Study of Phlebotomine Sand Flies (Diptera: Psychodidae) Collected in a *Leishmania*-Endemic Area of the Metropolitan Region of Belo Horizonte, Brazil

GUSTAVO M. L. CARVALHO, CÉLIA M. F. GONTIJO, ALDA L. FALCÃO, AND JOSÉ D. ANDRADE FILHO

Laboratório de Leishmaniose, Instituto René Rachou-Fiocruz, Av. Augusto de Lima 1715, CEP 30190-002 Belo Horizonte, MG, Brazil


ABSTRACT Phlebotomine sand flies are distributed across nearly all faunal regions of the world, represented by over 800 species, of which many are important vectors of human pathogens. Brazil is currently faced with the expansion and urbanization of leishmaniasis, with an increase in the numbers of human cases and seropositive dogs in various medium-sized to large cities. The objective of the current study was to survey the phlebotomine sand fly species in an area endemic for American cutaneous leishmaniasis (ACL) and American visceral leishmaniasis (AVL), i.e., the municipal district of Santa Luzia, lying within the metropolitan region of Belo Horizonte in the Brazilian State of Minas Gerais. Sand flies were collected monthly in 2004–2005 using modified Falcio light traps hung in the peridomiciles of houses and surrounding wooded areas in the district of Baronesa. A total of 1,552 sand flies belonging to seven species was collected, and an interesting pattern of the distribution of the most abundant species relative to the sampling locality was revealed. In the wooded areas *Lutzomyia whitmani* (Antunes & Coutinho) predominated, whereas in the urban area *Lutzomyia longipalpis* (Lutz & Neiva) was the most abundant species. These results indicate two possible epidemiological patterns of *Leishmania* transmission in Santa Luzia: one for American cutaneous leishmaniasis associated predominantly with wooded areas, and another for AVL, with transmission principally occurring around human habitations.

KEY WORDS leishmaniasis, Minas Gerais, Phlebotominae, sand flies

Brazil is currently faced with the expansion and urbanization of both American cutaneous leishmaniasis (ACL) and American visceral leishmaniasis (AVL), with increasing numbers of *Leishmania infantum* chagasi infections in humans and dogs in many medium-sized and large cities. Although all *Leishmania* transmission in Brazil was originally confined to rural environments, today it represents a severe public health problem in urban centers (Gontijo and Melo 2004). Leishmaniasis is currently one of the biggest public health problems of the Brazilian state of Minas Gerais. In the metropolitan region of Belo Horizonte, autochthonous cases of ACL and AVL have been recorded by health authorities since 1987 and 1989, respectively (Genaro et al. 1990, Passos et al. 1996). In Santa Luzia, a municipality within the metropolitan region of Belo Horizonte, 99 cases of ACL and 252 of AVL were reported between 2000 and 2007 (SINAN 2008).

Phlebotomine sand flies are distributed across nearly all faunal regions of the world, with many species considered to be important vectors of *Leishmania* based on epidemiological and/or experimental data. However, relatively few species have been identified as primary vectors, based on degree of anthropophily, natural infection, and spatial distribution overlapping that of the disease (Rangel and Lainson 2003).

It is therefore important to know about the phlebotomine fauna in urban foci of leishmaniasis. The identification of potential vectors within these foci is fundamental, each species presenting distinct biological and ecological characteristics that should be taken into account in the implementation of vector control measures. The objective of the present work was to study the phlebotomine sand fly fauna of a *Leishmania*-endemic area, i.e., the municipal district of Santa Luzia in Greater Belo Horizonte, state capital of Minas Gerais, Brazil.

Materials and Methods

The municipality of Santa Luzia occupies an area of 235 km² with 219,699 inhabitants (IBGE 2006). The
The current study was conducted between November 2004 and October 2005 in the urban district of Baronesa, which retains some rural characteristics and has previously reported autochthonous cases of human infection with *Leishmania*. Serological studies have revealed a high prevalence of positive dogs in the area (Diretoria de Ações Descentralizadas de Saúde de Belo Horizonte, unpublished data).

Sand flies were collected monthly using modified light traps (Falcão 1981) hung in specific areas in which the insects would most likely be found, such as dog kennels, henhouses, pigsties, and areas with vegetation. The light traps were switched on during the hours of darkness (18:00–06:00). Seventeen traps were used, 14 of them in the peridomiciles of houses, and three in a wooded area with vegetation on the margin of the district.

All sand flies collected were prepared and slide mounted in Berlese’s fluid or Canada balsam. The insects were identified based on the keys of Young and Duncan (1994). The voucher species were deposited in the phlebotomine sand fly collection of the Centro de Pesquisas René Rachou/Fiocruz. Climatological data (temperature, humidity, and rainfall) were obtained from the Controle de Zoonosis of Belo Horizonte (MG, Brazil). Sand fly density was correlated with climatic data using Spearman’s rank correlation coefficient.

### Results

A total of 1,277 phlebotomine sand fly specimens was collected in the light traps, of which 307 (24%) were females and 970 (76%) males. The distribution of species captured by month and sex is shown in Table 1. The following species were captured: *Lutzomyia longipalpis* (Lutz & Neiva), *Lutzomyia intermedia* (Lutz & Neiva), *Lutzomyia whitmani* (Antunes & Coutinho), *Lutzomyia pessoai* (Coutinho & Barreto), *Lutzomyia cortelezzii* (Brethes), *Lutzomyia neivai* (Pinto), and *Lutzomyia oliveirai* (Martins, Silva & Falcão). Another *Lutzomyia* sp. present in the collections could not be identified because the specimens were damaged.

The species *Lu. whitmani* represented 75% of the total of specimens of phlebotomines captured in the study area, followed by *Lu. longipalpis*, with 19% of the total (Fig. 1). Although the number of traps was lower in the wooded area than in the urban one, collections from the former area represented 77.8% of the total samples collected. The ratio of phlebotomine sand flies/trap for the period sampled was 311:1 in the wooded area and 20:1 in the urban area.

Although *Lu. whitmani* was more abundant overall than *Lu. longipalpis*, when the two species were compared separately for the two habitats, a statistically significant difference was revealed (*P* < 0.05; Fig. 2), with *Lu. whitmani* predominating in the wooded area and *Lu. longipalpis* more abundant around houses. Although the largest numbers of sand flies were collected during the month of October, there was no statistically significant correlation between the total density of sand flies and any of the climatic variables (Table 2, Fig. 3).

### Table 1. Distribution by month and sex of the sand flies collected between November (2004) and October (2005) in the district of Baronesa, Santa Luzia/MG

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<td><em>Lu. longipalpis</em></td>
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<td>2</td>
<td>10</td>
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<tr>
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<td>20</td>
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<td>24</td>
<td>37</td>
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<td>20</td>
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Discussion

As in several other Brazilian cities, the unplanned growth of the municipal district of Santa Luzia has been associated with increasing problems of public health, resulting in drastic environmental transformations and allowing the *Leishmania* transmission cycle to become established.

The transmission of *Leishmania* spp. involves different species of phlebotomine sand fly in close association with parasites and reservoirs (Rangel and Lainson 2003). Detailed serological surveys of domestic dog populations as well as sand fly sampling surveys have revealed high prevalence of infections in many areas associated with the predominance of certain vector species, resulting in a high risk of human exposure to *Leishmania* (Vieira and Coelho 1998). Rapid changes in environmental conditions in many tropical regions caused by habitat destruction, deforestation, and urbanization have had an enormous influence on vector populations and *Leishmania* transmission, favoring certain sand fly species over others (Bejarano et al. 2002).

Situations with domestic animal shelters very close to human habitations, poor hygiene conditions in the peridomicile, and close proximity to small remnants of forest are very common throughout Brazil. The urban district of Baronesa displays all of these factors, which together seem to favor the concentration of phlebotomines and mammalian reservoirs of *Leishmania* in the peridomicile (Gomes and Nevis 1998, Saraiva et al. 2006). There is strong evidence that the presence of domestic and wild animals in the peridomicile attracts large numbers of phlebotomines, including vectors of *Leishmania* sp. (Alexander 2000, Brazil et al. 1991, Barata et al. 2005, Nascimento et al. 2007).

Several epidemiologically important species were collected in the urban district of Baronesa, notably *Lu. longipalpis*, *Lu. intermedia*, *Lu. neivai*, and *Lu. whitmani*. The last species has been incriminated as a vector of *Leishmania braziliensis* (Azevedo et al. 1990, Queiroz et al. 1994, Luz et al. 2000).

The two most abundant species in this study, i.e., the *Le. braziliensis* vector *Lu. whitmani* (ACL) and the *Le. chagasi infantum* vector *Lu. longipalpis* (AVL), clearly favored different habitat types, with the former more abundant in wooded areas and the latter predominating around human habitations. Thus, it appears that two different transmission cycles are occurring within the Santa Luzia district, a sylvatic one for ACL involving *Lu. whitmani* and a truly urban one for AVL, as a result of biting by *Lu. longipalpis*. The patterns of geographical distribution of both species have been described in previous studies (Souza et al. 2004, Loyola et al. 2007, Andrade Filho et al. 2008, Paula et al. 2008, Souza and Borges 2008).

It should be noted that in this area, two species have already been found naturally infected using the polymerase chain reaction technique, i.e., *Lu. whitmani* with *Le. (Viannia)* spp. and *Lu. cortelezzii* with *Le. infantum chagasi* (Carvalho et al. 2008). However, the latter finding is not sufficient to incriminate *Lu. cortelezzii* as a vector of *Le. infantum chagasi*. Further studies are required on the behavior of this species, its spatial distribution in relation to AVL, and elucidation of the vector-parasite relationship (Carvalho et al. 2008).

Although captured in smaller numbers in Baronesa, *Lu. intermedia* and *Lu. neivai* have been implicated in

<table>
<thead>
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<th>Total density of phlebotomine sand flies</th>
<th>Climatic variables</th>
<th>Temperature</th>
<th>Humidity</th>
<th>Rainfall</th>
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<td>0.035(*)</td>
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<td>-0.336(*)</td>
<td>-0.175(*)</td>
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<td>-0.286</td>
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*Correlation not significant at P = 0.05.

![Fig. 3. Correlation of sand fly density with monthly climatic variables between November 2004 and October 2005, district of Baronesa, Santa Luzia/MG.](image)
the transmission of ACL-causing parasites in various regions of Brazil (Andrade Filho et al. 2007). The sympatric occurrence of these two species in some regions of Brazil and the great morphological similarity between them are noteworthy (Andrade Filho et al. 2003, Saraiva et al. 2008).

Climatic and ecological factors are important links in the epidemiology of AVL (Sherlock 1996), but influence phlebotomine populations in a variety of ways. Sand flies are usually found in greater numbers during hot and humid months (Aguiar and Soucasaux 1984, Andrade Filho et al. 2003, Saraiva et al. 2008).

Although the current study focused on only one area, these findings will be useful considerations in selection of the most appropriate control measures by public health authorities. Further studies are needed to provide more important information for support of leishmaniasis control programs in Brazil.

References Cited


Received 18 May 2009; accepted 21 June 2010.