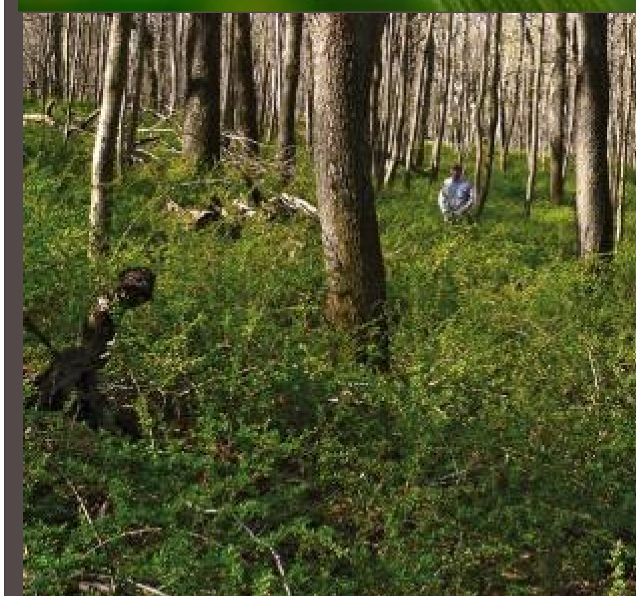
PUTTING SCIENCE TO WORK FOR SOCIETY: LINKS BETWEEN FOREST AND PUBLIC HEALTH



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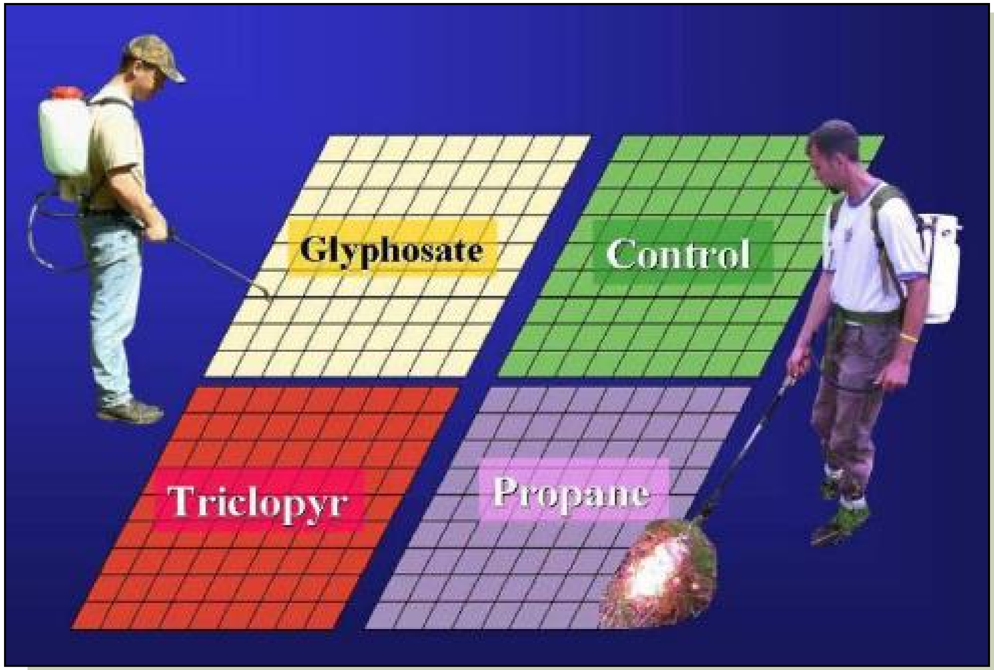
INVASIVE PLANT AND TICK ASSOCIATIONS

INITIAL TREATMENT-TOP KILL

- 3 sites in 2007
- 2 sites in 2008
- 1 site in 2010

- Intact barberry
- Managed barberry
- No barberry

SECONDARY TREATMENTS



- Estimated barberry cover 2007 – 2016
- Dragged adult *scapularis* fall 2007 – 2016
- Small rodent trapping, summers 2007 – 2016

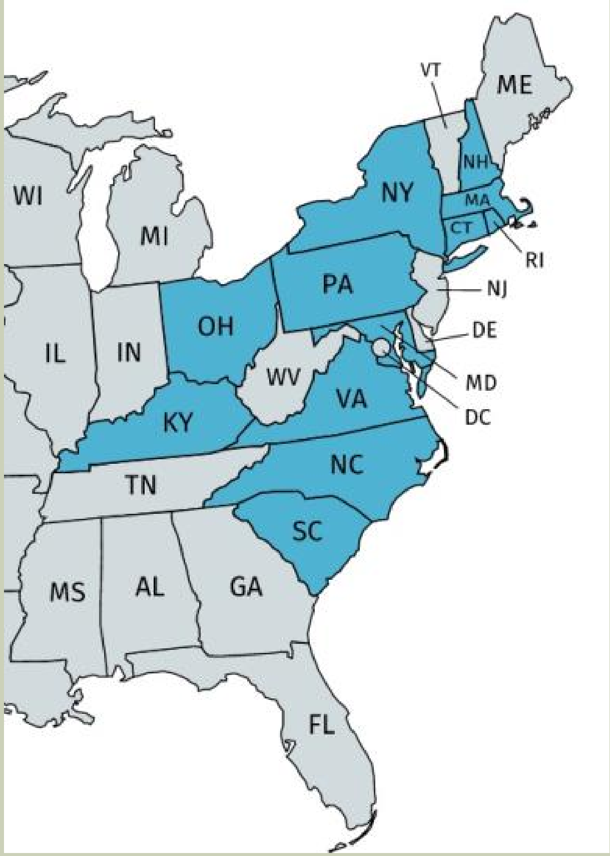
CONCLUSIONS

- Barberry can be effectively controlled
- Nearly 4x as many questing adult *scapularis* in barberry
- Nearly 5x as many *Borrelia*-infected questing adult *scapularis* in barberry
- Barberry creates humid microclimate
- Barberry management returns conditions to equal no barberry areas for up to 5 years

HARD MAST ABUNDANCE INFLUENCE

REGIONAL ANNUAL MAST SURVEY

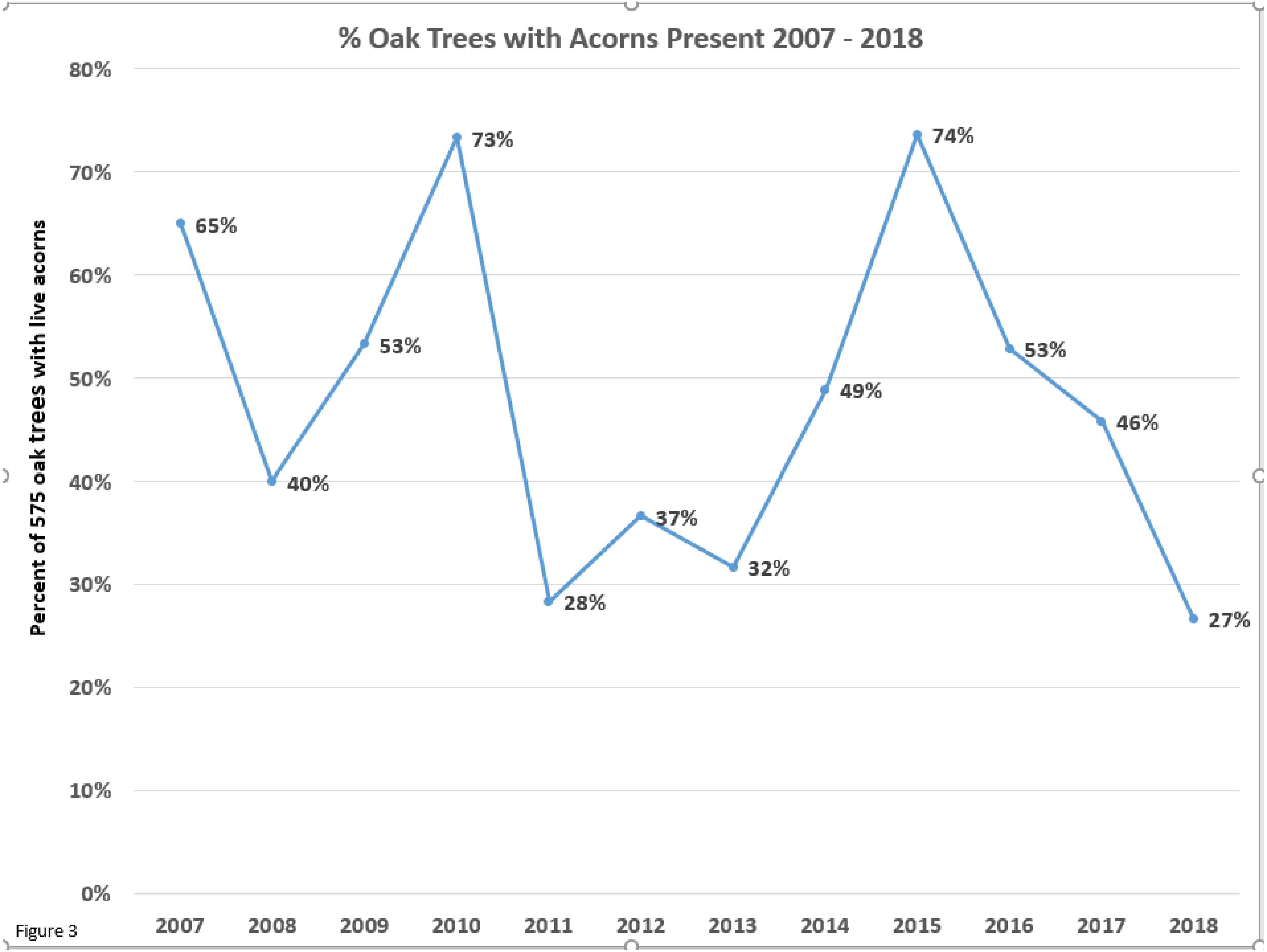
- Originated in 2004 by the Northeast Wild Turkey Technical Committee
- First survey in Connecticut in 2007
- Regional effort
- Shared data
- Mike Gregonis, CT DEEP Wildlife Division



TREE SELECTION AND MARKING

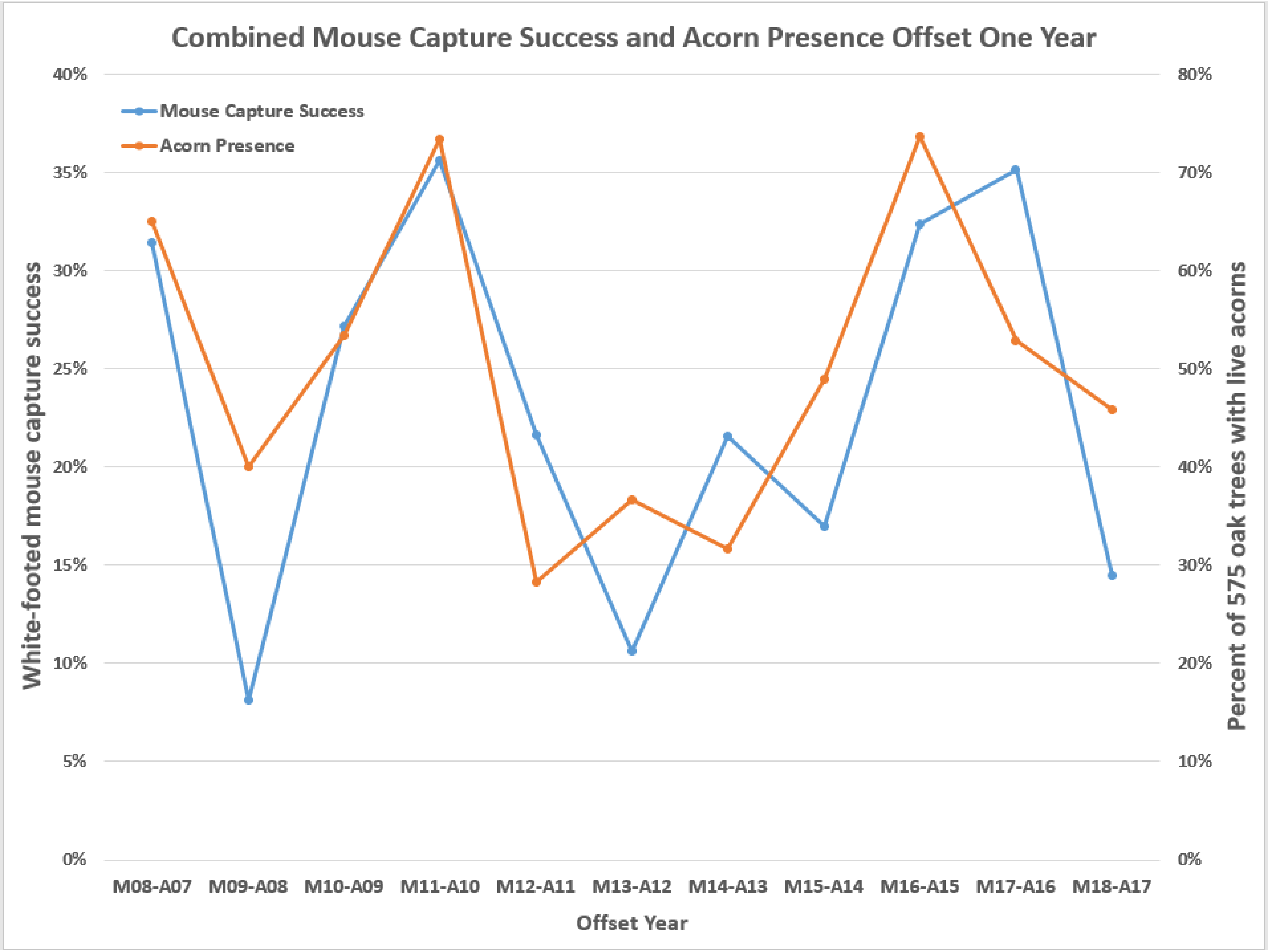
- 25 white oaks (white, swamp, chestnut) and 25 red oaks (black, red, scarlet, pin) in each of CT's 12 wildlife management zones (n = 600 oaks)
- Healthy, full crowns, near full sunlight, 12+" DBH
- Permanently marked and GPSed

- From August 15 – September 1
- 30 seconds
- Presence/Absence
- % crown occupied by acorns



% Oak Trees with Acorns Present 2007 - 2018
Percent of 575 oak trees with live acorns
80%
70%
60%
50%
40%
30%
20%
10%
0%
65%
40%
53%
73%
28%
37%
32%
49%
74%
53%
46%
27%
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018

Figure 3


Combined Mouse Capture Success and Acorn Presence Offset One Year
Mouse Capture Success
Acorn Presence
White-footed mouse capture success
Percent of 575 oak trees with live acorns
0%
5%
10%
15%
20%
25%
30%
35%
40%
0%
10%
20%
30%
40%
50%
60%
70%
80%
M08-A07
M09-A08
M10-A09
M11-A10
M12-A11
M13-A12
M14-A13
M15-A14
M16-A15
M17-A16
M18-A17
Offset Year

DIVERSITY AND DISEASE:

THE ROLE OF WILDLIFE IN THE ECOLOGY OF LYME DISEASE

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The Trash Panda's Dilemma: Residential vs. Woodland Living and Zoonotic Disease Impacts

Dr. Scott C. Williams
2017 Forest Health Workshop
New Haven, CT

Journal of Medical Entomology, 55(3), 2018, 681–690
doi: 10.1093/jme/tjx237
Advance Access Publication Date: 11 January 2018
Research Article

Vector/Pathogen/Host Interaction, Transmission

Ixodes scapularis (Acari: Ixodidae) Reservoir Host Diversity and Abundance Impacts on Dilution of *Borrelia burgdorferi* (Spirochaetales: Spirochaetaceae) in Residential and Woodland Habitats in Connecticut, United States

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Abstract

The dilution effect in the zoonotic disease transmission cycle theorizes that an increased diversity of host species will alter transmission dynamics, result in a decrease in pathogen prevalence, and potentially lower human disease incidence. The interrelationship of *Borrelia burgdorferi* (Johnson, Schmid, Hyde, Steigerwalt, and Brenner) (Spirochaetales: Spirochaetaceae), the etiological agent of Lyme disease (LD), and its primary vector, blacklegged ticks (*Ixodes scapularis* Say) (Acari: Ixodidae), is a commonly used example of the dilution effect, suggesting that an increased diversity of host species will be found in large, undisturbed forested tracts and lower diversity in fragmented forests. Given that Connecticut woodlands are mature with heavy upper canopies and generally poor habitat quality, we hypothesized there would be higher diversity of host species resulting in lower prevalence of *B. burgdorferi* in white-footed mice (*Peromyscus leucopus* Rafinesque) (Rodentia: Cricetidae) in forested residential areas. Using camera and live small mammal trapping techniques, we determined there was a greater richness of reservoir host species, significantly higher encounters with hosts, and significantly lower *B. burgdorferi* host-infection in residential areas as compared to large, intact forested stands. Furthermore, we determined that the driving factor of pathogen dilution was not host species diversity, but rather overall encounter abundance with alternative hosts, regardless of habitat type. Our study challenges major concepts of the dilution effect within the Connecticut landscape and calls for new managerial actions to address the current state of our woodlands and abundance of host species in the interest of both forest and public health.

Key words: biodiversity, ectoparasite, host immune response, Lyme disease, vector-borne pathogen

DILUTION EFFECT AND LYME DISEASE

- Increased host diversity should result in decreased pathogen presence
  - Lyme disease is a prime example
    - Varying degrees of competency
    - Greater opportunities to feed on alternative hosts
- Several studies indicate landscape plays a role
  - Larger, contiguous land parcels foster more host diversity
  - Fragmentation results in less diversity
    - More disease
- Spoiler alert!
- Our results are in direct contrast to these "facts"

HOST DIVERSITY

- Competent vs. incompetent hosts

White-footed mouse. Photo credit: Cary Institute of Ecosystem Studies/Ostfeld lab
http://southeasternmamosquitocontrol.com/2017/03/23/more-mice-last-summer-could-mean-more-ticks-lyme-disease-this-summer-in-southeastern-massachusetts/


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07 OCT 2016 10:38 am


MOULTRIE
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09 OCT 2016 09:39 am

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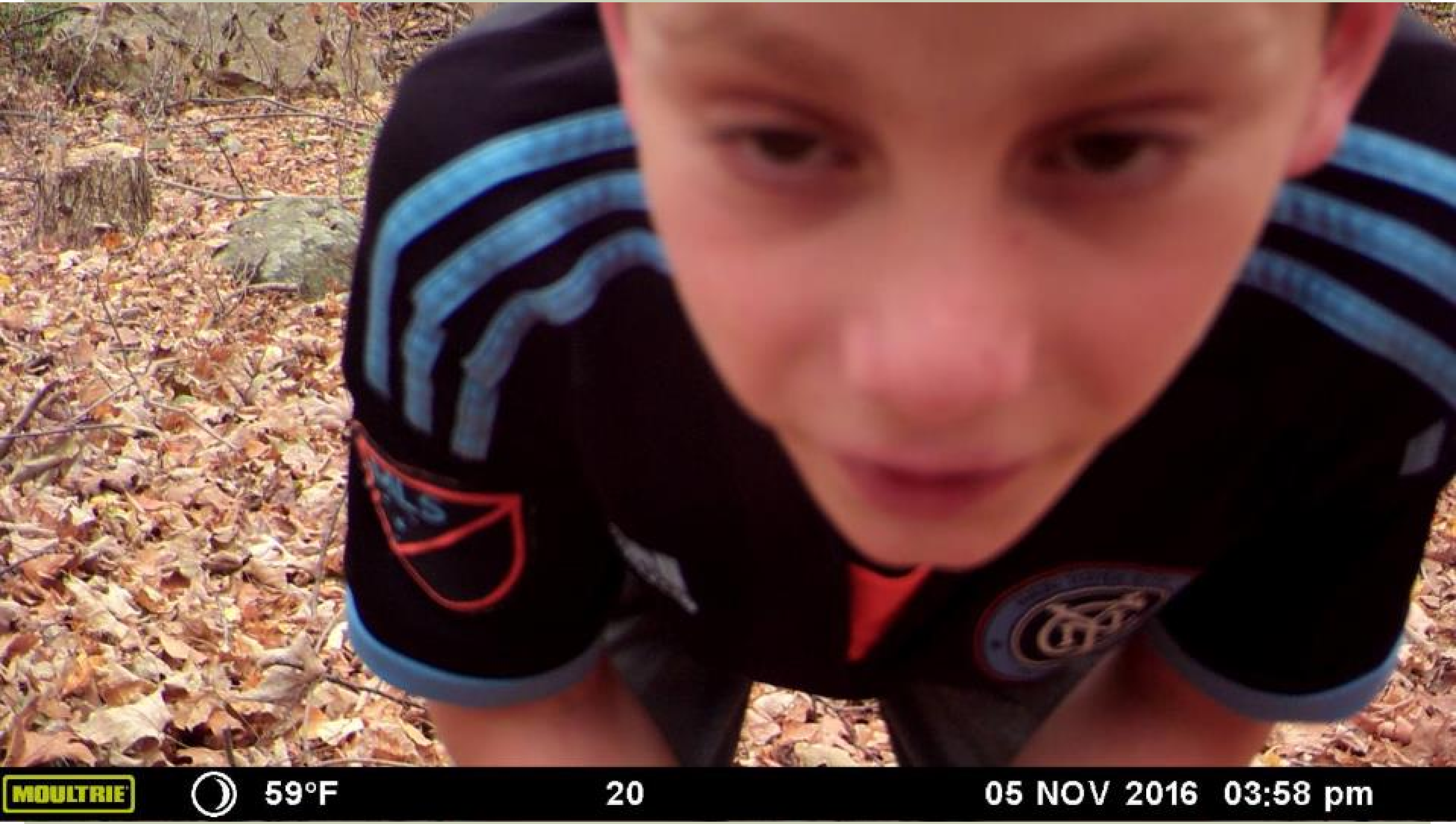
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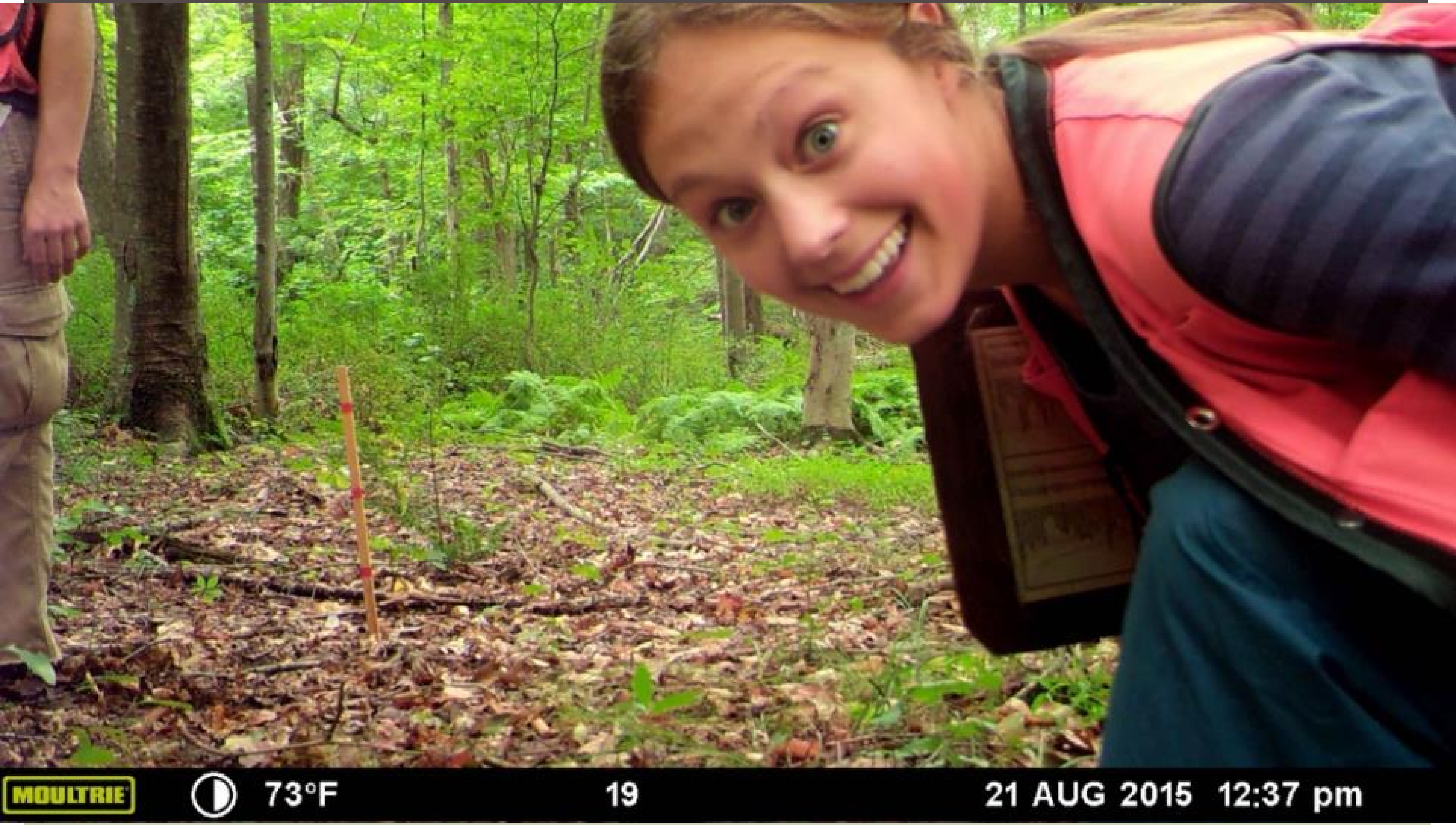
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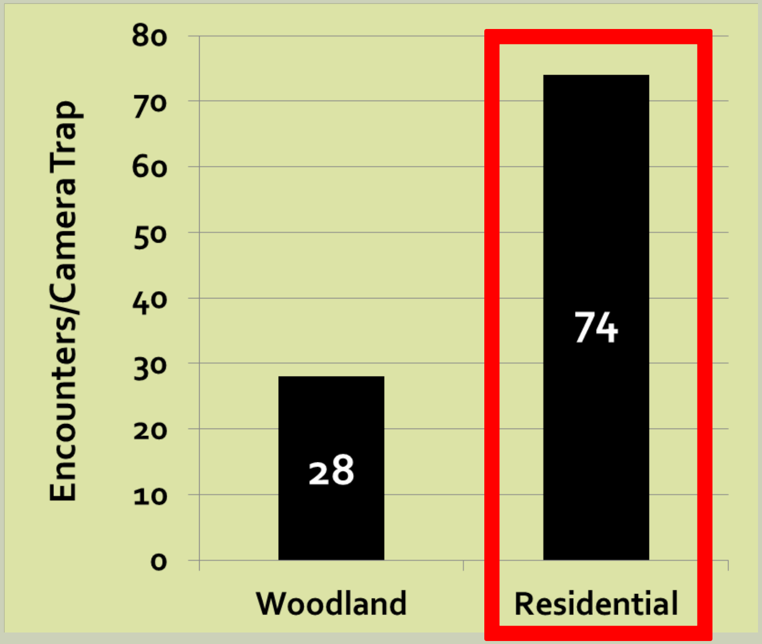
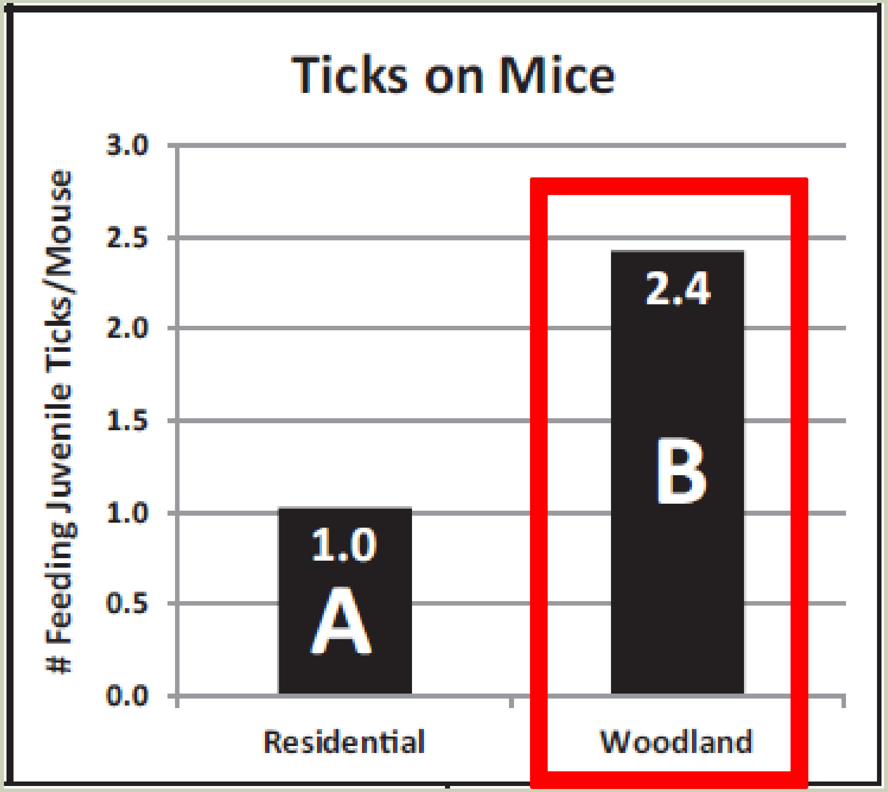
DIFFERENCES BETWEEN LANDSCAPES



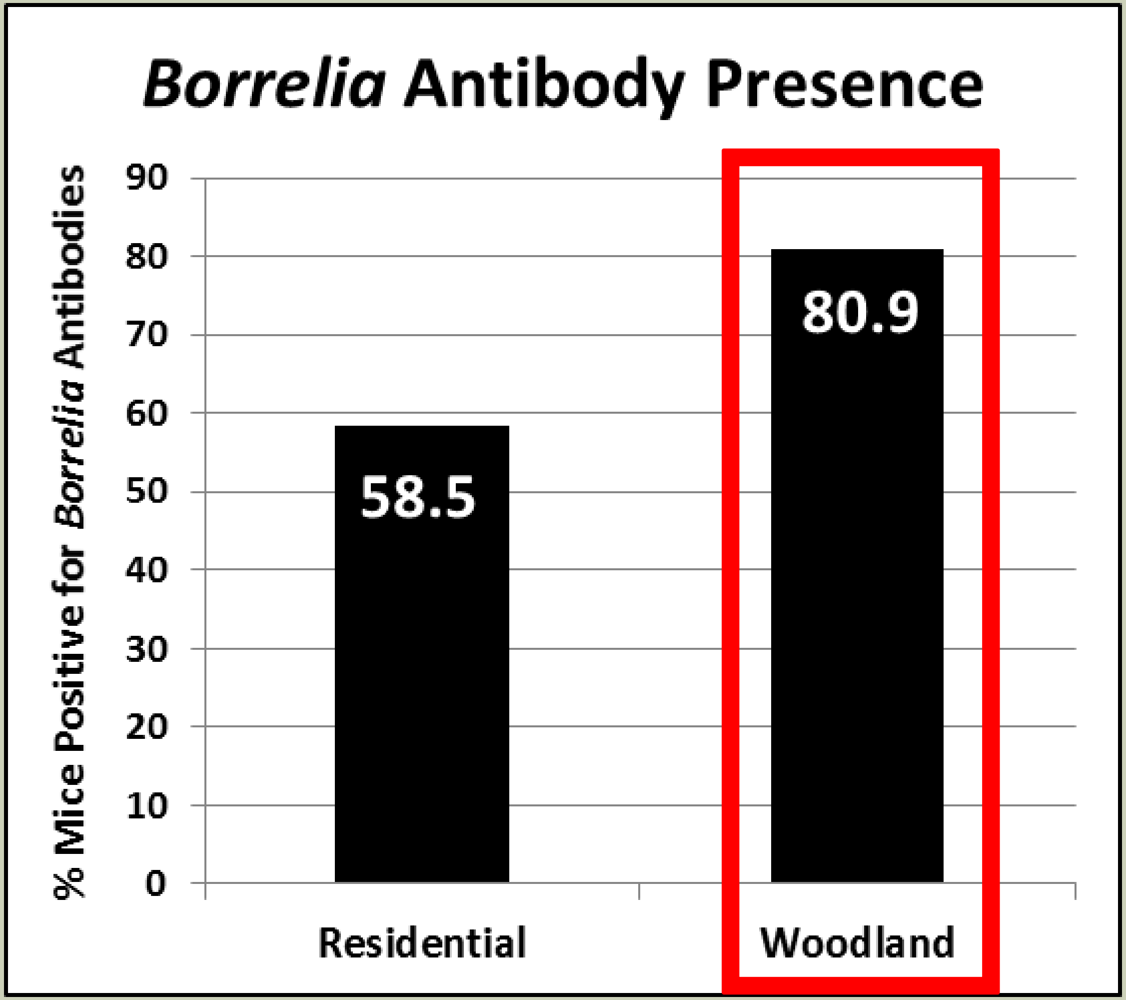
- Shows greater diversity and abundance of hosts in residential settings as compared with woodlands

TICKS/MOUSE BETWEEN LANDSCAPES



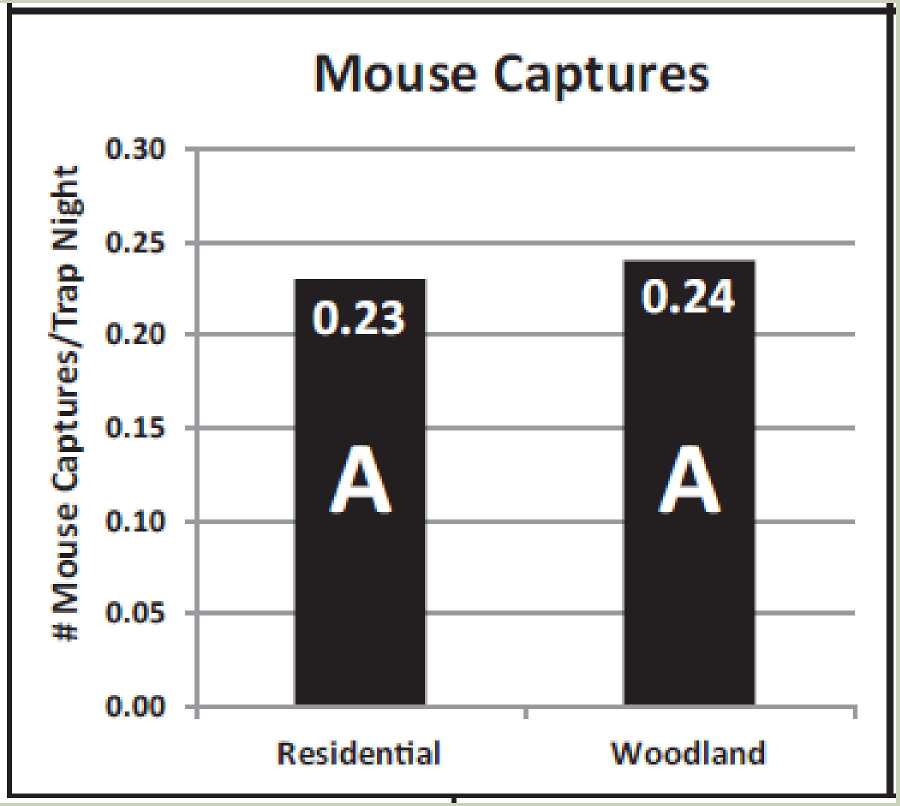
- Suggests a lack of host diversity/ availability in woodlands

BORRELIA ANTIBODIES IN CAPTURED MOUSE SERA



- Suggests a lack of host diversity/ availability
- Ticks prioritize bloodmeals on competent mice
- Ramps up infection

MOUSE CAPTURES BETWEEN LANDSCAPES



- No difference in mouse abundances between residential and woodland landscapes

Linske, M. A., S. C. Williams, K. C. Stafford III, and Isaac M. Ortega. 2018. *Ixodes scapularis* reservoir host diversity and abundance impacts on dilution of *Borrelia burgdorferi* in residential and woodland habitats in Connecticut, USA. Journal of Medical Entomology 55: 681-690.

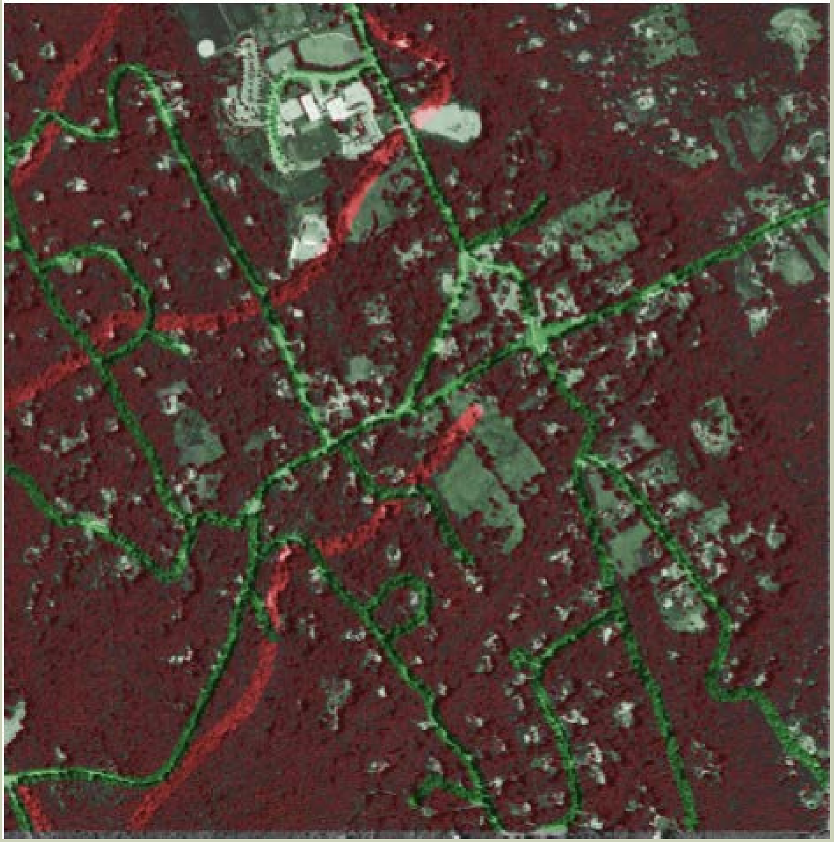
CONCLUSIONS

- Finding that invasive infested forests harbor more ticks and pathogens
- Poor habitats result in lower host diversity and more ticks and pathogens
- Oak stands are beneficial to a variety of wildlife species, thus increasing wildlife diversity
- Puts a public health component on proper forest management techniques, benefitting wildlife and humans alike

PAST PREDICTIVE EFFORTS

- Extensive
- Remote sensing
  - Limited to aerial photographs
  - Tree canopy an issue

- Predictive model
  - Green is low risk
  - Red is high risk
  - Deciduous tree cover is high risk
  - Too vague and low resolution

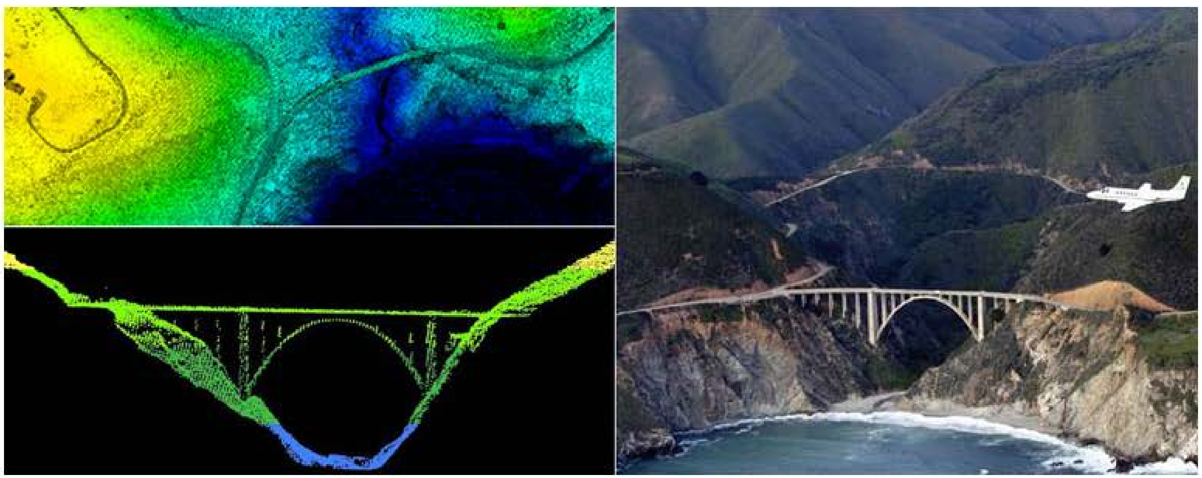


NOVEL APPROACH

- Need to map shrub layer, not tree canopy
  - UConn group has this aspect in the works
  - Dense growing, regardless of species
- Use combination of LIDAR and remote sensing to strip out tree canopy data leaving shrub layer data
- Quantify habitat at targeted and historic areas
- Ground-truth tick abundance, small mammals(?), and pathogen presence
- Use other variables to model predictive analytics based on outputs

What is LIDAR?

LIDAR—Light Detection and Ranging—is **a remote sensing method** used to examine the surface of the Earth.



LIDAR data is often collected by air, such as with this NOAA survey aircraft (right) over Bixby Bridge in Big Sur, Calif. Here, LIDAR data reveals a top-down (top left) and profile view of Bixby Bridge. NOAA scientists use LIDAR-generated products to examine both natural and manmade environments. LIDAR data supports activities such as inundation and storm surge modeling, hydrodynamic modeling, shoreline mapping, emergency response, hydrographic surveying, and coastal vulnerability analysis.

LIDAR, which stands for *Light Detection and Ranging*, is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses—combined with other data recorded by the airborne system— generate precise, three-dimensional information about the shape of the Earth and its surface characteristics.

Search Our Facts

search

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Introduction to LIDAR

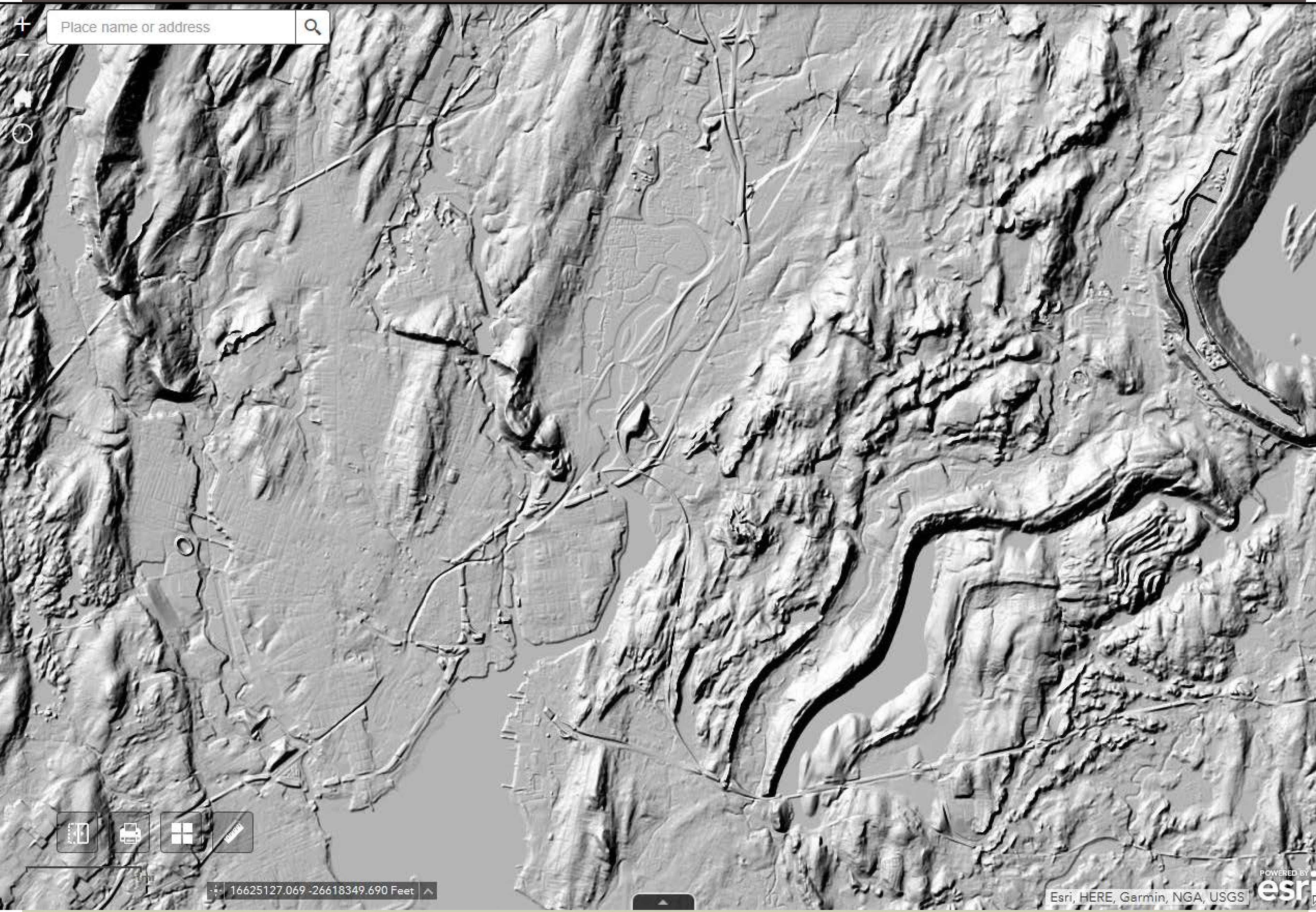
National Geodetic Survey

What is VDatum?

Digital Coast

How is LIDAR data collected?

When an airborne laser is pointed at a targeted area on the ground, the beam of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CT DEEP, USGS | Capitol Region Council of Governments
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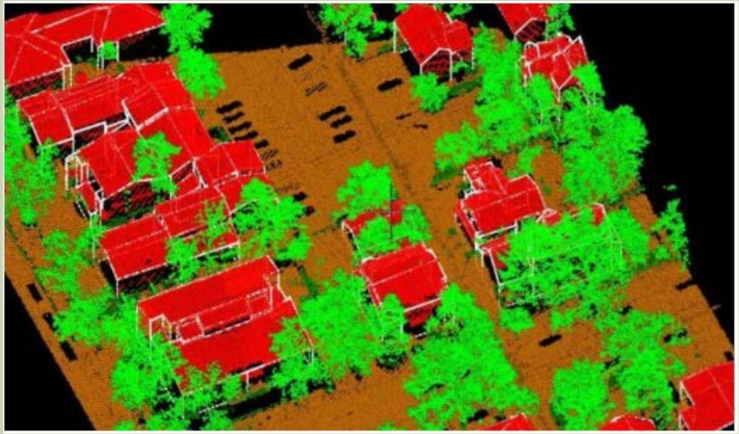
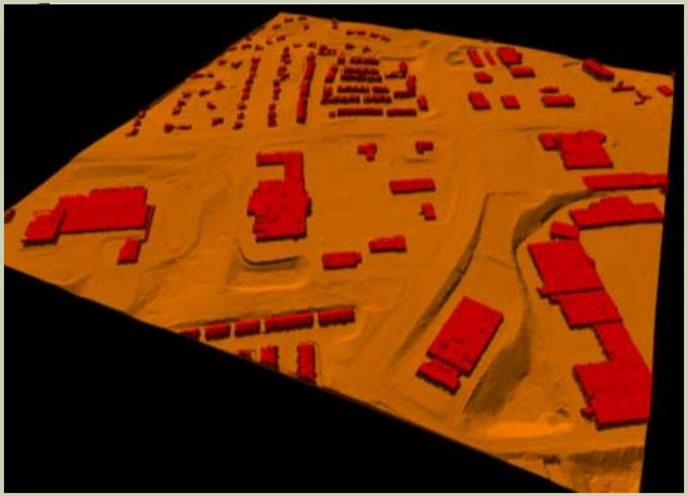
NOVEL APPROACH

- State of CT is flown with LIDAR every 5 years
  - Last in 2016
  - 1 meter cell size
- Current contract strips out vegetation data, but those data are available
- As it is infeasible to map state in higher resolution, we will investigate if current data are conducive to identifying tick "hotspots"





NEW DIRECTIONS

- Instead of individual properties, need to think regionally
  - Town-wide scale
- There is a need to identify hotspots instead of blanket approach
  - Effectiveness
  - Cost savings
- Once identified, intervention can occur if desired
- Should lessen abundance and/or infection in ticks, hosts, and humans
- We plan to test just this

ACKNOWLEDGEMENTS AND QUESTIONS

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