

Endoparasites in wild birds in the Brazilian Amazon

Endoparasitos em aves silvestres na Amazônia brasileira

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Abstract

Wild birds host a wide variety of endoparasites. These endoparasites are important because they can cause serious infections in birds. The present study aimed to conduct a copro-parasitological survey in wild birds captured in the Cazumbá-Iracema Extractive Reserve (Resex) located in the county of Sena Madureira, State of Acre, in northern Brazil. In order to capture these birds, ornithological mist nets were placed in different ecosystems of the Resex. Captured birds were identified and held in cloth sacks for 30 min. Fecal samples, from each bird, were collected if available. Direct examination and spontaneous sedimentation were used to analyze these samples. The prevalence rate of endoparasite infections in the fecal samples examined was 70.58% (72/102). Oocysts and cysts of protozoa were detected in 69.44% (50/72) of the samples, whereas helminth eggs were seen in 75.00% (54/72) of these specimens. To date, the southwest of the Amazon rainforest, northern Brazil, is a poorly explored area that warrants further research on the parasitic fauna of wildlife.

Keywords: wild birds, Cazumbá-Iracema Extractive Reserve (Resex), ecosystem health, parasitological diagnosis, enteroparasites, sanitary management.

Resumo

As aves silvestres são hospedeiras de uma grande variedade de endoparasitos. Esses endoparasitos são importantes, pois podem causar infecções graves às aves. O presente estudo teve como objetivo realizar um estudo copro-parasitológico em aves silvestres capturadas na Reserva Extrativista Cazumbá-Iracema (Resex) localizada no município de Sena Madureira, no estado do Acre, norte do Brasil. Para capturar essas aves, redes ornitológicas foram dispostas em diferentes ecossistemas da Resex. As aves capturadas foram identificadas e mantidas em sacos de pano por 30 minutos. Amostras fecais de cada ave foram coletadas, se disponíveis. O exame direto e a sedimentação espontânea foram os métodos utilizados para analisar as amostras. As amostras positivas para coccídeos foram submetidas a técnica de Ziehl-Neelsen modificada. A taxa de prevalência de infecções endoparasitárias nas amostras fecais examinadas foi de 70,58% (72/102). Oocistos e cistos de protozoários foram detectados em 69,44% (50/72) das amostras, enquanto ovos de helmintos foram observados em 75,00% (54/72) desses espécimes. Até o momento, esta é uma área pouco explorada que merece mais pesquisas sobre a fauna parasitária de animais silvestres no sudoeste da floresta amazônica.

Palavras-chave: aves silvestres, Reserva Extrativista de Cazumbá-Iracema (Resex), saúde do ecossistema, diagnóstico parasitológico, enteroparasitos, manejo sanitário.

Introduction

Copro-parasitological surveys, which focused on human infections until the 1970s, gave space and attention to analyses of the frequency of parasitism in indigenous and exotic animals (Ferreira et al., 1994; Bunbury et al., 2008). Birds have now gained prominence in this research due to their diversity in different geographical areas and also because they are hosts to a great diversity of parasites that pose a threat to animal and human health (Costa et al., 2010).

Of the health problems that affect wild birds, parasitic infections stand out as one of the most significant groups of avian disease because they can cause serious infections that can ultimately cause the death of infected hosts (Reed et al., 2003). Endoparasitic infections are a major public



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health concern as they can aggravate a number of other health problems. This is particularly true in developing countries where parasitic, neglected zoonotic diseases affect a large number of individuals (Costa et al., 2010).

Internal parasites can affect the health of the parasitized avian hosts in such a way that, depending on the severity of the infestation, they may lead to a rapid decline or even extinction of an avian population (Thompson, 2013).

There are a few published studies on the occurrence of internal parasites in wild birds from the Amazon biome. Magalhães-Matos et al. (2016) carried out a survey to determine parasite prevalence in wild birds raised in captivity in the state of Pará, northern Brazil. The authors examined fecal samples using light microscopy, and they detected helminth eggs and oocysts in these specimens. In the state of Acre, also in northern Brazil, a study conducted at the Federal University of Acre campus, on the occurrence of internal parasites in wild birds showed that these avian hosts are parasitized by protozoa and gastrointestinal helminths (Brito et al., 2017).

The State of Acre hosts more than 700 species of birds and many of them are endemic to the southwestern Amazon region (Guilherme, 2012, 2016). Despite this impressive array of birds, little is known about the endoparasites that infest avian hosts in Acre.

The lack of information on parasitic infections affecting wildlife in the Amazon, particularly for wild birds, warrants further research. Therefore, it is an opportune time to study the gastrointestinal parasites affecting free-living wild birds in the central-eastern region of the State of Acre, Brazil.

The present study aimed to conduct a coproparasitological survey in wild birds captured in the Cazumbá-Iracema Extractive Reserve (Resex) located in the county of Sena Madureira, State of Acre, north of Brazil.

Materials and methods

The present study was carried out in the Cazumbá-Iracema Extractive Reserve (Resex), which is a Federal conservation unit located in the State of Acre, southwestern Amazonia, Purus River basin, in the county of Sena Madureira (9°08'46.7"S 69°01'17.7"W), northern Brazil.

Birds were captured from September 2016 to May 2018. Seven ornithological mist nets were placed in four different ecosystems for 2 months: (a) pasture, (b) anthropic clearing, (c) secondary forest (in regeneration), and (d) primary forest. Nets were kept open during the mornings (from 5 AM to 12 PM) and afternoons (from 2 PM to 5 PM). The captured birds were identified and kept in cloth bags with absorbent paper inside. The birds were rested for 30 min until they defecated and the feces were collected, with only one fecal sample being collected from each individual. Fecal samples were conditioned in 50 mL flasks containing merthiolate-iodine-formaldehyde (MIF) solution. The feces were then examined for parasites using light microscopy (Olympus CX40) at the Research Support Unit and Laboratory Services for Wildlife of the Federal University of Acre (UFAC) in Rio Branco, Acre, Brazil.

The diagnosis of parasitic infection in each bird was made using laboratory methods to find oocysts, eggs, and larvae: (1) direct smear examination of fresh fecal material using light microscopy stained with Lugol solution, and (2) spontaneous sedimentation (De Carli, 2001), using 10x and 40x lenses for visualization. The positive samples for coccidia were submitted to modified Ziehl-Neelsen technique (Lenette et al., 1985). These parasites were identified according to Foreyt (2005), and Zajac & Conboy (2006).

Bird capture and sample collection were authorized by the Biodiversity Information and Authorization System - SISBIO N. 67436297 and by the Animal Research Ethics Committee - CEUA N. 2107.009788/2016-01.

Captured birds were identified by one of the authors (EG) who is the researcher in charge of the Ornithology Laboratory at UFAC. The classification of birds and the species nomenclature that were used in the present study were taken from Piacentini et al. (2015).

Results

Fecal samples were collected from 102 individuals and screened for the presence of parasites (Table 1). Of these, 18 individuals of seven species were non-Passeriformes (Pelecaniformes, Apodiformes, Coraciiformes and Galbuliformes) and 91 individuals of 45 species belonged to

the Passeriformes order (Table 1). Of the 18 non-Passeriformes individuals with fecal samples, 83.33% (n = 15) presented infection by endoparasites, and 62.63% (n = 57) of the fecal samples from 91 individual Passeriformes were positive for endoparasites.

Of the 102 fecal samples analyzed, endoparasites were detected in 70.58%. Oocysts were detected in 69.44% (50/72) of the fecal samples examined, whereas helminth eggs were observed in 75.00% (54/72) of the fecal samples analyzed. Fourteen types of internal parasites were found in the avian fecal samples tested: 35.71% were protozoa; 50% were nematode, 14.28% were cestode, and 7.14% were trematode.

Table 1. Results of the parasitological examination of fecal samples from wild birds captured in the Cazumbá-Iracema Extractive Reserve (Resex), Acre, Brazil. AC - total of samples collected and P - total of positive samples.

Taxon	AC	P	Endoparasites
Pelecaniiformes			
<i>Ardea alba</i>	1	1	<i>Eimeria</i> sp., <i>Capillaria</i> sp., Echinostomatidae
Apodiformes			
<i>Glaucis hirsutus</i>	8	6	Echinostomatidae, <i>Eimeria</i> sp., <i>Entamoeba</i> sp., <i>Strongyloides</i> sp. Ascaroidea
<i>Phaethornis hispidus</i>	1	1	Oxyuroidea
<i>Amazilia lactea</i>	1	1	<i>Eimeria</i> sp., <i>Entamoeba</i> sp., Syngamidae, <i>Isospora</i> sp.
Coraciiformes			
<i>Momotus momota</i>	3	2	<i>Entamoeba</i> sp., <i>Isospora</i> sp. Ascaroidea
Galbuliformes			
<i>Galbula cyanescens</i>	2	2	<i>Capillaria</i> sp., Ascaroidea, <i>Entamoeba</i> sp., Strongyloidea
<i>Monasa nigrifrons</i>	2	2	<i>Eimeria</i> sp., Ascaroidea
Sub total	18	15	
Passeriformes			
<i>Epinecrophylla leucophthalma</i>	1	1	<i>Eimeria</i> sp.
<i>Myrmotherula oreni</i>	1	0	-
<i>Myrmotherula</i> sp.	1	1	<i>Eimeria</i> sp.
<i>Iseria hauxwelli</i>	2	1	Ascaroidea, <i>Eimeria</i> sp., Davaineidae
<i>Thamnomanes ardesiacus</i>	3	2	<i>Entamoeba</i> sp., Oxyuroidea, Ascaroidea
<i>Thamnomanes schistogynus</i>	3	2	Davaineidae
<i>Thamnophilus doliatus</i>	2	2	<i>Entamoeba</i> sp., Ascaroidea, Oxyuroidea
<i>Taraba major</i>	3	2	Ascaroidea, <i>Entamoeba</i> sp.
<i>Hylophylax naevius</i>	1	0	-
<i>Hypocnemis peruviana</i>	2	1	Heterakidae
<i>Myrmoborus leucophrys</i>	3	3	<i>Eimeria</i> sp., <i>Entamoeba</i> sp., Ascaroidea
<i>Willisornis poecilinotus</i>	3	2	Dilepididae, <i>Eimeria</i> sp., <i>Strongyloides</i> sp.
<i>Phlegopsis nigromaculata</i>	4	3	<i>Eimeria</i> sp., Davaineidae, Ascaroidea
<i>Pheugopedius genibarbis</i>	3	2	<i>Eimeria</i> sp., Ascaroidea, Oxyuroidea
<i>Sclerurus caudacutus</i>	1	0	-
<i>Glyphorhynchus spirurus</i>	3	3	Heterakidae, <i>Entamoeba</i> sp., Echinostomatidae
<i>Xiphorhynchus guttatoides</i>	3	2	<i>Strongyloides</i> sp., Oxyuroidea, <i>Iodamoeba</i> sp., Strongyloidea
<i>Campylorhynchus trochilirostris</i>	3	2	Ascaroidea, <i>Eimeria</i> sp., Davaineidae, <i>Isospora</i> sp.
<i>Dendroplex picus</i>	2	2	Ascaroidea
<i>Automolus rufipileatus</i>	1	1	<i>Eimeria</i> sp., <i>Strongyloides</i> sp.
<i>Automolus ochrolaemus</i>	2	0	-
<i>Neopelma sulphureiventer</i>	4	3	<i>Eimeria</i> sp., Strongyloidea

Table 1. Continued...

Taxon	AC	P	Endoparasites
<i>Pipra fasciicauda</i>	3	0	-
<i>Ceratopipra rubrocapilla</i>	1	0	-
<i>Machaeropterus pyrocephalus</i>	2	1	Ascaroidea, <i>Entamoeba</i> sp., Oxyuroidea, <i>Eimeria</i> sp.
<i>Terenotriccus erythrurus</i>	1	0	-
<i>Myiobius atricaudus</i>	3	1	<i>Entamoeba</i> sp.
<i>Mionectes oleagineus</i>	1	0	-
<i>Corythopsis torquatus</i>	1	1	Ascaroidea, <i>Strongyloides</i> sp., <i>Entamoeba</i> sp., <i>Capillaria</i> sp.
<i>Rhynchocyclus olivaceus</i>	3	2	Ascaroidea, Heterakidae, <i>Entamoeba</i> sp.
<i>Tolmomyias flaviventris</i>	1	1	<i>Entamoeba</i> sp., Ascaroidea
<i>Ramphotrigon megacephalum</i>	1	1	<i>Entamoeba</i> sp.
<i>Myiarchus ferox</i>	2	0	-
<i>Megarynchus pitangua</i>	1	1	Echinostomatidae, Davaineidae
<i>Tyrannus melancholicus</i>	2	2	<i>Strongyloides</i> sp., Ascaroidea
<i>Troglodytes musculus</i>	2	2	<i>Isospora</i> sp., <i>Eimeria</i> sp.
<i>Tangara episcopus</i>	1	1	<i>Strongyloides</i> sp., Oxyuroidea, <i>Entamoeba</i> sp.
<i>Tangara palmarum</i>	2	2	<i>Entamoeba</i> sp., <i>Isospora</i> sp., Oxyuroidea, Ascaroidea
<i>Volatinia jacarina</i>	1	1	<i>Isospora</i> sp., <i>Eimeria</i> sp., <i>Entamoeba</i> sp.
<i>Sporophila angolensis</i>	6	3	<i>Entamoeba</i> sp.
<i>Sporophila castaneiventres</i>	1	1	<i>Isospora</i> sp., Ascaroidea
<i>Saltator maximus</i>	1	0	-
<i>Brotogeris cyanopectera</i>	2	0	-
<i>Furnarius leucopus</i>	1	1	<i>Eimeria</i> sp., <i>Capillaria</i> sp., <i>Strongyloides</i> sp.,
<i>Turdus ignobilis</i>	1	1	Davaineidae
Sub total	91	57	
Total	109	72	

Table 2. Frequency of endoparasites in the 44 birds species captured in the Cazumbá-Iracema Extractive Reserve (Resex), Acre, Brazil.

Parasites	Frequency (%)
PROTOZOA	
<i>Entamoeba</i> sp.	35.84
<i>Iodamoeba</i> sp.	1.88
<i>Eimeria</i> sp.	33.96
<i>Isospora</i> sp.	13.20
NEMATODES	
<i>Capillaria</i> sp.	7.54
Ascaroidea	37.73
Heterakidae	4.16
<i>Strongyloides</i> sp.	16.98
Strongyloidea	5.66
Oxyuroidea	15.09
Syngamidae	1.88
TREMATODES	
Echinostomatidae	7.54
CESTODES	
Dilepididae	1.88
Davaineidae	13.20

Three parasites were frequently detected among the 53 species of birds with samples analyzed: Ascaroidea (37.73%, n = 20), *Entamoeba* sp. (35.84%, n = 19), and *Eimeria* sp. (33.96%, n = 18). The least frequently detected endoparasites were Dilepididae (1.38%, n = 1), Syngamidae (1.88%, n = 1) and *Iodamoeba* sp. (1.88%, n = 1) (Table 2).

Discussion

There are few published studies on wild bird endoparasites that are similar to our study in which avian hosts were studied in their natural habitat (Marques et al., 2007; Costa et al., 2010; Luz et al., 2014; Brito et al., 2017).

The infestation rate of wild bird species captured in the Cazumbá-Iracema Resex was high: almost all of the sampled species showed some type of endoparasite. The results of the parasitological examination of the avian fecal samples, in the present study, using light microscopy show that the percentage of parasitized birds in our survey was higher than in a previous study conducted by Magalhães-Matos et al. (2016) in the State of Pará, northern Brazil, in which only 43.18% of the birds sampled were infected with internal parasites. The discrepancy between our findings and the findings previously published by other researchers may have been due to the fact that the wild birds analyzed in the State of Pará by Magalhães-Matos et al. (2016) were in captivity. However, when the results of our study were compared with the results from a previous study carried out by Brito et al. (2017), in which fecal samples from free-living wild birds at the university campus and Zoobotanical Park (PZ) of UFAC were examined, the results of each of these surveys (70.5% versus 70.4%, respectively) were highly similar to those in this study.

Eggs of Ascaroidea, cysts of *Entamoeba* sp. and oocysts of *Eimeria* sp. were generalist parasites, and they occurred in 20, 19, and 18 of the bird species studied, respectively. Cysts of *Iodamoeba* sp., eggs of Dilepididae and Syngamidae were more specialist parasites, and they were seen in the bird species *Xiphorhynchus guttatoides*, *Willisornis poecilinotus*, and *Amazilia lactea*, respectively. Among the protozoa that can induce disease in avian hosts, the coccidium *Eimeria* sp., which causes coccidiosis in birds, is cosmopolitan (Hubálek, 2004). This pathogen is considered the most important endoparasite in poultry farming. These coccidia cause diarrhea, apathy, decrease in egg production, weight loss, and ultimately death, especially in young birds (Júnior & Macari, 2000).

Marques et al. (2007) assessed the prevalence of gastrointestinal parasites in pigeons from urban areas in the city of Lages, State of Santa Catarina, southern Brazil, and they found that 86.05% (37/43) of the birds were parasitized by protozoa. Oocysts of *Eimeria* sp. were detected in all fecal samples examined under the light microscope.

Marietto-Gonçalves et al. (2009) carried out a study on parasitic infections in 11 orders of wild birds (Ciconiiformes, Columbiformes, Coraciiformes, Craciformes, Gruiformes, Passeriformes, Piciformes, Psittaciformes, Strigiformes, and Struthioniformes and Galliformes) of which, five (Ciconiiformes, Passeriformes, Galliformes, Piciformes and Psittaciformes) were parasitized. The parasites found by the authors were *Ascaridia* sp., *Balantidium* sp., *Blastocystis* sp., *Capillaria* sp., coccídios, *Entamoeba* sp., and *Heterakis* sp.

Eggs of *Capillaria* sp. were found in three different bird species (*Ardea alba* - great egret, *Galbula cyanescens* - bluish-fronted jacamar, and *Corythopsis torquatus* - ringed antpipit). *Capillaria* is one of the most pathogenic helminths for birds, and it can cause inappetence, emaciation, and diarrhea due to inflammation of the gastrointestinal tract (Júnior & Macari, 2000).

The presence of eggs of Ascaroidea, Heterakidae, and Davaineidae corroborates the results found by Giovannoni & Kubiak (2001), who described the parasitic fauna of helminths in domestic animals necropsied in different parts of the gastrointestinal tract, and by Brito et al. (2017) when analyzing the endoparasites of free-living wild birds in the Campus and PZ of UFAC. D'Ávila et al. (2017) in a study on helminths of *Columba livia* in the city of Juiz de Fora, State of Minas Gerais, southeastern Brazil, reported the presence of Davaineidae of the genus *Raillietina* sp.

Eggs of *Strongyloides* sp., cysts of *Entamoeba* sp. and oocysts of *Isospora* sp. were found in this study and also described by Snak et al. (2014) in 228 fecal samples from 37 captive bird species, in 22 enclosures of the Danilo Galafassi Municipal Park, in Cascavel - PR, finding parasites of the genera *Strongyloides*, *Eimeria*, *Capillaria*, *Delectrocephalus*, and *Isospora*. Magalhães-Matos et al. (2016) found a high prevalence of *Isospora* oocysts in wild birds bred in captivity in Pará, and in 163 samples analyzed by them, 71 (43.56%) were contaminated with these endoparasites.

Freitas et al. (2002) analyzed wild birds kept in captivity in the State of Pernambuco, northeastern Brazil and reported a high incidence of parasites, and of the 685 birds studied, 320 were parasitized with *Capillaria* sp., *Strongyloides* sp., *Ascaridia* sp., *Heterakis* sp., Spiruroides, Cestodea, Trematoda, Coccidia, *Entamoeba coli*, *E. histolytica*, and *Balantidium coli*.

Costa et al. (2010) only detected cysts of *Iodamoeba* sp. in *Xiphorhynchus guttatoides*, in a study on gastrointestinal parasites in wild birds in the municipality of Seropédica, State of Rio de Janeiro, southeastern Brazil, where they reported the presence of trichomonadidae, Chilomastix, coccidia, *Entamoeba coli*, *Iodamoeba butschlii*, and helminth eggs. The presence of cysts of *Entamoeba* sp. and *Iodamoeba* sp. in the local avifauna is worrying, because according to Costa et al. (2010), these protozoan parasites may be opportunistic pathogens in bird infections, and they are zoonotic.

Eggs of Dilepididae, Echinostomatidae, Oxyuroidea, and Strongyloidea in this study corroborates the results found by Brasil & Amato (1992), in a faunal analysis of the helminths of sparrows (*Passer domesticus*) captured in Campo Grande, State of Rio de Janeiro, southeastern Brazil. Brito et al. (2017) also found these parasites in the wild birds captured in the Campus and Zoobotanical Park of the Federal University of Acre.

The eggs of the nematode Syngamidae were found in the feces of *Amazilia lactea*, and this finding corroborates previous research published by Marques & Amato (2010). These authors carried out a survey on parasites affecting *Turdus rufiventris* (rufous-bellied thrush) in the metropolitan region of the city of Porto Alegre, State of Rio Grande do Sul, southern Brazil, where *Syngamus trachea* was seen infesting mainly immature birds.

However, infection by the eggs of cestode Davaineidae is a result that is similar to those published by D'Ávila et al. (2017). These authors studied helminths of *Columba livia* (rock dove) in the county of Juiz de Fora, State of Minas Gerais, southeastern Brazil, and they reported the presence of worms from the Davaineidae family. To our knowledge, eggs of Syngamidae have not been reported in wild birds in the State of Acre, being the only internal parasites found in our study that were not found in a previous study carried out by Brito et al. (2017).

Some of the endoparasites reported in the present study can pose a significant risk to wildlife health. They can be opportunistic or the primary cause of a disease (Daszak et al., 2000). These birds inhabit different geographical areas in the Resex and as a result, residents and domestic animals in this area may interact either directly or indirectly with infested wild birds, and they may end up acquiring some sort of parasitic infection from these birds.

The identification of the parasites found in this study was based on their morphometric characteristics, which hinders the differentiation between animal, human, and free-living parasites. For the proper identification of these parasites, it is necessary to use more sophisticated techniques that cannot be conducted in our laboratory such as culture, electron microscopy, and molecular biology. Even with our methodological limitations, we found parasites that may be pathogenic for both man and wild birds.

Conclusion

The wild birds of the Cazumbá-Iracema Extractive Reserve were parasitized by protozoa and helminths, with the order Passeriformes being the most studied and most parasitized. The main parasites were Ascaroidea, *Entamoeba* sp., and *Eimeria* sp.

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