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# Occurrence and variability of *Panstrongylus lutzi* in the State of Ceará, Brazil

## Ocorrência e variabilidade de *Panstrongylus lutzi* no Estado do Ceará, Brasil

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**ABSTRACT**

Panstrongylus lutzi *is generally restricted to the "caatinga" areas of north-eastern Brazil. Adult insects are frequently found in local houses, but colonies have not previously been registered in the statistics of the Control Programme of Chagas Disease. In Ceará State, our study revealed increasing occurrence of this species, usually with high infection rates for* Trypanosoma cruzi*, and always represented by adults that invaded the artificial environment. We also found nymphs in the peridomicile and inside the houses. In silvatic habitats we collected two adult females from hollow tree trunks, which may represent an alternative natural ecotope for the species in this state.* Panstrongylus lutzi *entomological collections from Sobral and Crateús, studied by morphology and morphometrics, showed great variability; those from Crateús were larger smaller and paler in colour, with individuals showing genital features consistent with those described for* Panstrongylus lutzi *or* Panstrongylus *sherlocki, whereas those from Sobral were darker and with genitalia compatible with P. sherlocki, nevertheless, all were considered to be* Panstrongylus lutzi.

***Key-words:*** Panstrongylus lutzi. *Triatominae. Chagas' disease. Morphometry. Variability.*

**RESUMO**

*O* Panstrongylus lutzi *é um triatomíneo de ocorrência restrita às áreas de "caatinga" do Nordeste brasileiro. Apesar da presença de adultos no ambiente artificial ser freqüente, a ocorrência de colônias nunca havia sido assinalada pelas estatísticas do Programa de Controle da Doença de Chagas. No Estado do Ceará, a ocorrência desta espécie aumentou paulatinamente ao longo do período estudado, com taxas de infecção natural com* Trypanosoma cruzi *geralmente altas, sempre associadas a adultos que invadem o ambiente artificial. Chama a atenção o encontro de ninfas no peridomicílio e no intradomicílio. No ambiente silvestre duas fêmeas foram coletadas em troncos de árvores, que podem representar ecótopos naturais alternativos para a espécie neste Estado. As amostras de* Panstrongylus lutzi *dos municípios de Sobral e Crateús estudadas morfológica e morfometricamente, demonstraram alta variabilidade, sendo os insetos de Crateús significativamente menores e de coloração pálida, apresentando alguns indivíduos padrão da morfologia do falo compatível com a descrição da espécie; os insetos de Sobral eram escuros e as genitálias coincidentes com o padrão de* Panstrongylus sherlocki*, mas sendo todos considerados por nós como* Panstrongylus lutzi.

***Palavras-chaves****:* Panstrongylus lutzi. *Triatominae. Doença de Chagas. Morfometria. Variabilidade.*

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*Panstrongylus lutzi* Neiva & Pinto, 1926 (Hemiptera, Reduviidae) is a little-studied species of Triatominae recorded from the caatinga region of northeastern Brazil (States of Ceará, Alagoas, Rio Grande do Norte, Pernambuco, Bahia, Paraíba and Sergipe)[8]. Its main natural habitat appears to be armadillo burrows[8] and although adults have been frequently noted flying into houses, they have rarely been reported to form domestic colonies[2,7]. In the state of Ceará[3], from 1964-1974, 28 adult bugs were reported entering houses in 17 municipalities (out of 141 municipalities investigated), showing a high rate of natural infection with the causative agent of Chagas' disease, *Trypanosoma cruzi* (17.7%). In more recent years, routine epidemiologic surveillance by the state Chagas Disease Control Programme (National Health Foundation, Ceará State – PCDCh/FUNASA-CE) has indicated an apparent increase in the rate of house invasion by this species, which prompted the study reported here (Figure 1).

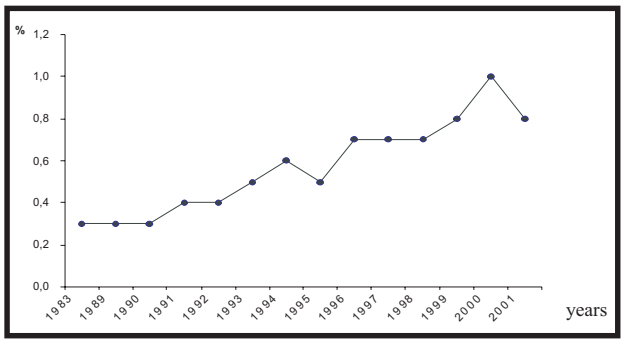



***Figure 1 - Percentage of* Panstrongylus lutzi *in relation to the total number of triatomines captured by the Chagas Disease Control Programme in the State of Ceará, Brazil, in the year of 1983 and during the period of 1989 to 2001.***

## MATERIAL AND METHODS

The historical records of the PCDCh/FUNASA-CE were assessed in terms of capture reports of domestic Triatominae by the PCDCh field agents. As baseline we took the records for 1983, when field activities were expanded under the national Chagas' disease control campaign to cover almost the entire endemic area of the state. This area comprised 107 of the 141 municipalities then defined in the State of Ceará. We also analyzed the yearly capture records for the period from 1989 to 2001 which was the year when field activities were transferred to municipal authority following decentralization, and included 149 municipalities of the 184 now defined in the state. Under the current decentralized system, municipal field personnel are trained by the Fundação Nacional de Saúde (FUNASA) using similar field surveillance methods as before. This includes microscopical assessment of rates of infection with *T. cruzi* from a sample of the collected bugs (by Giemsa staining of fresh bug feces). Distributional analysis of *P. lutzi* made use of the PCDCh/FUNASA information system for the years 1983 and 2001 (Figures 2A and 2B). For 2001, but not for 1983, this system also enabled localization of records of intradomiciliary colonies (defined by the finding of nymphs in domestic habitats).

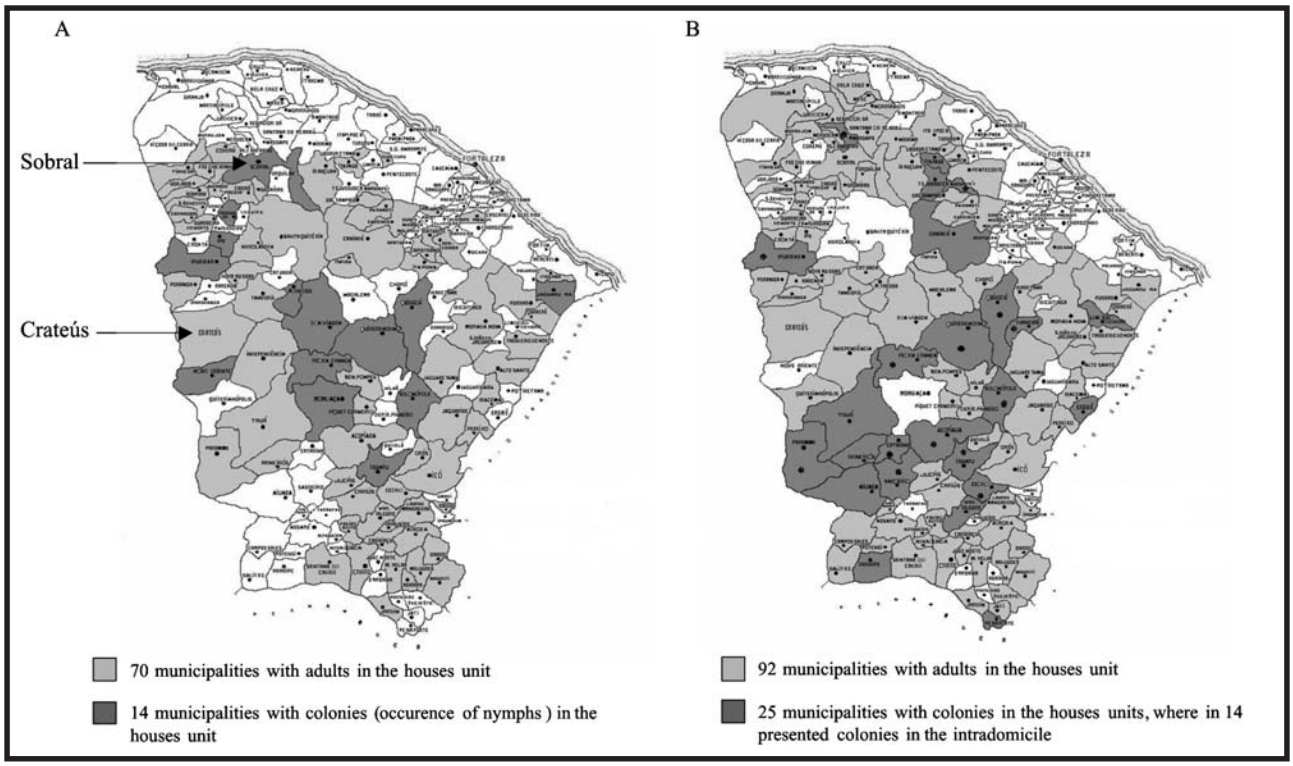
More detailed study was carried out on entomological collections of *P. lutzi* made between July 1999 and July 2000 from houses in the two municipalities of Crateús and Sobral (Figure 2A). Crateús is an arid region of caatinga-steppe, with mean annual rainfall of 758mm, more than 150 dry days per year[15], and temperatures of 25-26ºC. Geomorphologically it is classified within the Superfície Sertaneja[1], typified by pre-Cambrian formations with open wooded steppes dominated by *carnauba* palms (*Copernicia cerifera*). Sobral is similar, but with annual mean temperatures of 26-27.5ºC, and annual precipitation reaching 1,200mm. Like other regions of the caatinga, both these municipalities show hydrological deficits for over 8 months per year (rainfall less than 60mm in 63.9% of months, and less than 10mm in 45.7% of months)[4].

A search for natural silvatic habitats of *P. lutzi* was carried out in the rural areas of Sobral and Crateús for five days in each locality, by seeking bugs randomly in various potential ecotopes including rock-piles, under tree bark, and nests of rodents or birds. In the region of Crateús, during November 1999, we also attempted collections using a light trap (suspended white sheet illuminated by battery-operated fluorescent tube) for two consecutive nights between 18:00 and 22:00h.

Morphological analysis of *P. lutzi* from Crateús and Sobral followed the descriptions of Lent & Jurberg (1975)[14], the insects were carefully analyzed using the most recent description by *P. sherlocki*[14]. Additionally, male genitalia of 10 Crateús specimens and nine from Sobral were slide-mounted for comparison with the published descriptions. Morphometric studies were carried out on 12 females and 21 males from Sobral, and 10 females and 31 males from the Crateús entomological collections. Following Dujardin et al[10], six head measurements were taken from each specimen using an image analyzer system (KONTRON KS300): width of anteclypeus, length of antenniferous tubercle, anteocular distance, external distance between occelli, external distance between eyes, and post ocular distance excluding neck (Figure 3). These measurements were log-transformed and used for multivariate analysis, which included examination of variance-covariance matrices by common principal component analysis (CPCA) and discriminant analysis, performed based on the principal components to obtain shape components. All calculations were done using the software packages JMP[17] and NTSYS-pc[16].

## RESULTS

*Panstrongylus lutzi* was found in almost the entire endemic area of the State of Ceará. In 1983, *P. lutzi* was reported from 84 (78.5%) of the 107 municipalities included in the Chagas disease control activities (Figure 2A) represented by adult bugs alone in 70 municipalities, but with peridomestic colonies (defined by finding nymphs) reported from 14 municipalities (Tables 1 and 2). By 2001, *P. lutzi* was reported from 117 (78.5%) of the 149 municipalities examined, represented by adult bugs alone in 92 municipalities, but with domestic or peridomestic colonies reported from 25 (16.8%) municipalities; of these, intradomestic colonies were reported from 14 (9.4%) municipalities (Figure 2B). The dispersal data does not suggest an increase in distribution




Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 1 | Abaiara | x | |
| 2 | Acopiara | x | x |
| 3 | Aiuaba | | x |
| 4 | Alcântara | | x |
| 5 | Altaneira | | x |
| 6 | Alto Santo | x | x |
| 7 | Antonina do Norte | | x |
| 8 | Apuiarés | x | x |
| 9 | Aracoiaba | x | |
| 10 | Ararendá | | x |
| 11 | Araripe | | x |
| 12 | Arneiroz | x | x |
| 13 | Assaré | | x |
| 14 | Aurora | x | x |
| 15 | Baixio | x | |
| 16 | Banabuiú | | x |
| 17 | Barro | x | x |
| 18 | Baturité | x | |
| 19 | Bela Cruz | | x |
| 20 | Boa Viagem | x | x |
| 21 | Brejo Santo | | x |
| 22 | Campos Sales | | x |
| 23 | Canindé | x | x |
| 24 | Capistrano | x | |
| 25 | Caridade | x | x |

Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 26 | Cariré | x | x |
| 27 | Caririaçu | x | x |
| 28 | Cariús | x | x |
| 29 | Carnaubal | x | |
| 30 | Catarina | | x |
| 31 | Catunda | | x |
| 32 | Cedro | x | x |
| 33 | Choró | | x |
| 34 | Coreaú | x | |
| 35 | Crateús | x | x |
| 36 | Crato | x | x |
| 37 | Croatá | | x |
| 38 | Dep. Irapuan Pinheiro | | x |
| 39 | Ererê | | x |
| 40 | Farias Brito | x | x |
| 41 | Forquilha | | x |
| 42 | Frecheirinha | x | x |
| 43 | General Sampaio | x | x |
| 44 | Graça | | x |
| 45 | Granja | | x |
| 46 | Granjeiro | | x |
| 47 | Groaíras | | x |
| 48 | Guaraciaba do Norte | x | x |
| 49 | Hidrolândia | x | |
| 50 | Ibaretama | | x |

Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 51 | Ibiapina | x | x |
| 52 | Icó | x | x |
| 53 | Iguatu | x | x |
| 54 | Independência | x | x |
| 55 | Ipaporanga | | x |
| 56 | Ipaumirim | | x |
| 57 | Ipú | x | x |
| 58 | Ipueiras | x | x |
| 59 | Iracema | x | x |
| 60 | Irauçuba | x | x |
| 61 | Itaiçaba | x | |
| 62 | Itapajé | x | x |
| 63 | Itapipoca | | x |
| 64 | Itapiuna | x | |
| 65 | Itatira | x | x |
| 66 | Jaguaretama | x | x |
| 67 | Jaguaribe | x | x |
| 68 | Jaguaruana | x | x |
| 69 | Jardim | x | x |
| 70 | Jati | | x |
| 71 | Juazeiro do Norte | | x |
| 72 | Jucás | x | x |
| 73 | Lavras da Mangabeira | x | x |
| 74 | Limoeiro do Norte | | x |
| 75 | Madalena | | x |

Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 76 | Marco | | x |
| 77 | Massapê | | x |
| 78 | Mauriti | x | x |
| 79 | Meruoca | | x |
| 80 | Milagres | x | x |
| 81 | Milhã | | x |
| 82 | Miraíma | | x |
| 83 | Missão Velha | x | x |
| 84 | Mombaça | x | |
| 85 | Monsenhor Tabosa | x | x |
| 86 | Morada Nova | x | x |
| 87 | Moraújo | | x |
| 88 | Morrinhos | | x |
| 89 | Mucambo | x | x |
| 90 | Nova Olinda | | x |
| 91 | Nova Russas | x | x |
| 92 | Novo Oriente | x | |
| 93 | Ocara | | X |
| 94 | Orós | X | X |

Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 95 | Pacajús | x | |
| 96 | Pacujá | | x |
| 97 | Palmácia | x | |
| 98 | Parambú | x | x |
| 99 | Paramoti | x | x |
| 100 | Pedra Branca | x | x |
| 101 | Penaforte | | x |
| 102 | Pentecoste | | x |
| 103 | Pereiro | x | x |
| 104 | Piquet Carneiro | x | x |
| 105 | Pires Ferreira | | x |
| 106 | Poranga | x | x |
| 107 | Potengi | | x |
| 108 | Quiterianópolis | | x |
| 109 | Quixadá | x | x |
| 110 | Quixelô | | x |
| 111 | Quixeramobim | x | x |
| 112 | Quixeré | x | x |
| 113 | Reriutaba | x | |
| 114 | Russas | x | x |
| 115 | Saboeiro | | x |

Municípios do Ceará com captura de *P. lutzi* nos anos de 1983 e 2001

| Nº de Ordem | Município | 1983 | 2001 |
|---|---|---|---|
| 116 | Salitre | | x |
| 117 | Santa Quitéria | x | |
| 118 | Santana do Acaru | | x |
| 119 | Santana do Cariri | x | x |
| 120 | São Benedito | x | |
| 121 | São João de Jaguaribe | | x |
| 122 | São Luis do Curu | x | |
| 123 | Senador Pompeu | x | x |
| 124 | Senador Sá | | x |
| 125 | Sobral | x | x |
| 126 | Solonópole | x | x |
| 127 | Tabuleiro do Norte | x | x |
| 128 | Tamboril | x | x |
| 129 | Tauá | x | x |
| 130 | Tejuçuoca | | x |
| 131 | Tianguá | x | x |
| 132 | Tururu | | x |
| 133 | Ubajara | x | |
| 134 | Umirim | | x |
| 135 | Uruburetama | x | x |
| 136 | Uruoca | | X |
| 137 | Várzea Grande | X | X |

***Figure 2 - Ceará State maps showing the municipalities where National Health Foundation (FUNASA-CE) collected*** **Panstrongylus lutzi.** ***(A) data from 1983, the arrows indicate the municipalities of Sobral and Crateús; (B) data from 2001.***

***Table 1 - House units infestation and capture index of* Panstrongylus lutzi*, in the year 1983 and from 1989 to 2001. (Chagas Disease Control Programme, FUNASA, State of Ceará, Brazil).***

| Year | Municipalities nº | Municipalities with P. *lutzi* | | Houses units investigated | Infested houses units | Intradomiciles infested | P. *lutzi* capture index* in | P. *lutzi* capture index* in |
|---|---|---|---|---|---|---|---|---|
| | | nº | % | nº | nº | nº | the house unit | the intradomicile |
| 1983 | 107 | 84 | 78.5 | 797,910 | 180,358 | 150,658 | 0.4 | 0.5 |
| 1989 | 145 | 88 | 60.7 | 639,851 | 68,371 | 32,296 | 0.7 | 1.0 |
| 1990 | 151 | 81 | 53.6 | 605,442 | 58,508 | 22,670 | 0.7 | 1.4 |
| 1991 | 145 | 84 | 57.9 | 692,052 | 56,279 | 20,506 | 0.8 | 1.5 |
| 1992 | 140 | 62 | 44.3 | 661,484 | 51,327 | 18,256 | 0.7 | 1.5 |
| 1993 | 162 | 90 | 55.6 | 707,056 | 53,043 | 18,771 | 1.0 | 2.2 |
| 1994 | 97 | 50 | 51.5 | 317,234 | 21,502 | 8,027 | 0.9 | 1.9 |
| 1995 | 96 | 51 | 53.1 | 425,119 | 25,976 | 8,727 | 0.9 | 1.8 |
| 1996 | 96 | 68 | 70.8 | 480,065 | 37,429 | 13,579 | 1.2 | 2.3 |
| 1997 | 103 | 58 | 56.3 | 364,904 | 33,934 | 10,142 | 1.2 | 3.4 |
| 1998 | 112 | 79 | 70.5 | 410,377 | 39,488 | 16,325 | 1.5 | 3.1 |
| 1999 | 99 | 65 | 65.7 | 373,381 | 32,074 | 13,533 | 1.5 | 2.7 |
| 2000 | 60 | 27 | 45.0 | 137,334 | 7,466 | 2,716 | 1.9 | 4.5 |
| 2001 | 149 | 117 | 78.5 | 589,928 | 52,870 | 16,226 | 1.8 | 4.6 |

House unit: combination of the house (intradomicile) and the space around the house (peridomicile).

* Capture index = number of triatomine captured : per the number of positive houses unit or positive intradomicile x 100

***Table 2 - Presence of* Panstrongylus lutzi *in domiciliar units in the State of Ceará, Brazil, in the year 1983 and in the period 1989-2001 (*Chagas Disease Control Programme, Fundação Nacional da Saúde, *State of Ceará, Brazil).***

| | Number of triatomines | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | stage | | | | | | | | site of capture | | | | | | | | | | | |
| | adults | | | | nymphs | | | | intradomicile | | | | peridomicile | | | | total | | | |
| year | cap | exam | pos | % | cap | exam | pos | % | cap | exam | pos | (%) | cap | exam | pos | % | cap | exam | pos | % |
| 1983 | 702 | 84 | 1 | 1.2 | 48 | 10 | 0 | | 689 | 83 | 1 | 1.2 | 61 | 11 | 0 | | 750 | 94 | 1 | 1.1 |
| 1989 | 416 | 104 | 3 | 2.9 | 69 | 38 | 0 | | 338 | 96 | 3 | 3.1 | 147 | 46 | 0 | | 485 | 142 | 3 | 2.1 |
| 1990 | 355 | 77 | 1 | 1.3 | 60 | 32 | 0 | | 319 | 79 | 0 | | 96 | 30 | 1 | 3.3 | 415 | 109 | 1 | 0.9 |
| 1991 | 403 | 119 | 2 | 1.7 | 39 | 30 | 0 | | 301 | 75 | 2 | 2.7 | 141 | 74 | 0 | | 442 | 149 | 2 | 1.3 |
| 1992 | 298 | 91 | 4 | 4.4 | 71 | 36 | 0 | | 268 | 80 | 2 | 2.5 | 101 | 47 | 2 | 4.3 | 369 | 127 | 4 | 3.1 |
| 1993 | 480 | 99 | 2 | 2.0 | 48 | 19 | 1 | 5.3 | 421 | 78 | 2 | 2.6 | 107 | 40 | 1 | 2.5 | 528 | 118 | 3 | 2.5 |
| 1994 | 163 | 39 | 1 | 2.6 | 24 | 8 | 0 | | 156 | 35 | 1 | 2.9 | 31 | 12 | 0 | | 187 | 47 | 1 | 2.1 |
| 1995 | 180 | 41 | 1 | 2.4 | 50 | 31 | 0 | | 157 | 37 | 1 | 2.7 | 73 | 35 | 0 | | 230 | 72 | 1 | 1.4 |
| 1996 | 386 | 97 | 1 | 1.0 | 58 | 38 | 0 | | 306 | 64 | 1 | 1.6 | 138 | 71 | 0 | | 444 | 135 | 1 | 0.7 |
| 1997 | 373 | 136 | 4 | 2.9 | 43 | 16 | 0 | | 344 | 123 | 3 | 2.4 | 72 | 29 | 1 | 3.4 | 416 | 152 | 4 | 2.6 |
| 1998 | 543 | 254 | 9 | 3.5 | 67 | 37 | 0 | | 500 | 224 | 5 | 2.2 | 110 | 67 | 4 | 6.0 | 610 | 291 | 9 | 3.1 |
| 1999 | 431 | 141 | 7 | 5.0 | 56 | 32 | 1 | 3.1 | 371 | 118 | 6 | 5.1 | 116 | 55 | 2 | 3.6 | 487 | 173 | 8 | 4.6 |
| 2000 | 127 | 67 | 1 | 1.5 | 14 | 6 | 0 | | 122 | 64 | 0 | 19 | 9 | 1 | 11.1 | | 141 | 73 | 1 | 1.4 |
| 2001 | 878 | 303 | 6 | 2.0 | 70 | 56 | 1 | 1.8 | 747 | 245 | 4 | 1.6 | 201 | 114 | 3 | 2.6 | 948 | 359 | 7 | 1.9 |

Cap = captured. Exam = examined. Pos = positive for *Trypanosoma cruzi* infection

($\theta^2$, p = 0.9) but the average numbers of bugs captured did show some increase over this period. For 1983, the average number of bugs encountered was 0.4 per domestic unit examined, rising to 1.8 in 2001 ($p < 0.05$). This increase was most marked in intradomestic captures, which rose from averages of 0.5 to 4.6 ($p < 0.05$) over this period (Table 1). Rates of infection of the adult bugs with *T. cruzi* varied between 1 to 5% over the period considered, with only 3 nymphs found to be infected (Table 2).

Our searches for silvatic bugs revealed two adult females *P. lutzi* in hollow trunks of *pau branco* (*Auxemma oncocalyx*), a tree of the Borraginaceae family, near the town of Sobral (Figure 4A and 4B). In Crateús, no bugs were found by microhabitat examination, but two males were taken at the light trap.

From the bugs collected in domestic and peridomestic habitats of Crateús and Sobral, a clear distinction was observed in terms of color pattern. Those from Crateús were invariably paler in color, while the majority of those from Sobral (74% of 50 examined) were a much darker brown (Figure 5). Amongst these bugs, common principal component analysis indicated that the Sobral insects tended to be larger (both for males and females) with a marked differentiation between the two populations (Figure 6A). Likewise, discriminant analysis of shape components demonstrated separation between the two populations (Figure 6B).

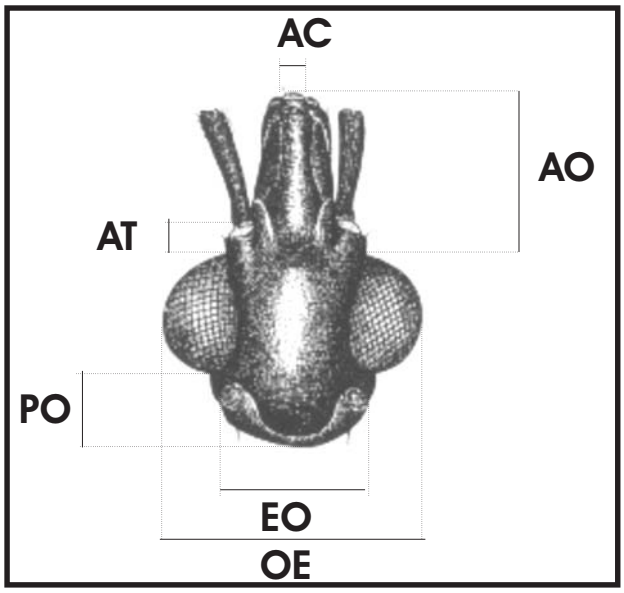



*Figure 3 - Dorsal aspects of an adult* Panstrongylus lutzi *head, showing the morphometric measurements taken. AC, width of anteclypeus; AT, length of antenniferous tubercle; AO, anteocular distance; EO, external distance between occelli; OE, external distance between eyes and; PO, postocular distance excluding neck.*


*Figure 4 - Natural ecotopes of* Panstrongylus lutzi *in the State of Ceará, Brazil. (A) "Caatinga" view; (B) Detail of a hollow trunks of "pau branco" (*Auxemma oncocalyx*), where the triatomines were captured.*

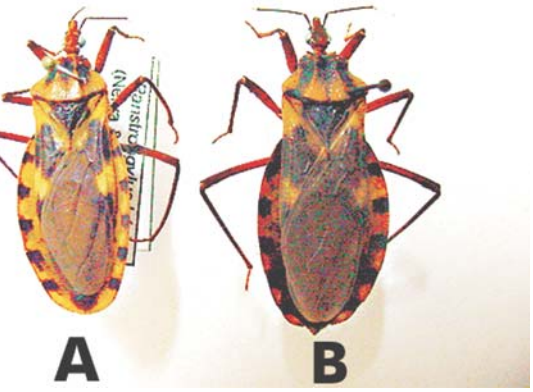
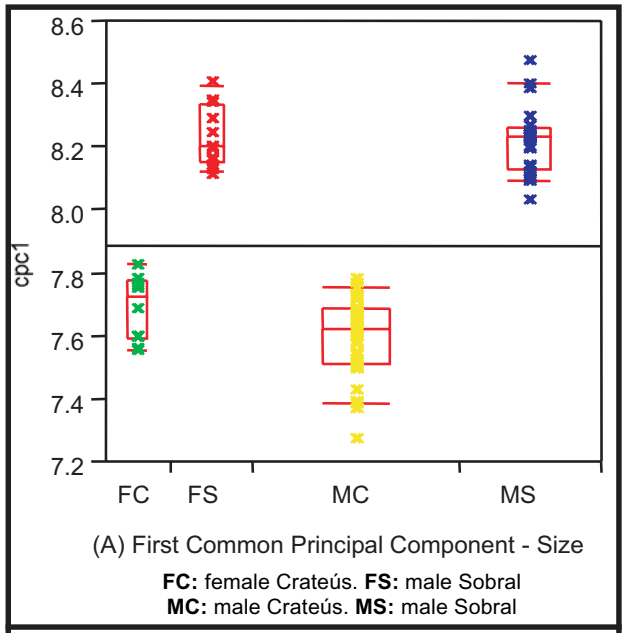



*Figure 5 - Male and female of* Panstrongylus lutzi *collected in the municipalities of Crateús (A) and Sobral (B), Ceará State, Brazil and maintained in the entomological collection.*



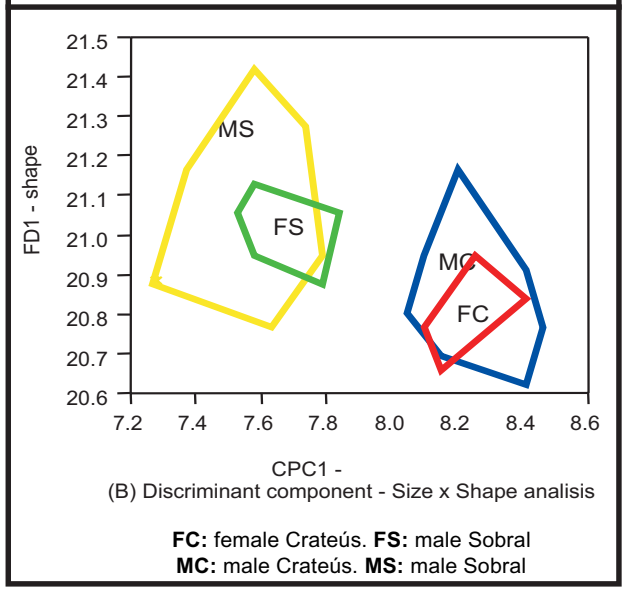




*Figure 6 - Multivariate analysis showing the distribution of males and females* Panstrongylus lutzi *from two different populations. (A) Common principal component analyses, that shows the global size of the insects. (B) Discriminant analysis showing both size and shape relationships.*

Comparison of male genitalia showed vesical forms amongst bugs from Crateús that were consistent with those described for both *P. lutzi* and *P. sherlocki*, whereas bugs from Sobral all showed vesical forms compatible with *P. sherlocki*. The endosomal process was similar in all bugs examined, generally displaying numerous apical spines (Table 3).

***Table 3 - Comparison of phallic structures of* Panstrongylus lutzi *collected in Crateús and Sobral, Ceará, Brazil.***

| | Pattern of the vesica | | Apical process of endosoma |
|---|---|---|---|
| | number of insects compatible | number of insects compatible | number of spines |
| Origin | with *P. lutzi* | with *P. sherlocki* | |
| Crateús (n = 10) | 5 | 5 | Many spines |
| Sobral (n = 9) | 0 | 9 | Many spines |

n = number of studied insects

## DISCUSSION

The main domestic vector of Chagas disease in the State of Ceara is *Triatoma brasiliensis*, and in our baseline year of 1983, the Chagas disease Programme of Ceará (PCDCh) captured a total of 210,439 specimens of this species[12]. By 2001 however, with a broadly similar capture effort, the total number of *T. brasiliensis* collected had declined to 55,280 specimens[13]. During the same period, a total of 750 specimens of *P. lutzi* was captured in 1983, compared to 948 specimens in 2001 – of which 93% were adults (Table 2). In other words, although the vector control interventions appear to have markedly reduced the capture rate of *T. brasiliensis*, they appear to have had little effect on the frequency of house invasion by *P. lutzi*. Moreover, the capture index for *P. lutzi* (number of bugs captured/ number of houses infested x 100) shows a steady increase over this period (Table 1), with greater frequency of house invasion. This is also paralleled by increasing reports of nymphs recorded in peridomestic habitats in 21.4% of the municipalities examined in 2001, and in intradomestic habitats in 12% of these municipalities.

The available data suggest that *P. lutzi* is increasingly likely to invade peridomestic and domestic habitats, and also increasingly likely to form peridomestic and domestic colonies. Discussion with householders in Sobral and Crateús revealed that adult *P. lutzi* are often seen flying into the houses – presumably attracted by light as indicated by our captures at light traps. Moreover, although infection rates with *T. cruzi* were relatively low (Table 2) invasion of houses by silvatic *P. lutzi* would appear to represent an additional mechanism to introduce silvatic strains of *T. cruzi* into the domestic transmission cycles.

Comparing the distributional maps for 1983 and 2001 (Figure 3), it appears that domestic colonies of *P. lutzi* were concentrated along the central and western regions of the state of Ceará, towards the neighboring state of Piauí – without any apparent association with the reported distribution of other species of Triatominae, nor with obvious geographic or anthropic factors. It is possible that the frequency of domestic invasion reflects the frequency of its occurrence in silvatic habitats[5 15], which in turn may reflect the density of silvatic hosts such as armadillos[10]. Our finding of adult *P. lutzi* in hollow trees could indicate an alternative silvatic habitat, although given the widespread association of species of *Panstrongylus* with armadillo burrows[8] this finding could equally be due to adventitious flying adult bugs.

The *P. lutzi* populations studied here showed marked variability in morphology, shown by colour and metric characteristics of the head capsule. In particular, comparison of anteocular and postocular distances, and length of antenniferous tubercle (Figure 5), allowed clear distinction between populations from Sobral and Crateús. Those of Sobral were invariably larger than those from Crateús, which may indicate a west-east axis of differentiation, since other studies have indicated that derivative populations are generally of smaller average size than their putative original forms[9].

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