

Preferential fixation sites and relative frequencies of ectoparasites at *Atelerix algirus* (Lereboullet, 1842) in a locality on the North East of Algeria

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ABSTRACT

The Algerian Hedgehog is an urban adapter that plays the role of vector and host for many parasites, causing the transmission of many pathologies. Our study consists in identifying the different ectoparasitic species according to their fixation site on the host organism and in analysing the flow of their relative frequencies according to the season and sex of the the host. The study was conducted in the locality of Berrihane from April 2017 until May 2018, where 32 field-collected hedgehogs (19 females, 13 males) were measured, weighed then dewormed. The ectoparasites were identified and counted for the calculation of the relative frequencies. The results showed two groups of ectoparasites: fleas and ticks. The taxonomic identification of the fleas allowed to characterize *Archeopsylla erinacea* but also *Ctenocephalide felis*, which confirms the tendency to urbanization of the host species. The results also show that the preferred sites of tick fixation on the body of *Atelerix algirus* are highly dependent on the anatomical characteristics of the mouthparts of ticks, and on the choice of heavily irrigated areas. Taxonomic identification of ticks characterized three species: *Rhipicephalus turanicus*, *Rhipicephalus bursa* and *Ixodes hexagonus*. Analysis of the relative frequencies of ectoparasites as a function of the seasons showed that *Rhipicephalus turanicus*, *Rhipicephalus bursa* and *Archeopsylla erinacea* are summer species, unlike *Ctenocephalide felis* which is present only in the wet season. The analysis of relative frequencies by sex, showed the same ectoparasitic species in each sex, except *Rhipicephalus Bursa* observed in males.

Key words: *Atelerix algirus*, Tick fixation site, Ticks, Fleas, Relative frequencies, Northeast of Algeria

Introduction

The study of parasitic infestation in wild Micromammals, and especially urban adapters, has experienced significant development in these last years (Gomes *et al.*, 2019; Uchida *et al.*, 2019). First, because the collection of definitive host mammals, or even intermediates, infested or infected with parasites, provides much more informations about

contemporary ecological associations than if hosts were considered regardless of parasitic wildlife (Gardner and Campbell, 1992), and others because “urban adapters” are the only species to exploit both urban and rural matrices (Hubert, 2008), and could play an important role in disease transmission cycles (Santiago *et al.*, 2007). Among these species, the hedgehog is considered as preferred model for studying parasitic - host relationships (Galglio *et al.*,

2010). Moreover, many aspects related to parasitic ecology have been extensively studied especially in the European species *Erinaceus europaeus* (Thamm *et al.*, 2012; Pfäffle *et al.*, 2014). In this study, we looked at the Algerian Hedgehog *Atelerix algirus*, whose range extends from southern France (Pyrénées-Orientales), the Spanish Mediterranean coasts, the Canary Islands, the Balearic Islands and Malta. In Africa, it is found in Algeria, Mauritania, the Spanish Sahara, Morocco, Libya, and Tunisia (Saint Giron, 1973; Aulagnier and Thevenot, 1986; Reeve, 1994). The objective of this study is to identify and analyse the preferred fixation sites of ticks at *Atelerix algirus*, and also to analyse the relative frequencies of ectoparasites according to the sex and season.

Methodology

This study was conducted from April 2017 until May 2018, in the locality of Berrihane (36° 55N / 8° 7E) in the north-east of Algeria (Fig. 1). This locality is characterized by a vivid sharps vegetation cover, dense oak and cultivated land and livestock (Fig. 2).



Fig. 1. Geographical situation of the study locality (Delimited in White) Source: <https://www.google.dz/maps/place/Berrihane/>. Modified by Senaoui (present work).

Catch campaigns were conducted due to two trips per month (24 to 48 hours intervals) for a total of 24 field trips. Since the animal is nocturnal, research starts from dusk. We proceeded during two hours of time (from 19h to 21h) to an active search of the hedgehogs while walking at constant speed (2 Km/h on average). 32 hedgehogs were caught, sexed, weighed, measured, dewormed and then released. Ectoparasites are harvested in sealed vials and fixed in ethanol at 70 °C. The parasites were



Fig. 2. Locality of Berrihane (Photo taken by Senaoui 2018)

identified by using dichotomous keys for ticks (Walker *et al.*, 2003), and for fleas (Beaucournu and Launey, 1990; Franc, 1994). We also characterized the preferential zones of the distribution of ticks on the body of 16 hedgehogs randomly selected (10 females and 6 males), after each deworming. Finally, we calculated the relative frequencies of ectoparasites (number of each ectoparasite species / number of all ectoparasite collected X 100). All results are illustrated in Microsoft Office Excel by histograms. For statistical analysis, we used Student's T-tests for the comparison of means by using Minitab 17 (2015 Edition).

Results

Preferential Tick Fixation Zones on Hedgehogs body

Our results showed that ticks attach preferentially to the lower paws (33%), followed by the anus (27%), the abdomen (13%), the ears (13%), and to a lesser extent the back and upper paws (7% for each). Spatial – temporal analysis of these data shows significant differences in tick distribution. In males, the preferred fixation site is the lower paws, whereas in females the ticks prefer to settle around the anus and lower paws.

Taxonomic Identification

The use of identification keys allowed us to characterise three species of ticks *Rhipicephalus turanicus*, *Rhipicephalus bursa* and *Ixodes hexagonus* and two species of Fleas *Archeopsylla erinacea* and

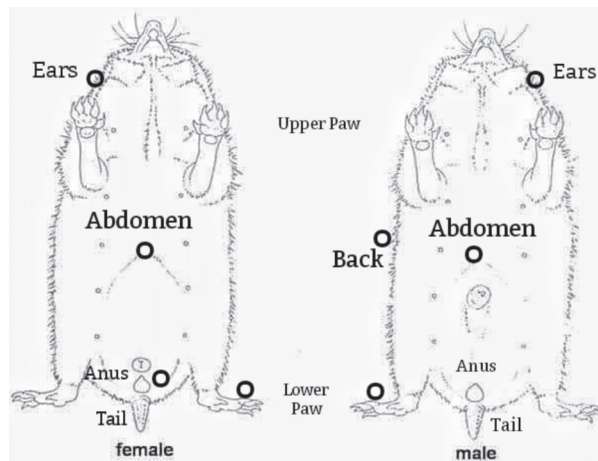


Fig. 2. Distribution of ticks in hedgehog's body (Modified after Reeve, 1994)

Ctenocephalides felis (Fig. 3 and 4).

Relative Frequencies

The calculation of the relative frequencies of the different parasites clearly shows that the most abundant species are: *Rhipicephalus Turanicus* (Ticks) and *Archeopsylla Erinacea* (fleas) during the dry season (*: $p < 0.05$). During the wet season, the most abundant species are essentially fleas. In ticks, *Rhipicephalus Turanicus* is the most abundant (*: $p < 0.05$) (Fig. 5).

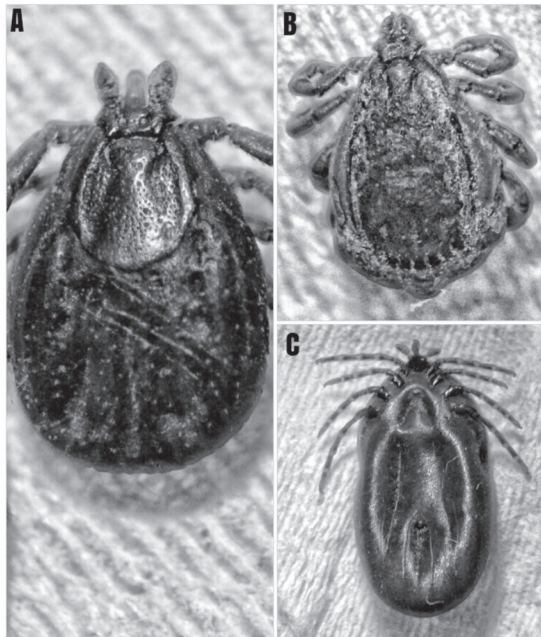


Fig. 3. Ticks in *Atelerix algirus*. A : *Rhipicephalus bursa*; B : *Rhipicephalus turanicus*; C : *Ixodes hexagonus*

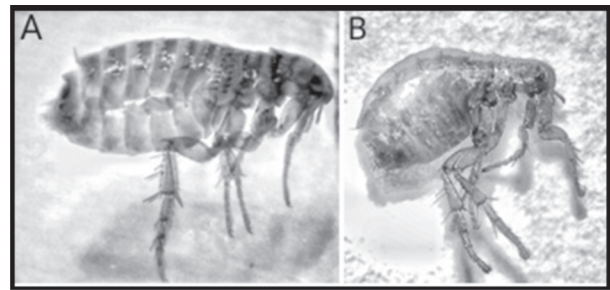


Fig. 4. Fleas in *Atelerix algirus* A : *Ctenocephalides felis* B : *Archeopsylla erinacea*

The calculation of parasite's relative frequencies in relation to the sex of the host showed that females ($F = 2.82$; *: $p = 0.03$) are most infested than males ($M = 1.58$; $p = 0.192$ NS) (Fig. 6).

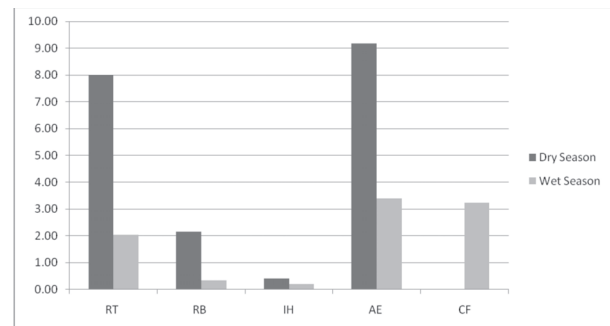


Fig. 5. Relative frequency of ectoparasites by season

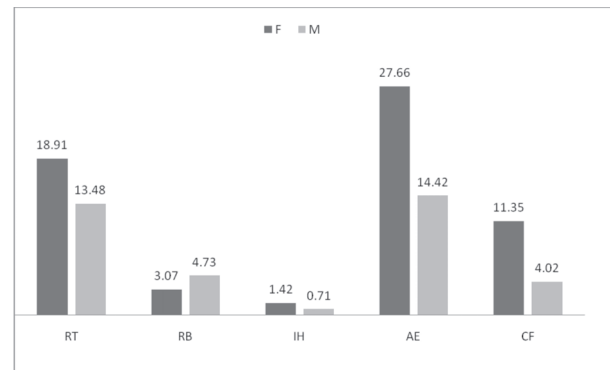


Fig. 6. Relative frequencies of ectoparasites relative to sex

Discussion

The parasitic ecology of *Atelerix algirus* (Lereboullet, 1842) has been particularly studied throughout the species' range (Khaldi *et al.*, 2012; Sakraoui *et al.*, 2014; Medina, 2016). In this study we first looked at the preferential fixation tropism of ectoparasites, especially in ticks, since by definition, fleas are more

attached to the nest than to the host species themselves (Bitam *et al.*, 2010). Our results reveal a preferential fixation in 4 areas: lower legs (33%), anus (27%), and equally the abdomen ears (13%). The preferred uptake sites of ectoparasites are generally influenced by various factors such as tick morphology (hypostoma length), host morphology (coat length), host immune responses, self-grooming, interspecific interactions, heat dissipation behaviour, and feeding phase duration (Belan and Bull, 1991; Shaw *et al.*, 2002). This explains the choice of tick fixation in an area of high vascularity where they can easily penetrate the skin, while avoiding accessible areas for grooming and where host skin is difficult to penetrate (Fourie *et al.*, 1991; Kiffner *et al.*, 2011). Regarding the taxonomic identification of ectoparasites, we identified three species of ticks: *Rhipicephalus turanicus*, *Rhipicephalus bursa*, and *Ixodes hexagonus*. Our results are similar to those found by many authors in Algeria (Madoui *et al.*, 2014; Boukheroufa, 2017) and through its range (Chochlakis *et al.*, 2014; Hosni *et al.*, 2014). Many authors have identified the genus *Rhipicephalus*, including *Rhipicephalus turanicus* and *Rhipicephalus bursa*, which colonize the Mediterranean region, including Algeria (Estrada – Pena *et al.*, 2004; Halos, 2005). *Rhipicephalus* ticks are potential reservoirs of many pathogens and can act as vectors for Rickettsia, Anaplasma, Theileria, Babesia, and arbovirus (Psaroulaki *et al.*, 2006). We also identified two species of Fleas: *Archeopsylla erinacea* which is the specific flea of the hedgehog (Franc, 2006), and *Ctenocephalides felis*, which usually parasites cats, but can infest other species such as dogs, rabbits and hedgehogs (Elsheikha, 2017). This species of chip is more attached to a microclimate than to a host. Thus, all mammals living in the same biotope are likely to be parasitized by *Ctenocephalides felis* (Bitam *et al.*, 2010). Their frequency is higher in the wet season, this suppose that in lack of food resources, hedgehogs will tend to get closer to agricultural or urban environments, which leads to contact with other animal species such as cats, dogs, sheep, goats and therefore exposed to infestation by *Ctenocephalides felis*. Analysis of relative frequencies by season showed that *Rhipicephalus turanicus*, *Rhipicephalus bursa* and *Archeopsylla erinacea* are more abundant in dry season, and that *Rhipicephalus turanicus* and *Ctenocephalides felis* are more abundant in the wet season. Estrada-Peña *et al.*, (2004) and Halos, (2005) characterized the habitat of the two Mediterranean

species *Rhipicephalus bursa* and *Rhipicephalus turanicus* as thermophiles. They are found around the Mediterranean basin, as far as the Caspian Sea to the east and the Atlantic Pyrenees to the west. They mainly use open or semi-open biotopes such as mediterranean scrub or wooded pastures, often close to domestic animal husbandry. *Ixodes hexagonus* is a summer nesting species found in burrows but also occasionally in caves. It is, like *Ixodes ricinus*, an ectoparasite common to hedgehogs, but with a particularity because it is specific to it and inhabits its nest (Liebisch and Walter.,1986; Toutoutoungi *et al.*, 1995; Camacho *et al.*, 2003). The analysis of relative frequencies by sex showed that parasitic infestation is greater in females than in males (with the exception of *Rhipicephalus bursa*). This phenomenon could be explained by all tasks accomplished by the female of *Atelerix algirus* during reproduction period, from the construction of the nests to the breeding of the youngs, which makes these females vulnerable to parasites infestation, particularly nesting parasites (Saboureau *et al.*, 1984; Mouhoub-Sayah, 2009).

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