

DESCRIPTIONS OF NEW SPECIES OF *BIRUBIUS* (AMPHIPODA:  
PHOXOCEPHALIDAE) FROM AUSTRALIA AND PAPUA NEW GUINEA WITH  
COMMENTS ON THE *BIRUBIUS*-*KULGAPHOXUS*-*TICKALERUS*-*YAN* COMPLEX

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**Abstract**

Taylor, J. and Poore, G.C.B., 2001. Descriptions of new species of *Birubius* (Amphipoda: Phoxocephalidae) from Australia and Papua New Guinea with comments on the *Birubius*-*Kulgaphoxus*-*Tickalerus*-*Yan* complex. *Memoirs of Museum Victoria* 58(2): 255–295.

Five new species of *Birubius* Barnard and Drummond, 1976 (Crustacea: Amphipoda: Phoxocephalidae) are reported: *B. drummondiae* sp. nov. and *B. heislarsi* sp. nov. from Victoria, Australia; *B. wallisae* sp. nov. from Queensland, Australia; and *B. lowryi* sp. nov., and *B. wilsoni* sp. nov. from Papua New Guinea. The present records extend the range of the genus previously reported from Australia and Indonesia. The genus *Birubius* is discussed and compared with the Australian genera *Tickalerus* Barnard and Drummond, 1978 (monotypic), *Kulgaphoxus* Barnard and Drummond, 1978 (two species) and *Yan* Barnard and Drummond, 1978 (two species) in light of the new species exhibiting a combination of characters from all genera. Their synonymy is foreshadowed.

**Introduction**

Barnard and Drummond (1978) discussed the relationships between all Australian species of the Phoxocephalidae. The subfamily Birubiinae was established to include the Australian type genus *Birubius* Barnard and Drummond, 1976, Australian genera *Tickalerus* Barnard and Drummond, 1978, *Kulgaphoxus* Barnard and Drummond, 1978 and *Yan* Barnard and Drummond, 1978 and the North and South American genera *Microphoxus* J.L. Barnard, 1960 and *Metharpinia* Schellenberg, 1931. Barnard and Karaman (1991) expanded the subfamily to include the North and South American genera *Foxiphalus* J.L. Barnard, 1979 and *Grandiphoxus* J.L. Barnard, 1979. The genus *Linca* Alonso de Pina, 1993 was erected based on a single specimen from the Argentine continental shelf and although showing some convergence with the Brolginae, its similarity to *Birubius* best placed it in the Birubiinae. *Linca* differs from *Birubius* by the presence of ventral setae on uropod 1 peduncle, an autapomorphy of this monotypic genus. Jarrett and Bousfield (1994) reassessed the North and South American genera and removed them from the Birubiinae. They erected the new subfamily Metharpiniinae to include *Beringiaphoxus* Jarrett and Bousfield, 1994, *Foxiphalus* J.L. Barnard, 1979, *Grandiphoxus* J.L. Barnard, 1979, *Majoxiphalus* Jarrett

and Bousfield, 1994, *Metharpinia* Schellenberg, 1931, *Microphoxus* J.L. Barnard, 1960 and *Rhepoxynius* J.L. Barnard, 1979. The genus *Linca* was not included in the new subfamily and so remains a member of the Birubiinae.

Our preliminary cladistic analysis (work in progress) of most species of Birubiinae, Brolginae, Leongathinae, Metharpiniinae, Parharpiniinae and Tipimeginae has failed to support the monophyly of any of the subfamilies or genera. We are unable to identify a synapomorphy for the subfamily Birubiinae, even in the restricted sense, nor for its type genus *Birubius*. The Birubiinae shares a broad form of the basis of pereopod 5 with all subfamilies except Harpiniinae which exhibit a narrow basis unique to that subfamily. It shares a biarticulate palp of maxilla 1 with all subfamilies except Phoxocephalinae and those members of the Harpiniinae that exhibit a uniarticulate palp. It differs from Brolginae, Harpiniinae, Phoxocephalinae and Pontharpiniinae by the medium to elongate (rather than short) length of peduncular article 2 of antenna 1, a state that it also shares with Tipimeginae, Parharpiniinae and some members of the Joubinellinae.

Examination of unidentified phoxocephalid amphipods from the Australian Museum, Museum Victoria and Queensland Museum collections revealed five new species belonging to

the nominal subfamily Birubiinae. The generic placement of some of the species was uncertain using Barnard and Karaman's (1991) generic diagnoses. Although closely fitting the description for *Birubius* four species exhibited a large dorsal hook on urosomite 3, a character restricted within the Birubiinae to members of *Tickalerus* and *Kulgaphoxus*.

Barnard and Drummond (1978) defined *Kulgaphoxus*, *Tickalerus* and *Yan* only on the basis of differences from *Birubius*, the largest genus. *Tickalerus* differs from *Birubius* in the presence of a dorsal hook on urosomite 3, shortened outer ramus of uropod 3 and rectangular coxa 4. *Kulgaphoxus* differs from *Birubius* in the presence of a dorsal hook on urosomite 3, shortened outer ramus of uropod 3, proximal placement of setae on peduncular article 2 of antenna 1 and the vestigial dactyl of pereopod 7. *Yan* differs from *Birubius* in the proximal placement of setae on peduncular article 2 of antenna 1 and the vestigial dactyl of pereopod 7. The new species share some but not all of the diagnostic features of *Kulgaphoxus*, *Tickalerus* and *Yan* and could not be placed in any of the genera as presently diagnosed.

The discovery of four species exhibiting a dorsal hook on urosomite 3 is significant. Previously it was a trait observed in only five phoxocephalid species belonging to *Kulgaphoxus*, *Microphoxus* and *Tickalerus* and was partly used to split these species from *Birubius*. The trait was formerly believed to be sexually dimorphic and restricted to females with males having a reduced hump at best. Males of the new species *B. drummondiae* sp. nov. and *B. wallisae* sp. nov. however exhibit a well developed dorsal hook as in females. It appears that sexual dimorphism is variable but the possibility that males without hooks belong to other species is a remote possibility.

Barnard and Drummond did not use cladistic methodology to define genera. Rather, small genera were picked off from larger clusters on the basis of few differences that may or may not be unique synapomorphies. The inevitable consequence of this is that the large genus, *Birubius* in this case, is paraphyletic because its numerous species lack a synapomorphy. We are forced to conclude that either (a) the small genera, *Kulgaphoxus*, *Linca*, *Tickalerus* and *Yan*, as presently constituted are gradal offshoots of Birubiinae which cannot be supported in a classification based on cladistic principles; or (b) the type species of the four genera represent much larger clades which may be redefined using very different character suites (synapomorphies).

Until the cladistic analysis is completed we are reluctant to complicate the taxonomy further by erecting new small genera simply because they do not comply with existing diagnoses. It is unclear whether the minor genera in question will come to encompass larger clades but it is certain that they cannot be justified as currently defined. Therefore in this contribution we describe the new taxa as members of *Birubius* in spite of their similarities to some members of *Kulgaphoxus*, *Tickalerus* and *Yan*. The synonymy of these genera with *Birubius* is foreshadowed. Our revised diagnosis of *Birubius* is written to include all species included in *Birubius*, *Kulgaphoxus*, *Tickalerus* and *Yan*.

Abbreviations are: A, antenna; H, head; rLM, right lacinia mobilis; MD, mandible; MX, maxilla; MP, maxilliped; GN, gnathopod; P, pereopod; EP, epimeron; U, uropod; PL, pleopod; T, telson; r, right; m, male; tl., total length; MAFRI, Marine and Freshwater Resources Institute, Queenscliff; NMV, Museum Victoria, Melbourne; AM, Australian Museum, Sydney, QM, Queensland Museum, Brisbane. All dissections and illustrations follow the methods of Barnard and Drummond (1978) whereby the left side of the animal is illustrated unless otherwise stated. Descriptions of the new species closely follow that of other species of the genus described in Barnard and Drummond (1978).

#### ***Birubius* Barnard and Drummond**

*Birubius* Barnard and Drummond, 1976: 543.—Barnard and Drummond, 1978: 191.—Barnard and Karaman, 1991: 635.

*Type species. Birubius panamunus* Barnard and Drummond, 1976 (by original designation).

*Diagnosis.* Rostrum variably constricted. Eyes present. Antenna 1 peduncular article 2 length variable, ventral setae not confined apically. Antenna 2 peduncular article 1 not or scarcely ensiform, article 3 with 2 facial setules, facial robust setae on article 4 in 2+ rows, all robust setae thick, article 5 ordinary. Right mandibular incisor with 3-4+ teeth, right lacinia mobilis bifid or simple, often flabellate or absent, molar not tritirative, with 4+ splayed robust setae; palpal hump small to medium, apex of palp article 3 oblique. Maxilla 1 inner plate with 3-4 setae, palp 2-articulate. Maxillipedal plates small to ordinary, apex of palp article 3 not strongly protuberant, dactyl elongate, apical nail distinct.

Gnathopods small, similar, gnathopods 1-2 carpus length medium to elongate, not cryptic

(posterior margin not concealed by the abutment of propodus and merus), palms oblique, gnathopods 1–2 propodus ordinary to narrow, ovate to rectangular, poorly setiferous anteriorly. Pereopods 3–4 carpus with (rarely without) postero-proximal robust setae, propodus with robust setae. Pereopod 5 basis of broad form (basis equal to or greater than twice width of ischium), pereopods 5–6 merus-carpus broad to narrow; pereopod 7 unreduced, article 3 not enlarged, dactyl well developed, vestigial or absent.

Epimera 1–2 with or without long facial brushes of setae, without posterior setae, epimeron 3 bearing long setae. Urosomite 3 with or without dorsal hook in females, sometimes in male only if in female. Uropod 1 peduncle without interrampal robust setae, without major displaced robust seta (seta that is shifted onto the apical margin disjunctly from the true inner margin), uropods 1–2 rami occasionally continuously setose to apex (thus with minute apical robust setae or nails), uropod 1 inner ramus with 1 row of marginal robust setae. Uropod 2 inner ramus ordinary to shortened. Uropod 3 variable, either unreduced (outer ramus longer than peduncle), or reduced (outer ramus shorter than or subequal to peduncle), bearing a second article on outer ramus, with 2 long apical setae. Telson ordinary to elongate.

*Species.* *Biribius batei* (Haswell, 1879); *B. rostratus* (Dana, 1853) = *B. barnardi* Pirlot, 1932. Species described by Barnard and Drummond, 1978: *B. apari*; *B. babaneekus*; *B. booleus*; *B. cartoo*; *B. chintoo*; *B. eake*; *B. eleebanus*; *B. gallangus*; *B. gambodeni*; *B. gelarus*; *B. jirrandus*; *B. kabbulinus*; *B. kareus*; *B. karobrani*; *B. kinkus*; *B. kokorus*; *B. kyeemus*; *B. lorus*; *B. lowannus*; *B. maamus*; *B. maldus*; *B. mayamayi*; *B. muldarpus*; *B. munggai*; *B. myallus*; *B. nammuldu*; *B. narus*; *B. panamunus*; *B. quearus*; *B. taldeus*; *B. thalmus*; *B. ularitus*; *B. wirakus*; *B. vulgaru*; *B. yandus*; *B. yorlunus*. Species added after 1978: *B. bali* Ortiz and Lalana, 1999; *B. drummondiae* sp. nov.; *B. heislarsi* sp. nov.; *B. lowryi* sp. nov.; *B. murariui* Ortiz and Lalana, 1997; *B. wallisae* sp. nov.; *B. wilsoni* sp. nov.

*Habitat and distribution.* Marine 0–70 m. Australia; Indonesia; Papua New Guinea.

*Remarks.* Barnard and Karaman's (1991) generic diagnosis has been altered to accommodate the new species and to reflect the foreshadowed synonymy of *Tickalerus*, *Kulgaphoxus* and *Yan*.

### *Biribius drummondiae* sp. nov.

Figures 1–6

*Material examined.* Holotype. Australia, Victoria, Western Port (38°22'S, 145°32'E) no further data, NMV J47227 (1 female, tl. 3.8 mm).

Allotype. Same locality as holotype, NMV J47228 (1 male, tl. 5.25 mm).

Paratypes. Same locality as holotype, NMV J47226 (27 females, tl. 3.0–5.7 mm).

*Diagnosis.* Rostrum constricted. Antenna 2, article 4 without well developed dorsal setation. Right lacinia mobilis bifid, distal branch denticulate. Pereopods 3–4 carpus with 2–3 proximoposterior robust setae. Pereopod 5 dactyl fully formed. Pereopod 7 basis without long ventral setae. Coxa 1 not expanded distally. Coxa 4 lacking long ventral setae. Epimeron 3 without large tooth; without ventral setae; without long posterior seta; with oblique row of facial setae. Urosomite 3 with large dorsal hook. Uropod 1 without basofacial setae. Uropods 1–2 inner rami lacking accessory apical nails. Uropod 3 unreduced, outer ramus longer than peduncle.

*Description of female.* Head about 18% of total body length, greatest width about 100% of length; rostrum constricted, exceeding apex of peduncular article 1 on antenna 1. Eyes medium, clear of pigment. Antenna 1 peduncular article 1 about 1.3 times as long as wide, about 1.8 times as wide as peduncular article 2, ventral margin with 4 setules, produced dorsal apex with 1 setule; peduncular article 2 about 0.8 times as long as peduncular article 1, with 5 ventral setae; primary flagellum with 10 articles, about 0.9 times as long as peduncle, bearing long aesthetascs; accessory flagellum with 8 articles. Antenna 2, peduncular article 4 robust setae formula = 1-3-4-3, dorsal margin with notch bearing 3 setae, ventral margin with 4–5 groups of 1–2 long to short setae, 1 long ventrodistal robust seta; peduncular article 5 about 0.8 times as long as peduncular article 4, facial robust seta formula = 1–2, dorsal margin naked, ventral margin with 3 sets of 1–2 long to short setae, without ventrodistal robust setae; flagellum 1.51 times as long as peduncular articles 4–5 combined, with 11 articles. Mandibles with medium palpal hump; right incisor with 4 teeth and notch; left incisor with 2 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal branch, denticulate, proximal branch simple, pointed, with facial hump; left lacinia mobilis sub-bifid; right raker 7; left rakers 7 plus 1 rudimentary; molar in form of bulbous hump, right molar with 4 long robust setae, plus 1 short robust seta strongly disjunct,

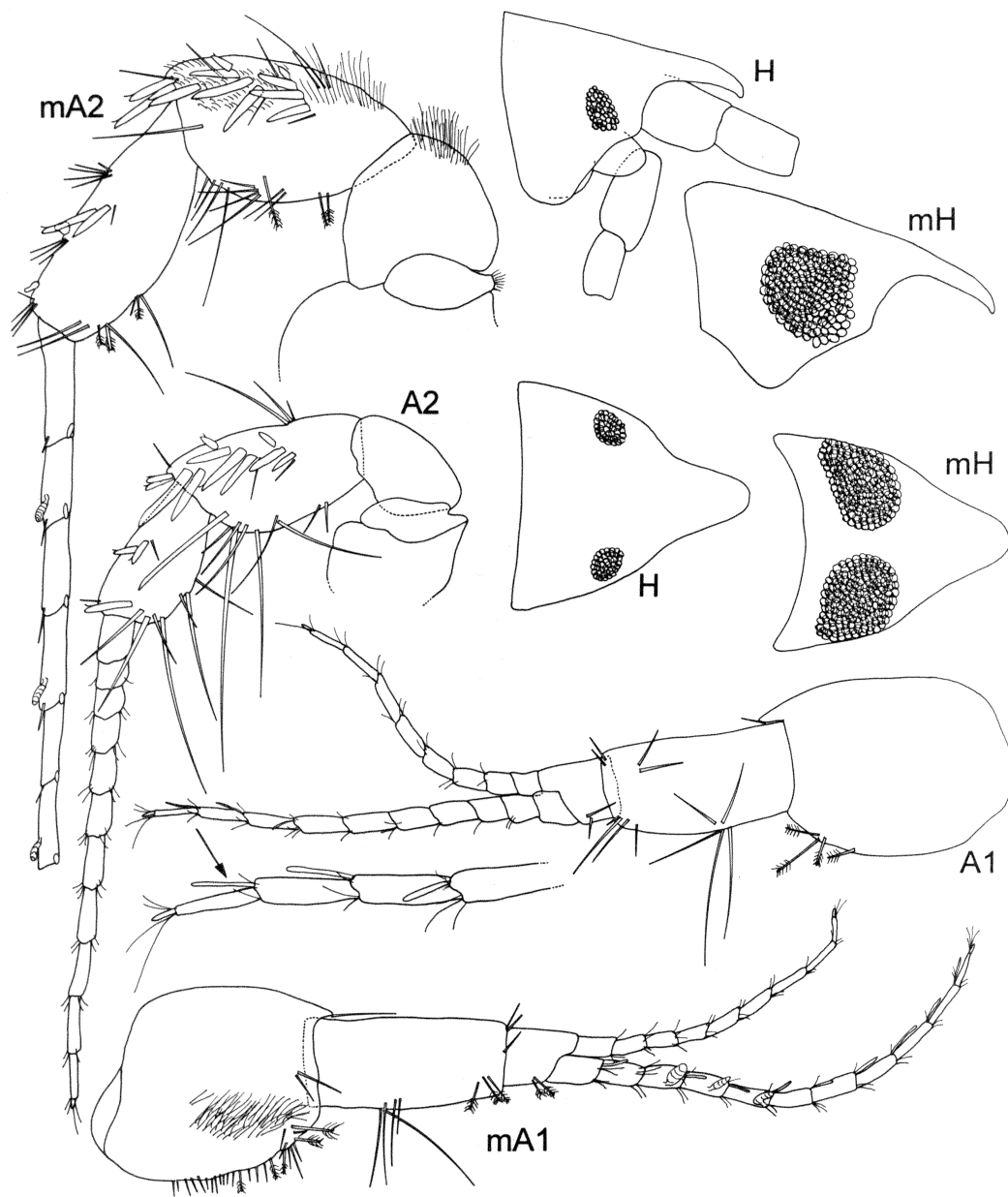


Figure 1. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm (m = male allotype, 5.25 mm).

left molar with 5 long robust setae, plus 1 short robust seta strongly disjunct; palp article 1 slightly elongate, article 2 with 1 medium inner apical seta and 2 other shorter inner setae, article 3 about equal in length to article 2, apex oblique with 6 robust to slender setae, with 3 basofacial

setae. Maxilla 1 inner plate narrow, bearing 1 long apical seta, 1 similar apicomedial seta, 2 apicolateral much shorter seta; palp article 2 with 1 apicomedial marginal robust seta, 3 apicomedial setae and 3 submarginal setae. Maxilla 2 inner and outer plates extending equally, outer not

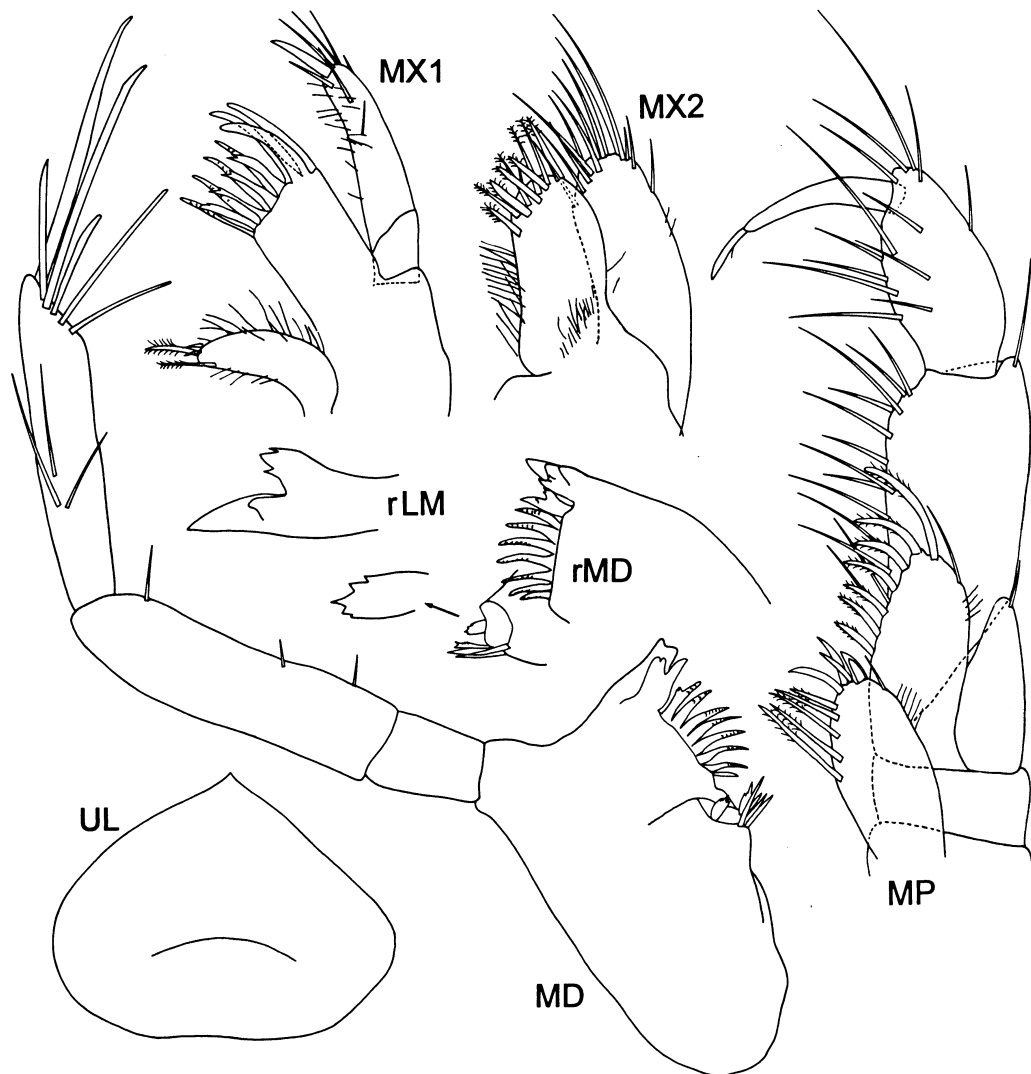


Figure 2. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm.

broader than inner. Maxilliped inner plates with 2 large thick apical robust seta, 3 apicofacial setae, 5 medial setae; outer plate with 7 medial and apical robust setae, 1 apicolateral seta; palp articles 1–2 with 1 apicolateral seta, article 3 weakly protuberant, with 3 facial setae, 1 lateral seta, nail of article 4 medium length, with 1 accessory setule. Coxa 1 not expanded distally; main ventral setae of coxae 1–4 = 5-5-5-0, posteriormost seta of coxae 1–3 shortened; anterior and posterior margins of coxa 4 parallel, posterior margin straight, posterodorsal corner sharp, posterodorsal margin

medium, width-length ratio of coxa 4 almost = 36:53. Long posterior setae on basis of gnathopods 1–2 and pereopods 3–4 = 4-1-5-7, short posteriors = 1-0-1-0, long anteriors = 4-8-0-0, short anteriors = 2-2-0-0.

Gnathopods, width ratios of carpus-propodus on gnathopods 1–2 = 20:27 and 20:27, length ratios = 21:26 and 1:1; palmar humps ordinary, palms oblique; gnathopod 1 carpus of medium length gnathopod 2 carpus slightly elongate. Pereopods 3–4 similar, facial setae on merus = 3 and 3, on carpus = 3 and 4; main spine of carpus

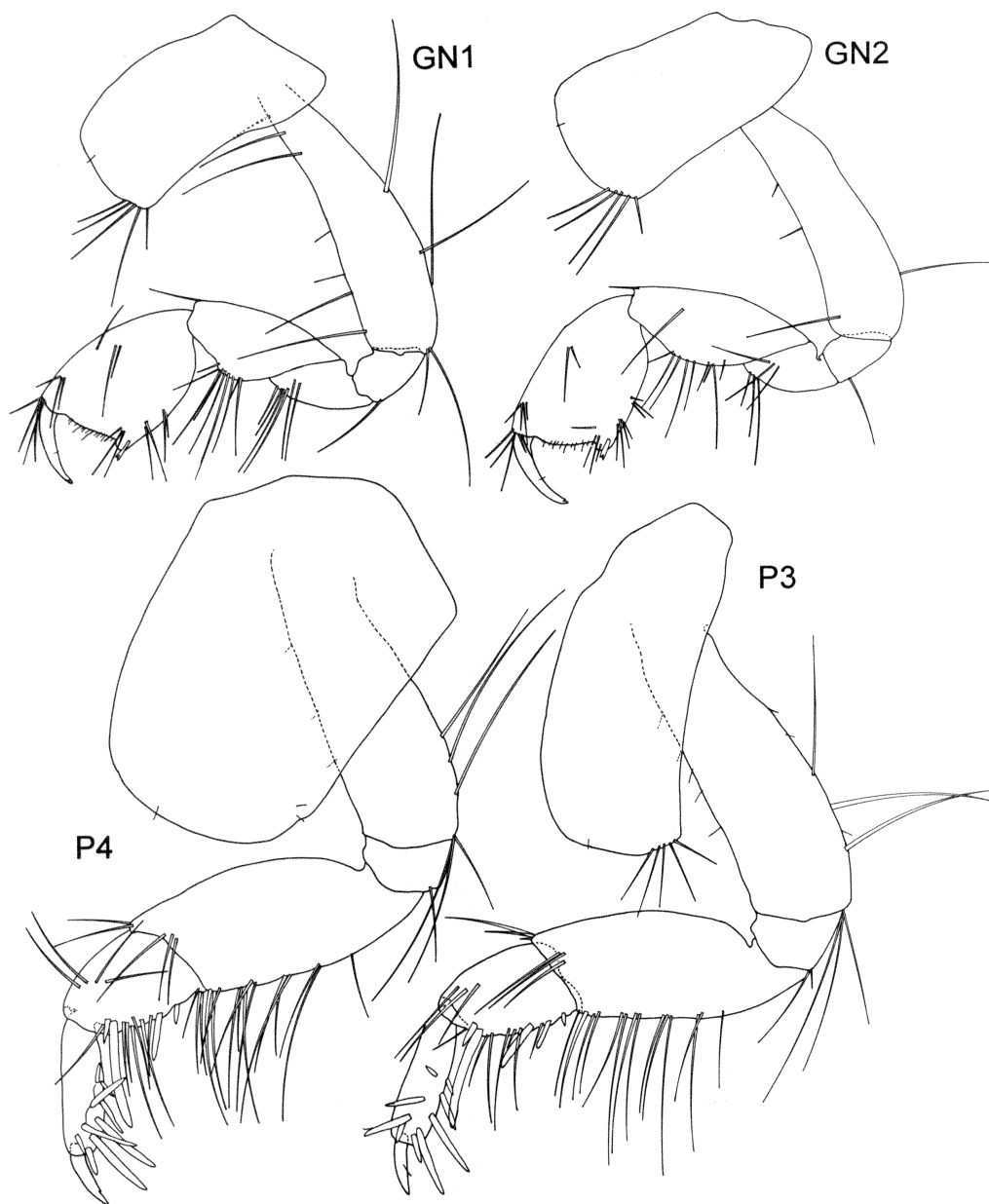


Figure 3. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm.

extending to M. 77 on propodus, carpus with 2 and 3 proximoposterior robust setae; robust setae formula of propodus = 4 + 5 and 4 + 5; acclivity on inner margin of dactyls of pereopods 3–4 weak, midfacial seta ordinary. Coxae 5–7 posteroventral seta formula = 2-2-1; merus-carpus of

pereopods 5–6 broad, facial robust setae rows dense, facial ridge formula on basis of pereopods 5–7 = 0-2-2, anterior ridge of pereopod 7 long; width ratios of basis, merus, carpus, propodus of pereopod 5 = 11:12:11:5, of pereopod 6 = 18:13:10:5, of pereopod 7 = 107:27:23:11, length

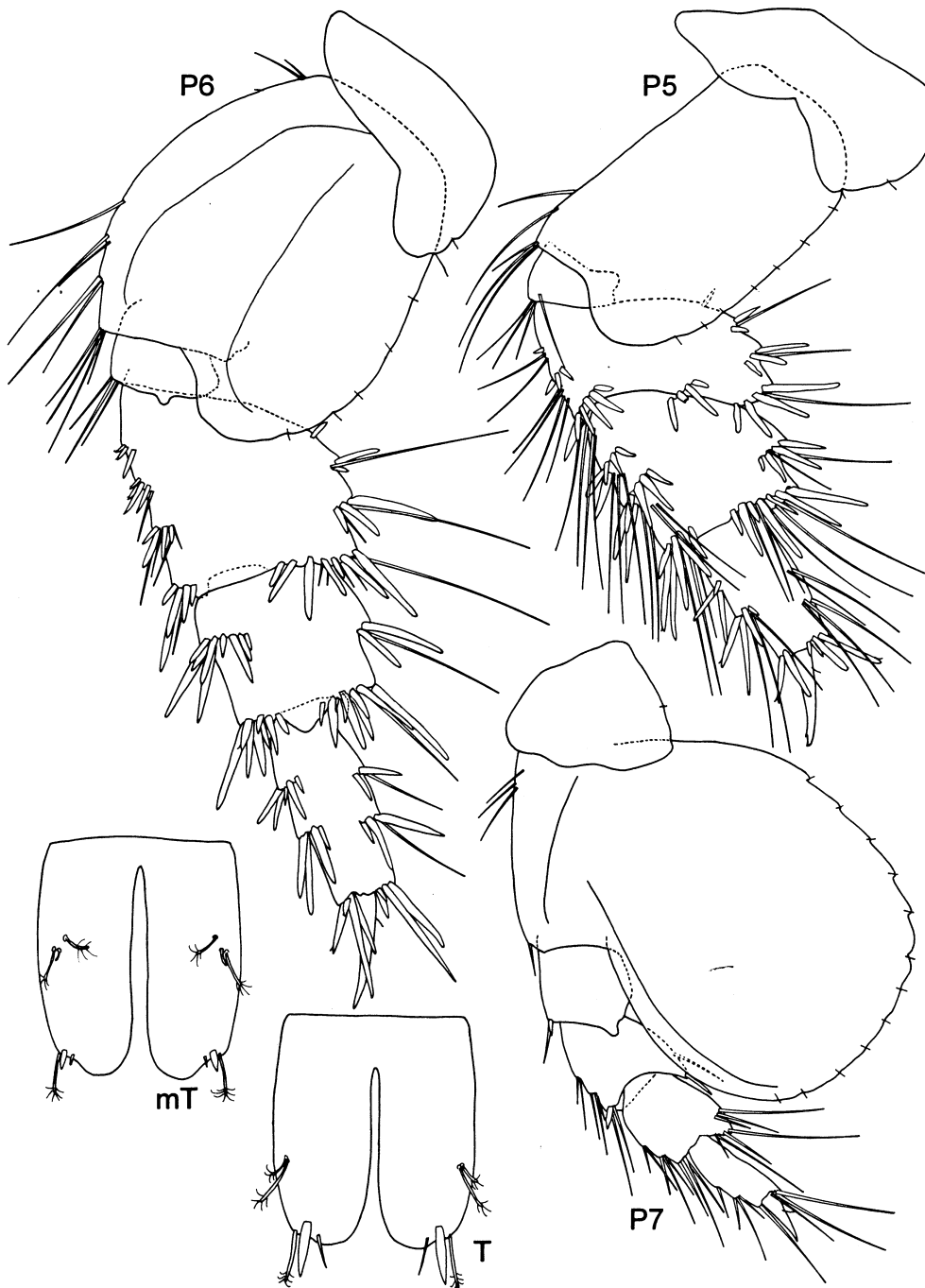


Figure 4. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm (m = male allotype, 5.25 mm).

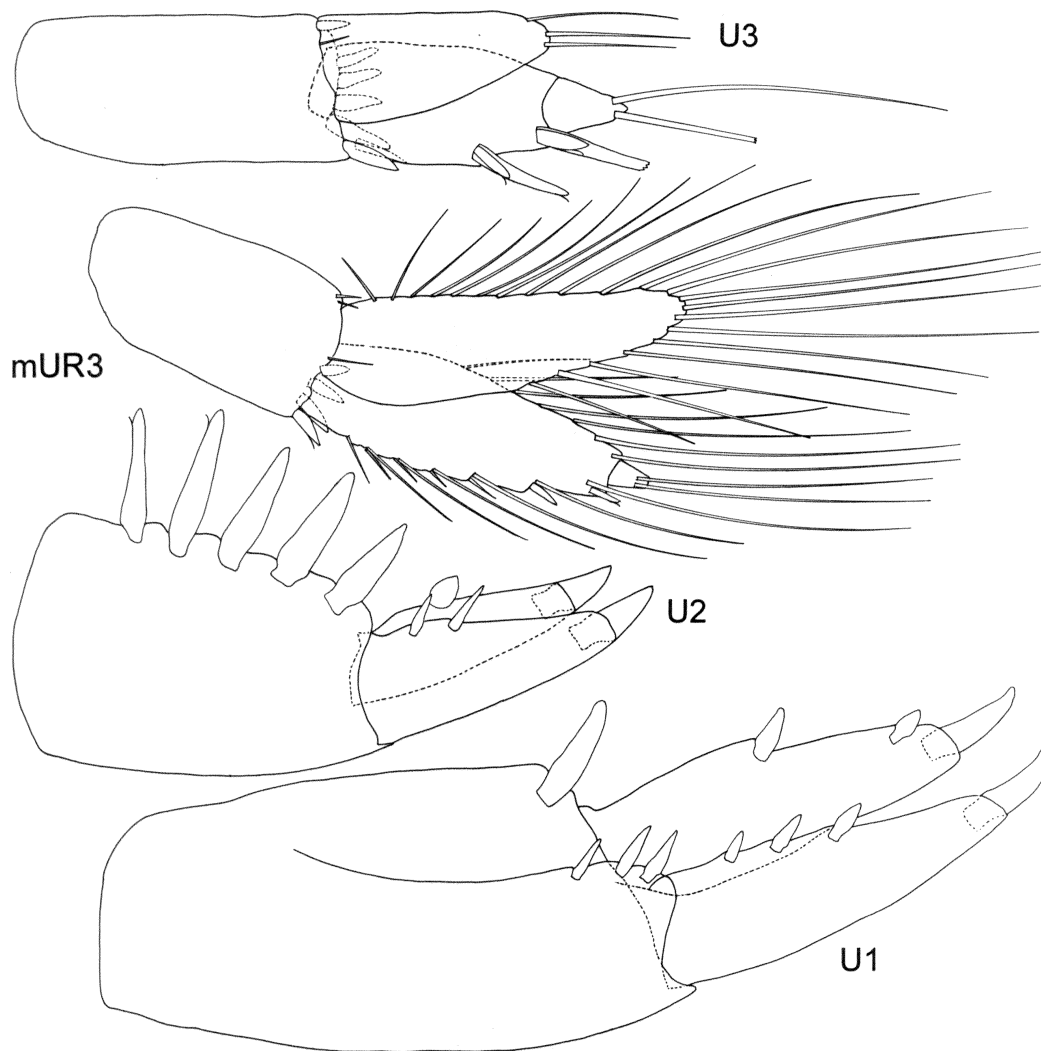


Figure 5. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm (m = male allotype, 5.25 mm).

ratios of pereopod 5 = 45:21:24:22, of pereopod 6 = 58:32:24:29, of pereopod 7 = 63:15:13:13; basis of pereopod 7 exceeding apex of merus, naked ventrally. Pleopods 1–3 with 2 coupling hooks; rear facial setae on peduncle = 2-2-3; articles on outer rami = 11-10-11, inner rami = 7-6-6.

Epimeron 1 posteroventral corner rounded, anteroventral margin with 3 setae, posteroventral face with 2 medium setae, set vertically; epimeron 2 posteroventral corner rounded, with 5 facial setae, posteriormost pair set almost verti-

cally; epimeron 3 posteroventral corner barely protuberant, with setule sinus, posterior margin almost straight, with 2 setule notches, ventral margin naked, midface with oblique row of 4 setae near posterior margin. Urosomite 1 naked, articulation line almost complete; urosomite 3 with large hook dorsally. Uropods 1–2 rami with articulate enlarged apical nails, uropod 1 outer ramus with 3 dorsal robust setae, inner with 1 dorsomedial and 1 subapical robust setae, uropod 2 outer ramus with 2 dorsal robust setae, inner



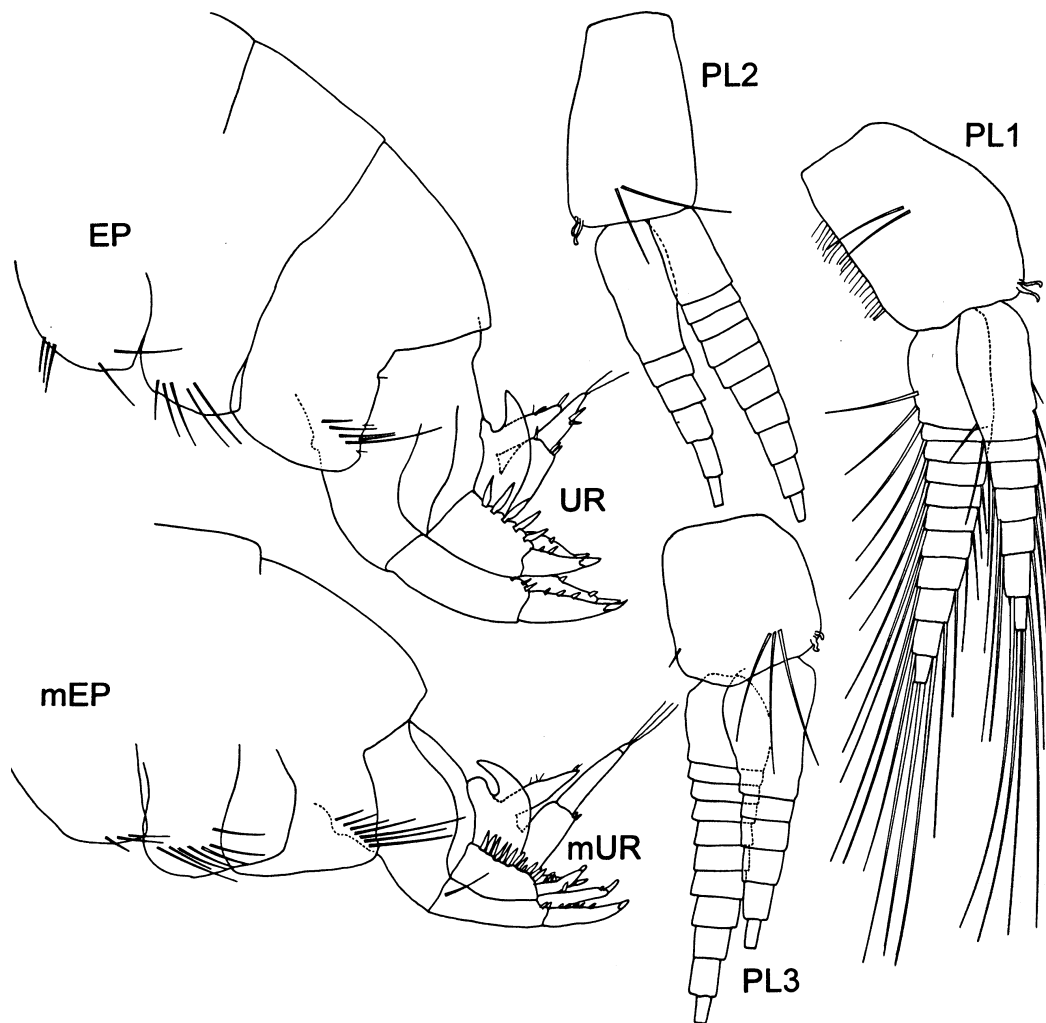


Figure 6. *Birubius drummondiae* sp. nov., holotype female, tl. 3.80 mm (m = male allotype, 5.25 mm).

with 1 broad dorsomedial robust seta; uropod 1 peduncle with 3 apicolateral robust setae, without basofacial slender setae, with apical enlarged robust seta; uropod 2 peduncle with 5 dorsal robust setae; apicolateral corners of peduncles on uropods 1–2 without comb. Uropod 3 unreduced, outer ramus longer than peduncle. Uropod 3 peduncle with 6 ventral robust setae, dorsally with 1 lateral robust seta; rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 3 setae, medial and lateral margins naked, article 2 of outer ramus elongate, 0.38, bearing 2 long setae, apicomedial margin of

article 1 naked, lateral margin with 1 acclivity, robust setal formula = 2-2, without slender setae formula. Telson long, length-width ratio = 34:29, not fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, robust setae next medial little longer than setule, midlateral setules diverse.

*Description of male.* Similar to female but eyes larger. Antenna 1 like female but with dense medial setation on peduncular article 1; primary flagellum bearing calceoli. Antenna 2 elongate, peduncular articles 3–4 with dense dorsal seta-

tion, peduncular article 5 about as long as article 4, dorsal margin bearing 2 calceoli and 3 groups of male setae, flagellum 28-articulate bearing calceoli. Maxilliped and maxillae 1–2 similar to female. Right lacinia mobilis bifid, distal branch much shorter than proximal branch, flabellate, proximal branch simple, pointed, with facial humps; left lacinia mobilis with 4 teeth; right raker 8; left rakers 9; right and left molars with 5 long robust setae; palp similar to female, article 3 with 6 basofacial setae. Main ventral setae of coxae 1–4 = 7–6–7–0. Gnathopods 1–2 similar to female. Urosomite 3 with large hook dorsally. Uropod 1 outer ramus with 5 dorsal robust setae, inner with 1 dorsomedial and 1 subapical robust setae, uropod 2 outer ramus with 3 dorsal robust setae, inner with 1 broad dorsomedial robust seta; uropod 1 peduncle with 2 apicolateral robust setae, with 1 basofacial slender seta; uropod 2 peduncle with 12 dorsal robust setae. Uropod 3 with inner ramus elongate, exceeding apex of article 1 on outer ramus. Telson elongate, length-width ratio = 7:6.

*Etymology.* For Margaret Drummond who identified this species as new from Museum Victoria collections and contributed so much to knowledge of Australian amphipods.

*Remarks.* The following variations from the holotype were observed in the paratypes. The main ventral setae of coxae 1–4 = (4–5)–(4–6)–(4–6)–0. Uropod 1 outer ramus with 3–4 dorsal robust setae, inner ramus with 1 dorsomedial and 1 subapical robust setae. Uropod 2 outer ramus with 1–2 dorsal robust setae, inner ramus with 1 dorsal robust setae.

*Birubius drummondiae* shares the dorsal hook of urosomite 3 with *Tickalerus birubi*, both species of *Kulgaphoxus* and three other new species of *Birubius* described herein. This species can not be placed in the genus *Tickalerus* as it lacks both the well developed dorsal setation on article 4 of female antenna 1 and the shortened outer ramus of uropod 3, characters diagnostic of the type species, *T. birubi*. It remains distinct from both species of *Kulgaphoxus* in its lack of accessory apical nails on the inner rami of both uropods 1–2, the unreduced rostrum and the perfectly rectangular coxa 4, a character it shares with *T. birubi*. *Birubius drummondiae* differs from previously described species of *Birubius* by the presence of the dorsal hook on urosomite 3, and from the other new species described herein by the combination of characters listed in the diagnoses. The species is number MoV3679 in Museum Victoria's TAXA database.

### *Birubius heislarsi* sp. nov.

Figures 7–11

*Material examined.* Holotype. Australia, Victoria, Ninety Mile Beach (38°30'S, 147°25.8'E), 40 m, Smith-McIntyre grab, 8 May 1998 (MAFRI stn 37C), NMV J47320 (1 female, tl. 6.8 mm).

Paratypes. Australia, Victoria, Apollo Bay, Skenes Creek (38°23.4'S, 144°15.6'E), 40 m, Smith-McIntyre grab, 3 May 1998 (MAFRI stn 18C), NMV J47321 (2 females, tl. 6.5–9.75 mm).

*Diagnosis.* Rostrum constricted. Antenna 2, article 4 without well developed dorsal setation. Right lacinia mobilis bifid, distal branch denticulate. Pereopods 3–4 carpus with 3–4 proximoposterior robust setae. Pereopod 5 dactyl fully formed. Pereopod 7 basis with 1 medium ventral setae, without long ventral setae. Coxa 1 expanded distally. Coxa 4 lacking long ventral setae. Epimeron 3 with small tooth; without ventral setae; without long posterior seta; with oblique row of facial setae. Urosomite 3 without dorsal hook. Uropod 1 with basofacial setae. Uropods 1–2 inner rami lacking accessory apical nails. Uropod 3 reduced, outer ramus shortened, subequal to peduncle.

*Description of female.* Head about 18% of total body length, greatest width about 78% of length; rostrum constricted, exceeding peduncular article 1 on antenna 1. Eyes medium, clear of pigment. Antenna 1 peduncular article 1 about 1.3 times as long as wide, about 1.6 times as wide as peduncular article 2, ventral margin with 10 setules, weakly produced dorsal apex with 3 setules; peduncular article 2 about 0.8 times as long as peduncular article 1, with 8 ventral setae; primary flagellum with 15 articles, about 0.95 times as long as peduncle, bearing aesthetascs; accessory flagellum with 13 articles. Antenna 2, peduncular article 4 robust setae formula = 1–3–5–6, dorsal margin with notch bearing 3 setae, ventral margin with 6 groups of 1–2 long to medium setae, 1 ventrodistal robust seta; peduncular article 5 about 0.7 times as long as peduncular article 4, facial robust seta formula = 0–3, dorsal margin naked, ventral margin with 3 sets of 1–2 long to short setae, 3 ventrodistal long to medium robust setae; flagellum 1.6 times as long as peduncular articles 4–5 combined, with 16 articles. Mandibles with medium palpal hump; right incisor with 3 teeth; left incisor with 3 teeth in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal branch, broad, denticulate, proximal branch simple, pointed, with marginal denticles; left lacinia mobilis with 4 teeth; right raker 10; left

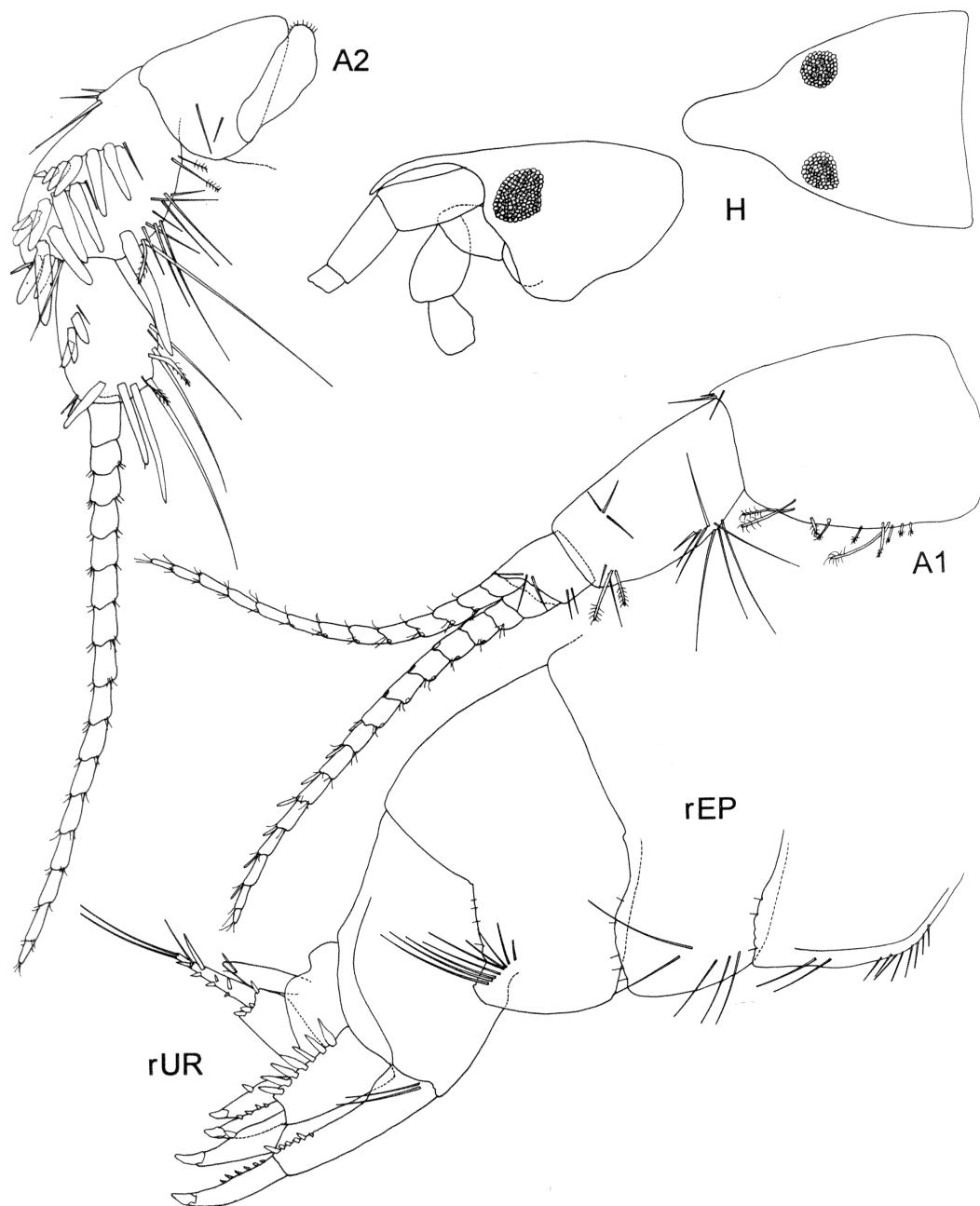


Figure 7. *Birubius heislarsi* sp. nov., holotype female, tl. 6.80 mm.

rakers 7; molar in form of short protrusion demarcated mainly by robust setae, right and left molar with 5–6 long robust setae, plus 1 short robust

seta strongly disjunct; palp article 1 slightly elongate, article 2 with 1 medium inner apical seta and 2 other shorter inner setae, article 3 about 0.8

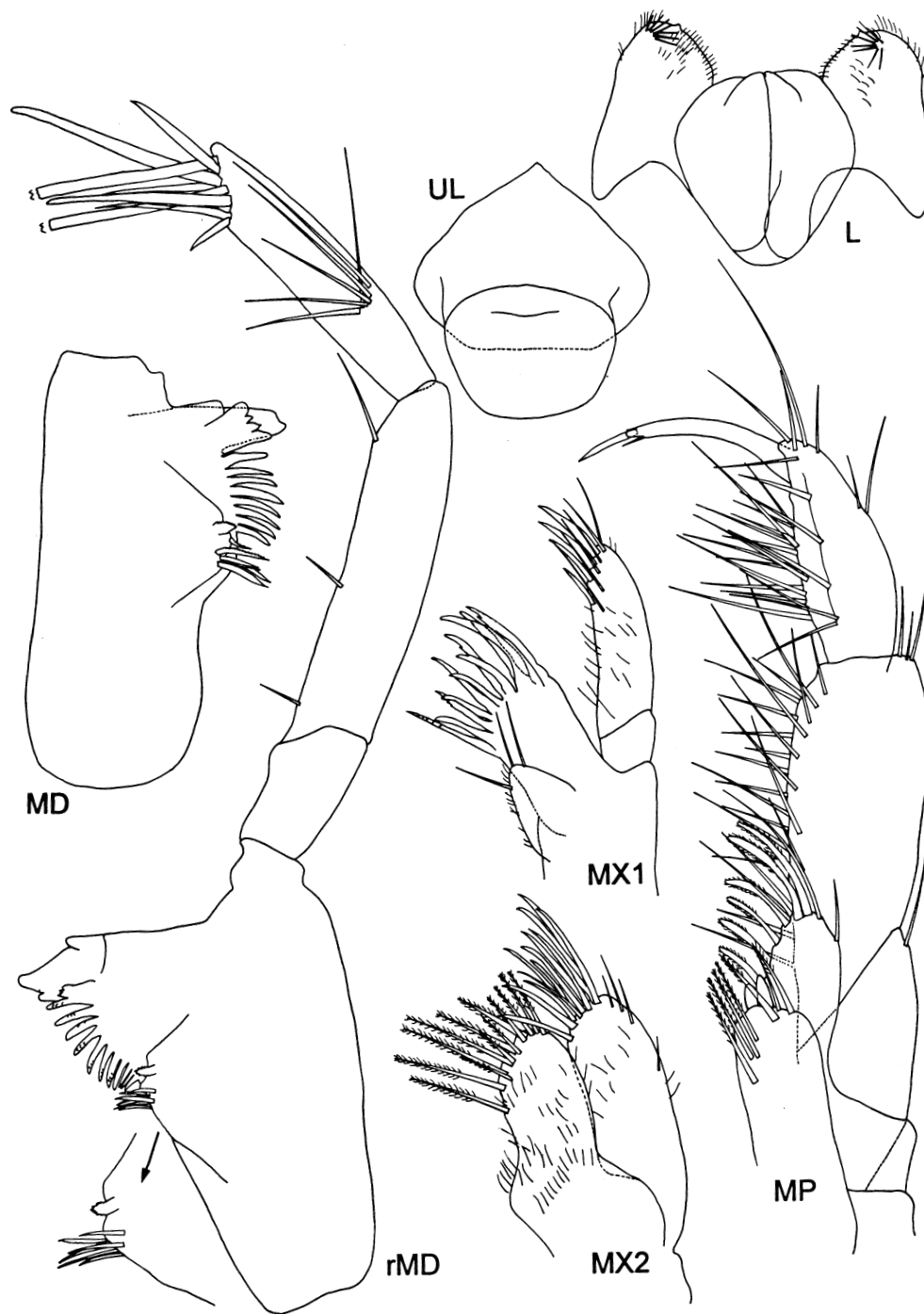


Figure 8. *Birubius heislarsi* sp. nov., holotype female, tl. 6.80 mm.

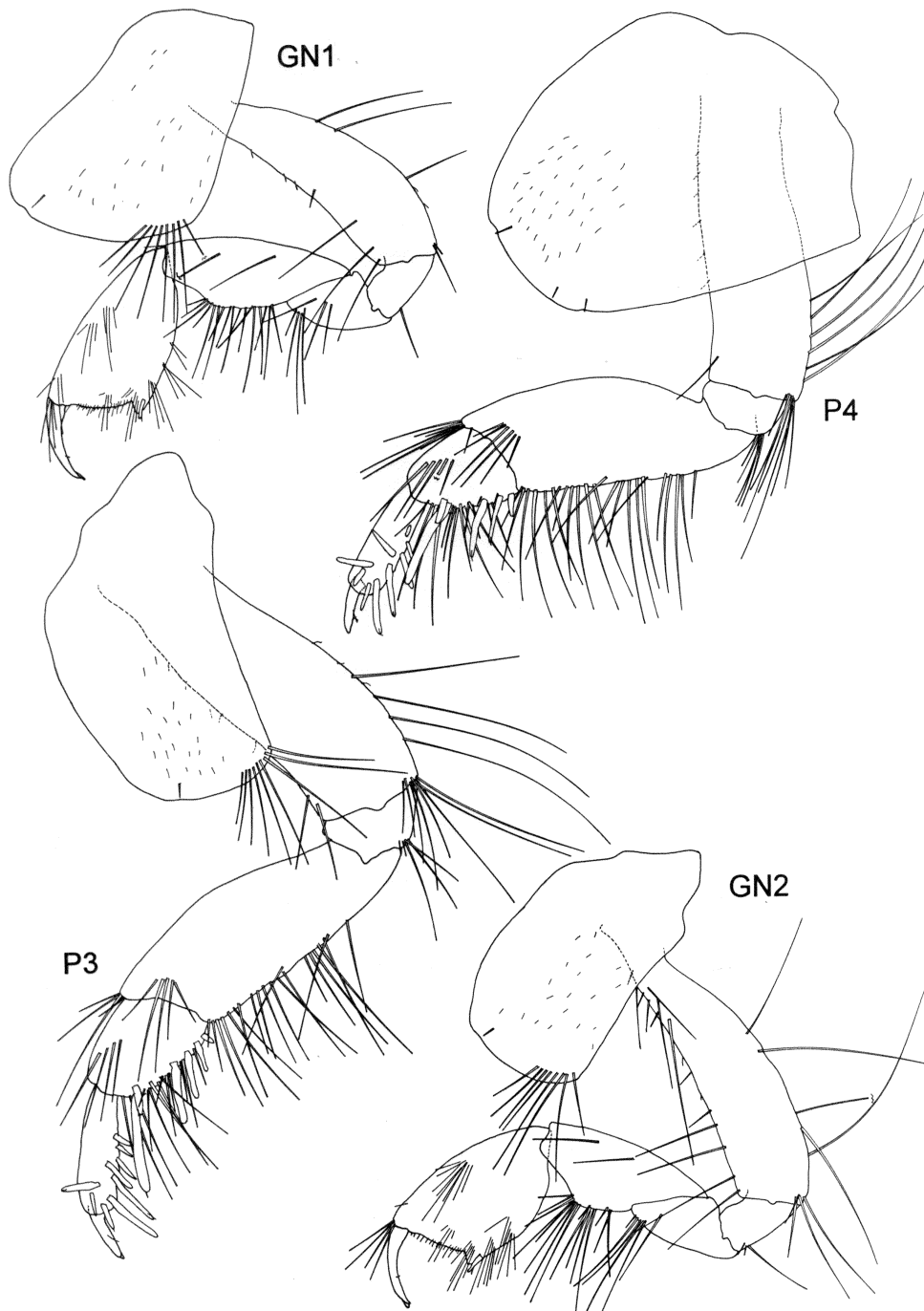


Figure 9. *Birubius heislarsi* sp. nov., holotype female, tl. 6.80 mm.

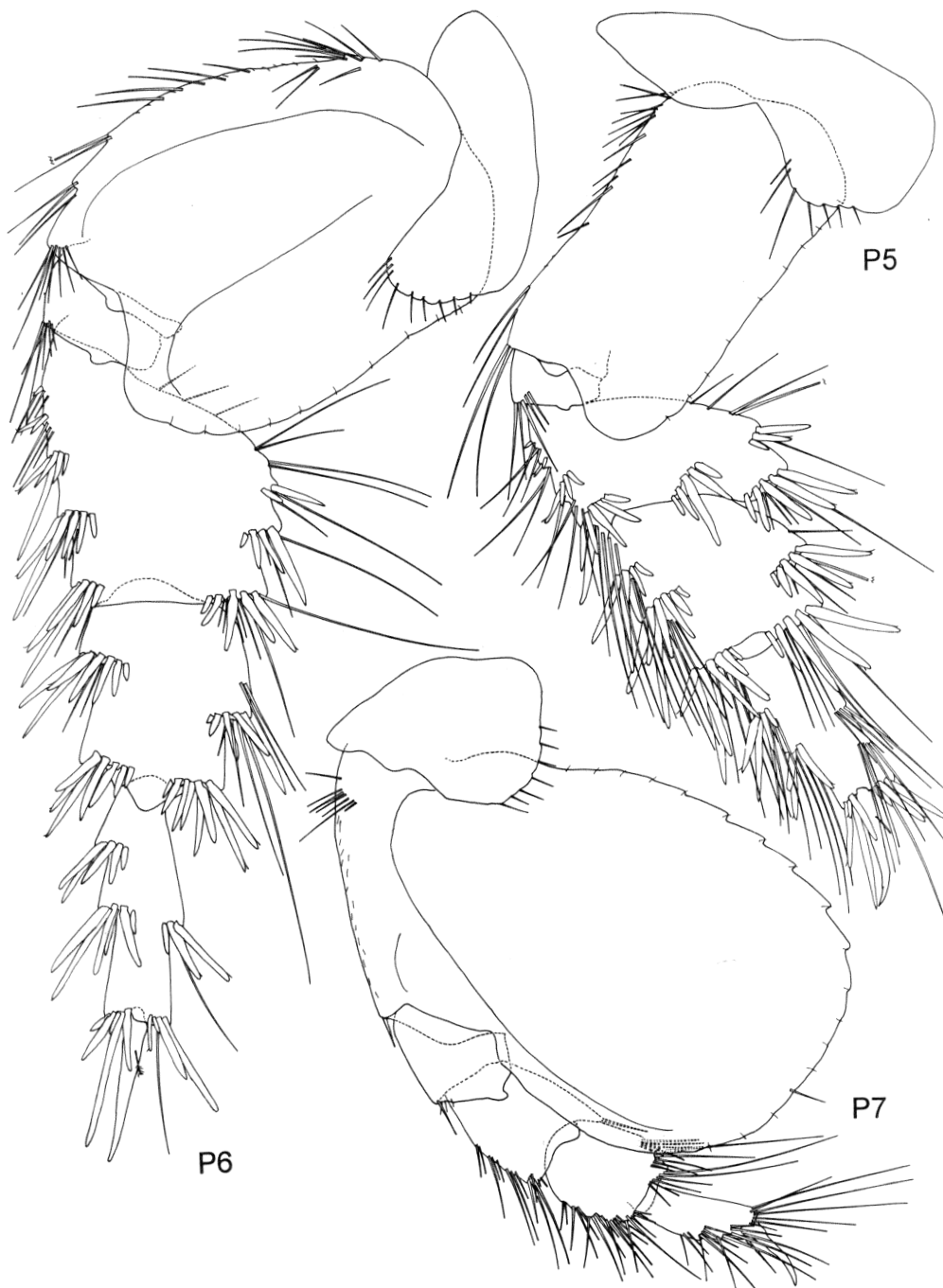


Figure 10. *Birubius heislarsi* sp. nov., holotype female, tl. 6.80 mm.

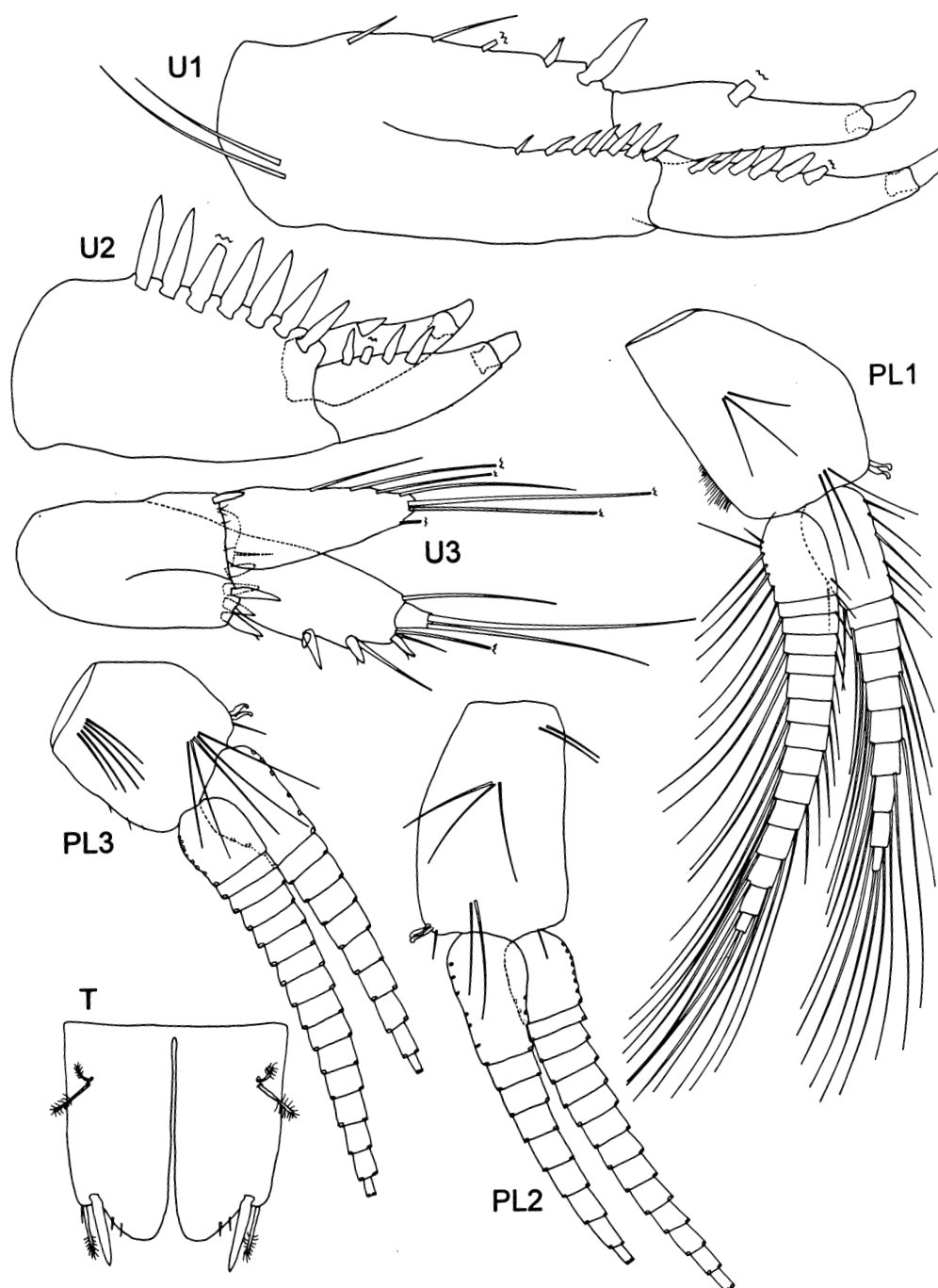


Figure 11. *Birubius heislarsi* sp. nov., holotype female, tl. 6.80 mm.

times long as article 2, apex oblique with 8 robust setae, with 6 basofacial setae. Maxilla 1 inner plate large, bearing 1 long apical seta, 1 similar apicomedial seta, 1 similar apicolateral seta; palp article 2 with 4 apicomedial marginal robust setae and 6 submarginal setae. Maxilla 2 inner and outer plates extending subequally, outer not broader than inner. Maxilliped inner plates with 2 large thick apical robust seta, 3 apicofacial setae, 4 medial setae; outer plate with 6 medial and apical robust setae, 2 apicolateral setae; palp article 1 with 1 apicolateral setae, article 2 with 3 apicolateral setae, article 3 protuberant, with 5 proximal facial setae, with 2 lateral setae, nail of article 4 medium length, with 1 accessory setules. Coxa 1 expanded distally, anterior margin weakly concave; main ventral setae of coxae 1–4 = 8–8–9–0, posteriormost seta of coxae 1–3 shortened; anterior and posterior margins of coxa 4 divergent, posterior margin oblique, almost straight, posterodorsal corner sharp, posterodorsal margin short, width-length ratio of coxa 4 = 59:50. Long posterior setae on basis of gnathopods 1–2 and pereopods 3–4 = 3–8–12–12, short to medium posteriors = 2–1–1–0, long anteriors = 3–7–2–1, short anteriors = 1–6–4–6.

Gnathopod propodus narrow; gnathopods 1–2 width ratios of carpus-propodus = 5:7 and 11:15, length ratios = 1:1 and 25:26; palmar humps ordinary, palms oblique; gnathopods 1–2 carpus elongate. Pereopods 3–4 similar, facial setae on merus = 5 and 6, on carpus = 4 and 5; main spine of carpus extending to M. 75 on propodus, carpus with 3–4 proximoposterior robust setae; robust setae formula of propodus = 4 + 5; acclivity on inner margin of dactyls of pereopods 3–4 weak, midfacial seta ordinary. Coxae 5–7 posteroventral setule formula = 7–9–7; merus-carpus of pereopods 5–6 broad, facial robust setae rows dense, facial ridge formula on basis of pereopods 5–7 = 0–2–2, anterior ridge of pereopod 7 very short; width ratios of basis, merus, carpus, propodus of pereopod 5 = 29:30:26:12, of pereopod 6 = 50:33:25:13, of pereopod 7 = 65:15:14:6, length ratios of pereopod 5 = 55:23:26:29, of pereopod 6 = 62:39:31:33, of pereopod 7 = 69:19:17:17; pereopod 7 basis reaching or exceeding middle of carpus, with 1 medium ventral setae. Pleopods 1–3 with 2 coupling hooks; pleopod 1 with 3 mid and 3 proximal facial setae, pleopod 2 with 2 proximal, 3 mid and 2 distal facial setae, pleopod 3 with 5 proximal and 5 distal facial setae; articles on outer rami = 15–14–16, inner rami = 10–9–10.

Epimeron 1 posteroventral corner rounded, anteroventral margin with 8 short to medium

setae, posteroventral face with 2 long setae, posterior margin with 3–5 setules in sinuses; epimeron 2 posteroventral corner rounded, with 5 facial setae, posteriormost pair set vertically, posterior margin with 5–6 setules in sinuses; epimeron 3 posteroventral corner weakly protuberant, with small tooth, posterior margin straight, with setule sinuses, ventral margin naked, face with horizontal row of 9 setae. Urosomite 1 naked, articulation almost complete; urosomite 3 weakly protuberant dorsally, without hook. Uropods 1–2 rami with articulate enlarged apical nails, uropod 1 outer ramus with 6 dorsal robust setae, inner with 1, uropod 2 outer ramus with 4 dorsal robust setae, inner with 1 dorso-medial robust seta; uropod 1 peduncle with 7 apicolateral robust setae and 2 basofacial slender setae, apically with 2 marginal robust setae, apicalmost enlarged, medially with 3 slender setae; uropod 2 peduncle with 7 dorsal robust setae; apicolateral corners of peduncles on uropods 1–2 without comb. Uropod 3 reduced, outer ramus shortened, subequal to peduncle. Uropod 3 peduncle with 5 ventral robust setae, dorsally with 1 lateral robust seta; rami masculine, inner extending to M. 100+ on article 1 of outer ramus, apex with 2 setae, medial margin with 1 seta, lateral margin with 4 setae, article 2 of outer ramus short, 0.21, bearing 2 long setae, apicomedial margin of article 1 with a single seta, lateral margin with 2 acclivities, robust setal formula = 1–1–2, slender setal formula = 2–1–0. Telson length-width ratio = 1:3, almost fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, robust setae next medial longer than setule, midlateral setules diverse.

*Male.* Unknown.

*Etymology.* For Simon Heislars, Museum Victoria, who identified this species as new from Museum Victoria collections.

*Remarks.* The following variations from the holotype were observed in the paratypes. The main ventral setae of coxae 1–4 = (5–8)–(5–8)–(5–9)–0. Uropod 1 outer ramus with 6–8 dorsal robust setae, inner ramus with 1 dorsal robust seta. Uropod 2 outer ramus with 3–4 dorsal robust setae, inner ramus with 1 dorsal robust seta.

*Birubius heislarsi* conforms well to Barnard and Drummond's (1978) diagnosis of *Birubius* except that it exhibits shortened rami of uropod 3 as seen in *Tickalerus* and *Kulgaphoxus*. It differs from these genera in the lack of a dorsal hook on urosomite 3. Attempts to identify this species



using Barnard and Drummond's (1978) key failed. *Birubius heislarsi* appears most similar to *B. lowannus* (Barnard and Drummond, 1978) but differs on many accounts including the denticulate vs simple distal branch of the right lacinia mobilis, more ventral setae on coxae 1–3, the presence of 3–4 vs 1 proximoposterior robust seta on carpus of pereopods 3–4 and the naked ventral margin of uropod 3. The species is number MoV3671 in Museum Victoria's TAXA database.

*Birubius lowryi* sp. nov.

Figures 12–17

**Material examined.** Holotype. Papua New Guinea, NW corner of Pig I. (05°9.98'S, 145°50.45'E), 21 m, J. D. Thomas, 4 Feb 1990 (stn PNG 33K), AM P60004 (1 female, tl. 4.75 mm).

Allotype. Papua New Guinea, Barracuda Point, E of Pig I. (05°10.26'S, 145°50.61'E), 30 m, J. D. Thomas, 8 Feb 1990 (stn PNG 37K), AM P56151 (1 male, tl. 3.75 mm).

Paratypes. Same data as allotype. AM P60005 (4 females, tl. 3.0–3.75 mm). Papua New Guinea, Horse-shoe Reef, Bootless Inlet (09°30.05'S, 147°15.50'E), 30 m, 28 Oct 1980, AM P60006 (2 females, tl. 3.75–3.9 mm).

**Diagnosis.** Rostrum constricted. Antenna 2, article 4 without well developed dorsal setation. Right lacinia mobilis bifid, distal branch simple. Pereopods 3–4 carpus with 1 proximoposterior robust seta. Pereopod 5 dactyl fully formed. Pereopod 7 basis with long ventral setae. Coxa 1 strongly expanded distally. Coxa 4 lacking long ventral setae. Epimeron 3 with small tooth; with ventral setae; without long posterior seta; without facial setae. Urosomite 3 with large dorsal hook. Uropod 1 with basofacial setae. Uropods 1–2 inner rami lacking accessory apical nails. Uropod 3 unreduced, outer ramus longer than peduncle.

**Description of female.** Head about 16% of total body length, greatest width about 84% of length; rostrum constricted, narrow, elongate, reaching middle of peduncular article 2 on antenna 1. Eyes large, clear of pigment. Antenna 1 peduncular article 1 about 1.5 times as long as wide, about 2.0 times as wide as article 2, ventral margin with 8 setules, unproduced dorsal apex without setule; peduncular article 2 about 0.6 times as long as peduncular article 1, with 5 ventral setae; primary flagellum with 10 articles, about 0.8 times as long as peduncle, lacking aesthetascs; accessory flagellum with 8 articles. Antenna 2, peduncular article 4 robust setae formula = 1-3-4-4, dorsal margin with notch bearing 2 setae, ventral margin

with 6–7 groups of 1–2 long to short setae, without ventrodistal robust seta; peduncular article 5 about 0.76 times as long as peduncular article 4, facial robust seta formula = 1–2, dorsal margin naked, ventral margin with 4 sets of 1–2 long to short setae, 2 ventrodistal long to medium robust setae; flagellum 1.07 times as long as articles 4–5 of peduncle combined, with 11 articles. Mandibles with medium to large palpal hump; right incisor with 3 teeth; left incisor with 2 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal branch, simple, pointed, proximal branch simple, pointed; left lacinia mobilis with 5 teeth; right raker 8; left rakers 7; molar in form of short protrusion demarcated mainly by robust setae, right molar with 6 long robust setae, left molar with 6 long robust setae, no seta disjunct; palp article 1 slightly elongate, article 2 with 2 long-medium inner apical setae and 2 other medium inner setae, article 3 about 0.86 times long as article 2, apex oblique with 6 robust to slender setae, without basofacial setae. Maxilla 1 inner plate narrow, bearing 1 long apical seta plus 1 shorter apicomедial seta; palp article 2 with 1 apicomедial marginal robust seta, 3 apicomедial setae and 3 submarginal setae. Maxilla 2 inner and outer plates extended equally. Maxilliped inner plates with 1 large thick apical robust seta, 3 apicofacial setae, 1 medial seta; outer plate with 5 medial and apical robust setae; palp article 1 with 1 apicolateral seta, article 2 with 2 apicolateral setae and 1 other lateral seta, article 3 unprotuberant, with 2 facial setae, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally; posterior setae of coxa 1–3 = 3-4-3, main ventral setae of coxae 1–4 = 6-6-8-0, posteriormost seta of coxae 1–3 elongate; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, posterodorsal corner rounded, posterodorsal margin medium, width-length ratio of coxa 4 almost = 1:1. Long posterior setae on basis of gnathopods 1–2 and pereopods 3–4 = 2-8-9-10, short posteriors = 5-6-6-7, long anteriors = 0-10-0-0, short anteriors = 6-6-12-12.

Gnathopods, width ratios of carpus-propodus on gnathopods 1–2 = 9:11 and 10:13, length ratios = 23:26 and 25:19; palmar humps ordinary, palms oblique; gnathopods 1–2 carpus of medium length. Pereopods 3–4 similar, facial setae on merus = 4 and 3, on carpus = 4 and 4; main spine of carpus extending to M. 91 on propodus, carpus with 1 proximoposterior robust seta; robust setae formula of propodus = 2 + 4; acclivity on inner margin of dactyls of pereopods 3–4 weak, mid-facial seta short. Coxae 5–7 posteroventral seta

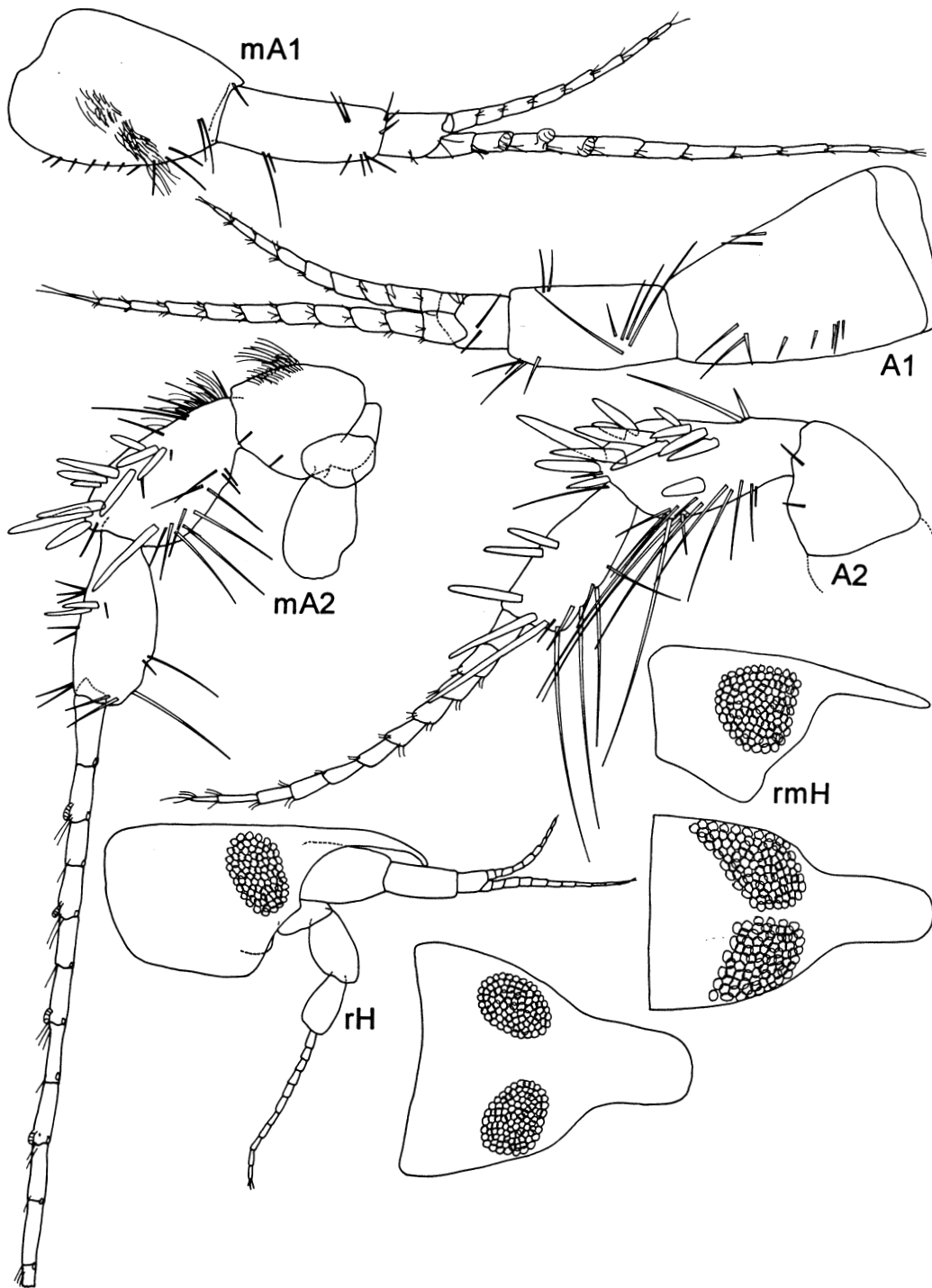


Figure 12. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm (m = male allotype, 3.75 mm).



Figure 13. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm.

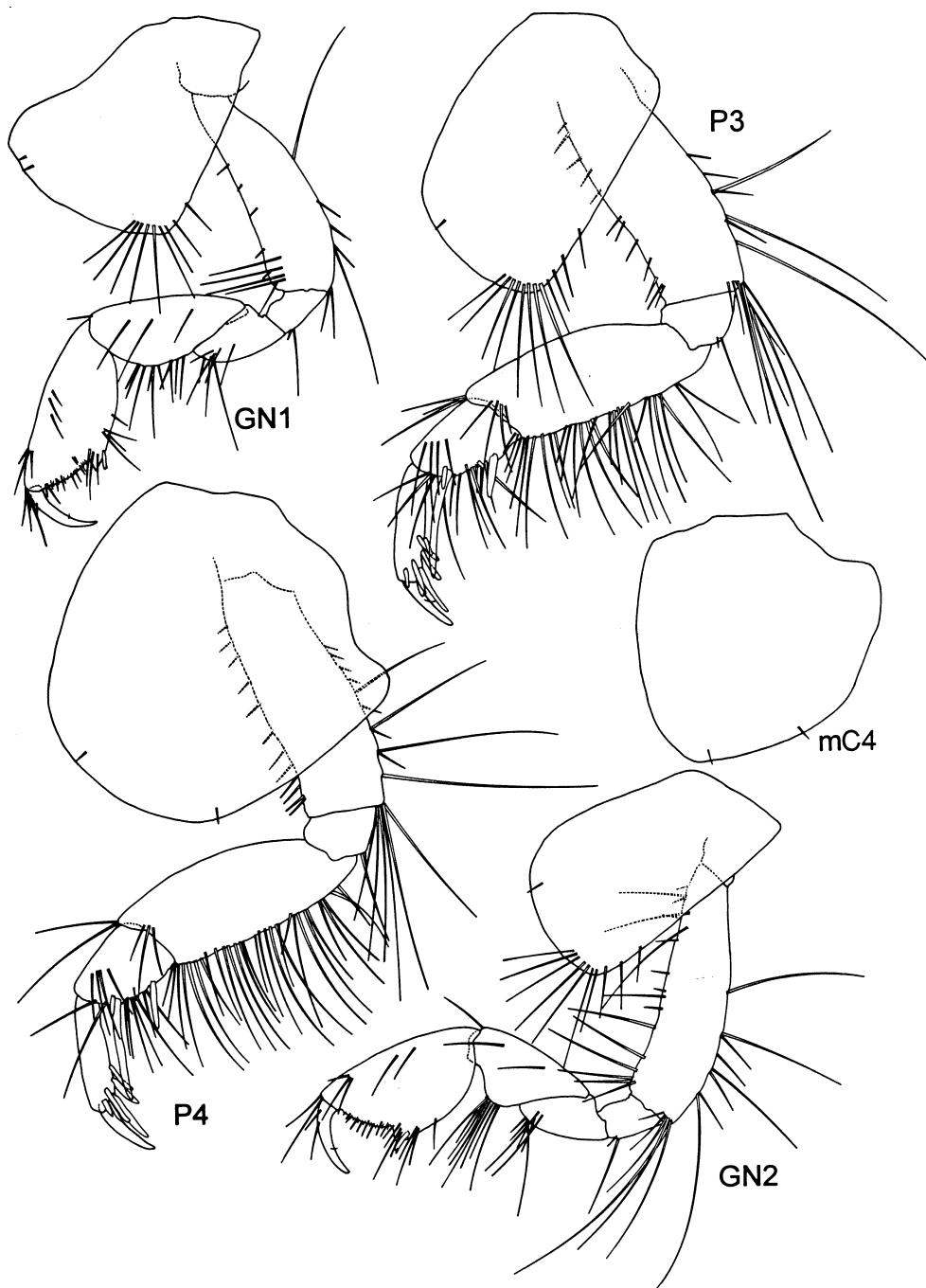


Figure 14. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm (m = male allotype, 3.75 mm).

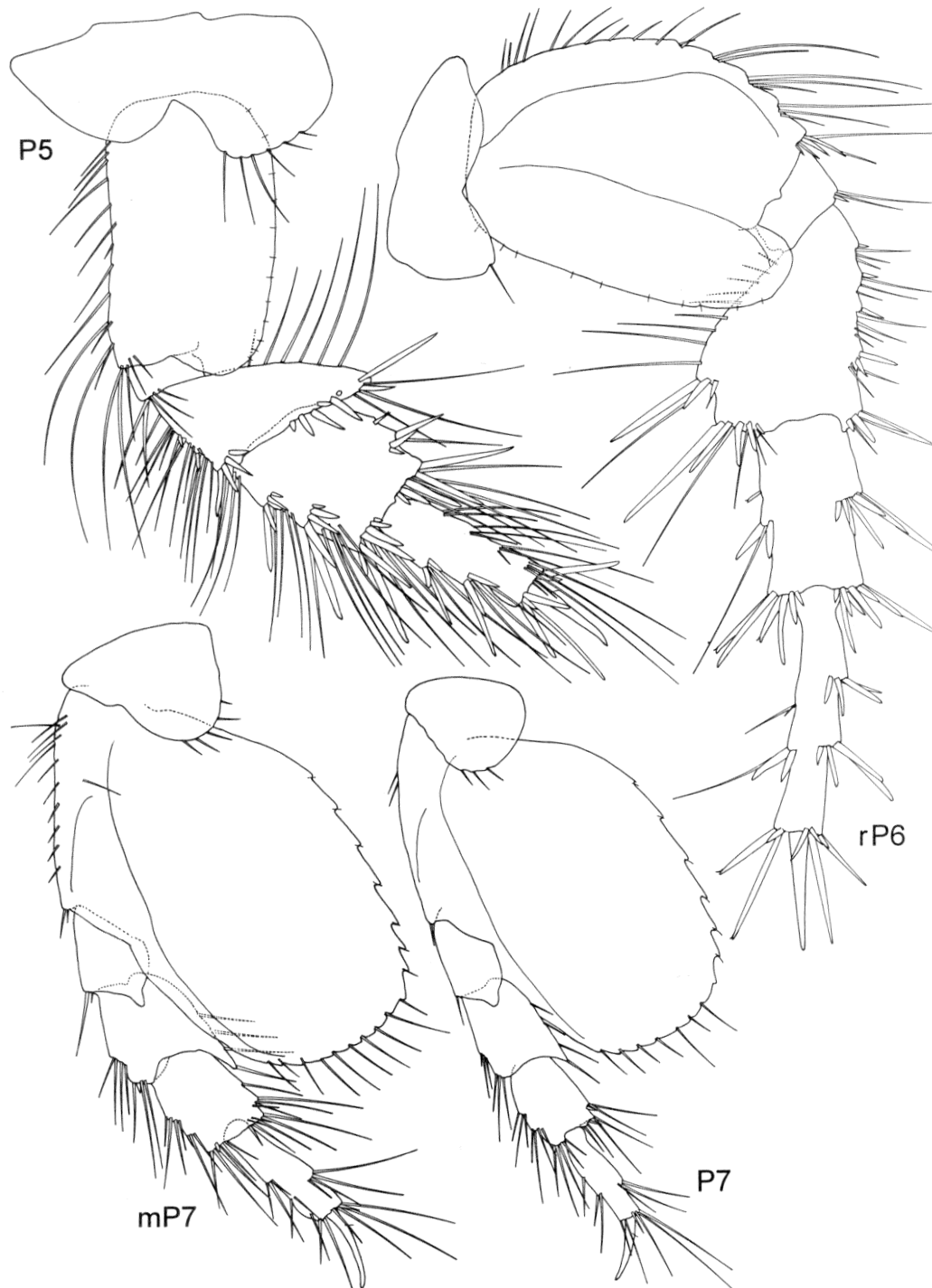


Figure 15. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm (m = male allotype, 3.75 mm).

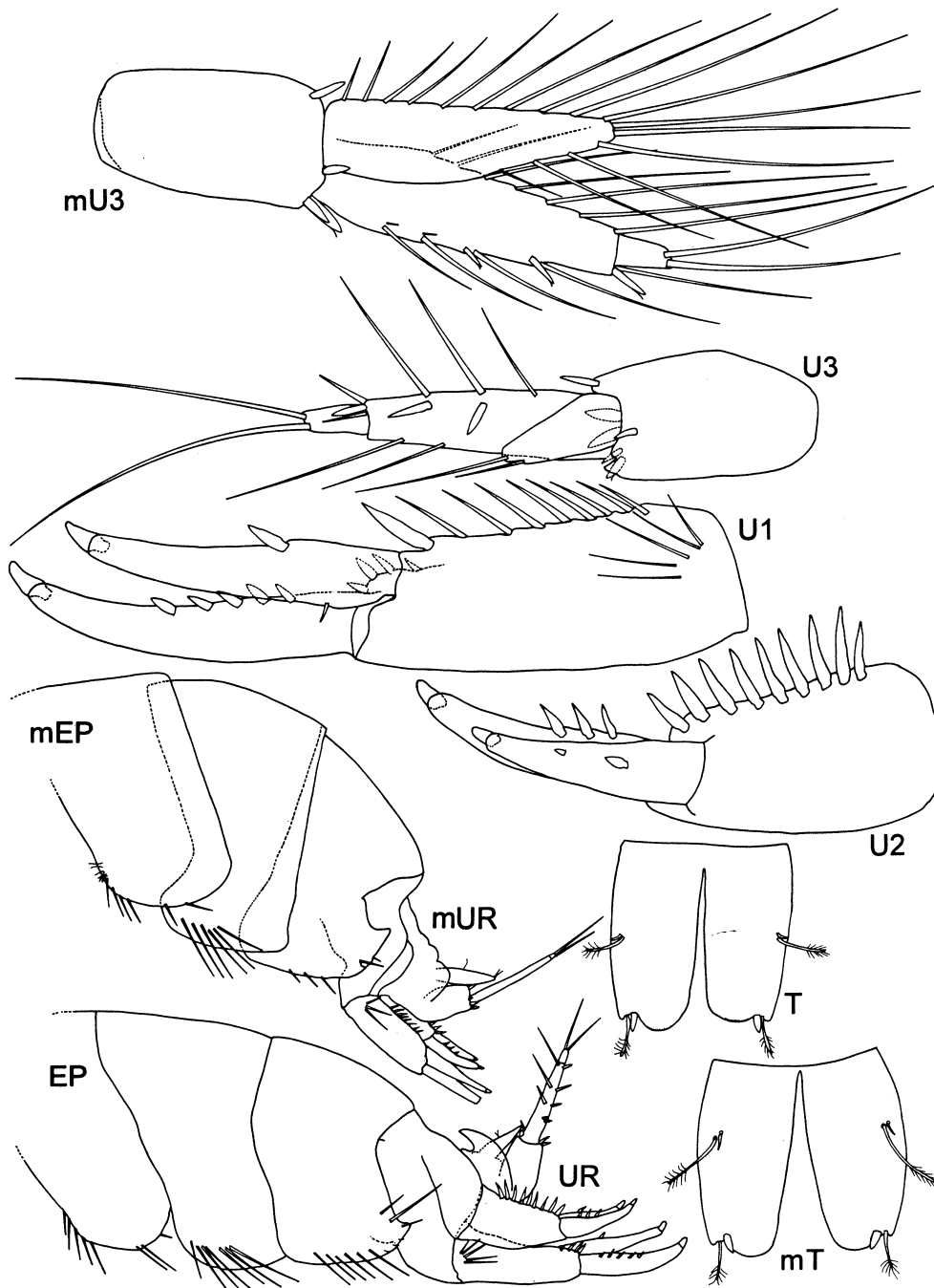


Figure 16. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm (m = male allotype, 3.75 mm).

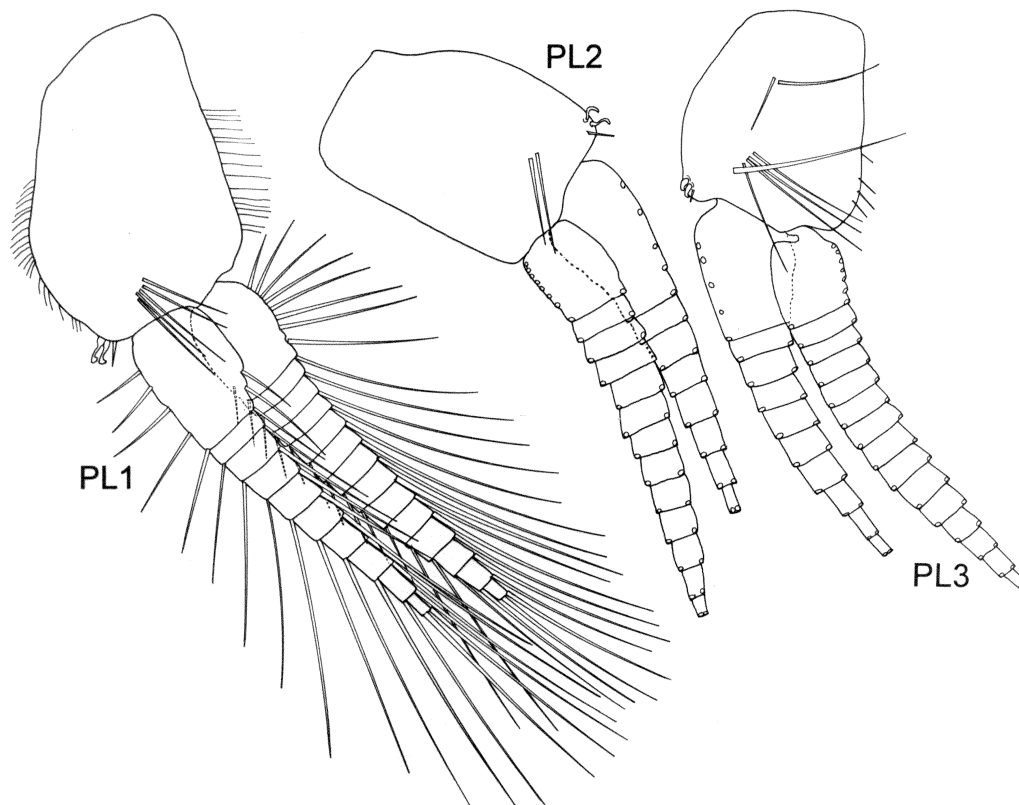


Figure 17. *Birubius lowryi* sp. nov., holotype female, tl. 4.75 mm.

formula = 6-1-3; articles 4-5 of pereopods 5-6 medium to narrow, facial robust setae rows poorly developed, facial ridge formula on basis of pereopods 5-7 = 0-2-2, anterior ridge of pereopod 7 long; width ratios of basis, merus, carpus, propodus of pereopod 5 = 24:27:20:9, of pereopod 6 = 37:23:15:8, of pereopod 7 = 25:7:6:3, length ratios of pereopod 5 = 41:17:26:24, of pereopod 6 = 49:32:26:36, of pereopod 7 = 53:14:13:15; Pereopod 7 basis of reaching apex of merus, moderately setose ventrally. Pleopods 1-3 with 2 coupling hooks; pleopod 1 with 5 distal facial setae, pleopod 2 with 2 distal facial setae, pleopod 3 with 2 mid and 5 distal facial setae; articles on outer rami = 14-13-15, inner rami = 10-8-10.

Epimeron 1 posteroventral corner rounded, anteroventral margin with 5 setae, posteroventral face with 3 medium setae; epimeron 2 posteroventral corner rounded, with 7 facial setae; epimeron 3 posteroventral corner with small to medium tooth, posterior margin almost straight

with 3 medium setae, ventral margin with 6 medium setae. Urosomite 1 naked, articulation line almost complete; urosomite 3 with large hook dorsally. Uropods 1-2 rami with articulate enlarged apical nails, uropod 1 outer ramus with 5 dorsal robust setae, inner with 1 dorsomedial robust seta, uropod 2 outer ramus with 3 dorsal robust setae, inner with 2 small robust seta; uropod 1 peduncle with 4 apicolateral robust setae, and 5 basofacial slender setae, medially with many marginal setae plus apical enlarged robust seta; peduncle of uropod 2 with 9 dorsal robust setae; apicolateral corners of peduncles on uropods 1-2 without comb. Uropod 3 unreduced, outer ramus longer than peduncle. Uropod 3 peduncle with 5 ventral robust setae, dorsally with 1 lateral seta; rami feminine, inner extending to M. 41 on article 1 of outer ramus, apex with 2 setae, medial and lateral margins naked, article 2 of outer ramus elongate, 0.26, bearing 2 long setae, apicomедial margin of article 1 with 2 setae, lateral margin with 3 acclivities, robust

setal formula = 1-1-1-0, slender setal formula = 1-1-1-1. Telson, length-width ratio = 27:26, not fully cleft, each apex wide, rounded, faintly setose, lateral acclivity broad, shallow, bearing ordinary lateral setule, robust setae next medial shorter than setule, midlateral setules diverse.

*Description of male.* Similar to female but eyes larger. Antenna 1 like female but with dense medial setation on peduncular article 1; primary flagellum bearing calceoli. Antenna 2 elongate, peduncular articles 3–4 with dense dorsal setation, peduncular article 5 about as long as article 4, dorsal margin lacking calceoli bearing 2 groups of male setae, flagellum 28-articulate bearing calceoli. Maxilliped and maxillae 1–2 similar to female. Right mandible damaged; left lacinia mobilis with 6 spines; left rakers 9, left molar with 7 long robust setae, palp similar to female, article 3 with 1 basofacial seta. Main ventral setae of coxae 1–4 = 5-7-6-0, Gnathopods 1–2 similar to female. Urosomite 3 without large hook dorsally. Uropod 1 outer ramus with 3 dorsal robust setae, inner with 1 dorsomedial robust seta, uropod 2 outer ramus with 3 dorsal robust setae, inner with 1 dorsal robust seta; uropod 1 peduncle with 3 apicolateral robust setae, with 3 basofacial slender setae; uropod 2 peduncle with 8 dorsal robust setae. Uropod 3 with inner ramus falling short of article 1 on outer ramus. Telson elongate, length-width ratio = 14:13.

*Etymology.* For Dr Jim Lowry, in gratitude for his assistance and advice during the first author's visit to examine Australia Museum collections.

*Remarks.* The following variations from the holotype were observed in the paratypes and material examined. The main ventral setae of coxae 1–4 = (5-7)-(5-7)-(5-7)-0. Uropod 1 outer ramus with 3–4 dorsal robust setae, inner ramus with 1 dorsal robust seta. Uropod 2 outer ramus with 2–3 dorsal robust setae, inner ramus with 1 dorsal robust seta.

*Birubius lowryi* conforms well to Barnard and Drummond's (1978) diagnosis of *Birubius* except that it exhibits a dorsal hook on urosomite 3 as seen in *Tickalerus* and *Kulgaphoxus*. It varies from these genera in the lack of a shortened outer ramus of uropod 3. It differs from the other new species described herein by the combination of characters listed in the diagnoses. It can be distinguished from *B. wilsoni*, the only other species described from Papua New Guinea, by the absence of posterior setae on coxae 1–3, long ventral setae on coxa 4 and the presence of proximoposterior setae on the carpus of pereopods 3–4.

The species is number MoV3667 in Museum Victoria's TAXA database.

***Birubius wallisae* sp. nov.**

Figures 18–24

*Material examined.* Holotype. Australia, Queensland, N entrance to Moreton Bay (27°02.85'S, 153°20.11'E), 19 m, Smith-McIntyre grab, G.C.B. Poore, 16 Mar 1998 (stn ASB/6/24), NMV J47236 (1 female, tl. 5.0 mm).

Allotype. Australia, Queensland, Middle Banks, Moreton Bay (27°15'S, 153°15'E), 18 November 1976 (stn 6), QM W25241 (1 male, tl. 4.8 mm).

Paratypes. Australia, Queensland, N entrance to Moreton Bay, all Smith-McIntyre grab, G.C.B. Poore, 16 Mar 1998: 27°02.94'S, 153°20.04'E, 24 m, (stn ASB/6/21), NMV J47237 (3 females, tl. 3.45–4.45 mm); 27°02.34'S, 153°19.42'E, 11 m, (stn ASB/6/26), NMV J41725 (1 female, tl. 4.10 mm); 27°02.34'S, 153°19.47'E, 13 m, (stn ASB/6/28), NMV J41726 (1 female, tl. 3.0 mm). Queensland, Middle Banks, Moreton Bay (27°15'S, 153°15'E), 18 Nov 1976 (stn 6), QM W8682 (12 females, tl. 3.10–4.75 mm, 9 males, tl. 4.10–4.80 mm).

*Diagnosis.* Rostrum constricted. Antenna 2, article 4 without well developed dorsal setation. Right lacinia mobilis bifid, distal branch simple. Pereopods 3–4 carpus with 2–3 proximoposterior robust setae. Pereopod 5 dactyl fully formed. Pereopod 7 basis without long ventral setae. Coxa 1 not expanded distally. Coxa 4 lacking long ventral setae. Epimeron 3 without tooth; with ventral setae; without long posterior seta; with oblique row of facial setae. Urosomite 3 with large dorsal hook. Uropod 1 with basofacial setae. Uropods 1–2 inner rami lacking accessory apical nails. Uropod 3 unreduced, outer ramus longer than peduncle.

*Description of female.* Head about 16% of total body length, greatest width about 100% of length; rostrum constricted, narrow, exceeding apex of peduncular article 1 on antenna 1. Eyes large, occluded with pigment. Antenna 1 peduncular article 1 about 1.3 times as long as wide, about 2.1 times as wide as peduncular article 2, ventral margin with 8 setules, unproduced dorsal apex with 1 setule; peduncular article 2 about 0.75 times as long as peduncular article 1, with 6 ventral setae; primary flagellum with 12 articles, about 0.6 times as long as peduncle, lacking aesthetascs; accessory flagellum with 10 articles. Antenna 2, peduncular article 4 robust setae formula = 1-2-4-5, dorsal margin with notch bearing 1 robust seta and 1 slender seta, ventral margin with 7–8 groups of 1–2 long to short setae, with ventrodistal robust seta; peduncular article 5



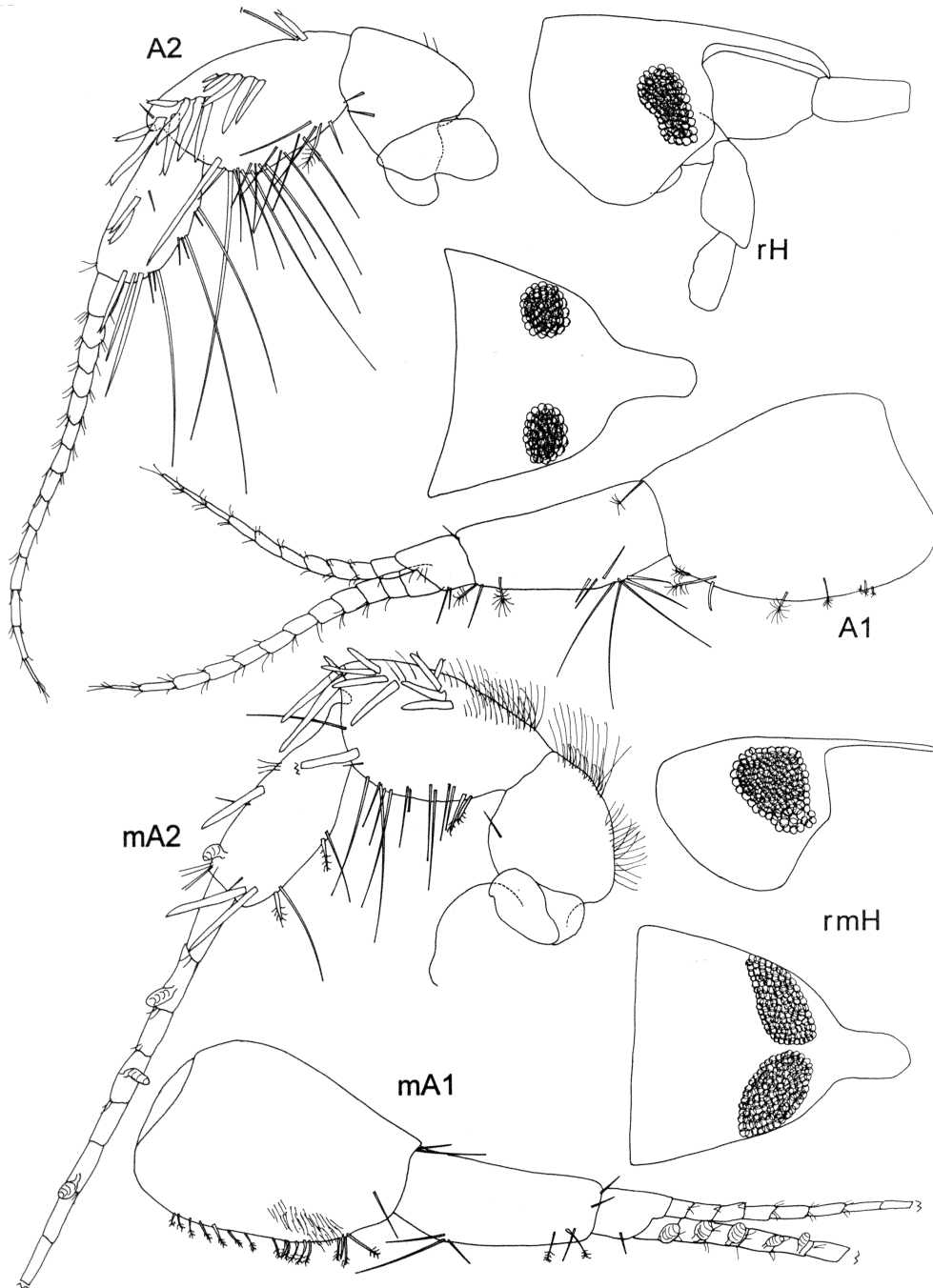


Figure 18. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm (m = male allotype, 4.80 mm).

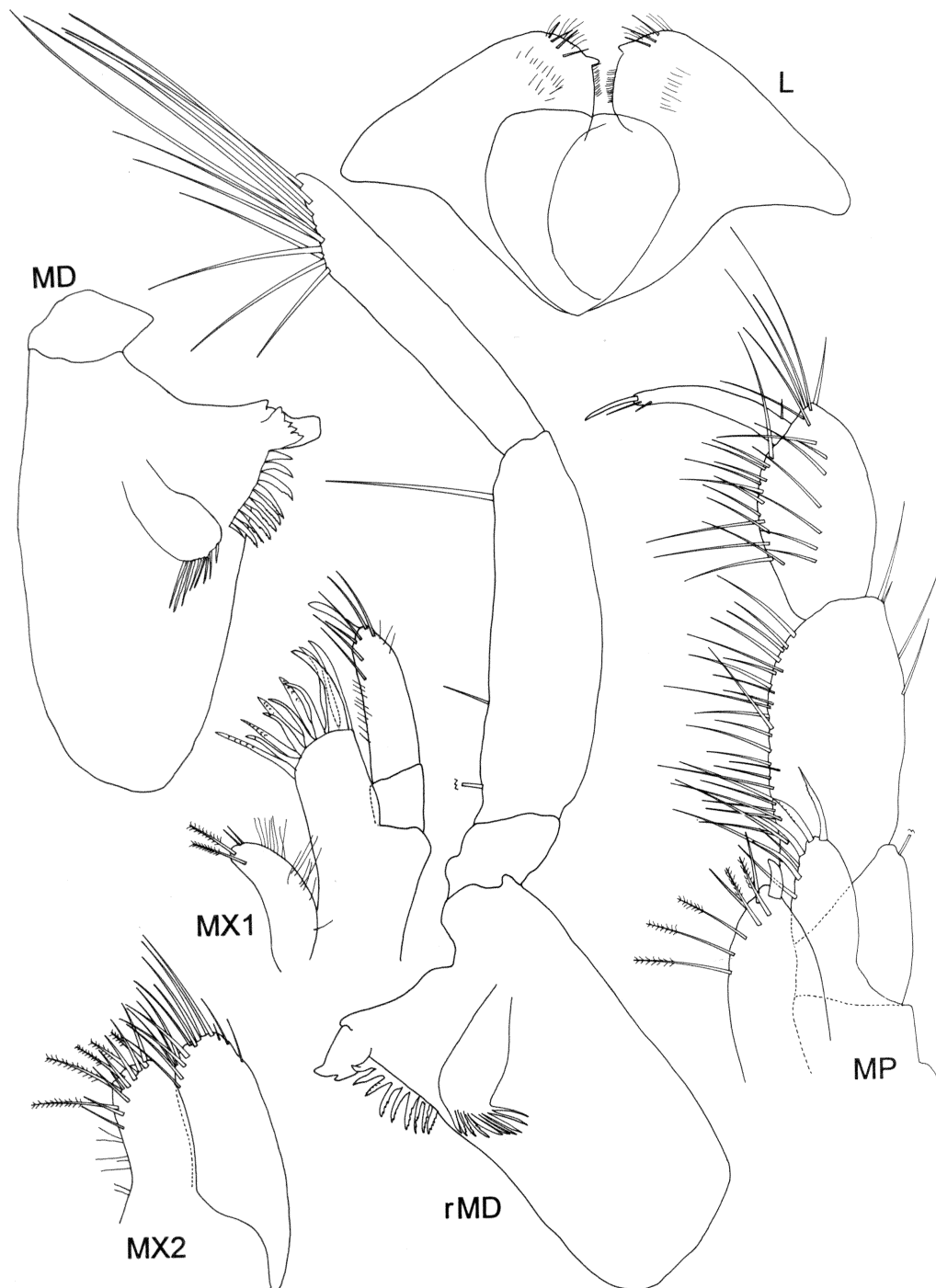


Figure 19. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm.

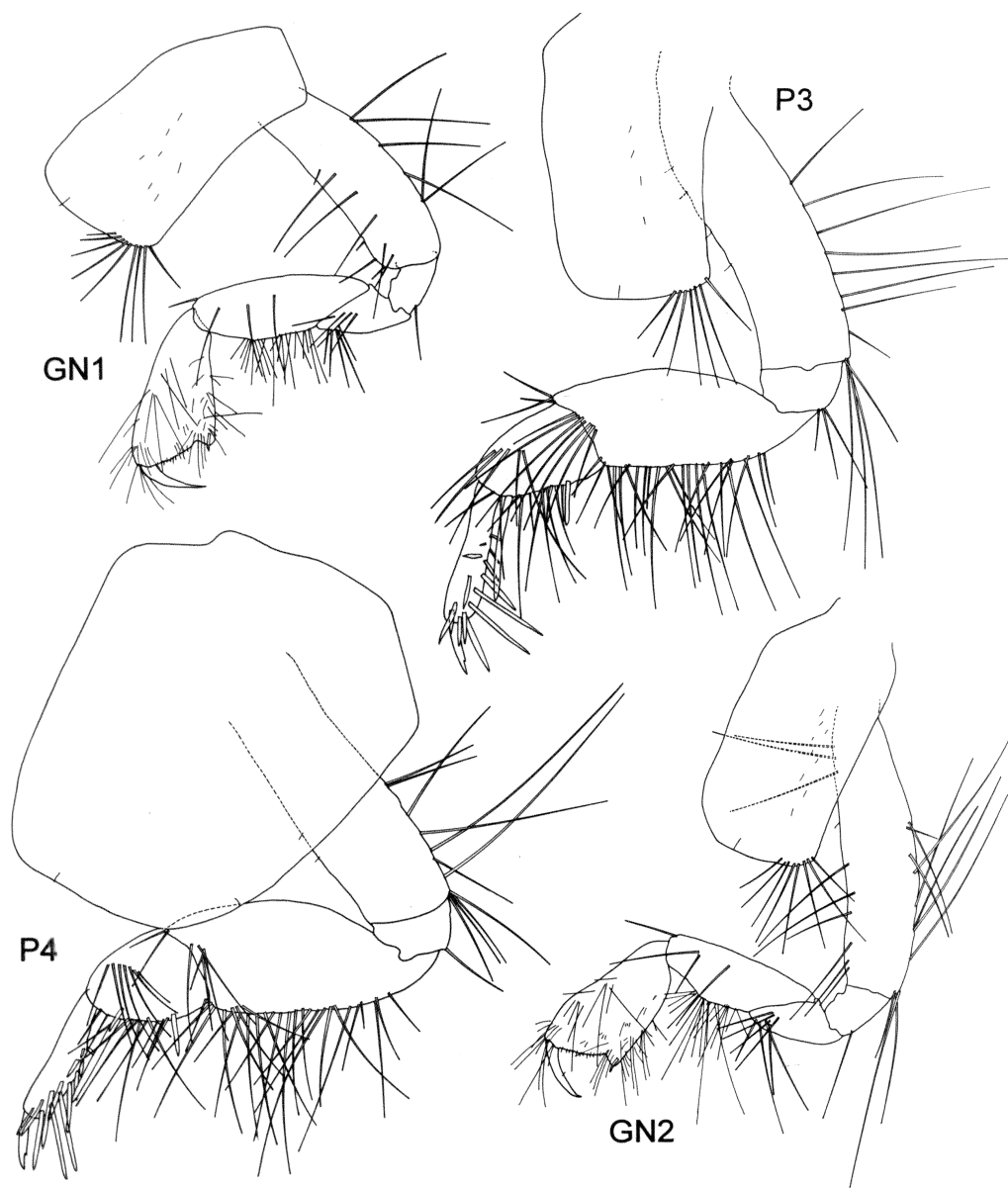


Figure 20. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm.

about 0.7 times as long as peduncular article 4, facial robust seta formula = 0-2, dorsal margin naked, ventral margin with 3 sets of 1-3 long to short setae, 2-3 ventrodistal long to medium robust setae; flagellum 1.15 times as long as peduncular articles 4-5 combined, with 14 articles. Mandibles with medium palpal hump;

right incisor with 3 teeth; left incisor with 2 humps in 2 branches; right lacinia mobilis bifid, distal branch shorter than proximal branch, simple, pointed, proximal branch simple, pointed; left lacinia mobilis with 5-6 teeth; right raker 8; left rakers 9; molar in form of short protrusion demarcated mainly by robust setae, right molar with 10

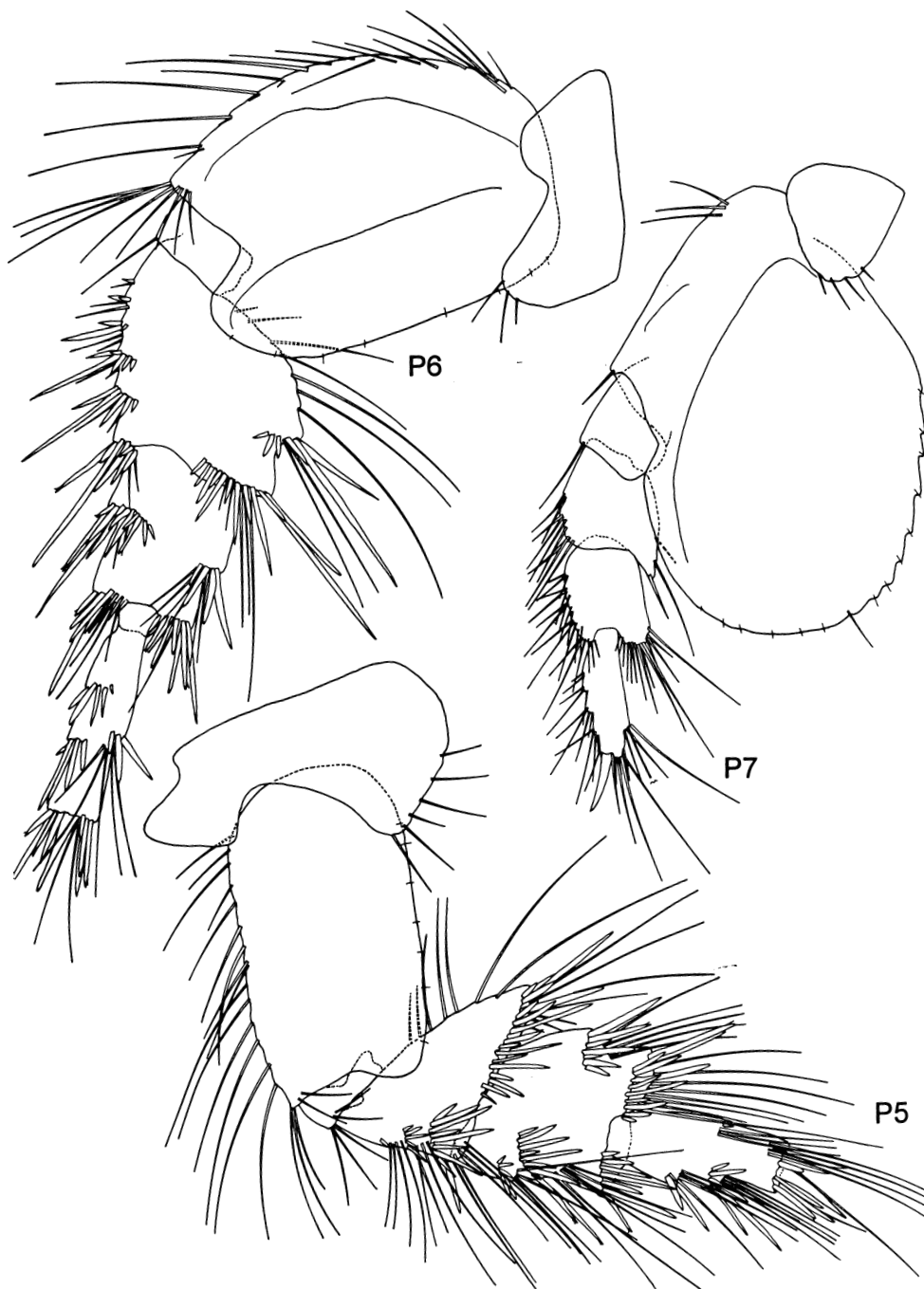


Figure 21. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm.

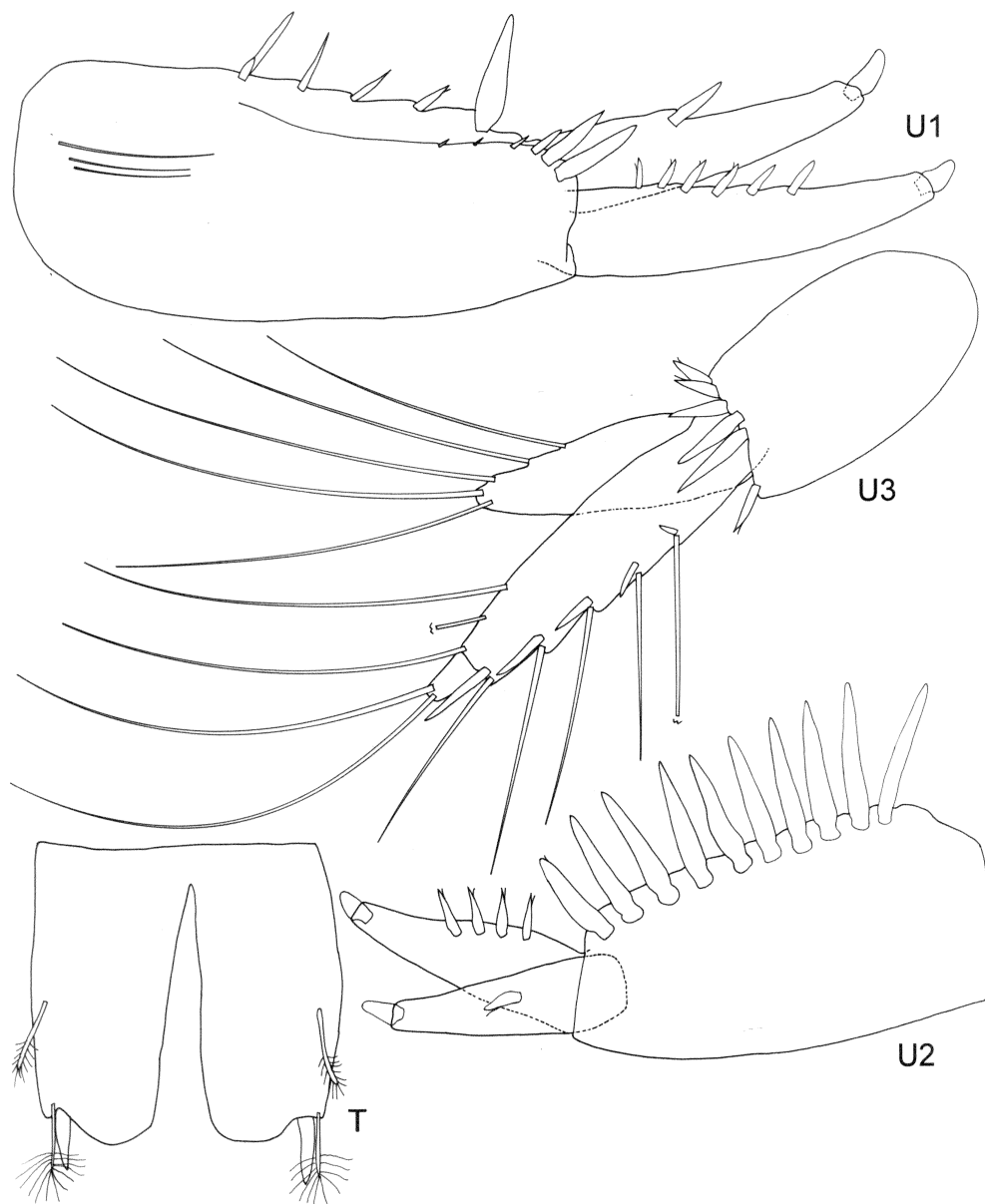


Figure 22. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm.

long robust setae, left molar with 8 long robust setae, no seta disjunct; palp article 1 short, article 2 with 1 long inner apical seta, and 2 other medium inner setae, article 3 about 0.91 times long as article 2, apex oblique with 11 robust to slender setae, without basofacial setae. Maxilla 1 inner plate narrow, bearing 1 long apical seta, 1

shorter apicomedial seta plus 2 shorter apical setae; palp article 2 with 1 apicomedial marginal robust seta, 3 apicomedial setae and 3 sub-marginal setae. Maxilla 2 inner and outer plates extended equally. Maxilliped inner plates with 1 large thick apical robust seta, 5 apicofacial setae, 1 medial seta; outer plate with 6 medial and api-

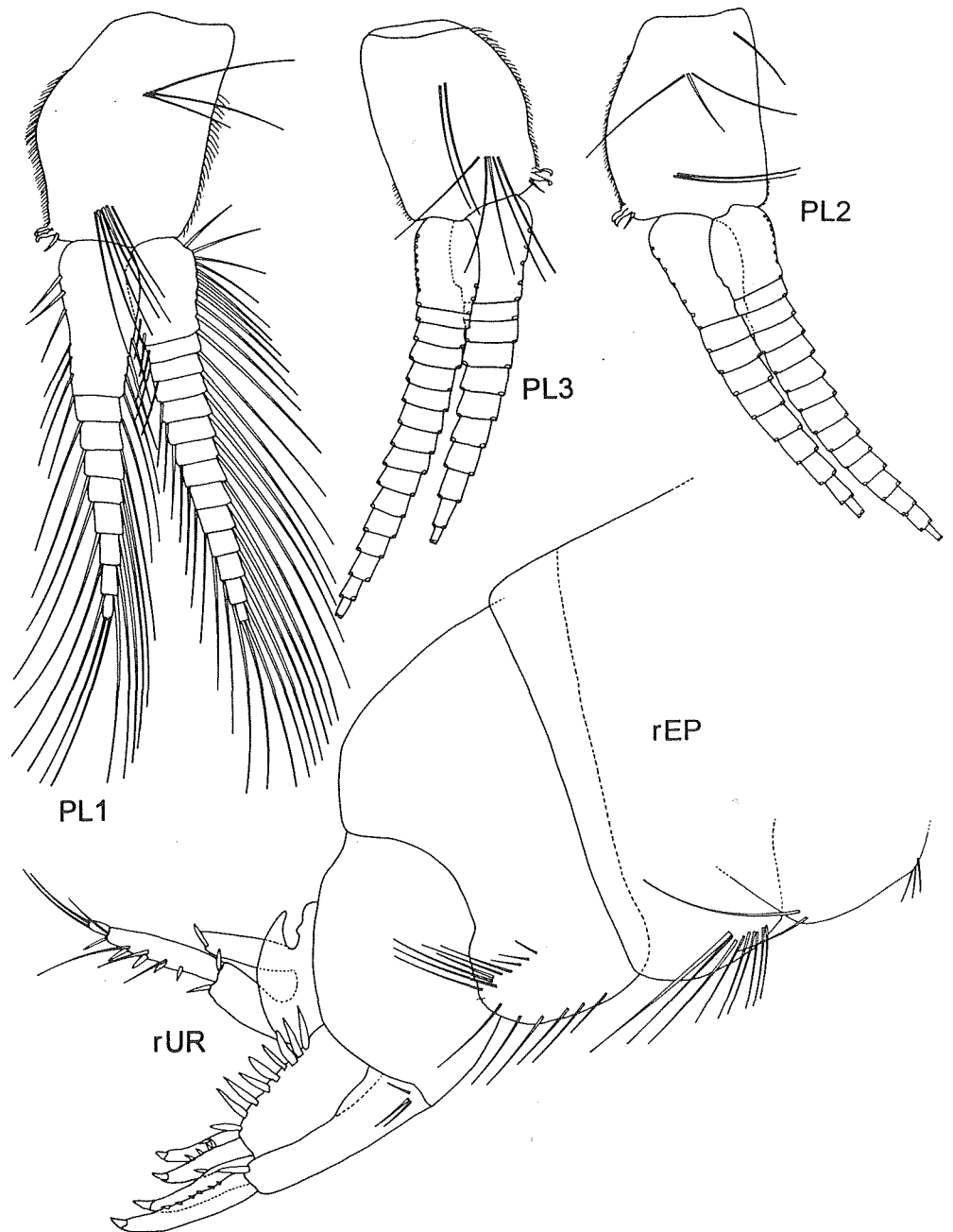


Figure 23. *Birubius wallisae* sp. nov., holotype female, tl. 5.00 mm.

cal robust setae; palp article 1 with 1 apicolateral seta, article 2 with 2 apicolateral setae and 2 other lateral setae, article 3 slightly protuberant, with 7 facial setae, nail of article 4 medium length, with

2 accessory setules. Coxa 1 unexpanded distally; main ventral setae of coxae 1-4 = 9-8-7-0, posteriormost seta of coxae 1-3 shortened; anterior and posterior margins of coxa 4 divergent, pos-

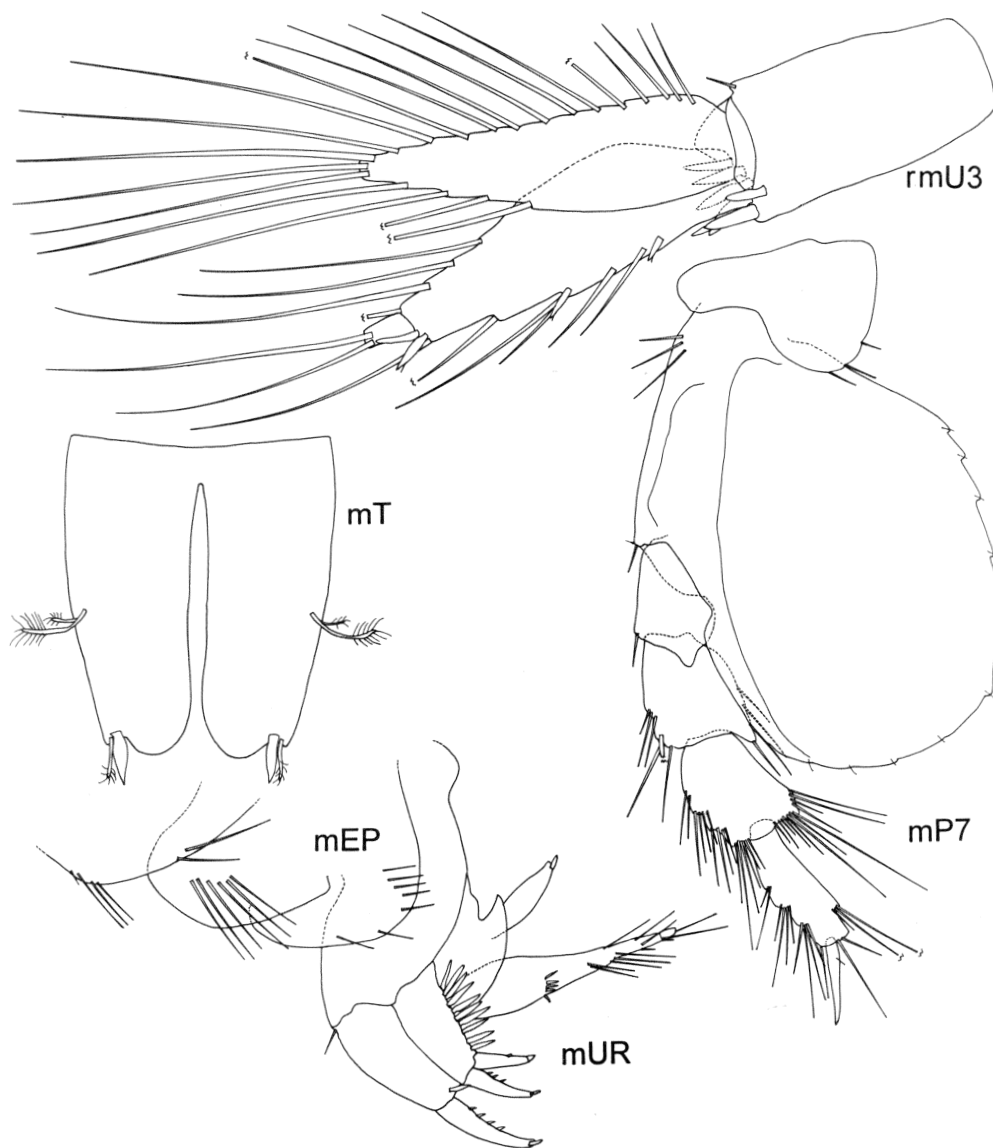


Figure 24. *Birubius wallisae* sp. nov., allotype male, tl. 4.80 mm.

terior margin oblique, posterodorsal corner rounded, posterodorsal margin medium, straight, width-length ratio of coxa 4 almost = 5:6. Long posterior setae on basis of gnathopods 1–2 and pereopods 3–4 = 6–10–11–10, short posteriors = 0–0–0–0, long anteriors = 6–6–0–0, short anteriors = 2–1–4–2.

Gnathopods, width ratios of carpus-propodus on gnathopods 1–2 = 8:11 and 2:3, length ratios =

12:11 and 1:1; palmar humps ordinary, palms oblique; gnathopods 1–2 carpus elongate. Pereopods 3–4 similar, facial setae on merus = 7 and 5, on carpus = 5 and 7; main spine of carpus extending to M. 100+ on propodus, carpus with 1 proximoposterior robust seta; robust setae formula of propodus = 6 + 7; acclivity on inner margin of dactyls of pereopods 3–4 weak, mid-facial seta short. Coxae 5–7 posteroventral seta

formula = 6-3-4; merus-carpus of pereopods 5-6 medium to narrow, facial robust setae rows poorly developed, facial ridge formula on basis of pereopods 5-7 = 0-2-2, anterior ridge of pereopod 7 short; width ratios of basis, merus, carpus, propodus of pereopod 5 = 26:28:25:11, of pereopod 6 = 41:31:19:8, of pereopod 7 = 50:15:12:6, length ratios of pereopod 5 = 47:19:23:25, of pereopod 6 = 27:15:13:16, of pereopod 7 = 60:16:15:18; pereopod 7 basis reaching apex of merus, with 1 medium ventral seta. Pleopods 1-3 with 2 coupling hooks; pleopod 1 with 3 mid and 3 proximal facial setae, pleopod 2 with 2 proximal, 3 mid and 2 distal facial setae, pleopod 3 with 5 proximal and 5 distal facial setae; articles on outer rami = 14-16-15, inner rami = 9-11-10.

Epimeron 1 posteroventral corner rounded, anteroventral margin with 3 setae, posteroventral face with 2 medium to long setae; epimeron 2 posteroventral corner rounded, with 9 facial setae, posteriormost pair set vertically; epimeron 3 posteroventral corner without tooth, posterior margin rounded, naked, midface with oblique row of 9 setae near posterior margin, ventral margin with 6 long setae. Urosomite 1 naked, articulation line barely present; urosomite 3 with large hook dorsally. Uropods 1-2 rami with articulate enlarged apical nails, uropod 1 outer ramus with 6 dorsal robust setae, inner with 1 dorsomedial robust seta, uropod 2 outer ramus with 4 dorsal robust setae, inner with 1 robust seta; uropod 1 peduncle with 3 apicolateral robust setae, 3 smaller setae, and 3 basofacial slender setae, medially with few marginal setae plus apical enlarged robust seta; uropod 2 peduncle with 9 dorsal robust setae; apicolateral corners of peduncles on uropods 1-2 without comb. Uropod 3 unreduced, outer ramus longer than peduncle. Uropod 3 peduncle with 5 ventral robust setae, dorsally with 1 lateral seta; rami feminine, inner extending to M. 76 on article 1 of outer ramus, apex with 2 setae, medial margin naked, lateral margin with 3 long setae, article 2 of outer ramus short, 0.15, bearing 2 long setae, apicomедial margin of article 1 with 2 setae, lateral margin with 4 acclivities, robust setal formula = 1-1-1-1-1, slender setal formula = 1-1-1-1-1. Telson, length-width ratio = 1:1, not fully cleft, each apex wide, rounded, lateral acclivity broad, shallow, bearing ordinary lateral setule, robust setae next medial shorter than setule, single midlateral setule.

*Description of male.* Similar to female but eyes larger. Antenna 1 like female but with dense medial setation on peduncular article 1; primary flagellum bearing calceoli. Antenna 2 elongate,

peduncular articles 3-4 with dense dorsal setation, peduncular article 5 about as long as article 4, dorsal margin bearing 1 calceolus and 2 groups of male setae, flagellum at least 19-articulate (both broken) bearing calceoli. Maxilliped and maxillae 1-2 similar to female. Right lacinia mobilis bifid, distal branch much shorter than proximal branch, simple; proximal branch simple, pointed; left lacinia mobilis with 5 teeth; right raker 6; left rakers 9; right molar with 4 long robust setae, left molar with 6 long robust setae, palp similar to female, article 3 with 2 basofacial setae. Main ventral setae of coxae 1-4 = 6-7-7-0. Gnathopods 1-2 similar to female. Urosomite 3 with large hook dorsally. Uropod 1 outer ramus with 4 dorsal robust setae, inner with 1 dorsomedial robust seta, uropod 2 outer ramus with 3 dorsal robust setae, inner with 1 dorsal robust seta; uropod 1 peduncle with 4 apicolateral robust setae, without basofacial slender seta; uropod 2 peduncle with 10 dorsal robust setae. Uropod 3 with inner ramus elongate, reaching article 1 on outer ramus. Telson elongate, length-width ratio = 11:9.

*Etymology.* For Dr Elycia Wallis, Museum Victoria, in appreciation of her support during the first author's PhD candidature.

*Remarks.* The following variations from the holotype were observed in the paratypes and material examined. The main ventral setae of coxae 1-4 = (5-8)-(4-8)-(5-8)-0. Uropod 1 outer ramus with 2-5 dorsal robust setae, inner ramus with 1 dorsal robust seta. Uropod 2 outer ramus with 1-3 dorsal robust setae, inner ramus with 1 dorsal robust seta.

*Birubius wallisae* conforms well to Barnard and Drummond's (1978) diagnosis of *Birubius* except that it exhibits a dorsal hook on urosomite 3 as seen in *Tickalerus* and *Kulgaphoxus*. It differs from these genera in the lack of a shortened outer ramus on uropod 3 but shares with *Kulgaphoxus* the proximal vs widely spread placement of ventral setae on antennae 1 peduncular article 2. *Birubius wallisae* differs from the other new species in the combination of characters listed in the diagnoses. The species is number MoV3716 in Museum Victoria's TAXA database.

#### *Birubius wilsoni* sp. nov.

Figures 25-30

*Material examined.* Holotype. Papua New Guinea, NW corner of Pig I. (05°9.98'S, 145°50.45'E), 21 m, J. D. Thomas, 4 Feb 1990 (stn PNG 33K), AM P56149 (1 female, tl. 4.20 mm).



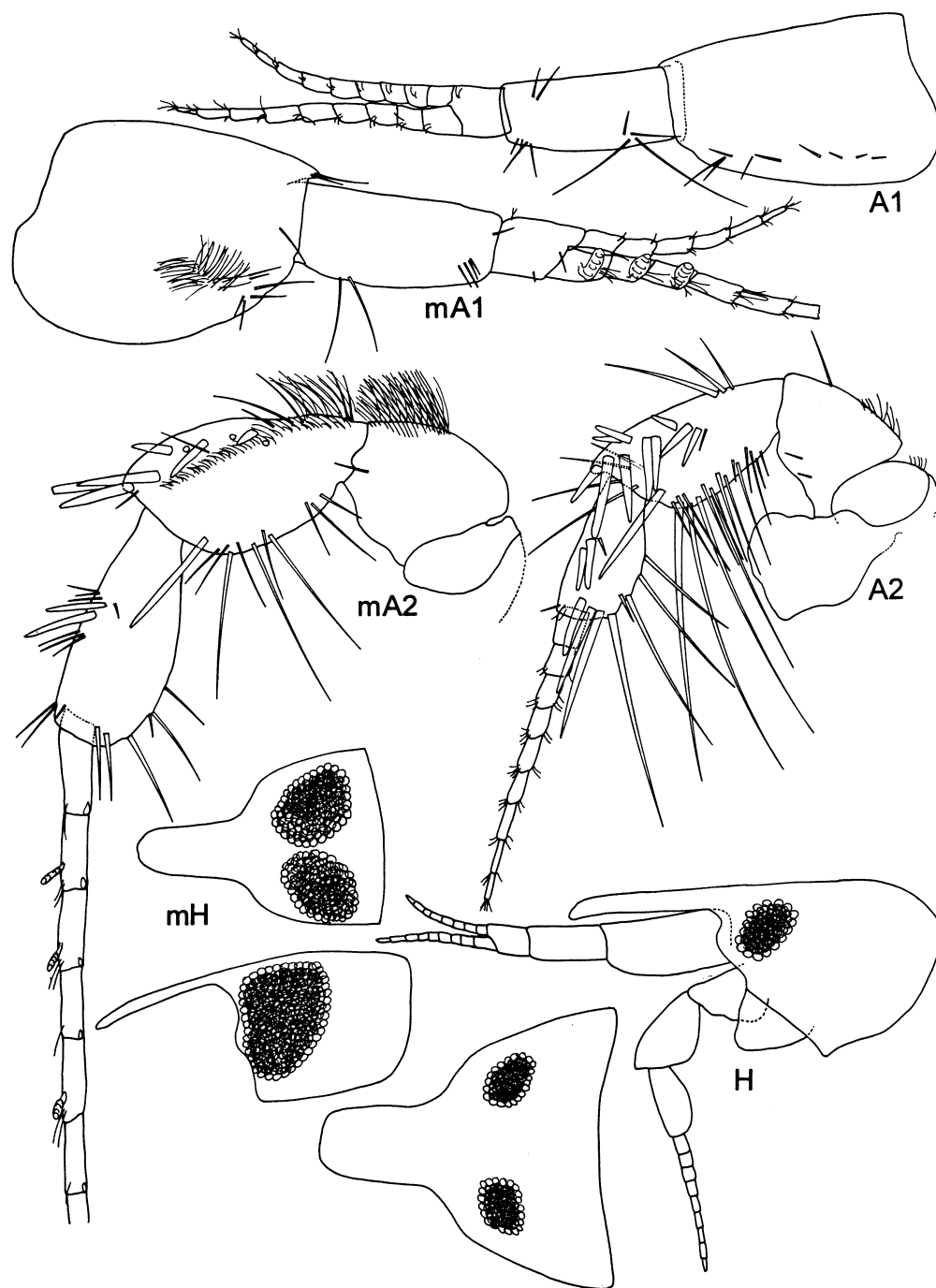


Figure 25. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm (m = male allotype, 3.55 mm).

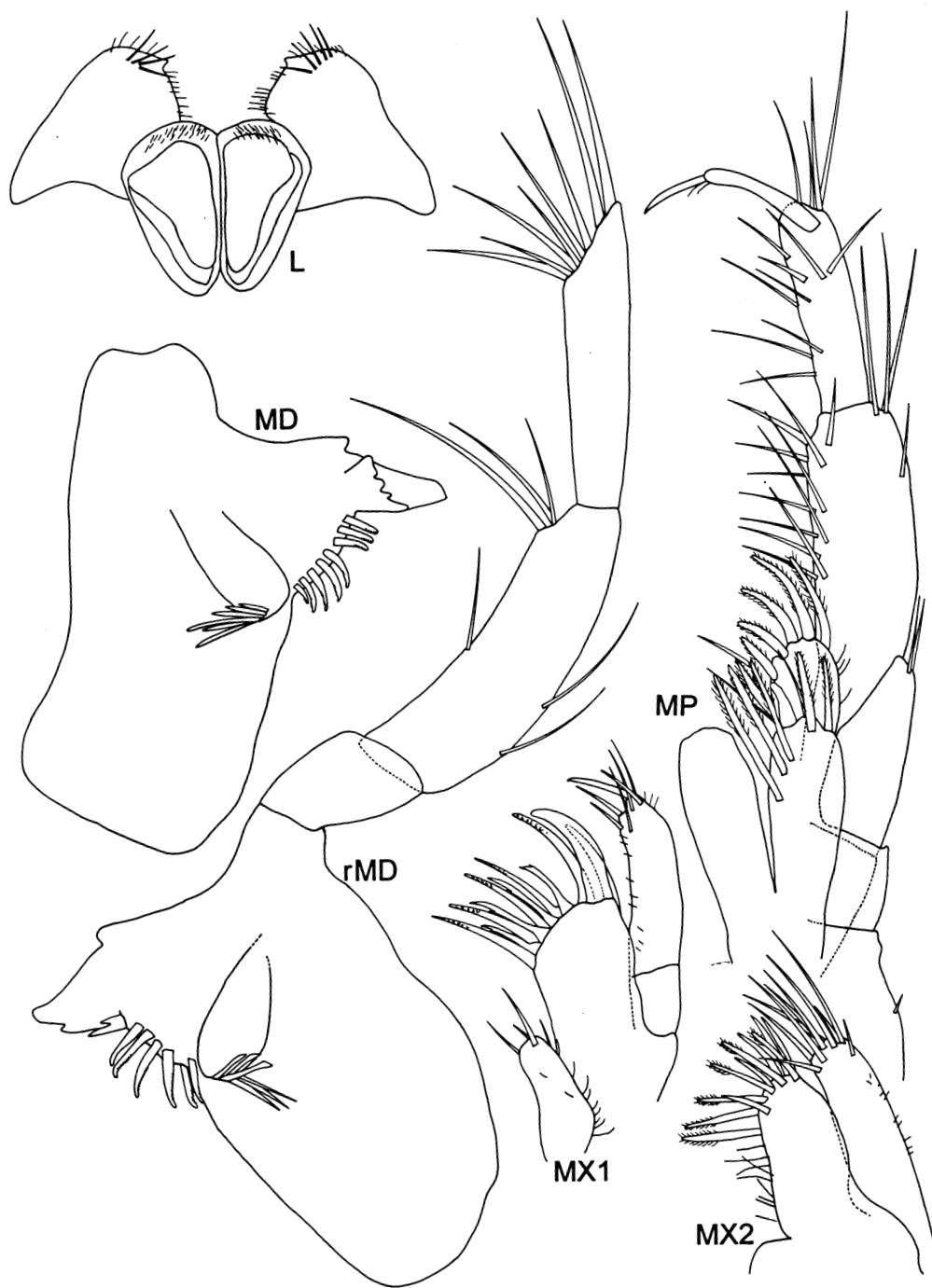


Figure 26. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm.

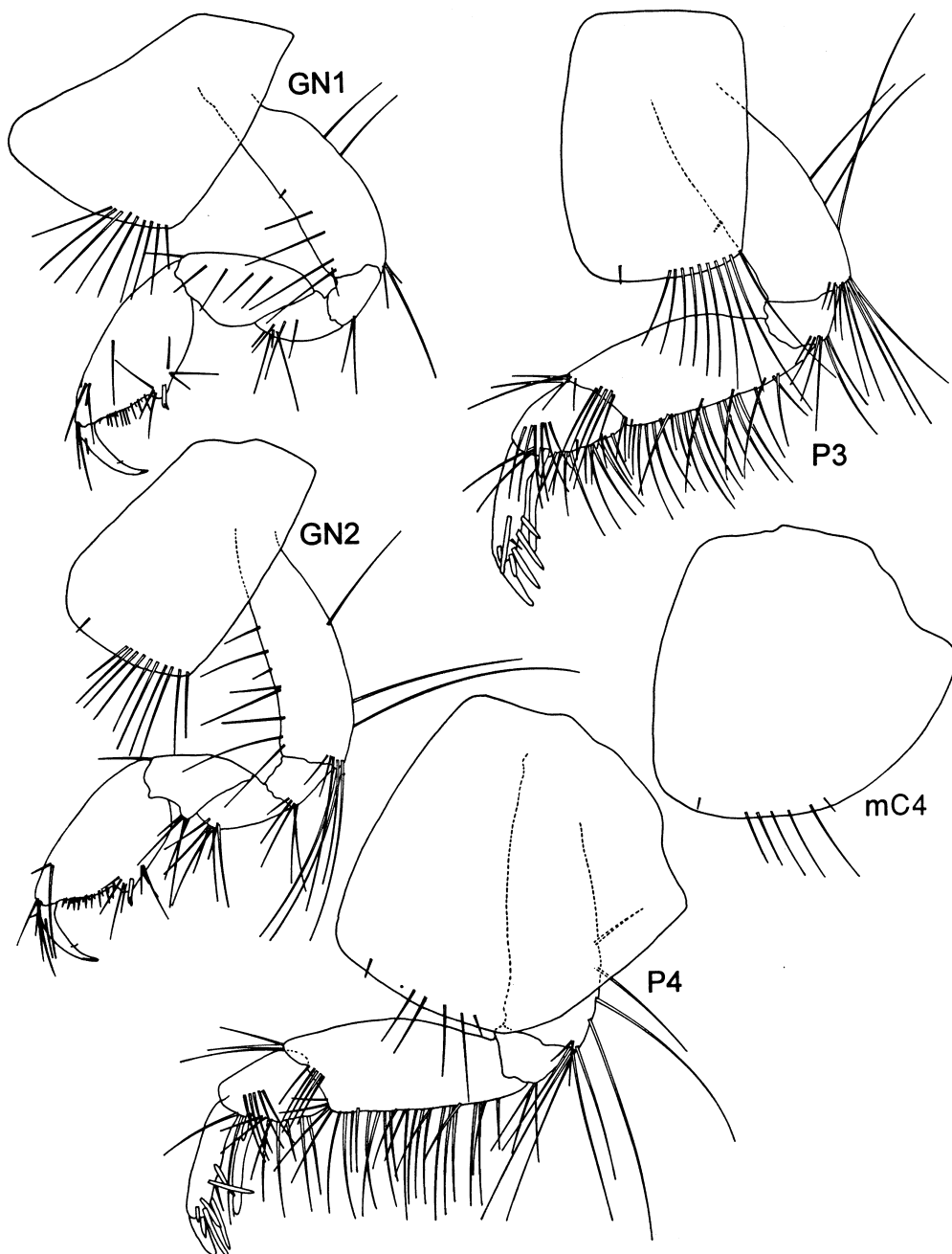


Figure 27. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm (m = male allotype, 3.55 mm).

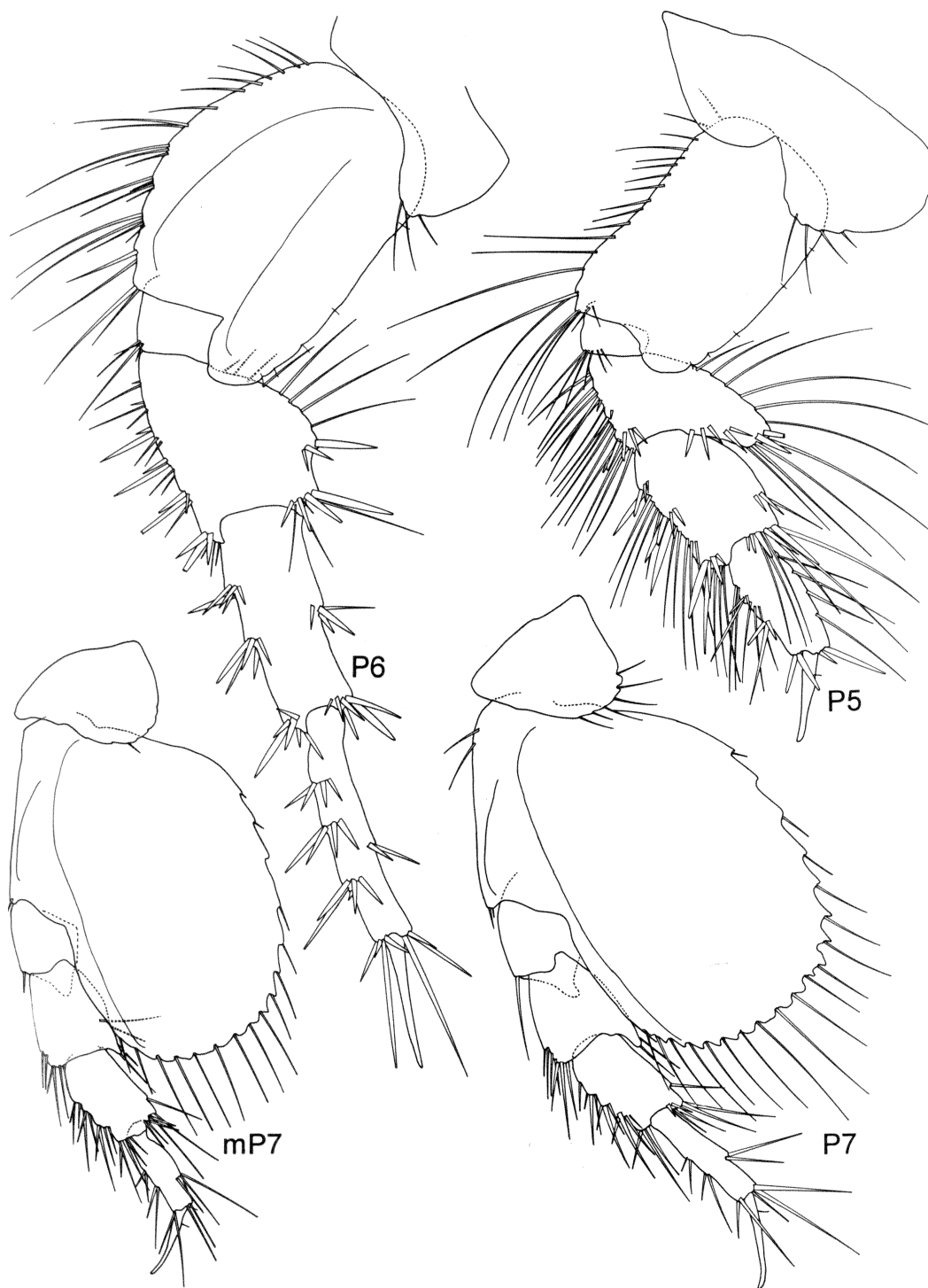


Figure 28. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm (m = male allotype, 3.55 mm).

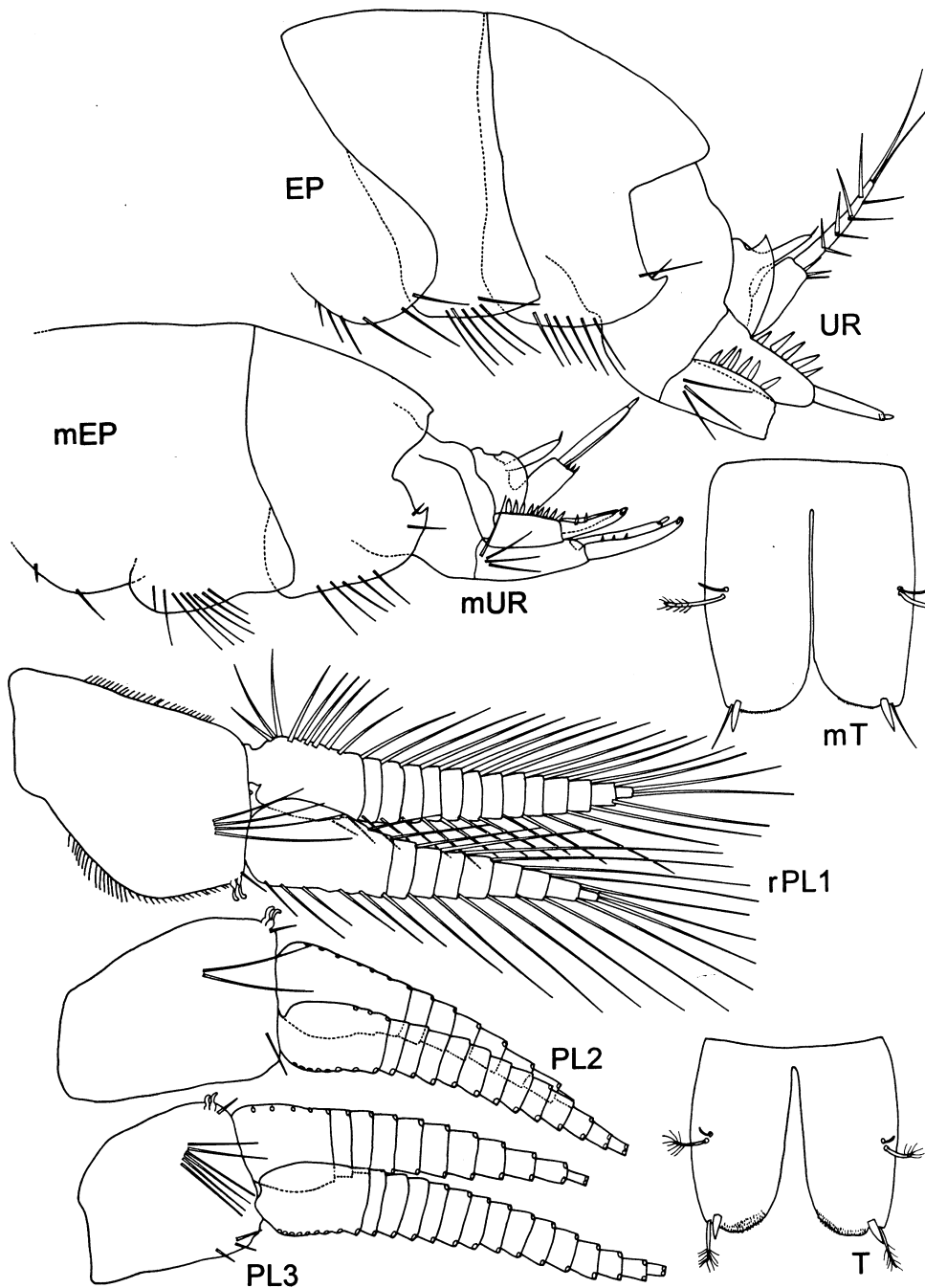


Figure 29. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm (m = male allotype, 3.55 mm).

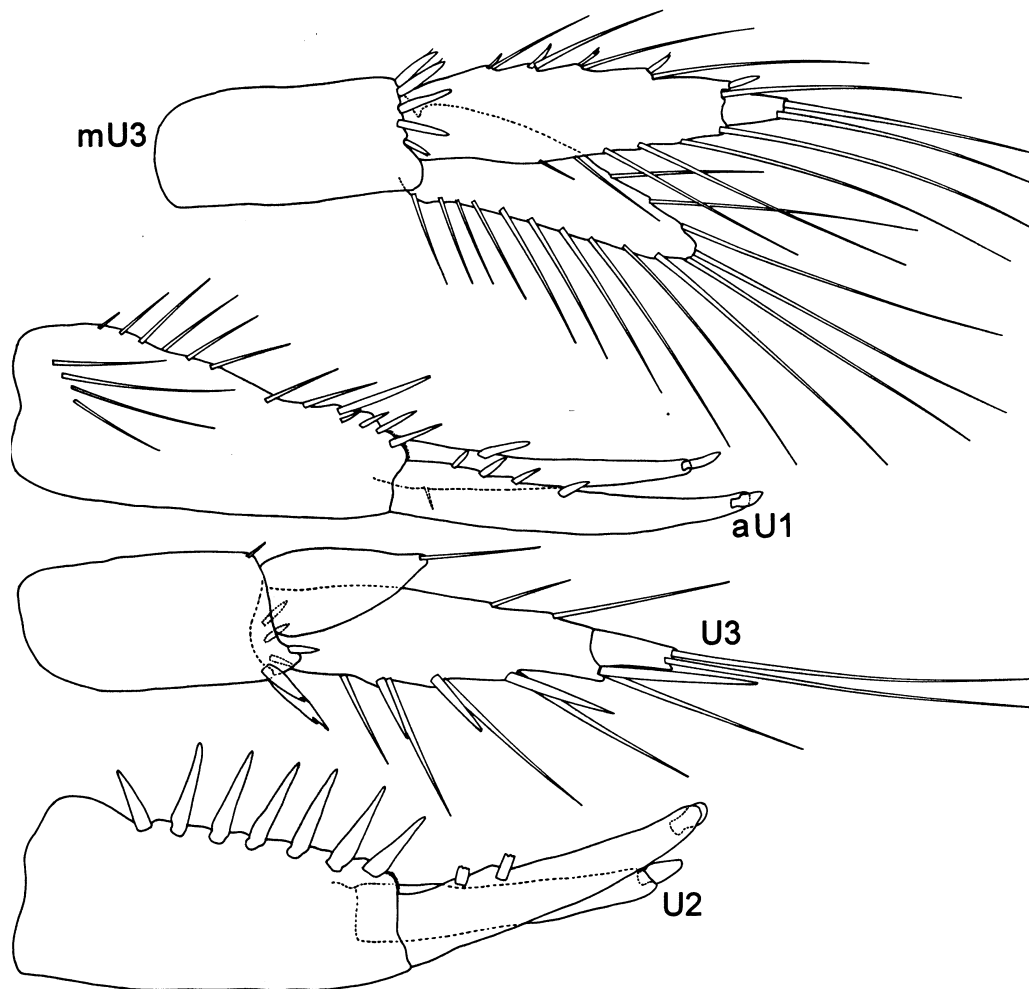


Figure 30. *Birubius wilsoni* sp. nov., holotype female, tl. 4.20 mm (m = male allotype, 3.55 mm).

Allotype. Papua New Guinea, Madang (05°9.57'S, 145°59.93'E), 4 m, J. D. Thomas, 20 Feb 1990 (stn PNG 54), AM P56150 (1 male, tl. 3.55 mm).

Paratypes. Same data as holotype, AM P60002 (1 male, tl. 3.7 mm). Papua New Guinea, Madang (05°9.57'S, 145°59.93'E), 4 m, J. D. Thomas, 20 Feb 1990 (stn PNG 54), AM P60003 (2 females, tl. 4.2–4.8 mm, 53 males, tl. 2.7–3.3 mm).

**Diagnosis.** Rostrum constricted. Antenna 2, article 4 without well developed dorsal setation. Right lacinia mobilis bifid, distal branch simple. Pereopods 3–4 carpus without proximoposterior robust setae. Pereopod 5 dactyl fully formed. Pereopod 7 basis with long ventral setae. Coxa 1 strongly expanded distally. Coxa 4 with long

ventral setae. Epimeron 3 with small tooth; with ventral setae; without long posterior seta; without facial setae. Urosomite 3 with small dorsal hook. Uropod 1 with basofacial setae. Uropods 1–2 inner rami lacking accessory apical nails. Uropod 3 unreduced, outer ramus longer than peduncle.

**Description of female.** Head about 19% of total body length, greatest width about equal to length; rostrum constricted, narrow, elongate, reaching middle of peduncular article 2 on antenna 1. Eyes medium, pigmented. Antenna 1 peduncular article 1 about 1.6 times as long as wide, about 2.1 times as wide as peduncular article 2, ventral margin with 9 setules, unproduced dorsal apex

without setule; peduncular article 2 about 0.66 times as long as peduncular article 1, with 9 ventral setae; primary flagellum with 9 articles, about 0.6 times as long as peduncle, lacking aesthetascs; accessory flagellum with 9 articles. Antenna 2, peduncular article 4 robust setae formula = 1-2-4-3, dorsal margin with notch bearing 3 setae, ventral margin with 7-8 groups of 1-2 long to short setae, 1 long ventrodistal robust seta; peduncular article 5 about 0.68 times as long as peduncular article 4, facial robust seta formula = 1-2, dorsal margin naked, ventral margin with 3 sets of 1-2 long to short setae, 2 ventrodistal long to medium robust setae; flagellum 0.85 times as long as peduncular articles 4-5 combined, with 9 articles. Mandibles with medium palpal hump; right incisor with 3 teeth; left incisor with 2 humps in 2 branches; right lacinia mobilis bifid, distal branch much shorter than proximal branch, simple, pointed, proximal branch simple, pointed; left lacinia mobilis with 4-5 teeth; right raker 6; left rakers 8; molar in form of short protrusion demarcated mainly by robust setae, right molar with 6 long robust setae, left molar with 6 long robust setae, no seta disjunct; palp article 1 slightly elongate, article 2 with 3 long-medium inner apical setae and 1 other medium inner seta, article 3 about 0.93 times long as article 2, apex oblique with 8 robust to slender setae, without basofacial setae. Maxilla 1 inner plate narrow, bearing 1 long apical seta, 1 shorter apicomедial seta, 2 apicolateral much shorter seta; palp article 2 with one apicomедial marginal robust seta, 3 apicomедial setae and 3 submarginal setae. Maxilla 2 inner plate shorter and broader than outer. Maxilliped inner plate with 1 large thick apical robust seta, 2 apicofacial setae, 3 medial setae; outer plate with 5 medial and apical robust setae; palp articles 1 and 2 with 2 and 3 apicolateral seta, article 3 unprotuberant, with 2 facial setae, nail of article 4 long, with 2 accessory setules. Coxa 1 strongly expanded distally; main ventral setae of coxae 1-4 = 9-9-10-6, posteriormost seta of coxae 1-2 medium, of coxa 3 elongate; anterior and posterior margins of coxa 4 strongly divergent, posterior margin oblique, posterodorsal corner rounded, posterodorsal margin medium, undulant, width-length ratio of coxa 4 almost = 29:31. Long posterior setae on basis of gnathopods 1-2 and pereopods 3-4 = 3-8-8-8, short posteriors = 2-2-4-3, long anteriors = 4-6-0-0, short anteriors = 2-1-1-0.

Gnathopods, width ratios of carpus-propodus on gnathopods 1-2 = 21:24 and 18:25, length ratios = 8:11 and 8:13; palmar humps ordinary, palms oblique; gnathopods 1-2 carpus of medium

length. Pereopods 3-4 similar, facial setae on merus = 5 and 5, on carpus = 6 and 5; main spine of carpus extending to M. 87 on propodus, carpus without proximoposterior robust setae; robust setae formula of propodus = 2 + 4 and 2 + 5; acclivity on inner margin of dactyls of pereopods 3-4 weak, midfacial seta short. Coxae 5-7 posteroventral seta formula = 4-3-6; merus-carpus of pereopods 5-6 medium to narrow, facial robust setae rows poorly developed, facial ridge formula on basis of pereopods 5-7 = 0-2-2, anterior ridge of pereopod 7 long; width ratios of basis, merus, carpus, propodus of pereopod 5 = 24:20:14:9, of pereopod 6 = 34:23:14:6, of pereopod 7 = 50:13:9:5, length ratios of pereopod 5 = 38:23:22:27, of pereopod 6 = 24:15:17:18, of pereopod 7 = 58:17:17:18; basis of pereopod 7 reaching apex of merus, heavily setose ventrally. Pleopods 1-3 with 2 coupling hooks; pleopod 1 with 4 distal facial setae, pleopod 2 with 2 distal facial setae, pleopod 3 with 6 mid facial setae; articles on outer rami = 14-13-15, inner rami = 9-8-11.

Epimeron 1 posteroventral corner rounded, anteroventral margin with 4 setae, posteroventral face with 3 medium setae; epimeron 2 posteroventral corner rounded, with 6 facial setae, posteriormost pair set vertically; epimeron 3 posteroventral corner with small to medium tooth, posterior margin almost straight with 2 medium setae, ventral margin with 6 medium setae. Urosomite 1 naked, articulation line absent; urosomite 3 with small hook dorsally. Uropods 1-2 rami with articulate enlarged apical nails, uropod 1 outer ramus with 4 dorsal robust setae, inner with 1 dorsomedial robust seta, uropod 2 outer ramus with 2 dorsal robust setae, inner without robust seta; uropod 1 peduncle with 4 apicolateral robust setae, and 4 basofacial slender setae, medially with many marginal setae plus apical enlarged robust seta; uropod 2 peduncle with 7 dorsal robust setae; apicolateral corners of peduncles on uropods 1-2 with comb. Uropod 3 unreduced, outer ramus longer than peduncle. Uropod 3 peduncle with 6 ventral robust setae, dorsally with 1 lateral seta; rami feminine, inner extending to M. 46 on article 1 of outer ramus, apex with 1 seta, medial and lateral margins naked, article 2 of outer ramus short, 0.23, bearing 2 long setae, apicomедial margin of article 1 with 2 setae, lateral margin with 4 acclivities, robust setal formula = 1-1-1-1-0, slender setal formula = 1-1-1-1-1. Telson, length-width ratio = 55:54, not fully cleft, each apex wide, rounded, setose, lateral acclivity broad, shallow, bearing ordinary lateral setule, robust setae next

medial shorter than setule, midlateral setules diverse.

*Description of male.* Similar to female but eyes larger. Antenna 1 like female but with dense medial setation on peduncular article 1; primary flagellum bearing calceoli. Antenna 2 elongate, peduncular articles 3–4 with dense dorsal setation, peduncular article 5 about as long as article 4, dorsal margin lacking calceoli, bearing 2 groups of male setae, flagellum 24-articulate bearing calceoli. Maxilliped and maxillae 1–2 similar to female. Right mandible damaged, left lacinia mobilis with 5 spines; left rakers 7; molar in form of bulbous hump, left molar with 4 long robust setae, palp similar to female, article 3 with 1 basofacial seta. Main ventral setae of coxae 1–4 = 8-7-8-5, Gnathopods 1–2 similar to female. Pereopod 7 basis narrower than female. Urosomite 3 without hook dorsally Uropod 1 outer ramus with 3 dorsal robust setae, inner with 1 dorsal robust seta, uropod 2 outer ramus with 2 dorsal robust setae, inner without robust seta; uropod 1 peduncle with 2 apicolateral robust setae, with 4 basofacial slender seta; uropod 2 peduncle with 9 dorsal robust setae. Uropod 3 with inner ramus falling short of article 1 on outer ramus. Telson elongate, length-width ratio = 6:5.

*Etymology.* For Dr Robin Wilson, Museum Victoria, a good friend and colleague of both authors.

*Remarks.* The following variations from the holotype were observed in the paratypes. The main ventral setae of coxae 1–4 = (7-9)-(7-9)-(8-11)-(6-9). Uropod 1 outer ramus with 1–4 dorsal robust setae, inner ramus with 1 dorsal robust seta. Uropod 2 outer ramus with 2 dorsal robust setae, inner ramus without dorsal robust setae.

*Birubius wilsoni* conforms well to Barnard and Drummond's (1978) diagnosis of *Birubius* except that it exhibits a dorsal hook on urosomite 3 as seen in *Tickalerus* and *Kulgaphoxus*. It varies from these genera in the lack of a shortened outer ramus on uropod 3 but shares with *Kulgaphoxus* the proximal vs widely spread placement of ventral setae on antennae 1 peduncular article 2. *Birubius wilsoni* differs from the other new species described herein by the combination of characters listed in the diagnoses. It can be distinguished from *B. lowryi*, the only other species described from Papua New Guinea, in the presence of posterior setae on coxae 1–3, long ventral setae on coxa 4 and the absence of proximoposterior setae on the carpus of pereopods 3–4. The species is number MoV3666 in Museum Victoria's TAXA database.

## Discussion

*Birubius* is by far the largest genus of phoxocephalid amphipods, now comprising 38 species from Australia (Barnard and Drummond, 1978), three species from Indonesia (Dana, 1853, Ortiz and Lalana, 1997, 1999) and two species from Papua New Guinea. Species of *Birubius* occur intertidally to 70 m in benthic sandy to muddy sediments. The new species expand the depth and geographic range of the genus from that previously known. The biogeographic relationships between the species from Australian waters and those from Papua New Guinea and Indonesia are as yet unknown but could be elucidated only by cladistic analysis of species of *Birubius*, *Kulgaphoxus*, *Tickalerus* and *Yan*.

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We acknowledge the assistance and support throughout the first author's PhD candidature of those people named in the etymologies. Examination of Australian Museum collections was made possible through financial assistance awarded to the first author in an Australian Museum Postgraduate Award. This project was supported by an Australian Research Council grant to G. C. B. Poore and R. S. Wilson.

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