

## Prevalence of Antibodies to Selected Viral and Bacterial Pathogens in Wild Boar (*Sus scrofa*) in Campania Region, Italy

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**ABSTRACT:** Serum samples were collected from wild boars (*Sus scrofa*) harvested during the 2005–2006 hunting season in Campania, southern Italy. Samples were tested for antibodies to *Leptospira interrogans*, *Brucella* spp., *Salmonella* spp., Aujeszky disease virus (ADV), porcine reproductive and respiratory stress syndrome virus (PRRSV), porcine parvovirus (PPV), classical swine fever virus (CSFV), and swine vesicular disease virus (SVDV). Of the 342 serum samples tested, 15 (4.4%) were seropositive to *Brucella* spp., nine (2.6%) were seropositive to *L. interrogans*, 66 (19.3%) were seropositive for *Salmonella* spp., 105 (30.7%) were seropositive for ADV, 27 (7.9%) were seropositive for PPV, and 129 (37.7%) were seropositive for PRRSV. All sera tested seronegative for SVDV and CSFV antibodies. These results, recorded for the first time in Campania, support the hypothesis that wild boar are reservoirs of certain infectious agents, but some infections in wild boars originate from their domestic counterparts.

**Key words:** Antibodies, Campania, European wild boar, prevalence, *Sus scrofa*.

Wild boar (*Sus scrofa*) are widely distributed throughout the Appennino Mountains in southern Italy, and this species often shares habitat with domestic animals. For this reason, wild boar can serve as a potential source of infectious diseases for domestic animals, especially domestic swine, sharing the same areas (Cvetnic et al., 2003). Wild boar can, under some circumstances, act as a reservoir for infectious diseases of domestic pigs (Al Dahouk et al., 2005), and interactions between these two populations can potentially result in the dissemination of these diseases (Vengust et al., 2006).

Animal health surveillance is routinely

applied to domestic animals, but limited data exist on the prevalence and distribution of infectious agents of wild boars in southern and north-central Italy (Siena 43°19'N, 11°18'E; Grosseto 42°46'N, 11°7'E; Leghorn 43°33'N, 10°19'E; Pisa 43°43'N, 10°24'E; Arezzo 43°28'N, 11°35'E; Florence 43°46'N, 11°16'E; Bologna, San Rossore Preserve 43°47' to 43°41'N, 10°16' to 10°2'E) (Giovannini et al., 1988; Quaranta et al., 1995; Ebani et al., 2003). The objective of this study was to determine the antibody prevalence against selected infectious pathogens in wild boars from the Campania Region. Study sites were located in the National Park of Cilento and Vallo di Daino; this is an 1,800-km<sup>2</sup> area representing a Mediterranean ecosystem. In the National Park of Cilento and Vallo di Daino, wild boar, marten (*Martes martes*), Eurasian badger (*Meles meles*), red fox (*Vulpes vulpes*), and a few wolves (*Canis lupus*) are present. There are several swine herds in the area; these are mainly on small farms. Thus, contact between wildlife and domestic livestock can easily occur, as pastures overlap with the feeding areas of wild boar.

Serum samples were collected from 342 hunter-killed wild boars that were harvested during the 2005–2006 hunting season. Age was determined using tooth eruption patterns, and animals were grouped into three age classes: <12 mo old (yearlings), 13 to <24 mo old (subadults), and >24 mo old (adults). Antibodies against *Brucella* spp., porcine parvovirus (PPV), *Salmonella* spp., Au-

TABLE 1. Serologic test results for antibodies against selected diseases in feral swine in Campania, Italy.

Disease agent	Test method(s) <sup>a</sup>	Positive	
		Number	%
<i>Brucella</i> sp.	C-ELISA	15	4.4
<i>Leptospira interrogans</i>	MALT	9	2.6
<i>Salmonella</i> sp.	i-ELISA	66	19.3
Pseudorabies virus	i-ELISA	105	30.7
PRRS virus	i-ELISA	129	37.7
Porcine parvovirus	C-ELISA	27	7.9
Swine vesicular disease virus	C-ELISA	0	0
Classical swine fever virus	i-ELISA	0	0

<sup>a</sup> C-ELISA = competitive enzyme immunoassay, i-ELISA = indirect enzyme immunoassay, MALT = microscopic agglutination test.

jeszky disease virus (ADV), porcine reproductive and respiratory stress syndrome virus (PRRSV), classical swine fever (CSFV), and swine vesicular disease virus (SVDV) were detected by enzyme-linked immunosorbant assay (ELISA), Brucella-Ab C-ELISA kit, porcine parvovirus (PPV-Ab) C-ELISA kits (Svanova Biotech AB, Uppsala, Sweden), HerdChek swine salmonella antibody test kits, HerdChek pseudorabies virus antibody test kits, HerdChek PRRSV antibody test kit, HerdChek classical swine fever virus antibody test kit (IDEXX, Westbrook, Maine, USA), and 5B7 MAb competitive ELISA (MAC-ELISA), respectively. Antibodies against *Leptospira interrogans* were detected by microscopic agglutination test (MALT) according to Ebani et al., (2003).

Of the 342 serum samples, 15 (4.4%) were positive for Brucella, 66 (19.3%) were positive for Salmonella, 105 (30.7%) were positive for ADV, 129 (37.7%) were positive for PRRSV antibodies, and 27 (7.9%) were positive for PPV antibodies. *Leptospira* serovar antibodies were detected in nine (2.6%) samples, two of which were positive for serovar Copenhageni, two were positive for serovar

Bratislava, and five were positive for serovar Tarassovi. Antibodies against SVD and CSFV were not detected (Table 1). The prevalence of antibodies did not differ between male and female wild boar for any of the diseases (Fisher's exact test,  $P > 0.05$ ).

In our study, 129 wild boar (37.8%) were positive for PRRSV antibody as tested by ELISA. This is an interesting finding because of the immense economic importance of PRRSV in the domestic population. Indeed, evidence of PRRSV infection has been found wherever there is a sizeable domestic swine population. This is the first report of evidence of PRRSV infection in wild swine in Southern Italy, even though PRRSV has been recently detected by polymerase chain reaction in one wild boar in the Emilia Romagna Region (Bonilauri et al., 2006).

Similar studies have been reported from Croatia (Zupancic et al., 2002), Slovenia (Vengust et al., 2006), Germany (Lutz and Wurm, 1996), and Spain (Vicente et al., 2002; Ruiz-Fons et al., 2006), but no antibodies were detected against PRRSV. Oslage et al. (1994) reported two PRRSV antibody-positive animals among 482 wild boars sampled from 1991–1992 in Germany. In France, Albina et al. (2000) did not detect PRRSV antibodies among 360 wild boars shot from 1993–1994, but eight antibody-positive boars were detected among 243 animals sampled during 1994–1995. Taken together, these results suggest that when PRRSV enters the wild boar population, its subsequent spread is rather limited, probably because the virus is not easily transmitted within a population of low or medium density. In our study, antibody prevalence was higher than that reported in France or Germany, and this may reflect the presence of this agent in their domestic counterparts.

Antibodies to *Salmonella* spp. were detected in 66 wild boar serum samples (19.3%). Prevalence was higher than that reported by Vicente et al. (2002) in Spain and lower than that reported by Vengust in

Slovenia (2006). *Salmonella* spp. are present in both domestic swine and wild boar (Perez et al., 1999; Vicente et al., 2002) and is a zoonotic agent transmissible to humans via infected carcasses and pork products.

Serologic evidence of PPV infection has been previously described in the European wild boar populations by several authors. In our study, antibodies were present in 27 (7.9%) sera. Antibody prevalence was lower than that reported in Germany (77%) (Lutz and Wurm, 1996), Italy (ranging from 56.7% to 99%; Cordioli et al., 1993; Mignone et al., 1995), Spain (56.6%; Ruiz-Fons et al., 2006), Slovenia (49%; Vengust et al., 2006) and Croatia (41.6%; Roic et al., 2005). Our data indicate that wild boar populations in southern Italy are commonly exposed to PPV and could represent a potential threat to domestic swine.

The prevalence of antibodies against ADV found in the present study (30.7%) is higher than that reported from Eastern Germany (8.9%; Müller et al., 1998), France (5.5%; Albina et al., 2000), Netherlands (ranging from 1.7 to 2.6%; Cromwijk et al., 1995) and lower than that reported from south-central part of Spain (44.4%; Vicente et al., 2002), Croatia (54%; Zupancic et al., 2002), Slovenia (31%; Vengust et al., 2006), and Corsica (61%; Albina et al., 2000). Our results confirm that ADV infection is endemic in the wild boar population in the Campania region; this is consistent with other parts of Italy and other European countries (Oggiano et al. 1991; Müller et al., 1998; Lari et al., 2006). In Italy, prevalence of ADV antibodies in wild boar populations is variable, usually ranging from 20% to 30% (Oggiano et al., 1991; Cordioli et al., 1993; Lari et al., 2006).

In this study, we demonstrate the presence of several important pathogens in wild boar in the Campania Region. To better understand the role of this species in serving as a reservoir of these diseases, additional epidemiologic data are needed, as well as the isolation and

molecular characterization of these etiologic agents.

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#### LITERATURE CITED

- AL DAHOUK, S., K. NÖCKLER, H. TOMASO, W. D. SPLETTSTOESSER, G. JUNGERSEN, U. RIBER, T. PETRY, D. HOFFMANN, H. C. SCHOLZ, A. HENSEL, AND H. NEUBAUER. 2005. Seroprevalence of brucellosis, tularemia, and yersiniosis in wild boars (*Sus scrofa*) from north-eastern Germany. *Journal of Veterinary Medicine Series B, Infectious Diseases and Veterinary Public Health* 52: 444–455.
- ALBINA, E., A. MESPLÈDE, G. CHENUT, M. F. LE POTIER, G. BOURBAO, S. LE GAL, AND Y. LEFORBAN. 2000. A serological survey on classical swine fever (CSF), Aujeszky's disease (AD) and porcine reproductive and respiratory syndrome (PRRS) virus infections in French wild boars from 1991 to 1998. *Veterinary Microbiology* 77: 43–57.
- BONILAURI, P., G. MERIALDI, M. DOTTORI, AND I. BARBIERI. 2006. Presence of PRRSV in wild boar in Italy. *Veterinary Record* 158: 107–108.
- CORDIOLI, P., S. CALLEGARI, A. BERLINZARI, E. FONI, P. CANDOTTI, AND G. BARIGAZZI. 1993. Serological survey in wild boars from "Appennino parmense" area. *Atti Societa Italiana Scienze Veterinarie* 47: 1159–1162.
- CROMWIJK, W. A. J. 1995. Serological studies on wild pigs in the Veluwe region of the Netherlands. *Tijdschr Diergeneeskd* 120: 364–365.
- CVETNIC, Z., M. MITAK, M. OCEPEK, M. LOJKIC, S. TERZIC, L. JEMERSIC, A. HUMSKI, B. HABRUN, B. SOSTARIC, M. BRSTILO, B. KRT, AND B. GARIN-BASTUJI. 2003. Wild boars (*Sus scrofa*) as reservoirs of *Brucella suis* biovar 2 in Croatia. *Acta Veterinaria Hungarica* 51: 465–473.
- EBANI, V. V., D. CERRI, A. POLI, AND E. ANDREANI. 2003. Prevalence of *Leptospira* and *Brucella* antibodies in wild boars (*Sus scrofa*) in Tuscany, Italy. *Journal of Wildlife Diseases* 39: 718–722.
- GIOVANNINI, A., F. M. CANCELLOTTI, C. TURILLI, AND E. RANDI. 1988. Serological investigations for some bacterial and viral pathogens in fallow deer (*Cervus dama*) and wild boar (*Sus scrofa*) of the San Rossore Preserve, Tuscany, Italy. *Journal of Wildlife Diseases* 24: 127–132.
- LARI, A., D. LORENZI, D. NIGRELLI, E. BROCCHI, S. FACCINI, AND A. POLI. 2006. Pseudorabies virus in European wild boar from central Italy. *Journal of Wildlife Diseases* 42: 319–324.
- LUTZ, W., AND R. WURM. 1996. Serological investigations to demonstrate the presence of antibodies

- to the viruses causing porcine reproductive and respiratory syndrome, Aujeszky's disease, hog cholera, and porcine parvovirus among wild boar (*Sus scrofa*, L., 1758) in Northrhine-Westfalia (Germany). *Zeitschrift für Jagdwissenschaft* 42: 123–133.
- MIGNONE, W., C. ERCOLINI, M. PERRUCHON, AND M. POGGI. 1995. Stato sanitario dei cinghiali selvatici (*Sus scrofa*) in Liguria: Indagini sierologiche. *BIPAS* 12: 69–71.
- MÜLLER, T., J. TEUFFERT, K. ZIEDLER, C. POSSARDT, M. KRAMER, C. STAUBACH, AND F. J. CONRATHS. 1998. Pseudorabies in the European wild boar from eastern Germany. *Journal of Wildlife Management* 34: 251–258.
- OCCIANO, A., C. PATTÀ, A. LADDOMADA, AND A. CACCIA. 1991. Epidemiological survey of Aujeszky's disease in wild boars in Sardinia. *Atti Società Italiana delle Scienze Veterinarie* 1: 1157–1161.
- OSLAGE, U., J. DAHLE, T. MÜLLER, M. KRAMER, D. BEIER, AND B. LIESS. 1994. Prevalence of antibodies against the viruses of European swine fever, Aujeszky's disease and "porcine reproductive and respiratory syndrome" in wild boars in the federal states Sachsen-Anhalt and Brandenburg. *Dtsch Tierarztl Wochenschr* 101: 33–38.
- PÉREZ, J., R. ASTORGA, L. CARRASCO, A. MENDEZ, A. PEREA, AND M. A. SIERRA. 1999. Outbreak of salmonellosis in farmed European wild boars (*Sus scrofa ferus*). *Veterinary Record* 145: 464–465.
- QUARANTA, V., R. FARINA, A. POLI, D. CERRI, AND L. PALAZZO. 1995. Sulla presenza di *Brucella suis* biovar 2 nella lepre in Italia. *Selezione Veterinaria* 36: 953–958.
- ROIĆ, B., S. CAJAVEC, J. TONČIĆ, J. MADIĆ, Z. LIPEJ, L. JEMERSIĆ, M. LOJKIĆ, Z. MIHALJEVIĆ, Z. CAC, AND B. SOSTARIĆ. 2005. Prevalence of antibodies to porcine parvovirus in wild boars (*Sus scrofa*) in Croatia. *Journal of Wildlife Diseases* 41: 796–799.
- RUIZ-FONS, F., J. VICENTE, D. VIDAL, U. HÖFLE, D. VILLANÚA, C. GAUSS, J. SEGALÉS, S. ALMERÍA, V. MONTORO, AND C. GORTÁZAR. 2006. Seroprevalence of six reproductive pathogens in European wild boar (*Sus scrofa*) from Spain: The effect on wild boar female reproductive performance. *Theriogenology* 65: 731–743.
- VENGUST, G., Z. VALENAK, AND A. BIDOVEC. 2006. A serological survey of selected pathogens in wild boar in Slovenia. *Journal of Veterinary Medicine B, Infectious Diseases and Veterinary Public Health* 53: 24–27.
- VICENTE, J., L. LEÓN-VIZCAÍNO, C. GORTÁZAR, M. JOSÉ CUBERO, M. GONZÁLEZ, AND P. MARTÍN-ATANCE. 2002. Antibodies to selected viral and bacterial pathogens in European wild boars from south-central Spain. *Journal of Wildlife Diseases* 38: 649–652.
- ZUPANČIĆ, Z., B. JUKIĆ, M. LOJKIĆ, Z. CAC, L. JEMERSIĆ, AND V. STARESINA. 2002. Prevalence of antibodies to classical swine fever, Aujeszky's disease, porcine reproductive and respiratory syndrome, and bovine viral diarrhoea viruses in wild boars in Croatia. *Journal of Veterinary Medicine Series B, Infectious Diseases and Veterinary Public Health* 49: 253–256.

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