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Flight dispersal of the Chagas disease vectors *Triatoma brasiliensis* and *Triatoma pseudomaculata* in northeastern Brazil

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Abstract

The present paper reports for the first time the capture of wild *Triatoma brasiliensis* and *Triatoma pseudomaculata* by means of light traps in Brazil. We tested commercially available lighting devices powered by batteries to attract the bugs to a white piece of cloth in the field. Two main findings showed to be significant: first, the results presented here show that light traps can be used for sampling these species in wild environments; second, they reveal that house colonization by triatomines may also happen as a consequence of the arrival of flying sylvatic bugs guided by artificial light sources. In addition, we discuss the effect of some environmental and biological factors on triatomine flight activity modulation.

Keywords: Triatominae; Light traps; Flight; Sampling; Northeastern Brazil

1. Introduction

Triatomine bugs are vectors of *Trypanosoma cruzi* Chagas, 1909, the etiological agent of Chagas disease. Currently, approximately 120 million people are exposed to infection in Latin America and 16–18 million are effectively infected with this parasite (TDR, 2002). There are more than 130 species of triatomine bugs described, and most of them feed on endothermic animals. Some of these species are closely related to human dwellings, and, therefore, they become epidemiologically important to man. On the other hand, most triatomines species are strictly sylvatic, almost with no contact with humans. Between these two opposite situations, there is a continuous gradient for other species sharing features of both groups (Schofield, 1994). This is the case of *Triatoma brasiliensis* Neiva, 1911 and *Triatoma pseudomaculata* Corrêa & Espínola, 1964, the two main vector species found in northeastern Brazil. *T. brasiliensis* is typically found in rock piles, in association with mammals and reptiles, and *T. pseudomaculata* is commonly found inhabiting hollow trees associated

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with birds (Carcavallo et al., 1997; Dias-Lima et al., 2003).

The predominant landscape in our study area is the "caatinga", characterized by the presence of the catingueira tree (*Caesalpinia pyramidalis*) in the north-eastern Brazilian region. This dominant vegetal species is distributed in rocky mountain ranges sparsely emerging from flat areas. Two different weather patterns can be described for this region: a remarkably hot and dry climate, that extends from May to the beginning of December; and intermittent rains throughout the rest of the year. As a consequence, there are many differences regarding foliage abundance and, therefore, host availability for the insects. As for the two Chagas disease vectors under study, *T. brasiliensis* is mostly found in the rocky mountain ranges, while *T. pseudomaculata* is more abundant in the flat areas of "caatinga".

Flight is one of the main mechanisms involved in long-distance movements in insects. The dispersal for either food or mate may be considered as the fundamental phenomena that induce them to fly. Nutritional (Lehane et al., 1992; McEwen and Lehane, 1993) and reproductive (McEwen and Lehane, 1994) status, as well as population density (McEwen et al., 1993) and environmental conditions, such as temperature (Lehane et al., 1992; Schofield et al., 1992), are factors known to modulate the flight activity in triatomines. Although triatomines are predominantly walking insects, colonization of new habitats seems to occur by flight and/or by passive dispersal (Forattini et al., 1979). Flight may be an important factor for the colonization of new houses not only by domiciliated species but also by wild species. Light may make human dwellings more attractive to these bugs, but few reports on light trap captures have supported this presumption (Tonn et al., 1978; Schweigmann et al., 1988; Wisnivesky-Colli et al., 1993; Noireau and Dujardin, 2001; Vazquez-Prokopec et al., 2004).

In this work, we analyzed whether *T. brasiliensis* and *T. pseudomaculata* can be captured in the field using light traps.

2. Materials and methods

The collecting area is located near Curaçá, Bahía State (S 8°57′ W 39°49′; 500 m a.s.l.), northeastern Brazil, in the caatinga region. In this area, natural colonies of both *T. brasiliensis* and *T. pseudomaculata* had been previously found by Dias-Lima et al. (2003). 15 light trap captures were done at two different sylvatic locations: a plain zone with arboreal vegetation (site a: 9 nights) and a pile of rocks on a foothill (site b: 6 nights). Only one light trap was operated during the 15 nights in three different periods (November 2001, November 2003 and May 2004, see Table 1).

Table 1
Triatomines captured by means of battery-powered light traps in Curaçá, Bahía State, Brazil

Date	Site	*Triatoma brasiliensis*		*T. pseudomaculata*		Wind	Moon
		Males	Females	Males	Females		
November 2001	b	2	1		1	Weak	No
	b	–	1	–	–	Weak	No
	b	–	–	–	–	Strong	No
	b	1	1	–	1	Weak	No
November 2003	a	–	–	–	–	None	No
	a	1	–	2	1	Weak	No
	a	–	–	1	1	Intermediate	No
	a	–	–	1	–	None	No
	a	–	–	1	1	Intermediate	No
	a	–	–	–	2	Weak	No
April 2004	a	–	–	–	1	Intermediate	No
	a	–	–	–	1	Intermediate	No
	b[a]	–	–	–	–	Strong	No
	a	1	–	2	–	Weak	Cloudy
	b	–	–	–	–	Weak	Yes
Total		5	3	7	9		

Insects were collected in wild environments during November 2001, November 2003 and April 2004. Capture sites corresponding to (a) "caatinga" plain; (b) rock piles on ridges of foothills.
[a] A male of *Panstrongylus lutzi* was captured.

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Two different battery-powered lighting devices were used: (i) an ATOMLUX 2050 Solar Design for four nights (2001 campaign) and; (ii) a Coleman 5359 Series (lamp HF/ED π.13 W/6500 °K) for 11 nights (2003 and 2004 campaign). The trap arrangement consisted of two pieces of white cloth (3 m × 2 m), one vertically extended and the other laid on the ground in order to prevent specimens from falling onto the ground when flying against the vertical cloth. The trap system was illuminated by the lighting device set 1 m away from the cloth and 1 m above ground. The whole device was mounted in daylight and the lights were turned on 30 min before sunset. If there was no triatomine captures after a period of approximately 1 h, traps were inactivated, i.e., lights were turned off.

All the triatomines that flew into or around the trap were caught with a forceps and collected in vials. Upon arriving in the laboratory, the species and sex of each individual were identified and recorded. Daily prevailing weather conditions during the sampling period were noted down, as well as the presence or absence of moonlight. Wind intensity was evaluated visually. A lack of movement of the trap cloths and the leaves in the surrounding vegetation was considered as "no wind". An intermediate situation was that in which the cloths and leaves moved slightly. For a single night, in which the clots were permanently inflated by the predominant air current, strong wind conditions were recorded.

3. Results

Triatomines reached light traps in 73% of the nights (11/15). The table shows the total number of captures, dates, sites, species and sex. *T. pseudomaculata* showed to be the predominant bug species collected and *T. brasiliensis* represented one-third (8/24) of the total number captured bugs. Additionally, a *Panstrongylus lutzi* male specimen was captured. No significant differences were observed in the sex ratio of the collected insects of both species (Table 1). Differences were observed between the number of captures performed during the dry (November 2001, 2003) and humid (May 2004) seasons. More insects were collected during the former (1.9 insects/night) than during the later (1 insect/night). According to our visual evaluation, all the triatomines collected showed to have flat abdomens characteristic of a fasting status.

The sites chosen for setting up the traps affected the ratio of species captured (Table 1, Fig. 1). When traps were set up on the plain caatinga, most triatomines captured were *T. pseudomaculata*, whereas *T. brasiliensis* was found in a higher proportion on the foothill.

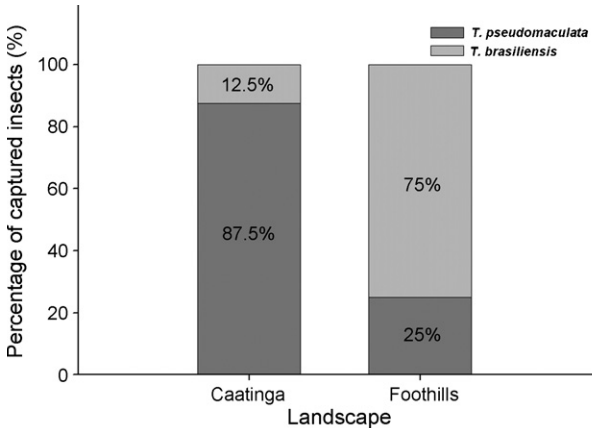

Fig. 1. Percentage of triatomines of each species captured with light traps at each of the two wild environments of Curaçá, Bahía State, Brazil.

4. Discussion

Our data suggest that *T. brasiliensis* and *T. pseudomaculata* are attracted by light. Thus, light traps can be used for sampling purposes, allowing the capture of live wild triatomines for laboratory study. The frequency of arrivals observed with these triatomine species was similar to that reported by Noireau et al. (2000) using light traps for capturing Triatominae. On the other hand, captures were scarce if compared with those of *T. protracta*, *T. sordida* and *T. guasayana* in other studies (Sjogren and Ryckman, 1966; Noireau and Dujardin, 2001).

The arrival of wild triatomine adults to our light trap suggests that light sources may enable bugs to colonize dwellings. If houses with artificial light were located at such capturing sites in the caatinga, one could expect that approximately 1.7 triatomines would reach these houses every night (88% being *T. pseudomaculata*). Because the sampling sites were located at least 2 km away from the nearest dwellings, it is likely that the insects captured were sylvatic. All of them were apparently in a fasting status, and *T. brasiliensis*, particularly, seemed to be very active at the time of their capture and motivated for feeding (they spontaneously extended their proboscis when captured).

The Triatominae fauna of the surrounding areas, where light trap surveys were carried out, was studied by Dias-Lima et al. (2003), showing that out of 58 trees investigated by means of live bait traps, 43.1% were positive for *T. pseudomaculata* and none for *T. brasiliensis*, which was the prevailing species found among rocks. One adult specimen of *P. lutzi* was also collected in a rocky shelter. Our results confirm that each species prefers different sylvatic habitats (see Fig. 1). Because

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the two different collection habitats were approximately 500 m apart and presented an altitude difference of approximately 60 m, we suggest that the effective range of light traps is a few hundred meters away from the actual collection sites. This resembles the results obtained by Vazquez-Prokopec et al. (2004) with *T. infestans*.

Some literature data (McEwen and Lehane, 1994; Lehane et al., 1992) suggest that the active process of colonization occurs by flying gravid starved females. Our survey suggests that both males and females of the species under study are equally motivated to approach light sources, as recently showed by Minoli and Lazzari (2006) in laboratory assays conducted with *T. infestans* and *Rhodnius prolixus*. The arrival of individuals of both sexes to houses as a response to light sources would facilitate the establishment of new domestic colonies.

The light trap success in collecting bugs during the two different survey periods (dry season, November, and humid season, April) contrasts with the collecting results by dissection of dead trunks when performed simultaneously (Carbajal de la Fuente et al., in preparation). The proportion of *T. pseudomaculata* adults collected in the trunks in November was lower compared to that observed in April. A low number of adults and small nymphs are normally captured during the dry season through habitat dissection, but figures change drastically as many well fed larger nymphs and adults are found inside tree-logs during the wet season. This dramatic difference with the captures of flying adults may mirror a modification of the nutritional status of insects between these two opposite environments. Therefore, our data may indicate that adult triatomines can fly more frequently in search for food sources during the dry season.

This work contributes to understand the dispersal mechanisms used by two epidemiologically important triatomine bugs, demonstrating that they can disperse by flight. Moreover, it shows that light from dwellings affects the orientation of these bugs during flight. We show here that *T. brasiliensis* and *T. pseudomaculata* are able to actively invade human houses with light sources. Finally, this report presents relevant information for Chagas disease control programs and scientists studying these triatomines, since it demonstrates that light traps can be employed as adult sampling/monitoring tools in this region.

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