

THE
WEST NILE VIRUS
ANALYSIS

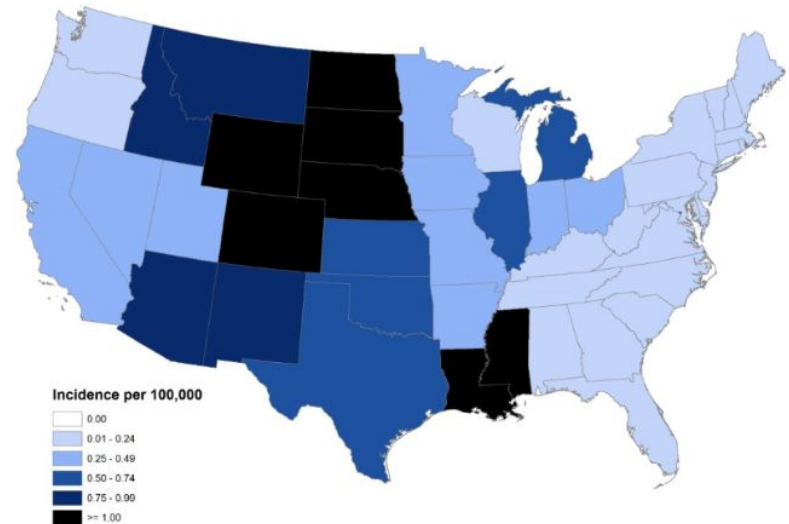
EVONNE, RONG, GRAHAM

About West Nile Virus



Average annual incidence of West Nile virus neuroinvasive disease reported to CDC by state, 1999-2015

- WNV is a zoonotic disease
- Bite of an infected mosquito
- First emerged in Eastern U.S in 1999
- At least 50,830 Infections, 2,330 Deaths (As of 2018)



Source: ArboNET, Arboviral Diseases Branch, Centers for Disease Control and Prevention

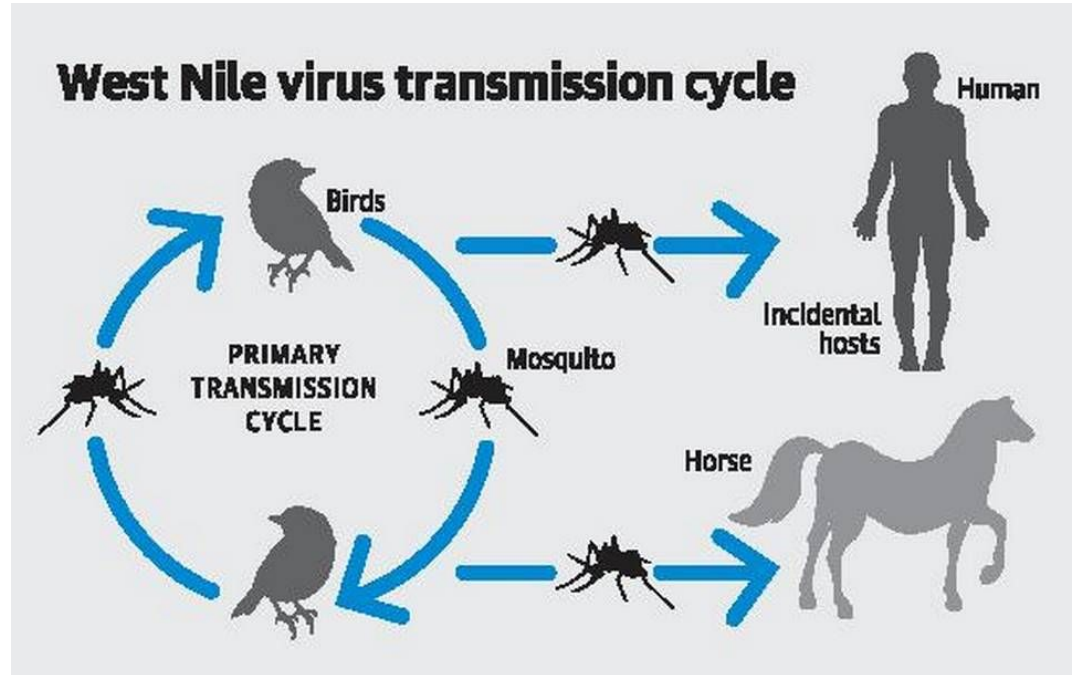
About West Nile Virus (Cont.)



Mosquitos are WNV Vectors

It is leading cause of mosquito-borne disease in the continental United States.

- Fatal neurological diseases
- 80% show no symptoms
- No vaccines available for human



In Chicago..



- Year 2002: 225 infections
- Highest nationwide infections and deaths in the same year.
- Chicago Department of Public Health (CDPH) implemented city- wide surveillance and mosquito control measures

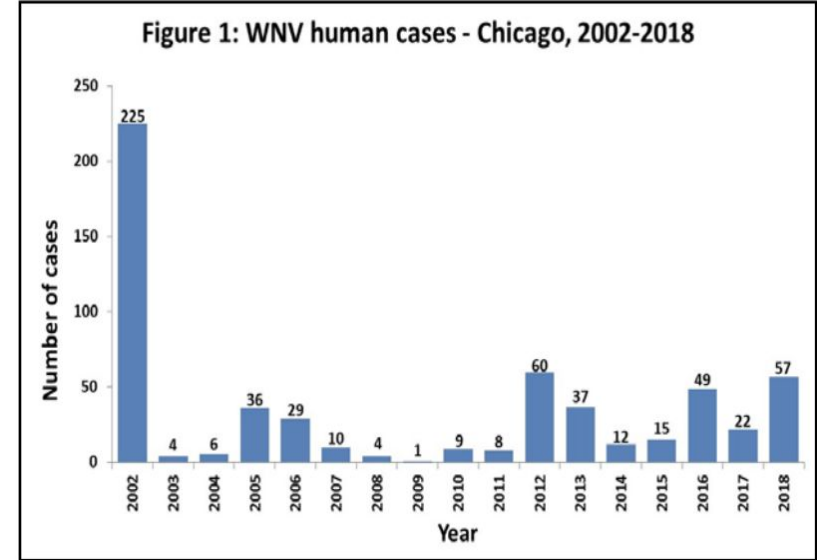


Image source: Healthy Chicago Data Brief West Nile Virus
(https://www.chicago.gov/content/dam/city/depts/cdph/food_env/general/West_Nile_Virus/WNV_2018databrief_FINALJan102019.pdf)



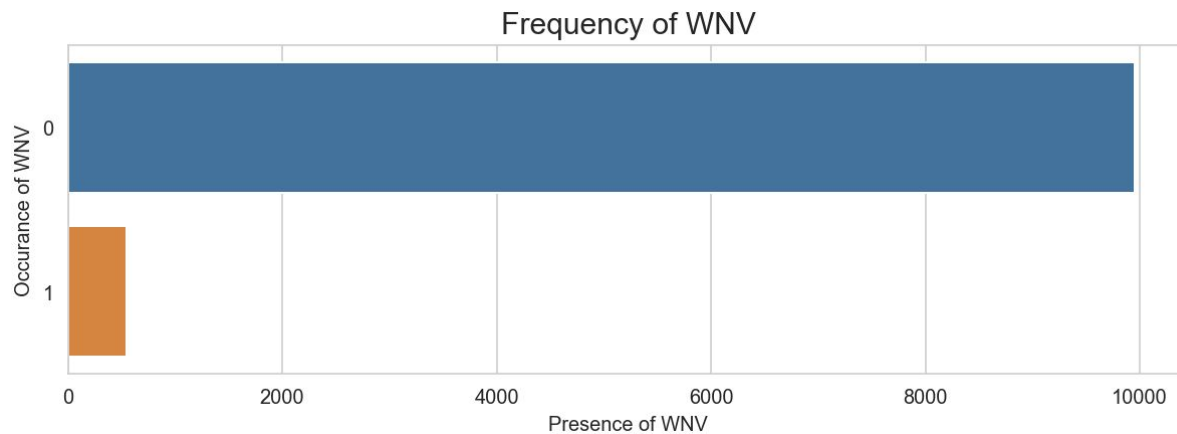
Defining Problem

How can we better predict the WNV in mosquitos to help the City of Chicago and CPHD more efficiently and effectively allocate resources towards preventing transmission of this potentially deadly virus.

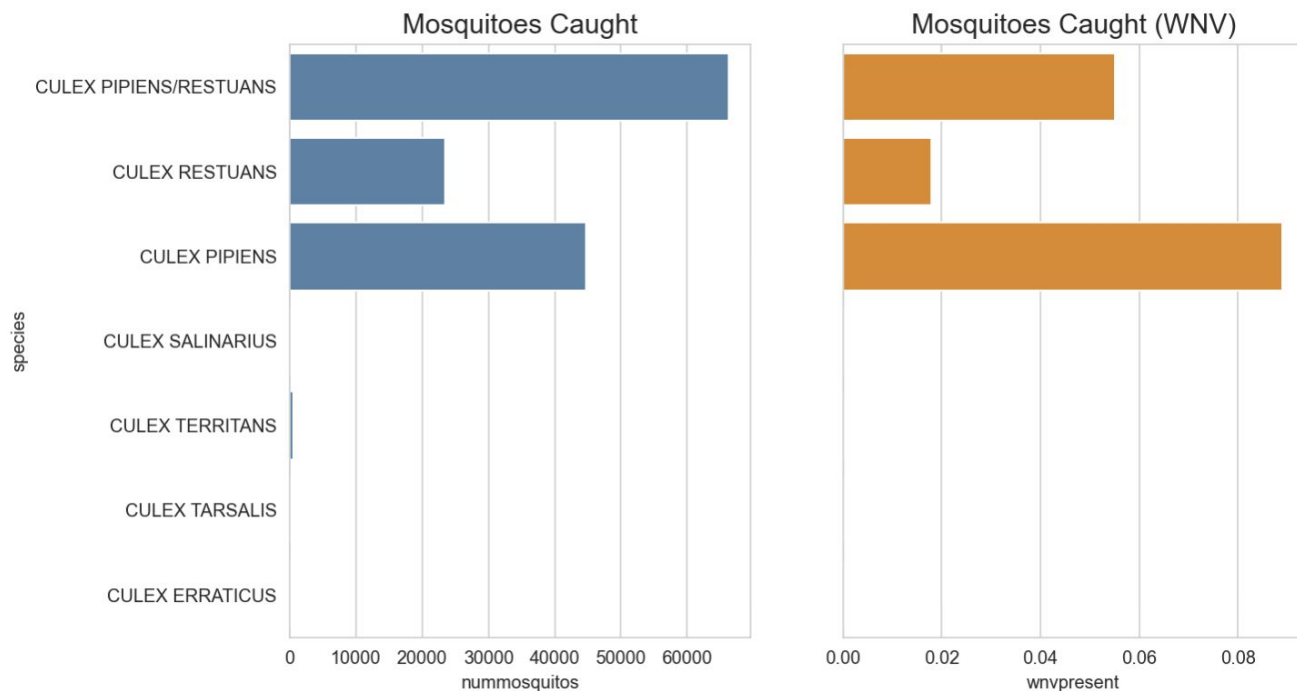
Datasets

- The training set: data from 2007, 2009, 2011, and 2013
 - used to predict test results from the test for 2008, 2010, 2012, and 2014.
- Chicago's weather condition from 2007 - 2014 during the months or mosquito testing
- The city of Chicago's GIS for their spray effort in 2011 and 2013

Imbalanced Data



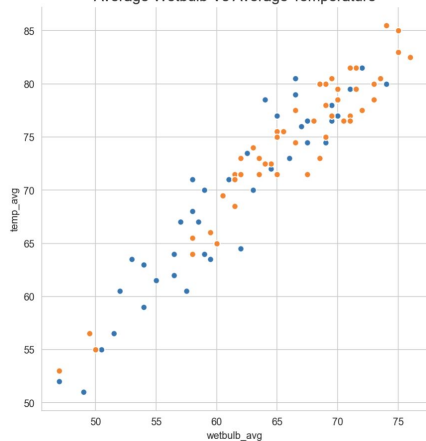
Species with WNV



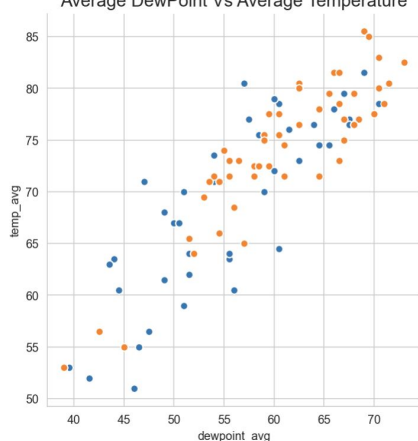
Conditions for WNV Mosquito



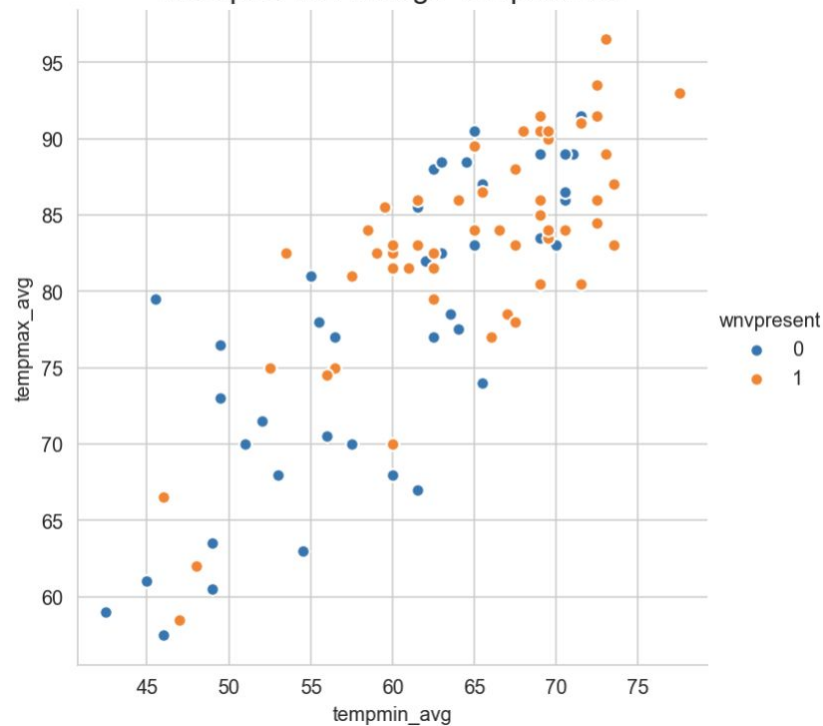
Average Wetbulb Vs Average Temperature



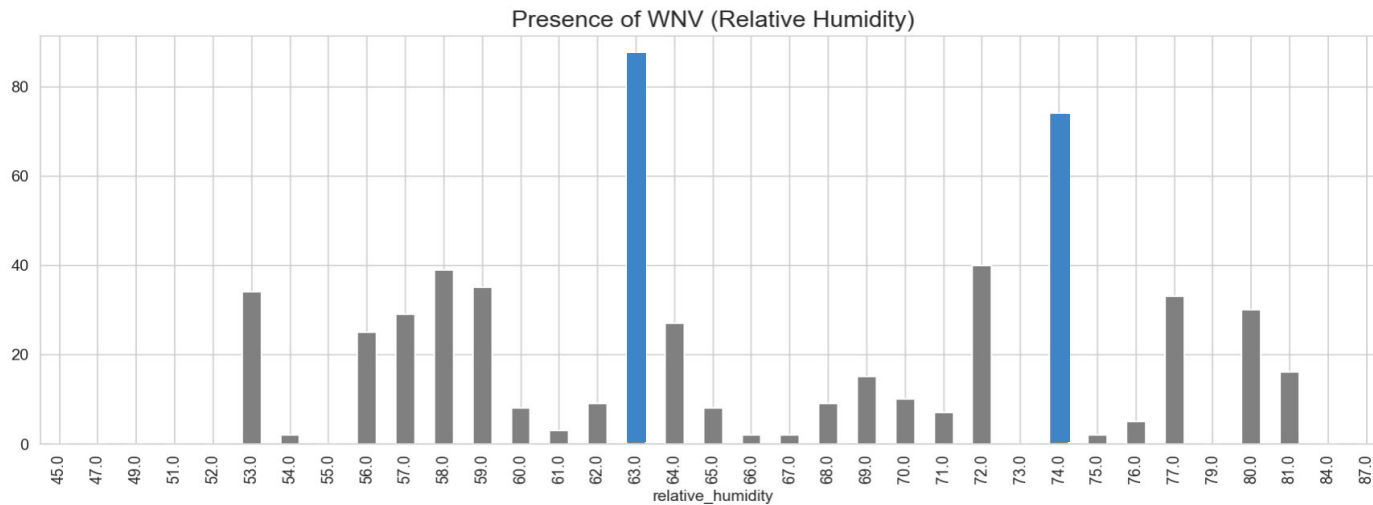
Average DewPoint Vs Average Temperature



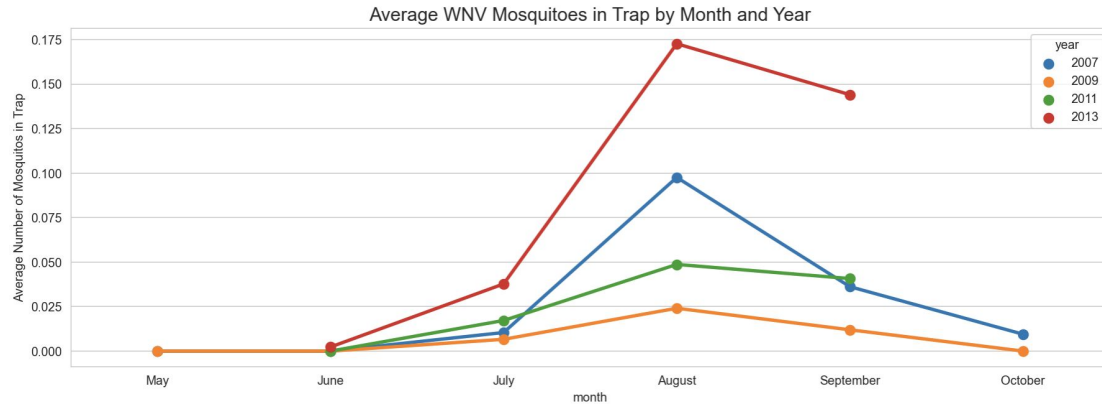
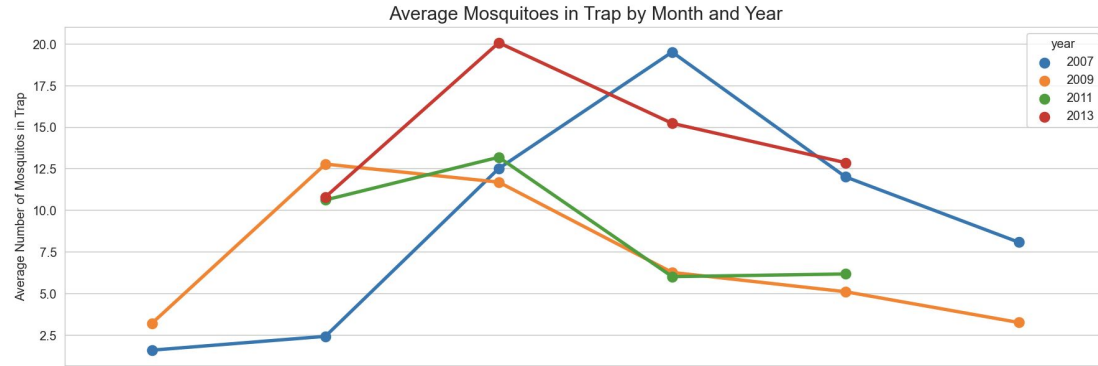
Mosquito Vs Average Temperature



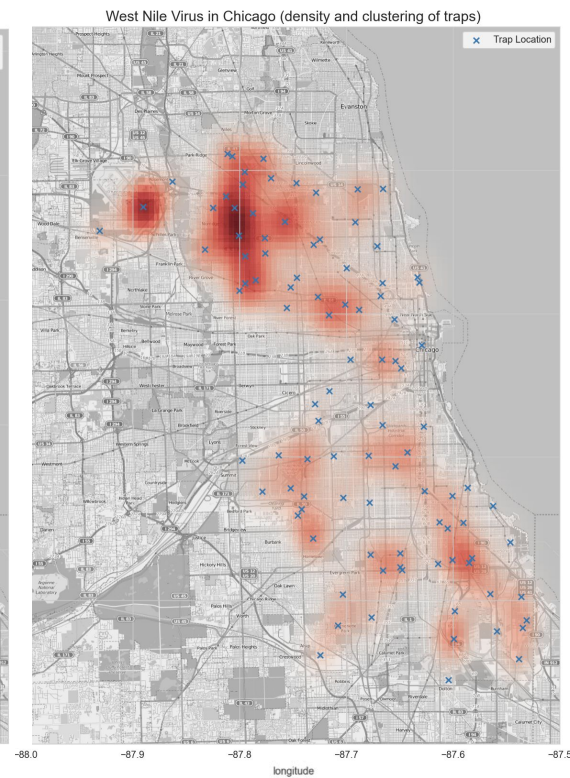
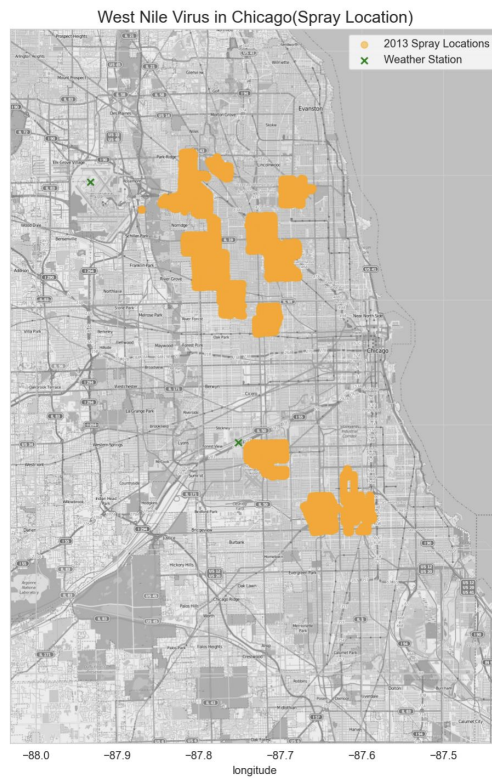
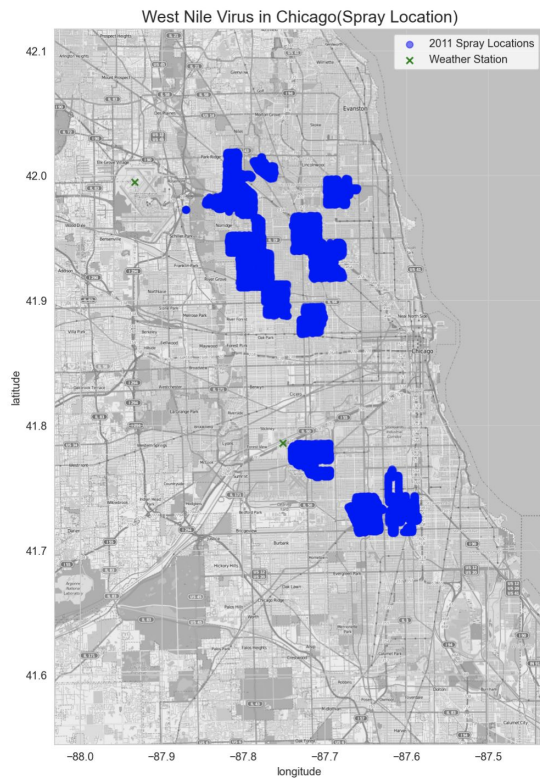
Humidity Triggers for WNV



Season of Highest Infection



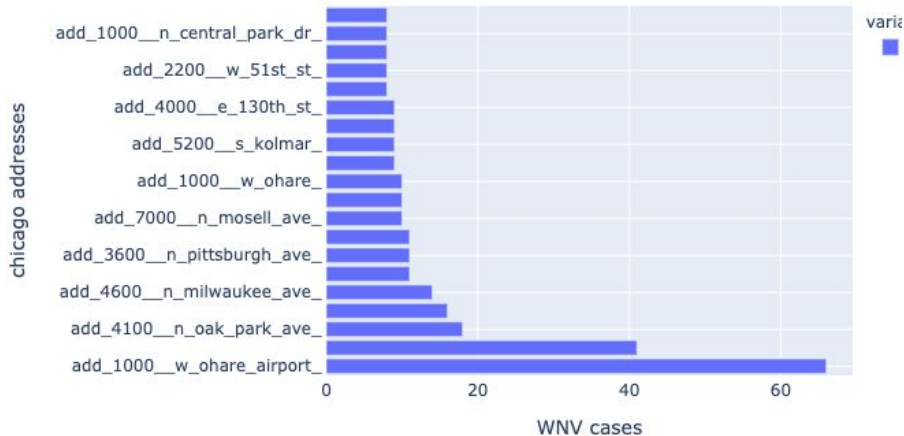
Spray



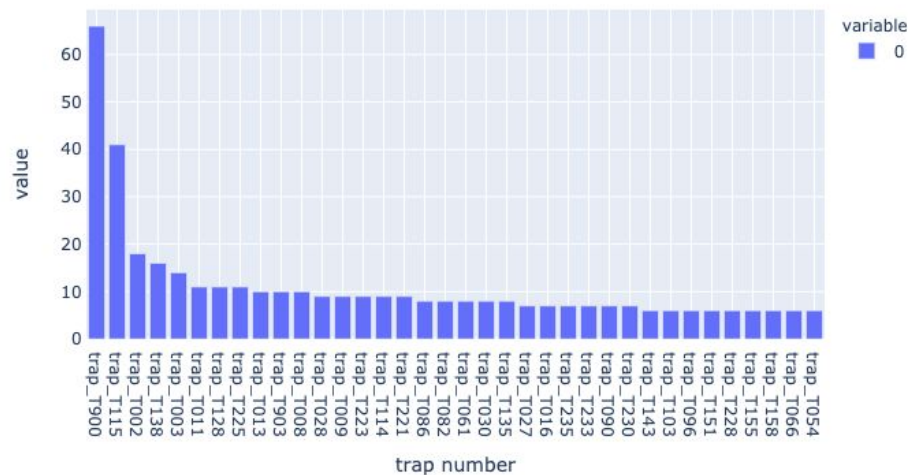
Feature Engineering Results



Top Addresses with WNV cases



Top Traps that are WNV Positive

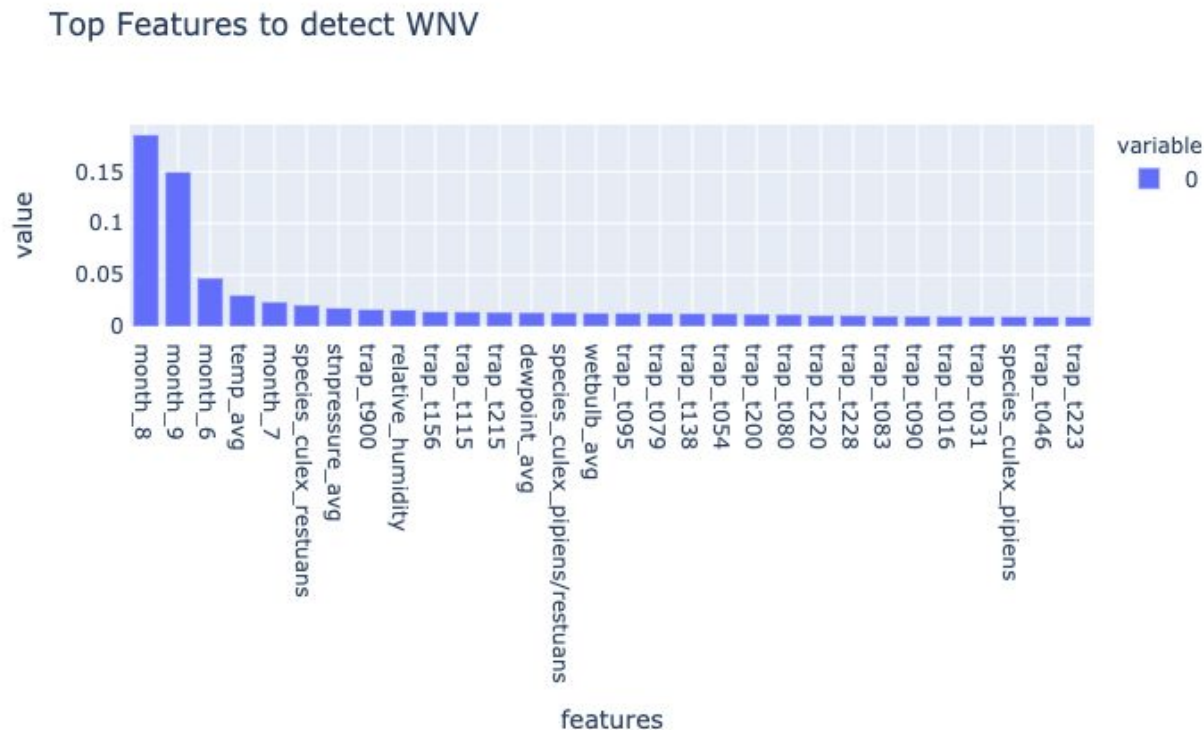


Final Model Evaluation



	train_score	val_score	gs.best_score_	auc	f1_score	precision	recall	test_score	auc_cross_val_score
K-Nearest Neighbours	0.9256	0.6675	0.7017	0.5074	0.0339	0.2222	0.0183	NaN	NaN
Random Forests	0.9240	0.7976	0.8353	0.5000	0.0000	0.0000	0.0000	NaN	NaN
Gradient Boosting	0.8822	0.7872	0.8288	0.5041	0.0179	0.3333	0.0092	NaN	NaN
XGB	0.8906	0.7896	0.8317	0.7133	0.1932	0.1107	0.7615	NaN	NaN
Support Vector Machine	0.9261	0.7697	0.8175	0.6933	0.2063	0.1232	0.6330	NaN	NaN
XGB Production Model on Recombined Train Set	0.7048	NaN	NaN	0.7378	0.2134	0.1236	0.7818	0.6984	0.8181

Best Model Features





Cost Benefit Analysis 2020 - Assumptions

- Assume 229 *human* WNV cases
- 2012 economic and medical costs = USD 6,888 (Mild) and USD 47,745 (Severe)
- 72% will suffer from WNV Mild, and 28% will suffer WNV Severe

Cost Benefit Analysis 2020 - Don't Spray



Chicago Would Lose ~

4,762,871.21 USD

if 229 human WNV cases arose in 2020.

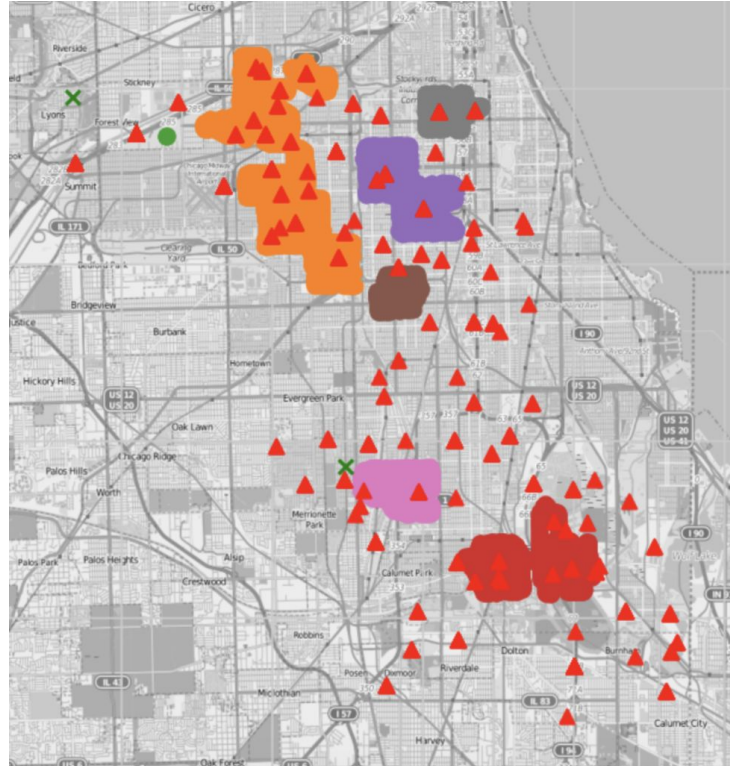
Cost Benefit Analysis 2020 - Spray (and Pray)



Pesticide Spraying would cost ~

928,399.00 USD

and needs to prevent 44.6 cases to breakeven in 2020.





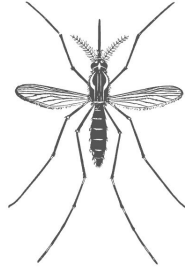
Cost Benefit Analysis 2020 - Recommendations

- Re-target the gaps in coverage - specific location WNV clusters around traps/addresses
- Intensify Spraying between June - September
- Preventative Campaigns

Cost Benefit Analysis 2020 - Limitations and Going Forward



- **COVID-19**
- Surveillance Tech
- Demographic Segmentation



THANK YOU!

Questions?

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Reference:



https://www.chicago.gov/content/dam/city/depts/cdph/food_env/general/West_Nile_Virus/WNV_2018databrief_FINALJan102019.pdf

<https://www.cdc.gov/westnile/statsmaps/cumMapsData.html>

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[https://naturalunseenhazards.wordpress.com/2010/09/17/west-nile-virus-reports-from-arizona-6-fatalities-california-2-including-1-fatality-colorado-1-fatality-connecticut-illinois-indiana-nevada-new-jersey-1-fatality-new-york-pennsylvania/#:~:text=should%20take%20comm on%20sense%20precautions,catch%20basins%20\(storm%20sewers\).](https://naturalunseenhazards.wordpress.com/2010/09/17/west-nile-virus-reports-from-arizona-6-fatalities-california-2-including-1-fatality-colorado-1-fatality-connecticut-illinois-indiana-nevada-new-jersey-1-fatality-new-york-pennsylvania/#:~:text=should%20take%20comm on%20sense%20precautions,catch%20basins%20(storm%20sewers).)