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## The cave mouth antlions of Australia (Neuroptera: Myrmeleontidae)

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**0250**

The cave mouth antlions of Australia (Neuroptera: Myrmeleontidae)

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## The cave mouth antlions of Australia (Neuroptera: Myrmeleontidae)

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**Abstract.** Larvae of thirty one species of antlions (Neuroptera: Myrmeleontidae) belonging to eleven genera live in the protection of cave mouths or large rock overhangs in Australia. New taxa proposed here include the following three **new genera**: *Australeon*, *Newleon*, *Speleon*. The following twelve **new species** are described: *Froggattisca kakadu*; *Froggattisca rennerensis*; *Newleon fragilis*; *Speleon cavernicolus*; *Speleon pilliga*; *Speleon yallingup*; *Stenoleon xanthopsis*; *Xantholeon cavernicolus*; *Xantholeon kakadu*; *Xantholeon newi*; *Xantholeon pallens*; *Xantholeon pentlandensis*. Two cave species are transferred into a new genus becoming **new combinations**: *Australeon illustris* (Gerstaecker), *Australeon manselli* (New and Matsura). The small non-cave species previously placed in *Stenoleon* Tillyard are transferred to *Bandidus* Navás, becoming *B. gradostratus* (New), *B. copleyensis* (New), *B. grandithecus* (New), and *B. navasi* (New), **new combinations**.

All known species of six genera (*Stenoleon* Tillyard, *Xantholeon* Tillyard, *Eophanes* Banks and three new genera) are known only in cave mouths. Also, species of *Heoclisis* Navás, *Froggattisca* Esben Petersen, *Glenoleon* Banks, *Heoclisis* Navás and *Myrmeleon* Linnaeus contain species living in cave mouths. Two main types of caves are found in Australia; those with loose organic material and those with loose inorganic material. The cave habitat is divided into four zones and several subzones. Many species are restricted to one zone or another but species of *Stenoleon* may overlap zones. Discussions of the species and some of their biological requirements are provided. One new parasite record is given, an undetermined species of *Echthrobacella* Girault (Hymenoptera: Encyrtidae) reared from the larvae of *Speleon yallingup* Miller and Stange. Diagnoses or descriptions are given for all of these cave species including distributional data. Keys to the cave mouth inhabiting antlions of Australia (adults and larvae) are provided including a revised key to the *Xantholeon* Tillyard.

**Resumen.** Se documentan treinta uno especies en once géneros de Myrmeleontidae que viven en las entradas de cuevas en Australia y representan mas especies que en cualquier otra parte del mundo. Se describen tres **géneros nuevos**, *Australeon*, *Newleon*, y *Speleon* y doce **especies nuevas**: *Froggattisca kakadu*; *Froggattisca rennerensis*; *Newleon fragilis*; *Speleon cavernicolus*; *Speleon pilliga*; *Speleon yallingup*; *Stenoleon xanthopsis*; *Xantholeon cavernicolus*; *Xantholeon kakadu*; *Xantholeon newi*; *Xantholeon pallens* y *Xantholeon pentlandensis*. Dos especies son transferidas en un nueva género resultando en dos **combinaciones nuevas**: *Australeon illustris* (Gerstaecker) y *Australeon manselli* (New and Matsura). Tambien, cuatro especies en el género *Stenoleon* Tillyard son transferidas al género *Bandidus* Navas, resultando en cuatro **combinaciones nuevas**: *B. gradostratus* (New), *B. copleyensis* (New), *B. grandithecus* (New) y *B. navasi* (New).

Hay dos tipos de cuevas en Australia, unas con detritus orgánicos y otras con detritus principalmente inorgánicas. En algunas cuevas existen cuatro principales zonas de habitación. Todas las especies de cinco géneros (*Eophanes* Banks, *Stenoleon* Tillyard, *Xantholeon* Banks y tres nuevos géneros) están restringidas a las cuevas. Se da un registro nuevo para un parásito, *Echthrobacella* Girault (Hymenoptera: Encyrtidae) criada de *Speleon yallingup* Miller and Stange. Se presentan diagnoses o descripciones para todas las especies incluyendo datos sobre distribución. Se presentan claves para los adultos y larvas de las especies que viven dentro de las cuevas en Australia, incluyendo una clave revisada del género *Xantholeon*.

## Introduction

Antlion species living in cave mouths or under rock overhangs are usually restricted to this type of habitat. The antlion cave fauna of Australia is very diverse, but no true cave species (such as *Eremoleon pallens* Banks in North America) are known to date in Australia. A true species of cave antlion has all of its life stages in the darkness of the cave. The female enters the cave or rock overhang area and selects the zone where her eggs are to be laid. Two main types of caves are found in Australia; those with loose organic material and those with loose inorganic material; the former type is much richer, but less common. The larvae need to exist in the correct zone to survive the cave environment. We recognize four major cave zones and several subzones and discuss which species are found in each zone (Table 1). Antlion larvae can be found in humid caves, but not usually in wet caves. They prefer dry caves although larvae of *Australeon* are very sensitive to temperature and humidity. The larvae remain in their preferred



zone until spinning their cocoons there. The adults often rest during the day on nearby shaded rock faces. Australia probably has the most diverse cave mouth antlion fauna in the world (Table 2).

The cave at Slaty Creek, Queensland, which is about five meters in length (Figure 1) contained more species of antlion larvae than any other single surveyed cave in Australia or elsewhere in the world. Nine species were found: *Froggattisca* sp., *Xantholeon pentlandensis* Miller and Stange, *Myrmeleon* sp., *Heoclisis fulva* (Esben-Petersen), *Heoclisis* sp., *Stenoleon cingulatus* New, *Newleon fragilis* Miller and Stange, and two species not reared or identified. Probably the existence of a dead kangaroo in the cave with thousands of dermestid larvae provided an exceptional feeding habitat. A later visit to this cave resulted in the finding of fewer species and individuals probably because most of the dermestid larvae were gone as well as the bats with their guano. Undoubtedly ants provide much of the needed prey items in all antlion habitats in the cave. All species of six genera are confined to the cave or rock overhang habitat. These are *Eophanes* Banks, *Stenoleon* Tillyard, *Xantholeon* Tillyard and three new genera described in this paper. In other Australian caves, there are cave dwelling species in the genera *Froggattisca* Esben-Petersen, *Eskura* Navás, *Glenoleon* Banks, *Heoclisis* Navás, and *Myrmeleon* Linnaeus which totals 31 cave mouth species in Australia.

A new organ of possible morphological and taxonomic importance is described. This is termed here “Miller’s organ” (Figures 17, 21) which is a small glandular-like structure on the metathorax and abdominal sternite I. This structure is found on sternite I on *Austrogymnocnemis* Esben-Petersen, *Ceratoleon* Esben-Petersen, *Platyleon* Esben-Petersen, *Riekoleon* New, *Speleon* Miller and Stange and some *Glenoleon* Banks. One new parasite record is given, an undetermined species of *Echthrobacella* Girault (Hymenoptera: Encyrtidae) reared from the larvae of *Speleon yallingup* Miller and Stange.

## Materials

Specimens studied are deposited in the following institutions:

<b>AMSA</b>	Australian Museum, Sydney, New South Wales, Australia.
<b>ANIC</b>	Australian National Insect Collection, CSIRO, Canberra City, A.C.T. Australia.
<b>BMNH</b>	The Natural History Museum, London, England.
<b>CASC</b>	California Academy of Sciences, San Francisco, California, U.S.A.
<b>EMAU</b>	Ernst-Moritz-Arndt Universität Greifswald, Zoologisches Institut und Museum, Greifswald, Germany.
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<b>MNHN</b>	Musée National d’Histoire Naturelle, Paris, France.
<b>NHRS</b>	Naturhistoriska Riksmuseet, Sektionen för Entomologi, Stockholm, Sweden.
<b>QDPC</b>	Queensland Museum, South Brisbane, Queensland, Australia.
<b>SAMA</b>	South Australia Museum, Adelaide, Australia.
<b>SANC</b>	South African National Collection of Insects, Pretoria, South Africa.
<b>TAMU</b>	Texas A and M University, College Station, Texas, U.S.A.
<b>USMB</b>	Upper Silesian Museum, Bytom, Poland.
<b>WAMP</b>	Western Australian Museum, Perth, Australia.
<b>ZMHB</b>	Zoologisches Museum der Humboldt Universität, Berlin, Germany.
<b>ZMUC</b>	Zoologisk Museum, University of Copenhagen, København, Denmark.

## List of Australian cave mouth antlions

### Tribe Dendroleontini Banks 1899

*Froggattisca* Esben-Petersen 1915

1. *F. anicis* New 1985
2. *F. kakadu* n.sp.
3. *F. rennerensis* n.sp.
4. *F. tipularia* (Gerstaecker) 1885

*Glenoleon* Banks 1913

5. *G. pulchellus* (Rambur) 1842

- 6. *G.* ?species
- Newleon* new genus
- 7. *N. fragilis* n.sp.
- Speleon* new genus
- 8. *S. cavernicolus* n.sp.
- 9. *S. pilliga* n.sp.
- 10. *S. yallingup* n.sp.

#### **Tribe Nemoleontini Banks 1911**

- Eophanes* Banks 1931
- 11. *E. distincta* (Banks) 1939
- Escura* Navás 1914.
- 12. *E. nigrosignata* (Tillyard) 1916
- Stenoleon* Tillyard 1916
- 13. *S. cingulatus* New 1985
- 14. *S. fieldi* Tillyard 1916
- 15. *S. xanthopsis* n.sp.
- Xantholeon* Tillyard 1916
- 16. *X. cavernicolus* n.sp.
- 17. *X. helmsi* Tillyard 1916
- 18. *X. kakadu* n.sp.
- 19. *X. lineatus* New 1985
- 20. *X. manselli* New 1985
- 21. *X. montanus* New 1985
- 22. *X. newi* n. sp.
- 23. *X. pallens* n.sp.
- 24. *X. pentlandensis* n.sp.
- 25. *X. xadnus* New 1985

#### **Tribe Acanthaclisini Navás 1912**

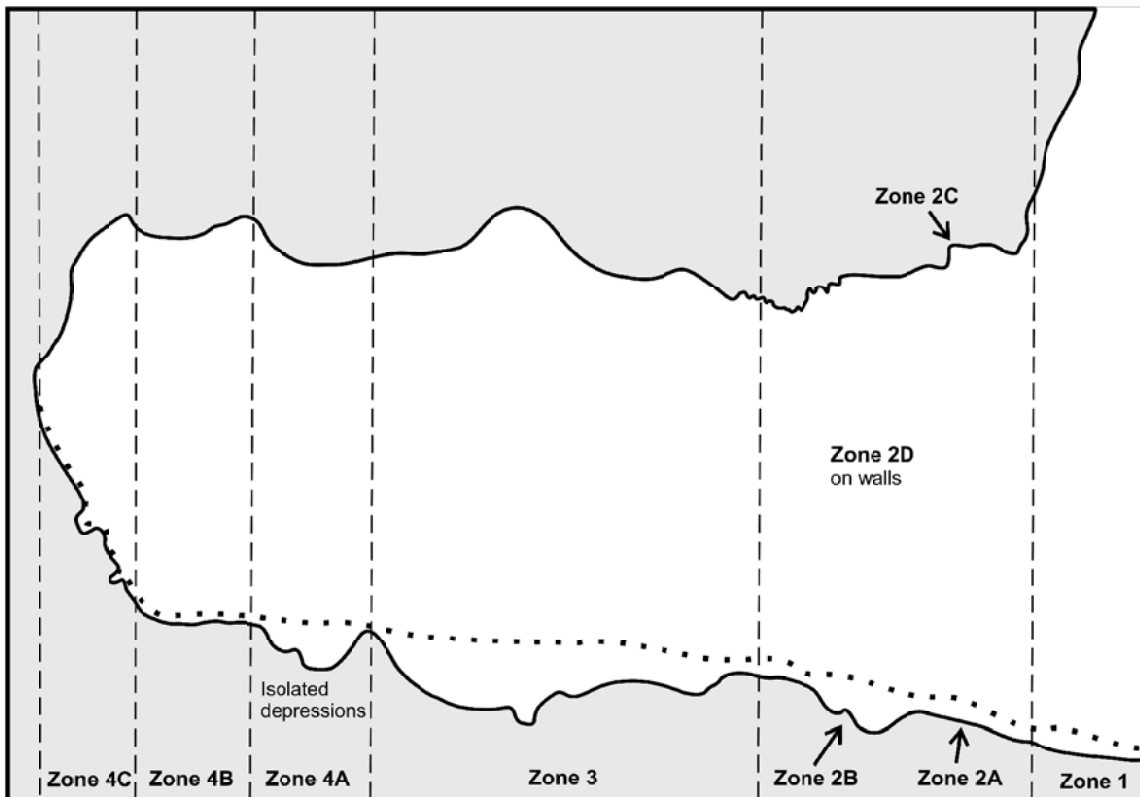
- Heoclis* Navás 1923
- 26. *H. fulva* (Esben-Petersen) 1912
- 27. *H.* ?species

#### **Tribe Myrmeleontini Latreille 1802**

- Australeon* new genus
- 28. *A. illustris* (Gerstaecker) 1885
- 29. *A. manselli* (New and Matsura) 1993
- Myrmeleon* Linnaeus 1767
- 30. *M. pallidus* (Esben-Petersen) 1918
- 31. *M.* ?species

#### **Explanation of Australia Cave Habitat Zones**

Caves in Australia are mainly of two habitat types. One type contains loose inorganic material and dust composed of limestone, sandstone, or iron ore. The other type contains loose organic material composed of decomposed plant material, decomposed bat guano, dermestid skins and feces, and small mammal nests. Both correspond to similar habitat zones as illustrated in the following ecological zone diagram (Table 1), but these two types usually harbor very different species due to specialization to type of substrate. Although species adapted to inorganic substrates can burrow into an organic substrate, species in general adapted to live in organic substrates are incapable of burrowing into inorganic substrates. They lack the ability to move in the higher density material, and are left exposed. With both

**Table 1.** Habitat zones for cave antlions.


Zone 4C	Zone 4B	Zone 4A	Zone 3	Zone 2D	Zone 2C	Zone 2B	Zone 2A	Zone 1
<i>Newleon fragilis</i>	<i>Xantholeon</i> species <i>Eophanes distincta</i> <i>Escura nigrosignata</i>	<i>Australeon illustris</i>	<i>Glenoleon</i> ?species <i>Heoclisis fulva</i>	<i>Froggattisca anicis kakadu rennerensis tipularia</i>	<i>Speleon cavernicolus pilliga yallingup</i>	<i>Myrmeleon pallidus</i>	<i>Stenoleon cingulatus fieldi xanthopus</i>	<i>Glenoleon pulchellus</i> <i>Stenoleon cingulatus fieldi xanthopus</i> <i>Heoclisis</i> ?species <i>Myrmeleon</i> ?species

types of substrates, some species are suspended in loose material, and some species prefer to rest in shallow material just covered with their legs firmly anchored to the underlying rock or hardpan. The type of cave with organic matter is less common and more difficult to locate but contains the greatest diversity of species. Volcanic caves usually show the best potential for being primarily organic since they lack rock generated dust and often offers good roosting positions for bats. The presence of predators in the area carrying kills into such a cave is also beneficial. Elimination of bat and predator populations in many areas will have a very adverse impact on many of the organic dependant species. For any given species, the cave or rock overhang zone they occupy is usually specific and avoids conflict or direct competition with other antlion species. Many caves will lack one or more of the described habitat zones. Only a characteristically optimal cave (like Slaty Creek Cave) will contain all the zones.

#### Description of Cave Antlion Habitat Zones (Table 1)

**Table 2.** Distribution of cave antlions.

<b>Taxon</b>	<b>North America</b>	<b>South America</b>	<b>Africa</b>	<b>Australia</b>	<b>Eurasia</b>
<b>Palparinae</b>	not present	no cave mouth species	no cave mouth species	not present	no cave mouth species
<b>Dendroleontini</b>	<i>Dendroleon</i>	not present	<i>Bankisus</i> <i>Tricholeon</i>	<i>Froggattisca</i> <i>Glenoleon</i> <i>Newleon</i> <i>Speleon</i>	<i>Dendroleon</i>
<b>Nemoleontini</b>	<i>Eremoleon</i> <i>Purenleon</i>	<i>Araucoleon</i> <i>Eremoleon</i> <i>Navasoleon</i> <i>Rovira</i>	no cave mouth species	<i>Eophanes</i> <i>Escura</i> <i>Stenoleon</i> <i>Xantholeon</i>	<i>Gymnocnemia</i>
<b>Myrmeleontini</b>	<i>Myrmeleon</i>	<i>Myrmeleon</i> <i>Porrerus</i>	<i>Myrmeleon</i>	<i>Australeon</i> <i>Myrmeleon</i>	<i>Baliga</i> <i>Myrmeleon</i>
<b>Brachynemurini</b>	<i>Scotoleon</i>	no cave mouth species	not present	not present	not present
<b>Lemolemini</b>	not present	<i>Lemolemus</i>	not present	not present	not present
<b>Myrmecaelurini</b>	not present	not present	no cave mouth species	not present	<i>Solter</i>
<b>Acanthaclisini</b>	no cave mouth species	no cave mouth species	no cave mouth species	<i>Heoclisis</i>	no cave mouth species
<b>Stilbopteryginae</b>	not present	not present	not present	no cave mouth species	not present

**Zone 1.** This zone is made up of substrate originating in the cave or rock overhang and is exposed to the sun, high temperatures, and rainfall. Species in this zone can handle outside conditions, but may prefer the specialized substrate originating from the cave.

Taxa in this zone are represented by *Stenoleon cingulatus*; *S. fieldi*; *S. xanthopus*; *Glenoleon pulchellus*; *Myrmeleon* sp.; *Heoclisis* sp.

**Zone 2.** This is the first zone having the all important characteristic of rainfall protection. It is cooler than Zone 1 but warmer than Zones 3 thru 4. It may also be exposed to sun part of the day. Temperatures in this zone will be higher if the cave opening points to the East or West as opposed to the North or South, and may affect what species are present. The researcher should consider sun orientation when selecting which caves are examined for this zone. It contains areas such as Zone 2A where dust or loose material, laying over a hard surface, is shallow and allows the antlions larvae to rest covered with their legs anchored. It contains isolated patches such as Zone 2B which are large enough for pit making species, but too small for acanthaclisine larvae. Zone 2C is sun and rain protected, but warm enough to support species living in horizontal, lichen filled, 90 degree cracks often characteristic of areas with shale. Zone 2D is represented by small, shallowly filled ledges, cracks, and holes in the walls of the cave or rock overhang. Species attached to slanted surfaces of dust covered rock are also considered to be found in this zone. Species will select their place according to their substrate, temperature, light, and anchoring requirements. Any of the above characteristics may also exist on large rocks or in sizable rock overhangs.

Taxa in this zone represented by: Zone 2A. *Stenoleon cingulatus*; *S. fieldi*; *S. xanthopus*; Zone 2B. *Myrmeleon pallidus*; Zone 2C. *Speleon cavernicolus*; *S. pilliga*; *S. yallingup*; Zone 2D. *Froggattisca anicis*; *F. kakadu*; *F. rennerensis*; *F. tipularia*.

**Zone 3.** This zone is represented by any area on the floor of the cave which is rain and sun protected and large and deep enough to support the roaming activities of large antlion larvae. In organic caves, the substrate is mostly composed of bat guano dust and dermestid skins. In inorganic caves, the substrate will be dust or fine sand. The large *Heoclisis* larvae (as well as the unknown dendroleontine larva) exclude species from the other zones by eating them. The unknown dendroleontine larva (probably *Glenoleon* sp.) was found only once (1989) in the cave at Slaty Creek. The *Heoclisis fulva* larvae were absent then but on the second trip (1995) the *Glenoleon* larvae were gone and apparently replaced by the *Heoclisis* larvae.

Taxa in this zone are represented by *Heoclisis fulva* (Esben-Petersen); *Glenoleon* sp.



**Figure 1.** Antlion cave near Slaty Creek, Queensland.

**Zone 4.** In this zone located in the back of the cave, the light is lower, air currents are less, humidity is usually higher, and for some types of caves, the dust is finer. This is mostly a shallowly covered area, with leg anchoring possibilities (Zone 4B) and in the back of the cave are some deep small patches (Zone 4A) with species isolated from the species in Zone 3. This includes the thinly covered floor of the cave near the back wall, which some genera of antlion larvae (*Xantholeon*; *Eophanes*) prefer. It provides the larvae with areas where they can rest covered with their legs anchored to the substrate or to small stones or pebbles. They are then able to capture larger prey without being dislodged. Deeper protected patches of material provide habitats with buffered temperatures and higher humidity for the genus *Australeon*. This zone may also include low ceiling mini-caves extending into total darkness. It is the most likely to contain two types of substrates in mostly inorganic caves where bats or animal burrows are present. This situation can add animal burrow inhabiting species to the mix. Zone 4C represents horizontal or diagonal cracks, small nooks or depressions, or slanted contours of the wall above the cave floor which can extend more than a meter above the floor. This is the favored habitat of *Newleon fragilis* in organic caves.

Taxa in this zone are represented by: 4A. *Australeon* spp.; Zone 4B. *Escura nigrosignata*, *Xantholeon* spp., *Eophanes distincta*; Zone 4C. *Newleon fragilis*.

## Key to the Cave Dwelling Genera of Australian Antlions

### Adults

1. Hindfemur with elongate sense hair; hindwing vein CuA unites with posterior fork of MP2 shortly after fork; male abdomen with hair pencils ..... ***Heoclisis* Navás**
- Hindfemur without elongate sense hair; hindwing vein CuA connected by crossveins to posterior fork of MP2 **or** not reaching fork; male abdomen without hair pencils ..... **2**
- 2(1). Hindwing with 4 or more presectoral crossveins (Figure 69); distal tarsomere with ventral setae much less than one-half length of tarsomere diameter (Myrmeleontini) ..... **3**
- Hindwing with 1 or 2 presectoral crossveins (Figure 51); distal tarsomere with ventral setae at least one-half length of tarsomere diameter ..... **4**
- 3(2). Distal tarsomere shorter than basal four tarsomeres together; female posterior gonapophysis usually less than twice as long as middle diameter; forewing usually without conspicuous dark brown spots ..... ***Myrmeleon* Linnaeus**

- Distal tarsomere slightly longer than basal four tarsomeres together; female posterior gonapophysis about three times longer than middle diameter; forewing with conspicuous dark brown spots ..... ***Australeon* Miller and Stange**
- 4(2). Forewing vein 2A runs in a fairly even curve toward 3A (Figure 60) ..... **5**
- Forewing vein 2A runs close to 1A for short distance, then bends at a sharp angle toward 3A (Figure 29) ..... **9**
- 5(4). Tibial spurs absent or very short (at most one-half length of basitarsus) ..... **6**
- Tibial spurs at least two-thirds length of basitarsus ..... **7**
- 6(5). Pretarsal claws can close against ventral setae of distal tarsomere (Figure 7); Miller's organ absent on sternite I ..... ***Froggattisca* Esben-Petersen**
- Pretarsal claws can not close against ventral setae of distal tarsomere; Miller's organ (Figures 17, 21) present on sternite I ..... ***Speleon* new genus**
- 7(5). Pretarsal claws can close against ventral setae of distal tarsomere ..... ***Newleon* new genus**
- Pretarsal claws can not close against ventral setae of distal tarsomere ..... **8**
- 8(7). Basal tarsomere of hindleg longer than distal tarsomere; Miller's organ absent on sternite I (helmsi group) ..... ***Xantholeon* Tillyard**
- Basal tarsomere of hindleg shorter than distal tarsomere; Miller's organ present on sternite I. .... ***Glenoleon* Banks**
- 9(4). Pretarsal claws as long or longer than distal tarsomere ..... **10**
- Pretarsal claws not one-half length of distal tarsomere ..... **11**
- 10(9). Forewing vein CuP + 1A runs to hind margin well beyond level of origin of radial sector (Figure 29) ..... ***Escura* Navás**
- Forewing vein CuP + 1A runs to hind margin at about level of origin of radial sector ..... ***Eophanes* Kimmins**
- 11(9). Body pale brown; antennal club moderately well developed, about three times the diameter of preceding antennal flagellomeres; hindleg conspicuously longer than foreleg; ocular rim setae absent (lineatus group) ..... ***Xantholeon* Tillyard**
- Body dark brown; antennal club weakly developed at most, about twice the diameter of preceding antennal flagellomeres; hindleg about as long as foreleg; ocular rim with short setae that project over eye ..... ***Stenoleon* Tillyard**

## Larvae

1. Labial palpus shorter than basal width of mandible; mesothoracic spiracle not borne on tubercle; head without dolichasters ..... **2**
- Labial palpus longer than basal width of mandible or mesothoracic spiracle borne on tubercle; head often with dolichasters ..... **4**
- 2(1). Mandible with longest setae on lateral margin less than one-half greatest mandibular width (Figure 95); sternite VIII without teeth on subapical margin; do not make pitfall traps (*Acanthaclisini*) ..... ***Heoclisia* Navás**
- Mandible with some setae on outer lateral margin as long as or longer than greatest mandibular width (Figure 98); sternite VIII with pair of inconspicuous submedian teeth near posterior margin; make pitfall traps (*Myrmeleontini*) ..... **3**

- 3(2). Legs long, hindcoxa longer than five times greatest diameter of coxa; distance between base of mandible and basal tooth much greater than that between mandibular teeth (Figure 97); pitfall traps often with lateral furrows..... ***Australeon* new genus**  
 — Legs shorter, hindcoxa less than four times greatest diameter of coxa; distance between base of mandible and basal tooth of mandible much less than between distance between mandibular teeth (Figure 99); pitfall traps simple, without lateral furrows..... ***Myrmeleon* Linnaeus**
- 4(1). Mesoscutum with tuft of setae medially ..... ***Glenoleon* Banks**  
 — Mesoscutum without tuft of setae medially ..... **5**
- 5(4). Anterior thoracic scolus much longer than wide (Figure 77) ..... **6**  
 — Anterior thoracic scolus not longer than wide (Figure 79) ..... **7**
- 6(5). Distance between base of mandible and basal mandibular tooth less than distance between teeth; ninth abdominal segment wider than long (Figure 77) ..... ***Speleon* new genus**  
 — Distance between base of mandible and basal mandibular tooth more than distance between mandibular teeth (Figure 71); ninth abdominal segment as long as wide ..... ***Froggattisca* Esben-Petersen**
- 7(5). Anterior thoracic scolus as long as wide; distance between base of mandible and basal tooth of mandible about as long as distance between mandibular teeth (Figure 79) ..... ***Escura* Navás**  
 — Anterior thoracic scolus wider than long; distance between base of mandible and basal tooth of mandible much less than between distance mandibular teeth (Figures 81, 83 ..... ) **8**
- 8(7). Antenna longer than width of head (Figures 81, 83); distance between mandibular teeth about as long as distance from distal tooth to apex of mandible ..... ***Stenoleon* Tillyard**  
 — Antenna shorter than width of head (Figures 85, 89); distance between mandibular teeth much shorter than distance from distal tooth to apex of mandible ..... **9**
- 9(8). Head capsule in ventral view about twice as long as greatest capsule width (Figure 89), without dark brown markings ..... ***Xantholeon* Tillyard**  
 — Head capsule in ventral view about 1.5 times as long as greatest width, with some dark brown markings ..... ***Eophanes* Kimmins**

## TRIBE DENDROLEONTINI BANKS 1899

**Distribution.** Afrotropical; Palaearctic; Oriental; Australian; Nearctic.

**Discussion.** The genera of this tribe were reviewed by Stange (1976) with further information on the rich Australian fauna provided by New (1985). Stange and Miller (1990) and Stange (1994) have further defined the tribe on the basis of larval characters. The larvae have a tuft of setae on the mesoscutum which holds a debris ball. Some of the Australian Dendroleontini (Subtribe Periclystina) have this structure further elaborated by having the setae much longer and united basally in a stalk. Also, the mandibles in many genera of Dendroleontini are upturned slightly. This mandibular modification is probably co-adapted with the mesoscutal setal “lure”. However, most of the cave mouth dwelling Dendroleontini do not have the mesoscutal setal lure. One very large species (probably *Glenoleon* species) with the typical mesoscutal lure structure and upturned mandibles was found in northern Queensland (Slaty Creek) but not reared and remains unknown. This species had dark larvae living in Zone 3 and were large, fast diggers. They were found in 1989 by Miller but were not present when Miller and Stange returned to this cave in 2005. One possible reason was that the large amount of dermestid larvae that were feeding on a dead kangaroo body and bat guano were not present, especially since the bats had left. One species of *Glenoleon* Banks (*G. pulchellus*) was found in a cave and has the mesoscutal setal lure. However, the species of the other genera lack the mesoscutal lure structure and do not have upturned



mandibles and consequently their phylogenetic relationships are not clear. These three genera may represent an early line of evolution of the Dendroleontini before the acquisition of the mesoscutal “lure” or perhaps, as probably in the case of the Oriental genus *Gatzara* Navás, have lost the lure in response to habitat adaptation. These three genera are *Froggattisca* Esben-Petersen and two new genera to be described. A new morphological and taxonomic structure is described. This is called Miller’s organ (Figures 17, 21) which is a small glandular-like structure on the metathorax and abdominal sternite I.

### ***Froggattisca* Esben-Petersen**

*Froggattisca* Esben-Petersen 1915: 64. **Type species:** *Froggattisca pulchella* Esben-Petersen, by original designation.

= *Adeloplectron* Esben-Petersen 1923: 577. **Type species:** *Adeloplectron testaceum* Esben-Petersen, by original designation. (after Stange 1976).

**Further description:** New 1985b: 63.

**Diagnosis. Adult:** pretarsal claws can close against ventral setae of distal tarsomere.

**Description. Adult:** body 13-23 mm, forewing 17-35 mm, hindwing 16-35 mm. **Structure:** distal tarsomere with ventral setae at least one-half length of tarsomere diameter; tibial spurs absent or very short (at most one-half length of basitarsus); pretarsal claws can close against ventral setae of distal tarsomere (Figure 7); forefemur and usually midfemur with short sense hair, about as long as femur diameter; forewing vein 2A runs in a fairly even curve toward 3A; hindwing vein CuA connected by crossveins to posterior fork of MP2 or not reaching fork; hindwing with 1 or 2 presectoral crossveins; male abdomen without hair pencils; Miller’s organ absent on sternite I.

**Larva:** mandibles not upturned; distance between base of mandible and basal mandibular tooth more than distance between mandibular teeth; antenna shorter than width of head; labial palpus longer than basal width of mandible; head capsule wider than long in dorsal view; mesoscutum without tuft of setae medially; anterior thoracic scolus much longer than wide; abdomen without scoli; ninth abdominal segment as long as wide.

**Distribution.** Only Australia.

**Biology.** The small larvae can be in different types of microhabitats as illustrated by our experiences in Kakadu National Park which is subject to massive floods forcing insects to higher ground. We found larvae living in the recessed, slightly rain protected, abandoned termite galleries on termite mounds. We found one first instar larva of *F. testacea* (Esben-Petersen) on a termite mound in Kakadu National Park. A second species, *F. kakadu*, was found in caves between layers of volcanic rock in small patches of finely decomposed leaf litter. A much larger species lives in white chalky material in a man made tunnel in wasp or bee crevices in the wall. Unfortunately this species was not reared. In all other areas *Froggattisca* larvae were only found in caves in Zone 2D and live in shallow dust on rock inclines (about 45°). This restricted microhabitat is not used by the other larvae of antlions.

**Discussion.** *Froggattisca* Esben-Petersen is restricted to Australia where 7 species are recorded (New 1985) and we now recognize three additional species. We have reared five species. The larvae of *F. tipularia* (Gerstaecker) and *F. anicis* New as well as two undescribed species live in cave mouths or under rock overhangs in Zone 2D. Probably most species of *Froggattisca* live in caves but the larvae need to be found. Adults of *F. testacea* (Esben-Petersen) differ from the other species in having a “goitre” (large, dark colored postlabium sac) in the male which is unique in Australian species. Perhaps *F. testacea* should be placed back into the genus *Adeloplectron* Esben-Petersen. This type of structure has evolved independently in the North American *Chaetoleon pusillus* (Currie) and in the Old World genus *Subgulina* Krivokhatsky. The generic value of this character is questionable since *Chaetoleon pusillus* (Currie) (with goitre) and *Chaetoleon pumilis* (Burmeister) (without goitre) are extremely closely related. Similarly, the species of *Subgulina* are very similar to those of *Maracanda* (without goitre). *Froggattisca* is



currently classified in the Dendroleontini based on adult characters (wing venation; female terminalia). However the larvae differ from those of other Dendroleontini larvae in not having upcurved mandibles nor the specialized setae at the middle of the mesoscutum. The development of the anterior gonapophysis in this genus is also highly variable, ranging from very large (*F. gemma*) to nearly absent (*F. anicis*). The genera *Parvoleon* New and *Compsoleon* Banks appear to be very close to *Froggattisca*, if not synonymous. New separates *Froggattisca* from *Parvoleon* because it does not have tibial spurs; however *Froggattisca anicis* New has minute tibial spurs similar to *Parvoleon*. New (1985) separates *Compsoleon* from *Parvoleon* and *Froggattisca* by not having the tibial claws opposable to distal tarsomere. However, in his description of *Compsoleon bembicidis* New he states that it does have opposable claws in contrast to the situation in his key to genera. Unfortunately the genus *Compsoleon* is known by only two specimens, both males, and this character can not be restudied at this time.

### Key to species of cave mouth *Froggattisca*

#### Adults

1. Tibial spurs absent..... *F. tipularia* (Gerstaecker)
- Tibial spurs present (at least on hindleg) but minute ..... 2
- 2(1). Forewing without markings (Figure 6); foreleg longer than hindleg (Figure 6) ..... *F. rennerensis* n. sp.
- Forewing with some markings (Figures 2, 8); foreleg shorter than hindleg (Figures 2, 8) ..... 3
- 3(1). Tibial spurs longer than one-half length of hind basitarsus ..... *F. anicis* New
- Tibial spurs shorter than one-fourth length of hind basitarsus ..... *F. kakadu* n.sp.

#### Larvae

1. Ventral head capsule without setae; ventral side of thorax and abdomen unmarked (Figure 76) ..... *F. tipularia* (Gerstaecker)
- Ventral head capsule with setae; thorax and abdomen with conspicuous dark brown markings ventrally (Figures 72, 74) ..... 2
- 2(1). Ventral head capsule prominently marked medially with dark brown submedian markings posteriorly with lateral dark brown spots (Figure 74); mandible shorter than length of head capsule; ventral head setae abundant with many dolichasters ..... *F. kakadu* n. sp.
- Ventral head capsule unmarked (Figure 72); mandible about the same length as head capsule; ventral head capsule with sparse, tiny black straight setae ..... *F. rennerensis* n. sp.

#### *Froggattisca anicis* New

(Figures 2, 3)

*Froggattisca anicis* New 1985b: 69, figures 953-965 (wings; male, female terminalia; male genitalia).

**Holotype female**, 1 km. north by northeast of Millstream HS, Western Australia, 16.IV.1971, Upton & Mitchell (ANIC).

**Description. Adult:** length of body 13 mm, forewing 17 mm, hindwing 18 mm. **Coloration:** antenna dark brown to black, apices of flagellomeres pale brown; labrum and clypeus slightly darkened; palpi pale; interantennal area broadly dark brown; vertex with anterior transverse brown bar linked medially with more extensive dark brown posterior markings; pronotum with broad dark brown median stripe and lateral dark brown stripe each side; wing venation mainly dark brown, some longitudinal veins intermittently pale brown, without golden brown suffusion; abdomen dark brown, some anterior tergites with slight median posterior yellow mark. **Chaetotaxy:** pronotum with long pale outstanding setae; femora with many elongate white setae; abdomen with mostly pale setae; female lateral gonapophysis

with about eight short thickened setae; male genitalic membrane with short median setae. **Structure:** male without goitre; vertex raised; antennae widely spaced, flagellomeres broader than long; club slightly developed over last six flagellar segments; pronotum longer than wide; wings narrow, venation as in Figure 2; legs long and slender, tibia shorter than femur, tarsus longer than tibia, distal tarsomere longer than tarsomeres I and II together which are longer than tarsomere III which is longer than tarsomere IV; foreleg shorter than hindleg; tibial spurs slender, longer than one-half length of basal tarsomere; female terminalia with small lateral gonapophysis, posterior gonapophysis broad and rounded; anterior gonapophysis absent; pregenital plate not evident but there are ventral sinuous sclerotized bars in membrane below tergites VIII, IX; spermatheca strongly coiled; male genitalia with gonarcus very deep, parameres slender, rugose ventrally.

**New record.** AUSTRALIA. **Western Australia:** Wittenoom, 4. III. 1994, R. Miller (A76 **reared**) (5m, FSCA; USMB).

**Discussion.** *Froggattisca anicis* has the longest tibial spurs in the genus.

### ***Froggattisca kakadu* Miller and Stange, new species**

(Figures 4, 5, 73, 74)

**Holotype female**, Bandedilidji Walk, Kakadu National Park, Northern Territory, 13. IX. 2005, Miller & Stange, **reared** (ANIC).

**Diagnosis. Adult:** foreleg shorter than hind leg; tibial spurs shorter than one-fourth length of hind basitarsus; wings without golden brown suffusion; male without goitre.

**Description. Holotype female:** length of body about 18 mm, forewing and hindwing about 22 mm. **Coloration:** palpi, frons, and clypeus pale; large shiny dark brown interantennal mark; antenna mostly dark brown with apices of flagellomeres pale brown, club dark brown preceded by 3 whitish flagellomeres; vertex with nearly complete anterior dark band connected medially with complete middle transverse dark brown band; pronotum with median dark stripe, incomplete lateral band; scutellum with split median dark band; forecoxa pale brown with dark brown area laterally; forefemur mostly dark brown, midfemur and hindfemur mostly pale with dark stripe laterally and apex dark brown; tibia pale brown with short dark apex; tarsus mostly pale brown, weakly dark brown apically on tarsomeres; pretarsal claws light reddish; wings mostly unmarked (Figure 4) except for small rhegmal spot and dark brown at pterostigma, no golden brown suffusion; abdomen with tergites and sternites mostly dark brown, often with pale posterior borders, separated by yellowish pleura. **Chaetotaxy:** forecoxa with several elongate white setae posteriorly; forefemoral sense hair about five times longer than femur diameter; midfemoral sense hair about three times as long as femoral diameter; forefemur with several elongate white setae on apical one-half; pronotum with long black setae; thorax with short white setae; abdomen with most tergal setae black, sternal setae mostly white; posterior gonapophysis with many black setae that are much longer than the gonapophysis. **Structure:** male without goitre; pronotum longer than wide; foreleg shorter than hindleg; femora shorter than tibia; tibial spurs vestigial, shorter than one fourth length of hind basitarsus; tarsus about one-half length of hindtibia; ectoproct with about 12 thickened black setae; anterior gonapophysis with about 8 thickened black setae; female posterior gonapophysis broad, about twice as long as greatest width.

**Larva. Coloration:** ventral head capsule prominently marked medially with dark brown submedian markings posteriorly with lateral dark brown spots; thorax and abdomen with conspicuous dark brown markings ventrally. **Chaetotaxy:** ventral head setae abundant with many dolichasters. **Structure:** mandible shorter than length of head capsule.

**Paratypes.** AUSTRALIA. **Northern Territory:** Bandedilidji Walk, Kakadu National Park, 13. IX. 2005, Miller & Stange, **reared** (2f paratypes, 1 larva, FSCA).

**Discussion.** *Froggattisca kakadu* has tibial spurs present but minute (shorter than one-fourth length of hind basitarsus) and the foreleg is shorter than hindleg. The larva was found in caves between layers of volcanic rock in small patches of finely decomposed leaf litter. The larva is distinguished from all other known cave *Froggattisca* species by the dolichasters present on the ventral side of the head. Also, the mandible is shorter than the length of the head capsule (Figure 73).

**Etymology.** This species is named for the type locality, and is used as a noun in apposition.

***Froggattisca rennerensis* Miller and Stange, new species**

(Figures 6, 7, 71, 72)

**Holotype male**, 20 km. north Renner Springs, Northern Territory, 17. XI. 1989, R. Miller **reared** (ANIC).

**Diagnosis. Adult:** pronotum with median dark brown stripe; claws pale brown; wings without golden brown suffusion; male without goitre; forewing at least 15 mm long; foreleg longer than hindleg, with second tarsomere at most as long as basitarsus; tibial spurs on all legs; radial sector and cubital fork originate less than one-fourth distance from base to apex; female posterior gonapophysis about twice as long as greatest breadth.

**Description. Holotype male:** length of body about 15mm, forewing and hindwing about 15 mm. **Coloration:** labrum and clypeus pale brown, large black interantennal dark brown area; vertex with long dark brown anterior band connected medially with long dark brown posterior band; pronotum with broad median dark brown stripe and smaller submedially dark brown stripe; scutellum with broad median dark brown stripe; claws dark brown; wings with longitudinal veins mostly all pale but mostly darkened with juncture with crossveins, without markings (Figure 6), no golden suffusion; femur with anterior face dark brown, closing face pale brown; tibia with color pattern similar to femur but hind tibia mostly pale brown; tarsus mostly pale, tarsus mostly pale brown with distal tarsomere dark apically, other tarsomeres weakly darkened apically; abdomen nearly all dark brown with tergites and sternites separated by yellowish pleura, ectoproct pale brown. **Chaetotaxy:** pronotum and thorax with short white setae; abdomen with mostly pale setae; legs with mostly black setae but also some white setae. **Structure:** vertex only slightly raised; antennae close together, separated by about diameter of scape, flagellomeres about as long as wide for most of distance before club; male without goitre; pronotum longer than wide; wings narrow (Figure 6); foreleg longer than mid and hindleg; tarsus with basitarsus longer than tarsomere II which is longer than tarsomere III which is longer than tarsomere IV; distal tarsomere shorter than basitarsus; tibial spurs present on all legs but vestigial, less than one-fourth as long as basitarsus; wings narrow, radial sector and cubital fork originate less than one-fourth distance from base to apex; abdomen shorter than wings.

**Larva: Coloration:** ventral head capsule unmarked (Figure 72); thorax and abdomen with conspicuous dark brown markings ventrally (Figures 70, 72). **Chaetotaxy:** ventral head capsule with sparse, tiny black straight setae. **Structure:** mandible about the same length as head capsule.

**Other records.** AUSTRALIA. **Northern Territory:** 20 km. north Renner Springs, 17. XI. 1989, R. Miller, **reared** (1m, ANIC; 1 larva, FSCA).

**Discussion.** The tibial spurs are present on all legs but minute. In the only known specimen, the foreleg is longer than the hindleg but this may be a deformity. The second tarsomere of the foreleg is about as long as the basitarsus. The larva lives in caves and is characterized by having the mandible about the same length as the head capsule. The ventral side of the larval head capsule is practically unmarked with sparse, tiny black straight setae.

**Etymology.** This species is named for the type locality.

***Froggattisca tipularia* (Gerstaecker)**

(Figures 8, 9, 75, 76)

*Gymnocnemia tipularia* Gerstaecker 1885: 102. **Holotype**, Peak Downs (EMAU).**Taxonomy:** Esben-Petersen 1917: 206 (in *Austrogymnocnemia*); New 1985b: 68 (in *Froggattisca*).**Further description:** Esben-Petersen 1923: 580, figure 6 (photo wings); New 1985b: 68, figures 943-952 (pronotum; wings; male, female terminalia, male genitalia).

**Description. Adult:** length of body 16 to 19 mm; forewing 18 to 21 mm, hindwing 17 to 20 mm. **Coloration:** predominantly dark brown; antenna mostly dark brown anteriorly with pale apices, mostly pale posteriorly with pale brown apices; palpi, labrum and clypeus pale brown; frons broadly black; vertex with narrow anterior ivory band; predominantly dark brown posteriorly; pronotum with anterior mid-line pale brown, with anterior pale brown spot usually linked with more elongate posterior streak laterally; pretarsal claws mostly black; wings venation dark brown where shaded, otherwise mainly pale brown; markings dark grayish brown (Figure 8) without golden brown suffusion; abdomen with slender black median line flanked by two yellow spots on each tergite; legs predominantly pale brown, apex and sides of femur dark brown, tibia faintly darkened at base, more so at apex; tarsus mostly dark brown. **Chaetotaxy:** pronotum with many long white setae; mesonotum with many long white setae and several outstanding black setae; setae on ventral side of distal tarsomere expanded apically; female lateral gonopophysis with about 8 to 12 thickened setae. **Structure:** antenna long and slender; vertex rounded; male without goitre; pronotum longer than wide; legs long and slender, distal tarsomere longer than basitarsus; tibial spurs absent; pretarsal claws straight; female ectoproct not ornamented; female anterior and lateral gonapophysis at most as long as their greatest width; posterior gonapophysis long, curved, not markedly expanded; small anterior membranous lobe at base of posterior gonapophysis; pregenital plate transverse, triangular in profile; spermatheca short, rather sinuous; male genitalia with broad gonarcus, strongly twisted ventrally at anterior margin; mediuncus broad and strongly hooked ventrally; parameres broad, hooked and tapered posteriorly.

**Distribution.** New South Wales; Northern Territory; Queensland.

**New records.** AUSTRALIA. **Northern Territory:** Kuyunba Nature Reserve, near Pine Gap Satellite Station southwest Alice Springs, 20.XI.1989, R. Miller, **reared** (3m, 3f, 1 larva, FSCA; USMB); Kings Canyon, 19.IX.2005, Miller & Stange, **reared** (2m, 1f, 1 larva, FSCA). **Queensland:** Burro Ridge, White Mountains National Park, 7.XI.2005, Miller & Stange (2m, 1f, FSCA); 30 km. west Pentland, 11.XII.1998, R. Miller, **reared** (1m, FSCA).

**Discussion.** This is the only known cave mouth dwelling species of *Froggattisca* that lacks the tibial spurs. Also, the larva is quite different in lacking setae on the ventral side of the head capsule.

***Glenoleon Banks****Glenoleon* Banks 1913: 223. **Type species:** *Glenoleon pulchellus* Rambur, by original designation.**Further description:** New 1985b: 31.

**Diagnosis. Adult:** pretarsal claws not opposable to ventral surface of distal tarsomere; tibial spurs present; Miller's organ present. **Larva** with stalked mesoscutal setal hairs.

**Description. Adult:** body 9-30 mm, forewing 11- 38 mm, hindwing 10- 34 mm. **Structure:** antenna with distinct club; distal tarsomere with ventral setae at least one-half length of tarsomere diameter; tibial spurs well developed; pretarsal claws can not close against ventral setae of distal tarsomere; forefemur and usually midfemur with short sense hair, about as long as femur diameter; wings narrow to very

broad; hindwing about as long as forewing; forewing vein 2A runs in a fairly even curve toward 3A; hindwing vein CuA connected by crossveins to posterior fork of MP2 or not reaching fork; hindwing with 1 or 2 presectoral crossveins; Miller's organ absent on sternite I; male abdomen without hair pencils; male without postventral lobe; female terminalia variable; posterior gonapophysis very short to very long, sometimes with apical digging setae.

**Larva:** labial palpus longer than basal width of mandible; mesoscutum with tuft of setae medially.

**Distribution.** Only Australia.

**Biology.** Very little is known of the biology of this genus. Many species of large dendroleontine larvae were found at the bases of trees but unfortunately not reared or confirmed. *Glenoleon pulchellus* lives in Zone 1 which is made up of substrate originating in the cave or rock overhang and is exposed to the sun, high temperatures, and rainfall. Species in this zone can handle outside conditions, but may prefer the specialized substrate originating from the cave. The fact that only one specimen was found of this species suggests that it was an unusual find and that the larvae prefer living outside of the cave area. A possible species of *Glenoleon* was found in Zone 3 living by itself in deep bat guano and dermestid skins. The large larvae were active but found only once (1989) in the cave at Slaty Creek, Queensland. Possibly because the microhabitat changed more to sand after the dermestids and bats left creating a microhabitat preferred by the *Heoclis* larvae and possibly shunned by the *Glenoleon* larvae.

**Discussion.** This genus contains thirty-one described species restricted to Australia and New Guinea. There is considerable variation in the genus and further studies may lead to further generic separations. The following species is one of the commonest in Australia.

***Glenoleon pulchellus*** (Rambur)

*Myrmeleon pulchellus* Rambur 1842: 408. **Holotype**, Australia (MNHN).

**Further description:** Froggatt 1902: 360; Adams 1936: 25, figure (drawing whole insect); New 1985b: 33, figures 588-595 (wings; male, female terminalia, male genitalia); Healy and Smithers 1972: plate 23 (photo of adult).

**Taxonomy:** Hagen 1866: 405 (in *Glenurus*); Banks 1913: 224 (in *Glenoleon*).

**Description. Adult:** length of body 21 to 25 mm; forewing 29 to 33 mm, hindwing 27 to 31 mm. **Coloration:** body dark brown to black with yellow markings; labrum and clypeus yellow; frons black; vertex with midline black, an anterior black bar and a central black bar with narrow pale spot each side of posterior midline; antenna black; pronotum with broad pale stripe each side of midline, irregular pale streak outside this along posterior one-half; scutellum with lateral pale spots; abdomen black; wing venation almost wholly dark brown, subcosta (especially) with intermediate pale brown areas; hindwing with two broad preapical black bands; femur dark brown with narrow pale preapical band; foretibia and midtibia with two dark brown bands; mesotibia pale except apex; tarsus dark brown except at base of basal tarsomere and distal tarsomere; abdomen black. **Chaetotaxy:** ocular rim without supraocular setae; forefemur with few, if any, long white setae on anterior face; female lateral gonapophysis with about ten thickened setae; posterior gonapophysis with about twelve thickened apical setae. **Structure:** antenna slender, club moderately developed; pronotum longer than broad; wings broad; legs slender; distal tarsomere about equal to basitarsus; tibial spurs apically curved, extending at least to apex of tarsomere II; pretarsal claws curved, slightly shorter than tibial spurs; male genitalia long and slender; parameres protuberant with few setae; female with ectoproct not ornamented; posterior gonapophysis large, broad; sternite VII deep; pregenital plate broad and deep, with pronounced dorsolateral arms.

**Larva:** with complex color pattern; mesoscutum with tuft of setae medially borne on a stalk.

**Distribution.** Australia (New South Wales, Queensland, South Australia, Victoria).

**New record.** AUSTRALIA. **New South Wales:** Pilliga Nature Reserve, 34 km. north Coonabarabran, New South Wales, September 23, 2005, R. Miller & L. Stange, **reared** (1f, FSCA).

**Discussion.** The color pattern of the wings, especially the two broad preapical bands on the hindwing is distinctive. The larva was found in coarse sand. The fact that only one larva was found near the entrance to the cave (Zone 1) suggests that this is not typical behavior for this species.

### ***Newleon* Miller and Stange, new genus**

**Type species:** *Newleon fragilis* Miller and Stange, by present designation.

**Diagnosis. Adult:** femoral sense hair not distinguishable; pretarsal claws modified to move against ventral patch of modified setae on distal tarsomere.

**Description. Adult:** body about 20 mm; forewing about 20 mm, hindwing about 20 mm. **Structure:** antenna long, slender, with moderately developed club; antennal fossae separated by about diameter of fossa; vertex weakly raised; distal palpomere of labium weakly swollen, oval palpimacula near center, about as long as penultimate palpomere; pronotum longer than greatest width, with elongate bristles except laterally; mesonotum with long bristles on prescutum and posterior margin of scutellum; metanotum without bristles except on posterior margin of scutellum; Miller's organ absent on sternite I; legs very long and all legs about equal in length; forecoxa over twice as long as greatest diameter, with several long, white bristles posteriorly; femora very slender, slightly swollen basally, with outstanding black bristles on closing face; femoral sense hairs not distinguishable from surrounding setae; tibia long and slender, shorter than femur, small black bristle subbasally on exterior face, several black bristles subapically; tibial spurs long, very slender, slightly curved apically, about one-half length of basitarsus; tarsi very elongate, about equal in length to tibia; basitarsus over six times longer than its greatest diameter, about equal in length to next three tarsomeres together; tarsomere II over five times longer than diameter; tarsomere III about four times longer than diameter; tarsomere IV about three times longer than diameter; distal tarsomere about five times longer than wide, arched apically, with ventral setae occupying most of length, thickened and bent apically; pretarsal claws about as long as distal tarsomere and slightly shorter than tibial spurs, modified to move against ventral patch of modified setae; forewing about the same length as hindwing but broader in width; anterior Banksian line present in both wings; forewing costal area simple, without interconnected crossveins; forewing vein CuP originates at level of basal crossveins; hind margin of forewing weakly emarginate near base (Figure 12); radial sector originates before cubital (forewing) or medial (hindwing) fork; posterior area of both wings about equal; male pilula axillaris present; abdomen of male and female about equal in length and about two thirds the length of wing; male ectoproct simple; male sternite IX lobe-like, not divided; male paramere plate-like, gonarcus strongly arched; female terminalia without digging setae; female posterior gonapophysis swollen, incurved toward middle (Figure 13); female anterior gonapophysis swollen lobe-like; gonapophyseal plate large; pregenital plate membranous.

**Distribution.** Only Australia.

**Biology.** Miller discovered the larvae living in guano powder in the wall of a cave which corresponds to Zone 4C according to our ideas. The Slaty Creek area is volcanic with a sandy stream bed between the hills. The larvae anchored themselves to the bedrock on the cave walls in small crevices up to one and one-half meters high and covered themselves with guano powder if available. Although their larval niche is similar to that of many *Froggattisca*, *Froggattisca* larvae in the cave were found only in Zone 2D, covered with inorganic matter blown in from outside the cave. Unfortunately none of the larvae of *N. fragilis* were preserved. The adult may be adapted to living on spider webs since one adult was found in the unlighted rear of the cave hanging from a thread in a spider web by its front tarsi. The primary food of the larvae in the cave are dermestid larvae.

**Discussion.** Although the adult structure agrees with the definition of the Dendroleontini, larval structure does not since the mesoscutal lure is absent. The type species may be related to some of the species that New (1985) has placed in the genus *Mossega* and also probably related to species of *Froggattisca*. New has confused the concept of *Mossega* by misidentifying the type species, *M. reticulata* Navás, which actually lacks the opposable tarsal claws and consequently is more similar to *Dendroleon* Brauer. Also, *M. rosea* New lacks the opposable tarsal claws and is probably related to *Dendroleon reticulata*. On the other hand, *Dendroleon amabilis* (Gerstaecker) has opposable claws and probably should be transferred to *Mossega* sensu New. Stange (1976) dealt with the problem by transferring the “*Mossega*” species to *Bullanga* Navás and synonymizing *Mossega* with *Dendroleon*. Studies of the Oriental *Bullanga* are needed to clarify this action. It is clear that *Newleon* is not closely related to *Dendroleon* (based on larval structure) and should be recognized as a distinct taxon. Whether some of the “*Mossega*” sensu New also belong to this genus needs to be studied further. Certainly the finding of the larvae of the various species of “*Mossega*” will help to clarify the taxonomic problem now existing. *Newleon* probably is closely related to *Froggattisca* since the adult structure is comparable. The elongate tibial spurs, emargination of the base of the forewing, membranous pregenital plate, and larval differences would indicate that *Newleon* is a distinct genus. Larvae were found living in caves and occupy similar habitats as the larvae of *Froggattisca*. Unfortunately no preserved larvae of *N. fragilis* exist but Miller remembers that the larvae are similar to those of *Froggattisca*, differing in the shape of the head capsule and the length of the thoracic scoli.

**Etymology.** The genus is named in honor of Dr. Timothy New who has provided a comprehensive taxonomic treatise on the Australian antlions, and is masculine in gender.

### ***Newleon fragilis* Miller and Stange, new species**

(Figures 10, 11, 12, 13)

**Holotype male**, Queensland, Australia, 13 km. west Cloncurry, 23 km. south of Barkley Highway, 8.XII.1989, R. B. Miller collector (ANIC).

**Diagnosis. Adult:** tibial spurs at least two-thirds length of basitarsus; pretarsal claws can close against ventral setae of distal tarsomere.

**Description. Holotype male:** length from head to tip of abdomen about 20 mm.; length of wings about 20 mm. **Coloration:** body color pale brown; head with shiny, dark brown epicranial band; antennal club brown; vertex scars brown; pronotum pale brown with double brown stripe in middle, laterally with lateral and sublateral brown band; pterothorax nearly all pale brown; forecoxa pale brown except for light brown areas on lateral face; femora pale brown with dark brown apical ring, forefemur with brown streaking on exterior face; tibiae pale brown with brown subbasal marking, foretibia with brown streaking on exterior face; tarsi all pale brown except darker brown apices; spurs and claws reddish brown; abdomen pale brown with dark brown on tergum II, posterior half of tergum III, and most of abdomen from tergum IV to apex brown. **Chaetotaxy:** head with about 10 dark, long bristles on clypeus; short appressed setae on vertex, short setae on flagellomeres and labrum; postlabium with two very long, pale setae in addition to several shorter ones; pronotum with many long, dark bristles on most areas except laterally; mesonotum with long, dark erect bristles on prescutum and posterior margin of scutellum, shorter setae on scutum; metanotum with bristles only on posterior margin of scutellum; forecoxa with 3 white bristles on posterior margin; forefemur with single row of black bristles on closing face, midfemur and hindfemur with double rows on closing face; femoral sense hairs not distinguishable from other setae; tibiae with several dark brown setae not much longer than tibial diameter on exterior face; distal tarsomere with distinctive setal patch ventrally covering most of tarsomere and consisting of a double group submedially; setae are longer than tarsomere diameter, thickened and hooked apically; abdomen with first segment nearly glabrous, rest of abdomen with rather uniform pattern of short setae; longest setae on ectoproct. **Structure:** head with vertex slightly raised; interantennal distance about equal to transverse width of fossa; antenna long, about 38 flagellomeres, basal flagellomere about twice as long as

diameter, next 17 longer than wide, decreasing in length apically, from about flagellomere 18 to club about as long as wide, club about twice as wide as rest of flagellum; palps moderately long, distal palpomere of labium about three times longer than greatest diameter, weakly swollen with oval palpimaculum about in middle, penultimate palpomere longer; pronotum longer than greatest width; scutellum not much bulged; forecoxa about twice as long as wide as viewed laterally; all legs about equal in length; femora and tarsi slender, forefemur over 14 times longer than middle diameter, somewhat swollen basally; tibial spurs long and slender but reaching only to about midpoint of basitarsus which is about seven times longer than middle diameter; tarsomere II about equal in length to basitarsus but somewhat narrower; tarsomere III about five times longer than middle diameter; tarsomere IV about three times longer than middle diameter; distal tarsomere arched apically, about five times longer than wide; pretarsal claws shorter than tibial spurs, about as long as distal tarsomere; wings about equal in length, forewing broader than hindwing (Figure 12); ectoproct without lobes.

**Female:** as described for male except for lack of pilula axillaris and terminalia.

**Paratypes.** AUSTRALIA. **Queensland:** 13 km. west Cloncurry, 23 km. south Barkley Highway, 8.XII.1989, R. B. Miller collector, in cave with dead kangaroo (1m, 1f, ANIC; FSCA); Slaty Creek, 21 km. south. Flinders, Queensland, 9. IX. 2005, R. Miller & L. Stange, **reared** (1 larva, 1f, FSCA).

**Discussion.** The paratype female was reared and broke off the tips of her tarsi while in the rearing container. This species has conspicuous opposable pretarsal claws which can move upon the specialized setal brush on the ventral side of the distal tarsomere. The tarsi are so fragile that the food source of the adults must be some soft bodied insect. In Australia, there are three genera of Dendroleontini with this type of pretarsal claws. *Parvoleon* New (1 described species) and *Froggattisca* Esben-Petersen (7 described species) lack the tibial spurs or they are vestigial (less than apical diameter of tibia). *Mossega* (sensu New) has the tibial spurs as long or longer than the basitarsus. In our opinion *Mossega* (sensu New) is a probable synonym of *Dendroleon* since the type species does not have opposable pretarsal claws. When the larvae of “*Mossega*” *indecisa* (Banks) and other species are known, it will become clearer whether they should be referred to *Newleon*. *Newleon fragilis* differs from all known “*Mossega*” by the very long tarsus with the tibial spurs reaching only midway the length of the basitarsus. *Newleon fragilis* might be referred in the future to *Froggattisca* since that genus has at least one species with short spurs, *F. rieki* New. The two localities listed for this species actually refer to the same locality.

**Etymology.** The specific name refers to the very fragile tarsi of this species.

### ***Speleon* Miller and Stange, new genus**

**Type species:** *Speleon yallingup* Miller and Stange, by present designation.

**Diagnosis. Adult:** antennal rim with several setae that project over eye; Miller’s organ developed; midfemoral sense hair not developed.

**Description. Adult:** body 18-21 mm, forewing 24-27 mm, hindwing 23-26 mm. **Structure:** antenna sturdy, moderately long; antennal fossae separated by about lateral width of scape; antennal rim with several short setae that project over eye; palps short, distal palpomere weakly swollen, oval palpomaculum about in center; pronotum longer than greatest width; forecoxa about 1.5 longer than greatest diameter as viewed laterally; foreleg shorter than midleg which is shorter than hindleg; forefemoral sense hair short, inconspicuous; midfemur without distinguishable sense hair; forefemur about five times longer than middle diameter, shorter than foretibia; tibial spurs absent or very short (no more than one-half basitarsal length); tarsus shorter than one-half length of tibia, basitarsus of hindleg longer than distal tarsomere; pretarsal claws small, about as long as tarsomere IV, not opposable; male pilula axillaris present; forewings slightly longer than hindwing; forewing vein CuP originates slightly distad of basal crossvein; forewing costal area simple, without interconnected crossveins, highest near middle of wing; Banksian lines absent; hindwing posteriorly at highest point higher than greatest presectoral area;



Miller's organ present (small gland-like structure) on abdominal sternite I; abdomen shorter than wings; male ectoproct without lobes; male paramere plate-like, gonarcus strongly arched; female terminalia without digging setae; posterior gonapophysis short, incurved (Figure 25), anterior gonapophysis present, but usually weakly swollen.

**Larva** (based on *S. yallingup*): mandible longer than head capsule, three teeth increasing in length distally; distance between teeth much longer than distance between mandibular base and basal tooth; mesoscutum without specialized setae medially; mesothoracic spiracle borne on very short tubercle; anterior thoracic scolus about three times longer than middle diameter, swollen distally; posterior mesothoracic scolus a little longer than middle diameter; metathoracic scoli weakly developed, much broader than long; abdominal scoli absent; abdominal spiracles small, flush with integument; sternite VIII without submedian teeth; abdominal segment IX about one-half as long as wide.

**Distribution.** Only Australia.

**Biology.** The larvae of *Speleon* are found in Zone 2C which is sun and rain protected, but warm enough to support species living in horizontal, sometimes lichen filled (*S. cavernicolus*), rock cracks, with 90 degree angles, characteristic of areas with shale. The mostly immobile larvae were nearly exposed because they lived in tight cracks usually oriented horizontally. They only had a partial covering of dust on their bodies.

**Discussion.** *Speleon* is distinct from the other 18 genera of Dendroleontini in Australia. In the key to genera presented by New (1985), this genus would key out to *Compsoleon* Banks. However, the pretarsal claws are opposable in *Compsoleon* which is probably closely related to *Froggattisca*. Several species of the speciose genera *Glenoleon* Banks and *Austrogymnocnemis* Esben-Petersen are known and the larvae have a mesoscutal setal lure which is not found in the larvae of *Speleon*. The presence of Miller's organ, a small gland-like structure located on sternite I (function unknown) is an apomorphy of *Speleon* found also in *Austrogymnocnemis* Esben-Petersen, *Platyleon* Esben-Petersen and some *Glenoleon* Banks. There are three species known in this genus.

**Etymology.** The genus name is from the Greek *spelos* (cave) and *leon* (lion), and is masculine in gender.

#### Key to species of *Speleon*

1. Tibial spurs absent; southern Western Australia..... *S. yallingup* n.sp.
- Tibial spurs present; New South Wales ..... 2
- 2(1). Tibial spurs about one half length of basitarsus; female anterior gonapophysis well developed; Miller's organ on sternite I dark (Figure 21) ..... *S. pilliga* n.sp.
- Tibial spurs about one third length of basitarsus; female anterior gonapophysis weakly developed; Miller's organ on sternite I pale brown (Figure 17) ..... *S. cavernicolus* n.sp.

#### *Speleon cavernicolus* Miller and Stange, new species

(Figures 14, 15, 16, 17)

**Holotype female**, 40 km. south Coonabarabran Clock Tower, New South Wales, Australia, 3.XII.1989, R. B. Miller collector (**reared**) (ANIC).

**Diagnosis. Adult:** tibial spurs about one third length of basitarsus; female anterior gonapophysis weakly developed.

**Description. Holotype female:** length from head to tip of abdomen about 19 mm; length of forewing 25 mm; length of hindwing 24 mm. **Coloration:** body coloration dark brown, sternum pale brown; head pale brown except with broad shiny dark brown epicranial mark extending a little above antennae;

vertex dark brown with pale brown sublaterally and medially; tiny dark brown spot above anterior tentorial slit; mouthparts pale brown; antennae with scape dark brown, scape and flagellomeres mostly dark brown except pale brown on apex, pre-club flagellomeres mostly pale brown, club dark brown; pronotum pale brown with broad dark brown medial stripe which has submedial dark brown extensions posteriorly; broad dark brown stripe sublaterally; anterior margin dark brown; mesonotum predominately dark brown with pale brown areas on sublateral area of prescutum, pale brown spot near wing base and near posterior margin, small pale brown spot medially, and pale brown area anterior to and lateral of scutellum; metanotum similar in coloration but somewhat more pale brown; pleura mostly dark brown with some pale brown areas; forecoxa dark brown posteriorly except for pale brown area near middle; femora with broad dark brown apical band. otherwise mostly pale brown except for anterior face, forefemur more extensively marked with dark brown; foretibia and midtibia mostly dark brown with pale brown area basally, longer area subbasally on exterior face and extensive pale brown area subapically; hindtibia mostly pale brown except for abbreviated dark brown apex; tarsi mostly dark brown except basitarsus pale brown basally; setal bases with small dark brown area; tibial spurs and pretarsal claws reddish brown; wings with veins and crossveins alternating dark brown and pale brown; forewing costal area with dark brown areas; small dark brown areas in forewing posterior area; hindwing with small dark brown rhagmal mark and hypostigmatic spot; Miller's organ on sternite I pale brown; abdomen mostly dark brown except for mostly pale brown first segment and terminalia. **Chaetotaxy:** vertex with short brown, appressed setae along anterior and posterior scar areas; area between antennae and below antennae with many decumbent white setae, about one-half as long as pedicel length; short white setae on scape and pedicel; clypeus with several white, erect setae; postlabium with several long, white setae; pronotum with moderately long, erect black setae scattered on most of disc; nota with few inconspicuous setae except for mesoprescutal lobe laterally; pleura with many long, mostly white setae; forecoxa with several long, white setae posteriorly, longer than coxal diameter; forefemur with many dark brown or white decumbent setae, two black erect bristles near apex on exterior face; femoral sense hair short, inconspicuous, shorter than femur diameter; foretibia with decumbent short setae with 8 black bristles on exterior face as well as several bristles laterally on closing face; midfemur and midtibia with similar pattern of chaetotaxy but pubescence less dense and setae shorter; hindfemur and hindtibia similar to midlegs in pubescence; tarsi with short setae on ventral surface, shorter than tarsal diameter; setae on wing veins fairly long, mostly longer than subcostal width; abdomen with inconspicuous setae except a few fairly long white setae on sternite I and base of tergite II; terminalia with short setae except fairly long on apex of sternite IX and with several long, black setae on posterior gonapophysis, nearly twice as long as gonapophyseal length. **Structure:** head with vertex moderately elevated above eyes; interocular distance about 1.5 longer than greatest ocular distance; interantennal distance about equal to width of scape; antenna with about 31 flagellomeres, basal flagellomere longer than wide, rest of flagellomeres broader than long becoming broader apically; club moderately well developed, about three times longer than preclub flagellomeres; distal palpomere of labium weakly swollen, oval palpmaculum about in middle; pronotum longer than wide; scutellum relatively flat; forecoxa about twice as long as greatest diameter; legs elongate, forefemur about three times longer than forecoxa; forelegs about equal in length to midleg, hindleg longer; tibial spurs about one-third length of basitarsus; basitarsus about three times longer than greatest diameter, about as long as distal tarsomere; pretarsal claws short, about one-third as long as basitarsus; Miller's organ well developed on metathorax and sternite I; forewing rather abruptly narrowed at base, a little longer and broader than hindwing; forewing costal area broad, about three times higher than subcostal area at radial sector, costal area highest near middle of wing, decreasing in height toward hypostigmatic cell; forewing with three presectoral crossveins; hindwing with posterior area at highest point slightly higher than greatest presectoral area height, with nine crossveins between CuA and hind margin; abdomen about one-third length of hindwing; female terminalia with posterior gonapophysis about twice as long as middle diameter, directed medially and becoming narrower distally.

**Male:** unknown.

**Discussion.** This species was reared from a larva found on a angled rock crack in a rock overhang and was exposed except for a partial covering of dust. The larva was oriented horizontally with the head to the side. The time in the cocoon lasted from February 4 to March 1, 1990. This species is very similar to *S.*

*yallingup* in color and structure but is easily distinguished by the conspicuous tibial spurs. It is also similar in appearance to *Dendroleon dumigani* Tillyard which has the tibial spurs extending to apex of the basitarsus.

**Etymology.** The specific name refers to the larval habitat of the species.

***Speleon pilliga* Miller and Stange, new species**

(Figures 18, 19, 20, 21)

**Holotype female**, Pilliga Nature Reserve, 34 km. north Coonabarabran, New South Wales, September 23, 2005, R. Miller & L. Stange (**reared**) (ANIC).

**Diagnosis. Adult:** tibial spurs present; tibial spurs about one half length of basitarsus; female anterior gonapophysis well developed.

**Description. Holotype female:** length from head to tip of abdomen about 19 mm; length of forewing 25 mm; length of hindwing 24 mm. **Coloration:** body coloration dark brown; head pale brown with darkened interantennal space, vertex with anterior brown stripe, posterior double dark brown spot medially, large shiny dark brown area laterally; antenna mostly dark brown with pale brown apices, scape pale brown with two dark brown rings, club nearly all black; pronotum with dark median stripe, dark submedial band on posterior one half, nearly complete dark brown stripe laterally; pteronotum mostly dark brown with small pale brown spot submedially on prescutum, short pale brown stripe submedially in front of mesoscutellum; abdomen dark brown with pale along mid line, sterna with more pale brown; forecoxa mostly pale brown with dark areas on lateral face; forefemur and foretibia mostly black, pale brown at anterior face of femur before large basal dark brown spot; foretibia mostly pale brown except dark brown apically; midfemur and most of midtibia dark brown; hindfemur mostly pale brown with dark apex, tibia mostly pale brown with some subbasal and apical dark brown markings; pretarsal claws reddish brown; forewing extensively with dark markings especially along subcostal area and posterior margin (Figure 19), hindwing with fewer markings but with a prominent rhegmal mark and dark at hypostigma, veins and crossveins alternating dark brown and pale brown; Miller's organ (Figure 21) on sternite I dark. **Chaetotaxy:** vertex with short brown, appressed setae along anterior and posterior scar areas; area between antennae and below; pronotum with long, erect black setae mostly laterally; nota with few inconspicuous setae except for mesoprescutal lobe laterally; forecoxa with several long, white setae posteriorly, longer than coxal diameter; forefemur with several dark brown setae at posterior one-half; femoral sense hair short, inconspicuous, shorter than femur diameter; foretibia with black setae along most of length, no decumbent setae; midfemur with few bristles, a few white ones near base; mesotibia with many long black setae; hindfemur and hindtibia with many fairly short (about equal to diameter of femur) black setae; tarsi with short setae on ventral surface, shorter than tarsal diameter; setae on wing crossveins fairly long, mostly longer than subcostal width; abdomen with many short setae; posterior gonapophysis with several elongate black setae longer than gonapophysis. **Structure:** head with vertex moderately elevated above eyes; interocular distance about 1.5 longer than greatest ocular distance; interantennal distance somewhat longer than width of scape; antenna with about 36 flagellomeres, basal flagellomere longer than wide, rest of flagellomeres broader than long; club moderately well developed with about 7 flagellomeres, about three times longer than preclub flagellomeres; distal palpomere of labium weakly swollen, oval palpiculum about in middle; pronotum longer than wide; scutellum relatively flat; forecoxa about twice as long as greatest diameter; legs elongate, forefemur about three times longer than forecoxa; forelegs about equal in length to midleg; hindleg longer; tibial spurs about one-half length of basitarsus; basitarsus about three times longer than greatest diameter, about as long as distal tarsomere; pretarsal claws short, about one-third as long as basitarsus; Miller's organ well developed on metathorax and sternite I; forewing a little longer and broader than hindwing; forewing costal area broad, about 2.5 times higher than subcostal area at radial sector, costal area highest near middle of wing, decreasing in height toward hypostigmatic cell; forewing with four, partly interconnected presectoral crossveins; hindwing with one presectoral crossvein, posterior area at high-

est point slightly lower than greatest presectoral area height, with eight crossveins between CuA and hind margin; abdomen about one-third length of hindwing; female terminalia with posterior gonapophysis about twice as long as middle diameter, directed medially; female anterior gonapophysis weakly developed.

**Male:** unknown.

**Discussion.** This species is most closely related to *S. cavernicolus* differing in having longer tibial spurs and more abundant wings markings.

**Etymology.** This species is named for the type locality. It is treated as a noun in apposition.

***Speleon yallingup* Miller and Stange, new species**

(Figures 22, 23, 24, 25, 77, 78)

**Holotype female**, Yallingup, Western Australia, 22.II.1994, R. Miller & L. Stange (ANIC).

**Diagnosis. Adult:** tibial spurs absent; femoral sense hair absent.

**Description. Holotype male:** length from head to tip of abdomen 20 mm; length of forewing 26 mm; length of hindwing 25 mm. **Coloration:** body pale brown; vertex mostly pale brown with most brown anterior to anterior row of pale scars; interantennal area shiny dark brown extending ventrally to dorsal surface of clypeus; antennal scape mostly pale brown posteriorly; pronotum with anterior part completely dark brown extended posteriorly as trifurcate dark brown longitudinal stripes, dark brown stripe also at posterior one-third; forecoxa mostly pale brown posteriorly with small dark brown spot; prescutum dark brown with light brown area laterally; pteronota mostly dark brown with light brown anteriorly and sublaterally of scutellum; metanotum dark brown with pale sublateral area anteriorly; abdomen mostly pale brown with dark brown areas at anterior margin and near middle; sternites mostly pale brown with wide dark brown stripes sublaterally; hindwing without evident rhegmal mark (Figure 23).

**Chaetotaxy:** head, pronotum, pteronota with scattered small black setae; forecoxa with many long white setae posteriorly; femur and tibia with short setae (shorter than femur diameter), mostly black except white setae on posterior face of femur; wing setae long on crossveins; abdomen with mostly short black setae, longer setae on segment VIII and ectoproct of male. **Structure:** vertex much raised; pronotum longer than broad; antenna with basal flagellomere longer than wide, rest of flagellomeres broader than long; foreleg about as long as midleg which is shorter than hindleg; hind basitarsus longer than distal tarsomere which is shorter than tarsomeres II to IV together; tibial spurs absent; femoral sense hair not present; male with pilula axillaris moderately well developed, brush about three times wider than long with many rows; wings moderately broad, hindwing posterior area higher than presectoral area; forewing with 3 presectoral crossveins, hindwing with one presectoral crossvein; Miller's organ well developed on metathorax, variable (vestigial to well developed) on sternite I; male ectoproct simple; sternite IX with small medial lobe.

**Female:** As described for the male except without pilula axillaris; female terminalia with posterior gonapophysis about twice as long as middle diameter, directed medially and becoming narrower distally.

**Larva: Coloration:** mandible dark brown; abdomen with extensive dark brown coloration dorsally and ventral. **Chaetotaxy:** ventral head capsule with many black setae, no dolichasters. **Structure:** head capsule wider than long in dorsal view; labial palpus longer than basal width of mandible; antenna shorter than width of head capsule; mandible with distance between teeth longer than distance from base to basal tooth; mesothoracic spiracle not borne on tubercle; mesoscutum without tuft of setae medially; anterior thoracic scolus much longer than wide; legs relatively short; ninth abdominal segment wider than long.

**Variation:** length 18 to 20 mm, forewing 21 to 26 mm, hindwing 20 to 25 mm; female posterior gonapophysis (Figure 25) with many long black setae longer than length of gonapophysis which is longer than wide and tapered distally.

**Paratypes.** AUSTRALIA. **Western Australia:** Yallingup, Western Australia, 22.II.1994, R. Miller and L. Stange collectors, **reared** (1m, 5f, 8 larvae, ANIC, FSCA).

**Discussion.** One female was captured sitting on the ceiling of a cliff overhang. The other specimens were reared from larvae living in the dusty rock shelves. Larvae were covered mostly with dust. Specific rearing data are as follows (time in cocoon): September 20 to October 30, 1994; July 27 to August 20, 1994; October 1 to November 8, 1994; October 15 to November 19, 1994. Parasites were obtained from one cocoon. This parasite was determined by John Noyes as a species of *Echthrobacella* Girault (Hymenoptera: Encyrtidae). This is a polybrionic species since about 20 specimens emerged from one cocoon. This species is very similar to *S. cavernicolus* in size, coloration and structure. However, the tibial spurs are completely absent in *S. yallingup*. There are some minor coloration differences such as pale brown posterior area of the scape and the mostly pale brown posterior area of the forecoxa.

**Etymology.** This species is named for the type locality. It is treated as a noun in apposition.

## TRIBE NEMOLEONTINI BANKS 1911

**Distribution.** Afrotropical; Palaearctic; Oriental; Australian; Nearctic; Neotropical.

**Discussion.** This is the largest tribe of antlions with species in all parts of the temperate to tropical world except for the Neantarctic Region (Chile and southern Argentina). This tribe is characterized by having the forewing vein 1A bending at sharp angle toward 3A (except some *Xantholeon*), only 1 or 2 presectoral crossveins in the hindwing, and lacking the male pilula axillaris. In Australia there are three genera containing cave dwelling antlions. These are *Eophanes* Banks, *Stenoleon* Tillyard, and *Xantholeon* Tillyard. Probably all the species of these genera are adapted to living in caves or rock overhangs. Elsewhere, cave dwelling nemoleontine genera are known only from the Western Hemisphere represented by *Eremoleon* Banks which is a speciose genus with nearly all of the reared species living in caves.

### *Eophanes* Banks

*Eophanes* Banks 1931: 60. **Type species:** *Eophanes formosa* Banks, by original designation.

**Further description:** New 1985c: 8.

**Diagnosis. Adult:** pretarsal claws large, about equal in length to distal tarsomere; wings broad, falcate.

**Description. Adult:** large size (forewing 30 mm long or longer). **Coloration:** pale brown. **Structure:** antenna long, with well developed fusiform club; wings broad, falcate, no Banksian lines; forewing radial sector arised just beyond cubital fork; forewing vein 2A strongly angled and connected to vein 1A by short crossvein; hindwing radial sector arise slightly basal to medial fork; legs rather slender but stout; tibial spurs long extending to about tarsomere IV; pretarsal claws long and slender; male ectoproct without postventral lobe; parameres flat plates; gonarcus broadly arched; female posterior gonapophysis long and tapered; anterior gonapophysis absent; pregenital plate small.

**Distribution:** Australia and Philippines.

**Biology.** The large larvae coexist with *Xantholeon* larvae in Zone 4B and probably feed on them. The larvae live in shallow dust so as to be able to anchor themselves to the substrate which allows them not to be pulled away too easily by captured prey.

**Discussion.** We are not familiar with the type species described from the Philippines which may or may not be congeneric with the species found in Western Australia. There appears to be an undescribed

species in Queensland. The species of *Eophanes* appear like large *Xantholeon* adults but have the broad, falcate wings and much larger pretarsal claws.

***Eophanes distincta* (Banks)**

(Figures 26, 27, 28)

*Formicaleon distinctus* Banks 1939: 457. **Holotype male**, Mullewa, Western Australia (ANIC).

= *Eophanes falcata* Kimmins 1955 (after New 1985c: 9). **Holotype male**, Monte Bello Island, Western Australia (BMNH).

**Further description:** New 1985c: 9, figures 1081-1087 (wings), 1088- 1096 (male genitalia, terminalia; female terminalia).

**Description. Adult:** body length 30 to 38 mm, forewing 33 to 40 mm, hindwing 31 to 39 mm. **Coloration:** body pale yellow or yellowish brown, with brown or grayish brown markings; antenna with scape brown, flagellum pale brown, club somewhat darkened; palpi slightly grayish; face pale; frons dark brown, band centrally emarginate anteriorly; vertex with anterior brown band, sometimes broken into three spots and two posterior spots (sometimes fused); pronotum pale brown, with prominent submedial stripe, or with small brown spots on transverse furrow and larger dark brown marks along posterior border; foretibia with pale brown stripe; midfemur, midtibia, and hindfemur with brown streaking; wing venation mostly pale brown, but many crossveins brown; forewing cubital mark and rhexmal mark rather variable; pterostigma pale, in forewing with dark base; thorax and abdomen dorsally with median line of dark brown spots, and submedial, sublateral and lateral rows of spots; abdomen below with many brownish spots, prominent sublateral spot on sternite VIII. **Chaetotaxy:** clypeus with few long dark brown hairs; distal tarsomere with ventral setae at least one-half length of tarsomere diameter; female ectoproct with about eight short, thickened setae; lateral gonapophysis with about twenty thickened ventral setae. **Structure:** antenna with well defined fusiform club; pronotum slightly broader than long, anterior angles rounded, transverse furrow well developed; femoral sense hair about four times as long as diameter of femur; Miller's organ present on metathorax, absent on sternite I; tibial spurs at least two-thirds length of basitarsus; pretarsal claws as long or longer than distal tarsomere, about equal in length to pretarsal claws; wings broad and falcate, venation as in Figure 27; forewing vein CuP + 1A runs to hind margin at about level of origin of radial sector; hindwing with 1 presectoral crossvein; male pilula axillaris absent; male ectoproct and sternite IX deep; gonarcus broadly arched, shallow; mediuncus not evident; parameres convergent posteriorly, with strong inner dorsal flange at anterior margin. Female ectoproct broad; lateral gonapophysis broad; posterior gonapophysis slender, much longer than greatest diameter; pregenital plate transverse, oval with median slender hooked prominence; spermatheca slender, duct convoluted.

**Larva: Coloration:** mostly pale in color with reddish brown mandibles and pretarsal claws; head capsule mostly dark brown anteriorly at mandibular base; dorsum with most of lateral margin dark brown, with 3 submedian dark spots increasing in size posteriorly, and with dark brown V-shaped area anteriorly; venter of head capsule with double dark stripe at middle, small pale brown spot sublaterally toward posterior margin; pronotum with pale brown submedian stripes; abdomen dorsally with series of pale brown spots medially, submedially, and sublaterally. **Chaetotaxy:** head capsule without dolichasters; sternite IX with two groups of four stout digging setae submedially near posterior margin. **Structure:** head capsule about 1.5 times longer than wide, shorter than length of mandible; mandible with three teeth gradually increasing in length distally, middle tooth a little closer to distal tooth than to basal tooth; distance between teeth about equal to distance between base of mandible and basal tooth and also to the distance from the distal tooth to the apex; labial palpus a little longer than base of mandible, distal palpomere about twice as long as wide; antenna shorter than width of head capsule; mesothoracic spiracle borne on tubercle that is about as long as greatest diameter, not projecting; abdominal spiracles small, nearly flush with tegument; abdominal sternite VIII without submedian teeth near posterior margin; sternite IX about 1.5 times wider at anterior margin than long.

**Distribution.** South Australia (New 1985c:10); Western Australia (New 1985c: 9).

**New records.** AUSTRALIA. **Western Australia:** 37 km. east Pt. Hedland, S20°23' 34.6", E118°54' 27.5", 1.III.1994, Miller & Stange, **reared** (1f, FSCA); 20 km. north Meekatharra, S26°25', 22.7" E118°35' 25.6", 9.III.1994, Miller & Stange, **reared** (2f, FSCA); 68 km. north Nanutarra, S21°59' 37", E115°37' 49.1", 28.II.1994, Miller & Stange, **reared** (f, FSCA); 126 km. north Nanutarra, E21°35' 36.4", E115°56' 3.3" (1m, FSCA); Talling Peak, 70 km. north Mullewa, S28°05' 36.8", E115°38' 37.6". 23.II.1994, Miller & Stange, **reared** (4m, 3f, FSCA).

**Discussion.** This rather large pale brown species is widespread in Western Australia and there are a few records from South Australia. The larvae live in the back of caves (Zone 4B) together with larvae of *Xantholeon*. The adults have huge pretarsal claws and strong tibial spurs and it is likely they predate on adult antlions. The larva also are probably predators of other antlion larvae in the cave, especially larvae of *Xantholeon*. The second instar larva has a more prominent mesothoracic spiracle which is borne on a tubercle that is longer than wide. The major distinction from *Xantholeon* are the broad, falcate wings.

### *Escura Navás*

*Escura* Navás 1914: 468. **Type species:** *Escura divergens* Navás, monotypy.

= *Alloformicaleon* Esben-Petersen 1915. **Type species:** *Formicaleon australis* Esben-Petersen, by original designation. (after New 1985c: 20.

**Further description:** New 1985c: 20.

**Diagnosis. Adult:** forewing vein CuP + 1A runs to hind margin well distad of origin of radial sector.

**Description. Adult:** medium size to rather large species. **Structure:** antenna with well developed club; abdomen shorter than wings which are rather narrow; forewing widest at apex of CuA2, sometimes then noticeably tapered towards apex; no Banksian lines; forewing vein CuP + 1A runs to hind margin well distad of origin of radial sector; legs moderately slender; tibial spurs variable, sometimes reaching to tarsomere III in hindleg; male without postventral lobe; male gonarcus usually broad and short; parameres plate-like, not hooked; female terminalia without anterior gonapophysis; posterior gonapophysis present, variable ranging from not much longer than greatest width to much longer than greatest width; pregenital plate small.

**Distribution.** Only Australia.

**Biology.** The biology of only one species is known. *Escura nigrosignata* Tillyard, which has been found in animal burrows in New South Wales by Miller and underneath a cliff overhang at Wanneroo, near Perth. This latter habitat would correspond to Zone 4B which is the zone where the commoner *Xantholeon* larvae live.

**Discussion.** This genus contains nine species according to New (1985c). The forewing venation with CuP + 1A running to the hind margin well distad of the origin of the radial sector is diagnostic for this genus. The pretarsal claws are large and agree well with those of *Eophanes*.

### *Escura nigrosignata* (Tillyard)

(Figures 29, 30, 31, 79, 80)

*Distoleon nigrosignatus* Tillyard, 1916. **Holotype male**, Cottesloe, Western Australia, Feb.-March 1913 (BMNH).

**Further description:** New 1985c: 20, figures 1183-1189 (wings; male, female terminalia, male genitalia).

**Description. Adult:** antenna about 6 to 8 mm; body about 20 to 24 mm; forewing 24 to 29 mm, hindwing 22 to 27 mm. **Coloration:** body dark brownish gray with grayish yellow markings; antennal base pale brown, flagellum and distal segments black with narrow pale apices; palpi pale except black apical segment of labial palpus; frons mostly dark brown to black; vertex dark brown except for central lateral transverse yellow patch; posteriorly with paired median spots and 2 lateral spots; pronotum with two broad grayish brown stripes narrowly separated by pale midline; ventral lateral margin pale brown; pterothorax dark brown, with slight traces of yellow streaks along lateral scutal lobes; abdomen dark brown, tergites beyond II with traces of anterior paired pale streaks, posterior rim usually narrowly pale; wing venation mostly pale brown except for some shaded areas; Sc dark at intersections with costal crossveins; hindwing radial sector stem dark brown; pterostigma white to cream, other markings as in Figure 30; femora mostly black, fore and midtibia with three black bands, including apex; meta tibia more extensively pale; tarsus dark brown except bases of I, V and sometimes II. **Chaetotaxy:** clypeus with about 19 long, pale hairs; femur with white hairs and few black setae. **Structure:** antenna slender, club well defined; pronotum slightly longer than broad; wings tapered, venation as in figure 30; legs short and sturdy; tibial spurs long slender, extending to beyond apex of tarsomere IV; pretarsal claws long, slender, about equal to spurs; male ectoproct large, sternite IX short; gonarcus broadly arched, mediuncus membranous; parameres simple, slender; female abdominal ectoproct not ornamented, lateral gonapophysis moderately broad; posterior gonapophysis slender; spermatheca broadened apically.

**Larva: Coloration:** body pale brown with extensive dark brown markings; mandibles pale brown, pretarsal claws reddish; head capsule above with lateral margin mostly dark brown, dark brown submedial stripe and V-shaped mark near anterior margin; venter of capsule mostly pale brown with small dark brown spot sublaterally near posterior margin and pale brown short stripe slightly posterior to sublateral spot. **Chaetotaxy:** dorsal surface with moderately long dolichasters; sternite IX with two groups of stout digging setae submedially near posterior margin, medial tooth of each group peg-like, not much longer than broad and about equal to submedial peg-like setae situated a little anterior to others. **Structure:** head capsule about as long as anterior width (dorsal view), somewhat shorter than length of mandibles; mandibles with 3 teeth increasing in length distally, middle tooth a little closer to distal tooth than to basal tooth; distance between teeth longer than distance from mandibular base to basal tooth; antenna about half as long as head capsule width; labial palpus slightly longer than base of mandible; mesothoracic spiracle borne on short tubercle which is shorter than greatest breadth; anterior thoracic scolus about as long as greatest diameter; abdominal spiracles raised above tegument on tubercle that is much broader than long; sternite VIII without submedian teeth near posterior margin; sternite IX about 1.5 broader at anterior margin than long.

**Distribution:** Queensland; South Australia; Western Australia.

**New records.** AUSTRALIA. **Western Australia:** 9 km. north Wanneroo, S 3°, 39' 25", E 115°, 44' 8", 9. III. 1994, R. Miller & L. Stange (**reared**) (5m, 4f, FSCA).

**Discussion.** The adult of this species can be distinguished from other species of *Escura* by the dark brown longitudinal streak which extends most of the length of the forewing. About fifteen larvae were found living under a large rock overhang about nine kilometers north of Wanneroo. Nine adults were reared. The time spent in the cocoon ranged from 33 to 37 days. Seven of the larvae made their cocoons near the end of August 1994. No parasites were present. The larvae live in Zone 4B and occupy the same niche as *Xantholeon* larvae. They live in the sand in the shade mostly near the rock wall. The third instar larva attains about 15 mm in length.

### ***Stenoleon* Tillyard**

*Stenoleon* Tillyard 1916: 60. **Type species:** *Stenoleon fieldi* Tillyard, by original designation.

**Further description:** New 1985c: 15.



**Diagnosis. Adult:** antenna long to very long with club absent or greatly reduced; tibial spurs present; female anterior gonapophyses absent, posterior gonapophyses long, often slender; male sternite IX simple rounded; male gonarcus broad and short, parameres platelike, angled anteriorly; male ectoproct without postventral lobe. .

**Description. Adult:** body 20 to 24 mm, forewing 20 to 25 mm, hindwing 19 to 25 mm. **Coloration:** body dark brown. **Structure:** antennal club weakly developed at most, about twice the diameter of preceding antennal flagellomeres; ocular rim with short setae that project over eye; tibial spurs well developed; pretarsal claws can not close against ventral setae of distal tarsomere, not one-half length of distal tarsomere; Miller's organ absent on sternite I; hindleg about as long as foreleg; female anterior gonapophysis absent; forewing slightly longer than hindwing; posterior gonapophysis long, usually slender, pregenital plate small, membrane below tergite VIII with distinct sclerotized bars; male sternite IX simple, rounded; gonarcus very broad and short; parameres plate-like, angled anteriorly.

**Larva:** head capsule about 1.5 times longer than greatest width as viewed dorsally, without dolichasters; antenna about as long as width of head capsule; labial palpus longer than base of mandible; mandible with three equally spaced teeth gradually increasing in length distally; distance between teeth about one-half distance from mandibular base to basal tooth and about equal to distance between distal tooth and apex; mesothoracic spiracle borne on short tubercle, much wider than long; abdominal spiracles not borne on tubercles; sternite VIII without submedial tooth near posterior margin; sternite IX about as wide posteriorly as length of sternite, set of 4 short digging setae posteriorly.

**Distribution.** Only Australia.

**Biology.** The larvae may be found in Zone 1 which is made up of substrate originating in the cave or rock overhang and is exposed to the sun, high temperatures, and rainfall. Species in this zone can handle outside conditions, but may prefer the specialized substrate originating from the cave. They mostly occurred in Zone 2A which has rainfall protection and is cooler than Zone 1 but warmer than other Zones. Also, there is dust or loose material laying over a hard surface but shallow enough to allow the larvae to be covered with their legs anchored. They live in either organic (bat guano powder) or inorganic matter (white calcium powder).

**Discussion.** New (1985c: 15) referred six species to this genus. However, our studies indicate that the small species of *Stenoleon* with short, clubbed antennae (*S. gradostratus* New, *S. copleyensis* New, *S. grandithecus* New, and *S. navasi* New) belong to *Bandidus* Navás and *Stenoleon* is restricted to the large species (*S. fieldi* Tillyard, *S. cingulatus* New, and a new species) which have very elongate and often filamentous antennae as well as much smaller pretarsal claws. All of the larger species with the elongate antennae inhabit cave mouths or rock overhangs. Thus, the small species of *Stenoleon* are here transferred to *Bandidus* Navás with the following **new combinations:** *B. gradostratus* (New), *B. copleyensis* (New), *B. grandithecus* (New), and *B. navasi* (New).

The larvae of the now restricted *Stenoleon* have the longest antennae discovered thus far of all the described larval Myrmeleontidae. The larvae are very similar to those of *Xantholeon* but live in the more light intense Zones 1 and 2A. The pale larva produces a dark colored adult. The major diagnostic character of *Stenoleon* larvae is the very elongate antenna (longer than head width, Figures 83, 85). Although the larval antenna of *S. cingulatus* is the same as in *S. fieldi*, it remains to be seen if the larval antenna of *S. xanthopus* is equally long since the adult antenna is not as long and filamentous as in the other two species. Unfortunately, the larval antennae are broken off in the larval exuviae found in the cocoons. Adult *Stenoleon* differ from *Xantholeon* in having forewing vein CuP originating slightly distal of M-Cu, forewing vein 2A bending at a sharp angle toward 3A (evenly curved in some *Xantholeon*), in having many long, erect white bristles on the mesoscutum, the forefemur is beset with many long bristles, narrower wings and smaller eyes.

### Key to species of *Stenoleon*

#### Adults

1. Antenna shorter than one-half length of forewing with a small but distinct club (Figure 38) .... ***S. xanthopus* new species**  
 — Antenna as long as one-half length of forewing, filamentous without club (Figure 35) ..... **2**
- 2(1). Antennal scape mostly pale brown posteriorly except basally; foretibial spurs reach to apex of tarsomere II; forewing without extensive spotting in basal one-half in contrast to apical one-fifth ..... ***S. cingulatus* New**  
 — Antennal scape mostly dark brown posteriorly; foretibial spurs reach to about apex of tarsomere I; forewing with extensive spotting in basal one-half ..... ***S. fieldi* Tillyard**

### Larvae

1. Mesothoracic spiracle borne on long tubercle; mandibular middle tooth about as long as distal tooth; abdomen with abundant dark brown areas not especially limited to midline (Figure 81) ..... ***S. cingulatus* New**  
 — Mesothoracic spiracle nearly sessile; mandibular middle tooth slightly shorter than distal tooth; abdomen with most dark brown areas along midline (Figure 83) ..... ***S. fieldi* Tillyard**

### ***Stenoleon cingulatus* New**

(Figures 32, 33, 34, 81, 82)

*Stenoleon cingulatus* New 1985c: 17. **Holotype male**, Carnarvon, Queensland, Nov. 1944, N. Geary (AMSA).

**Description. Adult:** body 20 mm, forewing 22 mm, hindwing 20 mm. **Coloration:** body dark brown to black; face yellow; frons narrowly black below eyes; interantennal space and all of dorsal head dark grayish brown; antenna dark brown, much of scape yellow; apices of flagellomeres narrowly pale brown; pronotum with trace of narrow median stripe, anterior angles narrowly ivory; partial weakly indicated dorsolateral streak; abdomen dark, posterior of tergites II-VIII very narrowly pale brown; forewing without extensive spotting in basal one-half in contrast to apical one-fifth; longitudinal veins predominantly dark brown, subcosta with intermediate pale areas; crossveins at base of wing dark brown, then with alternating bands of white and brown to give wing a banded appearance; pterostigma pale; rhagma with weak grayish brown shading; legs with femur dark brown, foretibia mostly dark brown, hind tibia pale brown except black apex; tarsomeres I, II, and V partially black, tarsomeres III and IV black. **Chaetotaxy:** forefemur and foretibia with white bristles; hindtibia with black bristles. **Structure:** antenna as long as one-half length of forewing, filamentous without club; vertex not raised; pronotum about as long as broad; foretibial spurs reach to apex of tarsomere II; wings slender, rather tapered; legs long and slender; tibial spurs slender, extending to apex of basitarsus; pretarsal claws slender, longer than tibial spurs; male abdomen with deep ectoprocts; sternite IX broad, apex transverse; gonarcus shallow, broadly rounded; parameres linked medially, deep and rounded posteriorly.

**Larva:** head somewhat longer than wide, with prominent dorsal median dark brown stripes, ventral side nearly all pale brown except for anterior dark brown spot (Figure 83); mandibular middle tooth reddish brown, slightly longer than distal tooth; mesothoracic spiracle borne on long tubercle; abdomen with abundant dark brown areas not especially limited to midline.

**New records. AUSTRALIA. Queensland:** Slaty Creek, 21 km south Flinders Highway, 9. IX. 2005, R. Miller, & L. Stange (**reared**) (2m, 9f, FSCA; TAMU); Highway 781 to Malbon, 8. XII. 1989, R. Miller (2 larvae in Guano, **reared**) (2m, 2f, FSCA); 21 km. south Barkley Highway, 13 km. west Cloncurry, 8.XII.1989, R. Miller (**reared**) (2f, FSCA).

**Discussion.** The adults are structurally very similar to *S. fieldi* Tillyard. The wing pattern is similar to *S. fieldi* but that species has many more dark brown markings especially in the basal half of the wing. The antennae of both species are identical in length and lack of apical club. The tibial spurs are longer than in *S. fieldi*.

***Stenoleon fieldi* Tillyard**

(Figures 35, 36, 37, 83, 84)

*Stenoleon fieldi* Tillyard 1916: 60. **Holotype male**, Tennant's Creek, Northern Territory, Nov. 1906, J. Field (BMNH).

**Further description:** New 1985c: 16.

**Description. Adult:** body 20 mm, forewing 20 mm, hindwing 19 mm. **Coloration:** body dark brown, face below antennae wholly pale yellow, above antennae dark brown; vertex brown, unmarked; antenna dark brown to black, flagellomeres with pale apices; pronotum dark grayish brown, indication of pale median line and broad grayish narrow pale border; wing venation mostly pale brown, anterior longitudinal veins darkened at crossvein intersections; forewing with extensive spotting in basal one-half (Figure 36); hindwing somewhat infumate along apical posterior border; pterostigma with dark basal spot; legs with femora dark brown, tibia irregularly dark brown; tarsus with apices of segment dark brown. **Structure:** antenna as long as one-half length of forewing, filamentous without club; pronotum longer than broad; wings slender (Figure 36); legs slender, distal tarsomere about twice as long as basitarsus; tibial spurs slender, reaching almost to apex of tarsomere II; foretibial spurs reach to about apex of tarsomere I; male with deep ectoproct; sternite IX long; gonarcus broadly rounded, short, mediuncus slender, parameres with anterodorsal flange.

**Larva:** head somewhat longer than wide, with prominent dorsal median dark brown stripes, ventral side nearly all pale brown except for anterior dark brown spot (Figure 84); mandibular middle tooth reddish brown, slightly shorter than distal tooth; mesothoracic spiracle nearly sessile; abdomen with abundant dark brown areas mostly limited to midline.

**New records.** AUSTRALIA. **Western Australia:** 58 km. north Nanutarra, S21°, 59', 33", E 115°, 37', 49.1", 28 II. 1994, R. Miller & L. Stange (**reared**) (1m, FSCA); 126 km. north Nanutarra, S21°, 35', 36.4", E 115°, 56', 33", 28. II. 1994, Miller & Stange (1f, FSCA).

**Discussion.** The pale larvae appear similar to the larvae of *Xantholeon* and inhabit a similar microhabitat in cave mouths although in more lighted microhabitats (Zone 1; 2A). The larvae spun their cocoons in February or March and the adults emerged about 42 days later.

***Stenoleon xanthopus* Miller and Stange, new species**

(Figures 38, 39, 40)

**Holotype female**, 30 km. west Pentland, Queensland, Australia, II.XII. 1989, R. Miller. (ANIC).

**Diagnosis.** Antenna shorter than one-half length of forewing with a small but distinct club.

**Description. Holotype female:** length from head to tip of abdomen 24 mm, forewing and hindwing 25 mm long **Coloration:** dark brown; vertex nearly all dark brown with paler brown scars; face pale brown except for dark brown interantennal area; mouthparts pale brown with some dark brown on stipes; scape, pedicel and most flagellomeres dark brown with pale apex; pronotum dark brown with narrow median pale stripe and submedian pale stripe; nota and pleura mostly dark brown, limited pale brown on transcutal carina, scutellum posteriorly, metanotum anteriorly; forecoxa brown posteriorly, pale brown mesally; other coxae mostly dark brown; trochanter pale brown; femora dark brown except for base; foretibia mostly dark brown with some pale brown areas near middle; midtibia and hindtibia mostly pale brown with dark brown band subbasally and broad dark brown apex, setal bases with large dark brown areas around base; tarsus dark brown except for basal half of basitarsus and distal tarsomere; wings unmarked except some distal spots on forewing, marginal dark streak near apex of hindwing; stigma dark brown; wing veins mostly dark brown with pale brown areas, subcostal vein with nearly equal alternating dark brown and pale brown areas; middle field of venation toward apex mostly pale brown; abdomen dark brown with narrow pale brown posterior margins on tergites. **Chaetotaxy:** head and

antennae with short setae except frons with many long, erect pale brown setae; mesonotum with five outstanding white setae submedially near middle, mesoscutellum with several white, erect setae; abdomen with short setae, those on sternites longer; forecoxa with mat of porrect white setae mesally, longer and more erect white setae posteriorly; femora and tibiae with many long black and white bristles; female terminalia without evident digging setae. **Structure:** vertex weakly elevated; antenna elongate, about one-fifth length of wing, with about 45 flagellomeres; basal flagellomeres longer than wide, more distal ones about as long as broad until club which is about twice as broad as flagellum; distal palpomere of labium weakly swollen, oval palpimaculum near center; interantennal distance less than width of scape; interocular distance about twice the greatest diameter of eye; ocular rim with few short setae projecting over eye; pronotal shield about as long as greatest width; scutellum flat, not raised; forefemur subcylindrical, swollen near basal one-third, about seven times longer than greatest diameter, about equal in length to foretibia; midfemur cylindrical, about seven times longer than greatest diameter, a little shorter than forefemur, hindfemur and midtibia; tibial spurs of foreleg reaches to apex of tarsomere II, those of midleg and hindleg extend to about middle of tarsomere II; basitarsus of foreleg about three times longer than greatest diameter, that of hindleg about five times longer than greatest diameter; distal tarsomere of foreleg about as long as other tarsomeres together; distal tarsomere of other legs shorter than other tarsomeres together; pretarsal claws about one-half length of tibia spurs and about one-third length of distal tarsomere; forefemoral sense hair about five times longer than femur diameter at point of attachment, longer than midfemoral sense hair; abdomen shorter than wing length, third tergite about three times longer than tergite II and about twice as long as width.

**Male:** unknown.

**Paratypes.** AUSTRALIA. **Queensland:** 30 km. west Pentland, 11.XII. 1989, **reared**, R. Miller (2f, ANIC, FSCA).

**Discussion.** Larvae were found in white dust in a cave mouth. The adult looks like *S. cingulatus* New in size, color, structure, the form and markings of the wings and in other particulars but differs from that species by the much shorter antenna with a small but evident club. Also, the femoral sense hair is longer in *S. xanthopus*.

**Etymology.** The specific name refers to the fact that the larva looks like those of *Xantholeon* and lives in the same type of habitat.

### ***Xantholeon* Tillyard**

*Xantholeon* Tillyard 1916: 61. **Type species:** *Xantholeon helmsi* Tillyard, by original designation.  
= *Cataleon* Navás 1933: 34. **Type species:** *Cataleon gratiosus* Navás, by original designation (after New 1985c: 10).

**Further description:** New 1985c: 10.

**Diagnosis. Adult:** pale brown coloration; antenna long with usually well developed club; wings tapered, sometimes slightly falcate; no Banksian lines; female anterior gonapophyses absent; female posterior gonapophyses moderately long, slender; female ectoproct and lateral gonapophyses with thickened setae; male sternite IX broad and rounded; male parameres angled anteriorly, not hooked; male ectoproct without postventral lobe..

**Description. Adult:** body 20-24 mm, forewing 23-32 mm, hindwing 24-31 mm. **Coloration:** pale brown to yellowish colored species. **Structure:** antenna long with well developed club; wings tapered, sometimes slightly falcate, without Banksian lines; forewing about as long as the hindwing which is longer than abdomen; forewing radial sector arises beyond cubital fork; forewing CuP + 1A reaches to posterior wing border opposite or before origin of radial sector; forewing vein 2A either strongly angled and connected to vein 1A by short crossvein or is curved toward hind margin; hindwing radial sector arises basal

to medial fork; legs slender; tibial spurs longer than basal tarsomere; male ectoproct broad and rounded; gonarcus various; parameres dorsally angled anteriorly, not strongly hooked; female terminalia without anterior gonapophysis, posterior gonapophysis moderately long and slender; pregenital plate small.

**Distribution:** only Australia.

**Biology.** The larvae are found in Zone 4B in the back of the cave in relatively shallow sand so that they can anchor themselves to the bedrock. The larvae are covered with sand or dust except usually for protruding mandibles and may move about from time to time. In this zone, light is lower, air currents are less and the humidity is usually higher. They co-exist with larger larvae of *Eophanes falcatus* which probably feed on them as well as the less common *Escura nigrosignata*.

**Discussion.** There are ten species currently recognized in this genus, eight of which were reared from larvae. All the species are pale colored and probably all of the larvae live under rock overhangs or cave mouths. There are two groups of species and are unusual in the tribe in that some species have the strongly angled forewing 2A that is characteristic in the tribe but a few species (helmsi group) have the forewing vein 2A curved toward the hind margin. The helmsi group consists of five species (*X. helmsi*, *X. manselli*, *X. kakadu*, *X. pallens*, and *X. pentlandensis*). The helmsi group has the forewing vein 2A curved toward hind margin (Figure 55) and the hind basitarsus is at least as one-half as long as the distal tarsomere (Figure 56). The lineatus group has forewing vein 2A strongly angled and connected to vein 1A by a short crossvein (Figure 52) and the hind basitarsus is less than one half the length of the distal tarsomere (Figure 50). This group includes *X. cavernicolus* n. sp., *X. montanus* New, *X. lineatus* New, *X. newi* n. sp., and *X. xadnus* New. The larvae are all morphological similar with minor differences in markings and differ from the similar *Stenoleon* by their shorter antenna.

### Key to species of *Xantholeon*

#### Adults

1. Forewing vein 2A connected to 1A by short cross vein, then strongly angled toward hind margin (Figure 51); hind basitarsus shorter than one half length of distal tarsomere (except *X. newi*) (lineatus group) ..... **2**
- Forewing vein 2A curved toward hind margin, not connected to 1A by cross vein (Figure 58); hind basitarsus at least one half as long or longer than distal tarsomere (helmsi group) ..... **6**
- 2(1). Forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more crossveins (Figure 52) ..... **3**
- Forewing without extended cubital mark (Figure 64) ..... **4**
- 3(2). Central abdominal tergites with small median dark brown mark clearly anterior to lateral marks; abdominal sternites pale; Western Australia ..... ***X. montanus* New**
- Central abdominal tergites with median dark brown mark extending between lateral marks; abdominal sternites partially darkened; Queensland ..... ***X. lineatus* New**
- 4(2). Forewing with several conspicuous dark brown spots near apex (Figure 64); forefemoral sense hair about three times as long as femur diameter at point of origin; Western Australia ..... ***X. xadnus* New**
- Forewing without conspicuous dark brown spots (Figure 42); forefemoral sense hair about four times as long as femur diameter at point of origin ..... **5**
- 5(4). Hind basitarsus less than one-half length of distal tarsomere; abdominal tergite III without distinct dark bands, somewhat variable but usually with a dark stripe medially; wing relatively broad (Figure 42); Northern Territory; Queensland ..... ***X. cavernicolus* n.sp.**

- Hind basitarsus more than one-half length of distal tarsomere; abdominal tergite III with distinct dark brown band at anterior end and near base; wings relatively narrow (Figure 56); Queensland ..... ***X. newi* n. sp.**
- 6(1). Forefemoral sense hair less than twice as long as diameter of femur at point of origin ..... ***X. pallens* n.sp.**
- Forefemoral sense hair more than two times as long as diameter of femur ..... **7**
- 7(6). Hind basitarsus as long as or longer than distal tarsomere ..... **8**
- Hind basitarsus shorter than distal tarsomere ..... **9**
- 8(7). Posterior half of abdominal tergites dark brown or gray; female posterior gonapophysis weakly tapered; male sternite IX with many pale setae posteriorly ***X. helmsi* Tillyard**
- Posterior half of abdominal tergite III-IV pale; female gonapophysis strongly tapered; male sternite IX without pale setae posteriorly ..... ***X. manselli* New**
- 9(7). Midfemoral sense hair a little more than twice as long as femur diameter; body pale, vertex with anterior vertex brown row most prominent; forewing without dark brown spots near apex (Figure 61); female posterior gonapophysis short, about as long as wide, sternite VIII with a few elongate setae; Queensland ..... ***X. pentlandensis* n. sp.**
- Midfemoral sense hair about three times as long as femur diameter; body with considerable brown coloration, especially pronotum and scutelli (Figure 46); vertex with middle brown row most prominent; forewing with several dark brown spots toward apex; female posterior gonapophysis about 2.5 times as long as greatest diameter; sternite VIII with many setae; Northern Territory ..... ***X. kakadu* n. sp.**

### Larvae

1. Dorsal head capsule with prominent submedian marks extending posteriorly from central head capsule; mandible brown or dark brown (Figure 89) ..... **2**
- Dorsal head capsule without prominent submedian marks extending posteriorly from central head capsule or marks interrupted medially; mandible straw colored (Figure 93) ..... **4**
- 2(1). Mesothoracic spiracle not borne on long stalk (Figure 89); Western Australia ..... ***X. montanus* New**
- Mesothoracic spiracle borne on long stalk (Figure 87); Northern Territory; Queensland ..... **3**
- 3(2). Abdomen well marked dorsally (Figure 85); mandible brown ..... ***X. cavernicolus* n. sp.**
- Abdomen poorly marked (Figure 88); mandible dark brown ..... ***X. kakadu* n. sp.**
- 4(1). Central dorsal head capsule entirely pale brown (Figure 93) ..... ***X. pentlandensis* n. sp.**
- Central dorsal head capsule with prominent submedian dark brown markings but not reaching to posterior area of head capsule (Figure 91) ..... ***X. pallens* n. sp.**

### lineatus group

**Diagnosis. Adults:** forewing vein 2A connected to 1A by short cross vein, then strongly angled toward hind margin (Figure 42); hind basitarsus usually shorter than one half length of distal tarsomere.

**Larva:** dorsal head capsule with prominent submedian marks extending posteriorly from central head capsule; mandible brown or dark brown.

### *Xantholeon cavernicolus* Miller and Stange, new species

(Figures 41, 42, 43, 85, 86)

**Holotype male**, Kings Canyon, Northern Territory 22.XI.1989, R. Miller, **reared** (ANIC).

**Diagnosis. Adult:** forewing without conspicuous dark brown spots (Figure 42); forefemoral sense hair about four times as long as femur diameter at point of origin.

**Description. Holotype male:** length of body 24 mm, forewing 27 mm, hindwing 26 mm. **Coloration:** general coloration yellowish brown; labrum, clypeus, genae and palpi pale yellow; narrow, transverse dark brown band below antenna; anterior and middle areas of vertex with sublateral dark areas; antenna mostly pale except for darker brown club; pronotum yellowish brown submedial brown stripe on posterior one-half, sublateral area with dark spot on furrow and some dark brown posteriorly; lateral margin nearly all dark brown; mesoscutellum pale brown with median brown stripe mostly posteriorly, laterally brown on anterior two-thirds; metascutellum pale brown with broad median stripe posteriorly, sublateral area brown; mesopleuron and metapleuron dark, shiny brown anteriorly; legs pale yellow brown, apical margins of femur, tibia and tarsomeres dark brown; forewing without significant suffusion, small area at juncture of vein 1A and posterior fork of cubitus, rhexma, outer gradates; pterostigma without suffusion; venation with pale longitudinal veins, mostly black at intersections with crossveins which are mostly dark brown; abdomen mostly pale brown with irregular transverse dark brown stripe anteriorly and posteriorly on tergites I and II, tergite III with conspicuous bands but with dark brown stripe medially, most abdominal tergites dark brown laterally;; abdominal sternites and ectoproct pale brown. **Chaetotaxy:** legs with mostly dark brown bristles; short pale setae on abdominal tergites about equal to those on sternites; ectoproct with fairly long black setae posteriorly. **Structure:** antennae close together, not separated by more than scape diameter; labial palpus not swollen; vertex not domed, scarcely raised; antenna slender, flagellomeres mostly longer than wide, club well defined but narrow over last segments; pronotum somewhat wider than long; scutelli little swollen, mostly flat; legs long and slender, foreleg somewhat shorter than midleg which is somewhat shorter than hind leg; tarsus shorter than tibia, distal tarsomere longer than basitarsus which is longer than tarsomere II which is longer than tarsomeres III and IV; hind basitarsus less than one-half length of distal tarsomere; tibial spurs slender, nearly straight, extending to beyond apex of tarsomere 4 (foreleg), or 3 (midleg) or 2 (hindleg); pretarsal claws slender; forefemoral sense hair about four times as long as femur diameter at point of origin, longer than that of midleg; wing relatively broad, forewing longer than hindwing; forewing costal area narrow with cells longer than high; abdomen shorter than hindwing.

**Female:** About as described for male except for terminalia. Female posterior gonapophysis long, slender, tapered;

**Larva:** dorsal head capsule with prominent submedian marks extending posteriorly from central head capsule; mandible brown; mesothoracic spiracle borne on long stalk (Figure 88); abdomen well marked dorsally (Figure 86).

**Variation:** Length of body varies from 23 to 27 mm; forewing 25 to 29 mm; hindwing 24 to 28 mm. Color variation exists mostly on vertex which ranges from nearly all pale brown to having prominent anterior and middle spots or bands and pronotum with may have submedian and sublateral dark bands nearly complete; abdominal tergites vary as to extent of dark banding. Abdominal sternites vary from nearly all pale brown to having dark brown areas especially on sternite III.

**Paratypes. AUSTRALIA. Northern Territory:** Devil's Marbles, 4.XI.2005, L. Stange (1m, 1f, FSCA); Kings Canyon, Northern Territory, 22.XI.1989, R. Miller, **reared** (6m, 5f, CASC, FSCA; TAMU); Kuyunba Nature Reserve, near Pine Gap, Northern Territory, 20. XI.1989, R. Miller, **reared** (7m, 4f, ANIC, FSCA); Kings Canyon, 19.IX.2005, R. Miller & L. Stange, **reared** (1f, FSCA); Pine Gap, 22.XI.1989, R. Miller (1f, FSCA). **Queensland:** 37 km. west Pentland, 11. XII. 1989, R. Miller (1f, FSCA).

**Etymology.** The specific name is based on the cave dwelling larvae.

***Xantholeon lineatus* New**

*Xantholeon lineatus* New 1985c:12, figures 1113-1120 (abdominal tergite III; wings; male, female terminalia; male genitalia). **Holotype female**, Carnarvon Range, Queensland, Australia, XI.1944, Geary (AMSA).

**Description. Adult:** length of body 20 to 24 mm; forewing 28-32 mm, hindwing 26 to 31 mm. **Coloration:** pale yellow; face nearly all pale brown except for dark brown mandibles; frons with broad dark brown band; vertex with two medially interrupted transverse brown bands, these obsolete laterally; antennal flagellum pale yellow, club brown; pronotum pale with two sinuous narrow dorsolateral dark brown streaks diverging to dark posterior angles; longitudinal wing veins pale brown except at junctions with dark brown crossveins; forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more cross veins; hindwing with small rhegmal spot; central abdominal tergites with median dark brown mark extending between lateral marks; abdominal sternites partially darkened. **Chaetotaxy:** pronotum with pale setae; female ectoproct ventrally with about 7 or 8 thickened short setae; lateral gonapophysis with about eight similar setae. **Structure:** slender; antenna slender with most flagellomeres longer than wide; pronotum slightly longer than wide; legs long and slender, distal tarsomere longer than basitarsomere; tibial spurs slender, incurved at tip, extending to apex of tarsomere III; claws slender, short; male ectoproct large; genitalia with gonarcus rounded, mediuncus a slight median lobe, parameres simple, arched in profile but with distinct dorsal flange; female posterior gonapophysis long, slender, tapered; pregenital plate small, crescentic with median prominence.

**Distribution.** This species is only known from two females from the Carnarvon Range of Queensland.

**Discussion.** We did not find the larvae of this species but judging from the adult characters there is a high probability that the larvae live in caves. This species differs from others in the *lineatus* group by having the forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more cross veins except for *X. montanus* which has the sternites pale brown in contrast to the partially darkened sternites of *X. lineatus*.

***Xantholeon montanus* New**

(Figures 51, 52, 53, 89, 90)

*Xantholeon montanus* New 1985c: 13, figures 1121-1125. **Holotype female**, Mt. Bruce, Western Australia, 15.V.1980, T. Houston, in cave (WAMP).

**Description. Adult:** length of body 24 mm, forewing 27 mm, hindwing 26 mm. **Coloration:** yellowish brown; labrum, clypeus, genae and palpi pale yellow; frons dark brown below antennae, paler dorsally; vertex with traces of two darker brown transverse bands and three brown posterior spots and with small median and larger lateral brown areas; antenna yellowish brown, club dark brown to black externally; pronotum mostly dark brown, lateral margins pale yellow along anterior one-half; mesopleuron darker than metapleuron, without dark brown anteriorly; legs pale yellowish brown, apex of femur, tibia and tarsomeres light brown; abdomen tawny, anterior part of tergite I and II nearly black; tergites III and beyond with central short black streak on anterior half and paired lateral posterior streaks almost fusing anteriorly; ectoproct pale; abdominal sternites mostly pale brown except sternite I mostly dark brown; wing venation with pale longitudinal veins, mostly black at intersections with crossveins; costal crossveins pale except posterior ones in forewing; forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more cross veins; forewing without extended cubital mark; central abdominal tergites with small median dark brown mark clearly anterior to lateral marks. **Chaetotaxy:** femur with mostly pale bristles, tibia with more numerous black bristles; female ectoproct with about 6 thickened short, ventral setae; lateral gonapophysis with about 12 similar setae, ventral region of tergite IX with 5 or 6 setae. **Structure:** vertex domed, scarcely raised; antenna slender, club well defined but narrow over last 10 segments; pronotum a little longer than wide; legs long and slender, tarsus shorter than tibia; basal tarsomere about three times longer than middle diameter, about equal to tarsomeres II and III



together; distal tarsomere longer than basitarsus which is longer than tarsomere II which is longer than tarsomeres III and IV; hindtibial spurs slender, straight, extending to beyond apex of tarsomere 2; pretarsal claws slender; female posterior gonapophysis long, slender, tapered; pregenital plate triangular.

**New records.** AUSTRALIA. **Western Australia:** 126 km. north Nanutarra Roadhouse, S21°, 35', 36.4", E 115°, 56', 33", 26.II.1994, Miller & Stange (1m, 1f, FSCA); 37 km. east Pt. Hedland, S20°23' 34.6", E118°54' 27.5", 1.III.1994, Miller & Stange (A71) (1f, FSCA); Rio Tinto Gorge, S22°, 14', 7", E 117°, 57', 55.5", 5.II.1994, Miller & Stange (2m, FSCA); Witternoom, 4.III.1994, R. Miller & L. Stange (**reared**) (3m, 4 f, FSCA; TAMU; USMB).

**Discussion.** This West Australian species has the forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more cross veins (Figure 52) similar to *X. lineatus*. However, *X. montanus* has the abdominal tergites paler than *X. lineatus* and the sternites are mostly pale brown. The larvae differs from *X. cavernicolus* and *X. kakadu*. by having the mesothoracic spiracle not borne on long stalk (Figure 89). These three species have the ventral surface of the head capsule with extensive dark brown markings.

***Xantholeon newi* n. sp.**  
(Figures 54, 55, 56)

**Holotype male**, 30 km. west Pentland, Queensland, Australia, 11.XII. 1989, R. Miller (ANIC).

**Diagnosis. Adult:** hind basitarsus more than one-half length of distal tarsomere; forefemoral sense hair about four times as long as femur diameter at point of origin; wings relatively narrow, forewing without extended cubital mark or conspicuous dark brown spots; abdominal tergite III with distinct dark brown band at anterior end and near base.

**Description. Holotype male:** length of body 24 mm; forewing 23 mm; hindwing 24 mm. **Coloration:** general coloration light yellowish brown; labrum and clypeus light brown with dark brown areas; palpi pale brown; frons pale yellowish brown; vertex light brown and unmarked; epicranial mark dark brown; antenna yellowish light brown with club becoming darker brown; pronotum pale yellowish brown with submedian dark brown areas posteriorly and lateral dark brown spots at furrow; legs pale yellowish brown except for dark brown spots on central exterior face of midtibia and hindtibia; mesopleuron and metapleuron pale brown; forewing without extended cubital mark (Figure 56) and without conspicuous dark brown spots (Figure 56); wing venation pale brown with dark brown areas at junctures of many crossveins; abdomen very pale yellowish brown; tergite I with thin dark brown margin; tergite II darker brown at anterior one-half; abdominal tergite III with distinct dark brown central band and pale brown margins; sternites all pale brown except dark anterior area of sternite VI; ectoproct pale brown. **Chaetotaxy:** legs with mostly pale setae but a few black bristles present; short, pale bristles on tergites and sternites. **Structure:** pronotum about as long as wide (Figure 54); vertex weakly domed; antennae close together, closer than scape diameter; flagellomeres mostly longer than wide; antennal club weak; legs slender with midleg about as long as foreleg, but shorter than hindleg; tarsus shorter than tibia; basal tarsomere of hindleg about five times longer than diameter; distal tarsomere of hindleg about equal to basal tarsomere; forefemoral sense hair about four times as long as femur diameter at point of origin, longer than that of midleg; tibial spurs nearly straight, extending to beyond apex of tarsomere 3 (foreleg and midleg) or to tarsomere 2 (hindleg); wings relatively narrow.

**Female:** unknown.

**Paratypes.** AUSTRALIA. **Queensland:** 30 km. west Pentland, 11.XII.1989, R. Miller (**reared**) (2m, FSCA).

**Discussion.** Similar appearance to *X. xadnus* but with different abdominal markings and leg structure. Also, it can be separated from *X. xadnus* and *X. cavernicolus* by the much weaker development of the antennal club.

**Etymology.** This species is named for Timothy New who has contributed greatly to our knowledge of Australian antlions.

***Xantholeon xadnus* New**

(Figure 63, 64, 65)

*Xantholeon xadnus* New 1985c: 11, figure 1107-1112. **Holotype male**, 21 km. northeast Kalbarri, 12.xii.1971, McFarland (ANIC).

**Description. Adult:** length of body 23 mm, forewing 25 mm, hindwing 24 mm. **Coloration:** pale yellowish brown; labrum and clypeus pale; frons with broad dark brown to black band; vertex reddish in midline, red marks flanking two partial brown bands across central region; antennal flagellomeres pale, club with about 10 segments black; pronotum with much of central third suffused with longitudinal brown streaks, posterior border partially blackened, mostly dark brown laterally; mesopleuron about same color as metapleuron, with little dark brown anteriorly; abdomen predominantly pale brown, anterior of tergite II dark brown and irregular but uniform dark brown mark towards anterior of other tergites; wing with pale brown longitudinal veins except at intersections with crossveins which are black except near wing apices; forewing with dark mark at fusion of CuA2 and CuP + 1A which extends along 3 or more cross veins; forewing without extended cubital mark; legs pale except darkened apices of all segments. **Chaetotaxy:** labrum and clypeus with pale brown hairs; midfemur with long dark sense hair other femoral hairs pale; tibia with sparse outstanding black bristles; male ectoproct with fringe of long black hairs. **Structure:** slender; antenna slender with flagellar segments longer than wide, club well defined; pronotum slightly longer than broad, incipient transverse furrow; legs slender, foretibia longer than forefemur, other tibia about equal to femoral length; tarsus shorter than tibia; distal tarsomere longer than basitarsus and tarsomeres II-IV; spurs slender, incurved apically, extending to apex of tarsomere III; pretarsal claws simple, slender, about equal to basitarsus; male sternite IX bluntly rounded; genitalia with gonarcus deeply hooded, tapered posteriorly; parameres widely spaced anteriorly, with strongly developed dorsal flange.

**New records. AUSTRALIA. Western Australia:** 37 km. east Pt. Hedland, S20°23' 34.6", E118°54' 27.5", 1.III.1994, Miller & Stange (2m, 3f, FSCA); 70 km. north Mullewa, Talling Peak, S28°, 05', 36.8", E 115°, 38', 37.0", 23.III.1994, Miller & Stange (1m, 1f, FSCA).

**Discussion.** New regarded *X. xadnus* as very similar to *X. montanus* differing mainly on color patterns. However, he only saw one male of *X. xadnus* and one female of *X. montanus* whereas we have seen 7 specimens of *X. xadnus* and 12 specimens of *X. montanus* of both sexes. The forewing with dark mark at fusion of CuA2 and CuP + 1A extending along 3 or more cross veins (Figure 52) differs from *X. lineatus* and *X. cavernicolus*.

**helmsi group**

**Diagnosis. Adult:** forewing vein 2A curved toward hind margin, not connected to 1A by cross vein (Figure 49); hind basitarsus at least one half as long as or longer than distal tarsomere.

**Larva:** dorsal head capsule without prominent submedian marks extending posteriorly from central head capsule or marks interrupted medially (*X. kakadu*); mandible straw colored (except *X. kakadu*).

***Xantholeon helmsi* Tillyard**

(Figures 44, 45)

*Xantholeon helmsi* Tillyard 1916: 61, Figure 12 (drawing insect). **Holotype female**, Sydney, New South Wales, X.1909, Helms (BMNH).

=*Cataleon graciosus* Navás 1933: 35 (after New 1985c: 10). **Holotype**, Sydney, Luddermann (ZMHB).

**Further description:** Tillyard 1918: 118, figure 2 (wing venation); Esben-Petersen 1923: 589; Adams 1936: 25; New 1985c: 10, figures 1097-1106 (abdominal tergite III, wings; male, female terminalia, male genitalia); Martins-Neto and Vulcano 1989: 395, figure 14a (forewing).

**Description. Adult:** length of body 20 to 23 mm; forewing 25 to 28 mm, hindwing 25 to 27 mm. **Coloration:** pale yellow; vertex unmarked except sometimes for paired pale brown posterior spots; antenna with basal one-fourth of most flagellar segments brown; pronotum pale yellow, sometimes slightly brown medially; abdomen pale yellow with most of tergite II and posterior half of following tergites brown; wings very pale with many crossveins brown, some apical veins very slightly shaded; legs predominantly pale; apex of femur dark brown; tibia with near basal brown annulus and dark apex; apices of tarsal segments slightly brown; posterior half of abdominal tergites dark brown or gray; male sternite IX with many pale setae posteriorly. **Chaetotaxy:** forefemoral sense hair more than three times as long as diameter of femur; femur with long white hairs, hindfemur with some black bristles; tibia with a few long black bristles; male with two double rows of minute spicules between parameres and longer anterior ventral spicules; female posterior gonapophysis with long, slender setae. **Structure:** antenna slender, club moderately developed; pronotum longer than broad; tibial spurs long and slender, extending to apex of tarsomere III; pretarsal claws short, about one half length of distal tarsomere; hind basitarsus as long as or longer than distal tarsomere; male sternite IX broad, spatulate, genitalia with broad and short gonarcus, strongly extended ventrally; parameres large with, moderate dorsal flange; female posterior gonapophysis long and moderately slender, tapered to a point.

**Distribution.** AUSTRALIA. **Queensland:** Capricorn Island, Crow's nest (ANIC). **New South Wales:** National Park (FSCA); Belrose; Kenthurst, Narrabeen, Sydney (BMNH, ZMHB). **Victoria:** Chiltern (ANIC). (New 1985c: 11).

**Discussion.** Within the helmsi group, this species appears closely related to *X. manselli* especially in having the hind basitarsus at least as long as the distal tarsomere. However, both the male genitalia and female terminalia are quite different from those of *X. manselli*.

### ***Xantholeon kakadu* Miller and Stange, new species**

(Figures 46, 47, 87, 88)

**Holotype male**, Kakadu National Park, Northern Territory, 13.IX.2005, R. Miller & L. Stange (**reared**) (ANIC).

**Diagnosis. Adult:** forefemoral sense hair more than five times as long as diameter of femur. forewing without conspicuous dark brown spots; female posterior gonapophysis at least twice as long as greatest diameter; hind basitarsus shorter than distal tarsomere; sternite VIII with many setae.

**Description. Holotype male:** length of body 23 mm; forewing 29 mm; hindwing 29 mm. **Coloration:** general coloration pale brown; face pale brown except broad band below antennae; vertex with elongate anterior transverse band anteriorly interrupted medially, complete transverse dark band at middle which is the most prominent vertex mark, and with subbasal spot posteriorly; antenna pale brown ventrally, mostly light brown dorsally, except dark brown club, and dark basally; pronotum pale brown with many dark brown dots between submedial stripe which runs laterally at anterior margin and sublateral stripe which fades anteriorly but runs laterally at posterior margin; lateral margin mostly dark brown; mesoscutellum and metascutellum similar in coloration with broad sublateral bands at middle, pale anteriorly and posteriorly; mesopleuron and metapleuron about equal in coloration with narrow dark brown margin anteriorly; forewing without conspicuous dark brown spots; legs nearly all pale brown with faint dark brown apically on femur and tibia; abdomen mostly pale brown, tergite I nearly completely so, tergite II with median stripe at middle transected by dark brown stripe; tergite III with medial

stripe before anterior margin. **Chaetotaxy:** forefemoral sense hair about five times as long as diameter of femur; midfemoral sense hair about three times as long as femur diameter; most setae dark brown including leg setae and abdominal setae; sternite VIII with many setae. **Structure:** antenna long, more than 40 flagellomeres, most flagellomeres longer than wide; labial palpus not inflated; pronotum about as long as wide; scutelli mostly flat; hind basitarsus shorter than distal tarsomere; forewing costal area narrow with cells longer than high.

**Female:** posterior gonapophysis about 2.5 times as long as greatest diameter.

**Larva:** mandible dark brown, longer than head capsule; dorsal head capsule with prominent submedian marks extending posteriorly from central head capsule; mesothoracic spiracle borne on long stalk.

**Paratypes.** AUSTRALIA. **Northern Territory:** Bardedjilidji Walk, Kakadu National Park, 13.IX.2005, Miller & Stange (5m, 2 f, FSCA).

**Discussion.:** This species appears most similar to *X. pentlandensis* but lacks the conspicuous dark brown spot in the forewing of *X. pentlandensis*. Also, the posterior gonapophysis of *X. kakadu* is at least twice as long as greatest diameter which contrasts with *X. pentlandensis* where the posterior gonapophysis is about as long as wide. These two species differ from other known *Xantholeon* by having the forefemoral sense hair more than five times as long as diameter of femur in combination in having the hind basitarsus over one-half the length of the distal tarsomere

**Etymology.** This species is named after the type locality. This name is treated as a noun in apposition.

### *Xantholeon manselli* New

(Figures 48 49, 50)

*Xantholeon manselli* New 1985c: 13, figures 1126-1134. **Holotype female**, Carnarvon Mt., 80 km. north Injune, Queensland, M. Mansell (ANIC).

**Diagnosis. Adult:** length of body 24 to 27 mm; forewing 26 to 27 mm, hindwing 26 to 28 mm. **Coloration:** color pale grayish yellow; antenna yellowish brown, darker basally; club darker; labrum pale yellow, sometimes with minute central dark gray spot; clypeus predominantly black, with narrow median pale stripe; vertex predominantly pale, with narrow pale castaneous band, more extensive transverse posterior mark each side of midline; pronotum brown, traces of pale midline and of diagonal lines converging towards posterior midline; scutelli with weak brown markings; mesopleuron about same color as metapleuron with narrow dark brown margin anteriorly; abdomen with weak central darker brown markings on tergites, sternites dark brown; posterior half of abdominal tergites III-IV pale; wing with longitudinal veins pale, many crossveins black, pterostigma slightly differentiated in forewing with dark brown base; legs pale, with apex of femur, apex and annulus of tibia and apex of distal tarsomere with dark brown to black markings. **Chaetotaxy:** clypeus with long, dense white hairs; pronotum with short, pale setae, of which those anteriorly have dark bases; forefemoral sense hair more than three times as long as diameter of femur; leg setae mostly dark brown; male sternite IX without pale setae posteriorly; female ectoproct with about 6 short, ventrally thickened setae; female lateral gonapophysis with about 10 slightly thickened black setae, posterior gonapophysis with fringe of long pale hairs. **Structure:** antenna slender, most flagellomeres longer than wide, club well defined; pronotum longer than broad; wings slender, venation as in Figure 49; legs slender, hind basitarsus as long as or longer than distal tarsomere; tibial spurs slender, extending somewhat beyond apex of tarsomere II (foreleg and midleg), or to apex of hind tarsomere III; pretarsal claws about one-half length of tibial spurs; male ectoproct broad, gonarcus a shallow transverse arch, with enlarged ventrally directed lateral plates; parameres long, parallel, with a slight anteriodorsal angle, anterior membrane with short central setae; female lateral gonapophysis broad, posterior gonapophysis strongly tapered.

**New records.** AUSTRALIA. **Queensland:** Carnarvon Mt., 80 km. north Injune, Queensland, M. Mansell, **reared** (2m, FSCA; SANC); Crows Nest, Perseverance Dam, V. 1971 (1f, FSCA).

**Discussion.** The abdominal markings are distinctive with dark brown sternites. Male genitalia of *X. manselli* are unusual and the female posterior gonapophysis is distinctive in the group by being much longer and more tapered than in other species.

***Xantholeon pallens* Miller and Stange, new species**

(Figures 57, 58, 59, 91, 92)

**Holotype male**, Pilliga Nature Reserve, 34 km. north Coonabarabran, New South Wales, 3.XII.1989, R. Miller (**reared**) (ANIC).

**Diagnosis. Adult:** femoral sense hair about as long as femur diameter; foreleg about equal in length to midleg which is shorter than hindleg.

**Description. Holotype male:** length of body 19 mm, forewing 25 mm, hindwing 24 mm. **Coloration:** general color pale brown with sublateral dark brown spots on clypeus; interantennal mark dark band below and above antennae; antenna pale with small dark brown spot at apices, club dark brown laterally; vertex with sublateral dark brown spot at middle; double brown spots posteriorly and sublaterally; pronotum pale brown with complex dark stripes at anterior, submedian sublateral areas (Figure 57); wings as in Figure 58; abdomen pale brown with subanterior, medial and posterior brown bands, tergites VII to VIII with most of posterior margin dark brown. **Chaetotaxy:** most of body with short white setae; forecoxa posteriorly with elongate white bristles; femur and tibia with short setae (less than femur diameter), mostly white on femur and black on tibia; femoral sense hair about as long as femur diameter; ectoproct and sternite IX with elongate black setae. **Structure:** palpi not swollen; antenna with basal flagellomere longer than wide, others about as long as wide or wider than long distally, club moderately expanded with about 7 flagellomeres; vertex weakly raised; pronotum about as long as wide; foreleg about equal in length to midleg which is shorter than hindleg; hind basitarsus longer than distal tarsomere; hind basitarsus longer than distal tarsomere; tibial spurs extend to tarsomere II; abdomen shorter than wings; forewing slightly longer than hindwing; forewing with five presectoral crossveins, hindwing with one presectoral crossvein; hindwing posterior area higher than presectoral area.

**Female:** About as described for male except for the terminalia. Female posterior gonapophysis small, about as long as wide.

**Larva:** central dorsal head capsule with prominent submedian dark brown markings but not reaching to posterior area of head capsule (Figure 92); mandible straw colored; body (Figures 92, 93) with irregular light brown markings dorsally; mesothoracic spiracle borne on short stalk.

**Variation:** length of body 11 to 18 mm, forewing 22 to 27 mm, hindwing 21 to 26 mm. Femoral sense hair variable, sometimes indistinguishable, sometimes longer than diameter of femur.

**Paratypes. AUSTRALIA. New South Wales:** Pilliga Nature Reserve, 34 km. north Coonabarabran, New South Wales, 3.XII.1989, R. Miller (**reared**) (26m, 20f, AMSA; ANIC; FSCA; SAMA; TAMU).

**Discussion.** Within the helmsi group, the short (sometimes absent) forefemoral sense hair is distinctive.

**Etymology.** The specific name refers to the very pale coloration of the species.

***Xantholeon pentlandensis* Miller and Stange, new species**

(Figure 60, 61, 62, 93, 94)

**Holotype male**, 30 km. west Pentland, Queensland, 11.XII.1989, R. Miller (**reared**) (ANIC).

**Diagnosis. Adult:** body pale, vertex with anterior vertex brown row most prominent; forewing without dark brown spots near apex (Figure 61); forefemoral sense hair more about five times as long as diameter

of femur; midfemoral sense hair about twice as long as femur diameter; hind basitarsus shorter than distal tarsomere; female posterior gonapophysis short, about as long as wide, with a few elongate setae.

**Description. Holotype male:** length of body 22 mm, forewing 26 mm, hindwing 26 mm. **Coloration:** general color pale brown with sublateral dark brown spots on clypeus; interantennal mark dark band below and above antennae; antenna pale with small dark brown spot at apices, club dark brown laterally; vertex with anterior brown row most prominent, other dark brown spots; pronotum pale brown with complex dark stripes at anterior, submedian sublateral areas (Figure 60); wings as in Figure 61, forewing without dark brown spots near apex; abdomen pale brown with subanterior, medial and posterior brown bands, tergites VII to VIII with most of posterior margin dark brown. **Chaetotaxy:** forefemoral sense hair about five times as long as diameter of femur; midfemoral sense hair about twice as long as femur diameter. **Structure:** antenna long, more than 40 flagellomeres, most flagellomeres longer than wide; labial palpus not inflated; pronotum about as long as wide; scutelli mostly flat; hind basitarsus shorter than distal tarsomere; wings narrow, forewing costal area narrow with cells longer than high.

**Female:** female posterior gonapophysis short, about as long as wide; sternite VIII with a few elongate setae.

**Larva:** mandible straw colored, longer than head capsule; dorsal head capsule entirely pale brown; most of body (Figures 94, 95) pale brown; mesothoracic spiracle not borne on long stalk.

**Paratypes. AUSTRALIA. Queensland:** 30 km. west Pentland, 11.XII.1989, R. Miller (**reared**) (2m, 2f, FSCA); Burra Ridge, Dura Ridge, White Mountains National Park, 7.IX.2005, R. Miller & L. Stange (**reared**) (13m, 1f, FSCA; QDPC; TAMU); 21 km. south Flinders Highway, Slaty Creek, 9.IX.2005, R. Miller & L. Stange (**reared**) (1f, FSCA).

**Discussion.** Within the helmsi group, the short hind basitarsus (shorter than distal tarsomere), length of the midfemoral sense (little more than twice as long as femur diameter), and lack of prominent dark brown spots near apex of forewing are distinctive.

**Etymology.** This species is named after the type locality.

#### TRIBE MYRMELEONTINI LATREILLE 1802

**Description. Adult:** body size 14-44 mm, forewing 10 to 40 mm, hindwing 10 to 40 mm. **Structure:** antennal fossae separated by more than diameter of scape (except *Porrerus* Navás); forewing vein CuP originates at or very near (about cubital vein diameter) basal cross vein; forewing vein 2A variable in form; forewing vein 2A runs close to 1A for short distance, then bends at sharp angle toward 3A; hindwing vein CuA connected to posterior fork of MP2 by crossveins, with four or more presectoral crossveins; hindfemur without sense hair; tibial spurs and tarsal claws well developed, not arched or bent; ventral surface of distal tarsomere with all setae reduced to less than one-third width of tarsomere (except *Porrerus*); male pilula axillaris usually present; male abdomen without hair pencils; male ectoproct without postventral lobe (except *Porrerus*).

**Distribution:** Afrotropical; Palaearctic; Oriental; Australian; Nearctic; Neotropical.

**Discussion.** This tribe has many apomorphic wing venational characters. The radial sector arises well distad of the base and forewing vein 2A is strongly angled. Another apomorphy of the tribe is the extreme reduction in length of the setae on the ventral surface of the distal tarsomere which distinguishes the subtribe Myrmeleontina from the monobasic subtribe Porrerina. All the larvae reared to date representing the genera *Australeon* Miller and Stange, *Baliga* Navás, *Dictyoleon* Esben-Petersen, *Euroleon* Esben-Petersen, and *Myrmeleon* Linnaeus construct pitfall traps. Larvae can only move backwards except for one aberrant population of *M. punctinervis* Banks in Taiwan. The larvae are structurally nearly identical in all of these genera. *Myrmeleon* is the only cosmopolitan genus of the family found on all continents and many oceanic islands. However, no authenticated record of the tribe is known from Chile south of the Atacama Desert.

***Australeon* Miller and Stange, new genus**

**Type species:** *Myrmeleon illustris* Gerstaecker, by present designation. **Key to species:** New and Matsura 1993: 93-94. **Further description:** New 1985a: 8 (as *Callistoleon*).

**Biology:** Mansell 1988 (pitfall trap with side trenches); New and Matsura 1993 (pitfall traps with side trenches); Matsura and Kitching 1993 (data on trench building).

**Diagnosis.** Adult: ventral setae of distal tarsomere much shorter than diameter of tarsomere; legs long, hindcoxa longer than five times greatest diameter of coxa; distal tarsomere longer than basal four tarsomeres together; posterior gonapophysis about four times longer than middle diameter.

**Description. Adult:** body 24-33 mm, forewing 26-35 mm, hindwing 26-35 mm. **Structure:** antennae widely separated; vertex strongly raised; legs long, hindcoxa longer than five times greatest diameter of coxa; distal tarsomere slightly longer than basal four tarsomeres together; ventral setae much shorter than diameter of tarsomere; tibial spurs about equal in length to pretarsal claws; Banksian lines not indicated; hindwing with four or more presectoral crossveins; forewing with dark brown spots; hindwing weakly falcate, infumate along posterior border; female posterior gonapophysis about four times longer than middle diameter; anterior and lateral gonapophysis broad; male ectoproct without postventral lobe, gonarcus broad, mediuncus well developed.

**Larva:** labial palpus shorter than basal width of mandible; distance between base of mandible and basal tooth much greater than that between mandibular teeth (Figure 93); distance between base of mandible and basal tooth much greater than that between mandibular teeth (Figure 93); mesothoracic spiracle not borne on tubercle; head without dolichasters; mandible with some setae on outer lateral margin as long as or longer than greatest mandibular width (Figure 98); sternite VIII with pair of inconspicuous submedian teeth near posterior margin; legs long, hindcoxa longer than five times greatest diameter of coxa; pitfall traps with lateral trenches.

**Distribution.** Only Australia.

**Biology.** The pitfall characteristics of *A. illustris* and/or *A. manselli* have been observed by Mansell (1988), Matsura and Kitching (1993) as well as Miller (pers. obs., 1989). These larvae live in the humid, poorly lighted rear areas of the caves. They often construct side trenches which run downward to the center of the pitfall. The trenches become deeper as the center pitfall is approached. Matsura and Kitching (1993) found that the pitfall traps with trenches were more efficient in prey capture. However, if the larvae were well fed, they tended not to construct the trenches. Miller (1989) also observed *Australeon* larvae with simple pitfall traps. These larvae are very sensitive to high temperatures and low humidity which can produce death. The abundant ant fauna probably provide much of the food for the antlion larvae.

**Discussion.** This genus contains two species characterized by the abundant wing markings and previously were included in the genus *Callistoleon* Banks. However, the type species of *Callistoleon*, *Myrmeleon erythrocephalum* Leach, which also has conspicuous spotting of the wings, is otherwise a typical species of *Myrmeleon*. One diagnostic character of *Australeon* is that the legs of the larvae are long with the hindcoxa longer than five times greatest diameter of coxa. *Australeon* differs from *Myrmeleon* in having the distal tarsomere longer than the other tarsomeres together and also the female posterior gonapophysis is longer than is usually found in *Myrmeleon*. The larvae have longer legs than those of *Myrmeleon* with the hindcoxa longer than five times the greatest diameter of the coxa.

**Etymology.** This genus is restricted to Australia and hence the name is formed by combining Australia and the Greek word *leon* (lion). Gender masculine.

**Key to species of *Australeon***

1. Anterior margin of frons dark brown; posterior margin of wings moderately darkened toward apex (Figure 67); male mediuncus deep, parameres much shorter than gonarcus (New South Wales) ..... ***A. illustris* (Gerstaecker)**
- Anterior margin of frons pale yellow; posterior margin of wings scarcely darkened toward apex; male mediuncus shallow, parameres nearly as long as gonarcus (Queensland) ..... ***A. manselli* (New and Matsura)**

***Australeon illustris* (Gerstaecker), new combination**

(Figures 66, 67, 68, 97, 98)

*Myrmeleon illustris* Gerstaecker 1885: 92. **Holotype**, Sydney (EMAU).

**Taxonomy:** Esben-Petersen 1915: 62 (in *Callistoleon*). **Further description:** Gerstaecker 1888: 111; New 1985a: 9, figures 42-50 (wings; male, female terminalia, male genitalia); New and Matsura 1993: 95, figures 10-19 (wings; male, female terminalia; male genitalia; spermatheca).

**Description. Adult:** body length 30 to 33 mm, forewing length 30 to 33 mm, hindwing length 26 to 30 mm. **Coloration:** general coloration dark brown; palpi, labrum and clypeus tawny; clypeus sometimes slightly darkened posteriorly; frons dark brown to black; vertex dark brown, unmarked; antennae black, dorsal side of scape partly tawny; pronotum tawny orange, sometimes darkened medially; pterothorax and abdomen black; wing venation generally pale brown except where shaded, but with anterior longitudinal veins brown; markings variable, mostly grayish brown; apical hind margin fumose; forefemur tawny except apex, midfemur and hindfemur dark brown; tibia and tarsomere dark brown. **Chaetotaxy:** pronotum with mostly black setae; femur and tibia with few black bristles; female ectoproct with about 6 to 10 long thickened setae; lateral gonapophysis with dense thickened setae toward apex, shorter than gonapophysis; anterior gonapophysis with black setae. **Structure:** antenna slender, club gradually broadened; vertex domed; pronotum broader than long; wings slender and tapered; distal tarsomere longer than basitarsus; tibial spurs somewhat curved, extending almost to apex of tarsomere II; pretarsal claws about equal to tibial spurs; female ectoproct with distinct ventral lobe; lateral gonapophysis very broad; posterior gonapophysis long and slender; anterior gonapophysis broad; spermatheca small, coiled; male ectoproct broad, sternite IX tapered to narrow apex; gonarcus very broad and shallow, mediuncus broad and deep; parameres parallel, heavily sclerotized along inner edge and at apex, with strong dorsal flange anteriorly.

**Distribution.** New South Wales.

**New record.** AUSTRALIA. **New South Wales:** Pilliga Nature Reserve, 34 km. north Coonabarabran, New South Wales, 3.XII.1989, R. Miller (**reared**) (1m, 1f, 1 larva, FSCA).

**Discussion.** *Australeon illustris* is very close morphologically to *A. manselli* but has more slender wings which are more infumate posteriorly and also has genitalic differences. It differs notably in coloration having the anterior margin of the frons dark brown in contrast to the pale yellow anterior margin of the frons in *A. manselli*.

***Australeon manselli* (New and Matsura), new combination**

*Callistoleon manselli* New and Matsura 1993: 93, figures 1-9 (wings, male, female terminalia, male genitalia, spermatheca). **Holotype female**, Carnarvon, Queensland, Australia (**reared**) (ANIC).

**Biology:** Mansell 1988: 351-356, figures 1-6 (pitfall traps as *C. illustris*); Matsura and Kitching 1993: 77-84.



**Description. Adult:** body length 26 to 29 mm, forewing length 26 to 33 mm, hindwing length 26 to 32 mm. **Coloration:** vertex black, slightly paler along central length of epicranial sutures; posterior one-half of frons black, anterior one-half of frons and remainder of face tawny orange, central region pale gray; abdomen dark gray to black; wings with pale venation except subcosta dark brown at origins of costal crossveins and where enclosed in dark brown spots; spots variable, not reaching margins, generally distributed along radial area, cubital area and posterior area at middle; with small dark spots at rhegma and pterostigma; hindwing with dark brown spots mainly at pterostigma and rhegma; wings weakly fumose posteriorly. **Chaetotaxy:** female ectoproct with 3-4 thickened setae; lateral gonapophysis with about 8 long, moderately thickened setae; anterior gonapophysis with about 8 long moderately thickened setae that are as long as gonapophysis. **Structure:** pronotum broader than long; legs moderately sturdy, tibial spurs reach beyond tarsomere II; wings moderately broad; female with ectoproct ventrally lobed; lateral gonapophysis not conspicuously broad; posterior gonapophysis long, slender; anterior gonapophysis about as broad as lateral gonapophysis; male with broad ectoproct, sternite IX tapered; genitalia with broad gonarcus, apex transverse, mediuncus shallow; parameres with strong anterior flange, heavily sclerotized along inner and ventral sides.

**Distribution.** Queensland.

**Discussion.** The anterior region of the frons is pale yellow in *A. manselli* in contrast to the dark brown anterior frons of *A. illustris*. Also, the wings appear to be broader in *A. manselli* than in *A. illustris*. *Australeon manselli* has been found only at Carnarvon in Queensland.

### ***Myrmeleon* Linnaeus**

*Myrmeleon* Linnaeus 1767: 913. **Type species:** *Myrmeleon formicarius* Linnaeus, by original designation.

=*Myrmeleonellus* Esben-Petersen 1918: 17. **Type species:** *Myrmeleonellus pallidus* Esben-Petersen, by original designation. **Synonymy** by New 1985: 10.

=*Leptoleon* Esben-Petersen 1918: 17. **Type species:** *Leptoleon regularis* Esben-Petersen, by monotypy and original designation. **Synonymy** by New 1985: 10.

=*Callistoleon* Banks 1910: 42. **Type species:** *Myrmeleon erythrocephalum* Leach, by original designation. **New synonymy.**

**Diagnosis. Adult:** antennae widely separated; ventral setae of distal tarsomere much shorter than diameter of tarsomere; distal tarsomere shorter than basal four tarsomeres together; female posterior gonapophysis usually less than twice as long as middle diameter.

**Description. Adult:** body 15- 40 mm, forewing 12-48 mm, hindwing 11-38 mm. **Structure:** vertex slightly to moderately raised; antennae widely separated with well developed club; distal tarsomere shorter than basal four tarsomeres; wings narrow to moderately broad, sometimes tapered; posterior Banksian line in forewing usually strongly developed, anterior Banksian line usually absent; hindwing with four or more presectoral crossveins; tibial spurs about equal in length to pretarsal claws; male pilula axillaris usually present; female posterior gonapophysis variable in length, usually slender, typically less than twice as long as middle diameter; anterior gonapophysis rounded; male ectoproct without postventral lobe, sometimes broadened ventrally; gonarcus arched, mediuncus usually well developed.

**Larvae:** legs short, hindcoxa less than four times greatest diameter of coxa.

**Distribution.** Afrotropical; Palaearctic; Oriental; Australian; Nearctic; Neotropical.

**Biology.** There is considerable diversity in habitat. Larvae have been found in lizard holes, organic matter in tree holes, in wind or water deposited sand, under rock overhangs or in cave mouths. Nearly all are similar in morphology and habits. *Myrmeleon punctinervis* Banks from Taiwan can move for-

wards and some larvae living in fine organic matter in tree holes are unable to dig under sand similar to one Mexican species that lives in dermestid skins and bat guano dust.

**Discussion.** Several species of *Myrmeleon* larvae were found in caves but the majority of them died before pupating. The following localities had cave inhabiting *Myrmeleon*. **Queensland:** Burra Creek, White Mts.; 21 Km. South Flinders, Slaty Creek. **Northern Territory:** Kakadu National Park; Devils Marbles; Kings Canyon National Park; **New South Wales:** 34 km. north Coonabarabran. We are synonymizing *Callistoleon* Banks with *Myrmeleon* because the type species of *Callistoleon* Banks is only a rather colorful species of *Myrmeleon*. The larvae of *C. erythrocephalum* build ordinary pitfall traps usually in the open and the legs and hindcoxae are shorter as is typical for the larvae of *Myrmeleon*.

***Myrmeleon pallidus* (Esben-Petersen)**

(Figures 69, 70, 71, 99, 100)

*Myrmeleonellus pallidus* Esben-Petersen 1918: 17. **Holotype female**, Kimberley District, Western Australia, II, Mjöberg (NHRS)

**Taxonomy:** New 1985a: 26 (in *Myrmeleon*). **Further description:** New 1985a: 26, figures 208-214 (wings, male, female terminalia, male genitalia, spermatheca).

**Description. Adult:** length of body 17-20 mm, forewing 18-21 mm, hindwing 16-19 mm. **Coloration:** body pale brownish with reddish brown markings; face and palpi not darkened; frons and lower vertex slightly darker brown; antenna beyond scape dark tawny brown, apex paler; pronotum with two broad reddish brown stripes narrowly separated medially, together pale yellow; vertex with posteriolateral polished brown spot; abdomen with tergites I, II rarely III with narrow pale median stripe, otherwise dark tawny brown; wings unmarked except for weakly indicated cream pterostigma; longitudinal veins pale; legs pale; apex of tibia and distal tarsomere narrowly darkened. **Chaetotaxy:** clypeus with few long black hairs; pronotum with white hairs; femur and tibia with sparse lack bristles; female ectoproct with about eight short thickened black setae; lateral gonapophysis with about 15 thickened setae, membrane with few hairs. **Structure:** slender; antenna slender, club moderately developed; pronotum slightly longer than broad; legs slender, relatively short; tibial spurs slender extending beyond apex of distal tarsomere; pretarsal claws about equal in length to tibial spurs; male pilula axillaris absent; female ectoproct broad; posterior gonapophysis short and very slender; anterior gonapophysis small, below tergite VIII which has sclerotized bars; male ectoproct slender; gonarcus arms slender, apex rounded; mediuncus a small apical hook; parameres deep, narrow, tapered and convergent posteriorly

**Distribution.** Western Australia.

**New records.** AUSTRALIA. **Northern Territory:** Alice Springs, 19.XI. 1989, R. Miller, **reared** (1m, FSCA); 12 km. north Alice Springs, 19.XI.1989, Miller **reared** (1f, FSCA); 146 km. north Alice Springs, 17.XI.1989, Miller, **reared** (1m, 1f, FSCA); Devil's Marbles, 4.XI.2005, L. Stange, **reared** (2f, FSCA; TAMU); 16 km. east Renner Springs, 19.XI.1989, Miller, **reared** (1m, FSCA); 20 km. north Renner Springs, 17.XI.1989, Miller, **reared** (3m, 2f, FSCA). **Western Australia:** Hackett Creek, 38 km. north Mullewa, 24.II.1994, Miller and Stange, **reared** (1f, FSCA); 37 km. east P. Hedland, S20°23' 34.6", E118° 54' 27.5", 1.III.1994, Miller and Stange (1f, FSCA); 20 km. north Laverton, 7.III.1994, Miller and Stange (1f, FSCA); 20 km. north Meekatharra, S26°25', 22.7" E118°35'25.6", 9.III.1994, Miller & Stange, **reared** (2f, FSCA).

**Discussion.** This pale species is separable from most other *Myrmeleon* by the two nearly complete submedian pronotal stripes (Figure 69). Also, the male pilula axillaris is absent but usually present in other species of *Myrmeleon*.

## TRIBE ACANTHACLISINI NAVÁS 1912

Tribe Acanthaclisini Navás 1912:40

**Further description:** Stange and Miller 1985: 29 (larvae); New 1985c: 53. **Keys to genera:** (Adults and larvae) Stange and Miller 1985: 31. **List of species:** Stange 2004: 340-363 (100 species).

**Distribution:** Afrotropical; Palaearctic; Oriental; Australian; Nearctic; Neotropical.

**Description. Adult:** body 16- 50 mm, forewing 20-50, hindwing 20-50 mm. **Chaetotaxy:** with long hair on pronotum, forefemur, and elsewhere; closing face of femora with many short, black spines, that of tibiae with small, fine hair. **Structure:** tibial spurs thick, strongly curved or bent, sometimes with flange; pretarsal claws thick with subbasal process, usually strongly curved or bent (except *Phanoclis*); forefemur, midfemur and sometimes hindfemur with 1 or 2 elongate sensory hairs; forewing vein CuP short; forewing with vein 2A running close to 1A basally, then strongly curved toward 3A; hindwing with 3 or more presectoral crossveins; hindwing vein CuA fuses with posterior fork of MP<sub>2</sub> some distance from fork or connected by short cross vein (*Paranthaclis*); male pillula axillaris well developed; male abdomen with pair of eversible sacs (usually bearing long setae) between segments VI and VII; female posterior gonapophysis clubbed-shape with long spines.

**Larva:** labial palpus shorter than basal width of mandible; distal palpomere less than twice as long as wide; mandible with 1, 2, but usually 3 teeth, when three teeth present, basal one shorter than distal one; lateral margin of mandible without long hairs; mesothoracic spiracle not borne on tubercle; scoli absent; dolichasters absent; abdominal sternite VII without submedian tooth; sternite IX broadly rounded posteriorly, much wider than long, without fossoria.

**Discussion.** This tribe is well defined in both adults and larvae (Stange and Miller 1985). Most of the species are large, robust and very pilose. Larvae do not construct pitfall traps, but a few genera (*Vella* Navás, *Phanoclis* Banks) contain species that move only backwards. The hindwing venation is distinctive (except *Paranthaclis* Banks) in having the vein CuA uniting with MP<sub>2</sub> shortly after the latter's origin. Pretarsal claws and tibial spurs are well developed, and in some genera the tibial spurs are strongly angled and with a tooth. Sometimes this tribe has been given subfamily status (New 1985). Hair pencils are found in all species except *Arcuaplectron woocallensis* New and *Paranthaclis nevadensis* Banks. At least two species of this tribe were found in caves. Unfortunately only one species was successfully reared and identified as *Heoclis fulva* (Esben-Petersen). The other species is probably a species of *Heoclis* or perhaps another genus such as *Cosina* Navás.

### *Heoclis* Navás

*Heoclis* Navás 1923: 12. **Type species:** *Myrmeleon fundatus* Walker, by original designation.

**Further description** New 1985c: 54. **Keys to species:** Esben-Petersen 1915: 58; Kimmins 1939: 591; New 1985: 54. **Biology:** Stange and Miller 1985: 35, figures 11, 17, 25 (larva).

**Description. Adult:** body 23-55 mm, forewing 25-74 mm, hindwing 25-72 mm. **Structure:** distal palpomere of labium elongate with a long slit-like palpimacula; tibial spurs gently curved; hindfemur without elongate sensory hair; forewing costal area broad and two-celled from near base; radial sector in about same relative position to cubital fork (forewing) medial fork (hindwing) in both wings; hindwing with hypostigmatic cell more than seven times longer than high.

**Larva:** anterior margin of clypeal-labrum weakly sinuate, slightly emarginate at middle; antenna longer than basal width; distal palpomere about 2.5 times longer than wide; mandible with three teeth, broadened at level of tooth 1, distance between tooth 1 and 3 greater than greatest mandibular width; long setae on exterior margin of mandible extend to about tooth 1, longest setae about one-fourth greatest mandibular width; head without dolichasters, ventral surface glabrous except laterally; abdomen

with long, black hair-like setae on sternites I-VII, sternites VIII and IX without short, peg-like setae but short, pointed setae present; sternite IX broadly rounded.

**Distribution.** Australia and possibly Oriental.

**Biology.** The larvae of *Heoclisis* have been found both in Zone 1 and Zone 3 as well as in open sand tracts. Zone 3 is represented by any area on the floor of the cave which is rain and sun protected and large and deep enough to support the roaming activities of large antlion larvae. The large *Heoclisis fulva* exclude species from the other zones by eating them. *Heoclisis* larvae found in Zone 1 have not been identified to species. Zone 1 is made up of substrate originating from the cave or rock overhang and is exposed to the sun, high temperatures, and rainfall. Species in this zone can handle outside conditions. Larvae do not construct pitfall traps and can move both forwards and backwards.

**Discussion.** Eight species are known from Australia and are among the largest species of antlions in Australia.

### *Heoclisis fulva* (Esben-Petersen)

(Figures 95, 96)

*Acanthaclisis fulva* Esben-Petersen 1912: 269. **Holotype female**, North Queensland (ZMUC).  
=*Acanthaclisis peterseni* Tillyard 1916: 66. **Holotype female**, Cooktown, Queensland, I. 1908, R. Tillyard (BMNH), after New 1985c: 57.

**Description. Adult:** length of body 45 to 55 mm; forewing length 53 to 74 mm, hindwing length 48 to 76 mm. **Coloration:** body and wings yellowish brown; antenna and face yellowish brown; abdomen yellow brown with each tergite with a pair of posterior black patches, midline irregular and narrowly black; wing venation yellowish brown, many intersections dark brown; legs with femur pale brown, tibia with one or two dark brown bands; apices of tarsomeres sometimes slightly darkened, sometimes tarsomere II to IV mostly dark brown. **Chaetotaxy:** face with white hairs, vertex with short black hairs; pronotum with dorsal hairs black, lateral setae white; thorax with mostly with white setae; femur and tibia with white hairs; male ectoproct with dorsal setae thickened; female with lateral gonapophysis with about six long thickened black setae. **Structure:** antenna with club moderately developed; pronotum longer than broad; wings very broad, somewhat falcate; legs short and stout, distal tarsomere about equal to other tarsomeres measured together; tibial spurs deep and strongly arched, extending about to apex of tarsomere III; pretarsal claws simple slightly shorter than tibial spurs; male with ventral expansion of ectoproct very long; sternite IX short; gonarcus short, with broad transverse apex; mediuncus a long slender dorsal spine; parameres broad with inner setose sclerotized rim and small ventral hooks; female with relatively short posterior gonapophysis. **Larva: Coloration:** body pink colored. **Chaetotaxy:** mandible with longest setae on lateral margin less than one-half greatest mandibular width (Figure 95); head without dolichasters. **Structure:** labial palpus shorter than basal width of mandible; mesothoracic spiracle not borne on tubercle; sternite VIII without teeth on subapical margin.

**New records.** AUSTRALIA. **Northern Territory:** 16 km. south Renner Springs, 19. II. 1989, R. Miller (**reared**) (1f, FSCA). **Queensland:** Slaty Creek, 21 km south Flinders Highway, 9. IX. 2005, R. Miller, & L. Stange (**reared**) (1m, FSCA).

**Discussion.** This is the largest species of *Heoclisis* in Australia and is yellowish brown. The larvae live in Zone 3 which consists of deep sand in the center part of the cave and is protected from sunlight and rainfall. The pinkish larvae probably feed on other antlion larvae. Pinkish larvae were found in caves at the following localities: **Queensland:** Burra Creek, White Mts.; 21 Km. south Flinders, Slaty Creek. **Northern Territory:** Kakadu National Park; 16 km. south Renner Springs, 19. II. 1989. At Slaty Creek and Kakadu National Park, two species of larvae (1 dark colored, the other pink) were found together.

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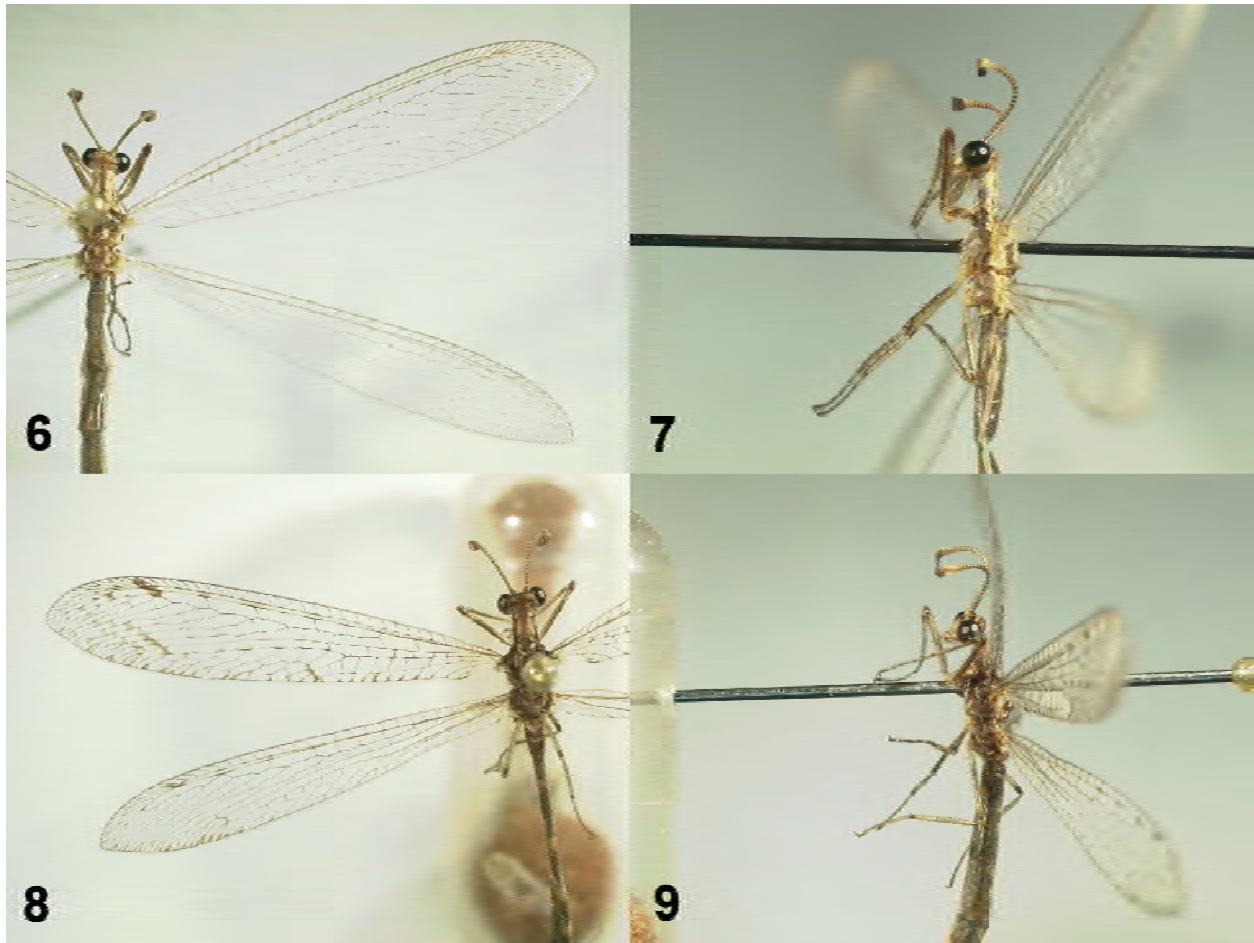
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**Figures 2-5.** *Froggattisca* spp. **2-3)** *Froggattisca anicis* New. **2)** Adult body and wings. **3)** Adult legs. **4-5)** *Froggattisca kakadu* Miller and Stange. **4)** Side view female. **5)** Adult legs.



**Figures 6-9.** *Froggattisca* spp. **6-7)** *Froggattisca rennerensis* Miller and Stange. **6)** Dorsal view, adult body and wings. **7)** Adult legs. **8-9)** *Froggattisca tipularia* (Gerstaecker). **8)** Dorsal view, adult body and wings. **9)** Adult legs.

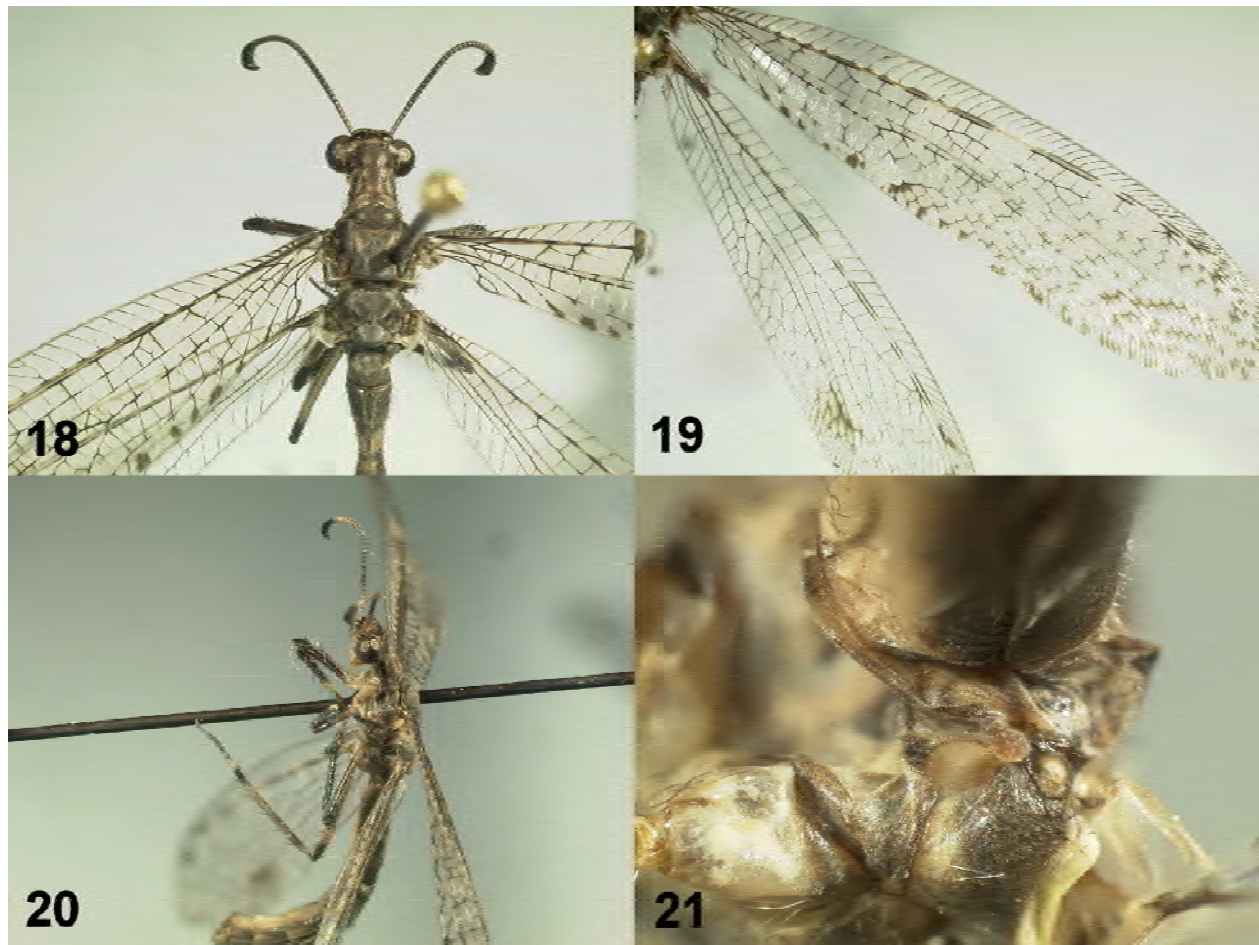




**Figures 10-13.** *Newleon fragilis* Miller and Stange. 10) Dorsal view, adult body and base of wings. 11) Adult legs. 12) Adult wings. 13) Female terminalia.



**Figures 14-17.** *Speleon cavernicolus* Miller and Stange. **14)** Dorsal view, adult body. **15)** Adult wings. **16)** Adult legs. **17)** Close-up of Miller's organ on sternite I.



**Figures 18-21.** *Speleon pilliga* Miller and Stange. **18)** Dorsal view, adult body and base of wings. **19)** Adult wings. **20)** Adult legs. **21)** Close-up Miller's organ on sternite I.



**Figures 22-25.** *Speleon yallingup* Miller and Stange. **22)** Dorsal view, adult body and base of wings. **23)** Adult wings. **24)** Adult legs. **25)** Female terminalia.

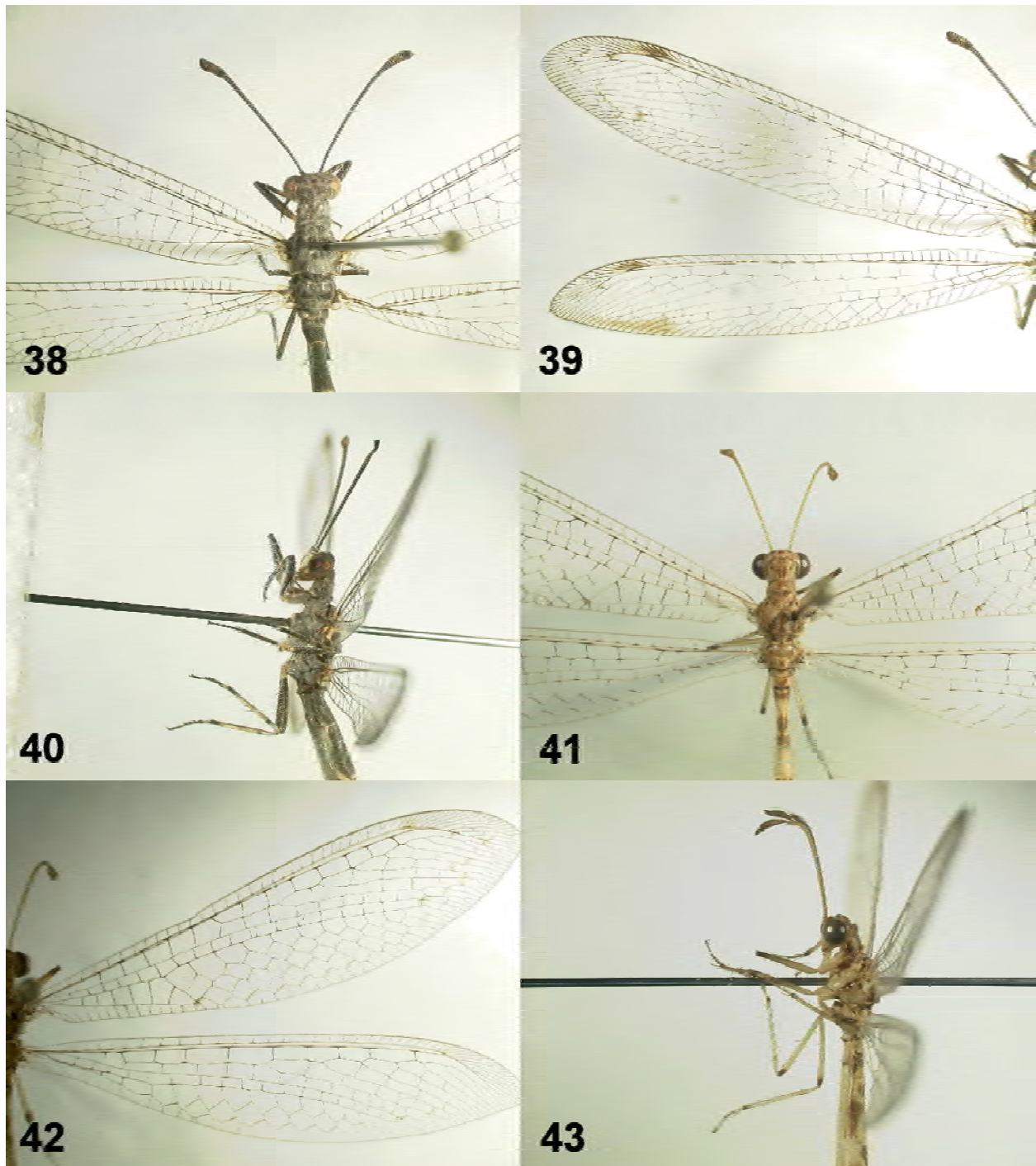




**Figures 26-31.** Adults. **26-28)** *Eophanes distincta* Banks. **26)** Close-up of body and base of wings. **27)** Adult wings. **28)** Adult legs. **29-31)** *Escura nigrosignata* (Tillyard). **29)** Dorsal view, adult body and base of wings. **30)** Adult wings. **31)** Adult legs.



**Figures 32-37.** *Stenoleon* spp. **32-34)** *Stenoleon cingulatus* New. **32)** Dorsal view, adult head, thorax, base of wings. **33)** Adult wings. **34)** Adult legs. **35-37)** *Stenoleon fieldi* Tillyard. **35)** Dorsal view, adult head, thorax, and base of wings. **36)** Adult wings. **37)** Adult legs.



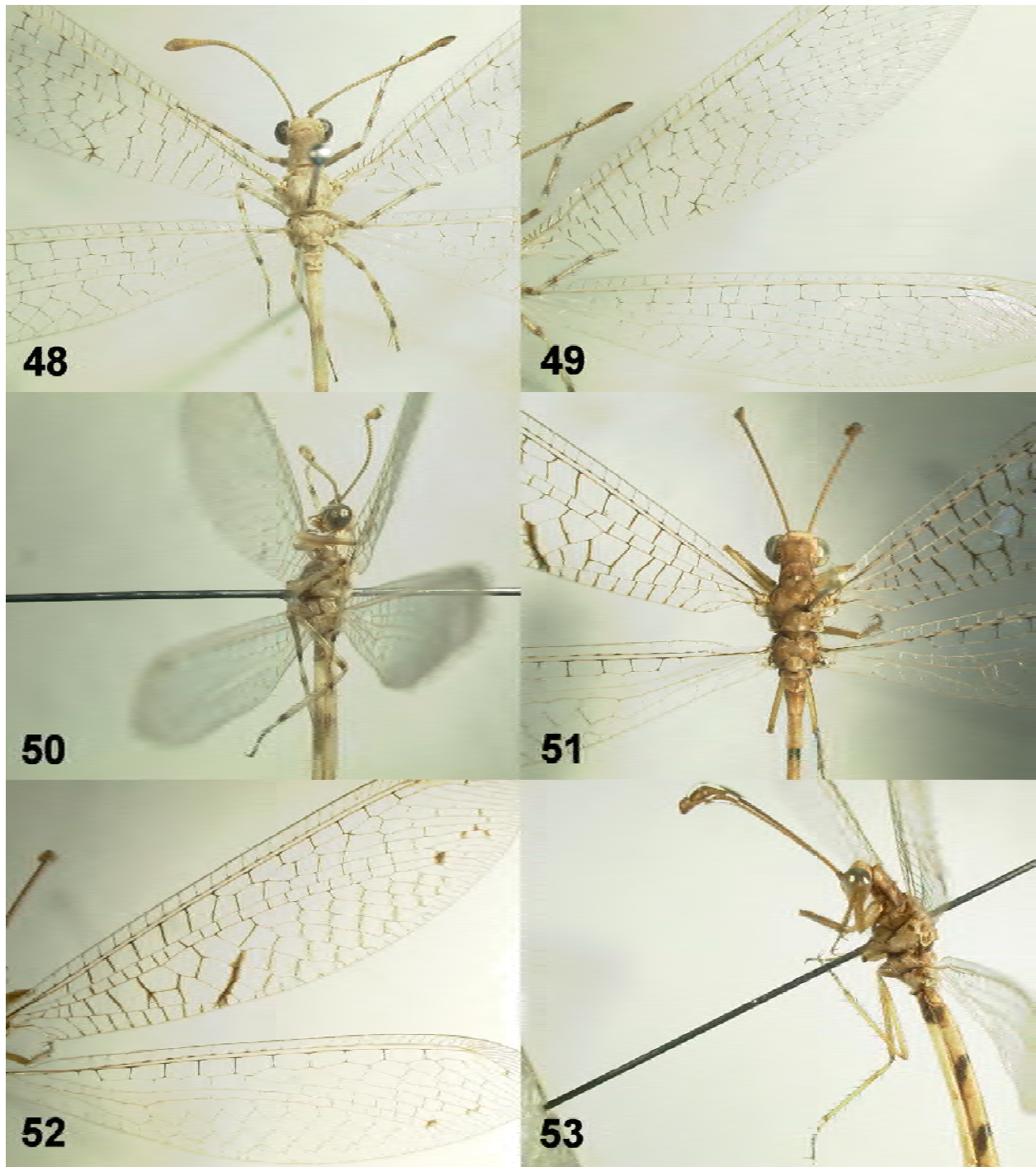
**Figures 38-43.** Adults. **38-40)** *Stenoleon xanthopus* Miller and Stange. **38)** Dorsal view, adult head, thorax and base of wings. **39)** Adult wings. **40)** Adult legs. **41-43)** *Xantholeon cavernicolus* Miller and Stange. **41)** Dorsal view, adult body and base of wings. **42)** Adult wings. **43)** Adult legs.



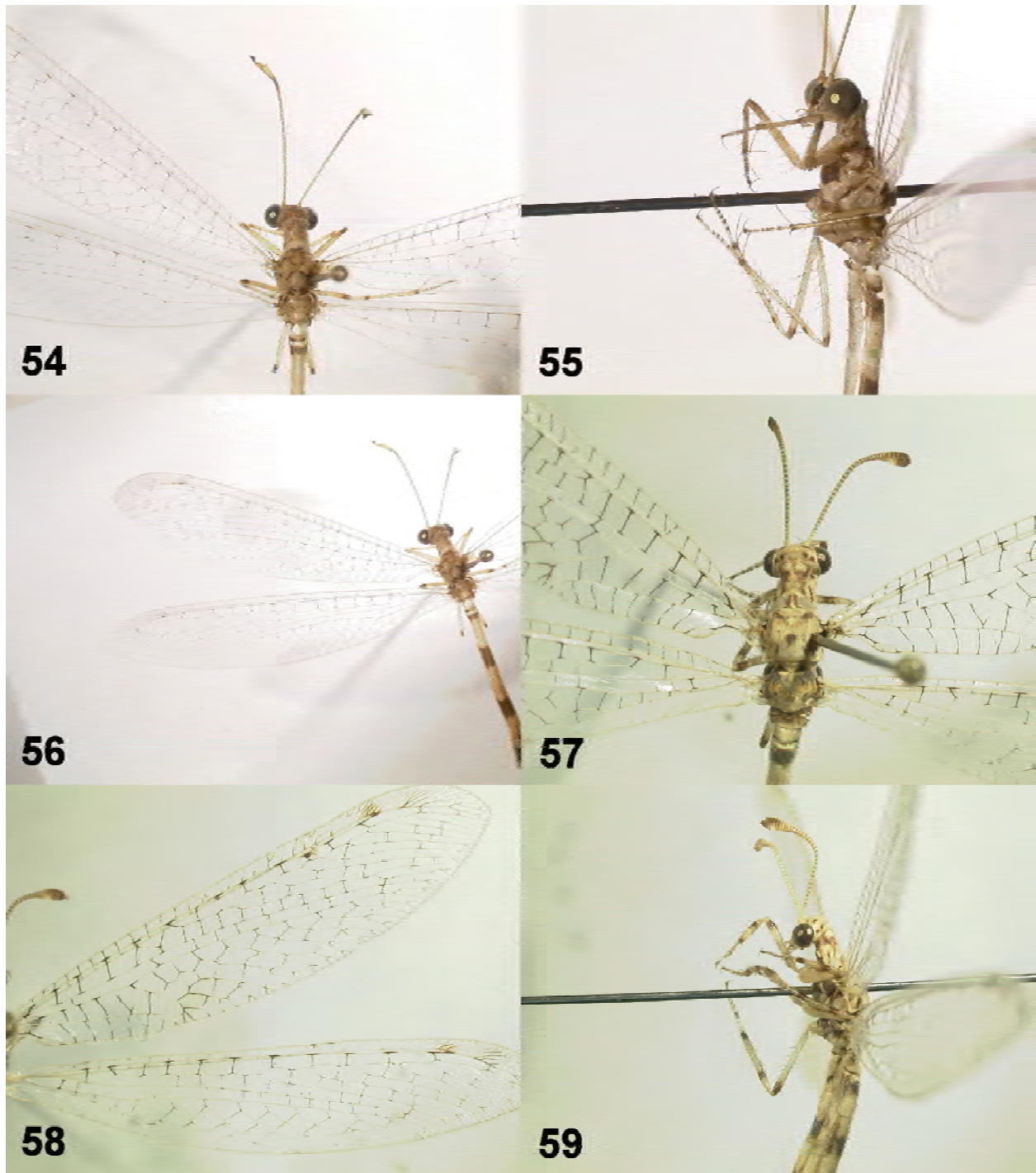


**Figures 44-47.** *Xantholeon* spp. **44-45)** *Xantholeon helmsi* Tillyard. **44)** Dorsal view, adult body and base of wings. **45)** Adult wings. **46-47)** *Xantholeon kakadu* Miller and Stange. **46)** Dorsal view, Adult head and thorax. **47)** Adult legs.

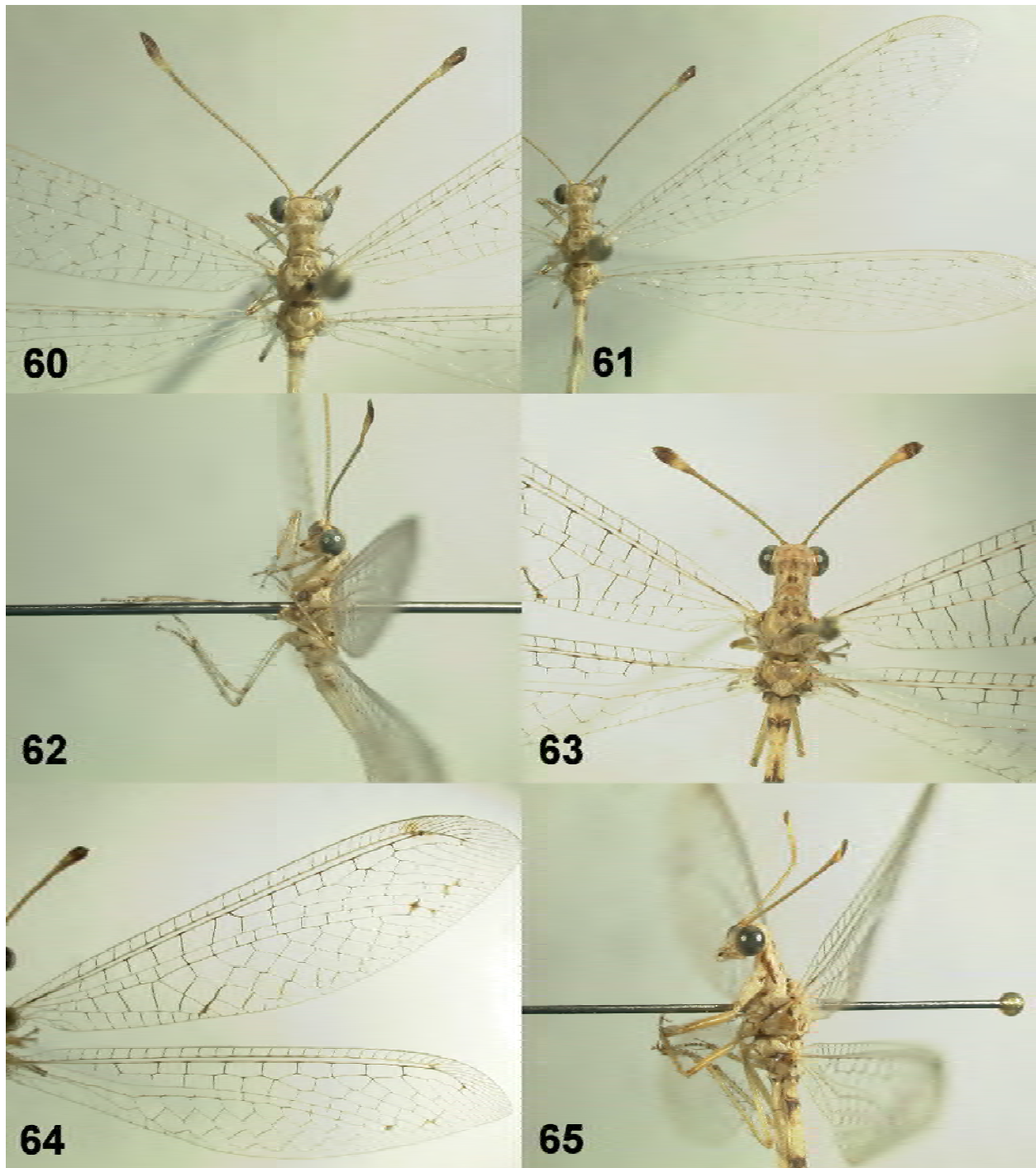




**Figures 48-53.** *Xantholeon* spp. **48-50)** *Xantholeon manselli* New. **48)** Dorsal view, adult body and base of wings. **49)** Adult wings. **50)** Adult legs. **51-53)** *Xantholeon montanus* New. **51)** Dorsal view, adult body and base of wings. **52)** Adult wings. **53)** Adult legs.

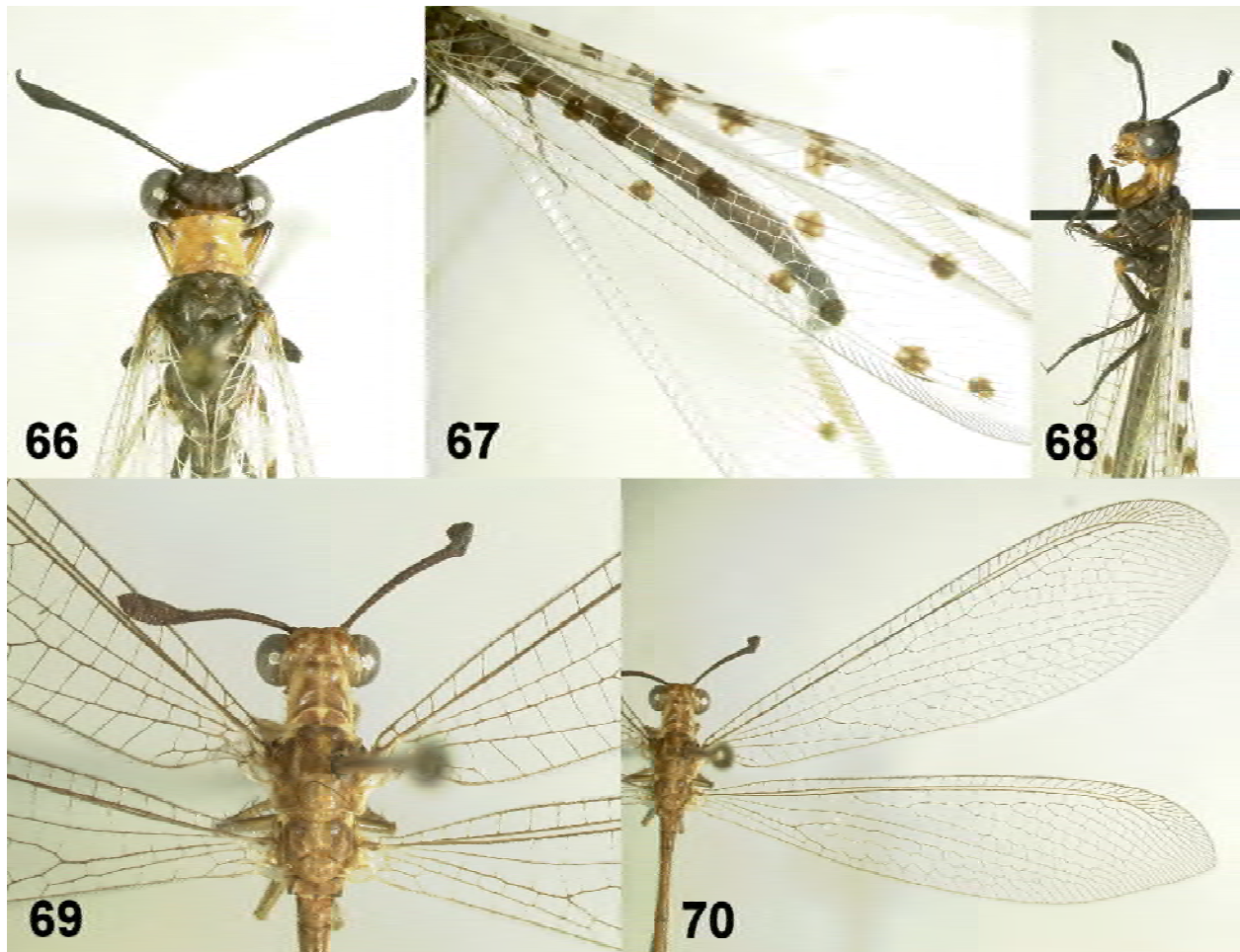


**Figures 54-59.** *Xantholeon* spp. **54-56)** *Xantholeon newi* Miller and Stange. **54)** Dorsal view, adult body and base of wings. **55)** Adult legs. **56)** Adult wings. **57-59)** *Xantholeon pallens* Miller and Stange. **57)** Dorsal view, adult body and base of wings. **58)** Adult wings. **59)** Adult legs.

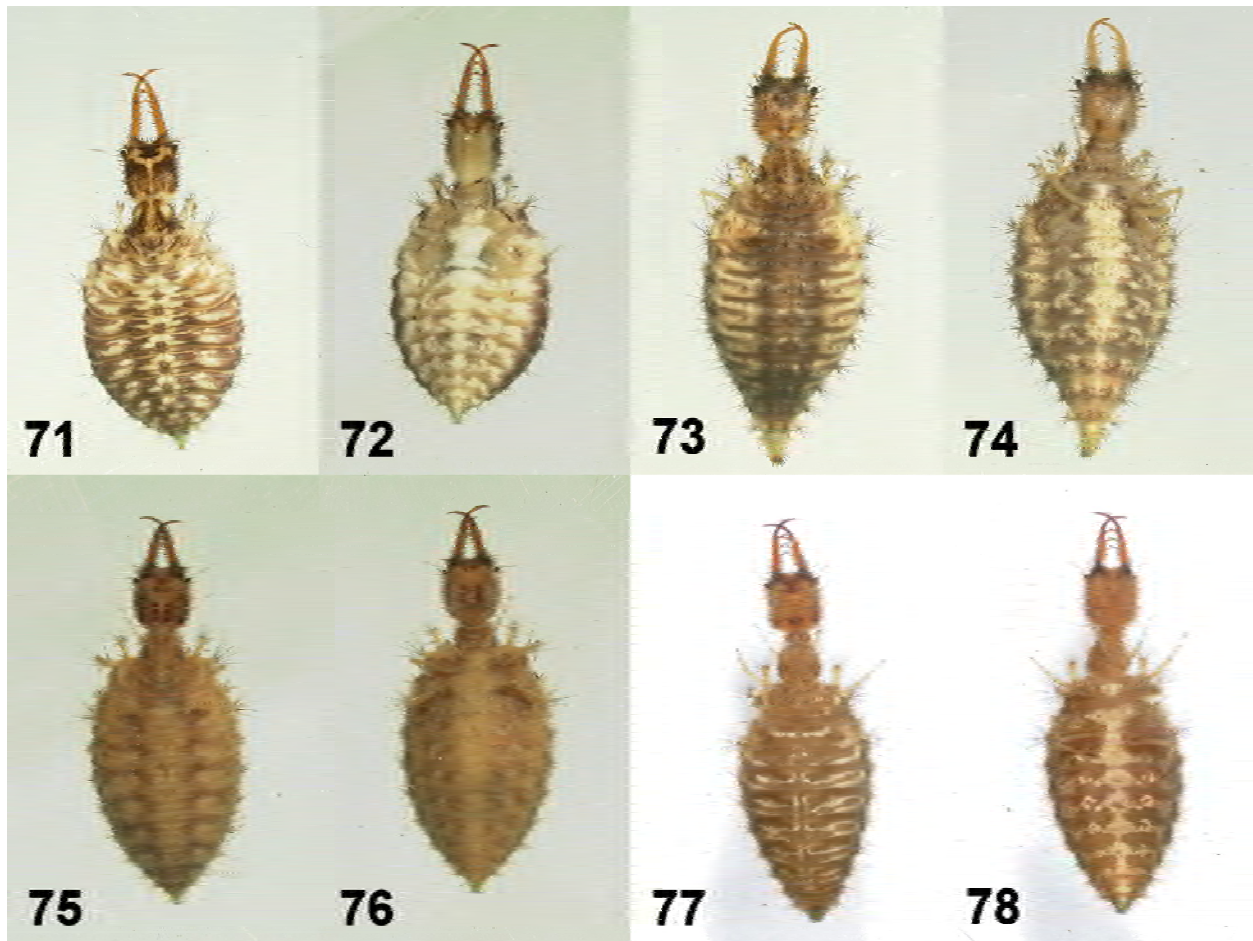


**Figures 60-65.** *Xantholeon* spp. **60-62)** *Xantholeon pentlandensis* Miller and Stange. **60)** Dorsal view, adult body and base of wings. **61)** Adult wings. **62)** Adult legs. **63-65)** *Xantholeon xadnus* New. **63)** Dorsal view, adult body and wings. **64)** Adult wings. **65)** Adult legs.

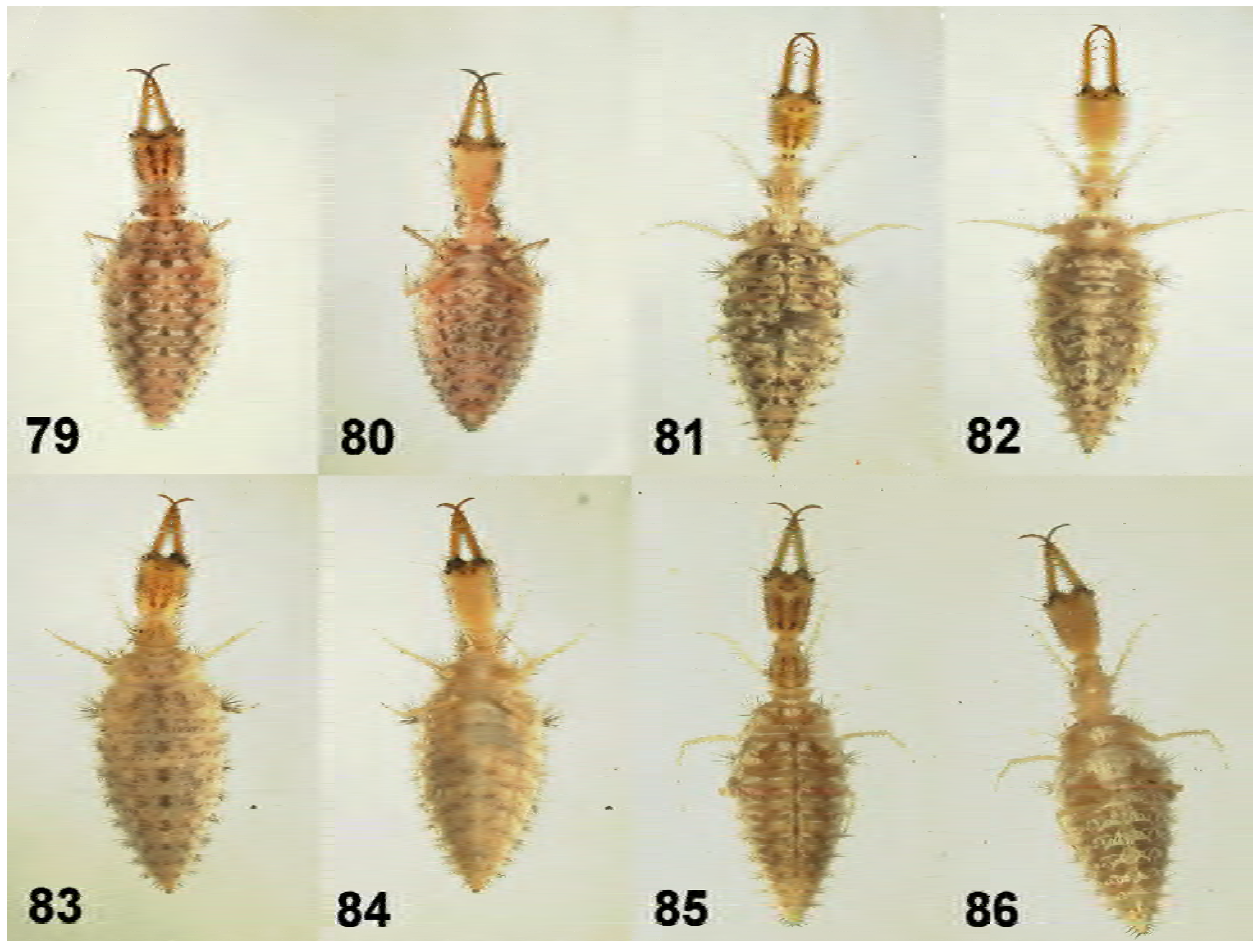




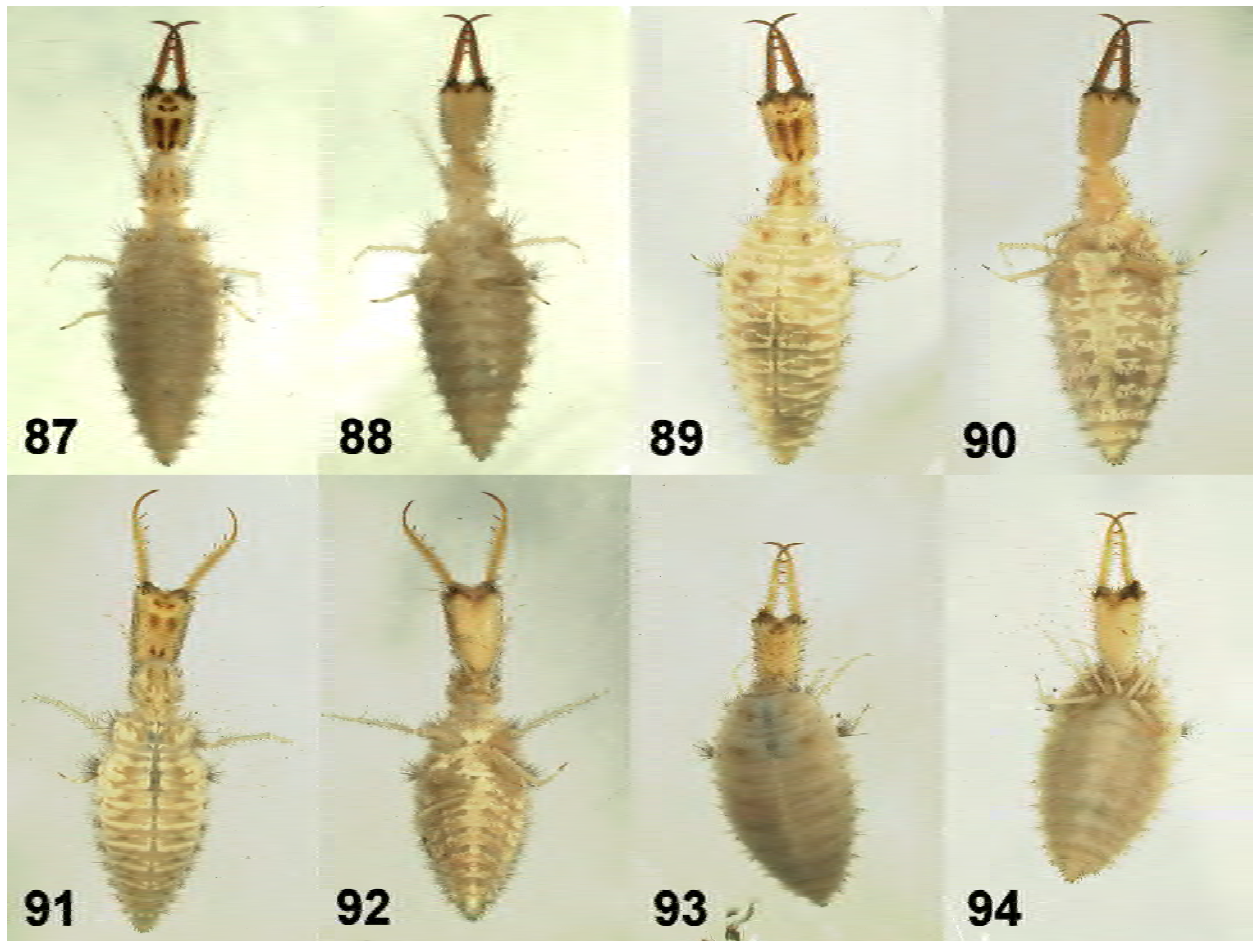
**Figures 66-70.** Adults. **66-68)** *Australleon illustris* (Gerstaecker). **66)** Close-up, adult head and thorax. **67)** Adult wings. **68)** Adult legs. **69-70)** *Myrmeleon pallidus* (Esben-Petersen). **69)** Close-up, adult body and base of wings. **70)** Adult wings.



**Figures 71-78.** Larvae, dorsal and ventral views. **71-72)** *Froggattisca rennerensis* Miller and Stange. **73-74)** *Froggattisca kakadu* Miller and Stange. **75-76)** *Froggattisca tipularia* (Gerstaecker). **77-78)** *Speleon yallingup* Miller and Stange.



**Figures 79-86.** Larvae, dorsal and ventral views. **79-80)** *Escura nigrosignata* (Tillyard). **81-82)** *Stenoleon cingulatus* Miller and Stange. **83-84)** *Stenoleon fieldi* Tillyard. **85-86)** *Xantholeon cavernicolus* Miller and Stange.



**Figures 87-94.** Larvae, dorsal and ventral views. **87-88)** *Xantholeon kakadu* Miller and Stange. **89-90)** *Xantholeon montanus* New. **91-92)** *Xantholeon pallens* Miller and Stange. **93-94)** *Xantholeon pentlandensis* Miller and Stange.





**Figures 95-100.** Larvae, dorsal and ventral views. **95-96)** *Heoclisis fulva* (Esben-Petersen), dorsal view of larva. **96)** Close-up view of larval head. **97-98)** *Australeon illustris* (Gerstaecker). **99-100)** *Myrmeleon pallidus* (Esben-Petersen).



