

Ecology

New records of bat flies (Diptera: Streblidae) in Oaxaca, Mexico

Nuevos registros de estréblidos (Diptera: Streblidae) en Oaxaca, México

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Abstract

Species richness and parasitic prevalence of bat flies in a bat cave community in Oaxaca are reported. Between 2016 and 2018, a total of 732 bats were captured and inspected for streblids. We recorded 15 bat species from 3 families and obtained 1,317 streblid specimens corresponding to 24 species and 8 genera, including 19 species that are new records for the state: *Nycterophilina fairchildi* Wenzel, 1966, *Nycterophilina parnelli* Wenzel, 1966, *Metelasmus pseudopterus* Coquillett, 1907, *Strebla guajiro* (García & Casal, 1965), *Strebla wiedemanni* Kolenati, 1856, *Aspidoptera phyllostomatis* (Perty, 1833), *Megistopoda aranea* (Coquillett, 1899), *Megistopoda proxima* (Séguy, 1926), *Paratrachobius longicrus* (Miranda-Ribeiro, 1907), *Trichobius brennani* Wenzel, 1966, *Trichobius diphyllae* Wenzel, 1966, *Trichobius galei* Wenzel, 1966, *Trichobius hoffmannae* Guerrero & Morales-Malacara, 1996, *Trichobius johnsonae* Wenzel, 1966, *Trichobius leionotus* Wenzel, 1966, *Trichobius sparsus* Kessel, 1925, *Trichobius sphaeronotus* Jobling, 1939, *Trichobius uniformis* Curran, 1935, and *Trichobius yunkerii* Wenzel, 1966. Bat species with the highest parasite prevalence were *Pteronotus parnelli* (Gray, 1843), *Desmodus rotundus* (É. Geoffroy, 1810), and *Artibeus jamaicensis* Leach, 1821 with 88.1, 77.5, and 62.3%, respectively. After this study, the number of bat fly species known for the state of Oaxaca increases from 9 to 27, corresponding to 49% of the total Mexican streblid species richness.

Keywords: Bats; Parasitic prevalence; Cave; Diversity

Resumen

Se reporta la riqueza y prevalencia de estréblidos en una comunidad de murciélagos cavernícolas en Oaxaca. Entre el 2016 y 2018, se capturaron y revisaron 732 murciélagos pertenecientes a 15 especies y 3 familias, en los cuales se encontraron 1,317 ejemplares de estréblidos que corresponden a 24 especies y 8 géneros, de las que 19

son registros nuevos para el estado: *Nycterophilia fairchildi* Wenzel, 1966, *Nycterophilia parnelli* Wenzel, 1966, *Metelasmus pseudopterus* Coquillett, 1907, *Strebla guajiro* (García y Casal, 1965), *Strebla wiedemanni* Kolenati, 1856, *Aspidoptera phyllostomatis* (Perty, 1833), *Megistopoda aranea* (Coquillett, 1899), *Megistopoda proxima* (Séguy, 1926), *Paratrachobius longicrus* (Miranda-Ribeiro, 1907), *Trichobius brennani* Wenzel, 1966, *Trichobius diphyllae* Wenzel, 1966, *Trichobius galei* Wenzel, 1966, *Trichobius hoffmannae* Guerrero y Morales-Malacara, 1996, *Trichobius johnsonae* Wenzel, 1966, *Trichobius leionotus* Wenzel, 1966, *Trichobius sparsus* Kessel, 1925, *Trichobius sphaeronotus* Jobling, 1939, *Trichobius uniformis* Curran, 1935 y *Trichobius yunkerii* Wenzel, 1966. Las especies de murciélagos con mayor prevalencia de estréblidos fueron *Pteronotus parnellii* (Gray, 1843), *Desmodus rotundus* (Geoffroy, 1810) y *Artibeus jamaicensis* Leach, 1821, con 88.1, 77.5 y 62.3%, respectivamente. Con este estudio, el número de especies de estréblidos conocidos en Oaxaca se incrementa de 9 a 27, lo que representa 49% de la riqueza total de estréblidos en México.

Palabras clave: Murciélagos; Prevalencia parasitaria; Cueva; Diversidad

Introduction

Bats are important components of ecosystems and provide critical environmental services for human well-being as pollinators, seed dispersers, and natural regulators of insect pests (Kunz et al., 2011). However, they are recognized as reservoirs of zoonotic pathogens, with more than 80 viruses detected in different groups of bats (Klimpel & Mehlhorn, 2016). They also harbor a variety of endoparasites like bacteria (Bai et al., 2012) such as *Rickettsia* (Dietrich et al., 2016), protozoa and helminths (Lima et al., 2018), as well as arthropod ectoparasites (Hutson, 1972) like mites and ticks (Baker & Craven, 2003), bat bugs (Usinger, 1966), fleas (Hutson, 1972), and bat flies from the families Nycteribiidae and Streblidae, which usually are highly host-specific (Dick, 2007).

Streblidae is a family of dipterans that are obligate parasites of bats (Dick & Patterson, 2006; Patterson et al., 2007; Wenzel et al., 1966). This family comprises 229 species classified in 33 genera and 5 subfamilies (Dick & Gracioli, 2018). Three of these subfamilies are distributed in the New World: Nycterophiliinae (2 genera and 6 species), Trichobiinae (20 genera and 15 species), and Streblinae (4 genera and 35 species; Dick & Miller, 2010).

Currently, a total of 55 species of streblid bat flies have been recorded in Mexico (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2016; Whitaker & Morales-Malacara, 2005), this based on regional faunistic studies carried out in different states of the country. The state of Oaxaca is considered megadiverse (Luis-Martínez et al., 2004), ranking second as the state with the highest number of bat species (Briones-Salas et al., 2015) and third in its richness of parasite dipterans (Llorente-Bousquets & Ocegueda, 2008). However, there are only 3 previous reports for the dipteran family Streblidae in Oaxaca, which all together recorded 9 species. Hoffmann

(1944, 1953) reported *Nycterophilia coxata* Ferris, 1916, *Trichobius adamsi* Augustson, 1943, *Trichobius parasiticus* Gervais, 1844, *Strebla mirabilis* (Waterhouse, 1879), and *Paraeuctenodes longipes* Pessôa & Guimarães, 1937. Guerrero & Morales-Malacara (1996) reported 4 additional species: *Aspidoptera delatorrei* Wenzel, 1966, *Nycterophilia mormoopsis* Wenzel, 1976, *Trichobius joblingi* Wenzel, 1966, and *Speiseria ambigua* Kessel, 1925. This shows the lack of studies and knowledge on the streblids for this Mexican state.

The goal of this report is therefore to provide data on the streblid flies species found in bats that occur in the coastal area of Oaxaca. Good knowledge of the streblid fauna and their hosts is needed to conduct studies on parasite-host relationships that would help understand their ecological importance.

Materials and methods

This work was conducted in the cave “Cerro Huatulco” found in the municipality of Santa María Huatulco, in the state of Oaxaca, Mexico (15°50’59.70” N, 96°21’3.90” S). The cave is located 4.1 km NE of the municipal capital of Santa María Huatulco. It is found at 450 m asl, surrounded by patches of tropical forest with medium-sized semideciduous trees, shade coffee plantations, and grasslands. Climate is predominantly warm-subhumid, with abundant rainfall in the summer. Annual temperature ranges between 19.5 °C and 33 °C, while mean humidity ranges from 52% in the dry season and 100% in the rainy season. Annual precipitation fluctuates between 2,300 and 3,500 mm (García, 1988). There are no previous studies in this site. The cave gives shelter to at least 15 bat species, with 3 of them having populations that can reach thousands of individuals (personal observation).

Sampling of bats was carried out from July 2016 to June 2018, during 2 nights each month. Bats were captured

using 2 mist nets (6 × 2.5 m) placed 20 m away from the cave entrance. One net was hung parallel and the other perpendicular to the cave entrance. Mist nets were opened at 19:00 hrs after the most abundant bat colony emerged (of about 10,000 individuals) and were closed the next morning at 06:00 a.m. During this time, bats were caught quickly, handling each bat separately in its own bag to avoid injuries, streblid escape, and parasite contamination between individuals. Bags were washed prior to being used. Bats were identified with the field guide by Medellín et al. (2008) and were released at their capture site.

Each captured bat was examined over a white background with an eyebrow brush soaked with ethanol gel. Ectoparasites were collected with soft forceps and placed in Eppendorf tubes with 75% ethanol. Each sample was labeled with the bat host species and the individual's identification number (e.g., *Pteronotus parnellii* # 1:Pp01). At the laboratory, streblids were examined under a stereoscopic microscope Nikon SMZ 800N and were identified using the taxonomic keys by Wenzel et al. (1966) and Wenzel (1976), complemented with other published references, as was the case for *Trichobius hoffmanae* Guerrero and Morales-Malacara (1996). The examined material was deposited in the Insect Collection of the Instituto de Ecología, A.C. (IEXA), Xalapa, Veracruz, Mexico.

Prevalence was estimated as the number of hosts infested with 1 or more individuals of bat flies divided by the total number of host species examined, expressed as a percentage (Bush et al., 1997).

Results

A total of 732 individuals of 15 species of bats were captured, corresponding to the families Phyllostomidae (10 spp.), Mormoopidae (4 spp.), and Natalidae (1 sp.). A total of 52.6% of the bats carried 1 or more streblid species, totalling 1,317 streblid specimens belonging to 24 species and 8 genera (Table 1).

The following list is organized by subfamily, genus, and species in alphabetical order. We include the primary references of valid genera and species and their synonyms if they exist, the examined material, relevant information of the taxa including previous records in Mexico, reported hosts, found parasitic prevalence, general streblid sex proportion and an account of the geographic distribution by country and by Mexican state.

Subfamily Nycterophiliinae Wenzel, 1966

Nycterophiliinae Wenzel, In Wenzel et al., 1966: 430. Type genus: *Nycterophilina* Ferris, 1916. Additional reference: Sabrosky, 1999: 217.

There are 2 genera of Nycterophiliinae, *Phalconomus* Wenzel, 1976, with 1 known species found in Venezuela (Wenzel, 1976), and *Nycterophilina* Ferris, 1916, with 6 described species (Dick, 2013; Reeves et al., 2013) with wider distribution in the Neotropics, including Mexico.

Genus *Nycterophilina* Ferris, 1916

Nycterophilina Ferris, 1916: 436. Type species: *Nycterophilina coxata* Ferris, 1916, by original designation.

Six species of this genus have been described (Reeves et al., 2013), 5 of them recorded in Mexico. The following species were found in the present study.

Nycterophilina coxata Ferris, 1916

Nycterophilina coxata Ferris, 1916: 437, fig. 5, pl. 22, fig. 6. Type locality: USA, California, Santa Margherita River, ex *Macrotus californicus* (Baird, 1858). Additional references: Guerrero, 1993: 67.

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 5♂, 2♀ (ex *Pteronotus personatus* J. A. Wagner, 1843 ♂); 30.IX.2016, 1♂, 1♀ (ex *P. personatus* ♀), Tlapaya-Romero, L., col.

Comments. In Mexico, *N. coxata* has been recorded in 12 states, on *Artibeus jamaicensis* Leach, 1821, *Desmodus rotundus* (É. Geoffroy Saint-Hilaire, 1810), *Glossophaga soricina* (Pallas, 1766), *Leptonycteris curasoae* Lydekker, 1891, *L. nivalis* (de Saussure, 1860), *L. yerbabuena* Martínez and Villa, 1940, *M. californicus*, *M. waterhousii* Gray, 1843, *Mormoops megalophylla* (Peters, 1864), *Natalus stramineus* Gray, 1838, *Pteronotus mesoamericanus* Smith, 1972, *P. davyi* (Thomas, 1892), *P. parnellii* (Gray, 1843), and *P. personatus*. In this study, *N. coxata* was poorly represented, as we only found it on 2 individuals of *P. personatus*.

Known distribution. USA, Mexico [(Baja California, Colima, Guerrero, Morelos, Oaxaca, Puebla, Sinaloa, Tamaulipas (Wenzel, 1970; Wenzel, 1976), Veracruz (Ryckman, 1956), Chiapas, Puebla, Yucatán (Guerrero & Morales-Malacara, 1996), and Jalisco (Ramírez et al., 2016)], Honduras (Dick, 2013), Colombia, Venezuela (Wenzel, 1976), and the Caribbean islands (Guerrero, 1993).

Nycterophilina fairchildi Wenzel, 1966

Nycterophilina fairchildi Wenzel, In Wenzel et al., 1966: 436. Type locality: Panama, Coclé, Penonomé caves, ex *Pteronotus suapurensis* (Allen) (= *Pteronotus gymnonotus* Natterer, 1843).

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 7.XI.2017, 1♂ (ex *G. soricina* ♀); 30.IX.2016, 1♂ (ex *G. soricina* ♀), Tlapaya-Romero, L., col.

Table 1

Bats captured and streblid species found in Cerro Huatulco cave. N = Number of specimens, I = infested individuals, PP = parasitic prevalence (percentage of parasitized hosts). * = Prevalence not calculated due to the small number of bats captured.

Host	Bats			Streblidae		
	N	I	PP (%)	Species	PP (%)	N
<i>Artibeus jamaicensis</i>	77	48	62.3	<i>Aspidoptera phyllostomatis</i>	24.7	26
				<i>Megistopoda aranea</i>	25.9	33
				<i>Metelasmus pseudopterus</i>	11.7	15
				<i>Trichobius brennani</i>	44.1	106
* <i>Artibeus lituratus</i>	4	4	-	<i>Paratrachobius longicrus</i>	-	2
				<i>Trichobius brennani</i>	-	2
<i>Dermanura phaeotis</i>	1	0	-	-	-	-
<i>Dermanura tolteca</i>	2	0	-	-	-	-
<i>Dermanura watsoni</i>	1	0	-	-	-	-
* <i>Carollia subrufa</i>	1	1	-	<i>Strebla guajiro</i>	-	4
				<i>Trichobius joblingi</i>	-	2
* <i>Sturnira hondurensis</i>	3	3	-	<i>Aspidoptera delatorrei</i>	-	6
				<i>Megistopoda proxima</i>	-	1
<i>Desmodus rotundus</i>	40	31	77.5	<i>Strebla wiedemanni</i>	45	41
				<i>Trichobius parasiticus</i>	67.5	236
<i>Glossophaga soricina</i>	438	233	53.2	<i>Paraeuctenodes longipes</i>	1.8	8
				<i>Strebla guajiro</i>	4.3	20
				<i>Trichobius diphyllae</i>	34.5	257
				<i>Trichobius parasiticus</i>	0.2	1
				<i>Trichobius uniformis</i>	29.6	199
				<i>Nycterophilia fairchildi</i>	0.4	2
<i>Leptonycteris yerbabuena</i>	5	4	80	<i>Nycterophilia parnelli</i>	40	6
				<i>Trichobius sphaeronotus</i>	40	3
				<i>Trichobius galei</i>	33.3	3
<i>Natalus mexicanus</i>	3	1	33.3	<i>Trichobius galei</i>	33.3	3
<i>Mormoops megalophylla</i>	18	4	22.2	<i>Nycterophilia parnelli</i>	5.5	3
				<i>Trichobius yunkerii</i>	5.5	5
				<i>Trichobius leionotus</i>	11.1	6
				<i>Nycterophilia parnelli</i>	3.1	3
<i>Pteronotus davyi</i>	96	23	23.9	<i>Trichobius diphyllae</i>	1	1
				<i>Trichobius hoffmannae</i>	20.8	73
				<i>Trichobius johnsonae</i>	7.3	9
				<i>Nycterophilia parnelli</i>	54	59
				<i>Trichobius hoffmannae</i>	2.7	2
<i>Pteronotus parnellii</i>	37	30	88.1	<i>Trichobius yunkerii</i>	64.9	174
				<i>Trichobius sparsus</i>	2.7	1
				<i>Trichobius uniformis</i>	2.7	1
				<i>Nycterophilia coxata</i>	33.3	9
				<i>Trichobius yunkerii</i>	16.7	1
				<i>Trichobius johnsonae</i>	16.7	1
<i>Pteronotus personatus</i>	6	3	50	<i>Nycterophilia coxata</i>	33.3	9
Total	732	385				1,317

Comments. *Nycterophilina fairchildi* is currently known to be distributed in the Mexican states of Sinaloa (Wenzel, 1970), Veracruz, and Jalisco (Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016), being found on *P. gymnonotus*, *P. davyi*, *P. parnellii*, *P. personatus*, *M. megalophylla*, *N. stramineus*, and *Sturnira parvidens* Goldman, 1917. This is the first record of *N. fairchildi* in the state of Oaxaca, Mexico.

Known distribution. Mexico (see state records in comments), Guatemala, Panama, Colombia, and Venezuela (Guerrero, 1993).

Nycterophilina parnellii Wenzel, 1966

Nycterophilina parnellii Wenzel, In Wenzel et al., 1966: 434. Type locality: Panama, Canal zone, Paraíso, ex *Pteronotus parnellii fuscus* J. A. Allen, 1911 (= *Pteronotus parnellii*).

Material examined. 72 specimens on 25 hosts of 4 bat species. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 4♂, 6♀ (ex *P. parnellii* 4♂, 1♀); 23.VII.2016, 1♂ (ex *P. davyi* ♂); 22.VIII.2016, 1♂ (ex *P. davyi* ♂); 22.VIII.2016, 4♂, 1♀ (ex *P. parnellii* ♂, ♀); 22.XI.2016, 3♂, 1♀ (ex *L. yerbabuena* ♀); 23.XI.2016, 1♂, 1♀ (ex *L. yerbabuena* ♀); 15.XII.16, 1♀, 1 non sexed (ex *P. parnellii* ♂, 1 non sexed); 13.II.2017, 1♂, 1♀ (ex *P. parnellii* ♂); 10.V.2017, 3♂ (ex *M. megalophylla* ♀); 22.VI.2017, 1♂ (ex *P. parnellii* ♀); 23.VI.2017, 18♂, 8♀ (ex *P. parnellii* 5♀); 2.VIII.2017, 2♂ (ex *P. parnellii* ♀); 17.I.2018, 3♂, 2♀ (ex *P. parnellii* ♂); 18.I.2018, 1♂ (ex *P. davyi* ♂); 11.V.2018, 1♂ (ex *P. parnellii* ♂); 18.VI.2018, 2♂, 4♀ (ex *P. parnellii* ♀), Tlapaya-Romero, L., col.

Comments. Mexican records of this species were found on the following hosts: *Balantiopteryx plicata* (Peters, 1867), *Natalus mexicanus* Miller, 1902, *N. stramineus*, and *P. parnellii* (Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016; Wenzel, 1970; Wenzel, 1976). In the present study *N. parnellii* was found on *L. yerbabuena*, *M. megalophylla*, *P. davyi*, *P. parnellii*, and *P. personatus*. Parasitic prevalence and sex proportion were different depending on the host; for *L. yerbabuena* it was 40% while female: male proportion was 2:4, for *M. megalophylla* there was 5.5% prevalence and only 3 males were recorded. For *P. davyi* the parasitic prevalence was 4%, with only males recorded, for *P. parnellii* the parasite prevalence was 54% with a female: male proportion of 23:36, and for *P. personatus* the parasitic prevalence was 16.6% with a female: male proportion of 2:5.

Known distribution. Mexico (Colima, Guerrero, Sinaloa, Yucatán (Wenzel, 1970; Wenzel 1976), Chiapas, Jalisco, Puebla, Veracruz (Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016), Guatemala, Nicaragua, Panama, Colombia, and Venezuela (Wenzel, 1970; Wenzel, 1976).

Subfamily Streblinae Kolenati, 1863

Streblinae Kolenati, 1863: 90, 103. Type genus: *Strebla* Wiedemann, 1824. Additional references: Sabrosky, 1999: 292.

Some taxonomic publications on Streblidae mentioned Speiser (1900) as the author of this group. Nevertheless, Sabrosky (1999) states that Kolenati (1863) was the first to use the group epithet based on the genus type *Strebla* Wiedemann, with *Hippobosca vespertilionis* Fabricius, 1805 as type, later suppressed by the International Commission on Zoological Nomenclature (1936), corresponding to *Strebla wiedemanni* Kolenati, 1856 (see also Dick et al., 2016). Currently, this subfamily comprises 4 genera: *Anastrebla* Wenzel, 1966, *Metelasmus* Coquillett, 1907, *Paraeuctenodes* Pessôa & Guimarães, 1937, and *Strebla* Wiedemann, 1824, 3 of them represented at least by 1 species in the present inventory.

Genus *Metelasmus* Coquillett, 1907

Metelasmus Coquillett, 1907: 292. Type species: *Metelasmus pseudopterus* Coquillett, by original designation.

Syn. *Lemosia* Pessôa & Galvão, 1936: 243. Type species: *Lemosia setosa* Pessôa & Galvão, by original designation. Additional references: Jobling, 1939: 494, as a synonym of *Metelasmus*.

Two species of *Metelasmus* have been described, but at least 1 other from Guatemala is known (Dick, 2013). *Metelasmus wenzeli* Gracioli & Dick (2004) occurs in Paraguay and southern Brazil (Gracioli & Dick, 2004). In Mexico, the following species have been reported.

Metelasmus pseudopterus Coquillett, 1907

Metelasmus pseudopterus Coquillett, 1907: 292, by original designation. Type locality: Paraguay, Sapucay, on *Artibeus lituratus* Olfers, 1818.

Syn. *Lemosia setosa* Pessôa & Galvão, 1936: 244, by original designation. Type locality: Brazil, São Paulo, M'ogi das Cruzes.

Material examined. 15 specimens on 9 bat species. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco: 22.VII.2016, 1♂ (ex *A. jamaicensis* ♂); 23.VII.2016, 2♀ (ex *A. jamaicensis* ♂); 12.II.2017, 1♀ (ex *A. jamaicensis* ♂); 21.III.2017, 1♂, 6♀ (ex *A. jamaicensis* 2♂); 22.VI.2017, 1♀ (ex *A. jamaicensis* ♀); 2.X.2017, 1♂ (ex *A. jamaicensis* ♀); 17.I.2018, 1♀ (ex *A. jamaicensis* ♂); 16.II.2018, 1♀ (ex *A. jamaicensis* ♀), Tlapaya-Romero, L., col.

Comments and known distribution. Hoffmann (1944) reported *Metelasmus pseudopterus* for the first time in Mexico, in the state of San Luis Potosí. Since then, this species has been reported in Jalisco, Yucatán and

Chiapas (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2015; Lira-Olguín et al., 2015; Ramírez et al., 2016; Tlapaya-Romero et al., 2015; Wenzel, 1970). In nearly all cases, *M. pseudoaterus* has been found parasitizing *A. jamaicensis*, except for Tlapaya-Romero et al. (2015), who also reported *Diphylla ecaudata* Spix, 1823, *Dermaptera tolteca* (de Saussure, 1860), *S. parvidens*, and *Sturnira hondurensis* Goodwin, 1940 as host species. According to Wenzel et al. (1966), *M. pseudoaterus* seems to be a specialist of Stenodermatinae bats, especially those from the genus *Artibeus*, and in the present work we only found the species on *A. jamaicensis*. This streblid species was not known for Oaxaca, so this is the first report of *M. pseudoaterus* in this Mexican state. Prevalence of *M. pseudoaterus* was 10.4%, with a female: male sex ratio of 11:4.

Genus *Paraeuctenodes* Pessôa & Guimarães, 1937

Paraeuctenodes Pessôa & Guimarães, 1937: 257. Type species: *Paraeuctenodes longipes* Pessôa & Guimarães, 1937, by original designation.

This genus has 2 described species. *Paraeuctenodes similis* Wenzel, 1976, is known in Brazil, Colombia, and Venezuela (Guerrero, 1996), and *P. longipes* Pessôa & Guimarães, 1937, with a wider distribution in the Neotropics including Mexico.

Paraeuctenodes longipes Pessôa & Guimarães, 1937

Paraeuctenodes longipes Pessôa & Guimarães, 1937: 258. Type locality: Brazil, São Paulo, Ipiranga, ex *Lonchoglossa ecaudata* (= *Anoura caudifer* E. Geoffroy St.-Hilaire).

Material examined. 8 specimens on 8 bat individuals. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 30.IX.2016, 1♀ (ex *G. soricina* ♀); 23.XI.2016, 1♀ (ex *G. soricina* ♂); 15.XII.2016, 1♀ (ex *G. soricina* ♂); 15.I.2017, 1♀ (ex *G. soricina* ♂); 16.I.2016, 1♀ (ex *G. soricina* ♂); 13.II.2017, 1♂ (ex *G. soricina* ♀); 14.II.2017, 1♀ (ex *G. soricina* ♀); 17.II.2018, 1♀ (ex *G. soricina* ♂), Tlapaya-Romero, L., col.

Comments and known distribution. Mexican records of *P. longipes* by Hoffmann (1944) are from a site on the border between Veracruz and Oaxaca, obtained from *G. soricina*, *Carollia perspicillata* (Linnaeus, 1758), and *S. parvidens*. Wenzel et al. (1966) mentioned a few specimens from Guatemala, and Wenzel (1970) reported it in Nicaragua. More recently, Dick (2013) recorded this species in Honduras. In this work, *P. longipes* was found parasitizing *G. soricina*, with a prevalence of 1.8%, for a total of 8 bat fly specimens in 438 bats, with a female: male proportion of 7:1.

Genus *Strebla* Wiedemann, 1824

Strebla Wiedemann, 1824: 19. Type species: *Hippobosca vespertilionis* Fabricius, 1805, by monotypy (= *Strebla wiedemanni* Kolenati, 1856).

Syn. *Euctenodes* Waterhouse, 1879: 310. Type species: *Euctenodes mirabilis* Waterhouse, by monotypy.

The genus *Strebla* currently includes 25 species, being the genus with the second highest species richness, only surpassed by *Trichobius* Gervais (Dick, 2013). Of all the species described, 9 have been recorded in Mexico, although *Strebla mexicana* Rondani, 1878, is unrecognizable.

Strebla guajiro (García & Casal, 1965)

Euctenodes guajiro García & Casal, 1965: 14. Type locality: Venezuela, Aragua, Campamento Rangel.

Syn. *Strebla carolliae* Wenzel, 1966: 619. Type locality: Panama, Canal Zone, Fort Davis, ex *Carollia perspicillata azteca* de Saussure, 1860.

Material examined. 24 specimens on 19 hosts. Mexico, Oaxaca, Santa María Huatulco Cueva Cerro Huatulco, 15.XII.2016, 1♂ (ex *G. soricina* ♂); 15.I.2017, 1♂ (ex *G. soricina* ♀); 14.II.2017, 1♂, 2♀ (ex *G. soricina* ♂, 2♀); 10.V.2017, 1♂, 1♀ (ex *G. soricina* 2♀); 11.V.2017, 2♂, 2♀ (ex *G. soricina* ♂, 2♀); 8.XI.2017, 2♂, 2♀ (ex *C. subrufa* ♀); 1.XII.2017, 1♂ (ex *G. soricina* ♂); 18.I.2018, 1♀ (ex *G. soricina* ♂); 9.IV.2018, 1♀ (ex *G. soricina* ♂); 11.V.2018, 1♂, 2♀ (ex *G. soricina* 2♂, ♀); 18.VI.2018, 1♂, 2♀ (ex *G. soricina* ♀, ♂), Tlapaya-Romero, L., col.

Comments. In Mexico, this species was reported in Chiapas as *Strebla carolliae* by Wenzel (1970). Recently, *S. guajiro* was confirmed in the same state on *Carollia sowelli* Baker, Solari & Hoffmann, 2002 (Colín-Martínez et al., 2018). In this work, we present the first report of *S. guajiro* in Oaxaca, parasitizing 2 host species, *G. soricina* and *Carollia subrufa* (Hahn, 1905). Parasite prevalence was 4.3%, and female: male proportion was 11: 9 for *G. soricina*, while for *C. subrufa* the parasitic prevalence and female: male proportion were 100% and 1:1, respectively.

Known distribution. Mexico (Chiapas) (Guerrero, 1996), Honduras (Dick, 2013), El Salvador, Trinidad, Panama, Venezuela, Peru, Brazil (Wenzel, 1976), Colombia, Guyana, Surinam (Guerrero, 1996).

Strebla wiedemanni Kolenati, 1856

Hippobosca vespertilionis Fabricius, 1805: 339, suppressed by the International Commission on Zoological Nomenclature, 1936: 46.

Strebla wiedemanni Kolenati, 1856: 46, nom. nov. for *H. vespertilionis* Fabricius.

Material examined. 41 specimens on 18 hosts. Mexico, Oaxaca, Santa María Huatulco Cueva Cerro Huatulco, 22.VII.2016, 3♂ (ex *D. rotundus* ♂) 23.VII.2016, 4♂, 3♀ (ex *D. rotundus* 2♂, 2♀); 21.VIII.2016, 1♂, 1♀ (ex *D.*

rotundus ♂); 22.VIII.2016, 8♂, 5♀ (ex *D. rotundus* 4♂); 21.XI.2016, 1♀ (ex *D. rotundus* ♀); 20.III.2017, 3♂ (ex *D. rotundus* ♂); 10.V.2017, 1♂, 1♀ (ex *D. rotundus* ♀); 2.VIII.2017, 4♂, 2♀ (ex *D. rotundus* 2♀); 17.I.2018, 1♀ (ex *D. rotundus* ♀), 9.IV.2018, 2♂, 1♀ (ex *D. rotundus* 2♂), Tlapaya-Romero, L., col.

Comments and known distribution. *Strebula wiedemanni* was reported for the first time in Mexico by Hoffmann (1944; 1953) in Chiapas, Yucatán and the state of Mexico, found on *Anoura geoffroyi* Gray, 1838, *S. parvidens*, and *Platyrrhinus helleri* (Peters, 1866). More recently, it has been recorded on *D. rotundus* (Cuxim-Koyoc et al., 2015; Lira-Olguín et al., 2015), as reported by Wenzel et al. (1966), who mentioned that 96% of the specimens were obtained from *D. rotundus*. In this study, *S. wiedemanni* was only found parasitizing *D. rotundus*, its principal host, although it can be found on other occasional hosts. In this work, parasitic prevalence was 45% and the female: male proportion was 15:26. This constitutes the first report of the species for the state of Oaxaca, Mexico.

Subfamily Trichobiinae Kishida, 1931

Trichobiinae Kishida, 1932: 84, 88. Type genus: *Trichobius* Gervais, 1844. Additional references: Sabrosky, 1999: 312.

Subfamily authorship had been given to Jobling (1936), but Sabrosky (1999) indicated that Kishida (1932) was the first who recognize this group. This subfamily is the most diverse of the Streblidae, represented by 20 genera including the recently recognized genus *Megistapophysis* Dick & Wenzel (2006).

Genus *Aspidoptera* Coquillett, 1899

Aspidoptera Coquillett, 1899: 334. Type species: *Aspidoptera busckii* Coquillett, 1899, by original designation (= *Aspidoptera phyllostomatis* (Perty)).

Syn. *Lepopteryx* Speiser, 1900: 42, 53. Type species: *Lipoptena phyllostomatis* Perty, 1833. Synonym by Speiser, 1907: 104.

Aspidoptera includes 3 species restricted to Stenodermatinae (Phyllostomidae) bats (Dick, 2013), of which *A. falcata* was not recorded in Mexico before this work.

Aspidoptera phyllostomatis (Perty, 1833)

Lipoptena phyllostomatis Perty, 1833: 190, pl. 37, fig. 16. Type locality: "Brazil".

Aspidoptera phyllostomatis (Perty): Speiser, 1900: 153.

Syn. *Aspidoptera busckii* Coquillett, 1899: 335. Type locality: Puerto Rico, Bayamon, from *Artibeus* sp., synonym by Speiser, 1900: 153. Additional references: Wenzel et al., 1966: 555 (resurrected); Wenzel, 1976: 107 (as synonym of *A. phyllostomatis*).

Material examined. 26 specimens on 19 host individuals. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 22.VII.2016, 1♀ (ex *A. jamaicensis* ♂); 23.VII.2016, 3♂, 4♀ (ex *A. jamaicensis* 3♀, 2 non sexed); 12.II.2017, 2♀ (ex *A. jamaicensis* ♂); 13.II.2017, 1♀ (ex *A. jamaicensis* ♂); 21.III.2017, 2♂, 3♀ (ex *A. jamaicensis* 3♂, 2♀); 22.VI.2017, 1♂, 1♀ (ex *A. jamaicensis* ♀); 2.VIII.2017, 1♂ (ex *A. jamaicensis* ♀); 2.X.2017, 2♀ (ex *A. jamaicensis* ♂, ♀); 1.XII.2017, 1♂, 3♀ (ex *A. jamaicensis* ♀); 11.V.2018, 1♀ (ex *A. jamaicensis* ♂), Tlapaya-Romero, L., col.

Comments. *Aspidoptera phyllostomatis* was reported as *A. busckii* for various localities of Mexico (not specified) by Wenzel et al. (1966). It was also reported for Jalisco, Mexico as *A. buscki* (sic!) by Wenzel (1977), and was later recorded (without indication of the precise locality) by Webb and Loomis (1977) on *A. jamaicensis* (Whitaker & Morales-Malacara, 2005), and Ramírez et al. (2016) confirmed its presence in the state of Jalisco. This is the first report of *A. phyllostomatis* for the state of Oaxaca, Mexico. It was found on *A. jamaicensis* with a prevalence of 24.7%, and sex proportion of 18 females: 8 males.

Known distribution. Mexico (Jalisco and Oaxaca), Cuba, Puerto Rico, Guatemala, Honduras, Costa Rica, Panama, Colombia, Venezuela, and Brazil (Dick, 2013; Wenzel et al., 1966; Wenzel, 1970, 1976).

Aspidoptera delatorrei Wenzel, 1966

Aspidoptera delatorrei Wenzel, in Wenzel et al., 1966: 557. Type locality: Panama, Guánico, Los Santos, ex *Sturnira lilium parvidens*.

Material examined. 6 specimens on 3 hosts. MEXICO, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 21.XI.2016, 2♂, 1♀ (ex *S. hondurensis* ♀); 14.XII.2016, 2♀ (ex *S. hondurensis* ♂); 8.XI.2017, 1♀ (ex *S. hondurensis* ♀), Tlapaya-Romero, L., col.

Comments. *Aspidoptera delatorrei* was first found in Mexico in the state of Jalisco by Wenzel et al. (1966). Later, it was reported in Chiapas, Oaxaca, Jalisco, Veracruz, and Yucatán (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2015, 2016; Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016; Wenzel, 1970). In these studies, *A. delatorrei* was commonly found on *S. parvidens* and *S. hondurensis*, but in other reports it was found on *A. jamaicensis* (Ramírez et al., 2016). In Michoacán, this species was found on *S. hondurensis* and *A. geoffroyi* (Trujillo-Pahua & Ibáñez-Bernal, 2019). Wenzel et al. (1966) mentioned *S. parvidens* as the main host, but unexpectedly it was also found on *C. perspicillata*. In this work *A. delatorrei* was found on *S. hondurensis* with prevalence of 100% and a female-male proportion of 4:2.

Known distribution. Mexico (Chiapas, Jalisco, Michoacán, Oaxaca, Veracruz, and Yucatán), Guatemala, Nicaragua, Panama, Colombia, and Venezuela (Cuxim-Koyoc et al., 2015, 2016; Dick, 2006; Ramírez et al., 2016; Trujillo-Pahua & Ibáñez-Bernal, 2019; Wenzel, 1970, 1976; Wenzel et al., 1966).

Genus *Megistopoda* Macquart, 1852

Megistopoda Macquart, 1852: 332. Type species: *Megistopoda pilatei* Macquart, by monotypy (= *Megistopoda aranea* Coquillett, according with Wenzel et al., 1966: 542).

Syn. *Pterellipsis* Coquillett, 1899: 333. Type species: *Pterellipsis aranea* Coquillett, 1899, by subsequent designation of Coquillett, 1910: 597).

Megistopoda includes 3 species, but the high morphological variation and difficulty in differentiating *M. proxima* (Séguy) from *M. theodori* Wenzel, highlights their taxonomic reevaluation (Dick, 2013).

Megistopoda aranea (Coquillett, 1899)

Pterellipsis aranea Coquillett, 1899: 334. Type locality: Jamaica, ex undetermined bats.

Syn. *Megistopoda desiderata* Speiser, 1900a: 57, pl. 3, figs. 6-8. Type locality: Brazil, Cuba, with no specific localities, ex. *Phyllostoma* sp.; Speiser 1900b: 154, as synonym of *P. aranea* Coquillett.

Material examined. 33 specimens on 20 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 1♂, 9♀ (ex *A. jamaicensis* 2♀, 2 not sexed); 21.VIII.2016, 2♂, 1♀ (ex *A. jamaicensis* ♂, ♀); 14.I.2017, 1♂ (ex *A. jamaicensis* ♂); 21.III.2017, 3♀ (ex *A. jamaicensis* 3♀); 11.V.2017, 1♂, 1♀ (ex *A. jamaicensis* ♀); 22.VI.2017, 1♂, 1♀ (ex *A. jamaicensis* ♀); 23.VI.2017, 1♀ (ex *A. jamaicensis* ♂); 2.VIII.2017, 3♂, 3♀ (ex *A. jamaicensis* 2♂, ♀); 2.X.2017, 2♂ (ex *A. jamaicensis* 2♀); 1.XII.2017, 1♂ (ex *A. jamaicensis* ♀); 11.V.2018, 2♂ (ex *A. jamaicensis* 2♂), Tlapaya-Romero, L., col.

Comments. Hoffmann (1953) reported *M. aranea* for the first time in Yucatán, Mexico. Since then, this species has been found in other states including Campeche, Chiapas, and San Luis Potosí (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2015; Hoffmann, 1953; Lira-Olguín et al., 2015; Tlapaya-Romero et al., 2015). In all the Mexican states, *M. aranea* was found parasitizing *A. jamaicensis*, and occasionally *A. lituratus* (Wenzel, 1976). This species was previously unknown for Oaxaca, making this the first report for this state. The parasitic prevalence found was 25.9%, and the female: male ratio was 19:14.

Known distribution. Mexico (Campeche, Chiapas, San Luis Potosí, Tabasco, Veracruz, and Yucatán, see

references above), Central America and Honduras on *A. jamaicensis* and *A. planirostris* (Spix, 1823) (Dick, 2013); Panama and Venezuela on *A. jamaicensis* (Wenzel, 1966); Paraguay on *A. fimbriatus* Gray, 1838 (Dick, 2006); Greater and Lesser Antilles, Trinidad and Tobago (Wenzel, 1970), Brazil, Peru, Paraguay (Wenzel, 1970, Wenzel, 1976), Bolivia (Guerrero, 1994); in Brazil it was also recorded on *A. planirostris*, *A. lituratus*, and as a rare record on *Carollia perspicillata* (Linnaeus, 1758) (Urbieta et al., 2014).

Megistopoda proxima (Séguy, 1926)

Pterellipsis proxima Séguy, 1926: 194. Type locality: Argentina, Misiones, environs of San Ignacio, Villa Lutecia, on an unidentified bat.

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 21.XI.2016, 1♀ (ex *S. hondurensis* ♀), Tlapaya-Romero, L., col.

Comments. *Megistopoda proxima* was first reported in Mexico in the states of Chiapas and Jalisco (Wenzel, 1970), and later in Jalisco, Veracruz, and Yucatán (Cuxim-Koyoc et al., 2015, 2016; Ramírez et al., 2016). This species has been found on *C. sowelli*, *N. mexicanus*, *S. parvidens*, and *S. hondurensis* (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2015, 2016; Ramírez et al., 2016; Wenzel, 1970). In our samples, we only observed 1 specimen of *M. proxima* parasitizing 1 of 3 specimens of *S. hondurensis*, despite that Wenzel (1966) mentioned that it is restricted to *S. parvidens* (= *S. lilium*). We are not aware of any previous record of this species in Oaxaca, making it the first for the state.

Known distribution. Mexico (Chiapas, Jalisco, Oaxaca, Veracruz), Guatemala, Honduras, Nicaragua, Panama, south of Peru, Paraguay, Brazil, Argentina (Wenzel, 1970), Cuba, Dominica, Martinique, and Uruguay (Guerrero, 1994, 1996; Hoffmann, 1944).

Genus *Paratrachobius* Costa Lima, 1921

Paratrachobius Costa Lima, 1921: 20. Type species: *Trachobius longicrus* Miranda-Ribeiro, by original designation.

Currently, there are 6 described species for this genus, but there are problems with the definition of its species limits (Dick, 2013). In Mexico, only 1 species has been recorded.

Paratrachobius longicrus (Miranda-Ribeiro, 1907)

Trachobius longicrus Miranda-Ribeiro, 1907: 236. Type locality: Brazil, Guanabara, Rio de Janeiro, Quinta da Boa Vista, ex *A. jamaicensis*.

Paratrachobius longicrus (Miranda-Ribeiro) of Costa Lima, 1921: 20.

Material examined. 2 specimens in 2 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco. 15.I.2017, 1♂ (ex *A. lituratus* ♀); 17.I.2018, 1♂ (ex *A. lituratus* ♂), Tlapaya-Romero, L., col.

Comments. In Mexico, *P. longicrus* was first reported in Chiapas (Kuns & Tashian, 1954), and later in the states of Jalisco, San Luis Potosí, and Tlaxcala. Host species reported for Mexico are *A. jamaicensis*, *A. lituratus*, *Dermanura azteca* (Andersen, 1906), and *Enchisthenes hartii* (Thomas, 1892) (Colín-Martínez et al., 2018; Guerrero & Morales-Malacara, 1996; Kuns & Tashian, 1954; Ramírez et al., 2016; Wenzel, 1970). In the present study we report this species for the first time in Oaxaca, with a parasitic prevalence of 50% and a female: male sex proportion of 1:1. All specimens were found on *A. lituratus*.

Known distribution. Mexico (Chiapas, Oaxaca, San Luis Potosí, Tlaxcala) (Guerrero & Morales-Malacara 1996; Wenzel, 1970), Central America, Honduras (Dick, 2013), Venezuela, Brazil, Peru (Wenzel, 1970), and Bolivia (Guerrero, 1994).

Genus *Trichobius* Gervais, 1844

Trichobius Gervais, 1844: 14. Type species: *Trichobius parasiticus* Gervais, 1844, by monotypy.

Syn. *Kolenatia* Rondani, 1878: 169. Type species: *Strebla wiedemanni* Kolenati, 1863 (not Kolenati, 1856), by original designation.

Syn. *Kesselia* Curran, 1934: 522. Type species: *Kesselia pallida* Curran, 1934, by original designation.

Trichobius is the most diverse streblid genus with 68 described species (Dick, 2013). In Mexico, 24 species have been recorded (Trujillo-Pahua & Ibáñez-Bernal, 2019), of which only 3 were known for Oaxaca. We report the occurrence of the following 12 species.

Trichobius brennani Wenzel, 1966

Trichobius brennani Wenzel, In Wenzel et al., 1966: 497. Type locality: Panama, Chiriquí, near Cerro Punta, casa Tilley, ex *Sturnira ludovici* Anthony, 1924.

Material examined. 106 specimens on 35 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco: 22.VII.2016, 5♂, 1♀ (ex *A. jamaicensis* ♂); 23.VII.2016, 20♂, 16♀ (ex *A. jamaicensis* 3♂, 7♀); 21.VIII.2016, 3♂, 4♀ (ex *A. jamaicensis* ♂, ♀); 21.X.2016, 1♀ (ex *A. lituratus* ♂); 14.I.2017, 1♀ (ex *A. jamaicensis* ♂); 2.II.2017, 6♂, 6♀ (ex *A. jamaicensis* 4♂); 12.II.2017, 1♀ (ex *A. lituratus* ♂); 13.II.2017, 3♂, 3♀ (ex *A. jamaicensis* ♂); 10.V.2017, 4♂, 2♀ (ex *A. jamaicensis* 2♂); 22.VI.2017, 5♂, 1♀ (ex *A. jamaicensis* ♀), 2.VIII.2017, 3♀ (ex *A. jamaicensis* 2♂, ♀); 2.X.2017, 7♂, 1♀ (ex *A. jamaicensis* ♂, 3♀); 17.I.2018, 2♂ (ex *A.*

jamaicensis ♀); 11.V.2018, 3♂, 7♀ (ex *A. jamaicensis* 3♂), Tlapaya-Romero, L., col.

Comments and known distribution. *Trichobius brennani* was recently recorded in Mexico, with specimens found on 1 individual of *S. hondurensis* in the state of Veracruz (Cuxim-Koyoc et al., 2016), and in the same bat species in Michoacán (Trujillo-Pahua & Ibáñez-Bernal, 2019). In accordance with Wenzel et al. (1966) this species is apparently restricted to *Artibeus* and *Sturnira* bats. This is the first time the species is recorded in the state of Oaxaca. We found *T. brennani* on *A. jamaicensis*, and *A. lituratus*. In *A. jamaicensis*, the parasitic prevalence of *T. brennani* was 44.1%, with a female: male proportion of 45:59. In the case of *A. lituratus* this species had a parasitic prevalence of 100%, but only 2 females were obtained.

Trichobius diphyllae Wenzel, 1966

Trichobius diphyllae Wenzel, In Wenzel et al., 1966: 492. Type locality: Guatemala, Jalapa, San Lorenzo, 4 miles northeast of Volcan Jumay, ex *Diphylla ecaudata centralis*.

Material examined. 258 specimens on 157 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 1♂ (ex *G. soricina* ♀); 30.IX.2016, 3♂ (ex *G. soricina* ♀); 21.XI.2016, 2♂ (ex *G. soricina* ♀, ♂); 23.XI.2016, 1♀ (ex *G. soricina* ♀); 14.XII.2016, 2♂ (ex *G. soricina* ♂, ♀); 15.XII.2016, 6♂, 3♀ (ex *G. soricina* 4♂, 2♀); 15.XII.16, 1♂ (ex *P. davyi* ♂); 14.I.2017, 3♂, 2♀ (ex *G. soricina* 2♀, ♂); 15.I.2017, 10♂, 11♀ (ex *G. soricina* 5♂, 8♀); 16.I.2017, 8♂, 11♀ (ex *G. soricina* 2♂, 6♀, 1 non sexed); 12.II.2017, 1♀ (ex *G. soricina* ♂); 13.II.2017, 21♂, 15♀ (ex *G. soricina* 4♂, 14♀); 14.II.2017, 31♂, 10♀ (ex *G. soricina* 9♂, 12♀); 21.III.2017, 1♂1♀ (*G. soricina* 2♀); 22.III.2017, 1♂ (ex *G. soricina* ♂); 10.V.2017, 5♀ (ex *G. soricina* 3♂, 2♀); 11.V.2017, 23♂, 11♀ (ex *G. soricina* 10♂, 13♀); 7.XI.2017, 6♂, 2♀ (ex *G. soricina* ♂, 6♀); 1.XII.2017, 5♂, 1♀ (ex *G. soricina* 3♀); 17.I.2018, 5♂ (*G. soricina* ♂, 2♀); 18.I.2018, 3♂, 1♀ (ex *G. soricina* 2♂); 16.II.2018, 2♂, 1♀ (ex *G. soricina* 2♂, ♀); 17.II.2018; 1♂, 3♀ (ex *G. soricina* 3♂); 9.IV.2018, 15♂, 3♀ (ex *G. soricina* 6♂, 4♀); 11.V.2018, 9♂, 4♀ (ex *G. soricina* 3♂, 3♀) and 18.VI.2018, 11♂, 2♀ (ex *G. soricina* 4♂, 4♀), Tlapaya-Romero, L., col.

Comments. In Mexico, *T. diphyllae* was recorded for the first time in the states of Quintana Roo and Yucatán (Wenzel et al., 1966; Wenzel, 1970). Recent studies have confirmed the records from Yucatán (Cuxim-Koyoc et al., 2015) and its presence in the state of Veracruz (Cuxim-Koyoc et al., 2016). These papers reported *D. ecaudata* as the host species. In the present study *T. diphyllae* was found on *G. soricina* with a parasitic prevalence of 35.8% and a female: male proportion of 88:169, on *P. davyi* with

a parasitic prevalence of 1%, and was represented by only 2 females that could be considered natural contamination from other species at the cave. This is the first record of *T. diphyllae* in the state of Oaxaca.

Known distribution. Mexico (Oaxaca, Quintana Roo, Veracruz, and Yucatán), Guatemala, Venezuela (Wenzel et al., 1966; Wenzel, 1970), Honduras (Dick, 2013), and Peru (Guerrero, 1995a).

Trichobius galei Wenzel, 1966

Trichobius galei Wenzel, In Wenzel et al., 1966: 449. Type locality: Panama, Canal Zone, Fort Sherman, San Lorenzo caves, ex *Natalus stramineus mexicanus*.

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 21.III.2017, 3♂ (ex *N. mexicanus* ♂), Tlapaya-Romero, L., Col.

Comments. *Trichobius galei* was recorded for the first time in Mexico in the states of Veracruz and Chiapas parasitizing *N. mexicanus* and *D. rotundus* (Cuxim-Kocoy et al., 2016; Lira-Olguín et al., 2015), but the latter was probably a case of contamination as indicated by the authors. This species was subsequently found in the state of Jalisco on *M. megalophylla* (Ramírez et al., 2016). In our study, *T. galei* was found on *N. mexicanus* with a parasitic prevalence of 33.3%, though only male specimens were found. This represents the first report of *T. galei* in the state of Oaxaca.

Known distribution. Mexico (Chiapas, Jalisco, Oaxaca, Veracruz) (Cuxim-Kocoy et al., 2016; Lira-Olguín et al., 2015; Ramírez et al., 2016), Panama (Wenzel et al., 1966), Honduras, Venezuela, and Paraguay (Dick, 2013).

Trichobius hoffmannae Guerrero & Morales-Malacara, 1996

Trichobius hoffmannae Guerrero & Morales-Malacara, 1996: 359. Type locality: Mexico, Veracruz, Puente Nacional, Cueva Arroyo Bellaco, ex *Pteronotus davyi*.

Material examined. 74 specimens on 21 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 2♂, 1♀ (ex *P. davyi* 2♂); 23.VIII.2016, 4♂, 5♀ (ex *P. davyi* 3♂, ♀); 15.XII.2016, 2♂, 2♀ (ex *P. davyi* ♂, 1 non sexed); 14.I.2017, 4♂ (ex *P. davyi* ♂); 15.I.2017, 11♂, 5♀ (ex *P. davyi* ♂ 1 non sexed); 20.III.2017, 4♂, 10♀ (ex *P. davyi* ♂); 21.III.2017, 2♂, 2♀ (ex *P. davyi* ♂); 22.VI.2017, 3♂, 8♀ (ex *P. davyi* ♂); 23.VI.2017, 1♂ (ex *P. parnellii* ♀); 16.II.2018, 2♀ (ex *P. davyi* ♀), 17.II.2018, 1♂, 1♀ (ex *P. davyi* 2♂); 9.IV.2018, 1♂, 1♀ (ex *P. davyi* 2♂); 11.V.2018, 2♂ (ex *P. davyi* ♀), Tlapaya-Romero, L., col.

Comments. *Trichobius hoffmannae* was described with specimens obtained from *M. megalophylla*, *N. stramineus*, *P. davyi*, *P. parnellii*, and *P. personatus* in the states of

Chiapas and Veracruz (Guerrero & Morales-Malacara, 1966). Specimens collected in this study came from *P. davyi* and *P. parnellii*. Parasitic prevalence was 20.8% on *P. davyi*, with a female: male proportion of 37:36. On the other hand, for *P. parnellii* only 1 female specimen of *T. hoffmannae* was found. This is the second report for this species since its description and constitutes the first record for the state of Oaxaca.

Known distribution. Mexico (Chiapas and Veracruz) (Guerrero & Morales-Malacara, 1966).

Trichobius joblingi Wenzel, 1966

Trichobius joblingi Wenzel, In Wenzel et al., 1966: 481. Type locality: Panama, Canal Zone, railroad culvert east of Summit Golf Club, ex *Carollia perspicillata azteca*.

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 8.XI.2017, 1♂, 1♀ (ex *C. subrufa* ♀), Tlapaya-Romero, L., col.

Comments. *Trichobius joblingi* was reported in the states of Chiapas and Veracruz (Wenzel 1970), but without mention of the hosts. In Chiapas, Jalisco, Oaxaca, and Yucatán, it was obtained from *A. jamaicensis*, *D. ecaudata*, *D. rotundus*, *C. perspicillata*, *G. soricina*, *S. ludovici*, and *Trachops cirrhosus* (Spix, 1823) (Guerrero & Morales-Malacara, 1996; Ramírez et al., 2018; Tlapaya-Romero et al., 2015). During this study, only 1 specimen was collected on *C. subrufa*. Wenzel et al. (1966) mentioned that *T. joblingi* seems to parasitize species of *Carollia*, considering that findings in other bat genera may be transitory associations by transference.

Known distribution. Mexico (Chiapas, Veracruz) (Wenzel, 1970), Oaxaca, Yucatán (Guerrero & Morales-Malacara, 1996), Puebla (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919692569> on 2015-04-12), Chiapas (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919683991> on 2015-04-12), Central America, Trinidad and Tobago, South America towards Brazil, and Peru (Wenzel, 1970), Bolivia (Guerrero, 1995).

Trichobius johnsonae Wenzel, 1966

Trichobius johnsonae Wenzel, In Wenzel et al., 1966: 455. Type locality: Panama, Coclé, Penonomé Cave, ex *Pteronotus psilotis* (Dobson, 1878) (= *Pteronotus personatus psilotis*).

Material examined. 10 specimens on 8 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 30.IX.2016, 1♂, 1♀ (ex *P. davyi* ♀); 15. I.2017, 1♂ (ex *P. davyi*); 20.III.2017, 1♂ (ex *P. davyi* ♂); 2.X.2017,

1♂ (*P. personatus* ♂); 18.I.2018, 1♂, 1♀ (*P. davyi* ♂); 17.II.2018, 1♂ (*P. davyi* ♂); 17.II.2018, 1♂ (*P. davyi* ♂); 9.IV.2018, 1♂ (*P. davyi* ♂), Tlapaya-Romero, L., col.

Comments. *Trichobius johnsonae* was reported in Mexico in the states of Chiapas and Veracruz (Guerrero & Morales-Malacara, 1996), on *M. megalophylla*, *N. stramineus*, *P. davyi*, *P. parnellii*, and *P. personatus*. It has also been found in the state of Jalisco on *P. personatus* (Ramírez et al., 2016). In this study, this bat fly species was found on *P. davyi* and *P. personatus*. Parasitic prevalence was of 7.3% on *P. davyi*, and female: male proportion was 2:7. In contrast, only 1 specimen was obtained from *P. personatus*. This is the first record in the state of Oaxaca.

Known distribution. Mexico (Chiapas, Veracruz) (Guerrero & Morales-Malacara 1996), Colima (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919682305> on 2015-04-12; 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919661549> on 2015-04-12), Sinaloa (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919714181> on 2015-04-12), Oaxaca (new record), Panama, Colombia, and Venezuela (Wenzel, 1970).

Trichobius leionotus Wenzel, 1976

Trichobius leionotus Wenzel, 1976: 43. Type locality: Guatemala, Alta Vera Paz, Lanquin, Cueva de Lanquin, ex *Mormoops megalophylla*. Paratypes on *Pteronotus davyi fulvus*.

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 2♂, 3♀ (ex *M. megalophylla*); 2.VIII.2017, 1♂ (ex *M. megalophylla*), Tlapaya-Romero, L., col.

Comments. *Trichobius leionotus* was reported in Mexico in the states of Puebla, Veracruz (Guerrero & Morales-Malacara, 1996), in Nuevo León from *Tadarida brasiliensis mexicana* (de Saussure, 1860) as an accidental record (Guzmán-Cornejo et al., 2003), and Jalisco (Ramírez et al., 2016). This is the first report from the state of Oaxaca. In this study the parasitic prevalence on *M. megalophylla* was 11.1%, and the female: male proportion was 3:3.

Trichobius parasiticus Gervais, 1844

Trichobius parasiticus Gervais, 1844: 14. Type locality: Guiane (locality not mentioned), ex *Desmodus rufus* (= *Desmodus rotundus*).

Syn. *Trichobius kesseli* Guimarães, 1938: 660, nom. nov. for *T. parasiticus* Gervais of Kessel, 1925: 15 (error).

Material examined. 237 specimens on 28 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 22.VII.2016, 7♂, 3♀ (ex *D. rotundus* 2♂); 23.VII.2016, 24♂, 19♀ (ex *D. rotundus* 2♂, 3♀); 22.VIII.2016, 32♂, 17♀, 3 non sexed (ex *D. rotundus* 4♂, ♀); 21.XI.2016, 3♂, 5♀ (ex *D. rotundus* ♀); 20.III.2017, 3♂, 1♀ (ex *D. rotundus* 2♀); 21.III.2017, 5♂, 6♀ (ex *D. rotundus* ♂, ♀); 10.V.2017, 9♂, 3♀ (ex *D. rotundus* ♀); 2.VIII.2017, 53♂, 26♀ (ex *D. rotundus* 3♀); 17.I.2018, 2♂ (ex *D. rotundus* 2♀); 18.I.2018, 1♂, 1♀ (ex *D. rotundus* ♂), 17.I.2018, 1♂ (ex *G. soricina* ♀); 9.IV.2018, 8♂, 5♀ (ex *D. rotundus* 2♂, ♀), Tlapaya-Romero, L., col.

Comments. Hoffmann (1944, 1953) reported *T. parasiticus* in the states of Yucatán, Puebla, Oaxaca, San Luis Potosí, and Guerrero, and Kuns & Tashian (1954), Lira-Olguín et al. (2015), and Ramírez et al. (2016) found this species in Chiapas and Jalisco parasitizing *D. rotundus* and *D. ecaudata*. It has also been found on *A. jamaicensis*, *Centurio senex* Gray, 1842, and *Chrotopterus auritus* (Peters, 1856); nevertheless, Cuxim-Koyoc et al. (2015) considered these cases of contamination. In the present study *T. parasiticus* was found on *D. rotundus* and *G. soricina*. Parasitic prevalence for the former was 70%, with a female: male proportion of 86:146, whereas in *G. soricina* only 1 strebid specimen was found, and probably represents natural contamination.

Known distribution. *Trichobius parasiticus* has been recorded in Mexico (Chiapas, Guerrero, Jalisco, Oaxaca, Puebla, Quintana Roo, San Luis Potosí, Veracruz, Yucatán (Cuxim-Koyoc et al., 2015; Hoffmann, 1944; Kuns & Tashian, 1954; Lira-Olguín et al., 2015; Ramírez et al., 2016), Chihuahua, and Sinaloa (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919690945> on 2015-04-13)), Central America, Trinidad, South America south to Brazil, Peru, Argentina (Wenzel 1970), Bolivia, and Chile (Guerrero, 1995).

Trichobius sparsus Kessel, 1925

Trichobius sparsus Kessel, 1925: 17. Type locality: Panama, Chilibrillo river, ex *Chilonycteris rubiginosa fusca* (= *Pteronotus parnelli fuscus*).

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 1♀ (ex *P. parnellii* ♂); 30.IX.2016, 1♂ (ex *P. davyi* ♀), Tlapaya-Romero, L., col.

Comments. *Trichobius sparsus* was previously reported in Mexico in the state of Veracruz (Guerrero & Morales-Malacara, 1996), and later in Jalisco (Ramírez et al., 2016), parasitizing *N. stramineus*, *M. megalophylla*, and *P. parnellii*. In this study, which reports the first record

in the state of Oaxaca, we found this species on *P. parnellii* and *P. davyi*, with a parasitic prevalence of 2.7% and 16.6 %, respectively.

Known distribution. Mexico (Veracruz (Guerrero & Morales-Malacara, 1996), Colima (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919678056> on 2015-04-13), Sonora (Field Museum: Field Museum of Natural History (Zoology) Insect, Arachnid and Myriapod Collection, 2014-06-25. Accessed via <http://www.gbif.org/occurrence/919662614> on 2015-04-13)), Guatemala, Panama, and Venezuela (Wenzel, 1970).

Trichobius sphaeronotus Jobling, 1939

Trichobius sphaeronotus Jobling, 1939: 494. Type locality: Mexico, Nuevo Leon, Cerro Potosi, ex *Leptoncyteris nivalis* (de Saussure, 1860).

Material examined. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 21.XI.2016, 2♂, 1♀ (ex *L. yerbabuena* ♂, ♀), Tlapaya-Romero, L., col.

Comments. *Trichobius sphaeronotus* was described in Nuevo Leon, Mexico (Jobling, 1939), since then, this species has been reported in Baja California, Colima, Guerrero, Jalisco, Nuevo Leon, Puebla, and Veracruz, on the following bat species: *D. rotundus*, *L. nivalis*, *L. curasoae*, *L. yerbabuena*, *M. californicus*, *M. megalophylla*, and *P. davyi* (Guerrero & Morales-Malacara, 1996; Hoffmann, 1944,1953; Ramírez et al., 2016). In this study *T. sphaeronotus* was found on *L. yerbabuena*, with a parasitic prevalence of 80% and a female: male proportion of 1:2. This is the first time the species is recorded in the state of Oaxaca.

Known distribution. USA, Mexico (Baja California, Colima, Guerrero, Jalisco, Nuevo Leon, Oaxaca, Puebla, and Veracruz).

Trichobius uniformis Curran, 1935

Trichobius uniformis Curran, 1935: 10. Type locality: Panama, Canal Zone, Paraíso, ex *Glossophaga soricina leachii* (= *Glossophaga leachii* (Gray, 1844)).

Material examined. 199 specimens on 131 hosts. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016. 3♂, 1♀ (ex *G. soricina* ♂, ♀); 23.XIII.2016, 2♂ (ex *G. soricina* ♂); 30.IX.2016, 1♂ (ex *G. soricina* ♀); 23.XI.2016, 7♂, 2♀ (ex *G. soricina* 4♂, 3♀); 15.XII.2016, 1♀ (ex *P. parnellii* ♀); 15.XII.2016, 5♂, 6♀ (ex *G. soricina* 4♂, 4♀); 15.I.2017, 13♂, 3♀ (ex *G. soricina* 5♂, 7♀); 16.I.2017, 12♂, 4♀ (ex *G. soricina* 5♂, 3♀, 1 non sexed); 13.II.2017, 9♂, 4♀ (ex *G. soricina* 5♂, 4♀); 14.II.2017, 7♂, 4♀ (ex *G. soricina* 4♂, 3♀); 21.III.2017, 1♂ (ex *G. soricina* ♀); 22.III.2017, 5♂ (ex

G. soricina 5♀); 10.V.2017, 4♂, 1♀ (ex *G. soricina* 2♂, 2♀); 11.V.2017, 27♂, 13♀ (ex *G. soricina* 10♂, 9♀); 7.XI.2017, 1♂, 1♀ (ex *G. soricina* ♀, ♂); 8.XI.2017, 1♂ (ex *G. soricina* ♀); 1.XII.2017, 9♂ (ex *G. soricina* 2♂, 4♀); 17.I.2018, 4♂, 1♀ (ex *G. soricina* 2♂, 2♀); 16.II.2018, 13♂, 2♀ (ex *G. soricina* 8♂, 5♀); 9.IV.2018, 8♂, 6♀, 1 non sexed (ex *G. soricina* 6♂, 3♀); 11.V.2018, 6♂, 2♀ (ex *G. soricina* 2♂, 3♀); 18.VI.2018, 6♂, 3♀ (ex *G. soricina* 3♂, 2♀), Tlapaya-Romero, L., col.

Comments. *Trichobius uniformis* is reported in Chiapas, San Luis Potosí, Tamaulipas (Hoffmann, 1944, 1953), Yucatán (Wenzel, 1970), Jalisco, and Veracruz (Cuxim-Koyoc et al., 2015; Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016). In nearly all cases except in Hoffmann's (1944, 1953) studies, the species was found on *Molossus rufus* È. Geoffroy Saint-Hilaire, 1805, *Myotis nigricans* (Schinz, 1821), *Saccopteryx bilineata* (Temminck, 1838), and *G. sorina*. In this study, we only found this species on *G. sorina*, with a parasitic prevalence of 29.6%, and a female: male proportion of 54:144. Only 1 specimen of *T. uniformis* was found on *P. parnellii*, which probably represents a case of contamination. This is the first record in the state of Oaxaca.

Known distribution. Mexico (see states in comments), to Venezuela, Guyana, Peru (Wenzel, 1970).

Trichobius yunker Wenzel, 1966

Trichobius yunker Wenzel, In Wenzel et al., 1966: 453. Type locality: Panama, Canal Zone, Paraíso, ex *Pteronotus parnellii fuscus*.

Material examined. 177 specimens on 27 hosts belonging to 3 bat species. Mexico, Oaxaca, Santa María Huatulco, Cueva Cerro Huatulco, 23.VII.2016, 1♂ (ex *P. personatus* ♂); 23.VII.2016, 16♂, 32♀ (ex *P. parnellii* 5♂, 3♀); 24.VII.2016, 1♀ (ex *P. parnellii* ♂); 22.VIII.2016, 10♂, 4♀ (ex *P. parnellii* 2♂, ♀); 12.II.2017, 1♂, 2♀ (ex *P. parnellii* ♂); 13.II.2017, 5♂ (ex *P. parnellii* ♂); 10.V.2017, 3♂, 2♀ (ex *M. megalophylla* ♀); 22.VI.2017, 3♂, 3♀ (ex *P. parnellii* ♀); 23.VI.2017, 30♂, 37♀ (ex *P. parnellii* 5♀); 02.VIII.2017, 13♂, 5♀ (ex *P. parnellii* ♀); 17.I.2018, 1♂, 1♀ (ex *P. parnellii* ♂); 11.V.2018, 1♀ (ex *P. parnellii* ♂); 18.VI.2018, 3♂, 3♀ (ex *P. parnellii* ♀), Tlapaya-Romero, L., col.

Comments and known distribution. *Trichobius yunker* is known to occur in the states of Guerrero, Jalisco, Sinaloa, Yucatán (Wenzel, 1970), Chiapas, Jalisco, Puebla, and Veracruz (Cuxim-Koyoc et al., 2015; Guerrero & Morales-Malacara, 1996; Ramírez et al., 2016). In these studies, *T. yunker* was found on *P. parnellii*, *P. personatus*, *P. mesoamericanus*, *M. megalophylla*, and *N. stramineus*. The specimens studied here were found on *P. parnellii*, *P. personatus*, and *M. megalophylla*, with the following

parasitic prevalence and female: male proportions: 67.6% and 89:82 for *P. parnellii*, 16.6% and 1 specimen male for *P. personatus*, and 5.5%, and 2:3 for *M. megalophylla*. This is the first record of the species in the state of Oaxaca.

Discussion

In the Neotropics, streblids are represented by 153 described species, corresponding to 64% of the known streblids worldwide (Borkent et al., 2018). Regional species inventories are currently more common in the literature, and constitute the first step towards understanding parasite relationships and their role in the transmission of pathogens in bat communities. Even though recent efforts to characterize the streblid fauna of Mexico have increased the number of known species to 55 (Colin-Martínez et al., 2018; Cuxim-Koyoc et al., 2015, 2016; Whitaker & Morales-Malacara, 2005), there are still large areas awaiting to be studied.

Even though Oaxaca is recognized as a megadiverse state, the streblid fauna has been poorly studied, with only 3 previous studies that altogether recorded 9 species. In this study, with an effort concentrated in only 1 cave but involving systematic and periodic sampling, 19 streblid species were added to the Oaxacan fauna, increasing the recorded bat fly species for the state to 27. This amounts to 49% of the Mexican species, obtained from 12 bat species that represent 12.9% of the species reported in Oaxaca.

It is important to mention that of the 9 streblid species previously recorded in Oaxaca, we did not find *Speiseria ambigua* and *Strebla mirabilis*, found on *Macrotus* sp. and *B. plicata* by Hoffmann (1953) and Guerrero and Morales-Malacara (1996). We did not find the latter 2 bat species in our study. Also, we did not obtain *T. adamsi*, despite that this species was reported on *D. rotundus*, a very abundant bat in our samples.

The Phyllostomidae family was the best represented in our study with 10 species, corresponding to 17.8% of the species known in Oaxaca (García-Grajales & Buenrostro-Silva, 2012). The Mormoopidae and Natalidae families were represented by 4 species each, comprising all the species known in this Mexican state. *Glossophaga sorina* presented the highest capture frequency, with 438 individuals followed by *P. parnellii* and *A. jamaicensis* with 96 and 77 individuals, respectively. In contrast, *C. subrufa* (N = 1), *S. hondurensis* (N = 3) and *N. mexicanus* (N = 3) were the species with the lowest number of individuals captured.

Phyllostomidae presented the highest streblid richness with 17 species, followed by Mormopidae with 8 streblid species and Natalidae with only 1 bat fly species. Even though few species of bat flies were found parasitizing

more than 1 bat species, in general the host species belong to the same family. This was the case of *T. brennani*, which was found on *A. jamaicensis* and *A. lituratus*; *S. guajiro* recorded on *C. subrufa* and *G. soricina*. Moreover, *T. hoffmannae* and *T. johnsonae* were collected on 2 species, whereas *T. yunkerii* was obtained from 3 Mormoopidae species. Only *N. parnellii* was found parasitizing 3 bat species from 2 different bat families (Phyllostomidae and Mormoopidae).

Of the 15 bat species recorded, *D. phaeotis*, *D. tolteca*, and *D. watsoni* (with 1 individual each) did not have streblids, but in the other 12 bat species (728 captured individuals) we obtained a total of 1,317 streblid specimens belonging to 24 species. This richness of streblid species is only similar to that obtained by Ramírez et al. (2016), who found 24 streblid species on 297 bats. Nevertheless, the latter study was more extensive, carried out throughout 4 years in a larger sampling area including different localities in southwestern Jalisco, southern coast and Sierra Amula, with different types of vegetation. In this study, we focused our effort on 1 cave with 2 sampling periods, representing the 2 seasons each year (wet and dry seasons). In the study by Guerrero & Morales-Malacara (1996), who sampled caves around central and southern Mexico, they reported 23 streblid species on 109 bats. Lira-Olguín et al. (2015) carried out a study for 8 days in Chiapas and recorded 7 streblid species on 34 bats captured in 4 caves, whereas Tlapaya-Romero et al. (2015) recorded 3 streblid species on 559 bats in 1 cave in Chiapas. The ratio between the number of bat species and the number of streblid species found in the above studies probably were affected by the sampling method and the season when sampling was done. Lira-Olguín et al. (2015) and Tlapaya-Romero et al. (2015) used a method similar to the one employed in this study, but the number of streblid species found was lower. Other factors that could affect the effectiveness of the sampling method could be related to the strategy of closing the mist nets during the periods of high bat activity, when the bat colonies leave or return to the refuge (17:30 and 18:30 and 04:00 and 05:00). This method helps prevent the mist nets from saturating quickly with bats, enabling workers to efficiently examine the captured bats. Of course, this sampling method has a negative impact on the number of bat specimens captured and examined, but for streblid samples it is probably much better, since it allows for carefully examination of the captured bats.

Another aspect of our sampling strategy included applying alcohol gel (antibacterial commercial gel) to the bats with a large number of streblids (more than 15 specimens), making difficult their mobility and loss during the extraction period. In spite of taking the appropriate precautions, 3 possible cases of contamination were

detected on 3 host species: *G. sorina*, *P. davyi*, and *P. parnellii* harbored 1 specimen of *T. parasiticus*, *T. diphyllae*, and *T. uniformis*, respectively. We considered these to be cases of contamination because these streblids were abundant in other hosts: *D. rotundus* with 236 specimens of *T. parasiticus* and *G. sorina* with 257 specimens of *T. diphyllae* and 199 specimens of *T. uniformis*.

The streblid prevalence observed shows contrasting variation, ranging from 22.2% on *M. megalophylla* to 88.1% on *P. parnellii*. Similar differences have been previously observed in studies with different sampling periods, in different capture sites with different types of vegetation (Colín-Martínez et al., 2018; Cuxim-Koyoc et al., 2015, 2016), as well as in natural bat refuges (Lira-Olguín et al., 2015; Ramírez et al., 2016; Tlapaya-Romero et al., 2015). Other studies mention that high ectoparasite prevalence can be explained by the high abundance of captured bats (Colín-Martínez et al., 2018). However, our results apparently differ from that pattern. For instance, *G. soricina*, which was the best represented species with 438 individuals, presented the highest streblid richness (N = 6) and higher streblid prevalence (53.2%), whereas *P. parnellii*, with only 37 captured individuals, had a high streblid richness (N = 5) and the highest streblid prevalence (88.1%).

Cuxim-Koyoc et al. (2015) mentioned that streblid richness and prevalence per bat species are related to the roosting habits. This means that bats that use caves as diurnal resting sites will show high streblid prevalence. Nevertheless, our results do not agree with this idea, because *M. megalophylla* and *P. davyi*, which are strict gregarious cave inhabitants (Torres-Flores & López-Wilchis, 2010), were the 2 species with the lowest prevalence values (22.2% and 23.9%, respectively). Our results indicate that prevalence variation and number of streblid species is specific for each bat species, suggesting that the bat species abundance and type of roost are not the main contributing factors. An alternative explanation for streblid richness and prevalence variability per host could be related to complexity in the cave structure complexity, which affects air flow and the amount of light per area, creating different microhabitats (McNab, 1974; Torres-Flores & López-Wilchis, 2010). However, this only can be confirmed after the microclimatic conditions per perching site inside the caves are assessed.

Our results show that an important streblid richness exists in the state of Oaxaca, comprising 49% of the Mexican streblid species, which were found in 16.1% of the total number of bat species found in the state. This study also highlights the importance of conducting systematic and periodic sampling in small areas to obtain robust data for analysis of community ecology.

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