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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/sperm 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 (Aguiar 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 palpal segment slightly longer than the third, genitalia longer than or equal to the thorax, gonocoxite with one or more groups of persistent setae, gonostyle with four spines, inserted at different levels, with the apical one shorter than the gonostyle’s length. Females of several *Trichophoromyia* are remarkably similar, and therefore, identifications are usually based on male morphology. The geographical overlapping occurrence of the species usually complicates the diagnosis (Young and Duncan 1994, Galati 2018).

The medical importance of *Trichophoromyia* has gained attention, since certain species are potentially implicated in the transmission of the agents of American cutaneous leishmaniasis (ACL). Therefore, *Trichophoromyia ubiquitalis* stands out in the list of *Leishmania* (*Viannia*) *lainsoni* Silveira, Shaw, Braga & Ishikawa, 1987 putative vectors on the basis of the naturally infected specimens, spatiotemporal congruence with ACL foci, and anthropophilic behavior under laboratory conditions (Silveira et al. 1991, Lainson et al. 1992).

In Bolivia, the naturally infected females of *Trichophoromyia velascoi* (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 (Martinez et al. 2001). *Trichophoromyia auraensis* (Mangabeira 1942) has also gained medical attention. This species was initially found with DNA of *L. (V.) lainsoni* and *Leishmania* (*Viannia*) *braziliensis* Vianna, 1911 in Madre de Dios, Peru (Valdivia et al. 2012). Furthermore, in Assis Brasil, Acre State, Brazil, the pooled samples of *Th. auraensis* ambiguously identified with the recently described closely related species, *Trichophoromyia ruifreitasi* Oliveira, Teles, Medeiros, Camargo & Pessoa, 2015, have been found with DNA tracks of *L. (V.) braziliensis* and *Leishmania* (*Viannia*) *guyanensis* Floch, 1954 (Teles et al. 2016). Further, in Rio Branco, individually processed *Th. auraensis* have been found with *L. (V.) braziliensis*-DNA (Araujo-Pereira et al. 2017), emphasizing the putative role of this fly species in carrying *Leishmania* (*Viannia*) 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](http://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

*Trichophoromyia iorlandobaratai* sp. n., Vasconcelos dos Santos, Santos Neto, Sánchez Uzcátegui & Galardo, 2018. (Zoobank LSID: urn:lsid:zoobank.org:act:B8D5F497-94FA-4B79-9C4D-131854B0E3A1)

### 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;  $n = 4$ ), FXII 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;  $n = 3$ ), PV 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

Ventricercal sensilla absent.

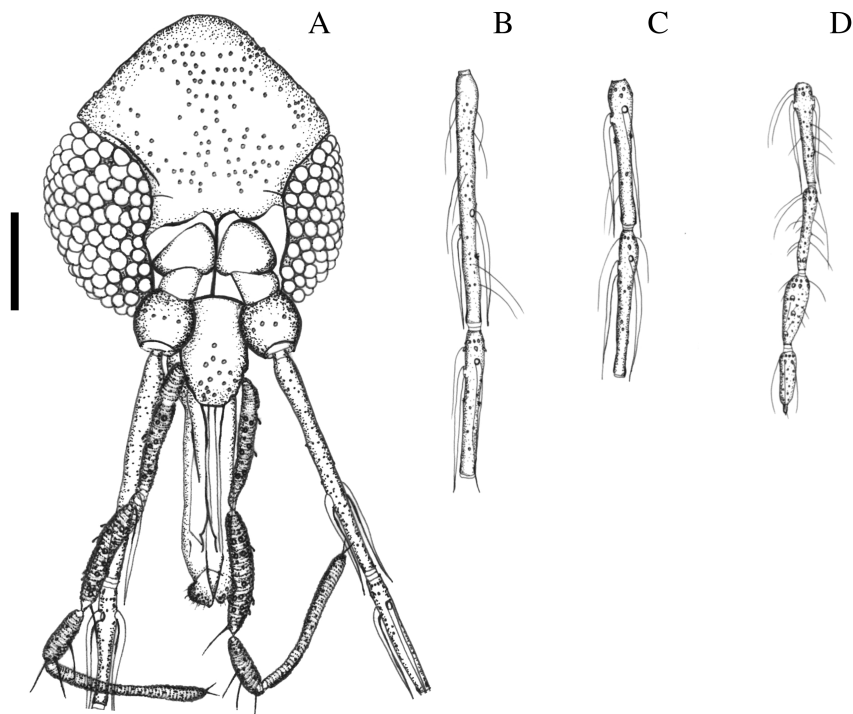


Fig. 1. *Trichophoromyia iorlandobaratai* sp. n. (A) Male head, dorsal view. (B) Flagellomeres I, II. (C) Flagellomeres III, IV. (D) Flagellomeres XI, XII, XIII, and XIV. Bar: 100  $\mu$ m.

### 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. Post alar, 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 (2007; 9.5;  $n=2$ ), 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;  $n=2$ ), *pi* 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;  $n=3$ ), 408 (386.3; 23.9;  $n=3$ ), 1127 (119.7; 7.5;  $n=3$ ), 697 (703.7; 7.6;  $n=3$ ), 752 (753.3; 13.1;  $n=3$ ); midleg: 339 (378; 37.2;  $n=3$ ), 862 (878.7; 22.3;  $n=3$ ), 1156 (1172.3; 24.9;  $n=3$ ), 733 (722.7; 9.3;  $n=3$ ); 915 (909; 6.6;  $n=3$ ); hindleg: 400 (391.7; 8.5;  $n=3$ ), 821 (842.7; 23.1;  $n=2$ ); 1517 (1555; 39.6;  $n=2$ ), 906 (946.7; 44.4;  $n=2$ ), 861 (851; 10.5;  $n=2$ ). Hind femora without spines.

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  $\pm$  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  $\times$  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;  $n=4$ ) semifoliateous, with pointed-apex, and a posterior group of 13 (12–16;  $n=4$ ) semifoliateous, with spatulated-apex. Paramere bilobate, bearing a compact patch of 23 (20–24;  $n=4$ ) modified setae near the middle-distal third with semifoliateous 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;  $n=4$ ), 5.75 (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,

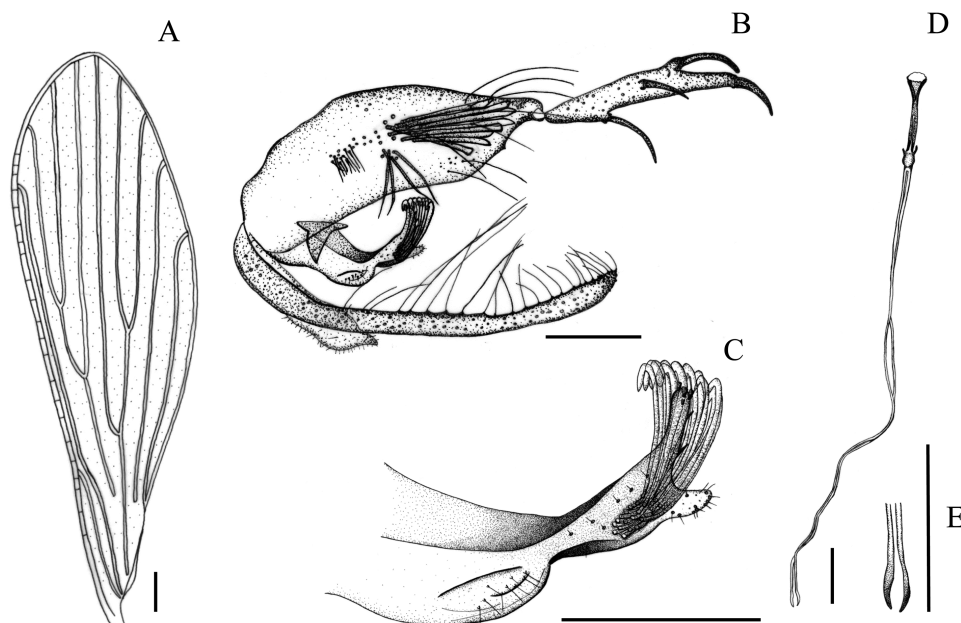


Fig. 2. *Trichophoromyia iorlandobaratai* sp. n. (A) Wing. (B) Genitalia (lateral view). (C) Paramere (lateral view). (D) Aedeagal ducts. (E) Aedeagal tips. Bar: 100  $\mu$ m.

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 adelsonsouzai* Vasconcelos dos Santos, Silva, Barata, Andrade & Galati, 2014; however, these species can be distinguished by the shape of the paramere; *Th. adelsonsouzai* 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 general 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 aedeagal 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.

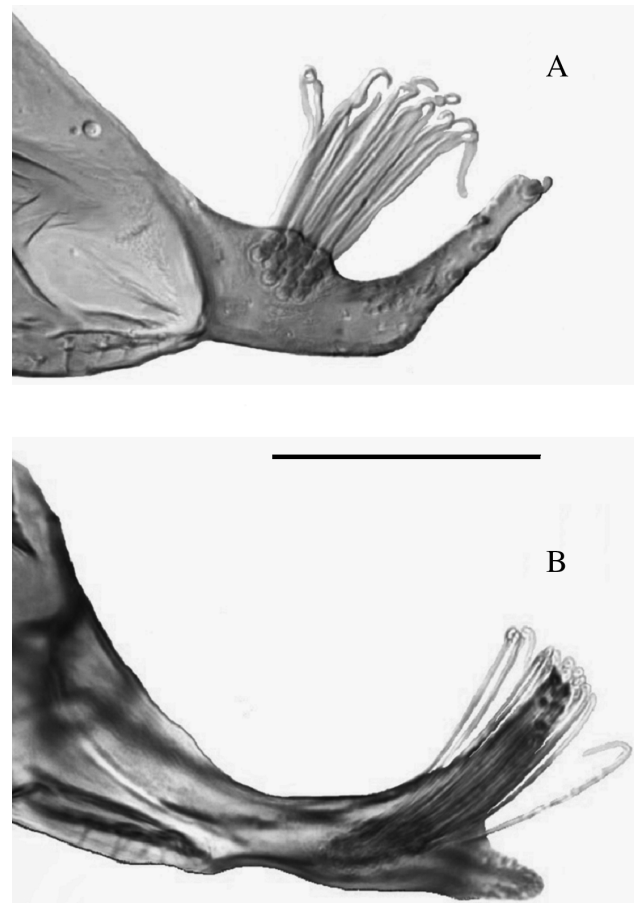


Fig. 3. Lateral view of paramere of (A) *Trichophoromyia reinerti* and (B) *Th. iorlandobaratai* sp. n. Bar: 100  $\mu$ m.

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 aedeagal 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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