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Determination of hard tick species (Acarina: Ixodidae) on sheep and cattle in Hamedan Province, Iran

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ABSTRACT

Objective: To determine the fauna and frequency of hard tick species on sheep and cattle in Hamedan Province, Western Iran.

Methods: Tick sampling was performed on the whole body of 18 000 sheep and 4 200 cattle in 3 rural regions (mountain, plateau, and plain-mountainous zone) during the year of 2010 to 2011. The ticks were identified with appropriate identification keys.

Results: A total of 1 534 hard ticks (62.1% male and 37.9% female) were collected in animals. The infestation rate was found 2.4% in animals (4.2% in cattle and 2.0% in sheep). The ticks were classified into 3 genera and 7 species including: *Hyalomma marginatum* (34.1%), *Hyalomma excavatum* (29.7%), *Rhipicephalus bursa* (13.8%), *Rhipicephalus sanguineus* (7.5%), *Hyalomma detritum* (7.1%), *Haemaphysalis punctata* (5.1%) and *Hyalomma dromedarii* (2.7%).

Conclusions: Current study is the first report of fauna and frequency of hard ticks in this region. The results showed that *Hyalomma marginatum* is the dominant hard tick species. Further studies are needed to determine the importance of Ixodidae ticks of veterinary and public health in this region of Iran.

1. Introduction

The hard ticks (Acarina: Ixodidae) are hematophagous arthropods with broad geographic distribution. They are obligatory ectoparasites of animals (mammals, birds, reptiles, amphibians) and humans[1-3].

Ticks and tick-borne diseases (TTBD) pose a major constraint for the development and improvement of the livestock industry[4,5]. The hard ticks can play a crucial role in economic losses by decreasing of milk production and weight loss, paralysis, anemia, skin irritation and transmission of wide range of pathogens including protozoa, bacteria, rickettsiae, spirochetes and viruses[6-8].

Important diseases in animals and humans such as Crimean-Congo hemorrhagic fever, tick relapsing fever, Botonoz fever, Omsk hemorrhagic fever, Russian spring-summer encephalitis, Colorado tick fever, Lyme disease, Rocky Mountain spotted fever, Q fever, babesiosis, theileriosis, anaplasmosis, ehrlichiosis, tularemia, rickettsiosis, tick encephalitis and tick paralysis, could be transmitted by various species of hard ticks[9-12].

The studies performed by the office of the Food and Agriculture Organization of the United Nations show that approximately 80% of the 1.28 billion populations of the worlds' cows are at risk of ticks' bites. The global economic losses due to TTBD have been estimated at 13.9 to 18.7 billion US$[10,13].

Knowing the fauna and prevalence of the tick species, which are involved in transmission of the diseases, and their geographical distributions, is important for the control of TTBD[6,8].

There are several limit scale reports on fauna and distribution of hard ticks in different region of Iran especially in northern regions[3,4,6-29]. However, there is no published information about

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the fauna and frequency of hard tick species on animals of Western Iran. The principal aim of our investigation was to determine the fauna and frequency of hard tick species on sheep and cattle in Hamedan Province, Western Iran.

2. Materials and methods

2.1. Study area

The Hamedan Province is mountainous and has a mild climate located in the western part of Iran (19 546 km^2: 34°49'11" N, 48°40'15" E). The mean annual rainfall and temperature is 317.7 mm and 11.3 °C, respectively. Hamedan Province is economically supported by an agricultural and animal husbandry, including sheep and cattle breeding. The Hamedan Province consists of 3 geographical areas including: the mountain (districts of Hamedan, Bahar, Asadabad, Toyserkan and Malayer), plateau (Razan and Kaboudarahang) and plain-mountainous (Nahavand).

2.2. Sample collection and examination

This study was conducted during 2010 and 2011. Tick sampling was performed on the whole body of 18 000 sheep and 4 200 cattle during the time of year when ticks are active in all of 3 rural regions. During the study, all animals were kept under natural condition without any application of acaricides. The collected specimens were counted and preserved in 70% ethanol in glass vials and brought to laboratory for further studies. Tick species determination was done using a stereo-microscope (Olympus) according to identification keys[26,30,31].

2.3. Data analysis

Statistical analysis was performed by using the software package SPSS version 16.0 for windows. Odds ratios, confidence interval (*CI*), χ^2 and *P*-value were calculated separately for each variable. *P*-value of less than 0.05 was considered statistically significant.

3. Results

In current study, 1 534 hard tick (male = 952 and female = 582) were collected from 22 200 animals (Tables 1, 2 and 3). Hard ticks were found on 2.4% of all animals surveyed (Table 4).

The statistical significant differences was seen between sheep and cattle infestations. The rate in cattle (4.2%; 95% *CI*: 3.6-4.8) was higher than sheep (2.0%; 95% *CI*: 1.8-2.2) (χ^2 = 66.993; *df* = 1; *P* < 0.000 1; odds ratios = 2.1). Regarding different geographical regions, the infestation rate in animals was 2.1% in Part 1, 3.6% in Part 2 and 3.8% in Part 3 (Table 4) (χ^2 = 5.162; *df* = 2; *P* = 0.075).

The ticks were classified into 3 genera and 7 species including: *Hyalomma marginatum* (*H. marginatum*) (34.1%), *Hyalomma excavatum* (*H. excavatum*) (29.7%), *Rhipicephalus bursa* (*R. bursa*) (13.8%), *Rhipicephalus sanguineus* (*R. sanguineus*) (7.5%), *Hyalomma detritum* (*H. detritum*) (7.1%), *Haemaphysalis punctata* (*H. punctata*) (5.1%) and *Hyalomma dromedarii* (*H. dromedarii*) (2.7%). Dominant species were determined *H. marginatum* (30.3%) in Part 1, *H. punctata* (29.8%) in Part 2 and *H. marginatum* (35.5%) in Part 3 (Table 3).

Table 1

The fauna and frequency of hard tick species in cattle. *n* (%).

Tick species	Part 1		Part 2		Part 3		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
H. excavatum	222 (68.5)		38 (86.4)		42 (39.6)		302 (63.7)	
	182	40	32	6	20	22	234	68
H. detritum	25 (7.7)		6 (13.6)		24 (22.6)		55 (11.6)	
	21	4	6	0	13	11	40	15
R. sanguineus	44 (13.6)		0 (0.0)		31 (29.2)		75 (12.8)	
	13	31	0	0	18	13	31	44
R. bursa	33 (10.2)		0 (0.0)		9 (8.5)		42 (8.9)	
	8	25	0	0	6	3	14	28
Total	324 (68.3)		44 (9.3)		106 (22.4)		474 (100.0)	
	224	100	38	6	57	49	319	155

Part 1: Mountain zone; Part 2: Plateau zone; Part 3: Plain-mountainous zone.

Table 2

The fauna and frequency of hard tick species in sheep. *n* (%).

Tick species	Part 1		Part 2		Part 3		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
H. excavatum	140 (17.5)		0 (0.0)		13 (11.4)		153 (14.4)	
	98	42	0	0	10	3	108	45
H. detritum	47 (5.9)		7 (4.9)		0 (0.0)		54 (5.1)	
	23	24	4	3	0	0	27	27
H. marginatum	398 (49.6)		48 (33.3)		78 (68.4)		524 (49.4)	
	205	193	40	8	52	26	297	227
H. dromedarii	31 (3.8)		10 (6.9)		0 (0.0)		41 (3.9)	
	20	11	6	4	0	0	26	15
R. sanguineus	35 (4.4)		5 (3.5)		0 (0.0)		40 (3.8)	
	26	9	1	4	0	0	27	13
R. bursa	151 (18.8)		18 (12.5)		0 (0.0)		169 (15.9)	
	86	65	10	8	0	0	96	73
H. punctata	0 (0.0)		56 (38.9)		23 (20.2)		79 (7.5)	
	0	0	38	18	14	9	52	27
Total	802 (75.6)		144 (13.6)		114 (10.8)		1060 (100.0)	
	458	344	99	45	76	38	633	427

Part 1: Mountain zone; Part 2: Plateau zone; Part 3: Plain-mountainous zone.

Table 3

The fauna and frequency of hard tick species in different studied regions. *n* (%).

Tick species	Part 1	Part 2	Part 3	Total
H. excavatum	362 (32.2)	38 (20.2)	55 (25)	455 (29.7)
H. detritum	72 (6.4)	13 (6.9)	24 (10.9)	109 (7.1)
H. marginatum	368 (35.3)	48 (25.5)	78 (35.5)	524 (34.1)
H. dromedarii	31 (2.8)	10 (5.3)	0 (0.0)	41 (2.7)
R. sanguineus	79 (7.0)	5 (2.7)	31 (14.1)	115 (7.5)
R. bursa	184 (16.3)	18 (9.6)	9 (4.1)	211 (13.8)
H. punctata	0 (0.0)	56 (29.8)	23 (10.4)	79 (5.1)
Total	1 126 (100.0)	188 (100.0)	220 (100.0)	1 534 (100.0)

Part 1: Mountain zone; Part 2: Plateau zone; Part 3: Plain-mountainous zone.

Table 4
The sample and infestation rate of animals in different studied regions.

Animals	Cattle			Sheep			Total		
	Sample (*n*)	Infestation [*n* (%)]	Range of infestation	Sample (*n*)	Infestation [*n* (%)]	Range of infestation	Sample (*n*)	Infestation [*n* (%)]	Range of infestation
Part 1	2900	124 (4.3)	1-22	14510	240 (1.6)	1-18	17410	364 (2.1)	1-22
Part 2	780	18 (2.3)	1-3	2010	83 (4.1)	1-8	2790	101 (3.6)	1-8
Part 3	520	34 (6.5)	1-5	1480	42 (2.8)	1-11	2000	76 (3.8)	1-11
Total	4200	176 (4.2)	1-22	18000	365 (2.0)	1-18	22200	541 (2.4)	1-22

Part 1: Mountain zone; Part 2: Plateau zone; Part 3: Plain-mountainous zone.

4. Discussion

Hard ticks (Ixodidae) members play a significant role as vector of pathogens on sheep and cattle in Iran[8]. In a study from the northwestern of central plateau of Iran, 3 genera of hard ticks were found including: *Hyalomma*, *Rhipicephalus* and *Haemaphysalis* which were parallel to our study[19]. Also, Telmadarraiy *et al*. carried out a study in the West-Azerbaijan area, Northwestern Iran, and reported 13 species of ticks including: *Boophilus annulatus*, *R. bursa*, *R. sanguineus*, *Dermacentor marginatus*, *Dermacentor niveus*, *Haemaphysalis sulcata*, *Haemaphysalis inermis*, *Hyalomma asiaticum*, *H. marginatum*, *Hyalomma aegyptium*, *Hyalomma dromdarii*, *Hyalomma schulzei*, *H. detritum* that 41% of collected ticks were from the genus *Hyalomma*[24]. In past studies in Iran, the population frequency of *Hyalomma* were reported to be higher than any genus[6,10,12-14,19,20,23,24,29], which is parallel to our finding.

In previous investigations in Iran, *H. marginatum* was reported in northern, northeastern, south, southeastern and central regions[6,11-14,18,26]. Also, the frequency rate was determined to be 65.3%, 46.0%, 20.3% and 13.2% in Northeast, Southeast, North and Central Iran, respectively[6,14,25,29]. In our study, *H. marginatum* is the dominant hard tick species (34.1%), which is similar to other investi gations[8,13,14,23,25,28].

H. marginatum with widely distribution has a 2-host life cycle. Adults infested cattle, horses, sheep, goats and camels are present on animals between March and November with a peak of activity in spring (April to May). The immature stages are active in summer and feed on small mammals such as hares and rabbits. The site of attachment on these hosts is the ears[26,30]. This species transmits the *Babesia caballi* and *Theileria annulata* (*T. annulata*) (under laboratory conditions). Also, it is responsible for transmission of the virus causing Crimean-Congo hemorrhagic fever to humans[30].

The distribution of *H. detritum* is widespread in Iran[26]. The frequency rate of this species was reported 3.5% and 4.9% in north and central of Iran, respectively[25,29]. Eastrada-Pena *et al*. assumed that adults of this two-host tick infest cattle, horse, sheep, goats and camels[30]. The immature stages feed on small mammals such as hares and rabbits and occur in the areas with Mediterranean climate of many widespread areas through to Central Asia. This species can transmit the *T. annulata* (causing tropical theileriosis) in cattle and *Coxiella burnetti* (causing Q fever) in livestock, small domestic animals and humans[30].

H. excavatum is adapted to the Mediterranean and steppe climates of North, Africa and to steppe and desert climates elsewhere. The distribution of this species is overlapped in some regions. *H. excavatum* have been reported all over of Iran[8,27,28]. The frequency rate of this species was reported 4.8%-14.8% in Iran[6,8,12-14,20,28]. Cattle, sheep, goats, camels, horses and donkeys are the hosts of this species. The ability of *H. excavatum* to act as vector of pathogens such as *Theileria* spp. is uncertain[30]. However, Razmi *et al*. showed that the *H. excavatum* was the dominant tick on the cattle in northeast of Iran and acted as vector of tropical theileriosis[8].

R. bursa and *R. sanguineus* have been reported all over of Iran[26,28]. Sofizadeh *et al*. emphasized that *R. bursa* occurred as a dominant tick in the most of domestic ruminants in Ghaemshahr County, Northern Iran[20]. In the study of Nabian *et al*., *R. bursa* was the minor species in sheep from Golestan and Ardabil regions, Northern Iran[25]. In Iran, the frequency rate of *R. bursa* and *R. sanguineus* were determined 4.6%-21.9% and 4%-19.8%, respectively[8,9,28]. *R. bursa* transmits the *Babesia bigemina*, *Babesia bovis*, *Babesia ovis*, *Babesia caballi* and *Anaplasma*[30]. *R. sanguineus* transmits the *Ehrlichia canis*, *Brucella canis* and *Hepatozoon canis* to dogs and *Rickettsia* spp. (causing tick typhus, or boutonneuse fever) in humans[30].

H. punctata was recorded throughout Rocky Mountain slopes of Caspian sea zone and in parts of the mountainous area in wooded, brushy location in northern part of Iran[9,26]. This species has been expending its range in most regions in Iran[9,14,20,21,25,27]. The frequency of *H. punctata* was determined 0.3%–17% in north regions of Iran[14,20,21,25]. The geographical distribution and ecological preferences of *Haemaphysalis* in domestic animals in Iran were studied by Rahbari *et al*.[27]. They found 7 species of *Haemaphysalis* on cattle, sheep and goats. *H. punctata* (3.4%) was the most abundant species[27]. This species is well known as the vector of *Babesia motasi* and *Babesia major*. Also, it has been demonstrated to carry *Rickettsia siberica* and to cause tick paralysis[25,30].

H. dromedarii is common in regions with Mediterranean, steppe and desert climates that are north of the equator in Africa. It is well adapted to extreme dryness of habitat and to camel hosts[30]. This species was reported in different regions (Sistan-va-balouchestan, Khorasan, Quom, Boushehr, Golestan, Boeenzahra and Takistan) of Iran[11,19,20,26]. In our report, this species had low frequency (2.7%) among collected ticks, unlike to Shemshad *et al*.[19]. The frequency rate of *H. dromedarii* was reported wide range (5.5% in Ilam to 55.9% in Yazd) in Iran[23,29]. The natural disease relations of this tick are not well understood. *H. dromedarii* can transmit the *T. annulata* in cattle under laboratory conditions[30].

In conclusion, the infestation rate in animals was more noticeable in plain-mountainous area. This is related to the favorite climatically condition as well as abundance of herds. The results of this research can provide baseline information for the future studies. Also, it seems the scientific strategic campaigning against tick infestation in this region is an inevitable task. This is the first report of fauna and frequency of hard ticks in this region. The results showed that *H. marginatum* is the dominant hard tick species. By attention to wide change of climate in this region, regular monitoring of distribution patterns of ticks is an important concern to control the TTBD. Also, the veterinary and public health importance of reported ticks should be emphasized.

Conflict of interest statement

We declare that we have no conflict of interests.

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