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Ecology

Rhinonyssidae and Ereynetidae mites in *Columba livia* (Columbiformes: Columbidae) in southern Brazil

Ácaros Rhinonyssidae y Ereynetidae en Columba livia *(Columbiformes: Columbidae) en el sur de Brasil*

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Abstract

This study aims to record mites associated with the respiratory system of *Columba livia* Gmelin, 1789, including data of parasitological indices and of coinfections in southern Brazil. Two hundred and two specimens of *C. livia* were collected in the urban area in Pelotas, Rio Grande do Sul (RS) state, Brazil. Fifty-six (27.7%) birds were parasitized by Rhinonyssidae and Ereynetidae mites. *Tinaminyssus columbae* (Crossley, 1950) and *Tinaminyssus melloi* (Castro, 1948) (Rhinonyssidae) were found in nasal cavities and tracheae of the birds. *Trispeleognathus striatus* (Crossley, 1952) (Ereynetidae) was found in hosts' nasal cavities. The prevalence of Rhinonyssidae mites (25.2%) was significantly higher than obtained for Ereynetidae (5.9%). Coinfections only occurred in nasal cavities of 8 (3.96%) birds. This study records for the first time *T. columbae* and *Trispeleognathus striatus* parasitizing *C. livia* in Brazil. In addition, mite infection indices and coinfections of Rhinonyssidae and Ereynetidae mites in this Columbidae species are recorded.

Keywords: Acari; *Tinaminyssus*; *Trispeleognathus*; Parasitological indices; Coinfections

Resumen

Este estudio tuvo como objetivo registrar los ácaros asociados al sistema respiratorio de *Columba livia* Gmelin, 1789, sus índices parasitológicos y la aparición de coinfecciones en el sur de Brasil. Se recolectaron 202 ejemplares de *C. livia* en la zona urbana de Pelotas, estado de Rio Grande do Sul (RS), Brasil. Cincuenta y seis (27.7%) aves estaban parasitadas por ácaros Rhinonyssidae y Ereynetidae. *Tinaminyssus columbae* (Crossley, 1950) y *Tinaminyssus melloi* (Castro, 1948) (Rhinonyssidae) se encontraron en las cavidades nasales y las tráqueas de las aves. *Trispeleognathus*

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striatus (Crossley, 1952) (Ereynetidae) se encontró en las cavidades nasales de los huéspedes. La prevalencia de los ácaros Rhinonyssidae (25.2%) fue significativamente mayor que la de los Ereynetidae (5.9%). Sólo se produjeron coinfecciones en las cavidades nasales de 8 (3.96%) aves. Este estudio registra por primera vez a *T. columbae* y *Trispeleognathus striatus* en *C. livia* en Brasil. Además, se registran los índices de infección por ácaros y las coinfecciones de ácaros Rhinonyssidae y Ereynetidae en esta especie de Columbidae.

Palabras claves: Acari; *Tinaminyssus*; *Trispeleognathus*; Índices parasitológicos; Coinfecciones

Introduction

Rhinonyssidae and Ereynetidae are composed of hematophagous and tissue-consuming mites, respectively. Since they parasitize the respiratory system of birds, they are preferentially found in the membrane of nasal cornets (Amaral & Rebouças, 1974; Pence, 1975). In Brazil, most records of Rhinonyssidae and Ereynetidae mites were found in native birds, but some of them were reported in exotic birds, introduced species, and domesticated birds (Mascarenhas et al., 2018).

Brazilian avifauna is abundant and diverse (Pacheco et al., 2021), which suggests that the nasal fauna of mites associated with birds is also diverse, making this group of parasites an exciting source of study (Mascarenhas et al., 2018). Columbidae is composed of 309 species, with representatives in all continents; 23 species of pigeons have been recorded in Brazil (Pacheco et al., 2021). In the Rio Grande do Sul, there are 13 species of Columbidae found in wild and urban areas (Belton, 1994; Sick, 1997). One of the species is *Columba livia* Gmelin, 1789, a domestic pigeon that originated in Eurasia and Africa and was introduced into several countries, such as Brazil, where it took place at the beginning of the Portuguese colonization (Höfling & Camargo, 2002).

Rhinonyssid mites have been reported on *C. livia* in the USA (Crossley, 1950; Pence, 1975), Canada (Knee & Proctor, 2010; Knee et al., 2008; Wilson, 1964), Russia (de Rojas et al., 2020) and Spain (de Rojas et al., 2018, 2001, 2002; Úbeda et al., 2003), while Ereynetidae mites has been recorded in this host in the USA (Crossley, 1952) and Australia (Domrow, 1969). In Brazil, there is only 1 record of *Tinaminyssus melloi* (Castro, 1948) (Rhinonyssidae) described as a parasite in *C. livia* (Castro, 1948).

Coinfections by mites associated with the respiratory system have been mainly recorded in Passeriformes in Canada (Knee et al., 2008), Brazil (Bernardon et al., 2018; Dimov & Mascarenhas, 2012), and Russia (Dimov & Mascarenhas, 2012). Coinfections by the respiratory system of mites in pigeons have been poorly reported. *Columba livia* was recorded in Canada, where 2 species of Rhinonyssidae were reported in the nasal cavity of a bird (Knee et al., 2008).

In Brazil, there is little knowledge about the diversity of mites associated with the respiratory system of native and introduced pigeons. Information on their infection indices and coinfections is scarce. Therefore, this study aims to confirm the presence of mites associated with the respiratory system of *C. livia*, as well provide data about the parasitological indices and the coinfections in southern Brazil.

Materials and methods

Two hundred and two *C. livia* specimens were collected in the urban area in Pelotas, RS, Brazil (31º46'34" S, 52º21'34" W). Collections were licensed by the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio No. 61235-1) and approved by the Ethics Committee on Animal Experimentation (CEEA/UFPel No. 12860/2018). The host collection is linked to other projects developed at the Microbiology and Parasitology Department at the Universidade Federal de Pelotas (UFPel).

Firstly, bird necropsy was performed so that tracheae could be removed and heads could be sectioned for nasal cavity dissection. Opening the nasal cavity was done through a cut of one of the nostrils until it reached the auditory meatus on the corresponding side; the process was also carried out on the opposite side. Then, nasal cornets were sectioned longitudinally, and the cranial cap was folded backward until a right angle was formed with the lower part (Fain, 1957). Nasal cavities and tracheae were washed with a water jet under sieve (150μm), and the resulting content was examined under the stereomicroscope. The mites were preserved in 70 ºGl ethanol, slide-mounted in Hoyer's medium, and identified, according to Castro (1948), Crossley (1952), Knee and Proctor (2010), and Pence (1975). Vouchers were deposited at the Coleção de Artrópodes do Laboratório de Parasitologia de Animais Silvestres of the Microbiology and Parasitology Department, Institute of Biology, UFPel, Pelotas, RS (CALAPASIL No. 603-632), at the, Brazil, and at the Collection of the Instituto Butantan, São Paulo, SP, Brazil (IBSP No. 16514-16523).

Prevalence (P%), mean intensity of infection (MII), and mean abundance (MA) were estimated in agreement with

Bush et al. (1997). Prevalences of mites were compared by the chi-square test (χ^2) ($p \leq 0.05$), while mean intensities of infection were compared by the bootstrap test ($p \leq 0.05$) with the use of the Quantitative Parasitology 3.0 program (Reiczigel et al., 2019).

Results

Fifty-six (27.7%) specimens of *C. livia* were parasitized by 2 species of Rhinonyssidae and 1 species of Ereynetidae mites. A total of 552 mites (nymphs and adults) were found, with a mean intensity of 9.9 mites/host. Prevalence of rhinonyssid mites (25.2%) was significantly higher than obtained for Ereynetidae (5.9%) (χ^2, $p = 0.0001$). Moreover, the mean intensity of infection of Rhinonyssidae (9.9 mites/host) was higher than values calculated for Ereynetidae (3.8 mites/host) (test t, $p = 0.005$).

Tinaminyssus melloi (Castro, 1948) and *Tinaminyssus columbae* (Crossley, 1950) (Rhinonyssidae) were found in hosts' nasal cavities and tracheae, while *Trispeleognathus striatus* (Ereynetidae) was only found in nasal cavities (Table 1). The mites in the trachea were observed in 3 birds; a bird was parasitized by 1 mite (*T. melloi*), and 2 birds had 1-13 specimens of *T. columbae.*

There was no significant difference between the prevalences of *T. melloi* (16.3%) and *T. columbae* (9.9%) (χ^2, $p = 0.055$). Likewise, mean intensities of infection of both species were similar (*T. melloi* = 9.6 mites/host and *T. columbae* = 9.5 mites/host) (test t, $p = 0.985$). *Tinaminyssus columbae* showed a range from 1 to 77 mites, while *T. melloi* showed a range from 1 to 37 mites (Table 1).

Coinfections were observed in 8 (3.96%) hosts. Rhinonyssidae and Ereynetidae mites coinfected 7 birds; ranges were 2-37 Rhinonyssidae mites and 1-15 Ereynetidae mites. A bird was parasitized with both species of Rhinonyssidae and Ereynetidae mites, with ranges of 2 (*T. columbae*), 3 (*T. melloi*), and 4 mites (*Trispeleognathus striatus*). Coinfection of Rhinonyssidae (*T. columbae* and *T. melloi*) only occurred in a bird, i.e., 1 mite per species. Three birds exhibited mites in nasal cavities and tracheae; however, these hosts did not exhibit more than a mite species, i.e., coinfections occurred only in nasal cavities.

Discussion

The mite species found in the present study has wide geographic distribution since it was registered in the American continent, Russia, Spain, Australia, and Africa. *Tinaminyssus columbae* and *T. melloi* were recorded in *C. livia* in the USA (Crossley, 1950; Pence, 1975), Canada (Knee & Proctor, 2010; Knee et al., 2008; Wilson, 1964), Russia (de Rojas et al., 2020) and Spain (de Rojas et al., 2001, 2002, 2018; Úbeda et al., 2003). In addition, *T. melloi* was found in *Zenaida macroura* Linnaeus, 1758 in Canada (Knee & Proctor, 2010; Knee et al., 2008). Even though *T. melloi* was described as a parasite in *C. livia* (Castro, 1948), there is no data on Brazil's infection indices. *Trispeleognathus striatus* was registered in *C. livia* in the USA (Crossley, 1952) and Australia (Domrow, 1969), in *Columbina talpacoti* (Temminck, 1810), *Leptotila verreauxi* Bonaparte, 1855 and *Geotrygon montana* (Linnaeus, 1758) in South America (Amaral, 1963; Fain & Aitken, 1968, 1970; Moraes, 2011), and in *Streptopelia semitorquata* (Rüppell, 1837) in Africa (Fain, 1957).

Parasitological indices are tools that help us to understand host-parasite relationships. Variation in prevalence of mites associated with the respiratory system found by different studies may be related to the biology of involved species (mites and birds) and to characteristics of the environment where parasitic associations occur (free life or captivity) (Santos et al., 2018). Most studies of this group of mites are taxonomic, so information on infection

Table 1

Site of infection (SI), prevalence (P%), mean intensity of infection (MII), mean abundance (MA), range (R), and total (T) of Rhinonyssidae and Ereynetidae mites in *Columba livia* Gmelin, 1789 (Columbiformes: Columbidae) (n = 202) in southern Brazil.

Mites	SI	P%	MII	MA	R	T
Rhinonyssidae						
Tinaminyssus columbae	nasal cavity and trachea	9.9	9.5	0.94	1 - 77	190
Tinaminyssus melloi	nasal cavity and trachea	16.3	9.6	1.56	1 - 37	316
Ereynetidae						
Trispeleognathus striatus	nasal cavity	5.9	3.8	0.23	1 - 15	46

rates and the occurrence of coinfections are scarce. In this study, the prevalence of Rhinonyssidae mites was higher than their prevalence in the same host species in Russia, where 3.8% of 262 birds under study were infected by *T. columbae* and *T. melloi* (de Rojas et al., 2020). Prevalence of mites associated with the respiratory system in Columbidae in Brazil was reported for *Zenaida auriculata* (Des Murs, 1847), in which *Tinaminyssus zenaidurae* (Crossley, 1952) was found in 6.4% of 34 hosts under investigation (Goulart et al., 2011).

Few studies address the occurrence of coinfections by mites associated with the respiratory system. Cases of coinfection by Rhinonyssidae species are reported more frequently than obtained in Rhinonyssidae and Ereynetidae mites. Pence (1973) recorded more than 1 species of Rhinonyssidae in birds of different families but author did not indicate their frequency. In *Chrysomus ruficapillus* (Vieillot, 1819) (Passeriformes: Icteridae) (n = 122 birds understudy), several hosts were coinfected by Rhinonyssidae and Ereynetidae mites, totaling 17 cases, while coinfection by 2 species of the same genus of Rhinonyssidae occurred in 13 birds (Bernardon et al., 2018). Regarding pigeons, only 1 bird specimen of *C. livia*, was coinfected by *T. columbae* and *T. melloi* in Canada (Knee et al., 2008).

Coinfections by mites associated with the respiratory system show low prevalence values (Butenko & Stanyukovich, 1999; Knee et al., 2008; Spicer, 1987). Although several studies have examined a significant diversity of hosts, most of them have investigated a low number of samples of the same species (Butenko & Stanyukovich, 1999; Knee et al., 2008; Spicer, 1987). Bernardon et al. (2018) commented that the sample size should be considered an important factor in studies aiming to evaluate coinfections by Rhinonyssidae species or by Rhinonyssidae and Ereynetidae species in Passeriformes and other groups of birds. In addition, aspects related to the biology of mite and bird species should also be considered in studies of coinfection, since the reproductive behavior of birds and mites can help understand coinfections by mites associated with the respiratory system. However, information on the reproductive characteristics of mites is scarce.

This study contributes to the knowledge of the diversity of mites associated with the respiratory system of birds in Brazil, since it registers, for the first time, *T. columbae* and *Trispeleognathus striatus* in *C. livia*, as well as indices of infection of Rhinonyssidae and Ereynetidae mites in the country. Furthermore, it registers the occurrence of coinfections by Rhinonyssidae mites and Ereynetidae in Columbidae.

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