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**Trichophoromyia iorlandobaratai** (Diptera: Psychodidae), a new phlebotomine species from the Brazilian Amazonia

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**Abstract**

*Trichophoromyia iorlandobaratai* sp. n. Vasconcelos dos Santos, Santos Neto, Sánchez Uzcátegui & Galardo is described and illustrated on the basis of male specimens collected in the municipality of Itaituba, Pará State, Brazilian Amazonia. This species can be differentiated from other morphologically similar species within *Trichophoromyia* by means of the male characters such as the ratio between the aedeagal ducts/sperrm pump, shape and distribution of setae in the gonocoxite, and particularly the distinct shape of paramere.

**Key words:** phlebotomine, *Trichophoromyia iorlandobaratai*, new species, Amazonia.

*Trichophoromyia* (Barretto 1962) (abbreviated as ‘Th.’ according to Marcondes 2007), comprises a genus of phlebotomines (Diptera: Psychodidae: Phlebotominae) of the subtribe Psychodopygina Galati, 2003, presently numbering 43 species in the Americas and 22 within Brazil (Aguair and Vieira 2018, Posada-Lopez et al. 2018). With the exception of two species, the other 41 species reveal a distribution to the east of the Andes, in particular, in the Amazon basin, where apparently several species have limited geographical ranges (Young and Duncan 1994, Galati 2018).

The *Trichophoromyia* species are chestnut colored flies, with the presence of Newstead’s spines on the second palpal segment and absence of ventrocervical sensilla on both sexes. Males present fifth setae in the gonocoxite, and particularly the distinct shape of paramere.

In Bolivia, the naturally infected females of *Trichophoromyia velascoll* (Le Pont and Desjeux 1992) have been found in an area of the occurrence of *L. (V.) lainsoni*-ACL, and without any record of other *Trichophoromyia* species (Martínez et al. 2001). *Trichophoromyia auraeensis* (Mangabeira 1942) has also gained medical attention. This species was initially found with DNA of *L. (V.) lainsoni* and *Leishmania* (*Vianna*) *brazilensis* Vianna, 1911 in Madre de Dios, Peru (Valdivia et al. 2012). Furthermore, in Assis Brasil, Acre State, Brazil, the pooled samples of *Th. auraeensis* ambiguously identified with the recently described closely related species, *Trichophoromyia ninfretarsi* Oliveira, Teles, Medeiro, Camargo & Pessoa, 2015, have been found with DNA tracks of *L. (V.) brazilensis* and *Leishmania* (*Vianna*) *guyanensis* Floc, 1954 (Teles et al. 2016). Further, in Rio Branco, individually processed *Th. auraeensis* have been found with *L. (V.) brazilensis*-DNA (Araujo-Pereira et al. 2017), emphasizing the putative role of this fly species in carrying *Leishmania* (*Vianna*) parasites (Teles et al. 2017).

During an entomological survey for the vector-borne diseases monitoring program conducted in an area affected by mineral exploitation in the municipality of Itaituba (Pará State, Brazil), male specimens of a new phlebotomine species belonging to the *Trichophoromyia* genus were collected. This new taxon is described here on the basis of male morphology and morphometry.

**Materials and Methods**

Phlebotomines were collected at a forested site, approximately 300 km south of Itaituba (BR163 highway), Pará State, Brazil (06°19′41.3″S 55°47′31.5″W). This region belongs to the Tapajós...
Mineral Province in the middle Tapajós basin (Amazonian biome). The vegetation comprises closed and open ombrophilous rainforest situated in an area of dry-land. The substrate includes a thin litter layer resulting from logging. Phlebotomines were collected with ground-level (0.5 m) CDC light traps, Shannon traps, and aspiration at the foot of trees with a ‘Nasci’ mechanical aspirator.

One specimen was prepared and mounted in berlese media, according to Ryan (1986), and the others were prepared and mounted in Canada balsam (Reagen), according to the technique adapted from Forattini (1973). Measurements were obtained using the software AxioVision version 4.7, coupled with a previously calibrated microscope-camera-computer system (Zeiss Axiostar plus; camera AxioCam HRC, Germany). Specimens were drawn using a camera lucida (Zeiss, Germany). Nomenclature and terminology are followed as discussed in Galati et al. (2017).

Nomenclature
In accordance with section 8.5 of the International Code of Zoological Nomenclature (ICZN), this paper and the nomenclatural act(s) it contains have been registered in Zoobank (www.zoobank.org), the official register of the International Commission on Zoological Nomenclature. The LSID (Life Science Identifier) number of the publication is: urn:lsid:zoobank.org:pub:54C29129-1AFF-40A7-A3DF-B351EE99ADB2

Results


Description
All measurements are given (in micrometers) for the holotype and the mean or range of countable characters, the standard deviation and the number of paratypes examined for each structure are included in brackets. Insect predominantly chestnut colored. Body length, from the thorax to the end of the gonostylus 2862 (2802.6; 42.5; n = 4).

Head (Fig. 1A)
Length 372 (376.2; 11; n = 4); width 368 (357.7; 9.3; n = 2). Eye: length 208 (210.8; 11.9; n = 4); width 141 (126.3; 13.7; n = 2) (frontal view). Interocular distance 131 (111.3; 19.5 n = 2). Clypeus length 112 (99.3; 10.6; n = 3), width 75 (73; 2.2; n = 3). Interocular suture separated from interantennal suture. Flagellomere lengths: FI 237 (240.6; 13.7; n = 4), FII 119 (127; 8.3; n = 4), FIII 110 (123; 8.2; n = 4), FIV 125 (124.2; 4.3; n = 4), FVII 77 (83.8; 5.9; n = 3), FXIII 77 (75.3; 1.5; n = 3), FXIV 65 (62.8; 2.6; n = 3). In FI, ascoids present rudimentary posterior spur, with anterior projection reaching the basis of the subsequent flagellomere (Fig. 1B); internal/external ascoids implanted nearly at the same level, (Fig. 1B); presence of papillae on FI, FII, FIII, FXII, and FXIII (Fig. 1B–D). Palpal formula: 1.4.2.3.5 (1.4.2.3.5; n = 3); Newstead’s sensilla present, scattered in the second and third palpal segments. Length of the palpal segments: PI 35 (35.4; 1.8; n = 4), PII 109 (96; 11.9; n = 4), PIII 132 (129; 3; n = 4), PIV 58 (59; 5; n = 3), PIV 166 (166; 1.7; n = 3). Spiniform setae present in PIII: 1 (1, n = 4), and PIV: 3 (3; n = 3). Pharynx unarmed. Labrum-epipharynx 214 (210; 7.6; n = 4) long. Labial suture united in furca.

Cervix
Ventrocervical sensilla absent.

Fig. 1. Trichophoromyia iorlandobaratai sp. n. (A) Male head, dorsal view. (B) Flagellomeres I, II. (C) Flagellomeres III, IV. (D) Flagellomeres XI, XII, XIII, and XIV. Bar: 100 µm.
Thorax
length 600 (603.4; 12.4; n = 4). Pleurae pale, with 12 (10–14; n = 4) upper anepisternal and 4 (3–4; n = 4) proepimeral setae. Postalar, paratergital, lower anepisternal, anepimeral, metaepisternal, metaepimeral setae absent. Setae absent from the anterior katepisternum margin. Suture between mesepimerum and metaepisternum absent. Metafurca with united vertical arms and long horizontal arms. Wing (Fig. 2A): length 2018 (970; 4 and 2); width 600 (570; 29; n = 2). Length of vein sections: R5 1358 (1345.7; 15; n = 2), alpha 600 (582; 17.1; n = 2), beta 250 (268; 15.9; n = 2), gamma 230 (247; 18.7; n = 2), delta 460 (451.7; 10.4; n = 2), ps 120 (116; 3.6; n = 2). Length of coxae, femora, tibiae, basitarsi, and the sum of tarsomeres II+III+IV+V: foreleg: 220 (216; 2.7; n = 4), midleg: 339 (378; 37.2; n = 4), hindleg: 400 (391.7; 8.5; n = 4).

Abdomen 2191 (2181.4; 56.5; n = 4) long. Tergites II–VII without tergal papillae; with sparse setae, not forming two bands. Genitalia (Fig. 2B): gonostyle 300 (301; 10.4; n = 4) long, with four strong-spines with the following disposition: one apical 76 (79.6; 6.2; n = 4) long, one upper external preapical 102 (106.6 ± 7.4; n = 4) long, one lower external 75 (70.8; 4.9; n = 4) long, implanted after the middle, and one internal 105 (106; 4.9; n = 4) long, implanted in the anterior third of the gonostyle. Subterminal seta absent. Gonocoxite 388 (367.4; 16; n = 4) long × 156 (166.6; 9.5; n = 4) wide, ornamented with cluster of persistent setae with the following characteristics: an anterior group of 16 (14–18; n = 4) filiform setae, an intermediate group of 7 (6–8; n = 4) semifiloseous, with pointed-apex, and a posterior group of 13 (12–16; n = 4) semifiloseous, with spatulated-apex. Paramere bilobade, bearing a compact patch of 23 (20–24; n = 4) modified setae near the middle-distal third with semifiloseous aspect and pointed-curved apex. The ventral lobe of paramere emerges from a bifurcation slightly ventrally ward on its distal third, after the patch of setae. The length of this lobe is slightly less than half the length of the dorsal lobe. An unusual roll of short ‘peg-like’ and rounded apex setae are present on the ventral margin and apex of the dorsal lobe (Fig. 2C); paramere dorsal margin 228 (215.8; 8.9; n = 4) long and ventral margin 152 (156.2; 7.9; n = 4) long. Parameral sheath broad, subtriangular, dorsal margin length 58 (63.8; 5.4; n = 4) and ventral margin length 57 (53; 3.3; n = 4). Sperm pump (Fig. 2D): 165 (160.8; 12.6; n = 4) long; ejaculatory apodeme 131 (128.8; 3.7; n = 4) long and 32 (32; 4.1; n = 4) wide; aedeagal ducts length 949 (966.2; 43.5; n = 4), 7.57 (6; 0.25; n = 4) times the length of sperm pump (Fig. 2D), with tips slightly expanded and pointed (Fig. 2E). Epandrial lobe length 507 (524; 21; n = 4); width 36 (37.6; 6.5; n = 4).

Type Material and Depository
Holotype was collected by a ‘Nasci’ mechanical aspirator. Paratype 1, Shannon trap; paratypes 2–4, CDC trap at 0.5 m. All types: BRAZIL, Rodovia Transgarimpeira, BR163 highway, 300 km south of Itaituba, Pará State on 24-I-2018 (A.K.R. Galardo and N.F. Santos Neto cols.). Type specimens are deposited in the Coleção de Flebotomíneos do Instituto Evandro Chagas – ColFleb IEC (holotype, 1 paratype), Coleção Entomológica do Instituto de Pesquisas Científicas e Tecnológicas do Estado do Amapá (1 paratype; DIP 11051), Coleção de Referência da Faculdade de Saúde Pública FSP-USP (1 paratype), and Coleção de Flebotomíneos do Instituto René Rachou (1 paratype).

Etymology
This species is named in honor of Mr. Iorlando da Rocha Barata, a field expert of the Instituto Evandro Chagas, in recognition of his 40 yr of collaboration in the study of phlebotomines.

Discussion
This new species can be included in the genus Trichophoromyia, by virtue of the aforementioned male characteristics, in accordance with Galati (2018). This genus can be initially divided into two groups,
based on the ratio between the aedeagal ducts and sperm pump (Galati 2018). The new species belongs to the group 2, in which the aedeagal ducts are four times longer than the length of the sperm pump. This group of males includes those species whose females are indistinguishable from each other.

_Th. iorlandobaratai_ sp. n. has been found sympatrically with _Th. readyi_ (Ryan 1986). The _Trichophoromyia_ females collected together could not be described as _Th. iorlandobaratai_ sp. n. due to their uncertain identity. _Th. readyi_ and _Th. iorlandobaratai_ sp. n. are closely geographically distributed; their type locality are less than 350 km apart (Ryan 1986). Geographical distribution of _Th. readyi_ is presently extended to the states of Amazonas and Rondônia (Galati 2018). _Trichophoromyia readyi_ and _Th. iorlandobaratai_ sp. n. can be distinguished from each other because the former has the epandrial lobe as long as the gonocoxite, and in the new species, the epandrial lobe is clearly longer than the gonocoxite. Furthermore, _Th. readyi_ and _Th. iorlandobaratai_ sp. n. reveal distinct paramere in relation to their shapes and group of bristles which allow them to be easily differentiated.

The shape of the epandrial lobe of _Th. iorlandobaratai_ sp. n. is also similar to that of _Trichophoromyia adelsonsouzaei_ Vasconcelos dos Santos, Silva, Barata, Andrade & Galati, 2014; however, these species can be distinguished by the shape of the paramere; _Th. adelsonsouzaei_ presents a distinct curvature in the apical region (Vasconcelos dos Santos et al. 2014), which is absent in _Th. iorlandobaratai_ sp. n.

Based on the illustration present on the description of _Th. reinerti_ (Young and Duncan 1994), this species is the closest to _Th. iorlandobaratai_. _Th. reinerti_ has been described from a single terminal male, whose holotype would be deposited in the Coleção de Flebotomíneos (COLFLEB) of the Instituto René Rachou (Young and Duncan 1994). We contacted the curator of this collection so that we could consult the type; however, he informed us that it was not deposited there. Interestingly, during the writing of this manuscript, we discovered that the holotype has been deposited at the Florida State Collection of Arthropods, USA. The present work facilitated the return of the _Th. reinerti_ holotype to the collection in Brazil and therefore made it available for analysis.

_Trichophoromyia reinerti_ and _Th. iorlandobaratai_ share the presence of distinct clusters of setae in the gonocoxites, parameres with an unusual tuft of semicircular setae recurved apically, which are implanted in a circular area on their dorsal margin, and a group of short peg-like bristles on the ventral margin and their apices. However, the paramere of _Th. reinerti_ presents a simple apical third (Fig. 3A), while in _Th. iorlandobaratai_ it is bilobed (Fig. 3B); the bristle tuft implanted on the dorsal margin is constituted by ca. 15 setae with recurved apices and in _Th. iorlandobaratai_ are 20 or more setae. In addition, the adeagal ducts are 4.8 times longer than the sperm pump in _Th. reinerti_ and 5.7 times longer than that in _Th. iorlandobaratai_. Regarding geographical distribution, their type localities are reasonably close, but placed on two distinct hydrographic basins. _Th. reinerti_ has been collected in the Xingu basin, while _Th. iorlandobaratai_ sp. n. belongs to the Tapajós.

Branched paramere apex is only present in _Trichophoromyia lopesi_ (Damasceno, Causey & Arouck 1945); however, in this species, it is trifurcate, and in _Th. iorlandobaratai_ sp. n., it is bifurcate. Furthermore, the paramere of _Th. lopesi_ does not possess the cluster of setae and reveals a dorsal projection on the third proximal, which is absent in the new species. In addition, _Th. lopesi_ belongs to the _Trichophoromyia_ group with bulky gonocoxite, whose length is less than twice its width; gonostyle with superior external spine so short, with apex, at maximum, reaching the insertion level of that apical (Galati 2018). _Th. iorlandobaratai_ sp. n. does not reveal these characteristics, belonging to another group.

No data regarding the medical importance of _Th. iorlandobaratai_ sp. n. are available. Collected specimens in animal burrows suggest these ecotopes to be the breeding/resting sites. The absence of specimens in the canopy level also suggests ground dwelling behavior. The new species has not been found outside the type locality and, as observed with several _Trichophoromyia_ species, they apparently have a restricted geographical distribution. Further studies are required on the bionomics of this species and with laboratory colonization to ensure the correct description of the corresponding female.

In summary, this new species can be differentiated from other species within _Trichophoromyia_ that are morphologically similar on the basis of male characters such as the ratio between the adeagal ducts/sperm pump, shape and distribution of setae in the gonocoxite, and particularly the distinct shape of paramere. The present description increased the number of _Trichophoromyia_ species in the Americas and in Brazil, to 44 and 23, respectively.

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