Chewing lice (Phthiraptera) species of wild birds in northwestern Turkey with a new host record

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The goal of this study was to identify the chewing lice species of migratory and non-migratory wild birds in the province of Bursa, which is located in northwestern Turkey, between August 2009 and November 2012. Sixty-eight birds were brought to the animal hospital in need of medical intervention, which belonged to 25 species, 20 genera and 15 families in 10 orders, were examined for ectoparasites. To sample for the presence of chewing lice, an insecticide was powdered on the feathers of each bird over a white piece of paper, and then all of the lice were collected and placed in tubes containing 70% alcohol. The lice specimens were cleared in 10% KOH for 24 h, mounted in Canada balsam and identified using a light microscope. Forty (58.8%) out of 68 birds examined were infested with at least one species of chewing lice, and a total of 28 lice species were found on the birds. This study represents the first documentation in Turkey of 9 of these lice species and also provides the first worldwide record of Degeeriella nisus on the Common buzzard (Buteo buteo).

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1. Introduction

Chewing lice (Ischnocera, Amblycera) are permanent ectoparasites primarily of bird species, and they feed on feathers and skin scales. These lice can be harmful to both domestic and wild hosts, as they deteriorate the quality of the plumage, provoke small holes on feathers (which diminish thermoregulatory capacity), and increase feather breakage (Booth et al., 1993; Kose and Møller, 1999; Vas et al., 2008). To date, over 4000 species of bird lice have been identified worldwide (Price et al., 2003).

Intense lice infestation can potentially produce direct (e.g., hyperkeratosis and feather damage) and indirect (e.g., negative sexual selection) pathological effects for hosts (Lopez et al., 2008; Liebana et al., 2011; Moreno-Rueda and Hoi, 2012). However, infestation was not found to affect nestling growth and survival of broods in American kestrels (Lesko and Smallwood, 2012).

Turkey covers an area of 779,452 km² and has 97 important bird areas (IBAs), which cover a total of 29,978 km² or 4% of the total land area. The country is divided into seven major geographical regions, each with different climates, habitats, flora and fauna. The Bursa province is part of the Marmara Region (40°11’N 29°04’E), which is located along the Marmara Sea, and this province lies along migratory flyways and contains four IBAs (Magnin et al., 2000).

Approximately 110 species of bird lice have been recorded in Turkey, and this number has increased in recent years. Regional studies of multiple wild bird species have been conducted in central and eastern Turkey (Dik, 2010; Inci et al., 2010a; Dik et al., 2011a,b), but few studies have focused on the western region (Inci et al., 2010b). Several studies have also focused on specific hosts, such as Storks (Ciconia ciconia) (Dik and Uslu, 2005), Great white pelicans (Pelecanus onocrotalus) (Dik and Uslu, 2005) and Common blackbirds (Turdus merula) (Dik and Dincer, 2012). Despite these studies, the knowledge of avian louse infestations of wildlife in Turkey remains limited (Inci et al., 2010a), and additional data on the prevalence of chewing lice in wild birds in Turkey is needed (Dik et al., 2011a,b).

Therefore, the objectives of this study were to gather new data regarding the lice species of wild birds in the Marmara Region of northwest Turkey, to increase the knowledge of the geographical distribution of lice found in the study area and to determine the rates of chewing lice infestation in both migratory and non-migratory avian hosts.
2. Materials and methods

2.1. Study area

This study was conducted at the Animal Hospital of Uludag University in Bursa, Turkey between August 2009 and November 2012. Bursa is a mountainous province with a surface area of 10,891 km² that is covered with natural forest. This region is also generally quite humid (average humidity of 73%) due to the close proximity of the Marmara Sea (Anonymous, 2012).

Due to the unique nature of this animal hospital, members of the public and veterinarians can bring any wild animal in need of medical intervention to the hospital. All of the birds examined in this study were wounded or sick when they reached the hospital. All of the birds studied were kept in separate cages or in limited areas to avoid contamination.

2.2. Sampling data

In total, 68 wild birds belonging to 25 species, 20 genera and 15 families in 10 orders were examined for ectoparasites. The identification of birds was conducted according to the guide developed by Heinzel et al. (1995).

Following the identification of the bird species, ectoparasites were collected using a specific product for ectoparasite control that contains a combination of 0.09% tetrametrin and 0.45% piperonyl butoxide. This wide-spectrum insecticide is not harmful to birds when it is pulverised on the feathers over a white piece of paper (Clayton and Drown, 2001). Additionally, the feathers of the wings, the tail and the head/neck region of the birds were separated and inspected (Mey, 2003). All birds were examined immediately following their arrival at the hospital.

The chewing lice collected from the infested birds were transferred to vials containing 70% alcohol and stored in the laboratory until microscopic examination. The protocols for each bird species and the collected lice from all of the infested birds were recorded. At the laboratory, the lice were clarified in 10% KOH for 24 h, mounted on permanent slides with Canada balsam and identified using a light microscope in accordance with the keys developed by Clay (1940, 1958, 1966, 1977), Carriker (1947), Clay and Hopkins (1954), Tandan (1958, 1964), Price and Beer (1963), Tendeiro (1973, 1974), Pilgrim (1976), Clayton (1990), Martín-Mateo (1994), Mey (1998) and Adams et al. (2005). All mounted specimens were stored at the parasitology department laboratories of the Veterinary Faculties of Uludag (Bursa) and Selçuk (Konya) Universities.

2.3. Parasitism rate analysis

The infestation prevalence of chewing lice was evaluated for bird families and bird species with a minimum of a single collected individual. The abundance mean and intensity mean level of each species of chewing lice on the avian hosts were determined.

3. Results and discussion

Chewing lice were found on 40 (58.8%) of the 68 species of wild birds examined. Fifteen birds (37.5%) were infested with at least two species of lice. Thirty-six species of migratory birds were examined, with 26 (72.2%) presenting infestation. Of the non-migratory birds, 32 species were examined, with 14 (43.7%) presenting infestation.

In addition, a new host-parasite association was found, and 9 species of chewing lice were identified for the first time in Turkey, thereby increasing the geographic distribution of these species (Table 1).

A total of 1,278 lice specimens were collected, representing 523 males, 573 females and 182 nymphs. Some birds had only one or a few lice (e.g., Passer domesticus, Larus cachinnans), while others presented numerous lice species (e.g., Pelecanus onocrotalus, Platalea leucorodia). The lice were distributed across two suborders and three families, including suborder Amblycera with families Laemobothriidae and Menoponidae and suborder Ischnocera with family Philopteridae. Identification to the species level was achieved for 30 taxa distributed across 20 genera.

For the family Laemobothriidae, a single species was identified: Laemobothriothron maximum (Scopoli, 1763).

For the family Menoponidae, five species were identified, including Ciconiphilus quadrripustulatus (Burmeister, 1838), Colpocephalum eucarenium (Burmeister, 1838), Colpocephalum zebra (Burmeister, 1838), Colpocephalum nanum (Piaget, 1890) and Plagieta titan (Piaget, 1880).

For the family Philopteridae, the following 23 species were identified: Ardeicola ciconiae (Linnaeus, 1758), Ardeicola plataleae (Linnaeus, 1758), Coloceras chinense (Kellogg and Chapman, 1902), Coloceras hilli (Bedford, 1920), Coloceras piageti (Johnston and Harrison, 1912), Columbicola bacillus (Giebel, 1866), Craspedorrhynchus platysomus (Burmeister, 1838), Cyclogastogaster heterographus (Nitzsch [in Giebel], 1866), Degeeriella fulva (Giebel, 1874), Degeeriella nisus (Giebel, 1866), Degeeriella rufa (Burmeister, 1838), Degeeriella leucopleura (Nitzsch), Struthiolipeurus struthionis (Gervais, 1844), Falcoilepeurus sutoralis (Rudow, 1869), Philopterus fringillae (Scopoli, 1772), S. saemundssonii lari (Fabricius, 1780), Strigiphilus curtisitans (Nitzsch [in Giebel], 1861), C. pavaevs (Linnaeus, 1758), Conooides dispar (Burmeister, 1838) and Ibdoeucus plataleae (Denny, 1842). Some individuals of the genera Pectinopygus and Degeeriella were also collected but could not be identified due to unsuccessful preparation.

The detection of D. nisus (Giebel, 1866) (Fig. 1) on Buteo buteo (Common buzzard) demonstrated here represents a new host record for the lice fauna of the world. The following nine new lice records for Turkey were obtained: Coloceras hilli isolated from Streptopelia decaocto (Eurasian collared-dove); L. plataleae and A. plataleae isolated from Platalea leucorodia (Eurasian spoonbill); F. sutoralis and D. nisus isolated from B. buteo; Coloceras chinense isolated from Streptopelia senegalensis (Laughing dove); S. curtisitans isolated from Athene noctua (Little owl); S. struthionis isolated from Struthio camelus (Ostrich); and G. pavonis isolated from Pavo cristatus (Indian peafowl).

A large number of chewing lice of various species were detected on birds in the northwestern region of Turkey. Of the 29 species of chewing lice identified, 5 were associated with only a single host species. However, cosmopolitan species were also found, including L. maximum, which has been reported to parasitize 50 species of Falconiformes, and S. lari, which has been reported to parasitize 36 species of Charadriiformes (Price et al., 2003).

Of the 25 wild bird species examined, 13 species had not been previously evaluated for ectoparasite infestation in Turkey. These species include the European turtle doves, the laughing doves, the Dalmatian pelicans, the ostriches, the grey herons, the hooded crows, the western jackdaws or willow warblers, whereas all of the other species examined were infested with lice.

In this study, the infestation rate of migratory birds was notably higher than that of non-migratory birds (72.2% and 43.7%, respectively). In generalised studies of wild birds in Turkey, which lacked segregation based on migration, infestation rates of 25.0% (Dik, 2010), 41.4% (Inci et al., 2010b) and 35.4% (Dik et al., 2011b) were found. Additionally, studies conducted in the
Table 1  
Distribution of louse species according to their avian hosts.

| Hosts         | Common name          | Chewing lice species                  | Abundance |
|---------------|----------------------|---------------------------------------|-----------|
|               |                      |                                       | Ni | M  | F  | N  | T  | MI |
| COLUMBIFORMES | Columbidae           |                                       | 51 | 0  | 0  | 0  | 1  | 1  |
| 1             | Streptopelia turtur  | Turtle dove                            | Columbicola bacillus          | 1  | 2  | 2  | 0  | 4  | 4.0|
| 1             | Streptopelia senegalensis | Laughing dove                        | Coloceras chinense^            | 1  | 5  | 1  | 0  | 6  | 6.0|
| 2             | Streptopelia decaocto | Eurasian collared-dove                 | Columbicola bacillus           | 1  | 1  | 1  | 2  | 2  | 2.0|
|               |                      |                                       | Coloceras hill^                | 1  | 0  | 2  | 1  | 3  | 3.0|
|               |                      |                                       | Coloceras piugeri              | 1  | 1  | 0  | 1  | 1  | 1.0|
| CICONIIFORMES | Ciconiidae           |                                       | 11 | 1  | 1  | 1  | 1  | 1  |
| 11            | Ciconia ciconia      | Stork                                 | Ciconiphilus quadripustulatus  | 4  | 189| 195| 57 | 441| 110.2|
|               |                      |                                       | Neophilopterus incompletus     | 3  | 6  | 0  | 0  | 6  | 2.0|
|               |                      |                                       | Colopocephalum zebra           | 1  | 1  | 2  | 0  | 3  | 3.0|
|               |                      |                                       | Ardeicola ciconiae             | 1  | 3  | 6  | 2  | 11 | 11.0|
| PELECANIFORMES| Pelecanidae          |                                       | 1  | 1  | 1  | 1  | 1  | 1  |
| 1             | Pelecanus crispus    | Dalmatian pelican                     | Piagetiella titan              | 1  | 5  | 5  | 3  | 13 | 13.0|
|               |                      |                                       | Pectinopygus sp.               | 1  | 2  | 0  | 0  | 2  | 2.0|
| 2             | Pelecanus onocrotalus| Great white pelican                   | Colopocephalum eucarenus       | 1  | 1  | 0  | 0  | 1  | 1.0|
|               |                      |                                       | Pectinopygus forficulatus      | 1  | 167| 212| 65 | 444| 444.0|
|               |                      |                                       | Pectinopygus sp.               | 1  | 2  | 7  | 2  | 11 | 11.0|
|               |                      |                                       | Ardeidae                      | 1  | 1  | 0  | 0  | 1  | 1.0|
| 1             | Ardea cinerea        | Grey heron                            |                           | 0  | –  | –  | –  | –  | –  |
| 1             | Platalea leucorodia  | Eurasian spoonbill                     | Ibidoecus platealea^           | 1  | 78 | 85 | 33 | 196| 196.0|
|               |                      |                                       | Ardeicola platealea^           | 1  | 2  | 1  | 0  | 3  | 3.0|
| STRUTHIONIFORMES| Struthionidae        |                                       | 1  | 1  | 1  | 1  | 1  | 1  |
| 1             | Struthio camelus (farmed) | Ostrich                                | Struthioloipeurus struthionis^ | 1  | 9  | 11 | 3  | 23 | 23.0|
| ACCIPITRIFORMES| Accipitridae         |                                       | 14 | 1  | 1  | 1  | 1  | 1  |
| 1             | Buteo buteo         | Common buzzard                        | Degeeriella fulva              | 5  | 5  | 3  | 1  | 9  | 1.8|
|               |                      |                                       | Degeeriella nisus^             | 1  | 1  | 1  | 1  | 3  | 3.0|
|               |                      |                                       | Degeeriella sp.                | 2  | 5  | 5  | 0  | 10 | 5.0|
|               |                      |                                       | Craspedorynchus platystomus    | 6  | 9  | 5  | 4  | 18 | 3.0|
|               |                      |                                       | Colopocephalum nanum           | 1  | 1  | 0  | 0  | 1  | 1.0|
|               |                      |                                       | Falcolepusurus naturalis^      | 1  | 1  | 1  | 0  | 2  | 2.0|
|               |                      |                                       | Laemobothrin maximum           | 3  | 4  | 1  | 1  | 6  | 2.0|
| 2             | Buteo rufinus       | Long-legged buzzard                   | Colopocephalum nanum           | 1  | 2  | 1  | 3  | 6  | 6.0|
|               |                      |                                       | Craspedorynchus platystomus    | 1  | 1  | 7  | 2  | 10 | 10.0|
| 1             | Circaetus gallicus   | Short-toed snake eagle                | Degeeriella leucopleura        | 1  | 3  | 0  | 0  | 3  | 3.0|
| 1             | Aquila pennatus      | Booted eagle                          | Laemobothrin maximum           | 1  | 1  | 0  | 0  | 1  | 1.0|
| 1             | Accipiter nisus     | Sparrowhawk                           |                           | 0  | –  | –  | –  | –  | –  |
| FALCONIFORMES | Falconidae           |                                       | 14 | 1  | 1  | 1  | 1  | 1  |
| 1             | Falco tinnunculus   | Common kestrel                         | Degeeriella rufa               | 1  | 3  | 0  | 0  | 3  | 3.0|
| PASSERIFORMES | Passeridae           |                                       | 1  | 1  | 0  | 0  | 1  | 1.0|
| 1             | Passer domesticus   | House sparrow                         | Philopterus fringillae         | 1  | 1  | 0  | 0  | 1  | 1.0|
| 2             | Pica pica           | Eurasian magpie                        |                           | 0  | –  | –  | –  | –  | –  |
| 1             | Corvus cornix       | Hooded crow                           |                           | 0  | –  | –  | –  | –  | –  |
| 1             | Corvus monedula soemmerringii | Western jackdaw    |                           | 0  | –  | –  | –  | –  | –  |
| 1             | Phylloscopidae      |                                       |                           | 0  | –  | –  | –  | –  | –  |
| 1             | Phylloscopus trochilus| Willow warbler                        |                           | 0  | –  | –  | –  | –  | –  |
| CHARADRIIFORMES| Laridae             |                                       | 14 | 1  | 1  | 1  | 1  | 1  |
| 1             | Larus cachinnans    | Caspian gull                          | Saemundssonia lari            | 4  | 5  | 1  | 2  | 8  | 2.0|
| STRIGIFORMES | Strigidae           |                                       | 1  | 1  | 3  | 1  | 5  | 5.0|
| 1             | Athene noctua       | Little owl                            | Strigiphilus curvisans^        | 1  | 1  | 3  | 1  | 5  | 5.0|
| 4             | Tyto alba          | Barn owl                              |                           | 0  | –  | –  | –  | –  | –  |

(continued on next page)
countries neighbouring Turkey showed infestation rates of 15.2% in Iran (Dik and Halajian, 2013), 10.7% in Bulgaria (Ilieva, 2005) and similar results in Russia (Lyakhova and Kotti, 2011). In addition, the species composition of the lice community and their hosts reported in our study were similar to those reported in Russia (Lyakhova and Kotti, 2011) and Bulgaria (Ilieva, 2005) but were markedly different than those reported in Iran (Dik and Halajian, 2013). This discrepancy may be due to geographical variations and the insufficient number of birds examined in the present study. In addition, infestation levels can vary according to habitat, the infestation rate in flocks of birds, the infestation of the nest, the general health of the birds and other environmental conditions (Poulin, 1991). Moreover, the higher infestation rates obtained in this study as compared to those conducted in other provinces in Turkey may have been the result of the high humidity levels in Bursa (Chen and Mullens, 2008; Bush et al., 2009).

Transmission of *D. nisus* between the Eurasian sparrowhawk, its normal host, and the Common buzzard was impossible because their reception at our hospital was separated by an interval of almost 1 year; the Common buzzard specimens were received in February 2011, while the Eurasian sparrowhawk was received in January 2012. In addition, special care was taken not to mix up the sampling tools. We are therefore confident that the Common buzzard represents a new host record for *D. nisus*.

In conclusion, we found that wild birds were infested by numerous lice species and that migratory birds were more significantly affected than non-migratory birds. Nine lice species, namely, *Coloceras hilli*, *C. chinense*, *I. plataleae*, *A. plataleae*, *F. suturalis*, *D. nisus*, *S. cursitans*, *S. struthionis* and *G. pavonis*, are reported here for the first time in Turkey. Additionally, we documented a new host report (*D. nisus* on *B. buteo*). Our findings indicate that Turkey is an important location in avian Phthirapteran research, and numerous lice species can be studied if a variety of bird species are examined on the flyways and/or important bird areas of Turkey.

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**References**

Clay, T., 1940. Genera and species of Mallophaga occurring on Gallinaceous hosts Part II. Goniodes. Zool. Soc. Lond. 110 (Ser B), 1–119.

Carriker, M.A.J., 1947. Neotropical Mallophaga miscellany. No. 2. The genus *Illefocus* Cummings. Bol. Entomol. Venezolana 6, 111–136.

Clay, T., Hopkins, C.J.E., 1954. The early literature on Mallophaga. Bull. Brit. Mus. (Nat. Hist.) Entomol. 3, 221–266.

Clay, T., 1958. Revisions of Mallophaga Genera. *Degeeriella* from Falconiformes. Bull. British Mus. (Nat. Hist.) Entomol. 7, 123–207.
Adams, R.J., Price, R.D., Clayton, D.H., 2005. Taxonomic revision of old world members of the feather louse genus Columbola (Phthiraptera: Ischnocera), including descriptions of eight new species. J. Nat. Hist. 39, 3545–3618.

Ilieva, M.N., 2005. New data on chewing lice (Insecta: Phthiraptera) from wild birds in Bulgaria. Acta Zool. Bulg. 57, 37–48.

Dik, B., Uslu, U., 2006. Mallophaga (Insecta) species occurring on storks (Ciconia ciconia Linnaeus, 1758). T. Parazitol. Derg. 30, 220–223 (In Turkish with English abstract).

Chen, B.L., Mullens, B.A., 2008. Temperature and humidity effects on off-host survival of the northern foul mite (Acari: Macronyssidae) and the chicken body louse (Phthiraptera: Menoponidae). J. Econ. Entomol. 101, 637–646.

Dik, B., Uslu, U. 2008. Mallophaga species observed in white pelicans (Pelecanus onocrotalus, Linnaeus) in Turkey. T. Parazitol. Derg. 32, 71–76 (In Turkish with English abstract).

Lopez, G., Figueroa, J., Sorriguer, R., 2008. Carotinoid-based masks in the European goldfinch Carduelis carduelis reflect different information in males and females. Ardea 96, 233–242.

Vas, Z., Czégó, T., Meller, A.P., Rózsa, L., 2008. The feather holes on the barn swallow Hirundo rustica and other small passerines are probably caused by Brueelia spp. lice. J. Parasitol. 94, 1438–1440.

Bush, S.E., Harbison, C.W., Slager, D.L., Peterson, A.T., Price, R.D., Clayton, D.H., 2009. Geographic variation in the community structure of lice on western scrub-jays. J. Parasitol. 95, 10–13.

Dik, B., 2010. Chewing lice species (Phthiraptera) found on domestic and wild birds in Turkey. T. Parazitol. Derg. 34, 55–60 (In Turkish with English abstract).

İnci, A., Dik, B., Kıcıar, M., Yıldırım, A., Düzioğlu, O., 2010a. Chewing lice (Phthiraptera) species on wild birds in Cappadocia region, Turkey. T. Parazitol. Derg. 34, 174–178.

İnci, A., Yıldırım, A., Dik, B., Düzioğlu, O., 2010b. Current knowledge of Turkey’s louse fauna. T. Parazitol. Derg. 34, 212–220.

Dik, B., Şekercioğlu, Ç.H., Kirpik, M.A., İnak, S., Uslu, U., 2011a. Chewing lice (Phthiraptera) species found on Turkish shorebirds (Charadriiformes). Kafkas Univ. Vet. Fak. Derg. 16, 867–874.

Dik, B., Yamaç, E.E., Uslu, U., 2011b. Chewing lice (Phthiraptera) found on wild birds in Kafkas Univ. Vet. Fak. Derg. 17, 787–794.

Liebana, M.S., Santillan, M.A., Cichiná, A.C., Sarasola, J.H., Martínez, P., Cabezás, S., Bo, M.S., 2011. Ectoparasites in free-ranging American Kestrels in Argentina: implications for the transmission of viral diseases. J. Raptor Res. 45, 335–341.

Lyakhova, O.M., Kotti, B.C., 2011. Chewing lice (Mallophaga: Insecta) of birds in the Central Ciscaucasia. Entomol. Rev. 91, 367–376.

Anonymous, 2012. Turkish State Meteorological Service: Meteorological Data in northwestern Turkey 1970–2011. Available from: <http://www.meteor.gov.tr/veri-degerlendirme/il-ve-ilceler-istatistik.aspx?m=BURSA> (accessed 18.09.12).

Dik, B., Dinçer, Ş., 2012. Chewing lice species (Phthiraptera: Ischnocera) found on blackbirds (Turdus merula): new records from Turkey. T. Parazitol. Derg. 36, 23–27.

Lesko, M.J., Smallwood, J.A., 2012. Ectoparasites of American Kestrels in northwestern New Jersey and their relationship to nestling growth and survival. J. Raptor Res. 46, 304–313.

Moreno-Rueda, G., Hoi, H., 2012. Female house sparrows prefer big males with a large white wing bar and fewer feather holes caused by chewing lice. Behav. Ecol. 23, 271–277.

Dik, B., Halajian, A., 2013. Chewing lice (Phthiraptera) of several species of wild birds in Iran, with new records. J. Arthropod-Borne Dis. 7, 83–89.