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# Distribution of *Lutzomyia whitmani* in phytoregions of the state of Maranhão, Northeastern Brazil

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## ABSTRACT

The study had the aim of characterizing the geographical distribution of *Lutzomyia whitmani* s.l. in the state of Maranhão, Northeastern Brazil. Between 1992 and 2005, 9,600 specimens (65.1% males and 34.9% females) were caught in the rural and urban zones of 35 municipalities in regions consisting of forests, savanna and mixed vegetation with coconut plantations, sandbanks and heath. Greater abundance was observed in areas surrounding dwellings (91.6%) than inside the dwellings (8.4%). The presence of the vector in different phytoregions and in rural and urban areas favors the transmission of tegumentary leishmaniasis in these environments. This taxon may constitute a complex of species in Maranhão, which can be confirmed by molecular biology studies.

**DESCRIPTORS:** Psychodidae, growth & development. Leishmaniasis, Cutaneous. Disease Vectors. Rural Zones. Urbanization. Biogeography.

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## INTRODUCTION

*Lutzomyia (Nyssomyia) whitmani sensu lato* is an important element of the South American phlebotomine fauna and there are records of its distribution in French Guiana, Argentina, Paraguay and Peru. In Brazil, this taxon occurs in all geographical regions,<sup>1</sup> although there are no records from the states of Amapá, Amazonas, Roraima and Santa Catarina.

In the Amazon region, this taxon may be essentially of wild type and zoophilic in forested areas. In the northeastern region, it is associated with anthropogenic areas and may exhibit both anthropophilic and zoophilic behavior. This variation in behavior has led to the hypothesis that this taxon consists of a complex of cryptic species<sup>2,4</sup> or different phylogenetic lineages that inhabit the bioclimatic zones of the Amazon forest, savanna (*cerrado* region) and Atlantic forest.<sup>5</sup>

In the state of Maranhão, *L. whitmani s.l.* exhibits characteristics that are intermediate between the Amazon and extra-Amazon populations, and it can be found both in wild environments and in rural and urban peridomestic environments. However, the populations distributed in the different geographical and vegetation regions of Maranhão have not yet been studied with regard to the lineages that belong to these regions, except for the population found in forest and peridomestic environments in the municipality of Buriticupu, in the west of the state, which belongs to the Amazon lineage.<sup>5</sup> Definition of the lineages may clarify the distribution pattern of this taxon and its association with *Leishmania* species in Maranhão.

The aim of the present study was to characterize the distribution of *L. whitmani s.l.* in foci of leishmaniasis in different phytoregions.

## METHODS

The study was conducted between 1992 and 2005 in 43 municipalities located in the northeast and southwest of Maranhão, Northeastern Brazil, covering three tropical climatic zones (hot and moist, semi-moist and semi-arid) and the following phytoregions: open evergreen seasonal forest, dense evergreen seasonal forest, ombrophilous forest, savanna (*cerrado*), sandbank, palm forest and scrub heath (*caatinga*). The specimens were caught using illuminated traps of CDC type, which were installed inside homes and in shelters for domestic animals, in the rural zone and urban periphery, between the hours of 6:00 pm and 6:00 am. The number of traps used varied from two to 20 and the number of hours worked varied from 120 to 1,440, according to the municipality: Paço do Lumiar,

Raposa and São José de Ribamar (two traps x 12 h x 12 months = 288 h); Dom Pedro (ten traps x 12 h x 3 nights = 360 h); Santa Quitéria (three traps x 12 h x 12 months = 432 h); São Luís (ten traps x 12 h x 12 months = 1440 h); Axixá, Barreirinhas, Tutóia, Santa Rita, Primeira Cruz, Santo Amaro and Icatu (20 traps x 12 h = 240 h); and, in the other 22 municipalities, ten traps x 12 h x 1 night = 120 h. To correct for the differences in the sampling strength, the mean number of specimens per trap/hour was calculated.

## RESULTS

*Lutzomyia whitmani s.l.* was found in 35 municipalities that had cases of tegumentary leishmaniasis (TL).<sup>a</sup> It was distributed between all of the phytogeographical zones of the state, from the dense and moist forest of Amazon origin to the more xeric areas (semi-moist and semi-arid), including mixed areas of these vegetation types.

In total, 9,600 specimens of *L. whitmani s.l.* were caught, with greater frequency in areas surrounding homes (91.6%) than inside homes (8.4%) (Table). Male specimens predominated, both inside homes (64.5%) and in areas surrounding them (65.2%).

This taxon was not found predominantly in any particular phytogeographical zone. However, within each zone, there were some municipalities with very low frequencies of specimens and others with high frequencies (Table). The mean number of specimens caught per trap/hour was greatest in the municipalities of Buriticupu (7), Dom Pedro (6.8), Barreirinhas (5.8), Imperatriz (4.7), Senador La Roque (4.3), Timon (3), Governador Edson Lobão (1.5), São Luís (1.4), Porto Franco (1.2), Santo Amaro (1.2) and Grajaú (1.1).

Despite the differences in structure and physical appearance of the vegetation and in climatic types in the state, *L. whitmani s.l.* was found indiscriminately in the peridomestic environment in all of the municipalities. However, this taxon was recorded inside homes in only 12 municipalities (Table). It was also caught within the urban area of ten municipalities: Amarante, Barreirinhas, Carolina, Caxias, Coelho Neto, Dom Pedro, Formosa Serra Negra, Imperatriz, Lageado Novo and Timon, which are located in different geographical areas that are ecologically distinct.

## DISCUSSION

Previous studies have shown that in the Amazon phytogeographical region of Maranhão, *L. whitmani s.l.*

<sup>a</sup> The map showing species occurrence can be consulted in the online version of this paper.

**Table.** Specimens of *Lutzomyia whitmani sensu lato* caught in peridomestic environments and inside homes, according to phytoregion. State of Maranhão, Northern Brazil, 1992 to 2005.

Environment/Municipality	Inside homes			Peridomestic areas			Total			
	Male	Female	Total	Male	Female	Total	Male	Female	n	M
<b>Open evergreen seasonal forest</b>										
Amarante	-	-	-	16	3	19	16	3	19	0,2
Buritirana	-	-	-	61	34	95	61	34	95	0.8
João Lisboa	-	-	-	37	14	51	37	14	51	0.4
Lageado Novo	-	-	-	25	2	27	25	2	27	0.2
Montes Altos	-	-	-	43	6	49	43	6	49	0.4
Senador La Roque	-	-	-	411	110	521	411	110	521	4.3
Total	-	-	-	593	169	762	593	169	762	-
<b>Dense evergreen seasonal forest</b>										
Açailândia	-	-	-	67	11	78	67	11	78	0.7
Buriticupu	308	160	468	1100	450	1550	1408	610	2018	7.0
Cidelândia	-	-	-	3	-	3	3	-	3	0.0
Davinópolis	-	-	-	44	25	69	44	25	69	0.6
Governador Edson Lobão	-	-	-	131	48	179	131	48	179	1.5
Imperatriz	46	12	58	404	106	510	450	118	568	4.7
Total	354	172	526	1749	640	2389	2103	812	2915	-
<b>Southern savanna (<i>cerrado</i>)</b>										
Carolina	-	-	-	13	4	17	13	4	17	0.1
Formosa Serra Negra	-	-	-	3	3	6	3	3	6	0.1
Grajaú	-	-	-	116	16	132	116	16	132	1.1
Porto Franco	-	-	-	133	12	145	133	12	145	1.2
Total	-	-	-	265	35	145	265	35	300	-
<b>Dunes/sandbanks/savanna (<i>cerrado</i>)</b>										
Axixá	3	4	7	39	21	60	42	25	67	0.3
Barreirinhas	87	38	125	891	367	1258	978	405	1383	5.8
Tutóia	1	-	1				1		1	0.0
Santa Rita	-	-	-	9	12	21	9	12	21	0.0
Primeira Cruz	-	-	-	64	27	91	64	27	91	0.4
Santo Amaro	-	-	-	185	89	274	185	89	274	1.2
Icatu	6	5	11	10	15	25	16	20	36	0.2
Total	97	47	144	1198	531	1729	1295	578	1873	-
<b>Open evergreen seasonal forest/babaçu palm forest/savanna (<i>cerrado</i>)</b>										
Codó	2	-	2	7	6	13	9	6	15	0.2
Caxias	1	-	1	45	6	51	46	6	52	0.5
Coelho Neto	0	1	1		1	1	0	2	2	0.0
Timon	72	37	109	166	82	248	238	119	357	3.0
Total	75	38	113	218	95	313	293	133	426	-
<b>Open evergreen seasonal forest with babaçu palm forest</b>										
Capinzal do Norte	-	-	-	2	4	6	2	4	6	0.0
Dom Pedro	18	14	32	1268	1140	2408	1286	1154	2440	6.8
Poço de Pedra	-	-	-	5	8	13	5	8	13	0.1
Total	18	14	32	1275	1152	2427	1293	1166	2459	-

To be continued

Table continuation

Environment/Municipality	Inside homes			Peridomestic areas			Total			
	Male	Female	Total	Male	Female	Total	Male	Female	n	M
Ombrophilous forest with sandbanks										
Paço do Lumiar	-	-	-	14	7	21	14	7	21	0.1
Raposa	-	-	-	23	27	50	23	27	50	0.2
São José de Ribamar	17	4	21	113	83	196	130	87	217	0.8
São Luís	252	158	410	1040	576	1616	1292	734	2026	1.4
Total	269	162	431	1190	693	1883	1459	855	2314	-
Savanna ( <i>cerrado</i> ) and <i>caatinga</i> scrub heath										
Santa Quitéria	14	11	25	14	11	25	28	22	50	0.1
Total	523	288	811	5731	3058	8789	6254	3346	9600	100.0
%	64.5	35.5	8.4	65.2	34.8	91.6	65.1	34.9	100.0	

M: mean number of specimens per trap/hour.

inhabits both wild environments and rural peridomestic areas, and it has been found to be naturally infected with *Leishmania*.<sup>3</sup> A similar behavioral pattern is observed in the northeastern part of the state. It is therefore pertinent to investigate whether the distribution pattern of this taxon has modified the epidemiological profile of TL transmission in Maranhão. Hence, it is possible that this vector may be transmitting *L. shawi* in the Amazon region of the state and *L. braziliensis* in the northeastern region of the state, as observed in the states of Pará<sup>6</sup> and Ceará,<sup>7</sup> respectively.

The open evergreen seasonal forest of Amazon origin formerly extended further east and mixed with the palm forest and savanna in the areas between the Itapecuru and Parnaíba rivers, where the climate is more xeric. Before the intensive process of deforestation, the original forest may have served as a corridor for dispersion of vector populations from west to east. In this case, the possibility that *L. (N.) whitmani s.l.* might also have transmitted *L. shawi* in the northeastern region of the state, bordering Piauí, would not be ruled out. Subsequently, the populations of this insect in the open areas (*caatinga* scrub heath, savanna and palm forest) would have had the opportunity to make the journey in reverse, from east to west, favored by the progressive increase in deforestation of the Amazon

forest type, which has been replaced by palm forests and rough pasture. This latter possibility sustains the hypothesis of Ready et al<sup>5</sup> that the peridomestic habit of the vector in Buriticupu (in the Amazon area) resulted from the gene flow of extra-Amazon lineage. In this case, it can be suggested that the *L. whitmani* population of the Amazon region of Maranhão may also transmit *L. braziliensis*.

In summary, the results from the present study show that *L. whitmani s.l.* occurs in all regions of the state in which entomological surveys have been conducted. However, because of the large area covered by the state of Maranhão, many municipalities have still not been studied in this respect, particularly in the northwest and southeast of the state, where the phlebotomine fauna remains unknown. Nevertheless, three points reinforce the hypothesis that this taxon consists of a complex of species in Maranhão: 1) its occurrence in different phytogeographical and climatic regions; 2) its frequent presence in wild and rural environments and its dispersion in the main settlements of some small-sized municipalities, independent of the region; and 3) its proliferation in the urban areas of medium-sized municipalities (with more than 100,000 inhabitants) in the northeast of the state. This hypothesis may be confirmed through future molecular biology studies.

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