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CHAGAS' DISEASE IN THE AMAZON BASIN: V. PERIURBAN PALMS AS HABITATS OF *RHODNIUS ROBUSTUS* AND *RHODNIUS PICTIPES* – TRIATOMINE VECTORS OF CHAGAS' DISEASE

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Trypanosoma cruzi *infected* Rhodnius robustus *and/or* Rhodnius pictipes *were commonly found, in large numbers, in the Brazilian Amazonian palms* Maximiliana regia *("inajá"),* Acrocomia sclerocarpa *("mucajá") and* Orbignya speciosa *("babaçu"). The common opossum*, Didelphis marsupialis, *was the animal most frequently associated with triatomine infested palms.* R. pictipes, *frequently light-attracted into houses from palm trees, was the probable source of an acute case of Chagas' disease in the vicinity of Belém. It is considered that triatomine infested palms are likely to cause some cases of acute Chagas' disease in the States of Amazonas and Rondônia. Possible control methods are suggested.*

Bromeliad epiphytes (*Aechmea* spp.), nests of *Phacellodomus* birds and palm trees are easily recognized as some of the natural habitats of triatomine bugs (Hemiptera: Reduviidae) – the vectors of Chagas' disease. No silvatic triatomine habitat is more obvious, abundant and epidemiologically significant to the spread of Chagas' disease than the palm tree. The triatomine genera *Microtriatoma, Parabelminus, Psammolestes, Panstrongylus, Triatoma* and *Rhodnius* are all known to occur in palms but several species of the genus *Rhodnius* especially *R. neglectus, R. pallescens, R. pictipes, R. prolixus* and *R. robustus,* are particularly closely associated with the palm tree ecotope (Lent & Wygodzinsky, 1979; Miles, 1979). In open country palms may provide almost the only available arboreal

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nesting sites for mammals and birds: individual palms may contain large numbers of triatomines and adult bugs of some species can be captured readily by attraction to light-traps (Whitlaw & Chaniotis, 1978). In Venezuela the principal domestic vector *R. prolixus*, is common in local palm trees that are used to construct both the roofs and walls of houses. Domestic triatomine infestations are propagated and replenished from infested palms by both light-attraction of adult bugs into houses and by the use of palm fronds in building.

In high, dry Amazonian forest with continuous canopy, palm tree species with large crowns may be present but appear to be widely dispersed or solitary: in such forest, important mammal hosts of triatomine bugs, like the common opossum *Didelphis marsupialis* are known to use a variety of nesting sites such as tree holes, burrows or "open nests" on tree forks (Miles et al., 1981b). In some Amazonian forest, particularly lowland forest without continuous canopy, large-crowned palms may be extremely common and provide an abundant mammal refuge. As forest is cleared by burning, palms seem to survive more frequently than other trees and propagate rapidly: they are often left standing or encouraged because of their attractive appearance, nutritious fruits or useful fronds. In Panama *R. pallescens* infested palms of the species *Scheelea zonensis* retained after forest clearing are believed to be responsible for the high prevalence of Chagas' disease in some rural communities (Whitlaw & Chaniotis, 1978). In Pará State palms heavily infested with *R. pictipes* carrying *Trypanosoma cruzi* have been clearly implicated as an important cause of sporadic cases of acute Chagas' disease (Miles et al., 1981 a, b). In this paper we record the common presence, in three species of palm trees, of large numbers of *R. robustus* or *R. pictipes* carrying *T. cruzi* in the city of Manaus, Amazonas State, in the city and vicinity of Belém, Pará State and in Rondônia State. We compare the ecotopes of *R. robustus* and *R. pictipes* and their importance as potential vectors of Chagas' disease in the Amazon basin.

MATERIALS AND METHODS

Study areas are listed in Table I and the geographical locations are shown in Figure 1. The localities were chosen primarily because numerous palm trees were present with large crowns and accummulated debris, suitable for nests of arboreal marsupials and rodents. The reasons for initial interest in each of the study areas were however different. Attention was first drawn to the forest of the Parque das Laranjeiras in Manaus by the occurence of cases of cutaneous leishmaniasis due to *Leishmania braziliensis guyanensis* (Arias & Naiff, 1981). Tracking of *D. marsupialis* captured around houses in the city of Belém lead to the Stand de Tiros site and discovery of triatomine-infested opossum nests in palms (Miles et al., 1981b). A well documented acute case of Chagas' disease on Mosqueiro Island (Silveira et al., 1979) stimulated a follow-up investigation of triatomine habitats in the immediate vicinity of the home where the case had occurred. Palms on Marajó Island were initially noted in conjunction with investigations of the distribution of *Trypanosoma vivax* on cattle farms (Lanham et al., 1981). Work in Porto Velho was performed in parallel with field studies on sandfly vectors and mammal reservoirs of leishmaniasis (Biancardi, 1981). At Parque das Laranjeiras the vegetation was primary forest, disturbed by man or adjacent secondary vegetation cleared of most trees except palms (Arias & Naiff, 1981). At the Stand de Tiros site "mucajá" palms stood in secondary scrub. The Mosqueiro and Marajó Island sites consisted of secondary forest. The Porto Velho forest was largely primary bordering a major highway but had been disturbed as a result of road construction and colonization programmes.

Only three types of palm are represented in this study: the "inajá" (*Maximiliana regia;* Figure 2a), the "babaçu" (*Orbignya speciosa;* Figure 2b) and the "mucajá" (*Acrocomia sclerocarpa:* Figure 2c). The "inajá", "mucajá" and "babaçu" were, respectively the only palms examined in the Parque das Laranjeiras, Stand de Tiros and Porto Velho field areas. "Inajá" and "mucajá" palms occurred together and were both examined at the Mosqueiro and Marajó Island sites. Other palm species, which were less common at each site, were slender, small-crowned types, considered to be unsuitable as mammal refuges.

TABLE I

Species and ecotopes of 1151 triatomine bugs collected from Amazonian palms

Locality	Triatomine *sp.*	*Palm habitat*	*Number of occasions found*	*Total no. of bugs*	*Range per palm*	*Overall population structure*[1] ♂	♀	*V*	*IV*	*III*	*II*	*I*	*Associated hosts*
A. Parque das Laranjeiras (Manaus)	*Rhodnius robustus*	*Maximiliana regia* (inajá)	26	211	1-31	83	24	36	7	32	25	4	*Didelphis marsupialis* (see text)
	Rhodnius pictipes	" "	22	124	1-27	17	16	11	9	27	19	25	*D. marsupialis* (see text)
B. Stand de Tiros (Belém)	*R. pictipes*	*Acrocomia sclerocarpa* (mucajá)	19	123	1-18	16	14	18	6	25	35	9	*D. marsupialis* (6 occasions) *Marmosa* sp. (1 occasion) Unidentified rodent sp. (2 occasions)
	Microtriatoma trinidadensis	" "	2	6	2-4	–	–	5	–	–	1	–	Unidentified rodent sp. (1 occasion)
C. Mosqueiro Island (70k N of Belém)	*R. robustus*	*M. regia*	3	23	2-14	21	2	–	–	–	–	–	
	R. pictipes	*A. sclerocarpa/ M. regia*	11	168	1-48	36	15	30	6	36	29	16	*D. marsupialis* (1 occasion)
	M. trinidadensis	" "	2	4	1-3	3	–	–	–	–	1	–	–
D. Fazenda de Paraíso Soure, Marajó Is.	*R. robustus*	*M. regia/A. sclerocarpa*	6	75	1-39	13	–	3	1	5	25	28	–
	R. pictipes	" "	9	88	5-14	35	5	4	11	19	13	1	*D. marsupialis* (2 occasions)
	M. trinidadensis	" "	3	4	1-2	not recorded							–
	Panstrongylus lignarius	" "	15	49	1-10	10	12	20	4	3	–	–	*D. marsupialis* (2 occasions) *Potos flavus* (1 occasion) Unidentified rodent sp. (1 occasion)
E. Porto Velho BR364 kms 23-119	*R. robustus*	*Orbignya speciosa* (babaçu)	24	244	1-25	61	21	29	30	62	31	10	*D. marsupialis* (1 occasion)
	R. pictipes	" "	6	32	1-10	13	–	1	5	10	3	–	

[1] Does not necessarily reflect true population structure (see text).

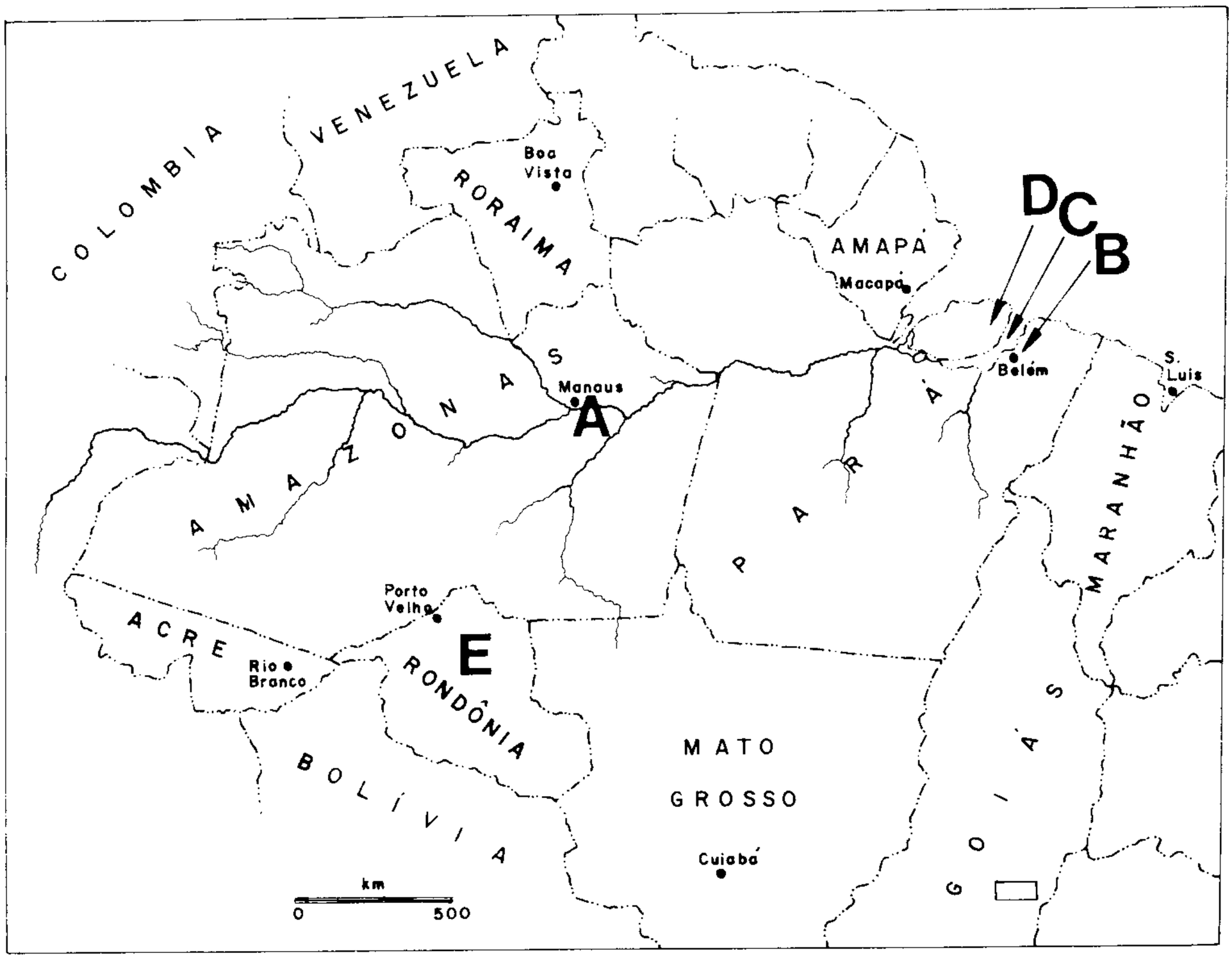

Fig. 1 – Map of the Brazilian Amazon Basin showing the localities in which triatomine bugs were collected from palm trees: A) Parque das Laranjeiras (Manaus); B) Stand de Tiros (Belém); C) Mosqueiro Island (70 kms N of Belém); D) Fazenda de Paraíso, Soure, Marajó Island; E) Porto Velho (BR-364 kms 23-119).

Fig. 2 – Amazonian palms: a) the "inajá" (*Maximiliana regia*); b) the "babaçu" (*Orbignya speciosa*); c) the "mucajá" (*Acrocomia sclerocarpa*).

In most cases palms were cut down with a chain-saw or an axe and systematically dissected, frond by frond, from stem to crown ("microhabitat dissection") as described elsewhere (Miles et al., 1981b). Where the palms were of economic or scenic importance, and if the local inhabitants wished to retain them, they were climbed using the branches of a stem of bamboo as a ladder or with climbing irons, and triatomine bugs were captured from the crowns and dead vegetation only.

Triatomine species were identified with reference to the characters described in the monograph of Lent & Wygodzinsky (1979). A proportion of bugs from each collection was dissected and the intestinal contents were examined microscopically to detect the presence of trypanosome infections. Some *R. robustus*, *R. pictipes* and *Panstrongylus lignarius* from field collections were maintained alive and used to supplement experimental laboratory colonies.

RESULTS

The results are summarized in Table I. A total of 1,151 triatomine bugs were collected from three species of palm in the five different localities.

Two triatomine species, *Microtriatoma trinidadensis* and *P. lignarius*, were present in small numbers only. The natural ecotope of *M. trinidadensis* has been described as between the folded leaves of opossum nests, apparently independently of where the nest is located (Miles et al., 1981b). *P. lignarius* has been described as an arboreal species: in forest nymphs have been found in hollow trees used by *D. marsupialis* and *Coendou* sp., and adults have been recorded moving freely on tree bark (Miles et al., 1981b). We have not previously collected *P. lignarius* from palm trees.

Although some palms were not infested with bugs, either *R. robustus* and/or *R. pictipes* were usually present in considerable numbers in the palms examined. In the small group of "mucajá" palms at the Stand de Tiros site in the city of Belém, *R. pictipes* was common but there were no *R. robustus*. The palms were in an isolated patch of scrub not far from the Utinga Forest Reserve (Lainson et al., 1979). At the Mosqueiro Island site *R. pictipes* was found in both "mucajá" and "inajá" palms but R. *robustus* was collected from the "inajá" only. On Marajó Island the two species occurred in almost equal numbers and were found in both "inajá" and "mucajá" palms. In Parque das Laranjeiras the area in which we were particularly interested as it formed part of a growing suburb of the city of Manaus, "inajá" palms were heavily infested with both *Rhodnius* species. *R. robustus* predominated in "babaçu" palms in Rondônia State. According to Lent & Wygodzinsky (1979) both *R. robustus* and *R. pictipes* have not been recorded previously from Rondônia State. Overall population structure (Table I) suggests a predominance of males in all collections of *R. pictipes* and *R. robustus*. As the lower instars were difficult to capture the number collected was probably a proportion only of those present.

Specimens of the common opossum, *D. marsupialis* and occasionally other mammals (Table I), were associated with palms in all five of the study areas. The majority of *R. pictipes* and *R. robustus* from all areas were heavily infected with *T. cruzi*, principally strains identified biochemically as zymodeme (Z) 1 (Póvoa et al., in press) and both bug species sometimes carried concomitant infections of a trypanosome of the subgenus *Herpetosoma* (Miles, unpublished observations).

DISCUSSION

The "mucajá", "inajá" and "babaçu" palms have similar features in that they have capacious crowns in which leaves and palm debris accummulate. They provide suitable nesting sites for the commom opossum *D. marsupialis* and other mammals, which

probably feed on palm fruit (Miles, unpublished observations). The "mucajá" palm is found in large areas of equatorial and subequatorial Brazil, apparently with the exception of Upper Amazonia, and is characteristic of fertile, alkaline soils (Bondar, 1964). The "inajá" is particularly common in Maranhão and Pará States and is characteristic of sandy soils; species of the genus *Maximiliana* extend into Venezuela and Peru. The "babaçu", which is closely related to the "inajá" occurs throughout Amazônia and well into the States of central Brazil but is apparently not present in the eastern States (Bondar, 1964).

The data in Table I give little indication of differential ecotopes of *R. pictipes* and *R. robustus*. We have noted from our other studies that *R. pictipes* occurs in forest with few palm trees, particularly in dry, tall forest with continuous canopy where it feeds on *D. marsupialis* in "open" arboreal nests (Miles et al., 1981b) and probably on other mammals. Apart from three adult specimens taken on a sloth on the BR364 highway, at km 181 (Porto Velho) we have only collected *R. robustus* from palm trees. Although both species may occur together in the same palm *R. robustus* appears to be more common in the "inajá" and "babaçu" than the "mucajá". Some degree of overlap might be expected, particularly in secondary vegetation or where forest or other vegetation types merge, between habitats and we have as yet been unable to define distinct ecotopes for the two species. When they are competing for precisely the same ecological niche, one might expect one of the species to predominate. To attempt to see if this was indeed the case, we classified each collection into one of the five categories shown in Table II, according to which of the two species were present and, if both were present, the degree of dominance. It can be seen from Table II that, in most collections, one species alone was present. There was also some evidence that one species excluded another, in that very few infestations contained equal numbers of each species. Both species were on occasions dominant, *R. robustus* marginally more frequently, and the conditions on which dominance depended, whether locality, palm species or associated hosts were not apparent. Both species seem to feed from the same major host, *D. marsupialis*, in support of which both carried *T. cruzi* and *Herpetosoma* infections. In any further assessment of the ecotopes of the two triatomine species it would be valuable to include blood meal analysis, with appropriate experimental control feeds.

TABLE II

The number of occasions on which *Rhodnius robustus* and *Rhodnius pictipes* were present singly or together in collections of triatomine bugs from Amazonian palms

Locality	*R. robustus* only	*R. robustus* dominant	*R. robustus* = *R. pictipes*	*R. pictipes* dominant	*R. pictipes* only
A. Parque das Laranjeiras (Manaus)	10	11	1	4	6
B. Stand de Tiros (Belém)	–	–	–	–	19
C. Mosqueiro Island (70k N of Belém)	1	–	–	2	9
D. Fazenda de Paraíso Soure, Marajó Island	5	1	–	–	8
E. Porto Velho BR364 kms 23-119	20	3	–	1	2

We have collected large numbers of adult *R. pictipes*, light-attracted into houses in the city of Belém and on Mosqueiro Island. In the latter case several *T. cruzi* infected adult *R. pictipes* were collected from the same house where there had been an acute case of Chagas' disease (Silveira et al., 1979). Heavily bug-infested "mucajá" and "inajá" palms were found within a few metres of the house. It was clearly demonstrated that *T. cruzi* from the patient, from silvatic *R. pictipes* collected in palms and from *D. marsupialis* carried the same strain or zymodeme of *T. cruzi* (Z1), all but proving that *R. pictipes* invading houses from infested palms were the source of the human infection (Miles et al., 1981a). Fortunately *R. pictipes* does not survive well when removed from its natural ecotopes. We have found high mortality rates when establishing laboratory colonies and so assume that *R. pictipes* is unlikely to adapt readily to houses (Miles et al., 1981b). It is not clear whether *R. robustus* is light-attracted into houses to the same extent as *R. pictipes*. We have no records at all of *R. robustus* in houses, but, as Table I indicates the species is not common in the vicinity of Belém, where we are likely to be informed of such incursions. Adult *R. robustus* are occasionally reported from houses in Venezuela, implying that light-attraction does occur. *R. robustus* thrives in laboratory colonies and seem to be as prolific and hardy as *R. prolixus*, to which it is closely related (Lent & Wygodzinsky, 1979). Nevertheless *R. prolixus* is the only major domestic vector in Venezuela where both *R. prolixus* and *R. robustus* infest palms. It is not clear why *R. robustus* cannot make the same transition as *R. prolixus* and establish domestic colonies. In the Amazon region both *R. pictipes* and *R. robustus* are likely to be introduced into houses with palm fronds used for roofing material. "Inajá" and "babaçu" fronds may both be used for house construction.

It seems largely a question of good fortune that the two *Rhodnius* species that this study demonstrates are widespread and common throughout the Amazon basin in palm trees, close to major cities and colonization areas, do not adapt to houses and cause endemic Chagas' disease. In the case of *R. robustus*, the reason for this failure to colonise houses is unclear. This investigation does indicate however, that it is likely that some sporadic cases of acute Chagas' disease, as detected near the city of Belém, will be acquired from triatomine infested palms. There are valid economic and ecological reasons for maintaining and cultivating palms near urbans areas. Nevertheless, the immediate risk of occasional cases of Chagas' disease or future adaptation of triatomine species to houses should not be overlooked as the Amazon basin is developed. Restricted felling, selection of palm species retained, barrier clearing around forest reserves, insecticide spraying of palms, opossum control (Arias & Naiff, 1981) or screening of dwellings against flying insects may be appropriate in some circumstances. There is clearly a need to establish the degree to which *R. robustus* is light-attracted into houses and broader studies of Amazonian palms as triatomine habitats, with definition of species ecotopes, would be worthwhile.

RESUMO

Rhodnius robustus e/ou *Rhodnius pictipes*, infectados com *Trypanosoma cruzi*, foram comumente encontrados, em grande número, nas palmeiras *Maximiliana regia* (inajá), *Acrocomia sclerocarpa* (mucajá) e *Orbignya speciosa* (babaçu) na Amazônia brasileira. O marsupial *Didelphis marsupialis* foi o animal encontrado mais freqüentemente nas palmeiras associadas à alta prevalência de triatomíneos. *R. pictipes* que é atraído pela luz nas residências de palmeiras vizinhas, provavelmente é a fonte de um caso agudo de doença de Chagas nas vizinhanças de Belém. Sugere-se que as palmeiras albergando triatomíneos poderiam ser relacionadas com infecções humanas de doença de Chagas nos Estados de Amazonas e Rondônia. Sugere-se, também, possíveis métodos de controle.

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