

Using Remote Sensing Based Modelling to Make Historic and Daily Highly Pathogenic Avian Influenza (HPAI) Risk Models for Individual Farms Farms in Asia

WOAH Epidemic Intelligence: Event-Based Surveillance for Animal Health in the Asia-Pacific

Maurice Pitesky

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Professor of Cooperative Extension, UC Davis Weill School of Veterinary Medicine,
Davis, California



World Organisation
for Animal Health

Big Picture Summary of Presentation: What happens off farm matters

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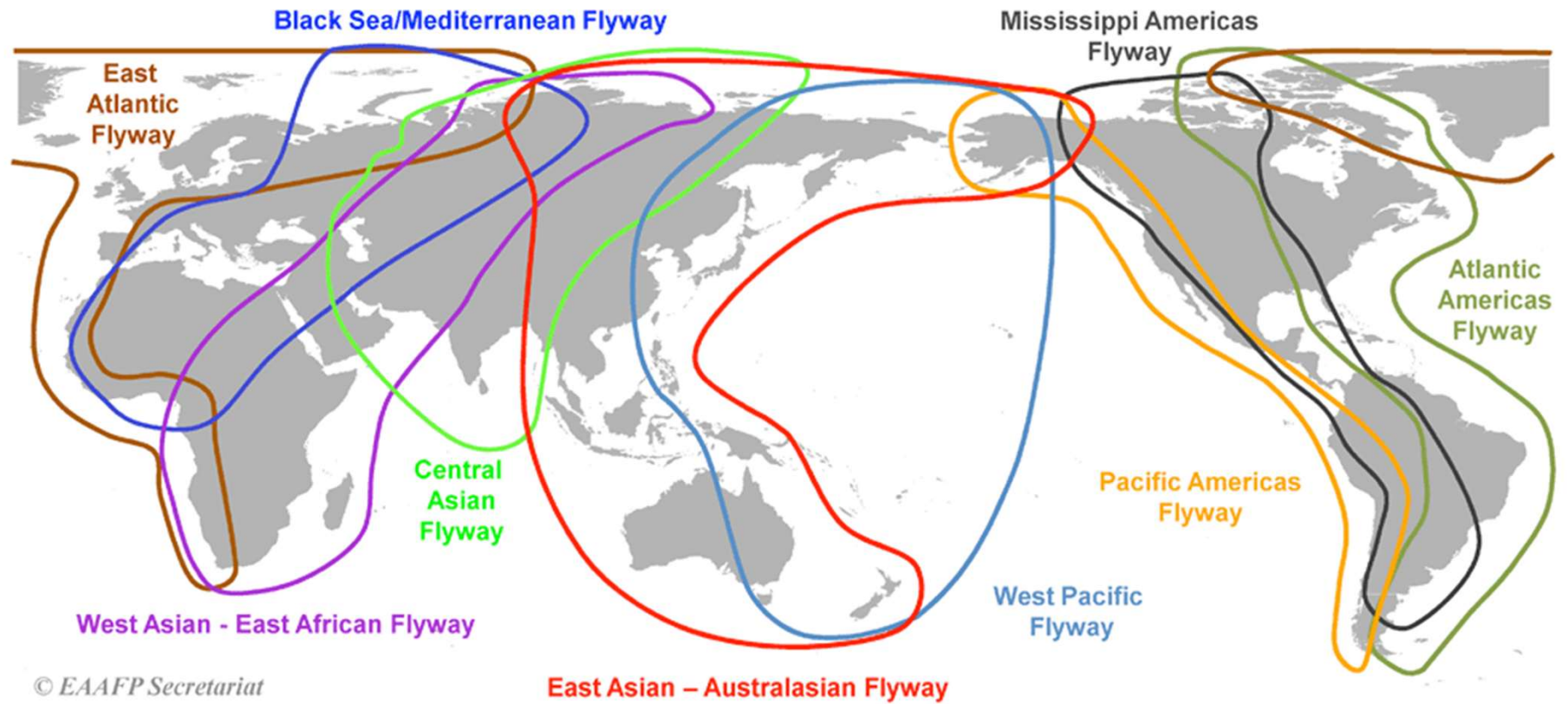


Conclusion: Risk assessments and biosecurity should not stop at the fence line.



Waterfowl Flyways

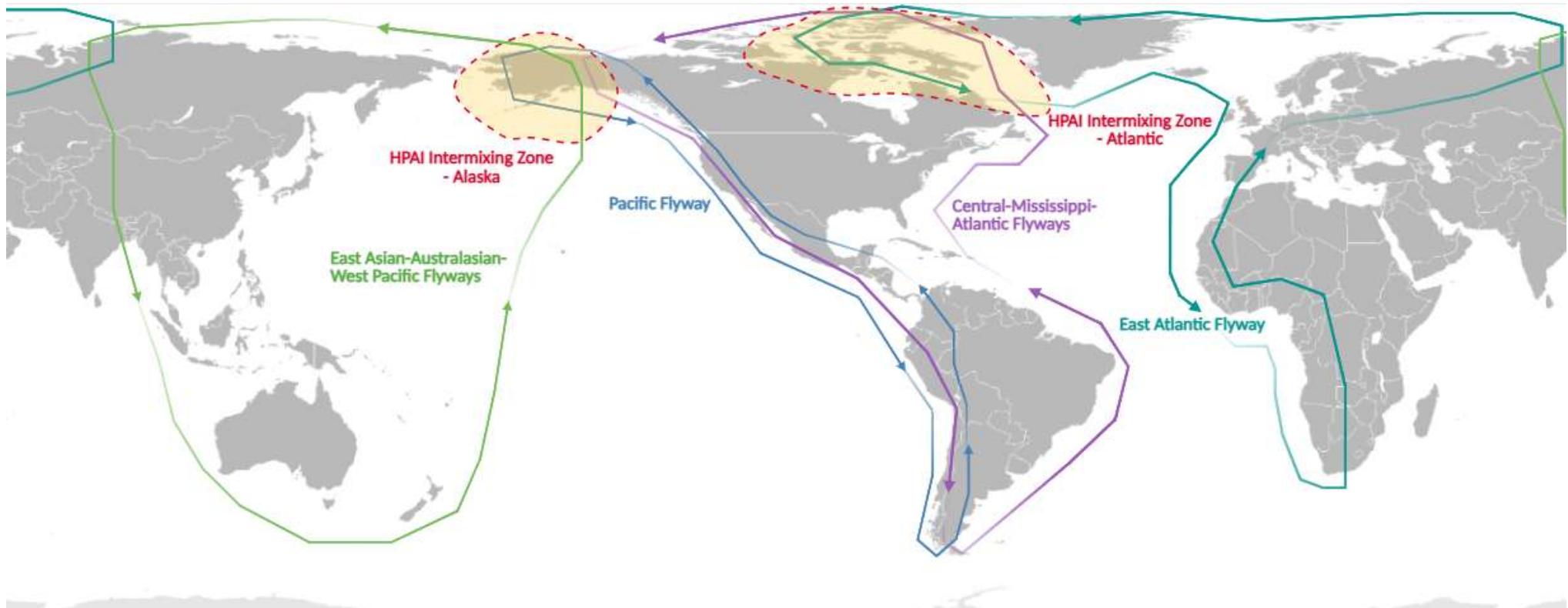
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Waterfowl Flyways and HPAI Intermixing Zones (Asia and N American Context)

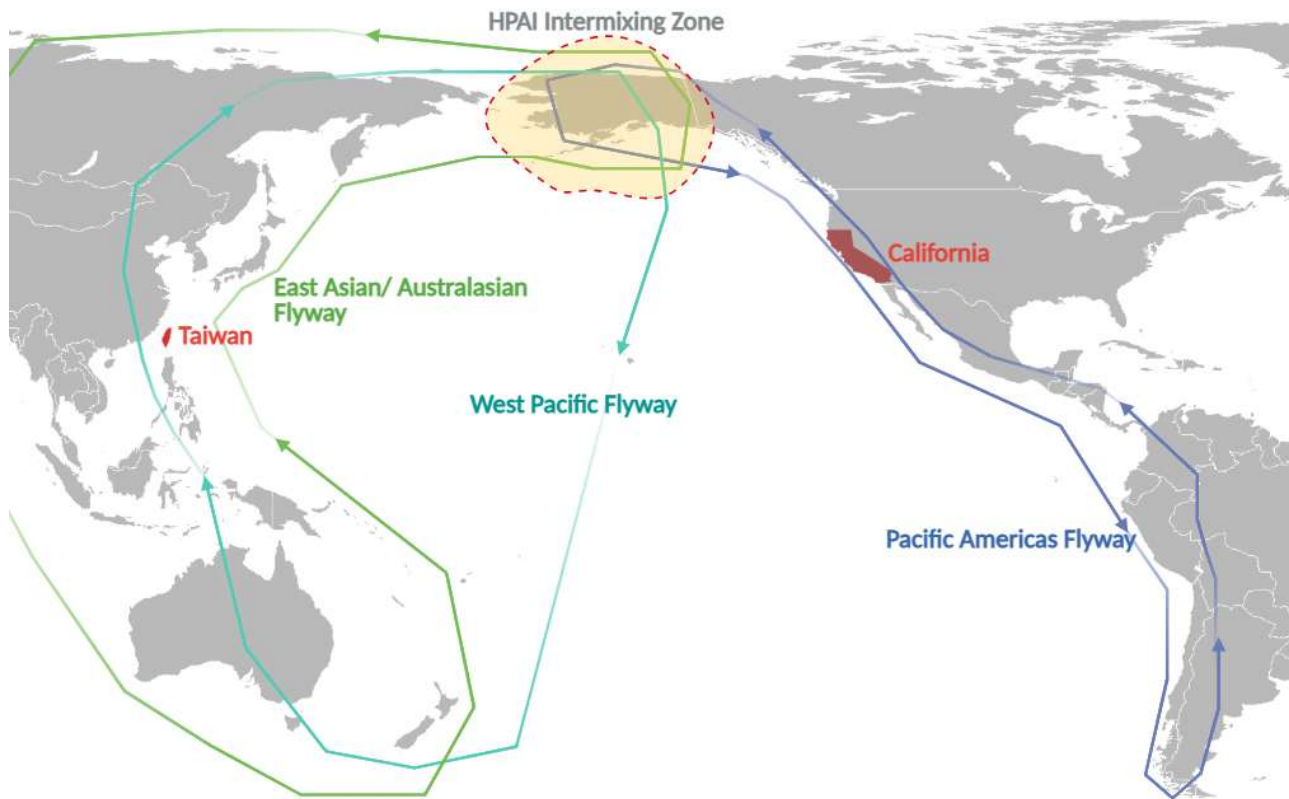
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Waterfowl Flyways and HPAI Intermixing Zones

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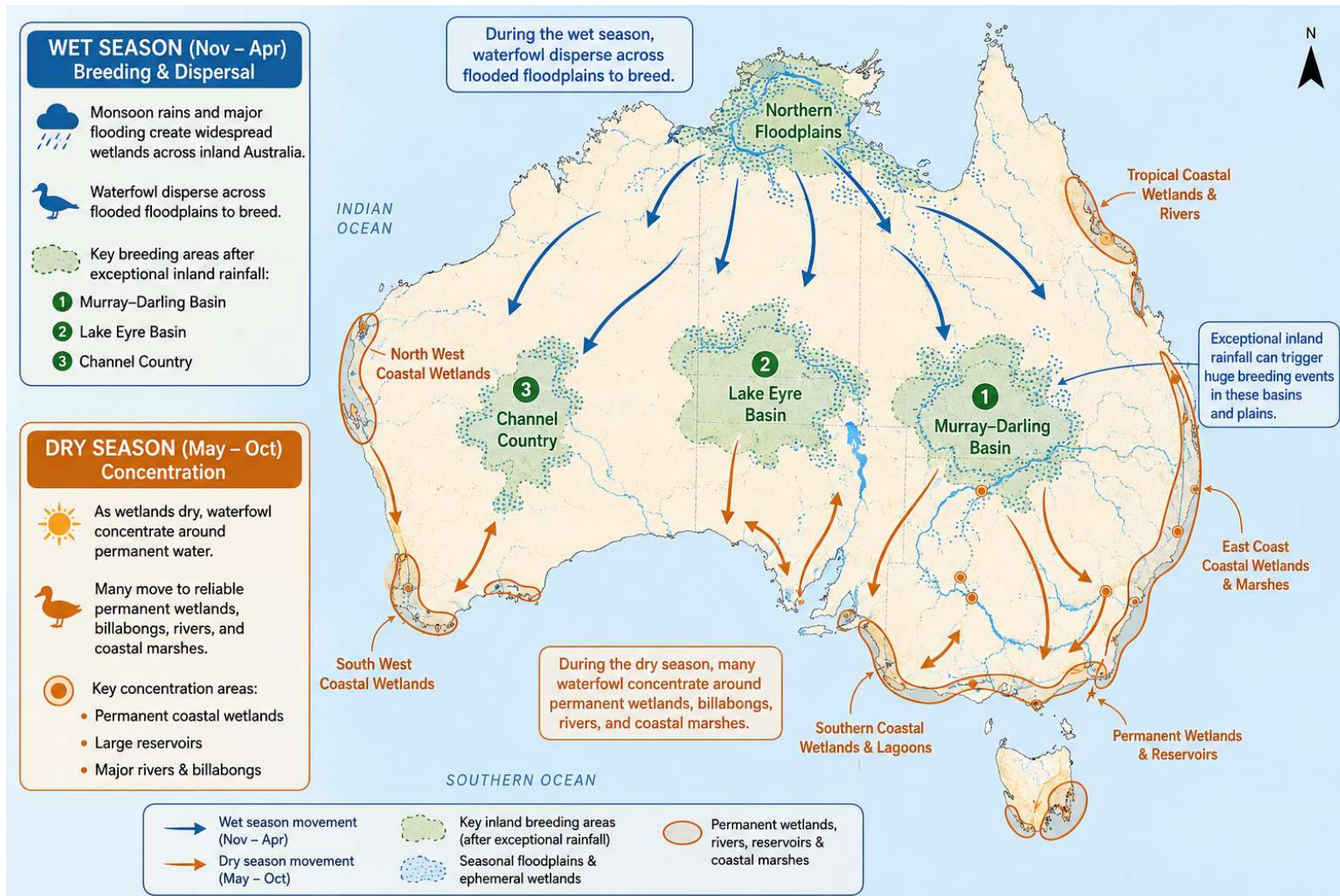


- Wild migratory waterfowl carry the most AI subtypes and the highest HPAI prevalence among wild birds.
- Poultry AIV can be linked in space, time, and phylogeny to waterfowl AIV.
- Poultry farms and waterfowl habitat often overlap, creating transmission pathways.
- Flyways interface during Arctic nesting, enabling intercontinental spread.



Seasonality and Waterfowl Distributions (Australian Example)

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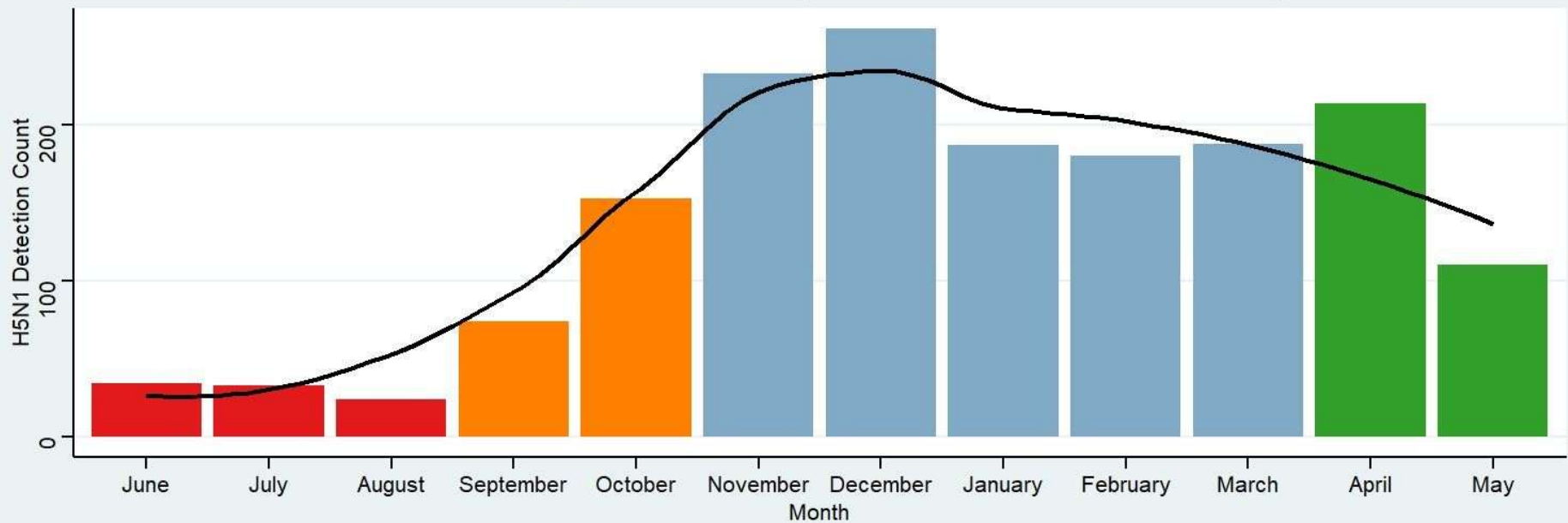




Seasonality of HPAI in the U.S.

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Commercial Poultry H5N1 Counts by Month and Period of Waterfowl Cycle

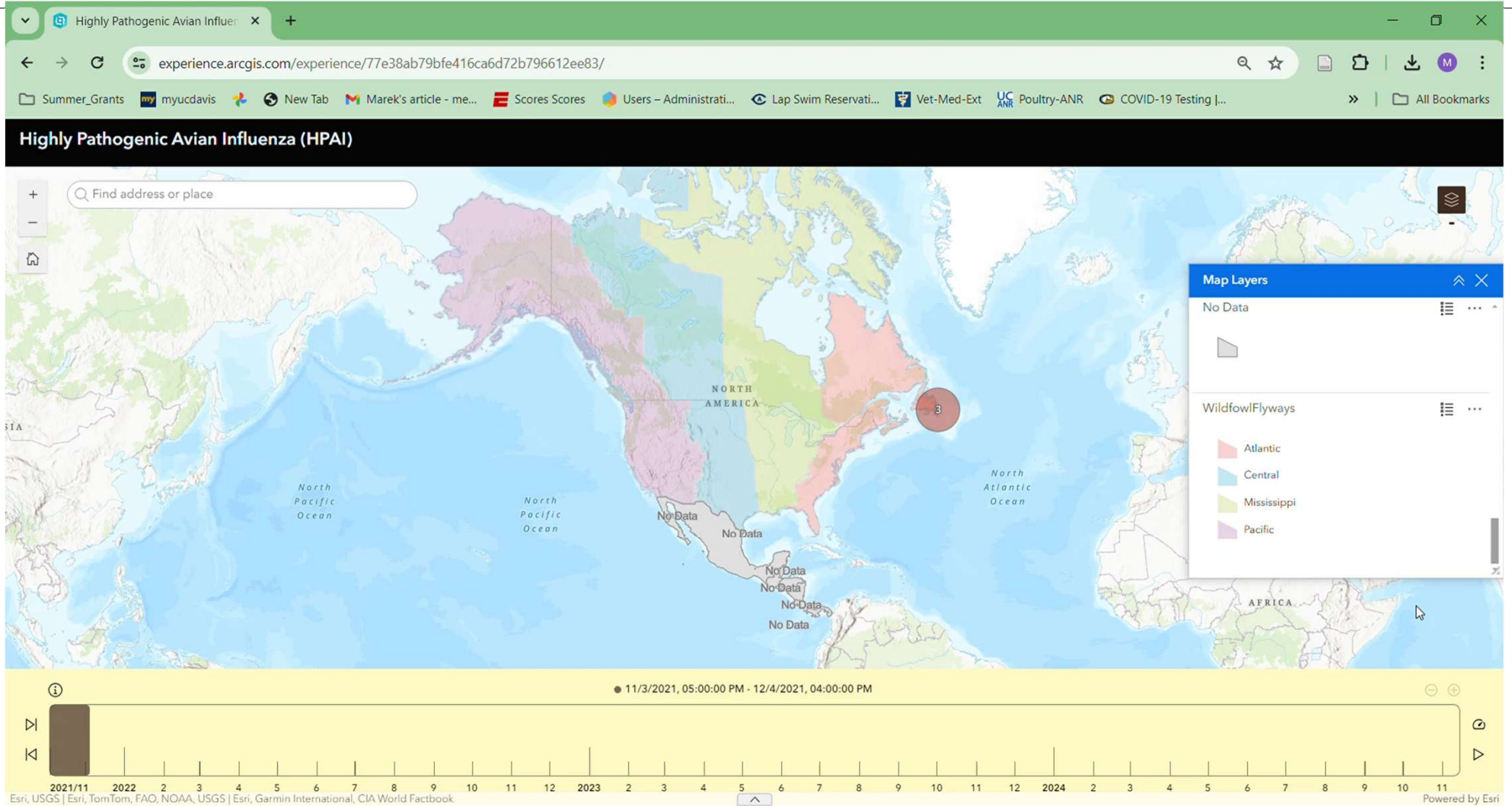


Period of Annual Cycle — Breeding — Fall_Migration_Staging — Spring_Migration_Staging — Winter



HPAI in the Americas

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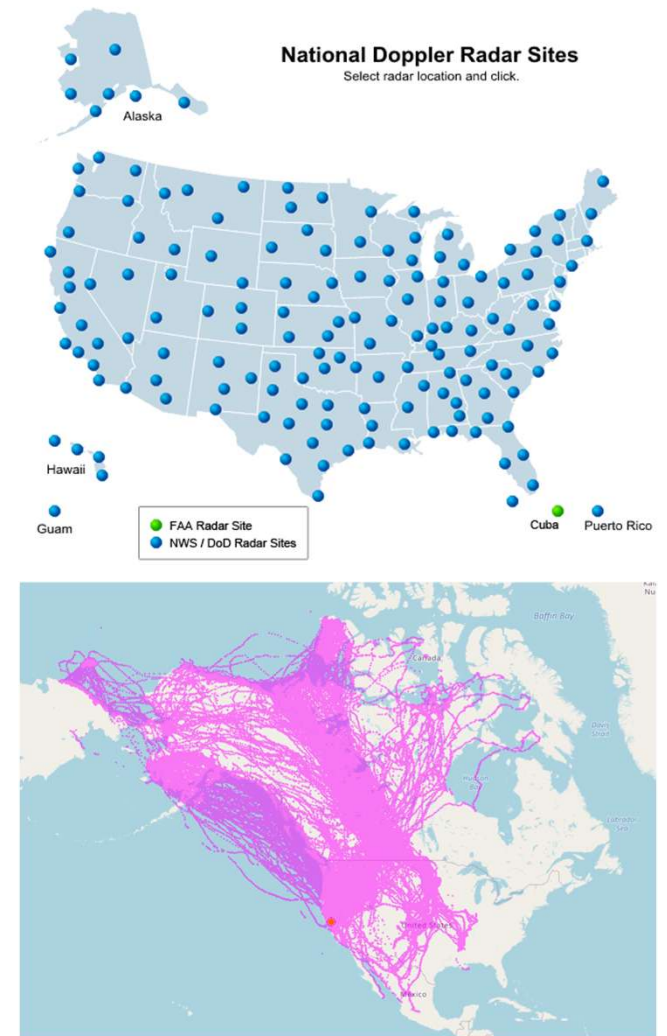
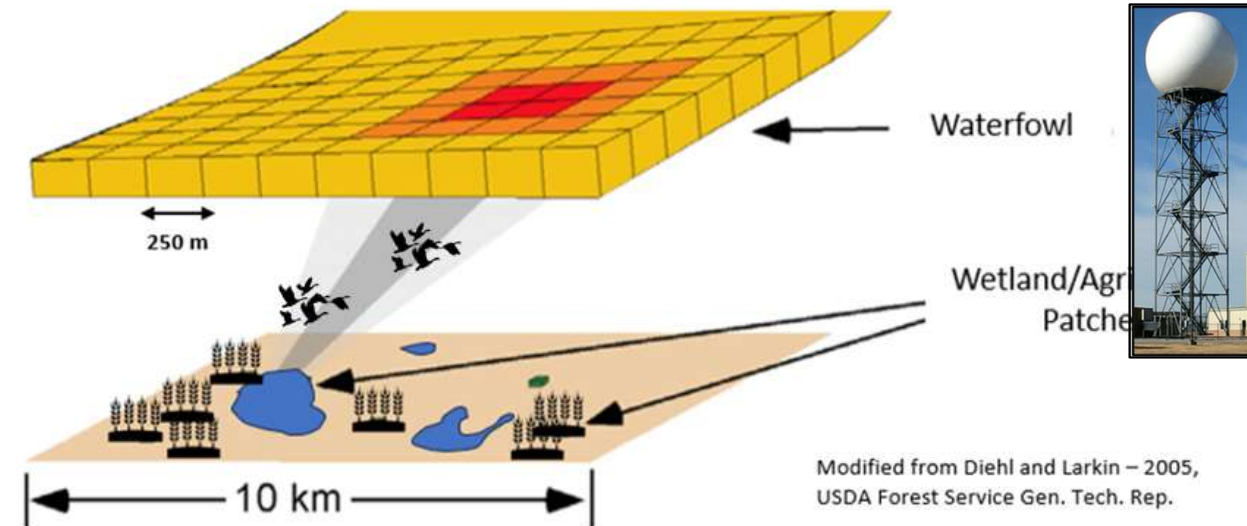




Using both Radar and Telemetry to Predict Waterfowl on the Landscape

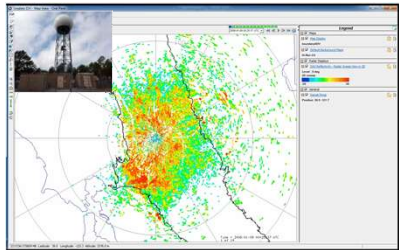
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- There are ~160 NEXRAD (Weather Radars) across the USA
- In addition to weather, they can be used to detect flying waterfowl.
- We use this information to make daily predictions of waterfowl on the landscape in respect to poultry and other livestock facilities based on ~28 covariates.





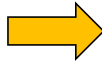
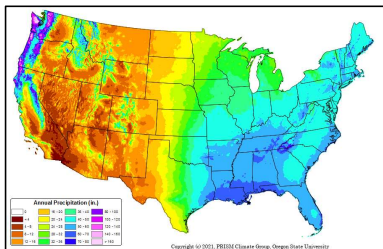
Leveraging Radar and Telemetry to Prediction Dynamic Waterfowl Abundance/Occupancy



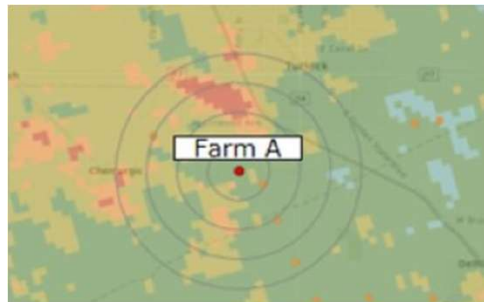
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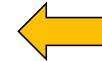
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Waterfowl Abundance



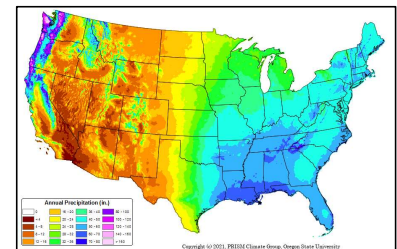
Waterfowl Occupancy



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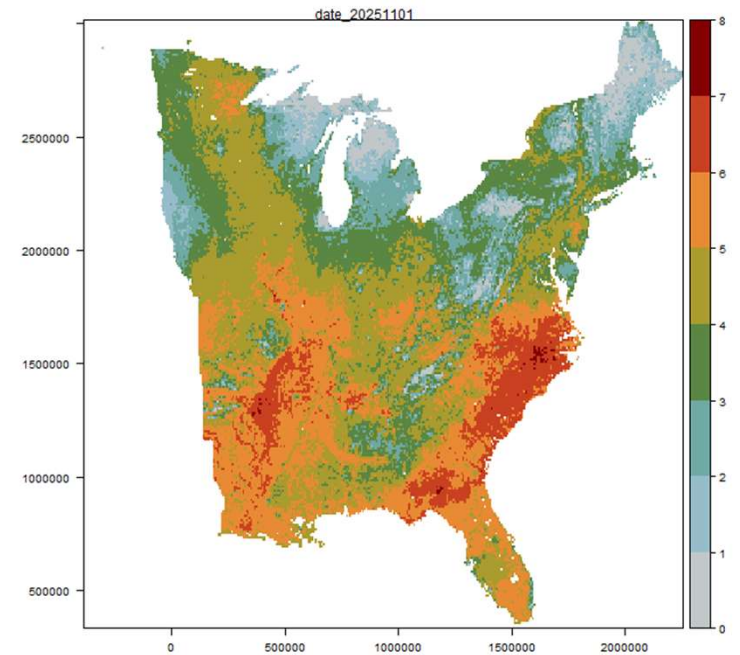
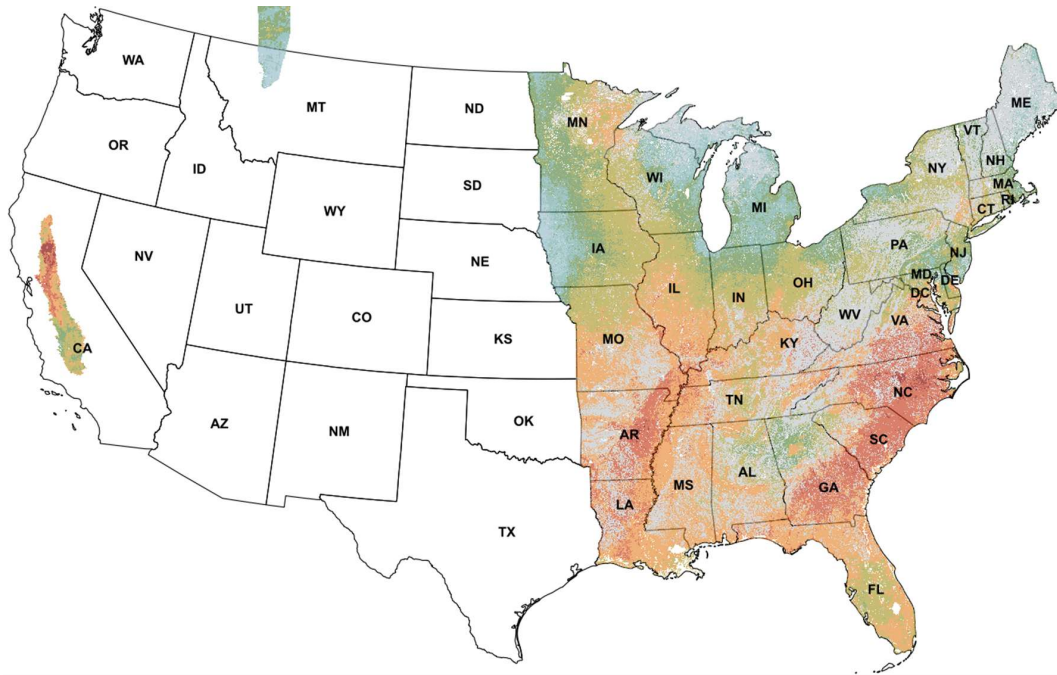
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Predictive Model of Waterfowl Roosting

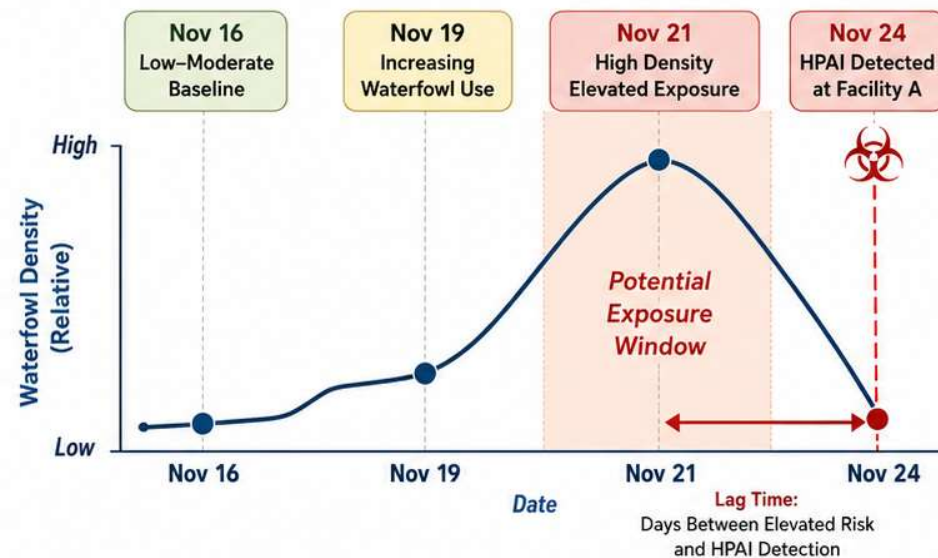
11



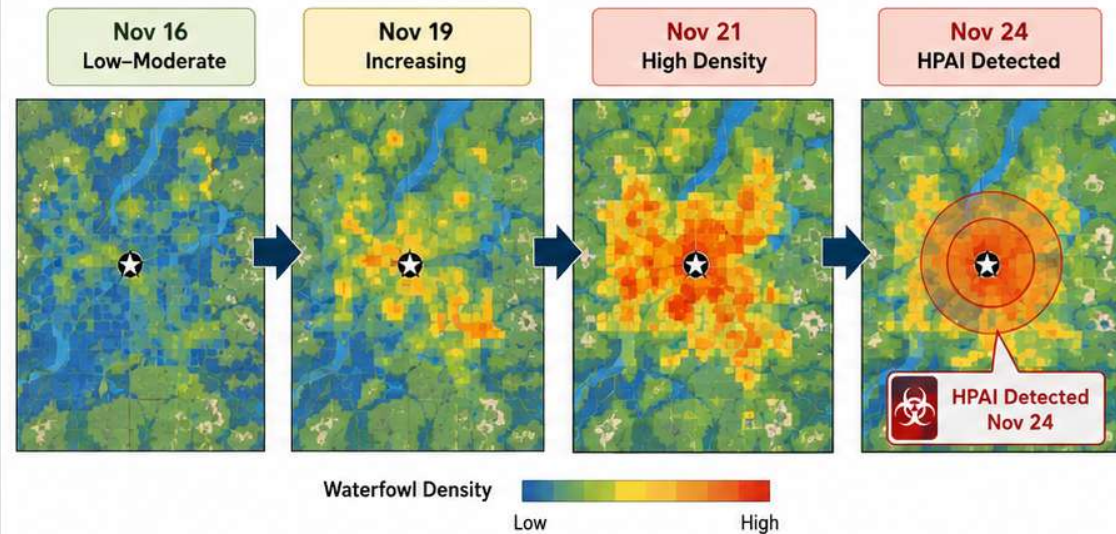
Understanding the Relationship Between Waterfowl and HPAI in Space and Time

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WATERFOWL DENSITY OVER TIME NEAR FACILITY A



SPATIAL REDISTRIBUTION OF WATERFOWL AROUND FACILITY A



DRIVERS OF RAPID CHANGE



KEY TAKEAWAY

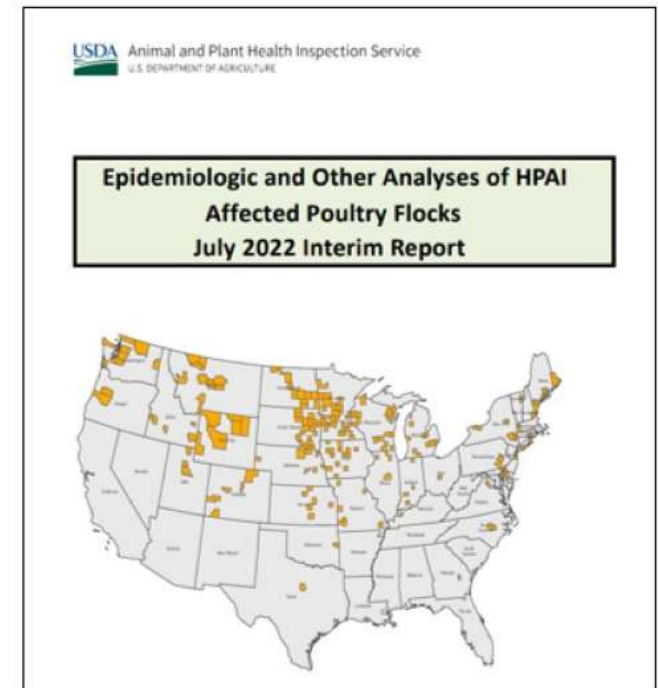
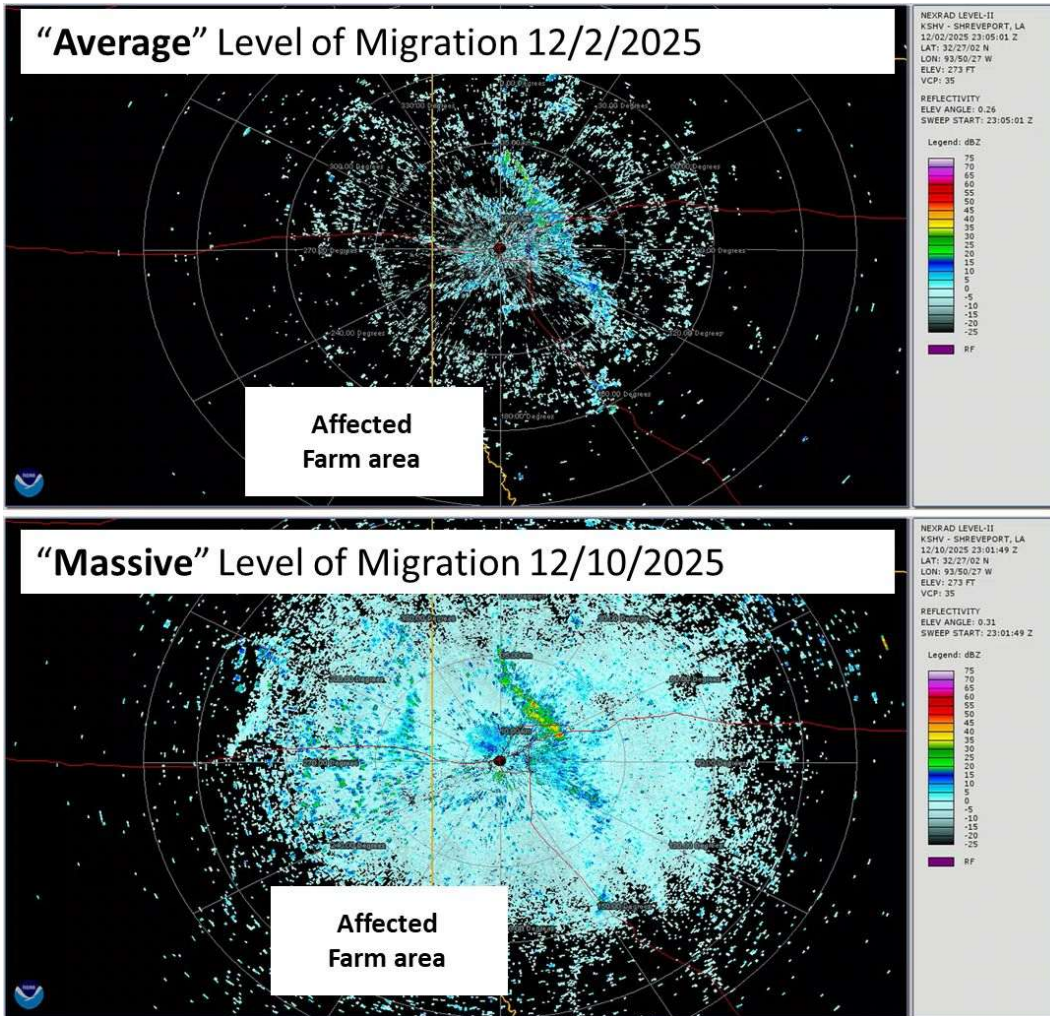


Environmental risk conditions can emerge several days before clinical detection, creating a critical window for heightened biosecurity and early intervention.



Using Radar to ID Waterfowl Movement Near Farms

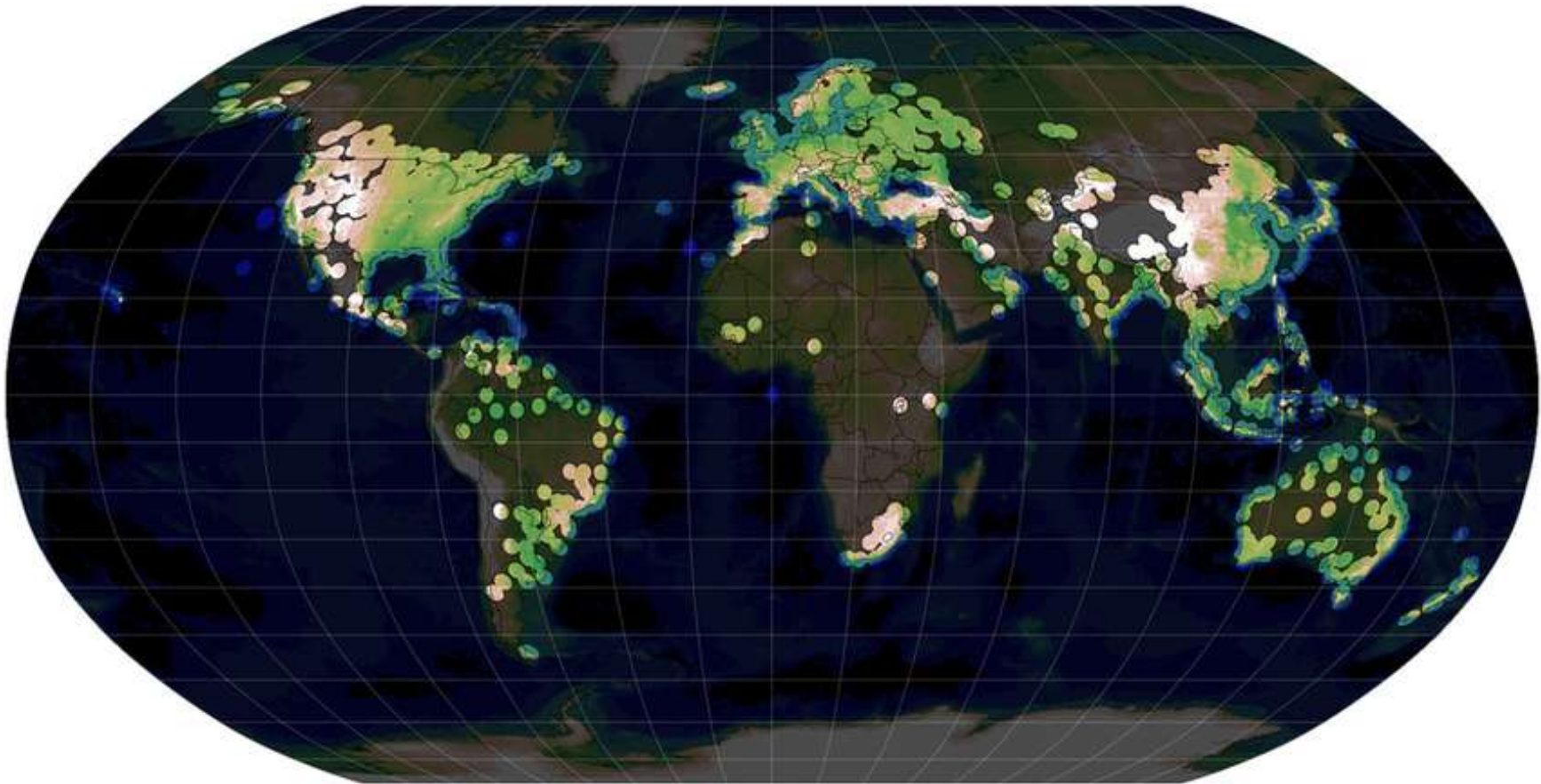
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~1,500 Weather Radar Globally

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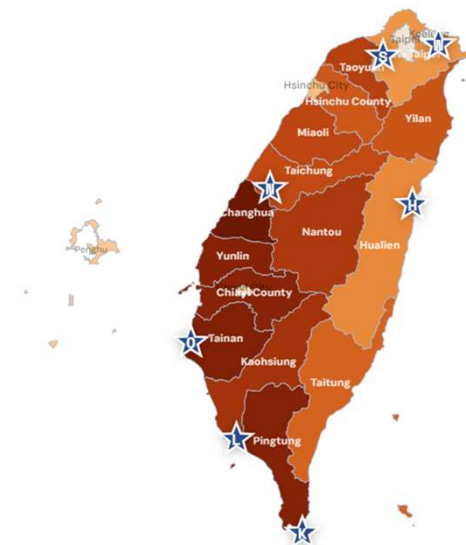
Worldwide distribution map of ground-based weather radar sites (illuminated regions), assuming coverage within a radius of 200 km. From Saltikoff et al. (2019).



Radar Data Specifications

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Source	Central Weather Administration
Radar Type	Doppler / Dual-Pol
Coverage	Stations covering poultry-farm regions
Temporal Range	Nov 2023 – Dec 2025 (2+ winter seasons)
Resolution	Target 250 m spatial (matching WFAN)
Format	Rainbow 5 (NEXRAD Level II equivalent)
Funding	UC Davis Global Affairs Seed Grant

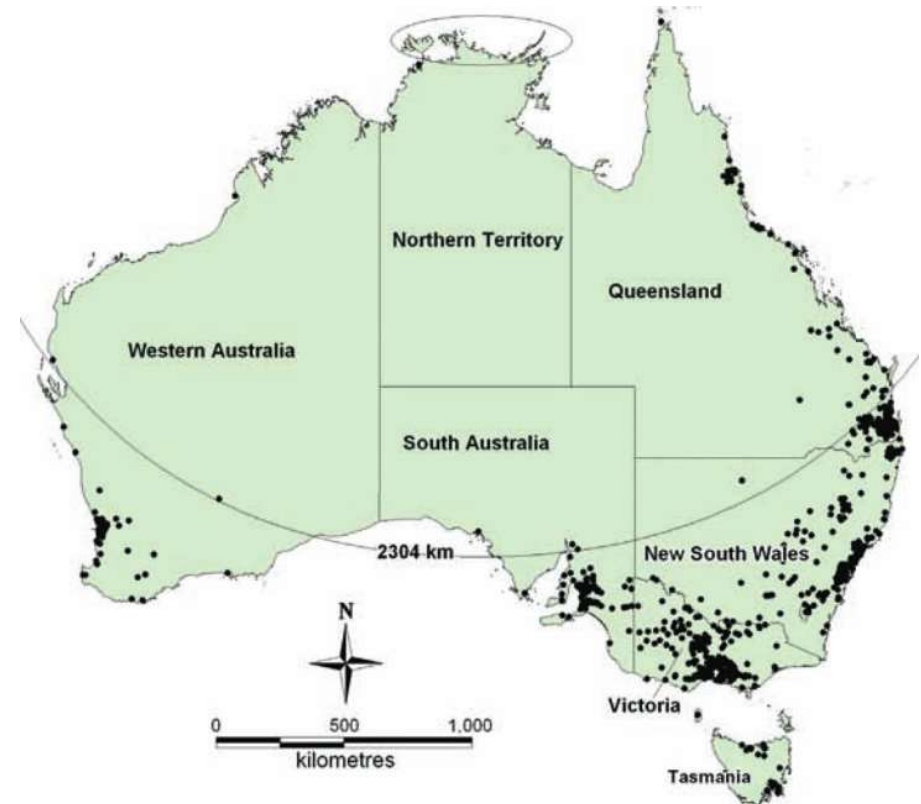
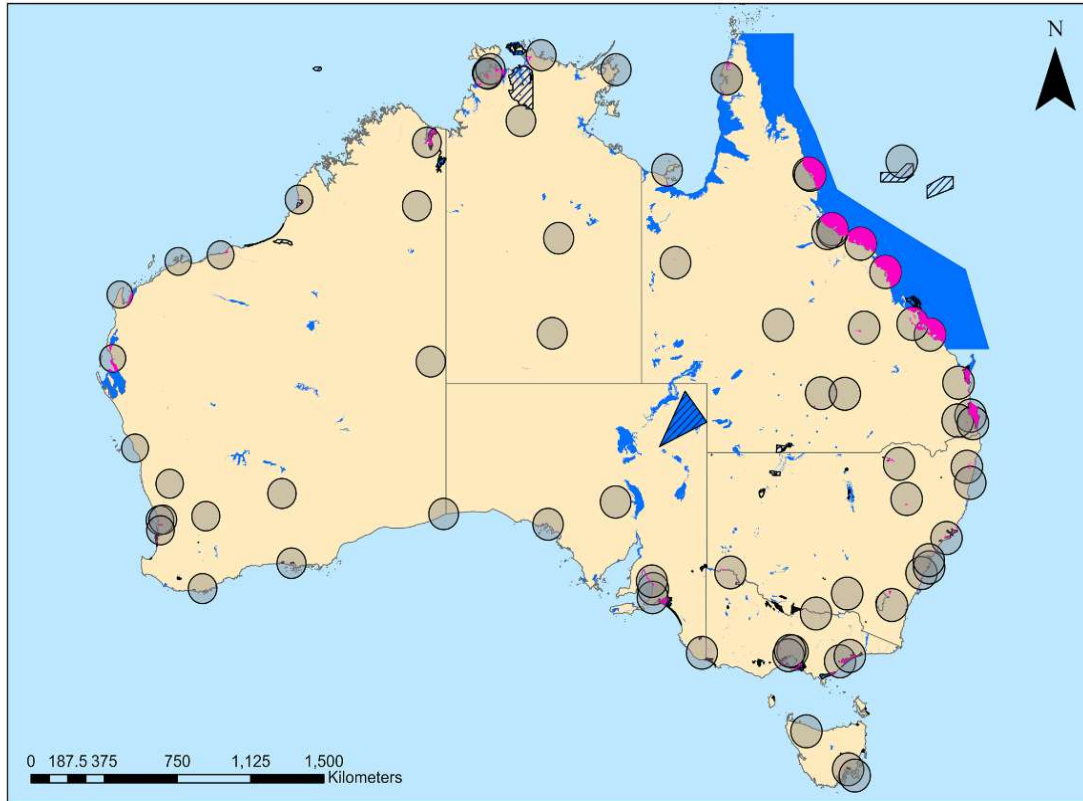


Candidate radar stations over Taiwan's poultry-producing regions.



Weather Radar in Australia and Locations of Poultry Farms

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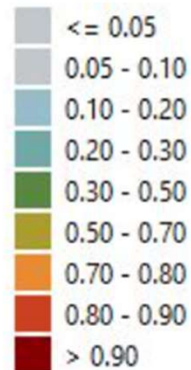
Daily Emails

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Waterfowl Tracker Report – Tuesday, May 12th, 2026

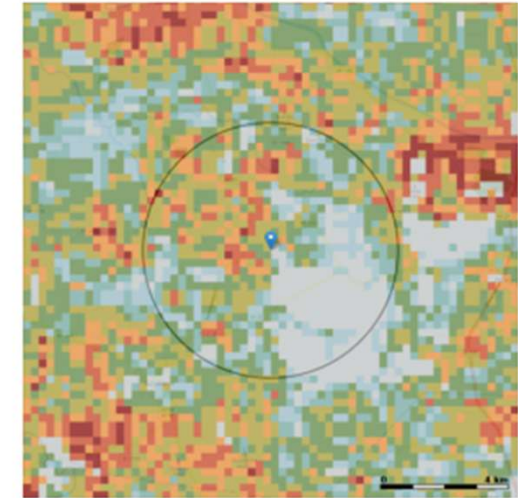
*O.P. - Occupancy Probability, the average value of the probability of waterfowl presence within the specified radius. Farm data shown in descending order of Risk Score and 4km O.P. Images show 4km radius from farm location. NA values indicate that one or more of the remote sensing data sources we use to calculate waterfowl density at the affected location are unavailable due to weather phenomena such as fog, wildfire smoke, or administrative changes to data availability by hosting agencies.



Risk Score **Moderate**

- 1km geofence - 0.44 O.P.*
- 2km geofence - 0.44 O.P.*
- 3km geofence - 0.38 O.P.*
- 4km geofence - 0.37 O.P.*

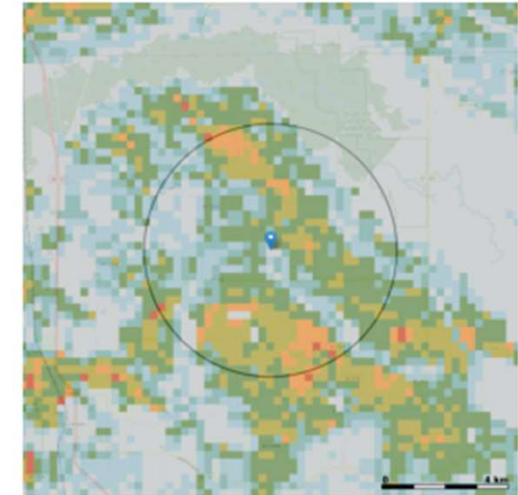
[View Data in App](#)



Risk Score **Low**

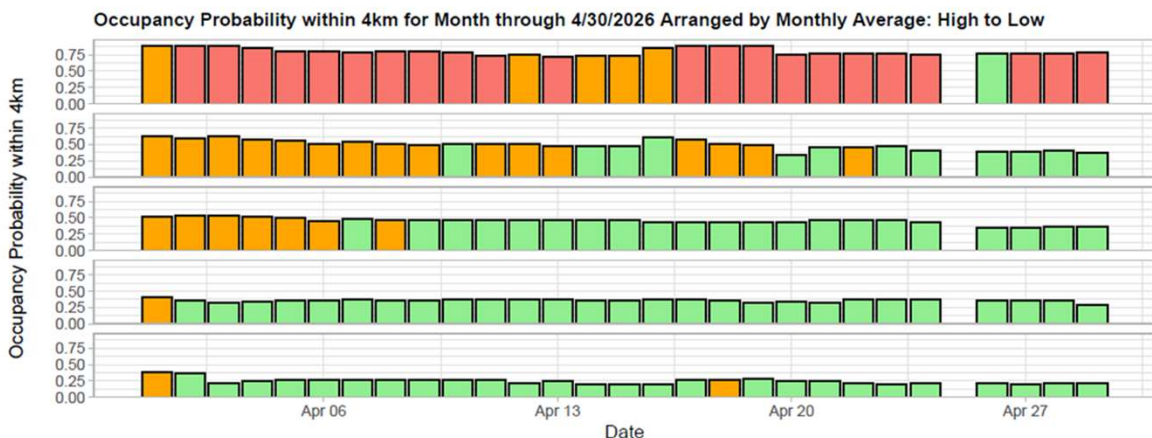
- 1km geofence - 0.31 O.P.*
- 2km geofence - 0.36 O.P.*
- 3km geofence - 0.37 O.P.*
- 4km geofence - 0.36 O.P.*

[View Data in App](#)

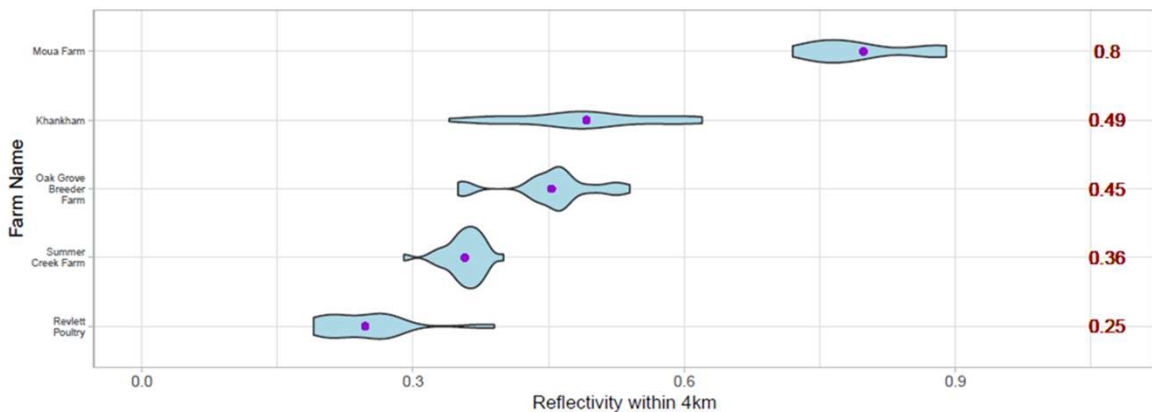




Monthly Reports



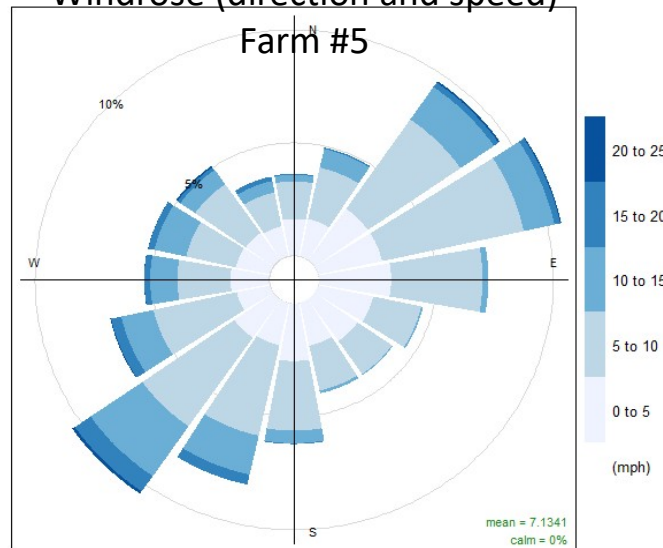
Risk Score ■ Low ■ Moderate ■ High



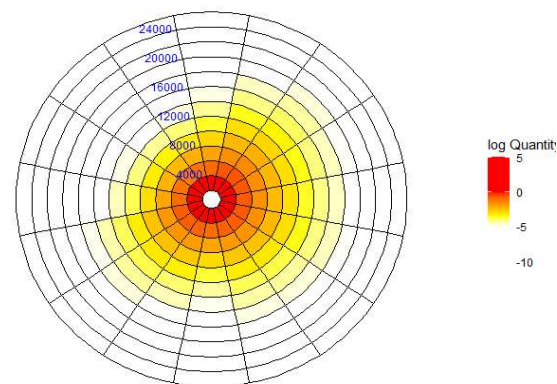
Mean ● Monthly Seasonal: Through Time Range HPAI Status ■ negative

Through Time Range refers to the period of 11/01/2025 to 4/30/2026

Windrose (direction and speed)



Wind Distribution





Annual Reports

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Summary

This summary examines how waterfowl density at Tyson - Hammond Farm interacts with local landscapes and infrastructure to influence HPAI risk. Multi-year data show that natural habitats, man-made waterbodies, and nearby poultry premises all affect waterfowl activity and potential virus exposure.

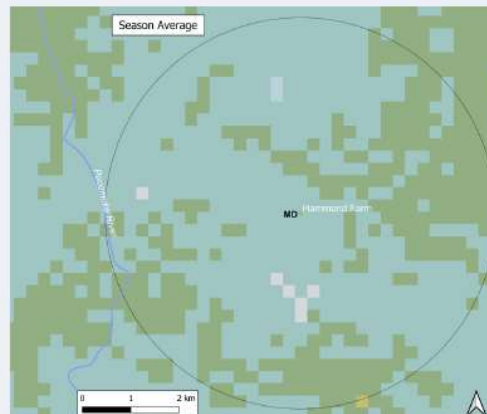
Key Attractants & Pathways (within ~5 km)

- Pocomoke River (Acquango & Poorhouse Branch)
- Assateague Island National Seashore
- Chincoteague National Wildlife Refuge
- Worcester County Solid Waste site & nearby ponds (Fivemile Branch)
- Retention ponds & agricultural fields
- Neighboring poultry operations

Seasonal Risk Patterns

- Highest risk: early November
- Lower risk: December – mid-February
- Moderate risk: late February – March

Effective management relies on flexible, location-specific strategies. Visual and auditory deterrents, habitat modification, coordinated region dynamic risk mapping help producers track bird movements chance of virus introduction. While farms are stationary, water risks they carry are mobile, making continuous adaptive biosecurity year-round.



Key Alert: Large dairy premise ~2km from farm, concerns of lateral spread.

Flooded fields, agriculture and wetlands on landscape

A: Agricultural and Waste Grain.

Spilled grain and unharvested crop residues provide abundant food sources for wild waterfowl and other birds. Congregations of ducks, geese, and gulls in these areas increase the likelihood of H5N1 circulation nearby. This creates a risk of virus introduction via contaminated bird movement, fecal matter, or equipment traveling between fields and barns. Keep feed secured in enclosed bins, promptly clean up spills, and use covered feeders to prevent wild birds from accessing poultry feed. Maintain careful control of farm vehicle traffic.

B: Retention Ponds.

Man-made ponds can serve as roosting and feeding sites for migratory waterfowl, especially in winter when natural wetlands freeze. These sites can harbor H5N1 in water contaminated by wild bird droppings. Proximity to such ponds raises the chance of spread to nearby poultry operations, emphasizing the importance of water management, deterrence of wild bird access, and physical separation of surface water from poultry housing areas.

C: Other Poultry Premises.

Neighboring farms present a unique risk pathway through shared labor, equipment, or service providers. If H5N1 is introduced to one flock, lateral farm-to-farm transmission can occur rapidly. This highlights the importance of strict biosecurity, vehicle and visitor controls, and open communication with nearby producers to limit potential spillovers, connectivity, and prevent cross-use of equipment or vehicles between lagoons and poultry areas to reduce introduction risk.



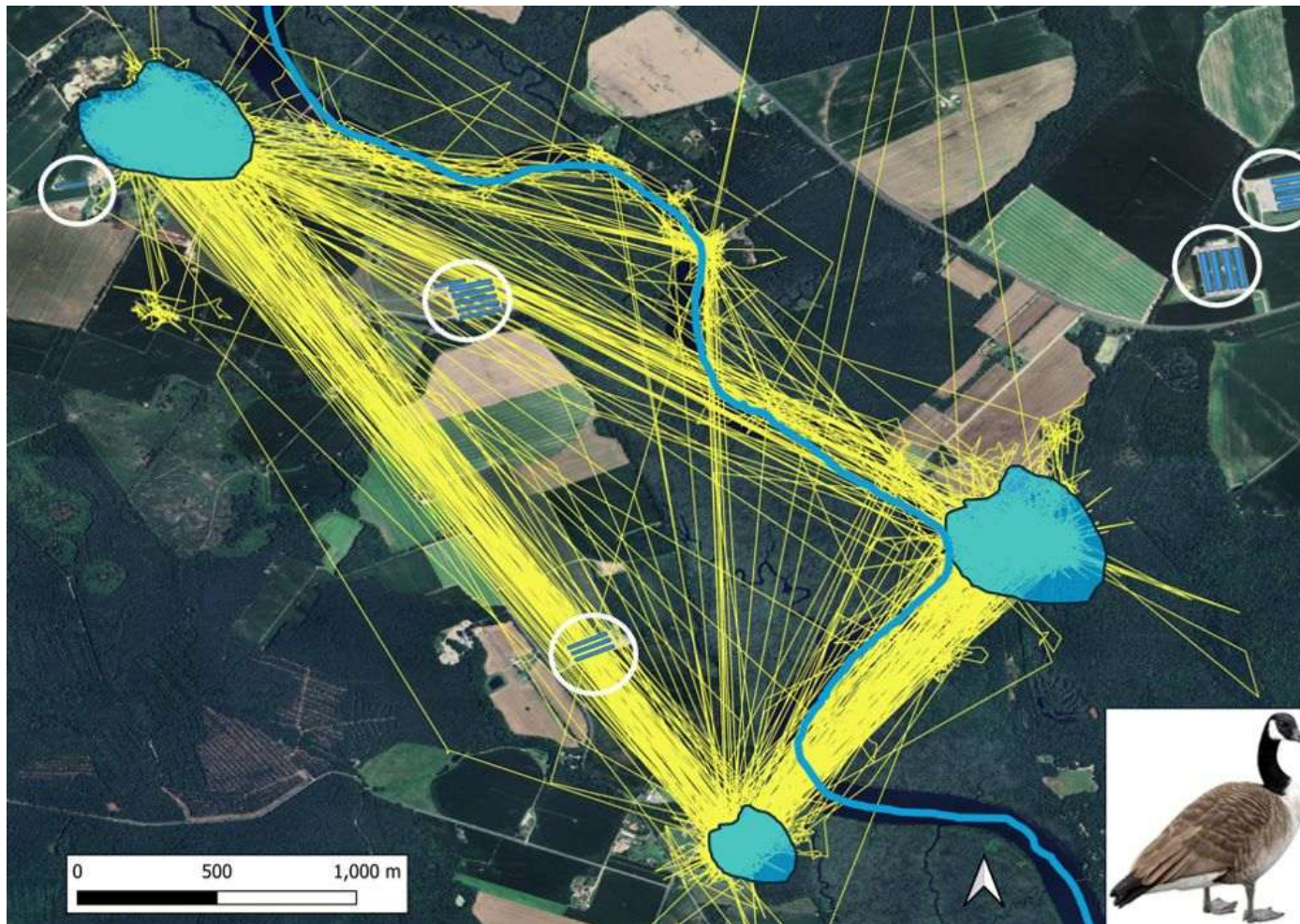
Large bodies of water nearby for waterfowl to roost and feed.

Drainage ditches running from large waterbodies, adjacent to premise



Telemetry Data

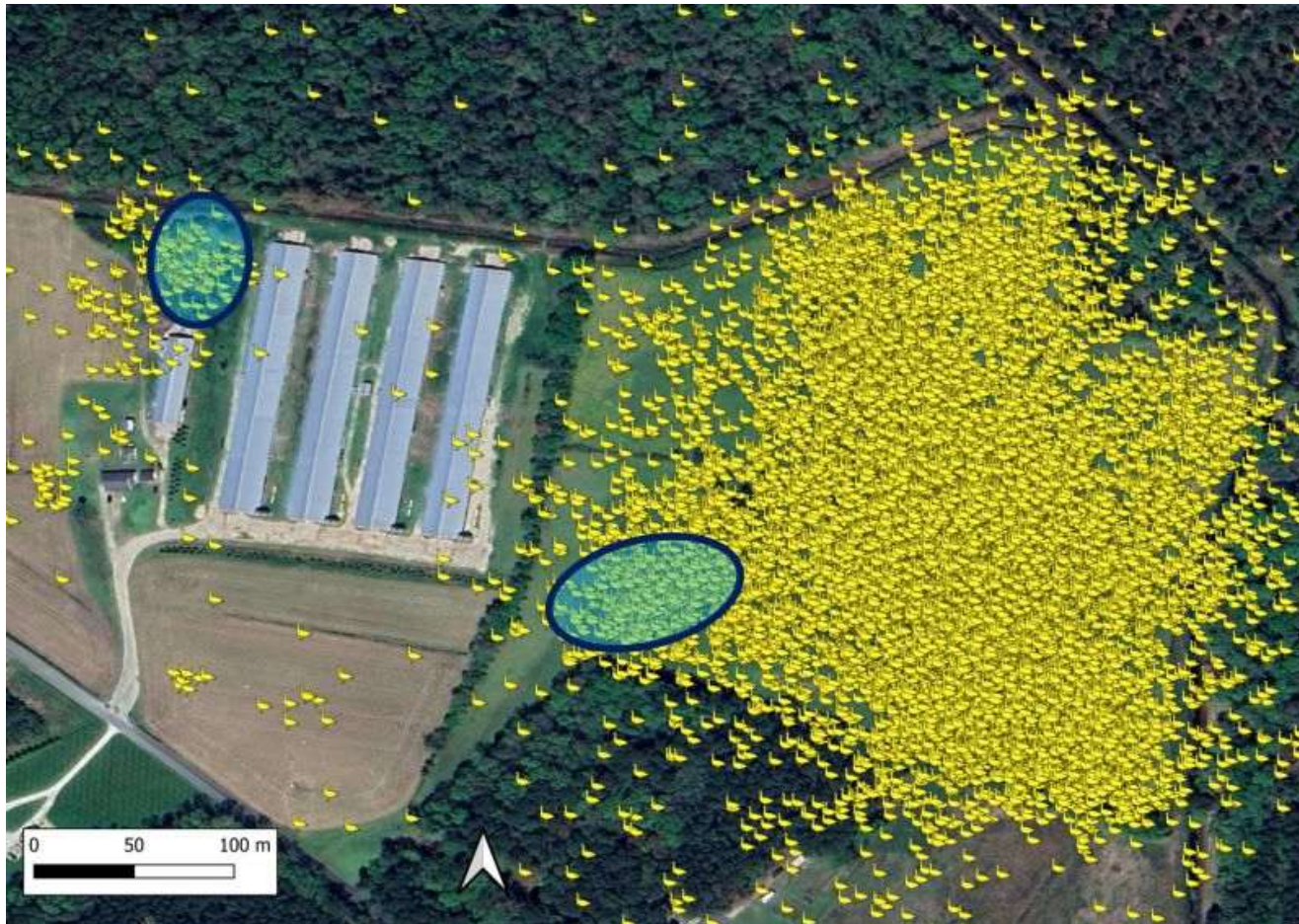
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Telemetry Data

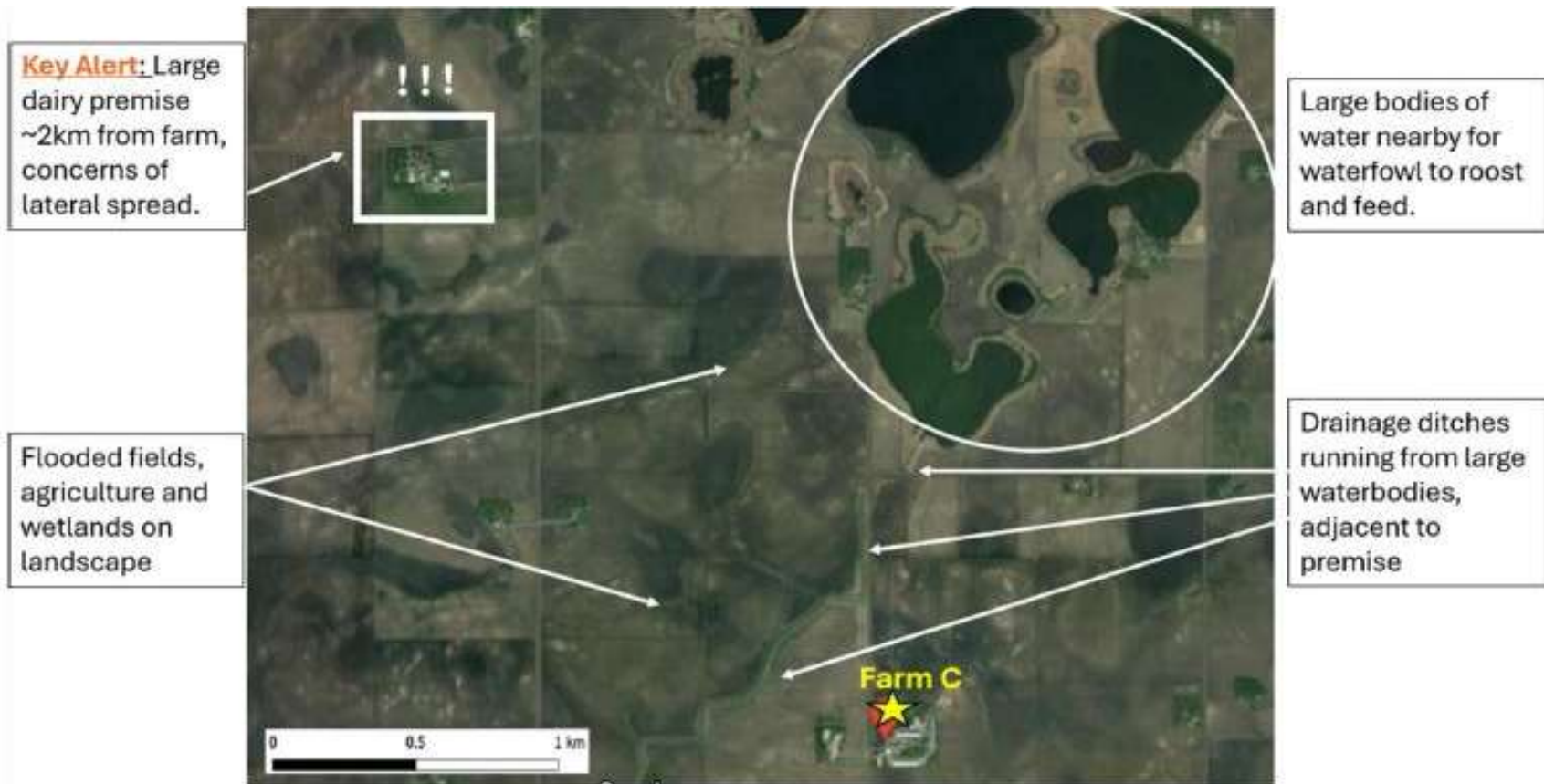
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Wildlife and Biosecurity Assessments Shouldn't Stop at the Farm

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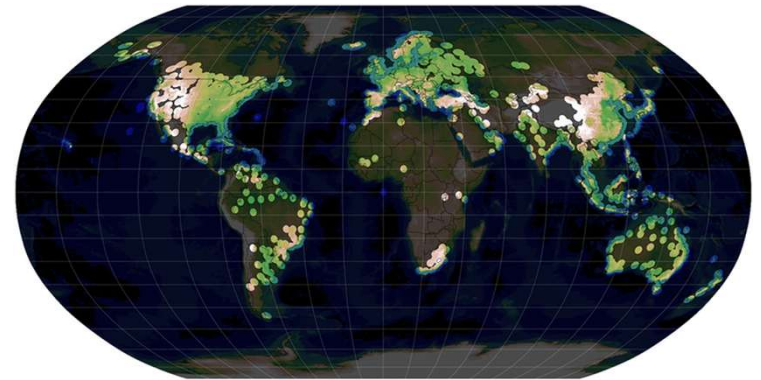
Conclusion: What happens **off** farm matters.



Goal: Collaborating to Build Global Models to Reduce the Risk of HPAI 24 Spillover (and other infectious diseases) from Wild Waterfowl to Domestic Food Animals

- 1 Weather radar observations and/or telemetry
- 2 Detection of large-scale biological movement signals
- 3 Waterfowl activity estimates
- 4 Environmental & landscape data integrated
- 5 Ecological context for poultry HPAI risk

- The model estimates when and where activity/risk may be higher.
- **Output gives farmers and other stakeholders context for HPAI risk.**



Saltikoff et al. (2019)

Thank you!

mepitesky@ucdavis.edu



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