Ocurrence of Mites and Parasitic Lice of the European Starling in Living in Olive-Growing Regions of Ouedsmar (Algiers, Algeria)

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Abstract

Wild birds existing in proximity to cities have potential to disease dispersal and could be reservoir for different zoonosis. Our goal was identify parasites from starlings, in olive-growing regions of OuedSmar (Algiers). A total of 32 Starlings trapped (December 2018 - January 2019), yielded 371 ectoparasitic, belonging to two groups with 8 species. (1) Bloodsucking mites (class Arachnids, order Astigmata) four families Trouessartiidae, Proctophyllodidae, Analgidae, Parasitidae (2) Bird lice Mallophagi two families Menoponidae and Philopteridae. Measurements and statistical calculation showed: Lengths (millimetres) Myrsidea sp. (males 2.94 ± 6.02, females 4.24 ± 8.37, larvae 1.55 ± 4.17, nymphs 0.22 ± 0.64). *Brueelianebulosa* (males 0.37 ± 0.79, females 0.63 ± 1.15, larvae 0.17 ± 0.37). *Menacanthus* sp. (females 1.15 ± 0.00, larvae 0.37 ± 0.00). *Sturnidoecussturni* (males 0.48 ± 0.39, females 0.69 ± 0.56, nymphs 0.18 ± 0.00). Trouesartiidea sp. (males 0.27 ± 0.90, larvae 0.28 ± 0.00). Prevalence Trouessartiidae sp. (males) 84.4% (dominant species gender). Following Analgidae sp. (males, and females) 46.9%, Myrsidea sp. (females, males and larvae), and Trouessartiidae sp. (females). *Brueelianebulosa* (females) 25%, (males) 21.9%, (larvae) 9.4%; Myrsidea sp. (nymphs), Proctophyllodidae sp. and *Sturnidoecussturni* (nymphs) 6.3% correspondingly. General Linear Model Proctophyllodidae sp. (female) $\alpha < 0.0001$, Myrsidea sp. $\alpha < 0.0001$, Trouessartiidae sp. $\alpha < 0.001$, *Menacanthus* sp. α

< 0.001 and *Sturnidoecussturni* $\alpha < 0.05$. So far we are aware this is the first report on mites and lice parasitizing starlings in Algeria.

Keywords: *Brueelianebulosa*, ectoparsits, Lice, Myrsideasp., parasitology analyses,*Sturnidoecussturni*,*Sturnus vulgaris*

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1. Introduction

European Starling *Sturnus vulgaris* (Linnaeus, 1758), living in close proximity to cities, denote a feasibly to be a source for standby and dispersal of various zoonotic diseases (Boon et al. 2007). In Algeria starlings are invasive species, and they remain around public gardens, household landfills, but particularly on olive groves (Berraï et al., 2015). Starlings is consider to be an ideal model for study dispersal, movement and assess their probability for disease propagation to urban faunae, and/or their potential risks for diseases transmission to humans (so-called zoonosis). Starlings are exposed to several diseases consequently could be used to study disease dissemination and arranged early warning. The pathogens carried by these wild birds could be transmitted to domestic animals, and could generate economic problems for farmers (e.g. avian plague; *salmonella*; occasioned soiling in silos for animal feed, subsequently decreases in production (milk, meat). Authors from diverse geographical regions have focused the importance of this aspect and they have described, potential zoonosis caused by starling, which could be avian influenza or H5N, avian influenza (AI), (Pantin-Jackwood and Swayne, 2009), Newcastle disease caused by avian paramyxovirus type 1 (Graves, 1996), histoplasmosis caused by a dimorphic fungus in soils enriched with bird faeces (pigeons, starlings, poultry) (Feare, 1984), salmonellosis, which has several strains of bacteria including *Salmonella panama*, a strain transmissible to humans, which could have direct consequences, particularly in urban areas where the concentration of starlings is high (Simitzis-Le Flohic et al., 1983; Dakman et al., 2017). Starlings host a diversity of parasites (Dik et al. 2009; Yera et al. 2015). Frequently parasites carry by starlings e.g. are *Isospora* sp. (*Coccidia*, Eimeridae) coccidiosis agents, *Listeria monocytogenes* (listeriosis), *Erysipelothrixrhusiopathiae*, *Escherichia coli* de-serotype O157:H7 cause of avian colibacillosis (Nielsen et al., 2004; Kauffman and Lejeune, 2011), *Taenia* sp. (Taeniasis), *Trichomonas* sp. (Trichomonosis) and also *Capillaria* sp. (Capillariosis) (Simitzis-Le Flohic et al., 1983).

Other parasitic diseases infecting starling are caused by “worms" e.g. nematodes, trematodes and cestodes. *Syngamus trachea* is a causative agent of Syngamosis. These parasites cause respiratory discomfort and may result with death by suffocation (Carrera-Játiva et al., 2020).

So far we are aware non writing account exists on mites and lice parasitizing starlings for the olive-growing region of OuedSmar (Algiers) Algeria.

2. Materials and methods

For our study wintering and migratory starlings were trapped from December 2018 to January 2019, in the olive growing region of OuedSmar (Algiers). The region of OuedSmar is sub-humid bioclimatic, located at 36°42′13"N., 3°10′20"E., with an altitude of 50 meter over sea.

For the study a total of 32 starlings were collected. Each individual was placed in a paper bag according to the method reported by Pinilla (2000). At the laboratory feathers of each bird were carefully examined in order to collect ectoparasites.

All collected ectoparasitic specimens were stored for 24 hours in test tubes containing potassium hydroxide (10% KOH) and then stored for one day in distilled water. Following with dehydration process using different alcohol percentage (70%, 80%, 90% and 99%).

For further studies the specimens were mounted in Canada balsam on slides according to the method indicated by Palma (1978). Identification was carried out with an optical microscope (Leica DM750).

The data obtained were processed with Quantitative Parasitology Version 3.0 (QP3) software (Margolis et al., 1982; Rozsa et al., 2000), using the R-Studio software version 4.2.1. Logistic regression was performed to predict the presence or absence of ectoparasites, and parasitology analyses, i.e. the prevalence and average intensity were performed.

3. Results

The 32 starlings trapped yielded a total of 371 ectoparasitic, belonging to 8species of Bloodsucking mites and bird lice. Two groups of ectoparasites were identified; families of ectoparasites are presented in Table 1.

Table 1. Ectoparasites found on the feathers of starlings (*Sturnus vulgaris*) trapped in olive-growing regions of OuedSmar (Algiers)

Groups	Classes	Orders	Families	Species
Bloodsucking mites	Arachnida	Astigmata	Trouessartiidae	Trouessartiidae sp.
			Proctophyllodidae	Proctophyllodidae sp.
			Analgidae	Analgidae sp.
			Parasitidae	*Pergamasus*sp.
Bird Lice	Insecta	Phthiraptera	Menoponidae	Myrsideasp.
			Philopteridae	*eelia nebulosa*
				*acanthus*sp.
				rnidoecussturni
Total	**2**	**2**	**6**	**8**

The first group is represented by bloodsucking mites belonging to the class Arachnids, order Astigmata. Four families have been identified, Trouessartiidae, Proctophyllodidae, Analgidae and

Parasitidae. The second group contains the Mallophagi (bird lice) assembling two families Menoponidae and Philopteridae. So far we are conscious we are reporting for first time the occurrence of bloodsucking mites and Mallophagi found parasitizing S. *vulgaris* in Algeria.

3.1. Measurement of ectoparasites collected from starlings

The ectoparasites average sizes (length millimetres) showed a variation depending on the species. In the first group of mites, different sizes were recorded between the two families.

Trouesartiidea sp. has an average length of (males 0.27 ± 0.90, larvae 0.28 ± 0.00).

Analgidea sp. has an average length (males 0.11 ± 0.35, females 0.16 ± 0.53).

In the second group bird lice Mallophagi, the average length for Myrsidea sp. was (males 2.94 ± 6.02, females 4.24 ± 8.37, and larvae 1.55 ± 4.17 nymphs 0.22 ± 0.64).

For *Brueelianebulosa* average length was (males 0.37 ± 0.79, females 0.63 ± 1.15, larvae 0.17 ± 0.37). For *Menacanthus* sp. the average length was (females 1.15 ± 0.00, larvae 0.37 ± 0.00). *Sturnidoecussturni* has an average length of (males 0.48 ± 0.39, females 0.69 ± 0.56, and nymphs 0.18 ± 0.00).

3.2. Parasitic index and prevalence

The index prevalence was calculated according Valtonen et al. (1997), the prevalence index (gender and life phase) for the 32 examined starlings, index for Trouessartiidae sp. (males) was 84.4% indicating as the dominant gender species as shown in Figure 1.

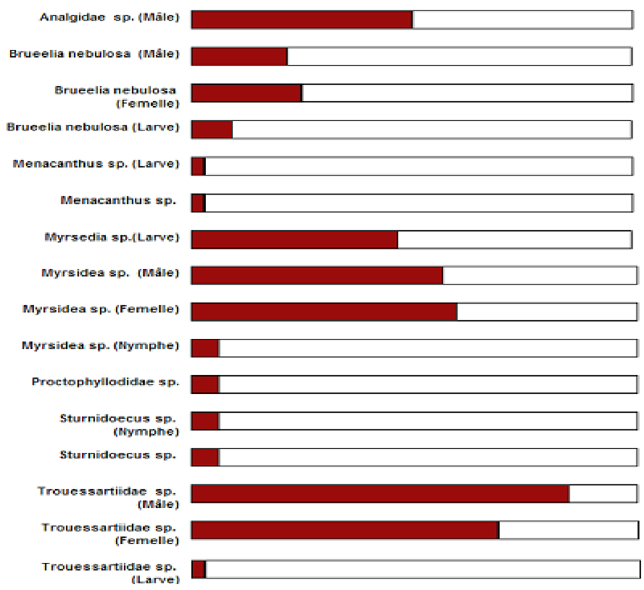

Figure 1. Diagram ectoparasiticprevalences on starlings in the OuedSmar region. Calculated with QP3 software (Quantitative Parasitology V 3.0.)

Other four including gender and life phase, dominance varies from 50% to 68.8% respectively Analgidae sp. (males), Myrsidea sp. (females), Myrsidea sp. (males) and Trouessartiidae sp. (females). 15 individuals were infested Analgidae sp. (females) and Myrsidea sp. (Larvae) shown

46.9% prevalence for both species. *Brueelianebulosa* (females) were found in 8 individuals (25% prevalence), males collected in 7 individuals (21.9% prevalence), and larvae found in 3 starlings (9.4%. prevalence). These three species are classified as satellite species.

The species Myrsidea sp. (Nymphs), Proctophyllodidae sp., *Sturnidoecussturni* (Nymphs) found in 2 starlings (6.3% prevalence).

The species *Menacanthus* sp. (females and larvae) and Trouessartiidae sp. (Larvae) found in a single starling (3.1%. prevalence). Deliberated that all these species may be classified as rare species.

The average intensity was calculated as 1.00 (very low) for Myrsidea sp. (females, males and larvae), *Brueelianebulosa* (females, and males), Menacanthus sp. (larvae), *Sturnidoecussturni* (females and nymphs), Analgidae sp. (females and males), Trouessartiidae sp. (females males) and Proctophyllodidae sp.

3.3. General Linear Model (GLM)

The results revealed that there is significance and risk of infestation by the two ectoparasitesProctophyllodidae sp. (female) and Trouessartiidae sp. at risk α < 0.0001 and α < 0.001 respectively as shown in Figure 2, 3.

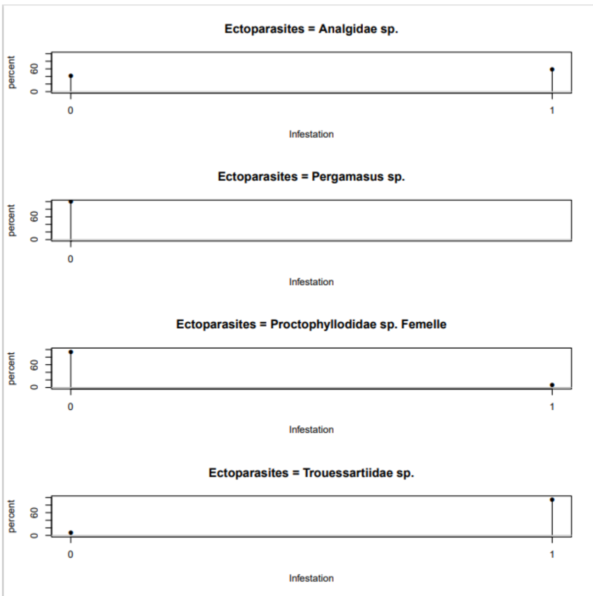

Figure 2.Logistic regression of ectoparasitic mites

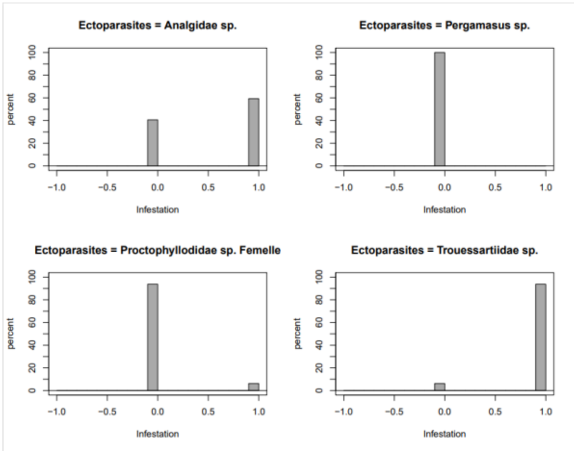

Figure 3.General Linear Model presentation of ectoparasiticmites infestation

3.4. The logistic regression interpreted in terms of odds ratios (ORs).

These measure the relative probability of presence or absence of mites and lice for each variable (Figure 4, 5).

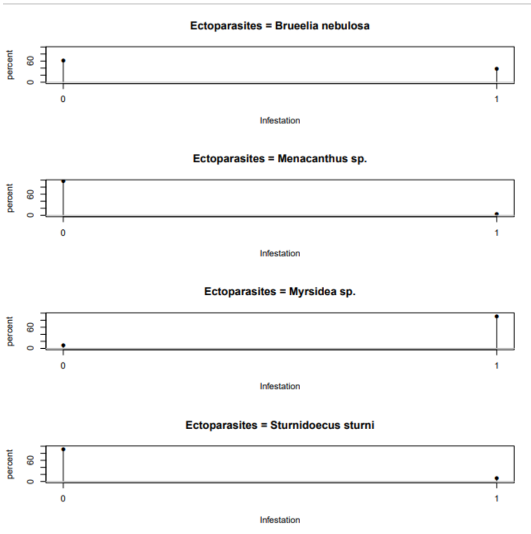

Figure 4.Logistic regression of ectoparasitic lice

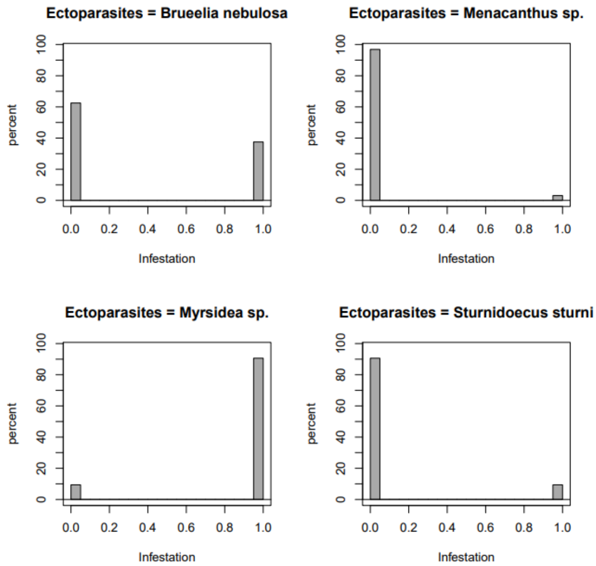

Figure 5.General Linear Model presentation of ectoparasitic lice infestation

For ectoparasitic mites, Proctophyllodidae sp. female the OR = 0.05. This indicates that the risk for infestation is low. On the other hand, for the ectoparasiteTrouessartiidae OR = 10.26, indicate that the risk of infestation is high, Viewing that the ectoparasiteTrouessartiidae sp. was 10 times higher in relation to Proctophyllodidae.

For ectoparasitic lice *Menacanthus* sp. OR = 0.05, and for the ectoparasiteMyrsidea sp. OR = 16.11. This indicates that the risk of infestation is low for Menacanthus sp. compared to Myrsideasp which have a high risk of infestation viewing that is 16 times superior to *Menacanthus* sp. We noticed that Myrsidea sp. is intensely present in starlings.

For the ectoparasite*Sturnidoecussturni* OR = 0.17 showed a low risk of infestation.

Additionally (GLM) showed significance and risk of infestation by the three ectoparasites*Menacanthus* sp., Myrsidea sp. and *Sturnidoecussturni* at risk $\alpha < 0.001$, $\alpha < 0.0001$ and $\alpha < 0.05$ respectively.

The effects for ectoparasitic variable were calculated. ANOVA showed a high significance at the risk $\alpha < 0.0001$, with a model accuracy of 60%.

4. Discussion

Our results is harmonised with the findings reported by authors of other countries, e.g. in Bulgaria Ilieva and Zehtindjiev (2005) reported Brueelianebulosa and *Sturnidoecussturni* on starlings. In Madrid, Spain Mateo (2006) observed 4 species of parasites infesting *Sturnus vulgaris.* He reported *Brueelianebulosa*, *Menacanthuseurysternus*, *Myrsideacucullaris*, *Ricinuselongatus* and *Sturnidoecussturni*. In Romania Adam et al. (2009) recorded 1624 lice on 80

individuals inspected. These lice belong to 27 genera and 55 species. These authors also reported *Brueelianebulosa*, *Myrsideacucullaris* and *Sturnidoecussturni* on 11 starlings.
Ticks are obligate bloodsucking arthropods, which parasitize all classes of vertebrates, in almost all regions of the world. They are a group of at least 989 species, of which "hard" ticks with two families (Ixodidae and Amblyommidae) are the largest in number (703 species) and "soft" ticks with a single family (Argasidae) (Dantas-Torres et al., 2012). Ticks, lice, mites and fleas are vectors of transmissible diseases. More than 3000 species of mites live in association with birds (Knee and Proctor, 2006). Some are not dangerous, such as most feather mites (Astigmata, Analgoidea, Pterolichoidea, Freyanoidea) while other groups feed on bird blood and tissue, damaging the host and act as true parasites (Proctor and Owens, 2000). The site of attachment of the parasite is always the head or neck, with a large number of ticks attaching themselves around the eyes. The lesions encountered are haemorrhage and subcutaneous oedema at the bite site (Carrera-Játiva et al., 2020). In the Sturnidae, *Sturnus vulgaris* we encounter the Mallophagi of the species *Menacanthusspiniferus* (Piaget, 1885) and the Ixodids: *Ixodespassericola* Schulze, 1933 and as mites: *Pteronyssoidestruncatus* (Trouessart, 1885) and *Trouessartiarosteri* (Berlese, 1883).
The calculation of the centesimal frequencies for ectoparasites shows that the most abundant species is Ixodidae sp. with 64.5% followed by *Myrsideacucullaris* with 17.2% and *Bruellianebulosa* with 10.8%. The species *Bovicola* sp. and *Sturnidoecussturni* are reported with low abundances at 5.4% and 2.2%, respectively. In the same way, Dik et al. (2009), for the first time in Turkey, identified 4 species of lice on starlings. These are *Myrsideacucullaris*, *Brueelianebulosa*, *Sturnidoecussturni* and *Brueelia* sp.
Studies including a triple microbiological survey (virological, parasitological and bacteriological) in a coastal zone in a port region of Brest, Finistere in Brittany conducted by Simitzis-Le Flohic et al. (1983), reported that out of 67 starlings, *Sturnus vulgaris* trapped, all starlings sheltered Analgesoideafeatherfish mites, no ticks were found.
In Turkey, Dik et al. (2009), found 4 starlings among 27 starlings infested with lice, a prevalence of 14.81%. In England, Kettle (1983), reported for Hampshire and Sussex the seasonal prevalence of lice (Phthiraptera) on starlings, (*Sturnus vulgaris*), 4 species of lice have been recovered: the Menoponidae with *Menacanthuseurysternus* and *Myrsideacucullaris* and the Philopteridae with *Brueelianebulosa* and *Sturnidoecussturni*. These authors showed that starlings often sheltered populations less than 10 lice and that Menoponidae were the most frequent in August and September. On the other hand, the Philopteridae, they are present in June and July. According to these authors the main factors that govern the amount of lice populations are host behaviour (predisposition), moulting and climate.
In Germany, in a study by Klaus et al. (2016), it was noted that 892 captured birds belonging to 48 different species were infested with ticks, *Ixodes* spp. and most often *Ixodesricinus*. Blackbirds, *Turdusmerula* and thrushes, *Turdusphilomelos*, are the most heavily infested. Birds are mainly

infested with nymphs (65.1%), followed by larvae (32.96%). These authors report that sedentary birds are more infested than migratory birds. Compared to migratory birds, short-distance migrants are more infested than long-distance migratory birds. Compared to other passerine species Hernandes and Valim (2015) in the Brazilian state of Tocantins reported a new species of ectoparasitic mite: *Trouessartiacanestrini* (Acari: Trouessartiidae) on a Brazilian bird of the family Tyrannidae, the Black-tailed Flycatcher, *Myiobiusatricaudus* (Lawrence, 1863).

In Algeria, the study conducted by Boulahbal et al. (2007) on ectoparasites inventory and their impacts on chicks on two populations of North African blue, *Paruscaeruleusultramarinus*, reveals that in urban and forest areas, 80 to 100% of nests are infested by mites (*Dermanyssus* moth, Ixodes tick), insects (DipteraProtocalliphora and *Ceratophyllus*fleas). Studies by Rouag-Ziane et al. (2007) on a species of waterbird, the Coot Fulicaatra, quantified ectoparasites on 17 Coots at Lake Tonga, Algeria, during the 2004-2005 wintering season. The results showed that *Grallobiafulicae* mites are the most abundant. They account for 65.6% of the total population, followed by lice *Pseudomenoponpilosum*, *Rallicolafulicae*, *Fullicofulalurida*, *Incidifronsfulicae* and *Laemobothrionatrum* with 34.4% and leeches *Theromyzone* sp. with 0.05%.

Two groups are reported for the measurement of ectoparasites in the region of OuedSmar (Algiers). The ectoparasites of starlings have average dimensions that vary depending on the species. In contrast, Kettle (1983) reports a smaller size for these similar species. According to this author, the size of *Brueelianebulosa* varies from 0.33 to 0.36 mm and between 0.3 and 0.32 mm for the male. The size of *Myrsideacucullaris* fluctuates between 0.47 and 0.49 mm for the female and 0.43 to 0.45 mm for the male. As with most animal species, the female is larger than the male. Finally, the size of *Sturnidoecussturni*varies from 0.55 to 0.58 mm for females and from 0.49 to 0.51 mm for males.

In Germany, Klaus et al. (2016) worked on the importance of ticks and tick-borne pathogens in birds and their impact on human and animal health. According to Moodi et al. (2013), out of 106 passerines examined in eastern Iran, 49% were infested with lice belonging to 3 families, namely Ricinidae, Menoponidae and Philopteridae. Sychra et al. (2014) conducted studies in South Africa for lice susceptibility, on a total of 655 individuals belonging to 28 families, fitting into 110 species of passerines. A total of 80 (12%) birds of 33 species were parasitized by chewing lice (Phthiraptera: Amblycera) belonging to three genera: *Menacanthus*, *Myrsidea* and *Ricinus*.

Fairn et al. (2014) identify a prevalence of 13.2% of lice, 15.1% fleas and 17% mites. They announce that birds play a more important role than wingless hosts and that ticks transmit encephalitis and several viral diseases. Avian lice show a general tendency to be more numerous during or immediately before the host's breeding season - early spring. This pattern was recorded by Ash (1960) on many British passerines and by Boyd (1951) on starlings. Regarding the average intensity, it is 1.00 (very low) for Myrsidea sp. (females), Myrsidea sp. (males), Myrsidea sp. (larvae), *Brueelianebulosa* (females), *Brueelianebulosa* (males), *Menacanthus* sp. (larvae), *Menacanthus* sp., *Sturnidoecus* sp. (nymphs), *Sturnidoecus*sp (females), Analgidae sp. (females), Analgidae sp. (males), Trouessartiidae sp. (females) and Trouessartiidae sp. (males) and Proctophyllodidae sp.

Parasites are sometimes so inconspicuous that they go unnoticed, but those of birds cause problems, some of which are simply annoying, while others are potentially fatal. Many birds can suffer from internal or external parasites. Salvage is possible if the problem is detected in time. It is essential to tactically treat birds from external and internal parasites. In perspective, it would be interesting to use blood samples for detection of possible endoparasites in different environments, namely cultivated environments, parks and gardens and also at the level of household landfills. Further research on starling parasites would be useful to determine their impact on human and animal health.

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Author contributions

All authors have contributed to the entire work, read and agreed to publish the present version of the manuscript. Additional Professor Ricardo Holgado delivered helpful comments for improve the redaction of the manuscript.

References

[1] Adam C, Chisamera G, Daróczi SJ, Sándor AD, Gogu-Bogdan MIRCEA. 2009. Data on the chewing louse fauna (Phthiraptera: Amblycera, Ischnocera) from some wild and domestic birds of Romania. *Travaux du Muséum National d'HistoireNaturelle "GrigoreAntipa*, *52*, 177-232.

[2] Ash JS. 1960. A study of the Mallophaga of birds with particular reference to their ecology. Ibis 102:93-110.

[3] Berlese A. 1883. Acari, MyriapodaetScorpionesbucusque in Italia reperta. – Padova, Portici, fasc. 9 Nr. 3.

[4] Berraï H, Chaouia C, Djennas-Merrar K, Doumandji S. 2015. Behaviour of the European starling Sturnus vulgaris in its wintering area in Algeria. 10th Congress of the European Ornithologist's, Badajoz.

[5] Boon AC, Sandbulte MR, Seiler P, Webby RJ, Songserm T, Guan Y, Webster RG. 2007. Role of terrestrial wild birds in ecology of influenza A virus (H5N1). Emerging Infectious Diseases, 13(11), 1720.

[6] Boulahbal A, Brahmia Z, Bouslama Z, Khelfaoui F, Benyacoub S. 2007. Infestation parasitairecomparée chez la Mésangebleue (Paruscaeruleusultramarinus) en milieu urbainetforestier au Nord-Estalgérien. Premiersrésultats. Journ. internati. zool. agri. for., 8-10avril2007, Dép., zool., agri., for., Inst., nati., agro., El Harrach, p. 82.

[7] Boyd EM. 1951. A survey of parasitism of the starling Sturnus vulgaris in North America. J.Parasitol. 37: 56-84.

[8] Carrera-Játiva PD, Morgan ER, Barrows M, Jiménez-Uzcátegui G, Tituaña JRA. 2020. Free-ranging avifauna as a source of generalist parasites for captive birds in zoological settings: An overview of parasite records and potential for cross-transmission. Journal of advanced veterinary and animal research, 7(3), 482.

[9] Dakman A, SahanYpicieÖ, Yasarer A, Gulec M. 2017. First isolation of Salmonella Hessarek from Sturnus vulgaris in Turkey: A case report. KafkasUniv.Vet. Fak. Derg, 23 (2): 343-346.

[10] Dantas-Torres F, Chomel BB, Otranto D. 2012. Ticks and tick-borne diseases: a One Health perspective.Trends in Parasitology, Vol. 28(10): 437-447.

[11] Dik B, Uslu U, Derinbay EO, Işik N. 2009. Chewing lice (Phthiraptera: Ischnocera, Amblycera) of starlings (Sturnus vulgaris, L.) in Turkey. Turkiyeparazitolojiidergisi, 33(4), 316-320.

[12] Fairn ER, Hornsby MAW, Galloway TD, Barber CA. 2014. Ectoparasites of nestling European starlings (Sturnus vulgaris) from a nest box colony in Nova Scotia. Canadian. J. Acad. Entomol. Soc., 10: 19-22.

[13] Feare CJ. 1984. The starling. Oxford Univ. Press, Oxford, 315 p.

[14] Graves IL. 1996. Newcastle disease viruses in birds in the Atlantic flyway: isolations, haemagglutination-inhibition and elution-inhibition antibody profiles. Veterinary research, 27(3), 209-218.

[15] Hernandes FA, Valim MP. 2015. A new species of the genus Trouessartiacanestrini (Acari: Trouessartiidae) from Neotropical passerines (Aves: Tyrannidae). International Journal Acarology, Taylor et Francis group, Vol. 41, (5): 382-388.

[16] Ilieva M, Zehtindjiev P. 2005. Migratory state: body mass and fat level of some passerine long-distance migrants duringautumn migration in north-easternBulgaria. The Ring, 27(1), 61-67.

[17] Kauffman MD, Lejeune J. 2011. European Starlings (Sturnus vulgaris) challenged with Escherichia coli O157 can carry and transmit the human pathogen to cattle. Letters in Applied Microbiology, 53(6):596-601.

[18] Kettle PR. 1983. The seasonal incidence of parasitism by Phthiraptera on starlings (Sturnus vulgaris) in England. New Zealand Entomologist, 7(4): 403-408.

[19] Klaus C, Gethmann J, Hoffmann B, Ziegler U, Heller M, Beer M. 2016. Tick infestation in birds and prevalence of pathogens in ticks collected from different places in Germany. Parasitol. Res., Cross- Marc,: 1-12.

[20] Knee W, Proctor H. 2006. Keys to the families and genera of blood and tissue feeding mites associated with Albertan birds. Canadian Journal of Arthropod Identification, 2(10.3752).

[21] Lawrence GA. 1863. Border and Bastille (Vol. 672). TinsleyBrothers, 266 p.

[22] Margolis L, Esch GW, Holmes JC, Kuris AM, Schad GA. 1982. The Use of Ecological Terms in Parasitology (Report of an Ad Hoc Committee of the American Society of Parasitologists).The Journal of Parasitology Vol. 68 (1) :131-133.

[23] Mateo MPM. 2006. Diversidad y distribución de las especies de Mallophaga (Insecta) en aves y mamíferos de la comunidad de Madrid. Graellsia, 62 (númeroextraordinario): 21-32.

[24] Moodi B, Aliabadian M, Moshaverinia A, Kakhki OM. 2013. New data on the chewing lice (Phthiraptera) of passerine birds in East of Iran. Science Parasitology, 14, 63-68.

[25] Nielsen K, Smith P, Widdison J, Gall D, Kelly L, Kelly W, Nicoletti P. 2004. Serological relationship between cattle exposed to Brucellaabortus, Yersinia enterocolitica O: 9 and Escherichia coli O157: H7. Veterinary microbiology, 100(1-2), 25-30.

[26] Palma RL. 1978. Slide-mounting of lice: a detailed description of the Canada balsam technique. New Zealand Entomologist 6(4): 432–436.

[27] Pantin-Jackwood MJ, Swayne DE. 2009. Pathogenesis and pathobiology of avian influenza virus infection in birds. Rev. Sci. Tech. Off. Int. Epiz., 28(1) : 113-136.

[28] Piaget É. 1885. Les Pédiculines. Supplément. EJ Brill, 200 p.

[29] Pinilla J. 2000. Manual para el anillamientocientífico de aves. SEO/ BirdLife y DGCN-MIMAM. Madrid (in Spanish).

[30] https://www.miteco.gob.es/en/biodiversidad/temas/inventarios-nacionales/manual_anillador_tcm38-200261.pdf

[31] Proctor H, Owens I. 2000. Mites and birds: diversity, parasitism and coevolution. Trends in ecology & evolution, 15(9), 358-364.

[32] Rouag-Ziane N, Boulahbal A, Gauthier-Clerc M, Thomas F, Chabi Y. 2007. Inventaire et quantification des ectoparasitesde la foulquemacroulefulicaatra(Gruiformes :Rallidés) dans le Nord-Est de l'Algérie. Journal, parasite, (14): 253 – 256.

[33] Rozsa L, Reiczigel J, Majoros G. 2000. Quantifying parasites in samples of hosts. Journal of Parasitology, 86, 228-232.

[34] Simitzis-Le Flohic AN, Leugeuneb, Quillien MC, Monnat JY, Chastel C. 1983. Essaid'appréciation de l'importanceépidémiologiqued'étourneauxsansonnets (Stumus vulgaris L.) dans la régionportuaire de Brest, Finistère des concentrations hivernalesdans la régionportuaire de Brest, Finistère .Cah. O.R.S.T.O.M., sér. Ent. méd. etParasitol., XXI(3) :159-164.

[35] Sychra O, Halajian A, Luus-Powell W, Engelbrecht D, Symes C, Papousek I. 2014. Amblyceran chewing lice (Phthiraptera: Amblycera) from wild passerines (Passeriformes) in South Africa, with a note to their phylogenetic relationships and with the description of a new species of the genus Myrsidea. African Entomology 22: 589–601.

[36] Valtonen ET, Holmes JC, Koskivaara M. 1997. Eutrophication, pollution and fragmentation: effects on parasite communities in roach (Rutilusrutilus) and perch (Percafluviatilis) in four lakes in the Central Finland. Can J AquatSci 54:572–585.

[37] Yera H, Frealle E, Dupouy-Camet J. 2015. Molecular confirmation of Anisakispegreffii as a causative agent of anisakidosis in France. Digestive and Liver Disease, 48(8), 970. ofectoparasitic lice infestation