Ectoparasitic flies (Diptera: Streblidae) on bats (Mammalia: Chiroptera) from a Private Natural Heritage Reserve in southeastern Brazil

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Abstract. Due to the small number of records of Streblidae on bats, despite extensive study on these mammals in the state of Rio de Janeiro, a survey was carried out in an area of the Atlantic Forest. The present study was carried out at Bom Retiro Farm Natural Heritage Private Reserve. We captured 401 bats of 17 species, 13 genera, and four families; bat flies infested 221 bats of only four species. Carollia perspicillata (Linnaeus, 1758) has the highest fly diversity, with seven fly species: Trichobius joblingi (Wenzel, 1966) (n = 23), Megistopoda proxima (Séguy, 1926) (n = 15), Strebla guajiro (Garcia & Casal, 1965) (n = 15), Aspidoptera falcata (Wenzel, 1976) (n = 6), Paratrichobius longicrus (Miranda Ribeiro, 1907) (n = 8), Paraeuctenodes similis (Wenzel 1976) (n = 3), and Trichobius anduci (Guerrero, 1998) (n = 1). Two species infested Platyrrhinus lineatus (É. Geoffroy, 1810): Aspidoptera falcata (n = 1) and Anastrebla caudiferae (Wenzel, 1996) (n = 1). Paradyschiria parvula (Falcoz, 1931) (n = 11) infested Noctilio leporinus (Linnaeus, 1758) and M. proxima (n = 12) and Trichobius uniformis (Curran, 1935) (n = 1) infested Sturnira lilium (É. Geoffroy, 1842). Sturnira lilium has the highest infestation rate, with ten out of 46 captured individuals parasitized, followed by Carollia perspicillata, with 33 out of 164 captured parasitized, and by P. lineatus with only two parasitized individuals out of ten. Among 97 streblid flies captured, M. proxima was the most abundant (27.83%), followed by T. joblingi (23.71%), and S. guajiro (15.46%). All remaining bat fly species represented 33%. Paradichyria parvula has the first record for Rio de Janeiro State.

Key-Words. Flying mammals; Parasitism; Megistopoda proxima; Atlantic Forest.

INTRODUCTION

Bats are the group of mammals with the second highest species diversity in the Neotropics (Findley, 1993; Nowak, 1994; Voss & Emmons, 1996; Burgin et al., 2018), only behind rodents. It has 1.386 species world wide (Burgin et al., 2018) and 180 recorded in Brazil (Reis et al., 2017), with seven species included on Brazilian Fauna Red List (ICMBio/MMA, 2018). Bats maintain parasitic relationships, such as endoparasitism and ectoparasitism. In endoparasitism, the relationships occur with protozoa, helminths, flatworms, and nematodes (Santos & Gibson, 2015). In the case of ectoparasitism, somearthropods use bats as a means of transport and feed on their hair follicles (Kunz, 1982). Despite the importance of investigating the ectoparasitic insect community, infestation patterns, and the factors that regulate this infestation, these topics are still poorly studied (Rui & Graciolli, 2005).

The distribution of ectoparasites in bats seems to follow a certain proportionality. The abundance of ectoparasites could differ among hosts in the same population according to different age, sex, and reproductive categories (Marshall, 1982). Cases of ectoparasite over population in bats are rare, as they would result in significant damage to the host, comprising from minor problems to severe injuries, such as blood loss, malnutrition, and skin and fur damage (Kunz, 1982). Only two families of hematophagous dipterans, Streblidae and Nycteribiidae, are known to parasitize bats (Silva & Ortêncio-Filho, 2011). Together with Glossinidae...
and Hippoboscidae, these families form the superfamily Hippoboscoidea within the Calyptrate, infraorder Schizophora, suborder Brachycera (Petersen et al., 2007). The relationships between the families in the superfamily are still in debate, although two clades have been accepted: Nycteribiidae and Streblidae, and Glossinidae and Hippoboscidae (Petersen et al., 2007).

In Brazil, there are few studies on bat ectoparasites (Komeno & Linhares, 1999; Bertola et al., 2005) as well as in the state of Rio de Janeiro State (Almeida et al., 2010; França et al., 2013). So, it is possible and expected that new records of the relationship between bat and ectoparasites will be found in areas with few studies. Thus, the present study aims to fill in the knowledge gap about ectoparasites found on bats captured at Bom Retiro Farm Private Natural Heritage Reserve, inserted in an Atlantic Forest fragment. We want to contribute to the knowledge of the ectofauna streblidae of the state of Rio de Janeiro, as the first record of the ectoparasite Paradichyria parvula (Falcoz, 1931) for the state.

**MATERIAL AND METHODS**

This study was carried out at Bom Retiro Farm Private Natural Heritage Reserve (RPPN), hereafter Bom Retiro Farm (22°27’S, 42°18’W), which is located at approximately 140 km from the city of Rio de Janeiro, southeastern Brazil. It comprises the municipalities of Casimiro de Abreu and Silva Jardim, with an area of 494.3 ha (Fig. 1), mostly covered by typical Atlantic Forest vegetation, which remains under the influence of the Tropical Atlantic Mass originated from the Tropical Atlantic Anticline for most of the year. The studied area is with in São João River Basin, in an intertropical zone (low latitudes), with intense solar radiation, under high influence of the Atlantic Ocean, with average annual temperatures of 18° to 24° (Cunha, 1995), and a predominantly humid tropical climate (Takizawa, 1995). Private Natural Heritage Reserves (RPPN) are private areas chosen to be protected by an initiative of owners, upon recognition by the Government (Federal Decree #1922/1996). They are relevant due to their biodiversity, landscape aspect and/or environmental characteristics that justify recovery actions. The regulation of RPPNs began in 1990, by the request of some landowners who wanted to turn part of their real estate into private reserves that allowed touristic and research activities (IBAMA, 2005).

Nineteen field expeditions were carried out between January 2012 and May 2016. Bats were captured using mist nets measuring 9 m x 2.5 m. In each campaign, five networks that were opened for 12 hours a night were used, with an capture effort of 25,650 k.m², following Straube & Bianconi (2002). The bats which were

![Figure 1. Location of the Bom Retiro Farm Private Natural Heritage Reserve (22°27’S, 42°18’W), Silva Jardim, Rio de Janeiro, southeastern Brazil.](image-url)
captured were put in individual cloth bags, previously
identified in the field, using the identification keys
by Emmons & Feer (1997) and descriptions provided
by Simmons & Voss (1998), Dias et al., (2002), and Dias & Peracchi (2008). The first specimen of each species
captured and the specimens that raised doubts about
identification were sacrificed and preserved in 70% alco-
hol. Voucher specimens were deposited in the Adriano
Lúcio Peracchi Collection (ALP) of the Mastozoology
Laboratory, Institute of Biology, Federal Rural University
of Rio de Janeiro (UFRJ). We declare that all actions per-
formed with the animals have followed and respected
the international rules of animals well being, through
all parameters required from Animal Ethics Committee
(AEC).

The bats analyzed were marked using the cap-
ture-mark-recapture method with numbered plastic
collars, following Esbérard & Daemon (1999), and then
released.

Flies on the body surface of bats were collected with
magnifiers. Captured ectoparasites were fixed in 70% alco-
hol and stored in Eppendorf tubes with a label identify-
ing the bat species on which the fly was collected, as well
as the site and date of collection. Dr. Gustavo Graciolli,
professor at the Biology Institute, Federal University of
Mato Grosso do Sul, identified streblid flies.

Associations between streblid flies and bats were an-
alyzed by counting the number of bats captured and the
number of infested bats. We also calculated the average
prevalence by counting the number of ectoparasites on
each bat species in relation to the number of ectopara-
sites collected and calculated the prevalence of ectopara-
sites (Margolis et al., 1982). To test for differences in the
number of ectoparasites in different bat species, regard-
less of sex, parasite or weight, the Mann-Whitney test
was applied. Species with a few number of individuals
were not included in the statistical test. We used the clus-
ter analysis to compare the present study with five other
studies carried out in different locations: Distrito Federal
(Graciolli & Coelho, 2001), Maranhão (Santos et al., 2009),
São Paulo (Bertola et al., 2005), Minas Gerais (Komeno &
Linhares, 1999), Paraná (Graciolli & Bianconi, 2007) and
Rio de Janeiro II (França et al., 2013).

RESULTS

Richness and relative abundance of species of flies and bats

401 bats of 17 species, 13 genera, and four families were
captured: family Phyllostomidae: Carollia perspicillata
(Linnaeus, 1758) n = 164, Desmodus rotundus
(É. Geoffroy, 1810) n = 64, Sturnira lilium (É. Geoffroy,
1842) n = 46, Artibeus lituratus (Offer, 1818) n = 28,
Artibeus fimbriatus (Gray, 1838) n = 24, Artibeus obscurus
(Schinz, 1821) n = 22, Anoura geooffroyi (Gray, 1838) n = 22,
Glossophaga soricina (Pallas, 1767) n = 10, Platyrrhinus
lineatus (É. Geoffroy, 1810) n = 10, Platyrrhinus recifinus
(Thomas, 1901) n = 6, Diphylla ecaudata (Spix, 1823)
n = 4, Diaemus youngii (Jentink, 1893) n = 2, Dermanura
cinerea (Gervais, 1856) n = 2, and Phyllostomus hastatus
(Pallas, 1767) n = 2; family Noctilionidae: Noctilio lepori-
num (Linnaeus, 1758) n = 1; family Vespertilionidae: Myotis
nigricans (Schinz, 1821) n = 1; and family Molossidae:
Molossus molossus (Pallas, 1766) n = 1.

A total of ten streblid species of eight genera was collected:
Anastrebla caudiferae (Wenzel, 1996) n = 1, Aspidoptera falcatula (Wenzel, 1976) n = 7, Megistopoda
proxima (Séguy, 1926) n = 27, Paratrichobius longicrus (Miranda-Ribeiro, 1907) n = 8, Paradychiria parvula
(Falcoz, 1931) n = 11, Paraeucenodes similis (Wenzel, 1976) n = 3, Streblida guajiro (Garcia & Casal, 1965) n = 15,
Trichobius anducci (Guerrero, 1998) n = 1, Trichobius
joblingi (Wenzel, 1966) n = 23, and Trichobius unformis
(Curran, 1935) n = 1. Megistopoda prooxima was the
most abundant species (27.83%), followed by T. joblin-
gi (23.71%), and S. guajiro (15.46%). Together, the other
species represented 33% of all collected specimens.

These ten species correspond to 97 specimens: 48
males (49.49%) and 49 females (50.51%). The male-female
ratio was 1:1.02. Sex-ratio was proportional in all fly
species captured, with a larger number of females in six
of ten species: A. falcata, M. prooxima, P. parvula, P. similis,
S. guajiro, and T. joblingi. Paratrichobius longicrus showed
the same number of males and females. We captured
only one male of A. caudiferae and T. unformis, and only
one female of T. anducci (Table 1).

Association of flies and bats

Streblids infested four bat species: Carollia perspicil-
lata, Noctilio leporinus, Sturnira lilium, and Platyrrhinus
lineatus. We collected 38 females and 33 males on C. per-
spicillata, seven females and six males on S. lilium, six
males and five males on N. leporinus, and one female and
one male on P. lineatus.

The specie with the highest number of streblid spe-
cies was C. perspicillata, with seven species. Secondly,
Platyrrhinus lineatus and S. lilium, both with two species
captured on each. Noctilio leporinus was parasitized only
by one species. Sturnira lilium showed the highest infes-
tation rate: ten out of 46 captured individuals showed
ectoparasitic flies; followed by Carollia perspicillata with 33
out of 164 captured specimens parasitized, and P. linea-
thus with two out of ten individuals parasitized (Table 1).

Megistopoda prooxima and A. falcata were the only spe-
cies on two different bat species; the former parasitized
C. perspicillata and S. lilium and the latter parasitized
C. perspicillata and P. lineatus.

The Mann-Whitney test used to compare the number
of ectoparasites on C. perspicillata and S. lilium, regard-
less of sex, parasite or weight was significant (U = 70,
Z = 2.4, and p = 0.01). Carollia perspicillata was more par-
asitized than S. lilium. Other species were not included in
the analysis due to the small number of individuals cap-
tured. According to the cluster analysis, there is a similar-
ity between Rio de Janeiro, São Paulo, Minas Gerais and
Paraná (Fig. 2).
Table 1. List of bats and ectoparasites species found in the present study and their sexual proportion.

| Bat                     | Nm | Ni | Pm | Ectoparasite                  | Ne/9 cf | Pe |
|-------------------------|----|----|----|-------------------------------|---------|----|
| Carollia perspicillata  | 164| 33 | 20.1| Trichobius andunci Guerreiro 1998 | 1/9     | 0.01 |
|                         |    |    |    | Trichobius joblingi Wenzel 1966 | 23/12 9/11 cf | 0.32 |
|                         |    |    |    | Streblus guapiro Garcia & Casal 1965 | 15/8 9/7 cf | 0.21 |
|                         |    |    |    | Paranactenodes similis Wenzel 1976 | 3/2 9/1 cf | 0.42 |
|                         |    |    |    | Parastreblus longicrus Miranda-Ribeiro 1907 | 8/4 9/4 cf | 0.11 |
|                         |    |    |    | Aspidoptera falcata Wenzel 1976 | 6/3 9/3 cf | 0.08 |
|                         |    |    |    | Megistopoda proxima Séguy 1926 | 15/8 9/7 cf | 0.21 |
| Stumira albus É. Geoffroy 1842 | 46 | 10 | 21.7 | Megistopoda proxima Séguy 1926 | 12/6 9/6 cf | 0.92 |
|                         |    |    |    | *Trichobius uniformis* Curran 1935 | 1/9     | 0.08 |
| Nectilio leporinus (Linnaeus 1758) | 1  | 1  | 100 | *Paradyschiria parvula* Falcoz 1931 | 11/6 9/6 cf | 1     |
| Platyrhimus lineatus (É. Geoffroy 1810) | 10 | 2  | 20  | Aspidoptera falcata Wenzel 1976 | 1/9     | 0.5  |
|                         |    |    |    | Anastrebla caudifera Wenzel 1996 | 1/9 cf   | 0.5  |
| Total                   | 221| 46 | 97 | 9/52 9/45 cf                 |         |     |

Nm = number of bats captured; Ni = number of bats infested; Pm = prevalence of ectoparasites on bat species; Ne = number of ectoparasites collected; Pe = Prevalence of ectoparasites.

Figure 2. Cluster analysis comparing studies carried out in five other Brazilian states: (1) Graciolli & Bianconi (2007) in Paraná, (2) Santos et al. (2009) in Maranhão, (3) Bertola et al. (2005) in São Paulo, (4) Komeno & Linhares (1999) in Minas Gerais, (5) Graciolli & Coelho (2001) in Distrito Federal, (6) the present study in Rio de Janeiro and (7) França et al. (2013) in Rio de Janeiro II.

Table 2. Published studies in other states with the family Streblidae.

| Authors                  | State       | Number of taxa   | Number of ectoparasites | Number of host species |
|--------------------------|-------------|------------------|-------------------------|-----------------------|
| Graciolli & Bianconi (2007) | Paraná      | 7 spp and 6 genera | 119                     | 4                     |
| Komeno & Linhares (1999)   | Minas Gerais| 11 spp and 6 genera | 158                    | 12                    |
| Santos et al. (2009)       | Maranhão    | 15 spp and 8 genera | 201                    | 9                     |
| Bertola et al. (2005)      | São Paulo   | 17 spp and 11 genera | 443                    | 22                    |
| Graciolli & Coelho (2001)  | Distrito Federal | 13 spp and 4 genera | 102                   | 8                     |
| França et al. (2013)       | Rio de Janeiro | 9 spp and 6 genera | 126                    | 7                     |
| Present study              | Rio de Janeiro | 10 spp and 9 genera | 97                     | 4                     |

**DISCUSSION**

**Fly species richness and relative abundance**

The present study represents about 10% of the Streblidae species that occur in Brazil (Eriksson et al., 2011; Graciolli & Azevedo, 2011; Graciolli & Dick, 2012).

The Streblidae richness at Bom Retiro Farm did not differ from the average observed in other studies (Table 2). When compared, our results regarding the number of bats analyzed, both the number of host species (4) and the number of fly species (10) were lower than recorded in other studies (e.g., Bertola et al., 2005, carried out in São Paulo). When comparing the present study with the other six carried out in different locations (Distrito Federal, Maranhão, São Paulo, Minas Gerais, Paraná, and Rio de Janeiro II), using a cluster tree, an important similarity in streblid composition related to the distance between research islands was observed (Fig. 2). There is a similarity between the results obtained and the distance, as closer states, such as São Paulo, Minas Gerais, and Paraná, have more species in common than Distrito Federal and Maranhão, which are far from each other. The similarity in the faunal composition of streblids in four of six studies (Rio de Janeiro, São Paulo, Minas Gerais and Paraná), may be related to the fact that these works also had a large amount of capture of C. perspicillata; more over, these have also been carried out in the same ecosystem, the Atlantic Forest, with the exception of Minas Gerais, which was in the Cerrado.

The high species richness of the family Streblidae found in Maranhão can be related to the higher abundance and distribution of this group in equatorial regions (Guerrero, 1993, 1994, 1995a, b; Santos et al., 2009).

Regarding the male–female ratio, the present study showed a slight dominance of females, as reported only by Santos et al. (2009). Usually, the number of male is higher, probably because they move more than females (Wenzel, 1976), which are more restricted to the roost for breeding purposes.

The present study records for the first time Paradyschiria parvula for the state of Rio de Janeiro, previously found only in the states of Pará and Rondônia in the North, Maranhão in the Northeast, Mato Grosso and Mato Grosso do Sul in the Mid west, and Paraná in the South (Graciolli, 2020). All P. parvula specimens (5 males and 6 females) were captured parasitizing a female from Noctilio leporinus. In addition to this, the second record
of *Trichobius uniformes* for the state of Rio de Janeiro was made in present study, with a female parasitizing *Sturnira lilium* being, which the first record was made by Lourenço et al. (2020).

**Association of flies and bats**

A total of 45 out of 221 bats had ectoparasites, which represents an infestation rate of 20.4%. Bats of the family Phyllostomidae were the most parasitized by ectoparasites, and *C. perspicillata* obtained a higher number of species than that observed in studies carried out in Minas Gerais (Komeno & Linhares, 1999), São Paulo (Graciolli et al., 2006) and Rio de Janeiro II (França et al., 2013). *Carollia perspicillata* had seven species, a number higher than those found in the study of Bertola et al. (2005; 5 species), Santos et al. (2009; 4 species), and França et al. (2013; 4 species). Simmons & Voss (1998) and Carvalho et al. (2013) pointed out that the height of mist nets between 2.5 and 3 meter sallow shigh capture of phyllostomines, in particular frugivores and nectarivores, as they prefer to fly at the understory level. The high number of *C. perspicillata* may be related to the predominance of plants of the family Piperaceae at Bom Retiro Farm, as species of this family comprises the most visited plants by *C. perspicillata* during feeding (Pereira et al., 2018; Muller & Reis, 1992). Among the ectoparasites found on *C. perspicillata*, *T. joblingi* was also observed in Minas Gerais (Komeno & Linhares, 1999), Maranhão (Santos et al., 2009), São Paulo (Bertola et al., 2005), Distrito Federal (Graciolli & Coelho, 2001), and Rio de Janeiro II (França et al., 2013); in all of these studies, this species was the most captured on *C. perspicillata*. *Strebla guajiro* was also observed in those studies, except for Distrito Federal (Graciolli & Coelho, 2001).

In the present study, we captured two ectoparasites of the Strebildae family on *P. lineatus* (*A. falcata* and *A. caudiferae*), but none of the other studies compared here reported the presence of ectoparasites on this bat species. The presence of *P. parvula* parasitizing *N. leporinus* corroborates previous findings, as this bat is considered one of the host types of this parasite (Graciolli & Carvalho, 2001).

The records of parasite-host associations and the occurrence of streblids carried out in the study represent a significant contribution to deepening the knowledge about the distribution of fly species and their relationship with bats. The few existing studies, presented here in this work, show how this group and the relationship of ectoparasitism with bats is neglected. Further more, understanding these ecological relationships can help in the management and conservation processes of these taxonomic groups, especially in environments such as fragments of the Atlantic Forest, a biodiversity hotspot. Our results show the need to expand these studies, not only to other areas but also in the same region of the present study, thus improving the understanding of ectoparasitism relationships between these groups and how the processes of fragmentation and loss of habitat can interfere in this.

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**AUTHORS’ CONTRIBUTIONS**

LFMJ: Conceptualization, Methodology, Software, Data curation, Formal analysis, Writing – original draft, Visualization, Investigation. Writing – review & editing. ACDPM: Writing – review & editing. DMCS: Writing – review & editing. ALP: Supervision, Writing – review & editing.

**REFERENCES**

Almeida, J.; Pereira, S.; Serra-Freire, N. & Peracchi, A.L. 2010. Diversidade ectoparasitológica em morcegos na Fazenda Maraambaia, Rio de Janeiro, Brasil. Chiroptera Neotropical, 16(1 Supl.): 118-121.

Bertola, F.B.; Aires, C.C.; Favorito, S.E.; Graciolli, G.; Amaku, M. & Pinto-da-Rocha, R. 2005. Batflies, (Diptera: Strebilidae, Nycteribiidae) parasitic on bats (Mammalia: Chiroptera) at Parque Estadual da Cantareira, São Paulo, Brazil: parasitism rates and host-parasite associations. Memórias do Instituto Oswaldo Cruz, Rio de Janeiro, 100(1): 25-32.

Burgin, C.J.; Colella, J.P.; Khan, P.L. & Upham, N.S. 2018. How many species of mammals are there? Journal of Mammalogy, 99(1): 1-14.

Carvalho, W.D.; Godoy, M.S.M.; Adania, C.H. & Esbérard, C.E.L. 2013. Assembléia de mamíferos não voadores da Reserva Biológica Serra do Japi, Jundiaí, São Paulo, sudeste do Brasil. Bioscience Journal, 29(5): 1370-1387.

Cunha, S.B. 1995. Impactos das obras de engenharia sobre o ambiente biófico da Bacia do Rio São João (Rio de Janeiro – Brasil). Rio de Janeiro, Edição do Autor. 415p.

Dias, D. & Peracchi, A.L. 2008. Quirópteros da Reserva Biológica do Tinguá, Nova Iguaçu, Estado do Rio de Janeiro, Brasil (Mammalia, Chiroptera). Revista Brasileira de Zoologia, 25(2): 333-369. DOI

Dias, D.; Peracchi, A.L. & Silva, S.S.P. 2002. Quirópteros do Parque Estadual da Pedra Branca, Rio de Janeiro, Brasil (Mammalia, Chiroptera). Revista Brasileira de Zoologia, 19(2): 113-140. DOI

Emmons, L.H. & Feer, F. 1997. Neotropical rainforest mammals: a field guide. 2.ed. Chicago, The University of Chicago Press. 392 p.

Eriksson, A.; Graciolli, G. & Fischer, E. 2011. Batflies on phyllostomids hosts in the Cerrado region: component community, prevalence and intensity of parasitism. Memórias do Instituto Oswaldo Cruz, Rio de Janeiro, 106(3): 274-278. DOI

Esbérard, C.E.L. & Daemon, C. 1999. Um novo método para marcação de morcegos. Chiroptera Neotropical, 5(1-2): 116-117.

Findley, J.S. 1993. Bats: a community perspective. Cambridge University Press, Cambridge, 167p.

França, D.S.; Pereira, S.N.; Maas, A.C.S.; Martins, M.A.; Bolzan, D.P.; Lima, I.P.; Dias, D. & Peracchi, A.L. 2013. Moscas ectoparasitas (Diptera, Strebilidae) de morcegos (Chiroptera, Phyllostomidae) em uma área de...
Mata Atlântica, sudeste do Brasil. Revista Brasileira de Biologia, 73(4): 847-854. DO
Gracioli, G. 2020. Streblidae in Catalogo Taxonômico da Fauna do Brasil. PNUD. Available: http://fauna.ibri.gov.br/faunadobrasil/6423. Access: 22/05/2020.
Gracioli, G. & Azevedo, A.A. 2011. Ectoparasites of bats (Chiroptera, Furipteridae), with a description of a new species of Synesthesstribea Townsend (Diptera, Streblidae) from Brazil. Revista Brasileira de Entomologia, 55 (4): 501-504. DO
Gracioli, G. & Bianconci, G. 2007. Moscas ectoparasitas (Diptera, Streblidae e Nycteriibiidae) em morcegos (Mammalia, Chiroptera) em área de floresta com araucária no Estado do Paraná, Sul do Brasil. Revista Brasileira de Zoologia, 24(1): 246-249. DO
Gracioli, G. & Carvalho, C.J.B. 2001. Moscas ectoparasitas (Diptera, Hippoboscoidea, Nycteriibiidae) de morcegos (Mammalia, Chiroptera) do Estado do Paraná. II. Streblidae. Chave pictórica para géneros e espécies. Revista Brasileira de Zoologia, Curitiba, 18(3): 907-960. DO
Gracioli, G. & Coelho, D.C. 2001. Streblidae (Diptera, Hippoboscoidea) sobre morcegos filostomídeos (Mammalia, Chiroptera) em cavernas do Distrito Federal Brasil. Revista Brasileira de Zoologia, 18(3): 965-970. DO
Gracioli, G. & Dick, C.W. 2012. Description of a second species of Joblingia Dybas & Wenzel, 1947 (Diptera: Streblidae). Systematic Parasitology, 81(3): 187-193.
Gracioli, G.; Passos, F.C.; Pedro, W.A. & Lim, B.K. 2006. Moscas ectoparasitas (Diptera, Streblidae) de morcegos filostomídeos (Mammalia, Chiroptera) na Estação Ecológica dos Caetetus, São Paulo, Brasil. Revista Brasileira de Zoologia, 23(1): 298-299. DO
Guerrero, R. 1993. Catálogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. I. Clave para los géneros y Nycterophiliniae. Acta Biológica Venezuelica, 14: 61-75.
Guerrero, R. 1994. Catálogo 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 Biológica Venezuelica, 15(1): 1-18.
Guerrero, R. 1995a. Catálogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. III. Los grupos: dugesii, dunni y phyllostomae del género Trichobius Gervais, 1844. Acta Biológica Venezuelica, 15(3-4): 1-27.
Guerrero, R. 1995b. Catálogo de los Streblidae (Diptera: Pupipara) parasitos de murciélagos (Mammalia: Chiroptera) del Nuevo Mundo. V. Trichobiiinae com alas reduzidas ou ausentes e miscelaneos. Boletín de Entomología Venezuelana, 10: 135-160.
Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA). 2005. Unidade de Conservação/Reservas Particulares do Patrimônio Nacional. Available: http://www.ibama.gov.br. Access: 10/07/2005.
Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio)/ Ministério do Meio Ambiente (MMA). 2018. Livro Vermelho da Fauna Brasileira Ameaçada de Extinção. Brasília, DF, Instituto Chico Mendes de Conservação da Biodiversidade. v. 1, 495p.
Komeno, C.A. & Linhares, A.X. 1999. Batflies parasitic on some phyllostomid bats in southern Brazil: parasitism rates and hostparasite relationships. Memórias do Instituto Oswaldo Cruz, 94(2): 151-156.
Kunz, T.H. 1982. Roosting ecology of bats,. In: Kunz, T.H. (Ed.). New York, Plenum Press. p. 1-55.
Lourenço, E.C.; Gomes, L.A.C.; Viana, A.O. & Famadas, K.M. 2020. Co-occurrence of Ectoparasites (Insecta and Arachnida) on Bats (Chiroptera) in an Atlantic Forest Remnant, Southeastern Brazil. Acta Parasitologica, 65: 750-759.
Margolis, L.; Esch G.W.; Holmes, J.C.; Kuris, A.M. & Schad, G.A. 1982. The use of ecological terms in parasitology (Report of an ad hoc committee of the American Society of Parasitologists). Journal of Parasitology, 68(1): 131-133.
Marshall, A.G. 1982. Ecology on insects ectoparasitic insects. Ecology of Bats. New York, Plenum. 450p.
Muller, M.F. & Reis, N.R. dos. 1992. Partição de recursos alimentares entre quatro espécies de morcegos frugívoros (Chiroptera, Phyllostomidae). Revista Brasileira de Zoologia, 9(3-4): 345-355. DOI
Nowak, R.M. 1994. Walker’s Bats of the World. Baltimore, The Johns Hopkins University Press. 287p.
Pereira, E.M.; Menezes Jr., L.F.; Menezes, A.C.D.P. & Santos, D.M.C. 2018. Horário de atividades de três espécies de morcegos da RPPN Fazenda Bom Retiro, Casimiro de Abreu, RJ. Revista Ciência Atual, Rio de Janeiro, 11(1): 2-15. Available: http://www.cnad.edu.br/revista-ciencia-atual/index.php/cfai/article/view/236/pdf. Access: 04/07/2019.
Peterson, F.T.; Meier, R.; Kutty, S.N. & Wiegmann, B.M. 2007. The phylogeny and evolution of host choice in the Hippoboscoidea (Diptera) as reconstructed using four molecular markers. Molecular Phylogenetics and Evolution, 45: 111-122.
Reis, N.R.; Peracchi, A.I.; Batista, C.B.; Lima, J.P. & Pereira, A.D. 2017. História natural dos morcegos brasileiros, chave de identificação de espécies. Rio de Janeiro, Technical Books Editora. 416p.
Rui, A.M. & Gracioli, G. 2005. Moscas ectoparasitas (Diptera, Streblidae) de morcegos (Chiroptera, Phyllostomidae) no sul do Brasil: Associações Hospedeiros – Parasitos e Taxas de Infestação. Revista Brasileira de Zoologia, 22(2): 438-445.
Santos, C.L.C.; Dias, P.A.D.; Rodrigues, F.S.; Lobato, K.S.; Rosa, L.C.; Oliveira, T.G. & Rebelo, J.M.M. 2009. Moscas ectoparasitas (Diptera: Streblidae) de morcegos (Mammalia: Chiroptera) do Município de São Luiz, MA: Taxas de Infestação e associações parasito-hospedeiro. Neotropical Entomology, 38(5): 595-601. DOI
Santos, C.P. & Gibson, D.I. 2015. Checklist of the Helmnhist parasites of South American bats, Zootaxa, 3937(3): 471-499.
Silva, J.J.R. da & Ortêncio-Filho, H. 2011. Dipteros ectoparasitas (Insecta, Diptera) em morcegos (Chiroptera, Mammalia) na Reserva Biológica das Perobas Paraná, Brasil. Iheringia. Série Zoologia, 101(3): 220-224. DOI
Simmons, N.B. & Voss, R.S. 1998. The mammals of Paracou, French Guiana: A neotropical lowland rainforest fauna part 1. Bats. Bulletin of the American Museum of Natural History, 237: 1-219.
Straube, F.C. & Bianconci, G.V. 2002. Sobre a grandeza e a unidade utilizada para estimar esforço de captura com utilização de redes-de-neblina. Chiroptera Neotropical, 8(1-2): 150-152.
Takizawa, F.H. 1995. Levantamento pedológico e zoneamento ambiental da Reserva Biológica de Poço das Antas. Piracicaba, Escola Superior de Agricultura Luis de Queiroz/USP. 56p. Monografia de Graduação. Departamento Ciências do Solo.
Voss, R.S. & Emmons, L.H. 1996. Mammalian diversity in neotropical lowland rainforests: a preliminary assessment. Bulletin of the American Museum Of Natural History, New York, 230: 1-115.
Wenzel, R.L. 1976. The streblid bat flies of Venezuela (Diptera: Streblidae). Brigham Young University Science Bulletin, Biological Series, 20(4): 1-177.