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A revision of the genus *Navasoleon* Banks (Neuroptera: Myrmeleontidae: Nemoleontini)

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A revision of the genus *Navasoleon* Banks (Neuroptera: Myrmeleontidae: Nemoleontini)

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Abstract. Nine species of *Navasoleon* (Neuroptera: Myrmeleontidae: Nemoleontini) are recognized in the present work with the description of seven **new species**: *N. amazonas* Stange, *N. brasiliensis* Miller, *N. egeri* Stange, *N. lithophilus* Miller, *N. lotti* Stange, *N. tarsalis* Miller, and *N. venezolanus* Stange. *Navasoleon bosqui* (Navás) is designated a **nomen dubium**. A key to the species is provided as well as to the genera of Nemoleontini with closing pretarsal claws. The larvae of two species are described and keyed with biological notes. Biological data presented in Miller and Stange (1985), erroneously attributed to *N. bolivianus* (Banks), has now been corrected to *N. lithophilus*. Included in this treatise are 71 color photographs including photos of male and female terminalia, male genitalia, and two species of larvae.

Key words. Biology, Zoogeography, keys to adults, larvae of *Navasoleon*, key to genera with closing tarsal claws, pretarsal claws.

Resumen. Se reconocen nueve especies de *Navasoleon* (Neuroptera: Myrmeleontidae: Nemoleontini) con las descripciones de seven **especies nuevas**: *N. amazonas* Stange, *N. brasiliensis* Miller, *N. egeri* Stange, *N. lithophilus* Miller, *N. lotti* Stange, *N. tarsalis* Miller, y *N. venezolanus* Stange. Se designa a *Navasoleon bosqui* (Navás) como **nomen dubium**. Se presenta una clave para las nueve especies y para las larvas además para los generos de Nemoleontini con uñas prensiles. Se provee una diagnosis para las especies además de datos sobre distribución geográfica. Se describen las larvas de dos especies con observaciones biológicas. Datos biológicos en el trabajo de Miller and Stange (1985), erroneamente asignado como *N. bolivianus* (Banks), ahora corregido a *N. lithophilus*. Se incluye 71 fotos de color, incluyendo fotos de las terminalias de los machos y hembras, las genitalias de los machos, y las larvas de dos especies.

Palabras clave. La biología, Zoogeografía, claves para los adultos, larvas de *Navasoleon*, clave para los géneros con uñas prensiles, uñas prensiles.

Introduction

The genus *Navasoleon* Banks differs from all other new world groups of antlions by having the foreleg elongate, usually much longer than the hindleg and midleg. The pretarsal claws can close against the setal brush on the ventral surface of the distal tarsomere. This South American genus is unusual as the larvae live on bare rock (Miller and Stange 1985). The larvae are ascalaphid-like in appearance, with abdominal scolus-like processes and with the mandibular teeth placed distally. Nine rather uncommonly collected species are known and are classified in three species groups based on leg structure, wing venation and female terminalia. The species appear to have restricted distributions suggesting that more species will probably be found in other areas. Descriptions and keys to the species are provided as well as biological notes. Also, a key to the genera of Nemoleontini with folding pretarsal claws is provided.

Materials and Methods

Adult terminology is based on Stange (1970a) and larval terminology on Badano and Pantaleoni (2014). Larvae were preserved in 75 percent ethanol after treatment with KAAD larval fixative (solution made from kerosene, ethyl alcohol, glacial acetic acid and dioxane). A machinist's caliper was used to

make measurements of adult wings and body length. Most photos of larvae were made from preserved specimens, which lack the natural coloration seen in live material. Photographs of adults and larvae were taken using an Auto Montage (Leica Z16 APO) zoom lens attached to a JVC 3-CCD digital camera (KY-F75U), and montaged with syncroscope Automontage software. Images of adult antlions were captured from pinned specimens. Male genitalia, after clearing in KOH and dissection, were photographed under ethanol submerged cover slips to prevent movement. After study and photographs, the genitalia were stored in microvials in glycerin associated with pinned specimens. Female terminalia, after clearing in KOH, were placed in petri dishes and covered with a microscope slide, where they were then photographed after correct positioning had been achieved. Preserved larvae were photographed under ethanol submerged microscope slides. Photographs were electronically enhanced and cleaned up using the Picasa program. Use of this program on terminalia was found to bring out visual contrast between tissues better than the use of chemical dyes. Measurements of the body and wing lengths are based on FSCA specimens, and were taken as accurately as possible given logistical challenges. Coloration characters provided are generally limited in extent in deference to the color photos, which provide much better detail than words. Six-dram plastic snap cap vials, $\frac{3}{4}$ internally lined with coarse dark blue craft paper, were used for field collecting and rearing because they provided a good gripping surface for the larvae. Papers could be slid out of the vials and attached to the wall of a Styrofoam cup emergence chamber after construction of the cocoon.

Twenty-nine adult and two larval specimens studied are deposited in the following institutions:

INPA Coleção Sistemática de Entomologia, Instituto Nacional de Pesquisas de Amazonia, Manaus, Brazil

MACN Museo Argentino de Ciencias Naturales, Buenos Aires, R. Argentina.

MCZC Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.

MNHN Museum National d'Histoire Naturelle, Paris, France

Results

Navasoleon Banks

Navasoleon Banks 1943: 168.

Type species. *Gymnocnemia boliviana* Banks, by original designation. Gender is masculine.

Taxonomy. Miller and Stange 1985: 122.

Further description. Stange 1963: 810; 1970: 11.

Biology. Miller and Stange 1985: 120-126, 6 figures (larva, pupa, habitat).

Catalog. Stange 1970: 231; 2004: 191.

Distribution. South America.

Description. Adult. Antenna long and slender, weakly clavate or filamentous; legs elongate, foreleg, in six species much longer than hindleg; tibial spurs absent; pretarsal claws capable of closing against ventral surface of distal tarsomere; black setae on ventral surface of distal tarsomere hooked apically on foreleg (except brasiliensis group) but usually not hooked on other legs; tarsomeres 1-4 with hair mat ventrally; femoral sense hair short, sometimes not distinguishable from other setae; foreleg tarsomere 1 and 2 combined length usually longer than distal tarsomere; forewing with anterior margin evenly curved toward apex, forewing radial sector arising at or beyond cubital fork; posterior fork of vein CuA at an oblique angle to hind margin; vein 2A widely separated from normal 3A before strong angle toward posterior margin; posterior fork of vein CuA reaches posterior border near or well beyond origin of radial sector; hindwing shorter than forewing, in repose apices of wings coincide; abdomen shorter than wings; male ectoproct without postventral lobe; male genitalia a gonarcus and two parameres with an oval sclerite structure sometimes present between parameres; female ectoproct with inconspicuous scraping

setae; posterior gonapophysis variably swollen and thumb-like, beset with many fine hair-like setae; lateral gonapophyses fused or not, with scraping setae; pregenital plate usually present.

Larva (Fig. 65–69). Mandible with three teeth, which arise well anterior to midpoint of mandible; tooth 2 closer to 3 than to 1; head capsule with long, fine white hair laterally; body flattened with metathorax with 2 pairs of scolus-like processes that are much longer than wide; abdomen with scolus-like process on segments 1–7; hindpretarsal claws less than twice as long as mesothoracic pretarsal claws; spiracles not borne on tubercles; sternite 8 without odontoid process; sternite 9 with small stout setae posteriorly.

Biology (after Miller and Stange 1985). The larvae of two species have been found and reared: *Navasoleon lithophilus* Miller in Peru and *N. venezolanus* Stange in Venezuela. Both live on smooth, clean rock surfaces where they are oriented head downward or are completely horizontal on the ceiling within meters of each other whereas nearby and apparently suitable rocks were devoid of larvae. *Navasoleon lithophilus* was misidentified as *Navasoleon bolivianus* (Banks) in Miller and Stange (1985).

Zoogeography. The species are localized. Five species are known from only one locality whereas *N. leptocerus* (Navás) is known only from the contiguous states of La Rioja and Catamarca in Argentina and *N. tarsalis* Miller from the nearby states of Falcon and Guarico in Venezuela. *N. brasiliensis* Miller occurs in three fairly separated states of Brazil. The leptocerus group is widespread in South America occurring in Peru, Bolivia, Argentina, and Venezuela. Two species occur in Argentina, one in arid areas (*N. leptocerus*) and the other in cloud forests (*N. lotti* Stange). Two species occur in Venezuela, *N. tarsalis* and *N. venezolanus* Stange.

Discussion. Species of *Navasoleon* are known only from South America where nine uncommon species are recognized. They are sorted into three species group based on adult morphology. The leptocerus group consists of five morphologically similar species. Two species of this group are known from larvae. The brasiliensis group differs notably from the leptocerus group in the relatively shorter foreleg, wing venation and female terminalia. The male genitalia of *N. brasiliensis* are unique in structure. These species are tentatively referred to *Navasoleon* but future discoveries of the larvae and genome analysis may not support this classification. The tarsalis group consists of one species with strange female terminalia and with different leg modifications. The midtibia is swollen and the tarsomeres of both the midleg and hindleg are weakly flattened.

List of species

*larva known

brasiliensis group

1. *Navasoleon amazonas* Stange
2. *Navasoleon brasiliensis* Miller
3. *Navasoleon egeri* Stange

tarsalis group

4. *Navasoleon tarsalis* Miller

leptocerus group

5. *Navasoleon bolivianus* (Banks)
6. *Navasoleon leptocerus* (Navás)
7. *Navasoleon lithophilus* Miller*
8. *Navasoleon lotti* Stange
9. *Navasoleon venezolanus* Stange*

Key to species of *Navasoleon* Banks

1. Forewing vein Cup+1A reaches hind margin of forewing well beyond radial sector (Fig. 38, 40,41); hindlegs and midlegs equal or subequal to length of forelegs; foreleg tarsomere 3 (Fig. 28) less than one half length of distal tarsomere; posterior gonapophysis paddle-like and greatly

- expanded (Fig. 55), as wide as long; setae brush on foreleg distal tarsomere not hooked (Fig. 29); wings marked (except *N. amazonas*) (Brazil, French Guiana) . . . (**brasiliensis group**) 2
- Forewing vein Cup+1A reaches hind margin of forewing at level of radial sector (Fig. 42–44); hindlegs shorter, and midlegs much shorter than forelegs; foreleg tarsomere 3 as long as distal tarsomere (Fig. 30); posterior gonapophysis much longer than broad; setal brush on foreleg distal tarsomeres hooked (Fig. 30); wings unmarked (Fig. 36) 4
2. Wings unmarked (Fig. 38); male (Fig. 47) with atypical gonarcus apparently partly separated in two broad halves, not arched **Navasoleon amazonas** Stange
- Wings marked where Cup+1A meets hind margin of forewing at rhagma, and at distal portion of hypostigmatic cell (Fig. 40, 41); male (Fig. 48, 49) with arched gonarcus. 3
3. Dorsal thorax with pale broad medial stripe from mesoscutellum to metascutellum (Fig. 12); male genitalia (Fig. 48) without large ovoid sclerite between parameres (Brazil) **Navasoleon brasiliensis** Miller
- Medial areas of mesoscutellum and metascutellum dark brown (Fig. 13); male genitalia with a large ovoid sclerite between paramere bases (Fig. 49) (French Guiana). **Navasoleon egeri** Stange
4. Midtibia swollen (Fig. 26); female terminalia with gonapophysis-like process extending from ventral margin of lateral gonapophysis (Fig. 62)
- (**tarsalis group**) (Guyana) **Navasoleon tarsalis** Miller
- Midtibia not swollen (Fig. 19–25, 27); female gonapophysis without gonapophysis-like process extending from lateral margin of lateral gonapophysis (Fig. 54–61) . . . (**leptocerus group**) 5
5. Antenna filamentous (Fig. 37); pronotum with all setae no longer than those on clypeus (Fig. 14, 16); foreleg tarsomere 3 70% length of distal tarsomere or less; hindwing with six presectoral crossveins (Fig. 42, 44) 6
- Antenna clavate (Fig. 36) (antenna of *N. bolivianus* unknown); pronotum (Fig. 15–18) with many long setae, usually longer than the longest setae on the clypeus; foreleg tarsomere 3 equal to length of distal tarsomere (Fig. 28); hindwing with seven to nine presectoral crossveins (Fig. 39, 43, 46). 7
6. Hindtibia with no setae longer than tibial diameter; pronotum mostly reddish brown with large submedial stripes (Fig. 14); third abdominal tergite darkened with central pale area; (Chaco and Subandean deserts of Argentina) **Navasoleon leptocerus** (Navás)
- Hindtibia with some setae longer than tibial diameter; pronotum (Fig. 16) nearly all pale yellow except lateral margins; third abdominal tergite pale without color pattern; (low cloud forests of northwestern Argentina) **Navasoleon lotti** Stange
7. Vertex markings (Fig. 6) with anterior dark brown nearly completely dark brown below antennae; anterior half of prothorax with median dark markings (Peru) **Navasoleon lithophilus** Miller
- Vertex markings (Fig. 2, 9) with anterior area pale brown, without dark brown area below antennae; anterior half of prothorax all pale 8
8. Mesoscutellum and metascutellum all pale brown (Fig. 18) (Venezuela).
- **Navasoleon venezolanus** Stange
- Mesoscutellum and metascutellum with median dark streaks (Fig. 11) (Bolivia).
- **Navasoleon bolivianus** (Banks)

Key to known larvae of *Navasoleon* Banks

1. Head capsule (Fig. 65–67) with abundant white setae laterally, longer than antennae, extending apically to distal tooth; middle tooth a little longer than distal tooth; metathoracic scolus-like processes doubled, followed by double pair on abdominal segment I, followed by size decreasing single scolus-like process to abdominal segment 7; terminal abdominal segment with small brown setae, elsewhere without stout setae **Navasoleon lithophilus** Miller

- Head capsule (Fig. 68–69) with lateral white setae shorter than antenna; mandible without dense white setae, middle tooth about as long as distal tooth; metathoracic scolus-like processes double followed by single pair scolus-like process on abdominal segment 1, which is smaller and more slender than next scolus-like process, followed by single scolus-like processes decreasing in length through abdominal segments 2–8 which has smallest scolus-like process; terminal abdominal segment with about ten well developed dark brown setae posteriorly, elsewhere with relatively stout setae *Navasoleon venezolanus* Stange

brasiliensis group

Description. Antenna weakly clavate (Fig. 36) (unknown in *N. brasiliensis*); posterior fork of CuP+1A ending at hindwing margin beyond level of radial sector which originates well distad of cubital fork; wings marked (except *N. amazonas*); midlegs and hindlegs as long or longer than forelegs, setae opposing pretarsal claws on forelegs not hooked (Fig. 29); midleg not swollen; midleg tarsomeres 1–4 not flattened ventrally; foreleg tarsomeres 2 and 3 (Fig. 28) less than one-half length of distal tarsomere; female gonapophysis without gonapophysis-like process extending from lateral margin of lateral gonapophysis; posterior gonapophysis greatly expanded (Fig. 55).

Discussion. The three species comprising this group have the foreleg no longer than the hindleg and the ventral setae on the distal tarsomere are not hooked apically. Also, two species have dark spots on the forewing. The female posterior gonapophysis are greatly expanded. The highly modified male genitalia of *N. amazonas* are unique in the genus. The discovery of larvae and genome analysis of the species may remove this group from *Navasoleon*.

***Navasoleon amazonas* Stange, new species**

Figures 1, 10, 19, 28, 29, 38, 47, 53

Type locality. Amazonas, Brazil.

Description. Pronotum longer than wide; foreleg distal tarsomere shorter than basal four tarsomeres together; antenna nearly all black; forefemur nearly all black with femoral sense hair about three times longer than femur diameter, equal to midfemoral sense hair; forewing unmarked; forewing radial sector arises well before cubital fork; female posterior gonapophysis greatly swollen, about twice as long as wide.

Holotype male. Length of body 15 mm., forewing length 23.5 mm., width 6 mm., hindwing length 23 mm., width 5 mm. **Coloration:** Face brownish with darker brown area at middle below antennae; antenna (Fig. 19) nearly all black except pale scape and pedicel; maxillary palpus dark brown, labial palpus pale brown; vertex (Fig. 10) mostly pale brown with dark brown area submedially at middle and anteriorly; pronotum (Fig. 10) mostly pale yellow anteriorly extending posteriorly as narrow pale band medially, pale brown laterally with large dark brown submedian area on posterior one-half; pteronotum nearly all dark brown; pterothoracic pleura (Fig. 19) mostly pale yellow with dark brown anteriorly; abdomen mostly dark brown with most pale brown areas on tergites 1–3; forefemur nearly all black; forewing (Fig. 38) unmarked; hindwing without hypostigmal dark brown spot. **Chaetotaxy:** Antenna densely covered with short pale setae; thoracic nota (Fig. 10) without setae except pronotum mostly laterally and prescutum; pterothoracic pleura (Fig. 19) without setae except few small dark ones ventrally; forefemoral sense hair about three times longer than femur diameter, equal to that of midfemur; distal tarsomere with many short, stout black setae along nearly entire distal surface; femora and tibia (Fig. 19) with dark setae shorter than femur diameter. **Structure:** Distal flagellomere slender; antenna weakly clavate, most flagellomeres before clava longer than wide; pronotum longer than wide; foreleg basitarsus shorter than distal tarsomere and pretarsal claws; forewing radial sector (Fig. 38) arises at or somewhat beyond cubital fork, 6 presectoral crossveins. **Male genitalia (Fig. 47):** With atypical gonarcus apparently partly separated in two broad halves, not arched, without mediuncus; parameres weakly sculptured, elongate, about 7 times longer than wide, broadly separated at gonarcus, converging posteriorly, produced anteriorly beyond gonarcus, separated by prominent ovoid sclerite posteriorly.

Female. About as described for male. **Female terminalia (Fig. 53):** With posterior gonapophysis swollen, especially basally, about twice as long as wide, with all setae shorter than gonapophyseal width; lateral gonapophysis elongate with scraping setae concentrated in transverse rows posteriorly; pregenital plate appears large (not clear from photo); ectoproct with only fine setae ventrally, spermathecal not visible in photo.

Distribution. Brazil.

Collection times. January and July.

Material studied. Holotype male, 1 male paratype, 2 female paratypes.

BRAZIL. Amazonas: AM 010 km 31 Embrapa, 23.I.1991, L. P. Albuquerque and J. E. Rinda, Arm Shannon C. Cacao, Isc. Fruta (2m, FSCA; INPA); Parque Nacional Jaú, O15427S, 613510W., 29.VII–08. VIII.2001, Henrisques and Vidal, Arm. malaise, campinarana baixa (1f, INPA); 26 km. N.E. Manaus, Reserva Ducke, 16.01.1989, malaise (1f, INPA).

Discussion. The male genitalia (Fig. 47) of *N. amazonas* is distinctive and highly modified in comparison to other species of the genus. Also, the wings are unmarked in contrast to other species of the group. The femoral sense hair is intact only in the holotype. They appear broken in other specimens.

Etymology. The name is based on the Brazilian state from which the holotype was collected.

Navasoleon brasiliensis Miller, new species

Figures 3, 12, 40, 48, 55, 56

Type locality. Virmond, Paraná, Brazil.

Description. Forewing (Fig. 40) with large dark brown spot at coalescing of vein CuP+1A and posterior fork of CuA near posterior border; pronotum (Fig. 12) with many long setae, as long as, or longer than the longest setae on the clypeus; foreleg tarsomere 3 shorter than distal tarsomere.

Holotype male. Length of body 15 mm., forewing length 21 mm., width 5 mm., hindwing length 21.5 mm., width 4 mm; wing span 44 mm. **Coloration:** Face (Fig. 3) pale brown with broad dark brown band below antennae and small dark brown area above antenna at middle; antennal scape and pedicel mostly dark brown; vertex (Fig. 12) with reduced dark brown markings, anterior vertex row most prominent; pronotum (Fig. 12) with broad pale yellow band at middle, broad dark brown band laterally; pterothoracic nota mostly dark brown with pale yellow scutelli; pterothoracic pleura mostly dark brown (Fig. 21); abdomen mostly dark brown but broad pale brown band on sternites; forefemora and midfemora and tibia brown with numerous small dark brown spots, rest of legs mostly pale brown; forewing (Fig. 40) with large dark brown spot at coalescing of vein CuP+1A and posterior fork of CuA near posterior border. **Chaetotaxy:** Maxillary and labial palpi with abundant black setae about as long as flagellomere diameter; thoracic nota (Fig. 21) without setae except pronotum mostly laterally and prescutum; pronotum (Fig. 11) with many long setae, as long as, or longer than the longest setae on the clypeus; pterothoracic pleura (Fig. 21) without setae except few small ones ventrally; forefemoral and midfemoral sense hairs short, about equal to femur diameter; femora and tibiae with short setae, shorter than femur diameter. **Structure:** Distal palpomere of labius slender (Fig. 3); flagellum missing; pronotum longer than wide; foreleg (Fig. 21) about same length as hindleg; foreleg tarsomere 3 shorter than distal tarsomere; midleg tarsomeres 1–4 longer than distal tarsomere; forewing (Fig. 40) about same length as hindwing, forewing radial sector arises well distad of cubital fork, with 8 presectoral crossveins; forewing costal cells above radial sector higher than wide. **Male genitalia (Fig. 48):** With gonarcus strongly arched, nearly uniform in width, with barely indicated mediuncus; parameres elongate, shallowly sculptured, about 5 times longer than wide, diverging posteriorly, nearly touching at anterior one-third.

Female. About as described for male. **Female terminalia (Fig. 55, 56):** With small pregenital plate but medial tooth long; posterior gonapophysis strongly swollen, about as long as wide, with some setae

that are about as long as gonapophyseal width; lateral gonapophyses fused, large and transverse, with many narrow digging setae on most of surface; ectoproct with few small scattered setae; spermatheca at least 12 times longer than wide, broadly curved.

Distribution. Brazil.

Collection times. January and March.

Material studied. Holotype male, 1 male paratype, 1 female paratype.

BRAZIL. Paraná: Virmond (1m, FSCA). Rio de Janeiro: Guanabara, Floresta da Tijuca, 13.I.1969, L. Stange (1m, FSCA) São Paulo, Ilha da Vitoria, 16-27.III.1964 (1f, FSCA).

Discussion. This is the second species known in the genus with markings on the forewing. The other species is *N. egeri*. The female posterior gonapophysis are the most swollen in the genus. The two paratypes are in bad condition.

Etymology. This species is named after the country where the holotype was collected.

Navasoleon egeri Stange, new species

Figures 4, 13, 22, 36, 41, 49

Type locality. nr. Roura, French Guiana.

Description. Antenna mostly dark brown with narrow pale brown apices on scape, pedicel and most flagellomeres; tarsomere 3 of foreleg shorter than distal tarsomere; tarsomeres 1–4 of midleg not flattened ventrally; forewing with large dark brown spot at coalescing veins CuP+1A and posterior fork of CuA.

Holotype male. Length of body 20.5 mm., forewing length 21 mm., width 5.0 mm., hindwing length 20.5 mm., width 3.5 mm; wing span 42 mm. **Coloration:** Face (Fig. 4) pale brown ventrally with broad dark brown band below antennae, not reaching ocular rim but extending dorsally to fuse with large dark brown area above antenna; maxillary and labial palpi pale brown basally, dark brown on apical palpomeres; antenna (Fig. 36) mostly dark brown with narrow pale brown apices on scape, pedicel and most flagellomeres, mostly pale brown toward apex which is mostly dark brown vertex (Fig. 13) mostly dark brown to black, with narrow transverse pale brown stripe submedially near middle; pronotum (Fig. 13) nearly all dark brown medially and laterally; pteronotum dark brown laterally, pale brown sublaterally on prescutum, mesonotum, mesoscutellum; metanotum dark brown except anteriorly and medially; metascutellum dark brown; thoracic pleura (Fig. 22) mostly dark brown with scattered pale brown areas; coxae mostly pale brown with small darker brown areas; legs light brown with darker areas at base of set; forewing (Fig. 41) with small dark brown rhegmal mark and large dark brown spot at coalescing veins CuP+1A and posterior fork of CuA; abdominal tergites mostly dark brown except tergites 1–2, other tergites mostly pale brown area anteriorly. **Chaetotaxy:** Face and vertex with brown setae, labrum with pale setae; scattered dark brown setae on antennal scape, pedicel, and flagellomeres; pronotum with many long setae, as long as, or longer than, the longest setae on the clypeus; pterothoracic nota nearly without setae except laterally on prescutum; pterothoracic pleura without setae except ventrally; forefemoral sense about equal to femur diameter, midfemoral sense hair not distinguishable from surrounding white setae; femora and tibiae with short setae, mostly shorter than femur diameter, a few somewhat longer; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, not hooked; ventral setae on other legs about equal in length to middle diameter of tarsomere. **Structure:** Distal palpomere of labius moderately swollen; antenna (Fig. 36) with most flagellomeres about 2 times longer than wide, weakly clavate; pronotum longer than wide; foreleg tarsomere 3 shorter than distal tarsomere; midleg tarsomeres 1–4 longer than distal tarsomere; forewing with costal cells broader than long basally, higher than wide near and beyond origin of radial sector, with 7 presectoral crossveins; forewing radial sector arises well beyond cubital fork; posterior fork of CuP+1A reaches hind margin well distal of radial sector (Fig. 41). **Male genitalia (Fig. 49):** With gonarcus nearly uniformly broadened, strongly arched, narrowed distally, no mediuncus; paramere strongly appressed to gonarcus, elongate, about 4 times longer than middle diameter, sculptured mainly in rows, strongly sclerotized on

mesal margin bending strongly near middle exposing ventral paramere structure; large, ovoid sclerite separating parameres near gonarcus, with strong sculpture.

Distribution. French Guiana.

Collection times. April and November.

Material studied. Holotype male and 1 paratype male.

FRENCH GUIANA. 33 km. southeast Roura on Kaw Rd., 12–13.IV.2007, D. Hall and J. Eger (1m, FSCA); Route de Kaw PK4, 25.XI.1997, Piège lumineux (1m, FSCA).

Discussion. This species (along with *N. brasiliensis*) can be recognized by the combination of having the pronotum with many long setae, as long as, or longer than the longest setae on the clypeus, forewing with small dark brown marks; posterior fork of CuP+1A of forewing reaching hind margin of wing beyond radial sector, and having unhooked setae on the distal tarsomeres of the forelegs.

Etymology. This species is named for Joseph Eger, who collected the holotype.

tarsalis group

Description. Foreleg tarsomere 1 longer than disal tarsomere, 3 about as long as distal tarsomere; midleg and hindleg tarsomeres 1–4 weakly flattened ventrally; midtibia swollen; lateral gonapophysis of female with additional gonapophysis-like structure.

Discussion. This appears to be a monotypic group since only *N. tarsalis* has the tarsomeres I–IV of midleg and hindleg weakly flattened ventrally and possesses an unidentified gonapophysis-like process near the ventral margin of the lateral gonapophysis extending below the vulva (Fig. 62). The swollen midtibia is also unique.

Navasoleon tarsalis Miller, new species

Figures 8, 17, 26, 34, 45, 62, 63

Type locality. San Juan de los Morros, Venezuela.

Description. Foreleg tarsomere 1 about twice as long as distal tarsomere, 2 longer than distal tarsomere; hindleg distal tarsomere about equal in length to tarsomeres 3 and 4 and nearly twice as long as pretarsal claws (Fig. 26); midtibia swollen; lateral gonapophysis of female with additional gonapophysis-like structure.

Holotype female. Length of body 18 mm., forewing length 25.5 mm., width 6.5 mm., hindwing length 25 mm., width 4.5 mm; wing span 53 mm. **Coloration:** Face (Fig. 8) pale brown with small dark brown median area below level of antennal sockets which extends dorsally to united with broad dark brown band which extends between ocular rims; supra-antennal dark brown area extending laterally nearly to ocular rim and ventrally onto frons; labial palpi mostly pale brown except dark brown distally, closely approximate with numerous short, non-digging setae dorsally; vertex pale brown with submedial dark brown areas at middle; pronotum nearly all pale brown with dark brown laterally; nota predominately dark brown laterally, pale brown medially; metascutellum all pale brown; pterothoracic pleura mostly pale brown with extensive dark brown areas as in (Fig. 26); legs pale brown, femora and tibia with numerous dark brown spots except hindtibia mostly pale brown with dark brown basally and apically.

Chaetotaxy: Pronotum with several long setae, longer than those on clypeus; pteronota with few setae on prescutum, scutella and elsewhere; forefemoral sense hair about 2 times as long as femoral diameter, midfemoral sense hair not distinguishable; **Structure:** Distal palpomere of labium weakly swollen, palpmacula distad to middle; pronotum (Fig. 17) longer than wide; forecoxa about 4 times longer than middle diameter; midtibia swollen (Fig. 26); foreleg basitarsus about as long as tarsomeres 2–4, about 3 times longer than distal tarsomere which is slightly bent subapically; basitarsus of hindleg about equal in length to tarsomeres 3 and 4 and nearly three times longer than pretarsal claws; forewing (Fig. 45)

with costal cells wider than long basally, higher than long somewhat before origin of radial sector, 7 presectoral crossveins; forewing radial sector arises well beyond cubital fork; posterior fork of CuP+1A reaches hind margin at about level of origin of radial sector. **Female terminalia (Fig. 62, 63):** With posterior gonapophysis moderately swollen, about 4 times longer than middle diameter, only apical setae about as long as gonapophyseal width; lateral gonapophyses elongate, separate, about 3.5 times longer than wide, with short, stout scraping setae anteriorly and more elongate, fine setae anteriorly; unknown process (Fig. 62) about 6 times longer than wide extending ventrally from the lateral gonapophysis to below vulva; ectoproct with short scraping setae ventrally; pregenital plate small, transverse, with medial tooth; spermatheca (Fig. 63) weakly sinuate elongate tube, about 15 times longer than greatest diameter, strongly curved and narrowed distally.

Distribution. Guyana and Venezuela.

Collection times. October to November.

Material studied. Holotype female and 1 paratype female.

VENEZUELA. Guarico: San Juan de los Morros, 23.XI.1955, O. Fernandez Y. (1f, FSCA). GUAYANA. Potero-Siparuni: Kaieteur (falls), X.1937 (1f, FSCA).

Discussion. There is an un-identified gonapophysis-like process extending ventrally from the lateral gonapophysis to below the vulva (Fig. 62) which is unique in the tribe. Also, the swollen midtibia and flattened tarsomeres of the midleg and hindleg set it apart from the other species.

Etymology. Named for the unusual tarsi which have tarsomeres I–IV of midleg and hindleg weakly flattened ventrally.

leptocerus group

Description. Antenna clavate or filamentous; foreleg longer than other legs; posterior fork of forewing vein CuP+1A reaches hind margin of forewing at level of radial sector; wings unmarked; foreleg tarsomere 1 at least twice as long as distal tarsomere, 2 slightly shorter or longer than distal tarsomere; midtibia not swollen; female terminalia without gonapophysis-like process extending from lateral margin of lateral gonapophysis, posterior gonapophysis longer than broad, weakly to moderately swollen.

Discussion. This group may be subdivided in the future since it contains some morphologically diverse species. The larvae of *N. lithophilus* and *N. venezolanus* are quite distinct morphologically. The antenna can be filamentous (*N. lotti*) or weakly clavate (*N. lithophilus*).

Navasoleon bolivianus (Banks)

Figures 2, 11, 20, 39, 54

Gymnocnemia boliviana Banks 1920: 330.

Type locality. Rio Longo, Bolivia.

Taxonomy: Banks 1943: 168 (in *Navasoleon*).

Holotype female. Length of body 18 mm., forewing length 26 mm., width 6.0 mm., hindwing length 26 mm., width 5.0 mm.; wing span 54 mm. **Coloration:** Face (Fig. 2) nearly all pale brown; broad brown transverse dark brown band above antennae, not reaching eye but produced ventrally between antennal sockets; mouthparts pale brown; palpi nearly all pale brown; antennal scape and pedicel mostly pale brown, flagellum missing; vertex all pale brown except for prominent sublateral dark brown round area near middle; pronotum (Fig. 11) nearly all light brown with irregular dark brown areas mostly lateral; pterothorax mostly pale brown with complex dark brown areas mostly paired along middle and lateral margin; mesoscutellum pale brown with prominent lateral dark brown area anteriorly; metascutellum nearly all pale brown with much reduced dark brown areas; forewing with small dark brown rhegmal mark (Fig. 39); vertex with anterior row of dark brown markings missing; midfemoral sense hair short

and dark brown; thoracic pleura (Fig. 20) mostly pale brown with scattered dark brown areas, ventrally mostly dark brown; legs pale brown with dark brown spots at setal bases on foretibia, midfemur, midtibia; abdominal tergites mostly dark brown with irregular pale brown areas; **Chaetotaxy:** Clypeus with long pale setae; pronotum with many long setae, as long as, or longer than the longest setae on the clypeus; forefemoral sense hair about equal to that midfemur and about 2 times as long as femoral diameter; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, hooked apically; ventral setae on other legs also long but not hooked apically. **Structure:** Distal palpomere of labius slender; pronotum about as long as wide (Fig. 11); foreleg basitarsus as long as tarsomeres 2–4, about 2.5 times longer than distal tarsomere which is slightly bent preapically; hindleg basitarsus about as long as tarsomeres 2–4, about 2 times longer than distal tarsomere; forewing (Fig. 39) costal cells wider than high basally, higher than wide starting about level of radial sector, with 7 presectoral crossveins; forewing radial sector originates well distad of cubital fork; posterior fork of CuP+1A reaches hind margin about at level of radial sector; **female terminalia** (Fig. 54) with posterior gonapophysis about 3.5 times as long as diameter with all setae shorter than gonapophyseal diameter); lateral gonapophyses transverse, partially fused, with numerous small scraping setae about equal to those on ventral area of ectoproct; pregenital plate small, about 4 times wider than long, with small central tooth; spermathecal (Fig. 54) serpentine in shape with posterior part strongly bent at about 180° angle.

Distribution. Bolivia.

Collection times. December to January.

Material studied. Holotype female and 1 paratype male.

BOLIVIA. Yungas: Chulumani, 1700 m, 18.XII.1955 (1m, FSCA); I.1948. (1f, FSCA). Rio Longo, H. Fassl (1f, MCZC).

Discussion. This Bolivian species can be recognized by coloration. The vertex markings with anterior area pale brown, without dark brown area below antennae; anterior half of prothorax all pale; mesoscutellum and metascutellum with median dark brown streaks.

Miller and Stange (1985) published a description of larvae that, at the time, were identified as *N. bolivianus*. However, all of those specimens have now been identified as the new species *N. lithophilus*.

***Navasoleon bosqui* (Navás)**

Gymnocnemia bosqui Navás 1922: 258.

Type data. Female, Santiago del Estero, Argentina. E. Wagner (?MNHN).

Taxonomy. Stange 1967: 58 (in *Navasoleon*).

Distribution. Argentina.

Discussion. The type of this species has not been found and the original description is inadequate to identify the species. It is probably a synonym of *Navasoleon leptocerus* (Navás) but for the present it should be considered a **nomen dubium**.

***Navasoleon leptocerus* (Navás)**

Figures 5, 14, 23, 35, 37, 42, 57, 58

Gymnocnemia leptocera Navás 1915: 125, figure 4 (vertex, pronotum, base).

Type locality. Catamarca, Argentina.

Taxonomy. Stange 1967: 58 (in *Navasoleon*).

Holotype female. Length 14 mm; forewing length 22 mm, width 5 mm; hindwing length 21 mm; width 4 mm; wing span 47 mm. **Coloration:** Face (Fig. 5) nearly all pale with small dorso-ventral stripe below antennae at middle; mouthparts mostly pale brown except distal palpomeres; antenna mostly pale

brown with some brown laterally; vertex (Fig. 14) pale with anterior row with 3 fairly large separated reddish brown areas; middle row with large submedial spot; pronotum pale with broad submedian stripes and brown at margins; pterothorax mostly pale brown with brown sublaterally on prescutum and mesonotum; mesoscutellum pale brown with large brown spot laterally and at middle; metanotum nearly all pale brown; pteropleura (Fig. 23) with complex mixture of pale to brown areas; wings (Fig. 42) without brown spots; coxae pale except forecoxa with small brown area basally; femora and tibiae pale brown with numerous dark brown spots at setal bases, hind tibia with small subapical brown stripe; abdomen mostly pale brown with some brown at base of some tergites and along some sternites. **Chaetotaxy:** Face with many small white setae; antennal flagellomeres with short setae, shorter than flagellomere diameter; pronotum with all setae shorter than those on clypeus, located mostly at margins and submedially; forefemoral sense hair about equal to that midfemur and about 1.2 times as long as femoral diameter; legs with no setae longer than femur diameter; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, apically hooked; ventral setae on other legs as long as middle diameter of tarsomere, not hooked; abdomen with inconspicuous setae except on terminalia. **Structure:** Distal palpomere slender with palpimacula near middle; antenna (Fig. 37) filamentous, with about 41 flagellomeres, flagellomere III longer than wide; pronotum little wider than long; foreleg tarsomere 3 longer than 4, tarsomere 2 shorter than distal tarsomere which is slightly bent subapically; forewing slightly longer than hindwing; abdomen shorter than wings. **Female terminalia (Fig. 57, 58):** Posterior gonapophysis about 4 times longer than medium diameter, weakly swollen, narrower apically; gonapophyseal plate short and broad about 5 times wider than median diameter, most setae shorter than gonapophyseal width; lateral gonapophyses transverse, fused, about 4 times wider than long with many well developed pale scraping setae; ventral margin of ectoproct with fine setae only; pregenital plate small, transverse, consisting mostly of median tubercle; spermatheca (Fig. 58) elongate with anterior one-third a broad tube tapering posteriorly into a thin, long, coiled tube.

Distribution. Argentina.

Collection times. November to March.

Material studied. Holotype female and 5 females.

ARGENTINA. Catamarca: Andagalá, 15.XI.1972, J. Neff (1f, FSCA); 6 km. north Belen, 1240 m, 19.XII.1971, L. Stange (2f, FSCA); 15.XI.1969, L. Stange (1f, FSCA). La Rioja: Anguinan (Chilecito), 1-15. III.1969, L. Stange (1f, FSCA); Chuquis, 1500 m., 6.XII.2003, L. Stange (1f, FSCA); Malligasta, 1000 m., 14.XII.2003, at light, P. Fidalgo and L. Stange (1f, FSCA); Santa Vera Cruz, 21.XI.2004, blacklight, L. Stange (1 without tip of abdomen, FSCA).

Discussion. This argentine species has unmarked wings and short setae especially those on the legs which are shorter than the femur diameter. The spermatheca is unusual in being elongate with most of the posterior part narrow and coiled (Fig. 58).

Navasoleon lithophilus Miller, new species

Figures 6, 15, 24, 43, 50, 59, 60, 65, 66, 67

Type locality. La Libertad, Peru.

Description. Vertex without anterior row of dark brown markings; interantennal area with large dark brown mark; forewing with small dark brown rhegmal mark; hind femur without dark spots; pronotum with many long setae, as long as, or longer than the longest setae on the clypeus; mid femoral sense hair short and dark brown; tarsomere 3 of foreleg shorter than distal tarsomere; tarsomeres I-IV of midleg not flattened ventrally.

Holotype male. Length of body 18 mm., forewing length 27 mm., width 5.5 mm., hindwing length 26.5 mm., width 4.5 mm.; wing span 56 mm. **Coloration:** Face (Fig. 6) nearly all pale brown with diagonal dark brown area below antenna socket; small band above antennae, v-shaped at middle; palpi all pale brown; antenna mostly pale brown with most dark brown areas laterally; vertex pale brown with L-shaped dark brown mark submedially near middle, anterior row of dark brown markings missing, posterior

row of dark brown markings reduced to small spots submedially; pronotum (Fig. 15) mostly pale brown with complex dark brown pattern consisting anterior area, sublateral spot near anterior margin, small median dark brown stripe at anterior, and large sublateral curved stripe on posterior two-thirds; some dark brown laterally; pterothoracic nota (Fig. 24) mostly pale brown with dark brown mostly confined laterally, prescutum with most margins dark brown and with small dark brown stripe medially; dark brown strip lateral of scutella which are mostly pale brown with dark brown on lateral margin and with dark brown medial stripe; pterothoracic pleura (Fig. 24) mostly pale brown with scattered small dark brown areas; coxae mostly pale brown with scattered dark brown spots; femora and tibia pale brown with numerous dark brown spots at setal bases; tarsi pale; abdominal tergites brown with darker area on tergites 1–2; sternites brown with pale brown stripe near pleural membrane; forewing (Fig. 43) with small dark brown rhagmal mark. **Chaetotaxy:** Face (Fig. 6) with inconspicuous setae; pronotum with many long setae, as long as, or longer than the longest setae on the clypeus; forefemoral sense hair about equal to that of midfemur and about 1.5 times as long as femoral diameter; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, apically hooked; ventral setae on other legs as long as middle diameter of tarsomere, not hooked; all setae on hindtibia shorter than tibial diameter; female ectoproct with short setae ventrally. **Structure:** Distal palpomere of labius (Fig. 6) weakly swollen, palpacula before center; antenna not clavate; pronotum longer than wide; foreleg tarsomere 2 slightly shorter than distal tarsomere which is bent subapically. **Male genitalia (Fig. 50):** With gonarcus nearly uniform in width, weakly arched; no mediuncus; paramere elongate and strongly divergent, about 6 times longer than greatest width, with sculpture limited to posterior margin; small ovoid sclerite apically behind paramere

Female. About as described for male. **Female terminalia (Fig. 59, 60):** Posterior gonapophysis swollen, narrowed apically, about five times longer than greatest diameter, without setae exceeding length of gonapophysis, distal setae longest, longer than gonapophyseal diameter; lateral gonapophyses transverse, fused, with many moderately long, curved, scraping setae; pregenital plate small; spermatheca serpentine, strongly bent posteriorly.

Larva (Fig. 65–67). Flattened with length about 12 mm. (not including jaws). **Coloration:** Pale yellow colored with dark brown pigmentation as follows: all setal bases; dorsal 3 stemmata; entire first antennal segment; maxillary lobe; mandibular teeth apically and apical curved part of mandible; head capsule dorsally with dark brown on area anterior in epistomal suture; transverse bar near posterior margin of epistomal suture; submedian dark brown spot near middle, and small submedian, converging stripe at about posterior one-half; large spot at anterolateral margin extending mesally about one-half distance where mark points anteriorly; two lateral spots before spiracular tubercle; thorax and abdomen with irregular dark speckling as in figure 65; all setae white with elevated dark bases except for a few dark ones on legs and brownish digging setae on sternite IX. **Chaetotaxy:** Dorsal head capsule with small dolichasters present; long, white, weakly plumose hairs on lateral surface of head and all scolus-like processes, those laterally on head capsule longer than antenna; mandible with abundant white setae on exterior margin, those on exterior margin extending nearly to distal mandibular tooth; elsewhere hairs abundant but short, plumose white setae dorsally and long fine plumose setae abundant ventrally; mandible with about 17 stout setae on elevated sockets from base to basal tooth, about three setae between tooth 1 and 2 and one setae between tooth 2 and 3; mandibles with abundant white, weakly plumose setae from near base to tooth 3; ocular tubercle with several small setae and with one prominent setae above stemmata; sternite 9 with small, relatively stout brown setae reduced to two groups of five subapically. **Structure:** Head almost quadrate, thickest near middle; posterior margin cordate; dorsum somewhat more convex than venter; labium strongly bilobed with broad emarginate at midline; ocular tubercle small, directed nearly laterally, broad than long; dorsal 3 stemmata smaller than others; antennal tubercle less than one-half length of ocular tubercle; antenna with about 19 segments, narrowing toward apex; scape swollen about three times longer than wide; all antennal segments longer than wide; antenna reaching far beyond end of ocular tubercle, about two times as long as basal width of jaw; labial palpus longer than basal width of mandible, first segment about three times longer than wide, longer than second but shorter than distal palpomere which is swollen with sensory orifice before middle; mandible falcate, about 1.5 times longer than head capsule, smoothly tapering to distal tooth

just beyond which is strongly curved tip; three teeth located well beyond midpoint of mandible; middle tooth slightly longer than distal one and about 1.3 times longer than basal tooth; middle tooth usually closer to distal tooth than to basal tooth (Fig. 69); left mandible of one exceptional specimen with teeth nearly equidistant; ventral mandibular condyle bounded medially by a large curved arm of anterior end of subgenal ridge; postlabium bilobate, rounded anteriorly; broadly articulating with widely separated prelabial lobes; latter mostly straight, strongly curved along anterior margin in apical fifth; pronotum about 1.5 times broader than long, anterior margin gently curved at anterolateral margin, somewhat prolonged posteriorly; forepretarsal claws small, midpretarsal claws somewhat larger and hind pretarsal claws larger still but less than twice as long as mesothoracic claws; mesothoracic spiracle borne on large cone-shape tubercle; metathoracic scolus-like processes double pair, followed by double lateral pair on abdominal segment I, followed in decreasing size by single lateral scolus-like processes to abdominal segment 7, weakly flattened, all more than two times longer than wide; spiracles not borne on tubercles; sternite 8 without odontoid processes.

Distribution. Peru.

Collection times. July.

Material studied. Holotype male, 2 adult male paratypes, 2 adult female paratypes, 1 larva.

PERU. La Libertad: 9 km. west Samne, Peru, 20.VII.1982, R. Miller and L. Stange, reared (3m, 2f, 1 larva, FSCA).

Biology. The biology of this species was originally discussed in Miller and Stange (1985), though at the time it had been misidentified as *Navasoleon boliviana*. In 1982, 18 larvae were collected at the type locality. The well camouflaged larvae sit and wait for days on a large rock overhang to ambush any suitable passing prey. A larva in the field was observed eating a fly. In the laboratory in 1982, larvae were selective regarding what types of food were acceptable. Larvae would remain still and refuse small spiders, small caterpillars, and termites, whereas flies, small moths, and small immature crickets were readily accepted. They lack the ability to dig. We have observed larvae in the same position in a tube, lined with coarse paper, for several months. In the tubes the larvae always oriented themselves head downward with the mandibles at a 180-degree angle. In the field, they may also be found horizontal on ceilings.

Cocoon construction is unique among known antlions since it is a double cocoon attached to vertical rock. The cocoon consists of an outer and inner cocoon structure. The larva first builds a domed, porous outer cocoon about 12 mm in diameter and 6 mm in height upon the rock face, over a three-day period. The larva spends three or four days spinning a spherical, dense inner cocoon, which also contacts the rock face. Scattered threads connect the rest of the inner spherical cocoon structure to the outer cocoon structure (Fig. 70).

The elapsed time from the start of the cocoon to emergence was about 52 days in four reared specimens. Orientation of the pupa during the emergence in *N. lithophilus* is different from that of other known antlion genera which spin cocoons in the soil and orient themselves by gravity to emerge from the top of the cocoon. The *N. lithophilus* pupa chews its way out of the cocoon at dusk through the center of the area of greatest light intensity (straight out from the rock wall. This was demonstrated when a cocoon was partially constructed on clear plastic and light was directed at the back of the cocoon. The pupa began chewing at the back of the cocoon toward the light. When the area in the back of the cocoon was covered with black tape and light was most intense at the front of the cocoon, the pupa chewed through the center of the exposed area of the cocoon as is normal.

Expansion of the adult *N. lithophilus* after ecdysis is different from that of any other antlion genus yet studied. In other genera, the adults emerge from the pupal skin which may or may not be half embedded in the soil after the pupa digs to the surface. The teneral adult then crawls to a vertical object to climb. There it expands its wings and abdomen at the same time. However, in *N. lithophilus*, after chewing open the front of the cocoon, the pupa protrudes the forward half of its body from the cocoon with the ventral surface of the pupa facing upward. The pupal skin splits along the dorsal center line of the thorax and the legs, head, and wings are pulled free of the pupal skin as the abdomen partially expands. This pushes the anterior portion of its body out and away from the cocoon. The adult remains

protruding from the cocoon by its partially expanded abdomen, the end of which is firmly in the cocoon. The body protrudes from the cocoon at an angle of about 15 degrees down from the horizontal. The head, antennae, and legs are held for about an hour in the same position as when they were in the pupal skin. At the end of this interval the legs have hardened sufficiently to grasp the wall or cocoon, climb it, and finish expanding the abdomen and expanding the wings. Species in other studied genera were able to use the legs shortly after getting free of the pupal skin.

Discussion. The larva is ascalaphid-like in structure with a weakly cordate head, ten pairs of scolus-like processes, hind pretarsal claws only somewhat larger than mesothoracic pretarsal claws, elongate mandible with teeth beyond middle and flattened appearance. The only other known *Navasoleon* larva, *N. venezolanus*, moves more frequently than does *N. lithophilus* and has one scolus-like process on abdominal segment one as opposed to the two found on *N. lithophilus*.

Etymology. The species name, litho (Greek for rock) and philus (Greek for loving), is in recognition of the rock-loving nature of the larvae.

Navasoleon lotti Stange, new species

Figures 7, 16, 25, 44, 51, 61

Type locality. Horco Molle, San Miguel de Tucumán, Argentina.

Description. Antenna filamentous; foreleg tarsomere 3 about one-half length of distal tarsomere; hindtibia with some setae longer than tibial diameter.

Holotype male. Length of body 14 mm., forewing length 20.5 mm., width 5 mm., hindwing length 20. mm., width 4.5 mm; wing span 42 mm. **Coloration:** Face (Fig. 7) nearly all pale brown with small irregular dark brown area between and below antennal sockets, extended onto vertex as short dark brown band; dark brown behind antennal sockets; palpi pale brown; antennal scape and pedicel dark brown dorsally, pale brown dorsally; flagellum nearly all pale brown except apical ten flagellomeres; vertex (Fig. 7, 16) with anterior row complete, narrow reddish brown band from eye to eye, slightly produced posteriorly at middle; middle vertex row consists of small, submedial dark brown spots; posterior row limited to brown triangular area at middle; elsewhere exist small dark brown areas; pronotum nearly all pale yellow except lateral margin at posterior two thirds which are slightly extended medially sub-basally and basally; pteronota nearly all pale brown with dark brown areas mostly laterally; scutelli pale brown with small dark brown line laterally; thoracic pleura mostly pale brown with predominate dark brown area on mesopleuron ventrally; coxae and trochanter pale; femora and tibia pale brown with numerous dark brown spots at setal bases; tarsi pale brown; wings without dark brown marks. **Chaetotaxy:** Face and vertex dorsally with pale setae; antenna with pale brown setae on scape, pedicel and flagellomeres; pronotum with all setae shorter than those on clypeus; forefemoral sense hair about equal to that midfemur and about 2 times as long as femoral diameter; hindtibia with some setae longer than femur diameter; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, apically hooked; ventral setae on other legs as long as middle diameter of tarsomere, not hooked; female ectoproct with short setae ventrally. **Structure:** Distal labial palpomere elongate, slender; antenna weakly clavate, with about 32 flagellomeres; most flagellomeres about twice as long as wide; foreleg tarsomere 3 longer than 4, tarsomere I about twice as long as distal tarsomere which is slightly bent subapically. **Male genitalia (Fig. 51).** With gonarcus narrow, moderately arched, narrowed apically; no mediuncus; parameres close together posteriorly and strongly sclerotized along mesal margin, less sclerotized along other margins; most of paramere strongly divergent laterally; sculpture not prominent.

Female. About as described for male. **Female terminalia (Fig. 61).** With posterior gonapophysis swollen, elongate and narrowed apically about 5x longer than middle diameter; lateral gonapophyses elongate, separate, with many prominent scraping setae which are darkened apically; pregenital plate small with median tooth.

Distribution. Argentina.

Collection times. November to January.

Material studied. Holotype male, 2 male paratypes, 2 female paratypes.

ARGENTINA. Tucuman: Horco Molle, San Miguel de Tucumán, 16.XII.1970, L. Stange (1m, FSCA); same data, 18.I.1973 (1f, FSCA); 19.XI.1970 (1f, FSCA).

Discussion. All of the specimens were collected at a porch light. The filamentous antenna is distinct from all other *Navasoleon* except *N. leptocerus*.

Etymology. This species is dedicated to Juan B. Lotti, formerly of Bertiole, Italy and San Miguel de Tucumán, in recognition of his assistance in field work. Gender is masculine.

Navasoleon venezolanus Stange, new species

Figures 9, 18, 27, 30, 31, 32, 46, 52, 64, 68, 69, 70, 71

Type locality. Falcon, Venezuela.

Description. Antenna weakly clavate; hindleg distal tarsomere, about equal in length to tarsomeres 3 and 4 together and about 1.5 times as long as pretarsal claws (Fig. 31).

Holotype male. Length of body 16 mm., forewing length 20.5 mm., width 4.5 mm., hindwing length 20 mm., width 3.0 mm.; wing span 42 mm. **Coloration:** Face (Fig. 9) all pale yellow; palpi pale brown; antenna with flagellomeres mostly pale brown except some dark brown laterally; supra-antennal dark brown area triangular, restricted to median area; vertex (Fig. 9, 18) pale yellow except for small dark brown spot submedially at middle and V-shaped dark area above and slightly below antennal sockets; pronotum completely pale yellow except dark brown area laterally on posterior one-third; broad pale yellow band on middle of pterothoracic nota including scutelli; pterothoracic pleura (Fig. 30) mostly pale brown with dark brown ventrally; coxae and trochanters all pale brown; femur and tibia pale brown with many dark brown spots at setal bases; tarsus pale brown except dark brown apex of distal tarsomere; wings without markings; abdomen mostly pale brown. **Chaetotaxy:** Face without setae except short setae on labrum; vertex with short, decumbent black setae dorsally; pronotum (Fig. 18) with moderately long, erect, black setae; fore femoral sense hair about equal to that mid femur and about 2 times as long as femoral diameter; ventral setae on distal tarsomere of foreleg longer than middle diameter of tarsomere, apically hooked; ventral setae on other legs not hooked, longer than middle diameter of tarsomere. **Structure:** Distal palpomere slender, palpimacula near center; antenna long, weakly clavate, basal flagellomeres (Fig. 9) about 1.5 times longer than wide; pronotum (Fig. 18) about 1.5 times longer (measured at center) as wide; foreleg tarsomere 2 about equal in length to distal tarsomere which is bent subapically; hindleg distal tarsomere about equal in length to tarsomeres 3 and 4 together and about 1.5 times as long as pretarsal claws; forewing with vein CuP+1A touching posterior vein a little before origin of radial sector; costal cells all broader than high. **Male genitalia (Fig. 52).** With gonarcus broad, short, not arched; mediuncus absent; parameres nearly touching dorsally, then somewhat below diverge greatly laterally; sculpture evident

Female. About as described for male. **Female terminalia (Fig. 64).** With posterior gonapophysis weakly swollen, about 4.5 times longer than middle diameter, with long setae especially apically which attain about ½ length of gonapophysis; lateral gonapophyses transverse, closely approximated, with numerous short scraping setae dorsally similar to ventral area of ectoproct and more elongate setae ventrally; pregenital plate about 4 times wider than long with small but prominent tooth at middle.

Larva (Fig. 68, 69). Flattened with length about 12 mm (not including jaws). **Coloration:** Pale yellow colored with dark brown pigmentation as follows: all setal bases; dorsal 3 stemmata; entire first antennal segment; maxillary lobe; mandibular teeth apically and apical curved part of mandible; head capsule dorsally with dark brown on area anterior in epistomal suture; transverse bar near posterior margin of epistomal suture; submedian dark brown spot near middle, and small submedian, converging stripe at about posterior one-half; large spot at anterolateral margin extending mesally about one-half distance where mark points anteriorly; two lateral spots before spiracular tubercle; thorax and abdomen with

irregular dark speckling as in (Fig. 68, 69); all setae white with elevated dark bases except for a few dark ones on legs and brownish digging setae on sternite IX. **Chaetotaxy:** Long, white, weakly plumose hairs on lateral surface of head and all scoli, those laterally on head capsule shorter than antenna; mandible without abundant white setae on margins; elsewhere hairs abundant but short, plumose white setae dorsally and long fine plumose setae abundant ventrally; mandible with about 17 stout setae on elevated sockets from base to basal tooth, about three setae between tooth 1 and 2 and one seta between tooth 2 and 3; mandibles with abundant white, weakly plumose setae from near base to tooth 3; ocular tubercle with several small setae and with one prominent setae above stemmata; sternite 9 (Fig. 61) with stout black setae posteriorly, elsewhere with well-developed setae. **Structure:** Head almost quadrate, thickest near middle; posterior margin cordate; dorsum somewhat more convex than venter; labium strongly bilobed with broad emarginate at midline; ocular tubercle small, directed nearly laterally, broader than long; dorsal 3 stemmata smaller than others; antennal tubercle less than one-half length of ocular tubercle; antenna with about 19 segments, narrowing toward apex; scape swollen about three times longer than wide; all antennal segments longer than wide; antenna reaching far beyond end of ocular tubercle, about two times as long as basal width of jaw; labial palpus longer than basal width of mandible, first segment about three times longer than wide, longer than second but shorter than distal palpomere which is swollen with sensory orifice before middle; mandible falcate, about 1.5 times longer than head capsule, smoothly tapering to distal tooth just beyond which is strongly curved tip; three teeth located well beyond midpoint of mandible; middle tooth about as long as distal one and about 1.3 times longer than basal tooth; middle tooth usually closer to distal tooth than to basal tooth (Fig. 68); left mandible of one exceptional specimen with teeth nearly equidistant; ventral mandibular condyle bounded medially by a large curved arm of anterior end of subgenal ridge; postlabium bilobate, rounded anteriorly; broadly articulating with widely separated prelabial lobes; latter mostly straight, strongly curved along anterior margin in apical fifth; pronotum about 1.5 times broader than long, anterior margin gently curved at anterolateral margin, somewhat prolonged posteriorly; forepretarsal claws small, mesopretarsal claws somewhat larger and metapretarsal claws larger still but less than twice as long as mesothoracic claws; mesothoracic spiracle borne on large cone-shape tubercle longer than wide; metathoracic scoli-like processes double followed by single scoli-like process on abdominal segment I, which is smaller and more slender than next scoli-like process, followed by single scoli-like process decreasing in length through abdominal segments 2–8; most scoli-like processes longer than wide except on segment 8 which is about as long as wide; spiracles not borne on tubercles; sternite 8 without odontoid processes.

Distribution. Venezuela.

Collection times. May and November.

Material studied. Holotype male, 1 male paratype, 2 female paratypes.

VENEZUELA. Falcon: 10 km north El Paují (Majoral Abajo), 15–24.V.1987, R. Miller and L. Stange, reared (2m, 1f, FSCA). Guárico: San Juan de los Morros, 24.XI.1955, Fernando Yopez (1f, FSCA).

Biology. The larval biology and adult emergence of this species is basically like that of *N. lithophilus* except that, under laboratory conditions, *Navasoleon venezolanus* is changing feeding position frequently whereas *N. lithophilus* is remaining motionless for weeks at a time.

Discussion. This species may be separated from others by where vein CuP+1A meets the hind margin of the forewing, the clavate antennae, lack of wing markings, and markings on the pronotum and head vertex.

Etymology. This species is named for the country of origin.

Pretarsal claws

The ability of the pretarsal claws to close upon the ventral surface of the distal tarsomere which has a corresponding setal patch is still considered a significant generic character (Stange 1963) but with certain problems (Miller and Stange 1989). *Pachyleon* Stange is structurally similar to *Dimarella*

but the pretarsal claws cannot close upon the distal tarsomeres. If moved toward the tarsomere they spread apart whereas they don't in *Dimarella* except for the species of the *D. angusta* group in which the pretarsal claws are spread apart to begin with so that when they approach the tarsomere they are on either side of the tarsomere upon closure. Michel and Akoudjin (2012: 34) include two species with folding claws with many species of *Neuroleon* Navas that lack them. They use tarsal setal characters as well as male genitalia and female terminalia to define *Neuroleon*. In the genus *Eremoleon*, one species, *E. macer* (Hagen), has the pretarsal claw weakly modified as folding claws. Folding pretarsal claws are present in about seventeen genera in the Myrmeleontidae. They are found in the **Dendroleontini** (*Bankisus* Navás, *Bullanga* Navás, *Froggattisca* Esben-Petersen, *Parvoleon* New, *Tricholeon* Kimmins), **Nemoleontini** (*Brasileon* Stange, *Dimarella* Banks, *Elachyleon* Esben-Petersen, *Megistopus* Rambur, *Negrokus* Navás, *Neuroleon* Navás, *Paraglenurus* van der Weele, *Rovira* Navás, *Sericoleon* Esben-Petersen, *Thaumatoleon* Esben-Petersen, *Visca* Navás), and **Brachynemurini** (*Stangeleon* Miller).

Key to genera of New World Nemoleontini with pretarsal claws that close upon the distal tarsomere

1. Antennal fossa separated from ocular rim by more than greatest width of pedicel; mid leg shorter than foreleg which is shorter than hindleg; midtibia usually swollen much broader than hind tibia; subcostal area narrowed at origin of cubital fork to less than diameter of radial vein (except *Dimarella riparia*) (Subtribe Dimarellina) **2**
- Antennal fossa separated from ocular rim by less than greatest width of pedicel; midleg as long as or longer than foreleg or foreleg longer than hindleg; midtibia not swollen broader than hindtibia (except few species of *Purenleon* Stange and *Navasoleon tarsalis* (Fig. 26); subcostal area not narrowed to less than diameter of radial vein (Subtribe Nemoleontina) **3**
2. Tibial spurs present on all legs; posterior fork of vein CuA and CuP + 1A parallel with each other and hind margin for long distance; male ectoproct with elongate postventral lobe ***Dimarella* Banks**
- Tibial spurs absent at least on midleg and hindleg; posterior fork of vein CuA runs obliquely to hind margin; male ectoproct without postventral lobe (Brazil) ***Brasileon* Stange**
3. Tibial spurs absent ***Navasoleon* Banks**
- Tibial spurs present **4**
4. Tibiae with long setae, more than four times longer than diameter of tibia; foretibial spurs longer than basal three tarsomeres; hindfemur with sense hair; distal tarsomere somewhat flattened dorsoventrally with setal brush lacking along midline (Chile; coastal Peru) ***Sericoleon* Esben-Petersen**
- Tibiae with short setae, longest less than twice as long as tibial diameter; foretibial spurs shorter than basal two tarsomeres; hindfemur without sense hair; distal tarsomere not flattened and with setae on midline (Argentina) **5**
5. Setal brush on distal tarsomere usually with apically hooked setae; hindleg tarsomere 2 usually over 4× longer than wide, sometimes as long as basitarsus; female terminalia with posterior gonapophysis produced thumb-like; ectoproct without digging setae ***Elachyleon* Esben-Petersen**
- Setal brush on distal tarsomere without hooked setae; hindleg tarsomere 2 at most 2.5 × longer than wide; female terminalia with posterior gonapophysis produced finger-like; ectoproct with short digging setae ***Rovira* Navás**

Acknowledgments

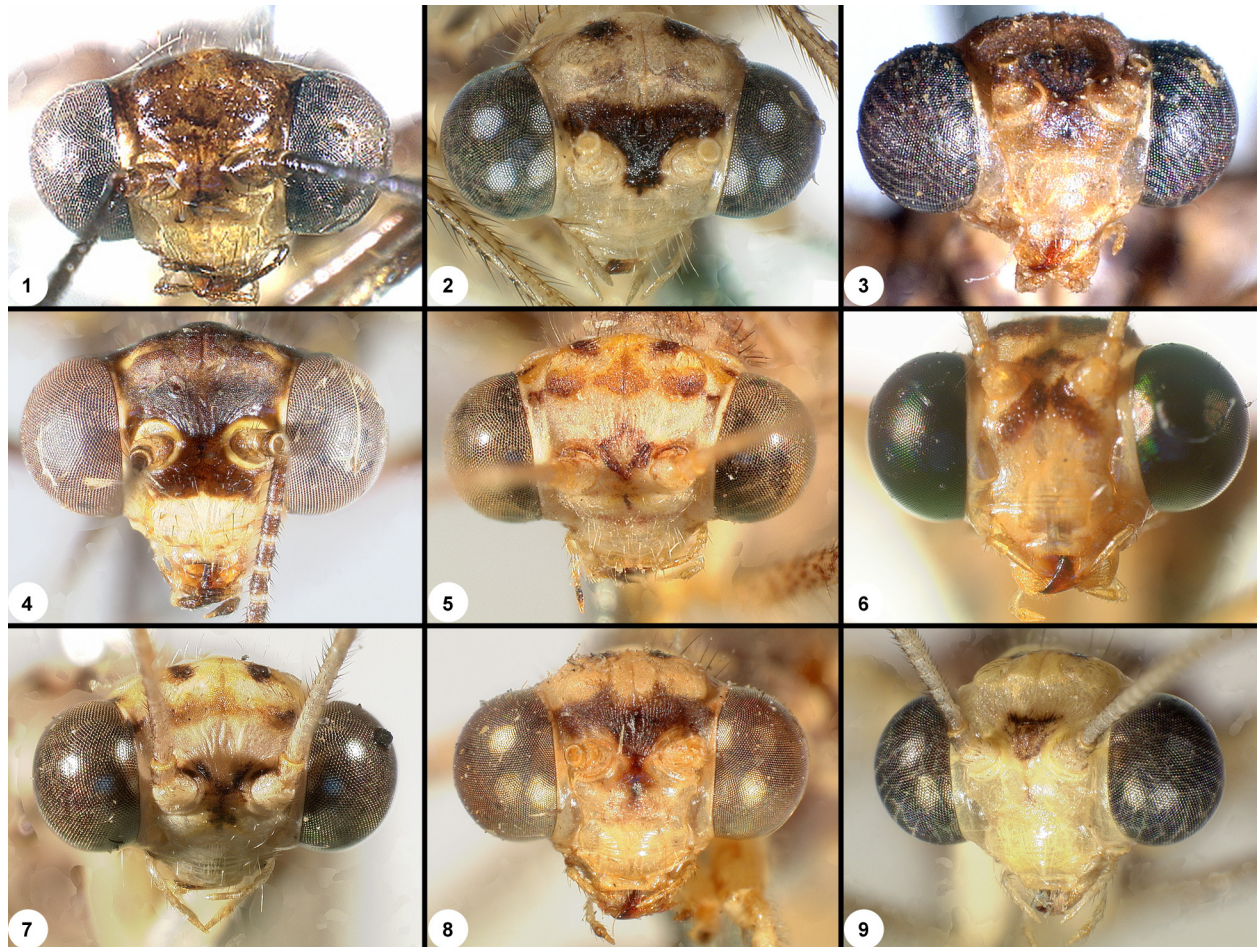
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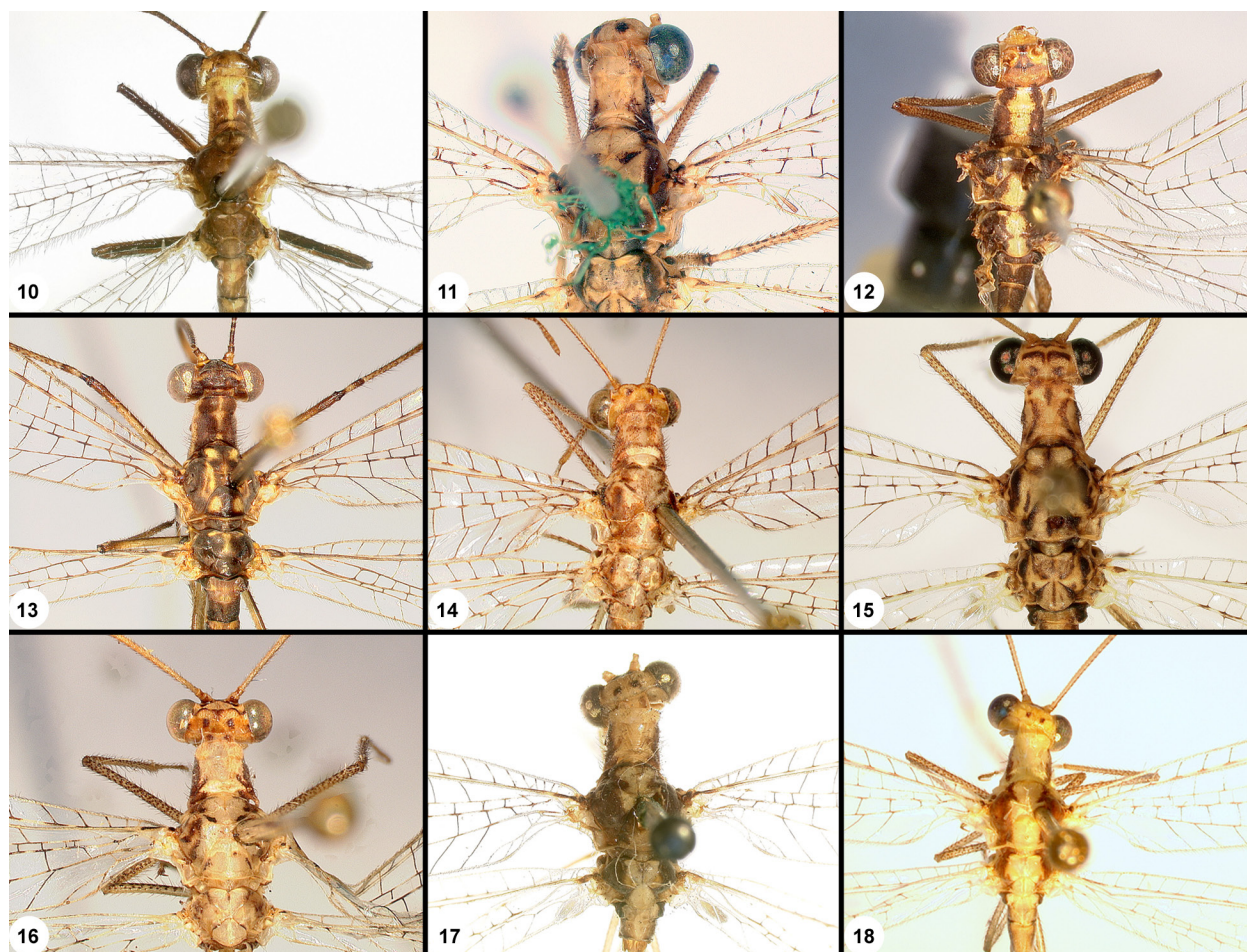
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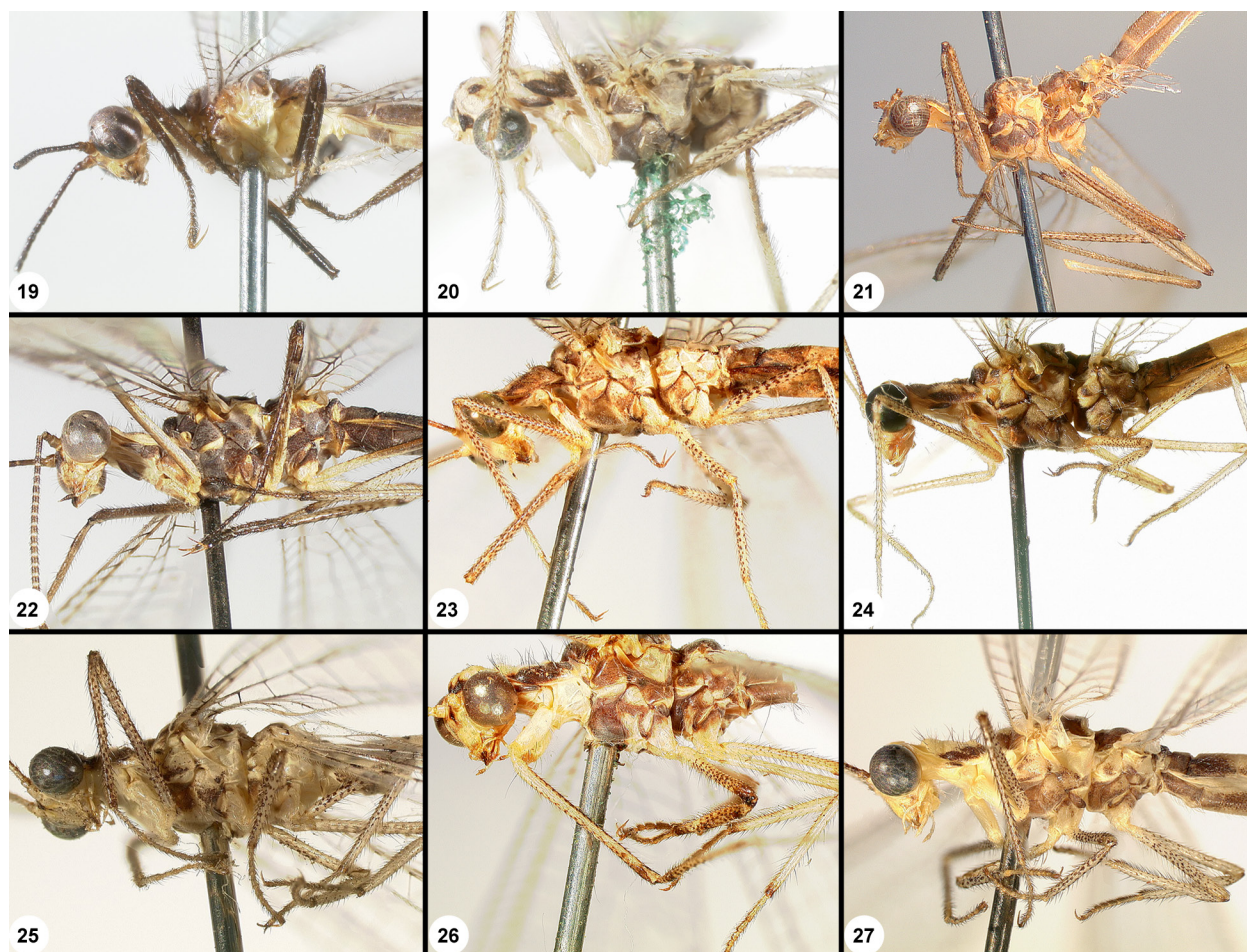
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Figures 1–9. Face of *Navasoleon* spp. 1) *Navasoleon amazonas*. 2) *Navasoleon bolivianus*. 3) *Navasoleon brasiliensis*. 4) *Navasoleon egeri*. 5) *Navasoleon leptocerus*. 6) *Navasoleon lithophilus*. 7) *Navasoleon lotti*. 8) *Navasoleon tarsalis*. 9) *Navasoleon venezolanus*.



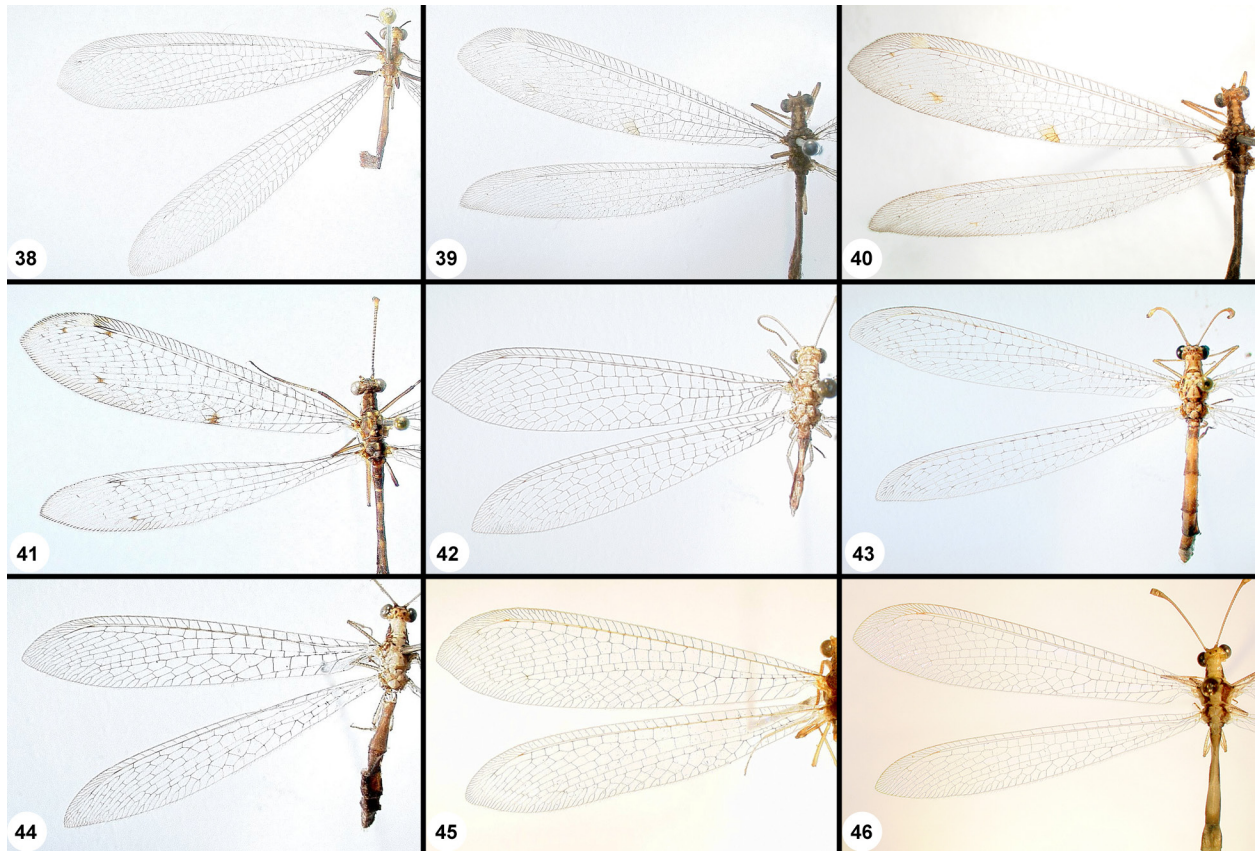
Figures 10–18. Dorsal view, head and thorax, of *Navasoleon* spp. 10) *Navasoleon amazonas*. 11) *Navasoleon bolivianus*. 12) *Navasoleon brasiliensis*. 13) *Navasoleon egeri*. 14) *Navasoleon leptocerus*. 15) *Navasoleon lithophilus*. 16) *Navasoleon lotti*. 17) *Navasoleon tarsalis*. 18) *Navasoleon venezolanus*.



Figures 19–27. Lateral view, thorax, of *Navasoleon* spp. 19) *Navasoleon amazonas*. 20) *Navasoleon bolivianus*. 21) *Navasoleon brasiliensis*. 22) *Navasoleon egeri*. 23) *Navasoleon leptocerus*. 24) *Navasoleon lithophilus*. 25) *Navasoleon lotti*. 26) *Navasoleon tarsalis* 27) *Navasoleon venezolanus*.



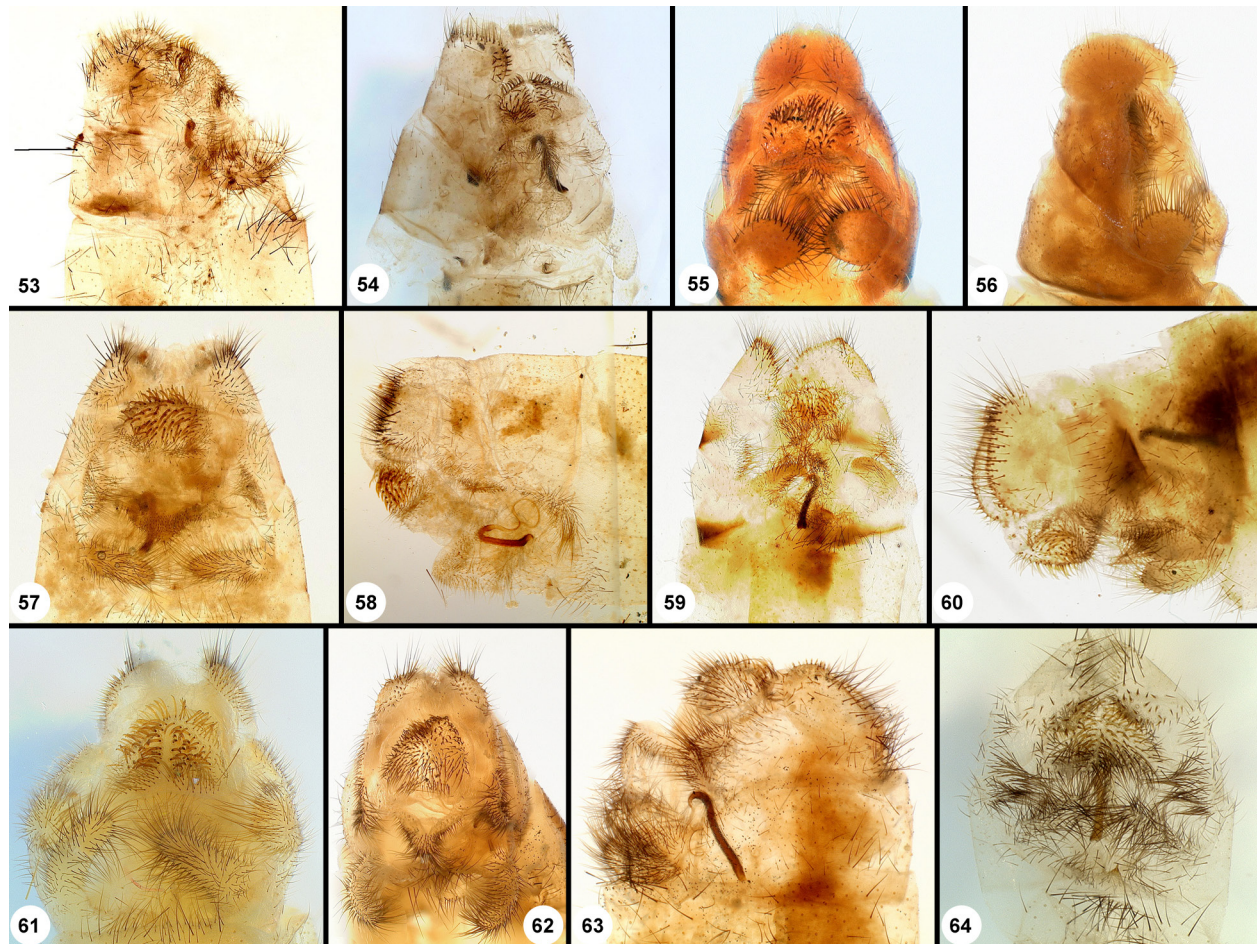
Figures 28–37. Legs and antennae of *Navasoleon* spp. **28)** Foretarsus, *Navasoleon amazonas*. **29)** Distal tarsomere of foreleg, *Navasoleon amazonas*. **30)** Tarsus of foreleg, *Navasoleon venezolanus*. **31)** Tarsus of hindleg, *Navasoleon venezolanus*. **32)** Tarsus of midleg, *Navasoleon venezolanus*. **33)** Fore tarsus, *Navasoleon egeri*. **34)** Foreleg tarsus, *Navasoleon tarsalis*. **35)** Fore leg tarsus, *Navasoleon leptocerus*. **36)** Antenna, *Navasoleon egeri*. **37)** Antenna, *Navasoleon leptocerus*.



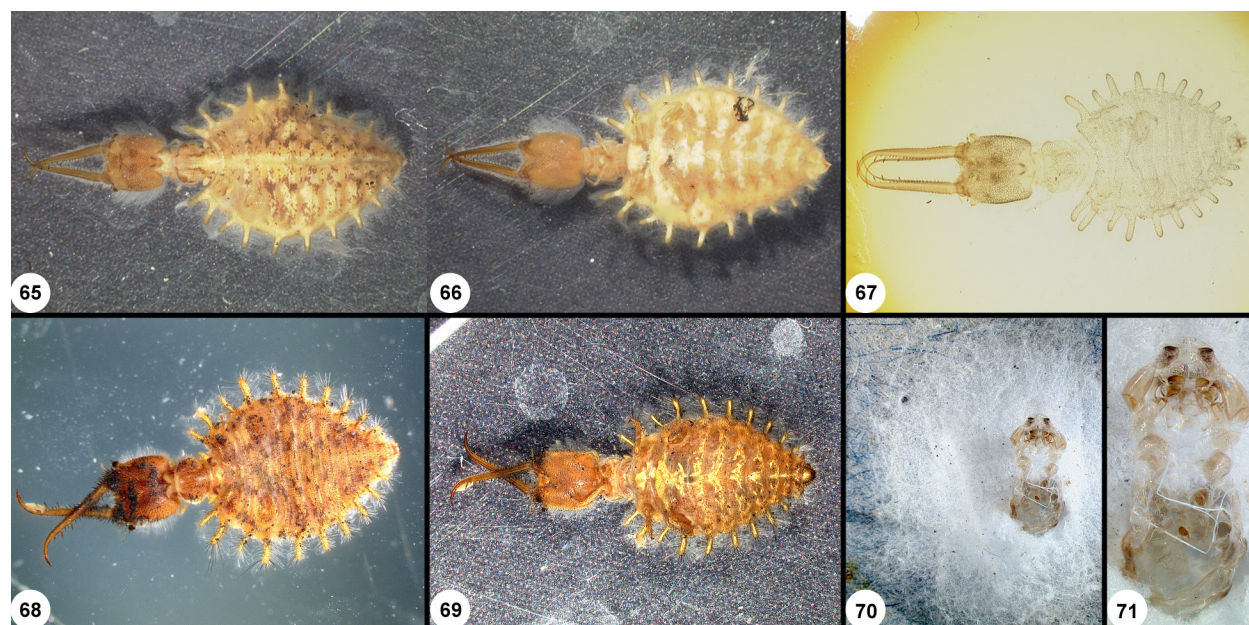
Figures 38–46. Wings of *Navasoleon* spp. 38) *Navasoleon amazonas*. 39) *Navasoleon bolivianus*. 40) *Navasoleon brasiliensis*. 41) *Navasoleon egeri*. 42) *Navasoleon leptocerus*. 43) *Navasoleon lithophilus*. 44) *Navasoleon lotti*. 45) *Navasoleon tarsalis*. 46) *Navasoleon venezolanus*.



Figures 47–52. Male genitalia of *Navasoleon* spp. 47) *Navasoleon amazonas*. 48) *Navasoleon brasiliensis*. 49) *Navasoleon egeri*. 50) *Navasoleon lithophilus*. 51) *Navasoleon lotti*. 52) *Navasoleon venezolanus*.



Figures 53–64. Female terminalia of *Navasoleon* spp. **53)** *Navasoleon amazonas*, ventral view. **54)** *Navasoleon bolivianus*. **55)** *Navasoleon brasiliensis*, ventral view. **56)** *Navasoleon brasiliensis*, lateral view. **57)** *Navasoleon leptocerus*, ventral view. **58)** *Navasoleon leptocerus*, lateral view. **59)** *Navasoleon lithophilus*, ventral view. **60)** *Navasoleon lithophilus*, lateral view. **61)** *Navasoleon lotti*, ventral view. **62)** *Navasoleon tarsalis*, ventral view. **63)** *Navasoleon tarsalis*, lateral view. **64)** *Navasoleon venezolanus*, ventral view.



Figures 65–71. Immatures of *Navasoleon* spp. **65)** *Navasoleon lithophilus*, dorsal view. **66)** third instar *Navasoleon lithophilus*, ventral view. **67)** *Navasoleon lithophilus*, cleared slide. **68)** third instar *Navasoleon venezolanus*, dorsal view. **69)** Third instar *Navasoleon venezolanus*, ventral view. **70)** Cocoon of *Navasoleon venezolanus*. **71)** Pupal skin of *Navasoleon venezolanus*.

