



NOTES ON PHLEBOTOMINE SAND FLIES OF MICHOACÁN, MEXICO, WITH A KEY FOR THE IDENTIFICATION OF SPECIES CURRENTLY RECORDED FROM THIS STATE (DIPTERA: PSYCHODIDAE)

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ABSTRACT. Four species of phlebotomine sand flies were collected in the Municipality of Sahuayo, on the High Plateau of Michoacán, representing the first records of phlebotomine sand flies in this region. Two of them, *Micropygomyia* (*Coquillettomyia*) *vindicator* (Dampf) and *Psathyromyia* (*Forattiniella*) *texana* (Dampf), are new records for Michoacán. A total of ten phlebotomine species are now known to occur in this state, and we present a key for their identification.

Key words: fauna, new records, sand flies.

INTRODUCTION

Species of subfamily Phlebotominae (Diptera, Psychodidae), commonly known as sand flies, feed on the blood of vertebrates, including humans. Some species are known to transmit agents of disease, most notably *Leishmania* species that cause visceral or cutaneous Leishmaniasis. Due to the role of sand flies as disease vectors, it is important for leishmaniasis surveillance programs to recognize them and understand their natural history, particularly factors which can influence the transmission dynamics of these diseases. Often little is known about the phlebotomine fauna in geographic regions where no leishmaniasis cases have been reported. In Mexico, most studies of these flies have been conducted in the southern and southeastern states, in areas where the greatest numbers of human leishmaniasis cases in Mexico are recorded.

According to the Mexican Health Secretariat (CENAPRECE, 2013, C. Guzmán, pers. com.), human leishmaniasis have been recorded in all south and southeastern states, in the coastal slope states of the Pacific toward Sinaloa (Ochoa-Díaz *et al.* 2012, Salazar-Mejía *et al.* 2010) and in the Gulf of Mexico toward Tamaulipas, with a few

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RESUMEN. Se capturaron cuatro especies de flebotomíneos en el municipio de Sahuayo, en el altiplano de Michoacán, siendo los primeros registros de flebotomíneos en esa región. Dos de ellas, *Micropygomyia* (*Coquillettomyia*) *vindicator* (Dampf) y *Psathyromyia* (*Forattiniella*) *texana* (Dampf), son nuevos registros para Michoacán. Un total de diez especies se conocen para este y se provee una clave para su identificación.

Palabras clave: fauna, nuevos registros, flebotomíneos.

cases recorded in the High Plateau states, specifically in Durango (Pérez-Vega *et al.* 2009), Coahuila (Díaz-Nájera 1971) and Nuevo León (Simpson *et al.* 1968). Sánchez-Tejeda *et al.* (2001) recorded about 326 cases of human local cutaneous leishmaniasis from 1987 to 1994 in Nayarit (currently a total of approximately 1,200 cases), but in neighboring southern states (Colima and Michoacán) there are almost no reports of cases, except one of diffuse cutaneous leishmaniasis in the Balsas River Basin of Michoacán. This scarcity of cases may be the reason for the low interest in the study of phlebotomine fauna in Michoacán and the paucity of records in that state for this group.

Eight species of Phlebotominae have previously been recorded in Michoacán based on few specimens collected on three occasions: in the year of 1935 by J. Ortega recording six species, in 1944 by the same collector recording one previously known species, and in 1951-1952 by A. Díaz-Nájera which found two additional species (Table 1) (Vargas & Díaz-Nájera 1953; for complete collection data of species see Godinez-Alvarez & Ibáñez-Bernal 2010). All historical records are from the warmer, lower altitude (below 1000 m asl) Tierra Caliente area of Michoacán.

Table 1. Phlebotominae sandfly species recorded in Michoacán, Mexico, including the new records reported in this work.

Species	Municipality	Date of collection
<i>Micropygomyia (Coquillettomyia) chiapanensis</i> (Dampf, 1947)	Carácuaro	1935
<i>Micropygomyia (Coquillettomyia) vindicator</i> (Dampf, 1944)	Sahuayo	In this work
<i>Micropygomyia (Micropygomyia) cayennensis maciasi</i> (Fairchild & Hertig, 1948)	Apatzingán	viii-1952
	Huetamo	viii-1935 & xi-1944
<i>Micropygomyia (Micropygomyia) durani</i> (Vargas & Díaz-Nájera, 1952)	Carácuaro	iv & v-1935
	Huetamo	vii, viii, x, xi, xii-1935
	Nocupétaro	vi, vii-1935
<i>Lutzomyia (Tricholateralis) cruciata</i> (Coquillett, 1907)	Nocupétaro	vi-1935
	Huetamo	viii-1935
	Sahuayo	In this work
<i>Lutzomyia (Tricholateralis) diabolica</i> (Hall, 1936)	Huetamo	xii-1935
	Nocupétaro	vi-1935
<i>Lutzomyia (Lutzomyia) longipalpis</i> (Lutz & Neiva, 1912)	Carácuaro	iv-1935
	Huetamo	vii, viii, xi-1935
	San Lucas	i-1936
	Apatzingán	1935
<i>Dampfomyia (Dampfomyia) anthophora</i> (Addis, 1945)	Nocupétaro	1935
	Cenobio Rodríguez	1951 & 1952
	Sahuayo	In this work
<i>Dampfomyia (Dampfomyia) dodgei</i> (Vargas & Díaz-Nájera, 1953)	Apatzingán	viii-1952
<i>Psathyromyia (Forattiniella) texana</i> (Dampf, 1938)	Sahuayo	In this work

No attempts have previously been made to collect phlebotomine sand flies from the highlands of Michoacán.

In this work we present new records of phlebotomine sand fly species collected in the High Plateau region of Michoacán (1500-1700 m asl) in the municipality of Sahuayo. Species listed in this paper can be identified using the comprehensive taxonomic keys of Ibáñez-Bernal (2005a, 2005b); however, in this work we include a taxonomic key to males and females of the ten species currently known from Michoacán.

MATERIAL AND METHODS

Collections were made in the Universidad de la Ciénega (20° 00' 50.05" N- 102° 44' 40.73" W, about 1700 m asl), in the Municipality of Sahuayo, state of Michoacán, Mexico, in June 5 and 12, and August 6, 2014, using a CDC miniature light trap additionally baited with Octanol.

The municipality of Sahuayo is located in the northeast portion of Michoacán de Ocampo and about 215 km from Morelia, the capital of the state, south of Chapala Lake.

Climate is temperate, with temperature between 10.4° to 26.0 °C, with rainy summer, recording about 709.0 mm of annual precipitation. Landscape is grassland type, dominated by mesquite (*Prosopis* spp.), linaloe (*Bursera* spp.) and nopal (*Opuntia* spp.) (INAFED 2010).

Phlebotomine specimens were preserved in 70% ethanol and subsequently cleared, dissected and permanently mounted on microscope slides following the procedure outlined by Ibáñez-Bernal (2005a). Observations were made using a Nikon Eclipse 50i compound microscope equipped with phase contrast and species identified using the keys of Young & Duncan (1994), Ibáñez-Bernal (2005a, 2005b), and Galati (2003). Abbreviations for genera and subgenera follow the proposal of Marcondes (2007). All specimens are deposited in the Psychodidae Collection of Instituto de Ecología, A. C.

RESULTS

A total of 63 phlebotomine specimens were obtained at the municipality of Sahuayo, belonging to three subtribes,



four genera, four subgenera and four species, according to the classification proposed by Galati (2003).

Tribe Phlebotomini Rondani, 1840

Subtribe Sergentomyiina Artemiev, 1991

Micropygomyia (Coquillettomyia) vindicator (Dampf, 1944)

Phlebotomus vindicator Dampf, 1944: 248 (♀). Type locality: Mexico, Morelos, Cuautla; Dampf, 1947: 205 (♂).

Diagnosis. Ascoids simple and long, reaching or extending beyond apex of flagellomere; palpal segment 5 longer than 3+4 segments. **Male:** Gonocoxite with a basal bipartite tubercle, the proximal covered with small spicules and the distal with *ca.* 8 long setae; gonostylus with a pair of spiniform proximal setae located at about the same level, one median spiniform seta inserted near the proximal setae and distant from the two apical spiniform setae, without subapical fine seta; paramere narrow at middle, with the apical portion broader apex rounded pointed and with a triangular small projection in the ventral edge near the apex, basally with a dorsal spinose rounded lobe; lateral lobe thin; ejaculatory ducts with lanceolate apex. **Female:** Cibarium with four radiated triangular horizontal teeth, an irregular row of small vertical teeth, and complete arch; spermathecal individual ducts shorter than 4 times the length of the furca stem; spermatheca broader than long, spherical, without annulations, narrowest than spermathecal common duct (Ibáñez-Bernal 2003).

Material examined. Mexico: Michoacán, Sahuayo, Universidad de La Ciénega, 5-vi-2014, 14 ♂♂, 15 ♀♀; 12-vi-2014, 4 ♂♂, 2 ♀♀; 6-viii-2014, 3 ♂♂, 2 ♀♀.

Distribution. This species is so far only known from Mexico, with records from the following states: Distrito Federal, Guerrero, Morelos, Oaxaca, San Luis Potosí (Ibáñez-Bernal 2003), and now Michoacán.

Remarks. Young & Duncan (1994) suggested that this species probably bites reptiles, and since then, no additional information on natural history of this species has been recorded.

Subtribe Lutzomyiina Abonnenc & Leger, 1976

Lutzomyia (Tricholateralis) cruciata (Coquillett, 1907)

Flebotomus cruciatus Coquillett, 1907: 102. Type locality: Guatemala, Alta Vera Paz, Trece Aguas, Cacao.

Diagnosis. Antennal ascoids simple; palpus segment 5 long, longer than segments 3+4. Scutum, pronotum and paratergite pigmented and contrasting with the rest of the pale pleura. **Male:** gonocoxite with basal tuft of setae with alveoli morular arrangement; gonostylus as long or longer than 0.5 the length of gonocoxite, without subterminal fi-

ne seta and four spiniform setae present; paramere simple, apex rounded and without isolated setae near the middle on dorsal margin; ejaculatory ducts simple; lateral lobe thin. **Female:** Cibarium with four evenly disposed horizontal teeth, an irregular row of small vertical teeth, and without patches of lateral teeth; spermathecal ducts thin, no more than 0.3 as spermathecal diameter, spermathecal common duct shortest than spermatheca, and individual spermathecal duct at least 4.0 times the length of spermatheca; spermathecal pyriform, with globular apical portion differentiated from the basal annuli (Ibáñez-Bernal 1999).

Material examined. Mexico: Michoacán, Sahuayo, Universidad de La Ciénega, 12-vi-2014, 3 ♀♀.

Distribution. USA (Florida, Georgia) (Young & Perkins 1984); Mexico (Campeche, Chiapas, Guerrero, Hidalgo, Jalisco, Michoacán [see Table 1], Morelos, Nayarit, Nuevo León, Oaxaca, Puebla, Quintana Roo, San Luis Potosí, Tabasco, Tamaulipas, Veracruz, Yucatán) (Ibáñez-Bernal 1999), Belize, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama (Martins *et al.* 1978; Young & Duncan 1994).

Remarks. Ibáñez-Bernal (1999, 2001b) indicated *Lutzomyia cruciata* as a highly anthropophilic phlebotomine species with a wide distribution in Mexico. The distribution of this species corresponds with some of the reported cases of human local cutaneous leishmaniasis in the country. Recently, Pech-May *et al.* (2010) found natural infection of this species with *Leishmania* parasites, therefore its presence in that region represents a risk for human leishmaniasis which deserves to be considered by surveillance programs.

Dampfomyia (Dampfomyia) anthophora (Addis, 1945)

Phlebotomus anthophorus Addis, 1945: 119 (♂, ♀). Type locality: USA: Texas, Uvalde Co., Uvalde.

Diagnosis. Palpus segment 5 longer than segments 3+4. **Male:** gonocoxite without basal setae tuft; gonostylus with one apical and one preapical spiniform strong setae and one thin setae at middle; paramere complex, with a short capitate superior branch which has point-curved setae along its margin and other group of setae at base of the apical region; ejaculatory ducts with no strong modified apices; lateral lobe thin. **Female:** Cibarium with two laminar horizontal teeth, a row of about 6 vertical teeth, and lateral teeth patches, arch complete; spermathecae amphora-like surrounded by many globular sacs that as a whole has a morular aspect. Females of *Da. anthophora* and *Da. dodgei* (Vargas & Díaz-Nájera, 1953) are indistinguishable, but here associated by the presence of *Da. anthophora* males.

Material examined. Mexico: Michoacán, Sahuayo, Universidad de La Ciénega, 6-viii-2014, 1 ♂, 6 ♀♀; 12-vi-2014, 1 ♂, 2 ♀♀.

Distribution. *Dampfomyia anthophora* is known from USA (Texas), and Mexico (Guerrero, Michoacán [see Table 1 for municipalities of Michoacán records], Morelos, and Nuevo León) (Young & Perkins 1984; Ibáñez-Bernal 2001a; Ibáñez-Bernal & Godinez-Alvarez 2010).

Remarks. This species is not anthropophilic but has been associated with the transmission of *Leishmania mexicana* to *Neotoma* rodents in Texas (Young & Duncan 1994). Subtribe Psychodopygina Galati, 1995

Psathyromyia (Forattiniella) texana (Dampf, 1938)

Phlebotomus texanus Dampf, 1938: 119. Type locality: USA, Texas, Bexar Co., San Antonio.

Diagnosis. Antennal ascoids with short proximal spur; palpus with segment 5 as long as 3+4; wing with apex of vein R₁ before middle of vein R₂. **Male:** gonocoxite with some non-caducous fine setae scattered at the middle; gonostylus with 4 spiniform setae, the preapical about the middle between the distal and the two proximal setae or nearest to the proximal setae, and without preapical fine seta; paramere simple; ejaculatory ducts with simple apex. **Female:** cibarium with about 12 horizontal small triangular teeth, one row of about 6 large vertical teeth and other row below of about four less differentiated teeth; arch complete but less visible at middle; spermathecae spherical smooth, without differentiated wide neck at the union with the individual spermathecal duct; individual spermathecal ducts as long as the furca stem and nearly inexistent common duct (Ibáñez-Bernal 2002).

Material examined. Mexico: Michoacán, Sahuayo, Universidad de La Ciénega, 5-vi-2014, 1 ♂, 6 ♀♀; 12-vi-2014, 1 ♀; 6-viii-2014, 1 ♂, 1 ♀.

Distribution. U. S. A. (Texas) (Young & Perkins 1984), Mexico (Chiapas [Mickery-Pacheco *et al.* 2012], Coahuila, Guerrero, Jalisco, Morelos, Nayarit, Oaxaca, San Luis Potosí, Tamaulipas, Veracruz) (Ibáñez-Bernal 2002).

Remarks. *Psathyromyia texana* is associated with armadillo borrows and has been collected also in *Atta* sp. nests (Young & Perkins 1984).

Taxonomic key for male and female identification of the currently known species of Michoacán

This key is compiled based on portions of those from Young & Duncan (1994), Galati (2003), and Ibáñez-Bernal (2005a, 2005b). It is intended to facilitate the rapid

identification of taxa currently recorded only in Michoacán (Table 1). For this reason, it is not necessarily useful for other Mexican states or for other species that may be present but unrecorded in Michoacán. Moreover, the key does not reflect the complete set of characteristics typically used for differentiating supraspecific taxa.

1. Cervical ventral sensilla absent; anterior katepisternal setae usually absent; palpal segment 4 shortest than 2; antennal ascoids with short spur. **Male:** Gonostylus with four spiniform setae, the internal spiniform seta near or just before the middle of gonostylus and at same level or slightly apical than external proximal spiniform setae, the preapical spiniform seta about the middle between the apical and the proximal nearest spiniform seta; gonocoxite with a group of isolated persistent setae on central area; paramere with setae on dorsal margin of distal one-half; aedeagal guide large, reaching or slightly overpassing the middle of paramere; ejaculatory filaments with simple apex and shorter than 5 times the length of aedeagal apodeme + pump. **Female:** Cibarium with a row of 10-12 short, triangular horizontal teeth, one or two rows of large central vertical teeth and with patches of small vertical teeth at their sides; spermatheca globular, smooth, with rounded not produced capitulum; common spermathecal duct nearly inexistent, individual spermathecal ducts about two times the length of spermatheca. *Psathyromyia texana*

1a. A pair of cervical ventral sensilla usually present, but if absent then with a patch of anterior katepisternal setae; antennal ascoids usually simple, at most with a proximal protuberance; male flagellomere 1 usually with the external ascoid apically implanted in relation to the internal ascoid; other characteristics variable **2**

2 (1a). Palpal segment 2 at most as long as 4, usually shorter; Newstead sensilla in a patch situated in basal half of palpal segment 3; anterior katepisternal setae absent; labial furcal sclerite present. **Male:** Gonostylus with 4-5 spiniform setae, of which two are apical; paramere simple, without dorsal arm. **Female:** Cibarium usually with more than 10 horizontal teeth, but if only 4 (*Mi. vindicator*) also arranged as a fence and spermathecal oval, wider than long *Micropygomyia* **3**

2a. Palpal segment 2 at least as long as 4, usually longer; Newstead sensilla forming a patch situated at middle of segment 3 or scattered; labial furcal sclerite absent. **Male:** Gonostylus with 4 or few spiniform setae of which only one is apical; paramere variable, with or without dorsal arm. **Female:** Cibarium variable, but usually with less than 8 horizontal teeth. **6**



- 3 (2). Male:** Lateral lobe longer than gonocoxite; gonocoxite with a basal tuft of about 7 setae preceded by a nude lobe; ejaculatory ducts with lanceolate apex; paramere dorsally humped at base, wider in the apical third, ending in acute apex and with a preapical triangular ventral projection. **Female:** Cibarium with 4 triangular horizontal teeth fused at base and arranged as a fence, and an irregular row of very small vertical teeth; spermathecal slightly wider than long, ovate or nearly rounded, individual spermathecal ducts about 5 times the length of common duct, gradually reducing its diameter toward spermatheca. *Micropygomyia vindicator*
- 3a. Male:** Lateral lobe shorter than gonocoxite; other characteristics variable. **Female:** Cibarium with many more than 4 horizontal teeth arranged as a fence; spermatheca with basal striations. 4
- 4 (3a). Male:** Gonostylus with 4 spiniform setae; gonocoxite without basal tuft of setae; paramere simple; ejaculatory ducts shorter than three times the length of apodeme + pump, with simple tips. **Female:** Cibarium with 12 or less horizontal teeth, their inter-apical spaces deep, reaching the middle of their length. *Micropygomyia cayennensis maciasi*
- 4a. Male:** Gonostylus with 5 spiniform setae. **Female:** Cibarium with more than 14 horizontal teeth with shallow interapical spaces 5
- 5. Male:** Ejaculatory ducts simple, not expanded near apex; gonostylus with the isolate spiniform setae nearest the apical pair; gonocoxite with a basal patch of fine setae. **Female:** Cibarium with inconspicuous row of vertical teeth; pharynx without spines; spermathecal ducts striated. *Micropygomyia chiapanensis*
- 5a. Male:** ejaculatory ducts expanded near apex; gonostylus with the isolate spiniform setae nearest the basal pair; gonocoxite without a basal patch of fine setae. **Female:** Cibarium with a row of small but conspicuous vertical teeth; pharynx with spines; spermathecal ducts smooth. *Micropygomyia durani*
- 6 (2a). Male:** Gonostylus with 2-3 spiniform setae; gonocoxite without basal tuft of setae; paramere complex with dorsal arm. **Female:** Spermatheca surrounded by many bubble-like membranous structures; cibarium with 2 laminar horizontal teeth, a group of small lateral teeth and a row of small vertical teeth (females of *Dampfomyia anthophora* and *Da. dodgei* cannot be separated) *Dampfomyia* 7
- 6a. Male:** Gonostylus with 4 spiniform setae; gonocoxite with basal tuft of setae; paramere simple, at most with two specialized setae dorsally. **Female:** Spermatheca not surrounded by membranous structures, its body piriform with the apically globular portion clearly differentiated from the basal annuli; common spermathecal duct shortest than spermatheca, and individual ducts at least 4 times the length of spermatheca; cibarium with 4 to 10 horizontal teeth, without lateral teeth and with a row of regular or irregular vertical teeth. *Lutzomyia* 8
- 7 (6). Male:** Paramere with a short and capitate dorsal arm, the capitate apex with a row of long setae which have the apex curved and other row at proximal margin near the origin of the expanded apical portion. *Dampfomyia anthophora*
- 7a. Male:** Paramere with a long and thin arcuate dorsal arm which has a row of setae with curved apex, progressively longer toward the apex; apex of paramere capitate and with a preapical ventral triangular projection *Dampfomyia dodgei*
- 8 (6a). Ascoids with proximal protuberance. Male:** Paramere with two long and strong setae with curved apex at middle of the dorsal margin; gonostylus with 4 spiniform setae all at different levels and with a preapical fine seta. **Female:** Spermatheca cylindrical and annulated, annuli with the same diameter; individual spermathecal duct about 0.3 the diameter of the furca steam; cibarium with about 10 horizontal teeth. *Lutzomyia longipalpis*
- 8a. Ascoids simple. Male:** Paramere simple, without specialized setae; gonostylus with 4 spiniform setae and without preapical fine seta. **Female:** Spermatheca pyriform, the apical portion wider than the basal annuli; spermathecal individual ducts with the same diameter or more than furca steam; cibarium with 4, sometimes up to 6 horizontal teeth 9
- 9 (8a). Scutum, pronotum and paratergite dark, other parts of pleura pale. Lutzomyia cruciata**
- 9a. Scutum, pronotum, paratergite and anepisternum dark Lutzomyia diabolica**
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