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HAEMOPARASITES IN CAPTIVE BIRDS AT UBERLÂNDIA ZOO, STATE OF MINAS GERAIS, BRAZIL

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Abstract

Haemoparasites are one of the most important groups of bird parasites, with emphasis on the genera *Haemoproteus*, *Plasmodium*, *Leucocytozoon* and *Trypanosoma*. Zoos sustain different wild animals and are valuable tools for the education and conservation of species. The conditions of captive animals differ from wild animals, as zoos have sufficient availability of food throughout the year, protection against predators and veterinary care for animals. This study aimed to determine the prevalence of haemoparasites in captive birds of the Sabiá Municipal Park Zoo, municipality of Uberlândia, state of Minas Gerais, Brazil. Blood samples were collected from the alveolar vein puncture to make blood swabs. This material was fixed with methanol, stained by the GIEMSA technique and examined under optical microscope. A total of 46 birds (19 species) were analyzed and only three individuals (6.52%) were positive for *Plasmodium* sp. The hosts were *Pavo cristatus* and *Tyto furcata*. This low positivity was expected, since haemoparasites do not generally present high infection rates among birds. Even if a parasite is not pathogenic for a given species, these individuals are important reservoirs for the infection of more vulnerable species. Differences in the prevalence and intensity of infection of these hosts depend on the virulence of the parasite, ability of the host to respond to such infections and vector availability. This low prevalence rate suggests a good health status of the captive birds in the study area.

Keywords: Avian Malaria. Blood Parasites. Captive Animals. Haematozoa. *Plasmodium*.

1. Introduction

All vertebrate groups have parasites that can interfere with evolutionary and ecological processes (Olsen 1974). Indeed, parasites influence mortality, reproduction and many other attributes related to the fitness of the host (Redpath et al. 2000). In birds, the parasitism is reflected in the secondary sexual characteristics, such as the brightness of the male plumage and the body weight of the individuals (Scheuerlein and Ricklefs 2004); which may represent an indication of low genetic quality and compromise sexual selection and other ecological, evolutionary and behavioral processes (Hamilton and Zuk 1982; Kirkpatrick et al. 1991). Blood parasites constitute one of the main bird parasite groups (Campbell 1995).

Zoos sustain different wild animal groups and are important in the education and conservation of species. The conditions of captive animals differ from wild animals, as zoos have sufficient availability of food throughout the year, protection against predators and veterinary care for animals. On the other hand, when in captivity, animals can live in a restricted space with many individuals, which can favor the transmission of infectious and parasitic diseases (Chagas 2017). Deaths caused by haemoparasites have

been recorded in zoos around the world (Valkiunas 2005). The main reasons for these occurrences are the high density of confined animals and the contact of species from different geographic regions (Silva and Corrêa 2006; Chagas 2017). In zoos, the environment and stress factors can influence the balance of captive animals, which facilitates the development of diseases (Panayotova-Pencheva 2013).

Despite the importance of blood parasites for captive birds, few studies have focused on this subject, and these are mainly based on necropsies (Grim et al. 2003; Schrenzel et al. 2003; Ferrell et al. 2007). In Brazil, little attention has also been paid to infections by blood parasites in zoos and commercial breeding grounds, resulting in a small number of studies (Belo et al. 2009; Tostes et al. 2015). This study aimed at determining the prevalence of blood parasites in captive birds at the Zoo of Sabiá Municipal Park, State of Minas Gerais, Brazil.

2. Material and Methods

Study area

The study was carried out at the Sabiá Municipal Park (48º14'02 "O - 18º54'52" S), located in the urban perimeter of the municipality of Uberlândia, State of Minas Gerais. This Park is managed by the Uberlandian Foundation for Tourism, Sports and Leisure and has a total area of 185 ha, of which 35 ha are occupied by remnants of native vegetation (Guilherme et al. 1998). The altitude varies around 890m above sea level. The region where the zoo is located presents metamorphic Aw type weather (Köppen 1948) with two well defined seasons, one with hot and rainy summer, which extends from October to April, and the other with cold, dry winter of May to September (Rosa et al. 1991).

In the Zoo of Sabiá Municipal Park the animals were housed in nurseries made of masonry and with metallic screens on the upper and lateral parts. All the enclosures have renewable water, removable and washable feeders, perches made of branches and trunks, nests or substrates for the making of nests. Shelters provide protection from sun, rain and wind, as well as an escape area that provides psychological security for birds. The nurseries have variable sizes and the types of floor can be of sand, earth, foliage and cement. In addition, they have shrub or arboreal vegetation and can have mirror of water, respecting the biology of each species.

Data collected

The study was conducted from May 2009 to July 2010. For the analysis of avian haemoparasites, blood samples from birds were collected from both individuals kept on display and from those who were quarantined. To obtain the samples, peripheral blood drops of the birds were collected from the alar vein (brachial/ulnar) puncture taking into account the biology / ecology of each species (Adriano and Cordeiro 2001). Blood collection was performed with capillary tubes.

Two blood smears were made per research subject. The smears were dried at room temperature, fixed with methanol and stained by GIEMSA solution in buffered water (pH 7.2-7.4). The smear blades were systematically examined under an optical microscope, with an immersion objective (1000x magnification), using the direct haemoparasite screening technique, in order to determine the presence of haematozoa (Valkiunas 2005; Fecchio et al. 2007). Blood smears were analyzed throughout their length. The leaf scanning consisted of detecting filariasis, as well as species of the *Trypanosoma*, *Haemoproteus*, *Plasmodium* and *Leucocytozoon*, which are the most commonly encountered avian hemoparasites (Valkiunas 2005; Sehgal et al. 2005; Arriero and Møller 2008). Subsequently, the positivity rate was calculated from the number of infected individuals divided by the total number of individuals examined.

3. Results

A total of 46 individuals (19 species) were analyzed and the overall prevalence rate of blood parasites was 6.5% (Table 1).

Table 1. Number of birds examined and parasitized by Plasmodium sp. in the zoo of the Sabiá Municipal Park, Minas Gerais, Brazil. The taxonomic order and the nomenclature of the native birds follow the determinations of the Brazilian Committee of Ornithological Records (CBRO 2015).

Taxonomic groups	Popular name	Individuals (n)	
		Examined	Infected (%)
Cathartiformes Seebohm, 1890			
Cathartidae Lafresnaye, 1839			
Sarcoramphus papa (Linnaeus, 1758)	King Vulture	2	0
Falconiformes Bonaparte, 1831			
Accipitridae Vigors, 1824			
Geranoaetus albicaudatus (Vieillot, 1816)	White-tailed Hawk	1	0
Heterospizias meridionalis (Latham, 1790)	Savanna Hawk	2	0
Rupornis magnirostris (Gmelin, 1788)	Roadside Hawk	1	0
Falconidae Leach, 1820			
Caracara plancus (Miller, 1777)	Southern Caracara	1	0
Falco femoralis Temminck, 1822	Aplomado Falcon	2	0
Falcosparverius Linnaeus, 1758	American Kestrel	1	0
Milvago chimachima (Vieillot, 1816)	Yellow-headed Caracara	1	0
Galliformes Linnaeus, 1758			
Phasianidae			
**Pavo cristatus*Linnaeus, 1758*	Indian Peafowl	4	2 (50)
Piciformes Meyer & Wolf, 1810			
Ramphastidae Vigors, 1825			
Ramphastos toco Statius Muller, 1776	Toco Toucan	1	0
Psittaciformes Wagler, 1830			
Psittacidae Rafinesque, 1815			
Amazona aestiva (Linnaeus, 1758)	Turquoise-fronted Parrot	4	0
Ara ararauna (Linnaeus, 1758)	Blue-and-yellow Macaw	5	0
Ara chloropterus Gray, 1859	Red-and-green Macaw	2	0
Eupsittula aurea (Gmelin, 1788)	Peach-fronted Parakeet	2	0
Psittacara leucophthalmus (Statius Muller, 1776)	White-eyed Parakeet	3	0
Brotogeris chiriri (Vieillot, 1818)	Yellow-chevroned Parakeet	10	0
Diopsittaca nobilis (Linnaeus, 1758)	Red-shouldered Macaw	2	0
Strigiformes Wagler, 1830			
Strigidae Leach, 1820			
Athene cunicularia (Molina, 1782)	Burrowing Owl	1	0
Tytonidae Mathews, 1912			
Tyto furcata (Temminck, 1827)	American Barn Owl	1	1 (100)
Total		46	3 (6.5)

* Exotic species.

The only blood parasite found in this survey was *Plasmodium* sp. (Figure 1). Psittacidae was the family with the highest number of individuals sampled (n= 28, 60.9%) (Table 1).

The results showed that two species were infected at the Sabiá Park Zoo: *Pavo cristatus* (two individuals) and *Tyto furcata* (one) (Table 1). *P. cristatus* was the only exotic species investigated. All the others came from the region of Uberlândia (MG).

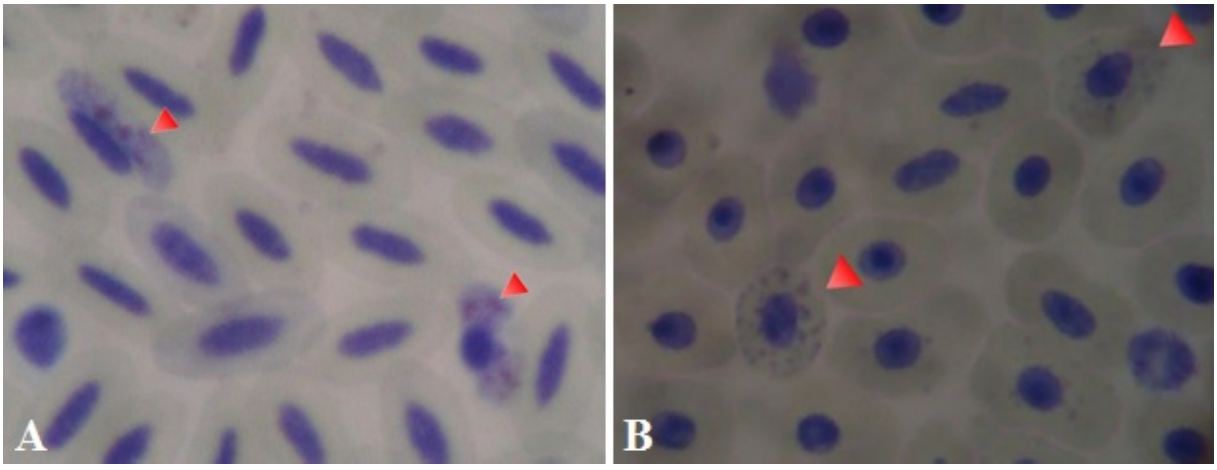

Figure 1. (A) Gametocytes of *Plasmodium* sp. in erythrocytes of *Tyto furcata* and (B) merozoites of *Plasmodium* sp. in the erythrocytes of *Pavo cristatus*. 1000x magnification.

4. Discussion

We expected a low positivity in the studied group, since haemoparasites do not generally present high infection rates among birds (Fecchio et al. 2007). Hemoparasitism rates below 7% have also been observed by other authors for neotropical birds (Bennett et al. 1991; Winchell 1978; Fecchio et al. 2007). We must also consider the effect of the method used in the present study, since several researches show that the Polymerase Chain Reaction (PCR) technique is generally more sensitive than microscopy in the detection of blood parasites (Fallon et al. 2003; Ricklefs et al. 2005; Ricklefs and Sheldon 2007). In spite of this, avian plasma has been used as an ecological model of host-parasite systems, being important for understanding the ecology, conservation and management of several bird species in natural conditions and in captivity (Ribeiro et al. 2005).

In natural areas of the Cerrado, Fecchio et al. (2007) reported a prevalence rate of 6.9%, identifying two genera of hemoparasites: *Plasmodium* and *Haemoproteus*. Differences in the prevalence and intensity of infection of these hosts depend on the virulence of the parasite, ability of the host to respond to such infections and vector availability (Fallon and Ricklefs 2008). In neotropical birds, the low prevalence of blood parasite region is possibly due to the scarcity of appropriate vectors (Valkiunas et al. 2005).

In a study conducted by Belo et al. (2009), with psittacines in captivity, *Amazona aestiva* and *Ara ararauna* were the species most infected by *Plasmodium* sp. These two species were also investigated in the present study, but none of them were positive for haemoparasites. Birds from other localities that are introduced into zoos can carry parasites and increase the risk of establishing emerging diseases. Likewise, these birds may be more susceptible to a new infection, since they did not coevolve with the local parasites of the destination region (Valkiunas 2005). It should be noted that a parasite may not even be pathogenic for a given species, but these reservoirs are important for the infection of more vulnerable species (Ziman et al. 2004).

The introduction of infected birds into zoos, native or exotic, is a risk factor for dissemination of communicable diseases (Atkinson et al. 2000; Belo et al. 2009). At the Sabiá Park Zoo, many birds live in close proximity to the precincts, including several species of pigeons (*Zenaida auriculata*, *Columbina talpacoti*, *Patagioenas picazuro* and *Columba livia*), ducks (*Cairina moschata*, *Amazonetta brasiliensis* and *Alopochena egyptiacus*) and little birds (*Pitangus sulphuratus*, *Passer domesticus*, among others), which potentiates the risk of transmission of infectious agents to captive birds. Marques et al. (2007), studying 58 individuals of *Columba livia* (domestic pigeon), found more than 40% of animals parasitized by *Haemoproteus*. Chagas et al. (2016) recorded *Haemoproteus columbae* on all sampled specimens of free-living *Columba livia* in the São Paulo Zoo and *Plasmodium* sp. in *Dendrocygna viduata* (white-faced whistling duck). We believe that this close and constant contact between captive and free bird species justifies the need for permanent monitoring of zoo animals. This is mainly because parasites can influence host biodiversity and dynamics by altering the competitive interaction between free-ranging birds and captive birds (Chagas et al. 2016).

Belo et al. (2009) also only found this genus in captive birds. Another group that has been found in studies with captive birds is *Haemoproteus* (Tostes et al. 2015). Both *Plasmodium* and *Haemoproteus* are most commonly found in natural environments (Fecchio et al. 2007; Belo et al. 2011). It is believed that more than 30 species of *Plasmodium* are infectious agents for birds (Atkinson 2001).

In the Neotropical region, the main vectors of *Plasmodium* spp. are ornitophilic mosquitoes of the Culicidae family, involving the genera *Culex*, *Aedes* and, rarely, *Anopheles*, which is a vector restricted to the parasites of mammals (Atkinson 2001). Bueno et al. (2010) found a high density and diversity of mosquitoes that can transmit avian malaria causing mortality in penguins at São Paulo Zoo. Chagas et al. (2013) had identified and characterized molecularly *Plasmodium (Novyella) nucleophilum* from a captive goose born at the same Zoo. In the municipality of Uberlândia, *Aedes aegypti* is widely distributed (Santos and Marçal Junior 2004), which increases the transmission risk of haemoparasites to captive birds. Thus, carrying out vector control is important, as birds can be reservoirs of pathogens and infections can easily be transmitted from captive birds to birds in natural habitat or that will be reintroduced (Tostes et al. 2015). It is important to mention that birds kept in captivity are often exported to other locations, which can be considered a risk factor in the spread of disease among uninfected birds. In addition, the introduction of infected birds into zoos can endanger the health of birds kept in captivity (Belo et al. 2009).

5. Conclusions

The captive birds at the Zoo of Sabiá Municipal Park show a low prevalence rate of blood parasites, compared to other bird communities in the Neotropical region. The only haemoparasite found in infected birds was *Plasmodium* sp., the avian malaria agent, which reinforces the importance of good management and care of the animals in the park.

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Ethics Approval: Not applicable.

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