

SHORT COMMUNICATION

Morphometric changes of *Rhodnius neglectus* (Hemiptera: Reduviidae) in the transition from sylvatic to laboratory conditions

Rodrigo Gurgel-Gonçalves; Maicon H. Maeda; Jônatas B.C. Ferreira;
Aline da F. Rosa & César A.C. Cuba

Laboratório de Parasitologia Médica e Biologia de Vetores, Área de Patologia, Faculdade de Medicina, Universidade de Brasília. Asa Norte, 70910-900 Brasília, DF, Brazil. E-mail: rgurgel@unb.br

ABSTRACT. In the present work, we investigated whether it is possible to detect morphometric changes in *Rhodnius neglectus* Lent, 1954 (a candidate vector of Chagas disease in Central Brazil) populations in the transition from sylvatic to laboratory conditions. We analyzed size and shape variation in wings of sylvatic parents and their laboratory descendants (first, third and fifth generations) using geometric morphometric techniques. Sexual size dimorphism and shape of wings were maintained, but wing size decreased from sylvatic specimens to their laboratory generations. Size variation in *R. neglectus* should reflect the expected morphometric changes between sylvatic and domestic populations and can be applied to analyze the level of adaptation of *R. neglectus* to domestic habitats. This information might be useful to detect persistent infestations in dwellings after insecticide application, or new infestations from the sylvatic environment, and is therefore important to guide vector surveillance strategies for Chagas disease.

KEY WORDS. Laboratory generations; Rhodniini; size; Triatominae.

Triatomine bugs (Hemiptera: Reduviidae) may develop morphological changes associated with adaptations to new habitats. During the transition from sylvatic to artificial habitats a decrease in average size, sexual dimorphism and numbers of antennal sensilla have been observed (DUJARDIN *et al.* 1999, CATALÁ *et al.* 2004). Differences between field and laboratory colonies could parallel those between sylvatic and synanthropic populations (CARO-RIANO *et al.* 2009). Thus, these morphological changes allow the discrimination between sylvatic and domestic triatomine populations and have been applied to study their ability to colonize human dwellings, the main condition required for Triatominae to be a vector of Chagas disease. The source of household re-infestation after insecticide application can also be detected by analysing these morphological changes (FELICIANGELI *et al.* 2007).

Rhodnius neglectus Lent, 1954 is a regular (although non-endemic) species of the Cerrado biome in Central Brazil, where it inhabits various species of palm trees (ABAD-FRANCH *et al.* 2009, GURGEL-GONÇALVES & CUBA 2009) and plays an important role in the maintenance of *Trypanosoma cruzi* Chagas, 1909 transmission in the wild (GURGEL-GONÇALVES *et al.* 2004). Moreover, adult specimens have been invading houses in Central Brazil; household infestations (with adventitious bugs occasionally establishing breeding colonies) have been reported in the states of Goiás, Minas Gerais, and São Paulo (GURGEL-GONÇALVES *et al.*

2008). *Rhodnius neglectus* is currently the second most common triatomine species infesting artificial environments in the states of Goiás (OLIVEIRA & SILVA 2007) and Mato Grosso do Sul (ALMEIDA *et al.* 2008), and is therefore considered as a candidate vector of Chagas disease. Thus, extensive longitudinal surveillance systems capable of detecting and eliminating synanthropic *R. neglectus* populations are needed across the distribution range of the species. In the present work, we attempted to detect morphometric changes in the wings of *R. neglectus*, from sylvatic parents to their laboratory descendants. We hypothesized that an obvious reduction in wing size would take place as a result of the transition from sylvatic to laboratory conditions.

Thirty-seven adult specimens of *R. neglectus* were collected in *Mauritia flexuosa* L. palm trees from Araguaína, Tocantins, Brazil (07°28'S, 48°22'W) in 2006. These bugs were reared in laboratory under environmental conditions regulated at 28 ± 2°C, 75 ± 10% rh, and fed every 15 days on mice. The sylvatic parents (n = 37) were used for morphometric analyses, together with specimens taken randomly from the colonies of first (n = 54), third (n = 55) and fifth (n = 62) generations resulting in a four-year follow-up study. The right forewing of each specimen were mounted on microscope slides and digitally scanned. Six type I and one type II landmarks were digitized, as shown in GURGEL-GONÇALVES *et al.* (2008). Landmark coordinates were

recorded using the software *tpsDig* 1.18 (ROHLF 1999a). We used “centroid size” (CS), an isometric size estimator derived from the morphometric coordinates. The CS value was extracted from the coordinate matrix of each individual wing using *tpsRelw* version 1.18 (ROHLF 1999b) and log-transformed to normalize the data. Shape variables were obtained using the Generalized Procrustes Analysis (GPA) superimposition algorithm; both uniform and non-uniform deformation components were used in the analyses. Shape variables were computed and tested for variation using *tpsRelw* 1.18 (ROHLF 1999b).

The data display a nearly normal, bell-shaped distribution of wing sizes. Moreover, the Kolmogorov-Smirnov test also verified the normality of the data. Thus, size variation (wing CS values) between populations (sylvatic parents and their laboratory descendents) and between the sexes was explored by means of a two-way ANOVA and post-hoc Tukey tests ($\alpha = 0.01$). The shape variables (partial warps) were used as input for a Principal Component Analysis (PCA) to determine whether any morphological groupings were detectable without *a priori* designation of groups. All analyses were computed with Statistica®.

We scored statistically significant differences among wings across the four groups analysed (ANOVA $F_{3,200} = 98.4$, $p < 0.01$). The wing size decreased from sylvatic parents to their laboratory descendents. A consistent sexual dimorphism was observed in the analyses of wing size variation: female wings were larger than those of males across all groups analysed (Tab. I). No morphological groupings were detectable in PCA analyses, indicating absence of marked differences in wing shape between sylvatic and laboratory populations.

Table I. Comparison of wing centroid size differences between males and females of *Rhodnius neglectus* populations (sylvatic parents and their generations). * Post-hoc Tukey tests, (SD) standard deviation, (n) number of wings.

Generations	Males	Females	p*
	Mean \pm SD; n	Mean \pm SD; n	
Sylvatic parents	0.65 \pm 0.01; 17	0.71 \pm 0.02; 20	<0.01
F1	0.64 \pm 0.01; 28	0.70 \pm 0.01; 26	<0.01
F3	0.63 \pm 0.01; 28	0.67 \pm 0.01; 27	<0.01
F5	0.61 \pm 0.01; 30	0.66 \pm 0.01; 32	<0.01

The reduction in wing size during the transition from sylvatic to laboratory or domestic conditions has been demonstrated in other Triatominae species, such as *Triatoma infestans* (Klug, 1834) (DUJARDIN *et al.* 1997), *Triatoma flavida* Neiva, 1911 (RODRÍGUEZ RODRÍGUEZ *et al.* 2007), *Rhodnius domesticus* Neiva & Pinto, 1923 (DUJARDIN *et al.* 1999) and *Panstrongylus geniculatus* (Latreille, 1911) (JARAMILLO *et al.* 2002, ALDANA *et al.* 2011). We postulate that laboratory conditions are quite similar to domestic conditions. DUJARDIN *et al.* (1999) proposed that in a

population near its carrying capacity – which is generally the case in domestic or laboratory populations – each individual would get less blood because of competition and would therefore be smaller. Currently there are two main hypotheses to explain environmental effects on triatomine size variation. According to the ‘selection’ hypothesis, size reduction could be a result of improved survivorship of smaller individuals in laboratory or domestic conditions (higher and more regular feeding frequency, absence of predators). Alternatively, larger specimens should be favored in sylvatic conditions due to their greater capacity to resist temporary food shortages. The ‘growth’ hypothesis states that the average size would decrease in domestic conditions because of higher population densities, which increases competition between individuals, therefore reducing bloodmeal amounts (see details about these hypotheses in CARO-RIANO *et al.* 2009).

Other studies found no significant size differences between wild, peridomestic and domestic populations of *Triatoma maculata* (Erichson, 1848) (SOTO VIVAS *et al.* 2007, TORRES *et al.* 2010). These results could be explained by a steady flow of individuals between environments. This dispersal process may not allow the isolation and morphometric differentiation of the population at domestic environment.

The absence of marked differences in wing shape between sylvatic and laboratory populations was an expected result, considering that shape is a more stable trait than size, and may require important changes to be significantly modified (DUJARDIN 2008). However, GÓMEZ-SUCERQUIA *et al.* (2009) suggested that laboratory colonies of *Rhodnius pallenscens* Barber, 1932 have a different genetic structure than their wild relatives. This could influence shape changes, even considering the shape of the wings as a more stable trait than size. Studies analyzing the shape of wings and genetic structure of generations of *R. neglectus* may clarify this issue.

As expected, we found a significant reduction in the size of the wing of *R. neglectus* from sylvatic parents to their laboratory descendents (until the fifth generation). Our results support the idea that size changes can be used as a marker of triatomine colonization in human dwellings. The size variation of *R. neglectus* detected in our work should reflect the expected morphological changes between sylvatic and domestic populations and can be applied to analyze the level of adaptation of *R. neglectus* to artificial ecotopes. This information might be useful to detect persistent infestations in dwellings after insecticide application or new infestations from the sylvatic environment, and is therefore important to guide vector surveillance strategies for Chagas disease.

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