

Isospora albicollis (Apicomplexa: Eimeriidae) in thrushes *Turdus* spp. (Passeriformes: Turdidae), in southeastern Brazil

Isospora albicollis (Apicomplexa: Eimeriidae) em sabiás *Turdus* spp. (Passeriformes: Turdidae), no sudeste Brasileiro

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Abstract

The aim of the present study was to report and describe *Isospora albicollis* Lainson and Shaw, 1989 parasitizing a white-necked thrush *Turdus albicollis* Vieillot, 1818 and a pale-breasted thrush *Turdus leucomelas* Vieillot, 1818 in two different localities: the Itatiaia National Park and Cacaria, in southeastern Brazil. The oocysts identified were ovoidal, $24.4 \times 19.7 \mu\text{m}$, with a smooth, bilayered wall, around $1.4 \mu\text{m}$ thick. Oocyst residuum was absent, but a micropyle and a polar granule were present. The sporocysts were ellipsoidal, $15.4 \times 10.1 \mu\text{m}$. The Stieda body was knob-like to rounded and the sub-Stieda body was prominent and wide. Sporocyst residuum was present, usually as a cluster of granules that appear to be membrane-bounded. The sporozoites were vermiform with one posterior refractile body and a centrally located nucleus. Besides recording the new host *T. leucomelas*, the identification of *I. albicollis* in the Itatiaia National Park and Cacaria, in southeastern Brazil, provide records of new localities for its parasitism, and reveals the wide distribution and dispersion of this coccidium in Brazil.

Keywords: Coccidia, oocysts, Taxonomy, Ecology, Parque Nacional do Itatiaia, Cacaria.

Resumo

O objetivo do presente estudo foi relatar e descrever *Isospora albicollis* Lainson e Shaw, 1989, parasitando um sabiá-coleira *Turdus albicollis* Vieillot, 1818 e um sabiá-barranco *Turdus leucomelas* Vieillot 1818, em duas localidades diferentes: Parque Nacional do Itatiaia e Cacaria, no Sudeste do Brasil. Os oocistos identificados foram ovóides, $24,4 \times 19,7 \mu\text{m}$, com uma parede lisa e dupla, com cerca de $1,4 \mu\text{m}$ de espessura. Resíduo do oocisto foi ausente, mas uma micrópila e um grânulo polar foram presentes. Esporocistos elipsoidais, $15,4 \times 10,1 \mu\text{m}$, corpo de Stieda em forma de botão arredondado e corpo de sub-Stieda proeminente e largo. Resíduo do esporocisto presente, usualmente como um aglomerado de grânulos que parecem estar envolvidos por uma membrana. Esporozóitos vermiformes com um corpo refrátil posterior e um núcleo centralizado. Além de registrar o novo hospedeiro *T. leucomelas*, a identificação de *I. albicollis* no Parque Nacional de Itatiaia e Cacaria, no Sudeste do Brasil, fornece registros de novas localidades para seu parasitismo e revela a ampla distribuição e dispersão desse coccídio no Brasil.

Palavras-chave: Coccidia, oocistos, Taxonomia, Ecologia, Parque Nacional do Itatiaia, Cacaria.

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Introduction

The thrushes *Turdus* spp. are passerines of the Turdidae family widely distributed in South America. In Brazil, they are abundant in the Atlantic and Amazon forests, preferentially inhabiting damp areas of taller trees on hillslopes, but also found near the ground feeding on small fruits and insects (SICK, 1997; IUCN, 2012).

Infections caused by isosporoid coccidia in Passeriformes are very common and are associated with several factors. As in most types of coccidiosis, there is a balance between the parasite and its host, but parasitism may possibly lead to cell death in the host during parasite development, causing clinical signs of variable severity. This evolution may arise when there is an imbalance, mainly associated with low immunity in the host (MARQUES et al., 2011).

Among the several *Isoospora* spp. recorded in Turdidae worldwide, *Isoospora tucuruensis* Lainson and Shaw, 1989, *Isoospora albicollis* Lainson and Shaw, 1989, and *Isoospora massardi* Lopes, Berto, Luz, Galvão, Ferreira and Lopes, 2014, have been described from the white-necked thrush *Turdus albicollis* Vieillot, 1818; however, no species has been described or reported from the pale-breasted thrush *Turdus leucomelas* Vieillot, 1818. Lopes et al. (2014) described *I. massardi* from white-necked thrushes on Marambaia Island in the state of Rio de Janeiro, whereas Lainson & Shaw (1989) described *I. albicollis* and *I. tucuruensis* from white-necked thrushes on Tocantins Island in the state of Pará, Brazil.

In this context, the aim of the present study was to report and describe *I. albicollis* from *T. albicollis* in the Itatiaia National Park and *T. leucomelas* in Cacaria, in southeastern Brazil.

Materials and Methods

Two expeditions were conducted in two different localities in southeastern Brazil: (1) Itatiaia National Park (22° 27' 38" S, 44° 35' 34" W), a protected area with a high degree of vulnerability, located in the Serra da Mantiqueira on the border of the States of Rio de Janeiro, Minas Gerais and São Paulo (ICMBIO, 2016); and (2) Cacaria (22° 42' 51" S, 43° 50' 38" W) at the Municipality of Pirai in the State of the Rio de Janeiro.

Three specimens of *T. albicollis* were caught in the expedition to the Itatiaia National Park in March 2015, and two specimens of *T. leucomelas* were caught in the expedition to Cacaria in June 2016. The thrushes were caught using mist nets, kept in individual boxes and feces were collected immediately after defecation. After identification of the species, the thrushes were photographed and released. The stool samples were placed in centrifuge tubes containing 2.5% potassium dichromate ($K_2Cr_2O_7$) solution at 1:6 (v/v). The samples were taken to the Laboratório de Biologia de Coccídios, Departamento de Biologia Animal, Instituto de Ciências Biológicas e da Saúde, Universidade Federal Rural do Rio de Janeiro (UFRRJ) where they were incubated at room temperature for one week. Oocysts were isolated by means of flotation in Sheather's sugar solution (specific gravity, 1.20) and were examined under a microscope using the technique described by Duszynski & Wilber (1997) and Berto et al. (2014). Morphological observations, line drawings, photomicrographs and measurements

were made using an Olympus BX binocular microscope coupled to a digital camera (Eurocam 5.0). Line drawings were edited using two software applications from CorelDRAW® (Corel Draw Graphics Suite, version 11.0, Corel Corporation, Canada), i.e. Corel DRAW and Corel PHOTO-PAINT. All measurements were made in micrometers and are presented as the range followed by the mean in parentheses. Field-collecting permits were issued to B.P. Berto and C.W.G. Lopes by SISBIO/ICMBio (licenses 42798-1; 45200-1) and CEUA/UFRRJ (protocols IV-036/2014; ICBS-008/2015).

Results

Three white-necked thrushes *T. albicollis* and two pale-breasted thrushes *T. leucomelas* were caught and their fecal samples were examined. One of each species shed oocysts that were identified as *I. albicollis*.

Isoospora albicollis Lainson and Shaw, 1989

(Figures 1, 2A-D)

Hosts: white-necked thrush *Turdus albicollis* Vieillot, 1818 (Passeriformes: Turdidae); pale-breasted thrush *Turdus leucomelas* Vieillot, 1818 (Passeriformes: Turdidae).

Material examined: Oocysts in 70% ethanol, photomicrographs and line drawings have been deposited and are available (<http://r1.ufrrj.br/labioc/colecao.html>) in the Parasitology Collection of the Laboratório de Biologia de Coccídios, at UFRRJ, located in Seropédica, Rio de Janeiro, Brazil. Photographs of the host specimens have been deposited in the same collection. The repository number is 67/2016.

Diagnosis: According to Duszynski & Wilber (1997) and Berto et al. (2011), a coccidian species should be compared in detail with coccidian species that are feature-similar and belong to the same host family. Among all coccidian species recorded

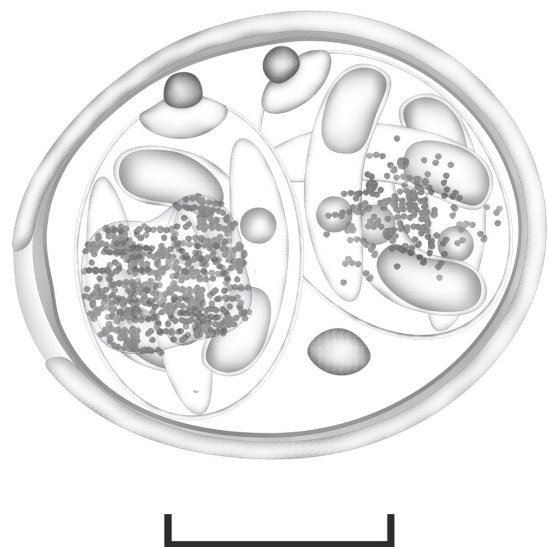


Figure 1. Composite line drawing of a sporulated oocyst of *Isoospora albicollis* from thrushes *Turdus* spp. in southeastern Brazil. Scale-bar: 10 μ m.

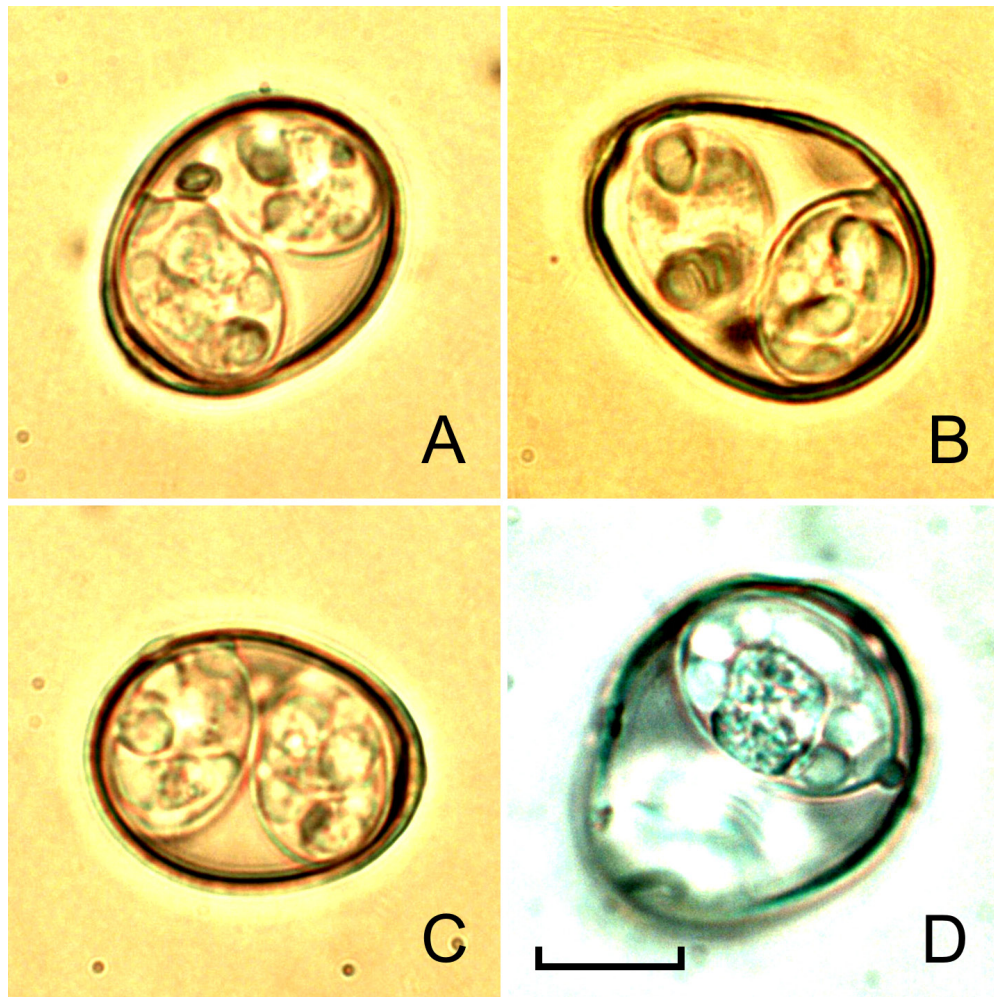


Figure 2. Photomicrographs of sporulated oocysts of *Isospora albicollis* from the white-necked thrush *Turdus albicollis* (A-C) and from the pale-breasted thrush *Turdus leucomelas* (D) in southeastern Brazil. Scale-bar: 10 μ m.

from Turdidae in the New and Old Worlds (BERTO et al., 2011; CARDOZO et al., 2015), only *I. albicollis* has a micropyle, which is a very uncommon characteristic feature in *Isospora* spp. In addition, all the morphological and morphometric characteristics of the oocysts observed in the present study were very similar to those of the original description of the oocysts of *I. albicollis* by Lainson & Shaw (1989), and were observed from the same host species. Thus, the oocysts shed by *T. albicollis* and *T. leucomelas* in the current study were easily identified as *I. albicollis*.

Description: Oocyst shape (n = 11) ovoidal; 23-26 \times 18-22 (24.4 \times 19.7) length/width (L/W) ratio 1.2-1.4 (1.24). Wall bilayered, 1.2-1.6 (1.4) thick, outer layer smooth, around two-thirds of total thickness. Micropyle present, without micropyle cap or wrinkles; however, generally with slight invagination of the inner layer. Oocyst residuum absent; but one polar granule present. Sporocysts (n = 11), ellipsoidal, 14-17 \times 9-11 (15.4 \times 10.1); L/W ratio 1.5-1.6 (1.52). Stieda body present, knob-like to rounded, 1.7 high, 1.3 wide; sub-Stieda body present, prominent and wide, 1.5 high, 3.1 wide; para-Stieda body absent. Sporocyst residuum present, usually as a cluster of granules that appear to be membrane-bounded. Sporozoite vermiform with one posterior refractile body and a centrally located nucleus.

Localities: Itatiaia National Park (22° 27' 38" S, 44° 35' 34" W) and Cacaria (22° 42' 51" S, 43° 50' 38" W), southeastern Brazil.

Prevalence: 2 of 5 (40%).

Discussion

Passerines establish a dynamic ecosystem beyond the physical aspects of diversity and behavioral biology, and perform several functions in the environment such as biological control of ants and ticks and seed dispersal (SEKERCIOGLU, 2006). In addition, these birds are host to a wide variety of parasites, which develop an adaptive mode of life in the body and can cause severe diseases that have an impact on the host's survival and reproduction and can affect various aspects of the host's life (DOLNIK et al., 2009).

Coccidiosis is a parasitic disease affecting the intestinal tract of vertebrates caused by coccidian Protozoa. This infection in wild birds in a habitat with favorable stable conditions is rarely a significant problem; however, symptomatic disease may occur when natural factors (changes, reproduction, heat, cold, migration, etc.) and/or anthropogenic factors (habitat loss, pollution, urbanization, agricultural activities, etc.) have an impact, thus contributing

towards stress and changing the birds' behavior (ATKINSON et al., 2008). Coccidiosis may give rise to severe symptoms in young or immunocompromised birds, including death (SOULSBY, 1985; GIRAudeau et al., 2014). In this context, thrushes are potential models for observing the dynamics of *Iso*pora spp. and the intensity of infection that is associated with several natural and anthropogenic environmental factors. Thrushes have high species richness, great diversity and wide geographic distribution. The species present greater or lesser adaptability to anthropogenic environments (SICK, 1997; CBRO, 2014).

*Iso*pora *albicollis* was originally described from white-necked thrushes in the state of Pará by Lainson & Shaw (1989). The type locality, Tocantins Island, no longer exists because it was flooded as part of the Tucuruí hydroelectric scheme. The Itatiaia National Park and Cacia, which are the new localities recorded in the present study are located at a distance of more than 2,800 km. In this regard, the wide distribution and dispersion of this coccidium in Brazil is noteworthy. Recently, Avendaño et al. (2013) investigated the dispersion of *Turdus nudigenis* Lafresnaye, 1848 in South America, and found that it migrated long distances. They suggested that the influence of the accelerated rate of habitat loss, fragmentation of natural forests and global warming might be having an effect regarding migration. In this manner, it can be seen that the wide distribution and migration of these species, combined with these predisposing factors, have promoted dispersion of *I. albicollis*, and probably other parasites, to other susceptible hosts in distant localities.

In conclusion, the present study identifies *I. albicollis* from the white-necked thrush *T. albicollis* and from the pale-breasted thrush *T. leucomelas*, in Itatiaia National Park and Cacia respectively. Therefore, *T. leucomelas* becomes a new host for *I. albicollis* and the records of these new localities in southeastern Brazil reveals the wide distribution and dispersion of this coccidium in Brazil.

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References

Atkinson CT, Thomas NJ, Hunter DB. *Parasitic diseases of wild birds*. Oxford: Wiley-Blackwell; 2008.

Avendaño JE, Cortés-Herrera JO, Briceño-Lara ER, Rincón-Guarín DA. Crossing or bypassing the Andes: a commentary on recent range

extensions of cis-Andean birds to the West of the Andes of Colombia. *Orinoquia* 2013; 17(2): 207-214.

Berto BP, Flausino W, McIntosh D, Teixeira-Filho WL, Lopes CWG. Coccidia of new world passerine birds (Aves: Passeriformes): a review of *Eimeria* Schneider, 1875 and *Iso*pora Schneider, 1881 (Apicomplexa: Eimeriidae). *Syst Parasitol* 2011; 80(3): 159-204. PMID:22002022. <http://dx.doi.org/10.1007/s11230-011-9317-8>.

Berto BP, McIntosh D, Lopes CWG. Studies on coccidian oocysts (Apicomplexa: Eucoccidiorida). *Rev Bras Parasitol Vet* 2014; 23(1): 1-15. PMID:24728354. <http://dx.doi.org/10.1590/S1984-29612014001>.

Cardozo SV, Berto BP, Fonseca IP, Tomás A, Thode FRPB, Lopes CWG. Characterisation of *Iso*pora *lusitanensis* n. sp. (Apicomplexa: Eimeriidae) from the Eurasian blackbird *Turdus merula* Linnaeus (Passeriformes: Turdidae) in mainland Portugal. *Syst Parasitol* 2015; 92(2): 171-179. PMID:26358076. <http://dx.doi.org/10.1007/s11230-015-9590-z>.

Comitê Brasileiro de Registros Ornitológicos – CBRO. *Lista das aves do Brasil*. Rio de Janeiro: CBRO; 2014.

Dolnik OV, Von Ronn JAC, Bensch S. *Iso*pora *hypoleuca* sp. n. (Apicomplexa: Eimeriidae), a new coccidian parasite found in the Pied Flycatcher (*Ficedula hypoleuca*). *Parasitology* 2009; 136(8): 841-845. PMID:19450377. <http://dx.doi.org/10.1017/S0031182009006131>.

Duszynski DW, Wilber P. A guideline for the preparation of species descriptions in the Eimeriidae. *J Parasitol* 1997; 83(2): 333-336. PMID:9105325. <http://dx.doi.org/10.2307/3284470>.

Giraudeau M, Mousel M, Earl S, McGraw K. Parasites in the city: degree of urbanization predicts poxvirus and coccidian infections in house finches (*Haemorhous mexicanus*). *PLoS One* 2014; 9(2): e86747. PMID:24503816. <http://dx.doi.org/10.1371/journal.pone.0086747>.

Instituto Chico Mendes de Conservação e Biodiversidade – ICMBIO. *Unidades de Conservação: Parque Nacional de Itatiaia*. Itatiaia; 2016. [cited 2016 Oct 17]. Available from: <http://www.icmbio.gov.br/parnaitatia>.

Lainson R, Shaw JJ. Two new species of *Eimeria* and three new species of *Iso*pora (Apicomplexa, Eimeriidae) from Brazilian mammals and birds. *Bull Mus Natl Hist Nat* 1989; 11(2): 349-365.

Lopes BB, Berto BP, Luz HR, Galvão GS, Ferreira I, Lopes CWG. *Iso*pora *massardi* sp. nov. (Apicomplexa: Eimeriidae) from the white-necked thrush *Turdus albicollis* (Passeriformes: Turdidae) from Brazil. *Acta Parasitol* 2014; 59(2): 272-275. PMID:24827098. <http://dx.doi.org/10.2478/s11686-014-0240-4>.

Marques MV, Vilela DA, Andrade EA, Galvão CZ, Resende JS, Ferreira-Junior FC, et al. Fatal coccidiosis by *Iso*pora *icterus* (Upton & Whitaker, 2000) in captive campo Troupial (*Icterus jamaicensis*) in Brazil. *J Zoo Wildl Med* 2011; 42(4): 735-737. PMID:22204073. <http://dx.doi.org/10.1638/2010-0229.1>.

Sekercioglu CH. Increasing awareness of avian ecological function. *Trends Ecol Evol* 2006; 21(8): 464-471. PMID:16762448. <http://dx.doi.org/10.1016/j.tree.2006.05.007>.

Sick H. *Ornitologia Brasileira*. Brasília: Nova Fronteira; 1997.

Soulsby EJ. Advances in immunoparasitology. *Vet Parasitol* 1985; 18(4): 303-319. PMID:3911547. [http://dx.doi.org/10.1016/0304-4017\(85\)90066-4](http://dx.doi.org/10.1016/0304-4017(85)90066-4).

The IUCN Red List of Threatened Species – IUCN. *Turdus albicollis*. Cambridge: IUCN; 2012 [cited 2016 Oct 17]. Available from: <http://dx.doi.org/10.2305/IUCN.UK.2012-1.RLTS.T22708942A39741540.en>.