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Ticks infesting birds in Atlantic Forest fragments in Rio Claro, State of Sao Paulo, Brazil

Carrapatos infestando aves em fragmentos de Mata Atlântica em Rio Claro, São Paulo, Brasil

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Abstract

In the present study, we report tick infestations on wild birds in plots of the Atlantic Forest reforested fragments with native species and plots reforested with *Eucalyptus tereticornis* in the municipality of Rio Claro, State of Sao Paulo, Brazil. A total of 256 birds were captured: 137 individuals of 33 species, in planted native forest; and 128 individuals of 37 species, in planted *Eucalyptus tereticornis* forest. Nymphs of two tick species were found on the birds: *Amblyomma calcaratum* and *Amblyomma longirostre*, the former was more abundant in the fragments reforested with Atlantic forest native species, and the latter in the fragment reforested with *E. tereticornis*. New host records were presented for *A. calcaratum*.

Keywords: Wild birds, *Amblyomma*, reforested fragments.

Resumo

O presente estudo apresenta infestações de carrapatos em aves silvestres em fragmentos de reflorestamento com espécies nativas e fragmentos de reflorestamento com *Eucalyptus tereticornis* no município de Rio Claro, São Paulo. No total foram capturadas 265 aves, sendo 137 indivíduos de 33 espécies nas áreas de reflorestamento com espécies nativas e 128 indivíduos de 37 espécies nas áreas reflorestadas com *Eucalyptus tereticornis.* Ninfas de duas espécies de carrapatos foram registradas: *Amblyomma calcaratum* e *Amblyomma longirostre*, sendo a primeira mais abundante na área nativa e a segunda na área de *Eucalyptus tereticornis*. Novos registros de hospedeiros para *A. calcaratum* são apresentados.

Palavras-chave: Aves silvestres, *Amblyomma*, fragmentos reflorestados.

Introduction

Ticks are obligate hematophagous ectoparasites commonly found all around the world parasitizing an enormous variety of hosts, from amphibians and reptiles to birds and mammals (ONOFRIO et al., 2006). They can transmit many pathogens to animals and humans during blood feeding (JONGEJAN; UILENBERG, 2004).

Wild birds can act as long-distance vectors for several microbial agents of human disease, including viruses, chlamydiae, enterobacteria, and spirochetes (BJÖERSDORFF et al., 2001; GEORGOPOULOU; TSIOURIS, 2008). They are also incidentally found infected by rickettsiae (SANTOS-SILVA et al., 2006; ELFVING et al. 2010; HILDEBRANDT et al., 2010), *Babesia* spp. and *Anaplasma* spp. (HILDEBRANDT et al., 2010).

The Brazilian bird fauna is one of the largest in the world, comprising around 1,832 species (CBRO, 2011). Recently, some studies have contributed to improve the data concerning ticks infesting Brazilian birds in the Amazon region (OGRZEWALSKA et al., 2010), and Atlantic Forest (OGRZEWALSKA et al., 2008, 2011; LABRUNA et al., 2007) and Cerrado (TOLESANO-PASCOLI et al., 2010).

In the present study, we reported tick infestations on wild birds in reforestation fragments with native Atlantic forest species and reforestation fragments with *Eucalyptus tereticornis* in the central-eastern region of the State of Sao Paulo, Brazil.

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Materials and Methods

1. Study area

This study was conducted in "Edmundo Navarro de Andrade" forest, located in the municipality of Rio Claro, State of Sao Paulo, Brazil (22° 25' S and 47° 33' W) (Figure 1). It is a protected area of stational semidecidual forest (Atlantic Forest) with fragmented regions of Cerrado and regions of reforestation. The study area was composed of four plots of Atlantic forest reforested with native species over 70 years ago (each plot represents a large planting field): N1 (7.6 ha), N2 (2.7 ha), N3 (1.6 ha) and N4 (1.0 ha), and four plots of *Eucalyptus tereticornis* over 80 years old: E1 (9.0 ha), E2 (11.0 ha), E3 (8.2 ha) and E4 (5.5 ha) (Figure 2). The Eucalyptus plots suffered selective logging over the years, reducing density and allowing for regeneration of native vegetation.

2. Bird capture

Between April 2009 and March 2010, wild birds were caught inside the reforestation plots using ten mist nets (12 m long × 2.5 m wide, 35 mm mesh). In each area, mist nets were left open from 6 AM. to 12 PM., totalizing 1,890 net-hours (56,700 h.m²). Bird species were identified according to Sick (1997), Souza (2002) and Sigrist (2009). Captured birds were carefully examined for the presence of ticks by checking their whole body. All ticks found attached to birds were removed with forceps. Before being released, the captured birds were marked with leg bands supplied by the 'Centro Nacional de Pesquisa para Conservação de Aves Silvestres', 'Instituto Chico Mendes de Conservação da Biodiversidade' (CEMAVE/ICMBIO) to verify any recapture, which were not considered in the counting. Thereafter, birds were released at the same site. Ticks removed from birds were placed in 70% alcohol and identified in laboratory for *Amblyomma* nymphs following Martins et al. (2010). Larval ticks were morphologically identified to the genus level. Tick specimens collected during this study were deposited in the tick collection "Coleção Nacional de Carrapatos" (CNC) of the Faculdade de Medicina Veterinária Preventiva e Saúde Animal, Universidade de São Paulo – USP, São Paulo, Brazil.

Field data of ticks on birds were used to calculate the prevalence and mean intensity of tick infestations on each bird species. These calculations were performed according to the concepts reported by Bush et al. (1997), where prevalence is the number of infested birds divided by the number of examined birds multiplied by 100 for each bird species, and mean intensity is the total number of ticks divided by the number of infested birds for each bird species. The overall prevalence of infested birds from native and eucalyptus plots was compared by the chi-square distribution using Minitab® release 15.

Figure 1. Location map – municipality of Rio Claro, State Sao Paulo, Brazil.

Results

A total of 265 birds from 45 different species were captured: 137 birds of 33 species belonging to 18 families captured in planted native forest, and 128 birds of 37 species belonging to 19 families captured in planted *Eucalyptus tereticornis* forest. Two species of ticks were recovered from birds during this study: *Amblyomma longirostre* (Koch, 1844) and *Amblyomma calcaratum* (Neumann, 1899). Out of the 137 birds captured in native forest, 10 (7.3%) were parasitized by ticks: 19 *Amblyomma* sp. larvae, three *A. longirostre* nymphs, and 10 *A. calcaratum* nymphs. The species with the highest mean intensity of ticks were *Turdus leucomelas* and *Antilophia galeata*, with 2.6 and 3 ticks/bird, respectively (Table 1). Of the 128 species of birds captured in *Eucalyptus*

Figure 2. Location map of the study area.

Table 1. Ticks collected on birds in fragments of reforestation with native Atlantic forest species in the municipality of Rio Claro, State of Sao Paulo, Brazil.

Birds						Ticks	
Family	**Species (Nº. Captured)**	**Nº. Infested**	**Prevalence**	**Mean instensity**	**Area**	**Nº. Larvae – Genus**	**Nº. Nymphs – Species**
Falconidae	*Micrastur semitorquatus* (*1*)	0	0	0	N1		
Columbidae	*Leptotila verreauxi* (*4*)	0	0	0	N1,N2		
	Geotrygon violacea (*1*)	0	0	0	N3		
Trochilidae	*Amazilia versicolor* (*1*)	0	0	0	N3		
Picidae	*Picumnus albosquamatus* (*1*)	0	0	0	N1		
	Veniliornis passerinus (*1*)	0	0	0	N3		
Thamnophilidae	*Thamnophilus doliatus* (*1*)	0	0	0	N1		
	Thamnophilus caerulescens (*2*)	0	0	0	N2		
	Dysithamnus mentalis (*1*)	1	100	2	N3		*2 A. calcaratum*
Conopophagidae	*Conopophaga lineata* (*3*)	0	0	0	N1,N2		
Dendrocolaptidae	*Sittasomus griseicapillus* (*6*)	0	0	0	N1, N3		
	Dendrocolaptes platyrostris (*7*)	0	0	0	N1, N2, N3		
Furnariidae	*Synallaxis ruficapilla* (*3*)	0	0	0	N2		
	Automolus leucophthalmus (*2*)	1	50	2	N3, N4	*2 Amblyomma* sp.	
Tyrannidae	*Tolmomyias sulphurescens* (*5*)	0	0	0	N1, N2		
	Leptopogon amaurocephalus (*2*)	0	0	0	N3		
	Platyrinchus mystaceus (*6*)	1	16.6	2	N1, N2, N3	*2 Amblyomma* sp.	
	Lathrotriccus euleri (*7*)	0	0	0	N1, N2, N3		
Pipridae	*Antilophia galeata* (*3*)	1	33.3	3	N1, N2, N4	*3 Amblyomma* sp.	
Thraupidae	*Lanio penicillatus* (*5*)	2	40	1	N1, N3		*2 A. longirostre*
	Lanio melanops (*7*)	3	50	1	N1, N2, N3, N4		*2 A. calcaratum; 1 A. longirostre*
	Tachyphonus coronatus (*1*)	1	100	2	N1, N4	*2 Amblyomma* sp.	
	Tangara sayaca (*1*)	0	0	0	N2		
Vireonidae	*Cyclarhis gujanensis* (*1*)	0	0	0	N1		
Turdidae	*Turdus rufiventris* (*3*)	1	33.3	2	N1, N2, N4	*2 Amblyomma* sp.	
	Turdus leucomelas (*28*)	5	17.8	2.6	N1, N2, N3	*8 Amblyomma* sp.	*5 A. calcaratum*
Emberizidae	*Volatinia jacarina* (*1*)	0	0	0	N1		
	Arremon flavirostris (*3*)	1	33.3	1	N1, N2		*1 A. calcaratum*
Cardinalidae	*Habia rubica* (*4*)	0	0	0	N2, N3		
Parulidae	*Basileuterus hypoleucus* (*3*)	0	0	0	N1, N2		
	Basileuterus flaveolus (*11*)	0	0	0	N1, N2, N3		
	Basileuterus leucoblepharus (*1*)	0	0	0	N2		

Nº - number.

stands, 12 (9.3%) were infested with ticks: 34 *Amblyomma* sp. larvae, two *A. calcaratum* nymphs, and nine *A. longirostre* nymphs. Individual infestations usually consisted of few ticks, with mean intensity lower than two ticks/bird (Table 2). The bird species *Habia rubica* and *Platyrinchus mystaceus* moved between the plots. *H. rubica* and *Dendrocolaptes platyrostris* also moved between the plots, but they were not found parasitized with ticks. Prevalence values of infested birds were statistically similar among native and eucalyptus plots (Chi-Sq = 0.375; DF = 1; *P*-Value = 0.541).

Discussion

In this study, we report tick parasitism in wild birds captured in two distinct reforestation areas: plots planted with native species and plots with *Eucalyptus tereticornis*. The species richness of birds was similar in the two areas, since 33 and 37 bird species were captured in native and eucalyptus plots, respectively.

The tick *A. calcaratum* predominated among the nymphs collected on birds in fragments of native species, whereas

A. longirostre predominated among the nymphs collected on birds in the *E. tereticornis* fragments; the latter fragments also presented higher abundance of *Amblyomma* sp. larvae.

The adult stage of *A. calcaratum* feeds almost exclusively on anteaters, while larvae and nymphs were found feeding on birds (GUGLIELMONE et al., 2003). Jones et al. (1972) cited immature stages of *A. calcaratum* on birds without species identification. Labruna et al. (2007) also recorded the occurrence of *A. calcaratum* nymphs parasitizing *Saltator similis*, *Conopophaga lineata*, *Turdus albicollis*, *Chiroxiphia caudata* and *Pyriglena leucoptera* captured in the interior of the State of Sao Paulo, Brazil, while birds captured on the coast of the same state were parasitized by *A. nodosum*. Labruna et al. (2007) speculated that larvae and nymphs of *A. calcaratum* host seek on the ground surface, since giant anteaters (*Myrmecophaga tridactyla*) are exclusively terrestrial (EMMONS; FEER, 1997).

Ogrzewalska et al. (2011) reported *A. calcaratum* nymphs parasitizing *Conopophaga melanops*, *Dixiphia pipra* and *Manacus manacus* in Atlantic forest. In the present study, we found additional species being parasitized for the first time by this tick: *Dysithamnus mentalis*, *Lanio melanops*, *Turdus leucomelas*, *Arremon flavirostris* and *Lathrotriccus euleri*. Indeed, these species have the habit to visit the ground to seek for food or collect material to build nests (SICK, 1997).

Table 2. Ticks collected on birds in fragments of reflorestation with *Eucalyptus tereticornis* in Rio Claro Municipality, State of São Paulo, Brazil.

Birds						**Ticks**	
Family	**Species (Nº. Captured)**	**Nº. Infested**	**Prevalence**	**Mean instensity**	**Area**	**Nº. Larvae – Genus**	**Nº. Nymphs – Species**
Columbidae	*Leptotila verreauxi* (*2*)	0	0	0	E1, E2		
Trochilidae	*Amazilia lactea* (*2*)	0	0	0	E1, E3		
Picidae	*Picumnus albosquamatus* (*2*)	0	0	0	E1, E2		
Thamnophilidae	*Taraba major* (*3*)	1	33.3	1	E2		*1 A. longirostre*
	Thamnophilus doliatus (*1*)	0	0	0	E2		
	Thamnophilus caerulescens (*4*)	0	0	0	E1, E2, E3		
	Dysithamnus mentalis (*3*)	0	0	0	E2, E3		
	Pyriglena leucoptera (*3*)	0	0	0	E1, E3		
Conopophagidae	*Conopophaga lineata* (*11*)	1	9	1	E1, E2, E3		*1 A. calcaratum*
Dendrocolaptidae	*Sittasomus griseicapillus* (*5*)	1	20	2	E1, E2		*2 A. longirostre*
	Dendrocolaptes platyrostris (*1*)	0	0	0	E1		
Furnariidae	*Synallaxis ruficapilla* (*7*)	0	0	0	E2, E3		
Rhynchocyclidae	*Tolmomyias sulphurescens* (*2*)	1	50	1	E1, E3		*1 A. longirostre*
	Leptopogon amaurocephalus (*1*)	0	0	0	E1		
Tyrannidae	*Platyrinchus mystaceus* (*10*)	3	30	0.6	E1, E2, E3	*2 Amblyomma* sp.	
	Lathrotriccus euleri (*6*)	4	66.6	1.75	E1, E3, E4	*4 Amblyomma* sp.	*2 A. longirostre; 1 A. calcaratum*
Pipridae	*Manacus manacus* (*1*)	0	0	0	E3		
	Antilophia galeata (*2*)	1	50	5	E2	*5 Amblyomma* sp.	
Tityridae	*Pachyramphus polychopterus* (*1*)	0	0	0	E1		
Vireonidae	*Cyclarhis gujanensis* (*6*)	0	0	0	E1, E2, E3		
Troglodytidae	*Troglodytes musculus* (*1*)	0	0	0	E2		
Turdidae	*Turdus rufiventris* (*3*)	0	0	0	E2		
	Turdus leucomelas (*9*)	5	55.5	1.8	E1, E2, E3, E4	*8 Amblyomma* sp.	*1 A. longirostre*
	Turdus subalaris (*1*)	1	100	1	E1	*1 Amblyomma* sp.	
Coerebidae	*Coereba flaveola* (*1*)	0	0	0	E1, E2, E3		
Thraupidae	*Saltator similis* (*1*)	0	0	0	E1		
	Thlypopsis sordida (*1*)	0	0	0	E2		
	Tachyphonus coronatus (*8*)	4	50	2	E2, E3, E4	*7 Amblyomma* sp.	*1 A. longirostre*
	Ramphocelus carbo (*1*)	0	0	0	E2		
	Lanio penicillatus (*1*)	0	0	0	E1		
	Lanio melanops (*3*)	0	0	0	E1		
	Trichothraupis melanops (*4*)	4	100	1.25	E4	*5 Amblyomma* sp.	
Emberizidae	*Sporophila caerulescens* (*1*)	1	100	2	E2	*2 Amblyomma* sp.	
	Arremon flavirostris (*3*)	0	0	0	E2, E3		
Cardinalidae	*Habia rubica* (*2*)	0	0	0	E3		
Parulidae	*Basileuterus hypoleucus* (*6*)	1	16.6	1	E1, E2, E3		*1 A. longirostre*
	Basileuterus flaveolus (*9*)	0	0	0	E1, E2, E3		

Nº - number.

Bird species parasitized by *A. longirostre* were *Lanio penicillatus*, *L. melanops*, *Taraba major*, *Sittasomus griseicapillus*, *Tolmomyias sulphurescens*, *L. euleri*, *T. leucomelas*, *Tachyphonus coronatus* and *Basileuterus hypoleucus*. Labruna et al. (2007) and Tolesano-Pascoli et al. (2010) reported *A. longirostre* on these same bird species in the Brazilian Atlantic Forest and Cerrado.

The species *A. longirostre* is a Neotropical tick widely distributed throughout South and Central America (GUGLIELMONE et al., 2003). Adults of this tick species feed primarily on porcupines, while its larvae and nymphs are frequently found on passerine birds (ARAGÃO, 1936; VENZAL et al., 2005; OGRZEWALSKA et al., 2010; TOLESANO-PASCOLI et al., 2010). Labruna et al. (2007) proposed that this tick might have an arboreal life cycle, since most of the birds species found parasitized by immature stages of *A. longirostre* were arboreal, some of them with no ground visiting habits.

Ogrzewalska (2009) suggested that different species of ticks respond differently to fragmentation; moreover, the prevalence of each tick species might be related to the abundance of their adult stage hosts. In fact, the tick species distribution found in this study can be related to the different ways that fragmentation affects anteaters and porcupines. Porcupines seem able to occupy anthropogenic habitats, while anteaters are more sensitive to the impacts of fragmentation (FAHRIG, 2001; HENLE et al., 2004).

Birds of the genus *Turdus* were previously reported to be important for the life cycle of several tick species, once they live in low forest stratum and are commonly found on the ground (ROJAS et al., 1999; ARZUA et al., 2003; VENZAL et al., 2005). In this study, we observed this bird genus parasitized by *Amblyomma larvae*, and nymphs of *A. calcaratum* and *A. longirostre*, with high prevalence and mean intensity.

The bird species *H. rubica*, *P. mystaceus* and *D. platyrostris* were recaptured in different plots, and although under very low infestation, they can act scattering ticks to other environments.

In conclusion, birds seem to play a fundamental role in the life cycle of some tick species; furthermore, wild birds have been associated with the transportation of infected ticks through lands and abroad continents, acting as long-distance vectors for several pathogens of human and animal diseases (BJÖERSDORFF et al., 2001; GEORGOPOULOU; TSIOURIS, 2008).

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