Original Article

Study on Hard and Soft Ticks of Domestic and Wild Animals in Western Iran

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Abstract

Background: Ticks are blood-sucking ectoparasites of many vertebrates and act as vectors of a wide range of vector-borne diseases. Alongside pathogens transmission, ticks also cause economic losses in animal industry such as production loss, physical damage, anemia, and poisoning. This study aimed to determine the fauna, geographical distribution and seasonal activity of ticks collected from animals in Lorestan Province, west of Iran.

Methods: Ticks were collected from domestic animals including cattle, sheep, goats, chickens, turkeys, pigeons, as well as wild animals such as jackals in 2017–2018. Then, they were identified based on morphological characteristics using valid identification keys.

Results: Out of a total of 706 ticks, 433 (61.33%), 104 (14.73%), 33 (4.67%) and 136 (19.26%) ticks were collected in spring, summer, autumn and winter, respectively. In terms of hard ticks, 4 genera and 6 species were identified: *Hyalomma asiaticum* (22.80%), *Hyalomma anatolicum* (3.68%), *Hyalomma marginatum* (2.40%), *Rhipicephalus sanguineus* (0.84%), *Dermacentor marginatus* (1.13%), and *Haemaphysalis sulcata* (0.64%). Additionally, two genera and four species fell into soft ticks: *Argas persicus* (60.48%), *Argas reflexus* (6.65%), *Ornithodoros canstrini* (0.70%) and *Ornithodoros erraticus* (0.42%). There was significant variation in the seasonal activity and abundance of ticks in different seasons but in the tick abundancy among different regions.

Conclusions: The present study provides a perspective of the distribution status of ticks in Lorestan Province, their seasonal activity and the likelihood of emergence of related diseases.

Keywords: Ectoparasites; Argasidae; Ixodidae; Lorestan; Tick Fauna

Introduction

Ticks are obligatory blood-sucking ectoparasites of different animals of mammals, reptiles, and birds which act as vectors of a wide range of viral, bacterial, and protozoan diseases. The most important diseases transmitted by ticks are Rocky Mountain spotted fever, Crimean-Congo hemorrhagic fever, Lyme disease, typhus, ehrlichiosis, tularemia, babesiosis, Colorado tick fever, and relapsing fever (1–6).

Alongside pathogens transmission, ticks cause important economic losses in animal industry. They also cause production losses, physical damages, anemia and poisoning, as well as negative impacts on human public health including annoyance, dermatitis, fatigue, malnutrition, and even death (7,8). Almost 900 recognized species of ticks fall into three major families: Ixodidae, Argasidae and Nuttalliellidae (a monotypic family representing the most primitive living lineage of ticks) (9). The growing number of ticks has a connection with rising accessibility of new environments and an increase in the number of host species specially in wild animals (10). Besides, climate chang-

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es, especially temperature rise, have expanded the range of many tick species as warm conditions make the environment more suitable for these vectors (11, 12).

Therefore, the effects of infestation with ticks impose more effects on the lives of humans and animals. Also, the need for studies on tick fauna and their environmental ecology in different geographical areas is felt more than before.

The first study of ticks in Iran was conducted by Delpy on the prevalence of hard ticks (Ixodidae); Furthermore, Abbasian-Lintzen (13) and Mazloum (14) reported a list of ticks, collected from different livestock. Over time, many studies were conducted in different parts of Iran regarding of ticks infesting livestock (15–20).

Some studies examined the fauna of ticks in western Iran. Davari and colleagues investigated the distribution and fauna of ticks in Aleshtar county in Iran (21). Kayedi et al. (22) also identified hard and soft ticks collected from livestock in Aleshtar and Aligudarz counties, Lorestan Province, Iran. Ramezani et al. (23) also studied the ticks of livestock and their seasonal activities in northwest of Iran. However, an up-to-date and comprehensive study that examines most of the province counties in all seasons seems necessary. The aim of this study was to determine the fauna, geographical distribution, and seasonal activity of ticks collected from animals in Lorestan Province, west of Iran.

Materials and Methods

Study area

Lorestan Province (33.4871°N; 48.3538°E) covers an area of 28,294km^2 in western Iran. It shares borders with Hamadan Province in the north, Markazi Province in the northeast, Isfahan Province in the east, Khuzestan Province in the south, Ilam Province in the west, and Kermanshah Province in the northwest. The highest point of the province is the Oshtorankuh mountain (more than 4,000m above sea level, asl) while the low-lying areas are in the southern parts of the province (500m asl). Climatically, the province can be divided into two types of the mountainous experiencing cold winters and moderate summers, and warm weather experiencing hot summers and relatively moderate winters. 70% of Lorestan villages are located in mountainous areas and 30% in plains. According to Iran's Statistics Organization in 2016, there were 246,900 cows, 1864,300 sheep and 814,900 goats in Lorestan Province.

Collection of ticks and their identification

In this investigation, 24 villages from 7 counties of Lorestan Province including Dorud, Dowreh, Delfan, Selseleh, Kouhdasht, Pol-e-Dokhtar, and Khorramabad were selected for sampling. Ticks were collected from both plains and mountains during winter 2017 until the fall of 2018 using forceps and were placed into separate labelled vials. A multistage random sampling method was used in which four livestock holding units were randomly selected from each village for tick collection. Ticks were collected from domestic animals including cattle, sheep, goats, chickens, turkeys, and pigeons, as well as wild animals such as jackals. Samples were transferred to the Tick laboratory, Department of Medical Entomology, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran, along with the cold chain for species identification. Genera and species were diagnosed under stereomicroscope according to valid morphological keys (24).

Ethical approval for this study was obtained from Tehran University of Medical Sciences Board (Approval number/ID: IR.TUMS.SPH.REC.1399.244).

Results

Of 706 ticks collected, 224 hard ticks (31.73%) and 482 soft ticks (68.27%) were identified during sampling period .In terms of hard ticks, four genera and six species were identified including: *Hyalomma asiaticum* Schulze

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and Schlottke, 1930 (22.80%), *Hy. anatolicum* Koch, 1844 (3.68%), *Hy. marginatum* Koch, 1844 (2.40%), *Rhipicephalus sanguineus* Latreille, 1806 (0.84%), *Dermacentor marginatus* Sulzer, 1776 (1.13%), and *Haemaphysalis sulcata* Canestrini and Fanzago, 1878 (0.64%). Aiddittonally, two genera and four species fell into soft tick family including: *Argas persicus* Oken, 1818 (60.48%), *A. reflexus* Fabricius, 1794 (6.65%), *Ornithodoros canstrini* Bir 1895 (0.70%) and *O. erraticus* Lucas, 1849 (0.42%). Chi-square test showed a significant difference between the sampling area and tick species (P= 0.001) (Table 1, Fig. 1).

Out of a total of 706 ticks, 433 (61.33%), 104 (14.73%), 33 (4.67%) and 136 (19.26%) ticks were collected in spring, summer, autumn and winter, respectively (Fig 2). Chi-square analysis revealed a significant difference between the tick distribution and different seasons (P= 0.000).

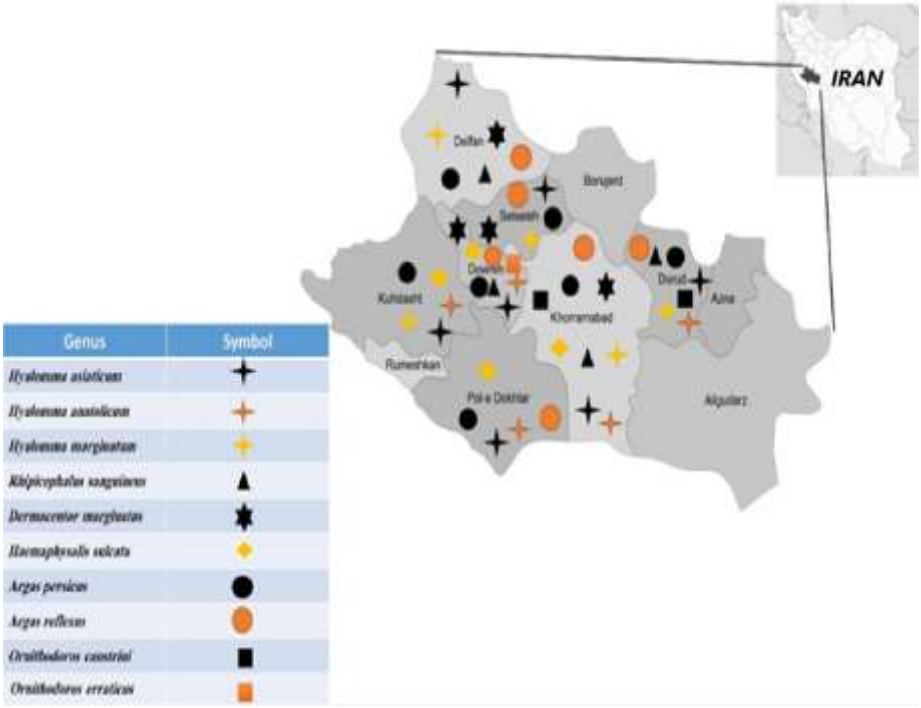

Fig. 1. Distribution map of tick species collected from different counties of Lorestan Province, west of Iran, 2017–2018

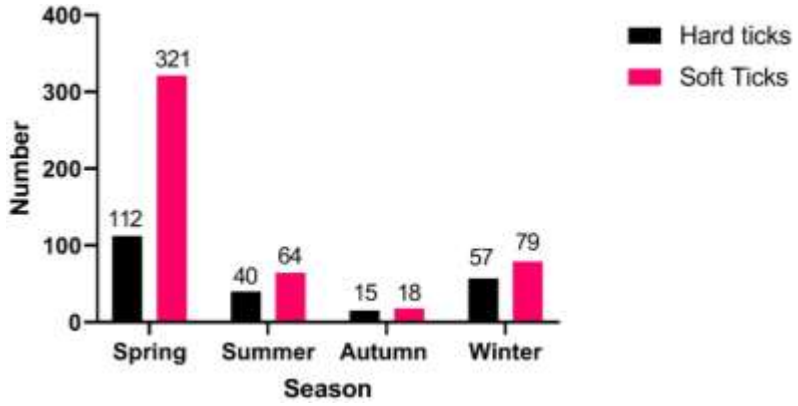

Fig. 2. Seasonal distribution of hard and soft ticks collected in Lorestan Province, west Iran, 2017–2018

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Table 1. Geographical abundance, percentage, and distribution of ticks in Lorestan Province, 2017–2018

Tick Species	Location							Total N (%)
	Dorud N (%)	Dowreh N (%)	Delfan N (%)	Selseleh N (%)	Kouh Dasht N (%)	Pol-e-Dokhtar N (%)	Khorramabad N (%)	
Hyalomma asiaticum	11 (6.8)	33 (20.5)	20 (12.4)	18 (11.2)	32 (19.9)	28 (17.4)	19 (11.8)	161 (22.8)
Hyalomma anatolicum	1 (3.8)	4 (15.4)	0 (0)	0 (0)	7 (26.9)	11 (42.3)	3 (11.5)	26 (3.7)
Hyalomma marginatum	1 (5.9)	0 (0)	6 (35.3)	7 (41.2)	1 (5.9)	0 (0)	2 (11.8)	17 (2.4)
Rhipicephalus sanguineus	1 (16.7)	3 (50.0)	1 (16.7)	0 (0)	0 (0)	0 (0)	1 (16.7)	6 (0.85)
Dermacentor marginatus	0 (0)	2 (25.0)	1 (12.5)	1 (12.5)	0 (0)	0 (0)	4 (50.0)	8 (1.1)
Haemaphysalis sulcata	0 (0)	1 (16.7)	0 (0)	0 (0)	1 (16.7)	1 (16.7)	3 (50.0)	6 (0.85)
Argas persicus	14 (3.3)	54 (12.6)	87 (20.4)	42 (9.8)	91 (21.3)	59 (13.8)	80 (18.7)	427 (60.5)
Argas reflexus	1 (2.1)	14 (29.8)	7 (14.9)	12 (25.5)	0 (0)	3 (6.4)	10 (21.3)	47 (6.7)
Ornithodoros canstrini	2 (40.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (60.0)	5 (0.7)
Ornithodoros erraticus	0 (0)	3 (100.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.4)
Total	31 (4.4)	114 (16.15)	122 (17.3)	80 (11.3)	132 (18.7)	102 (14.45)	125 (17.7)	706 (100)

Discussion

The results of the present study showed that of 706 collected ticks, 224 belonged to hard ticks and 482 were soft ticks. Further to soft ticks, the dominant genus was *Argas* and the dominant species was *A. persicus*. Among hard ticks, the most common genera and species were *Hyalomma* and *Hy. asiaticum*, respectively. Variation of *Hyalomma genus* was more demonstrated. Statistical analyzes showed that there is a significant relationship between seasons and tick distribution. As a result, the prevalence of ticks is higher in spring and summer than in autumn and winter. We suggest that temperatures increase in spring season and provides favorable weather conditions that facilitates the growth and survival of ticks during the spring season in the study area. Also, it is shown that abiotic factors such relative humidity, temperature, and rainfall and biotic (availability of animal richness impact tick densities and activity (25–27). This is in concordance with the results of other researchers indicating variation in seasonal activity of ticks (12).

The Chi-square test showed a significant difference between the sampling area and tick species. The frequency of *Hyalomma*, *Dermacentor*, *Haemaphysalis* and *Ornithodoros* genera were high in Khorramabad which is a mountainous region while *Argas* and *Repicephalus* were the most abundant species in plain region such as Delfan and Dowreh counties, respectively.

In concordance with our study, Davari et al. showed that *A. persicus* was the most frequent species of soft ticks in Lorestan Province (21). However, they also concluded that *Rh. sanguineus* was the dominant species in the region which is different from our results. This difference could be justified due to limited sampling area in Davari's research. Additionally, in both researches the frequency of ticks was higher in spring, which is reasonable due to the pick of tick activity in warmer seasons. Furthermore, Kayedi and colleagues reported that *A. persicus* was the dominant soft tick species in the area (22). However, they also concluded that the dominant species in Aleshtar and Ali-

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godarz counties was *Rh. sanguineus*. It should also be noted that they only surveyed two counties which were lower than our sampling areas. Kayedi et al. (22) also concluded that tick frequency deceased from spring to winter during the year, the same as our result. *Hyalomma asiaticum* is the second most prevalent species in the present study. A survey on fauna of ticks in West Azerbaijan Province showed high prevalence of *Rh. sanguineus* and *Hy. asiaticum* (24). Another study revealed presence of nine species of hard ticks in northwest of Iran (23). A study of tick fauna in Tandoureh National Park, Khorasan Razavi, east of Iran, revealed that six species were present: D. *niveus* (47.2%), *Rh. turanicus* (32.9%), *D. raskemensis* (8.6%), *Hy. turanicum* (5.6%), *Ha. sulcata* (3%) and *Hy. aegyptium* (2.6%) (28). In that study, *D. niveus* was the most predominant species. This species is distributed in semi-deserted areas. This could be the reason behind the absence of this genus in our study area. In another study conducted on hard ticks of domestic ruminants and their seasonal dynamics in Yazd Province, east of Iran, ticks were classified into three genera and seven species including *Hy. dromedarii* (55.92%), *Hy. marginatum* (13.20%), *Hy. anatolicum* (9.78 %), *Hy. detritum* (4.98%), *Hy. asiaticum* (3.94 %), *Rh. sanguineus* (11.84%), and *D. marginatus* (0.34%). The highest seasonal activities occurred in summer (29). In a study on the border of Iran-Pakistan, southeast corner of Iran, the collected ticks were classified into three genera: *Hyalomma* (90.7%), *Rhipicephalus* (6.1 %), and *Dermacentor* (3.2%) where *Hy. anatolicum* was the most common species in the study area (30).

In north of the country, 15 species of ticks were identified based on their morphological characteristics including *Rh. sanguineus, R. bursa, I. ricinus, Ha. punctata, H. sulcata, H. erinacei, H. inermis, Hy. marginatum, Hy. asiaticum, Hy. excavatum, Hy. anatolicum, Hy. dromedarii, Hy. detritum, B. anulatus* and *A. persicus.* Dominant species were *Rh. sanguineus* and *Hy. asiaticum* respectively (31). *Haemaphysalis asiaticum* also ranked second prevalent species in our study. However, fewer species were found in the present study. In a study in south Khorasan Province, east of Iran, two genera and seven species of ticks were identified including: *Rh. Sanguineus* (21.9%), *Hy. detritium* (25.0%), *Hy. marginatum* (2.4%), *Hy. anatolicum* (0.8%), *Hy. asiaticum* (1.6%), *Hy. dromedarii* (43.0%) and *Hyalomma* sp. (4.7%) (32). Other studies in eastern parts of Iran also revealed that *Rhipicephalus* and *Hyalomma* are more prevalent (33, 34). In terms of Soft ticks' dominance in Iran, *Argas* genus is the only or the dominant species. In general, the differences between different studies of tick fauna can be justified due to variations in sample size, geographic area, hosts, date of collection and vegetation.

Argas persicus (fowl tick or poultry tick), is found predominantly on chickens, ducks, and geese. Lorenz Oken reported this species in Mianeh for the first time. They are carriers of *Borrelia anserina*, causative agent of avian spirochetosis, one of the most serious infections of the poultry. *Hyalomma* genus is the most important tick species associated with Crimean-Congo haemorrhagic fever virus (CCHFV). The most abundant species found in Iran are as follows: *H. anatolicum, H. asiaticum, H. detritum, H. dromedarii, H. excavatum, H. marginatum, H. rufipes* and *H. schulzei* (1, 12, 35). *Repicephalus sanguineus* and *D. marginatus* are also involved in CCHFV transmission. Due to the predominant tick fauna of the region and the possibility of and *Borrelia* epidemics, further studies in this field seem necessary to prevent the risk of potential occurrence.

Ornithodoros erraticus which was identified in our study, plays an important role in the transmission of the Qalyub virus, African swine fever viruses, *Borrelia procedure*, and *B. hispanica* (36, 37). Clarification of the status of these diseases in the ticks of the region requires molecular approaches to provide a clear view, although the occurrence of these diseases in Iran seems rare.

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Conclusions

The present study provides a perspective of the distribution status of ticks in Lorestan Province, their seasonal activity and the likelihood of emergence of related diseases. Awareness of the potential risk of diseases will assist with animal and public health.

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Ethical considerations

Ethical approval for this study was obtained from Tehran University of Medical Sciences Ethics board (Approval number: IR.TUMS.SPH.REC.1399.244).

Conflict of interest statement

Authors declare that there is no conflict of interest.

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