

A review of the ticks (Acari: Ixodida) of Turkey: species diversity, hosts and geographical distribution

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Abstract Ticks are important ectoparasites, causing a variety of serious infectious diseases in humans and domestic animals. There is very limited taxonomic information about the tick species of Turkey in the literature, even though Turkey has very suitable climate and vegetation for ticks. In the current study, species diversity, hosts and geographical distribution of the ticks present in Turkey are reviewed based on taxonomic data in the literature from 1915 to 2011 and our recent observations. The names of tick species are arranged according to the most recent check lists. The taxonomic records in the literature and our studies on actual tick samples indicated that the tick fauna of Turkey consists of 46 species; 38 species from Ixodidae and 8 species from Argasidae.

Keywords Argasidae · Ixodidae · Tick fauna · Turkey

Introduction

Turkey is a Eurasian country occupying 783,562 square kilometers including Anatolian peninsula and Thrace. The territory of Turkey lies between latitudes 35° and 43°N and longitudes 25° and 45°E and is divided into seven geographic regions: Marmara, Aegean, Black Sea, Central Anatolia, Eastern Anatolia, Southeastern Anatolia and the Mediterranean (Fig. 1). Each region has specific climate, vegetation and wild life allowing a suitable habitat for various tick species.

Numerous studies on medical and veterinary importance of ticks have been made in Turkey since 1900s. However, there are limited studies on tick taxonomy in Turkey. Nuttall and Warburton (1915) were reported presence of *Haemaphysalis punctata* in Turkey. In addition, *Ixodes gibbosus* collected from Izmir, Turkey in 1913 was described originally by Nuttall (1916). In 1929, Hakki (1929) reported the presence of *Ixodes ricinus* and *Hyalomma aegyptium* in Turkey. Tuzdil (1936) showed that *Ornithodoros lahorensis* present in

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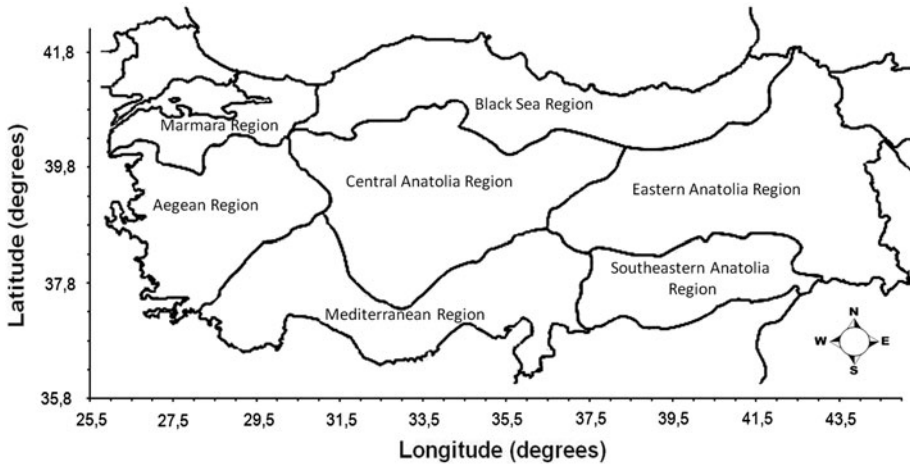


Fig. 1 Regional map of Turkey

Turkey and play a role in transmission of Tularemia. Later, several investigations have been done on ticks of Turkey by Koehler (1923), Vogel (1927), Schulze (1930), Minning (1934), Pandizis (1947), Delpy (1949), Arthur (1957), Hoogstraal (1959), Hoffmann et al. (1971) and Filippova et al. (1995).

The general information and list of tick species of Turkey were given in several papers and books on ticks by Oytun (1947), Kurtpinar (1954) and Merdivenci (1966, 1969). In late 70's, Ozkan (1978) reported 26 species of ticks, with three new species; *Haemaphysalis aksarensis*, *Haemaphysalis ibrikliensis*, and *Haemaphysalis yalvacii* and four new records; *Dermacentor daghestanicus*, *Ixodes redikorzevi*, *Ixodes hexagonus*, and *Hyalomma rufipes* from 12 provinces in East, Southeast, and Northeast Black Sea regions of Anatolia (Agri, Artvin, Diyarbakir, Erzincan, Erzurum, Gumushane, Hakkari, Kars, Malatya, Mus, Rize and Van). However, his work published in Turkish was not accessible to the scientific community. Later, Ozkan et al. (1988) and Erman et al. (2007) published the checklists of the Acari of Turkey, including ticks. Between 1978 and 2002, systematic studies on ticks almost stopped and limited to some veterinary studies. After the Crimean Congo Hemorrhagic Fever (CCHF) Disease outbreaks between 2002 and 2010 in Turkey, investigations on ticks and tick-borne diseases restarted. However, most of the recent studies were associated with tick-borne diseases affecting humans and animals. Our previous publications (Bursali et al. 2010, 2011) on actual tick samples from Tokat and Amasya provinces were the most recent contributions to tick fauna of Turkey. In the present study, species diversity, hosts and geographic distributions of Turkish ticks were reported. The records in the literature and our recent observations indicated that the tick fauna of Turkey composed of 46 tick species, 8 from the Argasidae and 38 from the Ixodidae.

Materials and methods

The list of the ticks presented here includes all species from Turkey reported in original papers, books, our previous studies (Bursali et al. 2010, 2011) and samples deposited to our collection from several provinces from Kelkit Valley (Table 1). At least, 30 tick species listed were from our collection (Table 1) in Gaziosmanpasa University, Department of

Table 1 Tick species reported from Turkey, their hosts and geographical distribution

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
Argasidae Murray, 1877			
Genus <i>Argas</i> Latreille, 1796			
^a <i>A. (Pericargas) persicus</i> (Oken, 1818)	<i>Gallus domesticus</i> (A), <i>Columba livia</i> (U), <i>Meleagris gallopavo</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. unpublished data
^a <i>A. (Pericargas) reflexus</i> (Fabricius, 1794)	<i>Columba livia</i> (A), <i>Passer</i> sp. (A), <i>Homo sapiens</i> (A)	AR	Kurtpinar (1957), Parrish (1961), Merdivenci (1969), Ozkan (1978), Keskin et al. (2010)
^a <i>A. (Carios) vespertilonis</i> (Latreille, 1796)	<i>Myotis myotis</i> (U), <i>Rhinolophus ferrumequinum</i> (U), <i>Homo sapiens</i> (A)	MA, BS, EA	Merdivenci (1969), Bursali et al. unpublished data
Genus <i>Ornithodoros</i> Koch, 1844			
<i>O. (Alectorobius) coniceps</i> (Canestrini, 1890)	<i>Columba livia</i> (U), <i>Homo sapiens</i> (U)	MA	Merdivenci (1969)
<i>O. (Alectorobius) erraticus</i> (Lucas, 1849)	Specimens were collected from rodent holes (A)	SEA	Ozsan and Akyay (1954), Hoogstraal (1956)
<i>O. (Alveonassus) lahorensis</i> Neumann, 1908	<i>Capra hircus</i> (N), <i>Ovis aries</i> (U), <i>Camelus dromedarius</i> (U), <i>Lepus europaeus</i> (U)	A, ME, EA	Hoffman et al. (1971), Parrish (1961), Merdivenci (1969), Ozkan (1978)
<i>O. (Alectorobius) tholozani</i> (Laboulbène and Mégnin, 1882)	Specimens were collected from barn (A)	EA	Merdivenci (1969), Ozkan (1978)
Genus <i>Otobius</i> Banks, 1912			
<i>O. megnini</i> (Dugés, 1883)	<i>Bos taurus</i> (N), <i>Homo sapiens</i> (N)	MA, SEA	Ozer and Aydın (1996), Gargili et al. (2011)
Family Ixodidae Murray, 1877			
Genus <i>Amblyomma</i> Koch, 1844			
<i>A. (Theileriella) variegatum</i> (Fabricius, 1794)	<i>Equus caballus</i> (A)	ME	Mimioğlu and Yazar (1961)

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
Genus <i>Haemaphysalis</i> Koch, 1844			
^a <i>H. (Aboimisisalis) punctata</i>	<i>Ovis aries</i> (A,N), <i>Capra hircus</i> (A), <i>Bos taurus</i> (U), <i>Equus caballus</i> (U), <i>Canis familiaris</i> (U), <i>Erinaceus concolor</i> (N), <i>Camelus dromedarius</i> (U), <i>Corvus</i> sp. (N), <i>Pica pica</i> (L), <i>Perdix perdix</i> (NL), <i>Coturnix coturnix</i> (U), <i>Turdus merula</i> (L), <i>Corvus monedula</i> (N), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Hoogstraal (1959), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010)
<i>H. (Alloceraea) ibrikliensis</i> Ozkan, 1978	<i>Ovis aries</i> (A)	EA	Ozkan (1978)
^a <i>H. (Alloceraea) inermis</i> Brula, 1895	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (U), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Canis familiaris</i> (U), <i>Vulpes vulpes</i> (U), <i>Camelus dromedarius</i> (U), <i>Homo sapiens</i> (A)	MA, CA, EA, SEA	Parrish (1961), Merdivenci (1969), Bursali et al. (2010), Gargili et al. (2011)
<i>H. (Allophysalis) aksarensis</i> Ozkan, 1978	<i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (A)	EA	Ozkan (1978)
^a <i>H. (Haemaphysalis) concinna</i> Koch, 1844	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (A), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Buffelus bubalus</i> (U), <i>Camelus dromedarius</i> (U), <i>Sus scrofa</i> (U), <i>Lepus europeus</i> (U), <i>Erinaceus concolor</i> (U), <i>Homo sapiens</i> (A)	ME, BS, EA,	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
^a <i>H. (Herpetobia) sulcata</i>	<i>Ovis aries</i> (U), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Vulpes vulpes</i> (N), <i>Erinaceus concolor</i> (N), <i>Gazella</i> sp. (U), <i>Camelus dromedarius</i> (U), <i>Pica pica</i> (N), <i>Allactaga williamsi</i> (L), <i>Apathya cappadocica</i> (N), <i>Agama stellio</i> (N), <i>Ophisops elegans</i> (N), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Hoogstraal (1959), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
<i>H. (Kaiseriana) yalvacii</i> Ozkan, 1978	<i>Vulpes vulpes</i> (A)	EA	Ozkan (1978)

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
^a <i>H. (Rhipistoma) erinacei</i> Pavesi, 1884	<i>Erinaceus concolor</i> (A), <i>Vulpes vulpes</i> (A,N), <i>Allactaga williamsi</i> (L), <i>Homo sapiens</i> (A)	MA, CA, BS	Hoogstraal (1959), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
^a <i>H. (Segaliala) parva</i> (Neumann, 1897)	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (A), <i>Equus caballus</i> (A), <i>Equus asinus</i> (A), <i>Erinaceus concolor</i> (L), <i>Camelus dromedarius</i> (A), <i>Canis familiaris</i> (A), <i>Vulpes vulpes</i> (A), <i>Meleagris gallopavo</i> (A), <i>Allactaga williamsi</i> (N), <i>Meriones blackleri</i> (N), <i>Meriones blackleri intraponticus</i> (N), <i>Spalax leucodon</i> (N,L), <i>Cricetulus migratorius cinerascens</i> (N), <i>Microtus guentheri</i> (N), <i>Mus musculus</i> (N), <i>Apodemus sylvaticus tauricus</i> (N), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Hoogstraal (1959), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
Genus <i>Hyalomma</i> Koch, 1844			
^a <i>H. (Hyalomma) aegyptium</i> (Linnaeus, 1758)	<i>Testudo graeca</i> (A,N,L), <i>Erinaceus concolor</i> (A), <i>Homo sapiens</i> (A,L)	AR	Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
^a <i>H. (Euhyalomma) anatolicum</i> Koch, 1844	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (A), <i>Equus caballus</i> (U), <i>Equus asinus</i> (A), <i>Lepus europaeus</i> (U), <i>Camelus dromedarius</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
<i>H. (Euhyalomma) asiaticum</i> Schulze and Schlotke, 1930	Specific hosts undefined (U)	SEA	Filippova et al. (1995), Apanaskevich (2002)
Koch, 1844	<i>Camelus dromedarius</i> (U), <i>Ovis aries</i> (A), <i>Capra hircus</i> (U), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (A), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U)	A, ME, BS, EA	Parrish (1961), Merdivenci (1969), Ozkan (1978)

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
^a <i>H. (Euhyalomma) excavatum</i> Koch, 1844	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
^a <i>H. (Euhyalomma) impelratum</i> Schulze and Schlotke, 1930	<i>Ovis aries</i> (U), <i>Bos taurus</i> (U), <i>Homo sapiens</i> (A)	MA, BS, EA	Hoogstraal (1956), Nemenz (1967), Keskin et al. (2010)
^a <i>H. (Euhyalomma) marginatum</i> Koch, 1844	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Canis familiaris</i> (U), <i>Camelus dromedarius</i> (U), <i>Sus scrofa</i> (U), <i>Erinaceus concolor</i> (U), <i>Lepus europaeus</i> (U), <i>Perdix perdix</i> (U), <i>Coturnix coturnix</i> (U), <i>Homo sapiens</i> (A)	AR	Merdivenci (1969), Ozkan (1978), Yukari and Umur (2002), Bursali et al. (2011)
^a <i>H. (Euhyalomma) rufipes</i> Koch, 1844	<i>Bos taurus</i> (A), <i>Equus caballus</i> (A), <i>Homo sapiens</i> (A)	A, MA, BS, EA	Ozkan (1978), Kar et al. (2009), Bursali et al. (2011), Bakirci et al. (2011)
^a <i>H. (Euhyalomma) scupense</i> Schulze, 1919	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (U), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Lepus europaeus</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2011)
<i>H. (Euhyalomma) turanicum</i> Pomerantzev, 1946	<i>Bos taurus</i> (U), <i>Equus caballus</i> (U), <i>Homo sapiens</i> (A)	CA, BS	Hoffmann et al. (1971), Zeybek and Kalkan (1984)
Genus <i>Ixodes</i> Latreille, 1796. Koch, 1884	<i>Rhinolophus ferrumequinum</i> (A,N), <i>Rhinolophus hipposideros</i> (N), <i>Rhinolophus euryale</i> (A,N,L), <i>Rhinolophus mehelyi</i> (U), <i>Myotis blythii</i> (U), <i>Myotis emarginatus</i> (U), <i>Myotis oxygnathus</i> (U), <i>Myotis myotis</i> (A), <i>Miniopterus schreibersii</i> (L)	A, ME, EA	Arthur (1956), Beaucourmu (1966, 1967), Merdivenci (1969), Sert et al. (2001), our data

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
<i>I. (Ixodes) gibbosus</i> Nuttall, 1916	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Camelus dromedarius</i> (A), <i>Equus caballus</i> (A)	A, MA, CA, BS	Nuttall (1916), Merdivenci (1972), Saratsiotis (1970), Deposited to USNTC with collection number RML 25276; RML 24254; RML 23036; RML 25260; RML 25269; RML 25275
^a <i>I. (Ixodes) laguri</i> Olenov, 1929	<i>Arvicola terrestris hintoni</i> (N,L), <i>Crocidura</i> sp. (N,L), <i>Microtus</i> sp., <i>Meriones blackeri intraponticus</i> (A,N,L), <i>Citellus citellus</i> (U), <i>Homo sapiens</i> (A),	MA, CA, BS	Arthur (1957), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
^a <i>I. (Ixodes) redikorzevi</i> Olenov, 1927	<i>Apodemus sylvaticus</i> (A,L), <i>Microtus majori</i> (L), <i>Microtus roborri</i> (L), <i>Sorex raddai</i> (N,L), <i>Neomys fodiens</i> (L), <i>Talpa europea</i> (L), <i>Erinaceus concolor</i> (A,N), <i>Homo sapiens</i> (A)	BS, EA	Nemenz (1967), Ozkan (1978), Bursali et al. (2010, 2011)
^a <i>I. (Ixodes) ricinus</i> (Linnaeus, 1758)	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (A), <i>Buffélu bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Canis familiaris</i> (U), <i>Felis catus</i> (U), <i>Felis sylvestrus</i> (U), <i>Sus scrofa</i> (U), <i>Vulpes vulpes</i> (U), <i>Rattus rattus</i> (U), <i>Erinaceus concolor</i> (A,N), <i>Orcitologus cuniculus</i> (U), <i>Lepus europaeus</i> (U), <i>Lacerta viridis</i> (L), <i>Allactaga williamsi</i> (N), <i>Spalax leucodon</i> (N), <i>Mus musculus</i> (L), <i>Homo sapiens</i> (A)	AR	Arthur (1957), Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
<i>I. (Pholeoixodes) crenulatus</i> Koch, 1844	<i>Vulpes vulpes</i> (A)	MA	Deposited to USNTC with collection number RML 61087
^a <i>I. (Pholeoixodes) hexagonus</i> Leach, 1815	<i>Erinaceus concolor</i> (A,N), <i>Vulpes vulpes</i> (A), <i>Lepus europaeus</i> (A), <i>Homo sapiens</i> (A)	MA, BS, EA	Ozkan (1978), Bursali et al. (2011)
<i>I. (Pomerantzzevella) simplex</i> Neumann, 1906	<i>Miniopterus schreibersii</i> (A,N,L)	MA	Beaucourmu (1966, 1967)

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
^a <i>I. (Trichotoxoides) frontalis</i> Panzer, 1798	<i>Scolopax rusticola</i> (A), <i>Homo sapiens</i> (A)	MA, BS, EA	Merdivenci (1969); our data
Genus <i>Dermacentor</i> Koch, 1844			
^a <i>D. (Dermacentor) reticulatus</i> Fabricius, 1794	<i>Ovis aries</i> (U), <i>Bos taurus</i> (U), <i>Equus caballus</i> (U), <i>Homo sapiens</i> (A)	BS	Oytun (1947), Sayin et al. (1982); our data
^a <i>D. (Serdjukovia) marginatus</i> (Sulzer, 1776)	<i>Ovis aries</i> (A), <i>Buffelus bubalus</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
^a <i>D. (Serdjukovia) niveus</i> Neumann, 1897	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Homo sapiens</i> (A)	AR	Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
Genus <i>Rhipicephalus</i> Koch, 1844			
^a <i>R. (Boophilus) annulatus</i> (Say, 1821)	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (U), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
<i>R. (Boophilus) kholisi</i> (Hoogstraal and Kaiser, 1960)	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U)	SEA	Merdivenci (1969), Ozer and Guler (1993)
^a <i>R. (Dignus) bursa</i> Canestrini and Fanzago, 1878	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Canis familiaris</i> (U), <i>Sus scrofa</i> (U), <i>Erinaceus concolor</i> (U), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)
<i>R. (Rhipicephalus) rossicus</i> Yakimov and Kol-Yakimova, 1911	Specific hosts undefined (U).	EA	Pomerantzev (1946, 1950)
^a <i>R. (Rhipicephalus) sanguineus</i> (Latreille, 1806)	<i>Ovis aries</i> (A), <i>Capra hircus</i> (A), <i>Bos taurus</i> (A), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Canis familiaris</i> (A), <i>Canis aureus</i> (U), <i>Felis catus</i> (U), <i>Sus scrofa</i> (U), <i>Erinaceus concolor</i> (U), <i>Orientalis cuniculus</i> (U), <i>Lepus europaeus</i> (U), <i>Vulpes vulpes</i> (A), <i>Homo sapiens</i> (A)	AR	Parrish (1961), Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)

Table 1 continued

Ticks	Host(s) and developmental stages ^b	Region ^c	Reference(s)/collection no
^a <i>R. (Rhipicephalus) turanicus</i> Pomerantzev, 1940	<i>Ovis aries</i> (U), <i>Capra hircus</i> (U), <i>Bos taurus</i> (U), <i>Buffelus bubalus</i> (U), <i>Equus caballus</i> (U), <i>Equus asinus</i> (U), <i>Canis familiaris</i> (U), <i>Erinaceus concolor</i> (U), <i>Vulpes vulpes</i> (U), <i>Homo sapiens</i> (A)	AR	Merdivenci (1969), Ozkan (1978), Bursali et al. (2010, 2011)

^a Tick species preserved in our tick collection

^b Developmental stages L larva, N nymph, A adult, U unknown

^c AR All regions, MA Marmara region, A Aegean region, BS Black Sea region, CA Central Anatolia region, ME Mediterranean region, EA Eastern Anatolia region, SEA Southeast Anatolia region

Biology, Tokat, TURKEY identified to species using the most recent tick identification keys (Hoogstraal 1959; Filippova 1997; Hoogstraal 1959; Walker et al. 2000; Apaneskevich and Horak 2005, 2008). Some of the tick samples in our collection reidentified by comparing with the specimens in the United States National Tick Collection (USNTC). In addition, Turkish tick samples such as *Ixodes crenulatus* and *Ixodes gibbosus* deposited to the USNTC were reexamined and their collection numbers were noted in Table 1. The names of tick species reported here updated according to the recent check list from Horak et al. (2002) and Guglielmo et al. (2010) and listed alphabetically with their hosts, developmental stage and geographical locations.

Results and discussion

Even though, Turkey is a very suitable habitat for ticks by climate, vegetation, variety of numerated wild and domestic animals, to date taxonomic studies on tick species of Turkey were very limited and only 46 valid tick species were reported. Majority of taxonomic studies on ticks of Turkey were generally focused on ixodid ticks represented by 38 species, whereas argasid ticks represented with only 8 ticks. Most of the ticks reported from Turkey have been preserved in personal collections rather than a national collection; therefore there is no information about preserved samples of some species.

In contrast to ixodid ticks, there are very limited investigations on argasid ticks in Turkey; therefore they are represented by only *Argas persicus*, *Argas reflexus*, *Argas vespertilionis*, *Ornithodoros lahorensis*, *Ornithodoros erraticus*, *Ornithodoros coniceps*, *Ornithodoros tholozani* and *Otobius megnini* (Table 1). Especially, *A. persicus*, *A. reflexus* and *O. lahorensis* are common throughout Turkey while *A. vespertilionis*, *O. erraticus*, *O. tholozani* and *O. coniceps* are rare and limited to several regions only. There are several reports indicating infestation of *A. persicus*, *A. reflexus*, *A. vespertilionis* and *O. megnini* are not limited to wild animals but also humans (Kurtpinar 1957; Keskin et al. 2010; Gargili et al. 2011; Bursali et al. unpublished data).

Since ixodid ticks transmit numerous disease agents affecting human and animal health, investigations on ixodid ticks were more intense than argasid ticks. *H. aegyptium*, *Hyalomma anatolicum*, *Hyalomma scupense*, *Hyalomma excavatum*, *Hyalomma marginatum*, *Rhipicephalus turanicus*, *Dermacentor marginatus*, *Haemaphysalis parva* and *I. ricinus* are dominant species in Turkey (Kurtpinar 1954; Merdivenci 1969; Aydin and Bakirci 2007; Bursali et al. 2010, 2011). Although, it is very rare and may be accidentally introduced, the presence of an adult sample of *Amblyomma variegatum*, which was collected from *Equus caballus* in Hatay province located on Syrian border, was reported only by Mimioglu and Yazar (1961), however the tick was not deposited in a museum or a collection.

Hyalomma aegyptium, *H. anatolicum*, *H. excavatum*, *H. marginatum*, *H. scupense* are very common species and very active during late spring to summer throughout of Turkey, whereas *H. asiaticum*, *H. dromedarii*, *H. impeltatum*, *H. rufipes*, *H. turanicum* are rare species in specific regions such as in east and southeast Anatolia. Although *H. rufipes* are known as rare species in specific regions such as in east and southeast Anatolia, it was recently reported from Aegean and Marmara regions in Turkey (Kar et al. 2009; Bakirci et al. 2011). Although, *H. dromedarii* and *H. turanicum* were reported from Turkey by various authors (Table 1), their presence needs to be further confirmed by comparing type samples. Previously reported species; *H. dromedarii*, *H. franchinii* and *H. turanicum* (Bursali et al. 2010, 2011) were reidentified as variants of *H. excavatum* and *H. marginatum*, respectively, after comparing with samples in USNTC. Even though *Hyalomma*

species generally infest on various domestic and wild animals, parasitism of various *Hyalomma* species, especially feeding of larval and adult forms of *H. aegyptium* on humans were surprising (Bursali et al. 2010, 2011). Therefore, we proposed that *Hyalomma* species such as *H. anatolicum*, *H. excavatum*, *H. marginatum*, and *H. scupense* play major role for transferring tick-borne pathogens such as CCHF virus to humans in Turkey (Albayrak et al. 2010; Bursali et al. 2011).

As listed in Table 1, there are three *Dermacentor* species; *D. marginatus*, *D. niveus* and *D. reticulatus* found in Turkey (Oytun 1947; Parrish 1961; Merdivenci 1969; Ozkan 1978; Sayin et al. 1982; Kolonin 1992; Fillipova 1997; Kolonin 2009; Bursali et al. 2010, 2011; Bursali et al. unpublished data). Earlier, we identified *D. daghestanicus* based on their several distinct morphological characters such as small body, ornamentation of conscutum, very smaller coxa IV, shape of spiracular plate and size and distribution of goblet cell in spiracular plate. However, after a detailed observation on these ticks in USNTC, we reidentified this species as variants of *D. marginatus*. Although *Dermacentor* species were common on domestic animals, immature and adult forms of *D. marginatus* and adults of *D. reticulatus* were also found humans especially in the fall (Bursali et al. 2010, 2011; Bursali et al. unpublished data). Since the presence of *Rickettsia* species have been reported in several *Dermacentor* species (Tekin et al. unpublished study), these ticks may contribute transmission of *Rickettsia* species to animals and humans in Turkey.

Haemaphysalis parva, *H. punctata* and *H. sulcata* are the most prevalent *Haemaphysalis* species throughout Anatolia. Although, they generally infest on variety of wild and domestic animals (Table 1), we have recently reported (Bursali et al. 2010, 2011) the presence of larva, nymph and adults of *Haemaphysalis concinna*, *H. erinacei*, *H. parva*, *H. punctata*, and *H. sulcata* on humans. Beside these prevalent *Haemaphysalis* species, three additional *Haemaphysalis* species; *H. aksarensis*, *H. ibrikliensis* and *H. yalvaci* were reported as new species by Ozkan (1978). Since his work published in Turkish, many acarologist were not able to reach (these taxa are a *nomen neglectum*); therefore these names were not listed in the tick name compendium of Camicas et al. (1998). However, we proposed that the type samples of these species needs to be verified to clarify whether they are actual new species or synonyms of others. Therefore, we consider these names provisionally valid until their status can be clarified.

The genus *Rhipicephalus* are represented by *Rhipicephalus bursa*, *R. sanguineus*, *R. turanicus*, *R. rossicus*, *R. (Boophilus) annulatus* and *R. (Boophilus) kohlsi* (Pomerantzev 1946, 1950; Parrish 1961; Merdivenci 1969; Hoffmann et al. 1971; Ozkan 1978; Ozer and Guler 1993; Bursali et al. 2010, 2011). These species are generally abundant especially in steppe habitats from late spring to early autumn in many regions of Anatolia. Their hosts are not limited to wild and domestic animals but humans (Bursali et al. 2010, 2011; Keskin et al. 2010). However, presence of adults of one host tick *R. (Boophilus) annulatus* on humans may indicate that these ticks are not noticed during feeding on humans or immature and adult ticks attack humans when their feeding on host animal is interrupted. Pomerantzev (1946, 1950) published the first reports of *R. rossicus* from the border with Armenia regions of Turkey. According to Walker et al. (2000), larva, nymph and adults specimens of *Rhipicephalus pumilio* was collected on a rabbit from Bornova, Izmir in Turkey in 1967 and deposited to USNTC (RML 98604; HH 31277). However, specimens in these bottles were not actually *R. pumilio*; instead these samples were reidentified by us as *R. turanicus* after comparing with other *R. pumilio* samples in USNTC. It is possible that some of these samples were used for electron microscopy (Walker et al. 2000; p 552–54) and the rest were misplaced.

Even though the genus *Ixodes* are the most populated group in the world, it is represented by 9 species; *Ixodes crenulatus*, *I. frontalis*, *I. gibbosus*, *I. hexagonus*, *I. laguri*, *I. redikorzevi*, *I. ricinus*, *I. simplex* and *I. vespertilionis* in Turkey (Arthur 1957; Parrish 1961; Nemenz 1967; Beaucournu 1967; Merdivenci 1969, 1972; Hoffmann 1971; Ozkan et al. 1988; Sert et al. 2001; Bursali et al. 2010, 2011). Although *I. laguri* and *I. simplex* are known as rare species in Turkey, Arthur (1957) collected numerous larvae, nymphs and several adults of *I. laguri* from two water voles, *Arvicola terrestris hintoni*. The larvae, nymphs and several adults of *Ixodes simplex* was also collected on Common Bent-wing Bat, *Miniopterus schreibersii* by Beaucournu from Turkey (Beaucournu 1966, 1967). In addition, adults of *Ixodes crenulatus* (RML 61087) collected from red fox, *Vulpes vulpes* in Marmara Region (Enez city: border of Greece) in Turkey was deposited to USNTC in 1967. The *Ixodes* species are mainly seen in provinces located in low altitudes of North Anatolia where the climate is mild and humid.

In summary, present study shows that the tick fauna of Turkey composed of 38 ixodid and 8 argasid species which present at least one of the seven geographic regions of Turkey and infest on variety of hosts. At least, 30 tick species listed on Table 1 were found on humans in Tokat, Sivas, Yozgat, Corum, Gumushane provinces of (Keskin et al. 2010; Bursali et al. 2010, 2011; Bursali et al. unpublished data) in Turkey. In conclusion, since the ixodid tick species reported here infest on both animals and humans, they have both veterinary and medical importance. Therefore, recognition of Turkish (Anatolian) tick fauna would help to implement appropriate strategies to control ticks and tick-borne diseases in the region.

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