poore and Lew Ton (1993) debated the possible synonymy of this species, and its probable synonym *I. duplicata* Nierstrasz, 1941 from Indonesia, with the European species *I. balthica* (Pallas, 1772). *Idotea balthica* is a facultative drifter on a variety of floating material in the North Atlantic (Thiel and Gutow, 2005; Thiel and Haye, 2006) and the probability of this species occurring naturally in tropical Australian waters seems low. Neither *I. brevicorna* nor *I. duplicata* has been reported since from the region and the possibility remains that the records, based on collections in the 19th century, are of translocated specimens from ships' hulls.

In this contribution, new species are described from tropical northern Australia, one holognathid from a shallow environment and another from bathyal depths, plus two new species of Idoteidae, one from shallow sedimentary habitat and another from flotsam.

Abbreviations in figures are: a1(f), antenna 1 (flagellum); a2(p), antenna 2 (peduncle); md, right mandible; mp, maxilliped; mx2, maxilla 2; p, penial plate; p1–p7, pereopods 1–7; pl2, pleopod 2; u, uropod. Material is lodged in Museum Victoria, Melbourne (NMV), Queensland Museum, Brisbane (QM) and the Museum of Tropical Queensland, Townsville (MTQ).

## Holognathidae Thomson, 1904

### *Cleantioides* Kensley and Kaufman, 1978

*Cleantioides* Kensley and Kaufman, 1978: 658. – Poore and Lew Ton, 1990: 59.

*Remarks*. The genus contains 12 species, four in Central America (Kensley and Kaufman, 1978; Brusca and Wallerstein, 1979; Kensley, 1987), five in the north-western Pacific (Richardson, 1912; Kussakin, 1982; Kwon and Kim, 1992), one in South Africa (Barnard, 1925), and two in southern Australia (Poore and Lew Ton, 1990). Poore and Lew Ton (1990) diagnosed the genus and discussed its synonymy. *Cleantis annadalei* Tattersall, 1921, previously included in this genus, has been removed to its own genus, *Chongxidotea* Liu, Poore and Lu, 2010.

***Cleantioides carpentaria*** sp. nov.

Figures 1–2

*Material examined*. Holotype. Queensland, Karumba, Norman River mouth (17°28'S, 140°49'E), sandy sediment with seagrasses *Halodule uninervis* and *H. pinifolia*, 1 m, K. Neil, 2001, NMV J62815 (ovigerous female, length 13.5 mm).

*Other material*. Queensland, Lucinda, Sugar Loading Jetty Outer (18°31.3'S, 146°19.9'E), sediments, 5 m, K. Neil, CRC Reef Research, 01 Jun 1999, QM 462915 (juvenile, 7.6 mm).

*Description*. *Ovigerous female*. Body approximately 6 times as long as wide. Dorsal surface largely smooth, without setae. Head 1.4 times as wide as long, excavate and depressed anteriorly at midpoint, with small medial pseudorostrum; posterior margin convex; transverse maxillipedal segmental groove obvious. Pleotelson 0.32 whole length, twice as long as wide; pleonite 1 free and articulating, barely visible under pereonite 7; pleonites 2 and 3 well defined but not articulating, pleonite 3 fused medially, lateral margin hidden under pleonite 2; remaining pleotelson parallel-sided and with semicircular apex; dorsum of distal half with oblique (c. 30° from horizontal) circular plane occupying 0.4 of pleotelson length, well-defined by a sharp ridge extending three-quarters around, with obscurely rugose surface.

Antenna 1 reaching to end of article 2 of antenna 2 peduncle; peduncle article 1 as long as wide; flagellum about third length of last article of peduncle, with 4 apical aesthetascs. Antenna 2 0.3 length of body, article 2 with narrow ventromesial projection with bilobed apex; flagellum of 1 article, 0.25 total antenna length, with fine setae all over and a dense clump at apex.

Maxillipedal endite with 2 plumose setae mesially and 8 on transverse apex, palp width 0.45 length, 5 articles visible but suture between 2 and 3 not articulating; articles 2–5 mesially setose; article 3 mesiodistally lobed; article 5 wider than long, 0.2 length of article 4; epipod tapering and obliquely truncate.

Pereopod 1 with dense robust setation on margins of merus, carpus and propodus; propodus 1.8 times as long as wide, with 13 robust setae on mesial face. Pereopods 2 and 3 similar, anterodistal setae on merus and carpus, and margins of propodus; propodus 2.4 times as long as wide. Pereopod 4 0.4 length of pereopod 3, ischium without setae; merus, carpus and propodus with posterodistal U-shaped rows of 11, 18 and 12 robust setae respectively; dactylus reduced to a compact unguis only. Pereopod 5 longer than 4, posteriorly with few spines; dactylus slightly hooked. Pereopods 6 and 7 more elongate than 5, propodus of pereopod 7 4.6 times as long as wide. Oostegites on pereopods 1–5.

Uropodal endopod as wide as long, distally truncate at right-angles to mesial margin over about 0.4 width.

*Colour*. Holotype unpigmented. Juvenile brown, darkest across front of head, antenna 1 peduncle, articles 1, 2 and 5 of antenna 2, laterally on body segments and coxa.

*Etymology*. From the type locality, Gulf of Carpentaria (noun in apposition).

*Distribution*. Australia, Queensland, east and west coasts of Cape York at c. 18°S; to 5 m depth.

*Remarks*. *Cleantioides carpentaria* is similar to the southern Australian species *C. albaniensis* Poore and Lew Ton, 1990. It differs in being narrower (6 times vs 5 times as long as wide) and having slightly narrower limbs. It differs from all other species in the obscurely rugose surface of the pleotelsonic plane. The other Australian species, *C. striata* Poore and Lew Ton, 1990, from NSW, is longitudinally striped, as are several species in this genus, and has a steeper pleotelsonic plane. The Asian species differ as follows: *C. emarginata* Kwon and Kim, 1992 has an emarginate telsonic apex, *C. poorei* Kwon and Kim, 1992 is more compact, *C. japonica* Richardson, 1912 has a median tubercle on the pleotelsonic plane, and *C. rotundata* Kussakin, 1982 has a more acute pleotelson. *Cleantioides natalensis* (Barnard, 1925) is more elongate (Kensley, 1978).

***Zenobianopsis*** Hale, 1946

*Zenobianopsis* Hale, 1946: 164–165. – Poore and Lew Ton, 1990: 74.

*Remarks*. Poore and Lew Ton (1990) rediagnosed the genus and redescribed the type species, *Z. caeca* Hale, 1946. This species and the second, *Z. rotundicauda* Kussakin, 1967 are both from the Southern Ocean. Here, a third is described from deep water at a more tropical latitude.

The head of this species and of *Z. caeca* (confirmed on NMV material) possesses an obvious horizontal groove at the base of antenna 2 reaching back about one third of the head length. The groove is not seen in species of any of the other genera, *Cleantis*, *Cleantioides* or *Holognathus*.

***Zenobianopsis cidaris*** sp. nov.

Figures 3, 4

*Material examined*. Holotype. Coral Sea, 17°34.58'S, 146°53.21'E, 458–500 m, M. Pichon et al., 15 May 1986, sledge (CIDARIS I stn 43.2), MTQ W34049 (ovigerous female, 14.2 mm).

*Description*. *Ovigerous female*. Body 5.6 times as long as greatest width at pereonite 3, pereonites 5–7 noticeably narrower than 1–4, dorsal surface smooth, with fur of fine setae on pleotelson. Head 1.1 times as wide as long, front with broad obtuse pseudorostrum as long as lateral margins; lateral margin with horizontal groove at base of antenna 2. Pleotelson 0.25 total length, 1.8 times as long as greatest width; pleonites 1 and 2 freely articulating; pleonite 3 indicated by lateral suture barely visibly in dorsal view; pleonite 4 very short, with short suture; remaining pleotelson parallel-sided, with semicircular apex, dorsally evenly domed curving posteriorly to oblique profile in lateral view, posterodistal margin not elevated.

Antenna 1 reaching to distal margin of second article of antenna 2; flagellum of major article plus 2 minute articles. Antenna 2 0.25 body length; flagellum broken.

Mandible (right) molar truncate, with acute toothed accessory blade, with 20 molar setae; spine row of 9 spines, lacinia mobilis bifid; incisor with 3 blunt teeth.

Coxa 2 subrectangular; coxa 3 tapering posteriorly, 0.9 pereonite dorsal length; coxa 4 smaller than 3; coxae 5–7 overlapping, ventrally concave, projecting acutely


Figure 1. *Cleantioides carpentaria* sp. nov. Holotype.

posteroventrally; coxa 7 reaching back to mid-pleonite 2. Pereopod 1 ischium with prominent proximal facial robust seta; merus with 2 robust setae on flexor margin, complex seta distally on extensor margin; propodus 2.5 times as long as greatest depth, palm with 5 strong setae and comb of fine short setae, mesial face with 10 pectinate setae; dactylus almost linear except for curved unguis, reaching back to mid-carpus. Pereopod 2 1.3 times as long as pereopod 1; propodus 4.6 times as long as wide; dactylus as long as propodus. Pereopod 3 1.1 times as long as pereopod 2; propodus 6.4 times as long as wide; dactylus almost as long as propodus. Pereopods 4, 5 missing. Pereopod 6 0.4 times length of pereopod 3; propodus extensor margin projected beyond articulation with merus; merus–dactylus 1.5 times length of propodus; dactylus twisted, compact. Pereopod 7 as long as pereopod 6; propodus extensor margin scarcely projected beyond articulation with merus; merus–dactylus 3.7 times length of propodus; dactylus twisted, damaged.

Uropod 2.5 times as long as greatest width; endopod about 0.4 length of total uropod, triangular with rounded apex, suture at 75° to long axis; with 1 seta.

*Etymology*. *Cidaris*, from the name of the cruise during which the specimen was taken; noun in apposition.

*Distribution*. Australia, Coral Sea, eastern continental slope of Queensland, c. 17°S; 458–500 m depth.

*Remarks*. The single specimen has been partially dissected by a previous investigator and most mouthparts, all pereopods of the left side and pereopods 4 and 5 of the right are missing. Nevertheless, the species is undoubtedly of this genus. The new species differs from the two others in the absence of a median carina on the anterior part of the pleotelson, absence of upcurved lateral pleotelson margins and more elongate anterior pereopods. *Zenobianopsis cidaris* has a more rounded uropodal endopod than *Z. rotundicauda*. In *Z. caeca*, the pleotelson is decidedly truncate.

**Idoteidae Samouelle, 1819**

***Synidotea* Harger, 1878**

*Synidotea* Harger, 1878: 374. – Poore and Lew Ton, 1993: 261–262.

*Remarks*. The valviferan idoteid genus *Synidotea* occurs worldwide and is represented by 59 species, most highly endemic (Schotte et al., 2008 onwards). Chapman and Carlton (1991, 1994) suggested that some described species are in fact a single one, the Japanese *Synidotea laevidorsalis* Miers, 1881 translocated elsewhere, especially to ports. This assertion was disputed by Poore (1996) who showed that morphological and ecological differences could be shown between several examples. Nevertheless, one other species does appear to be translocated. *Synidotea laticauda* Benedict, 1897, first described from the estuarine parts of San Francisco Bay, is now known, though wrongly identified, from the Gironde Estuary, France (Mees and Fockedey, 1993), the Guadalquivir River estuary, Spain (Cuesta et al., 1996) and Delaware Bay, USA (Buschek and Boyd, 2006).

Most idoteid genera are restricted to temperate shores but *Synidotea* is not (Schotte et al., 1995 onwards). Northern Australia is within the broad Indo-West Pacific biogeographic region and species recorded there could potentially occur in the Australian tropics. Four species have been described from India: *S. variegata* Collinge, 1917, *S. fluviatilis* Pillai, 1954, *S. worliensis* Joshi and Bal, 1959 and *S. hanumantharaoi* Kumari and Shyamasundari, 1984. Two, *S. fecunda* Javed and Yasmeen, 1994 and *S. indica* Javed and Yasmeen, 1994 occur in Pakistan and *S. poorei* Cai and Teo, 2012 in Singapore. Further afield, *S. oahu* Moore, 2004 was described from Hawaii and *S. pacifica* Nobili, 1906 from Tuamoto. All of these belong to the so-called *S. hirtipes* Milne Edwards, 1840 group of species; *S. hirtipes* is from southern Africa. Both new species differ from the Indian Ocean species as follows: from *S. hirtipes* in the absence of

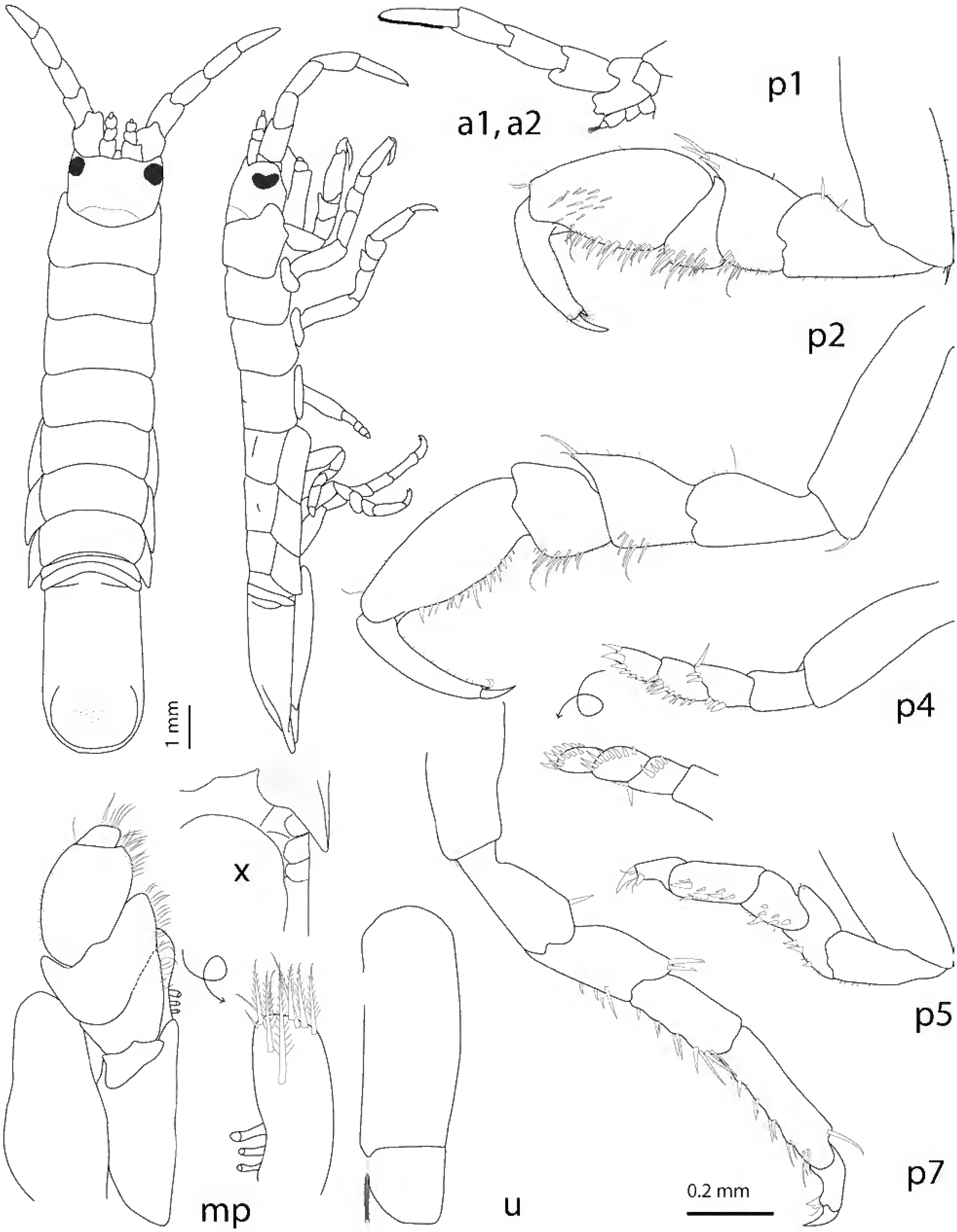


Figure 2. *Cleantioides carpentaria* sp. nov. Holotype. Left antennae 1 and 2 detail in ventral view. x = ventral view of left side of pereonite 7 and anterior pleotelson showing pleonal epimera 1–3. Scale bar = 1 mm (habitus only) and 0.2 mm (pereopods).

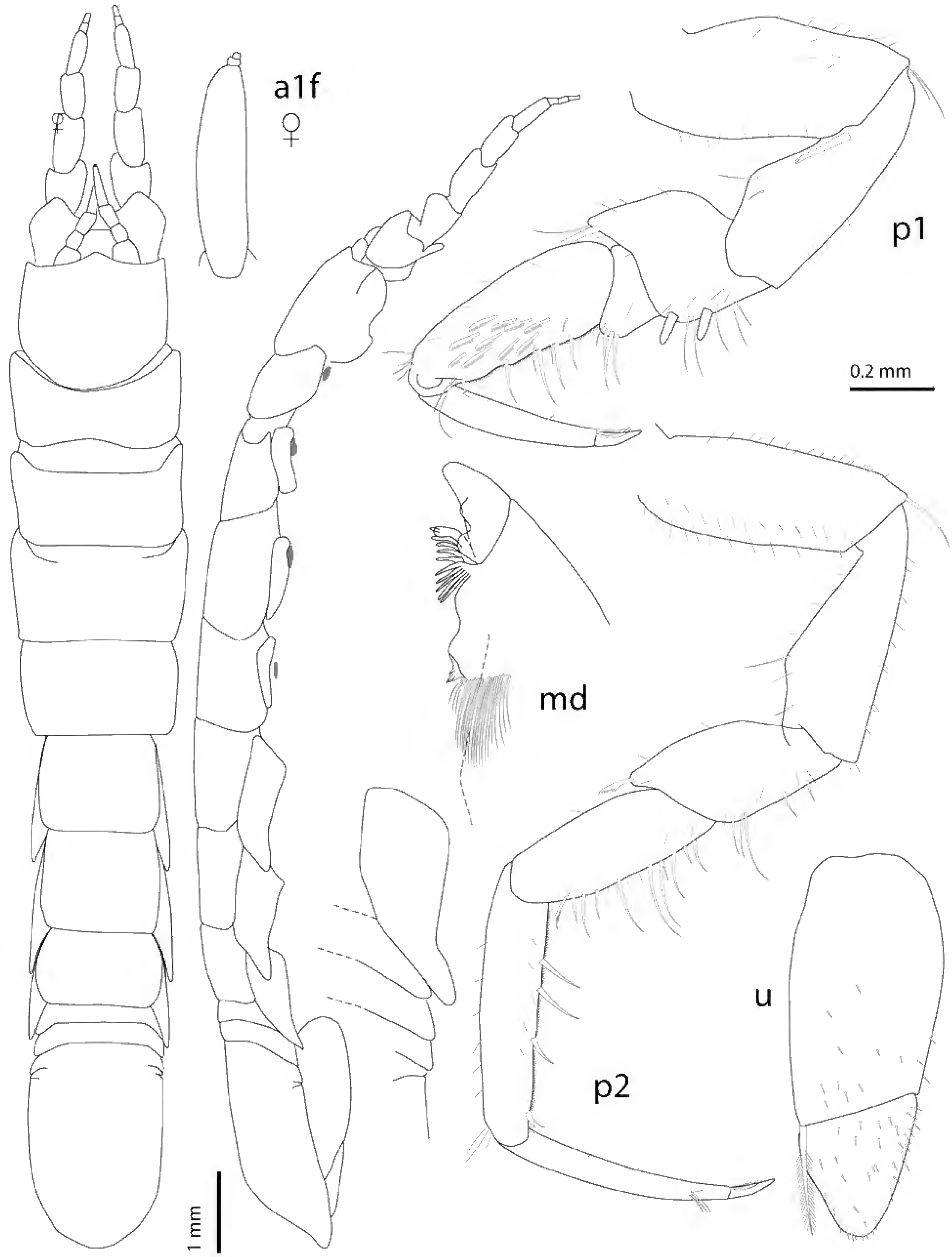


Figure 3. *Zenobianopsis cidaris* sp. nov. Right limbs from holotype. Scale bars = 1 mm (habitus only) and 0.2 mm (pereopods, uropod).

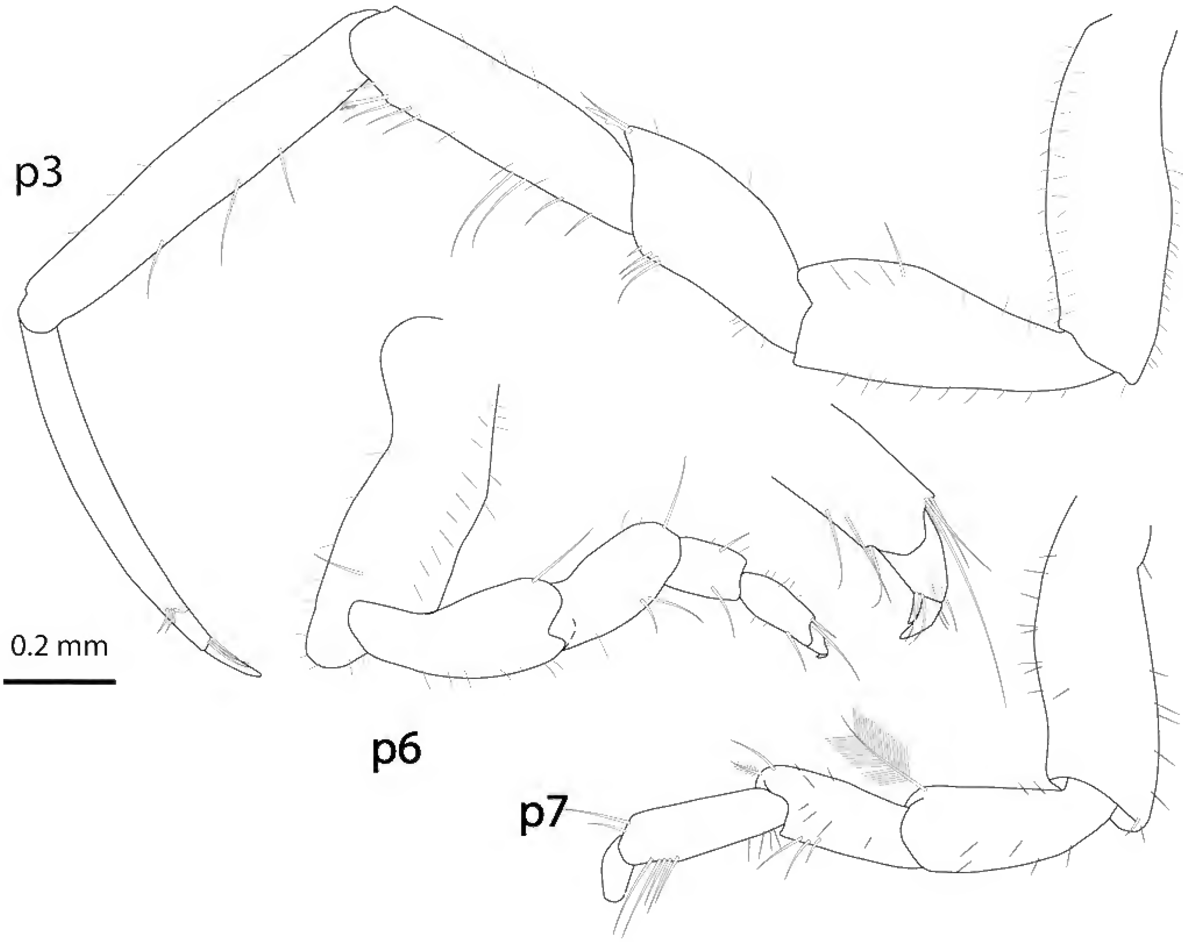


Figure 4. *Zenobianopsis cidaris* sp. nov. Right limbs from holotype; detail of p6 untwisted.

ridges on the uropod (Kensley, 1978), from *S. fecunda* in the absence of bosses on the head, from *S. indica* in the less angled pereonite margins, from *S. variegata* in the more robust antenna 2 and less obviously triangular uropodal endopod, and from *S. hanumantharaoi* and *S. worliensis* in the more elongate antenna 2. The new species differ from *S. poorei* in absence of or less dense persistent colour and more elongate antenna 2.

The four Australian species already described are temperate: *S. grisea* Poore and Lew Ton, 1993 and *S. keablei* Poore and Lew Ton, 1993 from southeastern states, *S. watsonae* Poore and Lew Ton, 1993 from southern WA and Vic., and an undescribed species from WA. Of these, the new species differ from *S. grisea* and *S. keablei* most obviously in the broader pleotelsonic apex, and from *S. watsonae* in the absence of sculpture. The two species differ from each other most obviously in colour, proportions of the articles of antenna 2, pereopods and uropodal endopod.

***Synidotea innatans*** sp. nov.

Figures 5–7

*Material examined*. Holotype, Australia, Timor Sea, (11°42.4'S, 125°06'E), discarded fragment of fishing net floating on sea surface, G.C.B. Poore et al. (with Consulting Environmental Engineers), 26 Oct 2001, NMV J62816 (male, 11.3 mm). Paratypes, same locality NMV J62817 (ovigerous female, 7.1 mm), NMV J62818 (12 males, 6.6–10.8 mm, 17 ovigerous females, 6.6–7.3 mm, 15 juveniles, 4.4–7.5 mm ). All specimens fixed in 70% alcohol.

*Description*. *Male*. Body 3.0 times as long as greatest width at pereonite 3, dorsal surface smooth, pale, ornamented with numerous, small distinct chromatophores, arranged in a dense median stripe, densely on head, pleotelson and laterally, in oblique wavy bands midlaterally on pereonites, and with even single rows along posterior margins of pereonites; without dorsal sculpture. Head 2.0 times as wide as long, 0.7 times width of pereonite 3, front straight, strongly tapering in front of eyes, with shallow transverse depression; eye bulging, 0.40 times as long as

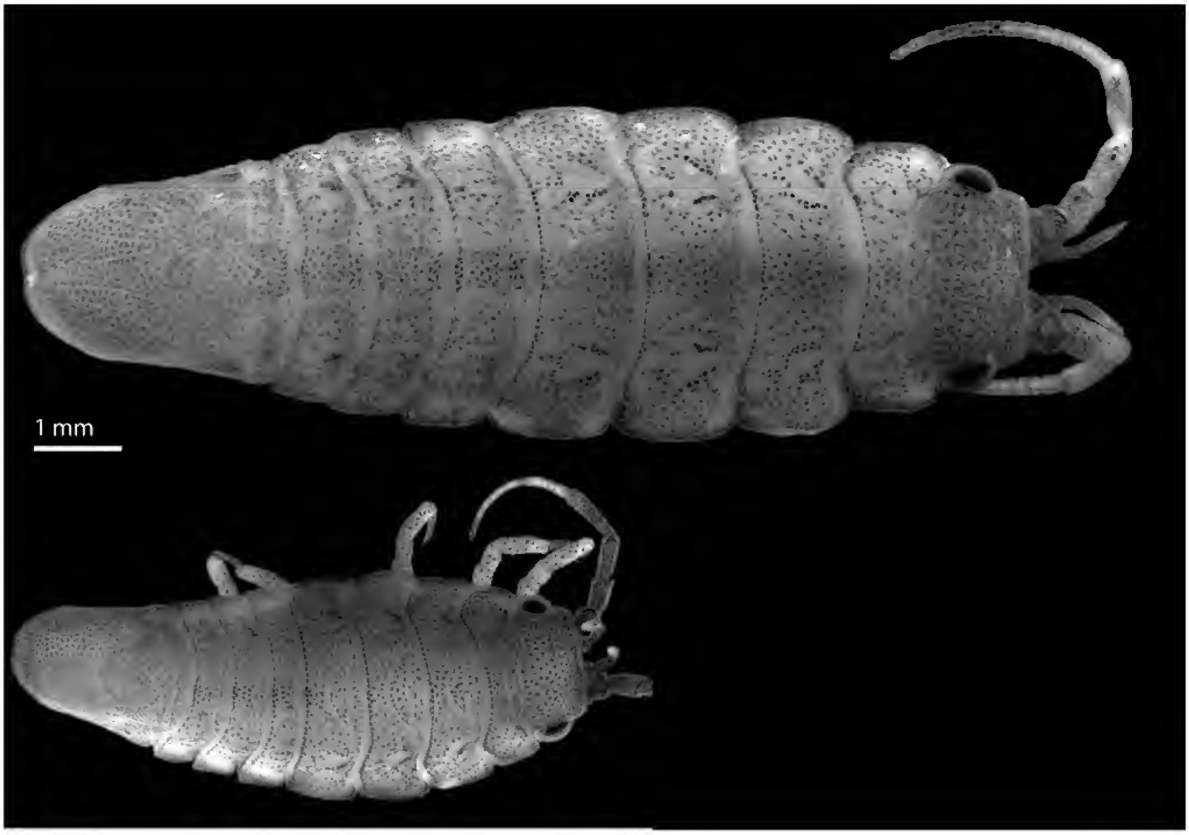


Figure 5. *Synidotea innatans* sp. nov. Holotype male top, paratype female below.

median head length. Pereonite 1 0.80 width of pereonite 3, margin with rounded obtuse angle one-quarter from anterior suture, posterior three-quarters with parallel margins. Pereonite 2 with rounded anterolateral margins, parallel-sided over posterior three-quarters. Pereonite 3 lateral margin broadly convex. Pereonite 4 lateral margin broadly convex. Pleotelson 1.33 times as long as greatest width; tapering beyond pleonite 1 suture to 0.85 of greatest width to an obtuse angle at 0.7 length, then more steeply to narrow, barely-excavate posterior margin.

Antenna 1 flagellum 0.9 length of peduncle, with 9 pairs of aesthetascs. Antenna 2 0.5 body length; article 4 2.5 times as long as wide; article 5 4.3 times as long as wide; flagellum with 12 articles, 0.8 length of peduncle.

Maxilla 2 outer lobe strongly produced laterally, with marginal row of 24 long plumose setae. Maxillipedal basal endite longer than wide, with 1 coupling hook, apex setose. Maxillipedal palp 1.6 times as long as greatest width; article 3 1.4 times as long as wide. Epipod 1.2 times as long as wide, with broad transverse apex.

Pereopods with dense mat of setation on flexor margins of merus–propodus. Pereopod 1 propodus 1.5 times as long as greatest depth, palm excavate, mesial face with about 90 plumose setae; dactylus almost linear except for curved unguis, reaching back to base of carpus. Pereopod 2 propodus 1.2 times as long as merus and carpus together, 3.0 times as wide as long. Pereopod 4 propodus 2.9 times as wide as long. Pereopod 7 propodus 3.2 times as wide as long.

Penial plate 1.6 times as long as wide, double-waisted, with excavate distal margin.

Pleopod 2 with appendix masculina 1.27 times as long as endopod, with rounded apex, distally with numerous superficial spines. Uropod 3.8 times as long as distal peduncle width; endopod about 0.25 length of peduncle, mesial length 0.7 proximal suture length, suture at 80° to long axis, distal margin convex-truncate, at 80° to long axis, lateral margin curved into distal margins; with 3 setae.

*Ovigerous female*. Body 2.5 times as long as greatest width at pereonite 3. Head 2.4 times as wide as long, 0.64 times width of pereonite 3; eye bulging, 0.55 times as long as median head length. Pereonite 1 0.80 width of pereonite 3, margin barely convex, oblique. Pereonite 2 margin barely convex, oblique. Pereonite 3 margin barely convex, parallel-sided. Pereonite 4 margin barely convex. Pleotelson 1.3 times as long as greatest width; tapering beyond pleonite 1 suture to 0.75 of greatest width to an obtuse angle at 0.7 length, then more steeply to narrow, barely-excavate posterior margin.

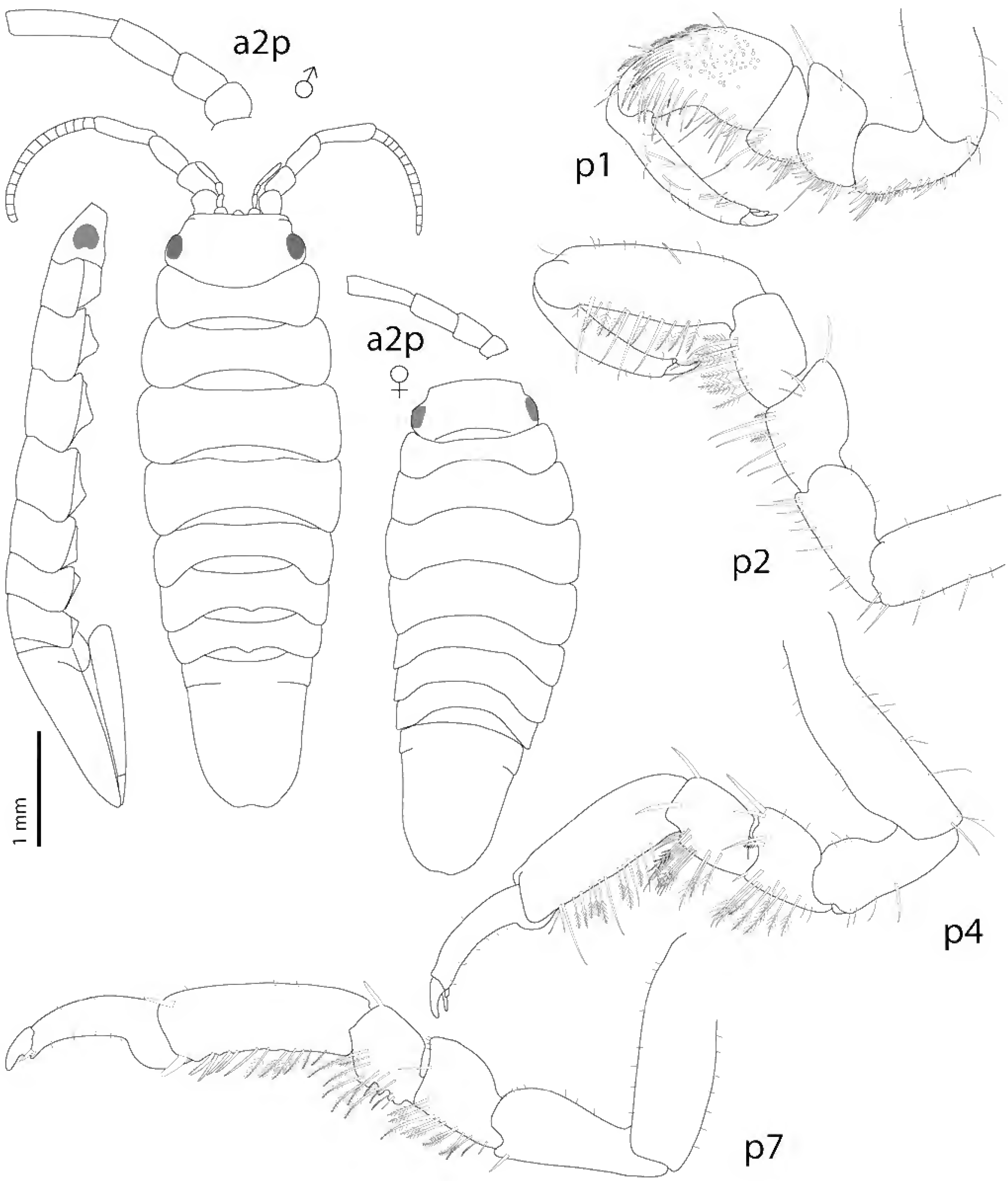


Figure 6. *Synidotea innatans* sp. nov. Holotype male left, paratype female right. Scale bar = 1 mm (habitus only).

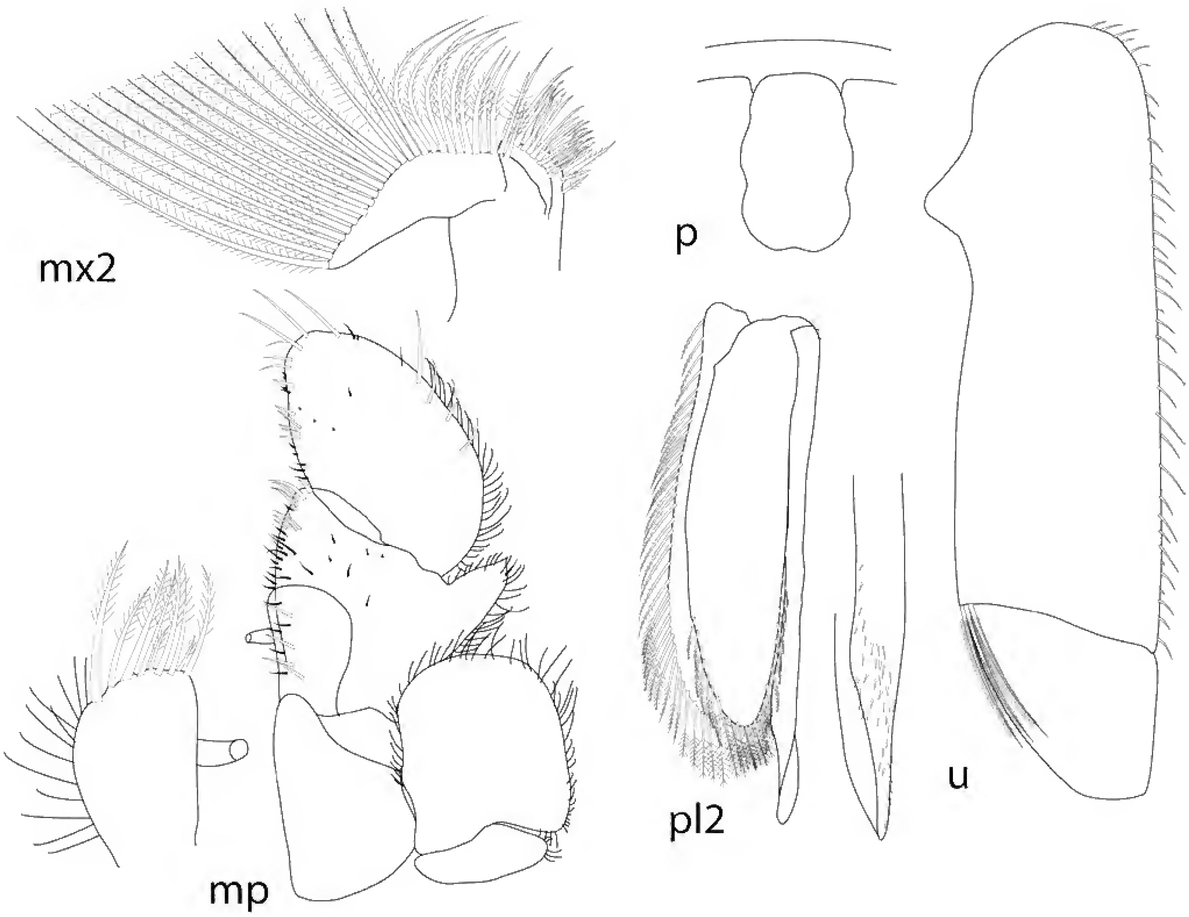


Figure 7. *Synidotea innatans* sp. nov. Limbs from holotype male.

Antenna 2 0.5 body length; article 4 2.2 times as long as wide; article 4 3.6 times as long as wide; flagellum with 13 articles, 1.3 times length of peduncle. Maxilla 2 outer lobe not expanded. Pereopods with mat of setae on flexor margins, less dense on pereopods 4 and 5 and sparse on 6 and 7.

*Etymology*. From *innatare*, Latin, to float, alluding to the discovery of this species on flotsam.

*Distribution*. Australia, Timor Sea, c. 11°S; on flotsam.

*Remarks*. The colour pattern of small chromatophores arranged in regular rows persists and is characteristic of *Synidotea innatans*. The new species differs in several respects from all other species in the region including *S. poorei* collected from buoys near Singapore (Cai and Teo, 2012) and from others as detailed above.

The discovery of numerous specimens of this species on flotsam (an abandoned fragment of a fishing net), in the company of numerous shrimps, crabs and fishes, 170 km from land (the island of Timor) raises questions about the distribution of this species. This is only the second record of a species of *Synidotea* from this habitat. Hobday (2000) reported the normally benthic *Synidotea harfordi* Benedict, 1897 from the kelp *Macrocystis pyrifera* off the Californian coast. The new species is less elongate than *S. harfordi* and differs from the only two others known from benthic habitats near to where it was taken, that from Singapore and *S. karumba*, as detailed above. Thiel and Gutow (2005) reviewed the distribution of 13 rafting species of *Idotea* worldwide. Only one, *I. metallica* (Bosc, 1802), would appear to be an obligate rafter and it is cosmopolitan in the world's oceans (Poore and Lew Ton, 1993 for numerous citations; Abelló and Frankland, 1997). There is no suggestion that the new species is similarly widespread. The ability of these species to raft can not be used to suggest that this is how *S. laticauda* became distributed between estuaries in San Francisco Bay, Delaware, France and Spain (Mees and Fockedey, 1993; Cuesta et al., 1996; Buschek and Boyd, 2006). Transportation by shipping seems more probable.

***Synidotea karumba*** sp. nov.

Figures 8–10

*Material examined*. Holotype. Queensland, Karumba, Norman River mouth (17°28'S, 140°49'E), sandy sediment with seagrasses *Halodule uninervis* and *H. pinifolia*, 1 m, K. Neil, 2001 NMV J53202 (male, 9.1 mm). Paratypes, same locality, 5 m, NMV J53203 (2 females, 6.3, 7.1 mm).

*Description*. *Male*. Body 3.1 times as long as greatest width at pereonite 3, dorsal surface smooth, pale, ornamented with numerous, evenly spaced, small distinct chromatophores; without dorsal sculpture. Head 1.6 times as wide as long, 0.57 times width of pereonite 3, middorsum evenly domed, without ornamentation, with shallow transverse depression near anterior margin, front barely excavate, strongly tapering in front of eyes; eye bulging, 0.37 times as long as median head length. Pereonite 1 0.75 width of pereonite 3, lateral margin with definite rounded obtuse angle one-third from anterior suture, posterior two-thirds with parallel margins. Pereonite 2 with rounded anterolateral margins, narrower at posterior suture. Pereonite 3 lateral margin evenly convex. Pereonite 4 lateral margin broadly convex. Pleotelson 1.2 times as long as greatest width; tapering beyond pleonite 1 suture to 0.8 of greatest width to an obtuse angle at 0.75 length, then more steeply to excavate posterior margin.

Antenna 1 flagellum 0.9 length of peduncle, with 12 pairs of aesthetascs. Antenna 2 0.7 body length; article 4 3.6 times as long as wide; article 5 6.2 times as long as wide; flagellum with 21 articles, as long as peduncle.

Maxilla 2 outer lobe expanded, with 17 long plumose setae. Maxillipedal basal endite longer than wide, with 1 coupling hook, apex setose. Maxillipedal palp 2.0 times as long as greatest width; article 3 1.3 times as long as wide. Epipod 1.5 times as long as wide, with broad oblique apex.

Pereopods with dense mat of setation on flexor margins of merus–propodus. Pereopod 1 propodus 1.7 times as long as greatest depth, palm excavate, mesial face setose; dactylus almost linear except for curved unguis, reaching back to base of carpus. Pereopod 2 propodus as long as merus and carpus together, 2.9 times as wide as long. Pereopod 4 propodus 3.3 times as wide as long. Pereopod 7 propodus 3.8 times as wide as long.

Penial plate 1.6 times as long as wide, slightly waisted, with rounded apex.

Pleopod 2 with appendix masculina 1.25 times as long as endopod, with rounded apex, with few superficial spines. Uropod 3.9 times as long as distal peduncle width; endopod 0.28 length of peduncle, mesial length 0.8 proximal suture length, suture almost at right-angles to long axis, distal margin truncate, at 75° to long axis, lateral margin straight and with curve between lateral and distal margins; with 1 seta.

*Female*. Body 2.6 times as long as greatest width at pereonite 3. Head twice as wide as long. Pereonite 1 0.8 width of pereonite 3, lateral margin more evenly curved than in male. Pereonite 2 with rounded anterolateral margins, parallel-sided over posterior two-thirds. Pleotelson 1.1 times as long as greatest width; tapering to 0.7 of greatest width beyond pleonite 1 suture to an obtuse angle at 0.75 length, then more steeply to excavate posterior margin.

Antenna 2 0.7 body length; article 4 3.2 times as long as wide; article 4 6.9 times as long as wide; flagellum with 16 articles, 1.2 times length of peduncle. Maxilla 2 outer lobe not expanded. Pereopods without mat of setae on flexor margins.

*Etymology*. *Karumba*, from the town where the specimens were found, noun in apposition.

*Distribution*. Australia, Queensland, west coast of Cape York at c. 17°S; 1 m depth.

*Remarks*. *Synidotea karumba* was compared with others above.

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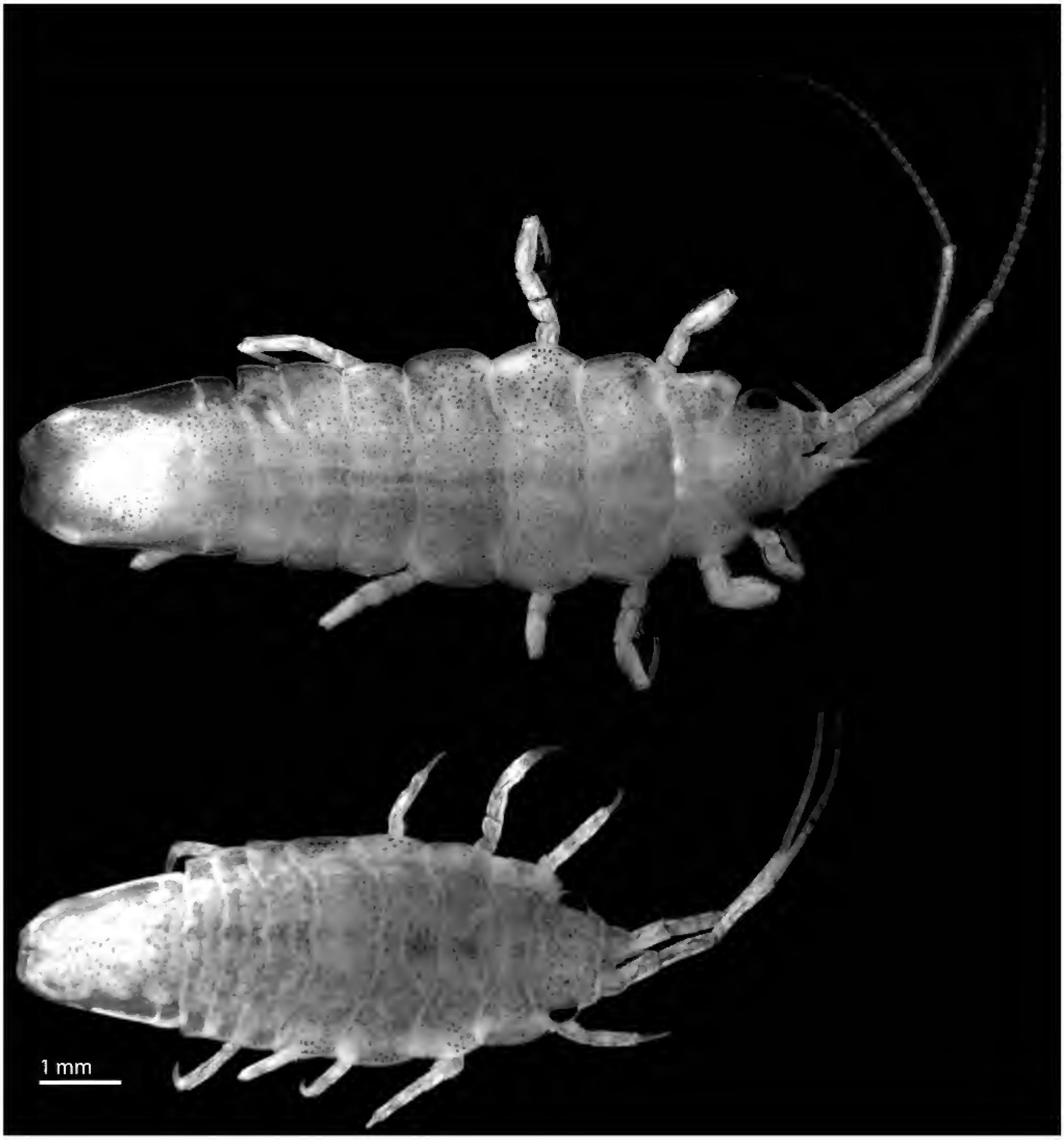


Figure 8. *Synidotea karumba* sp. nov. Holotype male top, paratype female below.

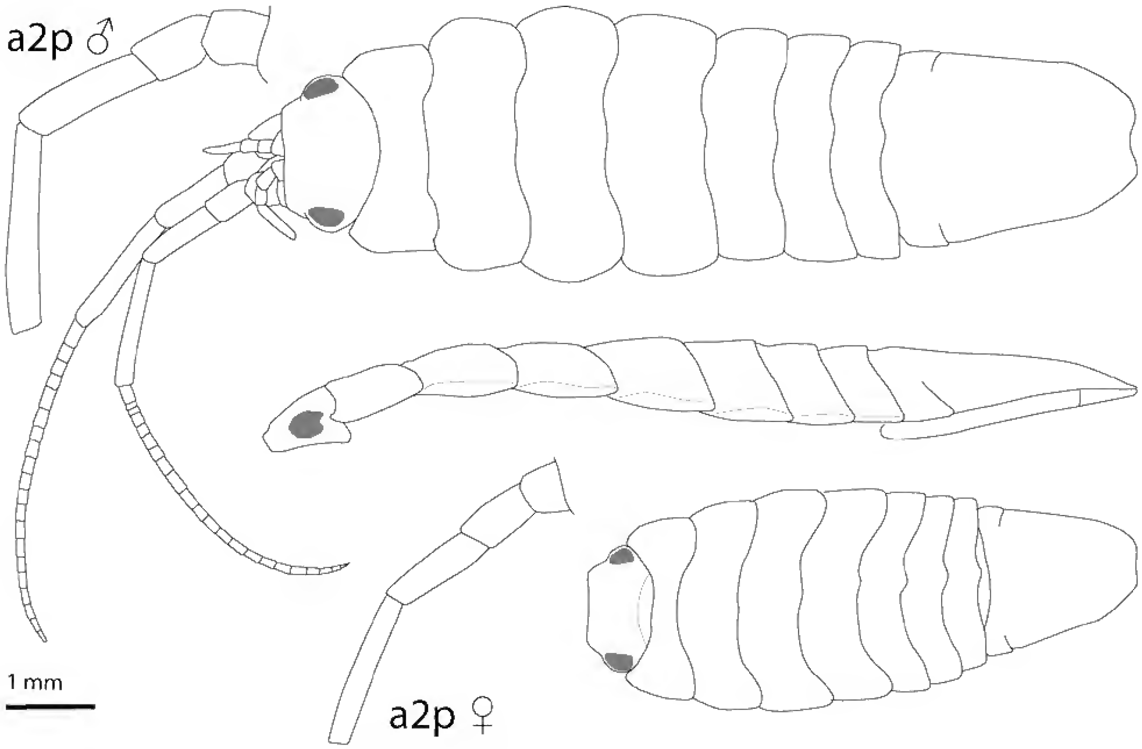


Figure 9. *Synidotea karumba* sp. nov. Holotype male top in dorsal and ventral view, paratype female below, with antennae 2 peduncles.

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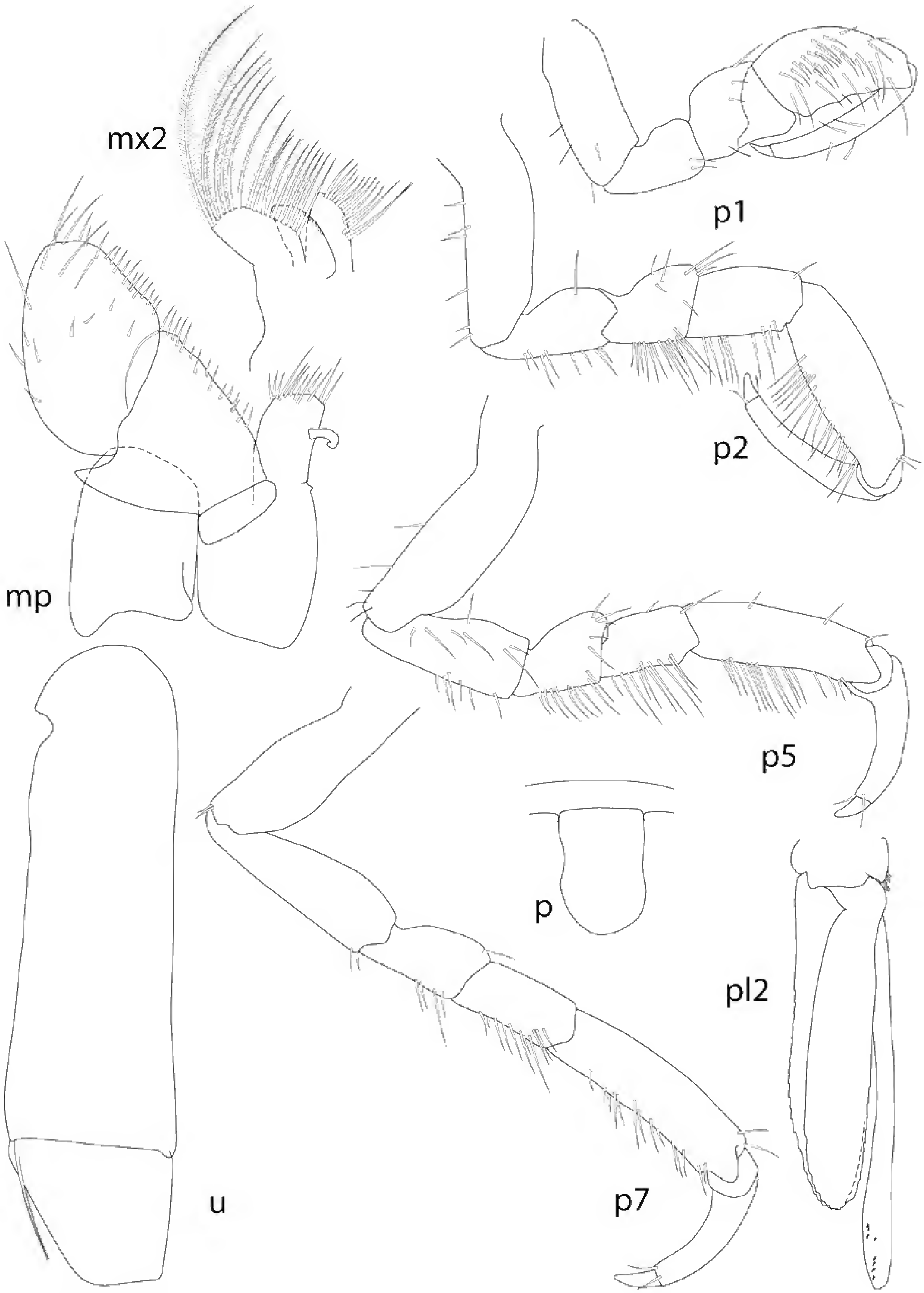


Figure 10. *Synidotea karumba* sp. nov. Limbs from holotype male.

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# A review of giant roughies of the genus *Hoplostethus* (Beryciformes, Trachichthyidae), with descriptions of two new Australasian species.

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**Abstract**

Roberts, C.D. & Gomon, M.F. 2012. A review of giant roughies of the genus *Hoplostethus* (Beryciformes, Trachichthyidae), with descriptions of two new Australasian species. *Memoirs of Museum Victoria* 69: 341–354.

*Hoplostethus gigas* McCulloch, 1914 and two previously unnamed species of the genus that reach a similarly 'giant' size are described. The redescription of *H. gigas*, which is confined in distribution to the southern coast of Australia, is based on specimens identified as comprising at least part of McCulloch's type series (one herein designated lectotype), together with subsequently collected material. The very similar *H. melanopeza* sp. nov., occurring in northern New Zealand and southeastern Australian waters, as well as seamounts in the intervening Tasman Sea, is distinguished by the distinctly black outer margins of fins in large adults and count of predorsal scales. The New Caledonian *H. grandperrini* sp. nov., known only from the two types, differs from previously described species in having the combination of 17 or 18 pectoral–fin rays, 13 or 14 abdominal scutes, 19 or 20 total gill rakers and a buccal cavity that is mostly pale, the only black pigmentation occurring posterior to the gill arches.

**Keywords**

Giant roughy, Trachichthyidae, *Hoplostethus*, *H. gigas*, lectotype, species nov., Australasia

## Introduction

In synthetic treatments of the Trachichthyidae and the Beryciformes, Kotlyar (1986, 1996) listed 23 species in the roughy genus *Hoplostethus* Cuvier (in Cuvier & Valenciennes, 1829). Thirteen of these he referred to the subgenus *Hoplostethus* (*Hoplostethus*), which he diagnosed as having pale colouration, scales on the ventral midline of the abdomen modified into enlarged, thickened scutes, 25–27 total vertebrae, dorsal fin with 4–8 (usually 6) spines and 14–18 (usually 15 or 16) soft rays, 14–19 (usually 15 or 16) pectoral–fin rays, 14–25 (usually 16–21) predorsal scales and 15–50 simple pyloric caeca. The resurrection of *H. latus* McCulloch, 1914 by Gomon (in Gomon et al., 1994) and descriptions of *H. vniro* by Kotlyar (1995), *H. ravurictus* by Gomon (2008) and *H. robustispinus* by Moore and Dodd (2010) brought the number referrable to the subgenus, according to Kotlyar's criteria, to 17. Moore and Dodd (2010) listed *H. intermedius* (Hector, 1875) as another species that would be referrable to this assemblage, but genetic evidence supports its synonymy with *H. mediterraneus* Cuvier (in Cuvier & Valenciennes, 1829) (Smith and Roberts, 2004). Although the validity of Kotlyar's four subgenera remains to be tested, the greatest diversity of species in this large complex is clearly in the Indo–Pacific. However, the conservative nature of the morphology of species in the group has caused great confusion about their numbers and identities (e.g. Kotlyar, 2011), especially in the geographical areas of greatest diversity.

Of the 17 described species of *Hoplostethus* (*Hoplostethus*), only four have been reliably recorded in the literature as reaching what might be regarded as a truly large size, well in excess of 250 mm SL, although we question one of these. The southern Australian *H. gigas* McCulloch is certainly the largest of the subgenus with one of the type specimens measuring 525 mm SL (McCulloch, 1914). *Hoplostethus robustispinus* Moore and Dodd, 2010, follows based on the sole type from the Philippines reported to be 340 mm SL and a 354 mm SL specimen from southern Japan (HUMZ 148072). Kotlyar (1996) recorded *H. mediterraneus* as reaching 30 cm, but only provided specimen information for specimens to 240 mm SL, the collection locality of these specimens reported as the North Atlantic. No reliable, published account of the species exceeding 200 mm SL is known from the Australasian region. The fourth species reaching a size in the 250 mm SL range is *H. crassispinus* from the Emperor Seamounts, which Kotlyar (2011) stated was confined to that seamount group and the Hawaiian Island chain. Although only reported by Kotlyar (1996) to a size of 123 mm SL, specimens identified by Kawai (in Inada and Wudianto, 2006) as *H. crassispinus* Kotlyar, 1980 (HUMZ 193945: 253 mm SL) and *H.* sp. (HUMZ 191163: 289 mm SL) are specimens of *H. confinis* Kotlyar, 1980 that are considerably larger than any of Kotlyar's specimens.

In 1989, Paulin et al. reported *Hoplostethus gigas* in New Zealand waters, based on captures of surprisingly large roughies from knolls and ridges in the Bay of Plenty on the northeastern coast of New Zealand's North Island. Subsequent work on these specimens motivated Roberts (1995, 1996, 2012) to implore New Zealand fishers to bring in additional examples of what he determined not to be *H. gigas*, but instead a yet undescribed species. The largest of the specimens now in hand exceeds a standard length of 500 mm, putting the species on par with *H. gigas* with respect to size. The species is very similar in appearance to *H. gigas* but is separable by colour pattern and minor though consistent morphological differences. In addition, a recent comparison of mitochondrial DNA sequences clearly separate the two (Te Papa/ NIWA/ CSIRO/NMV unpublished data).

At about the same time as the discovery of the New Zealand species, French surveys in New Caledonian waters turned up examples of a roughy that attains a size of similar magnitude, and which is clearly separable from *H. gigas* and the New Zealand species on the basis of meristic features.

The purpose of this publication is to provide a detailed redescription of *H. gigas*, together with descriptions and names for these two new large congeners. The three are clearly separable from each other and from other nominal species of the genus on the basis of a variety of features.

## Methods and Materials

Terminology and methodology is that of Kotlyar (1996). The number and size range in standard length (SL) for each lot of specimens examined is presented as a parenthetical expression after the respective registration number; if a lot comprises a single specimen only the standard length is presented. Institutional abbreviations are listed in Leviton et al. (1985). The descriptions are based on the lectotype or holotypes with variations observed in paratypes following in parentheses. Pectoral fins of the two new species were counted on both sides. Gill rakers reported are those on the lateral face of the first gill arch of the right side. Scale terminology is that of Roberts (1993). The considerable variation in transverse scale counts is attributable to the apparent irregular distribution of scales on the sides of *Hoplostethus* species with lateral line scales considerably larger than those elsewhere; although most fishes have scales arranged in discrete oblique rows, a homologous arrangement is not apparent in species of this genus; in addition, the profusion of spines on scales of some species makes the distinction between individual scales extremely difficult. Modified scales on the ventral midline of the abdomen are regarded as scutes when they have acquired a laterally compressed keel-like form with a pointed apex or apices; numbers of scutes in species having them appear to increase slightly with growth.

## Comparative material examined:

*Hoplostethus confinis* **HUMZ 191395** (282), Indian Ocean, off Sumatra, Indonesia, 03°29.03' N, 94°57.59' E – 03°29.23' N, 94°57.22' E, 760–790 m, 7 October 2004, coll. by K. Odani; **HUMZ 194238** (270) Indian Ocean, off Java, Indonesia, 08°19.07' S, 109°53.09' E – 08°19.00' S, 109°52.08' E, 864–950 m, 7 May 2005, coll. by T. Kawai; *H. robustispinus*: **HUMZ 148071** (195) and **HUMZ 148072** (354) southern Japan, 27°53.20' N, 128°28.72' E –27°51.70' N, 128°29.05' E, 603–586 m, 18 July 1994.

### *Hoplostethus gigas* McCulloch, 1914

Giant sawbelly

Figures 1 & 2; Tables 1 & 2

*Hoplostethus gigas* McCulloch, 1914: 101, plate xix, original description, Great Australian Bight.

*Hoplostethus gigas*. McCulloch, 1929: 132, listed ("holotype on deposit in Austr. Mus."), Great Australian Bight. –Munro, 1958; 79, fig. 548, description ex McCulloch, Great Australian Bight. –Whitley, 1964: 40, listed, Australia. –Scott, 1962: 108, fig., description ex McCulloch, Great Australian Bight. –Woods and Sonoda, 1973: 306, listed, Australia ("possibly a very large *japonicus*"). –Kotlyar, 1980: 197, fig. 10, family revision, description ex McCulloch, Australia. –Maxwell, 1980: 66, plate 155, description ex McCulloch, temperate Australia. –Kotlyar, 1986: 126, generic revision, key, description ex McCulloch, Australia. –Paxton and Hanley, 1989: 366, synonymy and Australian distribution. –Gomon, in Gomon et al., 1994 (in part): 403, Fig. 361, description, Great Australian Bight. –Paxton et al., 2006: 769, taxonomy, central south coast of Australia. –Gomon, in Gomon et al., 2008: 424, fig., description, central south coast of Australia. –Moore and Dodd, 2010: 138–141, morphological characters.

*Hoplostethus latus* (not McCulloch, 1914: 97, fig. 5). May and Maxwell, 1986: 219, fig., description ex McCulloch, Great Australian Bight.

**Material examined**. **Lectotype. AMS I.12766** (307) (herein designated), Great Australian Bight, FIS *Endeavour*, one of six registered, 27 March 1913.

**Paralectotypes** (5, 292–426 mm SL). **AMS I.15710-001** (ca. 375; skeleton, S.1285) same data as AMS I.12766; **NMV A.20541** (385; formerly E.4298) same data as AMS I.12766; **QMB I.1423** (426; formerly E.3238) Great Australian Bight, 33°18' S, 126°47' E, 238–311 m (130–170 fms), February 1913, FIS *Endeavour*.

**Non-types** (7, 293–378 mm SL). **CSIRO H.4874-01** (366), **CSIRO H.4874-02** (368), **CSIRO H.4874-03** (349), **CSIRO H.4874-04** (356), **CSIRO H.4874-05** (373), **CSIRO H.4874-06** (378) Great Australian Bight, 33°19' S, 128°25' E, 180–350 m, collected at end of tow over rough ground near a drop–off to canyon, FV *Noble Pearl*, demersal trawl, 21 September 1998; **NMV A.21541** (293) Victoria, south–west of Portland, 38°48' S, 141°44' E, 432–522 m, 19 June 2000, FV *Zeehaan*, demersal trawl, coll. by K. Graham.

*Diagnosis*. Pectoral–fin rays 15, rarely 14; total gill rakers on outer side of first arch 18; predorsal scales 9–15; abdominal scutes 9 or 10, few scutes in large individuals with multiple apical points; isthmus lacking scales; body scales adherent; lateral–line scales with tuberculate medial ridge, but no spine; scales on predorsal midline forming low raised ridge; body ovoid and deep, depth 2.0–2.2 in SL; nape distinctly curved, forehead almost straight to above upper lip; dorsal– and anal–fin spines of moderate thickness; body of adults grey, superimposed with orange–red to red in life, outer margin of soft portions of dorsal, anal and caudal fins greyish to almost blackish; buccal cavity and opercular recess black, vomer, underside of tongue and upper surface of lower jaw stark white. Reaches 525 mm SL.

Table 1. Selected meristic, standard length and morphometric values for types and other specimens examined of three species of *Hoplostethus*. Morphometric values are expressed as percent SL.

| | ***H. gigas*** | | ***H. melanopeza* sp.nov.** | | ***H. grandperrini* sp.nov.** | |
|---|---|---|---|---|---|---|
| | lectotype | all specimens | holotype | paratypes | holotype | paratype |
| | | (n=9) | | (n=27) | | |
| Dorsal fin | VI, 13 | VI, 13-14 | VI, 13 | VI-VII, 12-13 | VI, 13 | VI, 13 |
| Anal fin | III, 9 | III, 9 | III, 9 | III, 9-10 | III, 9 | III, 9 |
| Caudal fin | 6+2+17+2+6 | 6-7+2+17+2+6-7 | 6+2+17+2+6 | 6-7+2+17+2+6 | 6+2+17+2+6 | 6+2+17+2+6 |
| Pectoral fin | 15 | 14-15 | 15 | 14-16 | 17-18 | 17 |
| Pelvic fin | I, 6 | I, 6 | I, 6 | I, 6 | I, 6 | I, 6 |
| Lateral line scales | 26+2 | 26-28+1-2 | 27+1 | 26-29+1-2 | 28+1 | 28+1 |
| Transverse scales | 13/1/23 | 9-13/1/22-24 | 12/1/25 | 9-15/1/20-28 | 12/1/26 | 11/1/35 |
| Predorsal scales | 9 | 9-15 | 18 | 16-22 | 21 | 24 |
| Abdominal scutes | 10 | 9-10 | 10 | 9-12 | 14 | 13 |
| Gill rakers | 5+13=18 | 5+13=18 | 6+14=20 | 5-6+12-15=18-21 | 6+14=20 | 6+13=19 |
| Pseudobranch | ~46* | 19 | 16-21 | 15 | | |
| Vertebrae | 11+15 | 11+15 | 11+15 | 11+15 | 11+15 | 11+15 |
| Standard length | 307 | 292-378 | 286 | 72.6-515 | 455 | 131 |
| Body depth | 47.6 | 46.2-50.7 | 52.0 | 47.9-56.4 | 55.6 | 53.2 |
| Head length | 37.1 | 34.7-39.1 | 40.6 | 32.6-42.6 | 41.4 | 42.9 |
| Forehead height | | 39.8-40.1[1] | 41.2 | 34.1-46.4 | 41.0 | 44.2 |
| Eye diameter | 10.9 | 9.1-10.9 | 10.9 | 9.4-14.7 | 9.6 | 12.5 |
| Postorbital length | | 19.1-20.0[1] | 20.3 | 17.8-21.8 | 22.4 | 22.0 |
| Interorbital width | 11.5 | 11.5-12.9 | 10.9 | 10.2-12.8 | 14.1 | 13.4 |
| Maxillary length | 26.0 | 24.4-27.5 | 26.5 | 23.3-29.2 | 26.3 | 30.4 |
| Lower jaw length | | 24.7-28.4[1] | 28.2 | 23.6-29.6 | 28.6 | 31.1 |
| Snout length | 9.9 | 6.5-10.4 | 9.8 | 7.09-11.3 | 10.5 | 9.5 |
| Caudal peduncle depth | 11.3 | 9.9-12.5 | 12.0 | 10.4-15.3 | 12.5 | 13.0 |
| Caudal peduncle length | 25.2 | 21.9-27.1 | 23.0 | 20.2-26.1 | 22.6 | 22.9 |
| Predorsal length | 45.3 | 40.4-47.9 | 47.6 | 45.0-52.2 | 38.8 | 49.1 |
| Preanal length | | 71.9-72.9[1] | 70.6 | 64.4-73.5 | 76.7 | 73.2 |
| Prepectoral length | | 37.7-38.2[1] | 40.7 | 36.5-41.2 | 40.8 | 40.4 |
| Prepelvic length | | 42.8-44.9[1] | 44.3 | 39.1-45.3 | 42.6 | 43.8 |
| Pectoral Pelvic length | | 11.6-12.3[1] | 15.8 | 12.0-16.6 | 18.3 | 15.8 |
| Pelvic Anal length | | 34.0-38.2[1] | 32.1 | 25.3-36.8 | 42.4 | 35.5 |
| Dorsal base length | | 38.4-39.3[1] | 38.9 | 36.0-41.3 | 38.3 | 36.0 |
| Anal base length | | 17.1-18.7[1] | 19.0 | 15.3-21.8 | 17.2 | 17.0 |
| Pectoral fin length | 23.8 | 23.8-27.3 | 23.8 | 21.1-34.9 | 25.2 | 34.0 |
| Pelvic fin length | 19.5 | 19.1-21.0 | 19.5 | 17.0-26.4 | 18.4 | 23.5 |
| 1st dorsal spine length | | 2.5-3.7[3] | 3.9 | 1.8-7.5 | 2.9 | 4.7 |
| 2nd dorsal spine length | | 4.3-6.8[4] | 8.1 | 3.1-12.1 | 4.1 | 8.9 |
| Last dorsal spine length | 14.9 | 13.7-15.0[2] | 14.6 | 12.0-23.2 | 12.1 | 17.6 |
| 1st anal spine length | | 1.4-2.1[2] | 2.1 | 1.2-2.8 | 1.6 | 2.1 |
| Last anal spine length | 11.0 | 10.8-12.3[4] | 11.1 | 8.8-16.4 | 7.7 | 13.3 |

* 1 specimen only, [1] 2 of 9 specimens, [2] 6 of 9 specimens, [3] 7 of 9 specimens, [4] 8 of 9 specimens

Table 2. Frequency of abdominal scute numbers in specimens examined of *Hoplostethus gigas*, *H. melanopeza* sp. nov. and *H. grandperrini* sp. nov. Holotypes or lectotype indicated by *.

| **No. of scutes** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|
| *H. gigas* | 7 | 2* | | | | |
| *H. melanopeza* sp.nov. | 10 | 7* | 9 | 2 | | |
| *H. grandperrini* sp.nov. | | | | | 1 | 1* |

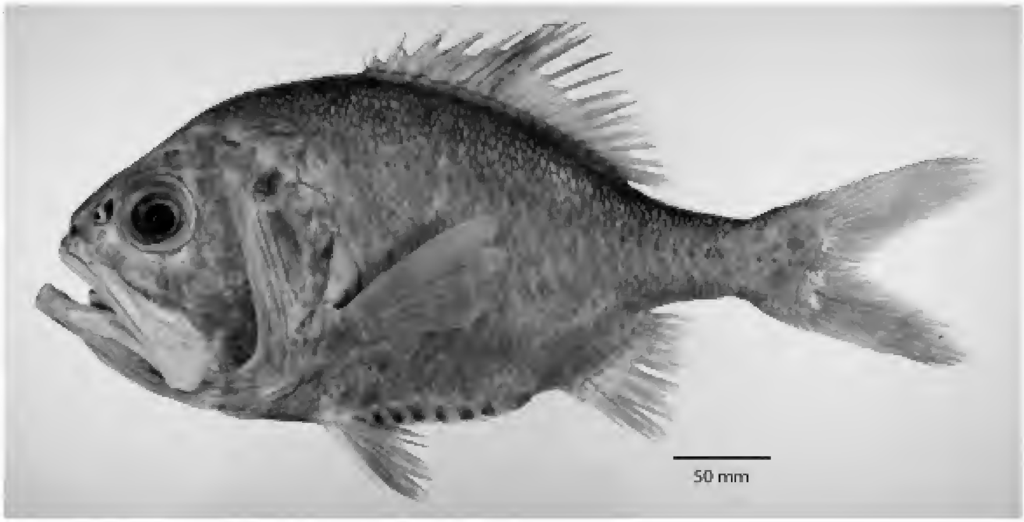


Figure 1. *Hoplostethus gigas* McCulloch, 1914. CSIRO H4874.02, 368 mm SL, photo by Thor Carter.

*Description*. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal–fin rays VI, 13 (VI, 14 in 1 of 9); anal–fin rays III, 9; caudal–fin rays 6 + 2 + 9 + 8 + 2 + 6 (6 or 7 + 2 + 9 + 8 + 2 + 6 or 7); pectoral–fin rays 15 (14 in 1 of 9); pelvic–fin rays I, 6; gill rakers 5 + 1 + 12; lateral–line scales 26 + 2 (26 to 28 + 1 or 2 = 28 or 29); transverse scales 13/1/23 (9–13/1/22–24); predorsal scales 9 (9–15); scutes 10 (9 or 10; Table 2); vertebrae 11 + 15; pseudobranch about 46; branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.98–2.16 in SL. Head large, its height slightly greater than its length, 110–115% HL; upper profile in front of dorsal fin distinctly curved to above rear of eye, then mostly straight to upper jaw, slightly concave above rear half of eye in some; anterodorsal profile well separated from upper orbital rim; space between eyes wide, interorbital width 28.8–35.2% HL; eye of moderate size, orbital diameter 24.0–32.8% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine with posteriorly tapering band of similar teeth, vomer apparently lacking teeth, at least in adults; tip of dentary with ossified knob at symphysis. Preopercular spine short, reaching about 1/4 way from preopercular margin to pelvic–fin base, broad basally in large specimens. Humeral and preopercular spines of similar size. Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/8 eye diameter and about 1/3 length of longest filaments of pseudobranch.

Body covered with adherent scales, with densely covered, finely spinoid scales above lateral line, posteriorly and low on side, scales above and covered laterally by pectoral fin cycloid (cycloid scales distributed more ventrally in smaller individuals); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about four vertical rows, posteriormost row with about 17 scales; isthmus scale–less; each lateral–line scale with tuberculate ridge but lacking distinct spine; deep serrated abdominal keel formed from greatly enlarged scales (scutes) with slender spine–like apices, most without sculpturing or multiple tips, some striated; scales on dorsal midline in front of dorsal fin slightly but noticeably raised, their spinules complex but not greatly enlarged. First dorsal–fin spine short, subsequent spines distinctly longer but only increasing progressively in length slightly; spines of moderate thickness, those posteriorly progressively thicker with distinct lengthwise striations; first soft ray distinctly longer than last spine, third ray longest, subsequent

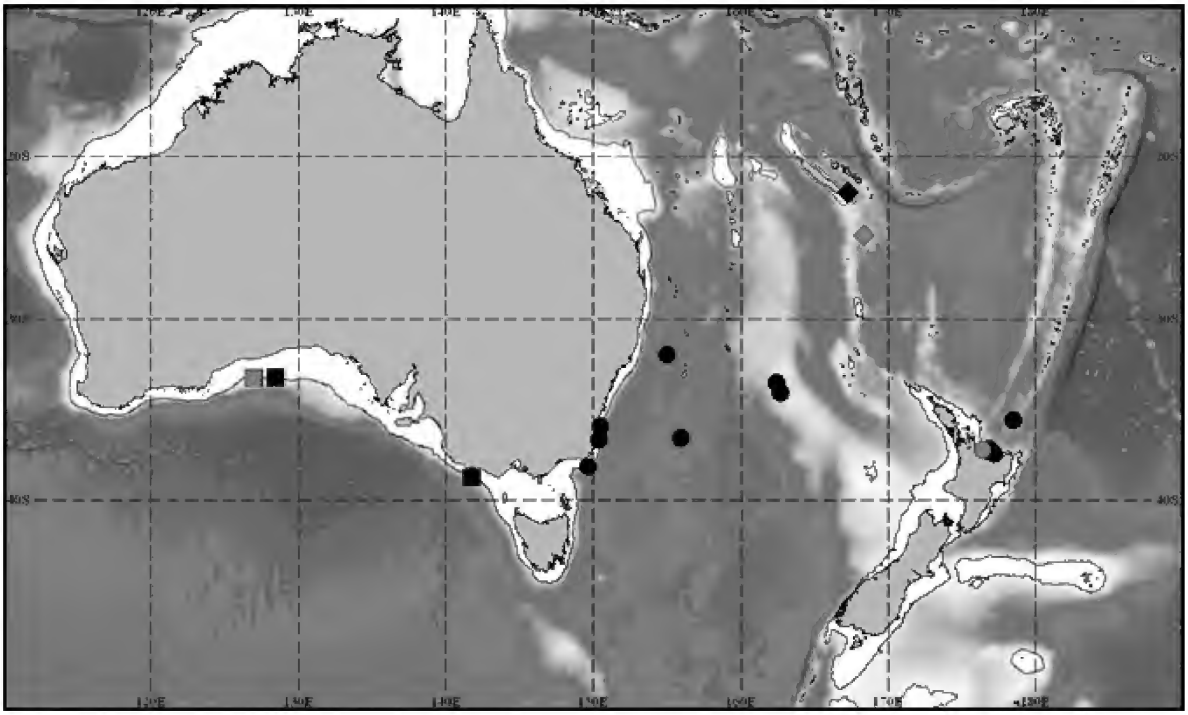

Figure 2. Collection localities for specimens examined of *Hoplostethus gigas* (squares), *H. melanopeza* sp. nov. (circles) and *H. grandperrini* sp. nov. (diamonds). Red symbols indicate holotypes or lectotype.

rays progressively decreasing in length, outer margin of soft dorsal fin curved anteriorly, straight posteriorly. First anal–fin spine short, second short or of intermediate length, and third long; spines of similar robustness to those in dorsal fin. Caudal fin distinctly forked, lobes of moderate breadth and rounded; middle rays about 40% length of longest rays. Pectoral fin moderately short, reaching to beyond anus in large specimens. Pelvic fin reaching to seventh or eighth scute in large specimens.

A large species, largest specimen examined 426 mm SL; reported to 525 mm SL (McCulloch, 1914).

*Colour in life*. Head and body grey, obscured by deep reddish orange to red; opercle black suffused with red; buccal cavity and opercular recess black, vomer, underside of tongue and upper surface of lower jaw stark white; fins deep red; membranes between dorsal fin spines grey, marginal strip on soft portions of dorsal, anal and caudal fins dark grey to almost blackish in large individuals (fig. 1).

*Pigmentation in alcohol*. Slightly dusky above, pale below; opercle dark; buccal and branchial chambers dark, including gill arches and rakers; vomer, palatines, underside of tongue and lower jaw uniformly pale; medial fins and pelvic fins dusky near outer edges.

*Distribution*. Confined to the southern coast of Australia, documented from the western part of the Great Australian Bight (126°47' E) to southwest of Portland, Victoria (141°44' E) with collection depths recorded between about 188 and 522 m (fig. 2). It is reported to "hang-out at canyon edges" and in areas with "rough ground" (pers. comm. T. Parsons, skipper of 'FV *Noble Pearl*').

*Comments*. The type locality given by McCulloch (1914) in his original description of *Hoplostethus gigas* does not accurately match registration records for specimens collected by the FIS *Endeavour* we have been able to locate. In his account, McCulloch presented it as Great Australian Bight, 33°18' S, 126°42' E, 130–170 fms (= 238–311 m). The closest locality we have been able to find for specimens identifiable as this species is that of three specimens registered in the South Australian Museum (SAM F137, formerly AMS E.3236), Western Australian Museum (WAM P.63-001, formerly E.3237) and Queensland Museum (QMB I.1423, formerly E.3238). So far, the specimens at the South Australian Museum and Western Australian Museum have not been found, although specimens of *Hoplostethus* collected by the *Endeavour* were received and registered by the institutions as indicated, and in both cases, like the Australian Museum material, they were recorded as *H. intermedius*. As no further *Endeavour* material identifiable as *H. gigas* appears to be in the Australian Museum collection, we assume the other six specimens of the type series were distributed to museums elsewhere in Australia, along with an assortment of other "E series" specimens currently in their collections. For instance, in addition to the assumed type of *H.*

*gigas* in the Museum Victoria collection listed above among Material examined, a specimen of *H. latus* was received as part of the same gift. That specimen, NMV R5962 (formerly AMS E.2350) is most likely one of the nine specimens on which *Hoplostethus mediterraneus* var. *latus* was based in the same McCulloch publication and is consequently considered a syntype of what is now regarded as the valid species, *H. latus*.

The ledger of original *Endeavour* numbers, which is in the care of the Australian Museum, records E.3236, E.3237 and E.3238 as having been collected at 33°18' S, 126°47' E, 130–170 fms and having been exchanged to the Adelaide, Perth and Queensland Museums, respectively. Although identified in the ledger as *Hopostethus intermedius* these are the specimens of *H. gigas* listed above. We suspect the discrepancy in minutes longitude is a misinterpretation of the handwritten record or a transcription error. Despite his lone locality for the species, McCulloch indicated the account is based on eleven specimens. We consider it unlikely that all were collected at the one station as specimens of this species are uncommonly rare in collections and the few that do exist were not taken in large numbers. As McCulloch was zoologist at the Australian Museum at the time of publication, we assume he retained at least one type and AMS I.12766 is one of two specimens currently registered in that collection as *H. gigas*, even though it was registered as *Hoplostethus intermedius* without locality information on 27 April 1913. No subsequent annotations were made to that ledger entry. The other specimen so identified in the AMS collection is a skeleton (AMS I.15710-001) prepared about the time of registration. AMS Skeleton Register records in the hand of McCulloch "S.1285, 28 Mar 1913, Hoplostethus intermedius" with intermedius crossed out and "gigas" inserted, in the same hand.

Based on our perceptions of human nature, we assume that McCulloch chose to retain the specimen he regarded as the most representative of the species (now regarded as a holotype). We adjudge AMS I.12766 to be that specimen and here designate it lectotype of *Hoplostethus gigas* McCulloch, 1914. Other specimens listed above as paralectotypes are considered to also be from the original series.

The redescription presented here is the first since the original description of the species nearly 100 years ago, and includes additional specimens and data ranges. This is the largest of currently described species and is easily separated from other nominal species by its maximum size attained and the combined morphological features comprising 9–15 predorsal scales, 9–10 enlarged abdominal scutes, 15 (rarely 14) pectoral–fin rays, and 18 total gill rakers. It is separable from the two species described below as discussed in the commentary following each treatment.

### *Hoplostethus melanopeza* sp. nov.

New Zealand giant sawbelly

Figures 2–5; Tables 1 & 2

*Hoplostethus gigas* (not McCulloch, 1914). Paulin & Stewart, 1985: 31, listed, Bay of Plenty, 100–300 m, first record for New Zealand. –Paulin et al., 1989: 153, 257, colour plate (opposite page 163), key. –Gomon, in Gomon et al., 1994 (in part): 403, Fig. 361, description, off Sydney, NSW, and Bay of Plenty, New Zealand.

*Hoplostethus ?gigas* (not McCulloch, 1914). Roberts, 1995: 106, colour figs, description, Bay of Plenty. –Roberts, 1996: 40, colour fig., description, Bay of Plenty.

*Hoplostethus* cf. *gigas* (not McCulloch, 1914). Roberts et al., 2009: 532 (listed). –Roberts, 2012: 38, colour fig., description, off Mayor Island, Bay of Plenty.

*Material examined*. *Holotype*. **NMNZ P.053205** (286) New Zealand, North Island, Bay of Plenty, Mayor Knolls, 12 km east of Mayor Island, 37°19.07' S, 176°25.35' E, 320 m, gill net, 3 hr soak, 5 March 2012, FV *Ruben Jack*, A. Oliver & C. Molloy.

*Paratypes*. (27, 72.6–515 mm SL). **AMS I.27085–001** (515) Australia, New South Wales, Taupo Seamount, 32° S, 155° E, March 1982; **AMS I.30415–001** (2, 72.6–123) Australia, New South Wales, Moruya, 36°03' S, 150°27' E, 383 m, 21 November 1979, K. Graham; **AMS I.40390–004** (108) Australia, New South Wales, Bermagui, 36°47' S, 150°21' E, 585 m, 23 July 2000, K. Graham; **CSIRO H5321–04** (107), Australia, Victoria, Cape Everard, 38°14' S, 149°36' E, 486–602 m, 23 July 2000, K. Graham; **CSIRO H7387–01** (380) formerly NMNZ P.053725, New Zealand, Bay of Plenty, east of Mayor Island, west of Rangitira Knoll, 37°15.52' S, 176°44.41' E, 500 m, set net, April 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd, A Oliver & C Molloy; **MNHN 2012–0268** (273) formerly NMNZ P.053206, same data as holotype; **NMNZ P.014162** (465) New Zealand, North Island, Bay of Plenty, Rangitira Knoll, 37°15.5' S, 176°51' E, 140 m, June 1983, G. Schroeder; **NMNZ P.015181** (2, 440–450) New Zealand, Tokokemoke Knoll, 12 miles west of White Island, 37°28' S, 176°54' E, 256 m, longline, FV *Arapawa I*, C. Walker; **NMNZ P.015854** (3, 397–467) New Zealand, North Island, Bay of Plenty, Rangitira Knoll, 37°15' S, 176°51' E, 366 m, February 1984, gill net, G. Schroeder; **NMNZ P.031100** (3, 449–482) New Zealand, North Island, Bay of Plenty, southeast of Rangitira Knoll, 37°17.2' S, 176°53.6' E, 240–500 m, April 1994, bottom trawl, FV *Margaret Philippa*, J. & J. McGrath; **NMNZ P.038312** (99) New Zealand, southern Kermadec Ridge, outer Bay of Plenty, Rumble 3 submarine volcano, 35°44.51' S, 178°29.62' E, 270–426 m, epibenthic sled, 11:31–11:51 hrs, 19 May 2001, GRV *Tangaroa*; stn. TAN 0107/004; **NMNZ P.038325** (395) Gascoyne Seamount, 36°42.00' S, 155°54.00' E, 925 m, 8 August 2001, dropline, D. Smith; **NMNZ P.038548** (178) same data as NMNZ P.015854; **NMNZ P.047799** (132) Tasman Sea, Lord Howe Rise, Central Plateau 34°11.95' S, 162°38.90' E, 712–760 m, 7 September 2010, trawl, FV *Voyager*, OBS 3177/058, J. Houston; **NMNZ P.053308** (486) New Zealand, North Island, Bay of Plenty, east of Mayor Island, 37°19.75' S, 176°29.57' E, 540 m, set net, March 2012, OPC Fish & Lobster Ltd., coll. A Oliver & C Molloy; **NMNZ P.053877** (468) New Zealand, Bay of Plenty, Mayor Knolls, east of Mayor Island, 37°18.6' S, 176°31.32' E, 347 m, set net, April 2012, FV *Ruben Jack*, A. Oliver & C. Molloy; **NMV A22070** (128) Tasman Sea, Lord Howe Rise, 33°38' S to 33°40' S, 162°21' E to 162°28' E, demersal trawl, 300–750 m, 22 March–2 April 2001, coll. K. Smith; **NMV A30942-001** (282) formerly NMNZ P.053307, New Zealand, Bay of Plenty, east of Mayor Island, 37°19.75' S,176°29.57' E, set net, 540 m, March 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver & C. Molloy; **NMV A30943–001** (393) formerly NMNZ P.053726, New Zealand, Bay of Plenty, E of Mayor Island, Rangitira Knoll, 37°15.522' S,176°44.408' E, set net, 500 m, April 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver & C. Molloy; **NMV A30944–001** (420) formerly NMNZ P.054048, New Zealand, Bay of Plenty, E of Mayor Island, Maungaiti Knoll, 37°17.25' S,176°51.63' E, set net, 450 m, June 2012, FV *Ruben Jack*, OPC Fish & Lobster Ltd., coll. A. Oliver; **USNM 406863** (262) formerly NMNZ P.053529, New Zealand, North Island, Bay of Plenty, Mayor Knolls, 12 km east of Mayor Island, 37°19.07' S, 176°25.35' E, 320 m, 5 March 2012, FV *Ruben Jack*, coll. A. Oliver & C. Molloy.

*Diagnosis*. Pectoral–fin rays 15, rarely 13, 14 or 16; total gill rakers on outer side of first arch 18–21; abdominal scutes 9–12,

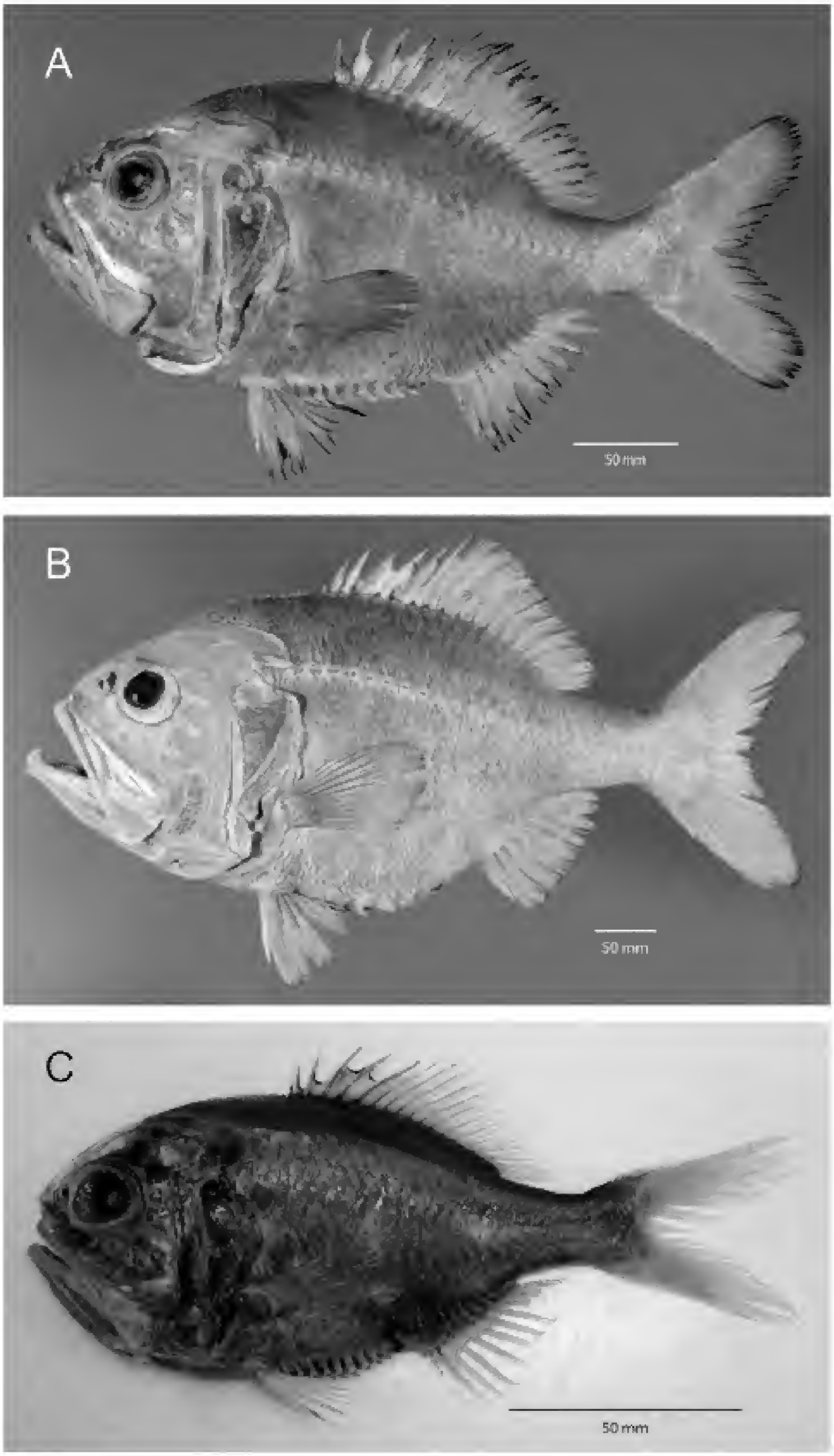


Figure 3. *Hoplostethus melanopeza* sp. nov. A, NMNZ P.053205, holotype, 286 mm SL, photo by C. Struthers; B, NMNZ P.053308, paratype, 486 mm SL, photo by C. Struthers; C, NMV A22070, paratype, 128 mm SL, photo by M. Gomon.

Figure 4. Buccal colouration of *Hoplostethus melanopeza* sp. nov. NMNZ P.053206, paratype, 273 mm SL, photo by C. Struthers.

some scutes in large individuals with multiple apical points; predorsal scales, 16–22; isthmus lacking scales; body scales adherent; lateral–line scales with strong medial ridge, but no spine in small and medium sized adults, with strong spine centrally on posterior margin in large adults; scales on predorsal midline forming low raised ridge; body ovoid and deep, depth 1.9–2.1 in SL; nape gently curved, forehead almost straight to above upper lip; dorsal– and anal–fin spines of moderate thickness; body of adults grey, superimposed with deep red in life, outer margin of all fins with narrow black edge in adults; buccal cavity and opercular recess black, vomer, margins of mouth roof lateral to palatines, underside of tongue and upper surface of lower jaw stark white. Reaches at least 515 mm SL.

*Description*. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal–fin rays VI, 13 (VI, 12 in 2 and VII, 12 in 1 of 27); anal–fin rays III, 9 (III, 10 in 1 of 27); caudal–fin rays 6 + 2 + 9 + 8 + 2 + 6 (7 + 2 + 9 + 8 + 2 + 6 in 2 of 21); pectoral–fin rays 15 (13 in 1, 14 in 2 and 16 in 4 of 54); pelvic–fin rays I, 6; gill rakers 6 + 1 + 13 (5 or 6 + 1 + 12–14 = 18–21, usually 6 + 1 + 13 = 20, mean total 19.7); lateral–line scales 27 + 1 (26–29 + 1, rarely 2, mean 27.7 + 1.1 ); transverse scales 12/1/25 (9–15/1/20–28; mean 11.1/1/23.4); predorsal scales 18 (16–22, mean 18.5); scutes 10 (9–12; Table 2); vertebrae 11 + 15; pseudobranch 19 (16–21); branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.92–2.08 in SL. Head large, its height slightly greater than its length, 94.1–114% HL; upper profile in front of dorsal fin gently curved to above rear of eye, then mostly straight to upper jaw, slightly concave above rear half of eye in some; anterodorsal profile only slightly separated from upper orbital rim; space between eyes wide, interorbital width 28.8–35.2% HL; eye of moderate size, orbital diameter 24.0–32.8% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine with narrow band of similar teeth, vomer apparently lacking teeth (with about 3 tiny teeth in small specimens); tip of dentary with ossified knob at symphysis. Preopercular spine short, reaching about 1/4 to 1/2 way from preopercular margin to pelvic–fin base, broad basally in large specimens. Humeral and preopercular spines of similar size. Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/8 eye diameter and about 1/3 length of longest filaments of pseudobranch.

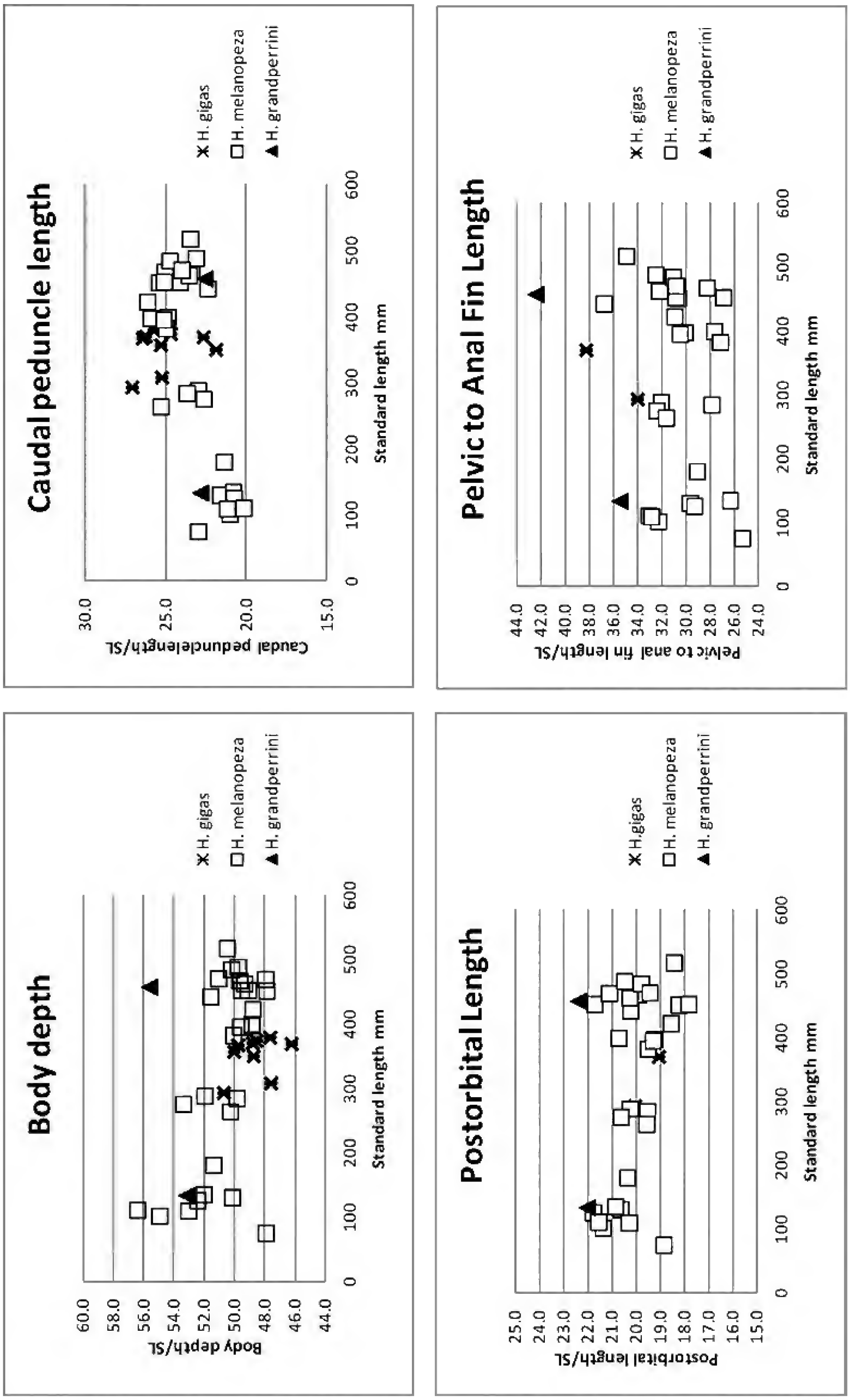


Figure 5. Selected proportional measurements relative to standard length for *Hoplostethus gigas*, *H. melanopeza* sp. nov. and *H. grandperrini* sp. nov.

Body covered with adherent scales, scales densely covered with low, knob–like spinules above lateral line, posteriorly and low on side, scales above and covered laterally by pectoral fin, cycloid (cycloid scales distributed more ventrally in small individuals); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about four vertical rows, posteriormost row with 8–12 scales; isthmus scaleless; lateral line with fine spinulation at free margin, each lateral–line scale with strong ridge but lacking distinct spine (no spine in small and medium sized adults, with strong spine centrally on posterior margin in large adults), considerably larger than other body scales, although adjacent scales intermediate in size between lateral–line scales and others away from lateral line; deep serrated abdominal keel formed from greatly enlarged scales (scutes) with spine–like apices, most without sculpturing or multiple tips, though with striations in some especially posteriorly; scales on dorsal midline in front of dorsal fin slightly but noticeably raised, their spinules not greatly enlarged. First dorsal–fin spine short, subsequent spines distinctly longer but only increasing slightly progressively in length; spines of moderate thickness, those posteriorly progressively wider with distinct lengthwise striations; first soft ray longer than last spine, subsequent rays progressively decreasing in length, outer margin of soft dorsal fin slightly curved. First anal–fin spine short, second only slightly or considerably longer, third long; spines of similar robustness to those of dorsal fin. Caudal fin distinctly forked, lobes of moderate breadth and rounded. Pectoral fin of moderate length, reaching to or beyond last few scutes (relatively longer in small individuals, to base of the third anal–fin ray in 99.3 mm SL paratype). Pelvic fin reaching just beyond middle scutes (to anal–fin origin in smallest paratype).

A large species, largest specimen examined 515 mm SL.

*Colour in life*. Head and body dark grey, obscured by deep red; opercle black suffused with red; dark areas of buccal and branchial cavities black; fins deep red with narrow black distal edges (figs 3 & 4).

*Pigmentation in alcohol*. Freshly preserved individuals dark grey (juveniles pale below a line between humeral spine and dorsal side of caudal peduncle near termination of dorsal fin base, dusky above); opercle dark; buccal and branchial chambers dark, including gill arches and rakers; vomer, roof of mouth lateral to palatines, underside of tongue and lower jaw uniformly pale; fins pale with narrow dark margins (juveniles with pale fins, except for slightly dusky outer portion of membrane between dorsal–fin spines).

*Etymology*. The name *melanopeza* is from the Greek *melano* for 'black' and *peza* 'edge', in reference to the characteristic black edge on all fins in large individuals of this species. As a noun in apposition, the spelling of *melanopeza* is not influenced by masculine gender of genus *Hoplostethus*.

*Distribution*. Confined to sub–tropical and temperate latitudes of the Tasman and South Fiji Basins in the south–western Pacific, documented from localities between about 33° and 37° S from south–eastern Australian slopes on the west to the outer Bay of Plenty and southern Kermadec Ridge at the north end of the North Island in New Zealand in the east (fig. 2). Occurs on continental slopes, seamounts and submarine rises with collection depths recorded between about 140 and 760 m, but most often 250–400 m.

*Comments*. *Hosplostethus melanopeza* is very similar to *H. gigas*, a species with which it was confused in the early 1980's when initial specimens were collected. The absence of detailed descriptive information beyond McCulloch's initial description of *H. gigas* nearly 100 years ago no doubt contributed to this confusion. McCulloch evidently received the specimens on which his description is based well after they were preserved, saying about the species' original colouration only that "when first received all the fins had traces of deep rose pink." Although both species have a similar overall red or reddish–orange colouration, *H. melanopeza* has distinct black margins to all fins in large individuals, while the edges of only the medial fins appear to be no more than dark grey to blackish in large individuals of *H. gigas*. The recognition of the two species is supported by Cytochrome Oxidase subunit one sequences (Te Papa/ NIWA/CSIRO/NMV unpublished data).

Morphologically *H. gigas* and *H. melanopeza* have nearly identical ranges for meristic values, but the latter has a greater number of predorsal scales (16–22 versus. 9–15) and a higher mean value for total gill rakers of 19.7 versus 18.0, based on material examined. Proportional measurements for the two are also extremely similar. The greater size range of specimens for the new species makes a full comparison of the two impossible, although an examination of the distribution of values in a number of other species shows morphometric ranges converging at smaller sizes and the greatest disparities evident as individuals approach their maximum size. At comparable sizes *H. melanopeza* seems to have a slightly deeper body and shorter pelvic to anal–fin length than *H. gigas* (fig. 5).

Morphological comparisons with other nominal species referred to the subgenus *H.* (*Hoplostethus*) are difficult because of the relatively small sample sizes that literature descriptions on which most are based and the considerably greater variation detected when greater numbers are examined. In comparison with *H. robustispinus*, which reaches a comparably large size, *H. melanopeza* has 15, rarely 16, versus 17, rarely 16 pectoral–fin rays, 9–12 versus 11–13 abdominal scutes, 26 versus 27 total vertebrae, and medial fin spines of a moderate breadth versus broad in large individuals. The Indian Ocean *H. confinis*, as mentioned in the Introduction, also reaches a reasonably large size and has meristic values that are more similar to those of *H. melanopeza* and *H. gigas*, apparently differing from the former in having the same lower mean value of total gill rakers as the latter. It is further separable from *H. melanopeza* in lacking the black margins to its fins at a large size. Two other species occurring in the Indo–Pacific region have pectoral–fin ray numbers that appear to be comparable with *H. melanopeza*, the Red Sea *H. marisrubri* Kotlyar, 1986 and western Indian Ocean *H. mikhailini* Kotlyar, 1986. Neither has been reported to have dark margins to their fins, but individuals of *H. melanopeza* do not appear to develop dark margins until they reach a standard length well in excess of 150 mm SL, a size that is greater than the largest specimen reported for either of these two species. *Hoplostethus melanopeza* differs from *H. marisrubri* in having 26 versus 27 total vertebrae and from *H. mikhailini* in having 18–21 versus 23–27 total gill rakers.

Although *H. melanopeza*, together with most other species of the genus reaching a significant size (apart from the commercially important orange roughy *Hoplostethus atlanticus* Collett, 1889), have long been regarded as very rare in deepwater environments. The type series took over 30 years to collect despite periodic requests to networks and the commercial and recreational fishing sectors (e.g. Roberts, 1995, 1996, 2012). The use of fishing gear such as deep droplines and set nets that are effective in capturing species living in rough bottom environments, have shown them to occur locally in greater numbers than originally thought. Even though life history details are yet to be identified for this and other giant roughy species, it is reasonable to believe their age and growth rate approach species like the orange roughy for which information is reasonably well known. Consequently, we urge restraint in the development of targeted commercial exploitation of what is potentially another long–lived, late maturing species, for which we currently have inadequate information on its abundance and biology.

***Hoplostethus grandperrini*** sp. nov.

Grandperrin's giant sawbelly

Figures 2, 5 & 6; Tables 1 & 2

*Hoplostethus* cf. *gigas*: Grandperrin & Lehodey, 1992: 7, 26 and 35, listed, seamount "B", Norfolk Ridge, New Caledonia.

*Holotype*. **NMNZ P.027462** (455) New Caledonia, Norfolk Ridge, Seamount "B", 24°55.15'S, 168°20.95'E, 600–675 m, BERYX 2, stn 3, N.O. *Alis*, chalut à poissons (= fish bottom trawl), 24 October 1991, R. Grandperrin and C. Roberts. (Lodged in NMNZ collection at the request of MNHN).

*Paratype*. **MNHN 2012–0269** (131) New Caledonia, SE slope of Grande Terre, 22°13.00' S, 167°14.00' E, 500–510 m, MUSORSTOM 4, stn 238, N.O. *Vauban*, chalut à perche (= beam trawl), 2 October 1985.

*Diagnosis*. Pectoral–fin rays 17 or 18; total gill rakers on outer side of first arch 19 or 20; abdominal scutes 13 or 14, scutes rectangular and rugose in large individuals; predorsal scales, 21–24; isthmus lacking scales; body scales adherent; lateral line scales with strong medial ridge and spine posteriorly and with numerous fine rather long spines in small individuals, scales rugose, lacking a posterior spine in large adults; scales on predorsal midline forming very low ridge in small individuals, no ridge apparent in very large individuals; body ovoid and deep, depth 1.8–1.9 in SL; dorsal profile of head gently curved; dorsal– and anal–fin spines of moderate thickness; pectoral fin of moderate length, reaching base of second anal–fin spine in small individuals, to tenth or eleventh abdominal scute in largest; adults orange–red; buccal cavity mostly white, black only on roof of mouth posteriorly, opercular recess black anteriorly, much paler near periphery. Reaches 455 mm SL.

*Description*. (See Table 1 for frequencies of values for selected meristic characters.) Dorsal–fin rays VI, 13; anal–fin rays III, 9; caudal–fin rays 6 + 2 + 9 + 8 + 2 + 6; pectoral–fin rays 17 (18 in 1 of 4); pelvic–fin rays I, 6; gill rakers 6 + 1 + 13 (6 + 1 + 12); lateral–line scales 28 + 1; transverse scales 12/1/26 (11/1/35); predorsal scales 21 (24); scutes 14 (13; Table 2); vertebrae 11 + 15; pseudobranch 15 (only holotype examined); branchiostegal rays 8.

(See Table 1 for comparative ranges of selected morphometric characters.) Body ovoid and deep, depth 1.8–1.9 in SL. Head large, its height equal to or slightly greater than its length, 99.1–103% HL; upper profile in front of dorsal fin gently curved to upper jaw; anterodorsal profile moderately separated from upper orbital rim; space between eyes wide, interorbital width 31.1–34.0% HL; eye of moderate size, orbital diameter 23.2–29.18% HL; crests of head bones strong, fine spinules on apices at skin surface; depressions between crests moderately deep, hidden by thick skin in adults; infraorbital bones becoming progressively broader with growth; nostrils immediately preceding orbits, posterior nostril two to four times area of anterior nostril; mouth reaching just beyond vertical through hind margin of eye; large, fine denticulate teeth covering oral margins and exposed lateral surfaces of premaxilla and dentary, palatine with narrow band of similar teeth, vomer apparently lacking teeth (with three small teeth in 131 mm paratype); tip of dentary with ossified knob at symphysis. Preopercular spine short and rounded (slender and pointed, reaching to pelvic-fin base in small individual). Humeral spines short and rounded (short and pointed in smallest individual). Longest gill raker about 2/3 eye diameter; gill filaments at angle of first gill arch very short, about 1/10 eye diameter and just less than 1/2 length of longest filaments of pseudobranch.

Body covered with adherent scales, those above lateral line, posteriorly and low on side densely covered by rather long fine spines, scales above and covered laterally by pectoral fin, cycloid (cycloid scales distributed more ventrally in smaller individual); head naked except for patch of scales on cheek posterior to rear tip of maxilla in about three or four vertical rows, posteriormost row with 13 or 14 scales; isthmus scaleless; lateral–line scales rugose, without a strong spine (smaller individual having each lateral–line scale with slender ridge and small pointed spine posteriorly, peripheral row of spinules noticeably longer than others); low serrated abdominal keel formed from slightly rugose, enlarged scales (scutes) with pointed apices (smaller individual with smooth scutes more typical of other species), scales on midline preceding scutes somewhat enlarged but not counted as scutes above; scales on dorsal midline in front of dorsal fin not forming low ridge (smaller specimen with posterior scales slightly raised medially), their spinules not enlarged. First dorsal–fin spine short, second and third spines progressively longer, last three increasing in length only slightly; spines of moderate thickness, those posteriorly progressively thicker with distinct lengthwise striations; first soft ray longer than last spine, subsequent rays progressively decreasing in length, outer margin of soft dorsal fin slightly curved. First anal–fin spine short, second short or of intermediate length, and third long; spines of similar robustness to those in dorsal fin. Caudal fin distinctly forked,

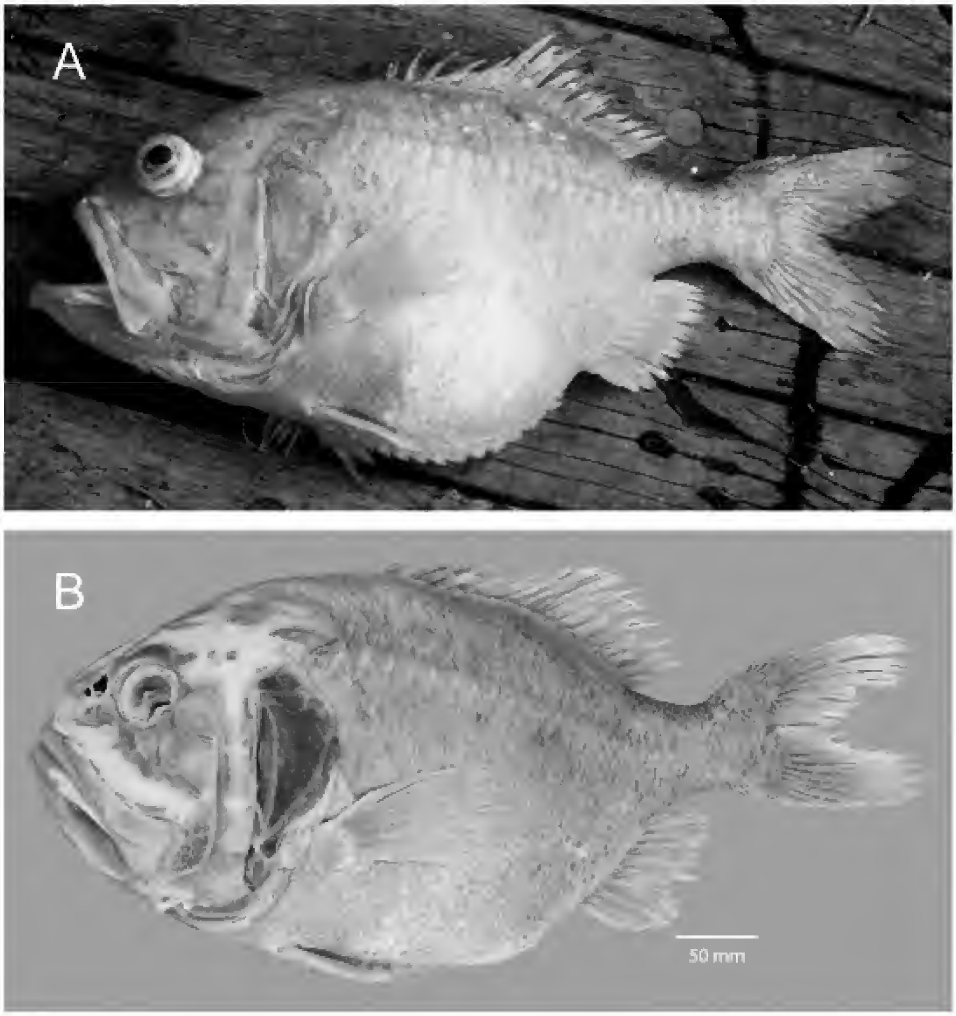


Figure 6. *Hoplostethus grandperrini* sp. nov., NMNZ P.027462, 455 mm SL, holotype. A, fresh, photo by C. Roberts. B, preserved, photo by C. Struthers.

lobes broad and rounded. Pectoral fin of moderate length reaching tenth or eleventh abdominal scute (reaching base of second anal–fin spine in smaller individual). Pelvic fin reaching to middle scutes (to eighth scute in smaller individual).

A large species, largest specimen examined 455 mm SL.

*Colour in life*. Head orange–red; body orange–tan dorsally, extending ventrally to pelvic–fin base anteriorly and to anal–fin base posteriorly; opercle black suffused with red; dark areas of buccal and branchial cavities black, pale areas stark white; fins orange to orange–tan, without darker margins (fig. 6).

*Pigmentation in alcohol*. Freshly preserved individuals grey–tan; opercle dark; buccal chamber pale, roof dark posteriorly; fins pale, outer edge of membranes between dorsal–fin spines dusky.

*Etymology*. The specific name *grandperrini* recognises Dr René Grandperrin, retired chief scientist of ORSTOM Nouméa, ardent fish researcher and leader of deepwater fish explorations off New Caledonia (Chef de Mission of research cruises BERYX 2 and HALIPRO2), in recognition of his strong support for collaborative fieldwork between French and New Zealand scientists.

*Distribution*. Known only from the types collected at Seamount "B" in the northern portion of the Norfolk Ridge, south of New Caledonia and on the south-eastern slope of New Caledonia's Grande Terre (fig. 2), from depths of 500–675 m.

*Comments*. The great similarity of many *Hoplostethus* species to one another has led to confusion about the identity of this species with two other apparently undescribed species living on seamounts in waters off southern New Caledonia. At least one of the latter reaches a considerable size, the largest known specimen measuring 355 mm SL, and has a distribution that includes Australian territorial waters. The three are consistently separable by a combination of characters, including numbers of pectoral–fin rays and abdominal scutes, and the pigmentation of the buccal cavity. The identities of the other two species will be the subject of a forthcoming publication by Gomon and Roberts (ms).

With regard to the three New Caledonian species we recognise, *G. grandperrini* has 17 or 18 pectoral–fin rays (versus 16 or 17, rarely 15 or 18, and 15, rarely 16 in the other two), 13 or 14 abdominal scutes (versus 10–15 and 11–13 scutes) and has a buccal cavity that is mostly pale, any black pigmentation confined to the rear of the mouth in the vicinity of the throat (versus buccal cavity entirely black behind the oral valves, including the underside of the tongue and top of the lower jaw, and buccal cavity black with vomer, underside of the tongue and the top of the lower jaw white). These same character combinations, plus high count of predorsal scales (21–24 versus 9–15, 16–22), separate *H. grandperrini* from the other two giant species treated above. Based on the limited series of types, *H. grandperrini* also appears to have a greater body depth, postorbital length, interorbital width, and pelvic fin to anal fin distance (fig. 5).

Of the remaining nominal species referred to the subgenus *H.* (*Hoplostethus*) apparently only two regularly have 17 or 18 pectoral–fin rays, *H. druzhinini* Kotlyar, 1986 in the Arabian Sea and *H. vniro* in the southeastern Atlantic. Both of these species differ from *H. grandperrini* in having on average more numerous gill rakers, 21–25, versus 19 or 20. In addition, *H. duzhinini* has only 8–12 abdominal scutes (versus 13–14) and a mostly black buccal cavity (versus mostly pale).

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# Some hydroids (Hydrozoa: Hydroidolina) from Dampier, Western Australia: annotated list with description of two new species.

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**Abstract**

Jeanette E. Watson, 2012. Some hydroids (Hydrozoa: Hydroidolina) from Dampier, Western Australia: annotated list with description of two new species. *Memoirs of Museum Victoria* 69: 355–363.

Eleven species of hydroids including two new (*Halecium corpulatum* and *Plumularia fragilia*) from a depth of 50 m, 50 km north of Dampier, Western Australia are reported. The tropical hydroid fauna of Western Australia is poorly known; species recorded here show strong affinity with the Indonesian and Indo–Pacific region.

**Keywords** Hydroids, tropical species, Dampier, Western Australia

## Introduction

A collection of hydroids provided by the Western Australian Museum is described. The collection comprises 11 species including two new. Material was collected 50 km north of Dampier, Western Australia, from the gas production platform *Ocean Legend* (019° 42' 18.04" S, 118° 42' 26.44" E). The collection was made from a depth of 50 m by commercial divers on 4th August, 2011.

The species in the collection show a strong affinity with the northern Indian Ocean, Indonesian and Indo–Pacific regions. The tropical hydroid fauna of the western Australian coast from Geraldton to Darwin is poorly known. Stechow (1925) reported on some hydroids collected in Shark Bay and Watson (1997, 2000) described collections from the Abrolhos Islands and Darwin. Other reports relevant to the present study are those from the Indonesian region by Billard (1913), Vervoort (1941) and Schuchert (2003) and from the Aru Sea (Stechow and Müller 1923). Other than those collected by scuba diving from the Abrolhos and Darwin, all other material is from dredging hence many new species are still being found in habitats only collectable by hand sampling.

Type and voucher material is deposited in the Western Australian Museum (WAM Z). In the following text only synonymies relevant to the Indonesian, Australian and Indo–Pacific and regions are given.

**Family** Eudendriidae L. Agassiz, 1862

***Eudendrium racemosum*** (Cavolini, 1785)

Figure 1A

*Sertolaria racemosa* Cavolini, 1785: 160, pl. 6, figs 1–7, 14–15
*Sertularia racemosa*. – Gmelin, 1791: 3854
*Eudendrium racemosum*.– Ehrenberg, 1834: 296.– von Lendenfeld, 1885: 351, 353.– Millard and Bouillon, 1973: 33.– Watson, 1985: 204, figs 63–67

*Material examined.* WAM Z31857, material ethanol preserved. Four infertile colonies, the tallest 40 mm long, on purple sponge.

*Description.* Hydrorhiza a tangled mass of stolonal tubes. Stems fascicled, stolons becoming stems in a loose untidy mass of tubes with much adventitious matter embedded between the tubes. Largest colony comprised of several heavily fascicled main branches, branching and rebranching roughly alternate, ultimate branches monosiphonic. Hydranth pedicels more or less alternate on ultimate branches, cylindrical, smooth, length variable, with two to four obscure annulations at base. Hydranth large with approximately 20 stubby tentacles.

Cnidome: all nematocysts undischarged,
– small euryteles, abundant in tentacles,
– large isorhizas, rare on hydranth body.

**Measurements of *Eudendrium racemosum*, (μm) preserved material**

| | |
|---|---|
| Branch, distance between pedicels | 1000–1800 |
| Hydranth pedicel | |
| length | 760–1700 |
| diameter | 136–184 |
| Hydranth, width below tentacles | 320–448 |

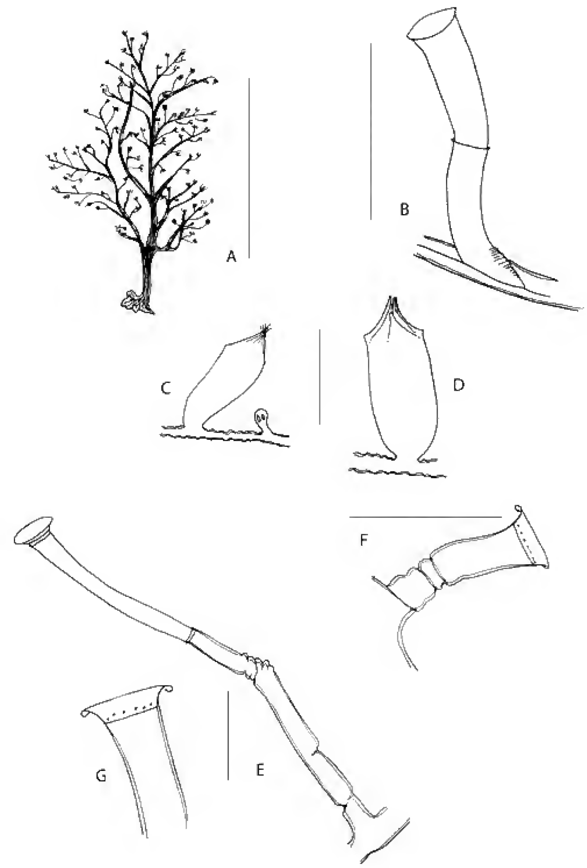


Figure 1A–G. A. *Eudendrium racemosum* from photograph of whole colony. B. *Filellum serratum*, regenerated hydrotheca. C, D. *Lafoeina amirantensis*. C, small hydrotheca and nematotheca on hydrorhiza. D, large hydrotheca. E–G. *Halecium ?tenellum*. E, unbranched stem. F, basally annulated hydrophore. G, hydrotheca with strongly everted rim and desmocytes. Scale bar, mm: A, 20. B, C, E, F, G, 0.2. D. 0.1.

*Remarks*. No supplementary cnidophores are present on the hydranths (see Watson 1985). The colonies of *E. racemosum* are substrate for most of the smaller hydroid species in the collection.

*Distribution.* Mediterranean Sea, Seychelles, Vietnam, South China Sea, Japan; previously recorded in Australia from the Great Barrier Reef (Pennycuik 1959).

**Family** Lafoeidae A. Agassiz, 1865

***Filellum serratum*** (Clarke, 1879)

Figure 1B

*Lafoëa serrata* Clarke, 1879: 242.
*Reticularia serrata*.– Ralph, 1958: 312.
*Filellum serratum*.– Millard, 1975: 178.– Gravier–Bonnet, 1979: 22.– Hirohito, 1995: 110.– Watson, 2000: 5, fig. 2C.

*Material examined*. WAM Z31858, microslide, malinol mount. One small infertile colony creeping on stem of *Eudendrium racemosum*.

*Description*. Hydrothecae long, tubiform, base adnate to substrate, distal two thirds of body erect, diameter narrower on adnate section, abcauline surface closely transversely striated above adnate adcauline wall. Margin circular, rim slightly everted, some with some marginal replications.

**Measurements of *Filellum serratum*, ($\mu$m)**

| | |
|---|---|
| Hydrotheca | |
| length of free part | 240–640 |
| diameter of free part | 84–92 |
| diameter at margin | 104–116 |

*Remarks*. Although the material is in poor condition the abcauline striations are a good indicator of identity as *Filellum serratum*. The dimensions conform with *F. serratum* from Darwin (Watson 2000).

*Distribution*. Cosmopolitan, previously recorded from Darwin and temperate Western Australia.

***Lafoeina amirantensis*** Millard and Bouillon, (1973)

Figure 1C, D

*Egmundella amirantensis* Millard and Bouillon, 1973: 40.– Millard, 1975: 133.– Gibbons and Ryland, 1989: 389.– Ramil and Vervoort, 1992: 22.

*Lafoeina amirantensis*.– Calder, 1991: 10.– Watson, 1994: 147.– Calder and Vervoort, 1998: 15.– Watson, 2000: 5, fig. 2A, B.

*Material examined*. WAM Z31850. Infertile colonies on *Eudendrium racemosum*; one microslide, malinol mount.

*Description*. Colonies stolonal, creeping on branches of host, stolons flattened, roughened and coated with fine sediment. Hydrothecae minute, arising at intervals along hydrorhiza, subconical to cylindrical, very variable in size, sometimes asymmetrically curved, base expanding from a short, wide pedicel, operculum of numerous segments overlapping at apex, no demarcation between opercular segments and body of hydrotheca. Nematothecae sparse, on hydrorhiza between hydrothecae, minute, clavate.

**Measurements of *Lafoeina amirantensis*, ($\mu$m)**

| | |
|---|---|
| Hydrorhiza, width | 28–48 |
| Hydrotheca | |
| length including operculum | 152–200 |
| maximum width | 52–80 |
| Nematotheca, length | 24–40 |

*Remarks*. The specimen conforms to previous descriptions of *Lafoeina amirantensis*.

*Distribution*. Cosmopolitan, previously recorded in Australia from Bass Strait and Darwin (Watson 1994a, 2000).

**Family** Haleciidae Hincks, 1868

***Halecium tenellum*** Hincks, (1861)

Figure 1E– G

*Halecium tenellum* Hincks, 1861a: 252, pl. 6, figs 1–4.– Vervoort, 1959: 229, fig. 8.– Vervoort, 1966: 102, fig. 2.– Millard, 1975: 156, fig. 50F–L.– Vervoort and Watson, 2003: 98, fig. 19A, B.

*Material examined*. WAM Z31849. Abundant infertile colonies on *Eudendrium racemosum*; one microslide, malinol mount.

*Description*. Hydrorhiza creeping on host, stolons tubular, undulating. Hydrocaulus monosiphonic, cylindrical, variable in length, mostly unbranched but some branched once or twice. Hydrophore smooth, cylindrical, a few transverse proximal septa marking site of branching from below or within a hydrotheca; hydrophore expanding slightly to below hydrotheca. Hydrotheca shallow dish–shaped, expanding to margin, rim strongly outrolled, diaphragm transverse, a row of desmocytes above, no marginal replications. Perisarc smooth, thin.

**Measurements of *Halecium ?tenellum*, ($\mu$m)**

| | |
|---|---|
| Hydrocaulus, basal length | 400–900 |
| Hydrophore | |
| length below hydrotheca | 80–520 |
| width | 48–60 |
| Hydrotheca | |
| width at diaphragm | 60–80 |
| depth to diaphragm | 20–22 |
| width across margin | 92–124 |

*Remarks*. Identification of *Halecium* to species level in closely similar species groups is difficult with infertile material. The present material is doubtfully referred to *H. tenellum*.

*Distribution*. Atlantic, Indian and Pacific Oceans, probably New Zealand. Not previously recorded from Australia.

***Halecium corpulatum*** sp. nov.

Figure 2A–F

*Material examined*. Holotype WAM Z31865, one microslide, malinol mount and remaining preserved material from holotype colony. Three sparsely fertile stems, probably fragmented colony.

*Description*. Hydrorhiza comprising tangled stolons becoming fascicular tubes of erect stem. Stems fascicled, thick, arborescent, almost planar, branching irregular from opposite to alternate, polysiphonic tubes reaching to base of ultimate branches.

Hydrophores arising from just below a hydrotheca, usually one but sometimes two opposite, one to six successive secondary hydrophores arising linearly from diaphragm of preceding hydrotheca. Hydrophores moderately long, cylindrical, increasing slightly in diameter to below hydrotheca, one to three proximal abcauline partial septa fading out on adcauline wall. One or two thickenings of perisarc at the base of a hydrotheca above junction with hydrophore.

Hydrotheca shallow dish–shaped, adcauline wall of primary hydrotheca closely adpressed to primary hydrophore, succeeding hydrothecae expanding smoothly from a transverse diaphragm to margin, a row of desmocytes just above diaphragm, sometimes a concave pseudo–diaphragm below. Margin everted and strongly outrolled, not replicated, ratio of depth of hydrotheca to diameter of margin 1:4–1:5.

Hydranth (preserved material) with a long conical or cylindrical peduncle with about 20 moderately long tentacles.

Gonotheca inserted on a very short pedicel within a hydrotheca, lenticular, wall smooth, perisarc thin, apex slightly pointed, no evidence of aperture. Gonophore probably male.

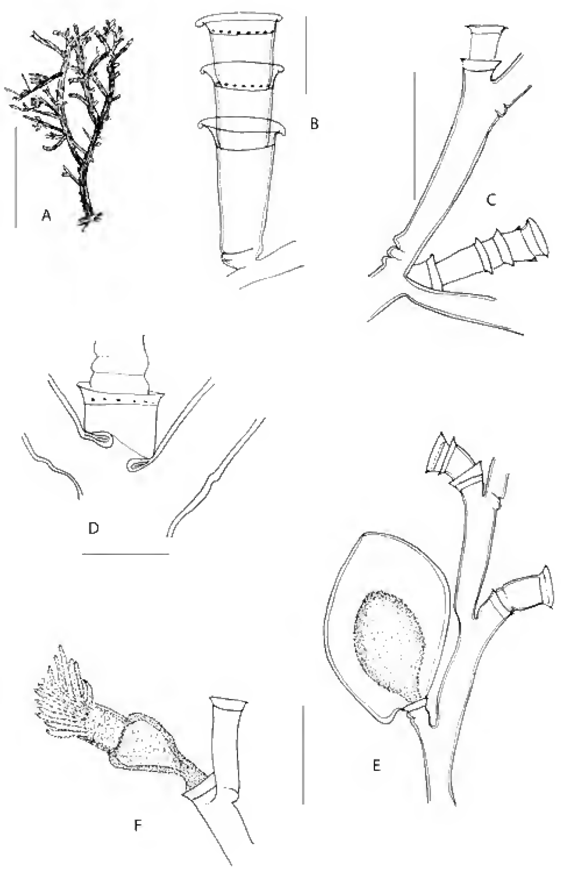


Figure 2A–F. *Halecium corpulatum* sp. nov. A, holotype colony. B, linear series of hydrophores. C, branching of stem. D, dichotomous branching of hydrophores from below a hydrotheca showing basal thickening below hydrotheca. E, male gonotheca. F, hyranth (preserved material). Scale bar, mm: A, 25. B, D, 0.2.C, E, F, 0.5.

**Measurements of *Halecium corpulatum*, ($\mu$m)**

| | |
|---|---|
| Hydrophore, primary | |
| length | 800–940 |
| width | 152–184 |
| Hydrotheca | |
| width at diaphragm | 140–180 |
| diameter of margin | 216–248 |
| depth, diaphragm to margin | 40–56 |
| Gonotheca | |
| height | 860 |
| width | 660 |

*Remarks*. The colony may have originally been much taller as it is broken off at the top. In many respects including the thickening at the base of many primary hydrophores *Halecium corpulatum* resembles *Hydrodendron sibogae* (Billard, 1929) but the absence of nematothecae places it in *Halecium*. The few gonothecae available for study do not resemble those of any large arborescent species such as *Halecium muricatum* (Ellis & Solander, 1786), *H. dichotomum* Allman, 1888 and *H. lankesteri* (Bourne, 1890). The gonothecae however, resemble Gibbons and Ryland's (1989) description of *Halecium sibogae* from Fiji; their specimen may well have been *H. corpulatum*.

While the unusually long skirt–like shape of the hydranth is probably an artefact of preservation the living hydranth nevertheless must have been extraordinarily large.

*Etymology*. Describes the large, corpulent hydranth.

**Family** Hebellidae Fraser, 1812

***Hebella costata*** (Bale, 1884)

Figure 3A

*Campanularia costata* Bale, 1884: 56.– Stechow and Müller, 1923: 463.
*Scandia corrugata* Millard and Bouillon, 1973: 60.
*Hebella muscensis* Millard and Bouillon, 1975: 10.– Boero *et al*., 1997: 22.
*Hebellopsis costata*.– Watson, 2000: 6, fig. 3A.
*Hebella costata*.– Watson and Vervoort, 2003: 64.

*Material examined*. WAM Z31866. Infertile colony on *Eudendrium racemosum*; microslide, malinol mounted.

*Description*. Hydrorhiza creeping on stem and branches of host. Hydrothecal pedicels variable in length, almost smooth and straight to gnarled, widening to base of hydrotheca. Hydrotheca tubular, straight to slightly bent, body with five to seven undulations becoming more pronounced distally, no diaphragm visible. Margin circular, transverse or slightly oblique to hydrothecal axis, rim weakly everted, not replicated.

**Measurements of *Hebella costata*, ($\mu$m)**

| | |
|---|---|
| Pedicel | |
| length | 176–440 |
| maximum width | 96–128 |
| Hydrotheca | |
| length | 800–1080 |
| diameter at margin | 460–600 |

*Remarks*. The material falls within the dimensional range of *Hebella costata* reported from Darwin (Watson 2000).

*Distribution*. Indian Ocean, Indonesia, tropical Australia.

**Family** Sertulariidae Lamouroux, 1812

***Diphasia digitalis*** Busk, (1852)

Figure 3B, C

*Sertularia digitalis* Busk, 1852: 387, 393.
*Diphasia digitalis* (Busk).– von Lendenfeld, 1885a: 415, 633.– Bale, 1884: 101.– Bale, 1915: 265.– Jäderholm, 1920: 4.– Billard, 1931: 249.– Vervoort, 1972: 99.– Pennycuik, 1959: 191.– Millard, 1975: 257.– Watson, 1996: 78.– Watson 2000: 14, fig. 10A, B.– Schuchert, 2003: 166, fig. 25.

*Material examined*. WAM Z31867. Two broken infertile stems, the longer 22 mm; microslide, malinol mount.

*Description*. Hydrorhiza creeping, stolons tubular. Stems sparingly branched, proximal athecate stem segment long, tubular, with a strong distal hinge joint. Hydrothecae paired, one pair per internode, nodes transverse, indistinct to absent, marked only by a narrowing of internode. Hydrotheca long, tubular, expanding from base to margin, free adcauline wall convex, abcauline wall concave. Margin quadrangular, with a low abcauline cusp and an indistinct longitudinal pleat extending downwards from margin, fading out near base of hydrotheca. Remains of operculae visible inside many hydrothecae. Perisarc smooth.

**Measurements of *Diphasia digitalis*, ($\mu$m)**

| | |
|---|---|
| Internode | |
| distance between hydrothecae | 1020–1300 |
| width across hydrothecal base pair | 256–384 |
| Hydrotheca | |
| adcauline wall length adnate | 800–840 |
| adcauline wall length free | 240–300 |
| width across margin | 264–296 |
| width at floor | 92–100 |

*Remarks*. The hydrothecae contain much adventitious matter presumably acquired during collection. The margins of most hydrothecae are damaged.

The specimens conform to previous descriptions of *Diphasia digitalis* from Australia (Watson 2000). The longitudinal hydrothecal pleat is inconspicuous and may be due to the young age of the colony.

*Distribution*. Circumglobal in tropical and subtropical waters. Australian distribution – Torres Strait (Busk 1852), Queensland (Pennycuik 1959), north–western Australia (Watson 1996, 2000).

**Family** Halopterididae Millard, (1962)

***Halopteris glutinosa*** Lamouroux, (1816)

Figure 3D

*Aglaophenia Glutinosa* Lamouroux, 1816:171.
*Plumularia glutinosa*.– Billard, 1909: 327.– Billard, 1910: 36, fig. 16.
*Plumularia buskii* Bale, 1884: 125, pl. 10, fig. 3, pl. 19, figs 34–35.– Bale, 1887: 22.
*Plumularia buski*.– Billard, 1913: 21, fig. 11.
*Halopteris buski*.– Watson, 1973: 184.– Schuchert, 1997: 58, figs 18, 19.– Vervoort and Watson, 2003: 353.
*Halopteris glutinosa*.– Watson, 2005: 537, fig. 37A, B.

*Material examined*. WAM Z31868. One stem fragment 5 mm long, detached from substrate; microslide, malinol mounted.

*Remarks*. Billard (1913) recorded *H. glutinosa* (as *Plumularia buski*) from nine sites on sand, shell sand and *Lithothamnion* from depths of 13–522 m in Indonesia. A specimen from Japan (author's collection) is also *H. glutinosa*.

*Distribution*. Southern and south–western Australia, New Zealand, Indonesia and Japan.

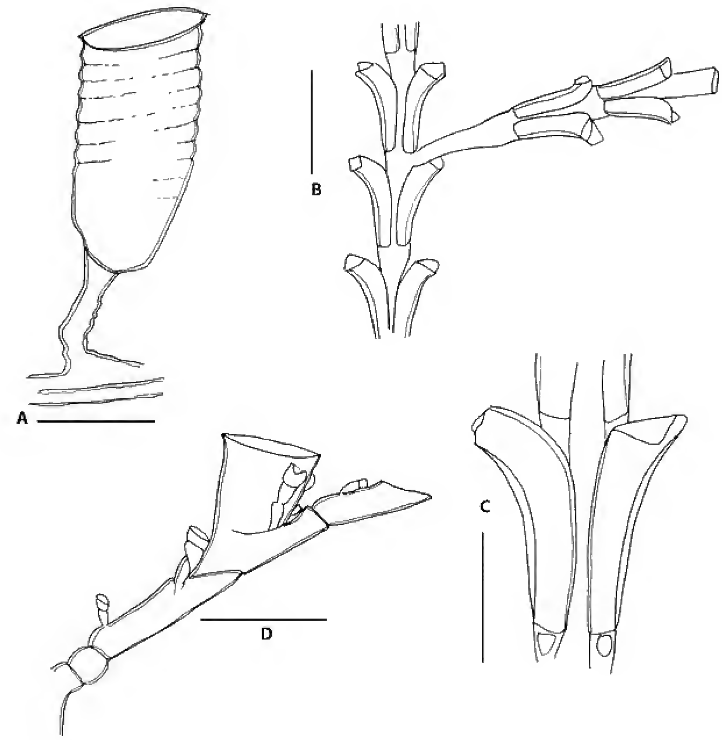


Figure 3A–D. A. *Hebella costata*. Hydrotheca with proximal corrugations. B, C. *Diphasia digitalis*. B, branched stem. C, stem internode with opposite hydrothecae. D. *Halopteris glutinosa*. Hydrocladial athecate and thecate internodes. Scale bar, mm: A, 0.5. B, 1.0. C, D, 0.25.

**Family** Plumulariidae McCrady, (1859)

***Plumularia fragilia*** sp. nov.

Figure 4A–D

*Material examined*. Holotype, WAM Z31846, One infertile stem on *Lytocarpia delicatula* (Busk, 1852); microslide, malinol mounted.

*Description*. Hydrorhiza a tubular creeping stolon. Stems pinnate, slender, to 13 mm long, monosiphonic, proximal hydrocauline segment long, straight, athecate, following internodes long, cylindrical, nodes transverse, distinct, a slight tumescence below each node.

Hydrocladia distal on cauline internode, alternate, position not quite planar. Apophysis smooth, directed upward at an angle of about 45° to hydrocaulus, abcauline apophysial wall contiguous with cauline internode, adcauline wall concave with three deep septa, distal node transverse.

Hydrocladia with two or three hydrothecae, cylindrical, narrow, beginning with a proximal athecate internode with transverse proximal and oblique distal node, usually with indistinct internal supplementary proximal and distal septa. First athecate internode followed by alternate hydrothecate and athecate internodes; athecate internodes variable in length, sometimes much longer than hydrothecate internode; hydrothecate internode long, straight with almost transverse distal node; nodes often with one or two internal septa.

Hydrotheca seated about halfway along internode, small, deep bowl–shaped, abcauline wall weakly concave to straight, adcauline wall weakly convex, completely adnate to internode, floor of hydrotheca transverse to hydrocladial axis, margin circular, oblique to hydrocladial axis, rim everted.

Nematothecae all of same shape and similar in size, bithalamic, moveable, slender conical, base long, cup wider than deep, margin circular, not excavated. One median nematotheca about halfway along athecate internode, one median inferior on hydrothecate internode well below base of hydrotheca, bases of twin laterals inserted just below hydrothecal margin; one or two nematothecae on cauline internode, standing out from internode, one about one third distance up internode from apophysis, the other two thirds distance up internode and on same side as hydrocladium, two nematothecae in axil, a bun–shaped hydrostatic pore at base of axillar nematothecae.

Colony colourless (preserved material), perisarc thin.

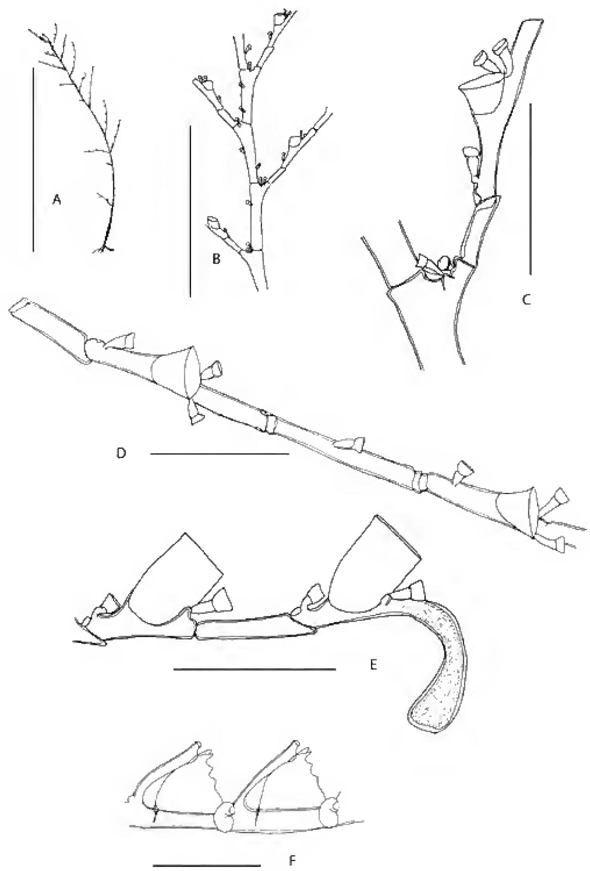


Figure 4A–E. A. *Plumularia fragilia* sp. nov., holotype colony. B, stem internodes and alternate hydrocladia. C, proximal part of hydrocladium and apophysis with axial nematothecae. D, hydrocladium with athecate and thecate internodes. E. *Plumularia bedoti*. Distal part of hydrocladium with developing anastomose. F. *Lytocarpia delicatula*. Two hydrocladial hydrothecae. Scale bar, mm: A 10. B, 1.0. C–F, 0.2

**Measurements of *Plumularia fragilia*, ($\mu$m)**

| | |
|---|---|
| Hydrorhiza, width | 40–56 |
| Stem | |
| internode length | 264–320 |
| width at node | 56–64 |
| Hydrocladium | |
| apophysis, adcauline length | 36–48 |
| first athecate internode length | 84–120 |
| succeeding athecate internodes, length | 220–260 |
| thecate internode, length | 248–284 |
| width at node | 24–36 |
| Hydrotheca | |
| abcauline wall, length | 40–46 |
| width at margin | 72–80 |
| Twin lateral nematothecae | |
| length of base | 42–52 |
| depth of cup | 10–14 |
| width of cup | 30 |

*Remarks*. *Plumularia fragilia* is a very small species. It closely resembles but is somewhat smaller than *Plumularia setacea* recorded from Darwin by Watson (2000). Stems are flaccid out of fluid. Cauline nematothecae may be absent leaving no scars on the internode

Descriptions of *Plumularia mossambicae* Millard, 1975, *P. Antonbruuni* Millard, 1967, *P. strobilophora* Billard 1913 and *P. orientalis* Billard, 1911 were compared with *Plumularia fragilia*. *P. mossambicae* is larger in dimensions, lacks cauline nematothecae, the abcauline hydrothecal wall is straight, and the margin is not everted. Millard's figure of *P. antonbruni* shows differences in structure and is also larger in all dimensions than *P. fragilia*. *P. strobilophora* is closer in overall dimensions, but the hydrothecae are more bowl–shaped and have no marginal eversion. While *P. orientalis* also has an outrolled margin, its dimensions are larger than *P. fragilia*.

*Etymology*. The species is named to describe the fragility of the colony.

***Plumularia bedoti*** Billard, (1911)

Figure 4E

*Plumularia bedoti* Billard, 1911: 64.– Billard 1913: 27.– Watson, 2000: 54, fig. 42A–D.

*Material examined*. WAM Z31847. Infertile stem fragment 13 mm long. Microslide, malinol mount.

*Remarks*. The material conforms with the description of *Plumularia bedoti* from Darwin (Watson 2000). The stem is lightly fascicled and there are distal anastomoses on the hydrocladia.

*Distribution*. Indonesia, tropical Australia (Darwin).

**Family** Aglaopheniidae Marktanner-Turneretscher, (1890)

***Lytocarpia delicatula*** Busk, (1852)

Figure 4F

*Plumularia delicatula* Busk, 1852: 396.
*Aglaophenia delicatula*.– Bale, 1884: 167.– Kirkpatrick, 1890: 604.– Billard, 1913: 106.– Pennycuik, 1959: 185. – Watson, 2000: 57, fig. 46A–E.
*Thecocarpus delicatulus*.– Millard and Bouillon, 1973: 94.
*Lytocarpia delicatula*.– Schuchert, 2003: 235, fig.76.

*Material examined*. WAM Z31848. Several pinnate stems to 35 mm long, one stem fertile; microslide, malinol mounted.

*Remarks*. The material conforms with the description of *Lytocarpia delicatula* from Darwin by Watson (2000) and from Indonesia by Schuchert (2003). Male and female gonophores are borne on the same corbula.

*Distribution*. Maldives, Moçambique, Indonesia, tropical northern and eastern Australia.

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