Exp Appl Acarol (2008) 45:195–198
DOI 10.1007/s10493-008-9167-5

Ticks infesting domestic animals in northern Greece

Vasiliki Pavlidou · Spyros Gerou · Melania Kahrimanidou · Anna Papa

Received: 13 March 2008 / Accepted: 30 May 2008 / Published online: 18 June 2008

Abstract The tick species infesting grazing animals in the countryside of 11 prefectures in Northern Greece were investigated during April–July and September–December of consecutive years 2003–2006. A total of 3,249 (1,952 males, 1,297 females) adult ticks were collected from goats, sheep, cattle and dogs. Ticks were identified as *Ixodes ricinus* (44.57%), *Ixodes gibbosus* (4.09%), *Rhipicephalus bursa* (19.14%), *Rhipicephalus sanguineus*, *Rhipicephalus turanicus* (5.79%), *Hyalomma marginatum marginatum* (12.40%), *Dermacentor marginatus* (0.31%) and *Boophilus annulatus* (4.43%). *Rhipicephalus* spp. and *Hyalomma* spp. were abundant in all prefectures, *Ixodes* spp. were present in 9/11 prefectures, *Boophilus* spp. in 4/11, while *Dermacentor* spp. were found only in one. Results of this study give an insight into the ecology of ticks and their potential of tick-borne diseases in the country.

Keywords Ticks · *Ixodidae* · Greece

Many tick species are responsible for the transmission of a variety of pathogens to humans and livestock. Spotted fever group rickettsiae, babesia, borrelia, ehrlichia, anaplasma, as well as tick-borne encephalitis (TBE) virus and Crimean Congo Hemorrhagic fever (CCHF) virus are common tick-borne pathogens (Parola and Raoult 2001, Charrel et al. 2004). The knowledge of the incidence, the prevalence and the geographical distribution of the tick species in a region is helpful for the prevention and control of tick-borne diseases.

Greece is divided into ten regions, which are further subdivided into 54 prefectures. The most common climate is the typical Mediterranean, characterized by hot but not torrid summer and mild and short winter with moderate rainfalls. The typical evergreen Mediterranean scrub vegetation is widespread. A previous study on ticks collected of domestic animals in Northern Greece during 1983–86 revealed that the most common tick, found in

V. Pavlidou · S. Gerou · M. Kahrimanidou · A. Papa (✉)
Department of Microbiology (WHO Collaborating Centre for Reference and Research on Arboviruses and Hemorrhagic Fever Viruses), Medical School, Aristotle University, 54124 Thessaloniki, Greece
e-mail: annap@med.auth.gr

all bioclimatic zones, was *Rhipicephalus bursa*, and that *Rhipicephalus* and *Hyalomma* ticks were active during spring-summer, while *Ixodes* spp., *Haemophysalis* spp. and *Dermacentor marginatus* were active mostly during autumn and winter (Papadopoulos et al. 1996). In another study, three species of Ixodid ticks (*Ixodes gibbosus, R. bursa* and *D. marginatus*) were collected from goats, and *I. gibbosus* was the most abundant and prevalent species collected from October to April (Papazahariadou et al. 1995). A recent study in Cephalonia Island revealed that a variety of tick species were present, some of them PCR-positive for *C. burnetii* and SFG rickettsiae (Psaroulaki et al. 2006).

In the present study we update the knowledge of the tick species parasitizing small mammals living permanently in farms located in the countryside of two regions (Macedonia and Thrace) of Greece, both in the northern part of the country. Tick collection was carried out during 2003–2006 in 9 of 13 prefectures of Macedonia, and in 2 of 3 prefectures of Thrace (Fig. 1). Specifically, the 9 prefectures of Macedonia were: Drama and Kavala from Eastern Macedonia—Serres, Kilkis, Halkidiki, Pella and Imathia from Central Macedonia—Florina and Kastoria from Western Macedonia. The two prefectures of Thrace were Evros and Xanthi. Ticks were collected from cattle, mainly sheep and goats, from 4 to 5 different areas of each prefecture. All farms were situated in hilly areas above 600 m, neighboring with forests of deciduous and evergreen vegetation (oaks and

Fig. 1 Prefectures of northern Greece where ticks of the present study were collected (4–5 areas of each prefecture was tested twice per year during 2003–2006)

coniferous trees). A continuous movement of the herds during the day involved the entry into the forests and probably the acquisition of questing ticks from the thick low vegetation. The collection was conducted during April–July and September–December of each year. The farms were visited at least twice during the collection period. Ticks were put into tubes labeled with the place and date of collection, the animal species and the name of the breeder. Data concerning the altitude, latitude, longitude, vegetation and climate type of the area were recorded. The tick classification was performed using identification keys taking into account the external morphological characters (Estrada-Pena et al. 2004).

In total, 3,249 ticks were collected. All were adults (1,952 males, 1,297 females) belonging to the *Ixodidae* family. Most ticks were collected from goats (n = 2,042, 62.85%) and sheep (n = 869, 26.74%), followed by collection from cattle (n = 243, 7.47%) and dogs (n = 95, 2.92%). Ticks belonged to five genera: *Ixodes* (*I. ricinus, I. gibbosus*), *Rhipicephalus* (*R. bursa, R. turanicus, R. sanguineus*), *Hyalomma* (*H. m. marginatum*), *Boophilus* (*B. annulatus*) and *Dermacentor* (*D. marginatus*). Most common was *I. ricinus* (44.57%), while *D. marginatus* was the most seldom (0.31%). The distribution of ticks in each region is seen in Table 1. *Rhipicephalus* spp. and *Hyalomma* spp. were abundant in all prefectures, *Ixodes* spp. was found in all prefectures except two (Florina and Xanthi), *Boophilus* spp. was present in Kilkis, Pella, Halkidiki and Xanthi, while *Dermacentor* spp. was found only in Imathia.

Rhipicephalus bursa, the main vector of *Babesia equi, Babesia ovis*, *Theileria ovis* and *Anaplasma ovis*, was found in every farm tested and in all animal species. *I. ricinus,* the main vector of TBE virus, *Borrelia burgdoferi* and several rickettsiae and piroplasms was also found very often. However, a recent study on epidemiology of TBE in Greece revealed that the disease is very rare in Greece (Pavlidou et al. 2007); this is probably due to the absence of synchrony in the seasonal activity of larval and nymphal *I. ricinus* ticks (Randolph et al. 2000). *I. gibbosus* was much less common, found in only 3 prefectures (Imathia, Pella and Kastoria), showing similar distribution as in a previous study (Papadopoulos et al. 1996).

Concerning seasonality, *I. ricinus* was collected in November (n = 1,037/1,448, 71.61%) and June (n = 411/1448, 28.38%). Compared to other European countries, the autumn maximum activity period of this species is prolonged in Greece by 1–2 months, probably due to the milder winter, suggesting that ticks adapt themselves in local climatic and ecological conditions. *I. gibbosus* was collected mainly in November. *Rhipicephalus* spp. was collected during May-July (peak in June). *H. m. marginatum* was collected during

Table 1 Distribution of collected tick species by region of Northern Greece

Tick species	Western Macedonia	Central Macedonia	Eastern Macedonia	Thrace	Total (%)
I. ricinus	156	844	368	80	1448 (44.57)
I. gibbosus	31	102	0	0	133 (4.09)
R. bursa	55	320	201	46	622 (19.15)
R. turanicus	0	116	72	0	188 (5.79)
R. sanguineus	32	225	44	0	301 (9.26)
H. m. marginatum	53	170	140	40	403 (12.40)
B. annulatus	0	70	0	74	144 (4.43)
D. marginatus	0	10	0	0	10 (0.31)
Total	327	1857	825	240	3249 (100)

June–July and October–November, while *B. annulatus* was present only in November. *D. marginatus* was collected during May–July.

Ticks were collected at areas with altitude more than 600 m, nearby evergreen forests, where the average humidity was approximately 80%. Studies from many European countries show that nowadays ticks are found in altitude of 1,200 m, as a result of the global warming phenomenon (Danielova et al. 2006). Because of the climatic changes, or changes in other factors that might affect tick population dynamics, studies on distribution and ecology of ticks have to be repeated over time to renew the existing knowledge and to provide data for reliable predictive models. The present study gives an update of the seasonal and geographical distribution and abundance of ticks in N. Greece, which might help the prediction of the disease transmission potential to humans and livestock.

References

Charrel RN, Attoui H, Butenko AM, Clegg JC, Deubel V, Frolova TV, Gould EA, Gritsun TS, Heinz FX, Labuda M, Lashkevich VA, Loktev V, Lundkvist A, Lvov DV, Mandl CW, Niedrig M, Papa A, Petrov VS, Plyusnin A, Randolph S, Süss J, Zlobin VI, de Lamballerie X (2004) Tick-borne virus diseases of human interest in Europe. Clin Microbiol Infect 10:1040–1055

Danielova V, Rudenko N, Daniel M, Holubova J, Materna J, Golovchenko M, Schwarzová L (2006) Extension of *Ixodes ricinus* ticks and agents of tick-borne diseases to mountain areas in the Czech Republic. Int J Med Microbiol 296:48–53

Estrada-Pena A, Bouattour A, Camica JL, Walzer AR (2004) Ticks of domestic animals in the Mediterranean region: a guide to identification of species. University of Zaragoza, Spain; Atalanta, Houten, The Netherlands, pp 1–131

Papadopoulos B, Morel PC, Aeschlimann A (1996) Ticks of domestic animals in the Macedonian region of Greece. Vet Parasitol 63:25–40

Papazahariadou MG, Papadopoulos EG, Himonas CA (1995) Seasonal activity of ixodid ticks on goats in northern Greece. Vet Rec 136:585–588

Parola P, Raoult D (2001) Tick-borne bacterial diseases emerging in Europe. Clin Microbiol Infect 7:80–83

Pavlidou V, Gerou S, Diza E, Antoniadis A, Papa A (2007) Epidemiological study of Tick-borne Encephalitis virus in Northern Greece. Vector Borne Zoonotic Dis 7:611–616

Psaroulaki A, Ragiadakou D, Kouris G, Papadopoulos B, Chaniotis B, Tselentis Y (2006) Ticks, tick-borne rickettsiae, and *Coxiella burnetii* in the Greek Island of Cephalonia. Ann N Y Acad Sci 1078:389–399

Randolph SE, Green RM, Peacey MF, Rogers DJ (2000) Seasonal synchrony: the key to tick-borne encephalitis foci identified by satellite data. Parasitology 121:15–23