VDH VIRGINIA DEPARTMENT OF HEALTH

Prevention of Tick-Borne Diseases in Virginia

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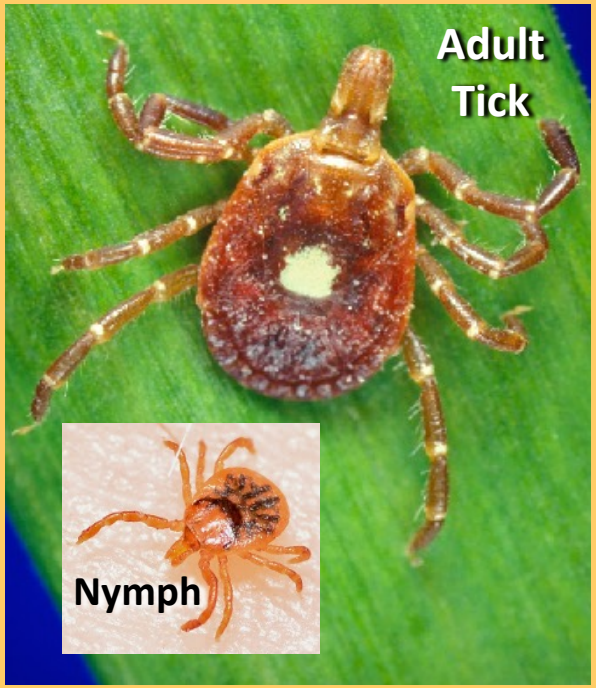
Overview

1. Ticks of Importance in Virginia and associated diseases
    1. Lone star tick
    2. Black legged tick
    3. American dog Tick
    4. Longhorned tick
2. Questions
3. Annual Tick Surveillance
4. Ecology of Lyme Disease
5. How to protect yourself against tickborne disease
6. Tick safe landscaping practices
7. How to safely remove a tick and what to do with it
8. Black legged tick surveillance

Ticks



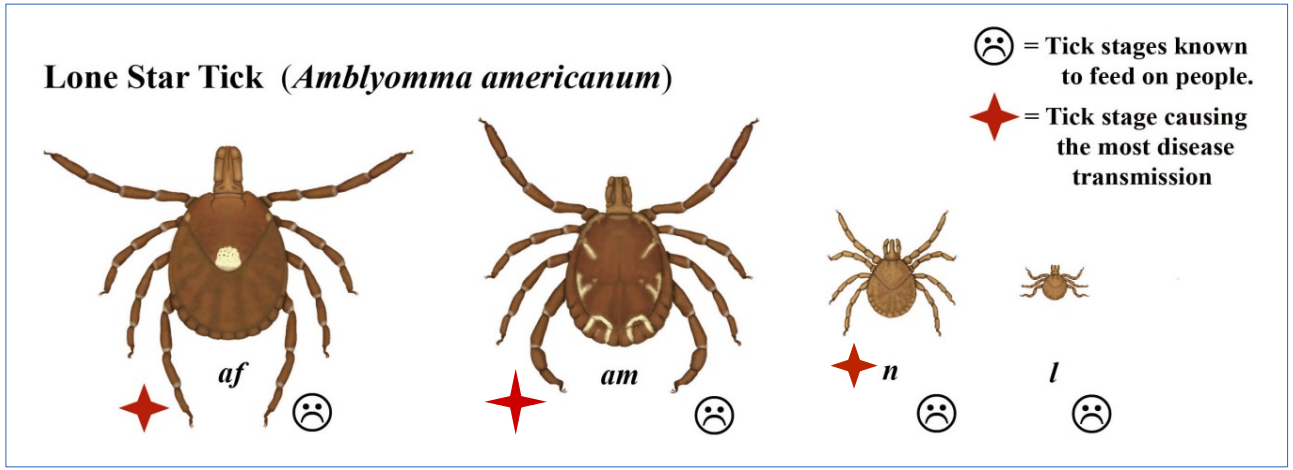
Lone Star Tick

Blacklegged Tick

American Dog Tick

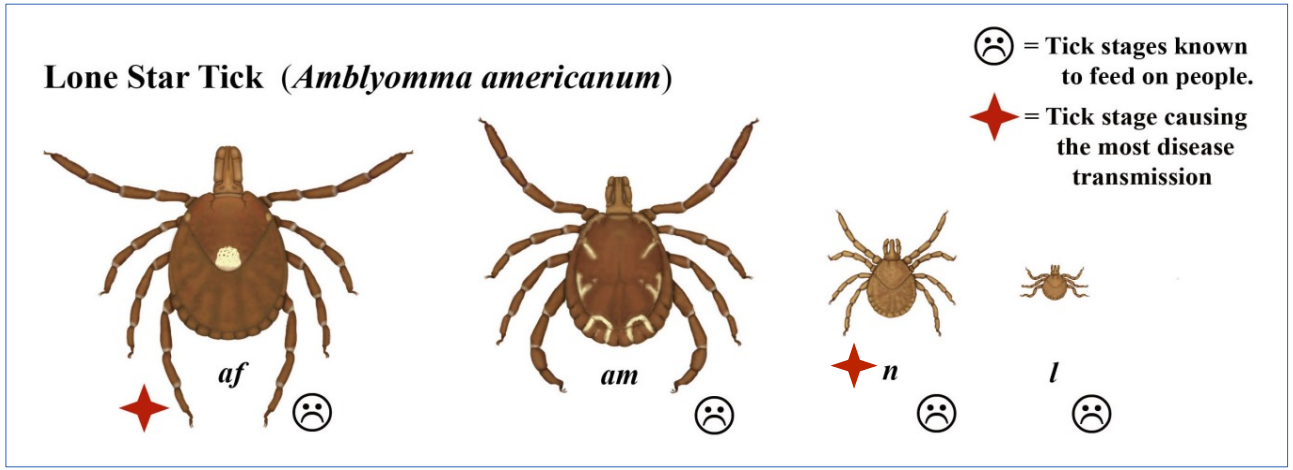
- Four tick species of veterinary and/or medical importance in VA
- Three tick species commonly bite humans out of 16 known species in VA
- These three species are currently the most impactful species for tick-borne diseases in humans

Lone Star Tick (*Amblyomma americanum*)



- All life stages of Lone star ticks are known to feed on humans
- Lone star ticks are one of the more aggressive and faster-moving species of ticks
- Adults and nymphs cause the most disease transmission, but larvae can spread viruses
- Often found in leaf litter in shaded areas and some areas with tall grass

Lone Star Tick (*Amblyomma americanum*) Diseases



1. Ehrlichiosis †
   - i. *Ehrlichia chaffeensis* †
   - ii. *Ehrlichia ewingii* †
2. Alpha-gal syndrome †
   - i. Caused by lone star tick saliva
3. Southern Tick Associated Rash Illness (STARI)
   - i. Possibly caused by an allergic reaction to lone star tick saliva
4. Tularemia †
   - i. *Francisella tularensis* †
5. *Rickettsia parkeri* spotted fever
   - i. *Rickettsia parkeri*
6. Heartland Virus †
   - i. Phlebovirus (Bunyaviridae) †

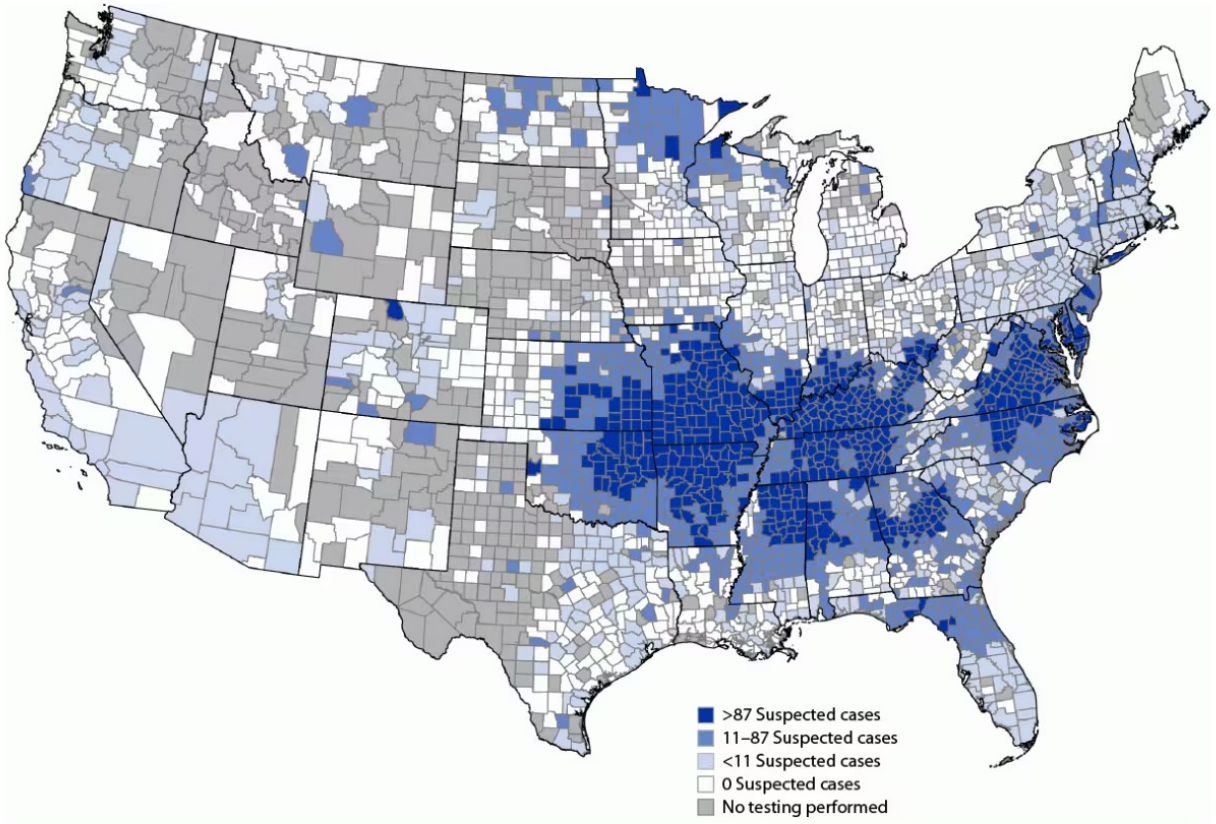
*Diseases are listed in order of prevalence in VA (most common → least common)

† = Potentially fatal disease/condition.

Top

FIGURE. Geographic distribution of suspected alpha-gal syndrome cases* per 1 million population per year — United States, 2017–2022

Return



Abbreviations: IgE = immunoglobulin E; IU = international unit; kU = kilounit.

* A suspected case of alpha-gal syndrome was defined as being in a person who had confirmatory laboratory evidence (serum or plasma alpha-gal–specific IgE ≥0.1 IU/mL or ≥0.1 kU/L) with no clinical information available.

Suspected alpha-gal syndrome cases, US

Thompson JM, Carpenter A, Kersh GJ, Wachs T, Commins SP, Salzer JS. Geographic Distribution of Suspected Alpha-gal Syndrome Cases — United States, January 2017–December 2022. MMWR Morb Mortal Wkly Rep 2023;72:815–820. DOI: http://dx.doi.org/10.15585/mmwr.mm7230a2.

Symptoms

- **Ehrlichiosis**
  - Fever, chills, severe headache, muscle aches, nausea, vomiting, diarrhea, loss of appetite, confusion, rash. The rash can look like red splotches or pinpoint dots.
  - 1 in 3 people report a rash and it is more common in patients infected with *E. chaffeensis*
  - If antibiotic treatment is delayed, late-stage illness can occur
    - Meningoencephalitis, respiratory failure, uncontrolled bleeding, organ failure, death

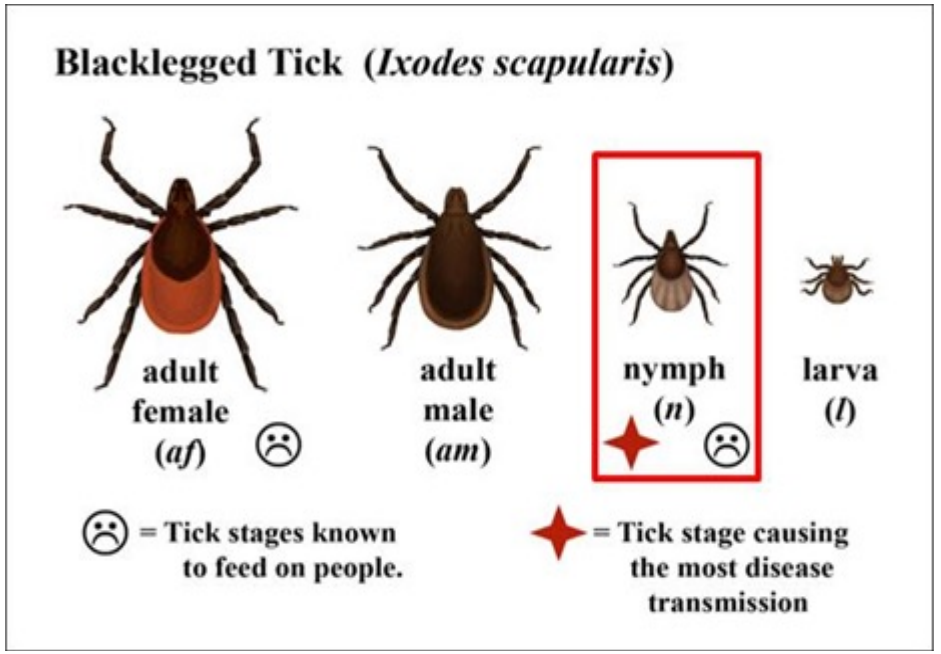
- **Southern Tick Associated Rash Illness (STARI)**
  - Rash is similar to Lyme but not caused by Lyme bacteria
  - Malaise, headache, fever, myalgia

- **Heartland Virus**
  - Fever, malaise, anorexia, nausea, and diarrhea

***Ehrlichia* Rash**

Black Legged Tick (*Ixodes scapularis*, "Deer Tick")

- Nymph stage is main disease vector (May-July)
- Adults bite less often, but have higher infection prevalence
  - Bites occur on warm days (September-April)
  - Unusually warm November: lots of tick submissions
- Black Legged tick bites (particularly nymphs) are difficult to find
- Often found in leaf litter in shaded areas



Other *Ixodes* Species

- Other species in the *Ixodes* genus found in VA include:
  - *I. affinis*
    - Sylvatic vector of Lyme Disease
  - *I. dentatus*
    - Sylvatic vector of Lyme Disease
  - *I. brunneus*
    - Avian tick paralysis

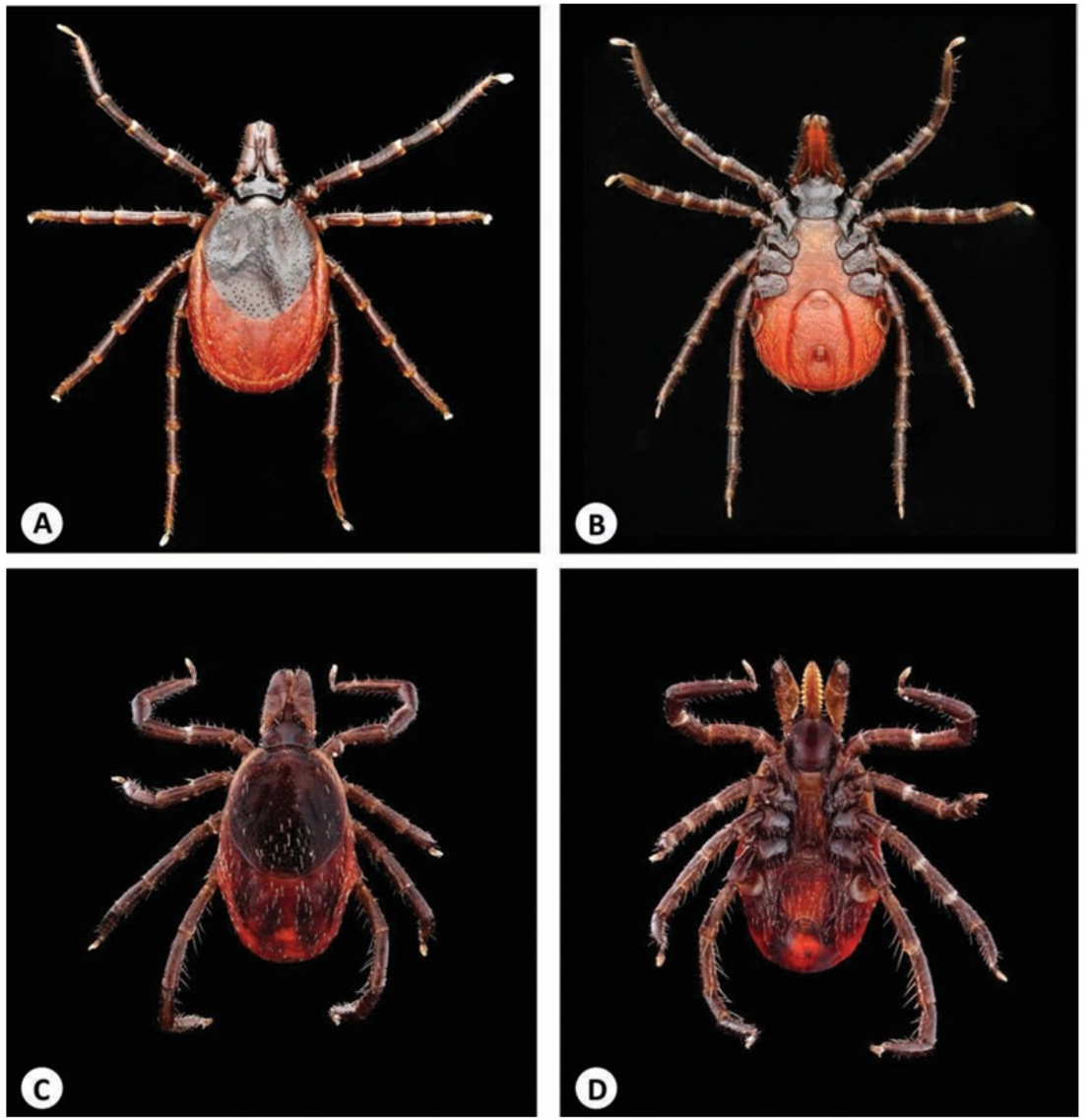
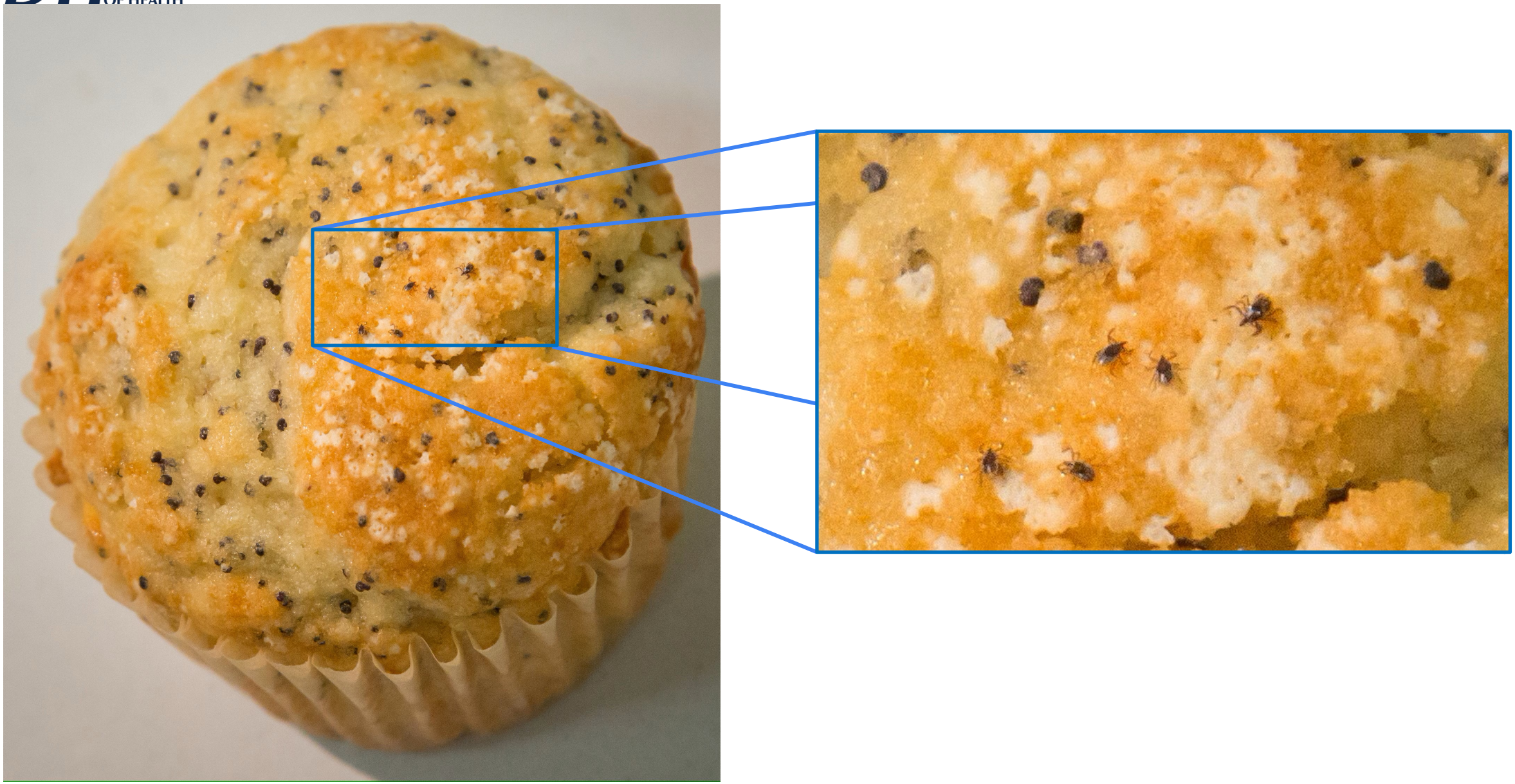


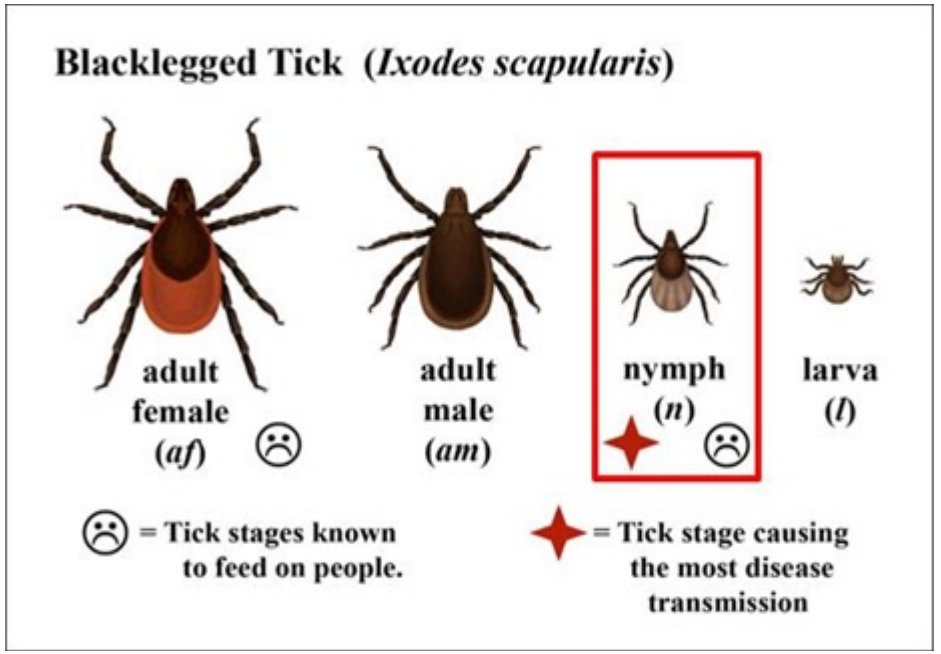
Fig. 2. (A) *Ixodes affinis* adult female, dorsal view. Note the comparatively rounder body, the extent of the scutum, and the lack of setae. (B) *Ixodes affinis* adult female, ventral view. (C) *Ixodes scapularis* adult female, dorsal view. Note the comparatively more oval-shaped body, with less of the body surface covered by the scutum, and the dense setae. (D) *Ixodes scapularis* adult female, ventral view.

Focus Stacking Images of Morphological Character States for Differentiating the Adults of Ixodes affinis and Ixodes scapularis (Acari: Ixodidae) in Areas of Sympatry
Robyn M. Nadolny, Marcée Toliver, Holly D. Gaff, John G. Snodgrass, and Richard G. Robbins



Black Legged Tick Diseases

1. Lyme Disease
   i. *Borrelia burgdorferi*
2. Anaplasmosis †
   i. *Anaplasmosis phagocytophilum* †
3. Babesiosis †
   i. *Babesia microti* †
4. *Borrelia miyamotoi* disease
   i. *Borrelia miyamotoi*
5. Powassan Virus (Tickborne encephalitis virus) †
   i. Flavivirus
6. May cause alpha-gal syndrome



*Diseases are listed in order of prevalence in VA (most common → least common)

† = Potentially fatal disease/condition.

Lyme Disease: Erythema-Migrans (EM) Rash

- The erythema-migrans (EM) rash may occur in up to 80% of cases
- EM rash typically is not itchy or painful
- May not be noticed if it is on the scalp or back
- EM rash can come in a variety of forms
  - Not always a bulls-eye, sometimes just a red patch of skin

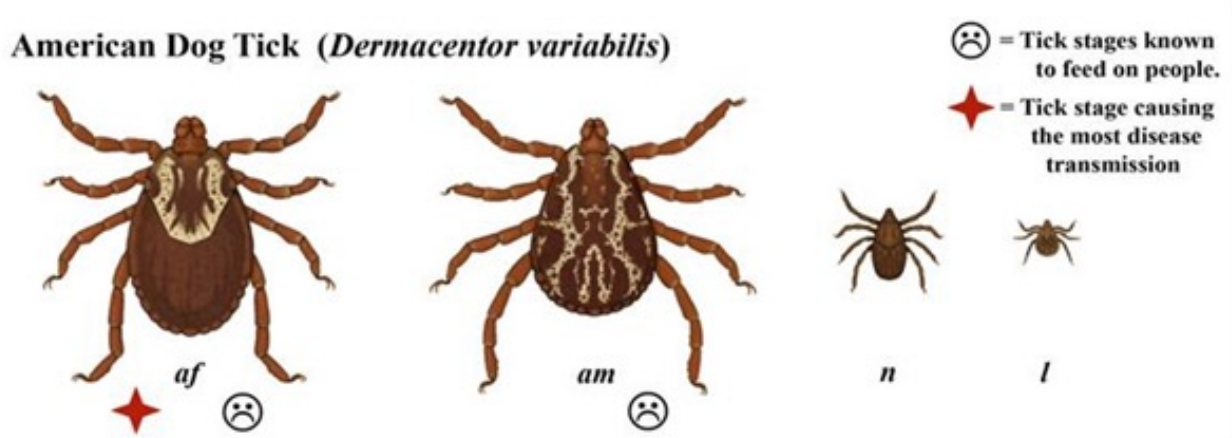
Three Stages of Lyme Disease

- Early localized infection (3-30 days)
  - EM rash (bulls-eye rash), fever, headache, muscle and/or joint aches, swollen lymph nodes
- Early disseminated infection (1-4 months)
  - Multiple EM rashes, severe headaches, Bell's palsy, shooting pains, tingling/numbness in extremities, cardiac symptoms
- Late disseminated infection (3 months to years)
  - Severe arthritis of large joints (knees), fatigue, neurological and/or cognitive disorder

Babesiosis

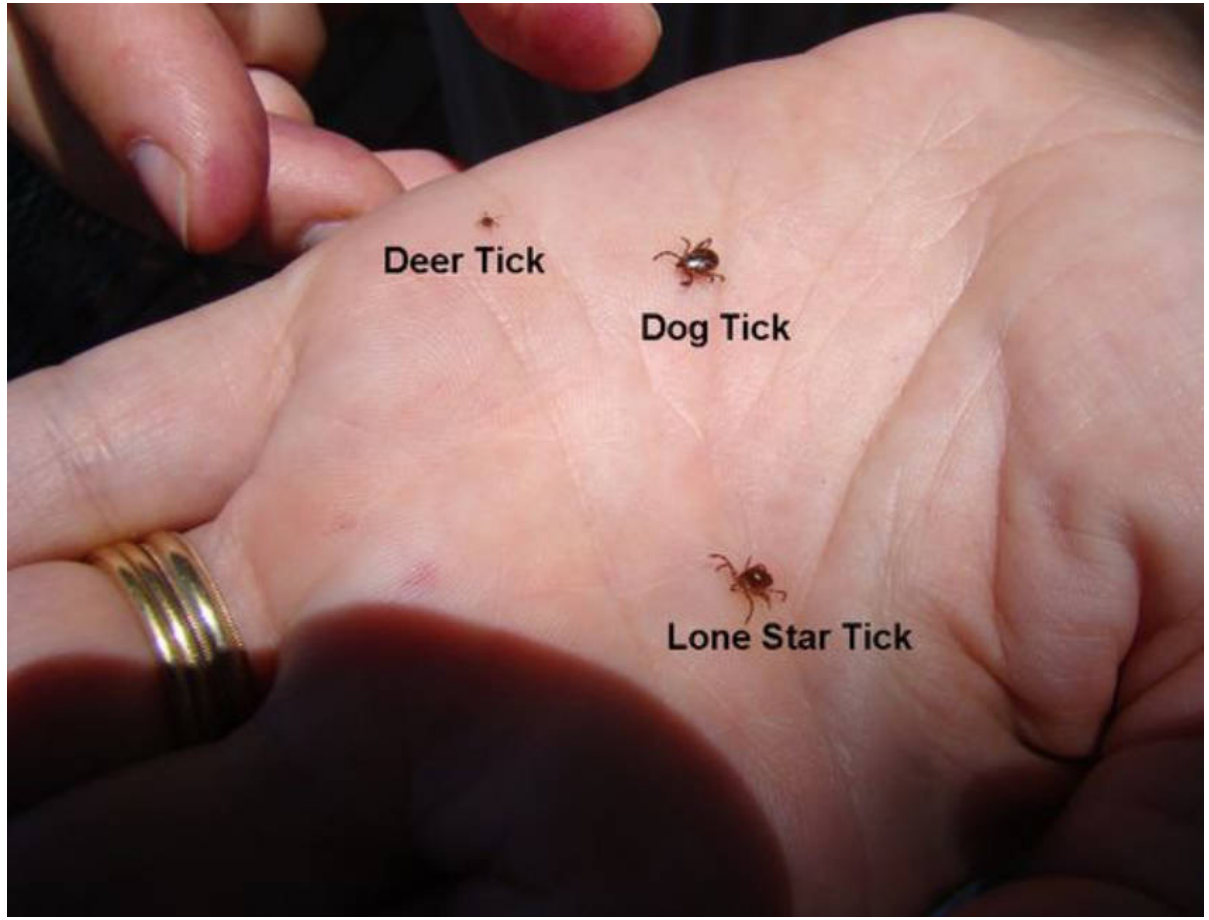
- Tick-borne parasitic disease, somewhat similar to malaria
- Infective agent: *Babesia spp.* (*B. microti*, *B. divergens*, *B. duncani)*
- Healthy, immune-competent patients may have symptoms that last for several weeks, and some patients may recover from babesiosis without treatment.
- Infections may be more severe, longer lasting and definitely require treatment (Atovaquone plus Clindamycin, or Clindamycin plus Quinine) in immunosuppressed, elderly, or splenectomized patients.

American Dog Tick (*Dermacentor variabilis*)

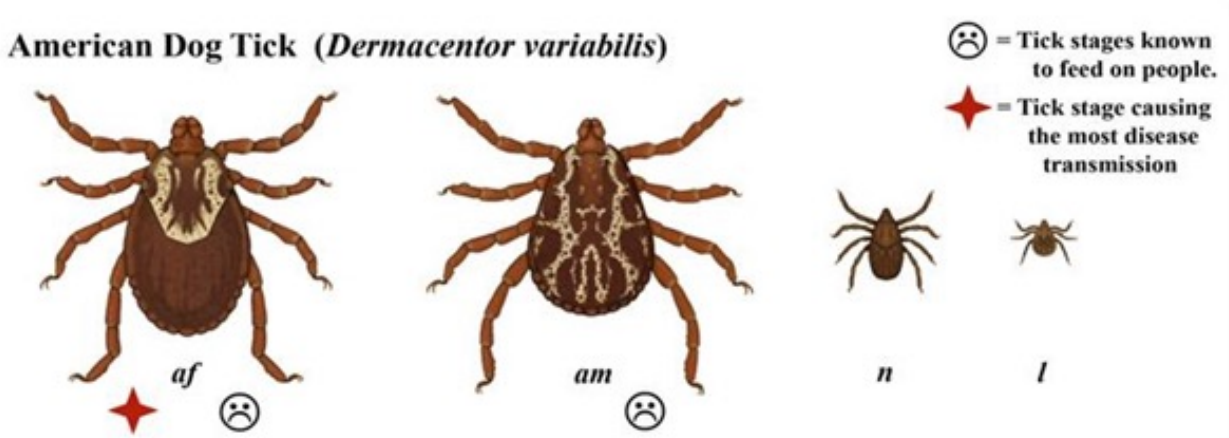


- Bites people slightly less frequently than other species, but this may be due to their large size making them easier to find
- Adult ticks are disease vectors (spring to late summer)
- Occur in fields with tall grass/vegetation (e.g., bushes and small trees)
- Also found in forest floor leaf litter near fields

Sizes of Adult Ticks



American Dog Tick Diseases



1. Rocky Mountain Spotted Fever (RMSF) †
    i. *Rickettsia ricketsii* †
2. Tularemia †
    i. *Francisella tularensis* †
3. *Rickettsia parkeri* spotted fever
    i. *Rickettsia parkeri*

*Diseases are listed in order of prevalence in VA (most common → least common)

† = Potentially fatal disease/condition.

Symptoms

- **Rocky Mountain Spotted Fever (RMSF)**
  - Sudden onset of moderate to high fever, a severe headache, fatigue, muscle pain, chills and a rash. The rash associated with RMSF typically begins on the ankles and wrists and spreads to the rest of the body including the soles of the feet and palms of the hands. If left untreated, RMSF can be fatal.

- **Tularemia**
  - Multiple clinical forms that depend on the transmission route. All forms are accompanied by fever, which can be as high as 104°F
  - Ulceroglandular, glandular, and pneumonic are the most common syndromes

- ***Rickettsia parkeri***
  - Typically has an eschar at the site of the bite
  - Fever, headache, rash, muscle aches.

Spotted Rash Associated with RMSF

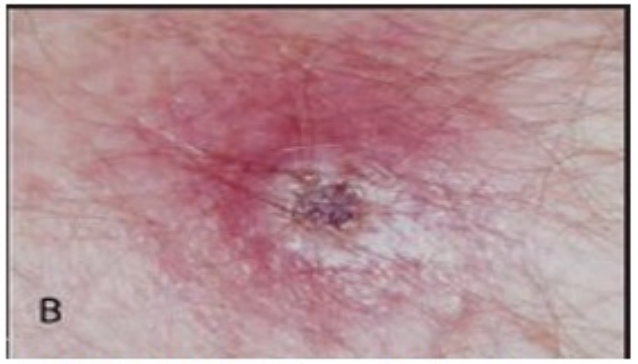
--RMSF rash always starts on wrists and ankles

--Ehrlichiosis rashes are variable, but might sometimes appear on arms, wrists or ankles.

Rash and Eschars from *Rickettsia parkeri* infection

EID – *Rickettsia parkeri* rash

EID –*Rickettsia parkeri* eschar

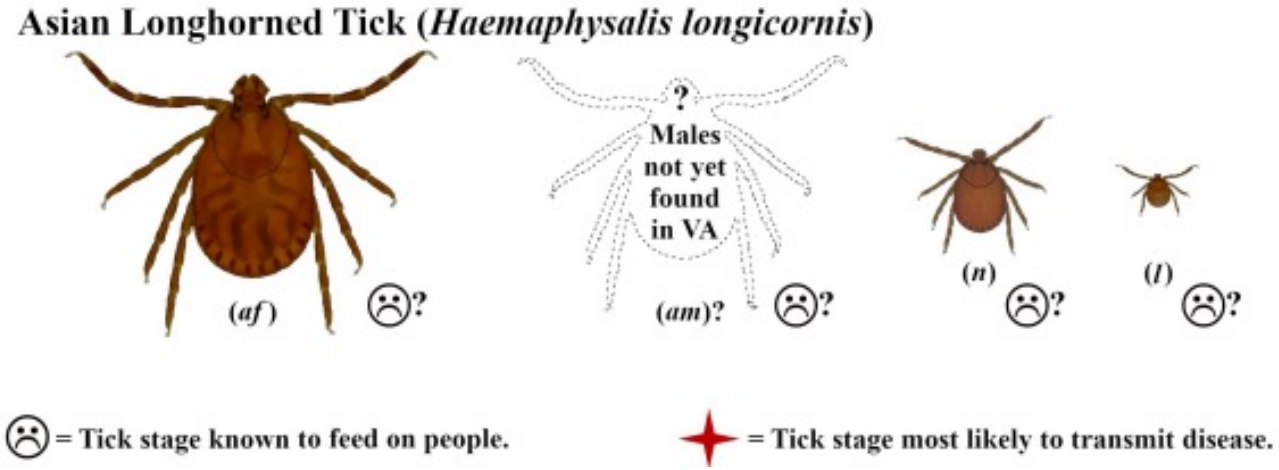


MMWR –*Rickettsia parkeri* eschar

What to do if you feel sick

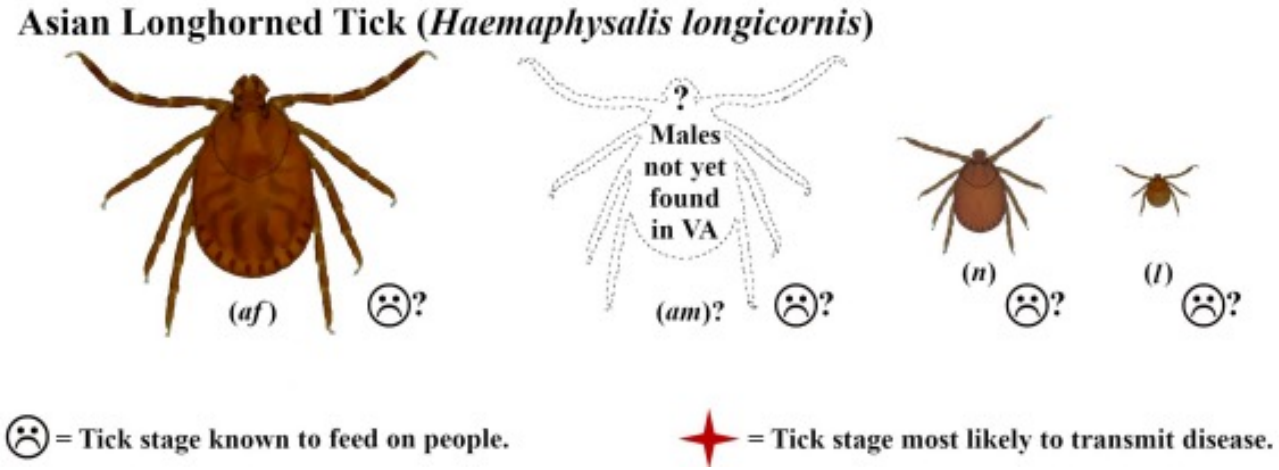
- Please see your doctor if you begin to feel ill after a tick-bite or spending time outdoors:
  - Common tick-borne disease symptoms
    - Fever
    - Rash
    - Headache (can be severe)
    - Malaise
    - Muscle/joint pain
    - Swollen lymph nodes

Longhorned Tick (*Haemaphysalis longicornis*)



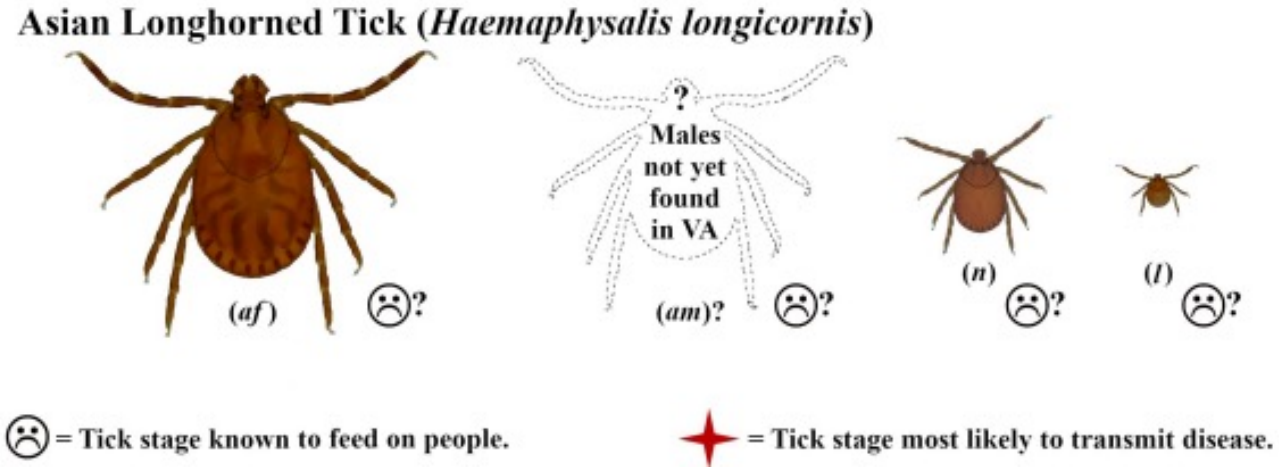
- Prefers to live in tall grass and wooded areas
- Invasive in the U.S., originally from east Asia
- Can reproduce asexually through parthenogenesis, so males are rare in the U.S.
- Major pest for livestock

Longhorned Tick (*Haemaphysalis longicornis*)



- The capability of spreading human disease in the U.S. is not yet well understood
- In a laboratory setting, it is **not** a competent vector for: Lyme Disease (*Borrelia burgdorferi*), Anaplasmosis (*Anaplasma phagocytophiolum*), and Tularemia (*Francisella tularensis*)

Longhorned Tick (*Haemaphysalis longicornis*)



- The capability of spreading disease in the U.S. is not yet well understood
- In lab setting, it **is** a competent vector for: Rocky Mountain Spotted Fever (*Rickettsia rickettsi*), Heartland Virus, Powassan Virus, and *Theileria orientalis* in cattle
- This tick is also known to spread other diseases in endemic areas, but those pathogens have not been found in the U.S.

Questions

Tick Surveillance Activities

- Tick dragging across the state from May-October
- Hired a contractor and two interns from University of Richmond and an MPH Student from Virginia Tech
- Collaborated with Holly Gaff's lab at Old Dominion University and Fairfax County Health Department

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Ecology of Tick-borne Disease – Lyme Disease

- White footed mice (*Peromyscus leucopus*) are reservoirs of Lyme disease bacteria (*Borrelia burgdorferi*)
- Mice infect larval black legged ticks, which then molt and become nymphs
- Nymphal black legged ticks are the most likely to transmit Lyme disease to humans

Ecology of Tick-borne Disease – Lyme Disease

- Dilution Effect Theory – Dr. Rick Ostfeld and Felicia Keesing, 2001
- Increased biodiversity and larger patches of forest decrease Lyme disease risk
- Forest fragmentation decreases mammalian biodiversity and therefore increases white footed mouse populations

- Habitat fragmentation → Biodiversity decreases → white footed mouse populations increase → tick infection prevalence increases

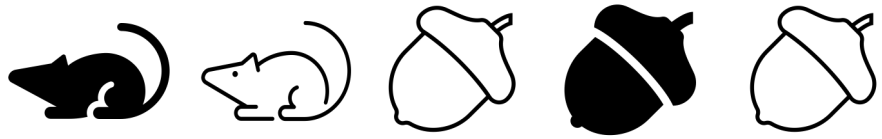



Climate, Acorns, Deer, Chipmunks, and Mice

- There is mixed evidence in the scientific literature as to the effect of deer populations on Lyme disease prevalence and black legged tick abundance is not well understood

- However, there is a lack of evidence in favor of culling deer for the purpose of Lyme disease prevention

- Climate (particularly temperature and elevation) has a weak effect on Lyme disease risk
  - As the previous year's temperature increased, nymphal population density and density of infected nymphs increased marginally
  - Intermediate levels of precipitation in the current year resulted in a marginal increase in nymphal population density and density of infected nymphs
  - However, there was no effect of climate on nymphal infection prevalence, which is dependent on which hosts the tick fed on during its larval stage



- Strongest predictors of a current year's risk of Lyme disease were the:
  - Previous year's abundance of mice and chipmunks
  - Abundance of acorns two years previous

- Acorn mast years lead to a higher population of mice and chipmunks the next year
- Both species act as hosts for larval black legged ticks and reservoirs for *Borrelia burgdorferi*
- Those infected larval ticks molt and become active the next spring/summer as nymphs that transmit Lyme to humans

How to Protect Against Tickborne Disease

- Most important tickborne disease prevention measure:
  - Don’t get bit!
- Use an EPA approved insect repellent
  - DEET
  - Picaridin
  - IR 3535
  - 2-undecanone
  - Oil of lemon eucalyptus (synthetic)
- Secret weapon: Permethrin
  - An insecticide that can be applied to clothing and outdoor gear and is safe to touch when dry

How to Protect Against Tickborne Disease

- Wear light colored clothing
- Tuck your long pants into your socks and tuck your shirt into your pants
  - Ticks often grab on to your shoes or socks and instinctually climb upwards, you can prevent them from reaching your skin by tucking your clothes in!

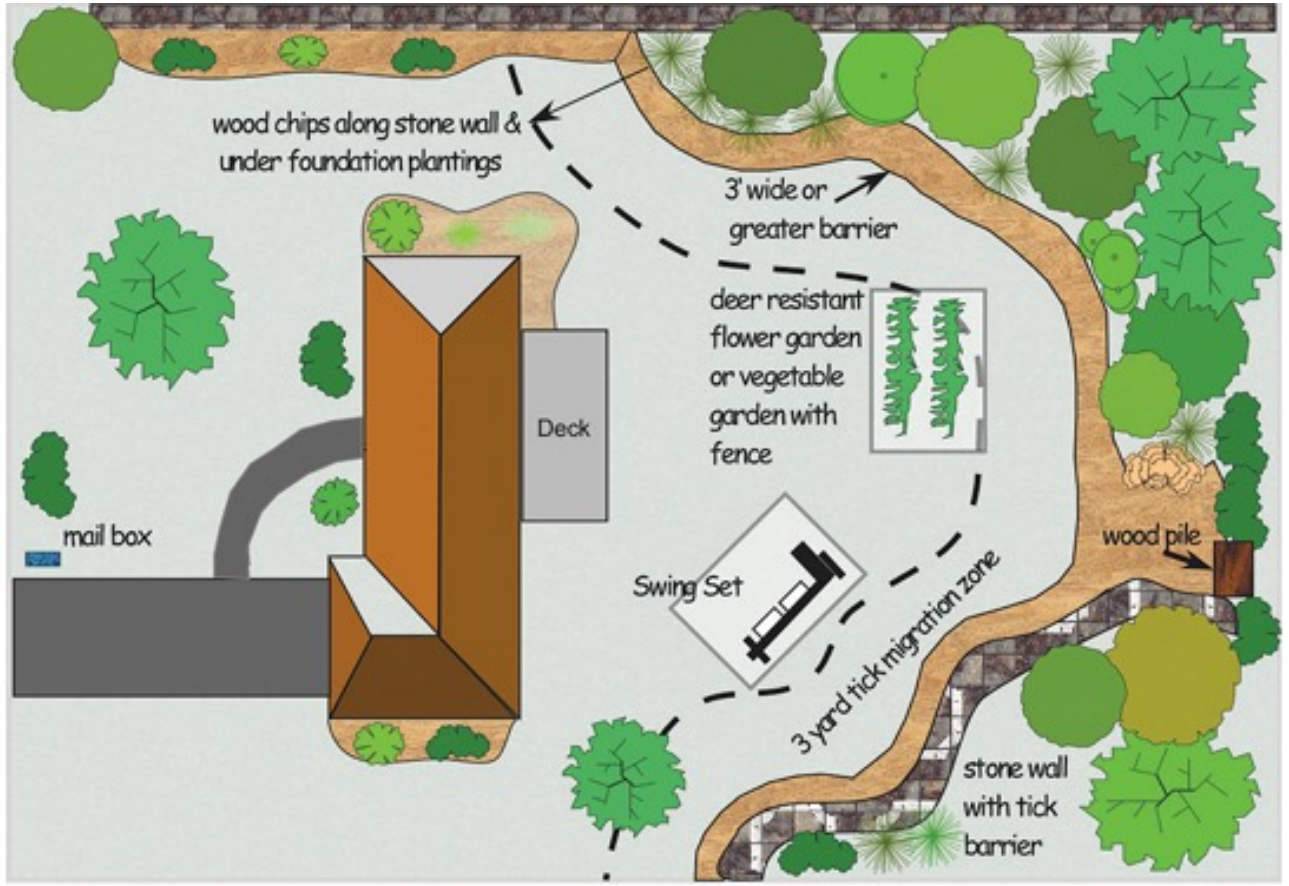
Tick-Safe Landscaping

1. Outdoor pesticide application
    - Always follow label instructions
    - Before spraying check with local health and/or agricultural officials about:
        - The best time to apply pesticide in your area
        - Best pesticide type to use
        - Rules and regulations regarding pesticide application on residential properties
2. “Tick-Safe Zones” via landscaping practices

Creating a Tick Safe Zone in a Residential Landscape aka “Tickscaping”

- Reduce shade, leaf litter, and groundcover plants (ex., pachysandra) in frequently used areas, especially children’s play areas
- Create a “moat” of woodchips or gravel at the edge of densely wooded areas to prevent tick migration
  - Pesticides can be focused primarily on this barrier
  - Woodchips must be frequently maintained or they will decompose and become tick habitat

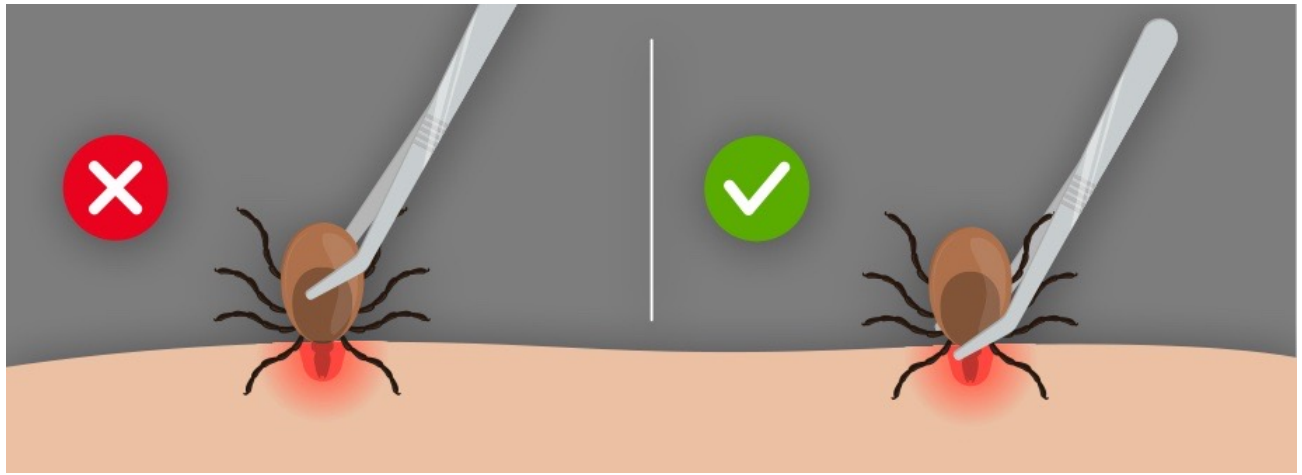
Source: Tick Management Handbook



How to Protect Against Tickborne Disease

- Take a shower and check yourself thoroughly for ticks after being outside
  - Ticks like to bite in areas with folds of skin, dark locations where they would be difficult to find, or where clothing is tight against your skin, and they can no longer climb upwards

How to Protect Against Tickborne Disease



Step 1: **Use a tweezer to grasp the tick as close as possible to the skin**

Step2: **Pull upward, with steady even pressure**, until the tick releases to avoid breaking the mouthparts of the tick or rupturing the tick's body.

Step 3: **After tick removal, clean the skin and bite area** with rubbing alcohol or soap and warm water.

Step 4: **Save the tick in a bag or container with rubbing alcohol for identification** in case an illness develops in the days after tick attachment. Never crush a tick with your fingers.

Send the Tick to VDH

- Virginia Tick Survey – Ticks
- The Vectorborne Disease Team will identify the species of tick for you and let you know what diseases that species can transmit to people

- VDH will not test the tick for disease
  - The CDC does not recommend tick testing for medical diagnostic purposes!

Why shouldn't you test a tick for disease?

- The CDC does not recommend tick testing for medical diagnostic purposes!
  - Laboratories that conduct tick testing are not required to have high standards of quality control
  - Positive results showing that a tick is infected does **not** necessarily mean you have been infected
  - **Negative** results can lead to false assurance and do not necessarily mean that you are **not** infected. You may have been bitten by another tick you didn't know about!
  - If you are infected with a tick-borne disease, you will probably develop symptoms before the tick test results are available. Do not wait for the tick testing results to seek treatment!

- Check out this link from the CDC for more information:
  - https://www.cdc.gov/ticks/after-a-tick-bite/index.html.

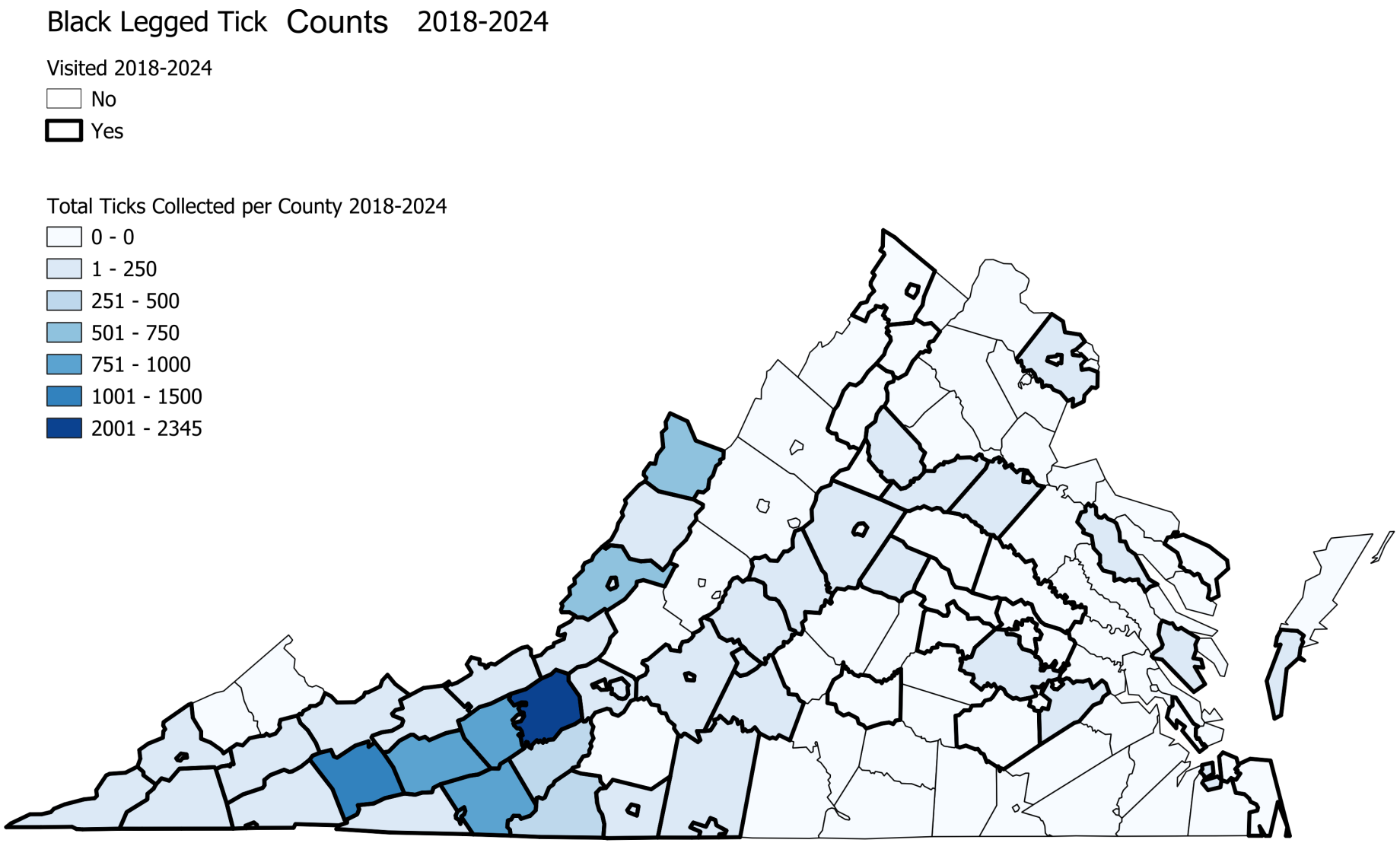
Blacklegged tick Disease Testing 2024

- 238 *Ixodes* ticks collected in 2024
  - 206 *I. scapularis*
  - 29 *I. affinis*
  - 3 *I. dentatus*
- All 238 were tested for disease by the CDC
  - 14 different counties

Tested for:

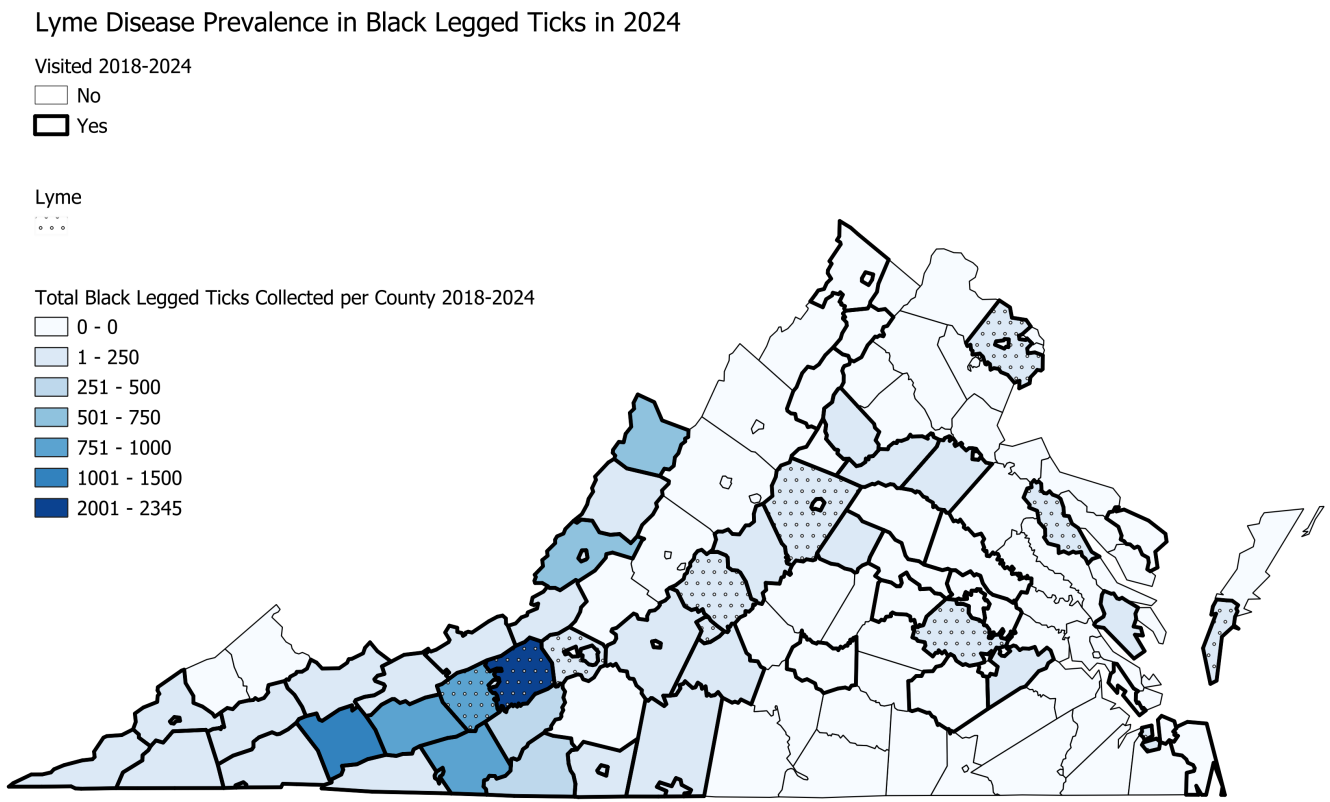
- *Anaplasma phagocytophilum* human active strain
- ★ ***Anaplasma phagocytophilum* non-human active strain**
- ★ ***Borrelia burgdorferi***
- *Borrelia mayonii*
- ★ ***Borrelia miyamotoi***
- *Babesia microti*
- *Ehrlichia muris euclairensis*

Black Legged Tick Surveillance Results



Maps do not account for sampling effort or tick population density. These are simply collection counts from 2018-2024.

Lyme Disease



- 32 *I. scapularis* tested positive for *B. burgdorferi*
- 15 *I. affinis* tested positive for *B. burgdorferi*
- 0 *I. dentatus* tested positive for *B. burgdorferi*
- 47 total positives out of 238
  - 19.7% infection prevalence
- Chesterfield Northampton Montgomery Albemarle Amherst Fairfax County Lynchburg Roanoke County Essex Portsmouth Pulaski

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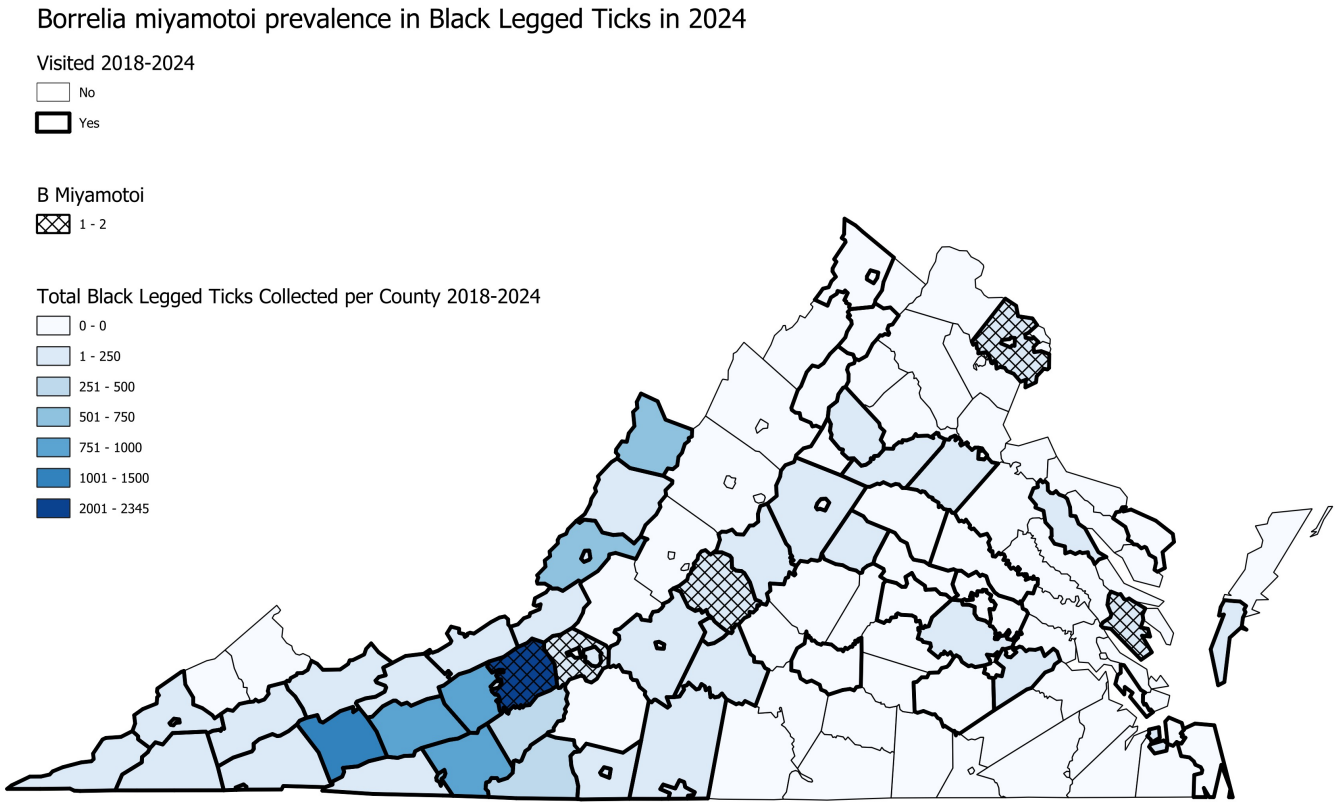
B. Miyamotoi infected ticks



- 7 *I. scapularis* tested positive for *B. miyamotoi*
- 1 *I. affinis* tested positive for *B. miyamotoi*
- 0 *I. dentatus* tested positive for *B. miyamotoi*
- 8 total positives out of 238
  - 3% infection prevalence
- Montgomery, Amherst, Roanoke Co., Fairfax Co., Gloucester

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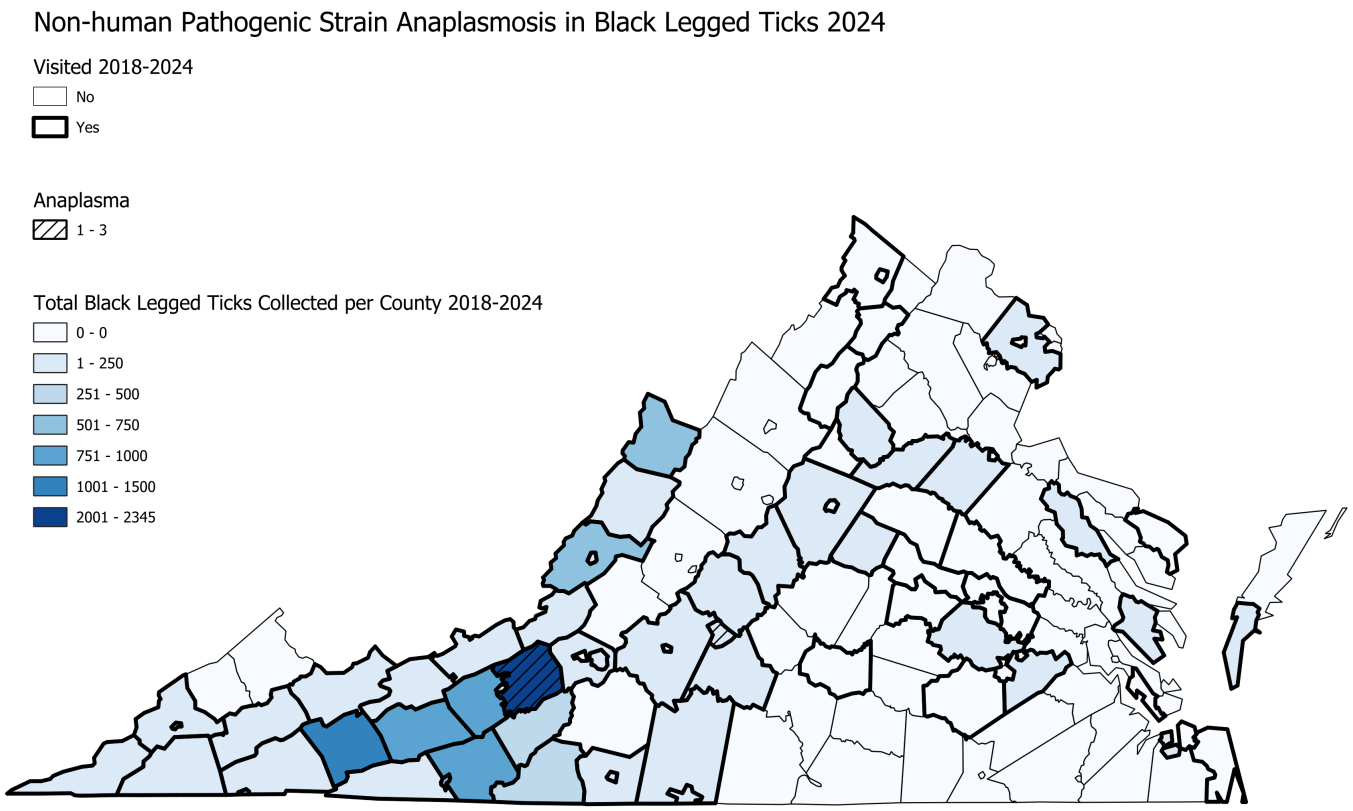
Anaplasmosis infected ticks



- 5 *I. scapularis* tested positive for *A. phagocytophilum*
- 0 *I. affinis* tested positive for *A. phagocytophilum*
- 0 *I. dentatus* tested positive for *A. phagocytophilum*
- 5 total positives out of 238
  - 2% infection prevalence
- Montgomery, Lynchburg

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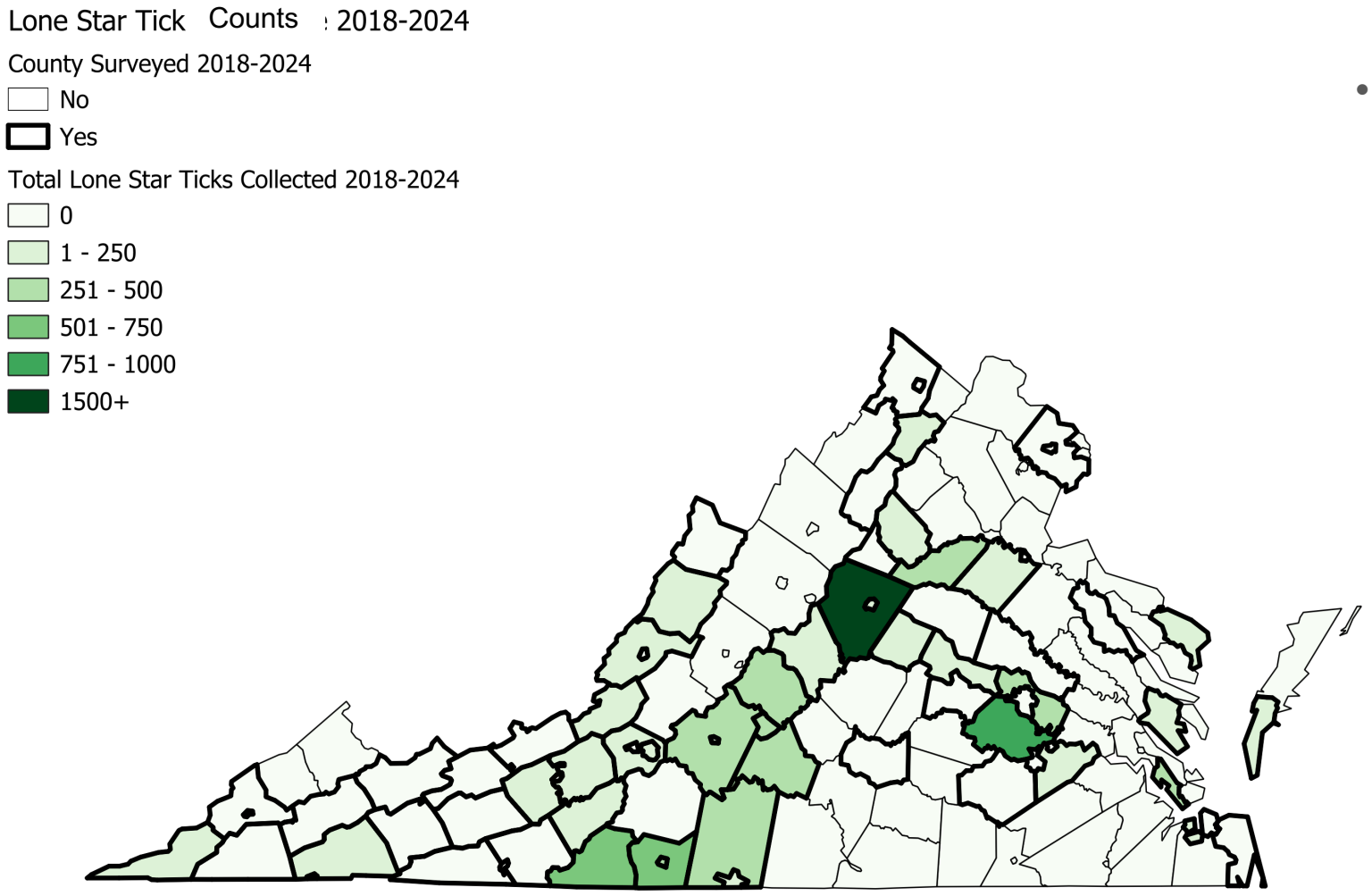
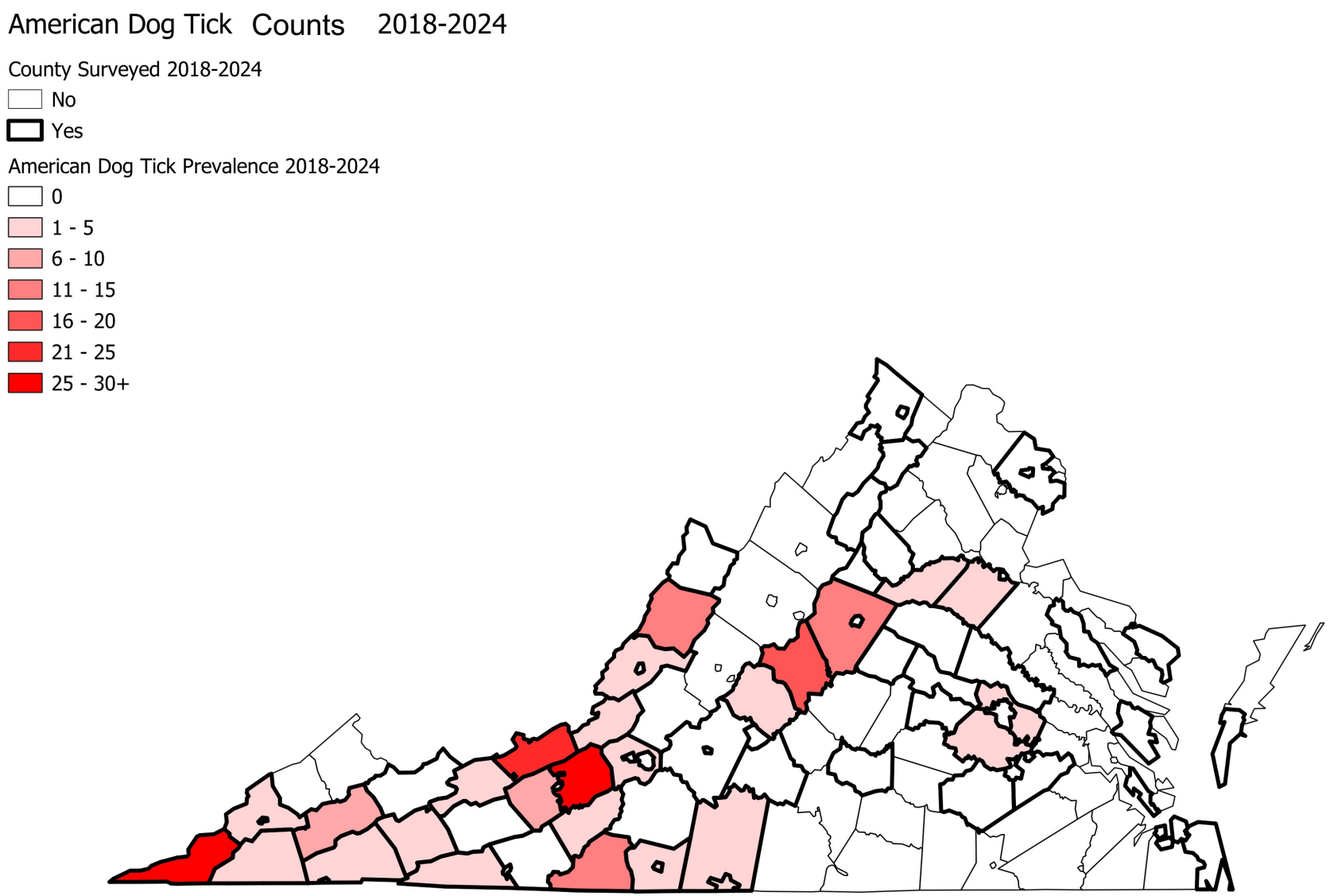
Lone Star Tick Surveillance Results



- Surveyed 65 counties since 2018

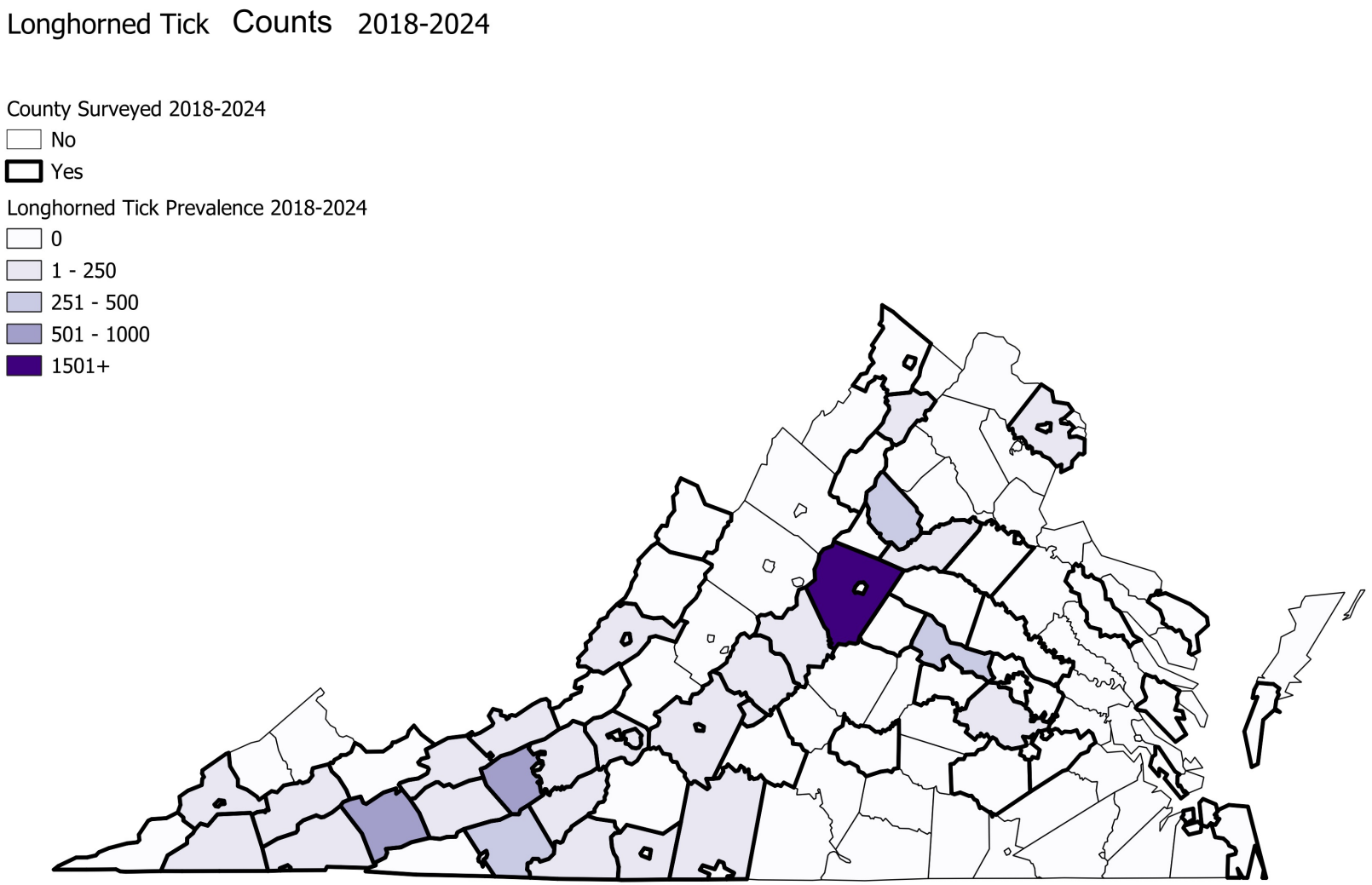
Maps do not account for sampling effort or tick population density. These are simply collection counts from 2018-2024.

American Dog Tick Surveillance Results



Maps do not account for sampling effort or tick population density. These are simply collection counts from 2018-2024.

Longhorned Tick Surveillance Results



Maps do not account for sampling effort or tick population density. These are simply collection counts from 2018-2024.

Thank you very much!

- Any questions?
- Reach out to me at elizabeth.forrey@vdh.virginia.gov or at va.ticksurvey@vdh.virginia.gov