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Original Article

Helmintological Examination of *Pica pica* (Linnaeus, 1758) (Passeriformes: Corvidae) Specimens Collected from Bursa and Its Surroundings in Türkiye

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Abstract

Background: The Eurasian magpie, *Pica pica* (Linnaeus, 1758), is a widely distributed bird species inhabiting both rural and urban environments in Türkiye. Despite its ecological importance, information on its helminth fauna remains limited. We aimed to investigate the helminth fauna of *P. pica* specimens collected in Bursa Province and to contribute to the knowledge of parasite biodiversity in Türkiye.

Methods: A total of 53 *P. pica* specimens, brought dead between June 2015 and August 2025 from Bursa Zoo and the Celal Acar Wildlife Rescue and Rehabilitation Center (Karacabey Ova Korusu, Bursa, Türkiye), were examined for helminths using standard parasitological techniques. Recovered helminths were identified morphologically.

Results: Ten helminth species were identified: *Brachylaima fuscata* (Rudolphi, 1819) Joyeux, Baer & Timon-David, 1932, *B. lobatum* (Railliet, 1900), *Lyperosomum longicauda* (Rudolphi, 1809) (Digenea); *Raillietina echinobothrida* (Megnin, 1881), *Passerilepis stylosa* (Rudolphi, 1809), *Choanotaenia macracantha* (Krabbe, 1869) (Cestoda); *Dispharynx nasuta* (Rudolphi, 1819), *Baruscapillaria obsignata* (Madsen, 1945) Moravec, 1982, *B. resecta* (Dujardin, 1845) (Nematoda); and *Sphaerirostris picae* (Rudolphi, 1819) (Acanthocephala). *R. echinobothrida*, *C. macracantha*, *B. obsignata*, and *B. resecta* were recorded from *P. pica* for the first time worldwide. In addition, *B. fuscata*, *B. lobatum*, *L. longicauda*, *C. macracantha*, *P. stylosa*, and *B. resecta* represent new records for the helminth fauna of Türkiye.

Conclusion: This study expands current knowledge of the helminth fauna of *P. pica* and provides several novel host and geographical records. The findings highlight the importance of continued parasitological investigations of wild birds in Türkiye to improve our understanding of parasite diversity and host–parasite associations.

Introduction

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Türkiye has a rich fauna in terms of migratory and native bird species, hosting a total of 497 bird species belonging to 76 families (1). The Corvidae family, widely distributed in Türkiye, includes 11 bird species (2). Among these species, *Pica pica* (Linnaeus, 1758) (Eurasian Magpie), which is the subject of this study, is easily distinguishable by its black and white color, long green-purple tail, and white belly. This type of host is widespread in Europe, large parts of Asia, the northwestern parts of North America, and northwestern Africa (3).

The aim of this study was to determine the gastrointestinal helminth fauna of Eurasian magpies (*P. pica*) collected in Türkiye and to provide new data on the parasite diversity of this host species.

Materials and Methods

Between Jun 2015 and Aug 2025, samples of *P. pica* (n=53) that had died for various reasons were collected with a research permit provided by the Ministry of Forestry and Water Affairs, Directorate of Nature Conservation and National Parks of the Republic of Türkiye (number 10936637) from the Bursa Zoo and Karacabey Ova Korusu Celal Acar Wildlife Rescue and Rehabilitation Center to the Parasitology Laboratory of the Department of Biology, Faculty of Science and Literature, Bursa Uludağ University. These specimens were stored in a deep freezer until the time of dissection.

For helminthological examination, the body and total lengths of all specimens previously stored in a deep freezer were measured before dissection. The mean body and total lengths were recorded separately for males Body and total length data were supplemented with mean (cm) ± standard deviation (SD) values to provide a clear-er description of the examined bird population. The birds were first examined for ectoparasites. Then, the feathers in the ventral region were plucked and dissection was performed. The organs belonging to the heart, lungs, kidneys and gastrointestinal system of the samples subjected to sex determination were opened in separate petri dishes and examined helminthologically. The helminth samples found were cleaned in physiological water and stored in bottles containing 70% ethyl alcohol until they were diagnosed. During diagnosis, Trematoda, Cestoda and Acanthocephala species were stained with aceto-carmine (4). Nematodes were prepared by clearing with lactophenol.

The species identification of helminths was performed using a Leica EZ4 Stereo microscope and an Olympus CH–2 light microscope, with reference to previous studies (5-10). The prevalence, mean intensity and mean abundance values of helminth species are used as defined earlier (11). The diagnosed helminth samples are stored at the Parasitology Laboratory, Department of Biology, Bursa Uludağ University.

The non-parametric Kruskal–Wallis test was employed to determine whether parasite distributions differed among female, male, and juvenile individuals, and the analysis was conducted using the SPSS version 29 statistical software (IBM Corp., Armonk, NY, USA). To visualize and evaluate the distributional relationships of parasite species within the examined *P. pica* hosts, Principal Component Analysis (PCA), a dimension reduction technique, was performed in CANOCO ver. 4.5.

Results

Overall, 40 (75.4%) of the 53 *P. pica* (22 ♂, 11 ♀, and 20 juveniles) samples were infected with helminths, while the remaining 13 (24.6%) were not infected with any type of parasite. Overall, 470 individuals from 10 helminth species (118 Digenea, 152 Cestoda, 140 Nematoda, and 60 Acanthocephala) were detected in infected *P. pica* samples. The highest prevalence value for the host bird species *P. pica* was recorded in *Passerilepis stylosa*, while the lowest

prevalence values were recorded in *Lyperosomum longicauda* and *Baruscapillaria resecta* (Table 1).

Table 1: Infection parameters of helminth species identified in *Pica pica*

Helmint species	Prevalence (%)	Mean intensity	Mean abundance	Infected male bird	Infected female bird	Infected juvenile bird	Total number of infected birds
Digenea							
Brachylaima fuscata	24.5	4.6	1.1	4	4	4	12
Brachylecithum lobatum	9.4	2.2	0.2	3	2	-	5
***B. lobatum* larva**	9.4	9	0.8	3	1	1	5
Lyperosomum longicauda	1.8	1	0.01	1	-	-	1
Cestoda							
Raillietina echinobothrida	5.6	2.3	0.1	3	-	-	3
Passerilepis stylosa	35.8	7.4	2.6	10	5	4	19
Choanotaenia macracantha	5.6	1.3	0.07	1	1	1	3
Nematoda							
Dispharynx nasuta	16.9	4.3	0.7	3	5	1	9
Baruscapillaria obsignata	24.5	7.5	1.8	7	3	2	12
Baruscapillaria resecta	1.8	3	0.05	-	-	1	1
Acanthocephala							
Sphaerirostris picae	24.5	4.6	1.1	6	3	4	13

Among the species found, the helminths *B. lobatum*, *B. lobatum* larva, and *L. longicauda* belonging to Digenea were localized in the liver. *D. nasuta* from Nematoda has been found in the crop. All Digenea, Cestoda, Nematoda and Acanthocephala specimens other than these species were detected in the small intestine.

One of the most striking aspects of the study is that the sampling period covers a broad time period (2015, 2024, and 2025) and includes systematic helminthological analyses based on postmortem examinations. The multi-year coverage distinguishes the study from studies focusing on a single season. This allows for a more comprehensive assessment of helminth prevalence, resulting in more reliable data (Table 2).

Table 2: Helminth numbers, prevalence and density in male, female and juvenile *Pica pica* in different sampling years (2015, 2024 and 2025) are given respectively

	2015 n= (5)			2024 n= (28)			2025 n= (20)			Total		
Gender of Birds	2♂	3♀	0J	12♂	8♀	8J	7♂	1♀	12J	21♂	12♀	20J
	NH, P, I	NH, P, I	-	NH, P, I	NH, P, I	NH, P, I	NH, P, I	NH, P, I	NH, P, I	NH, P, I	NH, P, I	NH, P, I
Digenea												
Brachylaima fuscata	-	-	-	33, 25, 11	8, 37, 2.6	2, 25, 1	2, 14.3 ,2	2, 100, 2	12, 16.6, 6	35, 19, 8.7	10, 33.3, 2.5	14, 20, 3.5
Brachylecithum lobatum	-	-	-	4, 17, 2	6, 25, 3	-	1, 14.3, 1	-	-	5, 14.3, 1.7	6, 16.7, 3	-
***B. lobatum* larva**	2, 50, 2	3, 66, 1.5	-	32, 16.6, 16	-	9, 12.5, 9	-	-	-	34, 14.3, 11.3	3, 16.7, 1.5	9, 5, 9
Lyperosomum longicauda	-	-	-	-	-	-	1, 14.3, 1	-	-	1, 4.8, 1	-	-
Cestoda												
Raillietina echinobothrida	-	-	-	7, 25, 2.3	-	-	-	-	-	7, 14.3, 2.3	-	-
Passerilepis stylosa	3, 50, 3	3, 33, 3	-	37, 41.6, 7.4	29, 50, 7.3	12, 37.5, 4	42, 57, 10.5	5, 100, 5	10, 8.3, 10	82, 47.6, 8.2	37, 41.7, 7.4	22, 20, 5.5
Choanotaenia macracantha	2, 50, 2	1, 33, 1	-	-	-	-	-	-	1, 8.3, 1	2, 4.8, 2	1, 8.3, 1	1, 5, 1
Nematoda												
Dispharynx nasuta	-	-	-	3, 8.3, 3	25, 50, 6.2	5, 12.5, 5	3, 28.6, 1.5	3, 100, 3	-	6, 14.3, 2	28, 41.7, 5.6	5, 5, 5
Baruscapillaria obsignata	-	-	-	2, 16.6, 1	20, 37.5, 6.6	-	7, 71.4, 1.4	-	15, 16.7, 7.5	9, 33.3, 1.3	20, 25, 6.7	15, 10, 7.5
Baruscapillaria resecta	-	-	-	-	-	3, 12.5, 3	-	-	-	-	-	-
Acanthocephala												
Sphaerirostris picae	-	-	-	1, 8.3, 1	23, 37.5, 7.6	14, 50, 3.5	7, 42.8, 2.3	-	15, 16.7, 7.5	8, 19, 2	23, 25, 7.7	29, 30, 4.8

n: İndividual number, J: Juvenile, ♂: Male, ♀: Female, NH: Number of Helminth, P: Prevalence, I: Intencity

Principal Component Analysis (PCA) was used to summarize the variation in helminth species distribution. The PCA revealed that the first two axes accounted for 55.6% of the total

variance in helminth species distribution, with corresponding eigenvalues (λ) of 0.372 and 0.183, respectively.

The PCA ordination diagram indicated that the 16th female individual, collected in 2024 and located in the upper right quadrant, showed a strong association with *S. picae*, *D. nasuta*, *B. obsignata* and *B. lobatum*. The total number of helminth specimens recovered from this *P. pica* individual was markedly higher than in the other examined hosts.

In the ordination diagram, *P. stylosa* positioned in the lower right quadrant, was detected in 19 of the 53 examined *P. pica* individuals, exhibiting notably high infection intensity in certain hosts (e.g., 32 helminths in specimen no. 34). Additionally, elevated infection intensities were observed in individuals no. 45, 15 and 9, which appeared closely associated with the species on the ordination diagram (Fig. 1).

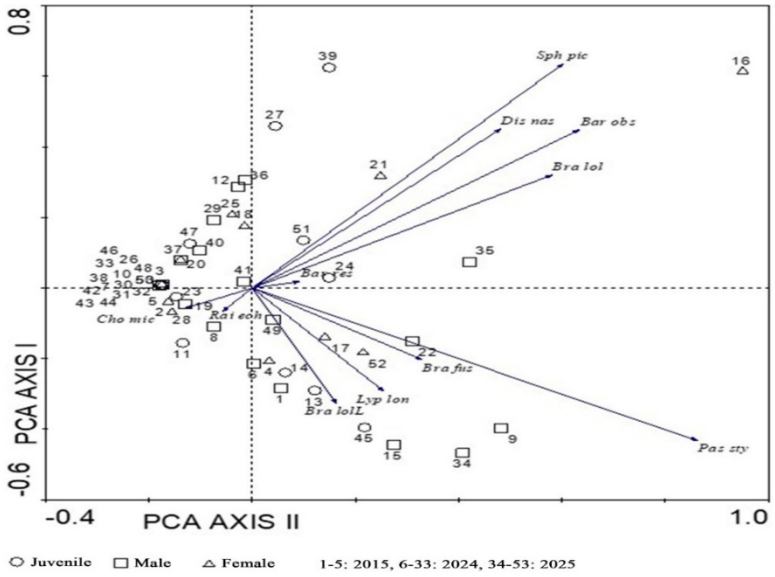

Fig. 1: Principal Component Analysis (PCA) showing the distribution of helminth infections in *Pica pica* individuals (male, female, juvenile) from different sampling years (2015, 2024 and 2025). Abbreviations in the figure (Bro fus= *Brachylaima fuscata,* Bro lol = *Brachylecithum lobatum,* Bro lolL= *B. lobatum* larva, Lyp lon= *Lyperosomum longicauda,* Rai ech= *Raillietina echinobothrida,* Pas sty= *Passerilepis stylosa,* Cho mic= *Choanotaenia macracantha,* Dis nas= *Dispharynx nasuta,* Bar obs= *Baruscapillaria obsignata,* Bar res= *Baruscapillaria resecta,* Sph pic= *Sphaerirostris picae*)

The Kruskal–Wallis test revealed that only *D. nasuta* exhibited a statistically significant variation among female, male, and juvenile *P. pica* individuals (H=7.39, *P*=0.025), whereas the remaining helminth species showed no sex-related differences in host preference.

Discussion

In Türkiye, there are seven studies conducted on the helminth fauna of *P. pica*. Eight of the ten helminth species identified in this study were recorded for the first time in this bird species (Table 3).

According to our current information, 50 helminth species have been reported in magpies outside Türkiye. The helminths found and their regional records are given in Table 4.

Table 3: Helminth records for *Pica pica* in Türkiye

Variable	Tolgay (1972a) (12)	Tolgay (1972b) (13)	Çetindağ and Bıyıkoğlu (1997) (14)	Girişgin et al. (2019) (15)	Yılmaz et al. (2020) (16)	Girişgin et al. (2021) (17)	Güven (2022) (18)	This study
	İzmir and Antalya (n=17)	İzmir and Antalya (n=10)	Ankara (n=10)	Bursa (n=8)	Van (n=43)	Bursa (n=4)	Denizli (n=4)	Bursa (n=53)
Species of Helminths								
Brachylaima fuscata								*
***Brachylaima* sp.**				*				
Brachylecithum lobatum								*
Lyperosomum petiolatum							*	
Lyperosomum longicauda								*
***Echinostoma* spp.**					*			
Railliatina echninobothrida								*
***Raillietina* spp.**					*			
Choanotaenia macrahantha								*
Passerilepis stylosa								*
***Passerilepis* sp.**				*				
Hymenolepis coronula	*							
***Capillaria* spp.**					*			
***Syngamus* spp.**					*			
***Trichinella* spp. larva**						*		
Baruscapillaria obsignata								*
Baruscapillaria resecta								*
Dispharynx nasuta			*					*
Mediorhynchus micracanthus		*						
Sphaerirostris picae							*	*

Table 4: Helminth species reported in *Pica pica* and their regional records

Helminth species	Country reported	Reference
DİGENEA		
Brachylaima fuscata	Czechia and Slovakia Czech Republic Bulgaria	Sitko et al. (19) Sitko and Heneberg, (20) Stoimenov (21)
Brachylecithum fillum	China China	Ryšavý et al. (22) Ryšavý et al. (22)
Brachylecithum lobatum	Czech Republic Czechia and Slovakia Czech Republic	Heneberg et al. (23) Sitko et al. (19) Sitko and Heneberg, (20)
Conspicuum acuminatum	Bulgaria	Stoimenov (21)
Echinostoma revolutum	Rusya Czechia and Slovakia	Chernobai (24) Sitko et al. (19)
***Echinostoma* sp.**	USA	Todd and Worley, (25)
Lyperosomum alagesi	Russia Bulgaria	Chernobai (24) Stoimenov (21)
Lyperosomum longicauda	Bulgaria	Stoimenov (21)
Lyperosomum petiolatum	Hollanda Czech Republic Czechia and Slovakia Czech Republic Czech Republic	Borgsteede et al. (26) Heneberg et al. (23) Sitko et al. (19) Sitko and Heneberg, (27) Sitko and Heneberg, (20)
Lyperosomum turdia	Czech Republic	Heneberg et al. (23)
Leucochloridium macrosto-mum	Russia Russia	Chernobai, (28) Chernobai (24)
Leucochloridium perturbatum	Czech Republic Czech Republic	Sitko et al. (19) Sitko and Heneberg, (20)
Morishitium dollfusi	Czech Republic	Sitko and Heneberg, (20)
Oswaldoia alagesi	Armenia	Skrjabin and Udınzew, (29)
Plagiorchis brauni	Russia Russia	Chernobai, (28) Chernobai (24)
Plagiorchis elegans	Czechia and Slovakia Czechia and Slovakia Czech Republic	Koubek and Vojtek (30) Sitko et al. (19) Sitko and Heneberg, (20)
Plagiorchis maculosus	Czechia and Slovakia Czechia and Slovakia	Koubek and Vojtek (30) Sitko et al. (19)
Prosthogonimus cuneatus	Russia Russia	Chernobai, (28) Chernobai (24)
Prosthogonimus ovatus	Russia Russia Iran Czech Republic	Chernobai, (28) Chernobai (24) Halajian et al. (31) Sitko and Heneberg, (20)
Strigea sphaerula	Russia Russia Czechia and Slovakia Czechia and Slovakia	Chernobai, (28) Chernobai (24) Koubek and Vojtek (30) Sitko et al. (19)
Tamerlania zarudnyi	Russia Bulgaria	Chernobai (24) Stoimenov (21)
Tetracotyle falconis	Russia	Chernobai (24)

Table 4: Continued…

Urogonimus macrostomus	Czech Republic	Sitko and Heneberg, (20)
Trematoda gen. sp.	Russia Russia	Chernobai, (28) Chernobai (24)
CESTODA		
Anomotaenia constricta	France USA	Gabrion, (32) Todd and Worley, (25)
***Anomotaenia* sp.**	China	Ryšavý et al. (22)
Aploparaksis picae	USA	Todd and Worley, (25)
Dilepis undula	USA	Todd and Worley, (25)
***Hymenolepis* sp.**	Holland USA	Clapham, (33) Todd and Worley, (25)
Passerilepis stylosa	Iran Poland USA	Halajian et al. (31) Luft (34) Todd and Worley, (25)
Passerilepis crenata	Iran Russia	Halajian et al. (31) Ryabov and Ponomaryov, (35)
Spiniglans sharpiloi	Ukraine	Kornyushin et al. (36)
NEMATODA		
Acuaria anthuris	Iran Poland	Halajian et al. (31) Luft (34)
***Acuaria* sp.**	USA	Todd and Worley, (25)
Baruscapillaria corvorum	Russia Poland	Kalmykov and Strelkov, (37) Luft (34)
Capillaria anatis	USA	Todd and Worley, (25)
Capillaria contorta	Holland	Clapham, (33)
Syngamus trachea	Britain Iran Poland Russia USA	Campbell (38) Halajian et al. (31) Luft (34) Ryabov and Ponomaryov, (35) Todd and Worley, (25)
Microtetrameres corax	USA	Todd and Worley, (25)
***Microtetrameres* sp.**	Iran	Halajian et al. (31)
Oxyspirura sygmoidea	Russia	Kalmykov and Strelkov, (37)
Chandlerella striatospicula	USA	Hibler, (39)
Pseudaprocta decorata	Russia China	Kalmykov and Strelkov, (37) Ryšavý et al. (22)
Porrocaecum ensicaudatum	Poland	Luft (34)
Porrocaecum picae	China	Ryšavý et al. (22)
Eufilaria kalifai	France	Millet and Bain, (40)
Eufilaria longieaudata	USA	Hibler, (39)
Splendidofilaria picacardina	USA	Hibler, (39)
ACANTHOCEPHALA		
Centrorhynchus pinguis	China	Ryšavý et al. (22)
Sphaerirostris picae	Iran Italy Iran	Amin et al. (41) Dezfuli et al. (42) Halajian et al. (31)

Previous studies conducted in different regions of Türkiye indicate that helminth species diversity in birds is generally limited (12–18). Only four species (*H. coronula, L. petiolatum, M. micracanthus* and *S. picae*) were reported in 31 samples collected from the provinces of İzmir, Antalya and Denizli (12,13, 18). In the study conducted in Ankara, only the *D. nasuta* species

was detected in 10 samples (14). In Van Province, where the number of samples was higher, four species (*Echinostoma* spp., *Raillietina* spp., *Capillaria* spp., and *Syngamus* spp.) were identified as a result of examining 43 individuals (16) (Table 3).

In two previous studies conducted in the province of Bursa, three helminth species (*Brachylaima* sp., *Passerilepis* sp. and *Trichinella* spp. larvae) were reported from 12 samples (15,17). In contrast, the present study identified 10 different helminth species from 53 samples collected from the same region. *P. pica* helminths exhibit greater species diversity than previous studies have shown and that an increase in the number of helminth species was observed in direct proportion to the increase in the number of samples collected.

In the present study, the presence of previously reported species was confirmed and some helminth species were identified for the first time in the literature. According to the reviews, although our study is the eighth study conducted on the same bird, with the exception of *D. nasuta* and *S. picae*, the eight species of *P. pica* are new records for Türkiye. The first record of *D. nasuta* was made by Çetindağ and Bıyıkoğlu (14). Our study represents the second record of *D. nasuta* in the literature. Additionally, *B. fuscata*, *L. longicauda*, *B. lobatum*, *C. macracantha*, *P. stylosa* and *B. resecta* are recorded for the first time in the helminth fauna of Türkiye in the present study.

Based on current data, the presence of various helminth species has been reported in *P. pica* specimens obtained from Russia, the Czech Republic, Armenia, Iran, Bulgaria, the United States, China and other regions. The helminth species found in the host species and regional records to date are provided in Table 4.

In addition to studies conducted in Türkiye, 50 helminth species have been reported in *P. pica* specimens worldwide to date (Table 4). Among these species, the highest species richness belongs to the Digenea group. Digenea species account for 48% (n=24) of the identified helminths. Digenea is followed by Nematoda (n=16), Cestoda (n=8), and Acanthocephala (n=2) in terms of number of species. When the distribution of helminth species identified in this study is examined, it is seen that each of the Digenea, Cestoda, and Nematoda groups is represented by three species and has an equal number of species. Furthermore, as in most studies, a type of Acanthocephala was also found in this study. These data reveal that *P. pica* has a wide host potential, capable of harboring ecologically distinct helminth taxa, and is an important species in terms of helminth biodiversity.

The underlying causes of this helminth diversity are closely related to the magpie's feeding ecology, habitat use, and social behavior. The Eurasian magpie (*P. pica*) is an opportunistic species capable of exploiting a wide variety of food resources; its feeding behavior encompasses insects, small vertebrates, seeds, fruits, eggs, carrion, and even human refuse (43, 44). This broad dietary spectrum enables contact with numerous intermediate host organisms, thereby increasing the risk of exposure to helminth infections. In particular, species such as trematodes and cestodes are transmitted via intermediate hosts, which represents an important factor contributing to the high parasite diversity observed in magpies (31). Moreover, the ability of magpies to exploit diverse habitats such as agricultural lands, forest edges, and urbanized areas (45) results in exposure to a variety of environmental parasite loads. The social structure and communal space use of *P. pica* also provide significant ecological opportunities for the horizontal transmission of helminths. Loye and Zuk (46) emphasized that horizontal transmission of parasites among birds occurs primarily through shared feeding and water sources, communal roosting sites and social interactions. Magpies frequently share agricultural fields and refuse sites with other omnivorous bird species, such as corvids and starlings. This shared use of habitats may facilitate interspecific transmission of helminth

eggs disseminated via feces. As a sedentary species, the helminth fauna detected in *P. pica* largely reflects local ecological conditions and the availability of intermediate hosts. Therefore, the helminth diversity observed in *P. pica* individuals is shaped not only by species-specific factors but also by ecological influences.

Conclusion

This study provides valuable new data on the helminth fauna of *P. pica*. The identification of *R. echinobothrida*, *C. macracantha*, *B. obsignata* and *B. resecta* as the first records for *P. pica* worldwide significantly enhances the originality and scientific value of the findings. The high diversity of helminth species detected, together with the fact that several represent new host records, highlights the important contribution of this research to the understanding of avian helminth fauna. Furthermore, the identification of species previously unreported from Türkiye contributes substantially to the country's biodiversity database. Overall, these results provide a solid scientific foundation for future studies on avian helminthology, ecology and biogeography.

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Conflict of interest

The authors declare that there is no conflict of interests.

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