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Brief communication

Rabies in humans and non-human in the state of Pará, Brazilian Amazon

Marcus Emanuel Barroncas Fernandes[a], *Lanna Jamile Corrêa da Costa*[a,*], *Fernanda Atanaena Gonçalves de Andrade*[b], *Lucila Pereira Silva*[c]

[a] *Instituto de Estudos Costeiros, Universidade Federal do Pará, Bragança, PA, Brazil*
[b] *Instituto Federal de Educação, Ciência e Tecnologia, Tucuruí, PA, Brazil*
[c] *Laboratório de Raiva, Laboratório Nacional Agropecuário no Pará/LANAGRO, Belém, PA, Brazil*

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ABSTRACT

We evaluate the relationship of positive cases of rabies with the continuing expansion of livestock production, and analyse the trends of this zoonosis in human population in the state of Pará, Brazilian Amazon. The distribution of rabies cases was recorded between 1999 and 2004. Of 148 cases of rabies, 21% were in humans and 79% in non-human mammals. The rapid growth in livestock numbers seems to be associated with the increase of positive cases in bovine livestock transmitted by vampire bats. This idea is supported by positive and significant relationship of both events in time ($p < 0.01$), but failed when spatial distribution among regions of the state was considered. However, rabies cases tend to occur toward the northeastern of the state of Pará, where rabies cases are proportionally five times greater than other mesoregions, suggesting that increased livestock production may influence the increase of this zoonosis.

Rabies, caused by *Lyssavirus*, is a disease found in humans and several other mammal species.[1,2] Up until the mid-1990s, the state of Pará, eastern portion of the Amazon, had the third highest rate of rabies cases in Brazil. According to the Brazilian Health Ministry only nine cases of rabies in humans (transmitted by vampire bats) were recorded in Pará between 1999 and 2002, all in the southeastern portion of the state. By contrast, from 2003 to 2004, the number of recorded cases more than doubled to 22, and was more widespread, ranging from the southeast to the northeast. Therefore, the present study was conducted primarily to assess whether positive human and non-human (cattle) cases of rabies were associated with the ongoing expansion of the bovine livestock production in the region, and to evaluate current trends in human rabies incidence in this part of the Brazilian Amazon.

All positive human samples ($n = 31$) resulted from infections that occurred in rural areas. The non-human group was represented by cattle ($n = 117$). Rabies was diagnosed using direct immunofluorescence assays and viral isolation through the intracranial inoculation of the central nervous system of newborn mice. Positive samples were identified using monoclonal antibodies.

The distribution of the rabies cases (human and non-human) was recorded in the different mesoregions of

* *Corresponding author at*: Instituto de Estudos Costeiros, Universidade Federal do Pará, Campus de Bragança, Alameda Leandro Ribeiro s/n, Aldeia, Bragança, PA 68600-000, Brazil.
E-mail address: lannacorrea@yahoo.com (L.J.C. da Costa).
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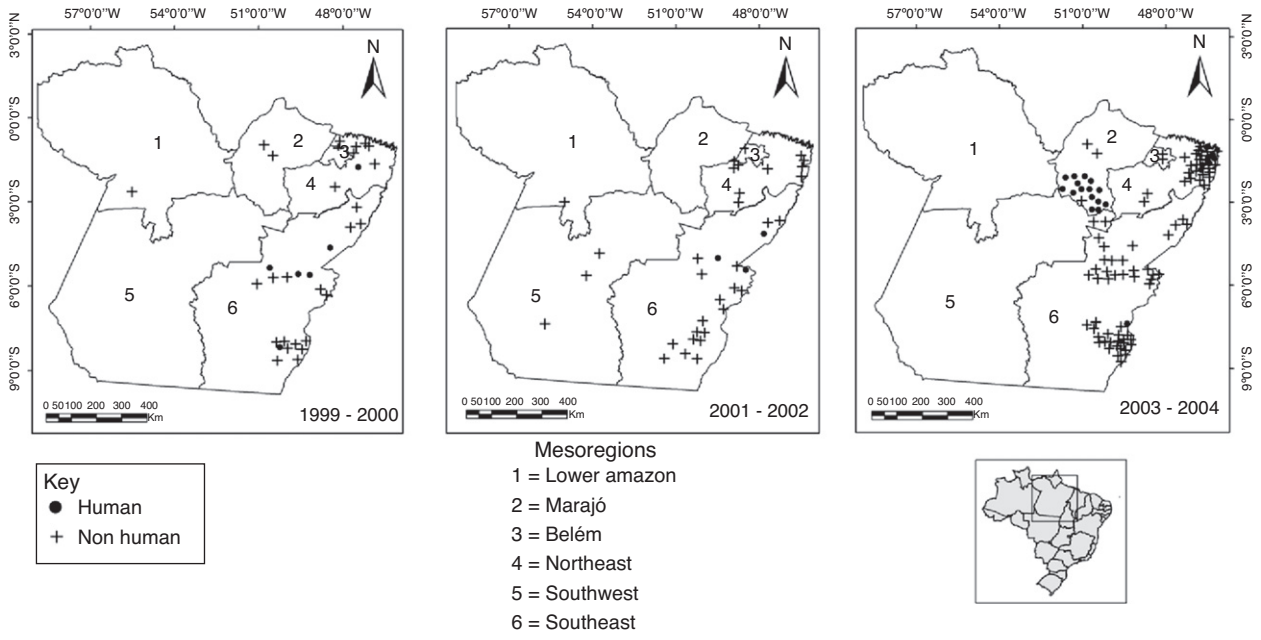

Fig. 1 – Positive human and non-human cases in intervals of two years, from 1999 to 2004, in the six mesoregions of the state of Pará, eastern Brazilian Amazon.

Pará between 1999 and 2004 (Fig. 1). Annual variation and different geographic regions were both evaluated with respect to the number of rabies cases in human and non-human by using Kruskal–Wallis's non-parametric analysis of variance (H), while linear regression (with data transformed) was applied to describe the relationship between the rabies cases (human and non-human) and livestock production, considering annual and mesoregion variations.

Between 1999 and 2004, 148 cases of rabies were recorded in Pará, of which, 31 (21%) were in humans, the remaining 117 (79%) in non-human mammals (cattle). The number of non-human cases varied significantly among the six geographic regions of the state ($H = 9.94$; df = 5; $p < 0.01$), with the majority of cases being recorded in the southeast ($n = 62$; 42%). On the other hand, no significant differences were found in the annual variation for non-human cases ($H = 2.12$; df = 5; $p > 0.05$), although most cases have been reported in 2003 and 2004. Regarding human cases there was no significant differences for both annual variation and geographic regions ($H = 9.8$; df = 5; $p = 0.07$ and $H = 3.05$; df = 5; $p = 0.69$, respectively), with half of cases recorded in the Marajó mesoregion.

The production of bovine livestock in the Brazilian Amazon basin has increased progressively since 1991. According to the Pará State Department of Agriculture (SAGRI), the local bovine herd increased annually by an average of 12% during the present study period (1999–2004) totaling 73,181,447 individuals, reaching the peak in 2004 (24%). Similarly, the numbers of rabies cases in cattle have noticeably grown in the same year ($n = 62$). Thus, it seems reasonable to assume that this rapid growth in livestock numbers, mainly in 2004, may be associated with the increase in the figures of positive cases of rabies in bovine livestock transmitted by vampire bats, *Desmodus rotundus*. In fact, the regression analysis between these two events showed a positive and significant relationship in time (regression, $F = 25.8$; df = 5; $p < 0.01$ – Fig. 2) supporting this hypothesis, but failed when spatial distribution among regions of the state was considered (regression, $F = 5.63$; df = 5; $p = 0.07$). However, it is important to emphasize that the southeast mesoregion has a livestock ten times higher than the Northeast, where the number of rabies cases is proportionally five times greater than that of southeast.

As a consequence of the increase of positive cases in cattle, one would expect a higher number of rabies cases in humans in rural areas. However, regression analysis revealed significant correlations of human cases neither with the increase of rabies cases in cattle (regression, $F = 0.44$; df = 5; $p = 0.54$) nor

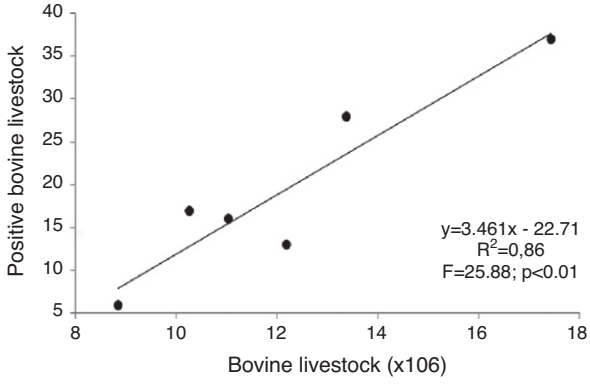

Fig. 2 – Relationship between positive rabies cases on bovine livestock and total bovine livestock from 1999 to 2004 in the state of Pará, Brazilian Amazon.

with the increase of total bovine livestock (regression, $F = 4.44$; $df = 5$; $p = 0.10$).

Rabies outbreaks in the state of Pará have occurred in rural areas, where the majority of the human population lives in relative poverty. Most victims reported in 2004, for example, lived in thatched houses, with no electricity or other utilities, and not close of water bodies. In most cases, information was available only for the confirmed cases by governmental entities and not for all clinical cases, i.e., the figures of positive individuals were underestimated, which is a barrier to more accurately define the trends of this disease in the Amazon region.

Once humans dwell in the focus area of bat-transmitted rabies, structural changes triggered by non-biological or social factors make the disease emerge.[3] In fact, the rabies virus may be spreading rapidly over wide areas within the Amazon basin and beyond, especially through intraspecies transmission among bat populations,[4] despite the low occurrence of this type of transmission.[5]

The association between vampire and other bats, and wild bat rabies is well documented at many South American sites,[4,6] but the lack of field surveys and monitoring of bat populations hinder the understanding of the spreading process and transmission routes within the Amazon basin. Additionally, the activities of surveillance and disease control also depend on information about the size of forested areas, topography, hydrography and land use by man,[5,7] being such factors straightly related to the livestock industry.

Conflict of interest

All authors declare to have no conflict of interest.

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