



A Survey of the Ectoparasites Found on Wild Birds in Northwest Turkey

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ABSTRACT

Background: Turkey is home to various resident and migratory wild bird species. The aim of the present study was to investigate the ectoparasites found on 188 injured or rescued resident and migratory wild birds from Bursa and surroundings between 2015 and 2019.

Methods: Sampled birds were examined for different ectoparasites and all of the collected parasites were placed into tubes containing 70% ethyl alcohol. After mounting onto slides or fixing onto a plate, each parasite was identified to species using a light or stereo microscope.

Result: Results revealed that 88 (46.8%) of the examined wild birds were infested with one or two of 3 different species of ectoparasites. The species identified were 38 lice, three ticks and two flies. The lice were highly prevalent (40.4%) species than the flies (2.1%) and ticks (2.1%). The results also first geographically documented the lice and ked fly species as follows, with additional new host records: *Fulicoffula gallinula* and *Pseudomenapon pilosum* in the common moorhens (*Gallinula chloropus*); *Ciconiphilus decimfasciatus* in the grey heron (*Ardea cinerea*); *Saemundssonina clayae* in the Eurasian woodcock (*Scolopax rusticola*); *Ardeicola ixobrychae* in the common little bittern (*Ixobrychus minutus*) and the ked fly as *Ornithophila metallica* in the Eurasian magpies (*Pica pica*) in Turkey. The study results provided valuable data on the ectoparasites living on migratory and resident bird species during their migration throughout northwest Turkey. Further research on the related pathogens that these ectoparasites harbor is in need.

Key words: Ectoparasite, Survey, Wild birds.

INTRODUCTION

Chewing lice and feather mites are common in all birds and can cause damage to their feathers. This affects their thermoregulation and behavior; reduces the nestling survival, mating success and growth; and influences their coloration. Blood-sucking arthropods, such as ticks or parasitic mites, may cause anemia and secondary or vector-borne infections. Infestations of parasites, such as lice, mites, flies, fleas and other biting insects, cause illnesses and may even cause death, especially of nestlings (Clayton and Walther, 1997; Bush and Clayton, 2018).

Turkey spans 779452 km² that contain 7 major geographical regions and 97 important bird ecosystems encompassing 4% of the country's total land. Each of the seven geographical regions have different climates, habitats, flora and fauna and they comprise approximately 460 documented wild bird species, some of which are migrants that summer in Turkey or use it as a flyway route (Anonymous, 2018a). Two of the world's major bird-migration routes pass through Turkey's Bosphorus and Canakkale Straits and the valleys of the Eastern Black Sea. Bursa Province (40°11'N 29°04'E), located along the Marmara Sea, lies along the Bosphorus and Canakkale Straits bird migratory flyway and encompasses four important bird areas (Magnin *et al.*, 2000).

The wild birds found in Turkey may be infested with hundreds of different ectoparasite species. The often found ectoparasites on these birds are the louse or feather mite species (Girisgin *et al.*, 2013; Gurler *et al.*, 2013; Dik *et al.*, 2015, 2017) and are recorded from the central or eastern part of Turkey.

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Even, number of studies have been carried out on tick infestation of the wild birds (Leblebicioglu *et al.*, 2014; Keskin and Erciyas-Yavuz, 2019), but studies on ked flies infestation is rare, except the study of Erdem *et al.* (2019).

Therefore, our study aimed to (a) provide information on the distribution of lice/ticks/flies within the study areas, (b) determine the ectoparasite infestation rates in both migratory and resident bird hosts and (c) create coincidence information on ectoparasite species infesting wild birds mainly in northwest of Turkey.

MATERIALS AND METHODS

Study area

The present study was conducted at the Animal Hospital of Bursa Uludag University in Turkey between January 2015 and February 2019. All of the examined animals were either

wounded or sick; but none was snared. All of the birds were separated to avoid contamination.

Most of the birds brought to the hospital were from different areas in Bursa Province, which is a forested area located on the northwestern slope of Mount Uludag. The area has a Mediterranean climate and is generally quite humid (mean humidity: 73%) because of its proximity to the Marmara Sea (Anonymous, 2018b). The wild birds brought to the hospital from outside but near to the area were accepted and included in study population. Balıkesir and Bilecik from Marmara Region and Bolu and Zonguldak from Black Sea Region (Fig 1) were the other cities from where the birds were taken.

Bird samples

The birds used in the study were identified to species using the guidelines described by Heinzel *et al.* (1995). A total of 188 wild birds belonging to 43 species, 36 genera and 26 families in 17 orders; were included in the study and were examined for ectoparasite infestations.

Birds were examined immediately after arriving. A wide-spectrum insecticide that containing 0.09% tetramethrin and 0.45% piperonyl butoxide was sprayed between the feathers of the wings, tail and head/neck and over a white piece of paper to collect the ectoparasites; these areas were then examined for any remaining ectoparasites (Clayton and Drown, 2001). In addition, the birds were carefully inspected for ticks, especially on the eye, beak and neck regions, which are possible attaching sites (Clayton and Walther, 1997). The detected ticks were manually collected from the birds using a steel tweezers.

The collected ectoparasites were transferred into plastic tubes containing 70% ethyl alcohol and stored in the laboratory until they were examined under a microscope. The data collected from all of the infested birds for each

bird species and the ectoparasites were recorded. The lice were dechitinised in 10% KOH for 24 h, mounted on Canada balsam and identified to species using a light microscope (Nikon Eclipse E600) with the morphological keys of Adam (2004), Adams *et al.* (2005), Clay (1940, 1958, 1962, 1974, 1977), Clayton *et al.* (1996), Clay and Hopkins (1954), Pilgrim (1976), Price (1965), Price and Beer (1963), Price *et al.* (2003), Tendeiro (1973) and Tuff (1970).

After one day immersed in 70% alcohol, the tick and fly species were identified at the species level under a stereomicroscope using the taxonomic keys of Estrada-Pena *et al.* (2004) for adult ticks, Heylen *et al.* (2014) and Walker *et al.* (2005) for immature ticks and Hutson (1984) for ked flies.

Data analysis

The prevalence of ectoparasites was evaluated for both the bird families and bird species and for each ectoparasite if there was at least one type of collected ectoparasites. The mean abundance and intensity levels were determined for each ectoparasitespecies on the avian hosts.

Ethical approval

All applicable international, national and/or institutional guidelines for the care and use of animals were strictly followed. All animal sample collection protocols complied with the current laws of Turkey. Permission to conduct the study protocol and the investigation on the birds was granted by the ethical committee of Bursa Uludag University (No: 2015-06/03) and the Ministry of Forestry and Water Affairs of Turkey on June 29, 2015 (No: 138216).

RESULTS AND DISCUSSION

During the study, 188 birds of 43 species were examined for ectoparasites. Of these, 71 birds (37.7%) of 21 species



Fig 1: Location and number of the collected wild birds.

Table 1: Avian hosts with and without lice infestation.

No. Hosts	Common name	Chewing lice species	Abundance						
			Ni	M	F	N	T	MI	
ACCIPITRIFORMES									
Accipitridae									
24	<i>Buteo buteo</i>	Common buzzard	<i>Craspedorrhynchus platystomus</i>	11	26	73	27	126	11.45
			<i>Colpocephalum turbinatum</i>	1	-	1	-	1	1.0
			<i>C. nanum</i>	4	5	17	1	23	5.75
			<i>Degeeriella fulva</i>	5	8	13	1	22	4.40
			<i>Laemobothrion maximum</i>	1	-	1	-	1	1.0
5	<i>Accipiter nisus</i>	Sparrow hawk	<i>Colpocephalum polonum</i>	1	1	3	-	4	4.0
			<i>Degeeriella nisus</i>	1	3	9	-	12	12.0
2	<i>Circaetus gallicus</i>	Short-toed snake eagle	-	-	-	-	-	-	-
ANSERIFORMES									
Anatidae									
1	<i>Cygnus cygnus</i>	Whooper swan	-	-	-	-	-	-	-
APODIFORMES									
Apodidae									
4	<i>Apus apus</i>	Common swift	<i>Dennyus hirundinis</i>	2	2	2	-	4	2.0
2	<i>A. melba</i>	Alpine swift	-	-	-	-	-	-	-
CHARADRIIFORMES									
Laridae									
47	<i>Larus cachinnans</i>	Caspian gull	<i>Saemundssonina lari</i>	20	21	31	18	70	3.5
			<i>Actornitophilus piceus</i>	2	2	10	8	20	10.0
1	<i>Chroicocephalus genei</i>	Slender-billed gull	<i>Saemundssonina lari</i>	1	4	1	-	5	5.0
			<i>Actornitophilus piceus</i>	1	-	1	-	1	1.0
Scolopacidae									
2	<i>Scolopax rusticola</i>	Eurasian woodcock	<i>Saemundssonina clayae</i> ^a	1	-	1	-	1	1.0
COLUMBIFORMES									
Columbidae									
8	<i>Columba livia</i>	Rock dove	<i>Columbicola columbae</i>	8	27	43	26	96	12.0
			<i>Campanulotes bidentatus</i>	1	-	1	-	1	1.0
			<i>Lipeurus caponis</i>	1	2	17	7	26	26.0
			<i>Goniodes dissimilis</i>	1	-	4	1	5	5.0
3	<i>Streptopelia senegalensis</i>	Laughing dove	<i>Columbicola bacillus</i>	1	1	1	1	3	3.0
			<i>C. columbae</i>	1	1	1	-	2	2.0
			<i>Coloceras chinense</i>	2	2	5	1	8	4.0
			<i>Cuclotogaster heterographus</i>	1	1	2	-	3	3.0
CICONIIFORMES									
Ciconiidae									
11	<i>Ciconia ciconia</i>	White stork	<i>Ardeicola ciconiae</i>	4	13	8	15	36	9.0
			<i>Ciconiphilus quadripustulatus</i>	1	19	32	11	62	62.0
			<i>Colpocephalum zebra</i>	3	6	22	7	35	11.6
			<i>Neophilopterus incompletus</i>	2	6	4	3	13	6.5
CORACIIFORMES									
Meropidae									
3	<i>Merops apiaster</i>	European bee-eater	<i>Meropoecus meropis</i>	3	2	6	5	13	4.3
			<i>Meropsiella apiastri</i>	2	1	2	1	4	2.0
			<i>Meromenopon meropis</i>	1	5	13	9	27	27.0
Upupidae									
1	<i>Upupa epops</i>	Eurasian hoopoe	-	-	-	-	-	-	-
PICIFORMES									
Picidae									
1	<i>Dendrocopos syriacus</i>	Syrian woodpecker	-	-	-	-	-	-	-

Table 1: Continue...

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PELECANIFORMES									
Ardeidae									
4	<i>Ixobrychus minutus</i>	Common little bittern	<i>Ardeicola ixobrychae</i> ^a	1	-	3	3	6	6.0
1	<i>Ardea cinerea</i>	Grey heron	<i>Ciconiphilus decimfasciatus</i> ^a	1	4	13	5	22	22.0
1	<i>A. alba</i>	Great white egret	<i>Comatomenapon elongatum</i>	1	2	2	-	4	4.0
FALCONIFORMES									
Falconidae									
3	<i>Falco tinnunculus</i>	Common kestrel	<i>Degeeriella</i> spp.	1	-	-	1	1	1.0
1	<i>F. eleonora</i>	Eleonora's falcon	-	-	-	-	-	-	-
GRUIFORMES									
Rallidae									
2	<i>Gallinula chloropus chloropus</i>	Common moorhen	<i>Fulicoffula gallinula</i> ^a	1	1	1	-	2	2.0
			<i>Pseudomenapon pilosum</i> ^a	1	-	1	-	1	1.0
PASSERIFORMES									
Corvidae									
12	<i>Pica pica</i>	Eurasian magpie	<i>Menacanthus eurysternus</i>	1	-	1	-	1	1.0
4	<i>Corvus monedula</i>	Western jackdaw	-	-	-	-	-	-	-
3	<i>C. corone</i>	Carrion crow	-	-	-	-	-	-	-
3	<i>C. cornix</i>	Hooded crow	-	-	-	-	-	-	-
2	<i>C. frugilegus</i>	Rook	<i>Myrsidea isostoma</i>	2	3	3	1	7	3.5
			<i>Brueelia tasniemae</i>	1	-	1	-	1	1.0
2	<i>Garrulus glandarius</i>	Eurasian jay	-	-	-	-	-	-	-
Turdidae									
3	<i>Turdus merula</i>	Eurasian blackbird	<i>Menacanthus eurysternus</i> ^b	1	3	6	-	9	9.0
			<i>Brueelia jacobi</i>	1	1	2	-	3	3.0
Motacilidae									
1	<i>Anthus trivialis</i>	Tree pipit	-	-	-	-	-	-	-
Passeridae									
7	<i>Passer domesticus</i>	House sparrow	-	-	-	-	-	-	-
Regulidae									
1	<i>Regulus regulus</i>	Goldcrest	-	-	-	-	-	-	-
Sylviidae									
1	<i>Sylvia atricapilla</i>	Eurasian blackcap	-	-	-	-	-	-	-
Sturnidae									
3	<i>Sturnus vulgaris</i>	Common starling	-	-	-	-	-	-	-
Hirundinidae									
1	<i>Hirundo rustica</i>	Barn swallow	-	-	-	-	-	-	-
PHOENICOPTERIFORMES									
Phoenicopteridae									
2	<i>Phoenicopterus ruber</i>	American flamingo	<i>Colpocephalum heterosoma</i>	2	1	1	1	3	1.5
			<i>Trinoton femoratum</i>	2	-	2	-	2	1.0
			<i>Anaticola</i> sp. ^c	1	-	-	2	2	2.0
STRIGIFORMES									
Strigidae									
4	<i>Athene noctua</i>	Little owl	<i>Strigiphilus cursitans</i>	2	8	14	7	29	14.5
2	<i>Strix aluco</i>	Tawny owl	-	-	-	-	-	-	-
1	<i>Asio otus</i>	Long-eared owl	-	-	-	-	-	-	-
1	<i>Bubo bubo</i>	Eurasian eagle-owl	-	-	-	-	-	-	-
Tytonidae									
6	<i>Tyto alba</i>	Barn owl	<i>Colpocephalum</i> spp. ^c	1	-	1	-	1	1.0

Table 1: Continue...

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CAPRIMULGIFORMES									
Caprimulgidae									
2	<i>Caprimulgus europaeus</i>	European nightjar	-	-	-	-	-	-	-
Total			104	182	375	74	631		

No: Number of birds examined, Ni: Number of birds infested, M: Male, F: Female, N: Nymph, T: Total, MI: Mean intensity.

*Considered for number of infested birds only.

^aNew geographic record for Turkey. ^bNew host record for Turkey. ^cUnspecified because of unsuccessful preparation.

Table 2: Distribution of tick species according to their avian hosts.

Hosts	Common name	Tick species	Abundance						
			Ni	M	F	L	N	T	MI
CICONIIFORMES									
Ciconiidae									
<i>Ciconia ciconia</i>	White stork	<i>Rhipicephalus sanguineus</i> ^a	2	-	-	-	2	2	1.0
PASSERIFORMES									
Corvidae									
<i>Corvus frugilegus</i>	Rook	<i>Haemaphysalis punctata</i> ^a	1	1	-	-	-	1	1.0
STRIGIFORMES									
Strigidae									
<i>Athene noctua</i>	Little owl	<i>Ixodes ricinus</i> ^a	1	-	-	1	-	1	1.0
Total			4	1	-	1	2	4	

No: Number of birds examined, Ni: Number of birds infested, M: Male, F: Female, L: Larvae, N: Nymph, T: Total, MI: Mean intensity.

*Considered for number of infested birds only. ^aNew host record for Turkey.

Table 3: Distribution of fly species according to their avian hosts.

Hosts	Common name	Fly species	Abundance				
			Ni	M	F	T	MI
COLUMBIFORMES							
Columbidae							
<i>Columba livia</i>	Rock dove	<i>Pseudolynchia canariensis</i>	3	-	3	3	1.0
PASSERIFORMES							
Corvidae							
<i>Pica pica</i>	Eurasian magpie	<i>Ornithophila metallica</i> ^a	1	1	-	1	1.0
Total			4	1	3	4	

No: Number of birds examined, Ni: Number of birds infested, M: Male, F: Female, T: Total, MI: Mean intensity.

*Considered for number of infested birds only. ^aNew geographic record for Turkey. ^bNew host record for Turkey.

were migrant and 117 birds (62.2%) of 22 species were resident. A total of 631 lice, four ticks and four flies were collected from 88 birds of 27 species, which corresponds to 46.8% of all birds examined. These birds were infested with at least one ectoparasite with a mean intensity of 8.3, 1.3 and 1.0 per bird for louse, tick and fly species, respectively.

Species-wise, 41 louse species, three tick species and two ked fly species were identified, with the louse species being more prevalent (40.4%) than the fly (2.1%) and tick (2.1%) species. The voucher specimens of lice, ticks and flies were deposited at the Department of Parasitology, Bursa Uludag University, Turkey.

The species of the ectoparasite identified in this study according to parasite orders were presented in Table 1 to 3.

Among the lice species, *Ciconiphilus quadripustulatus* had the highest mean intensity (62.0). Table 1 shows the ectoparasite-free birds together with infested birds.

Although some of the samples found in the study are similar to those previously made in the area, the new geographic records of lice samples were *Fulicoffula gallinula*, *Ciconiphilus decimfasciatus*, *Ardeicola ixobrychae* and *Saemundssonina clayae*. The new geographic record for the ked fly sample was *Ornithophila metallica*. In addition, there are new host records for Turkey: the louse species *Pseudomenapon pilosum* on common moorhens; the tick species *Rhipicephalus sanguineus sensu lato*, *Haemaphysalis punctata* and *Ixodes ricinus* on white storks, rooks and little owls, respectively and the ked fly species *Ornithophilus metallica* on Eurasian magpies.

Individually considering the migration status of infested birds, the ectoparasite infestation rate was higher in the residents (52/88; 59.09%) than in the migrants (36/88; 40.90%).

Several researchers throughout the world have studied ectoparasitic infestations in wild birds (Ilieva, 2005; Lyakhova and Kotti, 2011); however, most of these studies from Turkey were on lice (Girisgin *et al.*, 2013; Dik *et al.*, 2017). One of the reasons for this is that lice infestation is common on birds than other ectoparasitic infestation (Bush and Clayton, 2018). In contrast to previous studies, the present study includes all ectoparasites (except feather mites) obtained from both migratory and resident wild birds in Bursa and surroundings, Turkey.

Rehabilitation of wild birds, especially in endangered species requires expertise and special care (Debnath *et al.*, 2018; Aslan *et al.*, 2018). Ectoparasites are great menace to poultry production causing threat to growth, reproduction, behavior, or long-term survival (Clayton and Walther, 1997; Bush and Clayton, 2018). The dynamics of ectoparasite infestations on birds are complicated due to migration or residence, combined with other factors, such as seasonal influences and contact with each other. However, migratory birds may also face additional risks due to perilous journey. In our study, a higher ectoparasite infestation rate was determined on resident birds (59.09%). A previous study in Turkey showed a higher infestation rate on migratory birds (Girisgin *et al.*, 2013). Variation in rate of infestation in different type of birds could be difference in sample size, behaviors, or local conditions of birds (Bush and Clayton, 2018).

Although the ked fly infestation rate was low (2.1%), ked flies (Hippoboscidae) can feed on the host's blood and cause anemia (Hutson, 1984). Most of the fly species found in this study were similar to those recorded on domestic pigeons in Turkey (Erdem *et al.*, 2019; reviewed in Tezcan, 2020). In addition to the wild pigeons, a less common ked fly species (*O. metallica*) was detected on a Eurasian magpie, which is the first geographic record in Turkey.

Similar to ked infestation, low tick infestation rate (2.1%) was detected in the present study, which is consistent with that of the other studies conducted in Turkey ranging from 0.5% to 4.36% (Leblebicioglu *et al.*, 2014; Keskin and Erciyas-Yavuz, 2019). Nevertheless, our low numbers of ticks can, all or partially, be from accidental infestation. In addition, most of the detected ticks were larvae and nymphs, similar to those seen in previous studies in Turkey.

CONCLUSION

The avifauna of an environment plays a critical role in the ecosystem and is involved in the transmission of some zoonotic diseases (Smith *et al.*, 2020); therefore, their ectoparasites may play a role as vectors for spreading diseases. Results revealed numerous species of ectoparasites (lice, ticks and keds) on wild birds in Turkey being heavy infestation on resident birds than migratory.

Although these species can be possible vectors, additional research is needed to confirm the related pathogens that they harbor.

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