

PANSTRONGYLUS GENICULATUS (HETEROPTERA: REDUVIIDAE: TRIATOMINAE): NATURAL INFECTION WITH *TRYPANOSOMA CRUZI* UNDER CAVERNICOLOUS CONDITIONS IN PARAGUANÁ PENINSULA, VENEZUELA

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Abstract: The flagellate protozoan, *Trypanosoma cruzi*, causes Chagas disease, a zoonosis affecting millions of humans in the Americas. The triatomine insect, *Panstrongylus geniculatus*, a well known vector of this disease, inhabits and is infected with *T. cruzi* in Cueva del Guano, a limestone cave in Paraguaná Peninsula, Venezuela. *P. geniculatus* probably feeds on the blood of four rare or endangered bat species roosting in this cave, infecting them with *T. cruzi*. It is recommended that (1) any epidemiological activity at this cave be designed to minimize bat mortality, and (2) speleologists visiting tropical caves avoid contact with triatomine insects and their feces.

INTRODUCTION

Cueva del Guano is an underground limestone cave located in a flat thorn-scrub region, in Paraguaná Peninsula, Venezuela, at elevation 120 m. The cave has approximately 70 m of galleries, and has a 1 × 1 m entrance that opens on a 24 × 20 m antechamber, which in turn communicates with the exterior through an ample (15 × 6 m), 10 m deep, sink (SVE, 1972; Matson, 1974; Molinari et al., 2005). Inside the cave, atmospheric temperature is 31–36°C, and humidity is 88–96% (Matson, 1974; Bonaccorso et al., 1992). The crown of a large tree (*Ficus* sp.) rooted at the bottom of the antechamber occludes most of its sink. Therefore, the environment of the antechamber is dark, warm, and humid, though to a lesser degree than that of the cave proper.

MATERIALS AND METHODS

On the nights of December 8–10, 2004, a team of four persons, including two authors and a British Broadcasting Corporation (BBC) filming crew, spent approximately 20 hours in the antechamber of Cueva del Guano observing centipedes and bats. On several occasions during this activity, the team observed groups of flying triatomine insects (Heteroptera: Reduviidae: Triatominae) being attracted to the light of headlamps. These insects appeared to belong to a single taxon identifiable (Lent and Wygodzinsky, 1979) as *Panstrongylus geniculatus* (voucher material collected), a species known for being easily attracted by artificial light (Lent and Wygodzinsky, 1979; Miles et al., 1981; Omah-Maharaj, 1992; Pieri et al., 2001). In addition, on the morning of December 10th, we captured one nymph, also identifiable as *P. geniculatus*, found resting on a wall of the antechamber. Because this nymph arrived alive at the laboratory, it was tested for infection with *Trypanosoma cruzi*, the protozoan causing Chagas disease, a zoonosis also affecting an estimated 16–

18 million people in the Americas from Mexico to Argentina (Lent and Wygodzinsky, 1979; Prata, 2001). The test consisted of a microscopic examination of mixtures of its feces and hemocoel with isotonic saline solution. Abundant trypomastigotes (the infective stage of *T. cruzi*) were observed in the fecal mixture, and no trypomastigotes in the hemocoel mixture, a combination of findings indicating that the nymph was infected with *T. cruzi*, but not with *T. rangeli* (Cuba, 1998; Guhl and Vallejo, 2003). It must be noted that *P. geniculatus* is a major sylvatic vector for *T. cruzi* that has never been found naturally infected with *T. rangeli* or other *Trypanosoma* species (Lent and Wygodzinsky, 1979; Pova et al., 1984; Omah-Maharaj, 1992; Guhl and Vallejo, 2003; Feliciangeli et al., 2004).

RESULTS

P. geniculatus typically inhabits animal burrows, especially those excavated by armadillos (Lent and Wygodzinsky, 1979; Miles et al., 1981; Omah-Maharaj, 1992). Peridomestic colonies of the species have been found in Brazil (Valente et al., 1998; Valente 1999), and domestic colonies in Colombia and Venezuela (Angulo et al., 1999; Reyes-Lugo and Rodríguez-Acosta, 2000; Feliciangeli et al., 2004). Because triatomine nymphs are not capable of flight, and therefore have a low mobility, the finding of one *T. cruzi*-infected nymph (in addition to numerous adults) of *P. geniculatus* in the interior of the antechamber of Cueva del Guano proves that the species can be cavernicolous, and that it can act as a vector for Chagas disease in or around caves. To the authors' knowledge,

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only Omah-Maharaj (1992), who collected *T. cruzi*-infected nymphs in two caves (Caura, Tamana) in Trinidad, inhabited by seven bat species (*Anoura geoffroyi*, *Carollia pespicillata*, *Mormoops megalophylla*, *Natalus tumidirostris*, *Phyllostomus hastatus*, *Pteronotus davyi*, *P. parnellii* (Goodwin and Greenhall, 1961)), has reported similar findings for *P. geniculatus*. In addition, for *Triatoma pallidipennis*, another triatomine species, *T. cruzi*-infected nymphs have been found in bat-inhabited caves in Ticumán, Mexico (Villegas-García et al., 2001). Bats from the same locality, including cavernicolous (*Artibeus jamaicensis*, *Choeronycteris mexicana*, *Glossophaga soricina*, *P. parnellii*) and tree-dwelling (*Sturnira lilium*) species, were found to have high rates of infection with *T. cruzi* (Villegas-García et al., 2001).

DISCUSSION

The finding of *T. cruzi*-infected triatomine nymphs in bat-inhabited caves (Omah-Maharaj, 1992; Villegas-García et al., 2001; this study), the known role of bats as reservoir hosts of *T. cruzi* (Barretto, 1985; Villegas-García et al., 2001), and the fact that Cueva del Guano is inhabited by 45,000–50,000 bats of five species (*Leptonycteris curasoae*, *M. megalophylla*, *N. tumidirostris*, *P. davyi*, *P. parnellii* (Matson, 1974; Molinari et al., 2005)), indicate that cavernicolous bats are likely to be a part of the sylvatic cycle of *T. cruzi* in Paraguaná Peninsula. However, it should be emphasized that bats are by no means the only possible source of blood for *P. geniculatus* in or around Cueva del Guano. Armadillos (*Dasybus novemcinctus*) and skunks (*Conepatus semistriatus*) inhabit small limestone cavities that abound in the area. A large rat (probably *Proechimys* sp.) and a marsupial (*Marmosa* sp.) have been observed by the research team on the branches of the large *Ficus* rooted in the antechamber, and a domestic goat and her calf sleeping under the crown of this tree. Some of these mammals (*Marmosa* sp., goat) have been observed inside the antechamber.

CONCLUSIONS

To conclude, it should be noted that Cueva del Guano is the refuge of four rare or endangered bat species, namely *P. parnellii paraguayensis* (probably deserving full specific status and known to exist in only three caves in the Peninsula (Gutiérrez and Molinari, in press)), *M. megalophylla* and *N. tumidirostris* (known in Venezuela from only a few caves (Linares, 1998)), and *L. curasoae* (a migratory species essential for the pollination of cacti and other plants of Venezuelan arid zones (Nassar et al., 2003)). Although protective measures are being taken, vandalism is reducing the populations of these species. Therefore, it is recommended that any epidemiological activity at Cueva del Guano be designed to minimize the disturbance and mortality of bats. It is also recommended that speleologists

exploring tropical caves to learn to recognize triatomine insects, and avoid contact with them or with their feces.

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