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Short communication

Prevalence of antibodies against *Toxoplasma gondii* in roe deer from Spain

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Abstract

Roe deer (*Capreolus capreolus*) is an important game animal in Spain. Sera from 278 roe deer from eight areas in mainland Spain were assayed for antibodies to *Toxoplasma gondii* by modified agglutination test (MAT). Titers of 1:25 or higher were found in 109 (39.2%) of 278 deer. No significant differences in antibody prevalence were found between sex or age categories. In contrast, significant differences in seroprevalence between locations were evident. Roe deer from the Northern coastal habitats (high humidity and roe deer density) had the highest prevalence, compared with low prevalence in Central Spain (arid areas and low roe deer density). There was a positive correlation between antibody prevalence and mean annual rainfall ($r_s = 0.85$, $n = 8$, $P < 0.01$). These findings have environmental and/or public health implications because venison can be an important meat source of *T. gondii* infections for humans and feral cats.
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Keywords: *Toxoplasma gondii*; Roe deer; *Capreolus capreolus*; Seroprevalence; Spain

1. Introduction

Virtually all warm-blooded hosts can be intermediate hosts of *Toxoplasma gondii* (Dubey and Beattie, 1988). Humans, especially hunters, may get infected by consumption of uncooked venison (Sacks et al., 1983; Ross et al., 2001), and contacting the agent while dressing game (Dubey, 1994).

The roe deer (*Capreolus capreolus*) is a small sized cervid (subfamily Odocoileinae) abundant throughout Europe. In Spain, roe deer is an important game animal and its population is increasing (Acevedo et al., 2005; García-Sanchez et al., 2007; García-Sanmartin et al., 2007). In the present study we determined seroprevalence of *T. gondii* infection in roe deer from Spain and provided epidemiologically important information on risk factors including effect of sex, age, geographic origin and climate (rainfall) on the host parasite relationship.

2. Materials and methods

Sera from 278 roe deer from eight localities in mainland Spain (Fig. 1) were used for the present study. Sampling sites in Valdés, Portal and Cantabric

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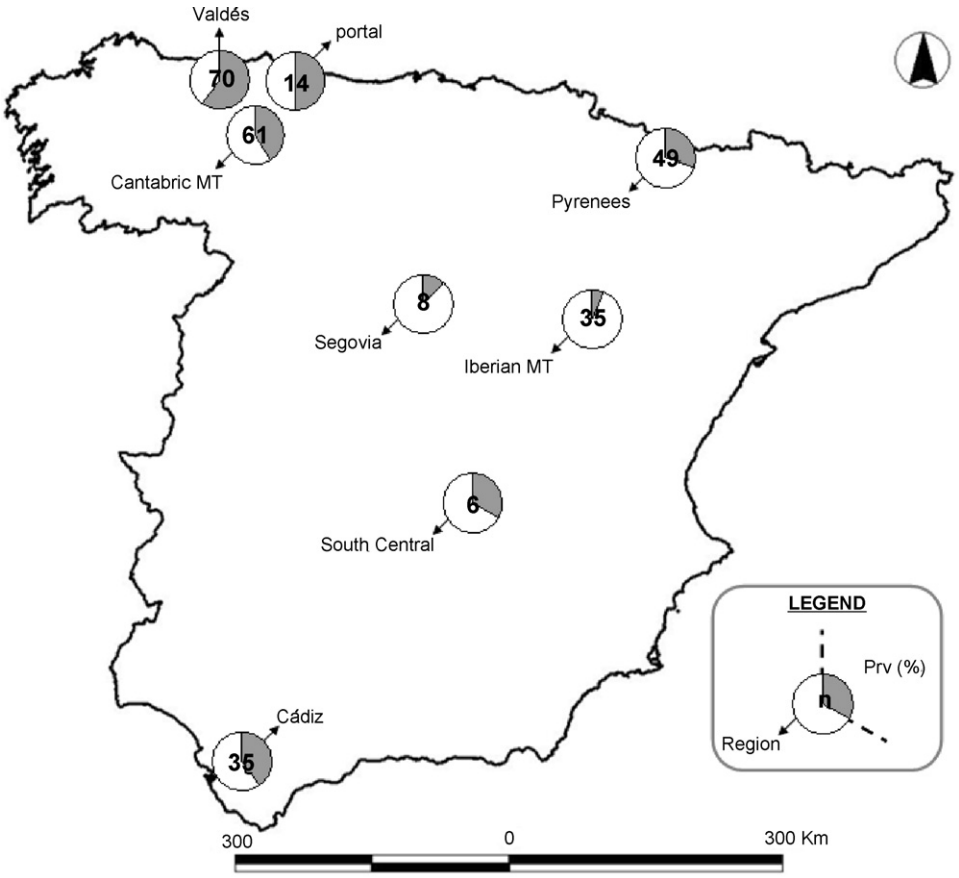

Fig. 1. Map of peninsular Spain showing sampling areas, sample size (*n*) and prevalence of *T. gondii* roe deer in each area.

Mountains, located in Asturias (Northern Spain) are characterized by a coastal Atlantic climate with high mean annual rainfall, spread human population and high roe deer density (Ruiz-Fons et al., 2008). Sampling sites in the Pyrenees have moderate rainfall and a more continental climate, low roe deer density and sparse human population (Gortazar et al., 2000). Sampling sites from Central Spain (Segovia and Iberian Mountains) and South-Central Spain are characterized by Mediterranean climate with low annual rainfall, low human density and very low roe deer density (Acevedo et al., 2005). Sampling sites in Cádiz (Southern Spain) have a Mediterranean climate with moderate annual rainfall, intermediate human density, and abundant roe deer.

Blood samples were collected from the heart or chest cavity of dead animals, centrifuged, and the sera obtained were stored at −20 °C until assayed. Age was determined based on tooth eruption, and each individual was classified either as juvenile (0–2 years) or adult (>2 years), based on the descriptions by Sáenz De Buruaga et al. (1991).

Antibodies to *T. gondii* were determined by the modified agglutination test (MAT) as described previously (Dubey and Desmonts, 1987; Sobrino et al., 2007). Each serum sample was tested at dilutions of 1:25, 1:50, 1:100, and 1:500. Positive and negative controls were included in each run (Sobrino et al., 2007). Sera with a titer of 1:25 or higher were considered positive and those with doubtful results were re-tested. Although the specificity and sensitivity of MAT have not been evaluated for the diagnosis of toxoplamosis in roe deer, it is the most evaluated and specific test for the diagnosis of toxoplasmosis in animals, particularly pigs (Dubey et al., 1995; Dubey, 1997).

Seroprevalence was statistically analyzed considering the variables geographical area, rainfall, sex and age of the animals. Data about roe deer density were not available from some of the sampled areas and different methods were used in some of the other areas, therefore density could not be included as a variable in the statistical analysis. The statistical data analysis was performed using the SPSS 14.0 Statistical program. We