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Short communication

Spatial distribution of *Dermacentor reticulatus* and *Ixodes ricinus* in Hungary: evidence for change?

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Abstract

A survey was conducted to investigate the spatial distribution of *Ixodes ricinus* and *Dermacentor reticulatus* in Hungary and to compare these data with the results of a previous large-scale survey. In the survey conducted in the 1950s, *D. reticulatus* adults were detected in two isolated areas of two counties, and the presence of these ticks in the collection was explained by accidental introduction. In the present survey, *D. reticulatus* became the second most common species occurring in all 16 counties involved in the monitoring and showed high prevalence. The change in the spatial distribution of this tick species, the increase of incidence of *Babesia canis* infection in Hungary, and the increasing number of canine babesiosis case reports from other Central and Central Eastern European countries since the 1970s suggest an expansion of the geographic range of *D. reticulatus* and intensification of the transmission rate of *B. canis* and probably other *D. reticulatus*-borne diseases (e.g. tularemia and tick-borne lymphadenopathy) in the region. The spatial distribution of *I. ricinus* was roughly in line with the results of the earlier survey. *I. ricinus* was the most common tick species being present in all 16 counties with the highest prevalence. Nevertheless, the comparison of the data of the previous and current survey cannot be used for fine-scale analysis; thus, it cannot be dismissed that the spatial distribution of *I. ricinus* also changed during the past decades. The spatial distribution patterns of tick-borne encephalitis in Hungary and other Central Eastern European countries may indicate such a change.

Keywords: Red fox; *Vulpes vulpes*; *Dermacentor reticulatus*; *Ixodes ricinus*; *Babesia canis*; Tularemia; Tick-borne lymphadenopathy; Prevalence; Geographical distribution; Spatial distribution

1. Introduction

Based on the results of previous studies, red foxes (*Vulpes vulpes*) are infested by five tick species, *Ixodes ricinus*, *Ixodes canisuga*, *Ixodes hexagonus*, *Dermacentor reticulatus* (syn. *D. pictus*), and *Haemaphysalis concinna* in Central and Central Eastern Europe (Hinaidy, 1971, 1976; Schöffel et al., 1991; Sréter et al., 2003b). Of these ticks, *I. ricinus* and *D. reticulatus* are important vectors of several viral (tick-borne encephalitis), bacterial (granulocytic ehrlichiosis, Lyme borreliosis, rickettsiosis helvetica,

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tick-borne lymphadenopathy, tularemia), and parasitic (babesiosis divergens, babesiosis microti, babesiosis odocoilei, babesiosis canis) diseases of man and animals in the region (Raoult and Roux, 1997; Gorenflot et al., 1998; Zahler et al., 1998; Randolph, 2001; Ellis et al., 2002; Herwaldt et al., 2003; Kálmán et al., 2003; Hartelt et al., 2004; Meer-Scherrer et al., 2004; Sréter et al., 2004; Sréter-Lancz et al., in press). There is some evidence that the geographical distribution of *I. ricinus* changed in Europe in the past decades, which might have influenced the epidemiology of some *I. ricinus*-borne diseases as tick-borne encephalitis and Lyme borreliosis (Lindgren and Gustafson, 2001; Randolph, 2001, 2004; Zeman and Bene, 2004). However, limited information is available on the change of distribution of *Dermacentor* spp. and *Dermacentor*-borne diseases in Europe.

The aim of the present study was to estimate the spatial distribution of *D. reticulatus* and *I. ricinus* in Hungary and to compare these data with the results of a large-scale survey conducted in the 1950s in Hungary (Janisch, 1959).

2. Materials and methods

A total of 2472 ticks were collected from the carcasses of 346 red foxes representing 329 different locations of 16 counties of Hungary (covering an area of about 70,000 km^2). Foxes were sent to the Central Veterinary Institute (Budapest) in connection with the rabies control program between January 2002 and June 2004. The origin, transportation, and storage of foxes and collection and identification of ticks were done as described earlier (Sréter et al., 2003a, 2003b). Statistical analysis was performed by using InStat 3.0 program (GraphPad Inc., San Diego, CA). The negative binomial values were evaluated as described (Sréter et al., 1994).

3. Results and discussion

The previous survey on the distribution of tick fauna of Hungary was conducted between 1954 and 1957, and the geographical distribution of tick species was based on the examination of approximately 15,000 specimens (Janisch, 1959). Nineteen tick species (including all those parasitizing foxes) were collected and identified either from wild animals or from the vegetation by flagging in 141 areas representing all 20 counties of Hungary. In the present survey, approximately 2500 ticks belonging to five species (*I. ricinus*, *I. canisuga*, *I. hexagonus*, *D. reticulatus*, and *H. concinna*) were identified. Ticks were collected from red foxes shot at 329 locations representing 16 counties (75% of the territory) of Hungary. As the methods of tick collection were partly different, the data of the two studies are not fully comparable and cannot be used for fine-scale analysis of change of spatial distribution. Nevertheless, the previous and current data sets together with past and current tick-borne infection data might be used for the identification of considerable changes.

The prevalence, mean intensity, and distribution of *D. reticulatus* and *I. ricinus* infestations of foxes are summarized in Table 1. The distribution of both tick species was highly overdispersed with *k*-values <0.001, i.e., most of the ticks were present on a small percentage of foxes.

In the study conducted in the 1950s, a few *D. reticulatus* adults were detected in two isolated areas of two counties, and the presence of these ticks in the collection was attributed to accidental introduction of the parasite. In the 1980s and 1990s, the parasite was detected in additional locations (Janisch, 1986; Földvári and Farkas, 2001). In the present survey, *D. reticulatus* appeared as the second most common species occurring in all counties with surprisingly high prevalence (range: 8–64%) (Table 1). This observation

Table 1
The frequency distribution, prevalence, and relative density of *I. ricinus* and *D. reticulatus* infestations of red foxes (*V. vulpes*) in Hungary

		I. ricinus[a]	*D. reticulatus*[b]
Number of parasites (% of animals within the range)	0	62	76
	1–10	33	21
	11–20	4	2
	≥21	1	1
Relative density (±standard error)		2.2 (0.2)	0.9 (0.1)
Prevalence (%)		38	24

[a] Mainly adults (94%).
[b] Exclusively adults.

may explain the sporadic occurrence of *Babesia canis* (a *D. reticulatus*-borne parasite) in Hungary until the mid 1970s and a continuous increase of incidence of babesiosis in dogs in the past three decades (Horváth and Papp, 1974, 1996; Csikós et al., 2001). As *Rhipicephalus sanguineus* (the vector of *B. canis* vogeli) was not detected (Uilenberg et al., 1989; Zahler et al., 1998), and only *B. canis* canis was identified in Hungary (GenBank accession numbers: AY611729–AY611733), the change of geographical and spatial distribution of *D. reticulatus* is most likely associated with the change of *B. canis* epidemiology in Hungary. Moreover, the seasonal activity of *D. reticulatus* observed in the present study (data not shown) and known from the literature (Babos, 1964) is in agreement with the monthly incidence data of canine babesiosis (Horváth and Papp, 1996; Csikós et al., 2001) that also supports the link between the two phenomena. In previous studies (Hinaidy, 1971, 1976), *D. reticulatus* was not detected on 295 foxes in Austria in the late 1960s and early 1970s. Nevertheless, sporadic cases of *B. canis* infection (3–4 cases per year) were observed from 1975 and the presence of *D. reticulatus* was also demonstrated in Austria in the 1990s (Schwendenwein, 1998; Hubalek et al., 1997). From the 1970s, new or previously unknown *D. reticulatus* endemic foci were identified and sporadic autochthonous *B. canis* infections were also reported in Slovakia, Poland, Switzerland, Germany, and The Netherlands (Aeschlimann et al., 1975; Szymanski, 1977, 1986; Uilenberg et al., 1985; Gothe and Wegerdt, 1991; Pfister et al., 1993; Gothe and Schmid, 1995; Hulas and Dobrzynski, 1995; Zahler and Gothe, 1997; Caccio et al., 2002; Candoga et al., 2002) suggesting that *D. reticulatus* may have changed its spatial distribution, may have expanded its geographic range, and may have intensified the transmission rate *B. canis* and probably other *D. reticulatus*-borne diseases (tularemia and tick-borne lymphadenopathy) in Hungary and other Central and Central Eastern European countries (Rehacek et al., 1979; Szent-Iványi, 1993; Hubalek et al., 1996, 1997; Gurycova et al., 2001; Lakos, 2002; Raoult et al., 2002). Nevertheless, it cannot completely be excluded that the emergence of canine babesiosis and other *D. reticulatus*-borne diseases in the region may be associated with increased awareness and improved diagnostic methods.

I. ricinus was the most common tick species on foxes in all counties with the highest prevalence (range: 14–72%). The spatial distribution and incidence of *I. ricinus* in the present study was roughly in line with the results of the earlier investigation (Janisch, 1959). Nevertheless, as the comparison of the data of the previous and current study cannot be used for fine-scale analysis, a moderate alteration of the spatial distribution of this tick species in the past decades should not be dismissed. The spatial patterns of human tick-borne encephalitis (*I. ricinus*-borne disease) in Central Eastern Europe may indicate such a change (Randolph, 2001, 2004).

The change of the spatial distribution of *D. reticulatus* and *B. canis* in Hungary supports the observations of others on the change of geographical and spatial distribution of some tick species and tick-borne diseases in Europe and America (Estrada-Pena, 2001; Lindgren and Gustafson, 2001; Randolph, 2001, 2004; Zeman and Bene, 2004). The background of these changes can be complex including the effect of global warming, the shifting use of landscape (e.g. reforestation, decreasing use of pests, and other chemicals), the population increase of wild animals as a result of nature conservation, the change of habitat structure of wildlife, and perhaps other unknown factors. As several tick-borne diseases of man and animals are emerging infections in Europe (Raoult and Roux, 1997; Parola and Raoult, 2001a, 2001b; Parola, 2004), the research in this field should be intensified.

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