

## New data concerning ectoparasites infesting two species of doves, the migratory turtle dove (*Streptopelia turtur*) and the exotic sedentary eurasian collared dove (*Streptopelia decaocto*) in south-eastern oases of Algeria (Biskra)

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### Abstract

This study was carried out in South-eastern Algerian Oases for two years (2017 and 2018) on 300 doves consisting of two species, *Streptopelia turtur arenicola* L. and *Streptopelia decaocto* (Fridvaldszky, 1838). A total of 854 ectoparasite specimens were identified. On *Streptopelia decaocto*, five lice species recorded for the first time in Biskra (Algeria) were detected and the population was dominated by *Columbicola bacillus* (82.67% ± 3.92) followed by *Coloceras piageti* (22% ± 3.35), *Hohorstiella* spp (9.33% ± 2.93), *Hohorstiella modesta* (8% ± 2.66), and *Bonomiella concii* (3.33% ± 3.12). Other orders such as Diptera (flies) were represented by *Pseudolynchia canariensis* (4.67% ± 1.72), Ixodida (ticks) by *Argas* spp (20.09% ± 1.91) and Mesostigmata (mites) by two species *Dermanyssus* spp (5.35% ± 1.59) and *Ornithonyssus bacoti* (1.94 ± 1.28). On *S. turtur*, two lice species were recorded *Columbicola bacillus* (85.47% ± 2.76) and *Coloceras britannicum* (28.67% ± 4.07). Ticks and mites were represented, respectively, by *Argas* spp (13.66% ± 2.85) and *Dermanyssus* spp (2% ± 1.18). Higher prevalence of a single infestation was observed on *S. decaocto* (50%), compared with double (36.66%), triple (9.33%) and quadruple (1.33%) infestations. However, the difference between single and mixed infestations on males and females was statistically significant ( $p < 0.05$ ). On the other hand, *S. turtur* had higher prevalence of single infestations (68.67%), compared with double (26.67%) and triple infestations (4.67%), the difference in the prevalence of single and mixed infestation was not statistically significant ( $p > 0.05$ ). The young chicks of the two dove species were not infested.

### Keywords

Doves, Ectoparasites, Lices, Ticks, Mites, Flies, Algerian Oases.

Nouvelles données sur les ectoparasites infestant deux espèces-hôtes de tourterelles migratrices, la tourterelle des bois (*Streptopelia turtur*) et une tourterelle exotique sédentaire turque (*Streptopelia decaocto*) dans des oasis du Sud-Est algérien (wilaya de Biskra)

### Résumé

Cette étude a été réalisée dans les oasis du Sud-Est Algérien de la wilaya de Biskra durant la période 2017-2018. Sur 300 individus de tourterelles constituées de deux espèces *Streptopelia turtur arenicola* L. et *Streptopelia decaocto* (Fridvaldszky, 1838), un total de 854 spécimens d'ectoparasites a été trouvé. Concernant *Streptopelia decaocto*, cinq espèces de poux ont été prélevées et identifiées pour la première fois. Ces poux étaient dominés par *Columbicola bacillus* avec (82,67 % ± 3,92) suivi par *Coloceras piageti* (22 % ± 3,35), *Hohorstiella* spp (9,33 % ± 2,93), *Hohorstiella modesta* (8 % ± 2,66) et *Bonomiella concii* (3,33 % ± 3,12). Cependant, l'ordre des Diptera (mouches) est représenté par *Pseudolynchia canariensis*

avec (4,67 % ± 1,72), celui des Ixodida (tiques) par *Argas* spp avec (20,09 % ± 1,91) et celui des Mesostigmata (acariens) par deux espèces *Dermanyssus* spp avec (5,35 % ± 1,59) et *Ornithonyssus bacoti* avec (1,94 % ± 1,28). Concernant *S. turtur*, deux espèces de poux ont été enregistrées *Columbicola bacillus* avec (85,47 % ± 2,76) et *Coloceras britannicum* avec (28,67 % ± 4,07). Les tiques et les acariens étaient représentés respectivement par *Argas* spp (13,66 % ± 2,85) et *Dermanyssus* spp (2 % ± 1,18). La prévalence la plus élevée d'infestation unique a été observée sur *S. decaocto* (50 %), par rapport aux infestations doubles (36,66 %), triples (9,33 %) et quadruples (1,33 %). Cependant, la différence d'infestation unique et mixte entre les mâles et les femelles était statistiquement significative ( $p < 0,05$ ), alors que pour *S. turtur*, la prévalence d'infestations uniques était plus élevée avec (68,67 %), par rapport aux doubles (26,67 %) et triples infestations (4,67 %), sachant que la comparaison de cette prévalence d'infestation unique et mixte entre les deux sexes est statistiquement non significative ( $p > 0,05$ ). Les jeunes poussins des deux espèces de tourterelles étaient indemnes des attaques des ectoparasites.

**Mots-clés** Tourterelles, Ectoparasites, Poux, Tiques, Acariens, Mouches, Oasis algériennes.

## Introduction

*Streptopelia doves* are different species in the Columbidae family, Columbiformes order. The Eurasian collared dove, *Streptopelia decaocto* (Frivaldszky, 1838), is a resident species, native to warm temperate and subtropical Asia. It represents one of the great colonies of birds in the world. It may use a range of habitat types including woodland, orchards and human habitation. In Algeria, the first observation of this species was signalled in 1994 in Annaba province and the first nest building was noted in 1996 (LEDANT *et al.*, 1981). In Biskra province, these birds appear to prefer palm groves. These provide most nesting sites and important food resources (ABSI *et al.*, 2015). The oases became a very interesting ecological habitat for doves (ADAMOU *et al.*, 2010).

The European turtledove *Streptopelia turtur arenicola* L. is a migratory bird. Its breeding area in Algeria stretches from the northern territory of the country to the palm groves (oases) in the South (HEIM DE BALSAC & MAYAUD 1962; LEDANT *et al.*, 1981; ISENMANN & MOALI, 2000; BOUKHAMZA *et al.*, 2008; FARHI & BELHAMRA, 2012; ABSI, 2012; ABSI *et al.*, 2015).

Bird health is affected by several organisms. Ectoparasitic arthropods, including lice, ticks, mites and flies, often grow on the skin or feathers of their hosts (RASSOULI *et al.*, 2016). They can be vectors of pathogens, and responsible for blood loss and toxicosis. Many of these ectoparasites (mostly lice) are host-specific, but others (ticks) parasitize a wide range of hosts (RASSOULI *et al.*, 2016).

In Algeria, few authors have treated the inventory of ectoparasites on some birds (BACIR & BOUSICIMO, 2006; ROUAG-ZIANE *et al.*, 2007; ROUAG-ZIANE & CHABI, 2008; DJELMOUDI *et al.*, 2014; TOUATI, 2014; BAZIZ-NEFFAH *et al.*, 2015; AOUISSI, 2016; TABIB, 2016; MARNICHE *et al.*, 2017; TEMIMI *et al.*, 2017; TOLBA *et al.*, 2018; ABDESSAMED *et al.*, 2018; BOUCHAMA *et al.*, 2020; ZIANI *et al.*, 2020).

Up to the current time, the survey of BENDJOURI *et al.* (2018) represented a rare report that treats ectoparasitic fauna of two Columbidae species, *Columba livia* and *Streptopelia decaocto* in Blida province (north Algeria). However, the aim of this survey is to report new data of ectoparasites infesting two different host species in Algerian South-Eastern Oases (Biskra), the migratory turtledove *S. turtur* and the collared dove *S. decaocto*, an exotic sedentary Eurasian species.

## Materials and methods

### Study area

The field work was conducted between May to August 2017 and from April to August 2018 at Biskra, located east of Algeria, in the foothills of the Aures (34, 48 N & 5, 44 E). It appears at the big door [? wide access route?] that opens up on the Sahara and its arid climate. It is limited in the north by the province of Batna, to the North-West of the province of M'Sila, to the Northeast of the province of Khenchela, to the south by the province of El Oued and Ouargla and to the Southwest of the province of Djelfa (Figure 1). The samples were collected from both sites: Sidi-Okba (31° 59'N and 5° 20' E), and Sidi-Khaled (34° 23' N and 4° 58' E), respectively, 20 km and 60 km from the chief town Biskra.

### Bird collection and the sampling of ectoparasites

All studied birds were recovered in Biskra province (Figure 1) between April-August over two years (2017 and 2018). Three hundred doves were captured in the Oases of Biskra by a trapping system, which consisted of luring them into the 1 x 1 x 1.5 m trap cages. The traps are raised early in the morning as well as in the evening as dusk approached. The examined subjects in this study included 150 individuals of *S. decaocto* with 55 females, 91 males and 4 young chicks, and 150 specimens of *S. turtur* with 34 females, 107 males and 9 young chicks.

The doves were individually treated in a container (30 x 25 x 15 cm) with a synthetic pyrethroid insecticide (Avispray), during 20 to 30 minutes, then they were released, and the ectoparasites were collected and stored in 70% ethanol. They were cleared up in KOH [concentration?] for one day, rinsed in distilled water and transferred to ethanol 70% and 99%. They were mounted in Canada balsam on microscopic slides, according to Palma's (1978) method. All species were identified and photographed with a phase-contrast trinocular microscope (Leica DM 750) by Professor DIK from Selçuk University, Konya, Turkey [this person is one of the authors, so there is no need to include the name here]. Identification followed ADAMS *et al.* (2005); PILGRIM (1976) and TENDEIRO (1969, 1973).

### Parasitism rate analysis

Terminology of infestation prevalence, relative abundance and abundance, follow MARGOLIS *et al.* (1982).

- *Infestation prevalence* =  $100 \times (\text{number of infested doves}/\text{number of examined doves})$ ;
- *Infestation abundance* = It corresponds to the ratio of the total number of individuals of a parasitic species (n) to the total number of individually examined doves;
- *Relative abundance* = is the number of individuals of all the species present in the site considered.

### Data and Statistical study

Statistical analysis was done by IBM© SPSS Statistics, Version 23. To determine the relationship between infestation abundance and month, we used XLSTAT 2016.02.27444- Descriptive statistics. A chi-square test was employed to determine the association between prevalence (frequency of occurrence) and sex from two species of doves.

## Results

### Ectoparasite diversity

A total of ten ectoparasite species was detected on two host doves, *S. decaocto* and *S. turtur arenicola*. They were dominated by lice of six species (Table 1).

The present data showed that each species of doves bears its own species of ectoparasite, and the resident dove *S. decaocto* harbours most identified species (Table 2).

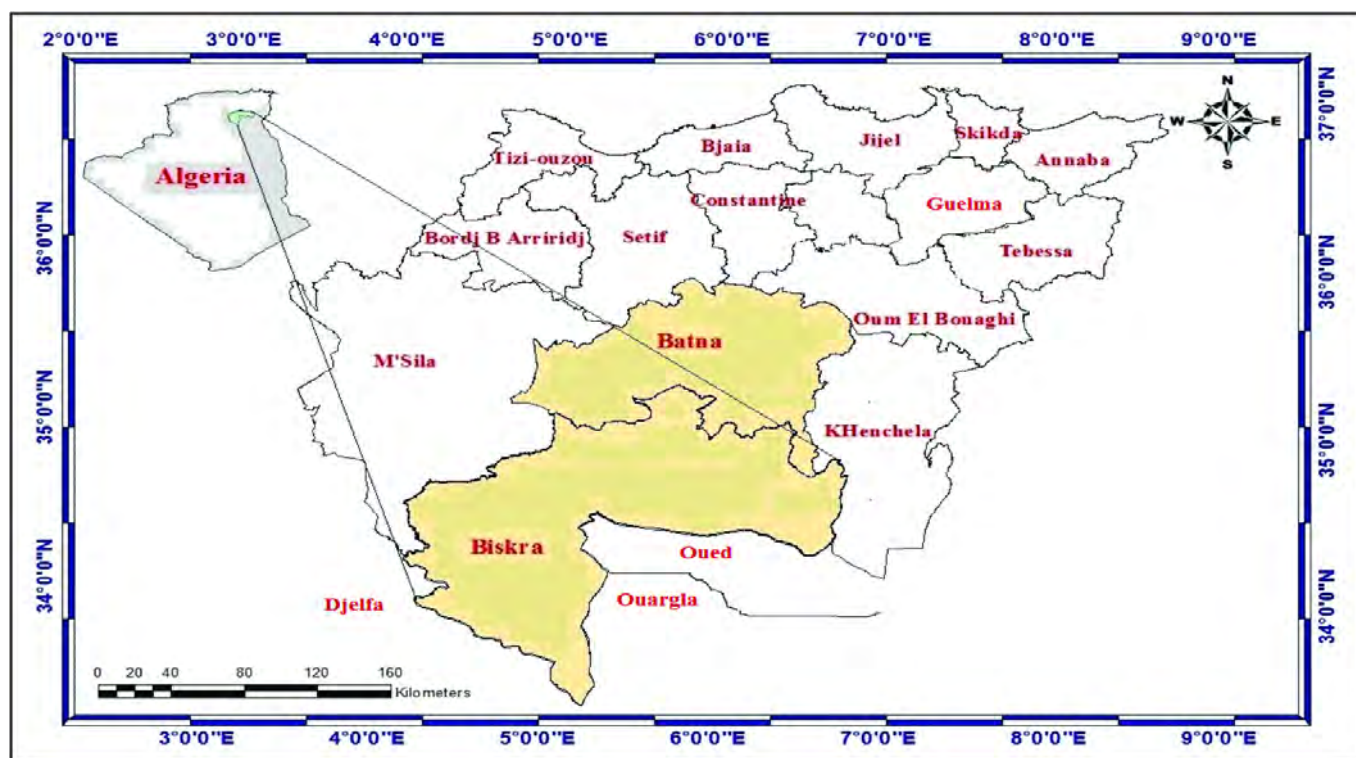
*C. bacillus* was the most common louse species in this study, and it was present on the two dove species (Figures 2A and 2B).

Interestingly, because of their specific-trophic relations, two louse species were identified peculiar to their hosts such

**Table 1**

List of ectoparasite species detected on *S. decaocto* and *S. turtur* in Biskra province during 2017-2018.  
Liste des espèces ectoparasites détectées sur *S. decaocto* et *S. turtur* dans la province de Biskra en 2017-2018.

Common name	Order	Family	Species
Lice	Phthiraptera	Philopteridae	<i>Columbicola bacillus</i>
		Goniodidae	<i>Coloceras piageti</i>
			<i>Coloceras britannicum</i>
		Menoponidae	<i>Hohorstiella modesta</i>
			<i>Hohorstiella</i> spp.
<i>Bonomiella concii</i>			
Flies	Diptera	Hippoboscidae	<i>Pseudolynchia canariensis</i>
Ticks	Ixodida	Argasidae	<i>Argas</i> spp.
Mites	Mesostigmata	Dermanyssidae	<i>Dermanyssus</i> spp.
		Macronyssidae	<i>Ornithonyssus bacoti</i>



**Figure 1**

Geographical location of the study site.  
Localisation géographique du site d'étude.



**Table 2**

Ectoparasite species collected from collared doves and turtle doves in the south- eastern Oases of Algeria (Biskra).  
 Espèces d'ectoparasites prélevées sur la tourterelle turque et la tourterelle des bois dans des oasis du sud-est algérien (province de Biskra).

Host species	Ectoparasite species	Comments
<i>Streptopelia decaocto</i> Frivaldszky (1838)	<i>Columbicola bacillus</i> (Giebel, 1866)	New record (in Biskra)
	<i>Coloceras piageti</i> (Johnston & Harrison, 1912)	New record (in Biskra)
	<i>Hohorstiella modesta</i> (Ansari, 1941)	New record (in Biskra)
	<i>Hohorstiella</i> spp.	BENJOUDI et al. (2018)
	<i>Bonomiella concii</i> (Eichler, 1947)	New record (in Biskra)
	<i>Pseudolynchia canariensis</i> (Macquart, 1839)	BENJOUDI et al. (2018) on rock pigeon
	<i>Argas</i> spp.	TOLBA et al. (2018) (on <i>Ciconia ciconia</i> Linnaeus, 1758)
	<i>Ornithonyssus bacoti</i> (Hirst, 1913)	Vector of few zoonoses according to MORO et al. (2005); BAZIZ-NEFFAH et al. (2015) .
<i>Streptopelia turtur arenicola</i> Linnaeus (1758)	<i>Dermanyssus</i> spp.	BAZIZ-NEFFAH et al. (2015) (on <i>Cyanistes caeruleus</i> )
	<i>Columbicola abacillus</i> (Giebel, 1866)	New record (in Biskra)
	<i>Coloceras britannicum</i> (Tendeiro, 1973)	New record (in Biskra)
	<i>Argas</i> spp	TOLBA et al. (2018) (on <i>Ciconia ciconia</i> )
	<i>Dermanyssus</i> spp	BAZIZ-NEFFAH et al. (2015) (on <i>Cyanistes caeruleus</i> )

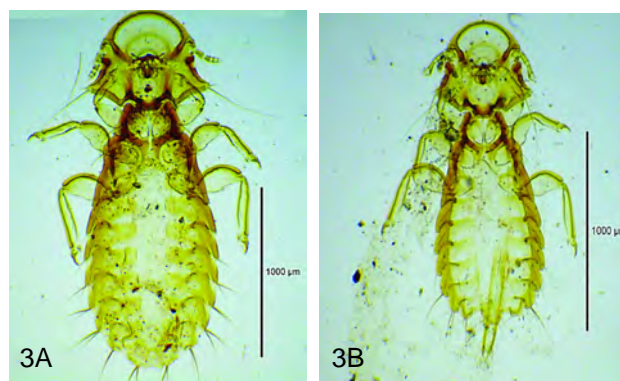
as *Coloceras britannicum* (Figures 3A and 3D) on *S. turtur arenicola* and *Coloceras piageti* on *S. decaocto* (Figures 4A and 4B). Other lice species; *Hohorstiella modesta*, *Hohorstiella* spp. and *Bonomiella concii* were detected on the non-migratory dove *S. decaocto* (Figures 5A, 5B and 5C).

In this study, the mites, ticks (Figures 6A and 6B) and flies were represented only by one or two species on dove hosts; however, *S. decaocto* remains the more infested species as compared to *S. turtur arenicola*.

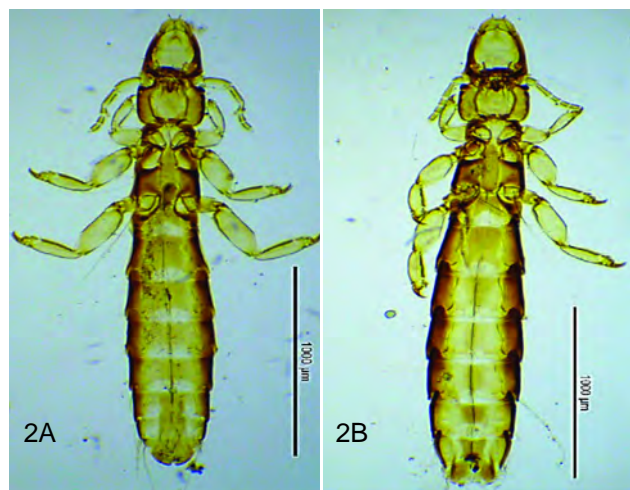
**Overall infestation indicators**

Among the 150 examined specimens of *S. decaocto*, *Columbicola bacillus* represents the most prevalent ectoparasite species with (82.67% ± 3.92) followed by *Coloceras piageti* (22% ± 3.35) and *Argas* spp. (20% ± 1.91) and a small population of mites represented by *Dermanyssus* spp. (4.67% ± 1.59) also *Ornithonyssus bacoti* (1.33% ± 1.28) (Table 3 + legend). Infestations, separated by species, sex and types, are indicated in Table 4. The Collared doves had a higher prevalence of single infestations (50%), compared with double (36.66%), triple (9.33%) and quadruple infestations (1.33%). None of the young chicks (4) (2.66%) was infested.

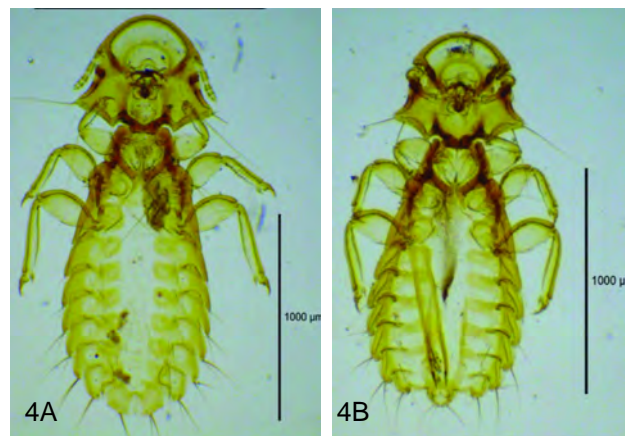
The difference in the prevalence of single and mixed infestations was significant (p=0.021). From 91 males and 55 females:



**Figures 3 A & B**  
*Coloceras britannicum*, **A.** Female, **B.** Male.  
*Coloceras britannicum*, **A.** Femelle, **B.** Mâle.



**Figures 2 A & B**  
*Columbicola bacillus*, **A.** Male, **B.** Female.  
*Columbicola bacillus*, **A.** Mâle, **B.** Femelle.

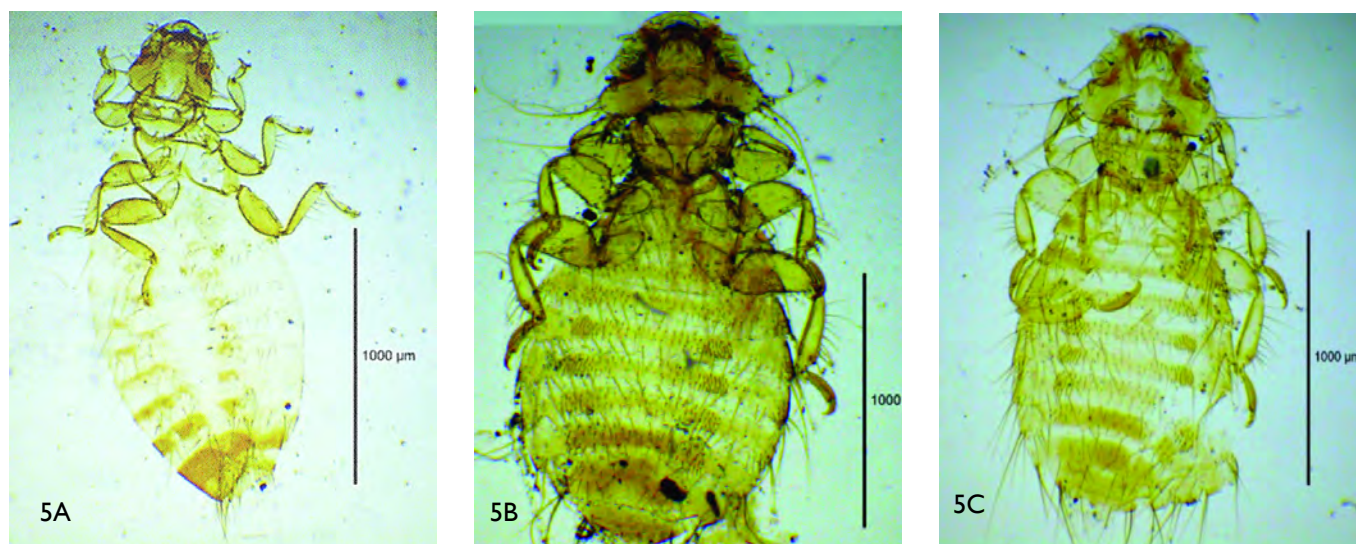


**Figures 4 A & B**  
*Coloceras britannicum*, **A.** Female, **B.** Male.  
*Coloceras britannicum*, **A.** Femelle, **B.** Mâle.

**Table 3**

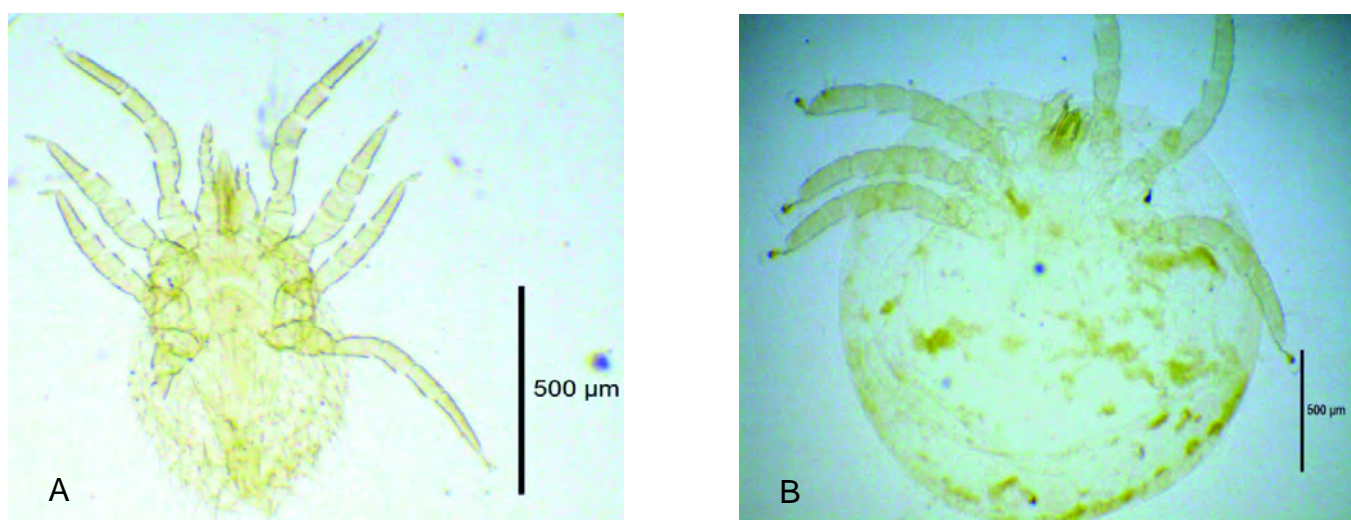
Parasitological parameters for the host dove *S. decaocto*.  
 Paramètres parasitologiques de l'hôte tourterelle *S. decaocto*.

Order/ common name	Species	Host infection/ examined	Number of specimens	Infestation Prevalence (%) ± SE	Infestation Relative Abundance (%) ± SE	Infestation Abundance ± SE
<i>Phthiraptera</i> <b>(Lice)</b>	<i>Columbicola bacillus</i>	124/150	324	82.67 ± 3.92	69.52 ± 4.73	2.24 ± 0.17
	<i>Coloceras piageti</i>	33/150	48	22 ± 3.35	11.57 ± 2.64	0.33 ± 0.05
	<i>Hohorstiella modesta</i>	12/150	16	8 ± 2.66	4.48 ± 1.88	0.11 ± 0.04
	<i>Hohorstiella</i> spp	14/150	14	9.33 ± 2.93	3.28 ± 1.43	0.09 ± 0.03
	<i>Bonomiella concii</i>	5/150	6	3.33 ± 3.12	1.99 ± 1.01	0.07 ± 0.04
<i>Diptera</i> <b>(Flies)</b>	<i>Pseudolynchia canariensis</i>	6/150	6	4 ± 1.72	1.36 ± 0.52	0.05 ± 0.02
<i>Ixodida</i> <b>(Ticks)</b>	<i>Argas</i> spp	30/150	38	20 ± 1.91	8.96 ± 1.47	0.27 ± 0.02
<i>Mesostigmata</i> <b>(Mites)</b>	<i>Dermanyssus</i> spp	7/150	8	4.67 ± 1.59	2.30 ± 0.96	0.06 ± 0.02
	<i>Ornithonyssus bacoti</i>	2/150	5	1.33 ± 1.28	2.12 ± 1.41	0.05 ± 0.03
S = 4	S = 9	S : Total richness		SE: Standard error		



**Figures 5**

**A.** *Bonomiella concii*, Female, **B.** *Hohorstiella* spp. Female and **C.** *Hohorstiella modesta*, Female.  
**A.** *Bonomiella concii*, Femelle, **B.** *Hohorstiella* spp. Femelle et **C.** *Hohorstiella modesta*, Femelle.



**Figures 6**

**A.** *Ornithonyssus bacoti* (Mite) and **B.** *Argas* spp., larva (Tick).  
**A.** *Ornithonyssus bacoti* (acarien) et **B.** *Argas* spp., larve (tique).



**Table 4**

Prevalence of negative, single and mixed ectoparasite infestations on *S. decaocto* adults  
 Prévalence des infestations des ectoparasites négatifs, uniques et mixtes sur les adultes de *S. decaocto*.

Infestation type	Parasites	Frequency of occurrence (%)					
		Total	%	Male (91)		Female (55)	
None (unharmed)	None	4	2.66				
	<i>Coluba</i>	65		36.26%	33	32	58.18%
Single infestation	<i>Hohspp</i>	2		1.10%	1	1	1.82%
	<i>Hohmod</i>	3		3.30%	3	0	0.00%
	<i>Colo pia</i>	5		3.30%	3	2	3.64%
	Total	75	50	43.96%	40	35	63.64%
Double infestation	<i>Hohspp</i> + <i>Argas</i> spp	1		1.10%	1	0	0.00%
	<i>Colo pia</i> + <i>Argas</i> spp	1		1.10%	1	0	0.00%
	<i>Hohspp</i> + <i>Bon c</i>	1		1.10%	1	0	0.00%
	<i>Colo pia</i> + <i>Bon c</i>	1		0.00%	0	1	1.82%
	<i>Colo pia</i> + <i>Hohmod</i>	1		1.10%	1	0	0.00%
	<i>Coluba</i> + <i>Bon c</i>	1		1.10%	1	0	0.00%
	<i>Coluba</i> + <i>Pseucan</i>	4		1.10%	1	3	5.45%
	<i>Coluba</i> + <i>Dermanyssusspp</i>	3		2.20%	2	1	1.82%
	<i>Coluba</i> + <i>Argas</i> spp	21		21.98%	20	1	1.82%
	<i>Coluba</i> + <i>Hohspp</i>	5		4.40%	4	1	1.82%
	<i>Coluba</i> + <i>Hohmod</i>	3		1.10%	1	2	3.64%
	<i>Coluba</i> + <i>Colo pia</i>	13		7.69%	7	6	10.91%
Total		55	36.66	43.97%	40	15	27.28%
Triple infestation	<i>Coluba</i> + <i>Argasspp</i> + <i>Ornibac</i>	2		2.20%	2	0	0.00%
	<i>Coluba</i> + <i>Colopia</i> + <i>Hohospp</i>	1		1.10%	1	0	0.00%
	<i>Coluba</i> + <i>Colopia</i> + <i>Hoho mod</i>	2		1.10%	1	1	1.82%
	<i>Colopia</i> + <i>Hoh spp</i> + <i>Pseucan</i>	2		2.20%	2	0	0.00%
	<i>Colopia</i> + <i>Hoh mod</i> + <i>Dermanyssus spp</i>	1		0.00%	0	1	1.82%
	<i>Colopia</i> + <i>Hoh mod</i> + <i>Argasspp</i>	1		1.10%	1	0	0.00%
	<i>Coluba</i> + <i>Bon c</i> + <i>Dermanyssus spp</i>	1		1.10%	1	0	0.00%
	<i>Coluba</i> + <i>Bon c</i> + <i>Argas</i> spp	1		0.00%	0	1	1.82%
	<i>Coluba</i> + <i>Colo pia</i> + <i>Dermanyssus spp</i>	2		1.10%	1	1	1.82%
	<i>Coluba</i> + <i>Colopia</i> + <i>Argas</i> spp	1		1.10%	1	0	0.00%
Total		14	9.33	11%	10	4	7.28%
Quadruple infestation	<i>Coluba</i> + <i>Colopia</i> + <i>Hoh spp</i> + <i>Argas</i> spp	1		1.10%	1	0	0.00%
	<i>Colopia</i> + <i>Hoh mod</i> + <i>Hoh spp</i> + <i>Argas</i> spp	1		0.00%	0	1	1.82%
	Total	2	1.33	1.10%	1	1	1.82%
TOTAL		150	100%	100%	91	55	100%

*Coluba*: *Columbicola bacillus*, *Hoh spp*: *Hohorstriella* spp, *Bon c*: *Bonomiella concii*, *Hoh mod*: *Hohorstiella modesta*, *Colo pia*: *Coloceras piageti*, *Pseucan*: *Pseudolynchia canariensis*, *Orni bac*: *Ornithonyssus bacoti*, *Hoh spp*: *Hohorstriella* spp

- single infestation was represented by (43.96%) (40) males, and (63.64%) (35) females;
- double infestation was represented by (43.97%) (40) males, and (27.28%) (15) females;
- triple infestation was represented by (11%) (10) males, and (7.28%) (4) females;
- quadruple infestation was represented by 1.10% (1) male, and (1.82%) (1) female.

The Chi-square test revealed that the difference in the prevalence of infestation on males and females of *S. decaocto* was significant ( $p < 0.05$ ).

In the case of *S. turtur arenicola*, the most prevalent species

was *Columbicola bacillus* with (85.33% ± 2.76) followed by *Coloceras britannicum* (28.67% ± 4.07), *Argas* spp (13.66% ± 2.85), and a small population of mites represented by *Dermanyssus* spp (2 % ± 1.18) (Table 5).

As seen in Table 6 concerning Turtledoves, the type of infestation was dominated by single infestation with the higher prevalence (68.67%), compared with double (26.67%) and triple infestations (4.67%). On the other hand, young chicks (9, i.e. 6%) remain uninfected (Table 6). The difference in the prevalence of single and mixed infestations was not significant ( $p=0,781$ ) ( $p > 0,05$ ). From one hundred and seven males and thirty-four females:

**Table 5**

List of ectoparasites and parasitological parameters for the dove *S. turtur arenicola* species.  
 Liste des ectoparasites et les paramètres parasitologiques associés à l'espèce de tourterelle *S. turtur arenicola*.

Order/ Common Name	Species	Infestation/ examined	Name of specimens	Infestation Prevalence (%) ± SE	Infestation Relative abundance (%) ± SE	Infestation Abundance ± SE
Phthiraptera (Lice)	<i>Columbicola bacillus</i>	128/150	294	85.33 ± 2.76	77.06 ± 3.60	2.12 ± 0.13
	<i>Coloceras britannicum</i>	43/150	65	28.67 ± 4.07	16.60 ± 2.20	0.45 ± 0.05
Ixodida (Tick)	<i>Argas</i> spp	20/150	27	13.66 ± 2.85	6.55 ± 1.70	0.18 ± 0.05
Mesostigmata (Mites)	<i>Dermanyssus</i> spp	3/150	3	2 ± 1.18	0.63 ± 0.42	0.02 ± 0.01
S = 3	S = 4	S: Total wealth		SE: Standard error		

**Table 6**

Prevalence of negative, single and mixed ectoparasite infestations on host *S. turtur* from male and female in the south-eastern Oases of Algeria (Biskra) (n=150) (Female=34) (Male=107) (young chick = 9 are Unharmed).  
 Prévalence des infestations négatives, uniques et mixtes d'ectoparasites sur l'hôte *S. turtur* chez les mâles et les femelles dans les Oasis du sud-est algérien (province de Biskra) (n = 150) (Femelle = 34) (Mâle = 107) (les jeunes poussins = 9 sont indemnes).

Infestation type	Parasites	Frequency of occurrence (%)					
		Total	%	Male (107)		Female (34)	
None (Unharmed)	None	9	6				
Single infestation	<i>Colu ba</i>	83		59.81%	64	19	55.88%
	<i>Colo brit</i>	6		4.67%	5	1	2.94%
	<i>Argas</i> spp	5		2.80%	3	2	5.88%
Total		94	68.67	67.28%	72	22	64.70%
Double infestation	<i>Colu ba</i> + <i>Colo brit</i>	29		19.63%	21	8	23.53%
	<i>Colu ba</i> + <i>Argas</i> spp	9		5.61%	6	3	8.65%
	<i>Colo brit</i> + <i>Argas</i> spp	1		0.93%	1	0	0.00%
	<i>Colu ba</i> + <i>Dermanyssus</i> spp	1		0.93%	1	0	0.00%
Total		40	26.67	27.10%	29	11	32.35%
Triple infestation	<i>Colu ba</i> + <i>Colo brit</i> + <i>Argas</i> spp	5		3.74%	4	1	2.94%
	<i>Colu ba</i> + <i>Colo brit</i> + <i>Dermanyssus</i> spp	2		1.87%	2	0	0.00%
	<b>Total</b>	<b>7</b>	<b>4.67</b>	<b>5.61%</b>	<b>6</b>	<b>1</b>	<b>2.94%</b>
		150	100%	100%	107	34	100%

*Colu ba*: *Columbicola bacillus*, *Colo brit*: *Coloceras britannicum*

- single infestation was represented by (67.28%) (72) males, and (64.70%) (22) females ;
- double infestation was represented by (27.10%) (29) males, and (32.35%) (11) females ;
- triple infestation was represented by (5.61%) (6) males, and (2.94%) (1) female.

However, the Chi-square test revealed that the difference in the prevalence of infestation between males and females of *S. turtur* was not significant ( $p > 0.05$ ).

The highest ectoparasite infestation abundance throughout the two years of study was observed from April to July. On *S. turtur*, the ectoparasites *Columbicola bacillus*, *Coloceras britannicum* and *Argas* spp. showed two peaks in 2017 in May and June, but in 2018, they were in April and June (Figure 7).

In the case of *S. decaocto*, peaks of the ectoparasites *Columbicola bacillus*, *Coloceras piageti* and *Argas* spp. were ob-

served during 2017 in May and July, but in 2018, they were observed in April and June (Figure 8).

## Discussion

According to PETERS (1930), lice are the most common parasites detected on birds. The lice species belonging to the genera *Bonomiella*, *Coloceras* and *Columbicola* parasitize the Columbiform hosts of (PRICE *et al.*, 2003). In Algeria, few studies have been performed on dove ectoparasites (DJELMOUDI *et al.*, 2014, BAZIZ-NEFFAH *et al.*, 2015 and BENJOUDI *et al.*, 2018), and they reported the lice species *Columbicola columbae* on rock pigeon, collared dove and chukar partridge. In the present study, six species belonging to the four genera of lice were detected, and *Columbicola bacillus* was the most abundant species on both host doves.

This louse species has been found on numerous species of the genus *Streptopelia*, and on *S. decaocto* throughout Europe, Middle East, Central Asia, and Africa (EICHLER, 1952; ADAMS *et al.*, 2005; DIK, 2010; SINGH *et al.*, 2018; ADLY *et al.*, 2019). *Columbicola bacillus* was previously recorded in Europe on species host *S. turtur turtur* (ADLY *et al.*, 2019). The genus *Coloceras* is represented by two different species, and each dove has its own species (CLAYTON *et al.*, 2008), which suggests that most chewing lice are host-specific and the new relation for Algeria *Coloceras britannicum*- *S. turtur arenicola* can be explained by geographical distribution of louse species that is similar to its host species. The same association (*Coloceras piageti*-*S. decaocto*) detected as new record in Algeria was previously reported in Turkey and Egypt by DIK *et al.* (2013) and ADLY *et al.* (2019). Besides these species, in India, *Coloceras hilli* was reported from collared dove (SING *et al.*, 2013, 2018). In Pakistan, *Coloceras piageti* was found on other Columbidae species (NAZ *et al.*, 2012).

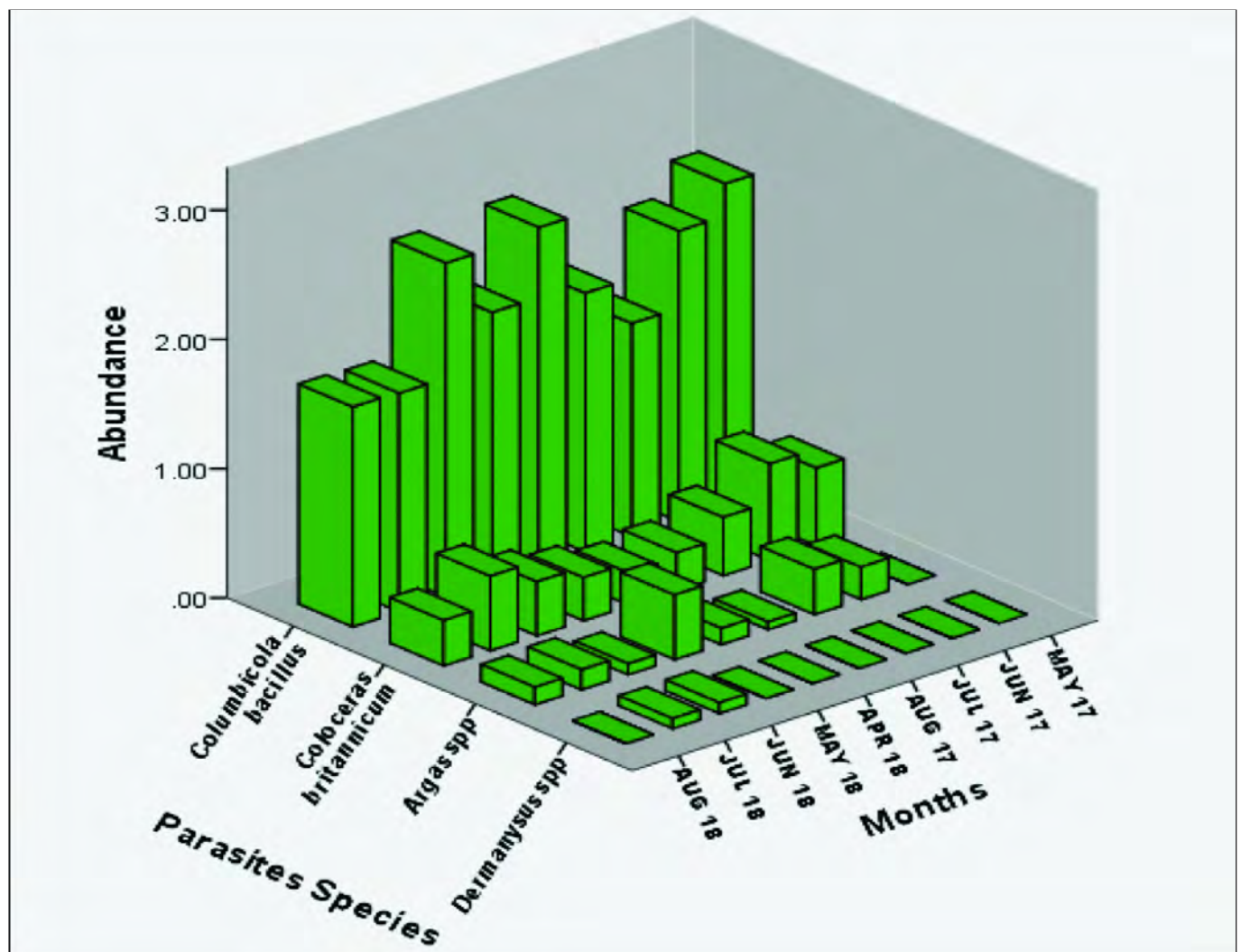
The lice species of the genus *Bonomiella* parasitize bird species belonging to the family Columbidae (Aves, Columbiformes) and the relation *Bonomiella concii*-*S. decaocto* was known in England (CICCHINO & GONZÁLEZ-ACUÑA, 2012). SING *et al.* (2012) reported that *Bonomiella concii* (Eichler, 1947) was found on *S. decaocto decaocto* in India.

We found also two lice species: *Hohorsteilla modesta* and *Hohorsteilla* spp.. *Hohorsteilla* spp. was previously detected on collared doves in Algeria by BENJOUDI *et al.* (2018), but *H. modesta* is recorded for the first time in Algeria.

Mite species such as *Dermanyssus* spp. and *Ornithonyssus bacoti* are very common on birds, and transmission may be through contact with infested animals, such as cats and rats (BOWMAN *et al.*, 2002; MORO *et al.*, 2005). In this study, the collared dove *S. decaocto* is the main harbor of ectoparasite species belonging to different orders (9/10) when compared to migratory dove *S. turtur arenicola* (4/10). The former had higher infestation rates of lice compared with the latter. Our results are the opposite to those of GIRIŞGIN *et al.* (2013) in Turkey and ROSE (2005) in Australia.

Diversity of ectoparasite assemblages may be related to many factors, which may include home range, behaviour, size and roosting habits of the host. The doves exploit a wide range of ecological niches for feeding, roosting, nesting (sedentary or migratory) and territoriality, where they may have been exposed to ectoparasites (GOODWIN, 1983; ADANG *et al.*, 2009).

Our results are similar to ADANG *et al.* (2009) in Nigeria for *S. senegalensis* Linnaeus (1766). The high prevalence of



**Figure 7**

Ectoparasite infestation abundance of *S. turtur* during the period 2017-2018.  
L'abondance de l'infestation de *S. turtur* par des ectoparasites pendant la période 2017-2018.



single infestation of doves compared with double and triple infestations suggests a form of competition (KENNEDY, 1975; ADANG *et al.*, 2009) in which resources shared by the ectoparasites determine the establishment of single or mixed infestations. This may also suggest an innate strategy of the ectoparasites to avoid competition on the two host doves. Similar results were signalled by ADANG *et al.* (2009) in Nigeria on *S. senegalensis*. A non-significant difference of single infestation according to gender was found in the case of *S. turtur* and is in agreement with the observations of SENLIK *et al.* (2005), ADANG *et al.* (2008) and ADANG *et al.* (2009), but with regard to *S. decaocto*, the findings are contrary to those found in Turkey and Nigeria, respectively, by SENLIK *et al.* (2005) and ADANG *et al.* (2008). The difference between dove species indicates that sedentary doves are more exposed to infestation than migratory doves, without the same level of infestation? in both sexes.

The highest abundance of lice ( $2.24 \pm 0.17$  *Columbicola bacillus*,  $0.33 \pm 0.05$  *Coloceras piageti*,  $0.11 \pm 0.04$  *Hohorstiella modesta*,  $0.09 \pm 0.03$  *Hohorstiella* spp and  $0.07 \pm 0.04$  *Bonomiella concii*) compared to ticks ( $0.27 \pm 0.02$  *Argas* spp), mites ( $0.06 \pm 0.02$  *Dermanyssus* spp,  $0.05 \pm 0.03$  *Or-*

*nithonyssus bacoti*) and flies ( $0.05 \pm 0.0$  *Pseudolynchia canariensis*) and the dominance of *Columbicola bacillus* lice species on *S. decaocto* [this is not a sentence – it is missing a verb]. However, on *S. turtur*, the highest abundance of lice ( $2.12 \pm 0.13$  *Columbicola bacillus* /  $0.45 \pm 0.05$  *Coloceras britannicum*) compared to ticks ( $0.18 \pm 0.05$  *Argas* spp), mites ( $0.02 \pm 0.01$  *Dermanyssus* spp) and the dominance of *Columbicola bacillus* may be explained by the relatively short life-cycle and a rapid proliferation of this parasite in sufficient resources (density-dependent effect) (DIK, 2006).

The two dove species were infested throughout the years of study (2017 and 2018) by the same ectoparasite species. The results showed synchronized infestation of the dominant ectoparasite species during April, May and June in both years.

### Conclusion

In summary, nine species of ectoparasites – *Columbicola bacillus*, *Coloceras piageti*, *Hohorstiella modesta*, *Hohorstiella* spp, *Bonomiella concii*, *Pseudolynchia canariensis*, *Argas* spp, *Der-*

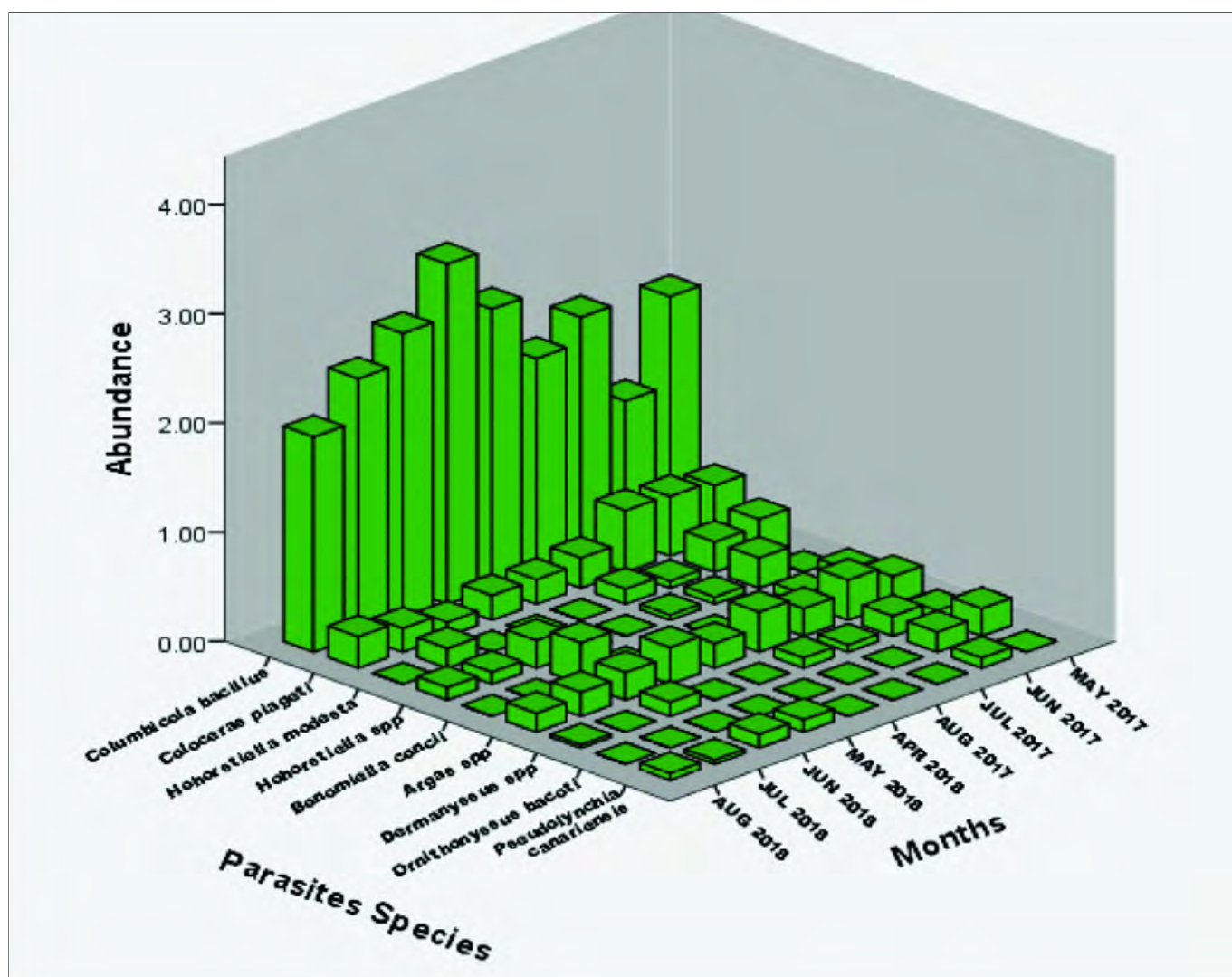


Figure 8

Ectoparasite infestation abundance of *S. decaocto* during the period 2017-2018.  
L'abondance de l'infestation de *S. decaocto* par des ectoparasites pendant la période 2017-2018.

*manyssus* spp, and *Ornithonyssus bacoti* – were collected from *S. decaocto*. While four species were found on the host *S. turtur* – *Columbicola bacillus*, *Coloceras britannicum*, *Argas* spp and *Dermanyssus* spp in south-eastern Oases of Algeria (Biskra). The dominant species were lice with relative abundances of 90.84% on *S. decaocto* and 93.66% on *S. turtur*. Data obtained in this study suggest that in Algeria (Biskra) there are specific lice for each host dove: *Coloceras piageti* – *S. decaocto* and *Coloceras britannicum* – *S. turtur*. This study gives the opportunity to enrich the Algerian fauna of ectoparasites. These results not only encourage more local contributors to join this study about parasitic arthropods from many birds, but also has its impact on research in the north of Africa consequently the whole world.

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