ECOLOGY OF EMERGING TICK DISEASE VECTORS IN SOUTHWEST VIRGINIA

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WHY ARE WE INTERESTED IN TICKS?

- Capable of **transmitting diseases** such as: Lyme Disease, Rocky Mountain Spotted Fever, Anaplasmosis, Ehrlichiosis, Babesiosis, Powassan, etc.
  - **Co-infections**: Ticks can carry more than 1 pathogen (risk for humans or animals to gain multiple infections from a single tick bite)

PUBLIC & ANIMAL HEALTH CONCERN

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Lyme disease

Anaplasmosis

Babesiosis

Ehrlichiosis

Rocky Mountain Spotted Fever

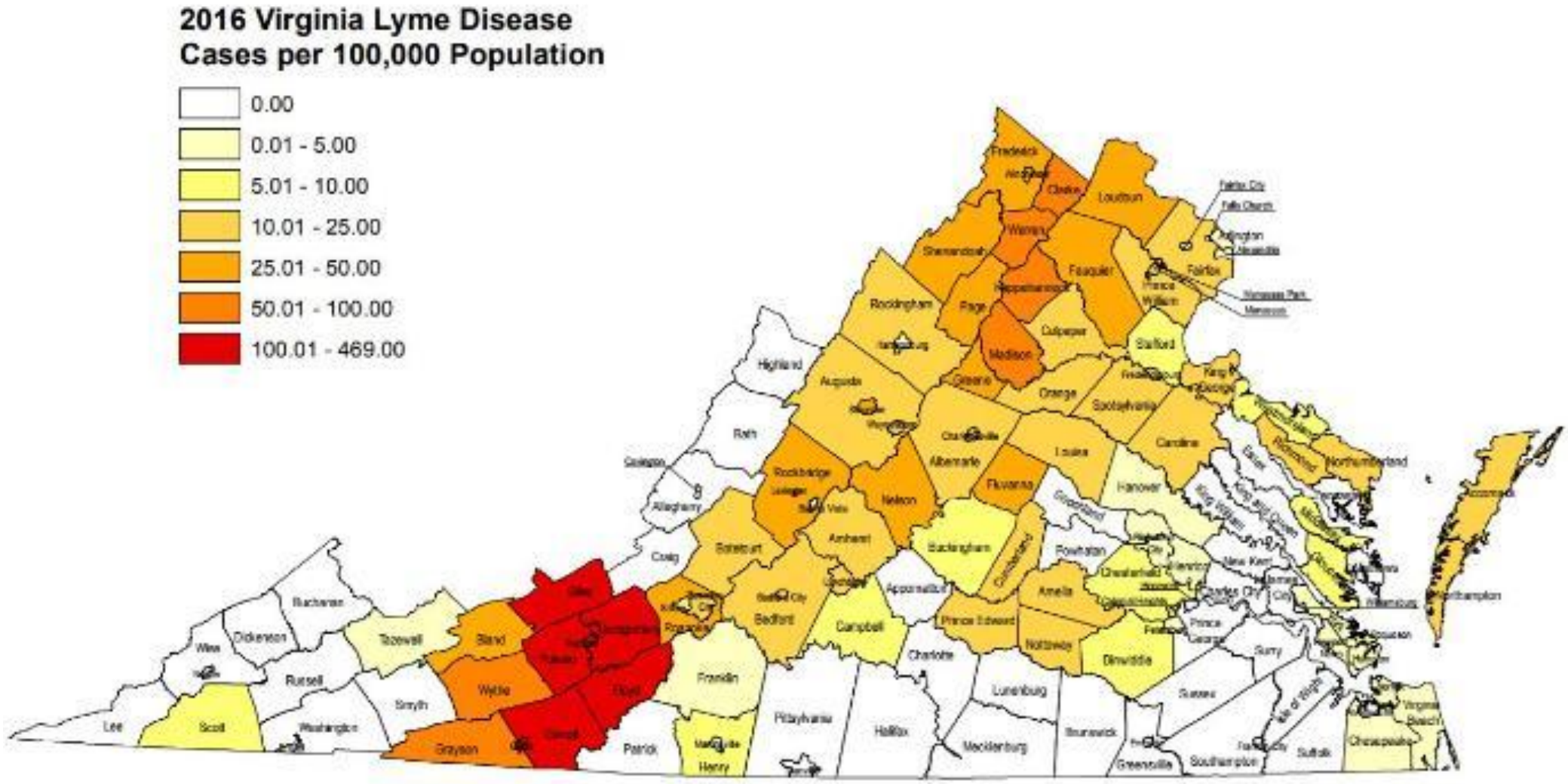
Powassan Virus

Each dot represents a reported case in the county of residence

Eisen R. Emerging tickborne diseases. CDC Public Health Grand Rounds, March 21, 2017. www.cdc.gov/cdcgrandrounds/archives/2017/March2017.htm. Accessed June 7, 2017.

LYME DISEASE IN VIRGINIA

HOTSPOT IN SWVA



EMERGENCE OF NEW TICKS/NEW PATHOGENS

- We are seeing **new invasive species** of ticks in the USA (e.g. *Haemaphysalis longicornis*)
- **New disease pathogens** could shift in the region (e.g. Powassan)

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IMPORTANT VECTORS FOUND IN VA

Dermacentor variabilis
(American Dog Tick)

Amblyomma americanum
(Lone Star Tick)

Ixodes scapularis
(Black-legged Tick)

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WHAT IS NOT KNOWN ABOUT TICKS HERE

- **900 species of ticks - 90 in the USA**
  - 17 tick species in VA
    - What is their distribution ?
    - What is the population structure of tick communities across varying habitat types?
    - Association of pathogens?
- Ticks have **4 life stages**: Egg, Larva, Nymph and Adult
  - When are the different life stages peaking?
  - Influence of seasonality on pathogen transmission?
- Different species predominate at different times of year

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OBJECTIVES

1. Determine species abundance and overall diversity across varying habitat types
2. Assess seasonality corresponding to different life stages
3. Screen collected tick specimens for tick-borne pathogens
   - Temporal/spatial trends in pathogen prevalence

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CURRENT THINKING: HABITAT PREFERENCES OF TICKS IN THE USA

- ***Dermacentor variabilis***
  - Grassy meadows, young forests, roadways and trails
- ***Amblyomma americanum***
  - Woodlands with dense underbrush, grassy meadows, young forests
- ***Ixodes scapularis***
  - Deciduous forests and adjacent brush or grass
- ***Haemaphysalis longicornis***
  - Can be found in open areas (grass/meadows/wood edge).

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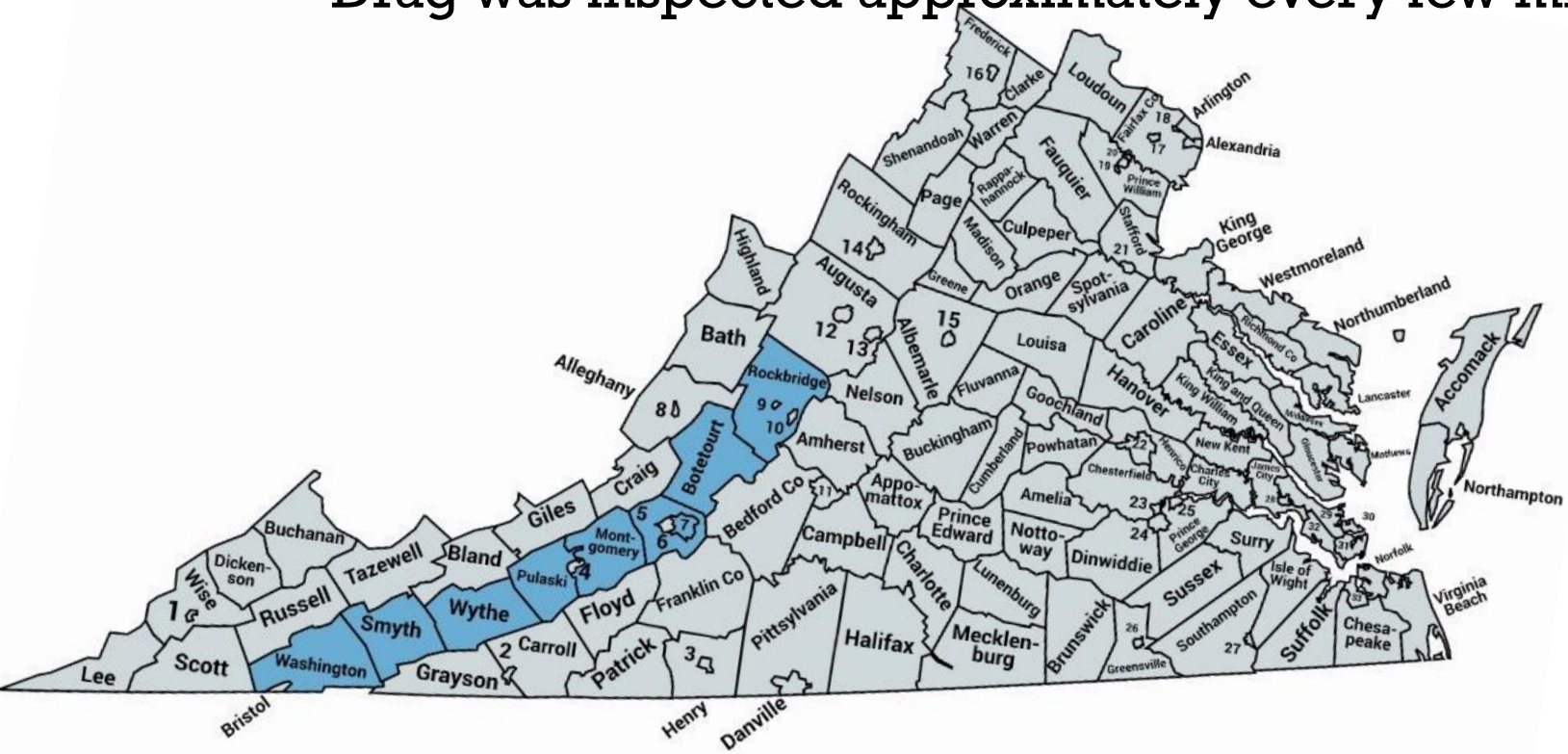
METHODS

- 8 counties
  - Per county: 1 **pasture** site, 1 **urban** site, and 1 **forest** site
  - 24 total sites
- Each site was dragged for 30 minutes approximately every 2 weeks
  - Drag was inspected approximately every few minutes / 10 yds



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SITE EXAMPLES

Urban

Withers Park

Wythe County

Forest

Bartlett Crowe Field Station

Washington County

Pasture

Kentland Farm

Montgomery County

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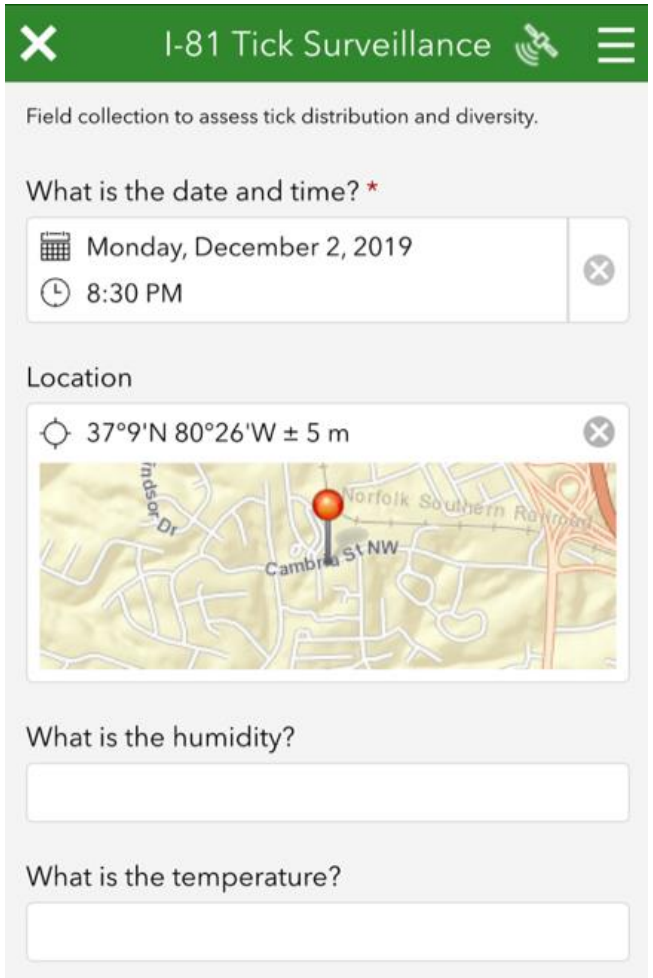
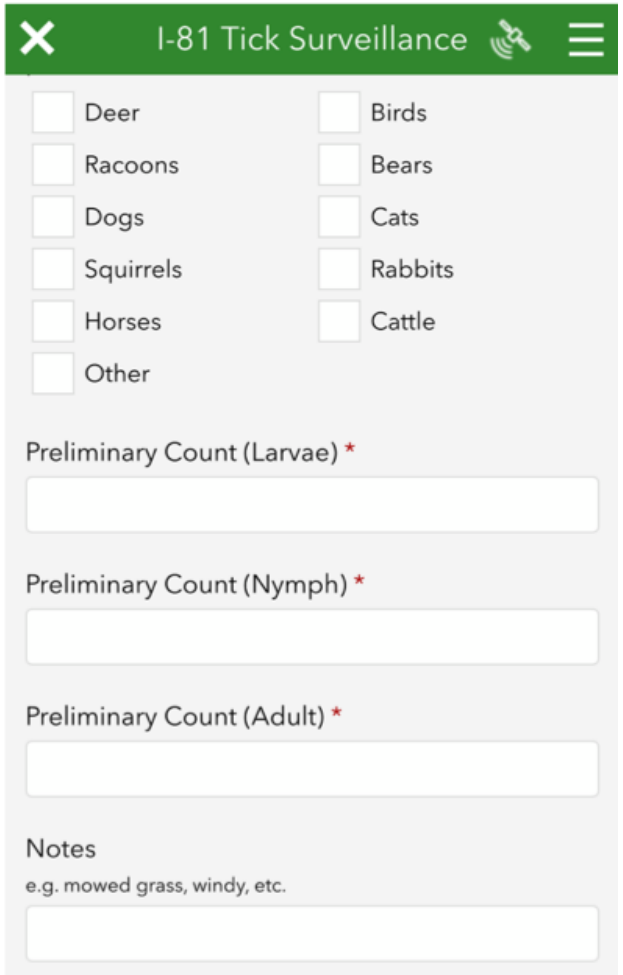
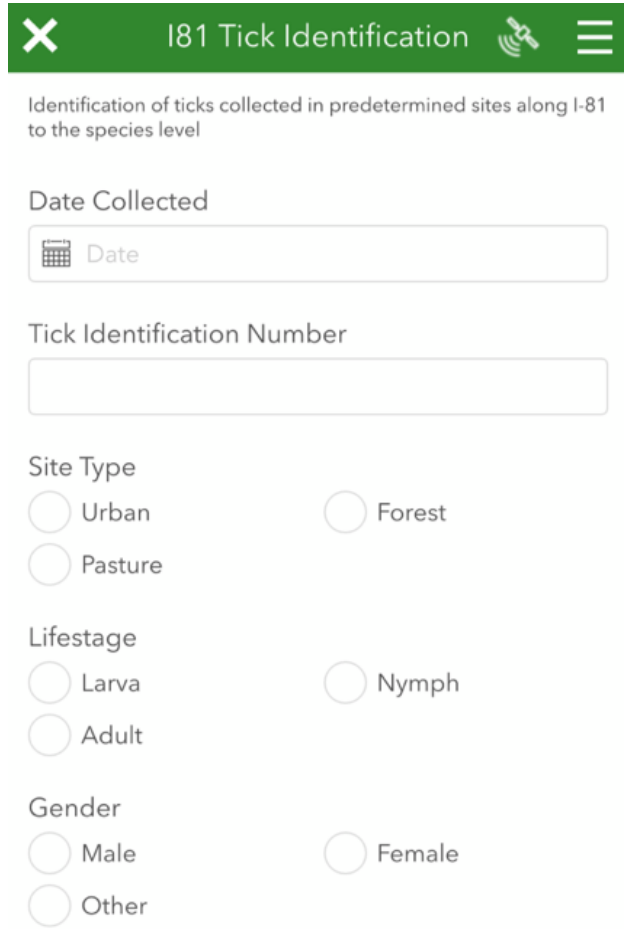
GIS SURVEY APPLICATION DEVELOPMENT







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RESULTS

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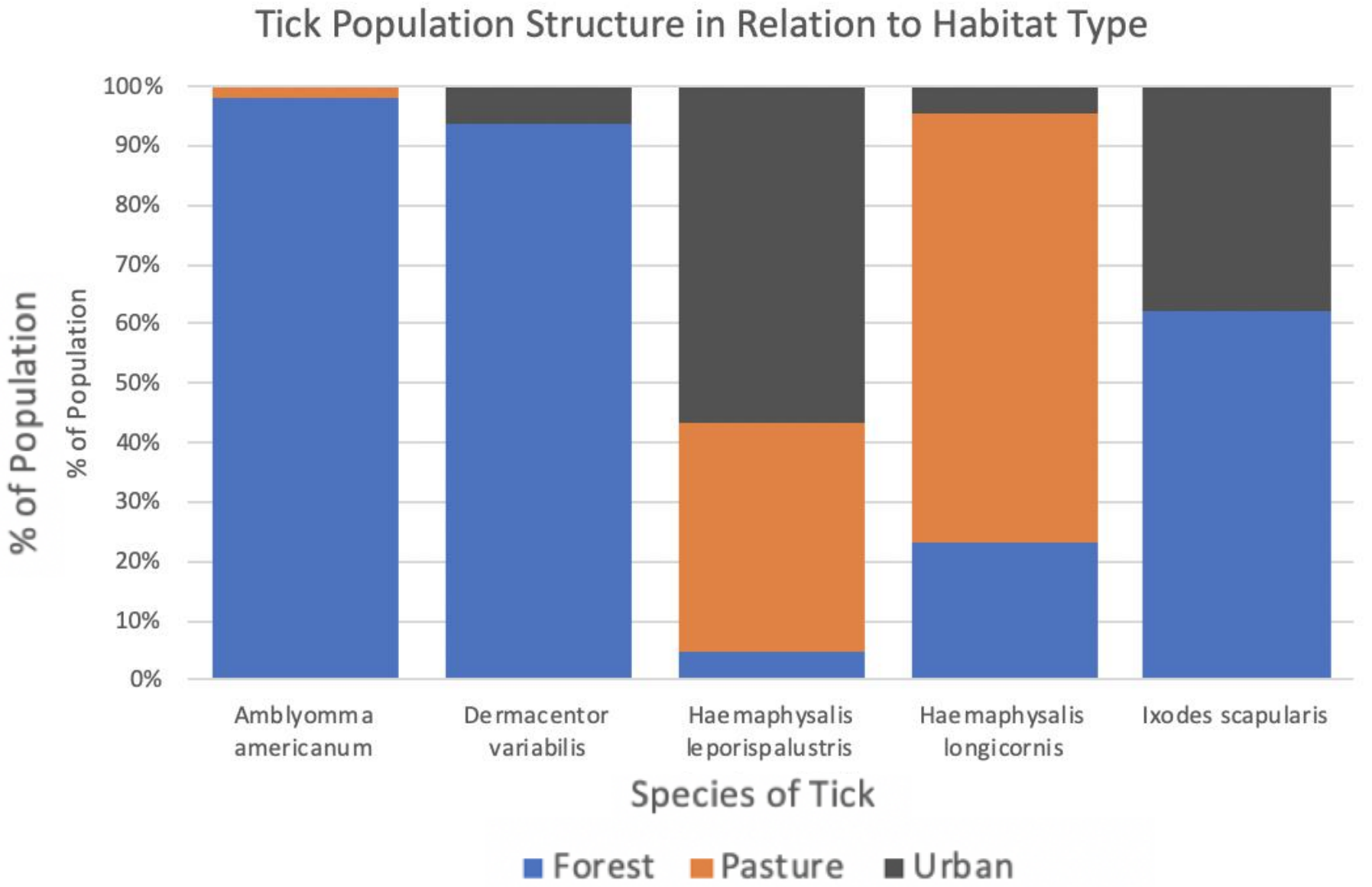
DISTRIBUTION OF TICKS



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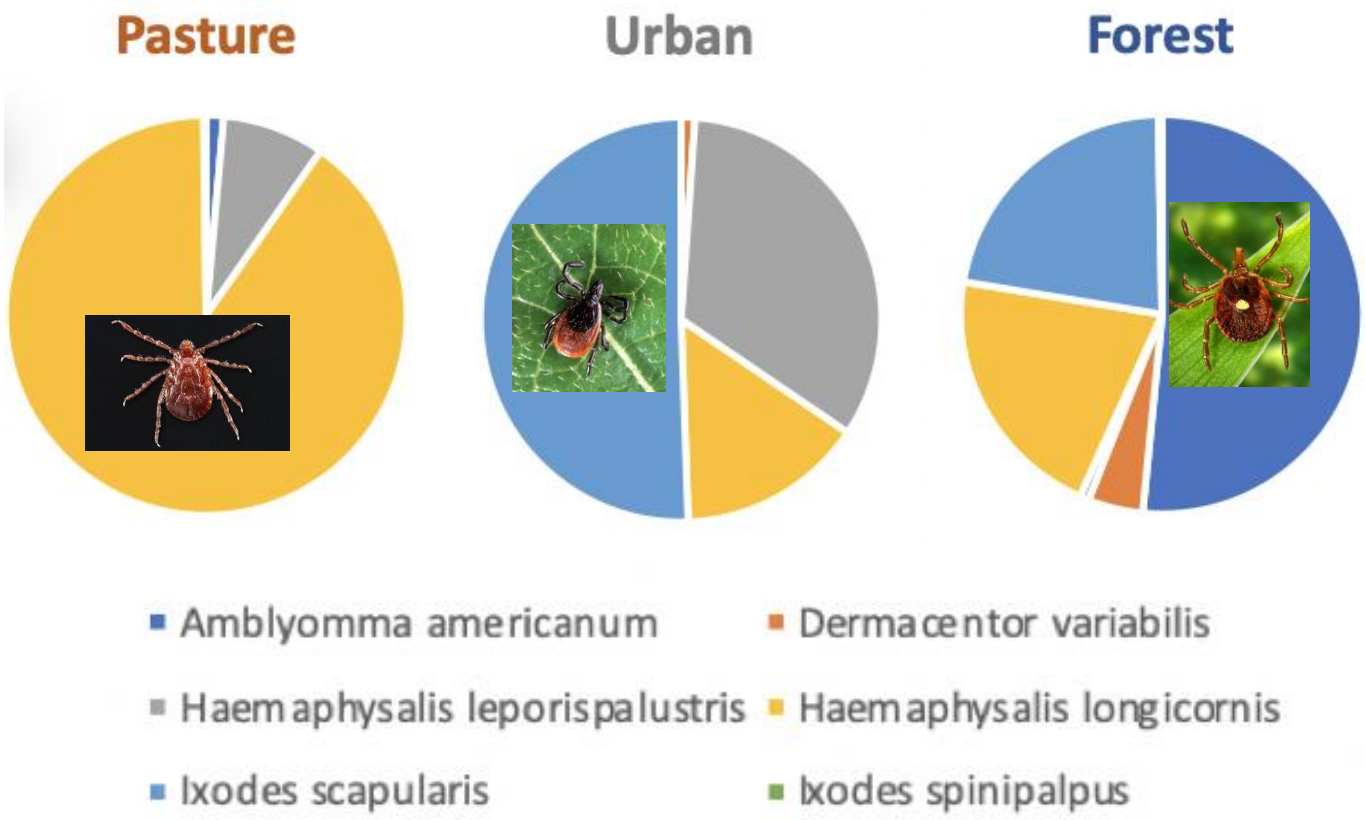
SPECIES DIVERSITY



Shannon's Diversity Index (H')

- Forest: 1.194
- Pasture: 0.372
- Urban: 1.046

Equitability (E_H)

- Forest: 0.67
- Pasture: 0.27
- Urban: 0.75

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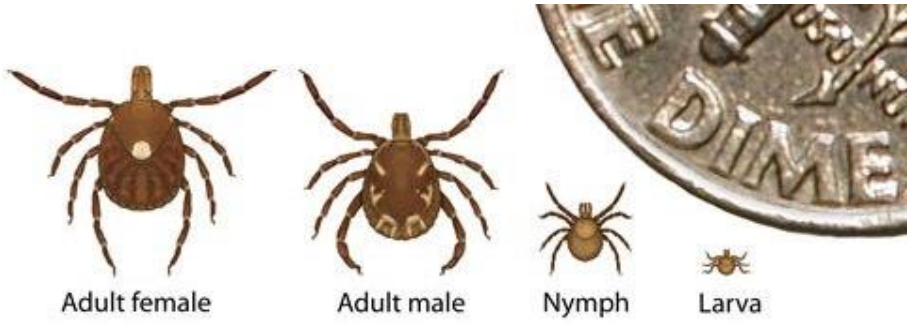
SEASONALITY



- ***Amblyomma americanum***
  - Larva peaks in August-September
- ***Dermacentor variabilis***
  - Adult peaks in May
- ***Haemaphysalis longicornis***
  - **Overlapping presence** of larva, nymphs, and adults
- ***Ixodes scapularis***
  - Larva in October and November
  - Nymphs in the **spring** and **fall**
  - Adults in November

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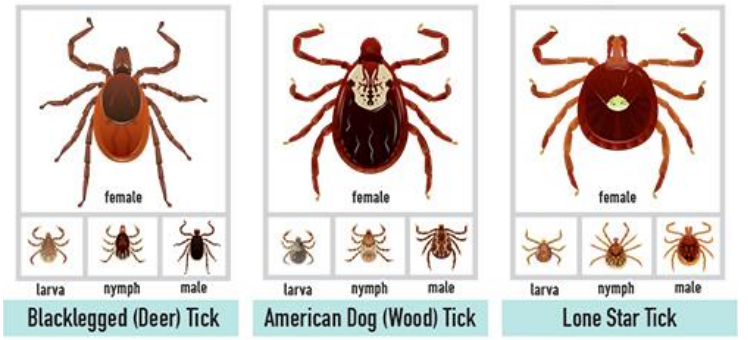
DISCUSSION

OUTCOMES

Understand Tick populations

- Preliminary data suggests:
  a) *Ixodes scapularis* is predominantly in Forest habitat
  b) *Haemaphysalis longicornis* is predominantly in Pasture habitat
- Seasonality:
  a) Overlapping of life stages in *Haemaphysalis longicornis*
  b) *Ixodes* nymph activity in the **spring** and **fall**



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EMERGENCE OF A NEW TICK & POTENTIAL VECTOR

Haemaphysalis longicornis
(Asian Longhorned tick)

- Identified across 12 states
  - 30 confirmed counties in VA (USDA 2019)
- Parthogenic
- Wide host range
- Confirmed identification of *Theileria orientalis* in *H. longicornis* found in the U.S. (Oakes et al. 2019)
- *Agricultural concern* - Infests livestock - to point of anemia!
- Abroad it transmits Powassan, SFTS(severe fever with thrombocytopenia syndrome), Anaplasma, Ehrlichia, Babesia spp.)
- As yet, we don't know **human threat** here

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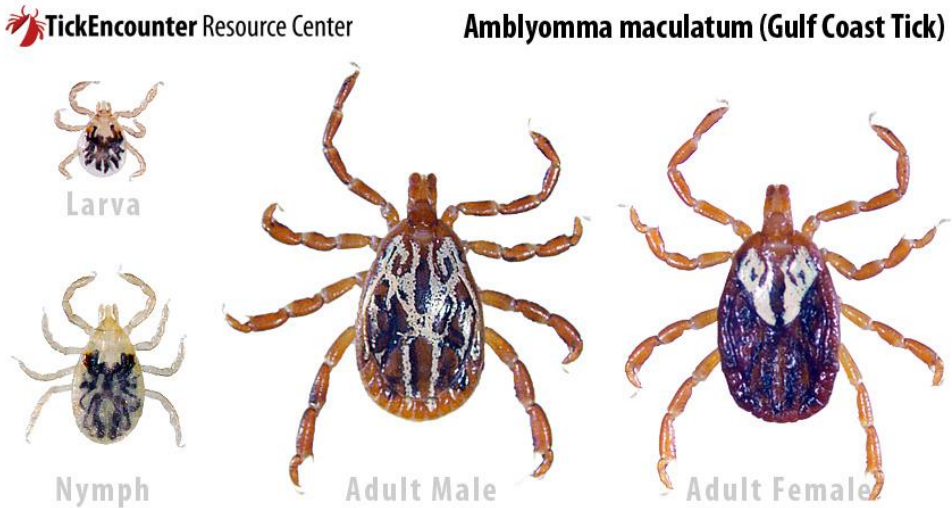
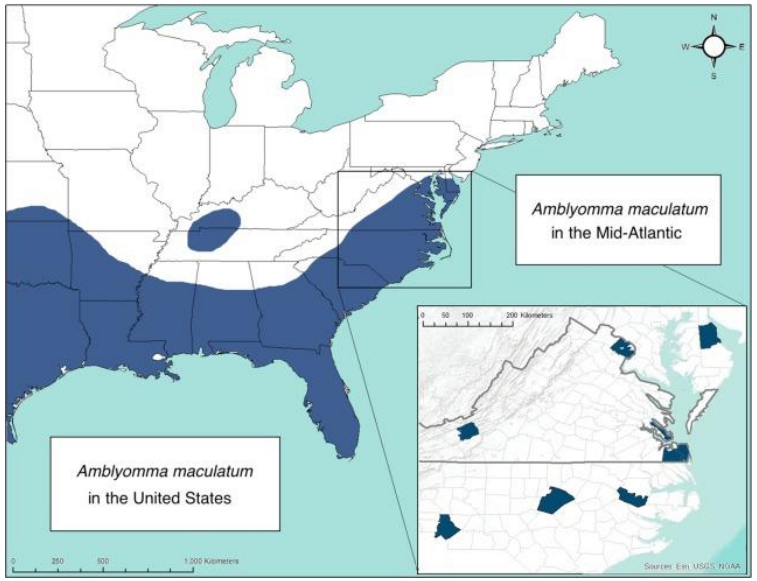
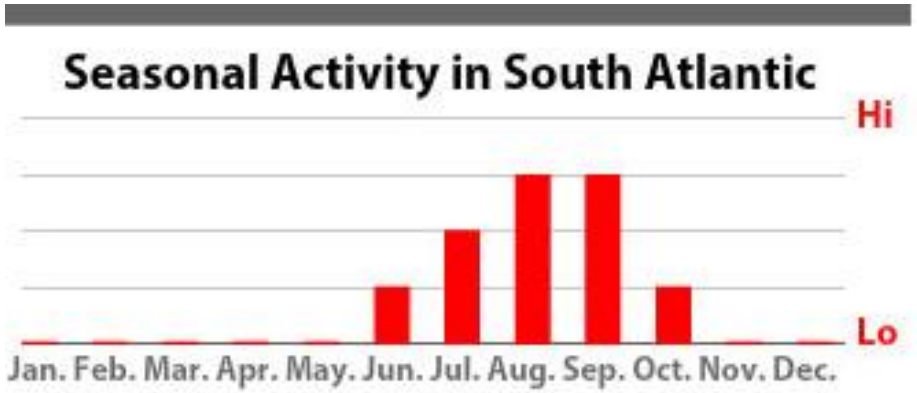
AMBLYOMMA MACULATUM (GULF COAST TICK)
RANGE EXPANDING INTO THE MID-ATLANTIC REGION



- Habitat: **Open** mowed grassy habitat.
  - SE Virginia
- Vector for Spotted Fever Rickettsiosis (*Rickettsia parkeri* – bacteria)
- Escar-associated febrile illness





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CONFOUNDING FACTORS

- Site selection
- Uneven sampling between habitat types
  - Incomplete season of sampling
- Sampling Efforts- weight data accordingly

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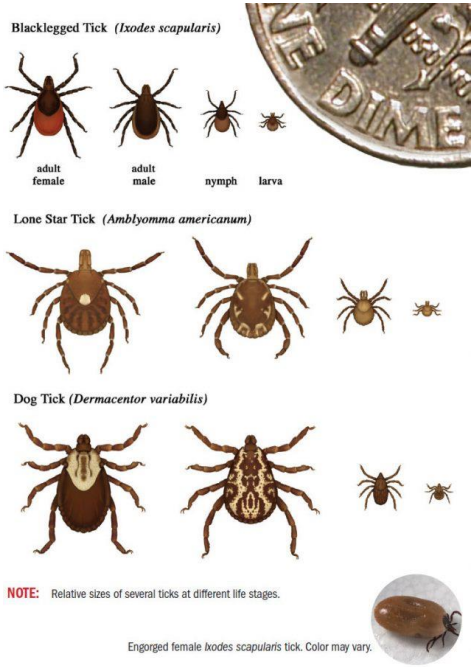
FUTURE DIRECTION

- Continuation of site sampling in 2020
  - Inclusion of Floyd and Giles County
- Screen all collected ticks for pathogens to establish prevalence
- Establishment of baseline data of tick populations in the region



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SIGNIFICANCE OF SURVEILLANCE & ESTABLISHING A BASELINE

- So we're aware of changes
  - New ticks
  - Novel pathogen emergence
  - Seasonal trends
  - Current distribution and abundance

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- Alwood Society
- Hill Travel Scholarship

Questions?

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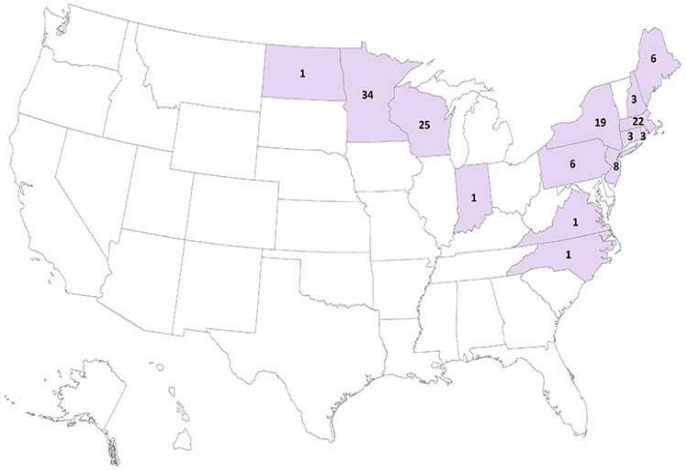
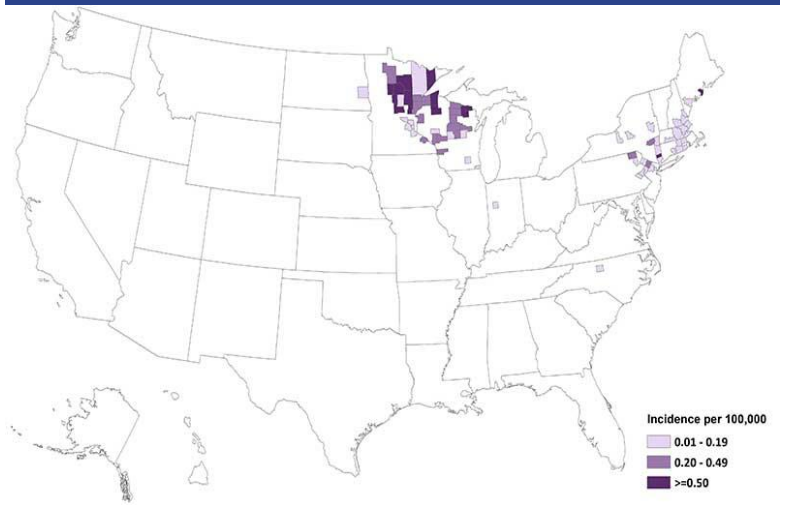
EXTRA SLIDES

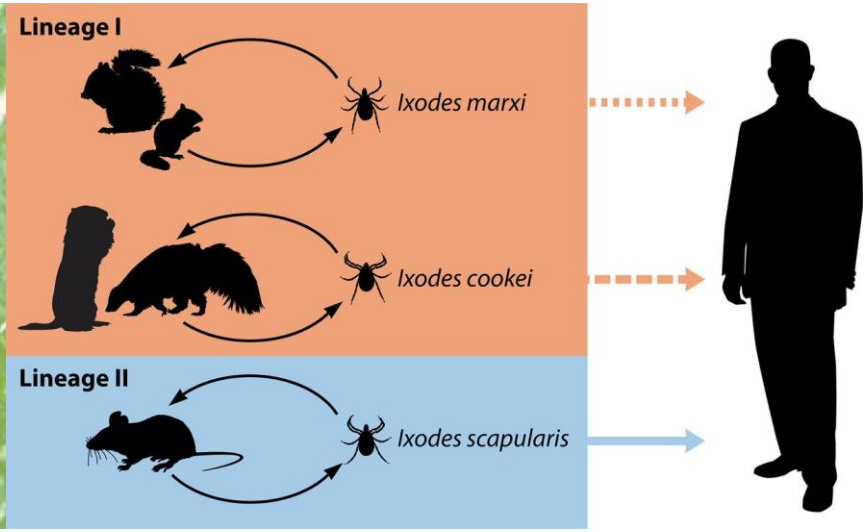
POWASSAN VIRUS

Powassan virus neuroinvasive disease cases reported by state of residence, 2009–2018



Powassan virus neuroinvasive disease average annual incidence by county of residence, 2009–2018





- Most cases have occurred in the northeastern and Great Lakes regions of the United States from the late spring through mid-fall when ticks are most active.
- Can lead to sever disease including encephalitis and meningitis
- Approximately 1 out of 10 people with severe disease die.

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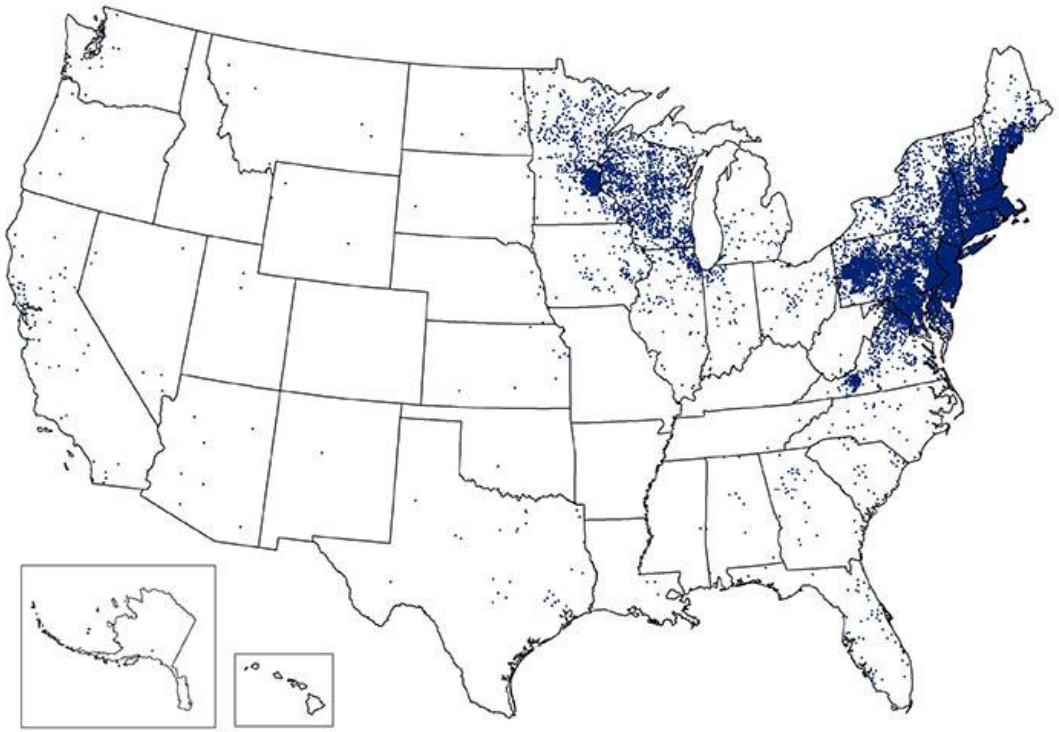
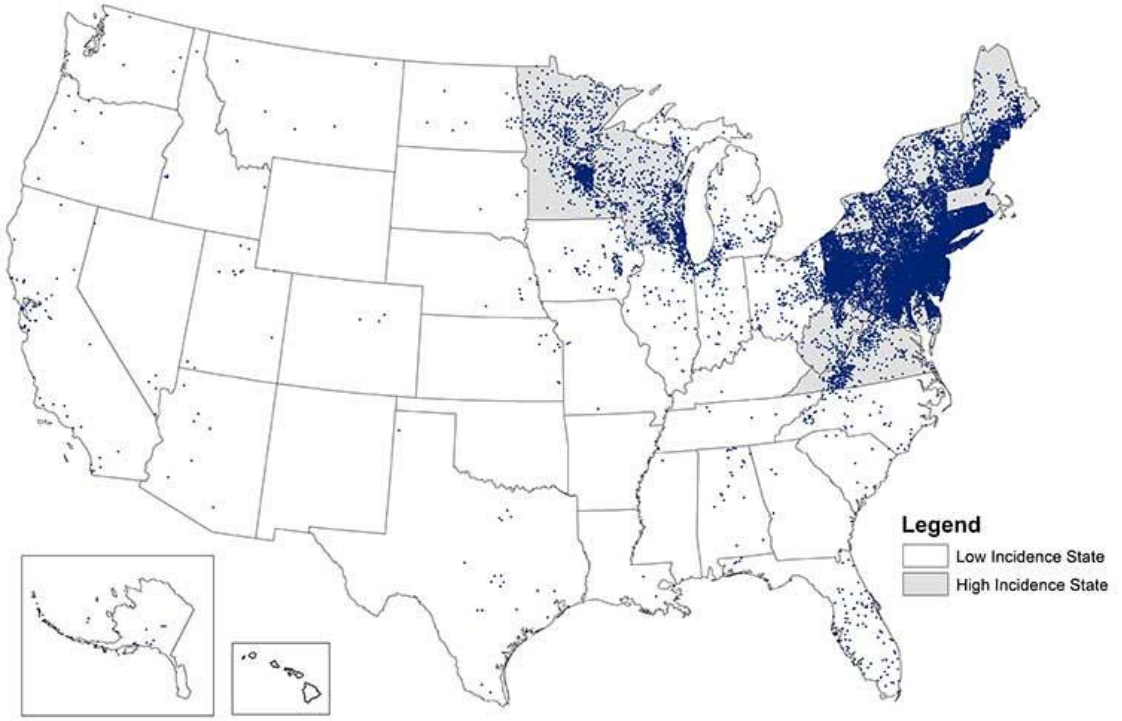
CDC REPORTED CASES OF LYME DISEASE



1 dot placed randomly within county of residence for each confirmed case

2012



2018

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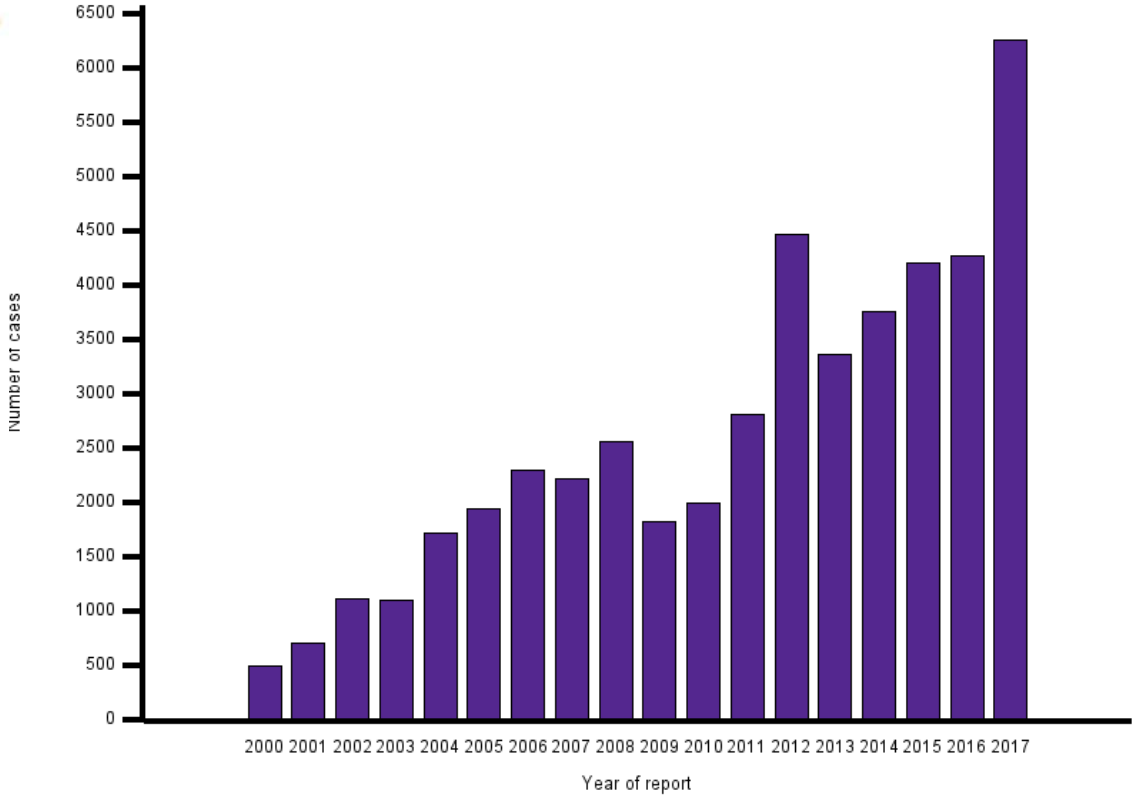
CDC SPOTTED FEVER RICKETTSIOSIS. REPORTED CASES



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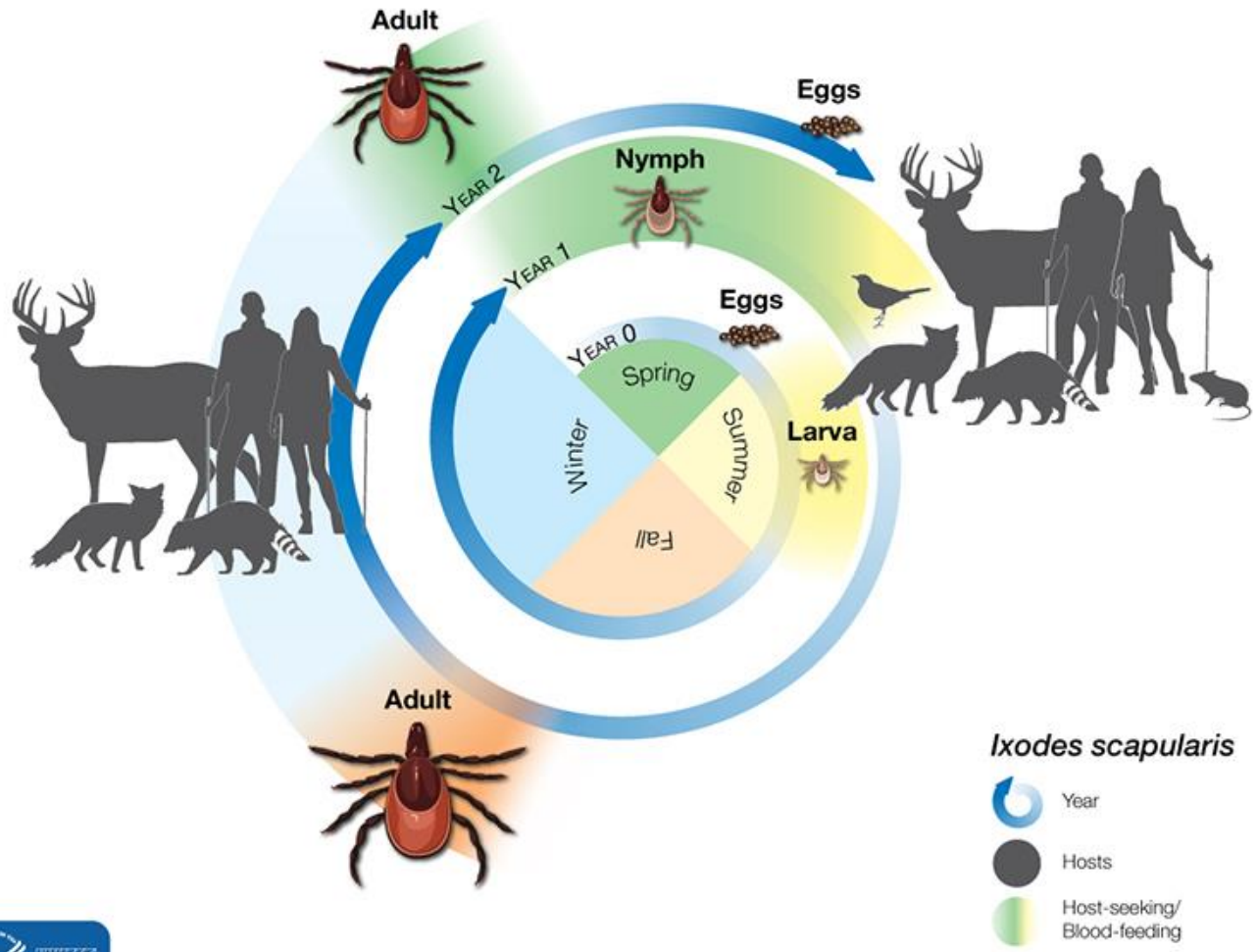
LIFE CYCLE OF *IXODES SCAPULARIS* TICK



CDC

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