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NEW RECORDS OF ECTOPARASITES FROM THE BLACK-HEADED GULL, *CHROICOCEPHALUS RIDIBUNDUS* (LINNAEUS, 1766) IN ALGERIA

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Abstract. The Black-headed Gull, *Chroicocephalus ridibundus* Linnaeus, 1766, is a migratory bird that winters along the entire Algerian coast and is considered a protected species. In this study, we report the first-ever collection and identification of ectoparasites from Black-headed Gulls in the province of Boumerdes, Algeria. From October and November of 2020 and 2021, a total of 45 live Black-headed Gulls were captured using modified Bal-chatri traps and examined for the presence of ectoparasites. The results revealed a total of 3537 ectoparasite specimens, 264 of which belonged to Phthiraptera and 3273 to Acari. Within Phthiraptera, two species from the suborder Ischnocera were identified: *Saemundssonia lari* Fabricius, 1780, with a prevalence of 62.22%, and *Quadraceps punctatus* Burmeister, 1838, with a prevalence of 93.33%. Additionally, one species from the suborder Amblycera, *Actornithophilus piceus lari* Packard, 1870, was found with a prevalence of 86.66% and the lowest mean intensity with the value of 0.90. As for Acari, *Zachvatkinia larica* Mironov, 1989, was the most common with a prevalence of 71.11% and the highest mean intensity value of 102.28. Notably, all the recorded parasite species found in the Black-headed Gull in this study are reported in Algeria and in North Africa for the first time. The Pearson's correlation test indicated a significant difference in parasite infestation of the gull population ($r = 0.716$; $p = 0.046$).

INTRODUCTION

The relationship between wild birds and ectoparasites has been a subject of significant interest among ecologists (Clayton et al. 2010). Ecologists have recognized that the distribution and dynamics of parasites can have a profound impact on the population dynamics of their hosts, influencing factors such as survival and reproductive success (Anderson and May 1978; Hudson and Dobson 1989).

Gulls, which encompass approximately 52 recognized species (Burger and Gochfeld 2019), are a group of aquatic birds known for their gregarious nature and diverse habitat preferences. These birds frequently share water resources and move between feeding sites, where they may consume diseased farmed shrimp and fish that are present in open tanks or cages. The interaction between Gulls and these infected food sources can potentially contribute to the transmission of parasites and infectious diseases within the Gull population. It is worth noting that, although the paragraph provides information about Gulls and their feeding habits, it does not explicitly discuss the specific link between Gulls and ectoparasites or the transmission of infectious diseases. Further research would be required to explore the extent of these associations and their implications. Consequently, urban birds, including Gulls, can act as potential carriers of parasites, facilitating their transmission among different avian species. Ecologists are increasingly recognizing the significant impact that parasites can have on host population regulation and the overall balance and functioning of ecosystems (Barroca 2005). The research attention given to the importance of ectoparasites in bird migration and their role in the transmission of infectious diseases has been limited (Hubálek 2004; Arnal et al. 2014). However, it is recognized that chewing lice, which are permanent and obligatory ectoparasites, play a significant role in these processes, often exhibiting a strong host specificity (De Brooke and Nakamura 1998; Johnson et al. 2005). Nevertheless, some chewing lice species demonstrate a lower level of host specificity (Clay 1964; Wecksten 2004).

In the context of Algeria, studies specifically focusing on the ectoparasites of water birds are relatively recent. Only a few species have been investigated, including the common coot *Fulica atra* (Rouag-Ziane et al. 2007), the Common Moorhen *Gallinula chloropus* (Ziani et al. 2021), the greater flamingo *Phoenocopterus roseus* (Touati and Samraoui 2013), the glossy ibis *Plegadis falcinellus* (Touati et al. 2015), the little egret *Egretta garzetta* (Blagoveshtchensky 1940; Temimi et al. 2017), and the White Stork *Ciconia ciconia* in urban and natural areas (Bouguessa-Cheriak et al. 2017) (Table 1). These studies highlight the limited scope of research conducted

Table 1. Overview of studies into ectoparasite infestations in diverse water bird species in Algeria.

Location	Habitat type	Host	Ectoparasite	Reference
Lake Tonga (Annaba)	Natural	*Gallinula chloropus* Linnaeus, 1758	*Pseudomenopon pilosum* Scopoli, 1763, *Rallicola minutus* Nitzsch, 1866, *Laemobothrion chloropodis* Schrank, 1803, *Incidifrons gallinulae* Dale, 1878, and *Fulicoffula* sp.	(Ziani et al. 2021)
Tebessa	Natural	*Ciconia ciconia* Linnaeus, 1758	*Colpocephalum* sp., *Colpocephalum zebra* Burmeister, 1838, *Ciconiphilus quadripustulatus* Burmeister, 1838, *Ardeicola ciconiae* Linnaeus, 1758, Ardeicola sp., *Neophilopterus incompletes* Denny, 1842, *Rhopalidae* sp. ind., *Apocrita* sp. ind., and *Protocalliphora* sp.	(Bouguessa-Cheriak et al. 2017)
Dréan (El Taref)	Urban	*Ciconia ciconia* Linnaeus, 1758	*Colpocephalum zebra* Burmeister, 1838, *Neophilopterus incompletus* Denny, 1842, *Ardeicola ciconiae* Linnaeus, 1758, and *Ciconiphilus quadripustulatus* Burmeister, 1838	(Touati et al. 2022)
Tonga Lake, Oubeira Lake and El-Mellah Lagoon (Annaba)	Natural	*Egretta garzetta* Linnaeus, 1766	*Ardeicola expallidus* Blagoveshtchensky, 1940 and *Ciconiphilus decimfasciatus* Boisduval & Lacordaire, 1835	(Temimi et al. 2017)
Chatt and Lake Fetzara (Annaba)	Natural	*Plegadis falcinellus* Linnaeus, 1766	*Plegadiphilus plegadis* Dubinin, 1938, *Colpocephalum leptopygos* Nitzsch [in Giebel], 1874, *Ardeicola rhaphidius* (Nitzsch [in Giebel], 1866, *Ibidoecus bisignatus* Nitzsch [in Giebel], 1866, and one tick (larva) *Ixodes ricinus* Linnaeus, 1758	(Touati et al. 2015)
Two Algerian salt lakes: Ezzemoul (Hauts Plateaux) and Safioune (Sahara)	Natural	*Phoenicopterus roseus* Pallas, 1811	*Colpocephalum heterosoma Piaget* Piaget, 1880, *Triniton femoratum Piaget* Piaget, 1880, *Anaticola phoenicopteri* Coinde, 1859 and *Anatoecus pygaspis Nitzsch* Nitzsch (in Giebel), 1866	Touati and Samraoui (2013)
Lac Tonga (Annaba)	Natural	*Fulica atra* Linnaeus, 1766	*Pseudomenopon pilosum* Scopoli, 1763, *Rallicolo fulicae* Denny, 1842, *Fullicofulo lurida* Nitzsch, 1818, *Incidifrons fulicae* Linnaeus, 1758, *Laemobothrion atrum* Nitzsch, 1818 and *Theromyzone* sp.	(Rouag-Ziane et al. 2007)
Garden of the National Agronomic Institute of El Harrach (region of Algiers), Marsh of Réghaïa (region of Algiers), Agueli islet, Forest of Mouzaia (Blida), Forest of Karimia (Chlef), as well as in Khemis Meliana (Ain Defla)	Natural and urban	*Larus michahellis* Naumann, 1840, *Carduelis carduelis* Linnaeus, 1758, *Turdus merula* Linnaeus, 1758, *Columba livia* Gmelin, 1789, *Luscinia megarhynchos* Brehm, 1831, *Alectoris chukar* Gray, 1830, *Muscicapa striata* Pallas, 1764, *Cyanistes caeruleus* Linnaeus, 1758, *Columba palumbus* Linnaeus, 1758, *Acrocephalus scirpaceus* Hermann, 1804, *Gallinula chloropus* Linnaeus, 1758 and *Aythya nyroca*	*Carios capensis* Neumann, 1901, *Hyalomma marginatum, marginatum* Koch, 1844, *Oeciacus hirundinis* Lamarck, 1816, *Menacanthus stramineus* Nitzsch, 1818, *Columbicola columbae* Linnaeus, 1758, *Dermanyssus gallinae* De Geer, 1778, *Dermanyssus* sp. and *Dasypsyllus gallinulae* Dale, 1878	(Baziz-Neffah et al. 2015)

on water bird ectoparasites in Algeria and demonstrate the need for further investigations to expand our knowledge in this area.

The Black-headed Gull is a migratory and wintering bird belonging to the Laridae family. It is commonly observed along the entire Algerian coast and in the country's interior wetlands (Jacobs 1979). The species primarily visits Algeria between September and March during the winter season (Jacobs and Ochando 1979; Ledant et al. 1981). The Black-headed Gull is classified as vulnerable by various institutions and has protective status under Annex 2 W2 and Annex 2 R2 designations in Algeria (Gourari et al. 2021). Although studies have been conducted on mite and lice infestations in the Black-headed Gull (e.g., Khan et al. 2019; Mohammed 2020), no specific research has been conducted on this topic concerning the Black-headed Gull in North Africa, including Algeria. The lack of available studies highlights the need for further research to better understand the presence and effects of chewing lice on Black-headed Gulls in this region. Therefore, the objective of this study was to identify the ectoparasites infesting the Black-headed Gull in Boumerdes, Algeria, and to assess changes in the prevalence and intensity of ectoparasites and examine their distribution across the host's body parts.

MATERIALS AND METHODS

Study area

Boumerdes is a coastal town in central Algeria (36°46′00″N, 3°28′00″E); with an area of 1456.16 km^2, and a 100 km coastline profile (Figure 1). It has a Mediterranean climate with a subhumid bioclimatic stage characterized by dry and hot summers, mild and humid winters.

Biological material

During October and November of 2020 and 2021, a total of 45 living Black-headed Gulls were caught using modified Bal-chatri traps and visually examined, inspecting their feathers and skin for ectoparasites, which were collected and preserved in ethanol 70%. All of the bird individuals were released.

Ectoparasites identification

The specimens of feather lice were meticulously cleared and mounted in the laboratory using Canada balsam, following the standardized procedure outlined by Palma (1978) and Price et al. (2003). The prepared slides were then sandwiched between a blade and a coverslip (lamella). Subsequently, they were examined under a Leica DM500 microscope at magnifications of G × 10 and G × 40.

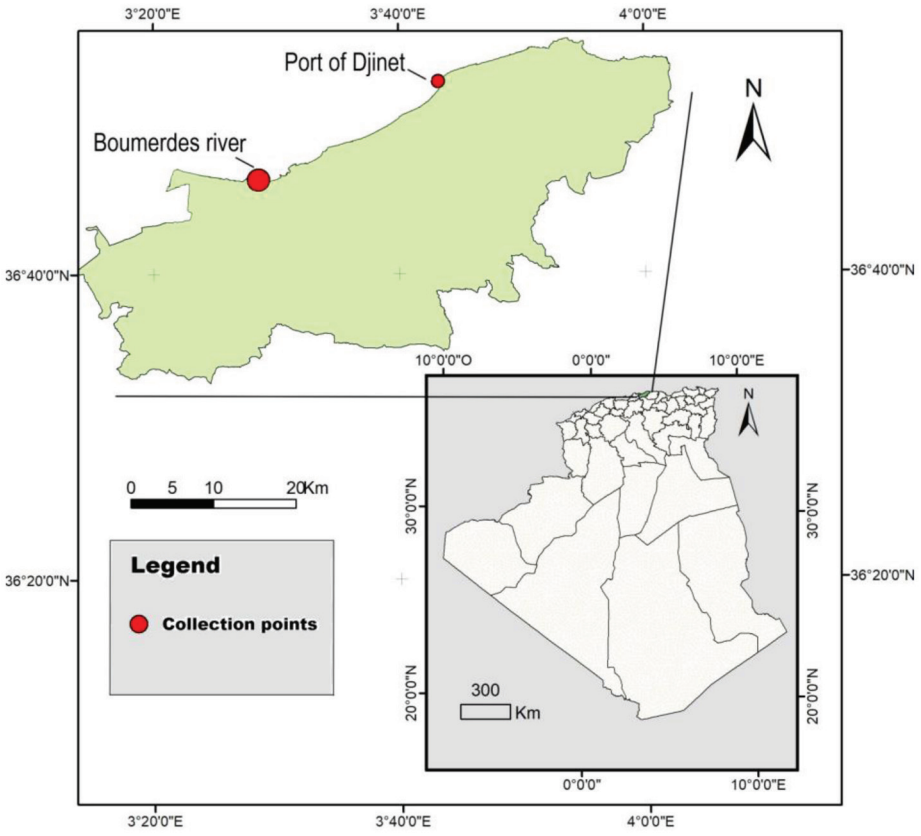

Figure 1. Map of Algeria highlighting the city of Boumerdes and the two banding points of Black-headed Gulls (Boumerdes River and Port of Djinet).

As for the mite specimens, they were cleared in lactic acid and subsequently mounted on slides as the mounting medium, following the method described by Downs (1943). The slides were then cured at 40 °C for 4 days on a slide warmer and examined using a Leica DM500 microscope at magnifications of G × 10 and G × 40. The taxonomic keys provided by Al-Ahmed et al. (2014), Timmermann (1952), and Price et al. (2003), were utilized for lice identification. For mite identification, the key by Mironov (1989) was employed.

Statistical analysis

The prevalence and mean intensity of ectoparasites were determined in accordance with the methodology outlined by Margolis et al. (1982). The distribution of ectoparasites across different body parts of the Gulls and the sex ratio were also examined. To assess the relationship between Gull morphometric parameters (mass, wingspan, length, tarsus, and beak) and ectoparasite infestation, the correlation test and descriptive statistics were conducted using IBM SPSS Statistics Version 25 (SPSS Inc., Chicago, Illinois, USA, 2017).

RESULTS

Acari

Among the isolated ectoparasites, Acari showed the highest total number of 3273 mite individuals sampled in the present study (Table 2). Out of the 45 Black-headed Gulls examined, 43 were found to be infected by one or more of these ectoparasites. Specifically, the Acari group belongs to the superfamily Analgoidea with the family Avenzoariidae Oudemans, 1905 and

Figure 2. Ectoparasites collected from Black-headed Gulls from Boumerdes, Algeria. **a.** Ventral Habitus of *Zachvatkinia larica* (female); **b.** Ventral Habitus of *Zachvatkinia larica* (male); **c.** Ventral Habitus of *Quadraceps punctatus* (Male); **d.** Ventral Habitus of *Saemundsonia lari* (Male); **e.** Ventral Habitus of *Actornithophilus piceus lari* (Female). Scale bar = 300 µm.

is represented by a single species, *Zachvatkinia larica* Mironov, 1989 (Figure 2a–b). It showed a notably high mean intensity value of 102.28, indicating a substantial number of mites per infested individual. Additionally, the prevalence of *Zachvatkinia larica* was found to be 71.11%, highlighting its wide distribution within the examined population of Black-headed Gulls (Table 2).

Phthiraptera

A total of 264 chewing lice belonging to two families were found in 39 out of the 45 Black-headed Gull individuals examined (Table 2, Figure 2). The family Philopteridae Burmeister, 1838 was the most abundant, comprising two species: *Quadraceps punctatus* Burmeister, 1838 (Figure 2 c) and *Saemundssonia lari* Fabricius, 1780 (Figure 2 d). The prevalence of these two species was 93.33% and 62.22%, respectively. Additionally, only one species from the family Menoponidae, *Actornithophilus piceus lari* Packard, 1870, was found (Figure 2 e), with a prevalence of 86.66% (Table 2).

Saemundsonia lari exhibited the highest mean intensity, while *Actornithophilus piceus lari* displayed the lowest mean intensity with a value of 0.90. Interestingly, the sex ratio of all the chewing lice species analyzed was biased in favor of males, with a ratio of 3.43 for *Actornithophilus piceus lari*, 2.61 for *Quadraceps punctatus*, and 2.60 for *Saemundssonia lari* (Table 2). Significantly, this study reports the first recorded occurrences of these lice species in both Algeria and North Africa.

As seen in Table 3, we found that *Quadraceps punctatus* prefers the back of the bird where we found 52.63% and 72.91% of our samples, respectively, with the rest being found on the belly of the birds. *Actornithophilus piceus lari* also prefers the back (80% of samples), with further specimens found on the tail (20%). *Saemundssonia lari* colonizes almost all parts of the body, with a high abundance of 62.96% on the head and neck. This value decreases progressively with 20.37% on the tail, 10.49% on the back and 6.18 % on the wings.

The abundance of lice on the Black-headed Gull and the morphometric parameters of the bird were tested with Pearson's correlation test (Table 4). On the one hand, there is a significant correlation between the parasitic load of lice and the host's mass ($r = 0.716$; $p = 0.046$). On the other hand, there is no significant relation with the rest of the morphometric parameters: length ($r = 0.464$; $p = 0.247$), tarsus ($r = -0.048$; $p = 0.911$), beak ($r = 0.185$; $p = 0.661$), and wingspan ($r = 0.695$; $p = 0.056$).

The parasitic load of mites was not correlated to the measured morphological parameters: tarsus ($r = -0.073$; $p = 0.864$), beak ($r = 0.011$; $p = 0.980$), mass ($r = 0.336$; $p = 0.416$), length ($r = 0.339$; $p = 0.411$) and wingspan ($r = 0.188$; $p = 0.656$).

Table 2. Ectoparasites of Black-headed Gulls from Boumerdes (Algeria), along with their prevalence, mean intensity, developmental stages, and sex-ratio.

Ectoparasites species		Host species		Parasites		Prevalence (%)	Mean Intensity	Males		Females		Nymphs		Sex-ratio
		Total *N*	Infected *N*	Totals	*N*			*N*	(%)	*N*	(%)	*N*	(%)	
Acari	*Zachvatkinia larica*	45	32	3273	3273	71.11	102.28	1233	37.68	1345	41.09	695	21.23	0.92
Phthiraptera	*Actornithophilus piceus lari*	45	39	264	35	86.66	0.90	24	68.57	7	20	4	11.43	3.43
	Saemundsonia lari		28		162	62.22	5.79	104	64.20	40	24.69	18	11.11	2.6
	Quadraceps punctatus		42		67	93.33	1.60	47	70.15	18	26.87	2	2.98	2.61

N: number of individuals.

Table 3. Distribution of ectoparasites across different body parts of Black-headed Gulls from Boumerdes, Algeria.

Ectoparasites		Head and neck	Belly	Back	Wings	Tail
Acari	*Zachvatkinia larica*	8.15%			75.36%	16.49%
Phthiraptera	*Actornithophilus piceus lari*			80%		20%
	Saemundssonia lari	62.96%		10.49%	6.18%	20.37%
	Quadraceps punctatus		27.08%	72.91%		

Table 4. Correlation and descriptive statistics of Gull's morphometric parameters (Mass, Wingspan, Length, Tarsus and Beak) and the ectoparasites. Top and bottom numbers represent r and *p* values, respectively.

Parameters	Mean ± SD	Lice	Mite	Mass	Wingspan	Length	Tarsus	Beak
Lice	5.250 ± 5.599		0.791 0.019	0.716 0.046	0.663 0.105	0.464 0.247	-0.048 0.911	0.185 0.661
Mite	47.250 ± 56.258	0.791 0.019		0.336 0.416	0.094 0.841	0.339 0.411	-0.073 0.864	0.011 0.980

DISCUSSION

Our examination of the ecotoparasites infesting the Black-headed Gull in Algeria has yielded significant findings. Among the species discovered, we identified *Zachvatkinia larica*, a species of Acari, and three species of Phthiraptera: *Saemundssonia lari*, *Quadraceps punctatus* and *Actornithophilus piceus lari*. Importantly, these findings mark the first recorded occurrences of these species in both North Africa and specifically in Algeria.

Acari

A few previous studies reported the presence of the *Zachvatkinia larica* mite in various species of Gulls (Laridae) in different countries. These studies include reports from Russia (Mironov, 1989), Chile (González-Acuña et al. 2011, 2020), Colombia (Barreto et al. 2012), North Mexico (Beltrán-Ontiveros and Vergara-Pineda 2016; Galloway et al. 2014), the Netherlands (Siepel et al. 2016), and Korea (Han et al. 2016). It is worth noting that this study marks the first reported occurrence of the species in North Africa.

The isolated feather mite species, *Zachvatkinia larica*, exhibits a preference for inhabiting the wings rather than the tail. Our observations indicate that *Zachvatkinia* mite is commonly found in easily accessible body parts, facilitating their transfer between host individuals (Dabert et al. 2015).

Phthiraptera

Actornithophilus piceus lari is found only in Gulls, usually on their wing feathers (Al-Ahmed et al. 2014). It has previously been reported from the Slender-billed Gull *Chroicocephalus genei* Breme, 1839 and Yellow-legged Gull *Larus michahellis* Naumann, 1840 in Iraq (Mohammad 2020), Franklin's Gull *Leucophaeus pipixcan* Wagler, 1831 in Chile (González-Acuña et al. 2020, 2011), Yellow-legged Gull *Larus michahellis* Naumann, 1840 in Portugal (Tomás et al. 2016), and several other gull species (Price et al. 2003). *Saemundssonia lari* is a cosmopolitan species that parasitizes a very large number of Franklin's Gull, *Leucophaeus pipixcan* Wagler, 1831 (Price et al. 2003). This species prefers the head and neck, which has already been reported in previous articles (Yamagishi et al. 2014; González-Acuña et al. 2020).

Quadraceps punctatus has previously been collected from many different Gull species (Price et al. 2003; Al-Ahmed et al. 2014) but our records from the Black-headed Gull in this report constitute a new host record. In our study, we confirmed the presence of this louse subspecies in hosts of the genus *Chroicocephalus*, but with a presence on the back rather than on the wings as reported by González-Acuña et al. (2020).

Sex ratio was biased in favor of males. The distribution of chewing lice species across the body of the Black-headed Gull is irregular. *Actornithophilus piceus lari* and the genus *Quadraceps* have a restricted microhabitat choice and primarily prefer the back, while *Saemundssonia lari* has a wider distribution where it is located almost on all the body parts.

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Ethics of wildlife and rehabilitation

The authors certify that the current study does not affect at any level the dynamics of the species population. After lice recovery, all the Black-headed Gulls were released alive to the same site of capture.

Conflict of interest

The authors declare that they have no conflicts of interest regarding this manuscript.

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