Triatominae Survey (Hemiptera: Reduviidae: Triatominae) in the South-Central Region of the State of Bahia, Brazil between 2008 and 2013

Vagner José Mendonça, Jader de Oliveira, Aline Rimoldi, Júlio C. R. Ferreira Filho,
Renato Freitas de Araújo, and João Aristeu da Rosa*

Laboratório de Parasitologia Médica e Biologia de Vetores, Área de Patologia, Faculdade de Medicina, Universidade de Brasília, Brasília, Brazil;
Faculdade de Ciências Farmacêuticas/UNESP, Campus de Araraquara, Araraquara, Brazil; Instituto de Biologia/UNICAMP, Campinas, Brazil;
Laboratório de Soroepidemiologia e Imunobiologia, Instituto de Medicina Tropical/USP, São Paulo, Brazil;
Laboratório Central/LACEN, Secretaria Estadual de Saúde da Bahia/SESAB, Salvador, Brazil

Abstract. Triatomine surveillance in rural areas, artificial ecotypes, and natural ecotopes of the cities of Caturama, Ibipitanga, Macaúbas, and Seabra in the south-central region of the Brazilian state of Bahia was carried out between 2008 and 2013. Natural infection by *Trypanosoma cruzi* was evaluated in the specimens collected to monitor vectors of Chagas disease. A total of 1,357 specimens were collected, and four species were identified: *Triatoma sordida* (83%), *Triatoma lenti* (16.4%), *Triatoma pseudomaculata* (0.5%), and *Panstrongylus geniculatus* (0.1%). *Triatoma sordida* was found in four cities, only 0.7% in intradomiciliary environments. *Triatoma lenti* was found only in Macaúbas; 8.5% were found in intradomiciliary environments, 88.3% in peridomiciliary environments, and 3.1% in sylvatic environments. Natural infection by *T. cruzi* was 0.5% for *T. sordida* and 3.1% *T. lenti*. All of these cases were found in peridomiciliary environments of Macaúbas. As the results show, triatomines were found in intradomiciliary environments in three cities that were surveyed in the south-central region of the state of Bahia. Thus, an epidemiologic survey should be performed to avoid the risk of transmission to the population.

Chagas disease, also known as American trypanosomiasis, is caused by the protozoan parasite *Trypanosoma cruzi* (Kinetoplastida: Trypanosomatidae). It is most frequently transmitted by the infected feces of blood-sucking triatomine bugs (Hemiptera: Reduviidae: Triatominae).^{1,2} Human infection is endemic throughout Latin America; however, 7 to 8 million people worldwide are estimated to be infected.^{3,4} In the subfamily Triatominae, 149 species are currently grouped into 18 genera and five tribes. Forty-three species are exclusively distributed within Brazil.^{5–11} The state of Bahia in north-eastern Brazil has the largest number of species (25 spp.).⁸

In Brazil, the National Chagas Disease Control Program (PCDCh) was implemented from 1975 to 1983, when *Triatoma infestans* infested households in 700 cities across 12 Brazilian states. Although the main vector *T. infestans* has been controlled, thirty different vector species or potential vector species of Chagas disease have been identified in the country. Of the 1,942 cities investigated, 1,854 were found to have these vectors in intradomiciliary and/or peridomiciliary environments (95.5%).^{8,12,13}

In 1996, the PCDCh, sponsored by the Brazilian National Health Foundation (FUNASA) and the Ministry of Health (MS), collected 290,576 triatomines, 201,156 (69.2%) of which were captured in the northeastern region of the country, where more measures are required in light of the presence of sylvatic species that are potentially invasive and difficult to control.¹⁴

An entomological survey in the state of Bahia between 1957 and 1971 was performed in 889,972 dwellings in 11,045 locations, and 33,588 bugs were collected. Four genera and 18 species of Triatominae were identified. This study allowed for the description of three species: *Triatoma bahiensis*, *Triatoma lenti*, and *Triatoma pessoai*.^{15,16} *Triatoma bahiensis* was found in the city of Seabra, whereas *T. pessoai* and *T. lenti* were all

found in the cities of Brotas de Macaúbas, Macaúbas, and Ipupiara, all of which are located in the south-central region of the state of Bahia. All three species were found inside houses. *Triatoma pessoai* and *T. lenti* were found to be naturally infected with *T. cruzi*.^{15,16} Lent and Wygodzinsky² prefer to list *T. pessoai* and *T. bahiensis* as synonyms of *T. lenti*. The epidemiological importance of these species in the cities justifies the survey in this region.

Studies on the geographic distribution of these species are crucial for understanding epidemiologic aspects of *T. cruzi* transmission, and must be considered when actions to control and monitor the disease are taken. The study of the potential geographic distribution of important vector species is essential for understanding the geographic dimensions and the risk of transmission of the disease.⁸

This study aimed to survey triatomine fauna and to determine the natural infection rates in four cities of the central region of Bahia State. It is hoped that this study will provide relevant information for improving the monitoring activities of Chagas disease.

The region studied is located in the Physiographic Zone of the Serra Geral (mountain range), which is part of the Chapada Diamantina mountain range region in south-central Bahia State (Figure 1). Bugs were collected by manual searches using forceps. The searches included intradomiciliary, peridomiciliary, and sylvatic environments. The specimens collected were grouped according to locality site and identified using an entomological key.²

Natural infection by trypanosomatid was evaluated using feces obtained by abdominal compression of the triatomines captured. Analyses were carried out at the Laboratory of Parasitology of the College of Pharmaceutical Sciences, São Paulo State University (UNESP), Araraquara, São Paulo, Brazil. The infectivity index was defined as the ratio between the number of infected triatomines and the triatomines examined.¹⁷

To isolate and confirm the parasite, samples that tested positive for trypanosomatids were diluted with 0.9% saline and examined between slide and coverslip using optical microscopy. Next, 0.3 mL was intraperitoneally injected into Swiss mice that

*Address correspondence to João Aristeu da Rosa, Depto. Ciências Biológicas, Faculdade de Ciências Farmacêuticas, Universidade Estadual Paulista, Rodovia Araraquara-Jaú km 1, CEP 14801-902, Araraquara, SP, Brazil. E-mail: joaoaristeu@gmail.com

FIGURE 1. Map showing the municipalities surveyed in the south-central region of the state of Bahia, Brazil.

were 23 and 35 days of age, and another 0.3 mL was inoculated in a Liver Infusion Tryptose (LIT) medium. Approximately 15 days following the inoculation, the peripheral blood of the mice was checked for flagellate forms, and the regular growth of the parasite in the LIT medium was verified.¹⁷

Twenty-four sites were surveyed in the four municipalities of the central region of Bahia State. Seventeen of these sites were positive for triatomine capture. In Caturama, the presence of triatomines was confirmed at three sites: Alecrim, Baraúnas, and Pedro Antônio. The three sites surveyed within Ibipitanga (Amargosa, Carrapato, and Remansso) were all positive for triatomine capture. Macaúbas had 11 sites surveyed; triatomines were found in seven of them (Cana Brava, Mangabeira, Maxixe, Coqueiros, Boqueirãozinho, Barreiro do Campo, and Brejo do João Urcino). In Seabra, four of the six sites surveyed were found to have triatomines (Baixão Velho, Poço Grande, São Lourenço, and Olho d'Água).

In 5 years (2008–2013) of triatomine fauna surveys, 1,357 specimens were collected (Table 1). Four species were found during the surveillance: *Triatoma sordida*, *T. lenti*, *T. pseudomaculata*, and *Panstrongylus geniculatus*.

TABLE 1

Number of triatominae species captured and infected with *T. cruzi*, in cities in the south-central region of the state of Bahia, Brazil, between 2008 and 2013

Species	City							
	Macaúbas			Seabra		Ibipitanga		Caturama
	P	I	S	P	I	P	I	P I
<i>T. lenti</i>	196	19	7					
Infection <i>T. cruzi</i>	7 (3.1%)	—	—					
<i>T. sordida</i>	601	6	245			95	2	177
Infection <i>T. cruzi</i>	6 (1%)	—	—			—	—	—
<i>T. pseudomaculata</i>	4	1	1					1
Infection <i>T. cruzi</i>	—	—	—					—
<i>P. geniculatus</i>				2				
Infection <i>T. cruzi</i>				—				

I = Intradomiciliary; P = Peridomiciliary; S = Sylvatic.

Triatoma sordida was the species with the largest number of specimens collected (1,131), and it was found in four of the municipalities surveyed. The specimens were found in intradomiciliary environments in the cities of Macaúbas and Ibipitanga. They were also found under the bed and in wall cracks inside houses at the Amargosa site, in the city of Ibipitanga (Figure 2A). In the municipalities of Caturama and Seabra the specimens were found only in peridomiciliary environments.

Triatoma lenti was found only in Macaúbas. Approximately 9% of the specimens captured were founded in intradomiciliary environments. Traces of triatomine blood were found within the walls of houses at the Cana Brava site (Figure 2B). Sylvatic specimens of this species were also found at the Mangabeira site, and seven specimens (3%) were captured (Figure 2C). Most of the peridomiciliary samples (88% of the specimens found) were collected in pigsties (Figure 2D) and chicken coops.

Triatoma pseudomaculata was collected in the municipalities of Macaúbas, Seabra, and Caturama. In Macaúbas, one specimen was found in an intradomiciliary environment (on the wall near the roof), and four specimens were captured in peridomiciliary environments (chicken coops). One specimen was captured in Caturama on a tree trunk 50 meters away from a house. In Seabra, one specimen was found in a peridomiciliary environment (a chicken coop). In addition, *P. geniculatus* was observed only in Seabra, where two adult specimens were provided by a resident who had found them invading the home.

All of the specimens collected were analyzed to determine natural infection by trypanosomatid from feces of triatomines. Approximately 1% were positive for *T. cruzi*. In addition, 3.5% of *T. lenti* specimens collected in peridomiciliary environments of Macaúbas were found to be infected with *T. cruzi*. In the case of *T. sordida*, 0.5% of the samples collected were positive for *T. cruzi*. No *T. pseudomaculata* or *P. geniculatus* specimens were found to be positive for *T. cruzi*.

FIGURE 2. (A) Feces in cracks in the walls inside residences at the Amargosa site, within the city of Ibipitanga; (B) Traces of triatomine blood on the indoor walls of homes at the Cana Brava site, within the city at Macaúbas; (C) Rocky wild environment where *T. lenti* specimens were collected; (D) Peridomiciliary pigsty where infected *T. lenti* specimens were found.

Our results suggest the ability of triatomines to invade intradomiciliary environments, and their potential vectorial capacity in the transmission of *T. cruzi*. *Triatoma sordida*, *T. lenti*, *T. pseudomaculata*, and *P. geniculatus* were collected in the south-central region Bahia State in this study. Other species, such as *P. diazi*, *P. lutzi*, *P. megistus*, *T. maculata*, *T. melanocephala*, and *T. tibiamaculata*, were also collected in the same region in a survey of triatomine fauna in the state of Bahia between 1957 and 1971.^{15,16}

Entomological surveys have shown that 17 vector species have been recorded from household environments, with varying degrees of colonization and natural infection.^{18,19} Costa and others¹⁸ performed a surveillance in 12 Brazilian states in the period between 1993 and 1999, and they captured 21 species of triatomines in intradomiciliary environments. In the state of Bahia, 14 species were found in this biotope, including *P. geniculatus*, *T. lenti*, *T. pseudomaculata*, and *T. sordida*.¹⁸

Previous studies have recorded *T. lenti* in Brotas de Macaúbas, Iupiará, and Macaúbas, cities of the state of Bahia. The geographic distribution of this species is restricted to the Caatinga biome. We have found *T. lenti* inside houses in Macaúbas (9%), and other authors have reported it in intradomiciliary environments in the Brazilian states of Bahia and Goiás.^{8,18} However, according to Silveira,²⁰ *T. lenti* is considered strictly sylvatic, as is *P. geniculatus*. Even so, two adult specimens were captured in intradomiciliary environments in this study. Although *P. geniculatus* was found only in Seabra in this study, Sherlocki and Serafim¹⁵ have recorded this species in eight cities in the state of Bahia, and Costa and others¹⁸ reported intradomiciliary specimens in the Brazilian states of Bahia, Ceará, Goiás, Maranhão, Minas Gerais, Paraíba, Pernambuco, and Tocantins. This wide geographic distribution of *P. geniculatus* reflects its occurrence in four biomes: the Atlantic forest, Caatinga, the Cerrado, and the Amazon.⁸

Triatoma pseudomaculata and *T. sordida* have been captured in either natural or artificial ecotopes, and have been

frequently found to present domiciliary colonies.²⁰ In addition to these two species, Forattini²¹ lists *P. megistus*, *T. brasiliensis*, and *T. infestans* as species of major epidemiological importance, because of their capacity for domiciliation. *Triatoma pseudomaculata* presents a wide geographic distribution; it has been recorded in all states in the Brazilian Northeast, and in the states of Distrito Federal, Goiás, Minas Gerais, Mato Grosso, Mato Grosso do Sul, and Tocantins. Thus, it has been found in the Atlantic forest, Caatinga, and Cerrado biomes.^{5,8,18} In this study, *T. pseudomaculata* was collected in three of the four cities surveyed; six specimens were captured in peridomiciliary environments and one in an intradomiciliary environment, the latter of which was in Macaúbas.

Triatoma sordida has been registered in the Atlantic forest, Caatinga, Cerrado, and Amazon biomes.⁸ Although previous studies have reported the occurrence of *T. sordida* in intradomiciliary environments,^{8,18} only eight specimens were found to have invaded houses in the present study: six in Macaúbas and two in Ibipitanga.

In northeastern Brazil, *Triatoma brasiliensis* is the most common Chagas disease vector because of its wide geographic distribution, its rates of natural infection, and its capacity to inhabit both natural and human environments.^{18,21–23}

Triatomines undergo a domiciliation process when they are forced out of their wild environments as a result of habitat destruction around human dwellings, after which they find shelter in rural constructions. Housing has thus become an aspect of vector habitat preferences, and it is important enough that even wild species have shown signs of adapting to artificial domestic ecotypes.²⁴ In addition, the presence of domestic animals in peridomiciliary constructions used for animal husbandry influences the presence of triatomines, because both these areas and the animals provide a permanent food source and also promote contact between vectors and humans.²⁵

Vector control is the most effective method of preventing Chagas disease in Latin America. The occurrence of sylvatic

vectors invading houses and the presence of intradomiciliary and peridomiciliary populations of triatomine species both represent a great difficulty for successful vectorial control.²⁶ Our results show that, in the south-central region of the Brazilian state of Bahia, species that were once considered strictly sylvatic (such as *T. lenti*) do, in fact, represent a threat to humans in the transmission of Chagas disease. Analyses of the invasive capacity of vector species are of high importance for evaluating and monitoring the domiciliation process, and also for directing control measures against Chagas disease vectors.¹⁸

Infection rates by *T. cruzi* in triatomines found in peridomiciliary environments in Macaúbas were 3.5% in the case of *T. lenti* and 1% in the case of *T. sordida*. These data represent the risk of vectorial transmission of Chagas disease in the city. The vectorial transmission of Chagas disease remains a serious public health problem. In an epidemiological surveillance study conducted in the city of Mulungu do Morro, in the state of Bahia, Brazil, the presence of antibodies against *T. cruzi* was found 25% in the population. These data are higher than overall percentages in both the state (5.4%) and the country (4.2%).²⁷ In the sample population studied, there was a high prevalence of seropositivity in school-aged children and young adults, a finding which indicates the occurrence of vector transmission.²⁸

As a consequence of intensive campaigns to eliminate domestic triatomines, Brazil has successfully reduced epidemic vector transmission of *T. cruzi*. In addition, there are no recent reports of transmission by *T. infestans*. However, outbreaks caused by contaminated food are being reported with increasing frequency. The risk of oral transmission of *T. cruzi* in Macaúbas was proven in 2008, with seven confirmed cases. On this occasion, several specimens of triatomines were found around and inside the house. They were *T. sordida* nymphs (Stal, 1859), in instars 2 to 5. A direct parasitological examination of their feces revealed that 50% of the triatomines were positive for *T. cruzi*.²⁹

The data have revealed the need for constant entomological surveillance and monitoring of the transmission of Chagas disease in the south-central region of the Brazilian state of Bahia, and continuous control measures against the vectors. Although most specimens have been collected in peridomiciliary environments, *T. lenti* was found to clearly possess the ability to invade intradomiciliary environments, because 9% of the specimens were collected in this ecotope.

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Authors' addresses: Vagner José Mendonça, Universidade de Brasília, Área de Pataologia, Brasília, Distrito Federal, Brazil, E-mail: vagjose@hotmail.com. Jader de Oliveira, Júlio C. R. Ferreira Filho,

and João Aristeu da Rosa, UNESP, Biological Sciences, Araraquara, São Paulo, Brazil, E-mails: jdr.oliveira@hotmail.com, julio_crff@yahoo.com.br, and rosaja@fcfcr.unesp.br. Aline Rimoldi, UNICAMP, Biologia Animal, Araraquara, São Paulo, Brazil, E-mail: linerimoldi@bol.com.br. Renato Freitas de Araújo, SESAB, LACEN, Salvador, Bahia, Brazil, E-mail: birdeagle01@yahoo.com.br.

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