AUSTRALIAN LEPISMATINAE (ZYGENTOMA: LEPISMATIDAE)

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Summary

Species of Lepismatinae present in Australia are discussed including a new record of *Xenolepisma penangi* Smith and Kuah, 2011 and the description of a new species of *Lepisma* Linnaeus, 1758 *sensu* Mendes, 1988 with a key to the species of this genus.

Keywords. Thysanura, Zygentoma, taxonomy, new record, new species, *Xenolepisma, Lepisma*

INTRODUCTION

Lepismatidae represent the most familiar silverfish family due to the occurrence of several anthropophilic species. This family is distinguished from other silverfish families by the presence of small but distinct eyes and a covering of scales, which imparts a black to silver or yellow to brown colour in life. The family is however quite diverse with many species living in soil, in leaf litter, under bark or even within the nests of ants and termites. The first silverfish to be described was the European anthropophilic species *Lepisma saccharina* Linnaeus, 1758. Its original description was very brief and could have described almost any species of the Lepismatidae. Wygodzinsky (1941) redescribed the species and Mendes (1988) further refined the description in line with current criteria.

Mendes (1991) divided the family Lepismatidae into six subfamilies of which, at that time, only two (Ctenolepismatinae and Heterolepismatinae), were recognized as having autochthonous species in Australia. Two other subfamilies, the Acrotelsatinae and Lepismatinae, were reported only from the introduced, cosmopolitan, anthropophilic species *Acrotelsa collaris* Escherich, 1905 and *Lepisma saccharina* respectively. The occurrence of the genus *Xenolepisma*, Mendes, 1981 (Lepismatinae) had been mentioned (e.g. Smith & Watson, 1991) but no species described. Recently, two Australian endemic *Xenolepisma* species have been described (Smith, 2015 and Smith (in press)).

The Lepismatinae have smooth macrochaetae (apart from an apical bifurcation) i.e. without the obvious barbs or pectinations seen on the macrochaetae of the Ctenolepismatinae. They can easily be distinguished from species of the Heterolepismatinae, which also have smooth macrochaetae, by the lack of a setal collar on the anterior margin of the pronotum; and from *Anisolepisma* Paclt, 1967 (to be included in the Acrotelsatinae in a review in preparation) by the presence of free thoracic sternites covering part of the coxae (absent in *Anisolepisma*).

This current paper will discuss the limited documented records of the Lepismatinae in Australia, report the presence of an additional species of *Xenolepisma*, originally described from Malaysia, and describe the first Australian species of the genus *Lepisma*.

MATERIALS AND METHODS

Records for *Lepisma saccharina* have been taken from the literature and from notes provided to me by Dr John Irish, following his examination of Australian silverfish material from several museum collections in the late 1980's. Methodology for the measurement of specimens, their dissection, mounting in Tendeiro solution and illustration conform to those of Smith (2013). Roman numerals are used to indicate abdominal segment number. In addition the following abbreviations are used: 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. The term *macrochaetae* refers to the larger stronger bristles, *setae* to smaller thinner bristles, *setulae* to the very small, usually straight setae associated with the combs and *cilia* to the curly thin hairs also often associated with the combs. References to left and right refer to the left and right of the animal when observed from above with the head forwards. The standard abbreviations ACT: Australian Capital Territory, NSW: New South Wales, QLD: Queensland, VIC: Victoria and WA: Western Australia are used for the territories and states of Australia.

Specimens are deposited with the Australian National Insect Collection (ANIC), Canberra, ACT, Australia (unless noted otherwise); specimen accession numbers are listed with the material examined. Locality grid references were estimated from Google

Earth using the locality description on the labels and are very approximate (± 10km).

SYSTEMATICS

Family **Lepismatidae** Latreille, 1802
Subfamily **Lepismatinae** Latreille, 1802

Xenolepisma Mendes, 1981

Asterolepisma (Xenolepisma) Mendes, 1981: 200.
Xenolepisma Mendes, 1988: 12.
Type species: *Lepisma globosa* Escherich, 1905 by original designation.
Remarks: The genus currently contains five species; *X. globosa* (Escherich, 1905) from southern Africa, *X. subnigrina* (Silvestri, 1938) from India and *X. penangi* Smith & Kuah in Smith *et al*. 2011 from peninsula Malaysia plus the two recently described Australian endemics, listed below. A key to the species of the genus is provided in Smith (in press).

Xenolepisma monteithi Smith, 2015

Xenolepisma monteithi Smith, 2015: 76.
Remarks: Collected with ants (*Crematogaster* sp.) using pyrethrum spray to the bark of a Eucalypt tree at Bramwell Station on Cape York Peninsula. The species has the same striking colour pattern seen with *X. globosa* and *X. penangi* (Figure 1).

Figure 1. *Xenolepisma penangi* Smith & Kuah, 2011 (photo of Malaysian specimen with permission from Lee Chow-Yang)

***Xenolepisma* sp.** Smith (in press)
Remarks: Very small species (ca 2 mm), known from a single specimen collected in a pitfall trap on Barrow Island. Numerous species of ants were also collected in this trap, which suggests it might also be an inquiline species.

Xenolepisma penangi Smith & Kuah, 2011 new record
(Figure 1)

Xenolepisma penangi Smith and Kuah in Smith *et al.*, 2011: 27.
Material examined: ♂ (HW 0.61) on three slides, Northern Territory: Darwin (12.4°S 130.9°E), 15.vii.1983, J.A.L. Watson, mangrove stump (ANIC 5-000015).
Remarks: The single specimen examined was not in perfect condition and the colour pattern could not be determined. In almost all other characters it appears to be conspecific with the species described from Penang, Malaysia where it was found living with the tramp ant species *Monomorium pharaonis* (Linnaeus, 1758). The specimen displays the same dorsal chaetotaxy (i.e. glabrous posterior margins to the thoracic nota, urotergite I with 2+2 macrochaetae, urotergites II-VIII with 3+3 and urotergite IX with 1+1 macrochaetae), whereas *X. globosa* from Africa has 1+1 macrochaetae only on urotergite I, *X.*

subnigrina from India has 5+5, *X. monteithi* has 6+6 on both the nota and the abdominal tergites and the Barrow Island species has only 1+1 macrochaetae on both the nota and abdominal tergites. The Darwin specimen also displays the same arrangement of specialized sensillae on the distal antennal articles as the Malaysian specimens (i.e. single three-armed asteriform sensillae located at the distal end of the proximal three subarticles of each four subarticled chain). This pattern is similar to that of *X. monteithi* but different to *X. globosa* and *X. subnigrina* where the specialised sensillae appear proximally in each subarticle. Molero-Baltanás *et al.* (2000) demonstrated that sensillae patterns were quite distinctive and consistent in species of *Neoasterolepisma* and *Tricholepisma* (both also Lepismatinae) but the usefulness of these sensillae patterns is yet to be confirmed in *Xenolepisma*.

The Darwin specimen differed from the Malaysian specimens of *X. penangi*, in having slightly longer antennal articles and the gap between the combs on the metasternum being only half as wide. These differences are not considered to be significant based on the limited knowledge of this genus.

Lepisma Linnaeus, 1758

Lepisma Linnaeus, 1758: 201.
Type species: *Lepisma saccharina* Linnaeus, 1758 by monotypy (second nominate species, *Lepisma terrestris*, is treated as *nomen nudum*).
Lepisma Linnaeus *sensu* Mendes, 1988: 10.

Lepisma saccharina Linnaeus, 1758

Lepisma saccharina Linnaeus, 1758: 201.
Forbicina plana Geoffrey, 1762: 613.
Lepisma vulgaris Scopoli, 1763: 378.
Lepisma semicylindrica De Geer, 1782: 14. Secondary source: De Geer, 1783: 198.
Lepisma saccharinum Linnaeus.—Gmelin, 1790: 2906.
? *Lepisma alba* Rafinesque-Schmaltz, 1814: 27.
? *Machilis cylindrica* Lacordaire and Boisduval, 1835. Secondary source: Escherich, 1905: 52.
Lepisma saccharina Linnaeus.—Wygodzinsky, 1941: 97.
Lepisma quercetorum Wygodzinsky, 1945: 419.
Lepisma saccharina Linnaeus.—Uchida, 1943: 8.
Lepisma saccharina Linnaeus.—Mendes, 1978: 89.
Lepisma saccharina Linnaeus.—Mendes, 1980: 220.
Lepisma saccharina Linnaeus.—Mendes, 1988: 23 (see also for more comprehensive list of citations).

Remarks: Silvestri (1908) recorded the species doubtfully from Denham, WA, noting it as being found in a box of corals that had been shipped from Australia to Hamburg. Womersley (1939) noted that the species had "been taken in grain and similar stores in most of the larger towns of the Commonwealth".

Irish (pers. comm.) identified specimens from various Australian collections noting the following records of *Lepisma saccharina*:

New South Wales Agriculture Collection: 1♂ and at least 2 other very broken specimens, unlabeled, presumably from somewhere in NSW.

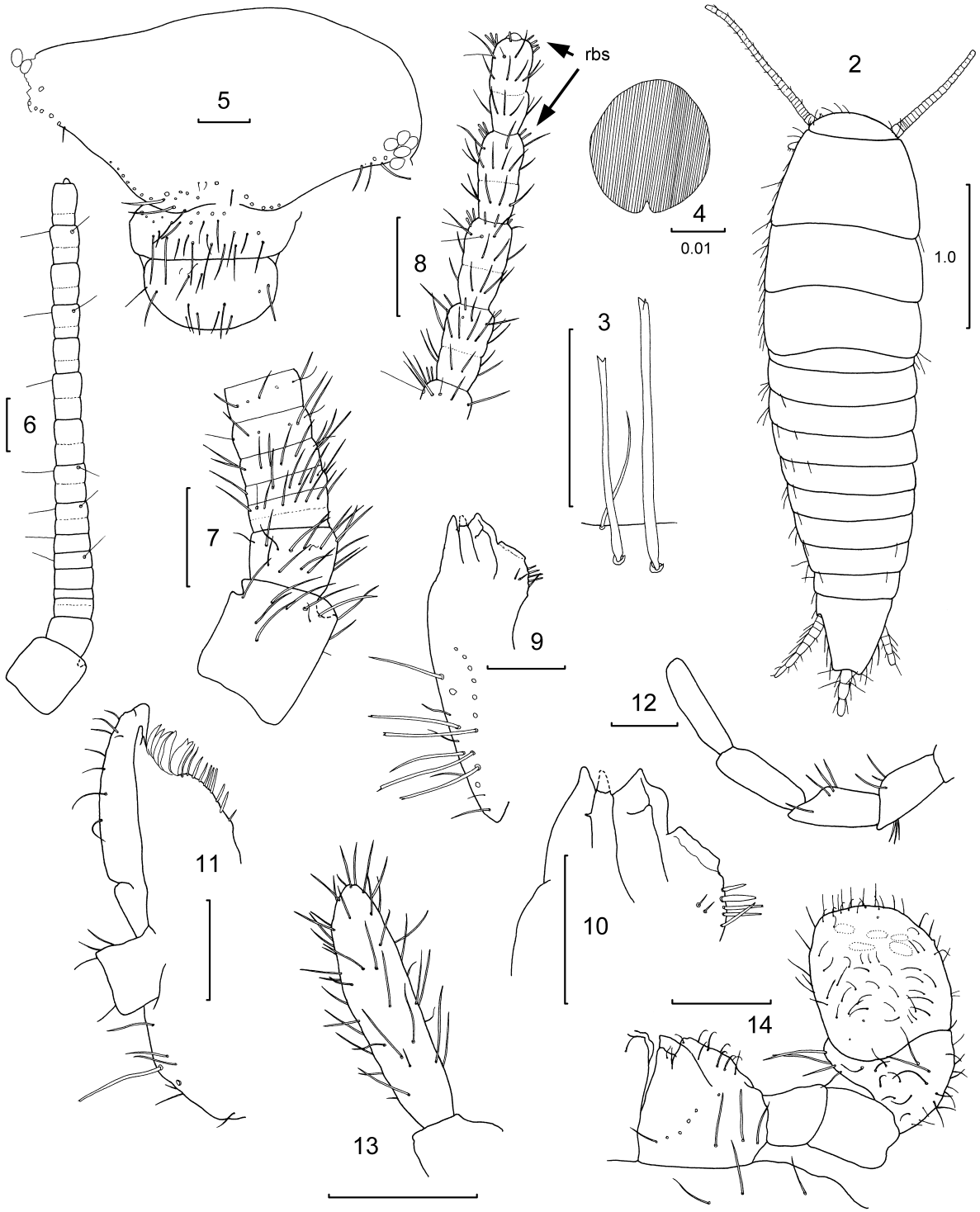
South Australian Museum: 2♂♂, 2 broken unsexed: *Lepisma saccharina* L., det. H. Womersley, in grain store, Melbourne, VIC, 4/37, Miss Lindsay; 1♂: *Lepisma saccharina* L., Miss Raff, det. H. Womersley on 2 slides; 6 slides (5 of mouthparts, 1 of legs) labelled *Lepisma saccharina*, no other data, unidentifiable; 1♀, 1♂: *Lepisma saccharina*, Melbourne, VIC, 1936, det. H. Womersley 3 slides (♂ mouthparts, ♂ genitalia, and ♀ genitalia); a variety of old slides of `*Lepisma saccharina* scales', at least one prepared by Womersley, some very old and obviously commercially bought.

Queensland University Insect Collection: 1♂: QLD, Guluguba, 26.viii.1959, D.F. Cameron (moderately damaged).

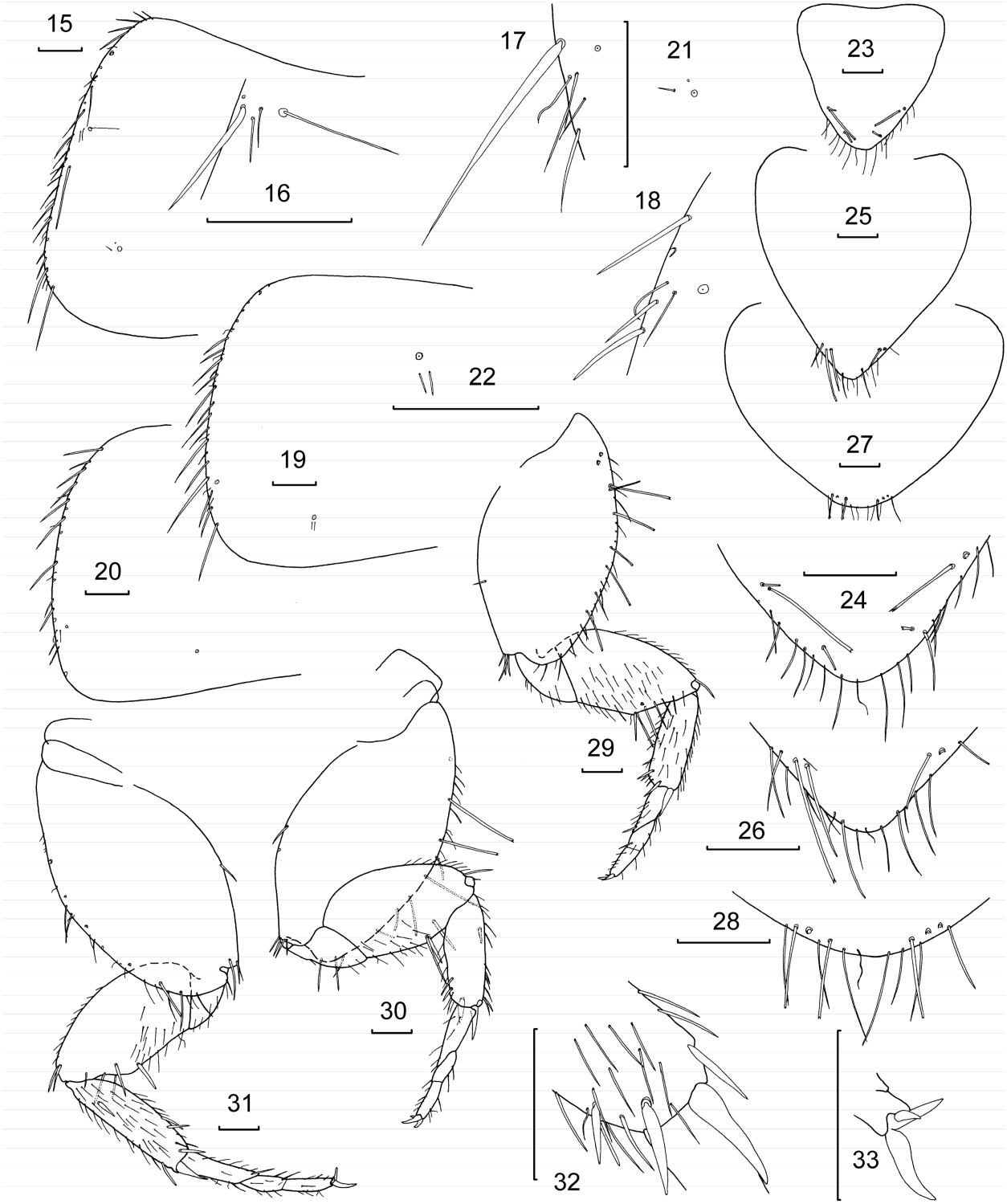
Remarks: The species clearly occurs in Australia, however the author has not seen any live or recently collected specimens. Whether it is still present at a low frequency or has been eliminated through competition with the larger peridomestic species *Ctenolepisma longicaudata* Escherich, 1905 is unknown. This latter species is the silverfish most commonly encountered in buildings in Australia, even in cooler, moister climates such as in Hobart.

Lepisma umbra sp. nov.
(Figs 2-54)

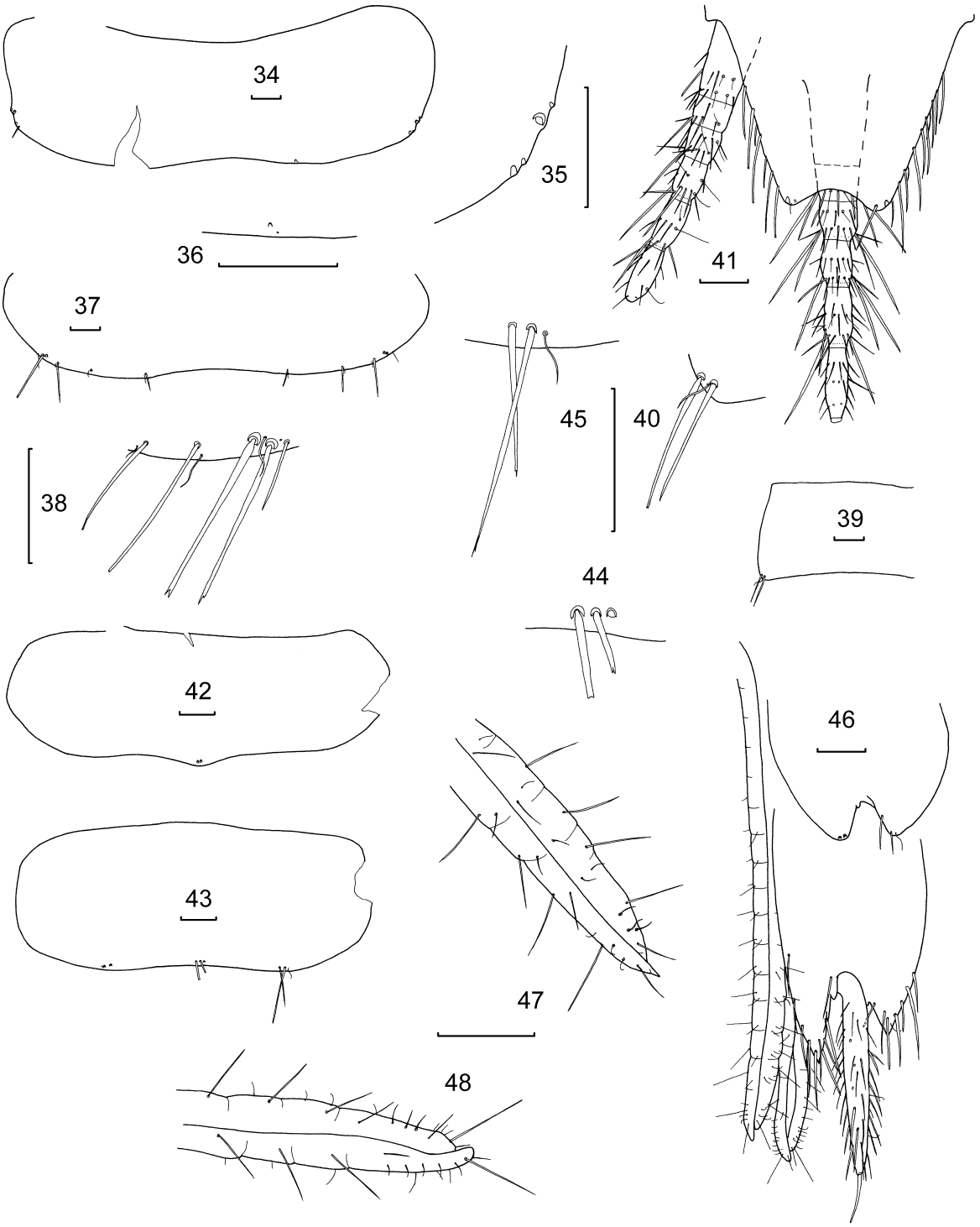
Material examined: Holotype: ♀ (HW 0.60) on two slides, Queensland, Townsville Common approx. 19.21°S 146.76°E, 25.vii.1966, F.J. Gay, (ANIC 5-000012).



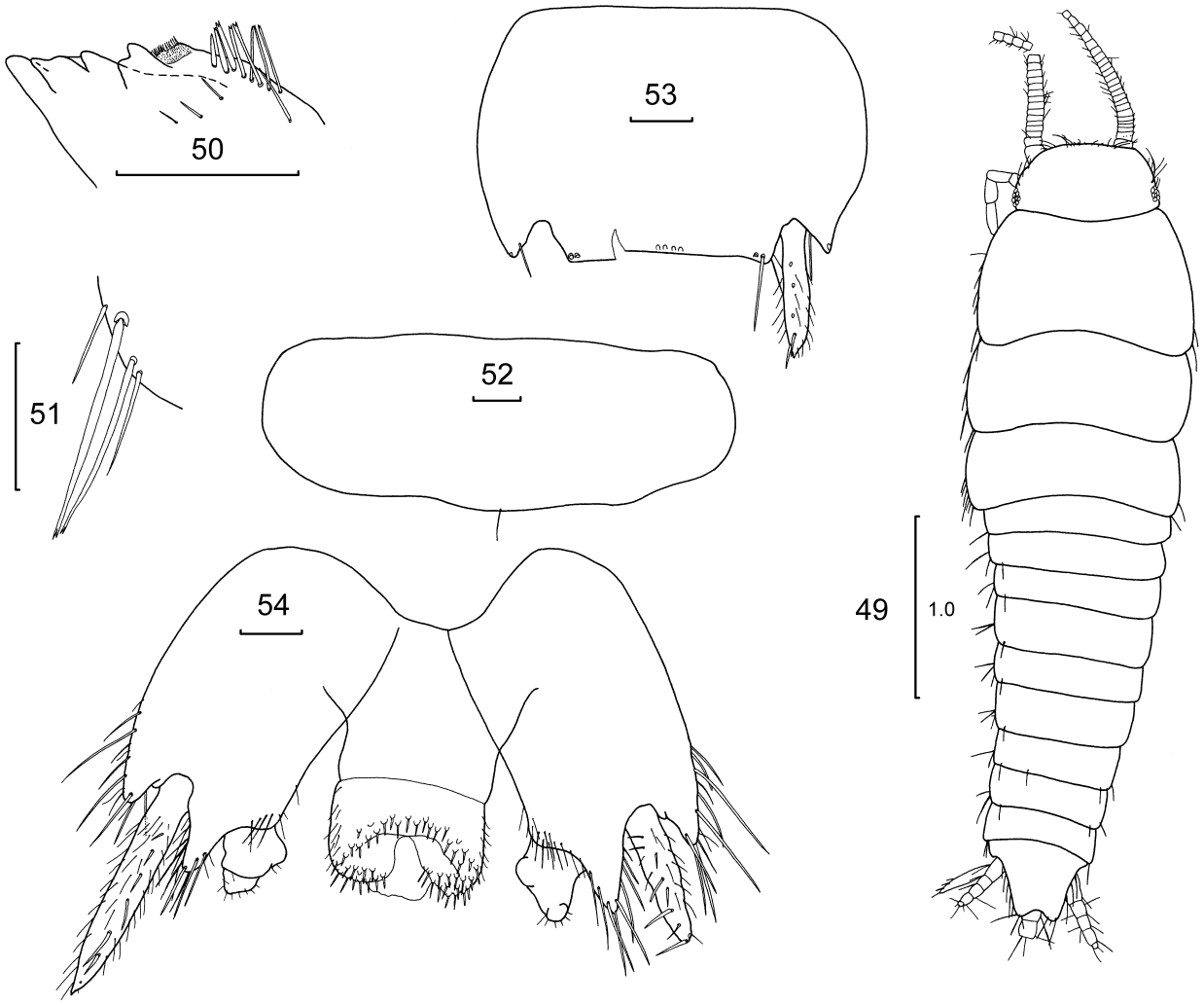
Figures 2-14. *Lepisma umbra* sp. nov. holotype ♀ (ANIC 5-000012) *(2)* habitus; *(3)* macrochaetae and seta of mandible; *(4)* scale from posterior urosternite; *(5)* head; *(6)* antenna; *(7)* basal articles of antenna; *(8)* distal articles of antenna showing long, rod-like basiconic sensillae (rbs); *(9)* mandible; *(10)* idem, detail of incisor and molar regions (dotted line showing shape of broken tooth, based on opposing mandible); *(11)* lacinia and galea of maxilla; *(12)* maxillary palp; *(13)* idem, ultimate article of palp; *(14)* labium, left half- detail of papillae of ultimate palp article very uncertain. Scale bar = 0.1 mm unless otherwise indicated.



Figures 15-33. *Lepisma umbra* sp. nov. holotype ♀ (ANIC 5-000012) *(15)* pronotum, left half; *(16)* idem, anterior trichobothrial area; *(17)* anterior trichobothrial area of mesonotum; *(18)* anterior trichobothrial area of metanotum; *(19)* mesonotum, left half; *(20)* metanotum, left side; *(21)* posterior trichobothrial area of pronotum; *(22)* posterior trichobothrial area of mesonotum; *(23)* prothoracic sternum; *(24)* idem, detail of chaetotaxy; *(25)* mesothoracic sternum; *(26)* idem, detail of chaetotaxy; (27) metathoracic sternum; (28) idem, detail of chaetotaxy; (29) PI; (30) PII; (31) PIII; (32) detail of end of tibia; *(33)* pretarsus PIII. Scale bar = 0.1 mm



Figures 34-48. *Lepisma umbra* sp. nov. holotype ♀ (ANIC 5-000012) unless indicated by specimen number *(34)* urotergite I (ANIC 5-000013); *(35)* idem, lateral chaetotaxy; (*36*) submedial chaetotaxy; *(37)* urotergite VII(?); *(38)* infralateral comb, lateral and sublateral isolated macrochaetae of posterior margin of right side; *(39)* urotergite IX; *(40)* idem, detail of comb; *(41)* urotergite X, left cercus and median filament; *(42)* urosternite I; *(43)* urosternite VII(?); *(44)* idem, medial comb; *(45)* idem, lateral comb; *(46)* left coxites VIII and IX, stylet IX and ovipositor; *(47)* apex of anterior gonapophyses; *(48)* apex of posterior gonapophyses. Scale bar = 0.1 mm.



Figures 49-54. *Lepisma umbra* sp. nov. paratype ♂ (ANIC 5-000014) *(49)* habitus; *(50)* apex of mandible; (*51*) urotergite I, lateral chaetotaxy; *(52)* urosternite I; *(53)* urosternite VIII; *(54)* coxites IX, penis, parameres and stylets. Scale bar = 0.1 mm.

Paratypes: ♀ (HW 0.63) on two slides, same data as holotype (ANIC 5-000013); ♂ (HW 0.75) on two slides, Queensland, Neerkol Creek at Capricorn Highway west of Kabra, 23.486°S 150.345°E, 20.vii. 1967, J.A.L. Watson (ANIC 5-000014).

Both female specimens were very difficult to dissect, especially the head capsule. In some cases certain morphological characters were difficult to observe due to their hyaline colouring or due to tissue obscuring the view. Any uncertainty in interpretation is noted in the description with an explanation or (?). The male was collected some 600km SSE from where the females were collected.

Diagnosis: This species differs from the other described species of the genus by its small size, pale colour (both cuticle and scales), infralateral groups on urotergites II-IX composed of two macrochaetae and an external seta, the presence of 1+1 sublateral isolated macrochaetae on urotergites II-VIII and the very short tail filaments.

Description: *Appearance*: Small pale silverfish with short antennae and tail filaments. Scale pattern in life unknown but probably uniform light yellow or off-white. In alcohol, off-white, covered in hyaline scales, antennae, terminal filaments and legs also off-white.

Body size: Small insects (Figure 2), about 4 mm long; head width 0.60-0.75 mm; the head free (probably not withdrawn under the pronotum as suggested by the habitus illustration of holotype; antennae incomplete in all specimens (>0.3 times H+B); cerci

short, about 0.15 times H+B; median dorsal appendage incomplete, a little longer than the cerci. Thorax comparatively long, about 0.40 times H+B, abdomen not much narrower at its base than the thorax.

Pigmentation: Integument white without any obvious pigment.

Macrochaetae: Smooth, hyaline, some robust and apically bifurcate or perhaps trifurcate (Figure 3), others more slender with delicate apical bifurcations or simple.

Scales: Small and hyaline, with numerous parallel rays that do not surpass the posterior margin of the scale (Figure 4), in alcohol quite difficult to see. Scales present on top of head but absent from mouthparts and antennae, present on thoracic sternites, absent from all leg articles except coxae, present on abdominal tergites and sternites; terminal filaments without scales.

Head: wider than long (Figure 5) with some strong curved setae across the front of the frons and along the anterior third of the lateral margins, followed by a gap and then more setae before the eyes. Clypeus and labrum with scattered setae. — Antennae (Figure 6) incomplete in all specimens; scape and pedicel (Figure 7) with several setae, third article (? indistinctly subdivided) with submedial rosette of setae, articles four to seven with submedial rosette of setae and at least one trichobothrium (sometimes two are visible), article eight divided into subarticles with rosettes submedially in both, the trichobothria only in the distal subarticle; further subdividing into four subarticles by the tenth article; subarticles of most distal surviving articles a little longer than wide, with groups of four subarticles forming a chain, delineated by the trichobothrium on the most distal subarticle. Specialized asteriform sensillae not visible but there appears to be numerous quite long rod-like basiconic sensillae around the apex of each subarticle in the distal part of the flagellum (Figure 8). Under the light microscope these resemble the basiconic sensilla type G of Adel (1984) but this needs to be confirmed with electron microscopy should further material become available. No campaniform sensillae were observed (?). — Mandibles (Figures 9, 10) with three large incisor teeth and a distinct molar region with a group of about four or five short simple or apically bifid setae adjacent to the molar region and a field of about 15 strong, simple or apically bifurcate macrochaetae on the external surface in the proximal two thirds. — Maxillae (Figures 11-13) with two macrochaetae and a few setae proximal to the palp, lacinia with two or three small teeth, one shorter than the other(s), followed by five to seven lamellate processes and three to ten setae; galea longer than lacinia; maxillary palp (Figure 12) not very long, its distal article subcylindrical about 3.5 times longer than wide and 1.3 times longer than the penultimate article, the second article subapically with an incomplete rosette of somewhat stronger setae, third article subapically with some simple setae only slightly more robust than the other setae on this article, ultimate article (Figure 13) with fine setae and without any obvious sensillae(?). — Labium (Figure 14), damaged, with 3+3 (?) setae in a row on the prementum, glossae and paraglossae with transverse and oblique rows of setae, apically with short curved setulae; apical article of palp subrectangular, slightly longer than wide, probably with 3+2 elongated compact sensory papillae apically (? very difficult to observe in all specimens).

Thorax: pronotum (Figure 15) lacking collar of setae along anterior margin, only slightly longer than the meso- and metanota. Anterior trichobothrial areas of all nota open (Figures 16-18) with one or two small setulae between the trichobothria and the margin, anterior trichobothrial area on the pronotum located about two fifths of the way along the margin, those of the meso- (Figure 19) and metanota (Figure 20) about three quarters along the margin; posterior trichobothrial areas (Figures 21, 22) of all nota closed, positioned increasingly more mediad from pro to metanotum, sometimes associated with one or two setulae. Pronotum with numerous long, thin, simple setae along the lateral margins also with two or three longer, stronger submarginal macrochaetae. Meso- and metanota also with marginal setae with only one near the anterior corner slightly submarginal. Presternum wide and narrow with marginal row of fine setae. Prothoracic sternum (Figures 23, 24) small, cordiform, about as wide at its base as long, with several fine marginal setae in distal third and 2+2 combs of apically bifurcate macrochaetae, the proximal comb of two, the more distal of only a single macrochaeta. — Mesosternum (Figures 25, 26) similar to prosternum but about 1.5 times larger with 1+1 combs each of two macrochaetae and also 1+1 submarginal setae distally, as well as finer marginal setae and cilia. — Metasternum (Figures 27, 28) 1.3 times wider than long with 1+1 apical combs each of three macrochaetae as well as thinner marginal setae and cilia. The distance between the combs being about 2.3 times the average width of each comb (range 2.1-2.4). Legs (Figures 29-31) not greatly different in size from PI to PII, tibia L/W PI 2.9 (2.75-2.95), PII 2.9 (2.74-3.1) and 1.1 times the length of the tibia of PI, PIII 3.2 (2.86-4.19) and 1.4 times the length of the tibia of PI; tarsi L/W PI 5.4 (4.6-6.4), PII 6.3 (5.8-6.6), PIII 7.2 (7.0-7.3). — Coxae of PI (Figure 29)

with a comb of two macrochaetae in the anterolateral corner, outer margin of coxae with strong apically bifurcate macrochaetae, some robust and other more delicate, as well as smaller finer setae and some cilia, inner margin with a single short macrochaeta and a small group of setae over the articulation, some scales visible along inner margin. — Trochanter with fine setae only. — Femur with two longer stout macrochaetae at medial posterior angle and some stronger setae along the ventral ridge distad of the medial angle; posterior external apex with one or two stout macrochaetae; rest of ventral surface covered in fine setae. —Tibia of PII and PIII with a short, macrochaeta on the ventral surface in the proximal third, tibia of all legs with some stout macrochaetae distally on both the outer and inner margins, the largest most distal macrochaeta is shorter than the apical spur; rest of surface covered in fine setae (Figure 32). — Tarsi consisting of three articles covered with setae. — Pretarsus with two lateral claws and a short medial empodial claw (Figure 33).

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Abdomen: Urotergite I (Figure 34) with 1+1 infralateral macrochaetae with a small seta insertion external to this and 1+1 lateral macrochaetae each mediad to and quite close to the infralateral macrochaeta, each of these lateral macrochaetae associated with a smaller seta (Figure 35) and small (judging by size of insertion sockets) 1+1 submedial macrochaetae, lacking the sublateral isolated macrochaetae (Figure 36). Urotergites II-VIII with 1+1 infralateral groups each of two macrochaetae located close together with a cilium between them and a small seta external to this group (Figure 37), 1+1 lateral, 1+1 sublateral and 1+1 submedial submarginal macrochaetae each usually associated with a cilium on the laterad side (Figure 38). Urotergite IX with 1+1 infralateral groups each of two macrochaetae with a small cilium located between the insertion of the macrochaetae (Figures 39, 40). Urotergite X (Figure 41) trapezoidal (0.83 times longer than wide at base), posterior corners with 2+2 stronger macrochaetae and setae along the lateral margins, posterior border distinctly concave.

Table 1 - Number of macrochaetae per bristle comb

Segment	Urotergites Number of		Urosternites Macrochaetae per comb	
	macrochaetae per infralateral group	isolated macrochaetae per side	Lateral	Medial
I	1	2	-	1-2
II	2	3	-	3-4
III	2	3	2	3
IV	2	3	2-3	3
V	2	3	2	3
VI	2	3	2	3-5
VII	2	3	2	3
VIII	2	3	2	0(♀), 4(♂)
IX	2	-	-	-

Urosternite I (Figure 42) with slightly protruding medial region on the posterior margin bearing a comb of one or two macrochaetae. Urosternite II with slightly concave posterior margin with a medial comb of three or four macrochaetae. Urosternites III-VII (Figures 43-45) with slightly concave posterior margins and 1+1+1 combs, the medial comb of three to five macrochaetae and the lateral combs of two, rarely three, macrochaetae with a cilium at the laterad end of each lateral comb.

Coxites VIII of ♀ (Figure 46) separate, round with two macrochaetae mediad to the deep stylet recess and some smaller setae on the inner margin of the outer process. Internal process of coxite IX of ♀ (Figure 46) acute, about 1.8 times as long as broad at the base and 1.4 times longer than the external process, with long setae along both margins. Inner process not reaching half the length of the stylet. — Stylets (Figure 46) on urosternites VIII and IX in ♀ holotype, those on VIII only two thirds as long as those on IX. Stylets with a single apical macrochaeta.

Ovipositor of primary type, quite thin with about 15 articles, surpassing the apex of coxites IX by a little more than the length of the inner process but not

reaching the apex of stylets IX. Apex of gonapophyses with simple thin setae (Figures 47, 48). Cerci short with only six articles (Figure 41), only surpassing the apex of urotergite X by less than the length of the tergite, with numerous small trichobothria and some fine and also stronger macrochaetae; median dorsal appendage incomplete (Figure 41), also short but longer than the cerci, probably of only seven articles, with numerous short trichobothria as well as fine setae and stronger macrochaetae.

Male: (Figure 49) as for females except in the following points: Group of setae on mandible adjacent to molar region nine or ten in number (Figure 50), the anterior trichobothrial area of the pronotum is slightly more posterior (about half way along the margin), and the anterior trichobothrial areas of the meso and meta nota not quite as close to the margin and with three setulae between the trichobothrium and the margin, the posterior trichobothrial areas associated with two to four setulae; prosternum with 2+1 combs, the more proximal of two to three macrochaetae, the most distal of just one macrochaeta or absent (on one side), the 1+1 combs of the mesosternum of three to four macrochaetae, the 1+1 apical combs of the metasternum of four to five macrochaetae; the chaetotaxy of the legs appears more robust but inconsistently so (more specimens in better condition, from both areas should ideally be compared to decide the significance of these differences); each lateral 1+1 isolated macrochaeta on urotergite I is located very close to the infralateral macrochaeta (Figure 51), urotergite X slightly longer than in female (0.9 times as long as wide at the base), urosternite I has a wide posterior median protrusion with just a single seta (Figure 52), urosternite VIII (Figure 53) entire with short stylets (half the length of those on IX), with 1+1 lateral combs of two macrochaetae mediad of the stylets and a medial comb of four macrochaetae, also with a few setae on the margins around the stylet; urosternite IX (Figure 54) with very prominent paramera, each with an apical bump armed with several small setulae, the surface of each coxite adjacent to the paramere with several thin setae, internal process about as long as wide at its base and twice as long as the outer process, both processes with long setae. Penis typical with two sections and apically with numerous rods mounted on pedestals around a wide opening (Figure 54).

Derivation of name: The species is named from the Latin noun *umbra* meaning ghost or uninvited guest, alluding to the species' pale colour and presence within a termite nest.

Habitat: According to the label, the Townsville specimens were found at the base of a mound of the termite *Amitermes laurensis* (Mjöberg, 1920) (Isoptera, Termitidae) and found with a specimen of *Ctenolepisma rothschildi* Silvestri, 1907, a species probably introduced into Australia (see Smith and Irish, 2013). The Neerkol Creek specimen did not have habitat information on the label, but as the collector (Dr "Tony" Watson) was primarily a termite researcher it is likely that the male was found in typical termite habitat.

Remarks: Mendes (1988) revised the very large genus *Lepisma*, creating five additional genera leaving only two species in the genus *Lepisma*. Molero-Baltanás *et al.* (1994) added a third species to the genus. *Lepisma umbra* differs from the other three described species in its hyaline scales and lack of colour. The other species of the genus are silvery to iridescent or matt black or even greenish in the case of *Lepisma chlorosoma* Lucas, 1846, which was redescribed in Mendes, 1988. A pale yellow colouring is typical in many inquiline species from other genera of the Lepismatinae, as well as the inquiline Atelurinae, and it is assumed that the pale colouring of *L. umbra* is an adaptation for an inquiline existence. Similarly, it has very short tail filaments which is also a typical morphology associated with inquiline species. Its tail filaments are of about 15% H+B whereas the other species have tail filaments of about 20-50% H+B. *L. umbra* seems most closely related to the anthropophilic *Lepisma saccharina* in its lack of epidermal pigment, the presence of two macrochaetae in the infralateral groups (only one in *L. chlorosoma*) and the presence of submedian isolated macrochaetae on urotergite II (lacking in *L. baetica*), but differs from *L. saccharina* strongly in body size, scale colouring and the relative length of the terminal filaments.

The inclusion of the male specimen from Neerkol Creek within *Lepisma umbra* is not conclusive but highly probable. It is very close to the females in its morphology, which is greatly different to any other described species of *Lepisma*. Nevertheless, the differences described above between the individuals of different sexes collected 600 km apart, need to be qualified over a greater range of specimens should these ever become available. The male specimen is slightly larger than the females and this could account for some of the differences noted.

Key to the known species of *Lepisma* Linnaeus *sensu* Mendes, 1988
(modified from Molero-Baltanás *et al.* 1994)

1. Infralateral group of macrochaetae on urotergites III-VIII with one macrochaeta ……*L. chlorosoma* Lucas, 1846 (Western Mediterranean)
— Infralateral group of macrochaetae on urotergites III-VIII with two macrochaetae . . . . ……2
2. Absence of epidermal pigment. Urotergite II with submedian isolated macrochaetae ……. 3
— With epidermal pigment. Urotergite II without submedian isolated macrochaetae…….*L. baetica* Molero-Baltanás *et al.* 1994 (Iberian Peninsula)
3. Maximum body length in adults about 4 mm. Scales hyaline, giving very pale appearance. Terminal filaments short, about 0.2 times H+B length. Not found living in houses ……...*L. umbra* sp. nov. (Queensland, Australia)
— Body length in mature specimens equal to or greater than 6mm. Scales dark, giving silvery appearance. Terminal filaments about half H+B length. Often found in houses …….*L. saccharina* Linnaeus, 1758 (cosmopolitan, free living in south western Europe).

Lepisma umbra is the first non-anthropophilic species of the genus *Lepisma* to be found outside the circum-Mediterranean region. The presence of this species so far from the other known species in the genus could suggest it is a relic of a much more widely distributed genus of this quite ancient family. The possibility that it has been introduced from elsewhere also cannot be excluded. It was found in the presence of another introduced species (*Ctenolepisma rothschildi* Silvestri, 1907) (see Smith & Irish, 2013) and other inquiline species of the Lepismatinae are suspected of being introduced elsewhere. For example, Wygodzinsky (1967) attributes the presence of the circum-Mediterranean species *Neoasterolepisma wasmanni* in Peru to an unintentional introduction. However it is just as likely that this apparent disjunct distribution is an artefact of the very poor knowledge of the world's silverfish fauna, with large parts of the world almost completely neglected. In fact, given the very superficial investigation to date of Australia's Zygentoma, it is quite possible that more species will also be found in Australia.

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REFERENCES

Adel, T. (1984). Sensilleninventar und sensillenmuster auf den Antennen von *Thermobia domestica* und *Lepisma saccharina* (Insecta: Zygentoma). *Braunschweiger Naturkundliche Schriften* **2**: 191-217.

De Geer, C. (1783). Lepisma. p. 198 *in* Genera et species insectorum e generosissimi auctoris scriptis. Lipsiae: Apud Sigfried Lebrecht Crusium. 252pp.

Escherich, K. (1905). Das System der Lepismatiden. *Zoologica* (Stuttgart) **43**: 1–164.

Geoffrey, E.L. (1762). Forbicina. pp. 611-614, plate XX, Fig. 3 Vol. 2 in Histoire abregée des insects qui se trouvent aux environs de Paris. Paris: Durand.

Gmelin, J.F. (1790). Aptera. pp. 2906-2907 *in* Caroli a Linné, Systema Naturae per regna tria naturae: secumdum classes, ordines, genera, species, cum characteribus, differentis, synonymis, locis. Vol. I. Part V Lipsiae: Georg. Emanuel. Beer

Linnaeus, C. (1758). *Systema Naturae per regna tria naturae, secundum classes, ordines, genera, species, cum characteribus, diffentiis, synonymis, locis. Editio decima, reformata.* 10th Edition Volume 1. 824 pp. Holmiae: Laurenti salvii.

Mendes, L.F. (1978). Essai phylogenetique sur les Lepismatidae (Apterygota, Zygentoma) a macrochetes non pectinees. *Proceedings of the 1st International Seminary on Apterygota, Siena* September 13-16, 1978: 87–98.

Mendes, L.F. (1980). Note sur les Zygentoma (Insecta: Apterygota) de L'Europe et du Bassin Mediterraneen. *Arquivos do Museu Bocage,* Lisboa (2)**7**: 215–260.

Mendes, L.F. (1981). Nota sobre o género *Asterolepisma* e descrição de una nova especie (Zygentoma, Lepsimatidae). *Revue de Zoologie Africaine* (Tervuren) **95**(1): 200–209.

Mendes, L.F. (1988). Revisão do género *Lepisma* Lin., 1758 *s. lat.* (Zygentoma, Lepismatidae). *Boletim da Sociedade Portuguesa de Entomologia* (Suppl.) **2**: 1–236.

Mendes, L.F. (1991). 1.1. On the phylogeny of the genera of Lepismatidae (Insecta: Zygentoma). p. 3–13 *in* Veeresh, G.K., Rajagopal, D. & Viraktamath, C.A. (eds) *Advances in management and conservation of soil fauna.* New Delhi Bombay Calcutta: Oxford & IBH Publishing Co. Pvt. Ltd.

Molero-Baltanás, R., Gaju-Ricart, M., Bach de Roca, C. & Mendes, L.F. (1994). *Lepisma baetica* sp. n. from Spain (Apterygota, Zygentoma, Lepismatidae). *Acta Zoologica Fennica* **195**: 104-106.

Molero-Baltanás, R., Gaju-Ricart, M. & Bach de Roca, C. (2000). On the taxonomic use of the distribution pattern of the antennal asteriform sensilla in *Neoasterolepisma* and *Tricholepisma* (Insecta, Zygentoma, Lepismatidae). *Pedobiologia* **44**: 248–256.

Rafinesque-Schmaltz, C.S. (1814). Précis des découvertes et travaux somiologiques de Mr. C. S. Rafinesque-Schmaltz entre 1800 et 1814. Royale typographie militaire. Palermo. 58 pp.

Scopoli, I.A. (1763). Ordo VII. Pedestria. Aptera. p. 378 *in* Entomologia Carniolica exhibens insecta Carnioliae indigena et distributa in ordines, genera, species, varietates : methodo Linnaeana. Vindobonae: Iaonnis Thomae Trattner, Caes. Reg Avlae Typo. et Bibliop. 420 pp.

Silvestri, F. (1908). Thysanura. p. 47-68 *in* Michaelsen, W. & Hartmeyer, R. (eds) *Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise 1905*. Jena: Gustav Fischer Vol. 2.

Smith, G.B. (2013b). A new species of *Heterolepisma* from Barrow Island (Zygentoma: Lepismatidae). *Records of the Western Australian Museum*. Supplement **83**: 229-240.

Smith, G.B. (2015). New silverfish taxa from Queensland (Zygentoma: Lepismatidae). *Records of the Australian Museum* **67**: 67-81.

Smith, G.B. (submitted for publication). New silverfish species (Zygentoma: Lepismatidae) from Barrow Island. *Records of the Western Australian Museum*.

Smith, G. and Irish, J. (2013). Further Australian locality data for *Ctenolepisma rothschildi* Silvestri (Zygentoma: Lepismatidae). *Australian Entomologist* **40**(2): 99-100.

Smith, G.B., Veera Singham, G., Kuah, M.-K. and Lee, C.-Y. (2011). Two new inquiline silverfish (Zygentoma: Ateluridae, Lepismatidae) from Malaysia. *Sociobiology* **57**(1): 19-34.

Smith, G.B. and Watson, J.A.L. (1991). Thysanura Zygentoma (Silverfish) p. 275-278 *in* CSIRO, Division of Entomology *The Insects of Australia*. Melbourne University Press. 1137 pp.

Uchida, H. (1943). Hompo ni okeru Seiyo-shimi (*Lepisma saccharina* L.) no saikento. *Bol. Zool. Tokyo* **11**: 8-10.

Womersley, H. (1939). Thysanura p. 9-45 *in* Primitive insects of South Australia. Silverfish, springtails and their allies. Adelaide: Frank Trigg, Government Printer 322 pp.

Wygodzinsky, P. (1941). Zur Kenntnis einiger europäischen Dipluren und Thysanuren. *Verhandlungen der Naturforschenden Gesellschaft in Basel* **52**: 63–100.

Wygodzinsky, P. (1945). Contribuição ao conhecimento dos "Entotrophi" e "Thysanura" de Portugal III. Família "Lepismatidae" (Thysanura). Conclusões. *Revista Brasileira de Biologia* **5**(5): 419–433.

Wygodzinsky, P. (1967). On the geographical distribution of the South American Microcoryphia and Thysanura (Insecta). p. 505–524 *in* Debouttville, D. & Rapoport, E. (eds) *Biologie de L'Amérique Australe*. Paris: Centre National de la Recherche Scientifique Vol. 3.