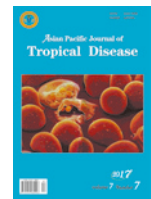


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A study of ectoparasites in wild rodents of the Jaz Murian area in the southeast of Iran

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ABSTRACT

Objective: To detect wild rodents ectoparasites in the southeast of Iran.

Methods: In this survey, the wild rodents were trapped from 2014 to 2015. The captured rodents were checked for any ectoparasites.

Results: In this study, 681 ectoparasites belonged to 6 species of flea, 2 species of lice, 1 species of mite and 2 species of hard tick were collected. The flea species were including, *Xenopsylla gerbilli*, *Xenopsylla cheopis*, *Xenopsylla buxtoni*, *Xenopsylla conformis*, *Nosopsyllus medus* and *Amphipsylla* spp., the lice species were including *Hoplopleura* spp. and *Polyplax* spp., the mite species was *Ornithonyssus bacoti* and tick species were *Rhipicephalus* spp. and *Hyalomma* spp.

Conclusions: Among all ectoparasites, *Hoplopleura* spp. and *Amphipsylla* spp. had the high and low frequency infestation in rodents, respectively. Also among captured rodents, the highest ectoparasites infestation was found in *Tatera indica* and no ectoparasites in *Apodemus witherbyi*, *Cricetulus migratorius*, and *Microtus mystacinus kermanesis*.

1. Introduction

Rodents are the largest order of mammals in the world and plays as a reservoir of many of the vector-borne diseases and as pests that can cause economic losses, spoilage of food and lead to structural damages[1,2].

In Iran, several studies have been conducted on rodents and their ectoparasites in different provinces of Iran[3-7]. Their results indicated the presence of different species of the flea, lice, mite and tick infestation in rodents. Other studies have been shown that ectoparasites associated with rodents could be responsible for distribution of the important zoonotic diseases such as Crimean-Congo Hemorrhagic fever (CCHF) and plague[8,9].

The Jaz murian region in the southeast of Iran situated in the tropical realm and is considered as an endemic area of malaria and CCHF in Iran[8,10]. Due to the diverse climatic and geographical

conditions in the Jaz Murian area, the identification of the fauna of ectoparasites in wild rodents could be helpful to control zoonotic arthropod-borne diseases. The aim of this study was to determine the frequency of ectoparasites infested on rodent in the Jaz Murian area, Southeast Iran.

2. Materials and methods

2.1. Study area

The Jaz Murian depression, a tectonic depression filled with quaternary desert deposits, is a broad oval in the southeast Iran covering about 25 000–30 000 square miles. It has been entirely surrounded by some mountains chains such as Jebel-e- Bariz and Bazman mountains chains in North, Bashagard and Makran mountains chains in South (Figure 1). Its geographical coordinates are 27°29'21" N, 58°32'46" E. The average annual precipitation is 500–600 mm in the north and 100 mm in the south of the Jaz Murian area, respectively[11].

Some rivers and streams are flowing to this depression, but two of them, Halil Rud (on the west) and Bampour Rud (on the east) are more important. The depression also receives discharge of temporary streams and drainage of the rainfall from surrounding highlands. The region as a dry land with the lowest precipitation

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in Iran and abruptly falling temperature during nights with the main vegetation including *Acacia*, *Gymnocarpos*, *Tamarix* and *Haloxylon*[11].

2.2. Collecting sampling

Rodent sampling was conducted from December 2014 to June 2015 from 31 sites various regions of the Jaz Murian area (Figure 1 and Table 1). The modified Sherman live traps for rodents were applied for two consecutive nights at each study site. The traps were checked in the early morning for the presence of rodents and the captured rodents were transferred to the Department of Environment in that area. Since jerboas cannot be caught by live traps, dipodid rodents were caught with a hand-net, using a searchlight and motorcycle at night. The species of rodents were identified based on identification keys[12-14].

2.3. Ectoparasites examination

Ectoparasites were brushed from the surface of rodent's skin on the water filled dissection tray in the field. Collected ectoparasites were kept in 70% ethanol and transferred to the parasitology laboratory in Veterinary Faculty of Ferdowsi University of Mashhad for further investigation. The ectoparasites were grouped and counted based on different morphological characteristic. They were cleared in potassium hydroxide or lactophenol and then transferred through a dehydration series (70%, 80%, 95%, and 100%) of ethanol for 30 min per step. Specimens were then transferred to methyl salicylate for 30 min, and xylene for 1 h, and finally mounted in Canada balsam. The mounted ectoparasites were identified based on valid entomological keys that are available for fleas[15], sucking lice[16] and hard tick[17].

Table 1

Sampling localities of Rodents from Jaz Murrian area.

No.	Collecting station City (Locality)	GPS information	
		Latitude	Longitude
1	Sardast (Biskove)	26°29'	57°51'
2	Sardast (Heidar mountain)	26°30'	57°29'
3	Minab (Tarom village)	27°01'	57°04'
4	Minab (Azad un.)	27°03'	57°06'
5	Fariab	27°28'	57°05'
6	Roodan	27°27'	57°09'
7	Bazman (Kalgande)	27°51'	60°10'
8	Bazman	27°51'	60°10'
9	Bazman (Kargokan)	27°50'	60°10'
10	Bazman	27°51'	60°10'
11	Bazman (Shandak)	27°50'	60°10'
12	Bazman (Sefid Abad)	27°51'	60°11'
13	Bazman (Cheshme Abgarm)	27°46'	60°07'
14	Jolge-chahashem	27°28'	59°24'
15	Dalغان	27°29'	59°27'
16	Houdian	27°29'	59°27'
17	Bampour (JafarAbad)	27°12'	60°32'
18	Bampour (AliAbad)	27°11'	60°34'
19	Iranshahr (TighAbad)	27°20'	60°45'
20	Fannoj	26°33'	59°38'
21	Nikshahr	26°12'	60°13'
22	Maskhutan	26°52'	59°49'
23	Dalغان	27°29'	59°27'
24	Fariab (Sardak)	28°11'	57°51'
25	Kahnoj (Avazabad)	27°57'	57°40'
26	Roodbar	27°31'	57°54'
27	Kahnoj	27°56'	57°41'
28	Anbarabad	28°36'	58°02'
29	Anbarabad (Amjaz)	28°28'	57°51'
30	Anbarabad (Kesht-o-Sanat)	28°54'	57°54'
31	Anbarabad (Sartagheen)	28°42'	58°05'

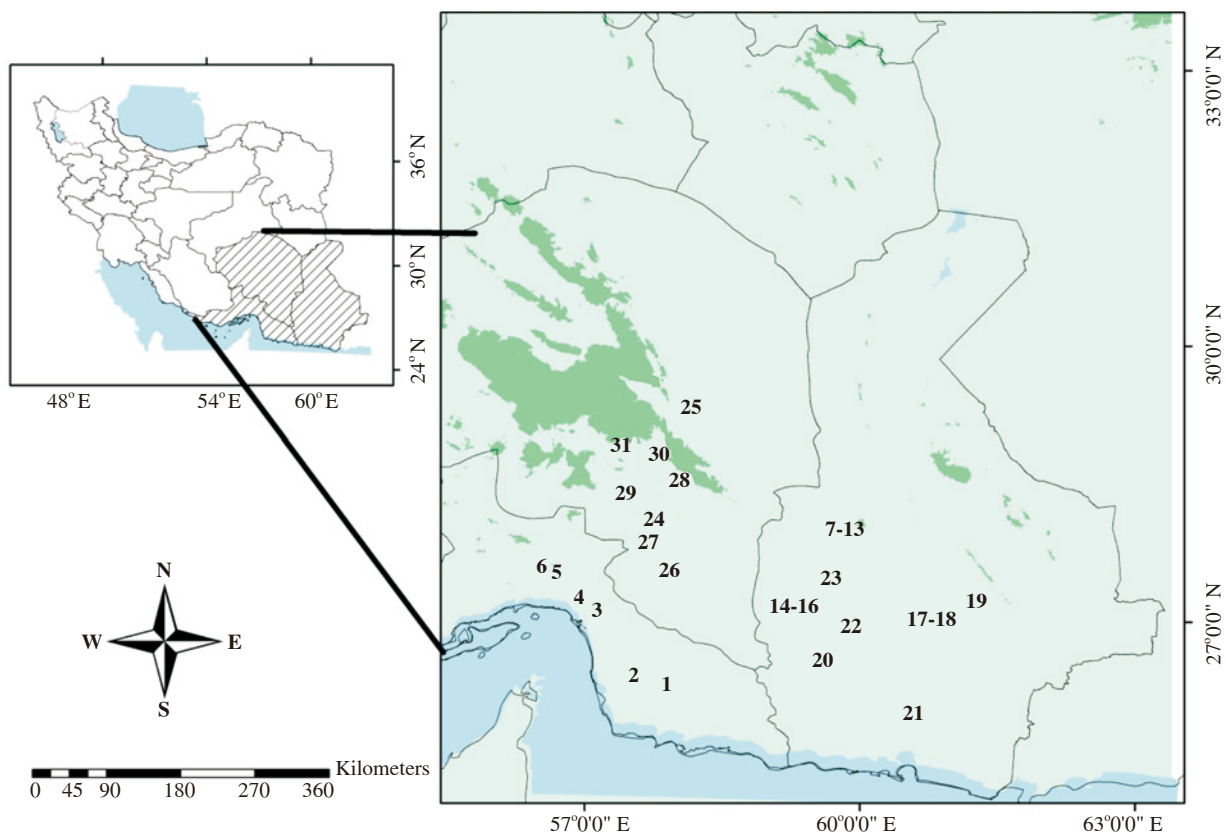


Figure 1. Map showing the sampling localities of rodents in the Jaz Murian area.

2.4. Statistical analysis

A Chi-square test was used to analyze for significant differences in frequency of ectoparasites infestation. A difference was statistically significant when a *P*-value of less than 0.05 was observed. Statistical analysis was estimated using SPSS 16 (SPSS Inc., Chicago, IL, USA).

3. Results

Total of 146 individuals of 13 different rodents' species belonging to Dipodidae, Calomysidae, Muridae and Criceitidae families were captured from different regions of the Jaz Murian area. The frequency of species of each rodent families was described in details as follow:

1-Family Dipodidae: *Jaculus blanfordi* (*J. blanfordi*) 7 (4.79%);

2-Family Calomysidae: *Calomyscus hotsoni* (*C. hotsoni*) 6 (4.10%);

3-Family Muridae, Subfamily Murinae: *Apodemus witherbyi* (*A. witherbyi*) 6 (4.10%); *Mus musculus* (*M. musculus*) 36 (24.65%); *Acomys dimidiatus* (*A. dimidiatus*) 21 (14.38%), *Rattus rattus* (*R. rattus*) 2 (1.36%); *Nesokia indica* (*N. indica*) 8 (5.47%); *Golunda ellioti* (*G. ellioti*) 2 (1.36%); Subfamily Gerbilinae: *Meriones libycus* (*M. libycus*) 13 (8.9%); *Gerbillus nanus* (*G. nanus*) 13 (8.9%); *Tatera indica* (*T. indica*) 30 (20.54%).

4-Family Criceitidae, Subfamily Arvicollinae: *Microtus mystacinus kermanesis* (*M. m. kermanesis*) 1 (0.68%); Subfamily Criceitinae: *Cricetulus migratorius* (*C. migratorius*) 1 (0.68%).

In this study, 681 ectoparasites belonged to flea, lice, mite and ixodid tick were collected from 76 (52%) infested rodents. The frequency of identified species of ectoparasites belonging following fleas group were: *Xenopsylla cheopis* (*X. cheopis*) 74 (10.86%), *Xenopsylla gerbilli* (*X. gerbilli*) 85 (12.48%), *Xenopsylla buxtoni* (*X. buxtoni*) 30 (4.60%), *Xenopsylla conformis* (*X. conformis*) 26 (3.81%), *Nosopsyllus medus* (*N. medus*) 20 (2.93%), *Amphipsylla* spp. 1 (0.14%); Mite group was: *Ornithonyssus bacoti* (*O. bacoti*) 70 (10.27%); Ticks group was: *Rhipicephallus* spp. 24 (3.52%) and *Hyalomma* spp. 8 (1.17%); Lice group was: *Hoploplura* spp. 181 (26.57%) and *Polyplax* spp. 162 (23.78%) (Table 2).

The frequency of ectoparasites infestation in rodent species was significantly different (*P* < 0.05). In this study, *T. indica* (60.00%) showed the highest frequency of ectoparasites infestation and *A. witherbyi*, *C. migratorius*, and *M. m. kermanesis* showed the lowest frequency (Table 2). Among all ectoparasites, *Hoploplura* spp.

(26.57%) and *Amphipsylla* spp. (0.14%) had the most and least frequency, respectively.

4. Discussion

In this study, *T. indica*, *A. dimidiatus*, *M. libycus* and *M. musculus* were found with high ectoparasites infestation with compare to other rodents. These rodents were collected from residential or adjacent to residential areas that had living close to human habitats. Generally, *T. indica* and *M. libycus* were confirmed as a reservoir host of cutaneous leishmaniosis in Iran[18-20]. Three species of rodents, *A. whiterbyi*, *C. migratorius* and *M. m. kermanesis* were free from any parasitic infestation. The result may be related to a low number of these species that were collected in the rodents' habitat away from human living.

In this study, the flea group with six species had more species diversity among collected ectoparasites in rodents. The frequency and distribution of *X. gerbilli* and *X. cheopis* were more than other flea species.

X. gerbilli was reported first time in *Rhombomys opimus* in the north east of Iran[21]. *X. gerbilli* was also found with high frequency in *Meriones persicus* in the northwest of Iran[22]. *X. cheopis* (rat flea) is one of the principal vectors of plague and murine typhus in many tropical and subtropical countries[23]. In Iran, *X. cheopis* as the predominance of flea is reported in *Rattus norvegicus* from the south of Iran[5].

X. buxtoni could be acted as the vectors of plague in Southeast Asia, Middle East, East Africa, Southern Africa and South America[23]. This flea was also reported from wild rodents in the northwestern, south and west of Iran[3,4].

X. conformis was collected from *Rhombomys opimus*, *Meriones vinogradovi*, *Meriones persicus* and *Mesocricetus brandti* in different area of Iran[21-23]. This species could be acted as vector of the plague.

N. medus was reported from *Rattus norvegicus* from Baghdad, Iraq. It has also been collected on *M. musculus* and is reported from Iran[24]. Recently, this species was reported from rodents in west of Iran[3].

In the present study, the *Hoplopleura* spp. and *Polyplax* spp. as lice ectoparasites were detected in *T. indica*, *M. libycus*, and *A. dimidiatus*. The frequency of lice infestation in *T. indica* was higher than other wild rodents. The *Hoplopleura* spp. and *Polyplax* spp. were reported with high infestation in different wild rodents in

Table 2

Diversity of rodents and their ectoparasites in the different location of the Jaz Murrain area, Iran.

Rodents	Fleas					Lice			Mite	Tick	
	<i>X. conformis</i>	<i>X. gerbilli</i>	<i>X. cheopis</i>	<i>X. buxtoni</i>	<i>Amphipsylla</i> spp.	<i>N. medus</i>	<i>Haploplura</i>	<i>Polyplax</i>	<i>O. bacoti</i>	<i>Rhipicephallus</i> spp.	<i>Hyalomma</i> spp.
<i>T. indica</i>	-	3,6,10,15,16,17,26	3,4,17,23,24	14	-	-	8,10,15,17,26	2,3,4,6,10,14,15,17,27	1,3,4,17,26	15,27	-
<i>G. nanus</i>	-	-	-	-	-	-	7	-	-	-	22
<i>M. libycus</i>	16	9,13,22	-	-	-	16,19	9,16,19	16,19	19	-	-
<i>G. ellioti</i>	-	-	-	-	-	-	29	-	-	-	-
<i>A. wütherbyi</i>	-	-	-	-	-	-	-	-	-	-	-
<i>M. musculus</i>	-	5,15,16	17,24	-	28	-	-	-	15	15,16	-
<i>N. indica</i>	-	24,27,29	18	-	-	-	-	-	18	-	-
<i>R. rattus</i>	-	3	-	-	-	-	-	3	-	-	-
<i>A. dimidiatus</i>	5	1	-	-	-	2	2,3,5	1,2,5	2,5	2,5	-
<i>J. blanfordi</i>	-	11	11	-	-	-	-	-	11	11	-
<i>C. hotsoni</i>	-	-	-	-	-	-	-	-	2	-	-
<i>C. migratorius</i>	-	-	-	-	-	-	-	-	-	-	-
<i>M. m. kermanesis</i>	-	-	-	-	-	-	-	-	-	-	-

Numbers show the sampling localities on the map.

Iran[3,4,7,25].

O. bacoti was collected with different frequency rate in *T. indica*, *M. libycus*, *M. musculus*, *N. indica*, *A. dimidiatus*, *C. hotsoni* and *J. blanfordi*. This mite is a potential vector of *Rickettsia* spp. and *Coxiella burnetii* and may cause dermatitis in human[26]. *O. bacoti* were previously reported amongst rodents from southeastern and southern Iran[4,5,7,27].

Rhipicephalus spp. infestation as ixodid tick was seen in *T. indica*, *M. musculus*, *A. dimidiatus*, *J. blanfordi* and *Hylaomma* spp. in *G. nanus*. Both ticks can be transmitted CCHF virus[28]. In recent years, there were an increasing number of reports about CCHF virus in the region under study[9].

In this study, the highest ectoparasites infestation was observed in *T. indica*. Among the collected ectoparasites, the species of flea and ixodid tick have the potential risk of transmission of plague and CCHF to human. The monitoring and controlling of vectors populations need more consideration especially in the southeast of Iran.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

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