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Acarologie

IDENTIFICATION AND SEASONAL DYNAMICS OF TICKS ON WILD BOAR (*SUS SCROFA*) IN THE EXTREME NORTH-EAST OF ALGERIA

par

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During a period of two years, from April 2011 to March 2013, and for the first time in Algeria, a study was undertaken to identify ticks on wild boar in the extreme northeast of Algeria. In total, 3266 tick specimens were collected. These were obtained from 111 boars killed by approved hunting associations, 80 of which were found infested with ticks, giving an infestation rate of 72.1 %. The highest rates of infestation were observed in summer and spring. The infestation of wild boar depends very significantly on season and altitude (P<0.00001). The highest rate of infestation was observed for the species *Rhipicephalus turanicus* (62.2 %), followed by *Dermacentor marginatus* (36.0%), *Hyalomma marginatum* (6.3 %) and finally *Ixodes ricinus* (3.6 %). Taken together, these results add to our knowledge of wild ixodid populations in Algeria and should help to improve control methods.

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Identification et dynamique saisonnière des tiques chez le sanglier (*Sus scrofa*) dans l'extrême nord-est algérien

Durant une période de deux ans allant du mois d'avril 2011 au mois de mars 2013, et pour la première fois en Algérie, une étude a été entreprise pour identifier les tiques chez le sanglier dans l'extrême nord-est algérien. Un total de 3266 tiques qui ont été collectées et conservées dans des tubes contenants de l'éthanol à 70°. Ainsi, 111 sangliers ont été abattus par des associations de chasses agrées, ces derniers ont fait l'objet de cette étude, dont 80 ont été révélés infestés par les tiques donnant ainsi un taux d'infestation de 72,1 %. Les taux d'infestation les plus élevés ont été observés en été et printemps. L'infestation des sangliers dépend très significativement de la saison et de l'altitude et (P<0.00001). Le taux d'infestation le plus élevé a été observé pour l'espèce *Rhipicephalus turanicus* (62,2 %) suivie par l'espèce *Dermacentor marginatus* (36,0 %), *Hyalomma marginatum* (6,3 %) et enfin *Ixodes ricinus* (3,6 %). L'ensemble de ces résultats participe à l'amélioration des connaissances de la faune Ixodidienne en Algérie afin d'améliorer les moyens de lutte.

Mots-clés : Sanglier, Algérie, tiques, *Rhipicephalus turanicus, Dermacentor marginatus, Hyalomma marginatum, Ixodes ricinus*.

Introduction

Ticks are haematophagous Acari recognized since the early 20th century as vectors of several pathogens affecting almost all vertebrates worldwide, occasionally biting humans (ESTRADA-PENA & JONGEJAN, 1999; PAROLA *et al*., 2001; WALKER *et al*., 2003; PEREZ-EID, 2007). Ticks are a major pest affecting agricultural development, as well as pets and human health. Their saliva has been characterized as a complex mixture of pharmacologically active compounds, having implications for the transmission of pathogens (WIKEL, 2013). More than 15 tick-borne rickettsioses have emerged throughout the world (PAROLA *et al*., 2005). The vector-borne diseases are of major importance for the health and well-being of humans and animals and the global economy (HARRUS & BANETH, 2005). Each tick species has optimum environmental conditions and lives in a particular habitat. Some ticks show important host specificity, feeding on a limited number (sometimes just one) animal species. Others have different hosts at each stage, and host specificity may vary from one stage to another within the same species (PAROLA *et al*., 2001).

The climate in the Mediterranean region is mainly characterized by the alternation of a warm season (summer), which corresponds to the driest period of the year, and a cold, rainy season (winter). A significant change in altitude can cause marked climatic changes. This variability in climatic characteristics is at the origin of a rich biodiversity of the tick fauna, with the result that the composition of the ixodid fauna of the Mediterranean region is extremely varied (ESTRADA-PENA *et al*., 2004).

The wild boar is a preferred host for some species of ticks, including *Dermacentor marginatus* (BOUATTOUR, 2002; DAVOUST *et al.,* 2010). Several studies have been conducted in different parts of the world to identify the species of ticks parasitizing the wild boar (ORTUNO *et al.,* 2006, 2007; SELMI *et al.,* 2009; BOUATTOUR, 2002; DAVOUST *et al.,* 2010). However, until now, no study has been conducted on the ticks of boars in Algeria. Although originally known as mountain animals, boars now come very often into urban areas to search for food, hence and their numbers in proximity to houses continue to increase. In this study, we identified the different tick species on boars and examined their seasonal dynamics along the 12 months of the year.

Materials and methods

Study Areas

Our study was conducted in two regions in the far northeast of Algeria, in the Annaba region and the area of El Tarf (Figure 1).

Animals

The study was conducted during a period of two years, from April 2011 to March 2013. The total number of boars examined was 111, including 7 piglets, 27 solitary, 49 sows, 14 redheads and 14 gossips.

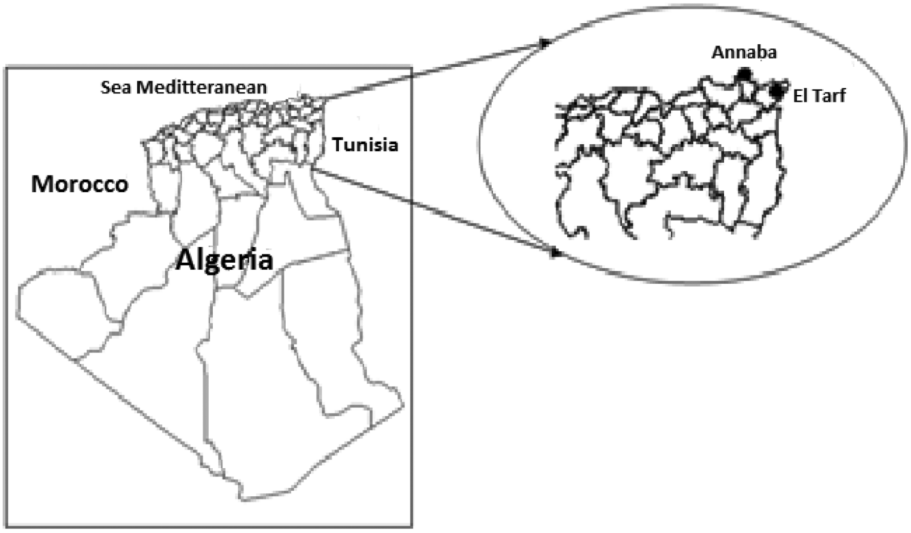

Figure 1

Location of the two study areas (El Tarf and Annaba) on the map of Algeria.
Présentation des deux régions d'étude (El Tarf et Annaba) sur la carte d'Algérie.

Collection and identification of ticks

Ticks were collected directly from wild boars and stored in a tube containing 70% ethanol for preservation. All ticks found on the body of the animal were collected taken. The total number of ticks collected was 3266, with 1820 males and 1446 females.

Identification of ticks

The identifications were carried out at the ecology of vector systems service of the Pasteur Institute of Algiers, based on the identification keys of BOUATTOUR (2002) and ESTRADA-PENA *et al*. (2005).

Statistical Analysis

ANOVA was used to compare the mean numbers of ticks isolated according to the different age classes of wild boar, the tick species and the season. The chi^2 test was used to study the affect of the age of the boar, the tick species and the season on the rate of infestation of wild boars. Our test was used to compare between the presence of male and female ticks.

Values were considered significant when the probability value $P < 0.05$.

Results

Of the 111 wild boars examined, 80 were found infested with ticks, giving an infection rate of 72.1%. The total number of ticks collected was 3266.

The number of ticks isolated according to the different age groups was 80 in piglets, 145 in gossip, 1091 in solitary, 1533 in sows and 417 in redheads. The average number of ticks per boar was 29 (Table 1). The results show that age has no significant influence on the level of infestation of boar by ticks. Also, the average number of ticks per boar seems to bear no relationship to the age of the animal.

The infestation rate of boars depends very significantly on the species of tick ($P < 0.00001$). The highest rate was observed for the species *Rhipicephalus turanicus*

Table 1

Average infestation with ticks and the number of ticks per boar in terms of age.
Taux d'infestation par les tiques et nombre moyen de tiques par sanglier en fonction de l'âge.

Age	Number of boars examined	Number of infected boars (%)	Total number of ticks collected (%)	Average number of ticks per boar
Piglets	7	4 (57.1%)	80 (2.4%)	11
Solitary and sows	76	56 (73.7%)	2624 (80.3%)	35
Redheads and gossips	28	20 (71.4%)	562 (17.2%)	20
Total	111	80 (72.1%)	3266	29

(62.2 %) (Table 2). Also, *Rhipicephalus turanicus* is the most abundant tick species found on the wild boar (P < 0.00001) (Table 2).

Table 2

Rate of infestation of wild boars by ticks and total number of ticks by species.
Taux d'infestation des sangliers par les tiques et nombre total de tiques en fonction de l'espèce de tique.

Tick species	**Number of boars examined**	**Number of infected boars (%)**	**Total number of ticks isolated (%)**
Rhipicephalus turanicus	111	69 (62.2%)	2718 (83.2%)
Dermacentor marginatus	111	40 (36.0%)	473 (14.5%)
Ixodes ricinus	111	4 (3.6%)	30 (0.9%)
Hyalomma marginatum	111	7 (6.3%)	45 (1.4%)

No significant difference was observed between wild boar infestation by female ticks (1446 ticks) and male ticks (1820 ticks). The rate of infestation by ticks on boars depends very significantly on the season (P <0.00001). The highest rates were observed in summer (100%) and spring (92.9%). Ticks are absent on wild boars in winter, except for a single occurrence of *Rhipicephalus turanicus* (Table 3). In contrast, the infestation of wild boars by different tick species seems to have no relation with the season (Table 3). However, *Hyalomma marginatum* was observed in spring only, and no boar infested with *Ixodes ricinus* was found in winter (Table 3).

Table 3

Infection rate of boars by different tick species by season.
Taux d'infestation des sangliers par les différentes espèces de tiques en fonction de la saison.

Season	Number of boars examined	Number of boars infected	*Rhipicephalus turanicus* (%)	*Dermacentor marginatus* (%)	*Ixodes ricinus* (%)	*Hyalomma marginatum* (%)
Spring	56	52 (92.9%)	43 (62.3%)	24 (44.4%)	2 (50%)	7 (100%)
Summer	13	13 (100%)	13 (18.8%)	10 (14.8%)	1 (25%)	0 (-)
Autumn	23	14 (60.9%)	12 (17.4%)	6 (24.1%)	1 (25%)	0 (-)
Winter	19	1 (5.3%)	1 (1.5%)	0 (-)	0 (-)	0 (-)
Total	111	80 (72.1%)	69 (62.2%)	40 (36.0%)	4 (3.6%)	7 (6.3%)

It appears that the season has a great influence on the number of ticks isolated from wild boars (P < 0.00001), the multiple range test indicates that the number of ticks isolated in spring is significantly higher than in other seasons (Table 4).

Table 4

Number of ticks collected in each season (total 3266).
Nombre de tiques collectées dans chaque saison (total 3266).

Season	Spring	Summer	Autumn	Winter
Mean temp °C (min-max)	14.51 (13.95-15.08)	21.50 (20.65-22.04)	20.69 (20.28-21.14)	14.47 (13.97-15.08)
Total number of ticks (%)	2619 (80.19%)	397 (12.15%)	247 (7.56%)	3 (0.001%)

The altitude also has a great influence on the rate of infestation of wild boars by different tick species ($p < 0.00001$). *Rhipicephalus turanicus* was observed especially at low altitudes (84.3%). *Dermacentor marginatus* was observed especially at low altitudes, its presence on wild boars decreases at higher altitudes. *Ixodes ricinus* was observed at medium and high altitudes. *Hyalomma marginatum* was mostly observed at medium altitudes (71.4%) and was not found at high altitudes (Table 5).

Table 5

Prevalence of infestation of wild boars by different tick species as a function of altitude.
Prévalence d'infestation des sangliers par les différentes espèces de tiques en fonction de l'altitude.

Altitude	*Rhipicephalus. turanicus*	*Dermacentor marginatus*	*Ixodes ricinus*	*Hyalomma marginatum*
Low (< 50 m)	61 (88.4%)	24 (60%)	0 (-)	2 (28.6%)
Medium (50-150 m)	3 (4.3%)	9 (22.5%)	2 (50%)	5 (71.4%)
High (151-850 m)	5 (7.2%)	7 (17.5%)	2 (50%)	0 (-)

Discussion

This is the first study conducted in Algeria for the identification of ticks on the wild boar. The results obtained serve as a basis for the establishment of an inventory of ticks in wild boar in this country and improve our knowledge of geographic distribution of the tick species obtained.

Out of a total of 111 wild boars examined, we detected ticks on 80 of them (72.1%). The infestation rate of boars in both study areas bore no relationship to the age of the host, but instead depended on the species of tick. The wild boar seems infested with *Rhipicephalus turanicus,* whereas previous studies have indicated that the most common tick on the wild boar is *Dermacentor marginatus* in Tunisia, Algeria and Morocco (BOUATTOUR, 2002), in northeastern Spain (ORTUNO *et al.,* 2006, 2007), in Tuscany, Italy (SELMI *et al.,* 2009) and in southern France (SANOGO *et al.,* 2003).

The tick species that we collected from wild boars are: *Rhipicephalus turanicus, Dermacentor marginatus, Ixodes ricinus* and *Hyalomma marginatum*. All of these species have been found on cattle in Algeria (BOULKABOUL, 2003) and

Morocco (LAAMRI *et al*., 2012). In Morocco, BAILLY-CHOUMARA *et al*. (1976) showed that the wild boar is a host for *Dermacentor marginatus, Ixodes ricinus, Hyalomma anatolicum excavatum, Hyalomma lusitanicum*.

The rate of infestation of boars by ticks depends very significantly on the season ($P < 0.00001$). The highest rates were observed in summer (100%) and spring (92.9%). *Rhipicephalus turanicus* is a spring species that appears in March and disappears in July (OUHELLI, 1985 & BOUATTOUR, 2002). In our study, this species was observed on wild boars throughout the year, but the highest rate of infection was observed in spring season (62.3%). The same observation was made in cattle by BENCHIKH-ELFEGOUN (2007) in Algeria and by LAAMRI *et al*. (2012) in Morocco.

Dermacentor marginatus is a two-host species with a three-phase cycle. The adult stage usually parasitizes ungulates (PEREZ-EID, 2007) and has higher thermal requirements (thermophilic species). Adults are active in late autumn to winter in the Mediterranean region (ESTRADA-PENA, 2004). In our study, this species showed two peaks of activity, one in spring (44.4%) and the other in autumn (24.1%). No infestation of boars was observed in winter.

Many animals have been reported as hosts of *Ixodes ricinus,* which has been found in North Africa in the humid and sub-humid bioclimatic zones. Adult activity is in autumn and winter (BOUATTOUR, 2002; ESTRADA-PENA *et al*., 2004). In Morocco, LAAMRI *et al*. (2012) found that *Ixodes ricinus* was more frequent on cattle in winter. In our study, only four boars were found infested (two in spring, one in summer and one in late autumn), thus giving a low infection rate (3.6%). We have not seen cases in winter.

Regarding *Hyalomma marginatum,* adult activity is essentially zero in the spring and winter (BOUATTOUR, 2002; ESTRADA-PENA *et al*., 2004). The same observation was made in our study of wild boar.

A significant change in altitude can cause significant changes in climate, favouring a rich biodiversity of the tick fauna (ESTRADA-PENA *et al*., 2004). In our study, variations in altitude had a great influence on the rate of infestation of wild boar by the different species of ticks. We note the presence of *Dermacentor marginatus* in all bioclimatic zones, while *Rhipicephalus turanicus* is found particularly in low altitude. *Ixodes ricinus,* which is known in Europe as the wood tick (ESTRADA-PENA *et al*., 2004), was observed in our study only at medium and high altitudes. *Hyalomma marginatum* was mostly observed at medium altitudes (71.4 %) but did not occur at high altitudes.

Conclusion

The infestation of wild boars by ticks in northeastern Algeria seems very important, the highest infestations rates being observed in spring and summer. Several species are concerned, particularly *Rhipicephalus turanicus,* which was

mainly found in spring at low altitudes, followed by *Dermacentor marginatus,* which was mainly found in spring and at low altitudes, *Hyalomma marginatum,* which occurs only in spring and mainly at medium altitudes, and finally *Ixodes ricinus,* which is the rarest species on wild boar and only occurs at medium and high altitudes.

The results obtained improve our knowledge of the ticks occurring on wild boar in Algeria and focus attention on the risks of disease transmission by these potential vectors of Rickettsiosis.

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