



RESEARCH ARTICLE - ANTS

Moth flies (Diptera: Psychodidae) collected in colonies of the fire ant *Solenopsis virulens* (Smith) (Hymenoptera: Formicidae), with description of two new species

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Abstract

Three species of Psychodidae were collected in colonies of the fire ant *Solenopsis virulens* (Smith, 1858) (Hymenoptera: Formicidae), in an area of Atlantic forest on the south of Bahia State, Brazil. Two of them are new to science, herein described: *Trichomyia myrmecophila* sp. nov. and *Quatiella truncata* sp. nov., the last one also occurring in other states of Northeastern Brazil (Paraíba and Ceará) and in the Amazonian Region. A new record of *Trichomyia annae* Bravo 2001 is given.

Introduction

Association between Diptera and Formicidae (Hymenoptera) has been reported for many species of Phoridae (Borgmeier, 1938; Brown, 2009), some Microdontinae (Syrphidae) (Reemer, 2013) and in nematoceros Diptera of the families Culicidae, Ceratopogonidae, Cecidomyiidae and Sciaridae (Kistner, 1982, Evenhuis *et al.*, 2007).

The association between Psychodidae (Diptera) and ants was only recorded in three psychodid species, each one of which in distinct subfamilies: adults of *Lutzomyia texana* (Dampf) (Phlebotominae) in *Atta texana* Buckley nest, southern U.S.A. (Young & Perkins, 1984); pupa of *Nemopalpus mopani* De León (Bruchomyiinae) in *Eciton hamatum* (Fabricius) nest, Guatemala and Ecuador (Kistner *et al.*, 2001) and larvae of *Alepia longinoi* Quate & Brown (Psychodinae) in nests of two species of the genus *Azteca* Forel, Costa Rica (Quate & Brown, 2004).

A recent Diptera collection in ant nests in the Atlantic Rain Forest Biome in the state of Bahia, Brazil, has resulted in the

discovery of three species of Psychodidae associated with colonies of *Solenopsis virulens* (Smith). Despite of its wide distribution, being found in forest areas of northeastern South America, from Bolivia to the state of Bahia at Atlantic Coast (Trager, 1991), there were already no report of myrmecophile interactions for this fire ant. Herein we describe two new species of moth flies, and also record for the first time Trichomyiinae species associated with ant nests.

Material and methods

The adults of Psychodidae were collected from fragments of 12 nests of *Solenopsis virulens* found on fallen tree trunks and at the base of trees. Approximately 2000 cm³ of the nests were collected, carried to the laboratory - in enclosed plastic container - and accommodated in an emergency trap, during the period of 15 days. The moth flies were fixed in 70% ethanol, then cleared with 10% sodium hydroxide and mounted in Canada balsam. The terminology of the morphological descriptions follows Cumming



and Wood (2009). The moth flies specimens are deposited in the Prof. Johann Becker Entomology Collection at the Zoological Museum of the Universidade Estadual de Feira de Santana, Bahia, Brazil (MZFS) and in the Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil (INPA). Specimens of the host ant were deposited in the Myrmecology Laboratory collection (CPDC) of the Cocoa Research Center, at Ilhéus, Bahia, Brazil

Results

Trichomyia annae Bravo, 2001

Material examined: BRAZIL, Bahia: Igrapiúna, Reserva Ecológica da Michelin, 13°50'S 39°10'W, 1 male, 22.V.2013, Pereira, T.P.L. col. (MZFS). From a nest of *S. virulens*.

Distribution: BRAZIL, Bahia: Serra da Jibóia (Bravo, 2001), Igrapiúna (new record).

Trichomyia myrmecophila Araújo & Bravo, sp. nov.

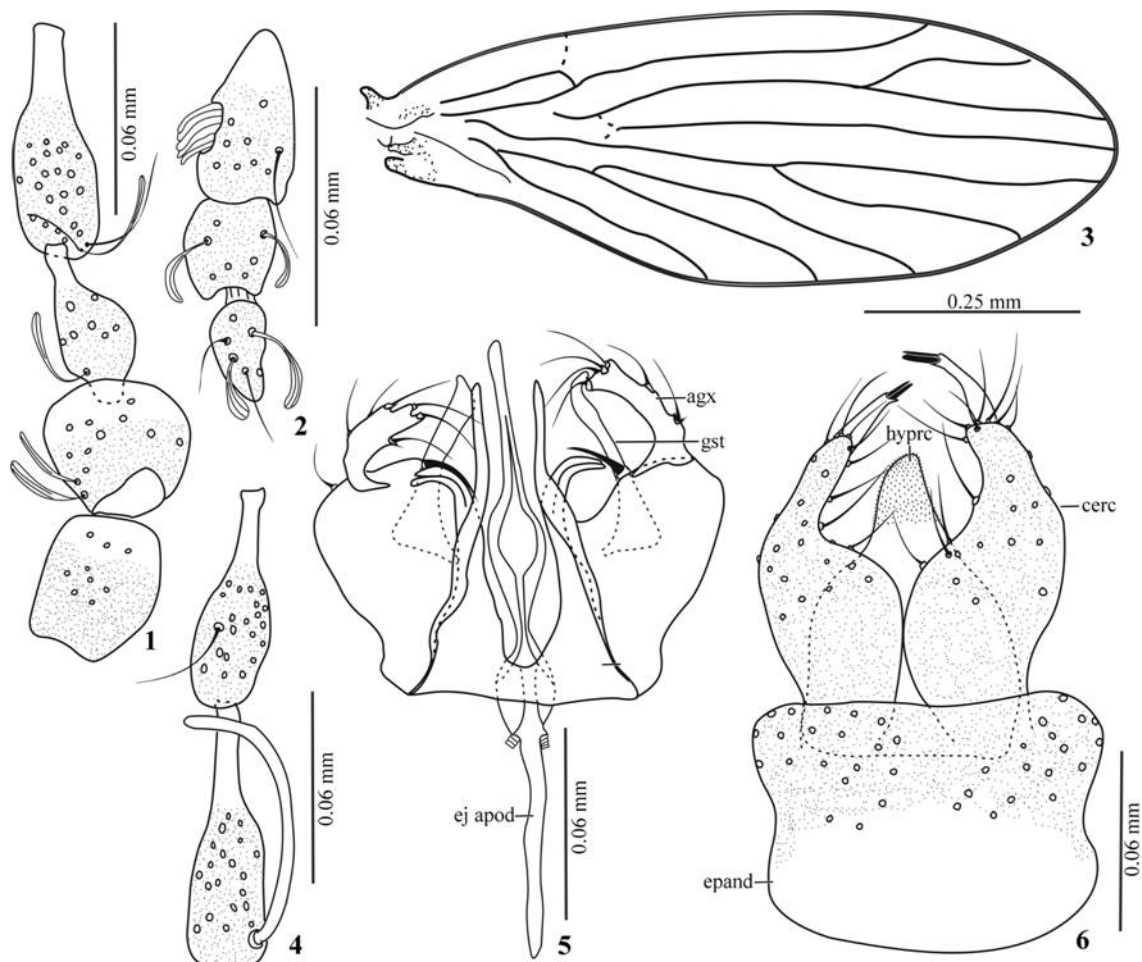
Type material: BRAZIL, Bahia state, Ituberá, Reserva Ecológica da Michelin, 13°50'S 39°10'W, 22.v.2013, holotype

male, Pereira, T.P.L. col. (MZFS). From a nest of *S. virulens*.

Etymology: The new species is named after its discovery in the nest of the fire ant *Solenopsis virulens*.

Diagnosis: Base of R_5 and r-m unsclerotized; gonocoxites fused with two internal expansions, the dorsal longer than ventral one, straight, narrow ending in a point and the dorsal ending in a bifurcated apex; gonocoxite with one pair of arms and with a strong setae in the interior margin of this structure; cercus pyriform, wider basally narrower apically with two distinct apical setae.

Description: Male. Head subcircular. Antenna incomplete in the studied specimen; scape subcylindrical; pedicel subspherical (Fig 1); basal flagellomeres pyriform and eccentric (Fig 1); ascoids C-shaped with the same length of flagellomere (Fig 4). Palpus three segmented; palpus formula 1.0:0.5:0.6 (Fig 2); first segment with sensilla in depressed pit on inner side (Fig 2). Wing: R_5 with base unsclerotized; r-m unsclerotized, m-cu present and Sc-c unsclerotized (Fig 3). Male terminalia: hypandrium and gonocoxites fused with two internal expansions, the dorsal longer than ventral one, straight, narrow ending in a point and the dorsal ending in a bifurcated apex; (Fig 5). Internal margin of gonocoxite with strong bristle (Fig 6). Dorsal arm of gonocoxite narrow with long setae along the margins and in the apex (Fig 5). Gonostylus slightly sclerotized, articulated ventrally to gonocoxite, bare, longer



Figs 1–6. *Trichomyia myrmecophila* Araújo & Bravo sp. nov. 1. Scape, pedicel and basal flagellomeres. 2. Palpus. 3. Left wing; 4. Flagellomeres with ascoid. 5-6. Male terminalia, dorsal 5. Gonocoxites, gonostyli and ejaculatory apodeme 6. Cerci, epandrium and hypoproct. Abbreviations: agx= arm of gonocoxite, cerc= cercus, ej apod = ejaculatory apodeme, epand= epandrium, gst = gonostylus, hyprct = hypoproct.

than gonocoxite (Fig 5). Aedeagus bifid fused apically (Fig 5). Ejaculatory apodeme, narrow, 1.5 times the length of gonostylus. Epandrium subretangular (Fig 6). Cercus pyriform, wider basally narrower apically with two distinct apical setae (Fig 6). Hypoproct with apical micropilosity (Fig 6).

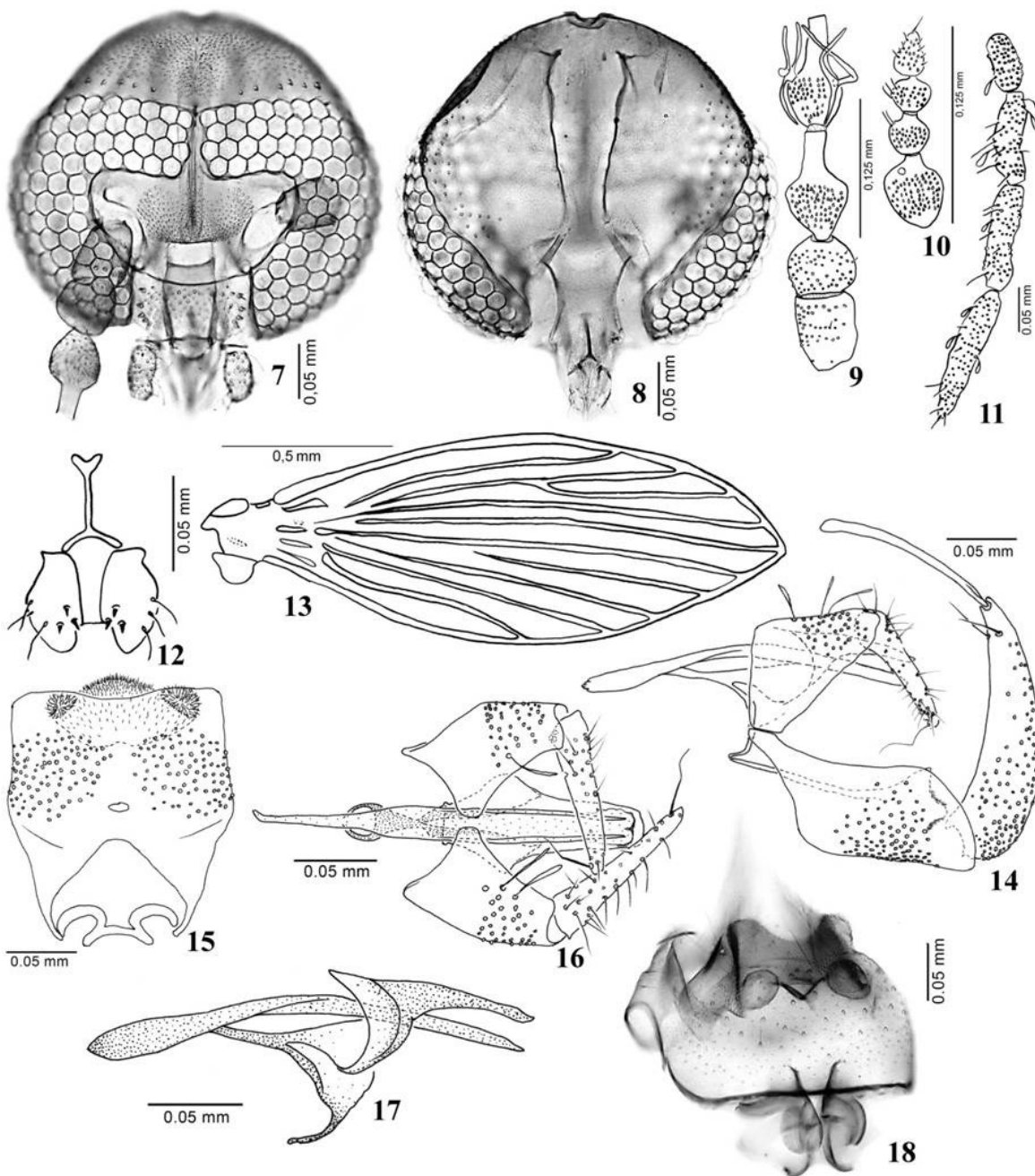
Female: Unknown.

Distribution: Known only from the type locality, Ituberá, Bahia, Brazil.

Remarks: No other Neotropical species of *Trichomyia* with one pair of arms have a pyriform cercus with two apical setae.

***Quatiella truncata* Chagas & Cordeiro sp. nov.**

Type material: BRAZIL. Holotype male, Bahia state, Igrapiúna, Reserva Michelin, 13°50' S 39°10' W, 22.v.2013, Pereira, T.P.L. col. (MZFS). From nest of *S. virulens*; Paratypes: 42 males, Pará state, Santarém, Chácara Nossa Senhora de Nazaré, Km 13-8, CDC – mata, 27.xi.1998, Freitas, R., Naiff, R.D., Silva, F.L. cols. (21 males INPA, 21 males MZFS); 1 male, Pará, Santarém, Estação do Aeroporto, Km 13, Comunidade Santa Maria, Chácara N. Sr. Nazaré, ponto 8, Mata alterada, 25.xi.1998 (INPA); 2 males, Amazonas state, Manacapuru, Cajatuba, ponto 4, CDC, 21.iv.1998, Lote: 01 04, col. Queiróz, R., Nonato, R. cols (1 male INPA, 1 male MZFS); 2 males and 1 female Paraíba state, Areia, Brejo Paraibano, (1 male 06° 58' S 39° 44' W), 25-29.ix.2011,



Figs 7-18. *Quatiella truncata* Chagas & Cordeiro sp. nov. 7. Head, anterior. 8. Head, posterior. 9. Scape, pedicel and basal flagellomeres. 10. Flagellomeres. 11. Palpus. 12. Labellum. 13. Wing. 14-17. Male terminalia. 14. Lateral view. 15. Ventral view: epandrium, epiproct and hipoproct. 16. Dorsal view: gonocoxites, gonostyli and aedeagal complex. 17. Aedeagal complex in detail, lateral view. 18. Female terminalia on ventral view showing subgenital plate and internal structures.

Nascimento, E. & Silva-Neto, A. cols (MZFS); 1 male CE [Ceará state], Parque Nacional Ubajara (03° 50' 21" S 40° 54' 59" W), 22-29.x.2011, Nascimento, E & Silva-Neto, A. cols (MZFS).

Etymology: Latin *truncata*, refers to the truncate apex of aedeagus.

Diagnosis: Male cercus slightly curved, with one apical long tenaculum, around 0.7 length of cercus; gonocoxites almost contiguous; gonocoxal apodemes forming a ventral sheath to aedeagus; aedeagus straight, long and slender, with truncate apex; female subgenital plate wider than long, bilobed, with a pair of strongly sclerotized round structures.

Description: Male: Head semicircular in frontal view; vertex higher than width of eye bridge (Fig 7); occipital foramen in upper position; frons hair patch extending to first row of eye bridge; eye bridge with 4 facet rows, separated by 0.2 X facet diameter in its closest point; vertex hair patch extending continuously to posterior margin of eyes (Fig 8); 7 supra-ocular setae, nearly continuous with the 4 larger occipital alveoli; interocular suture with short medial spur; clypeus wider than long with 4–5 larger lateral alveoli; frontoclypeal suture present; antenna with cylindrical scape, little longer than subspherical pedicel (Fig 9), and 14 flagellomeres, 12–14 reduced, 11–13 without necks, all separated, 14 conically shaped (Fig 10); ascoids Y-shaped (Fig 9); palpal formula 1.0:1.7:2.0:2.8 (Fig 11); labellum compact, fleshy, with 3 spines on inner margin and 5 latero posterior setae (Fig 12). Wing (Fig 13): wing membrane bare; Sc vein short; R_1 ending on the same of CuA_2 ; radial fork apical to medial fork, both complete, medial fork weakened. Leg: distitarsi without apical projection. Male terminalia: cercus entirely pilose (Fig 14), slightly curved, about same length of epandrium, with one apical tenaculum, one or two subapical setae, three subapical papilla and a group of short setae (probably pilose papilla) on inner margin at base; tenaculum long, around 0.7 length of cercus; epandrium with one small foramen (Fig 15); epiproct simple and short, pilose; hypoproct wider than long, pilose; hypandrium indistinguishable; gonostylus as long as gonocoxites, with several aparsely distributed short setae and one thin and long setae near apex (Fig 16); gonocoxites almost contiguous; gonocoxal apodemes ventral to aedeagus, surrounding the aedeagus to form a dorsal sheath to aedeagus; aedeagus straight, long and slender, with truncate apex; aedeagal apodeme simple and short, 0.4 length of aedeagus (Fig 17).

Female: Head, antenna and wing same as male. Genitalia as figured; subgenital plate slightly wider than long, pilose, bilobed with lobes well delimited (Fig 18); a pair of round sclerotized structures interior to the subgenital plate.

Distribution: Brazil (Amazonas, Pará, Bahia).

Remarks: This species is very similar to *Quatiella cubana*, but they can be differentiated by genitalic characters, as follows: in *Quatiella truncata* sp. nov. males present a long dorsal sheath to aedeagus (which may be fused parameres) and females presents subgenital plate wider than long with well delimited apical lobes and round internal structures,

while in *Q. cubana* the males have no dorsal sheath to aedeagus and the subgenital plate of female is slightly longer than wide with a pair of saculiform structures internally. The genus *Quatiella* was already considered a subgenus and a synonym of *Philosepedon* Eaton, 1904 by Duckhouse (1973, 1974, respectively), but was accepted as a genus by others (Vaillant, 1973, 1974, 1990, 1991; Ježek, 1985; Wagner & Masteller, 1996; Ibáñez-Bernal, 2004). This genus is similar to *Feuerborniella* (Ježek, 1985 even suggested they could be synonyms) by having eyes proximate, bulbous labellum with short spines on inner margin, 14 flagellomeres, 12-14 reduced, ascoids Y-shaped, male genitalia with cercus bearing one tenaculum at apex. But they can be differentiated by male terminalia characters. In *Quatiella*, the tenaculum is longer, at least half the length of cercus, the hipoproct is subretangular, much wider than long, and the gonocoxites are not separated by the hypandrium. In contrast, *Feuerborniella* has a shorter tenaculum, not reaching half of cercus, hipoproct projecting posteriorly, and gonocoxites separated by the hypandrium.

The paratypes of *Quatiella truncata* were collected with Malaise and CDC light traps and not found emerging from a fire ant nest, as the holotype. However, at least the specimens from the States of Amazonas and Pará were collected in a forest area, as the holotype, where *S. virulens* is known to occur (Trager, 1991).

Discussion

This is the first study about myrmecophilous interactions with fire ant *Solenopsis virulens*. However, inside fire ants - *geminata* group (Trager, 1991) – in the first study to survey myrmecophilous species associated with nests of *Solenopsis saevissima richteri* Forel, Collins & Markin (1971) cataloged fifty-two species of arthropods, including crustaceans, millipedes, arachnids, and eight orders of Hexapoda .

To explain the coexistence and permanence of these insects within the nests Vander Meer et al. (1989) discovered that many of the insects myrmecophilous have similar or identical cuticular hydrocarbons to those of their host. Although we can not affirm what kind of association the moth flies described here present with the ant nests, Kistner *et al.* (2001) and Quate and Brown (2004) notes on Psychodidae larvae inside ant nests show that moth flies may be capable of using this type of habitat for breeding.

In a recent work (Mendes et al, 2009), a new genus of Nicoletiidae (*Zygentoma*), *Allotrichotriura* was discovered in colonies of *Solenopsis saevissima*, demonstrating the need to further study the biodiversity of those insects that live in nests of ants.

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