# Ticks and tick-borne disease prevention


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Millstone Township Agricultural Advisory Council
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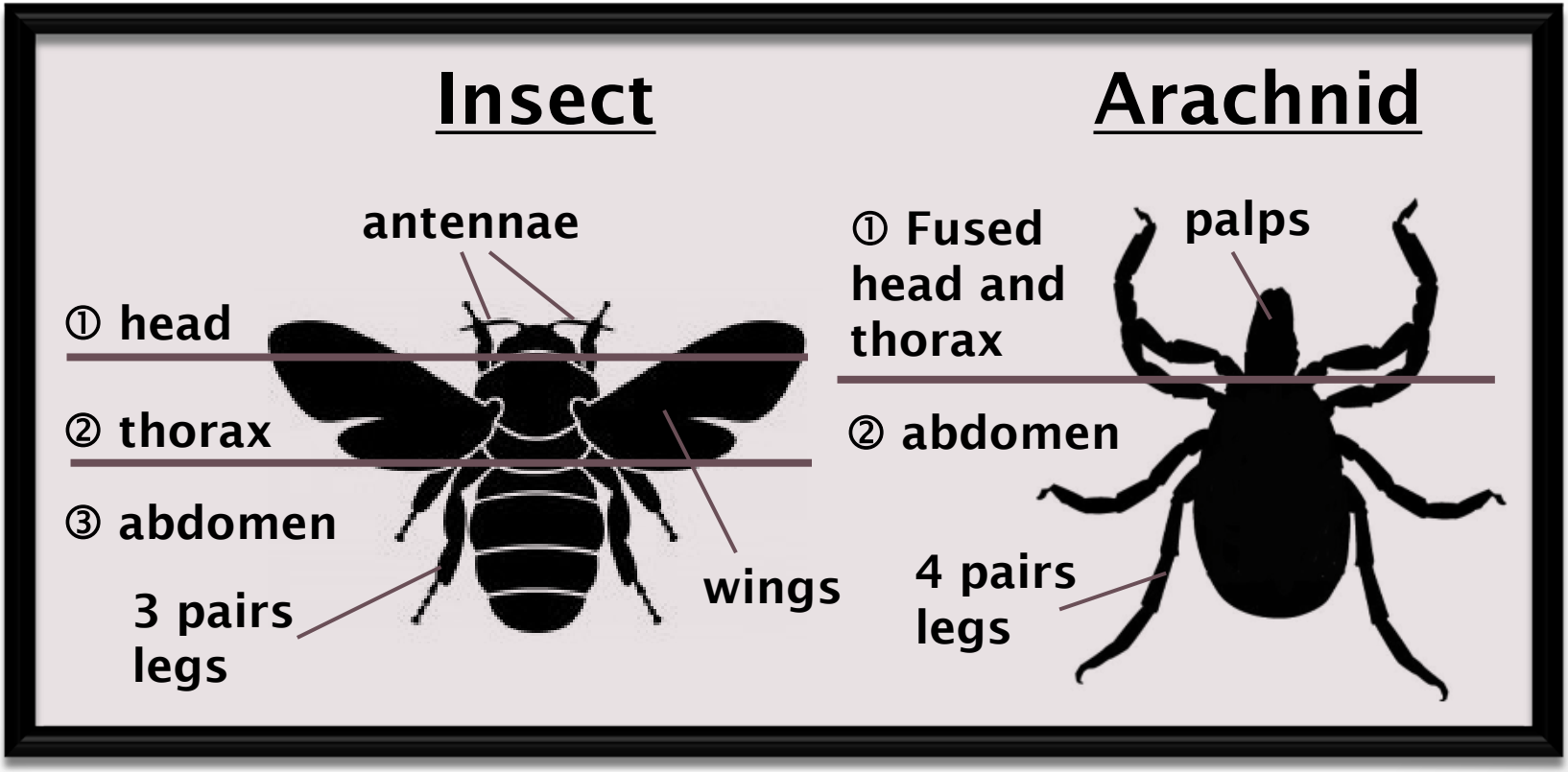
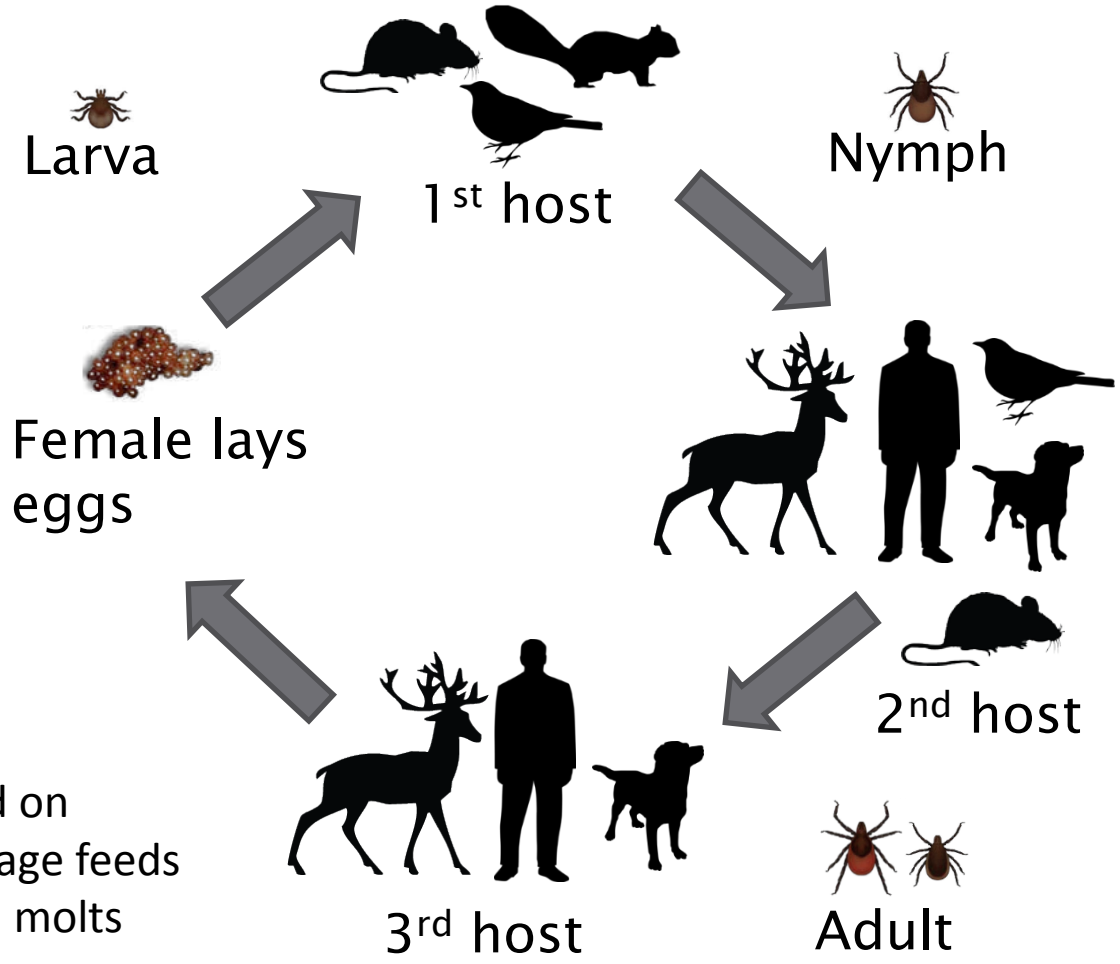
# What is a tick?

- Ticks are arachnids, like spiders and scorpions



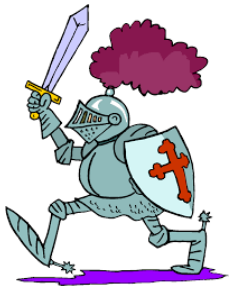
# 3-host tick life cycle

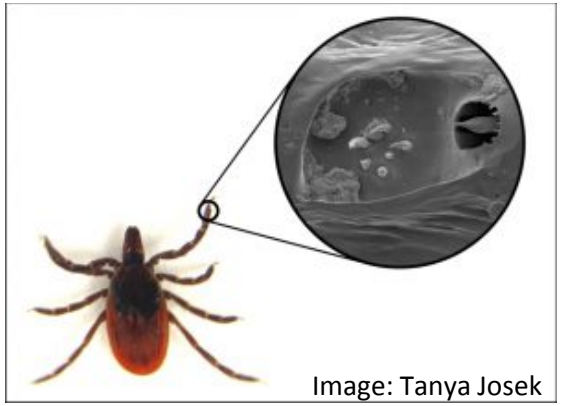



Ticks only feed on blood; each stage feeds once and then molts

# How does a tick find a host?

- Ticks do not jump, fly or fall on you from trees. They climb up vegetation and wait with their legs outstretched for a host to brush up against them.
- This is called “questing”…



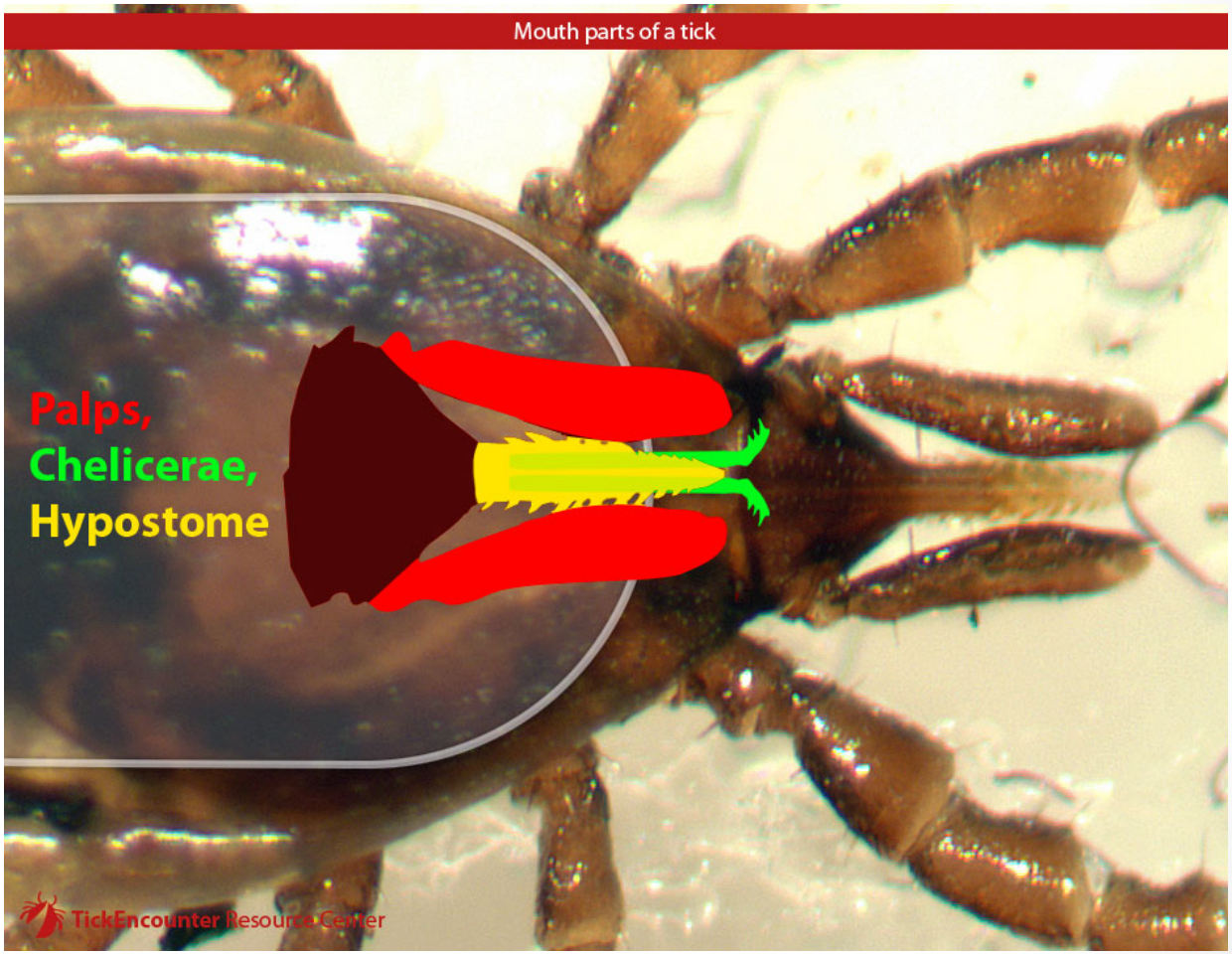



Organ on front legs senses heat, $CO_2$ and chemical odors

# Attachment

Chelicerae scissor their way into the skin and act like hooks to pull the hypostome in

Hypostome has backwards facing barbs that make it difficult to remove



# Feeding

-Chelicerae create wound where blood pools
-Hypostome sucks up the blood

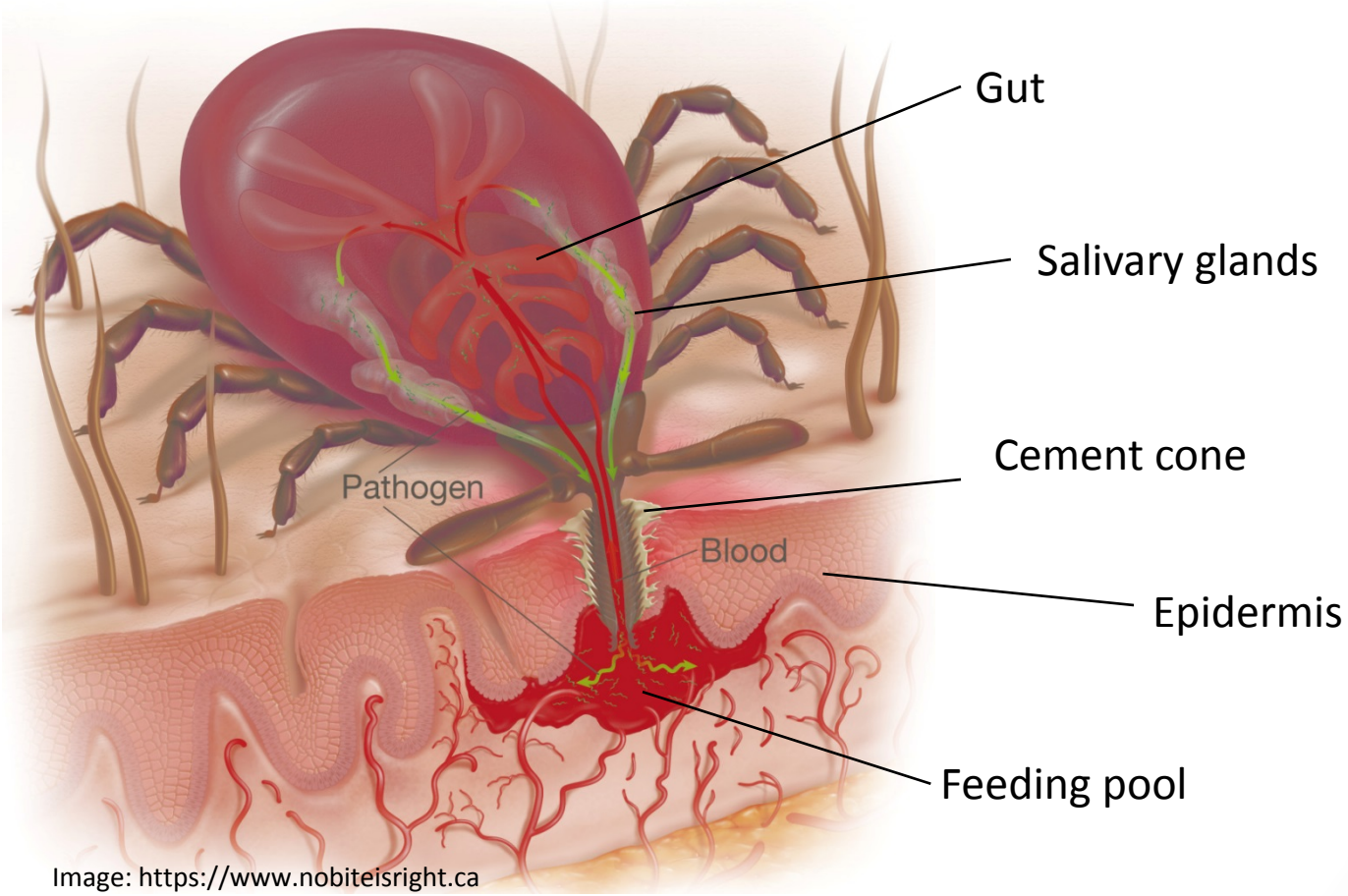



Image: https://www.nobiteisright.ca

The tick's gut filters the blood and returns excess water back to the host (green arrows). This circulation is what allows pathogens in the tick to enter the host.

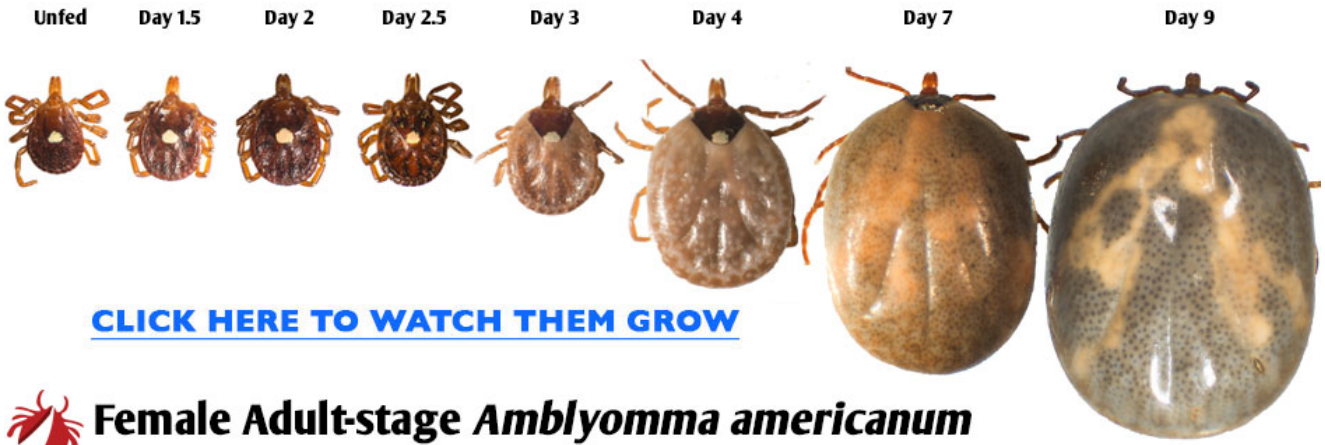
# Engorgement

Images from
https://tickencounter.org/

CLICK HERE TO WATCH THEM GROW

**Female Adult-stage *Ixodes scapularis* Growth Comparison**

*The longer a tick is attached, the larger it gets, and the greater risk for pathogen transmission.*




CLICK HERE TO WATCH THEM GROW

**Female Adult-stage *Amblyomma americanum* Growth Comparison**

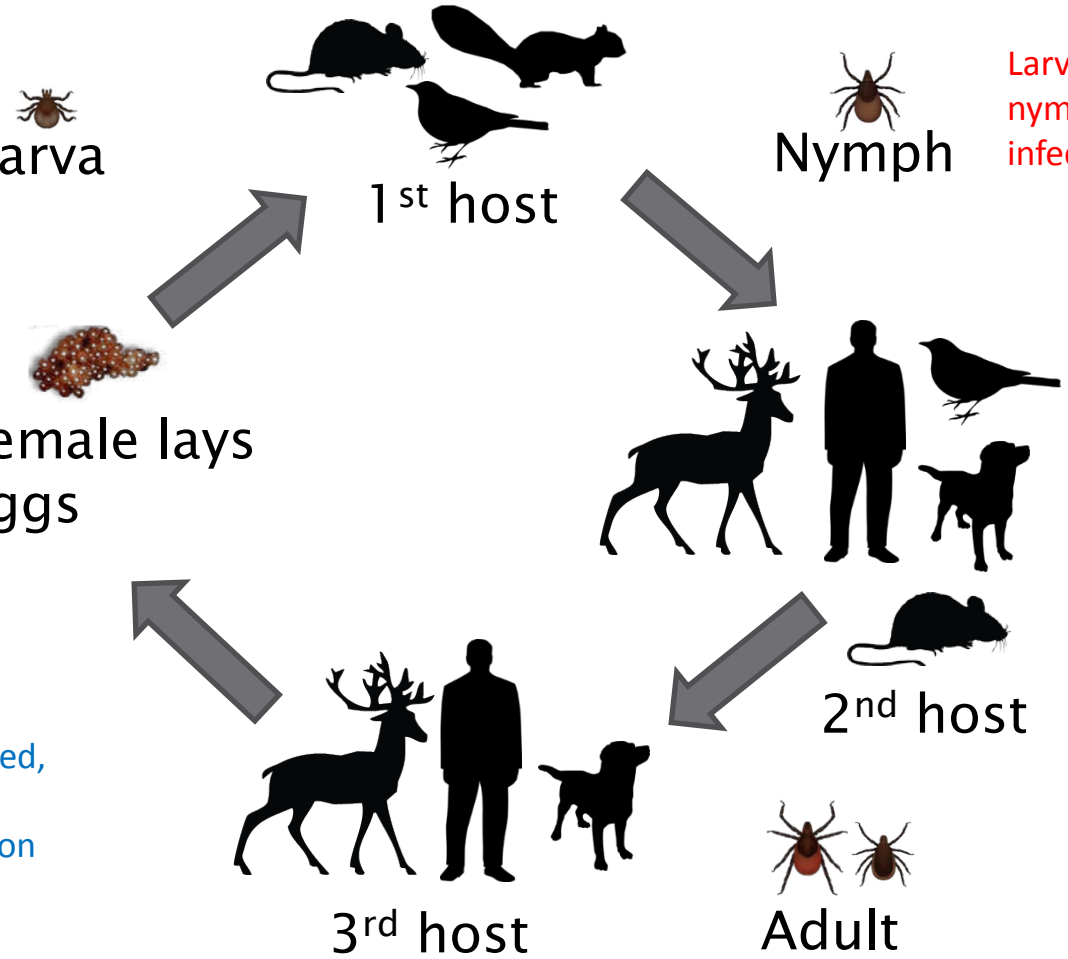
# Reproduction

- Mating occurs on the host before/during female feeding
- Insertion of spermatophore contains signal for female to finish feeding and drop off

- Female lays 2,000-3,000 eggs and then dies

# Pathogen transmission

Uninfected larva picks up pathogen by feeding on 1st host, like a mouse, that is infected.




Larva molts to a nymph that is now infected.

When nymph feeds on 2nd host, it can infect them with the pathogen.

If the 1st host is not infected, they can also pick up pathogens when feeding on the 2nd host as a nymph.

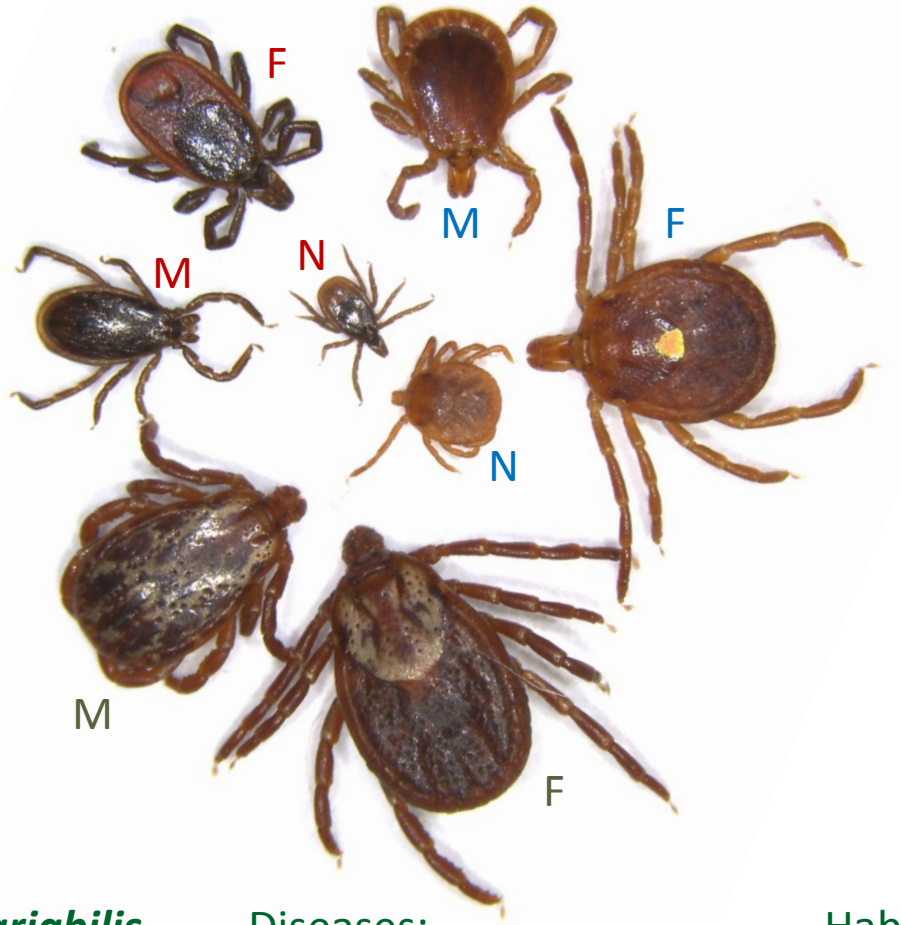
An infected nymph will stay infected as an adult and can infect the 3rd host with the pathogen.

# 3 Medically important ticks

***Ixodes scapularis***
"Blacklegged tick"

Diseases:
Lyme disease
Anaplasmosis
Babesiosis
Powassan virus

Habitat:
Woods and wood edges




***Amblyomma americanum***
"Lone star tick"

Diseases:
Ehrlichiosis
STARI

Habitat: Woods and wood edges

***Dermacentor variabilis***
"American dog tick"

Diseases:
Spotted fever rickettsiosis

Habitat: grass fields, meadows, wood edges

# Brown dog ticks

*(Rhipicephalus sanguineus)*

- The only NJ tick that can live completely indoors
- AKA “Kennel ticks”
- Can create large infestations

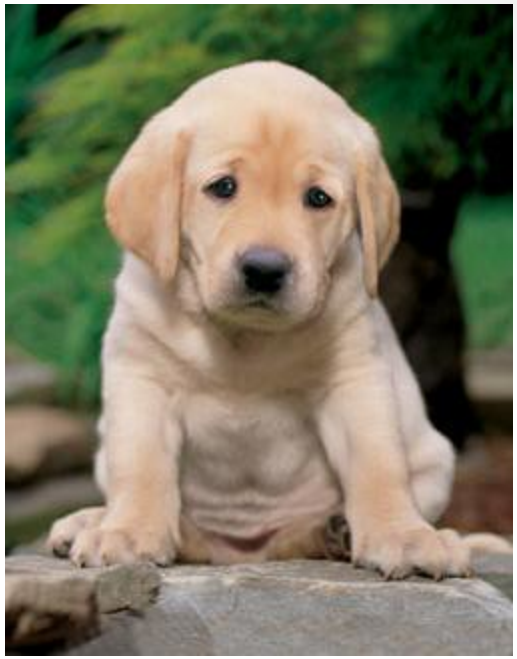


Image: darwinanimaldoctors.org

Image: entoweb.okstate.edu

Image: bugsbeeware.com

# Asian longhorned tick

*(Haemaphysalis longicornis)*

- Native to east Asia, invasive in Australia and New Zealand
- Detected in NJ Nov 2017; backdated to 2010 in WV
- Now found in 11 states; Broad list of recorded hosts
- Reproduces without mating (=1 tick can start a population)
- Large infestations on livestock; Human risk in US unknown

Image: Tadhgh Rainey

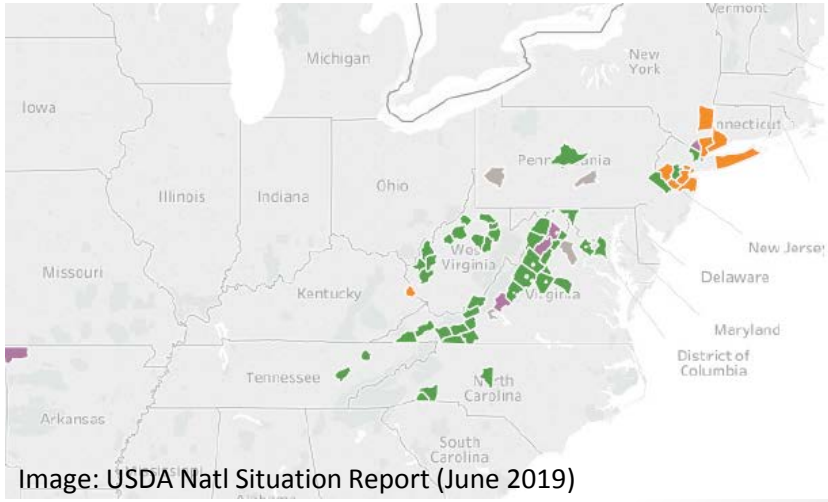



Image: USDA Natl Situation Report (June 2019)

*Link to PDF of article: click here*

*Link to USDA report: click here*

# The Gulf coast tick- coming soon?

*(Amblyomma maculatum)*

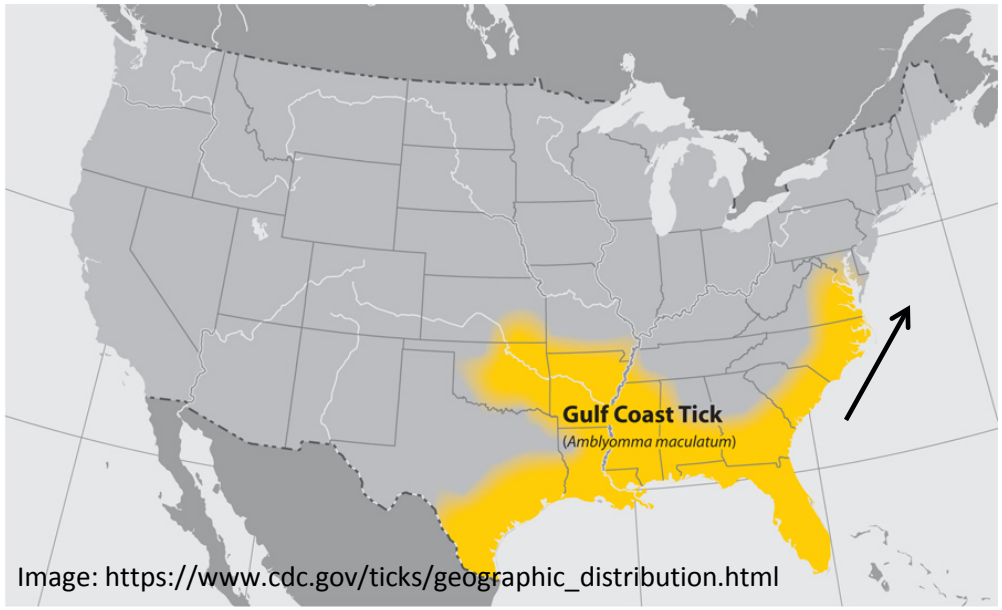


Image: https://www.cdc.gov/ticks/geographic_distribution.html

- Moving up the Atlantic coast; Established pops in Delaware
- Single male spotted in Atlantic Co. last year (but does not appear to be established)

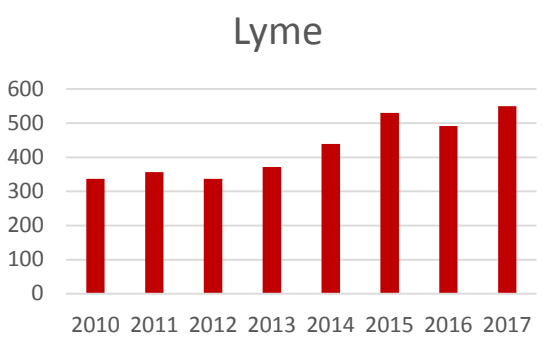
Vector of *R. parkeri* rickettsiosis (related to Rocky Mountain Spotted fever, though less severe)

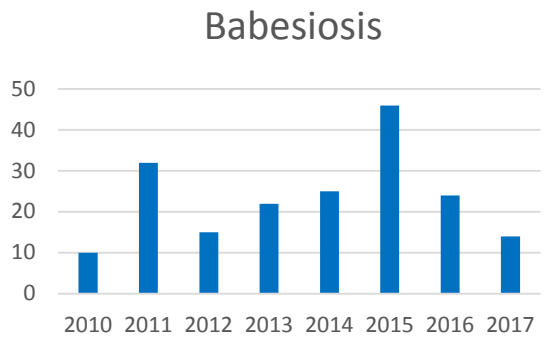
Image: http://entnemdept.ufl.edu/

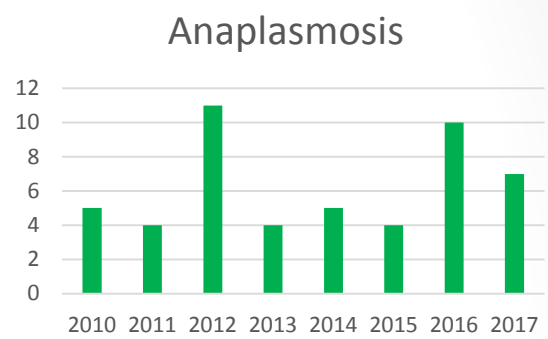
Color pattern similar to American dog tick & similar habitat

# Monmouth County Tick-borne Diseases

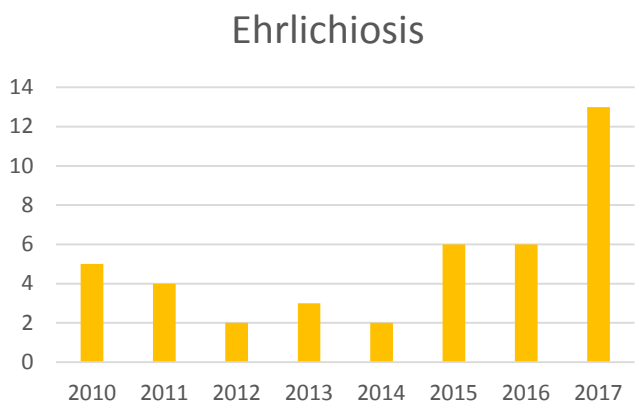
***3 transmitted by blacklegged (Deer) ticks:***



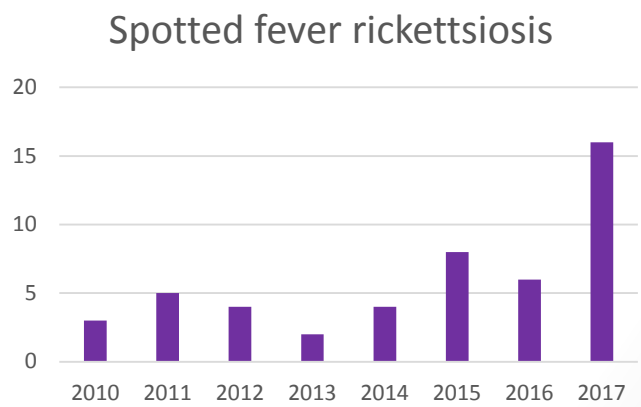




***1 transmitted by lone star ticks:***




***1 transmitted by American dog ticks:***




Data from NJSHAD: https://www-doh.state.nj.us/doh-shad/

# Tick-borne disease symptoms

- Fever/chills
- Aches and pains: headache, fatigue, muscle aches, joint pain
- Rash (LD bulls eye most well known, but other TBD also cause rash- like RMSF, ehrlichiosis, STARI)

See your doctor if you develop any of these symptoms after a tick bite.

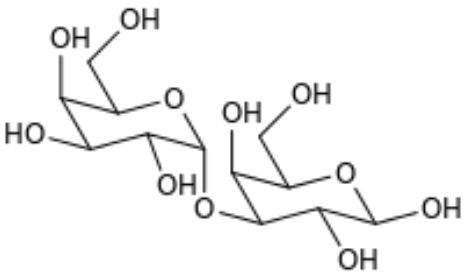
# Tick paralysis

- Caused by neurotoxin in female tick saliva
- In eastern US linked primarily to American dog ticks
- Affects children and dogs
- Rare- but serious
- Recovery quick once tick is removed- often within 24 hours

Image: Borislav Dopudja, Wikimedia commons

# Alpha-Gal syndrome

- Alpha-gal is a sugar molecule found in non-primate mammals
- An allergy to alpha-gal causes allergic reaction 3-6 hours after eating meat
- It has also been found in some types of tick saliva, leading to a hypothesis that it can be caused by a tick bite
- More research is needed to understand this syndrome, for example, why some people develop it and not others



Images: Wikimedia commons

# Removing a tick

- ✓ Remove as soon as possible. Do not apply a treatment and wait for it to leave on its own.
- ✓ Using a fine tipped tweezers, grasp the tick by the "head" very close to the skin, and pull upwards slowly and steadily.
- ✓ Wash and disinfect tick bite site.
- ✓ If the head remains inside: the head by itself cannot transmit a pathogen, although it can cause irritation, like a splinter.

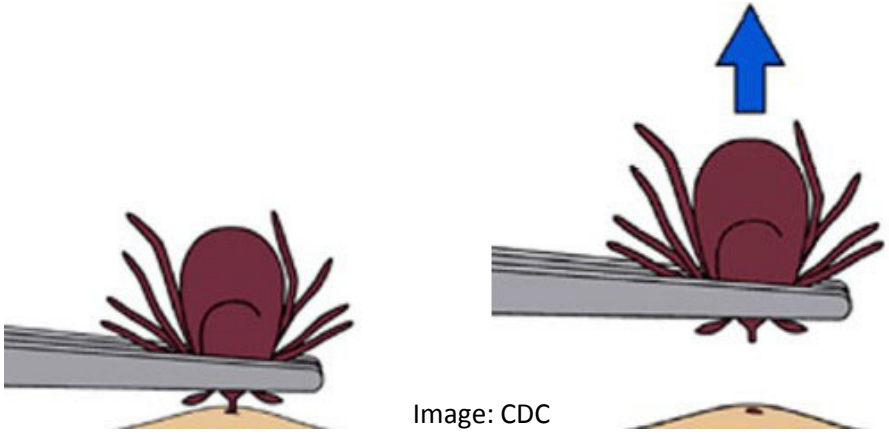


Image: CDC

# Monmouth County Tick Program

- ✓Active surveillance
- ✓Passive surveillance
- ✓Education

| TICK IDENTIFICATION (species) | DEVELOPMENTAL STAGE (larva, nymph; male or female) | ENGORGEMENT LEVEL (flat; engorged) | DATE REMOVED (mm/dd/yyyy) |
|---|---|---|---|
| Blacklegged (Deer) Tick | Female | Partial | 1 /1 /2017 |

**Blacklegged (Deer) Tick**
*(Ixodes Scapularis)*
Female

*Tick is enlarged to show detail*
*(not actual specimen submitted)*

**REMARKS:**

*About your tick*

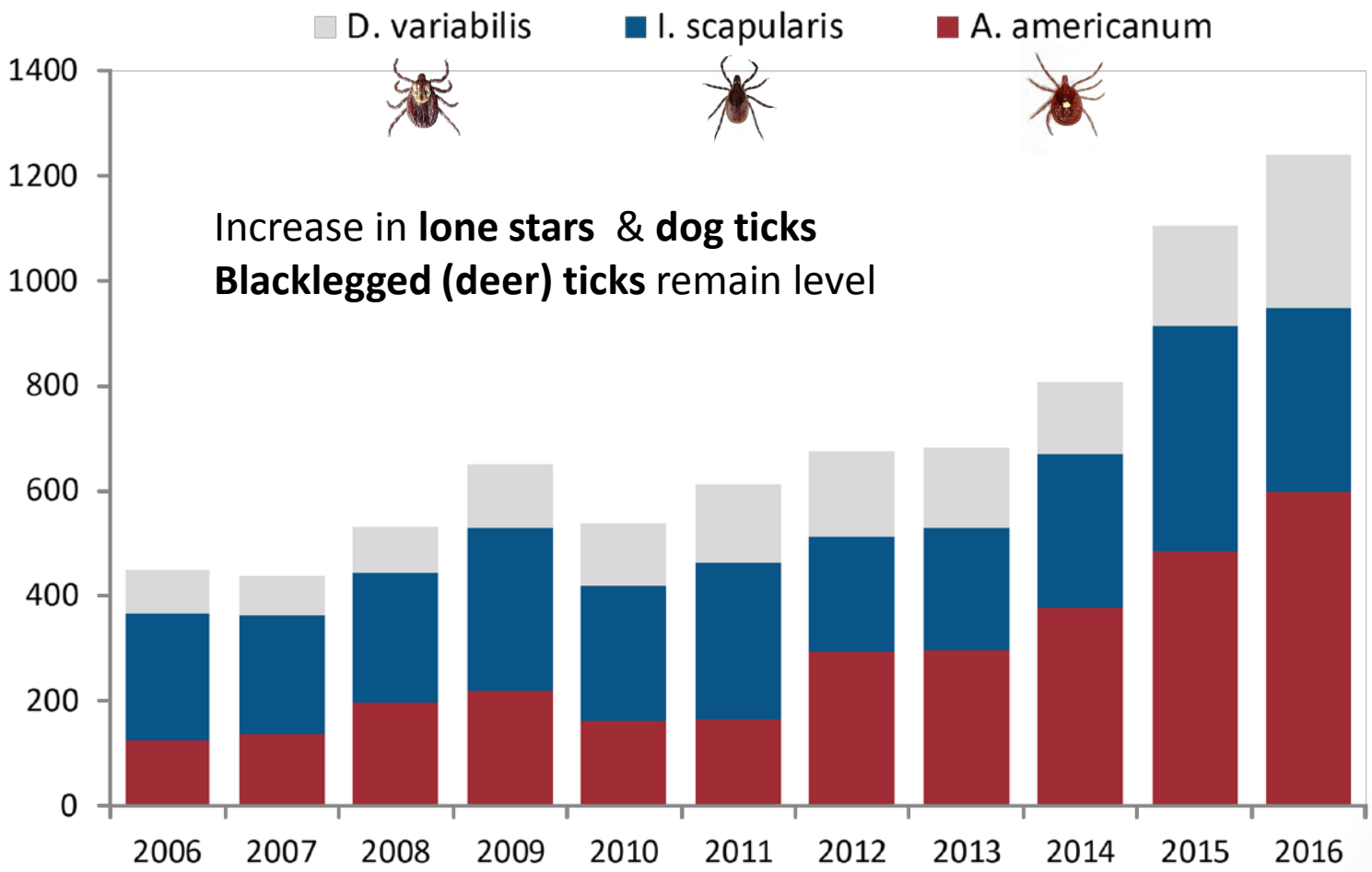
**The tick you submitted was a female blacklegged tick. The tick was at least partially filled with blood (had begun feeding).**

*About the Blacklegged (Deer) Tick*

**The blacklegged tick is capable of transmitting the Lyme disease bacterium (if infected). The tick must feed for a minimum of 24-36 hours before it can transmit Lyme disease. Therefore, the quicker you remove a tick, the less likely it can transmit any disease.**

We offer **FREE** tick identification for Monmouth residents!
For more information call or visit:
[visitmonmouth.com/mosquito](visitmonmouth.com/mosquito)
732-542-3630

# Public submissions 2006-2016




Data from Jordan & Egizi (2019) PLoS One
Publication available free online: https://doi.org/10.1371/journal.pone.0211778

# Spatial expansion of lone stars

Lone star ticks uncommon in the northern part of the county prior to 2012;
Now common nearly everywhere

2006-2011 | 2012-2016

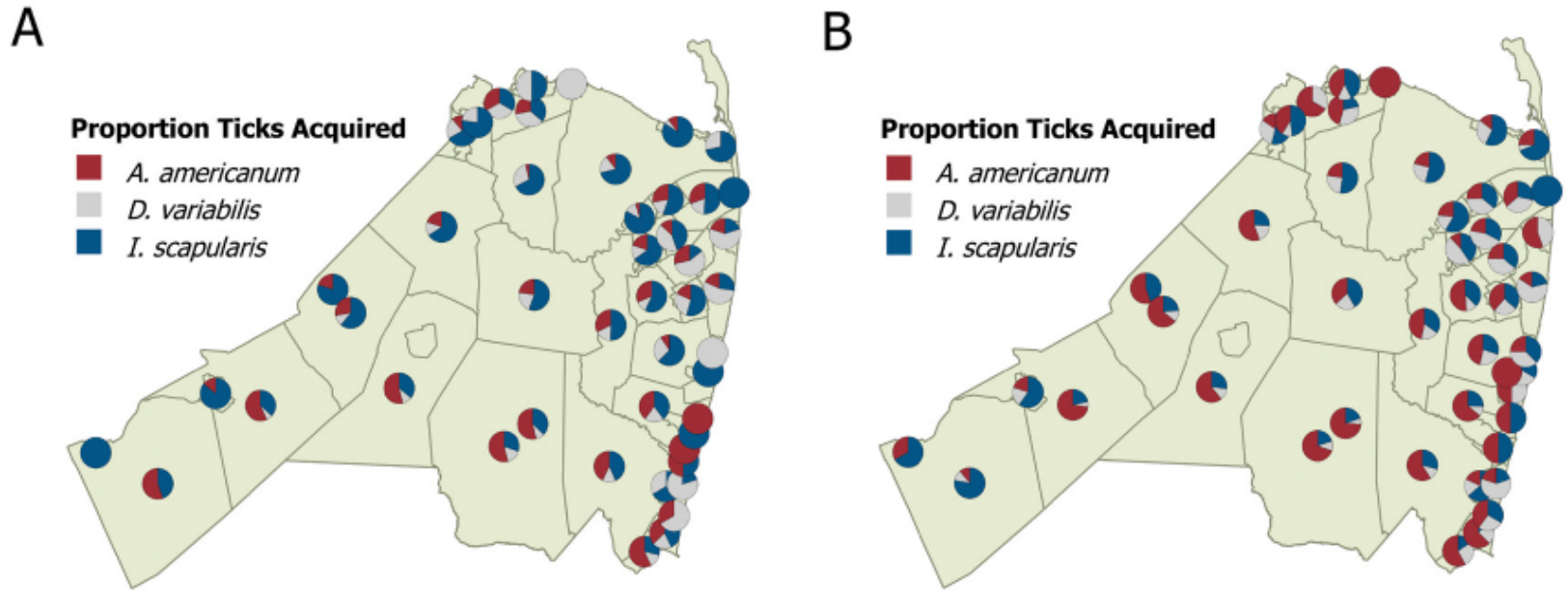
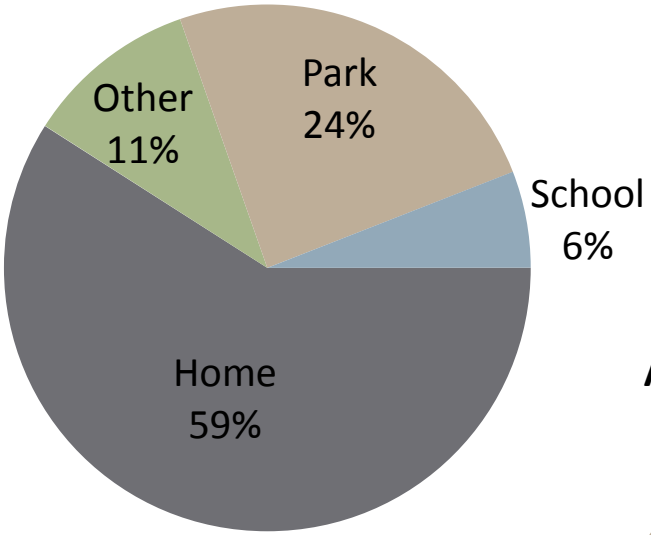



Fig 1. Species composition of ticks submitted in Monmouth County, by acquired municipality. A) 2006–2011, B) 2012–2016.

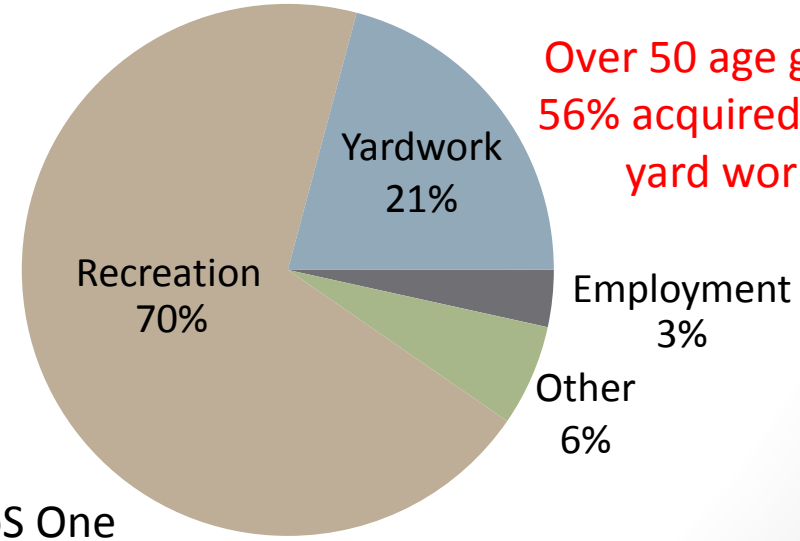
Data from Jordan & Egizi (2019) PLoS One
Publication available free online: https://doi.org/10.1371/journal.pone.0211778

# Where do people get bitten?

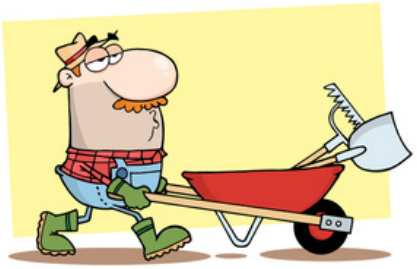
**Location where tick acquired**



**Activity where tick acquired**

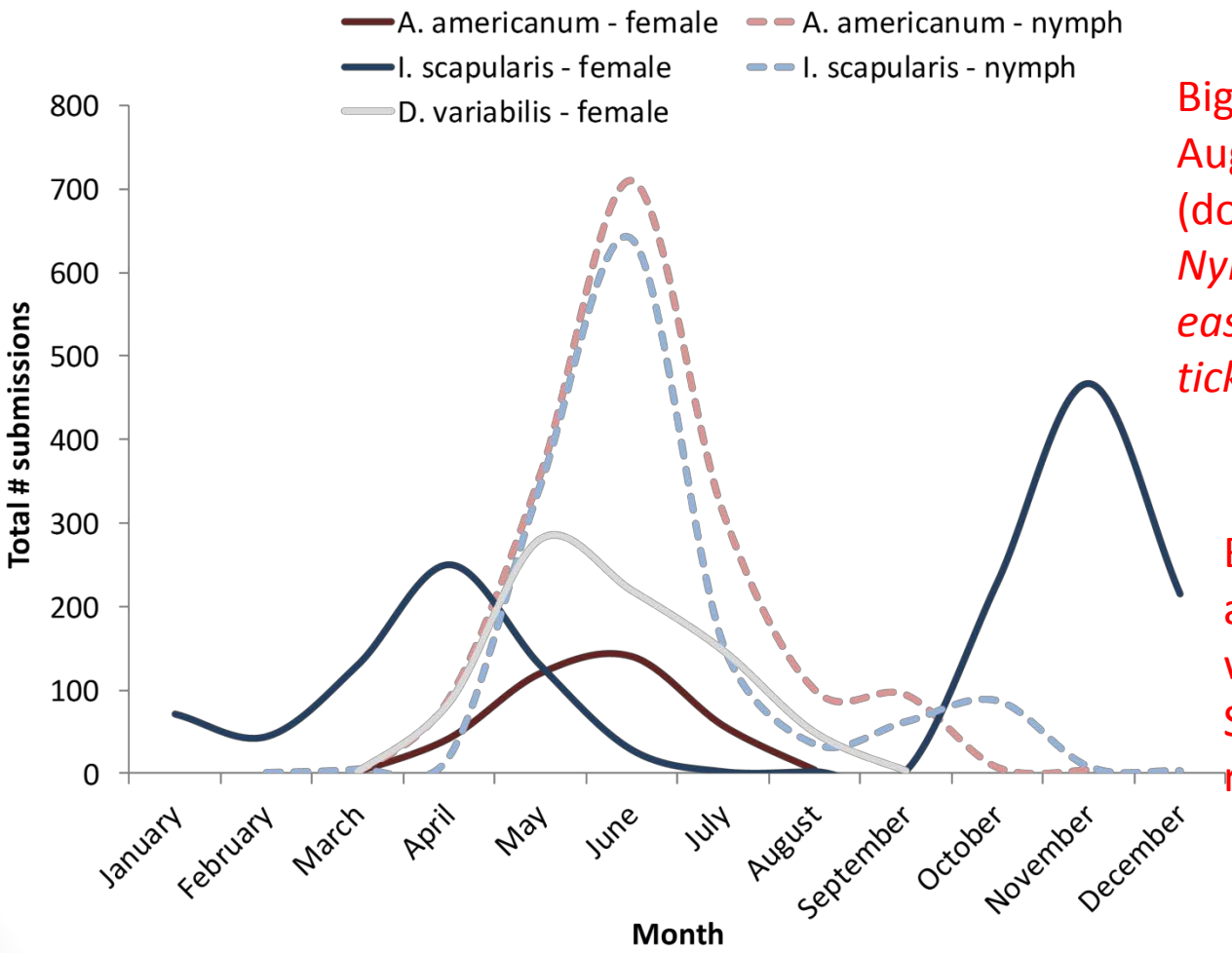



Over 50 age group: 56% acquired doing yard work!



Data from Jordan & Egizi (2019) PLoS One
Publication available free online: https://doi.org/10.1371/journal.pone.0211778

# When do people get bitten?



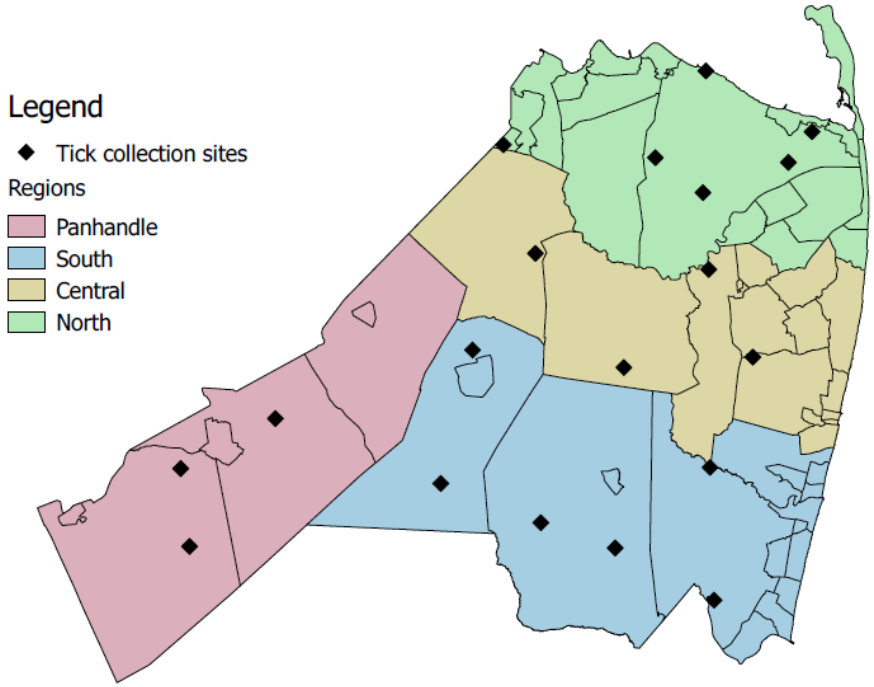

Biggest risk is May-August due to nymphs (dotted lines).
*Nymphs are smaller, easier to miss during tick check!*

BUT adult deer ticks are active in fall and winter!
So tick season is really year round...

Data from Jordan & Egizi (2019) PLoS One
Publication available free online: https://doi.org/10.1371/journal.pone.0211778

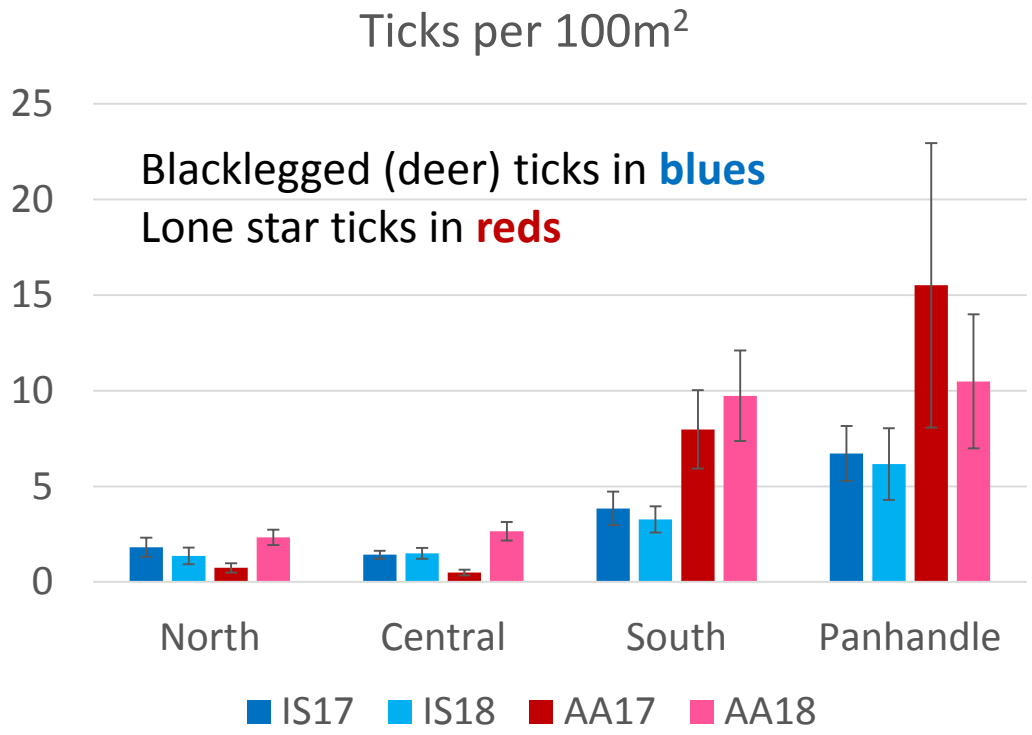
# Active surveillance program

- 19 sites surveyed annually (2017-present)
- Broken down into 4 regions
- Active surveillance means going out to the sites and collecting the ticks with a cloth dragged over vegetation.




Field collected ticks are tested for associated pathogens at the Tick-borne Disease Laboratory

# Tick density by year (2017-2018)



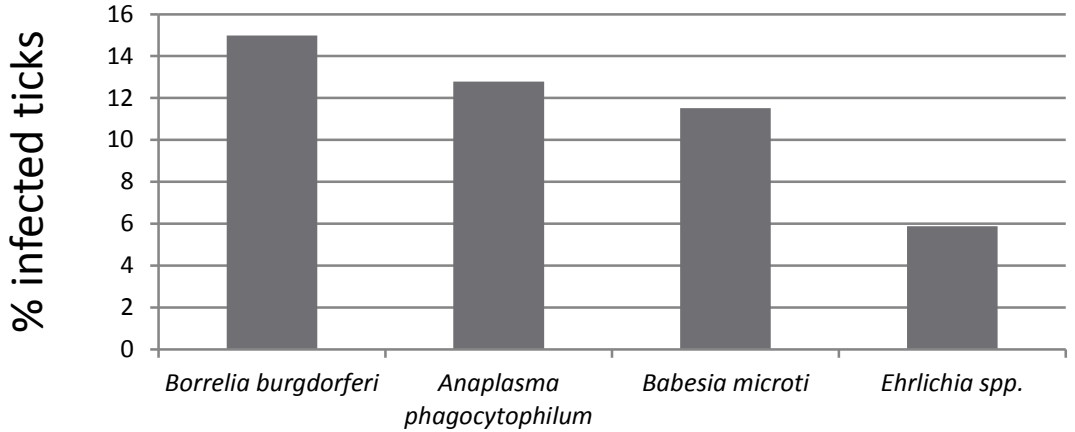

Conclusions:

-Lone stars more abundant than blacklegged ticks

-Higher tick populations in South & Panhandle regions

# Tick infection rates

Ticks collected from Active surveillance sites in Monmouth County
County-wide prevalence, 2017




**(Lyme disease)** **(Anaplasmosis)** **(Babesiosis)** **(Ehrlichiosis)**

*These rates are from **nymphal** ticks. Adult tick rates are expected to be higher.*

While Lyme disease remains the highest diagnosed vector-borne disease, local ticks carry other pathogens, at similar rates.

# Personal prevention works ....if you use it!

In a New Jersey study, while 84% of respondents could name at least one precaution against Lyme disease, only 43% reported taking ANY precaution!

Hallman et al. 1999 Environ. Behav. 27: 437-453.

# Protecting yourself

- Before you go out: apply repellents, wear light colored clothing. Can treat your clothing with Permethrin (kills ticks on contact) or buy clothing that is pre-treated at outdoor stores

- While outdoors: stay in center of trails, avoid brushing against vegetation or walking through tall grass

- After returning home: remove clothes and dry on high heat to kill ticks, shower promptly, do a tick check

**Recommended repellents**:
-DEET
-Picaridin
-Oil of lemon eucalyptus (PMD)

www.epa.gov/insect-repellents

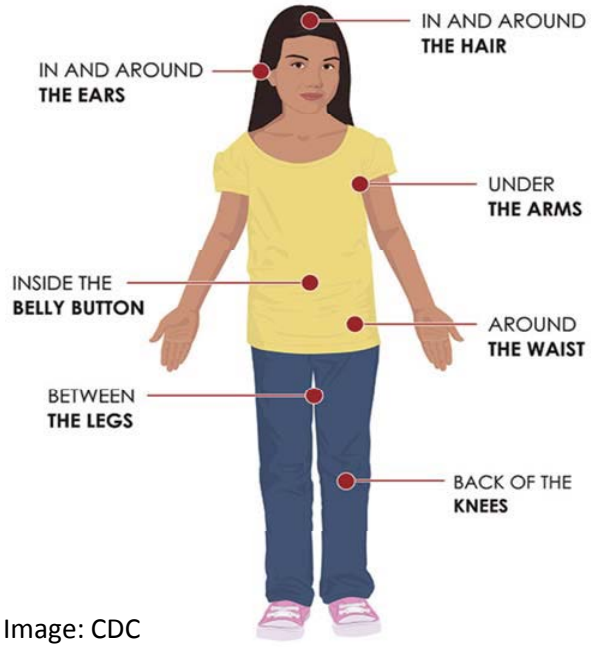


Image: CDC

*If you are often in tick habitat (e.g. your backyard), make a tick check part of your daily routine!*

# Protecting your pet

- Pets can get tick-borne diseases too! Symptoms similar to people (Fever, aches and pains, etc.)
- They can also bring ticks into contact with your family, so it's important to protect them for your own health as well.
- Use tick preventatives recommended by your veterinarian
- Perform tick checks on your animals
  - Places ticks hide: inside the ears and between the toes

Images: Darwinanimaldoctors.org

- There is a Lyme vaccine for dogs (ask your vet about it)

# Tick proofing your yard

- Reduce tick habitat
  - Keep grass short
  - Remove brush and fallen leaves
  - Trim vegetation
- Reduce host habitat
  - Rodents: Move woodpiles and birdfeeders to edge of property
  - Deer: deer resistant plants, exclusion fence
- Chemical treatment
  - Barrier spray

For a barrier spray, you only treat the "risky" parts, e.g. where lawn meets woods, instead of the whole lawn.

# Hiring a pest control company

1. Is the company licensed? NJ state law requires them to have a Pesticide Applicator Business license. Individual employees should have a Commercial Applicator license for the pest in question. Check with the NJ Pesticide Control Program (DEP): 609-984-6507
2. Is the company knowledgeable? Do they conduct surveillance first to ascertain the problem, know the biology of the pest, explain their plan of treatment?
3. Ask them for the label of the products they plan to use (they are required to provide) and research the active ingredients for safety and efficacy. A great resource is the National Pesticide Information Center hotline (1-800-858-7378; http://npic.orst.edu)
4. Does the company have a good track record? Look up reviews of the company online or talk to friends and neighbors.

# Natural products

Photo: K. Stafford

- Fungal acaricides- *Metarhizium* (Met52)
- Some essential oils (rosemary, thyme, geranium etc) kill ticks, but for a shorter amount of time than synthetic and more $$$
  - Purity/ concentration can vary
  - Non-target effects still an issue
- New plant extracts, like Nootkatone (from alaska yellow cedar and grapefruit skins) have been tested and show great promise- but not commercially available yet

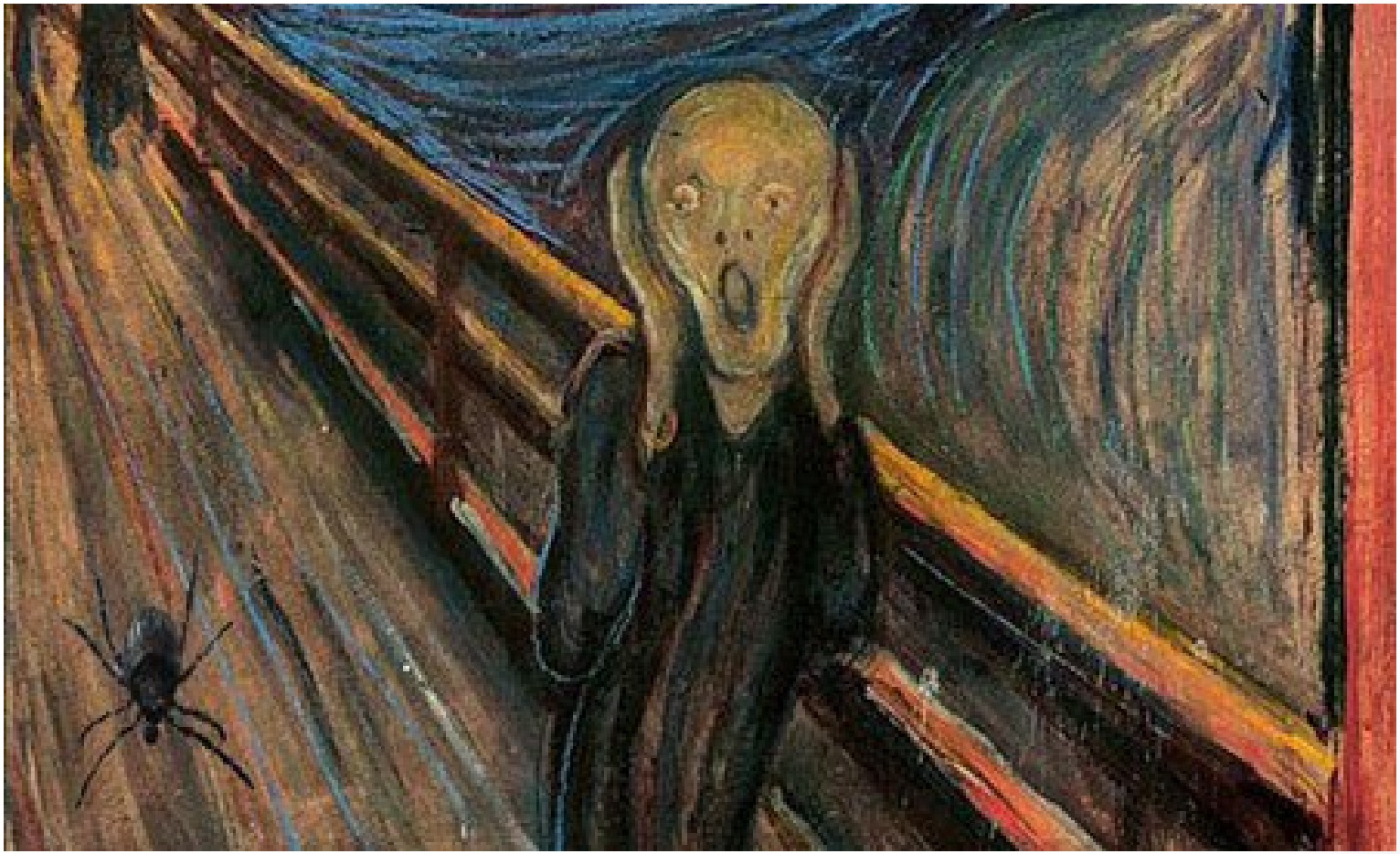
# Deer and ticks: it's complicated

- Deer DO NOT carry the Lyme disease bacterium, but they do help tick populations to proliferate: blacklegged ticks and lone star ticks mate on deer.
- There is evidence tick populations can be reduced in the long term if VERY LOW deer densities are achieved and maintained (<8/sq mi). Whether this is feasible or affordable is another question.
- In the short term, reducing deer could actually increase Lyme disease risk, via more ticks feeding on rodents (and picking up the bacterium) or more questing ticks looking for large hosts like humans....

Reference:
Kugeler KJ et al. 2016. Will culling white-tailed deer prevent Lyme disease? *Zoonoses Public Health* 63(5): 337-45.
https://www.ncbi.nlm.nih.gov/pmc/articles/pmid/26684932/

# Resources

- https://www.cdc.gov/lyme/toolkit/index.html
  - Educational materials- download or order from CDC for free
- CT Ag Station's Tick Management Handbook
  - Comprehensive & up to date manual on tick control
  - Link: https://portal.ct.gov/-/media/CAES/DOCUMENTS/Publications/Bulletins/b1010pdf.pdf
- TickEncounter.org
  - Tick ID resources & prevention info
  - Fact sheet on permethrin: https://tickencounter.org/prevention/permethrin
- www.spraysafeplaysafe.org
  - Short films about backyard tick control and prevention
- www.epa.gov/insect-repellents
  - Repellent selection tool and information

# Questions?

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