

The Phlebotominae fauna of Serra dos Carajás, Pará, Brazil, and its possible implication in the transmission of American tegumentary leishmaniasis

Fauna flebotomínica da Serra dos Carajás, Estado do Pará, Brasil, e sua possível implicação na transmissão da leishmaniose tegumentar americana

Flebótomos de la Serra dos Carajás (Estado de Pará, Brasil) y su posible implicación en la transmisión de la leishmaniasis cutánea americana

Adelson Alcimar Almeida de Souza
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Fernando Tobias Silveira
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil
Núcleo de Medicina Tropical, Universidade Federal do Pará, Belém, Pará, Brasil

Ralph Lainson
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Iorlando da Rocha Barata
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Maria das Graças Soares Silva
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

José Aprígio Nunes Lima
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Maria Sueli Barros Pinheiro
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Fábio Márcio Medeiros da Silva
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Lindomar de Souza Vasconcelos
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Marliane Batista Campos
Instituto Evandro Chagas/SVS/MS, Ananindeua, Pará, Brasil

Edna Aoba Yassui Ishikawa
Núcleo de Medicina Tropical, Universidade Federal do Pará, Belém, Pará, Brasil

ABSTRACT

Serra dos Carajás, located in the southeast of Pará State, Brazil, is a rich tropical forest where species of *Leishmania* sp. of medical interest are found, such as *Leishmania* (V.) *braziliensis*, L. (V.) *lainsoni*, L. (V.) *shawi* and L. (L.) *amazonensis*. They are transmitted by the following phlebotomi: *Psychodopygus complexus* or *Ps. wellcomei*, *Lutzomyia ubiquitalis*, *Lu. whitmani* and *Lu. flaviscutellata*. Considering the increase of immigrants in the region of the Carajás project, this study aimed to assess the Phlebotominae fauna and their possible participation in the transmission of American cutaneous leishmaniasis (ACL). The phlebotomi were captured from December 2005 to September 2007 at the following locations: i) Parauapebas Botanical Park; ii) an environmental protection area; and iii) Tapirapé-Aquiri National Forest. During the 172 days of collection, 10 CDC (18 h to 6 h) and 2 Shannon (18 h to 20 h) light traps were used. Of the 22,095 phlebotomi captured, 6,789 (31%) were male and 15,306 (69%) were female, and they belonged to 69 species and three genera, including *Psychodopygus*, *Lutzomyia* and *Brumptomyia*. A total of 19 (0.16%) natural infections of the following species were detected: *Ps. davisii* (4), *Ps. h. hirsutus* (3), *Lu. umbratilis* (3), *Lu. richardward* (2), *Lu. brachipyga* (2), *Lu. ubiquitalis* (2), *Lu. trinidadensis* (1) and *Lu. migonei* (1). Although no infection was found in *Ps. wellcomei/complexus*, the main vector of L. (V.) *braziliensis* in the region, this species was the most prevalent (1.6%), followed by *Ps. davisii* (15.4%), *Ps. carrerai* (4.2%), *Lu. shawi* (3.9%), *Lu. brachipyga* (2.5%) and *Lu. richardward* (1.2%). These results show the importance of these phlebotomi as possible vectors of ACL in Serra dos Carajás.

Keywords: Phlebotominae; Serra dos Carajás; Pará State; Brasil; Leishmaniasis, Cutaneous.

Correspondence / Correspondência / Correspondencia:

Adelson Alcimar Almeida de Souza
Instituto Evandro Chagas, Seção de Parasitologia
Rodovia BR316, km 7, s/nº, Levilândia
CEP: 67030-000 Ananindeua-Pará-Brasil
E-mail: adelsonsouza@iec.pa.gov.br

INTRODUCTION

American cutaneous leishmaniasis (ACL) is an important public health problem in Brazil, not only due to its incidence and geographic distribution but also due to the risk of severe clinical forms of the disease. The disease is caused by different protozoan species of the genus *Leishmania* Ross, 1903, of which at least seven species are now recognized as being medically important in the Brazilian Amazon^{15,17,2}. The transmission of these parasites among their primary reservoirs and, incidentally, to humans, occurs when species of the sand fly vectors feed on blood of living hosts (Diptera: Psychodidae: Phlebotominae)^{8,7}. The genus is most diverse in the Amazon, where all the regional species that infect humans are enzootic in wild mammals belonging to several orders^{9,4}. Humans contract the zoonotic disease when they come into contact with the sylvatic transmission cycle through hunting, swimming, panning, camping or clearing forests. The sand fly fauna of a given forested area is influenced by some variables, among which rainfall and the relative quality of food may serve to attract animal reservoirs. In Serra dos Carajás, Pará, Brazil, this fact can be observed in the region's main seasons, winter (the rainy season from December to June) and summer (the warm period from July to November), and success in capturing sand flies is greater in the rainy season than in the warm period. For this reason, it is important to study the seasonality of sand flies thought to be involved in the transmission of infection to humans¹⁴.

Our interest in researching the sand fly fauna in Serra dos Carajás dates back to the 1970s, when dozens of cases of ACL occurred among the labor force that worked on the large iron mining project, thus prompting the first investigations on the eco-epidemiology of the disease. Briefly, the main findings of this research include the description of *Psychodopygus wellcomei* Fraiha, Shaw and Lainson 1971, a highly anthropophilic sand fly species that incessantly bites humans in the deep forest, and its involvement as the main vector of ACL caused by *Leishmania (Viannia) braziliensis* in Serra dos Carajás and in other areas of the Brazilian Amazon^{5,12}. Furthermore, we also note that altitude makes a major difference in the habitats of the potential transmitter species, *Psychodopygus complexus* and *Ps. wellcomei*: the former proliferates up to 300 m at the base of Serra¹⁸ and the latter from 300 m up to 600-700 m¹¹.

Recently, considering the increase in immigrants in the villages surrounding the area included in the mining project in Serra dos Carajás, as well as the opening of forested areas for the establishment of new fronts for mineral exploration, a new study was established to evaluate the phlebotomine fauna in the area and its possible role in the transmission of agents of ACL. The results of this study are the subject of this report.

MATERIALS AND METHODS

STUDY CHARACTERISTICS

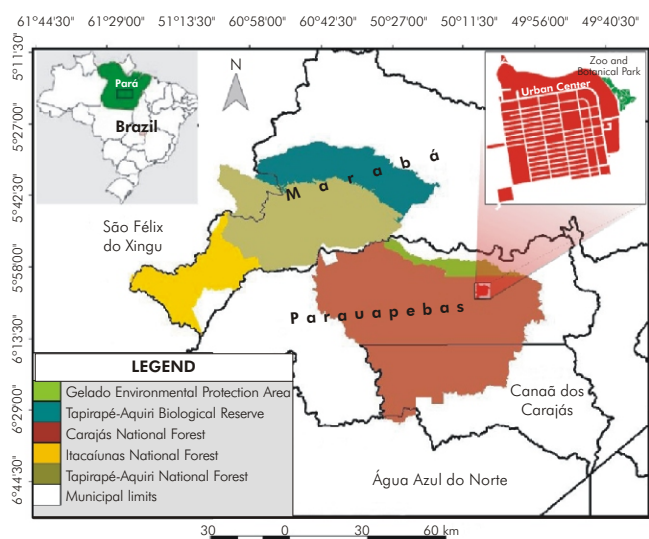
This study is a subproject of a research agreement between the Companhia Vale do Rio Doce (CVRD) and the Instituto Evandro Chagas (IEC/SVS/MS) entitled:

"Avaliação da situação saúde-doença nas áreas de influência do Projeto Salobo e Parque Zoobotânico de Carajás, Pará, Brasil, decorrente do ecossistema local e dos movimentos migratórios – Evaluation of the health and disease situation due to the local ecosystem and migratory movements in areas influenced by the Salobo Project and Zoo and Botanical Park of Carajás, Pará, Brazil", in which we evaluated, from December 2005 to September 2007, the sand fly fauna and its possible implication in the transmission of agents of ACL.

STUDY AREA

Serra de Carajás (5° 35' - 6° 00' S and 50° 24' - 51° 06' W) is located in the southeastern region of the state of Pará, Brazil (Figure 1) and has a mixed topography of mountains and valleys, with varied vegetation consisting of primary forest and cerrado, as well as soil and subsoil rich in iron and other minerals. The average temperature in this region ranges from 20° C to 26° C with 90% relative humidity in the winter and from 26° C to 32° C with 80% humidity in the summer. Within the Serra dos Carajás, we collected sand flies from three different areas:

- 1- Zoo and Botanical Park Quarantine: located in the Serra dos Carajás urban center and characterized by having a small forest reserve, which borders the zoo, where it is still possible to capture sand fly vectors and wild mammals;
- 2- Environmental Protection Area (EPA): an area that is totally degraded by many settlements, deforestation and the housing of two heavily populated communities, Vila Sansão and Paulo Fonteles;
- 3- Tapirapé-Aquiri National Forest: the only primary forest reserve in which we worked. It will also be partially deforested due to a mine with copper deposits. This area is located near the Salobo camp and the Itacaiúnas River.



Source: LabGeo/IEC/SVS/MS.

Figure 1 – Serra dos Carajás, Pará, Brazil. Study area: Zoo and Botanical Park (Urban Center); Environmental Protection Area; Tapirapé-Aquiri National Forest

METHOD FOR COLLECTING SAND FLIES

Two types of light traps were used to collect sand flies: the "CDC" and Shannon types. A total of 10 "CDC" type traps were used, 8 at ground level (1 m high) and 2 in the tree canopy (about 15 m to 20 m above the ground), from 18 h to 6 h, for a total collection time of 12 hours (Figure 2). Two Shannon type traps were used from 18 h to 20 h (Figure 3). These two sampling methods differ in that the "CDC" type trap catches all kinds of insects that are attracted to light, while the Shannon trap, although most insects are still attracted to the light, captures only sand flies by using a handheld suction apparatus.



Figure 2 – "CDC" type light trap



Figure 3 – Shannon type light trap

DISSECTION METHODS AND THE IDENTIFICATION OF SAND FLIES

The dissection of female sand flies was performed to observe the flagellates present in the intestinal tract of the insects, according to the techniques described by Ryan et

al¹². The females were then identified by the presence of spermathecae, and the males were mounted on slides for identification according to Young and Duncan²¹.

ISOLATION METHODS AND IDENTIFICATION OF FLAGELLATES (*LEISHMANIA* SPP)

For the laboratory isolation of flagellates found in the intestinal tract of the female sand fly, mainly flagellates from the genus *Leishmania*, the infectious content was inoculated into Difco B45¹⁹ culture medium and intradermally into hamsters (*Mesocricetus auratus*). Then, after the final isolation of the parasite from culture medium, they were identified using a *Leishmania*-specific monoclonal antibody analysis¹³.

RESULTS

During the seven field trips to Serra dos Carajás, in three target areas (Zoo and Botanical Park Quarantine, Environmental Protection Area and Tapirapé-Aquiri National Forest), 22,095 sand fly specimens were captured: 15,306 females (69%) (Table 1) and 6,789 males (31%) (Table 2). From this total, we identified 69 different species belonging to three genera: *Psychodopygus*, *Lutzomyia* and *Brumptomyia*. The periods with the highest density of flies occurred between March and June, with 3,372 and 3,878 catches, respectively. On the other hand, in September, there was less activity, with only 660 specimens captured in 2006. Of all the females captured (15,306), 11,259 (73.5%) were dissected and examined for *Leishmania* flagellates, and 19 (0.16%) natural infections were detected in the following species of sand fly: *Ps. davisii* (4), *Ps. h. hirsutus* (3), *Lutzomyia umbratilis* (3), *Lu. richardwardi* (2), *Lu. brachipyga* (2), *Lu. ubiquitalis* (2), *Lu. trinidadenses* (1) and *Lu. migonei* (1) (Table 3). From the 19 natural infections detected in sand flies, eight isolates of flagellates were obtained in the Difco B45¹⁹ culture medium. The analysis using the monoclonal antibody technique¹³ revealed the presence of *L. (V.) braziliensis* in two specimens of *Ps. davisii*. We were unable to identify the flagellates isolated from *Ps. h. hirsutus*, *Lu. brachipyga*, *Lu. richardwardi*, *Lu. umbratilis* and *Lu. ubiquitalis* (Table 4). From those sand flies that were not dissected, 2,912 females were placed in the cryobank (N2 and -70° C) at IEC's Leishmaniasis Laboratory for future analysis of natural *Leishmania* infection by molecular methods, and 1,135 were placed in alcohol (70%) for mounting and subsequent identification.

Although we did not find a natural infection in *Ps. wellcomei/complexus*, the main vector for *L. (V.) braziliensis* in the Brazilian Amazon, this species was the most prevalent (16%) among the sand flies captured, followed by *Ps. davisii* (15.4%), *Ps. carrerai* (4.2%), *Lu. shawi* (3.9%), *Lu. brachipyga* (2.5%) and *Lu. richardwardi* (1.2%).

Table 1 – Species of female sand flies from Serra dos Carajás, Pará, Brazil, from December 2005 until September 2007, dissected for the identification and research of flagellates

<i>Brumptomyia avellari</i>	1	<i>Lu. pinottii</i>	40
<i>Br. travassossi</i>	4	<i>Lu. richardwardi</i> (2)*	418
<i>Br. sp.</i>	8	<i>Lu. rorotaensis</i>	8
<i>Lutzomyia antunesi</i>	439	<i>Lu. saulensis</i>	35
<i>Lu. aragaoi</i>	3	<i>Lu. scaffi</i>	12
<i>Lu. bacula</i>	49	<i>Lu. sericea</i>	5
<i>Lu. begoniae</i>	57	<i>Lu. serrana</i>	19
<i>Lu. brachyphalla</i>	11	<i>Lu. shannoni</i>	4
<i>Lu. brachipyga</i> (2)*	647	<i>Lu. shawi</i>	600
<i>Lu. campbelli</i>	1	<i>Lu. sordellii</i>	46
<i>Lu. carvalhoi</i>	26	<i>Lu. spathotrichia</i>	3
<i>Lu. castanheirai</i>	11	<i>Lu. spinosa</i>	1
<i>Lu. choti</i>	2	<i>Lu. triacantha</i>	1
<i>Lu. damascenoii</i>	101	<i>Lu. trichopyga</i>	11
<i>Lu. dasypodogeton</i>	80	<i>Lu. trinidadensis</i> (1)*	52
<i>Lu. dendrophila</i>	38	<i>Lu. tuberculata</i>	17
<i>Lu. dreisbachi</i>	15	<i>Lu. ubiquitalis</i> (2)*	185
<i>Lu. evandroi</i>	25	<i>Lu. umbratilis</i> (3)*	294
<i>Lu. flaviscutellata</i>	75	<i>Lu. whitmani</i>	254
<i>Lu. furcata</i>	30	<i>Lu. williamsi</i>	1
<i>Lu. gomezi</i> (1)*	176	<i>Lu. y. pajoti</i>	1
<i>Lu. hermanlenti</i>	26	<i>Ps. amazonensis</i>	31
<i>Lu. infraspinosa</i>	60	<i>Ps. ayrozai</i>	1
<i>Lu. lenti</i>	3	<i>Ps. bispinosa</i>	38
<i>Lu. longipennis</i>	2	<i>Ps. c. carrerai</i>	945
<i>Lu. longispina</i>	12	<i>Ps. clautrei</i>	115
<i>Lu. lutziana</i>	5	<i>Ps. corossoniense</i>	62
<i>Lu. micropyga</i>	2	<i>Ps. davisii</i> (4)*	2,433
<i>Lu. migonei</i> (1)*	34	<i>Ps. geniculatus</i>	70
<i>Lu. monstruosa</i>	50	<i>Ps. h. hirsutus</i>	400
<i>Lu. monticola</i>	3	<i>Ps. lainsoni</i>	10
<i>Lu. nevesi</i>	1	<i>Ps. paraensis</i>	100
<i>Lu. paca</i>	1	<i>Ps. wellcomei/complexus</i>	1,409
Total			11,259

* Species naturally infected by flagellates.

Table 2 – Species of male sand flies captured in Serra dos Carajás, Pará, Brazil, from December 2005 to September 2007

<i>Brumptomyia avellari</i>	70	<i>Lu. saulensis</i>	18
<i>Br. pintoii</i>	1	<i>Lu. sericea</i>	5
<i>Br. travassossi</i>	35	<i>Lu. serrana</i>	12
<i>Lutzomyia antunesi</i>	220	<i>Lu. shannoni</i>	10
<i>Lu. bacula</i>	5	<i>Lu. shawi</i>	61
<i>Lu. begoniae</i>	135	<i>Lu. sordellii</i>	23
<i>Lu. brachyphalla</i>	152	<i>Lu. spinosa</i>	19
<i>Lu. brachipyga</i> (2)	892	<i>Lu. triacantha</i>	93
<i>Lu. campbelli</i>	1	<i>Lu. trinidadensis</i>	25
<i>Lu. carvalhoi</i>	30	<i>Lu. trispinosa</i>	36
<i>Lu. damascenoii</i>	3	<i>Lu. ubiquitalis</i>	267
<i>Lu. dasypodogeton</i>	242	<i>Lu. umbratilis</i>	153
<i>Lu. dendrophila</i>	42	<i>Lu. whitmani</i>	88
<i>Lu. equatorialis</i>	1	<i>Lu. williamsi</i>	5
<i>Lu. flaviscutellata</i>	17	<i>Ps. amazonensis</i>	61
<i>Lu. furcata</i>	30	<i>Ps. bispinosa</i>	25
<i>Lu. gomezi</i> (1)	35	<i>Ps. c. carrerai</i>	227
<i>Lu. hermanlenti</i>	21	<i>Ps. clautrei</i>	50
<i>Lu. infraspinosa</i>	23	<i>Ps. complexus</i>	76
<i>Lu. lutziana</i>	14	<i>Ps. davisii</i>	979
<i>Lu. micropyga</i>	45	<i>Ps. geniculatus</i>	5
<i>Lu. migonei</i> (1)	10	<i>Ps. h. hirsutus</i>	412
<i>Lu. monstruosa</i>	25	<i>Ps. paraensis</i>	6
<i>Lu. richardwardi</i>	21	<i>Ps. wellcomei</i>	22
Total			4,770

Table 3 – Species of the most prevalent sand flies in Serra dos Carajás, Pará, Brazil, and the species that were naturally infected by flagellates in the intestinal tract

Sand fly species	Frequency	Naturally infected	
<i>Ps. wellcomei</i>	5,352	34.9%	<i>Ps. davisii</i> – 4
<i>Ps. davisii</i>	2,443	15.9%	<i>Ps. h. hirsutus</i> – 3
<i>Ps. c. carrerai</i>	945	6.1%	<i>Lu. umbratilis</i> – 3
<i>Lu. brachipyga</i>	647	4.2%	<i>Lu. brachipyga</i> – 2
<i>Lu. shawi</i>	600	3.9%	<i>Lu. ubiquitalis</i> – 2
<i>Lu. richardwardi</i>	418	2.7%	<i>Lu. richardwardi</i> – 2
<i>Lu. antunesi</i>	439	2.8%	<i>Lu. gomezi</i> – 1
<i>Ps. h. hirsutus</i>	400	2.6%	<i>Lu. trinidadensis</i> – 1
<i>Lu. umbratilis</i>	294	1.9%	<i>Lu. migonei</i> – 1
<i>Lu. whitmani</i>	254	1.6%	–
		Total	19

Table 4 – Characterization of flagellates isolated from sand fly specimens captured in Serra dos Carajás, Pará, Brazil, using a *Leishmania*-specific monoclonal antibody technique

Sample	Sand fly species	Results
M 24 013	<i>Ps. h. hirsutus</i>	Negative
M 24 014	<i>Ps. h. hirsutus</i>	Negative
M 24 015	<i>Lu. brachipyga</i>	Negative
M 24 016	<i>Lu. richardwardi</i>	Indeterminate
M 24 017	<i>Ps. davisii</i>	<i>Leishmania</i> (V.) <i>braziliensis</i>
M 24 018	<i>Ps. davisii</i>	<i>Leishmania</i> (V.) <i>braziliensis</i>
M 24 019	<i>Lu. umbratilis</i>	Negative
M 24 244	<i>Lu. ubiquitalis</i>	Negative

DISCUSSION

When discussing the sand fly fauna from Serra dos Carajás, Pará, Brazil, we should not fail to mention that previous studies have already described part of the local fauna, identifying known species and even new species of sand flies in addition to their feeding habits in relation to human and animal reservoirs²⁰. From these findings, a description of the species *Psychodopygus wellcomei* Fraiha, Shaw and Lainson 1971, a highly anthropophilic sand fly that incessantly bites humans in the deep forest, and its subsequent involvement as the main vector of ACL caused by *L. (V.) braziliensis* in Serra dos Carajás⁵ was, without doubt, one of the most important discoveries related to the eco-epidemiology of ACL in Serra dos Carajás. For this reason, several attempts to colonize the sand fly in the laboratory were made to study the experimental transmission of *L. (V.) braziliensis* via *Ps. wellcomei*. Unfortunately, due to technical reasons, such as proper nutrition and the management of conditions for these sand flies, these experiments were unsuccessful. However, since one of the priorities of this study in Serra dos Carajás was to identify the vector of *L. (V.) braziliensis*, the principal agent of ACL in the region, large numbers of female sand flies were dissected and examined for the presence of parasite promastigotes, which resulted in the discovery of natural

infections not only in *Ps. wellcomei*, but also in *Ps. paraensis* and *Ps. amazonensis*⁵. Later, it was confirmed that *Ps. paraensis* participates in the transmission of *L. (V.) naiffi*, a species not commonly found in humans^{6,16}. Aside from those species, another species of *Leishmania* pathogenic to humans, *L. (L.) amazonensis*, has also been the subject of study in Serra dos Carajás, even though human infections are relatively rare because its vector, the sand fly *Lutzomyia flaviscutellata*, is not very anthropophilic⁸.

As with previous studies, the results of this study confirm the epidemiological importance of some species of sand flies found in the fauna of Serra dos Carajás: *Ps. wellcomei* and *Ps. complexus*, the vectors for *L. (V.) braziliensis*^{5,18}, *Ps. davis*, found infected with *L. (V.) braziliensis*, *Lu. umbratilis*, the vector for *L. (V.) guyanensis*³, *Lu. ubiquitalis*, the vector for *L. (V.) lainsoni*¹⁶. Our results also demonstrate the great diversity of local species, with a total of 69 identified belonging to three genera: *Psychodopygus*, *Lutzomyia* and *Brumptomyia*. Thus, there seems to be no doubt as to the importance of Serra dos Carajás as one of the largest global areas of primitive species of sand flies.

The results of this work appear to be significant when considering the epidemiological role of some species of sand flies in transmitting ACL. This study found 19 (0.16%) natural infections in the following species of sand flies: *Ps. davis* (4), *Ps. h. hirsutus* (3), *Lu. umbratilis* (3), *Lu. richardward* (2), *Lu. brachipyga* (2), *Lu. ubiquitalis* (2), *Lu. trinidadenses* (1) and *Lu. migonei* (1). Of all those findings, the most noticeable was, without a doubt, the discovery of four specimens of *Ps. davis* with flagellates in their intestinal tracts. We were able to confirm, through identification with monoclonal antibodies, that two of these examples were naturally infected by *L. (V.) braziliensis*. This evidence, combined with the other discoveries of *Ps. davis* naturally infected by *Leishmania* spp. in other locations where ACL occurs, such as Paragominas (Pará), Monte Dourado (Pará) and Serra do Navio (Amapá), substantiates our suspicion that this type of sand fly may also be involved in transmitting ACL caused by *L. (V.) braziliensis* in the Brazilian Amazon. Although we were not able to isolate and identify parasites in other species of sand flies, we should not fail to appreciate the presence of natural infections in *Lu. umbratilis* (3) and *Lu. ubiquitalis* (2), for example, because the importance of these species in the transmission of ACL caused by *L. (V.) guyanensis* and *L. (V.) lainsoni*, respectively^{16,3}, is already recognized. Of the other four species naturally infected by flagellates, we should also

point out that *Ps. h. hirsutus* and *Lu. migonei* naturally infected by *Leishmania (V.)* spp. were previously encountered in a region where ACL occurs in the states of Minas Gerais and Ceará^{10,1}, respectively. This reinforces our suspicion that these sand flies may participate in transmitting ACL in Serra dos Carajás.

We were surprised, however, to find no specimens of *Ps. wellcomei/complexus*, the main vector of *L. (V.) braziliensis* in the Brazilian Amazon, naturally infected with a parasite, even though 1,409 females from this species were dissected. Nevertheless, this species was the most prevalent (16%) among the sand flies captured, followed by *Ps. davis* (15.4%), *Ps. carrerai* (4.2%), *Lu. shawi* (3.9%), *Lu. brachipyga* (2.5%) and *Lu. richardward* (1.2%), which, in any case, supports its epidemiological importance in the research area.

Considering the findings discussed above, we feel confident in stating that the sand fly fauna of Serra dos Carajás is one of the most diverse in the world, with various species involved in the enzootic transmission of *Leishmania* spp. in wild animals, some of medical interest and others that have yet to be clarified.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Companhia Vale do Rio Doce for financial support, the Secretariat for Health Surveillance/Ministry of Health and the IEC for logistical support and dr. Gilberta Bensabath for her dynamic work as coordinator, overcoming all the difficulties and coordinating all the programs involved. Without their participation, we would have hardly obtained the same results. We would also like to acknowledge our colleagues from the Programa de Leishmanioses at the IEC for their valuable technical assistance in the laboratory and in the field. We would like to acknowledge Antônio Francisco Pires Martins, Antônio Júlio Monteiro, Domingas Ribeiro Ervedosa, Edna de Freitas Leão, Geraldo Mendes dos Santos, João Alves Brandão, João Batista Palheta da Luz, Leônidas Souza Elizeu, Luciene Aranha da Silva, Lucivaldo João Conceição Ferreira, Raimundo Negrão Coelho, Raimundo Sérgio Machado, Raimundo Nonato Barbosa Pires, Roberto Carlos Feitosa Brandão and Rosely Conceição dos Santos de Jesus. We would like to acknowledge the secretary Vania do Socorro do Espírito Santo Monteiro for the excellent work in typing this manuscript.



Fauna flebotomínica da Serra dos Carajás, Estado do Pará, Brasil, e sua possível implicação na transmissão da leishmaniose tegumentar americana

RESUMO

A Serra dos Carajás, localizada no sudeste do Estado do Pará, Brasil, representa uma rica floresta tropical, onde são encontradas espécies de *Leishmania* sp. de interesse médico, como *L. (V.) braziliensis*, *L. (V.) lainsoni*, *L. (V.) shawi* e *L. (L.) amazonensis*, cuja transmissão é feita pelos flebotomíneos: *Psychodopygus complexus* ou *Ps. wellcomei*, *Lutzomyia ubiquitalis*, *Lu. whitmani* e *Lu. flaviscutellata*. Considerando o incremento de imigrantes na região do projeto Carajás, realizou-se estudo para avaliar a fauna de flebotomíneos e sua possível participação na transmissão da leishmaniose tegumentar americana (LTA). Os flebotomíneos foram capturados: i) Parque Zoobotânico de Parauapebas, ii) Área de proteção ambiental e, iii) Floresta Nacional de Tapirapé-Aquiri, de dezembro/2005 a setembro/2007, usando-se dez armadilhas luminosas tipo "CDC" (18 h às 6 h) e duas tipo Shannon (18 h às 20 h), durante 172 dias de coleta. Foram capturados 22.095 flebotomíneos, 6.789 (31%) machos e 15.306 (69%) fêmeas, pertencentes a 69 espécies e três gêneros: *Psychodopygus*, *Lutzomyia* e *Brumptomyia*. Foram detectadas 19 (0,16%) infecções naturais nas seguintes espécies: *Ps. davisii* (4), *Ps. h. hirsutus* (3), *Lu. umbratilis* (3), *Lu. richardward* (2), *Lu. brachipyga* (2), *Lu. ubiquitalis* (2), *Lu. trinidadensis* (1) e *Lu. migonei* (1). Embora não tenha sido encontrada infecção em *Ps. wellcomei/complexus*, principal vetor da *L. (V.) braziliensis* na região, esta espécie foi a mais prevalente (16%), seguida de *Ps. davisii* (15,4%), *Ps. carrerai* (4,2%), *Lu. shawi* (3,9%), *Lu. brachipyga* (2,5%) e *Lu. richardward* (1,2%). Estes resultados evidenciam a importância destes flebotomíneos como possíveis vetores da LTA na Serra dos Carajás.

Palavras-chave: Flebotomíneos; Serra dos Carajás; Estado do Pará; Brasil; Leishmaniose Cutânea.

Flebótomos de la Serra dos Carajás (Estado de Pará, Brasil) y su posible implicación en la transmisión de la leishmaniasis cutánea americana

RESUMEN

La Serra dos Carajás, ubicada en la región sureste del Estado de Pará (Brasil), representa una rica floresta tropical, donde se encuentran especies de *Leishmania* sp. de interés para la medicina, como *L. (V.) braziliensis*, *L. (V.) lainsoni*, *L. (V.) shawi* y *L. (L.) amazonensis*, que se transmiten a través de especies de flebótomos; *Psychodopygus complexus* o *Ps. wellcomei*, *Lutzomyia ubiquitalis*, *Lu. whitmani* y *Lu. flaviscutellata*. Considerando el aumento de inmigrantes en la región del proyecto Carajás, se realizó un estudio para evaluar la fauna flebotomina en el área y su posible papel en la transmisión de agentes de la leishmaniasis cutánea americana (LTA). Las especies flebotominas fueron capturadas: i) en el Parque Botánico de Parauapebas; ii) en el área de protección ambiental; y iii) en el Bosque Nacional Tapirapé-Aquiri, de diciembre de 2005 hasta septiembre de 2007, utilizando diez trampas de luz "CDC" (18 h a 6 h), y dos de tipo Shannon (18 h a 20 h), durante 172 días de recogida. Fueron capturados 22.095 flebótomos, 6.789 (31%) machos y 15.306 (69%) hembras, pertenecientes a 69 especies y tres géneros: *Psychodopygus*, *Lutzomyia* y *Brumptomyia*. Fueron detectados 19 (0,16%) infecciones naturales en las siguientes especies de flebótomos: *Ps davisii* (4), *Ps. h. hirsutus* (3), *Lu. umbratilis* (3), *Lu. richardward* (2), *Lu. brachipyga* (2), *Lu. ubiquitalis* (2), *Lu. trinidadensis* (1) y *Lu. migonei* (1). Sin embargo, aunque no se ha encontrado infección natural en *Ps. wellcomei/complexus*, principal vector de *L. (V.) braziliensis* en la región, esta especie fue la más frecuente (16%), seguida de la *Ps. davisii* (15,4%), *Ps. carrerai* (4,2%), *Lu. shawi* (3,9%), *Lu. brachipyga* (2,5%) y *Lu. richardward* (1,2%). Estos resultados demuestran la importancia de estas especies de flebótomos como vectores potenciales de la LTA en la Serra dos Carajás.

Palabras clave: Fauna Flebotomínica; Serra dos Carajás; Pará; Brasil; Leishmaniasis Cutánea.



REFERENCES

- 1 Azevedo AC, Rangel EF. A study of sandfly species (Diptera: Psychodidae) in a focus of cutaneous leishmaniasis in the municipality of Baturité, Ceará, Brazil. Mem Inst Oswaldo Cruz. 1991 Oct-Dec;86(4): 405-10.
- 2 Lainson R, Shaw JJ. Leishmaniasis in the new world. In: Collier L, Balows A, Sussman M, editors. Topley & Wilson's microbiology and microbial infections. 10th ed. London: E Arnold; 2005. p. 313-49.
- 3 Lainson R, Shaw JJ, Ready PD, Miles MA, Póvoa MM. Leishmaniasis in Brazil. XVI. Isolation and identification of *Leishmania* species from sandflies, wild mammals and man in north Pará State, with particular reference to *Leishmania braziliensis guyanensis*, causative agent of "pian-bois". Trans R Soc Trop Med Hyg. 1981;75(4): 530-6.
- 4 Lainson R, Shaw JJ, Silveira FT, Souza AA, Braga RR, Ishikawa EA. The dermal leishmaniasis of Brazil, with special reference to the eco-epidemiology of the disease in Amazonia. Mem Inst Oswaldo Cruz. 1994 Jul-Sep;89(3):435-43.

- 5 Lainson R, Shaw JJ, Ward RD, Fraiha H. Leishmaniasis in Brazil. IX. Considerations on the *Leishmania braziliensis* complex: importance of sandflies of the genus *Psychodopygus* (Mangabeira) in the transmission of *L. braziliensis braziliensis* in north Brazil. *Trans R Soc Trop Med Hyg.* 1973;67(2):184-96.
- 6 Lainson R, Shaw JJ. A brief history of the genus *Leishmania* (Protozoa: Kinetoplastida) in the Americas with particular reference to Amazonian Brazil. *Cienc Cult.* 1992;44(2-3):94-106.
- 7 Lainson R, Shaw JJ. Evolution, classification and geographical distribution. In: Peters W, Killick-Kendrick R, editors. *The leishmaniasis in biology and medicine.* London: Academic Press; 1987. p. 12-120.
- 8 Lainson R. *Leishmania* e Leishmaniose, com particular referência à Região Amazônica do Brasil. *Rev para med.* 1997;11(1):29-40.
- 9 Lainson R. The American leishmaniasis: some observations on their ecology and epidemiology. *Trans R Soc Trop Med Hyg.* 1983;77(5):569-96.
- 10 Rangel EF, Ryan L, Lainson R, Shaw JJ. Observations on the sandfly (Diptera: Psychodidae) fauna of Além Paraíba, Minas Gerais State, Brazil, and a isolation of a parasite of the *Leishmania braziliensis* complex from *Psychodopygus hirsuta hirsuta*. *Mem Inst Oswaldo Cruz.* 1985 Jul-Sep;80(3):373-4.
- 11 Ready PD, Lainson R, Shaw JJ. Habitat and seasonality of *Psychodopygus wellcomei* help incriminate it as a vector of *Leishmania braziliensis* in Amazônia and Northeast Brazil. *Trans R Soc Trop Med Hyg.* 1984;78(4):543-4.
- 12 Ryan L, Lainson R, Shaw JJ. Leishmaniasis in Brazil. XXIV. Natural flagellate infections of sandflies (Diptera: Psychodidae) in Pará State, with particular reference to the rôle of *Psychodopygus wellcomei* as the vector of *Leishmania braziliensis braziliensis* in the Serra dos Carajás. *Trans Roy Soc Trop Med Hyg* 1987;81:353-9.
- 13 Shaw JJ, Ishikawa EA, Lainson R. A rapid and sensitive method for the identification of *Leishmania* with monoclonal antibodies using fluorescein-labelled avidin. *Trans R Soc Trop Med Hyg.* 1989 Nov-Dec;83(6):783-4.
- 14 Shaw JJ, Lainson R. Leishmaniasis in Brazil. VI. Observations on the seasonal variations of *Lutzomyia flaviscutellata* in different types of forest and its relationship to enzootic rodent Leishmaniasis (*Leishmania mexicana amazonensis*). *Trans R Soc Trop Med Hyg.* 1972;66(5):709-17.
- 15 Silveira FT, Ishikawa EA, Souza AA, Lainson R. An outbreak of cutaneous leishmaniasis among soldiers in Belém, Pará State, Brazil, caused by *Leishmania (Viannia) lindenbergi* n. sp. A new leishmanial parasite of man in the Amazon region. *Parasite.* 2002 Mar;9(1):43-50.
- 16 Silveira FT, Lainson R, Brito AC, Oliveira MRF, Paes MG, Souza AA, et al. Leishmaniose tegumentar americana. In: Leão RNG, coordenador. *Doenças infecciosas e parasitárias: enfoque amazônico.* Belém: CEJUP; 1997. p. 619-30.
- 17 Silveira FT, Mülher SR, Souza AA, Lainson R, Gomes CM, Laurent MD, et al. Revisão sobre a patogenia da leishmaniose tegumentar americana na Amazônia, com ênfase à doença causada por *Leishmania (V.) braziliensis* e *Leishmania (L.) amazonensis*. *Rev Para Med.* 2008 jan-mar;22(1):9-20.
- 18 Souza AA, Ishikawa E, Braga R, Silveira F, Lainson R, Shaw J. *Psychodopygus complexus*, a new vector of *Leishmania braziliensis* to humans in Pará State, Brazil. *Trans R Soc Trop Med Hyg.* 1996 Mar-Apr;90(2):112-3.
- 19 Walton BC, Shaw JJ, Lainson R. Observations on the *in vitro* cultivation of *Leishmania braziliensis*. *J Parasitol.* 1977 Dec;63(6):1118-9.
- 20 Ward RD, Shaw JJ, Lainson R, Fraiha H. Leishmaniasis in Brazil. VIII. Observations on the phlebotomine fauna of an area highly endemic for cutaneous leishmaniasis, in the Serra dos Carajás, Pará State. *Trans R Soc Trop Med Hyg.* 1973;67(2):174-83.
- 21 Young DG, Duncan MA. Guide to the identification and geographic distribution of *Lutzomyia* sand flies in Mexico, the West Indies, Central and South America (Diptera: Psychodidae). *Mem Amer Ent Inst.* 1994;54:88.

Received / Recebido em / Recibido en: 6/30/2009
 Accepted / Aceito em / Aceito en: 9/21/2009

