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Research Note

Bolivian Ectoparasites: A Survey of Bats (Mammalia Chiroptera)

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ABSTRACT: A survey collection of arthropods associated with bats documents new distributional records of Bolivian ectoparasites. New species records include Acari: Mesostigmata: Spinturnicidae—*Periglischrus caligus* Kolenati, *Periglischrus iheringi* Oudemans, *Periglischrus ojasti* Machado-Allison; Macroonyssidae—*Radfordiella oudemansi* Fonseca; Metastigmata: Argasidae—*Ornithodoros hasei* (Schulze); Insecta: Diptera: Streblidae—*Anastrebla caudiferae* Wenzel, *Anastrebla modestini* Wenzel, *Anatrichobius scorzai* Wenzel, *Exastinion deceptivum* Wenzel, *Megistopoda theodori* Wenzel, *Neotrichobius delicatus* (Machado-Allison), *Paradyschiria fusca* Speiser, *Paraeuctenodes similis* Wenzel, *Strebla curvata* Wenzel, *Strebla guajiro* (García & Casal), *Trichobius petersoni* Wenzel, and *Trichobius tiptoni* Wenzel.

KEY WORDS: Argasidae, Bolivia, Chiroptera, ectoparasites, Macroonyssidae, Spinturnicidae, Streblidae.

Bolivia is a country of megabiological diversity situated at the juncture of tropical, temperate, mountainous, and lowland zones of the south-central Neotropical region. Within the geopolitical boundaries of Bolivia more than 327 species of mammals have been documented, of which, about 5% are endemic to the country (Anderson, 1997). Prior work by Gardner and Campbell (1992) on endoparasites showed that areas of Bolivia are unique in having very old ecological connections with Australian monotremes and marsupials. We are continuing our work to describe the diversity of parasites of mammals of Bolivia with this study of the ectoparasites of bats.

From 1984–2000, the American Museum of Natural History (AMNH), the Museum of Southwestern Biology (MSB), the Harold W. Manter Laboratory of Parasitology (HWML), and the Bolivian National Museum of Natural History in La Paz mounted joint collecting expeditions throughout Bolivia to survey and inventory sylvatic mammals and their parasites. A major part of the work on the mammals has been published by Anderson (1997) in

“Mammals of Bolivia: Taxonomy and Distribution,” and many groups of parasites that were collected are only now being studied in earnest. From most of the mammals that were collected by these expeditionary research teams in Bolivia, data on habitat, habits, and biological associates were also collected and archived in museums. All of the parasites are on deposit in the HWML within the Bolivian Mammal Parasite Collection (BMPC). The BMPC includes all specimens of helminths and parasitic arthropods that were recovered from the more than 16,000 mammals collected and preserved in museums during the course of our work. During field work, numerous specimens of ectoparasitic arthropods were obtained from the skin and pelage of most species of mammals at time of collection. This article presents information gleaned from a study of the mites, ticks, and bat flies that were removed from bats.

With the exception of the bat-infesting argasid ticks (*Ornithodoros* spp.) reported by Kohls et al. (1965) and Kohls et al. (1969), the acarine fauna associated with Bolivian bats remained essentially undocumented, with few species and distributional records available in the literature. Our recent collection added 1 genus and 5 species to those previously known to occur in Bolivia.

In contrast with the mites, bat flies of the family Streblidae are relatively well known from Bolivia but with reports widely scattered through the literature. Wenzel et al. (1966) reported two species, Wenzel (1970) an additional three, and Guerrero (1994a, b, 1995a, b, 1996) another 30 species from his collecting efforts in the Department of Beni. Our recent collection of 60 host records, comprising 141 individual Streblidae, added four genera and 12 species to those previously known to occur in Bolivia (Appendix 1).

A total of 47 species representing 18 genera of bat flies of the family Streblidae have been reported from bats in Bolivia as documented by voucher specimens (Appendix 1). Species reported here for the first time are accompanied by collection

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records, institutional disposition, and comments regarding host association.

MATERIALS AND METHODS

From 1984–2000, bats were collected from throughout Bolivia. Mist nets were deployed following standard procedures (Kunz and Kurta, 1988) and were monitored continuously from early evening through early morning. Each captured bat was placed into a separate cloth holding bag. Data recorded for each net included standard locality, location, aspect or orientation, time open and time closed, and time and notes for any bats captured. Generally following the methods of Gardner (1996), bats were assigned a field number (NK), sacrificed in chloroform, brushed and inspected for ectoparasites, and then searched for endoparasites. Ectoparasites were preserved in 70% ethanol. Permanent mounts of mite specimens on glass microscope slides were made using Hoyer's medium ringed with Glyptal. Bat flies were studied in alcohol. Excepting the argasid tick, species listed in the results include only those that are new records for Bolivia. Most specimens were collected by one of us (S.L.G.), but some were collected by other parasitologists on the expeditions. S.L.G. compiled the bat-collecting information. Specimens of mites and ticks were identified by D.G. Bat fly specimens were identified by C.W.D. in comparison to type and other reference collections at the Field Museum of Natural History, Chicago, IL (FMNH). Ectoparasite specimens have been deposited in the Harold W. Manter Laboratory of Parasitology, University of Nebraska–Lincoln, NE (HWML), and the FMNH, and the records are available online within the HWML database "PARASITE" (see Gardner, 2006). To ensure ease of use and compatibility with previous publications, names of mammals and most specific localities follow Anderson (1997).

RESULTS

Acari: Mesostigmata: Spinturnicidae

Periglischrus caligus Kolenati, 1857

Locality, deposition, and host records: Tarija: Tape-cua, 21°26'13.4"S; 63°55'01.2"W, 1,500 m, 3 June 1995, 4 females (HWML) from *Glossophaga* sp.

Remarks: Kolenati's type host for *P. caligus* was *Glossophaga soricina* (Pallas, 1776), and this mite has been consistently reported from species of that genus (Furman, 1966; Herrin and Tipton, 1975; Gettinger and Gribel, 1989). Morales-Malacara (2001) further defined the morphological characteristics of this species, and Morales-Malacara and López-Ortega (2001) found clear taxonomic features that enabled them to separate mites infesting bats of the subfamily Glossophaginae from mites that occur on species of the genus *Choeronycteris* Tschudi, 1844. This is the first report of any species of *Periglischrus* from Bolivia.

Periglischrus iheringi Oudemans, 1902

Locality, deposition, and host records: Santa Cruz: 14 km NE San Ramón by road, Estancia Castedo, 16°35'S; 62°25'W, 540 m, 18 May 1991, 2 females (HWML) from *Artibeus* sp.

Remarks: This species is found commonly on species of *Artibeus* Leach and is widely distributed across various clades of phyllostomid bats, particularly the subfamily Stenodermatinae (Herrin and Tipton, 1975).

Periglischrus ojasti Machado-Allison, 1964

Locality, deposition, and host records: La Paz: 0.5 km E Saynani, Rio Zongo, 16°07'S; 68°05'W, 2,163 m, 2 June 1993, 1 female (HWML) from *Sturnira erythromos* (Tschudi, 1844), and 1 female (HWML) from *Sturnira* sp.; Tarija: Tape-cua, 21°26'13.4"S; 63°55'01.2"W, 1,500 m, 31 May 1995, 2 males, 1 nymph (HWML) from *Sturnira ororaphilum* (Tschudi).

Remarks: One hundred percent of 18 mites collected in Panama (Furman, 1966), 95% of 695 collected in Venezuela (Herrin and Tipton, 1975), and 100% of 61 in collected in Distrito Federal, Brazil (Gettinger and Gribel, 1989), were associated with hosts of the genus *Sturnira* Gray, 1842.

Acari: Mesostigmata: Macronyssidae

Radfordiella oudemansi Fonseca, 1948

Locality, deposition, and host records: Santa Cruz: 6 km by road W of Ascención, 15°43'S; 63°09'W, 240 m, 12 August 1985, 3 protonymphs (HWML) from *Desmodus youngi* Jentink, 1893.

Remarks: Although the type host was identified as *Desmodus rotundus* (É. Geoffroy, 1810) from São Paulo, Brazil, this mite is now known to be closely associated with *Desmodus youngi*.

Acari: Metastigmata: Argasidae

Ornithodoros hasei (Schulze, 1935)

Locality, deposition, and host records: Santa Cruz: 6 km by road W of Ascención, 15°43'S; 63°09'W, 240 m, 13 August 1985, 7 larvae (HWML) from *Noctilio albiventris* Desmarest, 1818.

Remarks: Although this tick has been reported from a wide variety of bats, especially those that roost in tree cavities, it occurs most commonly on the bulldog bats (Noctilionidae). The species has been reported

from Bolivia from the Departamento de Beni (San Joaquin and Magdalena), primarily from the same host species, *N. albiventris* (Kohls, Sonenshine, and Clifford, 1965). This is the first record from the Departamento de Santa Cruz.

Insecta: Diptera: Streblidae

***Anastrebla caudiferae* Wenzel, 1976**

Locality, deposition, and host records: La Paz: Chijchipa, 16°09'S; 67°44'W, 1,224 m, 6 July 1992, 1 male (HWML) from *Anoura caudifer* (É. Geoffroy, 1818); Tarija: Tapecua, 21°26'13.4"S; 63°55'01.2"W, 1,500 m, 3 June 1995, 1 male (FMNH) from *Choeroniscus* sp.

Remarks: Of the 35 *Anastrebla caudiferae* collected in Venezuela, 100% were associated with 19 *Anoura caudifer* (Wenzel, 1976). This is the first report of any species of *Anastrebla* for Bolivia.

***Anastrebla modestini* Wenzel, 1966**

Locality, deposition, and host records: La Paz: 0.5 km E Saynani, Rio Zongo, 16°07'7"S; 68°04'46"W, 2,163 m, 3 June 1993, 4 males (HWML) from *Anoura geoffroyi* Gray, 1838; Santa Cruz: 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 24 May 1991, 2 males (FMNH) from *A. geoffroyi*.

Remarks: Wenzel et al. (1966) reported that this species was found only on *Anoura geoffroyi* in Panama. Of the 69 specimens collected in Venezuela, 81.2% were associated with *A. geoffroyi*, whereas 17.4% were associated with *A. latidens* Handley, 1984 (Wenzel, 1976).

***Anatrichobius scorzai* Wenzel, 1966**

Locality, deposition, and host records: Cochabamba: Corani, 17°12'43"S; 65°52'09"W, 2,630 m, 30 June 1993, 2 males (FMNH) from *Myotis keaysi* J. A. Allen, 1914; Santa Cruz: 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 22 May 1991, 1 male (HWML) from *M. nigricans* (Schinz, 1821).

Remarks: Of 101 specimens of this bat fly collected in Panama, 100 were associated with species of *Myotis* Kaup, 1829 (see Wenzel et al., 1966). In Venezuela, 92.8% of the individuals recovered were associated with either *M. nigricans* or *M. oxyotis* (Peters, 1866) (see Wenzel, 1976). From Argentina, this species was collected by Autino et al. (1999)

from *M. keaysi*. This is the first report of any species of *Anatrichobius* from bats in Bolivia.

***Exastinion deceptivum* Wenzel, 1976**

Locality, deposition, and host records: La Paz: 0.5 km E. Saynani, Rio Zongo, 16°07'7"S; 68°04'46"W, 2,163 m, 2 June 1993, 2 males, 1 female (HWML) from *Anoura geoffroyi* and same locality, 3 June 1993, 6 males, 5 females (1 m, 1f FMNH, rest HWML); Santa Cruz: 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 24 May 1991, 2 males, 1 female (HWML) from *Anoura geoffroyi*.

Remarks: Of the 46 specimens of *E. deceptivum* comprising the type series of Wenzel (1976), all were associated with *Anoura geoffroyi*. This is the first report of any species of *Exastinion* from Bolivia.

***Megistopoda theodori* Wenzel, 1966**

Locality, deposition, and host records: La Paz: Chijchipa, 16°09'S; 67°44'W, 1,224 m, 7 July 1992, 1 male (HWML) from *Sturnira lilium* (see Anderson, 1997); Santa Cruz: San Rafael de Amboró, 17°36'S; 63°36'W, 400 m, 21 July 1985, 1 female (FMNH) from *Sturnira* sp.; 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 22 May 1991, 1 male (FMNH), 1 female (HWML) from *Sturnira* sp.; 1 female (HWML) from *Sturnira lilium* (É. Geoffroy), same location but date of collection, 23 May, 1991.

Department unknown: 1 male (HWML) from *S. lilium* (MSB Mamm 56181; Sydney Anderson catalog number SA 8638).

Remarks: In Panama, the 39 specimens comprising the type series were known only from *Sturnira ludovici* Anthony, 1924 (Wenzel et al., 1966), and 99.5% of 206 specimens collected in Venezuela were from this host (Wenzel, 1976).

***Neotrichobius delicatus* (Machado-Allison, 1966)**

Locality, deposition, and host records: Cochabamba: 12.5 km by road SW Villa Tuna, 17°03'51"S; 65°28'33"W, 400 m, 8 July 1993. 2 females (FMNH) from *Artibeus anderseni* Osgood, 1916.

Remarks: From Venezuela, Wenzel (1976) reported all 36 *N. delicatus* found were collected from only *Vampyressa pusilla* (Wagner, 1843). Some specimens previously identified as *N. delicatus* are actually

a complex of closely related species; 81.2% of the 132 specimens that Wenzel (1976) referred to the “*N. delicatus* complex” were taken from *Dermanura cinereus* (Gervais, 1856). The species now called *Artibeus anderseni* from Venezuela was, at the time Wenzel (1976) published his work, considered to be a subspecies of *D. cinereus* (Simmons, 2005). We refer these specimens collected by Gardner in Bolivia as *N. delicatus*, but the genus is in need of revision.

***Paradyschiria fusca* Speiser, 1900**

Locality, deposition, and host records: Santa Cruz: 6 km by road W Ascención, 15°43'S; 63°09'W, 240 m, 13 August 1985, 4 males, 3 females (FMNH) from *Noctilio albiventris*.

Remarks: In neighboring Argentina, Autino *et al.* (1999) collected this species from *N. leporinus* (Linnaeus), and from Paraguay, Dick and Gettinger (2005) reported all 227 specimens collected were taken from *N. leporinus*. Elsewhere throughout its range, this species is a characteristic parasite of *N. leporinus*.

***Paraeuctenodes similis* Wenzel, 1976**

Locality, deposition, and host records: La Paz: 0.5 km E. Saynani, Rio Zongo, 16°07'7"S; 68°04'46"W, 2,163 m, 3 June 1993, 1 male (HWML) from *Carollia castanea* H. Allen, 1890.

Remarks: From Venezuela, Wenzel (1976) reported that both specimens of this rare species were collected from *Carollia perspicillata* (Linnaeus). This is the first report of any species of *Paraeuctenodes* from Bolivia.

***Strebila curvata* Wenzel, 1976**

Locality, deposition, and host records: Tarija: Tape-cua, 21°26'13.4"S; 63°55'01.2"W, 1,500 m, 3 June 1995, 1 male (FMNH) from *Choeroniscus* sp.

Remarks: Wenzel (1976) reported from Venezuela that 90.5% of the 63 specimens collected were taken from *Glossophaga soricina* and *Glossophaga longirostris* Miller, 1898 whereas Dick and Gettinger (2005) reported that all 5 specimens of *S. curvata* were collected from *G. soricina* in Paraguay.

***Strebila guajiro* (García & Casal, 1965)**

Locality, deposition, and host records: Cochabamba: 12.5 km SW of Villa Tunari, Cavernas del Repechon, 17°03'S; 65°28'W, 3 July 1993, 1 male (HWML) from *Anoura caudifer*; La Paz: La Reserva, 15°44'S; 67°31'W, 840 m, 24 July 1992, 1 female (HWML) from *Carollia perspicillata*; Santa Cruz: Estancia Cachueta Esperanza, 16°47'S; 63°14'W, 22 August 1984, 1 female (HWML) from *Noctilio leporinus*.

Remarks: Throughout its range, the characteristic host of *S. guajiro* is usually *C. perspicillata*.

***Trichobius petersoni* Wenzel, 1976**

Locality, deposition, and host records: Santa Cruz: 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 22 May 1991; 1 male (FMNH) from *Sturnira erythromos*, and same location, but 23 May 1991, 2 males (HWML) from *Sturnira* sp.

Remarks: Of Wenzel's (1976) type series, all 23 specimens were collected from *Sturnira bogotensis* Shamel, 1927 and *S. erythromos*. These species are often confused when making identifications in the field (Simmons, 2005).

***Trichobius tiptoni* Wenzel, 1976**

Locality, deposition, and host records: Santa Cruz: 1 km NE Estancia Cuevas, km 101 by road from Santa Cruz de la Sierra, 18°11'S; 63°44'W, 1,300 m, 22 May 1991, 1 male (HWML) from *Anoura caudifer*.

Remarks: Of the 77 specimens that Wenzel (1976) reported from Venezuela, 94.8% were taken from *A. caudifer*.

DISCUSSION

Although the mites and ticks infesting Bolivian bats are still poorly known, streblid bat flies are known relatively well. The first reports of Bolivian bat flies (Wenzel *et al.*, 1966; Wenzel, 1970) were based on very few specimens that had been haphazardly collected. During the 1990s, however, Ricardo Guerrero undertook focused bat fly collections within the department of Beni, adding many new records for the country. Our records add 4 genera and 12 species, bringing the known fauna to 18 genera and 47 species. This level of species richness seems comparable to the 11 genera and 31 species known from neighboring Paraguay (Dick and Gettinger, 2005). Currently, 106 species of bats are known from Bolivia (Luis F. Aguirre, personal communication), nearly twice the number ($n = 54$) known from Paraguay (Lopez-Gonzalez, 1998: unpublished thesis, Texas Tech University, Lubbock, Texas, U.S.A.). As fly species richness is correlated with bat species richness (Dick and Gettinger, 2005), we predict many more bat fly species await discovery, associated with Bolivia's rich Chiropteran fauna.

Neotropical streblids exhibit remarkably high specificity to bat host species (Wenzel *et al.*, 1966;

ter Hofstede et al., 2004; Dick and Gettinger, 2005). The vast majority of bat fly species are monoxenous, associated exclusively with a single primary host species. Even those bat flies that are associated with nonprimary host species are largely attributable to transfers based on sampling disturbance or contamination (Dick, 2007). Unfortunately, our current records together with those reported previously are not sufficient to address the level of host specificity among Bolivian Streblidae. However, the host associations of Bolivian bat flies are for the most part consistent with those found in the literature reports for other Neotropical localities.

Bolivia is undergoing rapid change in both political and biological areas. Many of the sites from which we recorded species of ectoparasites from bats in Bolivia are now either completely deforested or in that process. This important collection of ectoparasites has become available at a time when biologists are formulating systematic and biogeographic perspectives of the diversity of ectoparasitic arthropods and their associations with small Neotropical mammals. This contribution to the knowledge of the biological diversity of Bolivian mammal ectoparasite will facilitate the understanding and future of Bolivian biodiversity.

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- Megistopoda proxima* (Séguy, 1926)
- **Megistopoda theodori* Wenzel, 1966
- Metelasmus pseudopterus* Coquillett, 1907
- Neotrichobius bisetosus* Wenzel, 1976
- **Neotrichobius delicatus* (Machado-Allison, 1966)
- Noctiliostrebla dubia* (Rudow, 1871)
- Noctiliostrebla maai* Wenzel, 1966
- **Paradyschiria fusca* Speiser, 1900
- Paradyschiria parvula* Falcoz, 1931
- **Paraeuctenodes similis* Wenzel, 1976
- Paratrichobius dunnii* (Curran, 1935)
- Paratrichobius longicrus* (Miranda Ribeiro, 1907)
- Pseudostrebla ribeiroi* Costa Lima, 1921
- Pseudostrebla sparsisetis* Wenzel, 1966
- Speiseria ambigua* Kessel, 1925
- Speiseria peytonae* Wenzel, 1976
- Stizostrebla longirostris* Jobling, 1939
- Strebla chrotopteri* Wenzel, 1976
- Strebla consocia* Wenzel, 1966
- **Strebla curvata* Wenzel, 1976
- Strebla diaemi* Wenzel, 1966
- **Strebla guajiro* (García & Casal, 1965)
- Strebla hertigi* Wenzel, 1966
- Strebla mirabilis* (Waterhouse, 1879)
- Strebla paramirabilis* Wenzel, 1976
- Strebla wiedemanni* Kolenati, 1856
- Trichobioides perspicillatus* (Pessôa & Galvão, 1937)
- Trichobius costalimai* Guimarães, 1938
- Trichobius dugesii* Townsend, 1891
- Trichobius dugesioides* “ssp.” (sensu Guerrero, 1995a:11)
- Trichobius dugesioides* Wenzel, 1966
- Trichobius furmani* Wenzel, 1966
- Trichobius joblingi* Wenzel, 1966
- Trichobius longipes* (Rudow, 1871)
- Trichobius macrophylli* Wenzel, 1966
- Trichobius parasiticus* Gervais, 1844
- **Trichobius petersoni* Wenzel, 1976
- **Trichobius tiptoni* Wenzel, 1976
- Trichobius uniformis* Curran, 1935
- Trichobius urodermae* Wenzel, 1966

APPENDIX 1: CHECKLIST OF BOLIVIAN STREBLIDAE

Checklist of 18 genera and 47 species of bat flies (Diptera: Streblidae) known from Bolivia and documented by museum specimens. New species records for Bolivia are denoted by an asterisk.

- **Anastrebla caudiferae* Wenzel, 1976
- **Anastrebla modestini* Wenzel, 1966
- **Anatrichobius scorzai* Wenzel, 1966
- Aspidoptera falcata* Wenzel, 1976
- Aspidoptera phyllostomatis* (Perty, 1833)
- **Exastininon deceptivum* Wenzel, 1976
- Mastoptera minuta* (Costa Lima, 1921)