

AFRICAN SWINE FEVER OCCURRENCE AND SEROPOSITIVITY TO ASF VIRUS IN SWINE HERDS IN SARDINIA

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La distribution temporelle et géographique des cas cliniques de la peste porcine africaine (PPA), ainsi que l'effet des pratiques d'élevage sur la séropositivité vis-à-vis du virus de la PPA (VPPA) dans les élevages traditionnels porcins ont été étudiés dans les régions endémiques de la province de Nuoro en Sardaigne. Le nombre de municipalités où des cas cliniques de PPA sont apparus en 1993, 1994, 1995 et 1996 était respectivement de 23, 21, 25 et 20. Le degré d'agrégation géographique des municipalités ayant eu des cas cliniques, évalué par "join count statistics", était le plus élevé en 1993 et 1994, et le risque de PPA dans une municipalité était associé avec l'élevage porcin de plein air et la présence de la maladie dans les zones avoisinantes. L'apparition de cas dans les troupeaux de porcs a montré une saisonnalité marquée, faible en été, s'accroissant en automne et atteignant un maximum de Février à Avril. Le risque de séropositivité à la PPA testée par la technique d'ELISA et confirmée par western blot a diminué significativement d'Avril 1996 à Février 1997 ($p < 0.05$), et était plus élevé dans les élevages de plein air que dans les élevages partiellement fermés ($OR = 3.6$, $p < 0.01$, régression logistique multiple). Le logarithme naturel du nombre de porcs testés par visite dans un élevage était positivement associé avec le risque de positivité du troupeau ($OR = 2.9$, $p < 0.001$).

INTRODUCTION

Following the eradication of African swine fever (ASF) from the Iberian Peninsula in 1995, Sardinia is the only non-African region where the infection still is present (Laddomada, 1996). The disease appeared in southern Sardinia in 1978--allegedly introduced from the Iberian Peninsula via garbage containing raw pork, which was subsequently fed to pigs. The infection was successfully eradicated from the southern part of the island, but an endemic area persists in five Health Districts in the Province of Nuoro, in eastern-central Sardinia (Laddomada et al., 1991). In this mountainous area (χ 1/4 of the island), traditional pig husbandry practices (such as grazing free-range herds on publicly-owned land) is considered a major obstacle to disease control. In this study, we carried out epidemiological analyses of routinely collected data from the ASF endemic area of the Province of Nuoro. Our purpose was to study the temporal pattern and the spatial distribution of clinical ASF, and to evaluate the time trend of seropositivity to ASFV in traditional pig farms.

MATERIALS AND METHODS

Clinical outbreaks of ASF in pig farms were confirmed by Direct Immunofluorescence (DIF) and Polymerase Chain Reaction (PCR) (Sanchez-Vizcaino, 1986; Caccia et al., 1992), carried out on kidney, spleen, and lymph nodes, at the Istituto Zooprofilattico Sperimentale (IZS) of Sassari and Nuoro. Following an ASF outbreak, all pigs in the affected farm were slaughtered. The monthly number of outbreaks was recorded. The spatial autocorrelation of ASF in the 82 municipalities of the endemic area of the Province of Nuoro was evaluated through join-count statistics, comparing observed and expected numbers of joins (common borders) among municipalities where clinical ASF occurred ("black-black" = BB joins), and between ASF-affected and unaffected municipalities ("black-white" = BW joins) (Odland, 1987).

In accordance with the guidelines of the Sardinian eradication program, funded by the European Union (EU Official Bulletin n. L116, 1990), serum samples from pigs older than three months of age from registered farms in the Health District n. 7, 8, 9, 10, and 11, of the Province of Nuoro, were analysed for ASFV antibodies at the IZS of Sassari, using a previously-described enzyme-linked immunosorbent assay (ELISA). Confirmatory western blotting (WB) was carried out on samples that tested positive by ELISA (Escribano et al. 1990). Seropositive pigs were to be destroyed and, on farms where seropositive pigs were found, serological exams on all remaining animals were to be repeated after one month.

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Time trend of the percentage of seropositivity to ASFV in pig farms from April 1996 through February 1997 was evaluated by three-month moving average. The adjusted effects of farm type, $\ln(\text{NTEST})$ (the natural logarithm of the number of tested pigs in a visit in a farm) and MONTH on farm seropositivity were evaluated through multiple logistic regression of data from municipalities where seropositive herds were found (Hosmer and Lemeshow, 1989; Mannelli et al., in press). Pig farms were divided into three types: a) free-range farms, with pigs grazing on vast publicly owned areas during the entire year; b) partial-confinement farms, where animals are grazing on public areas during the fall (to utilize acorns produced by evergreen oaks) and kept indoors for the rest of the year; c) total-confinement farms, with small number of animals reared for family consumption and kept permanently indoors.

RESULTS

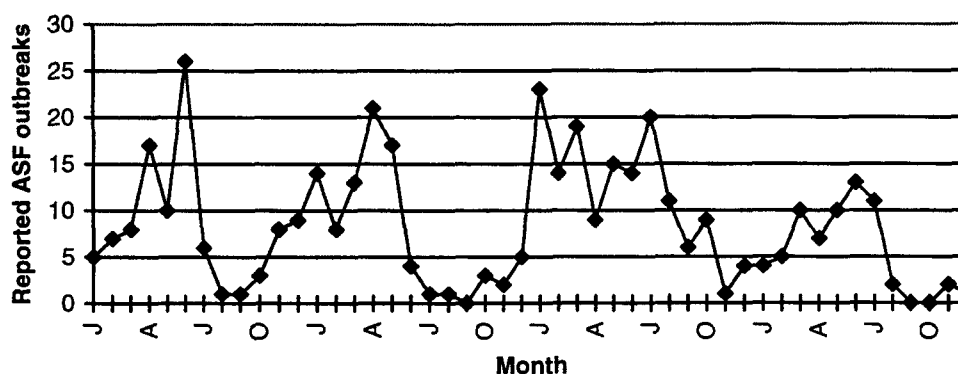
The number of ASF-affected municipalities and the frequency of reported outbreaks are presented in Table I. Seasonality of ASF is described in Figure 1. Spatial autocorrelation of ASF in municipalities, as evaluated by BB join counts, was statistically significant ($P < 0.01$) each year from 1993 through 1996--whereas the number of BW joins was significantly lower than expected only in 1993 and 1994.

Free-range pig farming was a significant risk factor for ASF occurrence at the municipality level from 1993 through 1996 (74% of municipalities with free-range pig farms were affected by ASF vs 35% of municipalities without free-range farms, $\text{RR} = 2.1$, $P < 0.001$).

Table I
Number of clinical ASF outbreaks in pig herds and affected municipalities in the ASF endemic area in the Province of Nuoro from 1993 through 1996.

Variable	1993	1994	1995	1996
Reported outbreaks	100	89	140	63
Affected municipalities	23	21	25	20

Figure 1
Seasonality of ASF clinical outbreaks in pig herds in the ASF endemic area of the Province of Nuoro from 1993 through 1996.



Serological tests were carried out on 29,180 pigs, from 5,226 traditional farms (out of 6,409 registered) in the ASFV endemic area in the province of Nuoro, from April 1996 through February 1997. In traditional farms, 1.02% of pigs that were examined tested positive for ASFV. The three-month moving average of the percentage of ASFV+ farms decreased from 2.0% in May 1996 to 0.30% in January 1997 (Figure 2). The likelihood-ratio test for the logistic regression model was significant (likelihood-ratio $\chi^2 = 102.3$, d.f.=6, $P < 0.001$; Table II). The interactions between farm type and MONTH (likelihood-ratio $\chi^2 = 3.5$, d.f.=2, $P > 0.10$), and between farm type and $\ln(\text{NTEST})$ (likelihood-ratio $\chi^2 = 0.2$, d.f.=2, $P > 0.10$) did not significantly improve the model and were not included in the final regression.

Figure 2

Time trend of the percentage of seropositivity to ASFV in swine farms in the endemic area of the Province of Nuoro from April 1996 through February 1997.

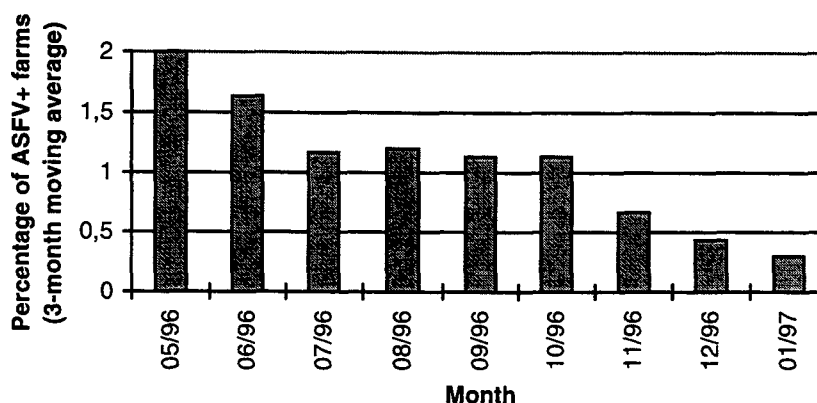


Table II

Logistic regression of the effects of farm type, MONTH of sampling, and natural logarithm of the number of tested pigs per visit, $\ln(\text{NTEST})$, on the seropositivity to ASFV. (Swine herds in the endemic area of the Province of Nuoro, from April 1996 through February 1997)

Variable test	β	OR	Wald's χ^2	P
Free-range vs partial-confinement	1.29	3.6	8.6	<0.01
Total-confinement vs partial-conf.	0.43	1.5	1.0	>0.05 (NS)
MONTH	- 0.12	0.89	5.6	<0.05
$\ln(\text{NTEST})$	1.05	2.9	44.7	<0.001

DISCUSSION

Reported outbreaks of clinical ASF in pig farms in the endemic area of the Province of Nuoro peaked in 1995 and decreased in 1996 (Table I). Disease occurrence showed a marked seasonality: it was low in summer, increased in fall, and peaked from February through April (Figure 1). In fall, pigs from free-range and partially-confined herds are concentrated in publicly-owned areas where acorn availability is highest, thus facilitating viral transmission. Municipalities where clinical outbreaks of ASF occurred were spatially aggregated. The risk of ASF in a municipality was associated with free-range pig farming and the occurrence of the disease in neighbouring areas. Free-range pig farms were at higher risk of seropositivity than the other farm types (Table II). Strict disease control measure, such as the slaughtering of high numbers of pigs following clinical ASF outbreaks, and the identification and elimination of seropositive animals resulted in a significant reduction of the percentage of ASFV-seropositive farms (Figure 2).

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