

EASTERN EQUINE ENCEPHALITIS IN MICHIGAN

2021 MICHIGAN
COMMUNICABLE DISEASE
CONFERENCE

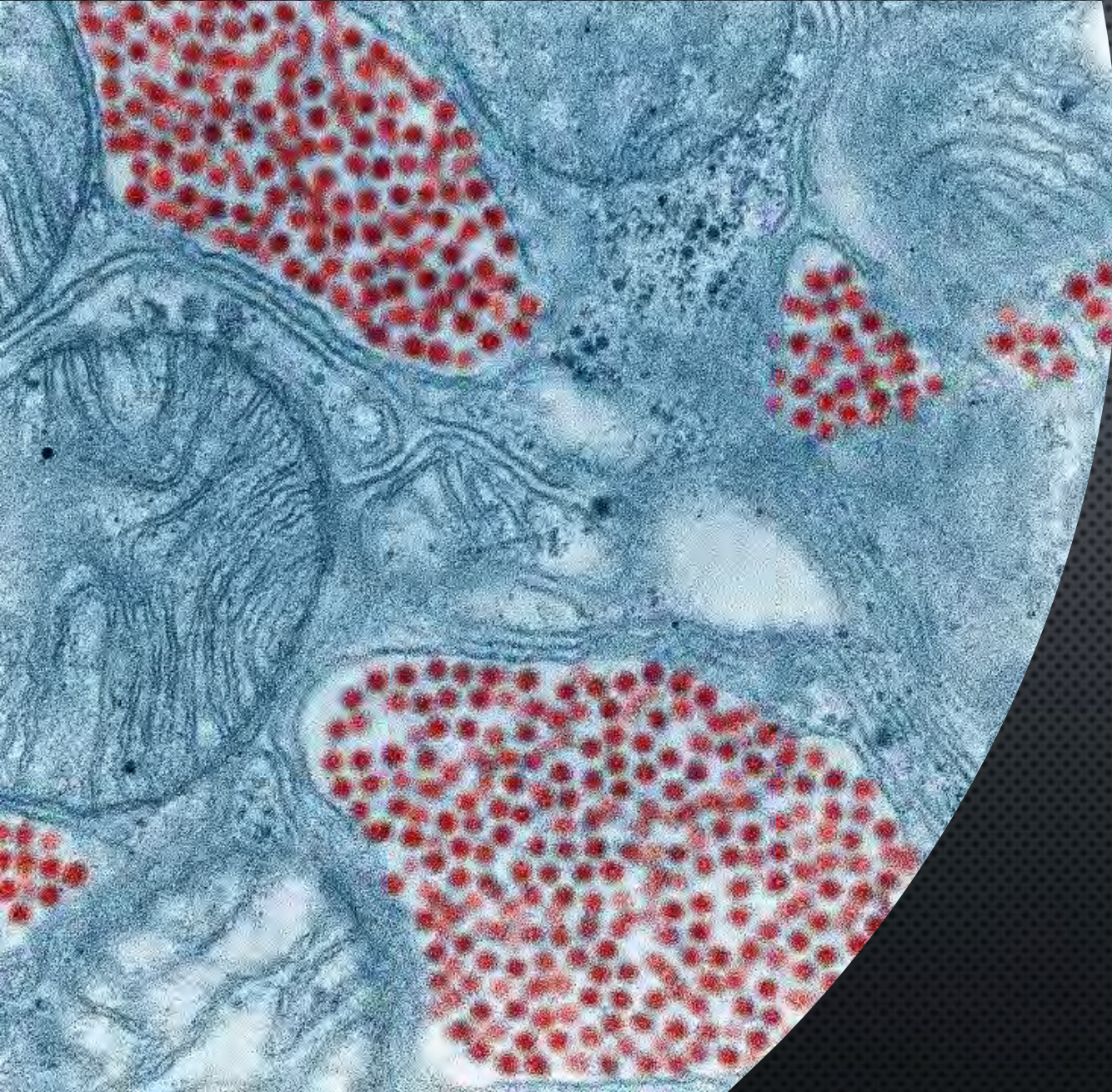
KIMBERLY SIGNS, DVM
EMERGING & ZONOTIC INFECTIOUS
DISEASES SECTION



*Coquillettidia
perturbans*

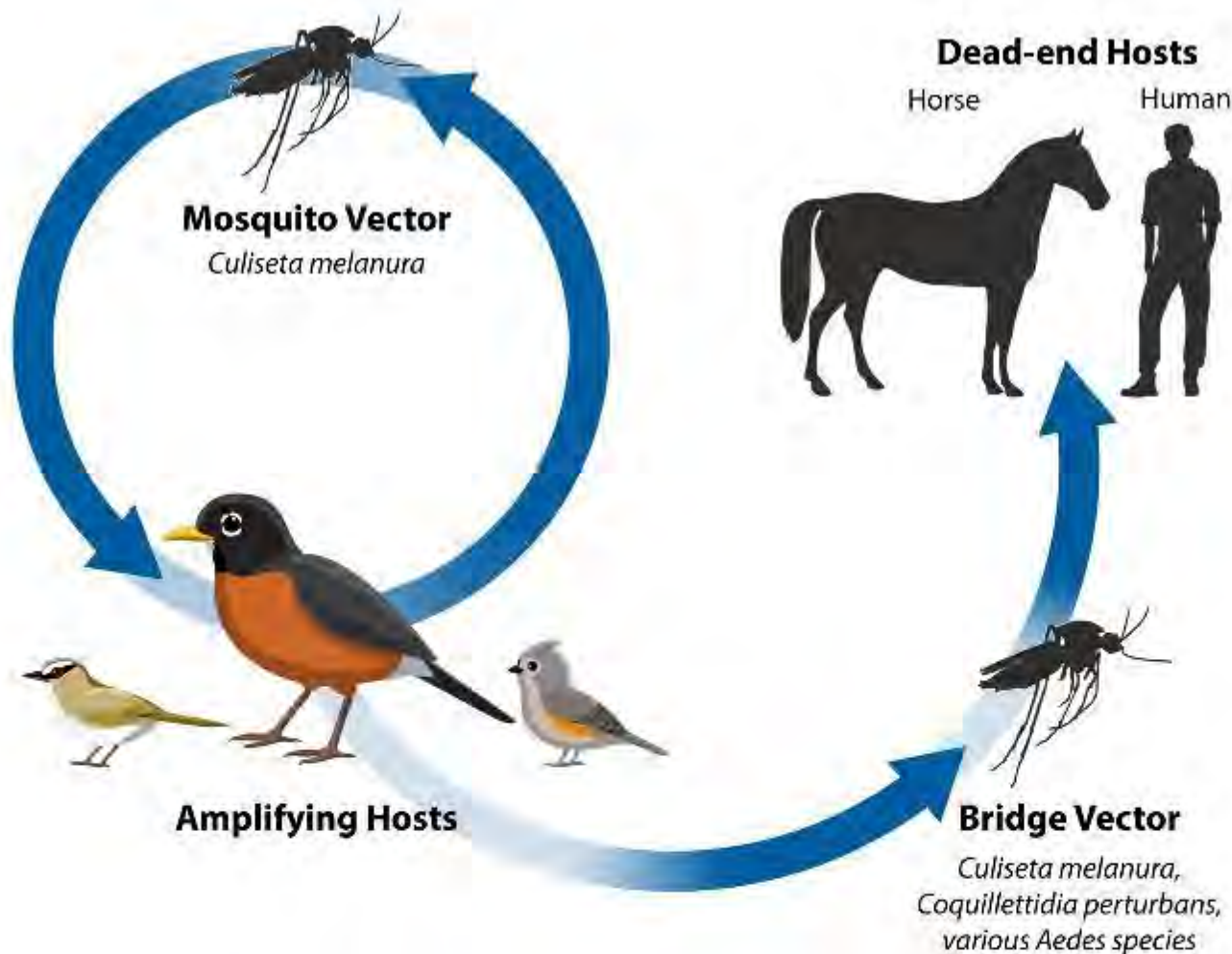
OVERVIEW OF TODAY'S TALK

- BACKGROUND ON EEE VIRUS (EEEV) AND ECOLOGY
- OVERVIEW OF THE EPIDEMIOLOGY OF EEEV IN THE U. S.
- HISTORY OF EEEV IN MICHIGAN
- EPIDEMIOLOGY OF EEEV IN MICHIGAN
- 2019-2020 EEEV SURVEILLANCE AND OUTBREAK RESPONSE
- FUTURE?



EASTERN EQUINE ENCEPHALITIS VIRUS (EEEV)

- Causes EEE, a rare but devastating, sometimes fatal brain infection
- Transmitted via mosquito bite (arbovirus)
- Endemic to the US



Eastern Equine Encephalitis Transmission

The Eastern equine encephalitis virus **cycles between mosquitoes and birds**. The *Culiseta melanura* mosquito, which primarily bites birds, is responsible for spreading the virus among birds. The virus then multiplies in the birds' bloodstream.

People and other animals, like horses, become infected with the virus when mosquito species that feed on many kinds animals, feed on infected birds and then bite people. People and horses are considered **dead-end hosts** because unlike birds, they don't develop high levels of virus in their bloodstream and cannot pass the virus on to other biting mosquitoes.



CS 318140

EEE IN HUMANS



- Illness begins 4-10 days after a bite from an infected mosquito
 - Abrupt onset of fever, chills, and/or joint and muscle pain
- When the brain is infected, onset can be swift and include fever, headache, and confusion – this is referred to as “neuroinvasive” disease
- ~1/3 of symptomatic cases result in death, typically within 2-10 days of illness onset
- Survivors often have long-lasting brain damage; many become disabled, and some require lifelong care
- There is no treatment beyond supportive care or vaccine for people

DIAGNOSIS



CSF includes neutrophilic pleocytosis, elevated protein

Serologic Testing:

- Commercial laboratories offer IFA-less sensitive than EIA
- State HD and CDC offer EIA/MIA
- Detection of IgM in CSF is suggestive of recent infection
- Confirmed with PRNT (measure of neutralizing or IgG antibody)

PCR: Narrow window for detection

- Only performed at CDC

In some cases, laboratory confirmation can take several weeks

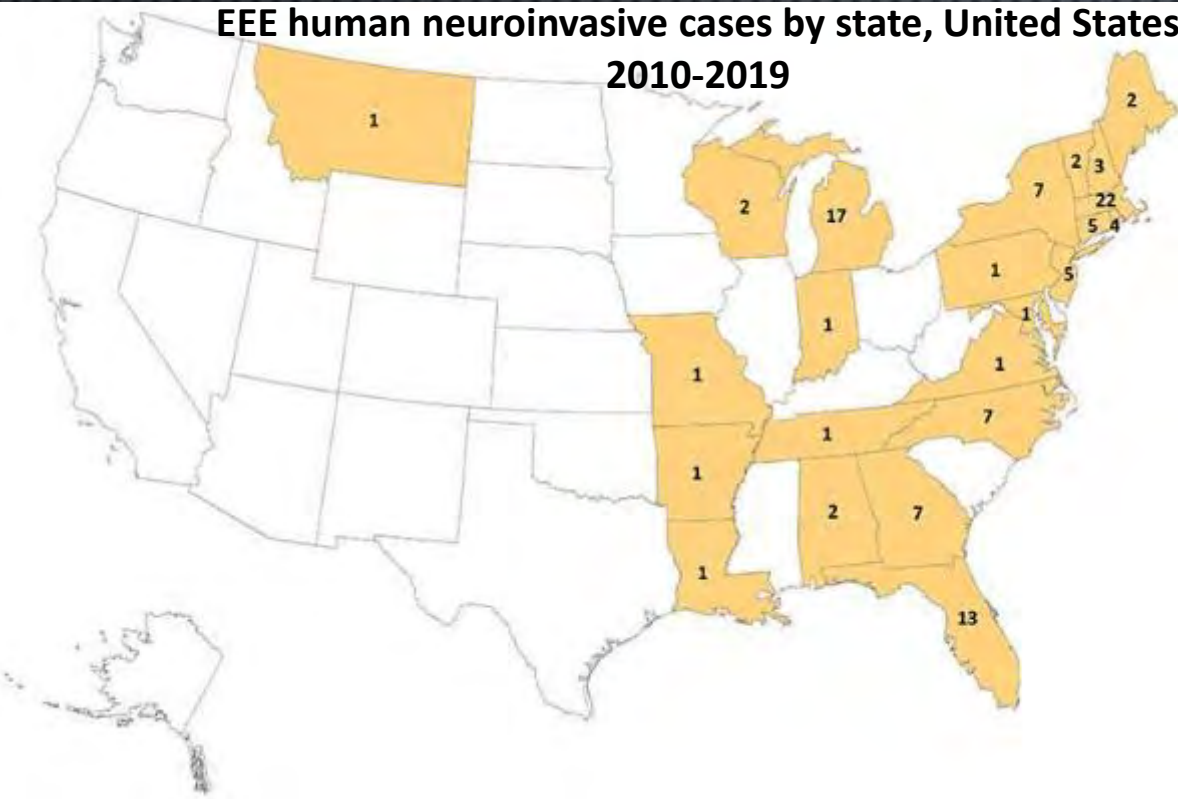
EEE IN ANIMALS



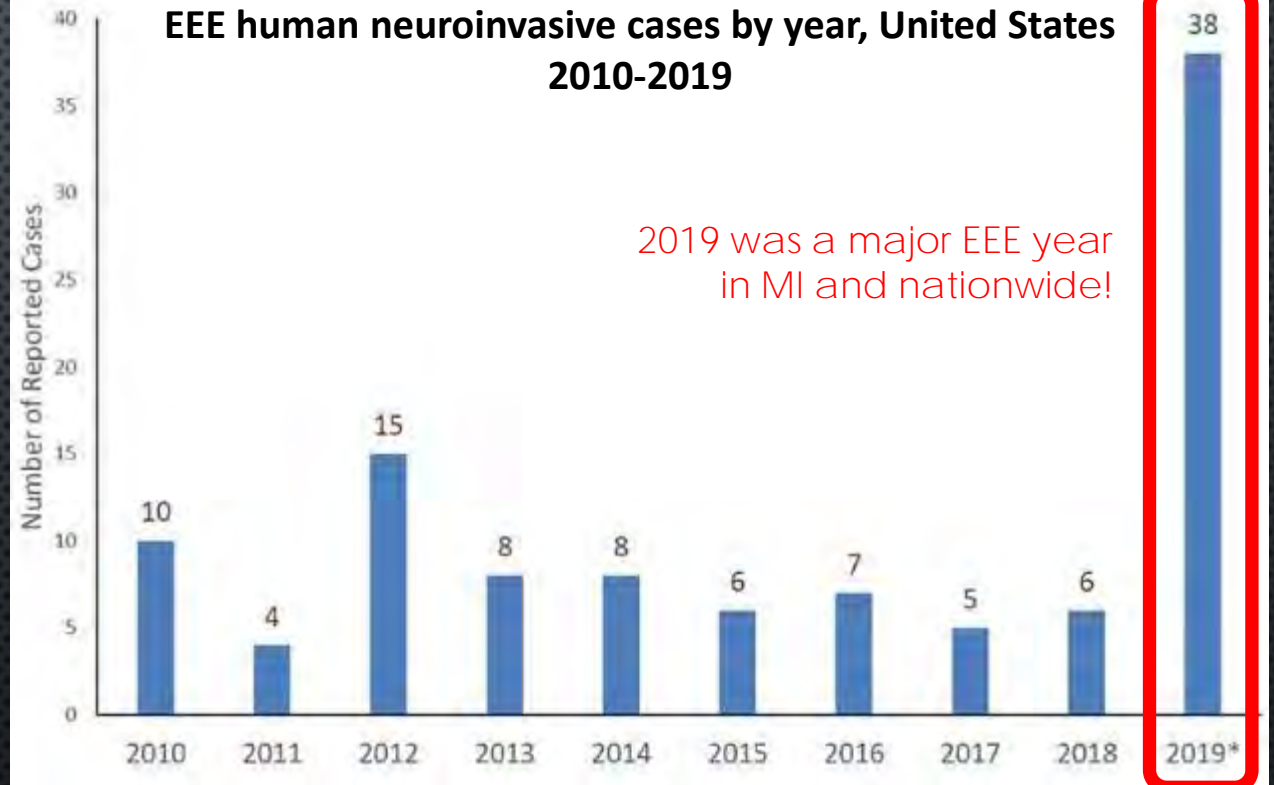
- Other mammals can become ill from EEE
- EEE is especially severe in horses
 - If a horse or other animal becomes ill with EEE, it means that there is also a risk to people in that area
 - MDHHS works with the Michigan Department of Agriculture and Rural Development (MDARD) to monitor for EEE in horses
 - There is a EEE vaccine available for horses
- MDHHS also works with the Michigan Department of Natural Resources (MDNR) to monitor EEE in wild animals, such as deer

EEE IN THE UNITED STATES: HUMAN NEUROINVASIVE† CASES 2010-2019

EEE human neuroinvasive cases by state, United States
2010-2019



EEE human neuroinvasive cases by year, United States
2010-2019

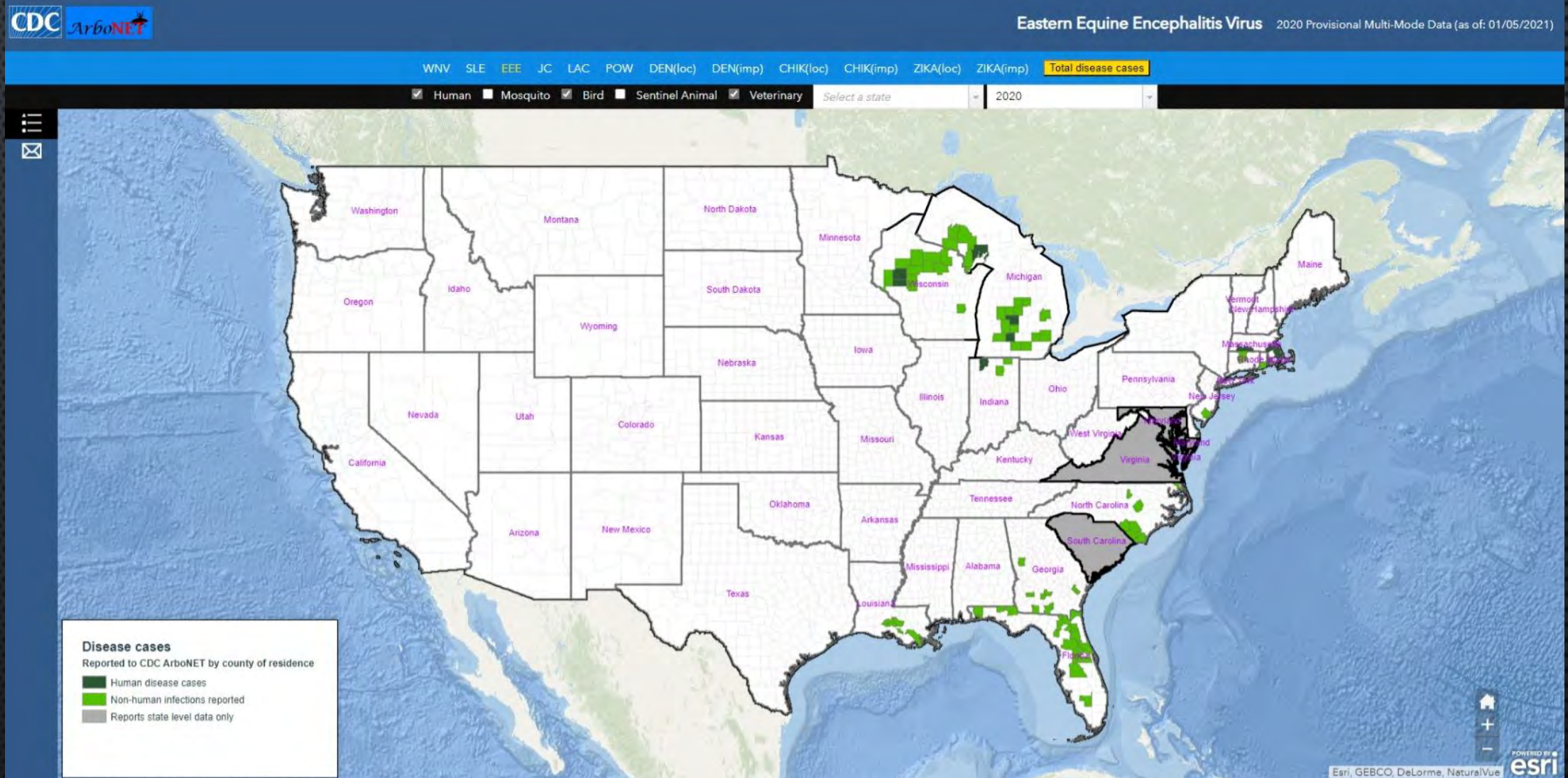


2019 was a major EEE year
in MI and nationwide!

†Neuroinvasive means “affecting the brain or spinal cord”

2020 EEE OUTBREAK

In 2020, Michigan and several other states again experienced an unusually high number of animal and human EEE cases



2019

EEE IN THE U.S. HUMAN NEUROINVASIVE CASES, 2020



| State | Neuroinvasive disease cases | Deaths |
|---------------|-----------------------------|--------|
| Indiana | 1 | 0 |
| Massachusetts | 4 | 1 |
| Michigan | 4 | 2 |
| Wisconsin | 2 | 1 |
| Total | 11 | 4 |

Data as of Jan. 5, 2021

BRIEF HISTORY OF EEE IN MICHIGAN

- 1942-43: Large horse outbreak in SW Michigan, 469 horse cases
 - EEE virus isolated from brain tissue of dead horses in 1942 and 1943
- 1973-75: Second outbreak of EEE in Michigan horses. Started in Oakland County, extended widely with scattered horse cases in SE Michigan. First mosquito and bird investigations.
- 1980: First human case of EEE in Michigan, in a 10-year-old boy from St. Joseph County
- 1980-83: Third outbreak of EEE in Michigan. EEE virus isolated from mosquitoes in state for first time, second human case.
- 1989, 1991, other years: outbreaks among animals
- 1991: SE & SW Michigan outbreak, two human cases
- 1990s-2000s: Several sporadic cases and outbreaks, 1995 in particular
- 2010: Outbreak with three human cases and 132 horse cases.
- **2019**: Largest human outbreak ever: 10 human cases (6 fatal), 50 animals
- **2020**: Outbreak with four human cases (2 fatal), 41 animals

BRIEF HISTORY OF EEE IN MICHIGAN

1942-43

- 1st reported outbreak - 469 horses in SW MI
- 1st viral isolation

1980-84

- 1980: 1st reported human case
- 3rd reported outbreak – 169 horses

2010s

- 2010: three humans, 134 horses
- 2019: 10 humans, 50 animals
- 2020: four humans, 41 animals

1973-76

- 2nd reported outbreak – 44 horses in south MI

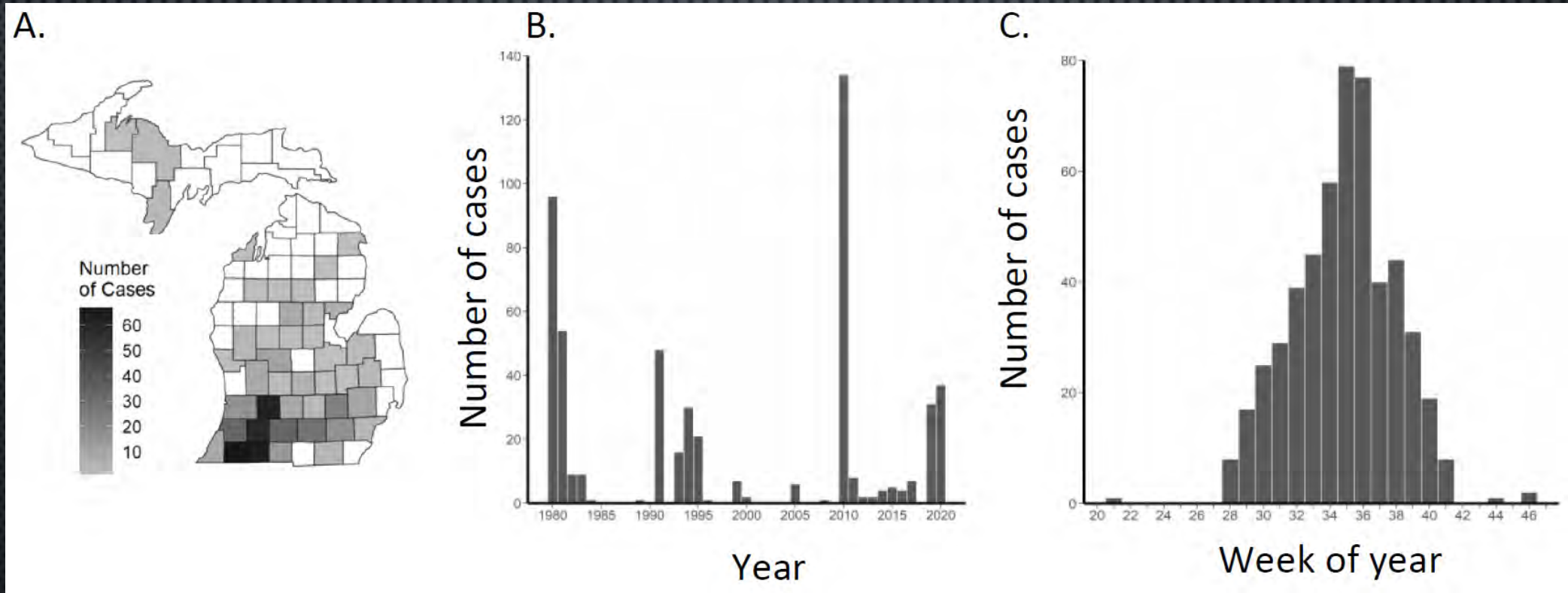
1990s-2000s

- Sporadic cases, outbreaks

MICHIGAN'S 80-YEAR HISTORY OF EEEV TO DATE

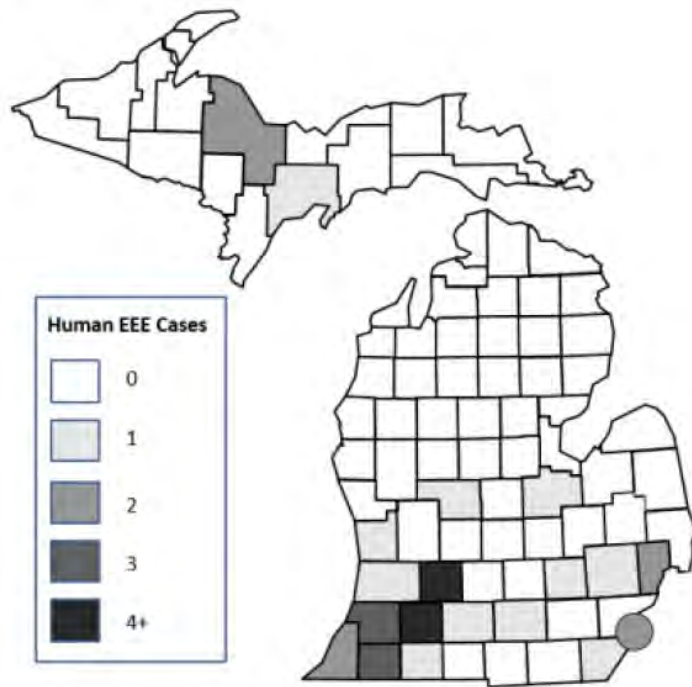
- ESTIMATED 1,036 EQUINE CASES (CONFIRMED AND SUSPECTED)
- 35 CONFIRMED HUMAN CASES
 - AGE RANGE: 1-81 YEARS
 - 70% MALE
 - DEATH RATE OF 35%
- SEASON: JULY-OCTOBER, PEAK IN AUGUST
- PREDICTABLE ECOLOGIC DISTRIBUTION (MOSTLY, COULD BE CHANGING)
- STUDIES HAVE FOUND EEEV IN MULTIPLE MI MOSQUITO AND BIRD SPECIES
- EEEV IS INCREASINGLY BEING DETECTED IN WILDLIFE, INCLUDING WHITE-TAILED DEER AND RUFFED GROUSE
- OTHER NOTABLE SPECIES INFECTED INCLUDE CANIDS AND RATITES (EMUS)
- RECENT YEARS SUGGEST NORTHERN SPREAD INTO NEW AND UNSUSPECTED ECOLOGIC FOCI

EQUINE CASE TRENDS

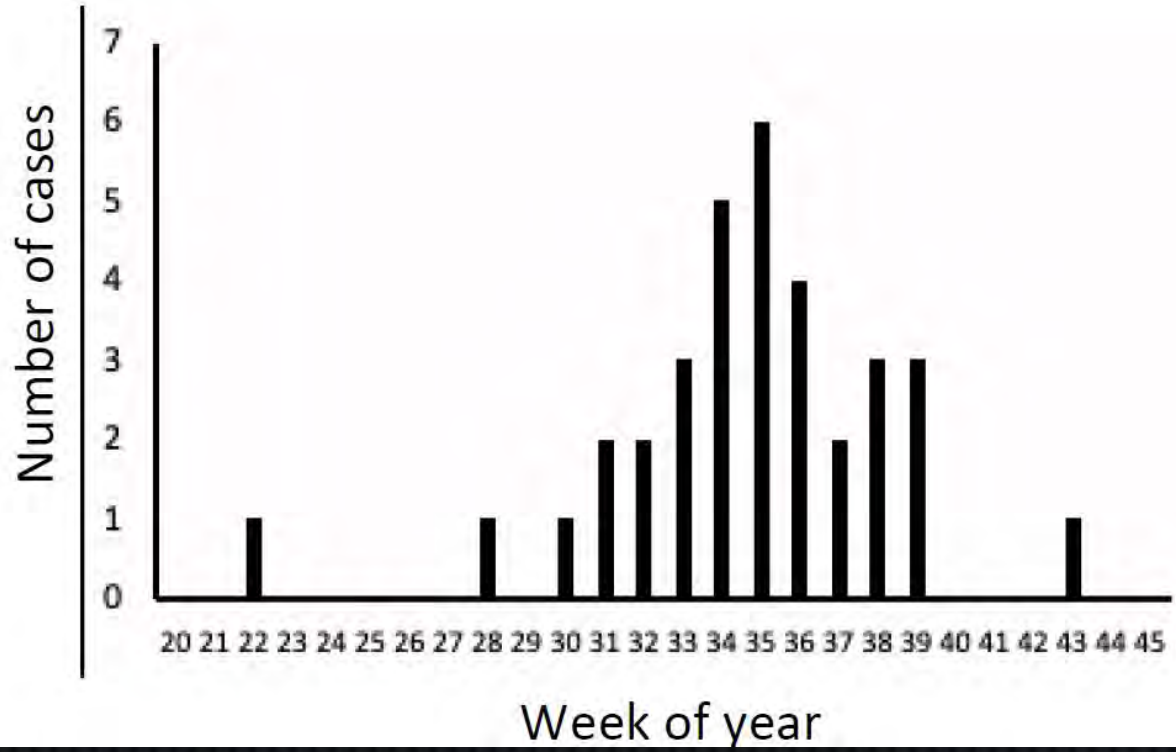


HUMAN CASE TRENDS

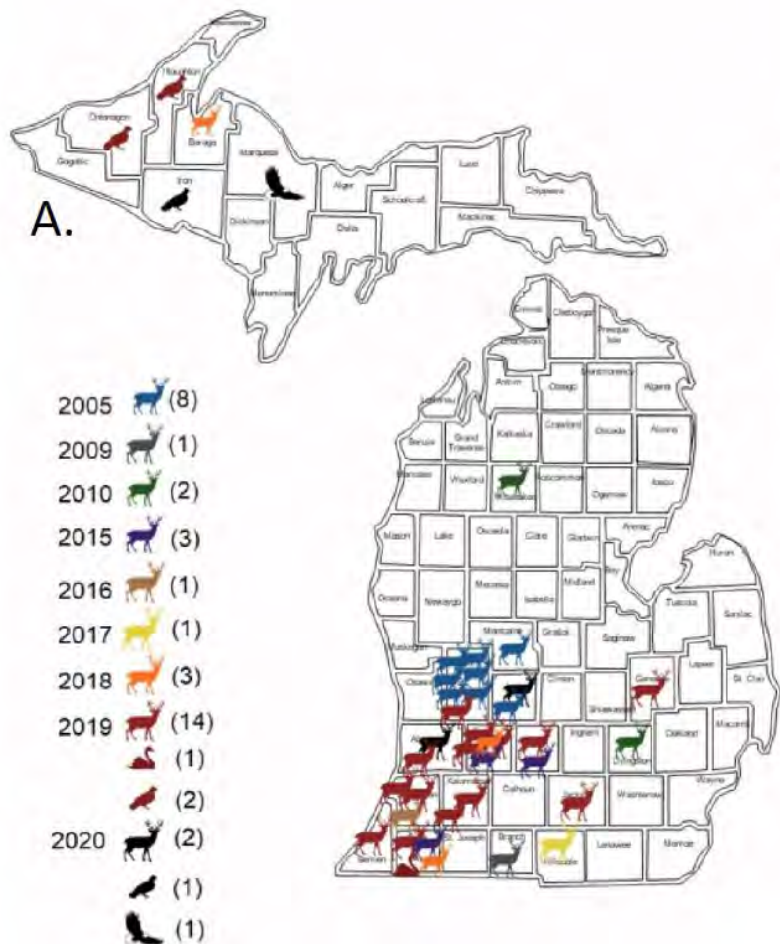
A.



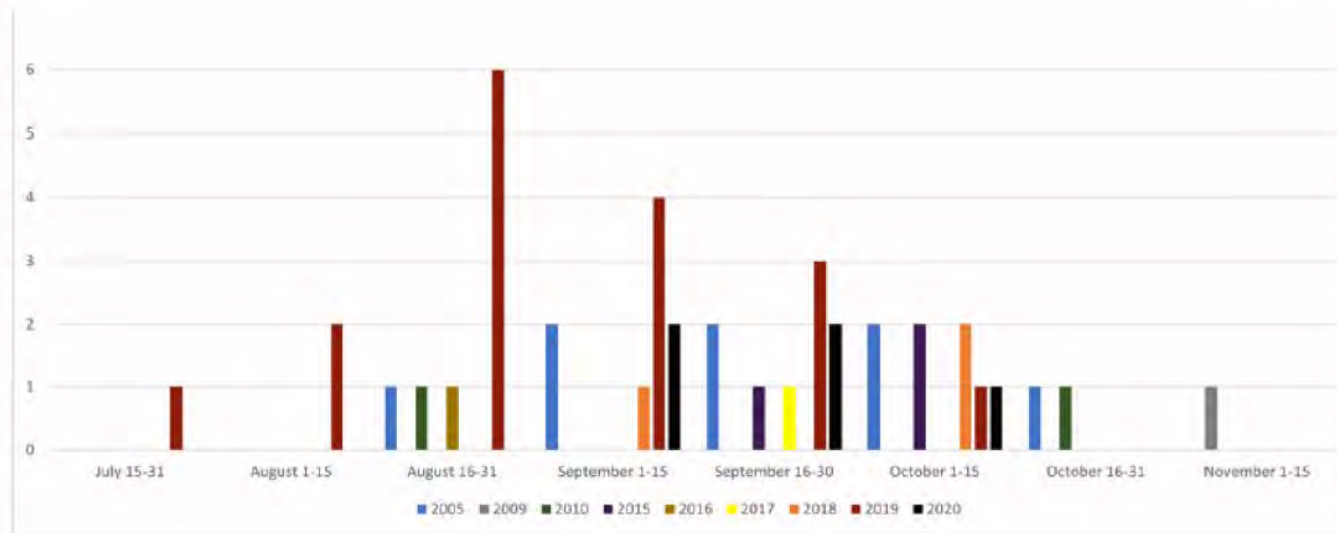
B.



WILDLIFE CASE TRENDS



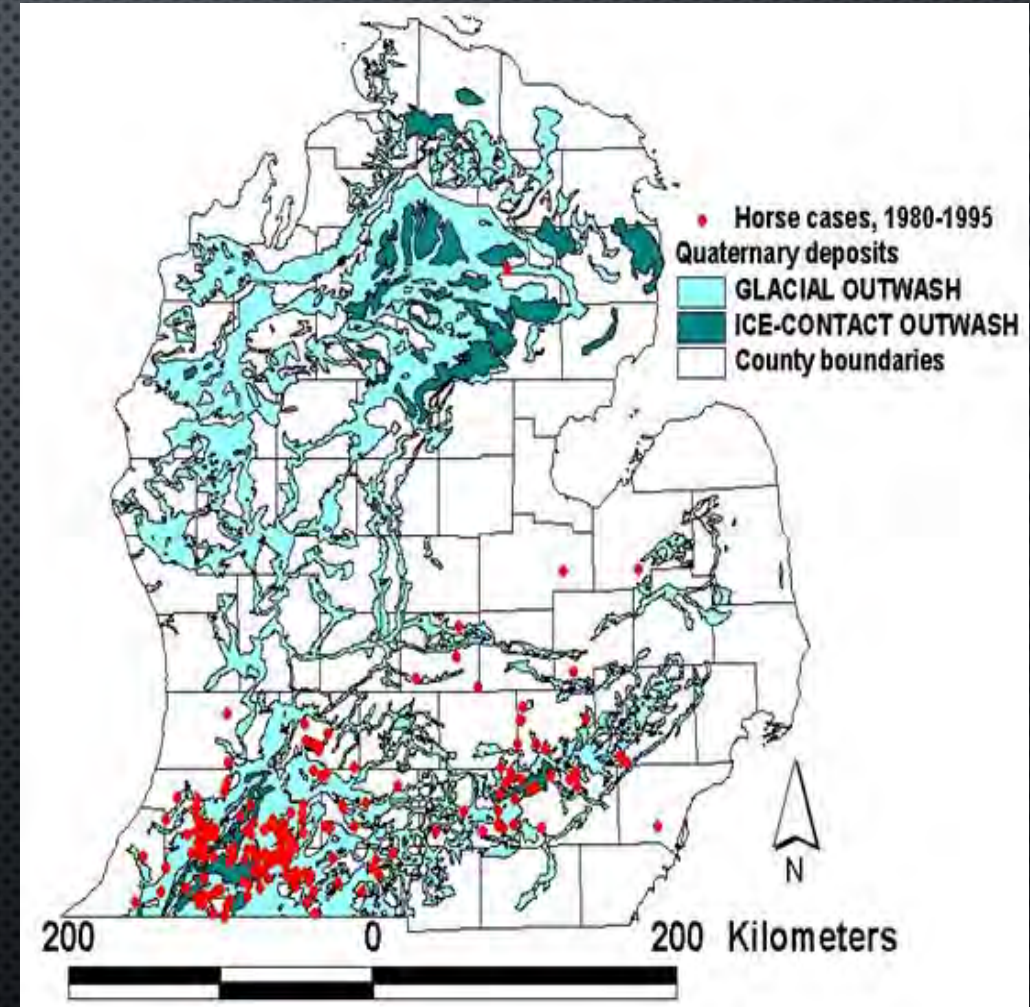
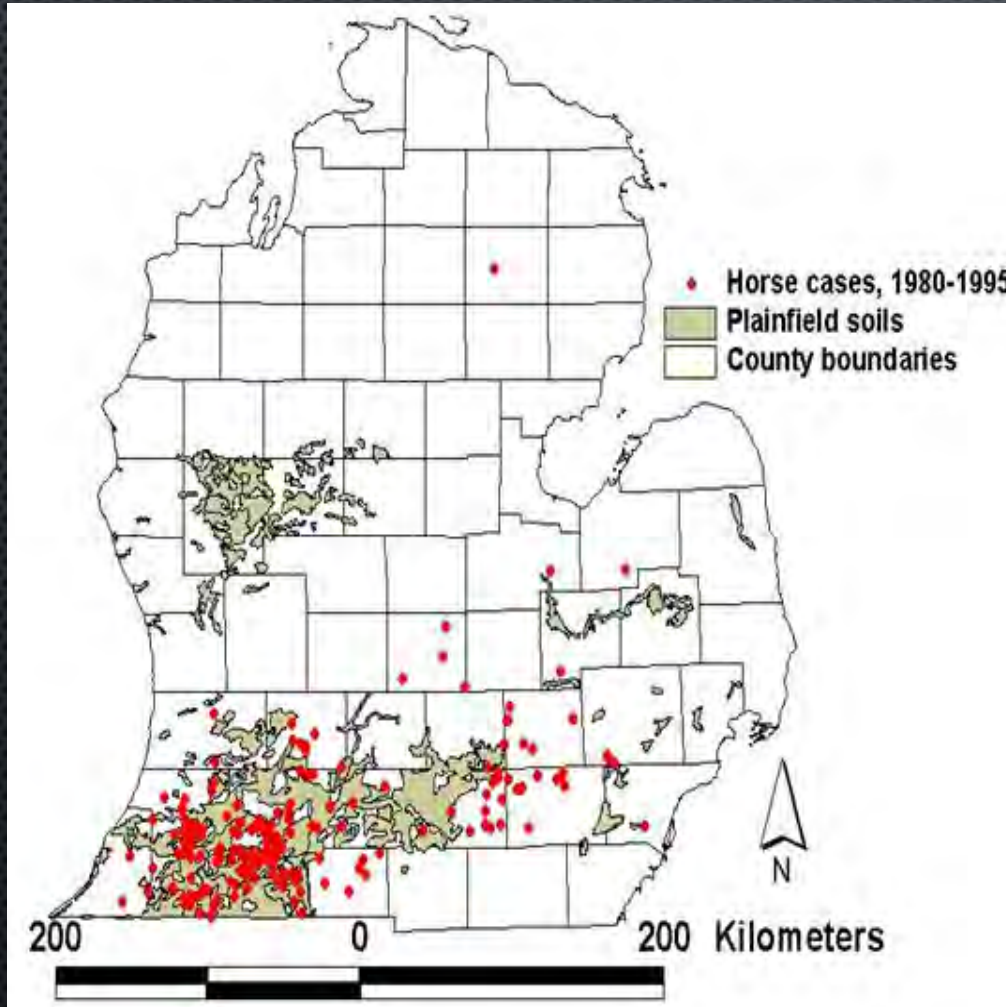
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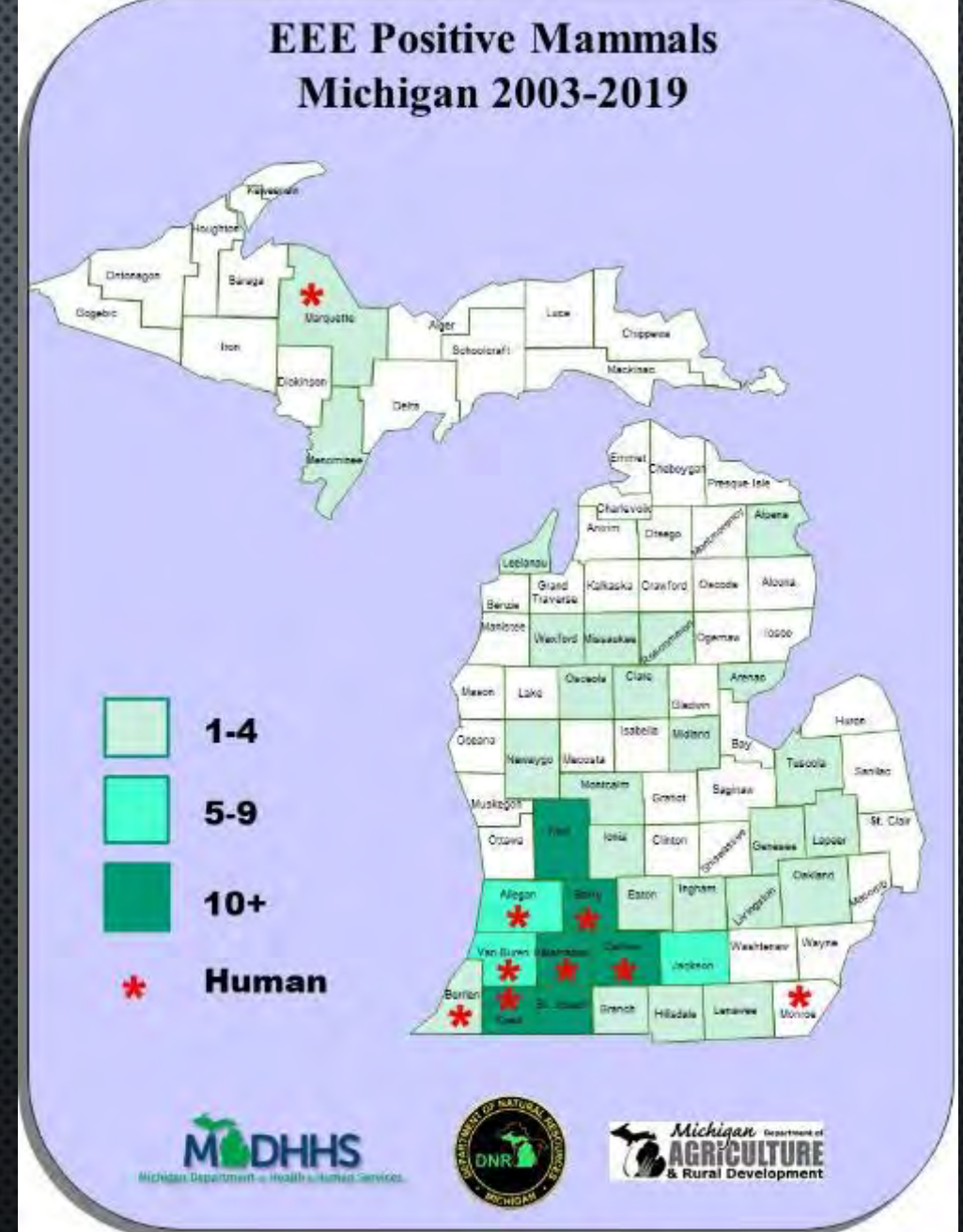
EEE HABITAT

GEOLOGIC FEATURES RELATED TO EEEV

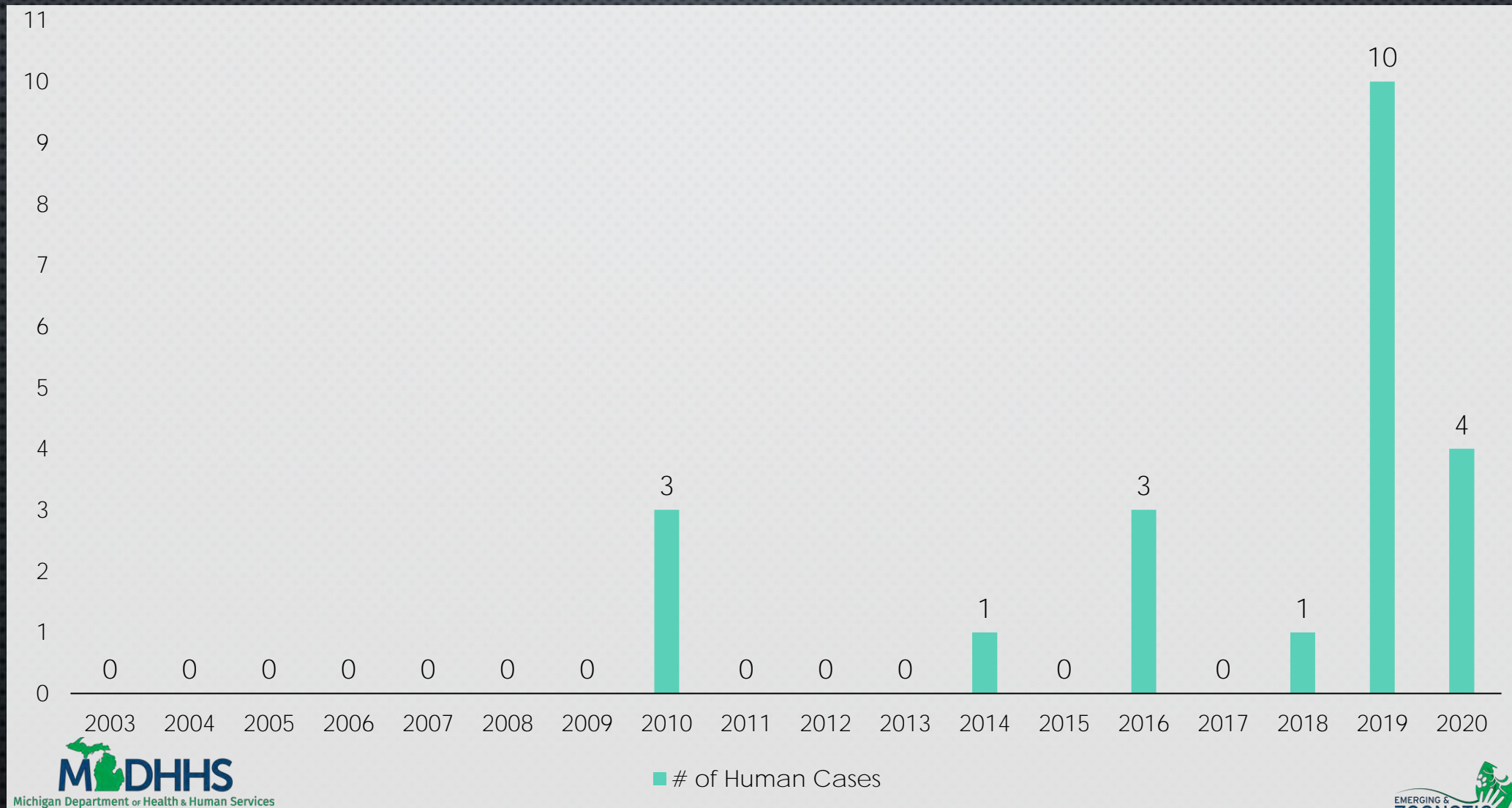


GEOGRAPHY OF EEE IN MICHIGAN

- SW MI has had greatest number of human and animal cases
- This is likely related to the area having lots of swamps and bogs, which provide habitat for the mosquitoes that transmit EEEV & bird hosts



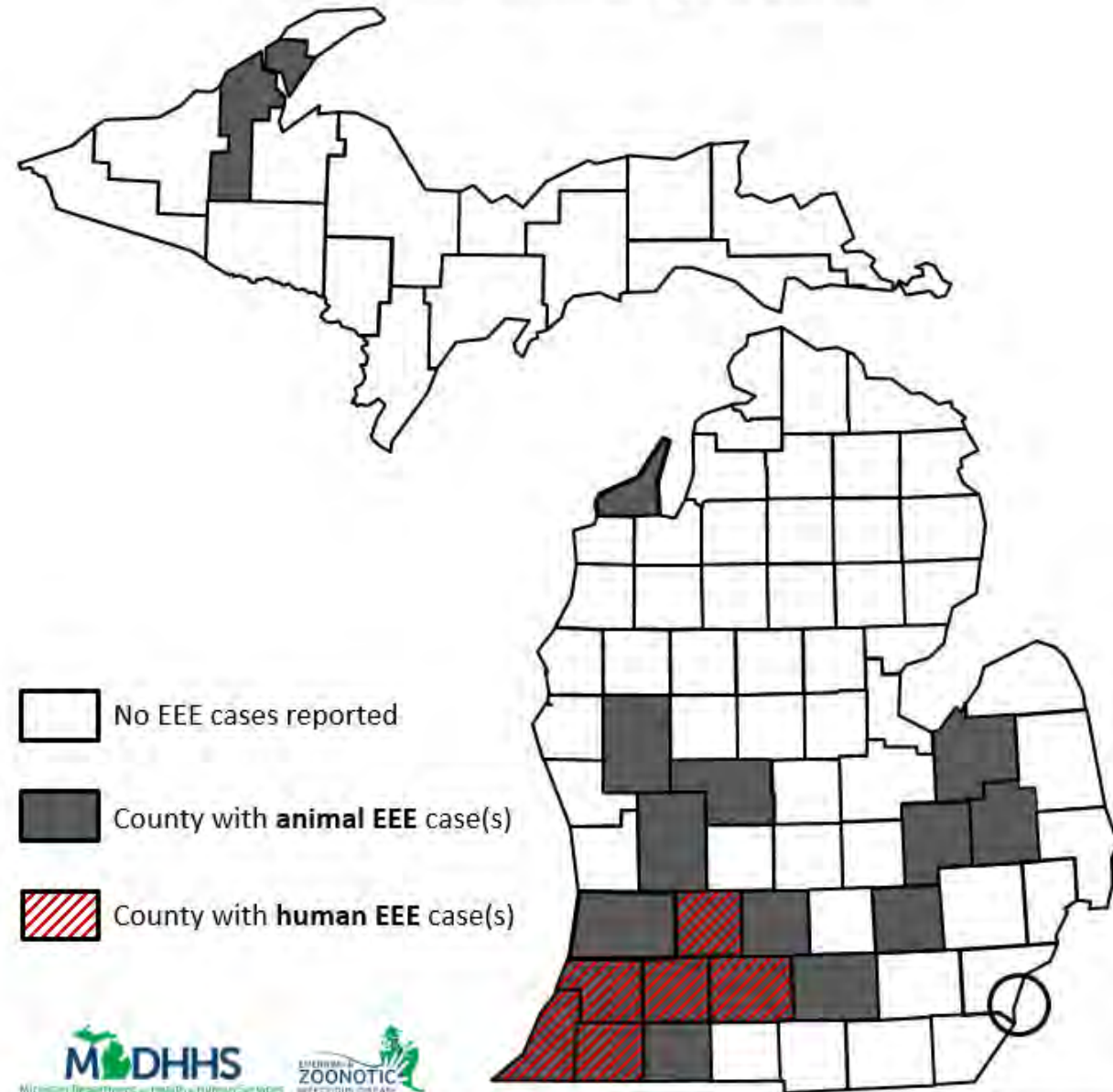
HUMAN CASES OF EEE IN MICHIGAN, 2003-2020



2019 EEE ACTIVITY IN MICHIGAN

- 10 human cases, 6 were fatal
- 50 animals tested positive
- 19 counties with positive cases
 - Most activity occurred in SW
- Positive animals included birds, horses, deer, & wolves
- Onset dates: July 22 – Oct 11

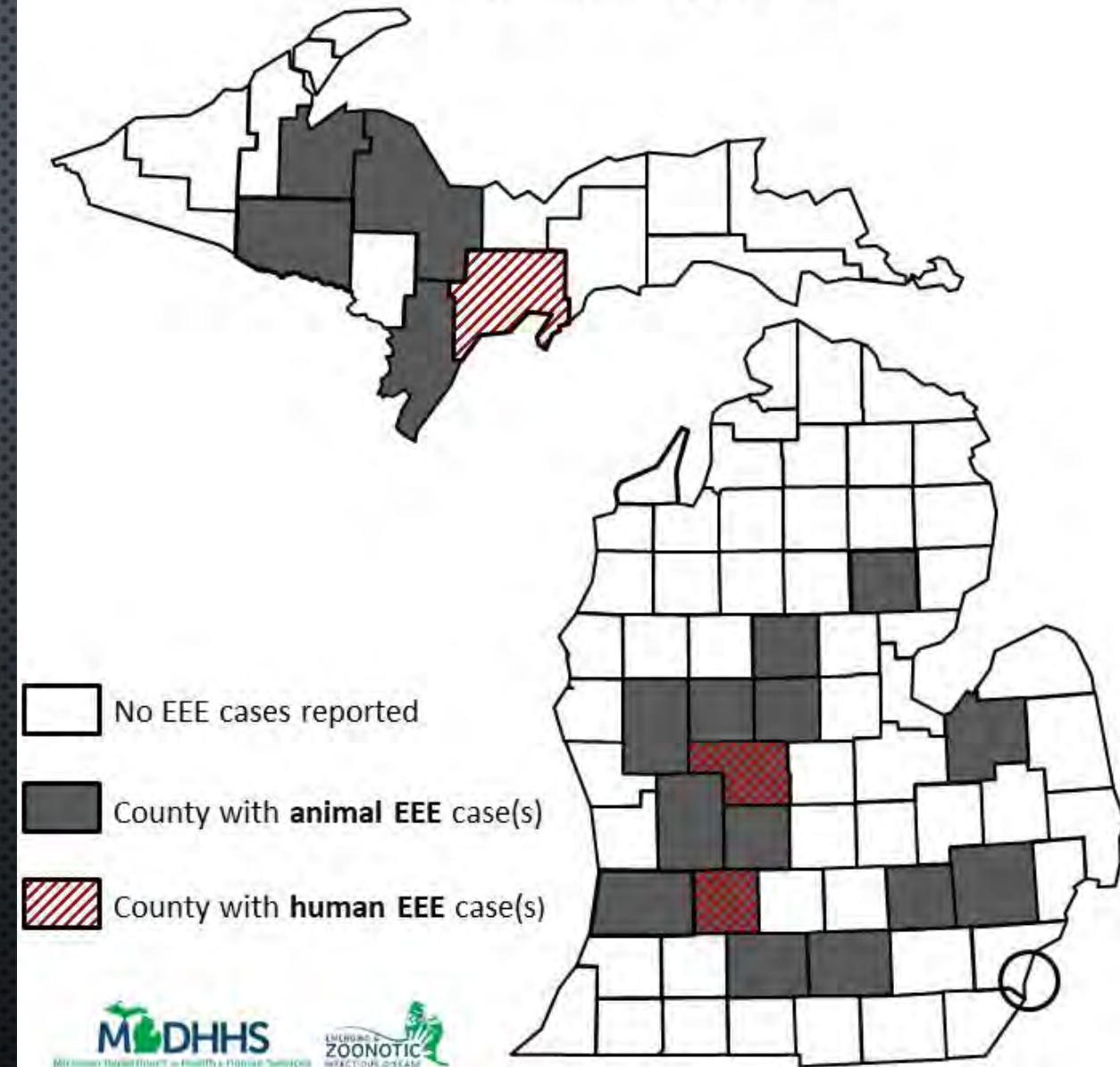
EEE Activity in Michigan, 2019



2020 EEE ACTIVITY IN MICHIGAN

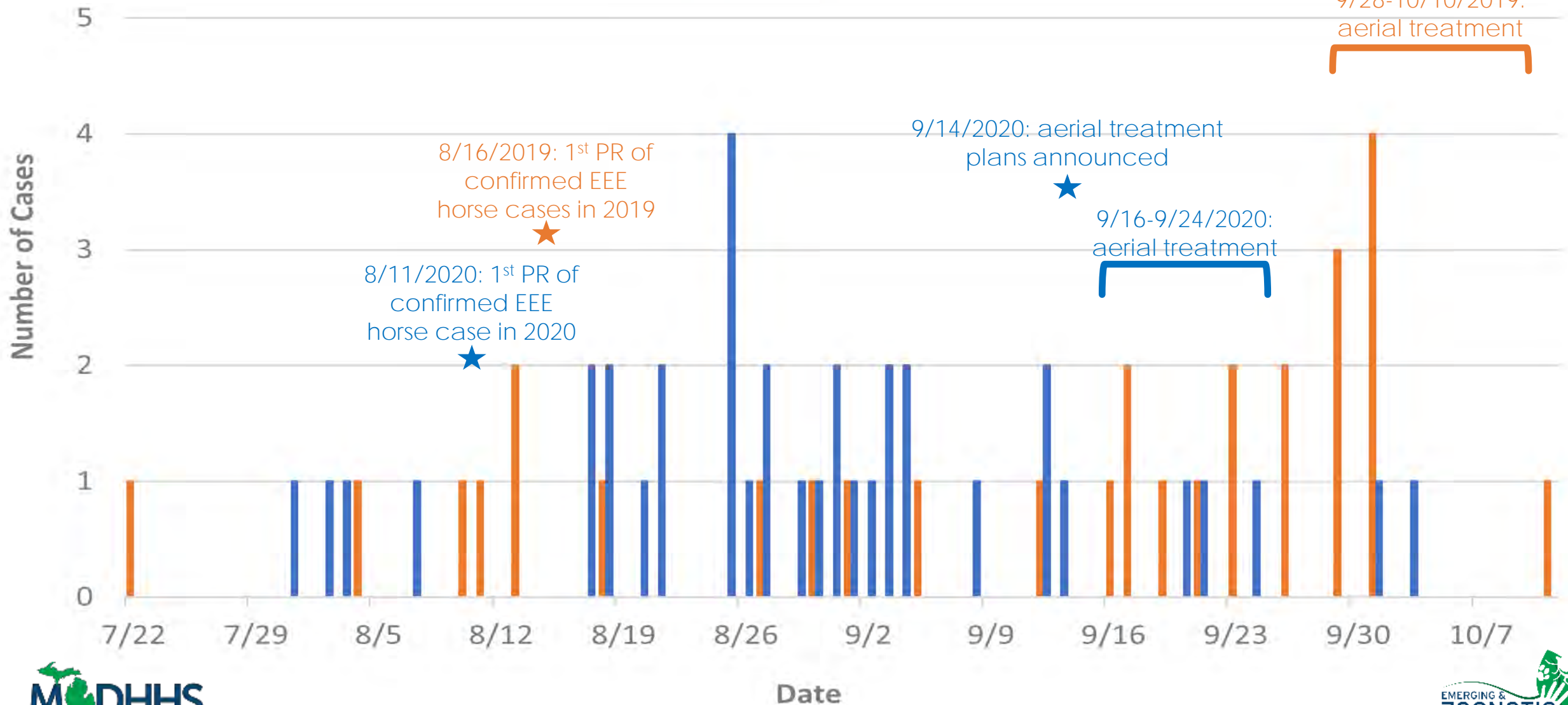
- 4 human cases, 2 fatal
- 41 animals
- 20 counties with positive cases
 - Most cases occurred in mid-MI
- Positive animals included horses, deer, birds
- Onset dates: July 31 – Oct 18
- Surveillance affected by COVID-19

EEE Activity in Michigan, 2020



Equine Case Onset Days 2019 vs 2020

2019 2020



8/16/2019: 1st PR of confirmed EEE horse cases in 2019

8/11/2020: 1st PR of confirmed EEE horse case in 2020

9/14/2020: aerial treatment plans announced

9/16-9/24/2020: aerial treatment

9/27/2019: aerial treatment plans announced

9/28-10/10/2019: aerial treatment

2019 & 2020 EEE MOSQUITO SURVEILLANCE

- Without regular mosquito surveillance and control to give an early warning of mosquito-borne disease risk, MDHHS must assess risk by identifying cases in humans and horses.
- MSU & MDHHS conducted surveillance for EEE mosquitoes in 2019 and 2020 after first horse cases were identified. EEE-positive horses in 2019 & 2020 did not travel before becoming ill, indicating risk was localized
 - EEE vector mosquitoes were found, indicating ongoing risk to humans & animals



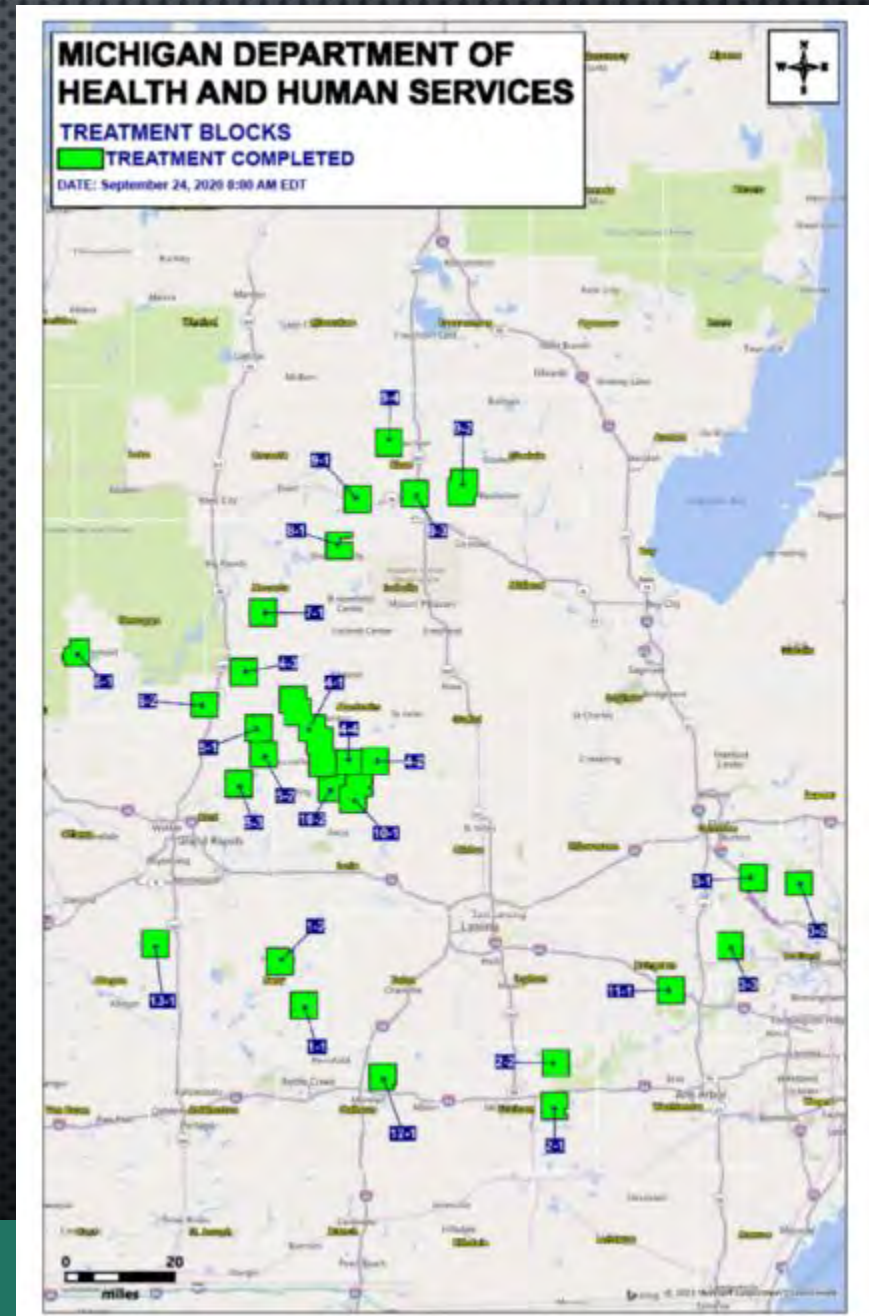
Culiseta melanura



Coquillettia perturbans

DECISION TO INITIATE AERIAL TREATMENTS

- By mid-Sept. 2020, Michigan had twice as many animal cases of EEE as we did in mid-Sept. 2019.
- The species of mosquito that transmits EEE was still being caught in traps
- MDHHS determined that a public health emergency existed
- Identified a contractor to perform treatments, obtained needed permits and waivers for pesticide (Merus 3.0) application
- Notified the public
- Michigan Department of Agriculture and Rural Development issued an emergency rule temporarily amending the rule for notification and participation for community pesticide applications for aerial treatment across affected counties



AERIAL TREATMENT, 9/16-9/24/2020

- Updated treatment maps daily based on weather conditions
- Daily calls with internal and external response partners
- Monitor weather for potential flight plan each day
- Alert local health of proposed treatment areas & product (Merus 3.0); put out daily press releases, updated website
- Monitored poison control, hospital data each day
- Approx. 462,000 acres treated

AERIAL TREATMENT DETAILS



- Aerial treatment involves the use of specially equipped airplanes, which spray a very fine mist of product as they fly. The tiny droplets drift through the air and kill adult mosquitoes that are flying around.
- In an outbreak, aerial treatment is the most effective control method when large areas must be treated quickly.
- Spraying from an aircraft allows treatment to be applied in places where trucks can't go (like swamps and wooded areas).
- Aerial treatment has been used in many other states.
- Monitoring of poison control and hospitals found no human illness associated with the treatment.
- No large-scale pollinator deaths were reported.

Perspective

Eastern Equine Encephalitis Virus — Another Emergent Arbovirus in the United States

David M. Morens, M.D., Gregory K. Folkers, M.S., M.P.H., and Anthony S. Fauci, M.D.

November 21, 2019

N Engl J Med 2019; 381:1989-1992

DOI: 10.1056/NEJMp1914328

“In the absence of vaccines or specific treatments, state and local health departments can provide early warning of imminent human infections by surveilling equids, birds, and mosquitoes; however, even these blunt prevention tools are continuously threatened by underfunding of public health efforts.”

“Arbovirus threats are not easily thwarted by piecemeal efforts.”

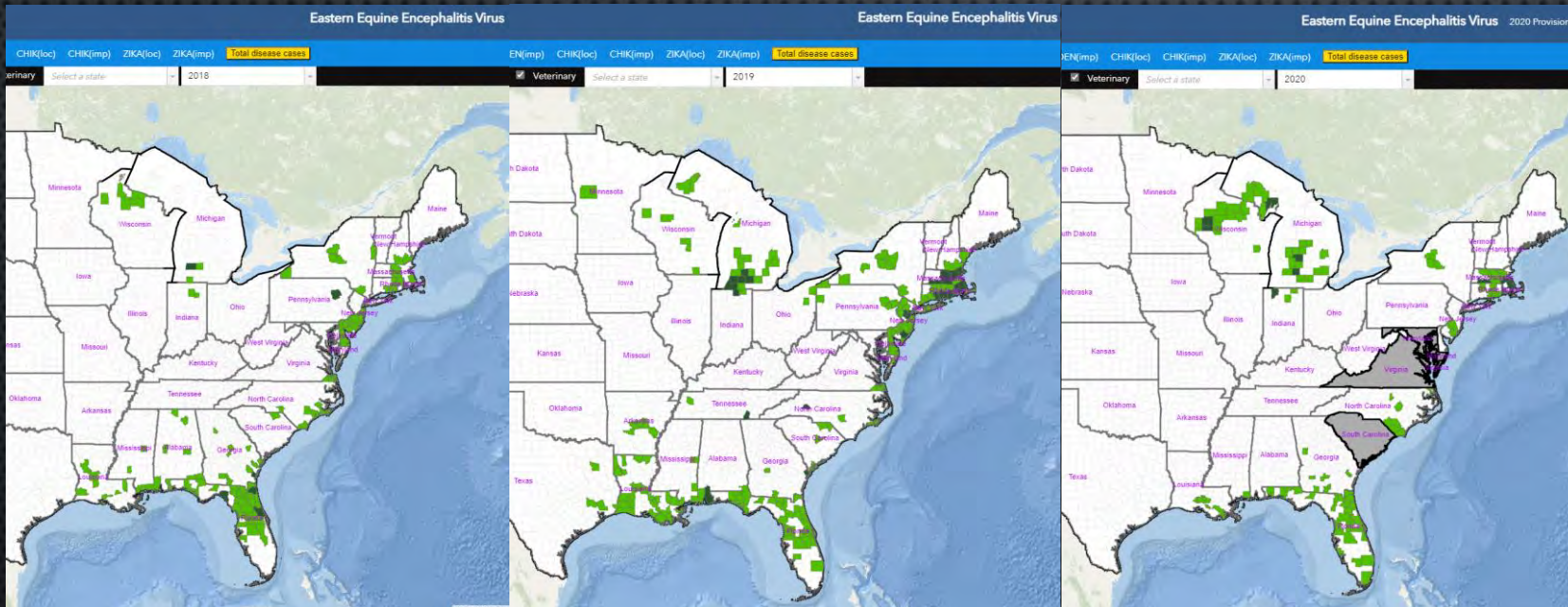
“Although EEE is not yet a disease of major national importance, this year’s spike in cases exposed our inadequate preparation for emergent disease threats. Though the best way to respond to these threats is not entirely clear, to ignore them completely and do nothing would be irresponsible.”

TAKE-HOME MESSAGES

- 2019 marked the most human cases Michigan has ever recorded in a single year
- 2020 – had high EEE risk in expanded geographic area. Mid-MI emerged as a new high-risk area.
- Arboviral illnesses are reported every year in Michigan
- Outbreaks of EEE can occur in large areas of the state
 - Risk varies each year
 - Weather and geography influence both historical and regional risk
- More mosquito surveillance is needed to better anticipate disease risk
- Controlling mosquitoes & arboviral diseases is complicated work that requires community support and sustained funding
- Preventing human disease requires a One Health coordinated approach

KNOWLEDGE GAPS AND OPPORTUNITIES FOR FUTURE RESEARCH

- MUCH ABOUT THE ECOLOGY OF EEEV REMAINS UNKNOWN OR POORLY UNDERSTOOD
- WE NEED TO BE BETTER ABLE TO PREDICT OUTBREAKS TO MITIGATE THEIR IMPACT
- WHAT IS THE ROLE OF:
 - GEOGRAPHY/GEOLOGY
 - BIRDS AND THEIR MOVEMENTS
 - CLIMATE/WEATHER
 - OTHER FACTORS?



A National Public Health Framework for the Prevention and Control of Vector-Borne Diseases in Humans



Centers for Disease Control and Prevention
National Center for Emerging and Zoonotic Infectious Diseases

Solution



VISION

A NATION WHERE VECTOR-BORNE DISEASES NO LONGER THREATEN HUMAN HEALTH AND WELL-BEING



MISSION

PROTECT PEOPLE FROM ILLNESS, SUFFERING, AND DEATH DUE TO VECTOR-BORNE DISEASES



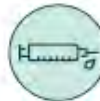
GOALS



1 Better understand when, where, and how people are exposed to and get sick or die from vector-borne diseases



2 Develop, evaluate, and improve tools and guidance for the diagnosis and detection of vector-borne diseases



3 Develop, evaluate, and improve tools and guidance for the prevention and control of vector-borne diseases



4 Develop and assess drugs and treatment strategies for vector-borne diseases



5 Disseminate and support the implementation of effective public health and vector control products, tools, and programs to prevent, detect, diagnose, and respond to vector-borne disease threats

A National Public Health Framework for the Prevention and Control of Vector-Borne Diseases in Humans

THE PROBLEM

Americans are at an increasing risk of vector-borne diseases, and the United States is not adequately prepared to respond to these threats. ←



A COORDINATED APPROACH

To address the growing threat to public health, CDC, five federal departments, and the Environmental Protection Agency developed a joint *National Public Health Framework for the Prevention and Control of Vector-Borne Diseases in Humans*.



VISION

A nation where vector-borne diseases no longer threaten human health and well-being



MISSION

Protect people from illness, suffering, and death due to vector-borne diseases

GOALS



1 Better understand when, where, and how people are exposed to and get sick or die from vector-borne diseases



2 Develop, evaluate, and improve tools and guidance for the diagnosis and detection of vector-borne diseases



3 Develop, evaluate, and improve tools and guidance for the prevention and control of vector-borne diseases



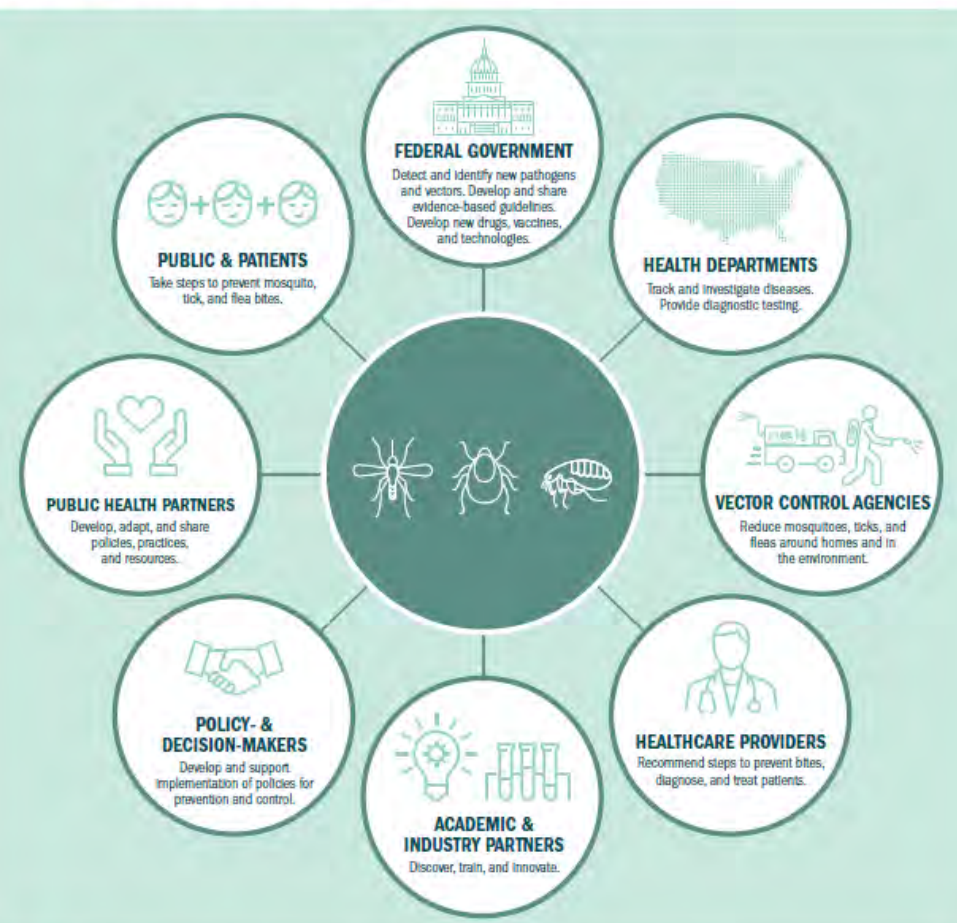
4 Develop and assess drugs and treatment strategies for vector-borne diseases



5 Disseminate and support the implementation of effective public health and vector control products, tools, and programs to prevent, detect, diagnose, and respond to vector-borne disease threats



WORKING TOGETHER: Protecting everyone from vector-borne diseases



Implementing the goals outlined in the *National Public Health Framework* requires continued partnerships, leadership, and excellence in innovation by public and private partners in order to prevent and control vector-borne diseases and save lives.



The *National Public Health Framework* was developed by the Departments of: Health and Human Services · Agriculture · Defense · Homeland Security · Interior and the Environmental Protection Agency

CS317820A

LEARN MORE → www.cdc.gov/ncezid/dvbd/framework.html

- MI Disease Mapper
- Ticks and Your Health
- Mosquitoes and Your Health
- Being Safe Around Animals
- Bed Bugs, Head Lice, and Scabies
- Diseases affecting wildlife

EMERGING DISEASE ISSUES

Lyme Disease

Lyme disease is caused by the bacterium *Borrelia burgdorferi* and is transmitted by the blacklegged tick. It is the most commonly reported vector-borne disease in the United States and it is spreading across the state of Michigan. Typical clinical signs include flu-like symptoms however, if left untreated may spread to joints, the heart, and/or the nervous system. The majority of cases can be treated successfully with antibiotics. Finding and removing ticks promptly can prevent Lyme disease.



Lyme Disease

GOT A TICK? SUBMIT IT FOR ID
Click here for more information on identifying and testing ticks

GOT A TICK? SUBMIT A PIC!
Click here for more information on picture ID



2017 Emerging and Zoonotic Disease Surveillance Summary



Who is at risk?



National Lyme Disease Map

Anyone living or recreating where Lyme disease ticks may be present could become infected. Lyme disease is endemic (prevalent) in the Northeast, Northwest, and much of the North Central United States, including Wisconsin, Illinois, Indiana, and Pennsylvania.



Michigan Lyme Disease Risk Map

In Michigan's Upper Peninsula, multiple counties have well-established tick populations, due in part to the close proximity to Wisconsin. In the Lower Peninsula, the first confirmed infected population of blacklegged ticks were detected in 2002 along the west coast. Since that time, the tick and the bacterium have been invading northward along the Lake Michigan coast. However, currently, infected ticks are spreading and being detected across several portions of the Lower Peninsula.

- Signs and Symptoms
- Diagnosis and Testing
- Treatment
- Prevention
- Educational Materials and Guidance Documents
- Data, Statistics, and Maps

MICHIGAN.GOV/EMERGINGDISEASES

Diseases that may affect humans or animals.

- MI Disease Mapper
- Ticks and Your Health
- Mosquitoes and Your Health
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2017 Emerging and Zoonotic Disease Surveillance Summary



Agricultural Exhibits and Events



Anaplasmosis



Avian Influenza



Babesiosis



Bed Bugs



Bovine Tuberculosis (bTB)



Chikungunya



Chronic Wasting Disease (CWD)



Dengue



For additional information, visit:
www.michigan.gov/eee

Michigan Emerging Disease Issues
 Diseases that may affect humans or animals.

Search

- MI Disease Mapper
- Ticks and Your Health
- Mosquitoes and Your Health
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- Diseases affecting wildlife

EMERGING DISEASE ISSUES

Eastern Equine Encephalitis

2020 EEE Outbreak Information

As of Oct. 1, EEE has been confirmed in 36 animals in 15 counties – 34 equine and two deer. To date, there is one confirmed human case in Barry County. There is an EEE vaccine available for horses, but not for people. Protecting horses with approved EEE vaccines is an important prevention measure.

In an effort to prevent spread of Eastern Equine Encephalitis (EEE), MDHHS has announced plans to conduct aerial mosquito control treatment in certain high-risk areas of Michigan. To prevent the loss of life and protect public health, MDHHS has determined a targeted aerial treatment plan is necessary. When there are high rates of animal infections, humans are just as at risk.

EEE is one of the most dangerous mosquito-borne diseases in the United States, with a 33 percent fatality rate in people who become ill. People can be infected with EEE from one bite of a mosquito carrying the virus. Persons younger than age 15 and over age 50 are at greatest risk of severe disease following infection. More than 25 percent of the nation's EEE cases last year were diagnosed in Michigan. The risk of bites is highest for people who work and play outdoors in affected areas.

Update for Thursday, September 24

Aerial treatment to help prevent the spread of Eastern Equine Encephalitis resulted in nearly 27,000 acres being treated in Blocks 4-4 and 10-2 on Wednesday, Sept. 23. Nearly 462,000 acres have been treated to date.

At this time, no additional treatment is planned. MDHHS will continue to monitor the situation and treatment zones could be added if new cases are found and aerial treatment would be effective to reducing risk of exposure.

The most up-to-date information will be posted here at Michigan.gov/EEE.

Arbovirus* Activity, Including West Nile Virus and Eastern Equine Encephalitis: Daily Outbreak Summary, Michigan 2020

*Arboviruses are viruses transmitted by mosquitoes or other insects. Updated: [Date], 2020

Mosquito pools testing positive for West Nile virus infection

Birds testing positive for West Nile virus infection

Human cases of West Nile virus or other arboviruses reported

| | |
|--|---|
| West Nile Virus (WNV) Positive Pools | 1 |
| Total Number of Mosquito Pools Tested | 1 |
| Total Number of Mosquitoes Tested | 1 |
| Human Cases | 1 |
| Human California Group virus cases | 1 |
| WNV Positive Birds | 1 |
| Equine Cases | 1 |
| Avian Cases | 1 |
| Human Eastern Equine Encephalitis (EEE) Cases | 1 |
| Animal Eastern Equine Encephalitis (EEE) Cases | 1 |

Highlights

- For 2020, West Nile Virus (WNV) has been reported in 1 bird from [County]. No other mosquito-borne virus infections have been reported in any other species to date.
- In 2019, Eastern Equine Encephalitis virus (EEE) infected 10 Michigan residents (1 Barry, 2 Berrien, 1 Calhoun, 2 Cass, 3 Kalamazoo, and 1 Van Buren) with 6 fatalities; 50 animals (2 Allegan, 3 Barry, 1 Berrien, 3 Calhoun, 4 Cass, 1 Genesee, 1 Eaton, 1 Houghton, 5 Jackson, 7 Kalamazoo, 2 Kent, 1 Lapeer, 1 Leelanau, 1 Livingston, 1 Montcalm, 1 Newaygo, 1 Ontonagon, 7 St. Joseph, 1 Tuscola, and 2 Van Buren).
- West Nile virus (WNV) sickened 12 Michigan residents and 3 were infected with a California group virus.

Human Cases

Animal Cases

Michigan Department of Health & Human Services
 Bureau of Epidemiology & Population Health
 Emerging & Zoonotic Infectious Diseases (EZD) Section

For more information: www.michigan.gov/westnile

MDHHS BOL MOSQUITO-BORNE DISEASE TESTING

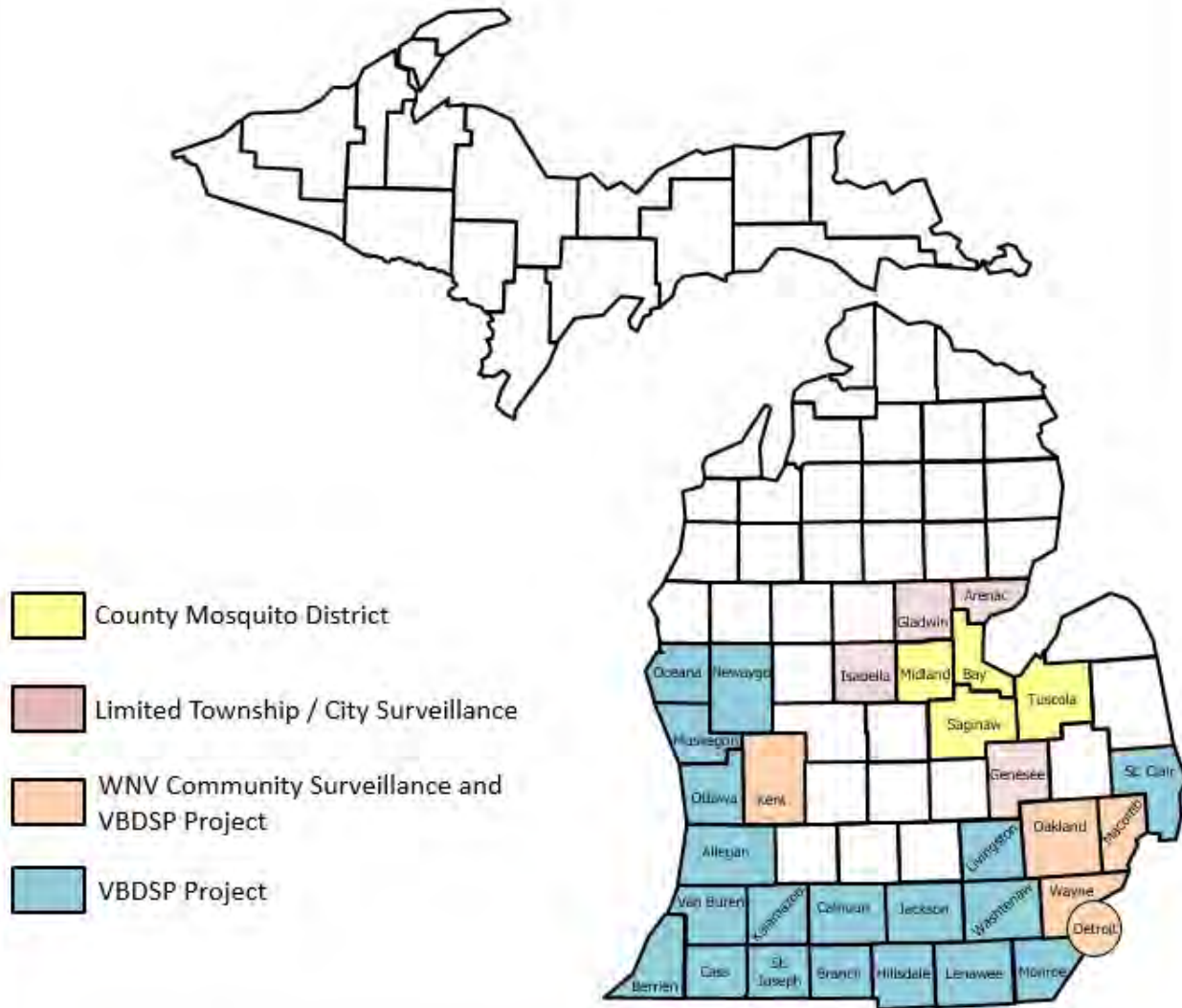
- TESTING FOR MOSQUITO-BORNE VIRUSES SHOULD BE CONSIDERED IN PATIENTS PRESENTING WITH MENINGITIS, ENCEPHALITIS, OR OTHER ACUTE NEUROLOGIC ILLNESS IN WHICH AN INFECTIOUS ETIOLOGY IS SUSPECTED DURING THE SUMMER MONTHS IN MICHIGAN
- THE MICHIGAN DEPARTMENT OF HEALTH AND HUMAN SERVICES BUREAU OF LABORATORIES (MDHHS BOL) OFFERS:
 - CALIFORNIA GROUP ENCEPHALITIS VIRUS (CGV), NOW INCLUDES JAMESTOWN CANYON VIRUS
 - EASTERN EQUINE ENCEPHALITIS VIRUS (EEE)
 - ST. LOUIS ENCEPHALITIS VIRUS (SLE)
 - WEST NILE VIRUS (WNV)
- TESTING IS AVAILABLE FREE OF CHARGE THROUGH MICHIGAN HEALTHCARE PROVIDERS FOR THEIR PATIENTS
- METHODOLOGIES INCLUDE:
 - IGM DETECTION FOR ARBOVIRUSES (CGV, JCV, EEE, SLE, WNV)
 - MOLECULAR DETECTION (PCR) FOR WNV ONLY; OTHERS PERFORMED AT CDC BY SPECIAL REQUEST
 - PLAQUE REDUCTION NEUTRALIZATION TEST (PRNT) AS CONFIRMATORY TEST WHEN INDICATED
- PREFERRED SPECIMEN FOR ARBOVIRUS SEROLOGY IS CEREBRAL SPINAL FLUID (CSF), FOLLOWED BY PAIRED SERUM SAMPLES (ACUTE AND CONVALESCENT)

NEW FOR 2021

MDHHS BUREAU OF LABORATORIES ADDS MOSQUITO TESTING CAPACITY

- BEGINNING IN 2021, THE MDHHS BOL IS OFFERING PATHOGEN TESTING OF MOSQUITO POOLS
- AVAILABLE TO MICHIGAN JURISDICTIONS CONDUCTING MOSQUITO SURVEILLANCE AND CONTROL
- THIS IS PART OF AN EFFORT TO SUPPORT THE DEVELOPMENT OF MOSQUITO SURVEILLANCE AND CONTROL PROGRAMS AT THE LOCAL LEVEL

MICHIGAN VECTOR SURVEILLANCE CAPACITY



- 4 MILLAGE-BASED DISTRICT MOSQUITO PROGRAMS
 - BAY, MIDLAND, SAGINAW, TUSCOLA
- LIMITED TOWNSHIP AND CITY MOSQUITO SURVEILLANCE
 - ARENAC, GENESEE, GLADWIN, ISABELLA
- WNV COMMUNITY SURVEILLANCE
 - FOCUSED IN AREAS THAT EXPERIENCE THE MOST WNV ACTIVITY
 - DETROIT, KENT, MACOMB, OAKLAND, WAYNE
- VECTOR-BORNE DISEASE SURVEILLANCE PROGRAM
 - EXPANDED GEOGRAPHIC RANGE AND MAGNITUDE OF MOSQUITO SURVEILLANCE
 - OVER 28,000 MOSQUITOES TRAPPED, IDENTIFIED, AND REPORTED TO MOSQUITONET IN 2019
 - ESTABLISH ROUTINE TICK SURVEILLANCE IN COUNTIES WITH BLACK-LEGGED TICK EMERGENCE, RISK FOR OTHER INVASIVE TICKS

TYPES OF MOSQUITO TRAPS

New Jersey Light Trap



Cq. perturbans – EEE
Ae. vexans – dog heartworm
Cx. pipiens – SLE, WNV, EEE

and more...

CDC Miniature Light Trap



Cq. perturbans, *Cs. melanura* – EEE
Ae. vexans – dog heartworm
Cx. pipiens – SLE, WNV, EEE
An. quadrimaculatus – malaria

and more...

CDC Gravid Trap



Culex pipiens, *Cx. tarsalis* --
 SLE, WNV, EEE

BG-Sentinel Trap



Ae. aegypti & *Ae. Albopictus* --
 Yellow fever, dengue, chikungunya,
 Zika

COMPONENTS OF A COMPREHENSIVE MOSQUITO SURVEILLANCE AND CONTROL PROGRAM

- PUBLIC SUPPORT-AND ONGOING PUBLIC EDUCATION
- ADEQUATE FUNDING
- STABLE AND TRAINED WORKFORCE
- EQUIPMENT AND SUPPLIES TO CONDUCT MOSQUITO SURVEILLANCE FOR THE TARGETED SPECIES
- MEANS OF QUICKLY TESTING MOSQUITO POOLS FOR PATHOGENS
- ABILITY TO CONDUCT MOSQUITO CONTROL-LARVACIDING/ADULTICIDING
- ABILITY TO PERFORM PESTICIDE RESISTANCE MONITORING
- ONGOING HUMAN AND ANIMAL CASE SURVEILLANCE
- MEANS OF REGULAR COMMUNICATION WITH THE PUBLIC ABOUT RISK AND PREVENTION
- PHASED ARBOVIRUS OUTBREAK RESPONSE PLAN
- PERMITS AND CONTRACTS IN PLACE IN THE CASE OF OUTBREAK EMERGENCY RESPONSE



THANK YOU

QUESTIONS?

SELECTED REFERENCES

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