Species structure of sand fly (Diptera: Psychodidae) fauna in the Brazilian western Amazon

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We surveyed areas of the state of Rondônia in western Amazon for phlebotomine, which are potential vectors of leishmaniasis. A total of 5,998 specimens were captured, resulting in the identification of 48 species within the Lutzomyia *(99.98%) and* Brumptomyia *(0.02%) genera. The predominant species was* Lutzomyia davisi, *followed by* Lutzomyia umbratilis, Lutzomyia llanosmartinsi, Lutzomyia c. carrerai, Lutzomyia dendrophyla, Lutzomyia nevesi *and* Lutzomyia whitmani. *All sand flies identified as vectors for cutaneous leishmaniasis in Brazil, i.e.,* Lu. davisi, Lu. umbratilis, Lu. c. carrerai *and* Lu. whitmani, *were found in the surveyed areas.*

Key words: phlebotomine - vectors of leishmaniasis - leishmania - Rondônia

Phlebotomine sand flies (Diptera: Psychodidae) are insects of medical and veterinary importance, as they are responsible for the transmission of various diseases such as bartonellosis, arboviruses and visceral and cutaneous leishmaniasis. Their bites are painful and may also produce allergic manifestations (Forattini 1973, Young & Duncan 1994). In the Neotropics, they are grouped in three different genera: *Brumptomyia* (França & Parrot 1921), *Warileya* (Hertig 1948) and *Lutzomyia* (França 1924). Only the last genus includes species of medical importance for the transmission of leishmaniasis in the New World. In the Amazon Region, these insects show a high richness of species (Young & Duncan 1994) with high indices of local diversity in terra-firme forests (Barrett et al. 1996). Of the more than 400 species of *Lutzomyia* already identified in Brazil, 122 can be found in the Amazon Region; of these, 25 have anthropophilic behaviour characteristics. The *Psychodopygus* and *Nyssomyia* subgenera predominate in many regions of the state of Amazonas (AM) (Ward et al. 1973, Grimaldi et al. 1991, Rangel & Lainson 2003) and their many species in these regions are demonstrated to be important vectors of cutaneous leishmaniasis in both enzootic and zoonotic cycles.

Cutaneous leishmaniasis is a major public health problem in the state of Rondônia (RO). Data from the Brazilian Ministry of Health shows the region has a high prevalence of cutaneous leishmaniasis with an annual incidence of 115 cases per 100,000 inhabitants. In 1997, there were 1,465 confirmed cases, with increasing numbers in 2002-2004 followed by some reduction in subsequent years. Many species of *Leishmania* cause disease in humans and the ones found in RO are *Leishmania* (*Viannia*) *braziliensis*, *Leishmania* (*Viannia*) *laisonni* and *Leishmania* (*Viannia*) *amazonensis* (MS 2007).

Knowledge of phlebotomine diversity, species prevalence, distribution and anthropophilic behaviour, especially in leishmania endemic areas, is necessary to understand the natural history of parasite transmission and to control the disease (Memmot 1991). This study supplies more information on the diversity of the phlebotomine fauna in RO, an endemic state for cutaneous leishmaniasis and identifies the potential vector of the parasite in the region.

MATERIALS AND METHODS

The climate in RO is characterized by well-marked dry and wet seasons. The average annual temperature is 28.6ºC and varies from 18-37ºC. Rain occurs mainly between November-April, with much drier weather conditions during the rest of the year (May-August). Sand flies were captured from May-August of 1997 (Figure), with two capture sessions in rural areas of Vilhena, Espigão D'Oeste, Vale do Anari and Porto Velho, three sessions in Nova União and Monte Negro and four sessions in Nova Mamoré and Costa Marques. Four CDC-type light traps were used at each locality from 6pm-6am and one Shannon trap was used from 6pm-8am. The CDC light traps were placed on tree canopies about 18 m high and near the ground about 1 m high. Captured sand flies were stored in 70% ethanol and later identified in the laboratory as described by Young and Duncan (1994).

RESULTS AND DISCUSSION

A total of 5,998 sand fly specimens were captured in eight localities, of which 1,736 were male (29%) and 4,262 were female (71%). A high diversity among the sand flies was observed, with 48 species being identified and distributed as follows: one species of the genus *Brumptomyia* and 42 of the genus *Lutzomyia*, divided

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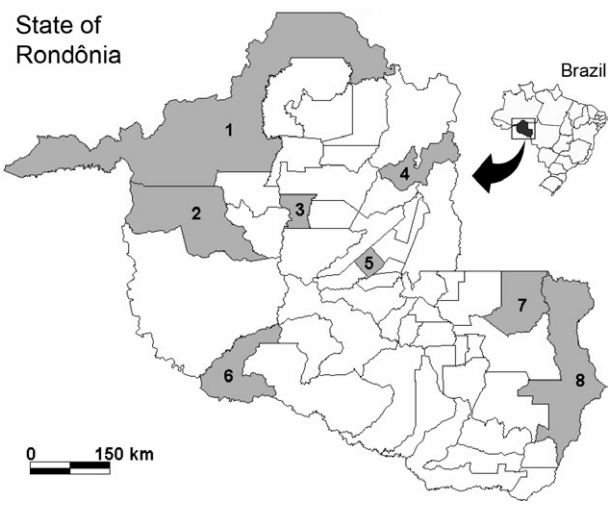

Locations of the eight study areas, municipalities of state of Rondônia. 1: Porto Velho; 2: Nova Mamoré; 3: Monte Negro; 4: Vale do Anari; 5: Nova União; 6: Costa Marques; 7: Espigão do Oeste; 8: Vilhena. Fonte: SEDAM.

into eight subgenera and three groups (Table). The subgenus *Psychodopygus* represented 59.5% of the total specimens captured and the subgenus *Nyssomyia* represented 23.7%. These two subgenera are indeed described as the most predominant in the Amazon Region and are more prevalent there than in any other region of the Americas (Ward et al. 1973, Silva et al. 2007). Species considered important vectors for cutaneous leishmaniasis, in both enzootic and zoonotic cycles, are classified into these two subgenera (Grimaldi et al. 1991, Gil et al. 2003).

Some of the species found in this survey are being described for the first time in the region. Amongst the new species recorded are *Lutzomyia brachyphalla* (Mangabeira 1941), *Lutzomyia castanheirai* (Damasceno, Causey & Arouck 1945), *Lutzomyia readyi* Ryan 1986 and *Lutzomyia spathotrichia* Martins, Falcão & Silva 1963. These species, however, are not related to the transmission of *Leishmania* (CIPA 1999).

The following 15 species have been previously reported in RO but were not observed in the present study: *Lutzomyia longipalpis* (Lutz & Neiva 1912), *Brumptomyia cunhai* (Mangabeira 1942), *Brumptomyia travassosi* (Mangabeira 1942), *Lutzomyia b. barrettoi* (Mangabeira 1942), *Lutzomyia brachipyga* (Mangabeira 1942), *evandroi* (Costa Lima & Antunes 1936), *Lutzomyia inpai* Young & Arias 1977, *Lutzomyia longipennis* (Barretto 1946), *Lutzomyia migonei* (França 1920), *Lutzomyia oswaldoi* (Mangabeira 1942), *Lutzomyia peresi* (Mangabeira 1942), *Lutzomyia shannoni* (Dyar 1929), *Lutzomyia anduzei* (Rozeboom 1942), *Lutzomyia brasiliensis* (Costa Lima 1932) and *Lutzomyia williamsi* (Damasceno, Causey & Arouck 1945). *Lu. longipalpis*, the main vector of American visceral leishmaniasis, was previously reported by Gil et al. (2003), suggesting a risk of endemic visceral leishmaniasis in the state. This species is in fact rare and in the previous survey, it was only captured during the rainy season, between August-November. The present study was performed from May-August, when rainfall is at minimum. Barros et al. (2000) reported that, in the neighbour state of Maranhão (MA), *Lu. longipalpis* density peaks in the months of February and March and gradually lowers until disappearing in the months of November/December.

The *Lutzomyia davisi* (Root 1934) (32.8%), *Lutzomyia umbratilis* Ward & Fraiha 1977 (10.4%), *Lutzomyia llanosmartinsi* (Fraiha & Ward 1980) (7.5%), *Lutzomyia c. carrerai* (Barretto 1946) (7.2%), *Lutzomyia dendrophyla* (Mangabeira 1942) (7.2%), *Lutzomyia nevesi* (Damasceno & Arouck 1956) (6.9%) and *Lutzomyia whitmani*(Antunes & Coutinho 1939) (6.8%) species represented 78.8% of the specimens in the present survey (Table). In the previous survey, the *Lutzomyia richardwardi* (Ward & Ready 1975), *Lu. umbratilis* and *Lu. c. carrerai* species were shown to be prevalent in the Samuel Ecological Station in RO (Azevedo et al. 1993). *Lutzomyia h. hirsuta* (Mangabeira 1942), *Lu. davisi, Lu. whitmani* and *Lu. c. carreirai* were shown to be prevalent in some counties of the state, while *Lu. umbratilis*, *Lu. llanosmartinsi*, *Lu. dendrophyla* and *Lu. nevesi* had no such prevalence (Gil et al. 2003). Variations in the pattern of species observed during different surveys are common and can be due to the length of capture time, seasonal variation or environmental changes (Cabanillas & Castellón 1999, Castellón et al. 2000, Azevedo et al. 2002).

Lu. davisi and *Lu. whitmani* have broad distribution in the Amazon Region (Rebêlo et al. 1996, Silva et al. 2007) and are demonstrated to have anthropophilic habits (Luz et al. 2000, Gil et al. 2003). In Mato Grosso (MT) and AM, *Lu. davisi* was recorded less often and was more arboreal than terrestrial (Azevedo et al. 2002, Dias-Lima et al. 2002). The predominance of *Lu. whitmani* has been recorded in drier seasons in Mato Grosso do Sul (Galati et al. 2006). However, this species has been observed with the highest frequency in the rainy month of March in RO (Gil et al. 2003), although adult forms can be found in any month of the year (Luz et al. 2000). In the state of Acre it was one of the most prevalent species and was considered one of the potential *Leishmania* vectors in the Bujari municipality and Rio Branco municipality (Azevedo et al. 2008). The high density of *Lu. whitmani* may also be associated with modifications in the original cover vegetation and better adaptation to new environmental conditions (Azevedo et al. 2002). It is found in all areas where cutaneous leishmaniasis is recorded (Luz et al. 2000) and previous studies have connected this species with the transmission of *Leishmania (Viannia) shawi* in the Amazon Region (Lainson & Shaw 1998, Rangel & Lainson 2003, Costa et al. 2007).

Lu. umbratilis is found in MA, with greater frequency in wild areas (Rebêlo et al. 1999). In the primary forests of the central Amazonia, it is the species with the greatest presence in tree canopies (Dias-Lima et al. 2002, Azevedo et al. 2008). However, stratification studies show that the density of *Lu. umbratilis* is as high in the canopy as it is on the ground, where it can feed during the night on the arboreal sloth *Choloepus*

TABLE

Sand flies captured in the state of Rondônia from May-August 1997 with Shannon and CDC light traps

Species	Female	Male	Total	%
Brumptomyia avellari	-	1	1	0.02
Lutzomyia aragaoi (Group *Aragaoi*)	-	1	1	0.02
Lutzomyia (*Evandromyia*) *brachyphalla*	-	1	1	0.02
Lutzomyia (*Lutzomyia*) *carvalhoi*	1	-	1	0.02
Lutzomyia (*Lutzomyia*) *evangelistai*	2	2	4	0.07
Lutzomyia (*Lutzomyia*) *gomezi*	11	5	16	0.3
Lutzomyia (*Lutzomyia*) *spathotrichia*	10	-	10	0.2
Lutzomyia nevesi (Group *Verrucarum*)	313	101	414	6.9
Lutzomyia (*Nyssomyia*) *antunesi*	3	7	10	0.2
Lutzomyia (*Nyssomyia*) *flaviscutellata*	23	23	46	0.8
Lutzomyia (*Nyssomyia*) *infraspinosa*	3	2	5	0.08
Lutzomyia (*Nyssomyia*) *richardwardi*	119	2	121	2
Lutzomyia (*Nyssomyia*) *shawi*	9	1	10	0.2
Lutzomyia (*Nyssomyia*) *umbratilis*	441	184	625	10.4
Lutzomyia (*Nyssomyia*) *y.yuilli*	169	32	201	3.3
Lutzomyia (*Nyssomyia*) *whitmani*	153	254	407	6.8
Lutzomyia (*Sciopemyia*) *sordellii*	30	18	48	0.8
Lutzomyia (*Sciopemyia*) *servulolimai*	-	2	2	0.03
Lutzomyia (*Pintomyia*) *damascenoi*	1	-	1	0.02
Lutzomyia (*Psathyromyia*) *campbelli*	-	1	1	0.02
Lutzomyia (*Psathyromyia*) *dendrophyla*	114	317	431	7.2
Lutzomyia (*Psathyromyia*) *lutziana*	-	2	2	0.03
Lutzomyia (*Psathyromyia*) *punctigeniculata*	-	1	1	0.02
Lutzomyia (*Psathyromyia*) *scaffi*	-	6	6	0.1
Lutzomyia (*Psychodopygus*) *amazonensis*	25	1	26	0.4
Lutzomyia (*Psychodopygus*) *ayrozai*	69	2	71	1.2
Lutzomyia (*Psychodopygus*) *bispinosa*	2	-	2	0.03
Lutzomyia (*Psychodopygus*) *c. carrerai*	381	53	434	7.2
Lutzomyia (*Psychodopygus*) *claustrei*	8	5	13	0.2
Lutzomyia (*Psychodopygus*) *chagasi*	3	19	22	0.4
Lutzomyia (*Psychodopygus*) *complexa*	35	22	57	1
Lutzomyia (*Psychodopygus*) *corossoniensis*	24	-	24	0.4
Lutzomyia (*Psychodopygus*) *davisi*	1,450	516	1,966	32.8
Lutzomyia (*Psychodopygus*) *geniculatus*	3	4	7	0.1
Lutzomyia (*Psychodopygus*) *h. hirsuta*	54	40	94	1.6
Lutzomyia (*Psychodopygus*) *lainsoni*	21	13	34	0.6
Lutzomyia (*Psychodopygus*) *llanosmartinsi*	391	60	451	7.5
Lutzomyia (*Psychodopygus*) *paraensis*	4	-	4	0.07
Lutzomyia (*Psychodopygus*) *wellcomei/complexus*[a]	363	-	363	6.0
Lutzomyia runoides (Group *Aragaoi*)	-	1	1	0.02
Lutzomyia saulensis (Group *Saulensis*)	1	-	1	0.02
Lutzomyia (*Trichophoromyia*) *castanheirai*	1	-	1	0.02
Lutzomyia (*Trichophoromyia*) *dasypodogeton*	2	8	10	0.2
Lutzomyia (*Trichophoromyia*) *auraensis*	1	6	7	0.01
Lutzomyia (*Trichophoromyia*) *octavioi*	2	1	3	0.05
Lutzomyia (*Trichophoromyia*) *readyi*	-	1	1	0.02
Lutzomyia (*Trichophoromyia*) *ubiquitalis*	19	19	38	0.6
Lutzomyia wilsoni (Group *Saulensis*)	1	2	3	0.05
Total	4,262	1,736	5,998	100

a: because there are no clear morphological distinction between the females of *Lu. complexus* and *Lu. wellcomei*, they are included together.

didactylus and on the terrestrial *Tamandua tetradactyla*, both reservoirs of leishmaniasis. *Lu. umbratilis* can also feed on humans in the first hours of daylight and at dusk when disturbed (Lainson 1983, Ready et al. 1986). In RO, *Lu. umbratilis* has been shown to be at a low density and is not considered a potential vector of leishmaniasis in some counties (Gil et al. 2003). However, in the Samuel Ecological Station, it was the second most prevalent species (Azevedo et al. 1993)

Worthy of special attention are the species *Lu. davisi*, *Lu. umbratilis, Lu. c. carrerai* and *Lu. whitmani,* which are considered potential vectors for cutaneous leishmaniasis and represent 57.2% of the specimens captured in the present survey. *Lu. davisi* is recognized as a potential vector of *Le. (V.) braziliensis* and *Leishmania (Viannia) naiffi and* specimens have been found in the wild that are infected with both pathogens (Grimaldi et al. 1991, Gil et al. 2003). *Lu. c. carrerai* is also recognized as a vector of *Le. (V.) braziliensis* in Brazil and Bolivia (Le Pont et al. 1988, Grimaldi et al. 1989). *Lu. whitmani* has been regarded as one of the most important vectors of American cutaneous leishmaniasis in both peridomiciliar and forest environments (Luz et al. 2000, Rangel & Lainson 2003, Leonardo & Rebêlo 2004). This species was found infected with *Le. (V.) braziliensis* in the states of Bahia, Paraná and Ceará (Luz et al. 2000). It is also considered a vector of *Le. (V.) shawi* which has various mammals as reservoirs such as primates (*Cebus paella*), bats (*Chiropotes satanus*), sloths (*Choloepus didactylus, Bradypus tridactylus*) and coati (*Nasua nasua*) (Rebêlo et al. 1996). This sand fly species maintains a more sylvatic cycle, as shown in various studies (Queiroz et al. 1994, Peterson & Shaw 2003).

Lu. umbratilis has great significance as a vector of *Leishmania (Viannia) guyanensis* in Northern Brazil and the Guianas (Lainson 1983, Ready et al. 1985, Rebêlo et al. 1999, Dias-Limas et al. 2002). Azevedo et al. (2002) suggest the existence of a species complex because, according to Lainson (1988), *Lu. umbratilis* only transmits *Le. (V.) guyanensis* in the north of the Amazon River while in the north of MT. It may also be that genetically heterogeneous populations could be associated with different cycles of leishmaniasis transmission in Brazil (Lainson 1988).

In conclusion, a predominant presence of *Lu. davisi* and the observed increase in the number of *Lu. umbratilis* flies suggest continuous transmission activity of leishmaniasis in the surveyed areas. *Lu. davisi,* a potential vector of zoonotic cutaneous leishmaniasis, continues to be a threat in the transmission of the disease in the region, as previously observed (Gil et al. 2003). The predominance of some species in anthropic environments is a relevant factor in leishmaniasis transmission, as shown in other studies regarding the phlebotomine fauna (Gomes et al. 1989, Mayo et al. 1998). Because of the diversity of sand fly species and the fluctuations in the predominance that can occur with any sand fly species that is a potential vector of American cutaneous leishmaniasis, we emphasize the importance of improving and further extending the entomological vigilance of the phlebotomine fauna in the region.

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