

The taxonomic status of *Phlebotomus oliverioi* (Diptera, Psychodidae) and a lectotype designation for *Psathyromyia brasiliensis*

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ABSTRACT. *Phlebotomus oliverioi* Barretto & Coutinho, 1941 was originally described based only on the male holotype and has since been considered junior-synonym of *Psathyromyia brasiliensis* (Costa Lima, 1932). The study of the holotype of *Ph. oliverioi* allowed us to conclude that the head of this specimen belongs to the genus *Psychodopygus* and the wings, thorax and abdomen belong to a different species of *Psathyromyia*. Thus, *Ph. oliverioi* is a not valid species, and must be removed from the synonym and excluded from the provisions of the International Code of Zoological Nomenclature (Articles 17.2 and 23.8). The specimen was measured, drawn, photographed and the morphological characters are discussed. Lectotype and paralectotypes to *Pa. brasiliensis* are designated.

KEYWORDS. Phlebotominae, sand flies, *Psathyromyia*, *Psychodopygus*, taxonomy.

RESUMO. Status taxonômico de *Phlebotomus oliverioi* (Diptera, Psychodidae) e designação de lectótipo para *Psathyromyia brasiliensis*. *Phlebotomus oliverioi* Barretto & Coutinho, 1941 foi originalmente descrita baseada em um único macho e desde então tem sido considerada sinônimo-júnior de *Psathyromyia brasiliensis* (Costa Lima, 1932). O estudo do holótipo de *Ph. oliverioi* nos levou a concluir que a cabeça deste espécime pertence ao gênero *Psychodopygus* e as asas, tórax e abdômen pertencem a *Psathyromyia*. *Psathyromyia oliverioi* não é uma espécie válida e deve ser removida da sinonímia e excluída de acordo com o recomendado pelo Código Internacional de Nomenclatura Zoológica (Artigos 17.2 e 23.8). O espécime foi medido, desenhado e fotografado e os caracteres morfológicos são discutidos. Lectótipo e paralectótipos são designados para *Pa. brasiliensis*.

PALAVRAS-CHAVE. Phlebotominae, flebotomíneos, *Psathyromyia*, *Psychodopygus*, taxonomia.

Phlebotomine sand flies play an important role in the transmission of *Leishmania* spp., the causative agents of leishmaniasis. Approximately 267 species of phlebotomine sand flies have been recorded in Brazil (ANDRADE *et al.*, 2013), and a revision of Brazilian species of sand flies recently undertaken by one of the authors (AJA) has found that *Phlebotomus oliverioi* Barretto & Coutinho, 1941 has since been considered a junior-synonym of *Psathyromyia brasiliensis* (Costa Lima, 1932) is not a valid species.

Psathyromyia Barretto, 1962, was described as a subgenus of *Lutzomyia* França, 1924, and it was elevated to genus level by GALATI (1995), with three subgenera within the subtribe Psychodopygina: *Forattiniella* Vargas, 1978, *Xyphomyia* Artemiev, 1991, and *Psathyromyia sensu strictu*. In accordance to BARRETTO (1962), the males of *Psathyromyia* are characterized by ascoids with posterior spurs, the fifth palpus segment longer than the third, the femur without spines, the genitalia longer than head, the gonocoxite without setae, the gonostyli with four spines and without pre-apical seta, simple paramere, and the lateral lobes (surstyli) simple. GALATI (2003) also considered as characters of this genus the posterior legs with the metatarsomere I to be longer than the sum of the tarsomeres II+III+IV+V, the absence of tergal papillae on all abdominal tergites, and the setae on the anterior margin of the katapisternum; 43 species, including one fossil and three unclassified species (*incertae sedis*), were included

in this genus, 26 of which have been recorded in Brazil, and 10 in the state of São Paulo.

Phlebotomus oliverioi was described in 1941 by BARRETTO & COUTINHO based on one male collected in forested areas in the municipality of Osasco (state of São Paulo, Brazil). In the description, *Ph. oliverioi* is included among species presenting “the fifth palpus shorter than the third palpus”. Based on this character, they compared the male of *Ph. oliverioi* to other phlebotomine sand fly species, which are today included in the genera *Psychodopygus* and *Nyssomyia*, according to the more recent classification of GALATI (1995, 2003), and also provided a taxonomic discussion based on genitalia characters. In the key to American sand flies, BARRETTO (1950) did not include or provide any comments on *Ph. oliverioi*. In his thesis, reported *Ph. oliverioi* as an aberrant species. Once again, the author did not include *Ph. oliverioi* in the proposed species key and he termed *Ph. oliverioi* “insufficiently known” (author’s pers. obs.).

Further taxonomic studies included *Ph. oliverioi* in the subgenus *Nyssomyia* (*intermedia* group) based on the absence of setae on the gonocoxite and the presence of four spines on the gonostyli (MARTINS *et al.*, 1978; READY & FRAIHA, 1981), while THEODOR (1965) considered it as “inquirenda species”. FORATTINI (1973) examined the holotype and concluded that it was conspecific to *Psathyromyia brasiliensis* (Costa Lima, 1932), but

MARTINS *et al.* (1978) and READY & FRAIHA (1981) did not accept the synonym proposed by FORATTINI (1973), and the latter authors claimed that *Ph. oliverioi* did not have the antennal ascoids with proximal spurs, and that the scutum was darker than the pleura, although they did not examine the holotype and could not have observed these characters. One of us (EABG) studied the holotype and observed that the characters of the head were similar to those of *Psychodopygus lloydi* (Antunes, 1937) and the characteristics of genitalia similar to those of *Pa. brasiliensis*, suggesting a probable mistake in mounting the specimen, leading to the misidentification of *Ph. oliverioi*.

Here we discuss the taxonomic status of *Ph. oliverioi*, only known from the morphological characters of its male holotype and, as a revision of *Pa. brasiliensis* was performed, its lectotype and paralectotypes were designated.

MATERIAL AND METHODS

The male holotype of *Ph. oliverioi* was measured with a Zeiss™ eye-piece calibrated according to a standard Zeiss™ scale, and drawings were made using an Olympus™ camera lucida. All measurements are given in micrometres (µm). The photomicrographs were captured using a Leica DFC295 digital camera attached to a Leica DM5000 B optical microscope, and were taken using the Leica Application Suite (LAS) software version 4.1.0. Terminology and nomenclature follows GALATI (1995, 2003), CUMMING & WOOD (2009), and genus abbreviations are according to MARCONDES (2007).

Material examined: **BRASIL, Minas Gerais:** Lassance municipality (44°34'W, 17°54'S), ♂ “cotype” of *Pa. brasiliensis* (CEIOC 1384); **São Paulo:** Cajamar municipality (46°52'W, 23°21'S), 3♂, 17.II.1994, Superintendência de Controle de Endemias of the São Paulo state (Sucen) coll. (no number); Várzea Paulista municipality (44°46'W, 22°30'S), 2♂, 28.III.1994 Sucen coll. (no number) of *Ps. lloydi*; Natividade da Serra municipality (45°25'W, 23°24'S), 3♂, 21.III.1994, Sucen coll. (no number); São Paulo municipality (Parque Estadual da Cantareira, 46°31'W, 23°22'S), ♂, 30.XII.1996, E. A. B. Galati coll. (no number) of *Ps. arthuri* (Fonseca, 1936).

The holotype of *Pa. oliverioi* is deposited in the entomological collection of the Departamento de Epidemiologia da Faculdade de Saúde Pública da Universidade de São Paulo (FSP). The specimens of *Ps. lloydi* and *Ps. arthuri* are deposited in the Coleção Entomológica do Laboratório de Entomologia em FSP/Phlebotominae (LESP/Phlebotominae).

Lectotype and paralectotype designations are provided for the “cotypes” of *Pa. brasiliensis* deposited in the Costa Lima collection in the Coleção Entomológica do Instituto Oswaldo Cruz (CEIOC), Rio de Janeiro, Brazil.

RESULTS

Psathyromyia brasiliensis (Costa Lima, 1932)

- Flebotomus* [*sic*] *brasiliensis* COSTA LIMA, 1932:48. 13 male “cotypes” on four slides numbered: 1383 (3 spp.), 1384 (5 spp.), 1387 (1 spp.), and 1389 (4 spp.). All marked with the number 1 (one). Type-locality: Lassance municipality, state of Minas Gerais, Brazil.
- Sergentomyia brasiliensis* BARRETTO, 1955:181 (taxonomy).
- Phlebotomus* (*Brumptomyia*) *brasiliensis* FAIRCHILD, 1955:195 (*shannoni* group, taxonomy).
- Phlebotomus brasiliensis* MANGABEIRA & SHERLOCK, 1962: 312 (female and immature stages).
- Lutzomyia* (*Psathyromyia*) *brasiliensis* BARRETTO, 1962:99 (taxonomy; *volcanensis* group?); YOUNG & DUNCAN, 1994:382 (*aragaoi* group; taxonomy and keys).
- Lutzomyia brasiliensis* THEODOR, 1965:186 (*aragaoi* group: *brasiliensis* series, taxonomy).
- Psychodopygus* (*Trichophoromyia*) *brasiliensis* FORATTINI, 1971:105 (taxonomy); 1973:451,461,462,484,489 (male, female and immature stages; keys).
- Psathyromyia* (*Forattiniella*) *brasiliensis* GALATI, 2003:42,111,112 (taxonomy and key).

The cotypes of *Pa. brasiliensis* are deposited in the CEIOC (Costa Lima collection), and slides are numbered as follows: 1383 (3 males), 1384 (5 males), 1387 (1 male), and 1389 (4 males), totalling 13 specimens. According to the International Code of Zoological Nomenclature (ICZN, 1999): “The valid designation of a lectotype permanently deprives all other specimens that were formerly syntypes of that nominal taxon of the status of syntype [Art. 73.2.2]; those specimens then become paralectotypes” [Art. 74]. A syntype has the same taxonomic value that of cotypes [Art. 72.4.6]. Here we provide a designation of one lectotype and 12 paralectotypes of *Pa. brasiliensis*. Comparison between drawings and photos from the original description of *Pa. brasiliensis* and with each specimen are provided to define the new taxonomic designation.

Phlebotomus oliverioi Barretto & Coutinho, 1941

(Figs 1 – 16)

- Phlebotomus oliverioi* BARRETTO & COUTINHO, 1941:233. Male holotype. Type-locality: Osasco, state of São Paulo, Brazil; FORATTINI, 1971:105 [as junior-synonym of *Psychodopygus* (*Trichophoromyia*) *brasiliensis*]; 1973:461 [as junior-synonym of *Psychodopygus* (*Trichophoromyia*) *brasiliensis*]; YOUNG & DUNCAN, 1994:382 [as junior-synonym of *Lutzomyia* (*Psathyromyia*) *brasiliensis* (*aragaoi* group)]; GALATI, 2003:42 [as junior-synonym of *Psathyromyia* (*Forattiniella*) *brasiliensis*].
- Phlebotomus* (*Brumptomyia*) *oliverioi* FAIRCHILD, 1955:195 (*shannoni* group, taxonomy).
- Sergentomyia oliverioi* BARRETTO, 1955:185 (taxonomy).
- Lutzomyia oliverioi* (*intermedia* group) THEODOR, 1965:184.
- Lutzomyia* (*Nyssomyia*) *oliverioi* MARTINS *et al.*, 1978:101.

Male holotype. Head (Fig. 1) 400 long, 400 wide; clypeus 90 long; ratio clypeus length/head length 0.2:1.0; eyes 270 long, 150 wide; interocular distance (ID) 90. Labrum-epipharynx (LE) 270. Maxillary lacinia with one row of external shallow teeth. Palpi (Fig. 1), palpus length: I 52, II 130, III 161, IV 55, V 107. Palpal formula: 1.4.5.2.3; presence of six hyaline sensilla (Newstead's spines) in the middle of the third palpus and absent in the second palpus (Figs 2, 3). Labial fork present. Antenna (Fig. 1): length of flagellomeres: FI 350; FII 130; FIII 122; FXIII 62; FXIV 62. Presence of two or three papillae on the FI and one apical papilla on the FII (Figs 4, 5). Papillae on FIII–FIX (Figs. 6, 7) absent and present on flagellomeres FX–FXIV (Figs 8–11). Ascoids short not reaching the apex of the flagellomere, without posterior spurs (Fig. 4). Ratio AIII/LE 1.0:1.3. Pharynx unarmed. Cibarium with small chamber and rudimentary teeth present; pigmented patch, posterior bulge and cibarial arch absent (Fig. 12).

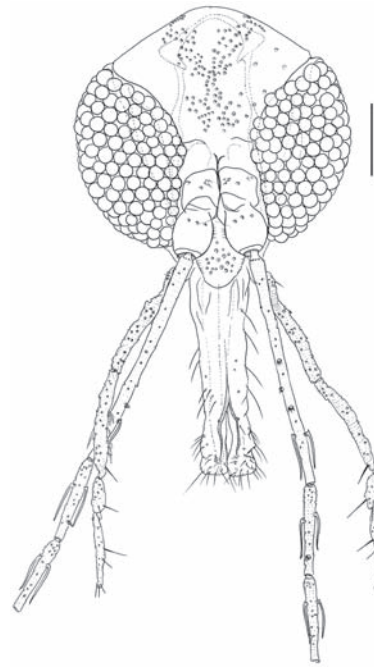
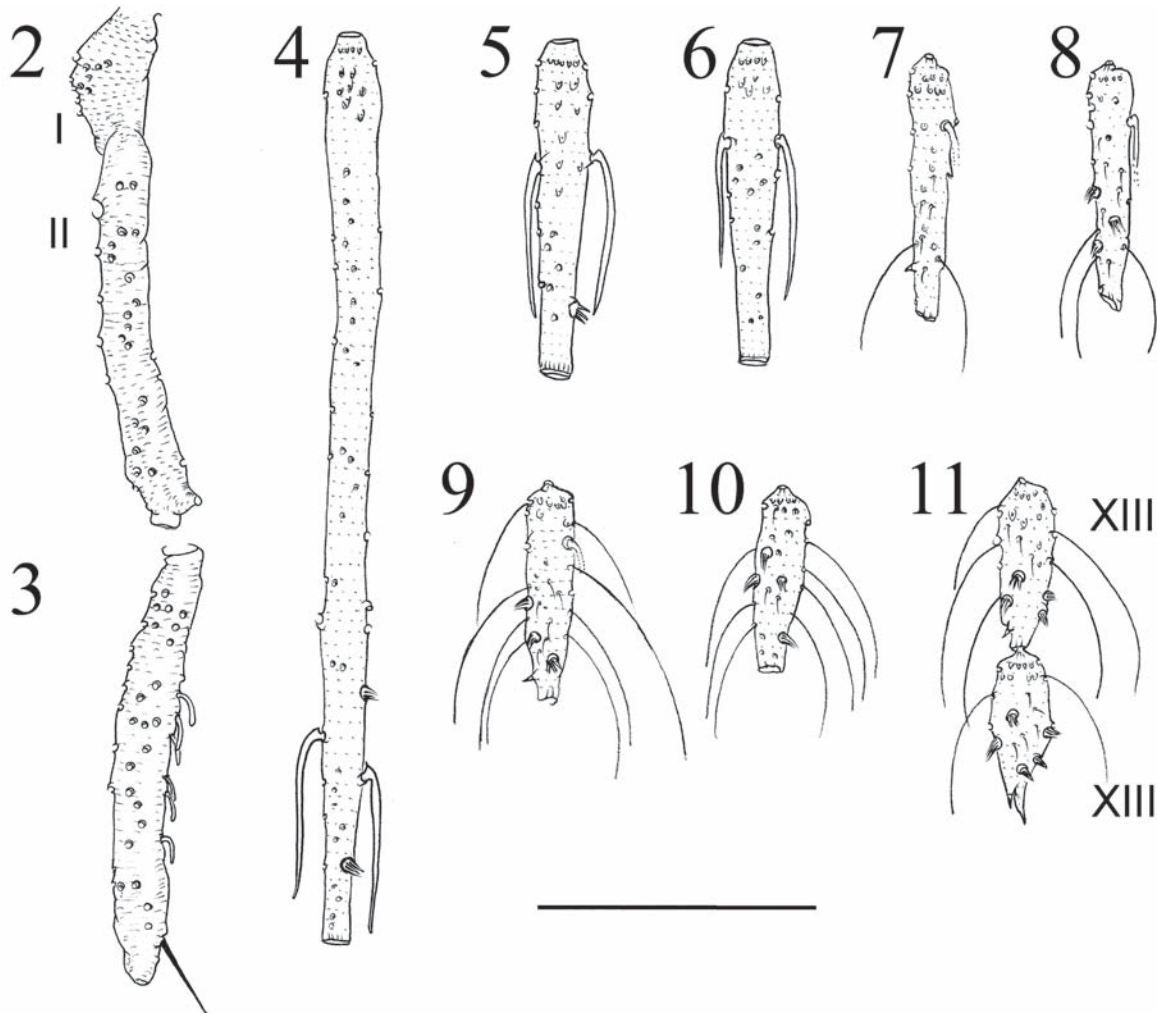
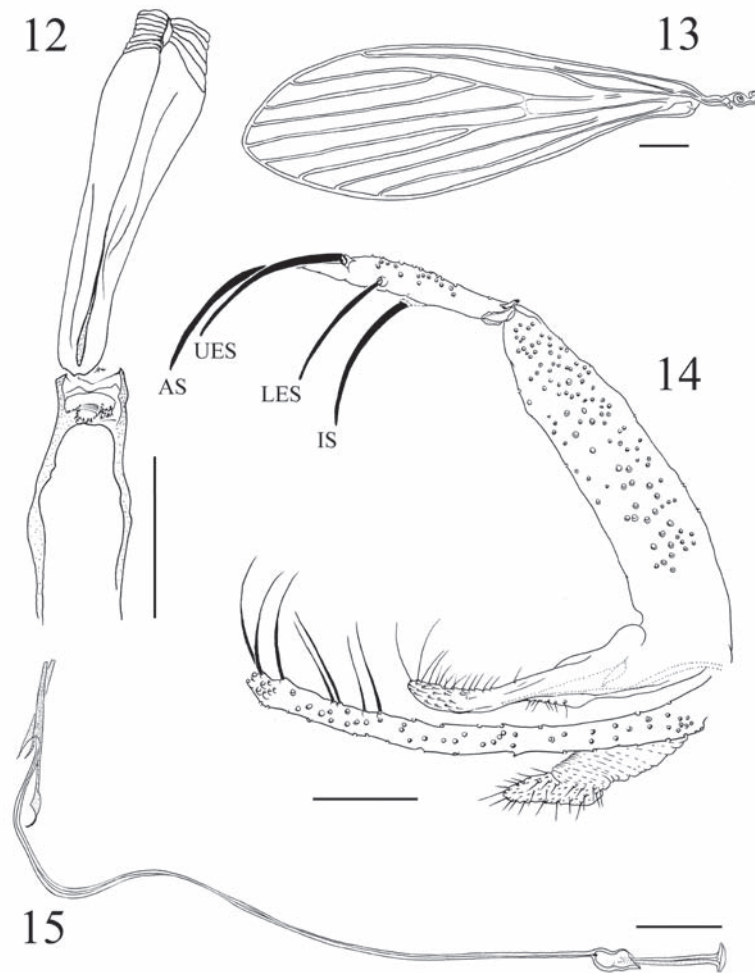


Fig. 1. Head of the male holotype of *Phlebotomus oliverioi* Barretto & Coutinho, 1941 (= *Psychodopygus* sp.) (Bar = 100 μ m).



Figs 2–11. Palpi and flagellomere of *Phlebotomus oliverioi* Barretto & Coutinho, 1941: 2, palpi I and II; 3, palpus III; 4, flagellomere I; 5, flagellomere II; 6, flagellomere III; 7, flagellomere IX; 8, flagellomere X; 9, flagellomere XI; 10, flagellomere XII; 11, flagellomere XIII and XIV (Bar = 100 μ m).



Figs 12-15. Male holotype of *Phlebotomus oliverioi* Barretto & Coutinho, 1941 (= *Psathyromyia* sp.): 12, pharynx and cibarium; 13, wing (Bar = 200 μ m); 14, terminalia; 15, aedeagus (Bar = 100 μ m). (AS, apical spine; UES: upper external spine; LE, lower external spine; IS, internal spine).

Thorax: 600 long, mesonotum 530 long. Paratergite, pleura, and katepisternum pale; mesonotum, katepimeron and coxae slightly brown. Ventro-cervical sensilla and setae on the anterior region of the katespiternum absent. Presence of 11–12 upper anepisternal setae and 0–1 pro-epimeral setae. Wing (Fig. 13): 2,360 long, 670 wide; veins R5 1, 250 long; *alpha* 670; *beta* 170; *gamma* 180; *delta* 350; *pi* 80. Coxae: anterior 370, medium 370, posterior 390. Femur: anterior 970, medium 860, posterior 1,000. Tibia: anterior 1,480, medium 1,370, posterior 1,800. Tarsomere I: anterior 850, medium 890, posterior 1,030. Tarsomeres II-V: anterior 780, medium 790, posterior 800.

Abdomen: 2,120 long; tergal papillae absent on all tergites. Terminalia (Fig. 14): gonocoxite 400 long, 88 wide; setae in the basal and median region absent. Gonostylus 400 long, with four spines: one apical; two external – the upper and the lower – and the inner spine; the inner spine located in the middle of the gonostylus, the external lower spine between the inner and the external upper spines (Fig. 14). Pre-apical seta absent. Paramere (Fig. 14): dorsal margin 182 long and ventral 286 long. Paramere simple without curved setae, *ca.* 15 dorsal simple setae inserted in the apical

half of the paramere; apical region digitiform. Aedeagus with basiphallus long, dorsal margin 122, ventral margin 182; ejaculatory apodeme (piston + sperm sac) 166 long; piston 132 long; ejaculatory ducts 972 long (Fig. 15). Tips of the ejaculatory ducts are not broken (Fig. 16). Lateral lobe (surstyle): 468 long, 26 wide, without pre-apical constriction (Fig. 14).

The male holotype of *Ph. oliverioi* was originally mounted in Canada balsam, and the specimen body parts were separated and covered by three coverslips: (1) one head, (2) one wing and (3), one wing, thorax and abdomen.

DISCUSSION

The holotype of *Ph. oliverioi* presents the head with both maxillary palpi and antenna complete, and is mounted ventrally in Canada balsam between slide and cover slip. The fifth palpus is much shorter than the third, with the sum of the fourth and fifth palpi being equal to the length of the third palpus (both palpi were measured); the ascoids do not present proximal spur, and there are two or three papillae on the first flagellomere. These characteristics are compatible

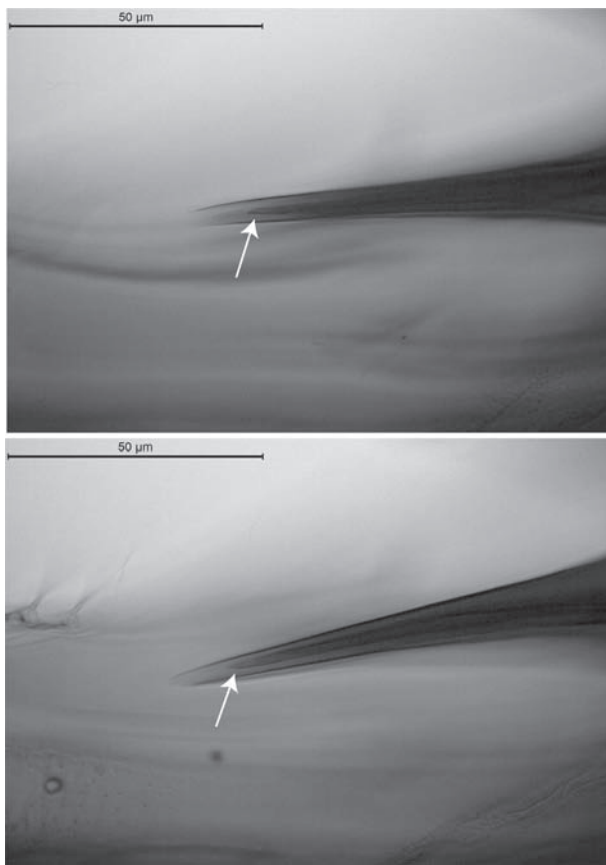


Fig. 16. Basiphallus of *Phlebotomus oliverioi* Barretto & Coutinho, 1941, white arrows indicate the integrated tips of the two ejaculatory ducts.

with the genus *Psychodopygus* in accordance to GALATI (2003). On the other hand, in the subgenus *Psathyromyia* as proposed by BARRETTO (1962), the fifth palpus is longer than the third and the ascoids present proximal spur. READY & FRAIHA (1981) mentioned that the antennal ascoids lack proximal spurs and the scutum is darker than the pleura. The presence of proximal spurs on the ascoids was not mentioned in the original description, and examination of the holotype revealed that the proximal spurs of the ascoids are absent on all flagellomeres. Also, the scutum is not dark, but slightly brown. BARRETTO & COUTINHO (1941) present the measurements of the fifth and fourth palpus segment as being longer than the third in *Ph. oliverioi*, but this is incorrect, as we showed by measuring the holotype. Probably, the head belongs either to the species *Ps. lloydi* or *Ps. arthuri* recorded in Osasco municipality (MARTINS *et al.*, 1978; GALATI, 1981; ANDRADE FILHO *et al.*, 1997), but the characters are not enough to distinguish between them.

Both wings were well-preserved and well-mounted on the slide. The analysis of wing venation showed that *delta* is longer than *gamma* (ratio *delta/gamma* = 2.0:1.0) and that *delta* reaches the middle of *alpha*. These measurements are consistent with the wing measurements in the description of *Pa. brasiliensis* (COSTA LIMA, 1932).

The thorax, with one wing, and the abdomen with one leg, were not separated, and thus they belong to the same individual. Examination of the terminalia

revealed that the specimen belongs to *Psathyromyia* sp. We also observed the absence of abdominal papillae in the tergites I–VII. In *Pa. brasiliensis*, the ejaculatory duct is long, approximately 10x the length of the ejaculatory apodeme (YOUNG & DUNCAN, 1994; GALATI, 2003), and in *Ph. oliverioi* it is 6x shorter than the ejaculatory apodeme, considering the length of 972 µm, which is also found in the Amazonian sister species *Pa. abunaensis* (Martins, Falcão & Silva, 1965), known to occur in Brazil, in the states of Rondônia (GALATI, 2003) and Amazonas (ALVES *et al.*, 2012). *Phlebotomus oliverioi* presents the basiphallus (aedeagus *sensu* GALATI) reaching beyond the middle of the paramere, and in *Pa. abunaensis* the basiphallus does not reach the middle of the structure. Others characters are very similar between the males of *Pa. brasiliensis* and *Pa. abunaensis*, but the latter is not recorded in the southeast region of Brazil.

YOUNG & DUNCAN (1994) suggested that *Ph. oliverioi* belongs to the *aragaoi* group, based solely on the original description and drawings of the species. These characters include the broad wing, paramere with proximal hump and external superior spine of the gonostylus on a well marked tubercle, and fifth palpus segment shorter than the third. In fact, these characters can be observed in the original description, and were probably used by FORATTINI (1973) to propose the synonym (the wing, thorax and abdomen are similar to the male of *Pa. brasiliensis*), after examining the holotype. Even though FORATTINI (1973) did not explicitly mention the observation of the holotype of *Ph. oliverioi*, he commented on the similarity of *Ph. oliverioi* and *Pa. brasiliensis*. However, MARTINS *et al.* (1978) and READY & FRAIHA (1981) did not consider *Ph. oliverioi* as a junior synonymy of *Pa. brasiliensis*, and included it in the *Nyssomyia* subgenus, as proposed by THEODOR (1965).

After the studying the sand fly species mentioned above, as well as the species description of *Ph. oliverioi*, we conclude that this species is a not valid, and that is constituted by the head of a species of the genus *Psychodopygus* sp. and the wing, thorax and abdomen of a *Psathyromyia* sp. Recently, a similar taxonomic study showed that *Phlebotomus breviductus* Barretto & Coutinho, 1950 was also not a valid species (Andrade *et al.*, 2013).

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