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Short Communication

Occurrence and distribution of triatomines (Hemiptera: Reduviidae) in municipalities of the Northeastern region of Minas Gerais State, Brazil

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Abstract

Introduction: Triatomines are targeted for the control of Chagas disease in endemic areas of Brazil. **Methods:** Data regarding triatomines captured during 2001-2008 in 34 municipalities in the Northeast of Minas Gerais were analyzed. **Results:** In total, 11,187 triatomines from eight species were captured, mostly in henhouses and bedrooms. Trypanosomes were found in 203 samples. Main species were *Triatoma sordida*, *Panstrongylus megistus*, and *Triatoma vitticeps*. The number of *P. megistus* adults was positively correlated with temperature and precipitation, whereas the number of nymphs followed the inverse pattern. **Conclusions:** Occurrence of triatomines in domiciles indicates the need for sustained entomological surveillance.

Keywords: Triatominae. Chagas disease. Entomological surveillance.

Although there are at least 148 living species of triatomine bugs, only a few of them are epidemiologically important for the transmission of *Trypanosoma cruzi* to humans[1]. In 2006, Brazil was certified as free from *Trypanosoma cruzi* transmission by *Triatoma infestans*, the country's main vector of this parasite. In this context, other species have become increasingly important in Chagas disease epidemiology, mainly owing to anthropic pressure on their natural ecotopes[2].

The Jequitinhonha Valley, located in the Northeastern region of Minas Gerais State, Brazil, represented a highly endemic area for Chagas disease, with domiciles densely infested by triatomines, mainly *Panstrongylus megistus* and *Triatoma infestans*. Since the 1950s, this region has suffered important environmental and demographic changes such as expansion of eucalyptus plantations, pasture areas, and rural exodus[3].

Activities for controlling Chagas disease spread in this region were started in the 1960s under the coordination of the *Departamento Nacional de Endemias Rurais* (DNERu) and continued in the 1970s under the supervision of the *Comissão de Desenvolvimento do Vale do Jequitinhonha* and the *Centro Regional de Saúde de Diamantina*, both of which implemented an entomological surveillance system. However, these activities were interrupted owing to political-administrative issues, thus contributing to re-establishment of intradomiciliary triatomine colonies. This imposed a reactivation of vertical actions by the national Chagas Disease Control Program (CDCP) in 1982, carried out by *Superintendência de Campanhas de Saúde Pública*[4]. Since the late 1990s, entomological surveillance has been a responsibility of the municipalities.

This study aimed to characterize the triatomine infestation in domiciliary environments of 34 municipalities under coordination of the Diamantina Regional Health Superintendence (DRHS), most of them situated in the Jequitinhonha Valley region. The total population of these municipalities is nearly 429,515 inhabitants, with 40.2% residing in rural areas[5].

Data on the triatomines captured and examined by the DRHS from October 2001 until December 2008 were obtained by consulting the records of triatomine examinations carried out in the DRHS laboratory. This period was the latest period with complete information available for all the municipalities of this region.

According to the routine followed for triatomine control actions, the insects captured in the municipalities (by means of notification by residents, by investigation of notification by health professional, or active search by health professionals

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even without previous notification by residents) were sent to the laboratory for identification and examination for trypanosomatids, and the date, locality, and municipality of the capture, the site where the specimen was found, and its sex or evolutionary stage were registered. The frequency of each species, capture site, presence in each municipality, sex or nymph instar, and trypanosomatid presence was analyzed. Chi-square test was used to compare the number of males and females ($\alpha = 0.05$).

Entomological data were compared to the region's mean temperature and monthly accumulated precipitation to correlate these variables and the seasonality of most often captured species and their evolutionary stages. The climate data were obtained from the climatological normals of the five weather stations located in the study area. These normals comprise the historical average of weather data of long and relatively uniform periods grouped by month; in this study, we used the data from 1961 to 1990 (available at http://www.inmet.gov.br/portal/index.php?r=clima/normaisClimatologicas). The entomological data from October to December 2001 were excluded from the analysis to avoid overestimation of these months.

Data normality was assessed by Shapiro-Wilk test, the correlation between the number of adults and nymphs captured and the monthly mean compensated temperature was evaluated by the Pearson linear correlation coefficient (r), and the correlation between the number of adults and nymphs and the monthly accumulated precipitation was evaluated by Spearman's correlation coefficient (ρ). All the statistical analyses were performed with Bioestat 5.0.

During 2001-2008, 11,187 triatomines were collected from all the municipalities, ranging from 5 to 2,477 specimens per municipality. Ten species were identified: *Panstrongylus diasi*, *Panstrongylus geniculatus*, *Panstrongylus megistus*, *Psammolestes tertius*, *Rhodnius domesticus*, *R. neglectus*, *Triatoma arthurneivai*, *T. pseudomaculata*, *T. sordida,* and *Triatoma vitticeps*, and their distributions were examined (**Figure 1**).

The intestinal content of 8,270 (73.9%) insects was examined, and 203 (2.5%) were positive for trypanosomatids. Adults were infected more frequently than nymphs, and the highest infection index was observed in *Panstrongylus geniculatus* and *T. vitticeps* (**Table 1**).

Regarding the capture site, 57.2% (6,401) of the insects were captured at the peridomicile; 36.7% (4,102), in the intradomicile; 2.2% (245), at other places, and for 3.9% (439) of the insects, the site of capture was unknown. The adult specimens were captured mainly in the intradomiciliary environments, while immature forms prevailed in the peridomicile. *T. sordida* and *P. megistus* were mainly captured in the peridomicile, while the others species were mostly captured in the intradomicile (**Table 1**).

In the intradomicile, there were significantly more females (♀) than males (♂) for *P. megistus* (716♂, 870♀; $p < 0.01$) and *T. sordida* (152♂, 301♀; $p < 0.01$), whereas the opposite trend was noted for *T. vitticeps* (559♂, 425♀; $p < 0.01$) and *P. geniculatus* (141♂, 101♀; $p = 0.01$). The number of males and females in *T. pseudomaculata* was not statistically significantly different (120♂, 116♀; $p = 0.85$). In the peridomicile, statistically significant difference between the number of males and females was recorded for *P. megistus* (394♂, 587♀; $p < 0.01$) and *T. sordida* (681♂, 1,095♀; $p < 0.01$) but not for *T. vitticeps* (69♂, 55♀; $p = 0.24$), *P. geniculatus* (14♂, 15♀; $p = 1.00$), and *T. pseudomaculata* (46♂, 49♀; $p = 0.84$). Other species had few specimens; thus, statistical analysis was not possible.

Although the capture site was unknown for a large part of the records (21.1% of peridomicile and 12.4% of intradomicile captures), the henhouse was the outbuilding with the greatest number of triatomine bugs captured (67.2%). In the intradomicile, the bedroom was the most frequently infested room (50%), followed by the living room (26.6%).

The largest number of *P. megistus* specimens was captured between the months of October and December, with a predominance of adults between October and April (**Figure 2A**). There was a strong direct correlation between the number of adult specimens and the monthly average temperature ($r = 0.71$, $p < 0.01$) and accumulated precipitation ($\rho = 0.94$, $p < 0.01$). In contrast, the number of nymphs of *P. megistus* was strongly negatively correlated with temperature ($r = -0.87$, $p < 0.01$) and precipitation ($\rho = -0.79$, $p < 0.01$).

A greater number of *T. sordida* was recorded for the month of November, although there was no defined pattern in the adults/nymphs relation for each month (**Figure 2B**). There was no statistically significant correlation between climatic variables and the number of captured adults (temperature: $r = -0.54$, $p = 0.07$; precipitation: $\rho = -0.27$, $p = 0.39$) or nymphs (temperature: $r = -0.17$, $p = 0.61$; precipitation: $\rho = 0.03$, $p = 0.93$).

Most *T. vitticeps* specimens were captured between October and November, with adults being predominant throughout the year. Nymphs were captured more frequently between May and August (**Figure 2C**). The number of adults captured has shown a positive moderate correlation with the monthly average temperature, although with no statistical significance ($r = 0.55$, $p = 0.07$). In contrast, the monthly accumulated average precipitation has shown a strong direct correlation with the number of winged specimens captured ($\rho = 0.74$, $p < 0.01$). A strong inverse correlation was observed between the number of nymphs and temperature ($r = -0.92$, $p < 0.01$) and the number of nymphs and precipitation ($\rho = -0.74$, $p < 0.01$).

Jequitinhonha Valley represented an area of intense transmission of Chagas disease. According to the data from the National Serological Inquiry collected in the 1980s, the municipalities that now belong to the DRHS reported an average of 14.9% of seropositive people, while the State of Minas Gerais reported approximately 8.8%[6]. In the 1980s, seven species of triatomine bugs were captured in domiciles of that region (*T. infestans*, *P. megistus*, *T. sordida*, *T. pseudomaculata*, *T. vitticeps*, *P. geniculatus*, and *R. neglectus*)[7]. Due to intense activities performed by the CDCP in that region, *Triatoma infestans* was eliminated and the remaining species were controlled inside the domiciliary environment, resulting in a significant decrease in the transmission of *Trypanosoma cruzi*, as demonstrated by the low prevalence of the disease observed in surveys performed among schoolchildren in the 2000s[8].

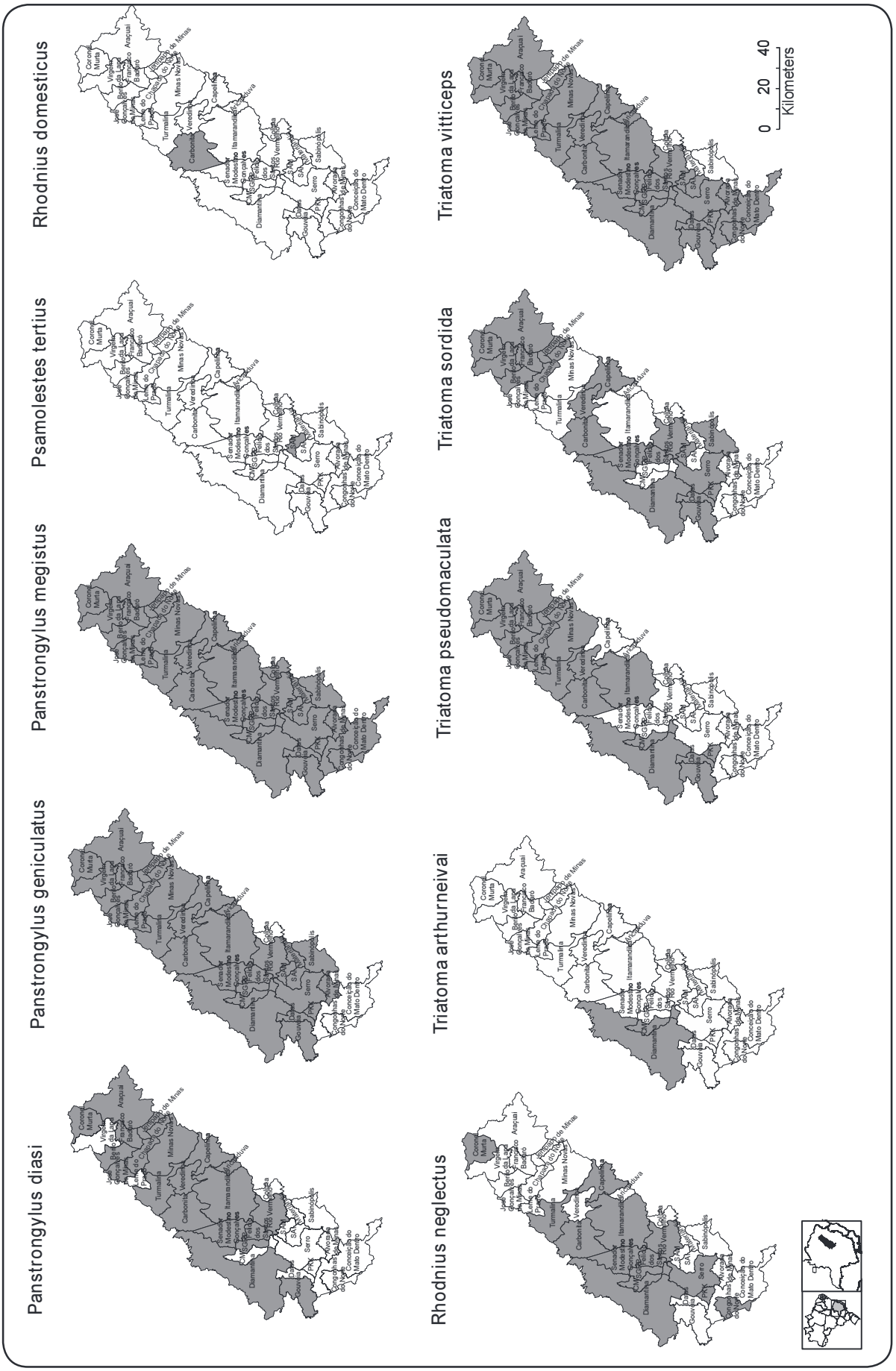

FIGURE 1. Distribution of triatomine species in municipalities of Diamantina Regional Health Superintendence (October 2001-December 2008).

TABLE 1

Number of triatomines captured in municipalities of Diamantina Regional Health Superintendence according to species, evolutionary stage, place of capture, and trypanosome presence from October 2001 to December 2008.

		Captured				Examined				Positives				infection (%)				
Species		**ID**	**PD**	**OP**	**NI**	**ID**	**PD**	**OP**	**NI**	**ID**	**PD**	**OP**	**NI**	**ID**	**PD**	**OP**	**NI**	**Total**
Triatoma sordida	adults	453	1,776	45	32	255	1,601	44	22	7	19	-	-	2.75	1.19	-	-	1.35
	nymphs	151	2,087	81	27	134	1,957	77	23	-	10	-	-	-	0.51	-	-	0.46
	NI	-	2	-	1	-	2	-	1	-	-	-	-	-	-	-	-	-
Panstrongylus megistus	adults	1,586	981	43	142	728	757	25	77	41	9	1	7	5.63	1.19	4.00	9.09	3.65
	nymphs	234	1,143	23	25	168	1,015	18	23	7	10	-	-	4.17	0.99	-	-	1.39
	NI	-	4	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-
Triatoma vitticeps	adults	984	124	27	128	621	82	21	87	58	9	2	5	9.34	10.98	9.52	5.75	9.12
	nymphs	44	111	3	15	38	105	3	15	1	-	-	-	2.63	-	-	-	0.62
Triatoma pseudomaculata	adults	236	94	13	21	82	69	6	13	2	3	-	1	2.44	4.35	-	7.69	3.53
	nymphs	2	16	2	10	2	13	2	10	-	-	-	-	-	-	-	-	-
	NI	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Panstrongylus geniculatus	adults	242	29	3	20	60	13	2	11	9	1	-	-	15.00	7.69	-	-	11.63
	nymphs	35	2	1	7	28	2	1	6	-	-	-	-	-	-	-	-	-
	NI	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Panstrongylus diasi	adults	91	13	4	5	17	6	-	2	-	-	-	-	-	-	-	-	-
Rhodnius neglectus	adults	40	13	-	4	13	5	-	1	1	-	-	-	7.69	-	-	-	5.26
	nymphs	-	4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Triatoma arthurneivai	adults	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhodnius domesticus	adults	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**4,101**	**6,399**	**246**	**439**	**2,148**	**5,632**	**199**	**291**	**126**	**61**	**3**	**13**	**5.87**	**1.08**	**1.51**	**4.47**	**2.45**

ID: intradomicile; **PD:** peridomicile**; OP:** other places; **NI:** no information.

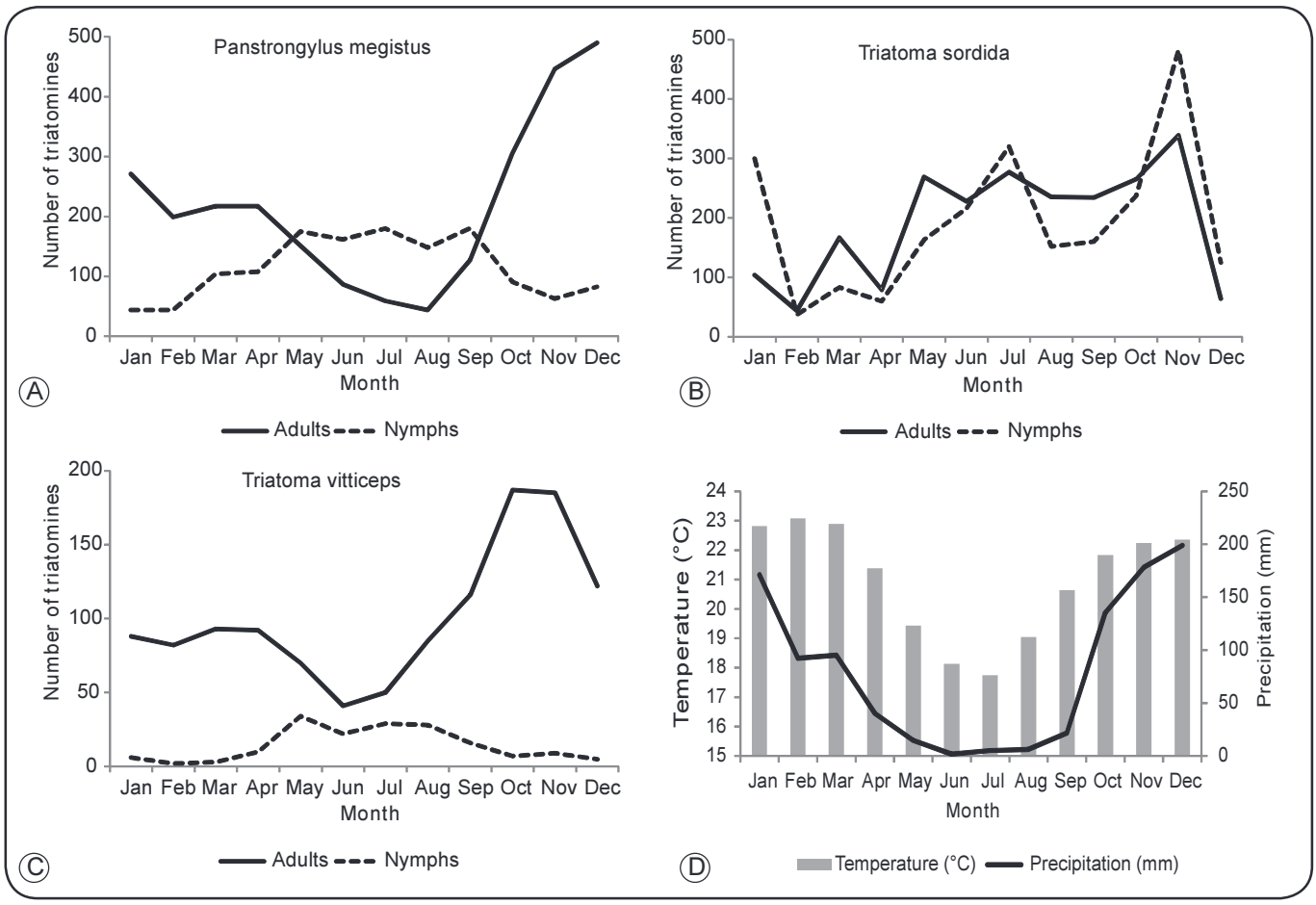

FIGURE 2. Seasonal distribution of nymphs and adults of *Panstrongylus megistus* **(A)**, *Triatoma sordida* **(B)** and *Triatoma vitticeps* **(C)** in municipalities of Diamantina Regional Health Superintendence, from October 2001 to December 2008, and monthly mean compensated temperature and monthly mean precipitation **(D)** of meteorological stations located in the DRHS region. **DRHS:** Diamantina Regional Health Superintendence.

The presence of *P. megistus* in domiciles of all the municipalities may be related to the conservation of this insect's natural ecotopes in vestiges of humid forests, mainly gallery forests. Adults seem to disperse from there by flight during the warmest and most humid periods of the year, as observed in municipalities of the midwestern part of Minas Gerais (**Figure 2D**)[9]. In that region, 22.5% of 416 *P. megistus* specimens had ingested human blood and 3.8% of specimens were positive for trypanosomatids, thus surpassing the percentage reported herein (2.7%)[10].

It is noteworthy that a high proportion of nymphs infected by trypanosomatids was captured inside the houses of the DRHS region (4.2%), indicating a possible intradomiciliar cycle of *Trypanosoma cruzi* probably involving men and domestic animals as synanthropic reservoirs.

Triatoma sordida is currently the most captured species in Brazil[2], with peridomiciliary habit and notable ornithophilic behavior that favors the establishment of great colonies in outbuildings, especially in henhouses, where re-infestations often occur despite constant intervention[11]. In the DRHS region, the species comprised 41.6% of the specimens captured, with only 0.9% infected by trypanosomatids. These results may be due to the ornithophilic feeding of these vectors, as indicated by the predominance of specimens in the henhouses.

Triatoma vitticeps was observed throughout almost all the municipalities of the region predominantly in its adult form in the intradomicile, thus corroborating other studies[12][13]. Such distribution can be related to its low capability to colonize domiciles, although the presence of nymphs in domiciles suggests that the species has a potential for colonizing artificial environments. Moreover, the species showed a high index of infection by trypanosomatids, indicating its trophic relationship with different reservoirs of *Trypanosoma cruzi*[12]. Thus, this triatomine can introduce the parasite in the domiciliary environment during its dispersion.

Geographically, *Triatoma vitticeps* is associated with humid areas, and its egg hatching is dramatically affected by humidity lower than 52%[13]. The correlation between the number of adults and the months with higher precipitation observed herein suggest that adults disperse during this period to guarantee the oviposition and the success of the hatching.

It is noteworthy that all species, except *P. megistus* and *T. sordida*, were more dispersed throughout the region during

the studied period than between 1975 and 1982, when the CDCP activities were more intense[7]. This fact may be associated to environmental (deforestation, urban expansion) and social (migration, electrification of rural domiciles) changes that occurred in the area, as observed for *T. pseudomaculata* in a municipality of this region, where the presence of the species seems to be related to the changes in primary land coverage and aridification[14].

Despite their preference for wild habitat, reports of *R. neglectus, P. diasi,* and *P. geniculatus* in domiciliary environments have increased, the last even being involved in the transmission of *Trypanosoma cruzi* to humans[2] [15]. *Triatoma arthurneivai* is a species rarely found in domestic and sylvatic environments and its reports are restricted to Southern Espinhaço Mountain Range[15]. The findings of *P. tertius* and *R. domesticus* in domiciles are sporadic and probably do not indicate changes in species behavior.

The changes in landscape in Jequitinhonha Valley region in the last decades caused by the establishment of great pastures and coffee and eucalyptus plantations will likely promote the dispersal of some triatomine bugs into the man-made environments and the colonization of domiciliary structures. The periodic findings of *P. megistus* and *Triatoma sordida*, as well as species considered secondary in the transmission of *Trypanosoma cruzi*, reflect the need for a sustainable surveillance of these species in DRHS municipalities.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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