

Discovery of a Parasitoid and a Predator of Bat Flies (Diptera: Streblidae) at La Selva, Costa Rica¹

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ABSTRACT

While netting bats to collect streblid bat flies at La Selva Biological Station, Costa Rica, two different natural enemies of streblids were found attacking the bat flies on two species of bats. One was identified as a parasitoid in the hymenopteran family, Braconidae, while the other was a predaceous plant bug in the hemipteran family, Miridae. This is the first description of a natural enemy of streblids being collected *in situ* (i.e., actively foraging through the hair of the streblid bat host).

RESUMEN

Durante la captura con red de murciélagos para colectar moscas de la familia Streblidae del orden Diptera en la estación biológica La Selva, Costa Rica, se encontraron dos enemigos naturales atacando las moscas Streblidae en dos especies de murciélagos. Uno fue identificado como un parásito de la familia Braconidae del orden Hymenoptera y el otro un insecto de la familia Miridae del orden Hemiptera que es un depredador de plantas. Este es la primera descripción de un enemigo natural de las moscas Streblidae colectado *in situ* (i.e., forrajeando activamente en el pelo del murciélago huésped de las moscas Streblidae).

Key words: bat flies; bats; Braconidae; ectoparasites; La Selva; Miridae; Phyllostomidae; Streblidae.

WITH 109 DESCRIBED SPECIES, bats are the most diverse members of the Costa Rican mammalian fauna (LaVal & Rodriguez 2002), and the extensive radiation of the Neotropical family Phyllostomidae is responsible for approximately 60 percent of this diversity. Due to their abundance and monopolization of many unique ecological niches, bats also serve as important hosts for many different kinds of ectoparasites. Perhaps the most important and conspicuous bat ectoparasites are the Streblidae and Nycteribiidae, often collectively referred to as bat flies, which are obligate sanguivorous members of the order Diptera that are highly specialized for feeding on and living with bats (Marshall 1982, Whitaker 1988). Patterson *et al.* (1998) reported that 24 genera and 153 species of Streblidae occur in the Western Hemisphere and can be collected from a variety of bat species (Wenzel & Tipton 1966, Timm *et al.* 1989, Miller & Tschapka 2001). In contrast, the Nycteribiidae are represented in the Western Hemisphere by only 2 genera and 37 species, which primarily parasitize bats of the family Vespertilionidae, but also of the family Emballonuridae and Phyllostomidae (Wenzel & Tipton 1966).

Recent phylogenetic analyses show that the streblid bat flies are actually paraphyletic consisting of two distinct clades: the New World Streblidae and the Old World Streblidae + Nycteribiidae (Dittmar *et al.*, in press). Streblid diversification in the New World has paralleled the diversification of the Phyllostomid bats (Timm

et al. 1989, Miller & Tschapka 2001), whereas the Old World streblids (+Nycteribiidae) appear to have diversified with the Pteropodid and Vespertilionid bats (Wenzel & Tipton 1966, Dittmar *et al.*, in press). In addition, numerous other ectoparasites have been documented from Neotropical bats such as ticks and mites (Acarina), fleas (Siphonaptera), and earwigs (Dermaptera; Marshall 1982, Whitaker 1988).

While netting bats to examine parasite loads among species with different roosting and feeding habitats and between males and females, we made two interesting discoveries on two of the sample bats that we collected. Bats were captured via mist nets at La Selva Biological Station, Heredia, Costa Rica on 25–26 June 2003. Nets were set up in both forested and open areas along trails, and nets were continuously serviced throughout the night. Upon capture, bats were immediately removed from the nets and placed in cloth bags to prevent ectoparasite escape. Ectoparasites were removed from all bats in the field with either soft-tip forceps or by hand and placed in labeled vials containing 85 percent ethanol for subsequent identification using criteria suggested by Wenzel and Tipton (1966). Each bat was then identified to species using Timm and LaVal's criteria (1998).

On the night of 25 June 2003, three adult male parasitic wasps (Hymenoptera) were collected in association with the streblid, *Paratrichobius dunni*. Two of these insects were found actively moving in the fur of a male *Carollia castanea* (Chiroptera: Phyllostomidae) while one was in direct contact with the streblid. All

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three specimens were later identified as an unknown species of *Heterospilus* (Hymenoptera: Braconidae: Doryctinae), and subsequent microscopic examination of the streblid revealed a small wound in the abdomen. Since the three specimens collected were all male and no identifiable egg could be recovered during dissection of the adult fly, it is likely that a female was present, perhaps in the process of ovipositing, just prior to capture of the bat and left while the bat struggled in the mist net.

At the same location, on 26 June 2003, we collected a species of predaceous plant bug, later identified as belonging to the genus *Eurychilella* (Hemiptera: Miridae: Bryocorinae: Ecritotarsini), in the process of probing/feeding on a different species of streblid, *Neotrichobius stenopterus*. Both the mirid and its streblid prey were collected from a different phyllostomid bat, *Dermanura watsoni*, which escaped prior to sexual determination.

Both instances are noteworthy as they represent the first records of members of these insect families to be described utilizing streblids as hosts or prey, though examples of braconids utilizing other dipteran families as hosts are well documented (Sharkey 1993). We find no record or reference to any known mirid species that attack Diptera (Schuh 1995), though this does not rule out the possibility of streblids serving as factitious hosts. Furthermore, we have found no reference of any Braconidae or Miridae living phoretically on bats.

While this hyperparasitic phenomenon involving insects appears to be undocumented in the literature, we find numerous reports of parasitic fungi in the family Laboulbeniales occurring on many different species of Diptera (Weir & Rossi 1995, Weir 1996), including Streblidae (Marshall 1981, Fritz 1983). However, this note documents the first occurrence of a second trophic level involving insects within the bat microhabitat. It is our hope that this paper will generate sufficient interest to encourage specialists to reexamine this system and determine if what we documented was an isolated case or if, in fact, it is more common than previously known.

Voucher specimens of the braconids and their respective host species of Streblidae have been deposited in the entomology collection of the Georgia Museum of Natural History (UGCA) at the University of Georgia. The mirid voucher specimen has been deposited in the entomology collection at the National Museum of Natural History at the Smithsonian (NMNH). All remaining streblid vouchers have been deposited in the Instituto Nacional de Biodiversidad, Costa Rica.

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