



# New records of bat flies (Diptera, Streblidae and Nycteribiidae) in Cerrado of Central Brazil

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**Abstract:** Here we record the occurrence of 38 species, including 30 species of Streblidae and eight species of Nycteribiidae. Of these, 12 are new records for the Distrito Federal, three are new for the Cerrado, and one, *Trichobius johnsonae* Wenzel, 1966 is the first record from Brazil. We also recorded a yet undescribed species of *Basilia* from the district.

**Key words:** Brasília, Chiroptera, Distrito Federal, Hippoboscoidea, *Trichobius johnsonae*

Four orders of insects are ectoparasites on bats. Of these, the order Diptera is represented by the most species in New World (Marshall 1982; Whitaker 1998). Two Diptera families, Streblidae and Nycteribiidae are obligatory ectoparasites on bats (Marshall 1982; Guerrero 1993). In Brazil, Streblidae is represented by nearly 70 species (Graciolli et al. 2008) from three subfamilies that exhibit high morphological variability (Whitaker 1988). In contrast, Nycteribiidae is very specialized, presenting a small thorax with dorsal insertions of the legs and head and absence of wings (Peterson and Wenzel 1987). Although more abundant in the Old World, there are 28 species of two genera of Nycteribiidae in Brazil (Graciolli et al. 2007).

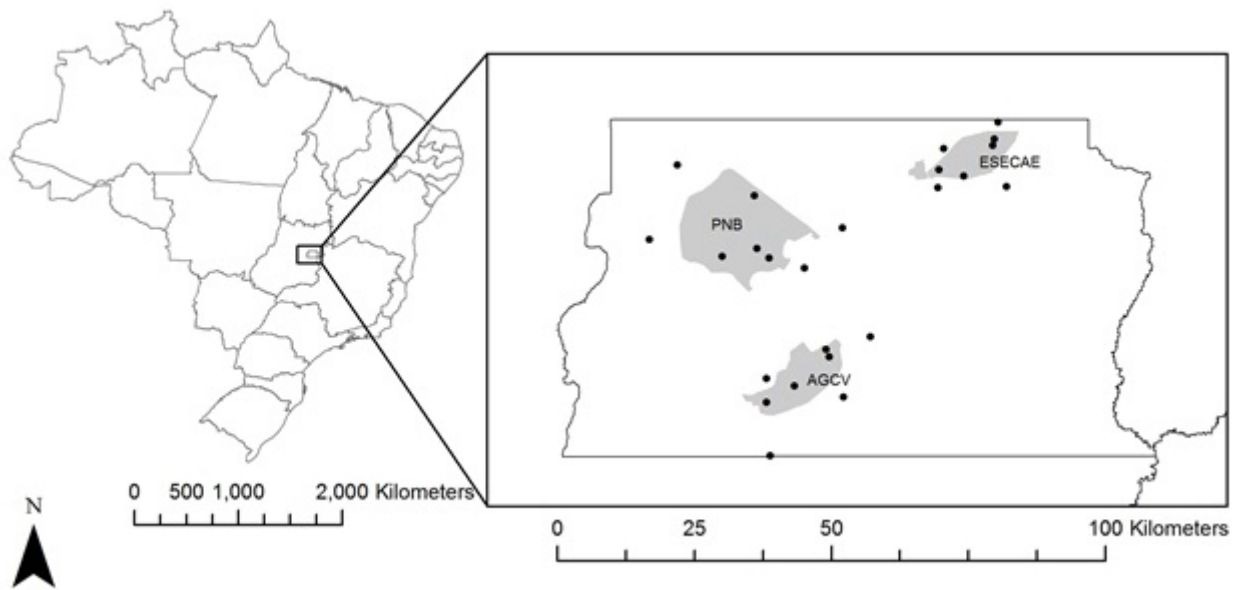
Notwithstanding, most studies of bat flies have been conducted in Southern and Southeastern Brazil. Though, the Distrito Federal in central Brazil has the largest number of bat fly species (Graciolli et al. 2010), and the first records date from the 1980s, when Coimbra Jr. et al. (1984) listed 12 streblid species. Currently, there are 44 species reported in the Distrito Federal, five belonging to Nycteribiidae (genus *Basilia*), and 39 species, 14 genera, and three subfamilies belonging to Streblidae (Graciolli

and Coelho 2001; Graciolli and Aguiar 2002; Aguiar et al. 2006; Graciolli et al. 2007; Graciolli et al. 2008; Aguiar and Antonini 2011). Herein, we report new records of bat flies in the Cerrado of central Brazil.

We conducted this study in three conservation units of Distrito Federal: Parque Nacional de Brasília (PNB) (15°41'42" S, 048°08'10" W), APA Gama-Cabeça-de-Veado (AGCV) (15°52'29" S, 047°50'48" W) and Estação Ecológica Águas Emendadas (ESECAE) (15°36'32" S, 047°33'03" W) (Figure 1). The climate in the areas is classified as typical savannah, with two well-defined seasons, a rainy season (October to April) and a dry season (May to September). Ectoparasitic bat flies were collected from bats captured from April 2012 to August 2013. Bat flies were removed from the bats with forceps and placed in numbered Eppendorf® pots containing 70% ethanol. We identified the flies under a stereomicroscope (Motic K-series) using specialized identification keys (Guerrero 1993, 1994a, 1994b, 1995a, 1995b, 1996).

From the 1,733 specimens of bat flies that we have captured, 30 species of the family Streblidae belonging to three subfamilies and 11 genera, and eight species of the family Nycteribiidae belonging to the genus *Basilia* Miranda-Ribeiro, 1903. Twelve records are new for the Distrito Federal (Table 1).

***Anastrebla caudiferae*** Wenzel, 1976 — Eight females from PNB, one female and four males from AGCV, and one female from ESECAE, all collected on *Anoura caudifer* specimens (Phyllostomidae). This species is known to occur in the states of Rio de Janeiro (Lourenço et al. 2014), Minas Gerais, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Graciolli et al. 2008), always in Atlantic Forest. This record is the first for the Brazilian Cerrado. Besides on the main host, *A. caudifer*, *A.*



**Figure 1.** Study areas in Distrito Federal, Brazil. PNB, Parque Nacional de Brasília; AGCV, APA Gama-Cabeça-de-Veados; and ESECAE, Estação Ecológica Águas Emendadas.

**Table 1.** New records of bat flies species, with their respective hosts, captured in different sites in Distrito Federal, Brazil, from April 2012 to August 2013.

Bat fly species	Host
<b>STREBLIDAE</b>	
<b>Streblinae</b>	
<i>Anastrebla caudiferae</i> <sup>b</sup>	<i>Anoura caudifer</i>
<i>Strebla carvalhoi</i> <sup>b</sup>	<i>Anoura caudifer</i> , <i>Sturnira lilium</i> <sup>a</sup>
<i>Strebla curvata</i> <sup>c</sup>	<i>Glossophaga soricina</i>
<i>Strebla hertigi</i> <sup>c</sup>	<i>Phyllostomus discolor</i>
<b>Trichobiinae</b>	
<i>Trichobioides perspicillatus</i> <sup>c</sup>	<i>Artibeus lituratus</i> <sup>a</sup> , <i>Phyllostomus discolor</i>
<i>Trichobius angulatus</i> <sup>c</sup>	<i>Artibeus lituratus</i> , <i>Platyrrhinus lineatus</i>
<i>Trichobius costalimai</i> <sup>c</sup>	<i>Artibeus lituratus</i> , <i>Platyrrhinus lineatus</i>
<i>Trichobius johnsonae</i> <sup>a</sup>	<i>Glossophaga soricina</i> <sup>a</sup> , <i>Pteronotus parnellii</i>
<i>Trichobius tiptoni</i> <sup>c</sup>	<i>Anoura caudifer</i> , <i>Artibeus planirostris</i> <sup>a</sup> , <i>Carollia perspicillata</i> <sup>a</sup> , <i>Micronycteris microtis</i> <sup>a</sup>
<b>NYCTERIBIIDAE</b>	
<b>Nycteribiinae</b>	
<i>Basilia lindolphi</i> <sup>b</sup>	<i>Myotis nigricans</i>
<i>Basilia mimoni</i> <sup>c</sup>	<i>Mimon crenulatum</i>
<i>Basilia new sp.</i> <sup>c</sup>	<i>Myotis nigricans</i>

<sup>a</sup>accidental record; <sup>b</sup>new record for Brazil; <sup>c</sup>new record for the Cerrado; <sup>d</sup>new record for the Distrito Federal.

*caudiferae* was collected on the phyllostomid bats *Anoura geoffroyi*, *Artibeus lituratus*, and *Glossophaga soricina* (Phyllostomidae) (Graciolli et al. 2008), probably due to accidental records.

***Strebla carvalhoi*** Graciolli, 2003 — one female and one male from PNB, and one female from ESECAE on *A. caudifer*; one female on *Sturnira lilium* (Phyllostomidae) from ESECAE. We extend the known distribution of this species northwards by 998 km to the Mid-west Region of Brazil. Previously, this species was known only from the Atlantic Forest of the states of São Paulo, Paraná,

and Santa Catarina (Graciolli 2003), and this is the first record in the Cerrado.

***Strebla curvata*** Wenzel, 1976 — one female from PNB and two females from ESECAE, on *G. soricina* (Phyllostomidae). It is a common species, with records known from the Cerrado of Goiás (Graciolli et al. 2010) and Mato Grosso do Sul (Eriksson et al. 2011). It is found on the primary host, *G. soricina* (Guerrero 1996).

***Strebla hertigi*** Wenzel, 1966 — four females on *Phyllostomus discolor* (Phyllostomidae) from ESECAE. This bat fly species has a broad distribution, is known from Bolivia, Colombia, Costa Rica, El Salvador, Guatemala, Guyana, Mexico, Nicaragua, Peru, Suriname, Trinidad, and Venezuela, and is associated mainly with *P. hastatus* (Guerrero 1996). Our record represents the southernmost one in Brazil, as this species was previously known only from the states of Pará (from an unknown host species; Graciolli et al. 2008), Rio de Janeiro (found on *Tonatia bidens*; Almeida et al. 2011), and Maranhão (also on *P. discolor*; Dias et al. 2009; Santos et al. 2013).

***Trichobioides perspicillatus*** (Pessoa & Galvão, 1937) — one female on *Artibeus lituratus* (Phyllostomidae), from AGCV, and one male on *P. discolor* from ESECAE. This species has been recorded from the states of Bahia (Graciolli et al. 2008), Goiás (Eriksson et al. 2011), Pernambuco (Soares et al. 2013), and Maranhão (Dias et al. 2009; Santos et al. 2013). Although the type-host of *T. perspicillatus* is *Carollia perspicillata* its primary host is *P. discolor*.

***Trichobius angulatus*** Wenzel, 1976 — recorded on *A. lituratus*, captured at the PNB (1 female, 1 male) and AGCV (1, 2); and on *P. lineatus* from PNB (4 females, 5 males), ESECAE (14, 3), and AGCV (2, 1). *Trichobius*

*angulatus* has been recorded from the state of Mato Grosso do Sul on *P. lineatus* (Eriksson et al. 2011). This is the first record for the Distrito Federal.

***Trichobius costalimai*** Guimarães, 1938 — three females and one male from PNB, 10 females and six males from ESECAE on *P. lineatus*; and one female from ESECAE and five females from AGCV on *A. lituratus*. It has been recorded from the states of Pernambuco (type locality), Rondônia (Graciolli et al. 2008), Maranhão (Dias et al. 2009), and Goiás (Graciolli et al. 2010). The primary host of this species is *P. discolor* (Phyllostomidae), the records on others bats are probably accidental (Guerrero 1994a).

***Trichobius johnsonae*** Wenzel, 1966 — 24 females and 17 males from PNB, and two females and three males from ESECAE, on *Pteronotus parnellii* (Mormoopidae); one male on *G. soricina* from PNB. This species belongs to the *caecus* group, recorded previously in Colombia, Panama, Venezuela (Guerrero 1994a), Mexico (Guerrero and Morales-Malacara 1996), and Belize (Bärtschi 2000). This is the first record of this species in Brazil (Figure 2). Its host-type is *Pteronotus gymnotus*, but it has been reported on other *Pteronotus* species (Guerrero 1994a); this suggests that our record is not accidental. We collected *T. johnsonae* on *P. parnellii* in PNB and ESECAE. In PNB we also observed the occurrence of *T. johnsonae* on *G. soricina*, but this may be an accidental record.

***Trichobius tiptoni*** Wenzel, 1976 — eight females and six males from PNB, two females and two males from ESECAE, and one female and seven males from AGCV, on *A. caudifer*; on *A. planirostris* and *C. perspicillata* from PNB (two and one females, respectively); one female on *M. microtis* from ESECAE. In Brazil, this species is known from the states of Goiás (Eriksson et al. 2011), Rio de Janeiro (Almeida et al. 2011; França et al. 2013; Lourenço et al. 2014), Minas Gerais, São Paulo, Paraná, and Rio Grande do Sul and is mainly associated with *A. caudifer* (Graciolli et al. 2008). We have two probable accidental records on *M. microtis* and *C. perspicillata* (although this later association was also found in São Paulo; Graciolli

et al. 2008).

***Basilisa lindolphoi*** Graciolli, 2001 — one female on *Myotis nigricans* (Vespertilionidae) from AGCV. *Basilisa lindolphoi* is known to be parasitic on *Myotis riparius* from São Paulo, on *M. nigricans* and *Myotis izecksohni* from Paraná, *M. nigricans* and *Myotis* sp. from Santa Catarina (Graciolli et al. 2008; Moratelli et al. 2011). There is also one accidental record on *Mimon bennettii* (Phyllosomyidae) (Graciolli et al. 2008). This is the first record of the species from the Brazilian Cerrado.

***Basilisa mimoni*** Theodor & Peterson, 1964 — two females on *Mimon crenulatum* (Phyllostomidae) from ESECAE. *Basilisa mimoni* is known from Peru (Graciolli 2001) and recorded in Brazil from the states of Pará and Maranhão. All records are on *M. crenulatum* (Graciolli et al. 2008; Dias et al. 2009).

***Basilisa new sp.*** — three males and four females on *M. nigricans* from PNB. This is an undescribed species, but it is known from the Cerrado of Goiás state where it was found parasitizing a *Myotis* sp. The species morphology is very similar to *B. quadrosae* Graciolli & Moura, 2004 and *B. ortizi* Machado-Allison, 1964 (Graciolli et al. 2010).

We present here the first record of *Trichobius johnsonae* to Brazil (Figure 2). We also record for the first time in the Cerrado three species: *Anastrebla caudiferae*, *Basilisa lindolphoi*, and *Strebla carvalhoi*. In addition, we present the first record of eight other species in Distrito Federal, including an undescribed species of *Basilisa*, increasing to 56 the number of known species to the state. The addition of 12 new species to the Distrito Federal highlights the need for more studies with bats and their ectoparasites in Brazil, because there are many areas with little or no study (Graciolli et al. 2010). Furthermore, with the increase in emergent diseases brought by bats and their ectoparasites, bat flies are the focus of international interest (Morse et al. 2012; Brook et al. 2015), which demonstrates the importance of studies with this group.



**Figure 2.** *Trichobius johnsonae* collected from *Pteronotus parnellii* in Cerrado of Central Brazil, in dorsal and lateral views.



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## LITERATURE CITED

- Aguiar, L.M.S. and Y. Antonini. 2011. Descriptive ecology of bat flies (Diptera: Hippoboscoidea) associated with vampire bats (Chiroptera: Phyllostomidae) in the cerrado of central Brazil. *Memórias do Instituto Oswaldo Cruz* 106(2): 170–176. doi: [10.1590/S0074-02762011000200009](https://doi.org/10.1590/S0074-02762011000200009)
- Aguiar, L.M.S., W.R. Camargo and A.S. Portella. 2006. Occurrence of white-winged vampire bat, *Diaemus youngi* (Mammalia, Chiroptera), in the cerrado of Distrito Federal, Brazil. *Revista Brasileira de Zoologia* 23: 893–896. doi: [10.1590/S0101-81752006000300041](https://doi.org/10.1590/S0101-81752006000300041)
- Almeida, J.C., S.S.P. Silva, N.M. Serra-Freire, M.P. Valim. 2011. Ectoparasites (Insecta and Acari) associated with bats in Southeastern Brazil. *Journal of Medical Entomology* 48(4): 753–757. doi: [10.1603/ME09133](https://doi.org/10.1603/ME09133)
- Bärtschi D 2000. A study of the Chiroptera of Shipstern Nature Reserve and north-eastern Belize (Central America) together with their ectoparasites (Streblidae, Nycterophiliinae, Acarina) and endoparasites (Cestoda, Nematoda, Trematoda, Acanthocephala). An occasional publication of the International Tropical Conservation Foundation. 16 pp.
- Brook, C.E., Y. Bai, A.P. Dobson, L.M. Osikowicz, H.C. Ranaivoson, Q. Zhu and M.Y. Kosoy. 2015. *Bartonella* spp. in Fruit Bats and Blood-Feeding Ectoparasites in Madagascar. *PLoS Neglected Tropical Diseases* 9(2): e0003532. doi: [10.1371/journal.pntd.0003532](https://doi.org/10.1371/journal.pntd.0003532)
- Coimba, Jr., C.E.A., L.R. Guimarães and D.A. Mello. 1984. Ocorrência de Streblidae (Diptera: Pupipara) em morcegos capturados em regiões do Cerrado do Brasil Central. *Revista Brasileira de Entomologia* 28(4): 547–550. <http://157.86.8.70:8080/certifica/handle/icit/18980>
- Dias, P.A., C.L.C. dos Santos, F.S. Rodrigues, L.C. Rosa, K.S. Lobato and J.M.M. Rebêlo. 2009. Espécies de moscas ectoparasitas (Diptera, Hippoboscoidea) de morcegos (Mammalia, Chiroptera) no estado do Maranhão. *Revista Brasileira de Entomologia* 53(1): 128–133. doi: [10.1590/S0085-56262009000100027](https://doi.org/10.1590/S0085-56262009000100027)
- Eriksson, A., G. Graciolli and E. Fischer. 2011. Bat flies on phyllostomid hosts in the Cerrado region: component community, prevalence and intensity of parasitism. *Memórias do Instituto Oswaldo Cruz* 106(3): 274–278. doi: [10.1590/S0074-02762011000300004](https://doi.org/10.1590/S0074-02762011000300004)
- França, D.S., S.N. Pereira, A.C.S. Maas, M.A. Martins, D.P. Bolzan, I.P. Lima, D. Dias, A.L. Peracchi. 2013. Ectoparasitic flies (Diptera, Streblidae) of bats (Chiroptera, Phyllostomidae) in an Atlantic Forest area, southeastern Brazil. *Brazilian Journal of Biology* 73(4): 847–854. doi: [10.1590/S1519-69842013000400022](https://doi.org/10.1590/S1519-69842013000400022)
- Graciolli, G. 2001. Distribuição geográfica e hospedeiros quirópteros (Mammalia, Chiroptera) de moscas nictéribidas americanas (Diptera, Nycteribiidae). *Revista Brasileira de Zoologia* 18(1): 307–322. doi: [10.1590/S0101-81752001000500026](https://doi.org/10.1590/S0101-81752001000500026)
- Graciolli, G. 2003. Uma nova espécie de *Strebla* Wiedemann, 1824 (Diptera, Streblidae, Streblinae) sobre *Anoura caudifer* (E. Geoffroy, 1818) (Chiroptera, Phyllostomidae, Glossophaginae). *Revista Brasileira de Entomologia* 47(3): 435–436. doi: [10.1590/S0085-56262003000300012](https://doi.org/10.1590/S0085-56262003000300012)
- Graciolli, G. and L.M.S. Aguiar. 2002. Ocorrência de moscas ectoparasitas (Diptera, Streblidae e Nycteribiidae) de morcegos (Mammalia, Chiroptera) no cerrado de Brasília, Distrito Federal, Brasil. *Revista Brasileira de Zoologia* 19 (1): 177–181. doi: [10.1590/S0101-81752002000500012](https://doi.org/10.1590/S0101-81752002000500012)
- Graciolli, G. and D.C. Coelho. 2001. Streblidae (Diptera: Hippoboscoidea) sobre morcegos filostomídeos (Chiroptera: Phyllostomidae) em cavernas do Distrito Federal, Brasil. *Revista Brasileira de Zoologia* 18: 965–970. doi: [10.1590/S0101-81752001000300028](https://doi.org/10.1590/S0101-81752001000300028)
- Graciolli, G., N.C. Cáceres and M.R. Bornschein. 2006. Novos registros de moscas ectoparasitas (Diptera, Streblidae e Nycteribiidae) de morcegos (Mammalia, Chiroptera) em áreas de transição cerrado-floresta estacional no Mato Grosso do Sul, Brasil. *Biota Neotropica* 6(2): 1–4. doi: [10.1590/S1676-06032006000200028](https://doi.org/10.1590/S1676-06032006000200028)
- Graciolli, G., A.G. Autino and G.L. Claps. 2007. Catalogue of American Nycteribiidae (Diptera, Hippoboscoidea). *Revista Brasileira de Entomologia* 51(2): 142–159. doi: [10.1590/S0085-56262007000200004](https://doi.org/10.1590/S0085-56262007000200004)
- Graciolli, G., A.A. Azevedo, M. Árzua, D.M. Barros-Battesti and P.M. Linardi. 2008. Artrópodos ectoparasitos de morcegos no Brasil; pp. 123–138, in: S. Pacheco, R.V. Marques and C.E.L. Esbérard (eds.). *Morcegos no Brasil: biologia, sistemática, ecologia e conservação*, 1<sup>st</sup> edition. Porto Alegre: Armazém Digital.
- Graciolli, G., M. Zortéa and L.F.A.C. Carvalho. 2010. Bat flies (Diptera, Streblidae and Nycteribiidae) in a Cerrado area of Goiás State, Brazil. *Revista Brasileira de Entomologia* 54(3): 511–514. doi: [10.1590/S0085-56262010000300025](https://doi.org/10.1590/S0085-56262010000300025)
- Guerrero, R. 1993. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. I. Clave para los géneros y Nycterophiliinae. *Acta Biologica Venezuelica* 14: 61–75.
- Guerrero, R. 1994a. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. II. Los grupos: *pallidus*, *caecus*, *major*, *uniformis* y *longipes* del género *Trichobius* Gervais, 1844. *Acta Biologica Venezuelica* 15: 1–18.
- Guerrero, R. 1994b. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. IV. Trichobiinae com alas desarrolladas. *Boletín de Entomologia Venezolana* 9: 161–192.
- Guerrero, R. 1995a. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. III. Los gupos: *dugesii*, *durni* y *phyllostomae* del género *Trichobius* Gervais, 1844. *Acta Biologica Venezuelica* 15: 1–27.
- Guerrero, R. 1995b. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. V. Trichobiinae con alas reducidas o ausentes y miscelaneos. *Boletín de Entomologia Venezolana* 10: 135–160.
- Guerrero, R. 1996. Catalogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. VI. Streblinae. *Acta Biologica Venezuelica* 16: 1–25.
- Guerrero, G. and J.B. Morales-Malacara. 1996. Streblidae (Diptera: Calyptratae) parásitos de murciélagos (Mammalia: Chiroptera) cavernícolas del centro y sur de México, con descripción de una especie nueva del género *Trichobius*. *Anales del Instituto de Biología de la Universidad Autónoma del México, Serie Zoología* 67(2): 357–373.
- Lourenço, E.C., P.M.P. Patrício, M.C. Pinheiro, R.M. Dias, K.M. Famadas. 2014. Streblidae (Diptera) on bats (Chiroptera) in an area of Atlantic Forest, state of Rio de Janeiro. *Revista Brasileira de Parasitologia Veterinária* 23(2): 1–7. doi: [10.1590/S1984-29612014029](https://doi.org/10.1590/S1984-29612014029)
- Marshall, A.G. 1982. Ecology of insects ectoparasitic on bats; pp. 369–401, in: J.H. Kunz (ed.) *Ecology of bats*. London: Plenum Publishing.
- Moratelli, R., A.L. Peracchi, D. Dias and J.A. de Oliveira. 2011. Geographic variation in South American populations of *Myotis nigricans* (Schinz, 1821) (Chiroptera, Vespertilionidae), with the description of two new species. *Mammalian Biology* 76: 592–607. doi: [10.1016/j.mambio.2011.01.003](https://doi.org/10.1016/j.mambio.2011.01.003)

- Morse, S.F., K.J. Olival, M. Kosoy, S.A. Billeter, B.D. Patterson, C.W. Dick and K. Dittmar. 2012. Global distribution and genetic diversity of *Bartonella* in bat flies (Hippoboscoidea, Streblidae, Nycteribiidae). *Infection, Genetics and Evolution* 12: 1717–1723. doi: [10.1016/j.meegid.2012.06.009](https://doi.org/10.1016/j.meegid.2012.06.009)
- Peterson, B.V. and R.L. Wenzel. 1987. Nycteribiidae; pp. 1283–1301, in: J.F. McAlpine, B.V. Peterson, G.E. Shewell, H.J. Teskey, J.R. Vockeroth and D.M. Wood (eds.). *Manual of Nearctic Diptera*, Vol. 2. Ottawa: Minister of Supply and Services, Monograph 28.
- Santos C.L.C., A.C.N. Pereira, V.J.C. Bastos, G. Graciolli and J.M.M. Rebêlo. 2013. Parasitism of ectoparasitic flies on bats in the northern Brazilian cerrado. *Acta Parasitologica* 58(2): 207–214. doi: [10.2478/s11686-013-0135-9](https://doi.org/10.2478/s11686-013-0135-9)
- Soares, F.A.M., G. Graciolli, D.M.C. Alcântara, C.E.B.P. Ribeiro, G.C. Valença and S.F. Ferrari. 2013. Bat flies (Diptera: Streblidae) ectoparasites of bats at an Atlantic Rainforest site in northeastern Brazil. *Biota Neotropica* 13(2): 242–246. doi: [10.1590/S1676-06032013000200024](https://doi.org/10.1590/S1676-06032013000200024)
- Whitaker, Jr. J.O. 1988. Collecting and preserving ectoparasites for ecological study; pp. 459–474, in: J.H. Kunz (ed.). *Ecological and behavioral methods for the study of bats*. Washington: Smithsonian Institution Press.

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DF collected the data and identified species; GG confirmed all identifications; DE, GG, and LMSA wrote the text.

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