



The megisthanid mites (Mesostigmata: Megisthanidae) of Australia

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Abstract

The Australian Megisthanidae are revised, resulting in the description of five new species from passalid beetles (Coleoptera: Passalidae) in Queensland: *M. manonae* **sp. nov.** from *Mastachilus australasicus*; *M. simoneae* **sp. nov.** from *Mastachilus polyphyllus*; *M. southcotti* **sp. nov.** from *Aulacocyclus fracticornis*; *M. womersleyi* **sp. nov.** from *Protomo-coelus australis*; and *M. zachariei* **sp. nov.** from *Aulacocyclus kaupii*. *Megisthanus womersleyi* is also based on material from Misima Island, Papua New Guinea, originally identified as *Megisthanus doreianus* Thorell, 1882. *Megisthanus modestus* Berlese, 1910, is redescribed based on material from *Pharochilus* spp. collected from Canberra, New South Wales, Queensland and Tasmania. The Papua New Guinean species *Mastachilus papuanus* Womersley, 1937 is diagnosed and discussed in relation to the other species from New Guinea. Additional collections of *Megisthanus leviathanicus* Seeman, 2017 and *M. thorelli* Womersley, 1937 are also reported. A genus description and a key to the eight Australian species of *Megisthanus* are provided.

Key words: Acari, Antennophorina, Passalidae, host associations, taxonomy, new species, identification

Introduction

Megisthanid mites are the largest of all Mesostigmata, with idiosomal lengths reaching 3.75 mm and body lengths of 5 mm (Seeman 2017). Twenty-six species are described, all in *Megisthanus* Thorell, 1882 (Seeman 2017). Adult males and females ride on adult passalid beetles (Coleoptera: Passalidae), which live as subsocial colonies built within rotting logs. The mites do not feed from the beetle, but scavenge and prey upon small arthropods (Butler &

Hunter 1968; pers. obs.). Their immature stages are not found on beetles, but likewise are scavengers and predators (Butler & Hunter 1968; pers. obs.). Of the 26 species, only five have had their host beetles identified, making their degree of host specificity uncertain (Seeman 2017).

The family has received little attention, with most species described > 100 years ago. Despite their size, species identification is difficult. In part, this is due to the rudimentary nature of many descriptions, but Seeman (2017) also identified two major types of intraspecific variation. Firstly, adults add significant amounts of secondary cuticle around their dorsal shields as they age; and secondly, males present a major form—with smooth dorsal shields due to extreme reduction of dorsal setae—and a minor form, with long dorsal setae similar to the female. Due to this variation, a single beetle can appear to have multiple species of *Megisthanus*, and past collectors have described these morphs as separate species. Such an example is *M. caudatus* Thorell, 1882, which was described as three species: a young female (*M. caudatus*), an older female with secondary sclerotisation (*M. brachyurus*) and the male (*M. testudo*).

The Australian fauna comprises three described species: *Megisthanus leviathanicus* Seeman, 2017, *Megisthanus modestus* Berlese, 1910 and *Megisthanus thorelli* Womersley, 1937. *Megisthanus modestus* has not been recollected since Berlese (1910) and its description is so brief that it could apply to many species of Megisthanidae. In contrast, *M. leviathanicus* is readily found on the large passalid beetle *Mastachilus australasicus* Percheron, 1841 in northern Queensland, and *M. thorelli* is the most common species found in southeast Queensland, where it is found on *Megisthanus quaestionis* (Kuwert, 1891) and *Pharochilus dilatatus* (Dalman, 1817) (Seeman 2002, 2017). Herein, I describe five new species of *Megisthanus* from various species of passalid beetle and review the species from Australia and New Guinea.

Materials and methods

Mites were collected, preserved and examined as per Seeman (2017). Measurements are presented in millimetres (body size) or micrometres (all measurements not indicated are in μm) as ranges; for some structures, the holotype measurement is provided first. Idiosomal and body size was rounded to the nearest 0.05 mm and was measured from intact and dissected specimens; structures measured at $\times 100$ and $\times 200$ are rounded to the nearest 10 and 5 μm , respectively. Photographs of slide-mounted specimens were taken with a Nikon™ DSFi1 camera attached to a Nikon™ Eclipse 80i compound microscope, except those in ethanol (Fig. 19), which were taken with a Visionary Digital™ BK+ system. Photographs based on two or more layers were focus stacked with Zerene Stacker™ (<http://zerenesystems.com/cms/stacker>).

Beetles were identified with the aid of Dibb (1938) and Seeman (2002). Terminology for the morphology of the gnathosoma follows Gorirossi & Wharton (1953) and Bourdeau-Gorirossi (1989). Leg chaetotaxy follows Evans (1963a). The previously described species of *Megisthanus* are dealt with first, in alphabetical order, followed by the new species, in alphabetical order.

Abbreviations for collections: ANIC (Australian National Insect Collection, Canberra); SAM (South Australian Museum, Adelaide); QM (Queensland Museum, Brisbane, Australia). “National Park” is abbreviated as NP throughout the manuscript.

Results

Megisthanus Thorell, 1882

Megisthanus Thorell, 1882: 48.

Type species: *Megisthanus caudatus* Thorell, 1882, by original designation.

Diagnosis. As per Seeman (2017).

Description. Female. Colour orange-brown or dark brown; large, idiosomal length 1.9–3.75 mm.

Dorsum. Dorsal shield ovate (most species; Fig. 1A), strongly tapered posteriorly (*M. caudatus*) or lyriform (*M. jacobsoni* Warburton, 1926, *M. leviathanicus*, *M. manonae* **sp. nov.**; Fig. 6A); secondary sclerotisation absent (Fig. 1B) or present (Fig. 1A), added progressively during adult stage; hypertrichous, sometimes heterogeneous in

setal form and length (Fig. 11). Soft cuticle with numerous setae, which may be on small platelets. Lyrifissures absent or unapparent. Sigillae often in four paired groups (anteromedially two pairs; medially one pair K-shaped sigillae; posteromedially one pair) and one unpaired sigillum posteriorly.

Venter. Tritosternal base elongate, just over twice as long as wide, laciniae pilose, at least twice as long as base (Fig. 1C). Presternal region membranous, paired presternal shields reduced to anterior, weakly sclerotised strap-like shields; setae st1 flanking tritosternum, positioned on more sclerotised, medial margin of each presternal shield. Sternal shield with 2–3 pairs of setae (st4 present or absent/displaced posteriorly to hypertrichous region of shield); fused to endopodal and ventral shield laterad sternogynal shields (Fig. 3A).

Genital opening with strongly thickened margin laterally and posteriorly. Sternogynal shields separate or weakly fused posteriorly, with strongly thickened posterior margin, each shield bearing one pair of lyrifissures and zero to seven setae; shields triangular (Fig. 3A) or medial margins eroded, forming C-shaped shields (Fig. 17A). Internal genitalia variable between species, but always comprising pyriform, free vaginal heads and a V- or U-shaped structure with medial porose areas (possibly derived from vaginal arms, which are fused posteromedially; Fig. 3C). Other elements possibly derived from external genitalic elements: a small medial mesogynal shield usually present, fused anteriorly with thickened posterior margin of genital opening and sometimes fused with vaginal arms posteriorly (Fig. 3C); latigynal element usually highly reduced or absent, but sometimes well developed (e.g., *M. leviathanicus*, *M. manonae* **sp. nov.**; Fig. 7B). Membranous sac extends posteriorly from genital opening (Fig. 1D).

Ventral shield long, narrows medially at level of coxa IV, somewhat expanded posteriorly; with several pairs of setae around shield margin, usually with additional setae within shield margin (Fig. 13A). Endopodal shield free from ventral shield and peritrematal-metapodal-exopodal shield. Ventrianal shield (Fig. 13C) free from ventral shield, rounded, subtrapezoid to subtriangular, posterior margin straight or curved; bearing several pairs of setae and pores; lyrifissures appear absent, possibly difficult to distinguish from other pores. Opisthogastric and lateral soft cuticle with several setae on small platelets.

Peritreme extends to coxa I (Fig. 1C); peritrematal shield broad, connected to dorsal shield anteriorly, extending posteriorly into metapodal region and fused with endopodal shields; anterior margin of peritrematal shield with three pairs of long barbed setae.

Gnathosoma. Gnathotectum triangular, reticulate, with strong keel. Subcapitulum with h1, h2, h3, and palpcoxal setae in usual arrangement (Fig. 4A). Subcapitular gutter with five rows of rudimentary fine denticles; anterior subcapitular gutter (between setae h1 and h3) flanked by longitudinal row of tiny denticles. Five processes discernible from tip of hypostome: labrum with distal part sparsely barbed, terminating in forked tip; paired hypopharyngeal processes with fringed edges; and paired broad hypostomal processes, hyaline proximally, each with medial bushy extension. Corniculi large, often with medial tooth (Fig. 4A). Palp with usual setation for Antennophorina (Evans 1963b); trochanter with ventro-distal spur, femur with tiny distal spur.

Chelicerae. Large, heavily sclerotised, denticulate, with numerous lobes and excrescences as shown in Seeman (2017). Fixed digit with 10–17 teeth; cheliceral seta scale-like, hyaline; arthrodistal process a proximal lobe and distal corona of cilia; adaxial surface with several smooth lobes proximally, and several fringed lobes dorso-proximally, fringed lobes coalesce distally into a ciliate membranous process that extends just past cheliceral tip; dorsally, ciliate process overlapped by lobe of fixed digit; pilus dentilis not apparent (possibly extraordinarily modified into ciliate process). Movable digit with 8–13 teeth; proximal part with small ventral fringe of cilia; medial part with three long dendritic excrescences (Fig. 16D); one complex, folded fringed excrescence arises from base of distal dendritic excrescence, extending past tip of movable digit.

Legs. Leg I without claws or ambulacrum. Setal counts for legs I–IV (coxa to tarsus): 2–6–12–12–13–42, 2–5–10–12–10–19; 2–5–7–10–9–19; 1–5–8–10–10–21. Femora I–IV (2, 2/2, 2/2, 2), (2, 2/1, 2/2, 1), (1, 2/1, 2/1, 0), (1, 3/1, 2/1, 0); genua I–IV (1, 3/2, 3/1, 2), (2, 3/1, 3/1, 2), (2, 3/1, 2/1, 1), (2, 3/1, 3/0, 1); tibia I–IV (3, 3/2, 1/2, 2), (2, 2/1, 2/1, 2), (2, 2/1, 2/1, 1), (2, 2/2, 2/1, 1). Setae not highly modified: several barbed and/or thickened, especially dorsal setae on femur II–IV; and several dorsal setae much longer than others. Ambulacra II–IV with slender seta-like paradactyli. Coxa I with two posterolateral distal spines; trochanter I with small distal spine; trochanter II with large distal spine; femur II with small ventral, distal spur; femur III often with distal spur; trochanter IV with large distal spine; femur IV with three ventro-distal spurs and with (Fig. 17D) or without (Fig. 3E) dorsal projections bearing setae pd2; setae ad2 on small or rudimentary projection; seta ad3 on small to large proximal projection.

TABLE 1. Selected morphometric measurements for the Australian species of Megisthanidae. Atypical abbreviations: go, genital opening; pps, post-peritrematal shield; sg, sternogynal shield.

	<i>leviathanicus</i>	<i>manonae</i>	<i>modestus</i>	<i>simoneae</i>	<i>southcootti</i>	<i>thorelli</i>	<i>womersleyi</i>	<i>zacharieti</i>
Females								
Dorsal shield (l x w)	2.75-3.40 x 1.15-1.35 mm	2.55-2.80 x 1.35-2.0	1.80-2.15 x 0.90-1.15	2.30-2.65 x 1.60-2.20	1.80-2.05 x 0.85-1.05	1.95-2.30 x 0.90-1.05	2.50 x 1.40	2.20 x 1.15
st1	165-205	130-170	115-180	130-180	135-155	155-170	no data	135
st2	150-180	115-160	80-135	65-105	100-110	110-130	100	100
st3	120-130	90-105	35-75	60	75-95	70-85	100	80
st4	absent	absent	15-40	absent	absent	absent	55	absent
go (l x w)	345-405 x 365-415	300-310 x 240-250	270-305 x 325-340	235-260 x 275-290	255-265	265-280 x 305-325	260 x 320	305 x 340
Anterior sg seta	80-90	55-75	15-27	40-50	85-110	40-65	20-25	35
Posterior sg setae	30-45	20-45	15-27	10-40	50-65	15-35	20-25	20-30
Ventral shield (l x w)	940-1130 x 295-410	830-920 x 275-290	750-850 x 310-400	710-870 x 350-420	725-820 x 340-370	780-900 x 310-375	1040 x 430	880 x 420
Ventrianal shield (l x w)	475-590 x 445-550	390-440 x 435-470	310-355 x 400-530	295-395 x 450-540	315-370 x 530-570	320-360 x 470-575	400 x 600	380 x 620
Pps shield length	720-880	620-670	390-520	385-450	450-520	440-520	760	530
h1	305-330	275-280	240-275	230-265	230-250	255-270	285	260
h2	170-205	150-175	140-165	145-170	150-160	160-180	180	145
h3	290-340	225-300	240-270	275-300	235-250	300-320	no data	240
pc	195-235	175-185	165-175	165-180	135-150	170-200	175	185
corniculi	275-310	250-265	235-270	235-265	230-255	250-280	265	250
Major males								
Dorsal shield (l x w)	2.95-3.55 x 1.60-2.00 mm	3.05 x 1.85	2.10-2.45 x 1.25-2.45	2.30-2.40 x 1.35-1.45	1.95-2.20 x 1.40-1.60	2.25-2.90 x 1.20-1.75	2.90 x 1.75	2.50 x 1.70
Ventrianal shield (l x w)	410-475 x 650-740	395 x 575	300-330 x 550-645	300-310 x 545-560	300-365 x 585-660	290-370 x 520-700	500 x 660	355 x 600
Modified ventral setae	160-215	80	65-80	85	40-50	120-160	50	no data
h1	275-310	225	220-240	205	200-215	250-305	250	200
h2	180-210	155	150-165	170	125-155	175-205	140	180
h3	335-375	190	240-265	275	210-215	285-325	215	180
pc	230-275	205	180-190	210	150-160	210-225	170	180
corniculi	470-560	390	350-390	350-360	365-385	330-460	410	195

Male (major). Similar in size to female or sometimes much larger than female. Idiosomal length 1.70–3.95 mm, body length (including gnathosoma, to tip of gnathotectum) reaching 5.05 mm. *Dorsum*. Dorsal shield ovate and appearing bare (setae greatly reduced), sometimes with short setae near margins; secondary sclerotisation similar to female. Soft cuticle around shield with small setae. Sigillae similar to female or more extensive, with two anterior pairs, and mid-lateral and mid-posterolateral sigillae merged, plus unpaired caudal sigillum.

Venter. Presternal area similar to female. Genital opening circular, positioned between coxae III (Fig. 3F), surrounded by thickened ring of cuticle that often (possibly always) bears several pores. Sternoventral shield with setae st2–3 anteriorly, setae st4, if present, often difficult to discern among other setae; setation often hypertrichous, especially around genital opening; sternoventral shield with several loosely paired setae around posterolateral margin (Fig. 2B); posteriorly with two discs of porose cuticle bearing an anterior unmodified pair of setae and a highly modified pair of setae centrally: these setae weakly sclerotised, broad, appearing hollow, with flared tip (Fig. 17F). Endopodal shield fused with sternal part of shield just anterior to setae st3, free from ventral shield (Fig. 3F). Ventrianal shield similar to female but sometimes larger. Peritreme and peritrematal shield similar to female.

Gnathosoma. Similar to female, but more robust, hypostomal setae often with fewer barbs or smooth (Fig. 15B). Corniculi larger than female, often lacking medial tooth (Fig. 15B). Palp often with larger spurs than female, sometimes spur on palp genu.

Legs. Similar to female but spurs and spines sometimes larger.

Male (minor): Dorsal shield ovate or, if female with lyriform shield, then shield narrows slightly; secondary sclerotisation present or absent. *Dorsum* hypertrichous, with setal form similar to that of female (Fig. 2C). *Venter* similar to major male, but often smaller structures, especially porose discs on ventrianal shield. *Gnathosoma* similar to major male, except corniculi always retains medial tooth as in female. *Legs* similar to male.

Remarks. The above description is based mostly on the Australian species, but also *Megisthanus floridanus* Banks, 1904 and *Megisthanus papuanus* Womersley, 1937, for which specimens were examined. Information from published descriptions was also referred to, but only those that have sufficient and reliable detail in their descriptions. These are: *Megisthanus afer* Stoll, 1897; *Megisthanus berlesei* Hunter & Costa, 1970; *Megisthanus caudatus* Thorell, 1882; *Megisthanus doreianus* Thorell, 1882; *Megisthanus gigantodes* Stoll, 1893; *Megisthanus hatamensis* Thorell, 1882; *Megisthanus jacobsoni* Warburton, 1926; *Megisthanus moaifensus* Oudemans, 1905; *Megisthanus obtusus* Kramer, 1894; *Megisthanus orientalis* Oudemans, 1905; *Megisthanus postsetosus* Karg, 1997; and *Megisthanus remilleti* Hunter & Costa, 1970. Although the descriptions of Oudemans (1905) are rudimentary, the illustrations can be found at the Wikimedia Commons for the Oudemans Mite Collection: https://commons.wikimedia.org/wiki/Category:Oudemans_Mite_Collection_at_Naturalis_Biodiversity_Center

***Megisthanus leviathanicus* Seeman, 2017**

Megisthanus leviathanicus Seeman, 2017: 3 (online edition)

Material examined. In addition to those listed in Seeman (2017): **Australia**, Queensland, ex passalid: 1 female, Atherton Tableland, 21.iii.1945 (J17327). 2 males, Atherton Tableland, 28.iii.1945 (J17314; J17315–16, chelicerae on separate slide). No host given: 1 female, 2 males, dorsum and chelicerae of another male specimen, Eubenangee, 11.xii.1949, D.C. Brooks (J17318–23, J17358–61). All in SAM.

Diagnosis: see Seeman (2017).

Remarks. *Megisthanus leviathanicus* belongs to a small group of species that have females with tapering or lyriform dorsal shields. The only other similar species are *M. caudatus*, *M. jacobsoni* and *M. manonae* **sp. nov.** The former two species are highly distinctive in also having an elongate, hourglass-shaped ventrianal shield, which *M. leviathanicus* and *M. manonae* lack. *Megisthanus leviathanicus* and *M. manonae* are separated based on the shape of the female's body setae (see the differential diagnosis for *M. manonae*).

***Megisthanus modestus* Berlese, 1910**

Figures 1–4

Megisthanus modestus Berlese, 1910: 377.

Material examined. **Australia, Queensland**, ex *Pharochilus scutellonotus* Kuwert, 1898. 1 female, Lamington NP, Box Forest Circuit, 13.ii.1996, O. Seeman, ex beetle #298 (QMS 109449). 1 female, same data except beetle #299 (QMS 109450). 1 female, 1 major male, same data as except beetle #311 (QMS 109451–2). 1 female, 1 minor male, Main Range NP, 11.ii.1996, O. Seeman, ex beetle #177 (log 3, passalid 1) (QMS 109453–4). In QM. **Australian Capital Territory**, Canberra, ex passalid. 1 female, 21.ix.1941, A. Shepherd, RL105 (J17305). **Tasmania**, ex passalid. 1 female, Launceston, 15.i.1925, V.V.H. (J17301–2), in poor condition (originally identified as *M. doreianus*). **New South Wales**: ex *Pharochilus dilatatus*. 1 female, 1 male, Glen Innes, 29°44'S 151°44'E, 9.x.1966, G. Bornemissza (J17380). ex *Pharochilus rugiceps* (Hope & Westwood, 1845). 3 females, 1 male, University of Western Sydney, A. Katlav, 25.xii.2017 (QMS 109445–8). No host given. 1 female, Upper Williams River, N.S.W., Wilson coll., x.1926 (J17336), in poor condition; 1 female, Coonabarabran, 31°16'S 149°17'E, 20.i.1974, G.F. Gross, skeletal knoll, dry forest (J17369). All J-registration numbers in SAM.

Diagnosis. *Female and male.* Sternal setae st4 present. Seta pd2 of femur IV on rudimentary projection. Dorsal shield finely punctate with faint reticulation. Ventrianal shield widest at anterior level of anus. *Female.* Dorsal shield ovate, length 1.80–2.10 mm, maximum width 0.90–1.15 mm, not including secondary sclerotisation. Most dorsal shield setae 250–320 in length, smooth or with few barbs; some marginal setae thicker and longer; podonotum more setose than opisthonotum. Sternogynal shields separate, each bearing 2–6 setae (usually 4–6); internal genitalia with rudimentary latigynal element. Ventrianal shield weakly to moderately reniform. *Major male.* Broader than female, dorsal shield length 2.40 mm, width 1.40 mm, with a few developed setae (up to 75 in length) anteriorly and posteriorly; setae on soft cuticle laterad dorsal shield short, length 40–80; 30 setae around genital opening; corniculi with small to rudimentary medial inner tooth; setae h1, h2 smooth, h3 and palp coxal seta barbed.

Description (based on specimens ex *P. scutellonotus*, Queensland). *Female.* *Dorsum* (Figs 1A–B). Idiosomal length 2.30–2.40 mm, width 1.50–2.10 mm, body length (including gnathosoma, to tip of gnathotectum) 2.90–3.20 mm. Dorsal shield ovate, length 1.80–2.10 mm, width 0.90–1.15 mm; secondary sclerotisation present (Fig. 1A), laterally and posteriorly; maximum length of dorsal shield including secondary sclerotisation 2.15–2.60 mm, width 1.25–1.75 mm. Dorsal shield hypertrichous, especially mid-dorsally, setation sparser posteriorly, at margins and off dorsal shield. Most dorsal shield setae smooth or with few small barbs, length 250–320; anterior and lateral setae similar but longer, and several marginal setae may be thicker, more barbed and longer (up to 500) (Figs 1A–B, 3D). Dorsal shield cuticle finely punctate with faint pattern of reticulation. Setae in soft cuticle with small barbs, on small platelets; setae close to dorsal shield long (300–350), subequal length compared with marginal dorsal setae; some posterolateral setae very long (550–600). Idiosomal pores absent in soft membrane, present on dorsal shield and on small platelets, often associated with setae.

Venter (Figs 1C–D, 3A–C). Setae st1 sparsely barbed, length 160–180. Sternal shield (Fig. 2A) reticulate, with three pairs of setae, 3–6 pairs of pores opening ventrally, without pores opening laterally, and one pair of lyrifissures; setae st2–3 sparsely barbed, st4 smooth, st2 105–125, st3 50–75, st4 25–40; shield medial length 80–85.

Sternogynal shields (Fig. 3A) free posteriorly, genital opening length 285–305, width 325–340, each sternogynal shield length 260–285, weakly lineate-reticulate, each bearing 4–6 setae (asymmetrical) and one lyrifissure; anterior seta similar in form and length to other setae (18–27, smooth). Internal genitalia comprise three obvious elements (*mg*, *va*, *vh*) and rudimentary latigynal (*lg*) elements, which are represented by small porose area on thickened ventral shield margin, near attachment of vaginal arms with sternogynal shield (Figs 3B–C).

Ventral shield (Figs 1C–D) extends 790–850 posteriorly from posterior margin of genital opening; maximum width behind coxa IV 360–400; shield with 11–12 pairs of setae around shield margin (posteriorly sometimes with one of these pairs within shield), no setae within shield close to sternogynal shield; setae often expressed asymmetrically; setae smooth, length 70–140; shield weakly reticulate, mostly appearing smooth.

Ventrianal shield weakly to moderately reniform (Figs 1C–D), anterior width 450 (400–450), maximum width either level with or anterior to anus, 520–575, length 320–355; shield reticulate; 14–16 loosely paired smooth setae, length 50–90.

Peritrematal shield hypertrichous, post-peritrematal region extends 450–520 behind coxa IV into metapodal region (Figs 1C–D); setae laterad legs smooth, length 10–50, those directly above legs III–IV shortest; anterior margin of peritrematal shield with three pairs of long barbed setae, length 260–340.

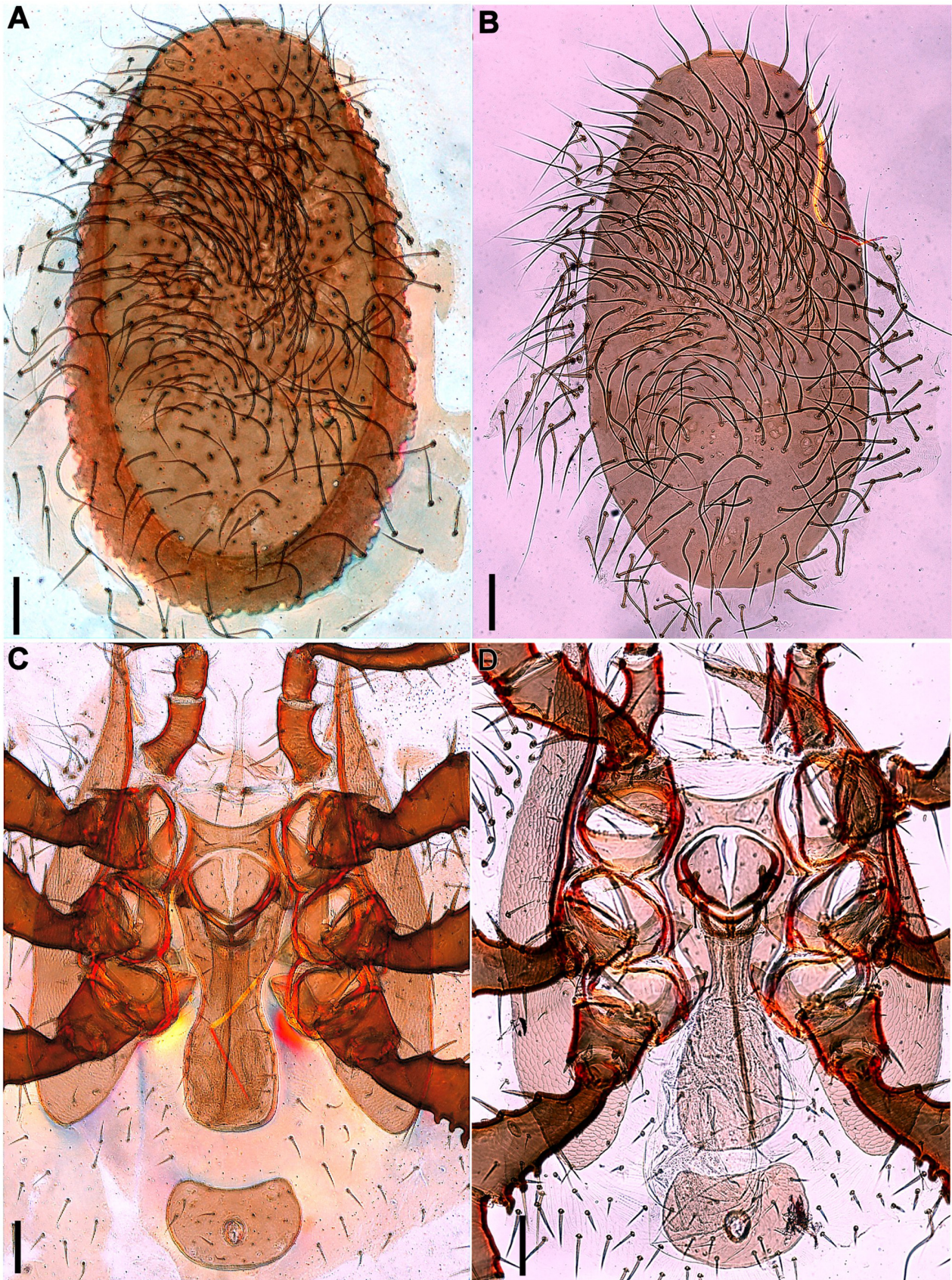


FIGURE 1. *Megisthanus modestus* Berlese, 1910, female, photomicrographs. (A) dorsal shield (secondarily sclerotised), specimen from Lamington NP; (B) dorsal shield (lacking secondary sclerotisation), specimen from Sydney; (C) venter, specimen from Lamington NP; (D) venter, specimen from Sydney. Scale bars = 200 μ m.

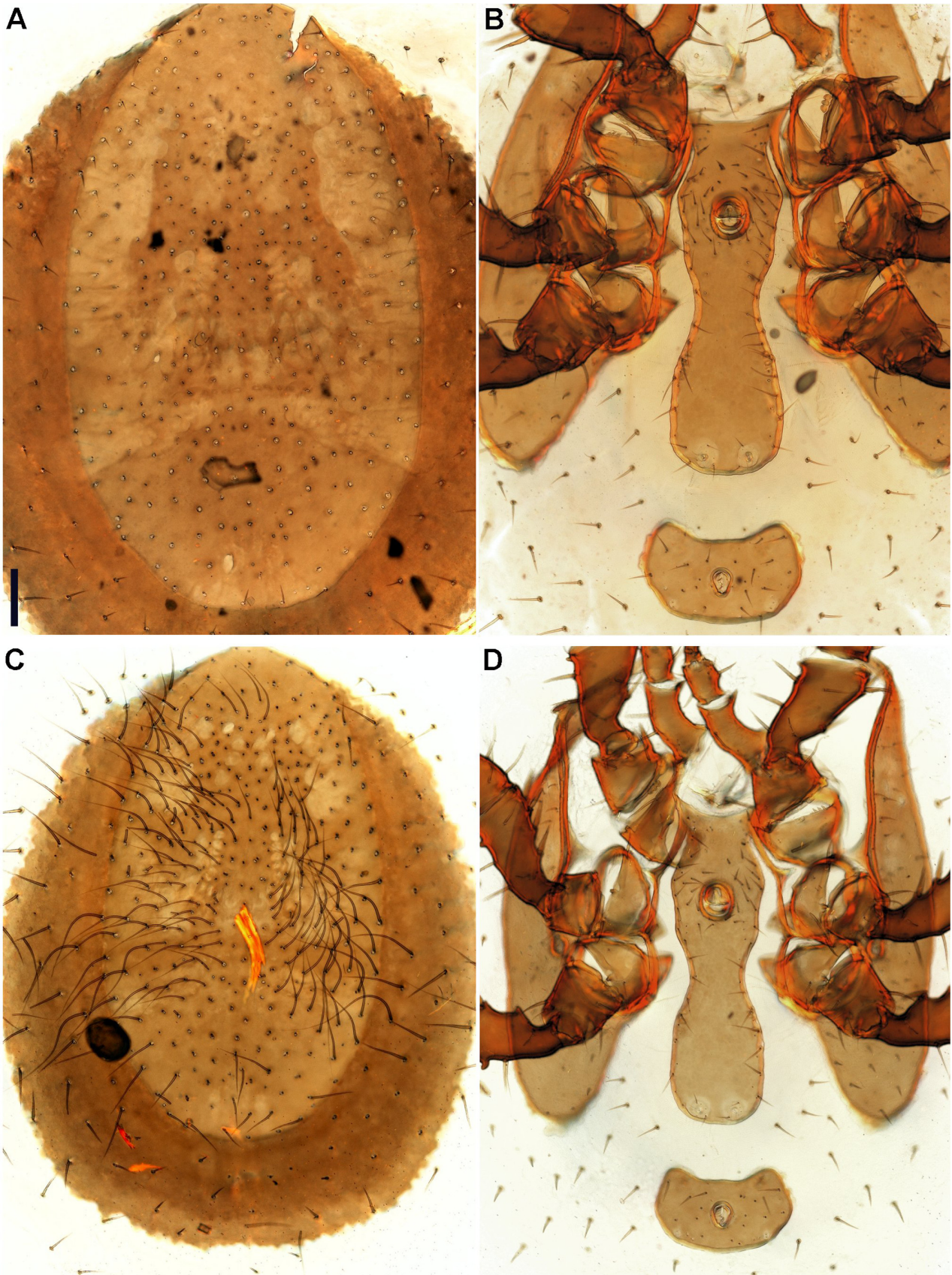


FIGURE 2. *Megisthanus modestus* Berlese, 1910, male, photomicrographs. (A) major male, dorsal shield (secondarily sclerotised), specimen from Lamington NP; (B) major male, venter, specimen from Lamington NP; (C) minor male, dorsum, specimen from Main Range NP (secondarily sclerotised); (D) minor male, venter, specimen from Main Range NP. Scale bar (A–D) = 200 μ m.

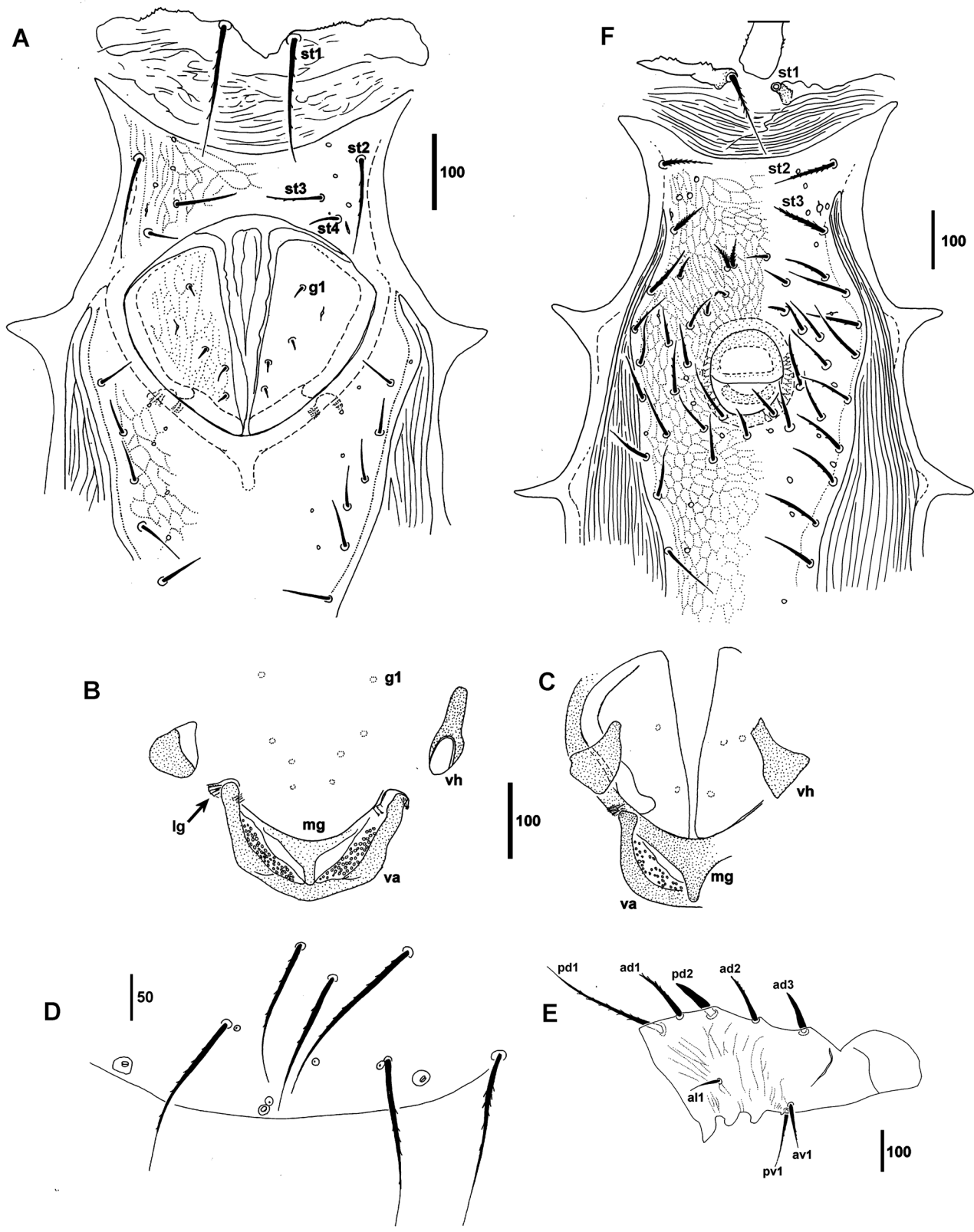


FIGURE 3. *Megisthanus modestus* Berlese, 1910, specimens from Lamington NP. (A) female, sternogenital region; (B) internal genitalia of same specimen (shields and thickened margins not shown); (C) internal genitalia, different specimen (shield and thickened margins shown); (D) female, posterior dorsal shield and setae; (E) female, femur IV; (F) major male, sternogenital region. Abbreviations: g1 = anterior pair of genital setae; lg = latigynal remnant; mg = mesogynal shield; va = vaginal arms; vh = vaginal heads.

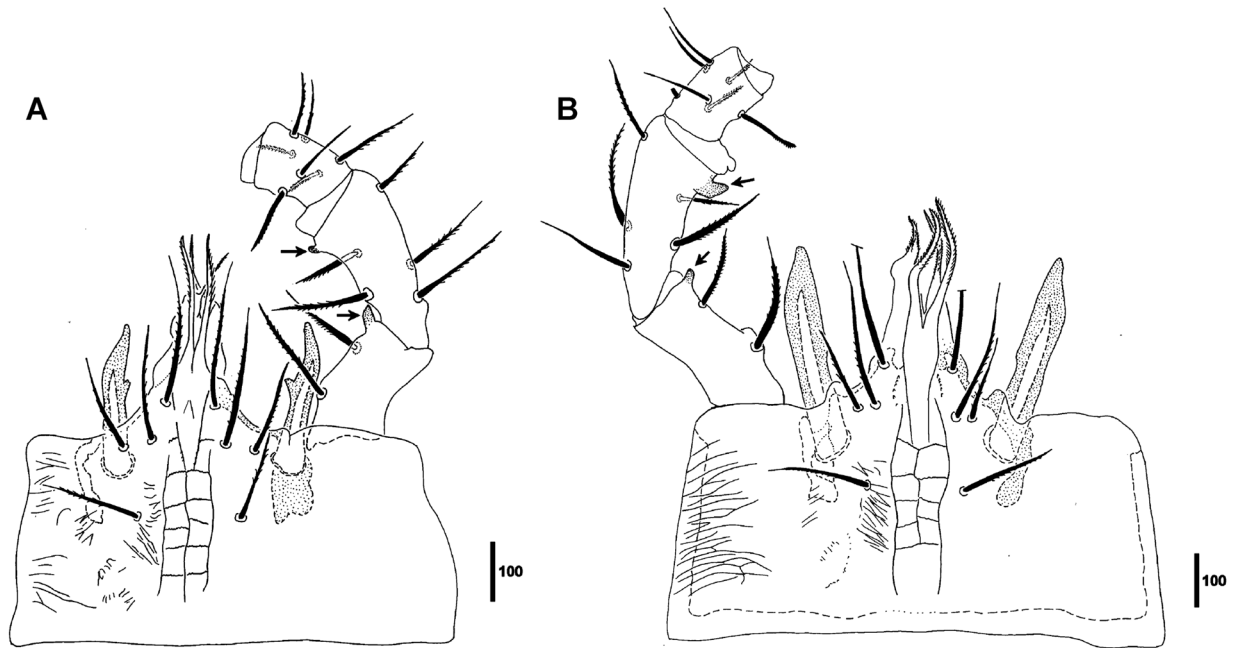


FIGURE 4. *Megisthanus modestus* Berlese, 1910, subcapitulum and palp trochanter–genu. (A) female; (B) major male (seta h1 broken). Arrows indicate spurs.

Gnathosoma (Fig. 4A). Gnathotectum reticulate, medial length 680–740. Subcapitulum with setae h1 250–275, h2 145–165, h3 250–270, pc 165–170, all setae barbed; medial subcapitulum with some fine striae, hypostome smooth. Corniculi length 250–270 with medial tooth. Palp trochanter with ventro-distal spur, length 20–30 (asymmetrical in holotype), palp femur with distal spur, length 10–15. Chelicerae with entire fixed digit length 670–730, movable digit length 380–390. Morphology as per genus description. Fixed digit with 12 teeth; cheliceral seta length 30–35. Movable digit with 8–10 teeth.

Legs (Fig. 1E). Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, 100–130; seta pd1 on genu III very long, 520–560, much longer than ad1, 150–155, tarsus III ad3 moderately long, 305–345, femur IV pd1 long, coarsely barbed, length 300–350, genu IV ad1 very long, 700–750, pd1 very long, 740–750, tibia IV pd1 long, 560–590 and tarsus IV ad4 long 400–450, pd3 long, 350–370. Femur IV with rudimentary projections bearing setae pd2, ad2, small projection bearing setae ad3.

Male (major) (n = 1). *Dorsum* (Fig. 2A). Idiosomal length 2.90 mm, width 2.60 mm, body length (including gnathosoma, to tip of gnathotectum) ca 3.70 mm. Dorsal shield ovate, length 2.40 mm, width 1.40 mm; secondary sclerotisation present, expanding laterally and posteriorly, length of dorsal shield including secondary sclerotisation 2.90 mm, width 2.40 mm. Dorsum hypertrichous. Setae on dorsal shield tiny, smooth, length < 5 excepting few anterior and posterior setae up to 75 in length. Setae in soft membrane close to dorsal shield smooth, small, length 40–80, setae becoming more barbed and longer laterally (80–100).

Venter (Figs 2B, 3F). Setae st1 barbed, length 145. Sternoventral shield reticulate, length from posterior margin of genital opening 940. Sternal setae st2 and st3 barbed, length 110 and 105, respectively; setae st4 shorter, 35; sternoventral shield (Fig. 3F) hypertrichous posterior to setae st3, with 30 setae around genital opening; posterior sternoventral shield with setae along margin; these setae smooth or sparsely barbed, shortest setae 75 (posterolateral setae) and longest setae 150 (just behind coxa IV); posterior sternoventral shield (Figs 2B) with two discs of porose cuticle (diameter 90), each bearing an anterior and posterior pair of unmodified smooth setae 55–60, and a highly modified pair of setae centrally, length 80.

Genital opening (Fig. 3F) length 150, width 125, surrounded by a ring of heavily sclerotised cuticle; this cuticle with 10–12 loosely paired pores laterad and posterolaterad genital opening.

Ventrianal shield (Fig. 2B) reniform, length 330, anterior width 450, maximum width 630, widest at anterior level of anus; shield reticulate, with 15–16 loosely paired setae. Peritreme and peritrematal shield similar to female.

Gnathosoma (Fig. 4B). Gnathotectum similar to female, medial length 800; subcapitulum similar, except with submedial projections (inner length 25). Setae h1 smooth, 240; setae h2 with few barbs, 150, setae h3 barbed, 265, palp coxal seta barbed, 190. Corniculi length 390, with medial tooth-like process present but smaller than female's process. Palp trochanter with small proximoventral rectangular process bearing proximal seta, and with distoventral cusps on trochanter (length 30) and femur (length 50). Chelicerae same as female.

Legs. Similar to female except spurs and spines larger.

Male (minor) (n = 1): Dorsum (Fig. 2C). Slightly smaller specimen compared to major male. Dorsal shield ovate, length 1.95 mm, width 1.10 mm; secondary sclerotisation present, extensive. Dorsum hypertrichous, with numerous long setae, similar to female. Venter similar to major male (Fig. 2D). Porose discs about same size, diameter 90–95, their modified setae slightly shorter, length 60–70. Ventrianal shield smaller, anterior width 420, maximum width 525, length 290. Gnathosoma similar to major male, except corniculi with medial tooth as in female; corniculi much shorter, length 275. Legs similar to major male, spurs and spines of a similar size.

Differential diagnosis. *Megisthanus modestus* retains setae st4, which are absent in all other Australian species except *M. womersleyi*, and these species are separated by numerous features (see Remarks for *M. womersleyi*). The species seems closest to *M. zachariei* **sp. nov.** in sharing a podonotum that is considerably more setose than the opisthonotum (Figs 1A–B, 21A). In addition to the presence of setae st4 only in *M. modestus*, this species has smaller ventral shields than *M. zachariei*, even though the species are a similar size, a difference especially apparent in the ventrianal shield (length 320–355, width 520–575 for *M. modestus*, 380 x 620 for *M. zachariei*).

Remarks. Berlese (1910) gave a rudimentary description of *M. modestus* based on specimens from an undetermined passalid and unspecified locality in New South Wales. His description compared the species with *M. doreianus*, noting that the ventral shield was somewhat narrower, the dorsal setae longer, the body size smaller, and that the post-peritrematal shields scarcely extended past the posterior margin of the ventral shield. Womersley (1937) found this description so inadequate that he seriously considered synonymising these species, but *M. doreianus* and *M. modestus* are clearly differentiated herein (see Remarks section for *M. womersleyi* **sp. nov.**). Briefly, *M. doreianus* differs by having a large dorsal tubercle on femur IV that bears seta pd2, eroded medial margins of the sternogynal shield, and females with a dense pelage of short setae (Fig. 16).

TABLE 2. Intraspecific variation in female *Megisthanus modestus* Berlese, 1910, according to selected sites in Queensland (Lamington NP, Main Range NP), New South Wales (Sydney), Canberra and Tasmania. n = number of specimens from each locality.

Site:	Lamington (n = 3)	Main Range (n = 1)	Sydney (n = 3)	Canberra (n = 1)	Tasmania (n = 1)
Dorsal reticulation	coarse	coarse	coarse	not visible	dense
Posterior dorsal shield setae (max length)	250–320	250	350–360	broken	125
Posterolateral setae in soft cuticle (max length)	550–600	390	480–550	broken	275
Number of sternogynal setae (pairs)	4–6	2–3	2–4	4–6	5–6
st1 length	160–180	145	140–165	160	115
st2 length	105–125	80	100	135	95
st3 length	50–75	50	70–75	65	35
st4 length	25–40	25	15–25	40	15
Post-peritrematal shield	450–520	390	400–460	475	450
Ventral shield length (from genital opening)	790–850	750	710–790	810	810
Ventral shield maximum width (behind Cx IV)	360–400	310	310–360	410	370

I attempted to see photographs of the holotype of *M. modestus*, but the specimen was not in a suitable condition for diagnostic photography. Of the features noted by Berlese (1910), only the character of the post-peritrematal shields is noteworthy. All specimens examined largely agree with Berlese's description, while other Australian species tend to have much larger post-peritrematal shields, extending to the ventrianal shield. However, this feature is not reliable because distortion of the ventral shields can occur with slide-mounting, and because of this some specimens of other species appear to have the smaller post-peritrematal shields of *M. modestus*.

My treatment of *M. modestus* makes it a broadly distributed species found in southern Queensland, New South Wales, Canberra and Tasmania. It is the only Australian species of Megisthanidae recorded from New South Wales—indeed any state other than Queensland—and is therefore also very likely to be the same species described by Berlese (1910). The host beetles are three species of *Pharochilus*; the host species *P. rugiceps* is perhaps the most widespread of all Australia's passalid beetles, being found from southern Queensland to Tasmania (Dibb 1938; Seeman 2002). It is the only species of Passalidae in Tasmania. The specimens of *M. modestus* from Queensland, New South Wales and Canberra are indistinguishable from each other, despite being separated by up to 700 km and occurring in different habitats (rainforest in Queensland; sclerophyll in New South Wales and Canberra) and on different host beetles (*P. dilatatus*, *P. scutellonotus* in Queensland; *P. rugiceps* elsewhere). However, the single specimen in good condition from Tasmania is tentatively considered *M. modestus*. Under phase-contrast microscopy, a denser reticulation is visible on the dorsal shield, and the opisthonotal setae are shorter than those of specimens found in mainland Australia (Table 2). However, with just a single good-quality specimen and no males, I consider this specimen *M. modestus* pending further collection of specimens from Tasmania.

***Megisthanus papuanus* Womersley, 1937**

Figure 5

Megisthanus papuanus Womersley, 1937: 178.

Material examined. 1 female, Finschafen, Papua, 1933, Rev. Wagner (J17326). In SAM.

Diagnosis. *Female* (male unknown). Sternal setae st4 probably present (all setae broken). Seta pd2 of femur IV on large projection. Dorsal shield finely punctate, ovate, length 3.35 mm, maximum width 2.00 mm (not including secondary sclerotisation), most dorsal shield setae 80–100 in length, smooth; posterolateral region with 35–40 larger, thicker setae, some of which are very long, forming a pair of tufts; podonotum and opisthonotum densely setose. Sternogynal shields fused posteriorly, each bearing five setae; internal genitalia with rudimentary latigynal element. Ventrianal shield large, strongly trapezoidal, widest posterior to anus.

Differential diagnosis. This species is unique in having both an extremely large, trapezoidal ventrianal shield (ca. 700 x 1200) and two posterolateral patches of very long setae on the dorsal shield (Fig. 5 Womersley 1937; broken off in examined specimen). As noted by Womersley (1937), the most similar species appears to be *Megisthanus gigantoides* Stoll, 1893, which shares a similarly shaped sternoventral and ventrianal shield, but is easily distinguished by lacking the posterolateral patches of very long setae. Instead, *M. gigantoides* has short dorsal setae interspersed with about 10 pairs of long setae inside the lateral and anterior margins of the dorsal shield.

Remarks. The specimen examined is probably one of the syntypes examined by Womersley (1937), but it is not marked as such, and was not even identified as *M. papuanus*. It may not be the specimen illustrated by Womersley (1937) as legs II–III are missing, most ventral setae are broken and all the long dorsal setae are also lost. However, the specimen could be a remount of the drawn specimen because it is ringed. Most specimens mentioned in Womersley (1937) are not ringed, but specimens acquired by Womersley after 1937 are ringed, suggesting that the specimen was, at some time, remounted. Much of Womersley's megisthanid collection is in poor condition, with the medium so degraded that, on some slides, psocids have crawled beneath the coverslip and become trapped. The only other specimen of *M. papuanus* in the SAM collection is a specimen in ethanol, which is also considerably damaged.

Megisthanus papuanus is a highly distinctive species. Diagnostic features obvious in Womersley's (1937) description are confirmed here: an extremely large, trapezoidal ventrianal shield (Fig. 5D) and the two posterolateral patches of very long setae on the dorsal shield (now only apparent from their large, sclerotised sockets; Fig. 5A). The species is also distinctive by having an exceptionally broad sternoventral shield (posterior width 740) that is highly porose or hypertrichous, having ca. 180 small setae or pores (Fig. 5C); due to all setae being broken, it is difficult to differentiate these, but they appear to be setal bases each with their own associated pore.

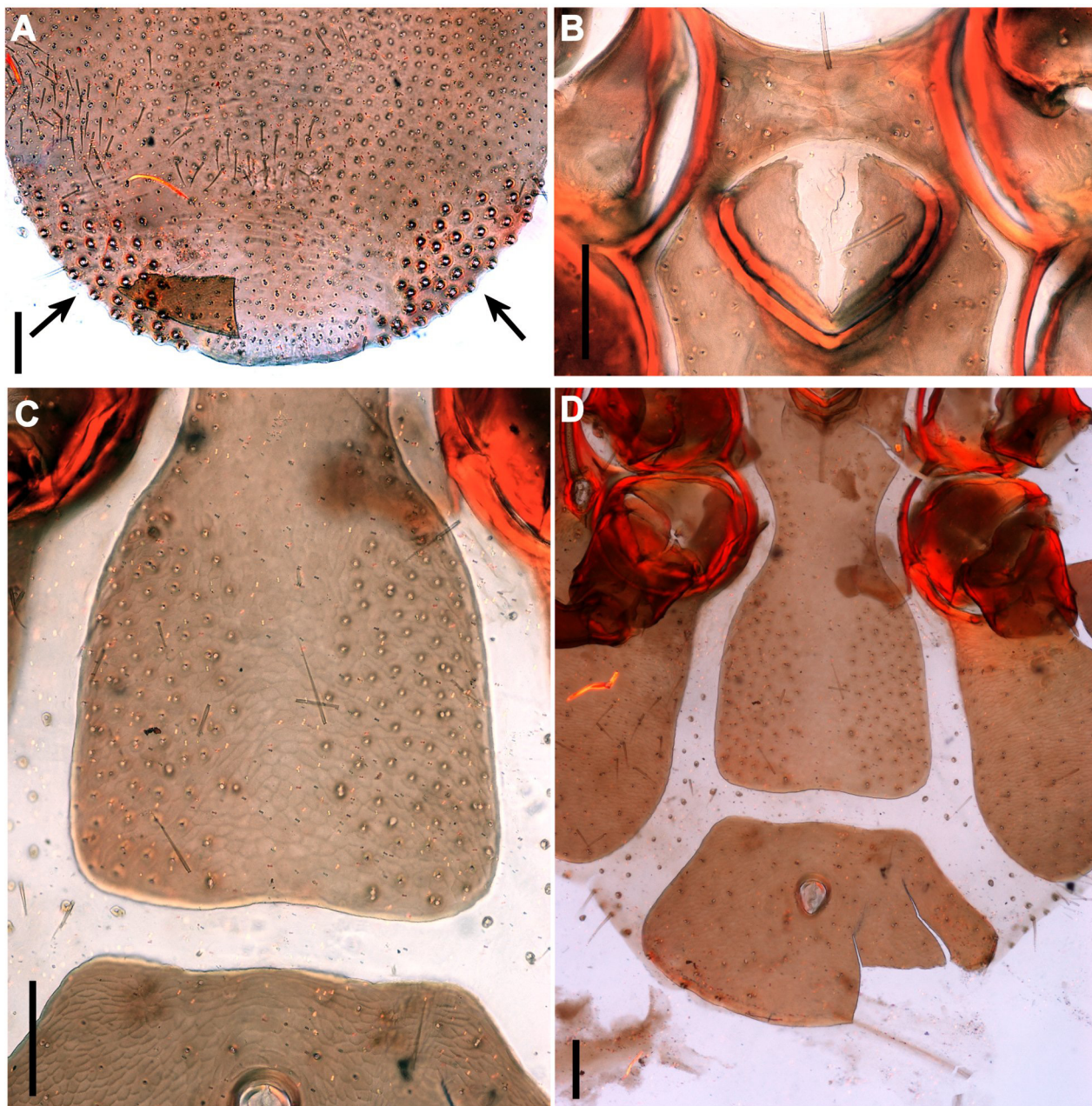


FIGURE 5. *Megisthanus papuanus* Womersley, 1937, female, photomicrographs. (A) Posterior dorsal shield, most setae broken; arrows indicated patches of sclerotised sockets that presumably represent broken long setae; (B) sternogenital region; (C) posterior sternoventral shield, setae broken; (D) ventral and anal region. Scale bars = 200 μ m.

***Megisthanus thorelli* Womersley, 1937**

Megisthanus thorelli Womersley, 1937: 177.

Material examined. In addition to material listed in Seeman (2017), the following non-type material was examined from non-type localities in Queensland, Australia. Main Range NP, ex *Mastachilus quaestionis*. 3 females, 1 major male, Box Forest Track, Cunningham's Gap, 28°02'S, 152°23'E, 18.iv.2012, H. Urbina, J. Bartlett & O. Seeman, beetle BG-12-4-18-11-1-1 (QMS 109455–8). 2 females, 1 major male, Mt Mitchell track, O. Seeman, 11.ii.1996, beetle #175 (log 1, passalid 1) (QMS 109459–61). Lamington NP, ex *M. quaestionis*. 2 females, Box Forest Circuit, 13.ii.1996, O. Seeman, beetle #321 (log 1, passalid 1) (QMS 109464–5); 2 females,

same data except beetle #322 (log 2, passalid 2) (QMS 109462–3); 1 major male, same data except beetle #332 (log 3, passalid 3) (QMS 109466). Goomburra State Forest, ex *M. australasicus* (southern form). 1 female, 1 major male, 27°58'S 153°30'E, 18.iv.2012, H. Urbina, J. Bartlett & O. Seeman, beetle BG12-4-18-14-6-1 (QMS 109474–5). Jimna State Forest, ex *Pharochilus dilatatus*. 4 females, 1 major male, 1 minor male, Peter's Rd, Sunday Ck, 17.iii.1996, O. Seeman, beetle #201 (QMS 109467–72). 1 female, 2 km E Sunday Ck, 17.iii.1996, O. Seeman, beetle #197 (QMS 109473). All in QM. Imbil, ex passalid. 1 major male, 11.ix.1946, F.J. Gay (on several slides: J17337–43, J17356). 1 female, same data (on several slides: J17345–17352). 1 female, same data (two slides: J17317, J17344). Lamington NP, ex passalid. 1 female, 1 major male, H. Womersley, 1949 (J17329, J17313). All in SAM.

Diagnosis. As per Seeman (2017).

Remarks. This common species from southeast Queensland is often found on *Mastachilus quaestionis*, Australia's largest passalid beetle, but was also recorded from *M. australasicus* (the southern form only) and *P. dilatatus*. *Mastachilus quaestionis* is found only in rainforests, while *M. australasicus* tends to be found in sclerophyllous forests; the widespread species *P. dilatatus* tends to be found in wet sclerophyll to rainforest.

***Megisthanus manonae* sp. nov.**

Figures 6–7

Material examined. **Australia, Queensland**, ex *Mastachilus australasicus* (Northern form): Holotype female, Pelion State Forest, 21.077°S 148.688°E, 17.iii.2014, C. Burwell, sampcode #36348 (QMS 109476). In QM. Paratypes: 1 female (ANIC 51-006450), 1 major male (QMS 109478), same data as holotype; 1 female, Eungella NP, 21.143°S 148.489°E, 13.xi.2013, C. Burwell, sampcode #25828 (QMS 109477). Holotype and two paratypes in QM; one female paratype in ANIC.

Diagnosis. *Female and male.* Sternal setae st4 absent. Seta pd2 of femur IV on rudimentary projection. Dorsal shield finely punctate. Ventrianal shield widest at posterior-level of, or just posterior to, anus. *Female.* Dorsal shield lyriform, length 2.50–2.55 mm, maximum width 1.05–1.15 mm, tapering to minimum width 420–450, expanding posteriorly to 460–490; shield appears ovate when secondarily sclerotised. Anterior dorsal shield setae sparsely barbed, length 80–150, becoming shorter and more barbed posteriorly; posterior dorsal shield setae short, with numerous large barbs, length 45–70; podonotum and opisthonotum densely setose. Sternogynal shields separate, each bearing 4–6 setae; internal genitalia with well-developed, separate latigynal-mesogynal and vaginal elements. Ventrianal shield subtriangular. *Major male.* Larger than female, dorsal shield length 2.85 mm, width 1.50 mm, without developed setae; setae on soft cuticle laterad dorsal shield of moderate length, 55–100; 65 setae around genital opening; corniculi without medial inner tooth; setae h1–3 smooth, palp coxal seta barbed.

Description. *Female* ($n = 3$). *Dorsum* (Figs 6A, 7D). Idiosomal length ca. 2.6 (2.55–2.80) mm, width 1.35 (1.35–2.00) mm, body length (including gnathosoma, to tip of gnathotectum) 3.30 (3.30–3.50) mm. Dorsal shield lyriform, length 2.50 (2.50–2.55) mm, maximum width 1.05 (1.05–1.15) mm, narrowing to 420 (420–450) then expanding slightly (ca. 40) to 460 (460–490); secondary sclerotisation absent or present laterally and posteriorly; maximum length of dorsal shield including secondary sclerotisation 2.80 mm, width 1.65 mm. Dorsal shield hypertrichous, densely setose, anterior setae sparsely barbed, longer (80–150) than posterior setae, which become shorter (45–70) and more barbed; posterior setae with numerous large barbs (Fig. 7D). Dorsal shield cuticle finely punctate, without reticulation. Setae in soft cuticle barbed, on platelets, most setae 180–260, becoming shorter laterally; some setae laterad narrowest part of dorsal shield very long, 550–600.

Venter (Figs 6B, 7A–C). Setae st1 170 (130–170), sparsely barbed. Sternal shield (Fig. 7A) reticulate, with two pairs of setae, 5–7 pairs of pores opening ventrally, 0–1 pore opening laterally, and one pair of lyrifissures; setae st2–3 sparsely barbed, st2 160 (115–160), st3 105 (90–105), st4 absent; shield medial length 120 (110–125).

Sternogynal shields (Fig. 7A) free posteriorly, genital opening length 305 (300–310), width 340 (340–350), each sternogynal shield length 270 (270–280), lineate-reticulate, each bearing 4–6 smooth setae (asymmetrical) and one lyrifissure; anterior setal pair (55–75) slightly barbed and longer and thicker than posterior setae (20–45). Internal genitalia comprise: mesogynal+latigynal element (*mg+lg*), the latigynal element well-developed as arms with porose areas, articulating with anterolateral margin of sternogynal shield; posteriorly, mesogynal element fused with latigynal element, its tip reaching margin of vaginal arms (*va*); pyriform vaginal heads (*vh*); and U-shaped vaginal arms articulating anteriorly with sternogynal processes (*sgp*) (Figs 7B–C).

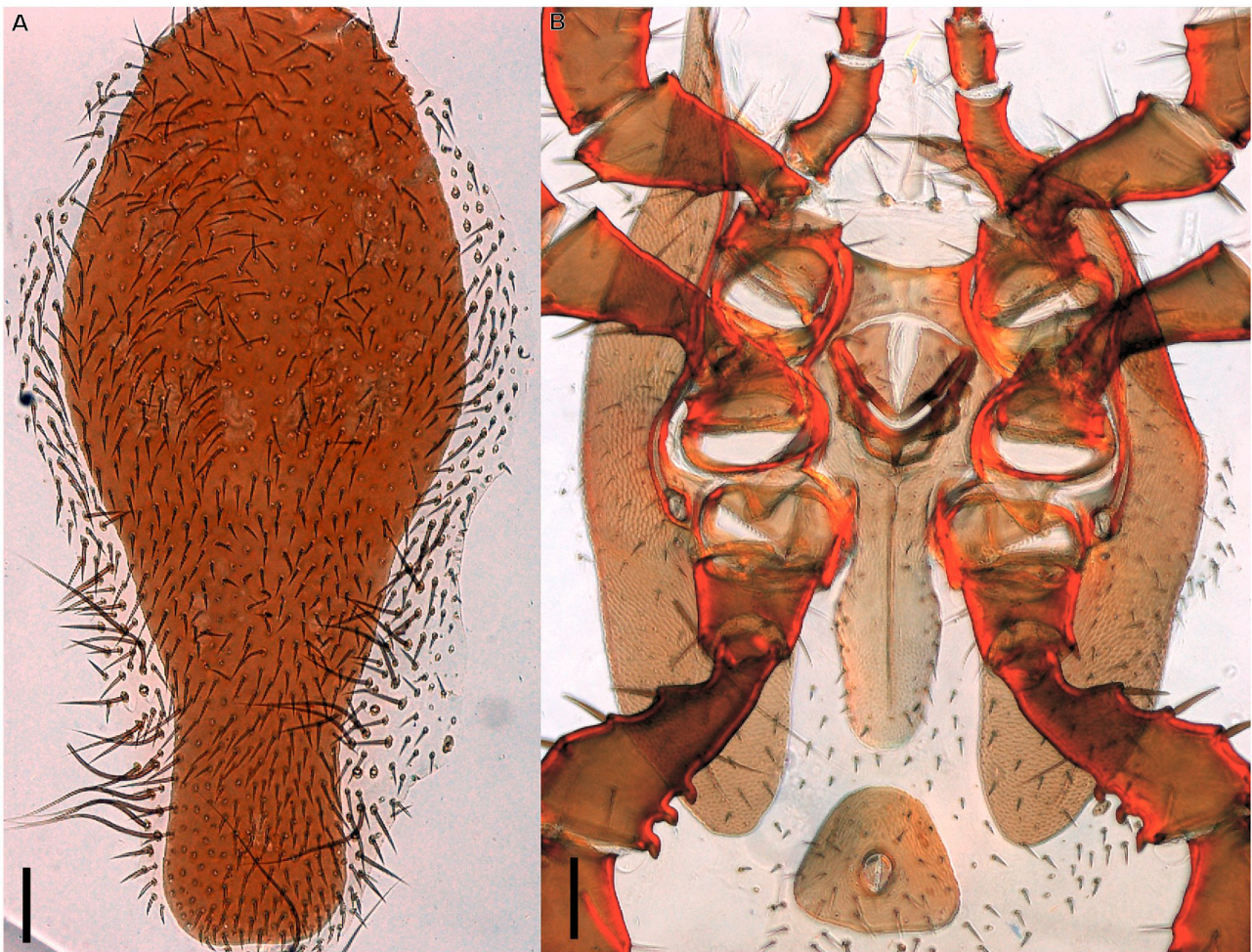


FIGURE 6. *Megisthanus manonae* sp. nov., female, photomicrographs. (A) dorsum; (B) venter. Scale bar = 200 μ m.

Ventral shield (Fig. 6B) extends 830 (830–920) posteriorly from posterior margin of genital opening; maximum width behind coxa IV 285 (275–290); shield with 13–20 pairs of setae around shield margin, 1 pair posteriorly within shield, and with 1–3 pairs of setae off shield margin close to sternogynal shield; setae smooth, length 35–110; with 3–5 pairs of pores around shield margin posterior of coxa IV, 7–8 pairs of pores within shield, and 1–3 pairs of larger porose areas on shield margin just level with posterior margin of coxa IV; shield reticulate, lineate-reticulate zones limited to posterolateral margins.

Ventrianal shield a rounded triangle (Fig. 6B), with anus slightly posterior of centre of shield; anterior width ca. 160–180, maximum width posterior to anus, 435 (435–470), length 390 (390–440); shield reticulate; 16–26 loosely paired setae, length 45–115.

Peritrematal shield hypertrichous, post-peritrematal region extends 640 (620–670) behind coxa IV into metapodal region (Fig. 6B); setae laterad legs sparsely barbed, length 40–50; three pairs of long setae on anterior margin of peritrematal shield, length 200–300.

Gnathosoma. Gnathotectum reticulate, medial length 760 (760). Subcapitulum with setae h1 275 (275–280), h2 150 (150–175), h3 300 (225–300), pc 185 (175–185), all setae sparsely barbed; subcapitulum finely striate. Corniculi length 265 (250–265) with medial tooth. Palp trochanter with ventro-distal spur, length 25–30 and dorsodistal spine 20, palp femur with distal spur, length 20. Chelicerae with entire fixed digit length 670 (670–705), movable digit length 380 (380–410). Morphology as per genus description. Fixed digit with 12–14 teeth; cheliceral seta length 30. Movable digit with 10 teeth.

Legs. Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, length 100–120; seta pd1 on genu III long (length 500–600), much longer than ad1 (length 150–210), tarsus III ad3 long, length 340–355, femur IV pd1 long, length ca. 500, genu IV ad1 very long, length ca. 750, pd1 ca. 650–700, tibia IV pd1 long, length ca. 550 and tarsus IV ad4 long, length ca. 470, pd3 long, length ca. 360. Femur IV with rudimentary projections bearing setae pd2, ad2, larger projection bearing ad3.

Male (major) (n = 1). *Dorsum*. Idiosomal length 3.05 mm, width 1.85 mm, body length (including gnathosoma, to tip of gnathotectum) 3.90 mm. Dorsal shield ovate, length 3.85 mm, width 1.50 mm; secondary sclerotisation absent. Dorsum hypertrichous. Most setae on dorsal shield tiny, smooth, length < 5; some anteromarginal setae longer (45–120). Setae in soft membrane close to anterior dorsal shield sparsely barbed, moderate length (55–100), lateral setae barbed short (20–50).

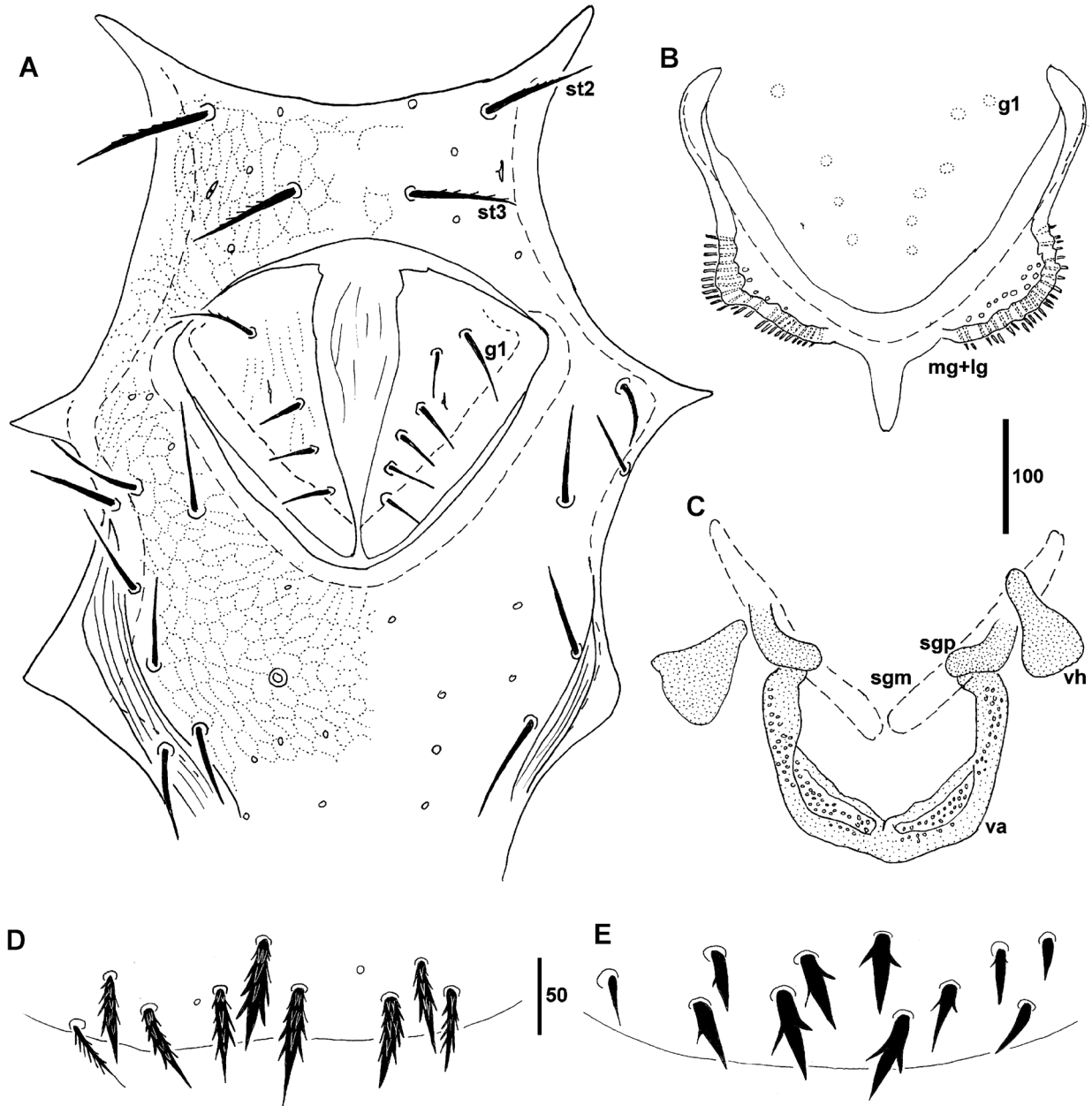


FIGURE 7. *Megisthanus manonae* sp. nov., female. (A) sternogenital region; (B) internal genitalia, fused mesogynal and latigynal shields (mg+lg), position of sternogynal setae indicated by dotted circles; (C) vaginal heads (vh) and vaginal arms (va), which articulate with sternogynal processes (sgp) arising from thickened sternogynal margins (sgm); (D) posterior dorsal shield setae. *Megisthanus leviathanicus* Seeman, 2017, female. (E) posterior dorsal shield setae.

Venter. Setae st1 barbed, length 165. Sternoventral shield reticulate, length from posterior margin of genital opening 1110. Sternal setae st2 and st3 barbed, st2 not measureable, st3 80; sternovenral shield hypertrichous posterior to setae st3, with ca. 65 setae around genital opening; posterior sternovenral shield with setae along margin; these setae smooth to sparsely barbed, shortest setae 40 (near genital opening) and longest setae 120 (posterior to coxa IV); posterior sternovenral shield with two large discs of porose cuticle (diameter 120), each

bearing an anterior (70) and posterior pair (100) of unmodified smooth setae, and a highly modified pair of setae centrally (80); unpaired seta between discs.

Genital opening length 150, width 130, surrounded by a ring of sclerotised cuticle; this cuticle with 13–14 pairs of loosely paired pores laterad genital opening.

Ventrianal shield a curved trapezoid, length 395, anterior width ca. 420, maximum width 575, widest posterior to level of anus; shield reticulate, with 25 setae. Peritreme and peritrematal shield similar to female.

Gnathosoma. Gnathotectum similar to female, medial length 870; subcapitulum similar, except with submedial projections (inner length 40). Setae h1 smooth, blade-like, 225; setae h2 smooth, 155, setae h3 barbed, 190, palp coxal seta barbed, 205. Corniculi without tooth-like process, corniculi length 390. Palp difficult to see, but cusps present. Chelicerae similar to female.

Legs. Similar to female, distal spurs and spines similar in size.

Etymology. It is with great pleasure that I name this species for Dr Manon Griffiths, a dear friend of the author and also the collector of this species, Dr Chris Burwell.

Differential diagnosis. This species is closely related to *M. leviathanicus* because it shares the lyriform dorsal shield and a distinct latigynal element. It is most easily distinguished from *M. leviathanicus* by the form of the posterior idiosomal setae: those of *M. manonae* have numerous barbs of moderate size (Fig. 7D), while those of *M. leviathanicus* have one or two large barbs (Fig. 7E). The males cannot be reliably distinguished, although the corniculi (390 vs 470–560) and setae h3 (190 vs 335–375) of *M. manonae* are shorter (Table 1).

Remarks. This species was found in the rainforests of middle-eastern Queensland, in contrast to *M. leviathanicus*, which occurs in the rainforests of the wet tropics of northern Queensland. These rainforest regions are separated by an expansive warm, dry region (the Burdekin Gap; see for example Moritz *et al.* 2005). Although represented by only two collections, I suspect *M. manonae* will be restricted to middle-eastern Queensland.

Megisthanus simoneae sp. nov.

Figures 8–11

Material examined. Australia, Queensland, ex *Mastachilus polyphyllus* (W.S. Macleay, 1826). Holotype female, Barakula Forest Station, cypress forest, 26°26'S 150°30'E, 10–16.x.2004, C. Burwell & S. Wright, samcode #52067 (QMS 109479). In QM. Paratypes. 2 females (QMS 109480; ANIC 51-006451), 1 major male (QMS 109481), same data as holotype. 2 females, 1 major male, Burleigh Heads, 3.x.1964, J. McMaster, under elytra of pinned beetle (QMS 109482–4). All in QM except one female in ANIC.

Diagnosis. *Female and male*. Sternal setae st4 absent. Seta pd2 of femur IV on rudimentary projection. Dorsal shield finely punctate. Ventrianal shield widest at anterior level of anus. *Female*. Dorsal shield ovate, length 1.80–2.15 mm, maximum width 0.95–1.20 mm, not including secondary sclerotisation. Anterior dorsal setae comprising short (40–70) dorsal setae intermingled with longer (140–225) sparsely barbed setae; both types becoming longer posteriorly; podonotum more setose than opisthonotum. Sternogynal shields separate, each bearing 3–5 setae; internal genitalia with rudimentary latigynal element. Ventrianal shield moderately reniform. *Major male*. Broader than female, dorsal shield length 2.30–2.40 mm, width 1.35–1.45 mm, without well-developed setae; setae on soft cuticle laterad dorsal shield short, length 10–25; 20 setae around genital opening; corniculi with small medial inner tooth; setae h1–3 smooth, palp coxal seta barbed.

Description. *Female* ($n = 4$). *Dorsum* (Figs 8A, 9A, 11A). Idiosomal length ca. 2.45 mm (2.30–2.65 mm), width ca. 2.00 mm (1.60–2.20 mm), body length (including gnathosoma, to tip of gnathotectum) ca. 3.10 mm (2.90–3.30 mm). Dorsal shield ovate, length 1.80 mm (1.80–2.15 mm), width 0.95 mm (0.95–1.20 mm); secondary sclerotisation present, extensive (Fig. 8A) laterally and posteriorly; maximum length of dorsal shield including secondary sclerotisation 2.35 mm (2.20–2.40 mm), width 1.80 mm (1.45–2.05 mm). Dorsal shield hypertrichous, densely setose. Podosomal part of dorsal shield with numerous short (40–70) barbed setae, intermingled anteriorly with long (140–225) sparsely barbed setae; opisthosomal part of dorsal shield with longer setae of both types, i.e., a shorter barbed seta (to 140) and long setae (200–525); longest setae posteromarginal. Dorsal shield cuticle appearing smooth, with inconspicuous fine punctation. Setae in soft cuticle barbed, on small platelets, length 150–500, longer posterolaterally.

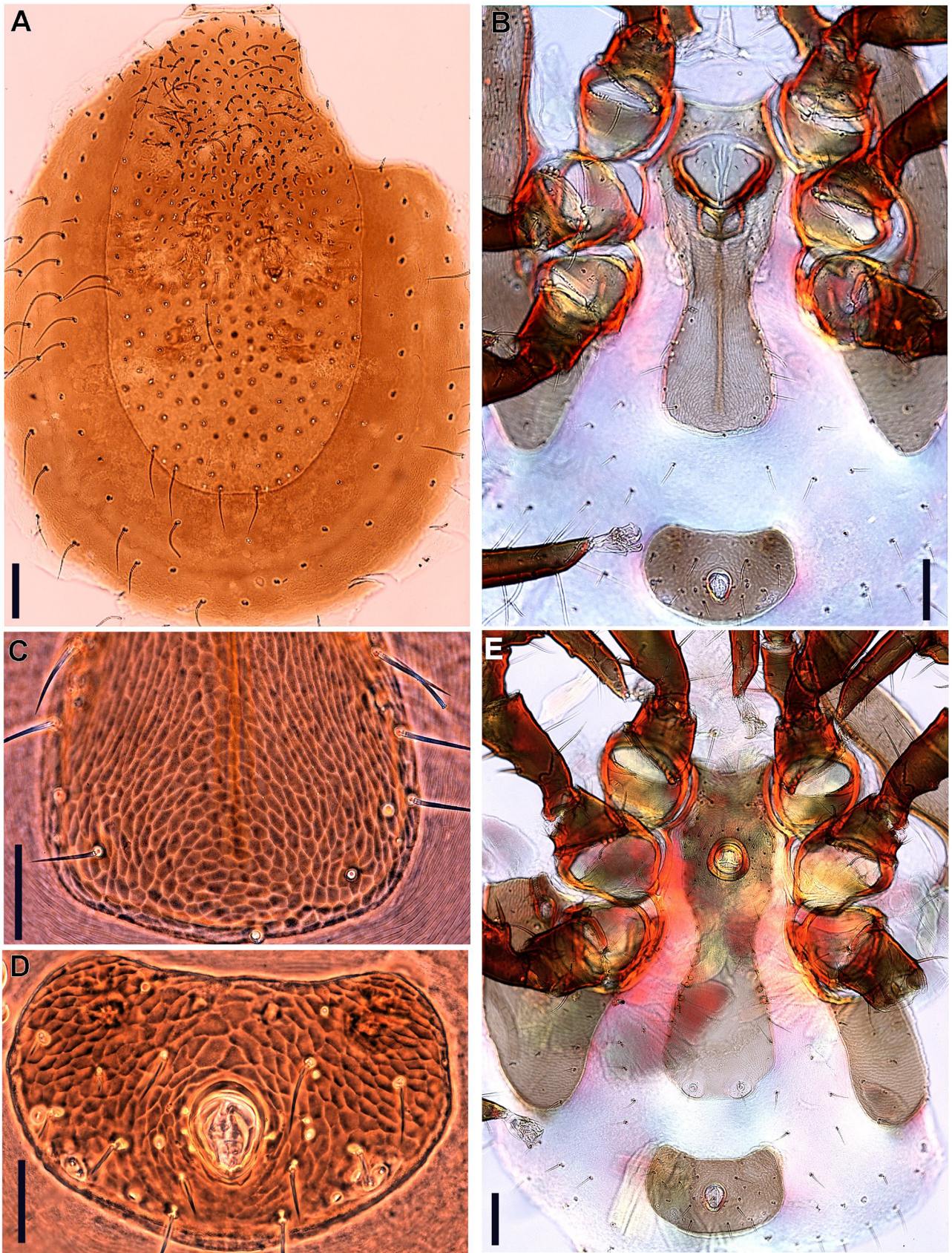


FIGURE 8. *Megisthanus simoneae* sp. nov. photomicrographs. (A) female, dorsum with secondary sclerotisation; (B) female, venter; (C) female, posterior margin ventral shield; (D) female, ventrianal shield; (E) major male, venter. Scale bar = 200 μ m (A, B, E) or 100 μ m (C, D).

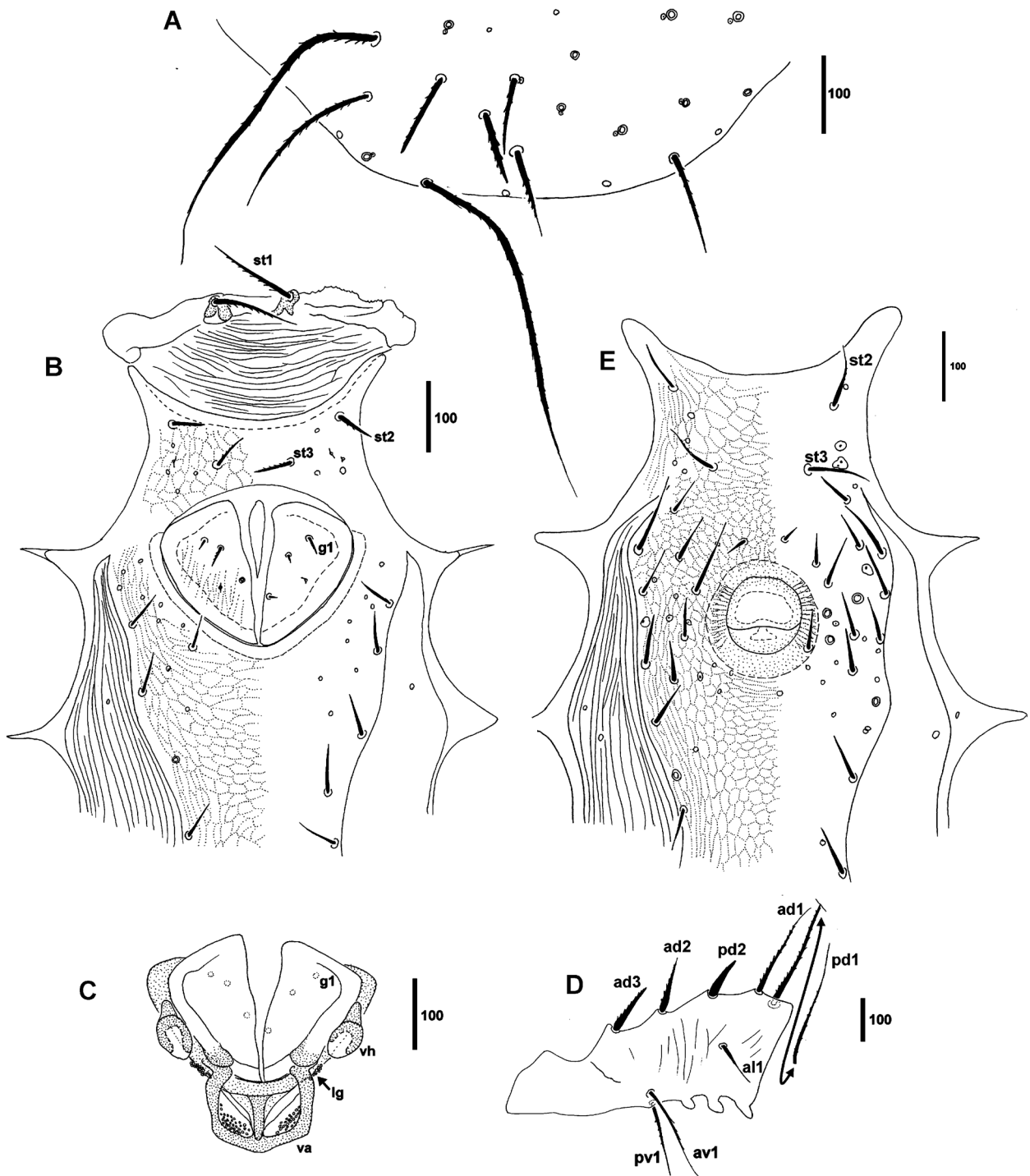


FIGURE 9. *Megisthanus simoneae* sp. nov. (A) female, posterior dorsal shield (several setae broken); (B) female, sternogenital region; (C) internal genitalia; (D) female, femur IV; (E) major male, sternogenital region. Abbreviations: g1 = anterior pair of genital setae; lg = latigynal remnant; mg = mesogynal shield; va = vaginal arms; vh = vaginal heads.

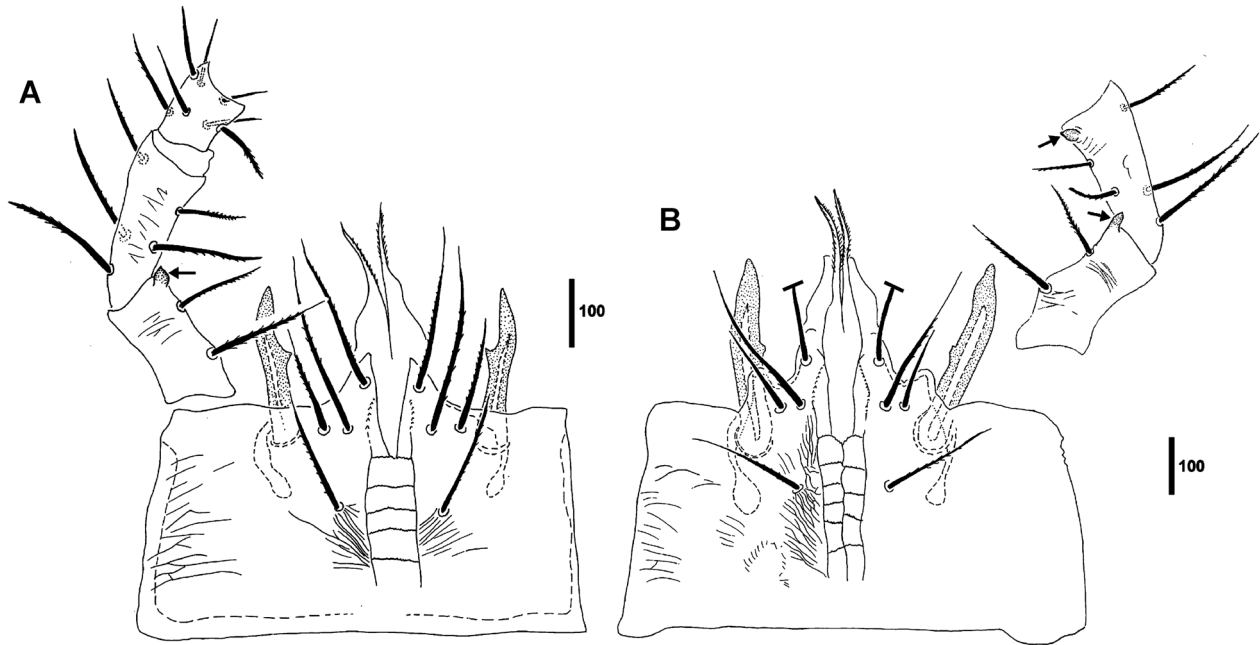


FIGURE 10. *Megisthanus simoneae* sp. nov. (A) female, subcapitulum and palp trochanter–genu; (B) major male, subcapitulum and palp trochanter–femur (seta h1 broken). Palps shown separate from capitulum; arrows indicate spurs.

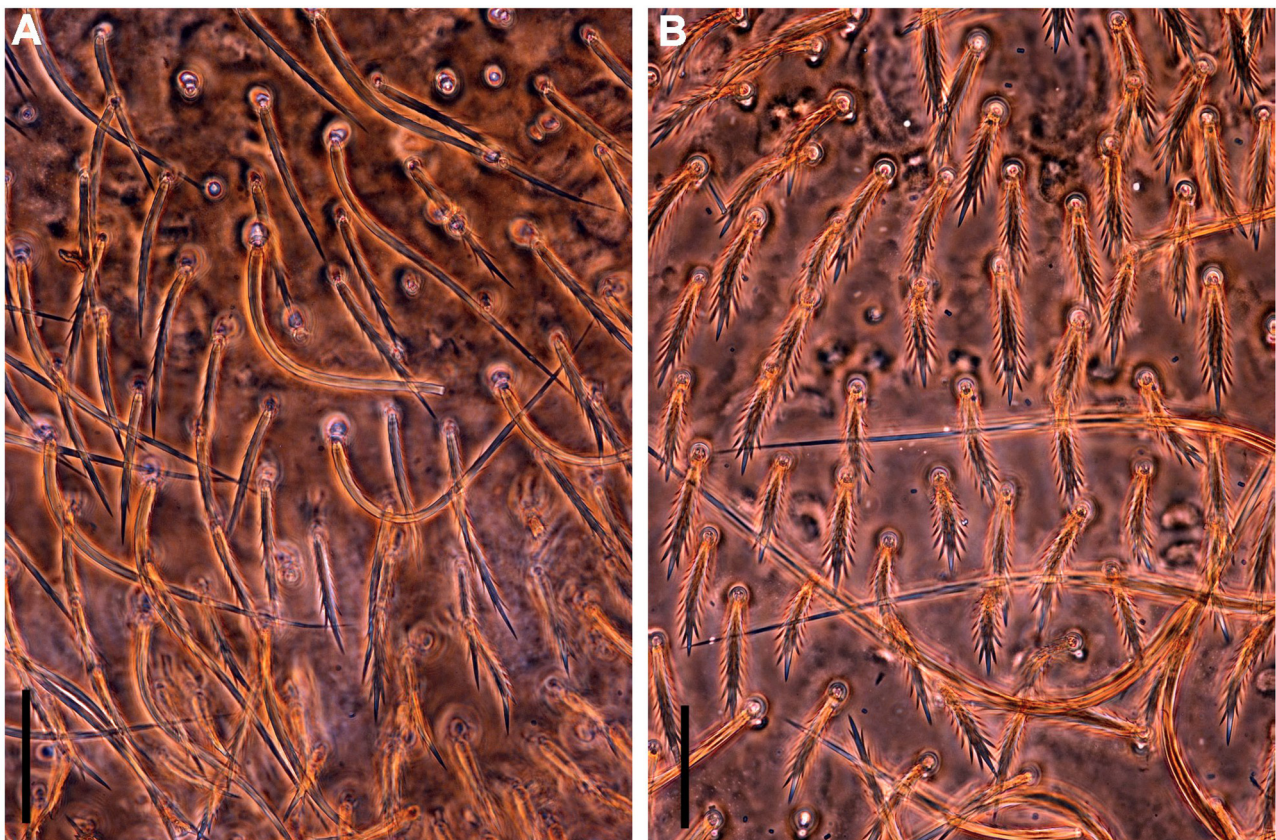


FIGURE 11. Mid-opisthotal setae of: (A) *Megisthanus simoneae* sp. nov.; (B) *Megisthanus thorelli* Womersley, 1937.

Venter (Figs 8B, 9B–C). Setae st1 130 (130–180), barbed. Sternal shield (Fig. 9B) reticulate, with two pairs of setae, 4 (4–9) pairs of pores opening ventrally, 0–1 pores opening laterally, and one pair of lyrifissures; setae st2–3

sparsely barbed, st2 65 (85–105), st3 60 (60), st4 absent; shield medial length 95 (95–115).

Sternogynal shields (Fig. 9B) free posteriorly, genital opening length 235 (235–260), width 275 (275–290), each sternogynal shield length 210 (210–240), weakly lineate-reticulate, each bearing 3 (3–5) setae and one lyrifissure; anterior setae barbed, longer (40–50) than smooth posterior setae (10–40). Internal genitalia comprise three obvious elements (*mg*, *va*, *vh*) and rudimentary latigynal (*lg*) elements, which are represented by small porose area on thickened ventral shield margin, near attachment of vaginal arms with sternogynal shield.

Ventral shield (Figs 8B, C) extends 710 (710–870) posteriorly from posterior margin of genital opening; maximum width behind coxa IV 350 (350–420); shield with 9–10 (7–10) pairs of setae around shield margin, with or without one pair posteriorly within shield (holotype, just within margin), and with 0–2 pairs of setae off shield margin close to sternogynal shield (often asymmetrical); setae smooth, length 40–95; shield mostly reticulate, small lineate-reticulate region at level just behind coxa IV.

Ventrianal shield moderately reniform (Fig. 8D), with anus mostly in posterior half of shield; anterior width ca. 340 (340–400), maximum width anterior to anus, 475 (450–540), length 295 (395–320); shield reticulate; 8–14 loosely paired setae, length 75–90 (60–80).

Peritrematal shield hypertrichous, post-peritrematal region extends 385 (385–450) behind coxa IV into metapodal region (Fig. 8B); setae laterad legs sparsely barbed, length 25–60, those directly above legs III–IV much shorter than other setae; three pairs of long setae on anterior margin of peritrematal shield 240–340.

Gnathosoma (Fig. 10A). Gnathotectum reticulate, medial length 620 (620–700). Subcapitulum with setae h1 240 (230–265), h2 160 (145–170), h3 broken (275–300), pc broken (165–180), all setae sparsely barbed; medial subcapitulum with some fine striae, hypostome smooth. Corniculi length 235 (235–265) with medial tooth. Palp trochanter with ventro-distal spur, length 25 (25–45), palp femur with distal spur, length 10 (10–15). Chelicerae with entire fixed digit length 610 (610–670), movable digit length 320 (320–380). Morphology as per genus description. Fixed digit with 12–13 teeth; cheliceral seta length 25–30.

Legs (Fig. 9D). Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, 95–120; seta pd1 on genu III, 350–490, much longer than ad, 120–150, tarsus III ad3 moderately long, 275–300, femur IV pd1 long, 340–450, genu IV ad1 very long, 530–620, pd1 very long, 550–850, tibia IV pd1 long, 470–600, tarsus IV ad4 long, length 350–400, pd3 long, length 300–315. Femur IV with rudimentary projections bearing setae pd2, ad2, small projection bearing setae ad3.

Male (major) (n = 2). *Dorsum* (Fig. 8E). Idiosomal length ca. 2.80–3.10 mm, width ca. 2.20–2.40 mm, body length (including gnathosoma, to tip of gnathotectum) ca. 3.55–3.75 mm. Dorsal shield ovate, length 2.30–2.40 mm, width 1.35–1.45 mm; secondary sclerotisation present, extensive. Dorsum hypertrichous. Setae on dorsal shield tiny, smooth, length < 5. Setae in soft membrane close to dorsal shield smooth, small (10–25), becoming more barbed and longer laterally, length to 125; some setae near posterolateral and posterior margin of shield also long (to 120).

Venter (Fig. 9E). Setae st1 barbed, length 175. Sternoventral shield reticulate (with some lineate-reticulate patterning behind coxa IV), length from posterior margin of genital opening 900. Sternal setae st2 and st3 barbed, length 85–135; sternoverventral shield hypertrichous posterior to setae st3, with 20 setae around genital opening; posterior sternoverventral shield with setae along margin; these setae smooth, shortest setae 65 (mesad coxa IV) and longest setae 120 (posterior to coxa IV); posterior sternoverventral shield (Fig. 8E) with two large discs of porose cuticle (diameter 90–100), each bearing an anterior and posterior pair of unmodified pair of smooth setae 65–70, and a highly modified pair of setae centrally, length 85.

Genital opening (Fig. 9E) length 125–135, width 115, surrounded by a ring of heavily sclerotised cuticle; this cuticle with 12–13 pairs of loosely paired pores laterad genital opening.

Ventrianal shield (Figs 8E) a curved trapezoid, length 300–310, anterior width ca. 420–440, maximum width 545–560, widest just anterior to anus; shield reticulate, with 12–14 loosely paired setae. Peritreme and peritrematal shield similar to female.

Gnathosoma (Figs 10B). Gnathotectum similar to female, medial length 740–770; subcapitulum similar, except with submedial projections (inner length 30–40). Setae h1 smooth, blade-like, 205; setae h2 smooth, 170, setae h3 smooth, 275, palp coxal seta barbed, 210. Corniculi with small medial tooth-like process, corniculi length 350–360. Palp trochanter with distoverventral cusps on trochanter (length 30) and femur (length 30). Chelicerae similar to female.

Legs. Similar to female except distal spurs and spines larger, and small spurs on femur and genu I.

Etymology. It is with great pleasure that I name this species for my niece Simone West.

Differential diagnosis. *Megisthanus simoneae* is most similar to *M. thorelli* in having females with two distinct types of setae on the dorsal shield, one being long with few barbs, the other being short and heavily barbed. The two species are most easily separated by the form of these shorter setae, a feature most apparent on the mid-opisthonotum. In *M. simoneae*, the shorter setae appear as shorter and more barbed versions of the long setae (Fig. 11A), but in *M. thorelli* the short setae are even shorter, thicker and more densely and strongly barbed (Fig. 11B).

Remarks. *Megisthanus simoneae* is found on *Mastachilus polyphyllus*, a passalid species infrequently collected from south-east Queensland. Records tend to be from relatively drier forests compared to the preferred rainforest habitats of many passalid species, including the host species of *M. thorelli*, the putative closest relative of *M. simoneae*.

***Megisthanus southcotti* sp. nov.**

Figures 12–15

Material examined. **Australia, Queensland,** ex *Aulacocyclus fracticornis* Kuwert, 1891: Holotype female, Mossman Gorge, 31.i.1996, O. Seeman, ex beetle #66 (log 1, passalid 1, pr A) (QMS 109486). In QM. Paratypes: 14 females, 7 major males, as follows. 1 female, same data as holotype (QMS 109488); 1 female, same data except ex beetle #71 (log 2 passalid 1) (QMS 109487); 1 major male, same data except ex beetle #220 (log 1, passalid 2, pr A) (QMS109489); 1 female, Wongabel, Atherton, 28.i.1996, O. Seeman, ex beetle #119 (log 1, passalid 3) (QMS109490); 1 major male, same data except ex beetle #86 (log 1, passalid 1) (QMS109491); 1 female, 1 major male, Gadgarra, Atherton, 27.i.1996, O. Seeman, ex beetle #90 (log 2, passalid 7) (QMS 109492–3); 1 major male, same data except ex beetle #92 (log 2, passalid 8) (QMS 109494); 1 female, Oliver Ck, Cape Tribulation, 30.i.1996, O. Seeman, ex beetle #17 (log 3, passalid 2) (QMS 109495); 1 major male, same data except ex beetle #14 (log 5, passalid 1) (QMS 109496); 1 major male, same data except ex beetle #8 (log 2, passalid 1) (ANIC 51-006453); 1 female, Earthwatch Site, Cape Tribulation, 30.i.1996, O. Seeman, ex beetle #51 (log 2, passalid 3) (ANIC 51-006452); 3 females, 1 male, 8 miles east Wondecla, 24.x.1943, R.V. coll., ex passalid (J17309–12). 2 females, Longlands Gap Rd, near Herberton, 10.i.1950, J.C. Brooks, ex small carabid (J17307–8). 1 female, Atherton Tablelands, 28.iii.1945, D.L. Pollier (J17328). Specimens with J-numbers in SAM, others in QM except one paratype female and paratype male in ANIC.

Other material examined, Queensland, ex *Austropassalus hultgreni* Mjöberg, 1917: 1 female, Mt Lewis Rd, Mt Lewis, 30.i.1996, O. Seeman, (beetle #57, log 1, passalid 2). 1 female, same data, except beetle #68 (log 1, passalid 5).

Diagnosis. *Female and male.* Sternal setae st4 absent. Seta pd2 of femur IV on rudimentary projection. Dorsal shield finely punctate. Ventrianal shield widest at posterior level of anus. *Female.* Dorsal shield ovate, length 1.95–2.05 mm, maximum width 0.85–1.05 mm, not including secondary sclerotisation. Most dorsal shield setae 90–120 in length, with fine but conspicuous barbs; some marginal setae thicker and longer; podonotum and opisthonotum densely setose. Sternogynal shields weakly fused posteriorly, each bearing 4–7 setae; internal genitalia with rudimentary latigynal element. Ventrianal shield a rounded trapezoid. *Major male.* Broader than female, dorsal shield length 1.95–2.20 mm, width 1.40–1.60 mm; setae on soft cuticle laterad dorsal shield short, length 15–30; 130–160 setae around genital opening; corniculi lacking medial inner tooth; setae h1-h2 smooth, h3 and palp coxal setae smooth or with 1–2 barbs.

Description. *Female.* *Dorsum* (Figs 12A, 13B). Idiosomal length 2.30 mm (2.20–2.30 mm), width 1.50 mm (1.25–1.50 mm), body length (including gnathosoma, to tip of gnathotectum) 2.80 mm (2.60–2.80 mm). Dorsal shield ovate, length 1.95 mm (1.80–2.05 mm), width 0.95 mm (0.85–1.05 mm); secondary sclerotisation absent or present (including holotype, Fig. 12A), mostly posterolaterally and posteriorly; maximum length of dorsal shield including secondary sclerotisation 2.20 mm, width 1.10 mm. Dorsal shield hypertrichous, especially mid-dorsally, setation sparser at margins and off dorsal shield. Most dorsal shield setae with several conspicuous but fine barbs, length 80–100; anterior and lateral setae similar but longer, and several marginal setae thicker and much longer (up to 360); posterior dorsal shield setae slightly longer, length 90–120 (Fig. 13B). Dorsal shield cuticle with obvious but fine punctation. Setae in soft cuticle with small barbs, on small platelets; mediolateral setae close to dorsal shield long (170–320), other setae much shorter (50–115).

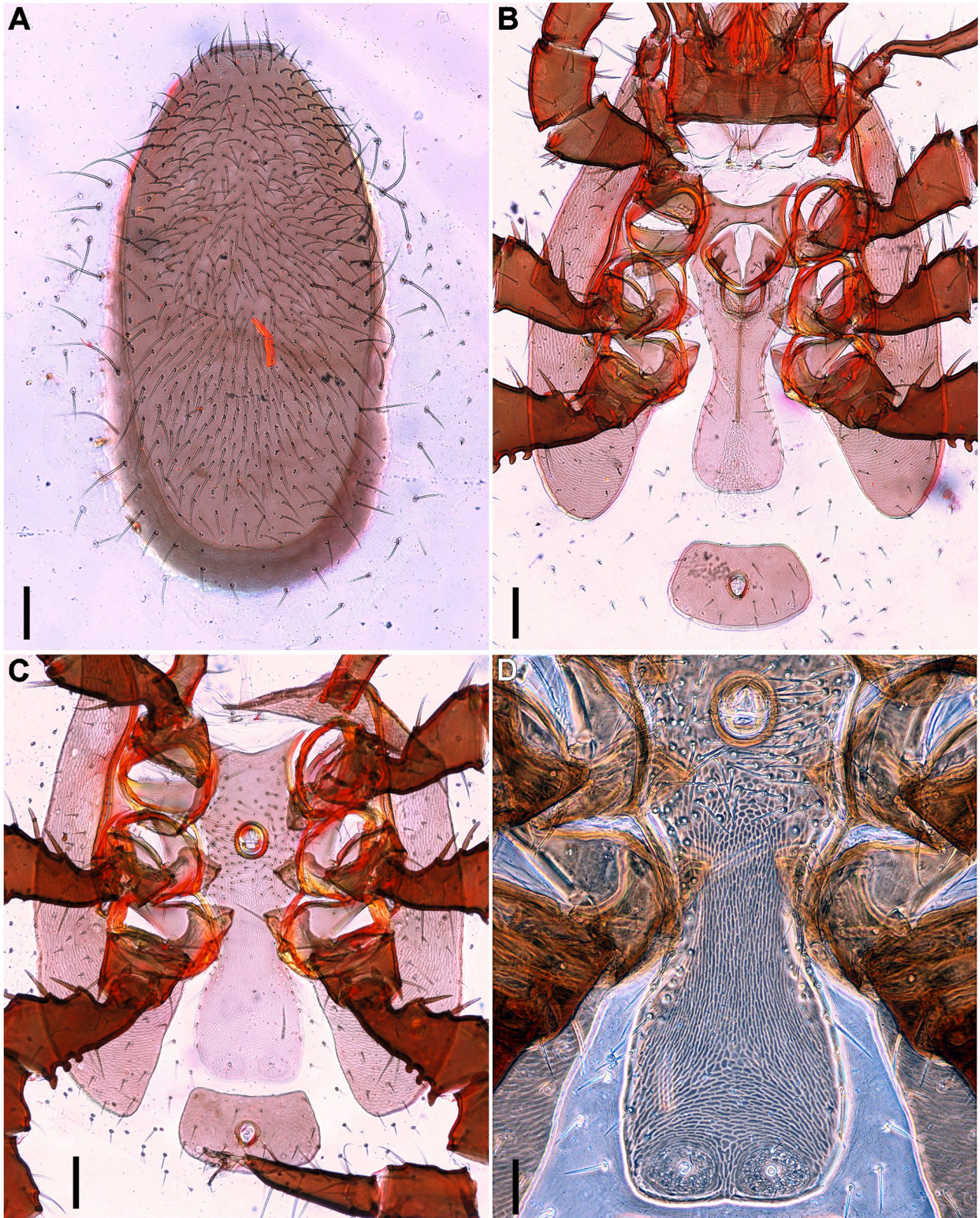


FIGURE 12. *Megisthanus southcotti* sp. nov. photomicrographs. (A) female, dorsal shield; (B) female, venter; (C) major male, venter; (D) major male, sternovenral shield. Scale bars: 200 μ m (A–C), 100 μ m (D).

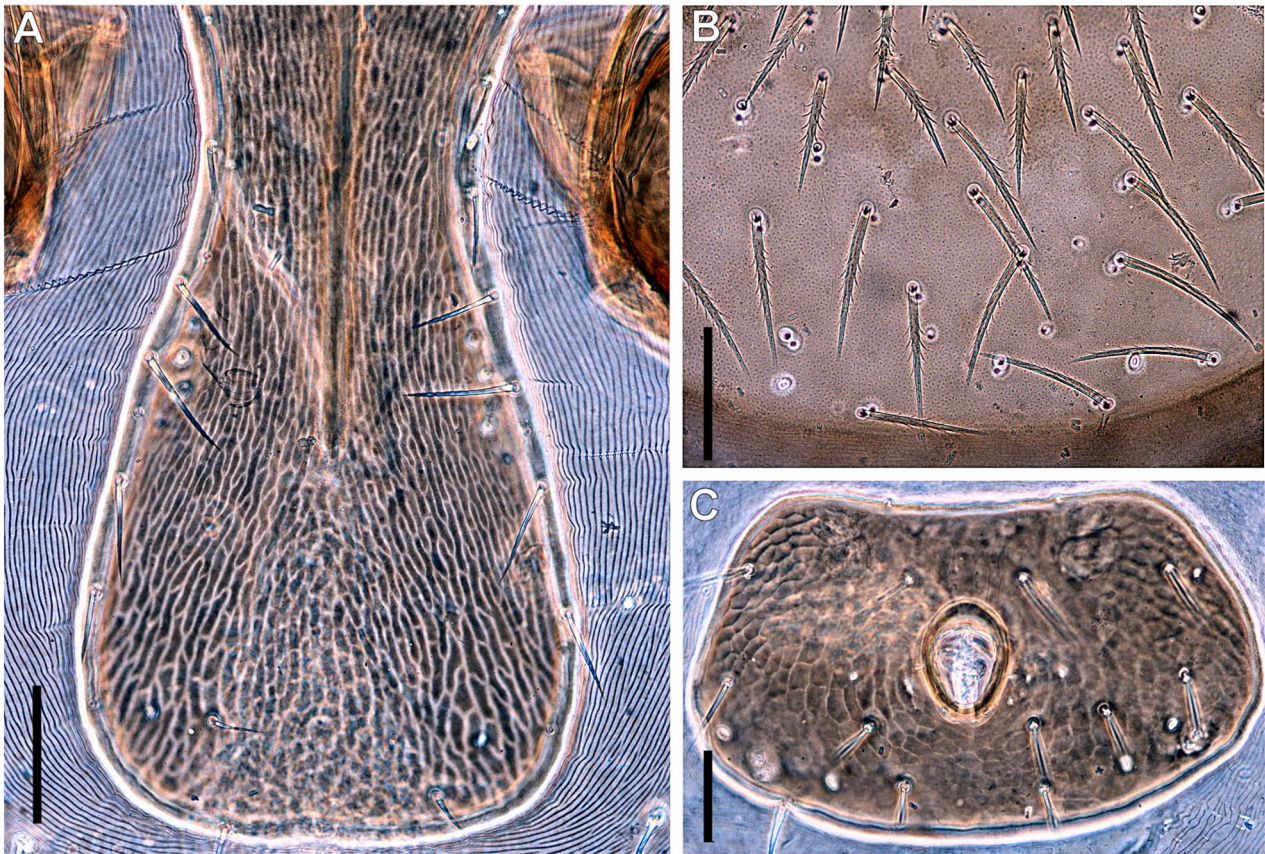


FIGURE 13. *Megisthanus southcotti* sp. nov. female, photomicrographs. (A) ventral shield; (B) posterior dorsal shield; (C) ventrianal shield. Scale bars = 100 μ m.

Venter (Figs 12B, 13A, 13C, 14A–B). Setae st1 sparsely barbed, length 140 (135–155). Sternal shield (Fig. 14A) reticulate, with 2 pairs of setae, 5–6 pairs of pores opening ventrally, without pores opening laterally; setae st2–3 sparsely barbed, st2 length 110 (100–110), st3 length 90 (75–95); st4 absent; shield medial length 60 (55–70).

Sternogynal shields (Figs 14A) weakly fused posteriorly, genital opening length 255 (255–265), width 285 (280–290), each sternogynal shield length 220 (220–240), weakly lineate-reticulate, each bearing 4 (4–7, asymmetry present) setae and one lyrifissure; anterior seta thicker, longer 90 (85–110) than posterior setae (50–65). Internal genitalia comprises three obvious elements (*mg*, *va*, *vh*) and rudimentary latigynal (*lg*) elements (Fig. 14B); rudimentary latigynal elements fused with thickened margin of sternogynal shield, with small porose area near attachment of vaginal arms with sternogynal shield.

Ventral shield (Figs 12B, 13A) extends 750 (725–820) posteriorly from posterior margin of genital opening; maximum width behind coxa IV 340 (340–370); shield with 9–12 pairs of setae around shield margin and 5–11 setae within shield and close to sternogynal shield; setae often expressed asymmetrically; setae smooth, length 40–90; shield reticulate posteriorly and posterior to genital opening, remainder lineate-reticulate.

Ventrianal shield a rounded trapezoid (Fig. 13C), anterior width 350 (350–420), maximum width 530 (530–570), length 320 (315–370); shield reticulate; 12–16 loosely paired smooth setae, length 55–90.

Peritrematal shield hypertrichous, post-peritrematal region extends 450 (450–520) behind coxa IV into metapodal region (Fig. 12B); setae laterad legs barbed, length 25–50; anterior margin of peritrematal shield with three pairs of long barbed setae, length 150–260.

Gnathosoma (Fig. 15A). Gnathotectum reticulate, medial length 680 (660–690). Subcapitulum with setae h1 240 (230–250), h2 155 (150–160), h3 245 (235–250), pc 135 (135–150), all setae barbed; medial subcapitulum with some fine striae, hypostome smooth. Corniculi length 230 (230–255) with medial tooth. Palp trochanter with ventro-distal spur, length 15 (12–15), palp femur with tiny distal spur, length 5 (5–8). Chelicerae with entire fixed digit length 610 (610–660), movable digit length 355 (350–370). Morphology as per genus description. Fixed digit with 12 teeth; cheliceral seta length 35–45 (not visible in holotype). Movable digit with 10–11 teeth.

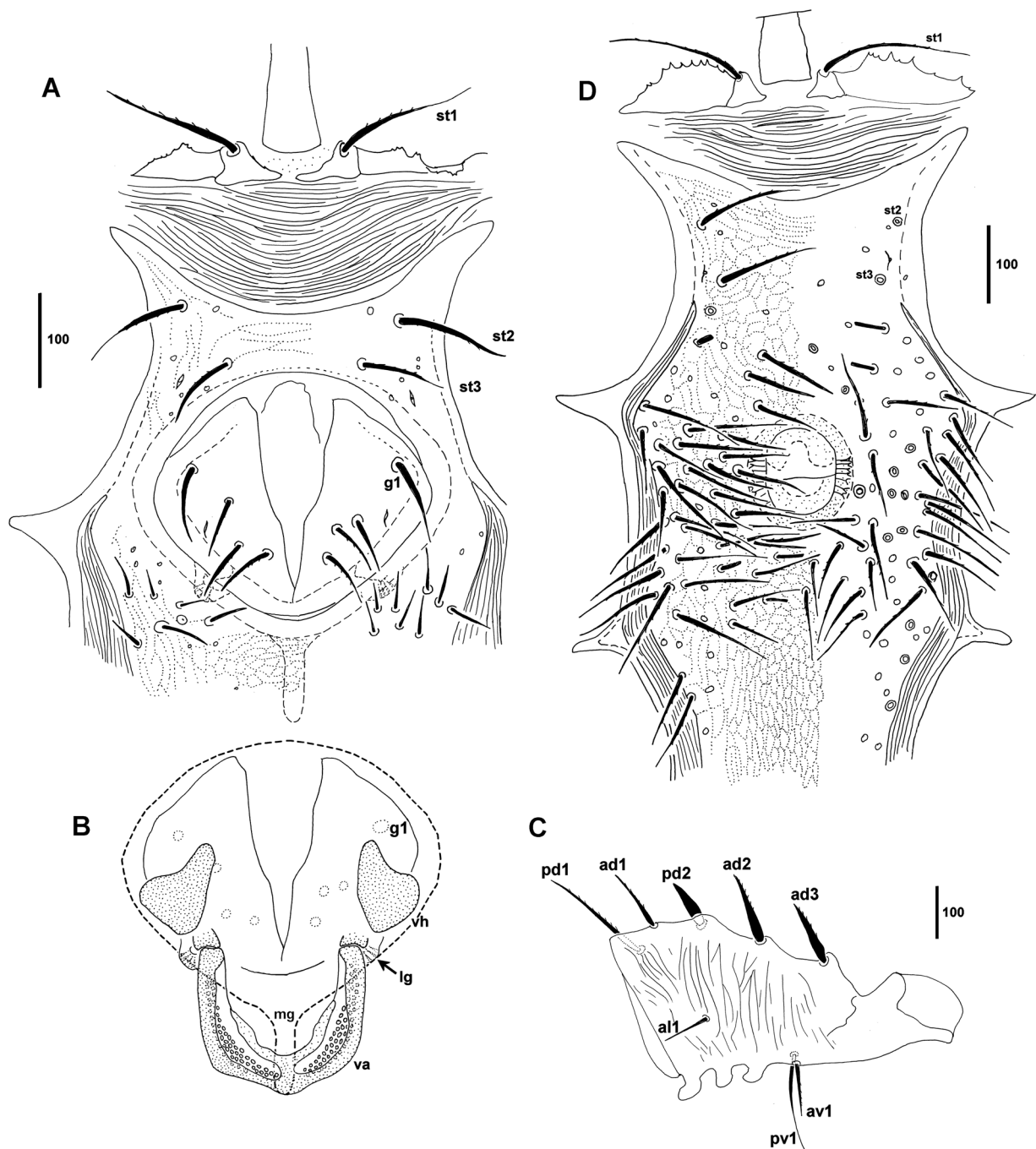


FIGURE 14. *Megisthanus southcotti* sp. nov. (A) female, sternogenital region; (B) internal genitalia; (C) female, femur IV; (D) major male, sternogenital region. Abbreviations: g1 = anterior pair of genital setae; lg = latigynal remnant; mg = mesogynal shield; va = vaginal arms; vh = vaginal heads.

Legs (Fig. 14C). Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, 85–100; seta pd1 on genu III very long, 220–300, much longer than ad1, 100–110, tarsus III ad3 moderately long, length 210–250, femur IV pd1 moderately long, 200–250, genu IV ad1 long, 375–410, pd1 long, length 435–510, tibia IV pd1 long, length 410–460 and tarsus IV ad4 long, length 320–340, pd3 long, length 315–325. Femur IV with small projections bearing setae pd2, ad2, and slightly larger projection bearing setae ad3.

Male (major). *Dorsum*. Idiosomal length 2.20–2.40 mm, width 2.00–2.30 mm, body length (including

gnathosoma, to tip of gnathotectum) 2.60 mm. Dorsal shield ovate, length 1.95–2.20 mm, width 1.40–1.60 mm; secondary sclerotisation absent or present, expanding laterally and posteriorly, length of dorsal shield including secondary sclerotisation 2.05–2.30 mm, width 1.50–1.75 mm. Dorsum hypertrichous. Setae on dorsal shield tiny, smooth, length < 5 excepting few anterior and posterior setae up to 30 in length. Soft membrane with setae smooth, length 15–30.

Venter (Fig. 12C–D, 14D). Setae st1 barbed, length 125–140. Sternoventral shield reticulate, length from posterior margin of genital opening 860–940. Sternal setae st2 and st3 sparsely barbed, length 115–130 and 115–135, respectively; sternoventral shield (Figs 14D) highly hypertrichous posterior to setae st3, with 130–150 setae around genital opening; posterior sternoventral shield with setae along margin; these setae smooth or sparsely barbed, shortest setae 70–80 (posterolateral setae) and longest setae 115–135 (between, and just behind, coxa IV); posterior sternoventral shield (Fig. 12D) with two discs of porose cuticle (diameter 130–145), each bearing an anterior and posterior pair of unmodified pair of smooth setae 20–35, and a highly modified pair of setae centrally, length 40–50.

Genital opening (Fig. 14D) length 115–120, width 90–110, surrounded by a ring of heavily sclerotised cuticle; this cuticle with 6–10 loosely paired pores laterad and posterolaterad genital opening.

Ventrianal shield (Fig. 12C) a curved trapezoid, length 300–365, anterior width 420–450, maximum width 585–660, widest just behind anus; shield reticulate, with 14–16 loosely paired setae. Peritreme and peritrematal shield similar to female.

Gnathosoma (Figs 15B). Gnathotectum similar to female, medial length 780–810; subcapitulum similar, except with submedial projections (inner length 20–40). Setae h1 smooth, 200–215; setae h2 smooth, 125–155, setae h3 smooth or with 1–2 barbs, 210–215, palp coxal seta smooth or with few small barbs, 150–160. Corniculi straight, lacking tooth-like processes, length 365–385. Palp with distoventral cusps on trochanter (length 25–30) and femur (length 40–45). Chelicerae same as female.

Legs. Similar to female except distal spurs and spines larger.

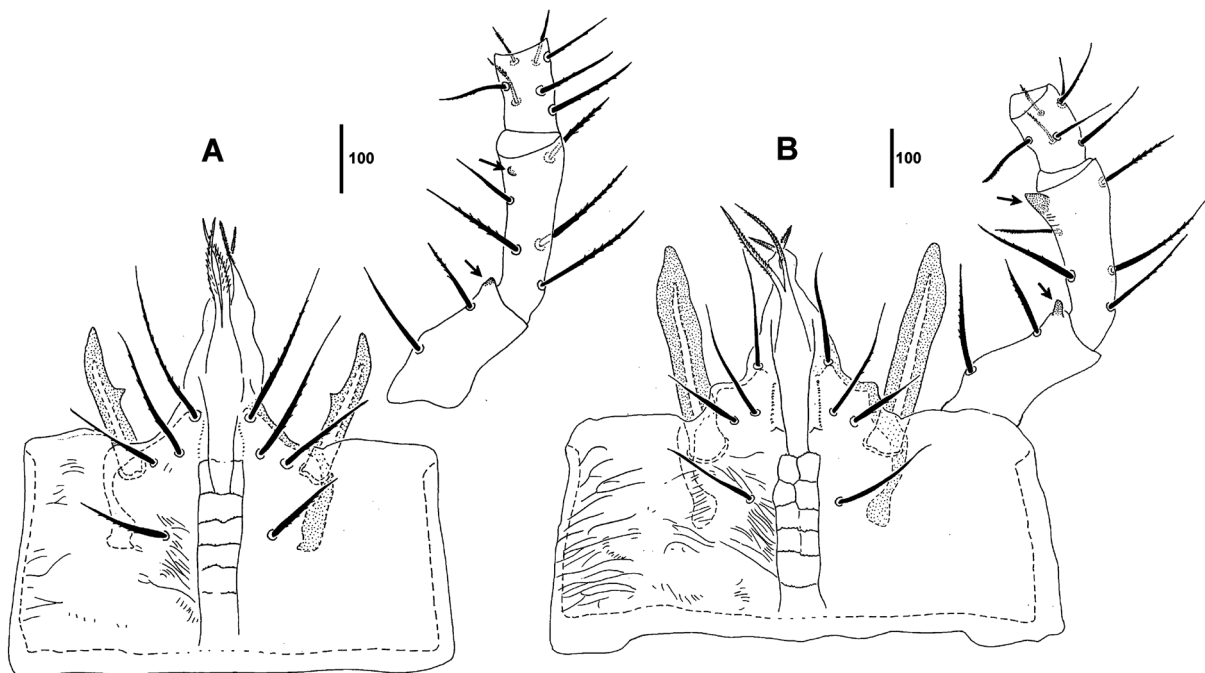


FIGURE 15. *Megisthanus southcotti* sp. nov. (A) female subcapitulum and palp trochanter–genu (shown detached); (B) major male subcapitulum and palp trochanter–genu. Arrows indicate spurs.

Differential diagnosis. This species is most similar to *M. zachariei* in having females with both setae st4 absent and their dorsal setae of all one form, being thin and sparsely barbed. Both species are also the only *Megisthanus* found on the genus *Aulacocyclus*. Female *M. southcotti* are most easily distinguished from *M. zachariei* by the length of the sternogynal setae (60–110 versus 20–35 in *M. zachariei*), and by the number of setae

behind the genital shields within the ventral shield margin (5–11 setae vs 1–2 setae). This reduction in hypertrichy in *M. zachariei* is also apparent in males (Fig. 22E). Female *M. southcotti* also have short dorsal setae with large barbs (longer dorsal setae with small barbs in *M. zachariei*) and a denser setation in the mid-opisthonotal region of the dorsal shield (Figs 12A, 21A).

Remarks. This species is usually found on *A. fracticornis* in north-eastern Queensland. Each beetle tended to carry just one mite each (9 of 11 *A. fracticornis*). Two specimens were collected from the unusual passalid species *Austropassalus hultgreni*. Despite the atypical host, the specimens agree closely with *M. southcotti*.

The specimens from the South Australian Museum were all marked by Dr Herbert Womersley as “*Megisthanus southcotti* n. sp.”, a name that was never published. This material from the South Australian Museum includes an unusual record of two females from a carabid beetle. Considering the strong preference for passalid hosts, this record is treated with suspicion.

Etymology. This species is named for Dr Ronald Southcott, thus fulfilling Dr Herbert Womersley’s intentions to honour one of Australia’s most significant acarologists with this patronym.

Megisthanus womersleyi sp. nov.

Figures 16–18

Type material examined. Australia, Queensland, ex *Protomocoelus australis* (Boisduval, 1835). Holotype female, Iron Range NP, 20.vii.1999, J. Skevington (QMS 109499). Paratype: 1 major male, same data as holotype (QMS 109500). Holotype and paratype deposited in QM.

Other material examined. Papua New Guinea. 1 female, Misima Is., Milne Bay Province, Louisiade Archipelago, Rev. H.K. Bartlett (J17296). 2 females, same data (ex J17373, slide mounted from spirit specimens). 2 females, 2 major males, Misima Is., Rev. Bartlett (SAM J17295, J17297–9, J17364), in very poor condition. All in SAM.

Diagnosis. *Female and male.* Sternal setae st4 present. Seta pd2 of femur IV on large projection. Dorsal shield finely punctate. Ventrianal shield widest posterior to anus. *Female.* Dorsal shield ovate, length 1.80–1.95 mm, maximum width 0.95–1.05 mm, not including secondary sclerotisation. Most dorsal shield setae 50–110 in length, with small barbs; some marginal setae thicker and longer; podonotum and opisthonotum densely setose. Sternogynal shields separate, each bearing 2 setae; internal genitalia with rudimentary latigynal element. Ventrianal shield moderately reniform. *Major male.* Broader than female, dorsal shield length 2.90 mm, width 1.75 mm, without well-developed setae; setae on soft cuticle laterad dorsal shield short, length 25–70; 19 setae around genital opening; corniculi without medial inner tooth; setae h1–3 smooth, palp coxal seta barbed.

Description (Australian specimens). *Female.* *Dorsum* (Figs 16A, C, 17C). Idiosomal length ca. 2.60 mm, width ca. 1.90 mm, body length (including gnathosoma, to tip of gnathotectum) 3.20 mm. Dorsal shield ovate, length 2.50 mm, width 1.40 mm; secondary sclerotisation weakly formed but present laterally and posteriorly (Figs 16A, C); maximum length of dorsal shield including secondary sclerotisation 2.55 mm, width 1.45 mm. Dorsal shield hypertrichous, densely setose excepting narrow band of bare cuticle posteriorly just within margin. Dorsal shield setae with small barbs, moderately short, length 50–110 (Figs 16C, 17C), excepting few anterolateral and posterolateral setae (up to 275); posterior margin with large setal sockets suggesting very long setae are present but broken off. Dorsal shield cuticle appearing smooth, with inconspicuous fine punctation. Setae in soft cuticle barbed, on small platelets, length 50–100, excepting some posterolateral setae close to dorsal shield long (up to 720).

Venter (Figs 16B, 17A, B). Setae st1 broken. Sternal shield (Fig. 17A) reticulate, with 3 pairs of setae, 1–2 pairs of pores opening ventrally, 1–3 pores opening laterally, and one pair of lyrifissures; setae st2–3 sparsely barbed, st4 smooth, st2 ca. 100, st3 100, st4 55; shield medial length 85.

Sternogynal shields (Figs 17A) free posteriorly, genital opening length 260, width 320, each sternogynal shield length 240, weakly lineate-reticulate, each bearing 2 setae and one lyrifissure; anterior seta similar in form and length to other setae (20–25), smooth. Internal genitalia comprises three obvious elements (*mg*, *va*, *vh*) and rudimentary latigynal (*lg*) elements (Fig. 17B); rudimentary latigynal elements fused with thickened margin of sternogynal shield, with small porose area near attachment of *va* with sternogynal shield.

Ventral shield (Fig. 16B) extends 1040 posteriorly from posterior margin of genital opening; maximum width

behind coxa IV 430; shield with 13–15 pairs of setae around shield margin, one pair posteriorly within shield, and without setae off shield margin close to sternogynal shield; some setae expressed asymmetrically; setae smooth, length 40–100; shield reticulate posteriorly, otherwise lineate-reticulate.

Ventrianal shield trapezoidal (Fig. 16B), with anus in anterior half of shield; anterior width ca. 400, maximum width posterior to anus, 600, length 400; shield reticulate anteriorly, reticulation evanescent posteriorly; 16 loosely paired, smooth setae, length 75–120.

Peritrematal shield hypertrichous, post-peritrematal region extends 760 behind coxa IV into metapodal region (Fig. 16B); setae laterad legs smooth, length 40–60, those directly above legs III–IV not much shorter than other setae; three pairs of long setae on anterior margin of peritrematal shield broken.



FIGURE 16. *Megisthanus womersleyi* sp. nov. photomicrographs (A) female, dorsum; (B) female, venter; (C) female, posterior dorsal shield; arrows indicate sockets of broken large setae along posterior margin; (D) major male, chelicera, showing dendritic excrescences characteristic for Megisthanidae. Scale bars: 200 μ m (A–B); 100 μ m (C–D).

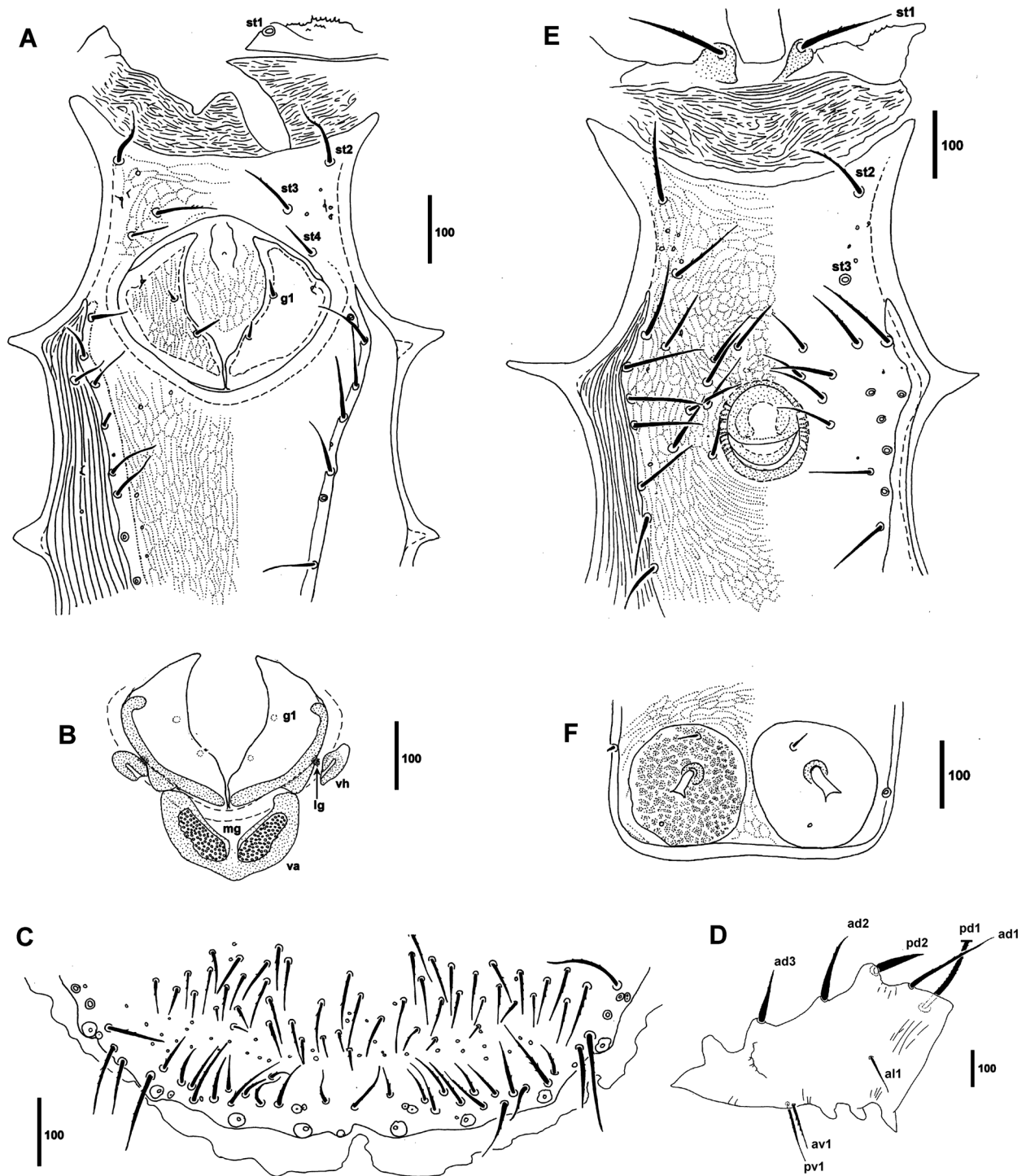


FIGURE 17. *Megisthanus womersleyi* sp. nov. female. (A) sternogenital region; (B) internal genitalia; (C) female, posterior dorsal shield, large setae broken (large sockets along margin remain), note submarginal porose band; (D) female, femur IV; (E) major male, sternogenital region; (F) major male, posterior margin of ventral shield. Abbreviations: g1 = anterior pair of genital setae; lg = latigynal remnant; mg = mesogynal shield; va = vaginal arms; vh = vaginal heads.

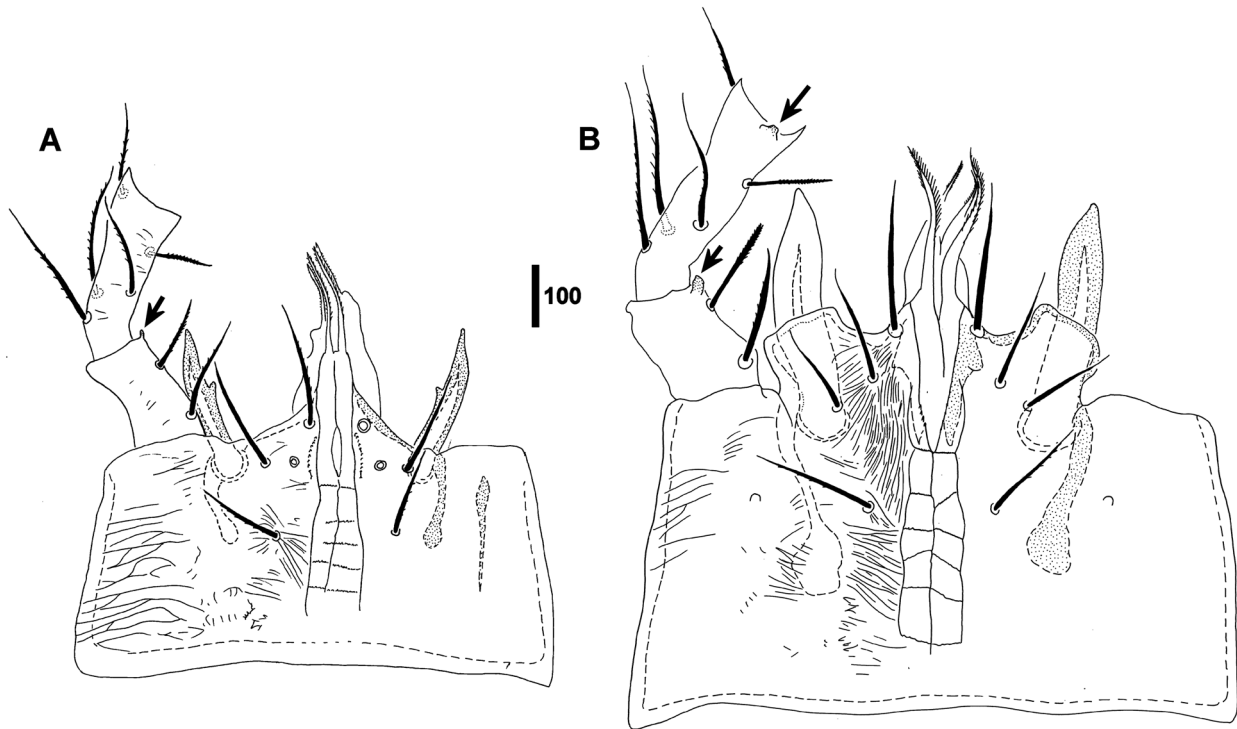


FIGURE 18. *Megisthanus womersleyi* sp. nov. (A) female, subcapitulum and palp trochanter–femur; (B) major male, subcapitulum and palp trochanter–femur. Arrows indicate spurs.

Gnathosoma (Fig. 18A). Gnathotectum reticulate, medial length 700. Subcapitulum with setae h1 285, h2 180, h3 broken, pc 175, all setae sparsely barbed; medial subcapitulum with some fine striae, hypostome smooth. Corniculi length 265 with medial tooth. Palp trochanter with small ventro-distal spur, length 10–15, palp femur without distal spur. Chelicerae (Fig. 16D) with entire fixed digit length 720, movable digit length 405. Morphology as per genus description. Fixed digit with 13 teeth; cheliceral seta length 30. Movable digit with 12 teeth.

Legs (Fig. 17D). Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, length 140–150; seta pd1 on genu III long, 425, much longer than ad1, 185, tarsus III ad3 moderately long, 250, femur IV pd1 long, > 360, genu IV ad1 very long, ca. 600, pd1 broken, tibia IV pd1 long, 570 and tarsus IV ad4 long, 360, pd3 long, 370. Femur IV with large projections bearing setae pd2, ad3, small projection bearing setae ad2.

Male (major) (n = 1). *Dorsum*. Idiosomal length ca. 3.00 mm, width ca. 2.10 mm, body length (including gnathosoma, to tip of gnathotectum) ca. 3.70 mm. Dorsal shield ovate, length 2.90 mm, width 1.75 mm; secondary sclerotisation present but weakly formed. Dorsum hypertrichous. Setae on dorsal shield tiny, smooth, length < 5. Setae in soft membrane close to dorsal shield smooth, becoming more barbed and longer laterally, length 25–70; some setae near posterolateral and posterior margin of shield also long (to 120).

Venter (Figs 17E–F). Setae st1 barbed, length 150. Sternoventral shield reticulate, length from posterior margin of genital opening 1190. Sternal setae st2 and st3 barbed, length 130; setae st4 indistinguishable among other sternoventral setae; sternoventral shield (Fig. 17E) hypertrichous posterior to setae st3, with 19 setae around genital opening; posterior sternoventral shield with setae along margin; these setae smooth or sparsely barbed, shortest setae 70 (mesad coxa IV) and longest setae 140 (anterolaterad genital opening); posterior sternoventral shield (Fig. 17F) with two large discs of porose cuticle (diameter 190), each bearing an anterior and posterior pair of unmodified pair of smooth setae 25–30, and a highly modified pair of setae centrally, length 50.

Genital opening (Fig. 17E) length 125, width 115, surrounded by a ring of heavily sclerotised cuticle; this cuticle with 11–12 loosely paired pores laterad genital opening.

Ventrianal shield a curved trapezoid, length 500, anterior width ca. 430, maximum width 660, widest posterolaterally, well behind anus; shield reticulate, with 12 loosely paired setae. Peritreme and peritrematal shield similar to female.

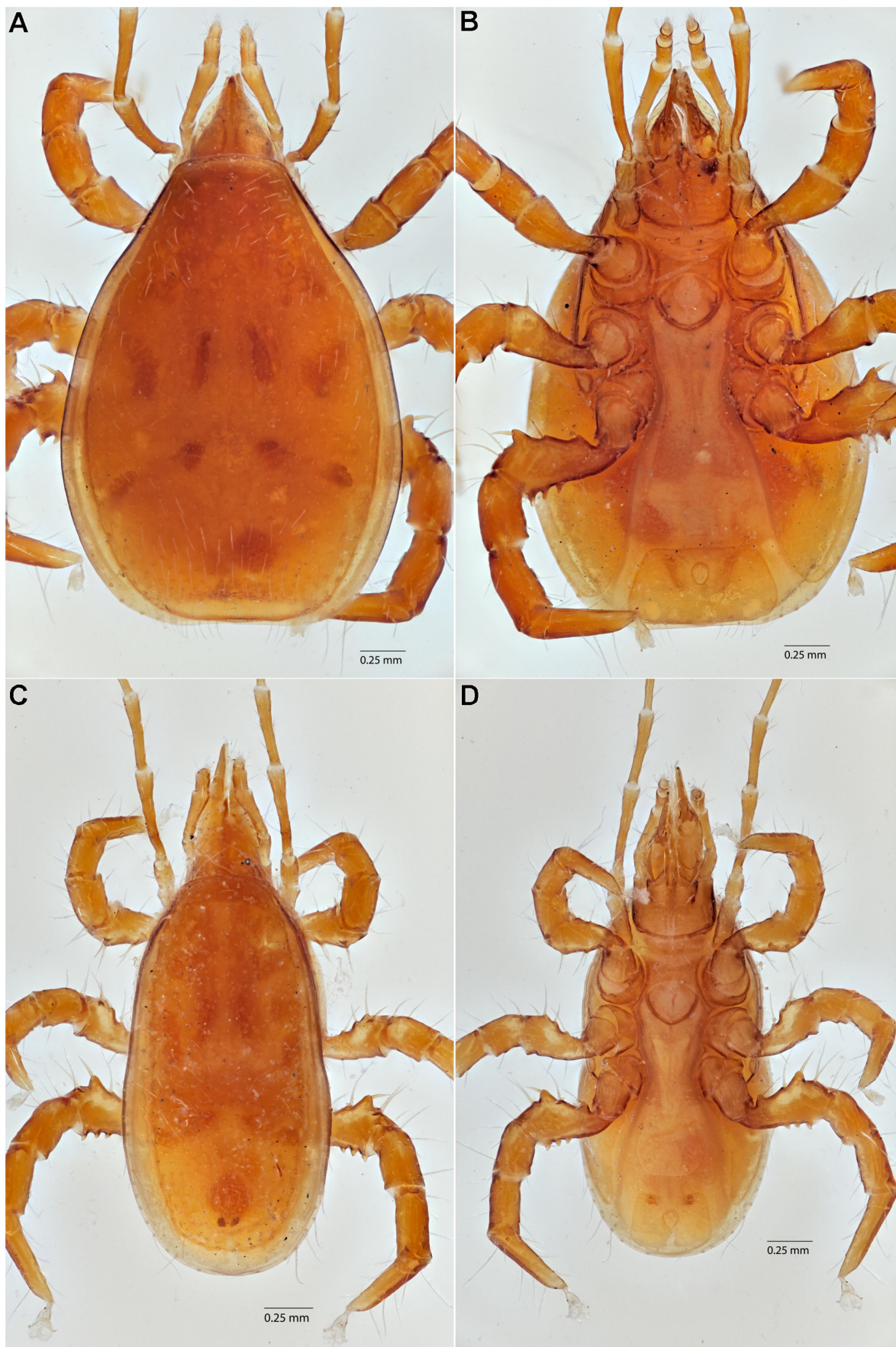


FIGURE 19. Photographs of the holotypes of *Megisthanus doreianus* Thorell, 1882, (A) dorsum; (B) venter; and *Megisthanus hatamanensis* Thorell, 1882, (C) dorsum; (D) venter. Photographs by Geoff Thompson, Queensland Museum.



FIGURE 20. The holotype of *Megisthanus postsetosus* Karg, 1997 (ZMB 45476). (A) photograph; (B) detail of posterior idiosoma, drawn from photograph. Photograph by Anja Friederichs from the Museum für Naturkunde Berlin.

Gnathosoma (Fig. 18B). Much larger than female gnathosoma. Gnathotectum similar to female, medial length 910; subcapitulum similar, except with large submedial projections (inner length 75). Setae h1 smooth, blade-like, 250; setae h2 smooth, 140, setae h3 smooth, 215, palp coxal seta barbed, 170. Corniculi without tooth-like processes, length 410. Palp trochanter with distoventral cusps on trochanter (length 30) and femur (length 15–20). Chelicerae similar to female except fixed digit with 17 teeth and movable digit with 13 teeth.

Legs. Similar to female except distal spurs and spines larger.

Differential diagnosis. *Megisthanus womersleyi* is most similar to five species of *Megisthanus* from New Guinea, as discussed below. *Megisthanus womersleyi* can be most easily distinguished from these species by the density of its dorsal setation, which is far greater than all other species from Australia and New Guinea.

Remarks. With the description of *M. womersleyi* **sp. nov.**, six species are now known from New Guinea, the others being: *Megisthanus doreianus* Thorell, 1882, *M. hatamensis* Thorell, 1882, *M. moaifensus* Oudemans, 1905, *M. orientalis* Oudemans, 1905, *M. papuanus* Womersley, 1937 and *M. postsetosus* Karg, 1997. All these species belong to a species group, previously found only in New Guinea, which is defined by a large dorsal tubercle on leg IV that carries seta pd2. Unlike all other Australian species, these species also have eroded medial margins of the sternogynal shield, so that they appear to form C-shaped shields.

Womersley (1937) originally identified the specimens from Misima Island as *M. doreianus*. To determine if Womersley's original decision was correct, I examined the holotypes of *M. doreianus*, *M. hatamensis*, *M. papuanus*, photographs of the holotype of *M. postsetosus*, and the drawings of Oudemans' species *M. moaifensus* and *M. orientalis*. *Megisthanus papuanus* is clearly different from all other species of *Megisthanus*, as explained under the separate treatment for that species. However, all the other species are similar to those of Womersley's specimens identified as *M. doreianus* (i.e. *M. womersleyi* **sp. nov.**), yet his specimens differ in one important aspect: the density of dorsal setation. Womersley's specimens have a dense pelage of setae (Fig. 16A), while all other species have considerably sparser covering setae (Figs 19–20; Oudemans Mite Collection, Wikimedia Commons).

The specimens from Iron Range match those of the New Guinea specimens closely. The host beetle, *Protomocoelus australis*, is found in the isolated pockets of rainforest in northern Cape York (such as Iron Range), as well as New Guinea, the Solomon Islands, New Britain, Seram, Waigeo and the Aru Islands (Gravelly 1914). This biogeographic pattern is matched by other genera of Indonesian and New Guinean Passalinae, such as *Gonatas* and *Labienuus*, which are also found only in Cape York in Australia. Southern regions are instead occupied mostly by species of *Pharochilus* and *Mastachilus*, as well as the widespread genus *Aulacocyclus*, which occurs throughout southeast Asia, northern Australia and along its east coast.

The other species of *Megisthanus* from New Guinea, excepting *M. papuanus*, are more difficult to separate from each other. The species described by Oudemans, *M. moaifensus* and *M. orientalis*, are both depicted with long setae, while the dorsal setae of *M. doreianus*, *M. hatamensis* and *M. postsetosus* are considerably shorter (Figs 19–20). These species may also differ in the form of the posterior setae on the dorsal shield, which comprise a row of short stiff setae in *M. moaifensus* and *M. orientalis*, as well as several very long setae, which are also present in *M. postsetosus*; these setae are either absent or broken in *M. doreianus* and *M. hatamensis*. The shape of the anal shield may also help separate species, with *M. doreianus*, *M. moaifensus* and *M. postsetosus* having a broad shield approximately twice as wide as long, and *M. hatamensis* and *M. orientalis* having a squarer shield approximately 1.5 x as wide as long. The species of New Guinea require revision based on new material so that intraspecific variation, host beetles and male morphology become known.

Etymology. This species is named in honour of Australian acarologist Dr Herbert Womersley, who treated the specimens from Misima Island under *M. doreianus* in his revision of the Megisthanidae (Womersley 1937).

***Megisthanus zachariei* sp. nov.**

Figures 21–23

Material examined. Australia, Queensland, ex *Aulacocyclus kaupii* Macleay, 1871. Holotype female, Goomburra State Forest, 27°58'S 152°19'E, 18.iv.2012, O. Seeman, H. Urbina & J. Bartlett (QMS 109500). Paratype: 1 major male, same data as holotype (QMS 109501). Holotype and paratype deposited in QM.

Diagnosis. *Female and male.* Sternal setae st4 absent. Seta pd2 of femur IV on rudimentary projection. Dorsal shield finely reticulate. Ventrianal shield widest at mid-level of anus. *Female.* Dorsal shield ovate, length 2.20 mm,

maximum width 1.15 mm, not including secondary sclerotisation. Dorsal setae long (160–380), smooth anteriorly, sparsely barbed posteriorly; podonotum more setose than opisthonotum. Sternogynal shields separate, each bearing 3–4 setae; internal genitalia with rudimentary latigynal element, small mesogynal element. Ventrianal shield weakly reniform. *Major male*. Larger than female, dorsal shield length 2.45 mm, width 1.70 mm; setae on soft cuticle laterad dorsal shield short to moderate length, 40–100; 25 setae around genital opening; corniculi with small medial inner tooth; setae h1–3 smooth, palp coxal seta barbed.

Description. Female ($n = 1$). Lightly sclerotised specimen. Dorsum (Figs 21A, C, 22A). Idiosomal length ca. 2.35 mm, width 1.60 mm, body length (including gnathosoma, to tip of gnathotectum) 3.05 mm. Dorsal shield ovate, length 2.20 mm, width 1.15 mm; secondary sclerotisation absent. Dorsal shield hypertrichous, densely setose anteromedially; all setae long (160–380), longest laterally, setae smooth anteriorly and sparsely barbed posteriorly. Dorsal shield cuticle finely reticulated. Setae in soft cuticle barbed, on small platelets, length 180–550, longer posterolaterally.

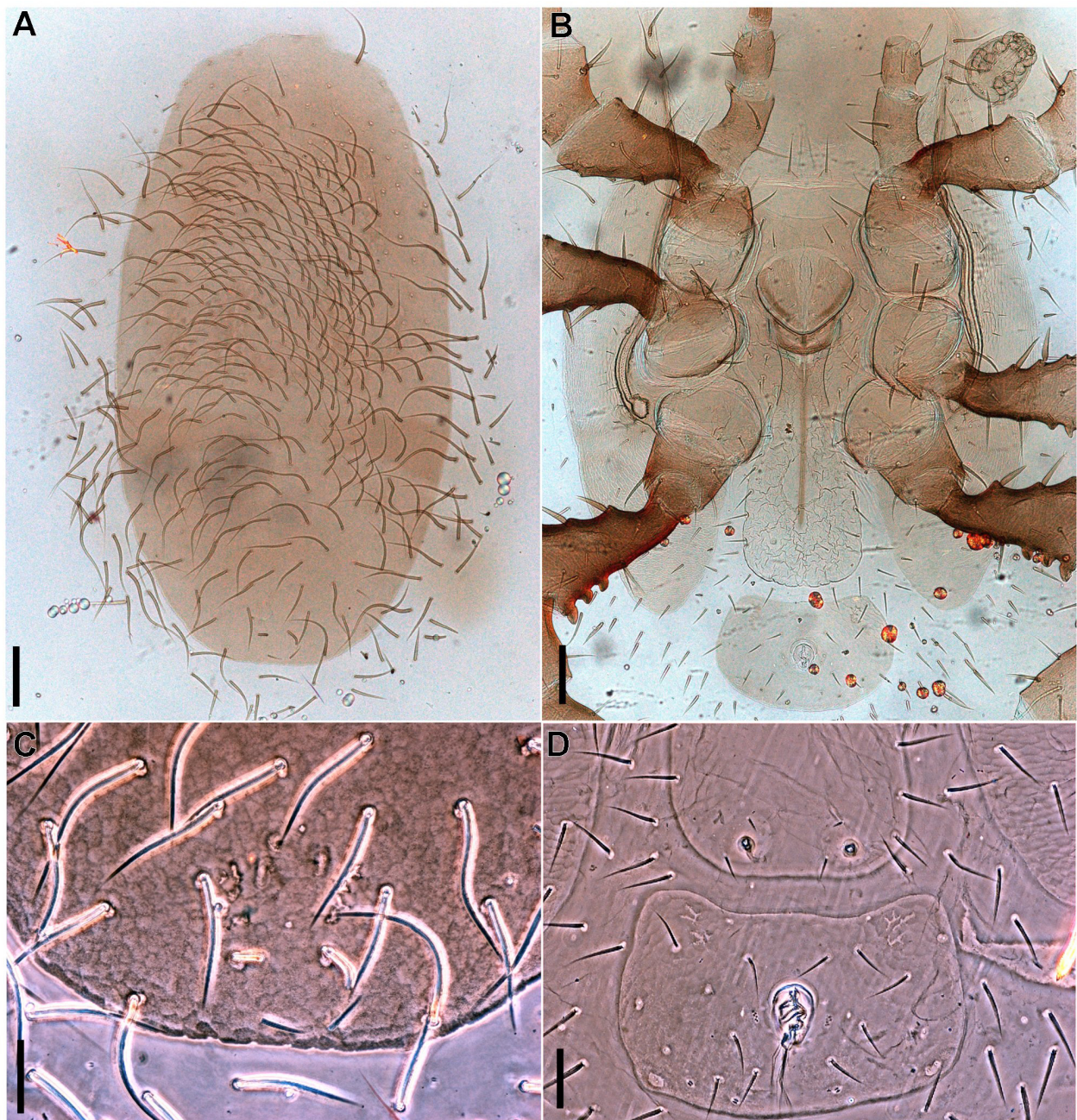


FIGURE 21. *Megisthanus zachariei* sp. nov. photomicrographs. (A) female dorsal shield; (B) female venter; (C) female posterior dorsal shield; (D) major male ventrianal shield. Scale bars: 200 μ m (A–B); 100 μ m (C–D).

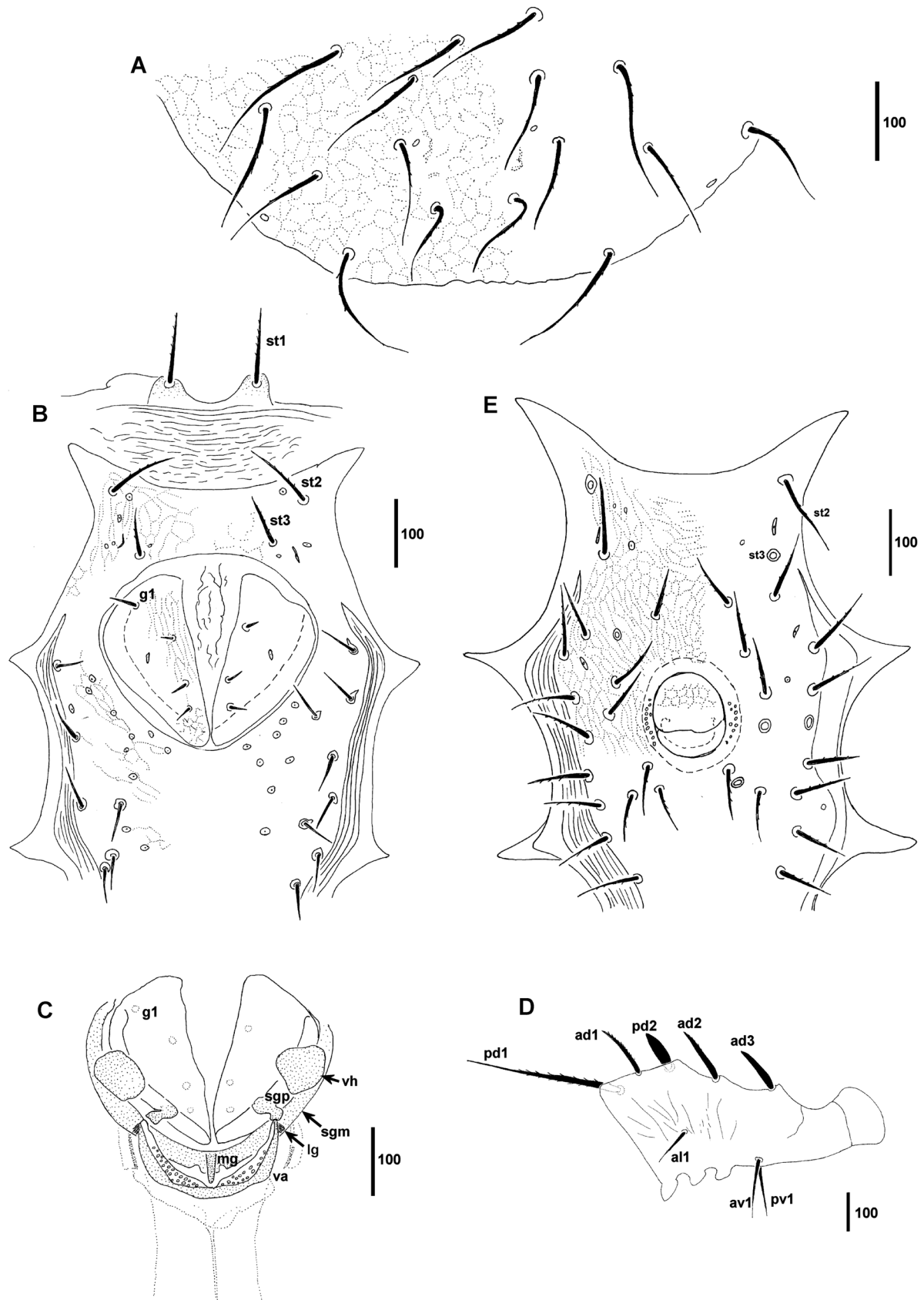


FIGURE 22. *Megisthanus zachariei* sp. nov. (A) female, posterior dorsal shield; (B) female, sternogenital region; (C) internal genitalia; (D) female, femur IV; (E) major male, sternogenital region. Abbreviations: g1 = anterior pair of genital setae; lg = latigynal remnant; mg = mesogynal shield; va = vaginal arms; vh = vaginal heads.

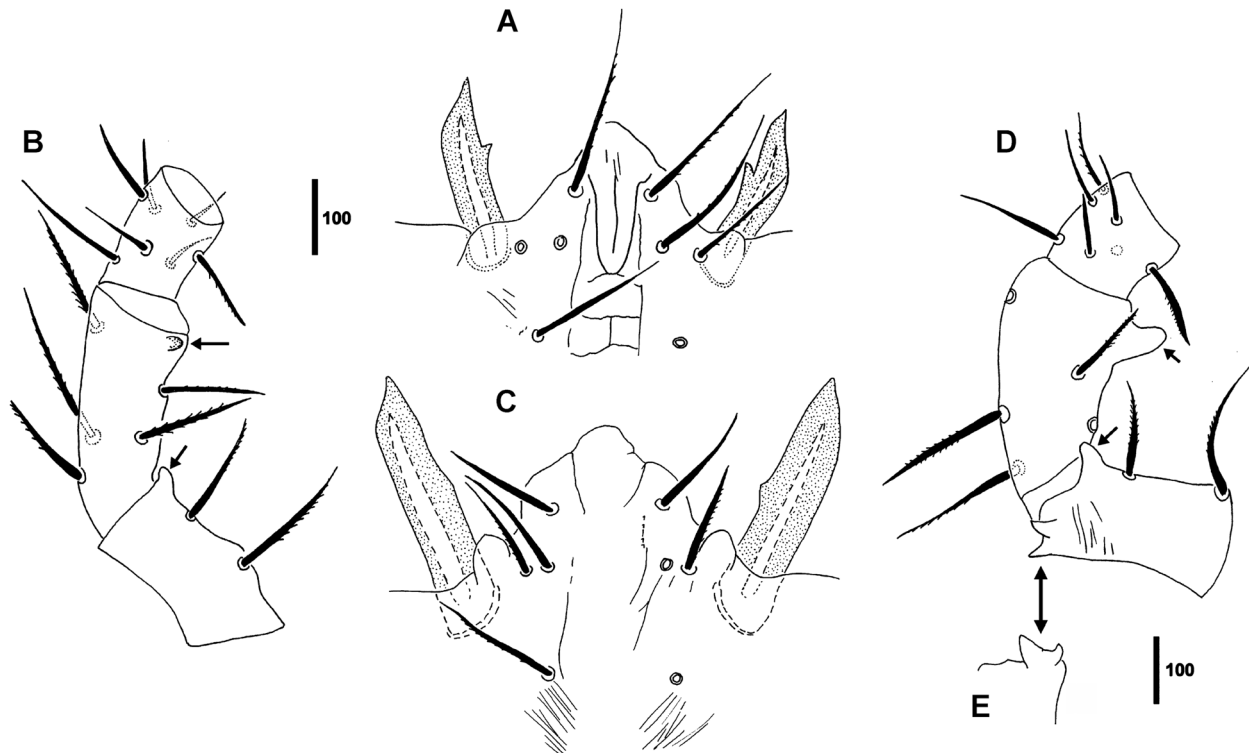


FIGURE 23. *Megisthanus zachariei* sp. nov. (A) female anterior subcapitulum; (B) female palp, trochanter–genu; (C) major male anterior subcapitulum; (D) major male palp, trochanter–genu; (E) palp trochantal spur, aspect from right palp. Arrows indicate spurs.

Venter (Figs 21B, 22B–C). Setae st1 135, sparsely barbed. Sternal shield (Fig. 22B) reticulate, with two pairs of setae, 3–4 pairs of pores opening ventrally and one pair of lyrifissures; setae st2–3 sparsely barbed, st2 100, st3 80, st4 absent; shield medial length 100.

Sternogynal shields (Fig. 22B) free posteriorly, genital opening length 305, width 340, each sternogynal shield length 270, lineate-reticulate, each bearing 3–4 smooth setae and one lyrifissure; anterior setae (35) slightly thicker and longer than posterior setae (20–30). Internal genitalia comprises three obvious elements (*mg*, *va*, *vh*) and rudimentary latigynal (*lg*) elements (Fig. 22C); rudimentary latigynal elements fused with thickened margin of sternogynal shield, with small porose area near attachment of *va* with sternogynal shield.

Ventral shield (Fig. 21B) extends 880 posteriorly from posterior margin of genital opening; maximum width behind coxa IV 420; shield with 12–13 pairs of setae around shield margin, 1 pair posteriorly within shield (holotype, just within margin), and with 1–2 pairs of setae off shield margin close to sternogynal shield; setae smooth, length 45–90; shield rugose due to incomplete sclerotisation.

Ventrianal shield slightly reniform (Fig. 21B), with anus in centre of shield; anterior width ca. 440, maximum width at mid-level of anus, 620, length 380; shield reticulate; 14–16 loosely paired, smooth setae, length 55–80.

Peritrematal shield hypertrichous, post-peritrematal region extends 530 behind coxa IV into metapodal region (Fig. 21B); setae laterad legs smooth to sparsely barbed, length 30–55; three pairs of long setae on anterior margin of peritrematal shield, length to 250.

Gnathosoma (Figs 23A–B). Gnathotectum reticulate, medial length 690. Subcapitulum with setae h1 260, h2 145 (detached), h3 240 (detached), pc 185, all setae sparsely barbed; subcapitulum poorly sclerotised, with some fine striae, subcapitular gutter with five folds where rows of denticles should be. Corniculi length 250 with medial tooth. Palp (Fig. 23B) trochanter with ventro-distal spur, length 30, palp femur with distal spur, length 15. Chelicerae with entire fixed digit length 660, movable digit length 380. Morphology as per genus description. Fixed digit with 13 teeth; cheliceral seta length 30. Movable digit with 10 teeth; excrescences not apparent due to poor sclerotisation.

Legs (Fig. 22D). Setation as per genus description. Selected setal measurements: genu II setae ad1, pd1 subequal, length 90–110; seta pd1 on genu III long (length 525), much longer than ad1 (length 135), tarsus III ad3 moderately long, length 250, femur IV pd1 long, length 420, genu IV ad1 very long, length ca. 500, pd1 ca. 500, tibia IV pd1 long, length ca. 500 and tarsus IV ad4 long, length ca. 350, pd3 long, length ca. 300. Femur IV with rudimentary projections bearing setae pd2, ad2, larger projection bearing seta ad3.

Male (major) (n = 1). Lightly sclerotised specimen. *Dorsum*. Idiosomal length ca. 2.50 mm, width ca. 1.70 mm, body length (including gnathosoma, to tip of gnathotectum) ca. 3.35 mm. Dorsal shield ovate, length 2.45 mm, width 1.45 mm; secondary sclerotisation absent. Dorsum hypertrichous. Most setae on dorsal shield tiny, smooth, length < 5; some marginal setae longer (30–80), especially anteriorly and posteriorly. Setae in soft membrane close to dorsal shield sparsely barbed, short to moderate length (40–100), becoming more barbed and longer laterally; platelets and pores in soft cuticle not apparent, probably due to poor sclerotisation.

Venter (Figs 21D, 22E). Setae st1 barbed, length 170. Sternoventral shield reticulate (poorly expressed due to weak sclerotisation), length from posterior margin of genital opening 940. Sternal setae st2 and st3 barbed, length 125–135; sternoventral shield (Fig. 22E) hypertrichous posterior to setae st3, with 25 setae around genital opening; posterior sternoventral shield with setae along margin; these setae smooth to sparsely barbed, shortest setae 80 (near genital opening) and longest setae 145 (posterior to coxa IV); posterior sternoventral shield (Fig. 21D) with two large discs of porose cuticle (diameter 90), each bearing an anterior (55) and posterior pair (35) of unmodified smooth setae, and a highly modified pair of setae centrally, shrivelled due to poor sclerotisation.

Genital opening (Fig. 22E) length 135, width 115, surrounded by a ring of sclerotised cuticle; this cuticle with 12–15 pairs of loosely paired pores laterad genital opening.

Ventrianal shield (Fig. 21D) a curved trapezoid, length 355, anterior width ca. 525, maximum width 600, widest at mid-level of anus; shield reticulate, with 13 loosely paired setae. Peritreme and peritrematal shield similar to female.

Gnathosoma (Figs 23C–E). Gnathotectum similar to female, medial length 840; subcapitulum similar, except with submedial projections (inner length 40). Setae h1 smooth, blade-like, 200; setae h2 smooth, 180, setae h3 smooth, 180, palp coxal seta barbed, 180. Corniculi with small medial tooth-like process, corniculi length 195 (similar to female in length). Palp (Figs 23D–E) trochanter with two distoventral cusps on trochanter (length 25, 35) and one large cusp on femur (length 70). Chelicerae similar to female.

Legs. Similar to female, distal spurs and spines similar in size.

Etymology. It is with great pleasure that I name this species for my nephew Zacharie West.

Differential diagnosis. *Megisthanus zachariei* is most similar to *M. southcotti* and their diagnostic differences are explained under the latter species. The species is also similar to *M. modestus*, from which it differs by lacking setae st4.

Remarks. Both specimens of *M. zachariei* are lightly sclerotised, so several aspects are difficult to see, but the setation of the dorsal and ventral shields distinguish the two species of *Megisthanus* found on the genus *Aulacocyclus*, *M. southcotti* and *M. zachariei*. The host beetle of *M. zachariei*, *A. kaupii*, is very common in southeast Queensland where it tends to be found on the verges of rainforests and into drier habitats where other genera, such as *Pharochilus* and *Mastachilus*, are rare. Despite this beetle species being collected frequently (n > 100), these two specimens are the only megisthanids collected from this host. Therefore it is a rare species on this host, at least in southeast Queensland, where my collecting effort was concentrated (Seeman 2002).

Key to species of Australian Megisthanidae (females required; males supplementary)

1. Dorsal shield lyriform (Fig. 6A); posterior dorsal shield setae thick, short, with strong barbs (Figs 7D–E); internal genitalia with well-developed latigynal element (Fig. 7B) 2
- Dorsal shield ovate (Fig. 1A); posterior dorsal setae slender, usually longer, smooth or with fine barbs (Figs 3D, 17C); internal genitalia lacking well-developed latigynal element (Figs 3B–C) 3
2. Posterior dorsal shield setae each with 0–2 barbs (Fig. 7D) *M. leviathanicus*
- Posterior dorsal shield setae with many (ca. 10) barbs (Fig. 7E) *M. manonae* **sp. nov.**
3. Seta *pd2* on femur IV on large projection (Fig. 17D); dorsal shield densely covered with short fine setae (Fig. 16A); sternogynal shields widely separated (by about width of sternogynal shield) (Fig. 17A) *M. womersleyi* **sp. nov.**
- Seta *pd2* on femur IV not on projection (Fig. 3E); dorsal shield less hypertrichous, with at least some long setae (Figs 1A, 12A, 21A); sternogynal shields not widely separated (by much less than width of sternogynal shield) (Fig. 3A) 4

4. Medial dorsal shield with two distinct types of setae: a short, heavily barbed form and a long, smooth or sparsely barbed form (Figs 11A–B) 5
- Medial dorsal shield with one type of seta, a long, smooth, barbed form (some long setae may be present on margins) (Figs 1A, 12A, 21A) 6
5. Medial opisthosoma with distinct patch of short pilose setae (Fig. 11B) *M. thorelli*
- Medial opisthosoma without distinct patch of short pilose setae (Fig. 11A), differentiation between long and short setal types less distinct than on podosoma *M. simoneae* **sp. nov.**
6. Setae st4 present (Fig. 3A); host *Pharochilus* spp. *M. modestus* **sp. nov.**
- Setae st4 absent (Figs 14A, 22B); host *Aulacocyclus* spp. 7
7. Podonotum and opisthonotum densely setose (Fig. 12A); genital setae long, 60–110; with 5–11 setae behind margin of genital shield (Fig. 14A); male sternoventral shield highly hypertrichous around genital opening (approximately 50–60 setae; Fig. 14D). *M. southcotti* **sp. nov.**
- Podonotum more setose than opisthonotum (Fig. 21A); genital setae short, 20–35; with 0–2 setae behind margin of genital shield (Fig. 22A); male sternoventral shield much less hypertrichous around genital opening (at most 20 setae; Fig. 22E) *M. zachariei* **sp. nov.**

Discussion

Megisthanid mites are remarkable for their size. Across the family, the female’s average idiosomal size is approximately 2.5 mm and, as a superfamily, megisthanoid mites are about twice as large as the next largest superfamily by body size, the Fedrizzioidea (Seeman & Nahrung 2018). Few other Mesostigmata come close to their size, but some species of *Macrodinychus* (Macrodinychidae), *Megalolaelaps* (Megalolaelapidae), *Uropoda* (Uropodidae), *Larvamima* (Larvamimidae) and *Neopodocinum* (Macrochelidae) also reach idiosomal sizes of 2.5 mm. Although we might expect large species to be described earlier than smaller species, these mites are exceptions, as new species continue to be found and described. Large-bodied species of *Macrodinychus* and *Uropoda* were described by Kontschán (2006, 2011), a new species of *Megalolaelaps* was described recently (Cómbita-Heredia *et al.* 2018), the Larvamimidae was described by Elzinga (1993), and new species of *Neopodocinum* (Ács *et al.* 2015) and other relatively large macrochelid mites (e.g., Özbek & Bal 2015) continue to be found. With the exception of the Larvamimidae, which live in close association with army ants, the other genera were all described more than 100 years ago. Thus a lack of regular taxonomic attention is the primary reason these relatively gigantic mites were left undescribed for so long.

TABLE 3. Host species, general region (north-east, middle-east and south-east Queensland; Tasmania) and habitat for the Australian species of *Megisthanus*.

<i>Megisthanus</i> species	Host species	Region	Habitat
<i>M. leviathanicus</i>	<i>Mastachilus australasicus</i> (northern form)	NE Qld	Rainforest
<i>M. manonae</i>	<i>Mastachilus australasicus</i> (northern form)	ME Qld	Rainforest
<i>M. modestus</i>	<i>Pharochilus</i> spp.	SE Qld to Tas.	Sclerophyllous forest
<i>M. simoneae</i>	<i>Mastachilus polyphyllus</i>	SE Qld	Cypress forest, coastal sclerophyll
<i>M. southcotti</i>	<i>Aulacocyclus fracticornis</i>	NE Qld	Rainforest, coastal wet forest
<i>M. thorelli</i>	<i>Mastachilus australasicus</i> (southern form) <i>Mastachilus quaestionis</i> <i>Pharochilus dilatatus</i>	SE Qld	Rainforest, wet sclerophyll
<i>M. womersleyi</i>	<i>Protomocoelus australis</i>	Cape York	Rainforest
<i>M. zachariei</i>	<i>Aulacocyclus kaupii</i>	SE Qld	Sclerophyllous forest

The mites collected in this study show various levels of host specificity, with no clear rules that apply to all taxa (Table 3). Within the north-east and south-east Queensland regions, different mites occurred on Aulacocyclinae (*Aulacocyclus*) or Passalinae (other genera), with the exception of two specimens of *M. southcotti*, which were collected once from one colony of the unusual monotypic passaline genus *Austropassalus*; its typical host was *Aulacocyclus fracticornis* (Table 3). Geographic separation and the preferred habitats of the host beetles may play a greater role in determining which megisthanid species occur on beetles. For example, *M. manonae* from

middle-east Queensland rainforest is a species close to *M. leviathanicus*, which is found in north-east Queensland on the same host species. Regarding habitats, in south-east Queensland, *M. thorelli* is readily found on three species of passalids in rainforest and wet sclerophyll, but passalid species in drier habitats have different megisthanid species: *M. modestus* on *Pharochilus* species throughout sclerophyllous forests of south-eastern Australia, and *M. simoneae* on *M. polyphyllus*, a species not recorded from rainforest. I expect new species are more likely to be found in isolated populations, such as the specimen from Tasmania tentatively attributed to *M. modestus*, or from host beetles that are less often collected, such as the genera *Analaches*, *Gonatas* and *Labiemus*.

Acknowledgements

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