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



C. Raimond



J. Brunner



Hilton Pond Center



M. Silgailis

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



J. Brunner



M. O'Brien



Dr. Dawn

Feeding Progression

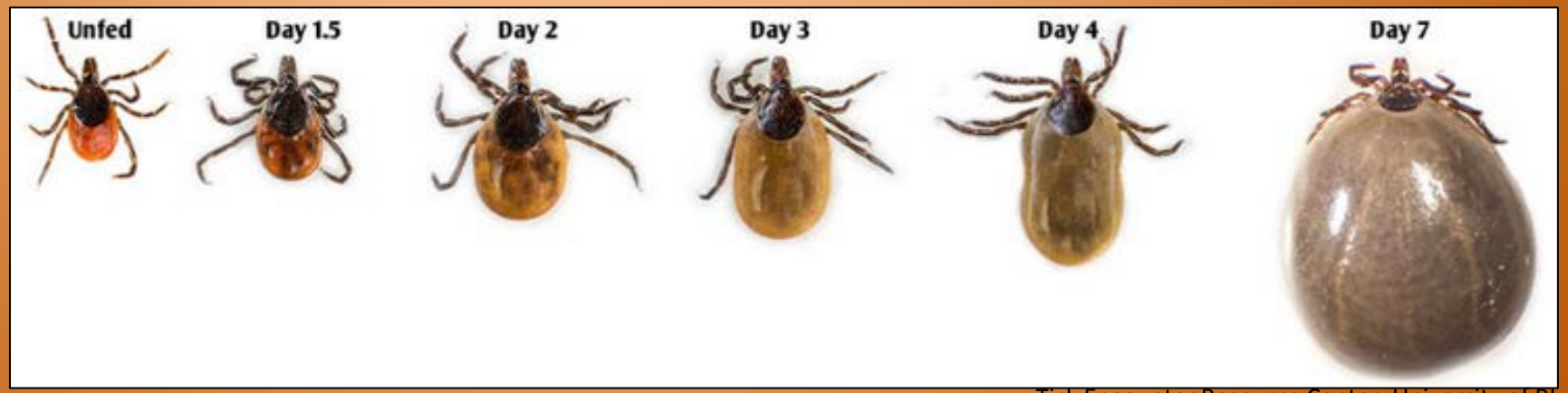
- Larvae take 3-5 days to fully engorge
- Nymphs take 3-5 days to fully engorge
- Adults take 5-7 days to fully engorge

Nymph



Tick Encounter Resource Center, University of RI

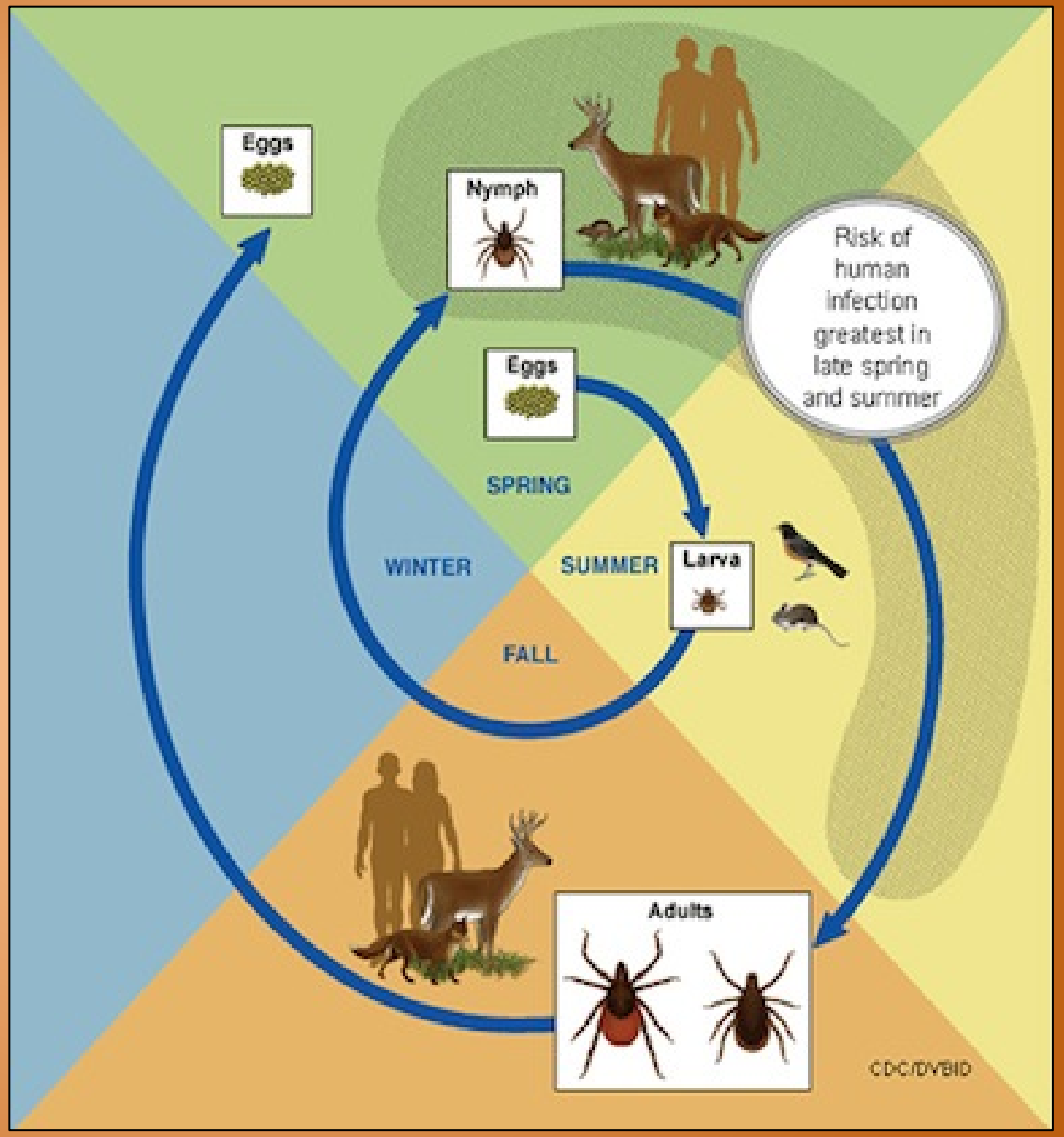
Adult Female



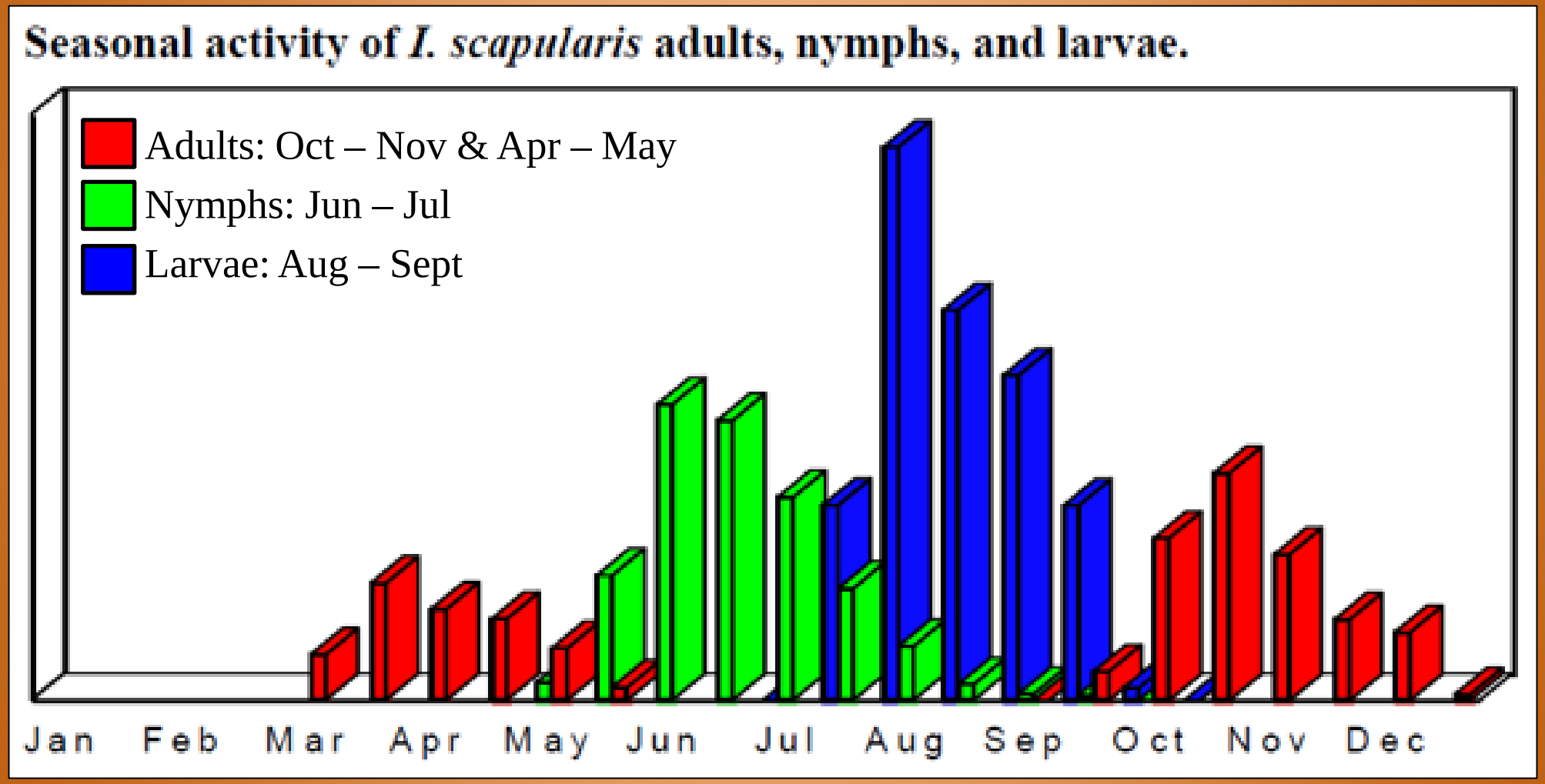
Tick Encounter Resource Center, University of RI

Life Cycle

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

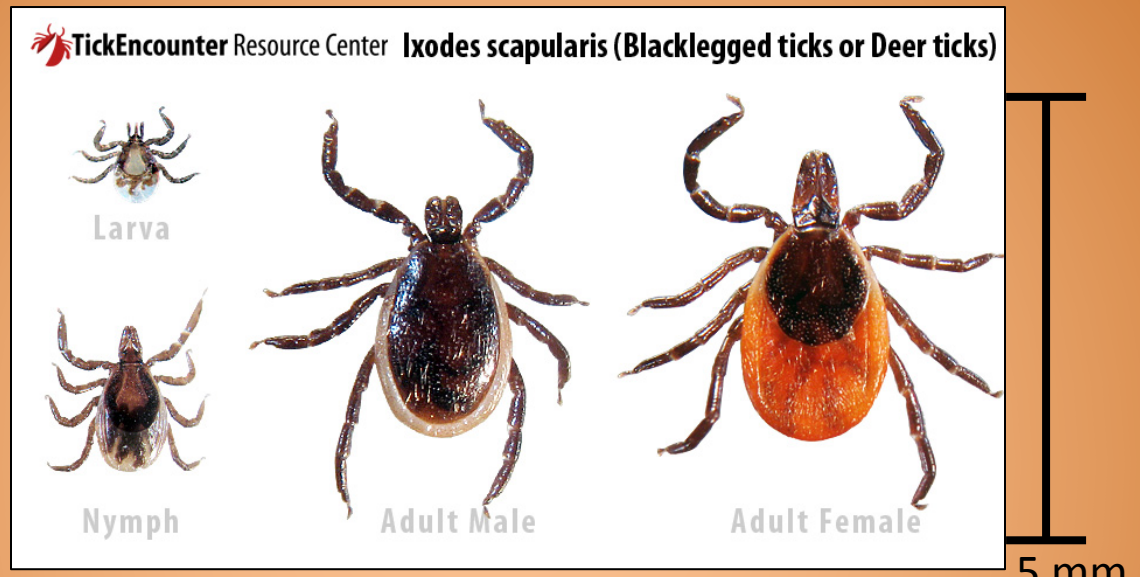


Seasonal Activity



Connecticut Agricultural Station

Blacklegged Ticks & Disease in NY

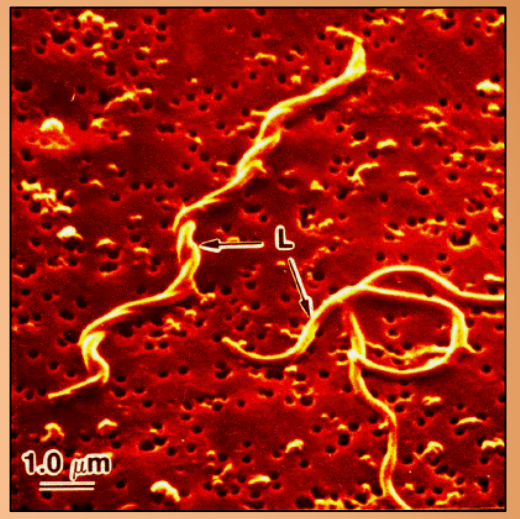


Tick Encounter Resource Center, University of RI

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

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



Wadsworth Center




eMedMD.com

Borrelia miyamotoi

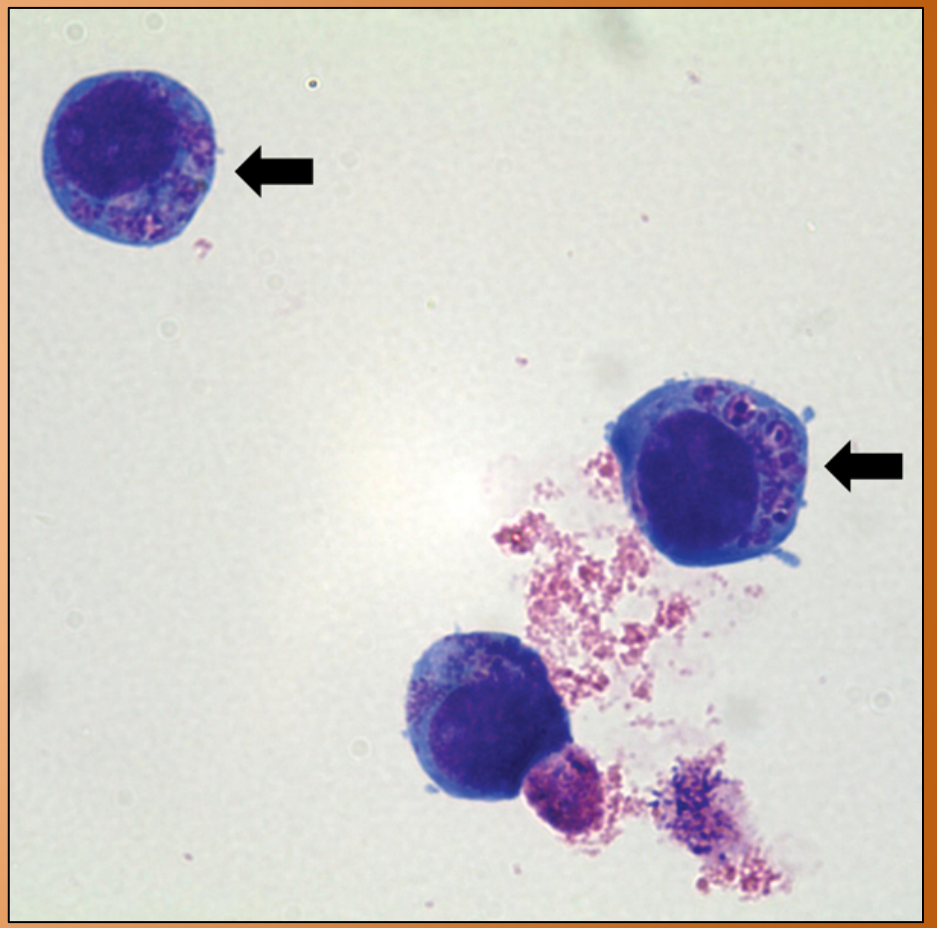
- Related to bacteria that cause tick-borne relapsing fever
- Symptoms: similar to Lyme disease (fever, headache, joint pain, etc.), but usually **no rash**
- Treatment: Doxycycline



Tick Encounter Resource Center, University of RI

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



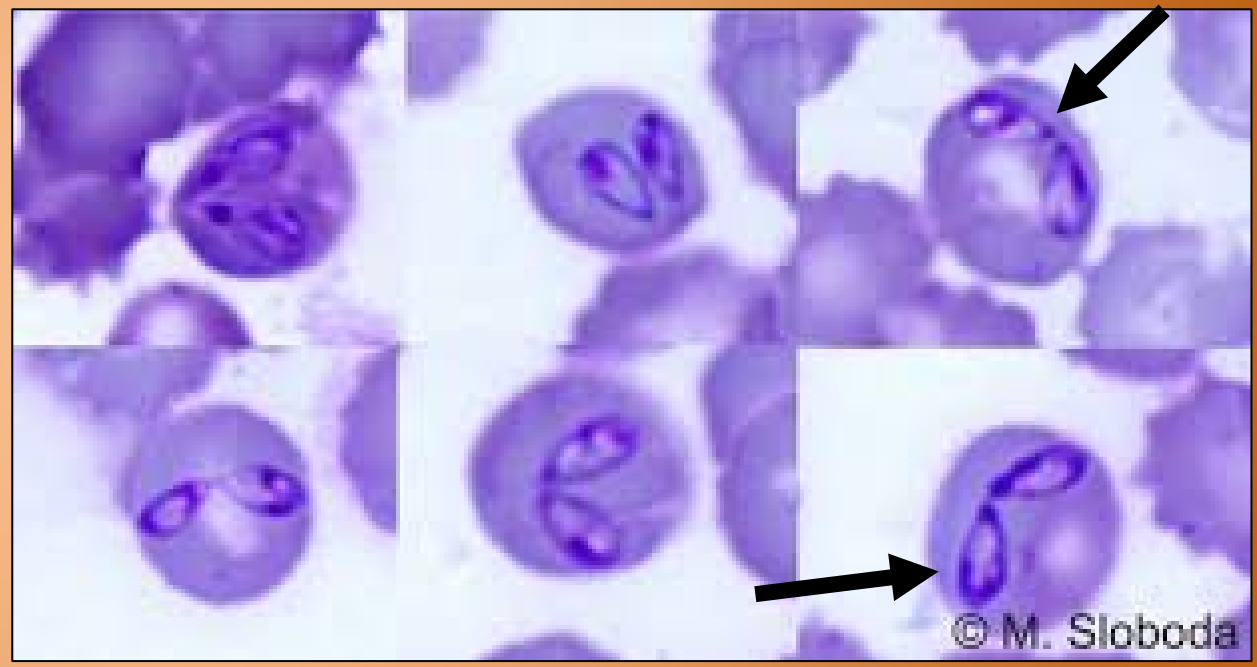
Kye-Hyung Kim et al. 2014

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

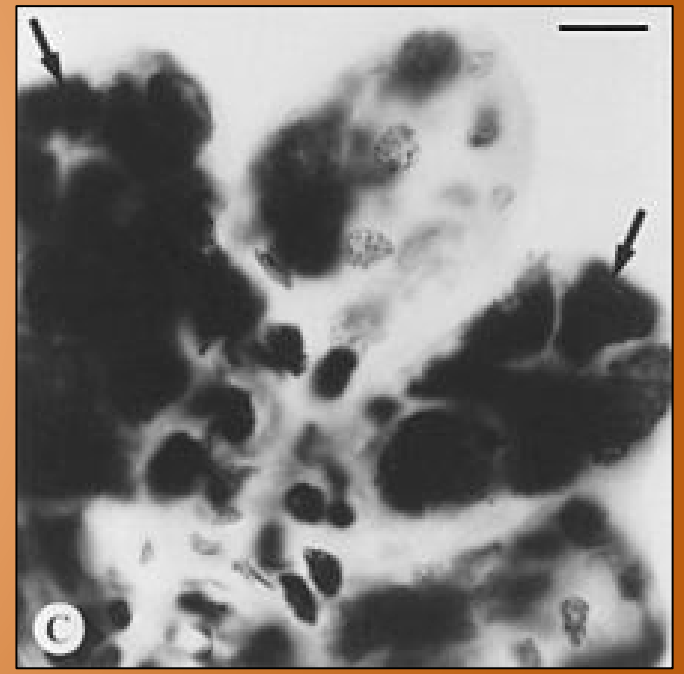
•Treatment:

  - Atovaquone & azithromycin
  - Clindamycin & quinine



Powassan Virus

- Flavivirus
- Causes tick-borne encephalitis
- 10% case fatality rate
- Permanent and severe neurological effects in ≈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 1: Diseases, Disease Agents, and Estimated Transmission Times Associated with Blacklegged Ticks

Disease	Disease Causative Agent	Estimated Transmission Time
Lyme Disease[1]	*Borrelia burgdorferi*	36-48 hrs
Anaplasmosis[2]	*Anaplasma phagocytophilum*	12-24 hrs
Human Babesiosis	*Babesia microti*	24-36 hrs
Powassan Virus[3]	*Flaviviridae sp.*	15 min

[1] Piesman et al. 1987

[2] Katavolos et al. 1998

[3] Ebel & Kramer 2004

Why do we care now?

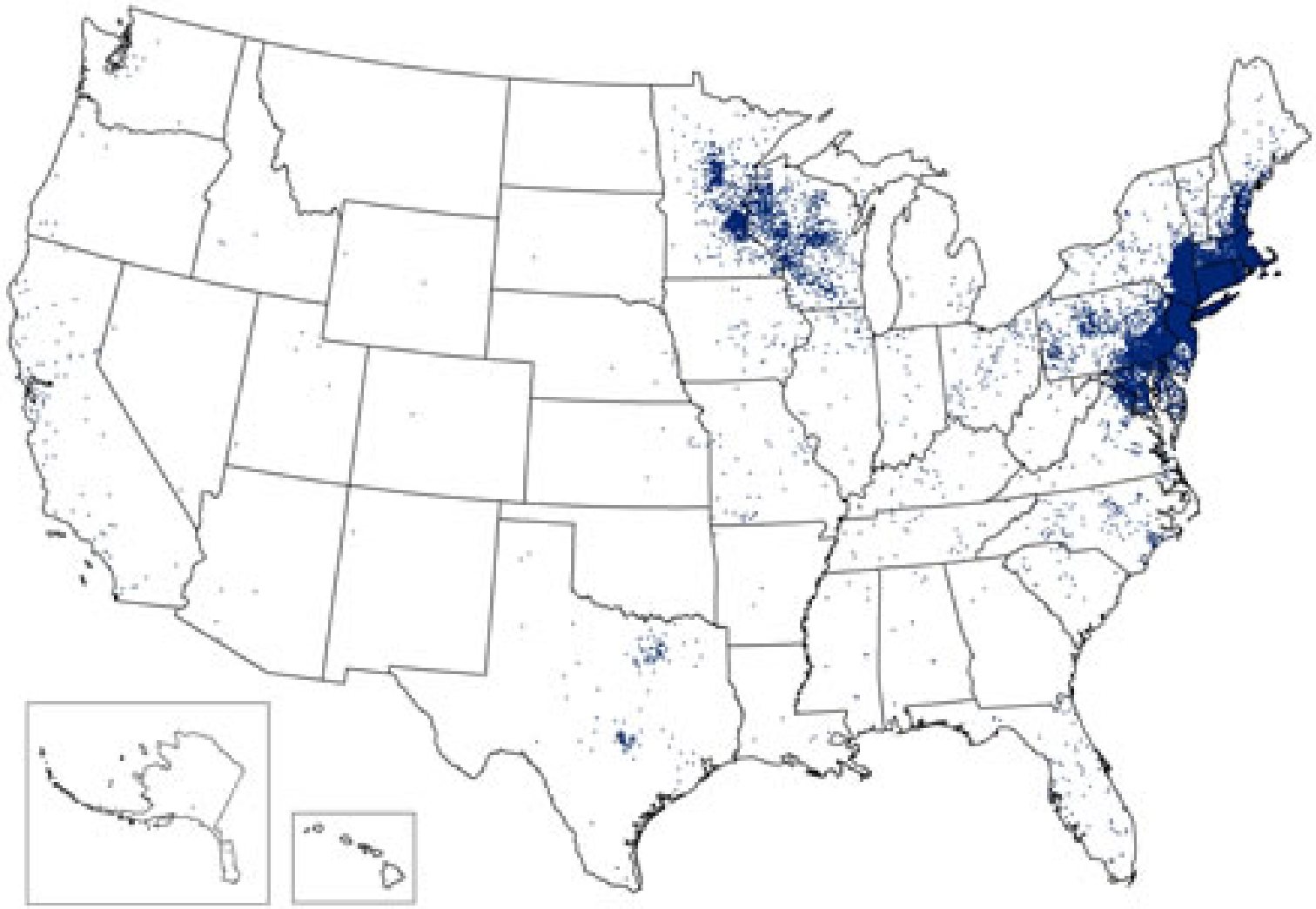
Reported Cases of Lyme Disease -- United States, 2001



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

CDC 2015

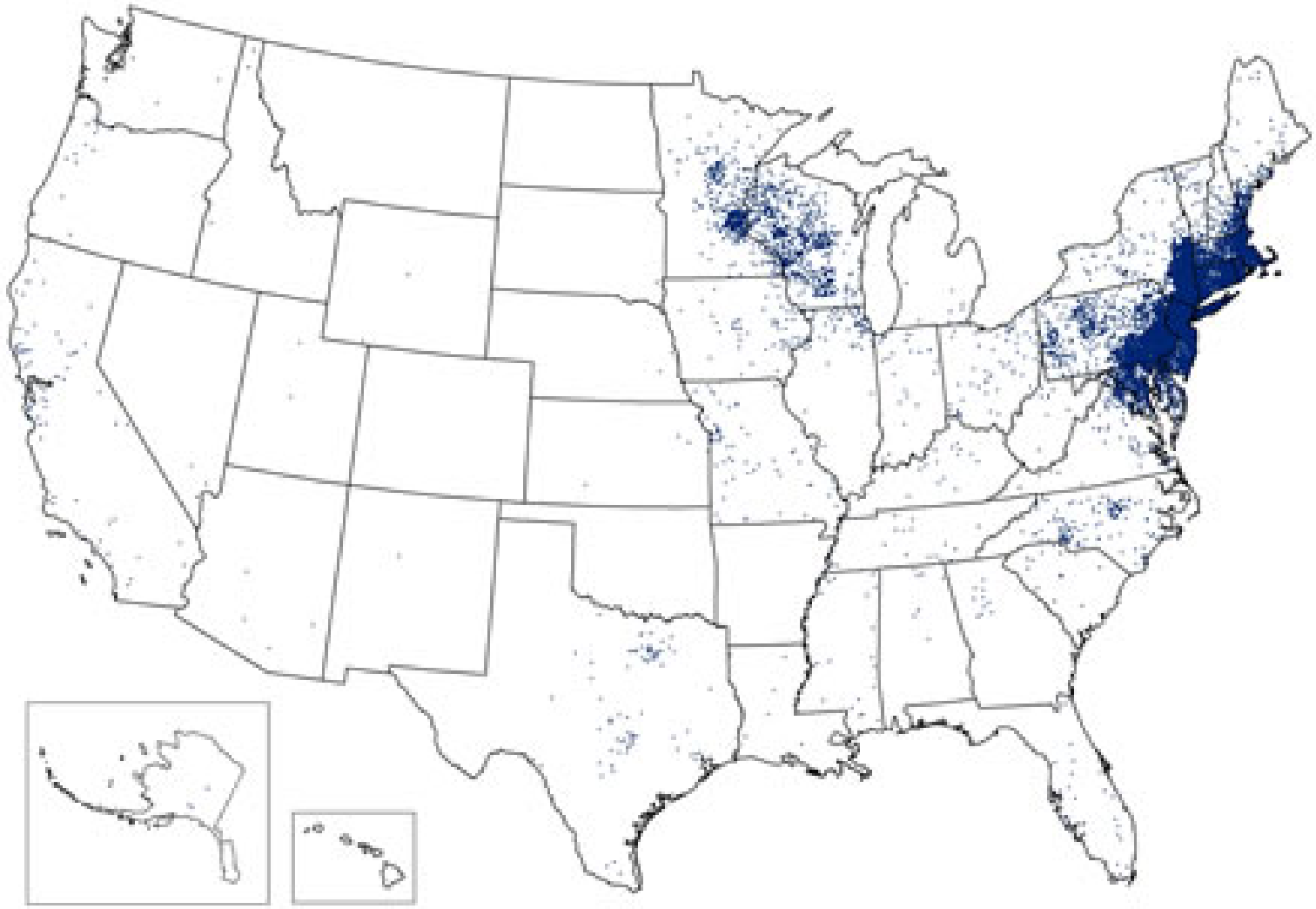
Reported Cases of Lyme Disease -- United States, 2002



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CDC 2015

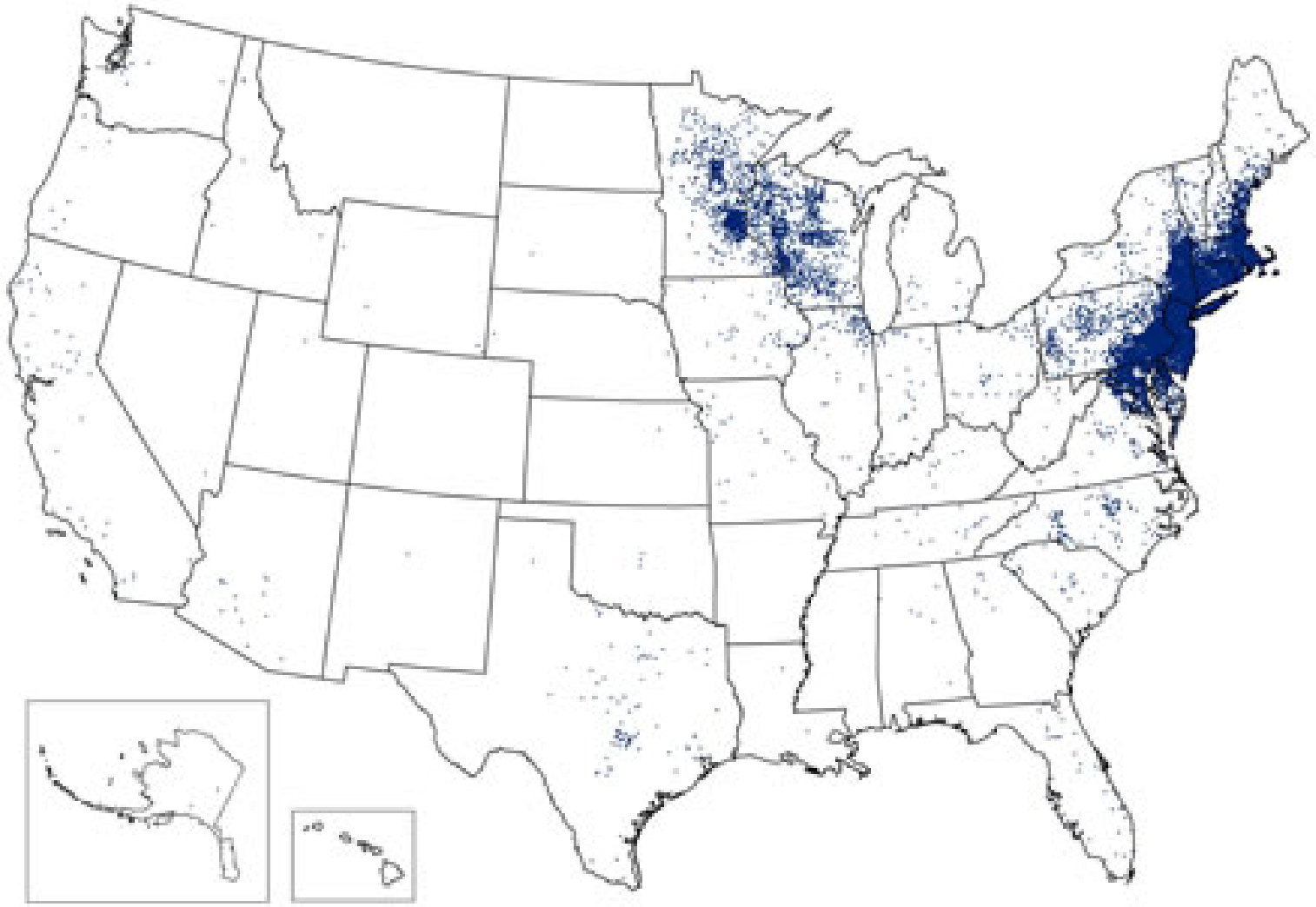
Reported Cases of Lyme Disease -- United States, 2003



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CDC 2015

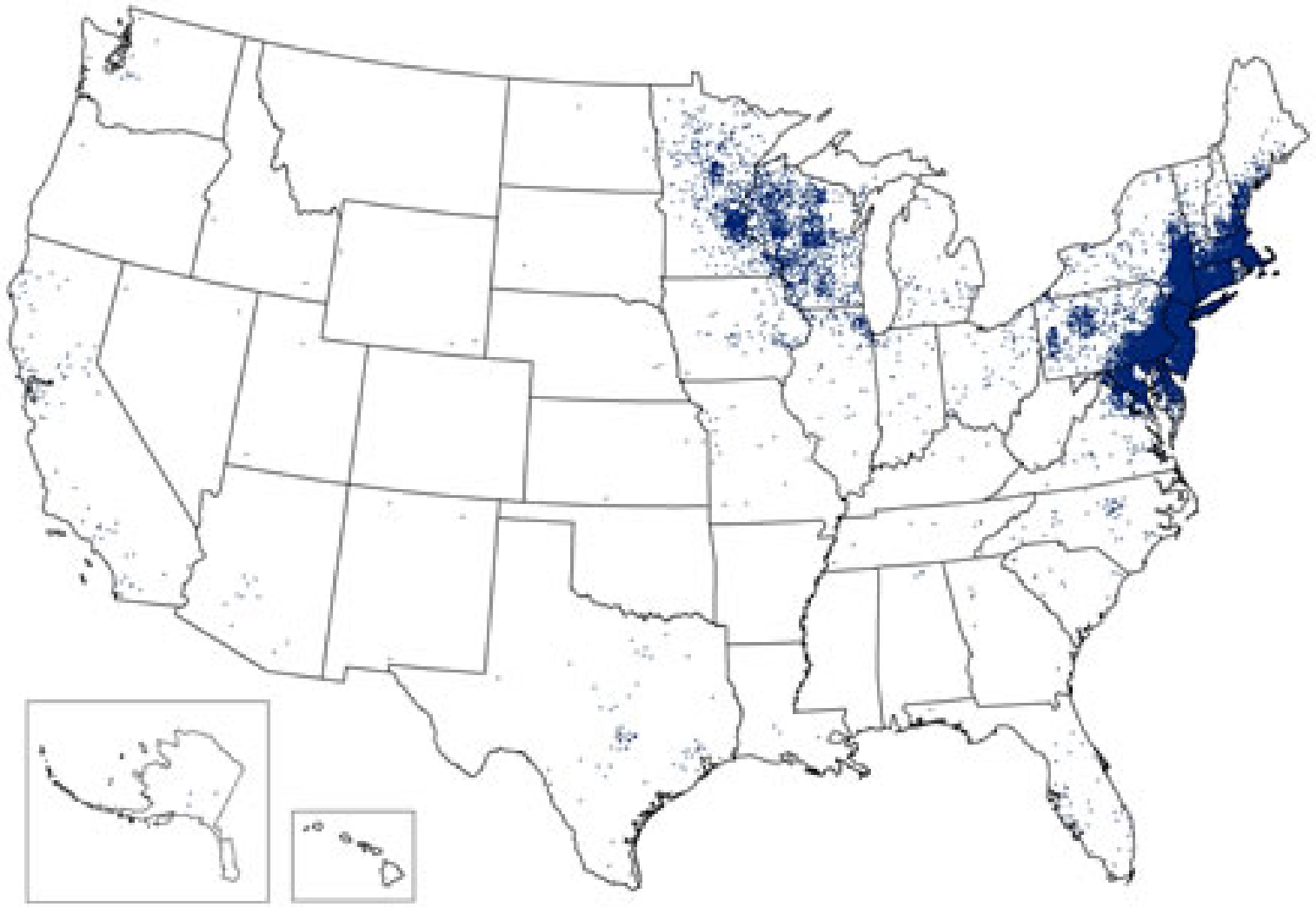
Reported Cases of Lyme Disease -- United States, 2004



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CDC 2015

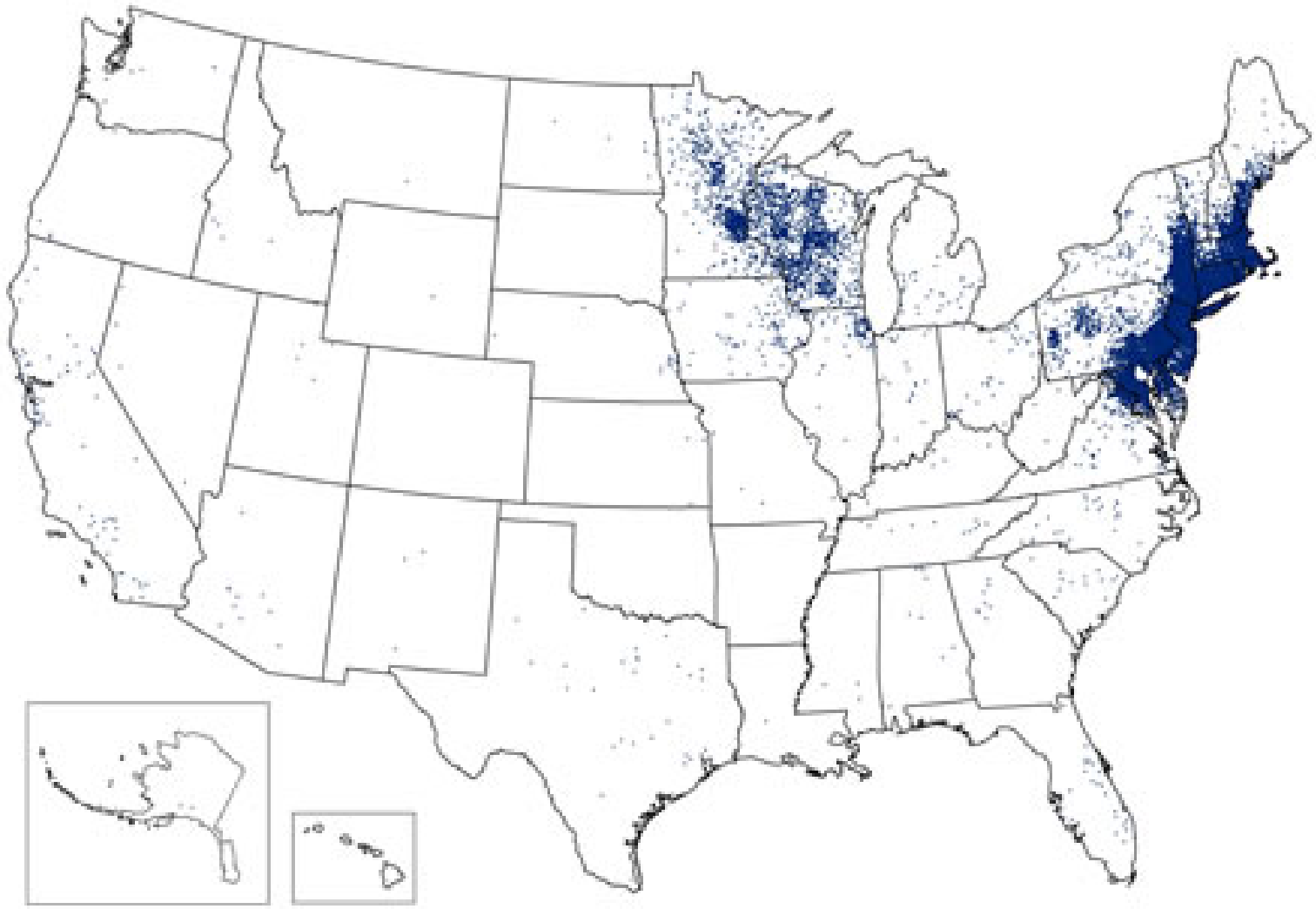
Reported Cases of Lyme Disease -- United States, 2005



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CDC 2015

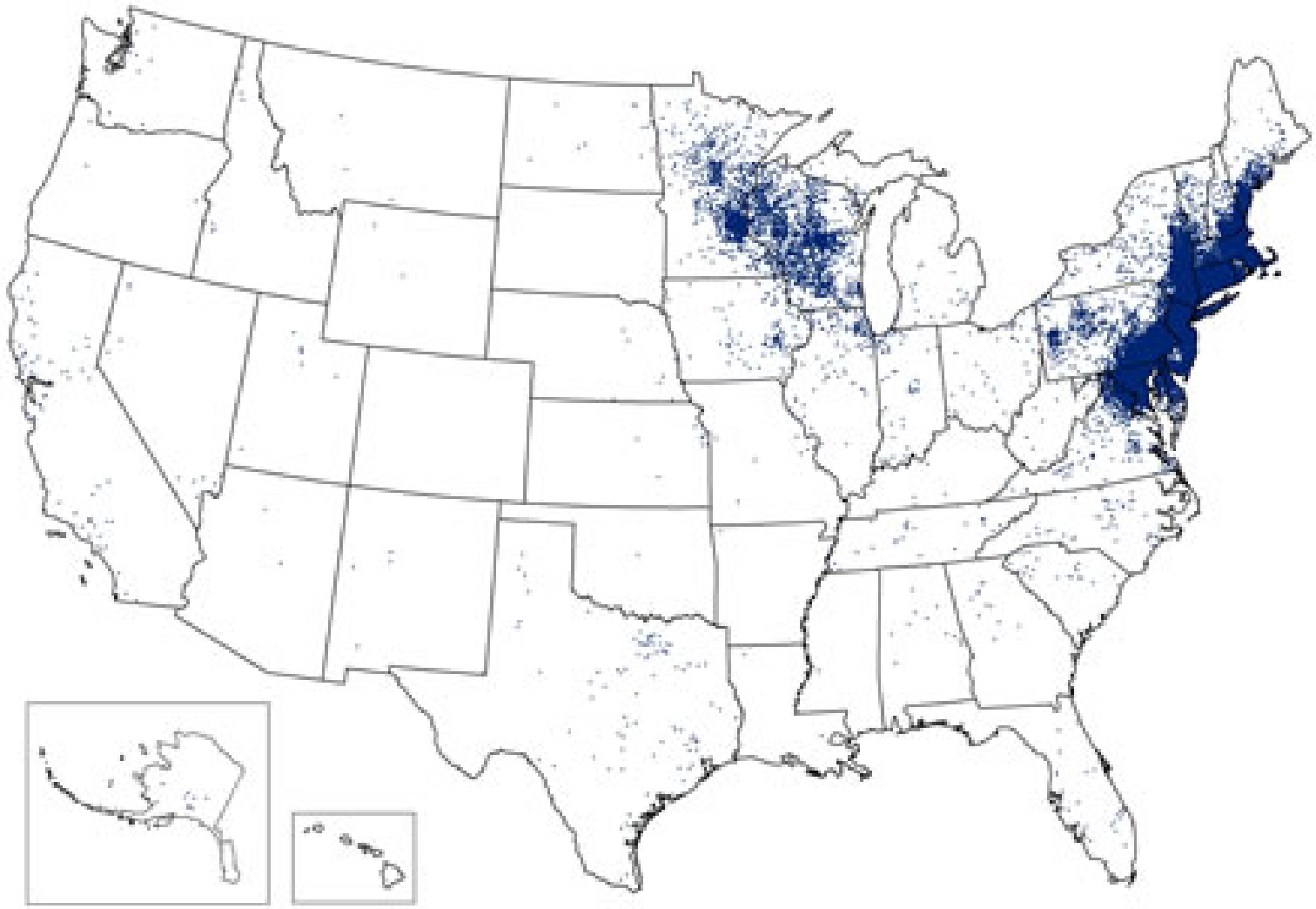
Reported Cases of Lyme Disease -- United States, 2006



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CDC 2015

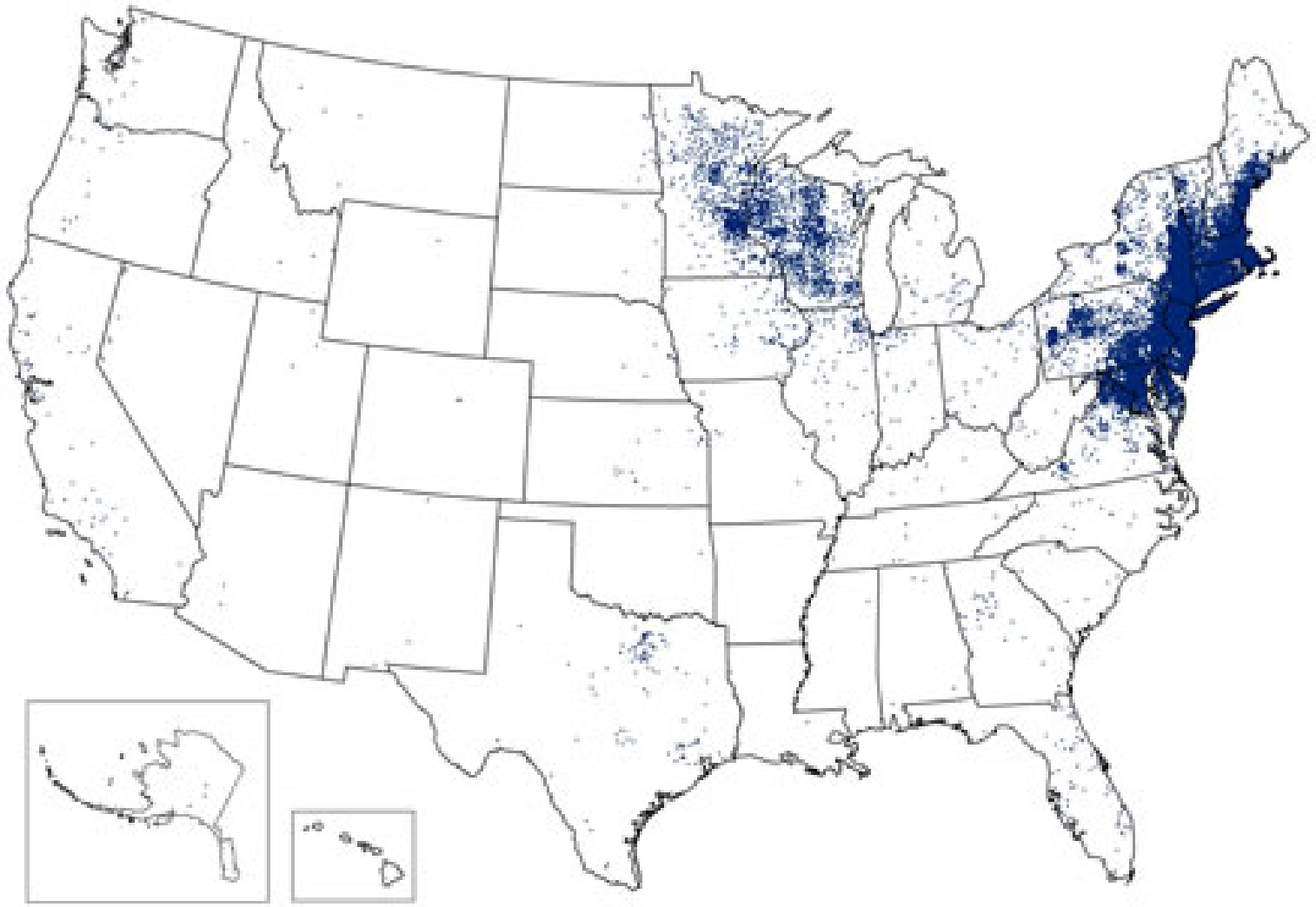
Reported Cases of Lyme Disease -- United States, 2007



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

CDC 2015

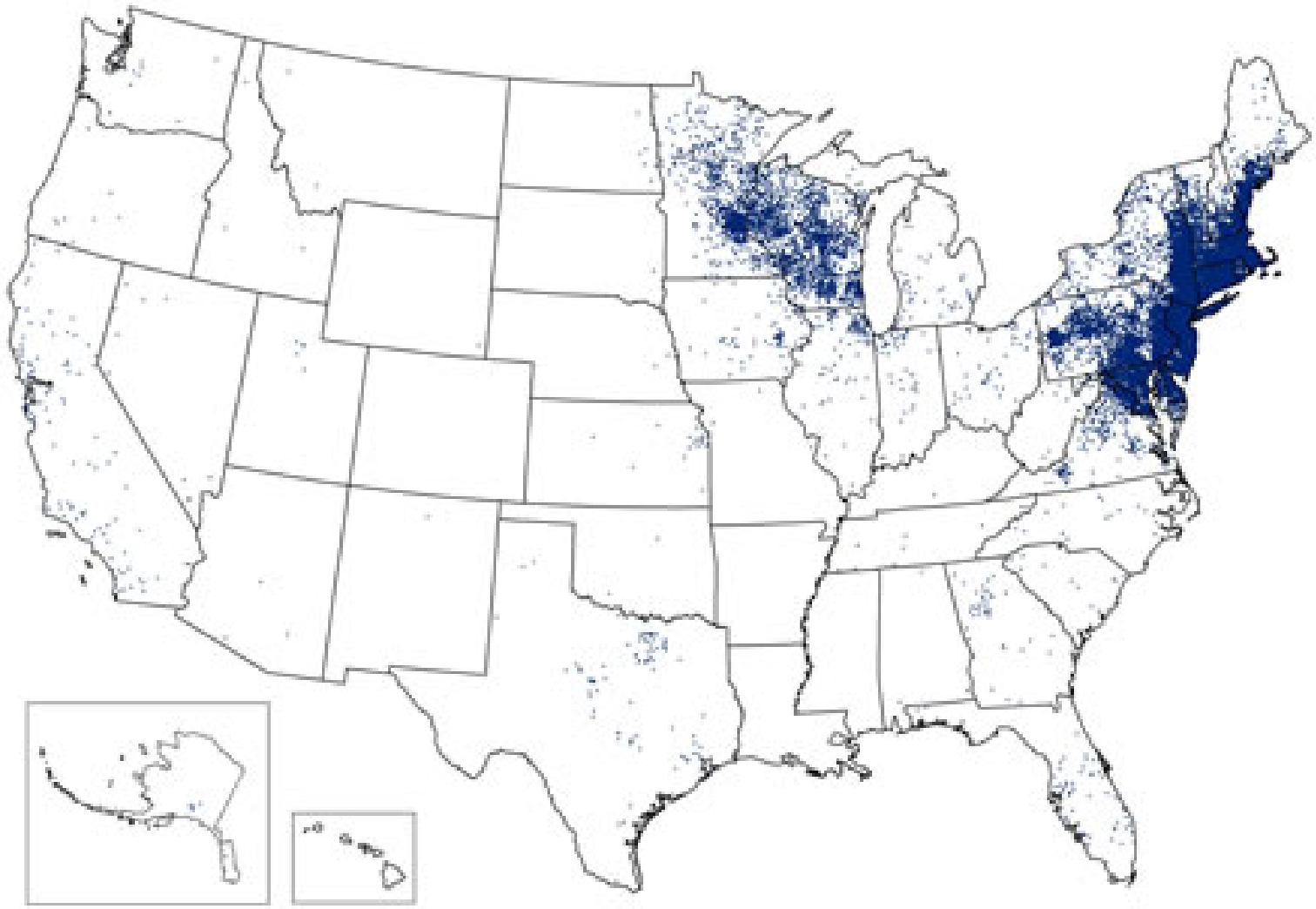
Reported Cases of Lyme Disease -- United States, 2008



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

CDC 2015

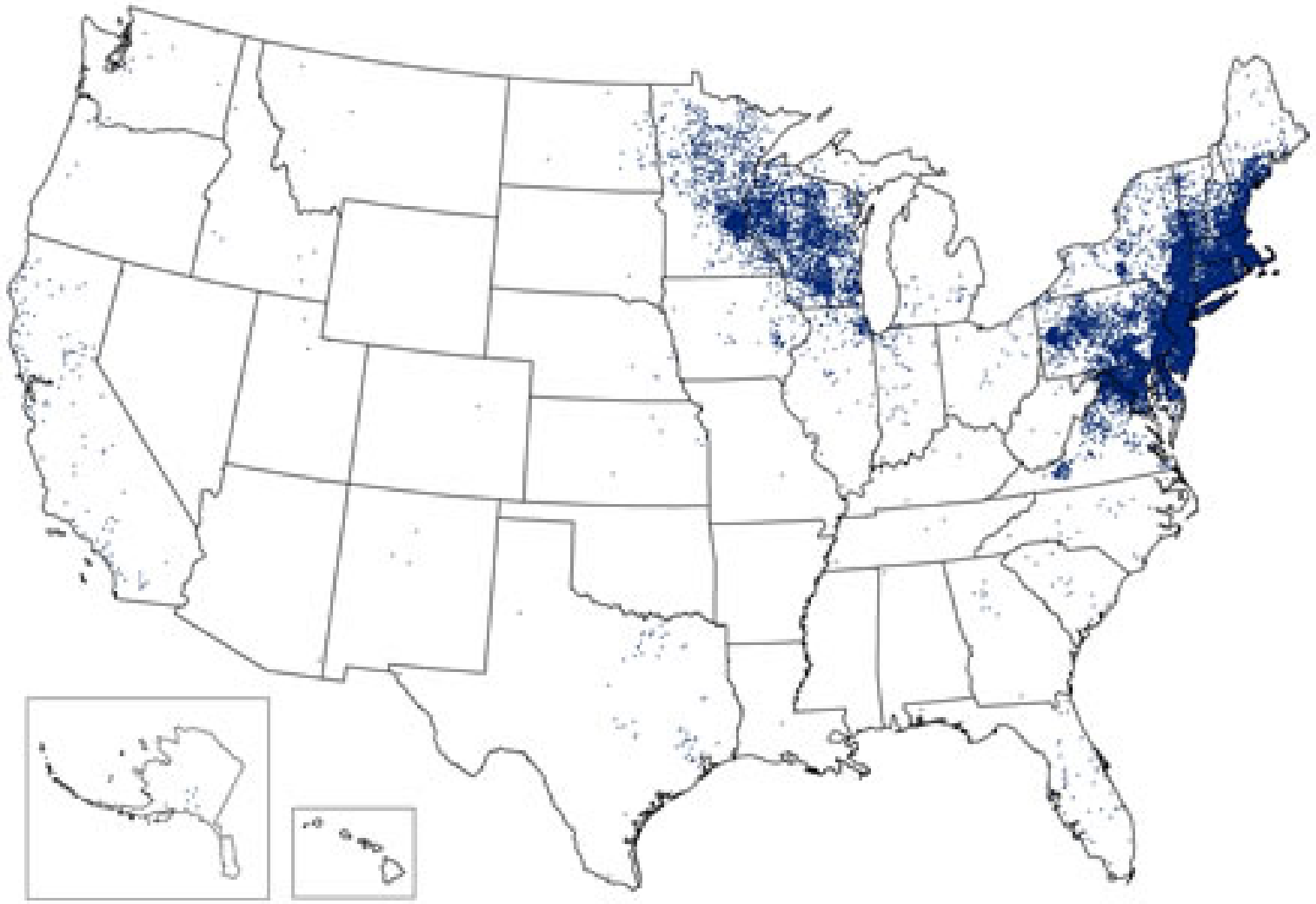
Reported Cases of Lyme Disease -- United States, 2009



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

CDC 2015

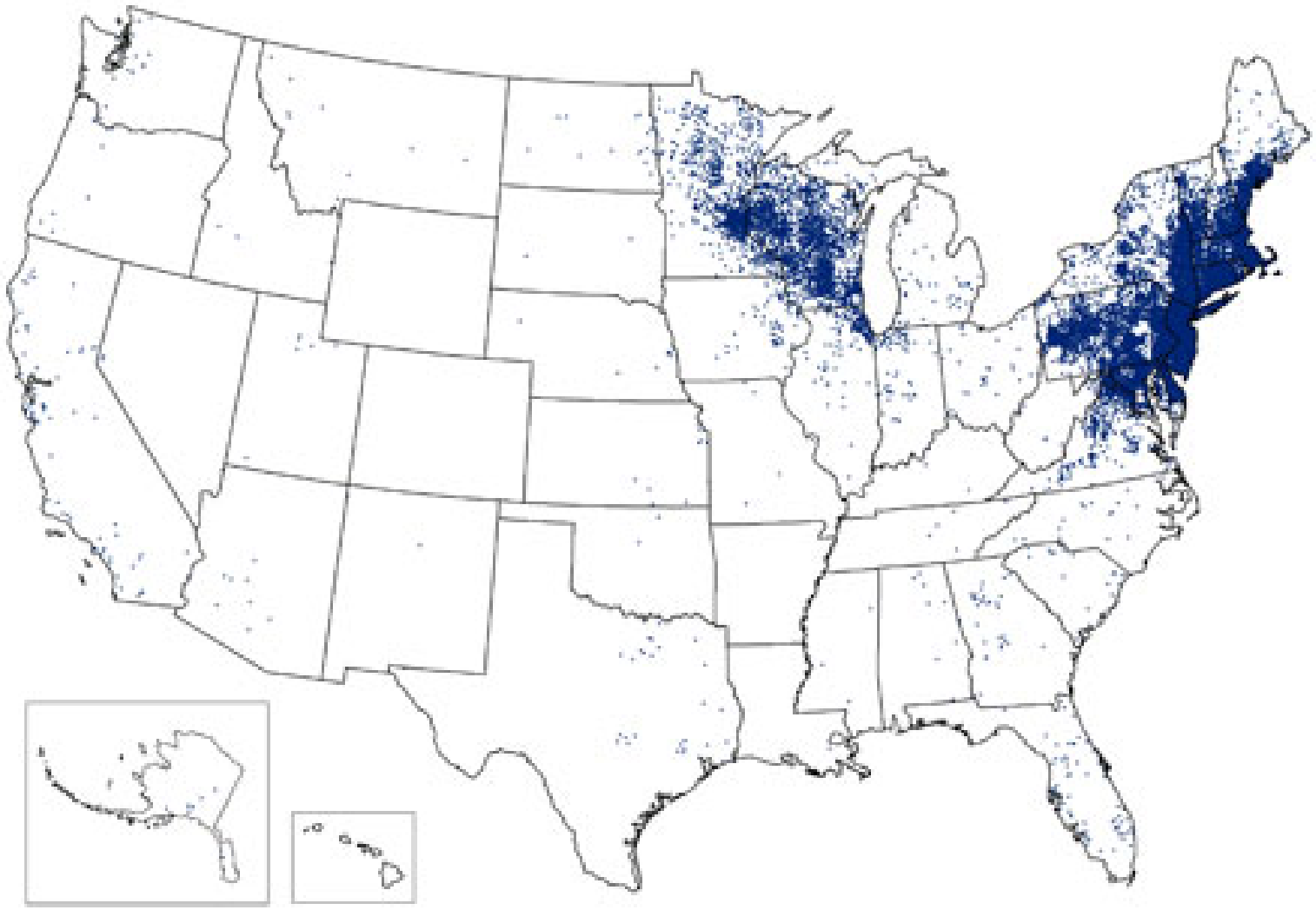
Reported Cases of Lyme Disease -- United States, 2010



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CDC 2015

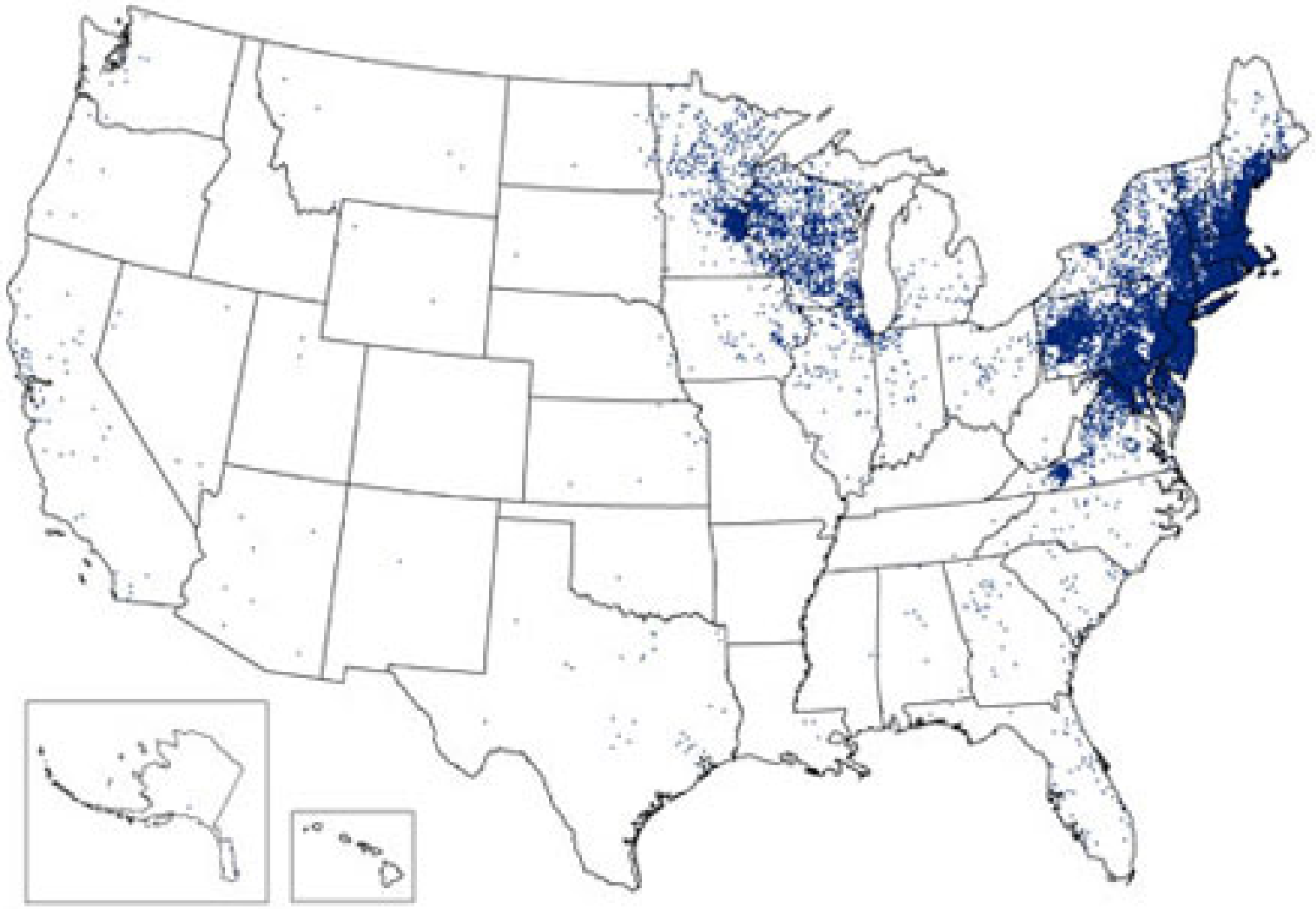
Reported Cases of Lyme Disease -- United States, 2011



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CDC 2015

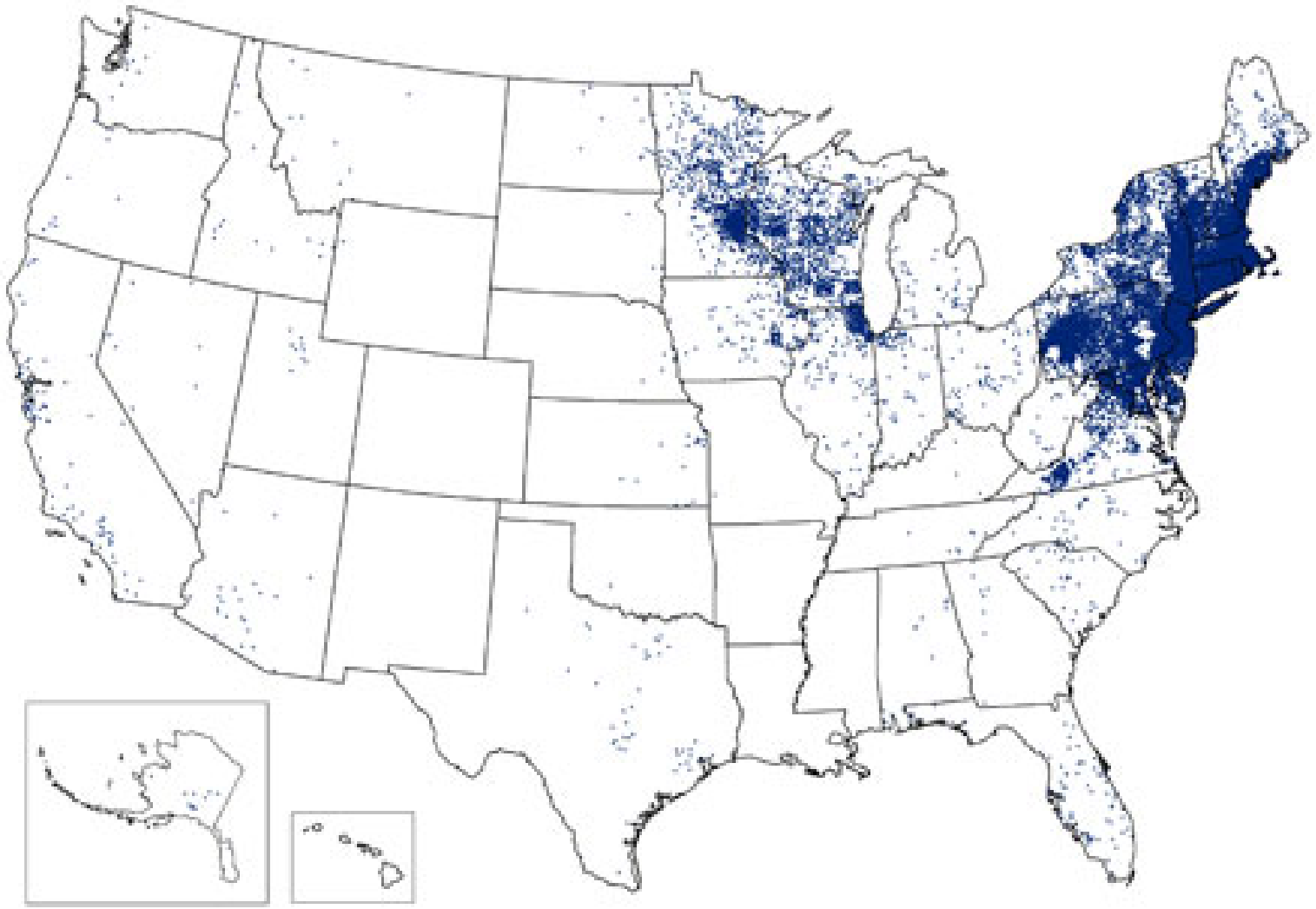
Reported Cases of Lyme Disease -- United States, 2012



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CDC 2015

Reported Cases of Lyme Disease -- United States, 2013



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CDC 2015

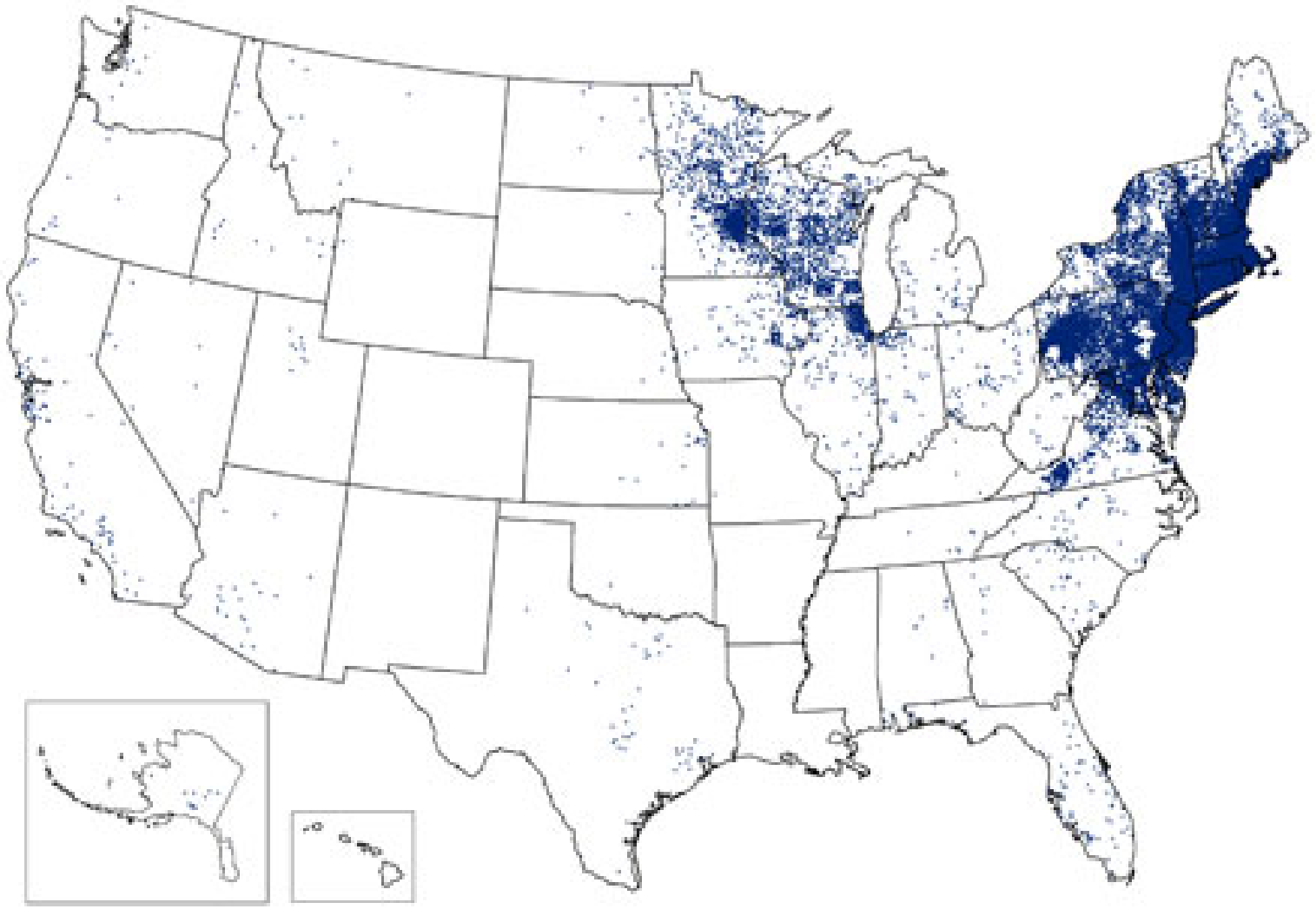
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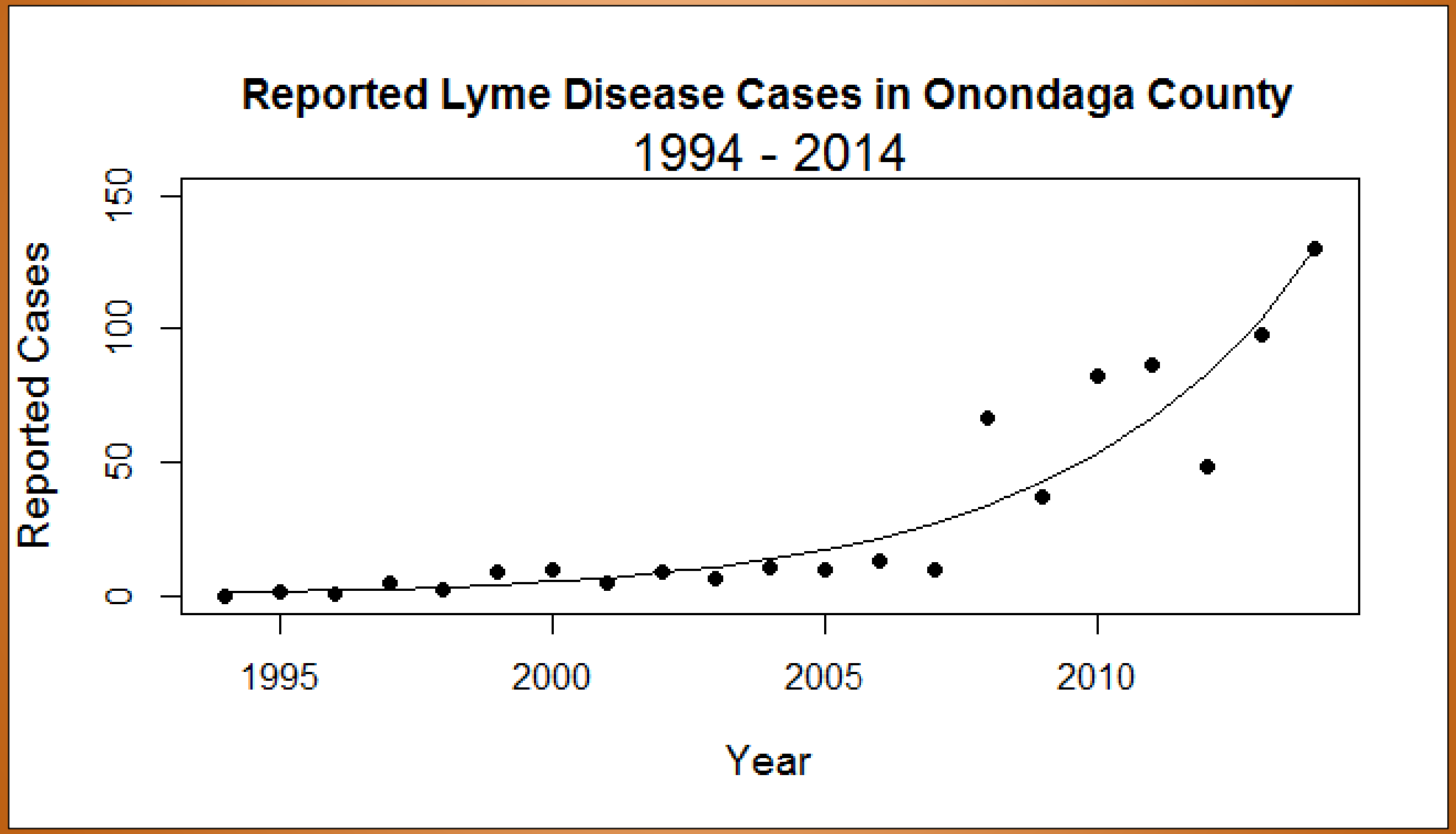
Reported Cases of Lyme Disease -- United States, 2013



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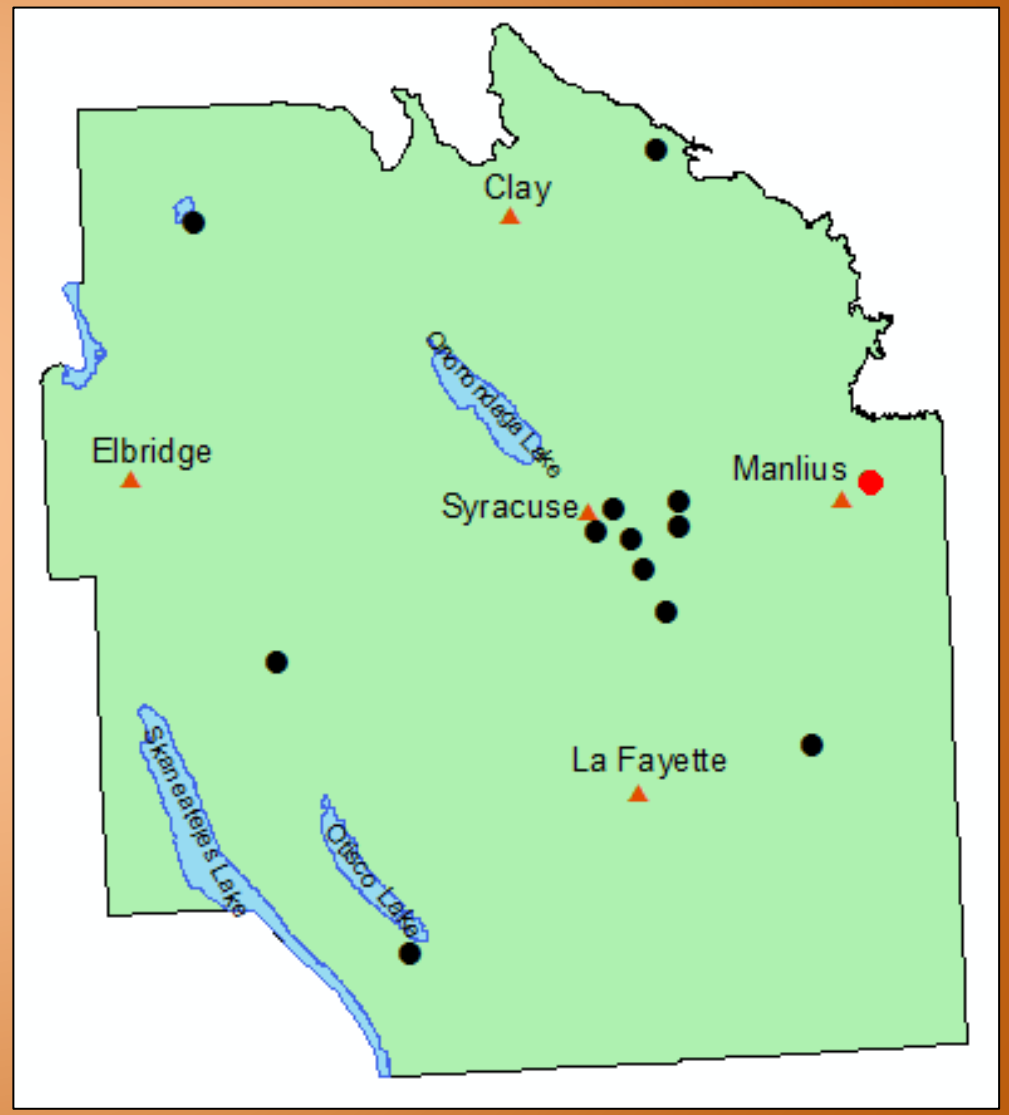
CDC 2015

NYSDOH Lyme Disease Case Data



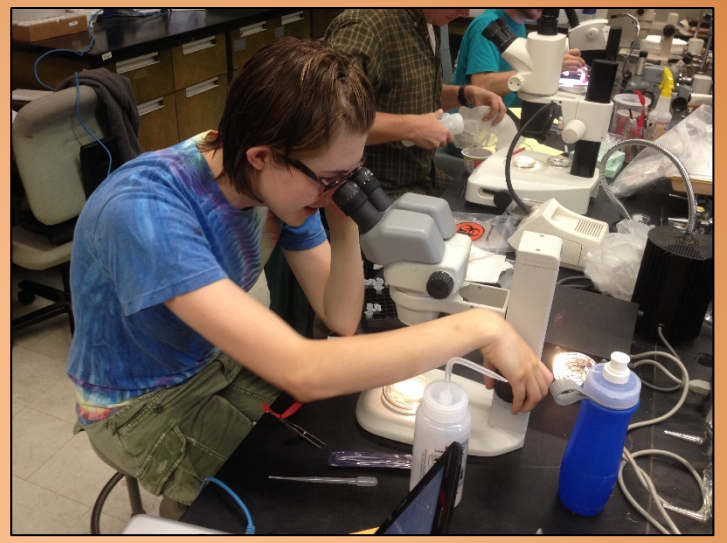
Research in Onondaga County

- 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



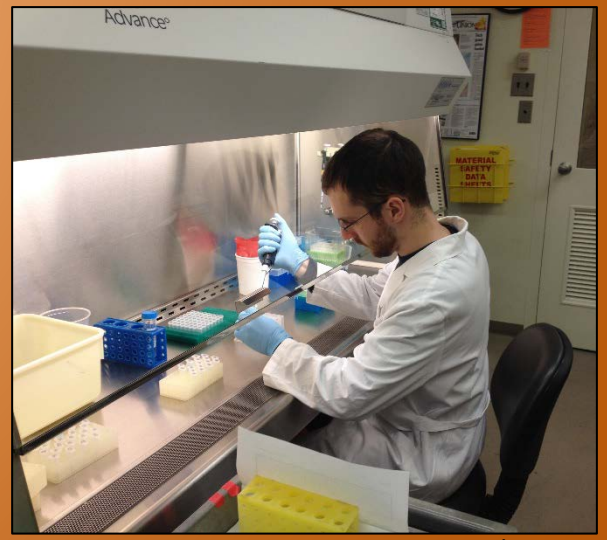
N. Piedmonte



N. Piedmonte



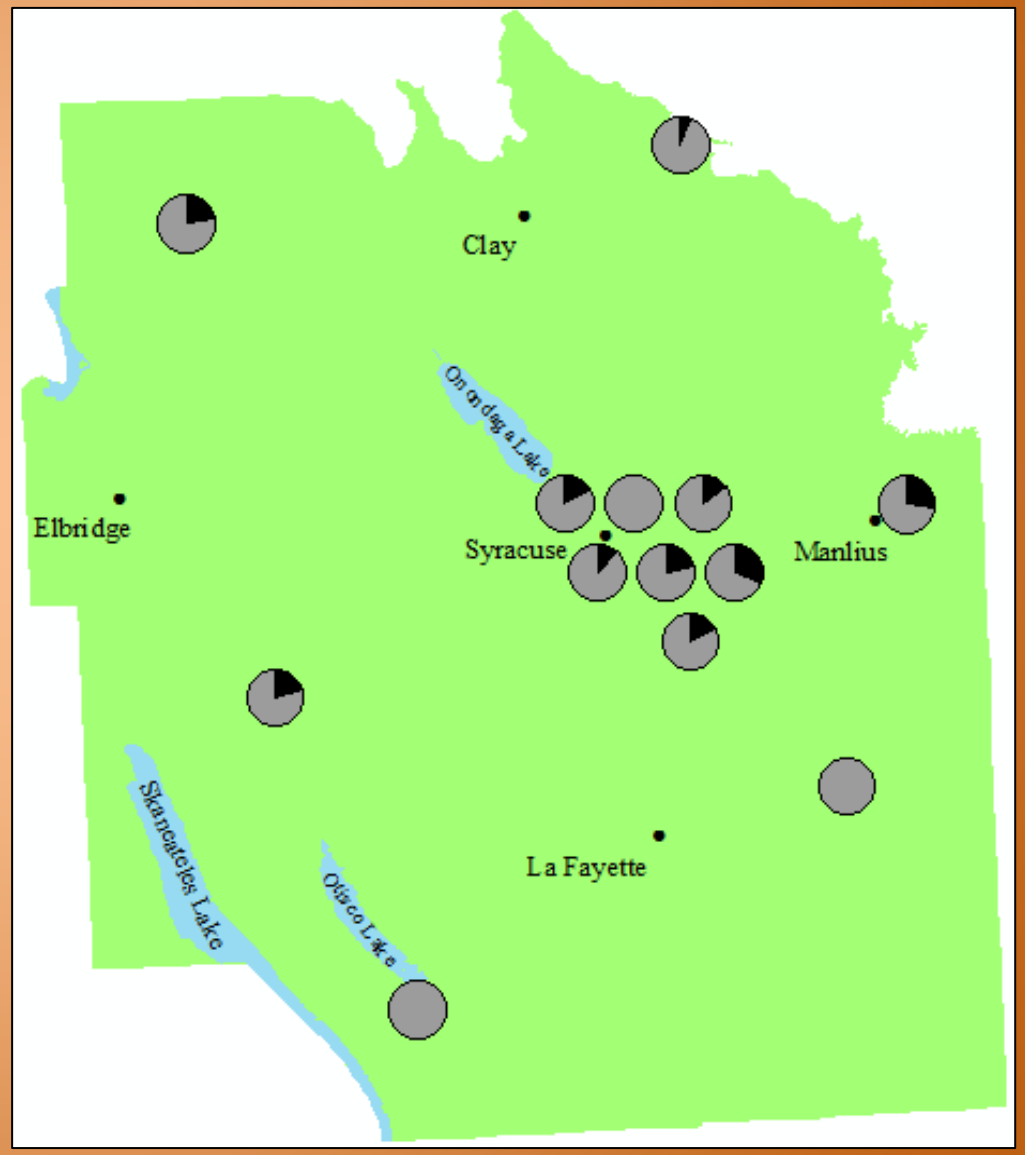
N. Piedmonte



M. Mahoney

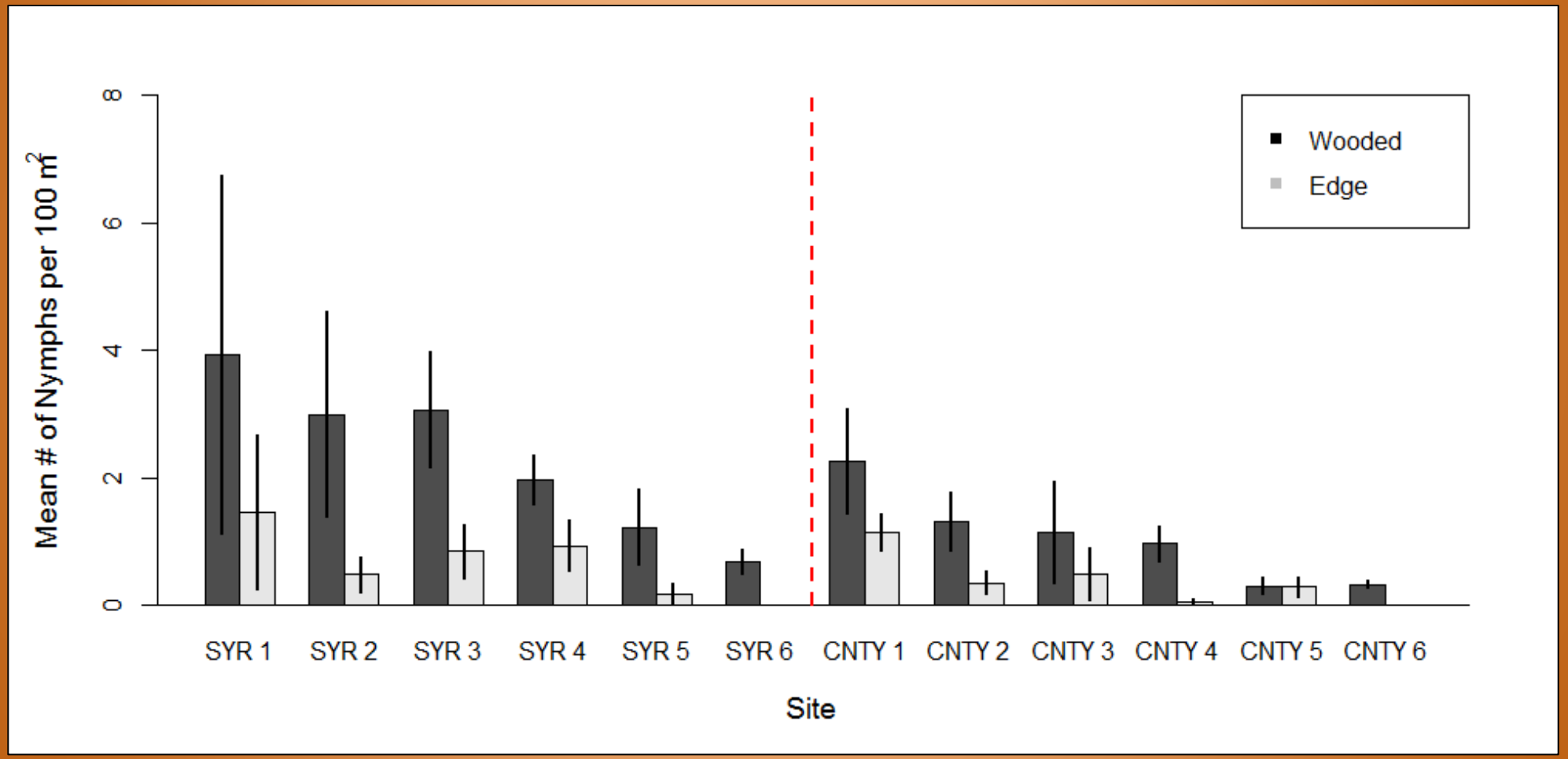
Disease Prevalence: Nymphs

- 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%

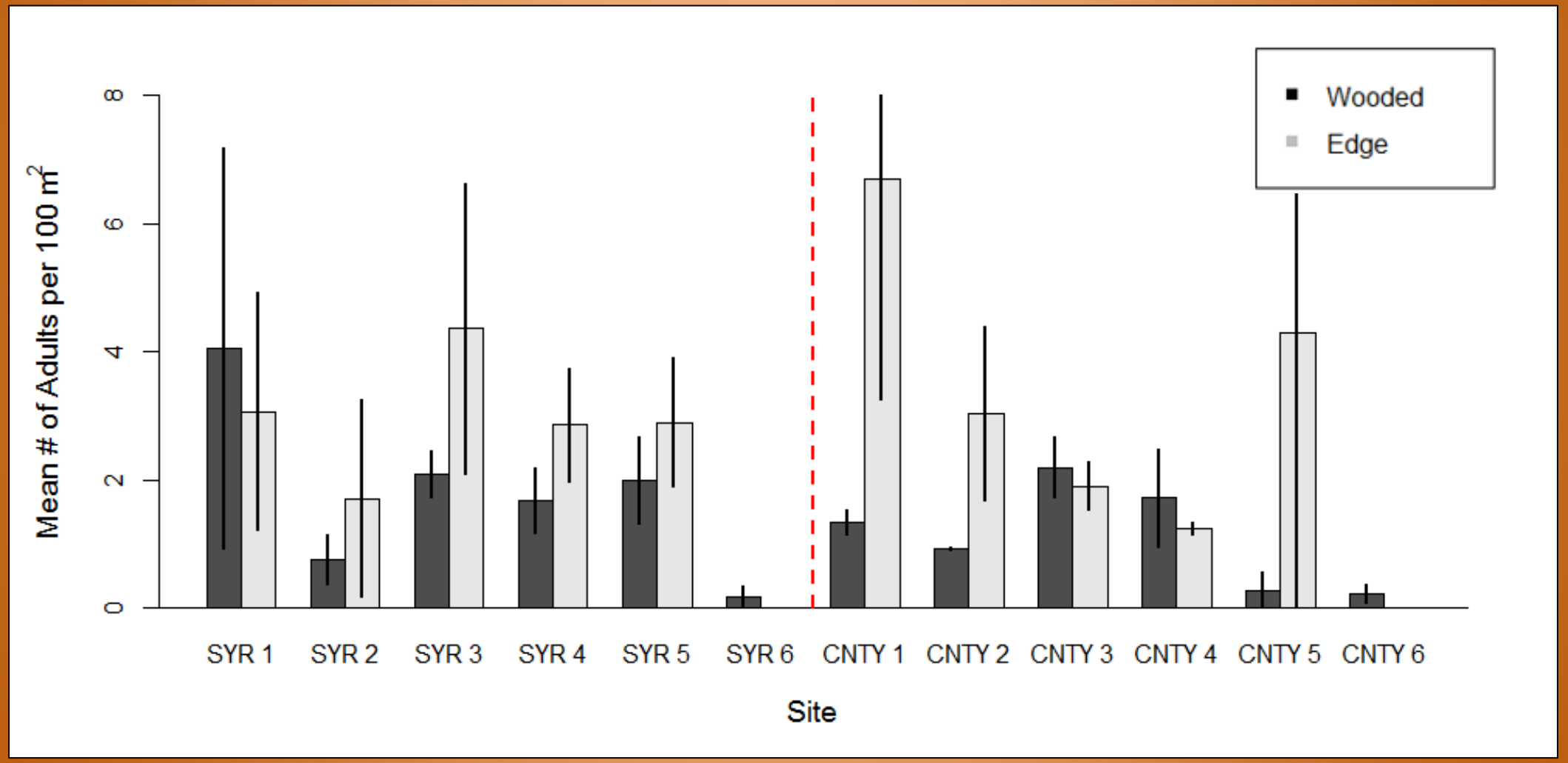


N. Piedmonte

Nymph Density



Adult Density



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

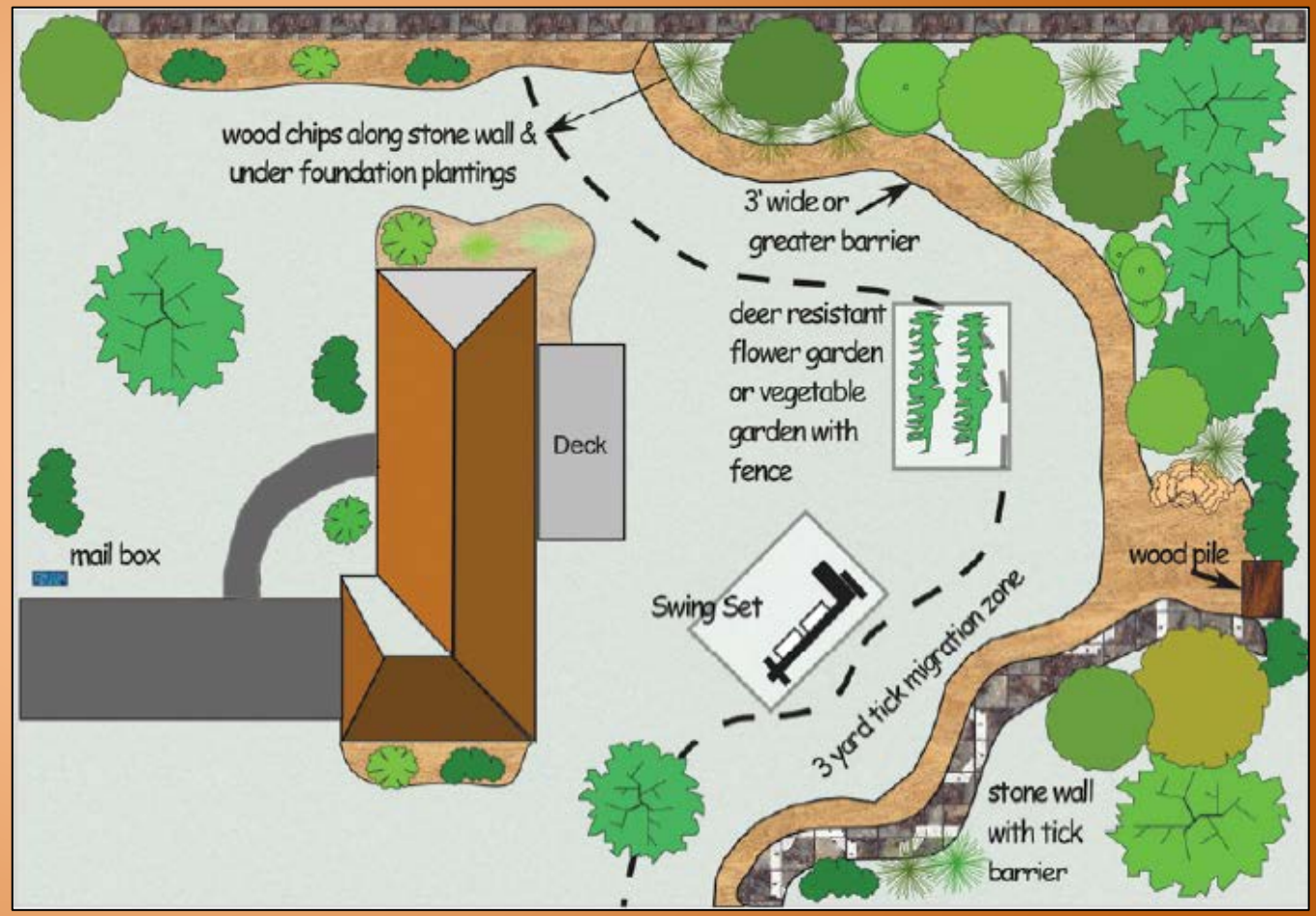
- Pants tucked into socks
- Shirt tucked into pants
- Insect repellants (DEET or permethrin)
  - Sprays
  - Infused clothing
- Periodic “tick checks”
- Showering within 2 hours of outdoor activity



B. Wierzbicki

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



Connecticut Agricultural Station

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



Connecticut Agricultural Station

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



J. Lane


MMCRI


MMCRI

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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- Brigitte Wierzbicki (SUNY ESF Undergraduate Field Technician)
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- New York State Department of Environmental Conservation
- McIntire-Stennis Program (funding)
- Landowners

ESF
State University of New York
College of Environmental Science and Forestry

NEW YORK STATE | Department of Health

DEPARTMENT OF ENVIRONMENTAL CONSERVATION • NEW YORK STATE •

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Questions?



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