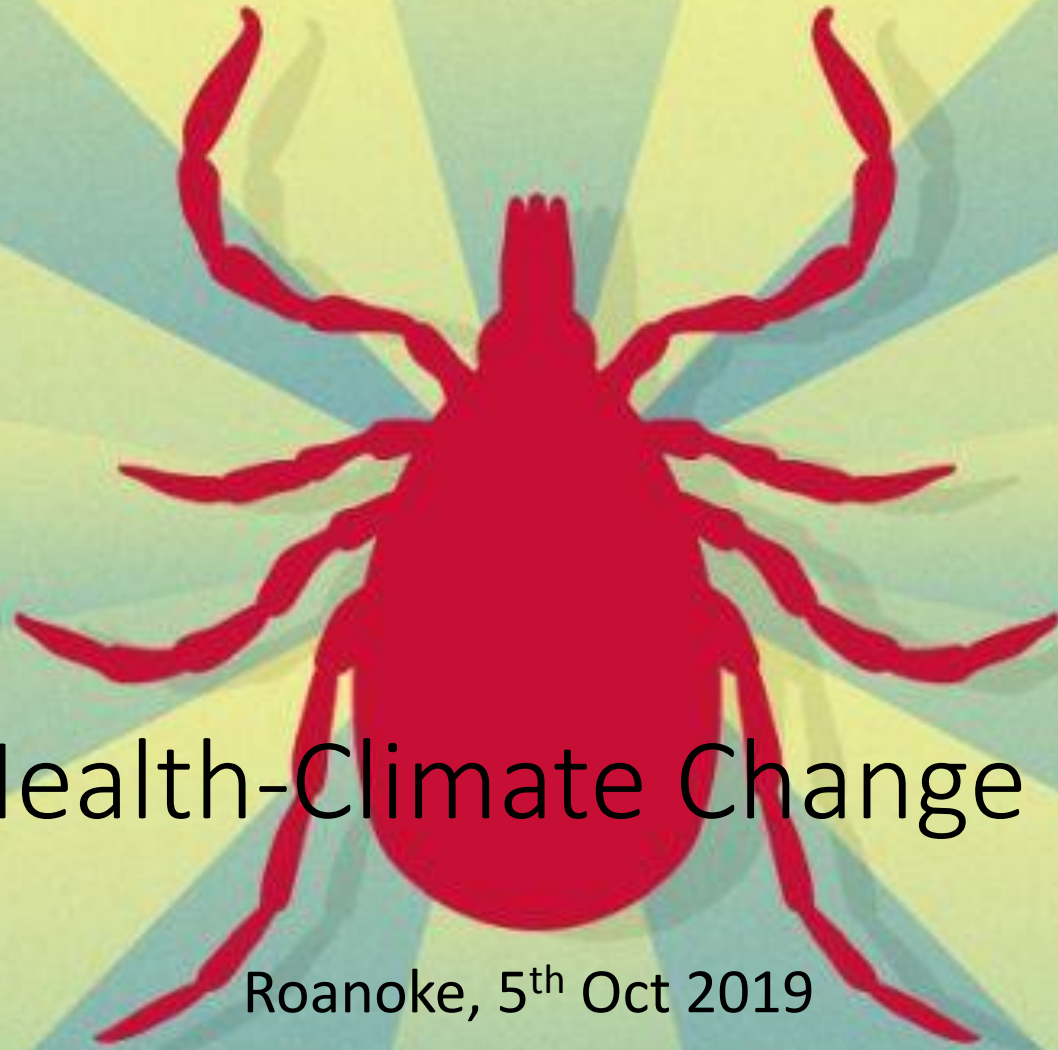


# The Changing Ecology of TICKS and their Public Health Impact



Human Health-Climate Change Conference

Roanoke, 5<sup>th</sup> Oct 2019

# Top 3 human-biting tick species in the eastern U.S.A



Blacklegged  
(deer) tick



Lone star tick



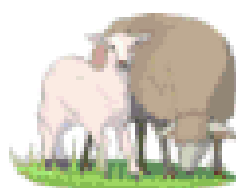
American dog tick



# THE LIFE CYCLE OF A TICK



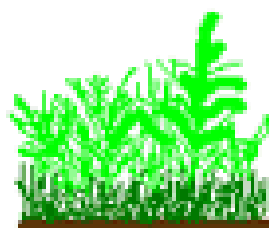
ANIMAL  
HOST 1



ANIMAL  
HOST 2



ANIMAL  
HOST 3

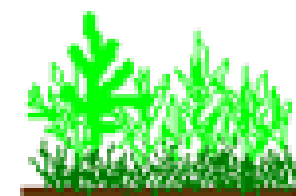


VEGETATION

BLOOD MEAL

BLOOD MEAL

BLOOD MEAL



VEGETATION

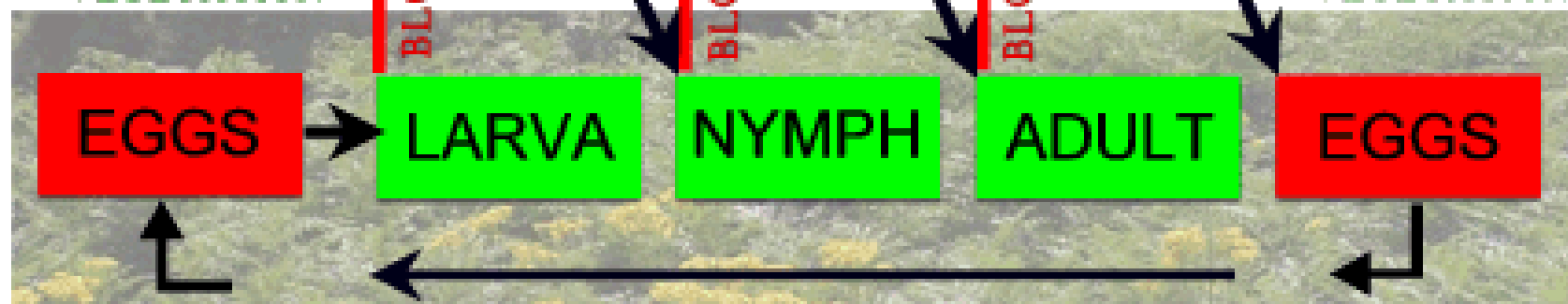
EGGS

LARVA

NYMPH

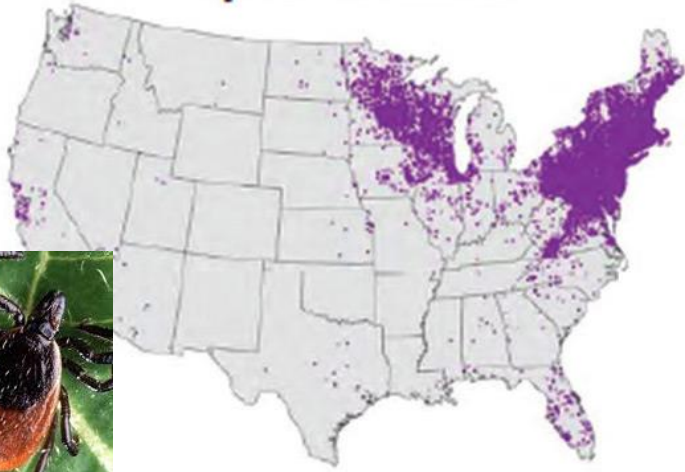
ADULT

EGGS





**Lyme disease**



**Anaplasmosis**



**Babesiosis**



**Ehrlichiosis**



**Rocky Mountain Spotted Fever**



**Tularemia**



Each dot represents a reported case in the county of residence

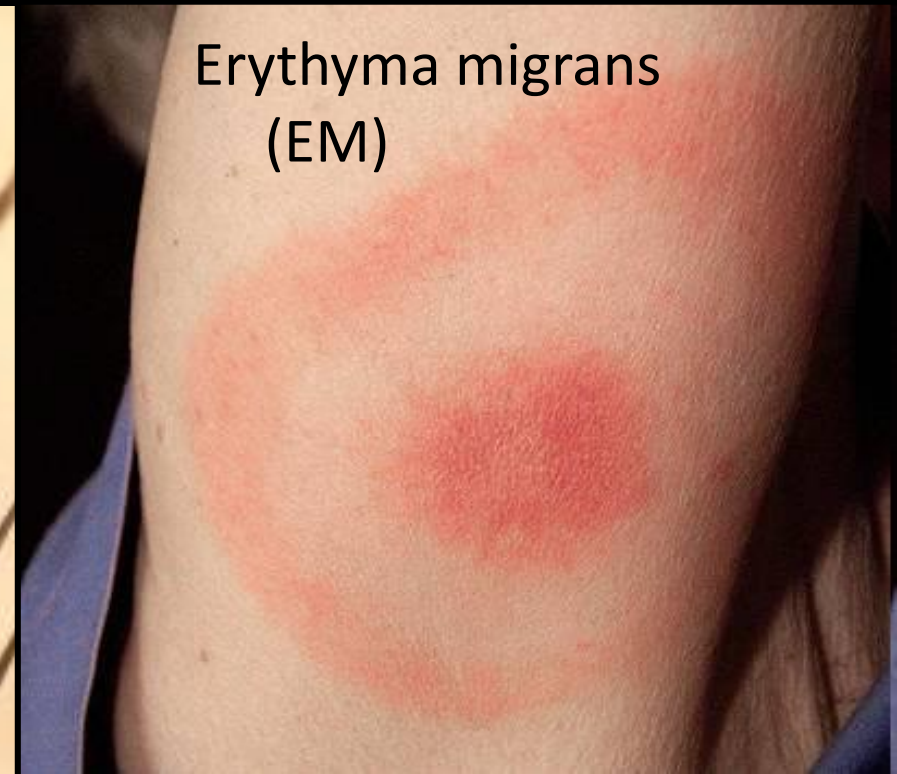
Blacklegged tick



*Borrelia burgdorferi*



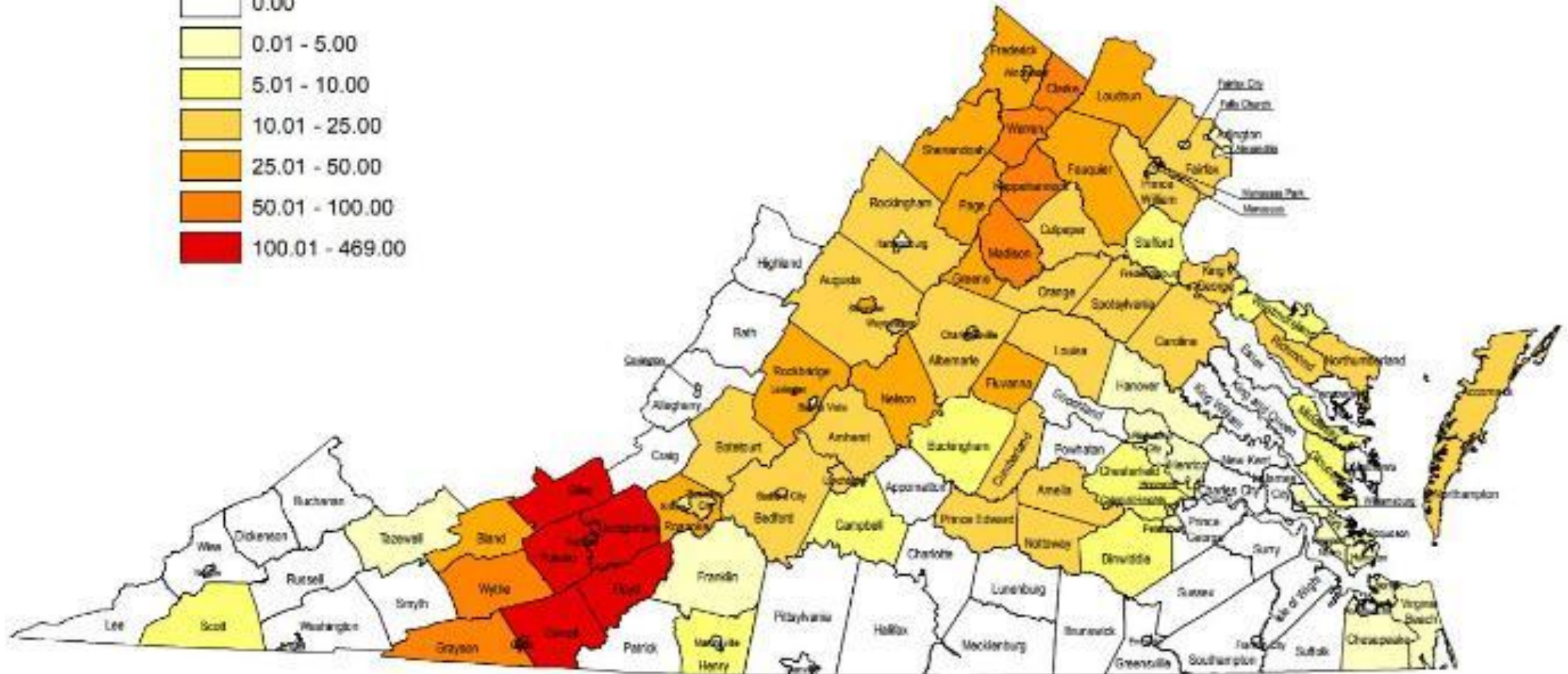
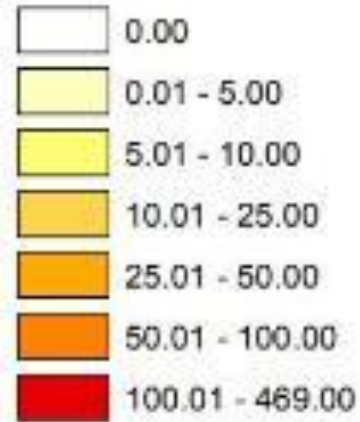
Erythema migrans  
(EM)





***“Warm weather and more people moving into tick habitats may contribute to the high number.”***

### 2016 Virginia Lyme Disease Cases per 100,000 Population



# Powassan virus - a flavivirus transmitted by Deer Tick

- Notifiable Arboviral disease
- Neuro-invasive, encephalitis
- First detected in Canada,
- Annual cases in NE & Midwest
- Rare, but 10% fatality rate
- Long-term sequelae in 50% survivors
- Will it shift to Virginia?



Powassan virus neuroinvasive disease cases reported by state, 2006-2015



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



# Ticks can be infected by more than 1 pathogen!

## Co-infection

*Ixodes scapularis*

*Anaplasma  
phagocytophilum*

*Babesia  
microti*

Powassan  
virus

*Borrelia  
spp.*

Q: **Prevalence of co-infection** in wild ticks?

Q: How does infection with Pathogen A & B  
**influence transmission** of each?



Drag-sweeping as a field collection method



Male & (engorged) female Nymphal ticks  
at a Tennessee deer check station



# TICKS ARE MOVING

## TICK-BORNE DISEASE IS ON THE INCREASE

The [rise of the blacklegged tick population](#), a main culprit of the spread of Lyme disease, can be correlated with [climate change](#) among a number of other factors, Pennsylvania has one of the highest Lyme disease incidence rates in the country, according to the CDC. [Warmer weather and milder winters](#) mean that ticks become active earlier and survive longer, [allowing more time for the disease to spread](#).

Two new disease-carrying tick types arrive in Connecticut

- **Asian long-horned ticks** are a non-native invasive species that turned up in New Jersey in 2017.
- A warming climate could be speeding **the lone star tick** north from its habitat in the southeastern US.

Ticks used to have spring and autumn peaks (so-called "rises") but in recent years, **due to the changing climate, they have become active all summer too.**

The exact reason for the increase in tick-borne illnesses??  
**A combination of potential ecological factors** — climate change, human behavior, migration of tick-bearing animals, weather patterns and mutations of the diseases themselves.

**As the climate warms, it pushes the timing of tick nymphs and larvae forward**, potentially changing the interactions they have with their hosts,". "October is a key month because the difference between a cold fall and a warmer fall can have a profound effect on when the ticks interact with their hosts."  
Oregon State University

# New invasive ticks to the USA

ASIAN LONGHORNED TICK  
*Haemaphysalis longicornis*



Origin: China, Korea

Habitat: **Can be found in open fields!**

Grassy areas and meadows, nr woods

Hosts: Broad

First detected: 2017 NJ

Infests livestock - to point of anemia!

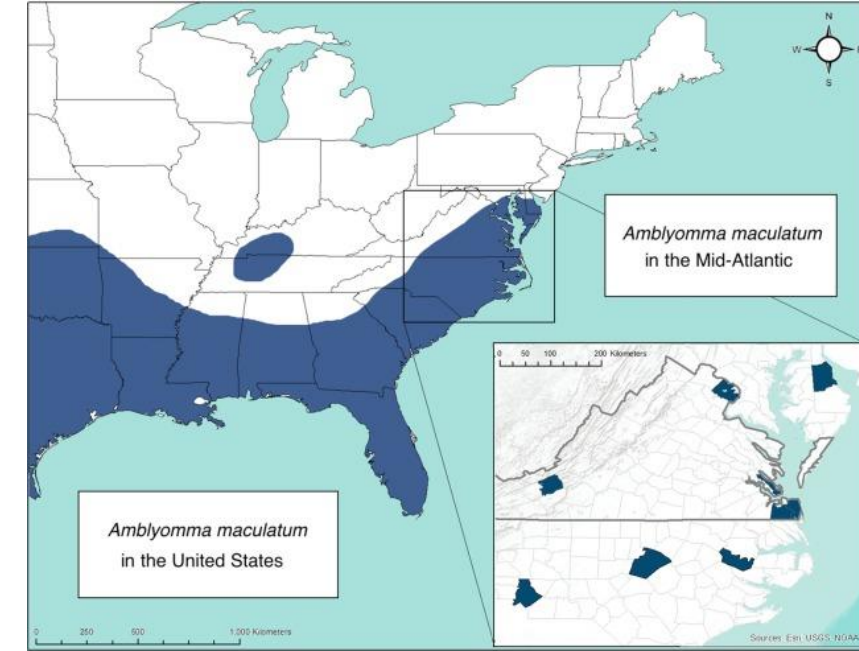
Vector for livestock pathogens - *Theileria*

Abroad it transmits **Powassan, SFTS**  
(severe fever with thrombocytopenia syndrome),  
**Anaplasma, Ehrlichia, Babesia** spp.

As yet, we don't know **human threat**

# *Amblyomma maculatum* (Gulf coast tick)

Range expanding into the mid-Atlantic region



Larva



Nymph



Adult Male

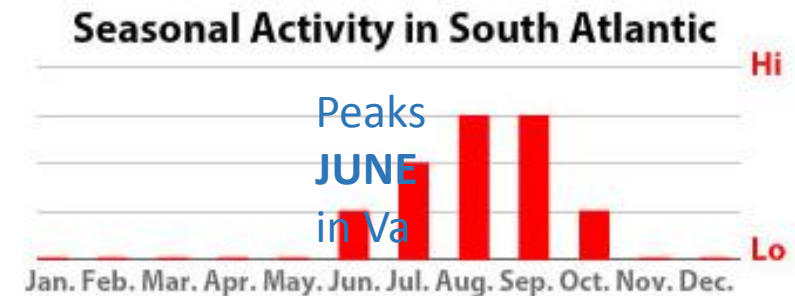


Adult Female

Survival & duration in each life stage is  
**dependent on environmental factors**  
– habitat, temperature and humidity

Habitat: Open mowed grassy habitat.

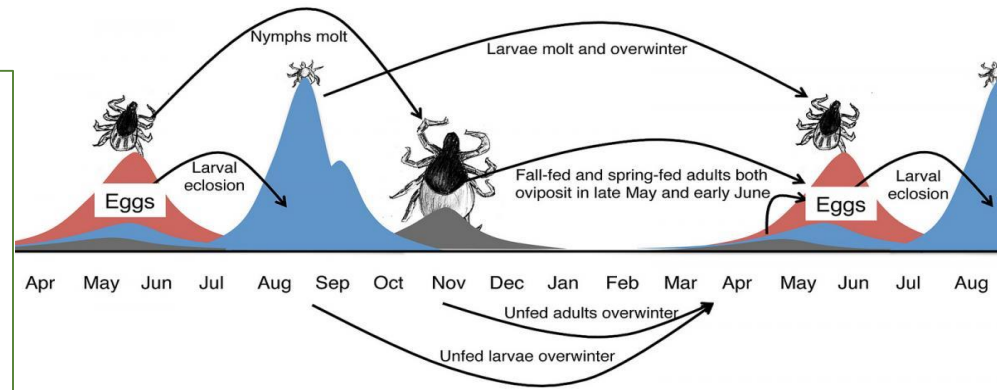
Vector for Spotted Fever Rickettsiosis  
(*Rickettsia parkeri* – bacteria)  
Escar-associated febrile illness





## Be Aware of SEASONALITY:

- Know the Peak seasons for different ticks
- Peak seasons to expect different diseases
- Determine what life stages the tick are at
- Region variation – even within VA  
(has the patient travelled?/exposed locally?)



Expect ticks all year round



## WHAT TO DO?

### ADVICE:

- Dress appropriately  
(Long pants, permethrin-coated clothing for outdoor activities)
- Avoid long grass areas
- Shower & tick checks
- Body checks – self & pets
- Remove any ticks promptly and carefully

Most LD transmission is from bite of a nymphal blacklegged tick

(Larvae aren't infected;  
adults are easier to see and remove)

### Be aware of tick-borne CO-INFECTIONS

Agents spread by ticks can be viral, bacterial or protozoan.

Treat accordingly