African Swine Fever in the Republic of North Macedonia: Modeling disease spread and evaluating mitigation strategies

O'Hara, Kathleen, C. [1], Gómez-Vázquez, Jose Pablo[1], González-Crespo, Carlos[1], Beltrán-Alcrudo, Daniel[2], Hovari, Mark[2], Tabakovski, Blagojcho, Martínez-López, Beatriz[1]

1. Center for Animal Disease Modeling and Surveillance (CADMS), Department of Medicine & Epidemiology, School of Veterinary Medicine, University of California, Davis, USA
2. Food and Agriculture Organization of the United Nations (FAO), Regional Office for Europe and Central Asia, Budapest, Hungary

Keywords: African swine fever, modeling, Republic of North Macedonia, Sus scrofa, pigs

Abstract:
As African swine fever (ASF) continues to spread globally, countries need tools to predict which regions are at highest risk of disease introduction, to inform risk-based implementation of surveillance and enhanced biosecurity measures, and to effectively target response resources in the event of an incursion. The Republic of North Macedonia reported its first cases of ASF in January 2022, on a backyard holding in the east of the country. An extensive swine industry survey led by the Food and Agriculture Organization (FAO), in partnership with North Macedonia's Food and Veterinary Agency, was previously used to generate farm-level biosecurity risk scores that correctly classified the Eastern region as being at high risk for ASF introduction[1]. Social network analysis of North Macedonia's live pig movement network provided risk-based targets for increased surveillance and enhanced biosecurity[2]. This work aimed to combine data from these previous analyses to inform a model to explore potential routes of ASF transmission in North Macedonia and to evaluate mitigation strategies for disease control. A spatially-explicit, stochastic, agent-based disease spread model was informed by domestic pig and wild boar population demographics and live pig movement data from 2017-2019. The country was divided into a hexagonal grid, with ASF spread simulated within and between 10 km radius cells. Disease transmission within each cell was modeled using a susceptible-infected-removed compartment approach. The time to detection, scale, and duration of outbreaks based on population and region of introduction were estimated. The influence and interactions of model parameters were assessed using random forest and classification regression trees. Our model estimated the expected number of infected pig herds and infected wild boar within 6 months following disease introduction were 30 (28, 32) and 26 (23, 28), respectively. Stamping out infected pig herds reduced affected herd estimates to 23 (19, 27). Reducing the average time to detection from 30 to 14 days reduced the expected number of infected pig herds to 12 (7, 17). The number of infected farms was reduced to 14 (9, 18) with improved biosecurity. This model provided projections of the spatiotemporal spread of ASF following disease introduction and evaluated the efficacy of mitigation efforts. This information can be used by North Macedonia's Food and Veterinary Agency to support risk-based, cost-effective ASF prevention and response efforts, directing resources to areas with the highest risk of disease spread, and informing the most impactful and cost-effective mitigations. Further, this study provides data on the swine industry in this region, informing future outreach, risk assessments, and modeling efforts.

References:

1. O'Hara, K.C., Beltran-Alcrudo, D., Hovari, M., Tabakovski, B., Martinez-Lopez, B. (2021). Descriptive and multivariate analysis of the pig sector in North Macedonia and its implications for African swine fever transmission. *Front Vet Sci*, 8, 733157. doi: 10.3389/fvets.2021.733157.

2. O'Hara, K.C., Beltran-Alcrudo, D., Hovari, M., Tabakovski, B., Martinez-Lopez, B. (2022). Network Analysis of Live Pig Movements in North Macedonia: Pathways for disease spread. *Submitted for publication January 2022.*