

Ticks on free-living wild mammals in Emas National Park, Goiás State, central Brazil

THIAGO F. MARTINS¹, MARIANA M. FURTADO^{1,2}, ANAH T. DE A. JÁCOMO², LEANDRO SILVEIRA², RAHEL SOLLMANN^{2,3}, NATÁLIA M. TÔRRES^{2,4} & MARCELO B. LABRUNA¹

¹Departamento de Medicina Veterinária Preventiva e Saúde Animal, Faculdade de Medicina Veterinária e Zootecnia, Universidade de São Paulo, Av. Prof. Orlando Marques de Paiva, 87, CEP 05508-000, Cidade Universitária, São Paulo, SP, Brazil.

²Instituto Onça-Pintada, Caixa Postal 193, CEP: 75830-000, Mineiros, GO, Brazil.

³Leibniz Institute for Zoo and Wildlife Research, Alfred-Kowalke-Str. 17, 10315, Berlin, Germany.

⁴Laboratório de Ecologia Teórica e Síntese, Instituto de Ciências Biológicas, Universidade Federal de Goiás, Caixa Postal 131, Campus 2, CEP: 74001-970, Goiânia, GO, Brazil.

E-mail: thiagodogo@hotmail.com

Abstract

This paper reports the occurrence of ticks on different species of free-ranging wild mammals in Emas National Park, Goiás State, Brazil. Between November 1999 and July 2008, ticks were collected from free-ranging wild mammals during 330 capture events. The tick species *Amblyomma cajennense* (Fabricius, 1787), *Amblyomma coelebs* Neumann, 1899, *Amblyomma naponense* (Packard, 1869), *Amblyomma ovale* Koch, 1844, *Amblyomma parvum* Aragão, 1908, *Amblyomma tigrinum* Koch, 1844, *Amblyomma triste* Koch, 1844, and *Rhipicephalus microplus* (Canestrini, 1888) were identified on hosts of the order Carnivora. Among other host orders (Xenarthra, Artiodactyla, Perissodactyla, Rodentia, Didelphimorphia, Primates), specimens of *A. cajennense*, *A. coelebs*, *A. ovale*, *A. triste*, *Amblyomma pseudoconcolor* Aragão, 1908, *A. naponense* and *Amblyomma nodosum* Neumann, 1899 were identified. Although most of the tick-host associations found in this study have been previously reported, this is the first report of adults of *A. tigrinum* parasitizing a pampas cat, *Leopardus colocolo* (Molina, 1782), nymphs of *Amblyomma parvum* and *Amblyomma ovale* on *Cerdocyon thous* (Linnaeus, 1766), nymphs of *Amblyomma naponense* on *C. thous* and *Tayassu tajacu* (Linnaeus, 1758), nymphs of *Amblyomma triste* on *C. thous* and *L. colocolo*, nymphs of *Amblyomma coelebs* on *Puma yagouaroundi* (Geoffroy, 1803) and *Dasyprocta azarae* Lichtenstein, 1823, and nymphs of *Amblyomma cajennense* on *L. colocolo*, *Conepatus semistriatus* (Boddaert, 1785), *Galictis cuja* (Molina, 1782) and *Nasua nasua* (Linnaeus, 1766). This study is therefore a significant contribution to our knowledge of the ectoparasites associated with free-ranging Brazilian wild mammals.

Key words: Ixodidae, *Amblyomma*, *Rhipicephalus*, wild mammals, Cerrado, Emas National Park, Brazil

Introduction

Ticks are cosmopolitan ectoparasitic arthropods belonging to the class Arachnida that parasitize all classes of terrestrial vertebrates: amphibians, reptiles, birds and mammals (Nava *et al.* 2009). Because of this, ticks are the most important vectors of infectious diseases of animals and are second only to mosquitoes as vectors of human diseases, transmitting viruses, bacteria, protozoa and helminths (Nava *et al.* 2009). Tick species that parasitize domestic animals have been well studied, while those parasitizing wildlife are still poorly known, especially with regard to their taxonomy, biology, ecology, geographical distribution, natural hosts, and capacity to transmit biological agents (Barros-Battesti *et al.* 2006).

The Emas National Park (ENP) covers 131,800 hectares in the southwestern part of the state of Goiás. Due to its size, integrity of natural habitats, faunal richness and the presence of rare and

endangered species, it is an important Cerrado reserve. The Cerrado, the second largest biome in Brazil, is considered a biodiversity hotspot, with approximately 80% of its area degraded by humans (Myers *et al.* 2000, Cavalcanti & Joly 2002). ENP is located in one of the most productive agricultural areas of Brazil. The park's surroundings are dominated by extensive crop plantations and, to a lesser extent, livestock ranches. The park is one of the last refuges for the native fauna, but its boundaries do not present barriers to animals, which can move freely between the park and the adjacent farms (Jácomo *et al.* 2009).

Considering the gaps in our knowledge of the tick fauna parasitizing mammals in their natural habitats, the objective of this paper is to report the occurrence of different tick species on free-ranging wild mammals in ENP.

Materials and methods

Ticks were collected from free-ranging wild mammals during 330 capture events between November 1999 and July 2008 in Emas National Park. The animals were captured as part of an ecological and epidemiological monitoring program for local carnivores and their prey.

Samples were collected during captures of 135 maned wolves *Chrysocyon brachyurus* (Illiger, 1815), 60 crab-eating-foxes *Cerdocyon thous* (Linnaeus, 1766), four hoary foxes *Lycalopex vetulus* (Lund, 1842), one bush dog *Speothos venaticus* (Lund, 1842), 10 pampas cats *Leopardus colocolo* (Molina, 1782), three ocelots *Leopardus pardalis* (Linnaeus, 1758), one jaguarundi *Puma yagouaroundi* (Geoffroy, 1803), two skunks *Conepatus semistriatus* (Boddaert, 1785), one grison *Galictis cuja* (Molina, 1782), one coati *Nasua nasua* (Linnaeus, 1766), six giant armadillos *Priodontes maximus* (Kerr, 1792), six hairy armadillos *Euphractus sexcinctus* (Linnaeus, 1758), one southern naked-tailed armadillo *Cabassous unicinctus* (Linnaeus, 1758), three giant anteaters *Myrmecophaga tridactyla* Linnaeus, 1758, 18 collared peccaries *Tayassu tajacu* (Linnaeus, 1758), 63 white-lipped peccaries *Tayassu pecari* (Link, 1795), 15 tapirs *Tapirus terrestris* (Linnaeus, 1758), one agouti *Dasyprocta azarae* Lichtenstein, 1823, one white-eared opossum *Didelphis albiventris* Lund, 1840, and one brown capuchin monkey *Cebus apella* (Linnaeus, 1758). Sampled animals belonged to different ages and sexes.

Ticks attached to the animals were detected by inspection of the skin and carefully removed by hand. The specimens were stored in 70% alcohol pending identification using a stereomicroscope and taxonomic literature for genera (Onofrio *et al.* 2006b), adult ticks (Guimarães *et al.* 2001, Onofrio *et al.* 2006a), and nymphs of *Amblyomma* (Martins *et al.* 2010). *Amblyomma* larvae could not be identified to the species level because there is insufficient literature available. The collected ticks were deposited in the tick collection Coleção Nacional de Carrapatos (CNC) of the Faculty of Veterinary Medicine, University of São Paulo, São Paulo, SP.

Results and discussion

A total of 4,181 adults and 882 nymphs of 10 tick species were identified. Tick identifications by host species are presented in Tables 1, 2 and 3. Among the tick-host associations found, we present the first report of a female of *Amblyomma tigrinum* Koch, 1844 parasitizing *L. colocolo* and a female of *Amblyomma triste* Koch, 1844 on *C. thous*. *Amblyomma tigrinum* is an especially common parasite of canids, as can be seen in the present results (Table 1). In an earlier study, *Amblyomma maculatum* Koch, 1844 was reported on *C. thous* (published as *Canis azarae*) in Uruguay (Vogelsang 1928), but later studies demonstrated that the species *A. maculatum* does not exist in

TABLE 1. Ticks collected from free-living wild carnivores in Emas National Park, Goiás State, Brazil, from November 1999 to July 2008.

Tick species and stages	No. tick specimens according to host species (number of individual hosts sampled in parentheses)									
	Carnivora									
	Canidae		Felidae		Mephitidae		Mustelidae		Procyonidae	
<i>Chrysocyon brachyurus</i> (135)	<i>Cerdocyon thous</i> (60)	<i>Lycalopex vetulus</i> (4)	<i>Speothos venaticus</i> (1)	<i>Leopardus colocolo</i> (10)	<i>Leopardus pardalis</i> (3)	<i>Puma yagouaroundi</i> (1)	<i>Conepatus semistriatus</i> (2)	<i>Galeotis cuja</i> (1)	<i>Nasua nasua</i> (1)	
<i>Amblyomma cajennense</i>	345	281	4	30	9	11			2	1
Nymph	1									
Male	2									
<i>Amblyomma coelebs</i>						2				
Nymph										
<i>Amblyomma naponense</i>										
Nymph		1								
<i>Amblyomma ovale</i>										
Nymph		1								
Male		1								
Female						1				
<i>Amblyomma parvum</i>										
Nymph		3								
Male		1								
Female		1								
<i>Amblyomma tigrinum</i>										
Male	2410	23	6							
Female	1164	24	10		1					
<i>Amblyomma triste</i>										
Nymph		1			1					
Female		1								
<i>Amblyomma</i> sp.										
Larva	126	143	1		12	2			7	
<i>Rhipicephalus microplus</i>										
Nymph		1								
Male		1								
Female		4								

Uruguay, and that all previous reports should be considered as *A. triste* or *A. tigrinum* (Kohls *et al.* 1956). However, it was not possible to determine whether the early record from *C. thous* (Vogelsang 1928) was *A. triste* or *A. tigrinum*.

Among the associations of *Amblyomma* nymphs and hosts found, we present the first nymphal records of *Amblyomma parvum* Aragão, 1908 and *Amblyomma ovale* Koch, 1844 on *C. thous*, *Amblyomma naponense* (Packard, 1869) on *C. thous* and *T. tajacu*, *A. triste* on *C. thous* and *L. colocolo*, *Amblyomma coelebs* Neumann, 1899 on *P. yagouaroundi* and *D. azarae*, and *Amblyomma cajennense* (Fabricius, 1787) on *L. colocolo*, *C. semistriatus*, *G. cuja* and *N. nasua*.

Other tick-host associations (Tables 1, 2 and 3) have been previously reported from different parts of the Neotropical Region, including Brazil, and, specifically, Emas National Park (Aragão 1913, 1936, 1938; Kohls 1956; Jones *et al.* 1972; Botelho *et al.* 1989; Ito *et al.* 1998; Labruna *et al.* 2002, 2005a, b). We found a large number of *C. brachyurus* parasitized by adults of *A. tigrinum*, indicating a strong host-parasite association between these two species, which is in agreement with previous reports from the Brazilian Pantanal and Cerrado (Labruna *et al.* 2005b). However, the geographical distribution of *A. tigrinum* stretches beyond these two biomes, from Patagonia to Venezuela, where the adult stage has been reported mainly from domestic dogs (Jones *et al.* 1972, Estrada-Pena *et al.* 2005).

TABLE 2. Ticks collected from free-living xenarthrans in Emas National Park, Goiás State, Brazil, from November 1999 to July 2008.

Tick species and stages	No. tick specimens according to host species (number of individual hosts sampled in parentheses)			
	Xenarthra			Myrmecophagidae <i>Myrmecophaga tridactyla</i> (3)
	<i>Priodontes maximus</i> (6)	Dasypodidae <i>Euphractus sexcinctus</i> (6)	<i>Cabassous unicinctus</i> (1)	
<i>Amblyomma cajennense</i>				
Male	2			
Female	1			2
<i>Amblyomma nodosum</i>				
Male				1
<i>Amblyomma pseudoconcolor</i>				
Male	5	19		
Female	3	8	1	1

The wild mammals sampled during this study carried a diverse tick fauna. These findings are important for understanding the role of wildlife in the maintenance of tick infestations, monitoring the health of wild animal populations, and augmenting our knowledge of the ecology of tick-borne diseases in the Cerrado biome.

Acknowledgements

The authors thank Alberto A. Guglielmone (INTA, Rafaela, Argentina) for providing data from his extensive files on Neotropical ticks, the Chico Mendes Institute of Biology (Instituto Chico Mendes de Biología/ICMBio), the Brazilian Institute of Environment and Renewable Natural Resources (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis/IBAMA) for assistance in obtaining the permits required for this project, and the ICMBio of Emas National Park for logistical support. We also thank all interns and volunteers that contributed to data collection. This study received financial support from FAPESP (Fundação de Amparo à Pesquisa do Estado de São Paulo) and CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for tick identification and the Earthwatch Institute, the Memphis Zoo, Conservation International Brazil and the National Environmental Fund (Fundo Nacional do Meio Ambiente) for field work.

TABLE 3. Ticks collected from free-living wild ungulates, rodents, marsupials and primates in Emas National Park, Goiás State, Brazil, from November 1999 to July 2008.

Tick species and stages	No. tick specimens according to host species (number of individual hosts sampled in parentheses)							
	Artiodactyla		Perissodactyla		Rodentia		Didelphimorphia	
	Tayassuidae		Tapiridae		Dasyproctidae		Didelphidae	
	<i>Tayassu tajacu</i> (18)	<i>Tayassu pecari</i> (63)	<i>Tapirus terrestris</i> (15)		<i>Dasyprocta azarae</i> (1)		<i>Didelphis albiventris</i> (1)	<i>Cebus apella</i> (1)
<i>Amblyomma cajennense</i>	4	87			1			1
Nymph								
Male	2	200						
Female	7	185						
<i>Amblyomma coelebs</i>								
Nymph								
<i>Amblyomma naponense</i>								
Nymph	1							8
Male								
Female								
<i>Amblyomma ovale</i>								
Female								1
<i>Amblyomma triste</i>								
Male								1
Female								6
<i>Amblyomma</i> sp.								
Larva	14	13						

References

- Aragão, H.B. (1913) Nota sobre algumas coleções de carrapatos brasileiros. *Memórias do Instituto Oswaldo Cruz*, 5, 263–270.
- Aragão, H.B. (1936) Ixodidas brasileiros e de alguns países limitrofes. *Memórias do Instituto Oswaldo Cruz*, 31, 759–843.
- Aragão, H.B. (1938) Nota sobre os ixodídeos da República Argentina. *Memórias do Instituto Oswaldo Cruz*, 33, 319–327.
- Barros-Battesti, D.M., Arzua, M. & Bechara, G.H. (2006) *Carrapatos de importância médico-veterinária da Região Neotropical: um guia ilustrado para identificação de espécies*. São Paulo, Vox/ICTTD-3/Butantan. 223 pp.
- Botelho, J.R., Linardi, P.M. & Encarnação, C.D. (1989) Interrelações entre Acari Ixodidae e hospedeiros Edentata da Serra da Canastra, Minas Gerais, Brasil. *Memórias do Instituto Oswaldo Cruz*, 84, 61–64.
- Cavalcanti, R.B. & Joly, C.A. (2002) Biodiversity and Conservation Priorities in the Cerrado Region. In: Oliveira, P.S. & Marquis, R.J. (eds.) *The Cerrados of Brazil. Ecology and Natural History of a Neotropical Savanna*. New York, Columbia University Press. pp. 351–367.
- Estrada-Peña, A., Venzal, J.M., Mangold, A.J., Cafrune, M.M. & Guglielme, A.A. (2005) The *Amblyomma maculatum* Koch, 1844 (Acari: Ixodidae: Amblyomminae) tick group: diagnostic characters, description of the larva of *A. parvitarsum* Neumann, 1901, 16S rDNA sequences, distribution and hosts. *Systematic Parasitology*, 60, 99–112.
- Guimarães, J.H., Tucci, E.C. & Barros-Battesti, D.M. (2001) *Ectoparasitos de importância veterinária*. Editora Plêiade, São Paulo, Brazil, 213 pp.
- Ito, F.H., Vasconcelos, S.A., Bernardi, F., Nascimento, A.A., Labruna, M.B. & Arantes, I.G. (1998) Evidência sorológica de brucelose e leptospirose e parasitismo por Ixodídeos em animais silvestres do Pantanal Sul-Mato-Grossense. *ARS Veterinária*, 14, 302–310.
- Jácomo, A.T.A., Kashivakura, C.K., Ferro, C., Furtado, M.M., Asteste, S., Tôrres, N.M., Sollmann, R. & Silveira, L. (2009) Home range and spatial organization of maned wolves in the Brazilian grasslands. *Journal of Mammalogy*, 90, 150–157.
- Jones, E.K., Clifford, C.M., Keirans, J.E. & Kohls, G.M. (1972) The ticks of Venezuela (Acarina: Ixodoidea) with a key to the species of *Amblyomma* in the Western Hemisphere. *Brigham Young University Science Bulletin, Biological Series*, 17, 1–40.
- Kohls, C.M. (1956) Concerning the identity of *Amblyomma maculatum*, *Amblyomma tigrinum*, *Amblyomma triste* and *A. ovatum* of Koch, 1844. *Proceedings of the Entomological Society of Washington*, 58, 143–147.
- Labruna, M.B., Paula, C.D., Lima, T.F. & Sana, D.A. (2002) Ticks (Acari: Ixodidae) on wild animals from the Porto-Primavera hydroelectric power station area, Brazil. *Memórias do Instituto Oswaldo Cruz*, 97, 1133–1136.
- Labruna, M.B., Camargo, L.M.A., Terrassini, F.A., Ferreira, F., Schumaker, T.T. & Camargo, E.P. (2005a) Ticks (Acari: Ixodidae) from the state of Rondônia, western Amazon, Brazil. *Systematic & Applied Acarology*, 10, 17–32.
- Labruna, M.B., Jorge, R.S.P., Sana, D.A., Jácomo, A.T.A., Kashivakura, C.K., Furtado, M.M., Ferro, C., Perez, S.A., Silveira, L., Santos, T.S.Jr., Marques, S.R., Morato, R.G., Nava, A., Adania, C.H., Teixeira, R.H.F., Gomes, A.A.B., Conforti, V.A., Azevedo, F.C.C., Prada, C.S., Silva, J.C.R., Batista, A.F., Marvulo, M.F.V., Morato, R.L.G., Alho, C.J.R., Pinter, A., Ferreira, P.M., Ferreira, F. & Barros-Battesti, D.M. (2005b) Ticks (Acari: Ixodida) on wild carnivores in Brazil. *Experimental and Applied Acarology*, 36, 149–163.
- Martins, T.F., Onofrio, V.C., Barros-Battesti, D.M. & Labruna, M.B. (2010) Nymphs of the genus *Amblyomma* (Acari: Ixodidae) of Brazil: descriptions, redescrptions, and identification key. *Ticks and Tick-borne Diseases*, 1, 75–99.
- Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature*, 403, 853–858.
- Nava, S., Guglielme, A.A. & Mangold, A.J. (2009) An overview of systematics and evolution of ticks. *Frontiers in Bioscience*, 14, 2857–2877.
- Onofrio, V.C., Labruna, M.B., Pinter, A., Giacomini, F.G. & Barros-Battesti, D.M. (2006a) Comentários e chaves para as espécies do gênero *Amblyomma*. In: Barros-Battesti, D.M., Arzua, M. & Bechara, G.H. (eds.) *Carrapatos de importância médico-veterinária da Região Neotropical: um guia ilustrado para identificação de espécies*. São Paulo, Vox/ICTTD-3/Butantan. pp. 53–113.
- Onofrio, V.C., Venzal, J.M., Pinter, A. & Szabó, M.P.J. (2006b) Família Ixodidae: características gerais, comentários e chave para gêneros. In: Barros-Battesti, D.M., Arzua, M. & Bechara, G.H. (eds.) *Carrapatos de importância médico-veterinária da Região Neotropical: um guia ilustrado para identificação de espécies*. São Paulo, Vox/ICTTD-3/Butantan. pp. 29–39.
- Vogelsang, E.G. (1928) Garrapatas (Ixodidae) del Uruguay. *Boletín del Instituto Clínico y Quirúrgico*, 4, 668–670.

Accepted by R. G. Robbins: 2 Sept. 2011; published 14 Oct. 2011