

Michigan Vector-Borne Disease Update

Jennifer Sidge, DVM, PhD

Medical Ecologist

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Education Conference

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Why do we care?

- ❑ *Mosquito-borne diseases are present in Michigan every year and present a serious risk to human and animal health.*
- ❑ *Mosquito Control is one of the foundations of preventive public health practice.*
- ❑ *MDHHS performs and supports human and ecologic surveillance for mosquito-borne disease in order to inform the public, healthcare providers, and stakeholder agencies about preventive measures and control options.*

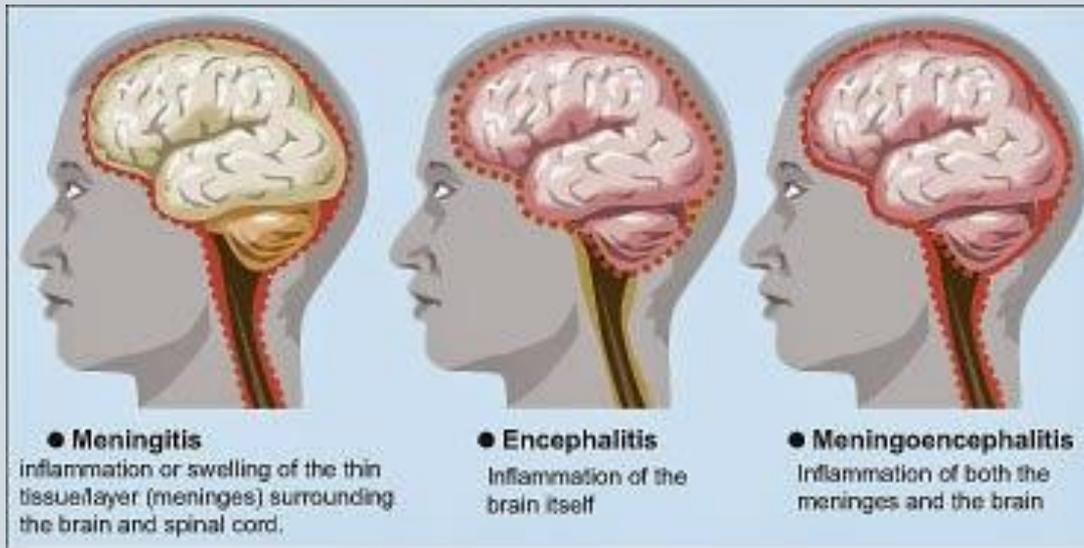


FIGHT **THE** **BITE**

Mosquito-borne virus illness

- Generally 3-15 days incubation period
- Symptoms range from acute febrile illness, to painful arthritis, to neuro-invasive disease and hemorrhage
- Depend upon age, medical history, etc.
- Various viruses with different abilities to cause clinical illness
 - West Nile: 1 in 5 morbidity/<1% severe/3-15% severe illness results in death
 - EEE: rare, but high mortality ~33%
 - Chikungunya: >70% morbidity, rarely fatal
 - Zika: mild clinical illness, but may cause severe birth defects
- Treatment is supportive

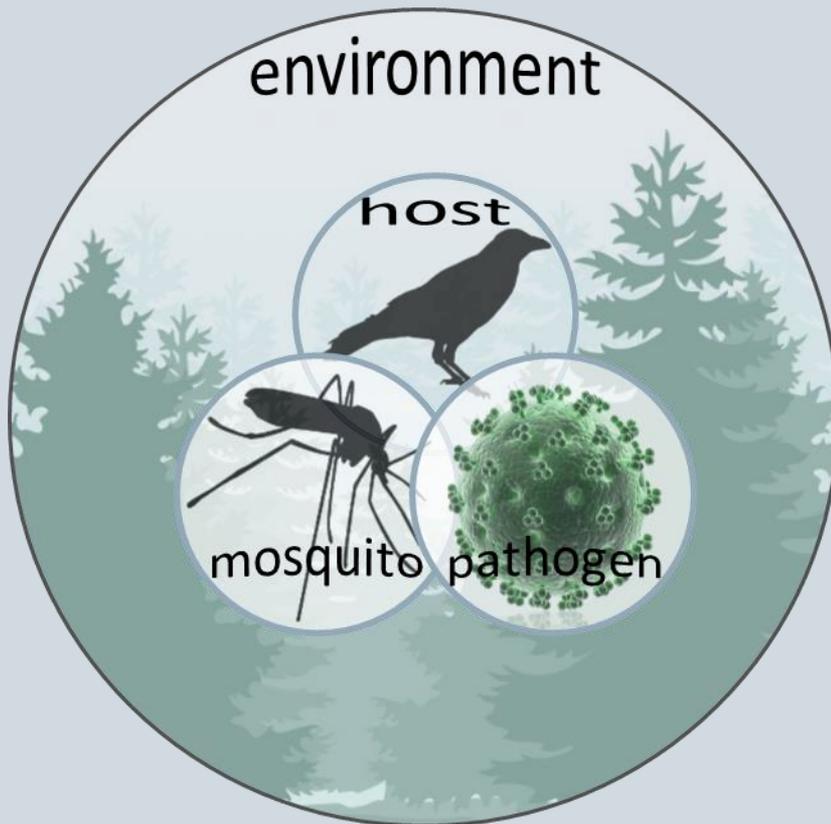
Neuro-invasive disease



Is an inflammation of the brain, or meninges with symptoms ranging from mild to acute, both physical and mental.

- Headaches
- Neck pain
- Fever
- Confusion
- Irritability
- Tremors
- Coma
- Death

Michigan mosquito-borne diseases



Endemic Diseases

West Nile Virus

St. Louis Encephalitis

Eastern Equine Encephalitis

California Group Viruses

Zoonotic

Imported Diseases

Chikungunya

Dengue

Zika

Zoonotic

&

Anthroponotic

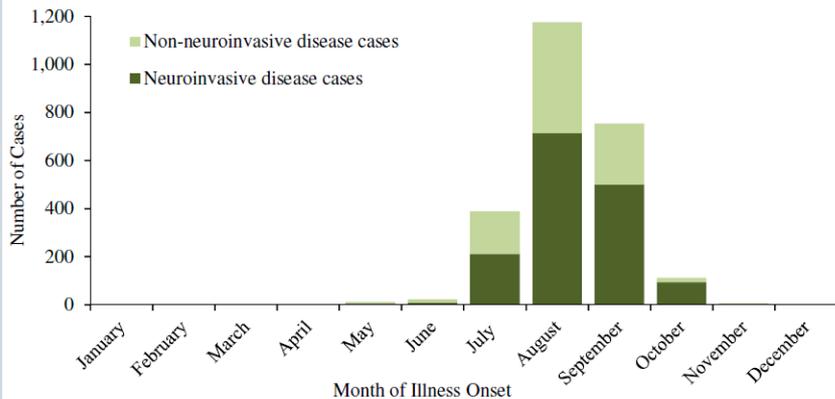
Arbovirus Human Cases: Michigan 2018

- Michigan's local health departments (LHDs) and the MDHHS promptly investigate all reports of mosquito-borne disease using the Michigan Disease Surveillance System (MDSS)
- As cases are confirmed, the information is reported to the Centers for Disease Control and Prevention (CDC) through the ArboNET system
- Throughout the arbovirus transmission season, surveillance information is posted to the Michigan Emerging Diseases website at www.michigan.gov/emergingdiseases

Arbovirus	Locally Acquired/Imported	2018 Cases	Fatalities
Eastern Equine Encephalitis	Locally Acquired	1 case (Allegan Co.)	0
Jamestown Canyon Virus	Locally Acquired	2 cases (Oakland, Menominee)	0
West Nile Virus	Locally Acquired	104 cases (3 rd highest year)	9
Dengue	Imported	8 cases	0

West Nile Virus – 2018 National Data*

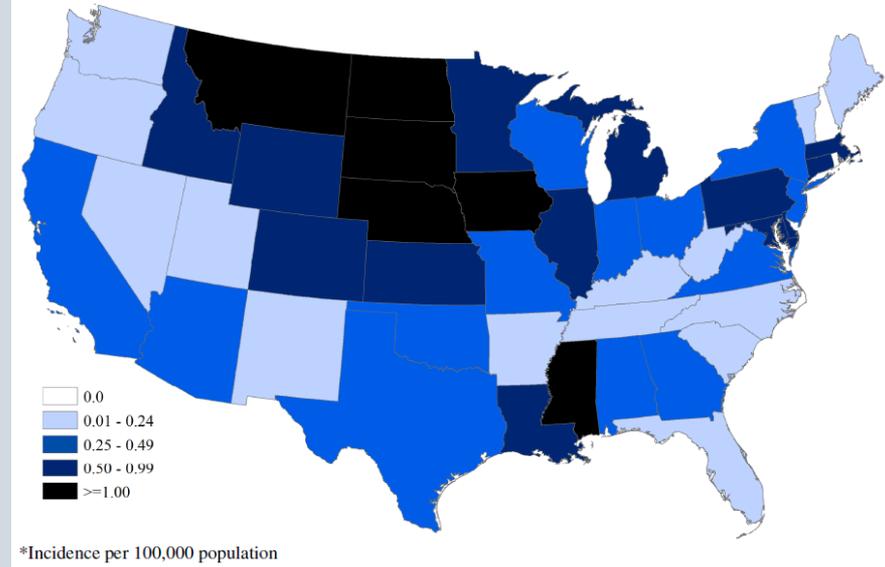
Figure 2. West Nile virus disease cases reported to ArboNET, by month of onset* — United States, 2018 (as of December 11, 2018)



*Cases missing onset date (n=2)

~2,500 WNV cases
>120 fatalities

Figure 3. West Nile virus (WNV) neuroinvasive disease incidence* reported to ArboNET, by state — United States, 2018 (as of December 11, 2018)



*Incidence per 100,000 population

*provisional data as of 12/11/18

WNV- MI Epidemiology

Geographic Distribution - Statewide

Seasonal epidemic late summer into fall

Habitat Distribution– primarily urban/suburban

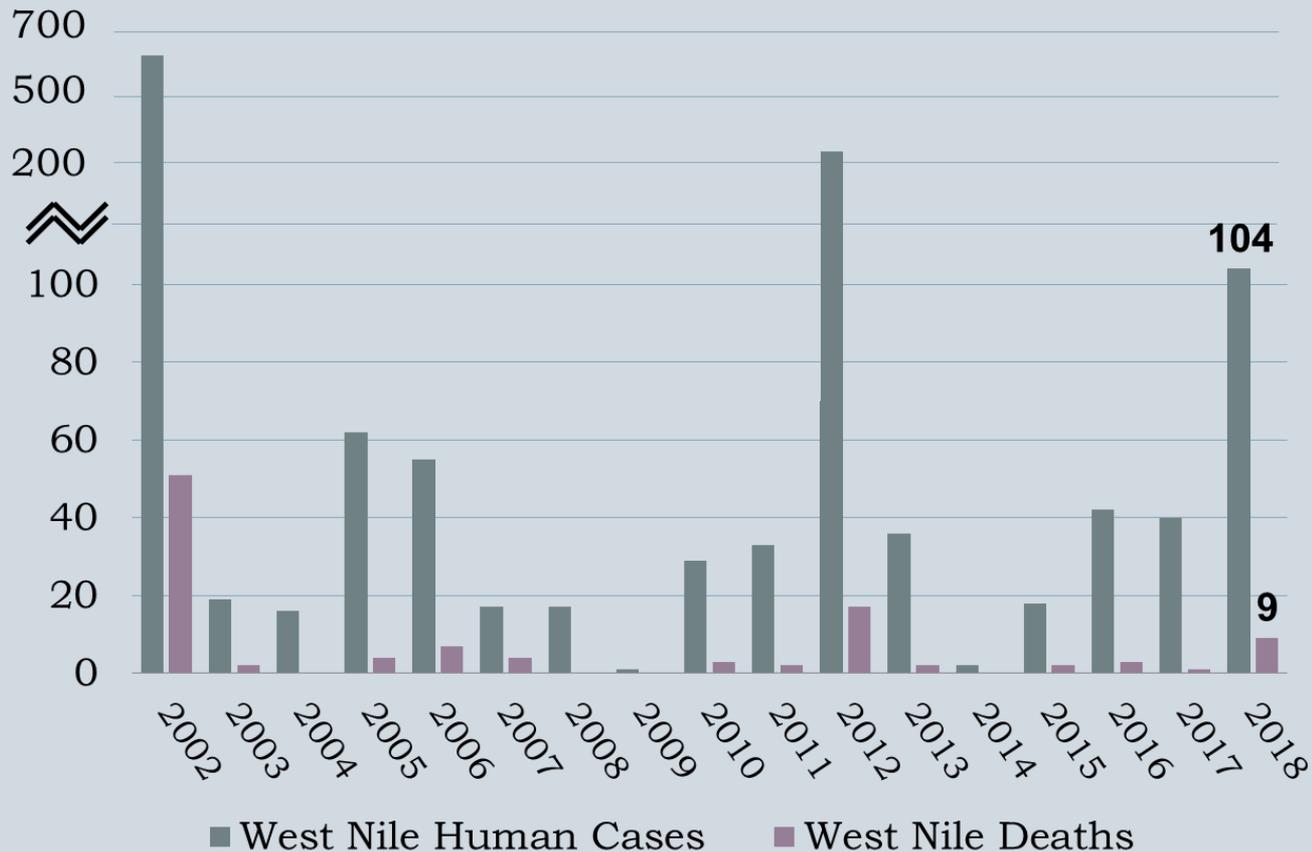
Humans – 1 in 150 severe symptoms; up to 20% mild; and 80% no symptoms

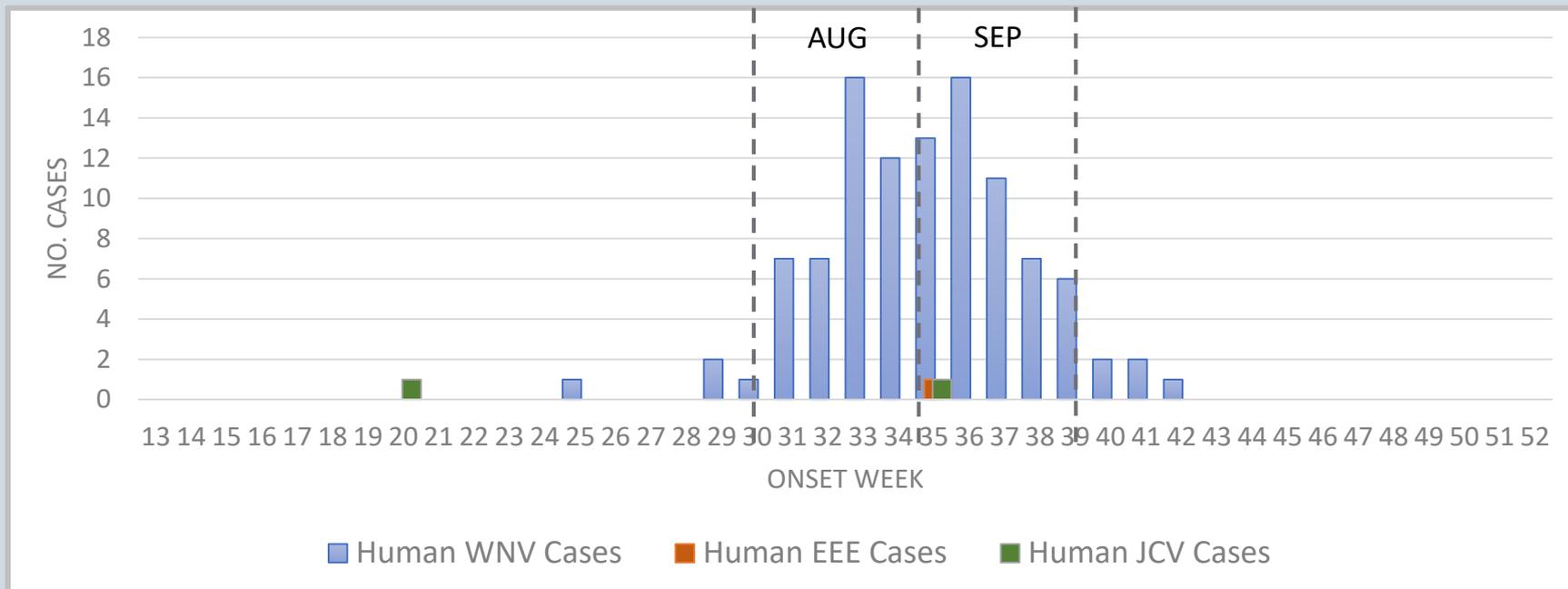
- **Age Distribution** – all ages, primarily older (50+)

Key Factors – *Culex* species & birds, hot/ dry summers



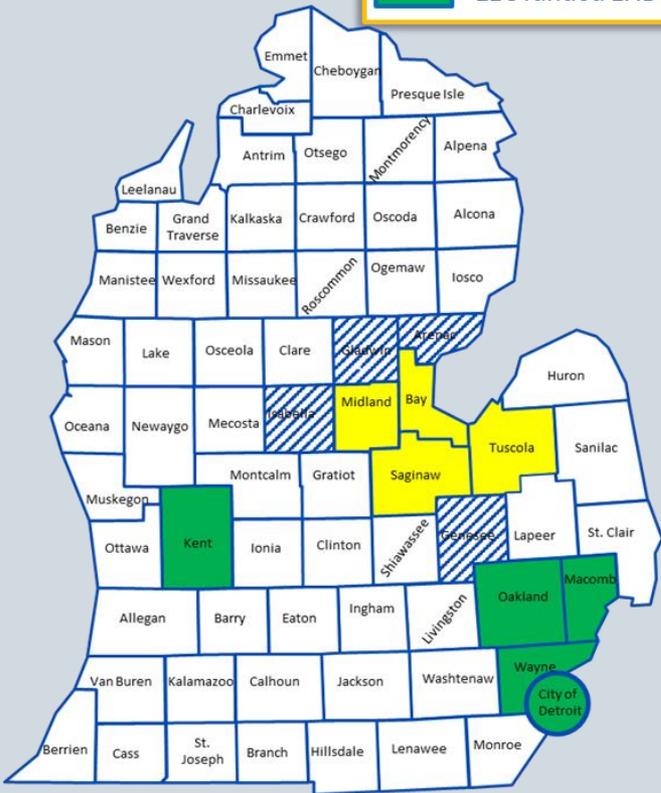
Michigan: West Nile virus human cases 2002-2018





2018 Arbovirus EPI Curve

Michigan Mosquito Surveillance Capacity



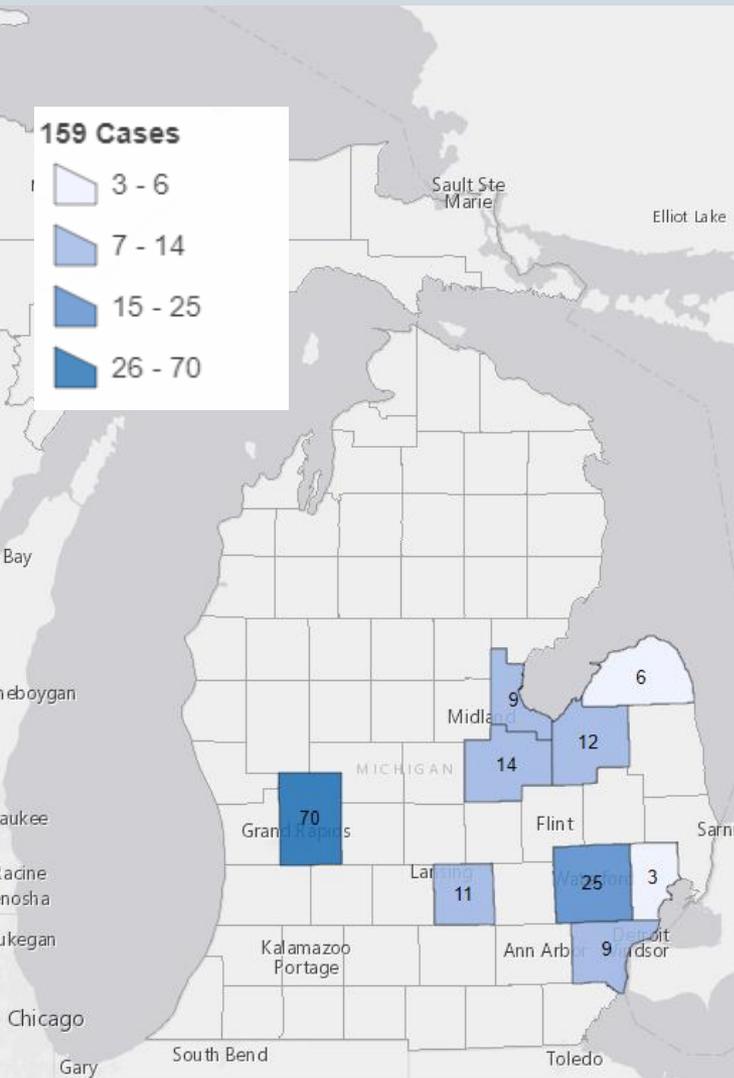
- Bay area county mosquito control districts (N=4)
- Commercial city and township mosquito control programs
- Federally funded local health department surveillance in WNV high-incidence jurisdictions (N=5)

Local Health Department Mosquito Surveillance



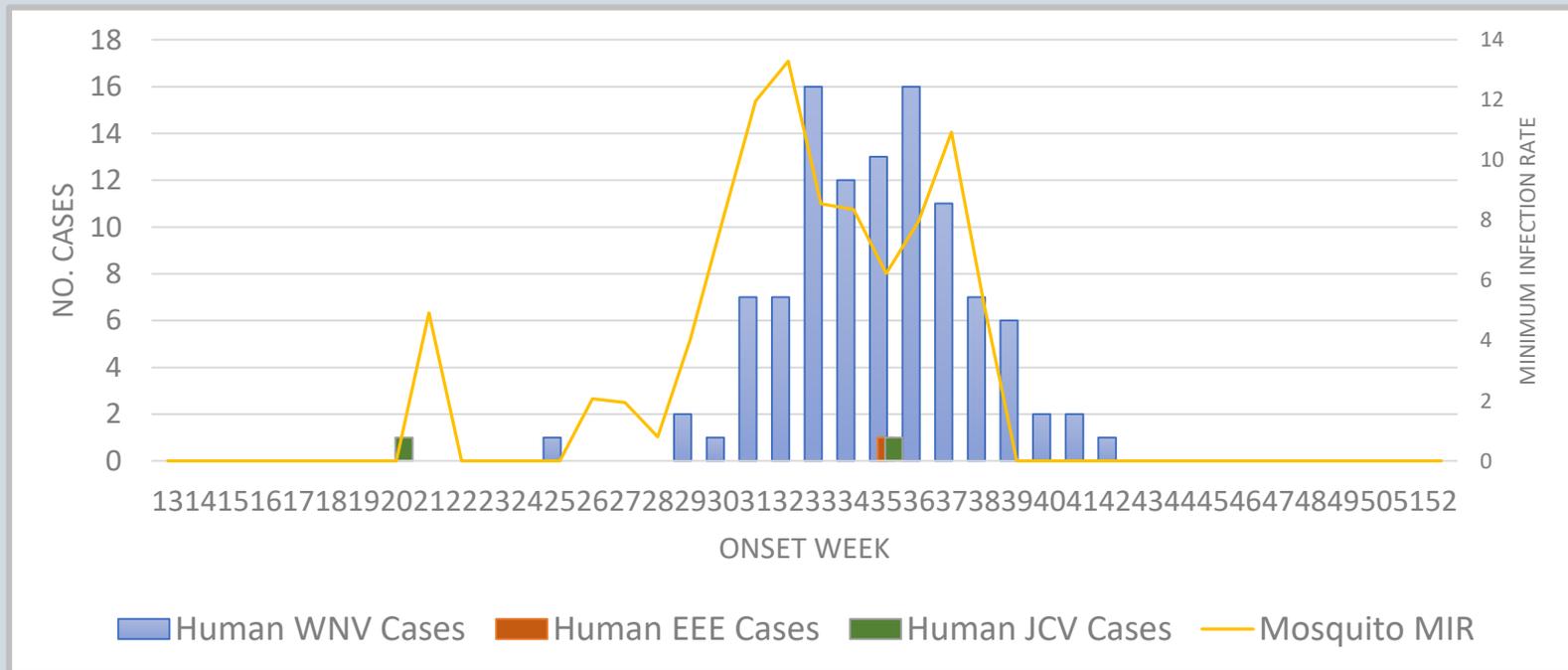
- CDC funded
- MDHHS provides training to LHDs in cooperation with MSU and MMCA
- Provide for timely, low-cost, non-labor intensive surveillance program to detect WNV activity at the community level
- Program to provide “actionable” information
- May provide training, expertise, and experience for future surveillance needs (emerging vector-borne diseases) and public health workforce

2018 Positive Mosquitoes



- 159 West Nile positive pools
- No other arboviruses identified in mosquito pools
- Most mosquito surveillance from Bay Area Mosquito Control Districts
- Michigan State University tests via PCR for EEE, LAC, SLE, and WNV
- Five local health jurisdictions test mosquito pools using VecTOR Test kits

Statewide Human & Mosquito EPI Curves



Mosquito MIR = #infected mosquitoes/1,000 mosquitoes

Arbovirus testing available at the MDHHS Bureau of Labs

- ❑ When to consider?
- ❑ Arbovirus serology
 - ❑ West Nile virus
 - ❑ Eastern Equine Encephalitis
 - ❑ St. Louis Encephalitis
 - ❑ LaCrosse Encephalitis
- ❑ Arbovirus travel panel
 - ❑ Chikungunya
 - ❑ Dengue
 - ❑ Zika



A screenshot of the MDHHS Bureau of Laboratories website. The header includes the MDHHS logo and a search bar. Below the header is a navigation menu with tabs for 'Assistance Programs', 'Adult & Children's Services', 'Safety & Injury Prevention', 'Keeping Michigan Healthy', 'Doing Business with MDHHS', and 'Inside MDHHS'. The main content area is titled 'Bureau of Laboratories' and provides contact information for the MDHHS After-Hour Emergency Phone Number (517-335-9030). It also lists various services and programs, including A-Z Test Listing, Bureau of Laboratories Holiday Business Hours, Laboratory Influenza Page, Test Request Forms, Bioterrorism Laboratory Preparedness, Chemical Terrorism Laboratory Preparedness, Radiological Preparedness, Laboratory Biosafety, Trace Metals Unit, Explore Lab Science Program, Electronic Test Ordering and Results Delivery (ETOR) Manual, Test Orders (OML) and Results (ORU) by HL7 Messaging, MDHHS BOL CAP Accreditation Certificate, MDHHS BOL CLIA Certificate, MDHHS BOL AHA-LAP Accreditation Certificate (Lab ID - 102247), and Contact Us. A 'Quick Links' section on the right side of the page lists links for Disaster Preparedness in Michigan, Michigan Public Health Institute, and Bureau of Laboratories - Laboratory Services Guide.

Human Diagnostic Testing for Arboviruses

Patients presenting with meningitis/encephalitis from May-Nov should be tested for all arboviruses potentially circulating in Michigan; WNV, SLE, EEE, California Group viruses (LaCrosse)

CSF is the preferred specimen

- MDHHS turn-around is approximately 1 week

Paired sera is an alternative to CSF

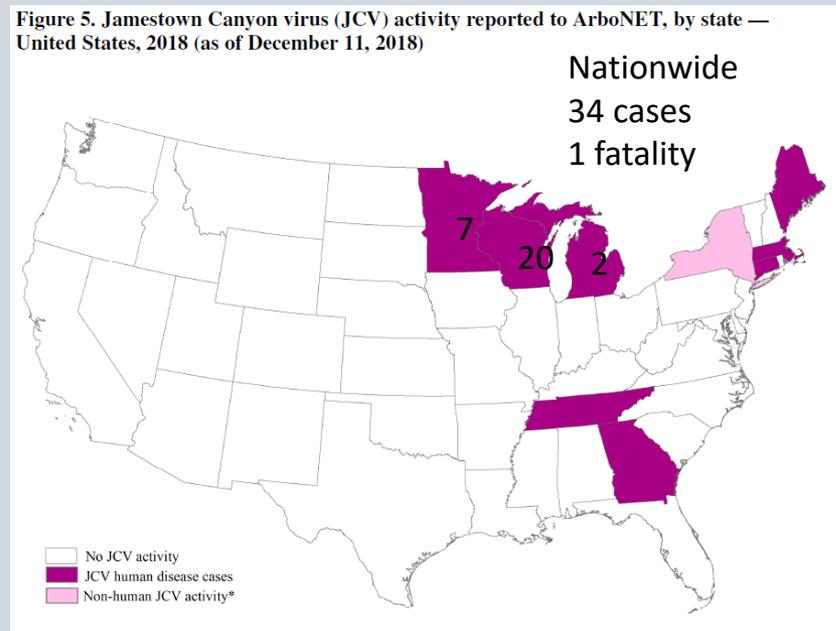
- At MDCH, reserved for hospitalized patients for whom CSF is not available, more prolonged turn-around time

Flavivirus (SLE, WNV) cross-reaction poses a diagnostic dilemma, particularly for commercial labs that lack an equivalent EIA for SLE.

Other arboviruses identified in Michigan: 2018*

Jamestown Canyon Virus

- Member of the California Group viruses
- Emerging arbovirus with focus in the Upper Midwest
- First human cases identified in Michigan in 2018
 - Two cases
 - Oakland and Menominee Counties

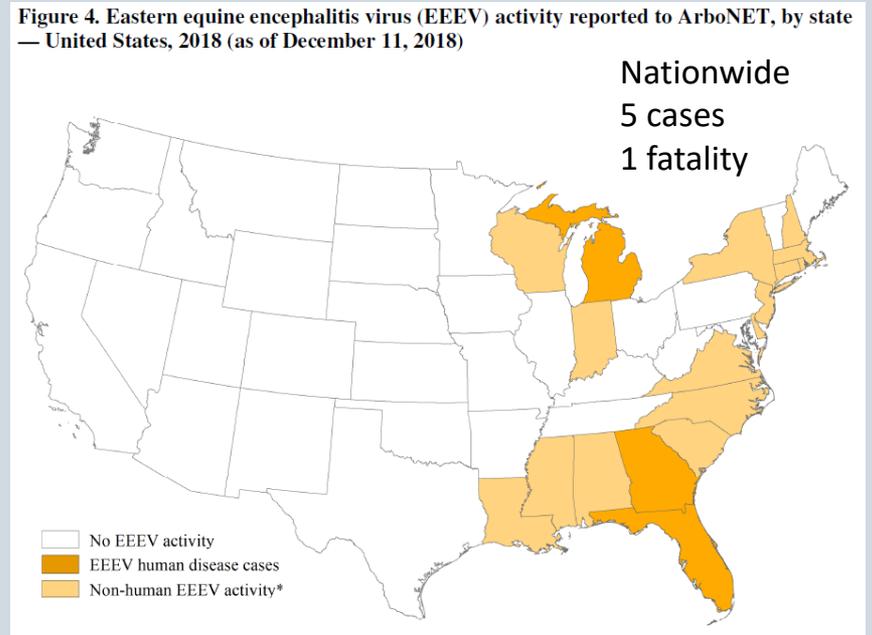


*provisional data as of 12/11/18

Other arboviruses identified in Michigan: 2018*

Eastern Equine Encephalitis

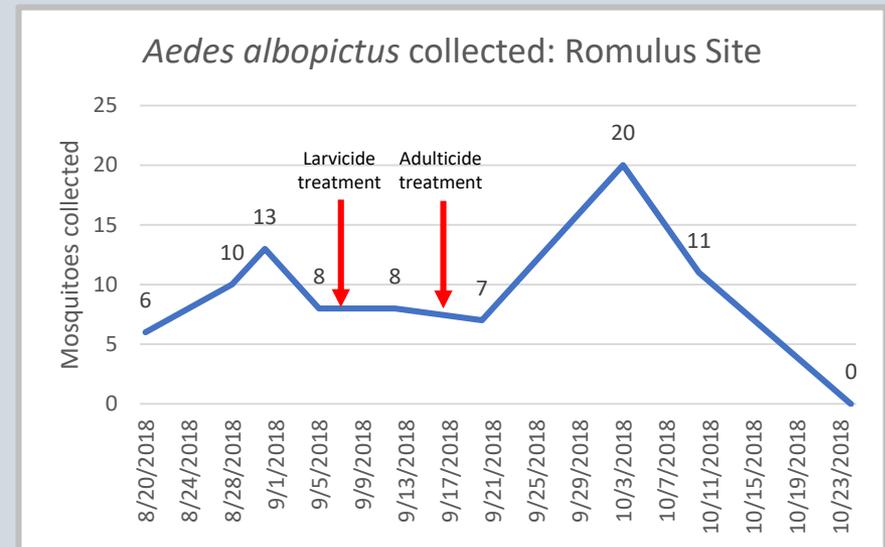
- Periodic outbreaks in horses in MI
 - Generally SW Lower MI, however recently identified further north
 - Last large outbreak 2010
- Sporadic cases identified in white-tailed deer
 - Two identified in MI 2018
 - Cass County (1), Barry County (1)
- Sporadic human cases and during outbreak years
 - One case identified in MI 2018
 - Allegan County



*provisional data as of 12/11/18

Aedes albopictus in Michigan

- On August 20, 2018 the Asian tiger mosquito was identified in Wayne County for the second year in a row
- Focal introduction/infestation near a tire business
- Wayne County health department, MDHHS, MSU, and the City of Romulus coordinated surveillance and response to the identification
- Mosquito control was initiated early September
- Increase in population until late October



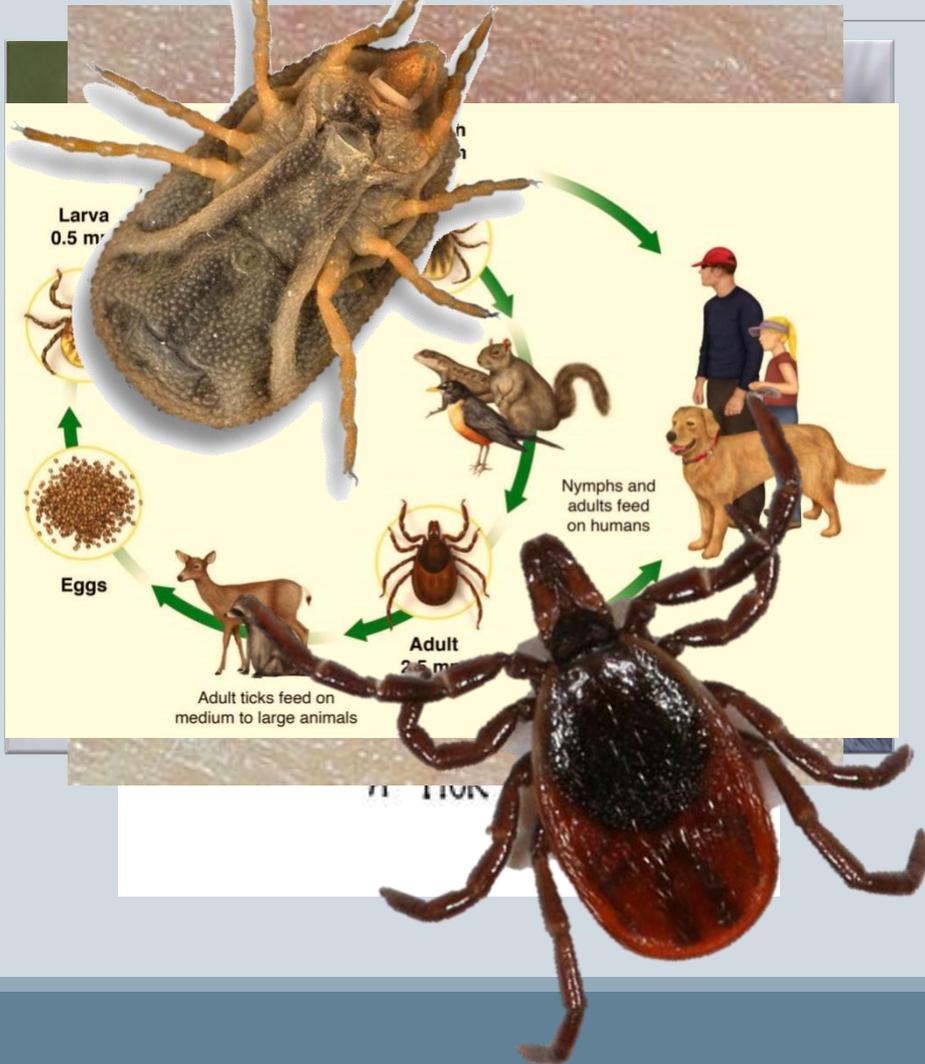
Using Tick Surveillance to Estimate Lyme Disease Risk and Drive Public Healthy Action in Michigan

Lyme disease: background information

- Lyme disease is the most common vector-borne disease in the United States (Mead 2015)
- Vector: Ticks
 - Main vector in northeastern and north central U.S.: *Ixodes scapularis* (AKA blacklegged and deer tick)
- Pathogen: *Borrelia burgdorferi*
 - Bacterium
 - Spirochete

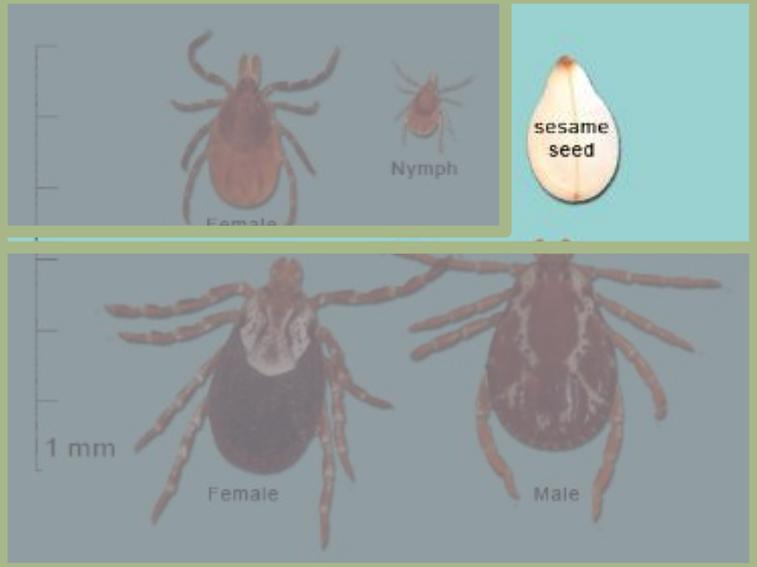


What is a tick?



- Ticks are more closely related to spiders and mites than insects
- They must feed on blood to complete their life cycle
- Ticks feed on a variety of animals from small and medium sized mammals, to birds and lizards
- It is generally within the enzootic, or tick/animal cycle that tick-borne diseases are maintained
- There are two major families of ticks
 - Argasidae – Soft ticks
 - Ixodidae – Hard ticks

Ticks are common in Michigan



Images: Kent Loeffler, Cornell University

Ixodes scapularis (blacklegged tick)

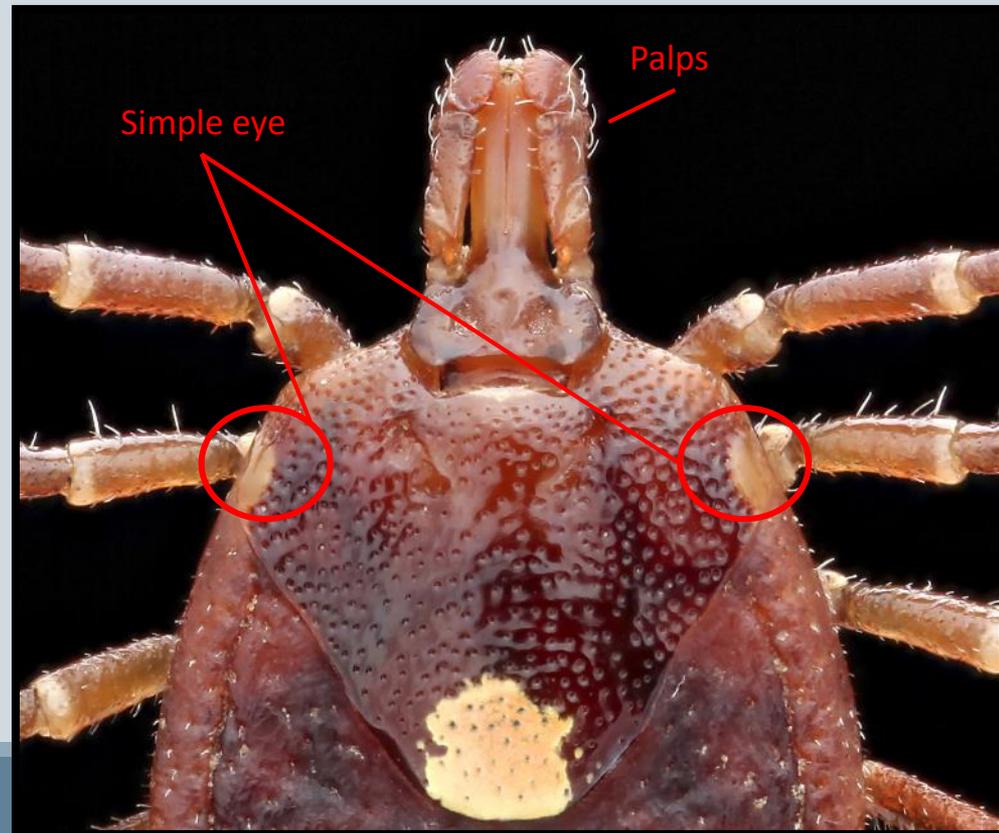
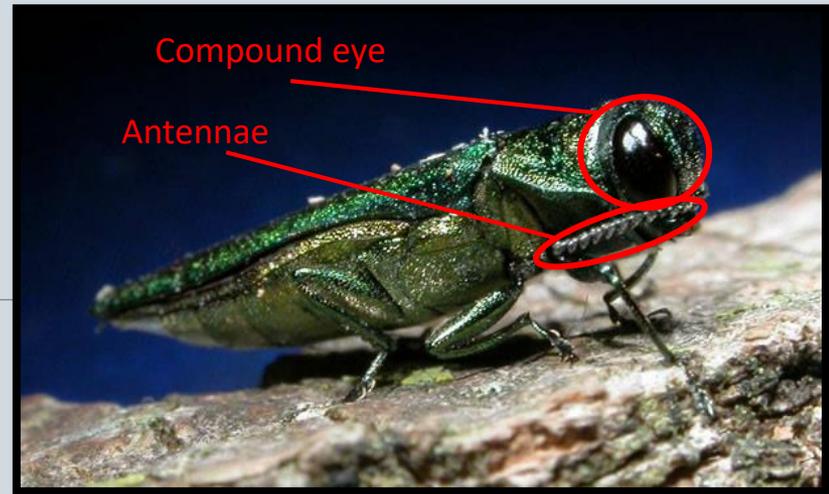
(American dog tick or wood tick)

- Smaller size than *D. variabilis*
- Found in wooded and brushy habitats
- Most common tick in Michigan
- Adults and nymphs will readily bite people.
- Adults: April – July, October – November
- Nymphs: May – August
- Vector: Lyme disease, anaplasmosis, babesiosis, deer tick fever, Ehrlichia, spotted fever



How do ticks sense their environment?

- Unlike insects ticks have no antennae
- Unlike insects or spiders, hard ticks have 2 simple eyes or no apparent eyes
- Ticks sense their environment with sensory organs on their legs and palps
- They can detect heat, CO₂, movement, and other ticks



How do ticks find their prey?

The ticks that concern us in human health in the U.S. find their prey by “questing”

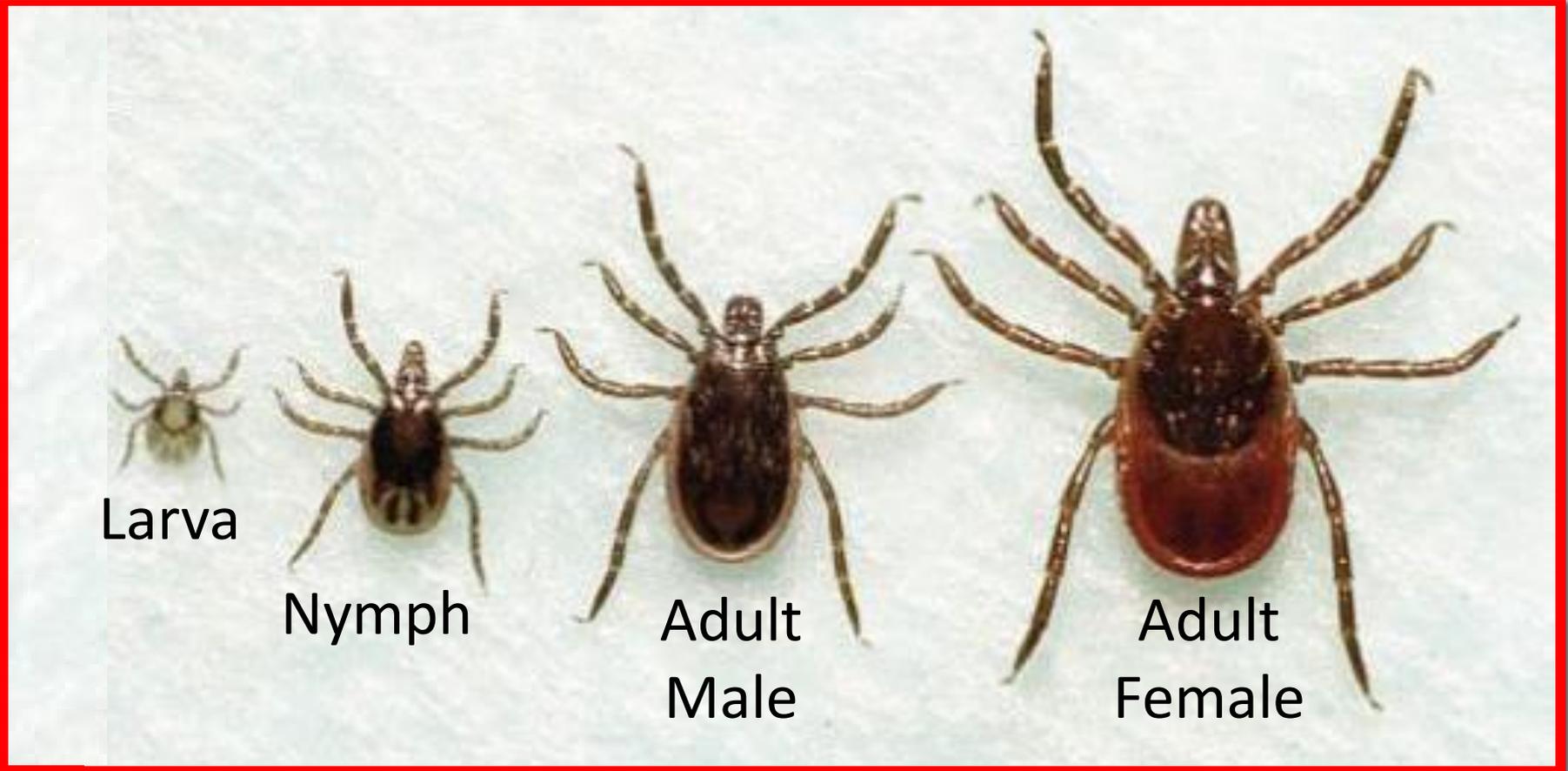
Ticks climb onto vegetation to await a passing animal often along animal and man-made trails

They may also crawl short distances in response to CO₂

Ticks DO NOT jump, fly, or drop onto people from trees



Blacklegged tick & *B. burgdorferi* biology



Nymphal stage: the epidemiologically most important stage for humans!

Responsible for the majority of Lyme disease illness in the U.S. This is due to:

Small size

First infectious stage

Active during peak outdoor recreation periods in the NE and Upper Midwest U.S.

CDC  @CDCgov · May 4

Ticks can be the size of a poppy seed. Can you spot all 5 ticks in this photo? Learn how to prevent tick bites. bit.ly/2rjox6U



Ecology of Lyme disease

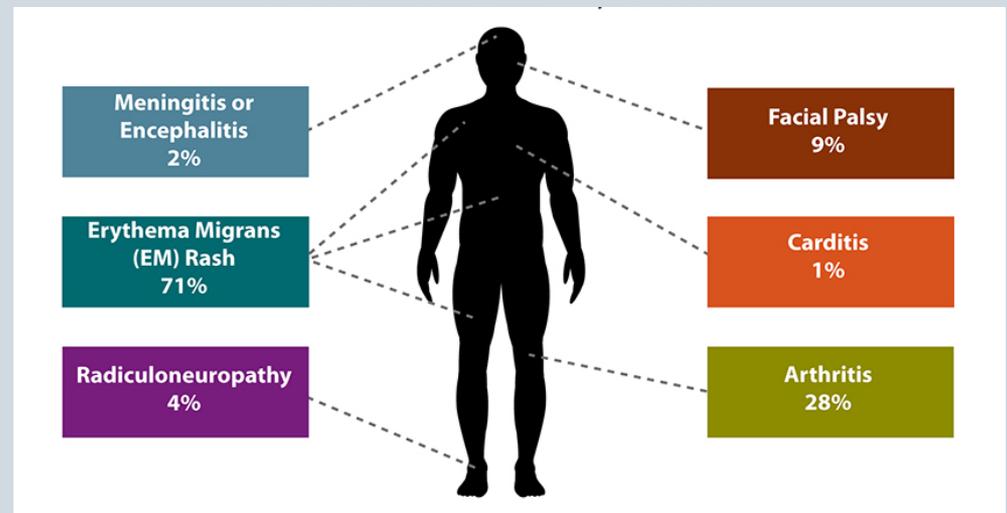
Lyme disease is contracted with ticks while even though recreating in wooded areas or areas with shade and vegetation, which is the preferred habitat for Blacklegged ticks and small mammals.



Lyme bacteria

What are symptoms of Lyme disease?

- Fever
- Fatigue
- Muscle aches (myalgia)
- Joint aches (arthralgia)
- Headache
- Erythema migrans (“bull’s-eye”) rash (3-30 days post-tick bite)
- Lameness/arthrititis



If untreated: may manifest as disease of the nervous system, the musculoskeletal system, or the heart

Prevention

Avoid tick habitats

Protect your body from ticks

- Repellents: DEET for exposed skin, and permethrin for clothing

Find and remove ticks promptly

- Daily tick checks/shower
- Remove attached ticks with tweezers

Protect pets from ticks

Perform daily tick checks

Use tick prevention



CDC.gov

Lyme disease vaccination

Avoid tick-infested areas

MDHHS

Michigan Department of Health & Human Services

Not all ticks are infected

- Only blacklegged ticks transmit Lyme disease
- Only two stages of blacklegged ticks transmit Lyme disease



Adult
Female

36-40%

B. burgdorferi infection rate*



Nymph

9-15%

B. burgdorferi infection rate*

*Endemic Locations

Hamer *et al.*, 2010; Foster, 2004.

Public health significance

 In 2013, Lyme disease was the 5th most commonly reported notifiable disease in the U.S.

(1. Chlamydia, 2. Gonorrhea, 3. Syphilis, 4. Salmonellosis)

 Approximately 3.4 million LD tests nationwide in 2008 from 7 large commercial laboratories⁴

 Cost estimates for laboratory services of \$492 million

 Estimate 288,000 LD cases/year

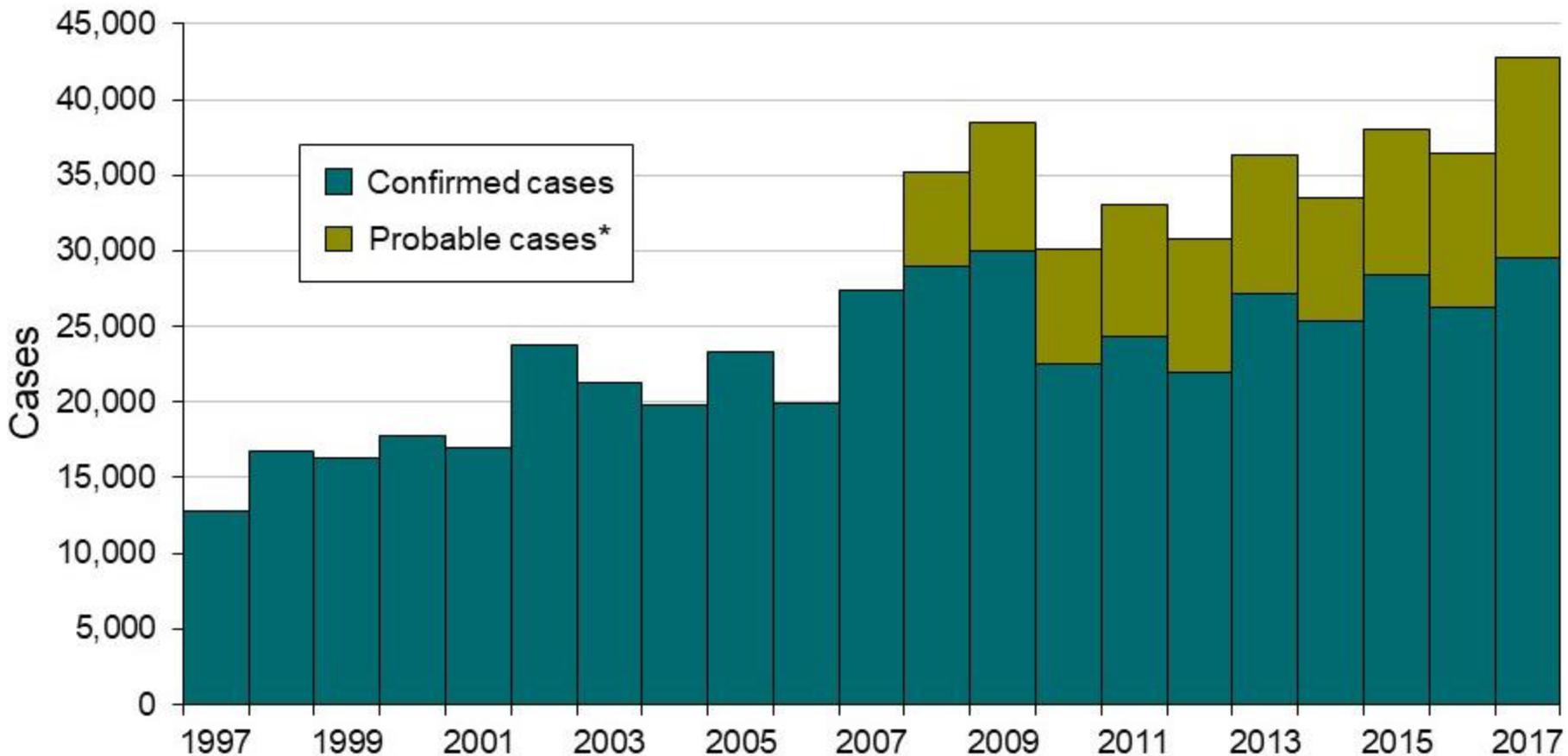
 2005-2010 Truven Health MarketScan Commercial Claims and Encounters Database analyzed⁵

 Estimate 329,000 LD cases/year

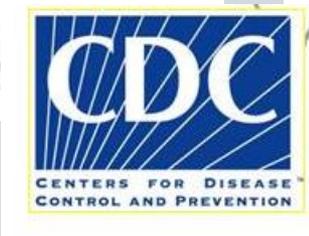
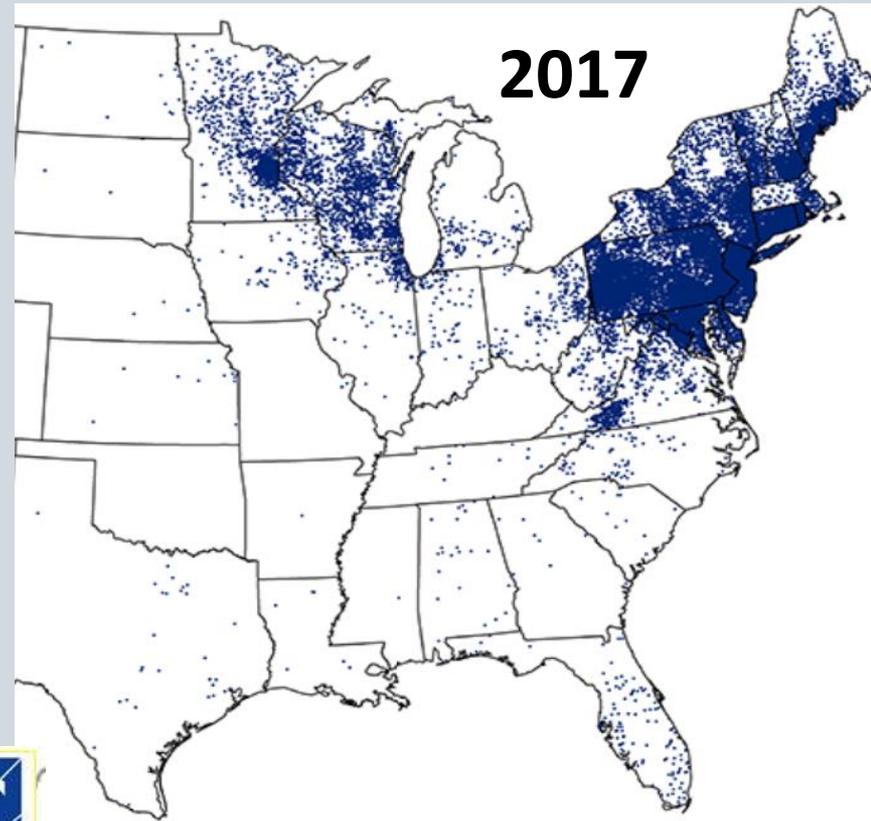
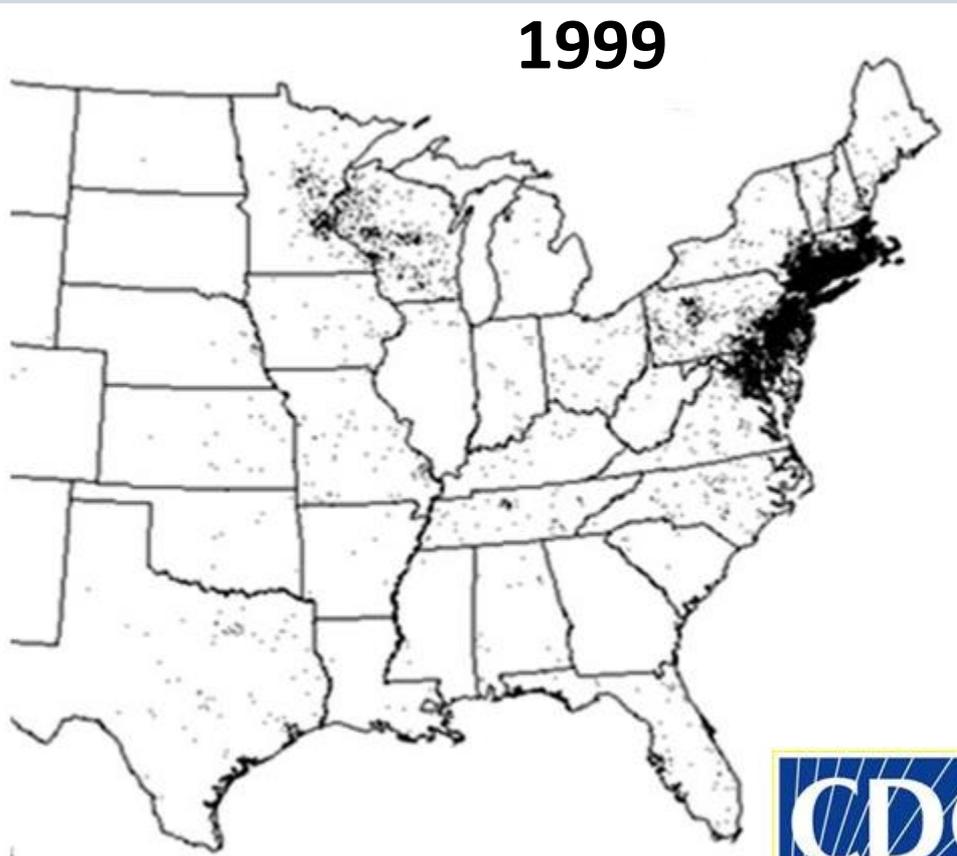
4. Hinckley, A.F., *et al.* 2014. Lyme disease testing by large commercial laboratories in the United States. *Clin Infect Dis.* 59 (5): 676-681.

5. Nelson, C.A., *et al.* 2015. Incidence of clinician-diagnosed Lyme disease, United States, 2005–2010. *Emerg Infect Dis.* 21(9). 1625-1631.

Leading vector-borne disease, with increasing incidence over time...



... and over space



First detection of ticks, pathogen, and cases: Michigan's UP late '80s, early '90s

North Central States Entomological Society MZ

FIELD STUDIES ON *IXODES DAMMINI* IN THE UPPER PENINSULA OF MICHIGAN

R. Malcolm Strand, Edward D. Walker, and Richard W. Merritt¹

1990

Prevalence of *Borrelia burgdorferi* in Host-Seeking Ticks (Acari: Ixodidae) from a Lyme Disease Endemic Area in Northern Michigan

EDWARD D. WALKER, TRACY W. SMITH, JAMIE DeWITT, DANIEL C. BEAUDO,
AND ROBERT G. McLEAN¹

Department of Entomology, Michigan State University, East Lansing, MI 48824

1992

Isolation of *Borrelia burgdorferi* from Two Patients in Michigan

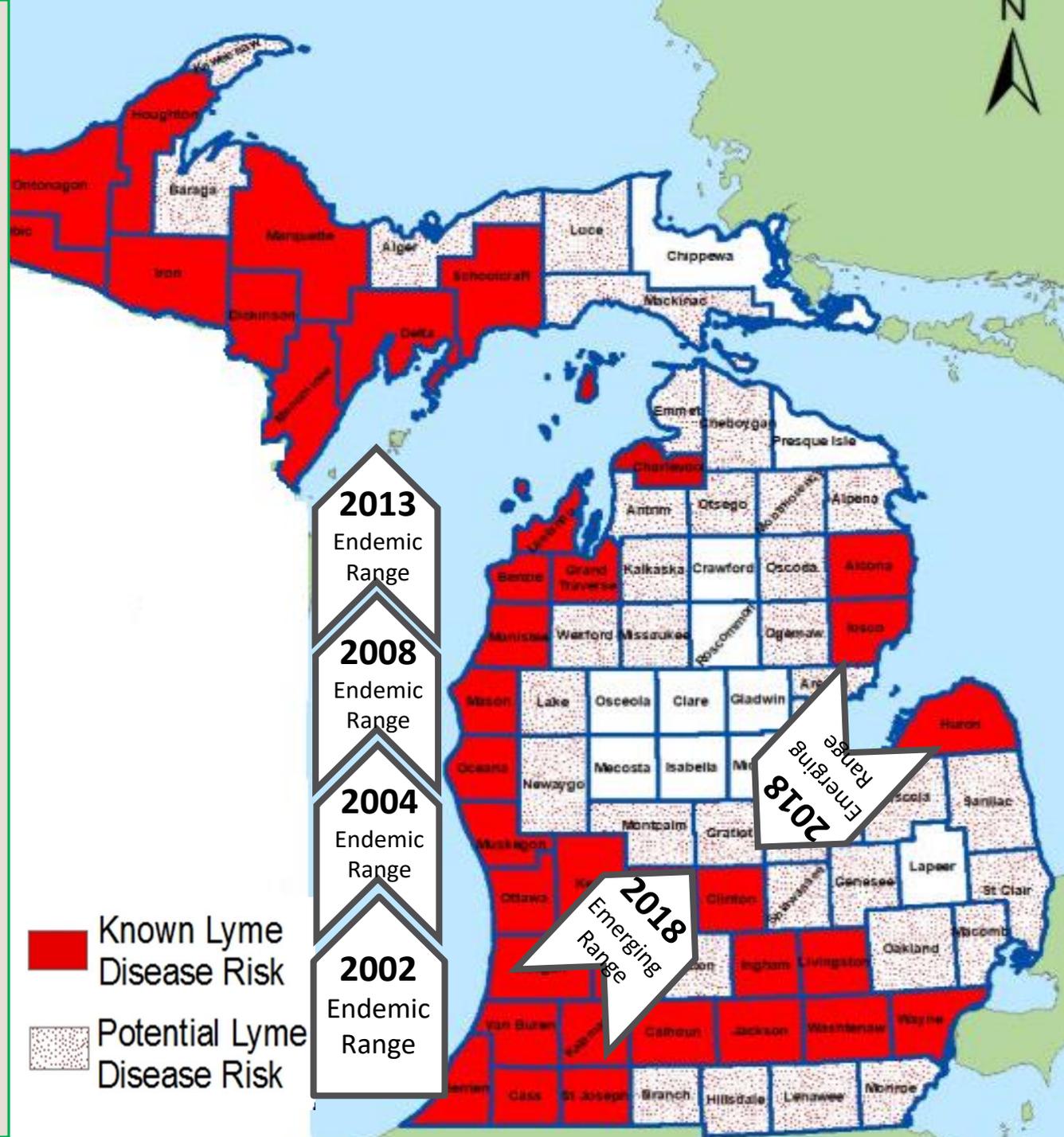
Mary Grace Stobierski, William N. Hall,
Barbara Robinson-Dunn, Harlan Stiefel,
Susan Shiflett, and Vernetta Carlson

*From the Bureau of Infectious Disease Control, Michigan Department of
Public Health, Lansing, and the Daggett Medical Clinic
Daggett, Michigan*

1992

Brief History of Lyme Disease in Michigan

- Low-incidence, emerging Lyme disease state
- Michigan's Upper & Lower Peninsulas differ in case incidence
 - UP >10/100,000
 - LP approx. 1/100,000
- Currently tracking the invasion of infected blacklegged ticks into new areas in the state



Who does tick-borne disease affect?

Anyone working or recreating in forested or forest-edge habitats, including:

Man-made trail systems

Trails used by animals

Campgrounds

Brushy or grassy areas near buildings or yards

Wooded river banks



Riverside Park, Ottawa County, MI

MDHHS Surveillance Efforts



PASSIVE

- Targeted surveillance
- More specific geographic location of ticks & potential tick-borne disease risk
- Emerging tick and pathogen surveillance

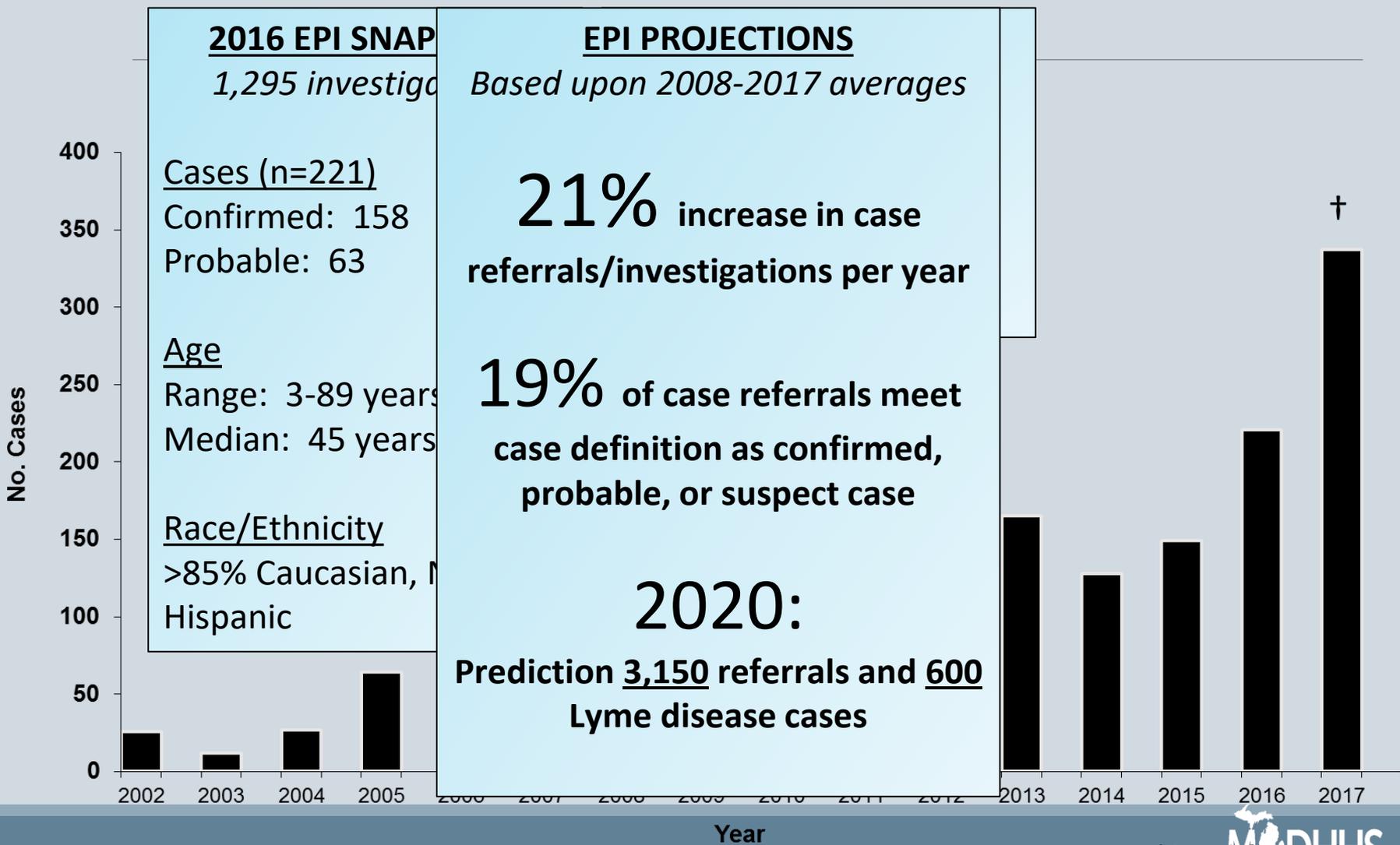


ACTIVE

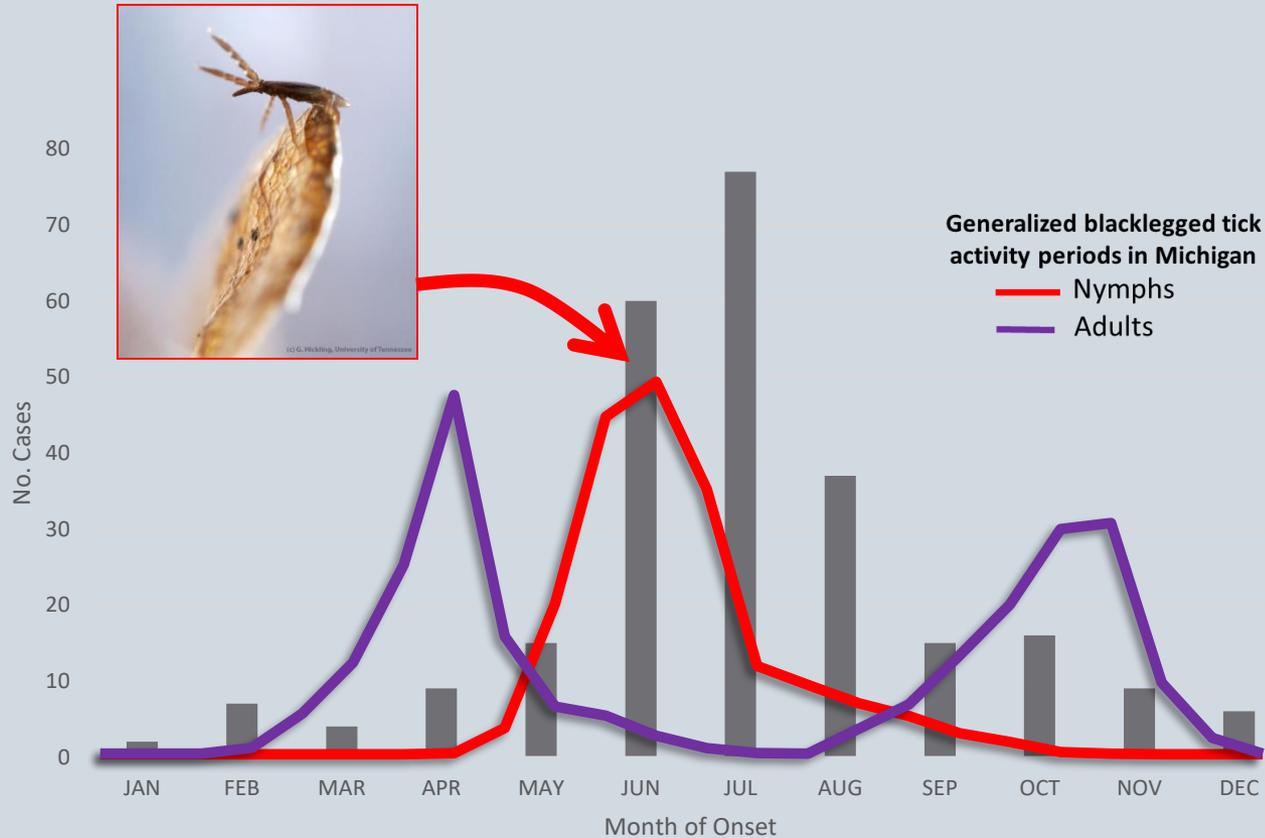
- Routine health code
- Required by public health code
- Broad picture of tick activity
- May lack specificity due to difficulty determining exposure location



Michigan Lyme Disease Cases by Year: 2002-2017

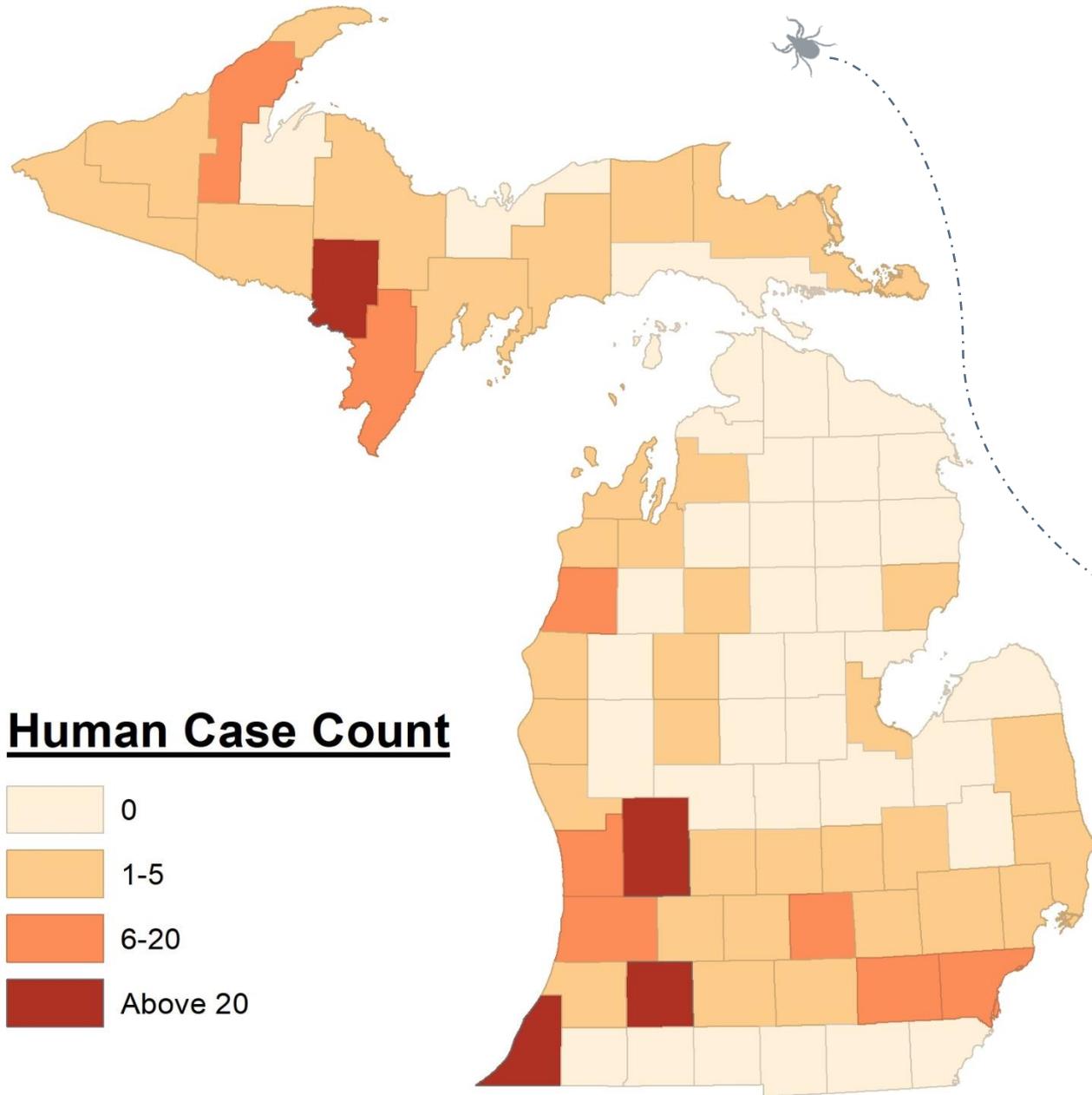


Reported Lyme disease cases in Michigan: 2017 EPI Curve



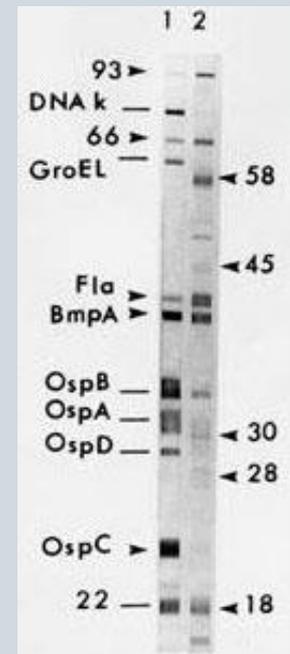
251/291 cases reporting onset date

2017 Human Lyme Disease Cases by County of Residence



Lyme disease testing available at the MDHHS Bureau of Labs

- When to consider?
- Nationally recognized two-step testing algorithm
 - Step 1. Enzyme Immunoassay screen (EIA)
 - Highly sensitive test
 - If Step 1 is equivocal or positive proceed to Step 2*
 - Step 2. IgM and IgG Immunoblot (IB/Western Blot)
 - Highly specific test
 - 2+ of 3 bands positive for IgM positive
 - 5+ of 10 bands positive for IgG positive



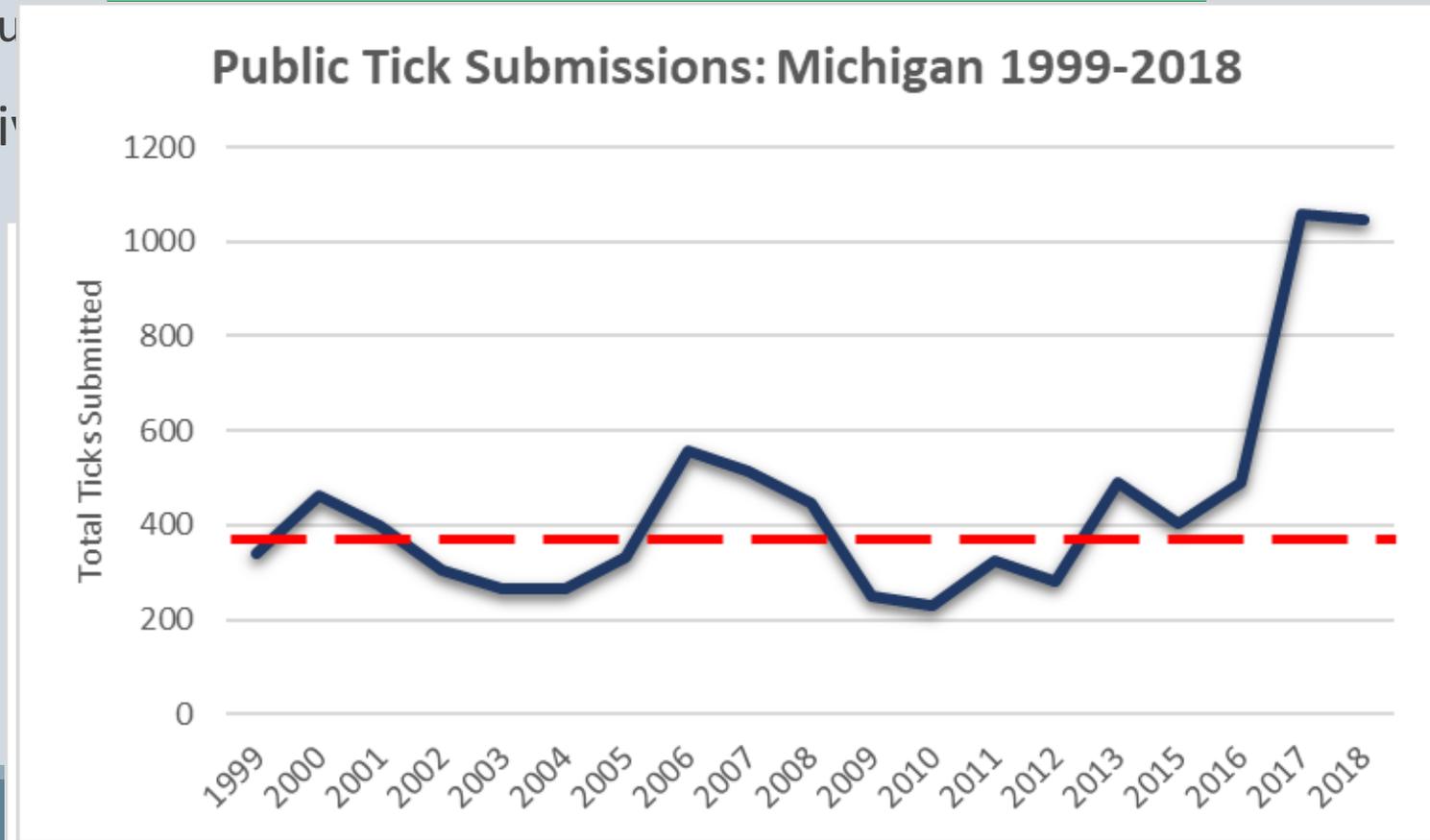
Positive western blot
Image: CDC

Passive Tick Surveillance: Public Tick Submission

From passive reporting to active Michigan Disease Surveillance program
Healthcare providers

- Future

Test li



Active Tick Surveillance: Focused Tick Drags

Benefits:

- Results can be verified
- Indicates high risk for human illness

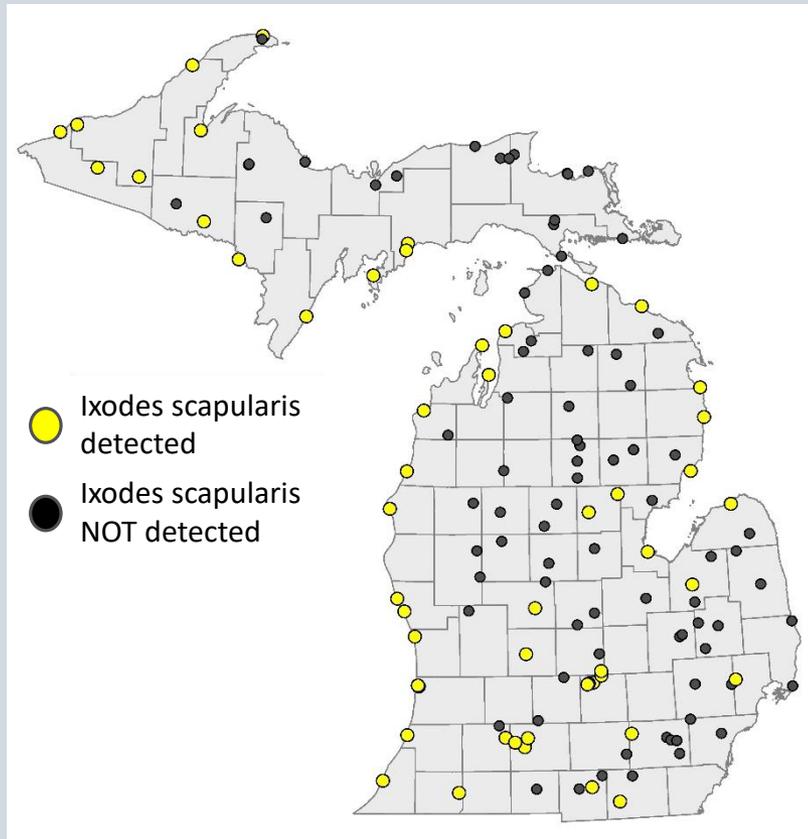
Drawbacks:

- Personnel & time constraints
- Influenced by weather & location



Active Tick Surveillance: Focused Tick Drags

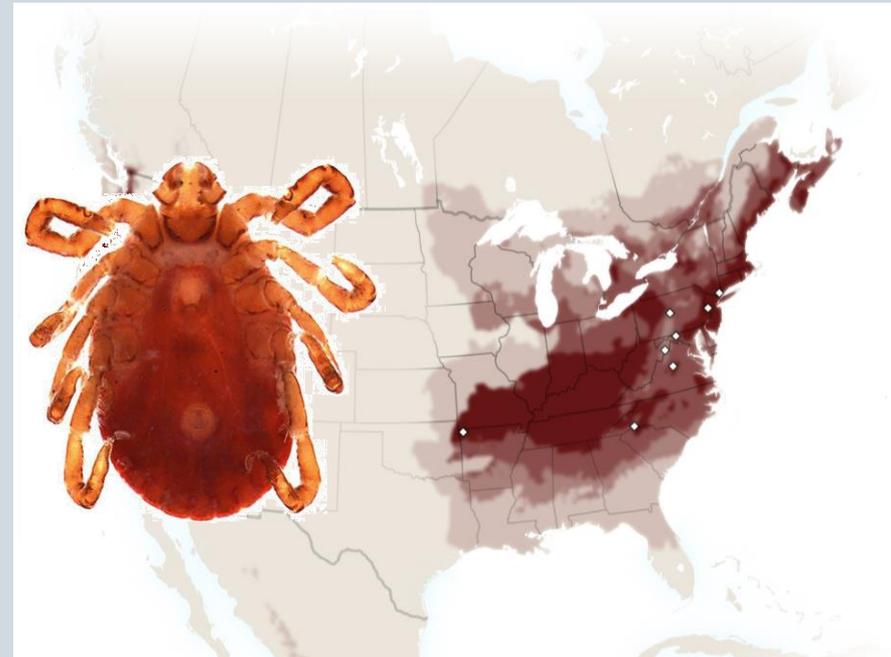
2018 Drag Field Sites



- Field surveillance coordinated with academic partners
- Locations directed by:
 - Public tick submissions
 - Veterinary submissions
 - Reported disease cases
- 2018 activities:
 - Over 220 total km sampled at 143 sites
 - 1,537 ticks collected April-November
 - Collaboration with CDC for emerging pathogen screening

Invasive Asian Longhorned Tick

- Not normally found in the Western Hemisphere, these ticks were first reported in the United States in 2017
- Have been found on pets, livestock, wildlife, and people
- The female tick can lay eggs and reproduce without mating
- In other countries, bites from these ticks can make people and animals seriously ill
 - As of October 2018, no harmful germs have been found in the ticks collected in the United States; research is ongoing
- As of October 2018 longhorned ticks have been found in: Arkansas, Connecticut, Maryland, North Carolina, New Jersey, New York, Pennsylvania, Virginia, West Virginia





Hands on Training: Local Health Department staff will gain hands-on experience in standard methods for field collection and identification of medically important ticks and mosquitoes.



Vector Surveillance Program Essentials: The workshop curriculum covers the essentials of maintaining a vector surveillance program, including methods for data collection, equipment and personnel considerations.



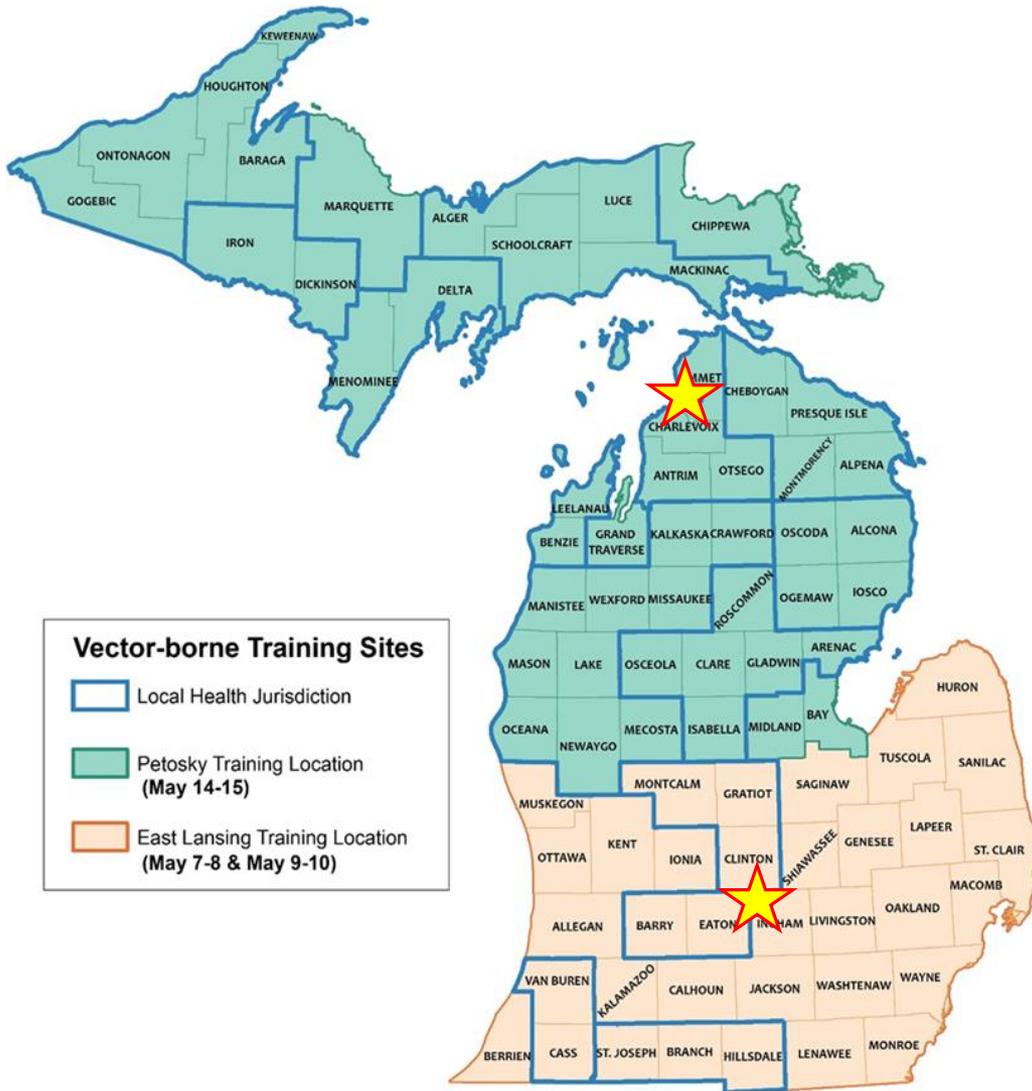
Expert Instruction: Workshop instructors include experts from public health, vector-control agencies, and academia that have extensive experience in the fields of tick and mosquito surveillance, identification, and control.



Networking: Participants will have multiple opportunities to engage with colleagues and counterparts from across Michigan, as well as interact with our team of vector-borne disease expert instructors.



Workshop Specifics



Designed for environmental health professionals working at Michigan Local Health Departments (two staff per health jurisdiction)

At the end of the training, attendees will:

- Understand vector-borne disease epidemiology in Michigan
- Be able to conduct sampling for medically important mosquitoes and ticks
- Be able to arrange for diagnostic testing of specimens from their jurisdiction
- Be able to consult with stakeholders regarding vector control

Cost: FREE – meals and lodging provided

Workshop FAQs

Who are the vector-borne surveillance workshops meant for?

Generally LHD Environmental Health staff, however if other LHD programs areas or partner agencies are interested in participating in vector surveillance, they may also attend.

What costs are supported for the vector-borne surveillance workshops?

The workshops are free. Participant lodging (up to two nights) and meals will be provided for the duration of the workshop. The MDHHS will not reimburse mileage.

What should I bring to the training?

Materials for taking notes. Attendees will also participate in a field exercise, appropriate outdoor clothing and footwear are recommended.



Workshop FAQs

What will we take with us from the workshop?

Participants will gain an understanding of vector-borne disease epidemiology in Michigan, methods for surveillance of medically important ticks and mosquitoes, the ability to identify mosquitoes and ticks, and a basic understanding of vector control.

Participants will also take home some surveillance equipment necessities, including:

BG2 mosquito trap lures

Tick drags (two per jurisdiction)

Collection equipment for tick surveillance

Flash drive with resources such as mosquito and tick keys, data sheets and reporting information, sample collection protocols, and a media tool kit.



Michigan Disease Mapper

www.michigan.gov/midiseasemapper



Michigan Disease Mapper

Zoonotic and Vector Borne

SEARCH

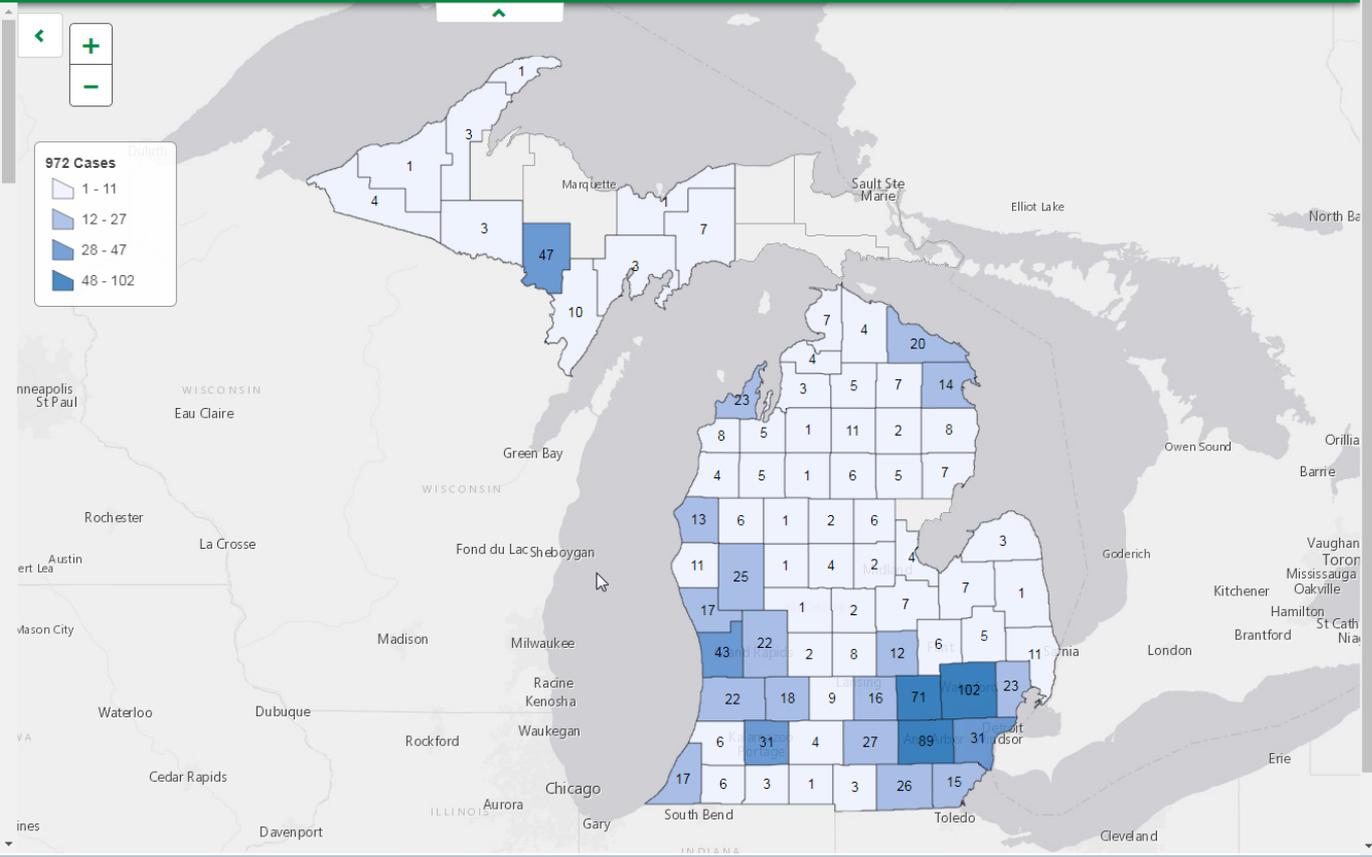
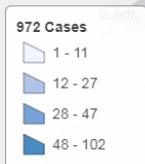
RESULTS

You searched for: 2017 Collected Citizen Submitted Ticks Tick Cases by County

[Try a new search](#)

972 total results statewide

COUNTY	CASES
Alcona	8
Alger	1
Allegan	22
Alpena	14
Antrim	3
Barry	18
Bay	4
Benzie	8
Berrien	17
Branch	1
Calhoun	4
Cass	6



Michigan Emerging Disease Issues

Diseases that may affect humans or animals.



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



Agricultural Exhibits and Events



Anaplasmosis



Avian Influenza



Bab

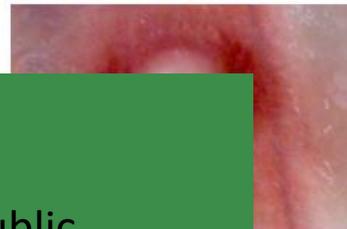


UPDATED!

*Mobile-friendly

*Great info. for the public

www.michigan.gov/emergingdiseases



osis



Chikunguya



Chronic Wasting Disease (CWD)



Dengue

More resources available online

Looking for a bull's-eye rash? Look again – erythema migrans can take many forms.

Central (Clearing) Target Lesions
The classic erythema migrans rash consists of a central clearing surrounded by a red ring. The ring may be more distinct in some cases than in others. Only about 10% of Lyme disease lesions have this appearance.

Uniformly Red Lesions
The erythema migrans rash can also be uniformly red. These lesions are most common in the early stages of the disease and may be more difficult to recognize as erythema migrans. Only about 10% of Lyme disease lesions have this appearance.

Actual Size Comparison: Michigan Tick ID Card

Blacklegged (Deer) tick
1 cm

American dog (Wood) tick
1 cm

Lone star tick
1 cm

Common tick found in Michigan
From left to right: Blacklegged tick, American dog tick, Lone star tick, Common tick found in Michigan.

Tick removal tips
www.michigan.gov/lyme

- Remove as quickly as possible.
- Use tweezers to grasp the head close to the skin.
- Pull gently.
- Use soap and water, or antiseptic on the bite.

...preventing tick bites

- Use a repellent containing no more than 30 percent DEET.
- Use repellents that contain permethrin on clothing.
- See your healthcare provider if you have symptoms of fever, rash, body aches or fatigue after a tick bite.

Michigan Department of Health & Human Services

Ticks and Your Health

Preventing tick-borne illness in Michigan

Michigan Department of Health & Human Services
Michigan Department of Agriculture & Rural Development
Michigan Department of Natural Resources

Patient Information

- Transmission**
How ticks spread Lyme disease...
- Signs and Symptoms**
Signs and symptoms of illness...
- Diagnosis and Testing**
What to expect from your office visit...
- Treatment**
What to expect...
- Rapid Diagnosis**
If symptoms...

General Lyme Topics

- Prevention**
Avoid getting infected...
- Tick Removal**
How to remove a tick...
- Communications Tool Kit**
Resources for spreading the message...
- Statistics**

Lyme Disease FAQs

- Frequently Asked Questions and Hot Topics**
All about Lyme disease...

Healthcare Professionals

- Clinicians, public health officials, and veterinarians...**
In-depth information and links...

Helpful Links

- New Handbook – Tickborne Diseases of the United States: A Reference Manual for Health Care Providers**

TICKBORNE DISEASES OF THE UNITED STATES

A Reference Manual for Health Care Providers

First Edition, 2013

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

www.michigan.gov/lyme

www.cdc.gov/lyme

If you find a tick...
Don't get Ticked!
We can Help!



CITIZEN SUBMITTED TICK PROGRAM

- Identify the tick
- Test blacklegged ticks (if alive & off a human)

www.Michigan.gov/lyme

Got a Tick? Submit a Pic!

Identify the tick electronically

MDHHS-Bugs@Michigan.gov

FREE service available to MI residents!

Questions?

Feel free to contact us at:

517-335-8165

MDHHS-Bugs@michigan.gov



**EMERGING &
ZOOONOTIC
INFECTIOUS DISEASE**