

Prevalence of Antibody to Six *Leptospira* Serovars in Swedish Wild Boars

Sofia Boqvist,¹ Karin Bergström,² and Ulf Magnusson^{3,4} ¹ Department of Biomedicine and Veterinary Public Health, Swedish University of Agricultural Sciences, PO Box 7009, SE-750 07 Uppsala, Sweden; ² Department of Animal Health and Antimicrobial Strategies, National Veterinary Institute, SE-751 89 Uppsala, Sweden; ³ Department of Clinical Sciences, Swedish University of Agricultural Sciences, PO Box 7054, SE-750 07 Uppsala, Sweden; ⁴ Corresponding author (email: ulf.magnusson@slu.se)

ABSTRACT: Zoonotic *Leptospira* bacteria are pathogens that may increase in importance with climate change. We investigated the prevalence of antibody to six *Leptospira* serovars (sv) in the Swedish wild boar (*Sus scrofa*) population, which is increasing in number and geographic distribution. The serovars we selected cause disease in pigs or may be of use as sentinel serovars to measure the potential spread in Swedish fauna. In total, 386 serum samples from wild boars collected between 2005 and 2007 were investigated using a microscopic agglutination test for *Leptospira interrogans* sv Bratislava strain Jez Bratislava, sv Icterohaemorrhagiae strain Kantorowicz, sv Pomona strain Pomona, *Leptospira kirschneri* sv Gripotyphosa strain Duyster, and *Leptospira borgpetersenii* sv Tarassovi strain Perepelitsin, and a domestic strain closely related to sv Sejroe. Twelve (3.1%) of the analyzed samples were antibody-positive. Of those, nine (2.3%) were positive for sv Bratislava and 0.8% for sv Icterohaemorrhagiae. All antibody-positive samples originated from areas where wild boars are reported to be common. We conclude that *Leptospira* infection is less common in Swedish wild boar than in continental Europe. However, we recommend continuous surveillance to follow the effects of climate change and an increasing wild boar population.

Key words: Antibody prevalence, *Leptospira*, Sweden, wild boar.

Wild boars (*Sus scrofa*) can be reservoirs of viral and bacterial pathogens that constitute a risk for livestock and humans. European examples are classical swine fever virus reported from Germany and France (Pol et al., 2008; von Rüden et al., 2008) and the zoonotic *Leptospira* bacteria reported from Poland, Germany, Spain, and Italy (Vicente et al., 2002; Krawczyk, 2005; Jansen et al., 2006; Montagnaro et al., 2010). *Leptospira* is a zoonotic agent considered to be of increasing importance in Europe because of

climate change (Dufour et al., 2008). The bacterium will probably be favored by the wetter and warmer climate that is anticipated in Sweden in the future (Swedish Ministry of the Environment, 2008). There were no domestic human cases reported in Sweden during the study period (2005–2007; Swedish Institute for Communicable Disease Control, 2011). During the past two decades, the wild boar population in Sweden has increased in number and expanded geographically (Lemel and Truvé, 2008; Fig. 1). This may lead to wild boars being more important as reservoirs of infectious agents, such as leptospires. Currently, there is no information about the presence of *Leptospira* infection in Swedish wild boars, but we have shown that antibody to leptospires is common in domestic pigs (*Sus scrofa domesticus*) kept outdoors (Boqvist et al., 2012), and *Leptospira* infection in wild boars may be a contributing factor. The lack of data on *Leptospira* antibody prevalence in the wild boar population and in other wildlife also means there is no baseline information to aid in estimating the potential effects of climate change in the future. We conducted a serologic study of *Leptospira* infection in wild boars to investigate wildlife as potential reservoirs of the bacteria.

Wild boar sera were obtained from the serum bank at the National Veterinary Institute (SVA), Uppsala, Sweden. These sera were collected by hunters who voluntarily sent in wild boar blood samples to the SVA. The serum bank represents the geographic distribution of wild boars but because the collection of sera is voluntary the bank may be geographically

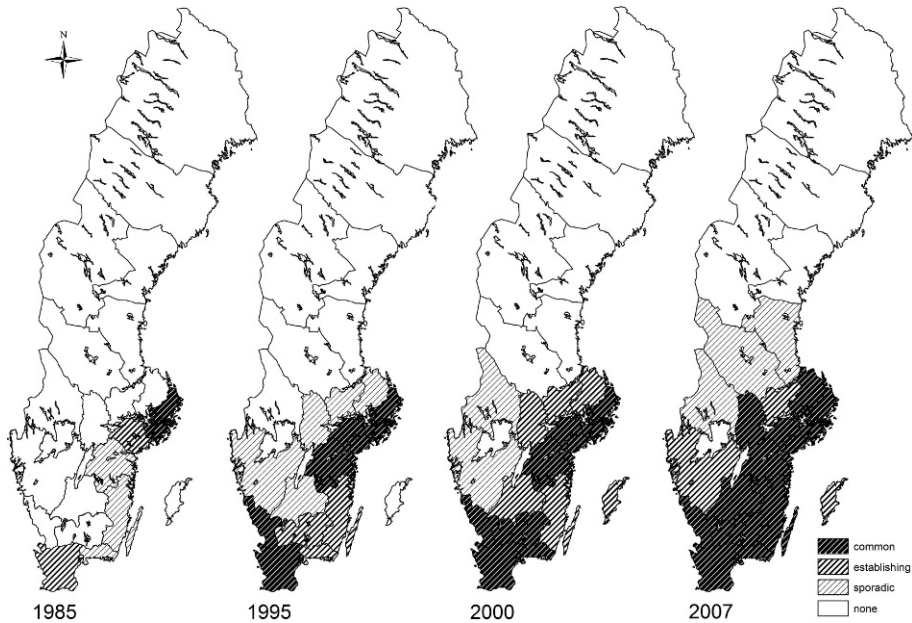


FIGURE 1. Geographic distribution of the wild boar (*Sus scrofa*) population in Sweden, 1995–2007. Figure courtesy of the Federation of Swedish Farmers, Stockholm, Sweden.

biased. There were 562 available sera from 2005 to 2007. Using the software program Win Episcopo 2.0, we determined that a sample size of 386 was required to estimate a prevalence of $50 \pm 5\%$, with a 95% confidence interval (CI). The samples were selected randomly from the serum bank. Based on a report from the Federation of Swedish Farmers, an estimated 60,000 wild boars were shot in Sweden during this period (Lemel and Truvé, 2008). All but five samples were from areas where wild boars were reported to be common (Fig. 2). The remaining five were from areas where wild boar populations were becoming established.

Sera were examined using the microscopic agglutination test (MAT; Faine et al., 1999) for the following *Leptospira* serovars (sv): *Leptospira interrogans* sv Bratislava strain Jez Bratislava, *Leptospira kirschneri* sv Grippotyphosa strain Duyster, *Leptospira interrogans* sv Icterohaemorrhagiae strain Kantorowicz, *L. interrogans* sv Pomona strain Pomona, *Leptospira borgpetersenii* sv Tarassovi

strain Perepelitsin, and one domestic strain (hereafter called mouse 2A) isolated from the kidney of a mouse (*Mus musculus*) caught in a Swedish pig herd. This strain was typed using monoclonal antibodies in the MAT at the Royal Tropical Institute, Amsterdam, The Netherlands, and was found to be closely related to sv Sejroe and also to sv Istrica. Five strains were selected as being known to infect pigs (Ellis, 1999; Faine et al., 1999; Adler and de la Pena Moctezuma, 2010), whereas the domestic strain was selected because it could potentially be of use as a sentinel serovar to measure possible future spread in Swedish fauna. All sera were screened at a dilution of 1:100 and positive samples were titrated in serial twofold dilutions to endpoint titer (50% agglutination). All serologic analyses were performed according to the SS-EN ISO/IEC 17025:2005-standard at the SVA by the same laboratory technician.

Overall antibody prevalence was 3.1% (95% CI=3.0–3.3). For sv Bratislava, antibody prevalence was 2.3% (95%

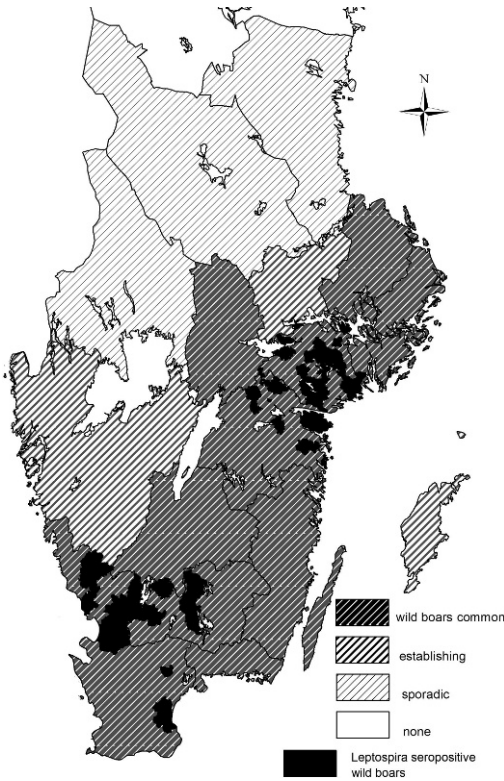


FIGURE 2. Geographic distribution of wild boar (*Sus scrofa*) in Sweden 2007, and *Leptospira interrogans* serovars Bratislava and Icterohaemorrhagiae antibody-positive wild boars sampled from 2005 to 2007.

CI=2.3–2.6%) and for sv Icterohaemorrhagiae it was 0.8% (95% CI=0.7–1.0%; Table 1). The highest titer was for sv Icterohaemorrhagiae. There were no antibody-positive samples for the other serovars. All antibody-positive samples were from animals shot in southwestern Sweden where wild boars are common (Fig. 2).

We found that *Leptospira* infection is present in the Swedish wild boar population, but generally at lower prevalences compared with reports from continental Europe. In Poland, an antibody prevalence of 25% was detected among wild boars; in Italy, 12%; and in Germany, 18%. However, comparisons between studies are limited due to the fact that the number of serovars included in these

studies ranged from one to 18 (Vicente et al., 2002; Krawczyk, 2005; Jansen et al., 2007; Montagnaro et al., 2010).

Wild boars can be important in the transmission of infectious diseases to livestock (e.g., domestic pigs) and humans (Jansen et al., 2006; Meng et al., 2009). Potentially, this is also the case in Sweden. Because the samples from the wild boars were obtained from a biobank and not prospectively, conclusions about associations between antibody prevalence in wild boars and domestic pigs kept outdoors must be made with caution. However, antibody to sv Bratislava was the most common in wild boars and second most common in outdoor pigs sampled in Sweden. This may support the idea that *Leptospira* infection is spread between wild boars and domestic pigs (Boqvist et al., 2012). However, the fact that no wild boar had antibody to the serovar most common in outdoor pigs, the domestic strain Mouse 2A, opposes this idea. The overall lower antibody prevalence among wild boars compared with pigs kept outdoors could be due to lower *Leptospira* transmission among wild boars because they are not confined to a common enclosed area.

It is possible that the maintenance host of strain Mouse 2A in the Swedish fauna thrives in farm environments, but not in the wild. The low antibody titers against sv Bratislava most likely reflect the fact that the pig is one of the maintenance hosts for this serovar in Sweden. Generally a serovar in its natural host, such as serovar Bratislava in the pig, exhibits low immunogenicity resulting in low serologic titers despite active infection (Ellis et al., 1986). Prevalence of infection might therefore be higher for this serovar than indicated by serology. In contrast, the titers were higher against sv Icterohaemorrhagiae, which probably reflects incidental infection with this serovar.

We conclude that *Leptospira* infections occur in the Swedish wild boar population, although none of the serovars considered to be important pig pathogens were identi-

TABLE 1. Prevalence and distribution of titers of *Leptospira interrogans* serovars Bratislava and Icterohaemorrhagiae among 386 wild boars (*Sus scrofa*) sampled from 2005 to 2007 in Sweden.

Serovar	No. of antibody-positive samples (%)					Total
	1:100	1:200	1:400	1:800	1:1600	
Bratislava	4 (1.0)	5 (1.3)	0	0	0	9 (2.3)
Icterohaemorrhagiae	0	0	1 (0.3)	1 (0.3)	1 (0.3)	3 (0.8)

fied. Given that only some percentage of the wild boars tested were positive, we regard the risk of transmission of leptospires from wild boars to outdoor domestic pigs as low under current circumstances. That condition may change as the wild boar population increases, and *Leptospira* infection prevalence may increase with anticipated climate changes such as a warmer and wetter climate in Sweden.

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