REVISTA BRASILEIRA DE CIÊNCIAS DA AMAZÔNIA

Seccion:
Ciências Biológicas e Biodiversidade

Article

Occurrence of triatomines (Reduviidae) in different seasonal periods in a rural community of Brazilian Eastern Amazon

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Abstract: The aim of this study was to analyze the occurrence of triatomines in the peridomicilar area of a rural community in the municipality of Barcarena, State of Pará, in different seasonal periods. Active capture of triatomines was carried out during a dry and rainy season. Twenty-eight triatomines specimens belonging to the species *Rhodnius pictipes* Stål, 1872 and *Panstrongylus geniculatus* Latreille, 1811 were collected, of which 57.1% were captured during the dry period and 42.9% during the rainy period. The occurrence of both species was not influenced by seasonality.

Keywords: Amazon Region; Dry and rainy seasons; Chagas disease vector.

Citation: Corrêa, I. C. Q., Solva, L. A. M. da, Romas, R. L., Kirchgatter, K., Oliveira, T. R. de, Rodriguez-Málaga, S. R. Occurrence of triatomines (Reduviidae) in different seasonal periods in a rural community of Brazilian Eastern Amazon. *RBCA* **2021**, *10*, 1. p.1-8 https://doi.org/10.47209/2317-5729.v.10.n.1.p.1-8

Seccion Editor: Paulo Cruz
Received: 04.03.2021
Accepted: 31.10.2021
Published: 01.12.2021

Resumo: O objetivo deste estudo foi analisar a ocorrência de triatomíneos na área peridomiciliar de uma comunidade rural do município de Barcarena, Estado do Pará, em diferentes períodos sazonais. A captura ativa de triatomíneos foi realizada durante a estação seca e chuvosa. Foram coletados 28 espécimes de triatomíneos pertencentes às espécies *Rhodnius pictipes* Stål, 1872 e *Panstrongylus geniculatus* Latreille, 1811, dos quais 57,1% foram capturados no período seco e 42,9% no período chuvoso. A ocorrência de ambas as espécies não foi influenciada pela sazonalidade.

Palavras-chave: Amazônia; Estações secas e chuvosas; Vetor da doença de Chagas.

1. Introdution

Chagas disease (CD), a zoonosis caused by the hemoflagellate *Trypanosoma cruzi* Chagas, 1909, is a serious public health issue, especially in Latin American countries. In these countries, CD is considered as one of the most neglected diseases, with 28.000 new cases, affecting approximately 6 million people and causing about 12.000 deaths annually (Lidani *et al.*, 2019). *Trypanosoma cruzi* has a wide variety of hosts, including more than 150 species of domestic and wild mammals, which constitute the reservoirs of the parasite. Disease transmission mediated by insect vector is considered the classic form of parasite infection in humans, which occurs through the feces deposits from the infected

insect during its feeding (Silver & Ferreira, 2012).

Triatomines are obligate hematophagous Hemiptera of the family Reduviidae, subfamily Triatominae, comprising 153 valid species into five tribes and 18 genera, of which species belonging to the genera *Triatoma* Laporte, 1832, *Panstrongylus* Berg, 1879 and *Rhodnius* Stål, 1859, are recognized as the main vectors for *T. cruzi* transmission (Oliveira & Alevi, 2017). In Brazil, 68 triatomine species are recorded, of which thirteen are considered of epidemiological importance in the transmission of CD (MS, 2019). Due to the imbalance caused by environmental changes, mainly associated with anthropic pressure, oral transmission of the parasite has increased significantly in some regions of Brazil due to the ingestion of contaminated foods such as sugar cane and fresh açaí pulp. Therefore, triatomines epidemiological importance can be directly related to the regional social and economic development, along with the vectors characteristics, such as the degree of anthropophilic behavior (Lidani *et al.*, 2019).

Despite the successes in the control of *T. infestans*, the main vector of Chagas disease (Schofield *et al.*, 2006; Bedin *et al.*, 2021), the interruption of surveillance as well as inauspicious environmental factors have contributed to the adaptation of new triatomine species, such as *P. megistus*, *T. brasiliensis*, *T. pseudomaculata*, *P. lutzi*, to human surroundings (Silva *et al.*, 2021; Candido *et al.*, 2019). According to Candido *et al.* (2019), the vector domiciliation process can be influenced by climate factors (temperature, relative humidity and rainfall indexes), vegetation and by the presence of animals close to the residences, creating conditions for maintaining the *T. cruzi* life cycle that increase the risk of human infection.

In the Amazon Region, triatomine domiciliation is rare. However, researchers have shown the presence of *R. robustus* Larrousse, 1927, *R. montenegrensis* Rosa *et al.*, 2012 and *P. geniculatus* in a residential area in Rio Branco city in the Acre State (Ribeiro et al., 2019) and, in the municipality of Itacoatiara, State of Amazonas, Batista et al. (2019) demonstrated the presence of adults and nymphs of triatomines in the intra and peridomicilar areas. Knowing the patterns of geographical distribution of triatomines and the environmental variables contributing to such distribution, are fundamental to understand the risk of CD transmission and the design of actions for their control. In this context, the present work analyzed the occurrence of triatomines in a rural community in the municipality of Barcarena, State of Pará, in different seasonal periods.

2. Material and methods

This research was carried out at Vila do Cafezal (1º11'30" and 1º42'00" S, 48º26'15" and 48º50'10" W), a community in the municipality of Barcarena, Pará State, in Northern Brazil. The region presents a typical regional rainy and humid tropical climate, with an average annual temperature and precipitation around 26 °C and 2.600 mm, respectively (Figure 1).

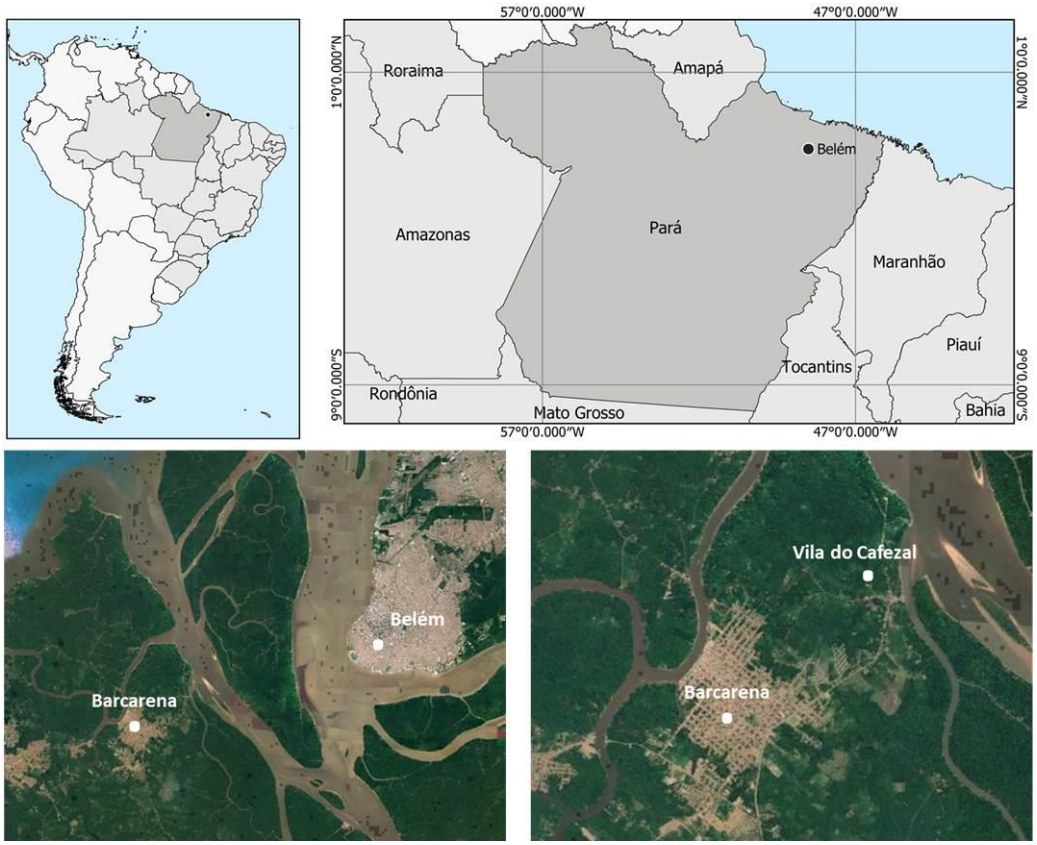

Figure 1. Location of the Vila do Cafezal community, in the State of Pará-Brazil. The map shows Belém, capital of the State of Pará, located in the northern region of Brazil and the municipality of Barcarena, close to the Vila do Cafezal community (Geographic coordinate system Datum CIRGAS 2000, IBGE cartographic bases 2017).

The triatomines were collected in the peridomicilar area, using metallic tweezers, during the period corresponding to the dry season of 2016 (September to October), in which monthly rainfall vary between 26.4 - 96.7 mm, and the rainy season of 2017 (February to May), with monthly rainfall between 269.1 - 596.5 mm. Thereby, 12 collections were carried out during the study period, six during the rainy period and six to the dry period. The collections were performed by three people from 10:00 am to 12:00 pm. The same places were analyzed both in the dry and rainy seasons. For each insect collected, the geolocation of sampling site was obtained by a portable GPS Garmin GPSMAP 62sc. The geographic coordinate maps and georeferencing maps were made using QGIS 3.16 (QGIS Development Team), Google Earth Pro (Google Ink/Maxar Technologies) and Trackmacker (Geo Studio Technology) programs. In this study, the peridomicilar environment was defined as the area around the house within a radius not exceeding 100 m, including chicken and dog houses, pig pens and wood piles (Figure 2). The insects captured were preserved in individual plastic tubes containing naphthalene granules and hydrophobic cotton, labelled with date and locality, and taxonomically identified at the Parasitology Laboratory of the Federal University of Pará, according to Galvão and Dale (2014).

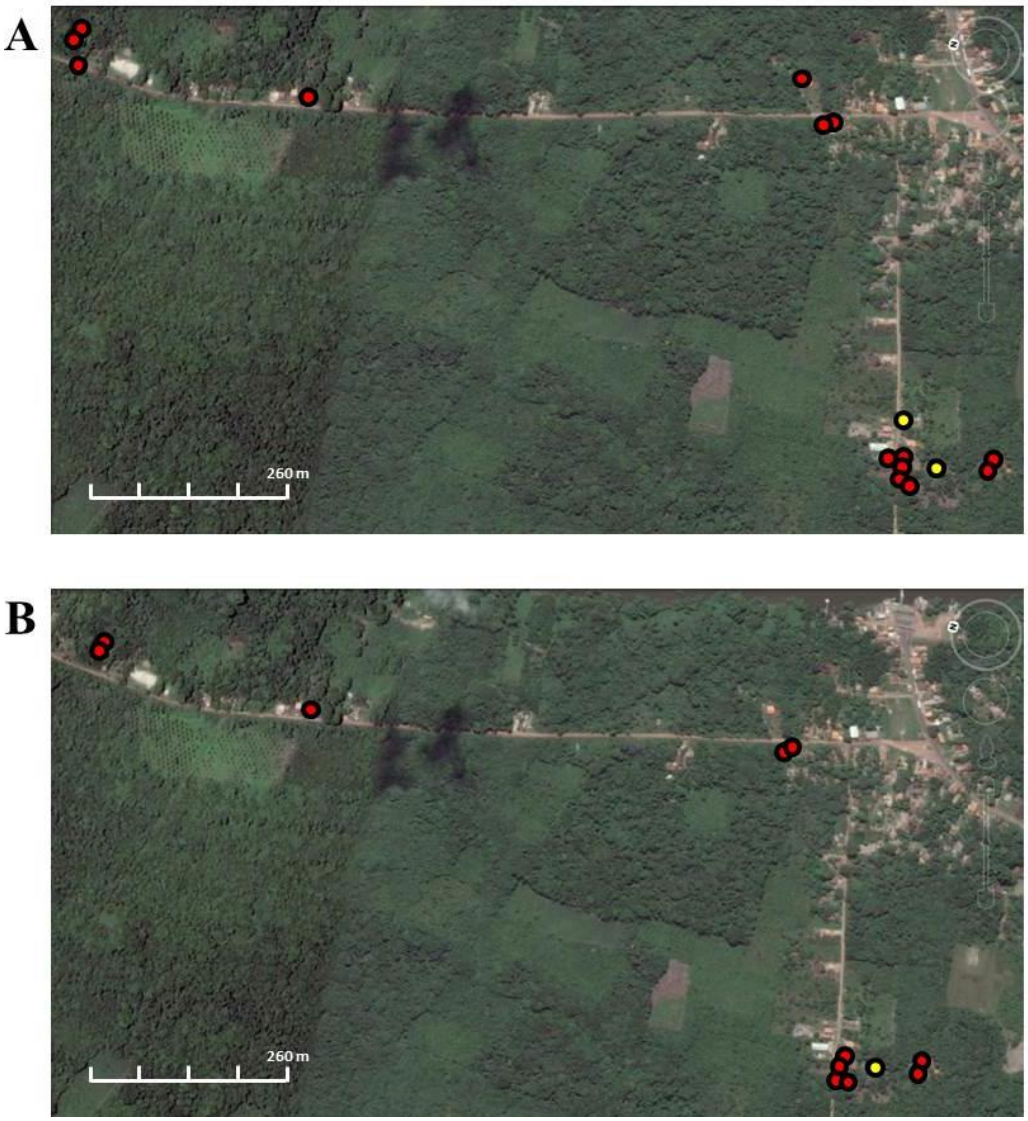

Figure 2. Georeferencing of triatomine capture sites in the Vila do Cafezal community. The figure shows the collection points in the rainy period (A) and in the dry period (B). Red dots show capture site of *Rhodnius pictipes* and yellow dots show capture site of *Pastrongylus geniculatus*.

Statistical analysis was performed using the GraphPad Prism version 3.0 (GraphPad Software). Chi-square test (χ^2) in contingency tables (2x2) with Yates correction was used to compare the percentage of triatomines captured in different seasonal periods. The *p* values <0.05 found with this analysis were considered statistically significant.

3. Results and discussion

A total of 28 specimens were captured in 14 residences analyzed, among which 25 (89.3%) were identified as *R. pictipes*, 21 females and four males. The other three individuals (10.7%) were identified as *P. geniculatus*, with two females and one male (Figure 3). All specimens were at the adult phase, showing no signs of recent engorgement; eggs or nymphs were not observed. Moreover, of the total specimens sampled, 57.1% were captured during the dry season, while the remaining 42.9% were collected during the rainy season. The statistical analysis indicated no significant difference in the number of triatomines captured in each climate season, suggesting that rainfall levels are not contributing factors for the presence of the insect in the area ($p>0.05$).

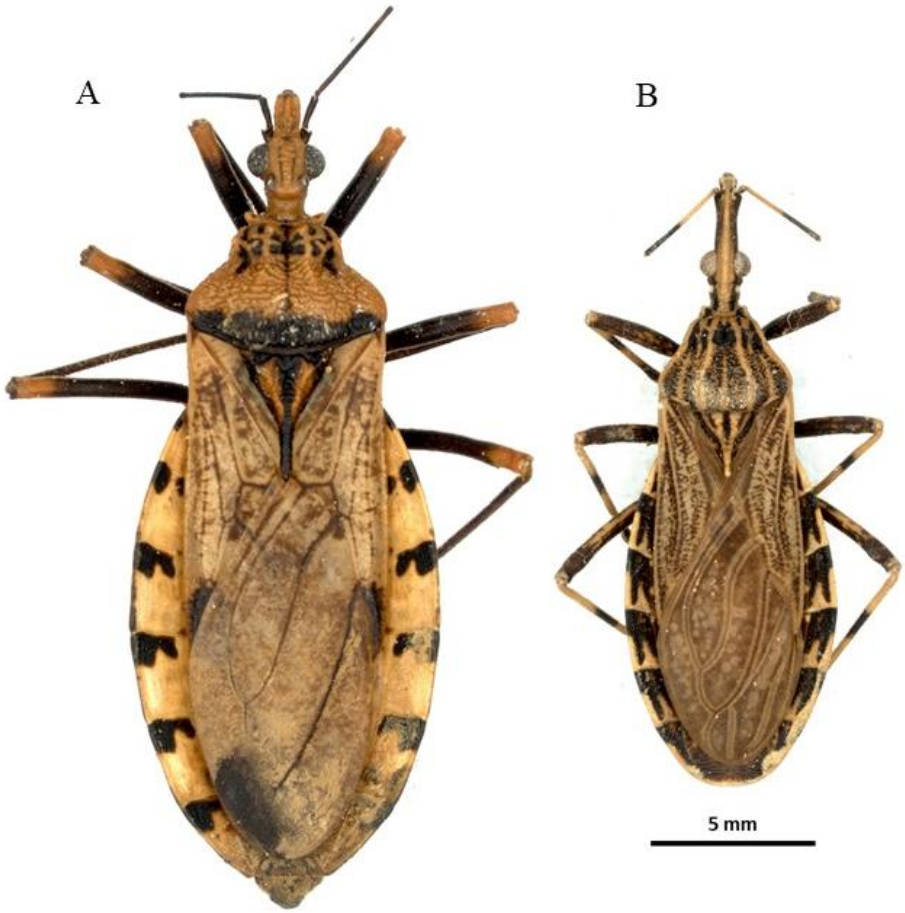

Figure 3. Triatomine specimens collected in the Vila do Cafezal community, dorsal view. (A) *Panstrongylus geniculatus* and (B) *Rhodnius pictipes*.

According to Galvão and Gurgel-Gonçalves (2014), most triatomine species described in Brazil is encountered both in the Cerrado and Amazon biomes. For the species captured in the present study, the authors describe that *R. pictipes* occurs mainly in the Amazon region, while *P geniculatus* is observed in more than 20 Brazilian States, demonstrating its ability to adapt to different ecological conditions. Furthermore, other studies describe the distribution of *R. pictipes* and *P. geniculatus* in rural and/or urban areas in different regions of the Brazilian Amazon (Massaro *et al.*, 2008; Batista *et al.*, 2019).

The georeferencing showed no differences in capture sites location between the dry and rainy seasons. In both periods, the triatomines were captured in regions associated with chicken and dog houses, pig pen and debris accumulation sites located in direct contact with the forest (Figure 4). The occurrence of these triatomines in the peridomicilar area could be related to the intensification of anthropic action in the study region. The municipality of Barcarena has stood out in recent years as an important logistic and industrial mining complex. The area has serious environmental problems related to contamination of water sources caused by the deposition of untreated toxic waste, changes in spatial distribution resulting from a disorderly population growth, and poor sanitation (Lemos & Pimentel, 2021). Several studies have shown that anthropic actions can promote changes in the natural ecotopes of triatomines and wild animals, resulting in the approximation of these vectors to the peridomicilar (Costa Junior & Cunha, 2016) and domestic areas (Massaro *et al.*, 2008; Ribeiro *et al.*, 2019).

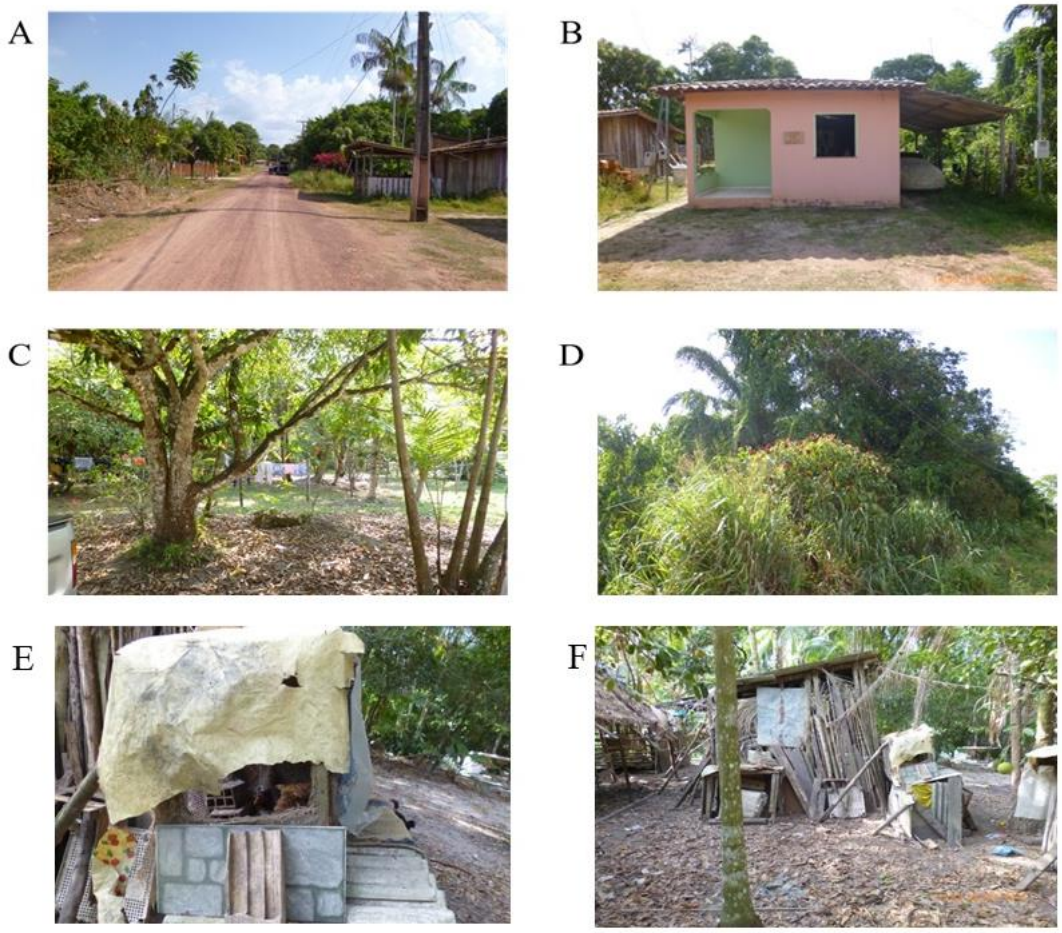

Figure 4. Sample areas in the rural community of Vila do Cafezal. (A) Main avenue; (B) Front view of a typical community house; (C and D) Peridomiciliary area in contact with the surrounding forest; (E and F) Peridomiciliary area with animal husbandry.

The influence of rainfall on the dynamics of the triatomine population has already been noticed. Gurgel-Gonçalves and Cuba (2007) described that the total number of the two species of triatomines, *R. neglectus* and *Psammolestes tertius*, captured in bird nests in the palm tree canopy, was similar in different climate seasons. On the other hand, Mendes and Lima (2011) and Meneguetti *et al.* (2012) demonstrated an increase in the number of triatomines captured during rainy season in the municipalities of Uberlandia-MG and Ouro Preto do Oeste-RO, results that differ from what was observed in this study, where rainfall levels did not influence the index of captured species ($p > 0.05$).

The Northern Region of Brazil has a high number of confirmed cases of acute Chagas disease, mainly acquired through the consumption of contaminated raw açaí juice, in family and/or community context outbreaks (Lidani *et al.*, 2019). Data from the Ministry of Health show that, in the period 2012-2016, a total of 1,156 cases of CD in the northern region of the country were recorded, of which 1,026 were reported in the state of Pará, reinforcing the importance of the açaí palm tree (*Euterpe oleracea* Mart.) as a possible natural ecotope for triatomines. In this study, it was observed that the sampled residences were surrounded by forests with abundant açaí palm trees, with precarious structured sheds for storing materials and accommodating farmed animals (Figure 2). All these factors create favorable environments for the procreation of triatomines close to human dwellings.

4. Conclusion

From the geographic distribution analyses of the triatomines collected in different periods of the year, it can be concluded that the presence of *R. pictipes* and *P. geniculatus* species in peridomicilar areas, regardless season, indicates a risk factor for CD transmission, reinforcing the need for the adoption of effective entomological surveillance programs.

5. Acknowledgments

The authors thank Prof. Dr. Maria Aparecida Lopes (ICB-UFPA) for the use of the GPS device and Ms. Abel Bustamante Ferrada for help with the triatomine images

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