

A survey of ticks (Acari: Ixodida) infesting some wild animals from Sivas, Turkey

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Received: 15 September 2014 / Accepted: 5 March 2015 / Published online: 18 March 2015
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Abstract In order to determine the species composition of infesting ticks, between 2011 and 2012 a total of 1118 wild animals were captured from various regions of Zara, Sivas province, Turkey. A total of 138 ticks were obtained from the 58 host animals. Ticks were identified as *Dermacentor marginatus* (Sulzer), *Haemaphysalis erinacei taurica* Pospelova-Shtrom, *Haemaphysalis parva* (Neumann), *Haemaphysalis punctata* Canestrini and Fanzago, *Haemaphysalis sulcata* Canestrini and Fanzago, *Hyalomma marginatum* Koch, *Ixodes laguri* Olenov, *Ixodes ricinus* (L.), *Ixodes vespertilionis* Koch and *Rhipicephalus turanicus* Pomerantzev. To the best of our knowledge, there are several new host records for *D. marginatus*, *H. e. taurica* and *I. laguri*. In addition, *I. vespertilionis* was recorded for the first time in the Central Anatolian Region in Turkey, whereas *I. laguri* and *H. e. taurica* are firstly reported in Sivas.

Keywords Ticks · Wild animals · Zara · Sivas · Turkey

Introduction

Most of the wild animals, especially ungulates and rodents, are known to be suitable hosts for ticks (Kolonin 2007). Wild animals may play an important role in natural cycles of several tick-borne pathogens, including viruses, bacteria and protozoa, acting as their reservoir or as feeding source for the tick vectors (Bengis et al. 2004; Skuballa et al. 2007;

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Silaghi et al. 2012). Therefore, the knowledge of ticks infesting wild animals is very useful to clarify to natural cycles of ticks and tick-borne pathogens.

Turkish tick fauna currently consists of 47 species belonging to nine genera (Bursali et al. 2012; Keskin et al. 2014). Most of literature regarding Turkish ticks has concentrated on their medical and veterinary significance (Bursali et al. 2010, 2011, 2013; Gargili et al. 2011; Bakirci et al. 2014). Nevertheless, ecological and systematic studies on Turkish ticks have been mainly neglected and many tick–host associations are still poorly known.

In this study, we investigated ticks infesting some wild animals in Zara region, Sivas, Turkey. Here, we detected new tick–host association and locality records for the Central Anatolian Region in Turkey.

Materials and methods

Study area

Zara region (Sivas province, Turkey) is located at the eastern part of the Central Anatolian region of Turkey with geographical coordinates of 39°53'42" North and 37°45'11" East. This region has a total land area of 2456 km². It is located on the Anatolian Diagonal and has a rich plant and animal diversity. The Central Anatolia Region climate is characterized by hot and dry summers and cold and snowy winters. Altitude within the districts ranges between 1350 and 3500 m. The mean annual precipitation is 528 mm. The mean annual minimum temperature is −36.2 °C in January, whereas the mean maximum temperature is 39.2 °C in July. Livestock farming is the main livelihood of Zara region. Wild animals such as wild boars, small rodents such as hares, reptiles and partridges are abundant in the fauna of the province.

Collection and identification of ticks

Between 2011 and 2012, ticks were collected from randomly captured some wild animals. Reptiles and hedgehogs were captured by hand, while bats, birds and rodents were captured by live animal traps (Sherman traps or mist-nets). All captured animals were checked for tick infestations and immediately released to nature. Ticks were removed from animals with the help of tweezers and stored (individualized per host) in labeled vials containing 70 % alcohol. Tick samples were deposited to the Turkish Tick Collection (TTC), Department of Biology, Gaziosmanpasa University, Tokat, Turkey. Adult ticks were identified based on morphological characters by given Filippova (1977, 1997) and Apanaskevich and Horak (2008), whereas immature ticks were identified by the use of keys of Nosek and Sixl (1972) and Filippova (1977, 1997).

Results

Overall, 1118 wild animals (97 amphibians, 691 reptiles, 9 birds and 321 mammals) belonging to 24 species were examined for tick infestation. Examined wild animals (total numbers/positive numbers in parentheses) were recorded as follows: from amphibians: *Pseudepidalea variabilis* (Pallas) (46/0), *Pelobates syriacus* Boettger (21/0), and *Pelophylax ridibundus* (Pallas) (30/0); from reptiles: *Parvilacerta parva* (Boulenger) (297/0),

Table 1 Ticks collected from some wild animals in Zara region, Sivas, Turkey

Tick data		Host data								
Species	L	N	M	F	Total	Species	M	F	Total	Collection dates
<i>Dermacentor marginatus</i>	6	38			44	<i>Erinaceus concolor</i> ^a	7	5	12	26.05.2011–14.08.2012
	1				1	<i>Plecotus macrobullaris</i> ^a	1		1	21-05-2012
<i>Haemaphysalis erinacei taurica</i>	3				3	<i>Apodemus flavicollis</i> ^a		1	1	03-08-2011
	2	15		5	22	<i>Erinaceus concolor</i>	8	1	9	28.08.2011–14.08.2012
<i>Haemaphysalis parva</i>	7	8		1	16	<i>Erinaceus concolor</i>	1	9	10	04.08.2011–14.08.2012
<i>Haemaphysalis punctata</i>	7	4			11	<i>Erinaceus concolor</i>		3	3	30.07.2012–04.08.2012
<i>Haemaphysalis sulcata</i>	2	1			3	<i>Erinaceus concolor</i>	3		3	28.08.2011–01.08.2012
<i>Haemaphysalis</i> sp.	3				3	<i>Erinaceus concolor</i>	3		3	30.07.2012–01.08.2012
<i>Hyalomma marginatum</i>			2	2	4	<i>Erinaceus concolor</i>	3	1	4	08.06.2011–02.08.2012
<i>Hyalomma</i> sp.	3				3	<i>Erinaceus concolor</i>	1	1	2	31.07.2012–01.08.2012
<i>Ixodes laguri</i>				1	1	<i>Erinaceus concolor</i> ^a		1	1	30-07-2012
<i>Ixodes ricinus</i>		1			1	<i>Erinaceus concolor</i>	1		1	28-08-2011
<i>Ixodes vespertilonis</i>				1	1	<i>Rhinolophus ferrumequinum</i>	1		1	25-05-2011
<i>Rhipicephalus turanicus</i>	1	13		11	25	<i>Erinaceus concolor</i>		7	7	29.06.2011–04.08.2012
Total	35	52	30	21	138		29	29	58	

L larva, N nymph, M male, F female

^a New tick–host association for Turkey

Lacerta viridis (Laurenti) (4/0), *Lacerta media* Lantz and Cyrén (25/0), *Lacerta trilineata* Bedriaga (6/0), *Darevskia valentini* (Boettger) (146/0), *Trachylepis vittata* (Olivier) (28/0), *Mediodactylus kotschy* (Steindachner) (23/0), *Ablepharus chernovi* Darevsky (17/0), *Dolichophis caspius* (Gmelin) (31/0), *Coronella austriaca* Laurenti (22/0), *Natrix natrix* (L.) (33/0), *Natrix tessellata* (Laurenti) (50/0), and *Hemorrhois ravergieri* (Ménétries) (9/0); from birds: *Athene noctua* (Scopoli) (5/0), *Otus scops* (L.) (3/0) and *Coturnix coturnix* (L.) (1/0); and from mammals: *Microtus levis* Miller (10/0), *Apodemus witherbyi* (Thomas) (10/0), *Apodemus flavicollis* (Melchior) (9/1), *Crocidura suaveolens* (Pallas) (27/0), *Hypsugo savii* (Bonaparte) (8/0), *Rhinolophus ferrumequinum* (Schreber) (87/1), *Plecotus macrobullaris* Kuzjakin (45/1), *Spermophilus xanthoprimum* (Bennett) (4/0), *Mustela nivalis* L. (4/0), *Nannospalax nehringi* (Satunin) (15/0), and *Erinaceus concolor* Martin (102/55).

A total of 138 ticks were obtained from the 58 host animals. Ticks were identified as *Dermacentor marginatus* (Sulzer), *Haemaphysalis erinacei taurica* Pospelova-Shtrom, *Haemaphysalis parva* (Neumann), *Haemaphysalis punctata* Canestrini and Fanzago, *Haemaphysalis sulcata* Canestrini and Fanzago, *Hyalomma marginatum* Koch, *Ixodes laguri* Olenev, *Ixodes ricinus* (L.), *Ixodes vespertilionis* Koch and *Rhipicephalus turanicus* Pomerantzev. Tick infested wild animals (% of infested animals in parentheses, individually) belonged to 4 species; namely *A. flavicollis* (11.1 %), *P. macrobullaris* (2.2 %), *R. ferrumequinum* (1.1 %) and *E. concolor* (53.9 %). Here, new tick–host associations for Turkey are also denoted in Table 1. There were no tick infestations in other wild animals.

Discussion

During the past 10 years, many qualified studies on ticks infesting humans and domestic animals in Turkey have been conducted (Aktas et al. 2004; Gargili et al. 2010; Bursali et al. 2010, 2011, 2013; Bakirci et al. 2012). In contrast, apart from the individual or incidental reports, tick infestations of wild animals are poorly investigated. Therefore, tick–host associations and natural cycles of many tick-borne pathogens are still far from being clarified in Turkey. In only recent studies, ticks infesting reptiles and birds have been reported from Southeastern and Black Sea regions in Turkey (Keskin et al. 2013, 2014). Other than these, there are reports for *Hyalomma aegyptium* (L.) collected from *Testudo graeca* L. (Široký et al., 2014); *Hyalomma* spp. collected from *Buteo rufinus* (Cretzschmar 1829) and *I. ricinus* collected from *Microtus* spp. (Orkun et al. 2014). Similar tick–host records (individual, incidental or limited) for Turkey have been compiled by Bursali et al. (2012).

In this study, we investigated the ticks infesting randomly captured some wild animals. Table 1 presents host data for ticks collected from wild animals examined at study area. Among the 24 host species, only 4 mammals' species have been recorded as ticks infested.

Based on our findings, *D. marginatus* was the predominant tick species infesting wild animals in the study area. In early studies, though *D. marginatus* have been documented on domestic animals and humans in Turkey (Bursali et al. 2013), there is not a report for the wild animals as the host of the tick to date. Principal hosts of adult *D. marginatus* are Artiodactyla (Bovidae and Suidae) and Perissodactyla (Equidae), while main hosts for larvae and nymphs are Erinaceomorpha (Erinaceidae), Lagomorpha (Leporidae) and Rodentia (several families). Several species belonging to Anura, Aves and Squamata have

also been documented as exceptional hosts (Guglielmone et al. 2014). Larvae of *D. marginatus* are abundant in June and July and its nymphs in July and August (Arthur 1960). Nymphs of *D. marginatus* can be distinguished from those of other *Dermacentor* species by a combination of the following characters: the second palpal segment about half as long again as that of third when viewed ventrally, on the scutum less than 40 short setae, spur of coxa IV is usually shorter than III. Larvae of *D. marginatus* can be distinguished from those of other *Dermacentor* species by a combination of the following characters: length gnathosoma less than its width or equal to it, scutal seta (sc_3) ≥ 1.5 times longer than central dorsal seta (cd_1) (Filippova 1997). In this study, larval and nymphal specimens of *D. marginatus* have been collected on *E. concolor* and *P. macrobullaris* (probably incidental). Best of our knowledge, these host species are new tick–host association for Turkey.

Second most encountered tick taxa on wild animals in our study were *H. e. taurica* and *R. turanicus*. While only larval *H. e. taurica* have been collected on *A. flavicollis*, its larvae and adults have been found on *E. concolor*. Three larval *H. e. taurica* have been collected on *A. flavicollis*, which is a new host record for *H. e. taurica* in Turkey. Larvae of *H. e. taurica* can be distinguished from those of other *Haemaphysalis* species by a combination of the following characters: basis capituli rectangular, about three times as wide as long, the ventral spur of palpal segment III is much reduced, while larvae of *R. turanicus* can be distinguished from those of other *Rhipicephalus* species by a combination of the following characters: palpi short, apex in form of a wide, shortened triangle; infrainternal setae narrow and feathered (Filippova 1997). In the present study, larvae and adults of *R. turanicus* have been collected on *E. concolor*. This species is widespread throughout Turkey, and it has been recorded on domestic animals, foxes, hedgehogs and humans (Bursali et al. 2012).

Another haemaphysalids collected from *E. concolor* were *H. parva* and *H. punctata*. Mainly adults of *H. parva* and *H. punctata* feed on domestic animals. On the other hand, immature *H. punctata* occasionally infest on small mammals, while immature *H. sulcata* infest on mainly reptiles (Camicas et al. 1998; Kolonin 2009; Guglielmone et al. 2014). Larvae and nymphs of *H. parva* can be distinguished from those of other *Haemaphysalis* species by a combination of the following characters: body oval, palpi conical, palpal segment 2 ventrally with caudal spur, while immature of *H. punctata* can be distinguished from those of other *Haemaphysalis* species by a combination of the following characters: gnathosoma dorsally hexagonal base, palpal segment II with a clear lateral spur, coxal spurs distinct (Filippova 1997).

Limited specimens of *H. marginatum* and *I. ricinus* have been collected on only *E. concolor*. Principal hosts for adult *H. marginatum* are bovids, while principal hosts for immature are leporids and birds (several orders) (Guglielmone et al. 2014). *H. marginatum* can survive a wide range of conditions and a variety of habitats and adapt to a wide range of temperature and humidity conditions (ECDC 2015). *H. marginatum* has also a high vectorial capacity which is a vector of important animal and human pathogens such as *Theileria annulata* and CCHF (Estrada-Peña et al. 2011). On the other hand, adults of *I. ricinus* can infest all accessible large and middle-sized mammals (Kolonin 2009). Immature of *I. ricinus* can parasitize some small mammals, birds and lizards (Filippova 1977). *I. ricinus* is also a vector of the *Borrelia lusitaniae* and *Borrelia garinii* and tick-borne encephalitis virus (Estrada-Peña et al. 2004). The present records of the *H. marginatum* and *I. ricinus* on *E. concolor* are usual and their hosts have been previously documented by Bursali et al. (2012). These species are also some of the ticks commonly encountered on humans in Turkey (Bursali et al. 2010, 2011, 2013; Gargili et al. 2010).

Thus, they are closely associated with several tick-borne pathogens, such as Crimean Congo hemorrhagic virus, borreliae, and rickettsiae (Tekin et al. 2012; Keskin et al. 2014).

A single specimen of *I. laguri* has been found on a female *E. concolor*. Main hosts of *I. laguri* are rodents, especially *Spermophilus* (formerly *Citellus*) species (Balashov 1997). There are very limited investigations about geographical distribution of *I. laguri* in Turkey. Human infestations by *I. laguri* have been recently documented in Amasya and Tokat provinces in Turkey (Bursali et al. 2010, 2011). With further detailed investigation of rodents, we believe that the distribution area of *I. laguri* in Turkey will be expanded. The present record of *I. laguri* on *E. concolor* is also a new tick–host association for Turkey.

Ixodes vespertilionis is a specific parasite of bats and there is no record for any other animal hosts. Records of *I. vespertilionis* on leporids and dogs have been found as doubtful by Guglielmone et al. (2014). In a recent study, human infestation of the tick has been reported in Poland (Piksa et al. 2013). Several bats species have been documented as usual hosts in Turkey (Bursali et al. 2012). In the present study, only a single specimen of *I. vespertilionis* has been collected on *R. ferrumequinum*.

It is known that association between ticks and their hosts are very important in order to understand tick ecology and to clarify their vectorial capacity. This is the first detailed study that investigated ticks associated with some wild animals from Turkey. Further studies should emphasize ticks infesting on wild animals and their vectorial status for the tick-borne pathogens.

Acknowledgments We are very grateful to Mesut Koyuncu (Gaziosmanpaşa University, Turkey) for valuable comments on this paper. This study has been partially supported by Gaziosmanpaşa University Scientific Research Fund (Project No: 2012/129).

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