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# Bat Rabies in the North- northwestern regions of the state of São Paulo, Brazil: 1997-2002

## Raiva em morcegos na região norte- noroeste do Estado de São Paulo: 1997-2002

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### ABSTRACT

**OBJECTIVE:** Reports on bat rabies in Brazil are sporadic and isolated. This study aimed at describing the detection of rabies virus in bats in the state of São Paulo.

**METHODS:** A total of 7,393 bats from 235 municipalities of the north and northwestern areas of the state of São Paulo, Southeastern Brazil, were assessed according to their morphological and morphometric characteristics from 1997 to 2002. Fluorescent antibody test and mice inoculation were used for viral identification.

**RESULTS:** Of all samples examined, 1.3% was rabies virus positive, ranging from 0.2% in 1997 to 1.6% in 2001. There were found 98 bats infected, 87 in the urban area. Fluorescent antibody test was detected in 77 positive samples, whereas 92 produced rabies signs in mice; incubation period ranging from 4 to 23 days. In 43 cities at least one rabid bat was observed. The highest proportion (33.7%) of rabies virus was found in *Artibeus lituratus*. *Eptesicus* and *Myotis* were the most frequent positive species (24.5%) of the Vespertilionidae family. The species *Molossus molossus* and *Molossus rufus* showed 14.3% positive bats. There were no differences in the distribution of positive rabies between females (33; 48.5%) and males (35; 51.5%).

**CONCLUSIONS:** Rabies-infected bats were found in environments that pose a risk to both human and domestic animal population and there is a need for actions aiming at the control of these species and public education.

**KEYWORDS:** *Chiroptera*. Rabies virus. Urban zones. Phillostomidae. Vespertilionidae. Molossidae.

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### RESUMO

**OBJETIVO:** Os relatos sobre a ocorrência de raiva em morcegos no Brasil são esporádicos e isolados. Assim, o objetivo do estudo foi descrever a detecção do vírus da raiva em morcegos do Estado de São Paulo.

**MÉTODOS:** Foram analisados 7.393 morcegos provenientes de 235 municípios do norte e noroeste do Estado de São Paulo, no período de 1997 a 2002 e identificados por meio de características morfológicas e morfométricas. Para a detecção do antígeno viral foi utilizada a técnica de imunofluorescência direta e o isolamento do vírus foi realizado por inoculação em camundongos.

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**RESULTADOS:** Das amostras examinadas, 1,3% foram positivas para raiva, com variação de 0,2% em 1997 a 1,6% em 2001. Foram encontrados 98 morcegos com o vírus, 87 deles em área urbana. O vírus da raiva foi detectado pela imunofluorescência direta em 77 do total de amostras positivas, enquanto 92 produziram doença em camundongos inoculados e o período de incubação variou entre 4-23 dias. Em 43 municípios foi encontrado pelo menos um morcego positivo. Entre as espécies analisadas o vírus da raiva foi detectado com maior frequência (33,7%) em *Artibeus lituratus*. Os vespertilionídeos do gênero *Eptesicus* e *Myotis* totalizaram 24,5% dos morcegos positivos e as espécies do gênero *Molossus* (*Molossus molossus* e *Molossus rufus*), 14,3%. A distribuição do vírus da raiva foi semelhante entre fêmeas (33; 48,5%) e machos (35; 51,5%).

**CONCLUSÕES:** Morcegos positivos para raiva foram encontrados em situações que colocam em risco tanto a população humana como animais de estimação, exigindo medidas voltadas para o manejo destas espécies e de educação da população.

**DESCRITORES:** Quirópteros. Vírus da raiva. Zonas urbanas. Phyllostomidae. Vespertilionidae. Molossidae.

## INTRODUCTION

Rabies transmitted by bats is recognizably as a serious problem in Brazil both to humans and livestock. Although human rabies transmitted by bats has not been linked to early Brazilian epizootics of bovine paralytic rabies, many deaths have been reported since 1960. The largest number of deaths occurred in 1990 in a mining camp near Apiacás, in the state of Mato Grosso, Midwestern Brazil.\* In another mining site in Piauí, human deaths were reported suspected of vampire-induced rabies.\* Two outbreaks of human rabies transmitted by common vampire bats were also described in Bahia, Northeastern Brazil, in 1991 and 1992.<sup>7</sup> Recently, an outbreak of human rabies transmitted by hematophagous bats was detected in the Brazilian Amazon.<sup>13</sup>

The prevalence of rabies infection in insectivorous and frugivorous bats is quite low and the role of these infected animals in initiating wild life epizootics has not been corroborated. However, they can accidentally transmit the virus both to domestic animals and humans. Rabies virus isolation in non-hematophagous bats in Brazil was first reported in 1957 from a *Phyllostomus hastatus hastatus* specimen in the state of Rio de Janeiro.<sup>16</sup> In the following years, several authors described the disease in many bats species of different countries.<sup>1,9,11,15,20</sup> However, reports on the occurrence of bat rabies in Brazil are sporadic and isolated. Thus, the present study aimed at describing the detection of rabies virus in bats in areas of the state of São Paulo, Southeastern Brazil.

## METHODS

Three overlapping data sets related to specimens submitted to three rabies laboratories, from January 1997 to November 2002, were used. Two data sets were obtained from the records of the São Paulo agricultural laboratories: Laboratório de Raiva e Encefalites Virais at Instituto Biológico, Agência Paulista dos Agonegócios (APTA), in São Paulo, and Laboratório do Pólo Regional Alta Sorocabana (APTA) in the city of Presidente Prudente. The third data set was obtained from the Rabies Laboratories at Universidade Estadual Paulista (UNESP), in Araçatuba. During the period studied, these rabies laboratories received 7,393 bats for testing. Bats came from different cities in the north and northwestern areas of the state of São Paulo.

Bat species identifications were made by morphological and morphometric characteristics according Taddei (1998).<sup>18</sup>

Brains from all bats were examined for rabies antigens by means of the fluorescent antibody test (FAT)<sup>5</sup> and virus isolation by means of mouse inoculation tests (MIT).<sup>8</sup> Groups of five to eight mice were inoculated intracerebrally with 0.03 mL of a 20% bat brain suspension. Mice were observed during 30 days for clinical symptoms.

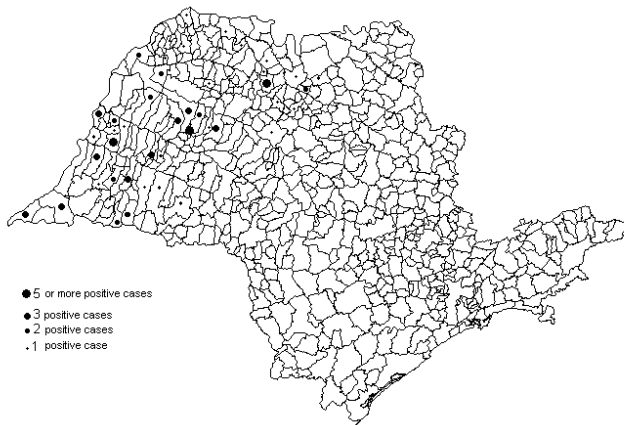
## RESULTS

Of a total of 7,393 bats examined, 98 (1.3%) were positive for rabies virus. Rabies positivity ranged from

\*Schneider MC. Epidemiological situation of human rabies transmitted by bats in Brazil. In: PAHO; WHO. Expert consultation on the care of persons exposed to rabies transmitted by vampire bats [relatório]. Washington (DC): 1991.

0.2% in 1997 to 1.6% in 2001 (Table 1). FAT detected 78.6% (77 out of 98) positive samples, whereas 92 out of 98 samples produced rabies signs in mice. Six samples could not be analyzed since the amount of brain tissue was insufficient for testing. Incubation period ranged from 4 to 23 days. The specimens examined came from northern and northwestern areas of the state, from a total of 235 cities.

Rabid bats were found in 43 cities, where at least one positive specimen was observed (Figure). Among



**Figure** - Map of the state of São Paulo showing the municipalities where bat rabies were detected according to the number of positive cases. January 1997 to November 2002, Brazil.

positive bats, 92 were identified by species and 68 by sex: 33 females and 35 males. Distribution of positive species according to the year is shown in Table 2. The highest proportion of positive animals were found or captured in urban areas (87/98) and the re-

**Table 1** - Annual numbers of confirmed bat rabies cases in the state of São Paulo, Brazil, 1997-2002.

Year	Total samples	Positive (%)		Total (%)
		FAT	MIT	
1997	272	1	1	1 (0.2)
1998	1,384	16	18 (2NT)	20 (1.4)
1999	685	5	6	6 (0.9)
2000	840	8	9	9 (1.0)
2001	1,261	14	19 (1NT)	20 (1.6)
2002	2,951	37	39 (3NT)	42 (1.4)
<b>Total</b>	<b>7,393</b>	<b>77</b>	<b>92 (6 NT)</b>	<b>98 (1.3)</b>

FAT: Fluorescent antibody test  
MIT: Mouse inoculation test  
NT: Not tested (insufficient brain samples)

maining in periurban (4/98) or rural areas (7/98). Information on the condition in which animals were found and on contact with humans or domestic animals showed that 27/63 (42.8%) were found alive and on the floor; 33/63 (52.4%) were dead; 3/63 (4.7%) entered households where they were captured; 5/63 (7.9%) contacted humans or domestic animals and 11/63 (17.4%) attacked nine humans and two animals.

**DISCUSSION**

The occurrence of rabies in bats is a public health problem, as evidenced by recent rabies-related deaths in Brazil. Reported cases of rabies in bats increased during recent years in São Paulo and other states.<sup>20,21</sup> Bat rabies reported in the present study included only those cases diagnosed by one of the three rabies laboratories in the state of São Paulo. They clearly show the disease incidence but not the extent of viral infection in wild or domestic animals in the area studied.

**Table 2** - Distribution and proportion of positive bats according to species and year. State of São Paulo, Brazil, 1997-2002.

Family/species	Year							N	Total %
	1997	1998	1999	2000	2001	2002			
Phyllostomidae									
<i>Artibeus jamaicensis</i>						1	3	3.0	
<i>Artibeus lituratus</i>		4	3	3	4	19	33	33.7	
<i>Desmodus rotundus</i>					3	1	4	4.1	
Vespertilionidae									
<i>Eptesicus furinalis</i>	1	1		1	2	2	7	7.1	
<i>Eptesicus sp.</i>					4		4	4.1	
<i>Lasiurus cinereus</i>				1		1	2	2.0	
<i>Lasiurus ega</i>		1				1	2	2.0	
<i>Myotis nigricans</i>		3		1	2	2	8	8.2	
<i>Myotis sp.</i>		1	1	1	1	1	5	5.1	
Molossidae									
<i>Eumops auripendulus</i>		1				1	2	2.0	
<i>Eumops glaucinus</i>					1		1	1.0	
<i>Molossops abrasus</i>				1		1	2	2.0	
<i>Molossus molossus</i>		2	1		1	2	6	6.2	
<i>Molossus rufus</i>		3		1		4	8	8.2	
<i>Nyctinomops laticaudatus</i>		2	1		1		4	4.1	
<i>Nyctinomops macrotis</i>					1		1	1.0	
Unidentified					1	5	6	6.2	
<b>Total</b>	<b>1</b>	<b>20</b>	<b>6</b>	<b>9</b>	<b>21</b>	<b>41</b>	<b>98</b>	<b>100.0</b>	

% = proportion of positive

Overall prevalence of rabies among bats in the present study (1.3%) was lower than that reported in similar studies in North America.<sup>2,3</sup> On the other hand, studies that attempted to randomly sample clinically normal bats from the wild reported rabies prevalences ranging from 0% to 3%.<sup>6,19</sup> Other studies showed that prevalence in randomly selected bats was usually lower than 0.1%.<sup>12</sup> A study involving 351 bats from nine species captured in their roosts in another area of the state of São Paulo reported 0.9% positive samples.<sup>4</sup>

Among the different species tested positive in the present study, the highest proportion (33.7%) was *Artibeus lituratus* (big fruit-eating bat). The occurrence of rabies virus in six bats of this species was reported by Uieda<sup>21</sup> (1996) in the states of Santa Catarina, Rio de Janeiro and São Paulo.

*A. lituratus* is a generalist species, has great ability in using a wide variety of food resources and lives in many different habitats, including urban forests and anthropically affected areas.<sup>22</sup> This species finds diversity and abundance of feeding sources and shelter in cities. The closed tops of various trees, such as the mango and the jambolan, provide adequate shelter to phytophagous bats, such as *A. lituratus* and *A. jamaicensis*. Studies in two Brazilian urban parks showed that *A. lituratus* is the most common species among frugivorous bats.<sup>10</sup> *A. lituratus* is also a common species in urban and periurban areas in the state of São Paulo and many species of plants may serve as food and shelter for them in this state.<sup>14</sup>

Vespertilionidae family bats live in small groups in trees and shrubs. However, *Histiotus velatus* and *Myotis nigricans* species were collected inside households. Among positive bats classified by Uieda<sup>21</sup> (1996) in Brazil, there were six specimens of four species of this family, two of them found in the state of São Paulo. Although bats in this family do not present anthropophilic habits as strong as those in the Molossidae family, a great number of specimens (28; 30.4%) were positive, and *Eptesicus* sp. and *Myotis*

sp., usually collected in households, were the most frequent ones. Bats in the *Molossidae* family present anthropophilic habits and may form great colonies. The largest and most concerning groups of bats in the state of São Paulo are *M. molossus* and *M. rufus*. A list of bats species found in São Paulo between 1988 and 1995 showed that 71.4% were molossoids, with 36.5% *M. molossus*.<sup>21</sup> The study data show *Molossidae* was the family with the largest number of positive species (7), although the proportion of positive bats (24.5%) was the smallest among the three families analyzed. On the other hand, Uieda et al<sup>20</sup> (1995), in a study in the state of São Paulo, showed that 13 (68%) out of 19 rabid bats were molossoids. The present study results also show that among *Molossidae*, *Molossus* sp., commonly found in urban areas in many Brazilian cities, was the most frequent bat species that tested positive (16.3%) for rabies.

There were no apparent differences in the distribution of rabies by sex, 33 (48.5%) were female and 35 (51.5%) were male bats. These results corroborate those found in rabid bats in Minnesota (USA).<sup>17</sup> On the other hand, bats studied in Illinois and New York (USA) showed that the prevalence in pooled species was significantly higher in females than males.<sup>2,3</sup>

The present study also showed that among rabid bats, many were found inside households and others attacked humans or domestic animals. A significant proportion of these animals was found partially paralyzed or already sick in a way that they could be handled or hunted and even begin a rabies outbreak in urban areas.

The presence of groups of frugivorous and insectivorous bats in urban environments is a complex problem with economic, public health and ecological implications. It is not practical or feasible to control bat population but potential exposure of humans to rabid bats may be reduced by keeping bats out from households and surrounding areas and by educating people not to handle sick or injured bats.

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