New Species and New Records of Scuttle Flies (Diptera: Phoridae) that Parasitize Leaf-cutter and Army Ants (Hymenoptera: Formicidae)

by

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ABSTRACT

The subgenus *Eibesfeldtphora,* of the genus *Neodohrniphora,* is raised to the rank of genus. *Cremersia* is synonymised with *Neodohrniphora* and *N. zikani* is restored to its original status as a species. New keys to the known males of *Myrmosicarius* and to all the females of *Neodohrniphora* are provided. The following new species from Argentina are described, *Dacnophora cumatta* Disney, *Eibesfeldtphora cumsaltensis* Disney and *E. trilobata* Disney, *Neodohrniphora setifemur* Disney from Ecuador, *N. unichaeta* Disney from Argentina and *Pseudacteon confusus* Disney from Ecuador.

Key Words: Parasitoid, army ants, new species, Phoridae, Ecuador, Argentina

INTRODUCTION

Parasitoid Phoridae may be attracted to ants that are not known to be among their host species (e.g. Weissflog *et al.* 2008). In order to establish the true ant hosts of any species of fly one needs to observe oviposition attacks and/or undertake rearings from known ant hosts. The principal purpose of this paper is to report on new such evidence obtained in Argentina. Most of the fly species proved to be new to science. The species of *Apocephalus* Coquillett are dealt with elsewhere (Brown *et al*. in preparation). The rest are described below, along with the evidence of their host ants.

Parasitoid flies collected over or reared from Argentinian leaf-cutter ants were identified, resulting in some revisions of genera, subgenera and species. In particular we review the hitherto unsatisfactory distinction between the subgenus *Neodohrniphora* and the genus *Cremersia*.

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The specimens dealt with below were obtained by LE, while being supervised by PJF. LE mounted a few on slides but most were mounted by RHLD, in Berlese Fluid (Disney 2001).

REVIEW OF SPECIES

Holotypes and some paratypes have been deposited in the Museum Bernardino Rivadavia, Buenos Aires (MBR). Other duplicates and paratypes have been deposited in the Muzeum of Zoology, University of Cambridge (MZUC) and the collection of PJF at the Universidad Nacional de Quilmes (PJF).

Genus *Cremersia* Schmitz

When providing a new key to the species of *Neodohrniphora* (Disney, 1996), three subgenera were proposed, *Neodohrniphora, Eibesfeldtphora* and also *Wallerphora*. Subsequently *Wallerphora* was treated as an aberrant species of *Eibesfeldtphora* (Brown, 2001). While these proposals clarified the distinction between *Eibesfeldtphora* and *Cremersia,* the distinction between the latter and the subgenus *Neodohrniphora* remained far from evident. The history of the supposed distinction helps to clarify our proposed taxonomic status changes.

Malloch (1914) had proposed the genus *Neodohrniphora* for *N. calverti,* which he described from the male sex only. Prado (1976) subsequently described the female. Schmitz (1924) proposed the genus *Cremersia* and designated *Apocephalus spinicosta* Malloch (1912), which was described from a single supposed male, as the type species, and described a further species, *C. zikani*. Borgmeier (1925) described three further species of *Cremersia* from their supposed males only, and reproduced Schmitz's figure of the supposed male hypopygium of *C. zikani.* Subsequently Borgmeier (1928) realized that both Schmitz and himself had misidentified the complex ovipositor sheaths of the females of *Cremersia* as male hypopygia. He also commented that *Cremersia* was evidently closely allied to *Neodohrniphora,* but insisted that *Cremersia* was a well defined genus. In his 1925 paper he had also described both sexes of new species of *Neodohrniphora.* However, their female ovipositor sheaths were not figured until his subsequent paper (Borgmeier, 1929). These figures were of his *N. declinata* and his *N. wasmanni,* a species subsequently

synonymised with *N. acromyrmecis* (of Borgmeier, 1925). In this 1929 paper he failed to realise that the ovipositor sheath of the latter resembled the supposed hypopygia of *Cremersia* and differed markedly from that of *N. declinata*. Indeed, these two types of ovipositor sheath became part of the basis for the subsequent designation of the subgenera *Neodohrniphora, Eibesfeldtphora*. We conclude that Borgmeier's (1928) opinion that when *Neodohrniphora* is compared with *Cremersia* the latter "is a well defined genus'" is true with respect to the subgenus *Eibesfeldtphora*. However, its distinction from the subgenus *Neodohrniphora* is not evident. We conclude that *Cremersia* is a synonym of the subgenus *Neodohrniphora*. Furthermore we propose that the subgenus *Eibesfeldtphora* be given the rank of a separate genus.

The species *Cremersia bifidcauda* Disney (Disney & Rettenmeyer 2007) is being transferred to *Apocephalus* (Brown *et al*. in preparation).

Genus *Dacnophora* Borgmeier

A key to the females of five Brazilian species is provided by Borgmeier (1961). The female of a Nearctic species is described by Brown (1988). Males can be named only when procured in association with their females.

Dacnophora cumatta Disney new species

In the key of Borgmeier (1961) this species runs to couplet 3, lead 1, to *D. legionis* Borgmeier, but it differs in its smaller size, shorter front tarsus (relative to the tibia) and the details of the terminal segments of the abdomen.

Female. Frons brown, broader than long, with 32-34 hairs and dense but very fine microsetae. Upper supra-antennal bristles about 1.2x as long as weaker lower pair. Antials about level with upper SAs and half as far from latter than from anterolaterals, which are higher on frons. Pre-ocellars about twice as far apart as upper SAs and further apart than either is from a mediolateral, with all four bristles in an almost straight transverse row. A small bristle on cheek and two longer, but unequal, bristles on jowl. Postpedicels subglobose, straw yellow lightly tinged greyish brown, and lacking subcutaneous pit sensilla (SPS vesicles). Its greatest width about 1.6x that of the almost colorless labrum. The equally pale labella narrow. Palps slightly darker, with 3-4 bristles, the most apical being about as long as the lower SAs, and with 2-3 hairs. Thorax brown with a bare mesopleuron. Each side of scutum with a

humeral, 2 notopleurals, a pre-alar, a postalar and a pre-scutellar dorsocentral bristle. Scutellum with an anterior pair of hairs (subequal to those in middle of scutum) and a posterior pair of bristles. Abdominal tergites brown with only a few small hairs on T1 to T5, which are a little longer at the rear of T5. T6 narrower than T5 and with longer hairs and a posterolateral bristle each side (Fig. 1). Venter light greyish brown and lacking hairs on segments 1-5, but segment 6 with a posterior lobe each side that bears hairs and longer bristles, and the terminal segments modified as an ovipositor and its embracing sheath (Fig. 1). Legs straw yellow apart from a brown tinge to the tip of hind femur and light brown mid coxa. Front tarsus a little shorter than tibia and its distal, strongly tapered, segment about 0.8x as long as the basal (compound) segment. Mid tibia with the dorsal hair palisade extending just over half the length. The fifth tarsal segment about 1.2x as long as 4. Hind femur with hairs below basal half clearly shorter than those of the anteroventral row of outer half. The tapered tarsal segment 5 about 1.2x as long as 4. Wing 0.8-0.9 mm long. Costal index 0.33. Costal ratios 4.6 : 1.6 :

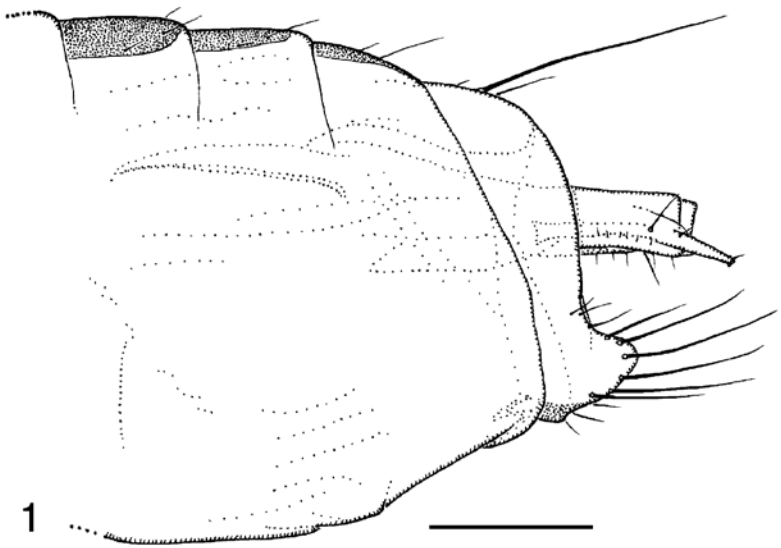


Fig. 1. *Dacnophora cumatta* female, left face of rear half of abdomen, tilted slightly dorsally. (Scale bar = 0.1 mm).

1. Costal cilia (of section 3) 0.06-0.07 mm long. Thick veins yellowish grey, 4-6 grey and 7 extremely pale. Sc does not quite reach vein 1. No hair at base of vein 3. Two bristles on axillary ridge, the outer one being subequal to the last costal cilium on section 3. Membrane only slightly tinged grey. Haltere mainly brown but with some pale areas.

Etymology. Named after being caught with *Atta saltensis.*

Material examined: Holotype female, ARGENTINA: La María (INTA), Santiago del Estero, over *Atta saltensis,* 20 October 2004, L. Elizalde (MBR).

Field observations. Flying over a foraging trail of *Atta saltensis.*

Genus *Eibesfeldtphora* Disney new status

We propose above (under *Cremersia*) that the subgenus *Eibesfeldtphora* be given the rank of a separate genus from *Neodohrniphora*.

Brown (2001) provides the most recent key to the females of *Eibesfeldtphora.* We describe a new species below.

Eibesfeldtphora cumsaltensis Disney new species

This species runs to *E. bragancai* Brown in Brown's (2001) key; and very closely resembles that species. However, the upper lateral lobes of abdominal segment 7 are less tapered. This small difference is associated with a different oviposition behaviour and a different host species. Thus *E. bragancai* oviposits into the gaster of *Atta bisphaerica* (Bragança, Della Lucia & Tonhasca 2001); but the new species was observed trying to oviposit into the head of its different host species (see below). The two fly species are evidently very closely related.

Female. Frons brown, its midline length a little greater than its maximum breadth but the length each side clearly shorter, and with numerous hairs. The frontal bristle strong. The anterolaterals about half as far apart as pre-ocellars and about as far from the median-situated antials as from the mediolaterals. The POs further apart than either is from a ML bristle, which is clearly lower on frons. Postpedicels yellow with the hairs of arista very short. Palps whitish yellow, with a strong apical bristle, two smaller bristles and about six hairs. Proboscis pale straw yellow. Thorax largely orange yellow and each side of scutum with a humeral bristle, two notopleurals, a pre-alar, a postalar

and a prescutellar dorsocentral. Scutellum with an anterior pair of fine hairs (subequal to those in middle of scutum) and a posterior pair of bristles. Abdominal tergites brown laterally but yellow along median third or more, especially on T4 and T5, and with fine hairs. Segment 6 almost entirely yellow. Venter dusky yellow with minute hairs below segments 3-5 but normal, but fine, hairs on 6 (Fig. 2), ovipositor sheath as Fig. 2 and the tip of ovipositor strongly sclerotised and black. Legs, apart from brown patch on mid coax, yellow. Front tarsus with a posterodorsal hair palisade on all four segments and segment 4 (the fused segments 4 and 5) longer than 3. 3-5 hairs below basal half of hind femur clearly longer than those of the anteroventral row of outer half. Wings 2 mm long. Costal index 0.37-0.40. Costal ratios 4.6-6.0 : 1.6 : 1. Costal cilia 0.04-0.06 mm long. Sc pale and not reaching vein 1. No hair at base of vein 3. Thick veins brownish grey. Thin veins grey, the tip of vein 4 being deflected rearwards. Membrane tinged slightly brownish grey (just evident to the naked eye when viewed against a white background).

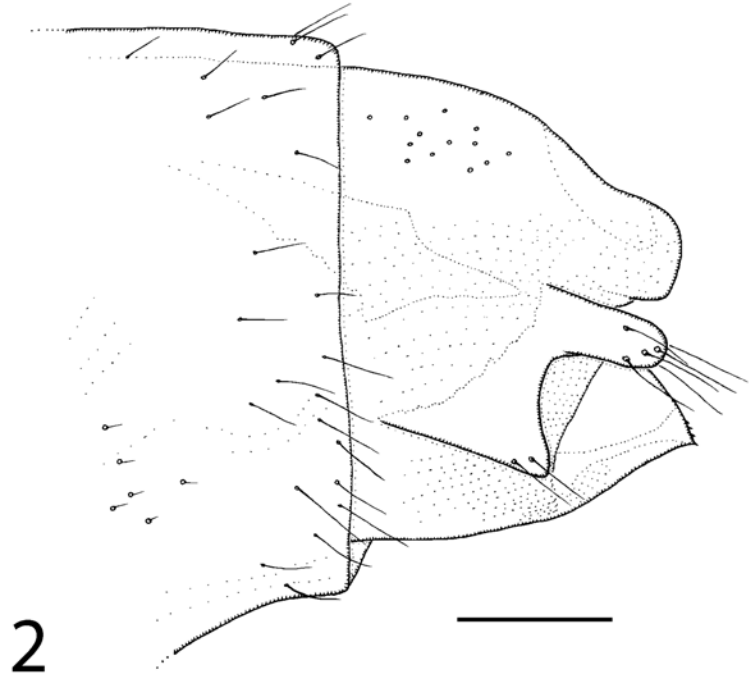


Fig. 2. *Eibesfeltphora cumsaltensis* female, left face of ovipositor sheath. (Scale bar = 0.1 mm)

With 4-6 (usually 5) bristles on axillary ridge, all being longer than costal cilia. Haltere knob brown.

Etymology. The name refers to the association with *Atta saltensis.*

Material examined: Holotype female, ARGENTINA: La María (INTA), Santiago del Estero, over *Atta saltensis,* 25 October 2004, L. Elizalde (MBR, 39-41); 5 females as holotype except (MBR & MZUC).

Field observations. Collected in the foraging trails of *Atta saltensis*, 2 of them were attempting oviposition on the head of the ants.

This species was treated as "*Neodohrniphora* sp. b" in Elizalde (2009).

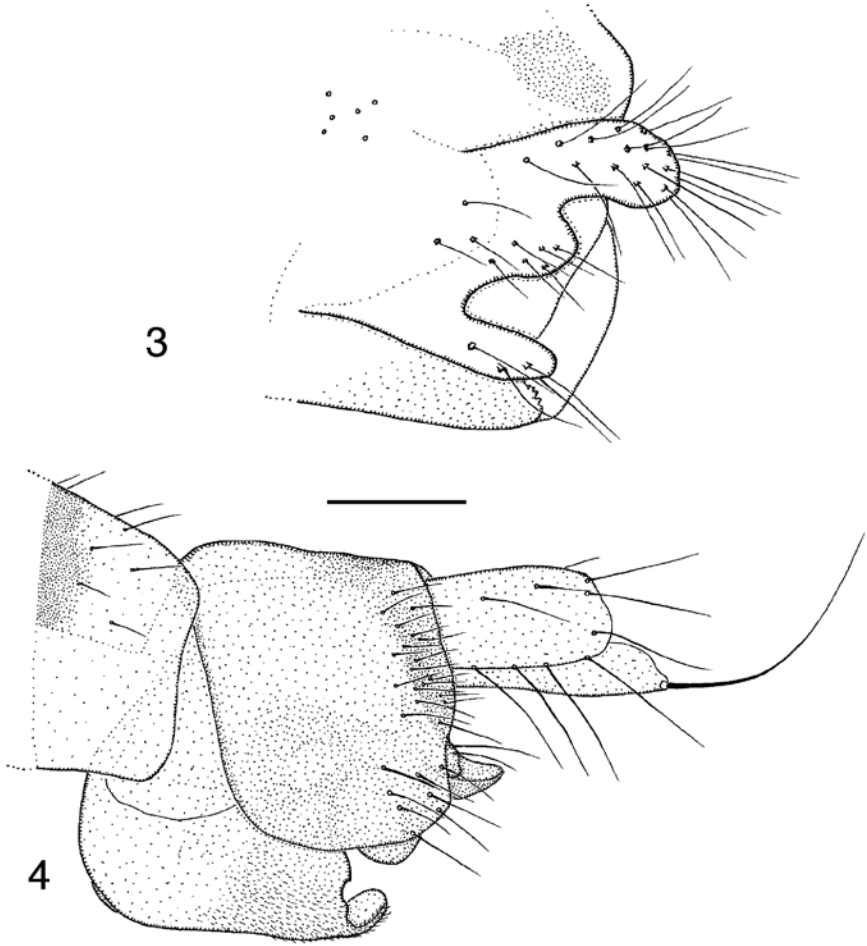
Eibesfeldtphora trilobata Disney new species

In the key of Brown (2001) the female falls at couplet 1 where the choice is between one lateral lobe or two lateral lobes each side at the rear of the ovipositor sheath. The new species has three lobes.

Female. Frons chestnut brown. The antial bristles are in a median position (reminiscent of supra-antennals) but the anterolateral and mediolaleral-bristles are close to the eye margin, the latter being lower on the frons than the pre-ocellars. In one specimen the right AL is absent and the left one is reduced to a short, fine bristle. Postpedicels yellowish brown with the hairs of arista very short. Palps whitish yellow, with a strong apical bristle, a few hairs and an irregular shallow depression on the inner face above. Proboscis pale straw yellow. Thorax brown and each side of scutum with a humeral bristle, two notopleurals, and intra-alar, a postalar and a pre-scutellar dorsocentral bristle. Scutellum with an anterior pair of hairs (subequal to those in middle of scutum) and a posterior pair of bristles. Abdominal tergites brown, but variably yellow along median band and more extensively on T5 and T6, and with sparse small hairs. Venter greyish yellow but with darker grey bands on flanks below lateral margins of tergites, and with minute hairs on segments 3-6. Left face of the brown ovipositor sheath as Fig. 3 and the tip of ovipositor strongly sclerotised and black. Legs straw yellow apart from brown patch on mid coxa. Front tarsus with a posterodorsal hair palisade on all four segments and segment 4 (the fused segments 4 and 5) longer than 3. 1-3 hairs below basal half of hind femur clearly longer than those of the anteroventral row of outer half. Wings 1.6-2.2 mm long. Costal index 0.37-0.39. Costal ratios 4.8-7.4 : 1.5-2.7 : 1. Costal cilia 0.04-0.06 mm long. Sc pale and not reaching

vein 1. No hair at base of vein 3. Thick veins yellowish grey. Thin veins grey, the tip of vein 4 being deflected rearwards. Membrane only slightly tinged grey. With 4-6 bristles on axillary ridge, all being longer than costal cilia. Haltere knob brown.

Male. Head similar to female except the antials are further apart. Thorax, abdominal tergites and venter similar to female. Hypopygium as Fig. 4., the epandrium being mainly brownish yellow and the anal tube and hypandrium



Figs. 3-4. *Eibesfeltphora trilobata*. Fig. 3. Female, left face of ovipositor sheath; Fig. 4. Male, left face of hypopygium. (Scale bar = 0.1 mm).

being straw yellow. Legs similar to female except front tarsus with segments 4 and 5 not fused and 5 is longer than both 4 and 3. Wings and halteres similar to female.

Etymology. The name refers to the three lobes at the rear of each side of the ovipositor sheath.

Material examined: Holotype female, ARGENTINA: San Cristóbal, Santa Fe, with *Atta vollenweideri,* 20 April 2004, L. Elizalde (MBR). Paratypes, 1 Female as holotype; 2 females as holotype, except 18 November 2004 (MBR, MZUC, 39-48); 6 females, 6 males, same locality, reared from same host in lab, 13 February, 11 & 18 September, 1, 4, 8 & 17 November and 12 December 2004, L. Elizalde (MBR, PJF & MZUC, 39-46-47).

Field observations. This species was mostly found sitting at the sides of the foraging trails of *Atta vollenweideri*. From a perch, they fly to attack a foraging host on the rear of its head, near the neck.

The pupa is similar to that described by Tonhasca (Tonhasca 1996) for other species of *Eibesfeldtphora*. It was found occupying the empty head capsule of the host ant, with the anterior end emerging through the mouth cavity.

This species was treated as "*Neodohrniphora* sp. f" in Elizalde (2009).

Genus *Myrmosicarius* Borgmeier

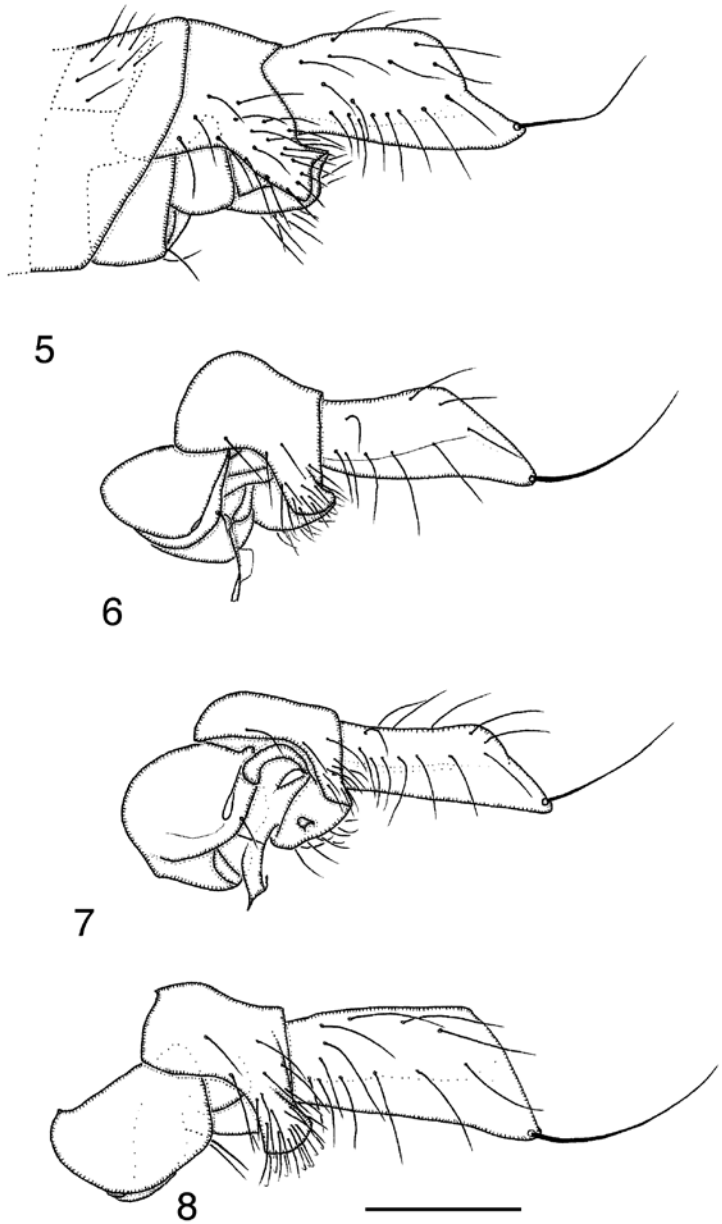
A key to the females of the single Nearctic and thirteen Neotropical species, and a partial key to the poorly known males was provided by Disney, Elizalde & Folgarait (2006). The males are still poorly known. We provide an improved partial key below.

Mymosicarius brandaoi Disney, *et al.*

Material examined: 5 males, ARGENTINA: San Cristóbal, Santa Fe, reared from *Atta vollenweideri* in lab, 13 & 27 June, 11 September & 15 November 2005, 13 June 2006, L. Elizalde (MBR, Vo4 No. 226, MZUC, 39-43); 1 male, same locality, reared from *Atta vollenweideri* in lab, 23 June 2006, L. Elizalde (MBR – 384 Medr. Vo5 D).

Recorded hosts. *Atta saltensis* and *A. vollenweideri.*

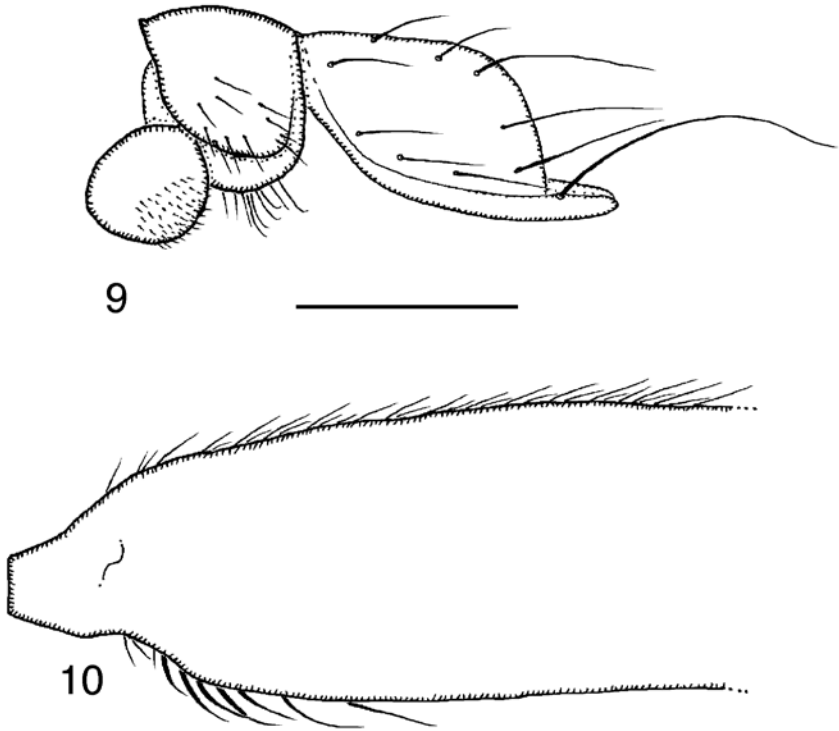
The pupa of this species is similar to that described by Tonhasca *et al.* (2001) for *M. grandicornis*. It was located inside the empty head capsule of the ant host, under the tentorial arms.



Figs. 5-8. *Myrmosicarius* males, left faces of hypopygium. Fig. 5. Species A; Fig. 6. Species B; Fig. 7. Species C; Fig. 8. *M. cristobalensis.* (Scale bar = 0.1 mm).

Mymosicarius cristobalensis Disney, *et al.*

Material examined: 1 male, ARGENTINA: San Cristóbal, Santa Fe, reared from *Acromyrmex lundii* in lab, 29 June 2005, L. Elizalde (MZUC, 39-44); same locality, reared from *Acromyrmex lobicornis* in labe, 26 September 2005, L. Elizalde (MBR, Lo13 No. 43); 1 male, 1 female, the same except 21 July 2005 (MZUC, 39-45); 2 males the same except 27 June 2005 & 20 March 2006 (MBR, Lo15 No. 208 & 441); 1 male the same except 26 September 2005 (MZUC, 39-46). Also, omitted in error from Disney *et al.* (2006), 1 male over *Atta vollenweideri* from Reserva Natural Formosa, Formosa, 6 October 2004, L. Elizalde (MBR-6.LRFH1); 1 male, same host, Parque Nacional Pilcomayo, Formosa, 6 June 2004, L. Elizalde (MBR-3.LEPH3); 1 male, same host, San Cristóbal, Santa Fe, 20 November 2004, L. Elizalde (MBR-27.LSCH1B)



Figs. 9-10. *Myrmosicarius* males. Fig. 9. Species D, left face of hypopygium; Fig, 10. *M. brandaoi,* posterior face of base of hind femur. (Scale bar = 0.1 mm).

Recorded hosts. *Acromyrmex fracticornis, Ac. heyeri, Ac. hispidus, Ac. lundii, Ac. striatus* and *A. subterraneus*..

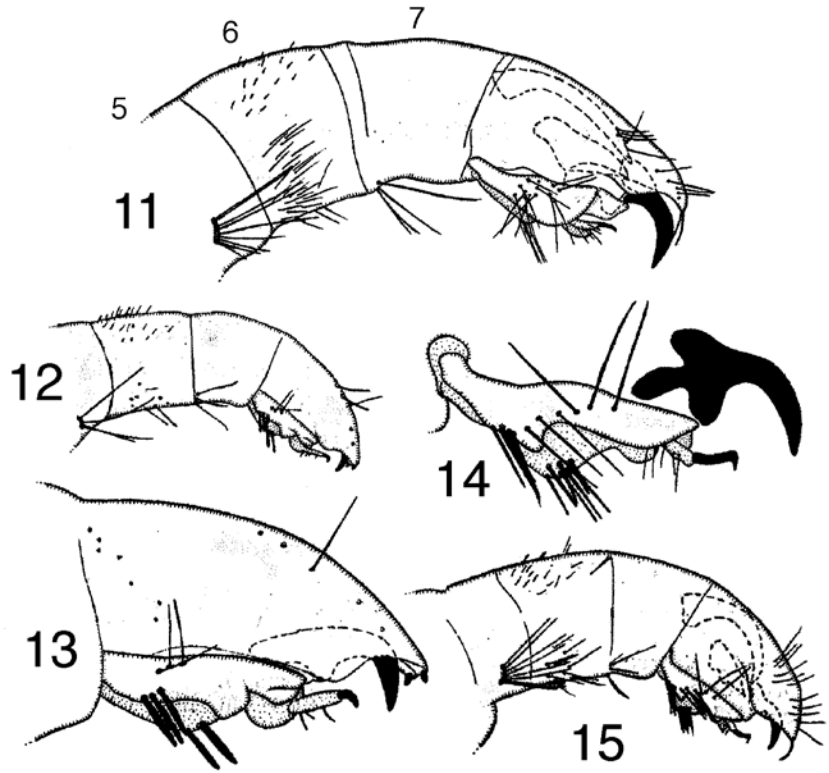
The pupa of this species is similar to that described by Tonhasca *et al.* (2001) for *M. grandicornis*. As with *M. brandaoi,* it was located inside the empty head capsule of the ant host, under the tentorial arms

Mymosicarius Species A

This species was recorded previously (Disney *et al.* 2006).

Material examined: 2 males, ARGENTINA: San Cristóbal, Santa Fe, reared from *Acromyrmex heyeri* in lab, 15 December 2005, L. Elizalde (MBR, No. 277 & Vo2 HP); 2 males, same locality, reared from *Ac. heyeri* in lab, 2 January & 21 September 2005, L. Elizalde (MZUC, 39-44).

Recorded host. *Acromyrmex heyeri*.



Figs. 11-15. *Neodohrniphora* females, left faces of ovipositor sheaths. Fig. 11. *N. cognata* (5-7 = abdominal segments 5-7); Figs. 12-13. *N. calverti*; Figs 14-15. *N. acromyrmecis*. (After Prado 1976).

Mymosicarius Species C

This species was previously recorded (Disney *et al.* 2006). The available specimens probably represent more than one species. The likely candidates are the undescribed males of *M. crudelis, M. gracilipes* and *M. longipalpis.* Until better specimens and associations with females are secured it is best to desist from firm identifications. Most specimens have a hypopygium like Fig. 7.

Material examined: 2 males, ARGENTINA: San Cristóbal, Santa Fe, ex *Ac. crassispinus,* 2 January 2006, L. Elizalde (MBR, CR 9 bos No. 289); 2 males, the same locality, reared from *Acromyrmex hispidus* in lab, 9 September 2005 (MZUC, 39-41); the same, 30 December 2005 (MBR, Hi1 – 562); 2 males, the same, 22 March 2006, MBR, Hi9 com. 154, MZUC, 39-42).

Recorded hosts. *Acromyrmex crassispinus* and *Ac. hispidus.*

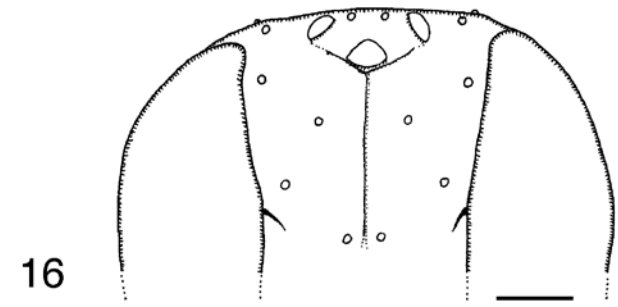
Mymosicarius Species D

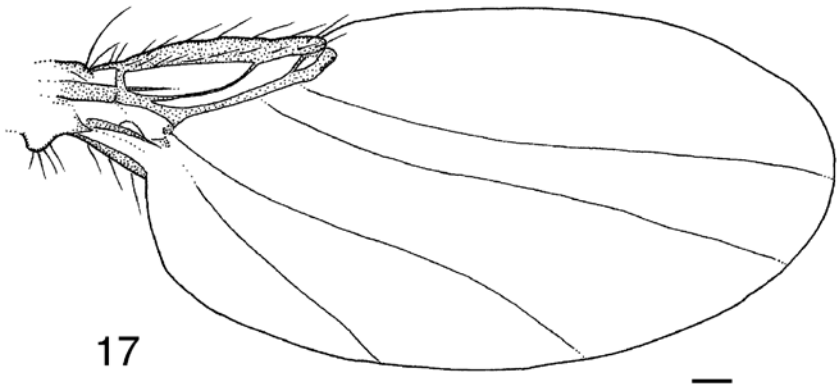
The single specimen is somewhat damaged. Its hypopygium is distinctive and also the absence of vein 2 (the inner fork of vein 3).

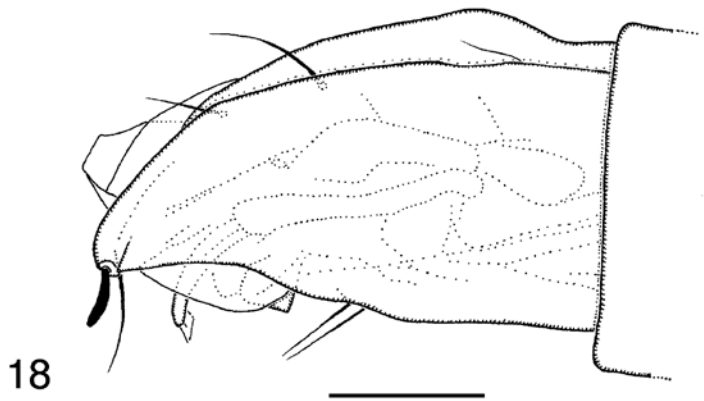
Male. Frons brown with the single pair of supra-antennal bristles only just differentiated from the adjacent hairs. Postpedicels brown and arista short. Palps straw yellow with small apical bristles. Thorax brown. Two bristles on notopleuron. Scutellum with an anterior pair of hairs and a posterior pair of bristles. Abdominal tergites brown with small hairs. Venter brown. Hypopygium brown with a light brown anal tube and as Fig. 9. Legs with mid and hind femora and tibiae brown, the front femur and tibia yellowish brown, and the rest of legs straw yellow. Front tarsus with a posterodorsal hair palisade on all five segments and segments 5 longer than each of segments 2, 3 and 4. The dorsal hair palisade of mid tibia extends about two thirds of length. The longest hairs below basal half of hind femur equal to or slightly longer than those of the anteroventral row of outer half. Wing 1.00-1.01 mm long. Costal index 0.29. Costal ratios 5.2-5.3 : 1. Costal cilia 0.05 mm long. A single axillary bristle about as long as costal cilia. Vein 3 unforked. Subcosta pale and not quite reaching vein 1. Thick veins brown. Thin veins 3-7 pale grey and 7 only observed with critical lighting. Haltere knob brown.

Material examined: 1 male, ARGENTINA: Noetinger, reared from *Acromyrmex crassispinus* in lab, 31 May 2005, L. Elizalde (MBR, C2, CR18 F31).

Recorded host. *Acromyrmex crassispinus.*







Figs. 16-18. *Neodohrniphora crassicostalis* female. Fig. 16. Frons with bristles indicated by their basal sockets only; Fig. 17. Right wing; Fig. 18. Right face of ovipositor sheath. (Scale bars = 0.1 mm).

PARTIAL KEY TO MALES

The males of most species remain unknown. The male of *M. infestans* was described by Borgmeier (1931) but without any figures. In the most recent keys to world genera (Disney 1994) this male was run out at couplet 164. However, the lengths of the anal tubes in some of the species keyed below will take them to couplet 170, to *Apocephalus* and *Anaclinusa,* but the latter has since been synonymised with *Apocephalus* (Brown 2000). The species in the latter genus running to this couplet have the anal tube even longer and the vein Sc obscure.

1. Notopleuron with three differentiated bristles (but rarely with middle one reduced on one side). Palps with distal half (or more) brown.....2
— Without this combination.....4
2. Fewer than 50 hairs on frons.....3
— At least 50 hairs on frons.....*grandicornis* Borgmeier
3. Base of hind femur as Fig. 10..... *brandaoi* Disney *et al.*
— Base of femur otherwise..... undescribed male

Note: this is probably the male of *M. gonzalezae.*

4. The dorsal hair palisade of mid tibia ends well before tip. With fewer than 15 hairs on each cercus.....5
— This palisade extends to tip of mid tibia. With more than 15 hairs on each cercus (Fig. 5).....Species A

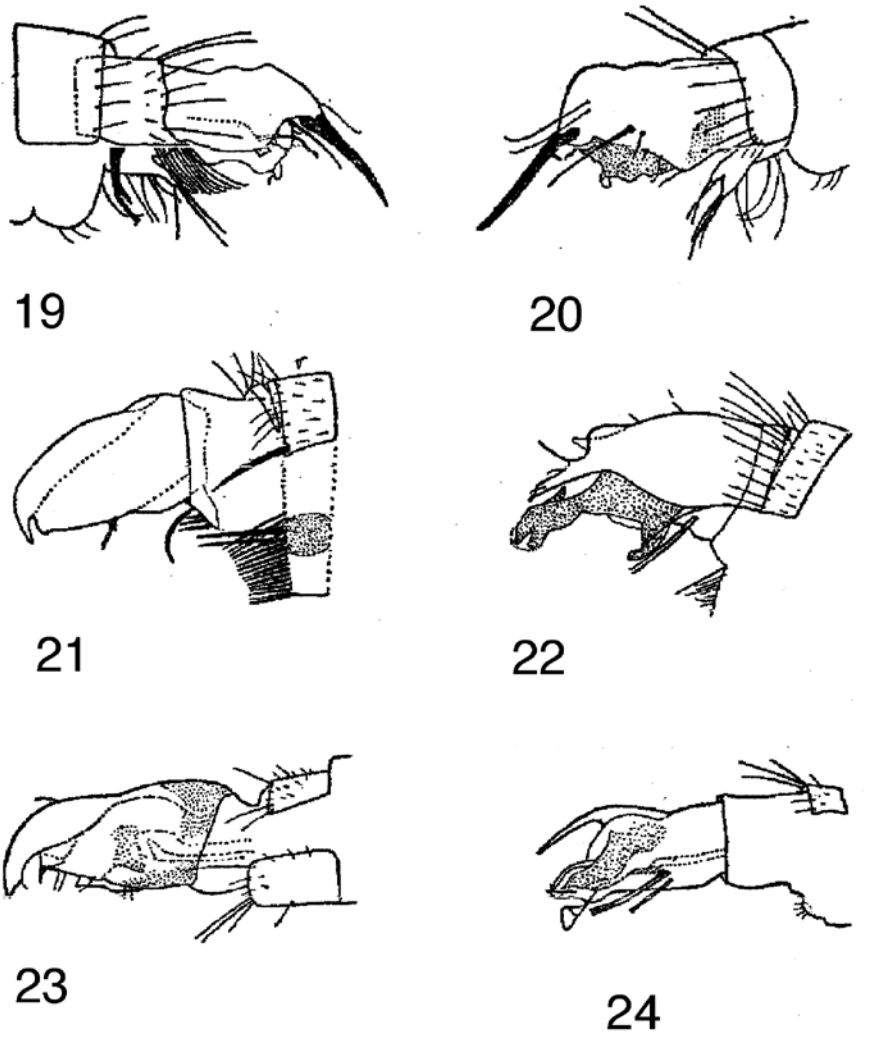
Note: this is probably the male of *M. catharinensis.*

5 The dorsal hair palisade of mid tibia extends for less than half its length. Hypopygium as Fig. 6.....Species B
— This palisade extends more than half the length of the tibia.....6
6 Ventral edge of left side of epandrium concave and bristles of proctiger at tip (Figs 7-8). Vein 3 forked.....7
—Ventral edge of left side of epandrium convex and bristle of proctiger well before tip (Fig. 9). Vein 3 unforked..... Species D

Note: this is possibly the unknown male of *M. crudelis*, except its females have a forked vein 3.

7 Hind femur pale yellow in basal two thirds and only tinged brown in apical third or less. The hypandrial bristles are about as strong and long as those

on the left side of the epandrium (Fig. 8).....*cristobalensis* Disney *et al.*
— Hind femur pale yellow at base but gradually turning brown towards tip so that apical two thirds are dominantly brown. The hypandrial bristles are shorter and also finer (Fig. 7) ..... Species C



Figs. 19-24. *Neodohrniphora* females. Figs. 19-20. *N. spinicauda* left and right faces of ovipositor sheath; Figs. 21-24. Right faces of ovipositor sheaths; Fig. 21. *N. crassispina;* Fig. 22. *N. brasiliensis;* Fig. 23. *N. adunca;* Fig. 24. *N. australis.* (After Borgmeier 1961).

Note: the available specimens probably represent more than one species. Candidates include the undescribed males of *M. crudelis, M. gracilipes* and *M. longipalpis.* Until better specimens and associations with females are secured it is best to desist from firm identifications.

Genus *Neodohrniphora* Malloch

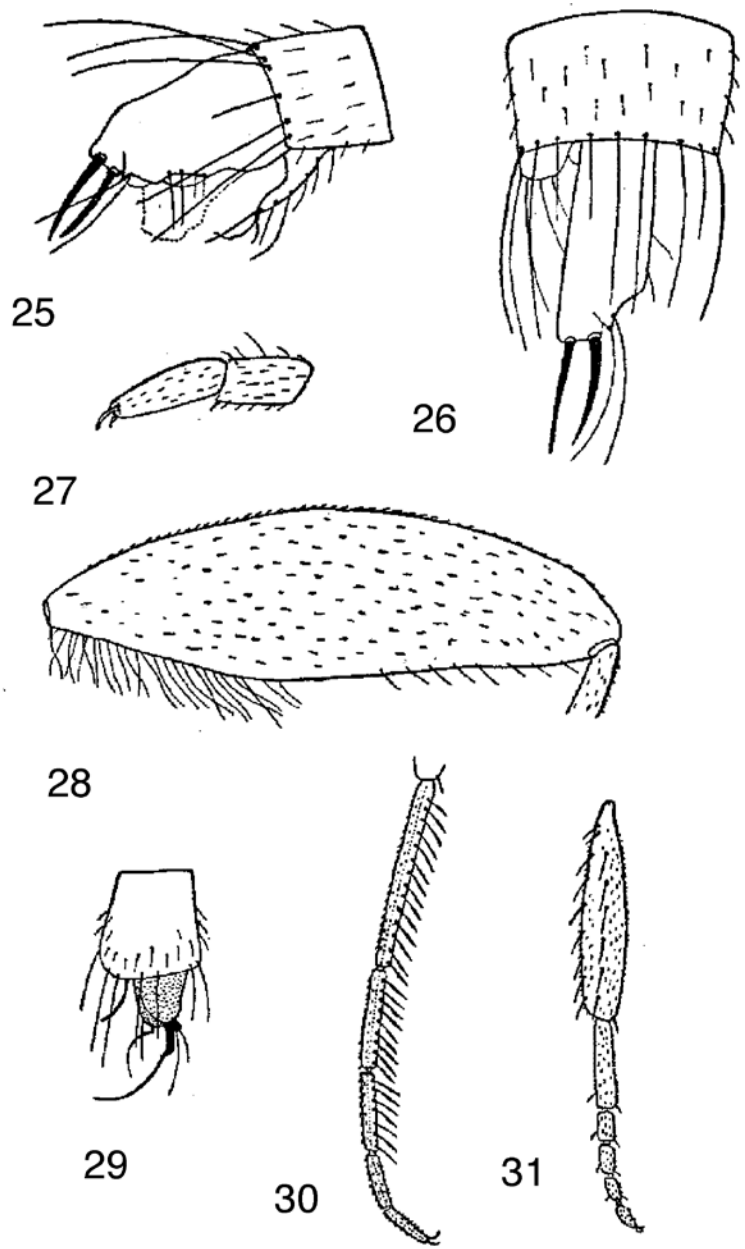
With the synonymising of *Cremersia* with *Neodohrniphora* and the exclusion of *Eibesfeldtphora* from this genus (see above under *Cremersia*) the key to the females of the former genus *Cremersia* (Borgmeier, 1961) and the key to females of *Neodohrniphora* in its more restricted sense (Disney, 1996) need amalgamating and the inclusion of subsequently described species. This new key is given below; following the description of new species and the restoration of *N. zikani* to its original species status. One of the new species is from Ecuador, but is included here for the sake of completeness.

Neodohrniphora setifemur Disney new species

The specimens are somewhat faded after 40 years in alcohol, so details of coloring are limited in the description below.

The affinities of this species are indicated in the key below.

Female. The pre-ocellars are closer to the mediolaterals than to each other and a little lower on frons than MLs. Postpedicels darker than the palps and proboscis, which are straw yellow. Palps with a longer apical bristle and 3-5 shorter bristles. Each side of thoracic scutum with a humeral bristle, two notopleurals, and intra-alar, a postalar and a shorter pre-scutellar dorsocentral bristle. Scutellum with an anterior pair of hairs (subequal to those in middle of scutum) and a posterior pair of long bristles. Abdominal tergites with obvious hairs, which are long at sides and hind margins of T2-T5. T6 with long bristles at rear margin (Fig. 32). Terminal segments of abdomen as Fig. 32. Front tarsus with a posterodorsal hair palisade on all five segments, but that on T5 is restricted to the basal half, beyond which the segment is a little tapered. T5 is longer than both T4 and T3. Mid femur with long, fine hairs along ventral margin, those in the basal half being clearly longer than those on hind femur. Mid tibia with dorsal hair palisade extending more than three quarters of length. Hind femur as Fig. 33. Wing 1.3 mm long. Costal index 0.36. Costal ratios 6.1-6.2 : 2.6 : 1. Costal cilia 0.10-0.11 mm long. No hair

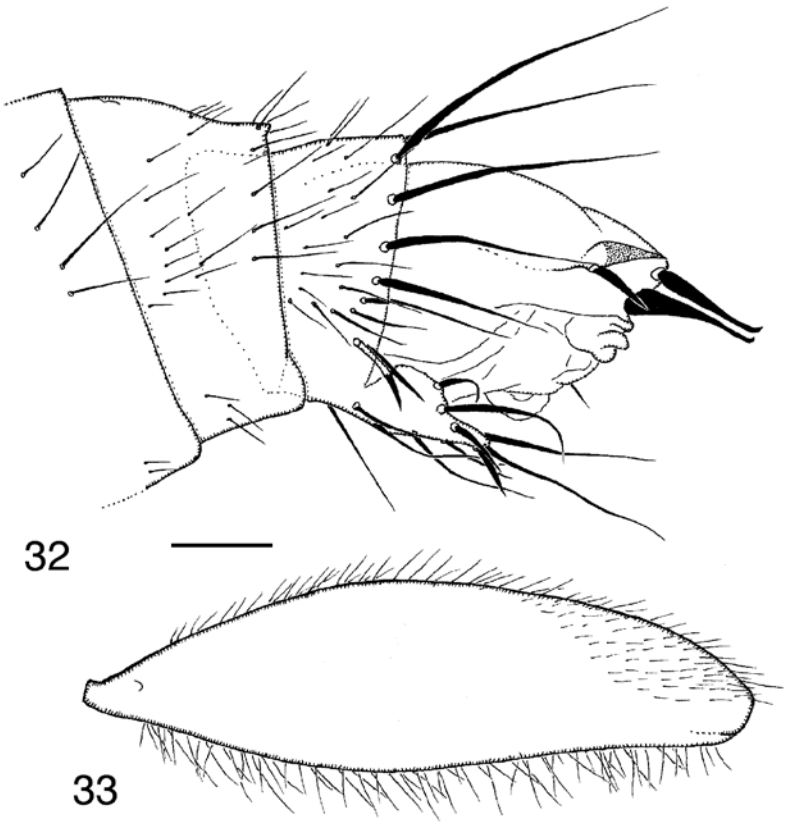


Figs. 25-31. *Neodohrniphora* females. Figs.. 25-28. *N. spinicosta:* Figs. 25-26. Right and dorsal faces of ovipositor sheath; Fig. 27. Segments 4 and 5 of front tarsus; Fig. 28. Hind femur; Figs. 29-31. *N. pilipes:* Fig. 29. Dorsal face of ovipositor sheath; Fig. 30. Mid tarsus; Fig. 31. Front tibia and tarsus. (After Borgmeier 1961).

at base of vein 3. Sc does not reach vein 1. Thick veins yellowish grey. Thin veins grey. Axillary ridge with 3 bristles that are almost as long as costal cilia, but not so robust. Haltere knob brown.

Material examined: Holotype female, ECUADOR, Oriente 00°24' S, 76°36' W, Limoncocha, hovering over emigration column of *Labidus* reticulatus Rettenmeyer & Powell (2009) (E-532), 10 November 1967, C. W. & M. E. Rettenmeyer (3688, Department of Ecology & Evolutionary Biology, University of Connecticut). Paratype female, same data as holotype except (MZUC, 30-162).

Etymology: Named after the long fine hairs along the ventral edges of the hind and mid femora.

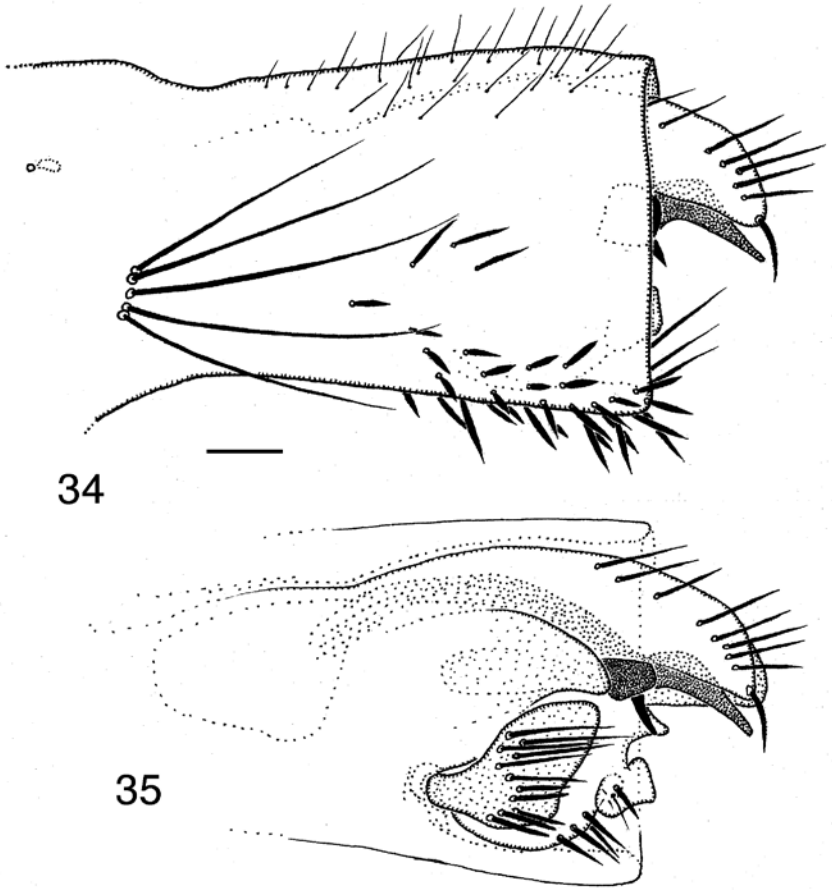


Figs. 32-33. *Neodohrniphora setifemur* female. Fig. 32. Left face of terminal segments of abdomen; Fig. 33 Posterior face of hind femur. (Scale bars = 0.1 mm).

Neodohrniphora unichaeta Disney new species

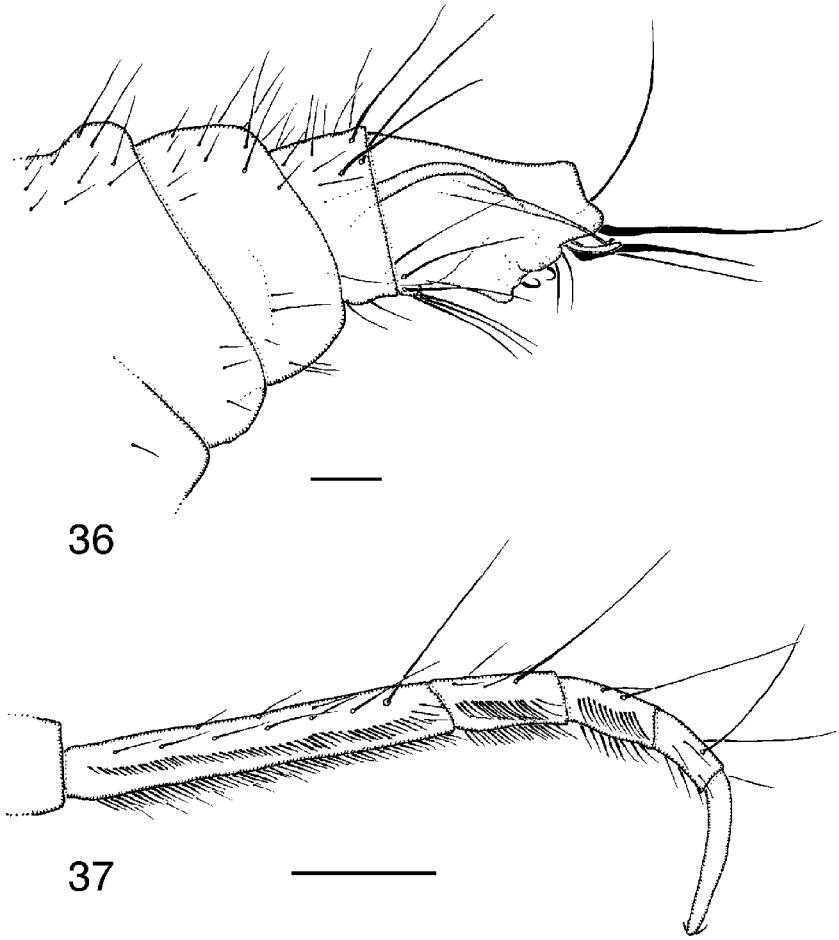
The affinities of this species are indicated in the key below.

Female. Frons brown. The pre-ocellars are closer to the mediolaterals than to each other and a little higher on frons than MLs. Postpedicels yellowish brown. Palps straw yellow, with a strong apical bristle and 3-4 smaller bristles behind it. Proboscis pale. Thorax yellow, being darkest on top. Each side of thoracic scutum with a humeral bristle, two notopleurals, and intra-alar, a postalar and a pre-scutellar dorsocentral bristle. Scutellum with an anterior



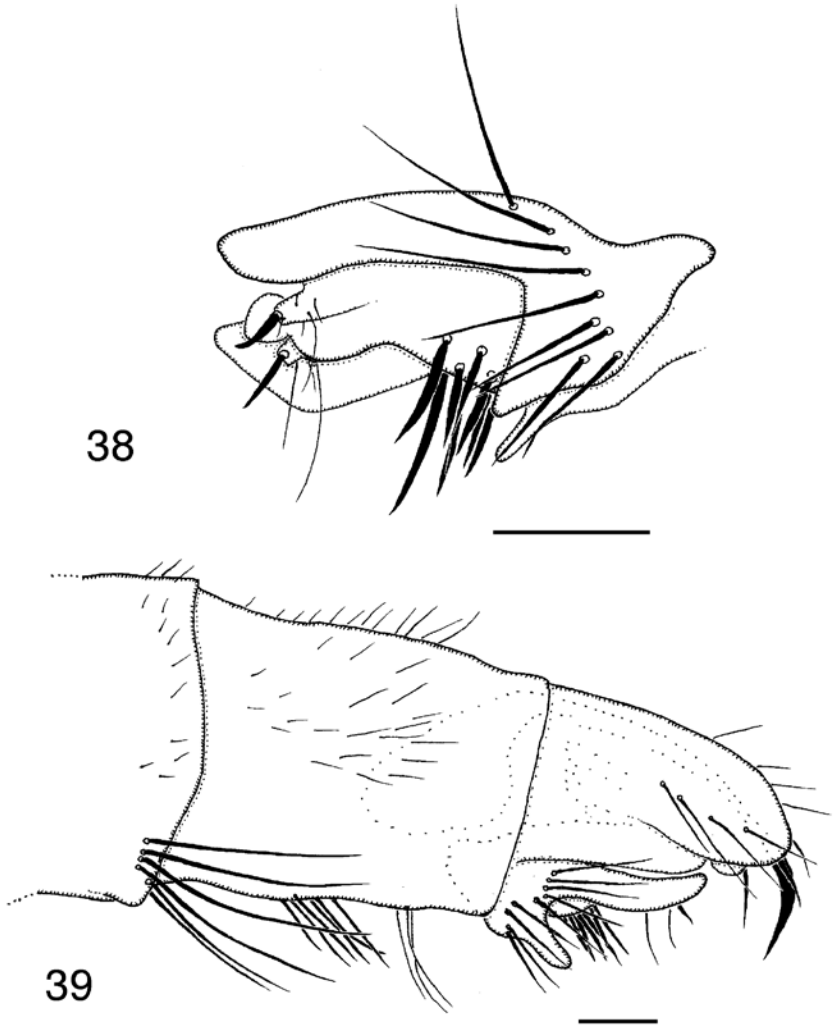
Figs. 34-35. *Neodohrniphora similis* female. Fig. 34. Left face of abdominal segment 6, with tip of abdomen protruding to rear; Fig. 35. Left face of ovipositor sheath and tip of ovipositor. (Scale bar = 0.1 mm).

pair of hairs (subequal to those in middle of scutum) and a posterior pair of bristles. Abdominal tergites mainly brown, but variably part straw yellow, especially along the median bands and in anterior halves of T2 and T5, and much of T6. The hairs are sparse and small but more numerous on T6 (Fig. 39). Ovipositor sheath as Fig. 39, with the right appendage at rear of segment 7 as Fig. 38. Ovipositor heavily sclerotised and dark brown to black. Venter dusky straw yellow with minute hairs below T3 and T4 and most of T5 before the bristle fans at rear each side (Fig. 39). Legs straw yellow, apart from brown



Figs. 36-37. *Neodohrniphora spinosissima* female. Fig. 36. Left face of ovipositor sheath; Fig. 37. Front tarsus. (Scale bars = 0.1 mm).

patch on mid coxa. Front tarsus with a posterodorsal hair palisade on all five segments. Segment 5 longer than both 3 and 4, and not tapered. Mid femur with ventral hairs scarcely longer than those of anterior face. Hair palisade on mid tibia extends its full length. Hind femur with a few short hairs and a single long bristle (0.15-0.17 mm long) below basal half. Wings 1.4-1.9 mm long. Costal index 0.40-0.44. Costal ratios 2.9-4.8 : 1.4-2.5 : 1. Costal



Figs. 38-39. *Neodohrniphora unichaeta* female. Fig. 38. Right appendage at rear of segment 7; Fig. 39. left face of ovipositor sheath. (Scale bars = 0.1 mm).

cilia 0.05-0.06 mm long. No hair at base of vein 3. Sc does not reach vein 1. Axillary ridge with 3-5 bristles, the outer 2-3 being longer than costal cilia. Thick veins yellowish grey. Thin veins grey. Membrane lightly tinged grey. Haltere knob brown.

Male. Head, thorax and abdominal tergites similar to female. Venter as female but without bristle fans on segment 5 and long bristles on segment 6, but the hairs at rear of T6 are stronger than the rest (Fig. 40). Hypopygium as Fig. 40, and brown with a straw yellow anal tube. Legs similar to female. Wings 1.6-1.8 mm long. Costal index 0.43-0.50. Costal ratios 3.6-6.6 : 1.9-2.5 : 1. Costal cilia 0.06-0.07 mm long. 4-5 axillary bristles. Otherwise wing and haltere as female.

Material examined: Holotype female, ARGENTINA: Parque Nacional Copo. Santiago del Estero, over *Acromyrmex hispidus,* 13 October 2004, L. Elizalde (MBR). Paratytpes, 2 males, 1 female, same data as holotype (except MBR, MZUC, 39-21), 1 female, Parque Nacional El Palmar, with *Acromyrmex crassispinus,* 4 April 2004, L. Elizalde (MZUC, 39-42); 1 female, San Cristóbal, Santa Fe, reared from *Ac. heyeri* in lab, 2 August 2006, L. Elizalde (MZUC, 39-42); 1 male, 1 female, same locality, reared from *Ac. heyeri* in

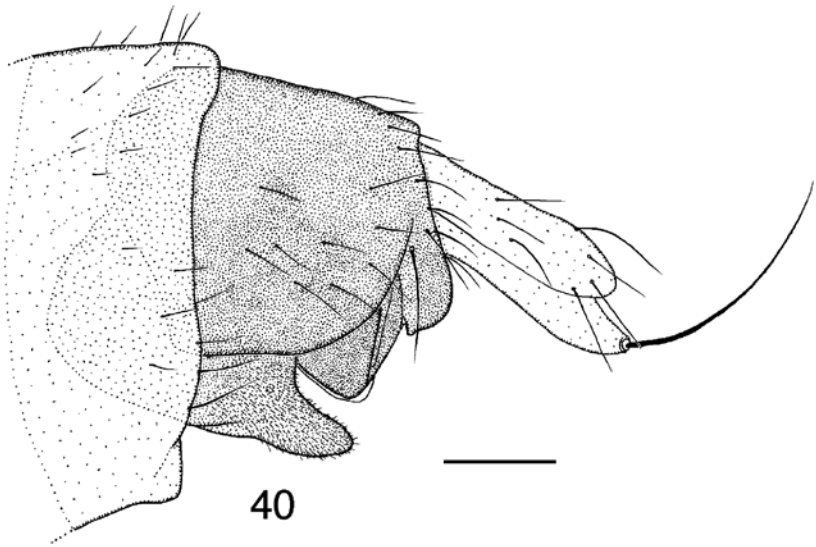


Fig. 40. *Neodohrniphora unichaeta* male, left face of hypopygium. (Scale bar = 0.1 mm).

lab, 4 January 2006 (MBR); 1 male, same locality, reared from *Ac. Lundii* in lab, 13 March 2006 (MBR).

Etymology: Named after the single long bristle below the base of the hind femur in both sexes.

Field observations. On one occasion, this species was observed pursuing ants on their foraging trail, flying very close to the ants. On another occasion, these flies were seen attempting oviposition on the back of the head of ants when they were reconstructing their accidentally excavated nests.

Recorded hosts. *Acromyrmex crassispinus*, *Ac. heyeri, Ac. hispidus* and *Ac. lundii.*

The pupa was similar to that described for the known *Eibesfeldtphora* species (Tonhasca 1996, and above)

This species was treated as "*Neodohrniphora* nr. *acromyrmecis*" in Elizalde (2009).

REVISED KEY TO THE FEMALES OF *NEODOHRNIPHORA*

1 Vein 3 forked 2
— Vein 3 unforked. (Wing less than 1.5 mm long. Mid tarsal segments 1-3 with fringe of hairs - Fig. 30. Ovipositor sheath as Fig. 29) ..... *pilipes* (Borgmeier)
2 Anterolateral bristles (ALs) close to eye margin (as Fig. 16) 3
— ALs closer to antials ..... *pernambucana* (Borgmeier)
3 Costa clearly thicker than vein 3 (e.g. Fig. 17) 4
— Costa not or only slightly thicker than vein 3 5
4 The hairs at rear of abdominal tergite 7 are longer than tergite and likewise those at rear of sternite 7 are longer than the sternite. Costa slightly concave anteriorly ..... *costalis* (Borgmeier)
— These hairs shorter. Costa slightly convex anteriorly (Fig. 17). (Ovipositor sheath as Fig. 18) ..... *crassicostalis* (Disney)

Note: if neither lead applies proceed to couplet 5.

5 Ventral edge of hind femur with a fringe of long fine hairs (Figs. 28, 33) 6
— Not such fringe below hind femur 8
6 The fine hairs below hind femur restricted to basal half (e.g. Fig. 28) 7
— These hairs extend the full length of femur (Fig. 33). (Ovipositor sheath as Fig. 32) ..... *setifemur* n. sp.

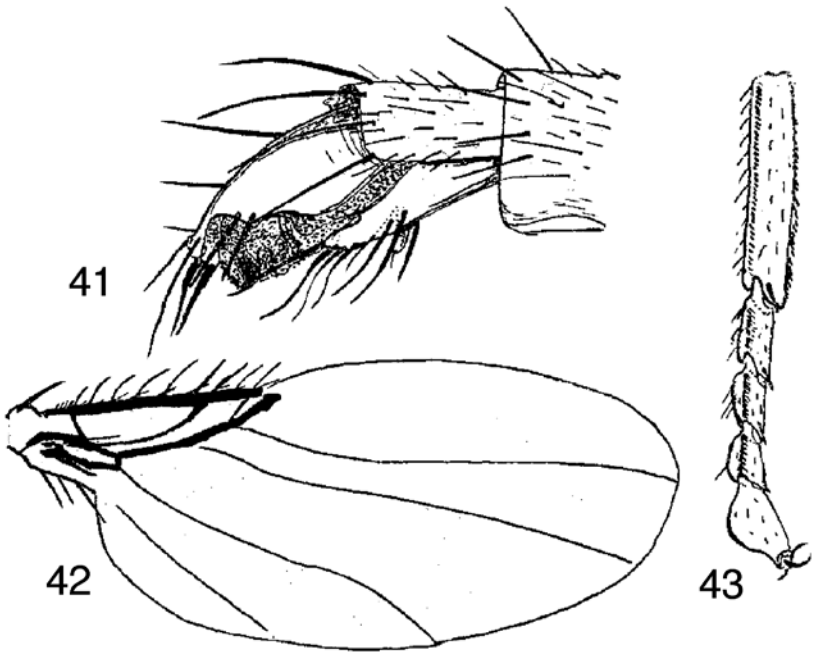
7 Segment 5 of front tarsus as Fig. 43. Ovipositor sheath as Fig. 41 .... *zikani* (Schmitz)
— Segment 5 of front tarsus as Fig. 27. Ovipositor sheath as Figs. 25-26..... .....*spinicosta* (Malloch)
8 Abdominal sternum 6 with a transverse row of long bristles at the hind margin and a pair of longer bristles on each side of segment 5 (Fig. 21)... ....*crassispina* (Borgmeier)
— Without this combination 9
9 Tip of hind femur brown..... 10
— Hind femur entirely yellow 11
10 Postpedicel reddish yellow and large (at least 0.2 mm long). Front tibia as long as first two tarsal segments. (Ovipositor sheath as Fig. 23)..... ..... *adunca* (Borgmeier)
— Postpedicel pale brown and not as large. Front tibia longer than first two tarsal segments ..... *pilosa* (Borgmeier)
11 Tip of ovipositor sheath with long spines projecting posteroventrally (Figs. 19, 20 & 36) 12
— Ovipositor sheath without such spines..... 13
12 Ovipositor sheath as Figs. 19 & 20 ..... *spinicauda* (Borgmeier)
— Ovipositor sheath as Fig. 36.....*spinosissima* (Borgmeier)
13 The hairs at rear margin of abdominal tergite 6 (T6) long (e.g. Figs. 22 and 24) 14
— The hairs at rear of T6 short (Figs. 11, 12, 15 and 39) 16
14 Segment 5 of front tarsus tapered (similar to Fig. 27) 15
— This segment not tapered. (Ovipositor sheath as Fig. 22) .... *brasiliensis* (Borgmeier)
15 Hairs at rear margin of sternum of abdominal segment 6 very short (Fig. 24) ..... *australis* (Borgmeier)
— These hairs clearly longer ..... *salesiana* (Borgmeier)
16 The pair of appendages at the rear of abdominal segment 7 with a ventrally directed lobe at base (Figs. 14 and 39) 17
— No such lobes (Figs. 11, 12 and 35) 18
17 The lobes of the aforesaid appendages are longer and the bristles are restricted to their basal halves (Figs. 38-39) ..... *unichaeta* Disney n. sp.
— These lobes are shorter and the bristles extend beyond the half way point

(Figs. 14 and 15).....*acromyrmecis* Borgmeier
18 The aforesaid appendages divided at their tips (Figs. 12 and 13) .....
..... *calverti* Malloch
— These lobes are undivided apically (Figs. 11 and 35)..... 19
19 The aforesaid lobes are longer (Fig. 11).....*cognata* Prado
— These lobes are shorter (Fig. 35).....*similis* Prado

Genus *Pseudacteon* Coquillett

About 50 species are known in this genus. The females of the Nearctic and Neotropical species are keyed by Borgmeier (1969), which needs supplementing by Borgmeier & Prado (1975), Disney (1982, 1991) Brown & Morrison (1999), Pesquero (2000), Porter & Pesquero (2001), Mattos & Orr (2002) and Brown, Folgarait & Gilbert (2003).

Pseudacteon confusus **Disney new species**



Figs. 41-43. *Neodohrniphora zikani* female. Fig. 41. Right face of tip of abdomen; Fig. 42. Wing; Fig. 43. Front tarsus. (After Schmitz 1924).

In the key of Borgmeier (1969) this runs to couplet 11, lead 2, to *P. dorymyrmecis* Borgmeier, which it closely resembles. It differs in being not so dark, in having more hairs on the each of the two separated rudiments of abdominal tergite 6, the terminal bristle of each palp being distinctly (but not strongly) differentiated and the costal index being a little longer (about 0.39, as opposed to 0.36).

Female. Frons brown, with only 6-8 hairs and 4-4-4-4 bristles. Borgmeier (1969) regards the median pair of the front row as supra-antennals but the ones standing close to the eye margin as an extra pair. Antials a little closer together than pre-ocellars (POs) and about level with the antero-laterals. POs further apart than either is from a mediolateral, which is a little lower on frons. Postpedicels brown and approximately oval. Palps pale yellow and as Fig. 45. Proboscis coloured as palps. Thorax brown. Each side of scutum with a small humeral bristle, two notopleurals, a pre-alar, a postalar and a pre=scutellar dorsocentral bristle. Scutellum with 4 bristles, the anterior pair being about two thirds as long as the pair behind. Abdominal tergites brown with a few small hairs that are little longer on T5 and the reduced T6 (Fig. 44). Venter brown and sternite 6 with two strong bristles and 6-8 hairs. T6 and ovipositor and its sheath as Fig. 44. Legs straw yellow apart from brown patch on mid coxa. Front tarsus with a posterodorsal hair palisade on all five segments. Segment 5 longer than 4 but not as long as basitarsus. Dorsal hair palisade of mid tibia extends almost two thirds of length. Hairs below basal half of hind tibia clearly shorter than those of anteroventral row of outer half. Wings 1.0 mm long. Costal index 0.39. Costal ratios 2.1-2.4 : 1. Costal cilia 0.04 mm long. Sc not reaching vein 1. No hair at base of vein 3. Axillary ridge with 3-4 bristles, the outer two being clearly longer than costal cilia. Thick veins pale yellowish grey, the thin veins 4-6 pale grey and 7 very pale. Membrane almost colourless. Haltere knob white.

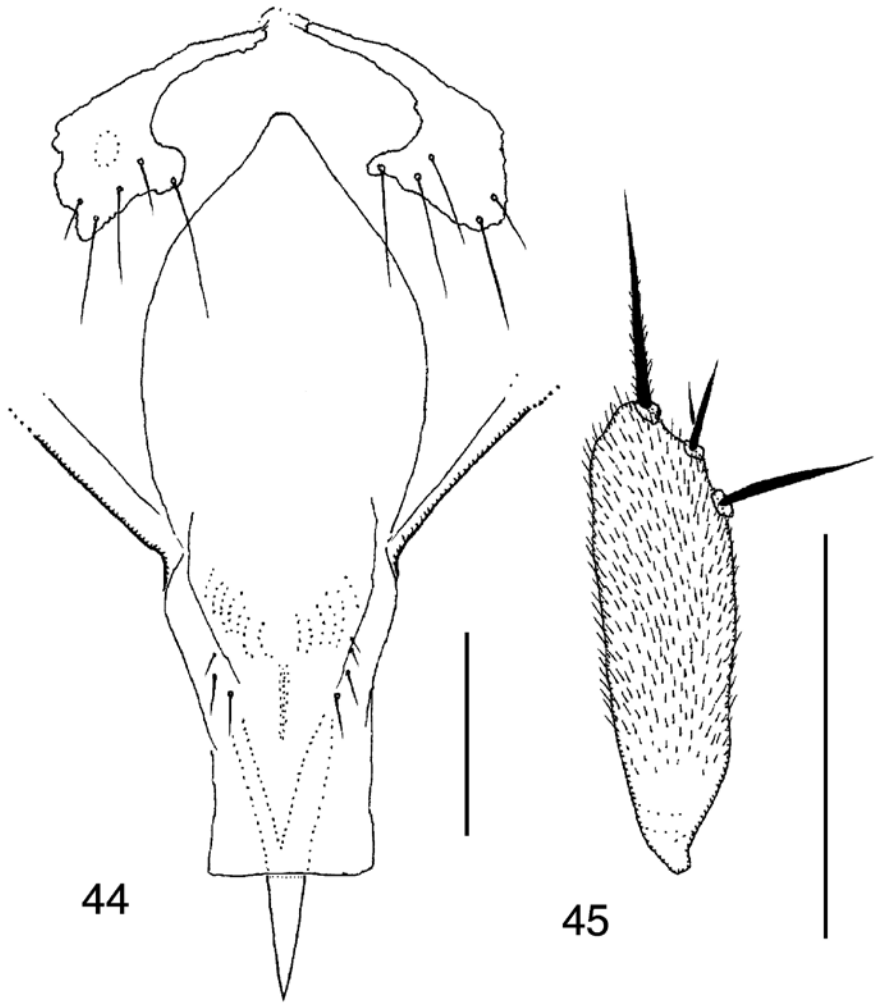
Etymology. Named after being easily confused with other very similar species.

Material examined: Holotype female, ARGENTINA: San Cristóbal, Santa Fe, over *Atta vollenweideri,* 9 May 2006, L. Elizalde (MBR). Paratype female, same locality, over *Acromyrmex striatus,* 29 April 2006, L. Elizalde (MZUC, 39-31).

Field observations. No oviposition attempts were observed as the flies hovered over or near the ants. Females of this species were also collected following workers of *Ac. lobicornis* and *Ac. heyeri*, but again no oviposition attempts were observed.

DISCUSSION

The specimens reared from ants provide unequivocal evidence of the hosts of these flies. The *Neodohrniphora* genus, as now diagnosed, has been reported



Figs. 44-45. *Pseudacteon confusus* female. Fig. 44. Abdominal tergite 6 and ovipositor and its sheath; Fig. 45. Inner face of left palp. (Scale bar = 0.1 mm).

to be associated with *N. acromyrmecis, N. calverti, N. cognata* and *N. similis* (Borgmeier 1929, 1931, Prado 1976) or attacking and being reared from the leaf-cutter ant *N. unichaeta*, as well as attacking the army ant *N. crassicostalis* (Disney *et al.* 2008). Those collected in the field in the vicinity of army ants may have been seeking other species flushed by the army ants or were assessing whether their preferred ant host was present, having been attracted to ants in general.

In addition, *Pseudacteon confusus* was collected hovering over *Atta vollenweideri* and *Acromyrmex striatus*, although no oviposition attempt was observed nor was this species reared from these ants, even after collecting thousands of individual ants and maintaining them in the laboratory. Thus, it is probable that the host of this phorid is another ant species, and the reason of this association needs to be established.

ACKNOWLEDGMENTS

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REFERENCES

Borgmeier, T. 1925. Novos subsidios para o conhecimento da familia Phoridae. Archivos do Museu Nacional, Rio de Janeiro 25: 85-281.

Borgmeier, T. 1928. Investigações sobre Phorideos myrmecophilos (Diptera, Phoridae). Archivos do Instituto Biologico de Defesa Agricola e Animal São Paulo 1: 159-92.

Borgmeier, T. 1929. Über attophile Phoriden. Zoologischer Anzeiger 80: 493-517.

Borgmeier, T. 1931. Sobre alguns Phorideos que parasitam a saúva e outras formigas cortadeiras (Diptera - Phoridae). Archivos do Instituto Biologico de Defesa Agricola e Animal, São Paulo 4: 209-28.

Borgmeier, T. 1961. Weitere Beitraege zur Kenntnis der neotropischen Phoriden, nebst Beschreibung einiger *Dohrniphora*-Arten aus der indo-australischen Region (Diptera, Phoridae). Studia Entomologica, Petropolis 4: 1-112.

Borgmeier, T. 1969. New or little-known Phorid flies, mainly of the Neotropical Region (Diptera, Phoridae). Studia Entomologica, Petropolis12: 33-132.

Borgmeier, T. & A. P. do Prado. 1975. New or little-known Neotropical Phorid flies, with description of eight new genera (Diptera, Phoridae). Studia Entomologica, Petropolis18: 3 - 90.

Bragança, M. A. L., T. M. C. Della Lucia & A. Tonhasca. 2001. Interaçâo entre o parasitóide *Neodohrniphora* sp. (Dip: Phoridae) e a saúva *Atta bisphaerica* (Hym: Formicidae). P. 284 in: Livro de Resumos – VII Simpósio de Controle Biolólogico, Poços de Caldas. Minas Gerais, Brazil.

Brown, B. V. 1988. Additions to the Phorid chapter in the "Manual of Nearctic Diptera, Volume 2" (Diptera: Phoridae). Canadian Entomologist 120: 307-22.

Brown, B. V. 2000. Revision of the "*Apocephalus miricauda*-group" of ant-parasitizing flies (Diptera: Phoridae). Contributions in Science (Natural History Museum of Los Angeles County) 482: 1-62.

Brown, B. V. 2001. Taxonomic revision of *Neodohrniphora*, subgenus Eibesfeldtphora (Diptera: Phoridae). Insect Systematics & Evolution 32: 393-409.

Brown, B. V., R. H. L. Disney, L. Elizalde & P. Folgarait. In preparation. New species and new records of *Apocephalus* Coquillett (Diptera: Phoridae) that parasitize ants (Hymenoptera: Formicidae) in South America.

Brown, B. V., P. Folgarait & L. Gilbert. 2003. A new species of *Pseudacteon* attacking *Solenopsis* fire ants (Hymenoptera: Formicidae) in Argentina. Sociobiology 41: 685-688.

Brown, B. V. & L. W. Morrison. 1999. New *Pseudacteon* (Diptera: Phoridae) from North America that parasitizes the native fire ant *Solenopsis geminata* (Hymenoptera: Formicidae). Annals of the Entomological Society of America 92: 308-11.

Disney, R. H. L., 1982. Three new species of scuttle-fly (Diptera: Phoridae) that parasitize ants (Hymenoptera: Formicidae) in North America. Journal of Zoology, London 197: 473-481.

Disney, R. H. L., 1991. The fire-ant parasitoids of the *Pseudacteon spatulatus* complex (Diptera, Phoridae; Hymenoptera, Formicidae). Sociobiology 18: 283-298 + 332.

Disney, R. H. L., 1994. Scuttle Flies: The Phoridae. Chapman & Hall, London.

Disney, R. H. L., 1996. A key to *Neodohrniphora* (Diptera: Phoridae), parasites of leaf-cutter ants (Hymenoptera: Formicidae). Journal of Natural History 30: 1377-1389.

Disney, R. H. L. 2001. The preservation of small Diptera. Entomologist's Monthly Magazine 137: 155-159.

Disney, R. H. L., L. Elizalde & P. J. Folgarait 2006. New species and revision of *Myrmosicarius* (Diptera: Phoridae) that parasitize leaf-cutter ants (Hymenoptera: Formicidae). Sociobiology 47: 771-809.

Disney, R. H. L., L. Elizalde & P. J. Folgarait 2008. New species and records of scuttle flies (Diptera: Phoridae) associated with leaf-cutter ants and army ants (Hymenoptera: Formicidae) in Argentina. Sociobiology 51: 95-117.

Disney, R. H. L. & C. W. Rettenmeyer 2007. New species and revisionary notes on scuttle flies (Diptera: Phoridae) associated with Neotropical army ants (Hymenoptera: Formicidae). Sociobiology 49: 1-58.

Elizalde, L. 2009. Biogeografía y comunidades de fóridos parasitoides de hormigas cortadoras de hojas: diversidad del sistema y partición del recurso hospedador. PhD thesis. Universidad Nacional de Quilmes, Bernal, Buenos Aires, Argentina.

Malloch, J. R. 1912. The insects of the Dipterous family Phoridae in the United States National Museum. Proceedings of the United States National Museum 43: 411-529.

Malloch, J. R. 1914. Costa Rican Diptera. Paper 1. A partial report on Borboridae, Phoridae and Agromyzidae. Transactions of the American Entomologiocal Society 40: 8-36.

Mattos, M. R. & M. R. Orr. 2002 Two new *Pseudacteon* species (Diptera:Phoridae), parasitoids of ants of the genus *Linepithema* (Hymenoptera: Formicidae) in Brazil. Studia dipterologica 9: 283-288.

Pesquero, M. A. 2000. Two new species of *Pseudacteon* (Diptera: Phoridae) parasitoids of fire ants (*Solenopsis* spp.) (Hymenoptera: Formicidae) from Brazil. Journal of the New York Entomological Society 108: 243-7.

Porter, S. D. & M. A. Pesquero. 2001. Illustrated key to *Pseudacteon* decapitating flies (Diptera: Phoridae) that attack *Solenopsis saevissima* complex fire ants in South America. Florida Entomologist 84: 691-699.

Prado, A. P. do. 1976. Records and descriptions of phorid flies, mainly of the Neotropical Region (Diptera; Phoridae). Studia Entomologica, Petropolis 19: 561-609.

Rettenmeyer, C.W. & S. Powell 2009. A New Species of Army Ant , *Labidus reticulatus*, (Hymentoptera, Formicidae, Ecitoninae) Scoiobiology (in press).

Schmitz, H. 1924. Een nieuwe Phoride, *Cremersia zikani* n. g. n. sp. Natuurhistorisch Maandblad 13: 32-34.

Tonhasca, A. J. 1996. Interactions between a parasitic fly, *Neodohrniphora declinata* (Diptera: Phoridae), and its host, the leaf-cutting ant *Atta sexdens rubropilosa* (Hymenoptera: Formicidae). Ecotropica, 2: 157-164.

Tonhasca, A. J., M. A. L. Bragança & M. J. Erthal. 2001. Parasitism and biology of *Myrmosicarius grandicornis* (Diptera, Phoridae) in relationship to its host, the leaf-cutting ant *Atta sexdens* (Hymenoptera, Formicidae). Insectes Sociaux, 48: 154-158.

Weissflog, A., U. Maschwitz, S. Seebauer, R. H. L. Disney, B. Seifert & V. Witte. 2008. Studies on European ant decapitating flies (Diptera: Phoridae): II. Observations that contradict the reported catholicity of host choice by *Pseudacteon formicarum* Sociobiology 51: 87-94.