

Rhipicephalus (Boophilus) microplus (Acari: Ixodidae) as a parasite of pampas deer (*Ozotoceros bezoarticus*) and cattle in Brazil's Central Pantanal

Rhipicephalus (Boophilus) microplus como parasita de veado-campeiro (*Ozotoceros bezoarticus*) e do gado bovino no Pantanal Central do Brasil

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Received May 31, 2008

Accepted February 27, 2009

Abstract

In the Pantanal, domestic and wild animals share the same habitats; their parasites and environment interact in a complex and dynamic way. The *Rhipicephalus (Boophilus) microplus* is the most important cattle tick in Brazil. In the past two decades, some traditional management practices are being replaced with the aim of intensifying cattle production. Forested areas are being replaced by exotic pasture and ranch owners are replacing Nelore for European breeds. The pampas deer (*Ozotoceros bezoarticus*) is a medium-sized cervid that occurs in grasslands of South America. Between December 2005 and January 2007, we captured and collected ticks from 15 pampas deer and 172 bovines. The abundance, intensity, and prevalence of ticks found in cattle were lower than those in pampas deer ($p < 0.05$), indicating that pampas deer is more susceptible than cattle. The high number of engorged females collected from pampas deer, their capacity to lay eggs, and the percentage of eclosion indicates that the pampas deer population in the Pantanal wetlands is sufficient to maintain the *R. (B.) microplus*, thus playing a important role in the transmission of ticks and tick-borne diseases. The recent deforestation to introduce *Brachiaria* sp. and European cattle needs to be carefully evaluated to prevent economic losses to the cattle industry and damage to the wildlife in Pantanal.

Keywords: *Rhipicephalus (B.) microplus*, Ixodidae, *Ozotoceros bezoarticus*, Pantanal, cattle.

Resumo

No Pantanal Brasileiro, onde animais domésticos e selvagens compartilham os mesmos habitats; hospedeiros, parasitas e ambientes encontram-se em interação complexa e dinâmica. *Rhipicephalus (Boophilus) microplus* é o carrapato bovino mais importante no Brasil. Nas últimas duas décadas práticas de manejo vem sendo substituídas com objetivo de aumentar a produtividade. Áreas de florestas estão sendo substituídas por pastagens exóticas e os produtores começam a utilizar raças européias no lugar do Nelore. O veado-campeiro é um cervídeo que ocorre em áreas de campo na América do sul. Entre dezembro de 2005 e janeiro de 2007, foram coletados carrapatos de 20 veados-campeiros e 172 bovinos. Os valores de abundância, intensidade parasitária e prevalência de carrapatos no gado foram menores que os valores encontrados no veado-campeiro ($p < 0,05$), indicando que o veado-campeiro é mais susceptível que o bovino. O elevado número de fêmeas ingurgitadas coletadas, sua capacidade de ovipor e o percentual de eclosão indicam que a população veado-campeiro na região de estudo é suficiente para manter o *R. (B.) microplus*, desta maneira participando na epidemiologia dos carrapatos e das doenças por eles transmitidas. O recente desmatamento, a introdução de *Brachiaria* sp. e do gado europeu precisam ser cuidadosamente avaliados, para prevenir perdas na indústria do gado e vida selvagem.

Palavras-chave: *Rhipicephalus (B.) microplus*, Ixodidae, *Ozotoceros bezoarticus*, Pantanal, bovinos.

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Supported by: CNPq, CAPES/PROEX and EMBRAPA/CPAP

Introduction

The Brazilian Pantanal is an important area for the cattle ranching industry in Latin America. The cattle population in the region reaches approximately 6 million animals and the major management practice is extensive cattle raising. As the Pantanal region has great relevance for the economy of cattle production in Brazil and in Latin America, the health status and the risks of disease emergence in this animal population need to be carefully investigated. Moreover, the Pantanal is recognized as one of the world's largest wetlands with a diverse mosaic of habitats resulting from different soil types and inundation patterns, and represents an extraordinarily rich terrestrial and aquatic biota (HARRIS et al., 2005). In this biome, where domestic and wild animals share the same habitats, their parasites and environment are found in complex and dynamic interactions.

Rhipicephalus (Boophilus) microplus is the most important cattle tick in Brazil and other countries. The most common cattle breed in the Pantanal region is the Nelore (*Bos indicus*), in which tick infestation is usually very low (BARROS and PELLEGRIN, 2002). The low susceptibility of Nelore cattle to ticks, in comparison to European breeds (*Bos taurus*), has been extensively documented (LEMONS et al., 1985; SARTOR et al., 1992; WAMBURA et al., 1998). In the past two decades, some traditional management practices are being replaced in order to intensify cattle production, and large forested areas are being annually replaced by exotic pastures (*Brachiaria* sp.) (HARRIS et al., 2006). In 2004, approximately 17% of natural habitats across the Pantanal wetlands were lost. Furthermore, some ranch owners are changing from Nelore to European breeds (*Bos taurus*) as a way to increase meat production.

The pampas deer (*Ozotoceros bezoarticus*) is a medium-sized deer that originally occurred in all grasslands of South America. This wide range, though, has been severely reduced by habitat loss, hunting, and competition with cattle. Currently, it is considered as the most endangered Neotropical cervid, with only small isolated populations being found throughout its historical range (GONZALEZ et al., 1998; DEMARÍA et al., 2003). The Pantanal shelters the largest population and largest reported densities of this species, especially in its central portion (MOURÃO et al., 2000). The population is known for strongly avoiding mature forest, and for selecting open habitats, which result in a close contact of this species with cattle.

Some reports on *R. (B.) microplus* as a pampas deer parasite have been published (MACHADO et al., 1985; SERRA-FREIRE et al., 1996; PEREIRA et al., 2000). However, these studies only reported on the occurrence of the tick-host relationship, without providing further biological information. Nevertheless, the authors highlighted that more studies on the role of pampas deer in *R. (B.) microplus* epidemiology are required. In another study, serological and molecular survey showed that high prevalence of *Babesia* sp. and *Anaplasma* sp. exists in the pampas deer (VILLAS-BOAS et al., 2007).

In this paper we present some biological data on *R. (B.) microplus* as a pampas deer parasite and compare the prevalence, abundance, and intensity of the tick infestation collected from cattle and pampas deer. We also highlight the importance of the host-parasite relationship to tick-borne disease epidemiology.

Material and Methods

1. Study site

The study was done in the Pantanal wetlands of Mato Grosso do Sul, Brazil, which is one of the largest continuous wetlands in the world, covering approximately 210,000 km² of low-elevation seasonal floodplains of the Rio Paraguay and its tributaries (HARRIS et al., 2005, 2006). In the Pantanal, the summers (November to March) are hot and rainy, with mean seasonal rain of 1100 mm and highest air temperature reaching more than 40 °C, and winters (April to October) are warm and dry, with mean winter rain below 300 mm, and average minimum air temperatures just under 20 °C.

Due to its geological, geomorphologic, and climatic characteristics, as well as its seasonal hydrological variations, the Pantanal can be separated into different sub-regions. We conducted this study in the centrally located Nhecolândia region (HAMILTON et al., 1996), in an area of approximately 400 km² (between 18° 55' and 19° 02' S; 56° 31' and 57° 47' W). The Nhecolândia are covered by a mosaic of seasonally flooded grasslands, savannas, scrub savannas, forests, and several permanent and temporary ponds (ALHO et al., 1987).

2. Capture and handling procedures for the pampas deer

Between December 2005 and October 2006, we captured 15 pampas deer at the study site (licenses numbers # 26/2005 and 032/2005, granted by the Brazilian Federal Wildlife Agency – IBAMA, Processes n° 02014.001890/2005-66 and n° 02014.002008/05-00, respectively) by darting them from cars or ATVs, or on foot, using a Distinfect® (Zurich, Switzerland) model 35 dartgun, following the methodology described by Piovezan et al. (2006). Animals were immobilized with an intramuscular dosage of Telazol® (1:1 tiletamine hydrochloride and zolazepam hydrochloride association; Fort Dodge Laboratories, Inc., Fort Dodge, IA, United States) (n = 8) or a combination of Telazol® plus xylazine hydrochloride (Rompun®; Bayer AG, Leverkusen, Germany) in 2:1 dosage (n = 12), using yohimbine hydrochloride as xylazine antagonist.

During handling, we weighted and measured the animals, collected blood samples, tagged the animals, and examined their vital signs continuously. After handling, the animals were monitored until they recovered from the anesthesia. All handling procedures followed the recommendations of the Guidelines for Capture, Handling, and Care of Mammals as approved by the American Society of Mammalogists (Animal Care and Use Committee, 1998). Captures were conducted as part of a GPS radiotracking research project of which details are presented elsewhere (ZUCCO, 2007).

3. Handling procedures for cattle

Between December 2005 and January 2007 we examined 172 bovines present at the same study site where the pampas deer were examined. The cattle were brought to the management's corral and held individually in a squeeze gate for full body examination.

4. Collection of ticks

Hosts were examined throughout the body for ectoparasites, and inspection ceased when searching time reached approximately 5 minutes with no more ectoparasites being found. Ticks were maintained at the collecting site in small plastic cases with humid hydrophilic cotton balls. They were kept until sent to the Laboratory of Acarology at Universidade Federal Rural do Rio de Janeiro for measuring oviposition and larval hatching to evaluate the pampas deer efficiency as a *R.(B.) microplus* host. Tick attachment sites were recorded.

After identification according to previous studies (GUIMARÃES et al., 2001; BARROS-BATTESTI et al., 2006), females were conserved in a climatic chamber (B.O.D.) with controlled humidity (80%) and temperature (27 °C) ideal for oviposition and larval hatching.

5. Statistical analysis

To compare the prevalence of ticks in cattle and in the pampas deer we performed the Fischer's Exact Test. To compare the mean of intensity of parasitism and abundance, we performed unpaired *t*-test with Welch correction. We used the Kolmogorov-Smirnov test to test for normality of data. When necessary, we performed the nonparametric Mann-Whitney test. All data were transformed to $\text{Log}(x + 1)$.

Results

All analyzed parameters were significantly different between cattle and pampas deer ($p < 0.05$). The abundance, intensity of infestation, and prevalence of *R. (B.) microplus* in the cattle were all lower than in the pampas deer. (Table 1, Figure 1).

All female ticks that were collected and sent to the laboratory laid fertilized eggs. The larval eclosion rate reached more than 80% of eclosion for each female egg mass.

On the skin of the cattle, the ticks were distributed throughout the ventral body region, from the lower perineum to the ventral neck. Similar distribution was observed on the pampas deer's skin, except for males with growing antlers, which was the prevalent site for tick attachment and engorgement.

Discussion

Results indicate that the pampas deer harbors higher infestations by *R.(B.) microplus* parasitism than cattle. This may be related to several factors yet to be investigated, including a possible higher (natural?) tick susceptibility in pampas deer than in Nelore cattle. Barros and Pellegrin (2002) have already registered low rates of tick infestation in Nelore cattle. These authors also stated that the ticks were not of economic relevance to the cattle industry of the region. In Brazil, Nelore cattle are recognized as a bovine breed resistant to tick infestations (LEMOS et al., 1985; MORAES et al., 1986; OLIVEIRA et al., 1989; OLIVEIRA; ALENCAR, 1990; SARTOR et al., 1992; WAMBURA et al.,

1998). As this tick species was probably introduced in the Pantanal two hundred years ago, the relationship between *R. (B.) microplus* and the pampas deer could be of a new tick-host interaction, thus resulting in the high susceptibility of the pampas deer to *R. (B.) microplus*.

The number of engorged females collected from the pampas deer, their capacity to lay fertilized eggs, and the high percentage of larval hatching indicates that the *R. (B.) microplus* feed successfully on pampas deer, suggesting that the pampas deer is a good host to *R. (B.) microplus*.

The pampas deer is a highly endangered species that is extinct in most of its original range. Currently, it is found in small isolated populations, mainly inside protected areas. The Pantanal shelters the largest population of the species (MOURÃO, 2000), which lives in complete sympatry with cattle. In the Pantanal, the highest pampas deer densities have been registered at the site where we conducted this study (MOURÃO, 2000; TOMAS et al., 2001).

In this scenario, the pampas deer population in the Pantanal wetlands seems to be sufficient to maintain the *R. (B.) microplus*, thus playing an important role in the transmission of ticks and tick-borne diseases.

Although similar distribution of ticks was found over the bodies of cattle and pampas deer, we also observed that a higher density of ticks was found attached to the growing antlers of the deer. This indicates that this site may be an important source

Table 1. Abundance, intensity and prevalence of *Rhipicephalus (Boophilus) microplus* collected on cattle and the on pampas deer (*Ozotoceros bezoarticus*) at Central Pantanal of Brazil.

Examined animals	N	Mean ± SD		
		Abundance	Intensity	Prevalence (%)
Cattle	174	0.65 ± 1.18 ^a	1.88 ± 1.3 ^a	34.5 ^a
Pampas deer	15	9.73 ± 17.11 ^b	14.6 ± 19.40 ^b	66.6 ^b

Different letters in the same column means statistical dissimilarity ($p < 0.05$).

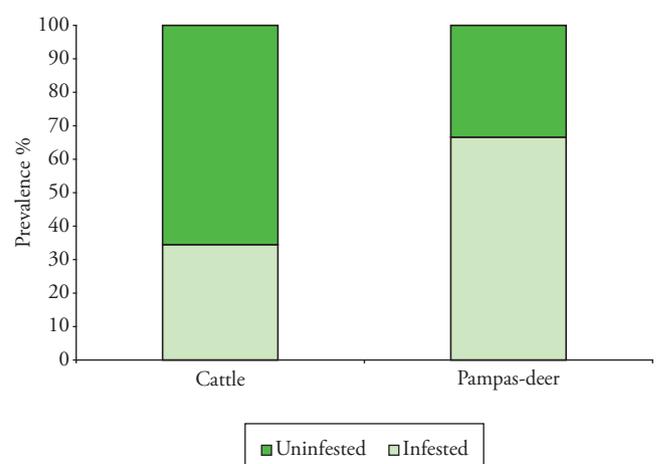


Figure 1. Prevalence of *Rhipicephalus (Boophilus) microplus* on cattle and pampas deer in Central Pantanal of Brazil. ($p < 0.05$)

of blood. Antler growth requires a great energy investment and occurs during the beginning of the dry season (TOMAS, 1995), a time when food availability is relatively low. In this period, the deer are in poor health condition, thus apparently an increase in tick population and tick-borne disease transmission may be due to a lower resistance. More studies are necessary to investigate this hypothesis.

The risk that a vector-borne disease will emerge depends on vector abundance (BENGIS et al., 2002). Additionally, tick population dynamics can only be fully understood by quantifying the rates of the demographic processes, which are influenced by both abiotic (climatic) factors and biotic (host) responses to the tick as a parasite (RANDOLPH, 2004). To date, the *R. (B.) microplus* population in the Pantanal region is low (BARROS; PELLEGRIM, 2002), but to increase livestock population the Pantanal environment has been modified by deforestation (HARRIS et al., 2006). The consequences of the environmental changes are still poorly known. However, there is evidence that habitat loss enhance tick populations (SZABÓ et al., 2003). Moreover, studies that compared areas with and without cattle raising found that tick population was denser in the areas where the cattle were present (CANÇADO et al., 2008). The recently replacement of forests and native pasture by *Brachiaria decumbens* could favor an increase in *R. (B.) microplus* populations. This exotic pasture is the most common introduced species used to replace the forests and native grasslands in the studied region. Numerous reports have indicated that this kind of pasture could favor the survival of the cattle tick *R. (B.) microplus* (e.g., THOMPSON et al., 1978; AYCARDI et al., 1984).

On the other hand, the tick-borne diseases have high prevalence in cattle from the Pantanal (MADRUGA et al., 1986). Villas-Boas et al. (2007) also reported high prevalence of *Babesia* sp and *Anaplasma* sp. in pampas deer in a serological and molecular surveillance done in the same study site. These results suggest the need for additional research to clarify the susceptibility of the pampas deer to babesiosis and anaplasmosis and its role in the maintenance of these diseases in nature. It should be noted that the presence of one host in an ecosystem is epidemiologically significant, and could be responsible for the long-term persistence of an infection in a given ecosystem (BENGIS et al., 2002).

The single most important factor responsible for an outbreak of any disease is the occurrence of direct or indirect (vector) contact of the infected wild host or populations with susceptible domestic animals at the interface of their ranges (BENGIS et al., 2002). Thus, we may conclude that the opposite would also be true; i.e., infected domestic animals in direct or indirect contact with a wild host could trigger a disease outbreak. Because of the extensive management of cattle in the Pantanal wetlands, there is no existing barrier, natural or man-made, between wildlife and cattle. The taxonomic and physiological proximities between bovines and deer increase the risk of them sharing ticks and consequently tick-borne diseases.

Finally, the epidemiology of the tick and tick-borne diseases shared by cattle and wild animals in the Pantanal wetlands needs to be better investigated to clarify the role each has in the epidemiological network. The recent changes in cattle management

and deforestation to introduce *Brachiaria* sp. and European cattle need to be carefully evaluated before implementation of these management practices, in order to prevent economic losses for the cattle industry and damage to the wildlife in the Pantanal.

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