

# Gastrointestinal helminths of two populations of wild pigeons (*Columba livia*) in Brazil

Helminthos gastrointestinais de duas populações de pombos de vida livre (*Columba livia*) no Brasil

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## Abstract

The present study analyzed gastrointestinal helminth communities in 265 wild pigeons (*Columba livia*) living in the municipalities of São Paulo and Tatuí, state of São Paulo, Brazil, over a one-year period. The birds were caught next to grain storage warehouses and were necropsied. A total of 790 parasites comprising one nematode species and one cestode genus were recovered from 110 pigeons, thus yielding an overall prevalence of 41.5%, mean intensity of infection of  $7.2 \pm 1.6$  (range 1-144) and discrepancy index of 0.855. Only 15 pigeons (5.7%) presented mixed infection. The helminths isolated from the birds were *Ascaridia columbae* (Ascaridiidae) and *Raillietina* sp. (Davaineidae). The birds' weights differed according to sex but this did not influence the intensity of infection. The overall prevalence and intensity of infection did not differ between the sexes, but the prevalence was higher among the birds from Tatuí (47.8%). The gastrointestinal helminth community of *C. livia* was characterized in the two areas studied and parasite homogeneity was observed over the 12 months analyzed at both locations. These results make contributions to the current literature on health aspects of wild *C. livia* populations.

**Keywords:** Columbiformes, helminthology, nematodes, cestodes, *Ascaridia*, *Raillietina*.

## Resumo

O presente estudo analisou comunidades gastrointestinais de helmintos em 265 indivíduos de *Columba livia* de vida livre nos municípios de São Paulo e Tatuí, estado de São Paulo, Brasil, durante um ano. As aves foram capturadas em áreas de armazenamento de grãos e sementes e necropsiadas. Um total de 790 parasitos representando uma espécie de nematódeo e um gênero de cestóide foram recuperados de 110 pombos com uma prevalência geral de 41,5%, intensidade média de infecção de  $7,2 \pm 1,6$  (amplitude 1-144) e índice de discrepância de 0,855. Somente 15 (5,7%) pombos tiveram uma infecção mista. Os helmintos isolados das aves foram *Ascaridia columbae* (Ascaridiidae) e *Raillietina* sp. (Davaineidae). O peso das aves foi diferente entre os sexos, mas não influenciou a intensidade de infecção. A prevalência geral e a intensidade de infecção não foram diferentes entre sexo, mas a prevalência foi maior nas aves de Tatuí (47,8%). A comunidade gastrointestinal de helmintos de *C. livia* foi caracterizada nas duas áreas estudadas e uma homogeneidade de parasitos foi observada nos 12 meses analisados, em ambas localidades. Os resultados contribuem para a literatura atual sobre aspectos sanitários de populações de *C. livia* em vida livre.

**Palavras-chave:** Columbiformes, helmintologia, nematódeos, cestódeos, *Ascaridia*, *Raillietina*.

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## Introduction

Pigeons (*Columba livia*) belong to the order Columbiformes and have adapted to adverse conditions in different parts of the world. They are often present at high densities in urban areas such as public parks and live very close to humans and domestic/wild animal species (HARLIN, 1994). These close interactions can be of concern, since pigeons might serve as a potential reservoir of parasites, with the capacity to spread them to wild birds, including threatened species (FORONDA et al., 2004; RADFAR et al., 2012).

Studies around the world have identified the parasitic communities that occur in pigeons and have recognized that gastrointestinal helminths are very common in this species, which can harbor these parasites without showing evident clinical signs (TORO et al., 1999). Nonspecific helminths infecting *C. livia* have been reported (FORONDA et al., 2004) and can vary according to the season, sex, and locations (SENLİK et al., 2005; SMITH & FEDYNICH, 2012). Despite this, little attention has been given to this avian species in Brazil, where its numbers have been increasing. Moreover, few data about health issues relating to wild pigeons are available in the veterinary medical literature (PEREZ, 2005; FERREIRA et al., 2016).

More information about the health of wild pigeons is essential, considering the overpopulation problems relating to this non-native species in Brazil. Therefore, the aims of this study were to identify the gastrointestinal helminths of two *C. livia* populations in the state of São Paulo, to assess any differences between the sexes and locations and to evaluate the effect of weight on the intensity of infection in these birds.

## Materials and Methods

### *Study areas and collection of pigeons*

This study was carried out at two grain storage warehouse facilities that had been suffering from an overpopulation of pigeons. The warehouses are located in the municipalities of São Paulo and Tatuí, state of São Paulo, Brazil, representing an urban area and a rural area, respectively, 87 miles from each other. Pigeons were caught randomly using traps in the same place at each locality once a month over a one-year period (January to December).

The birds were manually restrained, weighed and euthanized with approval from the Bioethics Commission of the School of Veterinary Medicine and Animal Science of the University of São Paulo (under number 1605) and authorization from ICMBio/SISBIO (Chico Mendes Institute for Biodiversity Conservation, under number 18919-1).

### *Parasitological analysis*

The pigeons were necropsied and the gastrointestinal tracts were removed and surveyed for parasites under a stereomicroscope. Any nematodes that were found were preserved in 70% ethanol, cleared with lactophenol and identified based on Vicente et al. (1995). Cestodes were fixed in AFA solution under slight pressure from a

coverslip, stained with hydrochloric acid-carmin and identified in accordance with Schmidt (1986). The parasites were analyzed using the Qwin Lite 2.5 computerized system (Leica Microsystems, Wetzlar, Germany).

### *Statistical analysis*

The prevalence with 95% confidence interval (CI) and mean intensity of infection (MII) with 95% CI were calculated as described by Bush et al. (1997), using the Quantitative Parasitology 3.0 software. Differences in weight between the sexes and differences in MII between the sexes and locations were determined using the Mann-Whitney test. The effect of weight on the intensity of infection was determined using Spearman's correlation test for each sex. The chi-square test was performed to analyze the influence of sex and location on the prevalence of the parasites. These tests were calculated using the BioEstat 5.3 software and the significance level used was 5%. A discrepancy index (D) was calculated as described by Poulin (1993), using the Quantitative Parasitology 3.0 software (RÓZSA et al., 2000).

## Results

A total of 265 specimens of *C. livia* were caught during the study period, comprising 146 females (55.1%) and 119 males (44.9%), with an average of 11 pigeons per month at each location. The birds had an overall mean weight of 258.7 g (range 140-360 g). The mean weight of the males (268.5 g) was greater than that of the females (250.7 g) ( $U = 6325.50$ ;  $p = 0.0001$ ). Weight had no effect on the intensity of infection, either for males ( $r_s = 0.1552$ ;  $p = 0.090$ ) or for females ( $r_s = 0.1528$ ;  $p = 0.0087$ ).

A total of 790 parasites, consisting of *Ascaridia columbae* (Ascaridiidae) and *Raillietina* sp. (Davaineidae), were recovered from 110 specimens of *C. livia* (overall prevalence = 41.5%). Fifteen pigeons (5.7%; nine females and six males) presented mixed infection. The overall prevalence (P), MII and discrepancy index (D) are showed in Table 1, which also shows these data per parasite and per municipality. Both helminth species presented a tendency towards aggregated distribution ( $D = 0.855$ ) among the pigeons.

Most of the birds had five or fewer parasites in the intestine: 76.1% (35/46) in the municipality of São Paulo and 71.9% (46/64) in the municipality of Tatuí. Five pigeons (10.9%) in São Paulo and nine (14.1%) in Tatuí had 6-10 parasites; and four (8.7%) and 8 (12.5%) in these cities had 11-50 parasites, respectively. Just two birds in São Paulo (4.3%) and one (1.8%) in Tatuí had more than 50 parasites.

The overall prevalence and MII did not differ between the sexes, but the prevalence was higher among the birds from the municipality of Tatuí (Table 2).

## Discussion

The evaluation of two populations of wild *C. livia* in the states of São Paulo and Minas Gerais determined the prevalence of helminths in the gastrointestinal tract, showing

**Table 1.** Gastrointestinal helminths of two wild pigeon populations (*Columba livia*) in the municipalities São Paulo and Tatuí, state of São Paulo, Brazil.

Helminth species	Reservoir location	Host (N)	P (95% CI) (%)	MII (95% CI) (range)	D	Site
Ascaridiidae						
<i>Ascaridia columbae</i>	SP	131	16.0 (10.2-23.5)	15.4 (6.0-38.8) (1-144)	0.956	Intestine
	TA	134	34.3 (26.3-43.0)	6.2 (4.1-10.7) (1-62)	0.856	
Davaineidae						
<i>Raillietina</i> sp.	SP	131	23.7 (16.7-31.9)	3.3 (2.4-5.1) (1-18)	0.857	Intestine
	TA	134	20.2 (13.7-27.9)	2.9 (2.1-4.7) (1-15)	0.886	
<b>Total</b>	SP + TA	265	41.5 (35.5-47.7)*	7.2 (5.0-11.8) (1-144)	0.855	

\*Based on the fact that 15 birds had both parasites (155 birds were not parasitized). N = number of pigeons examined; P = prevalence; CI = confidence interval; MII = mean intensity of infection; D = aggregation index; SP = São Paulo; TA = Tatuí.

**Table 2.** Comparison of prevalences and mean intensity of infection of gastrointestinal helminths in 265 wild pigeons (*Columba livia*) from the state of São Paulo, Brazil.

	Prevalence (%)	Test (p)	MII	Test (p)
Municipality of São Paulo	35.1	$\chi^2 = 4.364$ (0.0367)	9	U = 1424.5 (0.7735)
Municipality of Tatuí	47.8		6	
Males	47.0	$\chi^2 = 1.888$ (0.1694)	6	U = 1941 (0.9645)
Females	39.0		7	

MII = mean intensity of infection.

values of 4.9-29.1% for *A. columbae* and 14.6-24.6% for *Raillietina* sp. (OLIVEIRA et al., 2000; PEREZ, 2005). Some of these findings were similar to those of the present study. However, the prevalence of *A. columbae* and *Raillietina* sp. in wild *C. livia* vary widely between different locations, ranging from 5.0 to 46.7% and from 1.7 to 100.0%, respectively (TORO et al., 1999; FORONDA et al., 2004; BEGUM & SEHRIN, 2012; EDOSOMWAN et al., 2012; DIAKOU et al., 2013; DIPINETO et al., 2013). The MII (9.1) and range of parasitism (1-144) for *A. columbae* in the present study were similar to those in previous reports: mean intensities of 8.4 and 8.5 and ranges of 1-107 parasites (FORONDA et al., 2004; SENLIK et al., 2005), but lower MII (3.2) was observed among 55 semi-captive *C. livia* in the state of Rio de Janeiro (SILVA et al., 1990). Differently, a mean value of 12.3 was reported for *Raillietina* sp. among 50 wild *C. livia* in Spain (FORONDA et al., 2004), which was higher than the MII of the present study (3.2). Concerning mixed infections, similar prevalence in the state of Minas Gerais (3.3%) and higher prevalence in the state of São Paulo (14.6%) was observed in previous studies on wild pigeons. Nevertheless, both of these studies showed higher single infection than mixed infection (OLIVEIRA et al., 2000; PEREZ, 2005), which is in agreement with the present study.

Discrepant results can be found between helminth surveys because all the parasitological values included in the present study vary widely according to extrinsic environmental factors such as geographic location, season and precipitation, and to intrinsic factors

such as diet, immunity, co-occurring diseases, host susceptibility behavior, age and sex (FEDYNICH, 2008). Three pigeons in our study presented discrepant numbers of parasites (>50) that did not correspond to normal values, thus reinforcing the influence of intrinsic factors on values within the same investigation.

Low diversity of gastrointestinal helminths was observed in the present study. The species found in these pigeons are very common (Table 3). In the past, some authors found a similar diversity of parasite species (2-3 species) in wild and captive pigeons in the states of São Paulo and Minas Gerais (GIOVANNONI & MALHEIRO, 1952; FEDERMAN et al., 1973; OLIVEIRA et al., 2000). Other studies in Brazil and other countries have reported three to five helminth species in wild and semi-captive pigeons using diagnostic methods similar to those of the present study (CARNEIRO et al., 1975; SILVA et al., 1990; FORONDA et al., 2004; PEREZ, 2005; SMITH & FEDYNICH, 2012). Unfortunately, it was not possible to differentiate the species of *Raillietina*, which might have increased the number of helminth species in the present study. However, the low diversity of gastrointestinal helminths observed may have been a reflection of the local environment where the pigeons were feeding (SMITH & FEDYNICH, 2012). They had probably concentrated their feeding at the grain storage warehouse facilities and had acquired fidelity to these locations because these provided shelter, nest sites and, especially, a large variety of grains in large amounts. This fidelity to the warehouses probably decreased their exposure to the direct life cycle of nematodes and to intermediate hosts, which might be experienced by other

**Table 3.** Species of gastrointestinal helminths found in *Columba livia* in Brazil.

Parasite family	Parasite species	Bird origin	N	Prevalence (%)	Reference	
Ascaridiidae	<i>Ascaridia columbae</i>	Wild (SP)	265	25.3	<b>This study</b>	
		Wild (SP)	199	29.1	Perez (2005)	
		Wild (MG)	61	4.9	Oliveira et al. (2000)	
		Semi-captive (RJ)	55	11.4	Silva et al. (1990)	
		Not stated (GO)	30	65.5	Carneiro et al. (1975)	
		Captive (MG)	11	45.0	Federman et al. (1973)	
		Captive (SP)	100	57.0	Giovannoni & Malheiro (1952)	
Trichuridae	<i>Capillaria columbae</i>	Wild (SP)	199	6.5	Perez (2005)	
		Semi-captive (RJ)	55	25.7	Silva et al. (1990)	
		Not stated (GO)	30	8.3	Carneiro et al. (1975)	
		Captive (MG)	11	18.2	Federman et al. (1973)	
		Captive (SP)	100	4.0	Giovannoni & Malheiro (1952)	
Acuariidae	<i>Dispharynx spiralis</i>	Semi-captive (RJ)	55	2.8	Silva et al. (1990)	
Tetrameridae	<i>Tetrameres confusa</i>	Captive (SP)	100	1.0	Giovannoni & Malheiro (1952)	
		Not stated (GO)	30	4.1	Carneiro et al. (1975)	
Davaineidae	<i>Raillietina</i> sp.	Wild (SP)	265	21.9	<b>This study</b>	
		Wild (MG)	61	24.6	Oliveira et al. (2000)	
		Not stated (GO)	30	4.1	Carneiro et al. (1975)	
		<i>Raillietina (Raillietina) allomyodes</i>	Wild (SP)	199	14.6	Perez (2005)
		<i>Raillietina (Fuhrmannetta) crassula</i>	Wild (SP)	199	19.1	Perez (2005)
		<i>Raillietina (Skrjabinia) bonini</i>	Semi-captive (RJ)	55	45.7	Silva et al. (1990)
Brachylaemidae	<i>Brachylaemus (Mazzantia) mazzantii</i>	Wild (SP)	199	3.0	Perez (2005)	
		Semi-captive (RJ)	55	25.7	Silva et al. (1990)	

N = number of birds examined; SP = São Paulo; MG = Minas Gerais; RJ = Rio de Janeiro; GO = Goiás.

pigeons foraging in environments with greater diversity or at natural feeding sites (SMITH & FEDYNICH, 2012).

Furthermore, the prevalence of helminths found in *C. livia* from Tatuí was higher than that found in pigeons from São Paulo (Table 2). This result was probably due to the influence of the local environment. The warehouse in São Paulo is located in an urban area, while the warehouse in Tatuí is located in a rural area, which gives the pigeons wider possibilities for foraging at natural sites and maybe more exposure to helminths and intermediate hosts (SMITH & FEDYNICH, 2012). Moreover, in rural areas, the pigeons may have more contact with other avian species.

Similar numbers of males and females were caught in the present study, given that males and females live in close association, such that they move and feed together. Thus, the rate of parasitism would be expected to be similar in the two sexes because of equal exposure to parasites, as reported in other studies (TORO et al., 1999; FORONDA et al., 2004; SENLIK et al., 2005).

*Ascaridia columbae* is widely distributed and has been found not only in many dove species but also in other avian orders such as Psittaciformes (FEDYNICH, 2008). The genus *Raillietina* has a cosmopolitan distribution and is of major clinical importance for poultry. Some nonspecific species of this genus have the potential to be transmitted to other wild avian species (DIAKOU et al., 2013). Therefore, the pigeons investigated in this study may be important transmitters of helminths to other wild/domestic bird species. However, further studies are needed in order to understand the possible impacts of these populations and to

establish management and control measures. Similarly, further studies are needed in order to correlate ecological features such as reproduction characteristics, food intake, use of microhabitat and time of activity between the sexes, so as to better understand the influences of sex on MII and prevalence of helminths.

Although the overpopulation of pigeons presents some risks around the world, little is known about their health, and the findings from the present study make several contributions to the current literature. The gastrointestinal helminth community of a significant number of specimens of wild *C. livia* was reported, and such data are scarce in Brazil, particularly regarding free-living birds. Parasite homogeneity was observed over the 12 months analyzed at both locations in the present study, which provided a longitudinal evaluation on the helminth fauna in wild pigeons in Brazil.

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