

Climatic and Land-Use Changes Drive Bird Migration Patterns, Triggering HPAI Outbreaks

Bo Zhang

Oklahoma State University

Highly Pathogenic Avian Influenza (HPAI) has become a pressing global concern, with significant ramifications for biodiversity, agriculture, and public health. Understanding the drivers and dynamics of HPAI spread is therefore essential for developing targeted mitigation strategies. Migratory birds play a crucial role in the epidemiology of HPAI, serving as both reservoirs and vectors for the virus. Climatic changes and anthropogenic land-use transformations are additional factors influencing HPAI dynamics, primarily through their impacts on bird distribution and behavior. These intertwined ecological and anthropogenic drivers exacerbate HPAI risks, making it imperative to understand their combined effects on virus transmission. This study addresses these critical gaps by integrating ecological, climatic, and socio-economic data to assess the spatiotemporal dynamics of bird distribution and HPAI risks. Using advanced modeling techniques and scenario analysis, we provide a holistic framework for predicting future HPAI outbreaks under diverse environmental conditions. The findings will inform strategies for disease prevention, wildlife conservation, and sustainable agriculture, offering actionable insights for stakeholders across multiple sectors.

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