Turkish Journal of Zoology

Volume 46 | Number 6 Article 1

1-1-2022

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EREN, GÖKHAN; ÖZKOÇ, ÖMRAL ÜNSAL; and AÇICI, MUSTAFA (2022) "Contributions to the knowledge of the diversity of the chewing lice fauna in Turkey," *Turkish Journal of Zoology*: Vol. 46: No. 6, Article 1.
https://doi.org/10.55730/1300-0179.3099
Available at: https://journals.tubitak.gov.tr/zoology/vol46/iss6/1

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Turkish Journal of Zoology

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Review Article

Turk J Zool
(2022) 46: 444-455
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doi:10.55730/1300-0179.3099

Contributions to the knowledge of the diversity of the chewing lice fauna in Turkey

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Received: 06.06.2022 • **Accepted/Published Online:** 10.10.2022 • **Final Version:** 10.11.2022

Abstract: The aim of the study was to identify the chewing lice which were sampled from the birds found dead during ornithological studies in the natural areas of Samsun, and transported to the laboratory of Ondokuz Mayıs University, Veterinary Faculty, Department of Parasitology, between 2018 and 2020. All samples were collected by ectoparasite examination. The collected lice specimens were preserved in tubes with 70% alcohol. The specimens were cleared in 10% KOH for 24 h before being mounted in Canada balsam and identified under the light microscope. A total of 35 species under 3 families were detected in this study: Menoponidae: *Colpocephalum apivorus*, *C. impressum*, *C. nanum*, *C. napiforme*, *C. turbinatum*, *Colpocephalum* sp., *Pseudomenopon dolium*, *Kurodaia subpachygaster*, *Ciconiphilus cygni, C. decimfasciatus, C. quadripustulatus, Menacanthus agilis, M. curuccae, M. eurysternus, M. gonophaeus, M. stramineus, Menacanthus* sp., *Trinoton anserinum*, *T. querquedulae*; Laemobothriidae: *Laemobothrion maximum*; Philopteridae: *Anaticola crassicornis*, *A. mergiserrati*, *Anatoecus cygni*, *Anatoecus* sp., *Aquanirmus podicepis*, *Brueelia merulensis*, *Columbicula columbae*, *Cummingsiella ovalis*, *Degeeriella fulva*, *D. fusca*, *D. phlyctopygus*, *Craspedorrhynchus aquilinus*, *Incidifrons fulicae*, *Ornithobius cygni*, *Philopterus atratus*, *Saemundssonia lari*, *Strigiphilus cursitans*, and *Quadraceps punctatus*. The first records for the fauna of Turkey are: *Anatoecus cygni*, *Ciconiphilus cygni*, *Colpocephalum apivorus*, *C. napiforme, Kurodaia subpachygaster*, *Ornithobius cygni*, and *Philopterus atratus.* As a result of this study, the number of chewing lice species (Phthiraptera, Amblycera, and Ischnocera) detected on birds in Turkey reached 195 species.

Key words: Amblycera, birds, chewing lice, Ischnocera

1. Introduction

Around 4000 species of lice-infested birds have been identified in studies carried out so far around the world (Price et al. 2003). Species infesting birds are classified in the suborders Amblycera and Ischnocera and feed on the feathers and other epidermal structures of their hosts. Species in these two suborders are also called "chewing lice" because of their types of feeding. Most of the chewing lice species show high host specificity and exhibit one of the most important models of host-parasite evolution (Clayton et al., 2003). Mild infestations are usually subclinical, while heavy infestations may cause clinical symptoms. Furthermore, some lice species are vectors of filarial nematodes (Clayton et al., 2008; Cohen et al., 1991). Studies on bird chewing lice (Amblycera and Ischnocera) in Turkey have increased in recent years. Although the ornithofauna of Turkey is represented by nearly 500 species (Furtun et al., 2021), only quarter of these species have been studied in terms of lice infestation. With this study, 195 species of chewing lice have been detected from 126 different bird species (exotic and domestic and wild species) in Turkey so far (Table 1). When 43 species of chewing and blood-sucking lice (Merdivenci, 1970; Dik, 2020; Eren et al., 2021; Keskin and Dik, 2022) that were identified in mammals, including bloodsucking species in humans, were also accounted for, the lice fauna of Turkey (Phthiraptera; Amblycera, Anoplura, and Ischnocera) consists of 238 species.

The aim of this study is to contribute to the ornitho-parasitological studies that have increased in recent years and the Phthiraptera fauna of Turkey.

2. Materials and methods

This study was carried out using lice samples collected from birds found dead in the natural areas of Samsun, and transported to the laboratory of Ondokuz Mayıs University, Faculty of Veterinary Medicine, Department of Parasitology, between 2018 and 2020. Birds were identified by an ornithologist based on morphological criteria before systemic ectoparasite examination. After the collection of the lice samples, they were preserved in 70% ethanol. After 1 day of clearing in 10% KOH, the specimens were

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Table 1. List of identified taxa of chewing lice reported in Turkey so far.

	Family Menoponidae
Suborder Amblycera	*Actornithophilus multisetosus*, *A. patellatus*, *A. piceus lari*, *A. pustulosus*, *A. spinulosus*, *A. stictus*, *A. totani*, *A. umbrinus*; *Afrimenopon waar*; *Austromenopon alpinum*, *A. atrofulvum*, *A. durisetosum*, *A. lutescens*, *A. transversum*, *Austromenopon* sp.; *Ciconiphilus cygni**, *C. decimfasciatus**, *C. quadripustulatus*; *Colpocephalum apivorus**, *C. eucarenum*, *C. heterosoma*, *C. impressum*, *C. milvi*, *C. nanum*, *C. napiforme**, *C. polonum*, *C. subzerafae*, *C. trachelioti*, *C. turbinatum*, *C. zebra*, *Colpocephalum* sp; *Comatomenopon elongatum*; *Cuculiphilus fasciatus*; *Dennyus hirundinis*; *Eidmanniella pellucida*; *Holomenopon clypeilargum*, *H. leucoxanthum*, *H. obscurum*, *H. tadornae*, *Holomenopon* sp.; *Kurodaia fulvofasciata*, *K. longipes*, *K. subpachygaster**; *Menacanthus abdominalis, M. agilis, M. Alaudae, M. camelinus, M. cornutus, M. curuccae, M. eurysternus, M. fertilis, M. gonophaeus*, M. lyali, M. pusillus, M. stramineus, Menacanthus sp.; Menopon gallinae*; *Meromenopon meropis*; *Myrsidea cucullaris*, *M. isostoma*, *M. picae*, *M. rustica*, *Myrsidea* sp.; *Piagetiella titan*; *Pseudomenopon concretum*, *P. dolium*, *P. pilosum*, *P. scopulacorne*; *Trinoton anserinum*, *T. femoratum*, *T. querquedulae*, *Trinoton* sp.
	Family Laemobothriade
	Laemobothrion atrum, *L. maximum*, *L. tinnunculi*, *Laemobothrion* sp.
	Family Ricinidae
	Ricinus dolicocephalus, *R. elongatus*, *R. frenatus*, *R. fringillae*
	Family Philopteridae
Suborder Ischnocera	*Alcedoffula alcedinis*; *Anaticola anseris*, *A. crassicornis*, *A. magnificus*, *A. mergiserrati*, *A. phoenicopteri*; *Anatoecus cygni**, *A. icterodes*, *A. dentatus*, *A. pygaspis*, *A. regina*, *Anatoecus* sp.; *Ardeicola celeris*, *A. ciconiae*, *A. ixobrychae*, *A. plataleae*; *Aquanirmus podicepis*; *Brueelia apiastri*, *B. biocellata*, *B. cruciata*, *B. domestica*, *B. iliaci*, *B. jacobi*, *B. lais*, *B. locustellae*, *B. marginata*, *B. merulensis*, *B. munda*, *B. nebulosa*, *B. tasniemae*, *B. turdinulae*, *Brueelia* sp.; *Campanulotes bidentatus*; *Carduiceps meinertzhageni*, *C. scalaris*, *C. zonarius*; *Chelopistes meleagridis*; *Coloceras chinensea*, *C. hilli*, *C. piageti*; *Columbicola bacillus*, *C. columbae*; *Cuclotogaster heterographus*, *C. cinereus*, *Cuclotogaster* sp.; *Cuculicola latirostris*; *Cuculoecus latifrons*; *Cummingsiella ambigua*, *C. ovalis*; *Craspedorrhynchus fraterculus*, *C. platystomus*, *Craspedorrhynchus* sp.; *Degeeriella aquilarum*, *D. fulva*, *D. fusca*, *D. leucopleura*, *D. nisus*, *D. phlyctopygus, D. rufa*, *Degeeriella* sp.; *Falcolipeurus suturalisa*; *Fulicoffula gallinula*, *F. lurida*; *Goniocotes gallinae*, *G. hologaster*, *G. megalocephalus*, *G. pusillus*; *Goniodes astrocephalus*, *G. colchici*, *G. dissimilis*, *G. gigas*, *G. dispar*, *G. astrocephalus*, *G. pavonis*; *Ibidoecus plataleaea*; *Incidifrons fulica*; *Lipeurus caponis*; *Lunaceps drosti*, *L. actophilus*, *L. holophaeus*, *L. incoenis*, *L. numeni numeni*, *Lunacep* sp.; *Meropoecus meropis*; *Mulcticola hypoleucus*; *Neophilopterus incompletus*, *N. tricolor*; *Ornithobius cygni**; *Pectinopygus brevicornis*, *P. bifasciatus*, *P. excornis*, *P. forficulatus*, *Pectinopygus* sp.; *Penenirmus affectator*, *P. longuliceps*, *P. pikulai*, *P. rarus*, *P. serrilimbus*, *P. silvicultrix*, *Penenirmus* sp.; *Philopterus atratus**, *P. desertus*, *P. eurasiaticus*, *P. fringillae*, *P. mirificus*, *P. rapax*, *P. reguli*, *P. sittae*; *Rallicola fulica*, *R. lugens*, *R. minutus*, *R. ortygometrae*; *Rhynonirmus scolopacis*; *Quadraceps anagrapsus*, *Q. nycthemerus*, *Q. obscurus*, *Q. punctatus*, *Q. punctatus sublingulatus*; *Rhynonirmus helvolus*, *R. scolopacis*; *Saemundssonia clayae*, *S. lari*, *S. lobaticeps*; *Strigiphilus barbatus*, *S. cursitans*, *S. strigis*; *Sturnidoecus pflergi*, *S. sturni*; *Struthiolipeurus struthionisa; Upupicola upupae*
References	Mimoğlu, 1952; Merdivenci, 1963; Güralp and Doğru, 1966; Güralp and Mayılmayıl, 1971; Tiğin, 1973; Dik et al., 1999; Gıcık, 1999; Köroğlu et al., 1999; 2001; Gülanber et al., 2002; Aksın, 2003; 2004; Aldemir, 2004; Şenlik et al., 2005; Gülanber et al., 2006; Aksın, 2010; Açıcı et al., 2011; Dik, 2006; 2006b; Dik and Uslu, 2006a; 2006b; Dik and Özkahyan, 2007; Dik and Uslu, 2007; Dik and Yamaç, 2008; Dik and Uslu, 2008; Karataş et al., 2008; Dik, 2009; Dik and Uslu, 2009; Dik et al., 2009; İpek and Şaki, 2009; Orunç and Biçek, 2009; Değer et al., 2010; Dik, 2010a; 2010b; Dik et al., 2010; İnci et al., 2010; Dik et al., 2011a; 2011b; 2011c; Dik and Dinçer, 2012; Dik and Uslu, 2012; Esatlıgil et al., 2012; Girişgin et al., 2013; Dik et al., 2013a; 2013b; 2013c; Kılınç et al., 2013; Dik et al., 2015; Döner and Yaman, 2015; Göz et al., 2015; Oğuz et al., 2015; Dik et al., 2017a; 2017b; Karatepe et al., 2017; Elmacıoğlu et al., 2018; Açıcı et al., 2021a; 2021b; Dik and Kandir, 2021; Girişgin et al., 2022; *present study

mounted using the Canada balsam technique (Palma, 1978). The specimens were examined under a light microscope (Nikon Eclipse 80i) and comparisons with the literature were performed for species identification (Clay and Hopkins, 1950; Timmermann, 1952; Clay, 1957; Price and Beer, 1963a; Price and Beer, 1963b; Price and Beer, 1965; Nelson and Price, 1965; Edwards, 1965; Price, 1974; Eichler et al., 1981; Clayton and Price, 1984; Soler-Cruz et al., 1985; Gallego et al., 1987; Price and Hellenthal, 1998; Adams et al., 2005; Arnold, 2005; Adam and Daróczi, 2006; Castro and Cicchino, 1983; Naz et al., 2010). All identified specimens are being preserved in the same laboratory.

3. Results

In this study, 24 species of birds from nine orders (Accipitriformes, Anseriformes, Charadriiformes,

Ciconiiformes, Columbiformes, Falconiformes, Passeriformes, Pelecaniformes, Podicipediformes and Strigiformes) were examined for ectoparasites between 2018 and 2020. In total, 35 species belonging to 3 different families of chewing lice were identified (Table 2): Menoponidae: *Colpocephalum apivorus*, *C. impressum*, *C. nanum*, *C. turbinatum*, *Colpocephalum* sp., *Pseudomenopon dolium*, *Kurodaia subpachygaster*, *Ciconiphilus decimfasciatus*, *C. quadripustulatus*, *C. cygni*, *Menacanthus agilis, M. curuccae, M. eurysternus, M. gonophaeus, M. stramineus, Menacanthus* sp., *Trinoton anserinum*, *T. querquedulae*; Laemobothriidae: *Laemobothrion maximum*; Philopteridae: *Anaticola crassicornis*, *A. mergiserrati*, *Anatoecus cygni*, *Anatoecus* sp., *Aquanirmus podicepis*, *Brueelia merulensis*, *Columbicula columbae*, *Cummingsiella ovalis*, *Degeeriella fulva*, *D. fusca*, *D. turbinatum*, *Craspedorrhynchus aquilinus*, *Incidifrons fulicae*, *Ornithobius cygni*, *Philopterus atratus*, *Saemundssonia lari*, *Strigiphilus cursitans* and *Quadraceps punctatus*. The first records for the fauna of Turkey are: *Anatoecus cygni*, *Ciconiphilus cygni*, *Colpocephalum apivorus*, *C. napiforme*, *Kurodaia subpachygaster*, *Ornithobius cygni*, and *Philopterus atratus.* As a result of this study, the number of chewing lice species (Phthiraptera: Amblycera, Ischnocera) detected on birds in Turkey reached 195. Infestations of *Colpocephalum* and *Menacanthus* spp. were more intense on the hosts. Photographs of the lice species, the species recorded for the first time by this study, are presented in Figure.

4. Discussion

Chewing lice (Phthiraptera: Amblycera and Ischnocera) can cause many direct or indirect effects on birds. For dermatitis, hyperkeratosis, pruritis, insomnia, hemorrhagic ulcerative stomatitis in *Piagetiella* infestations, excessive feather growth, deterioration in the quality of the feathers, disruption of thermoregulation by making small holes in the feathers and breaking of the feathers, the prolongation of the migration period and the delay of reproduction due to the deterioration of the feather structure, especially in migratory birds, and the decrease in the chance of survival as a result of the decrease in the body condition score are the most important direct effects (Clayton et al., 2008; Moreno-Rueda and Hoi, 2012). The indirect effect is negative sexual selection—birds with a low parasite load have more sexual feathers, and females prefer males with more sexual feathers to mate with, thus decreasing breeding success because of the shortening of the singing duration and reducing the quality of the singing of infested birds (Clayton, 1991; Garamszegi, 2005).

Although studies about chewing lice on birds have increased in recent years in Turkey, the number of birds examined and reported lice species is still not at the desired level. More than 120 bird species have been examined in studies and 188 lice species—together with this study, a total of 195—species have been reported (Table 1). Some individuals of chewing lice can be overlooked during macroscopic examination due to the rapid movement of chewing lice species (Johnson and Clayton, 2003). In addition, factors such as the size of the host, the density of feathers, and the severity of the infestation make detection difficult. Synthetic pyrethroid insecticides are also used to make the collection of ectoparasite samples easier in ornitho-parasitological studies (Clayton and Walther, 1997). In ectoparasite studies conducted on dead birds, infestation rates may be lower than in other studies since the host is not alive and the ectoparasites may have left the host due to the long time elapsed since death. As chewing lice are host-obligate ectoparasites, they leave the host shortly after its death. The members of Ischnocera feed on the skin for a while, while the members of Amblycera leave the host more rapidly (Johnson and Clayton 2003).

Chewing lice of bird species in the order Columbiformes have been extensively studied throughout the world and in Turkey. As a result of these studies, species belonging to the genus *Auricotes*, *Bonomiella*, *Campanulotes*, *Cavifera*, *Coloceras*, *Colpocephalum*, *Hohorstiella*, *Goniocotes*, *Kodocephalon*, *Menacanthus*, *Menopon*, *Neomenopon*, *Physconelloides*, *Syrrhaptoecus*, *Turturicola*, and *Quateia* have been reported (Price et al., 2003; Adang et al., 2008; Jahantigh et al., 2016). *Columbicola columbae*, *Goniocotes bidentatus* (*Campanulotes compar*), *Goniocotes hologaster* (*Goniocotes gallinae*), *Lipeurus caponis*, *Menopon gallinae*, *Coloceras israelensis* were identified in the studies on domestic pigeons *Columba livia domestica* and rock pigeons (wild type of *Columba livia*) in Turkey. These studies show that *Columbicola columbae* is the dominant species causing infestation on rock dove *Columba livia* both in the world and Turkey. Besides these, infestation of *Columbicola bacillus*, *Coloceras hillia*, and *Coloceras piageti* on Eurasian collared dove *Streptopelia decaocto* (Dik, 2010; 2013; Girişgin et al., 2013); *Columbicola bacillus* on European turtle dove *Streptopelia turtur* (Girişgin et al., 2013; Açıcı et al., 2021b); and *Coloceras chinense*, *Columbicola bacillus*, *C. columbae*, and *Cuclotogaster heterographus* on laughing dove *Spilopelia senegalensis* (Girişgin et al., 2013; 2022) were determined. In this study, *Columbicola columbae* and *Menacanthus stramineus* were determined on rock dove *Columba livia* that has been reported as a host of *M. stramineus* in Turkey for the first time.

Infestations in owls belonging to the order Strigiformes are caused by the genera *Colpocephalum*, *Kurodaia*, and *Strigiphilus* (Price et al., 2003). A limited number of studies have been conducted on the chewing lice of owls in Turkey: *Strigiphilus cursitans* on little owl *Athene noctua* (Girişgin

Table 2. The identified chewing lice species and their hosts (*new record, **new host record).

Family	Genus	Species	Host
Philopteridae	*Quadraceps*	*Q. punctatus*	*Larus michahellis* (n: 3)
	Saemundssonia	*S. lari*	
Menoponidae	*Colpocephalum*	*C. impressum*	*Aquila chrysaetos* (n: 2)
Philopteridae	*Degeeriella*	*D. fulva*	
	Craspedorrhynchus	*C. aquilinus*	
Menoponidae	*Colpocephalum*	*C. apivorus*	*Pernis apivorus* (n: 1)
Philopteridae	*Degeeriella*	*D. phlyctopygus***	
Menoponidae	*Colpocephalum*	*Colpocephalum* sp.	*Buteo rufinus* (n: 2)
Philopteridae	*Craspedorrhynchus*	*C. platystomus*	
	Degeeriella	*D. fulva*	
Menoponidae	*Colpocephalum*	*C. napiforme**	*Pandion haliaetus* (n: 1)
Philopteridae	*Degeeriella*	*D. phlyctopygus*	
Philopteridae	*Aquanirmus*	*A. podicepis*	*Podiceps cristatus* (n: 1)
Menoponidae	*Pseudomenopon*	*P. dolium*	
Laemobothriidae	*Laemobothrion*	*L. maximum*	*Buteo buteo* (n: 5)
Philopteridae	*Degeeriella*	*D. fulva*	
Menoponidae	*Colpocephalum*	*C. nanum*	
		C. turbinatum	
Philopteridae	*Strigiphilus*	*S. cursitans*	*Athene noctua* (n: 1)
Menoponidae	*Kurodaia*	*K. subpachygaster**	*Tyto alba* (n: 1)
Menoponidae	*Ciconiphilus*	*C. decimfasciatus*	*Ardea cinerea* (n: 1)
Menoponidae	*Ciconiphilus*	*C. decimfasciatus***	*Egretta garzetta* (n: 2)
Menoponidae	*Ciconiphilus*	*C. quadripustulatus*	*Ciconia ciconia* (n: 2)
Philopteridae	*Degeeriella*	*D. fusca*	*Circus aeruginosus* (n: 1)
Menoponidae	*Menacanthus*	*M. gonophaeus***	*Corvus frugilegus* (n: 1)
Philopteridae	*Philopterus*	*P. atratus**	
Philopteridae	*Anatoecus*	*Anatoecus* sp.	*Netta rufina (*n: 1)
Philopteridae	*Cummingsiella*	*C. ovalis*	*Numenius arquata* (n: 1)
Philopteridae	*Anatoecus*	*A. cygni**	*Cygnus cygnus* (n: 1)
	Ornithobius	*O. cygni**	
	Anaticola	*A. crassicornis***	
Menoponidae	*Ciconiphilus*	*C. cygni**	
	Trinoton	*T. anserinum*	
Philopteridae	*Brueelia*	*B. merulensis*	*Turdus merula* (n: 1)
Menoponidae	*Menacanthus*	*M. eurysternus*	
Menoponidae	*Menacanthus*	*Menacanthus* sp..	*Lanius collurio* (n: 1)
Menoponidae	*Menacanthus*	*M. agilis*	*Phylloscopus collybita* (n: 2)
Menoponidae	*Menacanthus*	*M. curuccae*	*Sylvia atricapilla* (n: 2)
Philopteridae	*Columbicola*	*C. columbae*	*Columba livia* (n: 1)
Menoponidae	*Menacanthus*	*M. stramineus***	
Philopteridae	*Incidifrons*	*I. fulicae*	*Fulica atra* (n: 1)
Menoponidae	*Trinoton*	*T. querquedulae***	*Aythya ferina* (n: 1)
Philopteridae	*Anaticola*	*A. mergiserrati*	

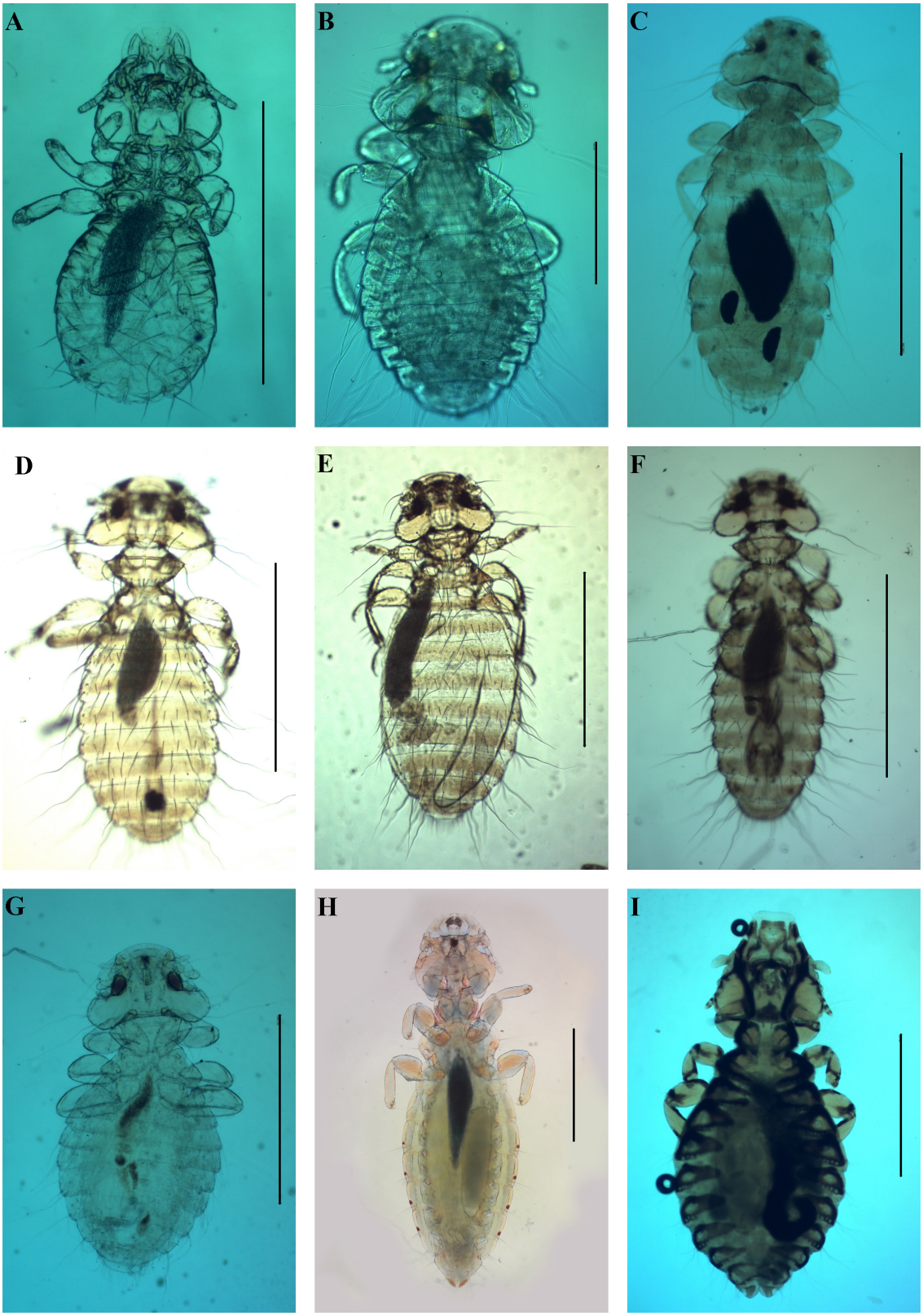

Figure. Original photos of chewing lice identified in this study: A, *Anatoecus cygni* (♀); B, *Ciconiphilus cygni* (♀); C, *Ciconiphilus decimfasciatus* (♀); D, *Colpocephalum apivorus* (♂); E, *Colpocephalum apivorus* (♀); F, *Colpocephalum napiforme* (♂); G, *Kurodaia subpachygaster* (♀); H, *Ornithobius cygni* (♀); I, *Philopterus atratus* (♀) (bar: 1 mm).

et al., 2013; 2022); *Strigiphilus barbatus* and *Columbicola columbae* on long-eared owl *Asio otus* (İnci et al., 2010; Dik et al., 2013); *Strigiphilus barbatus*, *Strigiphilus strigis* and *Kurodaia longipes* on Eurasian eagle-owl *Bubo bubo* (Dik and Uslu, 2007; Dik, 2010; Dik et al., 2015); *Colpocephalum* sp. on western barn owl *Tyto alba* (Girişgin et al., 2022) caused infestations. In this study, *S. cursitans* on little owl and *Athene noctua* and *K. subpachygaster* on western barn owl *Tyto alba* were identified. *Kurodaia subpachygaster* is a new record for the Phthiraptera fauna of Turkey.

Studies conducted on species in the order Podicipediformes (Price et al., 2003) have identified the lice of genera *Aquanirmus*, *Laemobothrion*, and *Pseudomenopon*. The studies of the effects of chewing lice on the hosts of this order are extremely limited in Turkey. Only infestations of *Aquanirmus podicepis* and *Pseudomenopon dolium* were detected in this order (Dik et al., 2017). In this study, both species were found on great crested grebe *Podiceps cristatus*.

Studies on the members of the Rallidae (rails) and Gruidae (cranes) in Turkey are extremely insufficient. In species of the order Gruiformes listed in the fauna of Turkey (Furtun et al. 2021), genera *Esthiopterum*, *Fulicoffula*, *Gruimenopon*, *Heleonomus*, *Incidifrons*, *Laemobothrion*, *Pseudomenopon*, *Rallicola*, and *Saemundssonia* can cause infestations (Price et al., 2003). The cases reported for infestations caused by genera *Fulicoffula*, *Incidifrons*, *Laemobothrion*, and *Pseudomenopon* species were as follows: infestations of *Fulicoffula lurida*, *Incidifrons fulicae*, *Laemobothrion atrum*, *Pseudomenopon pilosum*, and *Rallicola fulicae* on Eurasian coot *Fulica atra* (Dik et al., 2011a; 2017); *Fulicoffula gallinula*, *Rallicola minutus*, and *Pseudomenopon pilosum* on common moorhen *Gallinula chloropus* (Dik et al., 2011a; 2017; Girişgin et al., 2022); *Pseudomenopon concretum* and *Rallicola lugens* on Western swamphen *Porphyrio porphyrio* (Açıcı et al., 2021b); *Pseudomenopon scopulacorne* on little crake *Zapornia parva* (Dik et al., 2011c); and *Pseudomenopon scopulacorne* on water rail *Rallus aquaticus* (Dik et al., 2011c) were reported. In this study, an infestation of *Incidifrons fulicae* was reported in the Eurasian coot *Fulica atra*.

As a result of studies on storks (Ciconiiformes), it has been reported that *Anaticola*, A*natoecus*, *Austromenopon*, *Ardeicola*, *Ciconiphilus*, *Colpocephalum*, *Comatomenopon*, *Laemobothrion*, *Neophilopterus*, and *Trinoton* species cause infestation (Price et al., 2003). In Turkey, infestation of *Ardeicola ciconiae*, *Ciconiphilus quadripustulatus*, *Colpocephalum zebra* and *Neophilopterus incompletus* on white stork *Ciconia ciconia* (İnci et al., 2010; Dik et al., 2011, Girisgin et al., 2013; Dik et al., 2013; 2021; Açıcı et al., 2021b; Girişgin et al., 2022); infestation of *Neophilopterus tricolor* were reported on black stork *Ciconia nigra* (Açıcı et al., 2021b). In this study, an infestation of *Ciconiphilus quadripustulatus* was reported on white stork *Ciconia ciconia*.

Species of belonging to the genera *Ardeiphagus*, *Ardeiphilus*, *Ciconiphilus*, *Comatomenopon*, *Colpocephalum*, *Eucolpocephalum*, *Ibidoecus*, *Laemobothrion*, *Pectinopygus*, *Piagetiella*, and *Plegadiphilus* cause infestation on pelicans, herons, and ibises in the order Pelecaniformes (Price et al., 2003). Infestation of *Comatomenapon elongatum* on great egret *Ardea alba* (İnci et al., 2010; Girgin et al., 2022); *Ciconiphilus decimfasciatus* on grey heron *Ardea cinerea* (Girişgin et al., 2022); *Ardeicola celeris* and *Ardeicola ixobrychae* on little bittern *Ixobrychus minutus* (Dik et al., 2017b; Girişgin et al., 2022); *Colpocephalum eucarenum*, *Piagetiella titan*, *Pectinopygus forficulatus*, and *Pectinopygus* sp. on great white pelican *Pelecanus onocrotalus* (Dik, 2006b; Dik & Uslu, 2008; Girişgin et al., 2013; Dik et al., 2012; 2017a; 2021); *Piagetiella titan* and *Pectinopygus* sp. on Dalmatian pelican *Pelecanus crispus* (Girişgin et al., 2013); and *Ibidoecus plataleaea* and *Ardeicola plataleae* on Eurasian spoonbill *Platalea leucorodia* (Girişgin et al., 2013) were reported in the studies on this order conducted in Turkey. *Ciconiphilus decimfasciatus* was reported on grey heron *Ardea cinerea* and little egret *Egretta garzetta*. Along with this study, *Ciconiphilus decimfasciatus* is a new host for *Ardea cinerea* in Turkey.

Waders, gulls, and terns of the order Charadriiformes were listed in the ornithofauna of Turkey (Kirwan et al., 2010; Furtun et al., 2021). In the studies around the world, genera *Actornithophilus*, *Austromenopon*, *Carduiceps*, *Cirrophthirius*, *Cummingsiella*, *Haffneria*, *Lunaceps*, *Rediella*, *Rhynonirmus*, *Saemundssonia*, and *Quadraceps* cause infestation on the members of these groups (Price et al., 2003). The infestation of *Saemundssonia lari* and *Quadraceps punctatus* on yellow-legged gull *Larus michahellis* (Collinson et al., 2008)—this host is probably misidentified because Armenian gull *Larus armenicus* is distributed in the region where the study was carried out, but yellow-legged gull is not found in the same region (Furtun et al., 2021) and it is difficult to identify these two species (van Duivendijk, 2011)—; *Actornitophilus piceus* and *Saemundssonia lari* on Caspian gull *Larus cachinnans* and slender-billed gull *Chroicocephalus genei* (Dik et al., 2011; Girişgin et al., 2022); *Austromenopon transversum*, *Saemundssonia lari* and *Quadraceps punctatus* (Dik et al., 2017); *Actornithophilus umbrinus*, *Austromenopon alpinum*, *Carduiceps meinertzhagani* and *Lunaceps actophilus* on dunlin *Calidris alpina* (Dik et al., 2010; Açıcı et al., 2011;2021b); *Actornithophilus umbrinus*, *Austromenopon lutescens*, *Carduiceps zonarius* and *Lunaceps drosti* on little stint *Calidris minuta* (Dik et al., 2010); *Lunaceps incoensis* on Temminck's stint *Calidris temminckii* (Dik et al., 2010); *Austromenopon atrofulvum*, *Quadraceps anagrapsus*, and

Saemundssonia lobaticeps on white-winged tern *Chlidonias leucopterus* (Dik et al., 2010;2011a); *Actornithophilus stictus*, *Austromenopon durisetosum* and *Rhynonirmus scolopacis* on *Gallinago gallinago* (Dik et al., 2010; 2011b); *Actornitophilus spinulosus* and *Lunaceps* sp. on black-tailed godwit *Limosa limosa* (Dik et al., 2017); *Actornithophilus multisetosus* on jack snipe *Lymnocryptes minimus* (Dik et al., 2011b); *Actornithophilus patellatus*, *Cummingsiella ovalis*, and *Lunaceps numenii numenii* on Eurasian curlew *Numenius arquata* (Açıcı et al., 2021b); *Actornithophilus pustulosus*, *Austromenopon lutescens*, *Carduiceps scalaris*, and *Lunaceps holophaeus* on ruff *Calidris pugnax* (Dik et al., 2010); *Quadraceps anagrapsus* on little tern *Sternula albifrons* (Açıcı et al., 2011); *Rhynonirmus helvolus*, *Saemundssonia clayae*, and *Saemundssonia* sp. on Eurasian woodcock *Scolopax rusticola* (Dik et al., 2015; Girişgin et al., 2022); *Actornithophilus totani*, *Austromenopon* sp., and *Quadraceps obscurus* on wood sandpiper *Tringa glareola* (Dik et al., 2010;2017) were reported in Turkey. *Saemundssonia lari* and *Quadraceps punctatus* on yellow-legged gull *Larus michahellis* and *Cummingsiella ovalis* on *Numenius arquata* were reported in this study. Along with this study, *Larus michahellis* is a new host for *Saemundssonia lari* and *Quadraceps punctatus* in Turkey.

Species belonging to the genera *Acidoproctus*, *Anaticola*, *Anatoecus*, *Austrogoniodes*, *Ciconiphilus*, *Holomenopon*, *Ornithobius*, *Saemunssonia*, and *Trinoton* cause infestation on the hosts of the order Anseriformes (ducks, geese and swans) (Price et al., 2003). The infestation of *Anaticola crassicornis*, *Anatoecus icterodes*, *Holomenopon clypeilargum*, *Holomenopon* sp., and *Trinoton querquedulae* on Northern Pintail *Anas acuta* (Dik et al., 2011c; Dik et al., 2012;b2017); *Anaticola crassicornis*, *Trinoton querquedulae*, and *Holomenopon* sp. on northern shoveler *Spatula clypeata* (Dik et al., 2012); *Anaticola crassicornis*, *Anatoecus dentatus*, *A. icterodes*, and *Trinoton querquedulae* on Eurasian teal *Anas crecca* (Dik et al., 2012; 2017); *Anaticola crassicornis*, *Anatoecus icterodes*, *Holomenopon clypeilargum*, *Holomenopon leucoxanthum*, *Trinoton querquedulae*, and *Anatoecus* sp. on mallard *Anas platyrhynchos* (Aksin, 2010; Dik et al., 2012; Göz et al., 2015; Açıcı et al., 2021b); *Anaticola* sp. on gadwall *Mareca strepera* (Dik et al., 2017); *Trinoton querquedulae querquedulae* on garganey *Spatula querquedula* (Dik et al., 2012); *Anaticola anseris*, *Trinoton anserinum* and *Holomenopon* sp. on greylag goose *Anser anser* (Göz et al., 2015); *Trinoton anserinum* on whooper swan *Cygnus cygnus* and mute swan *Cygnus olor* (Açıcı et al., 2015; Oğuz et al., 2015; Açıcı et al., 2021b); *Anaticola mergiserrati* and *Anatoecus icterodes* on common pochard *Aythya ferina* (Dik et al., 2017); *Trinoton querquedulae* on tufted duck *Aythya fuligula* (Dik et al., 2017); *Anatoecus icterodes* on red-crested pochard *Netta rufina* (Açıcı et al., 2021b); *Anaticola magnificus*, *Anatoecus regina*, *Holomenopon tadornae* and *Trinoton querquedulae* on ruddy shelduck *Tadorna ferruginea* (Dik et al., 2012); *Anaticola crassicornis* and *Trinoton* sp. on common shelduck *Tadorna tadorna* (Dik et al., 2012); *Anatoecus icterodes* on marbled duck *Marmaronetta angustirostris* (Dik, 2010) were reported in Turkey. *Anaticola mergiserrati* and *Trinoton querquedulae* on common pochard *Aythya ferina*; *Anatoecus* sp. on red-crested pochard *Netta rufina*; and *Anaticola crassicornis*, *Anatoecus cygni*, *Ciconiphilus cygni*, *Ornithobius cygni*, and *Trinoton anserinum* on whooper swan *Cygnus cygnus* were reported in this study. *Anatoecus cygni*, *Ciconiphilus cygni*, and *Ornithobius cygni* are reported as the first record for chewing lice fauna of Turkey.

The diurnal predators found in Turkey are classified under the orders Accipitriformes (Accipitridae: hawks, buzzards, kites, harriers, eagles and vultures; Pandionidae: ospreys) and Falconiformes (Falconidae: falcons) (Kirwan et al., 2010; Mindell et al., 2018). The genera *Acutifrons*, *Aegypoecus*, *Colpocephalum*, *Craspedorryhynchus*, *Cuculiphilus*, *Degeeriella*, *Falcomenopon*, *Falcolipeurus*, *Falcolius*, *Kurodaia*, *Laemobothrion*, *Neopsittaconirmus*, *Nosopon*, and *Pterophilus* can cause infestation in members of these orders (Price et al., 2003). Many studies have been carried out on the chewing lice of diurnal raptors in Turkey. The infestation of *Colpocephalum polonum* on northern goshawk *Accipiter gentilis* (Dik et al., 2011a); *Colpocephalum nanum*, *C. polonum* and *Degeeriella nisus* on Eurasian sparrowhawk *Accipiter nisus* (Dik et al., 2013; 2017; Girişgin et al., 2022); *Colpocephalum trachelioti*, *Falcolipeurus quadripustulatus*, and *Laemobothrion vulturis* on cinereous vulture *Aegypius monachus* (Dik et al., 2013); *Laemobothrion* sp. on golden eagle *Aquila chrysaetos* (Göz et al., 2015); *Laemobothrion maximum* on golden eagle *Aquila chrysaetos* (Açıcı et al., 2021b); *Laemobothrion maximum* on booted eagle *Hieraaetus pennatus* (Girişgin et al., 2013); *Laemobothrion vulturis* on lesser spotted eagle *Clanga pomarina* (Açıcı et al., 2021b); *Craspedorrhynchus* sp., *Colpocephalum nanum*, *C. turbinatum*, *C. platystomus*, *Colpocephalum* sp., *Degeeriella fulva*, *D. nisus*, *Degeeriella* sp., *Falcolipeurus suturalis*, *Kurodaia fulvofasciata*, *Laemobothrion maximum*, and *Laemobothrion* sp. on common buzzard *Buteo buteo* and *long-legged buzzard Buteo rufinus* (Dik, 2006a; Gülanber et al., 2006; Dik et al., 2007; İnci et al., 2010; Dik, 2010; Girişgin et al., 2013; Dik et al., 2015; 2021; Göz et al., 2015; Açıcı et al., 2021b; Girişgin et al., 2022); *Colpocephalum turbinatum*, *Craspedorrhynchus rotundatus*, *Degeeriella fusca*, and *Kurodaia fulvofasciata* on *Circus aeruginosus* (Dik et al., 2013; Göz et al., 2015; Dik et al., 2017; Açıcı et al., 2021b); *Degeeriella leucopleura* and *Laemobothrion maximum* on *Circaetus gallicus* (Girişgin et al., 2013; Açıcı et al., 2021b); *Degeeriella rufa* and *Laemobothrion*

tinnunculi on lesser kestrel *Falco naumanni* (Göz et al., 2015); *Colpocephalum subzerafae*, *Degeeriella rufa*, *Degeeriella* sp., and *Laemobothrion tinnunculi* on common kestrel *Falco tinnunculus* (Esatgil et al., 2012; Girişgin et al., 2013; Dik et al., 2013; Girişgin et al., 2022); *Colpocephalum milvi* and *L. maximum* on black kite *Milvus migrans* (İnci et al., 2010); *Degeeriella fulva*, *D. phlyctopygus*, and *Colpocephalum* sp. on European honey buzzard *Pernis apivorus* (İnci et al., 2010; Dik et al., 2013) were reported in Turkey. *Colpocephalum nanum*, *C. turbinatum*, *Degeeriella fulva*, and *Laemobothrion maximum* on common buzzard *Buteo buteo*; *Colpocephalum nanum*, *Craspedorrhynchus platystomus* and *Degeeriella fulva* on long-legged buzzard *Buteo rufinus*; *Colpocephalum apivorus* and *Degeeriella phlyctopygus* on European honey buzzard *Pernis apivorus*; *Degeeriella fusca* on *Circus aeruginosus*; *Colpocephalum impressum*, *Craspedorrhynchus aquilinus*, and *Degeeriella fulva* on golden eagle *Aquila chrysaetos*; *Colpocephalum napiforme* and *Degeeriella phlyctopygus* on western osprey *Pandion haliaetus* were reported in this study. Along with this study, golden *Aquila chrysaetos* is a new host for *Craspedorrhynchus aquilinus* in Turkey

Chewing lice studies on families Acrocephalidae, Aegithalidae, Alaudidae, Cettiidae, Corvidae, Emberizidae, Fringillidae, Hirundinidae, Laniidae, Locustellidae, Motacillidae, Muscipapidae, Oriolidae, Paridae, Passeridae, Phylloscopidae, and Regulicidae belonging to order Passeriformes (Passerines) have been carried out in Turkey. In studies conducted around the world, it has been reported that species that belong to genera *Brueelia*, *Colpocephalum*, *Machaerilaeumus*, *Menacanthus*, *Myrsidea*, *Penenirmus*, *Philopterus*, *Ricinus*, and *Sturnidoecus* cause infestations (Price et al., 2003). The chewing lice of passerines have been studied in recent years, and many new records have been reported for the Turkish Phthiraptera fauna. The infestations of *Philopterus mirificus* and *Sturnidoecus pflergi* on marsh warbler *Acrocephalus palustris* (Açıcı et al., 2021b); *Menacanthus curuccae* on Eurasian reed warbler *Acrocephalus scirpaceus* (Açıcı et al., 2011; Dik et al., 2017; Açıcı et al., 2021b); *Menacanthus pusillus* on water pipit *Anthus spinoletta* (Dik et al., 2011c); *Penenirmus longuliceps* on Cetti's warbler *Cettia cetti* (Dik et al., 2015); *Philopterus eurasiaticus* on hawfinch *Coccothraustes coccothraustes* (Açıcı et al., 2021b); *Brueelia* sp. and *Menacanthus gonophaeus* on northern raven *Corvus corax* (Açıcı et al., 2021b); *Brueelia tasniemae* and *Myrsidea isostoma* on rook *Corvus frugilegus* (Girişgin et al., 2022); *Brueelia* sp. and *Penenirmus* sp. on black-headed bunting *Emberiza melanocephala* (Dik et al., 2015); *Menacanthus chrysophaeus* on common reed bunting *Emberiza schoeniclus* (Dik et al., 2011b); *Menacanthus eurysternus* and *Menacanthus* sp. on European robin *Erithacus rubecula* (Dik et al., 2011c; 2015; 2017); *Brueelia* sp. on collared flycatcher *Ficedula albicollis* (Dik et al., 2017); *Ricinus fringillae* on common chaffinch *Fringilla coelebs* (Açıcı et al., 2011; 2021b); *Philopterus rapax* on brambling *Fringilla montifringilla* (Dik et al., 2017); *Brueelia domestica*, *Myrsidea rustica* and *Menacanthus* sp. on barn swallow *Hirundo rustica* (Açıcı et al., 2011; Dik et al., 2011b; 2015; 2017; Açıcı et al., 2021b); *Menacanthus curuccae* on eastern olivaceous warbler *Iduna pallida* (Dik et al., 2011b); *Brueelia cruciata* and *Menacanthus camelinus* on red-backed shrike *Lanius collurio* (Açıcı et al., 2011; Dik et al., 2011b; 2017; Açıcı et al., 2021b); *Menacanthus camelinus* on lesser grey shrike *Lanius minor* (Açıcı et al., 2021b); *Brueelia locustellae* on Savi's warbler *Locustella luscinioides* (Açıcı et al., 2021b); *Brueelia lais*, *Menacanthus curuccae* on thrush nightingale *Luscinia luscinia* (Dik et al., 2017; Açıcı et al., 2021b); *Brueelia lais* on common nightingale *Luscinia megarhynchos* (Açıcı et al., 2021b); *Menacanthus alaudae* and *Menacanthus pusillus* on *Melanocorypha calandra* (Dik et al., 2011b; 2011c); *Menacanthus pusillus* and *Menacanthus* sp. on western yellow wagtail *Motacilla flava* (Dik et al., 2011b; 2017); *Philopterus desertus* and *Penenirmus* sp. on spotted flycather *Muscicapa striata* (Dik et al., 20137); *Brueelia munda*, *Menacanthus orioli*, *Ricinus dolicocephalus* and *Maculinirmus mundus* on Eurasian golden oriole *Oriolus oriolus* (Dik et al., 2013b; 2017); *Menacanthus eurysternus* and *Philopterus fringillae* on house sparrow *Passer domesticus* (Girişgin et al., 2013; Dik et al., 2013b; 2015; 2017); *Penenirmus silvicultrix* on common redstart *Phoenicurus phoenicurus* (Dik et al., 2015); *Menacanthus agilis*, *M. eurysternus*, *M. curuccae*, *Penenirmus rarus*, and *Penenirmus* sp. on common chiffchaff *Phylloscopus collybita* (Dik et al., 2011b; 2011c; 2015; 2017; Açıcı et al., 2021b); *Brueelia* sp., *Menacanthus agilis* and *M. eurysternus* sp. on willow warbler *Phylloscopus trochilus* (Dik et al., 2017; Açıcı et al., 2021b); *Brueelia biocellata*, *Menacanthus eurysternus*, and *Myrsidea picae* on Eurasian magpie *Pica pica* (Dik et al., 2011c; 2013a; Girişgin et al., 2022); *Philopterus reguli* and *Ricinus frenatus* on *Regulus regulus* (Dik et al., 2017); *Myrsidea* sp. on sand martin *Riparia riparia* (Dik et al., 2017); *Menacanthus curuccae* and *Menacanthus* sp. on Eurasian blackcap *Sylvia atricapilla* (Dik et al., 2015; 2017); *Menacanthus curuccae*, *Penenirmus affectator*, and *Myrsidea* sp. on garden warbler *Sylvia borin* (Açıcı et al., 2011; Dik et al., 2015; 2017; Açıcı et al., 2021b); *Menacanthus curuccae* and *Myrsidea* sp. on common whitethroat *Curruca communis* (Dik et al., 2015, 2017; Açıcı et al., 2021b); *Menacanthus* sp. and *Penenirmus* sp. on Sardinian warbler *Curruca melanocephala* (Açıcı et al., 2011; Dik et al., 2015; 2017); *Penenirmus pikulai*, *Menacanthus curuccae* and *Myrsidea* sp. on barred warbler *Curruca nisoria* (Dik et al., 2015; 2017; Açıcı et al., 2021b); *Brueelia nebulosa*, *Myrsidea cucullaris*, *Sturnidoecus sturni*

and *Brueelia* sp. on common starling *Sturnus vulgaris* (Dik et al., 2009; 2013b); *Brueelia iliaci* on redwing *Turdus iliacus* (Dik et al., 2015); *Brueelia jacobi*, *Brueelia merulensis*, *Menacanthus eurysternus*, *Menacanthus* sp., and *Ricinus elongatus* on common blackbird *Turdus merula* (Açıcı et al., 2011; Dik et al., 2011c; Dik and Dinçer, 2012; Dik et al., 2017; Açıcı et al., 2021b; Girişgin et al., 2022); *Brueelia turdinulae*, *B. marginata*, and *Menacanthus eurysternus* on song thrush *Turdus philomelos* (Açıcı et al., 2011; Dik et al., 2015; 2017; Açıcı et al., 2021b) were reported in Turkey. The infestation of *Menacanthus* sp. on red-backed shrike *Lanius collurio*; *Brueelia merulensis* and *Menacanthus eurysternus* on common blackbird *Turdus merula*; *Menacanthus agilis* on *Phylloscopus collybita*; *Menacanthus curuccae* on Eurasian blackcap *Sylvia atricapilla*; *Menacanthus gonophaeus*, and *Philopterus atratus* on rook *Corvus frugilegus* were reported on this study. *Philopterus atratus* are reported as the first records, and also *Menacanthus gonophaeus* is a new host for *Corvus frugilegus* for chewing lice fauna of Turkey.

Anatoecus cygni, *Colpocephalum apivorus*, *C. napiforme*, *Ciconiphilus cygni*, *Kurodaia subpachygaster*, *Ornithobius cygni*, and *Philopterus atratus* identified in this study are new records for the fauna of Turkey. Although Turkey has a rich ornithofauna, approximately 1/4 of the bird species have been studied for chewing lice. With each ornitho-parasitological study, new records are being reported for the Phthiraptera fauna of Turkey and host-parasite relationships are being revealed.

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