Records of the Australian Museum (2026)
vol. 78, issue no. 3, pp. 119–137
https://doi.org/10.3853/j.2201-4349.78.2026.3012

Records of the Australian Museum
a peer-reviewed open-access journal
published by the Australian Museum, Sydney
communicating knowledge derived from our collections
ISSN 0067-1975 (print), 2201-4349 (online)

Two new species of Heterolepismatinae (Zygentoma: Lepismatidae) from Far North Queensland

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ABSTRACT. The Australian silverfish fauna is still poorly known, requiring more extensive field surveys and descriptions, preferably supported by molecular data. Here two new species of *Silvestrisma* Molero-Baltanás *et al*., 2025 (a genus recently split from *Heterolepisma* Escherich, 1905) are described from Far North Queensland, along with molecular data (COI, 28S) and compared to the closest Australian species *S. howense* (Womersley, 1942) and *S. cooloola* (Smith *et al*., 2019) as well as *H. bisetosum* (Carpenter, 1916) which is reported from the Seychelles and Somalia. *Heterolepisma bisetosum* is transferred to *Silvestrisma* based on its close similarity to this group of Australian species.

Introduction

Australia has a fairly abundant silverfish (Zygentoma) fauna with 93 the 790 species described worldwide (Smith in press), of which only six are introduced peridomestic pests (Smith, 2017). Many undescribed species are held within various Australian museum collections and much of the material sent to, or collected by, the first author cannot be assigned to any of the described species, suggesting much is still to be discovered and documented. Species of Ctenolepismatinae and Heterolepismatinae are the most commonly encountered subfamilies in Australia. The Heterolepismatinae are an almost entirely southern hemisphere group with 24 of the 42 described species being Australian (mainland and surrounding islands), with the remainder mostly from oceanic islands, a few from South America as well as two from coastal Africa. Until quite recently all species were included in the genus *Heterolepisma* with the type species being *Heterolepisma pampeanum* (Silvestri, 1902) described from Argentina (Paclt, 1967). Smith and Mitchell (2019) created the genus *Maritisma* for two species, one known from an island in the Great Barrier Reef and the other from southern Japan which differed from the remaining *Heterolepisma* in having very long urosternal combs including a medial comb on urosternite I and only a single pair of abdominal styli. Smith *et al*. (2021) created the genus *Visma* for 11 species which have trapezoidal thoracic sternal plates, only 1+1 single macrochaetae on the abdominal sternites (no medial combs) and three to six pairs of abdominal styli. The name *Visma* was later found to be preoccupied and has recently been replaced by the name *Vistrolepisma* Molero-Baltanás *et al*., 2025. Furthermore, these authors redescribed the South American species *Heterolepisma andinum* (Silvestri, 1902) and, based on both molecular and morphological data, concluded that the Australian species of *Heterolepisma* should be moved to the new genus *Silvestrisma*, with *Heterolepisma michaelseni* Silvestri, 1908 as its type species. The remaining non-Australian species were retained in *Heterolepisma* as their descriptions were generally inadequate to determine affinities and molecular data completely lacking. These authors also recognised that the genus *Silvestrisma* is likely to be further split due to several characters considered as variable in their analysis of the Australian species.

The subfamily Heterolepismatinae has been challenging for morphologists. In contrast to species of the Ctenolepismatinae where consistent morphological differences can usually be

Keywords: Thysanura, taxonomy, new species, DNA barcodes, 28S ribosomal DNA
ZooBank registration: lsid:zoobank.org:pub:E002C75A-DDE1-4580-AE99-AD7579313078
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Submitted: 3 March 2026 **Accepted**: 30 April 2026 **Published**: 20 May 2026 (in print and online simultaneously)
Publisher: The Australian Museum, Sydney, Australia (a statutory authority of, and principally funded by, the NSW State Government)
Citation: Smith, G.B. and A. Mitchell. 2026. Two new species of Heterolepismatinae (Zygentoma: Lepismatidae) from Far North Queensland. *Records of the Australian Museum* 78: 119-137. https://doi.org/10.3853/j.2201-4349.78.2026.3012

identified when COI sequence data differed by about 5%, the Heterolepismatinae have proven more difficult and, in one study (Smith *et al*., 2019), as much as 9% difference in COI was found to be the threshold where small but reliable morphological characters could be identified. Similar problems have been encountered in this work.

Slow progress has been made in recent years in identifying additional morphological characters that are useful in identification and establishing a phylogeny within the Heterolepismatinae. For instance, the importance of the chaetotaxy of the anterior margin of the frons is now recognised but often not reported or illustrated in earlier papers. The type and distribution of scales is emerging as a useful character when fresh material is available and, especially so, when electron microscopy is employed. Unfortunately scale cover is often damaged and in many cases almost completely lost (see Molero-Baltanás *et al*. (2025)). Ideally, when specimens are collected into alcohol, a cotton wool plug should be inserted into the tube in a way that excludes air bubbles, as the movement of air bubbles during transport and handling, subjects the silverfish and its scale cover to severe abrasion. Only in the last couple of decades has comment on scale type and distribution become integral to publications (e.g. Molero-Baltanás *et al*. (2012); Smith *et al*. (2021)). In earlier papers even the shape of scales is rarely reported (round, lanceolate or subtriangular) and their distribution can be very difficult to see, especially the small lanceolate and subtriangular scales. Other characters now found to be useful but under-reported, include the chaetotaxy of the nota including the posterior combs and the trichobothrial areas (Molero-Baltanás *et al*., 2025). This study examines a series of *Silvestrisma* specimens collected in Far North Queensland using both morphological and molecular data (COI, 28S) which is compared with thirteen other species of Heterolepismatinae for which molecular data is available on public databases.

Materials and methods

Specimens

Holotype and allotype specimens are deposited in the entomological collection of the Queensland Museum and the remaining material held at the Australian Museum in Sydney (AMS). Locality co-ordinates are mostly taken using a hand-held Garmin eTrex®10 GPS with a claimed accuracy usually under five metres (see map, Fig. 1). Specimens were collected into either 80% or 100% ethanol and a leg removed into 100% ethanol as soon as practical after collection (within a few months) so that DNA could be extracted. Specimens are currently stored in 80% ethanol/water unless specifically mentioned as being in 100% ethanol or else mounted on slides. Dissected specimens were each mounted onto two slides using Tendeiro medium, with the head and thorax mounted on one slide and the abdomen on a second slide.

Morphology

Measurement data follow the methodology in Smith (2013) and Smith *et al*. (2021) however an additional measurement of urotergite X is now included in an attempt to quantify the degree of tapering. In this case the width is also measured at two-thirds the length of the urotergite and compared to the width across the base and referred to as the slender index (Fig. 2).

Roman numerals are used to indicate abdominal segment number. In addition, the following abbreviations are used: AMS: Australian Museum, 1 William St, Sydney 2010 Australia; asl: above sea level (in metres); HW: head width (in millimetres); H+B: head and body length (in millimetres); L/W: length to width (ratio); PI, PII, PIII: legs of prothorax, mesothorax and metathorax respectively; penult: penultimate, referring to second last article of maxillary palp; ult: ultimate (referring to last article); QM: Queensland Museum, corner of Grey and Melbourne Streets, South Bank, South Brisbane, Queensland. The prefixes pro, meso and meta are affixed to thoracic characters such as sterna, tibia and tarsus. The term macrochaetae refers to the larger stronger bristles usually slightly apically bifurcated, setae to smaller thinner bristles (usually simple), setulae to the very small, usually straight, setae and cilia to the curly thin hairs, often associated with the combs, setal collar or notal margins. Left and right refer to the animal when the dorsal surface is observed with the head forward. The comb associated with each of the notal trichobothrial areas is expressed using the terminology of Molero-Baltanás et al. (2010) where the most posterior comb along each of the thoracic nota is nominated as N and the combs anterior to this termed N-1, N-2, N-3 etc.

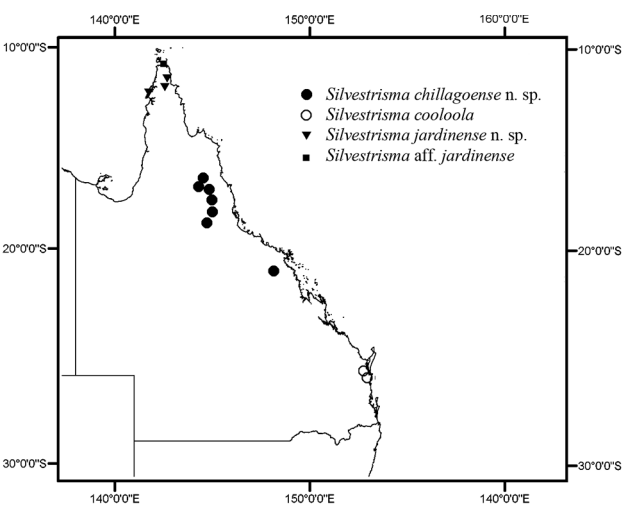


Figure 1. Distribution of material examined

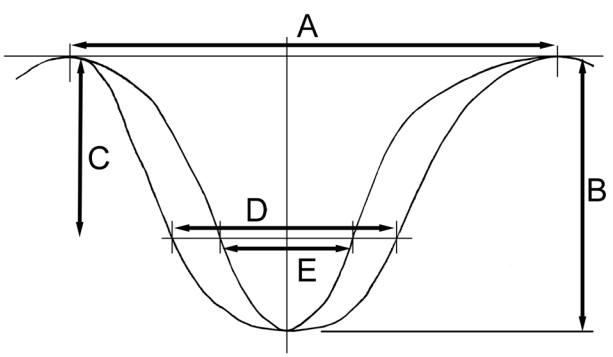


Figure 2. Urotergite X. Slender index measurements. A=total width, B=length, C=⅔ length, D=width at ⅔ of a specimen with wider urotergite X, E=width at ⅔ of a specimen with narrow urotergite X.

In the case of the species discussed here, the degree of lateral notal chaetotaxy is greatly reduced so that combs may only consist of two, one or even no macrochaetae but in the case of the latter always determined by the presence of the anterior trichobothrium. Only single macrochaeta distinctly remote from the margin of the nota within an area largely free of scales, are counted as combs, strong macrochaetae on or close to the margins, even if somewhat erect, are not considered to represent combs. Basiconic sensilla on the antennae and palps are described using the terminology of Adel (1984). Terminology for the "segments" of the antennae, terminal filaments and ovipositor follows that explained in Smith (2015) where the term *annulus* will be used for each single unit of the flagellum (excluding pedicel and scape), usually a widened region carrying a single ring of setae (but occasionally with a smaller secondary ring), *T-annulus* for each annulus bearing a trichobothrium, *interval* for the group of annuli between T-annuli with the T-annulus being the most distal annulus of the interval. For the terminal filaments and ovipositor, the term *division* will be used for each "segment" defined by a visible suture, albeit often faint.

Contrary to previous practice by the first author, we will adopt the terminology used by several European colleagues as denoted in Molero-Baltanás *et al.* (2024) for the urotergal combs using "infralateral" (instead of lateral) for the comb most laterad on the urotergites as illustrated when laid out flat on slides (e.g. Fig. 25) but which in fact are slightly mediad of the sides of the abdomen when the tergites are in their normal folded position. Our previous sublateral thus becomes "lateral" and the term submedial remains unchanged.

Seventy-nine characters or dimensions were evaluated using slide-mounted specimens from various localities for the two new species as well as *Silvestrisma cooloola* (Smith *et al*., 2019). Characters for other species were taken, as best as possible from the literature. These include: colour patterns (annulations) on antennae and caudal filaments, antennal sensilla, presence or absence as well as type of scales from frons, clypeus, labrum, pedicel, scape, leg and palp articles, styli and caudal filaments, chaetotaxy of head, size and shape of ultimate articles of maxillary and labial palps as well as the type and arrangement of papillae, shape, relative dimensions and chaetotaxy of the thoracic sterna, marginal and posterior chaetotaxy of the thoracic nota including details, position and associations of the trichobothrial area, chaetotaxy of abdominal tergites and sternites, shape dimensions and chaetotaxy of urotergite X, dimensions of inner processes of coxites IX, the number of pairs of styli and the size and number of divisions in the ovipositor.

Molecular methods

Sampling, DNA extraction, PCR and DNA sequencing

The 16 DNA voucher specimens new to this study, and their associated GenBank accession numbers are included within. The remaining DNA sequences were already reported in Smith *et al*. (2019) or obtained from BOLD.

DNA extractions used the Bioline Isolate II Genomic DNA Kit (Bioline, Eveleigh, New South Wales) following the manufacturers' protocols, with exceptions noted below. In general, a leg or whole specimens which had been stored in 100% ethanol, were soaked in 180 μL of DNA extraction buffer and 20 μL of proteinase-K at room temperature for 1–3 hours. In the case of whole specimens, the remaining cuticle was returned to 100% ethanol and later dissected in 80% ethanol and mounted on to two slides using Tendeiro medium. Polymerase Chain Reaction (PCR) amplification of the DNA barcode region of the mitochondrial COI gene used the primers and followed the method of Mitchell (2015). For the 28S rDNA D9–D10 region, we used one forward (28S_8fm) and two reverse PCR primers (28S_10rm and 28S_11rm), which were simply 5'–M13-tailed versions of Machida and Knowlton's (2012) primers [28S] #8, [28S] #10_RC and [28S] #11_RC, respectively. PCR conditions for both genes followed those reported in Mitchell (2015) for COI. PCR products were purified using ExoSAP and sequenced in both directions using ABI Big Dye Terminator v.3.1 chemistry by Macrogen Inc. (Seoul, South Korea).

DNA sequence assembly and phylogenetic analysis

Forward and reverse direction sequence trace files were assembled using Geneious Primer v. 2025.2.2 (Kearse *et al*., 2012) and consensus sequences were aligned using Muscle (Edgar, 2004) and adjusted by eye. DNA sequences, sequence trace files, and specimen collection data were uploaded to BOLD (Ratnasingham & Hebert, 2007) and can be downloaded from public project ZYIII (Zygentoma of Australia III). New sequences were submitted to GenBank (Table 1). A concatenated alignment was made for all sequences.

MEGA v. 11.0.13 (Tamura *et al*., 2021) was used to calculate genetic distances (p- or uncorrected distance) and to select the best models of DNA evolution for phylogenetic analysis, with four partitions (COI nt1, COI nt2, COI nt3, 28S). The remaining phylogenetic analyses were performed in Geneious Prime using the plugins available for Bayesian Inference (BI) using MrBayes 3.2.6 (Ronquist *et al*., 2012) and maximum likelihood analyses using RAxML v8.2.10 (Stamatakis, 2014).

The MrBayes analysis was set to run for one million generations, with a sample frequency of 500, using two runs, setting the number of chains to four. The stopping rule was used to cease the analysis when the average standard deviation of split frequencies dropped below 0.01, indicating convergence of the chains. The burnin fraction was set to 0.25. RAxML analysis used the hill climbing algorithm with 1,000 rapid bootstrap replicates as analysis of branch support. *Tricholepidion gertschi* was used as the outgroup.

Table 1 lists the GenBank accession numbers of all 31 sequences used, including 11 new COI sequences (646 nt) and 13 new 28S sequences (456 nt) for a total alignment length of 1,102 nt. The remaining sequences in the data sets were from previously published studies and the combined COI and 28S (concatenated) data set comprises 31 taxa.

Results

Molecular data

The completed MrBayes analysis had a final average standard deviation of the splits frequencies of 0.007626, suggesting convergence of the analysis. Figure 3 shows the Bayesian tree obtained for the concatenated data set, with maximum likelihood bootstrap values and posterior probabilities shown above, or to the left of, nodes if 90 or

0.9 respectively.

As shown in Figure 3, *S. chillagoense* sp. nov. is most closely related to *S. cooloola* (they differ from each other in COI by a distance of 13.1–15.0% and these species are sister group to *S. jardinense* sp. nov. and *S.* aff. *jardinense*. The two new species differ from each other in COI by 15.1-18.8%, whereas the lineage of *S. jardinense* from north of the Jardine River differs by 15.7-16.9% from the clade south of the river.

The combined data set identifies at least two species of *Silvestrisma* that belong in a group that lack macrochaetae along the anterior margin of the frons, which bear lanceolate scales on the clypeus, femora, tibia and the base of the terminal filaments, 2+2 combs on urotergite I, with 1+1 combs each of single macrochaeta on urosternites II–VIII and three pairs of styli in the female and only two in the male (i.e. *Heterolepisma bisetosum* (Carpenter, 1916)) from the Seychelles and Somalia, *S. howense* (Womersley, 1942) from Lord Howe Island, *Silvestrisma cooloola* (Smith *et al*., 2019) from SE Queensland and probably *S. kraepelini* (Silvestri, 1908) from SW Australia, although for the latter, the original description is so lacking in the detail which we now require, that we will make no attempt to include it in our discussion here. Other species, with a glabrous anterior margin of the frons and 1+1 macrochaetae on the urosternites, are excluded from the comparison for various reasons i.e. *H. serranoi* Mendes, 2011 has 3+3 combs on urotergite I, while *H. exactum* (Silvestri, 1918) and *H. mossambicense* Mendes, 1993 have three pairs of styli in both sexes and *H. tonga* Mendes, 2012 has two pairs of styli in both sexes. When comparing the new species to *H. bisetosum* from the Seychelles, we are primarily relying on the description of Somalian material in Mendes (1988), even though we have our doubts that the material is conspecific with the material originally described by Carpenter because the description of the Seychelles material lacks sufficient detail.

Table 1. Specimens used for DNA sampling

Identification	Sample ID	Museum	COI Accession	28S GenBank Accession	Institution GenBank Accession
Tricholepidion gertschi	NC_005437	—	NC_005437	—	Mined from GenBank, NCBI
Heterolepisma andinum	—	—	PV944212	—	Mined from GenBank, NCBI
Cactisma camanchaca	—	—	PV944206	—	Mined from GenBank, NCBI
Lapidisma paposanum	—	—	PV944209	—	Mined from GenBank, NCBI
Acrotelsella parlevar	gbs004624	K261103	MT674895	MK185706	Australian Museum, Sydney
Ctenolepisma longicaudatum	gbs005759	K541555	OR732097	PX971612	Australian Museum, Sydney
Vistrolepisma pallidum	gbs003495	K261312	MT674878	MT670074	Australian Museum, Sydney
V. tenebrosum	gbs003437	T246782	MT674875	MT670071	Queensland Museum
Silvestrisma parvum	gbs006169	—	PX971607	PX971623	Australian Museum, Sydney
S. buntonorum	gbs001784	K377620	N/A*	PX971619	Australian Museum, Sydney
S. highlandi	gbs001119	K377604	MF040924	KY951374	Australian Museum, Sydney
S. milledgei	gbs006066	K541579	PX971603	PX971616	Australian Museum, Sydney
S. coorongooba	gbs004626	K261208	MF040957	KY951407	Australian Museum, Sydney
S. sclerophyllum	gbs001024	K260992	MF040943	KY951392	Australian Museum, Sydney
S. pyramidum	gbs005494	K261254	MN133049	MN150480	Australian Museum, Sydney
S. aff. *jardinense*	gbs003751	K377760	PX971598	PX971610	Australian Museum, Sydney
S. aff. *jardinense*	gbs003750	K377759	MF040948	KY951397	Australian Museum, Sydney
S. aff. *jardinense*	gbs003752	K377761	PX971604	PX971617	Australian Museum, Sydney
S. aff. *jardinense*	gbs003756	K377762	PX971601	PX971615	Australian Museum, Sydney
S. jardinense sp. nov.	gbs003694	K541708	—	PX971618	Australian Museum, Sydney
S. jardinense sp. nov.	gbs003706	K541709	—	PX971611	Australian Museum, Sydney
S. jardinense sp. nov.	gbs003732	QM T262423	—	PX971621	Queensland Museum
S. jardinense sp. nov.	gbs003743	QM T262424	PX971600	PX971614	Queensland Museum
S. jardinense sp. nov.	gbs003762	K377764	PX971606	PX971622	Australian Museum, Sydney
S. cooloola	gbs003353	K377748	MF040952	KY951400	Australian Museum, Sydney
S. cooloola	gbs003330	QM207012	PX971599	KY951401	Queensland Museum
S. cooloola	gbs004879	K261182	MK185704	KY951404	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs001266	K377755	MF040950	—	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs001277	K377756	MF040949	—	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs003828	K377749	MF040934	KY951385	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs003829	K377750	—	PX971613	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs001313	—	PX971602	—	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs001322	K541707	—	KY951398	Australian Museum, Sydney
S. chillagoense sp. nov.	gbs002722	K621643	PX971605	PX971620	Australian Museum, Sydney

*Sequence <200 bp therefore not accepted by GenBank but available on BOLD

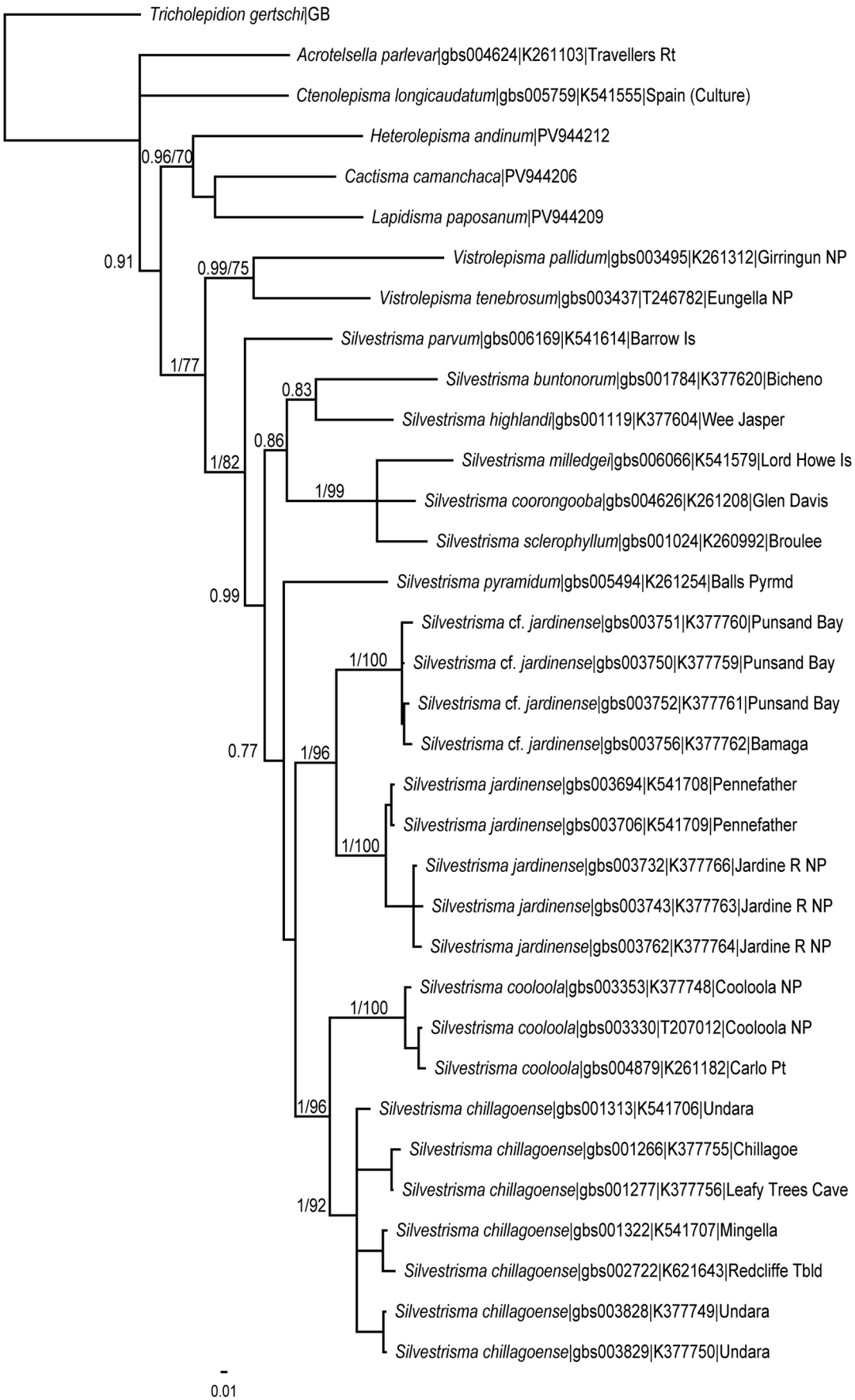


Figure 3. Tree derived by Bayesian Inference. Numbers above or to the left of nodes are posterior probabilities and maximum likelihood bootstrap values, shown if >0.9 or 70%, respectively.

Systematics

Order Zygentoma Börner, 1904

Family Lepismatidae Latreille, 1802

Subfamily Heterolepismatinae Mendes, 1991

Silvestrisma Molero-Baltanás, Zúñiga-Reinoso, Gaju-Ricart and Predel 2025

Heterolepisma Escherich, 1905: 63.
Isolepisma Escherich, 1905: 61.
Notolepisma Tillyard, 1924: 242.
Silvestrisma Molero-Baltanás, Zúñiga-Reinoso, Gaju-Ricart and Predel, 2025: 268.

Type species: *Heterolepisma michaelseni* Silvestri, 1908 by original designation.

Silvestrisma chillagoense sp. nov.

urn:lsid:zoobank.org:act:A4728300-FFB0-41D4-8229-F0628B5DCFBA

Figs 4-35

Holotype ♂ (HW 0.93) QUEENSLAND: ca 12 km W Chillagoe, 17.1238°S 144.4385°E 391m asl, 16.iv.2011, Graeme Smith, leaf and bark litter at base of tree (2 slides) QM T262421.

Paratypes ♀ (HW 1.05) QUEENSLAND: 242 km NW of Charters Towers (just SE of The Lynd), 18.9978°S 144.6971°E 384m asl, 14.iv.2011, Graeme Smith, leaf litter on rock ledges (2 slides) QM T262422; ♀ (HW 0.93), same data as previous (alcohol) K.621630; ♀ (HW 0.91) same data as holotype (2 slides) (K.541694); ♀ (HW 0.85) same data as holotype (alcohol) (K.621627); ♀ (HW 0.95) same data as holotype (alcohol) (K.621636); ♀ (HW 1.05) same data as holotype (alcohol) (K.621629); ♀ (HW 1.00) QUEENSLAND: Just S of Mt Garnet, 17.7166°S 145.0654°E 734m asl, 15.iv.2011, Graeme Smith, leaf and bark litter at base of tree (2 slides) (K.541695); 4♂♂ (HW 0.93, 0.93, 0.93, 0.85) 1♀ (HW 0.88), same data as previous (K.621634 alcohol shared); ♀ (HW 0.95) QUEENSLAND: Just S of Mt Garnet, 17.7167°S 145.0653°E 726m asl, 15.iv.2011, Graeme Smith, leaf and bark litter at base of tree (2 slides) (K.541696); ♀ (HW 0.93), same data as previous (alcohol) K.621625; ♀ (HW 1.03) QUEENSLAND: ca 1 km W Chillagoe, 17.1522°S 144.5007°E 384m asl, 16.iv.2011, Graeme Smith, base of tree (2 slides) (K.541697); ♀♀ (both HW 0.93), same data as previous (alcohol) (K.621624 shared); ♀ (HW 1.00) QUEENSLAND: ca 3 km W Chillagoe, 17.1461°S 144.4783°E 382m asl, 16.iv.2011, Graeme Smith, leaf litter on limestone (2 slides) (K.541698); ♂ (HW 0.85) same data as previous (alcohol) (K.621626); ♀ (HW 1.03) QUEENSLAND: East of Chillagoe, 17.1849°S 144.5435°E 405m asl, 17.iv.2011, Graeme Smith, Joe Sydney, Dave Rothery, leaf litter (2 slides) (K.541699); ♀ (HW 0.93) QUEENSLAND: Chillagoe Mundana Rampart section, 17.1912°S 144.5495°E 420m asl, 17.iv.2011, Graeme Smith, Joe Sydney, Dave Rothery, leaf litter (2 slides) (K.541700); ♂ (HW 0.85), same data as previous (alcohol) (K.621633); ♂ (HW 1.00) QUEENSLAND: Chillagoe, entrance doline to Leafy Trees Cave CH -MAGH CH82, 17.1024°S 144.4115°E 372m asl, 17.iv.2011, Graeme Smith, under stones (2 slides) (K.541701); ♀ (HW 1.03) same data as previous K.377756 (2 slides); 2♀♀ (HW 1.15, 1.08) 2♂♂ (HW 0.98, 0.96) QUEENSLAND: 6km from Chillagoe towards Mareeba, 17.1959°S 144.5498°E 416 m asl, 24.iv.2011, Graeme Smith and Dave Rothery, leaf and bark litter at base of tree (alcohol) (K.621631 shared); 2♂♂ (HW 0.95, 0.93) QUEENSLAND: 15km from Chillagoe towards Mareeba, 17.2634°S 144.5776°E 519 m asl, 24.iv.2011, Graeme Smith and Dave Rothery, leaf and bark litter at base of iron bark tree (alcohol) K.621628 shared.

Other material examined. ♀ (HW 1.08) QUEENSLAND: Along road to Mareeba, ca 5 km E of Almaden, 17.3634°S 144.7215°E 570 m asl, 25.iv.2011, Graeme Smith, leaf and bark litter at base of tree (2 slides) (K.541702); 3♀♀ (HW 1.08, 1.00, 0.95) 2♂♂ (HW 1.13, 0.98) same data as previous (K.621632 alcohol shared); ♀ (HW 1.03) QUEENSLAND: Along road to Mareeba, Emu Creek, 17.3338°S 144.9482°E 483 m asl, 25.iv.2011, Graeme Smith, leaf litter at base of tree (2 slides) (K.541703); 2♂♂ (HW 0.98, 0.88) same data as previous (alcohol) (K.621635 shared); ♂ (HW 0.95) QUEENSLAND: northern end of 40 Mile Scrub N.P. 18.0464°S 144.8662°E 785 m asl, 26.iv.2011, Graeme Smith, leaf litter at base of iron bark (2 slides) (K.541704); ♀ (HW 1.13) same data as previous (alcohol) (K.621637); ♀ (HW ? head damaged) QUEENSLAND: on side of road to Mt Surprise, 18.0952°S 144.4920°E 584 m asl, 26.iv.2011, Graeme Smith, leaf litter against fallen tree (2 slides) (K.541705); ♀ (HW 1.05) QUEENSLAND: Undara 18.2018°S 144.5696°E 764 m asl, 28.iv.2011, Graeme Smith, leaf litter on granite rocks (2 slides) (K.541706); ♀ (HW 0.94) QUEENSLAND: Undara 18.2048°S 144.5707°E 784 m asl, 5.viii.2013, Graeme & Louise Smith, leaf litter, (alcohol) K.377749 AMS; juvenile (HW 0.64) same data as previous (alcohol) (K.377750); ♀ (HW 1.10) QUEENSLAND: a few km S of Mingela along Ravenswood Rd, 19.9008°S 146.8679°E 320 m asl, 7.v.2011, Graeme Smith, under bark of old Eucalypt (2 slides) (K.541707); ♀ (HW 1.05) QUEENSLAND: Redcliffe Tableland, Site #19, 21.113°S 148.117°E 390 m asl, 15.iv.2012, Geoff Monteith, litter berlesate, melaleuca (K.621643 alcohol); ♀ (HW 0.89) QUEENSLAND: Redcliffe Tableland, Site #18 21.092°S 148.090°E 420 m asl, 18.iv.2012, Geoff Monteith, litter in vine scrub (K.541690) AMS (2 slides); ♀ (HW 0.98) QUEENSLAND: Redcliffe Tableland, Site# 4 21.141°S 148.156°E 390 m asl, 15.iv.2012, Geoff Monteith, litter, berlesate, open forest (K.541692) AMS (2 slides); ♀ (HW 0.93) juvenile ♂ (HW 0.64) same data as previous (alcohol) (K.621642 shared).

Diagnosis. This species can be distinguished from *S. howense* which has only 1+1 single large insertions on the posterior margins of the nota and abdominal tergites without any indication that a large submarginal seta may be present and all anterior trichobothrial areas on all three thoracic nota are not associated with a macrochaeta, whereas the new species always has a macrochaeta associated with the trichobothrium on the meso- and meta- nota. It can be distinguished from *H. cooloola* by its smaller prothoracic sternum (S1) relative to the metathoracic sternum (S3) with length S3/length S1 1.15–1.32 in the new species versus 0.97–1.08 in *cooloola*. The new species also has more

macrochaetae in the combs of the meso- and meta-sterna (3–5 and 3–6 versus 2–3 and 2–3 in *cooloola*). It differs from *H. bisetosum* which always has a medial seta or small comb of two macrochaetae on urosternite I, whereas this comb was absent on 15 of 19 specimens of the new species; it also differs in the shape of the prosternum which is described as having a distinct lateral constriction in *bisetosum* whereas there is rarely an indentation in the sides of the prosternum in the new species and the tail filaments of *bisetosum* are clearly annulated whereas they are generally even in colour in the new species. Mendes (1988) also illustrated the labial palp papillae in *S. bisetosum* as being arranged in two parallel lines whereas in the new species they are arranged in a cluster arrangement (with the more distal line of three larger papillae in an arc around the posterior smaller two; a common arrangement in Australian *Silvestrisma*). The ovipositor of the new species has 35–43 divisions compared to *S. bisetosum* with 32–34.

Description

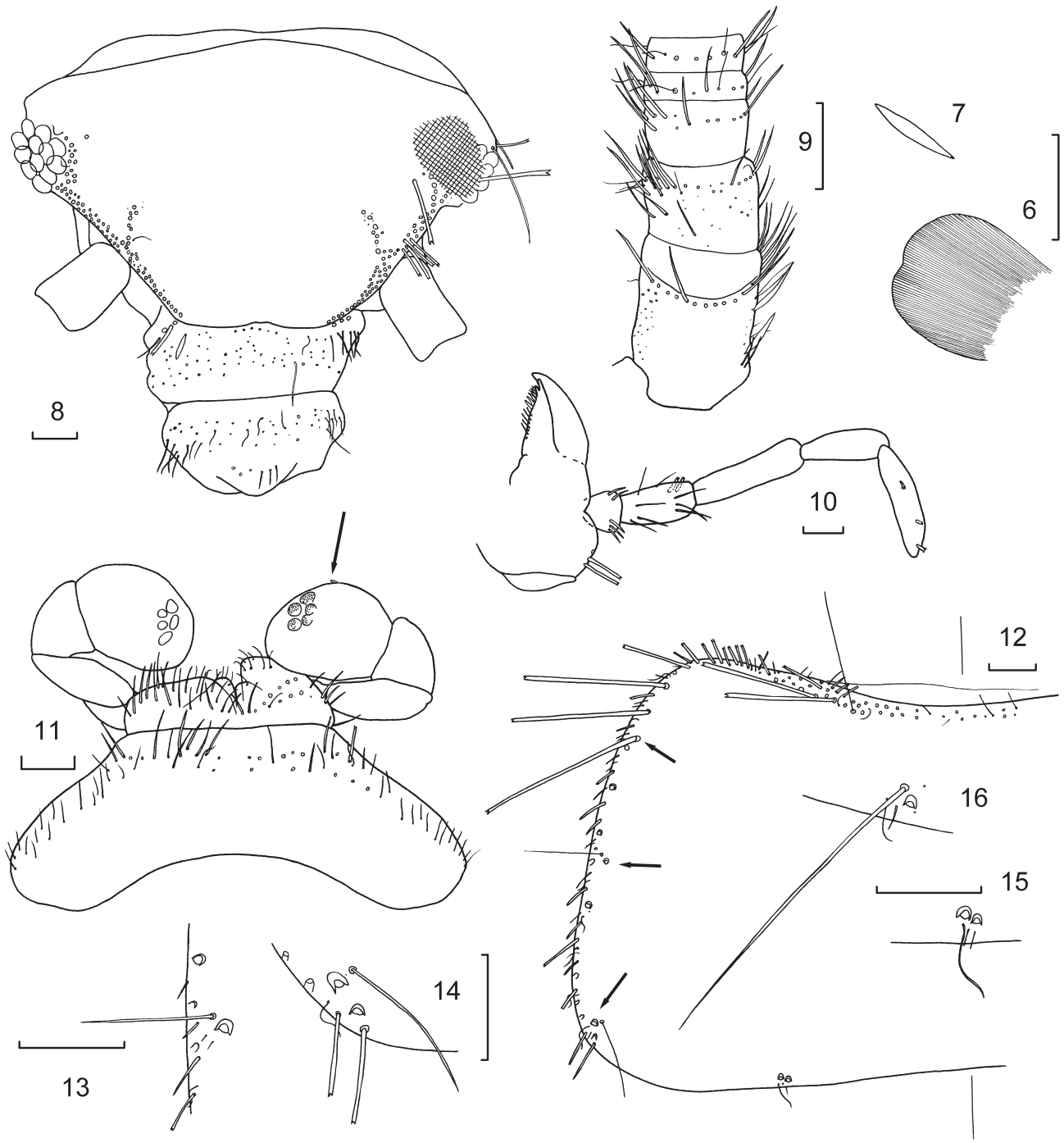
Appearance: Medium sized silverfish; appearance when live varies with quality of scale cover and also lighting. Well preserved scales (just after moulting) with dark scales overall and a distinct light line behind the head (Fig. 4), with less intact scale covering (Fig. 5), the silverfish appears to be mottled silver grey in colour, the light line behind the head less visible but the edges of the nota appear lighter in colour. In all cases the antennae and terminal appendages appear light pink in colour, the tarsi of the legs also being pale to pink in colour with slightly darker pigment on the tibia and femora. Styli light brown to very pale.

Body length: Maximum H+B 8.2 mm; HW 1.10 mm; thorax: length 2.4 mm or 0.30 H+B (range 0.22–0.31); width up to 1.7 mm with no great difference in length or width between the pro, meso and metanota although the pronotum the narrowest; almost(?) complete antennae about 0.7 H+B; terminal filaments up to 0.65 H+B).

Pigmentation: Pigment purplish/brown but can vary considerably between specimens. Flagellum of antennae evenly pale brown becoming slightly darker distally; pedicel and scape sometimes with some pigment on outer face. Terminal filaments with or without distinct annulations, although some annuli appear a little less dark than others, when present the lighter areas restricted to the annuli where divisions join. Head with pigment around eyes and along sides of head to the antennae and among the peri-antennal macrochaetae. Clypeus with some very faint pigment on each side, labrum without pigment, mandibles with pigment among the macrochaetae. Maxillary palp with some very light pigment basally, penultimate article with light pigment overall, antepenultimate article, with light pigment along dorsal face, second article only with a little pigment distally. Labial palp with some blotchy pigment in distal half of the antepenultimate article, penultimate article with stronger blotchy pigment especially along margin, ultimate article with some pigment around edges, more obvious basally. Legs

Figure 4. *Silvestrisma chillagoense* n. sp. Undara, freshly moulted specimen, soft even lighting.

Figure 5. *Silvestrisma chillagoense* n. sp. 12 km W. Chillagoe, partially degraded scale cover with brighter light.

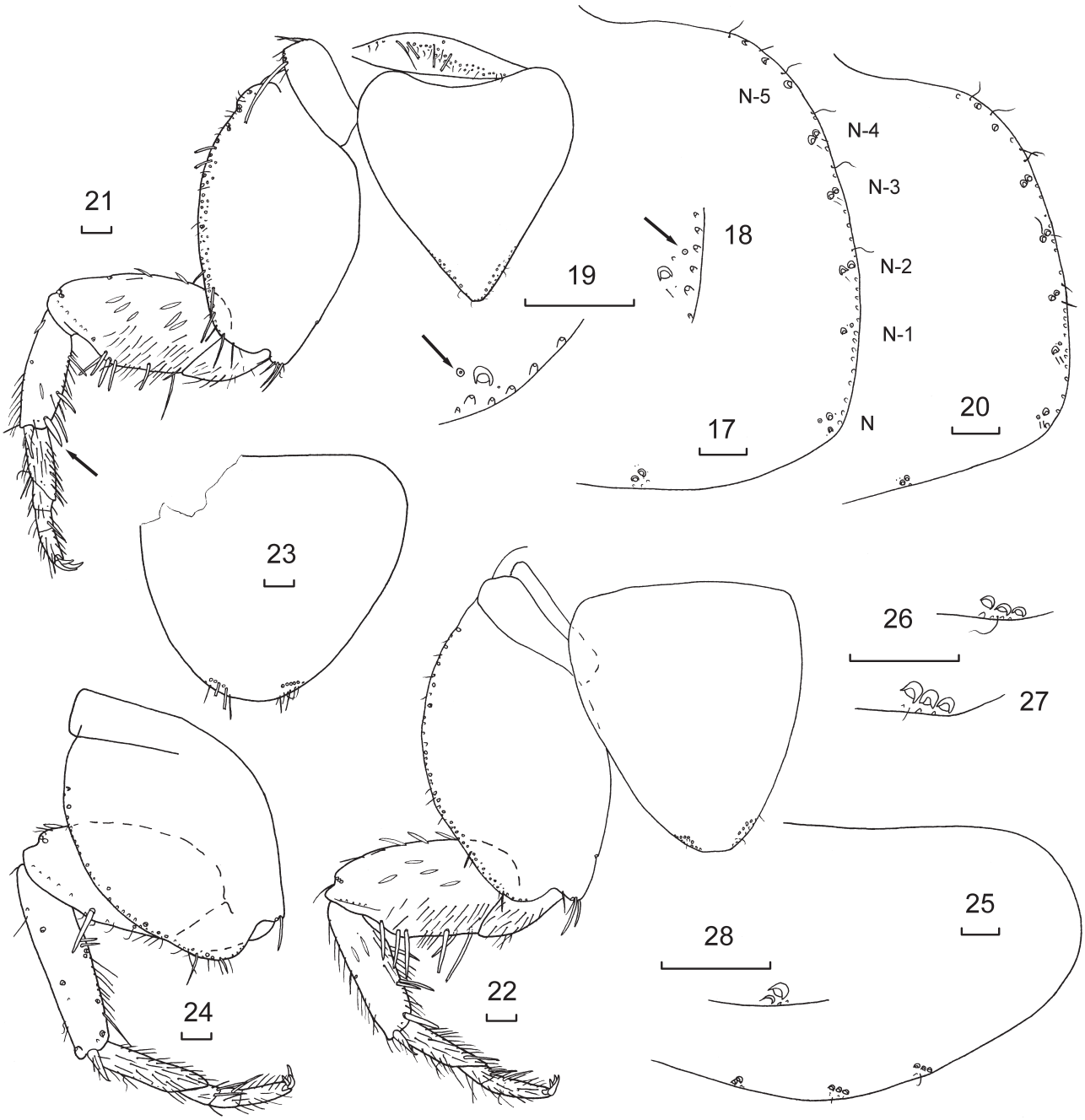


Figures 6–16. *Silvestrisma chillagoense* n. sp. ♂ holotype unless otherwise indicated by specimen number *(6)* apex of round scale from mesonotum (K.541694); *(7)* lanceolate scale from mesonotum (K.541694); *(8)* head; *(9)* antenna pedicel, scape and three intervals of flagellum; *(10)* maxilla, minor setae omitted; *(11)* labium, omitting setae from palps, arrow indicates position of basiconic sensillum; *(12)* pronotum, left side of K.541694, arrows indicate macrochaetae and insertions considered as submarginal; *(13)* idem, left anterior trichobothrial area; *(14)* idem, left posterior trichobothrial area; *(15)* idem, posterior comb insertions; *(16)* idem, posterior comb on newly forming cuticle of T262422. Scale bars = 0.1 mm.

with some pigment on anterior "shoulder" and along the outer margin of the coxae, some light pigment on the trochanter, light pigment over the face of the femora, strongest on the posterior bulge and distal dorsal apex, tibia with moderate pigment strongest both near the femora and near the distal dorsal end, tarsi with quite pronounced pigment on the basal article except for each end, remaining articles almost without pigment. Urotergite X with pigment in basal lateral region. Coxites IX with pigment over face, stronger distally. Styli VIII and IX with strong pigment, styli VII also pigmented but only lightly.

Macrochaetae: Smooth, hyaline or slightly straw coloured, apically bifurcate with truncated tips to each bifurcation. Some macrochaetae on tibia, stout carrot-shaped.

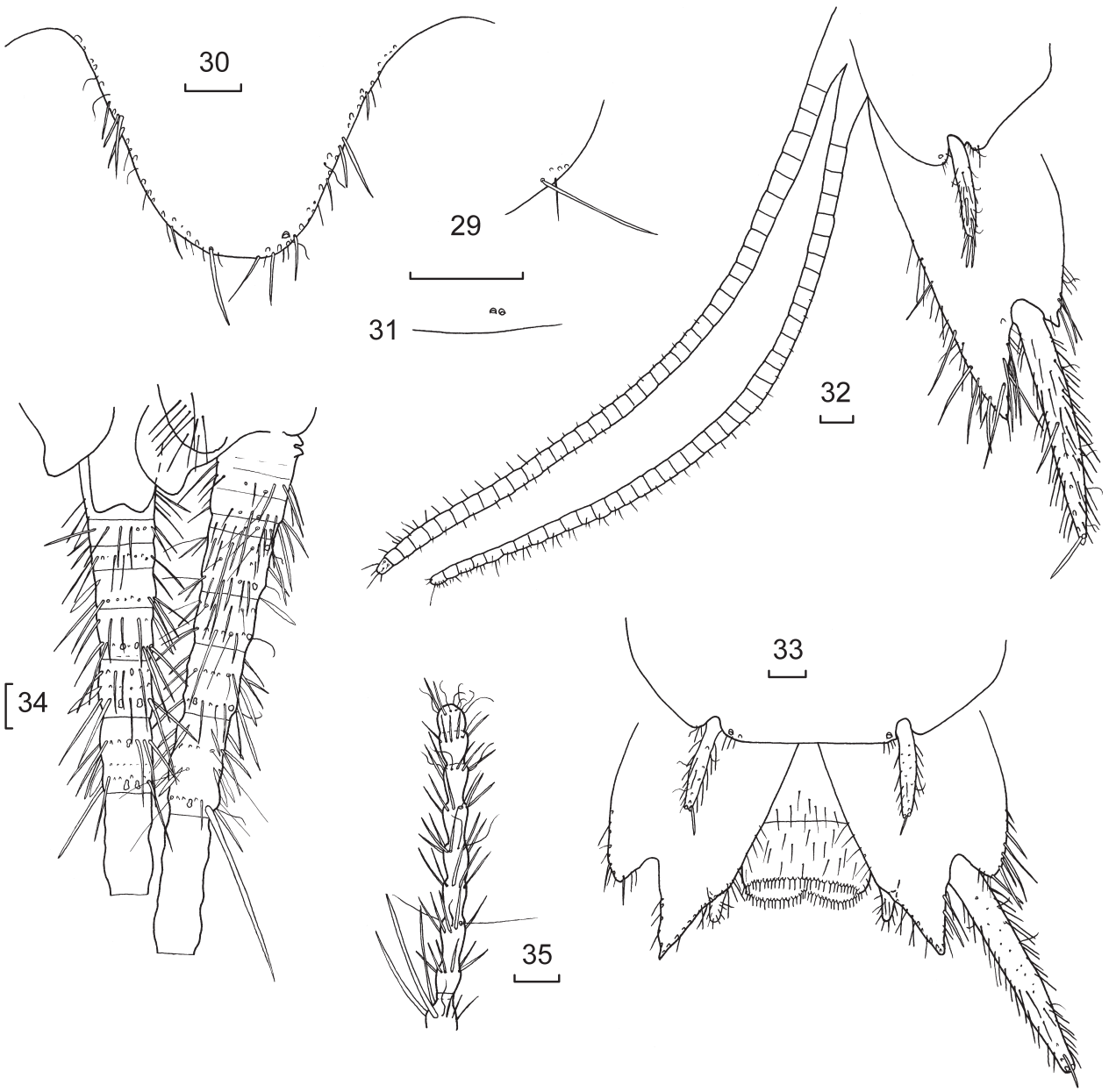
Scales: Quite broad, hyaline or with brown ribs, with numerous subparallel ribs that do not surpass the margin of



Figures 17–28. *Silvestrisma chillagoense* n. sp. ♂ *(17)* mesonotum, right side with combs numbered, combs of two macrochaetae are N-2, N-3, N-4; *(18)* idem, anterior trichobothrial area, arrow points to trichobothrium insertion; *(19)* idem, posterior trichobothrial area, arrow points to trichobothrium insertion; *(20)* metanotum, left side; *(21)* prosternum and PI, arrow indicates an example of "carrot-shaped" macrochaeta; *(22)* mesosternum and PII; *(23)* metasternum; *(24)* PIII; *(25)* urotergite III, chaetotaxy of right side; *(26)* idem, details of infralateral comb i.e. comb on right of figure 25; *(27)* idem, details of lateral comb i.e. comb in middle of figure 25; *(28)* idem, details of submedial comb i.e. comb on left of figure 25. Scale bars =0.1mm.

the scale (Fig. 6). Scales found on top of head, protruding forward over the margin in the medial region; round scales absent from clypeus and labrum as well as all cephalic appendages and styli; present on all nota, all thoracic sterna, and coxae of legs but absent from remaining leg articles, present on all urotergites and urosternites. Lanceolate scales (Fig. 7) present on clypeus, femora, tibia, basal divisions of terminal filaments and scape.

Head: Wider than long (Fig. 8), without distinct bushes. Anterior margin of frons glabrous with small medial indented region, lateral margins anteriorly with a single row of strong macrochaetae which becomes about 2–3 macrochaetae wide near the anterior margin of the antenna; peri-antennal groups fairly long with several larger macrochaetae and some small setae or cilia; the marginal rows continue back to the level of the eyes and a single row of strong macrochaetae extend back above the eyes. Clypeus with 1+1 short combs of small macrochaetae laterally close to the frons, numerous fine setae and cilia with numerous lanceolate scales medially. Labrum with several small setae scattered over the proximal half and



Figures 29–35. *Silvestrisma chillagoense* n. sp. ♂ holotype unless indicated by specimen number *(29)* infralateral chaetotaxy of urotergite IX; *(30)* urotergite X; *(31)* remnant medial comb of urosternite I on K.541699; *(32)* genital region of T262422 with stylets, coxites VII and IX, anterior and posterior valves of ovipositor; *(33)* coxite IX, penis and paramere; *(34)* base of terminal filaments; *(35)* distal division of cerci. Scale bars = 0.1 mm.

a row of six fine setae medially near the distal margin. — Antennae with scape longer than pedicel (Fig. 9), scape with a subapical ring of strong setae, the sides and ventral face with numerous smaller setae and lanceolate scales; pedicel also with subapical ring of strong setae but also several cilia and small setae proximal to the larger setae. First annulus of flagellum long with a subapical ring of setae; subsequent annuli shorter but becoming slightly longer, bearing a ring of small setae, cilia and trichobothria, dividing into two annuli by the tenth interval and into four annuli by the about the twelfth interval. Most distal surviving intervals of almost complete antenna divided into repeated patterns of eight annuli, each with one or two rings of fine setae; rod-like basiconic sensilla (Type B) present distally in the distal annulus of each interval but are very difficult to see in most specimens so they cannot be numerous. — Mandibles typical for Heterolepismatinae with well-developed molar and incisor areas; a group of about 9–12 strong and short or thin and longer, apically bifurcated setae distally adjacent to the molar region and a bush of about 60 macrochaetae externally. — Maxilla (Fig. 10) with three thick apically bifurcate macrochaetae externally proximal to the palp; lacinia typical for genus, with three strong teeth, one set further back than the other two, followed by about six lamellate processes and a row of eight or nine thin setae, galea with two slightly stronger seta proximally but otherwise with only short fine

cilia or setulae; apical article of maxillary palp 3.7 times longer than wide (range 2.3–4.7) and 1.1 times longer than the penultimate article (range 0.8–1.2), the ultimate article with three branched papillae, those in the female slender and those in the male much wider, ultimate and penultimate articles with fine setae only, third article with indistinct subapical ring of setae which are not obviously stronger than the rest, second article with subapical ring of stronger setae as well as several somewhat stronger setae on the ventral face, basal articles with ring of short thicker setae. — Labium (Fig. 11) wider than long, postmentum with setae and small macrochaetae scattered irregularly across the anterior third, prementum with transverse and oblique groups of stronger setae and with short setulae distally; apical article of labial palp about as wide as long (L/W 0.8–1.2) with five compact papillae of similar size arranged in a three plus two cluster arrangement, outer margin with one basiconic sensillum (type C), face covered with numerous fine short setae, those proximal and medial longer than those distal and/or lateral; penultimate article without particularly stronger setae.

Thorax: Pronotum damaged in holotype (Fig. 12) with setal collar of short macrochaetae some small setae and cilia, weaker in the mid region, 1+1 long trichobothria like hairs present; lateral margins with about three stronger distinctly submarginal macrochaetae in areas free of scales, plus stronger macrochaeta and smaller setae on the margins not in distinctly scale free aeras as well as setulae and long cilia; all macrochaetae are single. On K.541700 the last slightly sub-marginal insertion posterior to the trichobothrial area has a very elongate thin tapering seta on each side. Anterior trichobothrium about halfway (0.44 to 0.50) along the margin and associated with a single macrochaeta mediad of the trichobothrium (Fig. 13) in position N-1. The posterior trichobothrium 0.79–0.85 along the margin, mediad of a large submarginal macrochaeta with a further large seta or macrochaeta more posterior (Fig. 14). Both trichobothria with two or three setulae posterior to them. Posterior margin with 1+1 groups of two larger insertion points, associated with a cilium and one or two setulae (Fig. 15–16), the more antero-lateral is a very long thin trichobothria-like macrochaeta (at least in four specimens, T262422, K.541698, K.541694 and K.541704); there no surviving examples of the more postero-medial seta/macrochaeta. — Mesonotum (Figs. 17–19) with 2–3 combs of two macrochaetae along each margin anterior to the anterior trichobothrial area which is located at position N-1, the trichobothrium placed between the single macrochaeta and the margin and located about 0.67–0.73 of the distance along the margin, the posterior area as in the pronotum but more distal (0.88–0.92 along the margin); 1+1 posterior macrochaetae as in pronotum. — Metanotum (Fig. 20) similar to mesonotum but with trichobothrial areas 0.73–0.84 and 0.89–0.93 along the margin.

Presternum with transverse row of strong macrochaetae, setae and cilia (Fig. 21). All thoracic sterna with hyaline scales. — Prothoracic sternum (Fig. 21) rounded triangular, sometimes very slightly cordiform, and only in one specimen (K.541701) was a small but distinct constriction seen and then only on one side, suggesting it is a moulting anomaly, slightly longer than wide at its base (L/W = 0.85–0.99), posterior one quarter of lateral margins with tiny marginal cilia or setae, 1+1 weak submarginal combs each of 5–6 widely spaced macrochaetae running parallel to the margins; apex between the combs not truncate and also bearing cilia or tiny setae. — Mesosternum (Figs 22) longer than wide (L/W 1.12, range 1.07–1.22), a slightly truncated distal glabrous region between the setae, with 1+1 submarginal parabolic, sometimes with combs of about 2–5 macrochaetae as well as some marginal setae, cilia and setulae along the posterior tenth of the margin. — Metasternum (Fig. 23) quite large and apically rounded, much wider than long (L/W 0.73–0.91), with submarginal rows of 3–6 macrochaetae as well as some marginal setae (some of which are quite robust) and cilia in the postero-lateral corners; quite large in comparison to the prosternum (L metasternum/L prosternum 1.2, range 1.15-1.31).

Legs becoming progressively longer and more slender (length tibia PII/PI 1.0–1.4; tibia PIII/PI 1.4–1.9), tibia L/W ratio of legs PI 2.6 (range 2.2–3.3), PII 3.0, (range 2.4–3.4), PIII 3.7 (range 3.2–4.8); tarsi L/W ratio PI 6.0 (range 4.5–7.1), PII 6.8 (range 5.3–8.5), PIII 8.0 (range 6.7–10.8). Precoxa of PI (Fig. 21) with lateral comb of three strong macrochaetae. Coxa of PI with macrochaetae in about two rows along the external margin; inner margin with about three stout macrochaetae distally over the articulation and another one or two strong longer setae subdistally along the inner margin. Trochanter with several setae. Femur ventrally with several macrochaetae, some carrot-shaped, along the posterior margin and a macrochaeta about halfway along the anterior margin, distal anterior corner with 2–3 macrochaetae, ventral face and anterior margin covered with lanceolate scales with setae restricted to the proximal posterior half. Tibia with a very strong carrot-shaped macrochaeta distally as well as a few smaller strong setae along the ventral margin, dorsal or outer margin with a macrochaeta about midway along the margin; apical spur large and distinctly hooked and bearing a few small setae; ventral face of tibia mostly covered with lanceolate scales. Tarsi of four articles, the basal tarsal article of PI about equal in length to the remaining articles together, bearing some stronger setae below; second and third articles short and subequal, suture between third and fourth articles weak. Pretarsus with two long curved lateral claws and a shorter straight medial claw. PII (Fig. 22) and PIII (Fig. 24) similar to PI except lacking comb on the precoxa and a lower density of macrochaetae along the outer margins. The relative length of the basal tarsal article is only about half the total length of the tarsus on PIII.

Abdomen: Urotergite I with 2+2 combs; urotergites II–VII with 3+3 combs (Figs 25–28) as shown in Table 2, all combs associated with some cilia, small marginal setae and setulae; the submedial combs are composed of one macrochaeta plus a more medially posterior setae, the insertion of which is not much smaller than that of the macrochaeta but more so than on the nota; urotergite VIII with 2+2 combs similar to those on the preceding segments, lacking the lateral comb; urotergite IX (Fig. 29) without combs but with 1–2 marginal setae, a cilium and 0–2 setulae in each infralateral corner. Urotergite X (Fig. 30) quite long parabolic, L/W 0.49–0.59 with the L/W ratio at 2/3 length of 0.41–0.51, with 1+1 slightly larger submarginal posterior macrochaetae but with many strong setae as well as smaller setae, setulae and cilia along most of the lateral margins.

Urosternite I generally glabrous but on four of 19 specimens a single seta or a small comb of two insertions was present in the medial position of urosternites I (Fig. 31),

Table 2. Number of macrochaetae per bristle comb – *Silvestrisma chillagoense* n. sp.

Segment	Urotergite			Urosternite	
	Infralateral	Lateral	Submedial	Medial	Lateral
I	2–3	2	—	—**	—
II	2–3	2–3	2*	—	1
III	3–4	3	1–2*	—	1
IV	2–5	3	2*	—	1
V	4–5	3–4	2*	—	1
VI	3–5	3	2*	—	1
VII	3–4	3	2*	—	1
VIII	3–4	—	2*	—	1

* in reality just one macrochaeta plus a large seta whose insertion size is not greatly different to that of the macrochaeta.
**see text for discussion on variants.

urosternites II–VIII with 1+1 lateral combs each of a single macrochaeta each associated with a few cilia and setulae posterior to the macrochaeta. Slender styli present on VIII and IX in male and VII to IX in female; each stylus with about three robust macrochaetae apically. Styli IX (Figs. 32–33) (excluding the apical macrochaetae) almost three times the length of the internal process.

Coxite IX of male (Fig. 33) similar to female, inner process 1.1–1.5 times longer than wide at its base, bearing short parameres which protrude only slightly beyond the inner margin of coxites IX and bearing several short thin setae distributed over their surface. Penis typical with numerous glandular setae apically, each set on a protuberance.

Coxite IX of ♀ (Fig. 32), the internal process acute apically, 1.6 times (range 1.5–1.6) longer than wide at its base, external and internal margins of internal process and round external margin of outer process with moderately strong setae. — Ovipositor long about twice HW (range 1.5–2.2) surpassing the end of the inner process of coxite IX by about three times the length of the inner process, composed of about 40 divisions (range 35–43). Distal divisions of gonapophyses with only short fine setae and setulae.

Cerci (Figs 34–35) with basal divisions shorter than wide then progressively longer with a single ring of setae, macrochaetae and trichobothria becoming increasingly stronger and longer distally, sixth and seventh divisions with two rings, the more proximal with short trichobothria, smaller seta and possibly also lanceolate scales, macrochaetae restricted to the most distal ring; eighth and ninth divisions with four rings, the lanceolate scales restricted to the basal and penultimate rings. Most distal surviving divisions of eighth rings as illustrated (Fig. 35), lacking lanceolate scales but with trichobothria, cilia and setae. — Base of median dorsal appendage (Fig. 34) as illustrated.

Habitat. Collected from dry leaf litter accumulating at the base of trees or on rocks ledges.

Silvestrisma jardinense sp. nov.

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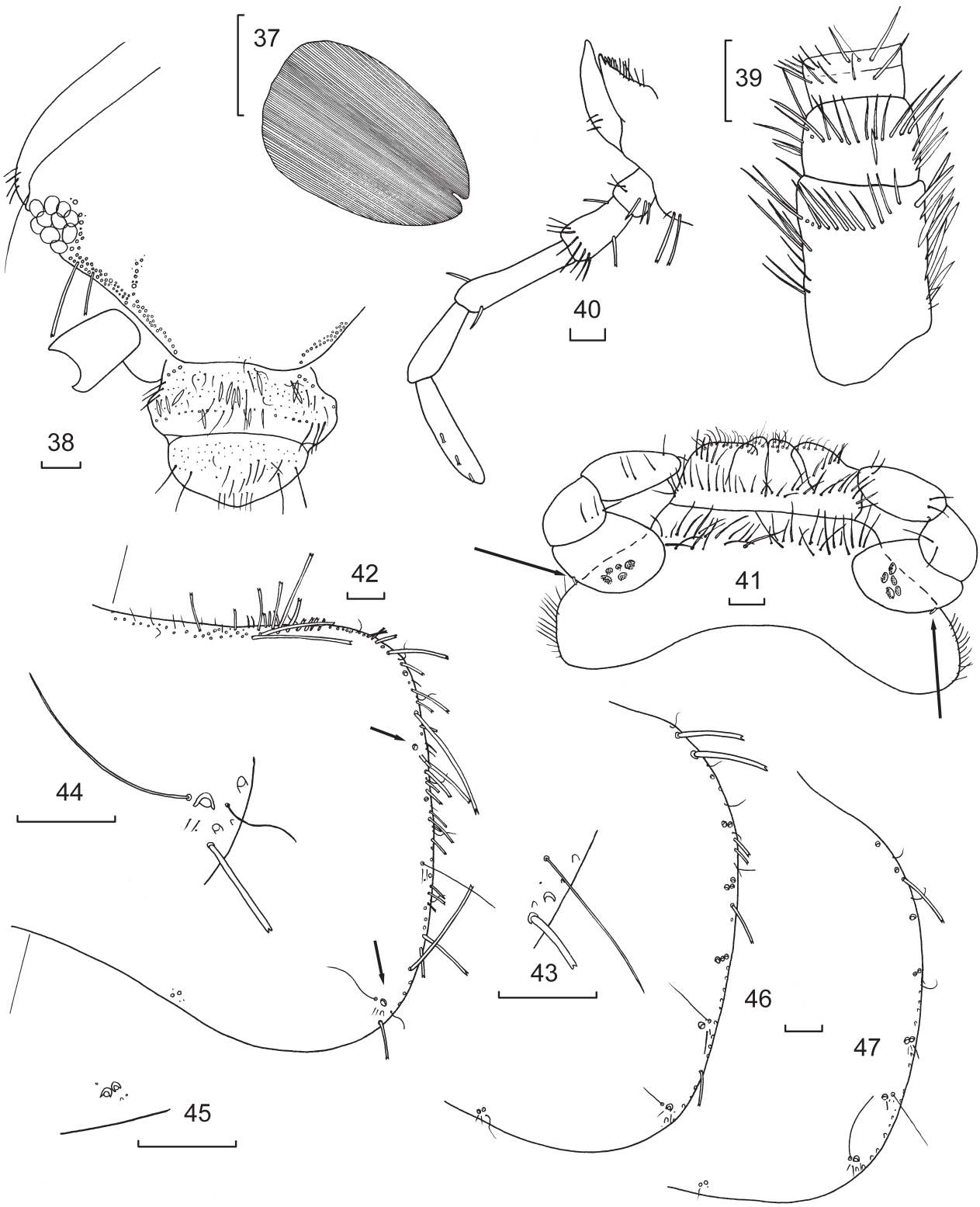
Figs 36–59

Holotype. ♀ (HW1.10) QUEENSLAND: Jardine Rr NP, Jardine River South campsite, leaf litter at base of tree, 11.1406°S 142.3626°E 15m asl, 21.vii.2013, Graeme Smith (2 slides) QM T262423.

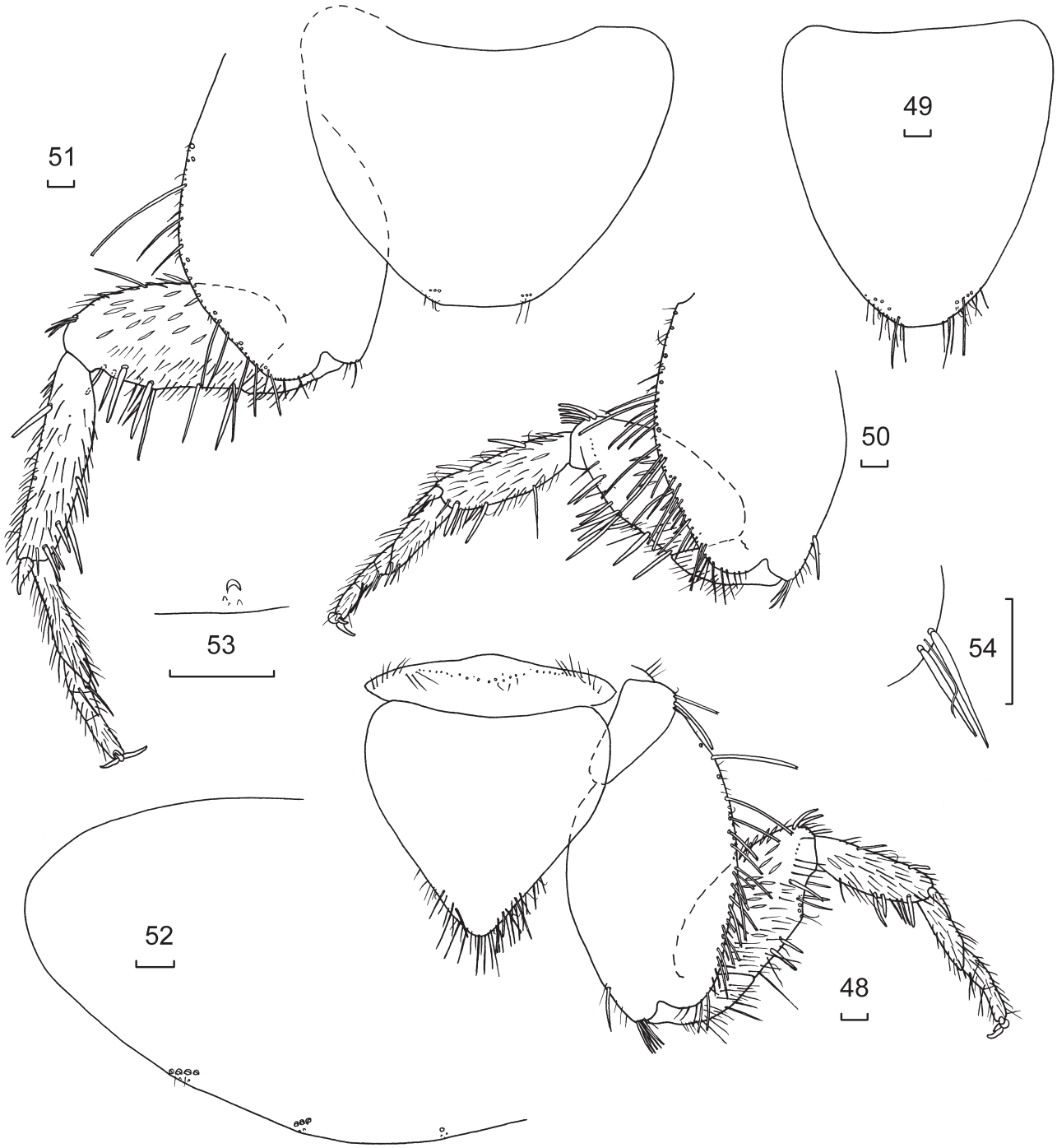
Paratypes. ♂ (HW 0.85) QUEENSLAND: Jardine Rr NP, track to Jardine River South campsite, Eucalypt leaf litter among *Xanthorrhoea*, 11.2167°S 142.3569°E 72m asl, 22.vii.2013, Graeme Smith (2 slides) QM T262424; ♀ (HW 0.95) QUEENSLAND: Pennefather campsite, paperbark leaf litter on sand, 12.2918°S 141.7033°E 7m asl, 19.vii.2013, Graeme Smith (2 slides) K.541708; ♀ (HW 0.88), same data as previous (2 slides) K.541711; ♀ (HW 0.95), same data as previous (2 slides) K.541710; ♀ (HW 0.98), same data as previous (2 slides) K.621638; ♀ (HW 0.88) QUEENSLAND: Pennefather campsite, bark spray to ti tree large leaf, 12.2919°S 141.7076°E 10m asl, 19.vii.2013, Graeme Smith (2 slides) K.541709; ♂ (HW 1.00), QUEENSLAND: Heathlands Recreation Reserve, 4km S. Fruit Bat Falls, leaf litter, 11.4882°S 142.4327°E 109m asl, 26.vii.2013, Graeme Smith (2 slides) K.377764; ♀ (HW 0.95), same data as previous (2 slides) K.377765.

Diagnosis. This species can be distinguished from the *S. chillagoense* n. sp., *S. cooloola* and *Heterolepisma bisetosum* by the absence of a macrochaeta mediad of the anterior trichobothrium of the pronotum only. It can be distinguished from *S. howense* which has only 1+1 single large insertions on the posterior margins of the nota and abdominal tergites without any indication that a large submarginal seta may be present and which lack macrochaetae associated with the

Figure 36. *Silvestrisma jardinense* n. sp. freshly moulted specimen, Jardine River National Park, 4km S. Fruit Bat Falls



Figures 37–47. *Silvestrisma jardinense* n. sp. ♀ holotype unless otherwise indicated by specimen number *(37)* apex of round scale from pronotum; *(38)* head (T262424); *(39)* antenna pedicel, scape and first interval(s) of flagellum; *(40)* maxilla, minor setae omitted; *(41)* labium, omitting smaller setae from palps, arrows indicate position of basiconic sensilla; *(42)* pronotum, right side, arrows indicate distinctly submarginal macrochaetae located within an area largely lacking scales; *(43)* idem, right anterior trichobothrial area; *(44)* idem, right posterior trichobothrial area; *(45)* idem, right posterior comb insertions; *(46)* mesonotum, right side; *(47)* metanotum, left side. Scale bars = 0.1 mm.



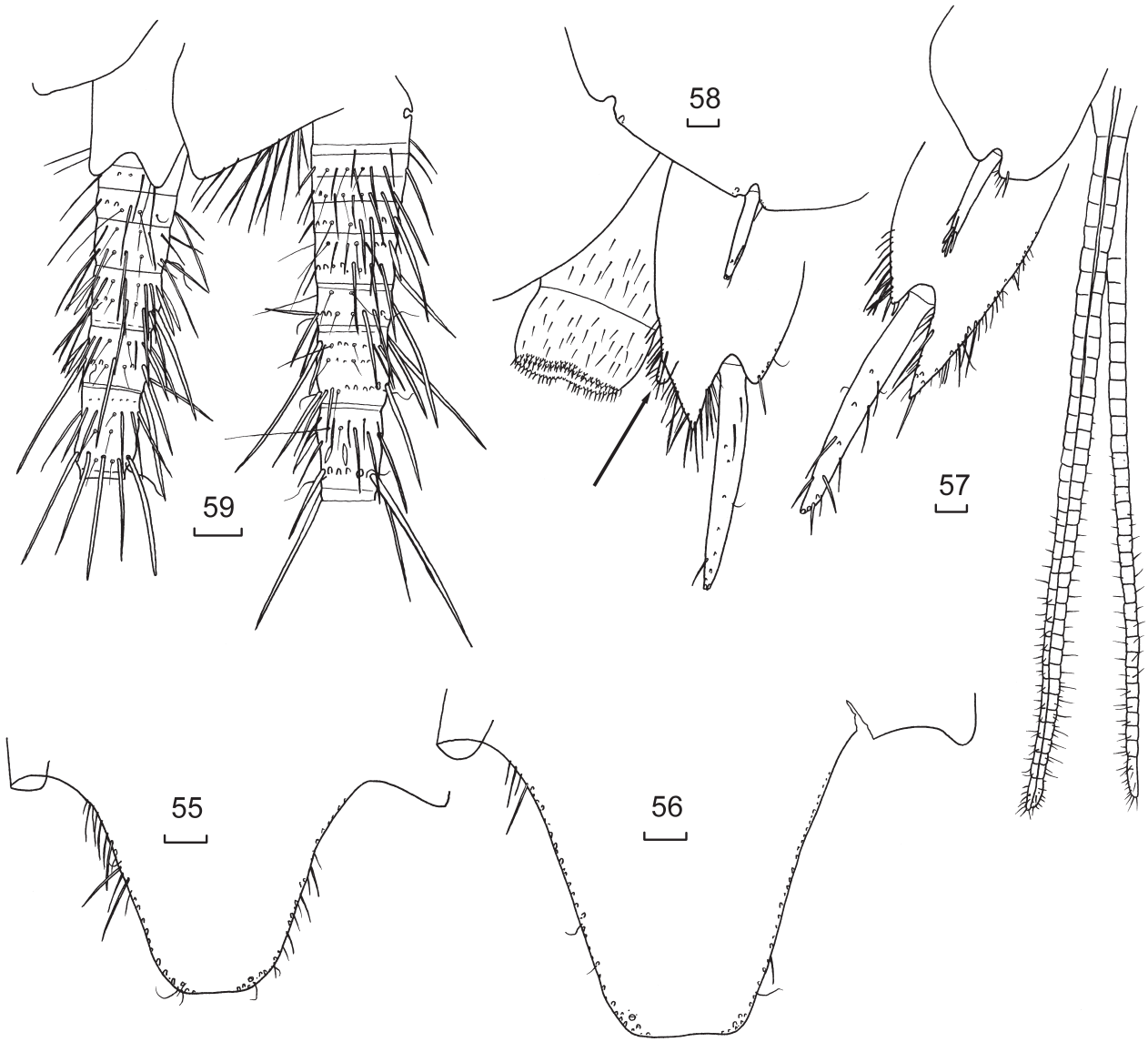
Figures 48–54. *Silvestrisma jardinense* n. sp. ♀ holotype unless otherwise indicated by specimen number *(48)* presternum, prosternum and PI; *(49)* mesosternum; *(50)* PII; *(51)* metasternum and PIII; *(52)* urotergite IV, chaetotaxy of right side; *(53)* idem, details of submedial comb; *(54)* infralateral chaetotaxy of urotergite IX. Scale bars =0.1 mm.

anterior trichobothrial area on all three thoracic nota, whereas the *S. jardinense* n. sp. always has a macrochaeta associated with the trichobothrium on the meso- and meta- nota.

Description

Appearance: Medium sized silverfish; appearance when live varies with quality of scale cover and also lighting. Well preserved scales (just after moulting) with dark scales overall and a distinct light line behind the head and a thin light margin to the nota, with less intact scale covering, the silverfish appears to be mottled silver grey in colour, the light line behind the head less visible but the edges of the nota appear lighter in colour (Fig. 36). In all cases the antennae and terminal appendages appear light pink in colour, and sometimes with faint banding on the tail filaments, the tarsi of the legs also being pale to pink in colour with slightly darker pigment on the tibia and femora. Styli light brown to very pale.

Body length: H+B 8.2 mm; HW 1.10 mm; thorax: length 2.4 mm or 0.28–0.32 H+B; most complete antennae 5.3 mm or 0.64 H+B; longest surviving cerci and median dorsal appendage almost complete at 3.6 mm and 5.4 mm (0.44 and



Figures 55–59. *Silvestrisma jardinense* n. sp. ♀ holotype unless otherwise indicated by specimen number *(55)* urotergite X; *(56)* urotergite X (K.377764); *(57)* right half of genital region of female with stylets, coxites VIII and IX and ovipositor; *(58)* base of urosternites VIII of male, left coxite IX, penis and paramere (arrow); *(59)* base of terminal filaments. Scale bars = 0.1 mm.

0.65 H+B) respectively.

Pigmentation: Pigment purplish-brown. Flagellum of antennae evenly very light brown becoming slightly darker distally; pedicel with very faint pigment in outer distal region, scape with more obvious patch of pigment on outer face, stronger distally. Terminal filaments moderate to light brown with the last two annuli of each division lighter in some specimens, the contrast between the light and dark annuli becoming more obvious distally. Head with pigment around eyes and along lateral margins to the level of the perpendicular band of macrochaetae. Maxillary palp with quite strong even pigment on distal three articles although this can vary, very little only apically of the second article and none on the basal. Ultimate article of labial palp with distinct pigment along lateral margins, dense proximally, occasionally also along distal margin, penultimate article pigmented, especially laterally and second article also with pigment over most of distal half. Legs not strongly pigmented. Coxae with some pigment only along lateral margins proximally only, trochanter with very small faint patch on outer subdistal margin, femur with small amount of pigment along posterior margin, strongest on the bulge, tibia with pigment over much of dorsal surface visible along the margins only when viewed from below, first tarsal article pigmented in all legs, other articles only strongly pigmented on PI. Urotergite X with light to medium pigment m. Coxites IX pigmented, especially around the stylus insertion. All styli with moderate pigment. Ovipositor white or perhaps slightly yellowish.

Macrochaetae: Smooth, hyaline to straw-coloured to moderate brown, apically bifurcate with truncated tips to each bifurcation. Some macrochaetae on legs, stout carrot-shaped.

Scales: Round scales orbicular, broad, brown with numerous subparallel ribs that do not surpass the margin of the scale (Fig. 37). Round scales found on top of head, thoracic sterna, coxae, nota, urotergites and urosternites. Lanceolate scales found on clypeus, femora, tibia, basal third

of terminal filaments, scape and probably the pedicel, scales apparently absent from labrum, mouthparts, tarsi and styli.

Head: Wider than long (Fig. 38). Anterior margin without macrochaetae except for a few tiny setae in the middle; strong macrochaetae along lateral margins with peri-antennal groups of about six macrochaetae and cilia which almost connect laterally with the rows of macrochaetae along the margin, the marginal macrochaetae continue along the sides of the head behind the antennae with a line of macrochaetae extending above the eyes. Clypeus with 1+1 combs of three macrochaetae laterally near the frons and a transverse line of setae distally about 1/3 the length of the clypeus, the region behind this line with numerous lanceolate scales as well as thin setae and cilia. Labrum with many fine setae across the proximal half and a line of six thinner setae anteriorly. — Scape (Fig. 39) quite long with a subdistal line of setae and numerous lanceolate scales and some setae along the margins, pedicel much shorter, with a submedial ring of setae, as well as some setae scattered over the surface, there are probably also scales but the angle of viewing makes interpretation difficult; first annulus of flagellum with ring of setae, annuli two to six similar but also with a trichobothrium and some cilia, annuli beyond here split into two and beyond the tenth into four annuli with the trichobothrium restricted to the most distal annulus. Most distal surviving intervals divided into repeated patterns of eight annuli, each with one or two rings of setae, with small setae of similar length in both rings but any cilia restricted to the more distal ring of each pair of annuli. Some annuli bear small basiconic sensilla (Type B) but these are not easy to find with a light microscope. — Mandibles typical for Heterolepismatinae with well-developed molar and incisor regions; a group of about six strong and short plus two thinner, apically bifurcated setae distally adjacent to the molar region and a bush of macrochaetae externally. — Maxilla (Fig. 40) with two strong apically bifurcate macrochaetae externally proximal to the palp; lacinia short and wide, with two strong teeth, one set further back than the other, followed by about six lamellate processes and a row of seven setae, galea with a few short setae near its base otherwise only short fine setulae; apical article of maxillary palp 3.3–5.2 times longer than wide and 1.1–1.6 times longer than the penultimate article, the ultimate article with three branched papillae, those of the female narrow and much wider in the males, other specialised sensilla (e.g. basiconic sensilla) not seen, last two articles of palp with fine setae only, two basal articles with subapical rings of thicker setae and the ante-penultimate article with two stout setae. — Labium (Fig. 41) wider than long, postmentum with long setae scattered in band across entire width including several small setae along and near the antero-lateral margins, prementum with transverse and oblique groups of strong setae and with short setulae distally; apical article of labial palp about as wide as long (L/W 0.8–1.3) with five papillae of the compact type arranged in a cluster arrangement, a single basiconic sensillum (Type C) on the outer margin near the level of the papillae, covered with numerous fine short setae especially below; penultimate article with some slightly stronger setae subapically; second article also with a few slightly stronger setae along the inner margin.

Thorax: Pronotum (Fig. 42) with complete setal collar of both short and long macrochaetae and some cilia, not very dense in mid region; lateral margins also with both short and long macrochaetae but only two macrochaetae are positioned distinctly remote from the margins in areas largely free from scales, one about one quarter the distance along the margin and the other about seven-eighths along the margin associated with the posterior trichobothrial area. Anterior trichobothrium, also in an area free of scales, about halfway (0.48–0.61) along the margin with a few setulae posterior to the trichobothrium, not associated with a macrochaeta (Fig. 43). The posterior trichobothrium mediad of a submarginal macrochaeta and its cilium, with two or three setulae and one or two setae posterior to this group (Fig. 44). Posterior margin with two insertion points on either side (Fig. 45), the macrochaetae lost in all mounted specimens, however specimen T262424 was about to moult and examination of the newly forming cuticle shows that the more posterior insertion point is occupied by a long thin trichobothria-like macrochaeta. — Mesonotum (Fig. 46) also with short macrochaetae along the margins as well as two (rarely three) combs each of two (rarely three) macrochaetae anterior to the anterior trichobothrial area, both trichobothrial areas are more posterior than on the pronotum, the anterior trichobothrium located about 0.66–0.78 the distance along the margin with a macrochaeta mediad of the trichobothrium and the posterior area as in the pronotum but 0.82–0.93 along the margin; 1+1 posterior macrochaetae as in pronotum. — Metanotum (Fig. 47) similar to mesonotum, but the anterior trichobothrial area is located 0.66–0.81 along the margin and always with a macrochaetae mediad of the trichobothrium.

Presternum with transverse row of long fine setae (Fig. 48) as well as some cilia. All thoracic sterna with hyaline scales. — Prothoracic sternum (Fig. 48) triangular or slightly cordiform, slightly longer than wide (L/W 0.91–1.08), 1+1 irregular combs of four to five bifurcate macrochaetae running subparallel to the margin, as well as some long marginal setae and cilia in distal one third, these setae almost as long as the macrochaetae of the combs. — Mesosternum (Fig. 49) parabolic, longer than wide at its base, (L/W 1.01–1.12) with 1+1 subdistal combs of 4–5 macrochaetae which are not positioned very close together and aligned somewhat subparallel to the margin, a few long setae also found along the posterior part of the lateral margins but setae absent for a short, sometimes straight region apically. — Metasternum (Fig. 51) wider than long (L/W 0.60–0.80), the length ratio of the metasternum to the presternum 1.01–1.17, apically sometimes a little truncate, 1+1 apical combs of about 2–4 macrochaetae, lateral margins with a few simple setae and cilia only adjacent to the combs.

Legs becoming progressively longer and more slender with the tibia of PII being 1.09–1.20 times longer than that of PI and the tibia of PIII being 1.54–1.71 times longer than that of PI, tibia L/W ratio of legs PI 2.4–3.2, PII 2.7–3.8, PIII 3.7–4.2; tarsi L/W ratio PI 6.3–8.7, PII 6.3–9.9, PIII 8.3–10.0. Precoxa of PI with lateral combs of two strong macrochaetae. — Coxa of PI (Fig. 48) without comb near the anterolateral corners, but many strong macrochaetae along the outer margin becoming two rows wide toward the distal end of the external margin; inner margin with a strong tapered macrochaeta subdistally and a group of five or six macrochaetae distally over the articulation. — Trochanter with many setae some quite strong. — Femur ventrally with a long fine tapered macrochaeta near the trochanter and several carrot-shaped apically finely bifurcate macrochaetae along the posterior margin, distal anterior corner with two stout

curved macrochaetae, lanceolate scales along the margin and extending onto the ventral face of the femur, rest of ventral surface with long setae. — Tibia with a few lanceolate scales on the ventral face proximally, rest of surface with setae, a strong carrot-shaped macrochaeta distally as well as a thinner pair subdistally, another pair midway along the margin, one carrot-shaped the other long and curved, smaller pair near the proximal end of the posterior margin, distal end of tibia with a row of stronger setae, anterior margin with two stout macrochaetae about one third and two thirds along the margin, as well a smaller stronger seta on the ventral margin closer to the femur; apical spine with several setae. — Tarsi of four articles, the basal tarsal article of PI not quite as long as the remaining articles together, bearing numerous long setae but none particularly stronger than the rest; second and third articles the shortest, each with two stronger setae ventrally. Pretarsus with two long curved lateral claws and a shorter straight medial claw. PII (Fig. 50) similar to PI, coxa with a stout macrochaeta subdistally on the outer margin and three strong macrochaetae over the articulation with the trochanter; trochanter with some strong setae, femora with many strong stout macrochaetae as illustrated, the tibia with two stout macrochaetae along the dorsal margin and the first tarsal article is a little longer than the remaining three together, and PIII (Fig. 51) similar to PII but with the typical long trichobothrium on the tibia (lost on most specimens).

Abdomen: Urotergite I with 2+2 combs; urotergites II–VII (Fig. 52) with 3+3 small combs as shown in Table 3; all combs associated with some cilia, small marginal setae and setulae; the submedial combs on urotergites IV–VIII with a single macrochaeta and one or two setae between the macrochaeta and the margin; on urotergites II and III the secondary seta insertion of the submedial comb (Fig. 53) may be present but very much smaller than the primary macrochaeta insertion, nor as large as the secondary insertions on the nota; urotergite VIII with 2+2 combs, lacking the lateral comb; urotergite IX without combs but with two setae and two cilia in each infralateral corner (Fig. 54). Urotergite X (Figs 55–56) long, trapezoidal L/W 0.54–0.70 with the L/W ratio at 2/3 length of 0.39–0.47, with 1+1 slightly larger submarginal posterior macrochaetae but with many strong setae as well as smaller setae, setulae and cilia along most of the lateral margins.

Urosternite I glabrous, urosternites II–VII with 1+1 lateral combs each of a single macrochaetae each associated with a few small setulae, urosternite VII with small styli, 1+1 combs of a single macrochaetae located mediad of each stylus, associated with two marginal setulae. Urosternite VIII in ♀ (Fig. 57) divided into separate coxites, each bearing a small stylus which is apically armed with some strong setae, a single macrochaeta is located mediad of the stylus insertion associated with a few small marginal setae. Styli present in three pairs, those on IX more than twice as long as those on VIII which are only slightly longer than those on VII.

Coxite IX of ♀ (Fig. 57) with the internal process acute apically, 1.4–1.8 times as long as wide at its base, reaching to about one 40% the length of the stylus; external and internal margins of inner process and external margin of outer process with a few moderately strong setae. — Ovipositor (Fig. 57) long and slender (2.0–2.30 HW) and of primary type, composed of about 36 divisions (range 32–39). Distal divisions of gonapophyses only with short fine setae and setulae.

Coxite IX of male IX (Fig. 58) similar to female, inner process 1.1–1.2 times longer than wide at its base, bearing short parameres which protrude only a little beyond the inner margin of coxites IX and bearing several short thin setae distributed over their surface. Penis typical, with numerous glandular setae apically, each set on a protuberance.

Cerci (Fig. 59) with basal divisions much wider than long bearing single ring of setae and trichobothria, from division six with two rings including also lanceolate scales in the basal ring, eight division with three rings and ninth with four rings, the lanceolate scales found in the basal and third rings, the ultimate ring bearing longer macrochaetae and cilia. — Median dorsal appendage (Fig. 59) similar.

Habitat. Collected in leaf litter and also using a pyrethrum spray to the bark of trees.

Etymology. Named after river near which the specimens were collected.

Silvestrisma cf. *jardinense*

Bamaga lineage

Material examined. ♀ (HW 0.90) QUEENSLAND: Punsand Bay campground, Eucalypt leaf litter, 10.7216°S 142.4599°E 5m asl, 23.vii.2013, Graeme Smith (2 slides) K.377759; ♂ (HW0.90), same data as previous (2 slides) K.377760; ♂ (HW0.95), same data as previous (80% ethanol) K.377761; (EV00606) ♂ (HW 1.00),

Table 3. Number of macrochaetae per bristle comb – *Silvestrisma jardinense* n. sp.

Segment	Urotergite			Urosternite
	Infralateral	Lateral	Submedial	Lateral
I	2–3	1–3	—	—
II	2–3	3	1*	1
III	3	3	1*	1
IV	3–4	3	1*	1
V	3–4	3–4	1	1
VI	3–4	3	1	1
VII	3–4	3	1	1
VIII	3	—	1	1

*second insertion point visible posterior and mediad of the macrochaeta, but only about half the size of the macrochaeta insertion

QUEENSLAND: Bamaga near DC3 wreck, leaf litter, 10.9174°S 142.4289°E 69m asl, 25.vii.2013, Graeme Smith (2 slides) K.377758; ♂ (HW 1.05), same data as previous (2 slides) K.377757; ♀ (HW 1.10), same data as previous (2 slides) K.377762.

Comments. Molecular data suggest that the specimens from near Bamaga and Punsand Bay (i.e. north of the Jardine River) could be a distinct species, with 15.7-16.9% difference in COI sequences. However extensive effort failed to find a consistent morphological difference between this lineage and the type lineage. While specimens from the Bamaga lineage all displayed distinct annulations of the tail filaments, at least two specimens from the type lineage also displayed some banding although it was less distinct. We have therefore chosen to leave the morphologically difficult to distinguish Bamaga clade as unnamed but related, until further evidence supports it being named as a distinct species.

Silvestrisma cooloola (Smith and Mitchell, 2019)

Material examined. Several specimens from the type series, mounted on slides were re-examined and measured. We can confirm that this species has lanceolate scales on the antennal scape, but none were observed on the pedicel and that the slender index was 0.32–0.43, which while mostly narrower than other species, demonstrated that there is a large degree of overlap in the ranges (*chillagoense* 0.38–0.51, *jardinense* 0.39–0.47) suggesting that this is not sufficiently robust as a diagnostic measurement.

Silvestrisma bisetosum (Carpenter, 1916 *sensu* Mendes, 1988) comb. nov.

Isolepisma bisetosa Carpenter 1916: 12. Type locality: Seychelles, Bird Island, Ile aux Récifs, Long Island, Aldabra, Farquhar; Providence Islands, Cerf Island, Amirante, Eagle Island.

Heterolepisma bisetosa (Carpenter). Stach, 1933: 346 placed the genus *Isolepisma* Escherich, 1905 and *Heterolepisma* Escherich, 1905 in synonymy.

Heterolepisma bisetosa (Carpenter) *sensu* Mendes, 1988: 4. Supplementary description based on about 1500 specimens from Sar Uanle, Somalia.

Heterolepisma bisetosum (Carpenter). ICZN, 2018: 290 ruling that *Lepisma* and all genus names derived from *Lepisma* should be treated as of neuter gender.

Comments. It is quite possible, and in our opinion even likely, that the species examined by Mendes (1988) is different to that described by Carpenter, although they are probably closely related. Given the great similarity between Mendes' species and the two species described here, it would appear that *Heterolepisma bisetosum* (or at least the form described by Mendes) is closely related to the Australian species and should be included in the genus *Silvestrisma* recently erected by Molero-Baltanás *et al*. (2025) when they redefined *Heterolepisma* based on new South American material. These authors selected the poorly described *H. michaelseni* Silvestri, 1908 as the type species, which has urosternal combs each of more than one macrochaeta, whereas the majority of Australian species have 1+1 single macrochaetae. It is therefore possible that most *Silvestrisma* species including *H. bisetosum* sensu Mendes (1988) and the new species described here will eventually be transferred to a new genus.

Discussion

Species delineation within the Australian Heterolepismatinae continues to be challenging. Molecular differences, which would normally be associated with clear morphological differences between species within the Ctenolepismatinae, do not seem to be sufficient within the Heterolepismatinae. This was reported in Smith *et al*. (2019) where the authors failed to find reliable morphological differences between the various clades of *Silvestrisma sclerophyllum* identified by COI and 28S molecular data. A similar situation occurs here where a 16% difference in COI occurs between clades of *Silvestrisma jardinense* from south of the Jardine River and Pennefather compared to those north of the Jardine River from Bamaga and Punsand. Significant differences were however identified between *S. jardinense* and *S, chillagoense* where 15-19% difference in COI was found.

The genus *Heterolepisma* had been a bit of a dumping ground for all Heterolepismatinae, in part due to the lack of published detail regarding the morphology of the South American type species *Heterolepisma pampeanum* (Silvestri, 1902). The recent description of some South American Heterolepismatinae (Molero-Baltanás *et al*., 2025) is therefore welcomed. Even though the authors did not obtain material of *H. pampeanum*, the morphological and molecular data on several other southern cone species, has helped identify important taxonomic characters and give some confidence to defining genera within the Heterolepismatinae. Here we have accepted the decisions of Molero-Baltanás *et al*. (2025) but, like them, we suspect that further refining of the generic structures will be required.

Acknowledgements. The authors would like to thank Joe Sydney and Dave Rothery of the Highland Caving Group and Louise Smith for assistance with collecting material. Funding for the COI and 28S work was also provided by the Australian Museum Research Institute.

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