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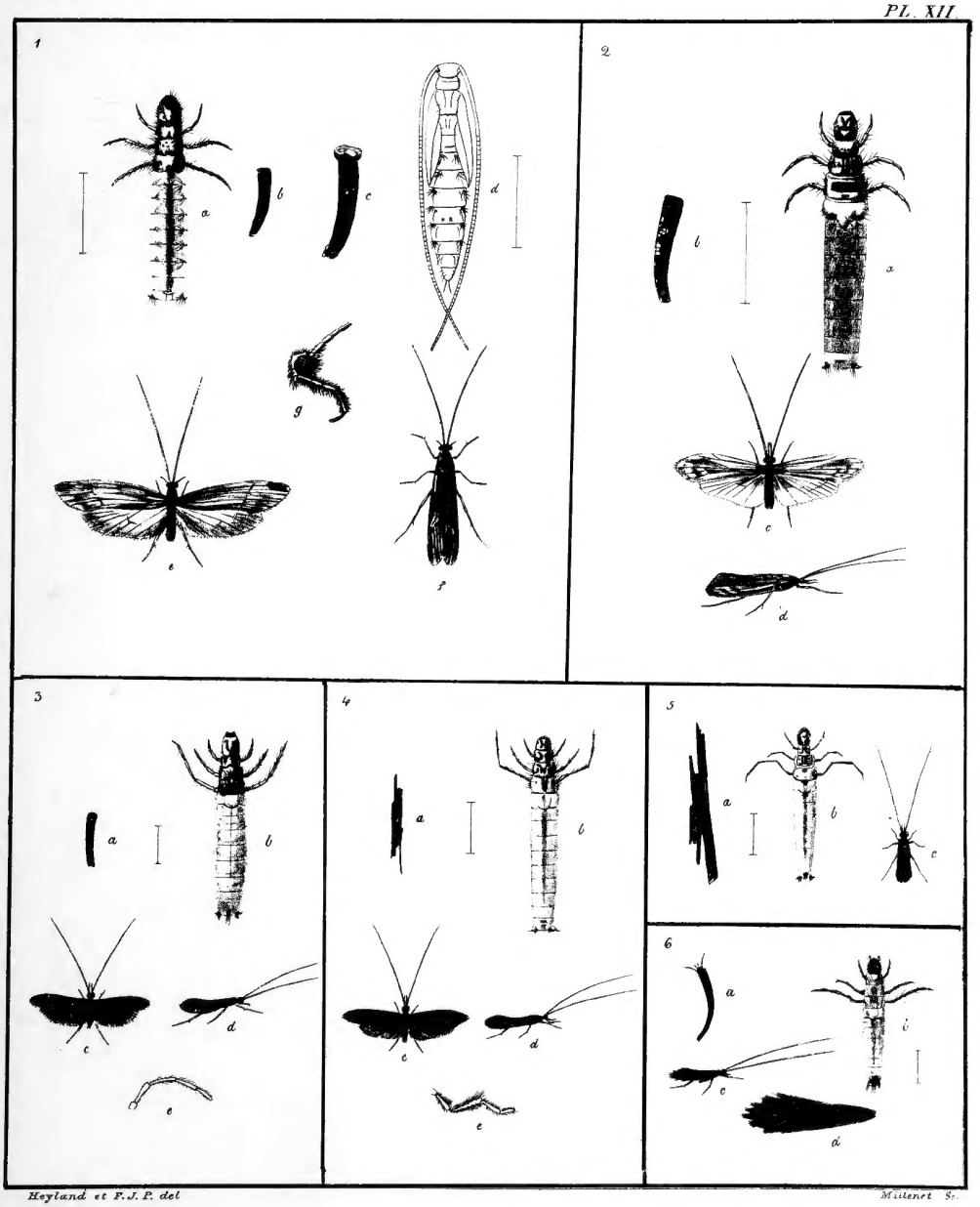

Front cover: Plate XII from the 1834 publication *Recherches pour servir à l'histoire et à l'anatomie des phryganides, ouvrage qui a remporté le Prix Davy fondé à Genève pour encourager l'étude des sciences physiques et naturelle* by François-Jules Pictet. The plate illustrates caddis-flies of the genus *Mystacides* of the family Leptoceridae to which also belongs the genus *Triaenodes*. Australian members are redescribed here by Arturs Neboiss.

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Instructions to Authors

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Wilson, B.R. and Allen, G.R., 1987. Major components and distribution of marine fauna. Pp. 43–68 in: Dyne, G.R. and Watson, D.W. (eds). *Fauna of Australia. General articles. Vol. 1A*. Australian Government Publishing Service: Canberra.

Reference citations use the following style: Paulin, 1986; Last and Stevens, 1994; Smith et al., 1990.

In taxonomic papers synonymies should be of the form: taxon, author, year, pages, figures. A period and dash must separate taxon and author except in the case of reference to the original description, e.g.,

Leontocaris Stebbing, 1905: 98–99.—Barnard, 1950: 699.

Photographs must have clear definition and be submitted as either glossy or flat prints at the actual size for reproduction. Line drawings for text-figures should be in black ink on white card or drawing film. Maximum full-page size is 140 mm wide by 193 mm; single column width is 67 mm. Clear lettering must be inserted. Original line drawings up to three times final size are acceptable.

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DENDROTIIDAE (CRUSTACEA: ISOPODA) OF THE SOUTHEASTERN AUSTRALIAN CONTINENTAL SLOPE

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Abstract

Cohen, B.F., 1998. Dendrotiidae (Crustacea: Isopoda) of the southeastern Australian continental slope. *Memoirs of the Museum of Victoria* 57: 1–38.

Four new species of *Acanthomunna* and four new species of *Dendrotion* are described from material collected from the southeastern Australian continental slope. *A. proteus* Beddard, 1886 is refigured. The new species of *Acanthomunna* represent the first records from Australian waters and the new species of *Dendrotion* represent the first records from waters of the Southern Hemisphere. A key to the genera of Dendrotiidae is presented along with keys to all described species of *Acanthomunna*, *Dendromunna* and *Dendrotion*. This paper highlights the rich dendrotiid fauna of the Australasian region with 10 of the 21 described species found between the Kermadec Trench in the South Pacific and the east coast of Australia. A table of habitat and distributional data for all described species of Dendrotiidae is presented.

Introduction

The crustacean fauna of the southeastern Australian continental shelf is species-rich (Barnard, 1991; Cohen and Poore, 1994; Poore and Wilson, 1993; Coleman et al., 1997) but before the survey by Poore and collegues little was known of the small crustacean fauna of the continental slope. Poore et al (1994) found a rich isopod fauna on the southeastern continental slope, more diverse than that found on comparable slopes in the Atlantic, Arctic and Antarctic. Dendrotiid isopods are one of the families contributing to this diversity. This paper describing new species of dendrotiid isopods is based on the 'SLOPE' collection housed mostly at the Museum of Victoria (Poore et al., 1994).

Dendrotiid isopods are confined to the shelf and deep sea (130–4885 m, Table 1). Prior to this study 13 species in three genera had been described. In this paper four new species of *Acanthomunna* are described, the first records of the genus from Australian waters and increasing the number of described species world-wide from five to nine. *Acanthomunna proteus* Beddard, 1886, from New Zealand is refigured. Four new species of *Dendrotion* are also described. They are the first records of this genus from the Southern Hemisphere and increase the number of described species world-wide from five to nine. Ten of the 21 species of Dendrotiidae now known are found between the Kermadec Trench in the South Pacific and the east coast of Australia; eight are found on the southeastern Australian continental slope.

Most of material on which this study is based has come from the southeastern Australian slope study, 1986 and 1988 (station prefix 'SLOPE') carried out by the Museum of Victoria (NMV), Melbourne (see Poore et al., 1994). Other material is from the Bass Strait Survey carried out by the Museum of Victoria and the Victorian Institute of Marine Science (Wilson and Poore, 1987), and from the Australian Museum (AM), Sydney and the Natural History Museum (BMNH), London.

The scale bar in the figures is 1 mm and refers to drawings of whole animals in dorsal view only. Figure labels are as follows: A1, A2, antenna 1 and 2; P1–7, pereopods 1–7; PL1–5, male pleopods 1–5; rMD, lMD, right and left mandible; MP, maxilliped; MX1, MX2, maxillae 1 and 2, and U, uropods. All illustrations are of the holotype unless otherwise stated.

The specific epithets of the new species are genera of Australian kangaroos and their relatives (Strahan, 1988) chosen only for their euphony, not to reflect any specific feature of either the isopod or the kangaroo. All are nouns in apposition.

Table 1. Distributional data for species of Dendrotiidae

Species	Locality	Depth (m)
Acanthomunna proteus Beddard, 1886	E of New Zealand, South Pacific	1281 and 2011
A. spinipes (Vanhöffen, 1914)	Off Antarctic Peninsula	385
A. hystrix (Hansen, 1916)	Iceland	1505
A. beddardi Menzies, 1962	South Atlantic	4885
A. tannerenis Schultz, 1966	Tanner Canyon, North Pacific	813
A. bettongia sp. nov.	Tasman Sea off Victoria and Tasmania	695–1264
A. lagorchestes sp. nov.	Tasman Sea from NSW to Bass Strait	130–429
A. macropus sp. nov.	Tasman Sea off NSW and Victoria	400–429
A. potorous sp. nov.	Tasman Sea off Point Hicks, Victoria	1840
Dendromunna spinipes Menzies, 1962	South Atlantic	1816
D. mirable Wolff, 1962	Kermadec Trench, South Pacific	5230–5340
D. compsa Lincoln & Boxshall, 1983	Rockall Trough, NE Atlantic	1271–2925
Dendrotion spinosum Sars, 1872	Hardanger Fjord, Norway	281
D. paradoxum Hansen, 1916	Iceland	1600
D. hanseni Menzies, 1956	Off Jamaica, Caribbean	1360
D. setosum Lincoln & Boxshall, 1983	Rockall Trough, NE Atlantic	1160 and 2076
D. elegans Lincoln & Boxshall, 1983	Rockall Trough, NE Atlantic	1600 and 2200
D. onychogalea sp. nov.	Tasman Sea off Point Hicks, Victoria	200–400
D. peradorcus sp. nov.	Tasman Sea off Victoria and Tasmania	500–2900
D. petrogale sp. nov.	Tasman Sea off NSW and Victoria	996 and 1277
D. thylogale sp. nov.	Tasman Sea from NSW to Tasmania	720–1840

Dendrotiidae Vanhöffen

Dendrotionidae Vanhöffen, 1914: 569.—Wolff, 1962: 64.—Lincoln and Boxshall, 1983: 298.

Munnini (part).—Hansen, 1916: 33.

Dendrotidae Menzies, 1962a: 28.

Dendrotioniidae Menzies, 1962b: 167.

Dendrotiidae Bowman and Abele, 1982: 19.

Diagnosis. Antennae long and slender. Pereon bearing spines or long setae dorsally. Mouthparts generally not modified except maxilliped palp articles narrow. Pereopod 1 prehensile, shorter than 2–7. Pereopods 2–7 ambulatory, long and slender; pereopod 7 absent in some species. Coxal plates maybe visible dorsally, extended in some species into long lateral projections. Uropods large, biramous and inserted on dorsolateral surface of pleotelson. Uropod insertion point marked by large socket on the pleotelson. Pleotelson extending beyond insertion point of uropods. Anus opening into brachial chamber. Pleopods generally typical of Asellota except male pleopod 2 in some species with extremely long penial filament.

Remarks. Wilson (1976) removed *Munella* from Dendrotiidae into his newly erected family, Haplomunnidae. As Wilson (1976) argued, the three remaining dendrotiid genera form a strong family, all united by the possession of large uropods inserted on the dorsolateral surface of the pleotelson. Many specimens loose these massive uropods when they are captured and brought to the surface. No confusion with species of the genus *Munella* should arise because a large pair of sockets on the pleotelson indicate where dendrotiid uropods attach; species of *Munella* lack these large sockets.

Some confusion exists in the literature concerning the correct spelling of the family name Dendrotiidae. Bowman and Abele (1982) introduced the correct spelling (Dendrotiidae) without explanation. *Dendrotion* is probably a conjunction of *dendro-* (branching) and the Greek word *-otion* (little ear). As family names are made of the Latinised genitive root, *oti-* in this case, the correct family name is Dendrotiidae (G.D.F. Wilson, pers. comm.).

Key to genera of Dendrotiidae

1. Cephalon with prominent lateral process supporting antennae; antenna 1 basal article elongate (more than 5 times as long as broad) ..... *Dendrotion*
— Cephalon without prominent lateral process supporting antennae; antenna 1 basal article not elongate (less than 2 times as long as broad).....2
2. Eyes present, pereon at most bearing many small spines, pereopod 7 present in adults..... *Acanthomunna*
— Eyes absent, pereon bearing few large dorsolaterally directed spine-like processes, each bearing apical cluster of spines, pereopod 7 absent in adults..... .....*Dendromunna*

Acanthomunna Beddard

Acanthomunna Beddard, 1886a: 102. Beddard, 1886b: 47.—Menzies, 1962b: 174.—Wolff, 1962: 65.—Schultz, 1966: 6.—Lincoln and Boxshall, 1983: 309.

Moromunna Vanhöffen, 1914: 569.

Pseudomunna Hansen, 1916: 47.

Type species. *Acanthomunna proteus* Beddard, 1886.

Diagnosis. Eyes present, located on small lateral protuberances. Cephalon broader than long, narrower than pereon. Antennae extremely long and slender. Antenna 1 basal article stout, not more than twice as long as wide; third basal article longer than first or second. Antenna 2 as long as animal and twice as long as antenna 1; peduncle articles 1–3 short, articles 1 and 2 with spiniform setae; peduncle articles 4 and 5 extremely long and slender. Pereon oval; 1.5 to 2 times as broad as long at broadest point; all pereonites and pereopods free and present. Mouthparts typical of Asellota, left mandible not stronger than right. Maxillipedal epipod broad and flat, distally tapered; endite internal margin reflexed; palp much narrower than endite, of 5 articles. Pereopod 1 prehensile, reflexed between carpus and propodus, shorter than other pereopods. Pereopods 2–7 ambulatory; long and slender, becoming successively more elongate; basis, ischium and merus compact, carpus and propodus greatly elongate; ischium to propodus articles with spiniform setae along anterior and posterior margins. Male pleopod 1 subrectangular. Male pleopod 2 peduncle tapered; exopod bilobed. Some species, with extremely long appendix masculina. Uropods large and robust with numerous spiniform setae, inserted posterolaterally on dorsal surface; rami subequal, peduncle obvious.

Remarks. Prior to this study only 12 specimens of *Acanthomunna* had been collected, three of the five species known from only one specimen: *A. hystrix* (Hansen, 1916); *A. beddardi* Menzies, 1962; *A. tannerenis* Schultz, 1966. *A. proteus* Beddard, 1886 is known from two specimens and *A. spinipes* (Vanhöffen, 1914) known from seven. The four new species represent the first substantial collection of individuals of *Acanthomunna*. *A. bettongia* sp. nov. is represented by over 200 specimens and *A. lagorchestes* sp. nov. by over 100 specimens.

Wilson (1976) suggested a phylogeny of the Dendrotiidae and a closely related family, Haplomunnidae. He argued that *Acanthomunna*, occuring in shallow waters, is the least derived genus of these two families because they have retained their eyes. The other genera have moved into deeper waters and lost their eyes. *A. lagorchestes* sp. nov. is the only dendrotiid recorded from less than 150 m (130–429 m, Table 1) although most individuals were caught around 400 m depth. *A. macropus* sp. nov. was also caught around 400 m (400–429 m). A fifth species of *Acanthomunna* was captured from 200 m (stn SLOPE 21, NMV J18589) but was too badly damaged to be described.

Key to species of *Acanthomunna*

1. Pereonites 3 and 4 with spiniform setae on middorsal surface.....2
— Pereonites 3 and 4 devoid of setae on middorsal surface (may have small spines near lateral margins of dorsal surface).....5
2. Cephalon with spiniform setae.....3
— Cephalon devoid of spiniform setae.....4
3. Spiniform setae branched.....*A. proteus* Beddard, 1886
— Spiniform setae not branched.....*A. beddardi* Menzies, 1962

4. Pereonite 1 with a single row of 4–5 large spiniform setae..... *A. potorous* sp. nov.
— Pereonite 1 with 2 rows of more than 5 large spiniform setae..... *A. tannerensis* Schultz, 1966
5. Pereonite 1 with more than 8 dorsal spines.....*A. hystrix* (Hansen, 1916)
— Pereonite 1 with 4 or fewer dorsal spines.....6
6. Pereonite 2 devoid of spiniform setae.....*A. bettongia* sp. nov.
— Pereonite 2 with spiniform setae.....7
7. Pereonite 1 with 4 spines.....*A. spinipes* (Vanhöffen, 1914)
— Pereonite 1 with 3 spines.....*A. lagorchestes* sp. nov.
— Pereonite 1 with 2 spines.....*A. macropus* sp. nov.

Acanthomunna bettongia sp. nov.

Figures 1–3

Material examined. Holotype. Tasmania. 48 km ENE of Cape Tourville (42°00.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al on RV *Franklin*, 30 Oct 1988, stn SLOPE 81, NMV J36984 (female).

Paratypes. Type locality, NMV J36985 (1 male).

Victoria. S of Point Hicks (38°16.40'S, 149°27.60'E), 800 m, coarse shell, biogenic seds, WHOI epibenthic sled, M.F. Gomon et al on RV *Franklin*, 23 Jul 1986, stn SLOPE 34, NMV J36983 (1 female).

Other material. Tasmania. Off Freycinet Peninsula, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 27 Jul 1986 (42°2.20'S, 148°38.70'E), 800 m, coarse shelly sand, stn SLOPE 45, NMV J18572 (4); (42°0.20'S, 148°37.70'E), 720 m, coarse shelly sand, stn SLOPE 46, NMV J18573 (1). Type locality: NMV J18574 (63), NMV J18575 (64).

Eastern Bass Strait, naturalists' dredge, G.C.B. Poore on HMAS *Kimbla*, Mar 1979: 55 km NE of Babel Island (39°38.2'S, 148°49.2'E), 695 m, rock-sand-mud, stn BSS 34, NMV J18576 (10), NMV J18577 (10); 87 km ENE of North Point, Flinders I. (39°28.2'S, 148°52.4'E), 841 m, muddy sand, stn BSS 37, NMV J18578 (1).

Victoria. S of Point Hicks, WHOI epibenthic sled on RV *Franklin*, 23 Jul 1986: 38°21.90'S, 149°20.00'E, 1000 m, G.C.B. Poore et al., stn SLOPE 32, NMV J18568 (18); 38°19.60'S, 149°24.30'E, 930 m, rock, rubble, clay, sand, biogenic sediment, M.F. Gomon et al., stn SLOPE 33, NMV J18569 (16); 38°16.40'S, 149°27.60'E, 800 m, coarse shell, biogenic sediments, M.F. Gomon et al., stn SLOPE 34, NMV J18570 (8), NMV J18571 (7).

Description. Total length of holotype 2.94 mm. Cephalon subrectangular, twice as long as wide; anterior margin with middorsal notch between base of antenna, covered with many fine scales. Antenna 1 flagellum with 10 articles with 9 aesthetases located on all flagellum articles except basal three. Antenna 2 flagellum with numerous articles of subequal sizes.

Pereon oval, widest at pereonite 3. Pereonites 1–4 separated by narrow dorsal sulcus; pereonites 5–7 compressed, successively becoming more posteriorly projected. Pereonites 2–4 with short spine-like extensions of posterior lateral margins. Lateral margins of pereonite 7 hidden dorsally by pleotelson; coxae visible dorsally on other pereonites, some with small tapered projections. Lateral margins of pereonites and coxae with numerous fine scales as found on anterior margin of cephalon. Pereonite 1 with transverse dorsal ridge supporting 2 diverging anterolateral spines and a bifid anteriorly directed middorsal spine; remaining pereonites smooth, devoid of obvious spination.

Pleonites fused to pleotelson. Pleotelson subtriangular, 1.2 times longer than wide; with pair of large anteriorly directed spines on anterior third of dorsal surface and a sulcus running along lateral margin to posterolateral bosses which support uropods; ventrolateral margins with 3 short spiniform setae; posterior margin with a pair of minute spiniform setae laterally and a crenulate margin between setae, extending beyond uropodal bosses.

Left mandibular incisor process 3-dentate, lacinia mobilis 2–3-dentate; right mandibular incisor process 4–5-dentate. Left mandibular spine row with 9 armed spines; right mandibular spine row with 9 armed spines. Left mandibular molar broad, flat, positioned against lacinia mobilis; with 5 spiniform setae. Right mandibular molar broad and concave; with numerous spiniform setae. Mandibular palp of 3 elongate articles, typical. Maxilla 1 outer lobe bearing 11 stout spines, 7 denticulate; inner lobe with numerous setae. Maxilla 2 with stout setae on all lobes; outer lobe with 2 simple and 2 denticulate setae; middle lobe with 1 simple and 2 denticulate setae and inner lobe with 5 denticulate setae. Outer and middle lobes with a row of simple setae on inner lateral margins. Maxilliped with 3 coupling hooks; endite distal margin with 7 denticulate setae.

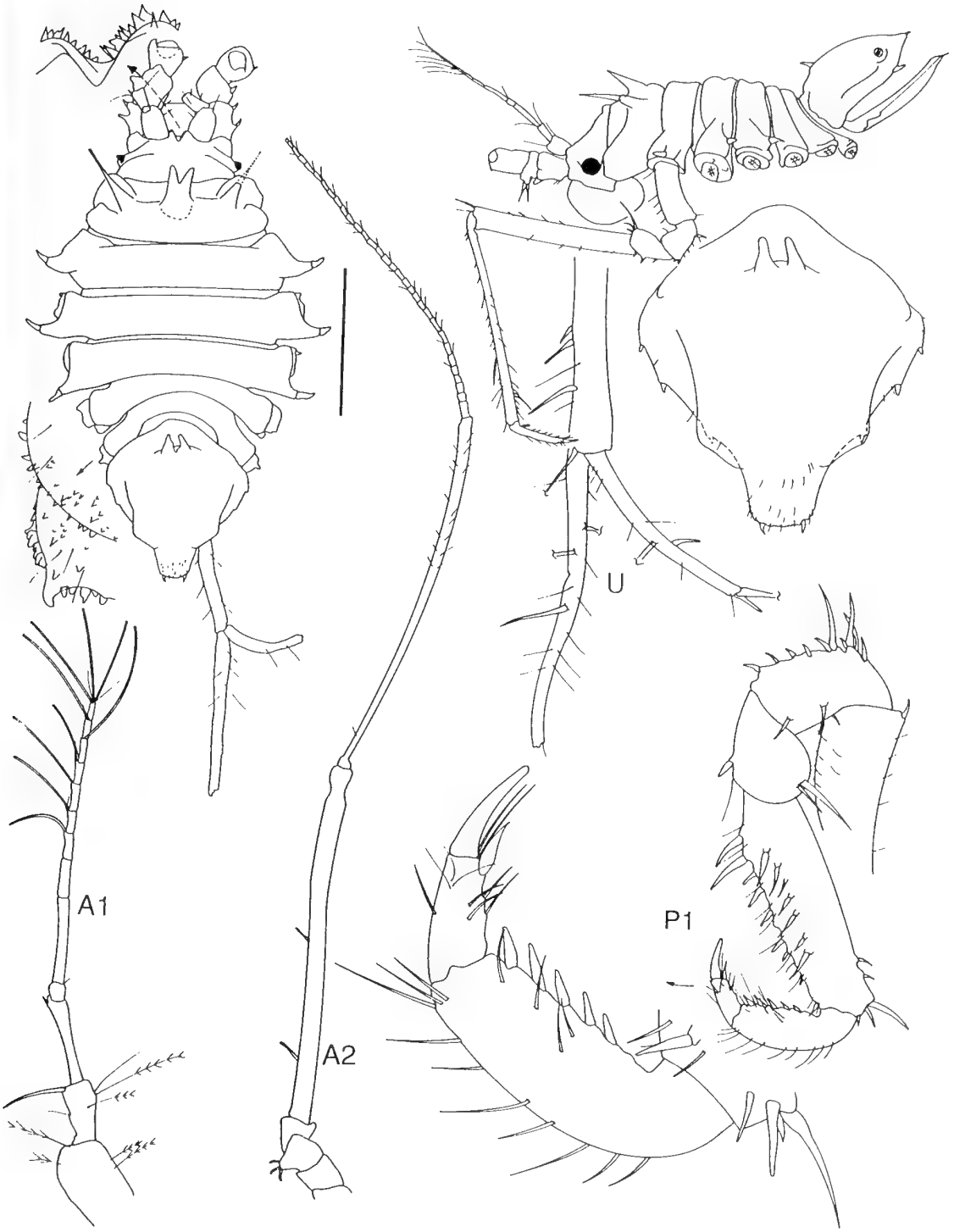


Figure 1. *Acanthomunna bettongia.* Holotype NMV J36984; A2 of paratype NMV J36983.

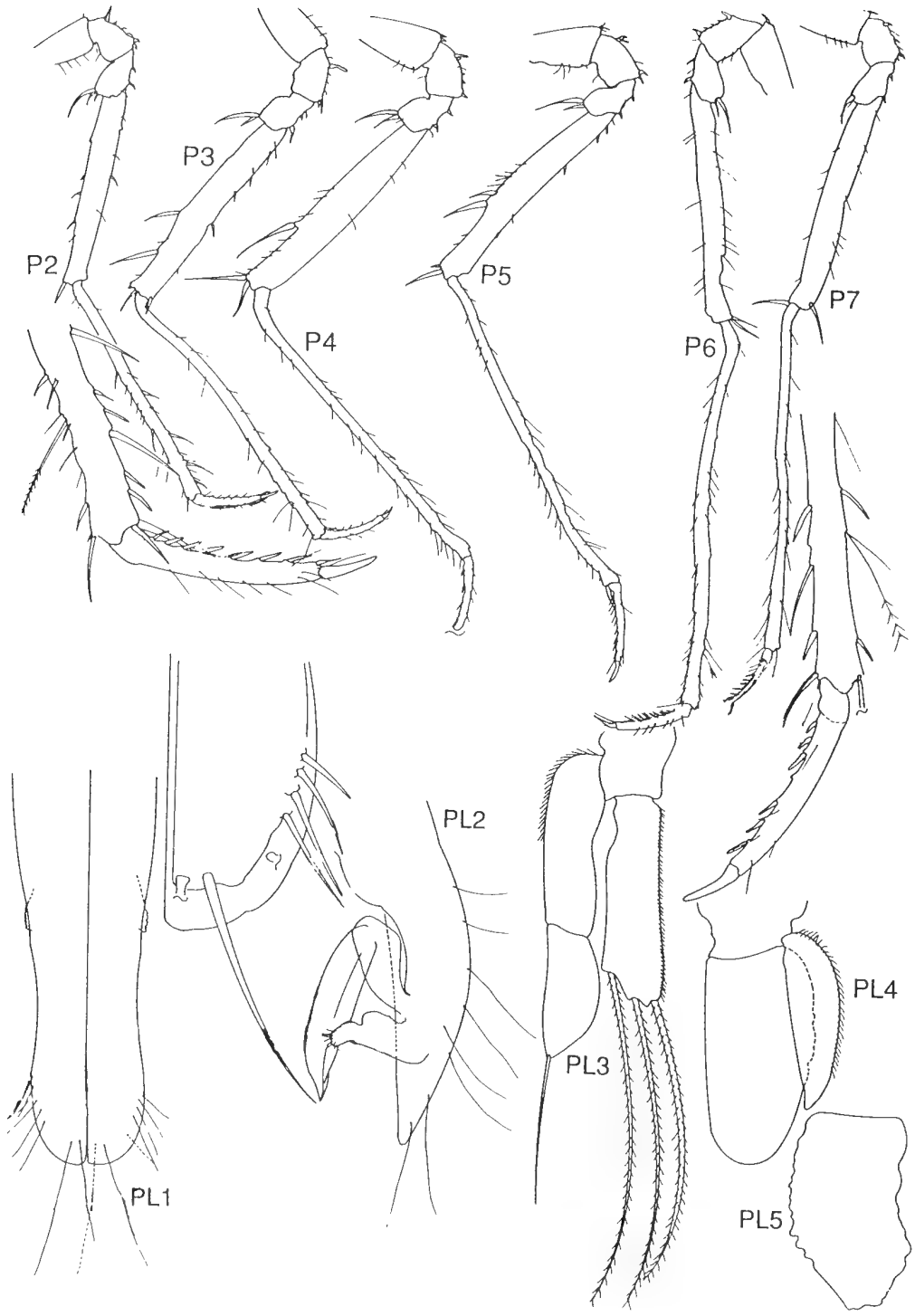


Figure 2. *Acanthomunna bettongia.* Holotype NMV J36984; PL1–5 of paratype NMV J36985.

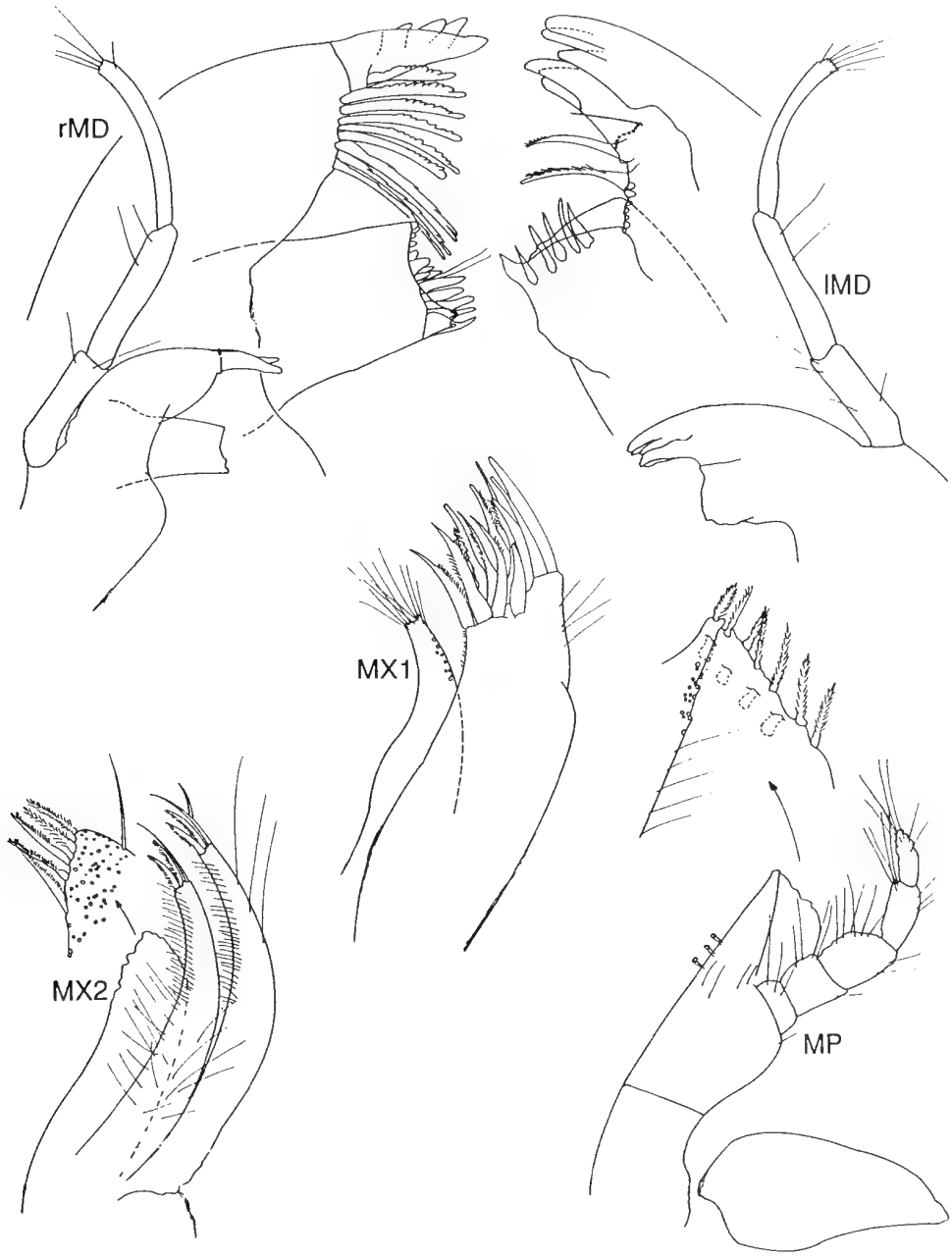


Figure 3. *Acanthomunna bettongia*. Holotype NMV J36984.

Pereopod 1 propodus with row of 5 stout setae on posterior margin; carpus with 2 rows of stout setae; other articles also with spiniform setae. Pereopods 2–7 typical, merus and carpus with large stout setae and dactylus with 7–8 spiniform setae posteriorly.

Male pleopod 1 with rounded distal margin bearing 7–8 long setae on each side. Male pleopod 2 proximal lobe small, knob shaped; distal lobe setose; appendix masculina (endopod) small, not reaching end of peduncle. Pleopod 3 endopod reaching beyond first article of exopod, with 3 long compound setae distally; exopod with 1 long setae. Pleopod 4 endopod longer than exopod and 2–3 times as broad. Pleopod 5 with no rami, lateral and distal margins crenulate. Uropod typical; exopod as long as peduncle, endopod one third longer than exopod.

Distribution. Tasman Sea off Victoria and Tasmania, 695–1264 m depth.

Remarks. Acanthomunna bettongia is most readily identified by the bifid, anteriorly directed middorsal spine on pereonite 1 and the pair of anteriorly directed large spines on anterior third of dorsal surface of the pleotelson. *A. bettongia* appears to be a common species on the upper continental slope of southeastern Australia. Over 200 specimens were collected from the SLOPE survey.

Acanthomunna lagorchestes sp. nov.

Figures 4–6

Material examined. Holotype. S of Point Hicks (38°17.70'S, 149°11.30'E), 400 m, coarse sand, gravel, mud, many sponges, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 24 Jul 1986, stn SLOPE 40, NMV J36980 (female).

Paratypes. Victoria. Type locality, NMV J36982 (1 male).

New South Wales. 44 km E of Nowra (34°55.79'S, 151°08.06'E), 429 m, muddy coarse shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 22 Oct 1988, stn SLOPE 56, NMV J36981 (1 female).

Other material. New South Wales. Off Nowra, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*: 34°59.52'S, 151°5.94'E, 204 m, coarse shell, 14 Jul 1986, stn SLOPE 1, NMV J18579 (1); 34°55.79'S, 151°08.06'E, 429 m, muddy coarse shell, 22 Oct 1988, stn SLOPE 56, NMV J18581 (37), NMV J18582 (38).

Tasmania. Eastern Bass Strait, 100 km NE of North Point, Flinders I. (38°52.6'S, 148°25.2'E), 130 m, fine sand, R.S. Wilson on RV *Tangaroa*, 15 Nov 1981, stn BSS 170, NMV J18583 (2).

Victoria. Type locality, NMV J18580 (20). 50 km S of Mallacoota (38°06.2'S, 149°45.5'E), 188 m, WHOI epibenthic sled, R.S. Wilson on RV *Soela*, 14 Oct 1984, stn S05/84/30, NMV J18584 (1).

Description. Total length of holotype 2.20 mm Cephalon quadrate, as long as wide; anterior margin straight, produced between base of antenna. Antenna 1 flagellum with 5 articles with 3 aesthetascs located on 3 distal articles. Antenna 2 flagellum with 18 articles.

Pereon oval, widest at pereonite 3. Pereonites 1–4 with narrow dorsal sulcus separating pereonites; pereonites 5–7 compressed, successively becoming more posteriorly projected. Lateral margins of pereonite 7 hidden dorsally by pleotelson; coxae visible dorsally on other pereonites, all with small lateral projections. Pereonite 1 with middorsal ridge supporting 3 small spines; pereonite 2 with middorsal ridge with six small projections which appear to be the attachments for setae; remaining pereonites smooth, devoid of obvious dorsal spination or setae. All pereonites except pereonite 7 with 1 or 2 pairs of small projections near lateral margins.

Pleonite 1 visible, pleonites 2–5 fused to pleotelson. Pleotelson subtriangular ventrally with pronounced posterolateral bosses protruding dorsally; 1.1 times longer than wide; distal margin rounded; devoid of any spination or setae.

Left mandibular incisor process 6–7-dentate, lacinia mobilis 1–2-dentate; right mandibular incisor process 4-dentate. Left mandibular spine row with 3 spines, simple; right mandibular spine row with 5 spines, most armed. Left mandibular molar broad and flat, split into two. Right mandibular molar broad and flat. Mandibular palp represented by single setae. Maxilla 1 outer lobe with 9 visible stout spines, 3 denticulate; inner lobe with numerous setae. Maxilla 2 with stout setae on inner lobe; outer and middle lobes with a row of simple setae on inner lateral margins. Maxilliped with 2 coupling hooks; endite distal margin with 6 denticulate setae.

Pereopod 1 propodus with row of 4 stout setae on posterior margin; carpus with stout setae on both margins; other articles also supporting a few spiniform setae. Pereopods 2–7 typical, merus and carpus with large stout setae and dactylus with 5–6 spiniform setae posteriorly.

Male pleopod 1 with rounded distal margin bearing 14 long setae on each side distal to oblique groove. Male pleopod 2 proximal lobe as a small rounded knob, distal lobe setose; appendix masculina (endopod) not long, extending just beyond peduncle. Pleopod 3 endopod reaching half way along second article of exopod, with 3 long compound setae distally; exopod with 1 long setae. Pleopods 4–5 similar to *A. bettongia* but with concaved depression centrally; pleopod 5 margins smooth. Uropod typical; endopod one

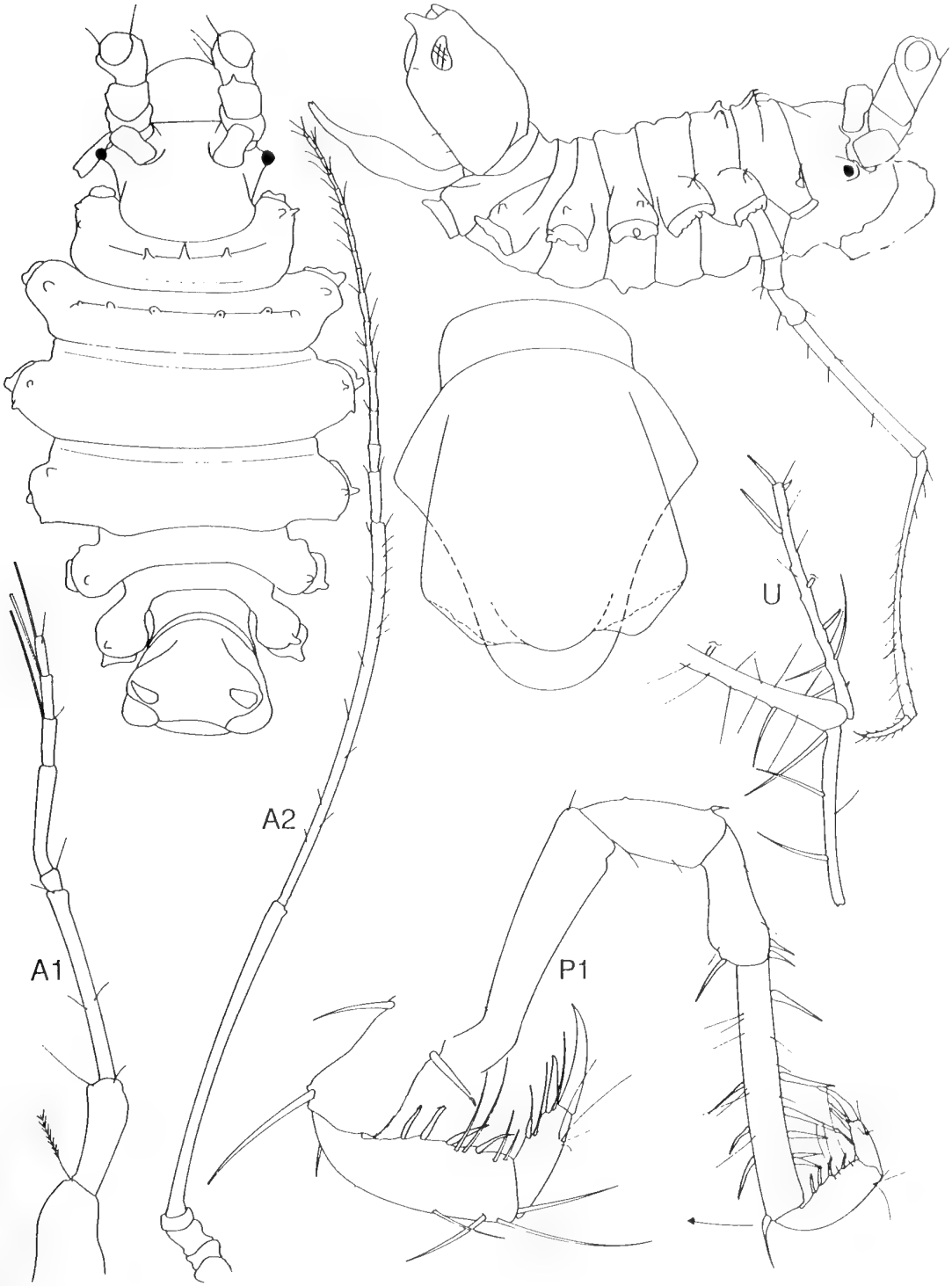


Figure 4. *Acanthomunna lagorchestes*. Holotype NMV J36980; U, P1, A1 and A2 of paratype NMV J36981.

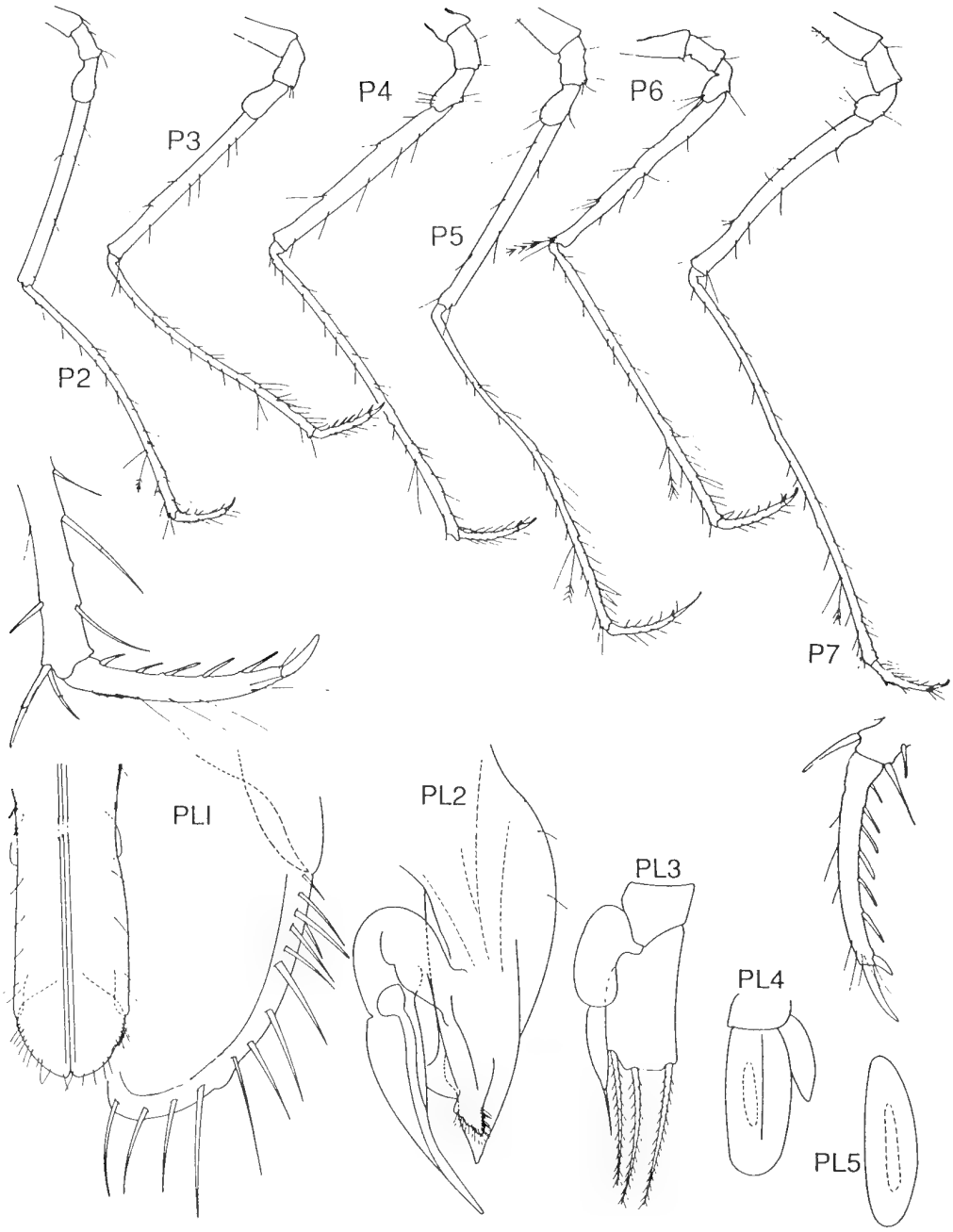


Figure 5. *Acanthomunna lagorchestes.* P2–6 of paratype NMV J36981; PL1–5 of paratype NMV J36982.

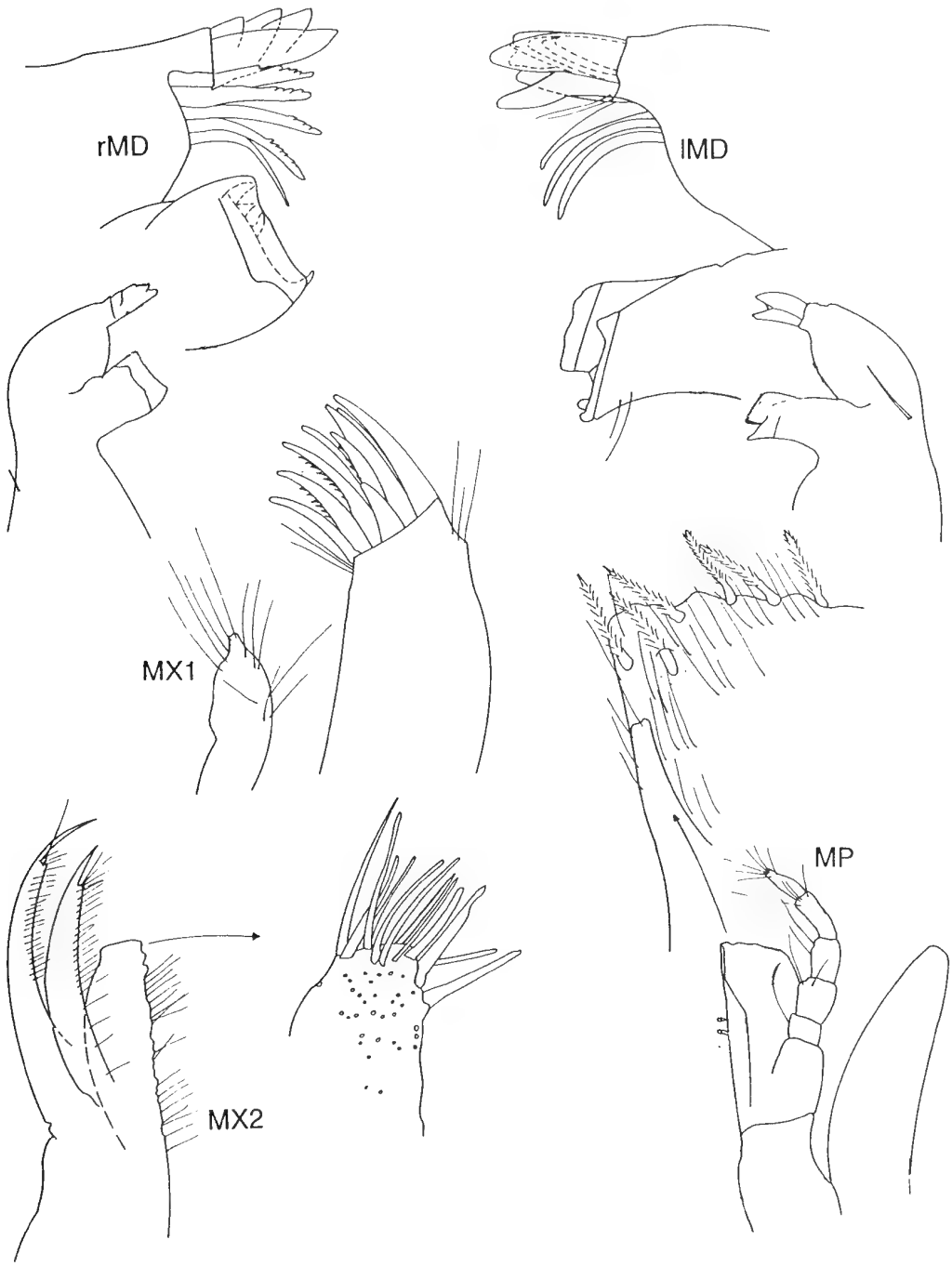


Figure 6. *Acanthomunna lagorchestes.* Paratype NMV J36981.

Figure 7. *Acanthomunna macropus*. Holotype NMV J36977.

quarter longer exopod; peduncle as large as endopod.

Distribution. Tasman Sea from NSW to Bass Strait, 130–429 m depth.

Remarks. Acanthomunna lagorchestes and *A. macropus* sp. nov. appear to be closely related species because they share many similarities, including their small size; pereonites with rounded lateral margins; pereonites 3–7 and pleotelson devoid of setae on middorsal surface and similarly shaped pleotelsons. *A. lagorchestes* is distinguishable by the greater pattern of spination on pereonites 1 and 2. *A. lagorchestes* appears to be a common species on the upper continental slope of southeastern Australia with over 100 specimens collected on the SLOPE survey.

Acanthomunna macropus sp. nov.

Figures 7–9

Material examined. Holotype. New South Wales. 44 km E of Nowra (34°55.79'S, 151°08.06'E), 429 m, muddy coarse shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 22 Oct 1988, stn SLOPE 56, NMV J36977.

Paratype. Type locality, NMV J36978 (1 female).

Victoria. S of Point Hicks (38°17.70'S, 149°11.30'E), 400 m, coarse sand, gravel, mud, many sponges, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 24 Jul 1986, stn SLOPE 40, NMV J18585 (1 male).

Other material. Type locality, NMV J18586 (3), NMV J18587 (1).

Description. Total length of holotype 1.67 mm. Cephalon subrectangular, twice as long as wide; anterior margin extended, straight with a pair of rounded projections at base of antennae. Antenna 1 flagellum with 6 articles with 3 aesthetascs located on 2 most distal articles. Antenna 2 flagellum with 27 articles, first article small.

Pereon oval, widest at pereonite 3. Pereonites 1–4 longer than 5–7; pereonite 5 compressed with concave posterior margin; pereonites 6–7 compressed more than pereonite 5. Lateral margins of pereonites 5–7 increasingly projected posteriorly; lateral margins of pereonite 7 dorsally hidden by pleotelson. Pereonite 1 with middorsal ridge supporting 2 small spines; pereonite 2 with middorsal ridge with 3 small projections which appear to be the attachments for setae; remaining pereonites smooth, devoid of dorsal spination or setae. Posterior margin of pereonites 2 and 3 overlapping slightly the following pereonites. All pereonites except pereonite 7 with 1 or 2 pairs of projections on lateral margins, coxae with similar lateral projections.

Pleonite 1 free, remaining fused to pleotelson. Pleotelson subtriangular ventrally with pronounced posterolateral bosses protruding dorsally; one quarter longer than wide; raised middorsally; devoid of any spination or setae dorsally; posterior margin rounded extending between posterolateral bosses which support the uropods, posterior and lateral margins fringed with short setae.

Left mandibular incisor process 1–2-dentate, lacinia mobilis 4–5-dentate; right mandibular incisor process 4-dentate. Left mandibular spine row with 5 spines; right mandibular spine row with 5 armed spines. Left mandibular molar broad with 3 spiniform setae. Right mandibular molar broad, flat. Mandibular palp absent. Maxilla 1 outer lobe with 11 stout spines, 5 denticulate; inner lobe with numerous setae. Maxilla 2 with 6 denticulate setae on inner lobe; outer and middle lobes with a row of simple setae on inner lateral margins. Maxilliped with 2 coupling hooks; endite distal margin with 8 denticulate setae.

Pereopod 1 propodus with row of 4 stout setae on posterior margin; carpus with stout setae on both margins; other articles also supporting a few setae. Pereopods 2–7 typical, merus and carpus with large stout setae and dactylus with 5–6 spiniform setae posteriorly.

Male pleopod 1 with rounded distal margin bearing 11 long setae on each side distal to oblique groove. Male pleopod 2 proximal lobe knob shaped, distal lobe setose; appendix masculina (endopod) not long, extending a little beyond peduncle. Pleopod 3 endopod reaching beyond first article of exopod, with 3 long compound setae; second article of exopod missing. Pleopods 4–5 similar to *A. bettongia* but with concaved depression centrally; pleopod 5 margins smooth. Uropods missing, thought large and inserted dorsolaterally on pleotelson.

Distribution. Tasman Sea off NSW and Victoria, 400–429 m depth.

Remarks. A. macropus is the smallest species of *Acanthomunna* described. It is most easily distinguished by the two plus three pattern of spination on pereonites 1 and 2.

Acanthomunna potorous sp. nov.

Figures 10–12

Material examined. Holotype. 76 km S of Point Hicks (38°29.33'S, 149°19.98'E), 1840 m, sandy mud, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 26 Oct 1988, stn SLOPE 69, NMV J36986 (male).

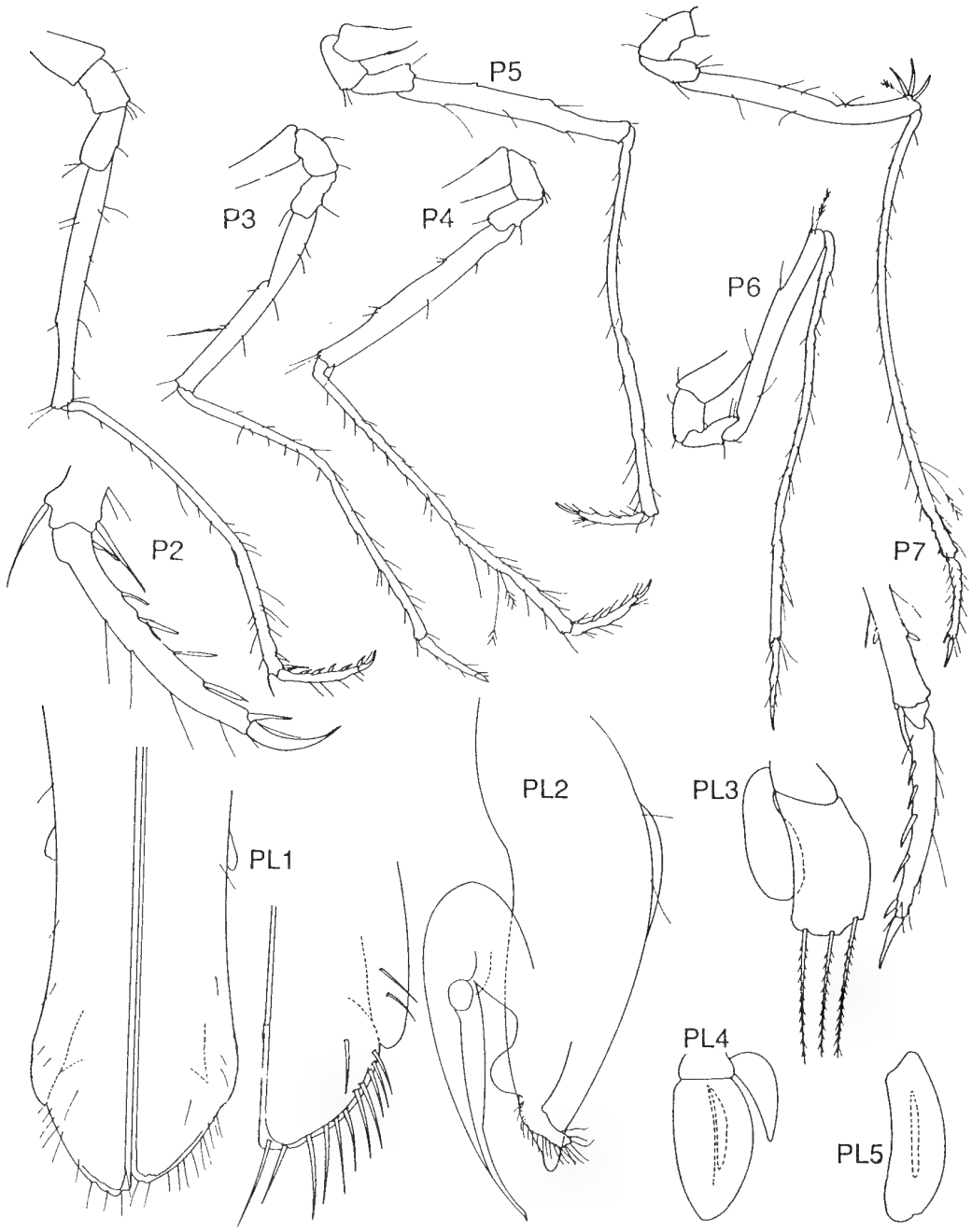


Figure 8. *Acanthomunna macropus*. Paratype NMV J18585.

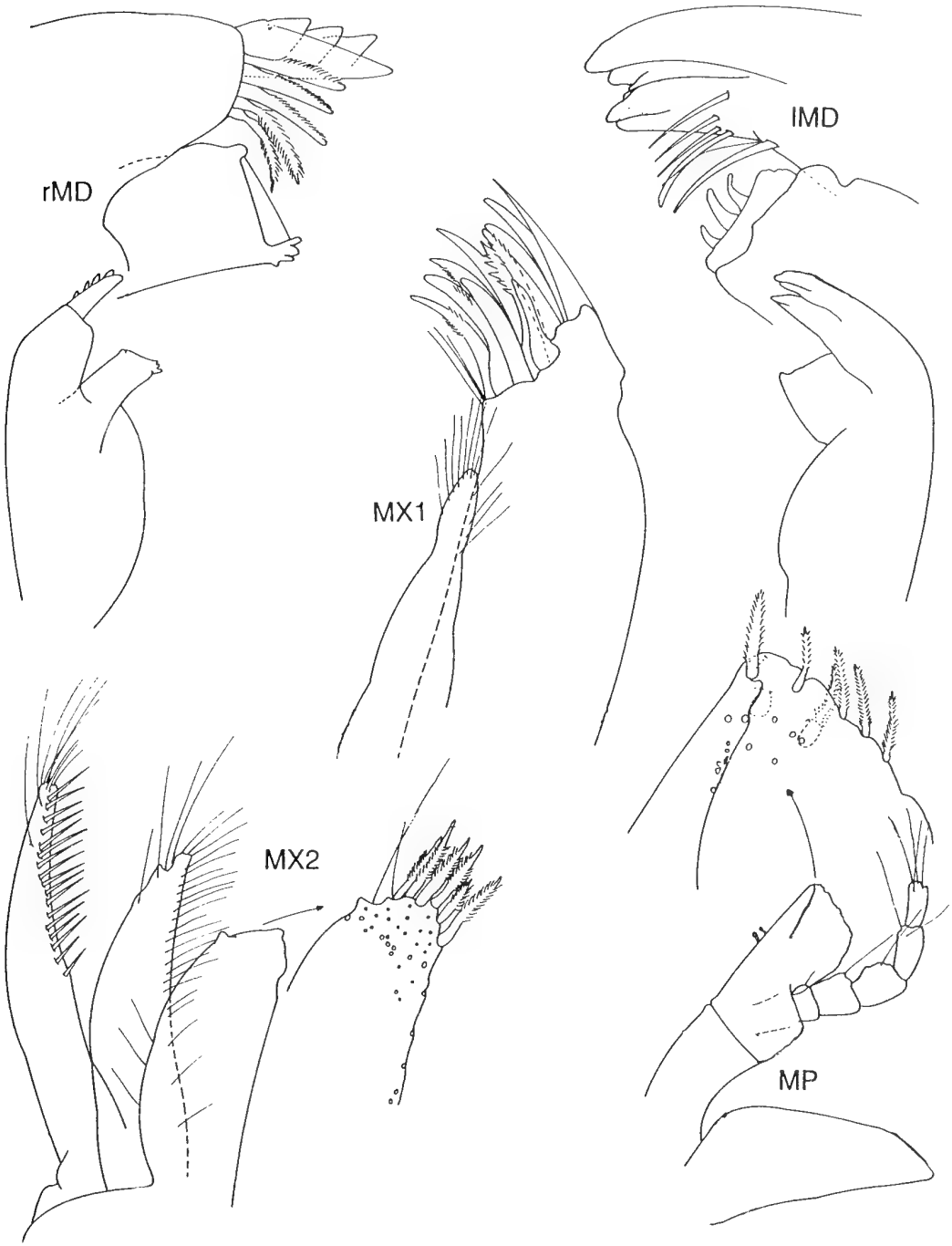


Figure 9. *Acanthomunna macropus*. lMD, MX1, MX2 and MP of paratype NMV J18585; rMD of paratype NMV J36978.

Paratypes. Tasmania, E of Cape Barren I., 40°45.94'S, 149°01.62'E, mud, 2500–2400 m, WHOI epibenthic sled, P. Hutchings, W. Ponder and R. Springthorpe, 10 Dec 1986, stn FR1086-4, AM P52116 (1); NMV J41663 (11).

Other material. Type locality, NMV J18588 (3).

Description. Total length of holotype 4.54 mm. Cephalon subrectangular, twice as long as wide; anterior margin produced between antennae. Antenna 1 flagellum with 26 articles with 21 aesthetascs located on all but proximal 3 articles; second flagella article much longer than others. Antenna 2 missing.

Pereon oval, broadest through pereonites 2–4. Lateral margins of pereonites 5–7 successively becoming more posteriorly projected; lateral margins of pereonite 7 hidden dorsally by pleotelson. Pereonite 1 with middorsal ridge supporting 5–6 large articulated, spiniform setae; pereonites 2–4 with 2 rows of articulated, spiniform setae, anterior row with 4–6 large setae and posterior row with 4–10 smaller setae; remaining pereonites smooth, devoid of setae. All pereonites with 1 or more articulated, spiniform setae on lateral margins; coxae with many sharp projections and articulated setae.

Pleonite 1 free, others fused with pleotelson; devoid of setae. Pleotelson oval with posterior margin extending out beyond uropodal bosses as a subrectangular projection; with numerous articulated spiniform setae arranged into three groups, a middorsal group with 7 large setae separated from the lateral group by a shallow inverted U-shaped sulcus. Lateral clusters of large setae arranged mostly along the margins of the pleotelson and separated by a shallow sulcus running towards the posterolateral bosses which support the uropods.

Left mandibular incisor process 5-dentate, lacinia mobilis 4-dentate; right mandibular incisor process 5-dentate. Left mandibular spine row with 9–10 spines, mostly armed; right mandibular spine row with 12 armed spines. Left mandibular molar broad and tapered with setae confined to posterior end. Right mandibular molar broad, slightly concave with 6 large setae and at least 3 teeth. Mandibular palp large, 3-articled. Maxilla 1 outer lobe with 11 stout spines, 7 denticulate; inner lobe with 5 spiniform setae and numerous other setae. Maxilla 2 with 14 denticulate setae on inner lobe; outer and middle lobes with 2 denticulate setae and row of simple setae on inner lateral margins. Maxilliped with 4 coupling hooks; endite distal margin with 15 denticulate setae.

Pereopod 1 propodus with row of 6 stout setae on posterior margin; carpus with 2 rows of stout setae on posterior margins; other articles also supporting a few setae. Pereopods 2–5 typical, some basis with setae; merus and carpus with large stout setae and dactylus with 4–5 spiniform setae posteriorly; pereopods 6 and 7 missing from holotype.

Male pleopod 1 with acute distolateral lobe proximal to flat distal margin; a single spiniform setae partially hidden by distolateral lobe and 3–4 pairs of spiniform setae in proximal third of pleopod. Distal margin bearing many long setae with another cluster of long setae laterally at base of distolateral lobe. Male pleopod 2 proximal lobe distally folded, distal lobe elongate and heavily setose, extending well beyond peduncle; appendix masculina (endopod) extremely long, approximately 3 times length of peduncle and protruding beyond pleotelson. Pleopod 3 endopod reaching just beyond first article of exopod, with 3 compound setae distally; external lateral area scabrous; second article of exopod with a single distal setae. Pleopods 4–5 similar to *A. bettongia*, with concaved depression which fit together with pleopod 3. Uropods missing, thought large and inserted on dorsal surface of pleotelson.

Distribution. Tasman Sea off Point Hicks, Victoria, 1840 m depth.

Remarks. A species-complex based around *A. proteus* Beddard, 1886 and including *A. beddardi* Menzies, 1962 and *A. potorous* can be recognised. Notable characteristics shared by this species complex include: dorsally pereonites 3 and 4 with articulated spiniform setae, often in multiple rows; pleotelson also with numerous articulated spiniform setae dorsally; pleotelson with a straight to concave posterior margin and extremely long appendix masculina protruding beyond pleotelson. The only known specimen of *A. tannerensis* Schultz, 1966 is female. The features of the male pleopods of *A. tannerensis* can not therefore be confirmed but the shape of the posterior margin of the pleotelson and pattern of dorsal spination suggest that *A. tannerensis* also belongs to this complex. *A. potorous* is easily distinguishable from the other members of this complex because its cephalon is devoid of spiniform setae. Also, *A. potorous* has only a single row of large spiniform setae on the first pereonite, the other species have multiple rows.

Figure 10. *Acanthomunna potorous*. Holotype NMV J36986.

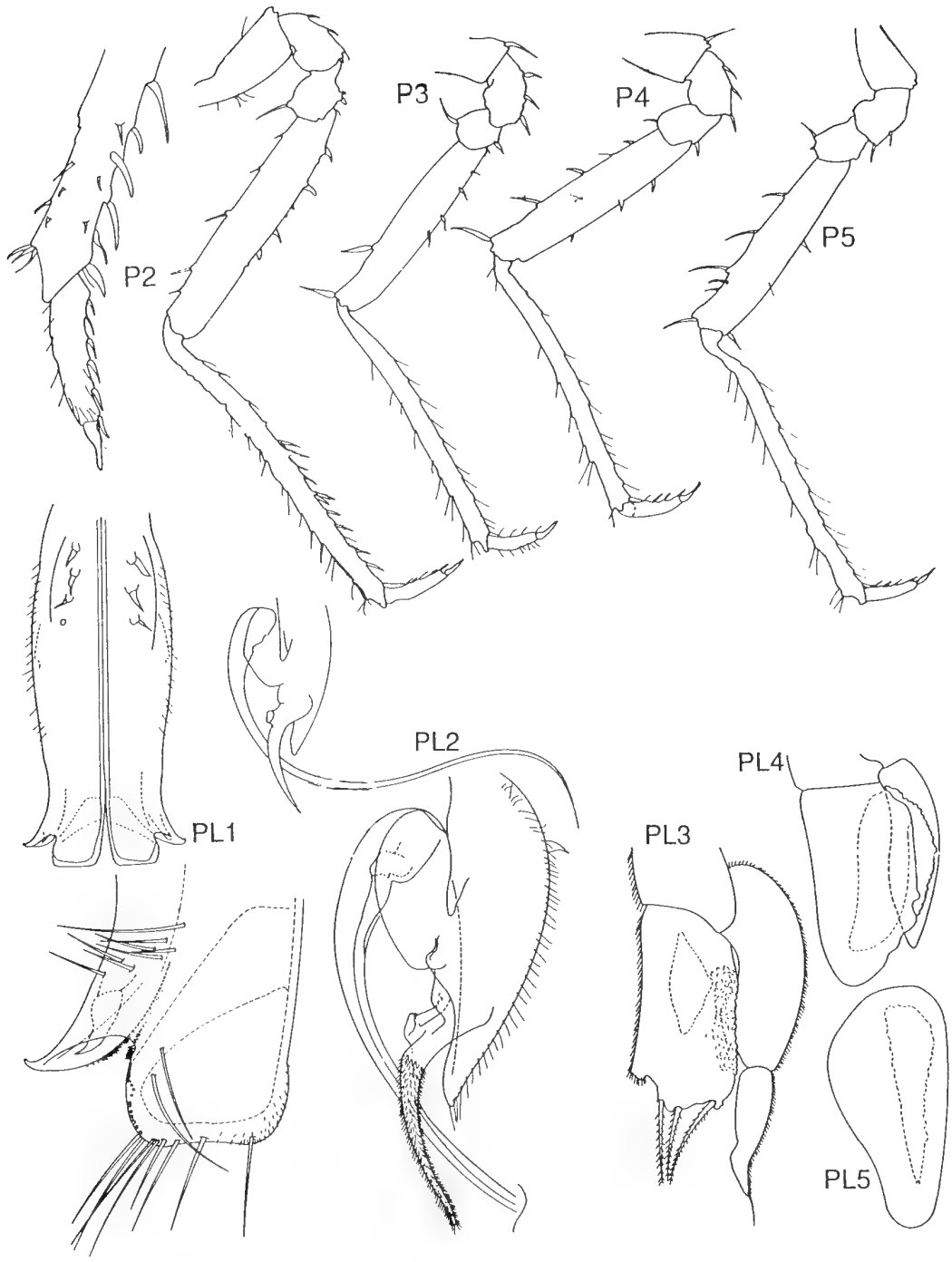


Figure 11. *Acanthomunna potorous.* Holotype NMV J36986; PL4–5 of paratype AM P52116.

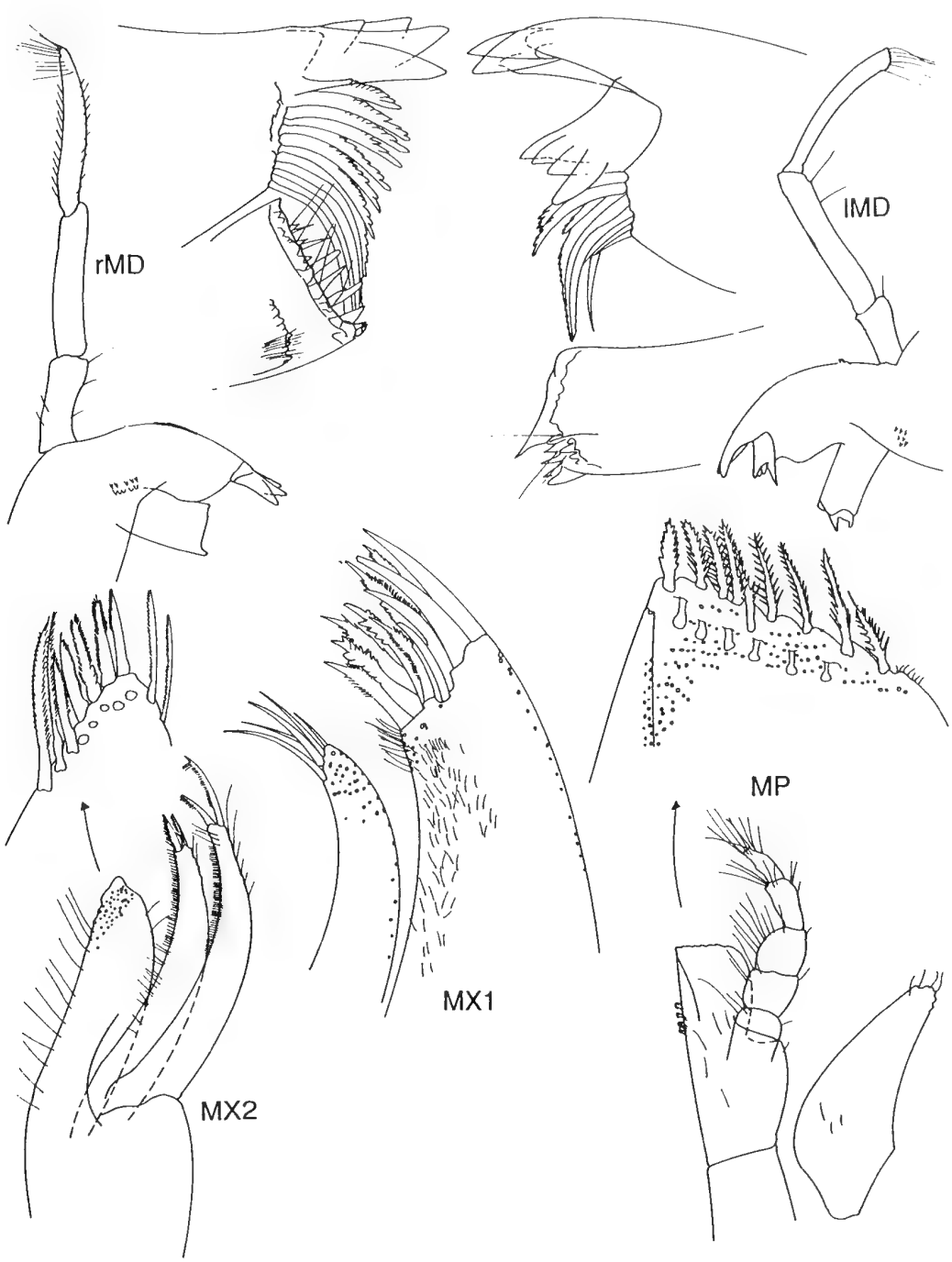


Figure 12. *Acanthomunna potorous*. Holotype NMV J36986.

Acanthomunna proteus Beddard

Figure 13

Acanthomunna proteus Beddard, 1886a: 103.—Beddard, 1886b: 47–50, pl. 12 figs 7–14.

Material examined. Syntype. 37°34'S, 179°22'E, 700 fathoms (1281 m), blue mud, RV *Challenger*, 10 Jul 1874 (stn 169), BMNH 1889.4.27.56.

Description. Total length of syntype 4.11 mm. Cephalon subrectangular, twice as long as wide with small branched articulated spiniform setae and at least 2 long compound setae. Anterior margin of cephalon concave, produced between antennae. Pereon oval, widest at pereonites 3. Pereonites 1 to 4 broad; pereonite 5–7 compressed with concave lateral margins; lateral margins of pereonites 5–7 becoming successively more posteriorly projected; lateral margins of pereonite 7 partially hidden dorsally by pleotelson. Coxae with many simple and branched setae. Pereonite 1 with 2 large compound setae on middorsal surface. Pereonites 1–4 with spiniform setae on 2 ridges; anterior ridge with larger spiniform setae and posterior ridge with smaller spiniform setae; pereonites 5–7 smooth dorsally, devoid of setae. All pereonites with spiniform setae on lateral regions of pereonites. Most spiniform setae branched (see Fig. 13).

Pleonite 1 free, others fused to pleotelson. Pleotelson oval with posterior margin extending beyond uropods as a subrectangular projection. Pleotelson with many small spiniform setae covering all of the pleotelson in no discernible pattern; larger setae mostly branched; shallow inverted U-shaped sulcus middorsally; lateral margins with irregular appearance because of setal articulation joints.

Male pleopod 1 with acute distolateral lobe proximal to flat distal margin, bearing many long setae with another cluster of long setae at base of distolateral lobe; many simple and branched spiniform setae in proximal two-thirds of ventral surface. Male pleopod 2 proximal lobe knob shaped with distal fold, distal lobe elongate and heavily setose across a small band, in line with distal margin of peduncle only; appendix masculina (endopod) extremely long, extending well beyond peduncle and protruding beyond pleotelson. Pleopods 3–5 similar to *A. bettongia*. Uropods missing, thought large and inserted on dorsal surface of pleotelson.

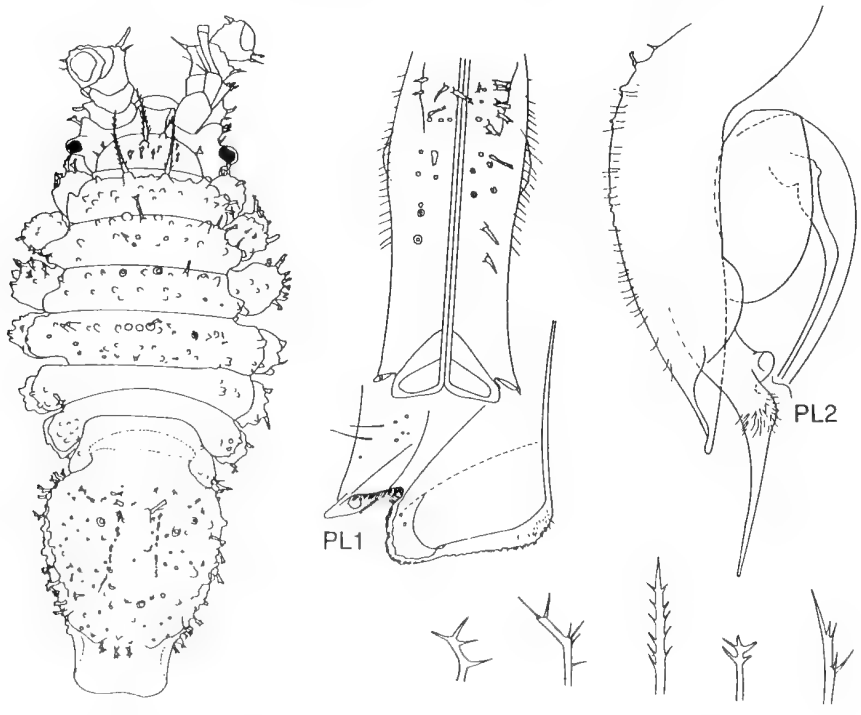


Figure 13. *Acanthomunna proteus*. Beddard, 1886. Syntype BMNH 1889.4.27.56.

Distribution. East of New Zealand, 1281 and 2011 m depth.

Remarks. Beddard's (1886b) description of *A. proteus* is outstanding even by modern taxonomic standards and should be referred to for further details. Unfortunately, the quality of the figures were not as high, therefore, the species has been refigured. A. proteus is easily recognisable as it is the only dendrotiid with branched spiniform setae.

Dendromunna Menzies

Dendromunna Menzies, 1962b: 167.—Wolff, 1962: 66.—Lincoln and Boxshall, 1983: 299.

Type species. Dendromunna spinipes Menzies, 1962b.

Diagnosis. Eyes absent. Antenna 1 basal article not elongate, at most twice as long as wide; peduncle articles 1–3 subequal. Pereonite 1 small, 2–4 large, 5–7 narrow. Pereonites 5–6 may be extended laterally. Lateral regions of pereonites 2–5 bearing dorsolaterally directed projections ending in a cluster of spines. Similar projections and spine clusters may be found dorsally on pereonites 2–4. Pereopod 7 absent. Uropods large but variable; rami subequal, minute to massive; peduncle indistinct to large. Posterior pleotelson margin rounded between uropods.

Remarks. Only three species have been described to date. One specimen was collected from the SLOPE survey but was not described due to its poor condition. The three species described differ markedly in the relative proportions of the uropodal rami and peduncle. The uropodal peduncle of the type species, *D. spinipes* Menzies, 1962, is long, proportionally longer than in any other dendrotiid, while the rami are much reduced. The rami of the other two species of *Dendromunna* are large and stout but the peduncle of *D. compsa* Lincoln and Boxshall, 1983, is indistinct. The definition of this genus needs refinement and awaits the discovery of more intact species.

Key to species of *Dendromunna*

1. Pereonites 5–6 fused, pereonite 7 not distinguishable from pleotelson.....*D. compsa* Lincoln and Boxshall, 1983
— Pereonites 5–7 not fused, pereonite 7 clearly distinguishable from pleotelson.....2
2. Uropodal rami much shorter than peduncle.....*D. spinipes* Menzies, 1962
— Uropodal rami long, endopod 4 times as long as peduncle.....*D. mirabile* Wolff, 1962

Dendrotion Sars

Dendrotion Sars, 1872: 30.—Sars, 1897: 116.—Hansen, 1916: 50.—Wolff, 1962: 65.—Lincoln and Boxshall, 1983: 304.

Type species. Dendrotion spinosum Sars, 1872.

Diagnosis. Eyes absent. Cephalon with pair of anterior dorsal processes supporting antennae. Antennae long and slender. Antenna 1 basal article long, more than 5 times longer than wide; second article short, third article as long as first. Antenna 2 marginally longer than antenna 1; peduncle articles 1–3 short, articles 4 and 5 extremely long and slender. Pereon cylindrical anteriorly, slender posteriorly. Pereonites 1–4 large and barrel shaped, length increasing posteriorly, with rounded lateral extensions; pereonites 5–7 narrow with pronounced lateral extensions becoming successively more posteriorly directed. Pereonites with spine-like projections laterally, often long, which appear to be derived from the coxal region on pereonites 5–7. Pereon devoid of spines dorsally though often adorned with long and conspicuous setae. All pleonites fused to pleotelson. Lateral margins of pleotelson adorned with a row of articulated spiniform setae, setae decreasing in length posteriorly; posterior margin protruding beyond posteriorlateral bosses which support uropods. Mouthparts typical of Asellota. Left mandible not stronger than right. Maxilliped palp much narrower than endite, of 5 articles; epipod broad and flat, distally tapered. Pereopod 1 prehensile, reflexed between carpus and propodus, shorter than other pereopods; carpus and propodus with stout setae along posterior margin. Pereopods 2–7 ambulatory; long and slender, becoming successively more elongate; basis, ischium and merus not compact as in Acanthomunna; carpus and propodus elongate. Pereopod 7 present in all but one species. Male pleopod 1 subrectangular. Male pleopod 2 peduncle tapered; exopod bilobed. Pleopods 4–5 similar to A. bettongia. Uropods large and robust, inserted posterolaterally on dorsal surface of pleotelson; peduncle elongate; endopod reduced; exopod

variable ranging from same to many times size of endopod.

Remarks. The four newly described species of *Dendrotion* are the first to be recorded from the Southern Hemisphere or outside the North Atlantic Ocean. Species of *Dendrotion* vary little in body morphology or proportions though ovigerous females become dorsoventrally flattened (Lincoln and Boxshall, 1983). All dendrotiids posses large and robust uropodal peduncles and insertion sockets on pleotelson. The number and location of dorsal setae and the size and shape of the lateral extensions off the pereonites (particularly pereonites 5–7) are the main characteristics used to separate species.

Key to species of *Dendrotion*

1. Pereonite 7 lacking lateral extension which supports pereopods, pereopod 7 absent; uropodal rami subequal, endopod only marginally longer than exopod.....*D. peradorcus* sp. nov.
— Pereonite 7 with lateral extension supporting pereopods, pereopod 7 present; uropodal endopod much larger than exopod.....2
2. Pereon and pleotelson devoid of dorsal setae.....*D. spinosum* Sars, 1872
— Pereon and pleotelson with at least a few dorsal setae.....3
3. Lateral projection off pereonites spinose and granular.....*D. paradoxum* Hansen, 1916
— Lateral projection off pereonites smooth.....4
4. Pereonites 5–7 lacking dorsal setae.....5
— Pereonites 5–7 with dorsal setae.....6
5. Pereonites 1, 3 and 4 lacking dorsal setae.....*D. onychogalea* sp. nov.
— Pereonites 1, 3 and 4 with many dorsal setae.....*D. setosum* Lincoln and Boxshall, 1983
6. Pereonites 1–2 devoid of setae.....*D. hanseni* Menzies, 1956
— Pereonites 1–2 with setae.....7
7. Pereonite 7 with 4 dorsal setae.....*D. thylogale* sp. nov.
— Pereonite 7 with 2 dorsal setae.....8
8. Pereonite 4 devoid of setae.....*D. petrogale* sp. nov.
— Pereonite 4 with anterior and posterior dorsal setae.....*D. elegans* Lincoln and Boxshall, 1983

Dendrotion onychogalea sp. nov.

Figures 14–16

Material examined. Holotype. Victoria. S of Point Hicks (38°17.70'S, 149°11.30'E), 400 m, coarse sand, gravel, mud with many sponges, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 24 Jul 1986 (stn SLOPE 40), NMV J36967 (female).

Paratypes. Type locality, NMV J36969 (1 male), NMV J37000 (1 female); S of Point Hicks (38°14.80'S, 149°9.30'E), 200 m, coarse sand and gravel, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 24 Jul 1986 (stn SLOPE 41), NMV J36968 (1 female).

Other material. Type locality, NMV J18545 (35 specimens); S of Point Hicks (38°14.80'S, 149°9.30'E), 200 m, coarse sand and gravel, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 24 Jul 1986 (stn SLOPE 41), NMV J18546 (10 specimens).

Description. Total length of holotype 2.39 mm. Cephalon subrectangular dorsally with anterolateral dorsal processes supporting antennae; twice as long as wide. Anterior margin of cephalon between processes straight. Antenna 1 flagellum with 11 articles with 3 aesthetascs located on 2 most distal articles. Antenna 2 flagellum with 9 articles of decreasing length.

Pereonites 1–4 with small projections on lateral margins which support long setae, most pronounced on pereonites 1 and 2; pereonite 2 with a pair of middorsal setae; other pereonites lacking dorsal setae. Posterior margin of pereonite 4 convex, overhanging pereonite 5; pereonite 5 with long, slender lateral extension with terminal spine-like spiniform setae which appear to be derived from the coxa. Coxae visible dorsally, some with small projections; lateral margins of pereonite 7 directed posterioventrally, hidden dorsally by pleotelson.

Pleotelson elliptical, 1.2 times longer than wide; a shallow sulcus along dorsolateral and posterior margins; 4–5 spiniform setae clumped anteriorlaterally, 5 spiniform setae along lateral margins and 8 simple setae along rounded posterior margin; some spiniform setae with bifid distal end and thread-like projection.

Left mandibular incisor process 4-dentate, lacinia mobilis 3-dentate; right mandibular incisor process 5-dentate. Left mandibular spine row with 3 spines, 2 armed; right mandibular spine row with 4 spines, 3 armed. Left mandibular molar sharply angled, with 5 long setae. Right mandibular molar crenulate, with 4 long simple setae. Mandibular palp absent. Maxilla 1 outer lobe with 10 stout spines visible, 3 denticulate; inner lobe with 1 long setae only. Maxilla 2 with stout setae on all lobes; outer lobe with 4 spiniform setae; middle lobe with 3 denticulate setae and inner lobe with 5 denticulate setae. Maxilliped with 2 coupling hooks; endite distal margin with 9 denticulate setae.

Pereopods typical, distal anterior margin of carpus on pereopod 6 bearing a long compound setae.

Male pleopod 1 with acute distolateral lobe proximal to straight distal margin bearing many long setae; 9–12 long setae proximal to distolateral lobe and oblique groove on distolateral margin. Male pleopod 2 proximal lobe large with linear distal margin; distal lobe elongate and setose, extending beyond peduncle and appendix masculina; appendix masculina (endopod) extending just beyond peduncle. Pleopod 3 endopod reaching to distal margin of second article of exopod, with 3 long compound setae distally; exopod with 1 short setae distally. Pleopods 4–5 similar to *A. bettongia*, with concaved depression centrally. Uropodal endopod reduced, one-fifth length of exopod; peduncle obvious, shorter than exopod.

Distribution. Tasman Sea off Point Hicks, Victoria, 200–400 m depth.

Remarks. Dendrotion onychogalea is remarkable for the shape of its pleotelson which is subcircular. All other described species of *Dendrotion* possess a more elongate pleotelson with a distinctive neck region anteriorly and tapered posterior margins. This pleotelson gives *D. onychogalea* a more compact and stout habitus than other species.

Dendrotion peradorcus sp. nov.

Figures 17–19

Material examined. Holotype. Victoria. S of Point Hicks (38°25'S, 149°0'E), 1500 m, compacted clay, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 22 Jul 1986 (stn SLOPE 27), NMV J36970.

Paratypes. Type locality, NMV J36972 (1 female). 76 km S of Point Hicks (38°29.33'S, 149°19.98'E), 1840 m, sandy mud with fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 26 Oct 1988 (stn SLOPE 69), NMV J36971 (1 male), NMV J36999 (1 female).

Other material. Tasmania. Off Freycinet Peninsula (42°2.20'S, 148°38.70'E), 800 m, coarse shelly sand, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 27 Jul 1986 (stn SLOPE 45), NMV J18548 (1 specimen); 42°0.20'S, 148°37.70'E, 720 m, coarse shelly sand (stn SLOPE 46), NMV J18549 (1 specimen); 41°58.60'S, 148°38.80'E, 500 m, coarse shell (stn SLOPE 47), NMV J18550 (1 specimen); 48 km ENE of Cape Tourville (42°0.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 30 Oct 1988 (stn SLOPE 81), NMV J18553 (6 specimens), NMV J18554 (6 specimens).

Victoria. Type locality, NMV J18547 (3 specimens). S of Point Hicks (38°40.29'S, 149°18.06'E), 2900 m, compacted clay, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 25 Oct 1988 (stn SLOPE 66), NMV J18551 (1 specimen); 38°29.33'S, 149°19.98'E, 1840 m, sandy mud with fine shell, 26 Oct 1988 (stn SLOPE 69), NMV J18552 (14 specimens); 38°23.95'S, 149°17.02'E, 1277 m, fine mud, 25 Oct 1988 (stn SLOPE 67), NMV J18557 (1 specimen).

Description. Total length of holotype 2.76 mm. Cephalon quadrate dorsally with anterolateral dorsal processes supporting antennae; as long as wide. Anterior margin of cephalon between processes slightly concave. Antenna 1 flagellum with 11 articles with only 1 aesthetasc located on most distal article. Antenna 2 flagellum with at least 5 articles, first article long and slender.

Pereon with pronounced lateral extensions of pereonites 5 and 6 only, directed posteriorly on pereonite 6. Pereonites 1–4 with small projections on lateral margins which support long setae, most pronounced on pereonites 1 and 2. Pereonite 1 with middorsal ridge running between rounded lateral extensions; pereonites 2–3 with a pair of long middorsal setae; pereonite 4 long, tapered posteriorly. Pereonites 5–6 with long spine-like extension which supports large, curved spiniform setae and appears to be derived from the coxal region; spiniform setae posteriorly directed on pereonite 5 and anteriorly directed on pereonite 6. Pereonite 7 with no lateral extensions.

Pleotelson elliptical posteriorly, 1.4 times longer than wide with a distinct anterior neck. A shallow sulcus running posteriorly to posteriorlateral bosses; ventral lateral margins with a row of 7–9 bifid rounded spiniform setae, setae similar to setae of *D. onychogalea*, decreasing in size posteriorly; distal margin tapered, with numerous long setae.

Left mandibular incisor process 4-dentate, lacinia mobilis 5–7-dentate; right mandibular incisor process 4-dentate. Left mandibular spine

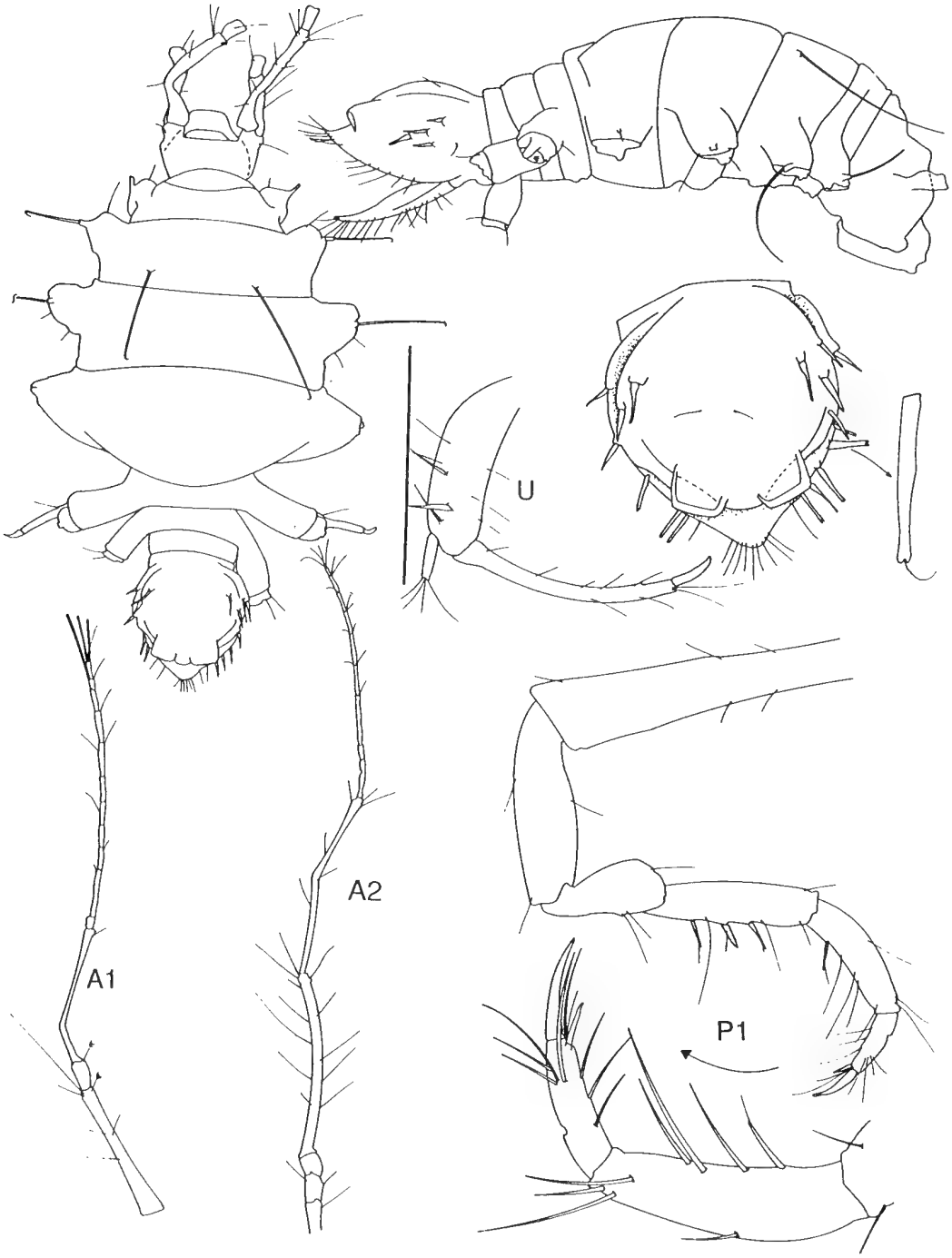
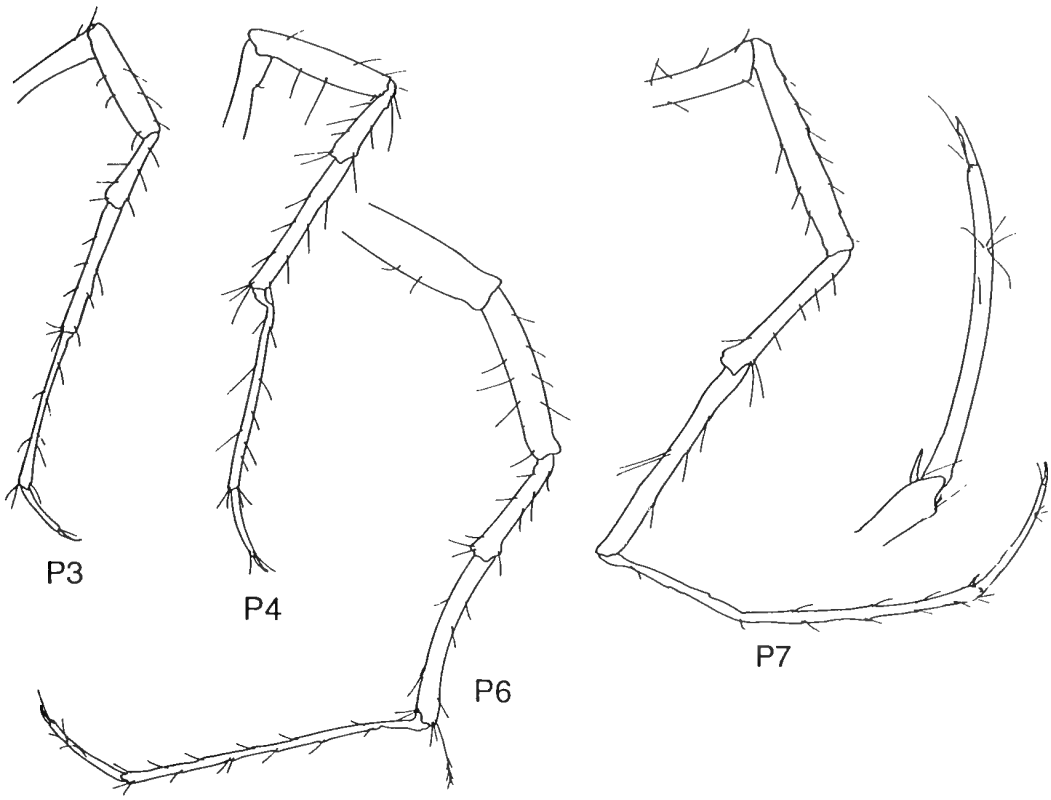


Figure 14. *Dendrotion onychogalea*. Holotype NMV J36967; A1 and A2 of paratype NMV J37000; Lateral view of paratype NMV J36968.



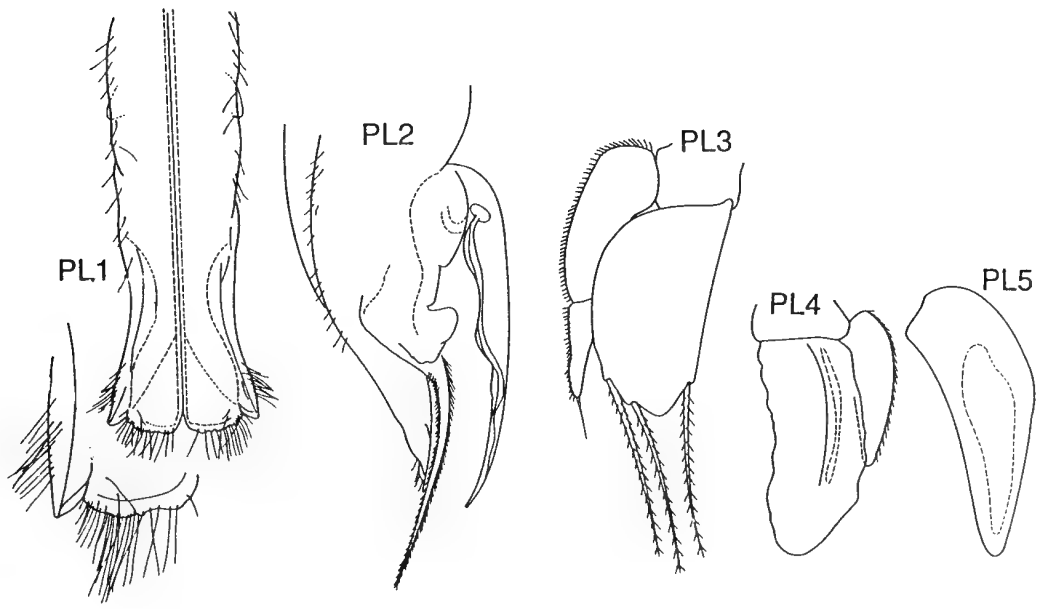


Figure 15. *Dendrotion onychogalea.* Holotype NMV J36967; P3–4 and PL1–2 of paratype NMV J36969; P6 and PL3–5 of paratype NMV J36968.

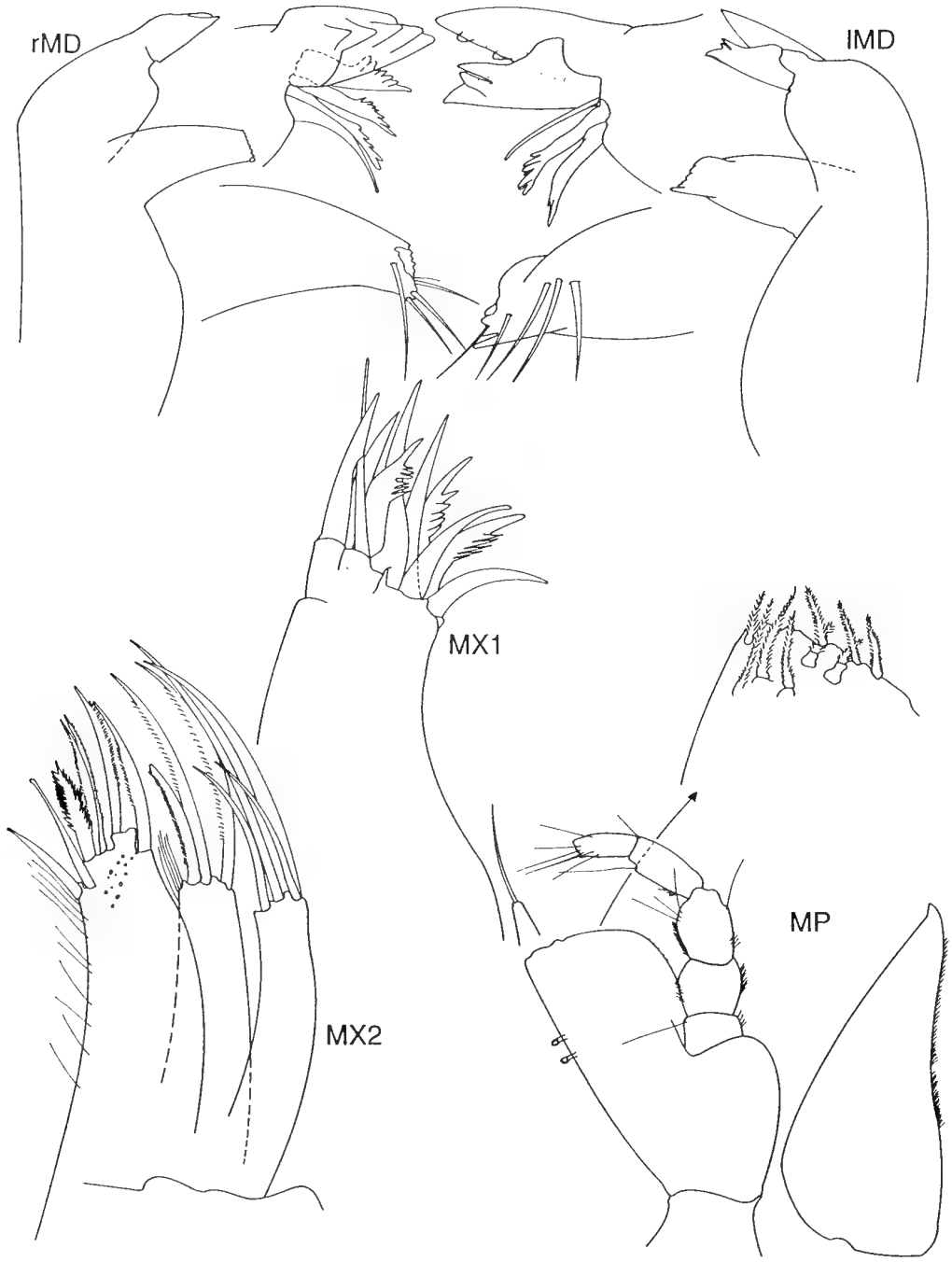


Figure 16. *Dendrotion onychogalea.* Holotype NMV J36967.

row absent; right mandibular spine row with 3 armed spines. Left mandibular molar sharply angled, with 11 compound setae. Right mandibular molar complex, with long simple setae and short, rounded spiniform setae. Mandibular palp absent. Maxilla 1 outer lobe with 10 stout spines visible, only 1 denticulate; inner lobe with 1 long setae only. Maxilla 2 with stout setae on all lobes; outer lobe with 3 long setae; middle lobe with 2 long setae and inner lobe with 7 setae, 2 denticulate. Maxilliped with 1 coupling hook; endite distal margin with 5 large setae.

Pereopods typical except pereopod 7 absent in adults.

Male pleopod 1 with rounded distal margin bearing 13–14 long setae each side distal to oblique groove and many long setae along lateral margins. Male pleopod 2 proximal lobe rounded and distal lobe short and setose; appendix masculina (endopod) short, extending just beyond peduncle. Pleopod 3 endopod just reaching second article of exopod, with 3 long compound setae distally; exopod with 1 short setae distally. Pleopods 4–5 similar to *A. bettongia*. Uropod exopod reduced, as long as endopod; peduncle 3 times as large as rami.

Distribution. Tasman Sea off Victoria and Tasmania, 500–2900 m depth.

Remarks. Dendrotion peradorcus is a remarkable species. It is the only species of *Dendrotion* to retain the neotenous characteristic of six pairs of pereopods into adulthood. Pereopod 7 is absent as in *Dendromunna*. Pereonite 7 also lacks lateral extensions on which the pereopods are supported in other *Dendrotion* species. Also, both rami of the uropods are similar in size. In all other species of *Dendrotion* which have been collected with intact uropods, the exopods are greatly enlarged, compared to the endopods. *D. peradorcus* is most easily recognised by the unique pereonite 7, the large extensions of pereonites 5 and 6 and subequal uropodal rami.

Dendrotion petrogale sp. nov.

Figures 20–22

Material examined. Holotype. Victoria. 67 km S of Point Hicks (38°23.95'S, 149°17.02'E), 1277 m, fine mud, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 25 Oct 1988 (stn SLOPE 67), NMV J36965 (male).

Paratypes. Type locality, NMV J37003 (1 male), NMV J37004 (1 female), NMV J37005 (1 specimen).

New South Wales. 54 km ESE of Nowra (34°52.72'S, 151°15.04'E), 996 m, mud, fine sand, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 22 Oct 1988 (stn SLOPE 53), NMV J18555 (1 specimen). E of Broken Bay, 33°40'S, 152°06'E, 1116 m, trawl, FRV Kapala, 19 Dec 1985, stn K85-21-05, AM P52117 (3).

Other material. Victoria. Type locality, NMV J18556 (10 specimens).

Description. Total length of holotype 2.21 mm. Cephalon quadrate dorsally with anterolateral dorsal processes supporting antennae; as long as wide. Anterior margin of cephalon between processes convex. Antenna 1 flagellum with 14 articles with 3 aesthetascs located on distal article. Antenna 2 flagellum lost.

Pereonites 1–3 with small projections off lateral margins which support long setae, most pronounced on pereonites 1 and 2. Pereonite 1 with middorsal ridge running between rounded lateral extensions; pereonites 2 and 3 with 2 pairs of long middorsal setae further towards lateral margins on pereonite 3; pereonite 4 long, devoid of middorsal setae, lateral margins with short spiniform seta anteriorly and tapered posteriorly. Pereonites 5–7 with long setae located on lateral extensions on pereonites 5 and 6 and middorsally on pereonite 7. Coxal regions visible on pereonites 3–7; supporting long setae on pereonites 5–7.

All pleonites fused to pleotelson. Pleotelson elliptical posteriorly, longer than wide with a anterior neck. A shallow inverted U-shaped sulcus located middorsally; ventral lateral margins with a row of 3–6 tapered spiniform setae; distal margin rounded, with numerous long setae.

Left mandibular incisor process 2-dentate, lacinia mobilis 3-dentate; right mandibular incisor process 5-dentate. Left mandibular spine row with 4 spines; right mandibular spine row with 4 armed spines. Left mandibular molar flat, with 8 simple setae. Right mandibular molar crenulate with 8 long simple setae. Mandibular palp absent. Maxilla 1 outer lobe with 10 stout spines visible, 3 denticulate; inner lobe with 1 long setae only. Maxilla 2 with stout setae on all lobes; outer lobe with 2 spiniform setae; middle lobe with 3 spiniform setae, 2 denticulate; inner lobe with 4 spiniform setae, 2 denticulate. Maxilliped with 2 coupling hook; endite distal margin with 7 spiniform setae.

Pereopod 1 lost; pereopods 2–7 typical, all pereopods heavily setose.

Male pleopod 1 with rounded distal margin bearing 7–8 long setae each side and 7 long setae along lateral margins. Male pleopod 2 proximal lobe rounded and distal lobe short and setose; appendix masculina (endopod) short, extending

Figure 17. *Dendrotion peradorcus*. Holotype NMV J36980; A1, A2 and U of paratype NMV J36972; P1 of paratype NMV J36999.

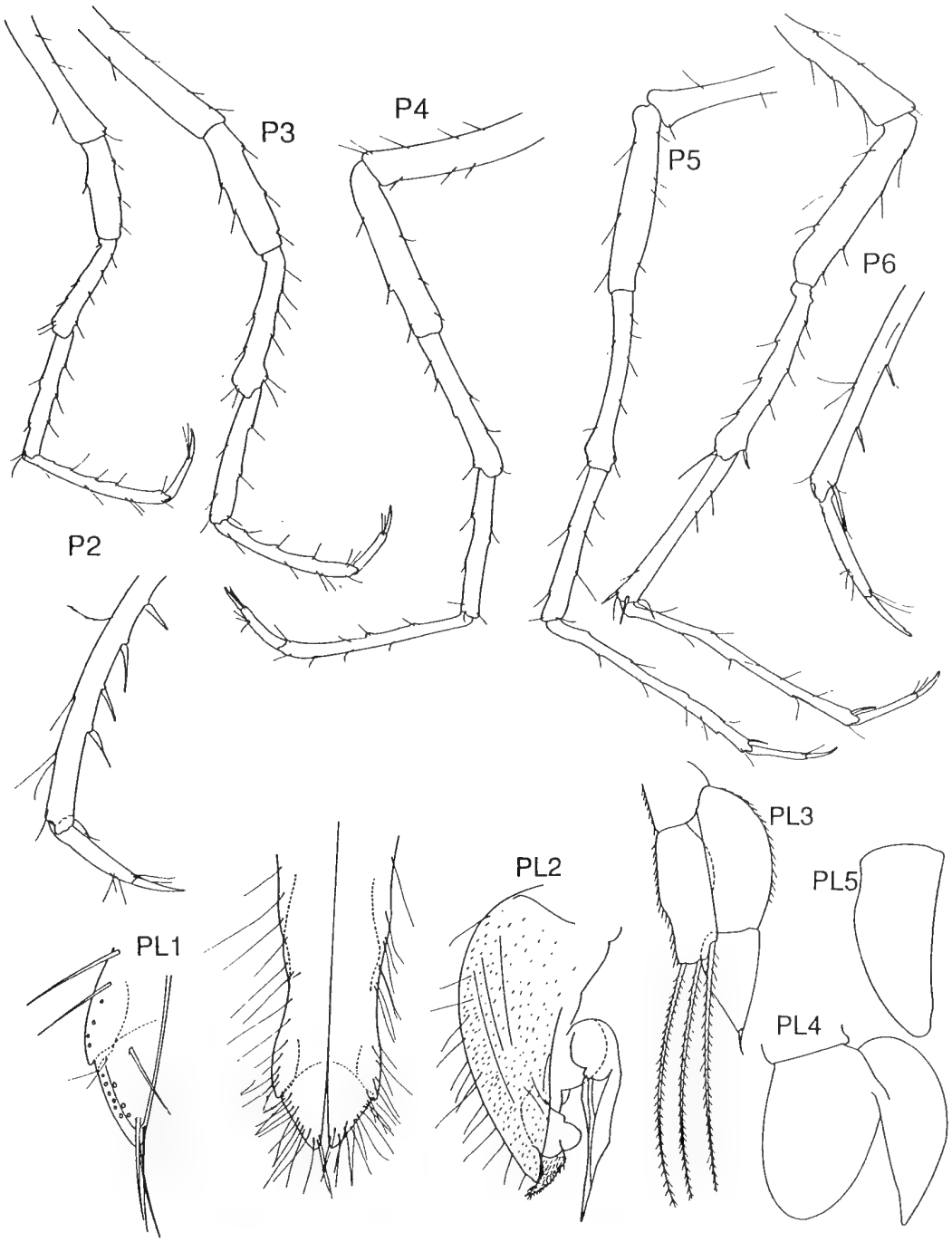


Figure 18. *Dendrotion peradorcus*. P2–7 of paratype NMV J36999; PL1–5 of paratype 36971.

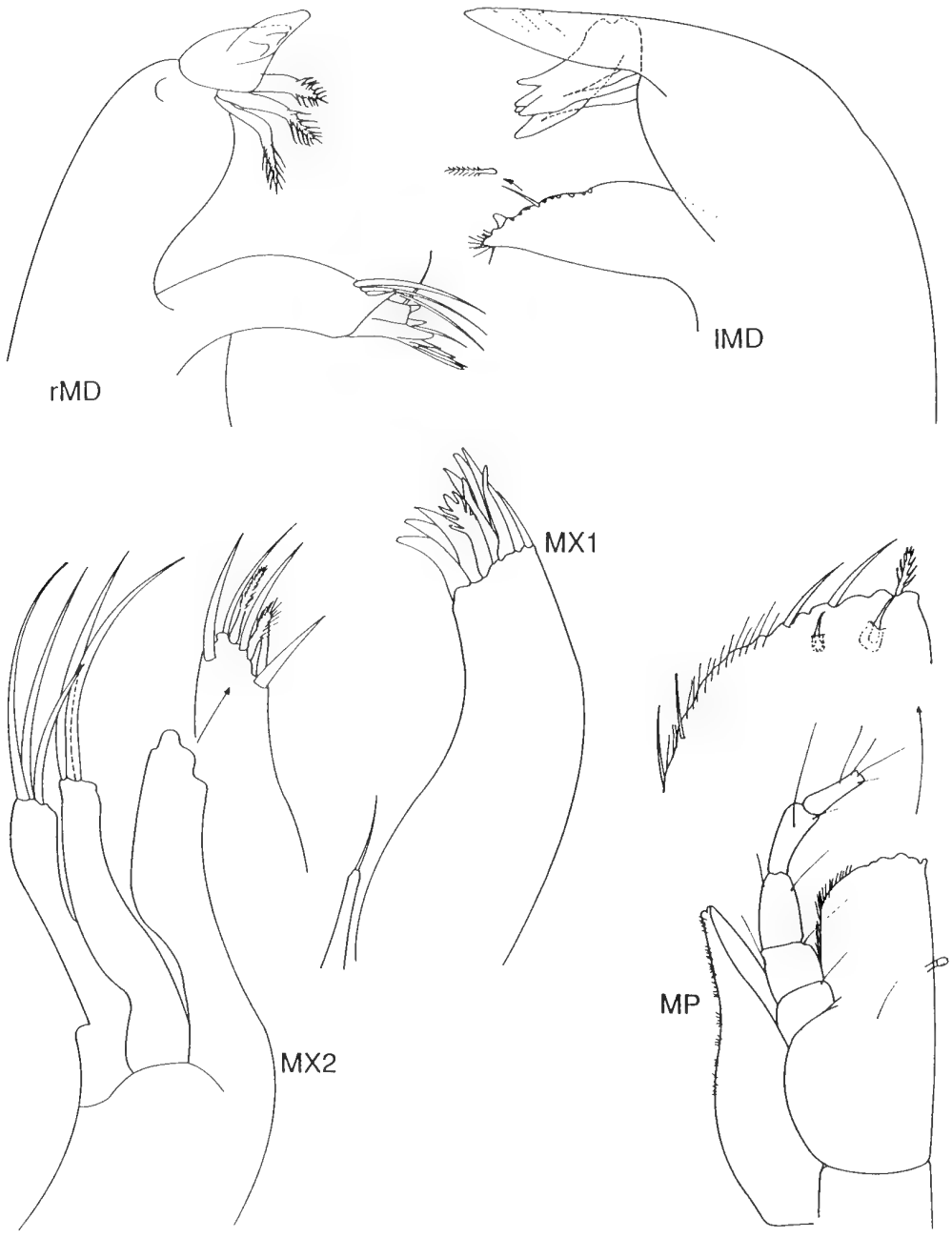


Figure 19. *Dendrotion peradorcus*. Paratype NMV J36972.

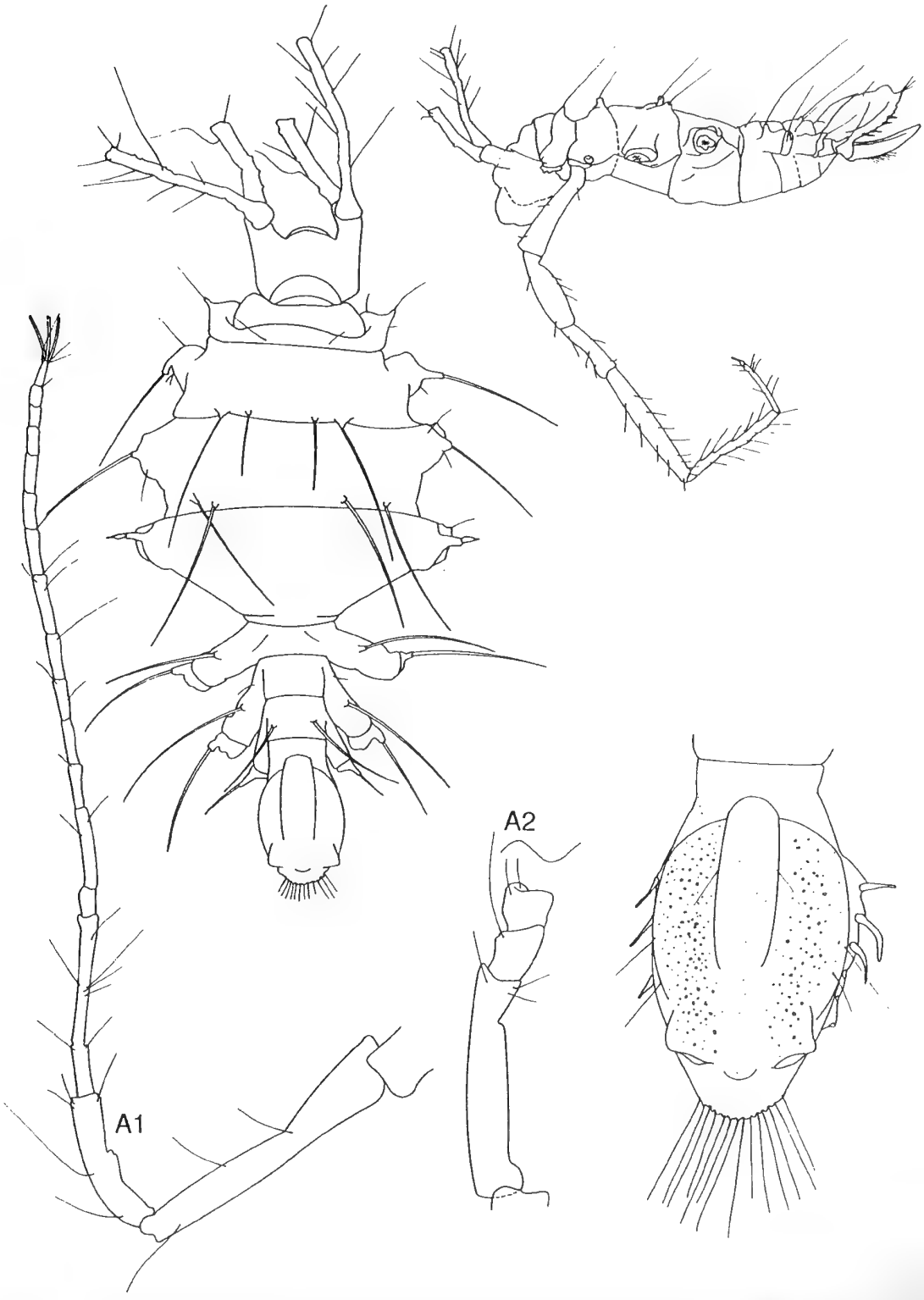


Figure 20. *Dendrotion petrogale*. Holotype NMV J36965; A1 of paratype NMV J37004.

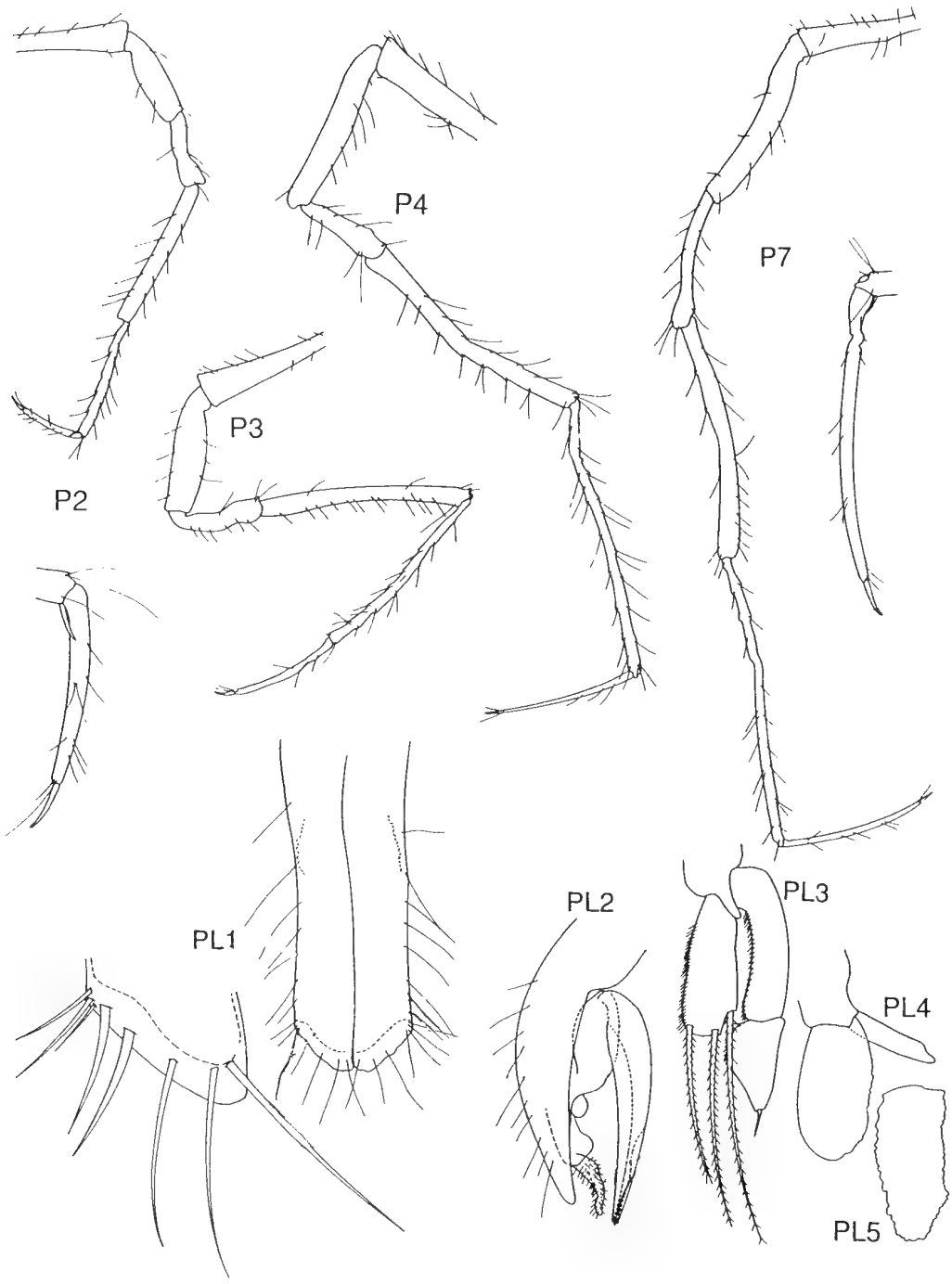


Figure 21. *Dendrotion petrogale.* PL1 -5 of paratype NMV J37003; P2–7 of paratype NMV J18555.

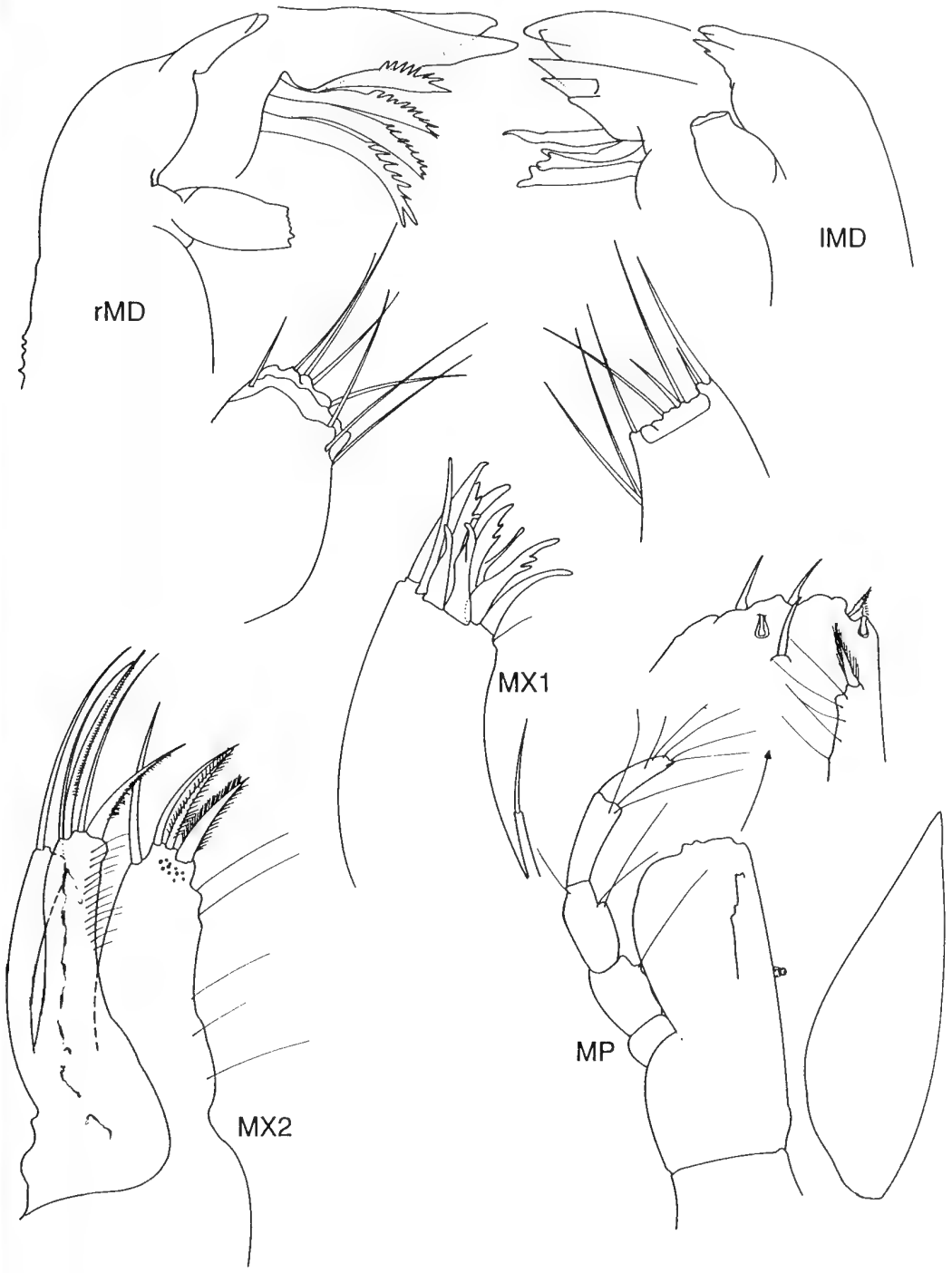


Figure 22. *Dendrotion petrogale.* MX1, MX2 and MP of paratype NMV J37004; LMD and RMD of paratype NMV J37005.

just beyond peduncle. Pleopod 3 endopod just reaching second article of exopod, with 3 long compound setae distally; exopod with 1 short setae distally. Pleopods 4–5 similar to *A. bettongia*; pleopod 5 lateral and distal margins crenulate. Uropods lost, thought large and inserted laterally on dorsal surface of pleotelson.

Distribution. Tasman Sea off NSW and Victoria, 996 and 1277 m depth.

Remarks. Dendrotion petrogale is easily distinguishable from the other known members of this genus. *D. petrogale* possess unique, small spiniform setae on the lateral margins of pereonite 4 with no other similar projections on any other pereonites.

Dendrotion thylogale sp. nov.

Figures 23–25

Material examined. Holotype. Tasmania. 48 km ENE of Cape Tourville (42°00.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 30 Oct 1988 (stn SLOPE 81), NMV J37001 (female).

Paratypes. Type locality, NMV J36973 (1 male). Eastern Bass Strait, 87 km ENE of North Point, Flinders I. (39°28.2'S, 148°52.4'E), 841 m, muddy sand, naturalists' dredge, G.C.B. Poore on HMAS *Kimbla*, 29 Mar 1979 (stn BSS 37), NMV J36974 (1 specimen).

Victoria. 76 km S of Point Hicks (38°29.33'S, 149°19.98'E), 1840 m, sandy mud with fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 26 Oct 1988 (stn SLOPE 69), NMV J36975 (1 specimen), NMV J37002 (1 specimen).

Other material. Tasmania. Off Freycinet Pen-insula (42°2.20'S, 148°38.70'E), 800 m, coarse shelly sand, WHOI epibenthic sled, M.F. Gomon et al. on RV *Franklin*, 27 Jul 1986 (stn SLOPE 45), NMV J18560 (2 specimens); 42°0.20'S, 148°37.70'E, 720 m, coarse shelly sand (stn SLOPE 46), NMV J18561 (3 specimens); 48 km ENE of Cape Tourville (42°00.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 30 Oct 1988 (stn SLOPE 81), NMV J18565 (8 specimens). Eastern Bass Strait, 87 km ENE of North Point, Flinders I. (39°28.2'S, 148°52.4'E), 841 m, muddy sand, naturalists' dredge, G.C.B. Poore on HMAS *Kimbla*, 29 Mar 1979 (stn BSS 37), NMV J18566 (4 specimens).

Victoria. S of Point Hicks (38°21.90'S, 149°20.00'E), 1000 m, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 23 Jul 1986 (stn SLOPE 32), NMV J18559 (2 specimens); 38°23.95'S, 149°17.02'E, 1277 m, fine mud, 25 Oct 1988 (stn SLOPE 67), NMV J18563 (1 specimen); 38°29.33'S, 149°19.98'E, 1840 m, sandy mud, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on RV *Franklin*, 26 Oct 1988 (stn SLOPE 69), NMV J18564 (1 specimen).

New South Wales. Off Nowra (34°52.29'S, 151°15.02'E), 1096 m, shell, WHOI epibenthic sled, G.C.B. Poore and C.C. Lu on RV *Franklin*, 15 Jul 1986 (stn SLOPE 7), NMV J18558 (1 specimen); 34°52.72'S, 151°15.04'E, 996 m, mud, fine sand and fine shell, G.C.B. Poore et al., 22 Oct 1988 (stn SLOPE 53), NMV J18562 (1 specimen).

Description. Total length of holotype 2.79 mm. Cephalon quadrate dorsally with anterolateral dorsal processes supporting antennae; as long as wide. Anterior margin of cephalon between processes straight. Antenna 1 flagellum with 10–11 articles with 3 aesthetases located on 2 most distal articles. Antenna 2 flagellum lost.

All pereonites with long slender protrusions off lateral extensions, derived from pereon on pereonites 1–4 and from the coxae on pereonites 5–7. Pereonites 2–3 with 3 pairs of long setae on posterior dorsal margins; pereonites 4 and 7 with 2 pairs of long setae on posterior dorsal margin. Pereonite 4 long, lateral margins tapered posteriorly; pereonites 5–6 with pair of long setae on lateral extensions of the pereonites. Coxal regions visible dorsally on pereonites 2–7; supporting setae on pereonites 3–7.

Pleotelson elliptical posteriorly, 1.5 times longer than wide; with anterior neck; surface pitted and granular. A shallow semicircular shaped sulcus located laterally of middorsal line; ventral lateral margins with only 2 tapered spiniform setae; distal margin rounded and crenulated, with numerous long setae.

Left mandibular incisor process appears damaged, lacinia mobilis 3-dentate; right mandibular incisor process 6-dentate. Left mandibular spine row with 2 spines; right mandibular spine row with 4 armed spines. Left mandibular molar tapered, with 8 simple setae and 3 large setae. Right mandibular molar crenulate with 6 long simple setae and 7 tapered spiniform setae. Mandibular palp absent, single setae in position of mandibular palp. Maxilla 1 outer lobe with 11 stout spines, 3 denticulate; inner lobe with 1 long setae and many small setae. Maxilla 2 with stout spiniform setae on all lobes; outer lobe and middle lobes with 3 setae; inner lobe with 6 setae, 2 denticulate. Maxilliped with no coupling hook; endite distal margin with 8 spiniform setae.

Pereopods typical.

Male pleopod 1 with acute distolateral lobe proximal to flat distal margin bearing many long setae; distolateral lobe bearing 5 setae and ventral margins with about 20 setae. Male pleopod 2 proximal lobe folded, distal lobe short and

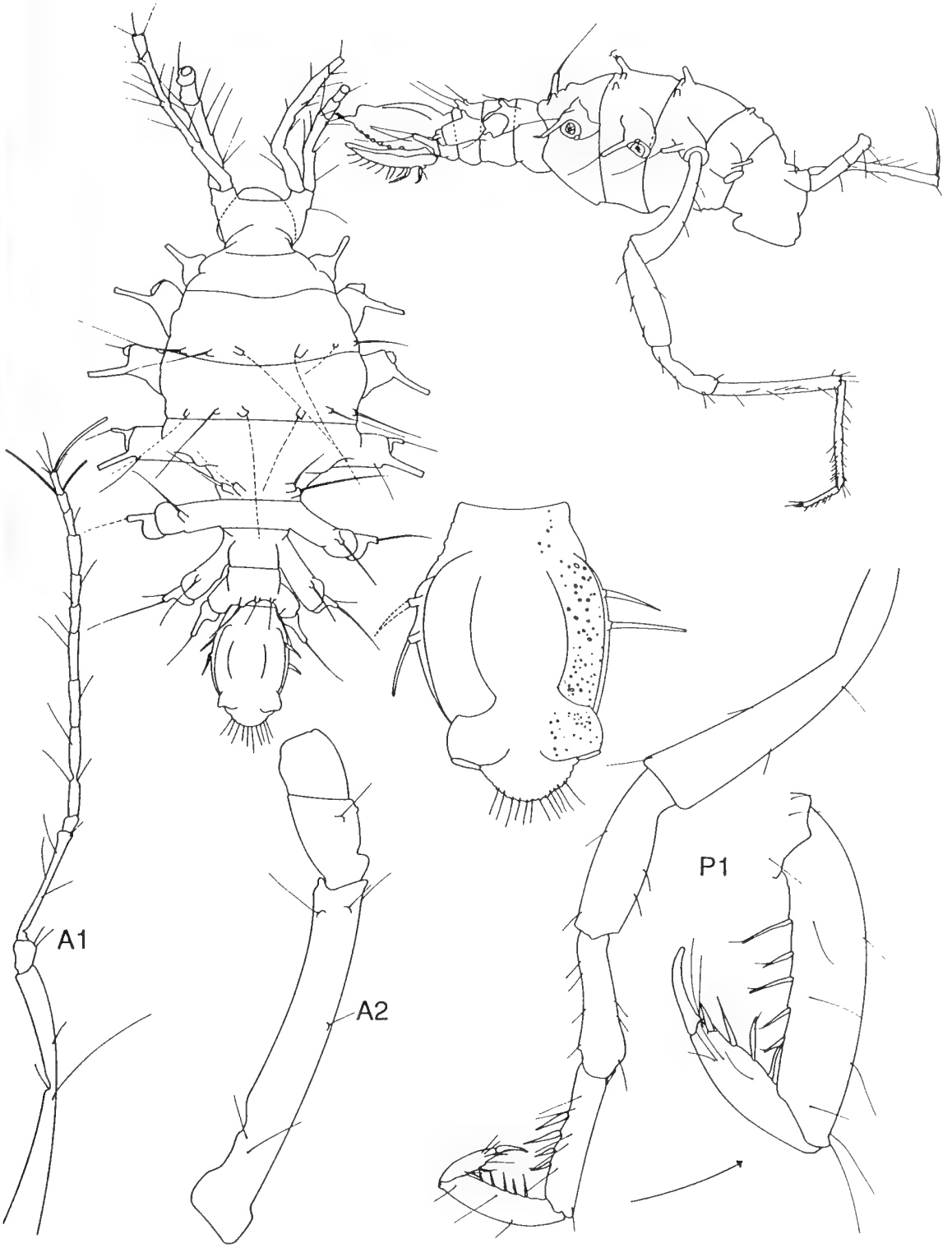


Figure 23. *Dendrotion thylogale*. Holotype NMV J37001; A1 and A2 of paratype NMV J36974; P1 of paratype NMV J36975.

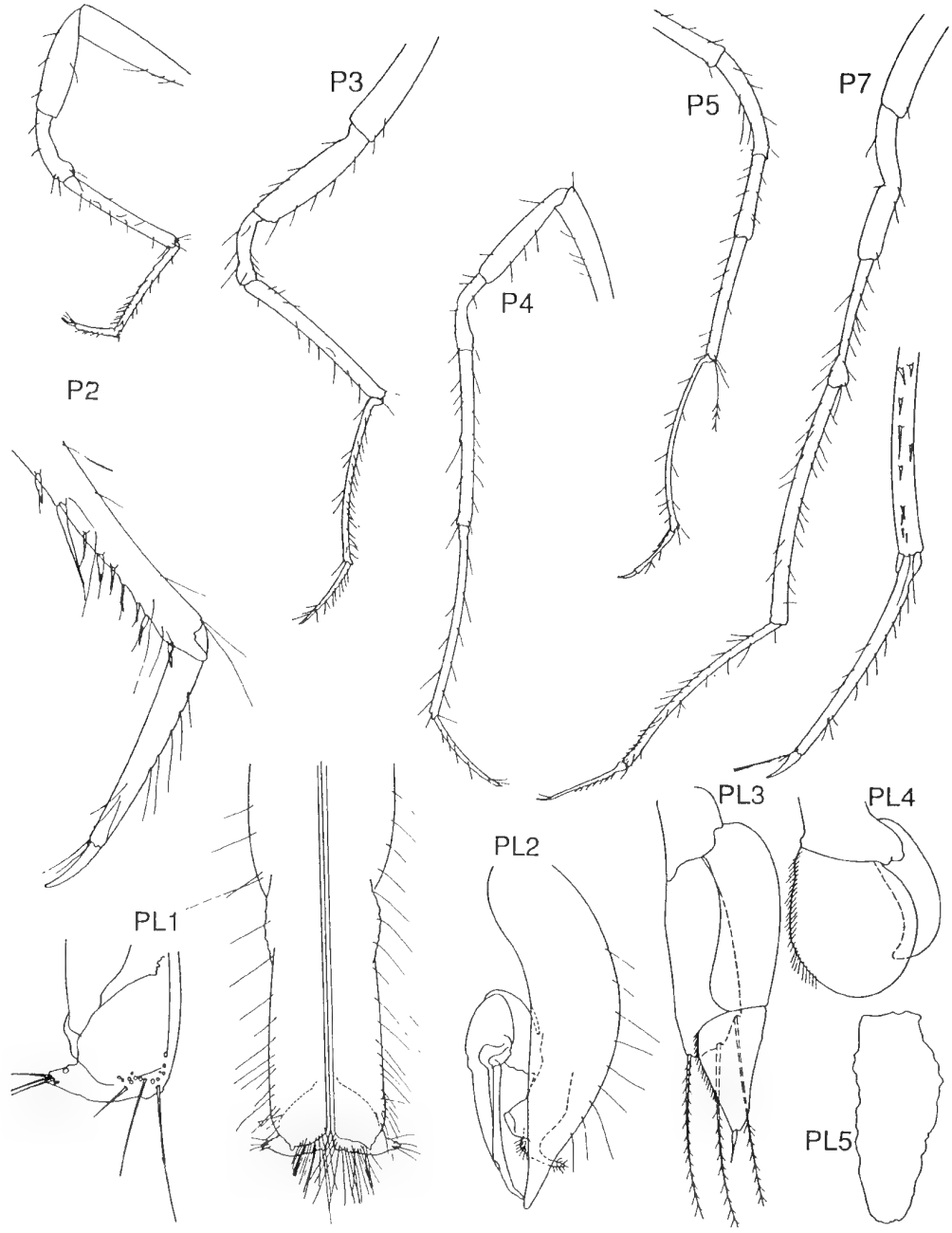


Figure 24. *Dendrotion thylogale*. PL1–5 of paratype NMV J36973; P2–7 of paratype NMV J3695.

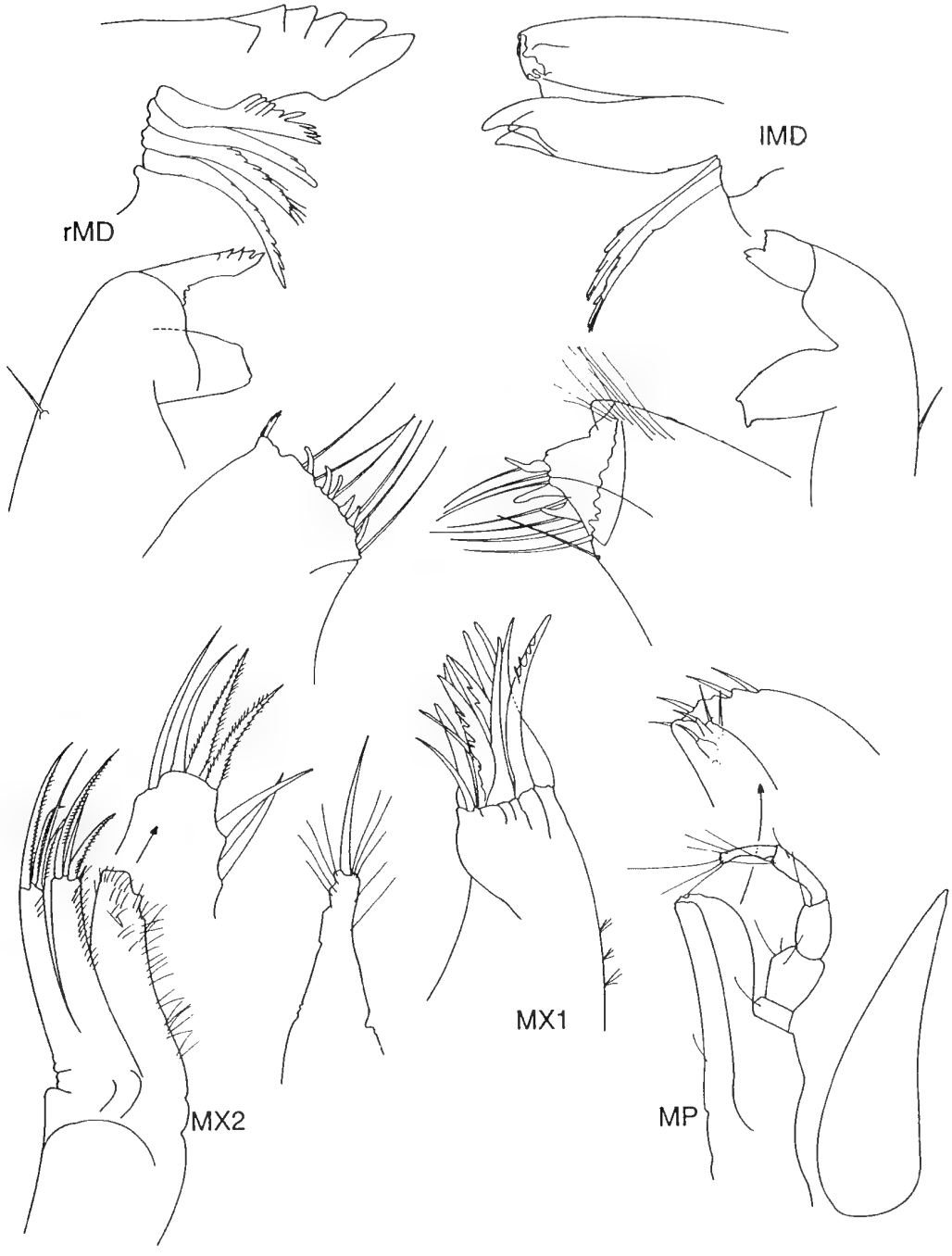


Figure 25. *Dendrotion thylogale.* Paratype NMV J37002.

setose; appendix masculina (endopod) short, not extending beyond peduncle. Pleopod 3 endopod reaching second article of exopod, with 3 long compound setae distally; exopod with 1 short setae distally. Pleopods 4–5 similar to *A. bettongia*; pleopod 5 margin crenulate. Uropods lost, thought clearly large and inserted laterally on dorsal surface of pleotelson.

Distribution. Tasman Sea from NSW to Victoria, 720–1840 m depth.

Remarks. Dendrotion petrogale is distinguishable from other species of Dendrotion by the unique pattern of dorsal spination of the pereon and the reduced setae pattern on the lateral margins of the pleotelson.

Acknowledgments

This paper is part of a wide-ranging exploration of the continental shelf and slope of southeastern Australia and has been supported by grants from the Australian Research Council and by the Victorian Institute of Marine Sciences. I am grateful to the ORV *Franklin* Steering Committee and to CSIRO Marine Laboratories, Hobart, for the provision of ship-time to Gary Poore and the Museum of Victoria which enabled this material to be collected. I would like to thank the following: Gary Poore for the opportunity to undertake this project, his support and guidance, Jean Just for sorting the material, J. K. Lowry, Australian Museum, Sydney and Joan Ellis, The Natural History Museum, London for the loan of material and Buz Wilson for a constructive review of the manuscript and information regarding the correct family name.

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Memoirs of the Museum of Victoria 57(1): 39–56 (1998)

A REVIEW OF *NEBALIELLA* (CRUSTACEA: LEPTOSTRACA) WITH THE DESCRIPTION OF A NEW SPECIES FROM THE CONTINENTAL SLOPE OF SOUTHEASTERN AUSTRALIA

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Abstract

Walker-Smith, G.K., 1998. A review of *Nebaliella* (Crustacea: Leptostraca) with the description of a new species from the continental slope of southeastern Australia. Memoirs of the Museum of Victoria 57: 39–56.

The genus *Nebaliella* Thiele, 1904 is reviewed and a new species is described from Point Hicks, Victoria, Australia. This is the first record of the genus from Australia and the fifth species of *Nebaliella*. Previously only 47 individuals world-wide had been recorded making the addition of 9 individuals to the literature significant. Sexual dimorphism within the genus is discussed and a key to the species is included.

Introduction

Nebaliella Thiele, 1904 belongs to the leptostracan family *Nebaliidae* Baird, 1850 with five other genera; *Nebalia* Leach, 1814, *Paranebalia* Claus, 1880, *Dahlella* Hessler, 1984, *Sarsinebalia* Dahl, 1985 and *Speonebalia* Bowman, Yager and Iliffe, 1985. The main features distinguishing *Nebaliella* from other nebaliids are: the presence of large curved eyestalks lacking visual elements and denticles, a rostral keel extending beyond the rostral flange, thoracopods without epipods and pleopod 6 larger than pleopod 5.

Nebaliella was erected for its type species *Nebaliella antarctica* from Kerguelen, Southern Ocean (Thiele, 1904). Thiele (1904) suggested a specimen collected from Akaroa Harbour, New Zealand also belonged to this species. A year later Thiele (1905) described a second species, *N. extrema* from 15 specimens collected off the coast of Kaiser Wilhelm II Land, Eastern Antarctica. *Nebaliella extrema* has also been recorded from Western Antarctica in the Palmer Archipelago (Cannon, 1931). In a series of expeditions in 1972, 1974–75 and 1982 to the subantarctic region of Kerguelen and Crozet Island, Ledoyer (1993) recorded ten specimens of *N. antarctica* from Kerguelen. These specimens included males and juveniles but females were not mentioned. During the same expeditions Ledoyer (1993) also recorded *N. extrema* from the Weddell Sea (5 specimens) and Kerguelen (1 specimen). *Nebaliella antarctica* has been recorded in shallow water ranging in depth from 9 m to 190 m while depth records for *N. extrema* range from 160 to 385 m.

In 1932 Clark described *Nebaliella caboti* from a single male found in the Cabot Strait between Newfoundland and Cape Brenton Island, Canada, at a depth of 378 m. *Nebaliella caboti* has also been recorded in New Jersey, USA on the lower portion of the continental slope at 2085 m (Hessler and Sanders, 1965) and the Rockall Trough at depths of 1390–2900 m (Mauchline and Gage, 1983). *Nebaliella brevicarinata*, the fourth species reported, was described from a single female from 270 m off the Princess Ragnhild Coast, Antarctica (Kikuchi and Gamô, 1992).

The fifth species, described here, was collected off the southeastern coast of Victoria, the eastern coast of New South Wales and Tasmania, Australia. The species was the only one in its genus collected during extensive sampling on the continental slope in this region (Poore et al., 1994). Several other undescribed species of Nebaliidae were collected at the same time. *N. declivatas* sp. nov. is a deep water species, found on the continental slope in water at 996–1840 m.

The addition of an Australian species to the literature extends the known geographical distribution of the genus (Table 1).

Table 1. Distribution of species of *Nebaliella*

Species	Locality	No. of individuals	Depth recorded (m)	References
N. antarctica Thiele, 1904	Kerguelen, Southern Ocean	3	9–20	Thiele, 1904
	Akaroa Harbour, New Zealand	1	?	Thiele, 1904
	Kerguelen, Southern Ocean	3	50–150	Hale, 1937
	Kerguelen, Southern Ocean	10	15–190	Ledoyer, 1993
N. extrema Thiele, 1905	Kaiser Wilhelm II Land, Antarctica	15	380–385	Thiele, 1905
	Palmer Archipelago, Antarctica	1	160–335	Cannon, 1931
	Weddell Sea, Antarctica	5	270–399	Ledoyer, 1993
	Kerguelen, Southern Ocean	1	177	Ledoyer, 1993
N. caboti Clark, 1932	Cabot Strait, Canada	1	378	Clark, 1932
	Off New Jersey, USA	1	2085	Hessler and Sanders, 1965
	Rockall Trough, Ireland	5	1392	Mauchline and Gage, 1983
N. brevicarinata Kikuchi and Gamô, 1992	Princess Ragnhild Coast, Antarctica	1	270	Kikuchi and Gamô, 1992
N. declivatas sp. nov.	Point Hicks, Vic., Australia	6	1840	present study
	Nowra, NSW, Australia	1	996	present study
	Cape Tourville, Tas., Australia	2	1264	present study

All specimens examined came from the collections of the Museum of Victoria (NMV). Specimens were dissected and mounted in glycerol and slides were viewed under an Olympus BH-2 or an Olympus BX50 compound microscope. Whole specimens and body parts were drawn with the aid of a camera lucida. Plumose setae are numerous on many body parts but in most cases they have been figured without their setules so as not to obscure other details. Abbreviations used in figures are as follows: RO, rostrum; E, eyestalks; A1, antenna 1; A2, antenna 2; MD, mandible; MX1, maxilla 1; MX2, maxilla 2; T1–T8, thoracopods 1–8; P1–P6, pleopods 1–6; CR, caudal rami or furca; A, anal scales.

Nebaliella Thiele

Nebaliella Thiele, 1904: 4–9, 24–25.—Cannon, 1931: 216–221.

Type species. *Nebaliella antarctica* Thiele, 1904 by monotypy and original designation.

Diagnosis. Eyestalks strongly curved, extending beyond the ventral margin of the rostral keel and lacking visual elements. Rostral keel longer than rostral flange. Mandibular incisor with 3 teeth, palp article 3 with a continuous row of setae along lateral and distal margins. Thoracopods without epipods. Smooth setae on lateral margin of pleopod 2 exopod not in pairs. Pleopod 6 longer than pleopod 5.

Composition. *N. antarctica* Thiele, 1904; *N. brevicarinata* Kikuchi and Gamô, 1992; *N. caboti* Clark, 1932; *N. declivatas* sp. nov.; *N. extrema* Thiele, 1905. See Table 1 for distribution.

Remarks. The eyestalks of *Nebaliella*, as in some species of *Sarsinebalia* and *Nebalia*, lack visual elements; they are strongly curved, and extend beyond the ventral margin of the rostrum like the eyestalks of *Dahlella caldariensis* but, unlike *D. caldariensis* the eyestalks lack denticles. Antenna 2, articles 3 and 4 are not fused in *Nebaliella*, *Speonebalia* and *Nebaliopsis* Sars, 1887 (Nebaliopsidae) but are fused or partially fused in other genera of Leptostraca. Thoracopodal epipods are absent in *Nebaliella* but present in other leptostracan genera. Pleopod 6 is larger than pleopod 5 in *Nebaliella* (Nebaliidae) and *Nebaliopsis* (Nebaliopsidae) but the reverse is true in other Nebaliidae.

Sexual dimorphism. The most obvious sexually dimorphic feature of males is the presence of a heavily setose peduncle and flagellum on antenna 2 which extends to the caudal furca (Figs 6 and 7). This flagellum is twice as long as in females. The flagellum of antenna 1 is also much longer in the males, extending beyond the caudal furca. A rudimentary flagellum, in addition to the normal flagellum, has also been observed on antenna 1 of females of *N. antarctica* and *N. declivatas*. This appears as a setose single article and is not found in males.

Key to species of *Nebaliella*

1. Ratio of rostral flange to exposed keel approximately 1:1 (Fig. 1E, F).....2
— Ratio of rostral flange to exposed keel approximately 3:1 (Fig. 1A, B)..... .....*N. antarctica* Thiele, 1904.
2. Carapace posterior margin not extending beyond pleonite 4 or less; body length more than twice carapace length; antenna 2 (Fig. 1G), article 1 with short spine on dorsodistal edge, article 2 with slender seta on distoventral corner of article 2; mandibular palp with strong spine on article 2 (Fig. 1H).....*N. brevicarinata* Kikuchi and Gamô, 1992
Carapace posterior margin extending beyond pleonite 4; body length less than twice carapace length; antenna 2 without slender seta on distoventral corner of article 2; mandibular palp without strong spine on article 2.....3
3. Carapace posterior margin extending to pleonite 5; maxilla 2 endopod (female) 1-articulate; pleopod 1 (male, female P1 unknown) exopod with a row of 13 setae increasing in length distally and becoming spiniform, along lateral margin.....*N. caboti* Clark, 1932
— Carapace posterior margin extending to pleonite 5; maxilla 2 endopod (female) 2-articulate in female (Fig. 1L); pleopod 1 (female) exopod with 17–19 short setae and 8–10 longer setae along lateral margin (Fig. 1M)..... .....*N. extrema* Thiele, 1908
— Carapace posterior margin extending beyond pleonite 7; maxilla 2 endopod 1-articulate in female; pleopod 1 (female) exopod with 6 short plumose setae and 11 longer plumose setae along lateral margin (Fig. 4)..... .....*N. declivatas* sp. nov.

Nebaliella antarctica Thiele

Nebaliella antarctica Thiele, 1904: 4–9, 24–25.—Hale, 1937: 55–56.—Ledoyer, 1993: 77–78.

Diagnosis. Body more than twice length of carapace. Carapace posterior margin covering pleonite 4 or less; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 3:1 (Fig. 1A, B). Antenna 2 with dorsal spine on article 1 and ventral horn-like projection or heel on article 2 (Fig. 1C); without slender seta on distoventral corner of article 2. Mandibular palp, article 2 with 4 setae; without strong spine on article 2. Maxilla 2 endopod (female) 1-articulate. T8 endopod 4-articulate (Fig. 1D). P1 exopod (female) with 19–23 short setae and 9 longer setae (including terminal ones). Pleopod 6 half length of pleonite 6.

Distribution. Kerguelen, Southern Ocean; Akaroa Harbour, New Zealand. 9–190 m depth.

Remarks. The most distinguishing feature of *Nebaliella antarctica* is its large rostral flange. The ratio of the flange to exposed keel is approximately 3:1 for *N. antarctica* but only 1:1 for all other species of *Nebaliella*. *Nebaliella antarctica* is also the only species of *Nebaliella* to possess 4 setae on article 2 of the mandibular palp. The number of articles in the protopod of maxilla 1 is uncertain. Thiele (1904) illustrated it as 1-articulate but Ledoyer (1993) drew a 3-articulate structure. As in *N. brevicarinata* the carapace of *N. antarctica* extends only as far as pleonite 4, but unlike *N. brevicarinata* the carapace does not possess a carina on the anterolateral lower corner.

Nebaliella brevicarinata Kikuchi and Gamô

Nebaliella brevicarinata Kikuchi and Gamô, 1992: 83–89.

Diagnosis. Body more than twice length of carapace. Carapace posterior margin covering pleonite 4 or less; with carina on anterolateral lower corner (Fig. 1J). Ratio of rostral flange to exposed keel approximately 1:1 (Fig. 1E, F). Rostrum with proximoventral tuberculate process (Fig 1E). Antenna 2 without dorsal spine on article 1; with slender seta on distoventral corner of article 2 (Fig 1G). Mandibular palp, article 2 with 1 seta; with strong spine on article 2 (Fig. 1H). Maxilla 1, protopod of palp 4-articulate (Fig. 1I). Maxilla 2 endopod (female) 2-articulate. Thoracopod 8 endopod 1-articulate (Fig. 1K). Pleopod 1 exopod (female) 8 short and 9 longer setae along lateral margin. Pleopod 6 approximately 0.75 length of pleonite 6.

Distribution. Princess Ragnhild Coast, Antarctica; 270 m depth.

Remarks. Nebaliella brevicarinata was described by Kikuchi and Gamô (1992) on the basis of a single female. The main character the authors used to distinguish *N. brevicarinata* from other species is a short vertical carina on the lower corner of the anterolateral portion of the carapace (Kikuchi and Gamô, 1992). Ledoyer (1993) observed a similar carina on the carapace of a specimen of *N. extrema*, but believed they were still two distinct species as the armature of pleopod 1 and the peduncle of the antenna were different. On the lateral margin of the pleopod 1 exopod *N. brevicarinata* has 8 short setae and 9 longer setae but *N. extrema* has 17–19 short setae and 8–10 longer setae. Antenna 2 peduncle article 1 has a short stout spine on the dorsodistal edge (Fig. 1G). A spine similar to this was recorded by Hale (1937) for *N. antarctica* (Fig. 1C). Antenna 2 peduncle article 2 of *N. brevicarinata* differs from all other species of Nebaliella having a long slender seta at the laterodistal corner. The possession of a strong spine on article 2 of the mandibular palp is a character unique to *N. brevicarinata*.

Nebaliella caboti Clark

Nebaliella caboti Clark, 1932: 218–225.—Hessler and Sanders, 1965: 72–73. –Mauchline and Gage, 1983: 628–630.

Diagnosis. Body 1.75 × length of carapace. Carapace posterior margin partially covering pleonite 5; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Antenna 2 without dorsal spine on article 1; without slender seta or horn-like projection on distoventral corner of article 2. Mandibular palp, article 2 with 2 setae; without strong spine on article 2. Maxilla 2 endopod (female) 1-articulate. Thoracopod 8 endopod 4-articulate. Pleopod 1 exopod (male, pleopod 1 female unknown) with a row of 13 setae increasing in length distally, becoming spiniform. Pleopod 6 equal to or slightly longer than pleonite 6.

Distribution. Cabot Strait, eastern coast of Canada; off New Jersey, USA; Rockall Trough, Ireland; 378–2085 m depth.

Remarks. Clark (1932) described *Nebaliella caboti* from a single male and Mauchline and Gage (1983) provided some drawings of a female from Rockall Trough, Ireland. *Nebaliella caboti*

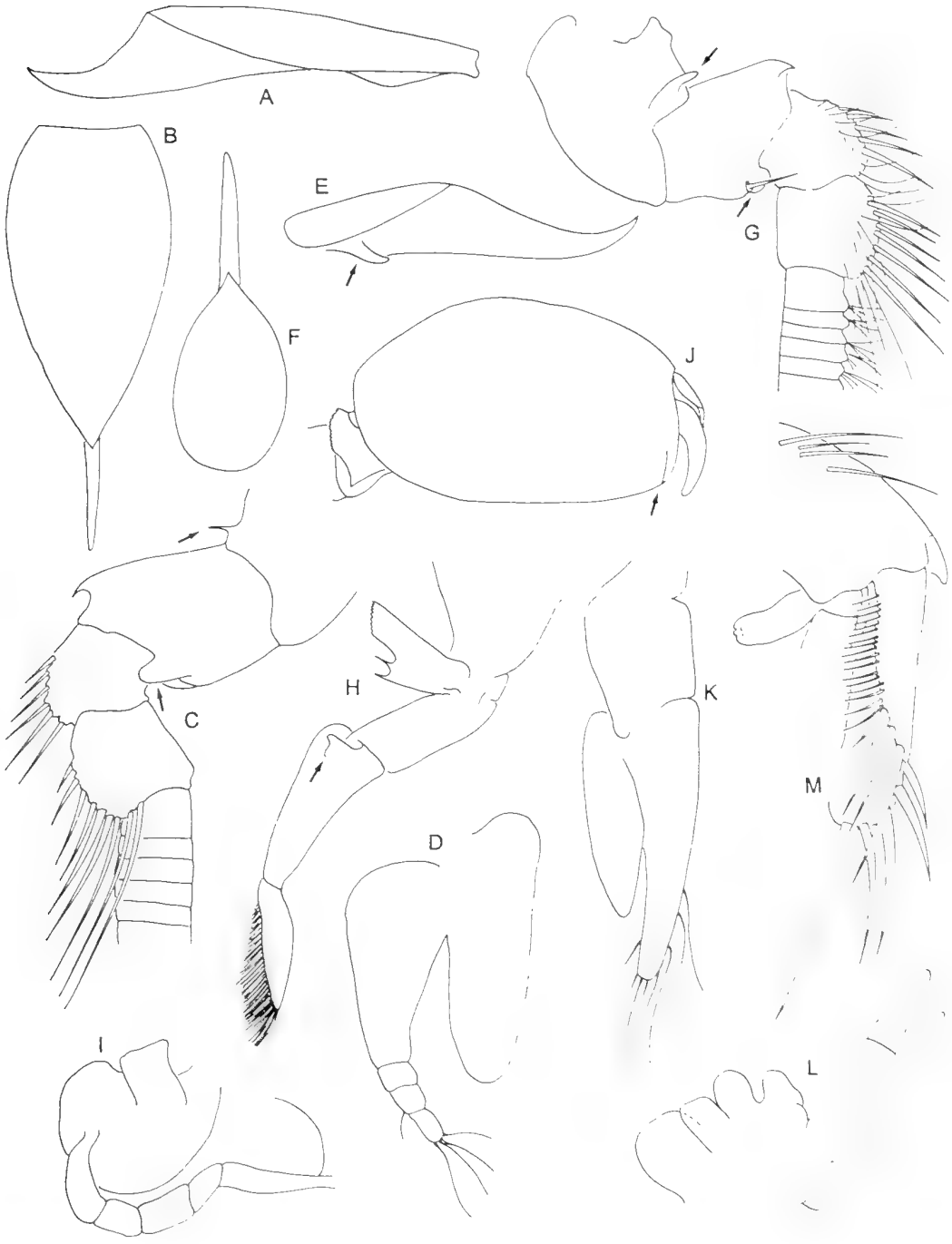

Figure 1. *Nebaliella antarctica* Thiele. A, B, rostrum, ventral and dorsal view; C, antenna 2; D, thoracopod 8. *Nebaliella brevicarinata* Kikuchi and Gamô. E, F, rostrum, ventral and dorsal view; G, antenna 2; H, mandible and mandibular palp; I, maxilla 1; J, carapace; K, thoracopod 8. *Nebaliella extrema* Thiele. L, maxilla 2; M, pleopod 1.

Figures traced from the following references: A–C, Hale, 1937; D, Ledoyer, 1993; E–K, Kikuchi and Gamô, 1992; L, M Ledoyer, 1993.

is most similar to *N. antarctica* and *N. declivatas*, having a carapace without a carina, maxilla 2 endopod 1-articulate and thoracopod 8 endopod with more than 1 article. *Nebaliella caboti* differs from *N. antarctica* in the size of the rostral flange and carapace and the possession of 2 setae on article 2 of the mandibular palp, *N. antarctica* has 4. *Nebaliella caboti* has a much larger pleopod 6 than either *N. antarctica* or *N. declivatas*, being equal to, or slightly longer than pleonite 6. *Nebaliella caboti* also differs from *N. declivatas* having a relatively smaller carapace, extending to pleonite 5 and not 7 as in *N. declivatas*.

Nebaliella extrema Thiele

Nebaliella extrema Thiele, 1905: 61–66.—Cannon, 1931: 216–221.—Ledoyer, 1993: 78–79.

Diagnosis. Body less than twice length of carapace. Carapace posterior margin partially covering pleonite 5; sometimes with carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Rostrum with proximoventral tuberculate process. Antenna 2 without dorsal spine article 1; without slender seta or horn-like projection on distoventral corner of article 2. Mandibular palp without strong spine on article 2. Maxilla 2 endopod (female) 2-articulate (Fig. 1L). Pleopod 1 exopod (female) with 17–19 short setae and 8–10 longer setae along lateral margin (Fig. 1M). Pleopod 6 as long as pleonite 6.

Distribution. Kaiser Wilhelm II Land, Palmer Archipelago, and Weddell Sea, Antarctica; Kerguelen, Southern Ocean. 160–385 m depth.

Remarks. *Nebaliella extrema* is distinguished from *N. antarctica* primarily on the basis of the rostrum. The ratio of the rostral flange to exposed keel is approximately 1:1 for *N. extrema* (and all other species of *Nebaliella*) and 3:1 for *N. antarctica*. The posterior margin of the carapace extends to partially cover pleonite 5 as in *Nebaliella caboti* but differs from *N. caboti* with maxilla 2 having a 2-articulate endopod. Maxilla 2 of *N. caboti* has a 1-articulate endopod. The pleopod 1 exopod (female) of *N. extrema* has 17–19 short plumose setae compared to only 6 in *Nebaliella declivatas*. Thiele (1905) did not mention a carina on the carapace of *N. extrema* and it was not illustrated by Cannon (1931). However, Ledoyer (1993) noted the presence of a small carina on the anterolateral lower corner of the carapace of *N. extrema*, similar to that possessed by *N. brevicarinata*. The most significant difference between *N. extrema* and *N. brevicarinata* is the lack of a slender seta on the distoventral corner of antenna 2 article 2 and the absence of a strong spine on article 2 of the mandibular palp, both features possessed by *N. brevicarinata*.

Nebaliella declivatas sp. nov.

Figures 2–10

Material examined. Holotype. Victoria. 76 km S of Point Hicks (38°29.33'S, 149°19.98'E), 1840 m, sandy mud, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 26 Oct 1988 (stn SLOPE 69), NMV J34659 (female).

Paratypes. Victoria. Collected with holotype, NMV J34664, (male, allotype), NMV J34592 (3), NMV J34593 (1).

New South Wales. 54 km ESE of Nowra (34°52.72'S, 151°5.04'E), 996 m, mud, fine sand, fine shell, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 22 Oct 1988 (stn SLOPE 53), NMV J34594 (1).

Tasmania. 48 km ENE of Cape Tourville (42°00.25'S, 148°43.55'E), 1264 m, gravel with lumps of sandy mud aggregate, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 30 Oct 1988 (stn SLOPE 81), NMV J34595 (2).

Diagnosis. Body approximately 1.5 × length of carapace. Carapace posterior margin extending beyond pleonite 7; without carina on anterolateral lower corner. Ratio of rostral flange to exposed keel approximately 1:1. Rostrum without proximoventral tuberculate process. Antenna 2 without dorsal spine on article 1, without horn-like projection or slender seta on distoventral corner of article 2. Mandibular palp, article 2 with 2 setae; without strong spine on article 2. Maxilla 1, protopod of palp 1-articulate. Maxilla 2 endopod (female) 1-articulate. Thoracopod 8 endopod 5-articulate. Pleopod 1 exopod (female) with 7 short plumose setae, 11 longer plumose setae along lateral margin and 4 terminal plumose setae. Pleopod 6 approximately 0.5 × length of pleonite 6.

Description of female holotype (without embryos). Body length (measured from anterior margin of carapace to tip of furca, excluding setae) 8.23 mm; carapace: length 5.23 mm; emarginate; dorsum convex; anterolateral margin narrowly rounded, posterolateral margin more broadly rounded; depth 0.6 × greatest length; 6.9 × length of rostrum; posterior margin reaching beyond pleonite 6; surface not sculptured, ventral surface of dorsodistal margin with row of small spines. Pleonites 2–7: margins entirely denticulate, denticles pointed.

Rostrum: flange length 2.0 × width; length of keel 4.6 × greatest depth of keel; keel 1.9 × length of rostral flange.

Eyestalks: without ommatidia; dorsal margin convex; ventral margin extremely concave; tapering distally; length measured in a straight line from top to bottom of eye; 1.1 × length of rostrum including keel; length 3.0 × greatest width; without dorsal papilla; without denticles; supraocular scale absent.

Antenna 1: article 1 without dorsal spine, as wide as article 2; article 2, length 2.4 × width, 6 mesial plumose setae and numerous distal setae; article 3, 0.6 × length of article 2, with 7 setae; article 4 with a single row of 10 plumose setae anteriorly; swollen scale, length 3.6 × width, heavily setose, with plumose setae; flagellum with 8 articles, setae clustered on anterodistal margin of each article; rudimentary second flagellum arising mesially from article 4. Antenna 2: article 2, small dorsal spine present; article 3 length 1.3 × width, with 1 anterior and 2 lateral rows of setae; articles 3 and 4 not fused; article 4 slightly longer than article 3, with 1 anterior and 2 lateral rows of plumose setae; flagellum with 17 articles.

Mandibular palp 3-articulate: article 2 with 2 medial setae; article 3, equal in length to article 2, margins tapering slightly, 1 row of plumose setae along posterior and distal margin, increasing in length distally, short seta terminally; well developed molar process, without setal brush; mandibular incisor with 3 teeth. Maxilla 1: sympod, endite 1 slightly rounded with 1 row of plumose marginal setae and 2 robust spinulose setae; palp long, well developed, with 3 articles, 13 lateral setae and 2 terminal setae; endite 2 broader than endite 1, with 1 row of stout simple setae, 1 row of plumose setae, and single longer supracuticular plumose seta. Maxilla 2: with 5 endites; endite 1 expanded distally, margin with 2 rows of plumose setae; endite 2 rectangular with 2 rows of plumose supracuticular setae; endite 3 with 2 rows of supracuticular plumose setae; endite 4 approximately half width of endite 3, with 4 plumose setae; endite 5 least developed, with 2 plumose setae; endopod tapering distally, 0.85 × length of exopod, 1-articulate; mesial margin of endopod with plumose setae; lateral margin of exopod with plumose setae.

Thoracopods: endopods 5-articulate, foliaceous, epipods absent. Ratio of endopods T1:T3 and T1:T8 endopod: 1:1.7 and 1:0.9 respectively. Ratio of exopods T1:T3 and T1:T8 exopod: 1:0.7 and 1:0.5 respectively.

Thoracopod 1: endopod with single mesial row of plumose setae, plumose setae also along posterodistal margin; exopod, lateral margin with plumose seta, length of exopod approximately equal to endopod. Thoracopod 3: endopod with single mesial row of plumose setae, articles 3–5 with posterolateral setae, article 6 heavily setose along margin; exopod distally rounded, 0.5 × length of endopod, with evenly spaced plumose supracuticular marginal setae. Thoracopod 8: endopod with mesial and anterior plumose setae; exopod tapering slightly, 0.6 × as long as endopod, with numerous plumose marginal setae.

Pleopods 1–4: lateral margin of peduncle denticulate; exopod 1-articulate; endopod 2-articulate, article 1 with retinaculum, article 2 with fine, long plumose setae on lateral and mesial margins, 1 robust smooth seta and one short, stout spine terminally.

Pleopod 1: peduncle with 2 groups of anterior plumose setae, 4 short plumose setae mesodistally, lateral margin with tiny spines; exopod, 0.5 × length of peduncle, 0.6 × length of endopod, comb-row of 7 short plumose setae along lateral margin of exopod, 0.2 × length of exopod, 11 longer plumose setae also along lateral margin, 4 plumose setae terminally, mesial margin with numerous long, fine plumose setae. Pleopod 2: peduncle with anterior row of 7 plumose setae, 4 small plumose setae mesodistally; exopod 0.8 × length of peduncle, 0.7 × length of endopod, lateral margin with 10 smooth setae, 2 terminal setae, mesial margin with long, fine plumose setae. Pleopod 3: peduncle with anterior row of 5 plumose setae; 4 short plumose mesodistal setae; exopod, 0.7 × length of peduncle, 0.6 × length of endopod, 9 subcuticular plumose setae, 2 smooth setae terminally, mesial margin with long, fine, plumose setae. Pleopod 4: peduncle with anteroproximal row of 7 plumose setae, 4 short plumose mesodistal setae; exopod, 0.8 × length of peduncle, 0.7 × length of endopod, lateral margin with 11 simple setae, 2 terminally, mesial margin with long, fine plumose setae. Pleopod 5: single ramus, length 2.7 × width; with robust simple seta on terminal margin; fine plumose setae on lateral and mesial margin. Pleopod 6: single ramus, length 3.5 × width; with 5 robust simple setae on lateral margin and 2 on terminal margin; small plumose setae on lateral and mesial margin.

Anal scales: triangular.

Caudal furca: length 3.3 × width; 1.5 × as long as telson, 0.3 × as long as carapace; with 21 smooth setae on lateral margin and 9 plumose setae on medial margin, 1 terminal seta.

Description of male allotype. Body length 5.57 mm; carapace: length 4.70 mm, 1.9 × width; dorsum convex; anterior margin rounded, posterior margin more broadly rounded; depth 0.6 × greatest length; length 4.6 × length of rostrum; posterior margin reaching anterior region of pleonite 7; surface not sculptured; ventral surface of dorsodistal margin with fine spines. Pleonites 2–7: margins entirely denticulate, denticles pointed;

Rostrum: flange length 2.0 × width; length of keel 3.5 × greatest depth of keel; keel 1.4 × length of rostral flange.

Eyestalks: without ommatidia; dorsal margin convex; ventral margin extremely concave; tapering distally; 1.2 × length of rostrum including keel; without dorsal papilla; without denticles; supraocular scale absent.

Antenna 1: article 1 with dorsal spine; article 2, length 2.5 × width, 8 mesial plumose setae and numerous distal setae; article 3, with group of distal setae; article 4 with a single row of 7 plumose setae anteriorly; swollen scale narrower than for female, length 4.4 × width, distally setose, with plumose setae; flagellum longer than carapace, extending beyond end of caudal furca; rudimentary second flagellum absent. Antenna 2: article 2, small dorsal spine present; article 3 with stout and fine setae; articles 3 and 4 not fused; article 4, with 3 rows of setae, 1 lateral row of stout setae with adjacent finely plumose setae and two rows of slender plumose setae; flagellum with many articles extending to caudal furca, heavily setose distally on each article.

Mandibular palp: article 2 with no medial setae; article 3, 1.3 × length of article 2, margins tapering slightly, 1 row of plumose setae along posterior and distal margin, long setae terminally; well developed molar process, without setal brush; mandibular incisor with 3 modified teeth. Maxilla 1: sympod, endite 1 narrowly rounded with a single row of 9 plumose setae, decreasing in length distally; endite 2 twice as wide as endite 1, slightly medially divided into two, each section with 1 row of short marginal spines; palp long, well developed, with 6 articles, 16 lateral setae and 2 terminal setae. Maxilla 2: with 4 endites; endite 1 margin with 8 plumose setae and 11 short spines; endite 2 rectangular with 7 short spines; endite 3, with 5 plumose setae; endite 4 fused with endite 5, with 5 plumose setae distally; endopod 2-articulate, tapering distally, 1.1 × length of exopod; mesial margin of endopod and lateral exopod with plumose setae.

Thoracopods: endopods foliaceous, epipods absent. Ratio of endopods T1:T3 and T1:T8 1:1.36 and 1:1:0.6 respectively. Ratio of exopods T1:T3 and T1:T8 1:1.9 and 1:1.06 respectively.

Thoracopod 1: endopod 6-articulate, with plumose setae along mesial margin; exopod 0.8 × length of endopod, lateral margin with plumose setae. Thoracopod 3: endopod 6-articulate, with plumose setae along mesial margin; exopod distally rounded, 0.9 × length of endopod, with evenly spaced plumose supracuticular marginal setae. Thoracopod 8: endopod incompletely 5-articulate (articles 1 and 2 not completely separate) with plumose setae along mesial margin; exopod tapering slightly, 0.4 × as long as endopod, with numerous plumose marginal setae.

Pleopods 1–4 posterior margin of peduncle denticulate; exopods 1-articulate; endopods 2-articulate, retinaculum attached to article 1, article 2 with long, fine plumose setae on lateral and mesial margins, 1 robust smooth seta and one short, stout spine terminally.

Pleopod 1: peduncle with single plumose setae; exopod, 0.6 × length of endopod, comb-row of short plumose setae along lateral margin of exopod absent, 14 longer plumose setae along lateral margin, 3 plumose setae terminally, mesial margin with numerous long, fine plumose setae. Pleopod 2: peduncle with anterior row of 7 plumose setae, single plumose seta distally; exopod, 0.5 × length of endopod, lateral margin with 9 smooth setae, 2 terminal setae, mesial margin with long, fine plumose setae. Pleopod 3: peduncle with anterior row of 5 plumose setae; exopod, 0.5 × length of endopod, 6 subcuticular plumose setae lateral, 3 smooth setae terminally, mesial margin with long, fine, plumose setae. Pleopod 4: peduncle with anteroproximal row of 4 plumose setae, 2 short plumose mesodistal setae; exopod, 0.5 × length of endopod, lateral margin with 9 simple setae, 2 terminally, mesial margin with long, fine plumose setae. Pleopod 5: uniramus, length 3.1 × width (not including peduncle); with 1 robust simple seta on terminal margin; fine plumose setae, on lateral and mesial margin. Pleopod 6: uniramus, length 3.3 × width (not including peduncle); with 5 robust simple setae on lateral and 2 on terminal margin; fine plumose setae on lateral and mesial margin.

Anal scales: triangular.

Caudal furca: length 3.7 × width; 1.7 × as long as telson, 0.3 × as long as carapace; with smooth setae on lateral margin and plumose setae on mesial margin, 1 terminal seta.

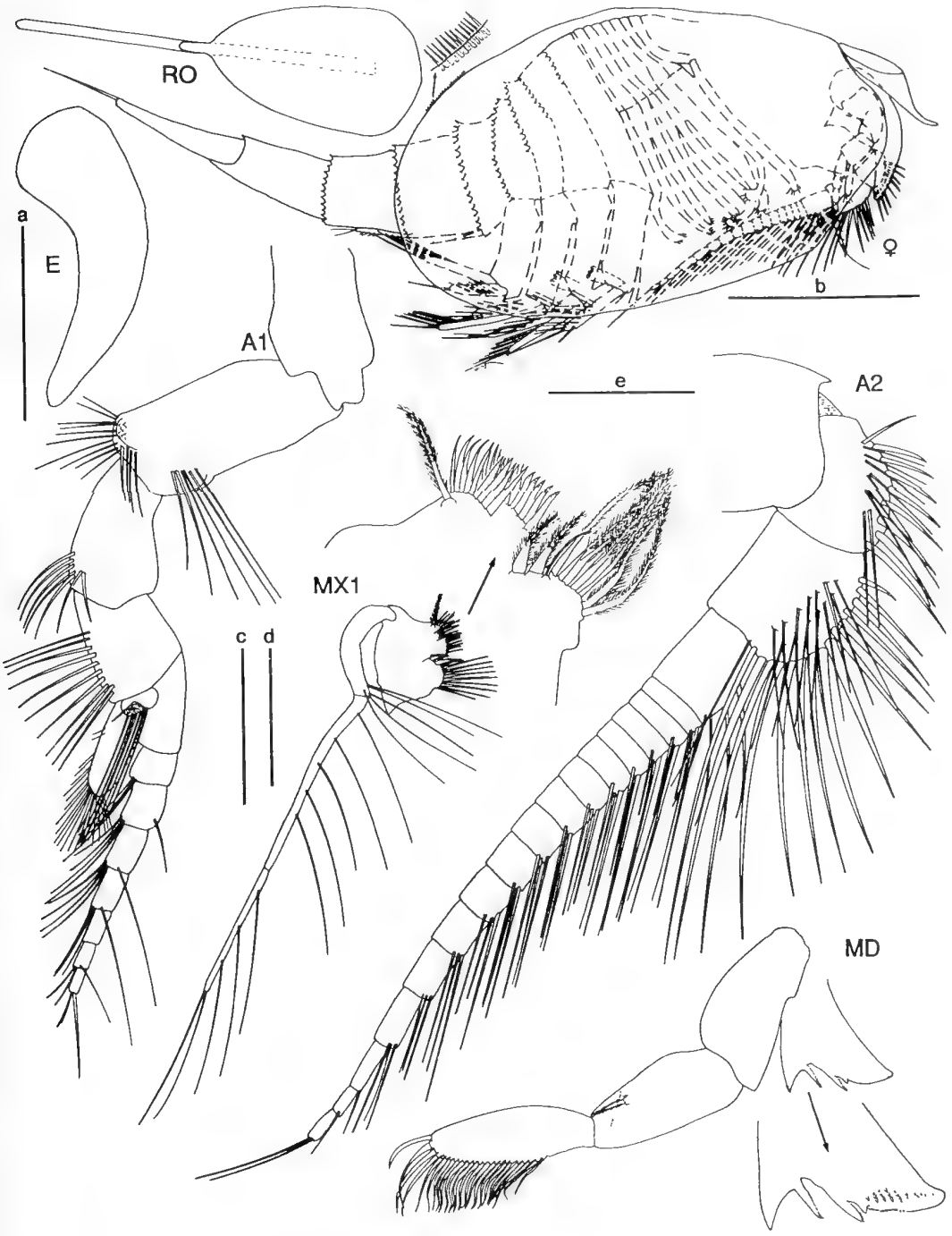

Figure 2. *Nebaliella declivatas*, female holotype. Dorsal view of rostrum. Lateral view of eyestalk. Mesial view of antenna 1 and antenna 2. Anterior view of maxilla 1, mandible. Scales a = E = 1 mm; b = whole body = 2 mm; c = A1, A2, MD = 1 mm; d = RO = 0.5 mm; e = MX1 = 1 mm.

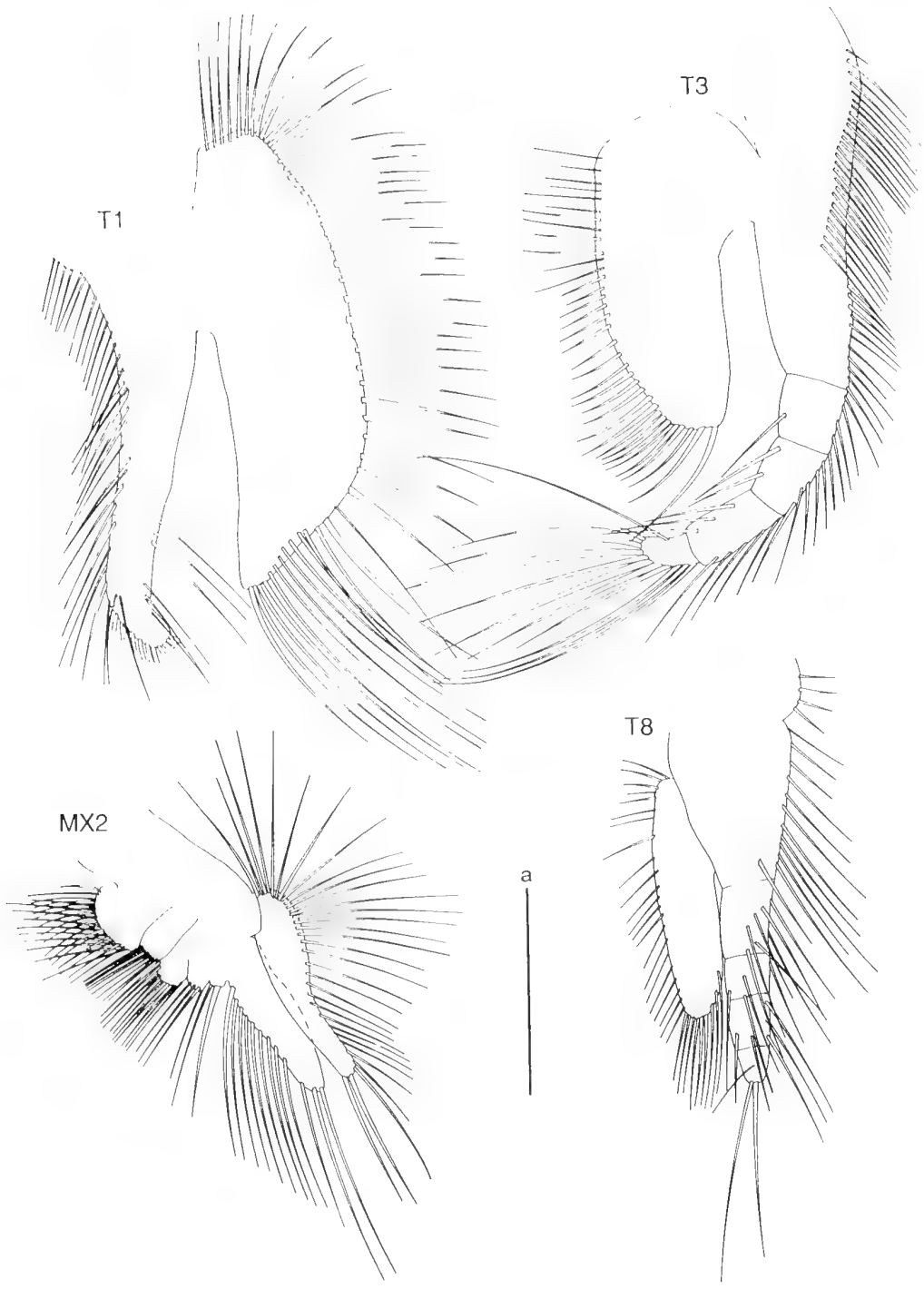

Figure 3. *Nebaliella declivatas*, female holotype. Anterior view of thoracopod 1, thoracopod 3, thoracopod 8 and maxilla 2. Scale a = 0.5 mm.

Figure 4. *Nebaliella declivatas*, female holotype. Anterior view of pleopods 1–3. Scales a = P1 and P3 = 1 mm: b = P2 = 1 mm.

Etymology. *Declivatas* (Latin) meaning a sloping place, referring to the continental slope where the holotype was found; noun in apposition.

Distribution. Point Hicks, Victoria, Australia; Nowra, NSW, Australia; Cape Tourville, Tasmania, Australia. 996–1840 m depth.

Remarks. The unique character separating *Nebaliella declivatas* from the other species of *Nebaliella* is the setation pattern of pleopod 1.

The overall appearance of the rostrum is similar to *N. extrema*, *N. caboti* and *N. brevicarinata* with the ratio of the flange to exposed keel being 1:1. The rostrum of *N. declivatas* does not possess the ventral tuberculate process or heel found in *N. antarctica*, *N. extrema*, and *N. brevicarinata*. The carapace is relatively larger than for any other species, with the posterior margin extending beyond pleonite 6. Posterodorsally there is a row of minute spines on the ventral surface of the carapace, protruding just beyond the margin. This type of spination is also found on *N. antarctica*, *N. extrema* and *N. caboti*. These tiny spines may be present on other species but could have been

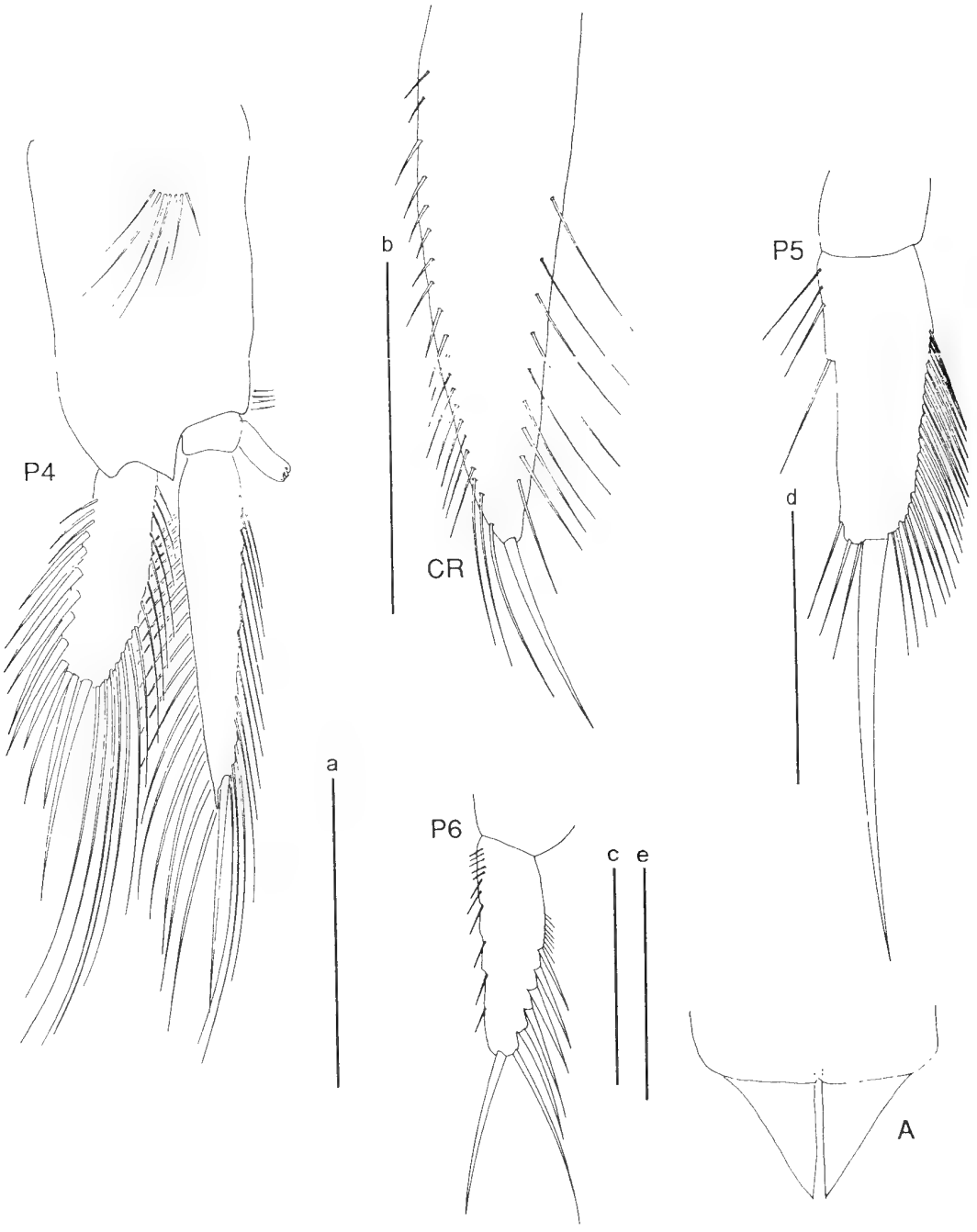

Figure 5. *Nebaliella declivatas*, female holotype. Anterior view of pleopod 4. Dorsal view of caudal rami, pleopod 5 and pleopod 6. Scales a = P4 = 1mm; b = CR = 1 mm; c = P6 = 0.5 mm; d = P5 = 0.3 mm; e = A = 0.5 mm.

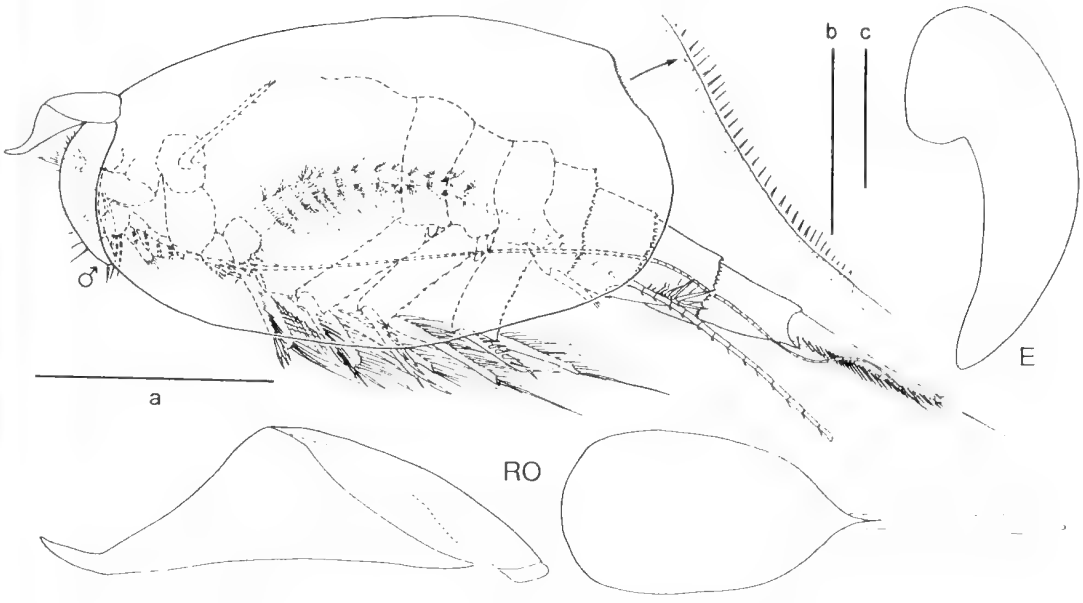

Figure 6. *Nebaliella declivatas*, male allotype. Dorsal and lateral view of rostrum. Lateral view of eye. Scales a = whole body = 2 mm; b = RO = 0.4 mm; c = E = 0.5 mm.

overlooked due to their small size. Antenna 2 does not possess a spinous projection on article 1 like that found in *N. brevicarinata* (Fig. 1G) nor is article 2 ornamented with the ventral horn-like projection or heel found on *N. antarctica* (Fig. 1C) and *N. extrema* or the slender seta as in *N. brevicarinata* (Fig. 1G).

The mouthparts of *N. declivatas* also differ from other species. The mandibular palp lacks the strong spine-like process found on article 2 in *N. brevicarinata* (Fig. 1H). The articles the protopod of the maxilla are fused, unlike *N. brevicarinata* which has 4 articles (Fig. 1I). Maxilla 2 endopod is 1-articulate in *N. declivatas*, as is the case for *N. caboti* and *N. antarctica*. The endopod of maxilla 2 is 2-articulate in *N. brevicarinata* and *N. extrema*. Thoracopod 8 is articulate in *N. declivatas*, *N. antarctica*, *N. extrema* and *N. caboti*. It is not articulate in *N. brevicarinata* (Fig. 1K).

One of the most striking characters of *N. declivatas* is the setation of pleopod 1. The female pleopod 1 exopod has a row of short plumose setae and 11 longer plumose setae along the lateral margin. This type of setal arrangement is similar to that found in *N. brevicarinata* which has 8 short spines and 9 longer setae but it is different from the exopod setation of *N. antarctica* (23 short setae and 8 long setae) and *N. extrema* (17–19 short setae and 8–10 long setae) (Fig. 1M). The female pleopod 1 exopod of *N. caboti* is unknown.

Sexual dimorphism

The discovery of *Nebaliella declivatas* allows description of sexual dimorphism in several characters. The male antenna 1 peduncle article 1 is much broader than for the female and has a strong dorsal tooth. The mouthparts of the male are slightly modified. The male maxilla 1 endites are less setose than those of the female and endite 1 lacks the two stout plumose setae found in the female. The male endite 2 differs from the female having a single row of short robust setae instead of 2 overlapping rows of robust setae and a longer plumose seta. Proximally the protopod of the male palp is articulated but the female protopod is not. The maxilla 2 endopod is 1-articulate in the female and 2-articulate in the male. Thoracopod endopods are broader in the male, particularly thoracopod 3 and the thoracopod 3 exopod of the male is much larger than the female. The endopod of thoracopod 1 and thoracopod 3 of male has one more article than the female. The major variation in the pleopods of males and females occurs in the setation of pleopod 1. Males of *N. declivatas* lack the very small plumose setae found on the proximolateral margin of the exopod of the females.

Figure 7. *Nebaliella declivatas*, male allotype. Mesial view of antenna 1, and antenna 2. Anterior view of mandible and maxilla 1. Scales a – MX1 0.5 mm; b = A1 = 1mm; MD = 0.5 mm; c = A1 scale = 0.3 mm; d = A2 = 0.5 mm.

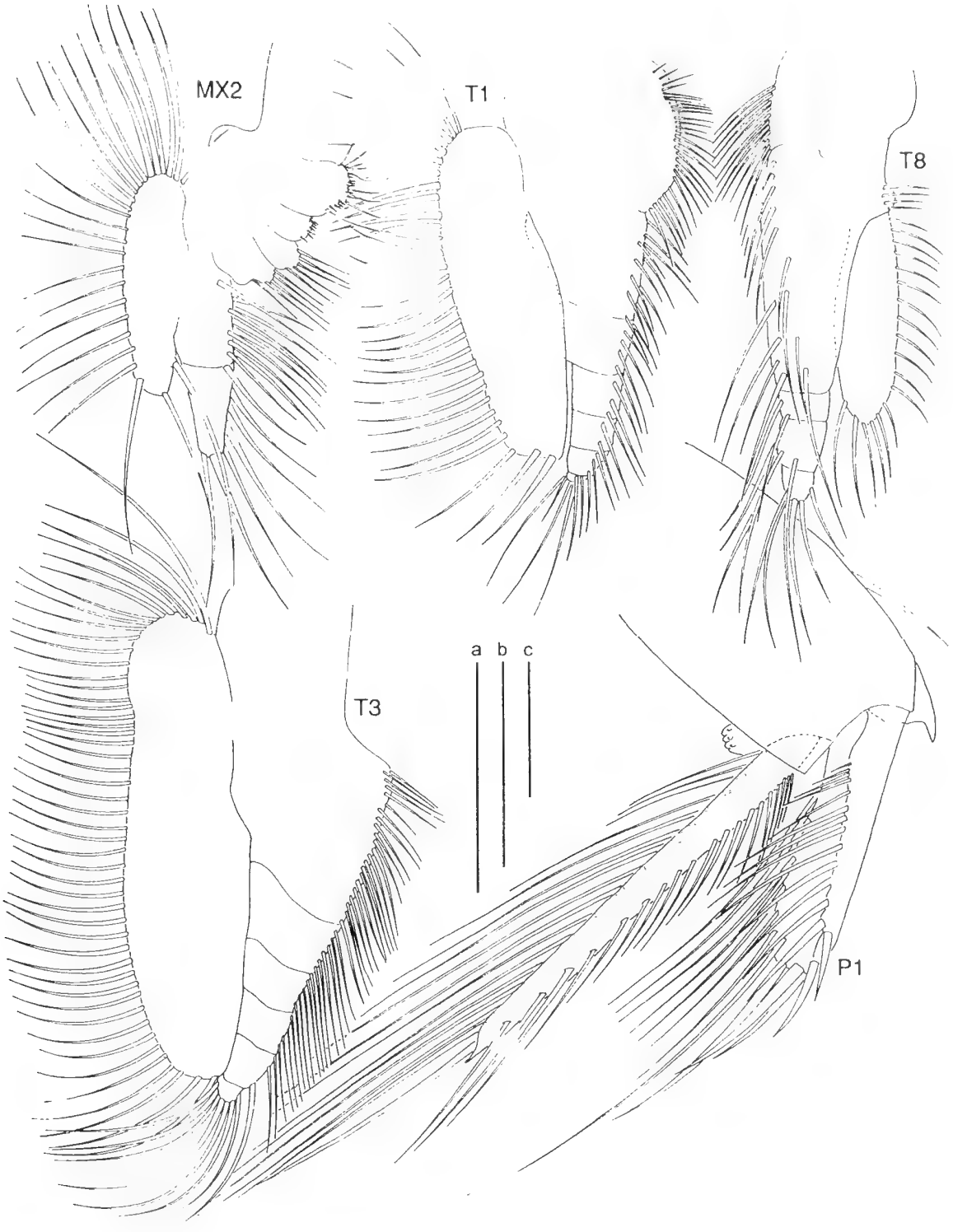

Figure 8. *Nebaliella declivatas*, male allotype. Anterior view of maxilla and thoracopod 1, thoracopod 3 and thoracopod 8. Lateral view of pleopod 1. Scales a = T1, T3, T8 = 0.5 mm; b = P1 = 0.5 mm; c = MX2 = 0.5 mm.

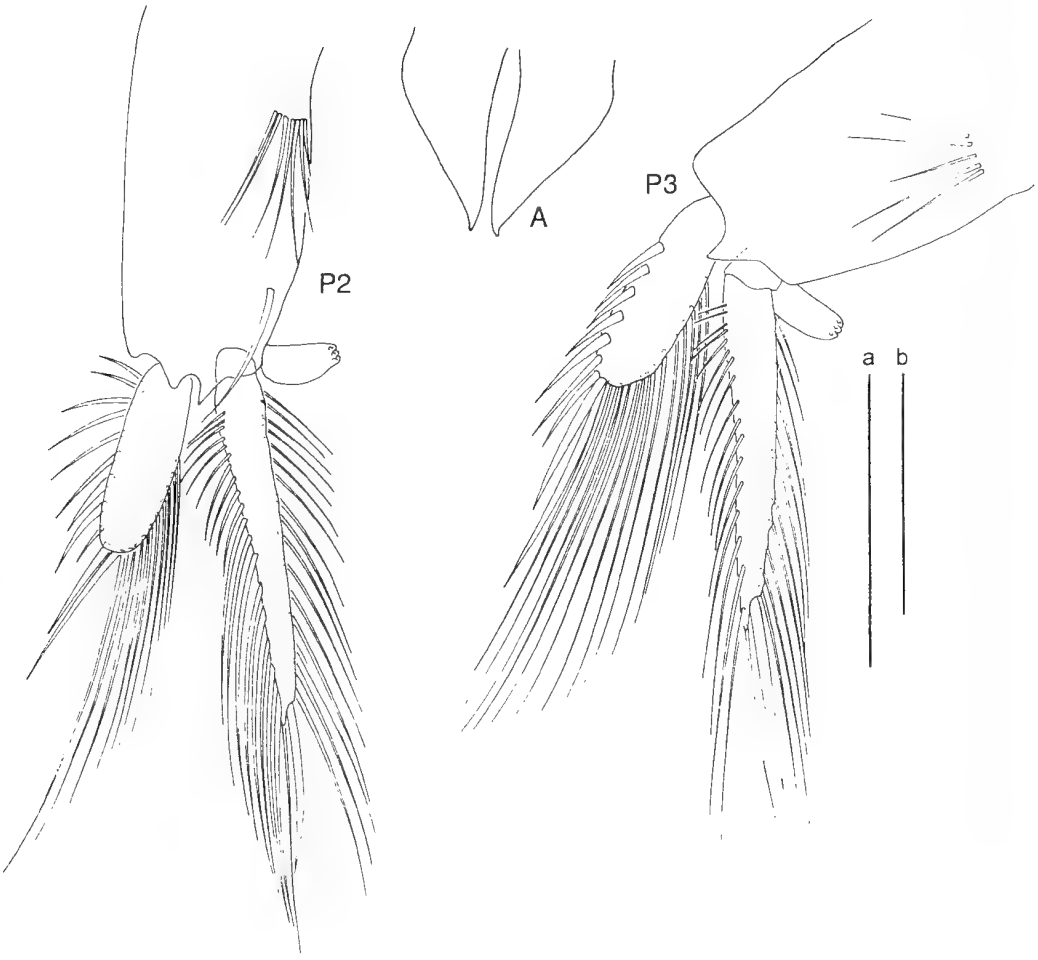

Figure 9. *Nebaliella declivatas*, male allotype. Anterior view of pleopod 2, pleopod 3 and anal scales. Scales a = P2, P3 = 1 mm: b = A = 0.3 mm.

The exopodal setation for the male pleopod 1 does not vary from the arrangement of setae found on pleopods 2, 3 and 4. The female pleopod 5 has a long smooth terminal seta but the male has a short stout one. The male caudal rami has a longer terminal seta and more heavily setose lateral and mesial margins than the female.

Acknowledgements

Special thanks to Dr Gary Poore for helpful comments and criticisms of draft manuscripts. This project is part of a wide-ranging exploration of the continental slope of southeastern Australia and has been supported by grants from the Australian Research Council and by the Victorian Institute of Marine Sciences.

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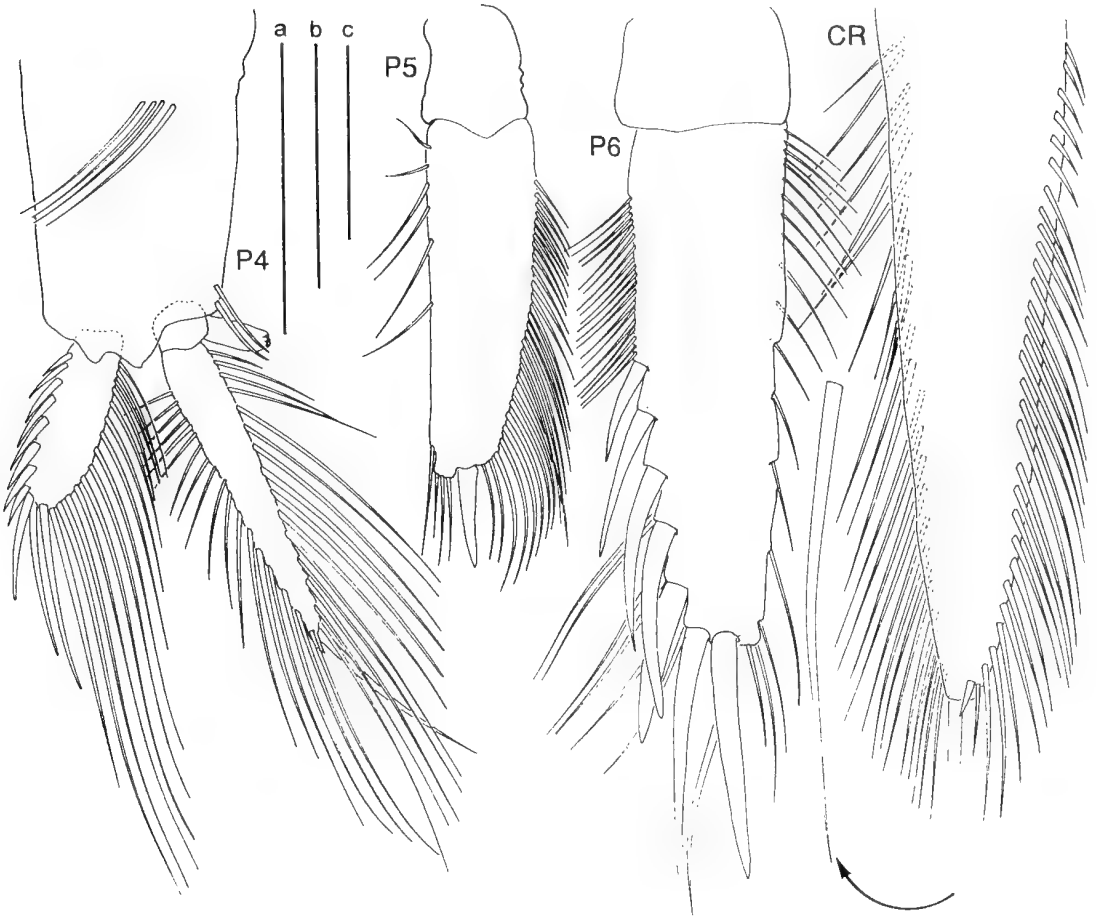

Figure 10. *Nebaliella declivatas*, male allotype. Anterior view pleopods 4–6 and caudal rami. Scales a = P4 = 1 mm; b = CR = 0.5 mm; c = P5, P6 = 0.2 mm

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A REVIEW OF THE GENUS *LEONTOCARIS* (CRUSTACEA: CARIDEA: HIPPOLYTIDAE) WITH DESCRIPTIONS OF THREE SPECIES FROM SOUTHEASTERN AUSTRALIAN SEAMOUNTS AND SLOPE

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Abstract

Taylor, J. and Poore, G.C.B., 1998. A review of the genus *Leontocaris* (Crustacea: Caridea: Hippolytidae) with descriptions of three species from southeastern Australian seamounts and slope. *Memoirs of the Museum of Victoria* 57: 57–69.

The genus *Leontocaris* and its species are diagnosed. *Leontocaris bulga* sp. nov. and *Leontocaris yarramundi* sp. nov. are described and illustrated, compared with four other species of the genus, and a key for their identification provided. New observations of *L. amplectipes* Bruce, 1990 are made from new material from seamounts southeast of Tasmania.

Introduction

Leontocaris Stebbing, 1905, a small genus of hippolytid caridean shrimps, comprises *L. paulsoni* Stebbing, 1905 from 240–265 m off South Africa (Barnard, 1950), *L. lar* Kemp, 1906 from 1000–1300 m from the northwest Atlantic Ocean off Ireland, *L. pacificus* Zarenkov, 1976 from 680–700 m from the Pacific Ocean off western South America and *L. amplectipes* Bruce, 1990 from 1000 m off southeastern Australia. Bruce (1990) reviewed the genus and provided a key to three species. He discussed the possible association of the species with cnidarians.

A small collection of hippolytid shrimps from seamounts (750–1450 m depth) southeast of Tasmania contains additional specimens of *Leontocaris* belonging to three species. Here, two new species are described, one on the basis of five specimens, and another on the basis of a carapace and anterior limbs. We take the opportunity to rediagnose *L. amplectipes* in the light of new material and the other species so far described. All species of *Leontocaris* possess a tympanum or thinning of the exoskeleton on the inner surface of the propodus of pereopod 2. The size of this varies between species and may play a part in extension of the folded limb.

Abbreviations are: cl., carapace length; NMV, Museum of Victoria, Melbourne; TM, Tasmanian Museum, Hobart, where material is lodged. In habitus drawings pereopods were drawn after separation from the body and flattened.

Leontocaris Stebbing

Leontocaris Stebbing, 1905: 98–99.—Barnard, 1950: 699.

Diagnosis. Pereopods without arthrobranchs. Mandible with incisor and 1- or 2-articulate palp. Maxilliped 3 without exopod or epipod. Epipods present only on maxilliped 1 and 2. Rostrum half as long or as long as carapace. Supraorbital spine absent. Pereopod 1 slender, carpus elongate. Pereopod 2 strongly asymmetrical, carpus 4-segmented. Major pereopod 2 with elongate and robust propodus and enlarged, chopper-shaped dactylus. Pereopods without arthrobranchs. Maxillipeds 2–3 and pereopods 1–4 with pleurobranchs.

Remarks. Barnard's (1950) generic diagnosis stated that the mandibular palp is small and uniarticulate. We amend that to allow the 2-articulate palp seen in *Leontocaris bulga* sp. nov.

Kemp (1910) reported a thin-walled sausage-shaped structure in the groove on the inner margin of the propodus of the major pereopod 2. This area of thin exoskeleton or tympanum is surrounded by what appear to be minute villi. The long proximal segment of the carpus lies in this groove when the limb is folded and is held in place by the merus which interacts with the groove. The size and shape of the tympanum differs between species, being elongate in most but only a small circular structure in *L. amplectipes*. What function, if any, this structure plays in the assumed rapid extension of the pereopod remains to be investigated.

Key to species of *Leontocaris*

1. Rostrum with 4–16 dorsal teeth, 2–4 in epigastric region; mandibular palp 1-articulate; scaphocerite with 11–21 marginal teeth.....2
   Rostrum with >19 dorsal teeth, 1 in epigastric region; mandibular palp 2-articulate; scaphocerite with 26 marginal teeth.....*L. bulga* sp. nov.
2. Rostrum 1.0–1.46 times carapace length, with 8 or more ventral teeth; ambulatory pereopods with dactylus between 0.1 and 0.25 of propodus length; exopod of uropod distolaterally serrate.....3
   Rostrum 0.58–0.85 of carapace length, with 2–4 ventral teeth; ambulatory pereopods with dactylus about 0.5 of propodus length; exopod of uropod distolaterally entire, with small mobile spine only.....*L. amplectipes* Bruce
3. Telson with 4-5 pairs of marginal dorsal spines and 2–3 pairs of terminal spines.....4
   Telson with 7 pairs of marginal dorsal spines and 1 pair of terminal spines.....*L. pacificus* Zarenkov
4. Inferior orbital angle acute; pereopod 2 with fixed finger teeth simple, pleuron of abdominal somite 5 with 1 posterior tooth; telson with 5 pairs of marginal dorsal spines.....5
   Inferior orbital angle blunt; pereopod 2 with fixed finger teeth denticulate, pleuron of abdominal somite 5 with 3 posterior teeth; telson with 4 pairs of marginal dorsal spines.....*L. yarramundi* sp. nov.
5. Rostrum with 9–10 dorsal teeth; distolateral tooth of scaphocerite small; cornea large; abdominal somite 3 without posterodorsal tooth; posterior margin of telson rounded.....*L. lar* Kemp
   Rostrum with 6 dorsal teeth; distolateral tooth of scaphocerite large; cornea small; abdominal somite 3 with posterodorsal tooth; posterior margin of telson bifid.....*L. paulsoni* Stebbing

Leontocaris amplectipes Bruce

Figure 1

Leontocaris amplectipes Bruce, 1990: 121–130, figs 1–6.

Material examined. Holotype. Victoria, S of Point Hicks (38°21.90'S, 149°20.00'E), 1000 m, WHOI epibenthic sled, G.C.B. Poore et al. on ORV Franklin, 23 Jul 1986 (stn SLOPE 32), NMV J19881 (?male).
Other material. Tasmania, 82.6 km SSE of Southeast Cape, "J1" seamount (44°14.4'S, 147°21.6'E), 1200–1450 m, 27 Jan 1997 (stn SS01/97/40), NMV J41247 (5 specimens, cl. 5.0–9.6 mm), TM G3952 (5 specimens, cl. 6.5–8.8 mm). 70.0 km SSE of Southeast Cape, "Macka's" seamount (44°12.6'S, 147°03.0'E), 750–900 m, 29 Jan 1997 (stn SS01/97/52), NMV J41248 (1 specimen, cl. 8.0 mm). 65.1 km SSE of Southeast Cape, "Andy's" seamount (44°10.8'S, 146°59.4'E), 900–1100 m, 29 Jan 1997 (stn SS01/97/57), NMV J41249 (2 specimens, cl. 8.7 mm, 9.6 mm). 81.3 km SSE of Southeast Cape, "38" seamount (44°13.2'S, 147°22.8'E), 1140–1140 m, 30 Jan 1997 (stn SS01/97/58), NMV J41250 (1 specimen, cl. 8.4 mm). 82.9 km SSE of Southeast Cape, "Sister 1" seamount (44°16.2'S, 147°17.4'E), 1100–1122 m, 23 Jan 1997 (stn SS01/97/15), NMV J41251 (1 specimen, cl. 8.5 mm). All collected using epibenthic sled by T.N. Stranks et al. on FRV *Southern Surveyor*.
Victoria, S of Point Hicks (38°21.90'S, 149°20.00'E), 1000 m, WHOI epibenthic sled, G.C.B. Poore et al. on ORV *Franklin*, 23 Jul 1986 (stn SLOPE 32), NMV J41438 (2 specimens). S of Point Hicks (38°19.60'S, 149°24.30'E), 930–951 m, rock, rubble, clay, sand, biogenic sediment, WHOI epibenthic sled, M.F. Gomon et al. on ORV *Franklin*, 23 Jul 1986 (stn SLOPE 33), NMV J41439 (2 specimens).

Diagnosis. *Rostrum* 0.58–0.85 of carapace length, shorter than antennular peduncle. Rostrum and carapace with 12–18 dorsal teeth (including 2–3 in epigastric region), and 2–4 ventral teeth. Inferior orbital angle blunt. Scaphocerite without strong distolateral tooth, with 11–15 marginal teeth. Cornea well developed, broader than stalk. Mandibular palp of 1 article. Major pereopod 2 with fixed finger short, stout, blunt, denticulate. Pereopod 3 with dactylus about 0.5 of propodus. Abdominal somite 3 posterodorsally unarmed. Abdominal somite 5 pleuron rounded, unarmed. Telson with 4 pairs of marginal dorsal spines; posterior margin broadly rounded, with 4 pairs of spines.

Remarks. The holotype falls within the variability of the rostrum in the new material. The number of ventral rostral teeth ranges from 2 to 4, the

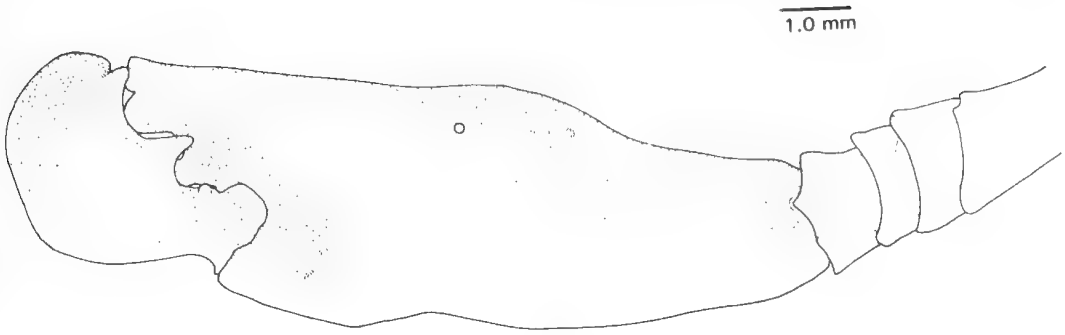

Figure 1. *Leontocaris amplectipes* Bruce, 1990, NMV J41247: major pereopod 2 chela, lateral view.

number of dorsal teeth on the carapace and rostrum ranges from 12 to 18 (2–3 in epigastric region). The rostrum of the holotype is 0.65 times the carapace length. The rostrum of the new material ranges from 0.58 to 0.85 of the carapace length. The scaphocerite is armed with 11–15 lateral teeth. Of the 12 complete specimens examined, six had the major pereopod 2 on the right, and six on the left.

The tympanum in the groove near the margin of the inner surface of the propodus of pereopod 2 is round, much smaller than other species, and does not seem to be surrounded by the villi seen in other species (Fig. 1). It was not illustrated by Bruce (1990).

Leontocaris amplectipes is distinct from all other species of the genus in that the rostrum is much shorter than the carapace length and does not exceed the antenna 1 peduncle. In addition, the dactylus of pereopod 3 is about half of the carpal length whereas in all other species it is 0.12–0.25 carpal length.

The new material extends the range of the species from southeastern Victoria at 1000 m depth to seamounts off southeastern Tasmania at depths between 750 and 1450 m.

Leontocaris bulga sp. nov.

Figures 2–4

Material examined. Holotype. Tasmania, 94.5 km SSE of Southeast Cape, "V" seamount (44°24.0'S, 147°09.0'E), 1400–1650 m, epibenthic sled, T.N. Stranks et al. on FRV *Southern Surveyor*, 31 Jan 1997 (stn SS01/97/69), NMV J39938 (1 specimen without abdomen, cl. 12.7 mm).

Diagnosis. Rostrum subequal to carapace length. Rostrum and carapace with >19 dorsal teeth (including 1 in epigastric region), and >11 ventral teeth. Inferior orbital angle rounded. Scaphocerite with 1 strong distolateral tooth and 26 marginal teeth. Cornea well developed, broader than stalk. Mandibular palp of 2 articles. Major pereopod 2 with fixed finger short, stout, blunt, dentate. Pereopod 3 with dactylus about 0.13 of propodus length. Abdomen unknown.

Description. Carapace smooth; rostrum well developed, slightly inclined dorsally over distal two-thirds, subequal to carapace length, exceeding antennular peduncle and scaphocerite, extreme tip missing; rostrum with 19 acute dorsal teeth on carapace and rostrum, uniform in size, 1 occurring in the epigastric region; 11 ventral teeth; supraorbital and hepatic spines absent; inferior orbital angle produced, rounded; antennal spine well developed, submarginal, falling short of inferior orbital angle; anterolateral angle of branchiostegite broadly rounded, falling short of inferior orbital angle.

Abdomen unknown.

Antenna 1 distinctly exceeding rostrum, with proximal article of peduncle subcylindrical, slender, 3.8 times as long as distal width, unarmed, stylocerite long, exceeding distal margin of proximal article; intermediate article 0.37 of proximal article length, subcylindrical, unarmed; distal article 0.44 of proximal article length, subcylindrical, unarmed; flagella damaged, upper flagellum robust, lower flagellum slender.

Antenna 2 scaphocerite well developed, exceeding antennular peduncle, broad, 4.8 times as long as central width, proximal third of lateral margin straight, entire, distal two-thirds mostly straight, feebly convex at most distal end, with 26 acute lateral teeth, distal lamella broadly rounded, as long as distolateral tooth. Basicerite with slender, well developed distoventral tooth.

Eye with large globular cornea, diameter 0.14 of carapace length, well pigmented, without ocellus; stalk short, broad.

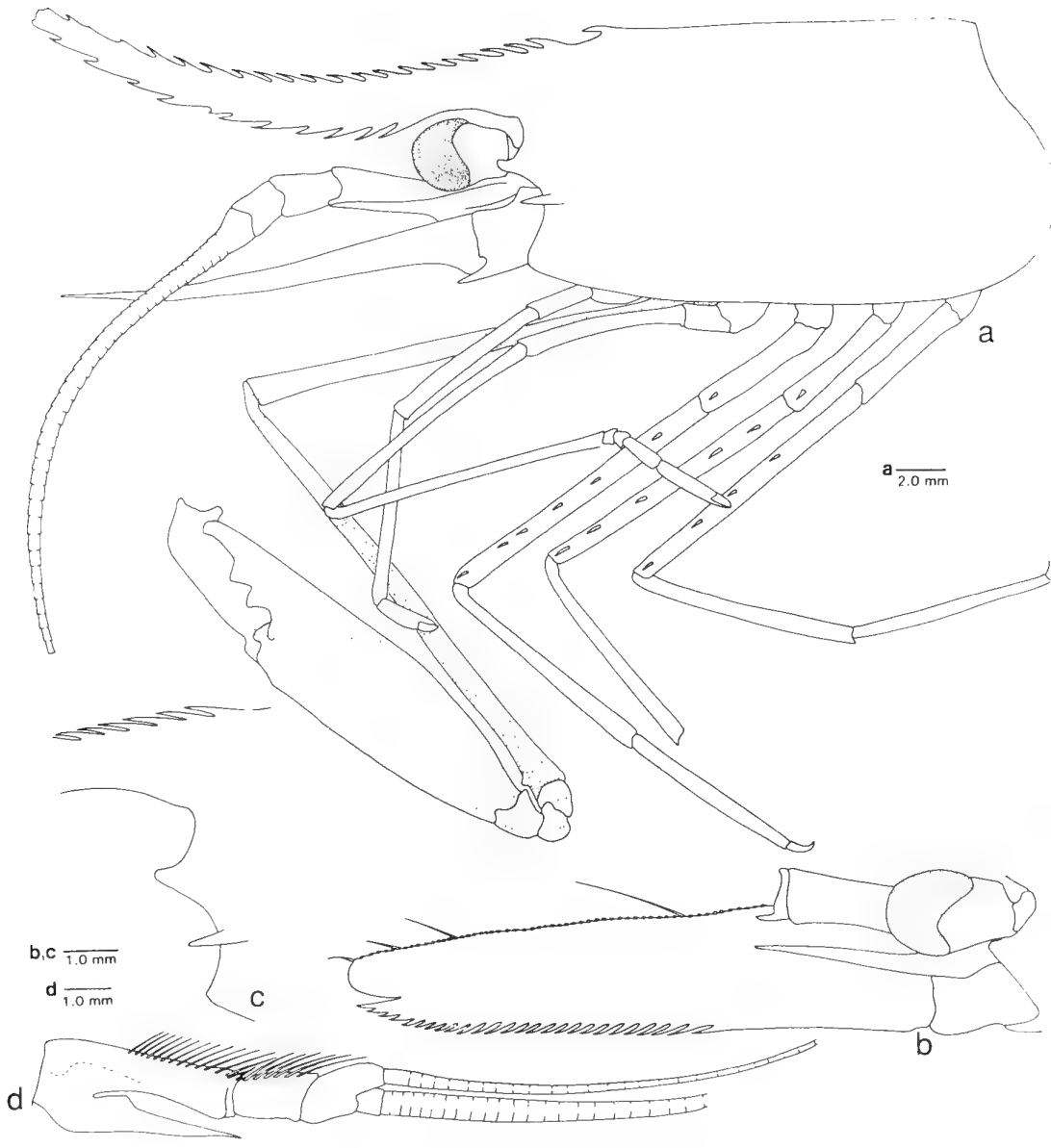

Figure 2. *Leontocaris bulga* sp. nov., holotype. a, habitus. b, eye and antenna 1 region, dorsal. c, anterolateral carapace, orbital region. d, antenna 1.

Mandible with 2-articulate palp, 9.6 times as long as wide, distal article 0.74 of proximal article, with 6 simple distal setae; incisor process with 5 acute teeth, medial and lateral teeth larger than central teeth. Maxilla 1 with slender feebly bilobed palp, upper lobe rounded, with 2 long setae, lower lobe angular, with single simple seta; upper lacinia broadened centrally, distal border with row of about 7 short, stout spines and numerous simple setae; lower lacinia slender, tapering distally with numerous long, simple setae. Maxilla 2 with short, slender palp, with 4 long distal

Figure 3. *Leontocaris bulga* sp. nov., holotype. a, mandible. b, maxilla 1. c, maxilla 2. d, maxilliped 1 e, maxilliped 2. f, maxilliped 3.

setae, basal endite bilobed, distal lobe broader than proximal, both with numerous simple setae distally, coxal endite simple, short, sparsely setose; scaphognathite 3.0 times as long as broad; posterior lobe broad, anterior lobe broad, as long as wide. Maxilliped 1 with short subcylindrical palp, with several terminal and preterminal simple setae; basal endite rounded, densely setose medially; exopod with large broad caridean lobe; flagellum well

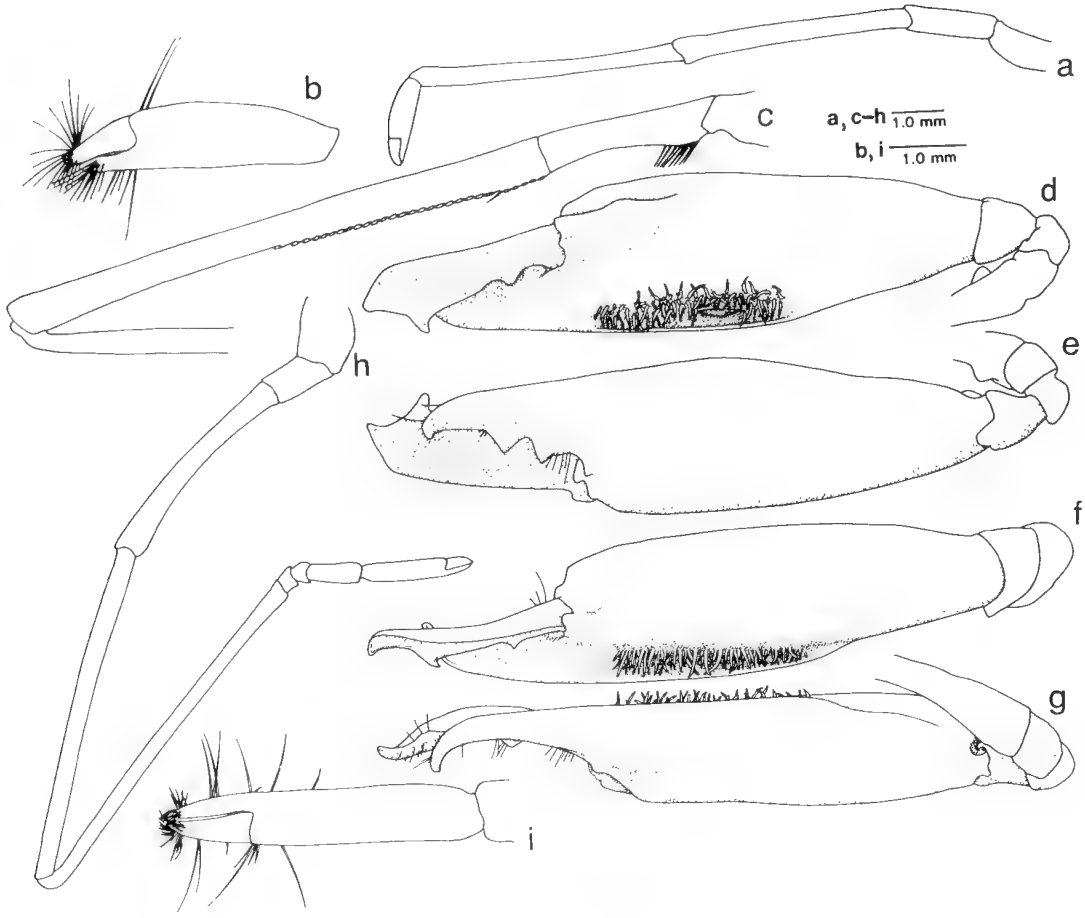

Figure 4. *Leontocaris bulga* sp. nov., holotype. a, pereopod 1. b, same, chela. c, major pereopod 2, ischium and merus. d–g, same chela in lateral, mesial, lower and upper views. h, minor pereopod 2. i, same, chela.

developed with short, simple setae; epipod large, deeply bilobed. Maxilliped 2 with endopod dactylar article short, 3.7 times as long as wide, coxa produced; exopod with slender flagellum; epipod simple with podobranch. Maxilliped 3 slender, falling short of scaphocerite, exceeding antenna 1 peduncle, without exopod or epipod; ishiomerus length 9.6 times proximal width, broadly expanded proximally, slender, subcylindrical distally, penultimate segment subcylindrical, 5.5 times as long as wide, 0.2 of ischial length, distal segment 14.5 times as long as proximal width, tapering distally, 0.5 of ischial length; basis without exopod, with small, well developed arthrobranch.

Pereopods 1 similar, reaching beyond distal margin of antenna 1 peduncle; without epipod or arthrobranch; without exopod; ischium 0.37 of carpal length, 3.50 times as long as distal width, unarmed; merus 0.88 of carpal length, 10.3 times as long as central width, unarmed; carpus 3.0 times chela length, unarmed, 12.7 times as long as distal width; chela 3.6 times as long as deep; dactylus 0.26 of propodus length, with dense arc of short setae distodorsally.

Pereopods 2 grossly unequal, dissimilar. Major (right) chela exceeding antennal peduncle by carpus and chela; ischium 0.31 of merus length, 8.1 times as long as central width, posteromedial margin armed with 9 strong setae; merus 0.73 of proximal carpal length, slightly expanded distally, 16.2 times as long as central width, with distinct flange posteromedially, evidence of the presence of setae along flange although

all but 1 are broken off; carpus long and slender, unarmed, 4-segmented with proximal segment 1.2 times palm length, subcylindrical, moderately expanded distally, 23.3 times as long as central width, most distal segment 1.5 times as long as proximal 2 segments which are subequal, distal segments unarmed; chela with propodus smooth, glabrous, 3.8 times as long as central width; groove on upper lateral face with lens-shaped tympanum and lined with numerous digitate villi; dactylus strongly compressed, laminar, far exceeding fixed finger, 3.5 times as long as central depth, lateral margin straight.

Minor pereopod 2 with distal margin of merus just falling short of proximal article of antenna 1 peduncle; ischium 0.62 of meral length, 11.4 times as long as central width; merus 0.89 of proximal carpal segment length, 18.2 times as long as distal width; carpus 4-segmented, unarmed, distal segment 0.46 of palm length, 2 subdistal segments short, subequal, 0.13 of palm length, proximal segment elongate, 3.4 times length of chela, 20.4 times as long as distal width; chela small, propodus smooth, 5.6 times as long as deep, dactylus 0.26 of palm length, 2.6 times as long as proximal width, small acute hooked tooth distally; fixed finger similar, with small distal tooth.

Ambulatory pereopods moderately slender. Pereopod 3 ischium 0.45 of merus length, armed with one distal spine; merus 1.27 times as long as carpus length, armed with 6 spines; carpus 1.30 times propodus length, 11.0 times as long as distal width, unarmed; propodus 12.0 times as long as central width, unarmed; dactylus curved ventrally, 0.13 of propodus length, 3.4 times as long as basal width, unguis visible. Pereopod 4 broken at distal end of carpus; ischium 0.45 of meral length, armed with 1 distal spine; merus armed with 6 spines. Pereopod 5 ischium unarmed, 0.43 of meral length; merus armed with 4 spines. Pereopod 5 propodus 1.1 times length of propodus of pereopod 3; carpus 0.95 length of carpus of pereopod 3; merus 0.95 length of merus of pereopod 3.

Measurements. Carapace and rostrum, 10 mm; carapace, 4.75 mm; major pereopod 2 chela, 4.40 mm; minor pereopod 2 chela, 0.85 mm.

Colour. No data.

Etymology. Derived from an Australian Aboriginal word for mountain.

Remarks. Although lacking an abdomen, this specimen is described as a new species because of the unequivocal differences it shows from all other species of *Leontocaris*. *Leontocaris bulga* is distinguished from all other species of the genus by the presence of a 2-articulate mandibular palp rather than a simple single palp, a higher number of dorsal rostral teeth (>19 compared to 5–16), and a single epigastric tooth compared with 2–4 in other species.

Leontocaris lar Kemp

Leontocaris lar Kemp, 1906: 299 300.—Kemp, 1910: 113–117, pl. 27 figs 1–17.—Bruce, 1990: 128–129.

Diagnosis. Rostrum exceeding length of carapace and of antenna 1 peduncle. Rostrum and carapace with 12–13 dorsal teeth (including 3 in epigastric region) and 9–13 ventral teeth. Inferior orbital angle acute. Scaphocerite without strong distolateral tooth and 17 marginal teeth. Cornea well developed, broader than stalk. Mandibular palp of 1 article. Major pereopod 2 with fixed finger acute, simple. Pereopod 3 with dactylus about 0.2 of propodus length. Abdominal somite 3 posterodorsally unarmed. Abdominal somite 5 pleuron with 1 posterior tooth. Telson with 5 pairs of marginal dorsal spines; posterior margin broadly rounded, with 3 pairs of spines.

Remarks. This species is recognised by the combination of the following characters: telson with five pairs of marginal dorsal spines, the absence of a posterodorsal tooth on the third abdominal somite, and the absence of a strong distolateral tooth on the scaphocerite. The species is known from 1000–1300 m depth from the northwest Atlantic Ocean off Ireland.

Leontocaris pacificus Zarenkov

Leontocaris pacificus Zarenkov, 1976: 8 18, fig 3.

Diagnosis. Rostrum approximately equal to length of carapace, exceeding antenna 1 peduncle. Rostrum and carapace with 6 dorsal teeth (including 2 in epigastric region) and 12 ventral teeth. Inferior orbital angle acute. Scaphocerite with strong distolateral tooth and 18-19 marginal teeth. Cornea well developed, broader than stalk. Mandibular palp of 1 article. Major pereopod 2 unknown. Pereopod 3 with dactylus about 0.2 of propodus length. Abdominal somite 3 posterodorsally armed. Abdominal somite 5 pleuron with 1 posterior tooth. Telson with 7 pairs of marginal dorsal spines; posterior margin rounded with 1 pair of terminal spines.

Remarks. This species is immediately recognised by the seven pairs of marginal dorsal spines and single pair of terminal spines on the telson. The species is known from a single specimen collected from 680–700 m depth at 31° off central Chile (Zarenkov, 1976).

Leontocaris paulsoni Stebbing

Leontocaris paulsoni Stebbing, 1905: 99–102, pl. 26.—Kemp, 1910: 113–117, pl. 27 figs 1–17.—Bruce, 1990: 128–129.

Diagnosis. Rostrum approximately 1.1 times length of carapace, exceeding antenna 1 peduncle. Rostrum and carapace with 8 dorsal teeth (including 2 in epigastric region) and 6–8 ventral teeth. Inferior orbital angle acute. Scaphocerite with strong distolateral tooth and 19 marginal teeth. Cornea reduced, narrower than stalk. Mandibular palp of 1 article. Major pereopod 2 with fixed finger slender, acute, simple. Pereopod 3 with dactylus about 0.25 of propodus length. Abdominal somite 3 posterodorsally armed. Abdominal somite 5 pleuron with 1 posterior tooth. Telson with 5 pairs of marginal dorsal spines; posterior margin acute, bifid, with 2 pairs of spines.

Remarks. This species is immediately recognised by the acute, bifid posterior margin of the telson and the reduced cornea. The species is known from 240–265 m off South Africa (Barnard, 1950), the shallowest depth of any species in the genus.

Leontocaris yarramundi sp. nov.

Figures 5–7

Material examined. Holotype, Tasmania, 82.8 km SSE of Southeast Cape, "U" seamount (44°19.2'S, 147°07.2'E), 1083–1448 m, trapline, T.N. Stranks et al. on FRV *Southern Surveyor*, 27 Jan 1997 (stn SS01/97/41), NMV J41272 (? male, cl. 10.5 mm)

Paratypes, Tasmania, 82.6 km SSE of Southeast Cape, "J1" seamount (44°14.4'S, 147°21.6'E), 1200–1450 m, 27 Jan 1997 (stn SS01/97/40), NMV J41273 (1 ovig. female, cl. 11.2 mm). 65.1 km SSE of Southeast Cape, "Andys" seamount (44°10.8'S, 146°59.4'E), 900–1100 m, 29 Jan 1997 (stn SS01/97/57), NMV J41274 (1 specimen, cl. 8.0 mm), TM G3951 (2 specimens, cl. 6.2 mm, 7.5 mm). All collected using epibenthic sled by T.N. Stranks et al. on FRV *Southern Surveyor*.

Diagnosis. Rostrum 1.05–1.46 times carapace length, exceeding antenna 1 peduncle. Rostrum and carapace with 9 dorsal teeth (including 4 in epigastric region) and 15–18 ventral teeth. Inferior orbital angle blunt. Scaphocerite with strong distolateral tooth and 17–21 marginal teeth. Cornea well developed, broader than stalk. Mandibular palp of 1 article. Major pereopod 2 with fixed finger short, acute, denticulate. Pereopod 3 with dactylus about 0.22 of propodus length, propodus about 0.76 of carpal length. Abdominal somite 3 posterodorsally unarmed. Abdominal somite 5 pleuron with 3 posterior teeth. Telson with 4 pairs of marginal dorsal spines; posterior margin broadly rounded, with 4 pairs of spines.

Description. Carapace smooth, glabrous, depressed anteriorly; rostrum well developed, inclined dorsally over distal two-thirds, 1.44 times carapace length, exceeding antenna 1 peduncle and scaphocerite, extreme tip missing; rostrum with 9 acute dorsal teeth on carapace and rostrum, 4 occurring in the epigastric region, decreasing slightly in size distally; 16 ventral teeth; supraorbital and hepatic spines absent; inferior orbital angle produced, blunt; antennal spine well developed, submarginal, falling short of inferior orbital angle; anterolateral angle of branchiostegite projecting further forward than inferior orbital angle.

Abdomen smooth; somite 3 without posterodorsal tooth; somite 4 with 1 dorsolateral tooth on the posterior margin; fifth somite with 1 dorsolateral tooth, lateral plate with 2 teeth on posterior margin; fifth somite 0.65 of sixth somite length; sixth somite 2.0 times as long as deep, posterolateral angle acute. Telson 1.7 times sixth somite length, 4.0 times as long as anterior width, 4 pairs of marginal spines at 0.20, 0.44, 0.67 and 0.88 of telson length, posterior margin 0.42 of anterior margin width, with 4 pairs of simple spines, lateral posterior spines about equal in size to the lateral marginal spines, submedian spine 0.07 of telson length, 2.0 times lateral posterior spine length.

Antenna 1 distinctly exceeding rostrum with proximal article of peduncle subcylindrical, slender, 5.4 times as long as distal width, unarmed; stylocerite long, broad; intermediate article 0.42 of proximal article length, unarmed; distal article 0.24 of proximal segment length, unarmed; upper flagellum robust, lower slender.

Antenna 2 scaphocerite well developed, exceeding antennular peduncle, broad, 4.0 times as long as central width, proximal two-fifths of lateral margin straight, entire, distal three-fifths mostly straight, feebly convex at most distal end, with 17 acute marginal teeth, distal lamella broadly rounded, shorter than distolateral tooth. Basicerite unarmed.

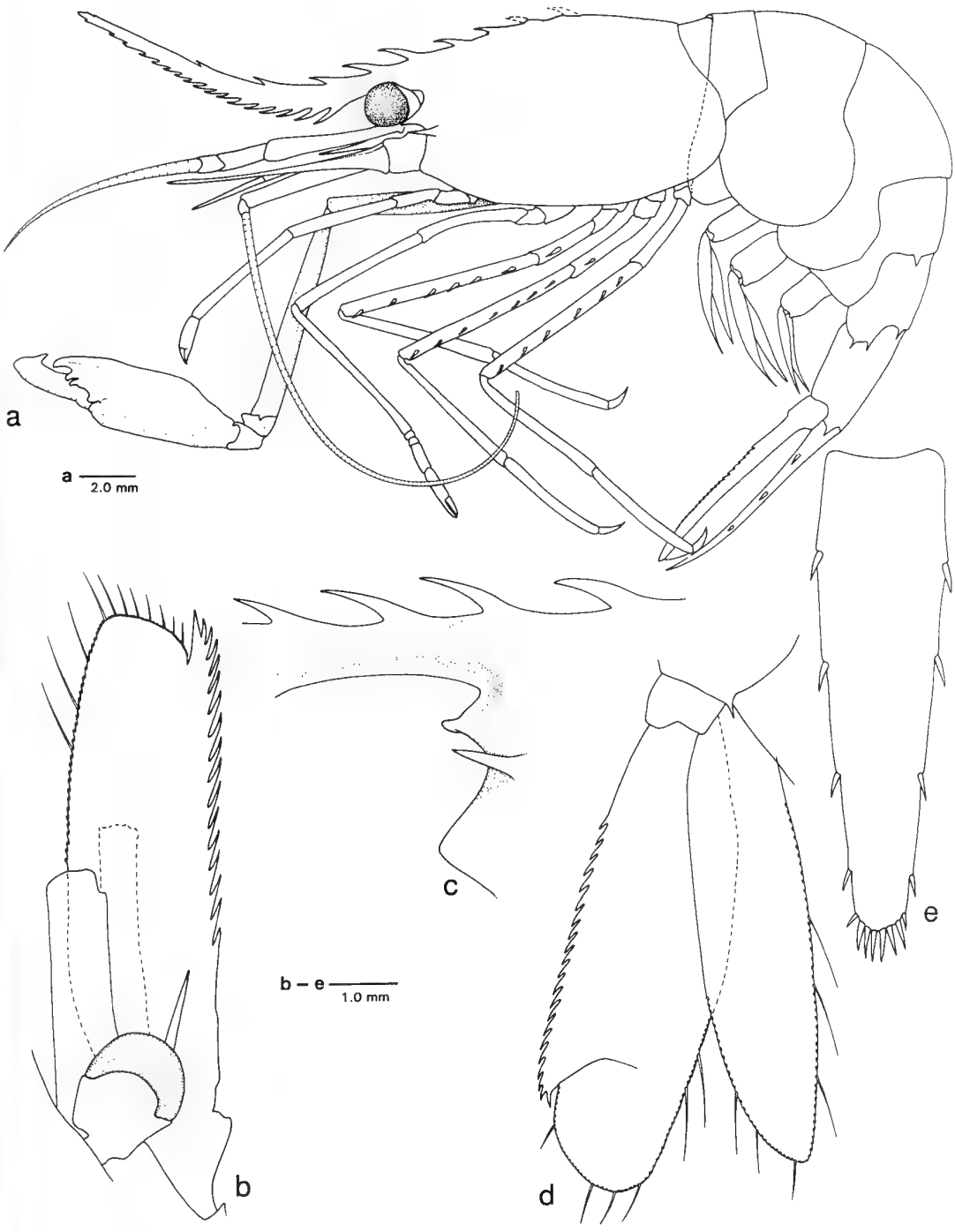

Figure 5. *Leontocaris yarramundi* sp. nov., holotype. a, habitus. b, eye and antenna 1 region, dorsal. c, anterolateral carapace, orbital region. d, uropod. e, telson.

Figure 6. *Leontocaris yarramundi* sp. nov., holotype. a, mandible. b, maxilla 1. c, maxilla 2. d, maxilliped 1 e, maxilliped 2. f, maxilliped 3.

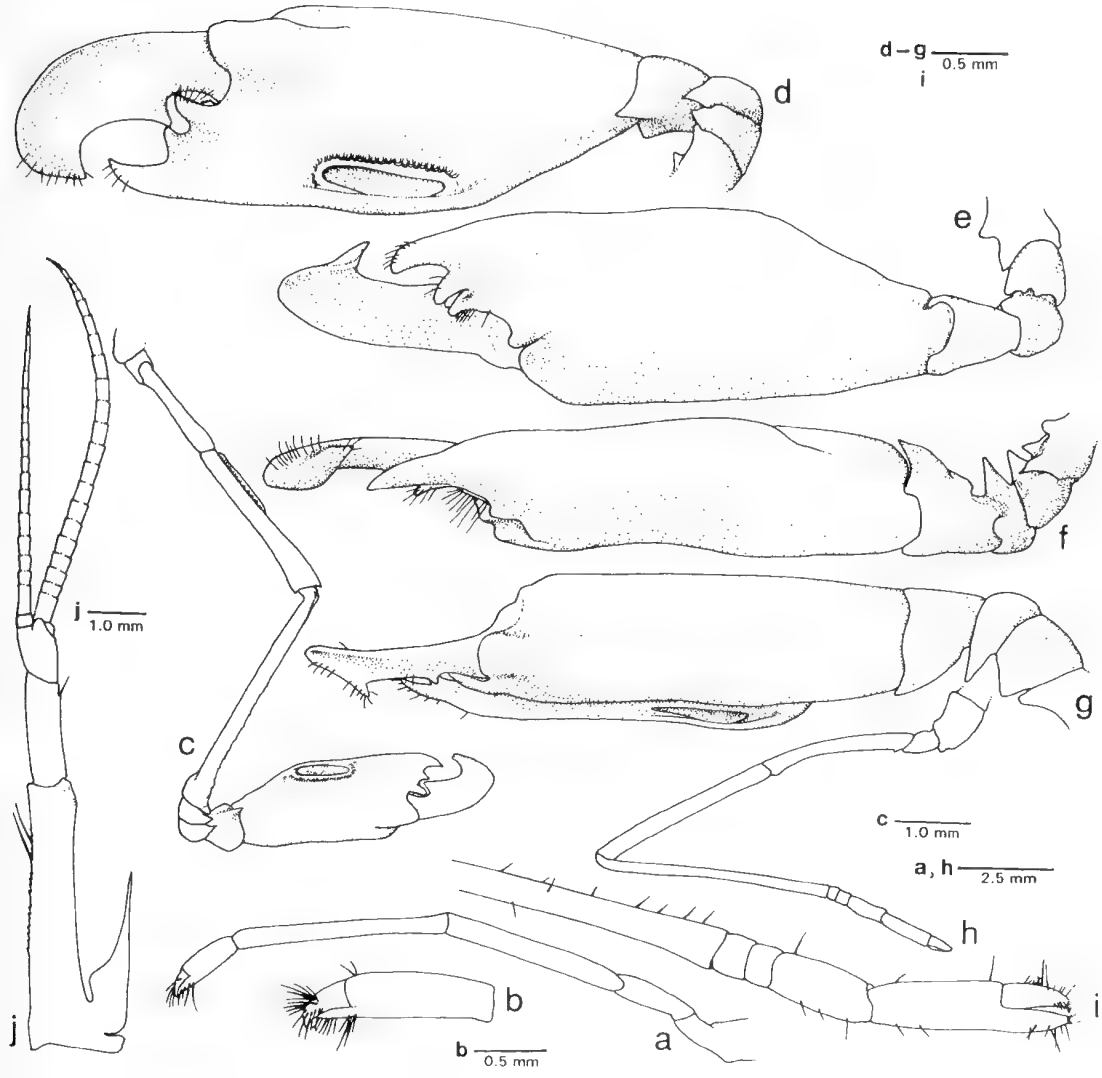

Figure 7. *Leontocaris yarramundi* sp. nov., holotype. a, pereopod 1 b, same, chela. c, major pereopod 2. d–g, same chela in lateral, mesial, lower and upper views. h, minor pereopod 2. i, same, chela. j, antenna 1.

Eye with large globular cornea, diameter 0.14 of carapace length, well pigmented, without ocellus; stalk short, broad.

Mandible with 1-articulate palp, slender, 4.1 times as long as wide, with single simple distal setae; incisor process with 5 acute teeth, medial and lateral teeth larger than central teeth. Maxilla 1 with slender, feebly bilobed palp, upper lobe rounded, with long slender setae, lower lobe angular, with shorter simple seta; upper lacinia broadened centrally, distal border with double row of about 9 short, stout spines and numerous simple setae; lower lacinia slender, tapering distally with numerous long, simple setae. Maxilla 2 with short, slender palp, with 6 long, distal seta, basal endite bilobed, distal lobe broader than proximal, both with numerous simple setae distally, coxal endite simple, short, sparsely setose; scaphognathite 3.0 times as long as broad; posterior lobe broad, anterior lobe broad, as long as wide. Maxilliped 1 with short subcylindrical palp, with several preterminal simple setae; basal

endite rounded, densely setose medially; exopod with large, broad caridean lobe; flagellum well developed with short, simple setae; epipod large, deeply bilobed. Maxilliped 2 with endopod dactylar article short, slender, 2.6 times as long as wide; exopod with slender flagellum; epipod simple with podobranch. Maxilliped 3 slender, falling short of scaphocerite, exceeding antennular peduncle; without exopod or epipod; ischiomerus distinct from basis medially, 6.3 times proximal width, broadly expanded proximally, slender, subcylindrical distally, penultimate segment subcylindrical, 9.0 times as long as wide, 0.3 of ischial length, distal segment 9.4 times as long as proximal width, tapering distally, 0.4 of ischial length; without exopod; with well developed arthrobranch.

Pereopods 1 similar, reaching to distal margin of antenna 1 peduncle; without epipod or arthrobranch; without exopod; ischium 0.44 of carpal length, 3.60 times as long as distal width, unarmed; merus 0.85 of carpal length, 7.8 times as long as central width, unarmed; carpus 2.7 times chela length, unarmed, 11.0 times as long as distal width; chela small, 3.2 times as long as deep; dactylus 0.34 of palm length, with small, acute hooked tip, dense arc of short setae distodorsally.

Pereopods 2 grossly unequal, dissimilar. Major (right) chela exceeding antenna 2 peduncle by distal third of carpus and chela; ischium 0.62 of merus length, 8.0 times as long as central width, unarmed; merus 0.67 of proximal carpal length, slightly expanded distally, 10.6 times as long as central width, unarmed, with distinct flange posteromedially; carpus long and slender, unarmed, 4-segmented, with proximal segment 1.12 times palm length, subcylindrical, moderately expanded distally, 18.8 times as long as central width, most distal segment 2.9 times as long as proximal 2 segments which are subequal, distal segments unarmed; chela with palm smooth, glabrous, 2.6 times as long as central width, groove on upper lateral face with elongate tympanum surrounded by row of digitate villi; dactylus strongly compressed, laminar, far exceeding fixed finger, 3.0 times as long as central depth, lateral margin straight.

Minor pereopod 2 with distal margin of merus extending to about end of proximal article of antenna 1 peduncle; ischium 0.66 of meral length, 10.3 times as long as central width; merus 0.84 of proximal carpal segment length, 10.3 times as long as distal width; carpus 4-segmented, unarmed, distal segment 0.52 of palm length, 2 subdistal segments short, subequal, 0.13 of palm length, proximal segment elongate, 3.10 times length of chela, 14.6 times as long as distal width; chela small, 0.19 of carapace length, palm smooth, 4.20 times as long as deep, dactylus 0.34 of palm length, 3.0 times as long as proximal width, small acute hooked tooth distally; fixed finger similar, with small distal tooth.

Ambulatory pereopods moderately slender. Pereopod 3 ischium 0.32 of merus length, armed with one distal spine; merus 1.25 times as long as carpus length, armed with 6 spines; carpus 1.30 times propodus length, 11.6 times as long as distal width, unarmed; dactylus curved ventrally, 0.22 of propodus length, 3.4 times as long as basal width, unguis visible, 12.0 times as long as central width, unarmed. Pereopods 4 and 5 generally similar, propodus of fifth subequal to propodus of third, propodus of fourth 0.92 of propodus of third; carpus subequal, 0.92 of third propodus length; merus subequal, 0.94 of third carpus length, pereopod 4 and 5 armed with 7 and 6 spines respectively; ischium of pereopod 4 armed with 1 distal spine, pereopod 5 ischium unarmed.

Uropods with protopod unarmed; exopod subequal to posterior margin of telson, 2.9 times as long as wide, lateral margin straight, armed with 21 conspicuous immobile spines; endopod 0.95 of exopod length, 4.4 times as long as wide.

Measurements. Total body length approx. 45 mm, carapace and rostrum, 22.5 mm; carapace, 10.5 mm; major second pereopod, chela, 6.7 mm; minor second pereopod, chela 1.7 mm.

Colour. No data.

Etymology. Derived from an Australian Aboriginal word for deep-water.

Remarks. All of the paratypes examined have 9 dorsal teeth on carapace and rostrum (4 occurring in epigastric region) but differ from the holotype in having 15–18 ventral teeth. The number of teeth on the scaphocerite varies from 17 to 21; the number of spines on the carpus of the ambulatory legs ranges from 6 to 8 for pereopod 3, 6 to 9 for pereopod 4 and 6 to 7 for pereopod 5. The major chela of pereopod 2 occurs on the right side for all but one specimen which has the major chela on the left side. *Leontocaris yarramundi* is distinguished from all other species by the presence of three posterior teeth on the fifth abdominal somite (excepting *L. bulga* where abdomen is unknown). Both *L. paulsoni* and *L. lar* have a single spine and *L. amplectipes* is unarmed. The number of ventral rostral teeth (15–18) exceeds those of *L. amplectipes* (2–4), *L. bulga* (approx. 11), *L. lar* (9–13) and *L. paulsoni* (6–8).

Discussion

The new species of *Leontocaris* increase from four to six the number of known species and point to a radiation in Australia. However, the monophyly of the Australian species remains to be demonstrated. The three species of *Leontocaris* from Australia are similar to each other and differ from the two species from the Atlantic in the following characters: the inferior orbital angle is blunt or rounded rather than acute; at least *L. amplectipes* and *L. yarramundi* have four pairs of marginal dorsal spines on the telson rather than five; the posterior margin of the telson has four pairs of spines rather than two as in *L. paulsoni* or three as in *L. lar*. The three species from Australia differ from *L. pacificus*, the Pacific species, by the absence of a posterodorsal tooth on abdominal somite 3 and the arrangement of spines on the telson.

The six species of *Leontocaris* all occur in deep water. *Leontocaris paulsoni* has been reported from 246 to 265 m (Barnard, 1950); *L. pacificus* is known from 680 to 700 m (Zarenkov, 1976); *L. lar* from 914 m and 1146 m (Kemp, 1910); and *L. amplectipes* from 700 to 1450 m. *L. amplectipes* and the new species were collected from Tasmanian seamounts at 900–1450 m. The seamounts are dominated by coral cover many metres thick and the association of the genus with corals is reinforced.

Acknowledgments

We thank CSIRO Division of Marine Research, Hobart, in particular Tony Koslow and Karen Gowlett-Holmes, for making this collection available to us for study. CSIRO's survey of Tasmanian Seamounts was funded by the Fisheries Research and Development Corporation (grant 95/058) and Environment Australia (Australian Nature Conservation Agency). We thank Kate Thompson who prepared some of the drawings and inked the figures and Elycia Wallis for her translation of Zarenkov's Russian description of *L. pacificus*.

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Memoirs of the Museum of Victoria 57(1): 71–72 (1998)

CORRECTIONS TO THE LIST OF COLLEMBOLA SPECIES RECORDED FROM TOOHEY FOREST, QUEENSLAND

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Greenslade, P. and Rodgers, D., 1998. Corrections to the list of Collembola species recorded from Toohey forest, Queensland. *Memoirs of the Museum of Victoria* 57:71–72.

The names of seven of the species listed by D. Rodgers (1997, *Memoirs of the Museum of Victoria* 56: 287–293) are corrected.

Introduction

Recently Rodgers (1997) published data on the collembolan fauna of a eucalypt woodland site, Toohey Forest, in southeastern Queensland. We now make some corrections to the species names and generic assignments listed in his paper in order to increase its value and to avoid possible future biogeographical errors. In particular, one of the genera recorded in the paper does not occur on mainland Australia, and another three do not occur in southeastern Queensland nor in forested habitats. Consequently it is important to correct these anomalous records in the literature. The list of corrections is given below.

Hypogastruridae

Mesogastrura sp.

Specimens recorded as *Mesogastrura* sp. are now identified as *Xenylla thibaudi thibaudi* Massoud, 1965. This species has been recorded from rainforest and grassy forested sites in southeast Queensland (Gama and Greenslade, 1981). A single record of an introduced species of *Mesogastrura*, *M. lybica* (Caroli, 1914), is currently the only known occurrence of this genus in Australia. It was found in the Jenolan Caves, New South Wales (P. Greenslade, unpublished record).

Neanuridae

Cephalachorutes sp.

Cephalachorutes sp. (not *Cephalochorutes* as in Rodgers, 1997), is a new genus record for Australia. This genus was recently described from Thailand (Bedos and Deharveng, 1991) and several undescribed species are known from eucalypt forest leaf litter in southern Australia (P. Greenslade, unpublished data).

Isotomidae

Isotomiella prussianae Deharveng and Oliveira, 1990 (not Olivera as in Rodgers, 1997). Parentheses around the authors' names as in Rodgers (1997) are not required.

Entomobryidae

Homidia sp.

Specimens recorded as *Homidia* sp. are now identified as belonging to the genus *Entomobrya*. Species of *Entomobrya* are known to be common in southeastern Queensland. Presently the genus *Homidia* is known to occur only in South-East Asia, Hawaii and possibly also North America. *Homidia cingula* Börner, 1906 which was described from Java, has been found on Christmas I., Indian Ocean (P. Greenslade, unpublished record) but has never been recorded from the Australian mainland.

Willowsia sp.

Specimens recorded as *Willowsia* sp. are now identified as *Acanthocyrtus lineatus* Womersley, 1934. Until now this species was only known from the type collection labelled as from "decaying leaves, Brisbane" (Womersley, 1934). Two syntypes exist in the South Australian Museum collection (Greenslade, 1994). This species was the only one of 25 listed by Rodgers which showed a statistically significant association with a single plant species, *Themeda triandra*. *Acanthocyrtus* species are generally associated with woody plants and fallen timber in the warmer parts of Australia. *Acanthocyrtus lineatus* has appendages and a body that are unusually elongated for the genus.

Sminthuridae

Jeannenotia sp.

The eight specimens recorded as *Jeannenotia* sp. can not now be located. Only one species in the genus, *J. stachi* (Jeannenot, 1955), is known in this genus in Australia (Greenslade, 1994). It was probably introduced from Europe and is restricted to crop-lands and improved pastures (Ireson, 1993). It is likely that the misidentified specimens belonged to one of the following genera, *Sphaeridia, Sminthurinus* or *Sminthurides*, because these genera have a superficial similarity to *Jeannenotia* and would be expected to occur in Toohey Forest.

Sminthurus sp.

Specimens recorded as *Sminthurus* sp. are now identified as belonging to the genus *Sminthurinus*. Only one species of *Sminthurus, S. viridis* (Linnaeus, 1758), is currently known from Australia. It is restricted to southern, nonarid regions being found on crop-plants and on exotic grasses in improved pastures and elsewhere (Ireson, 1993). The genus *Sminthurinus* is represented by numerous native and some introduced species in the more humid regions of Australia.

Toohey Forest, which was the subject of Rodgers' original paper, is a remnant patch of woodland isolated in an urban environment. It has never been cultivated and weed invasion is minimal. For these reasons it has already been identified as of high conservation significance through its listing as part of the National Estate. An extensive survey of its collembolan fauna will be carried out in the future in order to document its composition more completely and to detect rare and potentially endangered species.

Acknowlegements

We would like to thank B. Halliday, L. Mound and D. Rentz for suggesting improvements to the text.

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NEW SPECIES AND A NEW RECORD OF *ECNOMUS* MCLACHLAN (TRICHOPTERA: ECNOMIDAE) FROM PAPUA NEW GUINEA AND IRIAN JAYA

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Abstract

Cartwright, D.I., 1998. New species and a new record of *Ecnomus* McLachlan (Trichoptera: Ecnomidae) from Papua New Guinea and Irian Jaya. *Memoirs of the Museum of Victoria* 57: 73–87.

Descriptions, keys and a checklist are provided for males of twenty-one species of *Ecnomus* including seventeen new species from Papua New Guinea and Irian Jaya. The northern Australian species *Ecnomus larakia* Cartwright, 1990 is recorded from Papua New Guinea for the first time.

Introduction

Three species of *Ecnomus* have been described previously from Papua New Guinea (PNG) and Irian Jaya (*E. cyclopicus* Kimmins, 1962; *E. addi* Malicky, 1993; *E. papuanus* Ulmer, 1938). E. cyclopicus and *E. papuanus* are here redrawn from the original figures. No type or new material of these two species has been seen. Kumanski (1979) recorded two male specimens from PNG, which he identified as *E. cyclopicus* Kimmins.

Most of the material available for study was collected during the 1960s and deposited as dried pinned specimens in the B. P. Bishop Museum, Honolulu, Hawaii (BPBM).

A total of 67 males were examined during this study, which were placed in 18 species of which 17 were new to science. Almost half the specimens are referred to two species (*Ecnomus skruim* sp. nov. and *E. milnensis* sp. nov.), the remaining 37 specimens representing 16 species.

The Papua New Guinea- Irian Jaya total of 21 species compares with the Australian total of 40 species (Cartwright, 1990) and western Indonesian total also of 21 species (Cartwright, 1994).

The objectives of this study were to provide a key and descriptions for the males of *Ecnomus* species from Papua New Guinea and Irian Jaya.

Both males and females of *Ecnomus* species are best identified by differences in genitalia, which usually requires clearing the abdomen in potassium hydroxide. Males and females can seldom be associated positively unless collected in copula or bred through from larvae. Females have not been described in this paper because of the problem of positive association, which is increased when more than one species is collected from a site.

Depositories for specimens are abbreviated as follows: The Natural History Museum, London (BMNH); B. P. Bishop Museum, Honolulu, Hawaii (BPBM); National Natural History Museum, Sofia, Hungary (NHMS); Museum of Victoria, Melbourne (NMV); National Museum of Natural History, Lieden (RMNH); Zoölogisch Museum, Universiteit van Amsterdam (ZMA); Zoologisches Museum, University of Copenhagen, Copenhagen (ZMUC).

Figured specimens are identified by the author's notebook number, prefix CT-; occasional PT- numbers refer to the notebook used by Dr A. Neboiss (NMV). Abbreviations for genitalic parts are as shown in Figs 1 and 2.

Ecnomus McLachlan

Ecnomus McLachlan, 1864: 30.—Cartwright, 1994: 447.

Type species. Philopotamus tenellus Rambur, 1842 (by original designation).

Remarks. A revised diagnosis was provided by Cartwright (1994).

Key to males of Papua New Guinean and Irian Jayan species of *Ecnomus*

1. Superior appendages with large process present on ventral margin (Fig. 1)..... ..... *E. spia* sp. nov.
— Superior appendages without large process on ventral margin (Figs 3, 5).....2
2(1). Basal plate of inferior appendages with a pointed dorsal lobe (Figs 3, 5).....3
— Basal plate of inferior appendages without a pointed dorsal lobe (Figs 7, 9)..4

3(2). Inferior appendages in ventral view dilated, with strongly bifid apices (Fig. 4)..... *E. masalai* sp. nov.
Inferior appendages in ventral view with weakly bifid apices (Fig. 6)..... *E. cyclopicus* Kimmins

4(2). Superior appendages in lateral view with apical finger-like projection (Fig. 7)..... *E. digitulus* sp. nov.
Superior appendages in lateral view without apical finger-like projection (Fig. 9)..... 5

5(4). Superior appendages in lateral view short and broadbased, length about 2 × width (Fig. 9)..... *E. larakia* Cartwright
– Superior appendages in lateral view long and robust, length > 2.5 × width (Figs 11, 13)..... 6

6(5). Inferior appendages in lateral view deeply incised (Figs 11, 13, 15)..... 7
— Inferior appendages in lateral view not deeply incised (Figs 17, 19)..... 9

7(6). Superior appendages very long and slender, length > 6 × width (Fig. 11).... *E. addi* Malicky
— Superior appendages more robust, length < 5 × width (Figs 13, 15)..... 8

8(7). Inferior appendages in ventral with dorsomesal process (Fig. 14)..... *E. oriomo* sp nov.
— Inferior appendages in ventral without process (Fig. 16).... *E. cavatus* sp. nov.

9(6). Inferior appendages in ventral view with mesal digitiform process (Fig. 18), in lateral view with greatly enlarged basal segment of inferior appendages (Fig. 17)..... *E. illugi* sp. nov.
— Inferior appendages in ventral view without process (Fig. 20), basal segment of inferior appendages not enlarged (Fig. 19)..... 10

10(9). Parameres branched (Fig. 19)..... *E. skruim* sp. nov.
Parameres not branched (Figs 21, 23, 41)..... 11

11(10). Superior appendages in lateral view dilated strongly apically (Figs 21, 23)..... 12
Superior appendages in lateral view not obviously dilated or weakly dilated apically (Figs 25, 27)..... 13

12(11). Inferior appendages in ventral view slender and fairly straight (Fig. 22)..... *E. masong* sp. nov.
— Inferior appendages in ventral view robust and strongly bent (Fig. 24)..... *E. tamiok* sp. nov.

13(11). Parameres in lateral view downturned apically (Figs 25, 27)..... 14
Parameres in lateral view not downturned apically (Figs 35, 37, 41)..... 18

14(13). Inferior appendages in ventral view, tapered in apical half (Figs 26, 28)..... 15
Inferior appendages in ventral view, not tapered in apical half (Figs 30, 32)..... 16

15(14). Superior appendages with a swelling on dorsobasal margin (Fig. 25)..... *E. bullatus* sp. nov.
Superior appendages without a swelling on dorsobasal margin (Fig. 27)..... *E. aliceae* sp. nov.

16(14). Inferior appendages in ventral view, tapered strongly to narrow rounded apices (Fig. 30)..... *E. laensis* sp. nov.
Inferior appendages in ventral view, not tapered strongly, with short pointed apices (Figs 32, 34)..... 17

17(16). Inferior appendages in lateral view, tapered in apical half, with pointed apices (Fig. 31)..... *E. ulap* sp. nov.
Inferior appendages in lateral view, not tapered in apical half, with rounded apices (Fig. 33)..... *E. wamena* sp. nov.

18(13). Superior appendages in lateral view with a small mesally directed digitiform projection on ventrobasal margin (Fig. 35)..... *E. milnensis* sp. nov.
Superior appendages in lateral view without digitiform projection (Fig. 37)..... 19

19(18). Superior appendages very long and slender, length > 6 × width (Fig. 37).... ..... *E. dadi* sp. nov.
— Superior appendages more robust, length < 5 × width (Figs 39, 41).....20
20(19). Superior appendages tapered slightly distally, parameres simple and slender (Fig. 39)..... *E. iomari* sp. nov.
— Superior appendages not tapered distally, parameres complex (Fig. 41)..... ..... *E. papuanus* Ulmer

Ecnomus spia sp. nov.

Figures 1, 2

Type material. Holotype male, Papua New Guinea, Mamai Plantation, E of Port Glasgow, 150 m, light trap, 27 Feb 1965, R. Straatman (genitalia prep. CT-142 figured, BP-8324, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 reduced to inconspicuous rounded swellings each with 3 small setae apically. Superior appendages in lateral view long with a large ventrally directed, digitiform process mesally on ventral margin (Fig. 1), in ventral view with a field of mesally directed spiny setae apically; inferior appendages in ventral and lateral views with a subapical dorsally directed digitiform projection (Figs 1, 2); parameres straight and robust in lateral view; phallus acute apically (Fig. 1).

Female unknown.

Length of forewing: male 3.4 mm.

Etymology. Papua New Guinean word for spear, referring to the projection on the superior appendages, noun in apposition.

Distribution. Southeast Papua New Guinea (known only from type locality).

Remarks. The single male specimen is very distinctive and distinguished readily from all other known *Ecnomus* species by the very large process on each superior appendage.

Ecnomus masalai sp. nov.

Figures 3, 4

Type material. Holotype male, Papua New Guinea,Wau, 1150–1300 m, Malaise trap, 29 Dec 1965, J. Sedlacek (genitalia prep. CT-148, BP-8324, BPBM).

Paratypes: 1 male, Papua New Guinea, Kassam, 48 km E Kainantu, 1350 m, 7 Nov 1959, T.C. Maa (genitalia prep. PT-1608, BPBM); 1 male, Papua New Guinea, Morobe District, Mt Missim, 1300 m, 7°13'S, 146°20'E, 15-21 Dec 1966, G.A. Samuelson (genitalia prep. CT-122, BPBM); 1 male, Papua New Guinea, Wau, Morobe District, 1200 m, Malaise trap, 26 Oct 1961, J. Sedlacek (genitalia prep. CT-147, BPBM); 1 male, Papua New Guinea, Umboi Island, 1 km N Awelkom, 600 m, light trap, 21 -28 Feb 1967, G.A. Samuelson (genitalia prep. PT-1281 figured, BPBM).

Description. Male. Wings fawn, venation characteristic of genus. Ventrolateral processes of segment 10 short, broad based, with 3 short setae apically. Superior appendages in lateral view long, length about 5 × width (Fig. 3), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view, length about 2.5 × width, apices dilated, shallowly bifid (Fig. 4), in lateral view robust, length about 2 × width; basal plate of the inferior appendages with a large pointed dorsal lobe; parameres in lateral view robust, dilated and slightly down turned apically; phallus with apex extended into a short projection (Fig. 3).

Female unknown.

Length of forewing: male 4.4–5.7 mm.

Etymology. Papua New Guinean word for spirit of the waterways, noun in apposition.

Distribution. Northeast Papua New Guinea.

Remarks. Ecnomus masalai groups with *E. cyclopicus* Kimmins on the basis of the pointed dorsal lobe on the basal plate of the inferior appendages, and can be distinguished by the dilated, bifid apices on the inferior appendages, which are similar in appearance to the Australian species *E. turrbal* Cartwright.

Ecnomus cyclopicus Kimmins

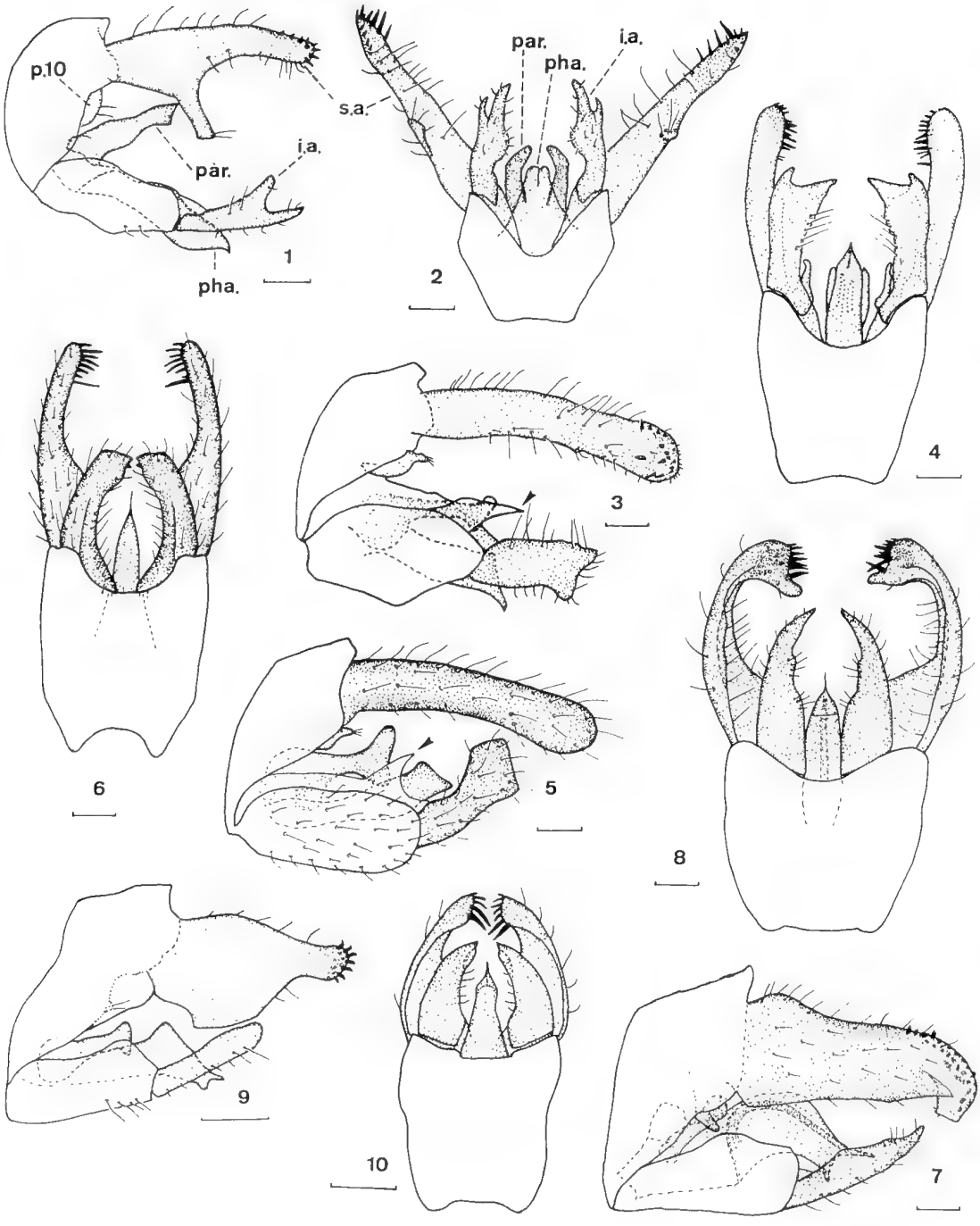
Figures 5, 6

Ecnomus cyclopicus Kimmins, 1962: 134, figs 35A–C.

Type material. Holotype male, Irian Jaya (Indonesia), Mt Cyclops, 3500 ft, Mar 1936, L.E. Cheesman (BMNH).

Paratype male, Irian Jaya (Indonesia), Cyclops Mts, Sabron, camp 2, 2000 ft, Jul 1936, (L.E. Cheesman) (BMNH). Types not seen, although Dr P. Barnard of the BMNH states that my reproduction of Kimmins lateral view drawing matches the holotype specimen prepared on a slide .

Other material. 2 males, Papua New Guinea, Telefomin, West Sepic Province, c. 1600 m, 25 Jul?–3 Aug 1975, P. Beron and/or P. Chapman (NHMS). Material not seen.



Figures 1–10. *Ecnomus* spp. Male genitalia in lateral and ventral views. 1, 2: *E. spia* sp. nov. 3, 4: *E. masalai* sp. nov. 5, 6: *E. cyclopicus* Kimmins (copied from Kimmins, 1962, Figs 35A–C). 7, 8: *E. digitulus* sp. nov. 9, 10: *E. larakia* Cartwright.

Abbreviations: i.a., inferior appendages; par, parameres; pha, phallus; p10, ventrolateral processes of segment 10; s.a., superior appendages. All scale lines 0.1 mm.

Description (revised after Kimmins, 1962). Male. Wings, forewing with sparse golden pubescence, brownish membrane with hyaline spots. Ventrolateral processes of segment 10 short, digitate, with several small setae apically. Superior appendages in lateral view long, length about 4 × width (Fig. 5), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view, robust, slightly incurved (Fig. 6), weakly bifid in dorsal view (Kimmins, 1962, Fig. 35B), in lateral view robust, narrowed slightly in middle, apices slightly dilated and truncated; basal plate of the inferior appendages with a large pointed dorsal lobe; parameres in lateral view robust, dilated and down turned apically; phallus slightly dilated subapically with acute apex (Fig. 5).

Female unknown.

Length of forewing: male 5 mm.

Distribution. Irian Jaya (Indonesia) and western Papua New Guinea.

Remarks. Ecnomus cyclopicus groups with *E. masalai* on the basis of having a pointed dorsal lobe on the basal plate of the inferior appendages The two species can be separated by the form of the inferior appendages, which are truncated and weakly bifid apically in *E. cyclopicus*. Kimmins (1962) figures are reproduced to allow direct comparisons and to accompany the description that is revised in light of new interpretations of *Ecnomus* genitalic structures.

Ecnomus digitulus sp. nov.

Figures 7, 8

Type material. Holotype male, Papua New Guinea, Muller Plateau (Duna Sands, Atem Karanda?), 5 Aug 1978, G.S. (genitalia prep. CT-260 figured, RMNH).

Description. Male. Wings pale fawn, venation characteristic of genus. Ventrolateral processes of segment 10 short. Superior appendages in lateral view long, broad-based, length about 2 × width, constricted and down turned subapically, with a finger-like projection apically (Figs 7, 8), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view, length about 3 × width, tapered to pointed apices (Fig. 8); in lateral view, length about 4 × width, tapered to pointed apices; parameres in lateral view short, straight, dilated apically; phallus robust, with ventral subapical projection, acute apex and embedded slender, elongated, down turned process (Fig. 7).

Female unknown.

Length of forewing: male 6.6 mm.

Etymology. Latin, a little finger, referring to the projection on the superior appendages.

Distribution. Central-west Papua New Guinea.

Remarks. Ecnomus digitulus can be separated from all other *Ecnomus* species by the distinctive apices on the superior appendages which are downturned, constricted and have a finger-like projection. The phallus has an unusual embedded process.

Ecnomus larakia Cartwright

Figures 9, 10

Ecnomus larakia Cartwright, 1990: 25, figs 77–78.

Type material. Holotype male, Australia, Northern Territory, Howard Springs, 9 Sep 1980, D. King (NMV).

Other material. 1 male, Papua New Guinea, Morobe Province, Wau Ecology Institute, 24 May 1986, A. Wells (genitalia prep. CT-242 figured, NMV).

Description. (revised after Cartwright, 1990). Male. Wings pale fawn, venation characteristic of genus. Ventrolateral processes of segment 10 very short, with 3 small setae apically. Superior appendages in lateral view short, broad based, tapered strongly distally, length about 2 × width (Fig. 9), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view, length about 3 × width, slightly constricted medially, dilated subapically, tapered to pointed apices (Fig. 10), in lateral view robust, straight, apices rounded; parameres in lateral view robust, dilated and down turned slightly apically; phallus slightly dilated subapically with acute apex (Fig. 9).

Female unknown.

Length of forewing: male 2.9–3.5 mm.

Distribution. Northern Australia and northeast Papua New Guinea.

Remarks. Ecnomus larakia can be distinguished from all other PNG and Irian Jaya species by the short and broad-based superior appendages.

Ecnomus addi Malicky

Figures 11, 12

Ecnomus addi Malicky, 1993: 1120, pl 8, 3 figs.

Type material. Holotype male, Papua New Guinea, Bismarck Island, date unknown, Noona Dan Expedition, (ZMK).

Paratypes. 8 males, 3 females, same data as holotype (ZMK). One male paratype seen and figured (now lodged in the NMV).

Description. (revised after Malicky, 1993). Male. Wings fawn. Ventrolateral processes of segment 10 long, broad based, with 3 small setae apically. Superior appendages in lateral view very long, slender, length about 6 × width (Fig. 11), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view, length about 3 × width, tapered to inflexed, pointed apices (Fig. 12), in lateral view robust, incised in distal half, apices upturned and pointed; parameres in lateral view robust, straight; phallus slightly dilated subapically with acute apex (Fig. 11).

Female known (but not described by Malicky, 1993).

Length of forewing: male 4 mm, female 5 mm.

Distribution. Northeast Papua New Guinea (type locality only).

Remarks. Ecnomus addi can be distinguished from all other PNG and Irian Jaya species by the very long and slender superior appendages combined with the incised inferior appendages, in lateral view. Malicky's (1993) figures are redrawn to allow direct comparisons and to accompany the description that is revised in light of new interpretations of *Ecnomus* genitalic structures.

Ecnomus oriomo sp. nov.

Figures 13, 14

Type material. Holotype male, Papua New Guinea, Western District, Oriomo River, 3 m, 8°50'S, 143°11'E, light trap, 4 Aug 1964, H. Clissold (genitalia prep. CT-121 figured, BP-8324, BPBM).

Paratype male, same data as holotype, 1 Aug 1964 (genitalia prep. CT-131, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 short, broad based, with 3 small setae apically. Superior appendages in lateral view long, length about 4 × width (Fig. 13), in ventral view with field of mesally directed spiny setae apically; inferior appendages robust, length about 2.5 × width, with small truncate, dorsomesal projection near middle, incised distally, tapered to pointed apices (Figs 13, 14); parameres in lateral view slender, down turned apically; phallus slightly dilated subapically with acute apex (Fig. 13).

Female unknown.

Length of forewing: male 3.8 mm.

Etymology. Named after type locality (Oriomo River), noun in apposition.

Distribution. Southeast Papua New Guinea.

Remarks. Ecnomus oriomo groups with *E. addi* and *E. cavatus* sp. nov. on the basis of the incised form of the inferior appendages, but can be distinguished by the small, truncate dorsomesal projection on the inferior appendages and the slender, downturned parameres.

Ecnomus cavatus sp. nov.

Figures 15, 16

Type material. Holotype male, Papua New Guinea, Wau, Morobe District, 1050 m, Malaise trap, 4 Nov 1961, J. Sedlacek (genitalia prep. CT-149 figured, BP-8324, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, with 3 small setae apically. Superior appendages in lateral view long, length about 3.5 × width, tapered slightly distally (Fig.15), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view robust, length about 2.5 × width, tapered to pointed apices (Fig. 16), in lateral view incised sub-apically with upturned apices; parameres in lateral view robust, dilated and down turned apically; phallus with acute apex extended into a short projection (Fig. 15).

Female unknown.

Length of forewing: male 5.2 mm.

Etymology. Latin, hollowed out, referring to appearance of inferior appendages.

Distribution. Northeast Papua New Guinea (type locality only).

Remarks. Ecnomus cavatus groups with *E. addi* and *E. oriomo* on the basis of incised inferior appendages, but can be distinguished by the absence of a mesal projection on the inferior appendages and the robust, downturned parameres.

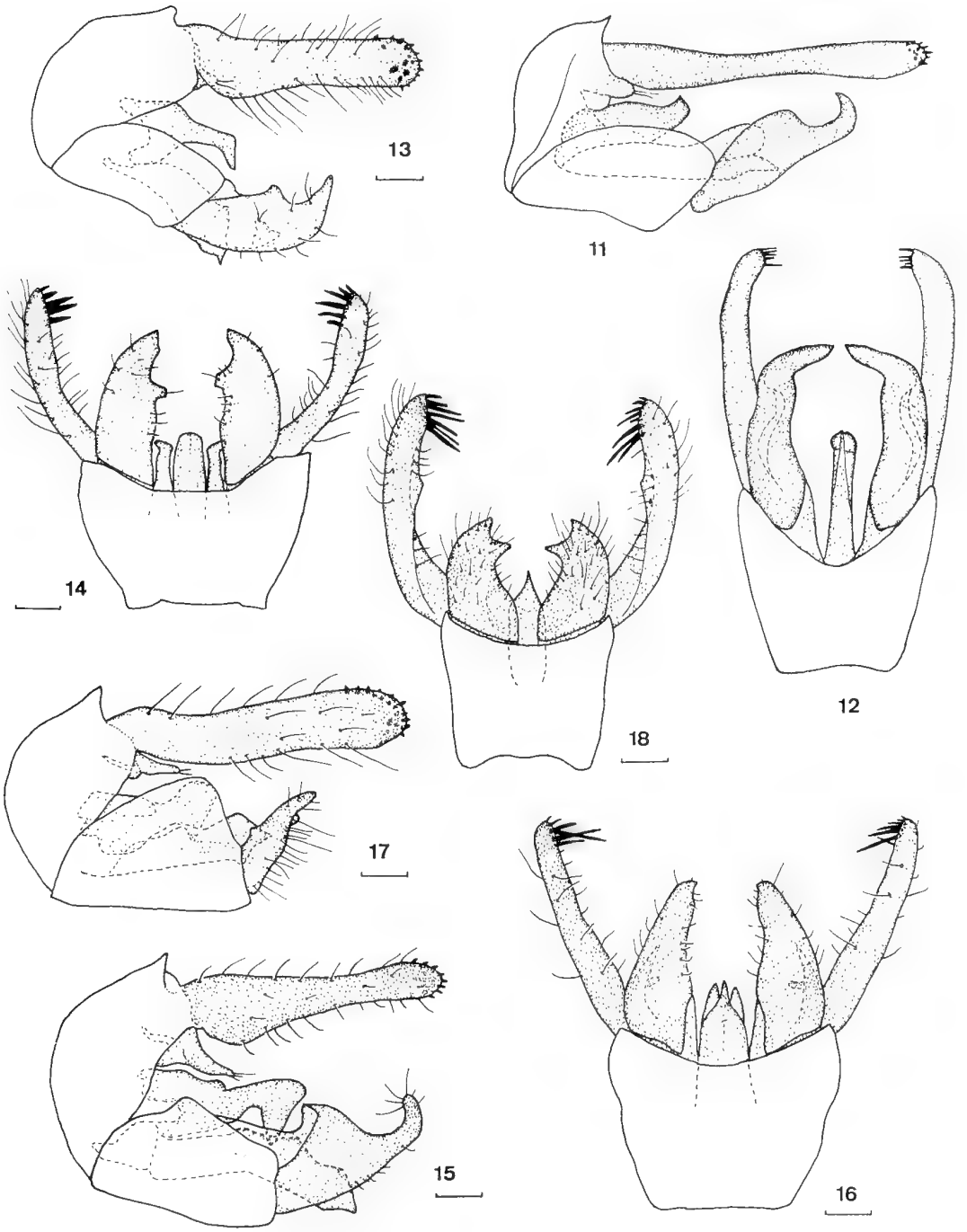
Ecnomus illugi sp. nov.

Figures 17, 18

Type material. Holotype male, Papua New Guinea, New Britain, Gazelle Peninsula, Upper Warangoi, Illugi, 220 m, Malaise trap, 15 Dec 1962, J. Sedlacek (genitalia prep. CT-132 figured, BP-8324, BPBM).

Paratype male, same data as holotype (genitalia prep. CT-136, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, with 3 small setae apically. Superior appendages in lateral view long, length about 5 × width (Fig. 17), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view



Figures 11–18. *Ecnomus* spp. Male genitalia in lateral and ventral views. 11, 12: *E. addi* Malicky (reproduced from Malicky, 1993, pl. 8, 3 figs). 13, 14: *E. oriomo* sp. nov. 15, 16: *E. cavatus* sp. nov. 17, 18: *E. illugi* sp. nov. All scale lines 0.1 mm.

robust, length about 1.5 × width, with mesal digitiform projection subapically, tapered to pointed apices (Fig. 18), in lateral view slender, tapered slightly to pointed apices, basal section of inferior appendages greatly enlarged, concealing parameres and phallus; parameres in lateral view robust, dilated and down turned apically; phallus with acute apex extended into a short projection (Fig. 17).

Female unknown.

Length of forewing: male 4.4 mm.

Etymology. Named after type locality (Illugi), noun in apposition.

Distribution. Northeast Papua New Guinea (type locality only).

Remarks. Ecnomus illugi separates from other PNG species on the basis of the distinctive, greatly enlarged basal section of inferior appendages, and digitiform mesal projection on the inferior appendages.

Ecnomus skruim sp. nov.

Figures 19, 20

Type material. Holotype male, Papua New Guinea, Mamai Plantation, E of Glasgow, 150 m, light trap, 27 Feb 1965, R. Straatman (genitalia prep. CT-153 figured, BP-8324, BPBM).

Paratypes: 7 males, same data as holotype (genitalia preps. CT-155, 156, 165-169, BPBM); 2 males, same data as holotype, 30 Jan 1965 (genitalia preps. CT-143, 144, BPBM); 2 males, Papua New Guinea, Lae, Singuawa River, 6°45'S, 147°10'E, 80 m, light trap, 13 Apr 1966, O.R. Wilkes (genitalia preps. CT-123, 173, BPBM); 1 male, Papua New Guinea, Wau, Morobe District, 1050 m, 11 Nov 1961, J. Sedlacek (genitalia prep. PT-1441, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, broad based, bilobed, with 3 small setae apically. Superior appendages in lateral view robust, length about 3.5 × width (Fig.19), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view robust, length about 3 × width, incised subapically, tapered to rounded apices (Fig. 20), in lateral view robust, straight, length about 2.5 × width; parameres in lateral view branched, with dorsal branch long and slender, down curved apically, ventral branch shorter, slightly down turned apically; phallus with acute apex extended into a short projection (Fig. 19).

Female unknown.

Length of forewing: male 3.2–4.2 mm.

Etymology. Papua New Guinean word meaning to join (arms), referring to the forked parameres.

Distribution. Northeast and southeast Papua New Guinea.

Remarks. Ecnomus skruim is separated from other PNG species on basis of the distinctive, branched parameres. Similar branched parameres also occur in the Sulawesi (Indonesian) species *E. seluk* Cartwright, *E. tipis* Cartwright and *E. tang* Cartwright.

Ecnomus masong sp. nov.

Figures 21, 22

Type material. Holotype male, Papua New Guinea, Umboi Island, about 8 km WNW Lab Lab, 300 m, Malaise trap, 8 19 Feb 1967, G.A. Samuelson (genitalia prep. CT-172 figured, BP-8324, BPBM).

Paratypes: 1 male, similar data to holotype, 600 m, light trap, 21-28 Feb 1967 (genitalia prep. CT-137, BPBM); 2 males, Papua New Guinea, New Britain, Gazelle Peninsula, Upper Warangoi, Illugi, 220 m, Malaise trap, 15 Dec 1962, J. Sedlacek (genitalia preps. CT-135, PT-1439, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, broad based, with 3 small setae apically. Superior appendages in lateral view long, length about 3.5 × width , narrowed over middle section, dilated subapically (Fig. 21), in ventral view with field of mesally directed spiny setae apically; inferior appendages long and slender, length about 5 × width, tapered slightly apically (Figs 21, 22), basal section of inferior appendages with dense group of long hairs near mid-dorsal margin; parameres in lateral view robust, dilated and slightly down turned subapically; phallus with acute apex extended into a long projection (Fig. 21).

Female unknown.

Length of forewing: male 3.3–3.6 mm.

Etymology. Papua New Guinean word for fine hairs, referring to dense group of long hairs on basal section of inferior appendages.

Distribution. Northeast Papua New Guinea.

Remarks. Ecnomus masong separates from other PNG species on basis of the distinctive group of long hairs on basal section of inferior appendages and long slender inferior appendages. I have not noted this group of hairs on any other *Ecnomus* species from Indonesia, PNG or Australia.

Ecnomus tamiok sp. nov.

Figures 23, 24

Type material. Holotype male, Papua New Guinea, Morobe District, Ulap, 800–1100 m, Sep 1968, W.A. Steffan and Y.M.Huang (genitalia prep. CT-124 figured, BP-8324, BPBM).

Paratypes: 1 male, same data as holotype (genitalia preps. CT-127, BPBM); 1 male, Papua New Guinea, 14.4 km W Lae, 28-30 Oct 1965, W.A. Steffan and Y.M.Huang (genitalia prep. CT-139, BPBM); 1 male, Papua New Guinea, Madang, 5°16'S, 145°45'E, 24 May 1990, W.F. Humphreys (genitalia prep. CT-261, RMNH).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, broad based, with 3 small setae apically. Superior appendages in lateral view long, dilated strongly apically, length about 2.5 × maximum width (Fig. 23), in ventral view with field of mesally directed spiny setae apically; inferior appendages relatively hairy, in ventral view robust, length about 2 × width, strongly inflexed at about the middle, tapered to pointed apices (Fig. 24), in lateral view tapered distally, length about 2 × width; parameres in lateral view robust, dilated slightly and down curved apically; phallus with acute apex extended into a short projection (Fig. 23).

Female unknown.

Length of forewing: male 3.0–3.4 mm.

Etymology. Papua New Guinean word for axe, referring to shape of superior appendages.

Distribution. Northeast Papua New Guinea.

Remarks. Ecnomus tamiok separates from other PNG species on basis of the distinctive dilated apices on the superior appendages and the strongly inflexed inferior appendages.

Ecnomus bullatus sp. nov.

Figures 25, 26

Type material. Holotype male, Papua New Guinea, Mamai Plantation, E of Port Glasgow, 150 m, light trap, 27 Feb 1965, R. Straatman (genitalia prep. CT-154 figured, BP-8324, BPBM).

Paratypes: 1 male, same data as holotype, 27 Jan 1965 (genitalia prep. CT-152, BPBM); 1 male, same data as holotype, 30 Jan 1965 (genitalia prep. CT-141, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, with 3 small setae apically. Superior appendages in lateral view long, length about 4 × width, with a swelling on dorsobasal margin (Fig. 25), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view short, length about 3 × width, broad based, narrowed at about the middle, tapered to pointed apices (Fig. 26), in lateral view short, straight, length about 3 × width, tapered distally; parameres in lateral view robust, dilated and down turned subapically; phallus with ventral subapical swelling and acute apex extended into a short projection (Fig. 25).

Female unknown.

Length of forewing: male 3.2–3.8 mm.

Etymology. Latin, swelling, referring to superior appendages.

Distribution. Southeast Papua New Guinea.

Remarks. Ecnomus bullatus separates from other PNG species on the distinctive superior appendages with the swelling on the dorsobasal margin.

Ecnomus aliceae sp. nov.

Figures 27, 28

Type material. Holotype male, Papua New Guinea, Central Province, Eilogo River, near Sergeri, 9°27'S, 147° 27'E, net, 21 May 1986, A. Wells (genitalia prep. CT-240 figured, T-16798, NMV).

Paratype male, Papua New Guinea, Mamai Plantation, E of Port Glasgow, 150 m, 30 Jan 1965, R. Straatman (genitalia prep. CT-140, BPBM).

Description. Male. Wings pale fawn, venation characteristic of genus. Ventrolateral processes of segment 10 broad based, with 3 small setae apically. Superior appendages in lateral view robust, length about 3.5 × width (Fig. 27), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view long, slender, length about 4 × width, narrowed or incised at about the middle, tapered to pointed apices (Fig. 28), in lateral view long, straight, length about 4 × width; parameres in lateral view long, slender, slightly dilated and down turned apically; phallus slender, with acute apex extended into a short projection (Fig. 27).

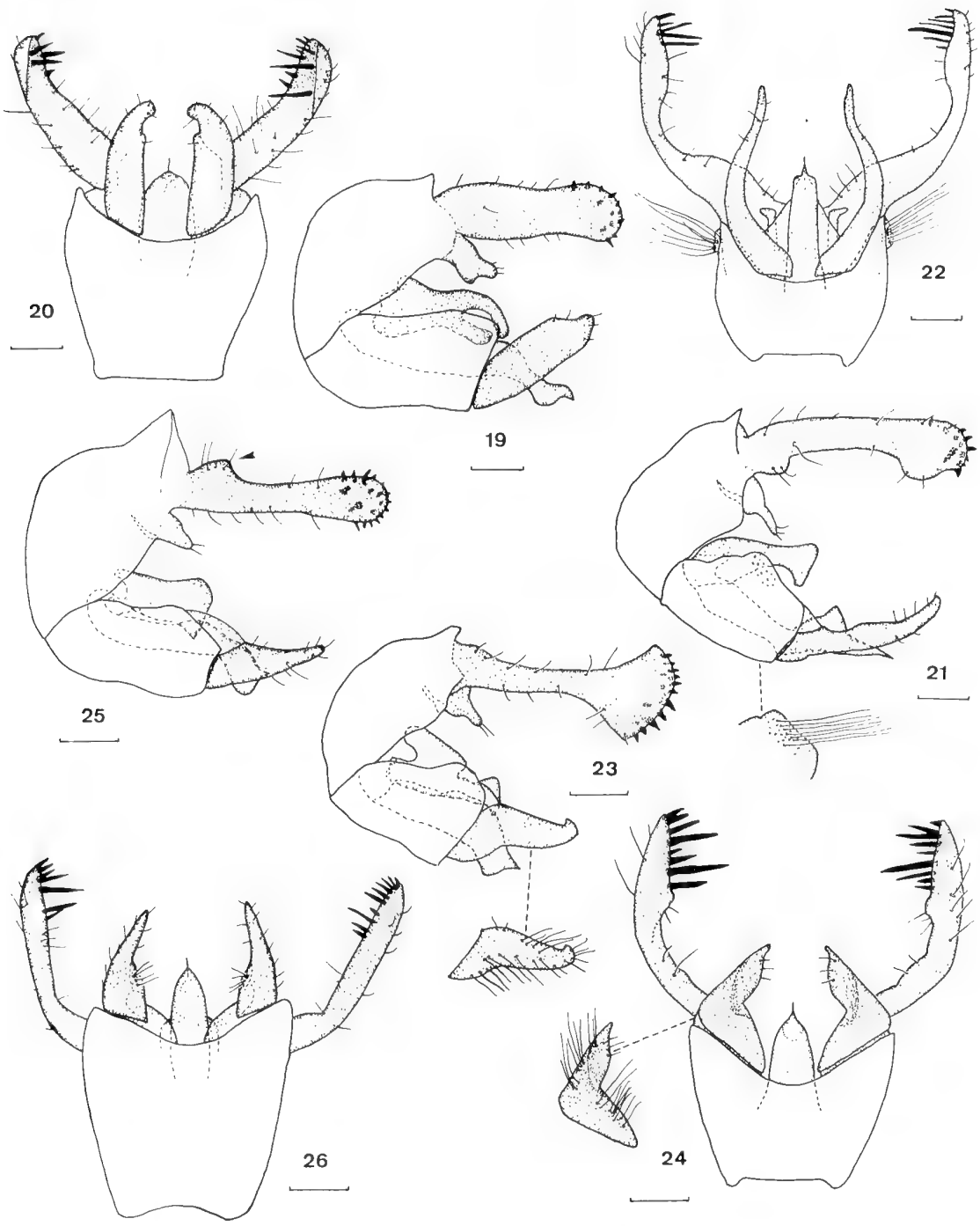
Female unknown.

Length of forewing: male 3.2–3.4 mm.

Etymology. The species is named for Alice Wells (collector).

Distribution. Central and southeast Papua New Guinea.

Remarks. Ecnomus aliceae separates from other PNG species on the combination of the straight superior appendages and the slender inferior appendages.



Figures 19–26. *Ecnomus* spp. Male genitalia in lateral and ventral views. 19, 20: *E. skruim* sp. nov. 21, 22: *E. masong* sp. nov. (with basal segment of inferior appendage showing hairs, lateral view). 23, 24: *E. tamiok* sp. nov. (with inferior appendage showing hairs, lateral and ventral views). 25, 26: *E. bullatus* sp. nov. All scale lines 0.1 mm.

Ecnomus laensis sp. nov.

Figures 29, 30

Type material. Holotype male, Papua New Guinea, 14.4 km W Lae, 28–30 Oct. 1965, W.A. Steffan and Y.M. Huang (genitalia prep. CT-138 figured, BP-8324, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 broad based, with 3 small setae apically. Superior appendages in lateral view long, length about 4 × width (Fig. 29), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view slender, length about 2.5 × width, broad based, with subapical swelling, tapered to narrowly rounded apices (Fig. 30), in lateral view long, straight, length about 3 × width, tapered slightly to rounded apices; parameres in lateral view robust, strongly dilated and down turned apically; phallus robust (Fig. 29).

Female unknown.

Length of forewing: male 3.8 mm.

Etymology. Named after type locality (near Lae).

Distribution. Northeast Papua New Guinea (type locality only).

Remarks. Ecnomus laensis separates from other PNG species on the combination of the straight superior appendages and the inferior appendages with a subapical swelling and tapered to narrowly rounded apices.

Ecnomus ulap sp. nov.

Figures 31, 32

Type material. Holotype male, Papua New Guinea, Morobe District, Ulap, 800–1100 m, Nov 1968, W.A. Steffan and Y.M. Huang (genitalia prep. CT-128 figured, BP-8324, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 broad based, with 3 small setae apically. Superior appendages in lateral view robust, broad based, slightly constricted at about two-thirds length, length about 2.5 × width (Fig. 31), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view length about 2.5 × width, narrowed near middle, with short pointed apices (Fig. 32), in lateral view long, straight, length about 3 × width, tapered slightly to pointed apices; parameres in lateral view robust, dilated and down turned apically; phallus dilated subapically, with acute apex extended into a short projection (Fig. 31).

Female unknown.

Length of forewing: male 3.6 mm.

Etymology. Named after type locality (Ulap).

Distribution. Northeast Papua New Guinea (type locality only).

Remarks. Ecnomus ulap separates from other PNG species on the combination of the robust and downturned parameres and the shape of the inferior appendages.

Ecnomus wamena sp. nov.

Figures 33, 34

Type material. Holotype male, Indonesia, Irian Jaya, Baheim Valley, Wamena, 1500 m, at light, 17 Oct 1993, A.J. de Beer, A.L.M. Rutten and R. de Vos (genitalia prep. CT-247 figured, ZMA).

Paratypes: 3 males, same data as holotype (ZMA).

Other material. 1 male, Papua New Guinea, Central Province, Eilogo River near Sergeri, 9°27'S, 147°27'E, net, 21 May 1986, A. Wells (genitalia prep. CT-241, NMV); 1 male, Papua New Guinea (Paniai, 3 Sep 1939, Nieuw Guinea Exp. K.N.A.G. 1939, RMNH).

Description. Male. Wings fawn, venation characteristic of genus. Ventrolateral processes of segment 10 long and broad based, with 3 small setae apically. Superior appendages in lateral view long, constricted slightly at about two-thirds length, length about 3 × width (Fig. 33), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view length about 3 × width, narrowed slightly near middle, with short pointed apices (Fig. 34), in lateral view robust, length about 3 × basal width, tapered and upturned slightly to rounded apices; parameres in lateral view dilated and down turned apically; phallus with acute apex extended into a short projection (Fig. 33).

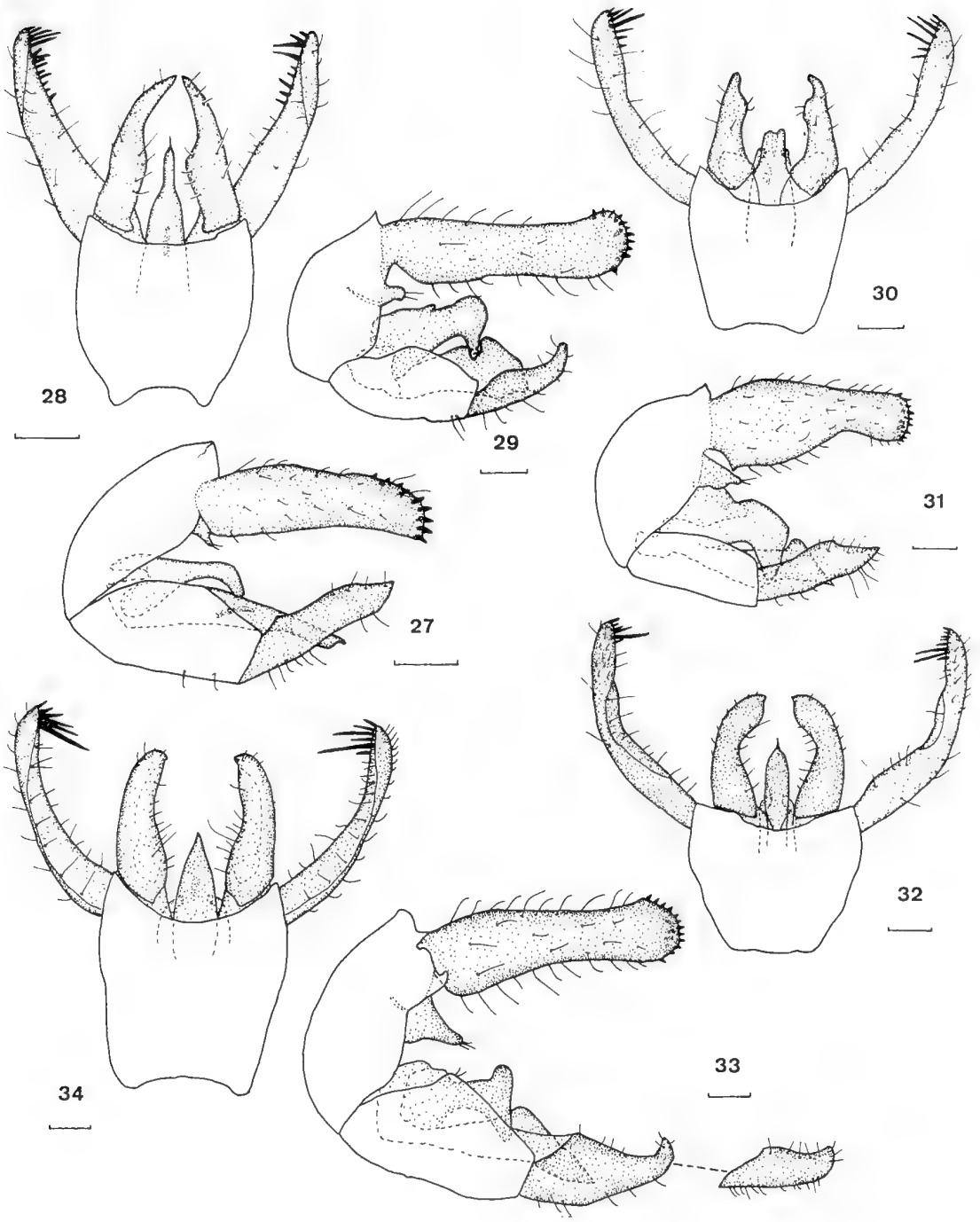
Female unknown.

Length of forewing: male 4.7–6.0 mm.

Etymology. Named after type locality (Wamena).

Distribution. Irian Jaya (Indonesia) and central Papua New Guinea.

Remarks. Ecnomus wamena separates from other PNG and Irian Jaya species on the combination of the downturned parameres and the shape of the inferior appendages. The Papua New Guinean specimen (CT-241) differs slightly from the type material in that the inferior appendages in lateral view are less upturned at the apices.



Figures 27–34. *Ecnomus* spp. Male genitalia in lateral and ventral views. 27, 28: *E. aliceae* sp. nov. 29, 30: *E. laensis* sp. nov. 31, 32: *E. ulap* sp. nov. 33, 34: *E. wamena* sp. nov. (with variation in form of inferior appendage [CT–241], lateral view). All scale lines 0.1 mm.

Ecnomus milnensis sp. nov.

Figures 35, 36

Type material. Holotype male, Papua New Guinea, Milne Bay, 10 m, 10°18'S, 150°20'E, light trap, Mar 1965, R.A. Straatman (genitalia prep. CT-120 figured, BP-8324, BPBM).

Paratypes: 15 males, same data as holotype (genitalia preps. CT-134, 145, 146, 150, 151, 157-164, 170, 171, BPBM); 1 male, Papua New Guinea, Mamai Plantation, near Port Glasgow, 27 Jan 1965, R.A. Straatman (genitalia prep. CT-130, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, broad based, with 3 small setae apically. Superior appendages in lateral view long, length about 3 × width, with a small ventromesally directed digitiform projection on ventrobasal margin (Fig. 35), in ventral view with field of mesially directed spiny setae apically; inferior appendages in ventral view robust, length about 2 × width, broad based, narrowed at about the middle, tapered to pointed and inflexed apices (Fig. 36), in lateral view length about 4 × width; parameres in lateral view robust, straight; phallus with acute apex extended into a long projection (Fig. 35).

Female unknown.

Length of forewing: male 4.0–4.6 mm.

Etymology. Named after type locality (Milne Bay).

Distribution. Southeast Papua New Guinea.

Remarks. Ecnomus milnensis separates from other PNG species on basis of the distinctive small ventromesally directed digitiform projection on ventrobasal margin of the superior appendages, reminiscent of the Australian species *E. turgidus* Neboiss and *E. digrutus* Cartwright, and the Indonesian species *E. bengkok* Cartwright.

Ecnomus dadi sp. nov.

Figures 37, 38

Type material. Holotype male, Papua New Guinea, Mamai Plantation, E of Port Glasgow, 150 m, 10°17'S, 149°35'E, light trap, 27 Feb 1965, R.A. Straatman (genitalia prep. CT-125 figured, BP-8324, BPBM).

Description. Male. Wings fawn. Ventrolateral processes of segment 10 long, with 3 small setae apically. Superior appendages in lateral view long and slender, length about 6.5 × width (Fig. 37), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view short, robust, length about 2 × width, broad based, narrowed at about the middle, tapered to pointed apices (Fig. 38), in lateral view short, broad based, length about 2 × width; parameres in lateral view slender, straight in apical third; phallus with acute apex extended into a long projection (Fig. 37).

Female unknown.

Length of forewing: male 3.2 mm.

Etymology. Dadi, anagram of addi *(E. addi* Malicky).

Distribution. Southeast Papua New Guinea (type locality only).

Remarks. Ecnomus dadi separates from other PNG species on the combination of the very long and slender superior appendages and the short, robust and broad based inferior appendages.

Ecnomus iomari sp. nov.

Figures 39, 40

Type material. Holotype male, Papua New Guinea, Central Province, Iomari Ck, Bereima-Port Moresby Road, UV light, 23 May 1986, A. Wells and J. Ismay (genitalia prep. CT-243 figured, T-16799, NMV).

Paratype male, Papua New Guinea, Umboi Island, about 8 km WNW Lab Lab, 300 m, Malaise trap, 8–19 Feb 1967, G.A. Samuelson (genitalia prep. CT-129, BPBM).

Description. Male. Wings pale fawn, venation characteristic of genus. Ventrolateral processes of segment 10 long, with 3 small setae apically. Superior appendages in lateral view long, tapered slightly distally, length about 3.5 × width (Fig. 39), in ventral view with field of mesally directed spiny setae apically; inferior appendages moderately hairy, in ventral view short, robust, length about 2.5 × width, broad based, narrowed or incised at about the middle, tapered to pointed apices (Fig. 40), in lateral view short, broadbased, straight, length about 2.5 × width; parameres in lateral view slender, straight in apical third, slightly dilated apically in dorsolateral view; phallus stout, tapered gradually from about middle, with acute apex (Fig. 39).

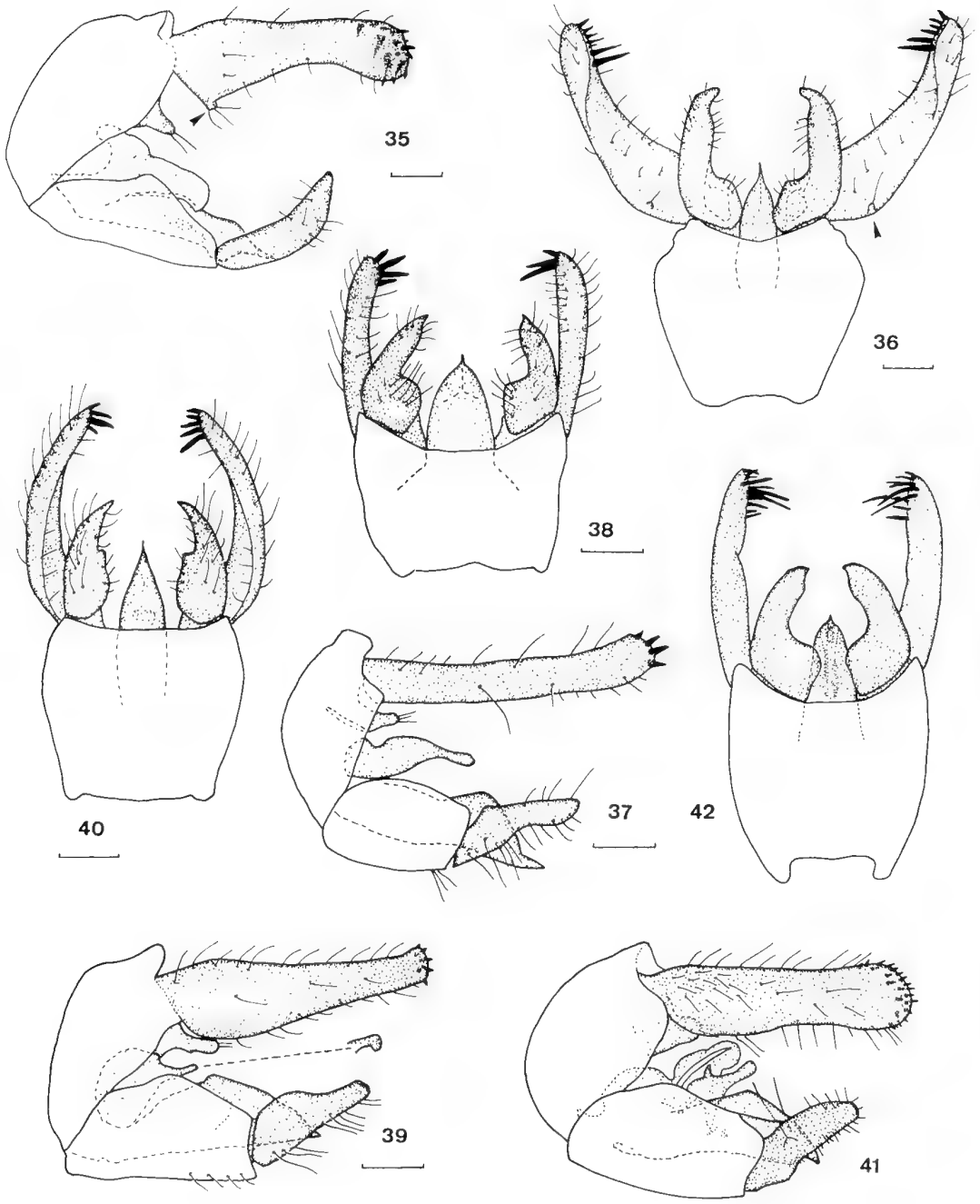
Female unknown.

Length of forewing: male 3.4–3.9 mm.

Etymology. Named after type locality (Iomari Creek).

Distribution. Central and northeast Papua New Guinea.

Remarks. Ecnomus iomari separates from other PNG species on the combination of the slightly tapered superior appendages and the simple and slender parameres.



Figures 35 42. *Ecnomus* spp. Male genitalia in lateral and ventral views. 35, 36: *E. milnensis* sp. nov. 37, 38: *E. dadi* sp. nov. 39, 40: *Ecnomus iomari* sp. nov. (with apex of paramere, dorsolateral view). 41, 42: *E. papuanus* Ulmer; 41 (reproduced from Neboiss, 1986: 151). All scale lines 0.1 mm.

Ecnomus papuanus Ulmer

Figures 41, 42

Ecnomus papuanus Ulmer 1938: 400–402, figs 3-5.—Neboiss 1986: 151.

Type material. Lectotype male, Papua New Guinea, Queen Augusta River Expedition (Sepik River area), 15–31 Jul. 1913 (figures based on genitalia prep. PT-1440 figured by Neboiss 1986, Berlin Museum). Type not seen.

Other material. 1 male, same data as lectotype (Hamburg Museum?). Specimen not seen.

Description. (revised after Ulmer, 1938). Male. Wings yellow and brown. Ventrolateral processes of segment 10 long, broad, with 3 small setae apically. Superior appendages in lateral view long, length about 4 × width (Fig. 41), in ventral view with field of mesally directed spiny setae apically; inferior appendages in ventral view robust, length about 2 × basal width, broad based, narrowed at about the middle, tapered slightly distally (Fig. 42), in lateral view robust, straight, length about 3 × width; parameres in lateral view complex, slender, straight in apical third, with dorsal spine medially, and subapical dorsal and ventral processes; phallus tapered gradually from about middle, with acute apex (Fig. 41).

Female unknown.

Length of forewing: male 4 mm.

Distribution. Western Papua New Guinea.

Remarks. Ecnomus papuanus separates from other PNG species on the combination of the long and straight superior appendages and the complex structure of the parameres. Neboiss' (1986: 151) figures have been redrawn to allow direct comparisons and to accompany the description that is revised in light of new interpretations of *Ecnomus* genitalic structures.

Acknowledgements

I thank Dr Arturs Neboiss for providing access to specimens on loan from the BPBM, for encouragement and together with Dr Alice Wells, and two referees for comments on a draft of this manuscript. I am grateful to Dr Hans Malicky for the loan of a paratype of *E. addi* and to Dr Peter Barnard for checking the type of *E. cyclopicus*.

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Memoirs of the Museum of Victoria 57(1): 89–132 (1998)

REVIEW OF AUSTRALIAN SPECIES OF *TRIAENODES* MCLACHLAN (TRICHOPTERA: LEPTOCERIDAE)

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Abstract

Neboiss, A. and Wells, A., 1998. Review of Australian species of *Triaenodes* McLachlan (Trichoptera: Leptoceridae). *Memoirs of the Museum of Victoria* 58: 89–132.

Australian representation in the widespread leptocerid caddisfly genus *Triaenodes* is reviewed and forms the basis for a brief discussion of *Triaenodes* subgenera. The Australian fauna comprises 48 species, 44 newly described. All species occur within the 500 mm rainfall isohyet, mostly in the northern and eastern to southeastern coastal fringe of the continent. These factors, as well as the occurrence of almost 63 % of the species in the northern or Torresian biogeographical province, and apparent patterns in male genitalic form, support the idea of a relatively recent Oriental origin for the genus in Australia. A key is provided to males of Australian species.

Introduction

Triaenodes McLachlan, 1865 (Trichoptera: Leptoceridae) is one of the most diverse leptocerid genera in Australia, with some 48 species. Until now, however, only four of these were named. Heralding this review in a brief conference paper (Neboiss and Wells, 1996), we discussed features of the Australian fauna, and particularly the difficulties of determining homologies among male genitalic structures. We presented a phylogeny for sets of species among the Australian fauna, and on the basis of that, questioned the validity of the three established *Triaenodes* subgenera. Here we describe 44 new species, consider their relationships, and examine their distributions.

In Australia, *Triaenodes* appears to be restricted to the coastal fringe of the continent and Tasmania, occurring from southwestern to northwestern Western Australia, across the north, south along the Great Dividing Range to Tasmania, and as far west as southern South Australia. Thus, the genus lies within the 500 mm isohyet (see Neboiss, 1981) and in this respect, differs from at least two of the other leptocerid genera that are well represented in Australia—*Triplectides* Kolenati, 1859 and *Oecetis* McLachlan, 1877—which are also present in the scattered water bodies of arid Australia. *Triaenodes volda* Mosely and Kimmins, 1953 and *T. bernaysae* Korboot, 1964 are both from southeastern Queensland, *T. intricata* Neboiss, 1977 from Tasmania and T. jubatus Neboiss, 1982 from southwestern Western Australia. The new species are mostly from northern and eastern localities (Table 1). Interestingly, for this genus as for many other aquatic groups, a northern or Torresian and a southern or Bassian fauna can be recognised, there being a clear disjunction or faunal barrier in the Townsville-Rockhampton area (Neboiss, 1981). Close to 63 % of Australian *Triaenodes* species are Torresian. Only *Triaenodes volda* and *T. stipulosa* sp. nov. are recorded from both faunal provinces, the latter from the northern part of the Bassian province only. For some species, the apparently limited distributions probably reflect the paucity of collecting, but for others such as those occurring in Victoria and Tasmania, they are probably real. The preponderance of northern species and the close affinities of some of these to species in New Guinea and the Western Pacific suggests that the advent of *Triaenodes* in Australia may be relatively recent. This hypothesis is supported by the presence of what appear to be sets of closely

Table 1. Torresian (northern) and Bassian (southern) species among Australian *Triaenodes*.

Torresian species (northwestern WA, northern Qld, NT) *allax, ataloma, barbarae, camura , celata, copelata, corynotra, dibolia, doryphora, drepana, dysmica, empheira, etheira, gibberosa, laciniata, mataranka, melanopeza, mouldsi, nymphaea, probolia, reclusa, rutella, tenerata, teresis, theiophora, torresiana, toxeres, triquetra, verberata, virgula*
Bassian species (southern Qld, NSW, Vic., Tas., SA, southwestern WA) *bernaysae, conjugata, cuspiosa, cymulosa, forficata, fuscinula, implexa, intricata, jubatus, nesiotina, notalia, perissotes, resima, uvida, vespertina, wannonense*
Species common to both provinces *stipulosa, volda*

related forms, which one might expect in a group that has radiated recently and is probably still splitting.

On a world scale, the Australian *Triaenodes* fauna is diverse, comprising about one-third of all described species. Elsewhere the genus is known from the Afrotropical, Holarctic and Neotropical regions, and New Guinea. No species are recorded from New Zealand or New Caledonia.

Generic relationships of the world Triaenodini tribe were examined recently by Yang and Morse (1993). They divided species of *Triaenodes* among three subgenera, accorded subgeneric status to *Triaenodella* Mosely, 1932 and erected a new subgenus, *T.* (*Austrotriaena*). They assigned Australian/Australasian species to each of these subgenera, and to the nominate subgenus. Neboiss and Wells (1996) invoked a slightly different interpretation of homologies among male genitalic structures, following which Australian species fall into two main groups which cut across those proposed by Yang and Morse.

The main point of contention between our interpretation and that of Yang and Morse (1993) is the true nature of the structures associated with the inferior appendages that they term the basal plate process and the mesal basodorsal process. Close scrutiny of these structures in several North American species fails to convince us that they are other than the homologues of a structure which, among the diverse Australian species, exhibits forms grading between the putatively separate structures.

As with this process, other male genitalic structures of Australian species also show extraordinary ranges of variation and in diverse combinations. In many instances, the variation, particularly in relative proportions of structures, makes precise verbal definition of species difficult—figures are far more informative. Patterns such as this conceivably indicate relatively recent radiations of the group. The variants are unique, and differences are generally in shapes of parts, not presence or absence. Radiations appear to have occurred in various directions, producing, by and large, a stellate effect—a polytomy, also suggestive of recent divergence, or rapid diversification (see Hoelzer and Melnick, 1994). Our phylogenetic analysis (Neboiss and Wells, 1996) produced little resolution and subsequent attempts to redefine characters and interpret relationships have proved difficult.

Four Australian species are separated from the rest by a clear disjunction—their male genitalia lack superior appendages, and show close similarities in other features. Thus, this *volda*-group is clearly monophyletic. For the remaining and large group of Australian species, here termed the *intricata*-group, monophyly was shown to be weakly supported. This group is here divided into sets, termed "complexes" for convenience of communication. Now designated by species names, these complexes correspond to sets recognised by Neboiss and Wells (1996), most of which were shown to be supported only weakly by synapomorphies.

A fascinating aspect of this and other studies on leptocerid genera is that repeatedly the same general male genitalic forms reappear in separate groups. Unlike the generally clearcut wing and general body features that diagnose these genera, male genitalic features appear to be very plastic. Often they show complex and apparently highly specialised arrangements that seem, intuitively, to represent derived states. The more parsimonious explanation is that groups having these are relatively basal in the family, the codes for their development having persisted in the genome under control of regulators which suppress expression of the genes, unless reactivated. The alternative explanation that they have arisen *de novo* on repeated occasions seems less probable.

Loss of specialised genitalic structures—structures which play critical roles in lock-and-key type mate recognition—may not be so improbable. Such loss could well accompany increased development of different sets of features, such as pheromone systems or courtship rituals. Similarly, the small interspecific differences seen in male genitalic form in some of the "complexes" could be inconsequential for species recognition compared with differences in patterns of behaviour. Comparative studies of behaviour in some of these groups could be very rewarding.

In some instances, though, the component structures of superficially similar male genitalic arrangements certainly do appear to be homoplaseous. For example, the parameres of *Setodes* species (illustrated with splendid clarity by Schmid (1987), resemble, in both appearance and juxtaposition, the spines formed by the mesal basodorsal process on the inferior appendages of *Triaenodes* species such as *T. mouldsi* sp. nov. or *T. teresis* sp. nov., or even parts of tergum X as in *T. copelata* sp. nov. The selective pressures for development or expression of these sorts of characters could also be particular behaviours. The structures involved could play à role in male-male agressive interactions, rather than having a direct function in the copulatory process, and as such be subject to strong directional selection.

Material examined is in the collections of the Museum of Victoria, Melbourne (NMV), Australian National Insect Collection, Canberra (ANIC), Queensland Museum, Brisbane (QM) and the Northern Territory Museum of Arts and Sciences, Darwin (NTM). Specimens were prepared for study following the method outlined by Neboiss (1994). Dissected specimens are identified by Neboiss' notebook numbers with the prefix PT on a yellow label. The Natural History Museum, London, is encoded BMNH.

Key to males of Australian *Triaenodes* species

1. Superior appendages absent.....*volda*-group...2
— Superior appendages present.....*intricata*-group....5
2. Inferior appendages in ventral view excavated roundly on inner distal margin giving pincer-like appearance.....3
— Inferior appendages in ventral view not excavated on inner distal margin.....4
3. Inner apical excavation, in ventral view, wide and deep, occupying close to half length of inferior appendage (Fig. 3).....*T. volda* Mosely
— Inner apical excavation, in ventral view, short and shallow, occupying about quarter length of inferior appendage (Fig. 5).....*T. dysmica* sp. nov.
4. Inferior appendages, in ventral view, slender, curved to form claspers (Fig. 9).....*T. mataranka* sp. nov.
— Inferior appendages, in ventral view, stout, not clasper-like, length less than twice basal width (Fig. 11).....*T. jubatus* Neboiss
5. Segment IX with a clear and complete ventrolateral suture between tergite and sternite.....6
— Segment IX without a clear and complete ventrolateral suture between tergite and sternite, although an oblique groove may give a false impression of a suture.....9
6. Inferior appendages, in ventral view, basically clasper-like or spiny, length at least 4 × width.....7
— Inferior appendages, in ventral view, irregularly lobose, length about twice width (Fig. 59).....*T. reclusa* sp. nov.
7. Inferior appendages with apices rounded (Figs 49, 50).....*T. celata* sp. nov.
— Inferior appendages spiny, with apices acute.....8
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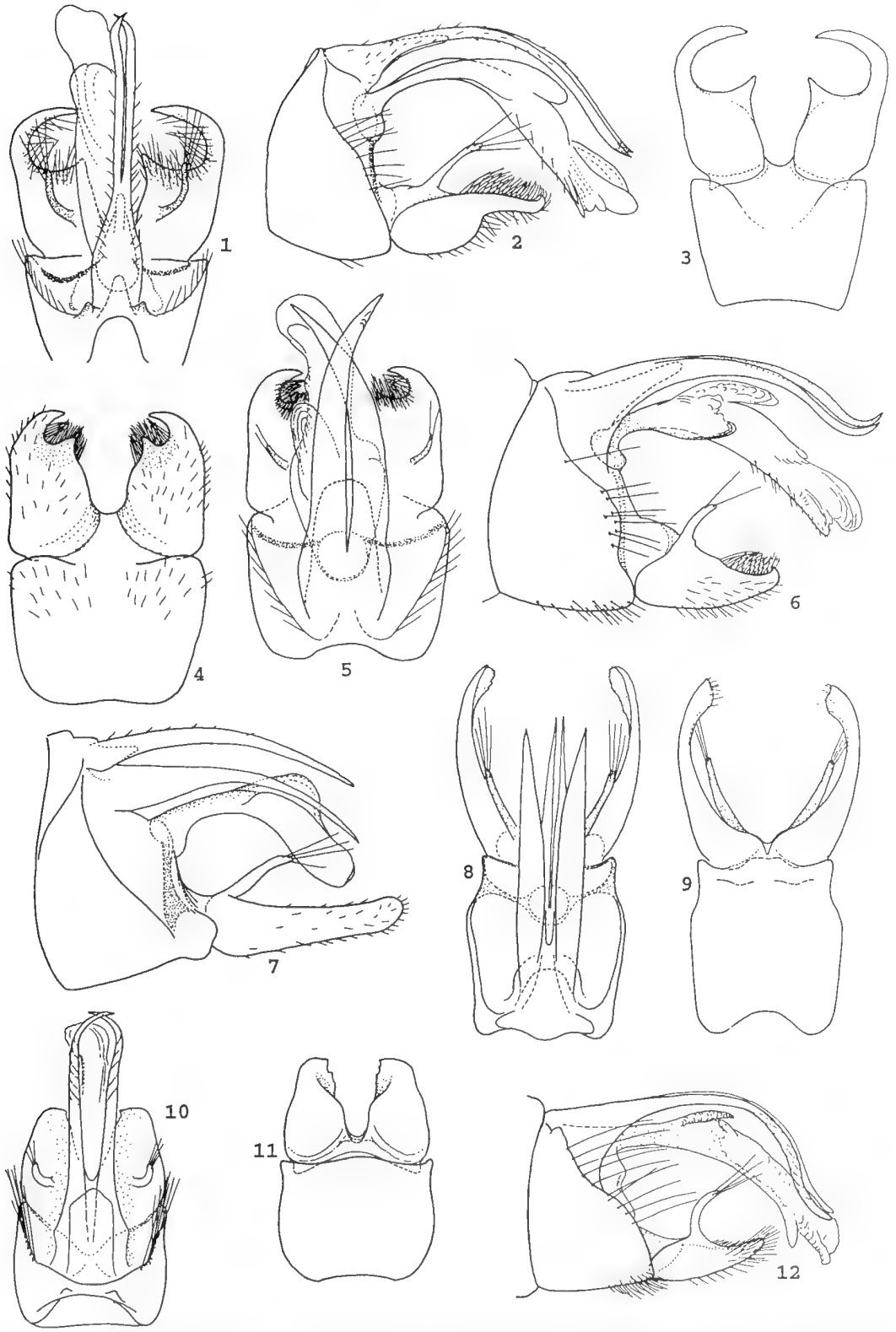
SYSTEMATICS

volda-group

The *volda*-group of four species, including *volda, dysmica, mataranka and jubatus*, is characterised by male genitalia lacking superior appendages; abdominal segment IX triangular in lateral view, very short dorsally; tergum X bipartite, upper part bifid and ventral part simple, short and triangular or longer and bifid; phallus dorsal in position, bulbous basally with sclerotised supporting strips; and inferior appendages with mesal basodorsal processes absent. The male genitalic features of the group are represented in Figs 1–12.



Figures 1–12, male genitalia: 1–3, *Triaenodes volda* Mosely, dorsal, lateral and ventral views; 4 6, *Triaenodes dysmica* sp. nov., ventral, dorsal and lateral views; 7–9, *Triaenodes mataranka* sp. nov., lateral, dorsal and ventral views; 10–12, *Triaenodes jubatus* Neboiss, dorsal, ventral and lateral views.

The group is recorded from southwestern and northwestern Western Australia, northern Northern Territory, along the Great Dividing Range of eastern Australia, and in the south, westwards to central Victoria. This group, apparently unique in the genus in lacking superior appendages, and widespread but not diverse on the Australian continent, may have an earlier origin in Australia than is apparent for other species. The group is not represented in Tasmania, which might be expected for a group with a Gondwanan origin.

Triaenodes volda Mosely

Figures 1–3

Triaenodes volda Mosely, 1953: 276.

Holotype, ♂, Queensland, Eidsvold, BMNH.

Material examined. ♂ , SE Queensland, Glastonbury Creek, 15 km W of Gympie, 27 Oct 1980, A.Neboiss, (NMV, genitalic prep. PT-796 illustrated).

Diagnosis. Closely resembling *T. dysmica* but with spines of tergum X slender, lying closely adpressed, apices crossed and with pincer-shape of inferior appendages derived from a deeper, broader subapical concavity.

Description (revised after Mosely, 1953). Length of forewing, ♂ 6.3–7.4 mm, ♀ 5.5–6.4 mm.

Genitalia, male (Figs 1–3). Tergum X with the upper part in the form of a pair of slender closely adpressed spines; the ventral part a simple membranous structure less than half length of upper part. Phallus strongly constricted in lower section but distally expanded and irregular in shape. Inferior appendages in ventral view broad-based, inner margins deeply and roundly excavated subapically; in lateral view rounded basally, narrow in distal half; lateral basodorsal process slender, setose apically.

Remarks. This species is one of the most widespread *Triaenodes* species in Australia. It has been collected from central Victoria through east Gippsland, from Albury on the River Murray to the northeast of New South Wales, from southeastern to northeastern Queensland, and from Cape Crawford in the northeast of the Northern Territory. In the south specimens were collected from October to February (NSW) and March (Vic.), March to April in southern Queensland, December to May in northern Queensland, and one record from the Northern Territory in November.

Triaenodes dysmica sp. nov.

Figures 4–6

Material examined. Holotype, ♂, Western Australia, Ashburton River, Nanatarra Roadhouse, 22°33'S, 115°30'E, 21 Apr 1992, P.J. Gullen and P. Cranston, (ANIC).

Paratypes: ♂, same data as for holotype, (NMV, genitalic prep. PT-2055 illustrated). ♂ Northern Territory, Humbert River 16°26'S, 130°28'E, 8–10 Jul 1966, I. Archibald, (NMV).

Diagnosis. Closely resembling *T. volda* but with upper part of tergum X forming stout spines, and pincer-like tips of inferior appendages produced by a small, relatively shallow subapical concavity on inferior appendages.

Description. Length of forewing, ♂ 6.6 mm.

Genitalia, male (Figs 4–6). Abdominal segment IX subquadrate in ventral view. Segment X comprising a pair of stout elongate spines, crossing subapically and about as long as phallus, lower part a simple short, apically rounded membrane. Phallus strongly constricted in lower section but expanded and elaborated in distal two-thirds. Inferior appendages stout in ventral view, with a concavity on inner subapical margin of apicolateral lobes giving each a pincer-like appearance, a tuft of hair anterodorsally to concavity; in lateral view subtriangular with lateral basodorsal process short, slender, with a pair of apical setae.

Etymology. From the Greek *dysmikos*—western, referring to the western distribution of the *volda-group.*

Remarks. Triaenodes dysmica is known only from a single sample from northwestern Western Australia.

Triaenodes mataranka sp. nov.

Figures 7–9

Material examined. Holotype, ♂ , Northern Territory, Roper River, Mataranka homestead, M.S. Moulds, 25 Jan 1977, (NMV, T-16418).

Paratypes: 2♂, same data as for holotype, (NMV, genitalic prep. PT-769 illustrated); ♂, Mataranka, 14 Jul 1969, J. LeSouef, (NMV); ♂, Roper Bar, 15 Jul 1969, J. LeSouef, (NMV).

Diagnosis. Distinguished from other members of the group by the narrow inferior appendages and bifid lower part of tergum X in the male.

Description. Length of forewing, ♂ 5.9–6.8 mm.

Genitalia, male (Figs 7–9). Abdominal segment IX elongate-rectangular in ventral view. Tergum X comprising two almost equal bifid structures, the lower of which appear to rest on grooves on

the phallus. Phallus constricted towards base but expanded in distal half, to form lateral grooves. Inferior appendages in ventral view clasper-shaped, apices slightly expanded; in lateral view rod-shaped, with lateral basodorsal process short with a cluster of setae apically.

Etymology. The name refers to the type locality.

Remarks. This species has been collected only from the Roper River, northeastern Northern Territory.

Triaenodes jubatus Neboiss

Figures 10–12

Triaenodes jubatus Neboiss, 1982: 317–319.

Holotype, ♂, Western Australia, (NMV).

Material examined. Paratype, ♂, WA, Gingin Brook nr Moore River junction, 12 km E of Guilderton, 19 Nov 1978, A. Neboiss, (NMV, genitalic prep. PT-653).

Diagnosis. This species resembles *T. dysmica* sp. nov. and *T. volda* in having stout inferior appendages but differs in lacking a concavity on the inner apical margin of the inferior appendages.

Description (revised after Neboiss, 1982). Length of forewing, ♂ 6–7 mm.

Genitalia, male (Figs 10–12). Abdominal segment IX subquadrate in ventral view. Tergum X comprising an upper pair of elongate spines overlying a short membrane. Phallus elongate, narrow towards base, but expanded and elaborated in distal two-thirds. Inferior appendages broadly lobose in ventral view, tapered to rounded apices in lateral aspect, lateral basodorsal processes slender and short, curved upwards, with a cluster of apical setae.

Remarks. This species is known only from southwestern Western Australia. No futher specimens have been collected since the original description.

***theiophora*-complex**

The two species included in this complex (referred to by Neboiss and Wells (1996) as "group A"), are characterised by male genitalia with superior appendages present; abdominal segment IX very short laterally and dorsally; tergum X a single simple plate; phallus not bulbous basally, with sclerotised supporting strips; and inferior appendages with mesal basodorsal process forming a slender curved spine. The male genitalic features of group are represented in Figs 13–18.

Both species are from northern Australia, one each from Queensland and Western Australia and probably form sister species.

Triaenodes theiophora sp. nov.

Figures 13–15

Material examined. Holotype, ♂, Western Australia, Fine Spring Creek between Lake Argyle village and Duncan Highway, 23 Feb 1977, J.E. Bishop, (NMV, T-16358).

Paratypes: 6 ♂, same data as for holotype, (NMV, genitalic prep. PT-766 illustrated).

Other material. Western Australia: 1♀, Drysdale River, 15°02'S, 126°55'E, 3–8 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale Survey 1975 Site A1, (ANIC); ♂, Carson Escarpment, 14°49'S, 126°49'E, 9–15 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale Survey 1975 Site B1, (ANIC); 1♂, 3♀, Drysdale River, 14°39'S, 126°57'E, 18–21 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale Survey 1975 Site C5, (ANIC).

Northern Territory, 5 ♂, 4♀, Radon Springs, 12°45'S, 132°55'E, 14 Apr 1989, P. Suter and A. Wells, (NMV).

Diagnosis. Triaenodes theiophora is distinguished from *T. toxeres* by the shape of the inferior appendages which in ventral view are constricted on the inner side at about two-thirds their length.

Description. Length of forewing, ♂ 4.1–4.4 mm.

Genitalia, male (Figs 13–15). Abdominal segment IX in ventral view with width exceeding length, laterally expanded medially to form "humps". Segment X in form of a short apically rounded membranous plate. Superior appendages short. Inferior appendages stout and almost skittle-shaped in lateral view, in ventral view abruptly contracted at two-thirds length, mesal basodorsal process in form of fine strongly recurved symmetrical spines. Phallus stout, inserted dorsally, curving downwards.

Etymology. From the Greek *theion*—sulphur, for the yellowish body colour.

Remarks. Triaenodes theiophora is known from localities in the northeast of Western Australia and northern Northern Territory. It is probably widespread across the northwest.

Triaenodes toxeres sp. nov.

Figures 16–18

Material examined. Holotype, ♂, Queensland, Currunda Creek, tributary of Freshwater Creek, Cairns district, 30 Apr 1978, A. Wells, (NMV, T-16602).

Paratypes, N Queensland: 3 ♂, Mt Molloy, 13 Jun 1971, E.F. Riek, (ANIC); ♂, Upper Freshwater Creek, Whitfield Range nr Cairns, 3 Apr 1975, M.S. Moulds,

(NMV, genitalic prep. PT-764 illustrated); 1 ♂, Jardine River, 11°17'S, 142°35'E, 17 Oct 1979, M.S. Moulds, (NMV); 1 ♂, same locality, 27 Oct 1979, M.S. Moulds, (NMV); 5 ♂, 5 km W by N Rounded Hill nr Hope Vale Mission, 15°17'S, 145°10'E, 7 Oct 1980, J.C. Cardale, (ANIC); ♂, Bellenden Ker range, Cable Base Station, 100 m, 17–24 Oct 1981, Earthwatch-Qld Museum expedition,(QM); 2 ♂, McLeod River crossing, W of Mt Carbine, 16°29'S, 144°59'E, 27 Dec 1984, MV light, G. and A. Daniels, (QU); ♂, 9 km ENE Mt Tozer, 12°43' 143°17'E, 5–10 Jul 1986, at light, J.C. Cardale, (ANIC); ♂, Heathlands HS, 15–26 Jan 1992, I. Naumann, (NMV, genitalic prep. PT-2058); 7 ♂, Bertie Creek, 1 km SE Heathlands HS, 4 Feb 1992, D. Cartwright and A. Wells, (QM); 5 ♂, Dulhunty River at telegraph crossing, 11°50'S, 142°30'E, 10 Feb 1992, D. Cartwright and A. Wells, (NMV); 1♂, Heathlands, Bertie Creek, 23 Mar 1993, M. Crossland, (ANIC).

Other material. N Queensland: 3♀, Mossman, 12 Jun 1971, E.F. Riek, (ANIC); 2♀, Mulgrave River W of Gordonvale, 29 Jun 1979, A. Wells, (NMV); 4 ♂, 5 ♀, Moses Creek, 4 km N by E Mt Finnegan, 15°47'S, 145°17'E, 14–16 Oct 1980, J.C. Cardale, (ANIC); 2 ♂ 1 ♀, 11 km W by N Bald Hill, McIlwraith Range, 520 m, 27 Jun 1989, I. Naumann, (ANIC); 1 ♂, 1♀, Gunshot Creek at Telegraph crossing, 11°44'S, 142°29'E, 16 Feb 1992, D. Cartwright and A. Wells, (NMV); 2 ♂, 4♀, same locality and collectors, 17 Feb 1992, (NMV); 2 ♂, Bridges Creek, 11°13'S, 142°33'E, 19 Nov 1992, P. Zborowski and A.A. Calder, (ANIC).

Diagnosis. This species most closely resembles *T. theiophora*, particularly in the form of tergum X, but is distinguished from that species by the more gradual tapering of the inferior appendages in ventral aspect.

Description. Length of forewing, ♂ 4.6–5.2 mm.

Genitalia, male (Figs 16–18). Abdominal segment IX quadrate in ventral view. Tergum X comprising a short tapered plate with its apex apically concave. Superior appendages short, rather stout. Inferior appendages clasper-like in ventral view, mesal basodorsal process forming a fine strongly recurved spine. Phallus stout, curving downwards, with dorsal furrows.

Etymology. From the Greek toxeres—meaning furnished with a bow, in reference to the shape of the male genitalia.

Remarks. This is a widespread and commonly collected species in northeastern Queensland. Collecting dates suggest a lack of seasonality in adult emergence times.

copelata complex

The *copelata*-complex of some eight species—*copelata*, *virgula*, *gibberosa*, *barbarae*, *camura*, *rutella*, *etheira*, *stipulosa* (referred to by Neboiss and Wells (1996) as "group B"), is characterised by presence of superior appendages; abdominal segment IX more or less rectangular in lateral view, with the apicodorsal angle rounded and a relatively narrow excavation middorsal; tergum X comprising usually a simple plate; phallus dorsal in position, mesal and lateral basodorsal processes slender, setose apically. The male genitalic features are illustrated in Figs 19–47.

All members of this complex are northern in distribution.

Triaenodes copelata sp. nov.

Figures 19–21

Material examined. Holotype, ♂, Northern Territory, Radon Springs, 12°45'S, 132°55'E, 13–14 Jun 1988, P. Suter and A. Wells, (NMV, T-16301).

Paratypes: 2 ♂, same data as for holotype, (NMV, genitalic prep. PT-2053 illustrated); 3♂, same locality and collectors, 14 Jun 1988, 1 h before dawn, Lt Tr., (NMV); 3 ♂, same locality, 13 Jun 1989, Lt Tr., P. Suter and A. Wells, (NMV).

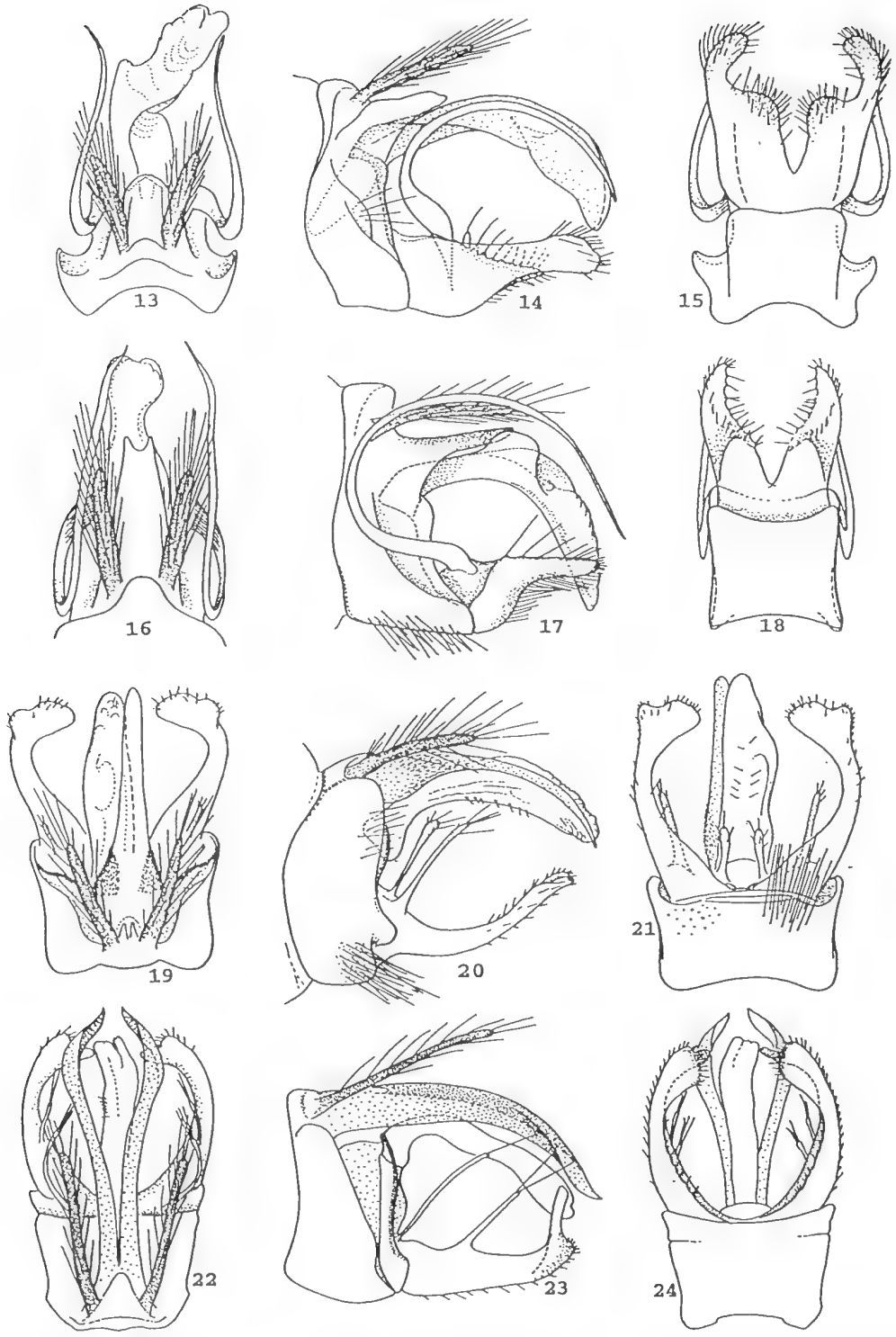
Diagnosis. In basic form of male inferior appendages, this species most closley resembles T. virgula, however the inferior appendages are expanded distally in a distinctive way, lack a terminal digitiform process and tergum X is a simple undivided plate.

Description. Length of forewing, ♂ 5.0–5.7 mm.

Genitalia, male (Figs 19–21). Tergum X an elongate, tapered plate with spinules basolaterally and a pair of small triangular structures between the bases of the superior appendages. Superior appendages about half length of tergum X. Phallus constricted slightly in lower third, with 2 rows of setae ventrally on distal third. Inferior appendages in ventral view clasper-shaped with apices expanded; in lateral view narrow, upturned, lateral basodorsal process slender, elongate with a cluster of short setae apically, mesal basodorsal process slightly shorter, setate apically.

Etymology. From the Greek *kopelatos*—oar-like in reference to the shape of the inferior appendages.

Remarks. Triaenodes copelata is known only from the type locality in Kakadu National Park, Northern Territory. This particular locality, a small springfed steam originating in the strata of an outlier of the Arnhem escarpment, appears to support a relictual fauna, its members having close sister taxa in the northeast of Queensland.



Figures 13–24, male genitalia: 13–15, *Triaenodes theiophora* sp. nov., dorsal, lateral and ventral views; 16–18, *Triaenodes toxeres* sp. nov., dorsal, lateral and ventral views; 19–21, *Triaenodes copelata* sp. nov., dorsal, lateral and ventral views; 22–24, *Triaenodes virgula* sp. nov., dorsal, lateral and ventral views.

Triaenodes virgula sp. nov.

Figures 22–24

Material examined. Holotype, ♂, NW Western Australia, Mitchell Plateau, Camp Creek, Crusher site, 20 Jul 1978, P. Suter, (NMV, T-16372).

Paratypes, NW Western Australia: ♂, same loc. and collector as holotype, 13 Jul 1978, (NMV); ♂, same loc. and collector as holotype, 21 Jul 1978, (NMV genitalic prep. PT-775 illustrated); 13 ♂, Drysdale River, 15°02'S, 126°55'E, 3–8 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale Survey Site A1, (ANIC); 2 ♂, Carson Escarpment, 14°49'S, 126°49'E, 9–15 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale Survey Site B1, (ANIC); ♂, Barnett River Gorge, Barnett Station, Kimberley, 1 Oct 1979, J. Blyth, (NMV); 2 ♂, Drysdale River headwaters, 30 km NW of Mt Elizabeth Homestead, 30 Sep 1979, J. Blyth, (NMV); 4 ♂, 16°31'S, 126°16'E, CALM site 25/1, Synnot Creek, 17–20 Jun 1988, T.A. Weir, (ANIC).

Other material. NW Western Australia: ♂, Fern Creek nr Mt Bell, King Leopold Range, 17°10'S, 125°17'E, 10 Apr 1988, T.F. Houston, (WAM).

Northern Territory: ♂, Alligator Rivers Region, Stag Creek at BHP camp, MV-lt, 25 May 1988, P. Suter and A. Wells, (NMV).

Diagnosis. In general form of abdominal segment IX, and processes on inferior appendages, most closely resembling *T. barbarae*, however the inferior appendages are simpler, without the inner dorsal pincer-like structures and the apices of the inferior appendage are produced dorsally in a small digitiform process.

Description. Length of forewing, ♂ 5.7–6.4 mm.

Genitalia, male (Figs 22–24). Abdominal segment IX short, subtriangular in lateral view. Segment X comprising a pair of long, spines which curve outwards distally, then converge apically. Superior appendages slender, elongate. Inferior appendages clasper-shaped in ventral view, in lateral view with an upturned digitiform apical process; lateral and mesal basodorsal processes in lateral view forming straight filaments with two and one apical setae respectively. Phallus elongate, slender, down-turned from close to base.

Etymology. The Latin *virgula* (dim.)—branch, twig, in reference to two thin processes on inferior appendages.

Remarks. This appears to be a common species in northwestern Western Australia, possibly multivoltine as it has been collected in a scattering of months throughout the year.

Triaenodes barbarae sp. nov.

Figures 25–27

Material examined. Holotype, ♂, Western Australia, Millstream, Fortescue River S of Roeburne, 22 Feb 1977, M.S. and B.J. Moulds, (NMV, T-16312).

Paratypes, Western Australia: 2 ♂, same data as for holotype, (NMV, genitalic prep. PT-778 illustrated); ♂, same locality and collectors, 12 Nov 1978, (NMV); 3 ♂, Millstream Crossing Pool, 21 Oct 1970, J.C. Cardale, (ANIC); ♂, Millstream, 25 Oct 1970, J.C. Cardale, (ANIC); 5 ♂, Millstream HS, 21°37'S, 117°06'E, 2 Apr 1971, E.F. Riek, (ANIC, NMV); 3 ♂, Fortescue Falls, Hammersley Range National Park, 27 Oct 1979, J. Blyth, (NMV); ♂, Nanatarra Roadhouse, Ashburton River, 22°33'S, 115°30'E, 21 Apr 1992, P.J. Gullen and P.S. Cranston, (NMV); ♂, Millstream National Park, Deep Reach, 21°37'S, 117°04'E, 24 Jun 1992, P.S. Cranston, (ANIC); ♂, Millstream National Park, Fortescue River, 24 Jun 1992, P.S. Cranston, (ANIC).

Diagnosis. This species is distinguised from others in the group by the mesodorsal elaborations on the inferior appendages and by having a slender mesal filament dorsally on tergum X.

Description. Length of forewing, ♂ 5.7–6.9 mm.

Genitalia, male (Figs 25–27). Abdominal segment IX short, not strongly excised dorsally. Tergum X an elongate triangular plate with a slender, straight median process dorsally. Superior appendages slender, about half length of tergum X. Inferior appendages cylindrical with pincer-shaped process dorsomesally at about two-thirds length in ventral view; in lateral view lateral mesodorsal process short with paired apical setae, mesal laterodorsal process filamentous, curved, bearing a single apical seta.

Etymology. Named for Mrs Barbara Moulds, in recognition of her contribution to collections of Australian Trichoptera.

Remarks. This species is known only from the Millstream area of Western Australia. Like Radon Springs in Kakadu National Park, Northern Territory, fresh waters of the Millstream area of Western Australia appear to support a relictual fauna with close associations with the fauna of northern Queensland.

Triaenodes gibberosa sp. nov.

Figures 28–30

Material examined. Holotype, ♂, NW Western Australia, Barnett River Gorge, Barnett Station, 16°38'S, 126°00'E, 1 Oct 1979, J. Blyth, (NMV, T–16378).

Paratypes, NW Western Australia: ♂, same data as for holotype, (NMV, genitalic prep. PT-776 illustrated); 5 ♂, Drysdale River, 3–8 Aug 1975, I.F.B. Common and M.S. Upton, Drysdale River Survey Site A1, (ANIC); 2 ♂, Morgan River, Theda homestead, 14°48'S, 126°30'E, 28 Sep 1979, J.Blyth, (NMV); ♂, Mitchell Plateau, Lone Pine Creek tributary of Mitchell River, 17 Feb 1979, J.E. Bishop, (NMV); ♂, Mitchell Plateau, Camp Creek, at lt, 19 Feb 1979, J.E. Bishop,

(NMV); 2 ♂, same locality and collector, 31 Jan 1978, (NMV); ♂, same locality and collector, 15 Feb 1979, (NMV); ♂, Drysdale River at Kalumburu Road Crossing, 15°41'S, 126°23'E, 28 Sep 1979, J. Blyth, (NMV); 3 ♂, Mitchell Plateau, Mining Camp, 14°49'S, 125°50'E, 9–19 May 1983, J.C. Cardale, (ANIC); 1 ♂, 15°36'S, 125°15'E, CALM Site 28/3, 4 km W of King Cascade, 12–16 Jun 1988, T.A. Weir, (ANIC); 10 ♂, Charnley River 2 km SW of Rolly Hill, 16°22'S, 125°12'E, CALM Site 25/2, 16–20 Jun 1988, I.D. Naumann, (ANIC, NMV).

Other material. NW Western Australia: ♂, Fine Spring Creek between Lake Argyle Village and Duncan Highway, 23 Feb 1977, J.E. Bishop, (NMV); 4 ♂, Fine Spring Creek between Lake Argyle Village and Duncan Highway, 2 Feb 1978, J.E. Bishop, (NMV).

Northern Territory: 2 ♂, South Alligator River, UDP Falls, 7 Sep 1970, J. Blyth, (NMV); male, Graveside Creek, 18 Jun 1988, P. Dostine, (NTM); ♂, Stag Creek at BHP camp, 25 May 1988, Lt Tr., P. Suter and A. Wells, (NMV); m, Bowerbird Billabong outlet, 1 Oct 1988, P. Dostine, (NMV).

Diagnosis. In general appearance this species appears quite distinct, but interpretation of homologies in genitalic parts suggests that it aligns most closely with *T. stipulosa* and *T. etheira*. In common with these species the superior appendages are short and tergum X comprises a membranous plate which may be bifid distally, but *T. gibberosa* is distinguished by its broad inferior appendages with irregular-shaped upturned apices and additional strap-like process on the inner side.

Description. Length of forewing, ♂ 5.4–6.8 mm.

Genitalic structures (Figs 28–30), generally short relative to most other species. Abdominal segment IX reduced to a narrow band ventrally. Segment X comprising a short membranous plate. Superior appendages very short, less than half length of tergum X. Inferior appendages are difficult to interpret: each is a broad plate in ventral view, in lateral view with an apical dorsally directed process; arising basomesally a curved, dorsally-directed strap; lateral basodorsal process elongate and stouter than the filamentous mesal basodorsal process. Phallus short, downturned.

Etymology. From the Latin *gibber*—humped, in reference to the elevated hump of segment X.

Remarks. This species has been collected commonly in the northwest of Western Australia and rather rarely from the Alligator Rivers region of the northern Northern Territory.

Triaenodes stipulosa sp. nov.

Figures 31–35

Material examined. Holotype, ♂, SE Queensland, Glastonbury Creek, 15 km W of Gympie, 27 Oct 1980, A. Neboiss, (NMV, T-16559).

Paratypes, Queensland: 4 ♂, Yabba Creek, 10 km W of Imbil, 26 Oct 1980, A. Neboiss, (NMV, genitalic prep. PT-782 illustrated); ♂, Obi Obi Creek, 8 km SW of Mapleton, 23 Oct 1980, A. Neboiss, (NMV); ♂, Camp Mountain, 31 Mar 1967, N. Dobrotworsky, (NMV); 2 ♂, Teviot Brook nr Wilsons Peak, 17–18 Nov 1980, M. Schneider and C. Daniels, (QM); ♂, Cooloola National Park, Noosa River, 28–29 Nov 1985, D. Bickle and G. Cassis, (NMV). North Queensland: 4 ♂, Alice River, Hervey River Road, 25 km W Townsville, 9 May 1979, A. Wells, (NMV); 3 ♂, Crystal Creek, Mt Spec turnoff, 2 May 1979, A. Wells, (NMV); ♂, Mulgrave River nr Gordonvale, 24 Mar 1992, G. Theischinger, (NMV); ♂, Mulgrave River, 8 km NW of Gordonvale, 15 Sep 1988, K. Walker, (NMV); ♂, Currunda Creek trib. of Freshwater Creek, Cairns District, 30 Apr 1979, A. Wells, (NMV); 2 ♂, 16 km W of Ravenshoe, 2 Jan 1975, M.S. Moulds, (NMV); 2 ♂, Annan River, 3 km W by S Black Mtn, 27 Sep 1980, J.C. Cardale, (ANIC); 2 ♂, Hann River, 73 km NW by W Laura, 27 Jun 1986, J.C. Cardale, (ANIC); ♂, Gunshot Creek, Telegraph Crossing, 10 Apr 1992, M. Crossland, (ANIC); 2 ♂, Cockatoo Creek crossing, 17 km NW Heathlands, 15–26 Jan 1992, T. Weir, (ANIC); ♂, Jardine River, Cape York Peninsula, 14 Oct 1979, M.S. Moulds, (NMV); ♂, same loc. 19 Oct 1992, P. Zborowski and T. Weir, (ANIC).

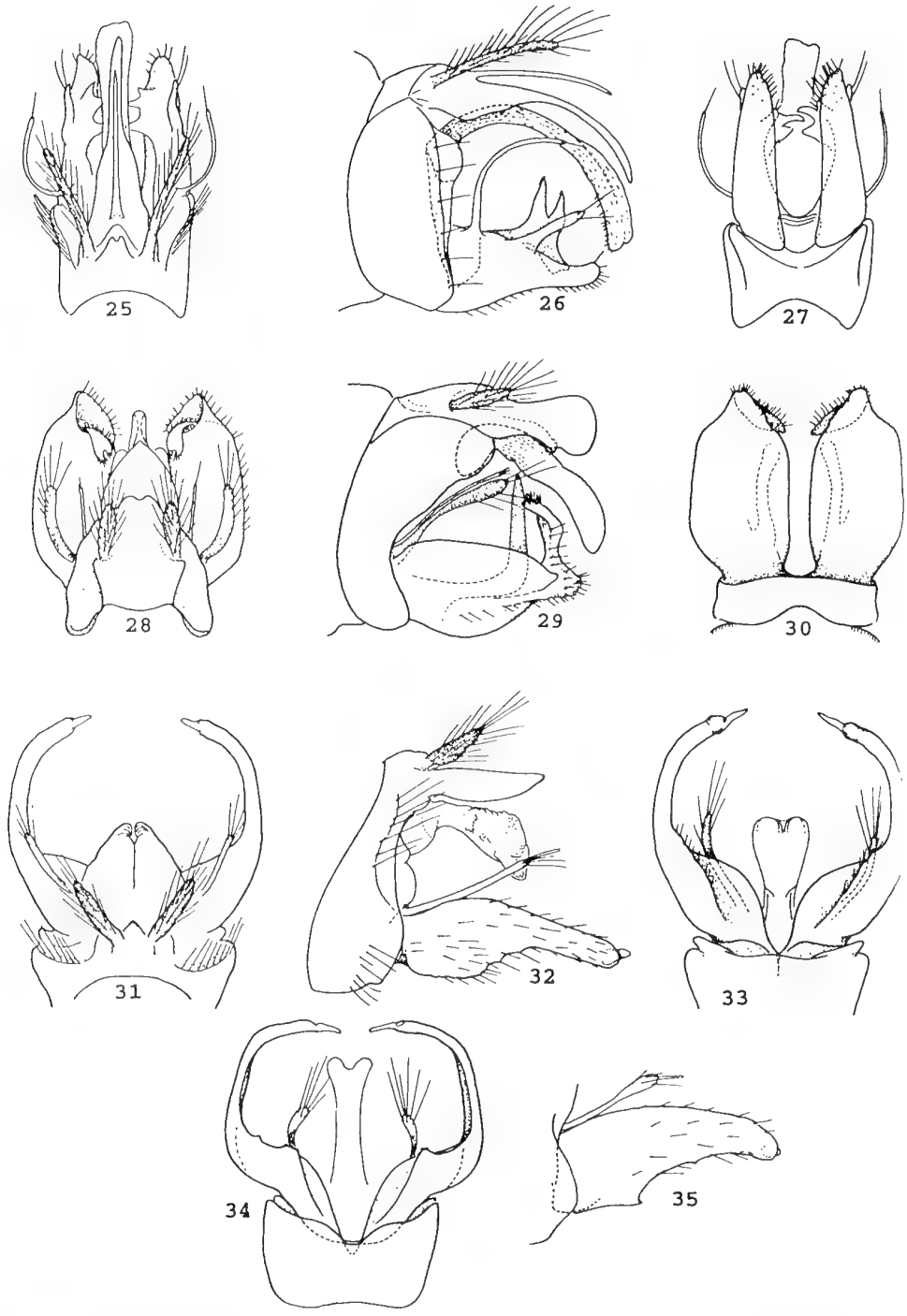
Other material. Western Australia: ♂, 12 km S of Kalumburu Mission, 14°25'S, 126°38'E CALM site 13/4, 7–11 Jun 1988, T.A. Weir, (ANIC), ♂, Ord River, 9 km N Kununurra, 19 Sep 1979, J. Blyth, (NMV).

Northern Territory: 2 ♂, Howard Creek, 3 km E of Howard Springs, 17 Aug 1979, J. Blyth, (NMV, genitalic prep. PT-784); 20 ♂, Holmes Jungle, 7 Apr 1991, Wells and Horak, (NMV); 4 ♂, McArthur River nr Cape Crawford, 25 Oct 1975, J.C. Cardale, (ANIC); ♂, Adelaide River, 15 km E of Stuart H-way, 15 Aug 1979, J. Blyth, (NMV). NE Queensland: ♂, Cockatoo Creek crossing, 17 km NW Heathlands HS, 11°39'S, 142°27'E, 22 Mar 1992, T.M. McLeod, (ANIC).

New South Wales: ♂, Clarence River at Yates Crossing, 26 Oct 1981, A. Wells and D. Carter, (NMV).

Diagnosis. In general form of male genitalia this species resembles *T. virgula* and *T. copelata*, from which it differs in having tergum X short, slightly divided distally and in lateral view, slender inferior appendages without the lateral basodorsal process.

Description. Length of forewing, ♂ 6.1–7.3 mm.



Figures 25–35, male genitalia: 25–27, *Triaenodes barbarae* sp. nov., dorsal, lateral and ventral views; 28–30, *Triaenodes gibberosa* sp. nov., dorsal, lateral and ventral views; 31–33, *Triaenodes stipulosa* sp. nov. (Yabba Creek, NE Qld), dorsal, lateral and ventral views; 34, 35, *Triaenodes stipulosa* sp. nov. (Howard Springs, NT), ventral view and inferior appendage, lateral view.

Genitalia, male (Figs 31–35). Abdominal segment IX reduced to a narrow band, width greatly exceeding length, posterolateral angles slightly produced. Segment X comprising a membranous plate, about half length of inferior appendages, broad mesally, tapered in distal half and cleft apically. Superior appendages narrow, about half length of tergum X. Inferior appendages clasper-shaped in ventral view, broad basally, slender in distal part, with a digitiform process apically; in lateral view skittle-shaped; lateral basodorsal process absent; mesal basodorsal process a single slender filament with a cluster of setae apically. Phallus arched, narrow proximally, slightly expanded distally.

Etymology. From the Latin, *stipes*—branch, in reference to the process arising at the base of the inferior appendage.

Remarks. Triaenodes stipulosa is widespread across northern Australia and down the Eastern Divide to northern New South Wales. At least in the Northern Territory it appears to be restricted to the slower low gradient, macrophyte rich silt-based streams. Males show considerable variation in genitalic form across the range, with the inferior appendages in ventral view being narrower in distal part and having a small angular projection posteroventrally at about one third distance from base (see Figs 34, 35).

Triaenodes etheira sp. nov.

Figures 36–41

Material examined. Holotype, ♂, Western Australia, Ord River, Kunnanurra Dam, 21 Feb 1977, J.E. Bishop, (NMV, T-16243).

Paratypes, Western Australia: 2 ♂, collected with holotype, (NMV, genitalic prep. PT-779 illustrated); 14 ♂, Drysdale River, 15°02'S, 126°55'E, 3–8 Aug 1975, I.F.B. Common and M.S. Upton, (ANIC, NMV, genitalic prep. PT-780, PT-781 for right side inferior appendage as illustrated); ♂, stream opposite Dead Horse Gap, Lake Argyle, 19 Feb 1977, J.E. Bishop, (NMV); ♂, the Crusher, 4 km S by W Mining camp, Mitchell Plateau, 2–6 Jun 1988, I.D. Naumann, (ANIC).

Northern Territory: ♂, McArthur River, 14 km S by W of Cape Crawford, 25 Oct 1975, J.C. Cardale, (ANIC); 3 ♂, Bessie Springs, 8 km ESE of Cape Crawford, 26 Oct 1975, J.C. Cardale, (ANIC, NMV); ♂, Limestone Gorge, 16°02'S, 130°23'E, 22 June–3 Aug 1986, M. Malipatil, (NMV); 7 ♂, Bullita outstation, 16°07'S, 130°25'E, 22 June–3 Aug 1986, MV light, M. Malipatil, (NTM, NMV); 2 ♂, South Alligator River, 23 Aug 1988, P. Dostine (NTM, NMV); m, same loc., Oct. 1988, P. Dostine, (NTM).

Diagnosis. In basic form of inferior appendages and tergum X this species appears most closely alligned with T. stipulosa. The form of the right inferior appendage resembles that of some of the more extreme forms of stipulosa, and the form of tergum X of both species is similar. However, T. *etheira* resembles *T. rutella* in having quite asymmetric inferior appendages. In this species the right inferior appendage has a stout, dorsally directed spine on the inner side near the base.

Description. Length of forewing, ♂ 5.7–6.7 mm.

Genitalia, male (Figs 36–41), with genitalic parts generally short compared to the width of the abdomen relative to most other Australian species. Abdominal segment IX with width greater than length. Tergum X comprising a membranous plate which is tapered distally and cleft apicomesally. Superior appendages slender, short, about two-thirds length of tergum X. Inferior appendages basically clasper-shaped, asymmetrical, left with a well-developed basodorsal spine which could be homologous with the lateral basodorsal process; on right in position of spine a variable-sized somewhat angular expansion on the dorsal surface; mesal basodorsal process dilated basally, with several apical setae. Phallus narrow proximally, greatly distended and downwturned in distal two-thirds.

Remarks. The shape of the right inferior appendage is variable (see Figs 39, 40, 41), sometimes appearing to retain vestiges of a spine to match that on the left side.

Etymology. The Latin *etheira*—mane or crest, in reference to the long hair tufts on the scape.

Remarks. Collected in the Ord River region of northwestern Western Australia and in the north of the Northern Territory, *T. etheira* may be more widespread across the north.

Triaenodes camura sp. nov.

Figures 42–44

Material examined. Holotype, ♂, Northern Territory, Devil Devil Creek, 70 km SW Daly River Mission, 23 Aug 1979, J. Blyth, (NMV, T-16486).

Paratypes, Northern Territory: ♂, same data as for holotype, (NMV, genitalic prep. PT-774 illustrated); 4 ♂, Muriella Park, 12 Oct 1971, E.F. Reik, (ANIC); 2 ♂, Cooper Creek, 19 km E by S Mt Borradaile, 9–10 Nov 1972, J.C. Cardale, (ANIC); ♂, Magela Creek, 2 km N Mudginberry Homestead, 14 Nov 1972, J.C. Cardale, (ANIC); 2 ♂, Nourlangie Creek, 6 km E Mt Cahill, 18 Nov 1972, J.C. Cardale, (ANIC); 7 ♂, same loc., 14–15 Jun 1973, J.C. Cardale; 2 ♂, Jim Jim Creek, 19 km WSW Mt Cahill, 17 Jun 1973, J.C. Cardale, (ANIC); 3 ♂, Katherine Gorge Nat. Park, 13 Aug 1979, J. Blyth,

(NMV); ♂, Jim Jim Waterhole, Kakadu National Park, 5 Sep 1979, J. Blyth, (NMV); 5 ♂, South Alligator River, UDP Falls, 7 Sep 1979, J. Blyth, (NMV); ♂, same loc., 18–19 Jul 1980, MV Lt, M. Malipatil, (NTM); 6 ♂, Magela Creek, 12 km N Arnhem Hwy on Oenpelli Road, 26 Mar 1980, M. Malipatil, (NTM, NMV); ♂, Graveside Gorge, 18 Jul 1988, P. Dostine, (NMV); ♂, Kambolgie Creek, 25 May 1988, P. Suter and A. Wells, (NTM); 2 ♂, South Alligator River, 23 Aug 1988, P. Dostine, (NMV); ♂, South Alligator River, Oct 1988, Lt tr., P. Dostine, (NTM); 2 ♂, Gulungul Creek at inlet to Billabong, 12°38'S, 132°53'E, 20 Apr 1989, A. Wells and P. Suter, (NMV).

Diagnosis. In form of male inferior appendages this species stands apart. The inferior appendages are symmetrical, each bearing subapically a broad, dorsally curving strap.

Description. Length of forewing, 6.1–6.9 mm.

Genitalia, male (Figs 42–44). Abdominal segment IX deepest ventrally, almost completely reduced dorsally. Tergum X comprising a pair of spine-like lobes which are slightly convergent distally. Superior appendages slender, about half length of tergum X. Inferior appendages symmetrical, narrow in lateral view; a strap-like process arising at about two-thirds length and twisting dorsally; lateral basodorsal process absent; mesal basodorsal process a single upwardly curved lobe, with sparse setae apically. Phallus narrow proximally, stouter in distal half, apically acute.

Etymology. From the Latin *camur*—turned inwards, crooked, in reference to the processes on the inferior appendages.

Remarks. This species is known only from the "Top End" of the Northern Territory. It is common in the Alligator Rivers Region where mass emergences appear to occur. Occasionally large numbers of individuals have been seen sitting on foliage of low riparian vegetation during the day.

Triaenodes rutella sp. nov.

Figures 45–47

Material examined. Holotype, ♂, Western Australia, Morgan River, Theda HS, Kimberley, 14°48'S, 126°43'E, 28 Sep 1979, J. Blyth, (NMV, T-16335).

Paratypes, Western Australia: 2 ♂, same data as for holotype, (NMV, genitalic prep. PT-770 illustrated); ♂, Charnley River, CALM site 25/2, 2 km SW Rolly Hill, 16°22'S, 125°12'E, 16–20 Jun 1988, I.D. Naumann, (ANIC).

Diagnosis. Triaenodes rutella is distinguished in the complex by the unequal but paired processes that arise dorsally on the inferior appendages. These are probably homologous with the straplike structures in *T. camura* from which this species also differs in having a simple undivided dorsal plate.

Description. Length of forewing, ♂ 5.6–5.7 mm.

Genitalia, male (Figs 45–47). Abdominal segment IX reduced to a narrow band with width greatly exceeding length, deeply excavated midventrally. Segment X a membranous plate, subapically expanded laterally, rounded apically in ventral view, acute in lateral view. Superior appendages slender, about two-thirds length of plate of tergum X. Inferior appendages in lateral view almost straight, narrow, on left a long slender curving strap-like process arises at about midway and twists dorsally, the right homologue is short and stouter, also twisted (these may have derived from the pincer-shaped process of *T. barbarae* and are surely homologous with the strap-like processes of *T. camura*); lateral basodorsal process absent, mesal basodorsal process slender, short, with a single apical seta. Phallus narrow, slightly curved.

Etymology. The Latin *rutella*—small shovel, in reference to the shape of segment X.

Remarks. Triaenodes rutella is known only from northwestern Western Australia.

celata **complex**

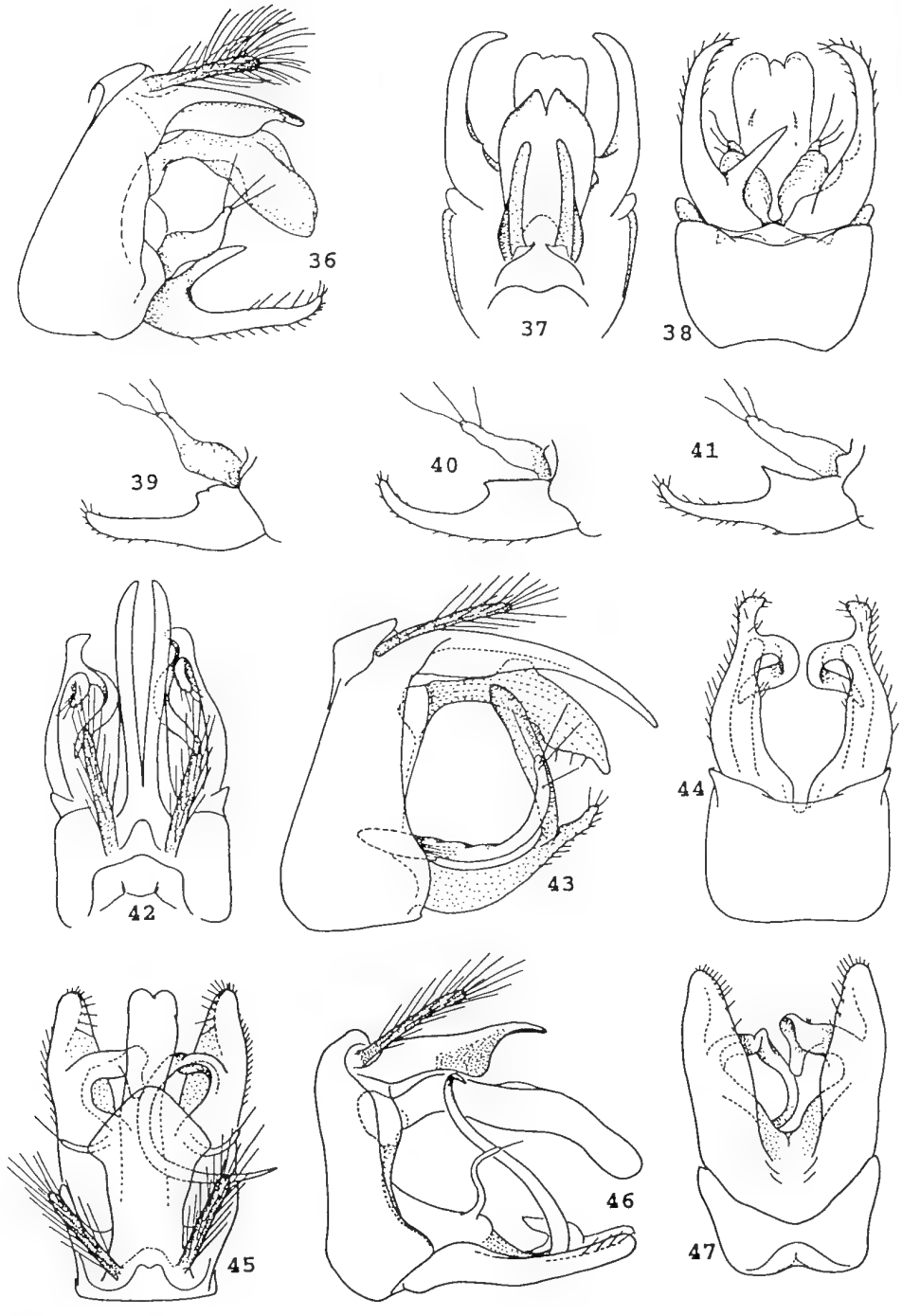
A set of four Australian species, here designated the celata complex (referred to by Neboiss and Wells (1996) as "group C") and including *Triaenodes celata* as well as *T. drepana* sp. nov., *dibolia* sp. nov., and *reclusa* sp. nov., all have the unusual feature of a suture completely dividing the IXth abdominal segment but more ventrally placed than the usual midlateral position of the separation of tergum and sternum. In this complex (see Figs 48–59) superior appendages are present; tergum X is a simple membranous plate; the inferior appendages lack the mesal basodorsal process, having only a slender apically setose lateral basodorsal process; and the phallus is not bulbous basally, lacks supporting strips and is positioned dorsally.

Species with this curious suture on abdominal segment IX appear to occur only in the north of Australia. No similar species are known at present from New Guinea or Indonesia.

Triaenodes celata sp. nov.

Figures 48–50

Material examined. Holotype, ♂, N Queensland, Alice River nr Townsville, 11 Apr 1979, A. Wells, (NMV, T-16431).



Figures 36–47, male genitalia: 36–41, *Triaenodes etheira* sp. nov., lateral, dorsal and ventral views, right inferior appendages of (39) PT-779 – Howard Springs, NT, (40) PT-780 and (41) PT-781 – Drysdale River, NT; 42–44, *Triaenodes camura* sp. nov., dorsal, lateral and ventral views; 45–47, *Triaenodes rutella* sp. nov., dorsal, lateral and ventral views.

Paratypes, N Queensland: 3 ♂, same data as for holotype, (NMV, genitalic prep. PT-801 illustrated); ♂, 16 km S of Coen, 29 Nov 1974, M.S. Moulds, (NMV); ♂, Lockerbie Scrub, Cape York Peninsula, 15 Jun 1975, M.S. Moulds, (NMV); ♂, Hervey Range, Two Mile Creek, 16 Apr 1979, A. Wells, (NMV); ♂, Stoney Creek on Mt Stuart Road nr Townsville, 27 Apr 1979, A. Wells, (NMV); ♂, Bertie Creek, 1 km SE of Heathlands Homestead, 4 Feb 1992, D. Cartwright and A. Wells, (NMV); 2 ♂, Cape York Peninsula, Tributary Bertie Creek, 2.5 km SW of Heathlands, 11 Feb 1992, D. Cartwright and A. Wells, (NMV); 26 ♂, Cape York Peninsula, Heathlands Homestead, Bertie Creek, 23 Mar 1993, M. Crossland, (ANIC, NMV).

Other material. N Queensland: 2 ♂, Iron Range, 27.vi–4 May 1973, S.R. Monteith, (ANIC); ♂, same loc., 5 Jan 1974, S. McEvey, (NMV); ♂, same loc., 5 May 1975, M.S. Moulds, (NMV); 10 ♂, Lockerby area, Cape York Peninsula, 13–27 Jun 1973, S.R. Monteith, (ANIC); ♂, Kalpower Crossing, NE of Laura, 2 Jun 1983, Storey and Brown, (NMV); ♂, 5 km WNW Captain Billy Landing, monsoon forest, 2 Apr 1993, P. Zborowski, (ANIC).

Diagnosis. Males of *Triaenodes celata* resemble those of *T. dibolia* sp. nov. and *T. drepana* sp. nov., but differ from both in having the apices of the inferior appendages rounded, a feature shared with *T. reclusa* sp. nov. They also differ from males of the latter species in that tergum X is undivided.

Description. Length of forewing, ♂ 5.0–5.8 mm.

Male genitalic structures (Figs 48–50) relatively simple. Abdominal segment IX with sternite heart-shaped in ventral view. Segment X in form of a simple membranous plate, slightly concave apically. Superior appendages short, about two-thirds length of tergum X. Inferior appendages clasper-shaped in ventral view, lateral mesodorsal process filiform, setate distally. Phallus in lateral view shaped rather like an inverted foot, being narrow anteriorly, swollen and down-turned in distal half.

Etymology. From the Latin *celo* (-atus)—hide, conceal, in reference to the pale cover on the antennal scape scent organ.

Remarks. Triaenodes celata is common in north-eastern Queensland.

Triaenodes dibolia sp. nov.

Figures 51–53

Material examined. Holotype, ♂, NW Western Australia, Mitchell Plateau, Camp Creek, 31 Jan 1978, J.E. Bishop, (NMV, T-16426).

Paratypes, NW Western Australia: ♂, same data as for holotype, (NMV, genitalic prep. PT-768 illustrated); ♂, Mitchell Plateau, Mining Camp, 14°49'S, 125°50'E, 9–19 May 1983, J.C. Cardale, (ANIC). Northern Territory: 2♂ , Goanna Lagoon, 1 km W of Jabiru off Arnhem Highway, 27 Feb 1979, R. Marchant, (NMV); ♂, Darwin, 1 Jun 1980, M. Malipatil, (NTM); ♂, Town Lake, Jabiru, 16 Feb 1991, MV-lt, A. Wells and C. Humphrey, (NMV).

Diagnosis. This species most closely resembles *T. celata* and *T. drepana* sp. nov. in general form of male genitalic structures, but is distinguished by having inferior appendages lanceolate and almost straight in lateral view.

Description. Length of forewing, ♂ 5.1–5.3 mm.

Genitalia, male (Figs 51–53). Abdominal segment IX with sternite somewhat barrel-shaped in ventral view. Segment X in form of a simple membranous plate, broad-based, obliquely truncate apically. Superior appendages about equal in length to tergum X. Inferior appendages forceps-like in ventral view, elongate, slender, apically acute, lateral basodorsal process slender, about two-thirds length of the inferior appendage, setose apically. Phallus stout, curving downwards.

Etymology. From the Greek *dibolia*—two-pointed lance, in reference to the shape of the inferior appendages.

Remarks. This species is known from north-western Western Australia and the Alligator Rivers region of Northern Territory. Two of the three Northern Territory records are from a lake and a billabong and it may well be restricted to lentic systems.

Triaenodes drepana sp. nov.

Figures 54–56

Material examined. Holotype, ♂, Northern Territory, Katherine Gorge National Park, 26 Jan 1977, M.S. and B.J. Moulds, (NMV, T-16392).

Paratypes: Northern Territory: 4 ♂, same data as for holotype, (NMV, genitalic prep. PT-777 illustrated); ♂, Birraduk Creek, 18 km E by N of Oenpelli, 12°17'S, 133°13'E, 4–5 Jun 1973, J.C. Cardale, (ANIC); ♂, 12 km NNE of Borroloola, 15°58'S, 136°21'E, 1 Nov 1975, J.C. Cardale, (ANIC); ♂, Roper River, Mataranka Homestead, 25 Jan 1977, M.S. and B.J. Moulds, (NMV); 3♂, Butterfly Gorge, Katherine Gorge National Park, 27 Jan 1977, M.S. and B.J. Moulds, (NMV); ♂, Cooper Creek, 11 km S by W of Nimbuwah Rock, 12°17'S, 133°20'E, 3–4 Jun 1979, J.C. Cardale, (ANIC); ♂, Magela Creek, S of Georgetown Billabong, 26 Mar 1983, A.J. Sharley, (NTM); 3♂, South Alligator River nr Coronation Hill, 9 Feb 1988, P. Dostine, (NMV); ♂, South Alligator River nr Coronation Hill, 16 Feb 1989, P. Dostine, (NTM); 2♂, Radon Springs, 1 hr before dawn, 14 Apr 1989, P. Suter

and A. Wells, (NMV), ♂, South Alligator River above Fisher Creek junction, 13°34'S, 132°34'E, 19–20 Apr 1989, P. Suter and A. Wells, (NMV), 5♂, Magela Creek, 15 Feb 1991, UV-lt, A. Wells, (NMV); ♂, Magela Creek, at Rum pipeline, 18–19 Feb 1991, P. Dostine, (NMV).

Other material. NW Western Australia: 3♂, Four Mile Creek, Kimberley, 2 Feb 1978, I.F.L., J.F. Bishop, (NMV), ♂, Maggie Creek, 3 Feb 1978, J.F. Bishop, (NMV), 15♂, Mitchell Plateau, Jan.–Feb. 1978, 1979, J.F. Bishop, J.C. Cardale, (NMV, ANIC); ♂, Pine Spring Creek, 2 Feb 1987, J.F. Bishop, (NMV).

Further material available in NTM and NMV from Magela Creek and Jabiru, Northern Territory.

Diagnosis. Grouped with *T. eclata* and *T. diboita* but distinguished by having inferior appendages slender and strongly curved anteriorly and dorsally.

Description. Length of forewing, ♂ 5.0–5.8 mm.

Genitalia, male (Figs 54–56). Abdominal segment IX wedge shaped in ventral view. Segment X in form of a simple membranous plate, broad based, tapered in distal half, somewhat irregular apically. Superior appendages about half length of tergum X. Inferior appendages forming a pair of symmetrical spine-like processes, arched anteriorly and dorsally; basodorsal process filamentous. Phallus stout, curved downwards in distal half.

Etymology. From the Greek *drepana* = sickle, in reference to the shape of the inferior appendages.

Remarks. This is a common species in northern Northern Territory and also occurs in NW Western Australia.

Triaenodes reclusa sp. nov.

Figures 57–59.

Material examined. Holotype, ♂, N. Queensland, Mulgrave River, W. of Gordonvale, 17°10'S, 145°53'E, 29 Apr 1979, A. Wells, (NMV, genitalic prep. PT-759 illustrated, I-16428).

Paratype, ♂, N. Queensland, Woodbadda River, 15°58'S, 145°22'E, 25 Aug 1992, J.C. Cardale and P. Zborowski, (ANIC).

Diagnosis. This species shares with others in the group the overall appearance of segment IX, but the separation of the upper and lower parts of the segment is greater. As in *T. drepana* the inferior appendages form curved spines, but here there is also a well developed rounded mesoventral lobe and tergum X comprises a short, simple ventral plate and a slender upper structure.

Description. Length of forewing, ♂ 6.2 mm.

Genitalia, male (Figs 57–59). Abdominal segment IX with sternite elongate rectanguloid. Tergum X comprising an elongate upper structure, almost spatulate in dorsal view, in lateral view rather sinuous with a pair of upwardly directed small spurs; and a membranous, triangular median plate. Superior appendages slender, elongate, only slightly shorter than upper structure of tergum X. Inferior appendages rounded basally, produced laterally into long recurved spines, mesoventrally a rounded lobe covered densely with small peg-like setae, lateral basodorsal process reduced to a small dorsal fingerlike projection. Phallus, narrow proximally, swollen and slightly downturned in distal two-thirds.

Etymology. From the Latin *reclusus*, in reference to the distinctness of the male genitalia.

Remarks. This species is known from only two records in NE Queensland.

intricata complex

Ten Australian species, *Triaenodes intricata*, *T. perissotes* sp. nov., *T. implexa* sp. nov., *T. resima* sp. nov., *T. cymulosa* sp. nov., *T. conjugata* sp. nov., *T. allax* sp. nov., *T. mouldsi* sp. nov., *T. teretis* sp. nov., and *T. fuscinula* sp. nov. form the *intricata* complex on the basis of their males sharing the feature of an incomplete oblique groove on abdominal segment IX, and tergum X comprising an upper median structure and ventrally a pair of spines. In this set (see Figs 60–85) the inferior appendages generally have some kind of dorsomesal lobe bearing peg-like setae. The mesal basodorsal process is bifid, but generally more lobose than spiny; and the phallus is median in position.

All the species in this complex are eastern in distribution, members being found in Tasmania, southern South Australia and along the Dividing Range to NE Queensland. At least two close species, *T. nigrolineata* Kimmins, 1962 and *T. mondoana* Kimmins, 1962, occur in New Guinea.

Triaenodes intricata Neboiss

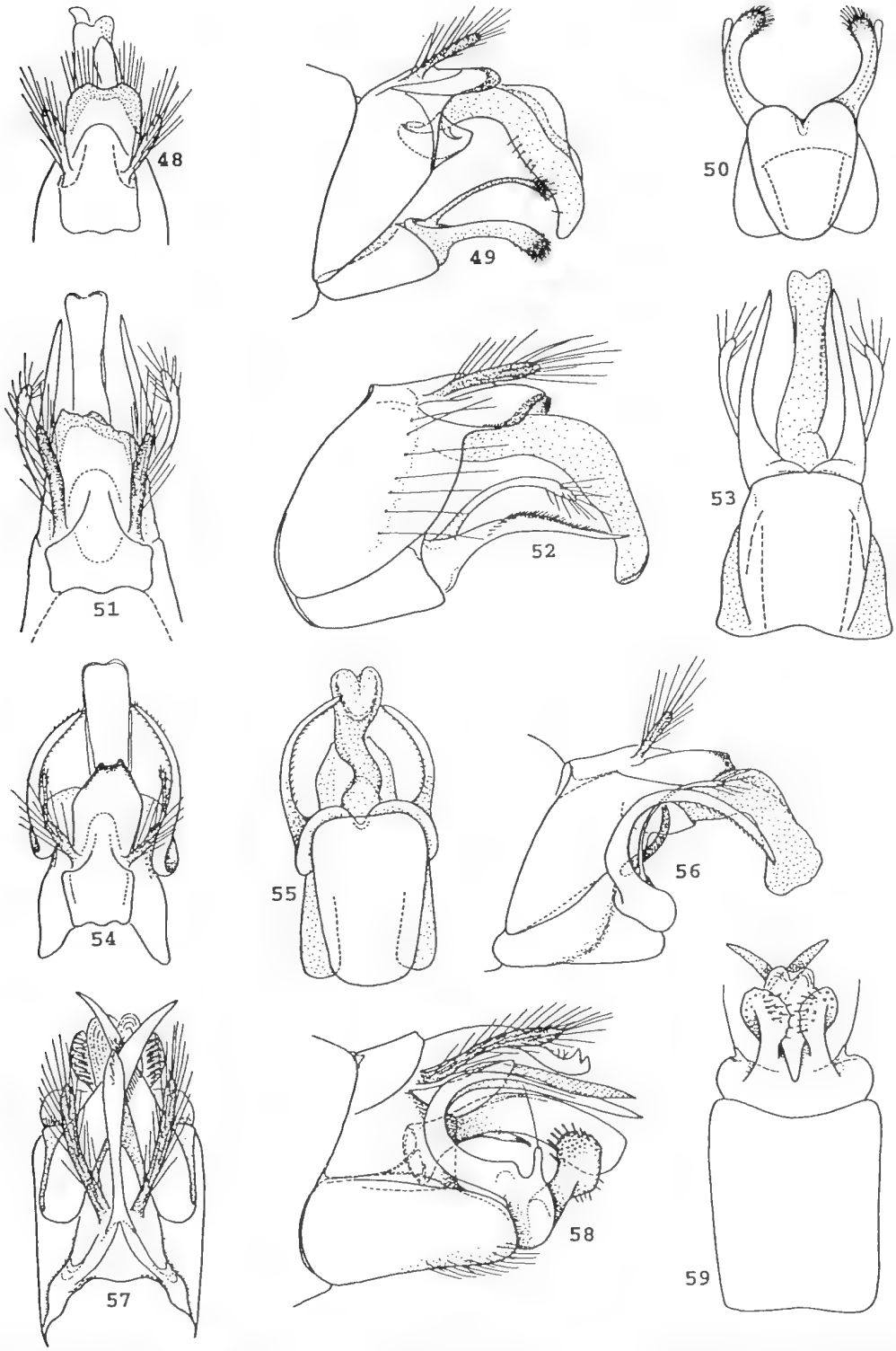
Figures 60, 61.

Triaenodes intricata Neboiss, 1977: 142.

Holotype ♂, Tasmania, South Esk River, Evandale.

Material examined.

Paratype, ♂, Tasmania, South Esk River, Evandale, 1 Mar 1967, A. Neboiss, (NMV, genitalic prep. PT-199).



Figures 48–59, male genitalia: 48–50, *Triaenodes celata* sp. nov., dorsal, lateral and ventral views; 51–53, *Triaenodes dibolia* sp. nov., dorsal, lateral and ventral views; 54–56, *Triaenodes drepana* sp. nov., dorsal, ventral and lateral views; 57–59, *Triaenodes reclusa* sp. nov., dorsal, lateral and ventral views.

Remarks. Known only from a small, clean, sandy-bottomed stream, *T. perissotes* is a close sister species to *Triaenodes implexa*, on the nearby mainland.

Triaenodes resima sp. nov.

Figures 66–68

Material examined. ♂, Victoria, Wingan River, 8 km S of Princes H-way, 37°37'S, 149°29'E, 30 Jan 1975, A. Neboiss, (NMV, T-16523).

Paratypes, 3♂, same data as holotype, (NMV, genitalic prep. PT-750 illustrated).

Diagnosis. This species closely resembles *T. implexa* and *T. perissotes*, but is distinguished by having more elongate parts, including longer superior appendages, longer and narrower parts of tergum X and more attenuated apices on the inferior appendages.

Description. Length of forewing, ♂ 6.2–6.7 mm.

Genitalia, male (Figs 66–68). Abdominal segment IX, in ventral view longer than wide; in lateral view the oblique groove and apicolateral margin separate a more or less triangular membranous area which effectively distances the upper and lower genitalic parts. Segment X with upper part elongate, apically tripartite, medial lobe acute apically, lateral lobes fine, extending well beyond medial lobe; ventral "spines" slender, unequal, divergent distally. Superior appendages elongate, about as long as upper part of tergum X. Inferior appendages in lateral view with apex produced posteriorly, upturned; mesodorsal lobe about twice as long as wide, rounded apically; lateral basodorsal process short, triangular; mesal basodorsal process bilobed, outer lobe slender, arching downwards, inner lobe swollen in median section, strongly down-turned, a small cluster of short setae apically. Phallus narrow proximally, down-turned and swollen in distal half.

Etymology. From the Latin *resimus*—turned upwards, in reference to the shape of the inferior appendages.

Remarks. Known only from the type locality in eastern Victoria.

Triaenodes conjugata sp. nov.

Figures 69–71

Material examined. holotype, ♂, Victoria, Bells Clearing, 6 km S of Aberfeldy, 37°45'S, 146°23'E, 6 Feb 1977, A.A. Calder, (NMV, T-16566).

Paratypes, Victoria: 2♂, same data as for holotype, (NMV, genitalic prep. PT-743 illustrated); ♂, same loc., 2 Dec 1977, A.A. Calder, (ANIC); 10♂, Yarra River, below Upper Yarra Dam, 28 Feb 1976, A. Neboiss, (NMV); ♂, Yarra River nr McMahons Creek, 19 Feb 1976, A. Neboiss, (NMV); ♂, Yarra River, Warburton East, 17 Feb 1976, A. Neboiss, (NMV); 6♂, Buffalo River nr Abbeyards, 27 Jan 1960, A. Neboiss, (NMV); 3♂, Ovens River, Porepunkah, 26 Jan 1960, A. Neboiss, (NMV).

Other material. Victoria: ♂, Mitta Mitta River, 4 Feb 1961, E. Matheson, (NMV); ♂, Mitta Mitta River, 8 km NE of Benambra, 5 Feb 1974, A. Neboiss, (NMV); ♂, 2♀, Wongungurra and Crooked River junction, 9 Feb 1981, J. Blyth, (NMV); 3♂, ♀, Myrtleford, Eucalyptus forest, small creek, 23 Jan 1973, A. Neboiss, (NMV); 3♂, Murrindal, 6 Jan 1967, E. Hamilton-Smith, (NMV); ♂, 2♀, Little River, 6 km E of Wulgulmerang, 12 Dec 1976, A. Neboiss, (NMV); 3 ♂, 4♀, Cobungra River, Anglers Rest, 4 Feb 1974, A. Neboiss, (NMV); ♂, same loc., 30 Jan 1957, A. Neboiss, (NMV); 2♂, same loc., 15 Jan 1982, A. Wells, (NMV); ♂, ♀, Wellington River, 23 Km NNE Licola, 21 Feb 1978, A.A. Calder, (NMV); ♂, 2♀, Tanjil River nr Old Tanjil, 5 Feb 1980 (no collector), (NMV); 5♂, 7♀, Cann River, 2 km S of Buldah, 17 Dec 1976, A. Neboiss, (NMV).

Also numerous records from many eastern Victorian rivers.

Diagnosis. In general form of male genitalia, *T. conjugata* sp. nov. resembles others in the group, but it is distinguished in lateral view by the more regular and apically truncate appearance of the inferior appendages and in dorsal view by tergum X with median dorsal lobe more elongate and with its apicomedial process longer than its lateral processes.

Description. Length of forewing, ♂ 6.5–7.3 mm.

Genitalia, male (Figs 69–71). Abdominal segment IX narrow and produced posteroventrally with an oblique lateral fold forming a pronounced pocket on each side and a rounded membranous area at the base of the inferior appendages. Tergite X dorsally comprising a slender elongate lobe which is produced distally to the length of the right ventral "spine", divided in distal third to form 2 short lateral processes and a longer, setose medial process, and basally above this lobe another short bilobed process; ventrally the paired "spines" are separated to their bases and are unequal, varying such that in about equal numbers of specimens the left less than half length of right and vice versa. Superior appendages slender, elongate. Inferior appendages stout, in lateral view almost rectangular, lateral basodorsal process probably represented by a short dorsal process on the upper margins; mesal basodorsal process divided to form a pair of lobes, the outer one hooked downwards, the inner angled posteriorly. Phallus elongate, curved down-wards, narrow proximally, stout in distal half.

Other material. Tasmania: 5 ♂, Tooms Lake, 4 Dec 1974, A. Neboiss, (NMV); 1 ♀, Scamander River, Upper Scamander, 9 Nov 1972, A. Neboiss, (NMV); 1♀, South Esk River, Evandale, 1 Mar 1967, (NMV); 11 ♂, ♀, Apsley River, 5 km NW of Bicheno, 20 Dec 1988, J. Jackson, (NMV); 3 ♀, Derwent River, 2 km NW of Derwent Bridge, 12 Feb 1971, A. Neboiss, (NMV); 1 ♀, Gordon River, 1 km above First Split, 11 Jan 1977, A. Neboiss et al., (NMV); 2 ♀, Swamp in Olga River, 19 km above Gordon River junct., 13 Jan 1977, A. Neboiss and R. Swain, (NMV); 1 ♀, Lake Fiddler, Lower Gordon River, 13 Dec 1977, D. Coleman, (NMV); 14 ♀, Sandfly Creek at Scotts Peak Road, 9 Feb 1988, K. Walker and J. Jackson, (NMV).

Diagnosis. Resembling *T. implexa* sp. nov., *T. perissotes* sp. nov. and *T. resima* sp. nov. in general form of male genitalia, but the form of tergum X, with a simple filamentous upper part, is quite distinct from those species.

Description. Length of forewing, ♂ 7–8 mm.

Genitalia, male (Figs 60, 61). Abdominal segment IX with an incomplete oblique lateral groove effectively distancing the upper and lower genitalic parts. Segment X comprising an upper median filament which is setate apically and paired equal length spines, the right one of which is upturned. Superior appendages short, tapered, about a third length of spines of tergum X. Inferior appendages in lateral view short, tapered and upturned apically, and with a rounded mesodorsal lobe; lateral basodorsal process short with a pair of short setae apically. Phallus short, narrow at base, greatly expanded and down-turned in distal two-thirds.

Remarks. This species is known only from Tasmania, where it appears to be quite widespread. It has been collected from December to early February.

Triaenodes implexa sp. nov.

Figure 62

Material examined. Holotype, ♂, South Australia, Mitcham, Brownhill Creek, A. Wells, 3 Mar 1976, (NMV).

Paratypes: ♂, same data as for holotype, (NMV, genitalic prep. PT-773 illustrated); ♂, same locality and collector as holotype, 21 Nov 1983, (NMV); ♂, South Australia, Ironbank, 17 Nov 1983, A. Wells, (NMV).

Diagnosis. Triaenodes implexa most closely resembles *T. perissotes* from which it is distinguished by the shape of the upper part of tergum X in which the terminal three lobes are equal in length.

Description. Length of forewing, ♂ 6.4–7.6 mm.

IX, with the oblique groove forming lateral ridges in ventral aspect. Segment X with upper part tripartite and all lobes equal in length; ventral "spines" slender, divergent distally. Superior appendages elongate, about length of tergum X. Inferior appendages in lateral view slightly upturned apically; a stout mesodorsal lobe inside the small lateral basodorsal process; mesal basodorsal process bilobed, outer lobe slender, arching downwards, inner lobe also slender, somewhat strap-like medially, strongly down-turned, a small cluster of short setae apically. Phallus narrow at base, down-turned and swollen in distal half.

Etymology. from the Latin *implexus*—interwoven, in reference to the male genitalic structures.

Remarks. This species is known only from the vicinity of Adelaide, South Australia. Larvae netted from among the dense macrophytes at one of the collecting sites were probably of this species.

Triaenodes perissotes sp. nov.

Figures 63–65

Material examined. Holotype, ♂, South Australia, Kangaroo Island, Rocky River at bridge, A. Wells, 20 Dec 1980, (NMV, T-16747).

Paratypes: 18 ♂, same data as for holotype, (NMV, genitalic prep. PT-749 illustrated).

Diagnosis. This species resembles *T. implexa* but is distinguished by unequal lobes subapically on the upper part of tergum X.

Description. Length of forewing, ♂ 6.5–7.5 mm.

Genitalia, male (Figs 63–65). Abdominal segment IX, quadrate in ventral view, lateral suture effectively distancing the upper and lower genitalic parts. Segment X comprising an upper part with median lobe of tripartite apex about half length of lateral lobes; "spines" of ventral part slender, equal, divergent distally. Superior appendages elongate, shorter than spines of tergum X. Inferior appendages short, in ventral view obliquely truncate apically; in lateral view with apex slightly upturned and mesodorsal lobe about 1.5 × basal width, rounded apically; lateral basodorsal lobe short; mesal basodorsal process bilobed, outer lobe slender, slightly arched downwards, inner lobe slender, spine-like, strongly down-turned. Phallus narrow at base, down-turned and swollen in distal half.

Etymology. From the Greek *perisseia*—abundance, in reference to the numerous projections in the male genitalia.

Etymology. From the Latin *junctus*—unite = conjugate, in reference to occurrence of both short and long genitalic processes in the one species.

Remarks. Commonly collected from eastern and central Victoria.

Triaenodes cymulosa sp. nov.

Figures 72–74

Material examined. Holotype, ♂, SE Queensland, Goomburra State Forest, NE of Warwick, 28°03'S, 152°07'E, 20 Jan 1986, G. Theischinger (NMV, T-16217).

Paratypes, 1♂, same data as for holotype, (NMV genitalic prep. PT-1747 illustrated).

Diagnosis. This species resembles *T. implexa* and *T. resima* but shows more extreme development of most structures, including the upper membranous part of segment IX, and has the ventral part of tergum X reduced to two short, apically rounded lobes.

Description. Length of forewing, ♂ 6.3–6.4 mm

Genitalia, male (Figs 72–74). Abdominal segment IX in lateral view produced posteroventrally beyond a pronounced groove to form a triangular part dorsal to which is a folded or concertinaed membranous area. Tergum X comprising a pair of dorsomedial digitiform lobes above an elongate median lobe which is tripartite distally with the median structure setose and longer than the lateral ones; ventral "spines" reduced to short apically rounded lobes. Inferior appendages in lateral view slender, upturned, mesodorsal lobe tapered distally, lateral basodorsal process short, digitiform, mesal basodorsal process bifid, strongly arched with inner spine almost reaching to tip of inferior appendages, outer lobe slender with setae at apex. Phallus elongate, slightly wider distally than proximally, down-turned.

Etymology. From the Latin *cymula*—cluster of branches in reference to the male genitalia.

Remarks. Known only from the type locality in SE Queensland.

Triaenodes allax sp. nov.

Figure 75

Material examined. Holotype, ♂, N Queensland, Tinaroo Dam, 2 km on Mt Edith Road, 23 Jun 1971, E.F. Riek, (ANIC, genitalic prep. PT-757 illustrated).

Other material. 3♀, collected with holotype, may be this species, (ANIC, genitalic prep. PT-1137).

Diagnosis. Triaenodes allax closely resembles *T. cymulosa* in the shape of abdominal segment IX and of the mesal basodorsal processes on the inferior appendages but in other respects the inferior appendages are more like those of *T. conjugata*. In the form of tergum X, too, this species and *T. conjugata* are closely similar.

Description. Length of forewing, ♂ 6.1 mm.

Genitalia, male (Fig. 75). Abdominal segment IX strongly produced posteroventrally, beyond a pronounced groove, to form a triangulat part below a membranous area. Segment X with dorsal lobe longer than superior appendages, apically trifurcate; spines reduced to short stubs. Superior appendages slender, elongate, shorter than median structure of tergum X. Inferior appendages broad in lateral view, apically truncate; lateral basodorsal process very short, subtriangular; mesal basodorsal process bifid, outer lobe filamentous, arched posteriorly and setose apically, inner lobe slender, elongate, forming a fine spine arching alongside the phallus. Phallus elongate, slender throughout length.

Etymology. From the Greek, *allax*—crosswise, alternate, in reference to double crossing of processes.

Remarks. Known only from the type locality in NE Queensland, this species closely resembles *T. nigrolineata* Kimmins, 1962 from New Guinea.

Triaenodes fuscinula sp. nov.

Figures 76–78

Material examined. Holotype, ♂, Victoria, Lake Mountain, 4600 ft, 17 Jan 1965, A. Neboiss, (NMV, T-16572).

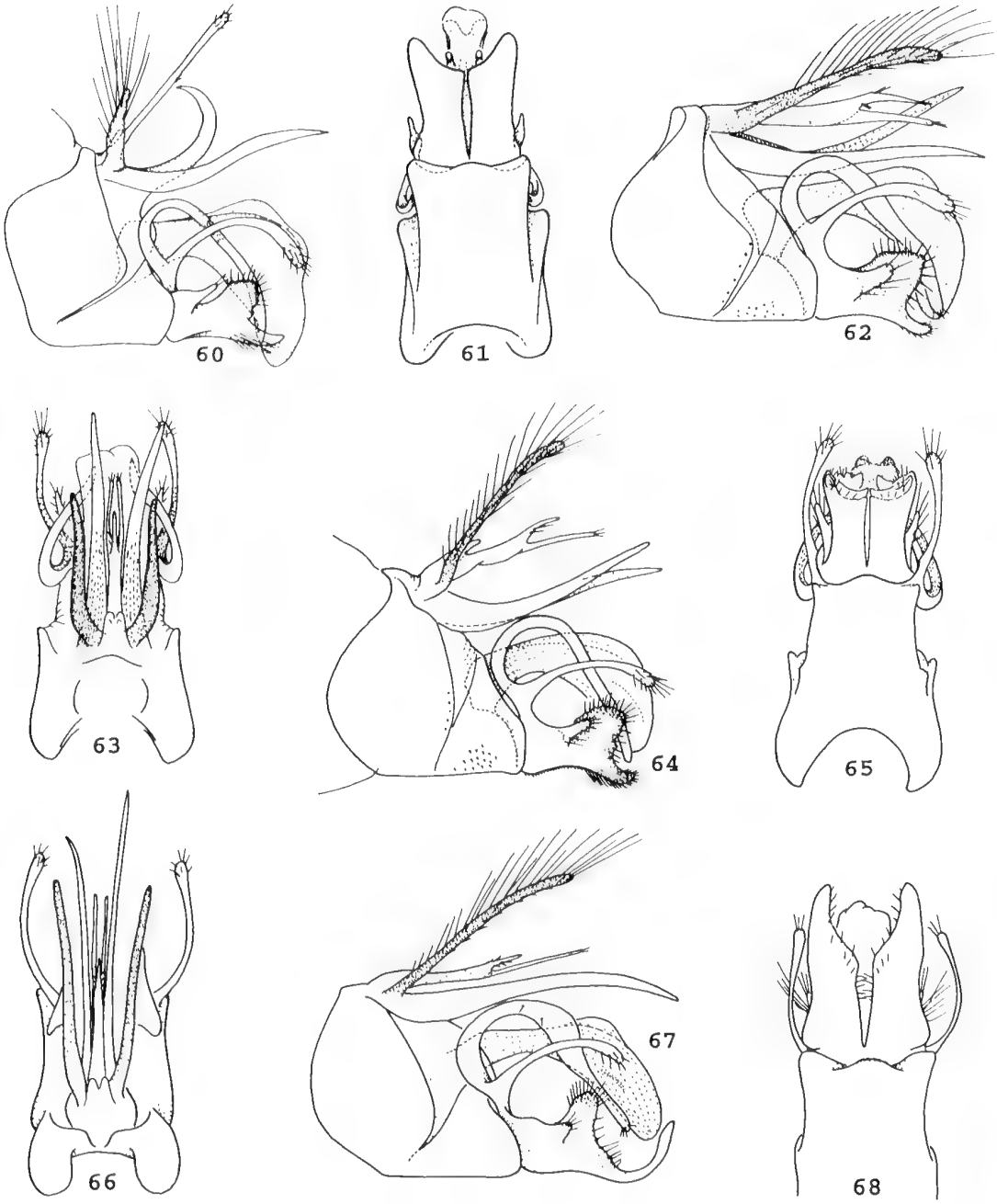
Paratypes, Victoria: 3♂, same loc. as for holotype, 17 Jan 1961, A. Neboiss, (NMV); 5♂, same loc. as for holotype, 11 Feb 1982, A. Neboiss and K. Walker, (NMV); ♂, 8 km NE Toolangi, 2 Dec 1970, A. Neboiss, (NMV); ♂, Delegate River, Gunmark track, 12 km SW of Bendock, 15 Dec 1976, A. Neboiss, (NMV, genitalic prep. PT-797 illustrated); ♂, Delegate River, 8 km SW of Bendock, 15 Dec 1976, A. Neboiss, (NMV).

Other material. Victoria, ♂, Murrindindi, Nov. 1987, A. Neboiss, (NMV); ♂, Wilsons Promontory, 26 Sep 1953, G.W. Douglas, (NMV).

Diagnosis. In the form of segment IX this species most closely resembles *T. conjugata* but the shape of the inferior appendages is closer to that of *T. resima*. *Triaenodes fuscinula* is distinguished by having the mesal basodorsal process bifid but very short and the spines of tergum X unequal.

Description. Length of forewing, ♂ 6.9–7.9 mm.

Genitalia, male (Figs 76–78). Abdominal segment IX, subrectangular in ventral view; in lateral



Figures 60–68, male genitalia: 60, 61, *Triaenodes intricata* Neboiss, lateral and ventral views; 62, *Triaenodes implexa* sp. nov, lateral view; 63–65, *Triaenodes perissotes* sp. nov., dorsal, lateral and ventral views; 66–68, *Triaenodes resima* sp. nov., dorsal, lateral and ventral views.

view with a deep oblique groove resulting in a stout distal extension. Segment X comprising an apically tripartite upper structure and ventrally paired slender, unequal spines, left spine about half length of right. Superior appendages slender, shorter than dorsal lobe of tergum X. Inferior appendages produced and tapered, narrow and upturned in distal section; dorsomesal lobe short, somewhat fan-shaped; lateral basodorsal process digitiform; mesal basodorsal process bilobed, outer lobe short, straight, digitiform, inner lobe slender, scythe-shaped, at base a rounded process. Phallus elongate, narrow at base, down-turned and swollen in distal half, with a lobose dorsal process.

Etymology. Latin, *fuscinula*—three-pronged fork, in reference to tergum X.

Remarks. Despite concentrated collection efforts throughout Victoria, *T. fuscinula* is known only from a few scattered localities. It is almost certainly rare; collecting dates are from November to February.

Triaenodes mouldsi sp. nov.

Figures 79–82

Material examined. Holotype, ♂, N Queensland, Midddle Claudie River, Iron Range, 2–9 Sep 1974, M.S. Moulds (NMV, T-16528).

Paratypes, NE Queensland: 5♂, same data as for holotype, (NMV); 4♂, same loc. as for holotype, 19.ix–23 Oct 1974, (NMV); ♂, Iron Range airstrip, 16 Sep 1974, M.S. Moulds, (NMV); ♂, Lockerby area, Cape York, 13–27 Apr 1973, S.R. Monteith, (QM); 5♂, West Claudie River, Iron Range, 17 Sep 1974, M.S. Moulds (NMV); ♂, Iron Range, 5 May 1975, M.S. Moulds, (NMV); 2♂, Gordon Creek, Iron Range, 18.iv–27 May 1975, M.S. Moulds, (NMV); 7♂, Upper Jardine River, Cape York Peninsula, 11°10'S, 142°35'E, 13–27 Oct 1979, M.S. Moulds, (NMV, genitalic prep. PT-763 illustrated); ♂, McIvor River, Cape York Peninsula, 15 Feb 1982, M.S. Moulds, (NMV); 15♂, 2–11 km NE Mt Tozer, 30.vi 10 Jul 1986, J.C. Cardale, (ANIC, NMV); 2♂, Claudie River, Iron Range, 10 Nov 1988, K. Walker, (NMV); ♂, Bertie Creek, 1 km SE Heathlands H.S., 4 Feb 1992, D. Cartwright and A. Wells, (QM); ♂, Gunshot Creek at telegraph crossing, 14–16 Feb 1992, D. Cartwright and A. Wells, (QM).

Other material. NE Queensland: ♂, ♀, Mt Molloy, 13 Jun 1971, E.F. Riek, (ANIC); ♂, McIvor River crossing, 40 km N Cooktown, 15–18 Jun 1976, S.R. Monteith, (QM); ♂, ♀, Cockatoo Creek, 19 Aug 1992, J.C. Cardale, (ANIC); ♂, Moreton HS, 12°27'S, 14°38'E, 21 Jun 1993, I.D. Naumann and P. Zborowski, (ANIC).

Northern Territory: ♂, Katherine River Gorge N.P., 13 Aug 1979, J. Blyth, (NMV); ♂, Katherine River Gorge N.P., 1 Apr 1981, M. Malipatil, (NTM).

Diagnosis. Triaenodes mouldsi most closely resembles *T. cymulosa, T. conjugata* and *T. allax* from which it is distinguished by the irregular appearance of the inferior appendages in lateral view and unequal ventral "spines" of tergum X.

Description. Length of forewing, ♂ 6.6–7.2 mm. Wings (Fig. 79) are distinctive in fresh specimens, with dark spots towards the apices.

Genitalia, male (Figs 80–82). Abdominal segment IX divided laterally by a deep groove in which one of the spines of the mesal basodorsal process of the inferior appendage rests. Tergum X with upper part in form of a long median structure, swollen and setose apically; "spines" of ventral part unequal, left shorter than superior appendages, right extended beyond apex of upper structure of tergum X. Superior appendages slender, about half length of median structure of tergum X. Inferior appendages relatively narrow in lateral view expanded and irregular in shape apically; lateral mesodorsal process digitiform, arising on inner margin near base; mesal basodorsal process bilobed, outer lobe long, spiny, curving anteriorly and arching posteriorly, inner lobe much shorter, curving towards tip of inferior appendage. Phallus, slender at base, greatly swollen and deeply divided in distal two-thirds.

Etymology. Named for M.S. Moulds, who has collected extensive material from Cape York localities.

Remarks. This appears to be a common species on Cape York and also occurs in northern Northern Territory.

Triaenodes teresis sp. nov.

Figures 83–85

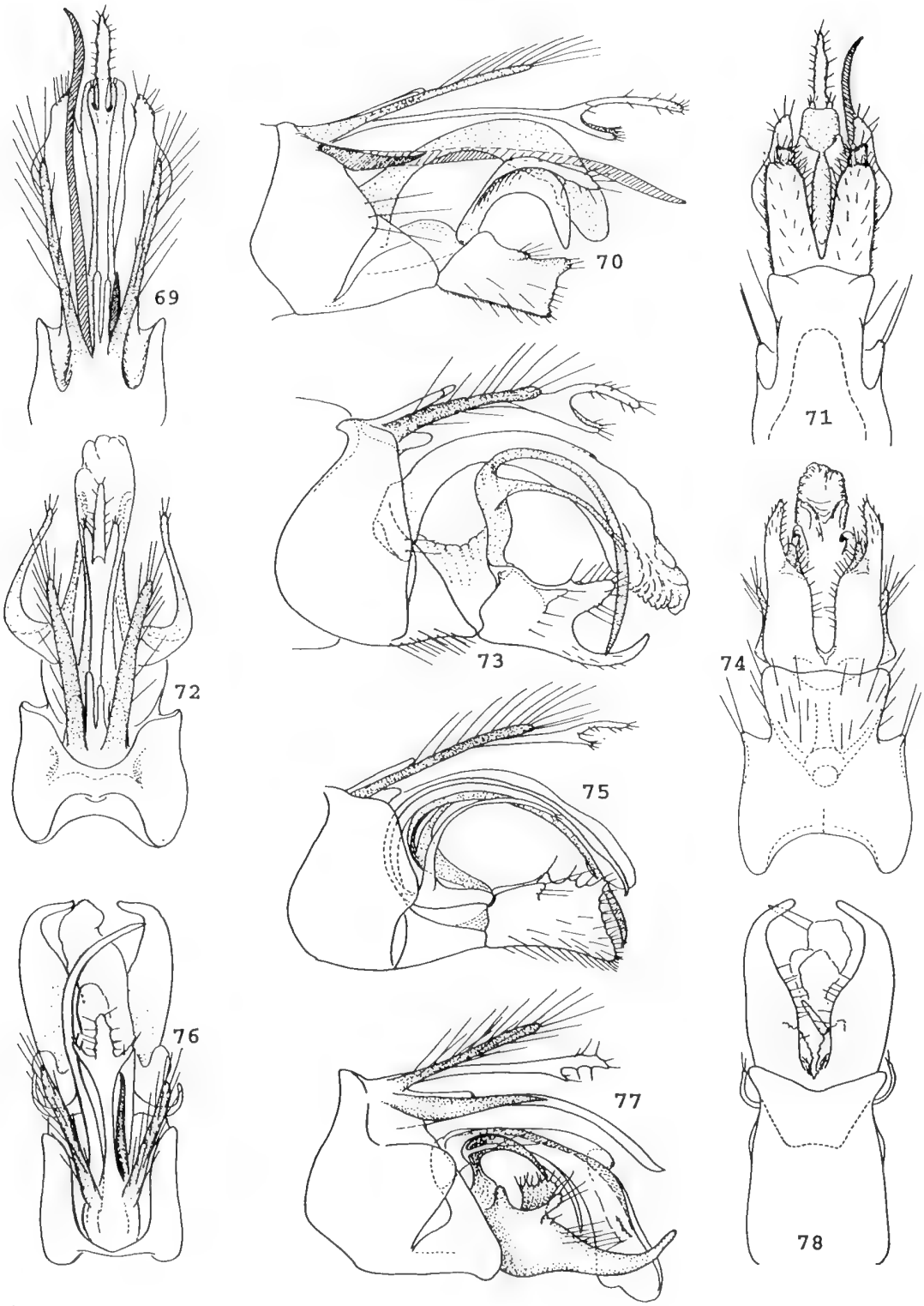
Material examined. Holotype, ♂, North Queensland, Mt Bartle Frere, 0.5 km N of South Peak, 6–8 Nov 1981, 1500 ♂ asl, Earthwatch/QM Expedition, (QM).

Paratypes, N Queensland: 2♂, same data as for holotype, (NMV, genitalic prep. PT-1090 illustrated); Bellenden Ker Range, Summit TV Station, 1560 m asl, 1–7 Nov 1981, Earthwatch/QM Expedition, (QM).

Diagnosis. T. teresis resembles *T. mouldsi* from which it is distinguished by the more regular appearance of the inferior appendages and shorter upper part and symmetrical ventral spines of tergum X.

Description. Length of forewing, ♂ 6.1–6.6 mm.

Genitalia, male (Figs 83–85). Abdominal segment IX in ventral view narrowly rectanguloid distally, widened abruptly towards base; in lateral view narrowly extended distally beyond a



Figures 69–78, male genitalia: 69–71, *Triaenodes conjugata* sp. nov., dorsal, lateral and ventral views; 72–74, *Triaenodes cymulosa* sp. nov., dorsal, lateral and ventral views; 75, *Triaenodes allax* sp. nov., lateral view; 76–78, *Triaenodes fuscinula* sp. nov., dorsal, lateral and ventral views.

complex, with which members share similarities in the form of the male abdominal segment IX and basic form of tergum X and inferior appendages. Members of this set are characterised by the simpler form of the inferior appendages in which the mesal basodorsal process is generally lobose, curving posteriorly and often is foot-shaped. Species in this complex more or less conform with Yang and Morse's subgenus *Austrotriaena*, however, they are clearly part of a broader complex which overlaps with subgenus *Triaenodella*.

Species in this complex are found in eastern Australia along the Great Dividing Range from Victoria to north Queensland. Allied species include *Triaenodes lanceolata* Kimmins, 1957 and *T. trifida* Kimmins, 1957 from Guam, *T. tafana* Kimmins, 1962 from New Guinea and *T. fijianus* Mosely, 1941 from Fiji, all of which were referred by Yang and Morse (1993) to their subgenus *Austrotriaena*.

Triaenodes bernaysae Korboot

Figures 89, 90

Triaenodes bernaysae Korboot, 1964: 50.

Material examined. Holotype, ♂, Queensland, Cedar Creek, (QM).

Paratypes New South Wales: 2♂, 2♀, Barrington Tops, Tubrabucca, 17 Nov 1953, A. Neboiss, (NMV); ♂, ♀, 8 mls W of Dorrigo, 22 Feb 1966, E.F. Riek, (NMV); 5♂, 9♀, Barrington Tops, 9 Nov 1967, N. Dobrotworsky, (NMV); 9♂, 4♀, 24 km S of Ebor, 10 Nov 1967, N. Dobrotworsky, (NMV); 4♂, 2♀, Boonoo Boonoo State Forest, Nov 1990, G. Theischinger, (NMV); ♂, 2♀, Rawley Point, 14 Nov 1992, D. Rentz and K. McCarron, (ANIC).

Queensland: ♂, 2♀, Acacia Ridge, Brisbane, 20 Jan 1963, (no collector given), (NMV); 4♂, 1♀, Bulimba Creek, Brisbane, 23 Oct 1979, (no collector given), (NMV, genitalic prep. PT-721 illustrated); ♂, Strathpine, nr Brisbane, 3 Dec 1984, G. Theischinger, (NMV).

Diagnosis. Triaenodes bernaysae males probably illustrate an early stage in development of the mesal basodorsal lobe in this group and in that respect resemble *T. verberata* sp. nov., but the other genitalic structure are relatively specialised. The dorsomesal lobe on the inferior appendages is pronounced and densely covered with short setae, and the ventral part of tergum X is asymmetrical; the phallus has a short process middorsally.

Description (revised after Korboot, 1964). Length of forewing, ♂ 6.5–7.0 mm, ♀ 5.9–6.8 mm.

Genitalia, male (Figs 89, 90). Abdominal segment IX produced lateroventrally distal to a lateral groove, ventrally with a medial U-shaped excavation in apical margin. Tergum X comprising a short, apically setose median lobe above a pair of unequal spines, the right less than half the length of the left. Superior appendages slender, about twice length of median lobe of tergum X. Inferior appendages broad based, narrow and upturned in distal half, mesodorsal lobe broad and densely setose, mesal basodorsal lobe slender, curved downwards, with a slight middorsal "hump". Phallus uniform in diameter throughout length, curved downwards, with a short process middorsally.

Remarks. Collected from northeastern New South Wales to southeastern Queensland, from October to February, this appears to be quite a widespread species with a typically temperate spring-summer emergence period.

Triaenodes verberata sp. nov.

Figures 86–88

Material examined. Holotype, ♂, N Queensland, Heathlands, 11°45'S, 142°35'E, 18 Aug 1992, at light, J.C. Cardale and P. Zborowski, (ANIC, genitalic prep. PT-2052 illustrated).

Paratype ♂ N Queensland 11 km W by N Bald Hill, McIlwraith Range 500 m asl. 13°44'S 143°20'E, 26 Jun 1989, I. Naumann (NMV).

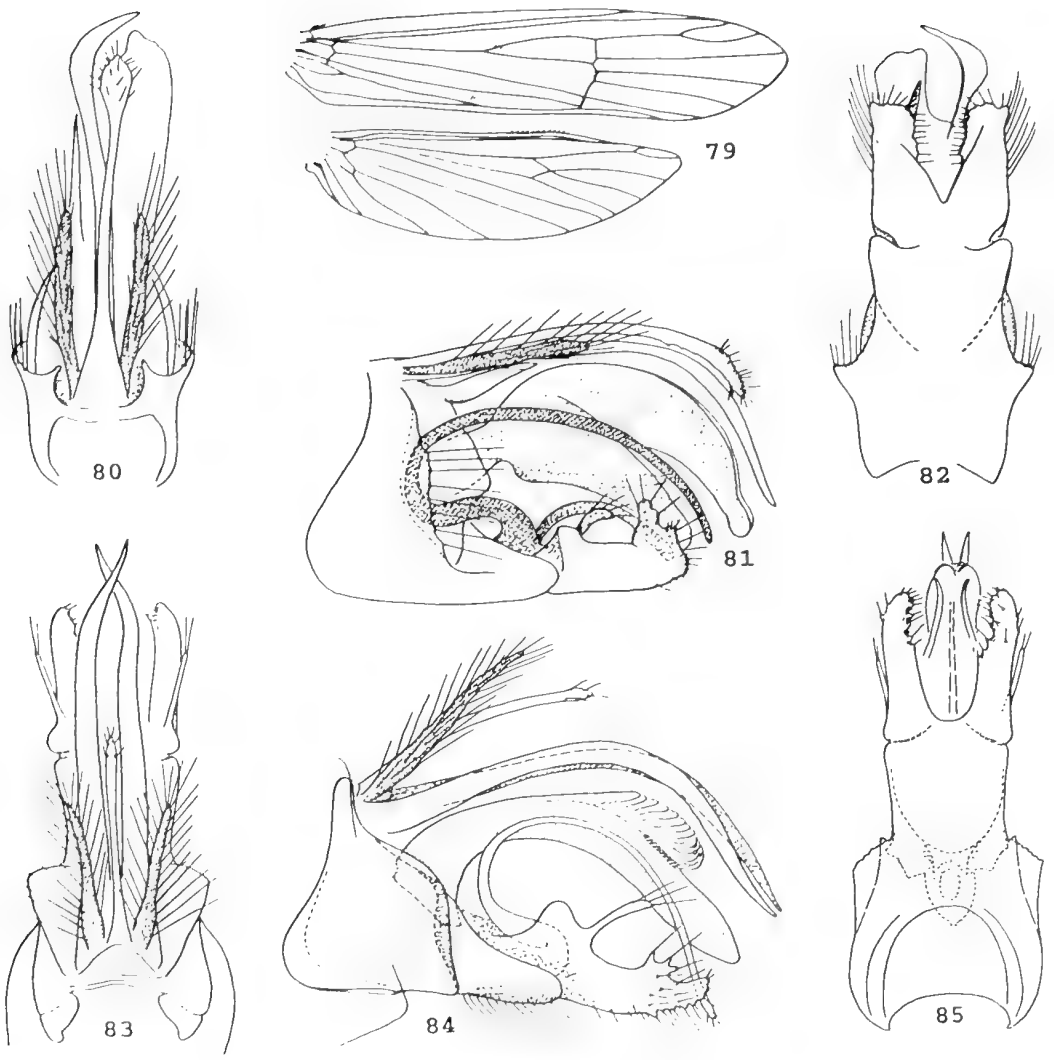
Diagnosis. In general form the male genitalia of this species resemble those of *T. cuspiosa*, however, *T. verberata* sp. nov. shows curious development of tergum X with one "spine" of the ventral part far longer than the rest of the genitalic structures and twisted slightly.

Description. Length of forewing, ♂ 3.7 mm.

Genitalia, male (Figs 86–88). Abdominal segment IX short and broad in lateral view, with a short oblique lateral groove beyond which the segment is produced posteriorly. Tergum X comprising a slender, unequally bilobed dorsomedial structure above a single elongate, distally slightly twisted "spine". Inferior appendages in lateral view skittle-shaped, apically rounded; mesal basodorsal process a long lobe, arching dorsally and posteriorly, expanded slightly near base. Phallus narrow, curved downwards, swollen apically.

Etymology. From the Latin *verber* whip referring to the long sinuous spine of the ventral part of tergum X.

Remarks. This species is known only from far north Queensland.



Figures 79–85: 79–82, *Triaenodes mouldsi* sp. nov., wings, male genitalia, dorsal, lateral and ventral views; 83–85, *Triaenodes teresis* sp. nov., male genitalia, dorsal, lateral and ventral views.

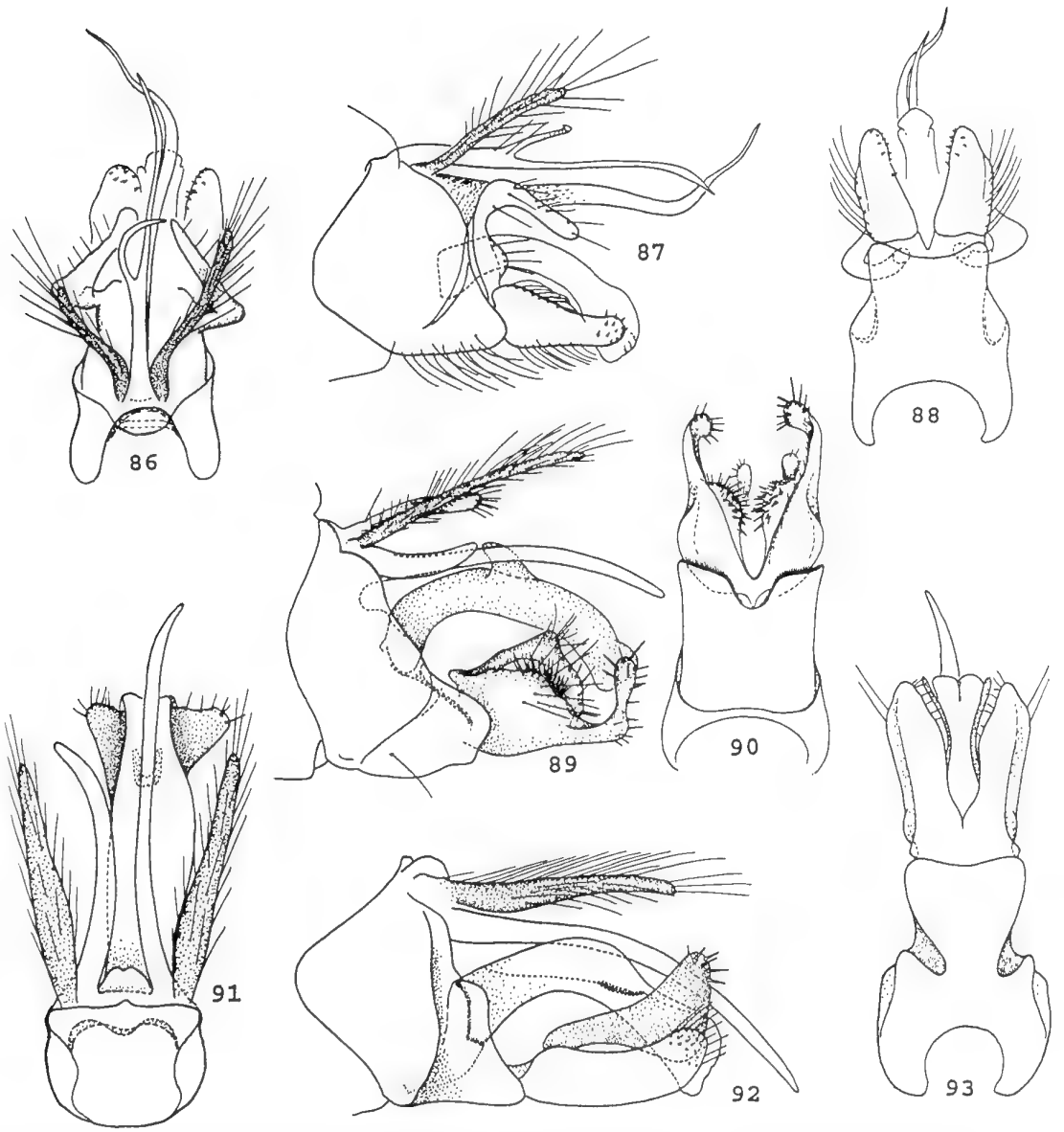
pronounced groove. Tergum X comprising an upper apically setose filement, slightly longer than superior appendages and below that a pair of equal elongate spines, intersecting subapically. Inferior appendages clasper-shaped in ventral view, in lateral view somewhat irregular in shape with bases of dorsal subapical setae papillose, lateral basodorsal process digitiform with several apical setae, dorsally between this process and the slender strongly recurved unipartite mesal basodorsal process is a rounded lobe. Phallus long with a horseshoe-shaped sclerite dorsally.

Etymology. From the Greek *teretikos*—watchful, observant, in reference to the Earthwatch expedition.

Remarks. This species is known only form the Bellenden Ker Range in NE Queensland. Males closely resemble those of the New Guinea species, *T. modoana* Kimmins.

bernaysae complex

The *bernaysae* complex of species (see Figs 86–114) is closely allied with the *intricata*



Figures 86–93, male genitalia: 86–88, *Triaenodes verberata* sp. nov., dorsal, lateral and ventral views; 89, 90, *Triaenodes bernaysae* Korboot, lateral and ventral views; 91–93, *Triaenodes corynotra* sp. nov., dorsal, lateral and ventral views.

the inferior appendage; mesal basodorsal process narrow at base, greatly expanded and truncate dorsally, rounded ventrally. Phallus broadest distally, downturned.

Etymology. From the Greek *probolos*—projecting prominence, in reference to the inferior appendages.

Remarks. This species is known only from the type locality in NE Queensland.

Triaenodes notalia sp. nov.

Figures 100–102

Material examined. Holotype ♂, Victoria, Yarra River, 2 km N of Wonga Park, 23 Feb 1976, A. Neboiss, (NMV, T-16219).

Paratypes, Victoria: 37 ♂, same data as for holotype, (NMV, genitalic prep. PT-798 illustrated, ANIC); 3 ♂, Yarra River–Diamond Creek junction, 14 Mar 1976, A. Neboiss, (NMV, ANIC).

Triaenodes cuspiosa sp. nov.

Figures 94–96

Material examined. Holotype, ♂, Victoria, Genoa creek, 5 km W of Genoa, 31 Jan 1975, A. Neboiss, (NMV, T-16356, genitalic prep. PT-752 illustrated)

Paratype: ♂, NSW, small creek nr Berowa, 19 Nov 1989, G. Theischinger, (NMV).

Diagnosis. Males of this species resemble those of *T. bernaysae* in ventral view, having the mesodorsal lobes on the inferior appendages well developed, but differ in that the mesal basodorsal process is greatly expanded distally to form a foot-shaped structure.

Description. Length of forewing, ♂ 6.3–6.7 mm.

Genitalia, male (Figs 94–96). Abdominal segment IX with a well developed "collar" formed by the lateral groove and posterior extension of the segment ventrolaterally. Tergite X comprising a short simple dorsal part and ventrally a pair of unequal spines, right shorter than left. Superior appendages slender, about as long as the inferior appendages. Inferior appendages in ventral view clasper-shaped, with a well developed, setose mesodorsal lobe at base; lateral basodorsal process small, digitiform; mesal basodorsal lobe narrow proximally, deeply humped at about half length to form a foot-shaped structure. Phallus slender medially, dilated distally.

Etymology. From the Latin *cuspis*—point, and *osus*—abundance, in reference to numerous small spikey setae on the mesal surface of the inferior appendages.

Remarks. Triaenodes cuspiosa appears to be restricted in distribution and probably is rare as it has been collected from only two localities, one in eastern Victoria, the other near Sydney, New South Wales.

Triaenodes corynotra sp. nov.

Figures 91–93

Material examined. Holotype ♂, Northern Territory, Kakadu National Park, Radon Creek, 12°45'S, 132°55'E, 14 Apr 1989, P. Suter and A. Wells, (NMV, T-16325).

Paratypes, Northern Territory: 4 ♂, same data as for holotype, (NMV); ♂, same locality and collectors as for holotype, 6 Jun 1988, (NMV); ♂, Radon Creek, Kakadu National Park, 3 Sep 1979, J. Blyth, (NMV, genitalic prep. PT-765 illustrated); ♂, 16 km E by N Mt Cahill, 12°50'S, 132°51'E, 16 Nov 1972, J.C. Cardale, (ANIC).

Diagnosis. Males of this species have genitalia of the same general form as *T. notalia* sp. nov., *T. probolia* sp. nov., *T. wannonense* sp. nov. and *T. forficata* sp. nov. but the structures are less elabo-rate and the mesal basodorsal process on the inferior appendage is club-shaped, not produced downwards and attenuate apically.

Description. Length of forewing, ♂ 5.3–5.8 mm.

Genitalia, male (Figs 91–93). Abdominal segment IX with an oblique groove producing strong constrictions laterally. Segment X comprising a short apically indented membranous upper structure between paired unequal spines, left longer than right by one third, right as long as superior appendages. Superior appendages unusually stout, elongate. Inferior appendages stout, almost cylindrical in lateral view, slightly upturned distally, in ventral view tapered distally; mesodorsal lobe and lateral basodorsal process absent; mesal basodorsal process in lateral view narrow in basal section, expanded and club-shaped distally. Phallus stout throughout length, slightly downturned with a dorsal sclerite at about half length.

Etymology. From the Greek *korynodes*—club, mace (clublike) in reference to the process on the inferior appendages.

Remarks. Triaenodes corynotra is known only from the restricted locality, Radon Springs in Kakadu National Park, and another very close site.

Triaenodes probolia sp. nov.

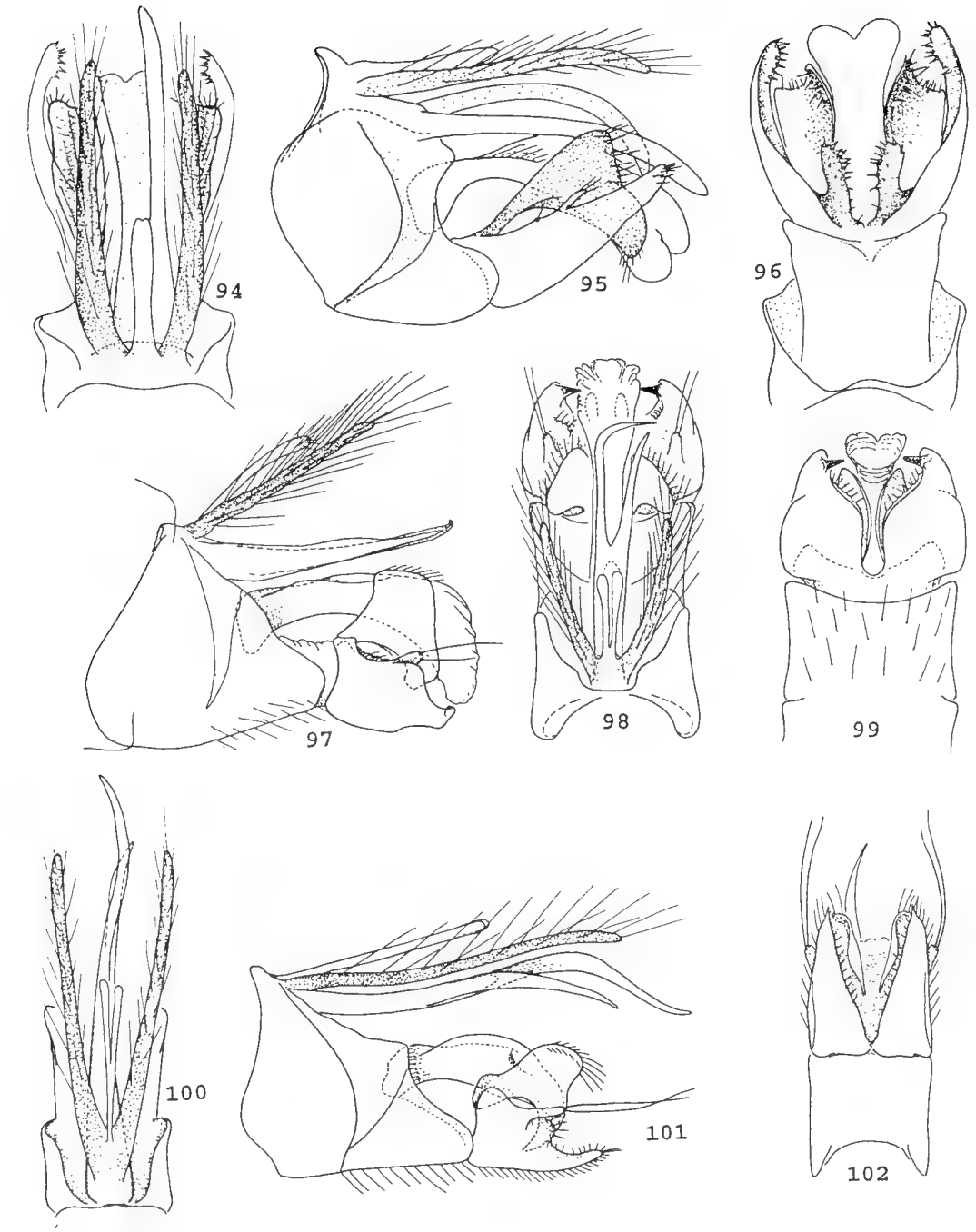
Figures 97–99

Material examined. Holotype ♂, N Queensland, 16 km W Ravenshoe, 2 Jan 1975, M.S. Moulds, (NMV, T-16324, genitalic prep. PT-2040 illustrated).

Diagnosis. This species groups with *T. notalia* sp. nov., *T. wannonense* sp. nov. and *T. forficata* sp. nov. in form of male genitalia but is distinguished by the form of the inferior appendages which in ventral view are broadly rounded in the basal two-thirds and have a dark spur on the inner apical margin.

Description. Length of forewing, ♂ 6.3 mm.

Genitalia, male (Figs 97–99). Abdominal segment IX with an incomplete oblique groove. Tergum X comprising a pair of short digitiform lobes above the spines which are fused in basal half and free, unequal and slender distally. Inferior appendages in ventral view stout and rounded basally, constricted at about two-thirds length and tapered distally with a dark spur on inner apical margin; lateral basodorsal process short with a pair of apical setae; mesodorsal lobe reduced to no more than a slight rounding of the margin of



Figures 94–102, male genitalia: 94–96, *Triaenodes cuspiosa* sp. nov., dorsal, lateral and ventral views; 97–99, *Triaenodes probolia* sp. nov., lateral, dorsal and ventral views; 100–102, *Triaenodes notalia* sp. nov., dorsal, lateral and ventral views.

Other material. Victoria: 3 ♂, Yarra River nr Burnley, Jan 1951, A. Neboiss, (NMV); 1 ♂, Franklin River, Toora, 6 Mar 1953, A. Neboiss, (NMV); 4 ♂, 2♀, Plenty River, South Morang, 6 Dec 1953, A. Neboiss, (NMV); ♂♂, ♀♀, Thurra River, Cape Everard, 22 Mar 1970, A. Neboiss, (NMV); ♂♂, ♀♀, LaTrobe River survey, 1973–1980, Morwell-Moe area, (NMV); ♂♂, ♀♀, Tanjil River, 1973–1980, lower section localities, (NMV); 2 ♂, Tyers river, LaTrobe River, survey site 22, 24 Feb 1974, (NMV); 5 ♂, 2♀, Wingan River, 8 km S of Princess H-way, 30 Jan 1975, A. Neboiss, (NMV); 6 ♂, Genoa Creek, 5 km W of Genoa, 31 Jan 1975, A. Neboiss, (NMV); 1 ♂, 1♀, Yarra River, Woori Yallock, 25 Feb 1976, A. Neboiss, (NMV); ♂, below Upper Yarra Dam, 28 Feb 1976, A. Neboiss, (NMV); 4 ♂, 2♀, Tarwin River, east branch, Dumbulk, 8 Nov 1977, A. Neboiss, (NMV).

Australian Capital Territory: 3 ♂, 3♀, Paddys River, nr Tidbinbilla NP, 23 Oct 1995, P. Murray and A. Wells.

Diagnosis. This species differs from *T. cuspiosa* in having the mesal basodorsal process on the inferior appendages more rounded dorsally and attenuate apically, but not so strongly sickle-shaped as in *T. wannonense*.

Description. Male antennal scape 1.5 × length of head, dorsally a long slit covered by a membranous flap. Length of forewing, ♂ 6.3–6.7 mm.

Genitalia, male (Figs 100–102). Abdominal segment IX with a deep oblique groove and dorsally an extensive membranous area. Tergum X comprising a slender upper part, forked at about half length of superior appendages; ventral spines unequal, fused in basal half, distally lying one above other. Superior appendages about length of shortest spine, elongate, slender. Inferior appendages stout in basal section, attenuate apically in lateral view; mesodorsal lobe short, rounded; lateral basodorsal lobe short, digitiform with a pair of long apical setae; mesal basodorsal process strongly hooked, stoutly humped dorso medially. Phallus slightly down turned, dilated in mid section.

Etymology. From the Latin *notalis*—southern, referring to the distribution of this species.

Remarks. This species is common in the Yarra River valley in central Victoria and throughout eastern Victoria, and has also been collected in the Australian Capital Territory. All the Victorian records are grouped between December and April, the ACT one is dated October.

Triaenodes vespertina sp. nov.

Figure 103

Material examined. Holotype, ♂, Victoria, Forrest, 19 Jan 1956, A. Neboiss, (NMV, T-16279).

Paratypes: 8 ♂, same data as for holotype (NMV, genitalic prep. PT-806 illustrated).

Other material. Victoria: ♀, same data as for holotype; ♂, Moorabool River, Durdidwarrah Road, 25 Mar 1953, A. Neboiss, (NMV); 4 ♂, ♀, Greendale, 6 Jan 1956, A. Neboiss, (NMV).

Diagnosis. Similar to *T. wannonense* in most features of male genitalia, but with the mesal basodorsal process of inferior appendage more rounded and spines of ventral part of tergum X more deeply separated.

Description. Length of forewing, ♂ 5.9–6.5 mm.

Genitalia, male (Fig. 103). Abdominal segment IX with a long groove and extensive membranous area dorsally clearly separating upper and lower genitalic parts. Tergite X comprising a median dorsal structure above a pair of deeply divided elongate spines. Superior appendages narrow, about as long as spines. Inferior appendages stout in basal section, in lateral view triangular apically; mesodorsal lobe strongly reduced; lateral basodorsal process short, digitiform with 2 long apical setae; mesal basodorsal process roundly humped medially and distally strongly and sharply down-turned, acuminate apically. Phallus about equal width throughout length, almost straight.

Etymology. The Latin *vespertina*—evening, western, in reference to its more westerly distribution in comparison with *T. notalia*.

Remarks. This species has been collected only from the Otway Ranges and from between Ballarat and Geelong districts in Victoria.

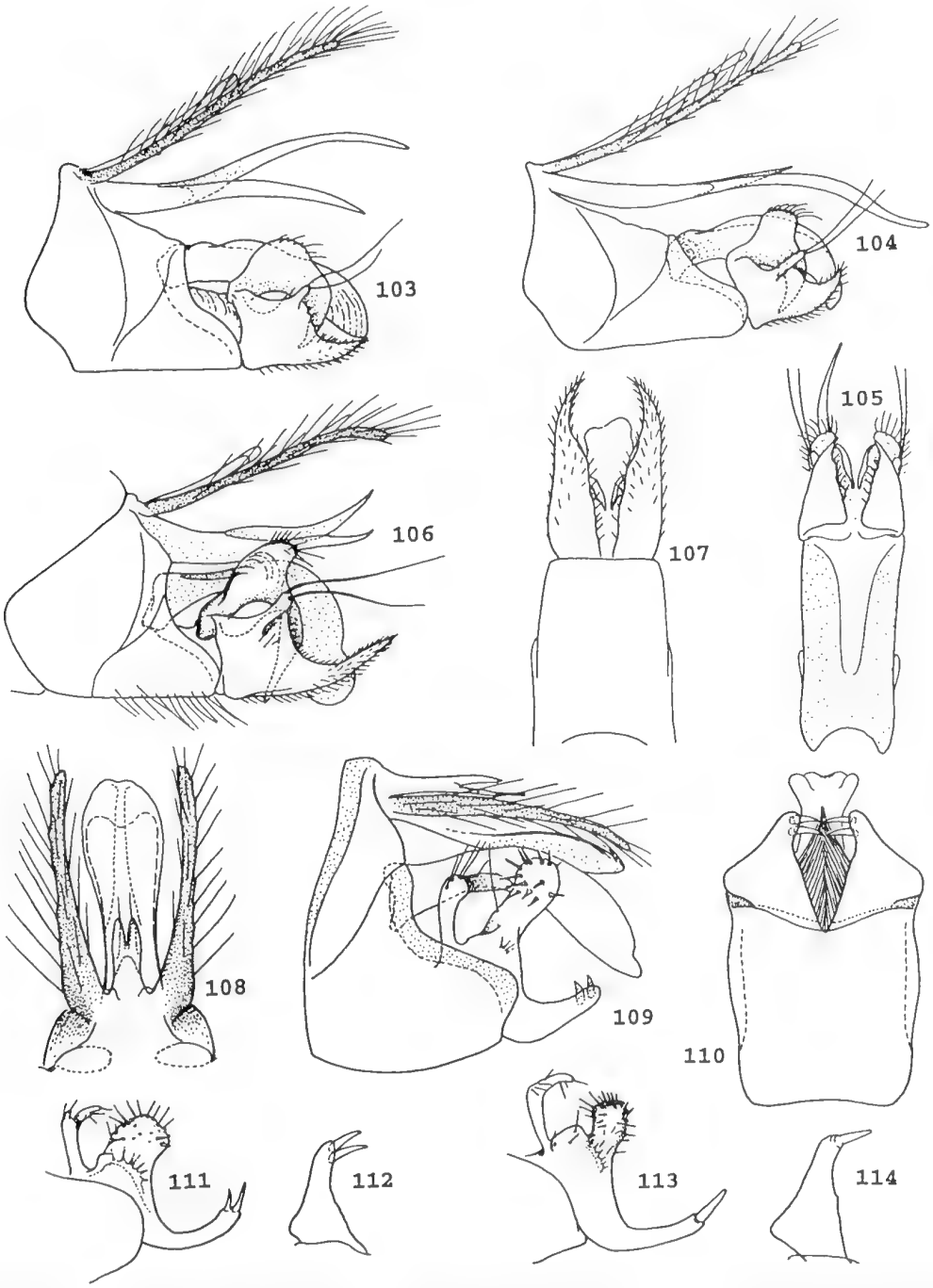
Triaenodes wannonense sp. nov.

Figures 104, 105

Material examined. Holotype ♂, Victoria, Wannon River, 25 km S of Halls Gap, Grampians, 10 Dec 1976, J.E. Bishop, (NMV, T-16248).

Paratypes: 40 ♂, same data as for holotype, (NMV, ANIC, genitalic prep. PT-804 illustrated).

Other material. Vic., 5 ♂, Stokes River, 8 km N of Dartmoor, 23 Nov 1977, P. Suter, (NMV); 1 ♂, Hopkins River, Hopkins Falls, 6 Mar 1978, A.A. Calder, (NMV).



Figures 103–114, male genitalia: 103, *Triaenodes vespertina* sp. nov., lateral view; 104, 105, *Triaenodes wannonense* sp. nov., lateral and ventral views; 106, 107, *Triaenodes forficata* sp. nov., lateral and ventral views; 108–110, *Triaenodes triquetra* sp. nov., dorsal, lateral and ventral views; 111–112, *Triaenodes triquetra* sp. nov. (PT-1116 Paluma Range), inferior appendages lateral and ventral views; 113, 114, *Triaenodes triquetra* sp. nov. (PT-1745 Yuccabine Creek), inferior appendages lateral and ventral views.

Diagnosis. This species closely resembles *T. notalia* from which it is distinguished in the male by the more delicate shape of the mesal basodorsal process on the inferior appendages and longer upper part of tergum X.

Description. Length of forewing, ♂ 6.4–7.0 mm.

Genitalia, male (Figs 104, 105). Abdominal segment IX ventrally narrowly elongate rectangular, longer than inferior appendages, with a deep oblique groove laterally and pronounced posterior extension resulting in considerable separation of upper and lower genitalic parts. Tergum X comprising a short, deeply divided upper part about half the length of the superior appendages; ventral spines fused basally, right spine less than half length of left. Superior appendages filiform. Inferior appendages stout in basal section, tapered to acuminate apices; mesodorsal lobe strongly reduced; lateral basodorsal process digitiform with a pair of long setae apically; mesal basodorsal process strongly and sharply hooked, roundly and stoutly humped dorsomesially. Phallus curved, slightly stouter in middle than proximally or distally.

Etymology. Named for the type locality.

Remarks. Triaenodes wannonense has been collected only in the Grampians area of Victoria.

Triaenodes forficata sp. nov.

Figures 106, 107

Material examined. Holotype, ♂, Victoria, Deddick River, half km above Snowy River junction, 13 Dec 1976, A. Neboiss, (NMV, T-16288).

Paratypes, Victoria: ♂, same data as for holotype, NMV, genitalic prep. PT-722); ♂, Towong, 28 Jan 1957, A. Neboiss, (NMV); ♂, same locality and collector, 29 Jan 1957, (NMV); 6 ♂, Tambo River at Tambo Crossing, 24 Jan 1960, A. Neboiss, (NMV); ♂, Mitta-Mitta River-Snowy Creek junction, 3 Nov 1975, A.A. Calder, (NMV); ♂, Genoa River, nr Wangarabell, 18 Mar 1977, A. Neboiss, (NMV, genitalic prep. PT-753 illustrated); ♂, Murray River, Indi bridge, Bigarra, 22 Jan 1988, J.E. Brittain, (NMV).

Other material. Queensland: 6 ♂, (2♀), Camp Mountain, 31 Mar 1967, N. Dobrotworsky, (NMV); 2 ♂, Bouloumba Creek, 8 km SW Kenilworth, 26°39'E 152°39'E, 12 Dec 1984, G. Theischinger, (NMV); 5 ♂, (♀), Crows Nest Falls, N of Toowoomba, 27°14'S, 152°07'E, 18 Jan 1986, G. Theischinger, (NMV); 18♂, Carnarvon Gorge National Park, 12 Nov 1990, G. Theischinger, (NMV).

New South Wales: ♂, Clarence River at Yates Crossing, 26 Oct 1981, Wells and Carter, (NMV); 2 ♂, Styx River at forest camp in Styx State Forest, 28 Oct 1981, Wells and Carter, (NMV).

Diagnosis. This species groups with *T. notalia* sp. nov., *T. probolia* sp. nov., and *T. wannonense* sp. nov. in general form of male genitalia but has the inferior appendages and their mesal basodorsal lobe far more attenuate apically, and abdominal segment IX stouter, with only a small membranous area dorsally.

Description. Length of forewing, ♂ 6.4–6.6 mm.

Genitalia, male (Figs 106, 107). Abdominal segment IX with the oblique groove less pronounced, producing a more normal separation between genitalic parts. Tergite X with upper part about half length of superior appendages, bifid apically; spines short, fused in basal half, unequal, left slightly shorter than right, curved to cross over right. Superior appendages narrow, longer than all other genitalic structures. Inferior appendages stout in basal section, apically forceps-like in ventral view, in lateral view slender and tapered to apex; mesodorsal lobe absent; lateral basodorsal process digitiform, with a pair of elongate setae apically; mesal basodorsal process strongly arched downwards, apically slender, spiny, middorsally produced into a pronounced hump. Phallus elongate, strongly curved downwards.

Etymology. From the Latin *forficatus*—scissor-shaped, in reference to the ventral part of tergum X.

Remarks. This is one of the two most widespread of all Australian *Triaenodes* species, occurring from central Victoria to southern Queensland.

Triaenodes triquetra sp. nov.

Figures 108–114

Material examined. Holotype ♂, North Queensland, Cape York Peninsula, Lockerbie Scrub, 15 Apr 1975, M.S. Moulds, (NMV, T-16209).

Paratypes: 7 ♂, same data as for holotype, (NMV, genitalic prep. PT-762 illustrated); 11 ♂, same locality, 13–27 Apr 1973, S.R. Monteith, (ANIC).

Other material. North Queensland: ♂, Bluewater State Forest, S end Paluma Range, WNW Townsville, 31 Jan 1981, M.S. Moulds, (NMV, genitalic prep. PT-1116 illustrated); ♂, Yuccabine Creek, Kirrama State Forest, 5 Mar 1985, R. Pearson (NMV, genitalic prep. PT-1745 illustrated).

Diagnosis. This species is distinct from all others in the Australian fauna and can be recognised by the stout spur-like setae on the mesal subapical margin of the inferior appendages.

Description. Length of forewing, ♂ 5.2–5.7 mm.

Genitalia, male (Figs 108–114). Abdominal segment IX quadrate in ventral view, an oblique upper-lateral suture divides the segment, which is produced posteroventrally but without a membranous area dorsally. Segment X comprising a very short bifid structure above a pair of digitiform setose processes and a ventral membranous plate of about the same length as the superior appendages. Superior appendages elongate, rather stout basally. Inferior appendages unusual in shape and difficult to interpret: the ventral-most lobe is subtriangular in ventral view, with paired stout setae apicomesally and is probably homologous with the apical region of other species; in lateral view a club-shaped median lobe bears bristle-like setae distally and probably represents the mesodorsal lobe; a narrower, mesally directed dorsal lobe with a pair of unequal processes apically, is here interpreted as representing the mesal basodorsal process; lateral basodorsal lobe absent. Phallus long, down-turned, slightly swollen distally.

Etymology. From the Latin *triquetrus*—triangular, in reference to the triangular shape of the inferior appendages in ventral view.

Remarks. This species is described from far northeastern Queensland, but two closely similar males from Paluma/Yuccabine Creek further south in Queensland are also referred to *T. triquetra* although most of the male genitalic parts show some differences in shape, particulary in proportions (see Figs 111–114).

uvida complex

Another set of species within the *intricata*-group, the *uvida* complex (referred to by Neboiss and Wells (1996) as "group D") (see Figs 115–130) includes five Australian species, *T. uvida* sp. nov., *T. nesiotina* sp. nov., *T. torresiana* sp. nov., *T. nymphaea* sp. nov. and *T. melanopeza* sp. nov., all with inferior appendages basically comprising four lobes, the dorsal one being highly irregular in shape. Members of the complex are widespread, occurring in Victoria, eastern Queensland and NW Western Australia.

Triaenodes uvida sp. nov.

Figures 115–117

Material examined. Holotype, ♂, Victoria, Cabbage Tree Creek, 8 Feb 1961, N. Dobrotworsky, (NMV, T-16354, genitalic prep. PT-751 illustrated).

Paratype, Victoria: ♂, Cann River, 23 Jan 1962, N. Dobrotworsky, (NMV).

Diagnosis. In form of male genitalia, *T. uvida* sp. nov. most closely resembles *T. nymphaea* but its inferior appendages are rounded on the inner margin in ventral view and have the basal angular extension on the mesal basodorsal process exaggerated such that they form wing-like structures.

Description. Length of forewing, ♂ 6.1 mm.

Genitalia, male (Figs 115–117). Abdominal segment IX lateral groove distally placed, segment quadrate in ventral view. Tergum X with a very short triangular upper part, ventral part forming a pair of overlapping spines. Superior appendages half length of spines of tergum X. Inferior appendages in ventral view with basal section subglobular; apicolaterally a short digitiform lobe; mesodorsal lobe triangular in ventral view, with inner margin bordered by peg-like setae; lateral basodorsal process slender, elongate, with a tuft of setae apically; mesal basodorsal process comprising a long curved lobe with its apex rounded beyond an apical swelling with an upwardly directed "beak", a downwardly directed flange towards the base, and a slender mesally directed lobe. Phallus stout, slightly expanded distally, apically blunt.

Etymology. From the Latin *uvida*—wet, damp, referring to conditions around type locality.

Remarks. Found only in southeastern Victoria.

Triaenodes nymphaea sp. nov.

Figures 118–120

Material examined. Holotype, ♂, Western Australia, Lily Creek, 15 km W of Kunanurra, 22 Feb 1977, J.E. Bishop, (NMV, T-16451).

Paratypes, Western Australia: 2 ♂, same data as for holotype (NMV, genitalic prep. PT-755 illustrated); 2 ♂, Spillway Creek, Kimberley, 2 Feb 1978, J.E. Bishop, (NMV); 2 ♂, Stonewall Creek, Kimberley, 2 Feb 1978, J.E. Bishop, (NMV); 2 ♂, same locality and collector, 4 Feb 1978, J.E. Bishop, (NMV); ♂, Fine Springs Creek, 2 Feb 1978, J.E. Bishop, (NMV).

Diagnosis. This species closely resembles *T. uvida* but is distinguished by the subtriangular appearance of the inferior appendages in ventral view and less prominent "wings" on the mesal basodorsal process.

Description. Length of forewing, ♂ 5.4–5.6 mm.

Genitalia, male (Figs 118–120). Abdominal segment IX with small lateral grooves, in ventral view width about twice length. Tergum X with upper part reduced to a small triangular plate dorsal to base of superior appendages or rarely with

a vestige of the more usual bifid process; spines crossing distally, separated in basal third by a membranous plate with rounded apex. Superior appendages narrow. Inferior appendages broad-based, mesodorsal lobe well developed and giving rise to the subtriangular appearance of the inferior appendages in ventral aspect, a row of peg-like setae on inner margin; lateral basodorsal process stout, rounded and with 3 to 4 moderate length setae apically; mesal basodorsal process in ventral view slender, with an inner margin hook towards base, distally beak-shaped, in lateral view expanded in distal half and divided apically to form a down-turned spur-like process and dorsally a stouter process angled upwards apically. Phallus dilated in distal half, down-turned and tapered apically.

Etymology. The Latin name of water lilies, *Nymphaea,* for the name of the creek beside which the type was taken.

Remarks. Known only from the Kimberley region of northwestern Western Australia.

Triaenodes melanopeza sp. nov.

Figures 121–123

Material examined. Holotype, ♂, N Queensland, Iron Range, Middle Claudie River, 2–9 Oct 1974, M.S. Moulds, (NMV, T-16465).

Paratypes, North Queensland: 9 ♂, same data as for holotype, (NMV, genitalic prep. PT-767 illustrated); ♂, same loc., 14 Sep 1974, M.S. Moulds, (NMV); 5 ♂, Little Mulgrave River, 28 Jun 1971, E.F. Riek, (ANIC, NMV); 3 ♂, Iron Range, 6 km N in dry scrub, 15 Sep 1974, M.S. Moulds, (NMV); 2 ♂, Iron Range, 24 Sep 1974, M.S. Moulds, (NMV); ♂, Iron Range, Gordon Creek, 16 Oct 1974. M.S. Moulds, (NMV); 2 ♂, Shiptons Flat, 15°47'S, 145°14', 17–19 Oct 1980, J.C. Cardale, (ANIC); 3 ♂, Bellenden Ker Range, Cable Base Station, 10 m asl, 17–24 Oct 1981, Earthwatch expedition, (QM); 3 ♂, 8–10 km E by N Mt Tozer, 5–10 Jul 1986, J.C. Cardale, (ANIC); ♂, Iron Range, Claudie River, 10 Nov 1988, K. Walker, (NMV); ♂, Cairns, Lake Morris Road, 16 Nov 1988, K. Walker, (NMV); 3 ♂, 8–11 km W by N Bald Hill, McIlwraith Range, 500 m asl, 26–27 Jun 1989, I. Naumann, (ANIC).

Other material. Queensland: ♂, 22 mls SW Ingham, 5 Jun 1961, R. Straatman, (dry mounted), (ANIC); ♂, 25 mls SW Ingham, Forestry road, 18 Apr 1961, R. Straatman, (ANIC); 2 ♂, Goodart Creek, Kirama State Forest, May 1993, G. Theischinger, (NMV).

Diagnosis. Males of this species are distinctive, making grouping difficult. On the basis of the form of abdominal segment IX we have placed *T. melanopeza* sp. nov. in the *uvida* complex, however, in features of the inferior appendages and tergum X it is distinctive. Males can be recognised by the long, distally inturned and somewhat pincer-shaped lateral lobes on the inferior appendages.

Description. Length of forewing, ♂ 6.5–7.3 mm.

Genitalia, male (Figs 121–123). Abdominal segment IX with a short lateral groove, in ventral view subquadrate. Tergum X comprising a slender, apically setose upper process about two-thirds length of paired slender spines arising laterally at its base, ventrally a broad membranous plate which is expanded laterally at the base and medially and divided apically. The inferior appendages comprise three main parts, the lateral ones probably being simply the posteroapical extension of the inferior appendages into pincer-like processes, mesoventrally the expanded mesodorsal lobes and dorsal to them, the lateral basodorsal processes. According to this interpretation, the mesal basodorsal processes have been lost. This structure may be represented by the pair of spines that appears to be associated with the phallus. Phallus with a pair of spines dorsally.

Etymology. From the Greek *peza*—border, edge, in reference to the black costal margin of the forewing.

Remarks. This is a commonly collected species in NE Queensland and closely resembles a New Guinean species, *T. costalis* Kimmins, 1962. Despite the distinctive form of the phallus of these two species, we are presently grouping them here on the basis of the general appearance of the other features. Future studies on the genus may lead to revision of this arrangement.

Triaenodes nesiotina sp. nov.

Figures 124–127

Material examined. Holotype, ♂, SE Queensland, Bulimba Creek, nr Brisbane, Kimmax Street riffle Site R1, 23 Oct 1979, (no collector given), (NMV, T-16340).

Paratypes, SE Queensland: 2 ♂, same data as for holotype (NMV, genitalic prep. PT-722 illustrated); 9 ♂, Fraser Island, Wanggoolba Creek, Central Station, at light, 19 Dec 1979, K.J. Lambkin, (NMV).

Other material. ♂, SE Qld, Searys Creek, Rainbow Beach, 25°58'S, 153°04'E, 9 Jan 1986, G. Theischinger, (NMV).

Diagnosis. In general appearance of male genitalia, this species is closely similar to

T. torresiana sp. nov., *T. uvida* sp. nov. and *T. nymphaea* sp. nov. It is distinguished by the simpler appearance of the male genitalia which have inferior appendages with apicolateral angles produced into narrow lobes, mesal basodorsal process rounded apically, not spurred and upturned, and no lateral flanges.

Description. Length of forewing, ♂ 5.3–6.4 mm.

Genitalia, male (Figs 124–127). Abdominal segment IX with small grooves lateral to which the cuticle is produced into pronounced lobes. Tergite X comprising a short upper bilobed process above a membranous plate which separates the pair of ventral spines for about half their length. Superior appendages slender, slightly longer than membranous section of tergum X. Inferior appendages in lateral view comprising 4 parts, 3 of which are regular lobose structures—the narrow apical region, a well developed mesodorsal lobe and the lateral basodorsal process; the fourth and upper-most, the mesal basodorsal process is slender at its base and expanded below the acute apex to form a rounded lobe posteriorly and a ventral spine. Phallus slightly expanded and curved downwards distally, shallowly bifid apically.

Etymology. From the Greek *nesiotes*—insular, for the island locality from which some of the paratypes were collected.

Remarks. This species is known only from southeastern Queensland.

Triaenodes torresiana sp. nov.

Figures 128–130

Material examined. Holotype, ♂, N Queensland, Lockerbie Scrub, 16 Apr 1975, M.S. and B.J. Moulds, (NMV, T-16460).

Paratypes, N Queensland: ♂, same data as for holotype, (NMV); 4 ♂, Lockerbie area, 13–27 Apr 1973, S.R. Monteith, (NMV, genitalic prep. PT-800 illustrated); 2 ♂, Station Creek, 15 km N Mt Molloy, 22 Jan 1981, M.S. and B.J. Moulds, (NMV).

Other material. N Queensland: 2 ♂, Bluewater State Forest, S end of Paluma Range, WNW of Townsville, 31 Jan 1981, M.S. Moulds, (NMV); ♂, Mt Spec State Forest, Running Water, 640 m asl, 16 Mar 1994, A.L. Sheldon, (NMV).

Diagnosis. Triaenodes torresiana sp. nov. shows what appears to be a further development of the genitalic elaborations seen in *T. nymphaea*. The mesodorsal lobe of the inferior appendages is prominent above the almost globular basal part and the lateral flanges on the mesal basodorsal process are more distad and well developed to form subapical flanges.

Description. Length of forewing, ♂ 5.2–5.4 mm.

Genitalia, male (Figs 128–130). Abdominal segment IX with a lateral groove. Tergum X with upper process reduced almost completely to a small, rounded structure; spines stout, separated in basal third by a membranous plate which is broadly rounded apically. Superior appendages half to two-thirds length of spines of tergum X. Inferior appendages in ventral view subglobular in basal section; mesodorsal lobe well developed, in ventral view triangular with inner margin bordered by bristle-like setae, in lateral view, club-shaped; lateral basodorsal process digitiform; mesal basodorsal process in lateral view with a slender dorsal spine, ventral portion in form of a pair of slender lobes, one curving anteriorly, the other with apex directed upwards. Phallus stout, slightly expanded distally, apically blunt.

Etymology. Named in reference to the Torresian zoogeographic province in Australia.

Remarks. Triaenodes torresiana has been collected only from northeastern Queensland.

***doryphora*-complex**

In another small subset of the *intricata*-group (referred to by Neboiss and Wells (1996) as "group E"), evolution of the inferior appendages appears to have taken a different course. They have developed into elaborately lobed structures, some of which show glimpses of similarities to species of the *uvida* complex and others to species of the *bernaysae* complex. Five Australian species are included (see Figs 131–142): *T. laciniata* sp. nov., *T. doryphora* sp. nov., *T. empheira* sp. nov., *T. tenerata* sp. nov., and *T. ataloma* sp. nov. Homologies of parts are difficult to ascertain, but it appears that in this complex the mesodorsal lobe on the inferior appendages has shifted to a ventrolateral position, the lateral basodorsal process is above it and the elaborate upper mesal process is the mesal basodorsal process.

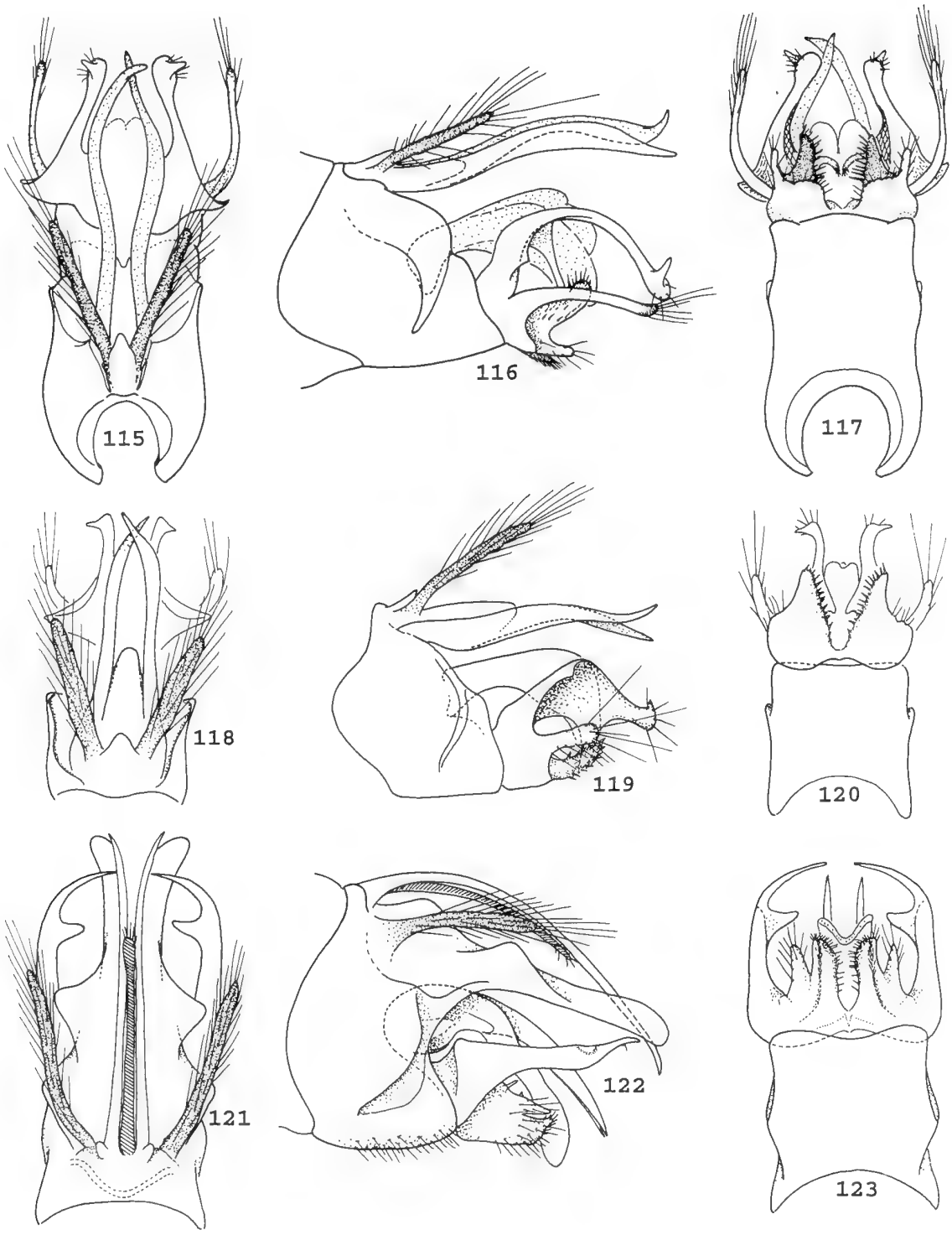
Species in this set all occur in northeastern Queensland.

Triaenodes doryphora sp. nov.

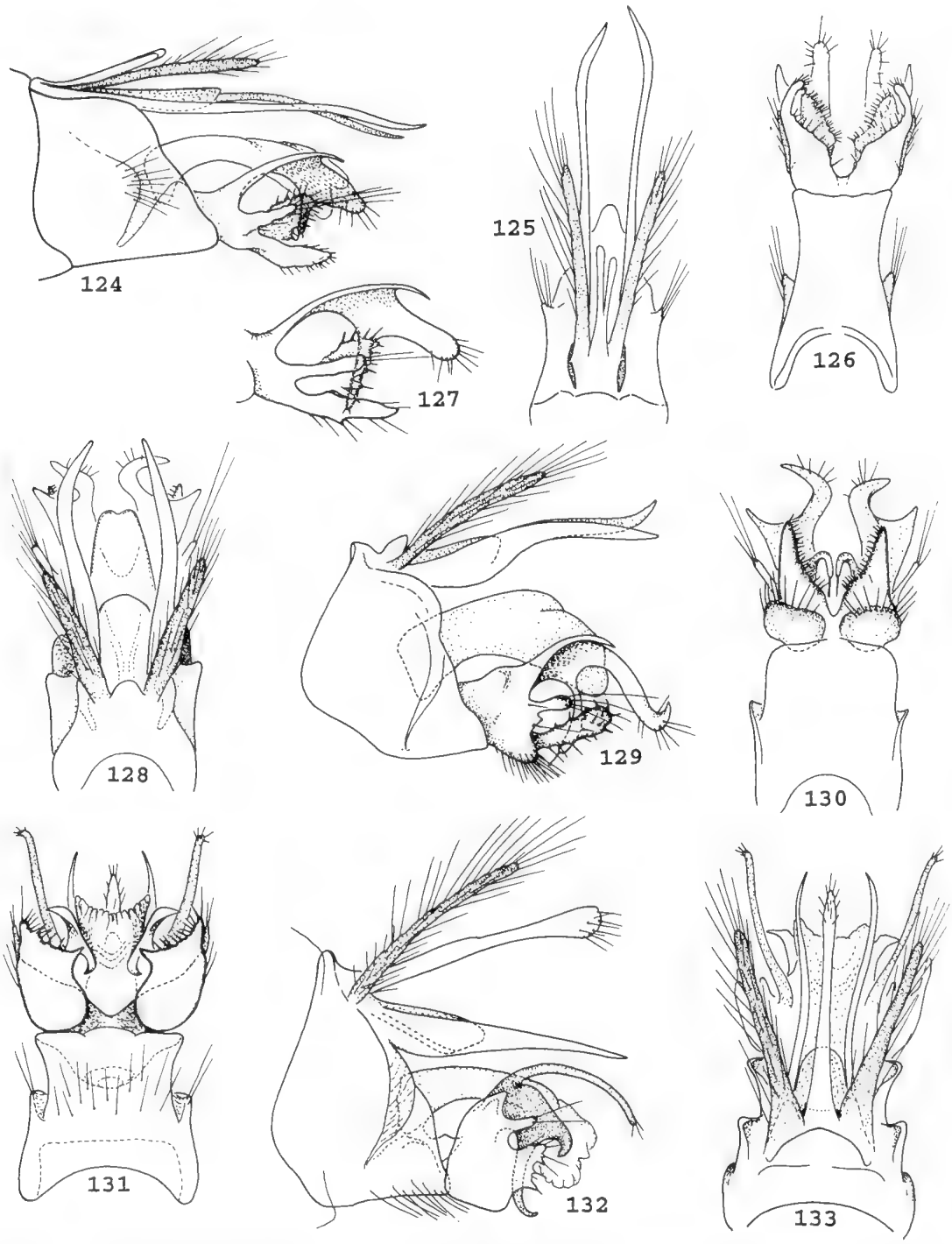
Figures 131–133

Material examined. Holotype, ♂, North Queensland, 2 km S by W Millaa Millaa, 15 May 1950, I.D. Naumann and J.C. Cardale, (ANIC, genitalic prep. PT-1122 illustrated).

Paratype: ♂, N Queensland, Bellenden Ker Range, Cableway Base Station, 100 ♂ asl, 17–24 Oct 1981, Earthwatch, (QM, genitalic prep. PT-1091).



Figures 115–123, male genitalia: 115–117, *Triaenodes uvida* sp. nov., dorsal, lateral and ventral views; 118–120, *Triaenodes nymphaea* sp. nov., dorsal, lateral and ventral views; 121–123, *Triaenodes melanopeza* sp. nov., dorsal, lateral and ventral views.



Figures 124–133, male genitalia: 124–126, *Triaenodes nesiotina* sp. nov., lateral, dorsal and ventral views; 127, *Triaenodes nesiotina* sp. nov., inferior appendage, lateral view of PT-758 – Fraser Island; 128–130, *Triaenodes torresiana* sp. nov., dorsal, lateral and ventral views; 131–133, *Triaenodes doryphora* sp. nov., ventral, lateral and dorsal views.

Diagnosis. Closely resembling *T. laciniata* but distinguished particularly on the finer structure of the mesal basodorsal process of the inferior appendages.

Description. Length of forewing, ♂ 6.2–6.8 mm.

Genitalia, male (Figs 131–133). Abdominal segment IX with a short oblique groove laterally. Tergum X comprising a slender upper part with setae apically and a pair of equal spines separated for about half their length by a membranous plate. Superior appendages slender, more than three-quarter length of upper lobe of tergum X. Inferior appendages in lateral view with height greater than length, posterior margin irregular, intermediate lobe short digitiform, mesal basodorsal process with a slender, curved upper lobe, and a more or less calliper-shaped ventral lobe. Phallus narrow basally, dilated distally.

Etymology. From the Greek *doryphoros*—spear bearing, in reference to the spear-like processes of tergum X.

Remarks. This species is known only from north-eastern Queensland.

Triaenodes laciniata sp. nov.

Figure 134

Material examined. Holotype ♂, N Queensland, Davies Creek National Park, nr Mareeba, 27 Oct 1988, MV-light, K. Walker, (NMV, T-16423).

Paratypes, N Queensland: ♂, N Queensland, Mossman Gorge, 16 Jun 1971, E.F. Reik, (NMV, genitalic prep. PT-760 illustrated); ♂, Moses Creek, 4 km N by E Mt Finnigan, 15°47'S, 145°17'E, 14–16 Oct 1980, J.C. Cardale, (ANIC); ♂, Woodbadda River, 15°58'S, 145°22'E, 25 Aug 1992, at light, J.C. Cardale and P.Zborowski, (ANIC).

Diagnosis. Triaenodes laciniata sp. nov. is distinguished from the closely similar *T. doryphora* sp. nov. by a the more massive mesal basodorsal process on the inferior appendages and the form of tergum X.

Description. Length of forewing, ♂ 5.5–5.6 mm.

Genitalia, male (Fig. 134). Abdominal segment IX with a long oblique lateral groove effectively distancing the upper and lower genitalic parts. Segment X with a rather stout elongate upper part with setae on the slightly expanded, blunt apex; spines stout at base, may have a short subsidiary spine dorsally, a short membranous plate between spines. Superior appendages slender, elongate, as long as the dorsal lobe on tergum X. Inferior appendages in lateral view wide; apicodorsal angle produced slightly; lateral basodorsal process short with 2 setae apically; mesal basodorsal process with a slender, spiny basal lobe, and dorsal lobe slender, curved, elongate, with several short setae apically. Phallus stout, down-turned.

Etymology. From the Latin *lacinia*—lappet, fringe, in reference to the flap on the antennal scape.

Remarks. Triaenodes laciniata is known only from northeastern Queensland.

Triaenodes tenerata sp. nov.

Figures 135–137

Material examined. Holotype ♂, North Queensland, Bluewater State Forest, S end of Paluma range, WNW Townsville, 31 Jan 1981, M.S. Moulds, (NMV, T-16417, genitalic prep. PT-1117 illustrated).

Paratype: ♂, North Queensland, Little Cedar Creek, Mt Spec, 31 Jan 1965, E.C. Dahms, MV light, (QM, genitalic prep. PT-1118).

Diagnosis. This species is distinguished from others in the group by its uniquely bifid and curved ventral spines of tergum X.

Description. Length of forewing, ♂ 5.0–5.1 mm.

Genitalia, male (Figs 135–137). Abdominal segment IX short, with a long oblique groove laterally, but without development of a dorsal membranous area. Segment X comprising a narrow upper part with setae distally; ventrally spines well separated basally by a membranous plate, divided and twisting distally. Superior appendages stout at base, tapered distally. Inferior appendages broad-based, triangular in ventral view; lateral basodorsal process short with 2 short setae apically; mesal basodorsal process with a stout, down-turned inner basal lobe and a slender curved dorsal lobe. Phallus narrow, down-turned.

Etymology. From the Latin *tener*—soft, delicate, for the appearance of the male genitalia.

Remarks. This species is known only from north-eastern Queensland.

Triaenodes empheira sp. nov.

Figures 138, 139

Material examined. Holotype ♂, N Queensland, Tinaroo Dam, 27 Apr 1967, D.H. Colless, (ANIC, genitalic prep. PT-761 illustrated).

Diagnosis. Although this species is clearly associated with *doryphora*-group species, the form of the measl basodorsal process on the inferior appendages is closely similar to that of

intricata-group members. This species is distinguished from *T. doryphora* and *T. laciniata* by the simpler, mesal basodorsal process which is only bilobed, and from *T. ataloma* sp. nov. by the small dorsal membranous area on abdominal segment IX.

Description. Length of forewing, ♂ 5.0 mm.

Genitalia, male (Figs 138, 139). Abdominal segment IX short, divided in lateral view by a groove but with only a very small membranous area dorsally. Segment X comprising a narrow elongate upper process, with setae on slightly swollen apex; ventrally paired spines separated by a short membrane. Superior appendages slender, elongate. Inferior appendages with basal section broad, triangular in ventral view; lateral basodorsal process short, a single short seta apically; mesal basodorsal process with a stout, down-turned basal lobe, and a slender curved dorsal lobe with a pair of short setae apically. Phallus narrow proximally, stouter distally, down-turned.

Etymology. From the Latin *emphereia*—likeness, in reference to the similarity of the species in this group.

Remarks. At present this species is known only from the type locality in northeastern Queensland.

Triaenodes ataloma sp. nov.

Figures 140–142

Material examined. Holotype ♂, N Queensland, Mt Spec State Forest, Birthday Creek above weir, 18°57'S, 146°10'E, 27 Jan 1994, lt tr., 820 m asl, A.L. Sheldon, (NMV, T-16338).

Paratype ♂, N Qld, Birthday Creek, 3.5 km WNW Paluma, 18°59'S, 146°10'E, 7 Apr 1990, at lt, R. St Clair, (NMV, genitalia prep. PT-2021 illustrated).

Diagnosis. Triaenodes ataloma sp. nov. resembles *T. tenerata* in general appearance of male genitalic parts, but the distal portion of abdominal segment IX is narrower and has an extensive and concertinaed membranous area distally, and the ventral spines of tergum X are undivided distally.

Description. Length of forewing, ♂ 5.3–5.9 mm.

Genitalia, male (Figs 140–142). Abdominal segment IX divided laterally into a proximal sclerite and a posteroventral part above which is a large area of concertinaed membrane. Tergum X comprising a slender upper part with setae distally, and ventrally a pair of elongate forceps-like spines which extend beyond the upper structure and the superior appendages. Superior appendages elongate, in ventral view almost parallel-sided. Inferior appendages more rounded at anterolateral angle than in tenerata, in lateral view almost truncate apically, lateral basodorsal process very short; mesal basodorsal process bilobed, in lateral view upper lobe slender, curving downwards, lower lobe skittle-shaped.

Etymology. From the Greek *atalo*—tender, delicate, referring to the soft, flexible part of segment IX; oma—designating condition.

Remarks. Triaenodes ataloma is known only from northeastern Queensland.

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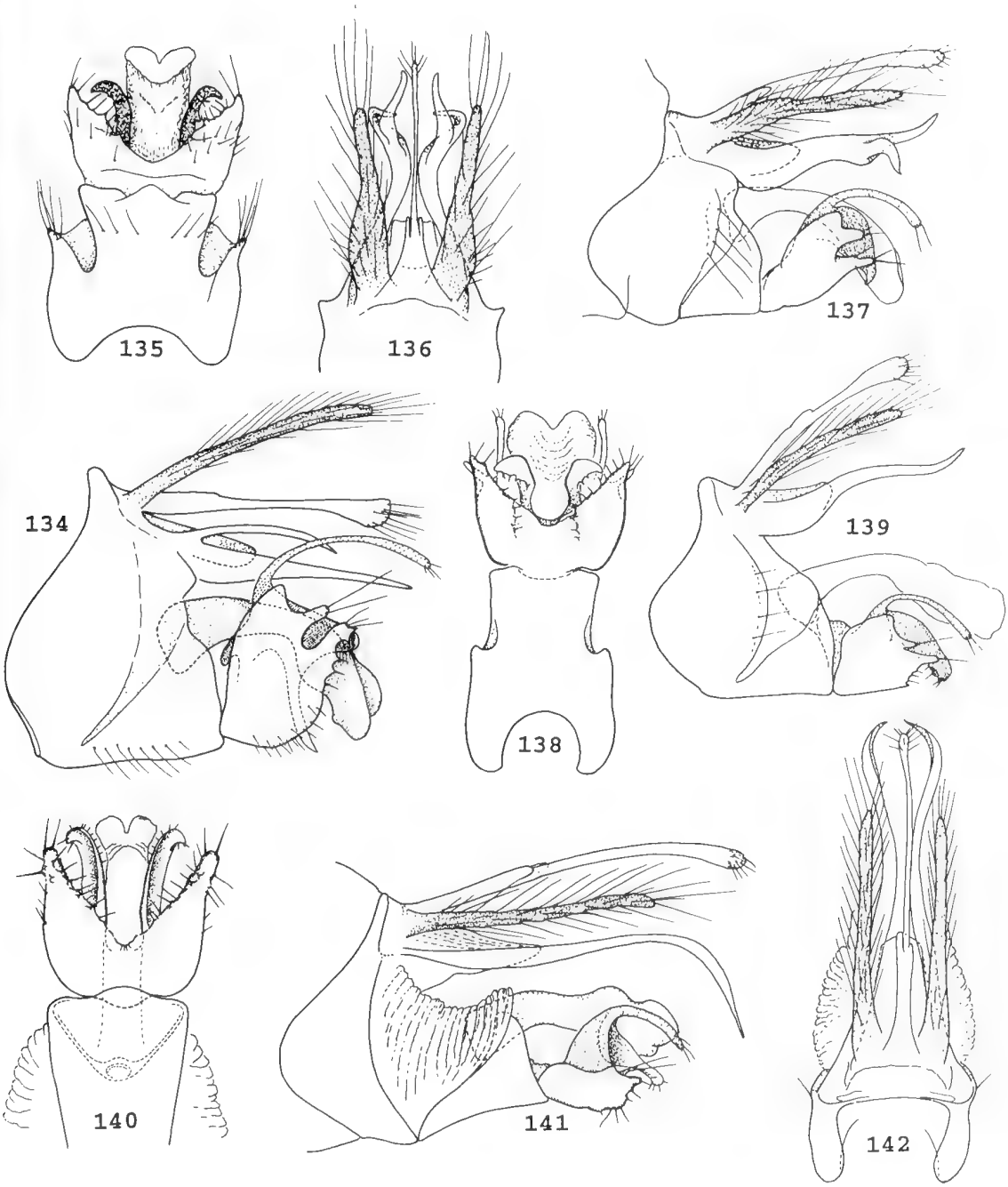

Figures 134–142, male genitalia: 134, *Triaenodes laciniata* sp. nov., lateral view; 135 -137, *Triaenodes tenerata* sp. nov., ventral, dorsal and lateral views; 138, 139, *Triaenodes empheira* sp. nov., ventral and lateral views; 140–142, *Triaenodes ataloma* sp. nov., ventral, lateral and dorsal views.

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Memoirs of the Museum of Victoria 57(1): 133–142 (1998)

TWO NEW SPECIES OF *CONOESUCUS* MOSELY FROM TASMANIA (TRICHOPTERA: CONOESUCIDAE)

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Abstract

Jackson, J.E., 1998. Two new species of *Conoesucus* Mosely from Tasmania (Trichoptera: Conoesucidae). *Memoirs of the Museum of Victoria* 57(1): 133–142.

Adults, pupae and larvae are described and illustrated for *Conoesucus adiastolus* sp. nov. and *Conoesucus notialis* sp. nov. from Tasmania. The first diagnoses of the pupae and larvae of Conoesucidae and *Conoesucus* are given.

Introduction

The Conoesucidae, now with 23 described Australian species, is the second most diverse of the case-making Trichoptera families in Australia, after the Leptoceridae. In addition, taxonomic work on larvae (Jackson, 1988) indicates that there are about 16 undescribed species in southeastern Australia (no further undescribed conoesucids are known from Tasmania). Conoesucid larvae are common in many lotic habitats in southeastern Australia. Conoesucidae also occur in New Zealand and the immatures of New Zealand species have been described by Cowley (1975, 1976, 1978).

The descriptions given here of two new Tasmanian species include the first larval and pupal descriptions of Australian Conoesucidae. Chromosome number and information on testis structure obtained during a chromosome study (Jackson, 1991) are included in diagnoses.

Materials and Methods

Collecting. Larvae and pupae were collected by hand picking from various substrates (rocks, wood, plants). Specimens required for rearing were transported in jars of shallow water on ice; others were preserved in 70% ethanol. Adults were collected from riparian vegetation with a sweep net during the day; at night adults were collected from a sheet hung behind a mercury vapour lamp, or in automatic UV light traps. Specimens were preserved immediately in 70% ethanol. All material was collected by the author unless otherwise stated. Type material and material examined is lodged in the Museum of Victoria (NMV). Grid references given with locality data refer to the Tasmap 1:100,000 map series (Lands Dept., Hobart).

Rearing of immatures. Larvae or pupae were reared to adults in small plastic containers with shallow, aerated tap or stream water at 10–15°C. Stones, sand, leaves, wood and/or algae were provided as food, case material and pupation sites. Transparent perforated lids prevented the escape of emerged adults. Association of larva with adult using metamorphotypes collected from the field was also possible, as conoesucids retain larval sclerites within the pupal case.

Electrophoresis. Standard methods of allozyme electrophoresis (Richardson et al., 1986) were used to confirm that *Conoesucus adiastolus* sp. nov. was distinct from the morphologically similar *C. brontensis* Neboiss. The criterion used to indicate specific status was a minimum of 15% of loci with fixed differences between allopatric populations (Richardson et al., 1986).

Preparation, drawing and description. Descriptions and figures are of late instar larvae. Whole larvae and adult abdomens were prepared for microscopic examination by clearing in hot 5% KOH for about 10 minutes (after puncturing larval abdomens), rinsing in glacial acetic acid, then transferring to glycerol. Specimens were mounted in glycerol; cleared material was subsequently stored in glycerol. To clarify the structure of the genitalia and the larval abdominal cuticle, a few specimens of each series were stained temporarily by adding a few drops of acid fuchsin to the acetic acid rinse. Untreated material was also examined, and larval sclerites from pupal cases often showed setal and scar patterns more clearly than other material.

Drawings of pupae were made from exuviae of reared specimens; whole specimens were also examined. Wings to be drawn were removed from the adult, denuded with a fine paint brush,

and stained in acid fuschin to show venation. They were mounted on a flat microscope slide in glycerol or alcohol. Drawings were made with the aid of camera lucida on a Wild M20 compound microscope and a Wild M5 stereomicroscope. Scale lines on figures are in millimetres. Terminology follows that of Wiggins (1977) (larvae), Wiggins (1984) (pupae) and Neboiss (1981) (adults). Abbreviations: L=larvae; P=pupae.

Conoesucidae Ross

Diagnosis. Adult diagnosis given by Neboiss (1977). Chromosome number: n=25.

Pupa: Gills absent. Lateral fringe extending from posterior of segment 6 to midsegment 8. Dorsal hook plates on anterior of segments 3–6 and posterior of segment 5, toothed ridges on segment 2. Mandibles broad basally, distal half tapered and curved, outer margins with 2 large basal setae. Labrum a truncated cone or hemisperical in shape, anterior margin papillate. Midleg setal fringe either dense on both sides, sparse on one side or absent; fore and hind legs lacking fringe. Anal processes elongate, with 2 pale apical bristles arising slightly subapically. Case constructed from larval case by shortening and adding anterior and posterior membranes. Anterior opening a transverse slit, posterior opening a vertical slit or oval.

Late instar larva: Small to medium sized (length 4–12 mm). Head more or less round in dorsal view and flat on top. Ventral apotome triangular, usually unpigmented posteriorly, genae widely separated at occipital margin. Antennae minute, very close to anterior margin of head, below carina if present. Pronotum strongly sclerotised. Mesonotum weakly sclerotised, metanotum predominantly membranous with one or two small pairs of sclerites. Legs unmodified, increasing in length and slenderness posteriorly. Abdomen cylindrical, lateral fringe of setae absent, lateral row of minute spicules on segment 8. Segment 1 lateral hump with small spiny oval area. Anal claw with single small accessory hook. Case cylindrical, usually curved and tapered; constructed of sand, secretion or concentric plant strips; posterior membrane with central circular or oval opening.

Conoesucus Mosely

Conoesucus Mosely, 1936: 408.—Mosely and Kimmins, 1953: 87.—Neboiss, 1977: 109.

Type species. Conoesucus fromus Mosely, 1936.

Diagnosis. Adult diagnosis given by Neboiss (1977).

Pupa: Labrum with anterior pair of median setae, 2 large pairs in midtransverse row and single seta on each lateral margin, 3 large setae in each posterolateral corner. Anterior hook plates roughly oval, hooks scattered or in a row; posterior hook plates rounded-quadrate or about twice as wide as long. Dorsum of segment 9 with tranverse row of 3–6 setae on each side, several setae laterally. Midleg with setal fringe on one side only, setae sparse or lacking in some species. Anal processes broad basally, cylindrical distally; setose dorsally. Case anterior membrane domed or flat with curved slit at or below centre; posterior membrane domed or flat.

Late instar larva: Length to about 12 mm. Head dorsally with polygonal reticulate sculpturing. Strong carina extends from anterior margin of head capsule to behind eye. Frontoclypeus with two erect dark setae in each anterolateral corner. Foretrochantin separated from propleuron by suture. Pronotum lateral face entirely pigmented, setose. Mesonotum approximately square. Abdominal gills present on segments 1–3 or absent. Tergum 9 with a pair of irregularly pigmented sclerites. Anal lateral sclerites pigmented, facing dorsally and with setae relatively uniform in length. Gonads: each testis with four round lobes. Case curved, about the same length as larva.

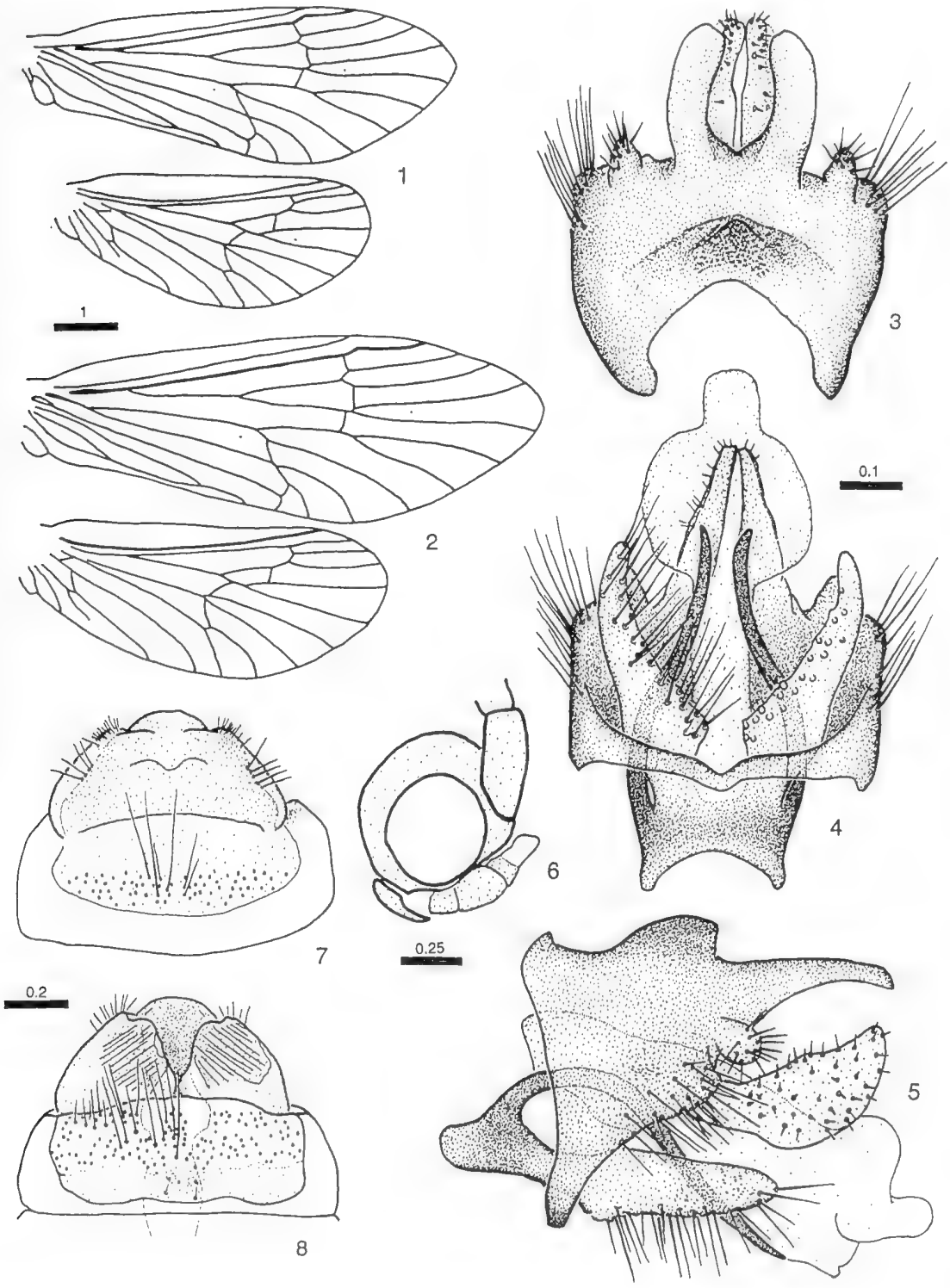
Conoesucus adiastolus sp. nov.

Figures 1–28

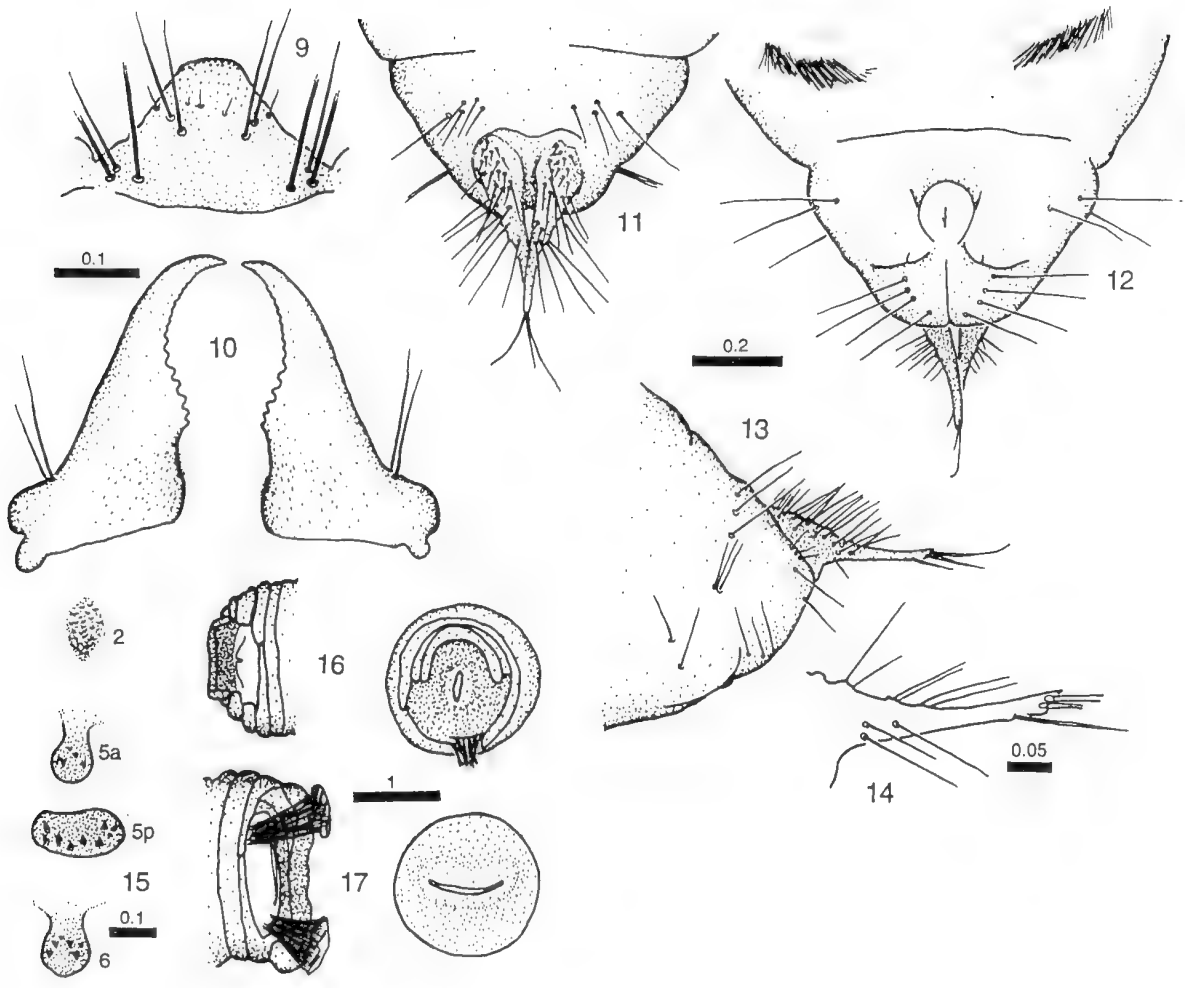
Type material. Holotype ♂(NMV T-10796), Tasmania, Gordon River 2 km downstream of Serpentine junction, grid ref. 8012: 134 667, 12 Jan 1977, A. Neboiss. Allotype ♀ (NMV T-10797), small creek on Serpentine Dam Road, grid ref. 8012: 168 644, 29 Dec 1988, emerged 2 Jan 1989.

Paratypes (NMV T-10798-10806): 3♂ cleared, same data as holotype; 2♂ same locality as allotype, emerged 8 Jan 1989, 15 Jan 1989; 1♂ 1♀ same data as allotype, 2♂ Nelson Valley Creek Lyell Hwy, grid ref. 8013: 933 385, emerged 12 Jan 1989, 22 Jan 1989; 5 L (NMV T-10807-10811) same data as holotype; 5 L (NMV T-10812-10816) small creek on Serpentine Dam Road, grid ref. 8012: 168 644, 29 Dec 1988. All lodged in Museum of Victoria.

Other material examined. 2♂, pharate ♀, 20 L, 5 P same data as holotype; 20♂, 7♀ reared, 2♂ netted, small creek on Serpentine Dam Road, grid ref. 8012: 168 644, 29 Dec 1988; 2♂ 2♀ reared, same locality, 11 Nov 1988; 36 L same locality, 1 Sep 1988, 14 Oct 1987; 22 P same locality, 11 Nov 1988, 29 Nov 1988, 29 Dec 1988; 2♂,1♀, Nelson Valley Creek Lyell Hwy, grid



Figures 1–8. *Conoesucus adiastolus* sp. nov.: 1, male wing venation. 2, female wing venation. 3, male genitalia dorsal. 4, ventral. 5, lateral. 6, male head lateral. 7, female genitalia dorsal. 8, ventral.



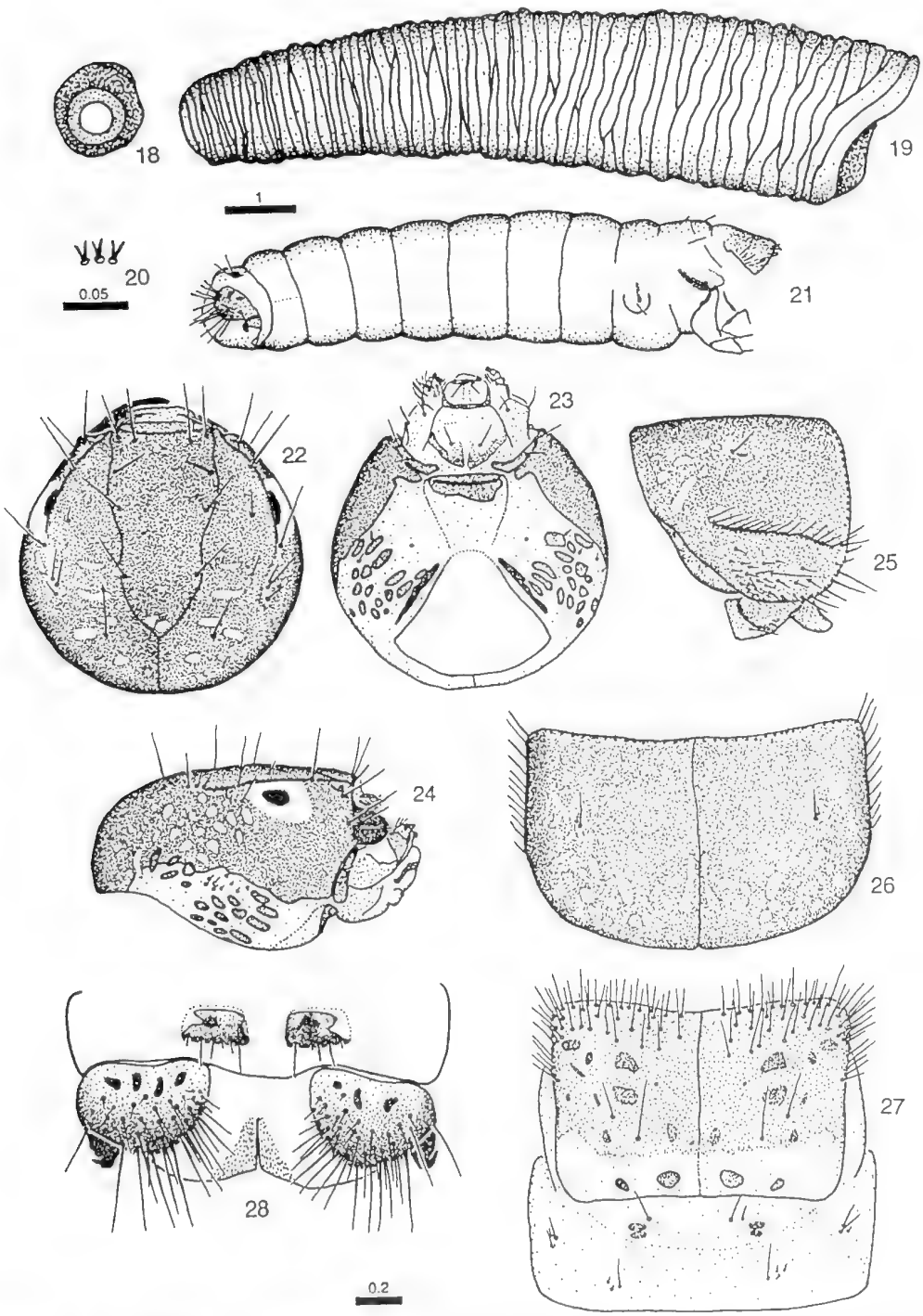
Figures 9–17. *Conoesucus adiastolus* sp. nov.: 9, pupal labrum. 10, pupal mandibles ventral. 11, male pupal terminalia dorsal. 12, ventral. 13, lateral. 14, anal process. 15, pupal hook plates of segments 2, 5 and 6. 16, pupal case posterior ventral and posterior membrane. 17, pupal case anterior ventral and anterior membrane.

ref. 8013: 933 385, 31 Oct 1988; 2♂ 6♀ same locality, 12 Jan 1989; 40 L same locality, 19 Sep 1988, 12 Jan 1989; 8 P same locality, 12 Jan 1989; 2♂ small creek near Teds Beach Gordon Rd, grid ref. 8112: 231 625, 29 Dec 1988; 3 L same locality, 11 Nov 1988, 29 Dec 1988; 2 P same locality, 29 Dec 1988; 1 L Yolande River Murchison Hwy, grid ref. 8013: 766 472, 20 Sep 1988; 6 L Hogarth Falls Strahan, grid ref. 7913: 641 319, 20 Sep 1988; 1 L Snake Creek Lyell Hwy, grid ref. 8013: 989 368, 19 Sep 1988; 5 L small creek 7 km W of Collingwood River Lyell Hwy, grid ref. 8013: 073 357, 31 Oct 1988; 6 L Double Barrel Creek Lyell Hwy, grid ref. 8013: 138 275, 19 Sep 1988.

Specimens figured: 1♀ reared Nelson Valley Creek Lyell Hwy, grid ref. 8013: 933 385, emerged 18 Dec 1988; 1♂ reared small creek on Serpentine Dam Road, grid ref. 8012: 168 644, emerged 8 Jan 1989; 1 P same locality, 29 Dec 1988; 2 L same data as holotype.

Diagnosis. Male: Abdominal sternite 7 without broad spatulate process (although there is a slight distal extension), segment 10 apically turned upwards almost at right angle. Maxillary palp with base of segment 3 sclerotised and segment 3 of about equal length to segment 2.

Late instar larva: pronotum anterior margin without dark setae, pronotum anterolateral corner strongly rounded, mesonotum with dense anterior band of setae 3–4 wide, case of concentric plant strips.



Figures 18–28. *Conoesucus adiastolus* sp. nov.: 18, larval case posterior membrane. 19, larval case lateral. 20, segment 8 lateral spicules. 21, larval abdomen lateral. 22, larval head dorsal. 23, ventral. 24, lateral. 25, pronotum and foretrochantin lateral. 26, pronotum dorsal. 27, mesonotum and metanotum. 28, tergite 9 and anal prolegs.

Description. Adults (Figs 1–8): Dark coloured. Male fore wings without specialised hairs or fold; hind wing with row of long hairs on Cu and Cu_2. Cu_2 ending at margin in both sexes, connecting to Cu_{1b} by cross vein. Hind wing Sc and R running separately to margin; f1 footstalk length variable; 2A not reaching margin in either sex. Length of fore wing ♂ 5.25–7.25mm, ♀ 7.25–9.0 mm. Male maxillary palps with long golden and brown hairs; segment 1 short, segment 2 about twice length of segment 1, broad; segment 3 short, about length of segment 2, base of segment 3 pigmented. Maxillary palps 5-segmented and normal in female. Male genitalia (Figs 3–5): Tergite 9 with prominent ridge or hump and extended distally into 2 curved processes; laterally produced into rounded setose process. Superior appendages short round lobes bearing pale setae. Inferior appendages tapered and curved slightly, inner (concave) margin setose, setal sockets not produced into finger-like projections; a pair of long slender processes with smooth pointed apices arise basally and protrude ventral to the phallus. Phallus expanded laterally near apex. Segment 10 consists of 2 laterally flattened broad processes, curved evenly upwards so that apices point dorsad, tapered to rounded apex, with slight convexity on upper margin. Distal margin of sternite 7 with broad extension but no free process.

Female abdomen (Figs 7, 8) terminates bluntly, tergite 9 median process prominent, without median concavity, dorsolateral areas setose distally. Ventral plates about as wide as long; ventral incision wider distally, margins approximately straight. Sternite 8 distal two-thirds with dense broad band of dark stout setae, other sternites with sparse dark setae; no process on sternite 7. Tergite 8 with 2 groups of dark setae, other tergites also setose.

Pupa (Figs 9–17): Midleg setae very sparse. Anterior hook plates with 6–8 hooks scattered or in semicircle; posterior hook plates oval, wider than long, with 8–14 small hooks. Additional hookplates occasionally present. Apices of anal processes pointed, dorsal surface smooth apart from setal sockets; apical bristles arise very close to apex. Case anterior opening broad, width about half membrane diameter, central, slightly raised, under small dorsal hood. Posterior membrane slit raised slightly in membrane, under small dorsal hood. Adhesive stalked discs at both ends.

Late instar larva (Figs 18–28): General colour of sclerites dark brown. Head with several erect dark setae on dorsum. Pronotum anterolateral corner round, anterior margin with minute pale setae, no long dark setae. Lateral face between carina and margin broad. Mesonotum with dense anterior band of setae, 3–4 setae wide; mesonotum anterior two-thirds pigmented. Metanotum: each setal area with 1–2 easily visible setae and 1–3 minute setae; setal area 1 sometimes pigmented. Abdominal gills absent. Case of concentric plant strips, may include some sand grains.

Distribution. Western Tasmania; locally abundant.

Larval habitat. Rocky streams with moss or algae. Pupates singly, case attached at both ends under rocks.

Etymology. From *adiastolos* (Greek), not separated, confused; refers to the similarity of adults of this species to *Conoesucus nepotulus* Neboiss and *C. brontensis* Neboiss, and of larvae (except for the case) to *C. brontensis*.

Remarks. This species was confirmed as specifically distinct from *C. brontensis*, with electrophoretic fixed differences at three of the eleven allozyme loci scored (27% fixed differences) (Jackson, 1991).

Male maxillary palp characters distinguish the three similar species *Conoesucus adiastolus* sp. nov., *C. brontensis* and *C. nepotulus*. In *C. nepotulus* segment 3 is unsclerotised. The base of segment 3 is sclerotised in *C. brontensis* and *C. adiastolus* sp. nov., which are distinguished by the long segment 3 in *C. brontensis* compared to segment 3 of about equal length to segment 2 in *C. adiastolus* sp. nov.

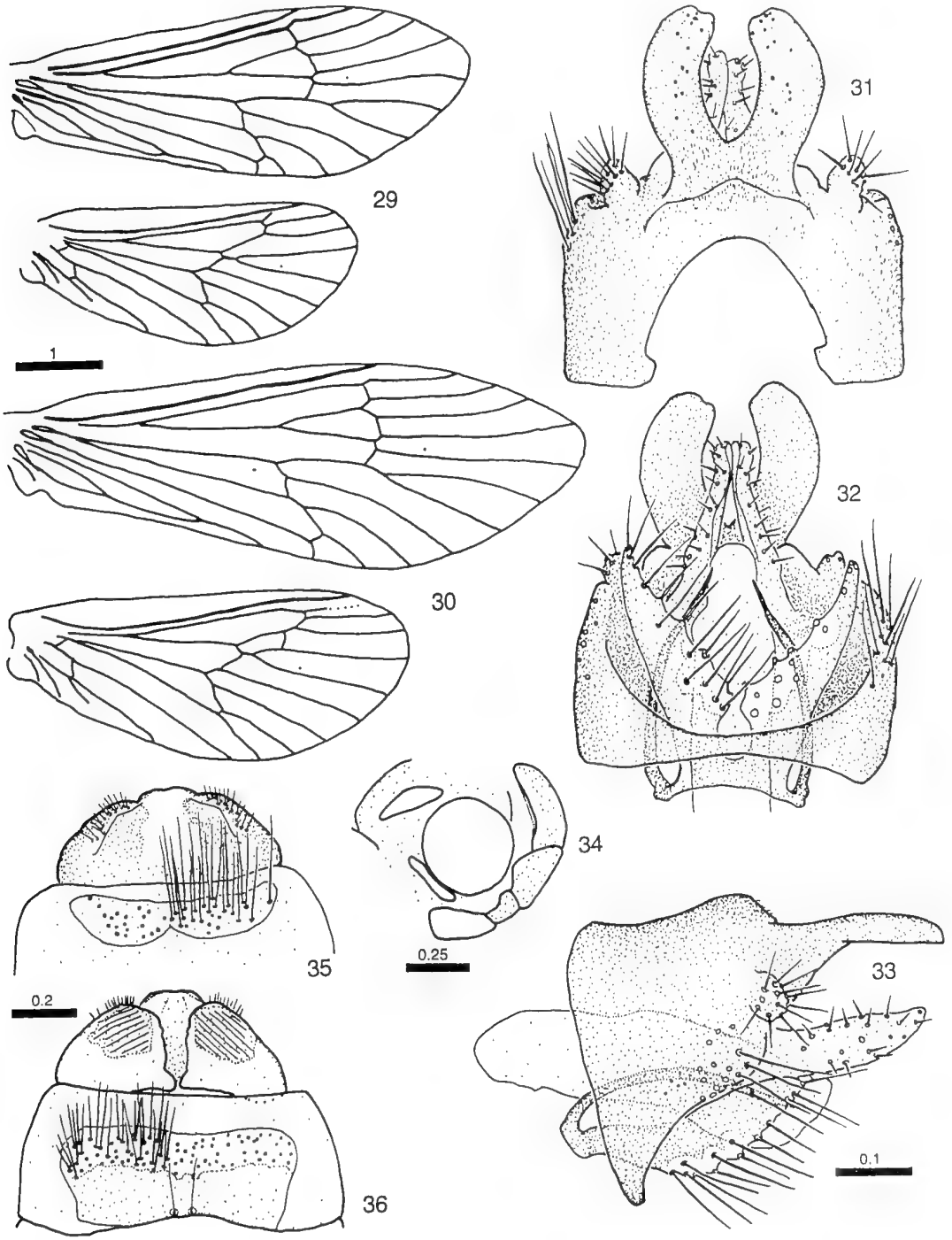
None of the following wing characters enable diagnosis of *C. adiastolus* males or females from *C. brontensis* or *C. nepotulus:* fore wing length, hind wing length, hind wing fork 1 footstalk length (f), hind wing fork 1 discoidal cell anterior margin length (dc), or the ratio f:dc (Jackson, 1991).

Conoesucus notialis sp. nov.

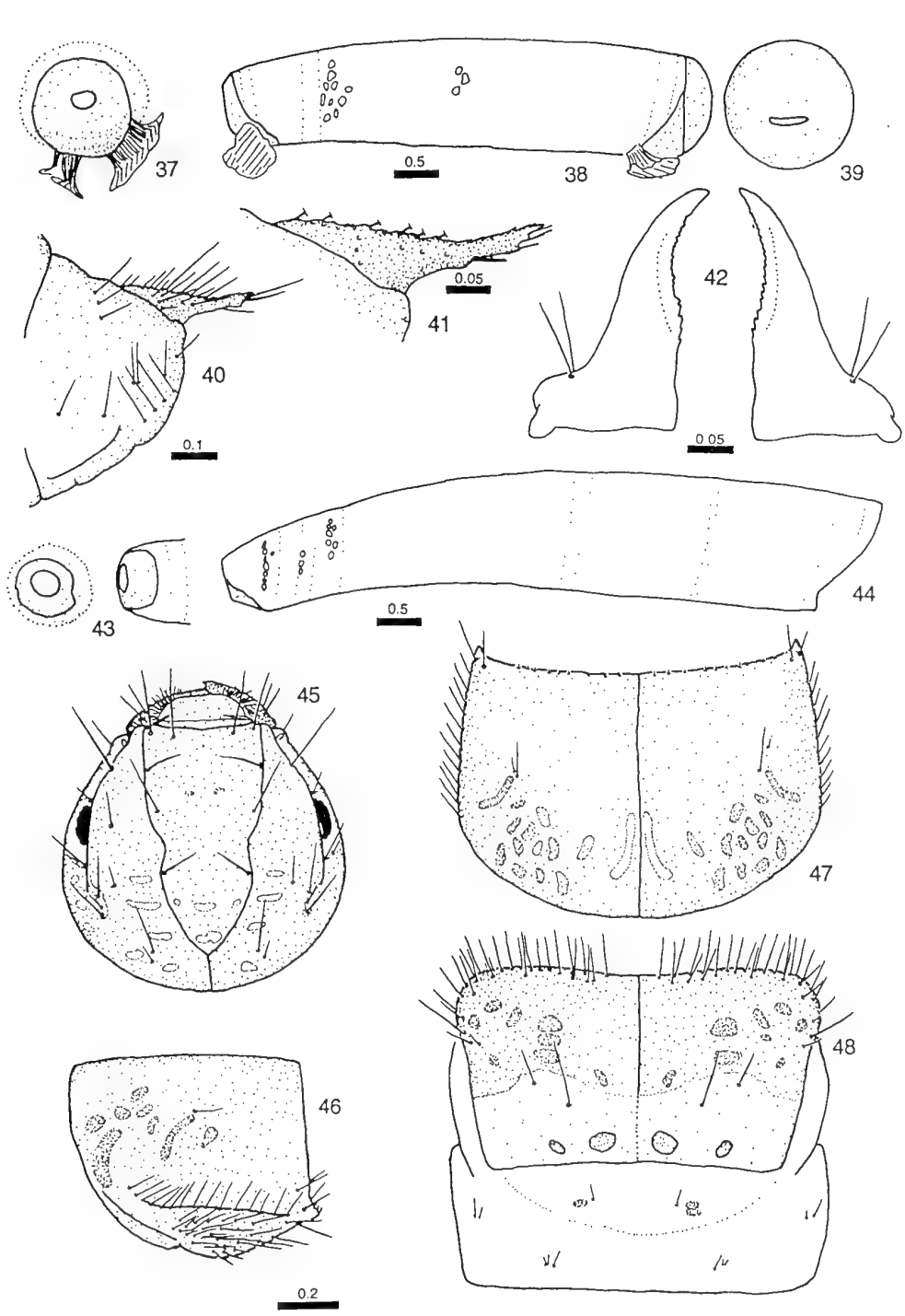
Figures 29–48

Type material. Holotype ♂ (NMV T-10817), allotype ♀ (NMV T-10818), Tasmania, Twin Creeks, Scotts Peak Dam Rd, grid ref. 8112: 483 413, 25 Aug 1988, emerged 9 Oct 1988.

Paratypes (NMV T-10819-10825): 3♂ 2♀ same locality, emerged 20 Nov 1988; 1♂ 1♀ Condominium Creek, Scotts Peak Dam Rd, grid ref. 8112: 479 434, 25 Aug 1988, emerged 12 Oct 1988; 5L (NMV T-10826 - 10830) same locality as holotype, 25 Aug 1988. All lodged in Museum of Victoria.



Figures 29–36. *Conoesucus notialis* sp. nov.: 29, male wing venation. 30, female wing venation. 31, male genitalia dorsal. 32, ventral. 33, lateral. 34, male head lateral. 35, female genitalia dorsal. 36, ventral.



Figures 37–48. *Conoesucus notialis* sp. nov.: 37, pupal case posterior membrane. 38, pupal case lateral. 39, anterior membrane. 40, pupal terminalia lateral. 41, anal process lateral. 42, pupal mandibles ventral. 43, larval case posterior membrane and ventral. 44, larval case lateral. 45, larval head dorsal. 46, pronotum lateral. 47, dorsal. 48, mesonotum and metanotum.

Other material examined. 14♂ 2♀ reared, Condominium Creek, Scotts Peak Dam Rd. grid ref. 8112: 479 434, 6 Oct 1987; 7♂ 1♀ reared, same locality. 25 Aug 1988; 15 L same locality, 26 Mar 1987, 25 Aug 1988; 7♂ 4♀ reared Twin Creeks, Scotts Peak Dam Rd, grid ref. 8112: 483 413, 25 Aug 1988; 10♂ 10♀ same locality, 12 Nov 1988; 42 L same locality, 9 Feb 1988, 3 Jul 1987, 25 Aug 1988. Specimens figured: holotype ♂; allotype ♀, 2 L, 1P Twin Creeks, Scotts Peak Dam Rd, grid ref. 8112: 483 413, 25 Aug 1988.

Diagnosis. Male abdominal sternite 7 without broad spatulate process. Male segment 10 processes with margins not parallel, processes almost straight, apices very slightly upturned; tergite 9 dorsal processes stout.

Late instar larva: pronotum anterolateral corner pointed, no long dark setae on anterior margin. Abdominal gills small and difficult to see, not branched. Case almost entirely of golden secretion.

Description. Adults (Figs 29–36): Dark coloured, abdominal sclerites charcoal black, flesh greenish when fresh. Length of fore wing ♂ 5.0–5.5 mm; ♀ 7 mm; Cu_2 ending at margin, connected by cross vein to Cu_{1b} in both sexes; in hind wing Sc may join R_1; male fore wings without folds, small scale-like hairs below R from base, not extending to margin. Male hind wing discoidal cell sometimes open. Male maxillary palps 3-segmented, segment 1 short, segment 2 about twice length of segment 1, segment 3 about as long as segments 1+2, all segments covered with flattened black setae; maxillary palps 5-segmented and normal in female. Male genitalia (Figs 31–33): Segment 9 dark brown, dorsally extended distally into 2 broad curved processes, laterally produced slightly into rounded setose process. Superior appendages short round lobes, bearing pale setae. Inferior appendages brown, tapered distally, only slightly curved, inner margin setal sockets produced into finger-like processes; a pair of long slender processes with smooth pointed apices arise basally and protrude on both sides of the phallus. Phallus broad, apex truncate. Segment 10 consists of 2 laterally flattened processes covered with short clear setae, processes widen slightly before tapering to apices, apices only slightly upturned.

Female abdomen (Figs 35, 36) terminates bluntly, tergite 9 concave, median process with slight concavity in distal margin; distal lateral areas with short clear setae. Ventral plates about as wide as long, ventral incision with parallel sides or slightly narrower distally. Sternite 8 distal half densely setose with dark setae, other sternites with sparse dark setae; no process on sternite 7. Tergite 8 with single broad band of dark setae.

Pupa (Figs 37-42): Midlegs without setal fringe. Anterior hook plates with 3–4 hooks, posterior hook plates slightly wider than long, with about 6 larger hooks irregularly arranged and several smaller teeth. Additional small irregular sclerites sometimes present in a row on anterior of segments 2–8. Sclerites present on thorax just behind wing bases. Anal processes with spiny apices and short projection beyond bases of apical bristles. Case with undercut anterior margin filled in with secretion. Anterior membrane domed, opening slit very slightly curved, just below centre; posterior membrane domed, opening a dorsoventrally flattened oval. Adhesive discs ventrally at both ends, arising from old (larval) case margin.

Late instar larva (Figs 43–48): General colour of sclerites mid-dark brown. Head tapered anteriorly in dorsal view. Pronotum anterolateral corner pointed, slightly projected forward of anterior margin, no long dark setae on anterior margin. Mesonotum anterior margin with irregular row, 1–2 wide, of medium-length setae; mesonotum pigmented in anterior two-thirds. Metanotum: each setal area with 1–2 easily visible setae and 0-2 minute setae; setal area 1 sometimes pigmented. Abdominal gills small and indistinct: dorsal gills on posterior of segment 1, segment 2 with anterior dorsal and ventral gills. Case entirely of golden secretion, sometimes with a few sand grains; slight dorsal overhang anteriorly, posterior opening dorsad of centre, posterior membrane fills in undercut ventral margin.

Distribution. Southwestern Tasmania; locally abundant.

Larval habitat. Rock surfaces in streams, rocks with film of algae. Pupates attached to the underside of rocks.

Etymology. From *notialis* (Latin), southern; for the southern distribution of the species.

Acknowledgements

This work was funded by a Commonwealth Postgraduate Award and the National River Health Program of the Land and Water Resources R&D Corporation. Permits to collect specimens were provided by the Tasmanian Inland Fisheries Commission and the Parks and Wildlife Service. Two referees and Dr G. Jordan provided helpful comments on the manuscript.

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Memoirs of the Museum of Victoria 57(1): 143-165 (1998)

FISHES OF WILSONS PROMONTORY AND CORNER INLET, VICTORIA: COMPOSITION AND BIOGEOGRAPHIC AFFINITIES

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Abstract

Turner, M.L. and Norman, M.D., 1998. Fishes of Wilsons Promontory and Corner Inlet, Victoria: composition and biogeographic affinities. *Memoirs of the Museum of Victoria* 57: 143–165.

A diving survey of shallow-water marine fishes, primarily benthic reef fishes, was undertaken around Wilsons Promontory and in Corner Inlet in 1987 and 1988. Shallow subtidal reefs in these regions are dominated by labrids, particularly Bluethroat Wrasse (*Notolabrus tetricus*) and Saddled Wrasse (*Notolabrus fucicola*), the odacid Herring Cale (*Odax cyanomelas*), the serranid Barber Perch (*Caesioperca rasor*) and two scorpidid species, Sea Sweep (*Scorpis aequipinnis*) and Silver Sweep (*Scorpis lineolata*). Distributions and relative abundances (qualitative) are presented for 76 species at 26 sites in the region. The findings of this survey were supplemented with data from other surveys and sources to generate a checklist for fishes in the coastal waters of Wilsons Promontory and Corner Inlet. 231 fish species of 92 families were identified to species level. An additional four species were only identified to higher taxonomic levels. These fishes were recorded from a range of habitat types, from freshwater streams to marine habitats (to 50 m deep). This fish fauna can be broken into a number of components: 45% are species which occur across all of southern Australia; 25% are southern or southwestern species, at or close to their eastern limit; 19% are restricted to the southeast coasts from South Australia to at least southern New South Wales; 7% are at or close to the western limit of their range; and 6% are at or close to the southern end of their range. Two Tasmanian species are at their northern limit at Wilsons Promontory. The influence of the East Australian Current, and the geomorphology and geological history of the area are discussed in relation to the composition, affinities and origins of the fish fauna of this region.

Introduction

Until relatively recently, there has been limited information available on the composition and distributions of coastal fishes along the southern coast of Australia, particularly for Victorian waters. This situation has recently improved through a number of publications on southern Australian fishes, particularly those of Edgar et al. (1982), Last et al. (1983), Hutchins and Swainston (1986), Coleman (1987), Kuiter (1993), Hutchins (1994), Gomon et al. (1994) and Last and Stevens (1994). Kuiter (1993) and the latter two publications provide the best coverage for Victorian waters.

In April 1988, a system of marine parks and reserves was established around Wilsons Promontory in eastern Victoria, principally to conserve marine flora and fauna associated with rocky reef communities in this region. Terrestrial habitats and biota of Wilsons Promontory have been protected since 1898. The coastal strip to low water mark and the offshore islands were incorporated into the National Park in the 1920s.

In 1987 and 1988, the then Department of Conservation and Environment funded a survey of distributions and abundances of benthic reef fishes within the proposed Wilsons Promontory Marine Park system. The objectives of this survey were twofold:

to determine the composition of fishes in waters surrounding Wilsons Promontory and in Corner Inlet; and

to provide a baseline census of composition and relative abundances of reef fishes prior to implementation of marine park legislation.

Several other studies have examined the composition of the fish fauna of the Wilsons Promontory region. In 1980, Barry Hutchins of the Western Australian Museum surveyed the reef fishes of the Glennie Group and Norman Bay, recording 58 species (unpubl. data). In 1982, the Museum of Victoria undertook a survey of

marine habitats around the promontory, generating a checklist of 140 fish species (Wilson et al., 1990). In the same year, the then Marine Science Laboratories (Marine and Freshwater Resources Institute) commenced a 3-year demersal trawl survey of Eastern Bass Strait. Data from this survey was kindly provided by D. Hobday, DCNR (unpubl. data). This survey recorded 99 species from trawl sites adjacent to Wilsons Promontory. Jackson and Davies (1983) examined the freshwater and estuarine fishes of Wilsons Promontory, recording 37 species.

The results of the study reported here, combined with data from the above studies, published records and museum collections, have been used to generate a checklist of the fish fauna of this region. As Wilsons Promontory forms the most southerly point of the Australian mainland, extending well into Bass Strait, the role and position of this prominent land mass in the distributions of southern Australian fishes is worthy of examination. The components and affinities of this fauna may provide insights into the biogeographic processes occurring in this region.

Study area and methods

Study area. Wilsons Promontory (39°00'S, 146°25'E) protrudes into Bass Strait from southeastern Victoria, forming the southernmost point of the Australian mainland (Fig. 1). This promontory consists of granite mountains and valleys extending below the water line and emerging as outcrops to form offshore islands. Drowned valleys have formed bays with sandy floors and beaches. The subtidal topography is diverse, ranging from vertical walls, to large granite slabs (with or without cracks), boulder slopes (boulder diameters from 0.2 to 20 m), to the extensive sand plains which surround the Promontory at depths of 30–50 metres. Located at the northern end of Wilsons Promontory is Corner Inlet, a large shallow estuarine bay of intertidal mud flats and sea grass beds. Deeper channels fill and drain this large bay. Several rocky reefs are present, adjacent to one of the inlet's primary channels.

Twenty six sites were surveyed around the coastline of Wilsons Promontory, including three sites within Corner Inlet. All sites were granite reefs, varying in aspect, topography, slope, depth and level of exposure to surge and currents. Specific locations were chosen to include the majority of reef habitat types and aspects.

Most sites were dominated by large species of brown algae, particularly *Phyllospora comosa* and *Ecklonia radiata*. These algae often formed thick stands. The understory was principally coralline turf algae interspersed with a mixture of brown algae (including species of *Cystophora* and *Sargassum*), green algae (including *Caulerpa* spp. and *Cladophora rugosa*),and a high diversity of smaller species of red algae. Algal growth is limited to areas of sufficient light. In the shade of overhangs and at depths greater than 20–35 metres (depending on water clarity), invertebrate communities predominated. The dominant groups are anthozoans, bryozoans and sponges. See Wilson et al. (1990) for treatment of the invertebrate fauna of the region.

Checklist sites for this survey are shown in figure 1. Site codes, location and habitat descriptions are presented in table 1 for each site.

Personnel and training. Fish surveys were undertaken by the authors in 1987 and 1988, assisted in the first year by staff and participants from *Operation Raleigh*, a British organization which provides educational and developmental experiences for young people ("Venturers"). Venturers were trained in fish identification by the authors employing photographs, illustrations, keys and reference texts. Sources for identifications were Edgar et al. (1982), Last et al. (1983), Hutchins and Swainston (1986), and Coleman (1987).

Survey techniques. Boats were used to access all sites. West coast sites were accessed using inflatable dinghies. South and east coast sites were accessed using larger boats (30 m *Blue Nabilla* and 18 m *Osprey*), provided through the National Safety Council.

At each site, two or more divers spent a minimum of 30 minutes recording all species present. Searches were made under overhangs, in caves and amongst kelp, using torches to investigate deeper caves and crevices. All fish encountered between the surface and the maximum depth (presented in table 1) were recorded. Fish identifications and numbers were recorded on acrylic slates. Illustrations and notes were made of unidentified fishes and compared to reference texts immediately following dives. Species of uncertain identity were discarded from checklists.

Approximate numbers of each fish species were recorded at each site, to provide an indication of relative abundances. As the search time, area covered and capabilities of personnel were not standardized, numbers at each site can not be directly compared. Instead, abundance of each

Table 1. Fish checklist sites around Wilsons Promontory and in Corner Inlet.

Site	Code	Location	Habitat	Maximum depth (m)	Date censused
West Coast					
Tongue Point	T1	Small cove on northern side of tip	Large boulders covered with *Phyllospora comosa* and swim-throughs at depth. Reef almost vertical without large horizontal areas. Sand at 16 m.	16	24.4.1987
Leonard Point 1	L1	Northern side of point, near tip.	*Phyllospora* covered large boulders, bommies and drop offs to sandy bottom at 22 m. Part of large reef.	22	18.4.1987
Leonard Point 2	L2	Midway between point and shore in Picnic Bay.	Heavy *Phyllospora* growth on narrow rocky slopes to sand at 12 m.	12	24.4.1987
Leonard Point 3	L3	Small sheltered cove on south side of point.	*Phyllospora* growth on granite boulders and patchy reef on sand.	5	18.4.1987
Pillar Point 1	P1	At tip of point close to deep water.	Large boulders covered in *Phyllospora* on extensive rock reef. Sand at 22 m.	22	11.4.1987, 19.4.1987
Pillar Point 2	P2	Small cove on south side, one quarter distance from point to shore.	Medium-sized boulders (~1m diameter) on narrow reef covered in *Phyllospora*. Sand at 10 m.	10	11.4.1987, 19.4.1987, 23.4.1987
Pillar Point 3	P3	On south side midway between point and shore.	Narrow rock reef with scattered boulders. Sand at 9 m.	9	12.4.1987
Pillar Point 4	P4	Midway from point to Squeaky Beach.	Boulders on rock slope to sand bottom at 10 m.	10	25.4.1987
Norman Point 1	N1	At tip of point close to deep water.	Extensive rock reef with *Phyllospora* covered ridges and gutters to sand at 18 m.	18	17.4.1987
Norman Point 2	N2	Small cove on north side, one third from point to beach.	Narrow *Phyllospora* covered reef sloping to sand at 10 m.	10	17.4.1987
Norman Point 3	N3	Midway from point to beach on northern side.	*Phyllospora* beds on narrow reef sloping to sand at 10 m.	10	26.4.1987
West Coast Islands					
Citadel Island	W1	East side of island.	Rock reef exposed to strong currents. Sand at 16 m.	16	15.4.1987
Dannevig Island	W2	North west corner of island.	Boulders to 10 m with canyons, swim-throughs and overhangs. Reef extends to at least 20 m.	20	11.5.1987
South coast					
Fenwick Bight	S1	West side of bight.	Vertical walls, slopes with caverns and large boulders. Sand at 20 m.	20	13.4.1987

Table 1. (cont.). Fish checklist sites around Wilsons Promontory and in Corner Inlet.

Site	Code	Location	Habitat	Maximum depth (m)	Date censused
Lighthouse Ramp	S2	Small bay on east side of point.	Huge boulders (>10m) and split slabs to 10 m, steep slope to 25 m.	25	14.4.1987
Prock Point	S3	At tip of point.	Extensive shallow reef with medium boulders (to 3 m diameter). Diverse algal turf.	9	13.5.1987
East Coast					
Brown Head	E1	South of Refuge Cove, close to shore.	Gradual sloping reef. Heavy *Phyllospora* and *Ecklonia* cover to 14 m.	14	8.4.1987
Larkin Cove	E2	Western shore of cove.	Medium-sized boulders (to 3 m diameter) near surface. Smaller boulders to sand bottom at 10 m.	10	8.4.1987
Refuge Cove	E3	South side of cove. Checklist made at night.	Medium-sized boulders gradually sloping to sand and seagrass beds at 9 m.	9	14.4.1987, 15.4.1987
Refuge Cove	E4	North side of cove.	Slope of small boulders near surface. Larger boulders forming overhangs and swimthroughs on sand at 15 m.	15	15.4.1987, 16.4.1987
Marker Light	E5	Navigation light between Refuge and Sealers coves.	Shallow reef covered with *Phyllospora* sloping to sand at 10 m.	10	9.4.1987
Sealers Cove	E6	South side of cove.	Small boulders on gentle slope to sand at 13 m.	13	16.4.1987
Rabbit Island	E7	North-west corner.	Shallow reef with sand floor at 6 m.	6	24.4.1987
Corner Inlet					
Tin Mine Cove	C1	Off north point of cove.	Small boulders for to 3 m, sand slope to 10 m. Large boulders from 10 to 15 m, on edge of channel with strong currents.	15	9.5.1987, 10.5.1987
Chinamans Beach	C2	North point of beach.	Scattered boulders and sand to 9 m on edge of channel.	9	10.5.1987
Freshwater Cove	C3	North point of cove.	Reef on slope of channel with strong current.	14	8.5.1987

species at each site has been placed into one of three broad categories: A: very common (>20 fish sighted); B: common/regularly encountered (5-20 fish sighted); and C: uncommon/rarely sighted (1-4 fish sighted).

As identifications were made visually (i.e., no fishes were captured and retained), certain fish groups such as flatheads (family Platycephalidae) and weedfishes (family Clinidae) were difficult to identify to species level.

Additional species were recorded by the authors in Wilsons Promontory waters outside of the checklist sites. These fishes are included in the appendix.

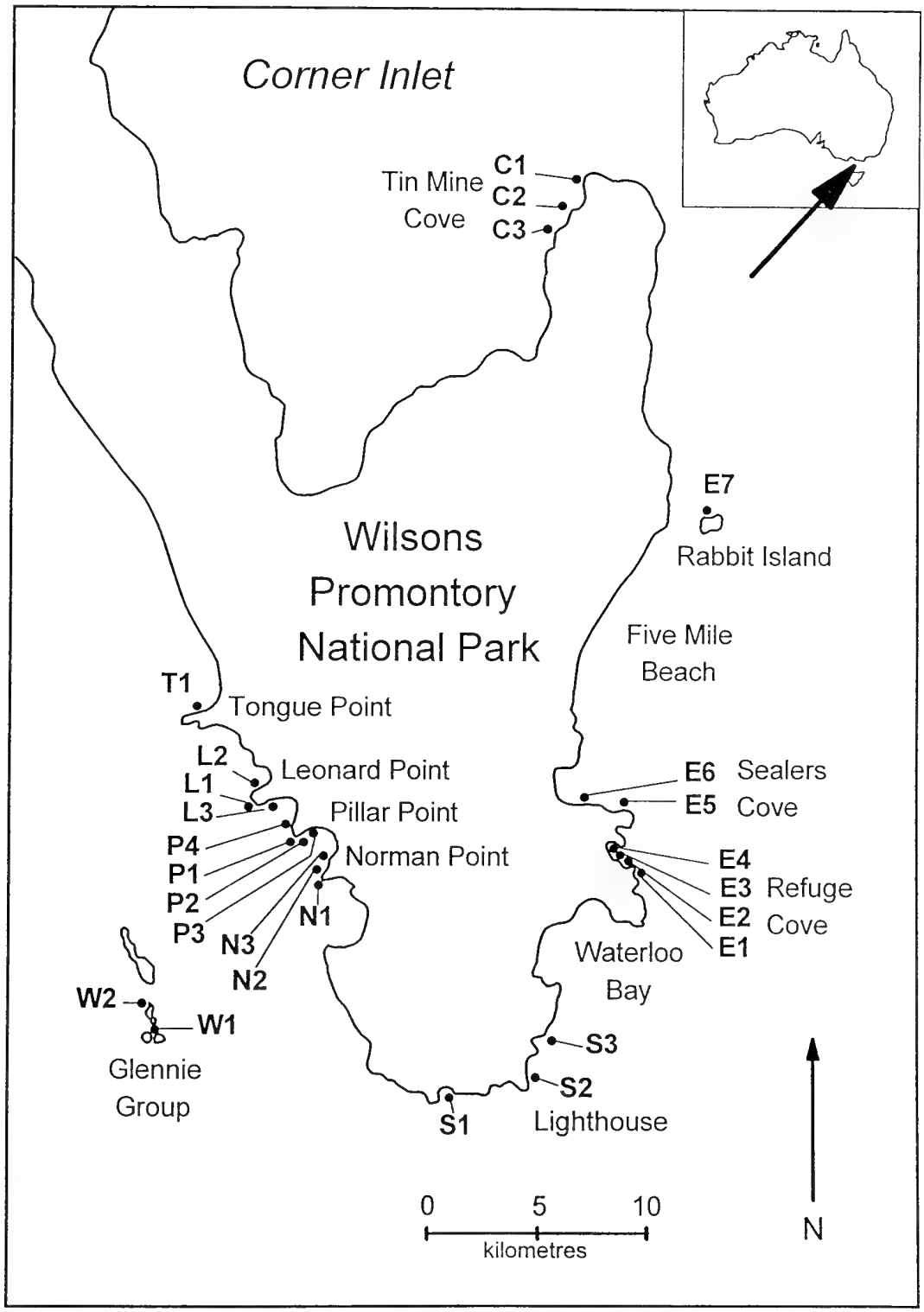

Figure 1. Fish checklist sites around Wilsons Promontory National Park and in Corner Inlet (see Table 1 for site codes).

Previous surveys. The visual census technique used in this survey primarily recorded the larger and more conspicuous species associated with shallow rocky reefs. The checklist presented here results from collation of our data with the results of previous surveys and published records. These surveys provide records of fishes from habitats not examined in this study, i.e., freshwater and estuarine systems (Jackson and Davies, 1983) and offshore soft substrates (Marine and Freshwater Resources Institute unpubl. trawl data), as well as records of cryptic and/or nocturnal species collected through different census techniques.

The Museum of Victoria survey (Wilson et al.,1990) employed observations by scuba divers, rotenone poison stations and benthic trawl stations. Two nets were used, an 18 m headrope otter trawl (at four stations) and a 6 m otter trawl (at three stations). Both nets had a 20 mm mesh size in the cod end. Trawling was undertaken primarily in shallow waters, with two stations at 50 m.

As part of a 3-year demersal trawl survey of Eastern Bass Strait, the then Marine Science Laboratories (now Marine and Freshwater Resources Institute, MAFRI) surveyed sites adjacent to Wilsons Promontory between 1982 and 1984. Sites were sampled every three months by the fisheries research vessel *Sarda*, using a wing trawl (26 m headline) fitted with a 25 mm mesh cod-end. Samples were collected off the east coast of Wilsons Promontory at depths of 13, 25 and 45 m.

Additional data were obtained through a search of the computerised records of fishes registered and housed in the collections of the Department of Ichthyology, Museum of Victoria, for material which had been collected from the Wilsons Promontory region.

With recent reviews of the taxonomy of many fish families in southern Australia (particularly reviews by Gomon et al.,1994, and Last and Stevens, 1994), a number of species names recorded from previous surveys have since been referred to other genera or synonymised with other names. Hence species names used in a number of original records are presented here under their senior synonyms. Where identifications could not be clarified, these records were dropped. The sequence of families and usage of scientific and common names follow Last and Stevens (1994) for sharks and rays, and Kuiter (1993) and Gomon et al. (1994) for all other fish families.

Results

Distributional and abundance patterns. A total of 84 fish species were recorded in this survey, of which 10 were observed by the authors outside checklist sites. Table 2 presents distributions and relative abundances of the 76 species encountered at 26 sites around Wilsons Promontory and in Corner Inlet (74 checklist species plus unidentified members of the family Platycephalidae and the genus *Pseudocaranx*).

General abundance and distribution trends of the species encountered in this survey can be divided into four broad categories:

Widespread and very common species (>20 seen at numerous sites): Barber Perch, (*Caesioperca rasor*); Sea Sweep (*Scorpis aequipinnis*); Bluethroat Wrasse (*Notolabrus tetricus*); Saddled Wrasse (*Notolabrus fucicola*); Herring Cale (*Odax cyanomelas*).

Widespread and common species (5–20 seen at numerous sites): Old Wife (*Enoplosus armatus*); Magpie (Morwong) Perch (*Cheilodactylus nigripes*); Scalyfin (*Parma victoriae*); Senator Wrasse (*Pictilabrus laticlavius*).

Widespread and uncommon species (<5 seen/per site, recorded at numerous sites): Longsnout Boarfish (*Pentaceropsis recurvirostris*); Southern Sea Carp (*Aplodactylus arctidens*); Bastard Trumpeter (*Latridopsis forsteri*); Maori Wrasse (*Opthalmolepis lineolata*); Toothbrush Leatherjacket (*Acanthaluteres vittiger*); Sixspine Leatherjacket (*Meuschenia freycineti*); Ornate Cowfish (*Aracana ornata*); Globefish (*Diodon nichthemerus*).

Widespread species but patchy in distribution and abundance: Butterfly Perch (*Caesioperca lepidoptera*); Longfin Pike (*Dinolestes lewini*); Red Mullet (*Upeneichthys vlamingii*); Common Bulleseye (*Pempheris multiradiata*); Zebra Fish (*Girella zebra*).

Distribution patterns around Wilsons Promontory could also be divided into geographic trends. Certain fish species were more frequently observed, and in larger numbers, in particular regions around Wilsons Promontory.

Predominantly eastcoast: Silver Sweep (*Scorpis lineolata*); Mado Sweep (*Atypichthys strigatus*); Silverbelly (*Parequula melbournensis*); Slender Weed Whiting (*Siphonognathus attenuatus*); Pencil Weed Whiting (*Siphonognathus beddomei*).

Predominantly west coast: Smooth Toadfish (*Tetractenos glaber*); Longfin Pike (*Dinolestes lewini*).

Primarily at Wilsons Promontory (compared with Corner Inlet): Herring Cale (*Odax cyanomelas*); Scaly fin *(Parma victoriae)*; Old Wife (*Enoplosus armatus*); Sea Sweep (*Scorpis aequipinnis*); Barber Sea Perch (*Caesioperca rasor*).

Primarily at Corner Inlet (compared with Wilsons Promontory): Banded Stingaree (*Urolophus cruciatus*); Ornate Cowfish (*Aracana ornata*).

Total checklist. A checklist of all fishes recorded from freshwater and shallow marine waters (to 50 m) of Wilsons Promontory and Corner Inlet is presented in the appendix. This checklist is based on the results of this study, species encountered in previous surveys (Hutchins, unpubl. data; Jackson and Davies, 1983; Wilson et al., 1990; MAFRI, unpubl. data), published records specifically referring to Wilsons Promontory (Kuiter, 1993; Gomon et al., 1994) and preserved material in the collections of the Department of Ichthyology, Museum of Victoria. A total of 231 fish species were identified to species level, four other species identified only to generic or family level. They represent 92 families of cartilaginous and bony fishes.

Discussion

Patterns within Wilsons Promontory waters. The nature of the survey technique employed in this study accounts for some of the observed patterns in distribution and abundance within Wilsons Promontory waters (table 2). The visual search techniques used were primarily targeted at benthic reef fishes at depths of less than 20 metres. As such there is likely to be underrepresentation of cryptic species (such as weedfishes, family Clinidae), pelagic species (such as East Australian Salmon or Jack Mackeral), those associated with other habitats such as soft sediment substrates and seagrass beds (e.g., King George Whiting), and species more typically found at greater depths (e.g., Butterfly Perch). The single night census at Refuge Cove (E3 in table 2) demonstrated the change-over between day and night shifts. Higher numbers of several nocturnal species such as eels and Southern Cardinalfish were detected, with a corresponding loss of many day-active species such as members of the families Labridae and Odacidae (table 2), presumably sheltering deep within reef cover at night.

Distributional trends for certain species around Wilsons Promontory may reflect the distribution of specific habitat types. A number of fishes more common along the east coast are associated with sheltered habitats along this coast, protected from the prevailing westerly winds and swell. These fishes include the Silverbelly (*Parequula melbournensis*), Slender Weed Whiting (*Siphonognathus attenuatus*) and Pencil Weed Whiting (*Siphonognathus beddomei*).

Differences in the fish fauna recorded from Corner Inlet and Wilsons Promontory may also reflect differences in habitat types between these two regions. Fish found around the promontory such as Herring Cale (*Odax cyanomelas*), Scalyfin (*Parma victoriae*), Old Wife (*Enoplosus armatus*), Sea Sweep (*Scorpis aequipinnis*) and Barber Perch (*Caesioperca rasor*) are all associated with extensive rocky reefs (less common within Corner Inlet), while fishes such as the Banded Stingaree (*Urolophus cruciatus*) and Ornate Cowfish (*Aracana ornata*), more common in Corner Inlet, are associated with soft substrates and seagrass beds.

Total checklist and biogeographic affinities. Based on data from all available sources, a total of 231 species of 92 families were identified to species level from this region (Appendix). This list includes many species associated with inshore reefs and habitats but also recorded passing pelagic or open-ocean species more typically associated with deeper waters, e.g., Gemfish, *Rexea solandri*, caught in trawls at 25 and 45 m (MAFRI data) and Ribbonfish, *Trachipterus arawatae* (Museum of Victoria data). The checklist presented here enables examination of the composition and biogeographic affinities of many of the fish species of Wilsons Promontory and Corner Inlet. The majority of these fishes can be placed into one of five categories.

1. Wide-ranging southern Australian species. Almost half of the fishes recorded (104 of 231, or 45%) occur across all of southern Australia, spanning New South Wales, Victoria and Western Australia. Five of these have not been recorded from Tasmania (* in table 3c).

2. Wilsons Promontory as an eastern limit to distribution of southern species. The known distributions of 33 fish species have their eastern limit at Wilsons Promontory, these species occurring further west and/or south (table 3a). An additional 25 species reported from Wilsons Promontory reach their eastern limit between Wilsons Promontory and Cape Howe to the east, often reported in the literature as "eastern Bass Strait" (table 3b). For these species no exact records have been published of their eastern limit, however they have not been recorded in the

Table 2. Distributions and relative abundances of reef fishes at 26 sites around Wilsons Promontory and Corner Inlet. (A = Very common, >20 fish sighted; B = Common/regularly encountered: 5-20 fish sighted; C = Uncommon/rarely sighted: 1-4 fish sighted). * = night dive

Species Name	Common Name	T1	L1	L2	L3	P1	P2	P3	P4	N1	N2	N3	W1	W2	S1	S2	S3	E1	E2	E3*	E4	E5	E6	E7	C1	C2	C3
Heterodontus portusjacksoni	Port Jackson Shark					C	C		C																		
Parascyllium ferrugineum	Rusty Carpetshark																	C									
Cephaloscyllium laticeps	Draughtboard Shark																			C	C			C			
Trygonorrhina fasciata	Southern Fiddler Ray									C																	
Raja whitleyi	Melbourne Skate							C																			
Dasyatis thetidis	Black Stingray																	C									
Urolophus cruciatus	Banded Stingaree																							C	A	A	B
Gymnothorax prasinus	Green Moray Eel																			C							
Conger verreauxi	Southern Conger Eel																		C	C							
Aulopus purpurissatus	Sergeant Baker																	C									
Lotella rhacina	Largetooth Beardie	C							C		C	C							C		C	C	C		C		
Genypterus tigerinus	Rock Ling		C						C														C				
Atherinid spp.	Hardyhead																				A						
Hyporhamphus melanochir	Southern Sea Garfish																			C	C						
Optivus sp.1 (GGK, 1994)	Violet Roughy																	C	B								
Trachichthys australis	Roughy																C				B		C				
Hippocampus abdominalis	Bigbelly Sea Horse																						C	C			C
Phyllopteryx taeniolatus	Common Seadragon					C	C	C											C	C	C						
Neosebates scorpaenoides	Ruddy Gurnard Perch			C			C											C		C							C
Platycephalid spp.	flatheads																			C							
Caesioperca lepidoptera	Butterfly Perch		C										A	A	B	A	A	B	B		A						
Caesioperca rasor	Barber Perch	A	A	A	B	A	A	B	B	A	A	B	A	A	A	A	A	A	A	B	A	A	A		C		C
Hypoplectrodes nigroruber	Banded Seaperch									C											C						
Paraplesiops meleagris	Blue Devil												C														
Trachinops caudimaculatus	Southern Hulafish	C																									C

Table 2. (cont.). Distributions and relative abundances of reef fishes at 26 sites around Wilsons Promontory and Corner Inlet.

Species Name	Common Name	T1	L1	L2	L3	P1	P2	P3	P4	N1	N2	N3	W1	W2	S1	S2	S3	E1	E2	E3*	E4	E5	E6	E7	C1	C2	C3
Vincentia conspersa	Southern Cardinalfish																		B	A	C						C
Dinolestes lewini	Longfin Pike	C	B	A	B	A	A	B	A	B	A	A			B	C	C	B			C		B				
Sillaginodes punctata	King George Whiting				C																						
Pseudocaranx spp.	trevallies			C																C							
Trachurus declivis	Cowanyoung/Jack Mackeral																	A									
Parequula melbournensis	Silverbelly	C											C			C		B	C	B	C						
Upeneichthys vlamingii	Red Mullet	C		B		C	B	C		B	B	B	B	C	C	C		B	A	B	B	C	C				
Pempheris multiradiata	Common Bullseye	B	B		C	B		B		B	C		A	C	B	B	A	C	A	A	A	B	B	C			
Scorpis aequipinnis	Sea Sweep	B	B	C	B	B	B	C	A	B	B	C			A	A	A	A	A		A	A	B	A			
Scorpis lineolata	Silver Sweep				C	B				A		A			B			A	A	C	B	A	A	A	A	A	
Kyphosus sydneyanus	Silver Drummer	C										C															
Girella elevata	Black Drummer												C		C				C								
Girella zebra	Zebra Fish	B			C	C	B	C	A			B	C		B	B	C	B	A		B		C	A	B		C
Atypichthys strigatus	Mado								C									B			B		B	A	A	A	
Tilodon sexfasciatum	Moonlighter		C																		B						
Enoplosus armatus	Old Wife	A	B	B	C	C	C		B	A	B	B	B	C	B	B	A	B	A	B	A	B	B				C
Pentaceropsis recurvirostris	Long-snouted Boarfish	B	C			C	C	C	C	C	C	C	C		B		C		C		C	C	B	C			
Aplodactylus arctidens	Southern Sea Carp	C	B	C	C	C	C	B	A		C	B	C	C	B	B		C	C		C	C		C			C
Cheilodactylus nigripes	Magpie (Morwong) Perch	B	B	C	C	B	C	C	C	A	B	C	B	B	B	B	B	A	A	B	B	B	C	C	C	C	
Cheilodactylus spectabilis	Banded Morwong	C			B	C				C			C	C	C	B	C		C		B	C		C	A		
Dactylophora nigricans	Dusky Morwong	C					C		C						C					C			C				
Nemadactylus macropterus	Jackass Morwong	C														A											
Latridopsis forsteri	Bastard Trumpeter	B	C	C			C	C	B	A	B	B	B		B	C		B	B		C	C	C	C	A		
Sphyraena novaehollandiae	Shortfinned Seapike/Snook																			C	C						
Parma microlepis	White Ear							C	C						C			C						C			
Parma victoriae	Scalyfin	B	C	B	B	C	B	C	B	B	B	B	B	C	C	B	C	A	A	C	B	C	C				
Dotolabrus aurantiacus	Pretty Polly																		C								

Table 3. Limits to fish distributions in relation to Wilsons Promontory

a. Fishes at their known eastern limit at Wilsons Promontory

Phycodurus eques, Maxillacosta scabriceps, Aetapcus maculatus, Gnathanacanthus goetzeei, Caesioperca rasor, Paraplesiops alisonae, P. meleagris, Trachinops caudimaculatus, Vincentia conspersa, Tilodon sexfasciatum, Chironemus georgianus, Parma victoriae, Dotolabrus aurantiacus, Siphonognathus attenuatus, S. beddomei, S. caninus, S. tanyourus, Norfolkia incisa, Heteroclinus adelaidae, H. johnstoni, H. macropthalmus, H. puellarum, H. eckloniae, Ophiclinops varius, Ophioclinus gabrieli, O. ningulus, Eubalichthys gunnii, Meuschenia australis, M. galii, M. hippocrepis, Thamnaconus degeni, Aracana ornata, Contusus richei.

b. Fishes with an eastern limit between Wilsons Promontory and Cape Howe

Geotria australis, Pristiophorus cirratus, P. nudipinnis, Parascyllium ferrugineum, P. variolatum, Trygonorrhina fasciata, Raja sp. A (L&S), *Urolophus cruciatus, Conger verreauxi, Galaxias truttaceus, Galaxiella pusilla, Aspasmogaster tasmaniensis, Eeyorius hutchinsi, Pseudophycis bachus, Stipecampus cristatus, Neoplatycephalus aurimaculatus, Platycephalus speculator, Parequula melbournensis, Acanthopagrus butcheri, Aplodactylus arctidens, Sphryaena novaehollandiae, Siphonognathus radiatus, Trianectus bucephalus, Seriolella brama, Ammotretis lituratus.*

c. Fishes at their known southern limit at Wilsons Promontory. (* also occur in Western Australia)

Herklotsichthys castelnaui, Optivus sp. 1 (GGK), *Platycephalus fuscus, Hypoplectrodes annulatus, *Trachurus novaezelandiae, *Arripis georgiana, Achoerodus viridis, *Eupetrichthys angustipes, *Ophthalmolepis lineolata, Gobiopterus semivestitus, Synaptura nigra, *Nelusetta ayraudi.*

d. Fishes at their known western limit at Wilsons Promontory

Gobiesocidae: Genus A, sp. 2 (GGK), *Acanthistius ocellatus, Callanthias allporti, Sillago flindersi, Girella elevata.*

e. Fishes at their western limit between Wilsons Promontory and Port Phillip Bay

Anguilla reinhardtii, Neoplatycephalus richardsoni, Hypoplectrodes maccullochi, Lepidoperca pulchella, Arripis trutta, Scorpis lineolata, Aypichthys strigatus, Paristiopterus labiosus, Cheilodactylus spectabilis, Nemadactylus douglasi, Parma microlepis.

(GGK = Gomon et al., 1994; L&S = Last and Stevens, 1994)

warmer waters of southern New South Wales. Hence 58 of 231 species (or 25%) reported from Wilsons Promontory are at or close to the eastern end of their range. Certain species listed in tables 3a and 3b have also been recorded from Tasmanian waters (see Appendix).

Species which occur on rocky reefs may be limited to the east as the area between Wilsons Promontory and Cape Howe differs from the marine habitats west of the promontory. This eastern area is predominantly long sand beaches (such as Ninety Mile Beach) adjacent to large sand plains with few reefs. Only a handful of tiny reefs occur adjacent to the shore at places such as Point Hicks, Mallacoota, Wingan Inlet and Cape Conran. Most offshore reefs are small, occur at around 30–40 metres and are composed of broken reef and rubble without significant vertical structure (Greg Parry, pers. comm). Hutchins (1987) proposed that the scarcity of shallow reefs across this region may explain the eastern limits of two plesiopid species, *Paraplesiops alisonae* and *P. meleagris*. Wide distances between limited reefs may prevent step-wise dispersal to the east. As no comprehensive survey of the fish fauna of scattered reefs between Wilsons Promontory and Cape Howe has been undertaken, distributional limits presented here should be treated as preliminary.

Table 2. (cont.). Distributions and relative abundances of reef fishes at 26 sites around Wilsons Promontory and Corner Inlet.

Species Name	Common Name	T1	L1	L2	L3	P1	P2	P3	P4	N1	N2	N3	W1	W2	S1	S2	S3	E1	E2 *	E3	E4	E5	E6	E7	C1	C2	C3
Eupetrichthys angustipes	Snakeskin Wrasse																	C	B								
Notolabrus fucicola	Saddled Wrasse	A	B	C	B	C	B		B	B	B	A	A	A	B	A	A	A	B		B	B	B		C	C	B
Notolabrus tetricus	Bluethroat Wrasse	A	A	A	B	A	B	B	A	A	A	A	A	B	A	A	A	A	A		A	A	A	C	A	B	A
Ophthalmolepis lineolata	Maori Wrasse	C		C			C		C	C	C		C		B	B		B	C		C	B					
Pictilabrus laticlavius	Senator Wrasse	B	C	C	B	B	C	C	C	B	B	B	B		C	B		B	A		B	C	C				
Pseudolabrus psittaculus	Rosy Wrasse	B	C			C							C						C		C		C				
Odax acroptilus	Rainbow Cale	C			C	C			C						B			C	B								
Odax cyanomelas	Herring Cale	A	A	A	B	B	B	B	A	A	A	A	B	B	A		A	B	B		A		C				
Siphonognathus attenuatus	Slender Weed Whiting						C									B					B	C	C	C			
Siphonognathus beddomei	Pencil Weed Whiting																	C	B		B	C	C				
Bovichtus angustifrons	Dragonet		C							C	C	C									C						
Parablennius tasmanianus	Tasmanian Blenny												C														
Rhombosolea tapirina	Greenback Flounder																								C		
Acanthaluteres vittiger	Toothbrush Leatherjacket	C	C		C	C	C				C	C	B		B	B	C		C		C			C		C	
Eubalichthys gunnii	Gunns Leatherjacket												C														
Meuschenia flavolineata	Yellowstriped Leatherjacket	B	C	C			C			B								B	C		C				C		C
Meuschenia freycineti	Sixspined Leatherjacket	C	C		C	C	C								C	C			C	C	C	C	C			B	
Meuschenia hippocrepis	Horseshoe Leatherjacket				C		C			C											B						
Nelusetta ayraudi	Chinaman Leatherjacket	C			C	C															C		C				
Aracana aurita	Shaws Cowfish		C	C					C		C					C									B		C
Aracana ornata	Ornate Cowfish		C	C		C	C	C	C	C	C							C	C	B			C	C	B	A	C
Contusus richei	Barred Toadfish									C																	
Tetractenos glaber	Smooth Toadfish	C	C	C	C		C	C	C		C	C															C
Diodon nichthemerus	Globefish	C	C	C	C	C	C	C	B	B	B	C	C		C		C	C	C	C	C	C	C	C	B	C	C

3. Cool temperate fishes of southeastern Australia. Few species (43 of 231 or 19%) are restricted to the southeastern coasts ranging from South Australia to at least southern New South Wales.

4. Wilsons Promontory as the southern or western limit to distribution of warm temperate species. Wilsons Promontory forms the southern limit for 12 species distributed further north (table 3c). Most extend up the New South Wales coast, with five also occurring in Western Australia (* in table 3c), but not in Tasmania. One additional species not reported from Tasmania, the Manybanded Sole (*Zebrias scalaris*), reaches its southern/western limits between Wilsons Promontory and Port Phillip Bay. Hence 13 of 231 species (or 6%) reported from Wilsons Promontory are at or close to their southern limit.

Five species recorded from New South Wales and northeastern and eastern Tasmania have their most westerly records at Wilsons Promontory (table 3d). Eleven species reported from northern and eastern Tasmania reach their western limits between Wilsons Promontory and Port Phillip Bay (table 3e). Hence 16 of 231 species (or 7%) reported from Wilsons Promontory are at or close to the western end of their range.

The distributional limits of warmer-water species extending south into Victorian and Tasmanian waters are less well defined than those of southern and western species. The East Australian Current is a southerly current carrying warm waters from Queensland and the Coral Sea down the coasts of New South Wales into the Tasman Sea and eastern Bass Strait. Towards the southern end of this current (off southern New South Wales), it breaks into irregular warm eddies entering colder southern waters off eastern Victoria and Tasmania (Bunt, 1987). The East Australian Current brings occasional warm-temperate and tropical marine species into southern latitudes. Such vagrants include whale-sharks in eastern Bass Strait, sea snakes and leatherback turtles at Wilsons Promontory and hawksbill turtles in Port Phillip Bay (M. Norman, pers. obs.), as well as planktonic young of subtropical species.

The southern limits of many fishes common in the warmer waters of New South Wales may be limited by exposure to the cooler waters of Bass Strait, southern ocean currents and large swell, as well as the wide expanses of sand between Cape Howe and Wilsons Promontory.

5. Wilsons Promontory as the northern limit to distributions. Only two species, otherwise confined to Tasmania, are found at Wilsons Promontory. There is little information available on the biology and distribution of the Flat-head Congolli (*Pseudaphritis* sp.), which is known from only a few individuals found in marine caves in western Tasmania and Wilsons Promontory (Gomon et al., 1994). The Tasmanian Mudfish (*Galaxias cleaveri*) occurs in freshwater streams and rivers in its adult stages and is reported as primarily found in Tasmania but is also recorded from Wilsons Promontory and the Otway Ranges (Gomon et al., 1994). Although the juvenile stage is marine, it is possible that the presence of this species in Victorian freshwater bodies may constitute relict populations dating back to times of lower sea levels when the Bass Strait land bridge was continuous. It is evident that Wilsons Promontory is not biogeographically linked with species primarily restricted to Tasmanian waters.

Overlap with other Australian states. Another way of examining the affinities of the fishes of Wilsons Promontory waters is as numbers of species shared with other Australian states (presence/absence data presented in Appendix).

New South Wales. 170 of 231 (or 74%) are shared with at least southern New South Wales (Kuiter, 1993; Gomon et al., 1994).

Western Australia. 140 of 231 (or 61%) extend west to at least southern Western Australia (Hutchins and Swainston, 1986; Gomon et al., 1994; Hutchins, 1994).

Southern Queensland. 58 of 231 (or 25%) extend at least as far north as southern Queensland (Kuiter, 1993; Gomon et al., 1994).

Tasmania. 207 of 231 (or 90%) are shared with at least the northern Tasmanian coast (Edgar et al., 1982; Last et al., 1983; Kuiter, 1993; Gomon et al., 1994). Very few fishes found in Tasmania do not also occur along the Victorian coastline. On the basis of published reports (Edgar et al., 1982; Last et al., 1983), the Real Bastard Trumpeter (*Mendosoma allporti*) is the only large, highly visible species common on rocky reefs in Tasmania that is not present at Wilsons Promontory. This species also occurs in New Zealand waters.

Comparisons with the fish assemblages in adjacent Victorian waters are not possible at this stage as checklists for other locations within this state, or in adjacent South Australian and New South Wales waters, are not available.

The majority of the fish species at Wilsons Promontory occur across much of southern Australia. In discussing the biogeography of Australian marine organisms, Wilson and Allen (1987) recognised the "Southern Australian Region", roughly bounded by Cape Howe in the east and Cape Leeuwin to the west. They suggested that the limits to this region could not be rigidly defined nor could it be divided into distinct biogeographic subunits. Instead they suggested that it contains four overlapping components: general southern (found from approximately Brisbane to Shark Bay); south-eastern Australian (Brisbane to the Great Australian Bight); endemic south coast (Cape Howe to Albany); and southwestern Australian (Shark Bay to Bass Strait). All four components are represented in the waters around Wilsons Promontory, as indicated by the general distributions and state records presented in Appendix.

Origins and affinities. There is high endemism in the fish fauna of southern Australia. Of the estimated 600 inshore species, around 85% of the species and 38% of the genera are endemic, compared with 13% and 9% respectively for tropical Australian waters (Wilson and Allen, 1987). The origins and affinities of the relatively isolated fish fauna of temperate Australia are poorly known. Wilson and Allen (1987) discussed two distinct origins for the marine fauna of southern Australia. Many of the fish families in this region are well-represented in tropical waters to the north and are likely to have originated from ancestral incursions south into cooler waters. These families include the syngnathids (seahorses and pipefishes), serranids (seaperches and relatives), labrids (wrasses) and gobies. Several groups underwent explosive radiations on reaching cooler waters, e.g., the monacanthids (leatherjackets) are represented by more than 25 species on the south coast with 17 recorded at Wilsons Promontory. Parallel processes are evident in the temperate fish fauna of southern Africa, where different families underwent such explosive radiations, e.g., the sparids (breams and snappers) are represented by 23 species, filling many of the niches occupied by other families in Australian temperate waters where only three sparid species exist.

Other fishes of southern Australia may have ancestry dating back to the break-up of the Gondwanan landmass in the Late Cretaceous and the subsequent long isolation and gradual passage of the Australian continent north into warmer latitudes. Biota carried on the continental shores and shelf of this migrating land mass are considered "palaeoaustral" and have been recognised in many marine invertebrate groups, particularly the shelled molluscs with strong fossil records (Wilson and Allen, 1987). Of the marine fishes reported from Wilsons Promontory (Appendix), four families (Enoplosidae, Dinolestidae, Pataecidae and Gnathanacanthidae) are restricted to southern Australia, while 62 of 156 genera are found only in temperate Australia, or both temperate Australia and New Zealand. The distributions of many of these groups may reflect such southern palaeoaustral ancestry, however the scarcity of fish fossils from this region prevent further speculation.

Overall, the fish fauna of the Wilsons Promontory region is composed primarily of wide-ranging southern Australian endemic species with a much smaller proportion of warmer-water temperate species towards the southern limits of their range. This study provides baseline data on composition and preliminary data on relative abundances of fish populations in the Wilsons Promontory region. The authors hope that such data will provide a useful basis for assessment of future marine park, fisheries and management decisions in the region.

In conjunction with the survey described here, two additional projects were carried out at Wilsons Promontory. The first was a baseline quantitative study of the population densities of twelve key species of benthic reef fishes carried out by the authors in 1987 and 1988. The results of that study will be presented elsewhere. The second project was the production of a layperson guide to flora, fauna, habitat and dive locations around Wilsons Promontory (O'Toole and Turner, 1990).

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Appendix. Checklist of marine, estuarine and freshwater fishes of Wilsons Promontory

Source codes: 1: this study; 2: Museum of Victoria 1982 survey (Wilson et al., 1990); 3: MAFRI unpublished trawl data; 4: Jackson and Davies estuarine and freshwater survey (1983); 5: specific records from Wilsons Promontory in Gomon, Glover and Kuiter (GGK), 1994; 6: specific records from Wilsons Promontory in Kuiter (1993); 7: records from Museum of Victoria fish database; 8: Hutchins unpublished data. Distributions: E = eastern Australia (north of Cape Howe), S = southern Australia (Cape Howe to Cape Leeuwin), W = western Australia (north of Cape Leeuwin). A = absent, P = present. # = species recorded in this study outside checklist sites; L&S, 1994 = Last and Stevens (1994); * = from Paulin (1986).

Family and species name	Common name	Source	Distribution	Tas	NSW	WA	Qld
Petromyzontidae							
Geotria australis	Pouched Lamprey	4 7	S/W	P	A	P	A
Mordacia mordax	Shorthead Lamprey	4	S/E	P	P	A	A
Pristiophoridae							
Pristiophorus cirratus	Common Sawshark	2 3	S/W	P	A	P	A
Pristiophorus nudipinnis	Southern Sawshark	2 3 5	S	P	A	A	A
Heterodontidae							
Heterodontus portusjacksoni	Port Jackson Shark	1 2 3	E/S/W	P	P	P	P
Parascyllidae							
Parascyllium ferrugineum	Rusty Carpetshark	1 2 3	S/W	P	A	P	A
Parascyllium variolatum	Varied Carpetshark	5	S/W	P	A	P	A
Scyliorhinidae							
Asymbolus vincenti	Gulf Catshark	3	S/W	P	A?	P	A
Cephaloscyllium laticeps	Draughtboard Shark	1 3 8	E/S/W	P	P	P	A
Triakidae							
Galeorhinus galeus	School Shark	3	E/S/W	P	P	P	P
Mustelus antarcticus	Gummy Shark	3	E/S/W	P	P	P	?
Sphyrnidae							
Sphyrna zygaena	Smooth Hammerhead	1# 2 3	E/S/W	P	P	P	A
Squatinidae							
Squatina australis	Australian Angel Shark	2 3 7	E/S/W	P	P	P	A
Rhinobatidae							
Trygonorrhina fasciata	Southern Fiddler Ray	1 3	S/W	P	A	P	A
Rajidae							
Pavoraja nitida	Peacock Skate	3	S/E	P	P	A	A
Raja sp. A (L&S, 1994)	Longnose Skate	3	S	P	A	A	A
Raja gudgeri	Bight Skate	3	E/S/W	P	P	P	A
Raja lemprieri	Thornback Skate	3	S/E	P	P	A	A
Raja whitleyi	Melbourne Skate	1 2 3	E/S/W	P	P	P	A
Narcinidae							
Narcine tasmaniensis	Tasmanian Numbfish	2 3	S/E	P	P	A	A
Dasyatidae							
Dasyatis brevicaudata	Smooth Stingray	3 7	E/S/W	P	P	P	P
Dasyatis thetidis	Black Stingray	1 8	E/S/W	P	P	P	A
Urolophidae							
Urolophus bucculentus	Sandyback Stingaree	3	S/E	P	P	A	P
Urolophus cruciatus	Banded Stingaree	1 2 3	S	P	A	A	A

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Urolophus paucimaculatus	Sparsely-spotted Stingaree	2 3 7	E/S/W	P	P	P	A
Urolophus viridis	Greenback Stingaree	3	S/E	P	P	A	P
Myliobatidae							
Myliobatis australis	Southern Eagle Ray	1# 2 3 8	E/S/W	P	P	P	P
Callorhinchidae							
Callorhinchus milii	Elephant Fish	3 7	E/S/W	P	P	P	A
Ophichthidae							
Muraenichthys australis	Shortfinned Worm Eel	2 7	E/S/W	P	P	P	A
Muraenichthys breviceps	Longfinned Worm Eel	2 7	E/S/W	P	P	P	A
Anguillidae							
Anguilla australis	Shortfin Eel	4 7	S/E	P	P	A	P
Anguilla reinhardtii	Longfin Eel	4	S/E	P	P	A	P
Muraenidae							
Gymnothorax prasinus	Green Moray Eel	1	E/S/W	P	P	P	P
Congridae							
Conger verreauxi	Southern Conger Eel	1 2 7	S	P	A	A	A
Clupeidae							
Herklotsichthys castelnaui	Southern Herring	5	S/E	A	P	A	P
Sardinops neopilchardus	Pilchard	3	E/S/W	P	P	P	P
Spratelloides robustus	Blue Sprat	4	E/S/W	P	P	P	P
Engraulididae							
Engraulis australis	Australian Anchovy	3 4	E/S/W	P	P	P	P
Prototroctidae							
Prototroctes maraena	Australian Grayling	4 7	S/E	P	P	A	A
Galaxiidae							
Galaxias brevipinnis	Climbing Galaxias	4 7	S/E	P	P	A	A
Galaxias cleaveri	Tasmanian Mudfish	4 5 7	S	P	A	A	A
Galaxias maculatus	Common Jollytail	2 4 7	E/S/W	P	P	P	P
Galaxias truttaceus	Trout Galaxias	4 7	S	P	A	A	A
Galaxiella pusilla	Eastern Little Galaxias	4	S	P	A	A	A
Argentinidae							
Argentina australiae	Silverside	3	E/S/W	P	P	P	A
Aulopidae							
Aulopus purpurissatus	Sergeant Baker	1 2	E/S/W	P	P	P	P
Gobiesocidae							
Genus A, sp. 2 (GGK, 1994)	Brown-spotted Spiny Clingfish	5	S/E	P	P	A	A
Alabes dorsalis	Common Shore-eel	7	E/S/W	P	P	P	P
Aspasmogaster liorhynchus	Smoothsnout Clingfish	7	E/S/W	P	P	P	A
Aspasmogaster tasmaniensis	Tasmanian Clingfish	1# 8	S/W	P	A	P	A

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Moridae							
Eeyorius hutchinsi	Finetooth Beardie	*	S	P	A	P	A
Lotella rhacina	Largetooth Beardie	1 2 7	E/S/W	P	P	P	A
Pseudophycis bachus	Red Cod	2 3 7	S	P	A	A	A
Ophidiidae							
Genypterus blacodes	Pink Ling	3	E/S/W	P	P	P	A
Genypterus tigerinus	Rock Ling	1 7	E/S/W	P	P	P	A
Bythitidae							
Dermatopsis sp. (unidentified)	blindfish	3	-	-	-	-	-
Carapidae							
Echiodon rendahli	Messmate Fish	3	S/E	P	P	A	A
Atherinidae							
Atherinosoma microstoma	Smallmouth Hardyhead	4	S/E	P	P	A	A
Exocoetidae							
*Exocoetid (*unidentified)	flying fish	1#	-	-	-	-	-
Hemiramphidae							
Hyporhamphus melanochir	Southern Sea Garfish	1	E/S/W	P	P	P	A
Berycidae							
Centroberyx affinis	Nannygai	3	S/E	P	P	A	A
Trachichthyidae							
Optivus sp. 1 (GGK, 1994)	Violet Roughy	1 2	S/E	A	P	A	P
Trachichthys australis	Roughy	1 2 7	E/S/W	P	P	P	P
Zeidae							
Cyttus australis	Silver Dory	2 3	E/S/W	P	P	P	A
Zeus faber	John Dory	3	E/S/W	P	P	P	P
Trachipteridae							
Trachipterus arawatae	Ribbonfish	5 7	S/E	P	P	?	A
Syngnathidae							
Heraldia nocturna	Upsidedown Pipefish	8	E/S/W	P	P	P	A
Hippocampus abdominalis	Bigbelly Sea Horse	1 2 3 7	S/E	P	P	A	A
Phycodurus eques	Leafy Seadragon	6	S/W	A	A	P	A
Phyllopteryx taeniolatus	Common Seadragon	1 2	E/S/W	P	P	P	A
Stigmatopora argus	Spotted Pipefish	2 4	E/S/W	P	P	P	A
Stigmatopora nigra	Widebody Pipefish	2	E/S/W	P	P	P	P
Stipecampus cristatus	Ringback Pipefish	1#	S	A	A	A	A
Scorpaenidae							
Gymnapistes marmoratus	Soldierfish	2 3	E/S/W	P	P	P	A
Maxillacosta scabriceps	Little Scorpionfish	2 3	S/W	A	A	P	A
Neosebastes scorpaenoides	Ruddy Gurnard Perch	1 2 3	S/E	P	P	A	A
Scorpaena papillosa	Red Rock Cod	2 3 7	S/E	P	P	A	A
Triglidae							
Chelidonichthys kumu	Red Gurnard	3	E/S/W	P	P	P	P
Lepidotrigla modesta	Minor Gurnard	3	E/S/W	P	P	P	A
Lepidotrigla mulhalli	Deepwater Gurnard	3	S/E	P	P	A	A

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Lepidotrigla papilio	Spiny Gurnard	3	E/S/W	P	P	P	A
Lepidotrigla vanessa	Butterfly Gurnard	3	S/E	P	P	A	A
Pterygotrigla polyommata	Latchet	3	E/S/W	P	P	P	A
Pataecidae							
Aetapcus maculatus	Warty Prowfish	5 7	S/W	P	A	P	A
Gnathanacanthidae							
Gnathanacanthus goetzeei	Red Velvetfish	2 5 6 7	S/W	P	A	P	A
Platycephalidae							
Neoplatycephalus aurimaculatus	Toothy Flathead	3	S	P	A	A	A
Neoplatycephalus richardsoni	Tiger Flathead	3	S/E	P	P	A	A
Platycephalus bassensis	Sand Flathead	2 3	S/E	P	P	A	A
Platycephalus fuscus	Dusky Flathead	4	S/E	A	P	A	P
Platycephalus laevigatus	Grassy Flathead	2	E/S/W	P	P	P	A
Platycephalus speculator	Yank Flathead	3	S/W	P	A	P	A
Serranidae							
Acanthistius ocellatus	Eastern Wirrah	5	S/E	P	P	A	P
Caesioperca lepidoptera	Butterfly Perch	1 2 3 7 8	E/S/W	P	P	P	A
Caesioperca rasor	Barber Perch	1 2 3 5 7 8	S/W	P	A	P	A
Hypoplectrodes annulatus	Blackbanded Seaperch	2 5 6	S/E	A	P	A	P
Hypoplectrodes maccullochi	Halfbanded Seaperch	2	S/E	P	P	A	A
Hypoplectrodes nigroruber	Banded Seaperch	1 2 7	E/S/W	P	P	P	A
Lepidoperca pulchella	Eastern Orange Perch	3	S/E	P	P	A	A
Callanthiidae							
Callanthias allporti	Rosy Perch	2	S/E	P	P	A	A
Percichthyidae							
Macquaria colonorum	Estuary Perch	4	S/E	P	P	A	A
Plesiopidae							
Paraplesiops alisonae	Alisons Blue Devil	5	S	P	A	A	A
Paraplesiops meleagris	Blue Devil	1	S/W	A	A	P	A
Trachinops caudimaculatus	Southern Hulafish	1 2 5 7 8	S	P	A	A	A
Apogonidae							
Vincentia conspersa	Southern Cardinalfish	1 2 5 6 7 8	S	P	A	A	A
Dinolestidae							
Dinolestes lewini	Longfin Pike	1 2 7 8	E/S/W	P	P	P	A
Kuhliidae							
Nannoperca australis	Pygmy Perch	4 7	S/E	P	P	A	A
Sillaginidae							
Sillaginodes punctata	King George Whiting	1 2 3 8	E/S/W	P	P	P	A
Sillago flindersi	School Whiting	2 3 5	S/E	P	P	A	P

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Pomatomidae							
Pomatomus saltatrix	Tailor	2 4	E/S/W	P	P	P	P
Carangidae							
Pseudocaranx dentex	White Trevally	1 2 3 4 7 8	E/S/W	P	P	P	P
Seriola lalandi	Yellowtail Kingfish	2	E/S/W	P	P	P	P
Trachurus declivis	Jack Mackeral/ Cowanyoung	1	E/S/W	P	P	P	P
Trachurus novaezelandiae	Yellowtail Horse Mackeral	2 3 7	E/S/W	A	P	P	P
Arripidae							
Arripis georgiana	Tommy Rough	1# 3	E/S/W	A	P	P	A
Arripis trutta	Eastern Australian Salmon	1# 2 4 7	S/E	P	P	A	P
Gerreidae							
Parequula melbournensis	Silverbelly	1 2 3 7 8	S/W	P	A	P	A
Sparidae							
Acanthopagrus butcheri	Black Bream	2 4 7	S/W	P	A	P	A
Chrysophrys auratus	Snapper	3	E/S/W	P	P	P	P
Mullidae							
Upeneichthys vlamingii	Red Mullet	1 2 3 5 7 8	E/S/W	P	P	P	A
Pempheridae							
Parapriacanthus elongatus	Slender Bullseye	1#	E/S/W	P	P	P	A
Pempheris multiradiata	Common Bullseye	1 2 7 8	E/S/W	P	P	P	A
Scorpididae							
Scorpis aequipinnis	Sea Sweep	1 2 7 8	E/S/W	P	P	P	A
Scorpis lineolata	Silver Sweep	1 2 7	S/E	P	P	A	P
Kyphosidae							
Kyphosus sydneyanus	Silver Drummer	1	E/S/W	P	P	P	P
Girellidae							
Girella elevata	Black Drummer	1 5	S/E	P	P	A	A
Girella tricuspidata	Luderick	1# 4	S/E	P	P	A	P
Girella zebra	Zebra Fish	1 2 8	E/S/W	P	P	P	A
Microcanthidae							
Atypichthys strigatus	Mado	1 2 7 8	S/E	P	P	A	A
Tilodon sexfasciatum	Moonlighter	1 5	S/W	P	A	P	A
Enoplosidae							
Enoplosus armatus	Old Wife	1 2 7 8	E/S/W	P	P	P	P
Pentacerotidae							
Paristiopterus labiosus	Giant Boarfish	3	S/E	P	P	A	A
Pentaceropsis recurvirostris	Long-snouted Boarfish	1 2 3 7 8	E/S/W	P	P	P	A
Chironemidae							
Chironemus georgianus	Tassled Kelpfish	5 7	S/W	P	A	P	A

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Bovichtidae							
Bovichtus angustifrons	Dragonet	1 2 7 8	S/E	P	P	A	A
Pseudaphritis urvilli	Congolli	4 7	S/E	P	P	A	A
Pseudaphritis sp. (GGK, 1994)	Flathead Congolli	5	S	P	A	A	A
Blenniidae							
Parablennius tasmanianus	Tasmanian Blenny	1	S/E	P	P	A	A
Tripterygiidae							
Norfolkia clarkei	Common Threefin	2 5 7 8	S/E	P	P	A	A
Norfolkia incisa	Notched Threefin	5 6 7	S/W	A	A	P	A
Trianectus bucephalus	Bighead Threefin	2 7	S	P	A	A	A
Clinidae							
Cristiceps australis	Southern Crested Weedfish	2 3 7	E/S/W	P	P	P	P
Heteroclinus adelaidae	Adelaide Weedfish	2	S/W	P	A	P	A
Heteroclinus eckloniae	Kelp Weedfish	5 8	S/W	A	P	P	A
Heteroclinus heptaeolus	Sevenbar Weedfish	2 7	E/S/W	P	P	P	A
Heteroclinus johnstoni	Johnstons Weedfish	2 7	S	P	A	A	A
Heteroclinus macropthalmus	Large-eye Weedfish	2 5 7	S/W	P	A	P	A
Heteroclinus puellarum	Little Weedfish	2 7	S	P	A	A	A
Heteroclinus roseus	Rosy Weedfish	8	E/S/W	P	P	P	A
Heteroclinus tristis	Longnose Weedfish	2	S/E	P	P	A	A
Heteroclinus wilsoni	Wilsons Weedfish	2 7	S/E	P	P	A	A
Heteroclinus sp. 2 (GGK, 1994)	Whitleys Weedfish	2	E/S/W	A	P	P	A
Heteroclinus sp. 4 (GGK, 1994)	Colemans Weedfish	2	S/E	A	P	A	A
Ophiclinops varius	Variegated Snakeblenny	2 5 7	S/W	P	A	P	A
Ophiclinus gabrieli	Frosted Snakeblenny	5	S	P	A	A	A
Ophiclinus gracilis	Blackback Snakeblenny	2 7 8	E/S/W	P	P	P	A
Ophiclinus ningulus	Variable Snakeblenny	2 5 7	S/W	P	A	P	A
Stichaerium dorsale	Sand Crawler	2 7	E/S/W	P	P	P	A
Callionymidae							
Eucallionymus papilio	Painted Stinkfish	2 7 8	E/S/W	P	P	P	A
Foetorepus calauropomus	Common Stinkfish	2 3 7	E/S/W	P	P	P	P
Gobiidae							
Arenigobius bifrenatus	Bridled Goby	4	E/S/W	P	P	P	P
Callogobius mucosus	Sculptured Goby	2 7 8	E/S/W	P	P	P	A
Favonigobius lateralis	Longfin Goby	2 4 7	E/S/W	P	P	P	P
Favonigobius tamarensis	Tamar River Goby	4	E/S/W	P	P	P	A
Gobiopterus semivestitus	Glass Goby	4	S/E	A	P	A	P
Nesogobius sp. (unidentified)	goby	2 4 8	-	-	-	-	-
Pseudogobius olorum	Bluespot Goby	4	E/S/W	P	P	P	P
Eleotrididae							
Philypnodon grandiceps	Flathead Gudgeon	4 7	S/E	P	P	A	P
Gempylidae							
Rexea solandri	Gemfish	3	S/E	P	P	A	A
Thyrsites atun	Barracouta	3	E/S/W	P	P	P	P

continued

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Aplodactylidae							
Aplodactylus arctidens	Southern Sea Carp	1 2 7 8	S	P	A	A	A
Cheilodactylidae							
Cheilodactylus nigripes	Magpie (Morwong) Perch	1 2 7 8	E/S/W	P	P	P	A
Cheilodactylus spectabilis	Banded Morwong	1 2 8	S/E	P	P	A	A
Dactylophora nigricans	Dusky Morwong	1 2 8	E/S/W	P	P	P	A
Nemadactylus douglasi	Blue Morwong	2 3	S/E	P	P	A	P
Nemadactylus macropterus	Jackass Morwong	1 2 3	E/S/W	P	P	P	A
Nemadactylus valenciennes	Queen Snapper	6	E/S/W	P	P	P	A
Latrididae							
Latridopsis forsteri	Bastard Trumpeter	1 2 8	S/E	P	P	A	A
Mugilidae							
Aldrichetta forsteri	Yellow-eye Mullet	3 4 7	E/S/W	P	P	P	A
Mugil cephalus	Sea Mullet	2 4	E/S/W	P	P	P	P
Sphryaenidae							
Sphryaena novaehollandiae	Shortfin Seapike/Snook	1	S/W	P	A	P	A
Pomacentridae							
Parma microlepis	White Ear	1 2 7	S/E	P	P	A	A
Parma victoriae	Scalyfin	1 2 5 7 8	S/W	P	A	P	A
Gadopsidae							
Gadopsis marmoratus	Freshwater Blackfish	4 7	S/E	P	P	A	A
Labridae							
Achoerodus viridis	Eastern Blue Groper	2 5 8	S/E	A	P	A	P
Dotolabrus aurantiacus	Pretty Polly	1 2 7 8	S/W	P	A	P	A
Eupetrichthys angustipes	Snakeskin Wrasse	1 2 7	E/S/W	A	P	P	A
Notolabrus fucicola	Saddled Wrasse	1 2 8	S/E	P	P	A	A
Notolabrus tetricus	Bluethroat Wrasse	1 2 7 8	S/E	P	P	A	A
Ophthalmolepis lineolata	Maori Wrasse	1 2 7 8	E/S/W	A	P	P	P
Pictilabrus laticlavius	Senator Wrasse	1 2 7 8	E/S/W	P	P	P	A
Pseudolabrus psittaculus	Rosy Wrasse	1 2 3 7 8	E/S/W	P	P	P	A
Odacidae							
Neoodax balteatus	Little Rock Whiting	2	E/S/W	P	P	P	A
Odax acroptilus	Rainbow Cale	1 2 7 8	E/S/W	P	P	P	A
Odax cyanomelas	Herring Cale	1 2 8	E/S/W	P	P	P	A
Siphonognathus attenuatus	Slender Weed Whiting	1 2 6 7	S/W	P	A	P	A
Siphonognathus beddomei	Pencil Weed Whiting	1 2 6 7 8	S/W	P	A	P	A
Siphonognathus caninus	Sharpnose Weed Whiting	2 6 7	S/W	A	A	P	A
Siphonognathus radiatus	Longray Rock Whiting	2	S/W	P	A	P	A
Siphonognathus tanyourus	Long-tail Weed Whiting	5 6 7	S/W	A	A	P	A
Uranoscopidae							
Gnathagnus innotabilis	Bulldog Stargazer	5	S/E	P	P	A	A
Kathetostoma sp. (unidentified)	stargazer	3	-	-	-	-	-

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Scombridae							
Scomber australasicus	Blue mackeral	3	E/S/W	P	P	P	P
Centrolophidae							
Seriolella brama	Warehou	3	S	P	A	A	A
Seriolella punctata	Spotted Trevalla	3	S/E	P	P	A	A
Bothidae							
Arnoglossus bassensis	Bass Strait Flounder	2 7	S/E	P	P	A	A
Lophonectes gallus	Crested Flounder	3	S/E	P	P	A	P
Pleuronectidae							
Ammotretis lituratus	Spotted Flounder	3 7	S	P	A	A	A
Ammotretis rostratus	Longsnout Flounder	2 3 7	E/S/W	P	P	P	A
Rhombosolea tapirina	Greenback Flounder	1 3 4 7	E/S/W	P	P	P	A
Taratretis derwentensis	Derwent Flounder	3 7	S/E	P	P	A	A
Soleidae							
Synaptura nigra	Black Sole	4 5 6	S/E	A	P	A	P
Zebrias scalaris	Manybanded Sole	3 5	S/E	A	P	A	P
Monacanthidae							
Acanthaluteres vittiger	Toothbrush Leatherjacket	1 2 3 7 8	E/S/W	P	P	P	A
Brachaluteres jacksonianus	Southern Pygmy Leatherjacket	1# 2 3 7	E/S/W	P	P	P	P
Eubalichthys gunnii	Gunns Leatherjacket	1 2 5 6 8	S	P	A	A	A
Eubalichthys mosaicus	Mosaic Leatherjacket	2 3	E/S/W	P	P	P	P
Meuschenia australis	Brownstriped Leatherjacket	2 5 8	S	P	A	A	A
Meuschenia flavolineata	Yellowstriped Leatherjacket	1 8	E/S/W	P	P	P	A
Meuschenia freycineti	Sixspine Leatherjacket	1 2 3 6 7 8	E/S/W	P	P	P	A
Meuschenia galii	Blue-lined Leatherjacket	6	S/W	A	A	P	A
Meuschenia hippocrepis	Horseshoe Leatherjacket	1 5 6 8	S/W	P	A	P	A
Meuschenia scaber	Velvet Leatherjacket	2 3 7	E/S/W	P	P	P	A
Meuschenia venusta	Stars-&-Stripes Leatherjacket	2	E/S/W	P	P	P	A
Nelusetta ayraudi	Chinaman Leatherjacket	1 2	E/S/W	A	P	P	P
Scobinichthys granulatus	Rough Leatherjacket	2 3	E/S/W	P	P	P	P
Thamnaconus degeni	Degens Leatherjacket	2 3 5 6 7	S/W	P	A	P	A
Aracanidae							
Aracana aurita	Shaws Cowfish	1 2 3 7 8	E/S/W	P	P	P	A
Aracana ornata	Ornate Cowfish	1 2 3 5 6 7	S	P	A	A	A
Tetraodontidae							
Arothron firmamentum	Starry Toadfish	2 3	S/E	P	P	A	P
Contusus brevicaudus	Prickly Toadfish	2 3 4 7	E/S/W	P	P	P	A

Appendix — *continued*

Family and species name	Common name	Source	Distr-bution	Tas	NSW	WA	Qld
Tetraodontidae (cont):							
Contusus richei	Barred Toadfish	1 2 3 5 6 7	S	P	A	A	A
Omegophora armilla	Ringed Toadfish	2 3 7	E/S/W	P	P	P	A
Tetractenos glaber	Smooth Toadfish	1 2 3 4 7 8	S/E	P	P	A	P
Diodontidae							
Allomycterus pilatus	Australian Burrfish	2 3	E/S/W	P	P	P	A
Diodon nichthemerus	Globefish	1 2 3 7 8	E/S/W	P	P	P	A

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