Memoirs of Museum Victoria 60(2): 197–206 (2003)

ISSN 1447-2546 (Print) 1447-2554 (On-line)
http://www.museum.vic.gov.au/memoirs

A new genus of Tasmanian millipedes (Diplopoda: Polydesmida: Dalodesmidae) with unusual spiracles and a mosaic distribution

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Abstract

Mesibov, R. 2003. A new genus of Tasmanian millipedes (Diplopoda: Polydesmida: Dalodesmidae) with unusual spiracles and a mosaic distribution. *Memoirs of Museum Victoria* 62(2): 197–206.

Dasystigma gen. nov. is erected for *Lissodesmus margaretae* Jeekel, 1984 (type species), *D. bonhami* sp. nov., *D. huonense* sp. nov. and *D. tyleri* sp. nov. A dense cluster of hair-like structures of unknown function emerges from each spiracle in all *Dasystigma* species, and the four geographic distributions form a closely fitted mosaic.

Keywords Diplopoda, Polydesmida, Dalodesmidae, millipede, taxonomy, Australia, Tasmania

Introduction

R.M. Shelley suggested that distribution mosaics may be common in the Diplopoda. Mosaics of closely related species, here called *lineage mosaics*, are "typically characterized by large generic distributions, limited component ranges, tightly fitted parapatry patterns with limited instances of sympatry, clustering of components, and slight or minor differences between some species" (Shelley, 1990a: 23). A lineage mosaic of five parapatric and two allopatric species has been documented in the Tasmanian polydesmidan genus *Gasterogramma* (Mesibov, 2003). In the *Gasterogramma* mosaic, the components are readily distinguished by cursory examination of the male gonopods, i.e. the species differences are not "minor".

Here, I describe a group of four similar Tasmanian dalodesmids forming a closely fitted lineage mosaic. The group is also unusual in having hair-like structures of unknown function emerging from all spiracles. A new genus *Dasystigma* is erected for the group, based on *Lissodesmus margaretae* Jeekel, 1984.

As is also the case for components in North American millipede mosaics (Shelley and Whitehead, 1986; Shelley, 1990b), it is not yet known whether the four *Dasystigma* taxa recognised here are fully reproductively isolated. Although *D. margaretae* and *D. tyleri* sp. nov. have been found in sympatry in south-western Tasmania (with *D. huonense* sp. nov. known from a locality only 5 km distant), the overlap zone appears to be narrow and may be a tension zone (Key, 1982) maintained by hybridisation, i.e. isolation is incomplete. I regard the four *Dasystigma* as evolutionary species sensu Wiley (1978).

Specimens were killed and preserved in 75–80% ethanol. Preliminary drawings on graph paper were made using material cleared in 60% lactic acid and viewed at 100 or 200× magnification through an eyepiece graticule. A Philips Electroscan ESEM 2020 operated in high-vacuum mode was used to examine preserved material which had been air-dried before sputter-coating with gold. SEM images were acquired digitally.

To save space in the printed version, full details of localities, dates, collectors, specimens and registration numbers for the 202 samples examined are provided separately on the *Memoirs of Museum Victoria* website, www.museum.vic.gov.au/memoirs/. The specimen data table is also available from the author and a copy has been deposited at the QVM.

Collecting sites for all but a few of the specimens examined were estimated in the field to be within particular 100 m Universal Transverse Mercator (UTM) grid squares on 1:25000 scale maps published by the State of Tasmania. Grid squares are recorded below in 2-letter, 6-digit form, e.g. 'EN700712.' The maximum horizontal error in these estimates is likely to be less than 100 m. Latitude/longitude equivalents were calculated using GeoCalc 4.20 (GeoComp Systems, Blackburn, Victoria) and are not as precise as the UTM grid references. LGRSS transect locations (see separate specimen data table) were derived from 1:2000 survey charts made available to the QVM by the Hydro-Electric Commission, Tasmania, in 1994.

Abbreviations and codes are as follows: AM, Australian Museum, Sydney, NSW; ANIC, Australian National Insect Collection, Canberra, ACT; LTV. Latrobe University, Bundoora; LGRSS, Lower Gordon R. Scientific Survey, 1976–1978; NMV, Museum Victoria, Melbourne, Vic.; NRCP, National Rainforest Conservation Program invertebrate survey, 1989–1990; PCS, posterior corner seta (a long, prominent seta arising dorsally near each posterior corner of the collum and all tergites); QVM, Queen Victoria Museum and Art Gallery, Launceston, Tas. Male and female refer to stadium 8 adults.

Order **Polydesmida** Leach, 1815

Suborder **Dalodesmidea** Hoffman, 1977

Dalodesmidae Cook, 1896

Dasystigma gen. nov.

Type species. Lissodesmus margaretae Jeekel, 1984, by present designation.

Diagnosis. Differs from *Lissodesmus* and other known Australian dalodesmids in (a) the dense brush of hair-like structures emerging from each spiracle and (b) the unusually wide separation between the bases of the solenomerite and tibiotarsus on the gonopod telopodite.

Description of males. Adult length 18–22 mm when contracted in alcohol, diameter of midbody metazonite c. 1.8 mm. Overall colour pale yellow-brown to deep chestnut brown. Head with labrum weakly emarginate in center; clypeus very weakly convex in lateral view, moderately setose; vertex bare, strongly convex in lateral view, vertigial sulcus extending forward to a point about one antennal socket width from an imaginary line joining socket centres. Antennal sockets separated by about twice the diameter of a socket, weakly impressed; antennomeres (Fig. 2) setose, more densely and finely so on 5–8, antennomere lengths decreasing in the order 2, (3, 6), (5, 4), antennomere 6 the widest. Collum slightly wider than head in front, widening posteriorly, anterior margin broadly convex, lateral margin with typically 3 small, seta-bearing teeth, posterior corner rounded and not projecting, posterior margin squarely transverse laterally but with the central third slightly emarginate; several transverse rows of sparse, long setae anteriorly on collum; a long seta extending posteriolaterally from point near posterior corner of collum (= posterior corner seta, PCS). Paranota inflated (Fig. 2), maximum width at about one-third the ring diameter from the dorsum in midbody segments. Somites 2–4 from above about equal in width and slightly wider than collum; somites 5–17 about equal in width and slightly wider than 2–4; somite 18 narrower than 17. Tergites unsculptured, bare apart from PCS near posterior corners (Fig. 3). Paranota on most somites with 4 or 5 (3–6) small marginal teeth, each bearing a seta (Fig. 3); paranotal margin a straight line in lateral view, rising posteriorly; margin in dorsal view either nearly straight (parallel to long body axis) or slightly convex (see also "Derwent form" under *D. margaretae* (Jeekel, 1984) comb. nov., below); posterior corner variably projected (Fig. 3), with minute terminal seta. Ozopores on somites 5, 7, 9, 10, 12, 13, 15–19; pore opening dorsally on paranotum, just mesal to marginal thickening and typically about one-fourth of lateral margin length from tip of posterior corner. Spiracles (Fig. 5) variably enlarged, all with hair-like structures variably emergent (Fig. 1A) (at low magnification, the swollen, "hairy" spiracles in *D. bonhami* and *D. margaretae* resemble ectoparasitic mites). Legs (Fig. 2) incrassate, much more so anteriorly beginning with leg-pair 3, prefemur and femur dorsally swollen, tibia on anterior legs in *D. bonhami*, *D. margaretae* and *D. tyleri* with slight ventrodistal swelling; tarsus about as long as or slightly longer than femur; dense pubescence ventrally on coxa, prefemur, femur and postfemur; numerous sphaerotrichomes ventrally on postfemur, tibia and tarsus; long, prominent seta at ventrodistal end of coxa and prefemur and at dorsodistal end of tibia. Genital opening inconspicuous on

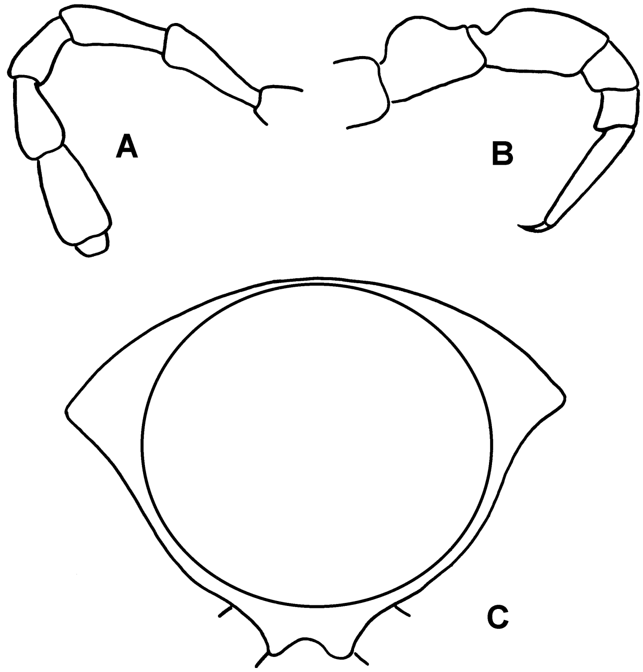

Figure 2. *Dasystigma bonhami* sp. nov., Sandspit R. male, QVM 23:15219. A, Antenna; B, leg 10; C, cross-section of somite 8. Setation not shown.

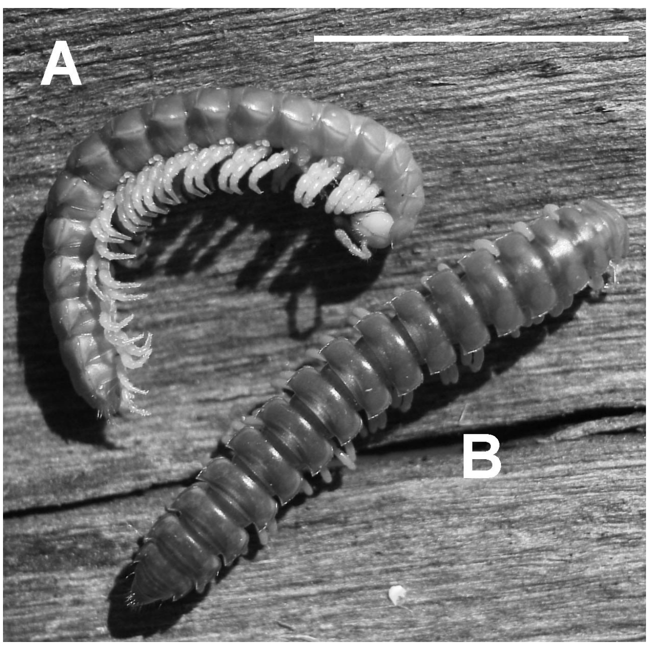

Figure 1. Whole-animal view of *Dasystigma margaretae* (Jeekel, 1984) comb. nov. A, Rocka Rivulet male, QVM 23:24949; B, Tiger Creek male, QVM 23:24950. Scale bar = 10 mm.

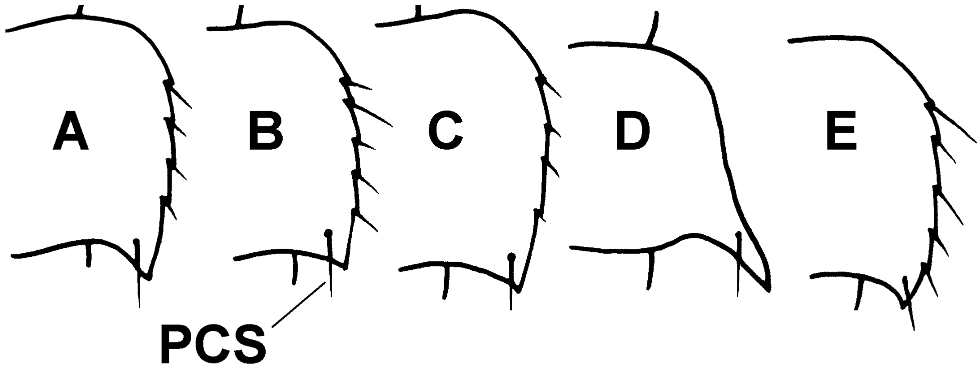

Figure 3. Dorsal views of right margin of tergite 14 of *Dasystigma* females. A, *D. bonhami* sp. nov., Sand R., QVM 23:40811; B, D. *huonense* sp. nov., Edwards Rd, QVM 23:15269; C, *D. margaretae* (Jeekel, 1984) comb. nov., Fingal Tier, QVM 23:15230; D, *D. margaretae* (Jeekel, 1984) comb. nov., Tarraleah, QVM 23:15252; E, *D. tyleri* sp. nov., Trackham Creek, QVM 23:15260. PCS = posterior corner seta.

slight distal swelling of leg 2 coxa. Preanal ring with numerous long setae, densest dorsally; epiproct in dorsal view a truncated triangle with weakly concave sides; hypoproct broadly paraboloid in ventral view.

Gonopod aperture one-third to one-half ring 7 prozonite diameter in width, about 1.5 times as wide as long; in ventral view with straight anterior and lateral margins, posterior margin slightly curved, concave anteriorly; in lateral view anterior aperture margin not raised, lateral margin not raised or slightly convex upwards, and higher than slightly raised posterior margin.

Gonopods (Fig. 4) retracted reaching as far as leg-pair 5 bases on ring 5, solenomerites and tibiotarsi of opposing gonopods interlaced. Telopodite in posterior view more or less straight, posterior and mesal faces sparsely setose from base to about level of solenomerite origin. Solenomerite arising at about half telopodite length on anteriomesal face, just proximal to origin of prefemoral process, directed first distad and mesad, then curving caudad and distad, tapering to a sharp point from about two-thirds its length and terminating at about three-quarters length of telopodite. A thin, curved ridge of cuticle on anterior surface of telopodite appearing to extend the line of the solenomerite proximad and strengthening it at its base; prostatic groove running along anterior surface of telopodite just lateral of this ridge. Tibiotarsus arising on posterior face of telopodite at about level where prefemoral process arises, smoothly curving mesad and distad, tapering near its apex to a blunt point on the telopodite just proximal to tip of solenomerite. Prefemoral process arising about midlength on telopodite, curved (concave posteriorly) and flattened anterio-posteriorly, bearing a large uncus on posterior surface at about half its length, tip of uncus pointed caudad and mesad. Femoral process arising from lateral surface of prefemoral process proximal to uncus, variably shaped, not extending further distad than prefemoral process.

Females longer and heavier-bodied than males. Legs not swollen apart from slight dorsal swelling on prefemur and femur on anterior leg-pairs; no ventrodistal swelling of tibia; no sphaerotrichomes or ventral pubescence. Cyphopods not examined.

Juveniles considerably smaller than adults, midbody metazonite diameters c. 1 mm in stadium VII and c. 0.8 mm in stadium VI. Paranotal teeth much more prominent than in adults, spiracles generally placed as in adults (see species descriptions, below) in stadium VII, but typically well-separated in stadium VI and younger.

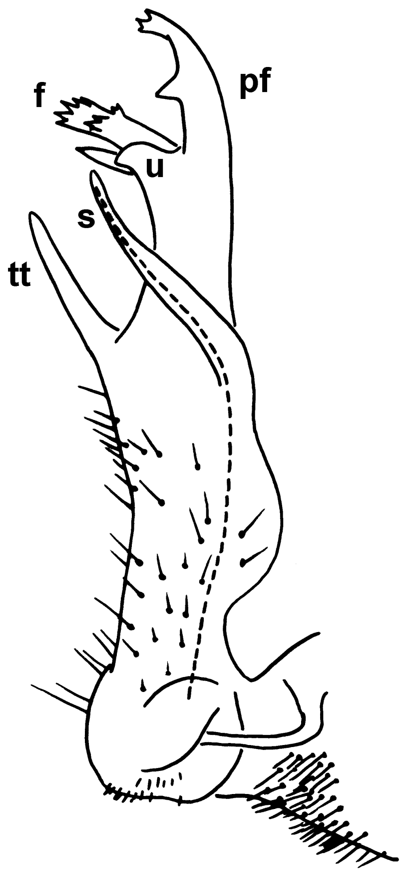

Figure 4. Mesal view of right gonopod of male holotype of *Dasystigma margaretae* (Jeekel, 1984) comb. nov., redrawn from Jeekel (1984). f = femoral process, pf = prefemoral process, s = solenomerite, tt = tibiotarsus, u = uncus. Dashed line marks path of prostatic groove.

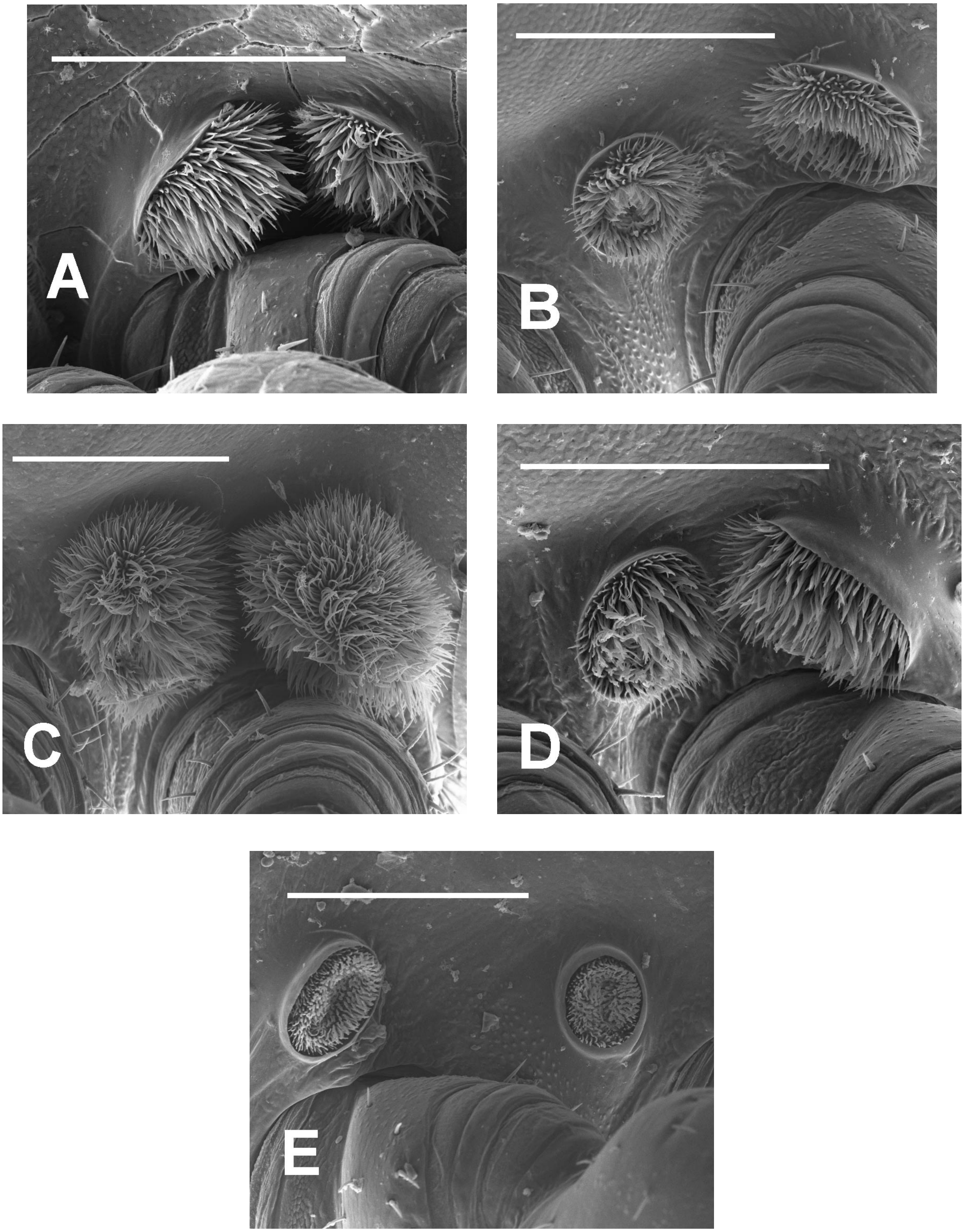

Figure 5. Spiracles on midbody segment of A, *Dasystigma bonhami* sp. nov., Sandspit R. male, QVM 23:15219; B, *D. huonense* sp. nov., Huon R. (Arve Rd) male paratype, QVM 23:40805; C, *D. margaretae* (Jeekel, 1984) comb. nov., Tooms Lake male, QVM 23:15214; D, *D. margaretae* (Jeekel, 1984), Dromedary Creek male, QVM 23:15212; E, *D. tyleri* sp. nov., White Spur male, QVM 23:15190. Scale bar in all cases = 0.25 mm; anterior to right for A–D, anterior to left for E.

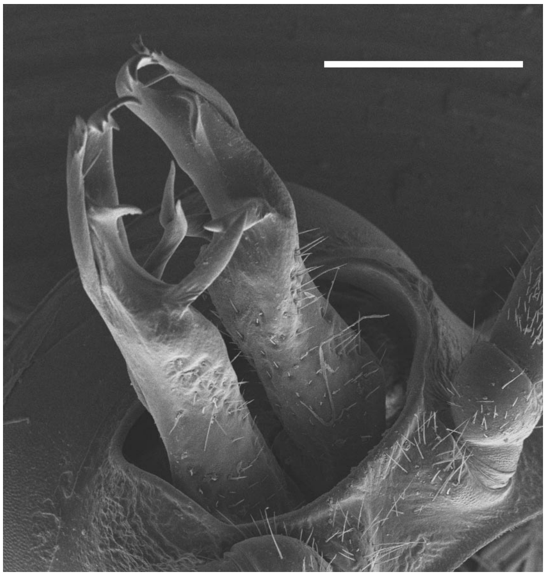

Figure 6. *Dasystigma bonhami* sp. nov. Gonopods in situ. Scale bar = 0.5 mm. Flash Tier male, QVM 23:15222.

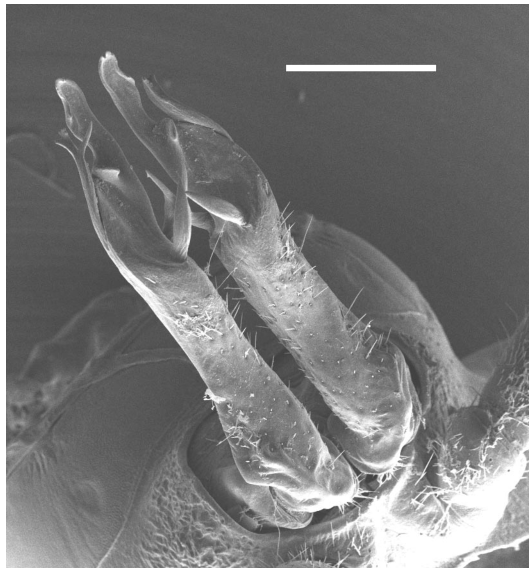

Figure 8. *Dasystigma huonense* sp. nov. Gonopods in situ. Scale bar = 0.5 mm. Picton R. male, QVM 23:40801.

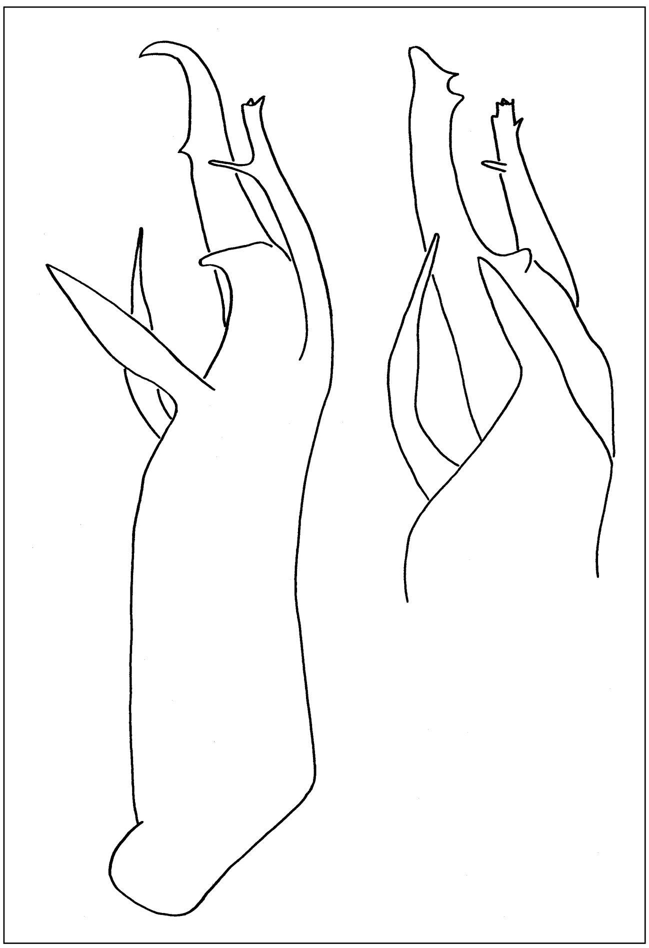

Figure 7. *Dasystigma bonhami* sp. nov. Approximately lateral (left) and mesal (right) views of left gonopod telopodite of Ravens Hill male, QVM 23:15223. Setation not shown.

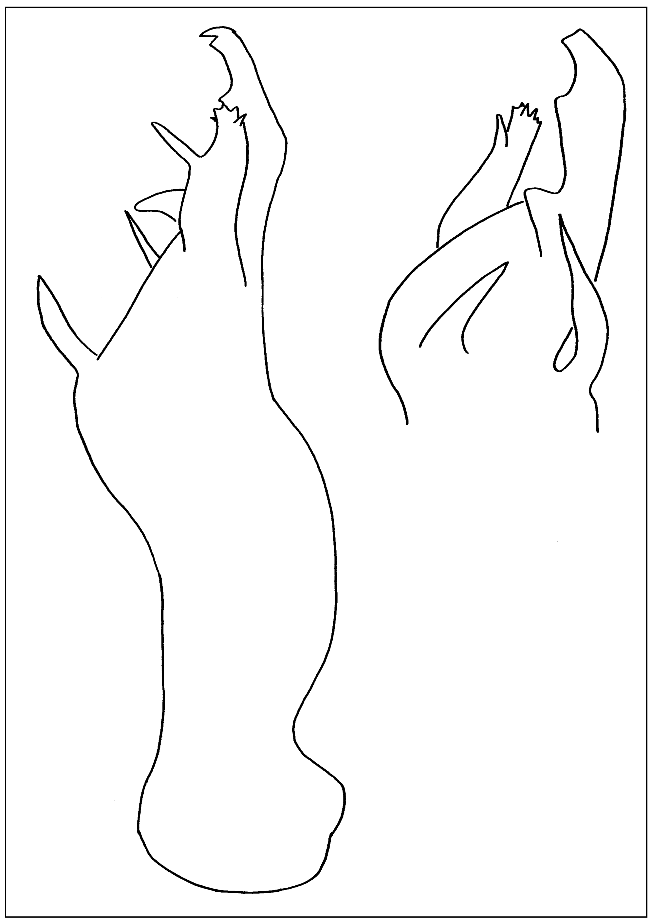

Figure 9. *Dasystigma huonense* sp. nov. Approximately lateral view (left) of left gonopod telopodite and mesal view (right) of right gonopod telopodite of Edwards Rd male paratype, QVM 23:15195. Setation not shown.

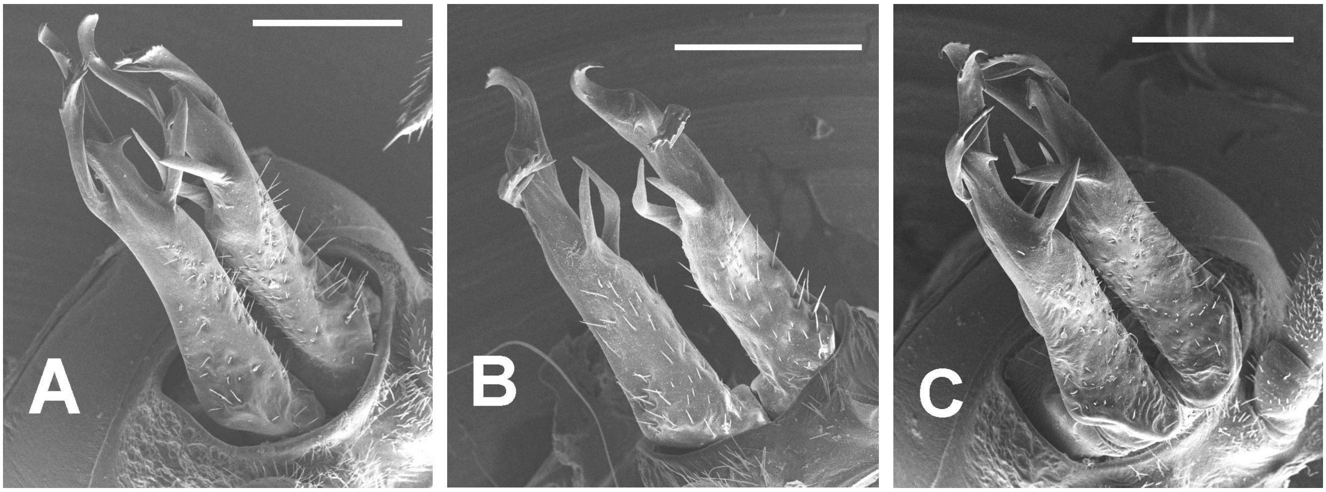

Figure 10. *Dasystigma margaretae* (Jeekel, 1984) comb. nov. Gonopods in situ, scale bar = 0.5 mm in all cases. A, Tooms Lake male, QVM 23:15214; B, Lake Augusta male paratype, (DPI-NT) 19A17; C, Coles Creek male ("Derwent form"), QVM 23:24932.

Remarks. The four species of *Dasystigma* recognised here are very similar in overall appearance (Fig. 1), distinguished partly on differences in the size, placement and "hairiness" of spiracles on diplosegments, but primarily on details of gonopod structure. The various processes on the gonopod are named here in accordance with the terminology used by Jeekel (1984) for *Lissodesmus margaretae*. Interspecific differences in gonopod structure are consistent in *Dasystigma* but subtle, and I have therefore provided for each species three different views of the gonopod, emphasising the prefemoral and femoral processes.

The dense spiracular "brush" of hairs is present in the type specimens of *D. margaretae* but appears to have been overlooked by Jeekel (1984). In 1972, P.M. Johns collected specimens of *D. bonhami* near Triabunna, in south-eastern Tasmania and later noted "spiracles greatly swollen, densely setose, the setae fine and short" (Johns, in litt., 15 Oct 1991). The function of the hair-like structures is unknown. Throughout their ranges, *Dasystigma* species co-occur in forest litter with dalodesmids of similar size and habits but with non-hairy spiracles.

Distribution and microhabitat. Tasmania south of 41ºS; in and under rotting wood, in leaf litter and in humus.

Etymology. Greek *dasys* ("hairy") + *stigma* (in entomology, "opening to tracheal system"), neuter.

Dasystigma bonhami sp. nov.

Figures 2, 3A, 5A, 6, 7, 14 (map)

Material examined. Holotype. Male, Australia, Tasmania. Sandspit R., EN700712 (42°42´30´´S 147°51´17´´E), 230 m, 31 Jul 1991, R. Mesibov, QVM 23:41726.

Paratypes. 2 males, details as for holotype, QVM 23:15219; 1 female, details as for holotype, QVM 23:15261; 2 males, Sandspit R., EN688712 (42°42´30´´S 147°50´24´´E), 200 m, 26 Jun 1988, R. Mesibov, NMV K-8803, K-8804 (formerly QVM 23:15220); 2 males, Nugent, EN559711 (42°42´37´´S 147°40´57´´E), 400 m, 9 Aug 1998, K. Bonham and R. Crookshanks, AM KS85095 (formerly QVM 23:40807).

Other material. 30 males, 25 females and 45 juveniles from 27 unique localities including Baldy Creek, Bellettes Creek, Bishop and Clerk (Maria I.), Black Hill, Blind Creek (Maria I.), Blue Gum Spur, Carlton R., Chauncy Vale, Douglas Creek, Flash Tier, Macgregor Peak, Maclaines Creek, Mother Browns Bonnet, Mt Walter, Ravens Hill, Sand R., Sandspit R., Sheepdip Creek and Three Thumbs.

Diagnosis. Differs from other *Dasystigma* in its slender, upright femoral process with a small mesal spike, from *D. huonense* and *D. tyleri* in having posterior spiracle on diplosegments located above anterior leg, and from *D. tyleri* in having large spiracles (unusually large for dalodesmids) with much greater spiracular "hairiness."

Description. As for the genus except in the following details. Both spiracles on diplosegments (Fig. 5A) positioned over anterior leg, hair-like structures emergent from spiracles and apparent at low magnification, spiracles unusually large for a dalodesmid. Paranotal margin very slightly convex; posterior corner projected caudad (Fig. 3A). Gonopod telopodite (Figs 6, 7) with prefemoral process narrowing slightly distad, apex curving caudad, with 2 teeth on lateral edge near apex and single tooth on mesal edge more proximad. Femoral process projecting parallel to prefemoral process and terminating just proximal to flexed apex of latter. Femoral process a narrow, somewhat flattened rod with a few, minute terminal teeth, a small, slender spike arising at about three-quarters of process length and projecting mesad.

Distribution and macrohabitat. Common in dry and wet eucalypt forest over c. 2000 km^2 in south-eastern Tasmania, from Campania east to Maria I. and from the Forestier Peninsula north to the Little Swanport River valley (Fig. 14); c. 100–600 m elevation.

Etymology. In honour of the Tasmanian malacologist Kevin J. Bonham, a very talented collector whose "bycatch" of millipedes nearly always contains specimens of interest.

Remarks. D. bonhami varies little in size and form across its range. However, even syntopic adults differ considerably in the depth of dorsal body coloration, with some pale and others honey- or chestnut-coloured.

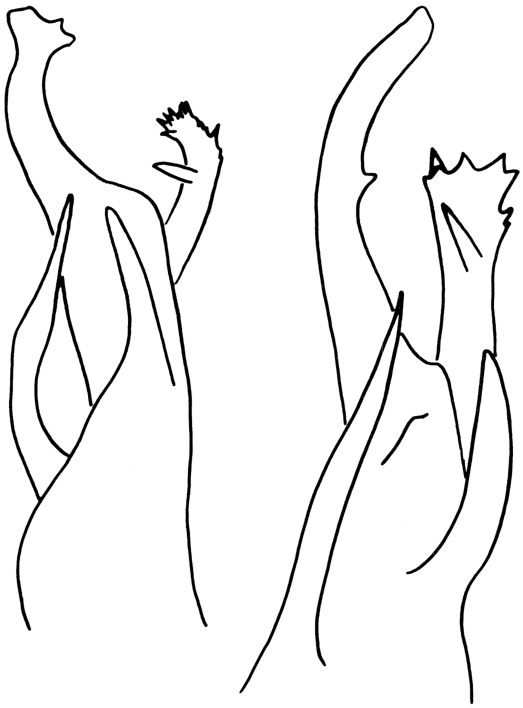

Figure 11. *Dasystigma margaretae* (Jeekel, 1984) comb. nov. Approximately mesal views of left gonopod telopodite of (left) Lake Augusta male paratype (DPI-NT) 19A17 and (right) Tarraleah male ("Derwent form"), QVM 23:15203. Setation not shown.

Dasystigma huonense sp. nov.

Figures 3B, 5B, 8, 9, 14 (map)

Material examined. Holotype. Male, Australia, Tasmania. Edwards Rd, DN797310 (43°04´23´´S 146°45´02´´E), 110–130 m, 15 Mar – 6 Apr 1988, R. Mesibov, QVM 23:41728.

Paratypes. 3 males, details as for holotype, QVM 23:15195; 1 male, Huon R. (Arve Rd), DN788280 (43°06´00´´S 146°44´22´´E), 150 m, 22 May 1997, R. Mesibov, plot 3M5, QVM 23:40805; 1 female, Huon R. (Manuka Rd), DN769286 (43°05´41´´S 146°42´58´´E), 100 m, 29 Apr 1997, R. Mesibov, plot 1R4, QVM 23:40800; 2 males, Coopers Creek, DN507635 (42°46´45´´S 146°23´50´´E), 460 m, 23 Feb 1994, R. Mesibov, AM KS85096 (formerly QVM 23:15199); 1 male, Picton Valley, DN737146 (43°13´14´´S 146°40´34´´E), 300 m, 15 Jul 1994, K. Michaels, pitfall collection, NMV K-8806 (formerly QVM 23:21294).

Other material. 13 males, 18 females and 18 juveniles from 22 unique localities including Collins Cap, Coopers Creek, the Huon/Picton Rivers junction, the Huon R. crossing on the Port Davey track, Lake Sydney, Mt Mangana and Mt Tobin (Bruny I.), Mystery Creek Cave environs, Palmers Lookout, Picton R., South Cape Bay, Waterfall Bay and Arve, Edwards and Manuka Rds in the vicinity of Tahune Bridge on the Huon R.

Diagnosis. Differs from other *Dasystigma* in the sinuous curve of lateral edge of prefemoral process and corresponding curvature of apposed femoral process; from *D. bonhami* and *D. margaretae* in having posterior spiracle on diplosegments located between anterior and posterior legs; from *D. tyleri* in lacking a toothed anterior margin on femoral process and in closer spacing of spiracles on diplosegments, spiracles being larger than those in *D. tyleri* (or in other dalodesmids).

Figure 12. *Dasystigma tyleri* sp. nov. Gonopods in situ. Scale bar = 0.5 mm. Wedge Inlet male, QVM 23:24953.

Description. As for the genus except in the following details. Posterior spiracle on diplosegments (Fig. 5B) between anterior and posterior leg, hair-like structures emergent from spiracles; spiracle 'hairiness' and separation of spiracles both apparent at low magnification, spiracles unusually large for a dalodesmid. Paranotal margin slightly convex; posterior corner projected caudad and slightly laterad (Fig. 3B). Gonopod telopodite (Figs 8, 9) with prefemoral process narrowing slightly distad and strongly flattened anterioposteriorly, the apex broadly rounded with a small terminal notch, mesal edge of prefemoral process straight, lateral edge sinusoidal, convex near apex with a small tooth projecting caudad. Femoral process curving mesad in parallel with concavity on lateral edge of prefemoral process, and terminating about halfway between thickened uncus and apex of prefemoral process. Femoral process flattened with a few, minute terminal teeth, a short thick spike arising at about three-quarters of process length and projecting mesad and distad.

Distribution and macrohabitat. In wet eucalypt forest and rainforest over c. 6000 km^2 in southern Tasmania including South Bruny I., from Tasman Peninsula south to South Cape and west to the vicinity of Lake Pedder (Fig. 14); from near sea level to c. 700 m elevation.

Etymology. After the Huon River in southern Tasmania.

Remarks. *Dasystigma huonense* varies very little in size and form across its range. Adult colour varies considerably, from very pale yellow-brown to deep chestnut brown.

Dasystigma margaretae (Jeekel, 1984) comb. nov.

Figures 1, 3C, 3D, 4, 5C, 5D, 10, 11, 14 (map)

Lissodesmus margaretae Jeekel, 1984: 99.

Material examined. Holotype and paratypes. Australia, Tasmania. "Lake Augusta, 25.IV.1979 [on cushion plant] 25 April 1979, Tasmanian Department of Agriculture 19A17, holotype, 6 , 1 ♀ (fragm.), 2 juv. ♀ (19 somites), 1 juv. ♀ (18 somites) paratypes" (Jeekel, 1984: 99). When I inspected the type-containing vial in 2001, I found two cotton-plugged genitalia tubes and (under a cotton pad) a number of body fragments. The genitalia tubes contained the male holotype and the fragmented mature female paratype, respectively, both in good condition. After removing a paratype male segment 7 for SEM examination, I placed the remaining body fragments in a small cotton-plugged glass tube. The three tubes and all accompanying labels were then sealed in an alcohol-filled McCartney vial for continuing storage at the New Town Laboratories of the Tasmanian Department of Primary Industries, Water and Environment (formerly the Department of Agriculture).

Other material. 97 males, 66 females and 72 juveniles from 52 unique localities including Alberts Marsh, Anglers Creek, Blackman R., Blue Tier Creek, Boyer, Brumbys Creek, Butlers Gorge, Coal Marsh, Coles Creek, Dromedary Creek, Fingal Tier, Flexmore Creek, Florentine R., Gulf Creek, Halls Creek, Lake Dobson, Liawenee, Little Florentine R., Lookout Hill, Lost Falls, Meehan Range, Mossy Marsh Creek, Mt Mismanagement, Native Tier, Old Mans Head, Pinnacles Creek, R. Dee, Rocka Rivulet, Sassafras Hill, St Pauls Dome, Tarraleah, Tiger Creek, Tooms Lake, Tooms White Gum Reserve and Yangena Hill.

Diagnosis. Differs from *D. bonhami* in having a broader, more flexed and more prominently toothed femoral process; from *D. huonense* and *D. tyleri* in having the posterior spiracle on diplosegments located above the anterior leg; from *D. tyleri* in having much "hairier" spiracles, spiracles also being larger than those in *D. tyleri* (or in other dalodesmids).

Description. As for the genus except in the following details. Both spiracles on diplosegments (Fig. 5C) positioned over anterior leg, hair-like structures emergent from spiracles and apparent at low magnification, spiracles unusually large for a dalodesmid. Paranotal margin slightly convex; posterior corner variably projected (Figs 3C, D; see *Remarks*). Gonopod telopodite (Figs 10, 11) with prefemoral process bent mesad, sharply narrowing distad, apex curving caudad, apical edge slightly serrulate, a single tooth on mesal edge of process at about three-quarters of process length. Femoral process curving caudad and mesad and terminating just proximal to level of tooth on mesal edge of prefemoral process. Femoral process massive, divided into a broadly cuneate anterior portion and a posterior spike; distal and posterior margin of cuneate portion with numerous heavy teeth, spike crossing below cuneate portion in manner of a thumb bent slightly towards palm.

Distribution and macrohabitat. Common in dry and wet eucalypt forest and in subalpine woodland over c. 12 000 km^2 in eastern and central Tasmania (Fig. 14), from the south side of the Fingal Valley south to the north side of the Little Swanport R. valley, and from near the east coast west to the Little Florentine R.; so far known at altitudes c. 100–1100 m elevation. Locally abundant in places in the Eastern Tiers, on the eastern fringe of the Central Plateau and in wet forests in the Derwent valley.

Remarks. Jeekel (1984) gave a complete description of this species from the type locality, Lake Augusta on Tasmania's Central Plateau; for the sake of consistency I have included my own summary. This taxon is the most variable within

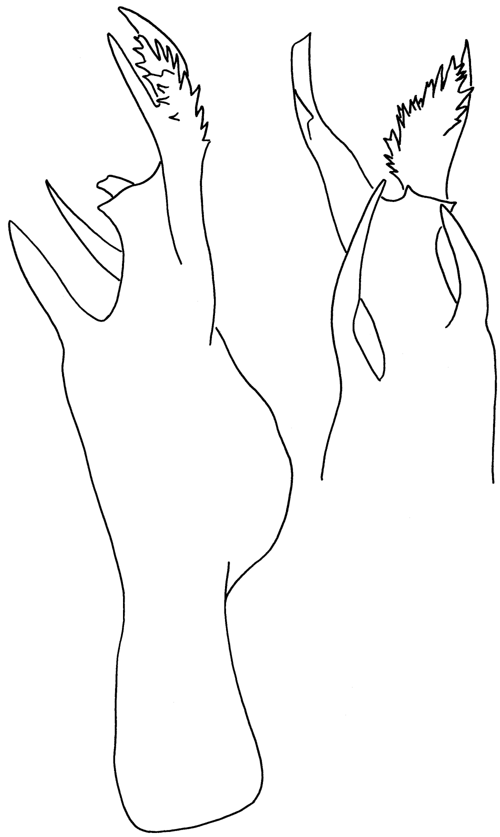

Figure 13. *Dasystigma tyleri* sp. nov. Approximately lateral (left) and mesal (right) views of left gonopod telopodite of Franklin R. male, QVM 23:15189. Setation not shown.

Dasystigma. The prefemoral process is straighter and narrower in the eastern portion of the range (Fig. 10A) than in the west (Fig. 10B) and the femoral process less bent mesad. A distinctive variant, here called the "Derwent form," is restricted to the valley of the Derwent R. (Fig. 14), where it replaces more typical *D. margaretae*. In the "Derwent form" the spiracles are somewhat less "hairy" (Fig. 5D) and the prefemoral process somewhat broader (Figs 10C, 11). The most striking difference, however, is in the form of the paranota: the margins have moved ventrad relative to those in typical *Dasystigma* and the posterior corners are very strongly projected caudad and laterad (Fig. 3D). In future, genetic data may justify the erection of a new species for this geographically and morphologically distinctive variant. I am reluctant at this time to name the "Derwent form" formally, as it differs less from more typical *D. margaretae* in gonopod details than do the three forms recognised here as new species.

Dasystigma tyleri sp. nov.

Figs 3E, 5E, 12, 13, 14 (map)

Material examined. Holotype. Male, Australia, Tasmania. Donaghys Hill, approx. DP120270 (42°12´S 145°56´), 480 m, 29 Apr 1987, N. Platnick, R. Raven and T. Churchill, QVM 23:41729.

Paratypes. 1 male, Little Florentine R., DN525683 (42°44´10´´S 146°25´10´´E) 440 m, 2 Dec 1986, R. Bashford, QVM 23:40796; 1

male, Trackham Creek, CQ822092 (41°27´36´´S 145°35´22´´E), 630 m, 28 Oct 1991, R. Mesibov, QVM 23:15180; 1 female, Wedge Inlet, DN379569 (42°50´16´´S 146°14´24´´E), 350 m, pitfall emptied 16 Nov 2001, D. Driscoll, sample EY4-75, QVM 23:24954.

Other material. 16 males, 4 females and 9 juveniles from 23 unique localities including Acheron Cave environs, Algonkian Mountain, Dismal Creek, Dohertys Range, Franklin R., Goderich Rd, Gordon R., Hardwood R., Hermit Hill, Laughing Jack Lagoon, Little Florentine R., Loddon R., Mt Rufus, Olga R., The Clump, Trackham Creek, Wakefield Creek, Wedge Inlet and White Spur.

Diagnosis. Differs from other *Dasystigma* in having a heavily toothed femoral process with teeth on anterior margin and small spiracles with no "hairiness" visible at low magnification, with posterior spiracle located just anterior to posterior leg on diplosegments.

Description. As for genus except in following details. Posterior spiracle on diplosegments (Fig. 5E) positioned just anterior to posterior leg and very clearly separated from anterior spiracle; hair-like structures only just emergent from spiracles, not apparent at low magnification; spiracles of size typical for dalodesmids. Paranotal margin slightly convex; posterior corner projected caudad and slightly mesad (Fig. 3E). Gonopod telopodite (Figs 12, 13) with prefemoral process narrowing sharply distad, truncated apex curving caudad and shallowly notched; on posterior surface a small tooth near apex; uncus apparently bifid, with second, caudally projected tip arising from its lateral edge. Femoral process arising in small depression on lateral surface of telopodite, projecting distad and slightly mesad. Femoral process massive, divided into broadly lanceolate anterior portion and robust posterior spike; entire margin of lanceolate portion with numerous heavy teeth, spike extending just past most distal teeth and nearly reaching as far distad as apex of prefemoral process.

Distribution and macrohabitat. An uncommon species in rainforest and wet eucalypt forest over c. 11 000 km² in western Tasmania, from Lake Pedder north to Balfour in a band 70–90 km wide extending inland from the west coast (Fig. 14); c. 50–1000 m elevation.

Etymology. In honour of the Australian limnologist Peter A. Tyler, whose investigations in Tasmania led to the recognition of the biogeographic divide known as Tyler's Line.

Remarks. There is little morphological variation over the *D. tyleri* range, but mature specimens tend to be somewhat larger and more heavily pigmented in northwest Tasmania than in the Southwest.

***Dasystigma* sp.**

A number of female and juvenile specimens cannot yet be assigned with confidence to any of the named species; this unidentified material is shown as "*Dasystigma* sp." in the specimen data table and the distribution map (Fig. 14). Males from Little Quoin (Yarlington Tier) seem closest to *D. huonense*, yet this locality, an isolated forest fragment, lies between the ranges of *D. bonhami* and *D. margaretae*. The Little Quoin and Boyd R. material includes DNA vouchers in absolute ethanol, and genetic analysis can be used in future to clarify taxonomic placement.

Biogeography and conservation

Where species of *Dasystigma* are not locally abundant, they can be hard to find and it has so far not been possible to map range boundaries on as fine as scale as has been done for other Tasmanian dalodesmids (Mesibov, 1997, 1999). It seems likely, however, that the apparently narrow parapatric boundary between *D. tyleri* and *D. margaretae* in western Tasmania (Fig. 14) is congruent with Tyler's Line (Mesibov, 1994), a major biogeographic divide in Tasmania which is also commonly a species boundary for millipedes. An uncertain divide in eastern Tasmania is the one between *D. bonhami* on Forestier Peninsula and *D. huonense* on Tasman Peninsula (Fig. 14); it is not yet known whether the two species meet in parapatry on one or the other of the peninsulas, or are separated by the narrow strip of interpeninsular land (Eaglehawk Neck). Also uncertain is the gap between *D. bonhami* and *D margaretae* in the valley of the Little Swanport River. The upstream portion of the valley now carries agricultural grassland and is unsuitable *Dasystigma* habitat, and access difficulties have so far limited sampling in the woodlands on the lower portion of the river. The nearest currently known localities for *D. bonhami* and

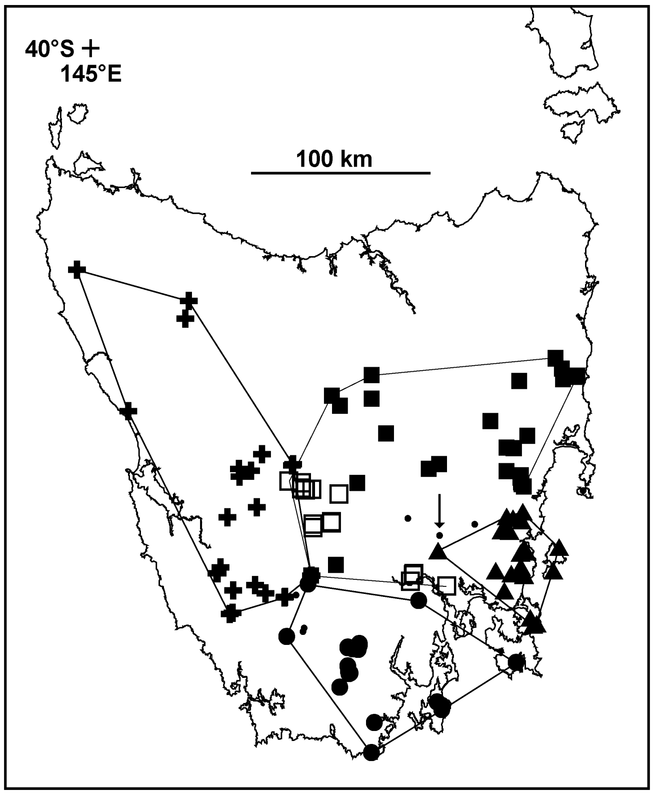

Figure 14. Known localities (to Jun 2002). *Dasystigma bonhami* sp. nov., ▲. *D. huonense* sp. nov., ●. *D. margaretae* (Jeekel, 1984) comb. nov., ■. *D.margaretae* (Jeekel, 1984) comb. nov. "Derwent form", □ *D. tyleri* sp. nov., +.Unidentified *Dasystigma* species, •. Polygons have been drawn through outermost known localities of each of the four named species to more clearly delineate the species ranges. Arrow marks Little Quoin (see text).

D margaretae are 14 km apart. About 12 km currently separates the nearest localities for *D. huonense* and *D. margaretae* ("Derwent form") across the Derwent River valley just downstream from New Norfolk. Forest in this portion of the Derwent valley has been largely cleared or degraded, and a search for evidence of *D. huonense/D. margaretae* overlap should begin much further up the Derwent system; the two species have been collected only 5 km apart just west of Maydena. Another mapping exercise for the future is documentation of the apparent parapatry (Fig. 14) between the typical and "Derwent" forms of *D. margaretae*.

Dasystigma bonhami, D. margaretae (all known variants) and *D. huonense* are often locally abundant and are found in formal State reserves. Much of the range of the less common *D. tyleri* is formally reserved, notably in national parks. The three eastern species have all been found in logged and regenerated native forest, including older regrowth (20+ years) from clearfall-and-burn operations. For evolutionary studies and for clarification of taxonomic boundaries it would be worthwhile to seek special, conservative management for public land forest patches in which different forms meet in narrow parapatry, and the author hopes to identify suitable patches in the near future.

Acknowledgements

I am grateful to the Plomley Foundation for financial assistance; to David Steele (University of Tasmania) for acquiring the SEM images; to Graeme Anderson and Owen Seeman (Department of Primary Industries, Water and Environment, Tasmania) for access to the *L. margaretae* types; to Graham Compton (CSIRO Entomology) and Dennis Black (La Trobe University) for access to ANIC material; and to Kevin Bonham and my wife Trina Moule for assistance in collecting *Dasystigma* specimens.

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