

A Generic Review of the Acanthaclisine Antlions Based on Larvae (Neuroptera: Myrmeleontidae)¹

Lionel A. Stange² and Robert B. Miller³

INTRODUCTION

The tribe Acanthaclisini Navas contains 14 described genera which we recognize as valid. We have reared larvae of 8 of these (**Acanthaclisis** Rambur, **Centroclisis** Navas, **Fadrina** Navas, **Paranthaclisis** Banks, **Phanocclisis** Banks, **Synclisis** Navas, **Syngenes** Kolbe, and **Vella** Navas). In addition, we have studied preserved larvae from Australia which probably represent the genus **Heocclisis** Navas. This represents the majority of the taxa, lacking only the small genera **Avia** Navas, **Cosina** Navas, **Madrasta** Navas, **Mestressa** Navas, and **Stiphroneuria** Gerstaecker. 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 illustrations. 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 relationships. Observations 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: **Acanthaclisis** Rambur, **Avia** Navas (=Jaya Navas), **Centroclisis** Navas (=Sogra Navas, =Neboda Navas, =Neocclisis Navas, =Stenocclisis Navas, =Sograssa Navas), **Cosina** Navas, **Heocclisis** Navas, **Madrasta** Navas, **Mestressa** Navas, **Paranthaclisis** Banks, **Phanocclisis** Banks (=Nora Navas), **Stiphroneuria** Gerstaecker (=Neriga Navas), **Synclisis** Navas, **Syngenes** Kolbe (=Onclus Navas), **Vella** Navas (=Gyroplectron Esben-Petersen) [Note: The genus **Vellassa** Navas is of uncertain status].

General Biology: Principi (1947) detailed the biology of **Synclisis baetica**

1. Contribution No. 603, Bureau of Entomology, Div. Plant Industry, Fla. Dept. Agric. & Consumer Services, Gainesville, FL
2. Taxonomic Entomologist, Div. Plant Industry, P. O. Box 1269, Gainesville, FL 32602.
3. FSCA Research Associate, P. O. Box 1092, Project City, CA 96079.

(Rambur), whereas Steffan (1975) provides additional data on this species as well as on **Acanthaclisis occitanica** (Villers). Our best biological data on the Acanthaclisini, excluding larval behavior, are based on observations of **Paranthaclisis congener** (Hagen) made near Reno, Nevada. In common with most antlions, **P. congener** lay eggs at dusk. As the female expels the eggs, she evenly coats them with sand, using the posterior 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, **Paranthaclisis** 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 **Paranthaclisis**. This is unlike other tribes where upon hatching the head capsule and mandibles expand with the mandibles hanging like limp spaghetti before expansion. Other characteristics 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 convenient 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 (**Paranthaclisis**), 2 (**Centroclisis**), 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 *Phanoclis* and *Vella*. Forward and backward movement are found in *Acanthaclis*, *Centroclis*, *Fadrina*, *Heoclis*, *Paranthaclis*, *Syngenes*, and *Synclis*. The latter three genera are fast runners and burrowers. *Centroclis* larvae are slow creepers and diggers. *Acanthaclis*, *Heoclis*, 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 *Centroclis* and *Paranthaclis*) 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 *Centroclis*, 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. *Centroclis* 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 - *Centroclis* and *Paranthaclis*; Group 2 - *Syngenes* and *Synclis*; Group 3 - *Acanthaclis*, *Fadrina*, and *Phanoclis*; Group 4 - *Heoclis* and *Vella*. Navas (1912) divided the tribe into 2 groups; "uncinati" (adult tibial spurs bent at nearly right angle)

and "uncati" (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*, *Mestressa*, and *Stiphroneuria* are known, a logical subdivision of the tribe can be made. The two most highly evolved genera based on larval structure and behavior are *Centroclis* and *Paranthaclis*. Both appear to be select feeders in the laboratory and show reductions in the mandibular teeth to 2 (*Centroclis*) or 1 (*Paranthaclis*). Also, both genera have highly reduced antennae which are also reduced in one species of *Fadrina*. *Synclis* 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, *Phanoclis* 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 (*Synclis baetica*) which is based on a 2nd instar larva. Figure 16 of *Acanthaclis* 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

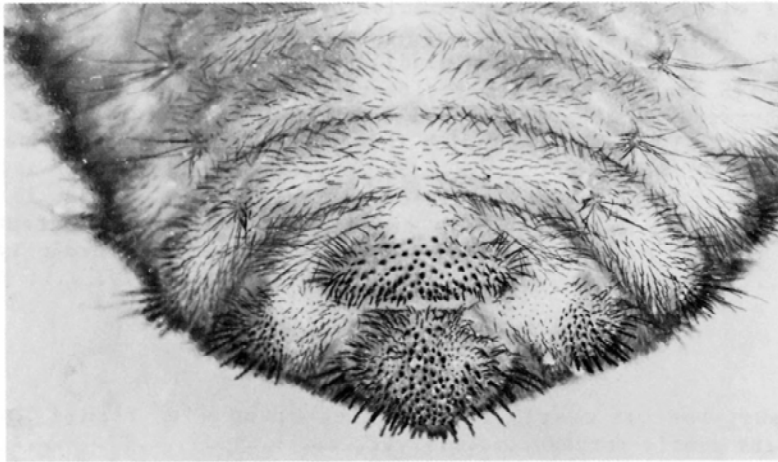
1. Sternite VIII without short, blunt, peg-like setae although stout but pointed digging setae present (Figs. 8 -11).....2
Sternite VIII with numerous short, peg-like setae (apex truncate) (Figs. 3-7) 5
2. Ventral head capsule densely setose, except along midline (Fig. 21); Western Hemisphere **Vella**
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 **Heoclisis**
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); Ethiopian **Syngenes**
Anterior margin of clypeal-labrum emarginate (Fig. 12);Palaeartic
..... **Synclisis**
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 **Fadrina**
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 **Phanoclisis**

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; Palaeartic **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 **Phanoclis** 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)
..... **Stiphoneuria Gerstaecker**
10. 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
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
12. 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**
13. Hindwing with hypostigmatic cell less than 4 times longer than high; apex of hindwing with strong concavity beyond cell distal to hypostigmatic cell; Philippines **Madrasta Navas**
Hindwing with hypostigmatic cell more than 7 times longer than high; hindwing without concavity in apical field; Australia, ?Indonesia
..... **Heoclisia 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.

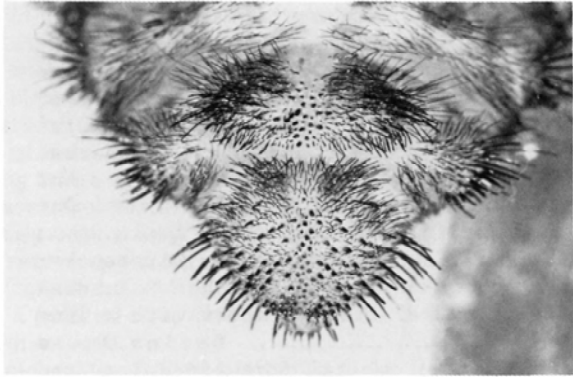
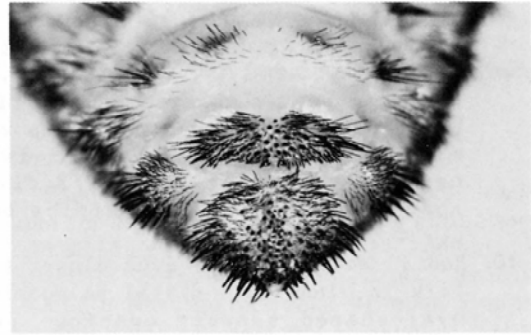
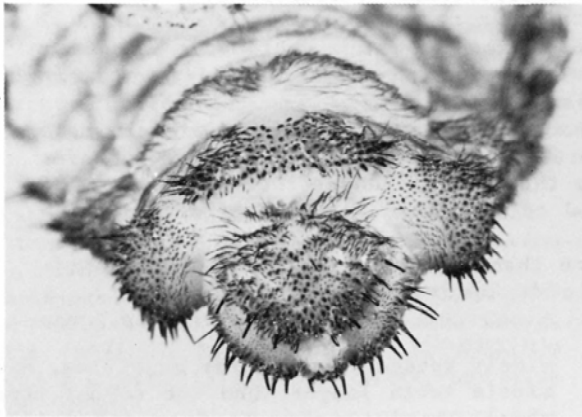
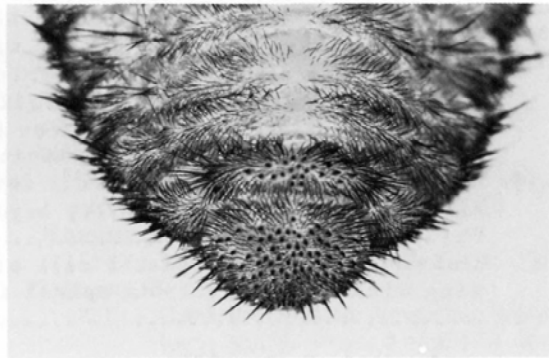
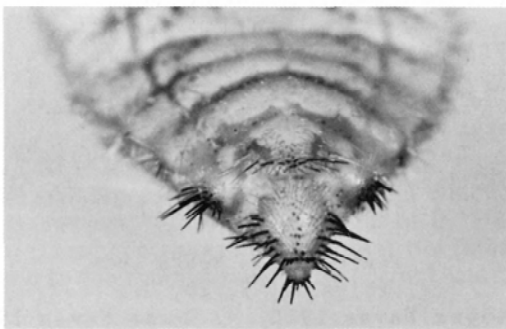
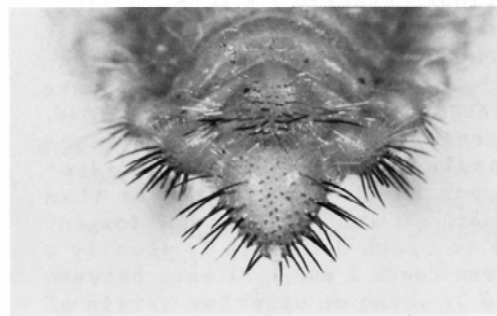
Larvae Studied: **Acanthaclisis** sp. EGYPT: Ismailia, June 6, 1984, R. B. Miller and L. A. Stange (3 SC, 5 MC).

Centroclisis Navas 1909

(Figs. 2, 3, 18, 22)

(=**Sogra** Navas 1912, =**Neboda** Navas 1911, =**Neoclisia** Navas 1914, =**Sograssa** Navas 1924, =**Stenoclisia** 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.5 *Fadrina* sp.6 *Paranthaclisis*7 *Phanoclis longicollis*8 *Synclisis baetica*9 *Syngenes longicornis*

1 mm.

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.

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 acanthaclisine 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.

Larvae Studied: *Centroclisis punctulata* Navas. Tunisia: Tozeur, May 17, 1984, R. B. Miller, L. A. Stange (1 MC, 3rd instar skin).

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

Description: Head capsule (1) 3.0 mm long, 2.3 wide; mandible 1.0 long, .5 wide; anterior margin of clypeal-labrum variable, sinuate, or produced as very broadly-rounded lobe; distal palpomere of labium about 2 times longer than wide; sensory opening not bulging; mandible very broad at level of tooth 1 and beyond to 3; tooth 3 at least 1.5 times longer than tooth 2; usually 1 seta between teeth; setae on exterior margin of mandible relatively long, some almost 1/3 greatest mandibular width; ventral head capsule glabrous; abdomen with numerous 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.

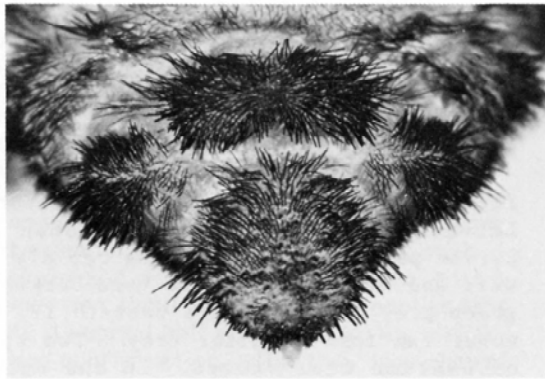
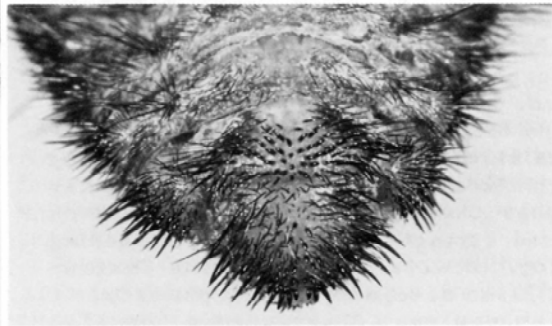
Larvae Studied: SOUTH AFRICA: Cape Province, 4 km. N. Clanwilliam, January 30, 1983, R. B. Miller, L. A. Stange (1 SC); Baines Kloof (3 MC, 1 SC).

***Heoclisis* Navas 1923**
(Figs. 11, 17, 25)

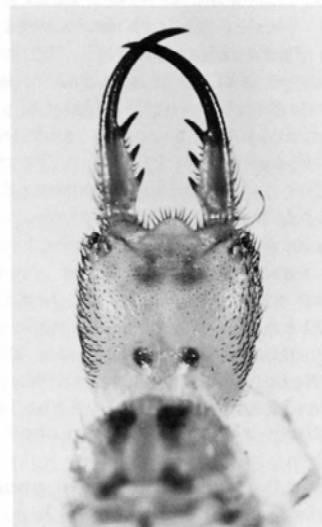
References: Adams (1936), Mathew (1950)

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 *Heoclisia* sp.

1 mm.

12 *Synclisis baetica*13 *Syngenes longicornis*

2 mm.

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).

Paranthaclisis 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 palpomere 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.

Larvae Studied: **Paranthaclisis hageni** (Banks). MEXICO: Baja California, Chapala Dry Lake, June 20, 1983, R. B. Miller, L. A. Stange (4 SC, FSCA); CALIFORNIA: Inyo County, Stovepipe Wells, Death Valley, January 3, 1965, F. Parker, L. A. Stange, (20 SC, FSCA); San Bernardino County, Kelso, August 15, 1973, R. B. Miller (1 MC).

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

Paranthaclisis congener (Hagen). NEVADA: Storey County, 27 miles E. Reno, August 9, 1980 (11 MC, SC, FSCA, from eggs); Washoe County, 4 miles N. Nixon, January 4, 1981, R. B. Miller (4 MC, SC).

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

Phanocclisis Banks 1913

(Figs. 7, 15, 24)

Description: Head capsule (1) 3.9 mm long, 3.2 wide; mandible 1.5 long, .8 wide; anterior margin of clypeal-labrum produced as a rounded lobe, slightly indented medially; distal palpomere of labium about 3 times longer than wide, sensory opening small, not bulging; antenna longer than basal width of mandible; mandible greatly

broadened at level of tooth 1, distance between 3 teeth equal to or slightly less than greatest width of mandible; mandibular tooth 2 longer than tooth 3, tooth 2 somewhat closer to 1 than to 3; usually 1 seta between teeth; setae on exterior margin of mandible about as long as one-half mandibular width; ventral surface of head capsule glabrous; sternites VIII and IX with numerous peg-like digging setae; sternite IX bluntly rounded.

Behavior: These larvae exhibit only backward movement and were found in sand dune habitats. They dig very rapidly after prey.

Larvae Studied: **Phanocclisis longicollis** (Rambur). TUNISIA: 30 km. NW Gafsa, Qued el Kebid, May 15, 1984, R. B. Miller, L. A. Stange (4 MC, SC). EGYPT: Abu Rawash (near Cairo), May 30, 1984, R. B. Miller, L. A. Stange (2 MC, 2 SC).

Syncclisis Navas 1919

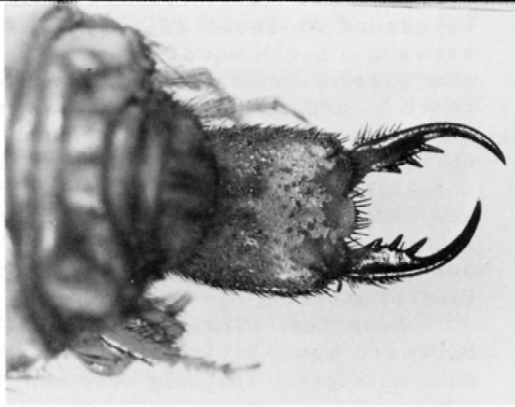
(Figs. 8, 12)

References: Redtenbacher (1884), Principi (1947), Steffan (1975)

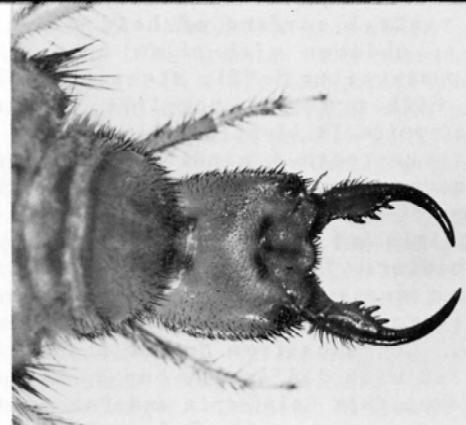
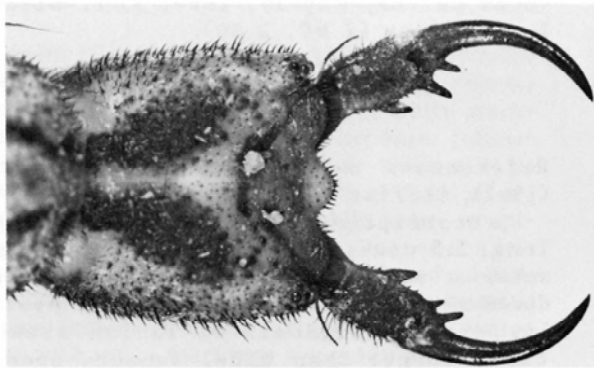
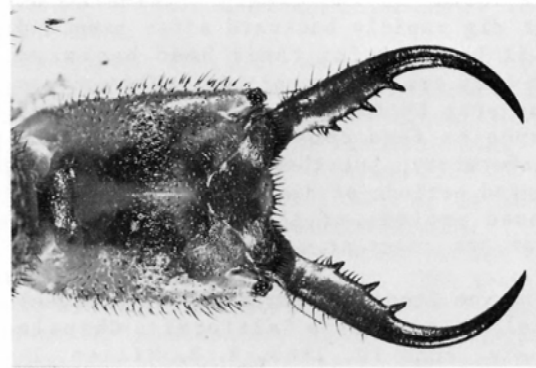
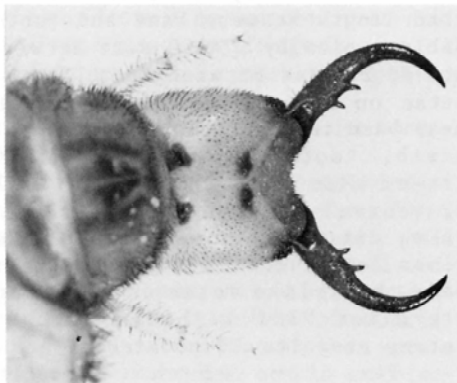
Description: Head capsule (3) 4.7 mm long, 3.5 wide; mandible 2.0 long, .6 wide; anterior margin of clypeal-labrum not produced medially, slightly emarginate medially; distal palpomere of labium about 2 times longer than wide, sensory opening moderately large and bulging; antenna with about 13 segments, 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.

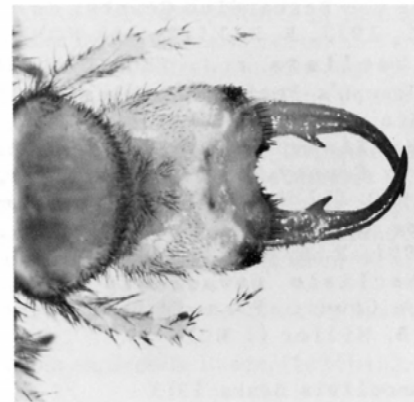
Behavior: These larvae are very fast runners and fast burrowers, preferring open sand dune areas. They will run forward or dig backward after prey.

14 *Fadrina* sp.

2 mm.

15 *Phanoclis longicollis*16 *Acanthaclisis* sp.17 *Heoclis* sp.18 *Centroclisis punctulata*

Larvae Studied: *Synclisis baetica* (Rambur). SPAIN:San Lucar de Barrameda, (6 SC); TUNISIA:Bizerte, May 28, 1984, R. B. Miller, L. A. Stange (10 SC, FSCA, 10 MC); EGYPT:Hannovil Beach (SW of Alexandria), June 7, 1984, R. B. Miller, L. A. Stange (4 MC, SC).

19 *Paranthaclisis hageni*

Syngenes 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.

Larvae Studied: *Syngenes longicornis* (Rambur). SOUTH AFRICA:Natal, Warner Beach, 10 miles S. of Durban, January 1983, R. B. Miller, L. A. Stange (10 SC, FSCA, 11 MC); Cape Province, Mossel Bay, January 26, 1983, R. B. Miller, L. A. Stange (1 SC).

Vella Navas 1913

(Figs. 10, 21)

(=*Cyroplectron* 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.

Larvae Studied: *Vella americana* (Drury). FLORIDA:Highland County, 5 miles S. Sebring, March 12, 1980, R. B. Miller, L. A. Stange (3 FSCA, SC); Archbold Biological Station, March 13, 1980, R. B. Miller, L. A. Stange (2 SC, 2 MC); Okaloosa County, 2 miles N. Holt, October 15, 1983, L. A. Stange (2 SC).

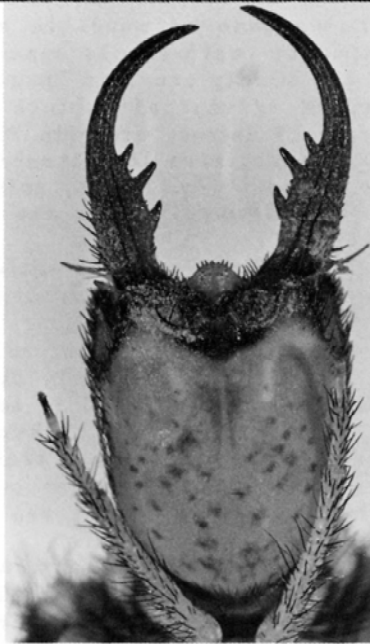
Vella assimilis Banks. PERU:La Libertad, Laredo Sand Hills, July 1, 1974, L. A. Stange (30 SC); July 16, 1982, R. B. Miller, L. A. Stange (2 SC, 4 MC).

Vella fallax fallax (Rambur). MEXICO:Baja California Sur, Juncalito Beach, May 1983, R. B. Miller, L. A. Stange (2 SC, 2 MC); Tamaulipas, San Antonio, June 26, 1981, R. B. Miller, L. A. Stange (1 FSCA, 1 MC).

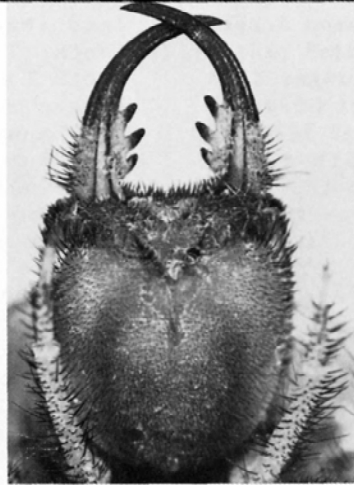
Vella fallax haitiensis Smith. FLORIDA:Monroe County, Bahia Honda, October 17, 1982 (1 SC, 9 MC).

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, Periclystina, 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*

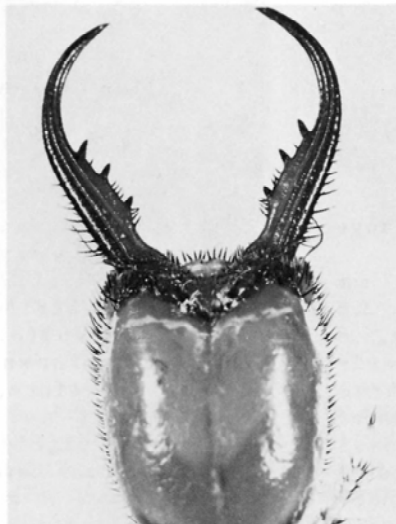


23 *Paranthaclisis hageni*



24 *Phanocclisis longicollis*

2 mm.



25 *Heocclisis* sp.



26 *Fadrina* sp.

closely related, and therefore some genera may overlap in structure. The Brachynemurini includes the tribes Gepini, Myrmecaelurini and Nesoleontini according to our larval studies, but some bizarre larvae are apparent in this tribe (**Gnopholeon**, **Jaffuelia**) which distorts the clear definition of this group. In general, the modifica-

tion 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)

1. 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 2
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 Myrmeleontinae 3
2. Tergite IX with median lobe bearing median sclerotized process; sternite IX without highly modified digging spines; sternite VIII with inconspicuous submedial teeth; mandible with 3 teeth; Australia Stilbopteryginae
Tergite IX with median lobe without sclerotized median process; sternite IX with pair (or more) of submedial digging setae greatly enlarged as blade-like to broadly triangular processes (except some **Dimares**); sternite VIII with well developed submedial teeth near posterior margin; mandible with 2 to 5 teeth; widespread except Australia and North America Palparinae
3. 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 4
Labial palpus longer than basal width of mandible or mesothoracic spiracle borne on tubercle; head often with dolichasters; backward and forward movement 5
4. Mandible with some setae on exterior margin as long or longer than greatest mandibular width; sternite VIII with pair of inconspicuous submedial teeth near posterior margin; make pitfall traps Myrmeleontini
Mandible with longest setae on exterior margin less than one-half greatest mandibular width; sternite VIII without teeth on subapical margin; pitfall traps absent Acanthaclisini
5. 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 submedial teeth near posterior margin (absent in **Nophis**, **Scotoleon**); scoli usually absent on abdomen and much reduced on thorax (known exceptions are **Gnopholeon** and **Jaffuelia**) (includes Gepini, Nesoleontini, and Myrmecaelurini) Brachynemurini
Mandible with distal tooth longer than middle tooth (**Glenurus** with 2 teeth), teeth more or less parallel and usually equidistant; sternite VIII with or without submedial teeth; scoli often developed on thorax, less common on abdomen 6
6. Mesoscutum usually with tuft of setae at middle; 9th abdominal segment nearly as long as wide Dendroleontini
Mesoscutum without tuft of setae at middle; 9th abdominal segment at least 2 times wider than long Nemoleontini

Genera Studied (Larval Stage)

(Approximate number of genera
in parentheses)

Palparinae (14):
 Palparini (9): **Nosa, Palpares, Stenares**
 Dimarini (includes Echthromyrmicini)
 (3): **Dimares**
 Maulini (1): None
 Pseudimarini (1): None
Stilbopteryginae (2): **Stilbopteryx**
Myrmeleontinae (138):
 Acanthaclisini (14): **Acanthaclisis, Centroclisis, Fadrina, Heoclisis, Phanoclisis, Paranthaclisis, Synclisis, Syngenes, Vella**
 Brachynemurini (includes Gepini, Isoleontini, Myrmecaelurini, Nesoleontini) **Abatoleon, Ameromyia, Brachynemurus, Chaetoleon, Cueta, Furgella, Gepus, Gnopholeon, Jaffuelia, Lemolemus, Menkeleon, Myrmecaelurus, Nophis, Scotoleon, Solter**
 Dendroleontini (31): **Bankisus, Dendroleon, Tricholeon**
 Myrmeleontini (5): **Myrmeleon, Weelius**
 Nemoleontini (includes Distoleontini, Formicaleontini, Protoplectrini, Creoleontini, Obini, Nyutini, Glenurini, Dimarellini) (64): **Creoleon, Distoleon, Elachyleon, Eremoleon, Gymnocnemia, Glenurus, Navasoleon, Neuroleon, Obus, Psammoleon**

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