

LUTZOMYIA VESPERTILIONIS (DIPTERA: PSYCHODIDAE): POTENTIAL VECTOR OF CHIROPTERAN TRYPANOSOMES IN PANAMA¹

In the course of our studies on the epidemiology of cutaneous leishmaniasis, a number of bats were collected from central Panama and processed for hemoflagellates. Christensen & Telford (1972, *J. Protozool.* **19**: 403-06) noted that Panamanian sand flies may be infected with 4 genera of trypanosomatid flagellates, and suggested that elucidation of these host-parasite relationships may help to clarify the role various phlebotomine species play in the transmission of *Leishmania*.

Fairchild & Hertig (1947, *Ann. Ent. Soc. Amer.* **40**: 617-23), in their original description of *Lutzomyia vespertilionis*, noted the close ecological association between this species and bats, and concluded that Chiroptera are the preferred, if not the sole, hosts of this sand fly. The validity of this conclusion was substantiated by Tesh, Chaniotis, Carrera & Johnson (1972, *Amer. J. Epidemiol.* **95**: 88-93), who reported that 100% of the blood meals from 40 *L. vespertilionis* tested by the precipitin method reacted with *Chiroptera* antiserum. McConnell & Correa (1964, *J. Parasitol.* **50**: 523-28) and Correa (1964, *Arch. Med. Panameños* **2-3**: 183-94) reported 5 (62.5%) of 8 *Carollia* bats and 747 (67.9%) of 1101 *L. vespertilionis* examined were infected with trypanosomes, and suggested that this sand fly was the probable vector. Infections in the sand flies were limited to the mid- and hindgut, and the authors suggested that transmission probably occurs via fecal expulsion of metacyclic forms from the sand fly into superficial lesions or the bite wound. Zeledón & Rosabal (1969, *Ann. Trop. Med. Parasitol.* **63**: 221-27) incriminated *L. vespertilionis* as the vector of *Trypanosoma leonidasdeanei*, a parasite of the El Salvador Sheath-tailed Bat, *Saccopteryx bilineata*, in Costa Rica. They theorized that transmission occurred when infected sand flies were eaten by the bats.

Despite the strong circumstantial evidence that *L. vespertilionis* is the vector of the unnamed bat trypanosome in Panama and *T. leonidasdeanei* in Costa Rica, the relationship between the trypanosomes of bats and sand flies has never been demonstrated unequivocally. The recent colonization of *L. vespertilionis* (Christensen, 1972, *Ann. Ent. Soc. Amer.* **65**: 683-86) facilitated limited xenodiagnostic studies on 2 species of infected bats in Panama, and provided additional evidence to support the theory that sand flies are vectors of certain chiropteran trypanosomes. The present paper reports these positive xenodiagnostic trials.

Bats were collected with large insect nets from the walls of several limestone caves in central Panama. Thin blood smears from wing veins were examined for hemoflagellates. Positive bats were placed individually inside feeding cages with laboratory-reared *L. vespertilionis*. Blood-engorged flies were isolated singly in oviposition vials and dissected after egg deposition.

Twenty-one (72.4%) of 29 *L. vespertilionis* showed well-

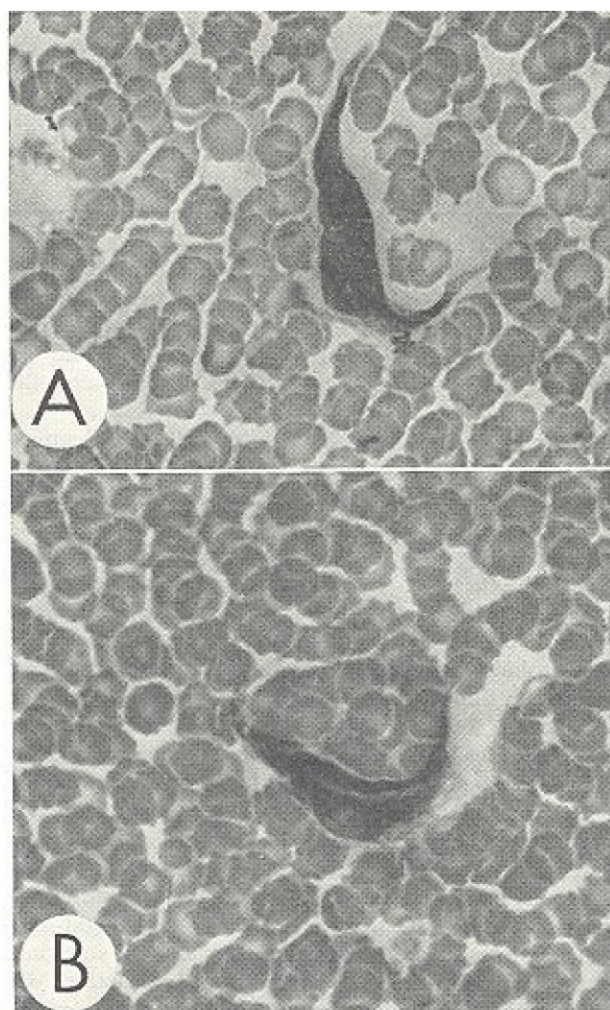


FIG. 1(A-B). *Trypanosoma leonidasdeanei* in thin blood smears from Panamanian *Saccopteryx bilineata*.

established infections 5 to 12 days after having fed on infected *Saccopteryx bilineata*. Trypomastigote and epimastigote forms were prevalent in these infections, all of which were restricted to that portion of the sand fly gut posterior to the midgut. Flagellates generally were found in several, if not all, of the morphologically distinct areas of the posterior tract; however, they were limited to the rectal ampulla in 6 (28.6%) of the infections. Infection rates in the various aspects of the posterior intestinal tract of positive flies were as follows: pylorus, 33.3%; hindgut, 61.9%; rectal ampulla, 71.4%. Actively motile unattached forms usually were evident in the gut lumen, but the majority of flagellates were affixed to the intestinal wall or rectal glands by their flagella. The marked proliferation of parasites in some flies caused distention of the intestine. There were no differences in the infection patterns in relation to the duration of the infection in the flies. In addition to the foregoing xenodiagnoses, 2

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TABLE 1. Measurements of 10 trypanosomes from thin blood smears, fixed in methanol and stained with Giemsa, from 3 *S. bilineata* (all measurements in μ).

	MEAN	MAXIMUM	MINIMUM
Total length, including flagellum	47.9	60	37
Body length	44.6	56	35
Free flagellum	3.3	4	2
Body width (at nucleus level)	6.0	11	4
Posterior end of body to kinetoplast (P-K)	19.2	25	14
Kinetoplast to middle of nucleus (K-N)	3.3	4	3
Posterior end of body to middle of nucleus (P-N)	22.5	29	17
Middle of nucleus to anterior end of body (N-A)	22.0	27	17
Nuclear index (P-N/N-A)	1.0	1.2	0.9

L. vespertilionis which fed on a sac-winged bat *Peropteryx macrotis* developed infections. Flagellates were restricted to the rectal ampulla of 1 fly dissected 9 days postprandially. The 2nd fly showed flagellates throughout the gut from the cardia to the rectal ampulla 12 days after the infective blood meal.

The trypanosome from *S. bilineata* (FIG. 1) is identified tentatively as *T. leonidasdeaneii*, a member of the *megadermae* group. Measurements of 10 trypanosomes from 3 *S. bilineata* are given in TABLE 1.

In fresh preparations, the trypanosome exhibited an active undulating membrane and traveled slowly in a single direction. The posterior part of the body remained rigid and often twisted. These characteristics, as well as the morphological appearance of stained specimens, agree closely with those described for *T. leonidasdeaneii* by Zeledón & Rosabal (1969, loc. cit.). All parasitemias were low grade, with less than a dozen parasites per slide.

The peritrophic membrane of *L. vespertilionis* probably forms an impenetrable barrier for the trypanosomes which are released into the hindgut upon disruption of the membrane. Occasionally, we have observed dissections in which an apparently malformed peritrophic membrane fails to contain the blood meal in the midgut and fresh erythrocytes are disbursed throughout the intestinal tract. This may account for the flagellate pattern observed in the 2nd *L. vespertilionis* which fed on *P. macrotis*.

Johnson, McConnell & Hertig (1963, Exp. Parasitol. 14: 107-22) noted that flagellates in unbroken, dissected-out guts of *L. vespertilionis* and *L. trinidadensis* may pass through the anus into saline dissecting medium. These workers also reported that living, undamaged sand flies can propel a drop of liquid from the anus with considerable force. A likely mode of transmission is through the deposition of infective sand fly feces during the day on the

fur or membranes of sleeping bats. This material would be subsequently ingested by the bats during their grooming and cleaning behavior prior to their evening foraging. The opportunity exists in species of bats such as *Carollia perspicillata*, which may cluster in colonies of as many as 1000 individuals (Bloedel, 1955, J. Mammal. 36: 232-35), for infective sand fly feces to be spread from one bat to another by contact and cross-grooming activity. In addition to the nocturnal hematophagus activity exhibited by most sand flies, *L. vespertilionis* also feeds frequently during the daytime when bats are resting in caves or other darkened recesses, and therefore most accessible to the flies. The short, low-level flights of sand flies would appear to exclude them from predation by insectivorous bats, and therefore we do not ascribe to the theory that transmission occurs when bats eat infected sand flies (Zeledón & Rosabal, 1969, loc. cit.).

Hoare (1972, *The trypanosomes of mammals*, Blackwell Scientific Publications, Oxford & Edinburgh, 749 p.) lists 54 bat species in the New World which host 1 or more of 9 trypanosome species. The bat-associated triatomid *Cavernicola pilosa* has been implicated as the possible vector of chiropteran trypanosomes (Dias, Mello, Costa, Damasceno & Azevedo, 1942, Rev. Brasil Biol. 2: 103-10; Marinkelle, 1966, Trans. Roy. Soc. Trop. Med. Hyg. 60: 109-16). Additional vector relationships, other than those pertaining to *L. vespertilionis* cited in the present paper, are unknown. From the evidence at hand, we feel that any phlebotomine sand fly which cohabits resting sites with bats should receive attention in future searches for vectors of chiropteran trypanosomes.—**Howard A. Christensen and Aristides Herrero**, Gorgas Memorial Laboratory, Panama 5, Republic of Panama. Mailing address, P. O. Box 2016, Balboa Heights, Canal Zone.