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Original Article

Helminthological 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.



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Introduction

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) $\pm$ standard deviation (SD) values to provide a clearer description of the examined bird population. The birds were first ex-

amined 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							
<i>Brachylaima fuscata</i>	24.5	4.6	1.1	4	4	4	12
<i>Brachylecithum lobatum</i>	9.4	2.2	0.2	3	2	-	5
<i>B. lobatum</i> larva	9.4	9	0.8	3	1	1	5
<i>Lyperosomum longicauda</i>	1.8	1	0.01	1	-	-	1
Cestoda							
<i>Raillietina echinobothrida</i>	5.6	2.3	0.1	3	-	-	3
<i>Passerilepis stylosa</i>	35.8	7.4	2.6	10	5	4	19
<i>Choanotaenia macracantha</i>	5.6	1.3	0.07	1	1	1	3
Nematoda							
<i>Dispharynx nasuta</i>	16.9	4.3	0.7	3	5	1	9
<i>Baruscapillaria obsignata</i>	24.5	7.5	1.8	7	3	2	12
<i>Baruscapillaria resecta</i>	1.8	3	0.05	-	-	1	1
Acanthocephala							
<i>Sphaerirostris picae</i>	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

Gender of Birds	2015 n= (5)			2024 n= (28)			2025 n= (20)			Total		
	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												
<i>Brachylaima fuscata</i>	-	-	-	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
<i>Brachylecithum lobatum</i>	-	-	-	4, 17, 2	6, 25, 3	-	1, 14.3, 1	-	-	5, 14.3, 1.7	6, 16.7, 3	-
<i>B. lobatum</i> 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
<i>Lyperosomum longicauda</i>	-	-	-	-	-	-	1, 14.3, 1	-	-	1, 4.8, 1	-	-
Cestoda												
<i>Raillietina echinobothrida</i>	-	-	-	7, 25, 2.3	-	-	-	-	-	7, 14.3, 2.3	-	-
<i>Passerilepis stylosa</i>	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
<i>Choanotaenia macracantha</i>	2, 50, 2	1, 33, 1	-	-	-	-	-	-	1, 8.3, 1	2, 4.8, 2	1, 8.3, 1	1, 5, 1
Nematoda												
<i>Dispharynx nasuta</i>	-	-	-	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
<i>Baruscapillaria obsignata</i>	-	-	-	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
<i>Baruscapillaria resecta</i>	-	-	-	-	-	3, 12.5, 3	-	-	-	-	-	-
Acanthocephala												
<i>Sphaeriostriis picae</i>	-	-	-	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: Individual number, J: Juvenile, ♂: Male, ♀: Female, NH: Number of Helminth, P: Prevalence, I: Intensity

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).

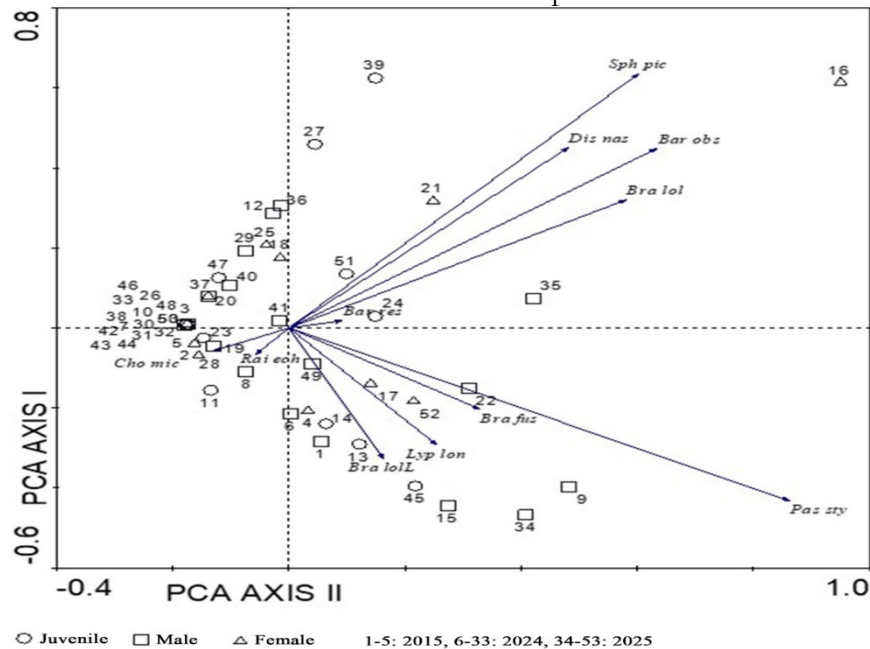


Fig. 1: Principal Component Analysis (PCA) showing the distribution of helminth infections in *Pica pica* individuals (male, female, juvenile) from different sampling years (2015, 2024 and 2025). Abbreviations in the figure (Bro fus= *Brachylaima fuscata*, Bro lol= *Brachylecithum lobatum*, Bro lolL= *B. lobatum* larva, Lyp lon= *Lypersosomum 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= *Sphaerostris 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 Bıykoğlu (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								
<i>Brachylaima fusca-ta</i>								*
<i>Brachylaima</i> sp.				*				
<i>Brachylecithum lobatum</i>								*
<i>Lyperosomum pet-iolatum</i>							*	
<i>Lyperosomum lon-gicauda</i>								*
<i>Echinostoma</i> spp.					*			
<i>Railliatina ech-ninobothrida</i>								*
<i>Raillietina</i> spp.					*			
<i>Choanotaenia macrahantha</i>								*
<i>Passerilepis stylosa</i>								*
<i>Passerilepis</i> sp.				*				
<i>Hymenolepis coronula</i>	*							
<i>Capillaria</i> spp.					*			
<i>Syngamus</i> spp.					*			
<i>Trichinella</i> spp. larva						*		
<i>Baruscapillaria obsignata</i>								*
<i>Baruscapillaria resecta</i>								*
<i>Dispharynx nasuta</i>			*					*
<i>Mediorhynchus micracanthus</i>		*						
<i>Sphaerirostris pi-cae</i>							*	*

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

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

Table 4: Continued...

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

cies was detected in 10 samples (14). In Van Province, where the number of samples was higher, four species (*Echinostoma* spp., *Railietina* 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 Bıykoğlu (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 inter-specific 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. ob-signata* 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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