Prevalence and Intensity of *Haemoproteus columbae* in Three Species of Wild Doves from Brazil

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The prevalence and intensity of blood parasites in three species of wild doves were studied in the municipality of Junqueirópolis, in the western region of the State of São Paulo, Brazil. Three species of doves were surveyed: 331 specimens of Zenaida auriculata *Des Murs, 1847, 62 specimens of* Columbina talpacoti *Temminck, 1811 and 57 specimens of* Scardafella squammata *Lesson, 1831.* Haemoproteus columbae *Kruse, 1890 was found in blood from all the doves species. The prevalence of this parasite was 100% in* Z. auriculata, *51.6% in* C. talpacoti *and 19.3% in* S. squammata. *Specimens of* Z. auriculata *had a higher intensity of infection than the other doves species.*

Key words: *Haemoproteus columbae* - *Zenaida auriculata* - *Columbina talpacoti* - *Scardafella squammata* - wild doves - Hippoboscidae

Haemoproteids occur widely in avian populations. In columbids seven species of *Haemoproteus* were described: *Haemoproteus columbae* Kruze, 1890; *Haemoproteus sacharovi* Novy and MacNeal, 1904; *Haemoproteus maccallumi* Novy and MacNeal, 1904; *Haemoproteus melopeliae* Laveran and Petit, 1909; *Haemoproteus turtur* Covaledo Ortega and Gallego Berenguer, 1950; *Haemoproteus perise* Son, 1960 (Bennett & Peirce, 1990). Levine (1961) regarded only *H. columbae* and *H. sacharovi* as distinct, and the remaining names were considered as synonyms of *H. columbae*. Baker (1966) described *H. palumbis* from *Columba palumbis palumbis* Linnaeus, 1758, and also questioned the validity of some of these species. Bennett and Peirce (1990), in a taxonomic review of the haemoproteids parasites of columbids, proposed that only *H. columbae* and *H. sacharovi* are valid species.

Hippoboscids flies are incriminated vectors of *Haemoproteus* spp. of Columbiformes. Natural vectors of *H. sacharovi* are unknown (Bennett & Peirce 1990), but *Peseudolinchia maura* (Bigot) transmitted this parasite in experimental infection (Huff 1932). *Pseudolinchia canariensis* (Macquart) was incriminated as the vector of *H. columbae* in *Columba livia* Gmelin, 1789 in nature (Klei & DeGiust 1975) and in experimental infection (Ahmed & Mohammed 1977). Greiner (1975) pointed out *Microlynchia pusilla* (Speiser) and *Stilbometopa podopostyla* (Speiser) as potential vectors of *H. sacharovi* and *H. macallumi* in *Zenaida macroura* Linnaeus, 1758.

Despite the importance of columbids in wild and/or domestic bird populations and also the synanthropic character of some doves species, few workers have studied the prevalence and intensity of haemoparasites in these birds (Greiner 1970, 1975, Gutiérrez 1973, Klei & DeGiusti 1975, Shamis & Forrester 1977, Dias et al. 1984, Mandal 1990).

In this work, the prevalence and intensity of haemoproteids were evaluated in three species of wild doves, namely, *Zenaida auriculata* Des Murs, 1847, *Columbina talpacoti* Temminck, 1811 and *Scardafella squammata* Lesson, 1831.

MATERIALS AND METHODS

Adult specimens of *Z. auriculata* (n=331), *C. talpacoti* (n=62) and *S. squammata* (n=57) were captured using gauze-traps (Ibama 1994) in the municipality of Junqueirópolis, in the western region of the State of São Paulo, Brazil (21º31'S, 51º31'W), between January and December 1998.

Blood samples for the preparation of blood smears were obtained from a brachial vein and the doves then tagged and released. The air-dried blood smears were subsequently fixed in absolute methanol and stained with Giemsa's solution. The slides were examined microscopically at a magnification of 1000x. Parasites were only counted in fields with a homogenous distribution of erythrocytes, which most frequently occurred in the tails of the smears.

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The number of parasitized cells in each smear was counted in 300 fields using a micrometer incorporated into the eyepiece. The area covered by a 1000x magnification corresponded to 3.6 mm^2.

Based on previous estimations, 300 fields contained an average of 30,000 red blood cells (RBC). The parasite species was identified by comparison with haemoproteid parasites of columbids described in the literature (Bennett & Peirce 1990). Linear dimensions were obtained as described by Bennett and Campbell (1972) using a Zeiss Photomicroscope Axioplan II and Image-Pro Lite 4.0 program (Media Cybernetics 1998). Areas were determined with the aid of a camera lucida and counting squares on a grid (Forrester et al. 1977). Measurements are expressed as means followed (in parentheses) by the standard deviation. The number of specimens is indicated by N and the Nuclear Displacement Ration by NDR. Photomicrographs were obtained using a Zeiss Standard microscope and Kodak TMAX 100 film.

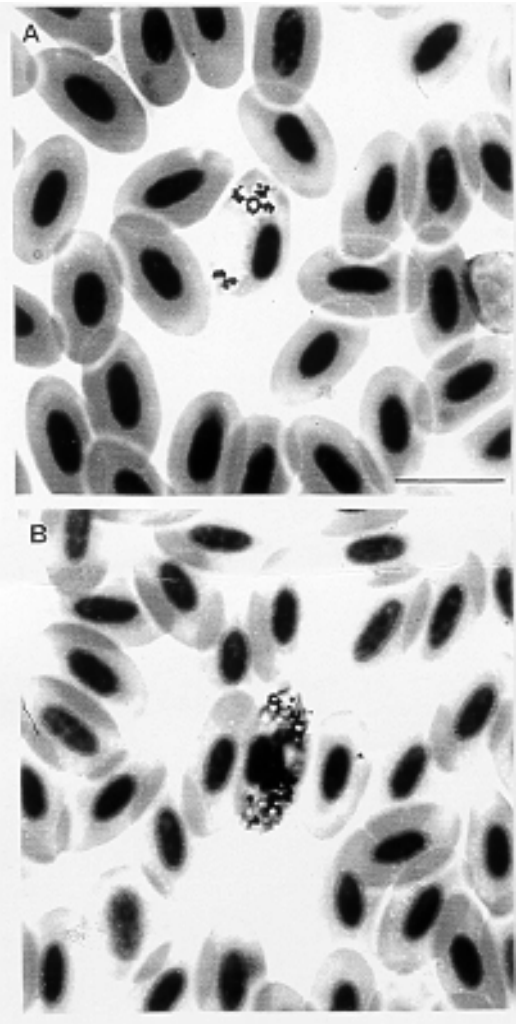
A chi-square test was used to compare the prevalence of the parasite among dove species. Pearson's correlation coefficient was used to determine if there was a correlation between the level of parasitaemia and the ambient temperature when the doves were caught.

RESULTS

Haemoproteus columbae Kruse, 1890 (Figure) was the only hemoparasite found in blood smears of the doves examined. The prevalence of infection was 100% in *Z. auriculata*, 51.6% in *C. talpacoti* and 19.3% in *S. squammata.* This difference among the prevalence in dove species was significant ($\chi^2_2 = 280.20$; $p<0.0001$).

The intensity of the parasitaemia in *Z. auriculata*, was 1-806 infected cells per 30,000 RBC, and 51.3% of the positive samples had a parasitaemia of 1-40 infected cells per 30,000 RBC. Parasitaemias of 41-100 infected cells per 30,000 RBC were recorded in 26.9% of the infected doves, and parasitaemias of 101-400 infected cells per 30,000 RBC were found in 18.3% of the infected birds. Only 14.7% of the parasitized doves had more than 500 infected cells per 30,000 RBC. The highest parasitaemia (2.7%) was observed in one specimen captured in August.

The intensity of parasitaemia in *C. talpacoti* was 1-30 infected cells per 30,000 RBC; 68.4% of the infected doves had parasitaemias of 1-6 infected cells per 30,000 RBC, 26% of the parasitized doves had parasitaemias of 9-15 infected cells per 30,000 RBC, and only 5.2% had more than 15 infected erythrocytes per 30,000 RBC. The highest parasitaemia (0.1%) was observed in one specimen caught in February.



Photomicrographs of gametocytes of *Haemoproteus columbae* in erythrocytes of *Zenaida auriculata*. A: microgametocyte; B: macrogametocyte. Bar = 10 µm

The intensity of parasitaemia in *S. squammata* was 1-9 infected cells per 30,000 RBC, and 81.8% of the samples positives had parasitaemias 1-6 infected cells per 30,000 RBC. Parasitaemias involving more than seven infected cells per 30,000 RBC were recorded in only 18.2% of the parasitized doves. One specimen with highest parasitaemia (0.03%) was captured in October.

The sex ratio of gametocytes was calculated for the three species of doves. It was 77.3% macrogametocytes for *Z. auriculata*, 81.9% for *C. talpacoti* and 76.9% for *S. squammata.*

There was no correlation between the level of parasitaemia and the variation in ambient temperature ($r=0.017$; $p=0.857$).

During this study we observed the occurrence of two species of hippoboscids flies on doves: *P.*

canariensis and *Stilbometopa* sp. The prevalence of *P. canariensis* was 58.4% in *Z. auriculata*, 36.5% in *C. talpacoti* and 33.6% in *S. squammata*. *Stilbometopa* sp. was found in 13.8% of the specimens of *Z. auriculata*, 7.2% of *C. talpacoti* and 8.4% of S. *squammata*.

DISCUSSION

This is the first study to compare the prevalence and intensity of *H. columbae* among dove species in the neotropical region. *Z. auriculata* had a higher prevalence and intensity of parasitism than *C. talpacoti* and *S. squammata*. The reasons for

TABLE

Morphometric parameters of gametocytes of *Haemoproteus columbae* of the three species of doves compared with *H. columbae* of *Columba livia* and *H. sacharovi* of *Zenaida macroura* according to Bennett and Peirce (1990)

	Our results			Bennett and Peirce (1990)	
	Haemoproteus (Z. auriculata)	*Haemoproteus (S. squammata)*	*Haemoproteus (C. talpacoti)*	*Haemoproteus columbae*	*Haemoproteus sacharovi*
N=	60	60	60	120	55
Uninfected erythrocyte					
Length µm	12.6(1)	13.2(0.8)	12.4(0.7)	13.3(1.1)	13.2(1.3)
Width µm	7.1(0.4)	7.4(0.4)	7.2(0.4)	7.1(0.5)	7.1(0.6)
Area µm^2	74.3(6.7)	86.3(8.3)	82.1(10.6)	75.6(9.4)	74.4(10.6)
Nucleus of uninfected erythrocyte					
Length µm	5.6(0.7)	6.8(0.5)	6.3(0.5)	6.0(0.8)	5.8(0.6)
Width µm	2.5(0.4)	2.7(0.2)	2.8(0.3)	2.0(0.3)	2.1(0.3)
Area µm^2	13.0(3)	15.6(5.3)	16.6(5.2)	10.2(2.1)	10.3(2.2)
N=	63	32	43	120	55
Macrogametocyte infected erythrocyte					
Length µm	13.6(0.7)	13.3(0.4)	14.1(0.8)	13.9(0.9)	16.0(0.9)
Width µm	7.4(0.8)	7.5(0.4)	7.1(0.6)	7.7(0.6)	9.3(1.7)
Area µm^2	83.2(8.7)	87.3(12.8)	84.7(12.2)	86.3(9.0)	115.6(20.7)
Nucleus of infected erythrocyte					
Length µm	5.4(0.9)	6.0(0.6)	5.6(0.5)	6.0(0.8)	10.0(1.4)
Width µm	2.2(0.3)	2.4(0.3)	2.3(0.3)	2.1(0.3)	2.5(0.4)
Area µm^2	11.8(3)	14.0(5.1)	14.5(5.2)	10.4(0.2)	19.7(3.7)
NDR	0.4(0.2)	0.5(0.3)	0.3(0.2)	0.5(0.2)	—
Macrogametocyte					
Length µm	12.8(0.7)	13.0(0.9)	13.3(0.8)	14.7(1.0)	16.0(0.9)
Width µm	3.5(0.6)	3.5(0.5)	3.1(0.6)	3.9(0.5)	8.2(1.6)
Area µm^2	51.0(8.2)	55.1(12.7)	53.5(11.3)	52.4(6.0)	95.1(19.3)
No. pigment granules	24.9(2.6)	25.5(6.6)	25.5(2.5)	27.3(2.9)	—
N=	42	32	36	120	55
Microgametocyte infected erythrocyte					
Length µm	13.5(0.8)	13.2(0.6)	13.2(0.6)	18.8(1.1)	16.2(1.0)
Width µm	7.8(0.7)	8.1(0.6)	6.8(0.6)	7.5(0.6)	8.9(1.4)
Area µm^2	87.8(9.1)	94.6(0.6)	84.2(12.1)	82.9(10.3)	110.1(16.4)
Nucleus of infected erythrocyte					
Length µm	5.6(0.5)	6.8(0.6)	5.7(0.4)	6.1(0.7)	10.2(1.0)
Width µm	2.2(0.3)	2.2(0.2)	2.4(0.4)	2.1(0.3)	2.7(0.5)
Area µm^2	11.9(2.5)	16.6(5.2)	13.5(4.8)	10.6(1.8)	22.5(0.5)
NDR	0.5(0.16)	0.5(0.2)	0.4(0.3)	0.6(0.2)	—
Microgametocyte					
Length µm	12.0(0.9)	11.8(1.5)	12.1(0.9)	14.7(1.6)	16.2(1.0)
Width µm	4.0(0.6)	4.5(0.9)	3.2(0.5)	3.5(0.5)	8.2(1.4)
Area µm^2	49.1(8.4)	49.9(10.4)	44.7(9.6)	48.2(6.5)	86.0(15.5)
No. pigment granules	12.9(2.8)	13.7(1.3)	16.2(1.8)	12.2(1.8)	—

N: number of specimens; NDR: Nuclear Displacement Ration

these differences are unknown but, as suggested White et al. (1978), may involve behavioral aspects or some physiological condition intrinsic to the species that may make the host more or less susceptible to the parasite.

From a behavioral point of view, *C. talpacoti* and *S. squammata* live in small flocks of a few individuals or are solitary (Hilty & Brown 1986), whereas *Z. auriculata* lives in large flocks (Aguirre 1976, Donatelli et al. 1995) which facilitates the transmission of vectors and leads to a high prevalence and intensity of parasites. The higher prevalence of *H. columbae* in *C. talpacoti* than in *S. squammata* indicates that, in addition to behavioral aspects, physiological factors may also be involved in the parasite-host-vector relationship.

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