Blacklegged Ticks (*Ixodes scapularis*) and Tick-borne Disease in Onondaga County, NY

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Ticks in New York

- About **30 species** of ticks are found in NY
- **10 species** are known to bite humans
- **4 species** are medically relevant

- Blacklegged or deer tick
- American dog tick
- Lone Star tick
- Woodchuck tick

Slide Courtesy of NYSDOH
Hosts

- Some generalists, some specialists
- Ticks infest every class of terrestrial vertebrates
  - Mammals
  - Birds
  - Reptiles
- Mammals and birds most relevant in our neighborhood
Unfortunately that includes…

Companion Animals

Humans
Primary Host Species in New York

• White-footed mouse
  – Primary reservoir host

• White-tailed deer
  – Primary reproductive host
  – Dispersal mechanism

• Migratory Birds
  – Ex. American Robin
  – Ground-feeding behavior allows host acquisition
  – Long-distance dispersal mechanism
Feeding Progression

- Larvae take 3-5 days to fully engorge
- Nymphs take 3-5 days to fully engorge
- Adults take 5-7 days to fully engorge

Nymph

Adult Female
Life Cycle

- Three blood-feeding life stages
- One blood meal/stage
Seasonal Activity

Seasonal activity of *I. scapularis* adults, nymphs, and larvae.

- **Adults:** Oct – Nov & Apr – May
- **Nymphs:** Jun – Jul
- **Larvae:** Aug – Sept

Connecticut Agricultural Station
Blacklegged Ticks & Disease in NY

- Three blood-feeding life stages
- Nymphs and adults most relevant to disease
- Capable of transmitting:
  - Lyme Disease
  - Anaplasmosis
  - Human Babesiosis
  - Borrelia miyamotoi
  - Powassan Virus
Lyme Disease

- *Borrelia burgdorferi* (Bacterium)
- Inflammatory disease characterized by a bullseye shaped rash (erythema migrans), headache, fever, chills, and fatigue
- May be followed by arthritic, neurological, and cardiac disorders if left untreated
- Treatment: Doxycycline
Borrelia miyamotoi

- Related to bacteria that cause tick-borne relapsing fever
- Symptoms: similar to Lyme disease (fever, headache, joint pain, etc.), but usually **no rash**
- Treatment: Doxycycline
Anaplasmosis

- Caused by *Anaplasma phagocytophilum*
- Bacterium
- Parasite of white blood cells
- Symptoms: fever, headache, absence of skin rash, white-blood cell reduction, platelet deficiency and liver damage
- Treatment: Doxycycline
Human Babesiosis

• Caused by *Babesia microti*
• Infects red blood cells
• Many without symptoms, but some nonspecific symptoms including: fever, chills, sweats, headache, body aches, loss of appetite, nausea, or fatigue
• Treatment:
  – Atovaquone & azithromycin
  – Clindamycin & quinine
Powassan Virus

- Flavivirus
- Causes tick-borne encephalitis
- 10% case fatality rate
- Permanent and severe neurological effects in \( \approx 50\% \) of survivors (partial paralysis, muscle atrophy, chronic severe headaches, and memory problems)
- Treatment: Currently no vaccines or medications to treat or prevent POW virus infection exist

Telford et al. 2015
# Estimated Transmission Times

<table>
<thead>
<tr>
<th>Disease</th>
<th>Disease Causative Agent</th>
<th>Estimated Transmission Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyme Disease¹</td>
<td><em>Borrelia burgdorferi</em></td>
<td>36-48 hrs</td>
</tr>
<tr>
<td>Anaplasmosis²</td>
<td><em>Anaplasma phagocytophilum</em></td>
<td>12-24 hrs</td>
</tr>
<tr>
<td>Human Babesiosis</td>
<td><em>Babesia microti</em></td>
<td>24-36 hrs</td>
</tr>
<tr>
<td>Powassan Virus³</td>
<td><em>Flaviviridae sp.</em></td>
<td>15 min</td>
</tr>
</tbody>
</table>

¹ Piesman et al. 1987  
² Katavolos et al. 1998  
³ Ebel & Kramer 2004
Why do we care now?
Reported Cases of Lyme Disease -- United States, 2001

1 dot placed randomly within county of residence for each reported case
Reported Cases of Lyme Disease -- United States, 2002

1 dot placed randomly within county of residence for each reported case
Reported Cases of Lyme Disease -- United States, 2003

1 dot placed randomly within county of residence for each reported case
Reported Cases of Lyme Disease -- United States, 2004

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

CDC 2015
Reported Cases of Lyme Disease -- United States, 2006

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

CDC 2015
Reported Cases of Lyme Disease -- United States, 2008

1 dot placed randomly within county of residence for each confirmed case
Reported Cases of Lyme Disease -- United States, 2009

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

CDC 2015
Reported Cases of Lyme Disease -- United States, 2010

1 dot placed randomly within county of residence for each confirmed case.
Reported Cases of Lyme Disease -- United States, 2011

1 dot placed randomly within county of residence for each confirmed case
Reported Cases of Lyme Disease -- United States, 2012

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

CDC 2015
Reported Cases of Lyme Disease -- United States, 2013

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

CDC 2015
Research in Onondaga County

- Research at SUNY ESF investigating blacklegged tick distribution and tick-borne disease prevalence in Onondaga County specifically
- Twelve sites selected throughout Onondaga
- Wooded and edge habitat sampled for host-seeking ticks
Research in Onondaga County

• Ticks are identified to species and sorted based on a variety of attributes (site, habitat, etc.)
• Subset from each site is tested for disease causative agents at NYSDOH facilities in Albany, NY
• Tick densities and disease prevalence can then be superimposed on the landscape
Disease Prevalence: Nymphs

- Onondaga Disease Status:
  - Lyme Disease = Present
  - Anaplasmosis = Present
  - Babesiosis = Absent
  - Powassan/DTV = Absent

- Coinfection…?
  - Yes, but very rare

- Lyme Disease
  - Average: 17.9 %
  - Range: 0 – 31.4 %

- Anaplasmosis
  - Average: 2.1 %
  - Range: 0 – 4%
Nymph Density

The graph shows the mean number of nymphs per 100 m² across various sites labeled SYR 1 to SYR 6 and CNTY 1 to CNTY 6. The sites are divided into two categories: Wooded (black bars) and Edge (gray bars). The y-axis represents the mean number of nymphs, while the x-axis lists the sites. The error bars indicate the variability in the data.
Adult Density

![Bar chart showing mean adult density per site (Syr 1 to Syr 6 and Cnty 1 to Cnty 6). The chart compares wooded and edge sites, with bars indicating variability in density across sites.](image)
Preliminary Conclusions

• Ticks & tick-borne disease are present throughout Onondaga County
  – Over 99% of tick samples were blacklegged ticks
  – Tick density varied from site to site, but every site had ticks
  – Ten of the thirteen sites sampled had nymphs with Lyme disease causative agent
  – Twelve of the thirteen sites sampled had adults with Lyme disease causative agent

• Some habitats may represent a greater risk of exposure than others based on the time of year (summer vs. fall)
  – Leaf litter and debris in wooded habitats, and tall vegetation along edge habitats, make these areas humid environments where ticks can thrive
Integrated Tick Management

- Personal Protective Measures
- Landscape Manipulation
- Landscape Acaricide Application
- Host Targeted Vaccinations
- Deer Sterilization or Culling
Personal Protective Measures

- Pants tucked into socks
- Shirt tucked into pants
- Insect repellants (DEET or permethrin)
  - Sprays
  - Infused clothing
- Periodic “tick checks”
- Showering within 2 hours of outdoor activity
Landscape Manipulation

- Creating landscapes inhospitable to ticks
  - Minimize shade
  - Hot and dry environments
- Minimize or move cavity forming structures
  - Wood piles
  - Stone walls
- Remove heavy leaf litter from recreational lawn space
- Bird feeders should only be operated during winter, if at all
  - Bird seed draws in small mammals, even if we don’t see them
Landscape Acaricide Application

• Acaricides can be applied directly to the landscape

• Pros
  – Seasonally effective

• Cons
  – Timing of application important
  – Pet health concerns (short term)
  – Annual/biannual application (costly)
  – May be ineffective if neighbors are not also applying acaricide
Host Targeted Acaricides

• Acaricides targeting most abundant host species
• Four-poster devices
  – Acaricide applied to deer
  – NOT legal in upstate NY
• Small mammal bait boxes
  – Acaricides applied to chipmunks and mice
• Medicated small mammal bait
Deer Sterilization

• Sterilization of deer population to control reproductive capacity of adult female ticks
• Pros
  – Nonlethal
  – Has other benefits in areas with high traffic (vehicle collision reduction)
• Cons
  – Has compounded the problem when incorrectly implemented
  – Costly
  – Ongoing implementation necessary
Deer Hunting or Culling

- Reduction or sterilization of deer population to control reproductive capacity of adult female ticks

**Pros**
- Has led to drastic reductions in tick populations in particular environments
- Has other benefits in areas with high traffic (vehicle collision reduction)
- Relatively cheap in comparison to other management options

**Cons**
- Lethal (Controversial)
- High level of reduction necessary to detect results (6-8 deer/mi$^2$)
- Recurring application of this strategy may be required
- Safety concerns in highly populated areas
Acknowledgements

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Literature Cited
