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Widespread exposure to *Sarcoptes scabiei* in wild European rabbits (*Oryctolagus cuniculus*) in Spain

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ABSTRACT

Sarcoptic mange was recently described in the wild European rabbit (*Oryctolagus cuniculus*) in north-eastern Mediterranean Spain, the first such infection reported in this species anywhere in the world. This finding has created concern in conservationists and game managers given that an outbreak of mange after a translocation would have catastrophic consequences for naïve rabbit populations in other parts of Spain. A retrospective serosurvey using an 'in house' ELISA test based on the use of a recombinant antigen aimed at determining the rates of contact with *Sarcoptes scabiei* was carried out on sera from 966 rabbits collected between 1993 and 2010 in Spain. Antibodies were found in 13% of wild rabbits in 60% of the 53 areas surveyed, as well as in 16 of the 17 Spanish provinces and islands studied. Seropositive rabbits were found amongst the oldest samples analyzed and in all studied years. Antibodies were also detected in 36% of rabbits from the protected island of Dragonera, where rabbits have probably not been released since the 1970s. On Mallorca, where 89 rabbits were inspected for both lesions and antibodies, the prevalence of lesions (5.6%) was much lower than the seroprevalence (22.5%), indicating that rabbits often survive infection or that ELISA detects infected rabbits before they develop visible lesions. Seroprevalence was higher in areas with medium levels of rabbit abundance, no restocking and high rainfall. The results show that mange is widespread in rabbits and that the mite is not a recent introduction. Thus, sarcoptic mange could be considered as an enzootic disease in the wild rabbit and so prophylactic measures implemented during rabbit translocations are to be encouraged to avoid local outbreaks in naïve populations.

1. Introduction

Sarcoptic mange is a highly contagious parasitic infection caused by a mite (*Sarcoptes scabiei*) that burrows into the epidermis of animals (Pence and Ueckermann, 2002). When introduced into a naïve population, it can lead to high morbidity and mortality rates. For example, in southern Spain, a mange epizooty affected up to 81% of a wild population of Spanish ibex (*Capra pyrenaica*) within a few months of the first cases being detected and eventually led to 100% mortality (León-Vizcaíno et al., 1999). Sarcop-

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tic mange is also thought to have affected the abundance of other wild species (e.g., Mörner, 1992; Skerratt et al., 1998). In Spain, despite being known to affect various animal species (Fernández-Morán et al., 1997; Gortazar et al., 1998; González-Candela et al., 2004; Oleaga et al., 2008a,b), the first cases of scabies in European wild rabbits (*Oryctolagus cuniculus*) were only recently reported (Millán, 2010).

The wild European rabbit is native to the Iberian Peninsula and is regarded as a keystone species in Iberian Mediterranean ecosystems (Delibes-Mateos et al., 2008a) due to its vital role as prey item for at least 29 predators (Delibes and Hiraldo, 1981) and as an ecosystem engineer (Gálvez-Bravo et al., 2009). Moreover, it is one of the main small game species traditionally hunted in this region (Angulo and Villafuerte, 2003). Although rabbits were historically numerous and widespread, habitat loss and the introduction of two viral diseases, myxomatosis in the 1950s and rabbit hemorrhagic disease (RHD) in 1989, resulted in a dramatic decline in rabbit populations in the second half of the twentieth century (Villafuerte et al., 1995; Calvete et al., 2002; Delibes-Mateos et al., 2010). The translocation and/or release of wild-caught or farm-reared wild rabbits are two very common practices in rabbit management and became much more frequent in the 1990s (Delibes-Mateos et al., 2008b), apparently as a consequence of the devastating effect of RHD on most Iberian rabbit populations.

It is still open to debate whether sarcoptic mange is enzootic in the Iberian wild rabbit population or whether it was introduced with released/translocated wild rabbits after contact with domestic rabbits. Nevertheless, researchers must strive to answer this question given that naïve rabbit populations may be put at risk by the introduction of mange, which will have a serious effect on local populations. To date, cases of scabies in wild rabbits have been only reported in a number of Mediterranean regions in northern and eastern Spain, namely in the Balearic Islands, Catalonia and Valencia (Millán, 2010; Navarro-González et al., 2010; Sánchez, pers. comm.). A study based on interviews with hunters in Catalonia indicated that mange cases were more frequent in areas where rabbit releases are carried out and detected a negative trend in rabbit populations in affected areas (Navarro-González et al., 2010). This apparently supports the hypothesis that mange was introduced – at least into the areas studied in the aforementioned article. However, mange cases have also been observed in some areas of Mallorca (Balearic Islands) where no rabbits have been released recently and, moreover, where the density of rabbits is so high as to cause important damage to crops (Millán, pers. obs.). In fact, Navarro-González et al. (2010) also found that local rabbit abundances were positively related with the occurrence of mange, which would seem to suggest that the hypothesis that mange is enzootic in rabbits and that outbreaks are due to as-yet undetermined factors cannot be ruled out.

The aim of the present study was to describe the distribution of sarcoptic mange by means of a large-scale retrospective serosurvey and to try to determine the factors affecting the distribution of this disease in Spain. As well, a prospective survey in which rabbits were inspected for mange lesions was carried out on the island of Mallorca in order to better understand the epidemiology of this disease.

2. Materials and methods

2.1. Study area and sampling

Spain includes a variety of habitats and climates, which on the mainland can be simplified into five different bioregions according to the Wildlife Diseases Surveillance Scheme (Spanish Ministry of Environment). In our particular case, we consider the Balearic Islands to be a sixth bioregion due to the isolation of its rabbit populations from those of peninsular Spain. We did not obtain any samples from bioregion 1, where rabbits are scarce. Table 1 summarises the most relevant characteristics of each bioregion.

Serums samples dating from 1993 to 2010 from a total of 966 wild rabbits from 53 areas in 17 Spanish provinces or islands were analyzed in the retrospective serosurvey (Table 2 and Fig. 1). The majority of rabbits were shot by hunters, although some were sampled during translocations. Fourteen samples were obtained from Dragonera, a 290 ha island that is part of the Balearic archipelago. It is

Table 1
Characteristics of the bioregions of Spain included in this study.

Bioregion	Climate	Environment
2.- Northern plateau	Continental Mediterranean climate. Dry, hot summers; dry, cold winters. Mean annual precipitation: 808 mm; mean annual temperature: 10.5 °C.	Open landscape with cereal cultivation and pine and/or oak woodland; bordered to the north by mountains.
3.- South central	Continental Thermo-Mediterranean climate. Mean annual precipitation: 605 mm; mean annual temperature: 14.5 °C.	Pastures and croplands with patches of vegetation, sometimes forming savannah-like structures. Low altitude mountains with scrubland.
4.- Interior mountains	Severe Continental Mediterranean climate. Mean annual precipitation: 568 mm; mean annual temperature: 11.3 °C.	Limestone upland and high-plateau habitats with cereal crops, pastures and pine and/or oak woodlands.
5.- South and east coast	Coastal Thermo-Mediterranean climate; arid in the centre. Mean annual precipitation: 720 mm; mean annual temperature: 15.7 °C.	Only a few well preserved wildlife habitats (mountains).
6.- Balearic Islands	Coastal Thermo-Mediterranean climate. Mean annual precipitation: 400–500 mm; mean annual temperature: 18 °C.	Mixture of croplands (mainly devoted to wheat), olive groves and vineyards.

Adapted from the Wildlife Diseases Surveillance Scheme (Spanish Ministry of Environment).