

Phlebotomine sand flies (Diptera: Psychodidae) from peridomestic environments at Los Amigos Biological Station, Madre de Dios, Peru

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ABSTRACT

Madre de Dios, a department in Peru, is an endemic area for cutaneous leishmaniasis, accounting for about 20% of the country's annual leishmaniasis cases. In April 2023, phlebotomine sand flies were captured from the peridomicile areas of Los Amigos Biological Station, located within Madre de Dios, using a modified Katchy light trap. A total of 801 individuals belonging to 19 species were identified and categorized based on their vectorial potential. Notably, this study's capture of a female *Evandromyia andersoni* marks the first report of this species in Peru. The most abundant species found were from the genera *Psychodopygus* (7 species), *Trichophoromyia* (3 species) and *Nyssomyia* (3 species), with several species likely involved in the transmission of leishmaniasis in the region.

KEY-WORDS: species registration, insect vectors, Cutaneous leishmaniasis, Peru

Flebótomos (Diptera: Psychodidae) de ambientes peridomésticos en la Estación Biológica Los Amigos, Madre de Dios, Perú

RESUMEN

Madre de Dios, un departamento de Perú, es una zona endémica de leishmaniasis cutánea, que representa alrededor del 20% de los casos anuales de leishmaniasis del país. En abril de 2023, se capturaron flebótomos de las áreas peridomiciliarias de la Estación Biológica Los Amigos, ubicada en Madre de Dios, utilizando una trampa de luz Katchy modificada. Un total de 801 individuos pertenecientes a 19 especies fueron identificados y categorizados de acuerdo con su potencial vectorial. Cabe destacar que la captura de una hembra de *Evandromyia andersoni* en este estudio marca el primer reporte de esta especie en Perú. Las especies más abundantes encontradas fueron de los géneros *Psychodopygus* (7 especies), *Trichophoromyia* (3 especies) y *Nyssomyia* (3 especies), con varias especies probablemente implicadas en la transmisión de la leishmaniasis en la región.

PALABRAS CLAVE: registro de especies, insectos vectores, Leishmaniasis cutánea, Perú

In the most recent classification, approximately 1060 species of phlebotomine sand flies have been described in the world, with over half of the species occurring in the Americas (Galati and Rodrigues 2023). It has been found that 56 species are proven or suspected vectors of *Leishmania* parasites in the New World (Maroli et al. 2013). In Peru, more than 140 species of phlebotomine sand flies have been reported and it was estimated that 80% of these are found in the Amazon region (Shimabukuro et al. 2017; Zorrilla et al. 2017). In 2022, a total of 5,358 cases of leishmaniasis were reported in Peru, 89% of which were cutaneous leishmaniasis (Peru 2023). The department of Madre de Dios, located in the lowland

Amazonian rainforest of southeastern Peru, stands out for having the highest incidence of leishmaniasis in the country, contributing about 20% of the annual cases (Peru 2023). In this region, sylvatic leishmaniasis is mainly caused by *Leishmania (Viannia) braziliensis* and *Le. (V.) guyanensis*; however, *Le. (V.) lainsoni*, *Le. (V.) shawi* and *Le. (Leishmania) amazonensis* have also been detected in suspected or confirmed vectors (Valdivia et al. 2012; Kato et al. 2016; Koarashi et al. 2016).

Los Amigos Biological Station (LABS) is located in the department of Madre de Dios, approximately 100 km West of Puerto Maldonado at the confluence of the Madre de Dios and Los Amigos rivers (12°34'9"S, 70°6'0.40"W) (Figure 1).

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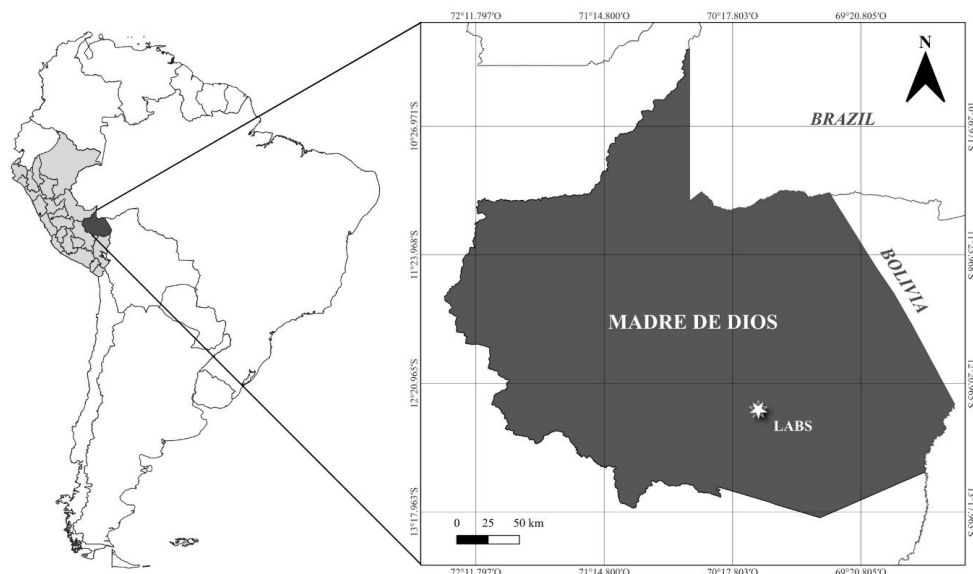


Figure 1. Map of South America highlighting the department of Madre de Dios, showing the location of Los Amigos Biological Station (LABS).

It is characterized by Amazonian lowland rainforest, at an elevation of approximately 268 m.a.s.l., with a mean annual temperature of 21-26 °C and distinct wet and dry seasons (Pitman 2010). A total of 12 species of phlebotomine sand flies were reported from this locality in a previous study on leishmaniasis risk factors along the Madre de Dios River (Lucero 2015). The aim of the present study was to characterize the composition of the phlebotomine sandfly fauna in anthropic environments of Los Amigos Biological Station.

Three sites in the peridomicile (site 1: around a cabin, site 2: around the living room, site 3: around the dining room) of Los Amigos Biological Station were sampled in this study during the first week of April 2023. Phlebotomine sand flies were captured using a modified Katchy UV light trap (Charope Inc., Walpole MA, USA) (Méndez-Cardona *et al.* 2025), operated from 18:00 to 6:00 for one night at each site. The trap has a metallic mesh opening that allows airflow but is large enough for phlebotomine sand flies to escape. To solve this, an external fine mesh collecting bag was attached using an elastic band over the bottom end of the trap. Phlebotomine sand flies were sorted and preserved in vials containing 70 % ethanol. In the laboratory, collected specimens were clarified using potassium hydroxide (KOH 10%) and saturated phenol. Species were identified following morphological characteristics described in the taxonomic keys by Galati (2018).

A total of 801 flies of the subfamily Phlebotominae were collected, 286 from site 1, 373 from site 2, and 142 from site 3. The majority of phlebotomine sand flies were female (82.6 %) and we identified 19 species belonging to eight genera (Table 1). To the best of our knowledge, one female identified as *Evandromyia andersoni* Le Pont & Desjeux, 1988 represents a new record for Peru, marking the westernmost

known distribution of this species, extending from Bolivia and Brazil (Young and Duncan 1994, Pinto *et al.* 2023).

Of the species captured, 11 have been recognized as vectors and/or probable vectors of *Leishmania* parasites in the Amazonian rainforest (Zorrilla *et al.* 2017; Rangel *et al.* 2018; Vadmal *et al.* 2023). *Nyssomyia shawi* (Fraiha, Ward & Ready, 1981) and *Psychodopygus llanosmartinsi* Fraiha & Ward, 1980 were the most abundant species accounting for 66.8 % of the captures. They were followed by *Ps. davisii* (Root, 1934), *Ps. hirsutus* (Mangabeira, 1942) and *Ps. paraensis* (Costa Lima, 1941), which made up 10.6 % of the total. Lastly, *Ps. carrerai* (Barretto, 1946), *N. antunesi* (Coutinho, 1939), *Ps. amazonensis* (Root, 1934), *Ny. yuilli* (Young & Porter, 1972), *Pa. aragaoi* (Costa Lima, 1932) and *Ps. yucumensis* (Le Pont, Caillard, Tibayrenc & Desjeux, 1986), represented only 1.4 % of the captures (Table 1).

Nyssomyia shawi, the most abundant species found in this study, has been found with *Leishmania* sp. flagellates in Brazil and *L. (V.) braziliensis* and *L. (V.) guyanensis* in Bolivia (Ryan *et al.* 1987; Garcia *et al.* 2007). Its predominant occurrence in human-modified environments suggest anthrophilic behavior (Valdivia *et al.* 2021). *Psychodopygus llanosmartinsi* and *Ps. davisii* have also been found infected with *L. (V.) braziliensis* and are considered as probable vectors in Madre de Dios (Zorrilla *et al.* 2017). The presence of these species surrounding human dwellings possibly aids in sustaining the transmission cycles of the disease, posing a risk to communities living in this region (Zorrilla *et al.* 2017). Additionally, *Psychodopygus paraensis*, *Ps. amazonensis*, *Ps. hirsutus* have been found with flagellates of *Leishmania* sp. (Ryan *et al.* 1987; Gil *et al.* 2003; Rangel and Lainson 2009). Although only a few individuals of *N. antunesi*, *Ps. yucumensis* and *N. yuilli* were

Table 1. Counts of phlebotomine sand fly by species and sex, collected in the peridomicile at Los Amigos Biological Station, Madre de Dios, Peru in April 2023.

Species	Site 1		Site 2		Site 3		Total (%)
	♀	♂	♀	♂	♀	♂	
Potential vectors							
<i>Nyssomyia antunesi</i> (Coutinho, 1939)	-	-	-	-	1	1	2 (0.25)
<i>Nyssomyia shawi</i> (Fraiha, Ward & Ready, 1981)	28	2	224	19	48	8	329 (41.07)
<i>Nyssomyia yuilli</i> (Young & Porter, 1972)	1	-	-	-	-	-	1 (0.12)
<i>Psathyromyia aragaoi</i> (Costa Lima, 1932)	-	-	-	-	1	-	1 (0.12)
<i>Psychodopygus amazonensis</i> (Root, 1934)	1	-	-	-	1	-	2 (0.25)
<i>Psychodopygus carrerai</i> (Barretto, 1946)	3	1	-	-	-	-	4 (0.50)
<i>Psychodopygus davisi</i> (Root, 1934)	28	2	4	1	6	-	41 (5.12)
<i>Psychodopygus hirsutus</i> (Mangabeira, 1942)	15	1	3	2	2	-	23 (2.87)
<i>Psychodopygus llanosmartinsi</i> Fraiha & Ward, 1980	103	2	47	6	47	1	206 (25.72)
<i>Psychodopygus paraensis</i> (Costa Lima, 1941)	18	-	3	-	-	-	21 (2.62)
<i>Psychodopygus yucumensis</i> (Le Pont, Caillard, Tibayrenc & Desjeux, 1986)	1	-	-	-	-	-	1 (0.12)
Non-vectors							
<i>Brumptomyia</i> sp. França & Parrot, 1921	-	-	-	1	1	1	3 (0.37)
<i>Evandromyia andersoni</i> * (Le Pont & Desjeux, 1988)	-	-	-	-	1	-	1 (0.12)
<i>Psathyromyia dreisbachi</i> (Causey & Damasceno, 1945)	1	-	-	-	-	-	1 (0.12)
<i>Psychodopygus geniculatus</i> (Mangabeira, 1945)	2	-	1	-	-	-	3 (0.37)
<i>Sciopemyia preclara</i> (Young & Arias, 1984)	-	-	-	1	-	-	1 (0.12)
<i>Trichophoromyia nemorosa</i> (Young & Pérez, 1994)	-	8	-	5	-	2	15 (1.87)
<i>Trichophoromyia</i> nr. <i>sinuosa</i> (Young & Duncan, 1994)	-	30	-	32	-	10	72 (8.99)
<i>Trichophoromyia</i> spp. Barreto, 1962	38	1	23	1	10	1	74 (9.24)
Total	239	47	305	68	118	24	801

Site 1 corresponds to collections around a cabin, Site 2 to those near the living room, and Site 3 to those around the dining room. Species labeled with an asterisk (*) represent new records for Peru.

captured, it is important to recognize that these species are often present in areas with disease transmission, not only in Peru but also in neighboring countries (Barreto *et al.* 2000; Santamaría *et al.* 2006; Teles *et al.* 2016).

Of the individuals belonging to the non-vector species group, 95% comprises three species of the subgenus *Trichophoromyia* Barreto, 1962. A similar number of *T. nr. sinuosa* (Young & Duncan, 1994) males and *Trichophoromyia* spp. females suggests that these females correspond to this male species, but sympatric occurrence with males of *T. nemorosa* (Young & Pérez, 1994) limits this inference. In general, most females of the genus *Trichophoromyia* are very similar in morphology and are identified by the presence of male individuals collected from the same site or habitat (Young and Duncan 1994). The genus *Trichophoromyia* contains 47 species of which 18 are present in the Amazon region of Peru (Fernandez *et al.* 2015; Shimabukuro *et al.* 2017; Méndez-Cardona and Cabrera-Quintero 2024). Because of the high abundance of this genus in peridomestic environments and a recent publication suggesting that some species may be involved in disease transmission, future study to determine their vector status is warranted (Santos and Silveira 2020).

Our findings reveal that multiple vector species of leishmaniasis were present in the peridomestic areas of Los Amigos Biological Station, posing a risk of the disease

transmission to visitors and inhabitants. Although *L. sherlocki* Martins, Silva & Falcão, 1971 and *T. auraisis* (Mangabeira, 1942) had been previously reported in this locality (Lucero 2015), they were not collected in our study. *Nyssomyia shawi*, the most abundant species in our study, is a suspected putative vector of *L. (V.) braziliensis* and *L. (V.) guyanensis* in Amazonian lowlands (Garcia *et al.* 2007). The abundant occurrence of species from the genera *Psychodopygus* Mangabeira, 1941 (7 spp.), *Nyssomyia* Barretto, 1962 (3 spp.) and *Trichophoromyia* (3 spp.) around human dwellings is consistent with previous studies conducted in Peru (Valdivia *et al.* 2012; Lucero 2015; Teles *et al.* 2016). This suggests that these species could play an important role in the transmission of leishmaniasis in the Peruvian Amazon basin region.

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