



A new species of *Procophorella* Mesibov, 2003 from Victoria, Australia (Diplopoda, Polydesmida, Dalodesmidae) and a reclassification of *Procophorella*, *Noteremus* Mesibov, 2009 and *Paredrodesmus* Mesibov, 2009

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Abstract

Procophorella bawbawensis n. sp. is described from high-elevation habitats near Mt Baw Baw in Victoria, Australia. Unlike the two Tasmanian species of *Procophorella* Mesibov, 2003, the new species has sphaerotrichomes on adult male legs. *Procophorella*, *Noteremus* Mesibov, 2009 and *Paredrodesmus* Mesibov, 2009 form a natural group and are currently *incertae sedis* within suborder Dalodesmidea. The three genera are here assigned to Dalodesmidae.

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Introduction

The three Tasmanian millipede genera *Procophorella* Mesibov, 2003, *Paredrodesmus* Mesibov, 2003 and *Noteremus* Mesibov, 2009 were originally placed in suborder Dalodesmidea because the gonopods of the known species are "dalodesmoid", i.e. the gonocoxae are small and entirely contained within a large aperture. Further, as with many described Australian Dalodesmidae, the gonopod telopodites are slender and closely appressed. I did not assign the three genera to a family because the known species lacked sphaerotrichomes on adult male legs, although Dalodesmidae includes species without these structures. I proposed, however, that the three genera form a natural group (Mesibov

2009). In all three genera the body plan is head + 19 rings (including telson), the pore formula is 5+7-18, paranota are absent or greatly reduced on most rings, and the ventral spinnerets are further apart than the dorsal pair.

In the new species of *Procophorella* described below there are numerous sphaerotrichomes on the tarsus of some anterior male legs. This indicates that the three genera in the unnamed group belong in Dalodesmidae and that sphaerotrichomes have been secondarily lost in Tasmanian lineages. I now classify species of *Noteremus*, *Paredrodesmus* and *Procophorella* in Dalodesmidae.

Methods

The specimens studied came either from litter samples (2023, 2024) or pitfall traps (2024). Leaf litter samples were collected and Tullgren funnel-extracted by Nick Porch (Deakin University) and his students. Specimen lots dated 2023 were from single 2 sq. m. litter patches, and 2024 lots were from four combined 0.25 m² patches collected within 10 m of each pitfall grid. Pitfall grids at a site comprised 16 plastic tubes set in a 4x4 grid with traps ca 2-3 m apart. Pitfall traps were each filled with 25 ml of 80% propylene glycol and removed after approximately two weeks. All specimens of *Procophorella bawbawensis* n. sp. are preserved in 70% or 95% alcohol in Museums Victoria.

Selected specimens of *Procophorella bawbawensis* n. sp. and freshly collected *P. innupta* Mesibov, 2003 were dissected for scanning electron microscopy and gonopod drawings. The whole-animal image (Fig. 1A) was captured with an OM Systems TG-7 digital camera. Gonopods were placed in 90+% lactic acid until cleared, temporarily mounted in a 1:1 glycerol:water mixture and imaged with an Omax A35180U3 eyepiece video camera mounted on an AmScope B210 microscope, with subsequent focus-stacking of manually focused images using Zerene Stacker 1.04 software. Outline drawings of telopodites were digitally traced from the focus-stacked images and checked against the temporary slide mounts. For scanning electron microscopy, material was air-dried and temporarily glued to stubs prior to coating with platinum and imaging with a Hitachi SU-70 operated in high-vacuum mode. The maps were composed with QGIS 3.22 and figures were composed and edited with GIMP 2.10.

Abbreviations used: VIC - Victoria, Australia; NMV - Museums Victoria, Melbourne; TMAG - Tasmanian Museum and Art Gallery, Hobart; M - adult male; F - adult female; J - juvenile; a.s.l. - above sea level.

Taxonomy

Order Polydesmida Pocock, 1887

Suborder Dalodesmidea Hoffman, 1980

Family Dalodesmidae Cook, 1896

Genus *Procophorella* Mesibov, 2003

Procophorella Mesibov (2003): 2

Type species. *Procophorella innupta* Mesibov, 2003 by original designation.

Other included species. *P. bashfordi* Mesibov, 2003, *P. bawbawensis* n. sp.

Remarks. *Procophorella* is an easily recognised genus: the body plan is head + 19 rings, paranota are represented only by a narrow trough with a thin marginal

ridge on most rings, the pore formula is 5 + 7-18, ozo-pores are partly contained at the rear of the narrow paranotal trough, tergite 2 has a small ventrally projecting tooth, the ventral spinnerets are further apart than the dorsal spinnerets and the gonopod is arcuate (concave posteriorly) with a small, lateral solenomere. The description of the new species incorporates these genus-level character states.

Procophorella bawbawensis n. sp.

Figures 1-3

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Holotype. Male, Australia, Victoria, Baw Baw National Park, 0.5 km NNE of Mt St Gwinear carpark, -37.8368 146.3346 ±25 m, 1270 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in riparian cool temperate rainforest, sample NP23-18, NMV K-16410.

Paratypes. 22M, 2F, same details as holotype, NMV K-16411; 10M, 3F, 3J, Mt St Gwinear Road, 1.08 km NE by N of Mt St Gwinear carpark, -37.8327 146.3386 ±25 m, 1205 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in riparian cool temperate rainforest, sample NP23-19, NMV K-16412; 4M, 1F, Baw Baw National Park, 0.41 km NNW of Mt St Gwinear carpark, -37.8370 146.3301 ±25 m, 1340 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-12, NMV K-16407; 3M, 1F, Baw Baw National Park, 0.26 km NNW of Mt St Gwinear carpark, -37.8388 146.3306 ±25 m, 1325 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-13, NMV K-16408; 4M, Baw Baw National Park, 0.14 km N by W of Mt St Gwinear carpark, -37.8396 146.3315 ±25 m, 1315 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-14, NMV K-16409.

Diagnosis. Differs from *Procophorella innupta* and *P. bashfordi* in having sphaerotrichomes on anterior male legs, and with the medial process of the gonopod telopodite extending as a long, spear-like structure curving basally, as opposed to abruptly bent basally as a short, broad structure in *P. innupta* and *P. bashfordi*.

Description. Male and female (Fig. 1A) with head + 19 rings. Male/female overall length ca 9/10 mm, maximum midbody vertical diameter ca 0.9/1.0 mm. In alcohol, well-coloured males and females light tan with cellular reddish-brown on prozonite and metazonite of diplosegments; darker brown colouring on posterior margins of tergites and metatergites and on collum margins; brown colouring on vertex, frons and distal antennomeres.

Male with vertex almost bare, frons and clypeus sparsely setose; vertigial sulcus indistinct; antennal bases separated by ca 1.5X socket diameter. Antenna short, reaching tergite 2 dorsally when manipulated; relative antennomere lengths 6 > (2,3) > (4,5); antennomere 6 widest. Collum with anterior and posterior margins very slightly convex, corner rounded. Head slightly wider

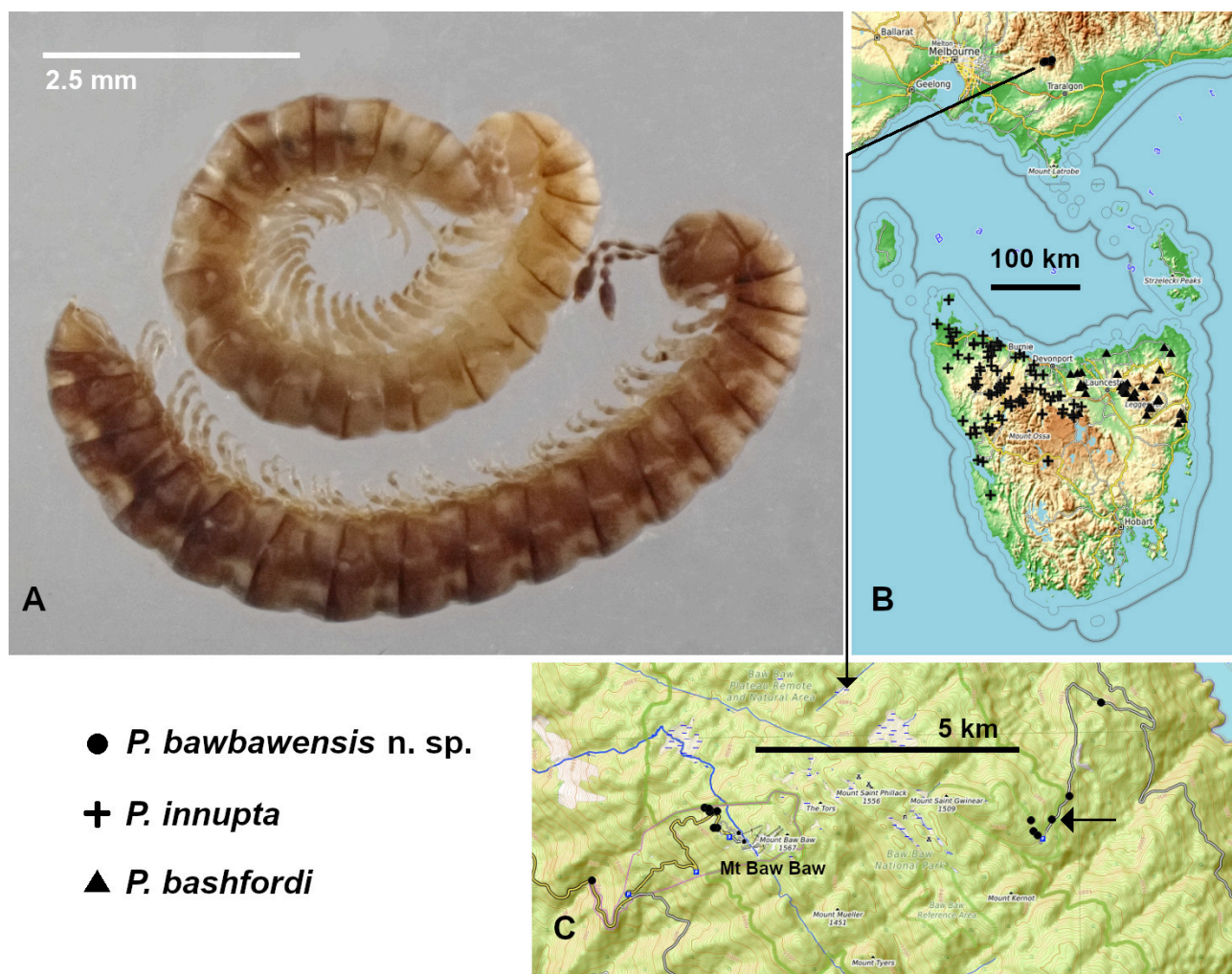


Figure 1. **A)** *Procophorella bawbawensis* n. sp., paratype male (top) and female (bottom) ex NP23-19 (NMV K-16412). **B)** Localities for *Procophorella bawbawensis* n. sp. (filled circles) in Victoria and *P. innupta* (crosses) and *P. bashfordi* (filled triangles) in Tasmania. **C)** Enlarged map with localities for *P. bawbawensis* n. sp. (filled circles) near Mt Baw Baw. Short arrow in **C** points to holotype site. Mercator projections; base map for **B** and **C** from OpenTopoMap (<https://opentopomap.org/>).

than collum; widths of collum and tergites 2, 3 and 4 subequal; ring widths 5-18 subequal. Tergite 2 with narrow, shelf-like paranotum, lower than both collum corner and ring 3 paranotum, and with small, blunt, ventrally projecting tooth below paranotum. Paranotum on rings 3-15 indistinct, marked by thin marginal ridge at about 1/2 ring height; rings 16-18 without obvious paranotum. Prozonite and metazonite without obvious sculpturing; waist prominent; metazonite with shallow transverse depression at mid-length and a few short setae, posterior margin straight. Limbus composed of scattered, very short, spine-like projections. Pore formula 5 + 7-18; ozopore (Fig. 2A) round, near posterior end of paranotum and partly contained within narrow paranal trough, as in *P. innupta* (Fig. 2B). Midbody sternites a little longer than wide; transverse and longitudinal impressions about equally deep. Spiracles small, round; on diplosegments with anterior spiracle above anterior leg base, posterior spiracle between leg bases. Preanal ring only sparsely setose; epiproct extending a little past anal valves, apex broadly rounded; hypoproct

trapezoidal; ventral spinnerets further apart than dorsal spinnerets (Fig. 2C), as in *P. innupta* (Fig. 2D). Length of midbody legs ca 1X ring diameter; relative podomere lengths (prefemur, femur, tarsus) > (postfemur, tibia); tarsus straight, claw short; anterior legs with prefemur and femur a little swollen dorsally. Numerous sphaerotrichomes (Fig. 2E) on tarsus of anterior legs near gonopods, a few on distal end of tibia; sphaerotrichomes with globular ridged base and short, bluntly tapering shaft; note lack of sphaerotrichomes in *P. innupta* (Fig. 2F).

Bases of legpairs 6 and 7 separated to accommodate retracted gonopods, sternites with setal brushes medially. Leg 2 coxa with gonopore opening distomedially. Ring 7 aperture oval, wider than long, about 1/2 prozonite width. Gonocoxae small, subconical, well separated from aperture margin, lightly joined medially. Telopodite (Figs 3A, 3D) with flattened, drum-shaped base bearing a few long setae; extending distally from anterior side of base as subcylindrical, arcuate shaft curving posteriorly; divided at about 1/2 telopodite

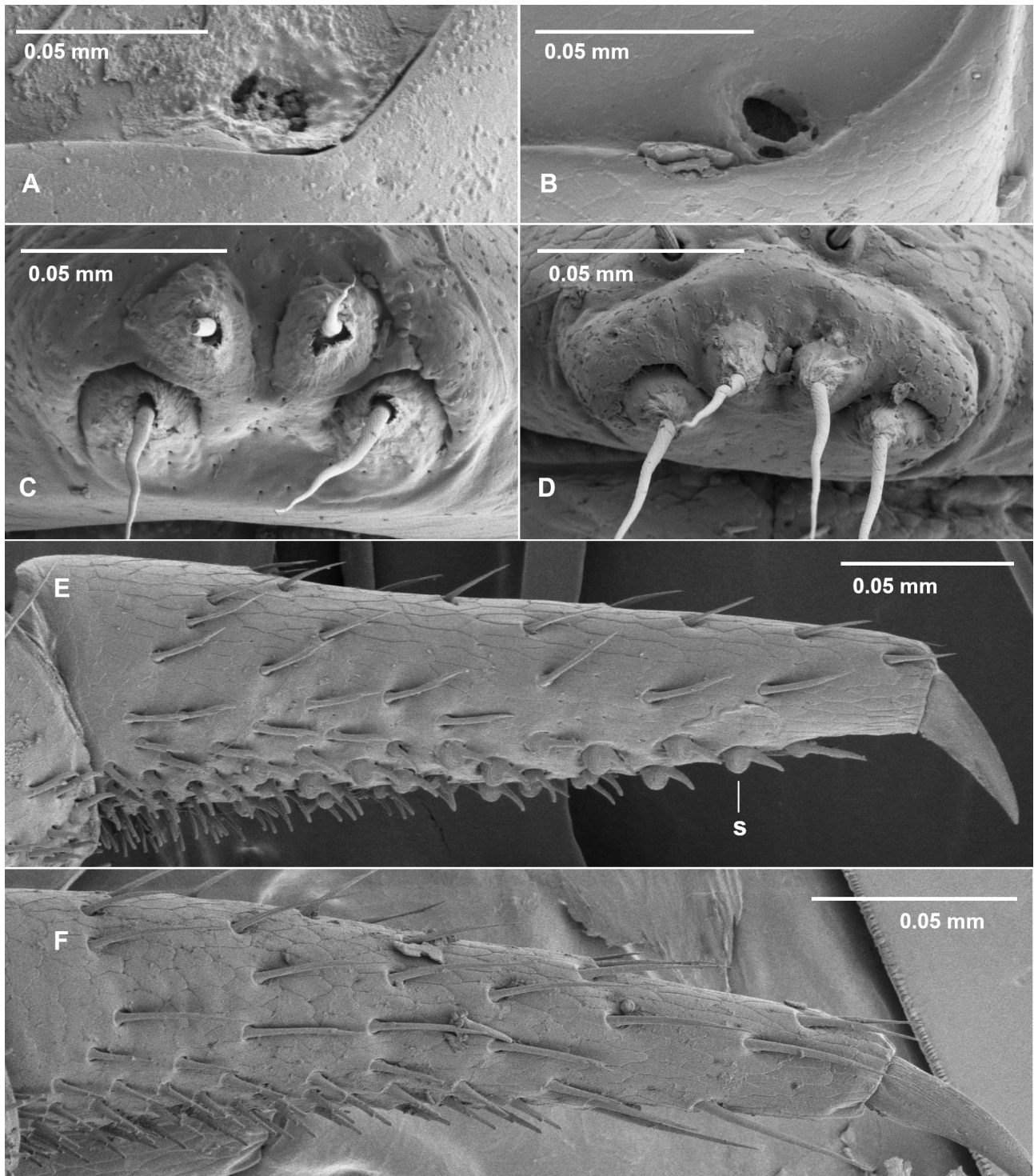


Figure 2. **A, C, E)** Paratype *Procophorella bawbawensis* n. sp. ex NP23-18 (NMV K-16411); **B, D, F)** *P. innupta* ex TMAG J7578. **A, B)** Left lateral view of midbody ozopore, partly contained in narrow paranotal trough. **C, D)** Posterior view of spinnerets. **E, F)** Leg 7 tarsus; note sphaerotrichomes (**s**) in **E**.

height into lateral solenomere and medial process, both curving posteriorly, with a few short setae on solenomere above division. Solenomere a little sinuous, tapering to blunt point; prostatic groove running on posterior telopodite surface to join solenomere base. Medial process divided at about 2/3 telopodite height into anterior and posterior branches. Anterior branch spear-like, directed posterodistally and terminating at level

of solenomere tip. Posterior branch curving posteriorly and sharply basally, tapering to point a little distal to main telopodite division and with tab-like extension on medial surface curving medially.

Female stouter than male with thinner legs; epigynum narrow-rectangular; cyphopods not examined.

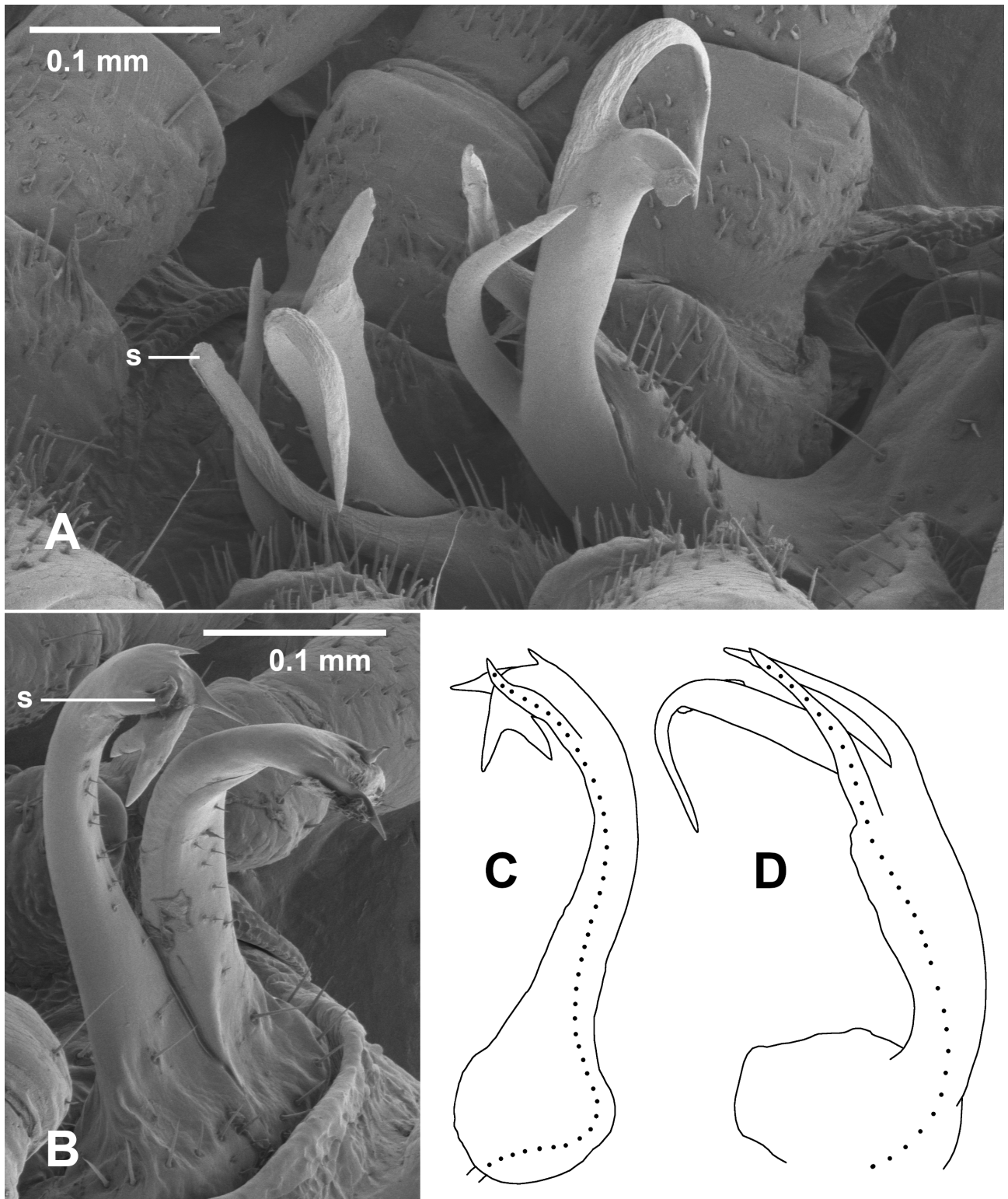


Figure 3. **A, D)** Paratype *Procophorella bawbawensis* n. sp. ex NP23-18 (NMV K-16411); **B, C)** *P. innupta* ex TMAG J7578. **A, B)** Left ventrolateral views of gonopods *in situ* with telopodites recumbent in aperture (**A**) or erect (**B**); **s** - solenomere. **C, D)** Lateral views of left gonopod telopodites. Dotted line marks course of prostatic groove, setation not shown and drawings not to same scale.

Other material examined. 7M, 1F, 1J, Baw Baw Alpine Reserve, near NW corner of carpark 3, -37.8383 146.2602 ±25 m, 1460 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-04, NMV K-16401; 1M, Baw Baw Alpine

Reserve, between carpark 4 and carpark 5, -37.8383 146.2594 ±25 m, 1455 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-06, NMV K-16402; 1M, Baw Baw Alpine Reserve, 30 m NE of Saxons Picnic Area, -37.8355

146.2585 ±25 m, 1430 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in riparian cool temperate rainforest, sample NP23-07, NMV K-16403; 6M, Baw Baw Alpine Reserve, 40 m N of Saxons Picnic Area, -37.8354 146.2589 ±25 m, 1435 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-08, NMV K-16408; 3M, Baw Baw Alpine Reserve, 0.12 km E by N of Saxons Picnic Area, -37.8354 146.2603 ±25 m, 1430 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-09, NMV K-16405; 3M, 1F, 2J, Baw Baw Tourist Road, 0.79 km WNW of Baw Baw Alpine Resort entrance, -37.8475 146.2324 ±25 m, 760 m a.s.l., 2023-03-05, coll. Nicholas Porch, berlesate from litter in snow gum woodland, sample NP23-11, NMV K-16406; 10M, 3F, 3J, Mt St Gwinear Road, 1.08 km NE by N of Mt St Gwinear carpark, -37.8327 146.3386 ±25 m, 1205 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in riparian cool temperate rainforest, sample NP23-19, NMV K-16412; 1M, Mt St Gwinear Road, 1.1 km WNW of junction with Thomson Valley Road, -37.8163 146.3456 ±25 m, 1035 m a.s.l., 2023-03-15, coll. Nicholas Porch, berlesate from litter in wet sclerophyll forest, sample NP23-20, NMV K-16413; 1M, 1F, Mt Baw Baw, 0.1 km NW by N of Saxons Picnic Area, -37.8349 146.2583 ±25 m, 1425-1445 m a.s.l., 2024-02-13, coll. Nicholas Porch and Daniel Kurek, berlesate from litter in closed shrubby subalpine snow gum woodland, sample HS17-C-L2, NMV K-16414; 2M, 3F, Mt Baw Baw, 0.18 km NW by W of Saxons Picnic Area, -37.8347 146.2574 ±25 m, 1420-1440 m a.s.l., 2024-02-13, coll. Nicholas Porch and Daniel Kurek, berlesate from litter in closed shrubby subalpine snow gum woodland, sample HS17-C-L3, NMV K-16415; 1M, same details but specimen in 95% EtOH, NMV K-16416; 1F, Mt Baw Baw, 0.1 km NW by N of Saxons Picnic Area, -37.8349 146.2583 ±25 m, 1425-1445 m a.s.l., 2024-01-31/2024-02-13, coll. Nicholas Porch and Daniel Kurek, pitfall trap in shrubby subalpine snow gum woodland, sample HS17-C-P2-5, NMV K-16417.

Distribution. So far known from snow gum woodland, wet eucalypt forest and riparian cool temperate rainforest from 760 to 1455 m a.s.l. at two locality clusters ca 6 km apart in and near Baw Baw National Park, Victoria (Figs. 1B,1C).

Name. Adjective, for the known distribution of this species near Mt Baw Baw in Victoria, Australia.

Remarks. The gonopod telopodite in *Procophorella bawbawensis* n. sp. (Figs 3A, 3D) is closely similar in structure to that of the type species *P. innupta* (Figs 3B, 3D), but with exaggerated features: the base is expanded, the telopodite curvature is stronger, the division between the lateral solenomere and the medial process begins lower on the telopodite, and the medial process is much longer and extends further basally.

Both the finding of sphaerotrichomes in the new *Procophorella* species and its presence in Victoria were unexpected. I collected dalodesmids in western and eastern Victoria in the 2000s and 2010s and also examined museum material of Victorian dalodesmids, and noted no specimens with the distinctive somatic characteristics of *Procophorella*. Other dalodesmid genera currently thought to be endemic to Tasmania may be found in future to have Victorian representatives with restricted distributions.

P. bawbawensis n. sp. may also occur in forests at lower elevations near Walhalla and Erica, southeast of Mt Baw Baw. In Tasmania, *Procophorella* species are widespread in their respective ranges (Fig. 1B) from near sea level to 1150 m a.s.l. (*P. innupta* on the Great Western Tiers) and 1200 m a.s.l. (*P. bashfordi* on Mt Barrow).

Procophorella having sphaerotrichomes in a Victorian species and not having sphaerotrichomes in two Tasmanian species has a curious parallel in the paradoxosomatid species *Dicranogonus pix* Jeekel, 1982. Victorian populations of *D. pix* have paranota on diplosegments while Tasmanian populations have none (Mesibov 2014), with the line separating the two forms running between islands in Bass Strait.

Disclosures

This study was funded by the author and there are no conflicts of interest.

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pix Jeekel, 1982 (Diplopoda, Polydesmida, Paradoxoso-



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