

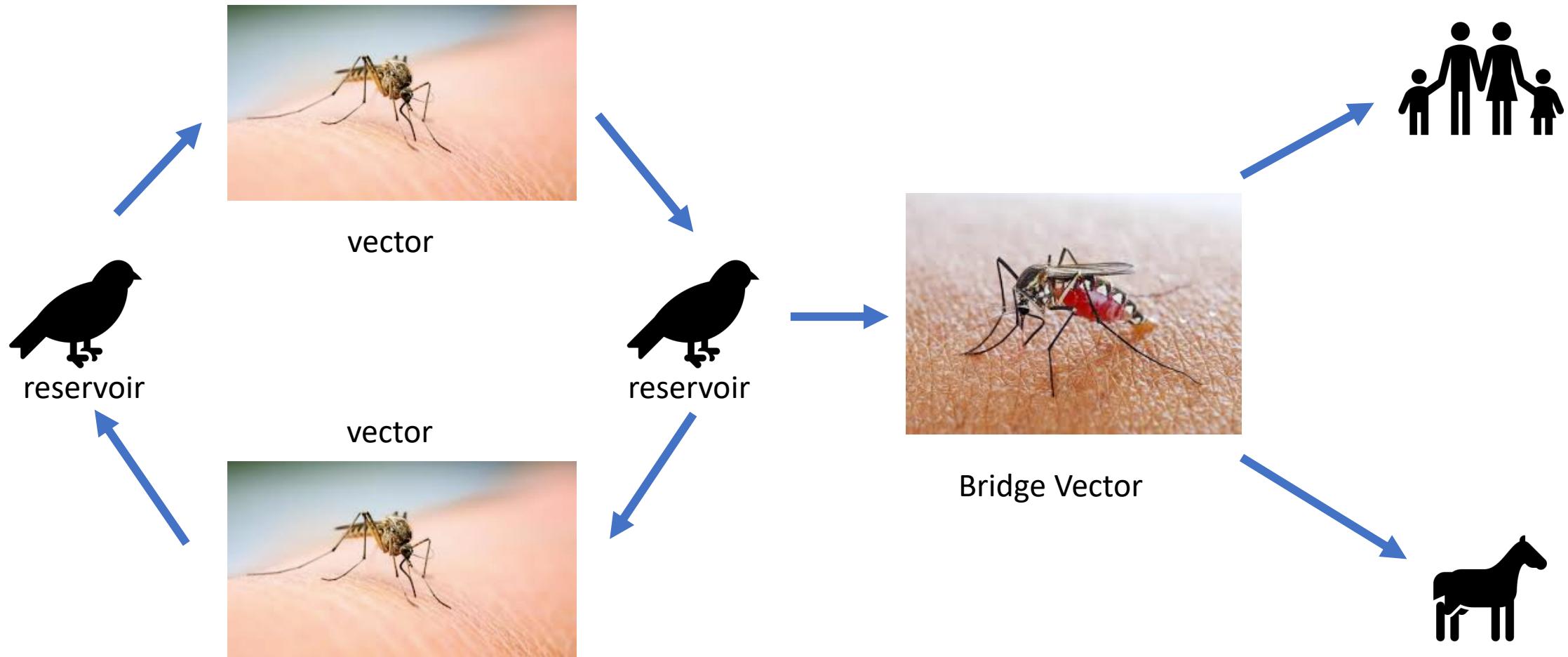
Eastern Equine Encephalitis: 2019 Outbreak or Outlier

David Chung
NSS Data Analytics Cohort 1

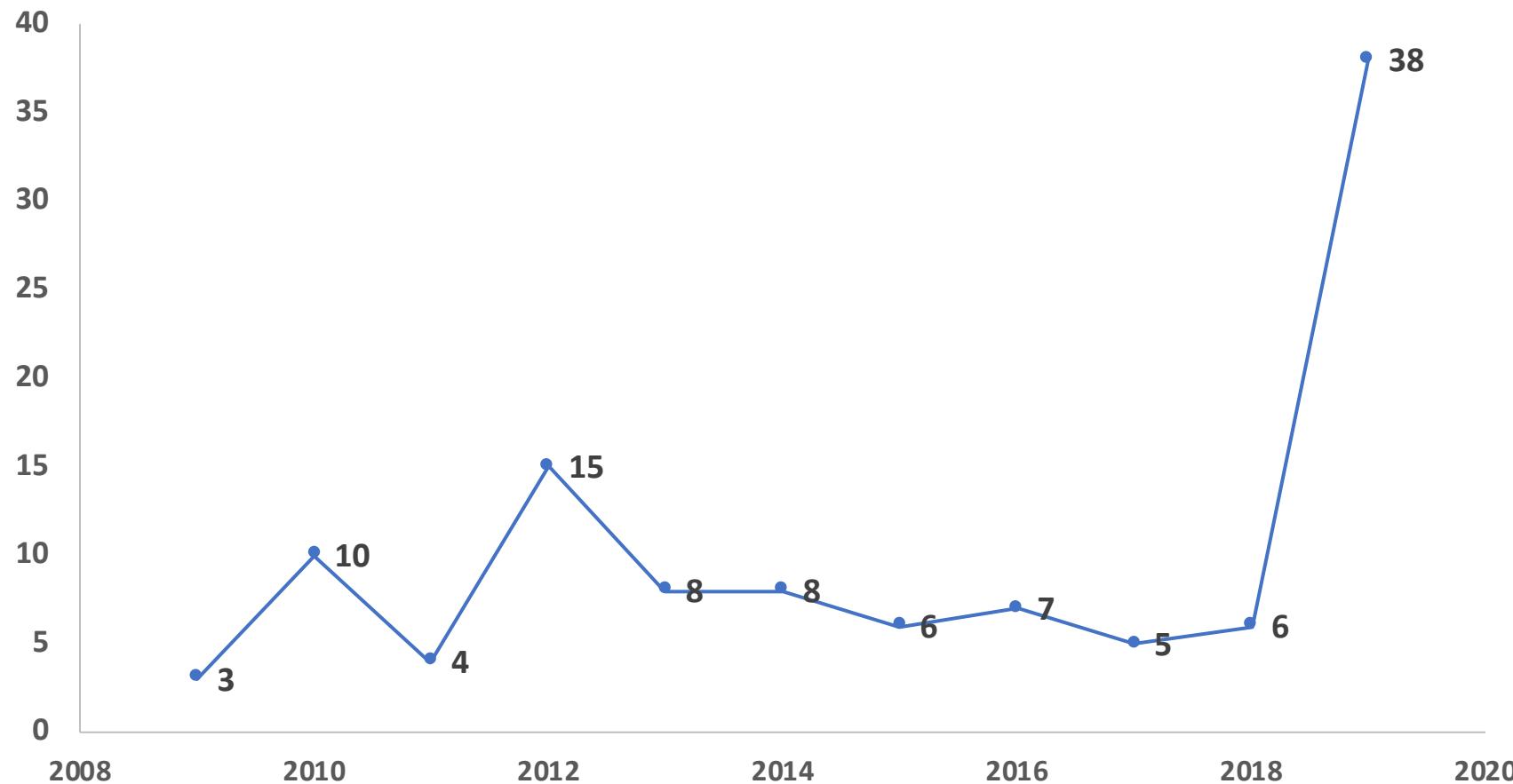
Eastern Equine Encephalitis (EEE)

- ❑ EEE virus is a rare cause of brain infections (encephalitis).
- ❑ Only a few cases are reported in the United States each year.
- ❑ Approximately 30% of people with EEE die and many survivors have ongoing neurologic problems.

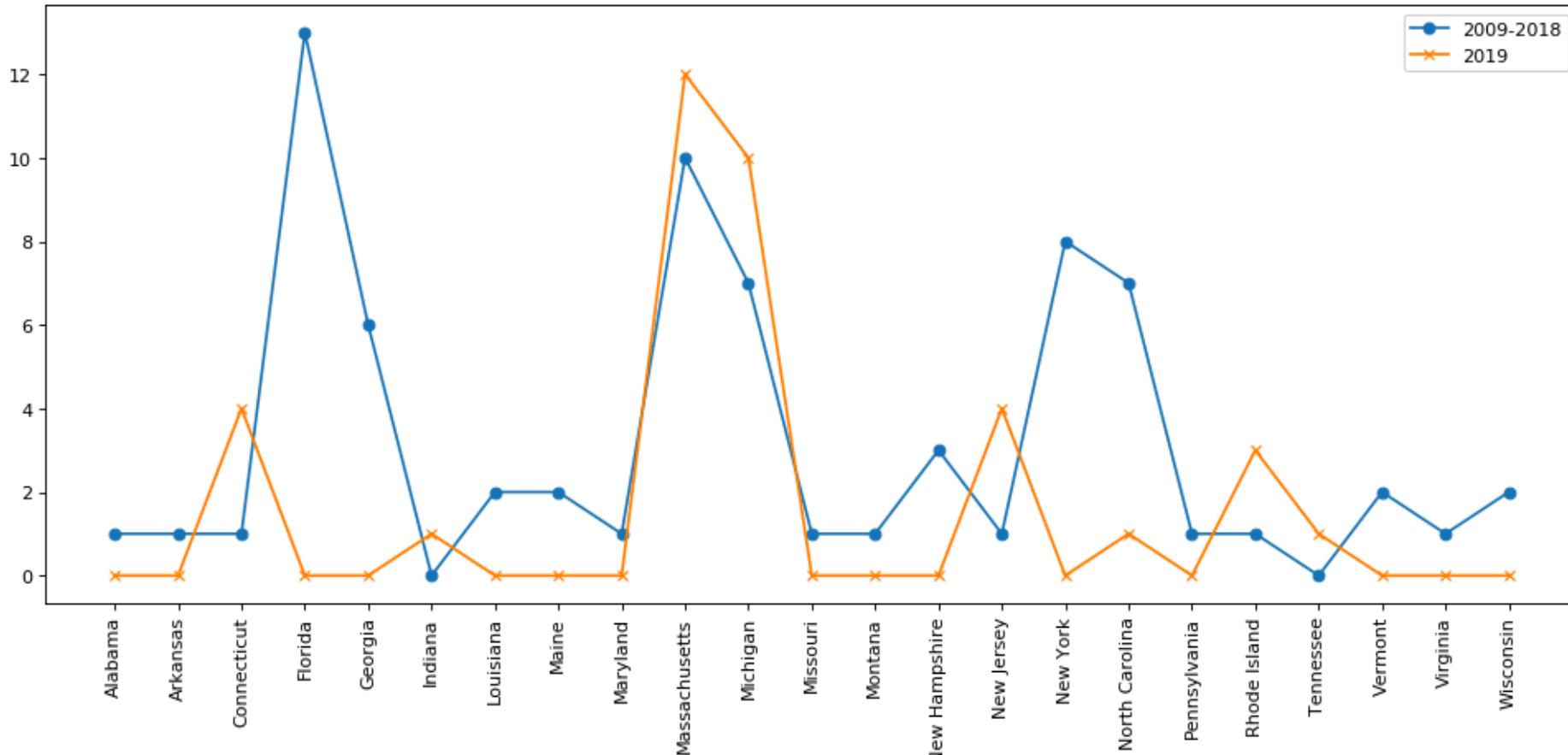
Eastern Equine Encephalitis Transmission Cycle



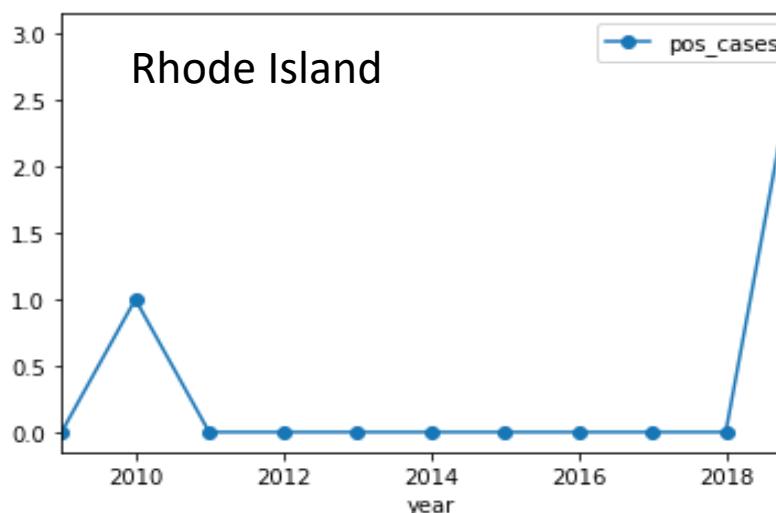
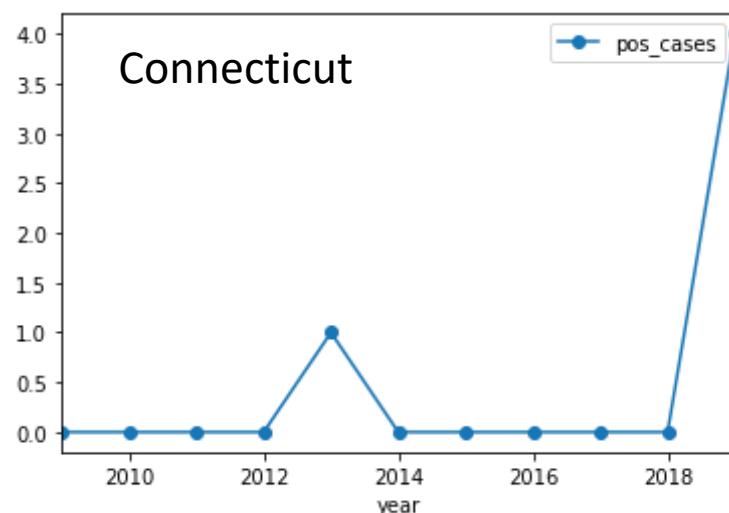
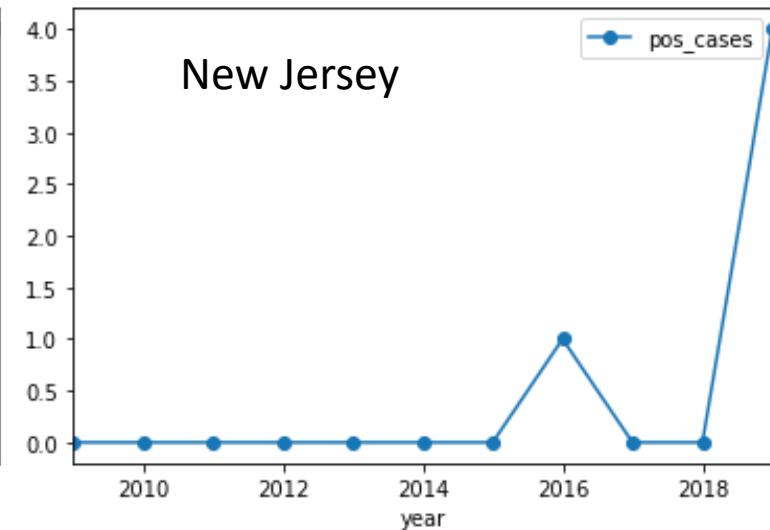
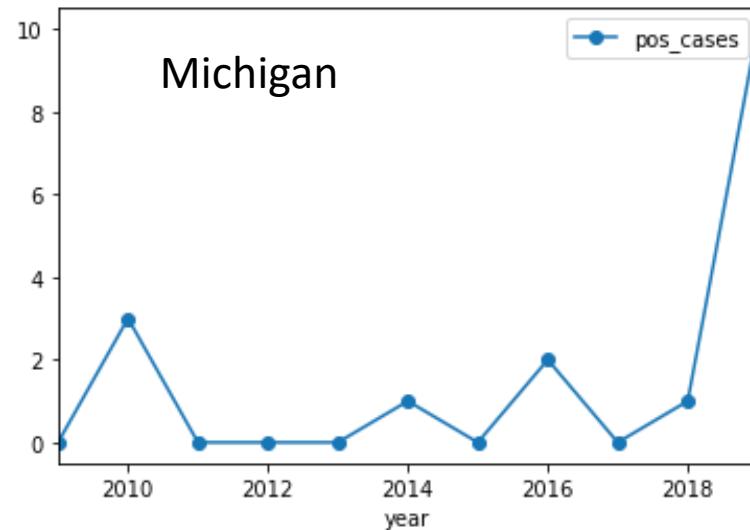
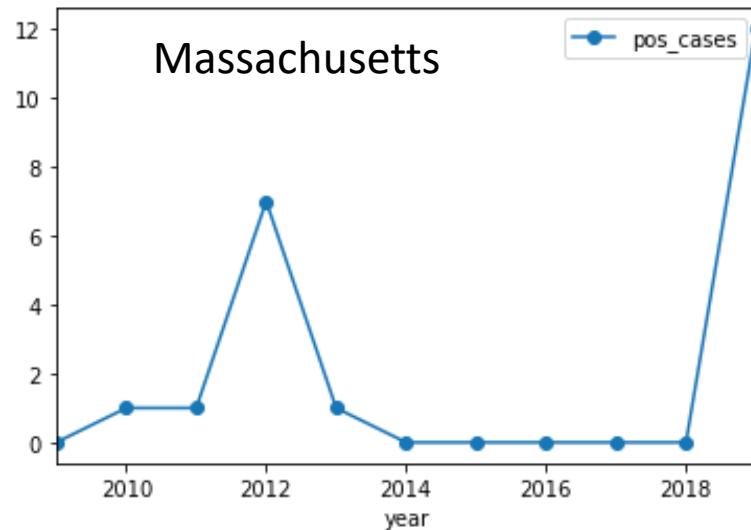
Human EEE cases in US 2019



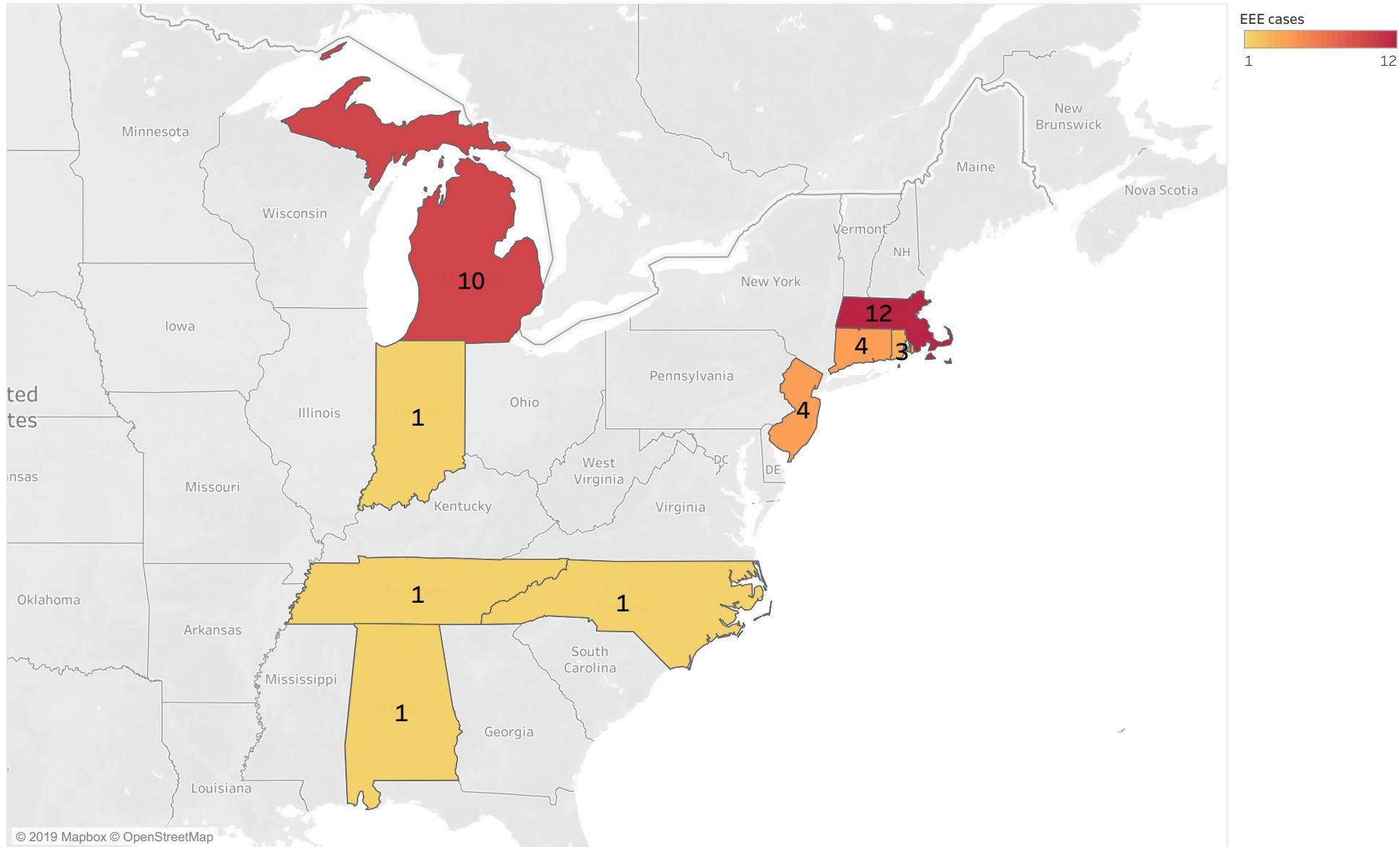
Comparison of EEE cases between 2019 and 2009-2018



Top 5 States of Human EEE cases in 2019

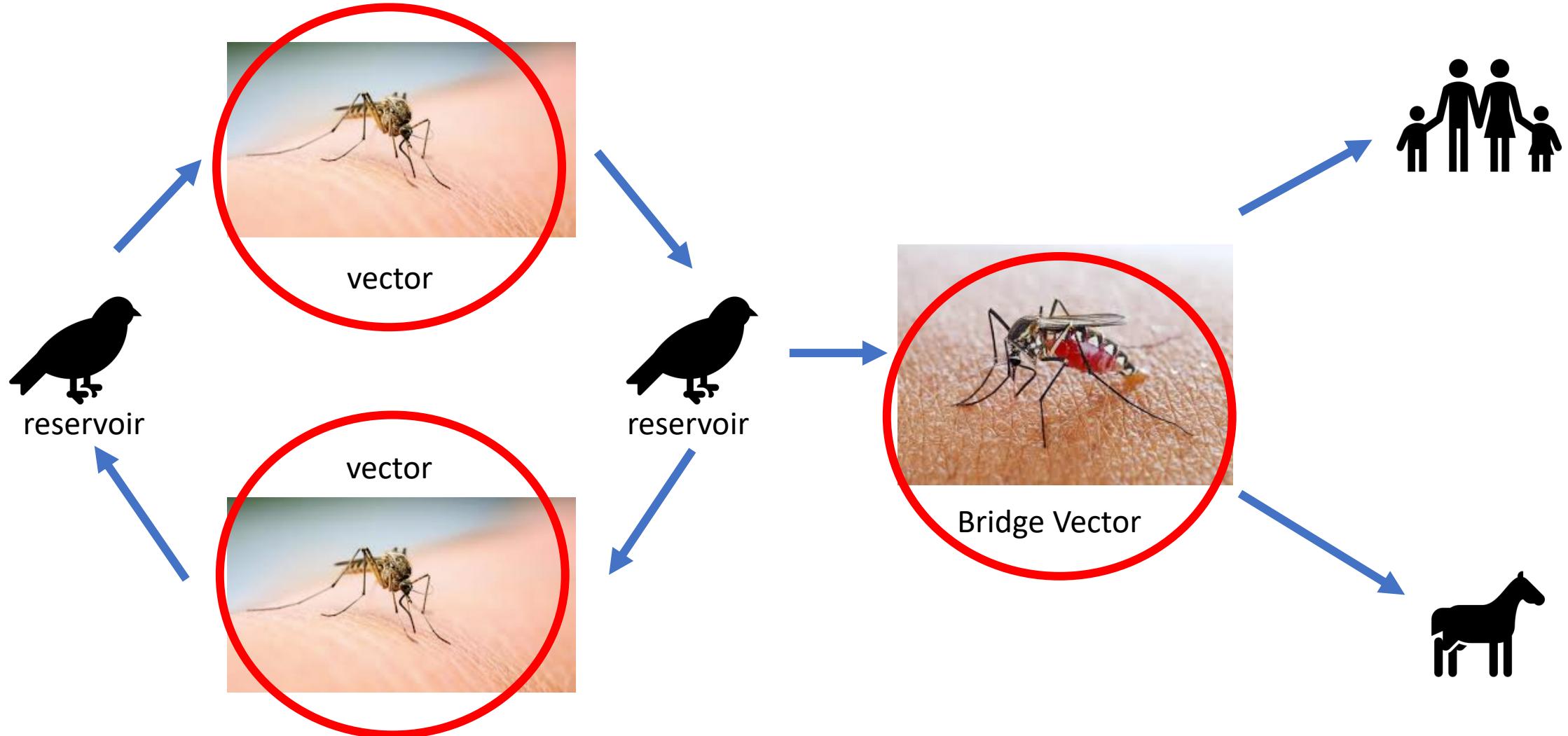


Human EEE cases in 2019

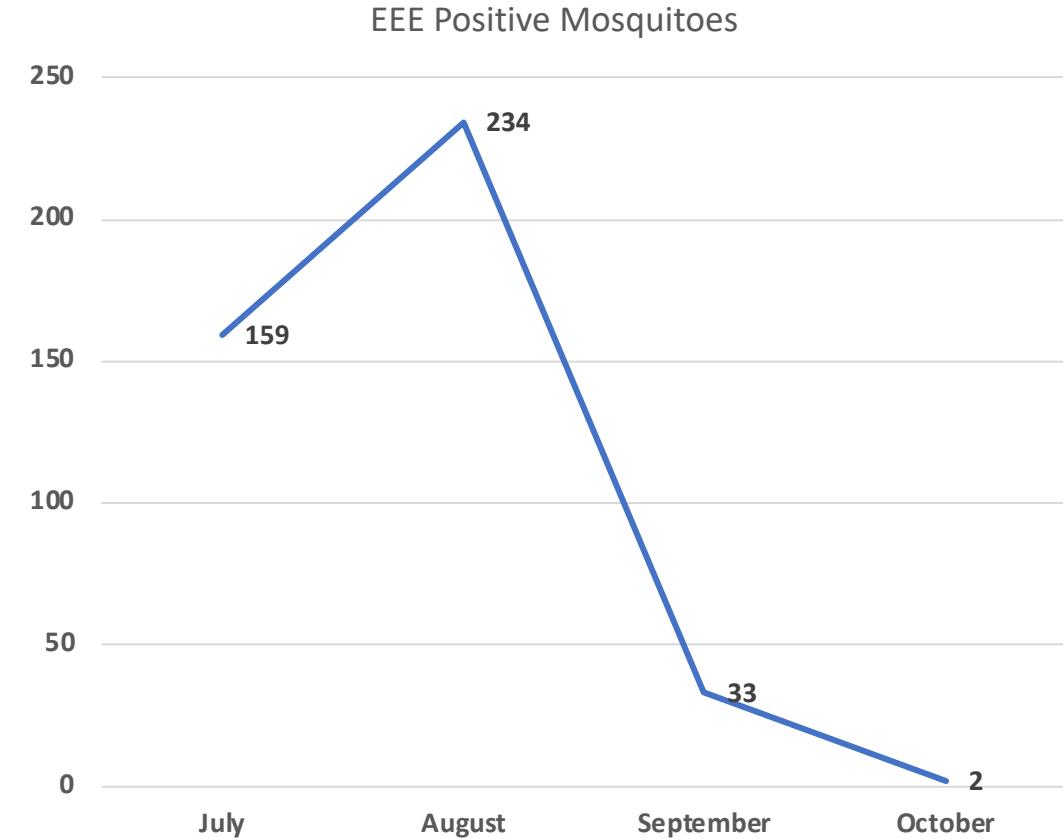
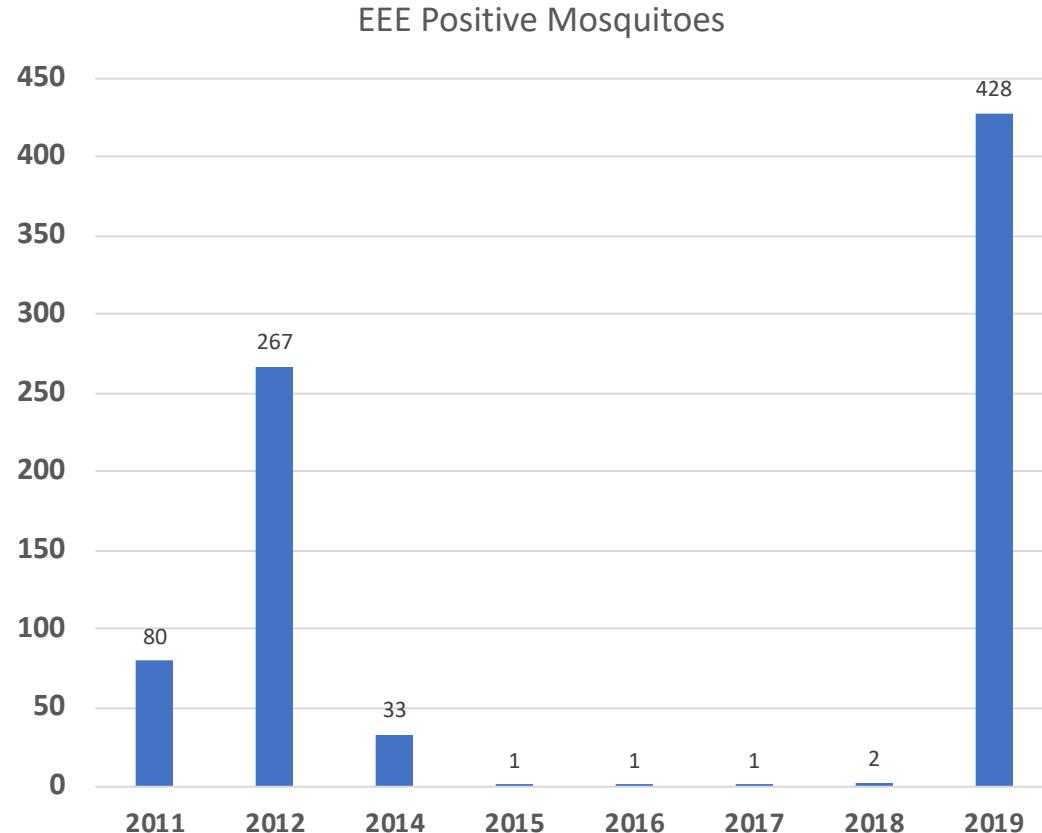


What is the Link between Michigan and Massachusetts (Northeast States)?

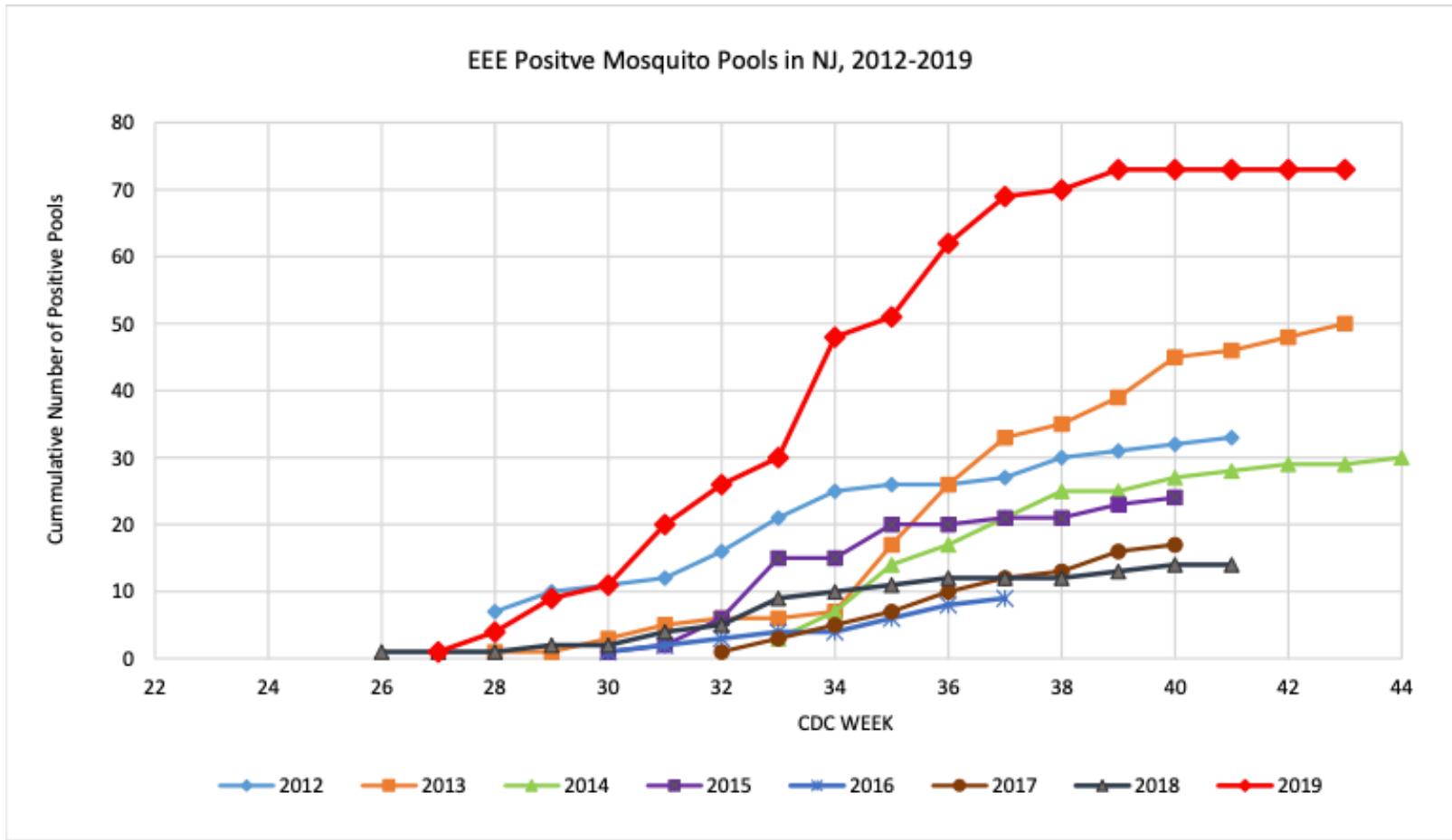
Eastern Equine Encephalitis Transmission Cycle



EEEV Positive Mosquitoes in Massachusetts

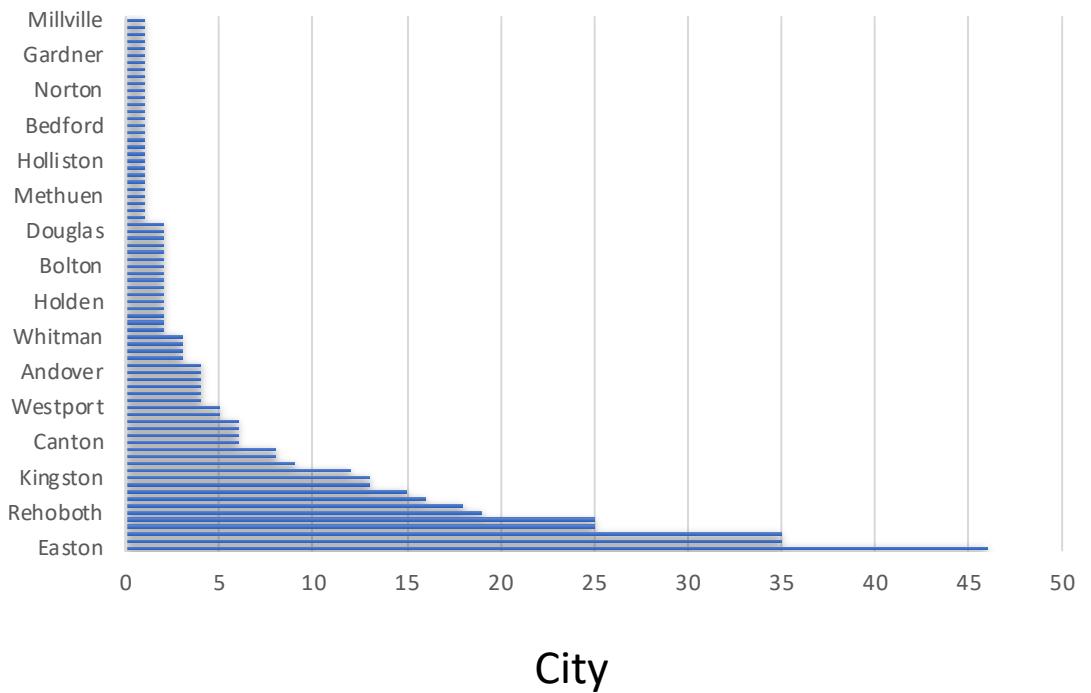
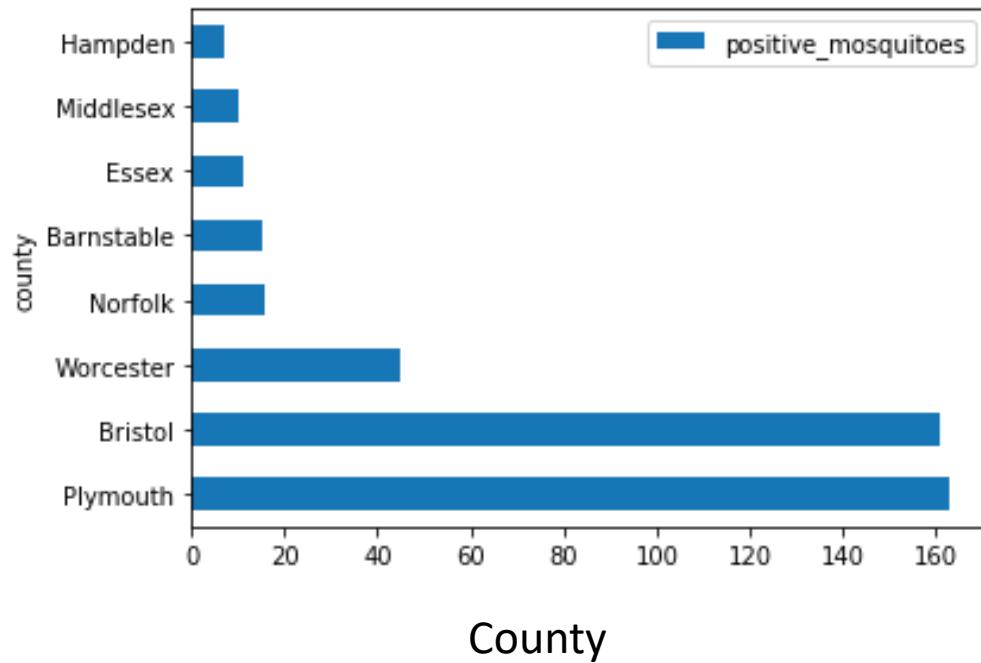


EEEV Positive Mosquitoes in New Jersey

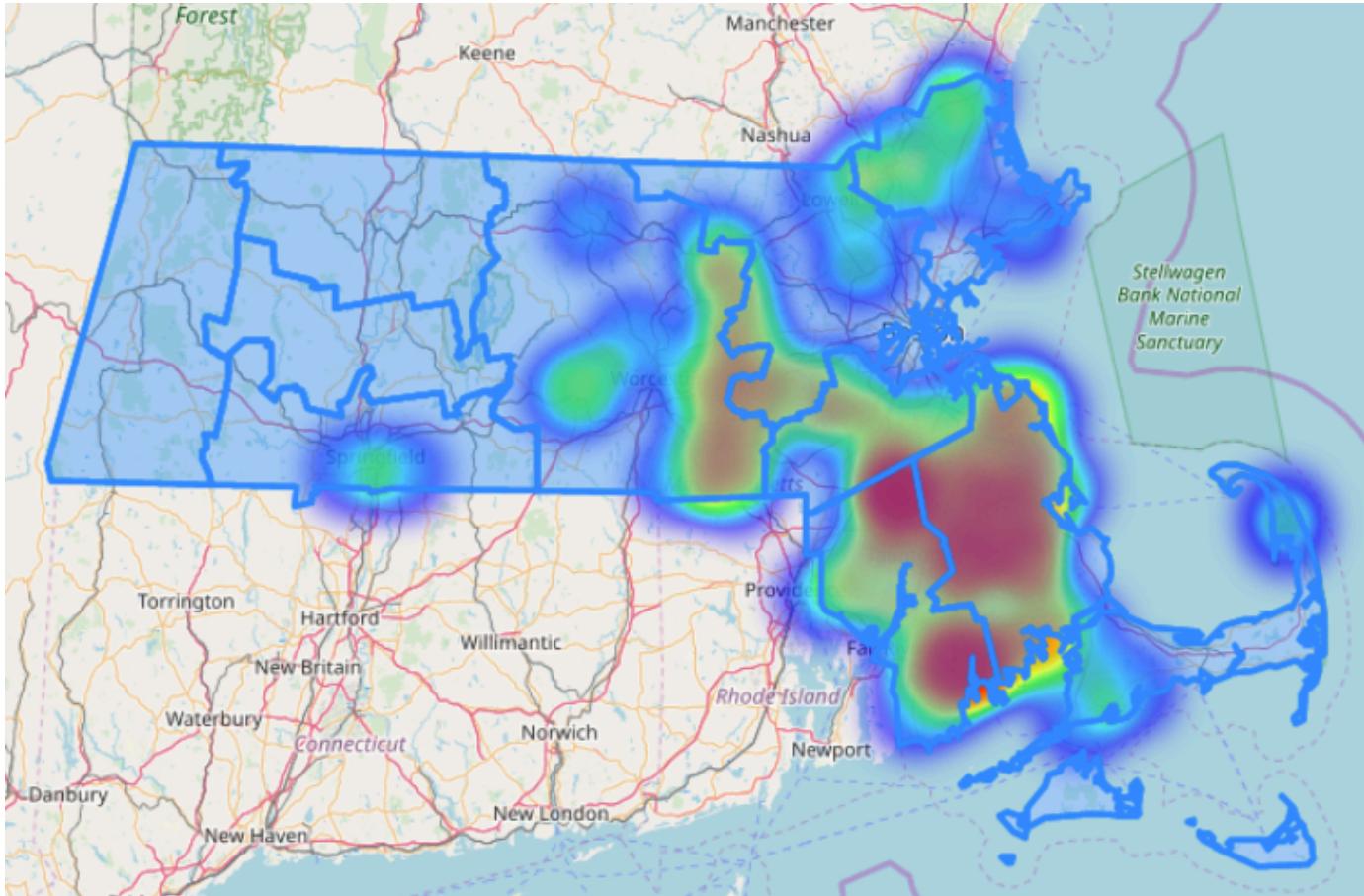


New Jersey Health Dept.

Distribution of Positive mosquitoes by county and city



EEEV positive mosquitoes in 2019

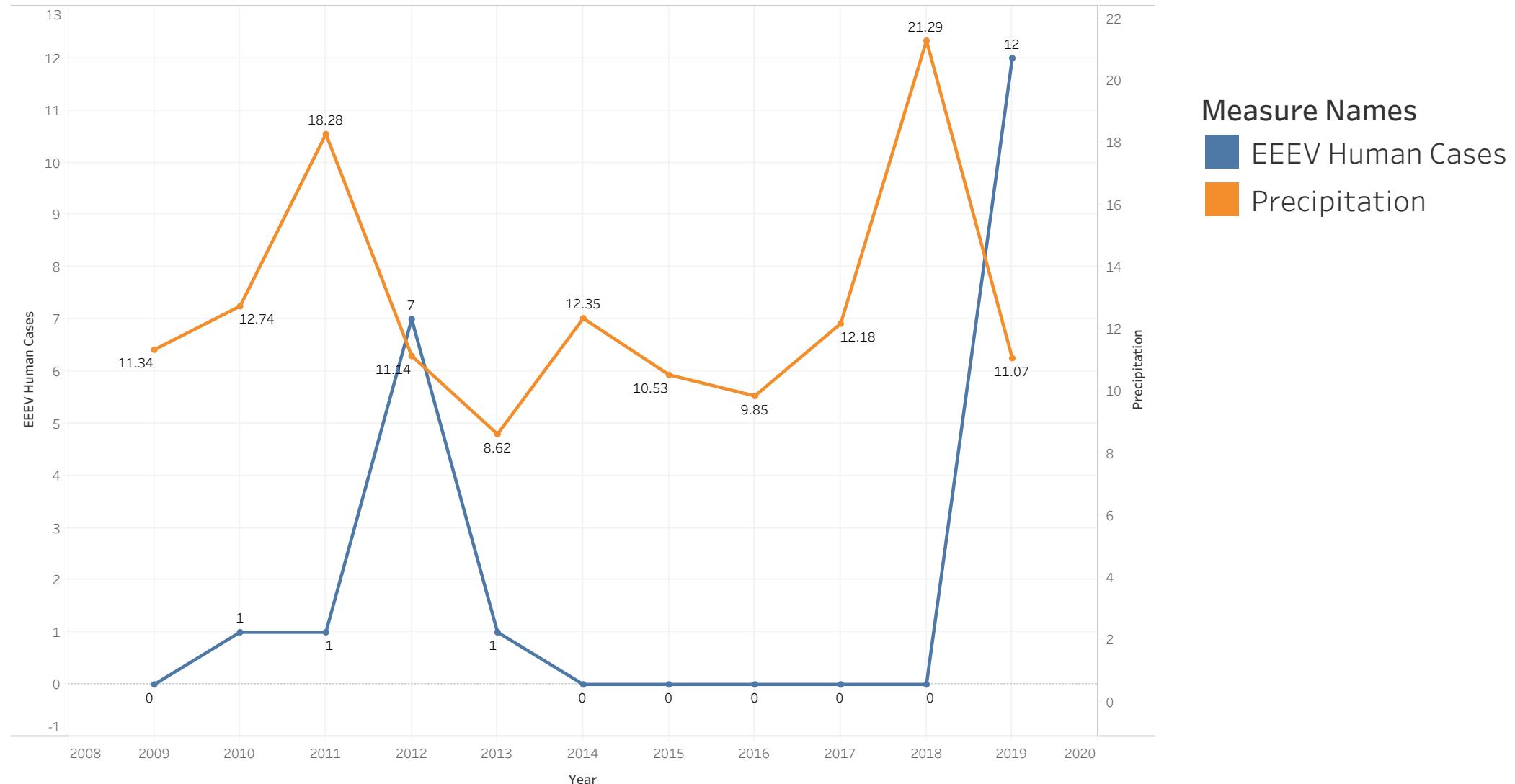


Factors influencing mosquito population

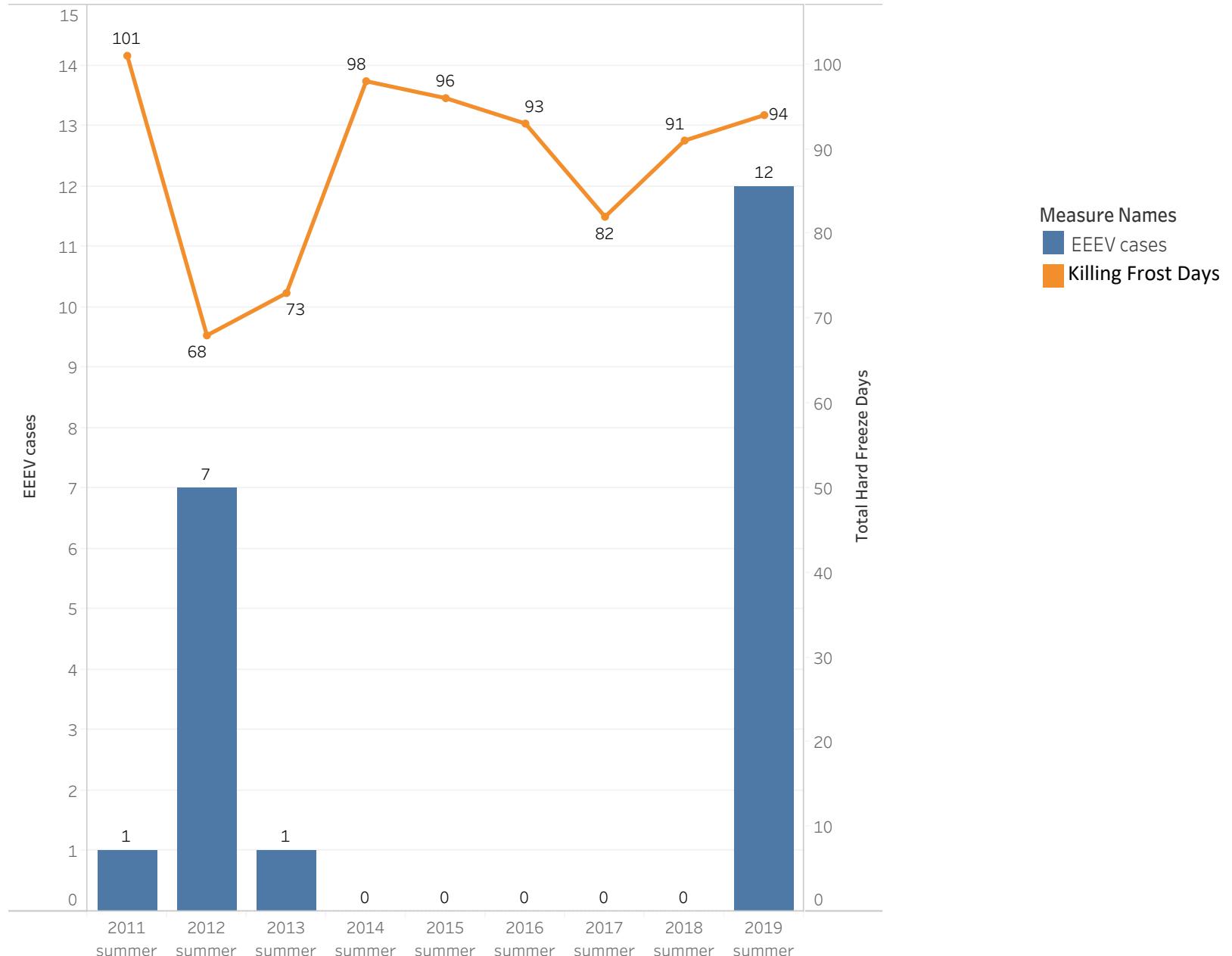
Precipitation: Many mosquito species experience an increase in larval habitat availability due to increased precipitation

Temperature: Killing frost is defined as two consecutive hours at a temperature below 28 degrees Fahrenheit

Precipitation and EEEV Human Cases in Plymouth County (MA)

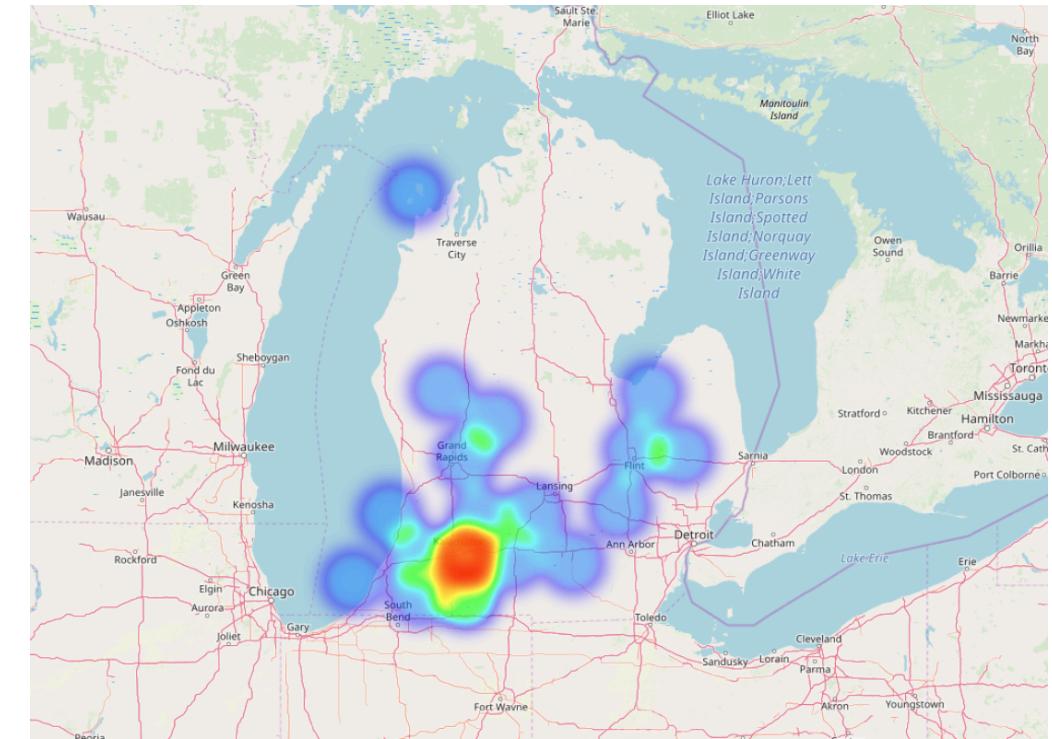
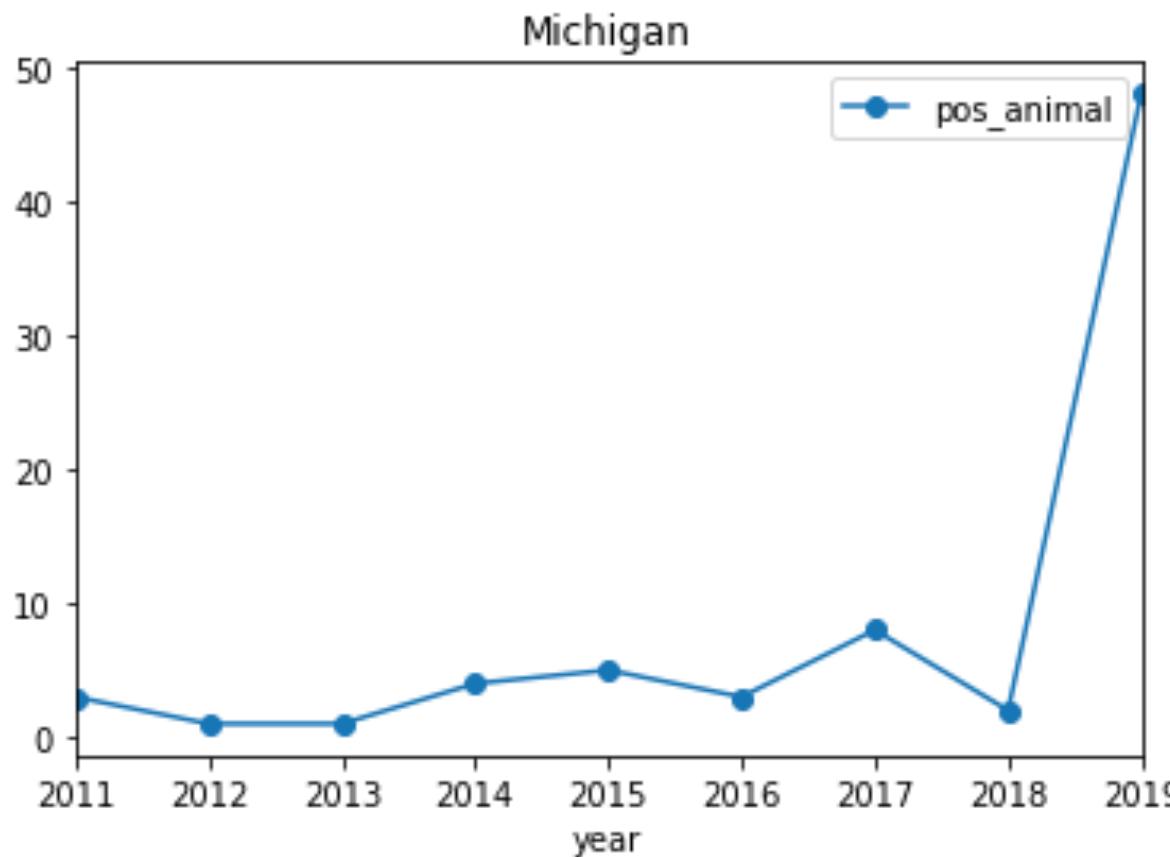


Killing frost days and EEEV human Cases

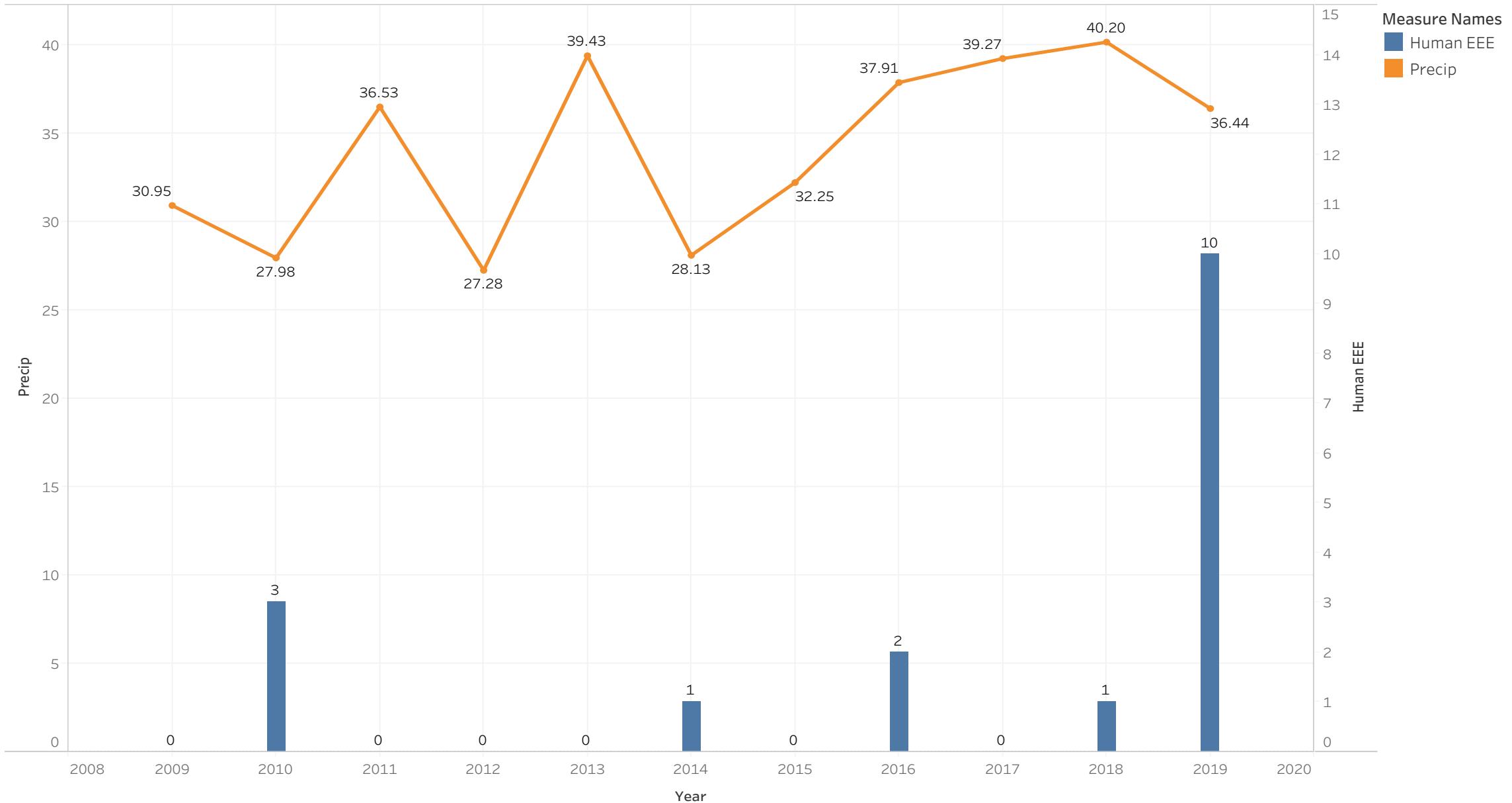


- 2012: High precipitation & Low Kill frost days -> Possibility of Increased Mosquito population -> 7 EEE Cases
- 2019: High precipitation & Average Kill frost days -> 12 EEE Cases?

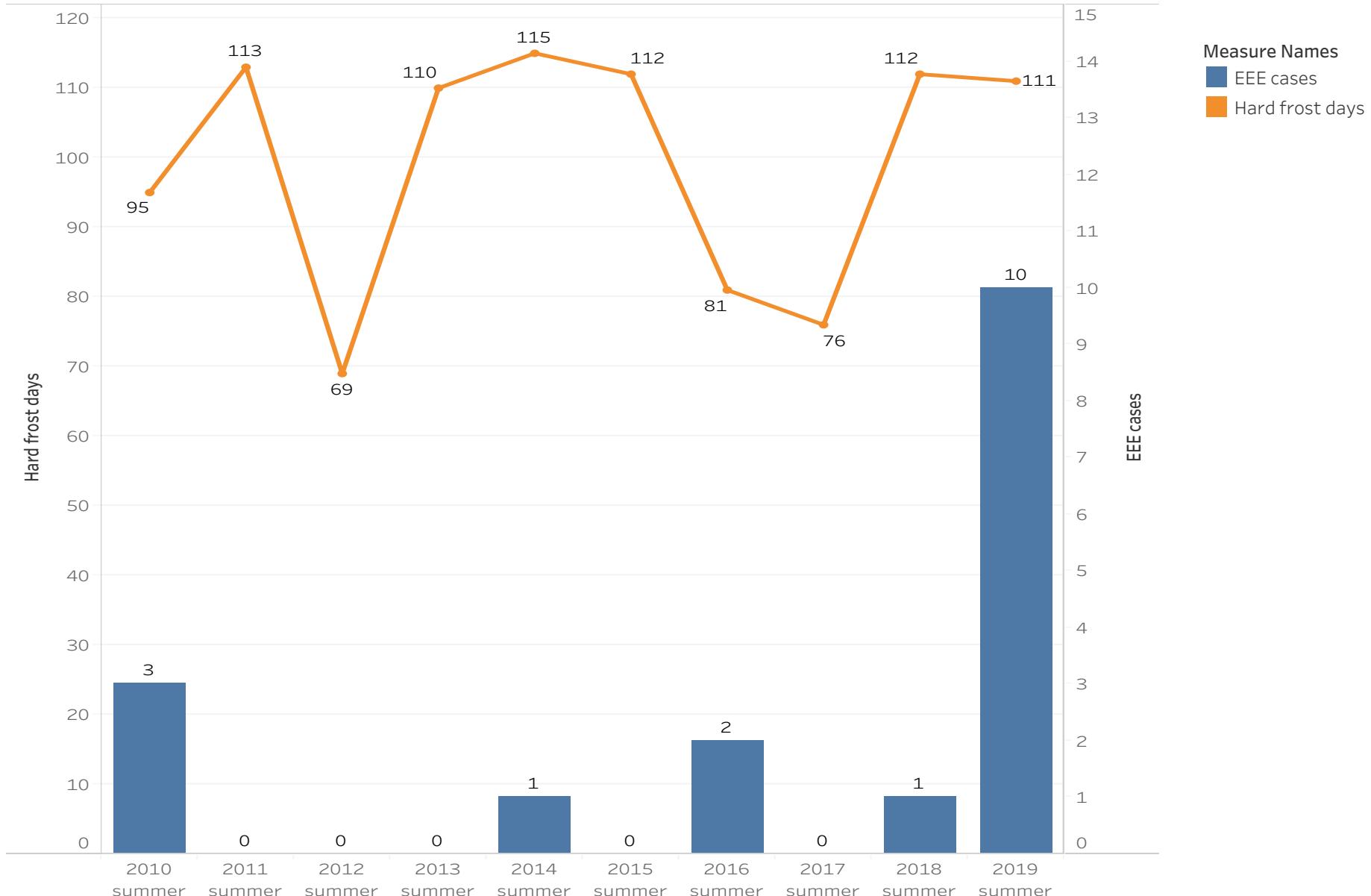
Distribution of EEEV Positive Animals and Humans in Michigan



Precipitation and Human EEEV Cases in Michigan

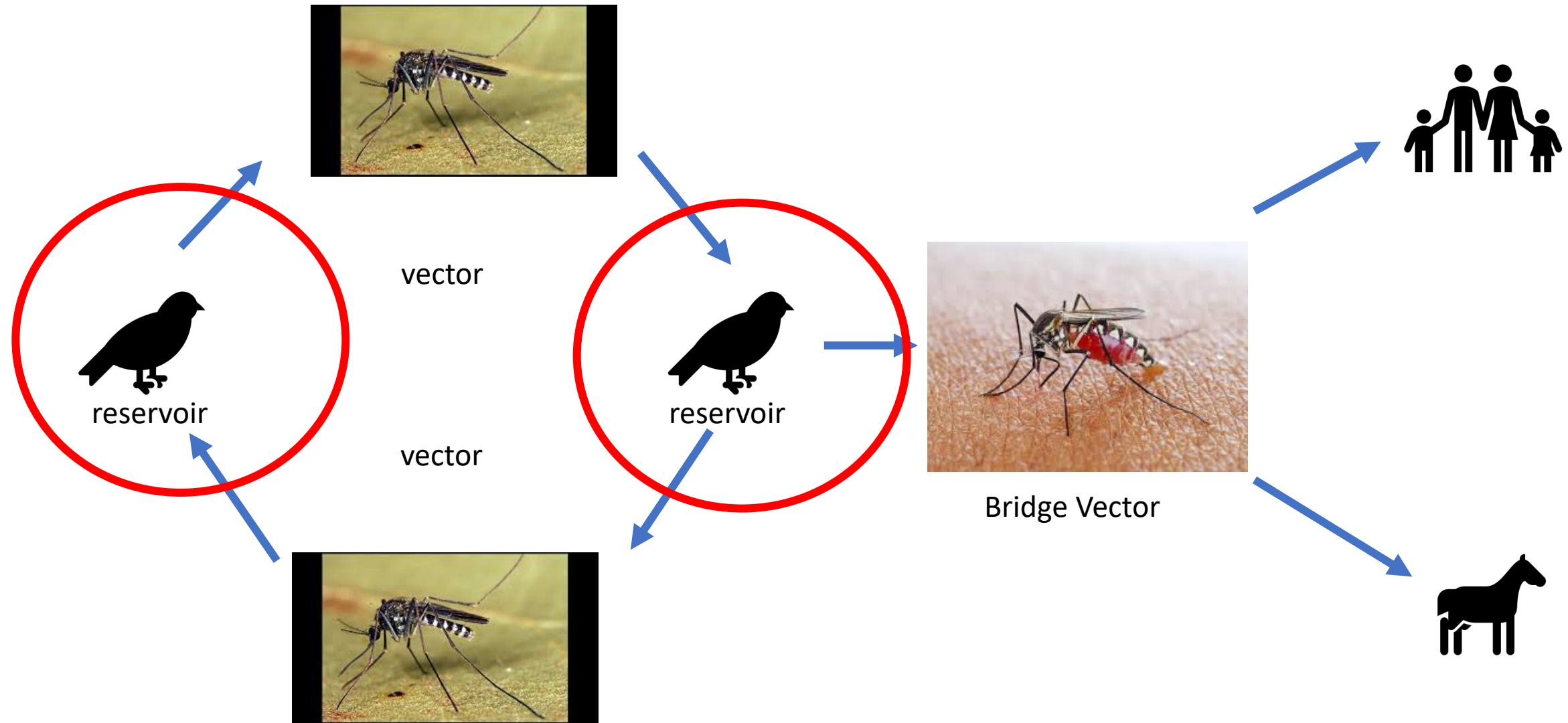


Killing frost days and human EEEV in Michigan



What is the Link between Michigan and Massachusetts (Northeast States)?

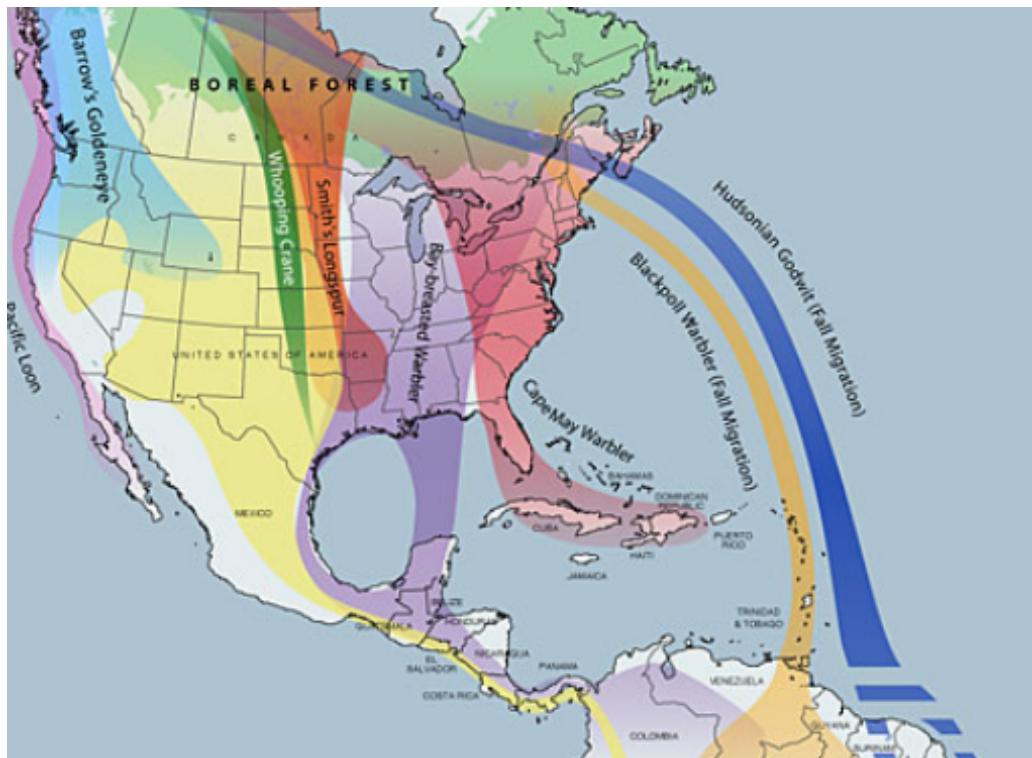
Eastern Equine Encephalitis Transmission Cycle



- Birds are known to be reservoirs for vector borne diseases (i.e. WNV)
- EEEV Infected wild birds are mostly asymptomatic but have high viral load such that mosquitoes that feed on them can transmit the virus.
- Analyze Migratory birds and Permanent Resident birds

Migratory Birds

If Migratory Birds are the source of EEEV, most likely would also see High incidences in Southern States



Birdcanada.com

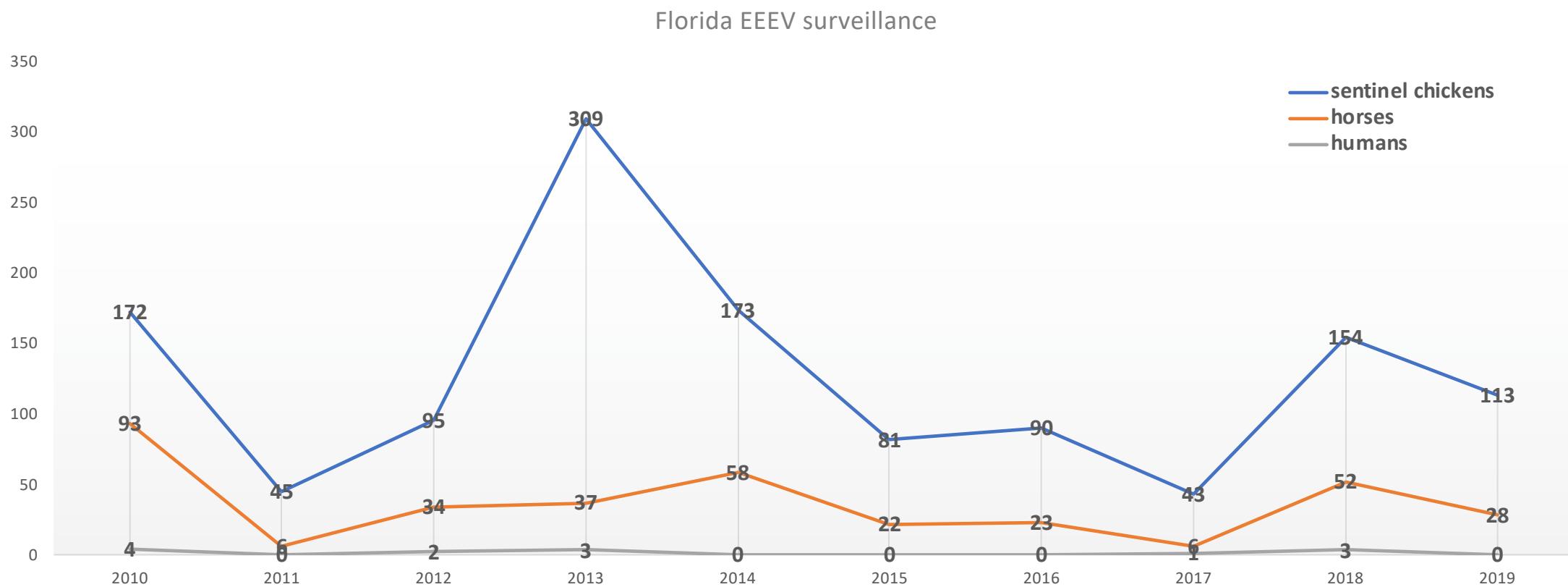
EEEV infection in animals all year round in Florida

Analyze EEEV surveillance data (sentinel chicken data)



University of Florida

EEEV activity in Florida



Which bird species is a carrier for EEEV?

Am. J. Trop. Med. Hyg., 95(1), 2016, pp. 206–211

doi:10.4269/ajtmh.15-0840

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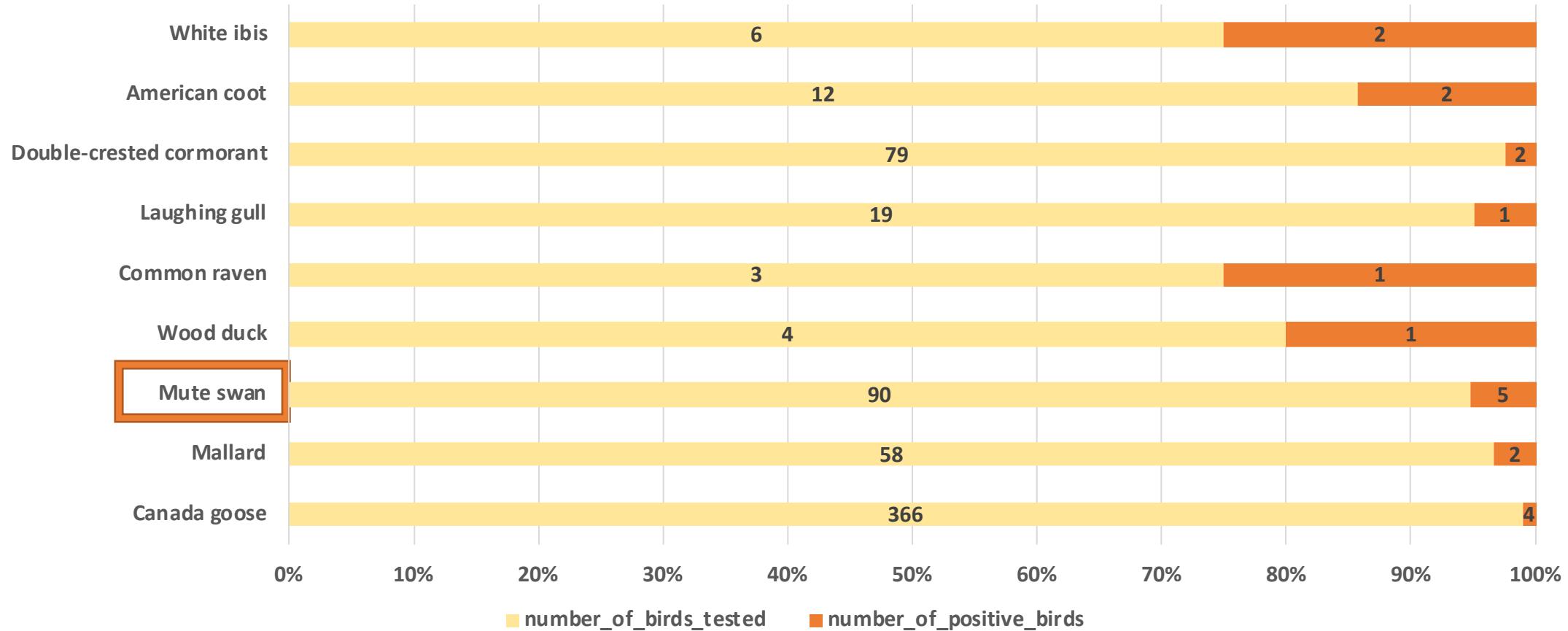
Widespread Detection of Antibodies to Eastern Equine Encephalitis, West Nile, St. Louis Encephalitis, and Turlock Viruses in Various Species of Wild Birds from Across the United States

Kerri Pedersen,^{1*} David R. Marks,² Eryu Wang,³ Gillian Eastwood,³ Scott C. Weaver,³ Samuel M. Goldstein,⁴
David R. Sinnott,⁵ and Thomas J. DeLiberto⁶

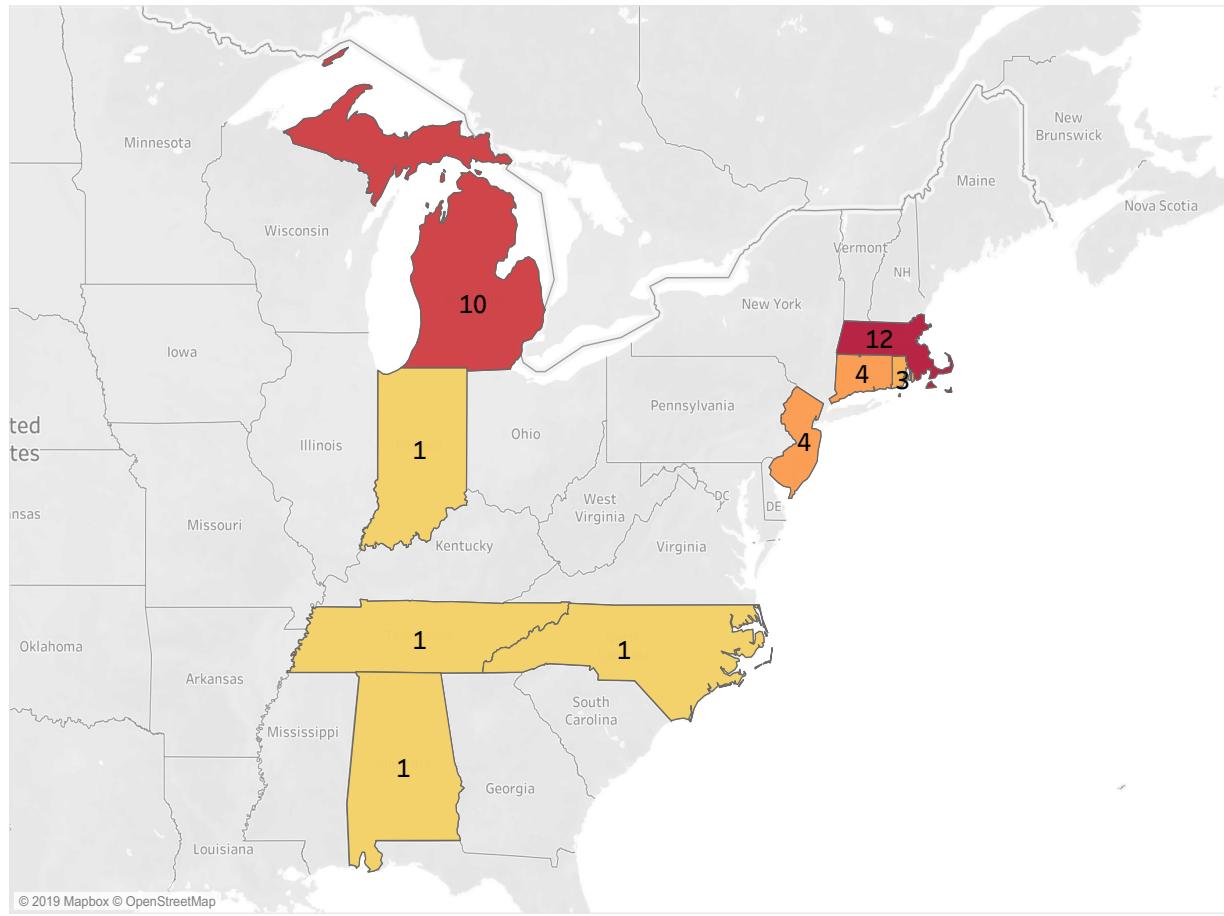
¹*U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Fort Collins, Colorado;* ²*U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Okemos, Michigan;* ³*Department of Microbiology and Immunology, Institute for Human Infections and Immunity, University of Texas Medical Branch, Galveston, Texas;* ⁴*U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Honolulu, Hawaii;* ⁵*U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, Palmer, Alaska;* ⁶*U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Research Center, Fort Collins, Colorado*

Method: EEEV Sampling of 997 wild birds 54 species, 44 states,
collected from 1/1/2013-9/30/2013, tested for antibodies

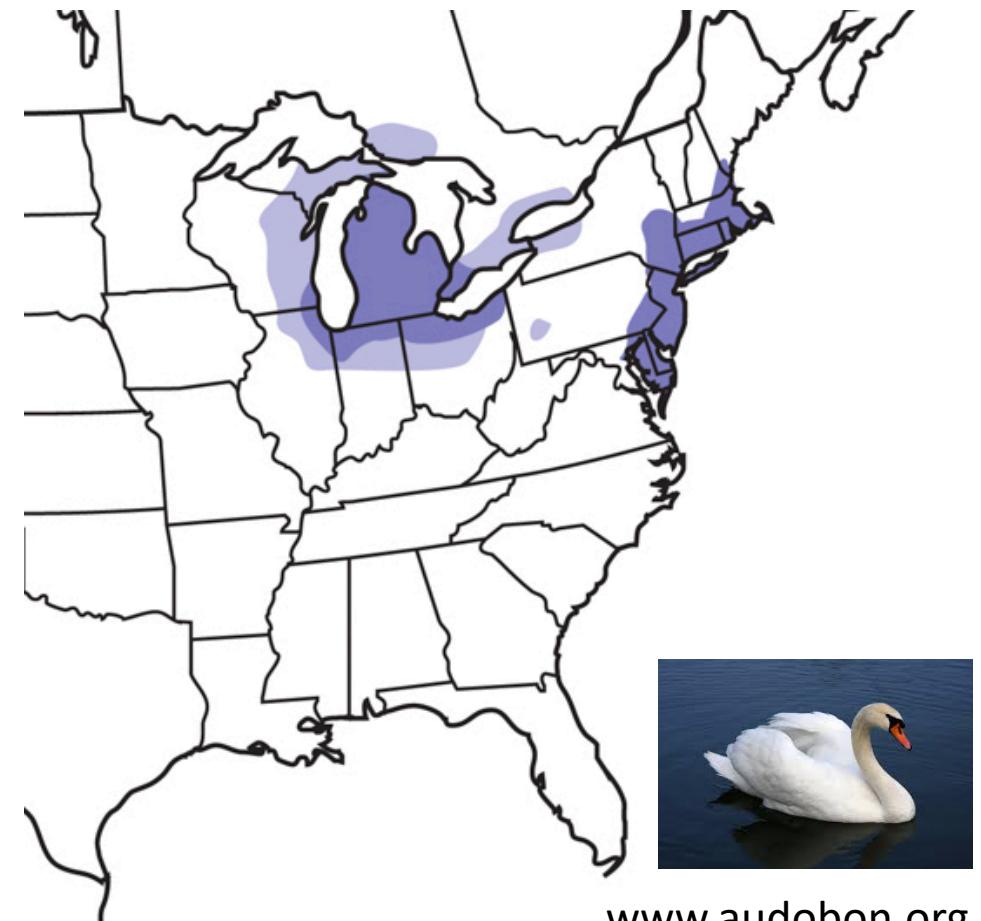
Next: Analyzed bird Migratory Path and Population distribution that carried EEEV in the study



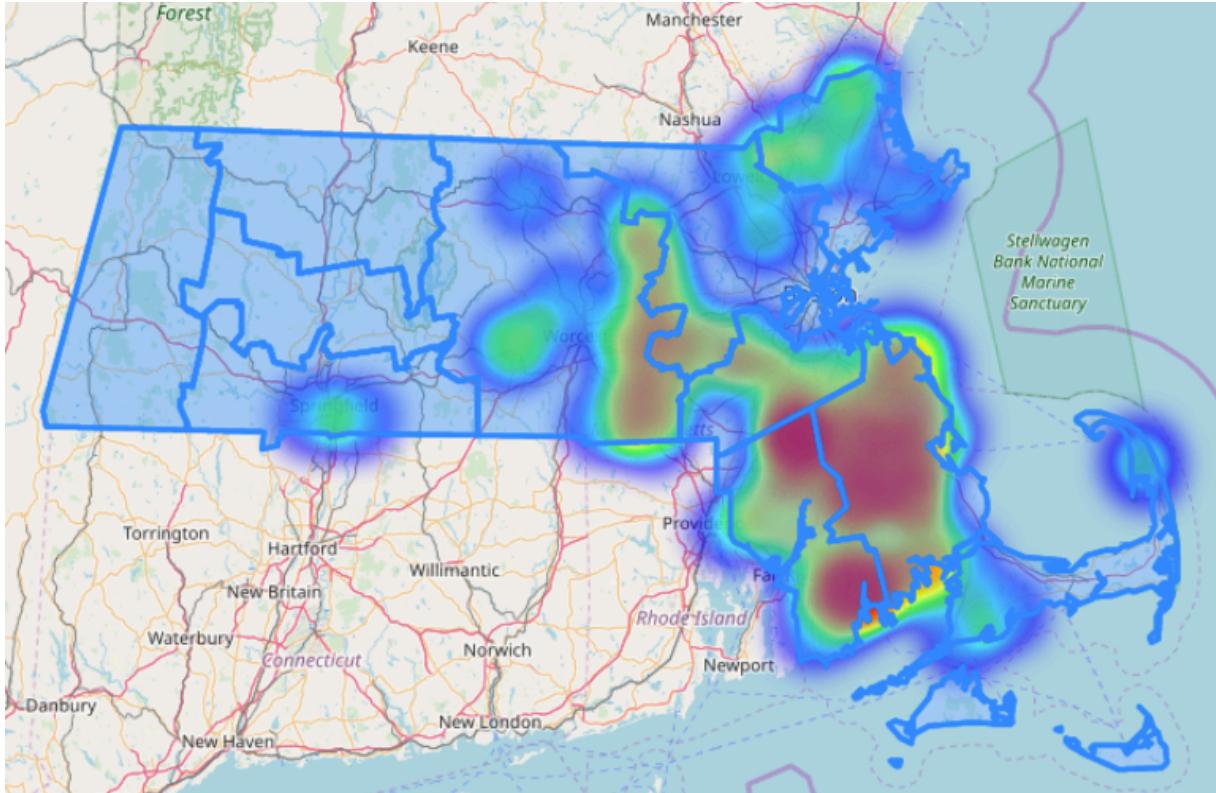
Human EEE cases in 2019



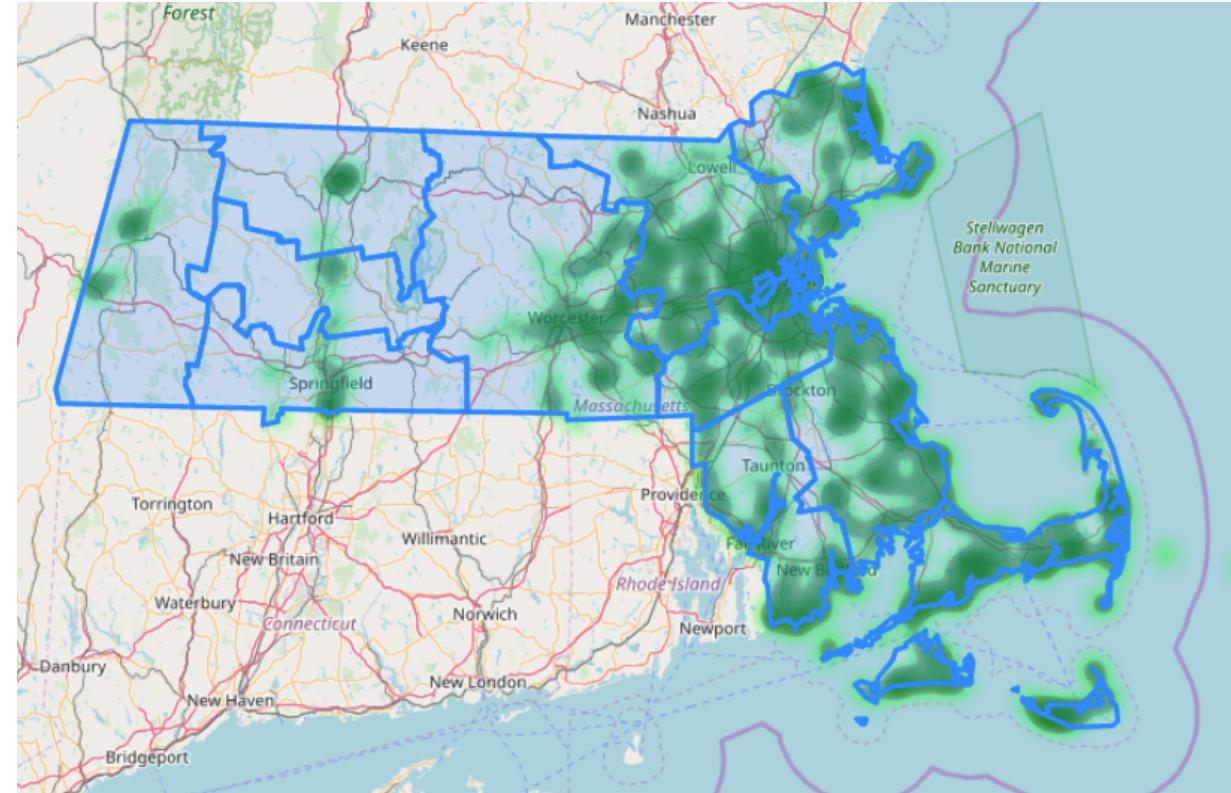
Distribution of Mute Swan Population



EEEV positive mosquitoes & Mute Swan population distribution in Massachusetts

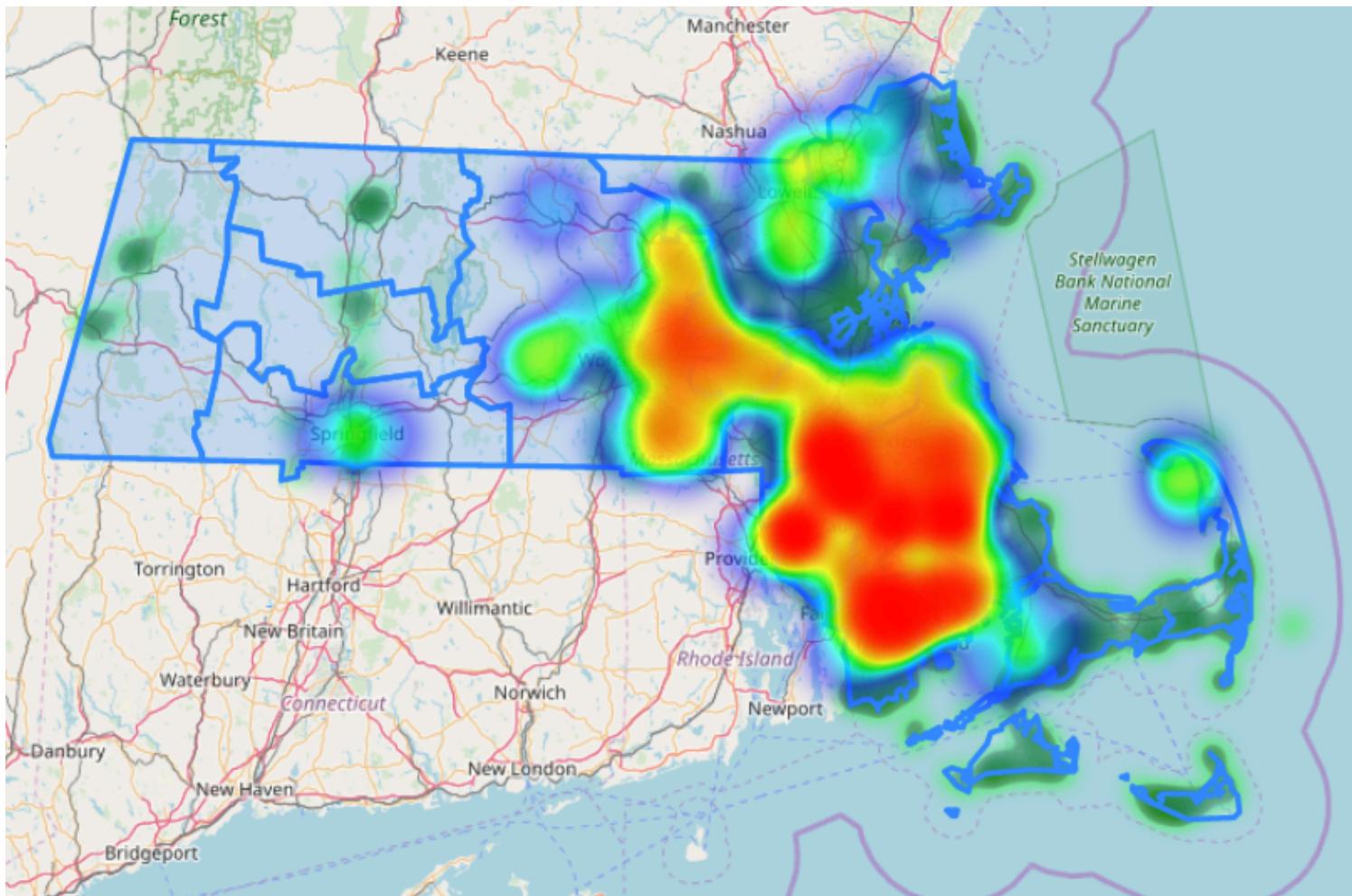


EEEV positive mosquitoes in 2019

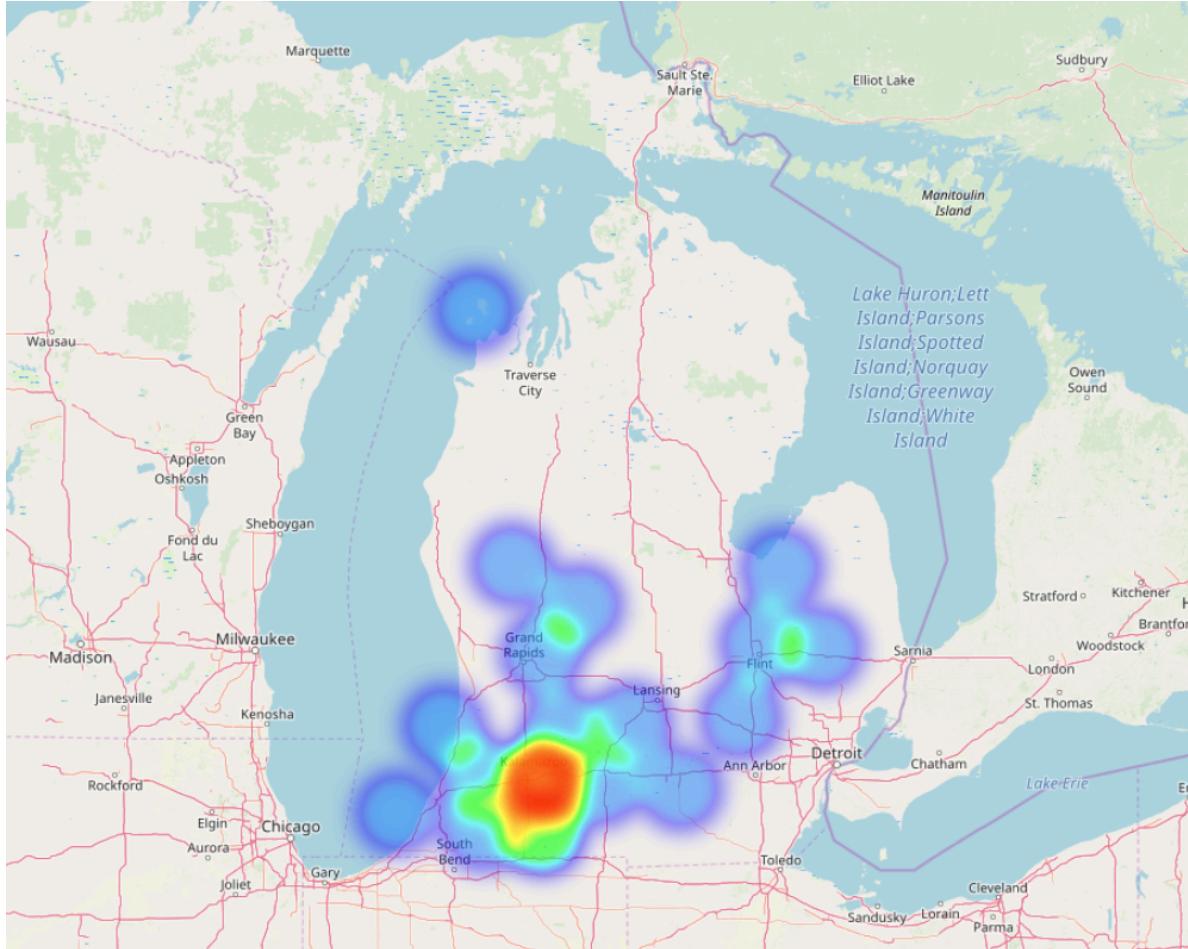


Mute Swan Distribution (2019)

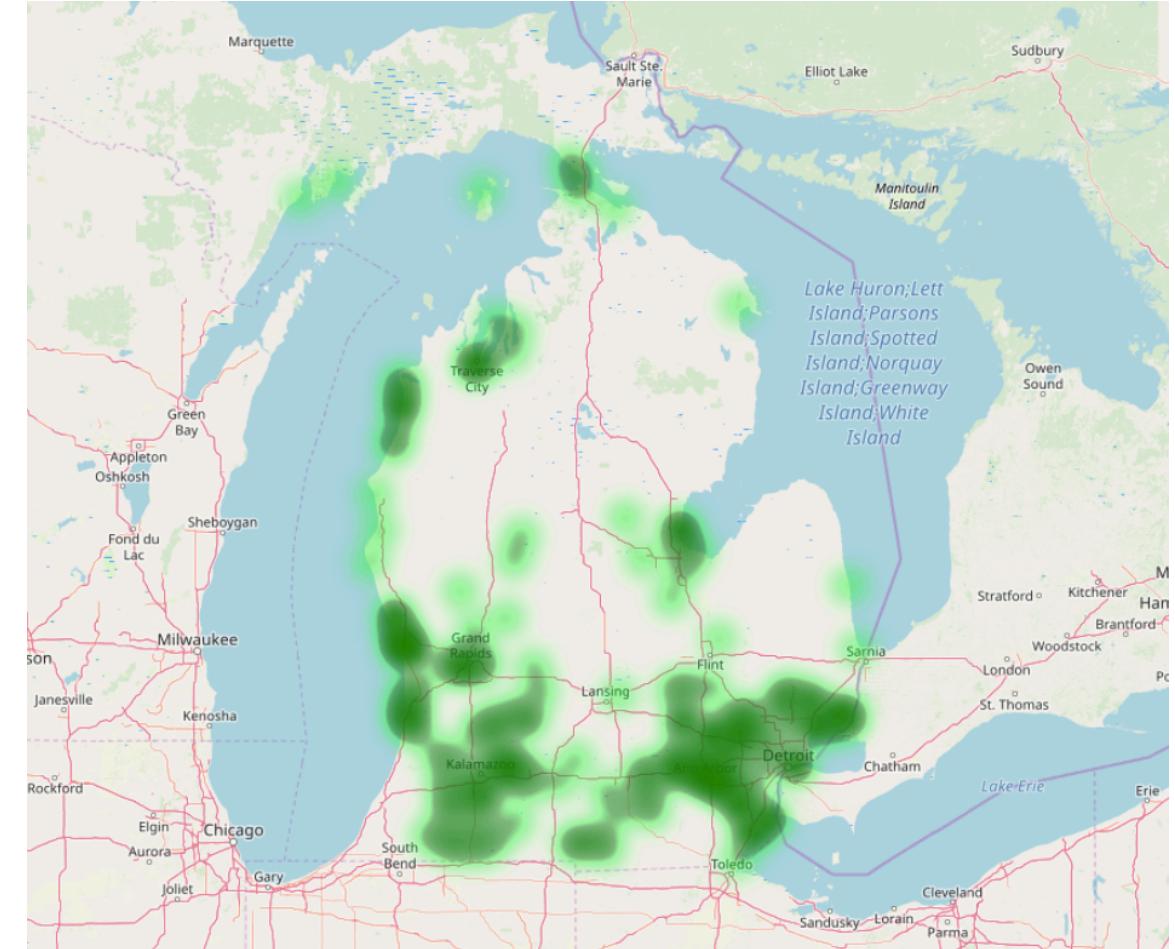
EEEV positive mosquitoes & Mute Swan population distribution in Massachusetts



EEEV positive animals & Mute Swan population distribution in Michigan

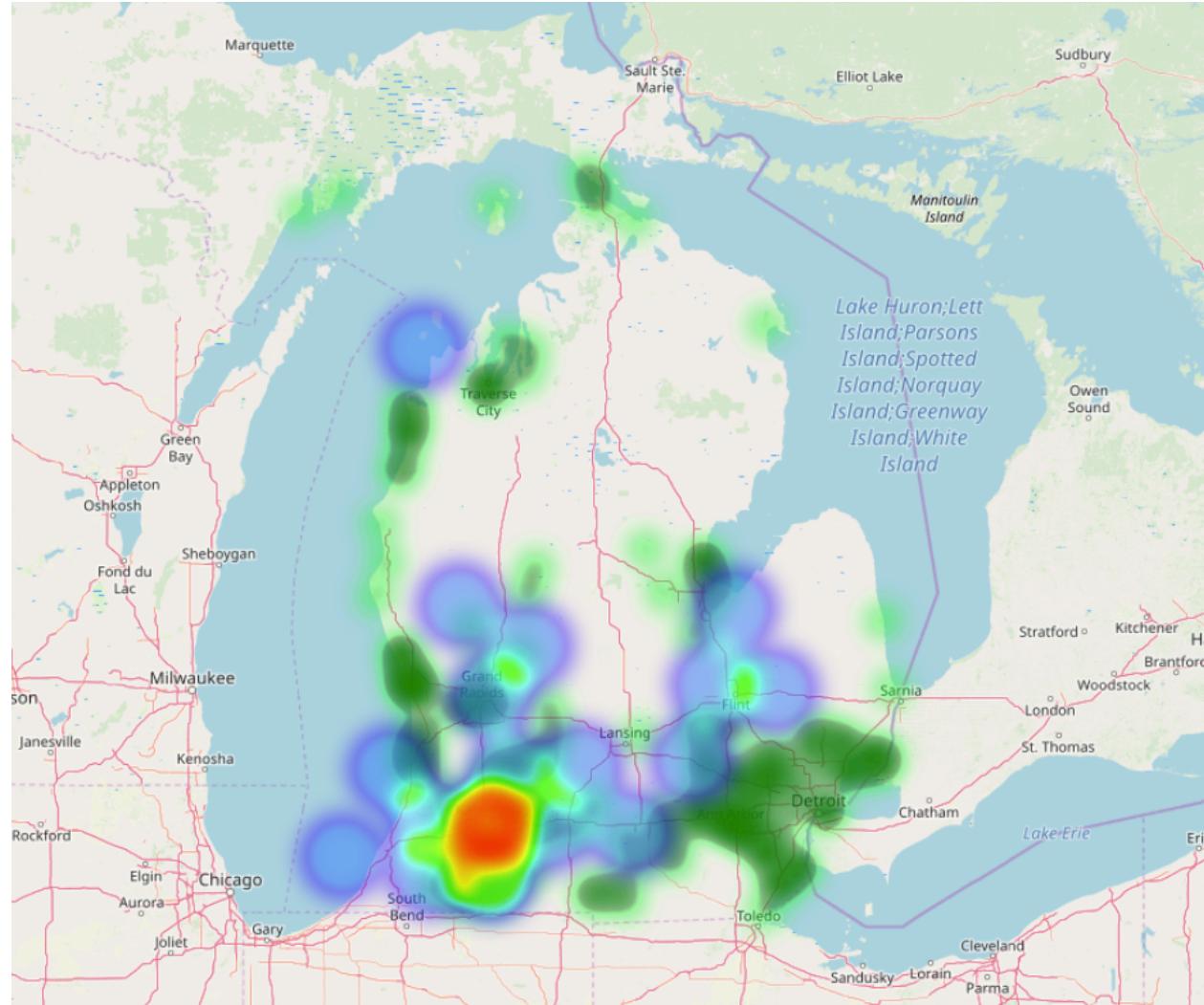


EEEV Positive Animals and Humans (2019)

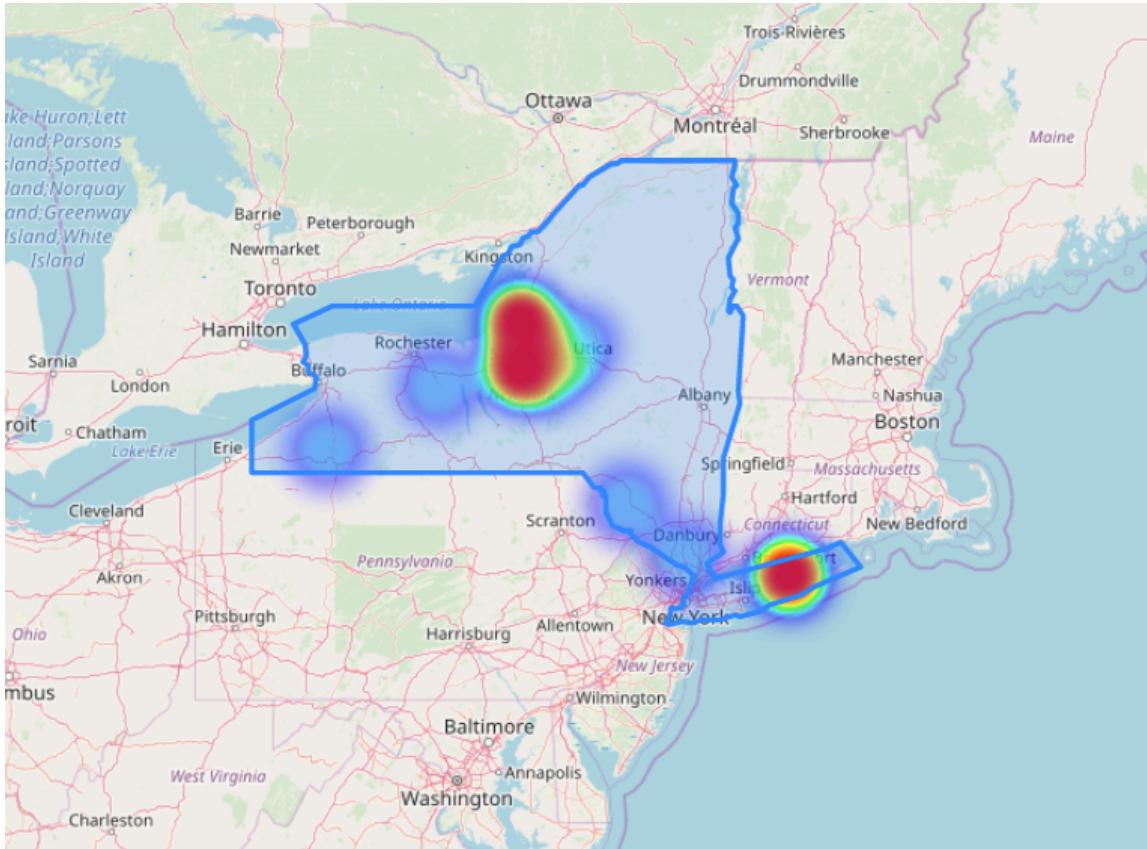


Mute Swan Population (2019)

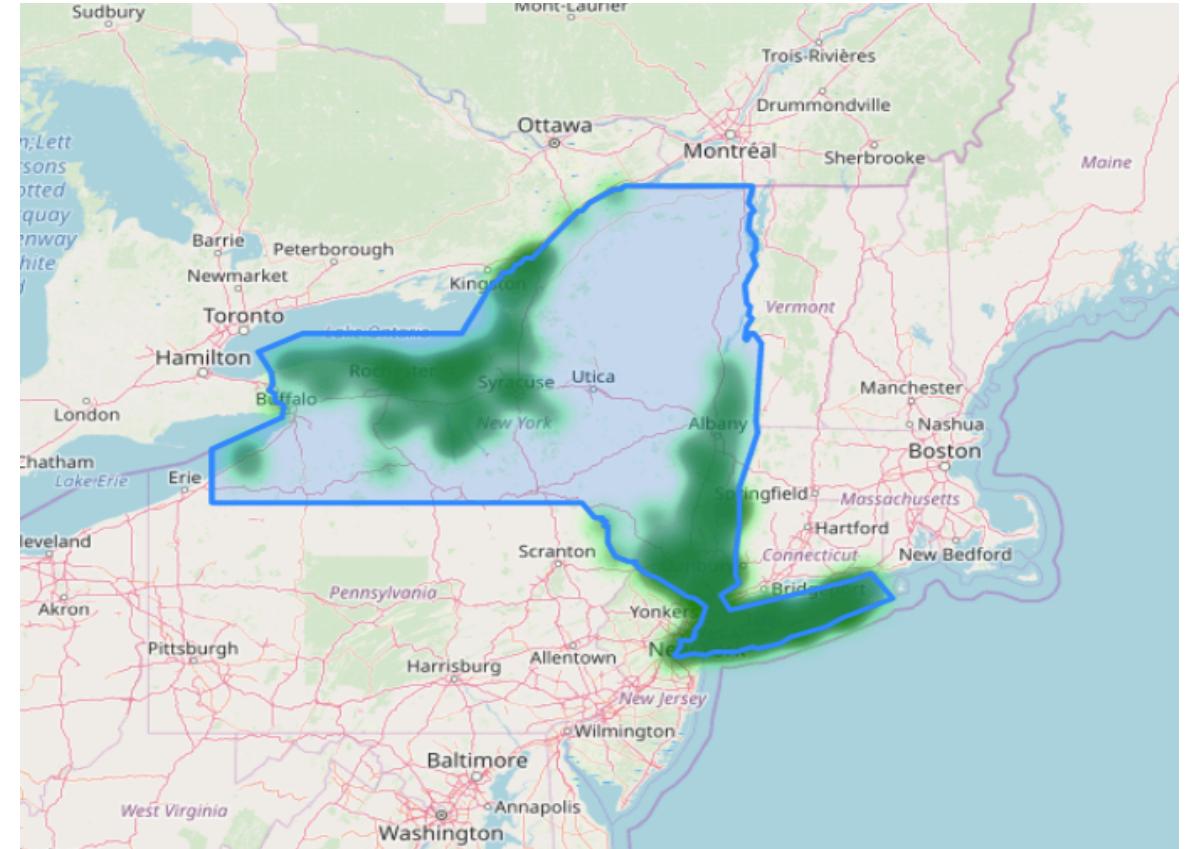
EEEV positive animals & Mute Swan population distribution in Michigan



EEEV positive Mosquitoes & Mute Swan population distribution in New York



EEEV positive Mosquitoes and Animals (2019)



Mute Swan Population Distribution (2019)

Conclusion

Increased incidences of EEE cases in 2019 in Michigan and Massachusetts (northeast states) could possibly be linked to Mute Swans.

There is a possibility an outbreak of EEEV among the Mute Swan population and as a result, EEEV is ‘spilling over’ to humans.

Further studies needed to confirm findings.

Data Sources

EEE Data: [CDC](#) (Center for Disease Control and Prevention)

Weather Data :[NOAA](#) (National Oceanic and Atmospheric Administration)

Mosquito Data: Massachusetts Health Department

Michigan Health Department

New York Health Department

Florida Health Department

Mute Swan Data: [GBIF](#) (Global Biodiversity Information Facility)