Classical Swine Fever Control

Oral mass immunisation under uncertain virulence

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Objective

Comparative assessment of adaptive spatial schemes to immunise wild boar populations against Classical Swine Fever (CSF) by oral mass vaccination. A spatially explicit, individual-based, stochastic simulation model was applied. Uncertainty about the severity of the disease outcome was considered.

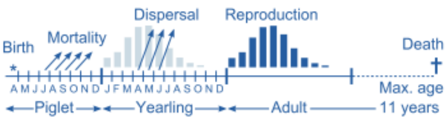
Introduction

In recent years, Classical Swine Fever Virus (CSFV) circulated in wild boar of several European countries and caused high economic impact when entering livestock. Much effort was spent on oral vaccination campaigns. The effect of the measure on disease dynamics was not fully understood due to variability of disease outcome and the shift of CSFV to decreased virulence during the last decades. Particularly, efficient spatio-temporal design of vaccination protocols is still debated. Therefore, we assessed spatially adaptive vaccination scenarios with regard to the efficacy in limiting spread and survival of the infection in an infected boar population while considering uncertain virulence.

Methods

The wild boar model

- Raster of home range cells of wild boar groups
- Wild boars as individuals
- Seasonal, age-dependent mortality and fertility

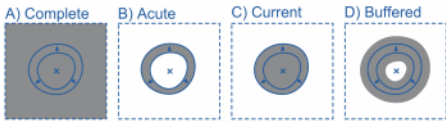


The virus model

- Stochastic disease outcome (transient, lethal acute, lethal chronic)
- Transient infections cause an infectious period of one week
- Lethal infections cause exponentially distributed infectious period

Simulation experiments

- Simulation of four baiting strategies (A complete, B recent infected area, C cummulative extension [current strategy], D like B but with spatial buffer)
- Simulation of different disease outcome, i.e. case mortality (0 ... 1) and infectious period after lethal infection (1 ... 10 weeks)



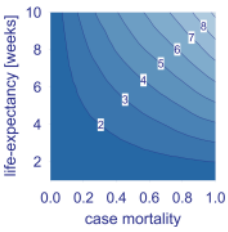
Results

Without vaccination ►

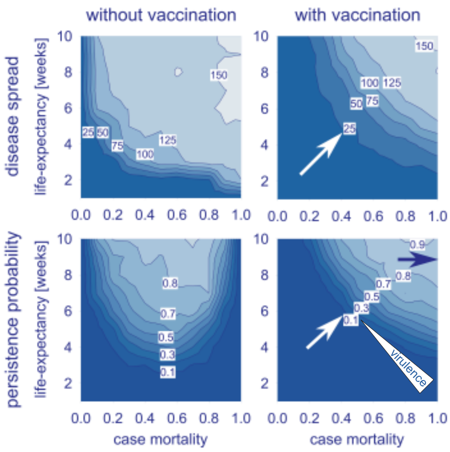
- Distance spread depends on the mean infectious period over all infected hosts ▼
- Disease persistence depends on the infectious period over all hosts and case mortality

With vaccination ►►

- Distance spread only for long infectious period over all infected hosts
- Disease persistence only for long infectious period over all infected hosts
- Disease persistence now occurs with high case mortality



Resulting infectious period over all infected hosts



Disease spread by distance (top) and probability of virus circulation exceeding 10 years (bottom) without (left) and with vaccination (right).

Comparison of strategies

- Virtually equal capacity to reduce spread and foster disease eradication by baiting of the **entire landscape** (A) compared to **buffered baiting** (D)
- No success in disease eradication and spread prevention by acute treatment of **infected area** (B)
- Late success in disease eradication and no spread prevention with **current cummulative strategy** (C)

- Strains of low to intermediate virulence are in the scope of maximum success in spread prevention and disease eradication
- Strains of high virulence are in a scope of potential increase in persistence due to vaccination

Conclusions

- **Disease outcome and virulence has crucial impact on efficacy of oral mass vaccination.**
- **Strategies currently applied to control CSF in wild boar populations perform suboptimal in virus eradication and spread prevention.**
- **Preventive strategy, i.e. buffered baiting, is particularly preferrable with marker vaccines.**
- **Vaccination can facilitate disease persistence under high virulence.**

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