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PENSOFT

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Boring Amphipods from Tasmania, Australia (Eophliantidae: Amphipoda: Crustacea)

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Abstract

An overview of boring Australian Eophliantidae is provided along with the description of two new species of the genus *Bircenna* Chilton, 1884, *B. thieli* **sp. nov.** and *B. hinojosai* **sp. nov.** Interestingly, these species co-occur in samples of the bull kelp *Durvillaea potatorum* (Labillardière) Areschoug, 1854 collected in Tasmania, Australia and present a number of novel urosomite and telson structures not previously recorded. An updated key to the 16 world species is given.

Key Words

Bircenna
Durvillaea potatorum
macroalgae
identification key

Introduction

Eophliantidae Sheard, 1936 are small body-size amphipods which burrow in the stipes of algae. Though most eophliantids are recorded from a single algal species, more widely surveyed species appear to burrow in a range of algae (Lörz et al. 2010). With a greater diversity and known distribution in the southern hemisphere, there are currently six genera and sixteen species of Eophliantidae including the new species described here in (Horton et al. 2019).

Until the present study, three species of Eophliantidae from two genera had been recorded for Australia. *Eophliantis tindalei* Sheard, 1936 was collected from Point Wynyard, Tasmania, being the type species for this monotypic genus and the type genus for the family Eophliantidae. *Bircenna nichollsi* Sheard, 1936 was collected from Sellicks Beach, Gulf of St Vincent, South Australia and remains a poorly described species with limited original illustration. Lastly, *Bircenna ignea* Nicholls, 1939, was collected from Shelly Beach, Nornalup in Western Australia and has the most stable identity of the Australian *Bircenna*, following a redescription by Barnard (1972a) which expanded the known characters and provided additional illustrations.

In a study of New Zealand Eophliantidae, J.L. Barnard (1972b) discusses at length the "unresolved problems" of *Eophliantis* given its limited original description with the unknown state of the labrum, the hypopharynx, the gland cone, the cephalic incision and maxilliped characters. Based on this discussion, Barnard (1972b) goes on to indicate that a new genus and new species was to be partitioned from part of the type material of *E. tindalei* (Barnard, 1972b p. 187). Barnard offers several hypothesis on the division of the type material of *E. tindalei* including that Sheard's type series could contain as many as four different species.

Barnard's comments on the *Eophliantis* problem are based on the original illustrations by Sheard (1936) and subsequent paratype illustrations by Nicholls (1939). Which is to say these ideas are not from the direct observation of type material (based on the phrasing of sentences in Barnard, 1972). Since the type material of

E. tindalei is considered lost, Barnard's hypothesis surrounding these specimens cannot be tested. It is however interesting to note that the Eophliantidae described here include species co-occurring within the same macroalga samples, which makes plausible Barnard's statement of having multiple species within the original *E. tindalei* type series. Although from a similar location of Tasmania, neither of the new species are attributable to *E. tindalei* sensu lato as both species have pereonite 1 ventral margin with a collar, which is absent in *Eophliantis* Sheard, 1936. Nicholls' (1939) dichotomous key defines the *Eophliantis* by a single character, pereonites 5 and 6 reduced, a character not listed by Sheard (1936) in the original description and therefore is presumably a new character from Nicholls' observation of a borrowed 'co-type'. Again this character was not seen in either of the new species, which had all pereonites of similar dimension.

The new Tasmania species, *B. hinojosai* and *B. thieli*, are a larger body size, of 6.7 and 7.5 mm respectively, than previously reported Eophliantids from Australia and globally (<3 mm). An updated key to the family Eophliantidae is provided along with a brief comments highlighting the novel structures observed.

Material and methods

Macroalga was collected by hand on snorkel during fieldwork in September 2015 by Martin Thiel. Individual specimens were removed from the macroalga *Durvillaea potatorum* (Labillardière) Areschoug, 1854 using forceps.

The body length of specimens was measured by tracing the dorsal length from the tip of the rostrum to the end of the telson. To ensure accuracy, telsonic setal counts were made by mounting whole animals on slides and observing on a stereomicrosope before being returned to ethanol. Specimens were dissected in a Euparal essence and 96% ethanol solution before being mounted in Euparal as slide preparations. The pencil drawings were conducted at a LeicaM125 -and an Olympus BX53 at CeNak, University of Hamburg.

In preparation for Scanning Electron Microscope (SEM) imaging, whole animal specimens and appendages were dehydrated through a graduated ethanol series from 80 to 99 percent, acetone dried, mounted on stubs and coated with gold-palladium. Stub mounted material was imaged using a SEM LEO1525.

Material of this study is deposited at the Australian Museum, Sydney, Australia, and the Center of Natural History (CeNak), Hamburg, Germany.

A search for type material of the poorly known *E. tindalei* and *B. nichollsi* was made as part of this study. We confirm the types appear to be lost for both species (Lowry & Stoddart, 2003). Sheard's original material was deposited with the South Australian Museum and later borrowed by Nicholls then at the Western Australian Museum, however no further trace of material can be established at either institutuion. Although Nicholls deposited material of contemporary species with the British Museum of Natural History (BMNH), it is confirmed here that no material appears to have been presented at the BMNH. Perhaps not surprisingly for a small inquiline species, no material of Eophliantidae was available for study at the Australian Museum within the unworked collections. Further fieldwork or tracing of unworked Eophliantidae in museum collections was beyond the scope of this work, leaving the identity of *E. tindalei* and *B. nichollsi* unresolved.

Systematics

Suborder Senticaudata Lowry & Myers, 2013
Infraorder Talitrida Lowry & Myers, 2013
Parvorder Talitridira Lowry & Myers, 2013
Superfamily Talitroidea Rafinesque, 1815
Family Eophliantidae Sheard, 1936
***Bircenna* Chilton, 1884**

***Bircenna hinojosai* sp. nov.**

http://zoobank.org/A70F3744-5621-44EA-8C94-4ABA0D361238

Figs 1–3

Type material. Holotype female, 6 mm, dissected, 3 slides, AM P.100648; paratypes 9 specimens (6 gravid females, 1 male, 2 juveniles), AM P.100649. Paratypes SEM stubs: ZMH-K 45996 (stub 6); ZMH-K 45997 (stub 3 edge); Bicheno, Tasmania, Australia, 41°52'28"S, 148°18'13"E, from macroalga *Durvillaea potatorum* (Labillardière) Areschoug, 1854, 20 September 2015, coll. M. Thiel.

Etymology. Named for Ivan Hinojosa in recognition of his work with Crustacea and his involvement in the fieldwork which collected this species.

Type locality. Bicheno, Tasmania, Australia.

Description. Body shape subcylindrical, head rounded. Cephalic sinus absent. Eyes oval.

Pereonite 1 ventral margin with collar. Coxae 1–5 small and discontiguous. Antennae 1 same length as antenna 2; flagellum with 6 articles. Antenna 2 flagellum with 5 articles. Lower lip inner and outer lobes rounded; inner lobes apically setose. Mandible lacking palp; left incisor with 4 teeth, lacinia mobilis weakly developed; right mandible incisor with 6 teeth, 25% larger than left mandible. Maxilla 1 lacking palp; inner plate slender,

bearing 1 stout seta; outer plate with 7 setal teeth. Maxilliped inner plate long, subequal in length to outer plate, reaching end of palp article 2, with 5 apical robust setae; palp 4-articulate; article 4 blunt.

Gnathopod 1 coxa bilobate, twice as broad as deep; ischium two-thirds of basis length, length twice breadth; merus and carpus subequal, length twice breadth; propodus parachelate, length 3 times breadth, palm pollex length subequal to width, subtriangular, apically acute; dactylus unguiform and setose. Gnathopod 2 similar to gnathopod 1, with articles slightly greater in length; coxa small, triangular, twice as broad as deep; merus smaller than carpus, length twice breadth, propodus parachelate, length 3 times

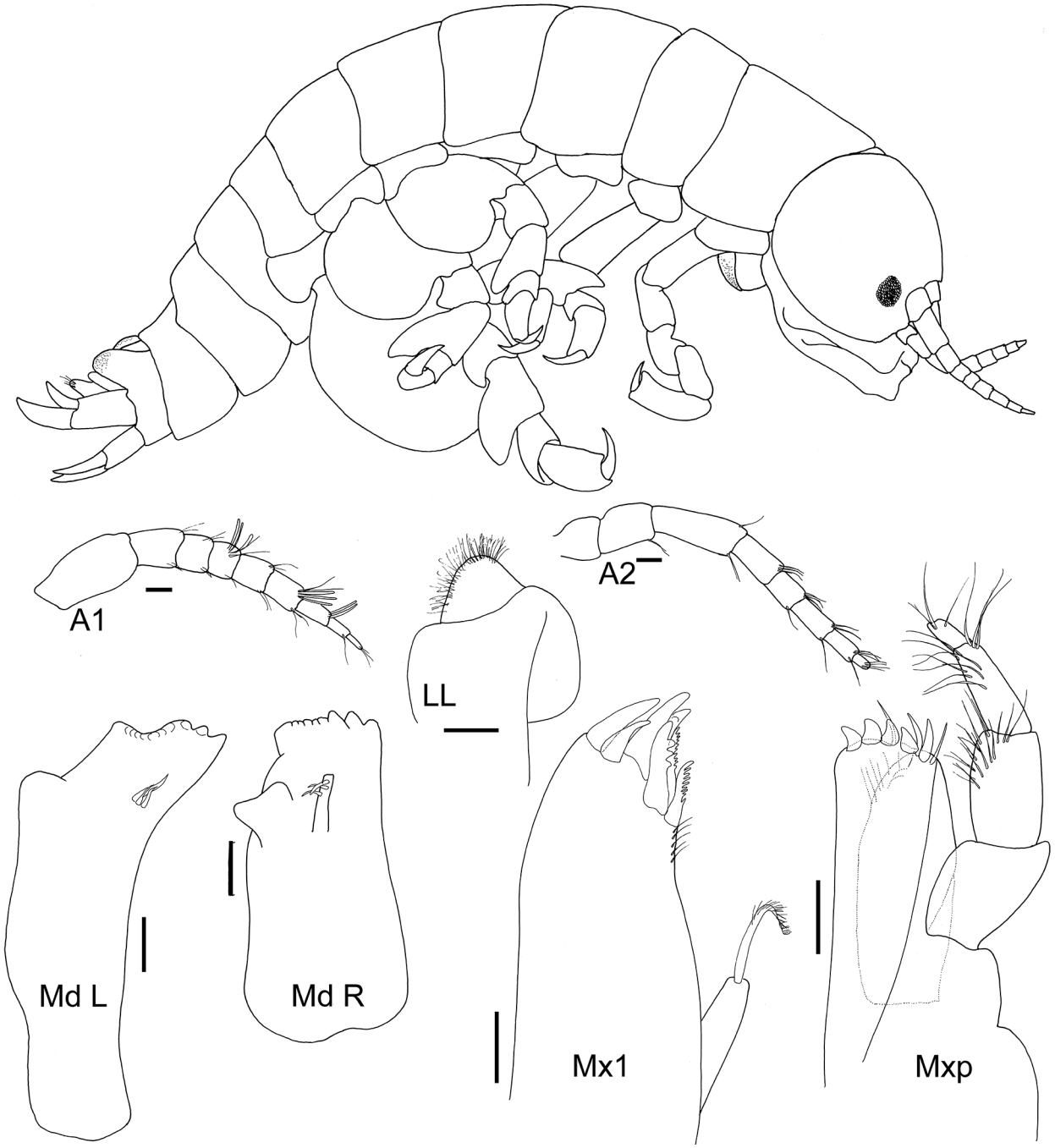

Figure 1. *Bircenna hinojosai* sp. nov. Holotype female, 6 mm, AM P.100648, Bicheno, Tasmania, Australia. Scale bars: 0.1 mm.

breadth, palm pollex length subequal to width, subtriangular, apically acute; dactylus unguiform and setose.

Pereopods 3–4 similar; coxae subrectangular (irregular); merus expanded anterodistally, anterodistal lobe with small slender setae. Pereopods 5–7 increasing in length. Pereopod 5 basis subrectangular, posterior margin expanded, evenly convex; merus and carpus with posterior distal lobe well developed with small slender setae; dactylus unguiform. Pereopod 6 basis as wide as long, posterior margin expanded subquadrate; merus and carpus with posterior distal lobe well developed with small slender setae; dactylus unguiform. Pereopods 7 length twice the depth of pereonite 7; basis rounded, posterior margin convex, anterodistal lobe reaching merus; merus and carpus with posterior distal lobe well developed with small slender setae; dactylus unguiform. Pleopods 1–3 biramus.

Epimeral plates 1–3 rectangular. Epimeron 3 posterior margin pectinate, corner produced rounded. Urosomite 1 twice length of fused urosomites 2 and 3, urosomite 1 with pair of dorsally rounded carinae. Urosomite 3 posterior margin between uropod 2–3 produced acute to subacute. Uropod 1 peduncle same length than outer ramus;

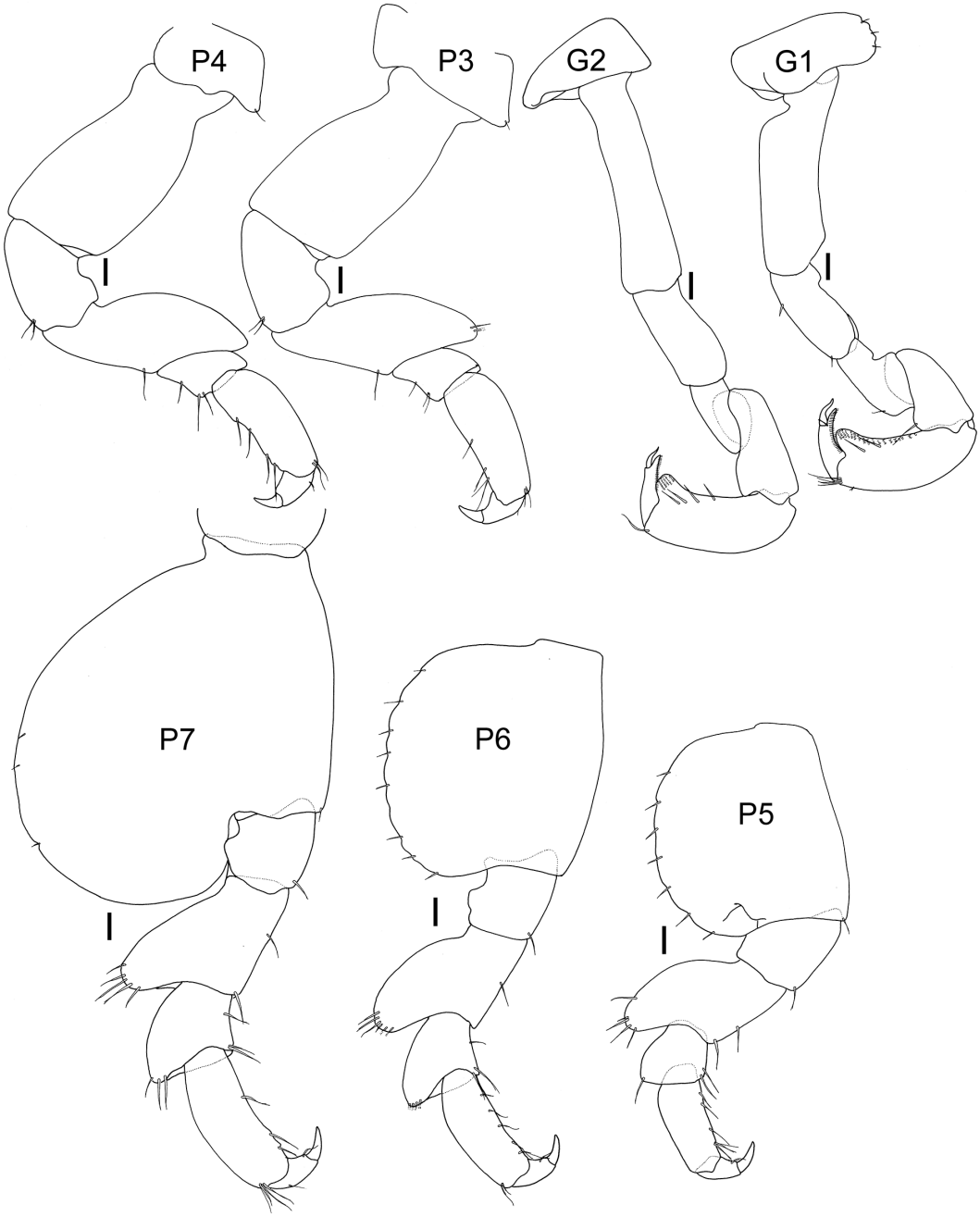

Figure 2. *Bircenna hinojosai* sp. nov. Holotype female, 6 mm, AM P.100648, Bicheno, Tasmania, Australia. Scale bars: 0.1 mm.

outer ramus about same length of inner ramus. Uropod 2 peduncle longer than outer ramus; outer ramus about 40% of inner ramus. Uropod 3 rami absent, subquadrate, with row of apical setae. Telson fleshy, deeply cleft, subquadrate; each lobe with feathered setae.

Remarks. *Bircenna hinojosai* sp. nov. has a pair of dorsally rounded carina on the urosomite 1 and the irregular geometric shape of the telson (Fig. 3). These two characters are presently unique to *B. hinojosai* sp. nov. and thus separate it from all other known Eophliantidae. The subquadrate to triangular coxa 2 to 4 in *B. hinojosai* sp. nov. is similar to *B. thieli* sp. nov and *B. macayi* Lörz et al., 2010.

See also remarks for *B. thieli* sp. nov.

***Bircenna thieli* sp. nov.**

http://zoobank.org/D35A87AA-A7B0-4171-AB48-EB261BBA182E

Figs 4–8

Type material. Holotype female, 6 mm, dissected, 2 slides, AM P.100645; paratype 1 b female, 7.5 mm, dissected, 3 slides, AM P.100646; paratypes 9 specimens, AM P.100647 (4 gravid females, 1 non-gravid female, 2 males, 2 juveniles).

Paratypes, SEM stubs: ZMH-K 45992, 5.5 mm (stub 2, entire animal); ZMH-K 45993, 5.4 mm, (stub 3, entire animal); ZMH_K-45994, (stub 4, head, urosome, body); ZMH-K 45995, 6.3 mm (stub 6 specimen at edge); ZMH-K 56619 (stub 5, mouthparts).

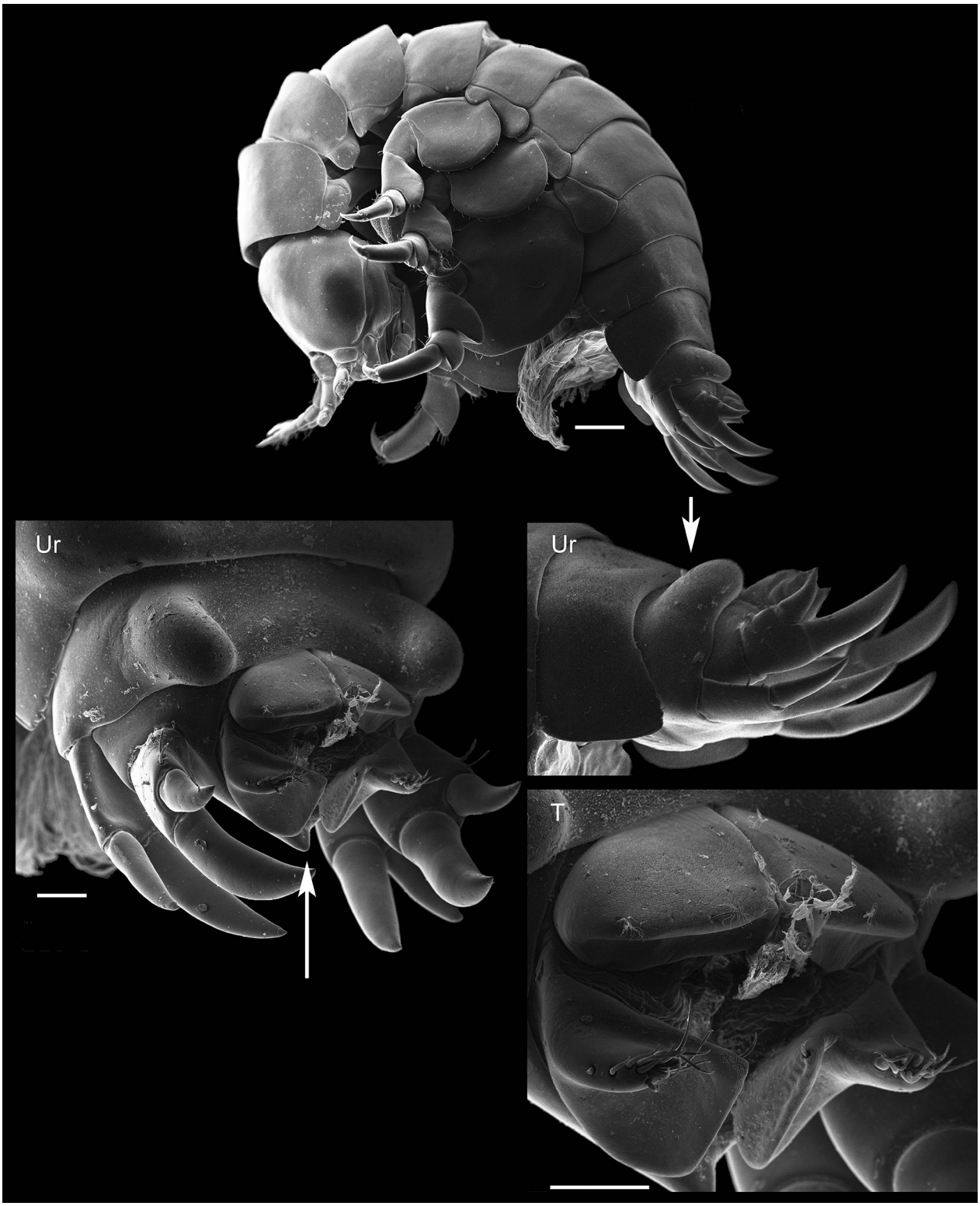

Figure 3. *Bircenna hinojosai* sp. nov. paratype SEM, gender indet. 6.7 mm, ZMH-K 45991, Bicheno, Tasmania, Australia. Scale bars: Habitus, 200 μm; Ur, 100 μm.

Bicheno, Tasmania, Australia, 41°52’28”S, 148°18’13”E, from macroalga *Durvillaea potatorum* (Labillardière) Areschoug, 1854, 20 September 2015, coll. M. Thiel.

Etymology. Named for Martin Thiel in recognition of his extensive contribution to Crustacea studies and specifically the collection of material studied here.

Type locality. Bicheno, Tasmania, Australia.

Description. Body shape subcylindrical, head rounded. Cephalic sinus absent. Eyes round. Pereonite 1 ventral margin with collar. Coxae 1–5 small and discontiguous. Antennae 1 length subequal to antenna 2; flagellum with 5–7 articles. Antenna 2 flagellum with 5–6 articles. Up-

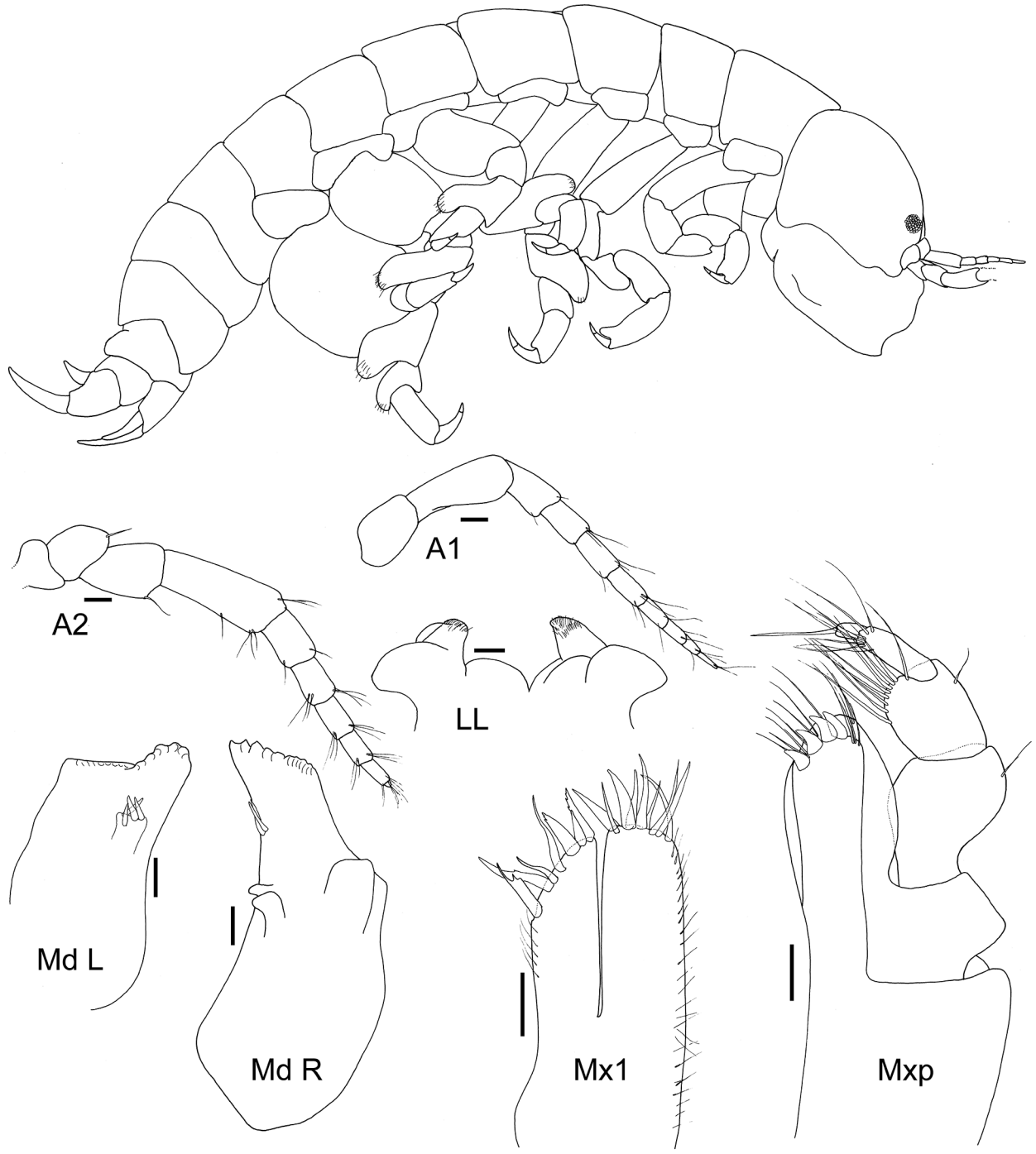

Figure 4. *Bircenna thieli* sp. nov. holotype female, 6 mm, AM P.100645, Bicheno, Tasmania, Australia. Scale bars: 0.1 mm.

per lip rounded. Lower lip inner and outer lobes rounded; inner lobes apically setose. Mandible lacking palp; left incisor with 8 teeth, lacinia mobilis weakly developed; right mandible incisor with 6 teeth, 30% larger than left mandible. Maxilla 1 lacking palp; inner and outer plates slender, similar in width, with stout apical setae. Maxilliped inner plate long, subequal in length to outer plate, extending halfway along palp article 2, with 4 apical robust setae; palp 4-articulate, article 4 blunt.

Gnathopod 1 coxa bilobate, twice as broad as deep; ischium two-thirds of basis length, length twice breadth; merus and carpus subequal, length twice breadth; propodus parachelate, length 2.8 times breadth, palm pollex length subequal to width, subtriangular, apically acute; dactylus unguiform. Gnathopod 2 similar to gnathopod 1, with articles slightly greater in length; coxa small, subrectangular, twice as broad as deep; merus and carpus subequal, length twice breadth; propodus parache-

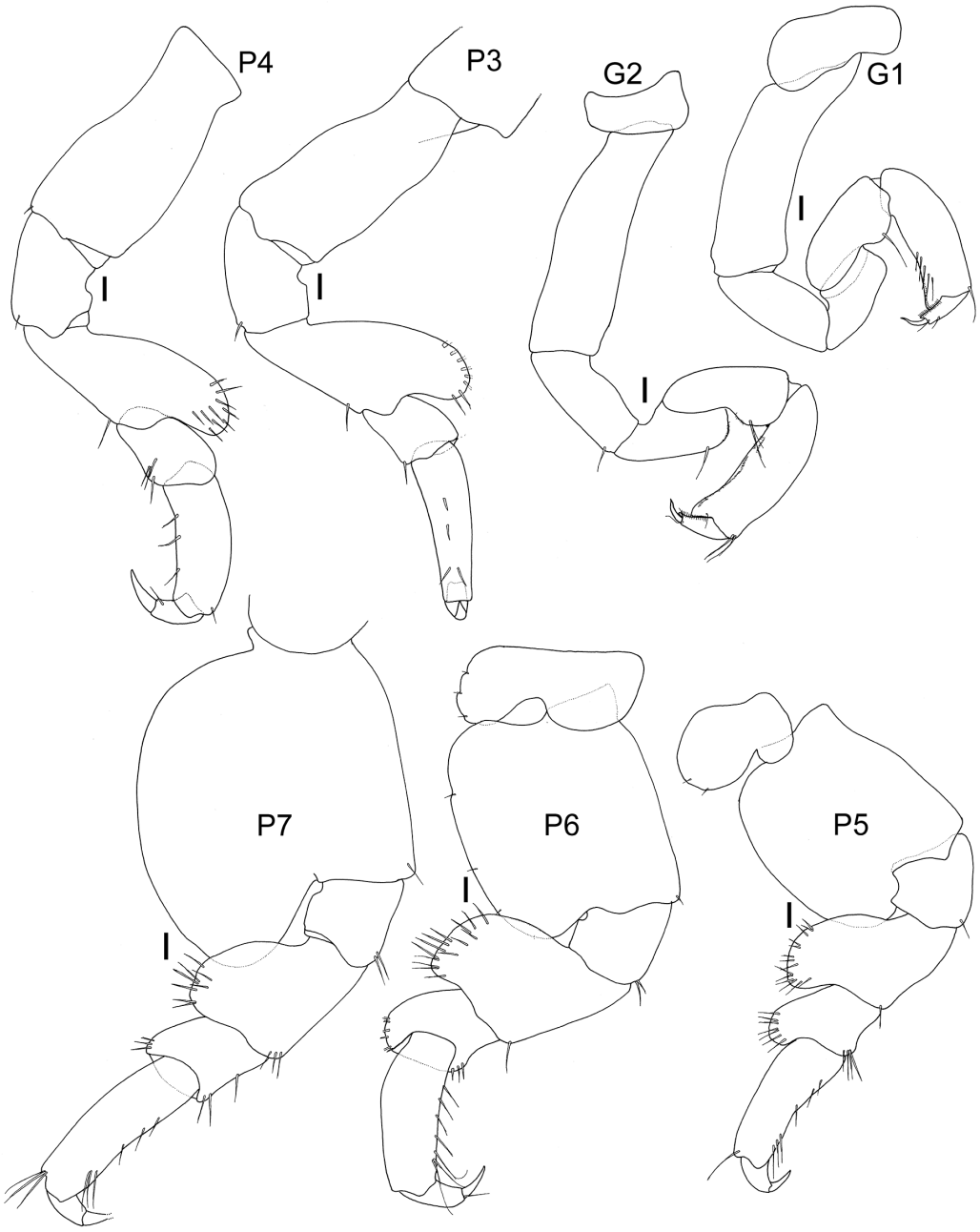

Figure 5. *Bircenna thieli* sp. nov. holotype female, 6 mm, AM P.100645, Bicheno, Tasmania, Australia. Scale bars: 0.1 mm.

late, length 3.4 times breadth, palm pollex length subequal to width, subtriangular, apically acute; dactylus unguiform. Pereopods 3–4 similar; coxae subrectangular (irregular); merus expanded anterodistally, anterodistal lobe with many small slender setae. Coxa 1, 2 and 3 less wide than their pereonite. Pereopods 5–7 increasing in length. Pereopod 5 basis subrectangular, posterior margin expanded, evenly convex; merus and carpus with posterior distal lobe well developed with many small slender setae; dactylus unguiform. Pereopod 6 basis as wide as long, posterior margin expanded subquadrate; merus and carpus with posterior distal lobe well developed with many small slender setae; dactylus unguiform. Pereopods 7 length twice the depth of pereonite 7; basis rounded, posterior margin convex, anterodistal lobe reaching beyond ischium; merus and carpus with posterior distal lobe well developed with many small slender setae; dactylus unguiform. Pleopods 1–3 biramus.

Epimeral plates 1–3 rectangular in shape. Epimeron 3 posterior margin pectinate, corner produced rounded. Urosomite 1 twice length of fused urosomites 2 and 3. Urosomite 3 posterior margin between uropod 2–3 produced acute to subacute. Uropod 1 peduncle shorter than outer ramus; outer ramus about two-thirds the length of inner ramus. Uropod 2 peduncle longer than outer ramus; outer

Figure 6. *Bircenna thieli* sp. nov. paratype SEM, gender indet. 6.3 mm, rego no. ZMH-K 45992, Bicheno, Tasmania, Australia. Scale bars: Head, 100 μm; Habitus, 1 mm.

ramus about 40% of inner ramus. Uropod 3 rami absent, subquadrate, with row of apical setae. Telson fleshy, deeply cleft, subquadrate; each lobe with a few apical setae.

Remarks. The presence of the collar on pereonite 1 ventral margin places this species in the genus *Bircenna*. *Bircenna thieli* sp. nov. is most similar to *B. macayi* Lörz et al., 2010 from New Zealand. These species differ in the pereopods 5 to 7 merus posterodistal lobe which in more broad in *B. thieli* sp. nov. The epimeron 3 in *B. thieli* sp. nov. is produced rounded with the posterior margin pectinate, while in *B. macayai*. the margin is unproduced and smooth.

Bircenna thieli sp. nov. is similar to *B. fulva* Chilton, 1884 based on the uropods 1 and 2 but the proportions are different in the length, with the outer ramus much shorter than the peduncle in *B. thieli* sp. nov.

Bircenna thieli sp. nov. can be distinguished from *B. hinojosai* sp. nov. with which it co-occurs by the absence of paired rounded carina on urosomite 1. The pereopod 7 basis of *B. thieli* sp. nov. has an angled pos-

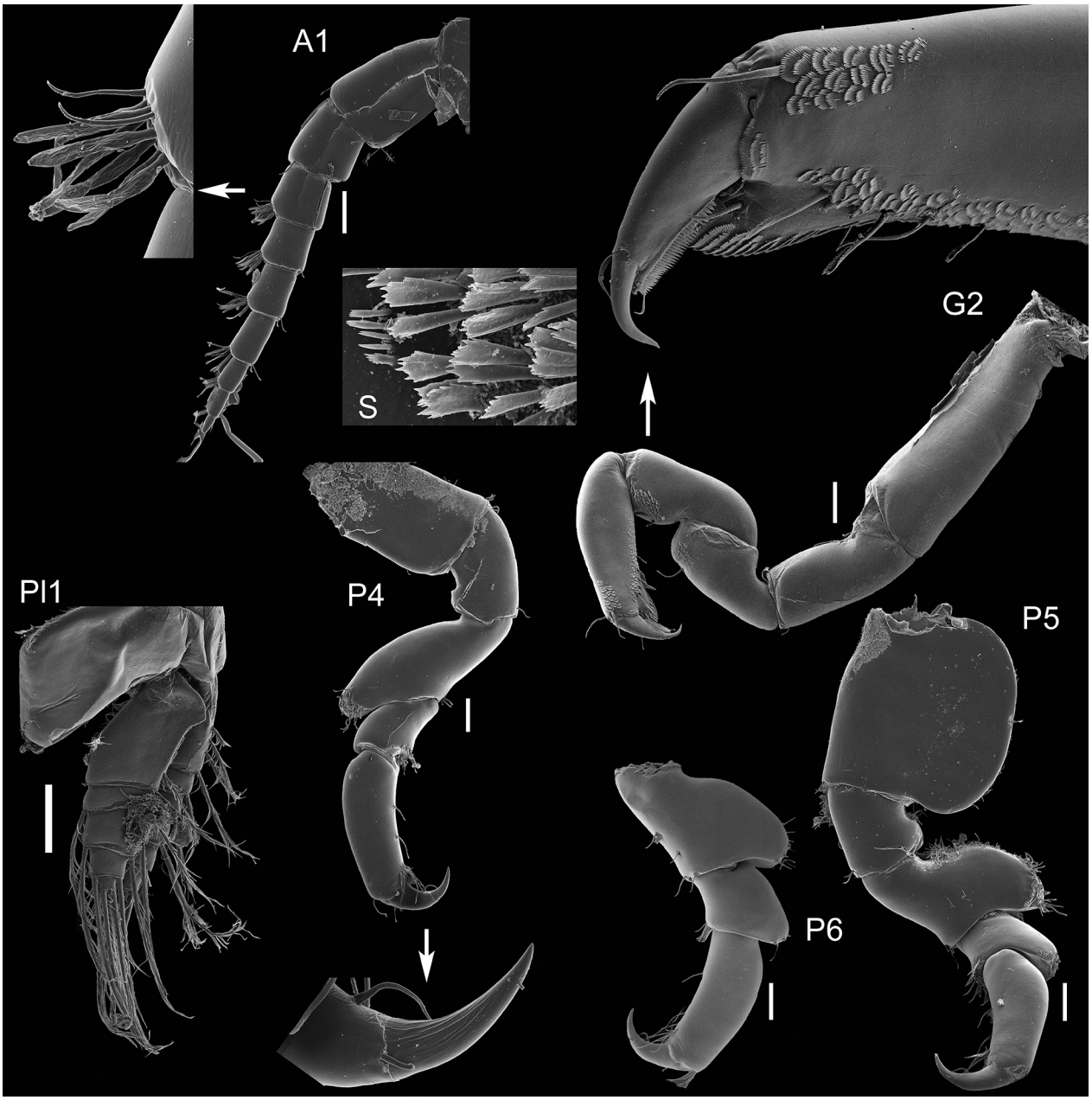

Figure 7. *Bircenna thieli* sp. nov. paratype SEM, gender indet. rego no. ZMH-K 45993, Bicheno, Tasmania, Australia. Scale bars: 100 µm.

teroventral margin, while in *B. hinojosai* sp. nov. this margin is broadly rounded. Coxa of gnathopod 2 subrectangular in *B. thieli* sp. nov. and subtriangular in *B. hinojosai* sp. nov.

Discussion

Reported for both *B. hinojosai* sp. nov. and *B. thieli* sp. nov., the horn on the posterior margin of the urosomite 3 is novel for the family Eophliantidae, and possibly for the Amphipoda (Fig. 3). The purpose of such a discretely placed structure is unknown, as a species level character its function may be ornamental.

Also novel for the Eophliantidae are the humps on the urosomite 1 (Figs 1, 3). Another wood-boring amphipod family Cheluridae Allman, 1847 has extreme modification to the urosome and rami, while algal boring *Biancolina* Della Valle, 1893 (Ampithoidae: Amphipoda) and wood-boring Limnoriidae White, 1850 (Isopoda) show no modifications to the posterior somites or uropods. It is difficult to hypothesise the purpose or function without observation of live in situ experiments. Freshly broken blades of the algae *Durvillaea potatorum* show the *Bircennas* excavating relative straight tunnels to the soft middle of the blade (Fig. 9). The natural history of host-use interaction between these species would be an interesting subject for further field ecology studies given

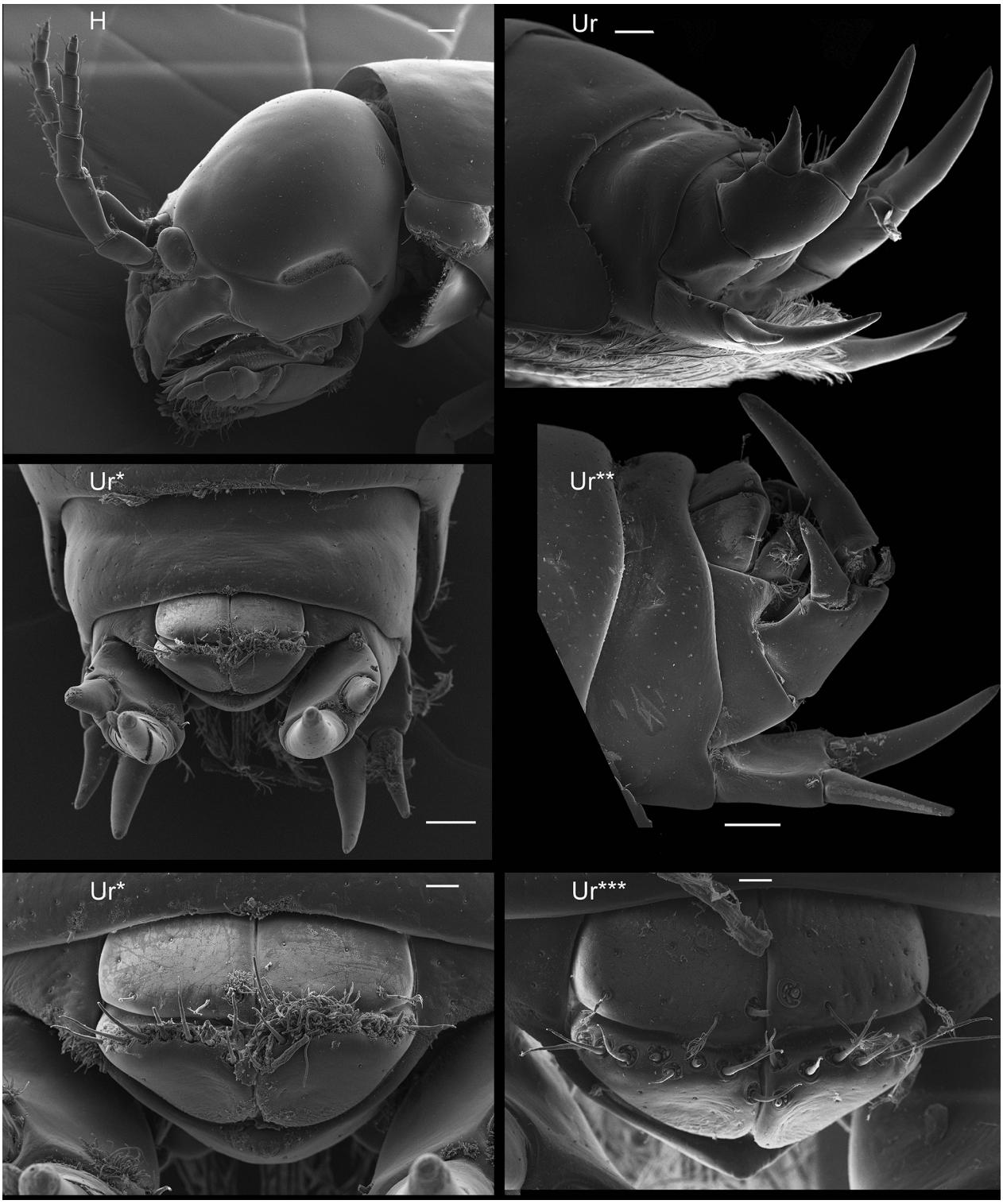

Figure 8. *Bircenna thieli* sp. nov. paratype SEM, gender indet, rego no. ZMH-K 45994 Bicheno, Tasmania, Australia. Scale bars: H, Ur, Ur* 100 µm; Ur*, 30 µm; ZMH-K 45995 Ur***, 20 µm.

the recognised Pleistocene divergence of the host macroalgae (Weber et al. 2017). Although the infection rates and influence of these new boring Eophliantid species on macroalgae is unknown, the impact of grazing amphipods on algae influences the growth of macroalgae (Mejaes et al. 2015, Poore et al. 2018).

The illustrations of *Bircenna fulva* from New Zealand are limited, yet hint at a similar complex three dimensional telson structure to *B. hinojosai* sp. nov. Further work on Eophliantidae would benefit from using SEM imaging techniques to inspect fine scale structures including the telson shape on these small body size creatures.

Figure 9. *Bircenna* species in their habitat, the bull kelp *Durvillaea potatorum* (Labillardière) Areschoug, 1854 collected in Tasmania, Australia.

Key to the world species of Eophliantidae (16 species)

1 Telson entire and fused to urosomites 2–3; antennae 1–2 flagella one-articulate .... *Lignophliantis pyrifera* J.L. Barnard, 1969
– Telson entire or cleft, urosomites distinct; antennae 1–2 flagella with more than 1 article 2
2 Pleopods uniramus 3
– Pleopods biramus 4
3 Uropod 3 rami with robust apical spine; telson lobes subquadrate; upper lip evenly rounded ..... *Cylindryllioides kaikoura* Barnard, 1972
– Uropod 3 rami lacking apical spine; telson lobes subtriangular apically acute; upper lip bilobate ..... *Cylindryllioides mawsoni* Nicholls, 1938
4 Coxae 1–7 contiguous 5
– Some or all coxa discontiguous 8
5 Coxa 1 weakly bilobed, anterior lobe shorter than posterior lobe; upper lip rounded with setae; telson lobes subtriangular ..... *Wandelia crassipes* Chevreux, 1906
– Coxa 1 subovate to subquadrate; telson lobes subquadrate 6
6 Head with cephalic sinus receiving antenna 2; antenna 1 flagellum 2-articulate ..... *Wandelia wairarapa* Barnard, 1972
– Head not incised; flagellum of antenna 1 with more than 2 articles 7
7 Uropod 1 outer ramus distinctly shorter than inner ramus; epimeral plate 3 posterior margin smooth ..... *Wandelia orghidani* Ortiz & Lalana, 1997
– Uropod 1 outer ramus subequal to inner ramus; epimeral plate 3 posterior margin crenulate ..... *Wandelia dronga* (Myers, 1985)
8 Pereonite 1 with ventral cradle 9
– Pereonite 1 without ventral cradle 14
9 Gnathopods 1–2 propodus parchelate, pollex acute 10
– Gnathopods 1–2 propodus subchelate or transverse 13
10 Coxae 2–4 subquadrate, subtriangular to rectilinear 11
– Coxae 2–4 bilobate ..... *Bircenna fulva* Chilton, 1884
11 Urosomite 1 smooth 12
– Urosomite 1 with pair of dorsally rounded carinae ..... *Bircenna hinojosai* sp. nov

12 Epimeron 3 posterior margin pectinate, corner produced.....*Bircenna thieli* sp. nov.
– Epimeron 3 posterior margin smooth, corner subquadrate .....*Bircenna macayai* Lörz, Kilgallen & Thiel, 2010
13 Coxa 2–4 subquadrate to rectilinear; telson lobes subtriangular..... *Bircenna nichollsi* Sheard, 1936
– Coxa 2–4 bilobate; telson lobes subovate.....*Bircenna ignea* Nicholls, 1939
14 Pereopods 5–7 merus and carpus posterior lobes with a few setae..... 15
– Pereopods 5–7 merus and carpus posterior lobes with densely long setae..... *Eophliantis tindalei* Sheard, 1936
15 Pereopods 6–7 basis posterodistal corner expanded, merus and carpus with posterodistal lobe.....
.....*Ceinina japonica* Stephensen, 1933
– Pereopods 6–7 basis posterior lobe evenly expanded, merus with posterodistal lobe, carpus without posterodistal lobe
.....*Ceinina latipes* Ledoyer, 1978

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