International Journal of Frontiers in
Science and Technology Research
Journal homepage: https://frontiersrj.com/journals/ijfstr/
ISSN: 2783-0446 (Online)

(REVIEW ARTICLE)

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Families Braulidae and Streblidae (Insecta: Diptera) as ectoparasites of mammals

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International Journal of Frontiers in Science and Technology Research, 2023, 05(01), 001–013

Publication history: Received on 29 September 2023; revised on 21 November 2023; accepted on 24 November 2023

Article DOI: https://doi.org/10.53294/ijfstr.2023.5.1.0066

Abstract

Once the larval development is complete, the *Braula*, Nitzsch, 1818 (Braulidae) becomes a pupa within the tunnels it has excavated, and when it reaches the adult state, it attaches itself to the body of the bee. Department of the cycle, from oviposition to the emergence of the adult parasite reaches 21 days. When the beekeeper carries out inspections of his hives. Parasitized bees, especially queens, are restless, nervous, weakened, and at intervals shake their legs or rub their bodies with their wings, in order to get rid of the parasites, but without any success. The Streblidae are viviparous ectoparasites, obligatory and exclusive to bats, which instead of laying eggs or larvae, what they do is put an already developed pupa. Viviparity is adenotrophic; that is, the larvae feed on glandular secretions in the uterus. In the third instar, the larva is deposited in the shelter of the host. One larva develops inside the female and feeds on secretions from the accessory glands, which are highly specialized. Eventually, the third-instar larva is deposited as a sessile prepupa in a substrate. The objective of this bibliographical production is to understand the biological, ecological, and taxonomic characteristics of the Braulidae and Streblidae families. In terms of the type of research source, we worked with scientific articles published in national and international journals. This type of production, in addition to being commonly the most valued in all bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, Hall, USP, UNB, CAPES, Qeios, and LILACS.

Keywords: Ectoparasites; Fhoresia; Ovoviviparous; Vector; Viviparous

1. Introduction

Carnoidea is a poorly defined superfamily. In 1989, ten synapomorphies were described for the group, but most of these have later been challenged. As of 2006, the following synapomorphies were described: the uppermost fronto-orbital bristle(s) of the head is acclimate; the phallus of the male is flexible, unsclerotized, simple, and elongate; and the phallus is microtrichose Braulidae are associated with honey bees, with larvae developing in beeswax while adults attach to bees and feed from bee mouthparts. Braulidae, or bee lice, is a family of true flies (Diptera) with seven species in two genera, *Braula*, Nitzsch, 1818, and *Megabraula* Grimaldi & Underwood, 1986. They are found in honey bee colonies due to their phoretic, inquiline, and kleptoparasitic relationships with the bees (Figure 1) [1-3].

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Source: https://infomiel.com/piojo-la-abeja/

Figure 1 *Braula coeca* Nitzsch, 1818

Objective

The objective of this bibliographical production is to understand the biological, ecological, and taxonomic characteristics of the Braulidae and Streblidae families.

2. Methods

In terms of the type of research source, we worked with scientific articles published in national and international journals. This type of production, in addition to being commonly the most valued in all bibliographic production, is the most easily accessed. Access to articles was through virtual libraries such as SciELO, ResearchGate, Hall, USP, UNB, CAPES, Qeios, and LILACS.

3. Family Braulidae

3.1 Geographical distribution

This fly has spread through: Africa: Congo, Egypt, and Morocco. Asia: India and the Soviet Union, Australia: Tasmania. Europe: for the most part. South America: Argentina, Chile, Brazil, Trinidad and Tobago, Venezuela. United States: Alabama, Delaware, Illinois, Maryland, Minnesota, York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin. In Florida, only a single specimen collected from a queen bee is known [1-4].

3.2 Stages

- **Egg:** The eggs are white, oval in shape, and with two flat lateral ridges, parallel to the long axis of the egg. Imms reported that the average length, without the ridges, is 0.78 to 0.81 mm and the width 0.28 to 0.33 mm. Including the flanges, a typical egg measured 0.84 mm by 0.42 mm. The eggs are laid in various places in a hive, in empty cells, in the breeding boxes, or in the gnawed wax that is usually on the floor of a colony. The incubation period for eggs varies between two days during summer and 7.4 days during winter.
- **Larva:** The larvae emerge from the eggs beginning to build a tunnel under the opercula and sometimes in the walls and bottom of the cells of the combs. These tunnels show the infested paintings as if they had fine fractures. The larvae feed on honey and pollen inside tunnels in the wax. The larvae take between 7.1 and 10.8 days to finish developing, depending on the season of the year.
- **Pupa:** The prepupa takes 1 to 2.7 days and its color is creamy white. The pupae are white or yellowish, 1.4 to 1.7 mm long by 0.5 to 0.75 mm wide.
- **Adult:** The adult has rudimentary eyes on the antennae that appear as pale dots on the surface of the cuticle surrounded by darker pigmented chitinous rings. There is no trace of wings or rockers. The tarsus has five segments; Each terminal segment contains a comb-like structure, divided in the center, with a variable number of teeth. The combs allow *Braula* to cling firmly to the host [1-6].

3.3 Biological Cycle

At the beginning of her biological cycle, the ovoviviparous female lays eggs on the inner surface of the opercula that cover the honey-filled cells or on their walls. Here larval development takes place, with the larvae excavating tunnels when they hatch and feed of honey and pollen. Then the pupa passes and, as an adult, attaches itself to the body of the adult bee. Affects all castes, however, it has a preference for workers that feed young larvae and the queen, as the latter has a richer diet in terms of quality and quantity, and moves less. *Braula* is a genus of insects in the order Diptera of the

family Braulidae. These insects are very unusual, they are wingless and flat, making them almost unrecognizable as Diptera [1-9].

3.4 Biology and Ecology

The *Braula coeca* Nitzsch, 1818 species is a pest of honey bees, called bee lice, its larvae make tunnels through the wax combs in hives and the adults attach themselves to the bees' bodies. There is debate among experts as to whether *B. coeca* actually causes significant harm to bees. These insects can be found in places where bees congregate, such as flowers or water and mineral sources (salt pans), waiting to grab hosts from uninfected hives. An adult *Braula* is about 1.6 mm long (Figure 2) [1-13].

Sources: Miles Zhang and https://www.pir.sa.gov.au/__data/assets/pdf_file/0011/341948/Notifiable_honeybee_pests_2020.pdf

Figure 2 *Braula*, Nitzsch, 1818, fly on worker bee

3.5 Sistematic

Species: *Braula coeca* is a pest of honey bees, *Braula kohli* Schmitz, 1914, *Braula orientalis* Òròsi Pál, 1939, *Braula pretoriensis* Òròsi Pál, 1939 and *Braula schmitzi* Orosin, 1939

Groups 1-*Coeca* group; *B. coeca*: in Europe, *B. coeca* in the 2-Schmitzi group in South Africa and Rhodesia; *B. schmitzi*; Georgia, Turkey, Israel, Portugal, Brazil, Argentina, in Asia Minor and Africa. *B. orientalis*; In Bulgaria, the coasts of the Pacific Ocean, Russia, Egypt, and Israel. 3-In the *Pretoriensis* group: *Braula kohli* is spread in Africa, and *B. pretoriensis* is spread in South Africa and Brazil [13-15].

3.6 Epizootiology.

The bee louse overwinters in the hives. The ovoviviparous female deposits the eggs, white and elliptical, 70um long, on the inner side of the opercula that cover the cells filled with honey. Sometimes she also deposits eggs on their walls, but never in the brood cells. Development is completed under these opercula and the larva makes a tunnel, which is small in diameter at first and increases in size when there is an increase in the size of the parasite, which obtains food from the honey and stored pollen.

Once the larval development is complete, the *Braula* becomes a pupa within the tunnels it has excavated, and when it reaches the adult state, it attaches itself to the body of the bee. Department of the cycle, from oviposition to the emergence of the adult parasite reaches 21 days. When the beekeeper carries out inspections of his hives. Parasitized bees, especially queens, are restless, nervous, weakened, and at intervals shake their legs or rub their bodies with their wings, in order to get rid of the parasites, but without any success.

There is an isolated treatment that is performed on the queen and that consists of removing the lice from her body using a toothpick dipped in honey. When parasitism is important, it is recommended to carry out a general treatment, which may include those indicated.

- **Nicotine vapors**: The spout and the interior of the hive are smoked with nicotine through the lid and below it. Then, cover the hive again and wait a few minutes for the tobacco to act on the lice. The effect of tobacco numbs the lice, so they break free from their host and fall to the floor of the hive. Therefore, either the floor is changed once the tobacco has done its job or it is protected with a sheet of newspaper before beginning to smoke the hive.

- **Naphthalene:** With mothballs, it is applied to the bottom of the hive and proceeds in a similar way to treatment with nicotine vapors.

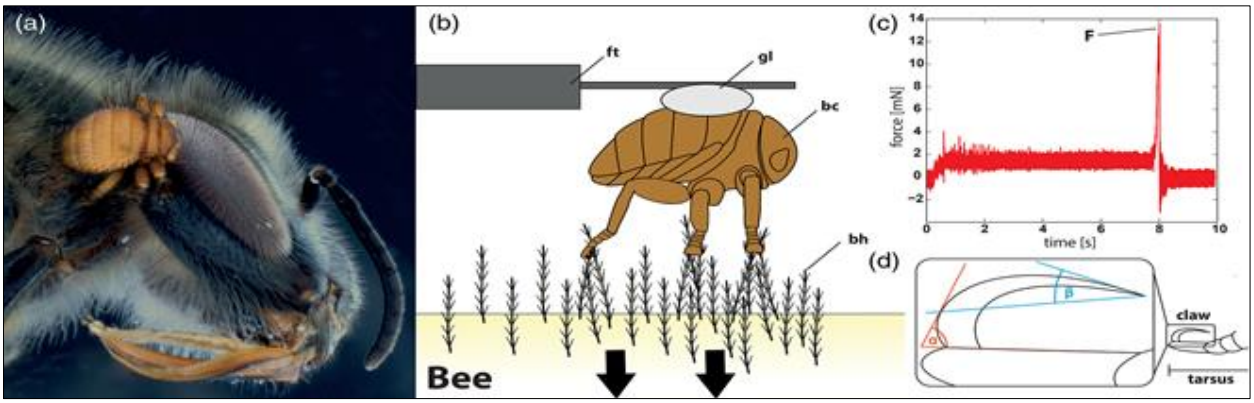
There is a method to eliminate the proliferation of the parasite, based on the hypothesis that the insect only has one generation per year, so it is enough to uncap the honey boxes present in the hive during the larval period of the parasite, in order to break their biological cycle [13-17].

4. Selected Studies

4.1 Study 1

4.1.1 *Braula coeca* Nitzsch, 1818

Braula coeca is an external commensal that is located on the body surface of the bee, more precisely on the back, between the junction of the thorax and abdomen. It mainly parasitizes the queen, less frequently in the workers, and almost never in the drones and pecoriators. The reason for the greater presence of lice on the queen is due to her permanent presence in the hive, and not to a predilection of lice (Figure 3).



Source: https://resjournals.onlinelibrary.wiley.com/doi/10.1111/phen.12378

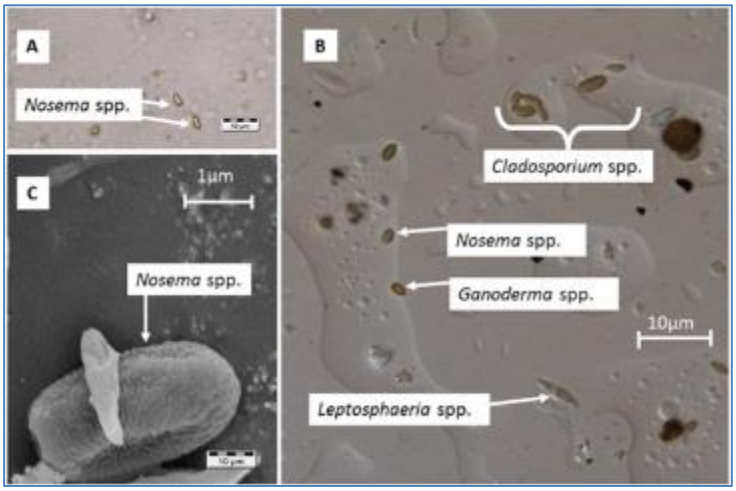
Figure 3 a) The bee louse *Braula*, Nitzsch, 1818 attached to the head region of its host, the honeybee *Apis mellifica mellifica silvarum* Goetze, 1964. (b) Experimental setup. The bee louse (bc) was attached to the tip of a strong needle which was mounted to a Fort25 force transducer (ft) and pulled off from the bee by actively pulling the bee away from the force transducer. (c) Representative force-time curve of the attachment force. (d) Schematic drawing of the measured base (α) and tip (β) claw angles. bc, *B. coeca*; bh, bee hair; F, maximum pull-off force; ft, force transducer; gl, queen bee marking glue

The damage that these insects cause to the hive occurs in two moments, the first during their development, when the larvae dig tunnels by digging the wax, and the second, in their adult phase, when they are on the queens in high frequency and number, being able to reach to the area of the proboscis and thus with its movements irritate the queen and cause regurgitation of the food content on which it feeds. Furthermore, the presence of lice on the queen's body causes discomfort that leads to a considerable decrease in oviposition, resulting in a decrease in the number of larvae and therefore the family [13-17].

4.2 Study 2

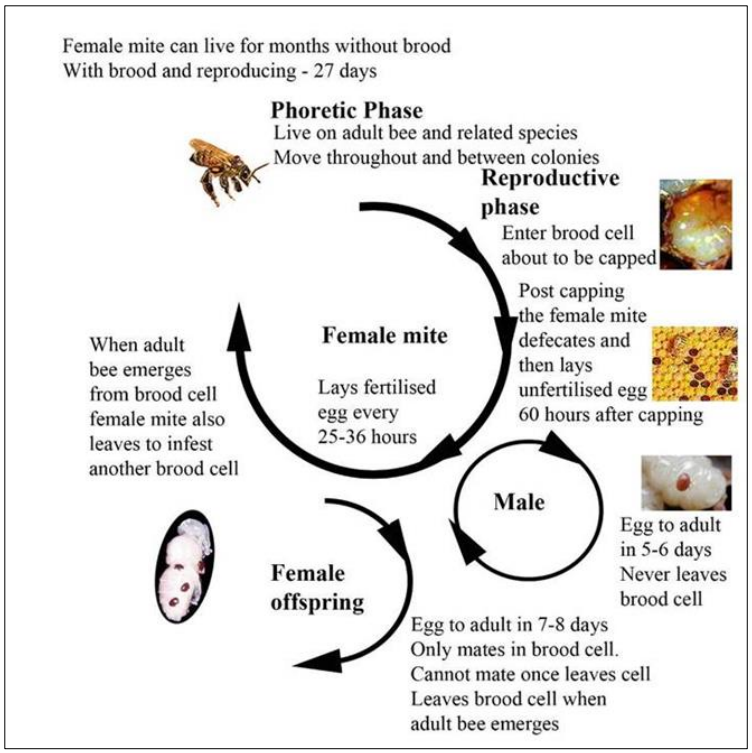
Genus *Braula*: Vector of the parasite *Nosema apis* (=*Varroa jacobsoni*) Zander, 1909 (Microspora: Nosematidae)

Nosema apis parasitic mite is a spore-forming protozoan that causes nosemosis in honeybees. It infects adults of honeybees. Sick bees cannot fly. They wait in front of the hive hole. Peak infection occurs in early spring. The spores of *N. apis* are light-refraction and oval. They are 2-4;3-7μ in size. They develop within the epithelial cells in the stomachs of adult bees. That's why it is an adult bee disease nosemasis does not pose a great danger in bees with normal conditions, but when it occurs together with another disease, it causes mass deaths in bees (Figures 4-5).



Source: https://www.nature.com/articles/s41598-019-50974-8

Figure 4 Microscope image. (A) Light microscope image of *Nosema* spp. spores on the tape. (B) Nomarski interference contrast microscope image of spores on the tape. (C) *Nosema* spp. spores on the tape visible under a scanning electron microscope



Source: http://www.carrsconsulting.com/honeybee/disorders/varroa.htm

Figure 5 *Braula*, Nitzsch, 1818, is considered to cause little damage to bee colonies and its potential as a pathogen vector has so far been ignored. Among pathogens, the Acute bee paralysis virus (ABPV) and the Israeli acute paralysis virus (IAPV) have shown a strong correlation with winter bee colony losses in at least two long-term. It is important to point out that the prevalence of virus infections increases dramatically when the Varroa mite is inside the colony because this mite has been shown to be a mechanical and biological vector of honey bee viruses

Other symptoms of the disease are swollen abdomen, decreased sting reflex, spread of wings, crawling walking, and the appearance of soil crumbs in front of the hive flight hole. It is difficult to obtain information about the disease based on clinical symptoms. The infection is transmitted to other colonies by marauding bees attacking the sick colony by

ingesting these spores along with honey or infected pollen. Contaminated equipment and ants also help spread the disease.

Other factors that play a role in transmission are briefly as follows: Use of infected frames at the end of summer Crushing of bees between covers Transferring colonies to other places. As a result of this infection, the lifespan of adult worker bees is reduced by half in spring and summer. Because they have to feed the babies during this period, they are less resilient.

Since the baby feeding glands are degenerated, the babies cannot be fully fed. Since these sick bees have a large amount of water in their stomachs, their risk of contracting dysentery increases. If the queen bee is infected, they show sensitivity, their ability to lay eggs decreases and they die, while some continue to lay eggs even if the disease is severe. *Nosema* is transmitted to the queen bee by worker bees*. N. apis* spores in water at 58 °C for 10 min. They also die. They are sensitive to stink. They die in approximately 20 hours when exposed to direct sunlight. A microscope is used to identify N. apis spores. The stomachs of the bees are removed, crushed with physiological saline, and stained with Giemsa, and spores are tried to be seen under the microscope.

Additionally, when the intestines crushed with physiological saline are stained with 0.1% Nigrosin, the spores appear white and shiny and the medium appears black. Again, native examination (physiological water) and bile (physiological water-1% safranin-methylene blue) examination methods are used.

At necropsy, the stomach of bees that die from nosemosis is white. However, the stomach of healthy bees is yellow or yellow-green in color. Protection and control: It is always necessary to ensure that the colonies are in strong condition. Old mothers should be replaced by young and strong mothers. Bees feed on fumagillin syrups new preparations (Fumidil B). The temperature of the syrup should not exceed 49 °C. For the treatment of Nosematose, fumigillin is added to the syrup at a ratio of 1/844 and given in early spring and late autumn feeding [13-20].

5. Family Streblidae

It is still uncertain whether bat flies and other parasitic arthropods of these flying mammals play a relevant role in the transmission of zoonotic diseases associated with bats and are of importance to humans and other animals. ectoparasitic viruses are ecologically and epidemiologically linked to bats but are rarely found in bats, they may actually represent viruses from bat flies or other bat ectoparasites. Ectoparasites and their hosts constitute very appropriate systems when one wishes to study issues related to diversity and abundance patterns related to intrinsic factors of spatial and temporal interaction between different species [21-22].

Several factors influence the diversity of the ectoparasitic community, among which the size and type of shelter of the host species stand out. The microclimatic favoring that the shelter provides to bats strongly influences ectoparasites. Shelters such as caves and artificial cavities have high environmental stability, thus favoring both the host and the organism parasite [23-25].

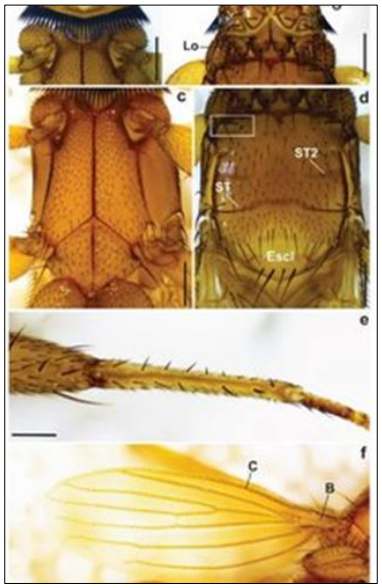
Ectoparasitic arthropods of bats belong to five different orders (Siphonaptera, Diptera, Hemiptera, Dermaptera, and Acari). However, they are not necessarily restricted to bats. About 690 species of insects are known ectoparasites of bats, of which six families (of four orders) are exclusively found in bats. Among Diptera, two families are exclusively ectoparasites of bats: Nycteribiidae and Streblidae [26-28].

Bats comprise one of the most diverse groups of mammals in the Neotropics and many of the parasite species associated with them range from specific to generalist. The biology, systematics, and phylogenetic aspects involving the host bats will be more well understood through knowledge of their ectoparasites. Such knowledge can also help in understanding the epidemiological aspects of the transmission of some diseases among bats [29-30].

The Streblidae family is formed by hematophagous dipterans ectoparasites of bats. They are found parasitizing 14 bat families worldwide, mainly associated with tropical environments, with only two species occurring in hibernating bats. Most Streblidae, 62.5% of the 251 species, occur exclusively in the New World. Despite being extremely adapted to the habit of parasitic life, these insects are quite mobile and about 78% of the total species have functional wings and can fly. The Streblidae are viviparous, having three larval stages that develop in the female's uterus, the pupa that develops in the shelter and the adult that is parasitic and hematophagous [31-33].

5.1 Description

One of the characteristic features of streblid bat flies is their variable degree of eye reduction. The compound eyes are highly, but variably reduced, with some species containing only rudimentary eye spots. Ocelli are absent in all species. Wing morphology also significantly varies within the family with some species containing fully functional wings, while others contain either reduced (non-functional or functional) wings or no wings at all (Figure 6) [34-35].



Source: file:///C:/Users/Lenovo/Downloads/THESIS_ALILIRA-OLGUIN.pdf

Figure 6 *Strebla wiedemannii* Kolenati, 1856. Head, a) ventral view, b) dorsal view. Habit, c) ventral view, d) dorsal view. e) sight metatibia dorsal. Wing, f) dorsal view. Scale bars: c, d: 0.5 mm; a,b,e,f: 0.2mm

5.2 Biology

They are viviparous ectoparasites, obligatory and exclusive to bats, which instead of laying eggs or larvae, what they do is put an already developed pupa. Viviparity is adenotrophic; that is, the larvae feed on glandular secretions in the uterus. In the third instar, the larva is deposited in the shelter of the host (Figures 7-8) [36-37].

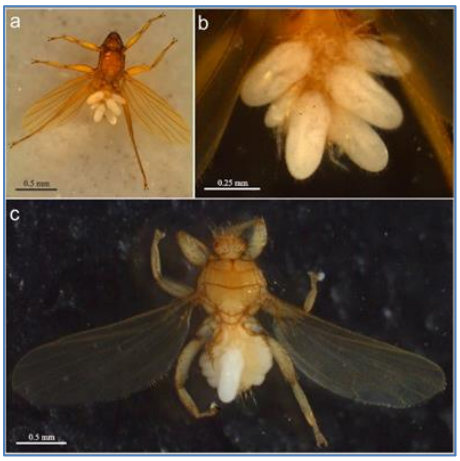
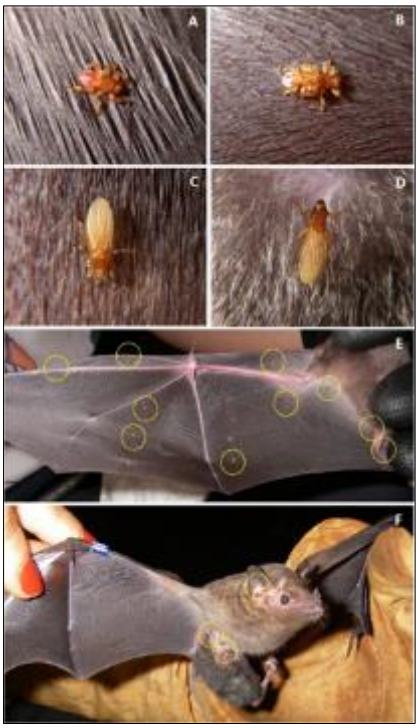


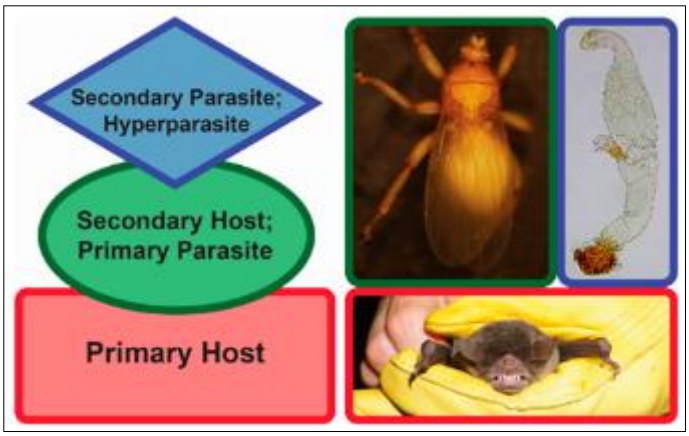
Figure 7 The mite species *Monunguis streblida* Wharton, 1938 (Neothrombidiidae) is reported in association with dipteran ectoparasites (Streblidae) of Brazilian bats for the first time. A 1-year study of two populations of the bat *Anoura geoffroyi* Gray, 1838, in caves in the state of Minas Gerais, Brazil, found them to be parasitized by four species of streblids, three of which were parasitized by *M. streblida*. Three hundred and thirty-two individuals of *M. streblida* were collected in association with 135 individuals of *Anastrebla modestini* Wenzel, 1966, two individuals of *Anastrebla caudiferae* Wenzel, 1976, and two individuals of *Trichobius* sp. (dugesii complex)



Source: https://link.springer.com/article/10.1007/s00436-021-07385-4

Figure 8 Bats are parasitized by many different arthropods, among which the dipteran families Nycteribiidae and Streblidae are exclusive to bats

Streblidae one larva develops inside the female and feeds on secretions from the accessory glands, which are highly specialized. Eventually, the third-instar larva is deposited as a sessile prepupa in a substrate. The pupa forms and remains in this state for at least four weeks; then, the adult emerges and proceeds to locate its new host. Streblidae family, which are parasites, are themselves infested by fungi of the order Laboulbeniales; these fungi are thus hyperparasitic (Figure 9) [38-40].



Sources: Photos: Danny Haelewaters, Thomas Hiller and https://www.mdpi.com/2309-608X/6/4/361

Figure 9 Hyperparasitism. Left, generalized diagram of hyperparasitism. Red, primary host (bat); green, secondary host/primary parasite (bat fly); blue, secondary parasite/hyperparasite (fungus). Right, *Pteronotus parnellii* (Mormoopidae), *Trichobius yunkeri* Wenzel 1966 (Streblidae), *Gloeandromyces nycteribiidarum* (Thaxt.) (Laboulbeniales)

5.3 Distribution

Most of the species are Neotropical with a well-defined distribution. However, some species may present a disjunct distribution; that is, species found in the southern United States may be found in northern South America, but not in Central America [38-41].

5.4 Classification

Within Brachycera and the Muscomorpha infra order is the Streblidae family, which are ectoparasitic flies of bats, along with the Hippoboscidae family. These dipterans are divided into five subfamilies: Ascopterinae, Nycterophiliinae, Nycteriboscinae, Streblinae and Trichobiinae, the first three being exclusive to the New World and the rest to the Old World. They are found parasitizing 14 order Chiroptera (Mammalia: Placentalia) and are mainly associated with tropical environments. The Streblidae family is relatively well known on the American continent, with records of several species distributed in Panama (69 species), Colombia (54 species), Venezuela (119 species), Peru (59), and Brazil, about 70 species [38-41].

6. Selected Manuscripts

6.1 Study 1

6.1.1 Estrebidae in Brazil.

Subfamily Brachytarsininae Speiser 1900.

Brachytarsina Macquart, 1851, *Megastrebla* Maa, 1971, *Raymondia* Frauenfeld, 1855, *Raymondiodes* Jobling, 1954).

Subfamily Ascodipterinae Monticelli 1898.

Ascodipteron Adensamer, 1896, *Maabella* Hastriter & Bush, 2006, *Paraascodipteron* Advani & Vazirani, 1981.

Subfamily Nycterophiliinae Wenzel, 1966.

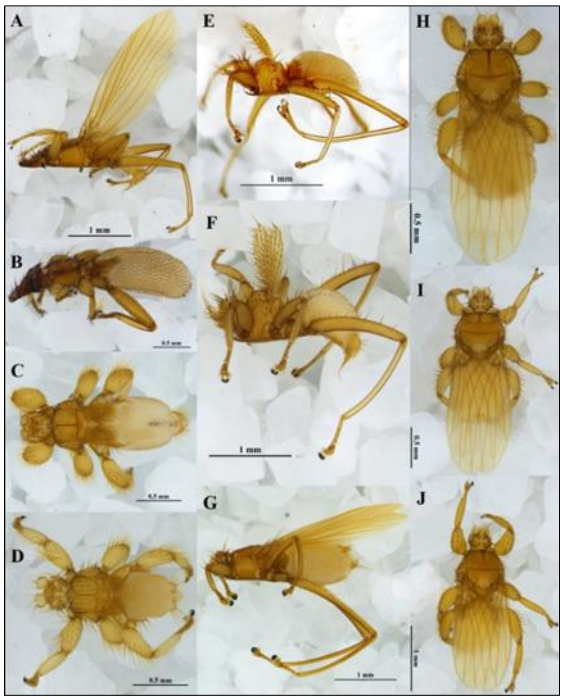
Nycterophilia Ferris, 1916 and *Phalconomus* Wenzel, 1984.

Subfamily Streblinae Speiser, 1900.

Anastrebla Wenzel, 1966, *Metelasmus* Coquillett, 1907, *Paraeuctenodes* Pessôa & Guimarães, 1937 and *Strebla* Wiedemann, 1824.

Subfamily Trichobiinae Jobling, 1936.

Anatrichobius Wenzel, 1966, *Aspidoptera* Coquillett, 1899, *Eldunnia* Curran, 1934, *Exastinion* Wenzel, 1966, *Joblingia* Dybas & Wenzel, 1947, *Mastoptera* Wenzel, 1966, *Megistopoda* Macquart, 1852, *Megistapophysis* Dick & Wenzel, 2006, *Neotrichobius* Wenzel & Aitken, 1966, *Noctiliostrebla* Wenzel, 1966, *Paradyschiria* Speiser, 1900, *Parastrebla* Wenzel, 1966, *Paratrichobius* Costa Lima, 1921, *Pseudostrebla* Costa Lima, 1921, *Speiseria* Kessel, 1925, *Stizostrebla* Jobling, 1939, *Synthesiotrebla* Townsend, 1913, *Trichobioides* Wenzel, 1966, *Trichobius* Gervais, 1844 and *Xenotrichobius* Wenzel, 1976 (Figure 10) [42].



Source: https://www.researchgate.net/figure/Species-of-Streblidae-occurring-in-dry-forest-in-vereda-El-Carbonero-Santander-de_fig1_338475017

Figure 10 Streblidae occurring in dry forest in vereda El Carbonero (Santander de Quilichao, Cauca, Colombia). Streblinae: A, *Anastrebla* sp.; B, *Metelasmus* sp.: C, *Aspidoptera* sp.; D, *Exastinion* sp.*;* E, *Megistopoda* sp.1; F *Megistopoda* sp.2; G, *Paratrichobius* sp.; H, *Trichobius* sp.1; I, *Trichobius* sp.2; J

6.2 Study 2

6.2.1 Blood-sucking arthropods of bats in urban refuges in the Rio de Janeiro state.

This work whose objective is to register hematophagous arthropod parasites of bats that use urban refuges.

A total of 14 species of ectoparasitic arthropods belonging to three Orders were collected. Diptera (Streblidae (N=500); Nycteribiidae (N=2), Siphonaptera (Tungidae N=5) and Hemiptera (Polyctenidae (N=1)) from 164 (18.06%) bats parasitized, 908 bats were captured, 196 of which were catches (21.58%), comprising 12 species of three families (Phyllostomidae, Molossidae, and Vespertilionidae), *Anoura caudifer* (É. Geoffroy, 1818) (N=1), *Anoura geoffroyi* Gray, 1838 (N=1), *Artibeus lituratus* (Olfers, 1818) (N=10), *Carollia perspicillata*, (Linnaeus, 1758) (N=137), *Desmodus rotundus* (Geoffroy, 1810) (N=3), *Glossophaga soricina* (Pallas,1766), (N=437), *Histiotus velatus* (Geoffroy, 1824), (N=1), *Molossus molossus* (Pallas, 1766) (N=67), *Myotis* spp. (N=24), *Phyllostomus hasarmadillos* (Pallas, 1767) (N=15), *Platyrrhinus lineatus* (Geoffroy, 1810) and (N=15), *Platyrrhinus recifinus*, (Thomas, 1901) (N=1).

Among the recorded species of Streblidae, Three species were added to the State's list. from Rio de Janeiro: *Strebla curvata* (Wenzel, 1976), *Trichobius angulatus* (Wenzel, 1976) and *Trichobius dugesii* (Townsend, 1891). Some bats were parasitized by Acari, however, they were not contagious identified, and unidentified. Only *A. geoffroyi, A. caudifer,* and *P. recifinus* were not parasitized by any ectoparasitic taxon analyzed. The most parasitized species was *G. soricina* (N=78).

Subfamília Streblinae.

Paraeuctenodes longipes Pessoa & Guimarães, 1936.

Host and Distribution: *Anoura caudifer* (Geoffroy, 1818), is the type host of this ectoparasitic and there is already a record for the State of Rio de Janeiro on this species.

Paraeuctenodes similis Wenzel, 1976.

Paraeuctenodes similis has been frequently observed in association with *Carollia perspicillata* (Linnaeus 1758).

Strebla curvata Wenzel, 1976. **Note:** First record of this species in the State of Rio de Janeiro. Its primary host is *Glossophaga soricina* (Pallas, 1766).

Strebla guajiro (García & Casal, 1965).

Host: Has as primary host *C. perspicillata*.

Subfamília Trichobiinae.

Trichobius anducei Guerrero, 1998. **Note:** Second record for Brazil and for the State of Rio de Janeiro: *C. perspicillata* is the primary host.

Trichobius angulatus Wenzel, 1976. **Note:** First record for the State of Rio de Janeiro and the Atlantic Forest. It was described as parasitizing *Platyrrhinus aurarius* (Handley & Ferris 1972).

Trichobius dugesii Townsend, 1891. **Note:** First record for the State of Rio de Janeiro. *Trichobius dugesii* (Wenzel & Tipton, 1966).

Trichobius joblingi (Wenzel, 1966). **Note:** Commonly recorded species parasitizing *C. perspicillata*.

Trichobius loncophyllae (Wenzel, 1966). **Note:** Originally described on *Lonchophylla robusta* Miller, 1912.

Trichobius longipes Rudow, 1871.

Host: *Phyllostomus hastatus* (Pallas, 1767) and *Trichobius tiptoni* (Wenzel, 1976) and *Anoura caudifer* (Geoffroy, 1818).

*Paratrichobius longicrus (*Miranda-Ribeiro, 1907) [43-45].

7. Conclusion

Braula is considered to cause little damage to bee colonies and its potential as a pathogen vector has so far been ignored. Among pathogens, the Acute bee paralysis virus (ABPV) and the Israeli acute paralysis virus (IAPV) have shown a strong correlation with winter bee colony losses in at least two long-term. It is important to point out that the prevalence of virus infections increases dramatically when the Varroa mite is inside the colony because this mite has been shown to be a mechanical and biological vector of honey bee viruses. Streblidae one larva develops inside the female and feeds on secretions from the accessory glands, which are highly specialized. Eventually, the third-instar larva is deposited as a sessile prepupa in a substrate. The pupa forms and remains in this state for at least four weeks; then, the adult emerges and proceeds to locate its new host. Streblidae family, which are parasites, are themselves infested by fungi of the order Laboulbeniales; these fungi are thus hyperparasitic.

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