

The Current Status of Ticks in Turkey: A 100-Year Period Review from 1916 to 2016

Türkiye’de Kenelerin Mevcut Durumu: 1916-2016 Yılları Arasındaki Yüzyıllık Periyoda Dayanan Bir Derleme

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ABSTRACT

Environmental and bio-ecological changes, some administrative and political mistakes, and global warming seriously affect the behaviors of ticks in Turkey and globally. The global public sensitivity toward tick infestations has increased along with increases in tick-borne diseases (TBDs). Recently, the World Health Organization (WHO) developed a new political concept, "One Health," for specific struggle strategies against tick infestations and TBDs. To highlight the importance of the issue, the WHO had declared the year 2015 for vector-borne diseases and adopted the slogan "small bites big threat". In global struggle strategies, the epidemiological aspects and dynamics of increasing tick populations and their effects on the incidence of the TBDs mainly with zoonotic characteristics have been specifically targeted. In Turkey, during the last century, approximately 47 tick species, including eight soft and 39 hard tick species in three and six genera belonging to Argasidae and Ixodidae, respectively, had already been reported. In this article, the recorded tick species, regional infestations, and medical and veterinary importance in Turkey were chronologically reviewed based on a 100-year period between 1916 and 2016.

Keywords: A century-old period, current status, ticks, Turkey

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ÖZ

Tüm dünyada olduğu gibi Türkiye’de de çevresel ve biyo-ekolojik değişiklikler, bazı idari ve politik hatalar ile küresel ısınma kenelerin davranışlarını ciddi bir şekilde etkilemektedir. Kene enfestasyonlarına ve kene ile bulaşan hastalıklara karşı halkın duyarlılığı küresel manada artmıştır. Bu noktada son yıllarda Dünya Sağlık Örgütü (WHO), keneler ve kenelerle bulaşan hastalıklara karşı spesifik mücadele stratejileri üzerine "Tek Sağlık" adı altında yeni bir konsept geliştirmiştir. Bu konunun önemini vurgulamak için WHO, 2015 yılını vektör-borne hastalıklar yılı olarak deklare etmiş ve "küçük ısırık büyük tehdit" şeklinde slogan geliştirmiştir. Küresel mücadele stratejileri arasında, kene popülasyonlarının artış dinamikleri ve epidemiyolojik bakış açısını açıkça ortaya koyma ve özellikle zoonotik karakterli kene kaynaklı hastalıkların insidensi üzerine kenelerin etkileri gibi konular özellikle hedef alınmıştır. Son yüzyılda Türkiye’de, argasidae ve ixodidae ailelerine ait sırasıyla üç ve altı soyda sekiz argasid ve otuz dokuz ixodid kene türünü kapsayan toplam kırk yedi kene türü rapor edilmiştir. Bu derlemede, Türkiye’de 1916 ve 2016 yılları arasındaki yüzyıllık periyotta, varlığı bildirilen kene türleri, bunların bölgesel ve mevsimsel dağılımları ile medikal ve veteriner önemleri gözden geçirilmiştir.

Anahtar Kelimeler: Yüzyıllık periyot, mevcut durum, keneler, Türkiye

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INTRODUCTION

Turkey is a peninsula subtropically located between the 36° and 42° northern parallels and 26° and 45° eastern meridians on the Mediterranean, Aegean, and Black seas in Eurasia. It covers 783.582 km² has a human population of over 80 million and a livestock population of over 50 million;

its economic structure currently depends on a mix of industrial and agricultural products. The location of Turkey allows it to be a natural bridge for the transmission of some tick species and also several tick-borne diseases (TBDs) from Africa to Europe and from Europe to Africa. In particular, migratory birds play an important role for this intercontinen-

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tal transmission of ticks and TBDs. Turkey has many valuable marshes and migratory bird stations in different geographical regions; these include the following: the "Büyük Menderes Delta" in the Aegean region, the "Sultan Marshes" in Central Anatolia, the "Manyas Bird Paradise" in Marmara, the "Kızılırmak Delta" in the Black Sea, the "Hevsel Bird Paradise" in the Southeast, and the "Aras Bird Paradise" in the North-eastern regions of Turkey. All of them highlight the intercontinental importance for the epidemiology of ticks and TBDs. Turkey covers several geographical regions such as Marmara, the Black Sea, Eastern Anatolia, South-eastern Anatolia, the Mediterranean, the Aegean, and Central Anatolia. A typical continental climate prevails in the plateaus of Anatolia, whereas temperate climates mainly dominate the coastal areas. However, each geographical region has different specific climatic conditions, vegetation structures, and wildlife, allowing suitable habitats for various tick species in all four seasons of the year. During tick seasons, several tick-borne pathogens, such as parasites, virus, and bacteria, are transmitted to their hosts by their specific vector ticks and cause very serious TBDs. Additionally, because of global warming, the temperate climate of Turkey affects the prevalence of various parasitic arthropod infestations and different emerging and re-emerging vector-borne diseases with zoonotic characteristics in some regions of Turkey. Approximately more than 40 of these vector-borne diseases have already been reported in humans, animals, and plants in Turkey (1, 2). These tick infestations and tick-borne pathogens might be most prevalent and seriously dangerous for public and livestock health, particularly in the tick seasons, in most parts of Turkey. Tick infestations and TBDs are the major impediment for the development and improvement of the livestock industry in Turkey, as well as in many other countries, and cause very serious economic losses of livestock by decreasing milk production, animal loss of weight, or increasing risk factors for bacterial and fungal infections as well as screw-worm attacks (3-5). Globally, it has been reported that 80% of 1.2 million cattle are at a risk of tick infestations and TBDs, causing losses of US \$7 billion, annually (6).

In this article, the recorded tick species and their regional distribution and infestations in man and animals and also the identified tick-borne pathogens in Turkey have been chronologically reviewed between 1916 and 2016.

Current status of tick species

In Turkey, preliminary taxonomic studies about ticks were performed as early as the beginning of the 1900s. The initial records about tick fauna in Turkey are based on *Ixodes ricinus* var. *gibbosus* n. var., *Haemaphysalis cinnabarina* var. *punctate*, and *Hyalomma aegyptium* ticks, and were collected from a domestic goat (*Capra hircus*) in November 1913 in the Izmir province of the Aegean region by Nuttall (7) in 1916. In the following decades, *Ixodes ricinus* and *Hyalomma aegyptium* were reported by Celebi (8) in 1926; *Ornithodoros lahorensis* was reported by Tuzdil (9) in 1936; *Rhipicephalus rossicus* was reported by Pomerantzev (10) in 1946 from Eastern Anatolia; and *Rhipicephalus bursa*, *R. sanguineus*, *R. (Boophilus) calcaratus*, *H. dromedarii*, *H. anatolicum*, *Hae. concinna*, and *Dermacentor reticulatus* were recorded by Oytun (11) in 1947 from livestock in Central Anatolia. In addition to the tick species

mentioned above, a lot of argasid and ixodid ticks such as *Argas reflexus*, *A. persicus*, *Hae. parva*, *Hae. inermis*, *Hae. sulcata*, *Hae. numidiana*, *D. niveus*, *H. detritum*, and *H. excavatum* were recognized by Kurtpınar (12) in 1954 from domesticated animals in the seven regions; *H. mauritanicum* was reported by Yasarol (13) in 1954; *O. erraticus* was collected from rodent holes at in southern Turkey at the Turkey-Syria border by Ozsan and Akyay (14) in 1954; *I. vespertilionis* was reported from Vespertilian bats by Arthur (15) in 1956; *Hae. erinacei* and *Hyalomma impeltatum* were reported in the Marmara region by Hoogstraal (16) in 1959; *Abylomma variegatum* was reported from a horse in the Hatay province (near the Syrian border) by Mimioğlu and Yazar (17) in 1961; *H. scupense*, *D. marginatus* and *R. (Boophilus) annulatus* were reported from cattle, buffalo, sheep, and goats by Parrish (18) in 1961; *I. redikorzevi* was reported from rodents by Nemenz (19) in 1967; *Argas vespertilionis*, *O. tholozani*, *O. coniceps*, *I. hexagonus*, *I. laguri*, *I. frontalis*, *R. turanicus*, *R. (Boophilus) kohlsi*, and *Hyalomma marginatum* were reported from either domestic animals or rodents throughout Turkey by Merdivenci (20) in 1969; and *H. turanicum* was reported from cattle by Hoffmann et al. (21) in 1971. Ten years later, *Hae. otophila* was reported by Sayin and Dumanlı (22) in 1982; *Hyalomma asiaticum* was reported by Filippova et al. (23) in 1995; and *Otobius megnini* was detected from cattle in the Malatya province in Eastern Anatolia by Ozer and Aydın (24) in 1996. Recently, *H. rufipes* has been reported by Kar et al. (25) in 2009 from Marmara and by Bakirci et al. (26) in 2011 from cattle in the Aegean region. In addition to the above tick species, most recently, *I. arboricola* was identified in the Black Sea region (Cernek Ringing Station, Kızılırmak Delta, Samsun Province) by Keskin et al. (27) in 2014 from Turkey (Table 1).

Meanwhile, Turkey's tick fauna has been reviewed by Karaer et al. (28), Aydın and Bakirci (29), and Bursali et al. (30), but the number of tick species found was controversial. Briefly, eight soft tick species (*Argas reflexus*, *A. persicus*, *A. vespertilionis*; *Ornithodoros lahorensis*, *O. tholozani*, *O. erraticus*, *O. coniceps*; and *Otobius megnini*) in three genera belonging to Argasidae; thirty-nine hard tick species in six genera [*Amblyomma variegatum*; *Dermacentor marginatus*, *D. niveus*, *D. reticulatus*; *Haemaphysalis concinna*, *Hae. erinacei*, *Hae. inermis*, *Hae. numidiana*, *Hae. otophila*, *Hae. parva*, *Hae. punctate*, *Hae. sulcata*; *Hyalomma aegyptium*, *H. anatolicum*, *H. excavatum*, *H. asiaticum*, *H. detritum*, *H. dromedari*, *H. impeltatum*, *H. marginatum*, *H. mauritanicum*, *H. scupense*, *H. rufipes*, *H. turanicum*; *Ixodes arboricola*, *I. frontalis*, *I. gibbosus*, *I. hexagonus*, *I. laguri*, *I. redikorzevi*, *I. ricinus*, *I. vespertilionis*; *Rhipicephalus (Boophilus) annulatus*, *R. (Boophilus) calcaratus*, *R. (Boophilus) kohlsi*, *R. bursa*, *R. rossicus*, *R. sanguineus*, and *R. turanicus*] in Ixodidae have already been reported in the last hundred years of Turkey. Currently, Turkey's tick fauna comprises 47 species of classified and renamed world ticks by Guglielmone et al. (31, 32)

The geographical distribution of ticks

Amblyomma variegatum was recorded as a solitary case in the Mediterranean region (border to Syria); *Rhipicephalus (Boophilus) kohlsi* and *Otobius megnini* are seen sporadically in South-eastern Anatolia. *Ixodes* spp. are mostly seen in the Black Sea and Marmara regions, *Ornithodoros lahorensis* is a prevalent tick

Table 1. The chronologically reported tick species belonging to Argasidae and Ixodidae families from Turkey in the last century period between 1916 and 2016

	Tick Species	Host	Location	Year	Reference
IXODIDAE	<i>Ixodes ricinus</i> var. <i>gibbosus</i> n. var., <i>Haemaphysalis cinnabarina</i> var. <i>punctate</i> , <i>Hyalomma aegyptium</i>	Domestic goat (<i>Capra hircus</i>)	Aegean region	1916	7
	<i>Ixodes ricinus</i>	Sheep	All regions	1926	8
	<i>Rhipicephalus (Rhipicephalus) rossicus</i>	unknown	Eastern Anatolia	1946	10
	<i>Rhipicephalus bursa</i> , <i>R. sanguineus</i> , <i>R. (Boophilus) calcaratus</i> , <i>H. dromedarii</i> , <i>H. anatolicum</i> , <i>Hae. concinna</i> , <i>Dermacentor reticulatus</i>	Livestock	Central Anatolia	1944	11, 50
	<i>Hae. parva</i> , <i>Hae. inermis</i> , <i>Hae. sulcata</i> , <i>Hae. numidiana</i> , <i>D. niveus</i> , <i>H. detritum</i> , <i>H. excavatum</i>	Domestic animals	All regions	1954	81
	<i>H. mauritanicum</i>	Cattle	Marmara region	1954	13
	<i>I. vespertilionis</i>	Vespertilian bats	Aegean region, Mediterranean region, Eastern Anatolia	1956	15
	<i>Hae. erinacei</i> , <i>H. impeltatum</i>	Hedgehog	Marmara region	1959	16
	<i>Abyomma variegatum</i>	Horse	Mediterranean region	1961	17
	<i>H. scupense</i> , <i>D. marginatus</i> , <i>R. (Boophilus) annulatus</i>	Cattle, buffalo, sheep, goats	All regions	1961	18
	<i>I. redikorzevi</i>	Rodents	Black Sea region, Eastern Anatolia	1967	19
	<i>I. hexagonus</i> , <i>I. laguri</i> , <i>I. frontalis</i> , <i>R. turanicus</i> , <i>R. (Boophilus) kohlsi</i> , <i>H. marginatum</i>	Domestic animals and rodents	All regions	1968	20, 79
	<i>H. turanicum</i>	Cattle	Central Anatolia, Black Sea region	1971	21
	<i>Hae. otophila</i>	Cattle	Eastern Anatolia	1982	22
	<i>H. asiaticum</i>	Cattle	South Eastern Anatolia	1995	23
	<i>H. rufipes</i>	Cattle	Marmara and Aegean regions	2009	25, 26
<i>I. arboricola</i>	Birds	Black Sea region	2014	27	
ARGASIDAE	<i>Ornithodoros lahorensis</i>	Sheep/goats	Eastern Anatolia	1936	9, 49, 52, 53
	<i>Argas reflexus</i> , <i>A. persicus</i>	Domestic animals	All regions	1954	12
	<i>O. erraticus</i>	Rodents	South Eastern Anatolia	1954	14
	<i>Argas vespertilionis</i> , <i>O. tholozani</i> , <i>O. coniceps</i>	Domestic animals and rodents	All regions	1968	20, 79
	<i>Otobius megnini</i>	Cattle	Eastern Anatolia	1996	24

species in Central and Eastern regions of Anatolia, and the remaining species belonging to *Dermacentor*, *Haemaphysalis*, *Hyalomma*, *Rhipicephalus* and as well *Argas* are seen widespread throughout Anatolia. In addition, the ecology of *Hyalomma marginatum* has been particularly investigated because of the Crimean Congo Hemorrhagic Fever that endemically occurred in areas of Turkey (33). The often-seasonal activities of ticks were also reported as *Rhipicephalus* species [except *R. (Boophilus) annulatus*] and were generally seen from early to late spring, and sometimes in summer periods, in the all regions while *R. (Boophilus) annulatus* generally infests its host between September and December in Central Anatolia (34, 35); *Hyalomma*

species were frequently found in the seasons between late spring and early autumn in the countryside; *Dermacentor* spp. were observed in winter periods in the all regions (29); *Haemaphysalis* spp. were reported generally in autumn from throughout the country; *Ixodes* spp. were frequently seen year-round in the Marmara, Aegean, Mediterranean, and Black Sea regions (29, 36). Except *O. megnini*, the other argasid ticks *Argas* and *Ornithodoros* species were generally found throughout the year in most parts of Turkey (29). In the Kayseri area of Central Anatolia, *Hyalomma* spp. and *R. (Boophilus) annulatus* were the most prevalent ticks found for cattle infestations. In this area, the seasonal fluctuation of tick species was determined as follows:

Rhipicephalus spp. (in spring, summer, and fall); the adults of *Hyalomma* spp. (in spring, peaking in summer, and in autumn); *Haemaphysalis* spp. (in autumn, winter, and early spring); *O. lahorensis* (in autumn, peaking in winter, and in spring); *Dermacentor marginatus* (in all seasons); and *R. (Boophilus) annulatus* (in spring) (35). On the other hand, the seasonal fluctuation of *H. scupense* and its infestation characteristics was specifically monitored on the infested cattle and also in the infested barns through two tick seasons in the Thrace region of Turkey (37).

Tick infestations in animals and man

In parallel to these taxonomic, distribution, and seasonal studies on ticks, numerous surveys have been conducted on the medical and veterinary importance of ticks throughout Turkey. In this scope, tick infestations have been reported in livestock animals, such as cattle (3, 11, 22, 35, 37-54); sheep and goats (11, 34, 36, 42, 46, 47, 49-53, 55-62); in horses (17, 63-65); in man (11, 37, 50, 51, 66-80); in poultry (12, 20); in birds (27, 81, 82); in bats (83); in foxes (20); and in reptiles (84, 85). Additionally, an aberrant tick infestation case has been observed in a man who had just returned to Turkey from a safari trip in Africa, and the removed tick was identified as *Amblyomma* spp. nymph (86).

Control measures for ticks

Integrated tick control strategies are very important to reduce the direct effects of ticks and also to prevent the transmission of TBDs in the country, as well as globally. Integrated tick control measures consist of environmental, personal, and prophylactic controls (87). In the last century in Turkey, environmental tick control measures have been applied depending on intensive chemical usage. The direct application of chemical acaricides is the most popular tick control measure in Turkey, as well as globally. Arsenicals were the first used acaricide for the global tick control and were first used against *Boophilus* spp. infestations in cattle in 1893 in South Africa. Generally, As_2O_3 was used against tick infestation for many years in Turkey as well as globally (88). After ticks developed resistance against this acaricide, the usage of this chemical was stopped in the beginning of the 1980s (89, 90). Subsequently, *chlorinated hydrocarbons*, *organophosphorous compounds*, carbamates, formamidines, synthetic pyrethroids, phenyl pirazols, macrocyclic lactones (MLs), and growth regulators were used for tick control in Turkey. Currently, formamidines, synthetic pyrethroids, phenyl pirazols, and MLs are used for tick control in Turkey. On the other hand, personal tick control is also used generally in rural areas and in some urban areas of Turkey. Personal tick control strategies depend on measures such as avoiding scrublands, wearing white or light-colored clothing, pulling socks over the bottom of pant legs, walking in the center of walkways and paths, avoiding roadside grass, wearing lotions (except the face and hands) containing 30% diethyltoluamide (DEET) as a repellent, wearing special permethrin-impregnated clothing, and daily tick control in the bathroom after each field trip. Recently, these kinds of personal tick control measures were frequently applied by some sensitive humans in Turkey. Another tick control measure is prophylactic tick control. This tick control measure has some different characteristics, requires advanced technology, and is applied through biological controls such as tick vaccines and RNA interference. No study has been reported

about the applying of prophylactic tick control in Turkey as of yet.

In conclusion, Turkey has a suitable geographic location, warming climate conditions, and many bird paradises that serve as a bridge for migratory birds from Africa to Europe and from Europe to Africa. This natural structure allows exposure of Turkey to many tick infestations in animals and also in humans across the different regions of the country. Today, a total of 47 tick species (8 soft and 39 hard ticks) have already been reported in animals and humans from seven major regions of Turkey throughout the past century (between 1916 and 2016). Therefore, Turkey requires new strategies and advanced control programs for integrated tick control. Thus, Turkey should also develop and maintain coordination with internal and international organizations for future safety.

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REFERENCES

1. Inci A, Yazar S, Tuncbilek AS, Canhilal R, Doganay M, Aydin L, et al. Vectors and vector-borne Diseases in Turkey. Ankara Univ Vet Fak Derg 2013; 60: 281-96. [CrossRef]
2. Inci A, Yildirim A, Duzlu O. Three emerging vector-borne diseases in Turkey. J Fac Vet Med Univ Erciyes 2014; 11: 117-20.
3. Inci A, Ica A, Yildirim A, Vatanser Z, Cakmak A, Albasan H, et al. Economical impact of tropical theileriosis in the Cappadocia region of Turkey. Parasitol Res 2007a; 101: S171-4. [CrossRef]
4. Jongejan F, Uilenberg G. The global importance of ticks. Parasitol 2004; 129: S3-S14. [CrossRef]
5. Bram RA. Tick-borne livestock diseases and their vectors: the global problem. Ticks and Tick-Borne Diseases, FAO Animal Production and Health Paper No. 36. Rome: Food and Agriculture Organization; 1983.
6. McCosker PJ. Global aspects of the management and control of ticks of veterinary importance. Recent Adv Acarol 1979; 2: 45-53. [CrossRef]
7. Nuttall GHF. Notes on Ticks. IV. Relating to the Genus Ixodes and including a description of three new species and two new varieties. Parasitology 1916; 8: 294-337. [CrossRef]
8. Celebi IH. Ixodidae (keneler) ve muvellidimaraz vazifeleri tahripleri (ixodid ticks and their harmful effects). Tibbi Bay Mec 1926; 3: 261-71.

9. Tuzdil AN. Mezbahalara Mahsus Parazitoloji. İstanbul; 1936.
10. Pomerantzev BI. Les tiques (Ixodidae) de la faune de l'URSS et des pays limitrophes. Opredeliteli po Faune SSSR, Izdavaemye Zoologicheskim Institutom Akademii Nauk SSSR 1946; (26): 1-28.
11. Oytun HS. Keneler, Zararları ve Savas Careleri. Ankara: YZE Basımevi; 1947.
12. Kurtpinar H. Türkiye keneleri (Ixodoidea). Morfoloji, Biyoloji, Konakçı, Yayılışları ve Medikal Önemleri. Ankara: Güven Matbaası; 1954.
13. Yasarol S. Sigirlarda kene kontrolünde toxophane. Turk Vet Hek Dern Derg 1954; 24: 1756-66.
14. Ozsan K, Akyay N. Relapsing fever in Turkey; presence in the South (Turko-Syrian border) of *Ornithodoros erraticus* infected with a spirochete of the *Crocicidae* group. Bull Soc Pathol Exot Filiales 1954; 47: 501-3.
15. Arthur DR. The Ixodes ticks of Chiroptera (Ixodoidea, Ixodidae). J Parasitol 1956; 42: 180-96. [\[CrossRef\]](#)
16. Hoogstraal H. Biological observations on certain Turkish Haemaphysalis ticks (Ixodoidea, Ixodidae). J Parasitol 1959; 45: 227-32. [\[CrossRef\]](#)
17. Mimioğlu M, Yazar MT. Türkiye'de ilk *Amblyomma variegatum* Fabricius, 1974 olayı. Ank Univ Vet Fak Derg 1961; 8: 239-40.
18. Parrish DW. The ticks (*Argasidae* and *Ixodidae*) of Turkey. J Econ Entomol 1961; 54: 91-2. [\[CrossRef\]](#)
19. Nemenz H. Zecken aus der Türkei (Acari, Ixodidae). Zool 1967; 178: 191-5.
20. Merdivenci A. Türkiye Keneleri Üzerine Arastirmalar. İstanbul: İstanbul Cerrahpaşa Tıp Fak Yayını, Yayın No 1488, Kutulmuş Matbaası; 1969.
21. Hoffmann G, Horchner F, Schein E, Gerber H. Saisonales auftreten von Zecken und Piroplasmen bei Haustieren in den Asiatischen Provinzen der Türkei. Berl Munch Tierarztl Wochenschr 1971; 94: 152-6.
22. Sayin F, Dumanlı N. Elazığ bölgesi evcil hayvanlarda gorülen kene (*Ixodidae*) türleri ile ilgili epizootiyolojik arastirmalar. Ank Univ Vet Fak Derg 1982; 29: 344-62.
23. Filippova NA, Musatov SA, Panova IV, Lobanov AL. The taxonomic pattern of the polytypic species *Hyalomma asiaticum* (Ixodidae). First experience of morphometric databases application. Parazitologiya 1995; 29: 65-82.
24. Ozer E, Aydın L. Presence of *Otobius megnini* (Duges, 1883) in cattle in Malatya. Turk J Vet Anim Sci 1996; 20: 231-4.
25. Kar S, Guven E, Vatansver Z. Marmara Bölgesindeki bir harada kene enfestasyonu ve *Hyalomma rufipes* varlığı. 16. Ulusal Parazitoloji Kongresi; Kasım; 1-7; Adana: 2009. p. 254.
26. Bakirci S, Sarali H, Aydın L, Latif A, Eren H, Karagenc T. *Hyalomma rufipes* (Koch, 1844) infesting cattle in the West Aegean region of Turkey. Turk J Vet Anim Sci 2011; 35: 359-63.
27. Keskin A, Koprulu TK, Bursali A, Özsemir AC, Yavuz KE, Tekin S. First record of *Ixodes arboricola* (Ixodida: Ixodidae) from Turkey with presence of *Candidatus Rickettsia vini* (Rickettsiales: Rickettsiaceae). J Med Entomol 2014; 51: 864-7. [\[CrossRef\]](#)
28. Karaer Z, Yukarı BA, Aydın L. Türkiye keneleri ve vektörlükleri. Özcel MA, Daldal N, editors. Parazitoloji'de Artropod Hastalıkları ve Vektörler. İzmir: Ege Univ Basımevi; 1997. p. 363-458.
29. Aydın L, Bakirci S. Geographical distribution of ticks in Turkey. Parasitol Res 2007; 101: S163-6. [\[CrossRef\]](#)
30. Bursali A, Keskin A, Tekin S. A review of the ticks (Acari: Ixodida) of Turkey: species diversity, hosts and geographical distribution. Exp Appl Acarol 2012; 57: 91-104. [\[CrossRef\]](#)
31. Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Pena A, Horak IG, et al. The *Argasidae*, *Ixodidae* and *Nuttalliellidae* (Acari: Ixodida) of the world: a list of valid species names. Zootaxa 2010; 2528: 1-28.
32. Guglielmone AA, Robbins RG, Apanaskevich DA, Petney TN, Estrada-Pena A, Horak IG. The hard Ticks of the World (Acari: Ixodida: Ixodidae). New York: Springer; 2014. [\[CrossRef\]](#)
33. Vatansver Z. Ecology of *Hyalomma marginatum* and Crimean-Congo hemorrhagic fever. 1st National Symposium on Vectors and Vector Borne Diseases with International Participation; September; 9-10; Avanos, Cappadocia, Nevşehir-Turkey: 2012. p. 44-59.
34. Sayin F, Dincer S, Karaer Z, Dumanlı N, Cakmak A, İnci A, et al. Status of tick infestations of sheep and goats in Turkey. Parasitologia 1997; 39: 145-52.
35. İca A, İnci A, Vatansver Z, Karaer Z. Status of tick infestation of cattle in the Kayseri region of Turkey. Parasitol Res 2007; 101: S167-9. [\[CrossRef\]](#)
36. Aydın MF, Aktas M, Dumanlı N. Türkiye'nin Karadeniz bölgesindeki koyun ve keçilerde kene enfestasyonları. Kafkas Univ Vet Fak Derg 2012; 18: A17-22.
37. Kar S, Akyıldız G, Vatansver Z. Trakya'da ineklerde *Hyalomma* scutense enfestasyonu ve enfestasyonun mevsimsel karakteristiği. 19. Ulusal Parazitoloji Kongresi ve Uluslararası katılımlı Ekinokokozis Sempozyumu; Ekim; 5-9; Erzurum: 2015a. p. 79.
38. Gökse K. Bazı Karadeniz Bölgesi illerinin sigirlarında müşahade edilen *Babesidae* (Sporozoa: Piroplasmida) enfeksiyonları ve kene enfestasyonları. Ank Univ Vet Fak Derg 1968; 15: 46-57.
39. Dumanlı N. Elazığ ve yöresinde *Hyalomma excavatum* (Koch, 1844)'un biyo-ekolojisi üzerinde arastirmalar. Tubitak Doga Bilim Derg 1983; 7: 23-31.
40. Karaer Z. Ankara ili ve civarında bulunan kene türleri ile *Hyalomma detritum* (Schulze, 1919)'un bazı ekolojik özellikleri üzerine arastirmalar. Tubitak 7. Bilim Kongresi Tebliğleri, Türkiye: 1983. p. 371-8.
41. Zeybek H, Kalkan A. Ankara yöresinde mera kenelerinin yayılışı ve mevsimle ilişkisi. Etlik Vet Mikrobiyol Enst Derg 1984; 5: 14-21.
42. Tasci S. Van bölgesinde sigir ve koyunlarda gorülen kene türleri ile bunların tasidigi kan parazitleri (protozoon) arasındaki ilişkiler. Ank Univ Vet Fak Derg 1989; 36: 53-63.
43. İnci A. Ankara'nın Cubuk ilçesinde sigirlarda babesiosis'in seroinsidensi üzerine arastirmalar. Ankara Univ Vet Fak 1992; 1-2: 153-67.
44. İnci A, Cakmak A, Karaer Z, Dincer S, Sayin F, İca A. Seroprevalence of bovine babesiosis around Kayseri. Turk J Vet Anim Sci 2002a; 26: 1345-50.
45. İnci A, İca A, Yıldırım A, Vatansver Z, Cakmak A, Alban H, et al. Epidemiology of tropical theileriosis in Cappadocia region. Turk J Vet Anim Sci 2008; 32: 57-64.
46. Yukarı BA, Umur S. Burdur yöresindeki sigir, koyun ve keçilerde kene (*Ixodidae*) türlerinin yayılışı. Turk J Vet Animal Sci 2002; 26: 1263-70.
47. Aydın L. Güney Marmara Bölgesi ruminantlarında gorülen kene türleri ve yayılışları. T Parazitolojisi Derg 2002; 24: 194-200.
48. Kar S, Akyıldız G, Vatansver Z. Kırklareli'nde CCHF olgularına rastlanan koyulardaki ineklerde kene enfestasyonu mevsimsel karakteristiği. 19. Ulusal Parazitoloji Kongresi ve Uluslararası katılımlı Ekinokokozis Sempozyumu; Ekim; 5-9; Erzurum: 2015b. p. 76.
49. Oytun HS. Memleketimizde gorülen *O. lahorensis* Neumann, 1908 morfolojisi ve biyolojisine dair yapılmış arastirmalar. YZE Derg 1944a; 3: 175-88.
50. Oytun HS. Kenelerin dis parazit olarak insan ve ehli hayvanlarda yaptıkları zararlar. Guzel Yurd Gazetesi 1944b; 31: 14/1/1944.
51. Oytun HS. Kenelerin yaptıkları cesitli zararlar. TVC Derg 1944c; 12: 2.
52. Oytun HS. *Ornithodoros lahorensis* biyolojisi ve yayılışına dair. TC Tarım Bak Derg 1948; 15: 10-12.
53. Oytun HS. Yurdumuzda gorülen *Ornithodoros lahorensis*'in epizootiyolojik durumu ve bu alandaki arastirmalarımız. TC Tarım Bak Derg 1949; 18: 8-12.
54. Oytun HS. Tıbbi Entomoloji. Ank Univ Tıp Fak Yayın, İkinci Baskı, Guzel İstanbul Matbaası, Ankara, 1961, p. 546.

55. Guralp N, Sayin F, Tigin Y, Tinar R. Texel, Merinos ve Kivircik koyunlari ile melezlerinde gorulen parazit turleri, bunlari enfeksiyon oranini ve savas careleri. Ankara Univ Vet Fak Derg 1975; 22: 1-17. [\[CrossRef\]](#)
56. Guler S. Ankara ve civarindaki koyun ve kecielerde kis Ixodidae'leri üzerine arastirmalar. Bursa Univ Vet Fak Derg 1982; 1: 45-54.
57. Kalkan A. Koyun kis kenisi (Ornithodoros lahorensis Neumann, 1908)'nin ekolojisi ve vektörlüğü üzerine incelemeler. Ank Univ Vet Fak Derg 1982; 29: 331-43.
58. Cakmak A, Dincer S, Karaer Z. Samsun yoresinde koyunlarda Babesia ovis'in serodiagnosisi üzerine arastirmalar. Ankara Univ Vet Fak Derg 1991; 38: 242-51.
59. Ozer E, Guler S. The occurrence of Boophilus kohlsi (Hoogstraal & Kaiser, 1990) in goats in Mardin. Doga Tr Vet Animal Sci 1993; 18: 23-6.
60. Inci A, Yukari B, Sayin F. Cankiri yoresinde bazı koyun ve keci surullerinde babesiosis ve theileriosis etkenlerinin mikroskopik kan muayenesiyle arastirilmesi. Ank Univ Vet Fak Derg 1998; 1: 105-13.
61. Inci A, Nalbantoglu S, Cam Y, Atasever A, Karaer Z, Cakmak A, et al. Kayseri yoresinde koyun ve kecielerde theileriosis ve kene enfestasyonlari. Turk J Vet Anim Sci 2003; 27: 57-60.
62. Cicek H, Duzgun A, Emre Z, Karaer Z. Seroprevalence of Babesia ovis in sheep around Afyon. Turk J Vet Anim Sci 2004; 28: 683-6.
63. Inci A. Gemlik askeri harasi atlarinda Babesia caballi (Nuttall, 1910) ve Babesia equi (Laveran, 1901)'nin mikroskopik muayeneyle saptanmasi. Turk J Vet Anim Sci 1997; 21: 43-6.
64. Aktas M, Dumanli N. Malatya Sultansuyu Tarim isletmesi atlarinda subklinik Babesia equi (Laveran, 1901) ve Babesia caballi (Nuttall, 1910) enfeksiyonlari. Türkiye Parazitoloji Dergisi 2000; 24: 55-6.
65. Kizilarlan F, Yildirim A, Duzlu, O, Inci A, Onder Z, Ciloglu A. Molecular detection and characterization of Theileria equi and Babesia caballi in horses (Equus ferus caballus) in Turkey. J Equine Vet Sci 2015; 35: 830-5. [\[CrossRef\]](#)
66. Inci A, Ica A, Duzlu O, Yildirim A, Biskin Z. Kayseri, Nevsehir, Nigde, Hatay, Adana, Osmaniye, Kahramanmaraş ve Gaziantep illerinde insanlarda gorulen kene enfestasyonlari. 15. Uluslararası Parazitoloji Kongresi; Kasim; 18-23; Kayseri ve Urgup: 2007b. p. 167-8.
67. Umur S, Hokelek M, Acici M, Gurler AT, Beyhan YM. Orta karadeniz bölgesinde insanlarda isirik sikayetiyle getirilen kene turleri. 15. Ulusal Parazitoloji Kongresi; Kasim; 18-23; Kayseri ve Urgup: 2007. p. 167.
68. Vatasever Z, Uzun R, Estrada-Pena A, Ergonul O. Crimean-Congo hemorrhagic fever in Turkey. Ergonul O, Whitehouse CA, editors. Crimean-Congo Hemorrhagic Fever: A Global Perspective. New York: Springer, Dordrecht; 2007. [\[CrossRef\]](#)
69. Vatasever Z, Gargili A, Aysul NS, Sengoz G, Estrada-Peña A. Ticks biting humans in the urban area of Istanbul. Parasitol Res 2008; 102: 551-3. [\[CrossRef\]](#)
70. Gargili A, Kar S, Yilmazer N, Cerit C, Sonmez G, Sahin F, et al. Evaluation of ticks biting humans in Thrace Province, Turkey. Kafkas Univ Vet Fak Derg 2010; 16: S141-6.
71. Gargili A, Kar S, Yilmazer N, Ergonul O, Vatasever Z. Different abundances of human-biting ticks in two neighboring provinces in Turkey. Kafkas Univ Vet Fak Derg 2011; 17: 93-7.
72. Gunes T, Poyraz O, Vatasever Z. Crimean-Congo hemorrhagic fever virus in ticks collected from humans, livestock, and picnic sites in the hyper endemic region of Turkey. Vector Borne Zoonotic Dis 2011; 11: 1411-6. [\[CrossRef\]](#)
73. Aktas M. A survey of ixodid tick species and molecular identification of tick-borne pathogens. Vet Parasitol 2014; 200: 276-83. [\[CrossRef\]](#)
74. Orkun O, Karaer Z, Cakmak A, Nalbantoglu S. Identification of tick-borne pathogens in ticks feeding on humans in Turkey. Plos NTD 2014a; 8: e3067. [\[CrossRef\]](#)
75. Orkun O, Karaer Z, Cakmak A, Nalbantoglu S. Spotted fever group rickettsiae in ticks in Turkey. Ticks Tick-borne Dis 2014b; 5: 213-8. [\[CrossRef\]](#)
76. Selcuk O, Aydin L, Girisgin AO, Senlik B, Ozakin C. Long-term investigations on tick infestations of human. Kafkas Univ Vet Fak Derg 2015; 21: 795-8.
77. Merdivenci A. Türkiye'nin entomolojik coğrafyasi (Türkiye'nin parazitolojik coğrafyasi, s. 114-192). Ege Univ Tıp Fak Yayini 1965; No. 42. Izmir.
78. Merdivenci A. Türkiye'de kene larvalari üzerine arastirmalar. VI MT Biol Kongr 15-21 Agustos, Izmir, 1966, s. 251-68.
79. Merdivenci A. Istanbul'da insanlarda Ornithodoros conciceps Canestrini, 1890 infestasyonu. Turk Mikrobiol cem 30.5.1968 gunku toplantisinde bildirilmistir. IU Tıp Fak Mec 1968; 31: 460-68.
80. Mimioglu MM. Veteriner ve Tibbi Arthropodoloji. Ank Univ. Vet Fak Yayin, No.295, Ders Kitabı. 196, Ank Univ Matbaasi, Ankara 1973, p. 343.
81. Kurtpinar H. Anadolu'da Argas reflexus Fabr. (guvercin kenisi)'nin insanlarda tevit ettigi sihhi bozukluklar üzerine arastirmalar. Turkish Bull Hyg Exp Bio 1957; 17 (3): 237-43.
82. Leblebicioglu H, Eroglu C, Erciyas-Yavuz K, Hokelek M, Acici M, Yilmaz H. Role of migratory birds in spreading Crimean-Congo hemorrhagic fever. Turk Emerg Infect Dis 2014; 20: 1331e1334.
83. Sert H, Yagci S, Albayrak I, Aktas M, Karaer Z. Türkiye'nin farkli bölgelerinden yakalanan yarasalarda (Vespertilionidae, Rhinolophidae) kene (Acari: Ixodidae, Argasidae) enfestasyonu. T Parazitoloji Dergisi 2001; 25: 174-7.
84. Aydin L, Yildirimhan HS, Ugurtas IH. Marmara Bölgesindeki bazı kertenkele ve kabumbaga turlerinde kenelerin (Ixodidae) yayginligi. T Parazitoloji Dergisi 2002; 26: 84-6.
85. Yaman M, Zerek A. Bir Akdeniz Bukalemunu'nda (Chamaeleo chamaeleon) Rhipicephalus (Boophilus) kohlsi (Hoogstraal and Kaiser, 1960) Olgusu. FÜ Sağ Bil Derg 2016; 30: 55-6.
86. Beyhan YE, Mungan M, Babur C. Yurtdisi seyahat iliskili Amblyomma spp. olgusu (Amblyomma spp. case related to overseas travel). Türkiye Parazitoloji Dergisi 2014; 38: 48-50. [\[CrossRef\]](#)
87. Walker AR. Eradication and control of livestock ticks: biological, economic and social perspective. Parasitol 2011; 138: 945-59. [\[CrossRef\]](#)
88. Bekker PM. The history of dipping. Veld 1960; 20: 1-5.
89. Matthewson MD, Baker JAF. Arsenic resistance in species of multi-host ticks in the Republic of South Africa and Swaziland. J S Afr Vet Assoc 1975; 46: 341-4.
90. Drummond RO. Tick-borne livestock diseases and their vectors. Chemical control of ticks. Wld Anim Rev (FAO) 1983; 36: 28-33.