A Generic Review of the Acanthaclisine Antlions Based on Larvae (Neuroptera: Myrmeleontidae)

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INTRODUCTION

The tribe Acanthaclisini Navas contains 14 described genera which we recognize as valid. We have reared larvae of 8 of these (Acanthaclisia Rambur, Centroclisia Navas, Fadrina Navas, Paranthaclisia Banks, Phano­
clisia Banks, Synclisia Navas, Syngenes Kolbe, and Vella Navas). In addition, we have studied preserved larvae from Aus­
tralia which probably represent the genus Neo­
clisia Navas. This represents the ma­
jority of the taxa, lacking only the small genera Avia Navas, Cosina Navas, Madrasta Navas, Mestressa Navas, and Stiphroneuria Gerstaeker. Studies of these larvae have revealed structural differences, especially of the mandible, which we have employed to provide identification of these genera by means of descriptions, keys, and illustra­
tions. Also, since no modern key exists, we are providing a key to the genera based on adults which will provide some further insight on the generic relat ionships. Ob­
servations on the tribal differences of Myrmeleontidae based on larvae are made with a preliminary key to the known tribes.

Tribe Acanthaclisini Navas 1912

Included genera: Acanthaclisia Ramb­
bur, Avia Navas (=Jaya Navas), Centroclisia Navas (=Sogra Navas, =Neboda Navas, =Neo­
clisia Navas, =Stemonclisia Navas, =Sograssa Navas), Cosina Navas, Heoclisia Navas, Madrasta Navas, Mestressa Navas, Parantha­
clisia Banks, Phano­
clisia Banks (=Nora Navas), Stiphroneuria Gerstaeker (=Neriga Navas), Synclisia Navas, Syngenes Kolbe (=Onclus Navas), Vella Navas (=Cyroplectron Esben-Petersen) [Note: The genus Vellasaa Navas is of uncertain status].

General Biology: Principi (1947) de­
tailed the biology of Synclisia baetica

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(Rambur), whereas Steffan (1975) provides additional data on this species as well as on Acanthaclisia occitanica (Villers). Our best biological data on the Acanthaclisini, excluding larval behavior, are based on observations of Paranthaclisia congner (Hagen) made near Reno, Nevada. In common with most antlions, P. congner lay eggs at dusk. As the female expels the eggs, she evenly coats them with sand, using the pos­
terior gonapophysis. The eggs are shallowly buried, in contrast to other known non­
acanthaclisine species which lay their eggs on the surface. Some females caught just after dusk still had egg material on the end of their abdomens where some had been broken. Their abdomens appeared empty. Like most antlion species with thick abdomens, Paranthaclisia species lay eggs in batches rather than a few every day. One female captured at dusk had a plump abdomen and layed 20 eggs which left her abdomen empty. The eggs were large and oblong and hatched in 24 days. Little or no expansion of the head capsule and mandibles takes place upon hatching in Parantha­
clisia. This is unlike other tribes where upon hatching the head capsule and mandibles expand with the mandibles hanging like limp spaghetti before expansion. Other char­
acteristics are similar to larvae in other tribes. There are three larval instars, and diapause, if assumed, occurs in the larva in the sand and not in the cocoon nor in the egg. The cocoon is constructed of silk beneath the sand with sand grains covering the surface. The mobile pupa digs its way to the surface of the sand where the adult emerges and then climbs any con­
venient object before expanding its antennae, wings, and abdomen.

Description (based on larvae): Three­
segmented labial palpus shorter than basal width of mandible; distal palpomere 1.5 to 3.0 times longer than wide; sensory opening variable in size; mandible with 1 (Paran­
thaclisia), 2 (Centroclisia), or 3 teeth­
when 3, basal tooth shorter than distal one; lateral margin with or without long setae, but setae never longer than one-half greatest width of mandible; mesothoracic spiracle not borne on tubercle; scoli ab-
sent; dolichasters absent on head; abdominal sternite VIII without submedian teeth; sternite IX without enlarged pair of digging setae; tergite IX without median lobe bearing median sclerotized process.

Larval Behavior: None of the larvae studied construct pitfall traps. Two distinct types of locomotion are present. Backward movement only is found in the genera Phanoclisis and Vella. Forward and backward movement are found in Acanthaelisia, Centroclisis, Fadrina, Heoclinis, Paranthesclisis, Syngenes, and Synclisis. The latter three genera are fast runners and burrowers. Centroclisis larvae are slow creepers and diggers. Acanthaelisia, Heoclinis, and Fadrina larvae are fast burrowers but seldom move forward rapidly, at least under laboratory conditions. The larvae usually inhabit open tracts of sand where considerable sand depth is required for temperature regulation, protection of the large cocoon, escape and concealment from predators, as well as space for hunting prey. Most species are incessant feeders (except notably Centroclisis and Paranthesclisis) and require a fairly high sand surface temperature to pupate. The cocoon is constructed in a single day and the period from construction of the cocoon to the emergence of the adult is 54±3 days in all of the genera reared so far except Fadrina (35 days). All of the genera studied, except Centroclisis, feed when the sand temperature is warm, but avoid extreme temperatures above or below safe levels by burrowing deeply in the sand. It is common to see them active on the surface in mid-morning, late afternoon, and very warm nights. Centroclisis is the exception as the species studied is strictly nocturnal.

Discussion: This tribe is well defined by both larval and adult characters and shows limited structural diversity in comparison to most tribes of antlions. Some group characters are present which suggest at least 4 subgroups: Group 1 - Centroclisis and Paranthesclisis; Group 2 - Syngenes and Synclisis; Group 3 - Acanthaelisia, Fadrina, and Phanoclisis; Group 4 - Heoclinis and Vella. Navas (1912) divided the tribe into 2 groups; "uncinati" (tibial spurs evenly curved). These 2 groups appear to be fairly natural divisions but since the names are not derived from included genera they are nomina nuda. Perhaps when the larval stages of Avia, Cosina, Madrasta, Nestressa, and Stiphroneruria are known, a logical subdivision of the tribe can be made. The two most highly evolved genera based on larval structure and behavior are Centroclisis and Paranthesclisis. Both appear to be select feeders in the laboratory and show reductions in the mandibular teeth to 2 (Centroclisis) or 1 (Paranthesclisis). Also, both genera have highly reduced antennae which are also reduced in one species of Fadrina. Synclisis and Syngenes appear to have evolved convergently in structure and behavior. Both genera are fast runners and burrowers, apparently favoring coastal beach dunes, having relatively long mandibles and with sternite IX relatively pointed and without peg-like setae on sternite VIII (Figs. 8, 9). Finally, Phanoclisis appears to be relatively plesiomorphic in many adult characters (distal palpomere, pretarsal claws) but its larva moves only backward, a behavioral trait shared by the unrelated Vella.

Measurements: Measurements (in mm) of the head capsule were made from the ventral surface. The longitudinal measurement was made along the midline from the base of the head capsule to the level of the mandible base. The width was measured at the widest part of the head capsule. The mandible length was measured (dorsal side) from the base to the distal side of the distal tooth. The width was measured at the widest part of the mandible. The average measurements are given with the number of specimens examined in parenthesis.

Illustrations: The photographs are all of the 3rd instar larva except for Figure 8 (Synclisis baetica) which is based on a 2nd instar larva. Figure 16 of Acanthaelisia sp. shows a deformed middle tooth of the right mandible. The left mandible of Figure 16 and both mandibles of Figure 20 show the normal condition of the mandibular teeth. The photographs were taken by Robert B. Miller.
Key to Genera of Acanthaclisini

LARVAE

1. Sternite VIII without short, blunt, peg-like setae although stout but pointed digging setae present (Figs. 8 -11) ................. 2
   Sternite VIII with numerous short, peg-like setae (apex truncate) (Figs. 3-7) ................................................................. 5

2. Ventral head capsule densely setose, except along midline (Fig. 21); Western Hemisphere ........................................... Vella
   Ventral surface of head capsule glabrous except laterally (Fig. 25) .... 3
3. Mandible with prominent setae on interior margin of mandible between tooth 1 and mandibular base; sternite IX broadly rounded (Fig. 11); Australia
   Mandible without setae between tooth 1 and mandibular base; sternite IX pointed (Figs. 12, 13) ............................. 4

4. Anterior margin of clypeal-labrum produced as a rounded lob (Fig. 13); Ethiopan
   Anterior margin of clypeal-labrum emarginate (Fig. 12); Palearctic ........ Synclisia

5. Mandible with 1 or 2 teeth and without setae on the interior margin of mandible (Figs. 18, 19) .................................. 6
   Mandible with 3 teeth and setae present on interior margin of mandible (Figs. 14-16) ................................................. 7
6. Mandible with 1 tooth (Fig. 19); Nearctic ....................... Paranthaclisis
   Mandible with 2 teeth (Fig. 18); Old World ......................... Centroclisis
7. Tooth 3 of mandible longer than middle tooth by at least 1.5 times (Fig. 14); Ethiopian
   Tooth 3 of mandible shorter than middle tooth (Figs. 15-16) .......... 8
8. Mandible with tooth 2 noticeably closer to tooth 3 than tooth 1 (Fig. 16); distance between mandibular teeth 1 and 3 greater than greatest width of mandible; ventral head capsule with thinly scattered setae; larva able to run forward ................................................. Acanthaclisis
   Mandible with tooth 2 slightly closer to tooth 1 than 3 (Fig. 15); distance between mandibular teeth equal to or slightly less than greatest width of mandible; ventral head capsule glabrous; larva moves backward only; Ethiopian .......................................................... Phanoclistis

ADULTS

1. Tibial spurs bent at nearly right angle, often with flange .......... 2
   Tibial spurs gently curved ..................................................... 8
2. Hindfemur without elongate sensory hair; costal area of forewing usually biareolate, upper series of cellules not much smaller than lower series .3
   Hindfemur with elongate sensory hair; costal area simple, or, if biareolate, then upper series of cellules much smaller than lower series .......... 4
3. Midfemur with 1 elongate sensory hair; male ectoproct with long postventral lobe; terga V and VI without silvery pubescence; Ethiopian, Middle East .... Syngenes Kolbe
   Midfemur with 2 elongate sensory hairs; male ectoproct short; terga V and VI with silvery, appressed pubescence; Palearctic .......... Synclisis Navas
4. Forewing costal area mostly simple; ocular rim with white setae that project over eye ....................................................... 5
   Forewing costal area predominately biareolate; ocular rim without setae except sometimes a tuft of black setae anteriorly ................. 6
5. Forefemur and midfemur with at least two elongate sensory hairs; ocular rim with long setae (much longer than width of scape); Old World ........ Centroclisis Navas
   Forefemur and midfemur with only 1 elongate sensory hair; ocular rim with very short setae (much shorter than width of scape); Nearctic ................ Paranthaclisis Banks
1 Paranthaclisis sp.  2 Centroclisis punctulata

3 Centroclisis punctulata

6. Pretarsal claws slender, longer than tibial spurs; pronotum longer than wide; distal palpomere of labium with small, oval-shaped sensory opening; Ethiopian .................................................. Phanoclisis Banks

Pretarsal claws smaller than tibial spurs; pronotum as wide or wider than long; distal palpomere of labium with an elongate slit-like sensory opening .................................................. 7

7. Tibial spur produced as flange just before "bend"; hindfemur not abruptly swollen near base; male ectoproct with postventral lobe more than 3 times longer than wide; Palearctic ......................... Acanthaclisis Rambur

Tibial spur not expanded just before "bend" but much wider somewhat before this point; hindfemur abruptly swollen near base; male ectoproct with postventral lobe much broader than long; Ethiopian ................. Fadrina Navas

8. Hindfemur with elongate sensory hair .................................................. 9

Hindfemur without elongate sensory hair .................................................. 10
9. Hindwing posterior area at medial fork at least 1.5 times higher than greatest presectoral height; hindwing presectoral area without accessory longitudinal vein; hindwing without large dark spots; Western Hemisphere


Vella Navas
Hindwing posterior area at medial fork no higher than greatest presectoral height; hindwing presectoral area with short accessory longitudinal vein near middle next to radial vein; hindwing with large dark spot near stigma and center of wing at about 2/3 distance to apex; India, Burma (Note: One species described from Africa but mislabeling is suspected)


StiphroDeuria Gerstaecker
Radial sector arises much closer to cubital fork in forewing than to medial fork in hindwing; distal palpomere of labium relatively short with a long oval-shaped sensory opening; Australia


Cosina Navas
Radial sector in about same relative position to cubital fork (forewing) and medial fork (hindwing) in both wings; distal palpomere of labium elongate with a long slit-like sensory opening


11. Forewing costal area narrow and single-celled at basal 1/2 sometimes becoming biareolate distally although not changing much in width before stigma


12. Forewing costal area broad and 2-celled from near base


13. Eye very large, greatest ocular width nearly twice that of interocular distance; male tergite VI posteriorly with dense black or white setae in marked contrast to preceding tergites; Ethiopian


Avia Navas
Eye only moderately enlarged, less than 1.5 times interocular distance; male tergite VI without unusual vestiture; Australian


Mestressa Navas
Hindwing with hypostigmatic cell less than 4 time longer than high; apex of hindwing with strong concavity beyond cell distal to hypostigmatic cell; Philippines


Hadrasta Navas
Hindwing with hypostigmatic cell more than 7 times longer than high; hindwing without concavity in apical field; Australia, ?Indonesia


Madrasta Navas
Hindwing without concavity in apical field; Australia


Heoclisis Navas


Acanthaclisis Rambur 1842
(Figs. 4, 16, 20)

Reference: Steffan (1975), Brauer (1855), Hagen (1873, 1887), Redtenbacher (1884), Willmann (1977)

Description: Head capsule (1) 4.9 mm long, 3.8 wide; mandible 1.5 long, .8 wide; anterior margin of clypeal-labrum produced as a rounded lobe; antenna longer than basal width of mandible; distal palpomere of labium about 2 times longer than broad, sensory opening small, not bulging; mandible strongly broadened at tooth 1, distance between teeth 1 and 3 greater than greatest width of mandible; tooth 2 longest and closer to tooth 3 than to 1; usually 2 setae between teeth 1 and 2, 1 seta between teeth 2 and 3; setae on exterior margin of mandible extending somewhat beyond tooth 2, longest setae about 1/3 greatest mandibular width; ventral head capsule with several well-separated setae (2nd and 3rd instars), or glabrous (1st instar); abdomen with long dark setae especially laterally on sternites I-VI; sternite VIII and IX with many peg-like setae; sternite IX broadly rounded.

This genus has a combination of peg-like setae on sternites VIII and IX, three widely spaced teeth on the mandibles, and a middle tooth longer than the distal tooth, which distinguishes it from other known genera. It is unique in having thinly-scattered setae on the ventral head capsule.

Behavior: Large larvae were found in Egypt in deep sand around the base of a palm tree. They move backward and forward rapidly. However, in pursuit of prey they appear to move only backward.

Larvae Studied: Acanthaclisis sp.
EGYPT: Ismailia, June 6, 1984, R. B. Miller and L. A. Stange (3 SC, 5 MC)

Centroclisis Navas 1909
(Figs. 2, 3, 18, 22)

(Sogra Navas 1912, =Neboda Navas 1911, =Heoclisis Navas 1914, =Sograssa Navas 1924, =Stenoclistis Navas 1932)

Description: Head capsule (1) 3.4 mm long, 3.0 wide; mandible 1.1 long, .55 wide; anterior margin of clypeal-labrum not produced, widely emarginate; distal palpomere of labium about 2 times longer than wide; sensory opening moderately large, bulging; antenna about as long as basal width of mandible; mandibles thick with 2
4 Acanthaclisis sp.

6 Paranthaclisis

8 Synclisis baetica

strong teeth and no setae on along interior margin; teeth of about equal size; exterior margin of mandible with short setae ending at tooth 2; mandible of uniform width to distal tooth; abdomen with numerous long black setae on sternites I-VII; sternites VIII and IX with numerous short, blunt peg-like setae; sternite IX broadly rounded.

5 Fadrina sp.

7 Phanoclisis longicollis

9 Syngenes longicornis

The 2-toothed mandible without setae on the inner margin is unique among the known genera of the tribe.

Behavior: The larva of the species studied moves both backward and forward but quite slowly. The mandibles are the most powerful observed in the Acanthaclisini which allows the larva to feed on harder-
bodied prey than most other types of antlions known to us. The mandibles are built for more powerful grasping of prey. This suggests why no setae are present on the inner margin of the mandibles, as these would be broken if present. Other acanthacrisine larvae studied drag prey swiftly through the sand killing them relatively slowly as they are eaten. They rely on speed and strength rather than fast-acting toxicity. However, although the Centroclisis larva studied was very powerful it was slow moving. Observations revealed that very strong toxin was injected into prey since large prey were paralyzed in a few seconds and were lifeless within 10 seconds. This is important to the larva because it lacks sufficient speed to protect itself against its prey by rapidly digging through the soil. The larva was not an incessant feeder as are other genera discussed except Paranthaclisis. It would rest for a few days after a sizeable meal without digging near the surface. Also, it proved to be strictly nocturnal, and would dig deeply if exposed to light. It captured prey by slowly digging backward and whipping its head backward at prey. The time passed from cocoon construction to adult emergence was 56 days. This appears to be the largest acanthaclisine genus in terms of described species (34) and also the most widely distributed, from South Africa north to Morocco and east to Malaya. Since the larvae live deep under the sand during the day they should be searched for at night.


Fadrina Navas 1912 (Figs. 5, 14, 26)

Description: Head capsule (1) 4.12 mm long, 3.31 wide; mandible 1.9 long, .66 wide; anterior margin of clypeal-labrum weakly sinuate, slightly emarginate at middle; antenna much longer than basal width of mandible; distal palpomere of labium about 2 to 2.5 times longer than wide; mandible broadened at level of tooth 1, distance between teeth 1 and 3 longer than greatest mandibular width; tooth 3 slightly longer than 2 which is slightly longer than 1; tooth intervals vary (2 species seen), tooth 2 closer to tooth 3 (sp. A, Fig. 17) or to tooth 1 (sp. B); setae on exterior margin of mandible extend from near base to level of tooth 3, longest setae about 1/4 greatest mandibular width; ventral surface of head capsule glabrous; abdomen with long, black setae on sternites I-VII; sternites VIII and IX with numerous short, blunt, peg-like setae; sternite IX bluntly rounded.

The larvae of Fadrina represent an extreme 3-toothed mandible type where the teeth are very close together and near the base of a strongly broadened mandible (Fig. 14).

Behavior: Larvae move backward or forward, but are reluctant to run forward. Larvae were found living in open sand. Larvae pursue prey by digging rapidly backward and then whipping the head backward to grasp prey when they are beneath it. They never ran forward after prey. Two species of Fadrina were reared. In one species, the anterior margin of the clypeal-labrum is sinuate, the antennae are equal in length to the basal width of the mandible, and tooth 3 is twice as long as tooth 2. In the other species, the anterior margin of the clypeal-labrum is produced as a broadly-rounded lobe, the antennae are twice as long as the basal width of the mandible, and tooth 3 is 1.5 times longer than tooth 2.

Larvae Studied: SOUTH AFRICA: Cape Province, 4 km. N. Clanwilliam, January 30, 1983, R. B. Miller, L. A. Stange (1 MC, 3rd instar skin); Baines Kloof (3 MC, 1 SC).

Beoculis Navas 1923 (Figs. 11, 17, 25)

References: Adams (1936), Mathew (1950)

Description: Head capsule (1) 4.12 mm long, 3.31 wide; mandible 1.9 long, .66 wide; anterior margin of clypeal-labrum weakly sinuate, slightly emarginate at middle; antenna much longer than basal width of mandible; distal palpomere of labium about 2 to 2.5 times longer than wide; mandible broadened at level of tooth 1, distance between teeth 1 and 3 longer than greatest mandibular width; tooth 3 slightly longer than 2 which is slightly longer than 1; tooth intervals vary (2 species seen), tooth 2 closer to tooth 3 (sp. A, Fig. 17) or to tooth 1 (sp. B); setae on exterior margin of mandible extend from near base to level of tooth 3, longest setae about 1/4 greatest mandibular width; ventral surface of head capsule glabrous; 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 especially along midline; sternite IX bluntly rounded.

We have studied only 2 preserved larvae from Australia which represent 2 different species. It is possible that at least 1 of these could be Cosina Navas. The large size of both larvae precludes
10 Vella fallax

11 Heocclusis sp.

12 Synclisis baetica

them from being Mestressa Navas, the third known genus from Australia.

Behavior: Mathew (1950) stated that these larvae only move backward. Adams (1936) remarked that some specimens were found at the base of trees. Mansell (personal communication) has reared at least one species found under rock overhangs in Australia. He observed that the larvae can walk forwards with great agility, but very seldom seem to do this, preferring to move backwards through the sand when pursuing prey and leave conspicuous tracks.

Larvae Studied: AUSTRALIA: Queensland, near Hughender, September 7, 1972, R. E. Woodruff (1 FSCA); 3 miles S. Woodstock, September 6, 1972, R. E. Woodruff (1 FSCA).

13 Sygeneses longicornis

Paranthaclis Banks 1907
(Figs. 1, 6, 19, 23)

References: Hagen (1887), Stange (1970, 1980)

Description: Head capsule (3 hageni) 2.8 mm long, 2.7 wide; mandible .9 long, .5 wide; anterior margin of clypeal-labrum not produced medially, roundly emarginate; distal palpmere of labium about 1.5 times longer than wide, sensory opening large and bulging; antenna with about 11 segments and shorter than basal width of mandible; mandible only slightly broadened at level of tooth; mandible with 1 tooth; mandible without setae except for short setae on exterior margin from base to about level of
tooth; ventral surface of head capsule glabrous; abdomen with short hair-like setae on sternites I-VII; sternites VIII and IX with numerous peg-like digging setae; sternite IX bluntly rounded.

The one-toothed mandible is unique among known genera of the tribe. Also, the reduction of the antenna is shared only by Centroclisis and one species of Fadrina.

**Behavior:** These larvae are found in sand dune areas and flat areas of deep sand, and move both forward and backward rapidly. Colonies from Nevada and California fed with difficulty but P. hageni (Banks) from Baja California and Paranthaclisis sp. from Florida fed on lepidopterous larvae and were reared. Field observations in Nevada showed P. nevadensis to be feeding on lepidopterous larvae and beetle larvae of the family Coccinellidae. Larvae dig rapidly backward after prey and grab it by whipping their head backward after they are underneath it. They never pursue prey by running forward. None of the species feed constantly, at least in the laboratory, but those from Nevada have prolonged periods of diapause corresponding to those periods of the year when their habitat has constant sub-freezing temperatures.


**Paranthaclisis** sp. FLORIDA: Gulf County, St. Joseph's Peninsula, November 1, 1978, L. A. Stange (1 FSCA, 1 MC).


**Paranthaclisis nevadensis** Banks. NEVADA: Washoe County, Pyramid Lake, June 10, 1980, R. B. Miller (1 MC).

**Phanoclisis** Banks 1913

(Figs. 7, 15, 24)

**Description:** Head capsule (3) 4.7 mm long, 3.5 wide; mandible 2.0 long, .6 wide; anterior margin of clypeal-labrum not produced medially, slightly emarginate medially; distal palpomere of labium about 2 times longer than wide, sensory opening moderately large and bulging; antenna with about 13 segments, longer than basal width of mandible; mandible weakly broadened at level of tooth 1, width at this point less than length between base and tooth 1; mandible typically with 1 seta between teeth 1 and 2, 2 setae between teeth 2 and 3, small setae on exterior margin of mandible from near base to about tooth 2; mandible with 3 teeth, tooth 3 longer than 2 which is longer than 1; tooth 2 closer to 1 than to 3; ventral surface of head capsule glabrous; distal palpomere of labium about 2 times longer than wide; abdomen with fine, pale, hair-like setae on sternites I-VII; sternites VIII without short, peg-like setae; sternite IX pointed (Fig. 8).

The shape of the last sternites (broadly pointed) is distinctive as is the shape of the mandible (evenly tapered from tooth 1 to 3), showing the most similarity to Syngenes. However, the anterior margins of the clypeal-labrum of the 2 genera are quite different.

**Behavior:** These larvae are very fast runners and fast burrowers, preferring open sand dune areas. They will run forward or dig backward after prey.
14 Fadrina sp.  2 mm.  15 Phanoclistis longicollis

16 Acanthaclisis sp.

17 Heoclisis sp.

18 Centroclisis punctulata


19 Paranthaclisis hageni

Syngenyes Kolbe 1897 =Onclus Navas 1912
(Figs. 9, 13)

Description: Head capsule (3) 3.5 mm long, 2.8 wide; mandible 1.60 long, .5 wide; anterior margin of clypeal-labrum
produced as a rounded lobe; antenna longer than basal width of mandible; distal palpomere of labium about 2 times longer than wide, sensory opening small, not bulging; mandible moderately broadened at level of tooth 1 (Fig. 13); mandible with distal tooth much longer than middle tooth, tooth 1 and 2 much closer together than tooth 2 and 3; distance between teeth somewhat longer (about 1.5 times) than greatest mandibular width; usually 2 setae between teeth 1 and 2 and between teeth 2 and 3; setae on exterior margin of mandible at least 1/3 length of mandible, extending to tooth 3; abdomen with only 5 pale setae on sternites I-VII; sternite VIII with weakly produced digging setae, no peg-like setae; sternite IX with many small peg-like setae; sternite IX pointed.

Syngenes larvae are distinguished from other acanthaclisine larvae by the median lobe of the clypeal-labrum in combination with the lack of the peg-like digging setae on sternite VIII. Also, the mandible is relatively slender with tooth 1 and 2 closer together than 2 and 3. Tooth 3 is the longest in contrast to most genera in the tribe. The 9th sternite is pointed (Fig. 9), most similar to the condition of Synclisis.

Behavior: We observed large numbers of larvae in sand dune areas of coastal South Africa. They can run fast forward and burrow quickly. They use both of the capabilities in capturing prey. In South Africa, their prey consisted mostly of large sand-burrowing Lepidoptera larvae.


Vella Navas 1913
(Figs. 10, 21)
(=Gyroplectron Esben-Petersen 1928)

References: Hagen (1873, 1887), Stange (1970, 1980)

Description: Head capsule (4) 4.2 mm long, 3.5 wide (fallax) or 4.7 long, 3.8 wide (americana); mandible 1.1 long, .6 wide (fallax) or 1.9 long, .7 wide (americana); anterior margin of clypeal-labrum (Fig. 10) nearly straight, weakly indented at middle; antenna much longer than basal width of mandible; distal palpomere about 3 times longer than wide, sensory area moderately long, bulging; mandible weakly broadened at tooth 1, width at this point less than between base of mandible and tooth; 3 mandibular teeth evenly spaced, tooth 2 and 3 are nearly equal in length, longer than tooth 1; ventral surface of head capsule densely setose; sternite VIII and IX densely setose, many long truncate setae, no peg-like setae, but short, pointed setae on sternite VIII; sternite IX bluntly rounded.

The densely pubescent ventral surface of the head capsule is a diagnostic character in the tribe.

Behavior: We have found the larvae in dunes (V. assimilis) and in fairly deep tracts of sand (V. americana and V. fallax). These larvae only move backward through the sand leaving conspicuous trails on the surface. V. americana has been observed feeding on Myrmeleon larvae in Florida.


Vella fallax haitiensis Smith. FLORIDA:Monroe County, Bahia Honda, October 17, 1982 (1 SC, 9 MC).

Higher Category Larval Characters

To help identify larvae of the tribe Acanthaclisini we are providing a key to the subfamilies and tribes of Myrmeleontidae. However, many genera (about 75%) are unknown in the larval stage as are several tribes (Maulini, Pseudimarini, Porrerini) and many subtribes (Dimarellina, Percystina, Voltorina, Acanthoplectrina, etc.) are unknown to date in the larval stage. Therefore, the following key will undoubtedly not fit all the genera, especially highly specialized genera, and should be considered as a preliminary key. It is obvious to us that the Dendroleontini and Nemoleontini (including Glenurini, Creoleontini, Formicoleontini, etc.) are...
20 Acanthaclisis sp.

21 Vella fallax

22 Centroclisis punctulata

23 Paranthaclisis hageni

24 Phanoclisis longicollis

25 Heoclisis sp.

26 Fadrina sp.
closely related, and therefore some genera may overlap in structure. The Brachynemurini includes the tribes Gepini, Myrmeceaelurini and Nesoleontini according to our larval studies, but some bizarre larvae are apparent in this tribe (Gonopholeon, Jaffuelia) which distorts the clear definition of this group. In general, the modification of the terminal abdominal segments (highly modified digging setae, presence or absence of submedial teeth on sternite VIII), the shape of the mandible, the development of the labial palpus, and the structures of the mesothoracic spiracles (borne on tubercles or not) appear to offer significant tribal characters.

### Key to Subfamilies and Tribes of Myrmeleontidae

**LARVAE**

(Porrerini unknown)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Decision</th>
<th>Subfamily/tribe</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Tergite IX with median lobe bearing median sclerotized process or sternite IX with highly modified pair (or more) of digging setae (blade-like to broadly triangular); sternite VIII with pair of submedial teeth near posterior margin</td>
<td>2</td>
<td>Myrmeleontinae</td>
</tr>
<tr>
<td>2.</td>
<td>Tergite IX without median lobe bearing sclerotized process; sternite IX without highly modified digging setae; sternite VIII with or without submedial teeth near posterior margin</td>
<td>3</td>
<td>Palparinae</td>
</tr>
<tr>
<td>3.</td>
<td>Labial palpus shorter than basal width of mandible; mesothoracic spiracle not borne on tubercle; head without dolichasters; backward movement only (many genera) or backward and forward</td>
<td>4</td>
<td>Acanthaclisini</td>
</tr>
<tr>
<td>4.</td>
<td>Mandible with some setae on exterior margin as long or longer than greatest mandibular width; sternite VIII with pair of inconspicuous submedian teeth near posterior margin; make pitfall traps</td>
<td>5</td>
<td>Dendroleontini</td>
</tr>
<tr>
<td>5.</td>
<td>Mandible with distal tooth equal to or shorter than middle tooth, distal tooth often set at different angle (acute projecting anteriorly); usually middle tooth closer to distal tooth than to basal tooth; sternite VIII often with pair of inconspicuous submedian teeth near posterior margin (absent in Nophis, Scotoleon); scoli usually absent on abdomen and much reduced on thorax (known exceptions are Gonopholeon and Jaffuelia) (includes Gepini, Nesoleontini, and Myrmeceaelurini)</td>
<td>6</td>
<td>Nemoleontini</td>
</tr>
<tr>
<td>6.</td>
<td>Mesoscutum usually with tuft of setae at middle; 9th abdominal segment nearly as long as wide</td>
<td>Dendroleontini</td>
<td>Nemoleontini</td>
</tr>
</tbody>
</table>

The Brachynemurini includes the tribes Gepini, Myrmeceaelurini and Nesoleontini according to our larval studies, but some bizarre larvae are apparent in this tribe (Gonopholeon, Jaffuelia) which distorts the clear definition of this group. In general, the modification of the terminal abdominal segments (highly modified digging setae, presence or absence of submedial teeth on sternite VIII), the shape of the mandible, the development of the labial palpus, and the structures of the mesothoracic spiracles (borne on tubercles or not) appear to offer significant tribal characters.
**Genera Studied (Larval Stage)**

(Approximate number of genera in parentheses)

<table>
<thead>
<tr>
<th>Family</th>
<th>Genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palparinae (14):</td>
<td>Palparini (9): Nosa, Palpares, Stenares</td>
</tr>
<tr>
<td></td>
<td>Dimarini (includes Echthromyrmicini): Dimares</td>
</tr>
<tr>
<td></td>
<td>Pseudimarini (1): None</td>
</tr>
<tr>
<td>Stilbopteryginae (2):</td>
<td>Stilbopteryx</td>
</tr>
<tr>
<td>Myrmeleontinae (138):</td>
<td>Acanthaclisini (14): Acanthaclisis, Centroclis, Padrina, Heoclisis, Phanoclisis, Paraclisida, Synclisida, Syngenes, Vella</td>
</tr>
<tr>
<td>Brachynemurini (includes Gepini, Isoleontini, Myrmecaelurini, Nesoleontini): Abatoleon, Ameromyia, Brachynemurus, Chaetoleon, Cueta, Furgelia, Gepus, Gnopholeon, Jaffuelia, Lemolemus, Menkeleon, Myrmecaelurus, Nophis, Scotoleon, Solter</td>
<td></td>
</tr>
<tr>
<td>Dendroleontini (31):</td>
<td>Bankisius, Dendroleon, Tricholeon</td>
</tr>
<tr>
<td>Myrmeleontini (5):</td>
<td>Myrmeleon, Weelius</td>
</tr>
<tr>
<td>Nemoleontini (includes Distoleontini, Formicaeleontini, Protoplectrini, Creoleontini, Obini, Nyutini, Glenurini, Dimarellini) (64): Creoleon, Distoleon, Elachyleon, Eremoleon, Gymnocnemia, Glenurus, Navasoleon, Neureleon, Obus, Psammoleon</td>
<td></td>
</tr>
</tbody>
</table>

**ACKNOWLEDGMENTS**

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**BIBLIOGRAPHY**

Bibliography of the Neuropterida

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