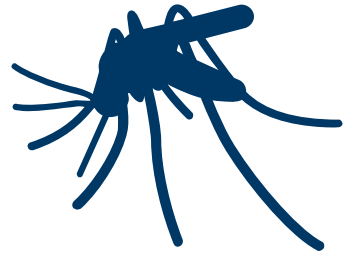
Effects of Climate Change on Vectorborne Disease Risk

Jenna Bjork, DVM, MPH | Senior Epidemiologist

October 30, 2019

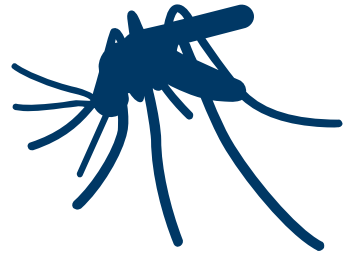
DEPARTMENT OF HEALTH

Outline of Presentation

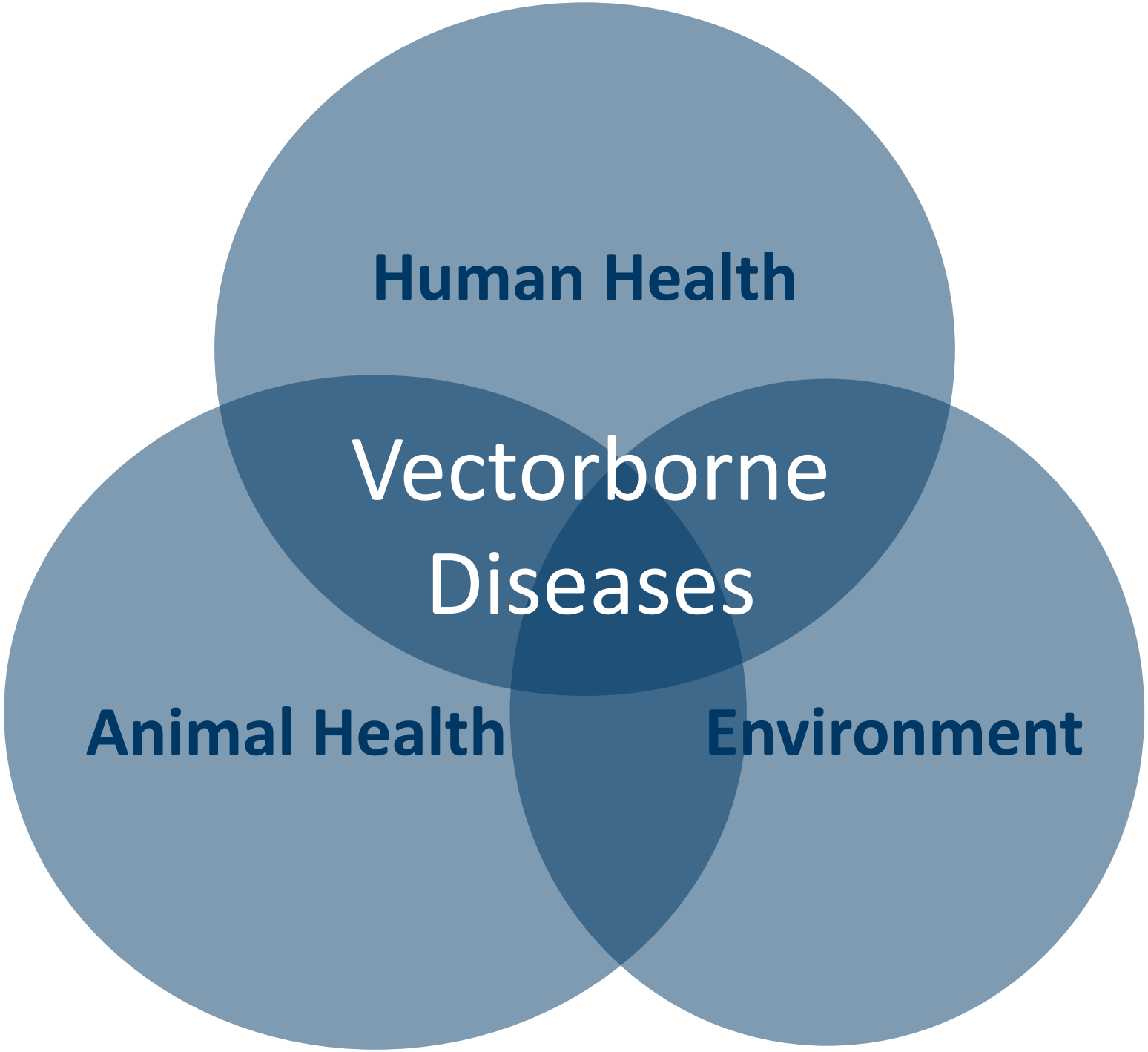


1) Complexities of Vectorborne Diseases
2) Epidemiology of Vectorborne Diseases in Minnesota
3) Climate and Predicting Changes in Vectorborne Disease Risk
4) Impacts of Climate Change on the MDH Vectorborne Diseases Unit

Outline of Presentation



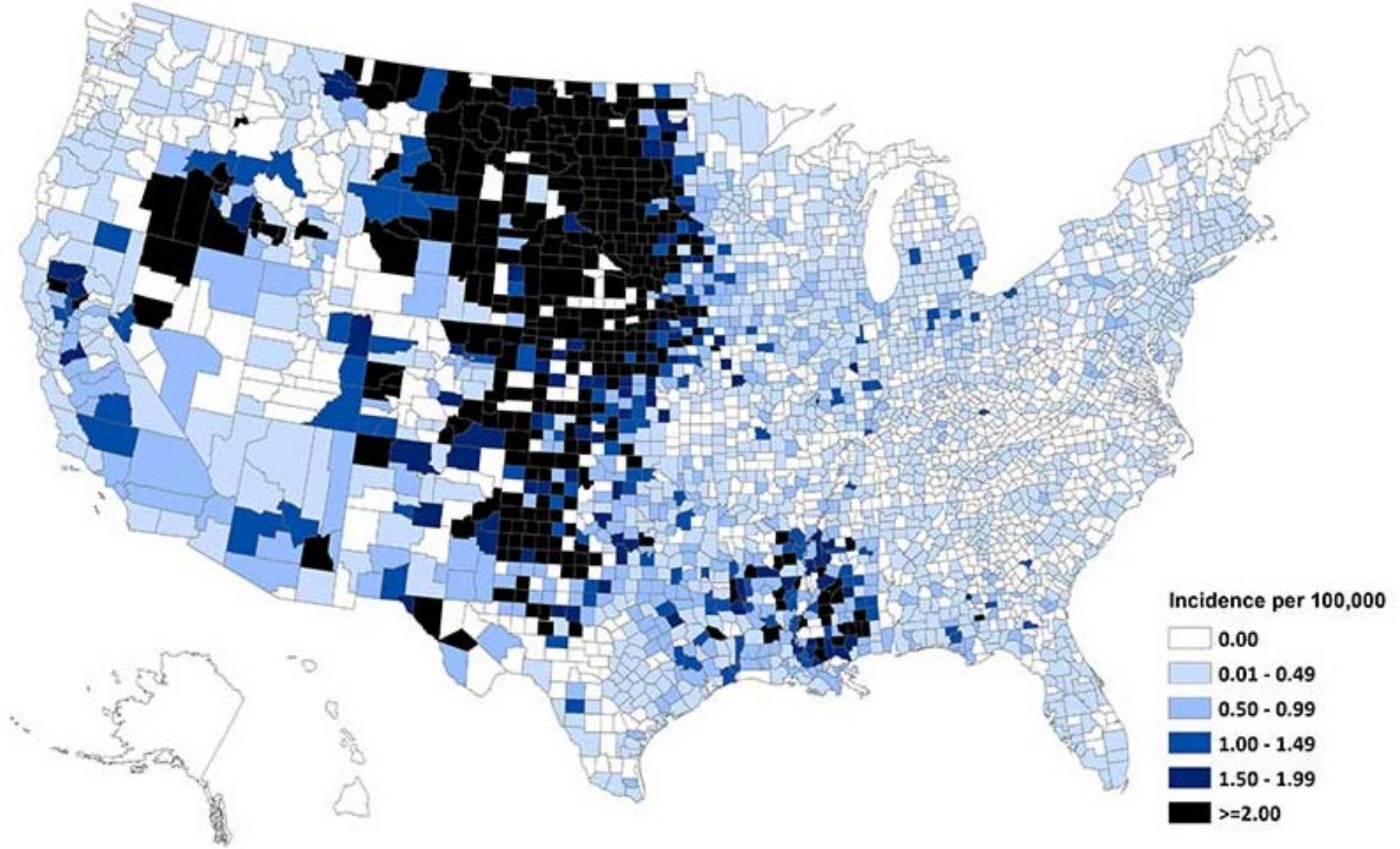
1) Complexities of Vectorborne Diseases


Human Health
Vectorborne Diseases
Animal Health
Environment

Ecological Provinces of the United States

ftp://newftp.epa.gov/EPADataCommons/ORD/Ecoregions/cec_na/NA_LEVEL_I.pdf

Average Annual Incidence of West Nile Virus Neuroinvasive Disease Reported to CDC by County, 1999 - 2018



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

West Nile Virus Disease Risk in Minnesota

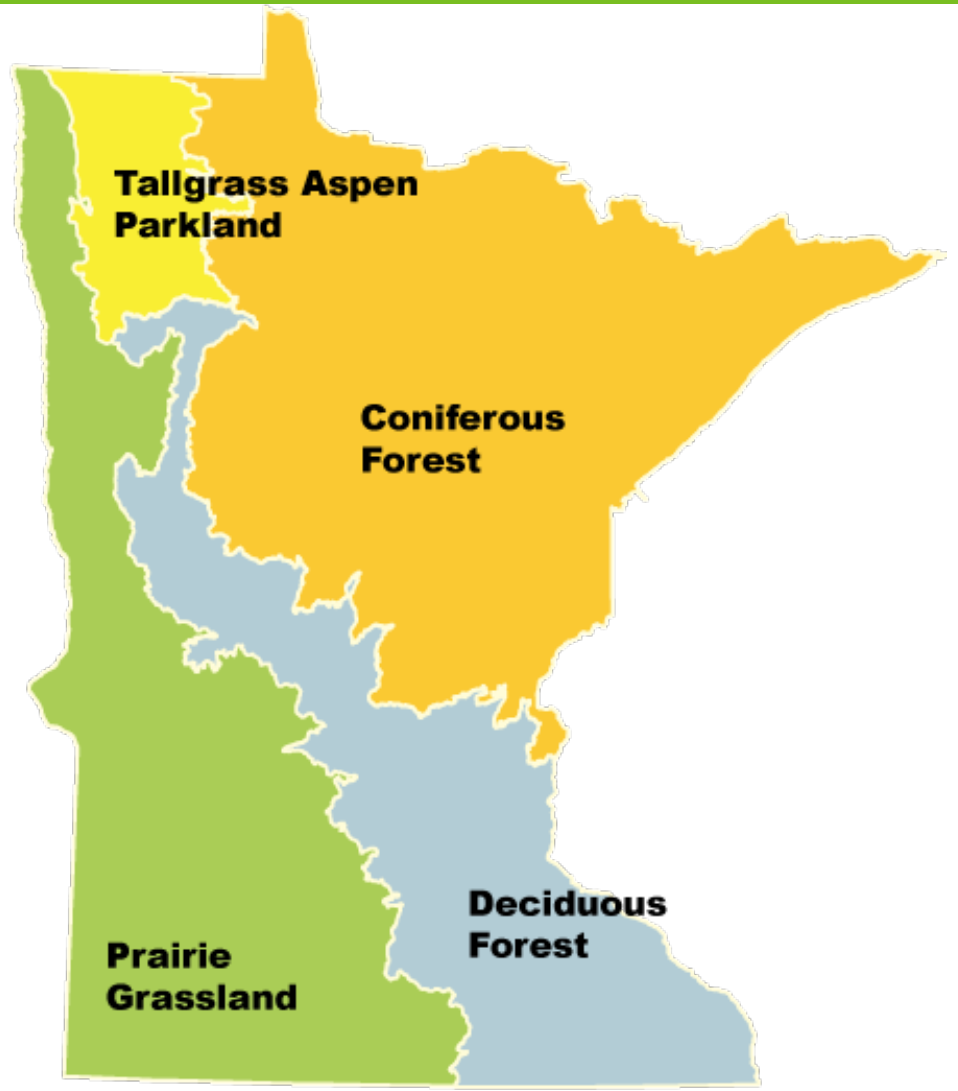
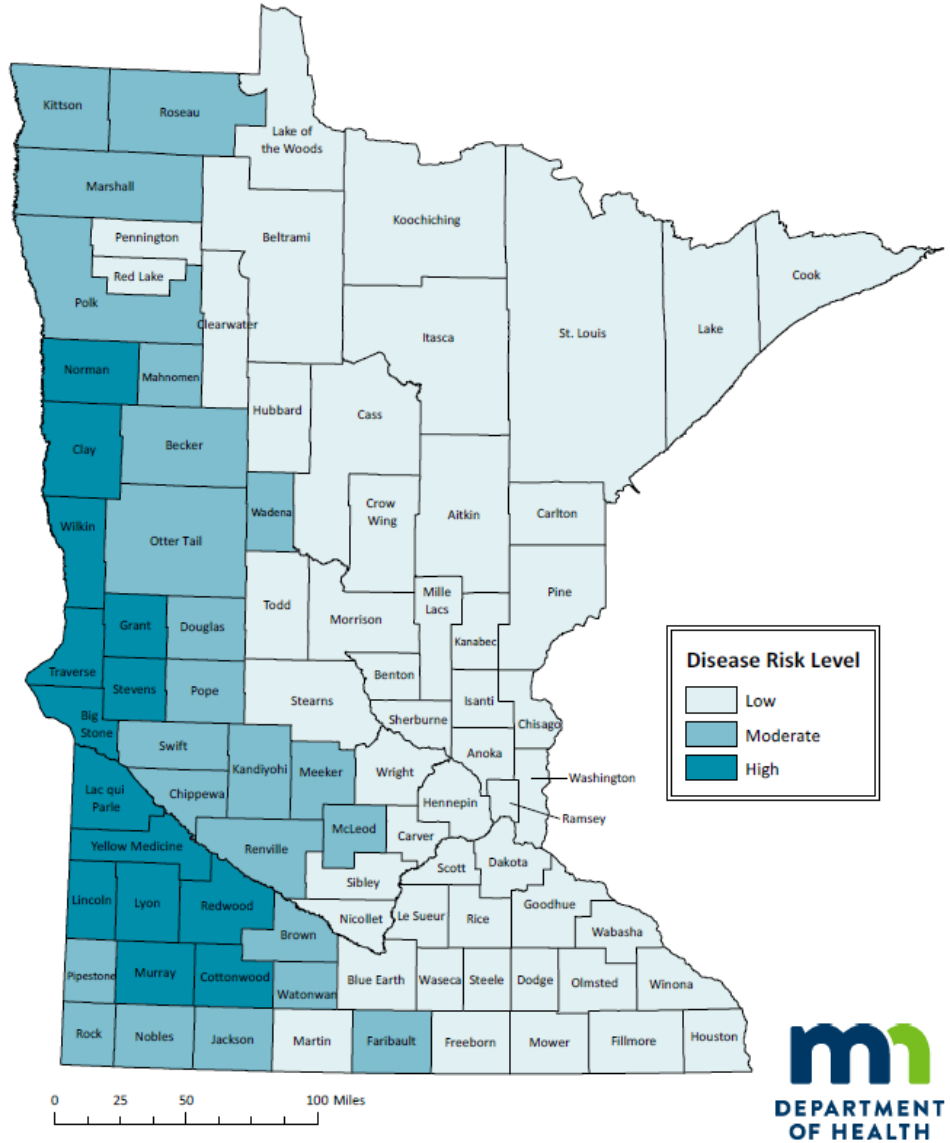


Photo courtesy of MN Department of Natural Resources (accessed 7/23/2019)
http://www.dnr.state.mn.us/biomes/index.html



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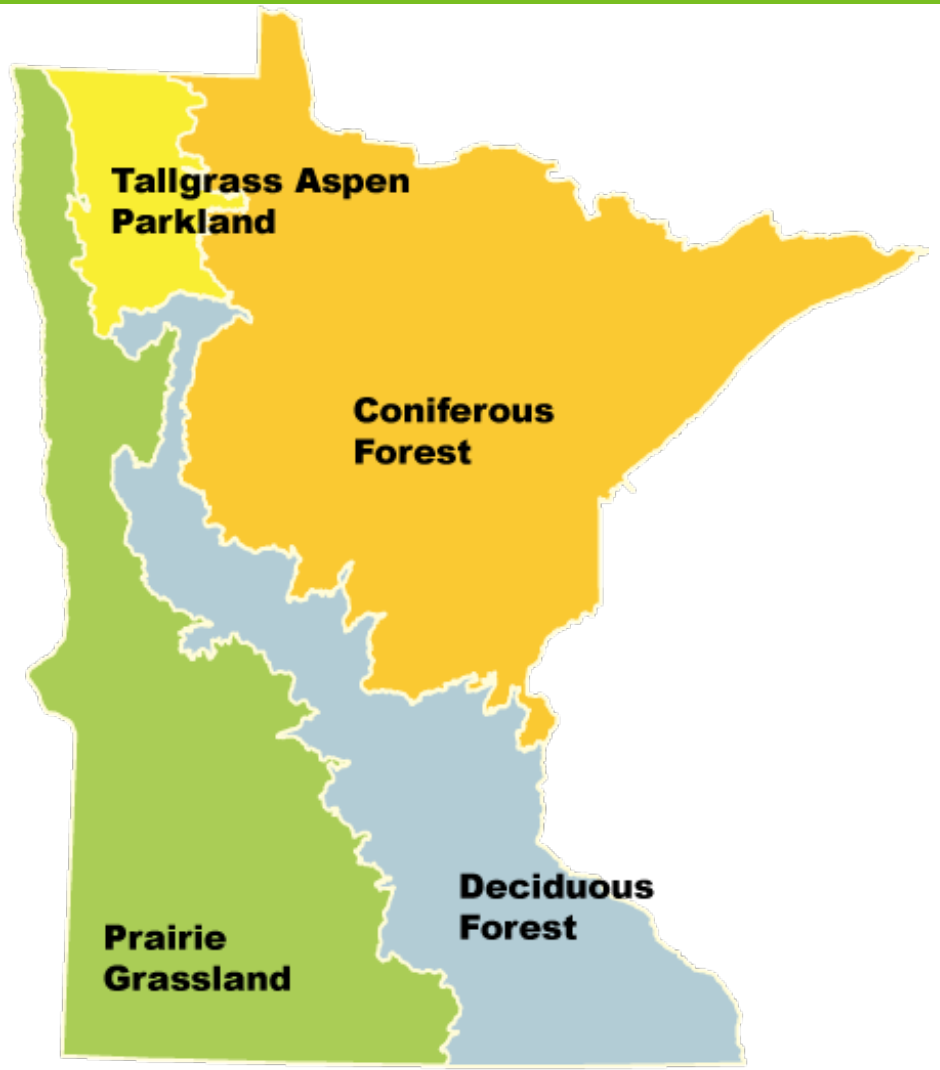
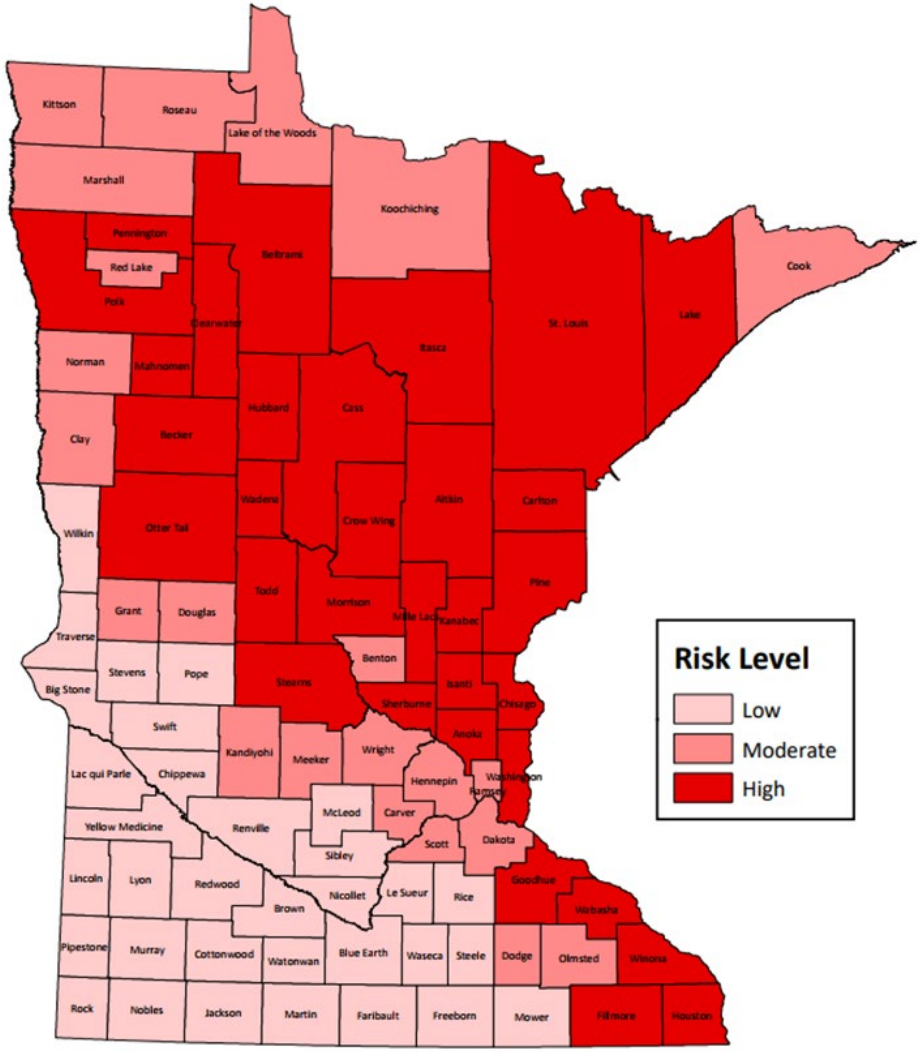
Tickborne Disease Risk in Minnesota





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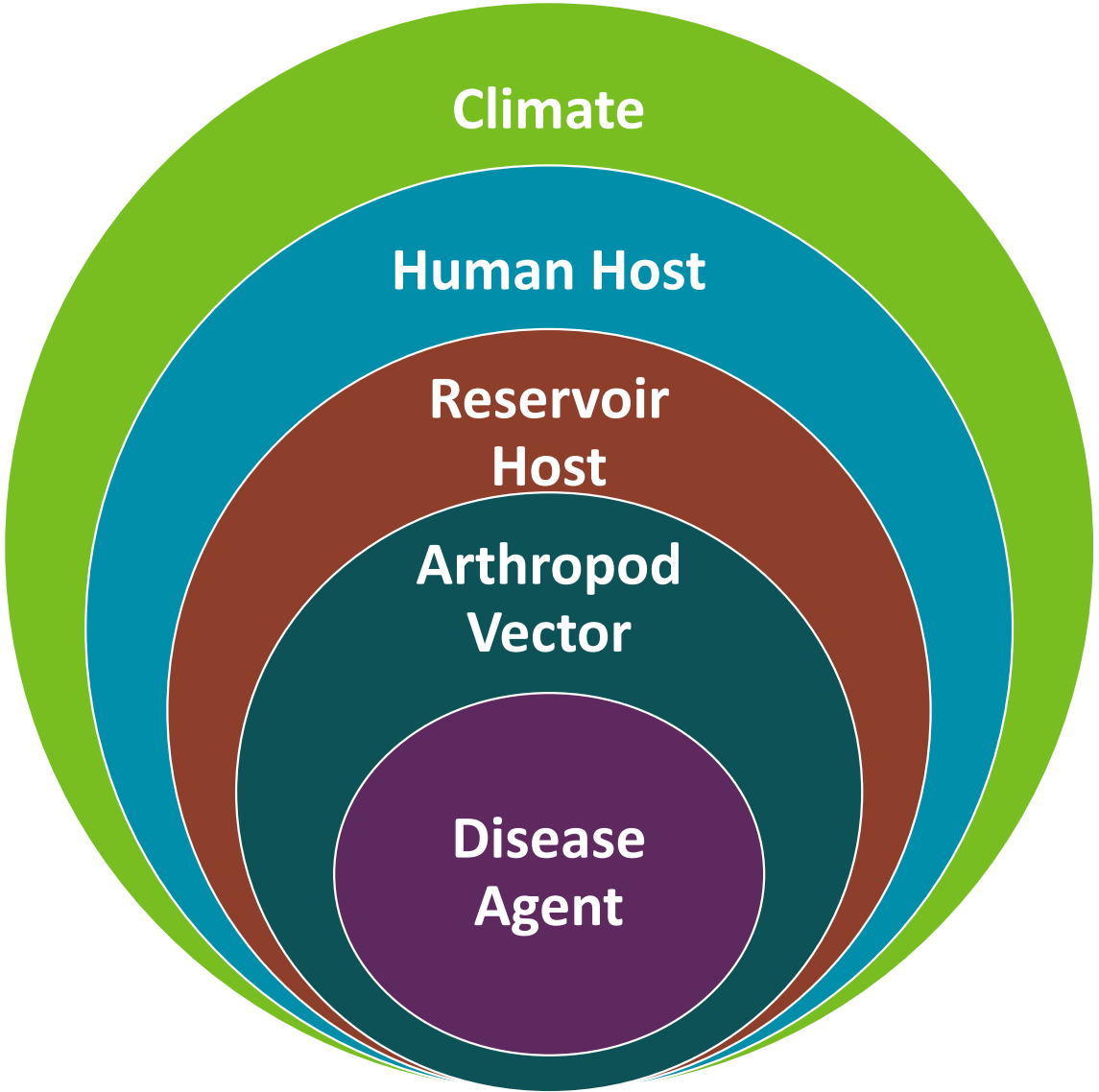
Vectorborne Disease Risk



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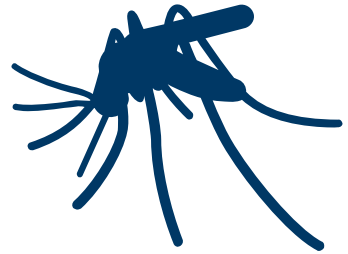
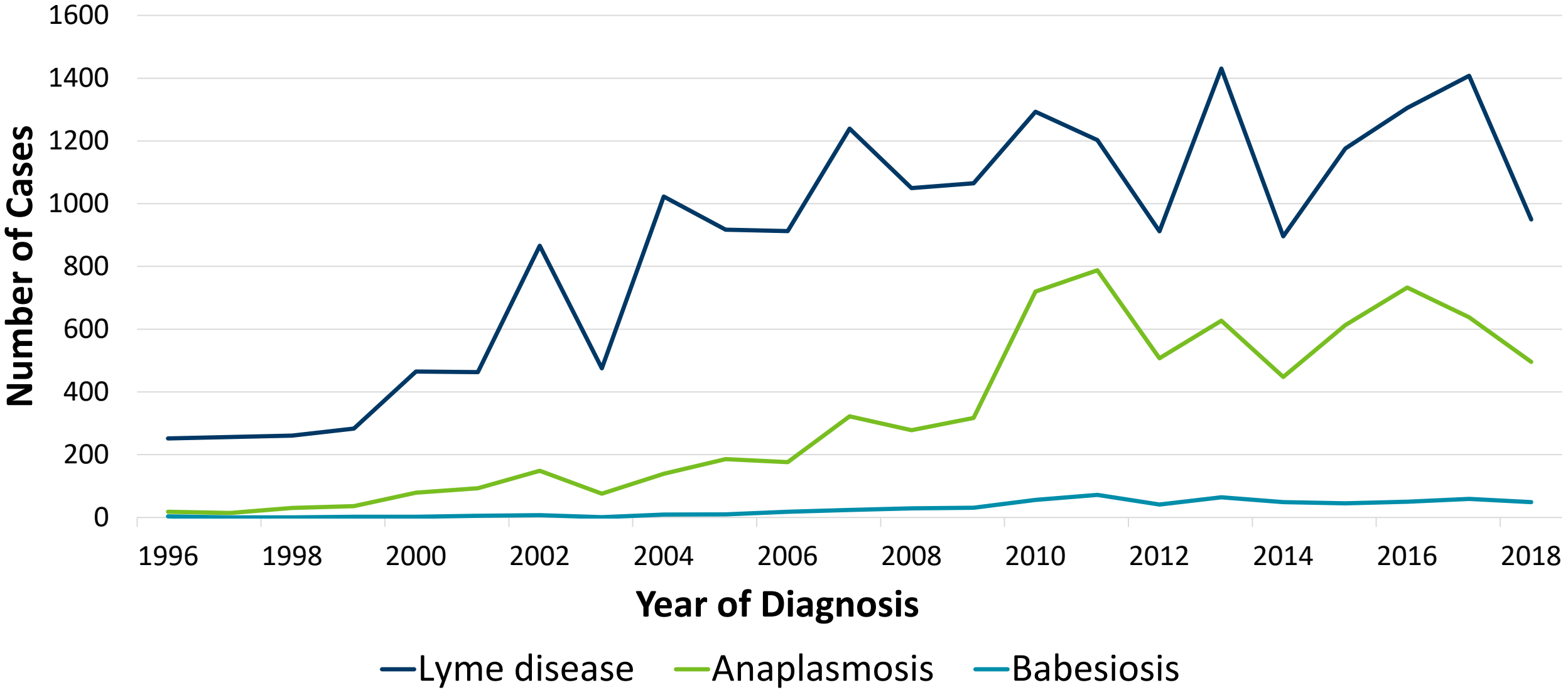
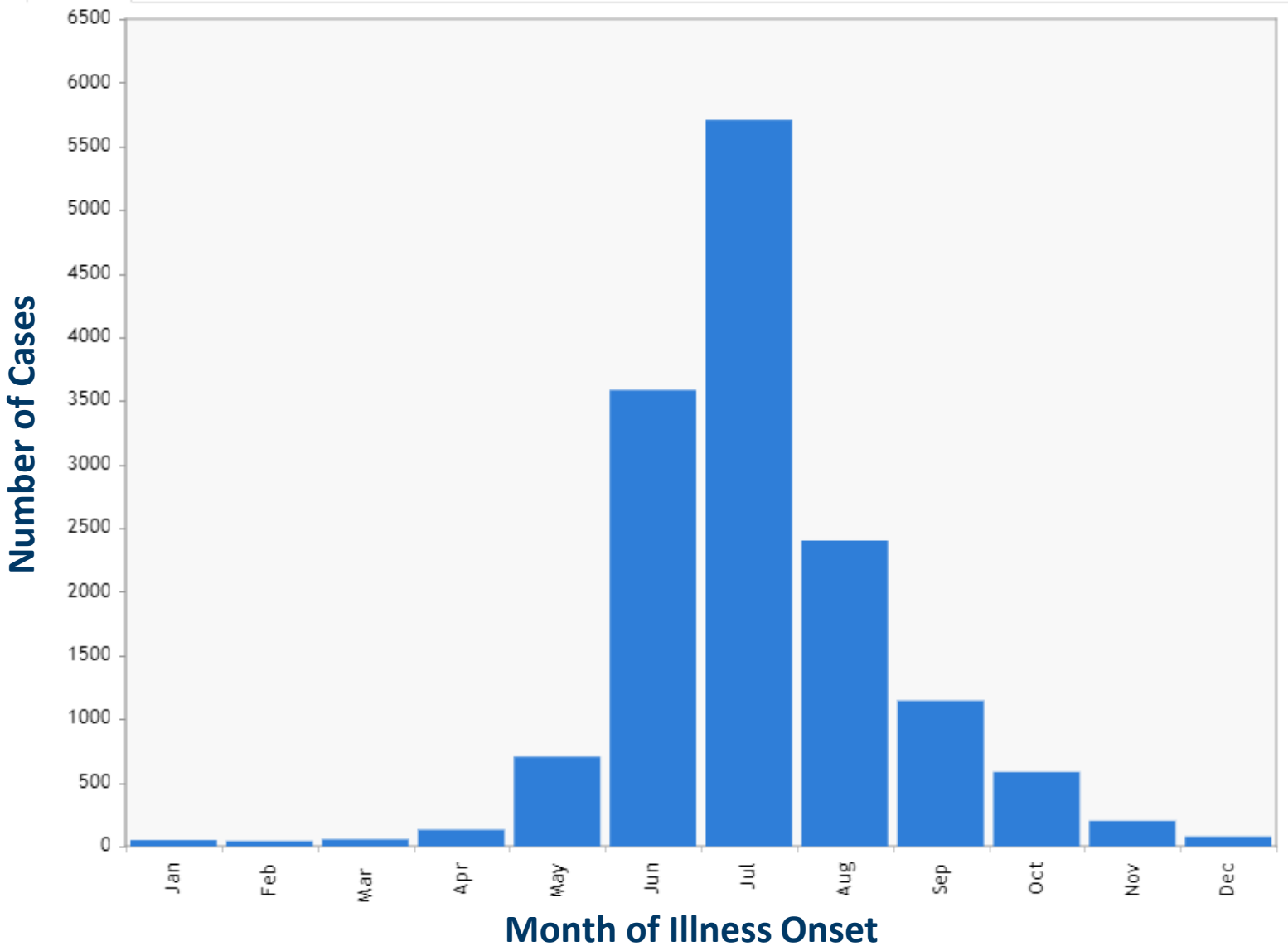


2) Epidemiology of Vectorborne Diseases in Minnesota

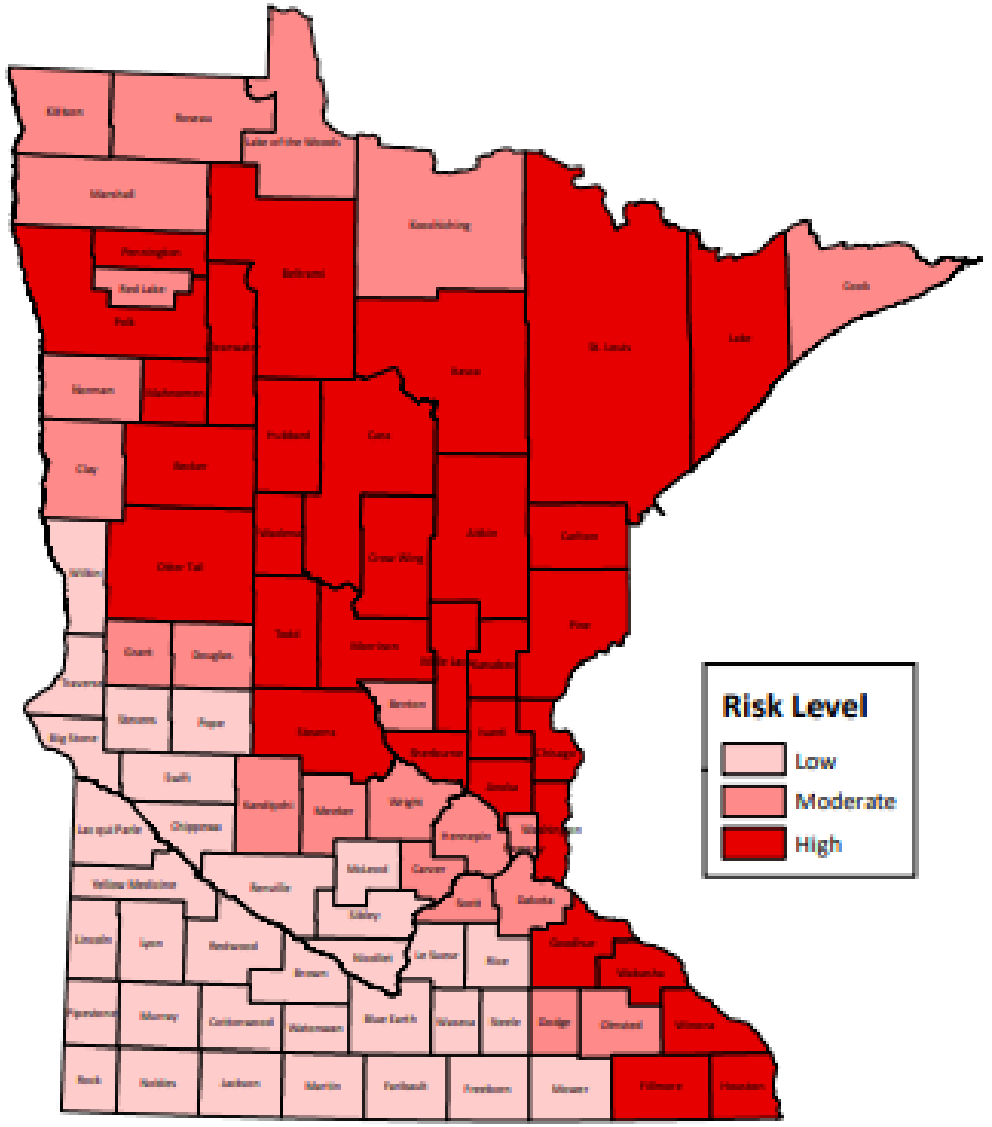
Reported Tickborne Disease Cases in Minnesota, 1996 - 2018



When tickborne disease risk is highest in Minnesota

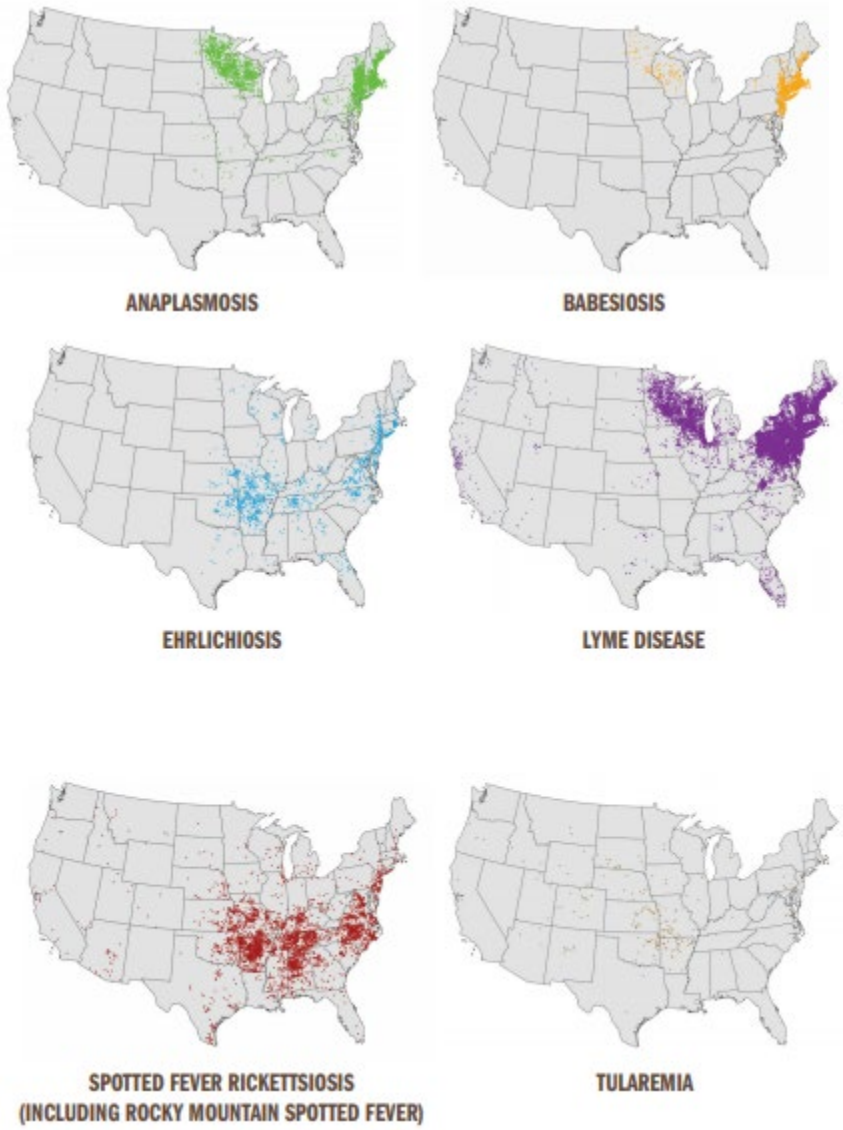


Where tickborne disease risk is highest in Minnesota

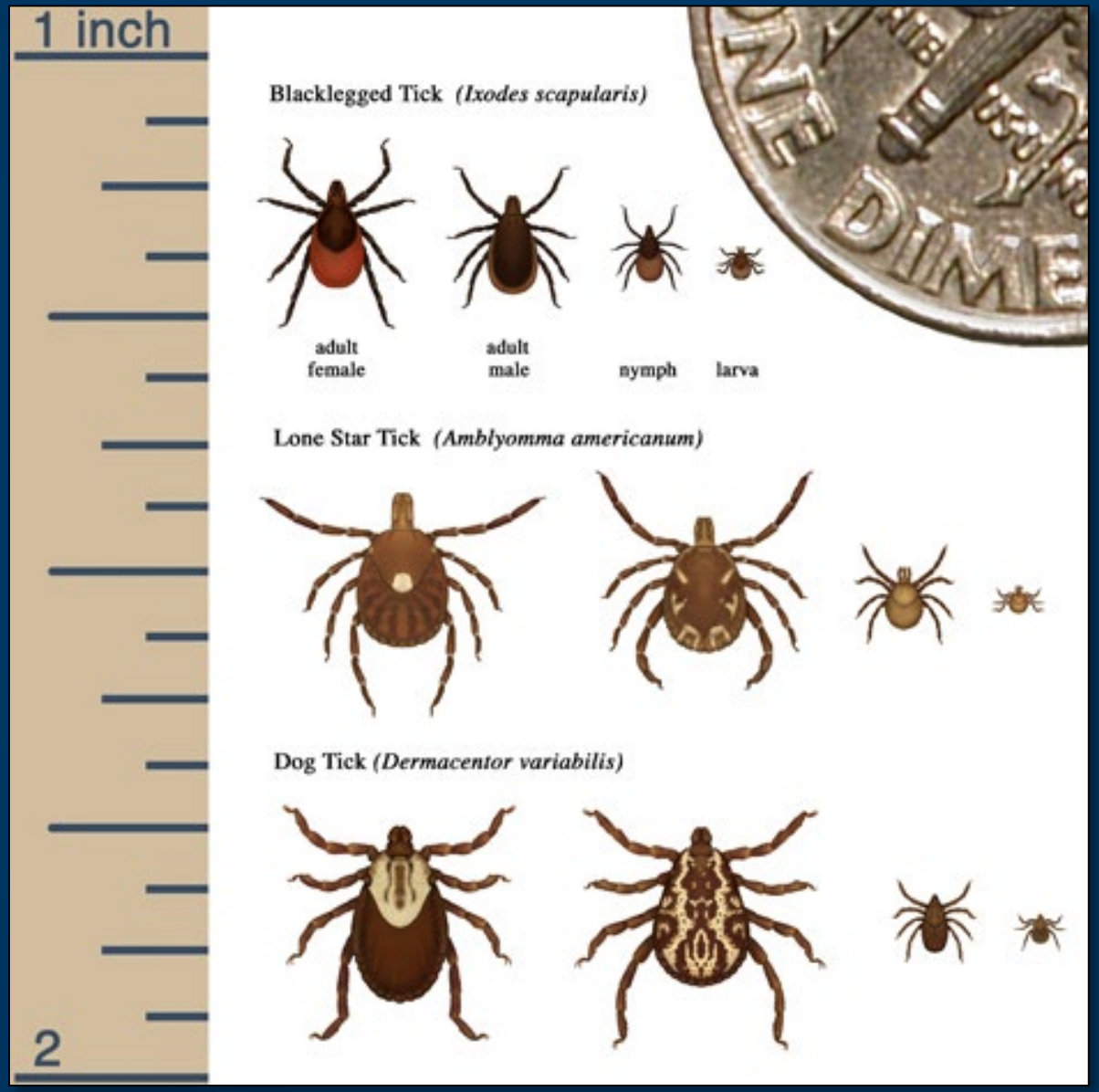


Tickborne Diseases in Minnesota

- Lyme disease
- Anaplasmosis
- Babesiosis
- Ehrlichiosis (due to *E. muris eauclairensis*)
- *Borrelia miyamotoi* disease
- *Borrelia mayonii* disease
- Powassan virus disease
- Spotted Fever Rickettsiosis
- Tularemia



Three Main Ticks of Public Health Concern



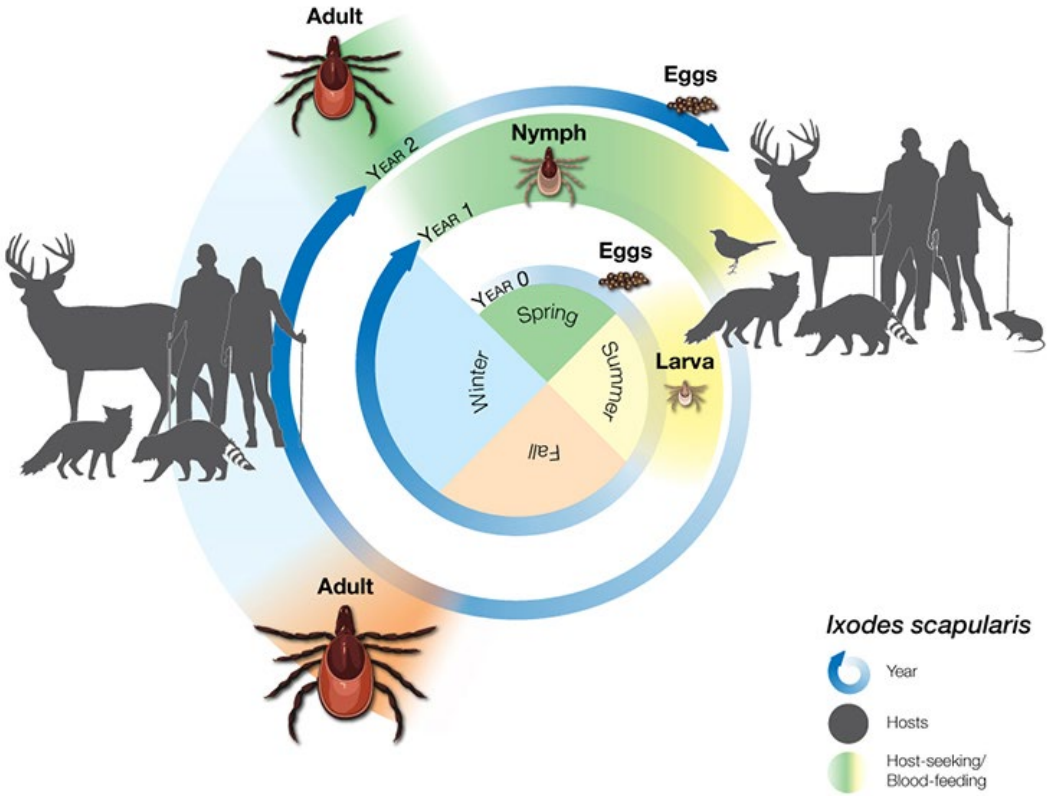
Larva

Nymph

Adult

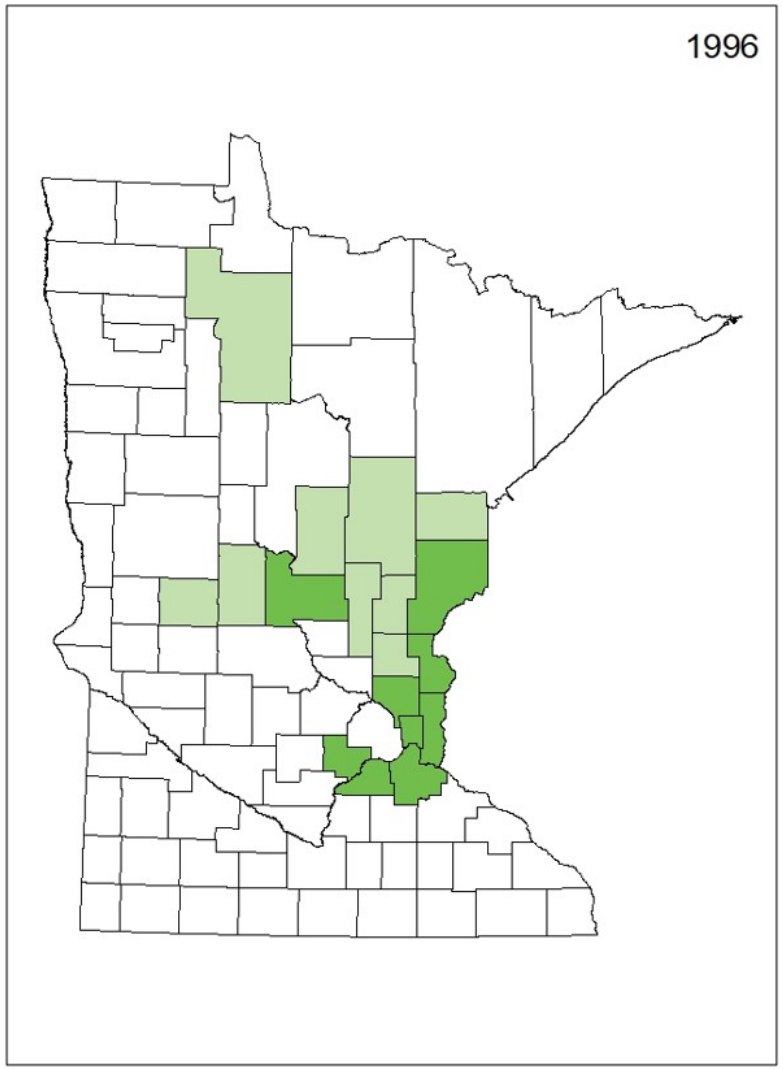
Blacklegged Tick Life Cycle

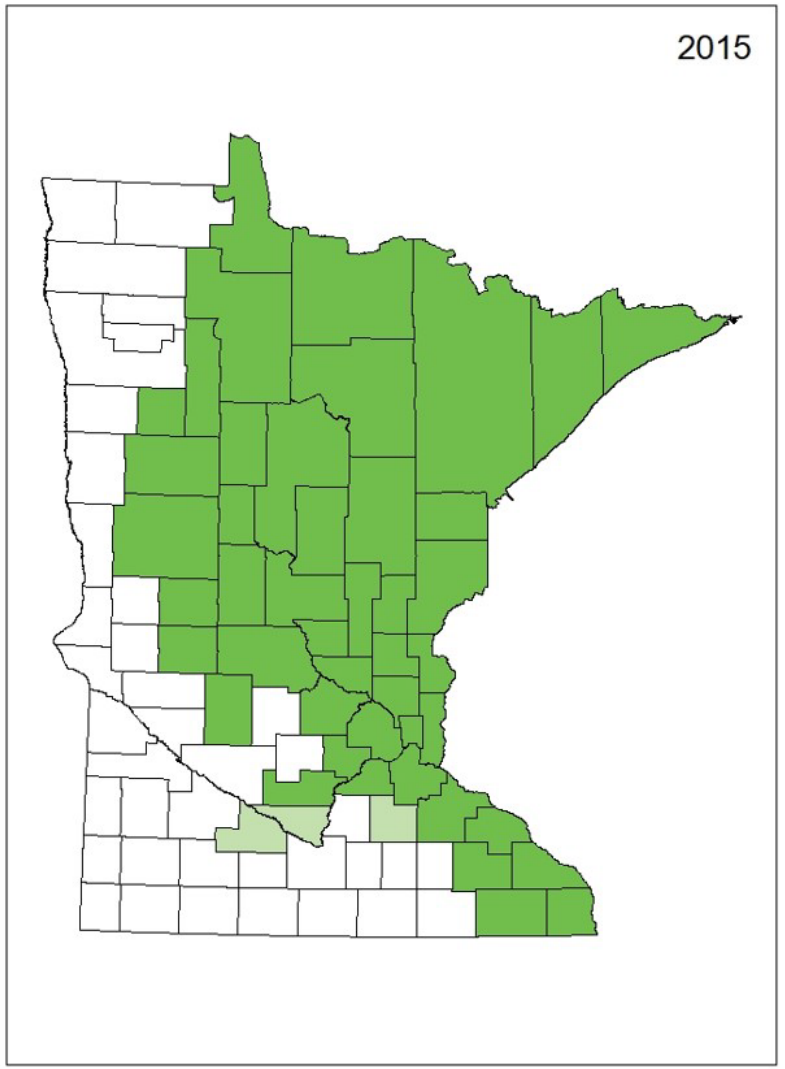
- Sp … nt
- Ty …
- Th … dult
- Ta … stage
- Nc …
  - …
  - …
- Dr … fter fe…
  - -“3 host tick”

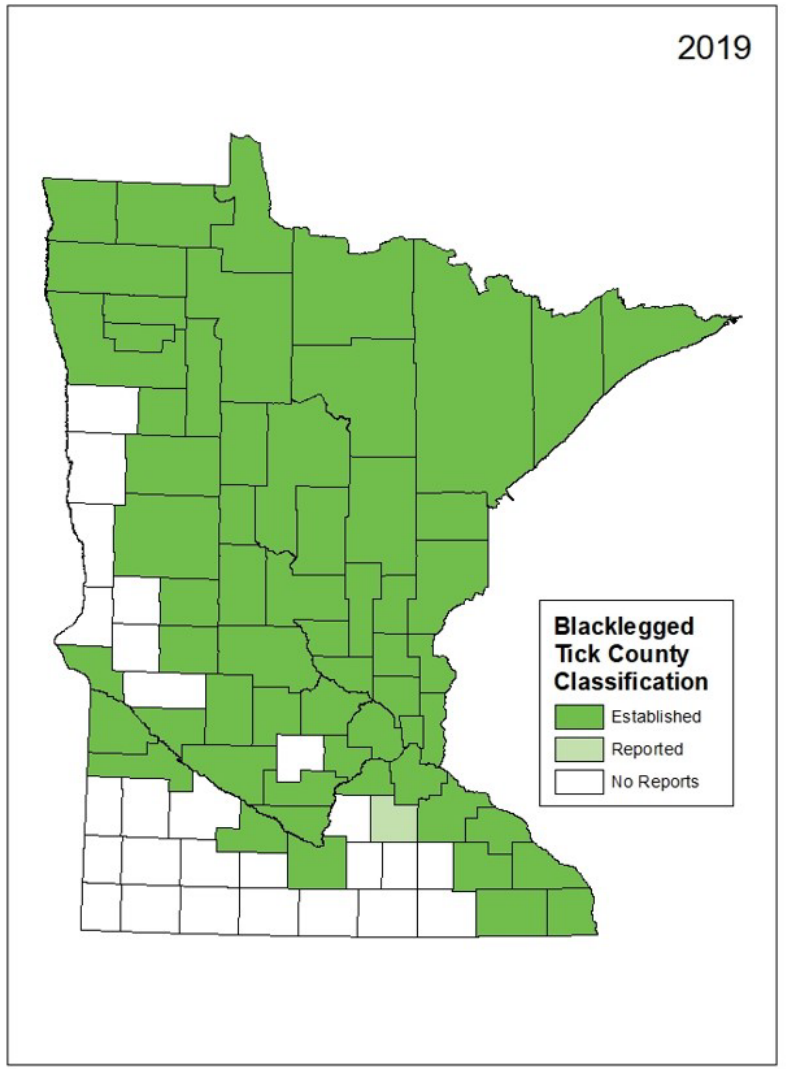


Blacklegged Tick Habitat

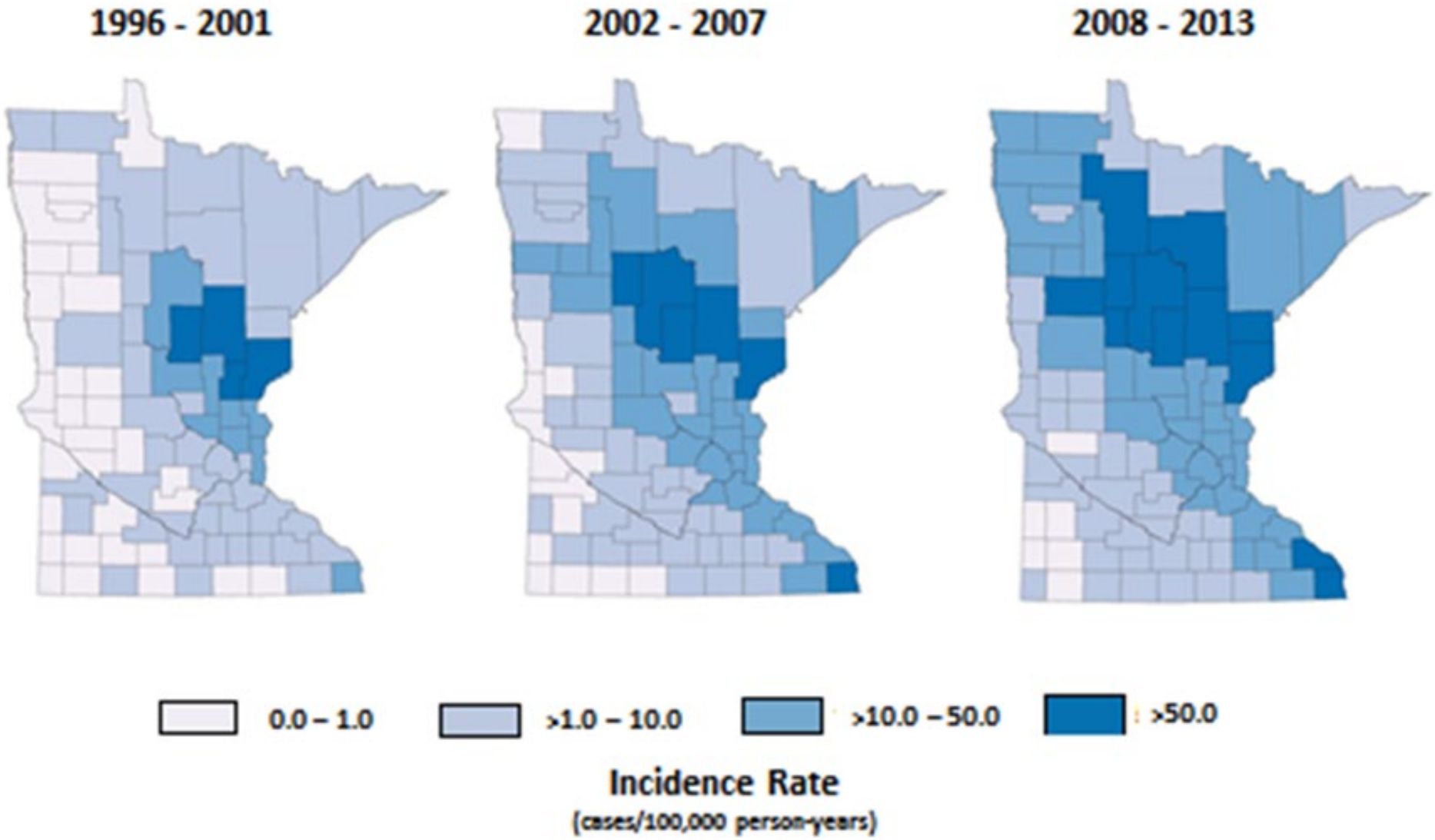
Distribution of Blacklegged Tick Populations by County in Minnesota, 1996 - 2019





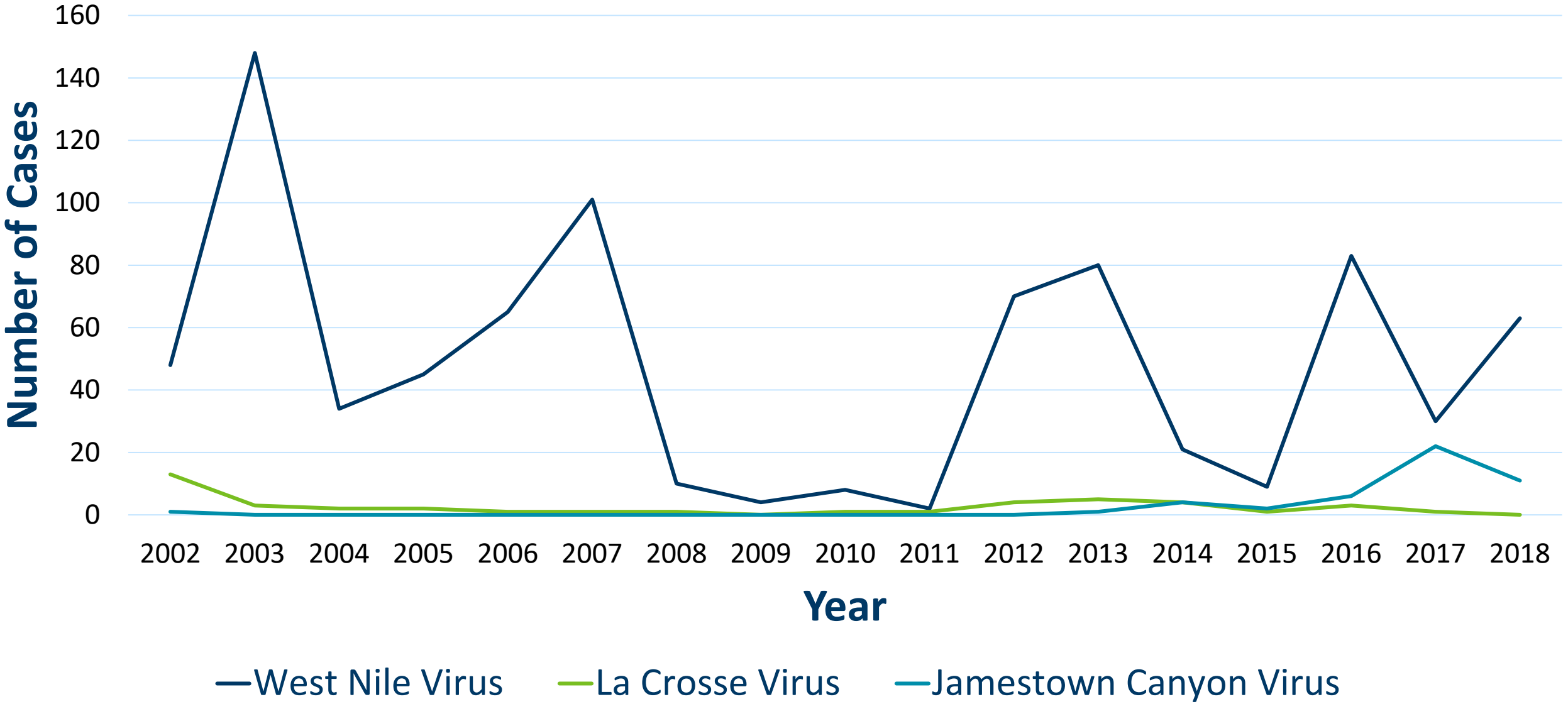


Distribution of Lyme Disease Cases in Minnesota by County of Residence, 1996 - 2013

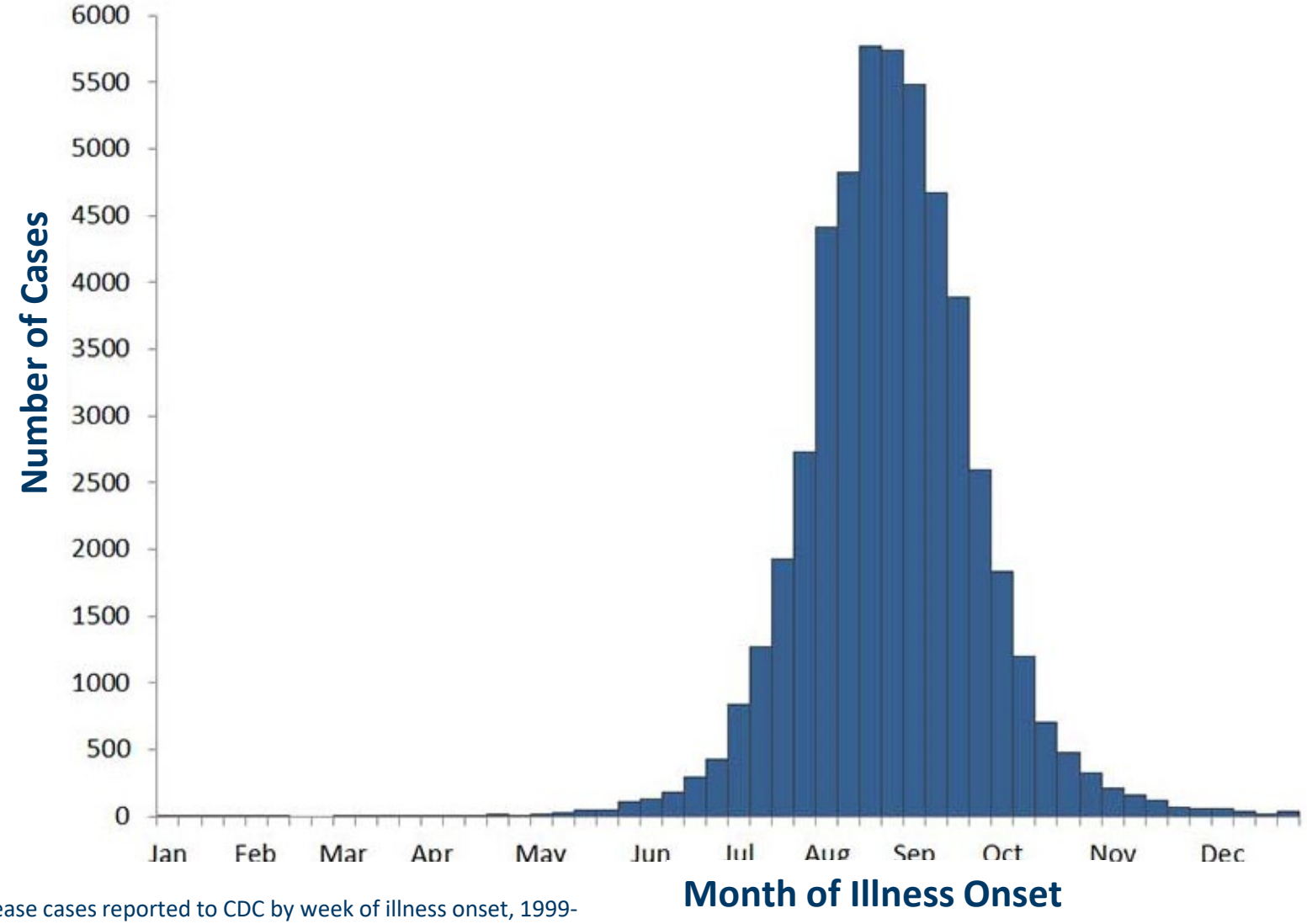


Mosquitoborne Diseases Affecting Minnesotans

Reported Mosquitoborne Disease Cases in Minnesota, 2002 - 2018



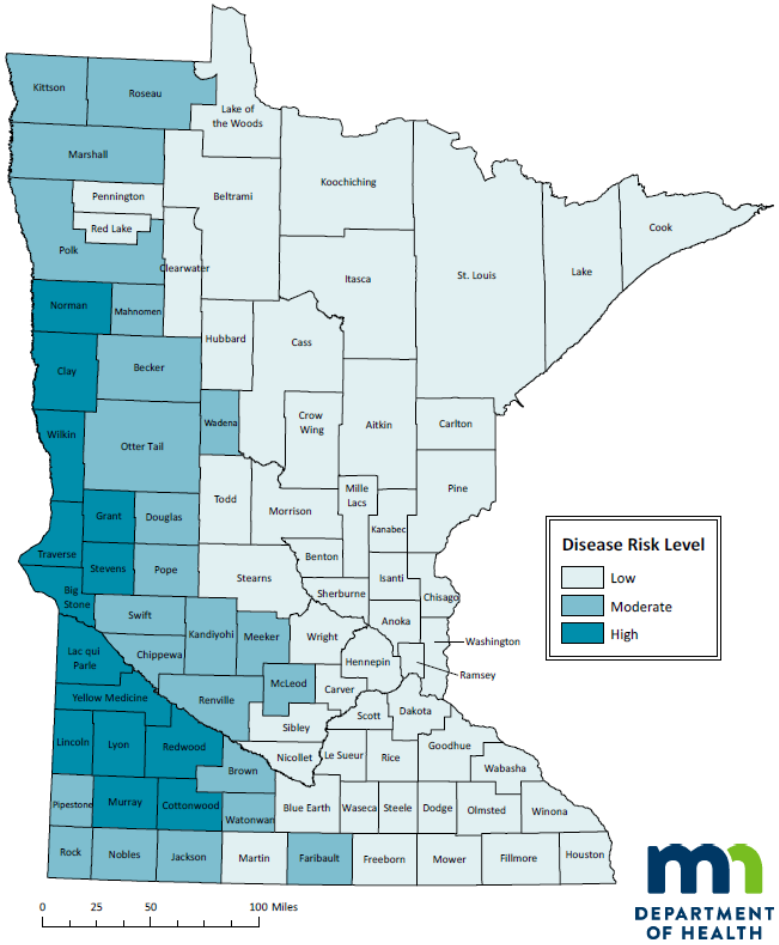
When Mosquitoborne Disease Risk is Highest in Minnesota



Graph courtesy of CDC: West Nile virus disease cases reported to CDC by week of illness onset, 1999-2018 (accessed 10/25/2019). https://www.cdc.gov/westnile/statsmaps/cumMapsData.html#eight

Where Mosquitoborne Disease Risk is Highest in Minnesota

West Nile virus disease cases, 2002-2018



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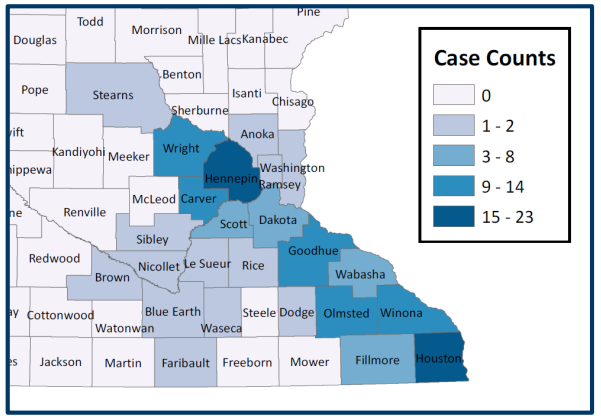
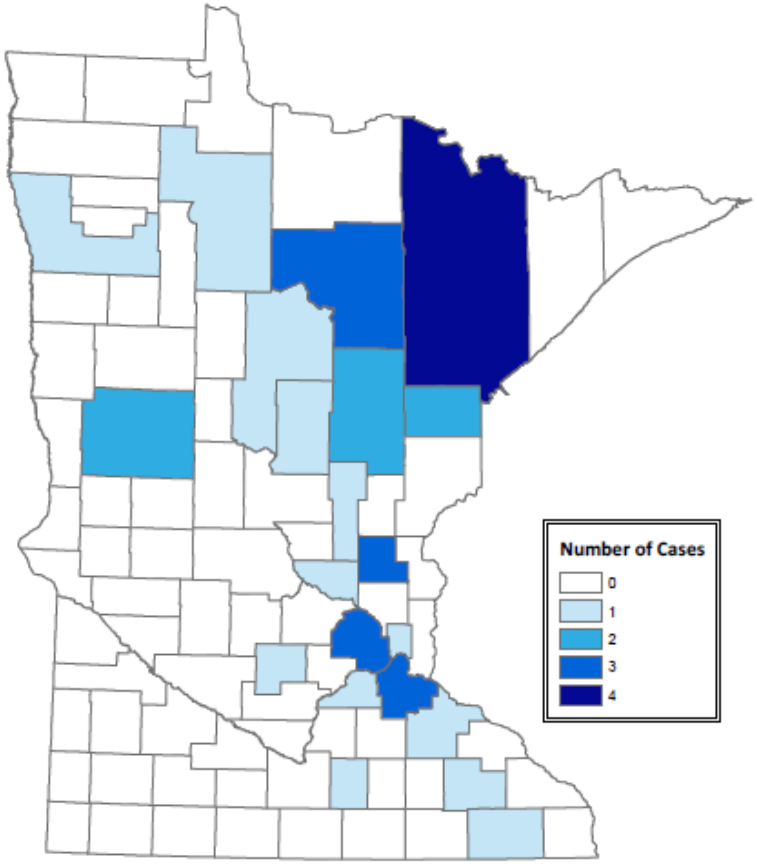
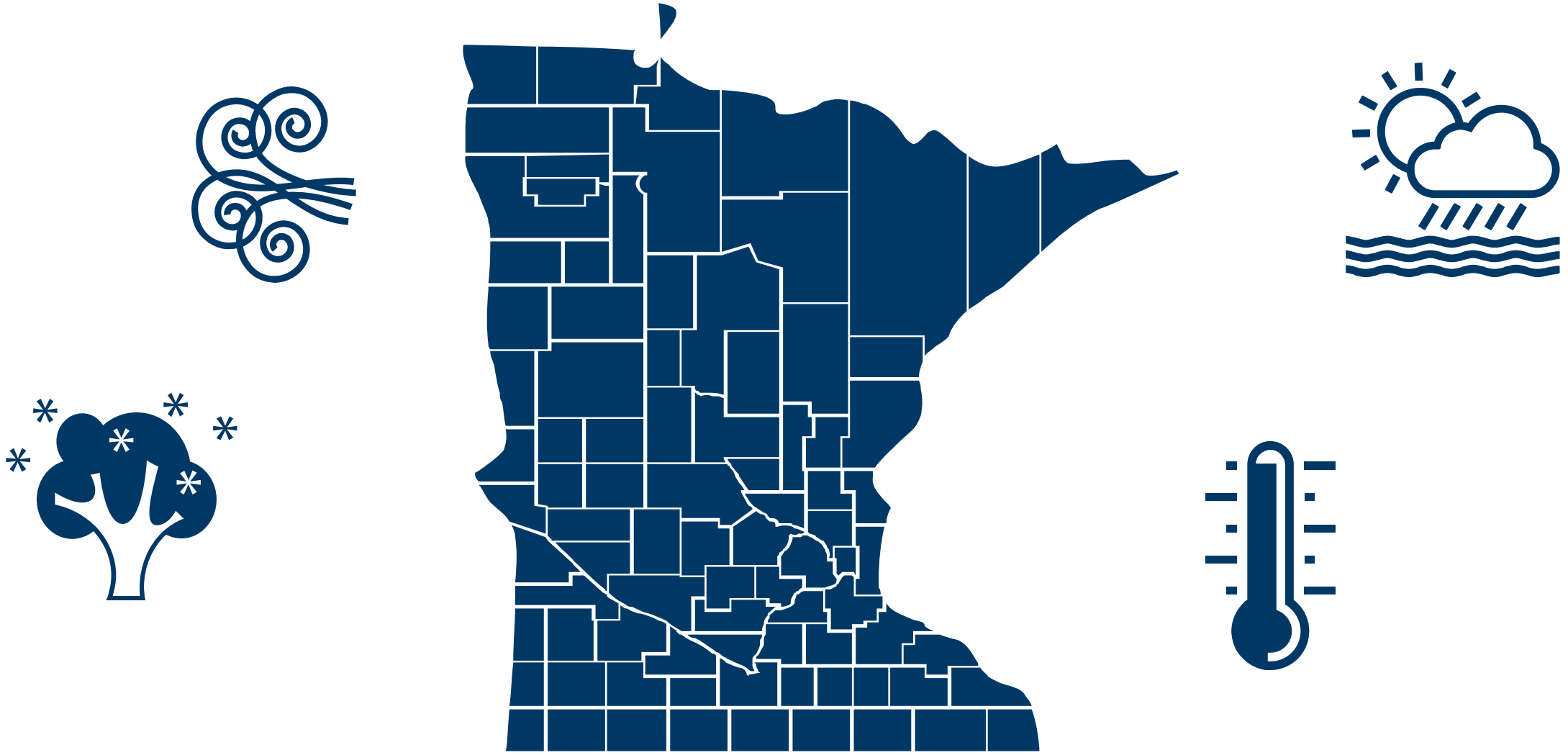
La Crosse Encephalitis Cases, 1985-2018



Jamestown Canyon virus disease cases, 2013-2017



Vectorborne Disease Risk in Minnesota



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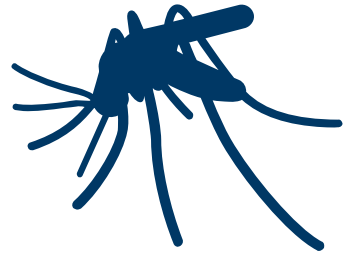


3) Climate and Predicting Changes in Vectorborne Disease Risk

Vectors and Climate

- Climate plays a key role in vector…
  - -Life cycle
  - -Activity
  - -Geographic distribution

Potential Climate Change Effects and Tickborne Disease Risk

- Increased temperature
  - -Longer tick feeding season
  - -Lower mortality in winter
- Increased precipitation/humidity
  - -Increased blacklegged tick survival in warm season
  - -Increased time available for tick feeding each day
- Potential survival of non-native tick species
  - *-Amblyomma americanum*
  - *-Amblyomma maculatum*
  - *-Haemaphysalis longicornis*

Potential Climate Change Effects and Mosquitoborne Disease Risk

- Warmer and drier conditions
  - -Increased West Nile virus risk
- Warmer and wetter conditions
  - -Increased La Crosse virus risk
- Potential emergence or re-emergence of exotic diseases
  - -Malaria
  - -Chikungunya
- Potential survival of non-native mosquito species
  - -*Aedes albopictus* (Asian tiger mosquito)
  - -*Aedes japonicus* (Japanese rock pool mosquito)

Vectorborne Disease Risk Over Time

- Situation in Minnesota is similar to that of other areas in the US

  -Expansion of vector distribution

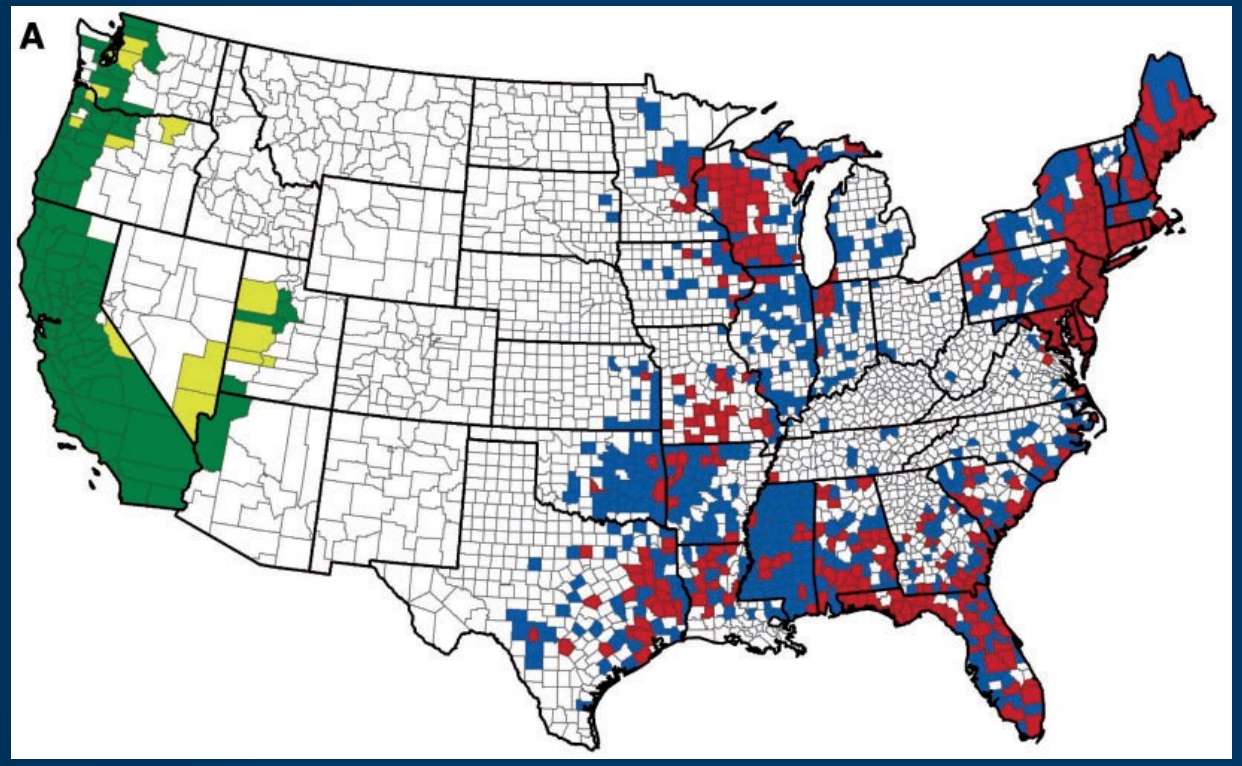
  -Rise in vectorborne disease case numbers

  -Emergence of new disease agents

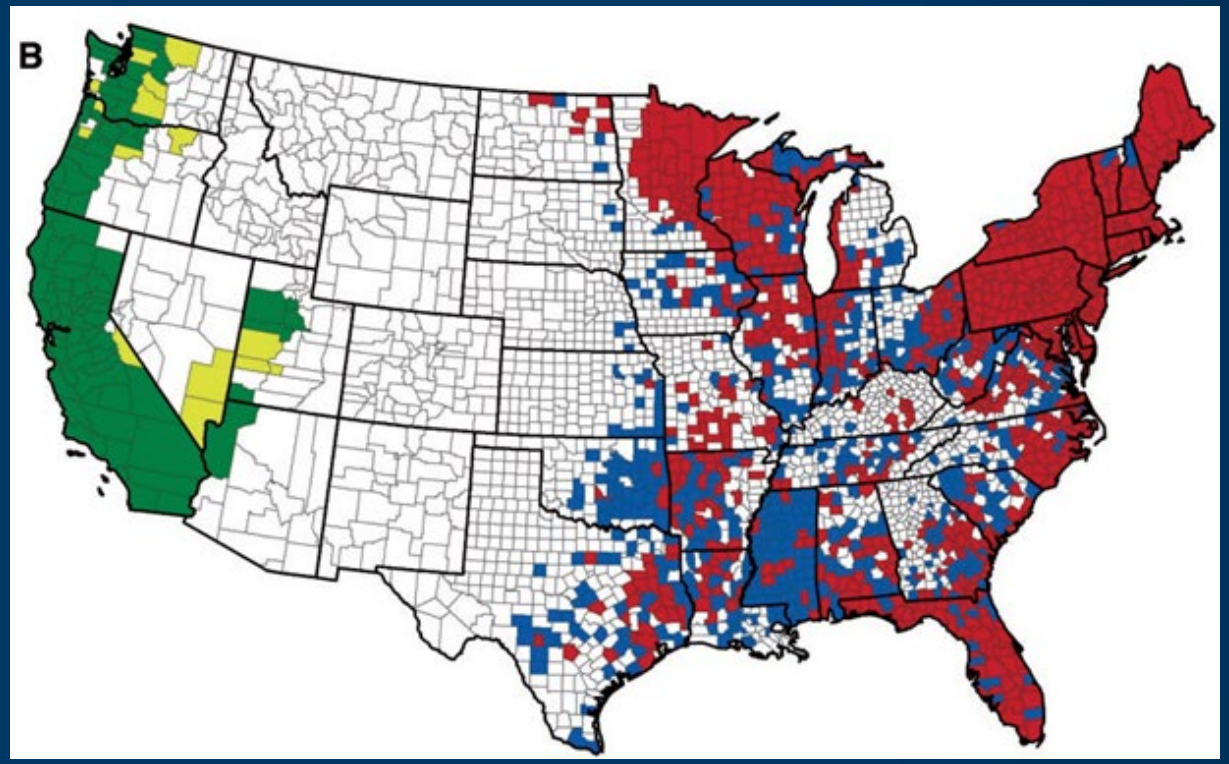
  -Re-emergence of known disease agents

Blacklegged Tick Distribution by County of Recorded Presence

1907-1996



1907-2015

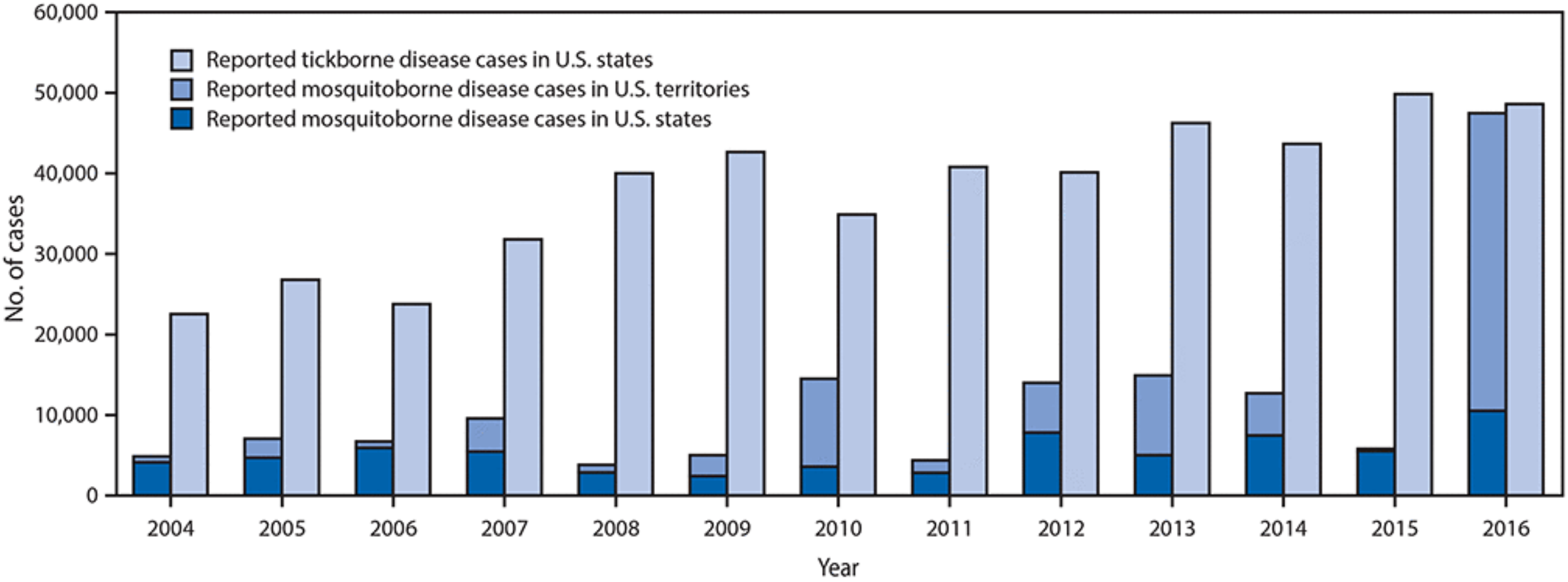


Established*
Reported**
No Records

* ≥ 6 ticks or two life stages recorded within a single calendar year
** fewer ticks of a single life stage

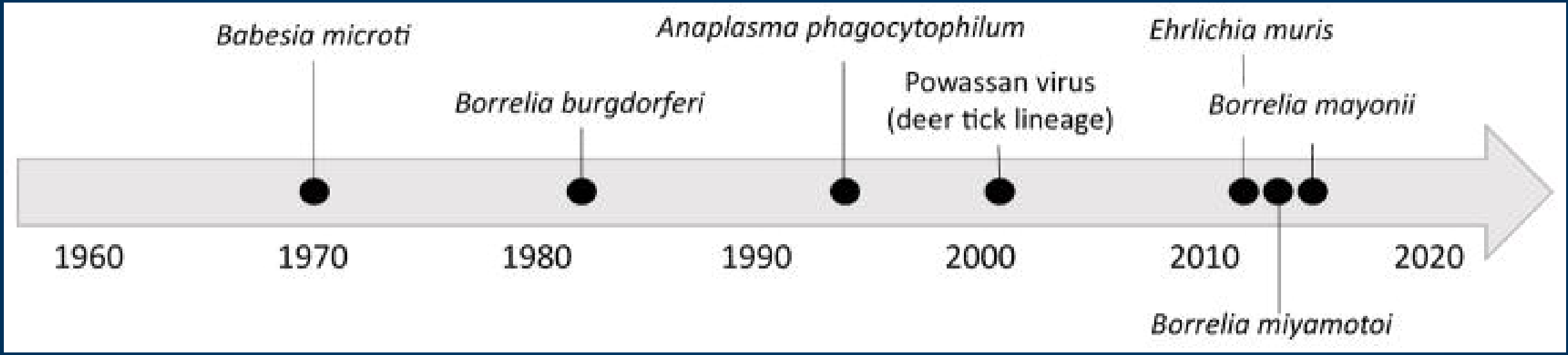
Eisen, R. J., Eisen, L., and C. B. Beard. County-Scale Distribution of *Ixodes scapularis* and *Ixodes pacificus* (Acari: Ixodidae) in the Continental United States. 2016. J Med Ent 0:0 (1-38). doi: 10.1093/jme/tjv237

Reported number of vectorborne disease cases in the United States, 2004 - 2016



Rosenberg R, Lindsey NP, Fischer M, et al. *Vital Signs*: Trends in Reported Vectorborne Disease Cases — United States and Territories, 2004–2016. MMWR Morb Mortal Wkly Rep 2018;67:496–501. DOI: http://dx.doi.org/10.15585/mmwr.mm6717e1external icon.

Timeline Showing Discovery of the Seven Human Pathogens Transmitted by Blacklegged Ticks



(Eisen and Eisen, 2018)

Reported number of human tularemia cases in the United States, 1950 - 2017

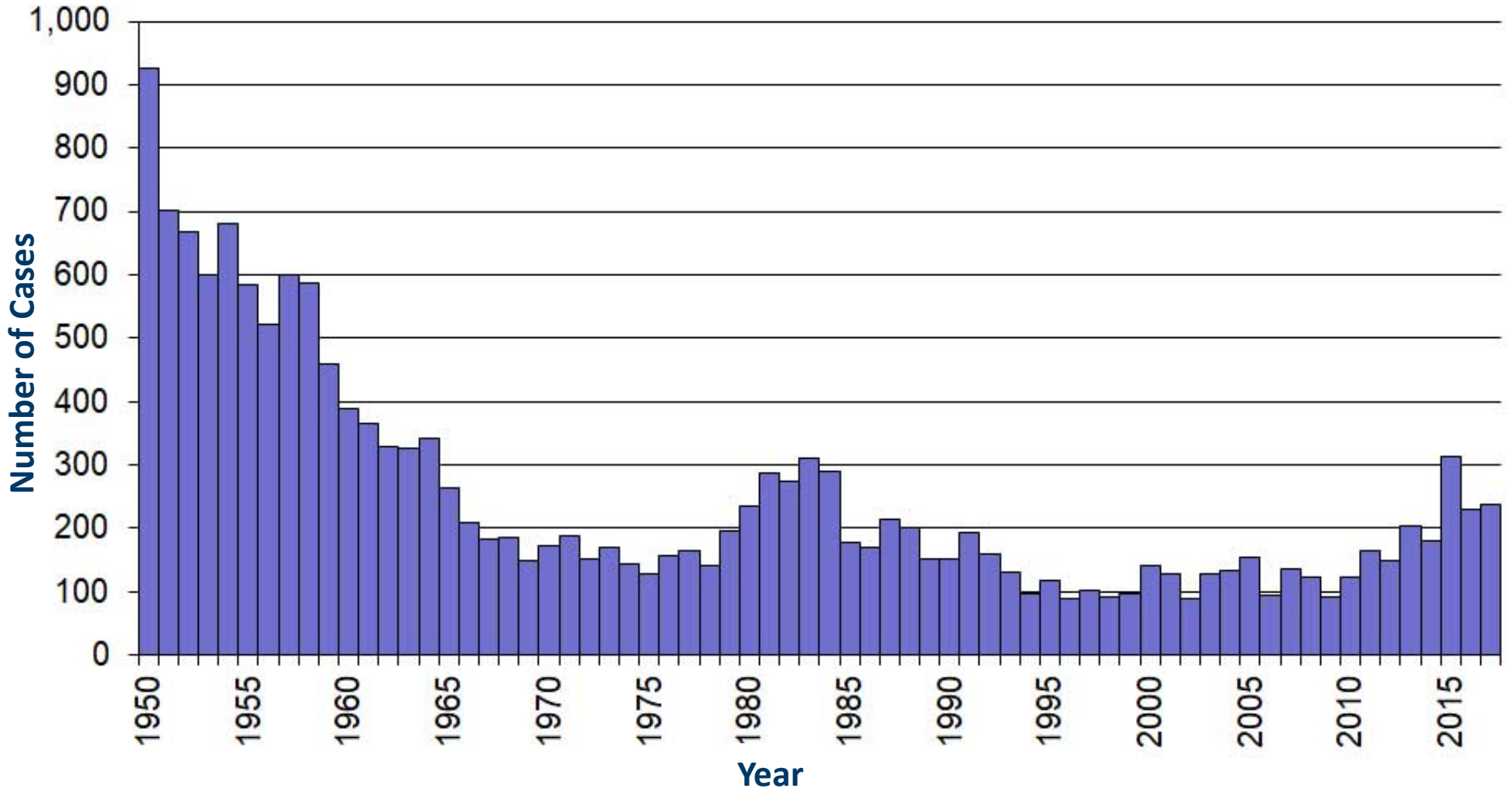
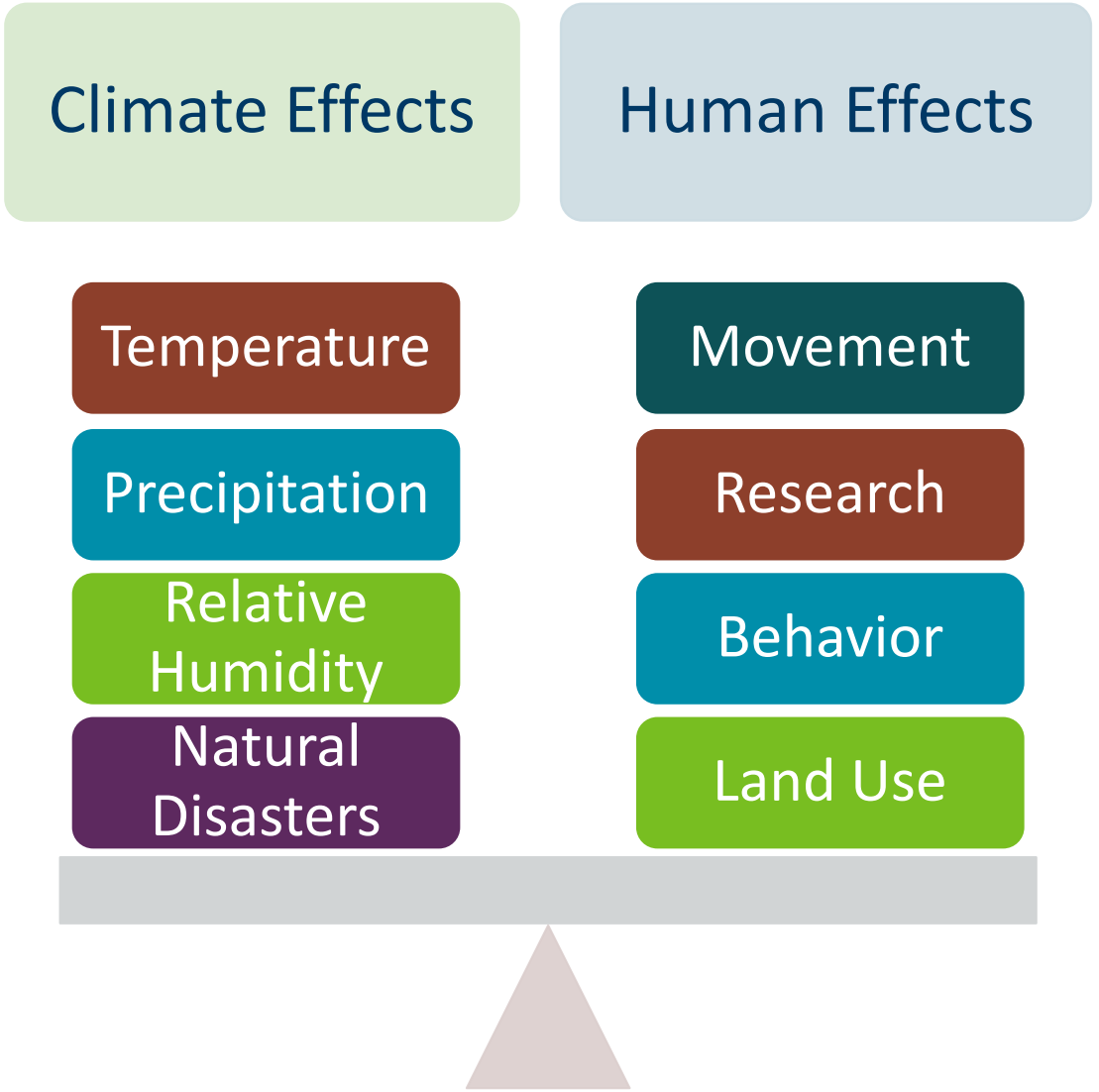


Chart courtesy of CDC: Tularemia Statistics: Yearly Reported Cases – U.S. 1950-2017 (accessed 10/25/2019): https://www.cdc.gov/tularemia/statistics/index.html

Climate Change & Vectorborne Disease Risk in Minnesota



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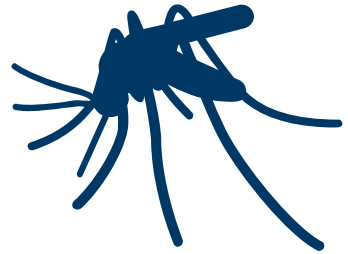
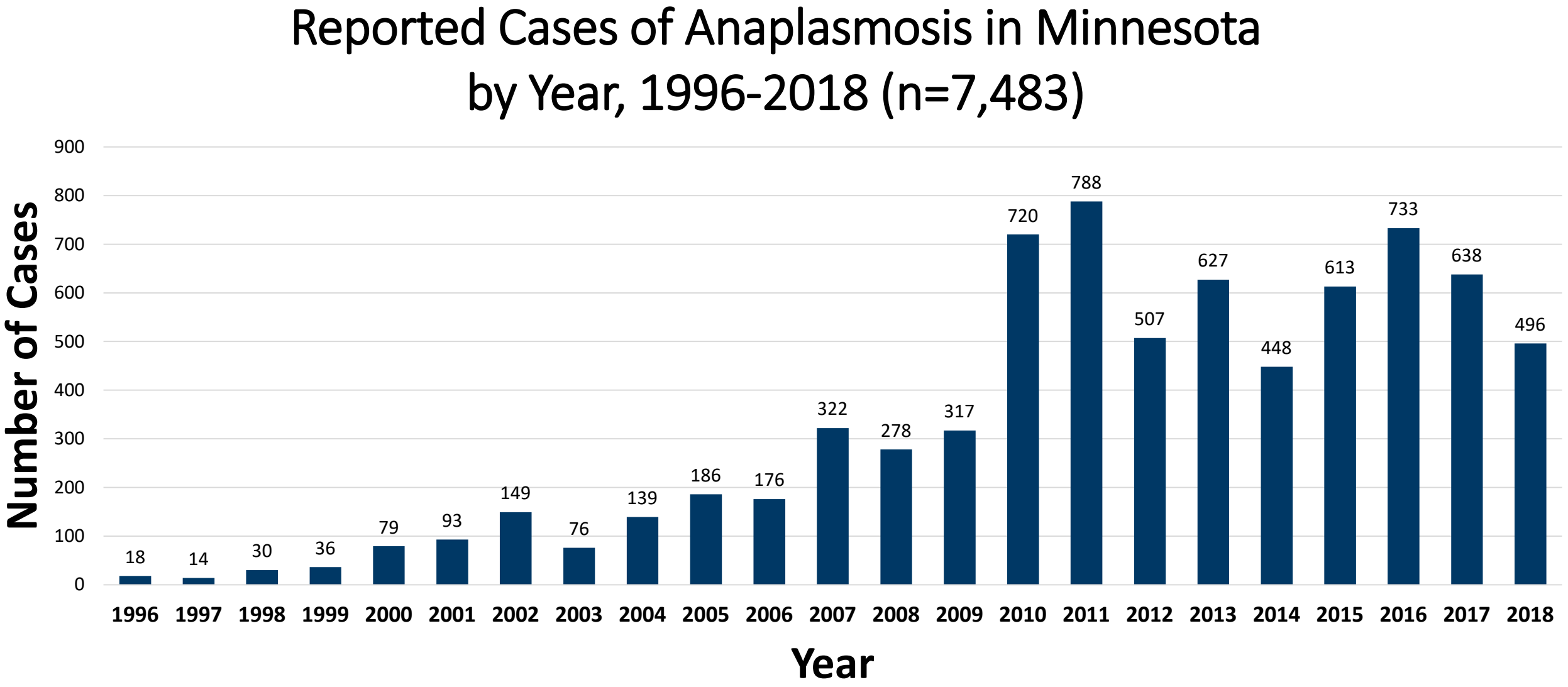


4) Impacts of Climate Change on the MDH Vectorborne Diseases Unit

Impacts of Climate Change on the MDH Vectorborne Diseases Unit

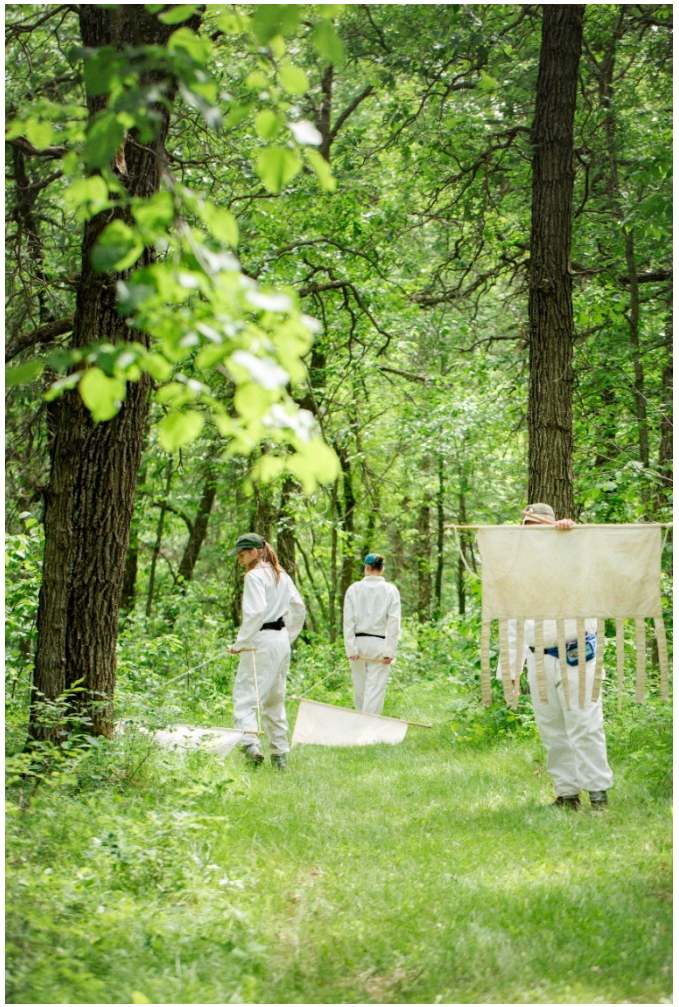
- Value vector, pathogen, and human case surveillance over time
- Collaborate with local, regional, and national partners
- Be proactive to the emergence of new vectors and pathogens
- Serve the public with science-based knowledge and prevention messages

Today's novel pathogen could be tomorrow's epidemic…

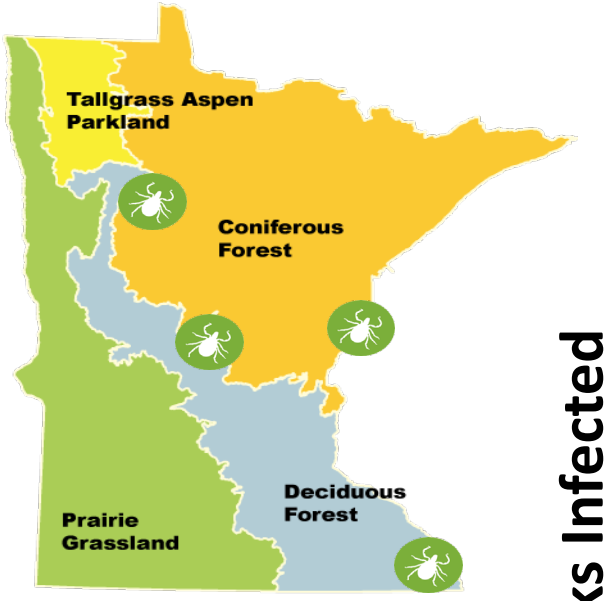


Tick Surveillance in Minnesota

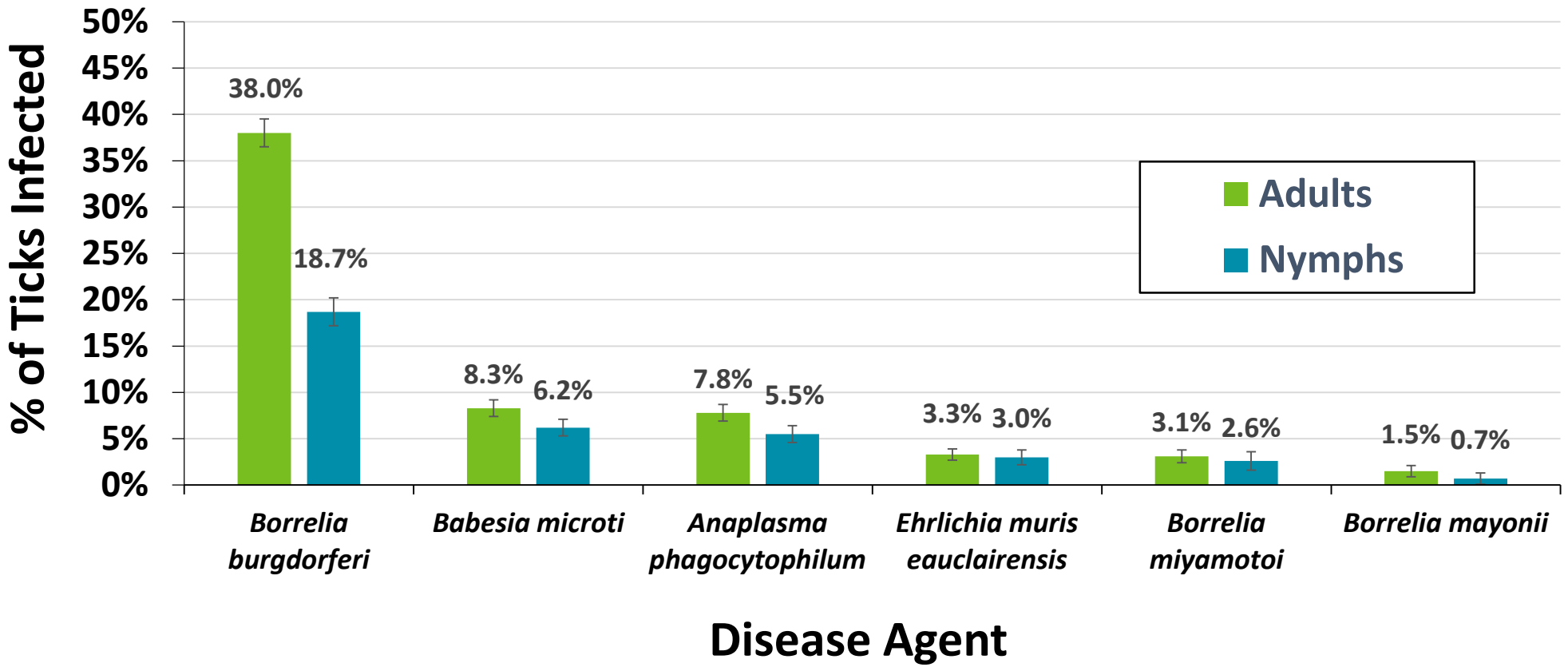
- Communication network with partners
  - -Metropolitan Mosquito Control District
  - -Midwest Center of Excellence for Vectorborne Disease
  - -USDA Longhorned Tick Stakeholder Group
  - -Centers for Disease Control and Prevention
- Passive surveillance through tick identification services
- Active surveillance through long-term monitoring sites
- Research studies through TickNET and other researchers



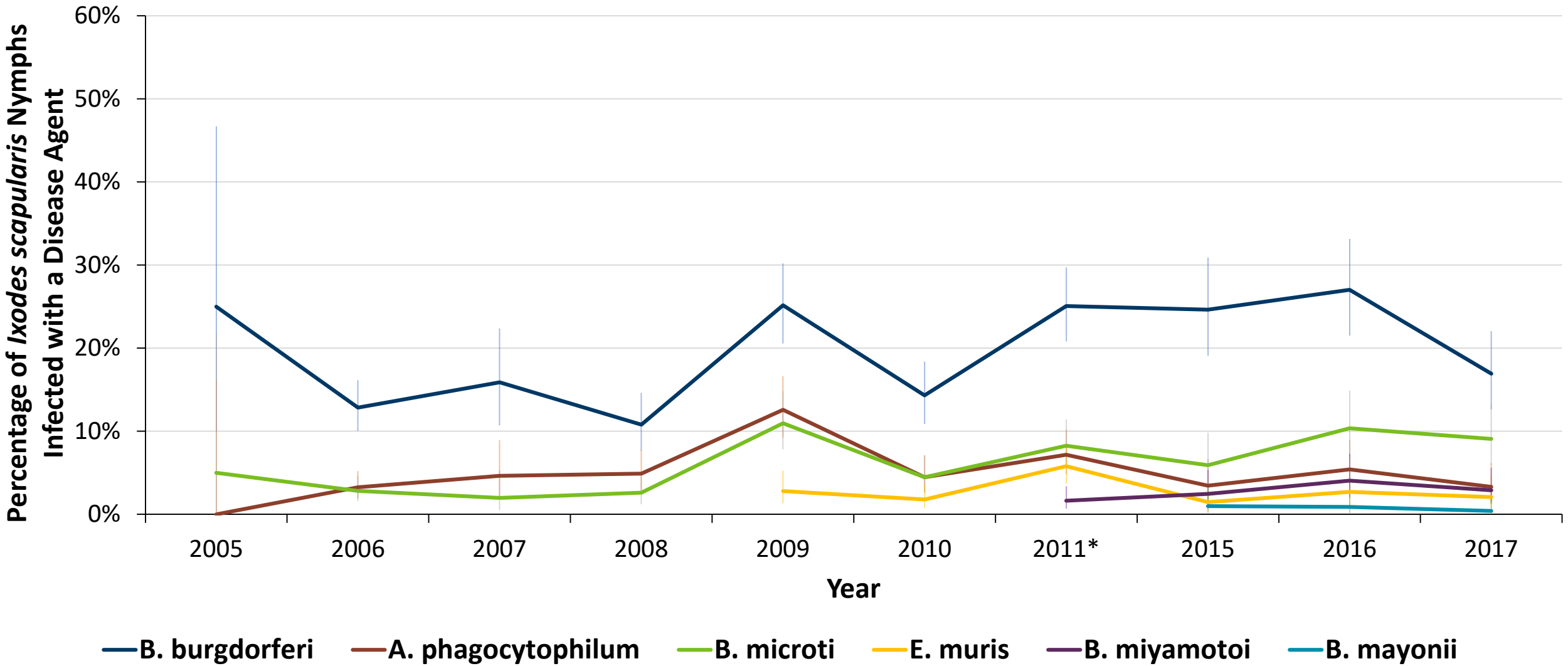
Blacklegged Tick Infection Prevalence Monitoring



Average Blacklegged Tick Infection Prevalence Rates Across Four Sites in Minnesota, 2005-2017

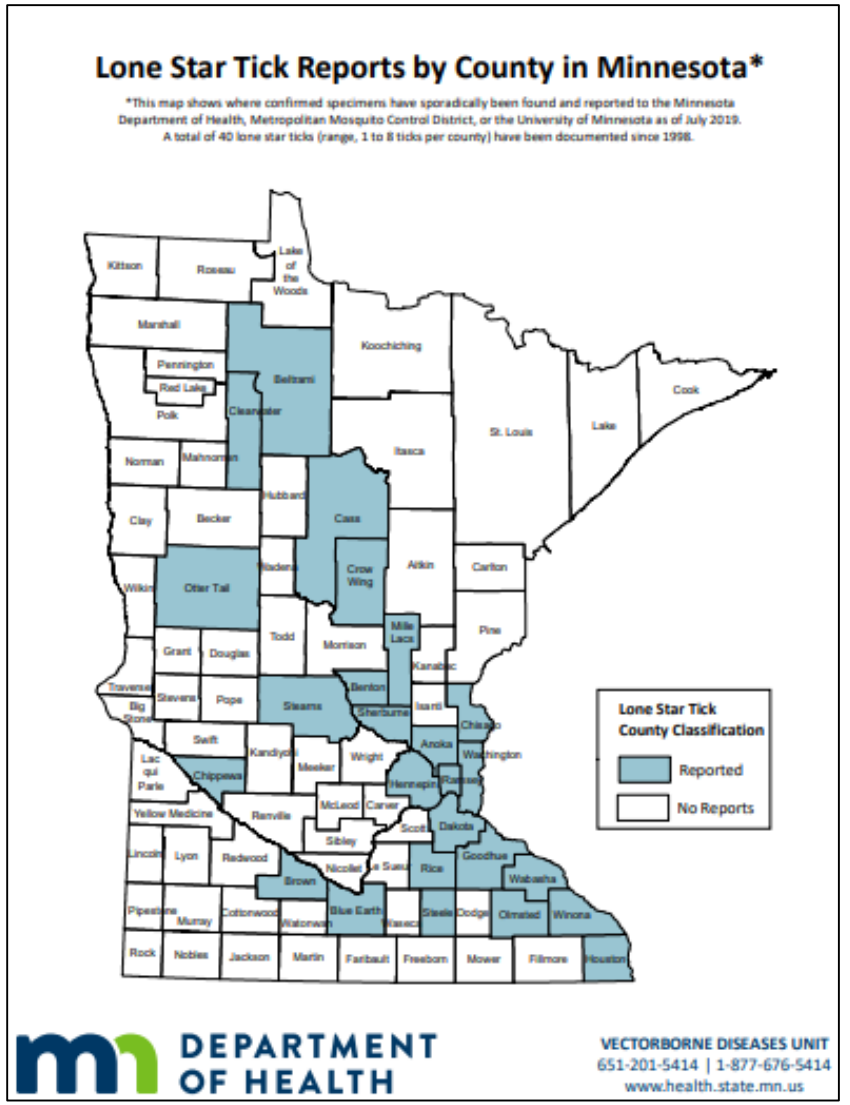


Blacklegged Tick Infection Prevalence Monitoring

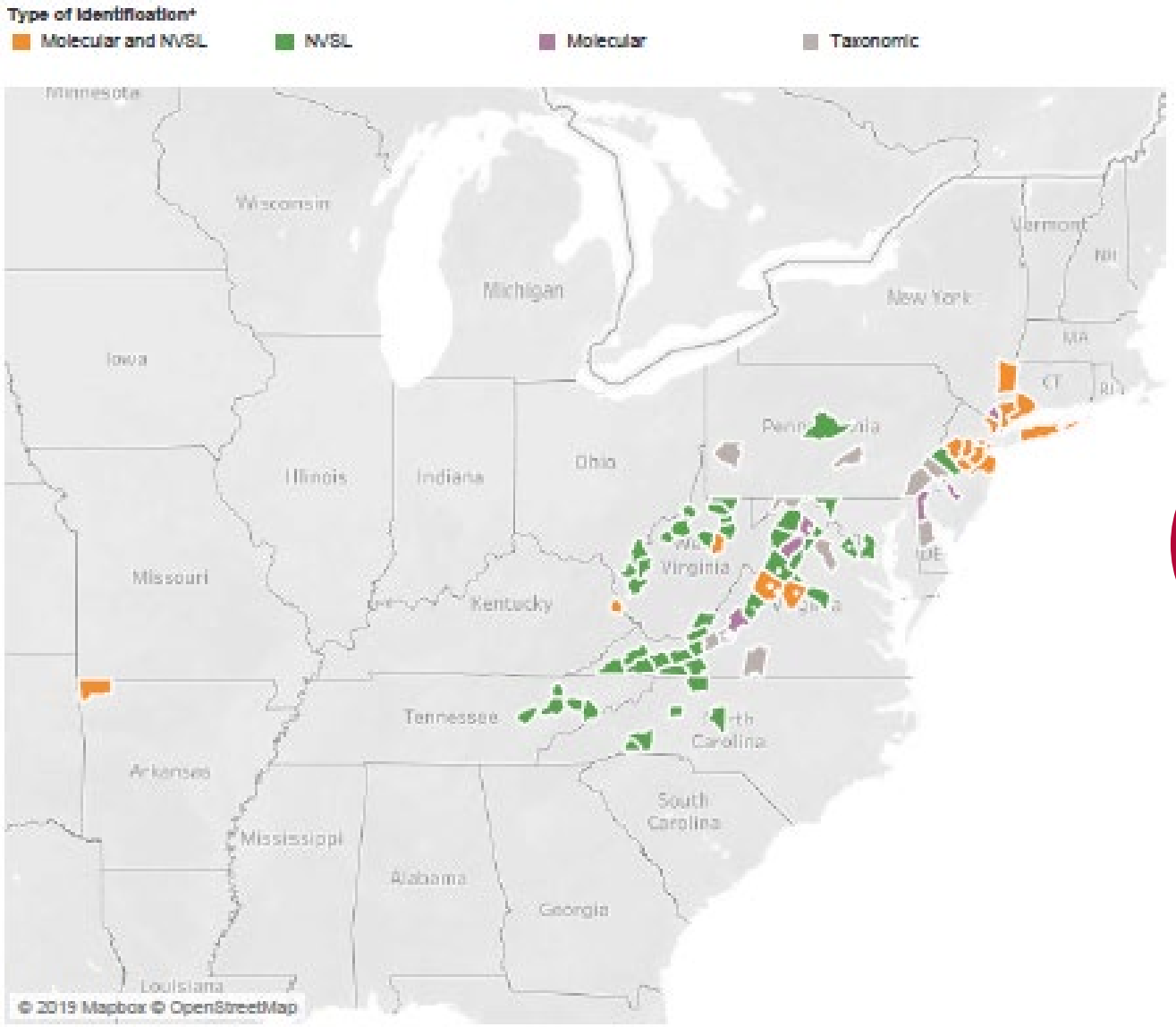


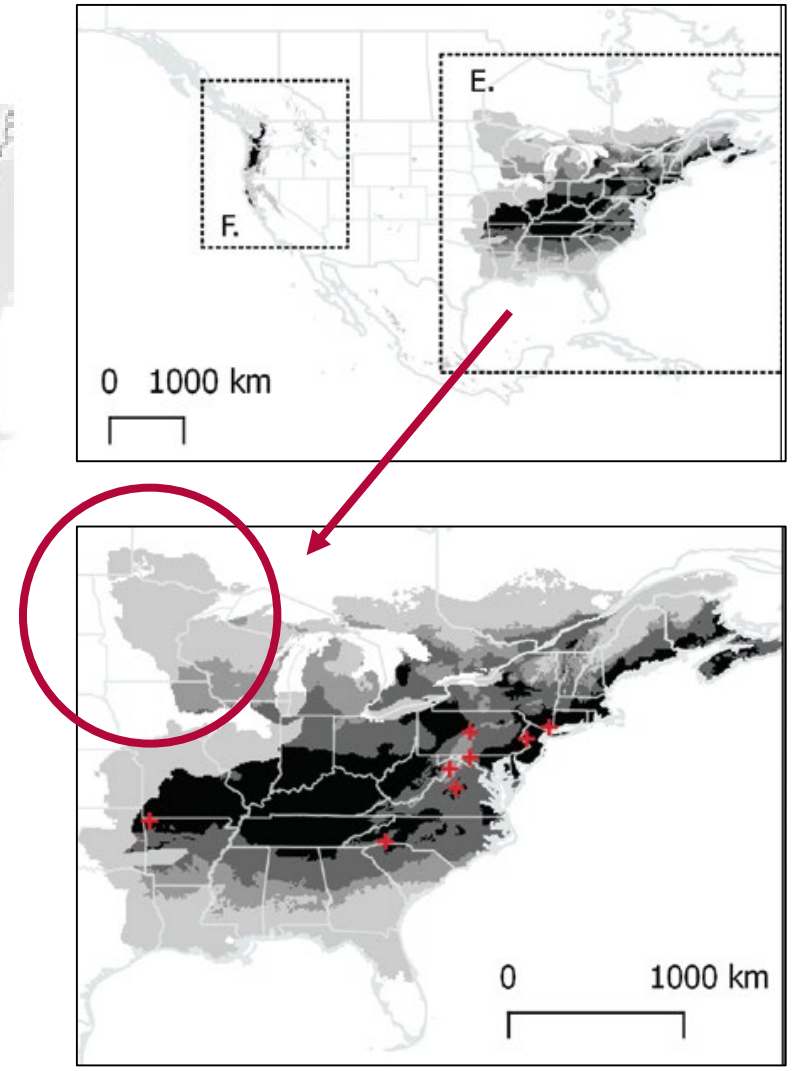
*Due to limited resources, no ticks were tested in 2012 and 2013

Invasive Tick Monitoring: *Amblyomma americanum*



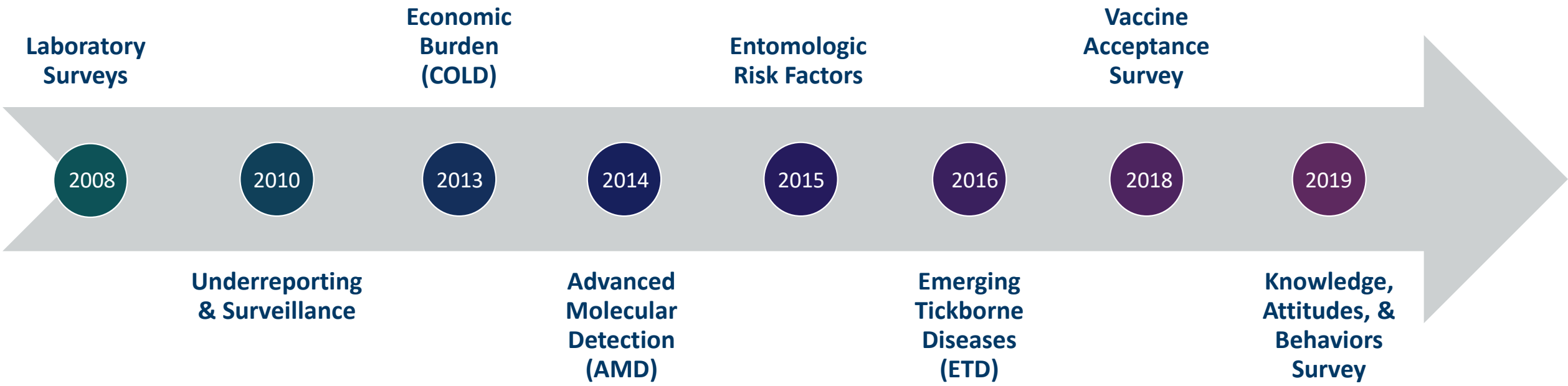
Invasive Tick Monitoring: *Haemaphysalis longicornis*





Rochlin I. Modeling the Asian Longhorned Tick (Acari: Ixodidae) Suitable Habitat in North America (2018). J. Med. Ent. 56(2): 384-391

Minnesota Department of Health
TickNET Research Projects



TickNET

Vectorborne Disease Prevention = Bug Bite Prevention

Take in the sights.

Not the ticks.

Jack, grade 7, Cottage Grove, 2017 Tickborne Disease Prevention Poster Contest Winner

Check for ticks.
Use EPA-approved tick repellent.
Contact your doctor if you get sick.

For more information on ticks and tickborne diseases:
health.state.mn.us/ticks

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Conclusions

- Climate change is not the driving force for all activities at MDH but it is a significant factor that we recognize
  - -Challenging to quantify the true impacts of climate change
  - -Requires measuring the interplay of many factors over time
- MDH is dedicated to maintaining long-term public health infrastructure that supports disease and vector surveillance as well as pathogen prevalence and other factors that affect vectorborne disease risk

Thank You!

Questions?

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651-201-5803

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