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Survey of ruminant infestation by lice in north-east Algeria

Basma Ouarti^{a,b*}, Souad Righi^d, Mamadou Lamine Tall^{b,c}, Mohamed Nadir Meguini^{d,e}, Khaoula Ouarti^e, Philippe Parola^{a,b}, Ahmed Benakhla^d.

^a Aix Marseille Univ, IRD, AP-HM, SSA, VITROME, Marseille, France.

^b IHU-Méditerranée Infection, Marseille, France.

^c Aix-Marseille University, IRD, AP-HM, Microbes, MEPHI, 13385 Marseille CEDEX 05, France.

^d Université Chadli Bendjdid, Département des sciences Vétérinaire, El-Tarf 36000, Algeria.

^e Institut des Sciences Vétérinaire et Agronomiques, Université Mohamed Cherif Messaadia, Souk-Ahras 41000, Algeria.

Informations	Abstract
Keywords : Lice Phthiraptera Ruminants Souk-Ahras Guelma *Correspondance : basmaveto@gmail.com	Lice are highly host specific insects belonging to the order of phthiraptera. The medical importance of lice is not only related to the damage caused by their stings or bites but also to their potential ability to transmit some pathogens. The aim of this study was to update the available information on species of lice encountered in ruminants in the northeast of Algeria. A total of 16 sheep, 13 cattle and 12 goats were examined for the presence of lice. The study was conducted from 2014 to 2015 in four livestock farms. In the region of Guelma, the results revealed the following prevalence of infection: 100%, 60% and 66.66% in cattle, sheep and goats, respectively, and at Souk-Ahras the prevalence was 71.41%, 63.63%, and 66.66% in cattle, sheep and goats respectively. The presence of a single species in sheep <i>Bovicola ovis</i>, four species in cattle <i>B. bovis</i>, <i>Linognathus vituli</i>, <i>Haematopinus eurysternus</i>, <i>Solenopotes capillatus</i> and two species in goats <i>B. caprae</i>, <i>Linognathus africanus</i> was observed. The largest infestations were recorded during the winter season. Infestations were also more pronounced in females than males. The results of this study will contribute towards the control of lice and the diseases transmitted by them.

1. Introduction

Ectoparasites, represent undoubtedly a non-negligible economic scourge for ruminant livestock farming in Africa. They include a wide variety of parasitic arthropods belonging to the class of Arachnida (order of Acari (Ticks and mites) or to the class of Insecta (orders of Siphonaptera (Fleas), Phthiraptera (sucking and chewing lice) and Diptera (suborders of nematocera and brachycera)[1]. Lice are among the ectoparasites that are frequent in livestock farming in Algeria. They are obligate wingless insects that parasitize mammals and birds [1]. Nearly five thousand lice species are known as obligate, highly specific and permanent parasites of birds and mammals [2, 3].

Lice fall within the order of Phthiraptera, which is divided into four suborders, namely anoplura, amblycera, ischnocera, and rhynchophthirina [4]. Anoplura lice (Sucking lice) feed exclusively on mammalian blood (requiring several daily meals) [5] and they can lead to economic losses for livestock, skin damage and anaemia[6].

Mallophaga lice infests mostly birds and incidentally mammals and feed on feathers, skin, blood or secretions from their hosts. They compose the remaining three sub-orders, namely amblycera, ischnocera, and rhynchophthirina [7].

Currently, lice identification is primarily morphological and based on dichotomous keys, which consider the host animal from which the louse was collected [9]. In the world the main species of lice that infest mammals are (*L. vituli* (*Linognathus vituli*), *S. capillatus* (*Solenopotes capillatus*), *H. eurysternus* (*Haematopinus eurysternus*), *H. quadripertusus* (*Haematopinus quadripertusus*) and *B. bovis* (*Bovicola bovis*)) hosted in cattle, (*B. ovis* (*Bovicola ovis*), *L. ovillus* and *L. stenopsis* (*Linognathus stenopsis*)) found in the sheep and (*B. caprae* (*Bovicola caprae*) and *L. africanus* (*Linognathus africanus*)) in goats.

Lice infestations are more marked in winter, and there is intense multiplication of parasites in this season. This is due to several reasons: More dense coat in winter, Promiscuity of animals under the effect of cold undernourishment, and various

stresses. Contamination is essentially direct, but it can also be indirect through the environment or for example by the tufts of wool transported by the birds [10]. Lice are potential biological or mechanical vectors for many infectious agents, these insects can play a role in the transmission of pathogens from one host to another [11]. We notice that DNA of some bacterial have been detected in animal lice from susceptible hosts citing examples of *Rickettsia slovaca*, *Acinetobacter* species and *Anaplasma platys* detected in wild boar, domestic animals and dogs respectively [12–14]. The detection of these DNAs is not sufficient to say that lice are vectors, but they may play a role in the transmission of pathogens. Considering the importance of the subject, it is more interesting to conduct a study on these Phthiraptera through surveys carried out in the North East of Algeria in order to update information on the species of lice found in this region and to study the influence of receptivity and sensitivity, namely sex and season.

2. Material and methods

2.1. Study area

This study was carried out on four private farms. Farm 1 and 2 are located in the region of Guelma (36 ° 27'0 "N, 7 ° 25'0" E) while Farm 3 and 4 are located in Souk-Ahras region (36 ° 17'11 "N, 7 ° 57'4" E) (Fig. 1). The region of Souk-Ahras is characterised by a sub-humid climate in the north and semi-arid in the south. There is up to 700 mm of rainfall in the north and 250 mm in the south, with an average of 550 mm/year and snowfall at altitude. The Guelma region is characterised by a sub-humid climate in the centre and the north, and semi-arid in the south. Rainfall ranges from 400 to 500 mm/year in the south to nearly 1,000 mm/year in the north (Fig. 1).



Fig.1: Location of the study area (Souk-Ahras and Guelma regions) and selected farms on the map of Algeria.

2.2. Sample collection

Lice were predominantly collected during the winter period, when they are most active. The survey was performed between 10 October 2014 and 29 April 2015, covering three seasons (winter, autumn,

spring). We collected lice from sheep, goats and cattle from four farms in the Souk-Ahras and Guelma regions in Algeria, namely the Yelfouf farm and the Djouimaie farm in the commune of Oued Cham in the region of Guelma and the Djebrane farm and Dababi farm that are located in the municipality of Machrouha in the Souk-Ahras region (Fig. 1).

The animals were carefully inspected by examining the different parts of the body surface to detect the presence of lice. After detecting lice in cattle and goats, they were brushed with a comb for between 10 and 30 minutes depending on the infestation's intensity. Sheep were brushed in the opposite direction to that of the animal's wool, and the skin was visually inspected for lice. Lice collected from the same animal were recovered and stored in identified tubes -20°C to perform additional analyses.

2.3. Identification of lice

The identification of lice took place in the Parasitology Laboratory of the Department of Veterinary Sciences, University of El Tarf in Algeria, using a binocular loupe and confirmed in a laboratory in Marseille, France.

Each louse was rinsed with ethanol (70%) for 15 minutes and then with distilled water for one minute. All body parts of the collected lice were examined under a microscope at x56 magnification (Zeiss Axio Zoom. V16, Zeiss, Marly-le-Roi, France) based on the morphological identification keys established by Wall and Shearer [15] and Pajot [9]. In generally blood sucking lice are morphologically recognisable by the head being generally narrower than the prothorax, as well as by their bite-sucking type mouth parts [15]. They cannot spend more than four days without eating [10]. They move little and very slowly on the skin to find the ideal temperature (29-30°C) [16]. And mallophagous lice are discernible by their head which is wider than their prothorax and have crusher-type mouthpieces located on the head's ventral surface [15]. They move more quickly on the skin surface than anoplura [10].

A part of these lice was identified by molecular biology and by mass spectrometry (MALDI-TOFMS) the details of the protocol were mentioned in a previous study [4].

2.4. Statistical analysis

The rstudio software was used to perform statistical analyses. On the other hand the statistical tests and the graphics [17, 18] were made using the package ggplot2 and ggpubr respectively (<https://cran.rproject.org/web/packages/ggplot2/index.html>) and (<https://cran.rproject.org/web/packages/ggpubr/index.html>).

Whatever test is used a difference is declared significant if $p \leq 0.05$.

3. Results and discussion

The results of the survey conducted in the region of Guelma revealed 3 out of 5 sheep (60%), 6 out of 6 cattle (100%) and 4 out of 6 goats (66.66%) were infested with lice (**Table 2**). In the Souk-Ahras region the infestation rates noted were as follows 7/11 (63.63%) in sheep, 5/7 (71.42%) in cattle, and 4/6 (66.66%) in caprae (**Table 3**). The results of the morphological identification revealed the presence of seven species of mammalian lice including one species in sheep (*B. ovis*), four in cattle (*B. bovis*, *L. vituli*, *S. capillatus* and *H. eurytenuis*) and two species in goats (*B. caprae*, *L. africanus*) (**Fig. 2**).

In total we examined 16 sheep, 13 cattle and 12 goats located at the four farms. In the region of Guelma our results revealed a prevalence of infestation for farms 1 and 2 respectively: 50%, 50% in cattle, 33.33%, 66.66% in sheep, and 75%, 25% in goats. For the Souk-Ahras region, we have marked the following prevalence for farms 3 and 4 respectively: 40%, 60% in cattle, 57.14%, 42.85% in sheep and 50%, 50% in goats (**Table 1**).

Table. 1: Lice infestation in sheep, cattle and goats.

Farms	Species	Guelma	Souk-Ahras
Farm 1	Cattle	50%	/
	Sheep	33.33%	/
	Goat	75%	/
Farm 2	Cattle	50%	/
	Sheep	66.66%	/
	Goat	25%	/
Farm 3	Cattle	/	40%
	Sheep	/	57.12%
	Goat	/	50%
Farm 4	Cattle	/	60%
	Sheep	/	42.85%
	Goat	/	50%

In Guelma, the infestation rate is higher in winter 66.66% in cattle and sheep, 33.33% in spring and in autumn in cattle and sheep respectively. Concerning goats, we have recorded an infestation rate of 50% in spring, 25% in autumn and winter.

Concerning the region of Souk Ahras, the cattle infestation rates of 40% in winter and spring and 20% in autumn were observed. For sheep, we noted 14.28%, 57.14% and 28.57% in autumn, winter and spring respectively and for goats 50% in spring and 25% in autumn and winter (Fig.3).

In figure 3, as can be observed from, the number of infestation is important during the winter but there

is no effect of the season on the infestation at the 5% threshold.

We noticed much higher rates of infestation in females than in males in both regions. On Guelma the infestation rates were as follows (Female versus male): 83.33% vs. 16.66%, 66.66% vs. 33.33%, and 50% vs. 50% in cattle, sheep and goats respectively. On Souk-Ahras the infestation rates were as follows (Female versus male): 80% vs. 20%, 85.71% vs. 14.28% and 75% vs. 25% in cattle, sheep and goats respectively (Fig. 4).

Table 2: Lice infestation in ruminants in northeastern Algeria (Guelma).

Host	Species	Number of infested cattle and rate infestation (%)	Percentage of average infestation rate (%)	Lice Number	Sex	season
cattle	B. bovis	1(16.66)	100	201	Female	Winter
	B. bovis	1(16.66)		100	Male	Winter
	L. vituli	1(16.66)		48	Female	Winter
	H. eurytenuis	1(16.66)		4	Female	Winter
	H. eurytenuis	1(16.66)		15	Female	Spring
	S. capillatus	1(16.66)		60	Female	Spring
Total		6		428		
Sheep	B. ovis	1(20)	60	48	Female	Autumn
	B. ovis	1(20)		39	Male	Winter
	B. ovis	1(20)		10	Female	Winter
	B. ovis	1(20)		10	Female	Winter
Total		3		117		
Goat	B. caprae	1(16.66)	66.66	20	Male	Autumn
	B. caprae	1(16.66)		35	Female	Winter
	B. caprae	1(16.66)		8	Female	Spring
	B. caprae	1(16.66)		4	Male	Spring
Total		4		67		

Fig.2: Pictures of lice species with their sex included in this study 1. *Bovicola bovis* ♂, 2. *Bovicola ovis* ♂, 3. *Linognathus vituli* ♀, 4. *Linognathus africanus* ♀, 5.

Solenopotes capillatus ♂, 6. *Bovicola caprae* ♀, 7. *Haematopinus eurysternus* ♀.

Host	Species	Number of infested cattle and rate infestation (%)	Percentage of average infestation rate (%)	Lice Number	Sex	Seasons
cattle	<i>B. bovis</i> *	1(14.28)	71.42	15	Female	Autumn
	<i>B. bovis</i>	1(14.28)		12	Female	Winter
	<i>B. bovis</i>	1(14.28)		10	Male	Winter
	<i>B. bovis</i>	1(14.28)		8	Female	Spring
	<i>B. bovis</i>	1(14.28)		5	Female	Winter
Total	/	5	7	50	/	/
Sheep	<i>B. ovis</i>	1(9.09)	63.63	100	Female	Autumn
	<i>B. ovis</i>	1(9.09)		150	Male	Winter
	<i>B. ovis</i>	1(9.09)		100	Female	Winter
	<i>B. ovis</i>	1(9.09)		80	Female	Winter
	<i>B. ovis</i>	1(9.09)		50	Female	Winter
	<i>B. ovis</i>	1(9.09)		48	Female	Spring
Total	/	7	11	570	/	/
Goat	<i>B. caprae</i>	1 (16.66)	66.66	15	Male	Autumn
	<i>B. caprae</i>	1 (16.66)		20	Female	Winter
	<i>L. africanus</i>	1 (16.66)		5	Female	Spring
	<i>L. africanus</i> *	1 (16.66)		2	Female	Spring
Total	/	4	6	42	/	/

*Lice identified by molecular biology and mass spectrometry.

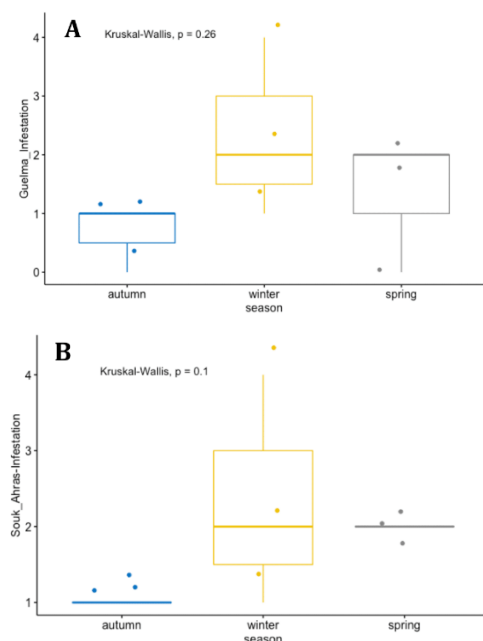


Fig.3: Distribution of the number of lice infestations in the two regions Guelma (A) and Souk Ahras (B) according to the season.

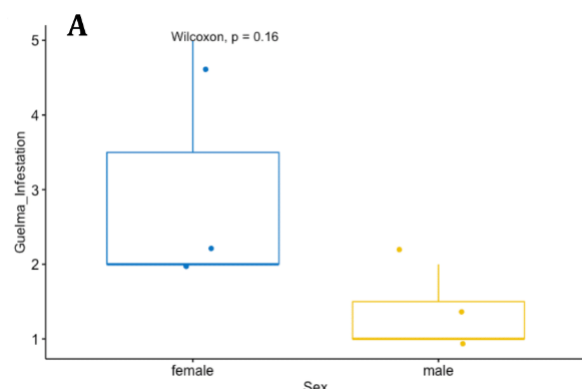


Fig.4: Distribution of the number of lice infestations in the two regions Guelma (A) and Souk Ahras (B) according to sex.

Figure 4 shows that females are more affected in the two regions, but there is not at the 5% threshold the effect of sex on the number of infestations for the two regions.

The prevalence of the infestations recorded in our study is higher compared to the work carried out by Meguini *et al.*, in the regions of Souk-Ahras and Guelma [19]. These authors reported rates of 63%, 39% and 53% respectively in cattle, sheep and goats in the Souk-Ahras region and 27%, 24% and 30% in cattle, sheep and goats in the Guelma region [19].

The differences in prevalence found in the studies carried out in the Souk-Ahras and Guelma regions can be attributed to various factors including the breeding conditions, the state of health of the animals examined, and their diet quality. In Tunisia, Gharbi *et al.*, reported a prevalence of 4.7% in cattle [20].

Identification by mass spectrometry (MALDI-TOF MS) has become a new tool for identifying arthropods [21]. MALDI-TOF MS is an efficient method for the identification of lice [4].

Only one species of mallophagan lice has been identified in sheep, one species of anoplura and one of mallophagan in goats and three species anoplura and one mallophagan in cattle. Our results are partly in line with those reported by Meguini *et al.*, 2018 who, in addition to these species, reported the presence of *L. ovillus* in sheep [19]. *B. ovis* was the most frequently encountered louse in our study (Fig.5). We take note that several species of lice can coexist on the same animal. For example, in small ruminants *B. ovis*, *L. ovillus* and *L. stenopsis* can coexist [22].

Molecular and mass spectrometric identification carried out on three species of lice has been successfully carried out (Table 2-3).

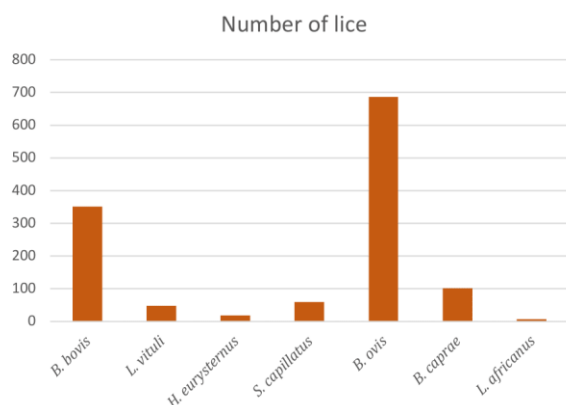


Fig.5: A diagram represents the distribution of species in the two regions Guelma and Souk-Ahras.

In Tunisia, Gharbi et al., 2013 and in Algeria, Meguini et al., 2018, reported also the predominance of *B. bovis*. The predominance of this species can be explained by the fact that this chewing louse is considered to be more adapted to the climate with dry winters and a tropical climate is unfavourable for its development [23].

Three species of anoplura lice (*L. vituli*, *H. eurysternus* and *S. capillatus*) were identified in our cattle survey, and one species (*L. africanus*) identified in Goat. These results are consistent with the findings reported by Meguini et al., 2018, where the presence of these species was also reported. *L. vituli*, *H. eurysternus*, *S. capillatus* and *L. africanus* species are cosmopolitan but are more abundant in temperate and cold climates. In general, their distribution is the same as that of their main host (domestic livestock) and they can be found wherever livestock are raised [23]. It should be noted that even in small numbers, lice from sheep and goats can cause damage to the skin and devalue wool and hair. As a result, significant wool losses have been incurred by major wool-producing countries such as Australia, New Zealand and South Africa [24].

The study of the influence of sex on animals' infestation showed a much more marked infestation in females compared to males. This difference can be attributed to the fact that females remain more prone to infestation for physiological reasons. (gestation, parturition and lactation).

We noticed greater infestation rates during the winter. These results corroborate those noted by Gharbi et al. [20]. These results are explained by the fact that the winter temperature is much more favorable for the survival of the lice, the animal's hair is longer during this period, favoring infestation by lice, and the fact that the animals huddle together, which facilitates the transmission of the lice from one animal to another [8].

In our study, the p value was greater than the threshold of 5% but this can be explained by the fact that the sample size is small due to the constraints during collection.

Pediculosis in ruminants often reflects a more serious underlying disease or problem because the pelts of sick or undernourished animals are damaged[15].

Small infestations are generally well tolerated and pass unnoticed, but losses can be considerable in significant infestations that can affect the entire body surface and cause considerable stress and itching [10]. In addition, an animal's infestation by a larger number of biting lice can cause significant blood loss and cause anaemia, weakness, a decrease in milk production and weight gain. Hence the need to pay more attention to controlling these insects [24–26].

4. Conclusion

Very little number of works have been carried out in Algeria on lice which continue to affect the country's flocks. This work is therefore a very important step towards understanding the distribution of lice in the north-east region of Algeria.

Considering the economic and medical consequences of mammalian lice, it is imperative to identify these arthropod species in Algeria through other surveys across the country to offer new opportunities for vector surveillance.

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