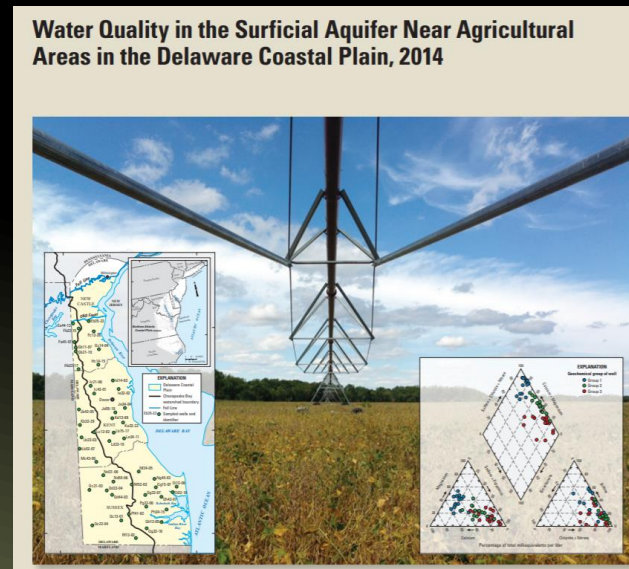
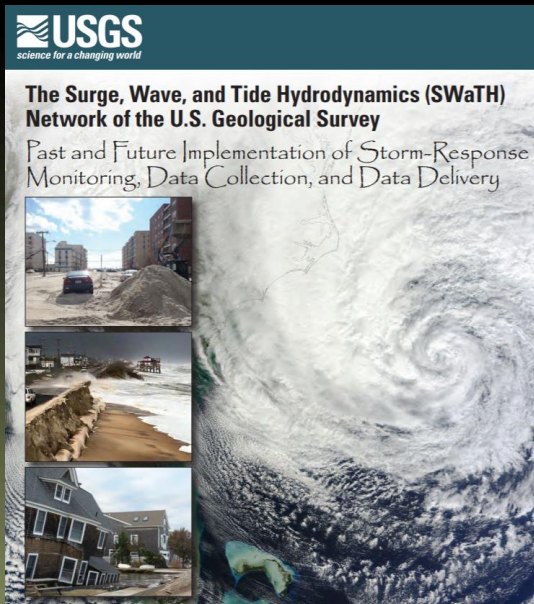


Mark Nardi, Supervisory Geographer MD-DE-DC Water Science Center, Dover DE



Geospatial Analysis
Soil Water Balance Modeling
Lidar Data
HEC River Modeling



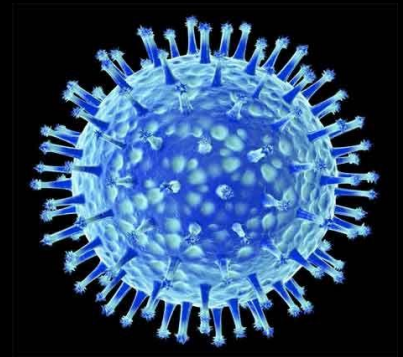
Diann Prosser, Research Wildlife Ecologist Patuxent Wildlife Research Center, Laurel, Maryland



Waterbird and
wetland ecology,
spatial analysis



Integrating Field
Studies and Spatial
Modeling
-Wildlife Disease, AIV
-Restoration



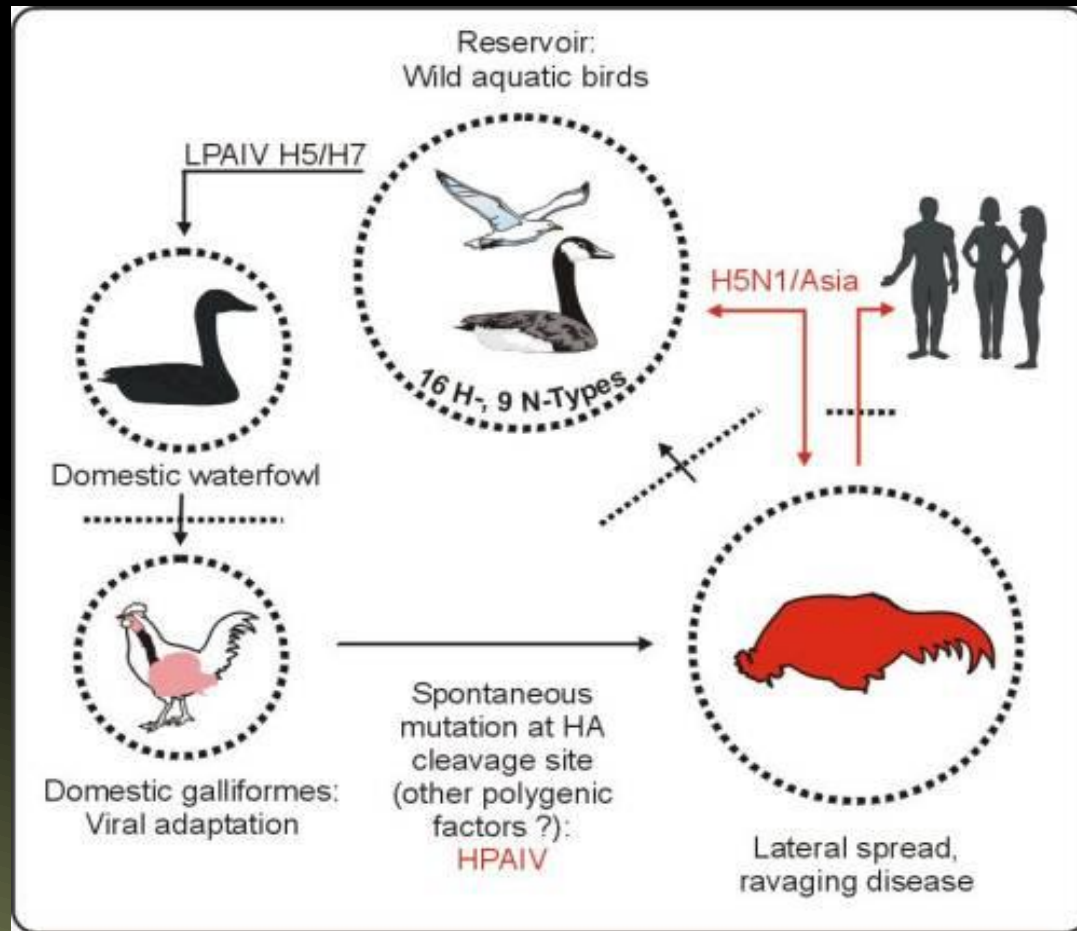
Research-based
science to inform
surveillance,
prevention, and
preparedness efforts

Interaction with the Agriculture Workgroup (why are we here today?)

- We work on multiple aspects of avian influenza science, globally, nationally, and regionally
- We would like to learn more from this network of members from very diverse backgrounds
- We would like to share our work and get feedback on
 - Usefulness of our work to folks in the room
 - Areas of interest for Delmarva region
- In order to answer questions at the wild-domestic interface for AIV, it takes interdisciplinary interaction. We are open to all levels of communication from feedback to potential collaboration
- We hope this can be an introduction to possible further communication

Wild birds are the reservoir for low-pathogenic AIVs

Importance of wild-domestic interface



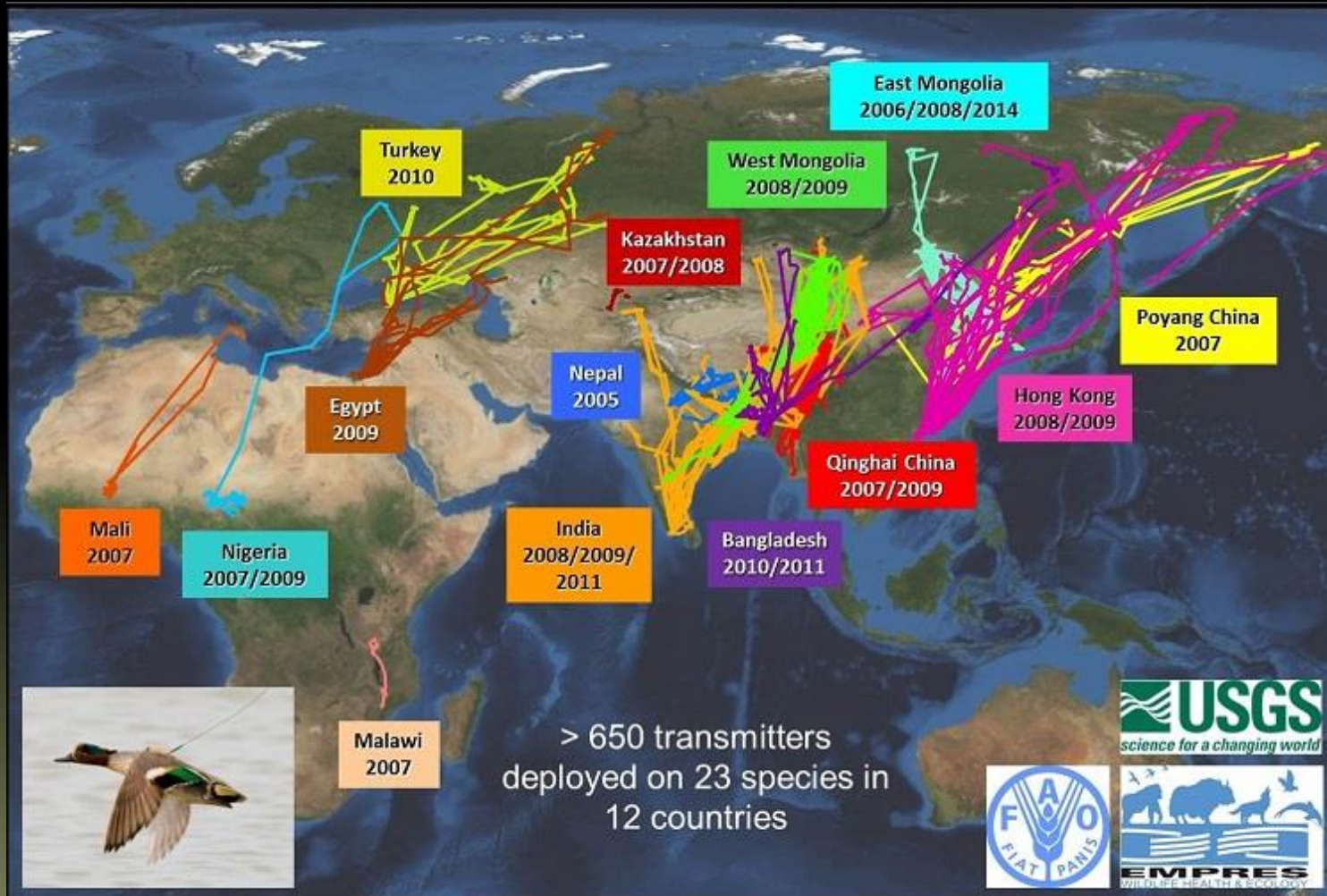
LPAI – causes mild to no disease in wild birds



HPAI – >90% mortality within 48h in chickens

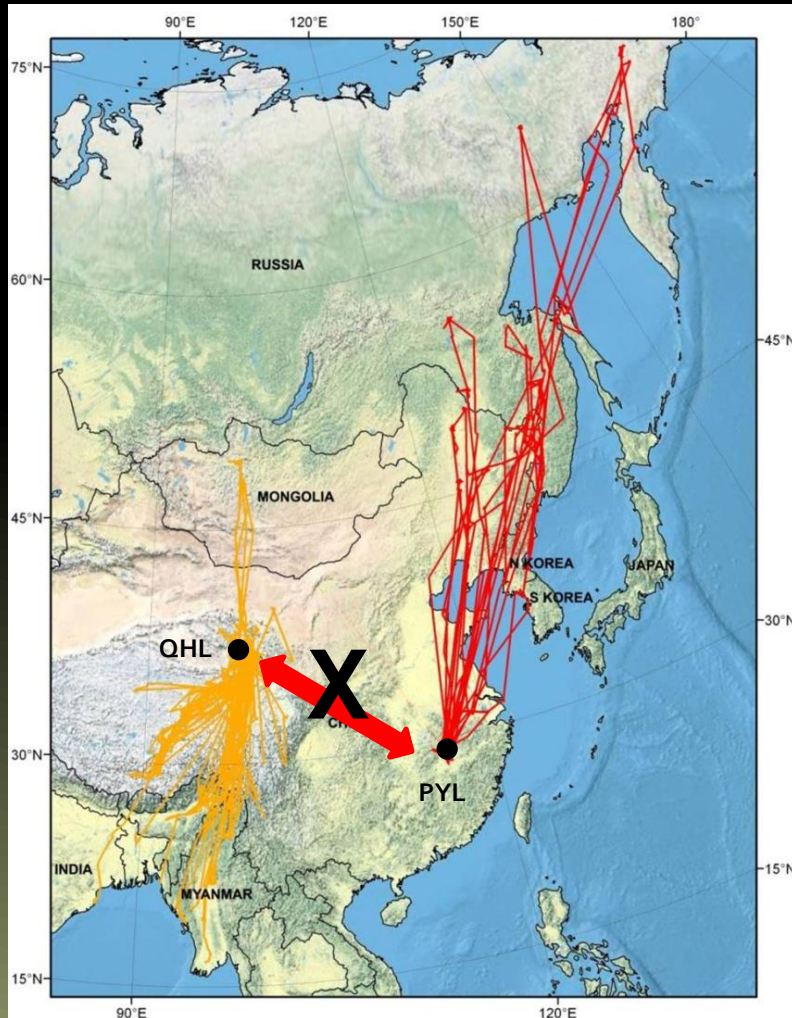
- Fecal to oral transmission route
- Prior to H5N1, no spillback to wild birds

Prosser AIV work began in Asia – 2005 H5N1
At that time, there was little to no info on HPAI and wild birds
Needed to go where the virus was to study it



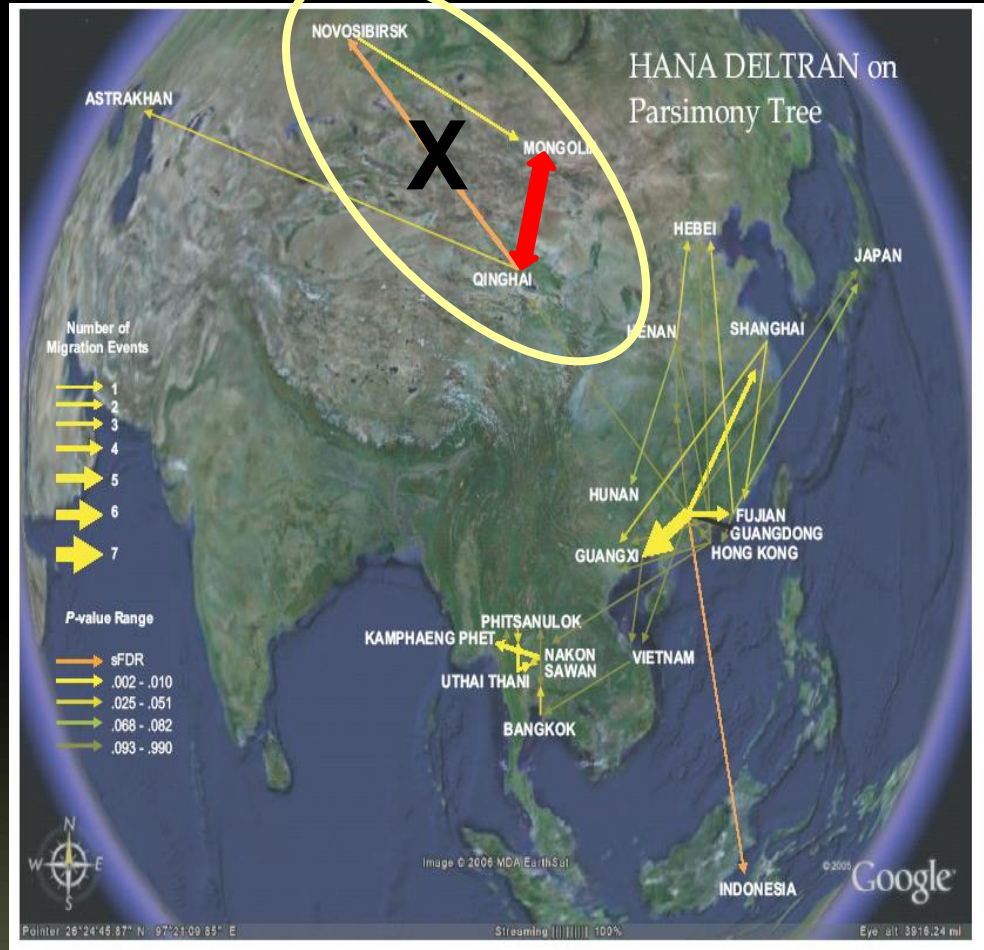
We have many products from our work in Asia, however, Main lesson: Host Ecology is Important and often overlooked or understudied!

Chen et. al. 2006, PNAS
Hypothesized PLY to QHL via wild birds



Takekawa et al. 2010, *Avian Diseases*

Wallace et. al. 2006, PNAS
Hypothesized QHL to Russia to Mongolia, wild birds



Prosser et al. 2009, *Ibis*

China, 1km resolution spatio-temporal models identifying areas of higher risk of transmission for avian influenza viruses at wild to domestic interface

Why China? Epicenter of HPAI H5N1 and many novel viruses

frontiers in
PUBLIC HEALTH

ORIGINAL RESEARCH ARTICLE

published: 30 August 2013
doi: 10.3389/fpubh.2013.00028



Mapping avian influenza transmission risk at the interface of domestic poultry and wild birds

Diann J. Prosser^{1,2*}, Laura L. Hungerford^{2,3}, R. Michael Erwin⁴, Mary Ann Ottinger⁵, John Y. Takekawa⁶ and Erle C. Ellis⁷

Density Dependent, Environmental Transmission Models

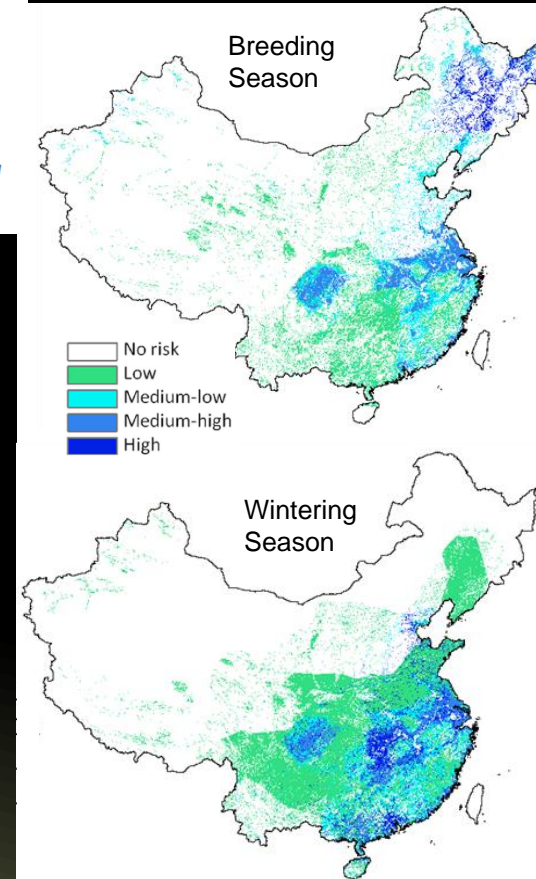
Wild to poultry transmission

$$T_{WtoP} = ([W_{pr} * V_{wf}]) * ([P_{te} * B_{te}] + [P_{aq}]) * U$$

Waterfowl distributions

Viral shedding

Poultry distributions



Currently working on Interface Risk models for USA. Partnering with USDA for poultry models.

USDA CEAH models
for spread of HPAI in/
between commercial
and backyard poultry
flocks



USGS models for wild
bird distribution; HPAI
spread between wild birds
and domestic
populations; and
environmental risk factors



Combined disease transmission risk
models for the United States



Wild-Domestic Interface Risk Modeling

Waterfowl Distribution Models



Identify distribution of waterfowl

Poultry Distribution Models



Identify locations of poultry production

Challenge Studies



Identify asymptomatic period, shedding rate, and other clinical factors

Genetic Sequencing

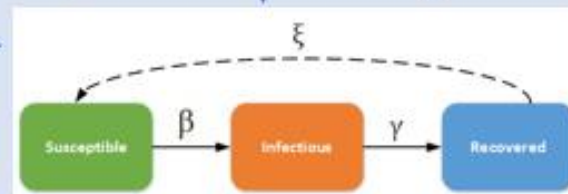


Identify the origin of viral strains and how they change over time

Prevalence Surveillance



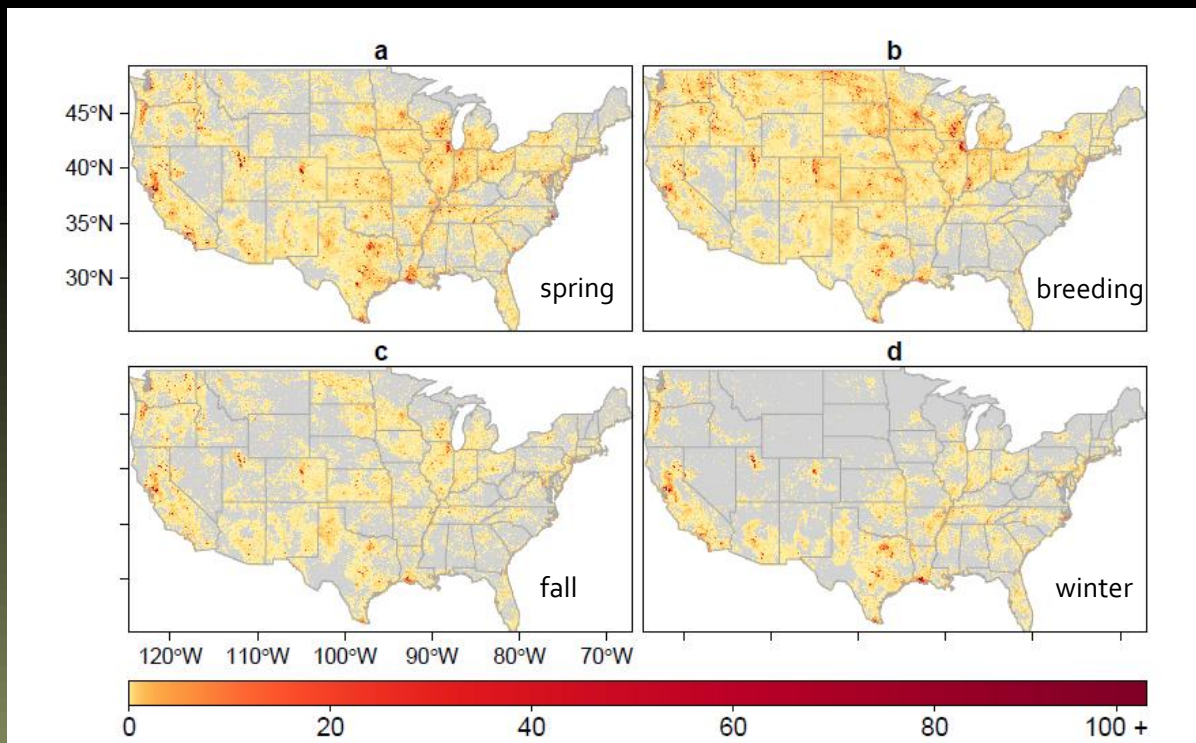
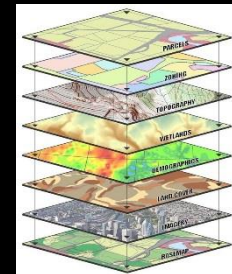
Identify viral strains and infection rate for critical flyways



Spatiotemporal Waterfowl Inputs for Disease Risk Modeling, USA

Species Distribution Modeling (4 seasons)
11 dabbling duck species

Ebird Data, Advanced Computing
Hierarchical Bayesian modeling using INLA



Northern shoveler (*Anas clypeata*)

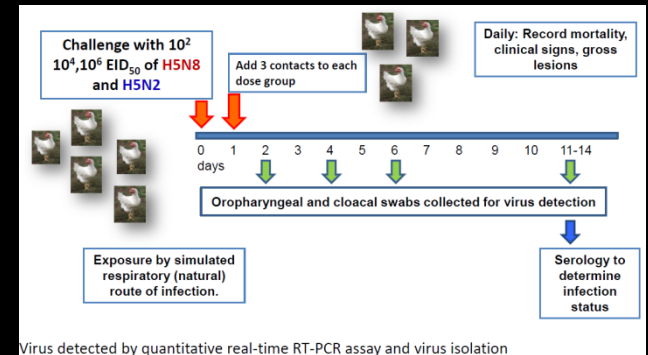
*Diversity and
Distributions, 2019*

AIV challenge studies in understudied diving ducks

Partners: USDA Southeast Poultry Research Laboratory
USGS PWRC – Seaduck Colony

- Characterizing HPAI in two diving duck species
 - Susceptibility
 - Virus shed
 - Symptoms
 - Mortality

2017, 2018 Avian Diseases



2020 BMC Veterinary Research (in press)

Ruddy duck



Lesser Scaup



Surf Scoter



Shed virus, zero to minimal clinical signs

Environmental Persistence – Field and Lab study across NA

Partners: USGS WERC, University of Georgia-Southeast Cooperative Disease Study, USGS ASC and multiple partners

PROCEEDINGS B

royalsocietypublishing.org/journal/rspb

Research



Cite this article: Ramey AM *et al.* 2020
Influenza A viruses remain infectious for more
than seven months in northern wetlands of
North America. *Proc. R. Soc. B* 20201680.

Influenza A viruses remain infectious for more than seven months in northern wetlands of North America

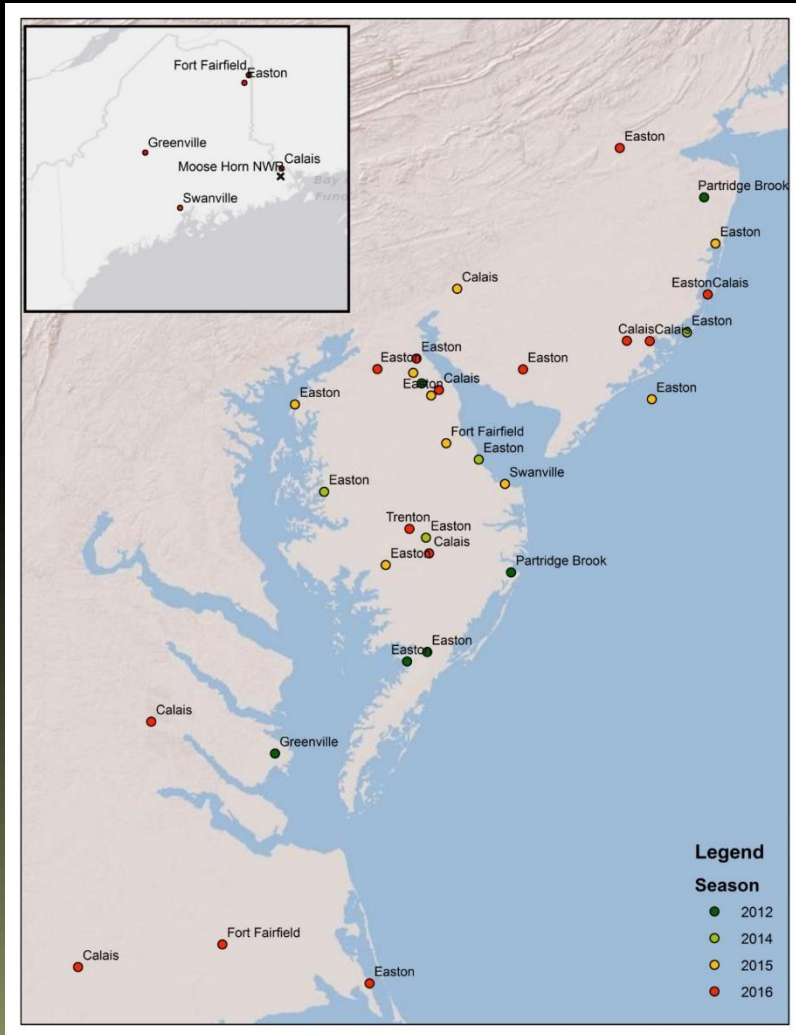
Andrew M. Ramey¹, Andrew B. Reeves¹, Judith Z. Drexler²,
Joshua T. Ackerman³, Susan De La Cruz⁴, Andrew Lang⁵, Christina Leyson^{6,7},
Paul Link⁸, Diann J. Prosser⁹, Gregory J. Robertson¹⁰, Jordan Wight⁵,
Sungsu Youk^{6,7}, Erica Spackman^{6,7}, Mary Pantin-Jackwood^{6,7},
Rebecca L. Poulson^{11,12} and David E. Stallknecht^{11,12}



Avian Influenza in Waterfowl, the Atlantic Flyway

Partners: University of Georgia-Southeast Cooperative Disease Study, USGS ASC

BBL Encounters – connection to Maine AIV sampling sites



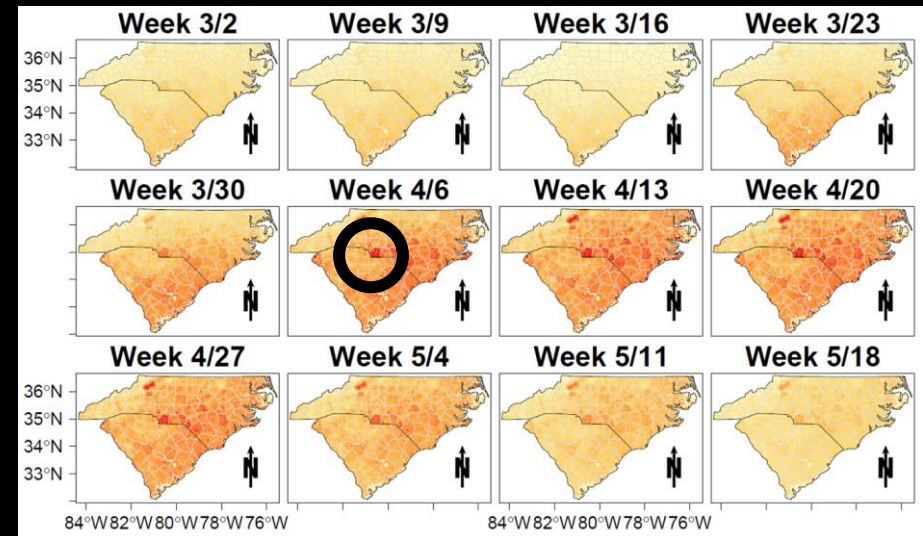
- Sampling waterfowl in Ches Bay (migration/wintering areas) and Maine
- Investigating banding data for connections
- Investigating subtypes and genetics for virus connectivity

Blue Winged Teal Movements and Avian Influenza

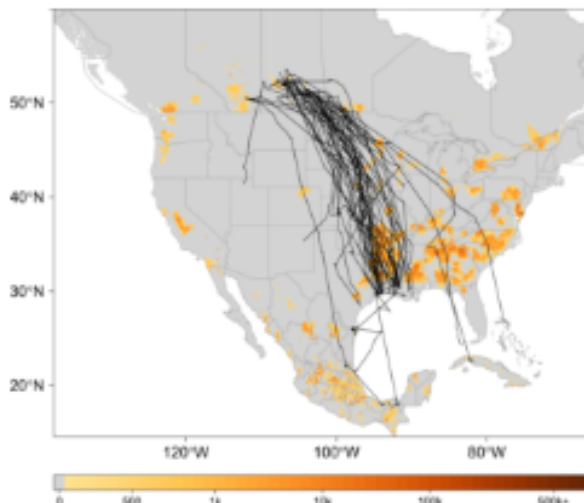


Partners: USGS ASC

Models



Subsequent H7N3 outbreak in NC: LPAI March 10, HPAI April 9, 2020



Waterfowl occurrence and residence time as indicators of H5 and H7 avian influenza in North American Poultry | Scientific Reports - Nature

Avian influenza (AI) affects wild aquatic birds and poses hazards to human health, food security, and wildlife conservation globally. Accordingly, there is a recognized need for new methods and ...

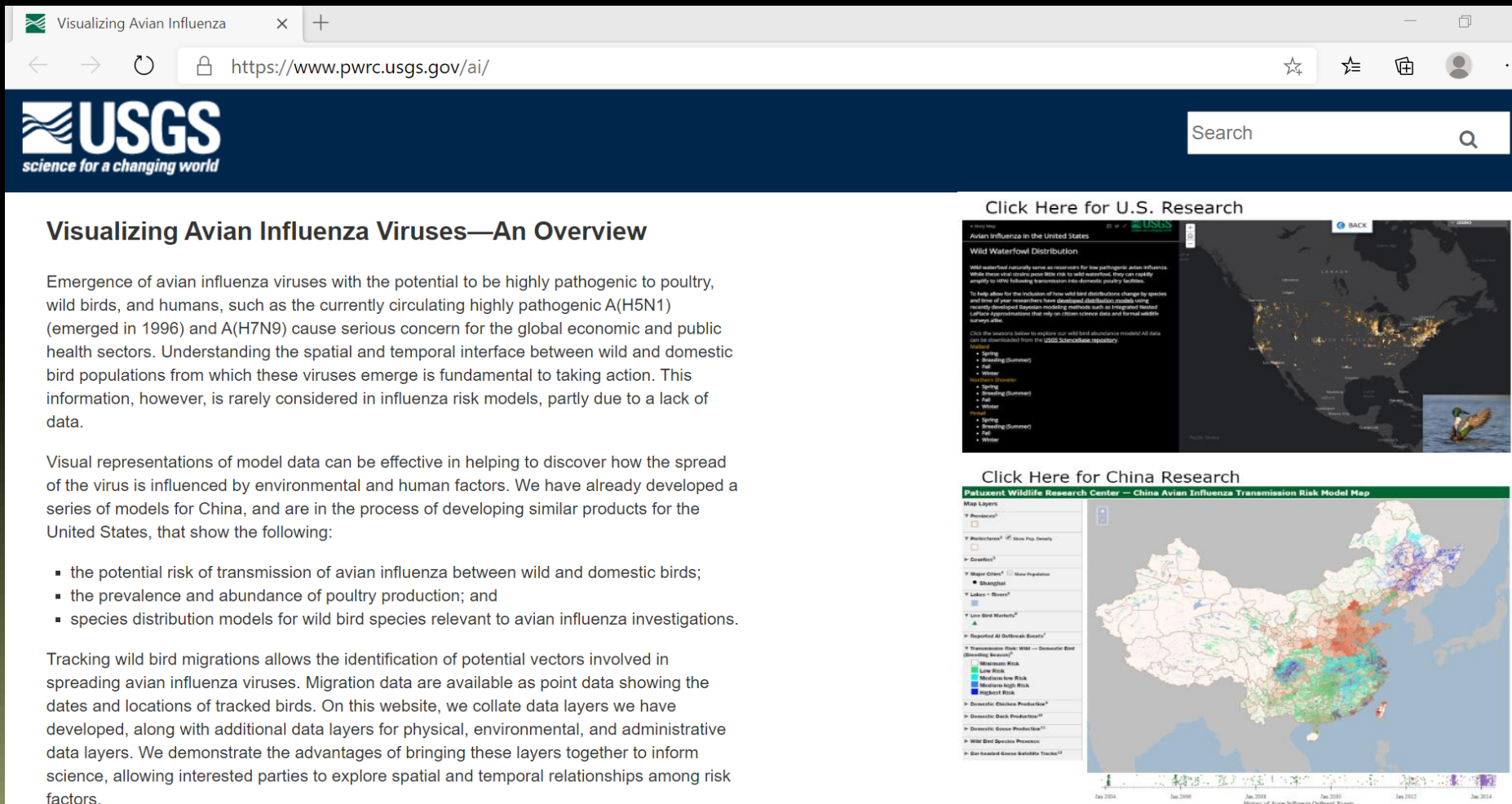
www.nature.com

Scientific Reports, 2020

Web-based Visualization Tool

Online interactive web interface
Model download portal

<http://www.pwrc.usgs.gov/ai/>
(in development)



Visualizing Avian Influenza

USGS
science for a changing world

Search

Visualizing Avian Influenza Viruses—An Overview

Emergence of avian influenza viruses with the potential to be highly pathogenic to poultry, wild birds, and humans, such as the currently circulating highly pathogenic A(H5N1) (emerged in 1996) and A(H7N9) cause serious concern for the global economic and public health sectors. Understanding the spatial and temporal interface between wild and domestic bird populations from which these viruses emerge is fundamental to taking action. This information, however, is rarely considered in influenza risk models, partly due to a lack of data.

Visual representations of model data can be effective in helping to discover how the spread of the virus is influenced by environmental and human factors. We have already developed a series of models for China, and are in the process of developing similar products for the United States, that show the following:

- the potential risk of transmission of avian influenza between wild and domestic birds;
- the prevalence and abundance of poultry production; and
- species distribution models for wild bird species relevant to avian influenza investigations.

Tracking wild bird migrations allows the identification of potential vectors involved in spreading avian influenza viruses. Migration data are available as point data showing the dates and locations of tracked birds. On this website, we collate data layers we have developed, along with additional data layers for physical, environmental, and administrative data layers. We demonstrate the advantages of bringing these layers together to inform science, allowing interested parties to explore spatial and temporal relationships among risk factors.

Click Here for U.S. Research

Wild Waterfowl Distribution

Wild waterfowl naturally serve as reservoirs for low pathogenic avian influenza. While these viruses pose little risk to wild animals, they can readily amplify to H5N1 following transmission into domestic poultry facilities.

To help allow for the inclusion of low wild bird distribution change by species and time of year, researchers have developed distribution models using recently developed Bayesian modeling methods such as Integrated Nested Laplace Approximations that rely on sparse evidence data and formal wildlife survey data.

Click the queries below to explore our wild bird abundance models. All data can be downloaded from the [USGS Data Store](#).

Legend

- Spring
- Summer (Summer)
- Fall
- Winter

Click Here for China Research

Patuxent Wildlife Research Center — China Avian Influenza Transmission Risk Model Map

Map Layers

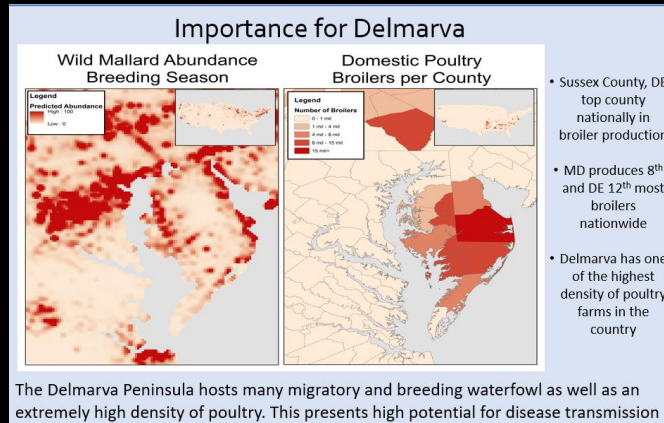
- Provinces
- Counties
- Major Cities
- Water Bodies
- Land Use
- Reported AI Outbreak Events
- Transmission Risk: Wild - Domestic Bird (Spring/Summer)
- Transmission Risk: Wild - Domestic Bird (Fall/Winter)
- Domestic Duck Production
- Domestic Goose Production
- Wild Bird Species Presence
- Wild Bird Species Abundance

Legend

- Low Risk
- Medium Low Risk
- Medium High Risk
- High Risk

Time Slider: Jan 2004, Jan 2006, Jan 2008, Jan 2010, Jan 2012, Jan 2014

Spatio-temporal Wild-Domestic Bird AIV Risk Modeling for Delmarva



Items for input

-We believe focused risk models for Delmarva are important for this region

- Do others agree? Would these be helpful to you?

-We are working on focal improvements for Delmarva

- open to input

- open to working together if common need identified

Additional Data for Delmarva Risk Modeling

To better understand factors affecting waterfowl and their habitats more data is needed

Survey data vs Ebird



Collect regional telemetry data?



- Identification of local poultry
- Hydrological Surface Flow Connectivity?
- Avian surveys of farm stormwater ponds?

Improved waterfowl distributions for Delmarva

Hoping to open discussion with WG members
Feedback on model targets, useful research
Happy to follow up with additional meetings, if interested



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Diann Prosser, dprosser@usgs.gov