

Cladistic analysis of the antlions (Family: Myrmeleontidae) of Egypt

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ABSTRACT

A cladistic analysis of 48 morphological characters is used to produce a cladogram for the 27 genera and 40 Egyptian species of antlions (Myrmeleontidae). Egyptian genera and species are classified within three subfamilies: the Myrmeleontinae, which includes the tribes Myrmeleontini and Gepini; the Acanthaclisinae, which includes the tribe Acanthaclisini; and the Dendroleoninae, which includes both the Creagrini and Neuroleini. Egyptian genera are classified under these tribes as follows: a) the Myrmeleontini includes *Nophis*, *Iranoleon* and *Myrmeleon*; b) the Gepini includes *Cueta*, *Lopezus* and *Gepus*; c) the Acanthaclisini includes *Acanthaclisis*, *Neoclisis*, *Centroclisis* and *Phanoclisi*; we suggest including the three Egyptian species of genus *Palpares* in this tribe, but more characters need to be examined to confirm the taxonomic status of this genus; d) the tribe Creagrini includes *Creoleon*, *Macronemurus*, *Mesonemurus*, *Formicaeleo*, *Distoleon*, *Pseudoformicaeleo*, *Myrmecaelurus* and *Nohoveus*; e) finally the Neuroleini includes *Solter*, *Noaleon*, *Maracanda*, *Neurleon*, *Geyria*, *Megistopus*, *Ganguilus* and *Deflimeus*.

KEYWORDS: cladistics, antlions, Myrmeleontidae, Egypt

INTRODUCTION

The Myrmeleontidae represents the largest of the twelve families of the order Neuroptera, with about 2000 species described worldwide (Mansell 1985). The supergeneric classification of the family is largely unresolved (Stange 1970; Aspöck *et al.* 1980; Mansell 1985). Several authors have attempted to arrange the family Myrmeleontidae into subfamilies, tribes and subtribes, but overall stability of these categories has not been achieved.

At subfamily level, Banks (1911) in his work on African Myrmeleontidae mentioned two subfamilies, Myrmeleontinae and Dendroleoninae. Stange (1961) mentioned three subfamilies, Acanthaclisinae, Macronemurinae and Dendroleoninae. Williman (1977) divided the family into two subfamilies, Myrmeleontinae and Papparinae. Mansell (1985) stated that whilst some agreement on subfamilies seem to be emerging, with either three (Palparinae, Acanthaclisinae and Myrmeleontinae: Stange 1976), or two (Palparinae and Myrmeleontinae: Aspöck *et al.* 1980, who include the Acanthaclisinae in the Myrmeleontinae), an extra subfamily (the Stibopteryginae) was designated by New (1982). Concerning tribal classification, in addition to the four tribes recognised by Banks (1926) (Palparini, Myrmeleontini, Dendroleonini and Nemoleonini), a further nine tribes were designated by Navas (1926) (the Gymnocnemini, Acanthaclisini, Creagrini, Megistopini, Neuroleini, Fomicaleonini, Dimarini, Porrerini and Pignatellini). In 1954, Markel classified the myrmeleontid genera into 23 tribes, adding 10 new tribes. He synonymised Neuroleini with Formicaeleonini, and Lopezini with Myrmecaelurini, and established the Creoleonini as a replacement name for Creagrini. However, this author overlooked the existing tribe Macronemurini erected by Ebsen-Petersen (1918), while he erected the tribes Pseudimarini and Gepini. Holzel (1969, 1970) and Stange (1976) included the tribes of the subfamily Dendroleoninae within the Myrmeleontinae.

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Table 1: Classification of the Egyptian genera and species into tribes and subfamilies.

Genera/ species	Subfamily classification			Tribal classification		
	Ebsen-Petersen, 1918	Aspöck, 1980	Mansell, 1985	Ebsen-Petersen, 1918	Navas, 1926	Mansell, 1985
<i>Myrmeleon alternus</i> Brullé		Myrmeleontinae	Myrmeleontinae		Myrmeleontini	Myrmeleontini
<i>hyalinus</i> Olivier						
<i>Palpares cephalotes</i> (Klug)	Dendroleoninae	Palparinae	Palparinae	Dendroleonini	Palparini	Palparini
<i>solidus</i> Gerstaecker						
<i>walkeri</i> McLachlan						
<i>Acanthacalis occitanica</i> (Villers)	Myrmeleontinae	Myrmeleontinae		Acanthacalisini	Acanthacalisini	
<i>Centroclisis speciosa</i> (Rambur)		Myrmeleontinae	Acanthacalisinae			Acanthacalisini
<i>Creoleon aegyptiaca</i> (Rambur)	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Creagrini	Creagrini	Myrmeleontini
<i>antennatus</i> (Navas)						
<i>gularis</i> Navas						
<i>Cueta klugi</i> (Klug)		Myrmeleontinae	Myrmeleontinae		Myrmeleontini	Gepini
<i>longula</i> Navas						
<i>puella</i> (Navas)						
<i>Deflimeus scripta</i> Navas		Myrmeleontinae			Neuroleini	
<i>Distoleon annulatus</i> (Klug)		Myrmeleontinae	Myrmeleontinae			Nemoleontini
<i>Formicaleo annulatus</i> (Klug)	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Formicaleonini	Pignatellini	
<i>Ganguilus pallescens</i> (Navas)	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Formicaleonini	Dendroleonini	
<i>Gepus curvatus</i> Navas	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Dendroleonini	Myrmeleontini	Gepini
<i>Geyria lepidula</i> (Navas)	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Formicaleonini	Pignatellini	
<i>Iranoleon octavus</i> Holzel		Myrmeleontinae				
<i>Lopezus fedtschenkoi</i> (McLachlan)	Myrmeleontinae	Myrmeleontinae	Myrmeleontinae	Lopezini	Myrmeleontini	
<i>Macronemurus appendiculatus</i> (Latreille)	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Macronenurini	Pignatellini	Nemoleontini
<i>maghrebicus</i> Holzel						
<i>Maracanda omoena</i> McLachlan	Dendroleoninae	Myrmeleontinae	Myrmeleontinae		Gymnocnemini	
<i>Megisotrupis mirabilis</i> Holzel	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Megistopini		
<i>Mesonemurus harterti</i> (Navas)		Myrmeleontinae	Myrmeleontinae		Pignatellini	
<i>Myrmecaelurus laetus</i> (Klug)	Myrmeleontinae	Myrmeleontinae	Myrmeleontinae	Myrmecaelurini	Myrmeleontini	
<i>lobatus</i> Navas						
<i>trigramms</i> (Pallas)						
<i>Neurleon hieraticus</i> Navas	Dendroleoninae	Myrmeleontinae	Myrmeleontinae	Formicaleonini	Neuroleini	Nemoleontini
<i>tenellus</i> (Klug)						
<i>Noaleon limbatellus</i> (Navas)		Myrmeleontinae	Myrmeleontinae		Neuroleini	
<i>Nohoveus palalis</i> (Klapalek)		Myrmeleontinae	Myrmeleontinae		Myrmeleontini	
<i>venalis</i> Navas						
<i>Nophis flava</i> Holzel		Myrmeleontinae	Myrmeleontinae		Myrmeleontini	
<i>teillardii</i> Navas						
<i>Phanoclis longicollis</i> (Rambur)	Myrmeleontinae	Myrmeleontinae	Acanthacalisinae	Acanthacalisini	Acanthacalisini	
<i>Pseudoformicaleo nobilis</i> Navas	Dendroleoninae	Myrmeleontinae		Dendroleonini	Creagrini	
<i>Solter propheticus</i> Holzel		Myrmeleontinae		Myrmeleontinae	Myrmeleontini	
<i>virgilii</i> Navas						
<i>Neoclis lineata</i> Navas		Myrmeleontinae		Acanthacalisini	Acanthacalisini	

As we can see there is a great debate about the higher classification of Neuroptera in the literature (see Table 1). The present work represents the first attempt to study the phylogenetic relationships between myrmeleontid genera of the Egyptian fauna; furthermore it depends on many characters other than wing venation. Labelled illustrations for these characters are provided.

MATERIALS AND METHODS

In the course of this study, 27 genera and 40 species of Myrmeleontidae were examined, representing all the recognized species of this family in the Egyptian fauna. All the genera and species with their authors are included in Tables 1 and 2. To construct the phylogenetic relationships between these taxa, a total of 48 morphological characters of taxonomic importance in antlions were assessed in the adult stage. Among these characters, we used the length of the palpi, the pronotum, and the shape of scutellum; various characters of the male abdomen were also used, such as the length of the ectoproct, the position of the hair brush, the shape of the 6th segment, and the ratio of segments 3-5 to 6-8. These characters have been used only to a certain extent in the literature before, and this study deals with these characters in more detail.

The characters were scored as in Table 2 and are clarified by labelled drawings (Figs 1-28). Some species [*Centroclisis speciosa* (Rambur), *Distoleon annulatus* (Klug), *Iranoleon octavus* Holzel, *Megistopus mirabilis* Holzel, *Myrmecaelurus laetus* (Klug), *Neoleon limbatellus* (Navas), and *Nohoveus palalis* (Klapalek)] are not represented in Egyptian collections, and the characters found in Table 2 were scored after Holzel (1972, 1980).

The cladistic analysis followed the principle of phylogenetic reasoning elaborated by Hennig (1966). The resulting character table was analyzed using the Hennig86 software to infer phylogeny under the principle of maximum parsimony. We rooted the tree by making the assumption that *Myrmeleon alternus* Brullé was the most primitive taxon because it contains the most primitive characters. Mansell (1990) mentioned that genus *Myrmeleon* is very old, and that pit-building habit was an early innovation which led to a successful and widespread radiation of this branch of the family.

RESULTS

Character Analysis (Table 2):

1. Wings characterized by large brown or black bands (0) (Fig.1) or without these bands (1).
2. Labial palp very long, 2-3 times length of maxillary palp (0) (Fig. 2) or not as such (1).
3. Forewing with long posterior cubital vein (cup) reaching the margin of the wing and branched (0) (Fig. 3) or short and not reaching the margin of the wing (1).
4. In the forewing, cup and 1A distinct, not fused (0) (Fig. 3), or fused and close to wing base (1).
5. Pronotum very short in length, its length shorter than width (0) (Fig. 4), or pronotum short, its length slightly shorter than width (1) (Fig. 5), or equal to its width (2) (Fig.6), or its length is longer than its width (3) (Fig. 7).
6. Male abdomen with very long ectoproct (0) (Fig. 8), fairly long (1) (Fig. 9), moderate in length (2) (Fig. 10), or short (3) (Fig. 11).
7. Tibial spurs geniculate (0) (Fig. 12), or tibial spurs normal (1).
8. Body hairs dense (0), or sparse (1).
9. Costal area of forewing with two series of pentagonal cells (0) (Fig. 13), or costal area with two series of pentagonal cells in the middle region only (1), or with one series of cells (2).

10. Male with hair brush on segments of 6 & 7 or segment 7 only (0) (Fig. 14), or without hair brush (1).
11. Male abdomen longer than hindwing (0), or equal to hindwing (1), or shorter than hindwing (2).
12. Segment 6 of male abdomen strongly curved (0); this character is frequent in species of *Nophis*, while other genera of the family have the 6th abdominal segment normal (1).
13. In male abdomen, the ratio between segments 3-5 to 6-8 is 1:2 as in both species of genus *Nophis*, or 2:1 (1) as in other species of the family.
14. Wings wide (0), moderate in width (1), or narrow (2).
15. The apical area of both wings with some cross veins (0) (Fig. 15), or the apical area of fore wing only with cross veins (1), or the two wings without such structures (2).
16. Hind wing with one cross vein (0) (Fig. 16), or with 2-3 cross veins before Rs (1) (Fig. 17), or with 4-5 cross veins before Rs (2), or with 5 or more cross veins (3) (Fig. 18).
17. In forewing, veins 2A and 3A coalasce (0) as in most species of the family, or separated (1) (Fig. 3) as in the species of genera *Palpares*, *Gepus* and *Solter*.
18. In forewing, veins 2A and 3A coalasce for a long distance (0) (Fig. 19), or for short distance (1) (Fig. 20), or fore wing not as such (2).
19. In forewing, veins 2A forked and 3A unforked (0), or 2A unforked and 3A forked (1) (Fig. 21), or both 2A and 3A are forked (2), or 2A and 3A un-forked (3) as in species of *Myrmeleon*.
20. In forewing, vein Rs arises before cubital fork (0) as in *Centrocheris speciosa*, or arises beyond it (1) as in most genera of the family, or arises at the level of cubital fork (2) (Fig. 22) as in *Lopezus fedtschenkoi*.
21. Wings strongly spotted (0), or not spotted (1), or slightly spotted (2) as in all species of *Palpares* and *Pseudoformicaleo nobilis*.
22. Veins Cu₁ & Cu₂ in forewing parallel (0) (Fig. 23), which occurs only in *Creoleon* and *Pseudoformicaleo*, or not parallel (1) as in other species of the family.
23. Length of forewing 11-12mm (0), or 18-29mm (1), or more than 30mm (2).
24. Pterostigma indistinct (0), or distinct and pale in colour (1), or distinct and dark in colour (2).
25. Veins unicoloured (0), or veins with yellow and brown stripes (1).
26. Mesonotum with arched scutellum (0) (Fig. 24), or normal (1).
27. Hind end of forewing with papillae-like structure (0), as in all species of *Gepus*, or normal (1) as in all other species.
28. Forewing with brown speckles (0), or not as such (1).
29. Female seventh sternite with deep incision (0) (Fig. 25), or normal (1).
30. Tibial spurs not distinct (0), as in *Delfimeus scripta* and *Maracanda omoena*, or distinct (1) as in all other species.
31. Foreleg with long tarsi (0) (Fig. 26), as in all species of *Pseudoformicaleo*, or normal (1), as in all other species of the family.
32. Hind leg very long and thin (0) as only in *Ganguilus*, or normal (1) as in all other species of the family.
33. Legs strongly hairy (0), or not hairy (1).
34. Spurs of foreleg shorter than segment 1 (0), or equal to segment 1 (1), or spurs longer than segment 1 (2).
35. In foreleg, tarsus very long, longer than tibia (0), or not as such (1).
36. First tarsal segment very long and equal to segments 2-4 (0), or normal (1).
37. Last abdominal segment very short (0), or normal (1).
38. Small species (0), or moderate (1), or large in size (2).
39. Antennae rather close together at base (0), or not as such (1).

40. First tarsal segment nearly as long as the fifth (0), or not as such (1).
41. Last segment of tarsus shorter than the preceding three segments (0), or equal or longer (1).
42. Abdomen unicoloured (0), or banded longitudinally (1) (Fig. 27), or banded transversally (2) (Fig. 28).
43. Veins 1A and 2A in forewing forked basally (0) as in the three species of *Myrmeleon*, or forked apically (1) as in all other species of the family.
44. In hindwing, vein 2A hardly visible (0), or visible (1).
45. Male hind leg mostly with dense long bristles (0), or not as such (1).
46. Body colour dark brown (0), or pale yellow (1).
47. Head and thorax with long bristles and hairs (0) (Fig. 29), or not as such (1).
48. Wings with banksian line (0), or without banksian line (1).

Cladogram

The cladogram of Figure 1 represents the most probable course of evolutionary events for the Egyptian species of Myrmeleontidae (Neuroptera) based on the 48 characters considered here. Each number at a node or branching point represents a hypothetical ancestor and the numbers on lines correspond to the characters tabulated in Table 2. On the basis of these 48 characters, the following results were obtained. Figure 1 was the only shortest tree that resulted from the analysis. From the cladogram, it is possible to separate the Egyptian species of Myrmeleontidae into five clades based on nodes 72, 69, 66, 65 and 54.

The first clade includes *Nophis flava* and *N. teillardi*, *Iranoleon octavus* and species of genus *Myrmeleon*. This group is based on node 72, defined by the following characters: male abdomen with hair brush on segments 6 & 7 or 7 only; hind wing with 4-5 cross veins before Rs, body pale yellow in colour. *Iranoleon* evolved early, based on: male abdomen shorter than hind wing. The two species of genus *Nophis* at node 70 are closely related, sharing the character states of the male abdomen longer than hind wing, abdomen with 6th segment strongly curved, ratio between segments 3-5 to 6-8 is 1:2, fore wing 2A and 3A coalesce for short distance, body large in size.

Depending on the distinctiveness of the pterostigma, node 71 separates into 2 clades, nodes 69 and 68. The clade based on node 69 originated where *Cueta puella*, *C. longula*, *C. klugi*, *Lopezus fedtschenko* and *Gepus curvatus* cluster together. *Gepus curvatus* evolved early, based on having three character states: a wing wide, forewing with 2A & 3A not coalesced, and abdomen unicoloured. The next species to evolve is *Lopezus fedtschenko* based on having the male abdomen with moderate sized-ectoproct, 7th abdominal segment with hair brush, and the wings with a banksian line. The three species of *Cueta* evolved from node 64 based on: male abdominal ectoproct long, male abdomen longer than hindwing, forewing with veins 2A and 3A coalesced for a long distance, tarsi with 1st segment equal to the 5th, and wings without a banksian line.

Node 68 splits into two nodes (66 and 65). The first of these, node 66, includes species of *Phanoclisia*, *Neoclisia*, *Acanthaclisia*, *Centroclisia* and *Palpares*. This clade is defined by: body large in size, body hairs dense, wings wide, length of wing more than 30mm, legs strongly hairy, head and thorax with long bristles. *Phanoclisia longicollis* evolved early, based on the pronotum longer than wide and costal area of fore wing with two series of pentagonal cells in the middle. *Neoclisia lineata* evolved at node 61 based on: hind wing with more than 5 cross veins before Rs. *Acanthaclisia occitanica* and *Centroclisia speciosa* are derived from node 57 and are hence closely related to each other, but differ in the following characters: in the first species, the costal area of forewing has two series of pentagonal cells, Rs arises beyond cubital fork, the pterostigma is distinct and dark, the foretarsi have a spur longer than basal segment; while in the second species, the costal area of the forewing has a single series

of pentagonal cells, Rs arises before the cubital fork, the pterostigma is distinct and pale, and the foretarsi has a spur equal in length to the basal segment. At node 60, the three species of *Palpares* (*solidus*, *cephalotes* and *walkeri*) are very similar to each other, sharing the character states of wings with large brown or black bands, forewing with long posterior cubital vein reaching to the wing margin and branched, cup and 1A distinct not fused, male abdomen with very long ectoproct, tibial spur normal, apical area of wings with degree of cross veins, hindwing with 2-3 cross veins, forewing with 2A and 3A separate, forewing with 2A and 3A forked, and wings spotted. The three species differ from each other in the pterostigma, which is indistinct in *P. cephalotes*, distinct and dark in *P. solidus* and distinct and pale in *P. walkeri*.

The fourth clade is based on node 65. *Nohoveus* evolved early with character states of the male abdomen with ectoproct moderate in length, hindwing with 4-5 cross veins before Rs, and wings with a banksian line. Depending on the length of male ectoproct, node 62 separates into 2 main groups based at nodes 58 and 59. All species at node 59 have the male abdomen longer than the hindwing, and a long ectoproct. *Mesonemurus harterti* has evolved further, based on it having: wings narrow, hind wing with 2 cross veins before Rs and wings without a banksian line. The two *Macronemurus* species are very similar to each other but differ in having: in the first species, the pronotum is longer than wide, and the pterostigma is indistinct; while in the second species, the pronotum is as long as wide, and the pterostigma is distinct and pale. Depending on length of male ectoproct, node 58 splits into two groups at nodes 55 and 54. All species from node 55 are similar in that the wings are moderate in width, and the apical area of both wings have some cross veins. *Pseudoformicaleo nobilis* evolved early based on pronotum longer than wide and Cu₁ and Cu₂ in forewing being parallel. Node 53 branched at nodes 49 and 50 based on these characters: hair brush of male abdomen, wing width, wing cross veins. *Formicaleo annulatus* and *Distoleon annulatus* evolved further at node 49. The two species differ from each other in that in the former, the abdomen is transversely banded, the hind legs with bristles not so long, and the body is yellow; the latter has the abdomen not banded, hind legs with long and dense bristles, and the body is dark brown. The three species of *Creoleon* (*gularis*, *antennatus* and *aegyptiaca*) are closely related to each other based on: Cu₁ and Cu₂ parallel, wings without banksian line, but *Creoleon aegyptiaca* differs from other two species based on the abdomen being shorter than the hindwing. *Creoleon gularis* and *Creoleon antennatus* are more or less identical in all characters except in the colour of pterostigma which is dark in the first and pale in the second. At node 50 the species *Myrmecaelurus* (*laetus*, *lobatus* and *trigramms*) share the male abdomen with hair brush on segments 6 and 7 or only on segment 7, wings wide, and the hindwing with 4-5 cross veins before Rs. The three species differ in length of pronotum and colour of wing veins.

The fifth clade based on node 54 includes the other eight genera. They share the character states that the wings are narrow, and the apical area of the two wings are without degree of cross veins. Based on the colour of wing veins and body size this clade splits into two groups at nodes 51 and 52. *Megistopus mirabilis* and *Ganguilus pallescens* at node 52 differ from each other, in that in *M. mirabilis*, the forewing has veins 2A and 3A coalesced for a long distance, 2A is forked and 3A is unforked, the hindwing has 2A hardly visible, the hind leg is normal, and the body is pale yellow. In *G. pallescens*, however, the forewing has 2A and 3A coalesced for a short distance, 2A is unforked and 3A is forked, the hindwing has 2A visible, the hind leg is long and thin, and the body is dark brown in colour. *Maracanda omoena* separated from species of *Solter* at node 48 based on: pronotum longer than wide, wings narrow, forewing with 2A & 3A coalesced. At node 45, both *Solter virgilii* and *propheticus* are similar to each other, in that the pronotum is as long as wide, the wings are wide, and 2A and 3A of the forewing are separate. The two species differ in the length of the

forewing and the body colour. At node 44, *Deflimeus scripta* and *Noaleon limbatellus* are separated from each other by length of pronotum and length of tibial spurs, length of forelegs and terminal tarsal segment. At node 43, *Geyria lepidula* has evolved to be separate from species of *Neurleon* by the male abdomen with a long ectoproct. *Neurleon hieraticus* and *tenellus* are very similar, but differ in pronotum length which is equal to width in *N. hieraticus* and longer than wide in *N. tenellus*.

DISCUSSION

All genera of Myrmeleontidae in the Egyptian fauna have been analyzed using 48 morphological characters. The analysis suggest that there are five clades among the genera examined. The first clade includes genera *Nophis*, *Iranoleon* *Myrmeleon* sharing these characters: male abdomen with hair brush on segments 6 and 7 or 7 only, hind wing with 4-5 cross veins before Rs, body pale yellow in colour.

The second clade includes *Cueta* and *Lopezus* which are two sister genera, and *Gepus* is linked with these two genera. The third group includes five genera, from which *Centroclisis*, *Acanthaclisis* and *Neoclisis* are sister genera, *Palpares* is linked to them. *Phanoclisis* linked to the previous four genera by sharing the following characters: body clothed with dense hairs, wings wide, fore wing more than 30mm in length, legs strongly hairy, body large in size, head and thorax with long bristles. These results partly agree with Navas (1926), who placed *Centroclisis*, *Acanthaclisis*, *Phanoclisis*, *Neoclisis* in one tribe, the Acanthoclisini. On the other hand, many authors (Navas 1926, Holzel 1986, Mansell 1990) placed species of genus *Palpares* in the tribe Palparini (Palparinae) depending on characters of wing venation. In our study using other characters such as length of labial palp, length of body, forewings, and the hairs and bristles of the body, it appears that *Palpares* is more related to genera of Acanthaclisini than to genera of Palparini. The other 16 genera overlap together with no clear relationship except for the three genera *Solter*, *Nohoveus* and *Myrmeaelurus* which cluster together; all authors agree in classifying these three in the Myrmeleontinae (tribe Myrmeleontini).

For the other 13 genera, there is great disagreement in literature about the classification of these genera, which are included under different tribes such as Creagrini, Neurolini, Pignatellini, Dendroleonini, Gymnocnemini, Macronemurini, Formicaleonini and Nemoleontini (Ebsen-Petersen 1918; Navas 1926; Mansell 1985). Even so Ebsen-Petersen (1918) classified these genera in the Dendroleoninae, which reflects the close relationships between them. The confusion in their classification is due to the shortage of characters, and as a result it is based only on one or two characters. Therefore, we recommend classifying these genera under the tribes Creagrini and Neurleonini. Further characters should be looked at, probably molecular and biochemical, or rely more on examining characters from the immature stages, which may give a clearer idea about the classification of this group of genera.

In conclusion, we suggest classifying Egyptian genera of antlions into three subfamilies: the Myrmeleontinae, which includes the tribes Myrmeleontini and Gepini; the Acanthaclisinae, which includes the Acanthaclisini; and the Dendroleoninae, which includes both the Creagrini and Neuroleini. Furthermore, we propose classifying Egyptian genera under the following five tribes: a) the Myrmeleontini which includes *Nophis*, *Iranoleon* and *Myrmeleon* (as in Navas 1926; Mansell 1985); b) the Gepini, which includes *Cueta*, *Lopezus* and *Gepus* (as in Mansell 1985); c) the Acanthaclisini, which includes *Acanthaclisis*, *Neoclisis*, *Centroclisis* and *Phanoclisis* (as in Navas 1926, Banks 1926), but we suggest also including the three Egyptian species of genus *Palpares* in this tribe but more characters need to be examined to confirm this decision; d) the Creagrini, which includes *Creoleon*,

Macronemurus, *Mesonemurus*, *Formicaeleo*, *Distoleon*, *Pseudoformicaeleo*, *Myrmecaelurus* and *Nohoveus*; this agrees in general with Ebsen-Petersen (1918) and Navas (1926) except they exclude both *Nohoveus* and *Myrmecaelurus* from this tribe; e) the Neuroleini, which includes *Solter*, *Noaleon*, *Maracanda*, *Neurleon*, *Geyria*, *Megistopus*, *Ganguilus* and *Deflimeus*, as in Ebsen-Petersen (1918) and Navas (1926) except for the genus *Solter*.

Table 2: Data matrix of the 48 characters used to construct the phylogeny of antlion species (family: Myrmeleontidae) of Egypt

Species	Character States					
	1	1 0	2 0	3 0	4 0	4 8
<i>Myrmeleon alternus</i> Brullé	1	1	1	1	1	1
<i>Myrmeleon hyalinus</i> Olivier	1	1	1	1	1	1
<i>Palpares cephalotes</i> (Klug)	0	0	0	0	0	0
<i>Palpares solidus</i> Gerstaecker	0	0	0	0	0	0
<i>Palpares walkeri</i> McLachlan	0	0	0	0	0	0
<i>Acanthaclisis occitanica</i> (Villers)	1	1	1	1	1	1
<i>Centroclisis speciosa</i> (Rambur)	1	1	1	1	1	1
<i>Creleon aegyptiaca</i> (Rambur)	1	1	1	1	1	1
<i>Creleon antennatus</i> (Navas)	1	1	1	1	1	1
<i>Creleon gularis</i> Navas	1	1	1	1	1	1
<i>Cueta klugi</i> (Klug)	1	1	1	1	1	1
<i>Cueta longula</i> Navas	1	1	1	1	1	1
<i>Cueta puella</i> (Navas)	1	1	1	1	1	1
<i>Deflimeus scripta</i> Navas	1	1	1	1	1	1
<i>Distoleon annulatus</i> (Klug)	1	1	1	1	1	1
<i>Formicaeleo annulatus</i> (Klug)	1	1	1	1	1	1
<i>Ganguilus pallescens</i> (Navas)	1	1	1	1	1	1
<i>Gepus curvatus</i> Navas	1	1	1	1	1	1
<i>Geyria lepidula</i> (Navas)	1	1	1	1	1	1
<i>Iranoleon octavus</i> Holzel	1	1	1	1	1	1
<i>Lopezus fedtschenkoi</i> (McLachlan)	1	1	1	1	1	1
<i>Macronemurus appendiculatus</i> (Latreille)	1	1	1	1	1	1
<i>Macronemurus maghrebinus</i> Holzel	1	1	1	1	1	1
<i>Maracanda omoena</i> McLachlan	1	1	1	1	1	1
<i>Megistopus mirabilis</i> Holzel	1	1	1	1	1	1
<i>Mesonemurus harterti</i> (Navas)	1	1	1	1	1	1
<i>Myrmecaelurus laetus</i> (Klug)	1	1	1	1	1	1
<i>Myrmecaelurus lobatus</i> Navas	1	1	1	1	1	1
<i>Myrmecaelurus trigramms</i> (Pallas)	1	1	1	1	1	1
<i>Neurleon hieraticus</i> Navas	1	1	1	1	1	1
<i>Neurleon tenellus</i> (Klug)	1	1	1	1	1	1
<i>Noaleon limbatellus</i> (Navas)	1	1	1	1	1	1
<i>Nohoveus palalis</i> (Klapalek)	1	1	1	1	1	1
<i>Nohoveus venalis</i> Navas	1	1	1	1	1	1
<i>Nophis flava</i> Holzel	1	1	1	1	1	1
<i>Nophis teillardii</i> Navas	1	1	1	1	1	1
<i>Phanoclisia longicollis</i> (Rambur)	1	1	1	1	1	1
<i>Pseudoformicaeleo nobilis</i> Navas	1	1	1	1	1	1
<i>Solter propheticus</i> Holzel	1	1	1	1	1	1
<i>Solter virgiliai</i> Navas	1	1	1	1	1	1
<i>Neoclisia lineata</i> Navas	1	1	1	1	1	1

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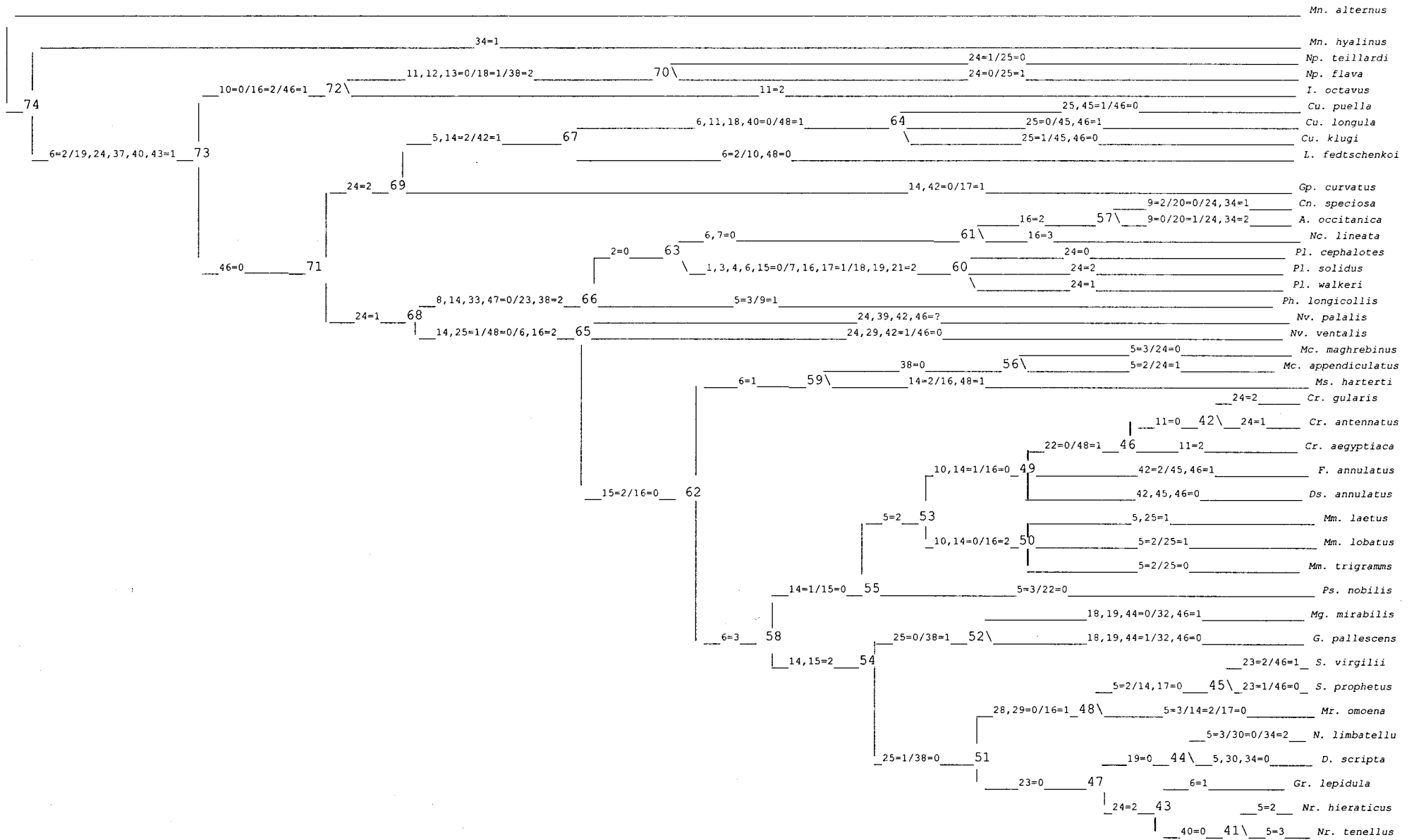
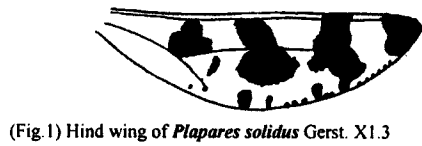


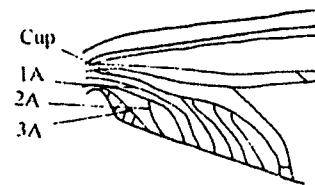
Figure 1: Cladogram for the Egyptian genera and species of antlions (Family: Myrmeleontidae) showing the relationship between them (length=154, ci=42). Mn= Myrmeleon, Np.= Nophis, Pl= Palpares, A.= Acanthaclisis, Cn= Centroclisis, Cr= Creleon, Cu= Cueta, D.= Deflimeus, Ds= Distoleon, F.= Formicaleo, G.= Ganguilus, Gp= Gepus, Gr.= Geyria, I.= Iranoleon, L.= Lopezus, Mc.= Macronemurus, Mr.= Maracanda, Mg.= Megistopus, Ms.= Mesonemurus, Mm.= Myrmecaelurus, Nr.= Neurleon, Nv.= Nohoveus, Ph.= Phanoclis, Ps.= Pseudoformicaleo, S.= Solter, Nc.= Neoclis, N= Noaleon.



(Fig.1) Hind wing of *Palpares solidus* Gerst. X1.3



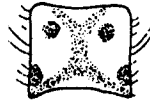
(Fig.2) Labial palp *Acanthaclisis occitanica* (Vill.)



(Fig.3) Fore wing of *Palpares cephalotes* klug X2



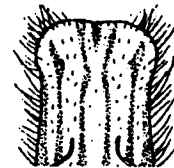
(Fig.4) Head & pronotum of *Deffleus scripta* Na. X15



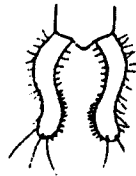
(Fig.5) Pronotum of *Gepus invisus* Na. X5



(Fig.6) Pronotum of *Formicaleo annulatus* (L.) Na. X11



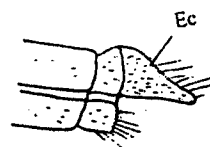
(Fig.7) *Phanochlisis longicollis* (Rambur) X7



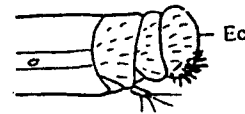
(Fig.8) Male ectoproc of *Palpares klugi* Kol. X7



(Fig.9) Male ectoproc of *Neoclisis lineata* Na. X10



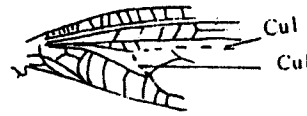
(Fig.10) End of male abdomen of *Myrmeleon hyalinus* Oliver X16



(Fig.11) End of male abdomen of *Myrmeleon hyalinus* Oliver X16



(Fig.12) Tibial spure X14

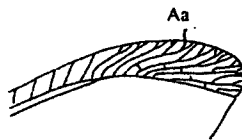


(Fig.13) Hind wing X2.6

(Fig. 12 & 13) *Acanthaclisis occitanica* (vill.)



(Fig.14) 6th & 7th abdominal segments X10



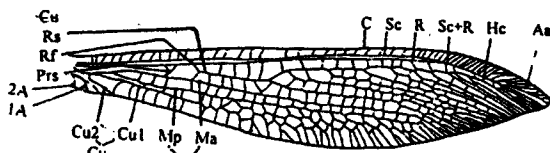
(Fig.15) Apex of fore wing X4



(Fig.17) Hind wing of *Maracanda omoena* Mc Lachlan X5



(Fig.18) Hind wing of *Cueta longula* Na X14

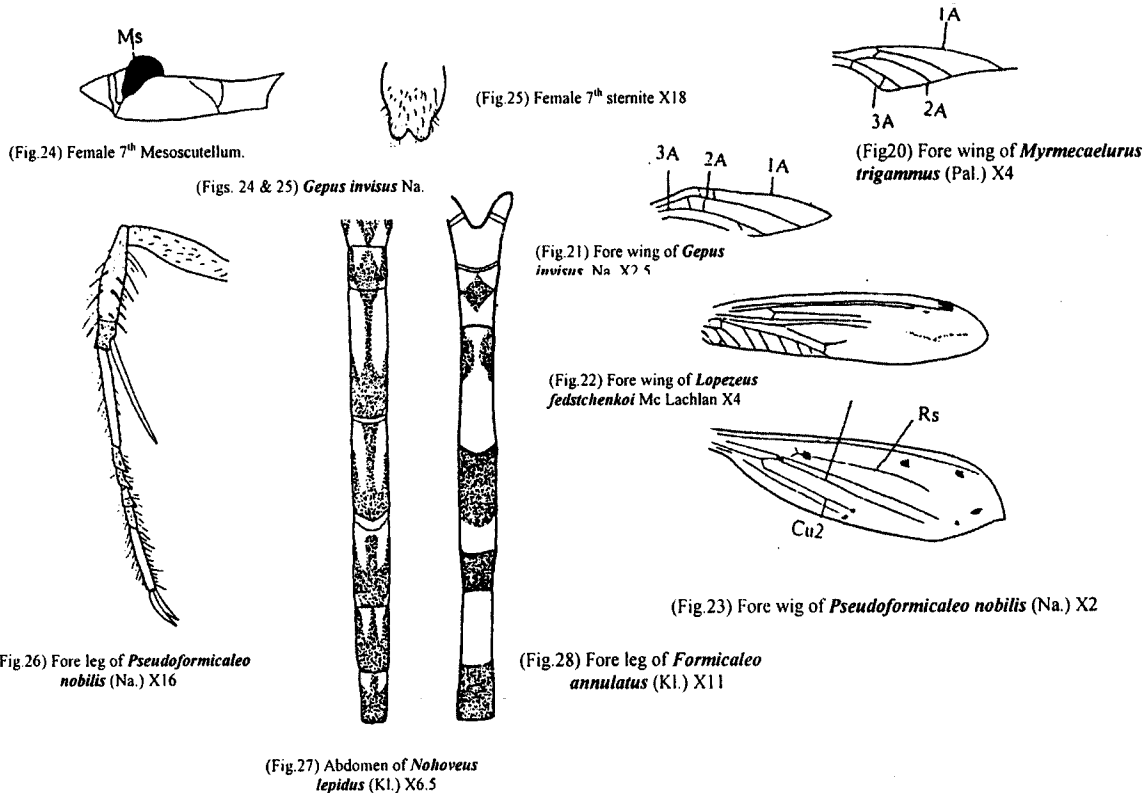


(Fig.16) Hind wing X31



(Fig.19) Fore wing of *Myrmeleon hyalinus* Oliver X4.5

(Figs.14-16) *Myrmecaelurus trigammus* (Pal.)



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الملخص العربي

دراسة وتحليل تطور أنواع أسد النمل (فصيلة: ميرميليويتينيدى) فى مصر
هيام الحامولى^١ ، سامى زلط^٢ ، سهير جادالله^١

١. قسم علم الحشرات - كلية العلوم - جامعة عين شمس - القاهرة - مصر
٢. قسم علم الحيوان - كلية العلوم - جامعة قناة السويس - الإسماعيلية - مصر

تم دراسة تطور أنواع أسد النمل من فصيلة ميرميليويتينيدى فى مصر وذلك باستخدام ٤٨ صفة مورفولوجية فى الحشرات الكاملة للأجناس المصرية والتي يبلغ عددها ٢٧ جنسا والتي تضم حوالى ٤٠ نوعا. بناء على الصفات المستخدمة والتحليل الإحصائية باستخدام برنامج هينيج والذي يساهم فى رسم وبيان العلاقات التطورية بين الأنواع المختلفة فقد تم تصنيف فصيلة ميرميليويتينيدى فى مصر الى ثلاث تحت فصائل وهم:

- تحت فصيلة ميرميليويتينيا: والتي تضم قبيلة ميرميليويتيني، وحبيني
 - تحت فصيلة أكانثاسليسينيا والتي تضم قبيلة أكانثاسليسيني
 - تحت فصيلة ديندروليونيبيا والتي تضم قبيلة كرياترينى ونيورولينى
- وبالنسبة للأجناس فقد تم اقتراح تصنيفها على النحو التالى:-
- قبيلة ميرميليويتيني وتضم كل من الأجناس نوفيس، إرنوليون وميرميليون
 - قبيلة حبيني وتضم الأجناس كيوتا، لوبيزاس وحبيايس
 - قبيلة أكانثاسليسيني وتضم الأجناس أكانثاسليسيس، نيوكليسيس، سينتروكليسيس، وفانوكليسيس وقد تم اقتراح ضم الأنواع المصرية الثلاثة لجنس بالباريس إلى هذه القبيلة ولكن لتأكيد هذا الافتراض لابد من فحص صفات أخرى (ريما صفات فى الأطوار الغير كاملة أو صفات بيوكيميائية أو وراثية) وذلك للتأكد التام من الوضع التصنيفى لهذا الجنس ضمن هذه القبيلة
 - قبيلة كرياترينى وتضم الأجناس كرياترينى، ماكرونيمياريس، ميسونيميارياس، فورميكالينو، ديستوليان، بسيدوفورميكالينو، ميرميكشيلياياس وميجيستوبياس
 - قبيلة نيورولينى وتضم الأجناس سولتير، نوليا، ماراكاندا، نيارليون، حبيريا، ميجيستوبياس، جانجالياس وديفليمياس.