

Investigation on Species Composition of Hard Tick (Metastigmata: Ixodidae) Vectors of Different Microbiological Agents in Sari County, Iran

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(Received: 20 March 2012; accepted: 07 May 2012)

This paper introduces the first faunestic, abundance and distribution of ixodid ticks in Sari County, Iran by inspecting domestic ruminants. A total of 2356 domestic ruminants were examined for ticks. The species collected from livestock showed presence and abundance of six species in four genera. The most abundant species were *Hyalomma marginatum* (41.2%) followed by *Hyalomma anatolicum excavatum* (21.35%) and *Ixodes ricinus* (17.78%). Ixodid tick infestations on hosts were 46.16%, 32.49% and 21.35% for goats, cattle and sheep, respectively. The seasons of highest infestation were fall and spring, the least being winter and summer. The occurrences of the ticks on various parts of the hosts' body were different. Based on the results veterinary and public health investigations are necessary in the study area.

Key words: Distribution, Hard ticks, Domestic ruminants, Sari, Mazandaran, Iran.

Ticks are very important obligate ectoparasite of wildlife, domestic animals, and humans in tropical and sub-tropical areas (Bram, 1983). They are of terrestrial vertebrates and all the stages of their life cycle are exclusively feed on blood and cause server economic losses (Sonenshine, 1993; Ghosh *et al*, 2007a). Because of changing in ecology and the environment due to land development, global warming and man-made disasters, much information from the past may no longer be relevant and there is a need to update this information for public health interests

and research purposes (Nabian *et al*, 2007). In recent years, the problems of re-emerging and emerging diseases especially tick-borne diseases (TBDs) have gained increased attention (de Castro 1997; Ghirotti and Maroli 1997; Jongejan 1999). Delpy in 1938 carried out the first faunestic studies of ticks in Iran, and later Filippova *et al*. (1976) presented data for 642 ixodid ticks taken from small wild mammals in different topographical areas of the country. Having information about prevalence of different tick species and their geographical distribution is very important for the control of ticks and Tick-borne diseases. However, so far, there is little study about tick fauna and distribution in different hosts in Iran including Sari County

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(Abbasian, 1961; Mazlum, 1971; Rahbari, 1995; Shayan and Rafinejad, 2006; Nabian *et al.*, 2007, Shemshad *et al.*, 2010; Sheikh, 2010; Nourollahi Fard and Khalili, 2011). Complete information regarding the availability of different species in different months of the year is very important in relation to devise necessary control strategies. Therefore, the main aim of this survey was to determine data on the species and distribution of ticks infesting domestic ruminants in Sari County.

MATERIALS AND METHODS

Study area

Mazandaran province with the area of 23,833 km² has been located in north of Iran, bordering the Caspian Sea. Sari is the provincial capital. Among the counties of Iran, Sari has a mild climate together with adequate vegetation conditions, abundant superficial water resources, which is favorable to agriculture and animal husbandry and provides adequate conditions for the survival of several hard tick species (Figure 1).

Tick collection

During 2009-2010, ticks were collected from 2,356 domestic ruminants including cattle, goats and sheep that grazed in the study area over a period of one year. At each sampling season, a variable number of whole bodies of randomly selected domestic animals were examined for tick infestations. All specimens were stored in 70% alcohol in glass vial, labeled with the data including date of collection, location, host, and method of collection. The infestation rate was categorically determined examining different body parts of hosts through naked eye. Time spent for each collection was 30 minutes for each locality and the collections

were arranged for two days per week. Ticks were cleared using 15% potassium hydroxide before their identification. Collected hard ticks examined under a stereomicroscope (Zeiss) and identified using available taxonomic keys to the species level (Hoogstraal, 1956; Walker *et al.*, 2003) in medical entomology laboratory, Faculty of Health, Mazandaran University of Medical Sciences. Identification of sexes and different lifecycle stages (except eggs) were made.

RESULTS

Ticks on domestic ruminants

During the study period from September 2009 to August 2010, a total number of 324 cattle, 575 goats and 1457 sheep were examined for tick collection. A total number of 1068 ticks in 4 genera and 6 species including 578 males, 393 females and 97 nymphs were collected from different localities of the study area and identified at the species level. Ticks species found were *Hyalomma marginatum* Koch, 1844 (41.20%) followed by *Hyalomma anatolicum excavatum* Koch, 1844 (21.35%) and *Ixodes ricinus* (Linnaeus, 1758) (17/78%), *Rhipicephalus (Boophilus) annulatus* (Say, 1821), *Rhipicephalus bursa* Canestrini & Fanzago, 1878 and *Hyalomma asiaticum*. The least abundance of the species was found in winter. The most diversity of tick species determined within the genus *Hyalomma* with three species; *Hyalomma marginatum marginatum*, *Hyalomma anatolicum excavatum* and *Hyalomma asiaticum* (Table 1). Table 2 shows the collection of ticks from different body parts of the hosts. The goat and sheep were infested with highest numbers of ticks in under the tails. The results show that maximum number

Table 1. Number and percentages of tick species collected from domestic ruminants in Sari County during 2009-2010

Species	Number of ticks	Percent (%)	Male (n/%)	Female (n/%)	Nymph (n/%)
<i>Boophilus annulatus</i>	44	4.12	18(3.11)	16(4.07)	10(10.31)
<i>Rhipicephalus bursa</i>	76	7.12	38(6.57)	29(7.38)	9(9.27)
<i>Ixodes ricinus</i>	190	17.78	105(18.17)	67(17.05)	18(18.56)
<i>Hyalomma marginatum</i>	440	41.20	250(43.25)	164(41.73)	26(26.81)
<i>Hyalomma anatolicum excavatum</i>	228	21.35	118(20.41)	81(20.61)	29(29.90)
<i>Hyalomma asiaticum</i>	90	8.43	49(8.49)	36(9.16)	5(5.15)
Total	1068	100	578	393	97

of ticks were collected from udder and testis 135(38.90%), followed by udder and under the tail 74(21.33%) and minimum number of ticks were found on the chest 34(9.80%).

Seasonal activity of adult and nymph stage

The adult and nymph seasonal activity curves have been shown in Fig. 2. The most ticks were found on the host during humid months,

spring and autumn, and out of the total collection the majority of ticks (34.08%) were collected in the spring season followed by summer (23.22%), and 28.93 in autumn. The minimum numbers (13.77%) were collected in the winter (Table 3).

Incidence and infestation rate

Of the 2356 domestic ruminants examined, 1068 (45.33%) were infested with a total number of

Table 2. Distribution of Ixodid ticks in different body parts of domestic ruminants in the study areas in Sari County during 2009-2010

Animals	Ear (n/%)	Chest (n/%)	Udder and testis (n/%)	Under the tail (n/%)	Shoulder and neck (n/%)	Other parts (n/%)	Total (n/%)
Cattle	47(13.54)	34(9.80)	135(38.90)	74(21.33)	41(11.82)	16(4.61)	347(32.49)
Goat	113(22.92)	54(10.95)	89(18.05)	186(37.73)	38(7.71)	13(2.64)	493(46.16)
Sheep	127(55.71)	5(2.19)	32(14.04)	46(20.17)	18(7.89)	0(0)	228(21.35)
Total	206	93	256	387	97	29	1068

Table 3. Number and percentages of different sexes and stages of hard ticks collected from study areas in different seasons in Sari County during 2009-2010

Season	Male (n/%)	Female (n/%)	Nymph (n/%)	Total (n/%)
Spring	196(33.90)	123(31.30)	45(46.39)	364(34.08)
Summer	135(23.36)	95(24.17)	18(18.56)	248(23.22)
Autumn	162(28.03)	118(30.03)	29(29.90)	309(28.93)
Winter	85(14.71)	57(14.50)	5(5.15)	147(13.77)
Total	578	393	97	1068

Table 4. Number of hard ticks collected from different hosts in the study areas of Sari County during 2009-2010

Animals species	Number of animal observed	Percentage (%)	Number of ticks collected	Percentage (%)
Cattle	324	13.57	347	32.49
Goat	575	24.40	493	46.16
sheep	1457	61.85	228	21.35
Total	2356	100	1068	100

Table 5. Total domestic ruminants examined inspecting for hard ticks in Sari County during 2009-2010

Hosts	Animal observed (n/%)	Animal infested (n/%)	Animal non infested (n/%)
Cattle	324(13.75)	38(15.83)	286(13.52)
Goat	575(24.41)	86(35.83)	489(23.11)
Sheep	1457(61.84)	116(48.34)	1341(63.37)
Total	2356	240	2116

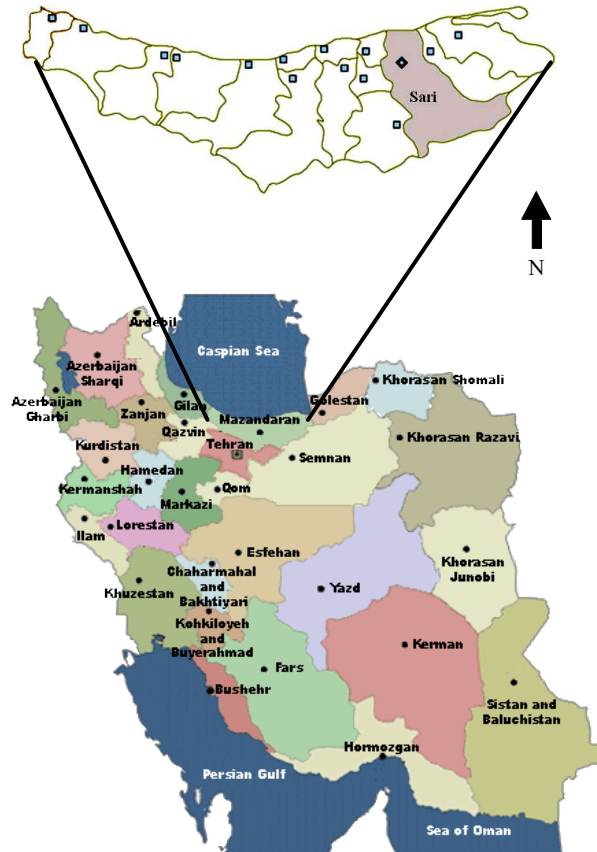


Fig. 1. Map of Iran and location of Sari county in Mazandaran Province, Iran Meteorological organization 2010

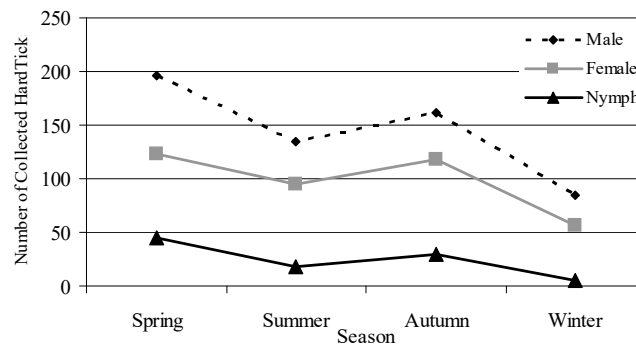


Fig. 2. Seasonal abundance of hard ticks collected from Sari county during 2009-2010

1068 ixodid ticks. During the study period, a total of 2356 domestic animals, including 324 cattle, 575 goat and 1457 sheep were searched which cattle 38(15.83%), goat 86(35.83%), sheep 116(48.34%) were positive for ixodid ticks (Table 3). Results showed that the overall infestation rate with different species of hard ticks and stages was

generally high. The highest number of ticks were collected from goat 493 (46.16 %) followed by cattle 347(32.49%) and minimum number of ticks were found on sheep 228(21.35%) (Table 4). Different rate of male and female hard ticks was observed in different seasons of the year (Table 2). Hard ticks nymphs peaked in the spring. Infestations with

Hyalomma anatolicum excavatum were the highest density. The peak of infestation occurred on goats were infested with a percentage of 46.16%. The sex ratio varied throughout the year of study. The smallest male/female ratio was in autumn and the largest was in spring but the number of male ticks was found higher than female ticks in all examined hosts (Table 4, 5).

DISCUSSION

The occurrence of suitable hosts and favorable climate conditions in Sari benefit distribution and maintenance of ticks' abundance. This descriptive study, extending over four seasons, considered the species composition of hard ticks involved, the levels of infestations, and the seasonal activity carried out in Sari County. During the survey of one year a total 2356 domestic animals (sheep, goats and cows) were examined for tick infestation. Overall 10.19 of the total farm animals were found positive with highest infestation in sheep (48.34) following by goat (35.83%) and cattle (15.83%). The population densities of *Hyalomma marginatum* were higher than the other species. Genus *Hyalomma* comprises about 41.20% of collected species in the areas. Mazlum (1971) reported all of these *Hyalomma* species, excluding *H. asiaticum* in Mazandaran province. Nabian *et al* (2007) observed only *H. anatolicum* and *H. detritum* with low prevalence in Mazandaran. The high infestation rate maybe due to livestock high exposing to the ticks during grazing in field. The *Hyalomma* sp. was the most common species among domestic ruminants in the study area. In the present study the percentage of infestation as well as mean number of ticks per infested host was found higher in goats which indicate that goats are the most suitable host for ticks. Animals were found infested with ticks throughout the year but their infestation rate varied with the season. When comparing data from the cold and dry seasons (winter and summer) with those from the wet and rainy seasons (spring and autumn), the mean numbers of ticks were the highest frequency during spring and autumn, and minimum in winter. The reason for this observation is probably due to the optimal conditions including climatic conditions, such as temperature and

relative humidity for hard ticks' development in the study area (Heath, 1995). Yakhchali and Hosseine (2006) reported higher prevalence of different species of tick in winter and lower prevalence in summer seasons from different parts of Iran. Most of the tick distribution on body of host showed a strong preference for some particular site on their hosts. The highest number of ticks collected from udder and testis followed by under the tail of cattle, whereas sheep in ears and goat under the tail were preferable infestation sites. The reason for this result is maybe due to the fact that, skin is comparatively softer at udder, testes and under the tail and has rich blood supply as a result. Omar *et al* (2007) collected maximum number of ticks from ear of sheep and goats and chest as well as under tail of cattle from Iraq. Wahid ur-Rahman *et al* (2004) collected maximum number of ticks from ear of cattle, goat and udder of buffalo from Rawalpindi and Islamabad of Pakistan. In the collected ticks the males were found highest in comparison to females and nymphs. The reason for this result is maybe due to the fact that females leave the animals after they reach to adult stage. It is an established fact that ticks act as a vector of various diseases to animals as well as human beings, causing great economic losses. Furthermore, the farmers are not taking serious consideration about the frequency of occurrence of ticks. Hard ticks were found feeding on domestic ruminants throughout the year of study. The size and seasonality of tick populations depend on the survival of ticks through the different life cycle processes (Sutherst *et al*, 1979). The gross climatic features affect such survival in the different geographical areas (Sutherst and Maywald, 1985). Local microclimatic conditions, vegetation, soil, topography are also important and depend upon the topography and the type and amount of the vegetation cover (Theiler, 1969; Branagan, 1970). Therefore, more epidemiological and molecular studies are needed in this region of Sari county in order to establish measures for their control, as well as to find out the factors that create control program and to find out the role of these tick species in transmission of other diseases. To the best of our knowledge comprehensive faunistic study of Sari County has not been described before.

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