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Ticks of the genus *Amblyomma* (Acari: Ixodidae) on wild birds in the Brazilian Amazon

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Abstract

The Amazon biome harbors the richest avifauna in the world. However, in the Brazilian Amazon only a single previous study has systematically evaluated wild birds for ticks. During 2012, wild birds were captured in two areas of the Brazilian Amazon forest, one located in the State of Amazonas, and another in the State of Pará. Overall, 581 wild birds representing 118 species were captured, but only 18 individuals (3.1% prevalence) were infested by ticks, comprising immature stages of *Amblyomma calcaratum* Neumann, 1899, *Amblyomma geayi* Neumann, 1899, *Amblyomma humerale* Koch, 1844, and *Amblyomma longirostre* (Koch, 1844). The only previous study of birds in the Brazilian Amazon reported 40.2% tick prevalence. Such contrasting prevalence values may stem from seasonal differences or differences in forest disturbance at the two sites.

Key words: Ticks, genus *Amblyomma*, wild birds, Brazilian Amazon

Introduction

The Amazon is the largest and most diverse of the world's tropical forests, covering more than 6.6 million km^2 in nine countries of South America (Mittermeier *et al.* 2003). Approximately two-thirds of the bird species reported from Brazil can be found in the Amazon (Silveira 2013). This wilderness harbors the richest avifauna in the world: 1,294 known species, of which 263 are endemic to this biome (Mittermeier *et al.* 2003). Not surprisingly, Brazil has the world's second most diverse avifauna, with 1,840 species (Silveira 2013). Despite such avian diversity, only 3 tick species are known in Brazil to use birds as primary hosts for all parasitic stages: *Argas miniatus* Koch, 1844, a parasite of domestic fowl, and *Ixodes auritulus* Neumann, 1904 and *Ixodes paranaensis* Barros-Battesti, Arzua, Pichorim & Keirans, 2003, parasites of wild birds (Arzua *et al.* 1994, Arzua & Barros-Battesti 1999, Barros-Battesti *et al.* 2003, Dantas-Torres *et al.* 2009). Curiously, accidental infestations by *Rhipicephalus sanguineus* (Latreille, 1806) have been reported on native and non-native birds in Brazil (Diogo *et al.* 2003, Szabó *et al.* 2008, Luz *et al.* 2012). For the most part, however, studies have reported the occurrence of immature stages (larvae and nymphs) of *Amblyomma* spp. on wild birds that were captured in different areas of the Brazilian Cerrado and Atlantic Forest biomes (Marini *et al.* 1996, Neves *et al.* 2000, Arzua *et al.* 2003, Storni *et al.* 2005, Labruna *et al.* 2007, Ogrzewalska *et al.* 2008, 2009, 2011b, 2012, Tolesano-Pascoli *et al.* 2010, Luz *et al.* 2012, Santolin *et al.* 2012, Pacheco *et al.* 2012, Amaral *et al.* 2013, Pascoal *et al.* 2013, Sanches *et al.* 2013, Torga *et al.* 2013). Within the Amazon biome, only a single Brazilian study, in the State of Pará, has systematically evaluated wild birds for ticks (Ogrzewalska *et al.* 2010). The goal of our

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research was to report the prevalence of ticks on wild birds in two undisturbed areas of the Brazilian Amazon.

Materials and methods

During the months of April, July and October 2012, wild birds were captured in two areas of the Brazilian Amazon forest, one located in the municipality of Santa Isabel do Rio Negro (0°35'S, 64°55'W), State of Amazonas, and another in Amazon National Park (4°38′S, 56°28′W), Municipality of Itaituba, State of Pará. Birds were captured using 30–50 mist nets (mesh = 35 mm) 12 m long and 2.5 m high. Nets were opened from sunrise until midday and were monitored every 30 min. Bird species nomenclature follows the South American Classification Committee (Remsen *et al.* 2011). Every captured bird was examined for ticks by carefully checking its entire body and by deflecting the feathers.

Any tick found attached to a bird was removed with forceps, preserved in 95% ethanol, and sent to the laboratory for taxonomic identification based on current literature (Barros-Battesti *et al.* 2006, Martins *et al.* 2010, 2013). Ticks collected in this study have been deposited in the Coleção Nacional de Carrapatos (CNC), Faculty of Veterinary Medicine, University of São Paulo (accession numbers: CNC 2385–2398).

Results and discussion

Overall, 581 wild birds representing 118 species were captured and examined for ticks, but only 18 individual birds were found to be parasitized (3.1% prevalence). A total of 24 ticks (8 larvae and 16 nymphs) of 4 tick species were identified: *Amblyomma calcaratum* Neumann, 1899 (7 nymphs), *Amblyomma geayi* Neumann, 1899 (1 nymph), *Amblyomma humerale* Koch, 1844 (1 nymph), *Amblyomma longirostre* (Koch, 1844) (7 nymphs), and *Amblyomma* sp. (8 larvae) (Table 1). In Santa Isabel do Rio Negro, a total of 153 birds representing 44 species were sampled; 5 birds (3.3% prevalence) were infested by ticks in this area. In Itaituba, a total of 428 birds representing 97 species were sampled; 13 birds (3.0% prevalence) were infested by ticks in this area.

Bird species sampled in the municipality of Santa Isabel do Rio Negro but not found infested by ticks were (number of individuals in parentheses): Columbiformes, Columbidae: *Geotrygon montana* (1); Galbuliformes, Bucconidae: *Malacoptila fusca* (1); Apodiformes, Trochilidae: *Thalurania furcata* (1), *Phaethornis bourcieri* (3), *Phaethornis ruber* (1); Passeriformes, Conopophagidae: *Conopophaga aurita* (4); Polioptilidae: *Microbates collaris* (5); Scleruridae: *Sclerurus caudacutus* (1); Turdidae: *Turdus albicollis* (2); Tyrannidae: *Ramphotrigon ruficauda* (1); Tityridae: *Schiffornis turdina* (3), *Terenotriccus erythrurus* (1); Vireonidae: *Hylophilus brunneiceps* (1), *Hylophilus ochraceiceps* (1); Pipridae: *Chiroxiphia pareola* (1), *Lepidothrix coronata* (10), *Pipra erythrocephala* (3); Rhynchocyclidae: *Cnipodectes subbrunneus* (1), *Corythopis torquatus* (1), *Mionectes oleaginous* (1); Furnariidae: *Automolus infuscatus* (10), *Automolus rubiginosus* (1), *Hyloctistes subulatus* (3), *Xenops minutus* (3); Dendrocolaptidae: *Deconychura stictolaema* (1), *Dendrocincla fuliginosa* (4), *Dendrocincla merula* (3), *Glyphorynchus spirurus* (5); Thamnophilidae: *Cymbilaimus lineatus* (1), *Dichrozona cincta* (1), *Epinecrophylla haematonota* (3), *Gymnopithys leucaspis* (7), *Hylophylax naevius* (6), *Hypocnemis hypoxantha* (1), *Myrmoborus myotherinus* (3), *Myrmotherula longipennis* (3), *Phlegopsis erythroptera* (2), *Pithys albifrons* (11), *Thamnomanes caesius* (9), *Thamnophilus murinus* (1), and Tyrannoidea: *Platyrinchus platyrhynchos* (2).

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TABLE 1. Larval (L) and nymphal (N) ticks collected from birds in two areas of the Amazon forest in Brazil: Santa Isabel do Rio Negro municipality, State of Amazonas (AM), and Itaituba Municipality, State of Pará (PA).

Birds					
Order	**Family**	**Species**	**No. Infested/ No. examined (%)**	**Tick species (No. of specimens)**	**Area**
Falconiformes	Falconidae	*Micrastur ruficollis*	1/1 (100)	*Amblyomma longirostre* (1N)	PA
Passeriformes	Cardinalidae	*Cyanoloxia cyanoides*	1/4 (25.0)	*Amblyomma* sp. (1L)	PA
	Dendrocolaptidae	*Deconychura longicauda*	1/4 (25.0)	*A. longirostre* (1N)	PA
		Dendrocincla merula	1/6 (16.7)	*A. longirostre* (1N)	PA
		Dendrocolaptes certhia	1/2 (50.0)	*A. longirostre* (1N)	PA
		Glyphorynchus spirurus	1/20 (5.0)	*A. longirostre* (1N)	PA
		Xiphorhynchus ocellatus	1/5 (20)	*Amblyomma calcaratum* (1N)	AM
	Pipridae	*Lepidothrix nattereri*	1/10 (10.0)	*Amblyomma* sp. (1L)	PA
	Thamnophilidae	*Epinecrophylla leucophthalma*	1/9 (11.1)	*A. longirostre* (1N)	PA
		Thamnophilus aethiops	3/8 (37.5)	*A. calcaratum* (5N), *A. longirostre* (1N)	AM
		Thamnomanes caesius	2/6 (33.3)	*Amblyomma geayi* (1N), *Amblyomma humerale* (1N)	PA
		Willisornis poecilinotus	1/17 (5.9)	*A. calcaratum* (1N)	AM
	Thraupidae	*Ramphocelus carbo*	2/12 (16.7)	*Amblyomma* sp. (5L)	PA
	Tyrannidae	*Knipolegus poecilocercus*	1/6 (16.7)	*Amblyomma* sp. (1L)	PA

Bird species sampled in the municipality of Itaituba but not found infested by ticks were (number of individuals in parentheses): Piciformes, Picidae: *Celeus elegans* (3); Coraciiformes, Alcedinidae: *Chloroceryle aenea* (2); Columbiformes, Columbidae: *Geotrygon montana* (1), *Leptotila rufaxilla* (5); Galbuliformes, Bucconidae: *Malacoptila rufa* (2), *Monasa nigrifrons* (3); Galbulidae: *Galbula cyanicollis* (7), *Jacamerops aureus* (1); Apodiformes, Trochilidae: *Campylopterus largipennis* (2), *Glaucis hirsutus* (8), *Phaethornis malaris* (18), *Phaethornis philippii* (3), *Phaethornis ruber* (4), *Thalurania furcata* (17), *Threnetes leucurus* (1); Passeriformes, Cotingidae: *Lipaugus vociferans* (1); Dendrocolaptidae: *Certhiasomus stictolaemus* (2), *Dendrocincla fuliginosa* (1), *Dendroplex picus* (4), *Sittasomus griseicapillus* (1), *Xiphorhynchus elegans* (6), *Xiphorhynchus guttatus* (2), *Xiphorhynchus obsoletus* (3), *Xiphorhynchus ocellatus* (1); Emberizidae: *Arremon taciturnus* (2), *Sporophila angolensis* (2); Formicariidae: *Formicarius colma* (2); Furnariidae: *Automolus ochrolaemus* (3), *Automolus paraensis* (2), *Cranioleuca vulpina* (2), *Hyloctistes subulatus* (1), *Philydor erythrocercum* (1), *Philydor pyrrhodes* (4), *Xenops minutus* (4); Pipridae: *Dixiphia pipra* (1), *Heterocercus linteatus* (12), *Lepidothrix vilasboasi* (2), *Pipra fasciicauda* (1), *Pipra rubrocapilla* (7); Polioptilidae: *Ramphocaenus melanurus* (1); Rhynchocyclidae: *Corythopis torquatus* (1), *Mionectes macconnelli* (2), *Rhynchocyclus olivaceus* (1), *Tolmomyias flaviventris* (1), *Tolmomyias sulphurescens* (2); Scleruridae: *Sclerurus caudacutus* (1); Thamnophilidae: *Hylophylax naevius* (2), *Hylophylax punctulatus* (5), *Hypocnemis striata* (21), *Hypocnemoides maculicauda* (8), *Myrmeciza ferruginea* (1), *Myrmoborus myotherinus* (13), *Myrmornis torquata* (1), *Myrmotherula axillaris* (15), *Myrmotherula hauxwelli* (4), *Myrmotherula longipennis* (11), *Phlegopsis nigromaculata* (10), *Rhegmatorhina berlepschi* (3), *Schistocichla leucostigma* (2), *Thamnomanes saturninus* (11), *Thamnophilus aethiops* (3), *Thamnophilus amazonicus* (1), *Thamnophilus nigrocinereus* (13), *Thamnophilus schistaceus* (2), *Willisornis poecilinotus* (4); Thraupidae: *Lanio cristatus* (2), *Lanio surinamus* (2), *Saltator coerulescens* (5), *Saltator maximus* (2); Tityridae: *Myiobius barbatus* (2), *Onychorhynchus coronatus* (2), *Schiffornis turdina* (6), *Terenotriccus erythrurus* (2); Troglodytidae: *Cantorchilus leucotis* (10), *Microcerculus marginatus* (1), *Pheugopedius genibarbis* (3); Turdidae: *Turdus albicollis* (2), *Turdus fumigatus* (7); Tyrannidae: *Attila spadiceus* (4), *Cnemotriccus fuscatus* (5), *Myiarchus ferox* (1), *Ramphotrigon ruficauda* (2), *Rhytipterna simplex* (2); Vireonidae: *Hylophilus ochraceiceps* (2), and Tyrannoidea: *Platyrinchus platyrhynchos* (2), *Platyrinchus saturatus* (1).

In the present study, a 3.0–3.3% prevalence of tick infestation was reported for birds from two undisturbed areas of the Brazilian Amazon. The only previous study with birds in this biome reported 40.2% tick prevalence among 331 birds (mostly Passeriformes) captured in a disturbed area of the State of Pará (Ogrzewalska *et al.* 2010). Because Ogrzewalska *et al.* (2010) sampled birds during November, and we sampled during April, July and October, it is possible that these contrasting prevalence values were affected by season. On the other hand, the contrasting disturbance status of the areas should also be considered, since a recent study in the Atlantic Forest biome in southeastern Brazil reported significantly higher prevalence of ticks on birds from degraded forest patches when compared to less disturbed forest patches (Ogrzewalska *et al.* 2011a). In this same study, degraded forest patches had significantly lower bird diversity than less disturbed areas. If we apply a simple biodiversity index (no. bird species/no. individual birds) (Sokal & Rohlf 1995) to the two areas in the present study (Santa Isabel do Rio Negro and Itaituba), similar values (0.287 and 0.225, respectively) result. In contrast, a lower diversity index (0.169) applies to the Amazonian area studied by Ogrzewalska *et al.* (2010), where much higher tick prevalence was found on birds. While these results suggest that, similar to the Atlantic Forest biome, tick infestations on Amazonian passeriform birds are higher in disturbed fragments with lower bird diversity, more studies are needed to confirm such observations.

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Although we found immature stages of four *Amblyomma* species on birds (mostly Passeriformes), the adult stages of these ticks have a distinct preference for non-avian hosts: adults of *A. calcaratum* feed chiefly on anteaters, *A. geayi* on sloths, *A. humerale* on tortoises, and *A. longirostre* on porcupines (Aragão 1936, Labruna *et al.* 2005). Except for *A. longirostre,* for which passerine birds have been shown to be principal hosts of larvae and nymphs (Nava *et al.* 2010), little information is available regarding host usage by the immature stages of the other three *Amblyomma* species. Our results, in conjunction with another recent study (Ogrzewalska *et al.* 2010), suggest that passeriform birds may also be important hosts for the immature stages of *A. calcaratum, A. geayi* and *A. humerale* in the Amazon biome.

In the present study, we provide the following tick-host records for the first time: *A. longirostre* on *Micrastur ruficollis, Dendrocolaptes certhia, Epinecrophylla leucophthalma* and *Thamnophilus aethiops*; *A. calcaratum* on *Xiphorhynchus ocellatus, Thamnophilus aethiops* and *Willisornis poecilinotus*; *A. geayi* on *Thamnomanes caesius*; and *Amblyomma* sp. on *Lepidothrix nattereri* and *Knipolegus poecilocercus.* Tick-host associations found in the present study but also previously reported are: *A. longirostre* on *Deconychura longicauda, Dendrocincla merula* and *Glyphorynchus spirurus* (Ogrzewalska *et al.* 2010, 2011b); and *A. humerale* on *T. caesius* (Ogrzewalska *et al.* 2010).

Finally, all four *Amblyomma* species found in the present study have been reported to carry bacteria of the genus *Rickettsia,* such as *Rickettsia parkeri* in *A. calcaratum* (Ogrzewalska *et al.* 2013), *R. amblyommii* in *A. longirostre* and *A. geayi* (Ogrzewalska *et al.* 2008, 2010), and *Rickettsia bellii* in *A. humerale* (Labruna *et al.* 2004). While these *Amblyomma* species are not considered to be important human-biting ticks, they could be involved in enzootic maintenance cycles of rickettsial organisms, and in this case, birds could play an important role in the dissemination of infected ticks, as reported for other tick-borne agents on other continents (Hasle 2013). In fact, records exist of *A. calcaratum, A. humerale,* and *A. longirostre* in North America, where these ticks are not established but were transported via migratory birds from the Neotropical Region (Bloemer *et al.* 1987, Scott *et al.* 2001, Morshed *et al.* 2005).

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