



## Original article

## Epidemiology of *Ornithodoros brasiliensis* (mouro tick) in the southern Brazilian highlands and the description of human and animal retrospective cases of tick parasitism

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## ABSTRACT

*Ornithodoros brasiliensis*, also known as the “mouro” tick, is an argasid tick found exclusively in the southern Brazilian highlands. *O. brasiliensis* parasitism is frequently associated with severe symptoms directly induced by the tick bite, a condition compatible with the definition of tick toxicosis. The objectives of this work include (i) the determination of the distribution of *O. brasiliensis* in farms located in the tick-endemic region, (ii) the description of the characteristics of *O. brasiliensis* habitats, (iii) the analysis of risk factors associated with *O. brasiliensis*, and (iv) the retrospective description of cases of human and animal parasitism by *O. brasiliensis*. Of the 30 farms included in this study, *O. brasiliensis* was identified on 5 farms (frequency 16.7%), in which several ticks found in high density buried in soil were collected. Information regarding the tick habitats and the local population was recorded. The data indicated that *O. brasiliensis* feeds on humans, dogs, armadillos (*Dasypus hybridus*), and possibly skunks (*Conepatus chinga*). The analysis of risk factors indicated that the presence of house basements with an unpaved (natural soil) floor on farms and insufficient sanitary conditions significantly enhanced the probability of identifying *O. brasiliensis*. Additionally, we describe retrospectively cases of tick parasitism in 28 humans and 11 dogs including the most common symptoms associated with tick toxicosis. This is the first study concerning *O. brasiliensis* epidemiology, distribution, and habitat, and the report represents the most comprehensive characterization of *Ornithodoros* bite-associated toxicosis syndrome.

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## Introduction

Ticks are obligate blood-feeding arthropods that are distributed worldwide. They are able to parasitize almost all terrestrial vertebrate animals. In several regions, the noxious effects of tick feeding and the associated tick-borne diseases denote these parasites as a serious hazard to both human health and animal production (Estrada-Peña and Jongejan, 1999; Jongejan and Uilenberg, 2004; de la Fuente et al., 2008).

There are hundreds of tick species, which are divided into 3 families, Ixodidae, Nuttalliellidae, and Argasidae. Argasid ticks, also called soft ticks due to the lack of a sclerotized dorsal plate, are generally divided in 4 genera: *Argas*, *Carios*, *Ornithodoros*, and *Otobius*

(Horak et al., 2002). *Ornithodoros* are nidicolous ticks, which live in high-density populations either inside (endophilic nidicoles) or in harborages in close proximity (non-endophilic nidicoles) to host burrows. Ticks belonging to the *Ornithodoros* genus are well known as disease vectors, as they transmit several diseases, particularly relapsing fever (Sonenshine, 1991). *Ornithodoros* ticks are also able to induce severe injuries directly associated with the tick bite. These types of non-infectious injuries and illnesses directly associated with tick bites are referred to as tick toxicosis, the results of which ranges from a mild local pathology (pain and pruritus) to death (Mans et al., 2004).

*Ornithodoros brasiliensis*, locally known as the “mouro” tick, is an argasid that was first described in 1923 with the collection of few specimens in the São Francisco de Paula municipality located in the southern Brazilian highlands (Aragão, 1923). Until now, this tick has been exclusively observed in this region. Based on early reports largely involving anecdotal data, *O. brasiliensis* parasitism is frequently associated with immediate and severe reactions to the tick bite (Pinto and di Primio, 1931; Aragão, 1936; di Primio, 1937),

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which is a clinical profile compatible with the definition of tick toxicosis syndrome. Later, it was demonstrated that in addition to toxicosis syndrome, *O. brasiliensis* occurrence might be associated with pathogen transmission, as a potential tick-borne microorganism (*Borrelia brasiliensis*) was once shown to be associated with *O. brasiliensis* occurrence under laboratory conditions (Davis, 1952).

Since there have been no reports for more than 50 years, it was believed that *O. brasiliensis* was eradicated and potentially extinct in the region. Nevertheless, in 2007, a few tick specimens were identified in São Francisco de Paula, southern Brazil, and cases of human parasitism were observed among the general public and local veterinary authorities (Martins et al., 2011). Additionally, a recently published case report described clinical findings (compatible with tick toxicosis syndrome) involving a dog bitten by *O. brasiliensis* in the southern Brazilian highlands (Reck et al., 2011).

Although *O. brasiliensis* has been described several decades ago, there are no data concerning its ecology, habitat, distribution, and the associated parasitism risk factors. With the exception of the recently published dog case, there is a lack of reports concerning putative *O. brasiliensis* toxicosis syndrome. Moreover, no retrospective analyses of clinical case series or even a single case report associated with human parasitism have been published. This contrasts with the quantity of anecdotal data of human cases of parasitism, including some cases with severe symptoms (Pinto and di Primio, 1931; di Primio, 1937; Aragão, 1936; Davis, 1952).

As a result of the recent re-emergence of *O. brasiliensis* parasitism in southern Brazil, we performed an epidemiological study describing the characteristics of this potential health issue. Therefore, this work aims (i) to determine the frequency of *O. brasiliensis* on farms located in the tick-endemic region, (ii) to describe the environmental characteristics of its habitat, (iii) to analyze the risk factors associated with the presence of these ticks, and (iv) to describe the retrospective cases of human and animal parasitism.

## Materials and methods

### Study area and sample size calculation

This study was carried out in a region that includes the neighboring localities/villages of Vargem do Cedro and Faxinal dos Pelúcius, which are located in the municipalities of São Francisco de Paula and Jaquirana (the former district of São Francisco de Paula), respectively, in the state of Rio Grande do Sul, Brazil. This region belongs to the southern Brazilian highlands region and is characterized by an average elevation of 920 m above sea level, annual temperatures ranging from  $-8$  to  $36$  °C, an average precipitation of approximately 1500 mm per year, and an aluminic humic cambisol, highly acidic characteristic type of soil. The southern Brazilian highlands region was selected for the study because it is the only region in the world where *O. brasiliensis* has already been described (Aragão, 1923; Martins et al., 2011; Reck et al., 2011).

According to the local authorities, there are 180 farms within the study area. Samples were collected from the farms and information regarding *O. brasiliensis* occurrence and the retrospective human and animal cases was assessed. The sampling procedure was performed via hypergeometric-based sampling. As there are no reports describing *O. brasiliensis* prevalence in any environment, the hypothetical value of 10% prevalence obtained by anecdotal information of the local veterinary office was utilized for sampling calculation. Thus, considering 180 farms as the target population ( $N$ ), 10% of the expected prevalence ( $p$ ), and 95% confidence level ( $z$ ), the calculated sample size ( $n$ ) was 30 farms. The inhabitants of the study area were verbally informed of the research project, and the properties selected for the study were the first 30 farms in which the owners agreed to participate in the project.

**Table 1**  
Interview/questionnaire.

Section/subject	Questions
General characteristics	Farm size, number of inhabitants, family income, existence of basement-like structure with unpaved (natural soil) floor, hen house, and shed/storehouse
Respondent characteristics	Age, education level
Health	Medical service, veterinary service available
Animals	Domestic animals on the farm, wild animals seen on the farm, other ticks seen on the farm, pest control
Mouro tick	Have you ever heard about mouro tick? From whom? Have you ever seen a mouro tick?
Authors' observations	Sanitary conditions
Retrospective cases	Human/animal cases, identification of the bitten person, clinical symptoms, progression, medical service, treatment

### Tick sampling

Technical visits, which involved tick sampling (to determine the presence of *O. brasiliensis*) and the completion of a questionnaire (as explained later), were performed at the selected farms (30 properties) during spring to autumn (September–June) of 2009/2010 in association with the local veterinary authorities. Tick sampling was performed by careful visual examination and sifting sand/soil (with sieves) from the house floor, sheds, storehouse, hen house, domestic animal shelters, and house basements. Unpaved and vegetation-free areas (with exposed sand/soil) in the proximity of human habitations, animal shelters, rocks, and trees were inspected and sifted, as the tick primarily lives buried in sand/soil (5–40 mm deep) (Martins et al., 2011; Reck et al., 2011). The sifting procedure was performed by at least 3 investigators for 4–6 h per farm. Additionally, all sites where *O. brasiliensis* are commonly found on farms were also investigated. Domestic animals were also inspected. Tick sampling was always performed during daylight and non-rainy conditions.

### Data collection and questionnaires

During the technical visits, the inhabitants were interviewed using the elaborated questionnaire to collect information regarding (i) the basic characteristics of the target area and the local human population, (ii) the risk factors associated with the presence of *O. brasiliensis*, (iii) and the retrospective cases of human and animal parasitism. Interview questions and questionnaire are shown in Table 1. A complete copy of the questionnaire is available to the readers upon request directed to the corresponding author. Retrospective cases were described based on the information obtained from the interviewed individuals. For a retrospective case to be included in the study, it was necessary that the respondent witnessed the tick bite and the clinical progression for at least 6 h after the incident. Regarding the animal retrospective cases, only the reports provided by the animal owners were included in the study. For the retrospective cases, it was required that the respondents provide full identification of the bitten person or animal to avoid counting the same case more than once if reported by different respondents. To bolster the reliability of the retrospective history provided by the respondent and to verify whether they had actually observed an *O. brasiliensis*, an adult specimen was shown to the respondents before the interview, and they were asked to confirm whether it was indeed a mouro tick. The purpose of the visit was previously explained to the people by the local authorities, and all the respondents verbally agreed to answer the questionnaire and provide information for this study. The interview/questionnaire

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