

Ectoparasites of the Ground Squirrel (*Citellus citellus* (L.)) in Turkey

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SUMMARY: A total of 100 ground squirrels, *Citellus* (*C.*) *citellus* were trapped in rural regions of Konya in order to determine the presence of ectoparasites. Of these *C. citellus* examined, 16% (16/100) were infected with at least one ectoparasite species. Two types of ectoparasites were found including 10% fleas and 7% ticks. Only two flea species were found on *C. citellus* including *Nosopsyllus fasciatus* 10% (10/100) and *Pulex irritans* 1% (1/100). Also, only two species of ticks were found on the *C. citellus* examined. The rate of *Haemaphysalis* sp. nymphs was found to be 5% (5/100). Both *Ixodes* sp. adults and *Ixodes* sp. nymphs were found in 1% (1/100) of the *C. citellus* examined. The prevalence of ectoparasites showed no specific relationship with the gender and age of the host. Evidently, ground squirrels carry relatively few ectoparasite species in Turkey. This is the first report describing ectoparasites of *C. citellus* in Turkey

Key Words: Ground squirrel, ectoparasites, flea, tick, Turkey

Türkiye’de, Tarla Sincaplarının (*Citellus citellus* (L.)) Ektoparazitleri

ÖZET: Bu çalışma, Konya yöresinin kırsal bölgelerinden yakalanan, 100 adet tarla sincabının ektoparazitlerini belirlemek amacıyla yapılmıştır. Muayene edilen tarla sincaplarının %16’sı, en az bir ektoparazit ile enfekte bulunmuştur. Tarla sincaplarında iki çeşit ektoparazite rastlanmıştır, %10’unun pirelerle, %7’sinin ise kenelerle enfeste olduğu tespit edilmiştir. Muayene edilen tarla sincaplarının üzerinde *Nosopsyllus fasciatus* %10 ve *Pulex irritans* %1 oranlarında bulunmuştur. Aynı şekilde, araştırılan *Citellus citellus*’ların üzerinde *Haemaphysalis* sp. nimfleri %5, *Ixodes* sp. ve *Ixodes* sp. nimfleri %1 oranında tespit edilmiştir. Ektoparazitlerin prevalansı konağın cinsiyet ve yaşı ile ilişkili bulunmamıştır. Türkiye’de yer sincapları nispeten çok az ektoparazit taşımaktadır. Bu araştırma, Türkiye’de tarla sincaplarının (*Citellus citellus*) ektoparazitleri üzerine yapılan ilk çalışmadır.

Anahtar Sözcükler: Tarla sincabı, ektoparazit, pire, kene, Türkiye

INTRODUCTION

Ground squirrels (*Citellus citellus* L.) have a wide habitat throughout Turkey and thus play an important role in the contagion of some zoonotic diseases to carnivores and people prey on them.

So far, there have been a few studies carried on ectoparasites of ground squirrels (7, 8, 10-15). In Czechoslovakia, Honzakova et al. (7) came across *Ixodes laguri* in the nests of *Citellus citellus*. In a study on the ectoparasites of ground squirrels, Shevchenko et al. (15) found three different species of flea (*Neopsylla setosa*, *Citellophilus tesquorum* and *Ctenophthalmus breviatus*) and specie of tick (*Rhipicephalus schultzei*). In another study, Shvarts (17) found three types of flea (*Citellophilus trispinus*, *Neopsylla setosa* and *Oropsylla*

ilovaiskii) and Ryba et al. (13, 14) detected five species of flea (*Neopsylla setosa*, *Citellophilus simplex*, *C. orientalis*, *Ct. assimilis* and *Ct. agyrtes*) in the nests of *Citellus citellus*.

Ground squirrels are considered to be the source of pest contagion in some countries (1). In China, *Citellus dairucus ramosus* is considered to be the main source of pest (4). This study aims to determine the species of ectoparasites and the rate of infestation seen in ground species.

MATERIALS AND METHODS

The study area is located in Konya region at 1016 m above sea level and between latitudes 37.59 N and 32.34 E. The region (Central Anatolia) has a climate that is hot and dry in the summer, cold and rainy in winter seasons. The region is the largest earth of Turkey (38.257 km²). Natural plant cover of the province is steppe.

The investigation was carried out in three selected rural regions of Konya. Ground squirrels (*Citellus citellus*) were captured in 15 randomly selected villages. In most villages, do-

Makale türü/Article type: **Araştırma/Orijinal Research**

Geliş tarihi/Submission date: 28 Ocak/28 January 2008

Düzeltilme tarihi/Revision date: -

Kabul tarihi/Accepted date: 26 Şubat/26 February 2008

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mestic animals (sheep, cattle, cats, dogs, horse and poultry) were present as well.

A total of 100 ground squirrels (*C. citellus*) were trapped alive and were transported to laboratory in plastic bags. In laboratory, the squirrels were euthanized individually with dietileter in a glass vessel. Then, the carcasses were placed on a white tray and brushed. Large ectoparasites were removed from the fur, ears by using fine combs, brushes or tweezers and immediately stored in 70% ethanol. Ear canals were also inspected for ectoparasites. Ectoparasites were cleared in potassium hydroxide and slide-mounted in faure forte for microscopic examination and taxonomic identification by means of standard keys (6). Ground squirrels (*C. citellus*) were categorized in three groups, as adults, subadults and juveniles. There were 39 adults, 43 subadults and 18 juveniles. Gender was determined by visual inspection of external sexual organs. Among 100 ground squirrels, 63 ground squirrels were males and 37 ground squirrels were female.

RESULTS

Totally hundred ground squirrels (*C. citellus*) were examined and ectoparasites infestation were found in 16% of ground squirrel. From ground squirrels examined, four species of ectoparasites were obtained (Table 1) including Acari Ixodidae: *Haemaphysalis sp.* nymphs, *Ixodes sp.* and *Ixodes sp.* nymph, Siphonaptera: *Nosopsyllus fasciatus* and *Pulex irritans*.

A total of 22 flea and 8 ticks were found in examined ground squirrels. Among these 16 female and 5 male, *N. fasciatus* (21 fleas from 10 positive ground squirrels), 1 female *P. irritans* (1 flea from 1 positive ground squirrel), 5 *Haemaphysalis sp.* (nymphs), 1 *Ixodes sp.* and 2 *Ixodes sp.* (nymph) (8 ticks from 7 positive ground squirrels) were found. Ectoparasite found in infested ground squirrels and their rates are shown in Table 1.

Table 1. The prevalence of ectoparasites recovered from ground squirrel (*Citellus citellus*)

Ectoparasite	No. infested	Prevalence %	Total no. collected
<i>Haemaphysalis sp.</i> (Nymphs)	5	5.0	5
<i>Ixodes sp.</i>	1	1.0	1
<i>Ixodes sp.</i> (Nymphs)	1	1.0	2
<i>Nosopsyllus fasciatus</i>	10	10.0	21
<i>Pulex irritans</i>	1	1.0	1

Ground squirrels (*C. citellus*) were categorized in three groups, as adults, subadults and juveniles. The prevalence of infestation was 8 (20.51%) in adults 5 (11.63%) in subadults and 3 (16.66%) in juveniles. Infestation rates were higher in female squirrel than male squirrel (Table 2).

14 of the ground squirrel (76.67%) were found infested with only one type and 2 (23.33%) with two types (Table 3).

The flea species *Nosopsyllus fasciatus* and *Pulex irritans* were found in 10% of ground squirrel. The *N. fasciatus* infestations were observed significantly increased with age and were found in significantly higher number (21.70%) from the other species. *N. fasciatus* had the highest prevalence and was observed in 10% of *C. citellus* (4 male and 6 female). The other flea specie, *Pulex irritans* was observed only in 1% of male *C. citellus* (Table 1). The tick species, *Haemaphysalis sp.* nymphs, *Ixodes sp.* and *Ixodes sp.* nymph were found in 7% of *C. citellus* (Table 1). The infestation with *Haemaphysalis sp.* nymphs increased with age. However, statistical analyses showed that presence of observed ectoparasites was not related with sex and ages.

Only one subadult ground squirrel was infested with two species (*N. fasciatus*+*P. irritans*) and also one adult ground squirrels were also seen infection with two species (*N. fasciatus*+*Haemaphysalis sp.*(nymphs)). The other ground squirrels were infested with only one specie (Table 3).

The tick and flea species collected in this study were fairly few but they are quite common ectoparasites of ground squirrels in other countries Ectoparasites of *Citellus citellus* had not been studied in Turkey until our survey.

The flea *Nosopsyllus fasciatus* was previously reported from *Citellus citellus* in Czechoslovakia (14), in USSR (18) and *Pulex irritans* was previously from reported *Citellus citellus* in USSR (9, 16), in Mongolia (10). Whereas, both *N. fasciatus* and *P. irritans* has not been reported from ground squirrel in Turkey. As far as we can determine, our collections of *Nosopsyllus fasciatus* and *Pulex irritans* from the *Citellus citellus* represent new host records for these fleas in Turkey.

The human flea is found all over the world. Besides man, it infests cats, dogs, and many other domestic animals, particularly the pig.

DISCUSSION

The oriental rat flea, *Xenopsylla cheopis*, is the most important vector of the plague bacillus, *Yersinia pestis*, from rat to man but at least 29 other species of fleas can transit the disease such as including the northern rat flea (*Nosopsyllus fasciatus*) and the human flea (*Pulex irritans*). *Pulex irritans* may also transmit murine typhus, tularemia, and tapeworm (*Dipylidium caninum*), *Rickettsia typhi*, *R. felis* and *Bartonella henselae* (2), but the chances of this are relatively rare. Lewis (11) indicated that *P. irritans* was cosmopolitan specie that is usually found on various large, coarse-coated mammals such as pigs, canids, mustelids, deer, tapirs, and peccaries, but that it also occurred on humans. *Pulex irritans* was listed as a vector for plague in the United States.

Table 2. Prevalence of ectoparasites infestation according to age and sex ground squirrel examined in Konya.

	Total no of animal examined	Prevalence (% no infested ground squirrel)	Total no.of ectoparasites	<i>Haemaphysalis sp.</i> (Nymphs)	<i>Ixodes sp.</i>	<i>Ixodes sp.</i> (Nymphs)	<i>Nosopsyllus fasciatus</i>	<i>Pulex irritans</i>
Age								
Juveniles	18 a	3 (16.66)	3	1	1	-	1	-
Subadults	43 a	5 (11.63)	9	1	-	2	5	1
Adults	39 a	8 (20.51)	18	3	-	-	15	-
Sex								
Male	63 A	9 (14.29)	18	3	1	2	11	1
Female	37 A	7 (18.92)	12	2	-	-	10	-
Total	100	16 (16.0)	30	5 (16.67) ^Y	1 (3.33) ^Y	2 (6.67) ^Y	21 (70) ^X	1 (3.33) ^Y

a, A: There was no found statistically significance ($p>0.05$) and ^{X,Y} are statistically significant ($p<0.05$) in the same row.

Table 3. Infestation situation of the infested ground squirrel with one or more ectoparasites type

Infection status	Ectoparasite	Infected Squirrel Number	Total Number of Ectoparasite	%
Infection with one species	<i>Haemaphysalis sp.</i> (nymph)	4	4	76.67
	<i>Ixodes sp.</i>	1	1	
	<i>Ixodes sp.</i> (nymph)	1	2	
	<i>Nosopsyllus fasciatus</i>	8	16	
Infection with two species	<i>N. fasciatus</i> + <i>P. irritans</i>	1	2+1	23.33
	<i>N.fasciatus</i> + <i>Haemaphysalis sp.</i> (nymph)	1	3+1	

The tick *Haemaphysalis sp.* occurs in China (4), in Mongolia (5) and *Ixodes laguri* occurs in USSR (9), in Czechoslovakia (7), in Brazil (12). *Ixodes sculptus* is a parasite mostly of rodents, especially ground squirrels (3). However, no *Haemaphysalis sp.* and *Ixodes sp.* have been reported from ground squirrels in Turkey. The nymphs infest birds, small mammals, the adults tick infest domesticated pets, livestock and wild animals.

Turkey has two endemic species of squirrel: *Citellus* (Spermophilus) *citellus* (Linnaeus 1766) and *Citellus* (Spermophilus) *xanthophrymnus* (Benett, 1935). However, nothing is known about ectoparasites of this species.

The fleas and ticks species have been reported on ground squirrel in the world (5, 10, 12, 14). In this study, however, we found only two species of ectoparasite on *Citellus citellus*. Honzokova et al. (7) listed three tick species (*Ixodes laguri slovacicus*, *I. laguri colchicus*, *I. laguri armeniacus*). Ryba et al. (13) also reported three fleas species (*Neopsylla setosa*, *Citellophilus simplex*, *Ctenophthalmus orientalis*) and Ryba et al. (14) found five flea species (*Citellophilus simplex*, *Neopsylla setosa*, *Ctenophthalmus orientalis*, *Ct. assimilis* and *Ct. agyrtes*) on *Citellus citellus*. The limited ectoparasite fauna of

C. citellus found in our study could be attributed to the small number and conditions of ground squirrels at the time of their introduction to Turkey. Ectoparasites of ground squirrel serve as reservoir of murine typhus, tularemia and human plague in Turkey or others country. We can conclude, that our findings, pathogens and exist of this ectoparasites might be contributed to proliferation for zoonotic diseases at public health. Because, WHO registered that ground squirrels had been reservoirs of plague in many parts of the world (19). But, there is lack of information about ground squirrel pathogens in Turkey and other countries, thus more investigations are needed.

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