

The genus *Lithoseopsis* (Psocodea: Amphientomidae) in the Western Australian fauna, with description of the male of *Lithoseopsis humphreysi* from Barrow Island

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ABSTRACT – The Australian Amphientomidae species *Seopsis incisa* Smithers, 1989 and *S. humphreysi* New, 1994 are transferred to the genus *Lithoseopsis* Mockford, 1993 as *L. incisa* new combination and *L. humphreysi* new combination, as a result of the discovery of specimens of *L. humphreysi* from Barrow Island, Western Australia. The male of *L. humphreysi* is described for the first time, and both macropterous and brachypterous individuals are described. The genus *Lithoseopsis* was previously known from North America only, and the addition of the Western Australian species significantly increases its range. A key is provided to the genera of Amphientomidae.

KEYWORDS: 'Psocoptera', bark-lice, taxonomy, generic identification

INTRODUCTION

Barrow Island is located off the north-west coast of Western Australia. Due to its relatively undisturbed environment, with a very low proportion of established non-indigenous taxa, it is recognised by Australian legislation as a 'Class A' nature reserve. Barrow Island has also been a working oilfield since 1967, and is currently subject to further development to open utilisation of the Gorgon and Jansz natural gas deposits off its western coast. Because of the island's ecologically sensitive nature, this development has only been permitted to proceed under strict conditions limiting potential impact. Measures taken to limit impact have included extensive monitoring of the Barrow Island environment, including the terrestrial invertebrate fauna. As a result of regular surveys conducted since 2005, Barrow Island now has one of the most extensively investigated invertebrate faunas of anywhere in Australia (Callan et al. 2011).

The Psocoptera of Barrow Island were first described by Smithers (1984) who recorded only five species for the island. A further twenty species have since been recorded, though most are only identified at morphospecies level and may represent as yet undescribed species (Gunawardene et al. 2012). One such species of particular note is a representative of the family Amphientomidae.

This family has only been represented in Australia to date by three described species (Smithers 1989; New 1994) though New (1994) also referred to an undescribed species from Victoria. Each of the previous species has been described from a single specimen. The Barrow Island material is noteworthy in not only comprising multiple specimens but also including both macropterous and brachypterous specimens of a single species. The specimens are here assigned to *Seopsis humphreysi* New, 1994 (here transferred to the genus *Lithoseopsis*), previously known only from a single female collected in Cape Range, Western Australia (New 1994). This allows for the description of the previously unknown male of this species.

METHODS

Specimens were observed whole in alcohol or slide-mounted in Hoyer's solution. Two of the four available specimens were slide-mounted: these specimens have been indicated as such in the taxonomic description. Photographs and measurements were taken using a Nikon SMZ1500 stereo microscope and the NIS-Elements D 4.00.03 programme, and a Leica DM2500 compound microscope. Coloration is described as in alcohol. Measurements are given in millimetres, and were taken from unmounted specimens.

The holotype of *Seopsis humphreysi* New, 1994

was examined in the collection of the Western Australian Museum. The specimens described herein will also be deposited in the Western Australian Museum (WAM).

Family Amphientomidae Enderlein, 1903

Subfamily Amphientominae Enderlein, 1903

Lithoseopsis Mockford, 1993

TYPE SPECIES

Lithoseopsis hellmani (Mockford & Gurney, 1956), by original designation.

OTHER INCLUDED SPECIES

Lithoseopsis hystrix (Mockford, 1974), *L. incisa* (Smithers, 1989), *L. humphreysi* (New, 1994), *L. cervantesi* García Aldrete, 2004, *L. chamelensis* García Aldrete, 2004, *L. insularis* García Aldrete, 2004, *L. tuitensis* García Aldrete 2004.

DESCRIPTION

Head with three ocelli (may be reduced); lateral ocelli placed close to compound eyes, distant from median ocellus. Both pairs of wings with outer margins smoothly rounded, tips not acuminate. Forewing with distal Sc remnant present or absent; if present, distal Sc remnant diverging from R_1 ; stem of R_s more than half length of R_{2+3} ; M_3 diverging prior to $M_1 + M_2$; Cu_2 present; two anal veins present; nodulus present. Hind wing well developed or reduced and lacking venation; if venation present, then vein R_1 not reaching edge of wing, ending blindly in wing membrane; vein R_{2+3} divided from R_{4+5} ; vein M undivided. Fore femur with ventral spine row present or absent; tarsal claws with one subapical tooth. Abdomen of female with semicircular sclerotised plate anterior to clunium, bearing numerous elongate setae, ante-clunial plate present or absent in male; phallosome with well-developed basal stem below parameres, posterior sections of parameres broad and simple (non-sinuous), not sclerotised internally; gonapophyses with dorsal and ventral valves elongate and slenderly acuminate, external valve bluntly rounded with broad rounded dorsal lobe.

Lithoseopsis humphreysi (New, 1994)

Figures 1, 2

Seopsis humphreysi New, 1994: 233–235, Figures 1–6.

MATERIAL EXAMINED

Australia: Western Australia: 1 ♂ (macropterous), Barrow Island, 24 April 2005, S.

Callan (WAM E83791); 1 ♂ (brachypterous, slide-mounted), Barrow Island, 17 May 2005, S. Callan (WAM E83792); 1 ♂ (macropterous, slide-mounted), Barrow Island, near accommodation camp, 15 March 2006, S. Callan, R. Graham (WAM E83793); 1 ♂ (brachypterous), Barrow Island, central sector, 27 July–5 August 2010, pitfall trap, N. Gunawardene, C. Taylor (WAM E83794); 1 ♂ (macropterous), Barrow Island, northern sector, 9 May 2012, emergence trap on topsoil from gas plant site, LN5131, S. Rodman (WAM E83858); 1 adult, gender unknown (abdomen lost; macropterous), Barrow Island, north-west sector, 10–21 September 2012, flight intercept trap, N. Gunawardene, C. Taylor (WAM E83795); 1 ♀ (slide-mounted), Barrow Island, gas-plant site, 10–21 September 2012, pitfall trap, N. Gunawardene, C. Taylor (WAM E83859).

DIAGNOSIS

Lithoseopsis humphreysi can be distinguished from all other *Lithoseopsis* species (including *L. incisa*) by the absence of a comb of short spines on the fore femur. It can also be distinguished from *L. incisa* by their distinct facial markings, with the presence in the latter of (amongst other features) a brown stripe on the front of the face in place of the anterior arms of the epicranial suture, and by the lack of a deeply divided lacinia.

DESCRIPTION

Adults

Macropterous male: Head patterned with broken orange-brown vertical stripes on medial margins of compound eyes (stopping shortly above lateral ocelli) and on either side of median epicranial suture, as well as across dorsal margin of head, and smaller orange-brown spots on either side and slightly below median ocellus; remainder of frons pinkish cream. Ocelli orange. Pedicel basally pale, distally dark brown; antennae dark brown. Gena with vertical purple stripe behind antennal insertion. Postclypeus in dorsal part with reticulate pattern of very pale orange-brown and pinkish cream; ventral part of postclypeus, anteclypeus and labrum white, but black mouthparts visible through translucent labrum. Maxillary palps not preserved, lacinia dark yellow-brown. Dorsum of pterothorax mostly whitish cream, with some darker medial shading. Forewing scales forming mottled pattern of dark and light brown with white patches distally; discal scales squarely truncate, about five times as long as wide; marginal scales elongate, narrow, hair-like. Forewing membrane mostly purplish-brown on proximal two-thirds, except hyaline band parallel and posterior to proximal Sc remnant, and along Cu_2 , and some hyaline mottling including hyaline spot around nodulus; distal one-third of

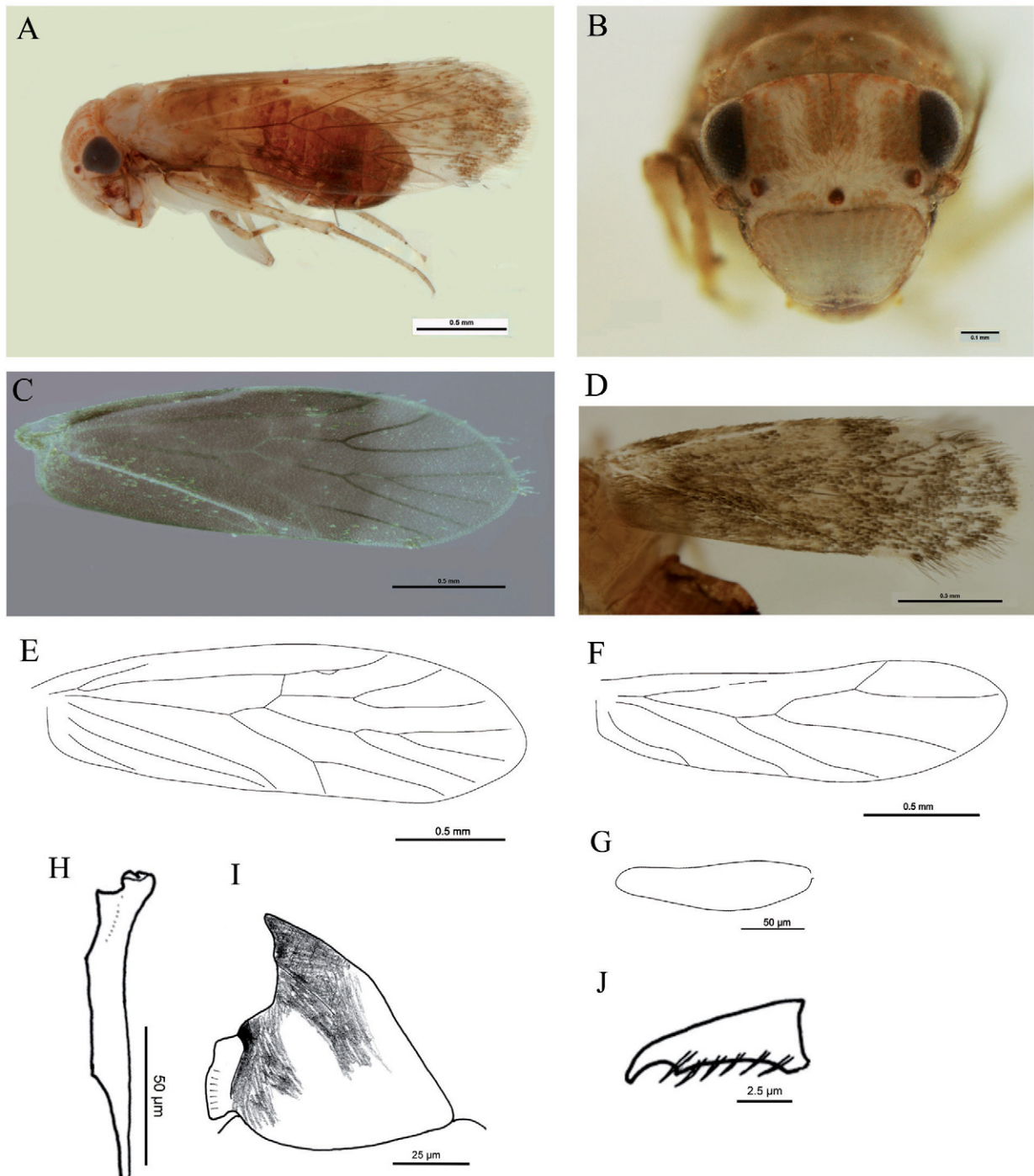


FIGURE 1 *Newseopsides smithersi* sp. nov.: A, lateral view; WAM E83791; B, facial view, WAM E83791; C, right forewing, WAM E83795; D, right forewing, WAM E83858; E, right forewing, venation, WAM E83795; F, right hind wing, WAM E83795; G, left hind wing, brachypter, WAM E83792; H, right lacinia, WAM E83793; I, right mandible, WAM E83793; J, tarsal claw, WAM E83793.

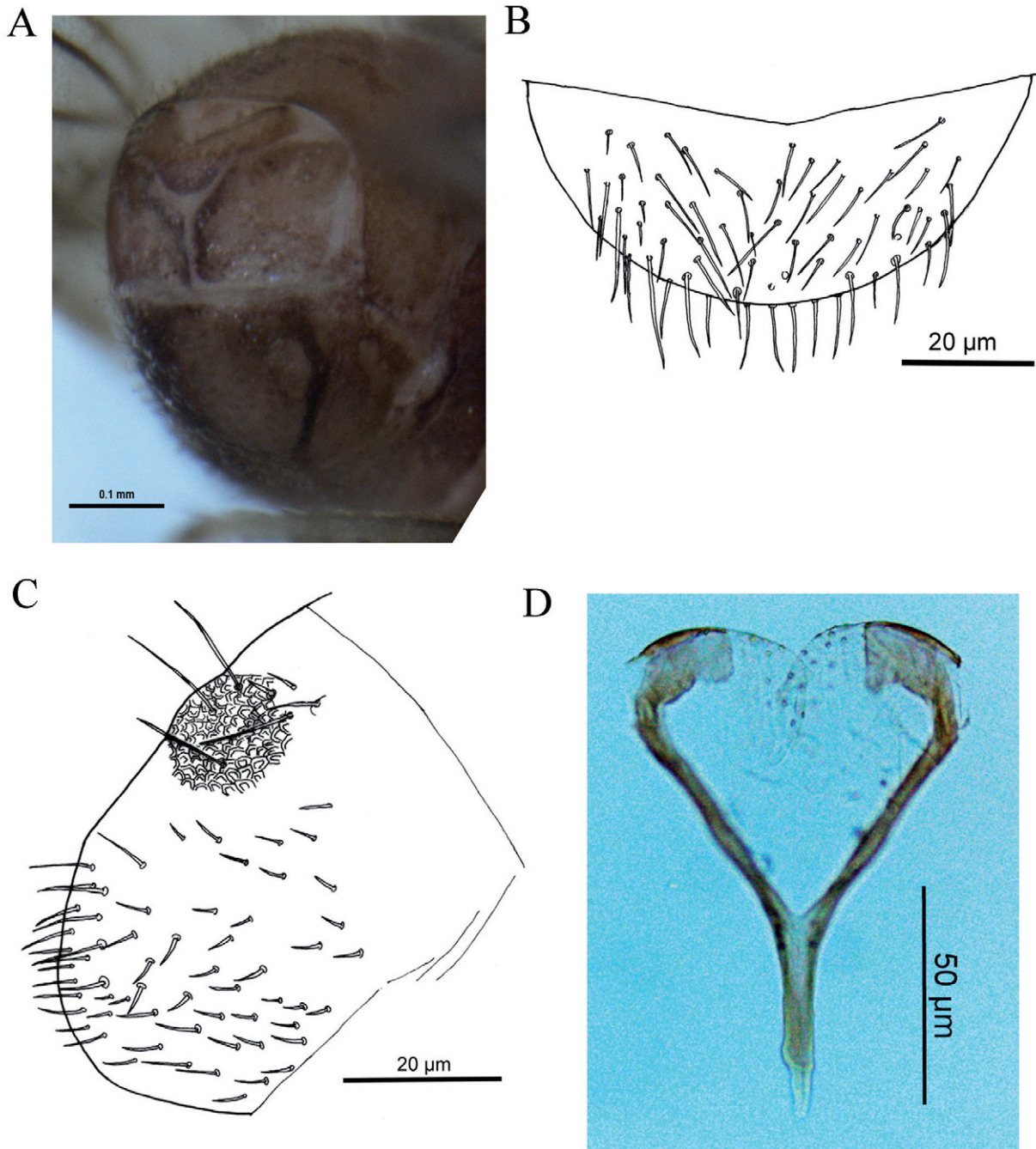


FIGURE 2 *Newseopsides smithersi* sp. nov.: A, posterior view, WAM E83791; B, epiproct, WAM E83792; C, paraproct, WAM E83793; D, phallosome, WAM E83792.

forewing membrane mostly hyaline; wing veins mostly dark brown except Cu_2 bright white, other veins paler when crossing hyaline patches on wing membrane. Thoracic pleura patterned in purple and white. Coxae, trochanters and femora mostly white except darker dorsal shading in distalmost parts of femora, this latter more extensive on hind femora in which it extends to mid-point of femur;

tibiae basally pale with darker dorsum, roundly darkening to yellow distally; first tarsal segment basally darker yellow-brown, becoming paler distally, second and third tarsal segments darker yellow-brown. Abdomen mottled purple-brown dorsally in basal part, becoming darker yellow-brown in apical half, ventrally medium yellow-brown.

Total body length (excluding wings) 1.98. Median epicranial suture very distinct, lateral arms indistinct. Antennae fine with sparse fine setae; first flagellar segment subequal to second. Length of flagellar segments: f1 0.28, f2 0.30. Eyes relatively large, reaching level of lateral part of vertex. Vertex slightly higher in middle than at sides. IO/D: 2.16; PO: 0.60. Three well-developed ocelli present; lateral ocelli close to compound eyes, just below lower margins of eyes; median ocellus slightly smaller than lateral ocelli, located just below line drawn between lower margins of lateral ocelli. Lacinia not deeply divided. Fore wing length 2.19 mm, width 0.71 mm. Fore wing with basal remnant of Sc but no distal remnant above R_1 . Two evanescent anal veins present. Hind wing length 1.80, width 0.56. Measurements of hind leg: femur 0.30, tibia 0.58, t1 0.31, t2 0.04, t3 0.056. Hind femur with two dorsal distal curved macrosetae, retrolateral seta slightly larger than prolateral; hind tibia with several straight dorsal and ventral macrosetae, four terminal ventral and two dorsal spurs. Claws each with subapical ventral tooth, followed proximad by row of five or six ventral setae. Epiproct rounded, subtriangular, with posterior marginal region only sclerotised and setose. Paraproct with prodorsal rosette of about eight long fine setae on vermicular base. Phallosome with basal stem about one-half length of parameres, posterior sections of parameres broad, subrectangular.

Brachypterous male. As for macropter, except for following: Background colour of head and body darker pinkish. Head markings less distinct due to darker background, but overall patterning as for macropter. Maxillary palp with second segment medium yellowish brown, third and fourth segments darker yellowish brown. Femora darker than macropter, hind femora dark yellowish brown; tibiae medium yellowish brown with pale distal section.

Total body length 1.80. Length of flagellar segments: f1 0.36, f2 0.35. IO/D: 1.75, PO: 0.47. Maxillary palp with single long acute sensory cone near midpoint of second segment. Fore wing length 1.55, width 0.54. Fore wing venation as for macropter except somewhat shortened distally. Hind wing length 0.74, width 0.15. Hind wing venation absent. Measurements of hind leg: femur 0.53, tibia 0.92, t1 0.46, t2 0.05, t3 0.07.

Female. As described by New (1994), with the following additions: wings as described by New (1994), with forewing relatively shorter than macropterous male, or as described above for macropterous male. Abdomen with dorsal sclerotised, semi-circular plate anterior to clunium, bearing numerous long setae.

REMARKS

The Barrow Island material does exhibit some slight differences from the holotype collected in Cape Range. The holotype retains a basal vestige of the distal Sc remnant (New 1994), apparently absent in the Barrow Island specimens, but examination of the holotype slide reveals that the vestigial vein is very faint. The fore wings of the holotype are also distinctly shorter than those of macropterous Barrow Island specimens, but are comparable to those of brachypterous specimens. However, the hind wings of the holotype are not notably reduced. The ocelli of the Cape Range specimen also appear smaller than those of the Barrow Island specimens. Reduction of the ocelli is often correlated in Psocodea with reduction in wing development (Mockford 1965); however, the brachypterous specimens from Barrow Island do not exhibit notably reduced ocelli. It is possible that the Cape Range and Barrow Island populations may in fact represent closely related but separate species; however, without further specimens available from the Cape Range it cannot be said whether the differences cited above represent more than individual variation.

Though two morphotypes of Amphientomidae are present on Barrow Island, they are here regarded as variants of a single species rather than two separate species. Though there is some difference between specimens in leg coloration, the facial patterning does not differ significantly between the macropterous and brachypterous forms. Available brachypterous specimens do have a darker background coloration and less sharply distinct banding, but this is quite possibly an artefact of preservation. Wing polymorphism is not uncommon in Psocoptera (Mockford 1965). The current species represents the first record of wing polymorphism within a single sex for Amphientomidae, though wing polymorphism between the sexes, with macropterous males and brachypterous females, has previously been recorded in two species of amphientomid (Mockford 1965).

Two species of Amphientomidae have been described to date from Western Australia (Smithers 1989; New 1994) and placed in the genus *Seopsis* Enderlein, 1989, in which genus they would be placed by the most recent generic key for the family (Smithers 1990). However, both differ from other *Seopsis* species in having the lateral ocelli widely placed close to the proventral edges of the compound eyes, rather than close to the midline of the head. *Seopsis* species also have male genitalia with internal sclerites associated with the phallosome (Li 2002) whereas these are absent in

the Western Australian species. Subsequent to the publication of Smither's (1990) key, Mockford (1993) described a new genus of Amphientomidae from North America, characterised by (among other features) laterally-placed ocelli together with the presence of a semi-circular sclerotised plate anterior to the clunium. Examination of the holotype of '*Seopsis*' *humphreysi* has allowed the identification of such a structure in this species, indicating a re-assignment to *Lithoseopsis*. The ante-clunial plate is absent in the male of *L. humphreysi*, but males of North American *Lithoseopsis* species may also show a reduction in the ante-clunial plate (A. García Aldrete, personal communication 2013). Smithers (1989) made no mention of any ante-clunial plate in '*Seopsis*' *incisa*, but this species is currently known from the male only. As *S. incisa* also appears to lack the diagnostic features of any other genus of Amphientomidae with laterally placed ocelli, none of which are recorded from Western Australia, I feel justified in also provisionally assigning *S. incisa* to *Lithoseopsis*.

Lateral ocelli placed close to the compound eyes as in the Western Australian species are uncommon among Amphientomidae, and characteristic of only a small number of the currently recognised genera. The two genera of the subfamily Tineomorphinae, *Tineomorpha* Enderlein, 1906 and *Cymatopsocus* Enderlein, 1903, differ from the Western Australian taxa in having the hind wing vein M divided; the undivided vein M of the Western Australian taxa places them in the Amphientominae. Genera of the Amphientominae with comparable ocelli are *Hemiseopsis* Enderlein, 1906, *Lithoseopsis* Mockford, 1993, *Marcenendius* Navás, 1913 and *Nephax* Pearman, 1935 (Mockford 1993; Lienhard & Baz 2011).

Hemiseopsis differs from the Western Australian species in having the hind wing vein R_1 complete to the wing margin rather than ending blindly in the wing membrane (Smithers 1990). This genus has mostly been described from Africa; Smithers (1989) also described an Australian species *Hemiseopsis alettae* Smithers, 1989. The inclusion of this species in *Hemiseopsis* deserves re-investigation: notably, the morphology of its gonapophyses is very similar to that of the Western Australian *Lithoseopsis humphreysi*, while differing from that of the African species. However, its status is here left unchanged until a more detailed study can be conducted.

The genera *Nephax* and *Marcenendius* are found in the western Palaearctic and Africa (as noted by Lienhard & Baz 2011, the South African *Nephax capensis* Pearman, 1935 is almost certainly misplaced). *Nephax* species have characteristic reduced mandibles as opposed to the more normally developed mandibles of the Western

Australian taxa (Lienhard & Baz 2011), and the phallosome of the type species *N. sofadanus* Pearman, 1935 lacks a well-developed basal stem (Lienhard 1998). *Marcenendius* species have phallosomes with longitudinal internal sclerites in the posterior half; they also differ from *Newseopsides humphreysi* in female genital morphology, including having the dorsal and ventral valves no longer than the external valve (Lienhard 1998; Lienhard & Baz 2011). *Nephax* species also invariably lack the median ocellus, even in macropterous specimens, though this character should be treated with caution as the median ocellus may be reduced in brachypterous or semi-brachypterous individuals of *Marcenendius* and *Newseopsides*. As the nymphs of *Lithoseopsis* have not been described, it cannot be confirmed whether they lack the distinctive 'corkscrew setae' of *Marcenendius* (Lienhard & Baz 2011).

KEY TO RECENT GENERA OF AMPHIENTOMIDAE

Since the publication of a key to genera of Amphientomidae by Smithers (1990), several advances have been made in amphientomid classification. Notable among these are the description of several new genera from China by Li (2002), and redescription of the genus *Marcenendius* by Lienhard & Baz (2011). A revised key has therefore been prepared for the genera of Amphientomidae and is included below. This key has been prepared using descriptions provided in the literature: important sources include Enderlein (1906), Smithers (1990) and Li (2002). *Obeliscus* Li, 2002 has been renamed *Lifashengia* by Lienhard (2003) due to the former name being preoccupied. The system of Amphientomidae would benefit from a broad review: the current system is perhaps overly influenced by wing venation, while potentially significant characters such as genital morphology remain undescribed for many taxa.

1. Wings present..... 2
Wings absent 22
2. Hind wing vein M with two branches 3
Hind wing vein M simple, or hind wings without venation..... 5
3. Hind wing vein R_s with two branches; median ocellus absent; lateral ocelli widely spaced, closer to eyes than midline of head .. 4
Hind wing vein R_s undivided; median ocellus present; lateral ocelli close to median ocellus..... *Compressionis* Li, 2002

4. Outer margin of fore wing smoothly rounded; ocelli immediately adjacent to compound eyes.....*Tineomorpha* Enderlein, 1906
Outer margin of fore wing emarginate behind apex; ocelli separated from compound eyes by greater than their diameter
.....*Cymatopsocus* Enderlein, 1903
5. Two or three ocelli present 6
Ocelli absent 21
6. Lateral ocelli widely divergent, close to compound eyes 7
Lateral ocelli more closely placed to each other than to compound eyes 10
7. Hind wing vein R_1 reaching wing margin
.....*Hemiseopsis* Enderlein, 1906
Hind wing vein R_1 ending blindly in membrane, or hind wing reduced and lacking venation 8
8. Mandibles shortened apically; median ocellus always absent.....*Nephax* Pearman, 1935
Mandibles not shortened; median ocellus usually present 9
9. Labrum with distal pair of well-sclerotised longitudinal rods; phallosome with internal sclerites; neither sex with ante-clunial plate....
.....*Marcenendius* Navás, 1913
Labrum without such rods; phallosome lacking internal sclerites; female (and often male) with semicircular dorsal plate bearing numerous elongate setae anterior to clunium
.....*Lithoseopsis* Mockford, 1993
10. Hind wing vein R_1 reaching wing margin .. 11
Hind wing vein R_1 ending blindly in membrane, or hind wing reduced..... 14
11. Fore wing with distal section of Sc present.....
.....*Amphientomum* Pictet, 1854
Fore wing with distal section of Sc absent... 12
12. Fore wing with vein M_3 diverging before M_1+M_2 13
Fore wing with vein M_1 diverging before M_2+M_3*Neuroseopsis* Li, 2002
13. Fore wing with M_1 distally subparallel to M_2 , reaching wing margin just posterior to wing apex.....*Lifashengia* Lienhard, 2003
Fore wing with M_1 diverging from M_2 , reaching wing margin distinctly anterior to wing apex.....*Ancylentomus* Li, 2002
14. Tarsal claw with one subapical tooth..... 15
Tarsal claw with two subapical teeth..... 18
15. Fore wing with distal section of Sc present
.....*Seopsis* Enderlein, 1906
Fore wing with distal section of Sc absent... 16
16. Median ocellus absent..*Biocellientomia* Li, 2002
Median ocellus present 17
17. Maxillary palp with spine-like sensilla on at least second segment; apex of fore wing generally without distinctly produced tip
.....*Stimulopalpus* Enderlein, 1906
Maxillary palp lacking sensilla; apex of forewing distinctly produced
.....*Cornutientomus* Li, 2002
18. Fore wing stem of Rs very short or almost lacking, so that branches of Rs appear to arise separately*Seopsocus* Roesler, 1940
Fore wing stem of Rs at least third length of R_{2+3} 19
19. Fore wing with distal section of Sc present
.....*Diamphipsocus* Li, 1997
Fore wing with distal section of Sc absent... 20
20. Fore wing with apex produced into distinct elongate acuminate tip
.....*Syllysis* Hagen, 1865
Fore wing with apex not produced.....
.....*Paramphientomum* Enderlein, 1906
21. Fore wing and distal section of Sc closely approximate.....
.....*Stigmatopathus* Enderlein, 1903
Fore wing and distal section of Sc diverging
.....*Pseudoseopsis* Badonnel, 1955
22. Paraproct with field of four or five trichobothria; gonapophyses complete 23
Paraproct without trichobothrial field; gonapophyses reduced, with external valve only present*Antivulgaris* Li, 2002
23. Subgenital plate with well-developed internal sclerite..... 24
Subgenital plate without internal sclerite
.....*Yinia* Li, 1994
24. Dorsal and external valves of gonapophyses deeply bilobed*Neoseopsis* Badonnel, 1986
Dorsal and external valves of gonapophyses simple.....*Yunientomia* Li, 2002

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