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SHORT COMMUNICATION

Ticks parasitizing free-ranging armadillos in the Caatinga biome, Brazil

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Abstract This study reports the occurrence of ticks on free-ranging armadillos in the Serra das Almas Natural Reserve located in the interior of the state of Piauí, northeastern Brazil. Collected ticks were morphologically identified by using standard taxonomic keys and stereomicroscope. We provide the first records of *Amblyomma sculptum* on *Tolypeutes tricinctus*, in addition to *A. auricularium* adults on *Dasypus septemcinctus* in the Brazilian exclusive biome, the Caatinga.

***Keywords*:** Acari, Cingulata, Chlamyphoridae, Dasypodidae, Ixodidae

Carrapatos parasitando tatus de vida livre no bioma Caatinga, Brasil

Resumo O presente estudo teve como objetivo relatar a ocorrência de carrapatos em tatus de vida livre na Reserva Natural Serra das Almas, localizada no interior do estado do Piauí, Nordeste do Brasil. Os carrapatos coletados foram identificados morfologicamente utilizando-se chaves taxonômicas e estereomicroscópio. Fornecemos os primeiros registros do carrapato *Amblyomma sculptum* em *Tolypeutes tricinctus*, além de adultos de *A. auricularium* em *Dasypus septemcinctus* no bioma exclusivo brasileiro, a Caatinga.

***Palavras-chave*:** Acari, Cingulata, Chlamyphoridae, Dasypodidae, Ixodidae

Ticks are known worldwide for parasitizing a wide range of hosts, including domestic and wild mammals. These ectoparasites are important for veterinary medicine and public health, since they are related to the transmission of several pathogens both to animals and to humans (Nava *et al.*, 2017). Ticks of the genus *Amblyomma* are of great medical and veterinary importance in Brazil. Nevertheless, there are few studies on ticks in the Caatinga biome in Brazilian territory (Barros-Battesti *et al.*, 2006; Horta *et al.*, 2011). The tick genus *Amblyomma* includes the most abundant species in Brazil, with 33 species already registered in the country (Martins *et al.*, 2010, 2016, 2019; Krawczak *et al.*, 2015). Within the limits of the national territory there is a wide diversity of armadillos distributed in the families Chlamyphoridae (*Priodontes maximus*, *Euphractus sexcinctus*, *Cabassous tatouay*, *C. unicinctus*, *Tolypeutes matacus*, *T. tricinctus*) and Dasypodidae (*Dasypus septemcinctus*, *D. novemcinctus*, *D. kappleri*, and *D. hybridus*) (ICMBio, 2015). The Caatinga is the only exclusively Brazilian biome, with an area of approximately 82 million hectares, occupying 11% of the national territory. It is the main ecosystem of the northeast region of the country, being very important from the biological point of view. It has a vast biodiversity with endemic flora and fauna species, many of which are threatened with extinction (Cortez *et al.*, 2007).

Table 1. Ticks collected from free-living armadillos in the Serra das Almas Natural Reserve, Buriti dos Montes municipality, Piauí state, Brazil.

Armadillo species	Sex	Capture date	Ticks species: number per stage*
Tolypeutes tricinctus	♀	2 September 2013	*Amblyomma sculptum*: 1 ♀
T. tricinctus	♀	8 April 2016	*A. sculptum*: 6 ♂
T. tricinctus	♀	10 April 2016	*A. sculptum*: 2 ♂
T. tricinctus	♂	4 August 2016	*Amblyomma auricularium*: 5 ♂, 1 N
T. tricinctus	♀	7 August 2016	*A. auricularium*: 5 ♂
T. tricinctus	♂	8 August 2016	*A. auricularium*: 4 ♂
T. tricinctus	♀	8 August 2016	*A. auricularium*: 7 ♂
T. tricinctus	♂	8 August 2016	*A. auricularium*: 3 ♂, 2 N
Dasypus septemcinctus	♂	5 August 2016	*A. auricularium*: 4 ♀

*Tick stages shown as adult male (♂), adult female (♀) and nymph (N)

The Brazilian three-banded armadillo (*T. tricinctus*), locally known as "tatu-bola", is the smallest and least known armadillo species in Brazil. It occurs exclusively in the country, predominantly in the Caatinga and in some areas of the Brazilian Cerrado (Guimarães, 1997; Feijó *et al.*, 2015). The species suffers a high degree of threat from hunting and destruction of its habitat. It has been included in the Official List of Brazilian Fauna Threatened with Extinction in the category "Vulnerable", and recently its risk of extinction has been raised to "Endangered" (ICMBio, 2014; 2015). The seven-banded armadillo (*D. septemcinctus*) is distributed from the southeastern portion of the Amazon basin to the extreme north of Argentina, bounded to the west by Mato Grosso and Chaco in Paraguay, and encompassing central and southern Brazil (Faria-Corrêa *et al.*, 2015). It is a common species, relatively tolerant to environmental changes, with a broad distribution and therefore categorized as Least Concern (LC) by the Official List of Brazilian Fauna Threatened by Extinction (ICMBio, 2015).

Due to the importance of the tick systematics for the provision of information for the management of captive and free-ranging populations, especially for those threatened with extinction, the present study aimed to report tick species parasitizing free-ranging armadillos in the Caatinga biome. For this purpose, this study was carried out in the Serra das Almas Natural Reserve (5°15'–5°00'S, 40°15'–41°00'W), located in Buriti dos Montes municipality, in a highly preserved area of the Caatinga biome in the state of Piauí, Brazil.

Captures of armadillos consisted of active search, their capture by hand, and physical-chemical restraint. A combination of anesthetic drugs (8 mg/kg ketamine hydrochloride; Dopalen, Ceva, São Paulo, Brazil; and 1 mg/kg midazolam hydrochloride; Dormire, Cristália, São Paulo, Brazil) was used for sedation. This dosage allowed safe handling of the animals for 30–45 minutes. Emergency equipment and drugs capable of improving cardio-respiratory capacity were available at pre-calculated doses. Changes in doses of anesthetics and other drugs were performed as needed to meet all emergency situations. During the anesthetic procedure, heart rhythm and rate, respiratory rate, and oxygen saturation were monitored, the latter using a pulse oximetry device (Nellcon®, Medtronic, United Kingdom). Other procedures were performed during immobilization, such as transponder application, sexing, and collection of morphometric data. Clinical evaluations and collection of blood, fecal samples, swabs, ectoparasites, and skin biopsies were also performed for different studies.

During the clinical examinations, all armadillos (8 *T. tricinctus* and 1 *D. septemcinctus*) were found to be infested by ticks, which were collected and shipped in 70% ethyl alcohol to the Laboratory of Parasitic Diseases of the Department of Veterinary Preventive Medicine and Animal Health of the Faculty of Veterinary Medicine and Animal Science of the University of São Paulo (FMVZ–USP). The ticks were identified using a stereomicroscope (ZEISS, Stemi, DV4, Germany), taxonomic keys, and corresponding literature (Barros-Battesti *et al.*, 2006; Martins *et al.*, 2010, 2016). All ticks were deposited at the tick collection "Coleção Nacional de Carrapatos Danilo Gonçalves Saraiva" of the FMVZ–USP, under the accession numbers CNC 3386–3387. In

eight *T. tricinctus*, eight males and one female of *Amblyomma sculptum* were identified, as well as 24 males and three nymphs of *Amblyomma auricularium*. In a *D. septemcinctus*, four females of *A. auricularium* were collected. All associations between ticks and armadillos are shown in **Table 1**.

Amblyomma sculptum was already registered in Brazil on armadillos by Witter *et al.* (2016), who found adult ticks on *E. sexcinctus* and nymphs on *C. unicinctus*. On the other hand, Miranda *et al.* (2010) and Martins *et al.* (2011) reported *A. sculptum* adults (published as *Amblyomma cajennense*), and Kluyber *et al.* (2016) adults and nymphs of *A. sculptum*, on *P. maximus*. Kluyber *et al.* (2016) also recorded *A. sculptum* adults on *C. unicinctus*, and adults and nymphs on *E. sexcinctus* and *D. novemcinctus*. Botelho *et al.* (1989) and Campos Pereira *et al.* (2000) recorded adults of *A. sculptum* on *D. novemcinctus*, and Medri *et al.* (2010) adults of the same species on *E. sexcinctus* (all published as *A. cajennense*). Martins *et al.* (2017) also collected adults of this same tick species from *D. novemcinctus*. Thus, the present work reports for the first time the parasitism of *A. sculptum* on *T. tricinctus*.

In a compilation of previous records of *A. auricularium* on armadillos, Nava *et al.* (2017) reported this tick in 11 species of armadillos, of which only six occur in Brazil. Tick records refer to *A. auricularium* adults on *E. sexcinctus*, *T. tricinctus*, *D. kappleri*, and *D. hybridus*, as well as adults, nymphs, and larvae on *T. matacus* and *D. novemcinctus*. In the Caatinga biome, Horta *et al.* (2011) reported adults of *A. auricularium* on *E. sexcinctus*, Fonseca *et al.* (2013) described adults and nymphs on *D. novemcinctus*, and Maia *et al.* (2018) found adults and a nymph on *T. tricinctus*. Thus, the present study records for the first time adults of *A. auricularium* on *D. septemcinctus* in the Brazilian Caatinga.

Regarding the medical and veterinary relevance of the two tick species found in this study, *A. sculptum* is an important vector of *Rickettsia rickettsii*, a bacterium that causes a severe human disease known as Brazilian spotted fever in southeastern Brazil (Krawczak *et al.*, 2014; Martins *et al.*, 2016). While this disease is also known to affect domestic dogs (Labruna *et al.*, 2009) and capybaras (*Hydrochoerus hydrochaeris*) (Ramírez-Hernández *et al.*, 2020), nothing is known about the pathogenicity of *R. rickettsii* to any armadillo species or if these animals could act as amplifying hosts of the bacterium to tick vectors. On the other hand, there are some records of *A. auricularium* infected by *Rickettsia amblyommatis* in the Caatinga biome (Saraiva *et al.*, 2013; Lugarini *et al.*, 2015). This *Rickettsia* species is currently considered of unknown pathogenicity (Karpathy *et al.*, 2016). To date, there has been no indication of harmful effects of ticks on armadillos, nor has there been a record of pathogens transmitted by ticks on armadillos. This scenario is probably linked to the absence of studies in this field.

Amblyomma auricularium was the most prevalent and abundant tick species in the present study. In fact, this tick species is very common in the Caatinga biome, where armadillos are well known as their natural hosts (Saraiva *et al.*, 2013; Nava *et al.*, 2017). Hence, the conservation of armadillos in the Serra das Almas Natural Reserve will result in the conservation of their natural ticks, such as *A. auricularium*. On the other hand, infestations of armadillos by *A. sculptum* should be considered unusual, since larger mammal species are considered more important for sustaining populations of *A. sculptum* in Brazil (Martins *et al.*, 2016).

Finally, we found no clinical alterations of the tick-infested armadillos, a condition possibly related to the low tick load (< 10 ticks per armadillo), which is expected to be found in highly preserved areas such as the Serra das Almas Natural Reserve.

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