

Ticks parasitizing wild mammals in Atlantic Forest areas in the state of Rio de Janeiro, Brazil

Carrapatos parasitando mamíferos silvestres em áreas da Floresta Atlântica no estado do Rio de Janeiro, Brasil

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Abstract

Mammals captured in the Serra dos Órgãos National Park (PARNASO) and the Pedra Branca State Park (PBSP) between 2012 and 2015 were examined for the presence of ticks. In total, 140 mammals were examined, and 34 specimens were found to be parasitized by ticks. *Didelphis aurita*, *Akodon montensis* and *Oligoryzomys nigripes* were the species most parasitized. From these specimens, 146 ticks were collected, including 10 larvae. The ticks belonged to eight species: one in the genus *Ixodes* and seven in the genus *Amblyomma*. This study reports new associations of ticks and wild mammals in Brazil.

Keywords: PARNASO, *Amblyomma*, *Ixodes*, mammals, parasitism.

Resumo

Mamíferos capturados no Parque Nacional da Serra dos Órgãos (PARNASO) e no Parque Estadual Pedra Branca (PBSP) entre 2012 e 2015 foram examinados quanto à presença de carrapatos. No total, 140 mamíferos foram examinados, e 34 espécimes foram parasitados por carrapatos. *Didelphis aurita*, *Akodon montensis* e *Oligoryzomys nigripes* foram as espécies mais parasitadas. A partir desses espécimes, 146 carrapatos foram coletados, incluindo 10 larvas. Os carrapatos pertenciam a oito espécies: uma no gênero *Ixodes* e sete no gênero *Amblyomma*. Este estudo relata novas associações de carrapatos e mamíferos silvestres no Brasil.

Palavras-chave: PARNASO, *Amblyomma*, *Ixodes*, mamíferos, parasitismo.

Introduction

Ticks have wide distribution throughout the world, parasitizing a variety of wild and domestic animals and humans (LABRUNA et al., 2005; BARROS-BATTESTI et al., 2006; GUGLIELMONE et al., 2014). These ixodids have direct and indirect impacts on human and animal health by feeding and acting as vectors for pathogenic microorganisms (PAROLA, 2004; BORCHERS et al., 2015). The numbers of studies on the ecology and geographical distribution of ticks that parasitize wild mammals

and on transmission of pathogens have been increasing worldwide over the last few years, along with studies on the major zoonotic pathogens they transmit to humans (DE LA FUENTE et al., 2004; PADURARU et al., 2012).

Although there are numerous studies on ticks that are associated with wild mammals in Brazil (e.g. LABRUNA et al., 2005; SARAIVA et al., 2012; MARTINS et al., 2016), there are still gaps that need to be filled. In the state of Rio de Janeiro, there are few studies on this topic, and the records have mainly been on domestic animals (GAZÊTA et al., 2001; LUZ et al., 2014). In this context, the aim of the present study was to report on tick species parasitizing mammals in two areas of the Atlantic Forest

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in the state of Rio de Janeiro, thus contributing to improve our knowledge of the host-tick relationships.

Materials and Methods

This study was carried out in preserved areas of the Serra dos Órgãos National Park (PARNASO) (22°30'S 43°07'W, 22°29'S 43°07'W and 22°27'S 43°05'W), altitude 700-1200 meters, and in a sylvatic-urban interface area on the Atlantic Forest Campus of the Oswaldo Cruz Foundation (Campus Fiocruz da Mata Atlântica) (22°56'S 43°24'W and 22°55'S 43°26'W), altitude 30-100 meters, which is a buffer zone of the Pedra Branca State Park (PBSP). In PARNASO hosts were captured in November 2014 and in July 2015 whereas in PBSP they were captured between July 2012 and April 2015 with Sherman® and Tomahawk® traps for small mammals which were set along transects, at ground level. In addition, ticks of medium-sized and large mammals were also collected from road-killed animals, on the highway that crosses the PARNASO. Trapping effort was of 1200 per period in PBSP totalizing 9600 trap-nights. In PARNASO it was 1800 trap-nights per period totalizing 3600 trap-nights. In PARNASO, 80 pitfall traps were also used per night, totalizing 1600 pitfall-nights.

The animals caught in the traps were anesthetized and euthanized for parasite recovery and for other studies. Mammal species were identified morphologically (REIS et al., 2006; BONVICINO et al., 2008), except for rodent hosts, which were identified by external and cranial morphology, and by cytogenetic analysis (2N and FN) for *Oligoryzomys nigripes* (Olfers, 1818) and *Akodon montensis* (Thomas, 1913). Voucher specimens were deposited in the scientific collection of the National Museum of the Federal University of Rio de Janeiro (UFRJ) under access numbers: 83165; 83167; 83170; 83174; 83175 83768-83769; 83998; 83999; 84000-84014. All procedures followed the guidelines for animal capture, handling and care of the Ethics Committee for Animal Use of the Oswaldo Cruz Foundation (license numbers L-39/14 and LW81/12). These animals were captured under authorization from the Chico Mendes Institute for Biodiversity and Conservation (Instituto Chico Mendes de Conservação da Biodiversidade, ICMBio; license numbers 13373 and 45839-2) and by the Environmental Institute of the State of Rio de Janeiro (Instituto Estadual do Ambiente, INEA; license number 020/2011). Biosafety practices and protective equipment were used during all procedures involving animal handling and biological sampling.

The ticks were identified in the Acarology Laboratory of the Federal Rural University of Rio de Janeiro (UFRRJ). Larvae and engorged nymphs, when alive, were kept under 27°C and 80% humidity in BOD's in order to obtain the respective molts to nymphs and adults. Identification of ticks was based on the following dichotomous keys: Martins et al. (2010) for nymphs; Barros-Battesti et al. (2006) for adults of *Amblyomma*; and Onofrio et al. (2009) for adults of *Ixodes*. Tick prevalence and intensity of infestation were calculated as described by Bush et al. (1997). Voucher specimens were deposited in the tick collection "Coleção Nacional de Carrapatos Danilo Gonçalves Saraiva" (CNC) of the FMVZ-USP under the numbers 3655-3658. Nymphs of *A. aureolatum* and *A. ovale* were photographed for

morphological comparisons (Figure 1), these were photographed under a stereomicroscope (Zeiss Stemi SV 11, Zeiss, Munich, Germany).

Results

Overall, 140 mammals were examined. Five orders of mammals were found parasitized: Didelphimorphia (17 specimens), Rodentia (11 specimens), Pilosa (three specimens), Carnivora (two specimens) and Cingulata (one specimen) (Table 1). Three rodent species, three marsupials, two carnivores, one sloth, one anteater and one armadillo species were found parasitized by ticks in PARNASO (Table 1), while in PBSP only the common black-eared opossum (*Didelphis aurita* Wied-Neuwied, 1826) was found parasitized by ticks. The seven-banded armadillo (*Dasyus septemcinctus* Linnaeus, 1758) was the species most infested, with 43 ticks on one specimen, followed by *D. aurita*, the montane grass mouse *A. montensis* and the black-footed colilargo (*O. nigripes*) (Table 1).

A total of 146 ticks were collected, including 10 larvae. In PARNASO, eight species of ticks were observed, while only one was observed in PBSP (Table 1). *Ixodes loricatus* Neumann, 1899, parasitized several hosts and was found in both areas. The other tick species found belonged to the genus *Amblyomma*: *Amblyomma auricularium* (Conil, 1878), *Amblyomma ovale* (Koch, 1844), *Amblyomma longirostre* (Koch, 1844), *Amblyomma sculptum* (Nava et al., 2014), *Amblyomma aureolatum* (Pallas, 1772), *Amblyomma varium* Koch, 1844, and *Amblyomma nodosum* Neumann, 1899. Larvae of *Amblyomma* with non-identified morphotypes were collected on the rodents *A. montensis* (two larvae), *Delomys dorsalis* Hensel, 1873 (one larva), *O. nigripes* (five larvae) and *Oligoryzomys flavescens* (Waterhose, 1837) (two larvae).

Overall, 34/140 (24.3%) mammals were found to be parasitized by adult, nymph and larva of ticks and the average intensity of parasitism was 4.3 ticks per host. All tick species had prevalence greater than 10%, except for *A. aureolatum* on *D. aurita* in PARNASO which was recorded in only one out of 13 examined hosts (Table 1).

Discussion

All tick-host associations recorded here had previously been reported elsewhere in Brazil (BARROS-BATTESTI et al., 2006; SARAIVA et al., 2012; SZABÓ et al., 2013; GUGLIELMONE et al., 2014; OLIVEIRA et al., 2014; KRAWCZAK et al., 2016b; MARTINS et al., 2016; 2017), except for records of *A. longirostre* on *Trinomys dimidiatus* and *B. torquatus*. This tick species has wide distribution throughout the Neotropical region, and its adults have commonly been reported parasitizing rodent species, especially of the genus *Coendou* (BARROS-BATTESTI et al., 2006; NAVA et al., 2010; 2017). Immature stages prefer wild birds, especially Passeriformes (OGRZEWALSKA et al., 2009; LUZ & FACCINI, 2013; LUZ et al., 2017). Among the sloths, only *Bradypus tridactylus* had previously been reported parasitized by *A. longirostre* (NAVA et al., 2010). Thus, the present study provides a new record for *A. longirostre* in *B. torquatus*, which is regarded as an endangered species (BRASIL, 2003; IUCN, 2004).

The arboreal habits of this mammal probably enable parasitism by this tick species as has already been hypothesized by Labruna et al. (2007) for the association of *A. longirostre* and porcupine rodents.

The species *A. ovale*, which was recorded on two rodent species (*O. nigripes* and *A. montensis*) had previously been reported in association with a variety of species of small mammals in South America (SARAIVA et al., 2012; KRAWCZAK et al., 2016b; MARTINS et al., 2016; NAVA et al., 2017). Immature stages of *A. ovale* are commonly found in association with rodents of the families Cricetidae and Echimyidae (SARAIVA et al., 2012; SZABÓ et al., 2013; SPONCHIADO et al., 2015; MARTINS et al.,

2016; NAVA et al., 2017). Adults of this tick species mostly infest wild and domestic carnivores (GUGLIELMONE et al., 2003b, 2014; LABRUNA et al., 2005). They can also parasitize animals of the orders Artiodactyla, Didelphimorphia, Perissodactyla and Primates (GUGLIELMONE et al., 2014). Sporadically, *A. ovale* larvae have been found parasitizing wild birds (LUZ & FACCINI, 2013; LUZ et al., 2017). This is the second record of this tick species parasitizing *O. nigripes*, the first one has been recorded in São Paulo state (MARTINS et al. 2016). *A. ovale* is a possible vector for a new human rickettsiosis in Brazil, named Atlantic Rainforest Rickettsiosis (SZABÓ et al., 2013; BARBIERI et al.,

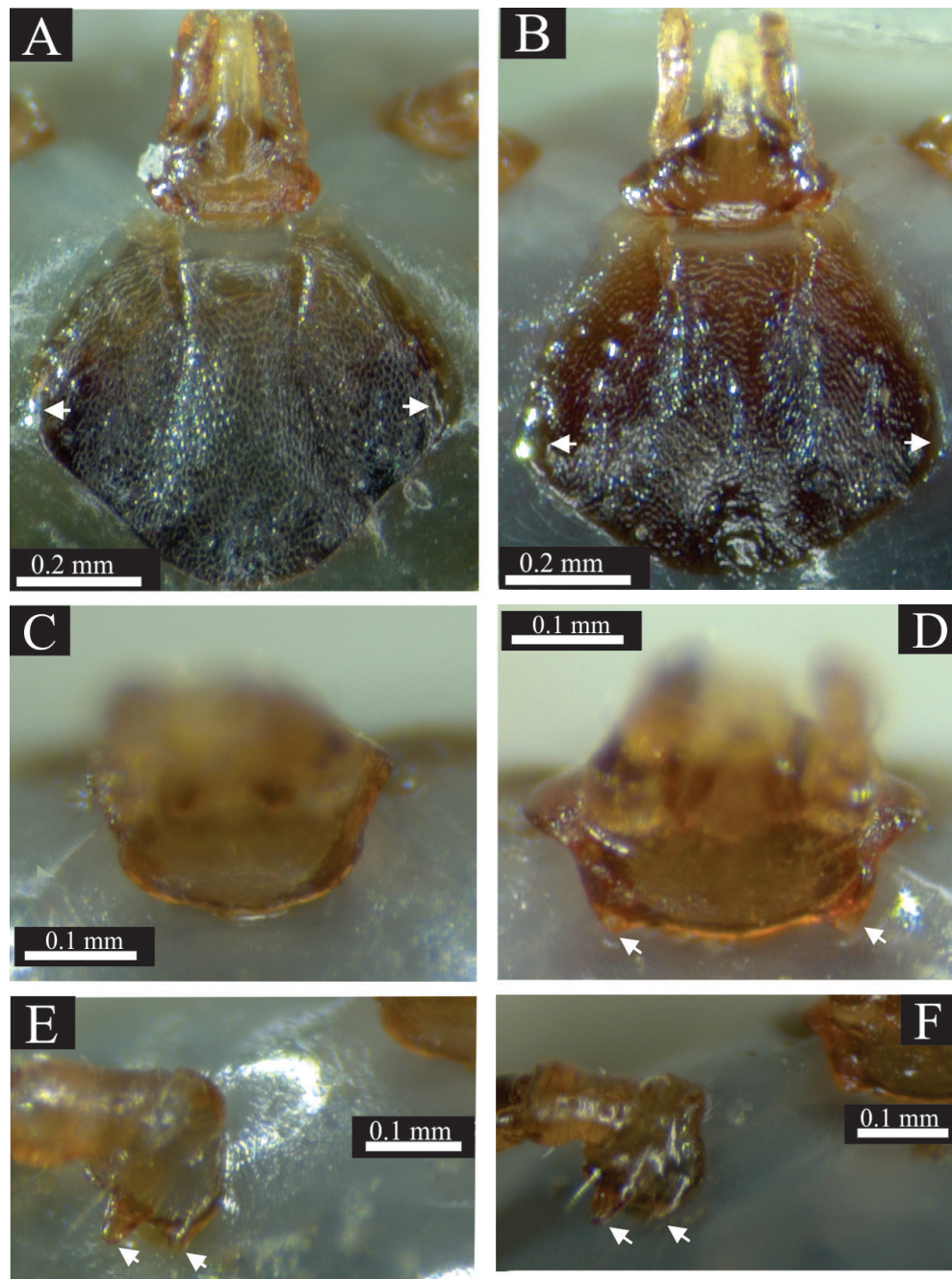


Figure 1. *Amblyomma aureolatum* (A, C and E) and *Amblyomma ovale* (B, D and F) infesting wild mammals in the Serra dos Órgãos National Park (PARNASO), Rio de Janeiro. A and B = arrows indicating eye location; C and D = arrows indicating presence of auriculae in the basis capitulum in *A. ovale* letter D; E and F = arrows indicating spurs of the coxa I.

2014; KRAWCZAK et al., 2016a). In the present study, all nymphs of *A. ovale* were recorded at altitudes 720 and 740m, reinforcing the findings of Barbieri et al. (2015), where this species was reported at altitudes ranging from <100 to 700 meters, with sporadic records above 700 meters (range 2 - 1,040 meters). Possibly this is a region (\cong 700 meters) altitude limit for the establishment of populations of *A. ovale* in the latitudes between 21° and 23°.

The tick *A. auricularium*, which was recorded exclusively on *D. septemcinctus*, has wide distribution in the Americas, and has been recorded on several vertebrates in the Neotropical region, preferentially on species of the family Dasyopodidae (GUGLIELMONE et al., 2003a; BARROS-BATTESTI et al., 2006; NAVA et al., 2017). Within this family, high parasitism on *Dasyopus* spp. can be seen, especially on *D. novemcinctus* (GUGLIELMONE et al., 2003a; NAVA et al., 2017).

The species *A. sculptum* and *A. aureolatum* were only recorded parasitizing didelphids. Both of these species were previously reported in association with these hosts in Brazil (SPONCHIADO et al., 2015; NAVA et al., 2017). *A. sculptum* and *A. aureolatum* have been proved to transmit *Rickettsia rickettsii* to humans in Brazil (PINTER & LABRUNA, 2006; LABRUNA et al., 2011). In this way, didelphids may have an important role in relation to Brazilian spotted fever, through maintaining and dispersing these ixodids in different regions (HORTA et al., 2009). Specimens of *A. aureolatum* were recorded at altitudes 780, 820 and 1200m, agreeing with reports by Barbieri et al. (2015) at high altitudes (> 700 meters) in the southeast region.

Our records of *I. loricatus* on *D. aurita* and on *P. frenatus* confirm the reports that adults of *I. loricatus* mostly parasitize didelphids in the Neotropical region (BARROS-BATTESTI et al., 2000, 2006; DANTAS-TORRES et al., 2012; OLIVEIRA et al., 2014). In the state of Rio de Janeiro, this species had previously been reported in association with *Didelphis aurita* in PBSP (BITTENCOURT & ROCHA, 2003; OLIVEIRA et al., 2014).

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