West Nile Virus Prediction

Predicting WNV in mosquitoes across the city of Chicago

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10/24/2022

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Context

Problem Statement

Given weather, location, and potentially spray data, how can we predict whether or not West Nile Virus (WNV) is present for a given time, location, and species?

Virus Facts

Why be concerned?

- 8 out of 10 - No symptoms
- 1 in 5 people - Febrile illness
- 1 in 50 people - If over 60, severe illness
- 1 in 150 people - Severe central nervous system illness
- No vaccine for West Nile virus!

Source: https://www.cdc.gov/westnile/symptoms/

~53,000

West Nile virus disease cases reported 1999 - 2020

Source: CDC

West Nile virus in Chicago

- September 2001 - First case in Chicago Area
- End 2002 - Illinois records most cases and deaths in USA
- 2004 - Chicago establishes surveillance and control program
- 2005 to now - WNV persists, despite efforts

Source: https://dph.illinois.gov/topics-services/diseases-and-conditions/west-nile-virus.html

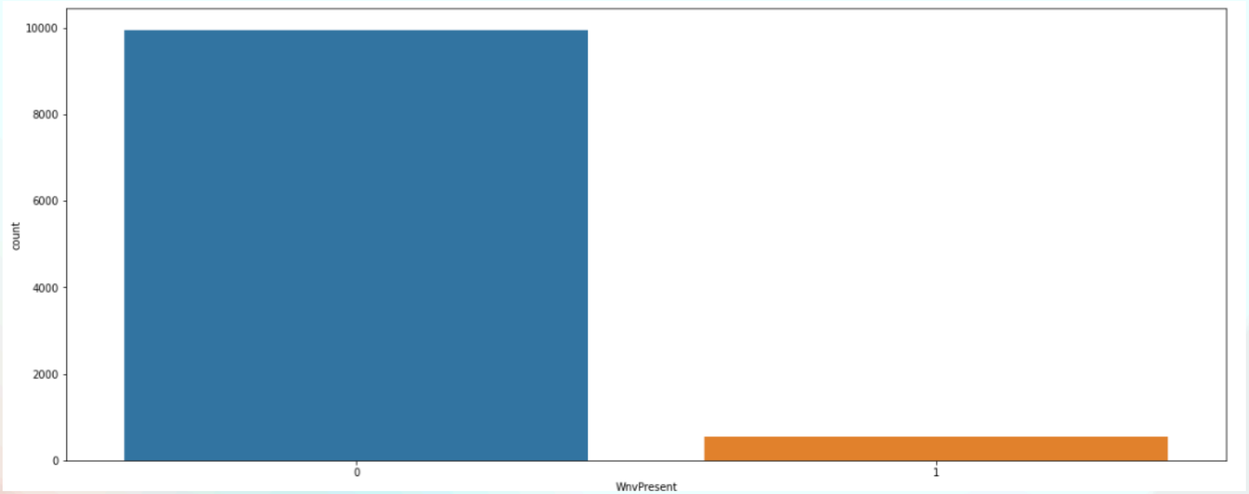
Data

What are we working with?

- Spraying Efforts
- Weather Conditions
- Mosquito Trap Surveillance

Needle in a haystack?

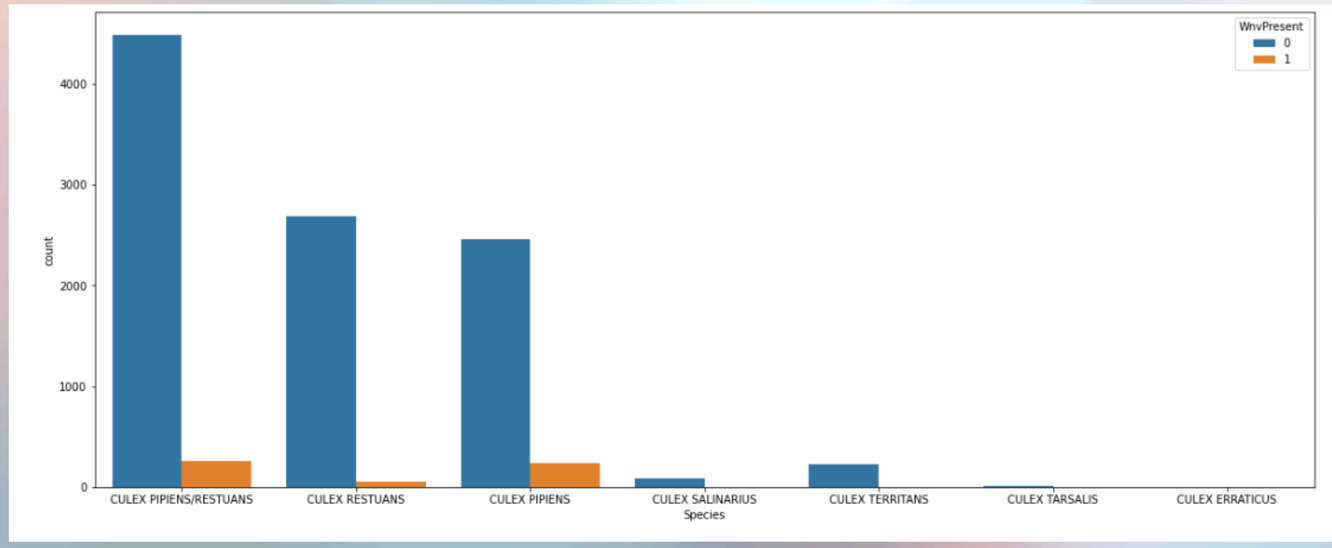
Far more likely to NOT detect West Nile virus!



Repeat offenders….

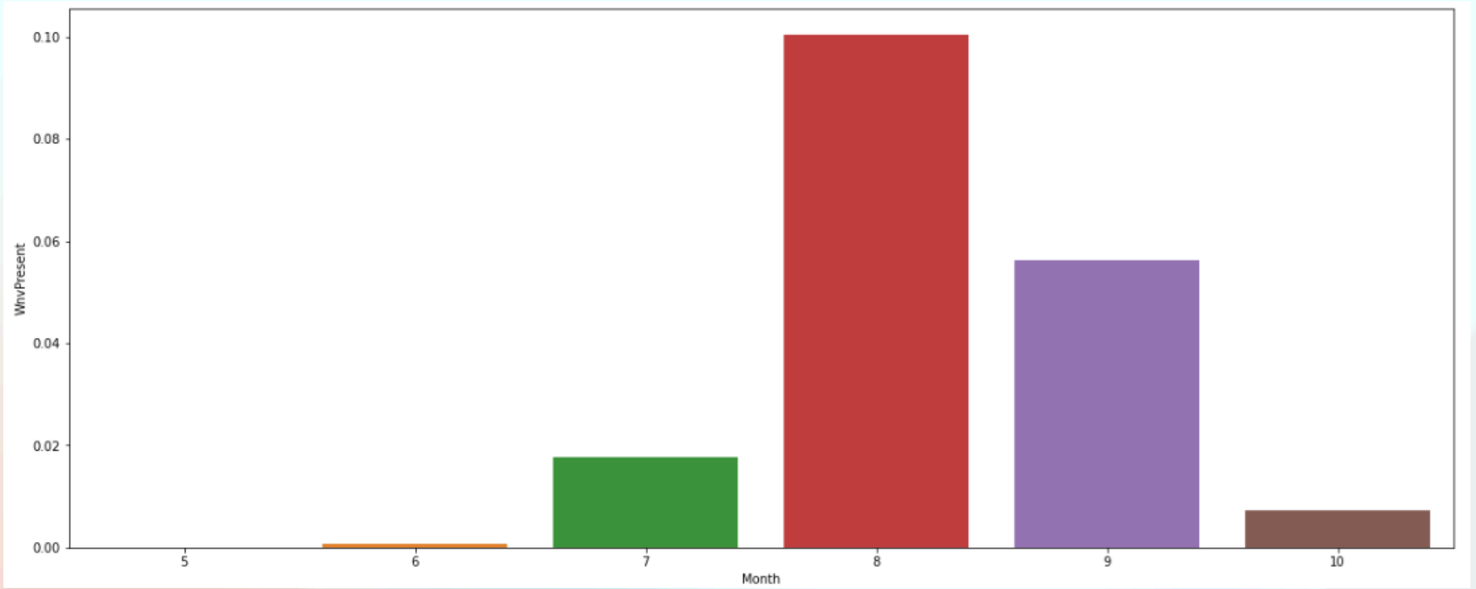
Two species, one hybrid.

Pipiens. Restuans.



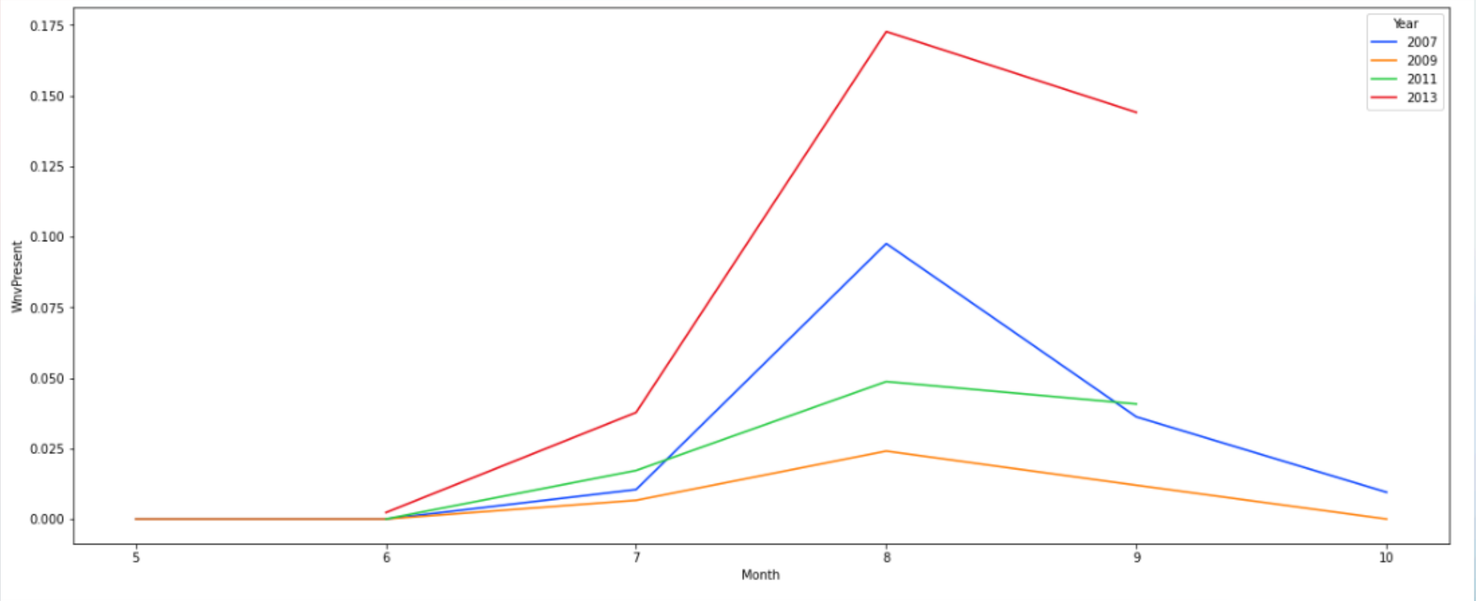
When?

August and September!



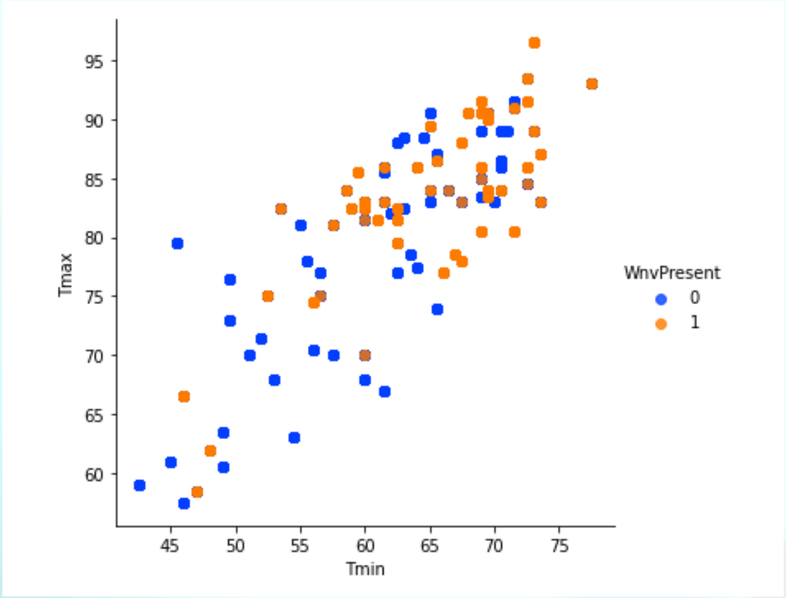
Every year?

Consistently!



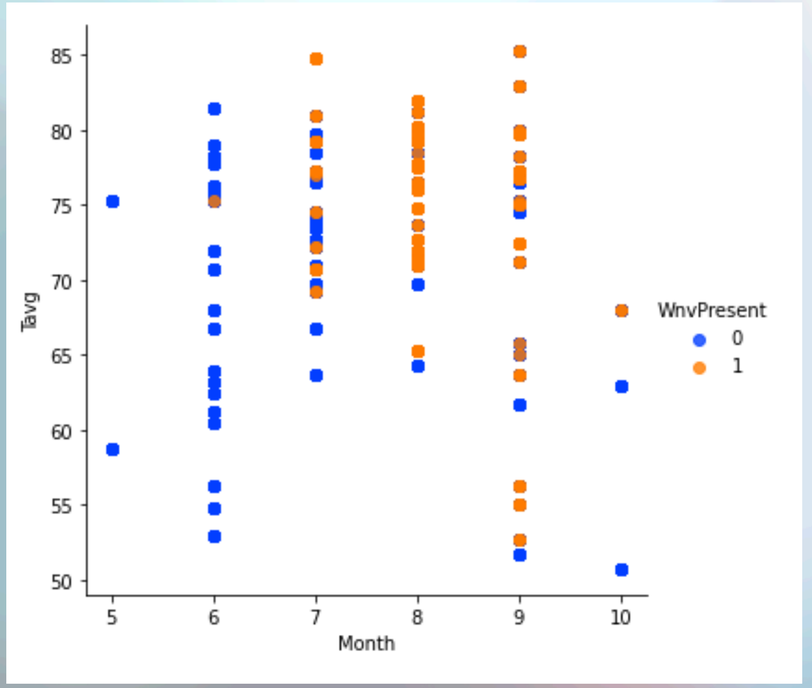
When it’s warm?

As temperature increases, so do instances of West Nile virus.



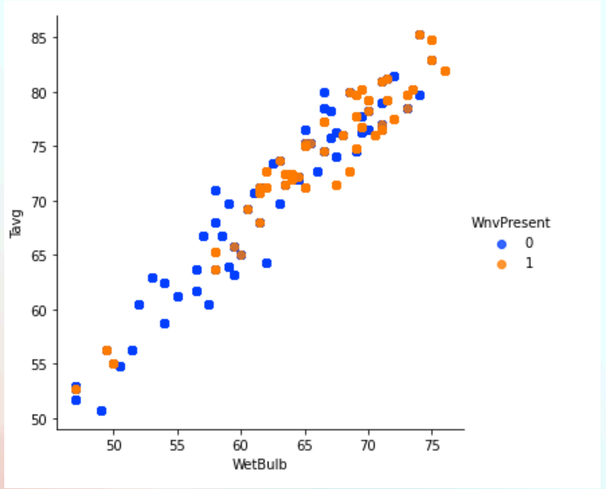
By month?

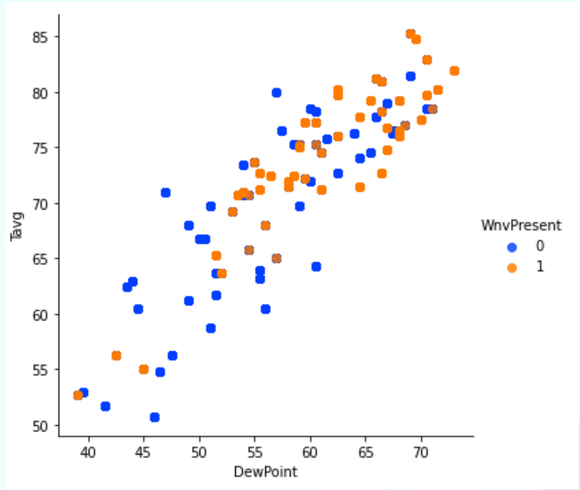
Warmer months see more West Nile virus.



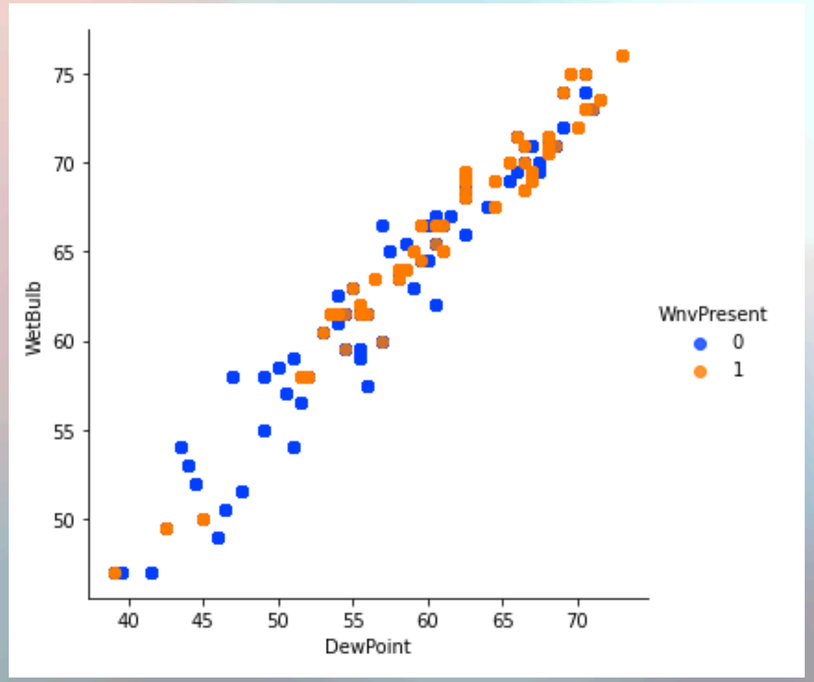
When it’s damp?

There’s something to humidity!





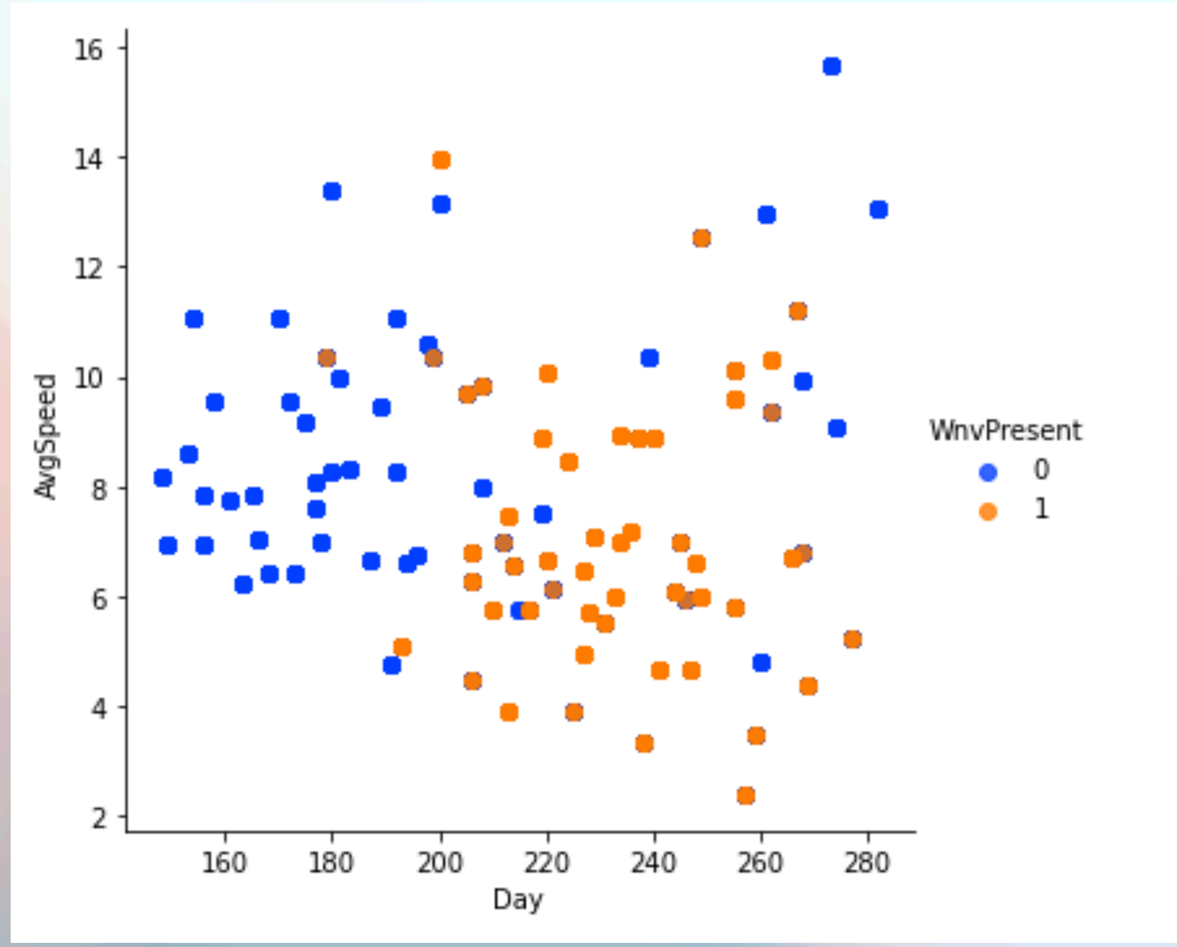
The wetter, the better.



Mosquitoes fly….

Do they like wind?

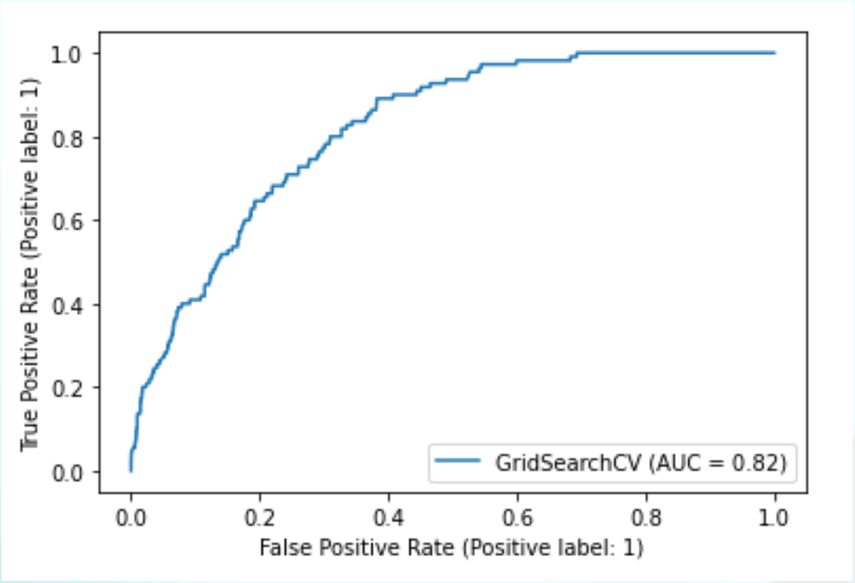
Not so much.

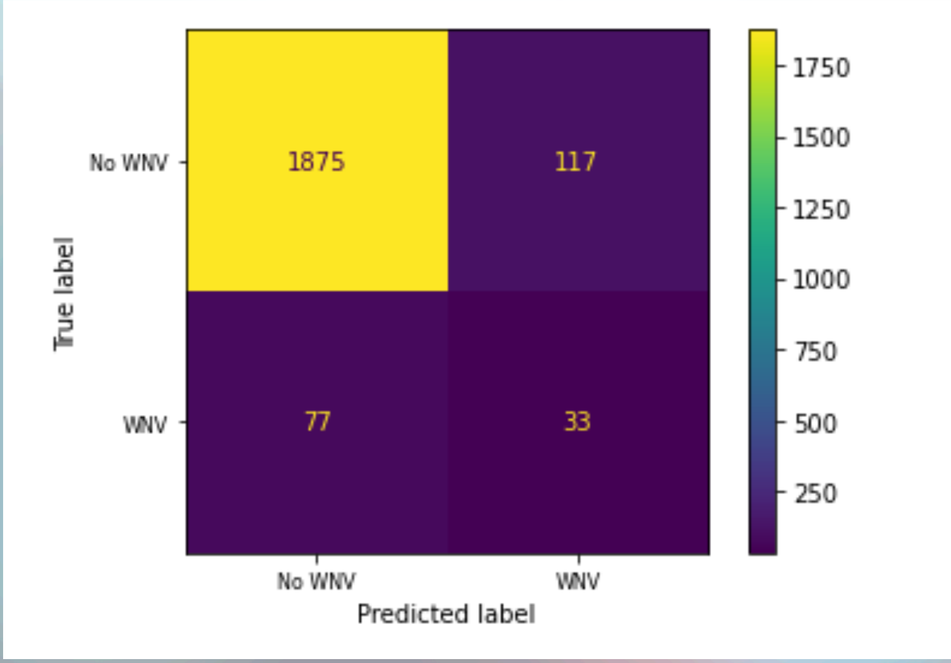


Chosen Model?

Tuned XG Boost!

- Best AUC
- Minimizes false negatives
- Most explainable
- Most potential for further tuning

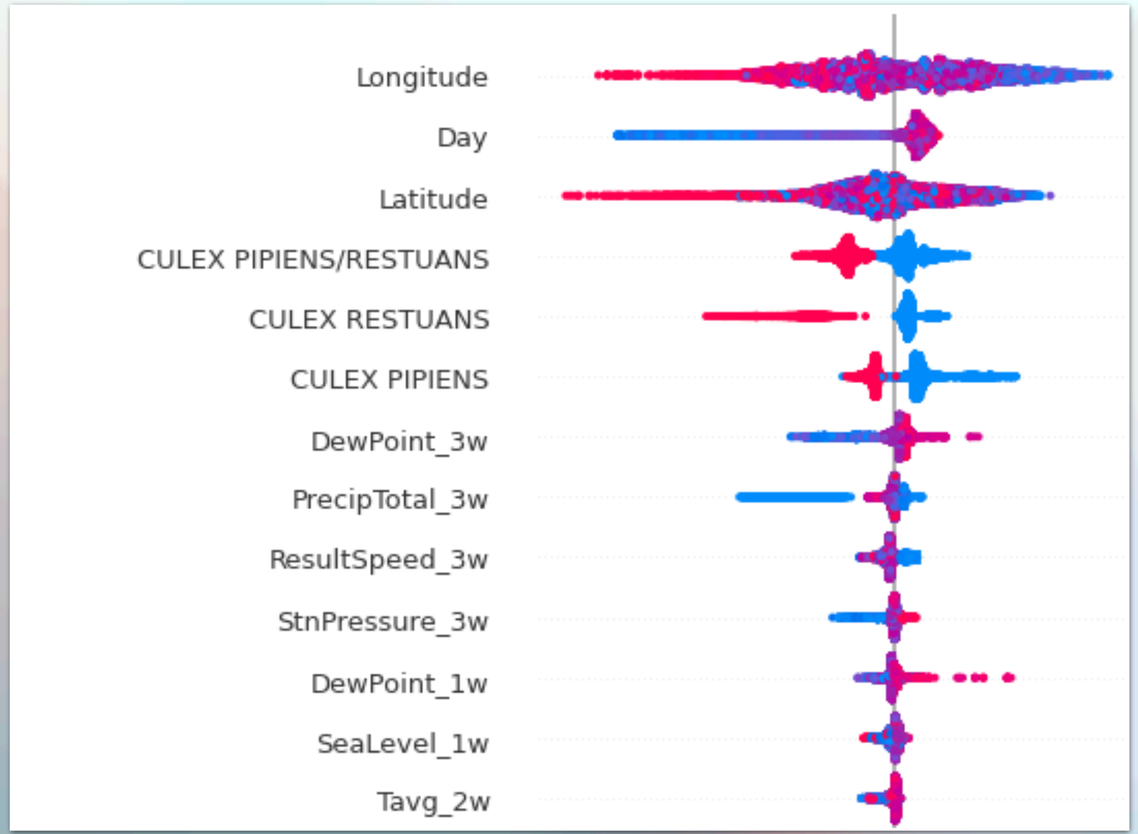




Feature Importance

What has the most impact?

- Location (latitude & longitude)
- Day of the year
- Species
- Lagged moisture features (precipitation, dew point)
- Wind and Temperature



Takeaways

Mosquitoes Like

- Warm or hot weather
- Damp/humid weather (for breeding)
- Dry weather (for seeking a blood meal)
- Low wind

Mosquitoes Dislike

- Cold weather
- Excessive precipitation
- Excessive wind
- Extreme weather conditions in general

Recommendations

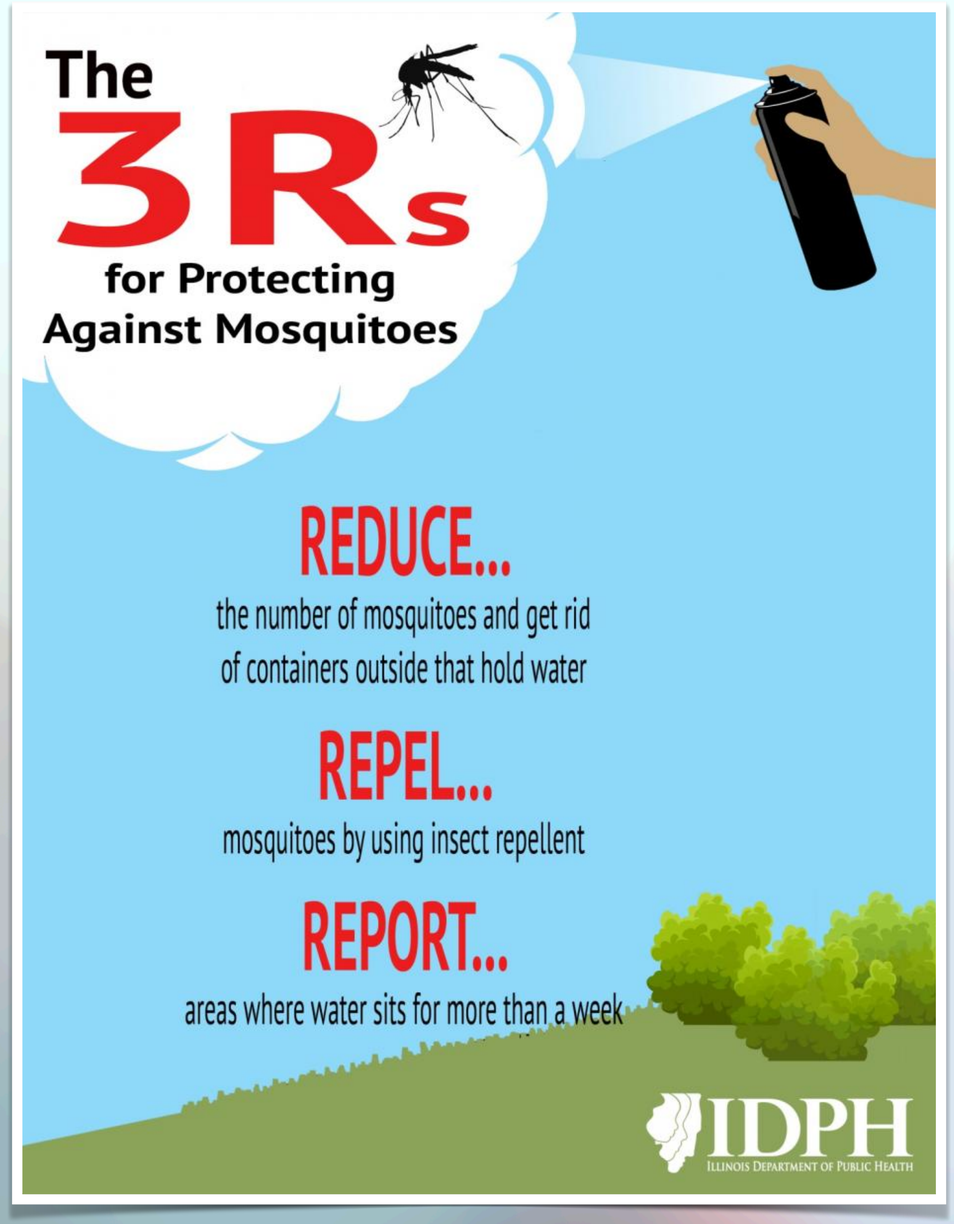
What can we do about it?

- Consider cost-benefit
- Citizens take action
- City government takes action

Citizens Take Action

Encourage best practices

- Remove stagnant water
- Reduce potential for stagnant water
- Remove overgrowth
- Use repellant
- Wear long sleeve tops and pants
- Report bad conditions



Government Takes Action

Facilitate Prevention

- Educate citizens
- Spray suspected hotspots
- Identify & eliminate stagnant water
- Identify & eliminate overgrowth
- Distribute repellant
- Offer mosquito maintenance to citizens