Fire and Ticks – Can the restoration of fire dependent ecosystems with prescribed fire reduce ticks?

NRS Rooted in Research
2/3/2021

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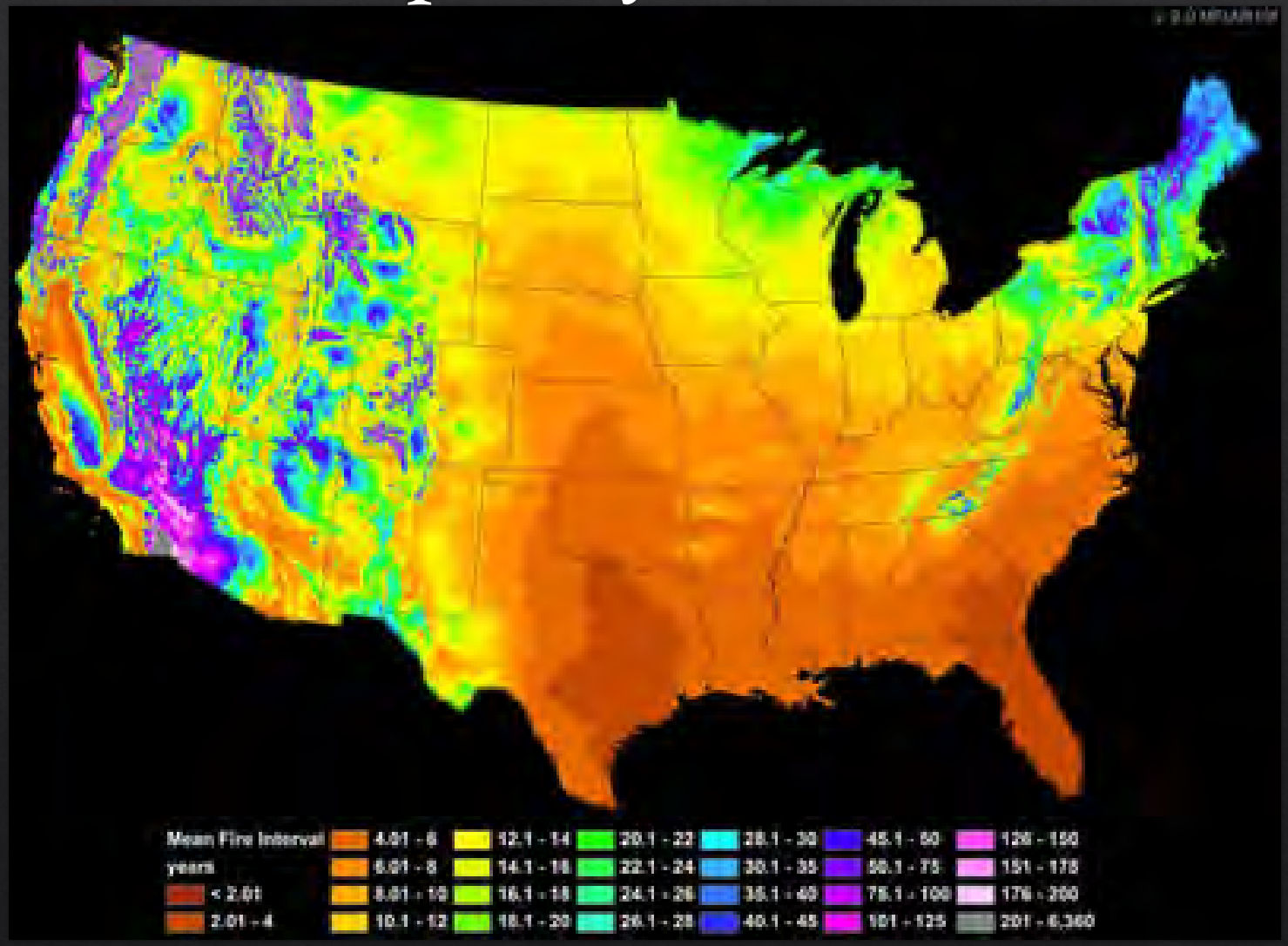
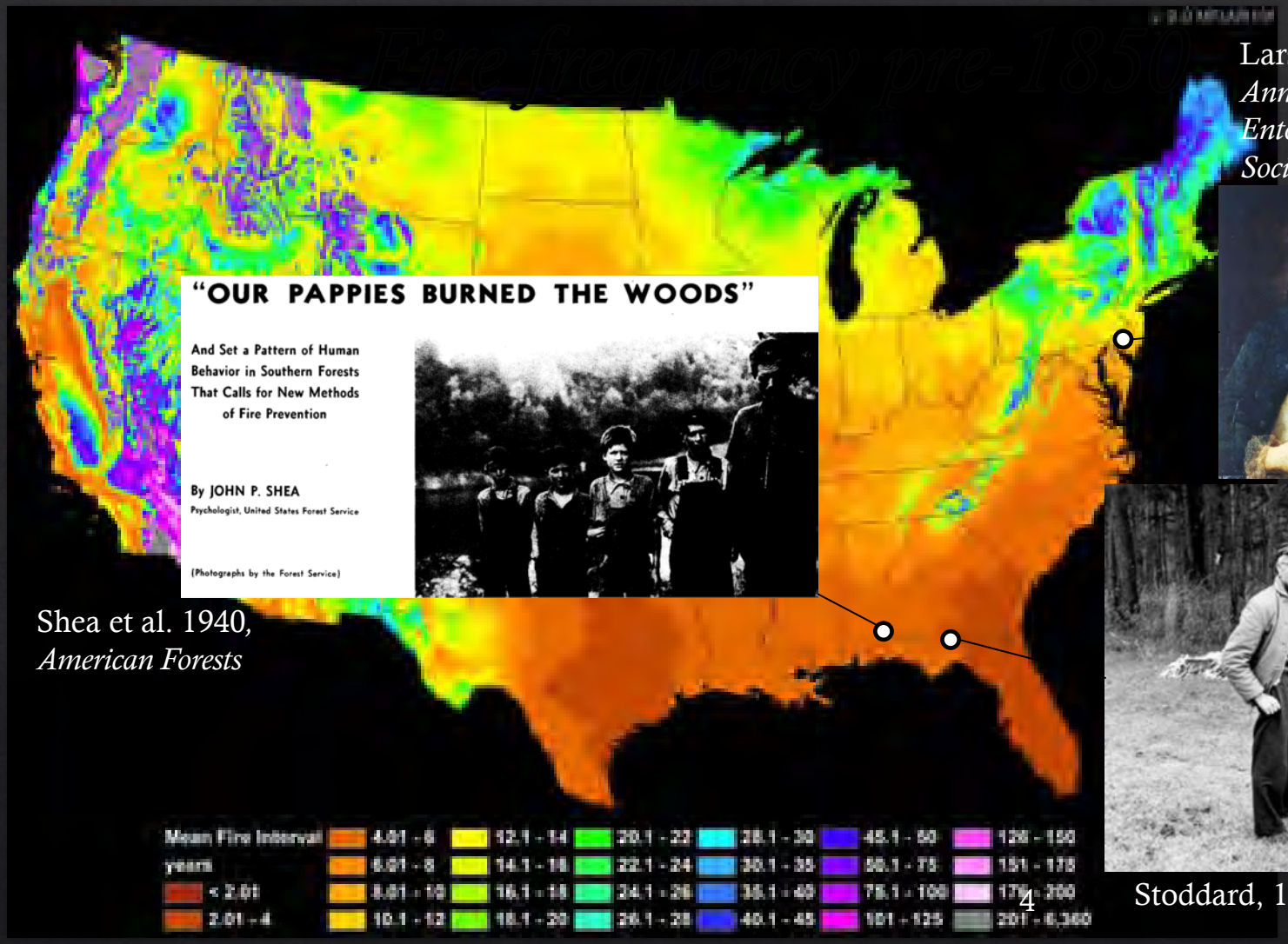
Fire frequency before 1850



Stambaugh et al. 2016

Fire frequency pre-1850



"OUR PAPPIES BURNED THE WOODS"

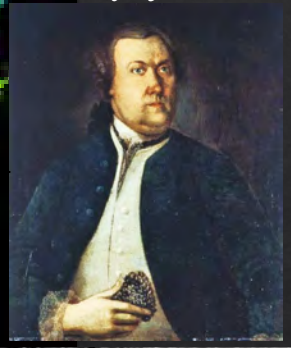
And Set a Pattern of Human Behavior in Southern Forests That Calls for New Methods of Fire Prevention

By JOHN P. SHEA
Psychologist, United States Forest Service

(Photographs by the Forest Service)

Shea et al. 1940, *American Forests*

Larsen 1955, *Annals of the Entomological Society of America*



Stoddard, 1969, (Memoir)

Decline in fire

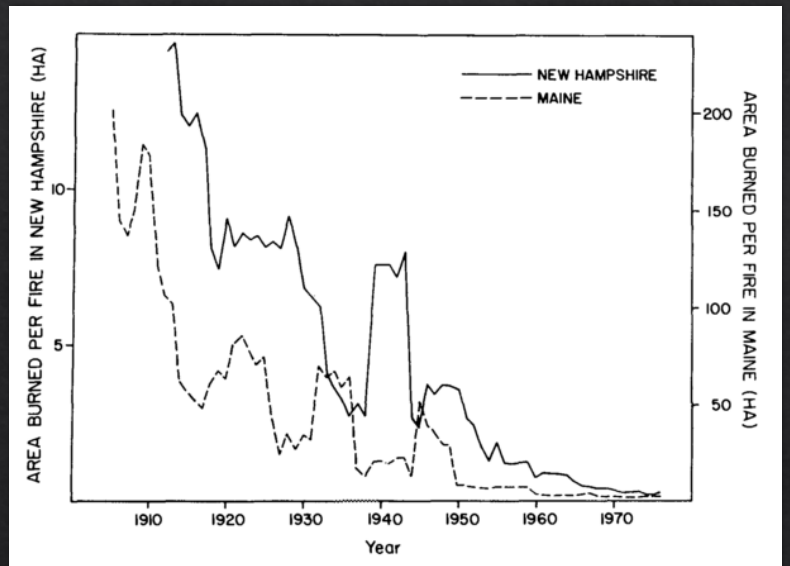


Fig. 2. Five-year running averages of area burned per fire in New Hampshire (1910–1978) and Maine (1903–1978). Note the difference in scale between the two States.

Fahey, 1981, *Torrey Botanical Club*

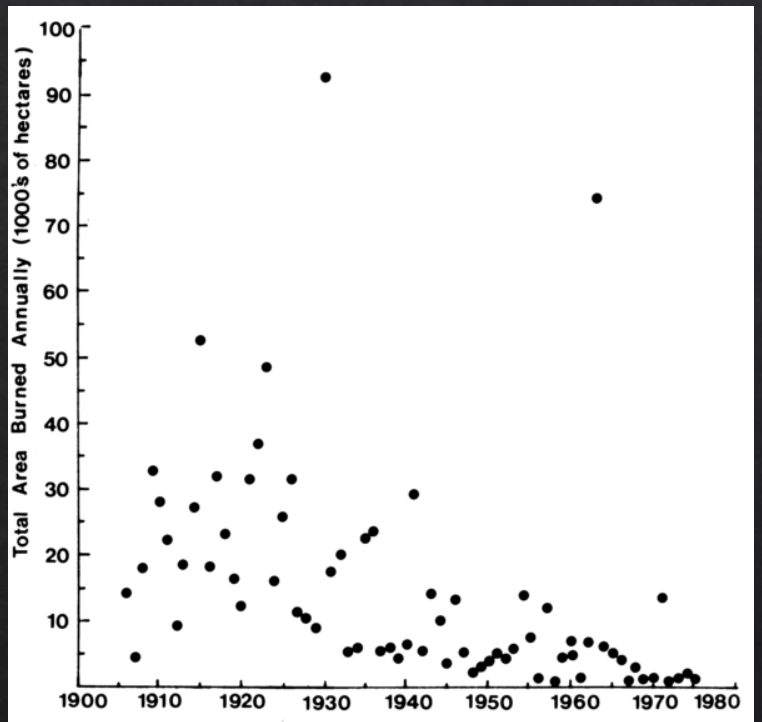
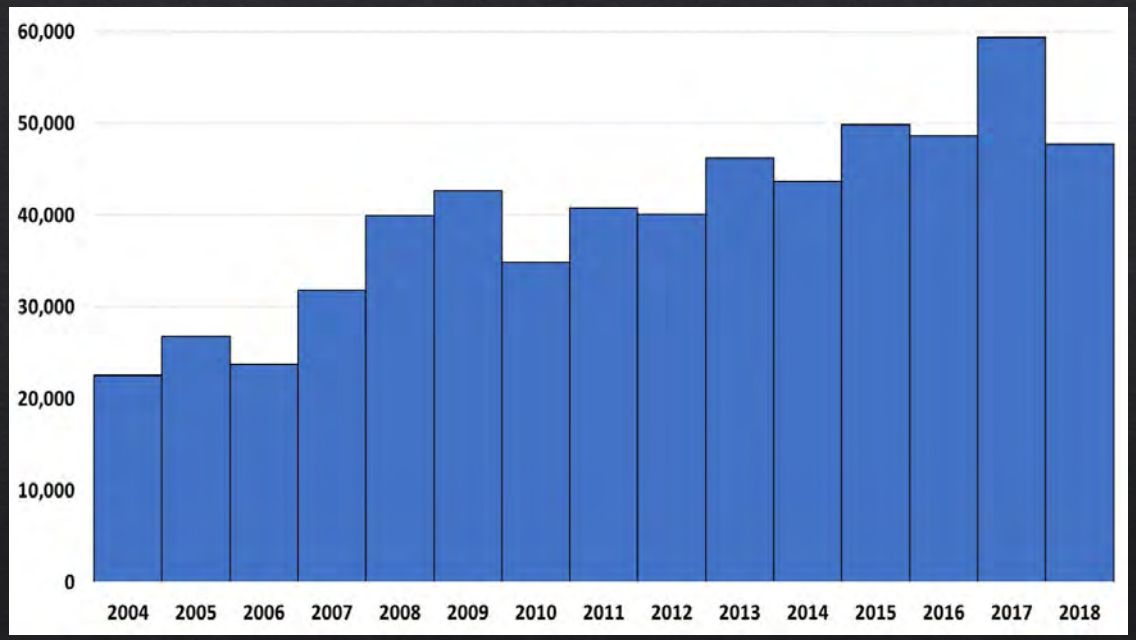


Fig. 3. Total area burned in the Pine Barrens since 1906.

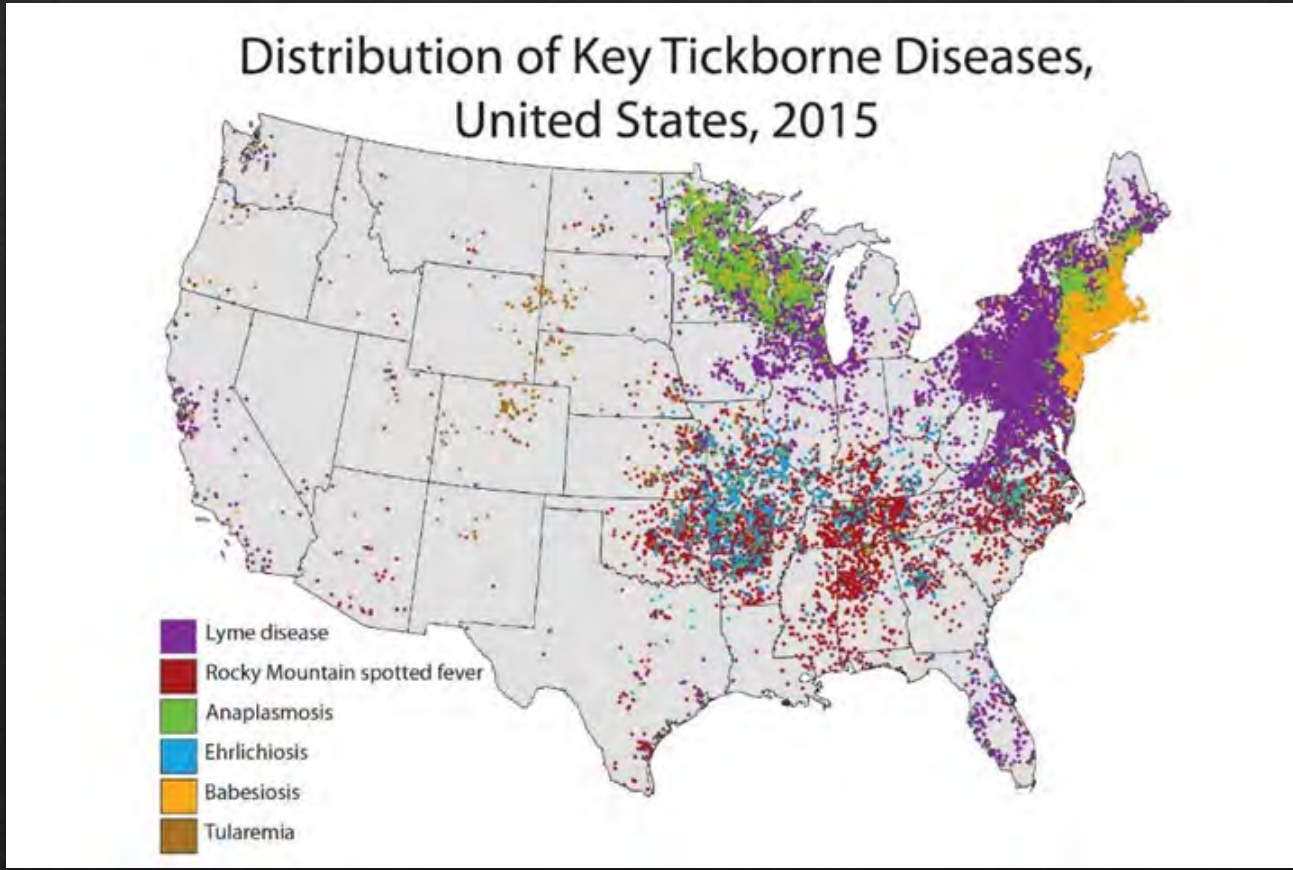
Forman and Boerner, 1981, *Torrey Botanical Club*

Reported Cases For Selected Tick-Borne diseases (2004-2018)

Total Cases Per Year



Gray and Herwaldt (2019); www.cdc.gov (2019)

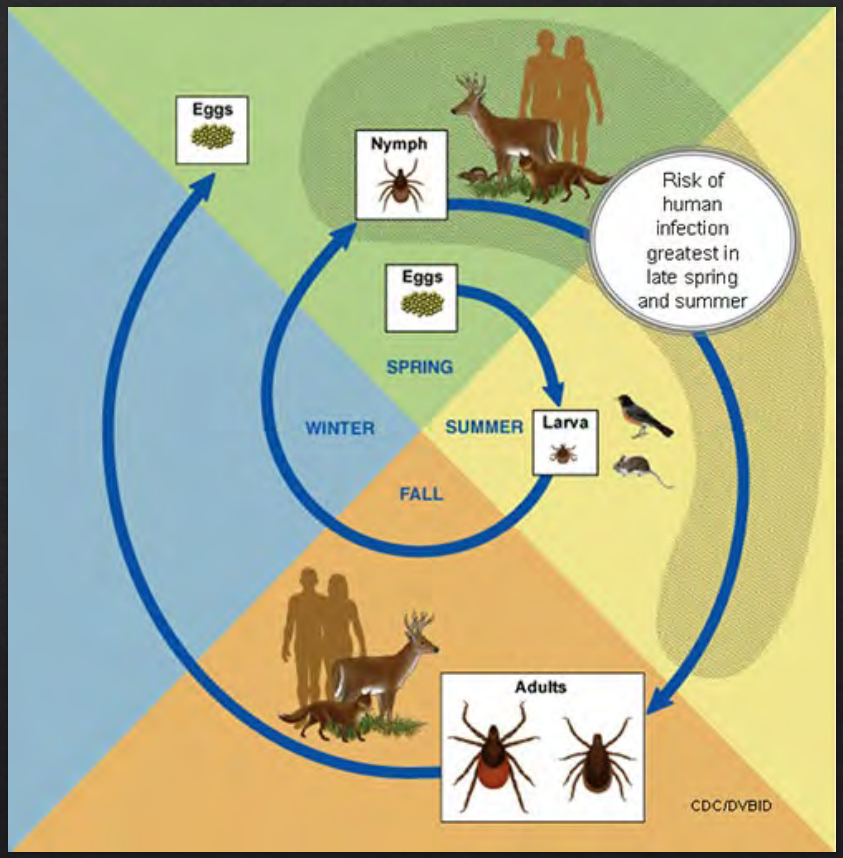

Distribution of Key Tickborne Diseases,
United States, 2015
Lyme disease
Rocky Mountain spotted fever
Anaplasmosis
Ehrlichiosis
Babesiosis
Tularemia

(cdc.gov)

Tick-borne diseases of the US, their vectors and primary regions (Source: www.cdc.gov).

Disease	Agent	Vector	NE	MW	SE
Alpha-gal syndrome	galactose-α-1,3-galactose molecule	Presumably Amblyomma americanum		•	•
Anaplasmosis	Anaplasma phagocytophilium	Ixodes scapularis	•	•	
Babesiosis	Babesia microti	I. scapularis	•	•	
Borrelia miyamotoi Disease	Borrelia miyamotoi	I. scapularis	•	•	
Ehrlichiosis	Ehrlichia chaffeensis	A. americanum	•	•	•
	Ehrlichia ewingii	A. americanum	•		•
	Ehrlichia muris eauclairensis	I. scapularis		•	
Heartland Virus	Heartland virus	A. americanum		•	
Bourbon Virus Disease	Bourbon virus	Presumably A.americanum		•	
Powassan Virus Disease	Powassan virus	I. scapularis, I. marxi, I. cookei	•	•	•
Rocky Mountain Spotted Fever	Rickettsia rickettsii	D.variabilis	•	•	•
Ricketsia parkeri Rickettsiosis	Rickettsia parkeri	A. maculatum	•		
Tickborne Relapsing Fever	B. turicatae	O. turicata	•	•	•
Tularemia	Francisella tularensis	D. variabilis, A. americanum		•	
Lyme Disease	Borrelia burgdorferi	I. scapularis	•	•	•
	Borrelia mayonii	I. scapularis	•	•	
Southern Tick-Associated Rash Illness (STARI)	Unknown	A. americanum			•

How could fire impact ticks?



Does dormant season fire impact ticks?

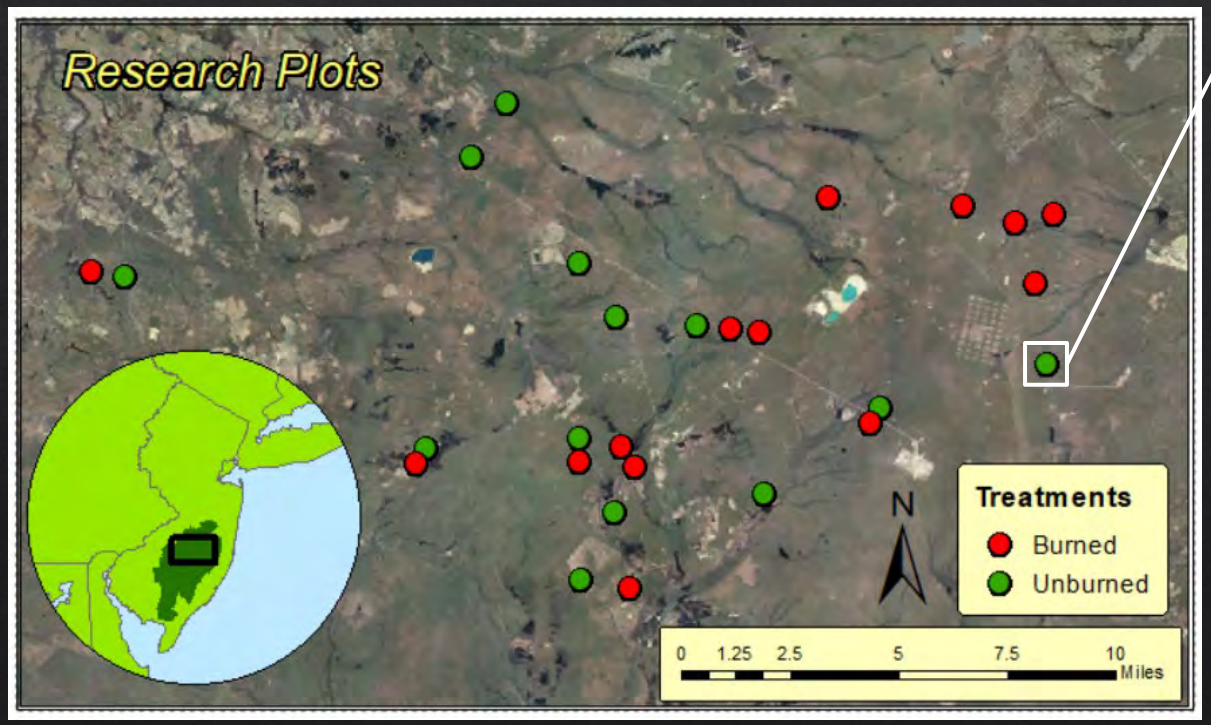
Populations?

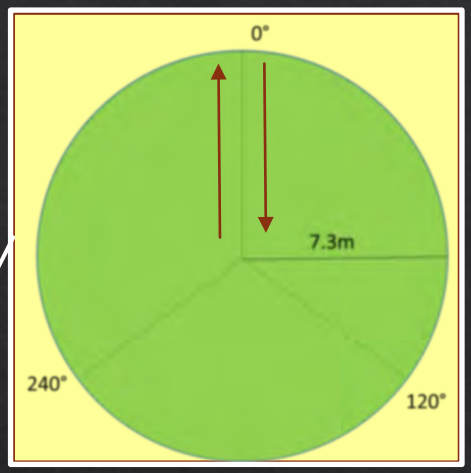
Disease prevalence?

Habitat?

Does dormant season fire impact ticks?

Populations?
Disease prevalence?
Habitat?

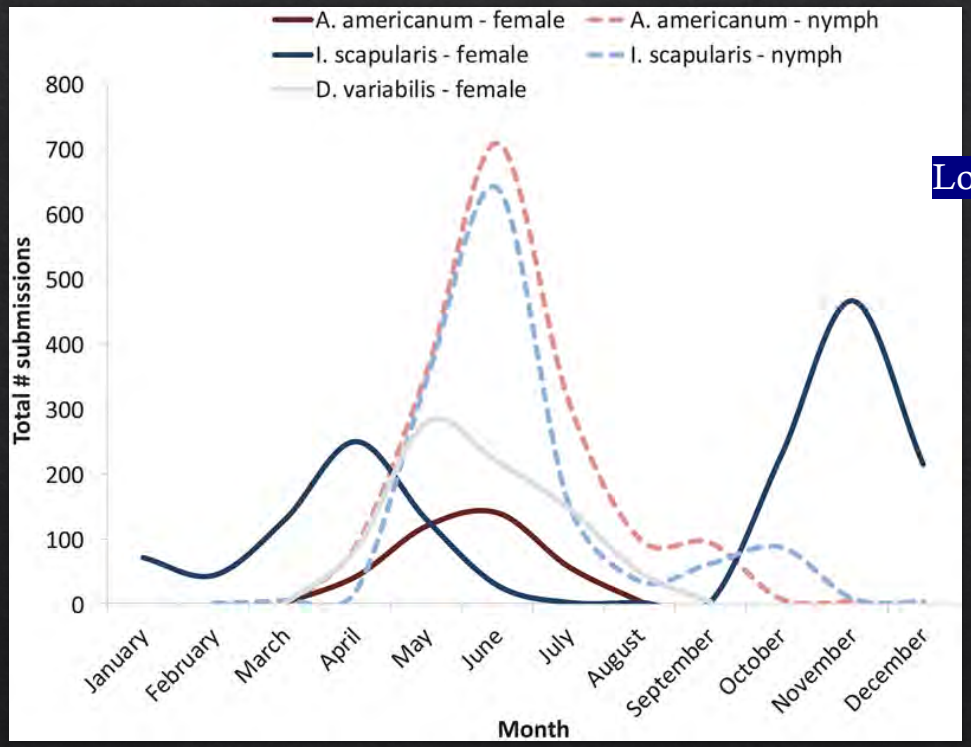




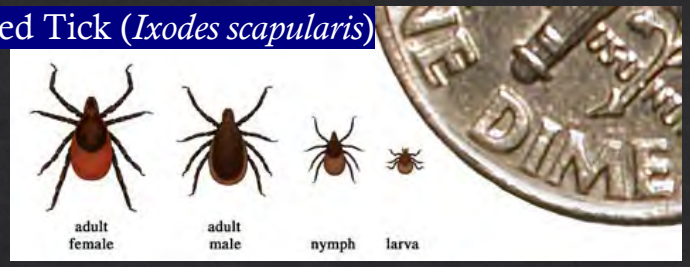
Additional Fire Characterization

Fire Excluded	Low Severity	Mod. Severity	High Severity

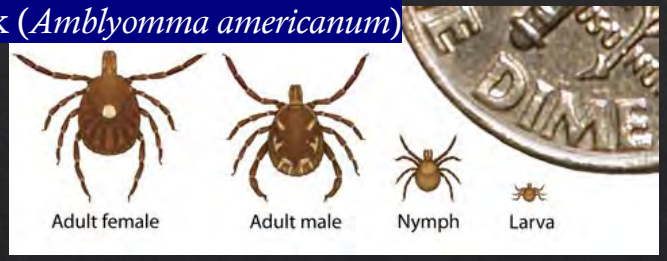
Sample Timing



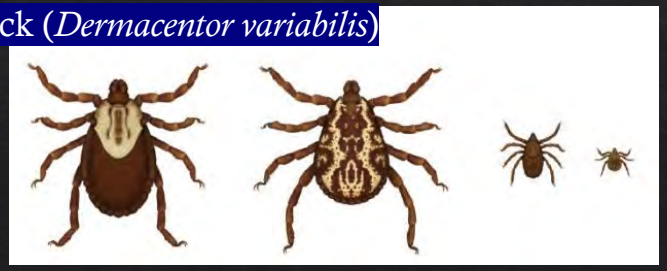
Blacklegged Tick (*Ixodes scapularis*)

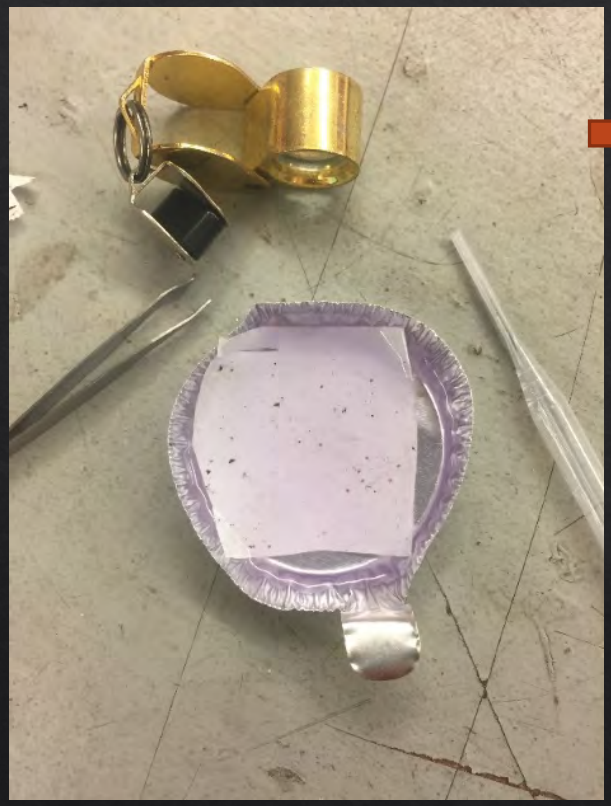


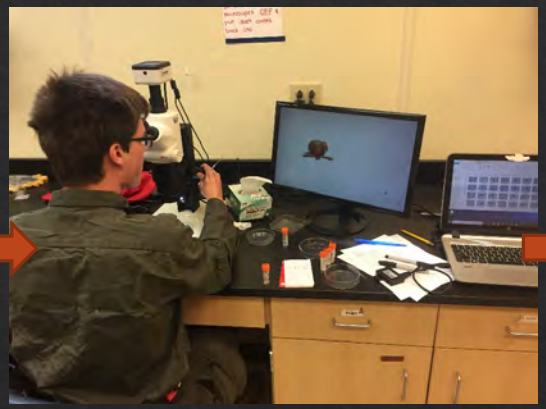
Lone Star Tick (*Amblyomma americanum*)

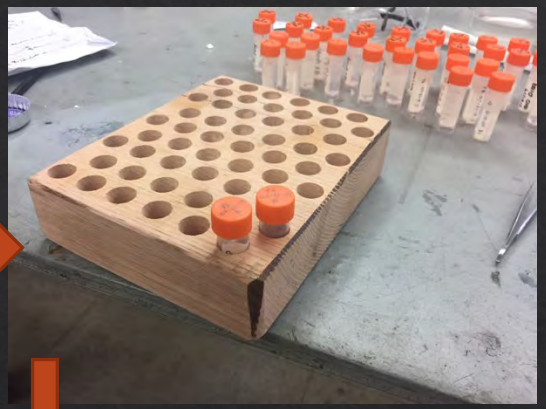


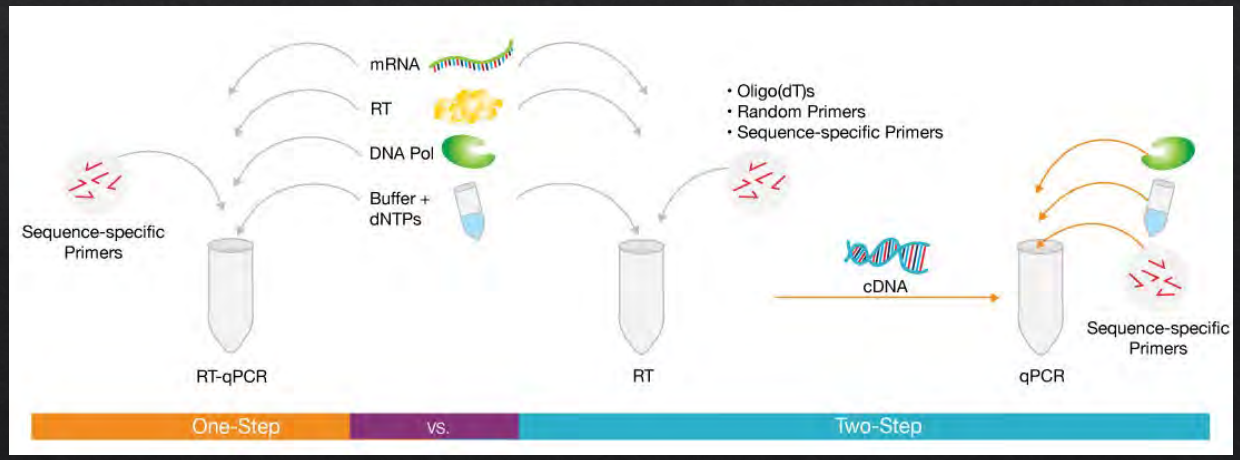
Dog Tick (*Dermacentor variabilis*)





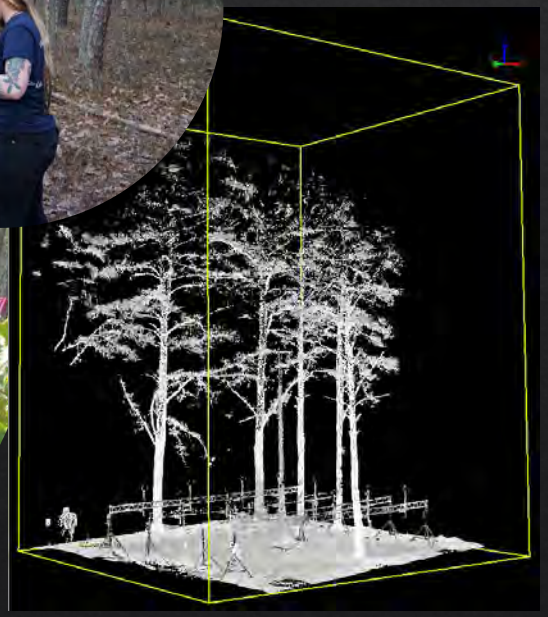




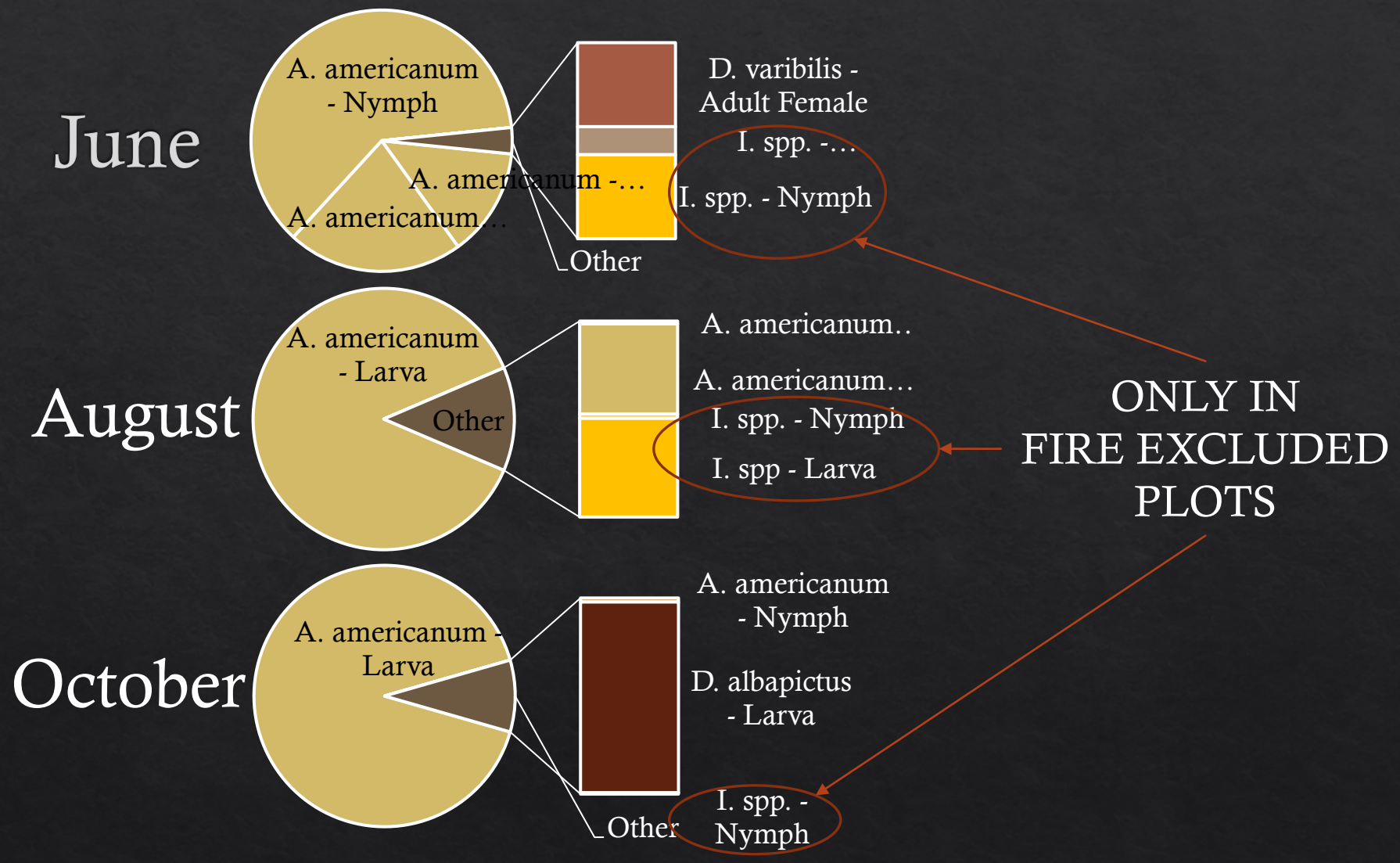

mRNA
RT
DNA Pol
Buffer + dNTPs
Sequence-specific Primers
RT-qPCR
• Oligo(dT)s
• Random Primers
• Sequence-specific Primers
RT
cDNA
qPCR
Sequence-specific Primers
One-Step
vs.
Two-Step

Vegetation and Microclimate Measurements

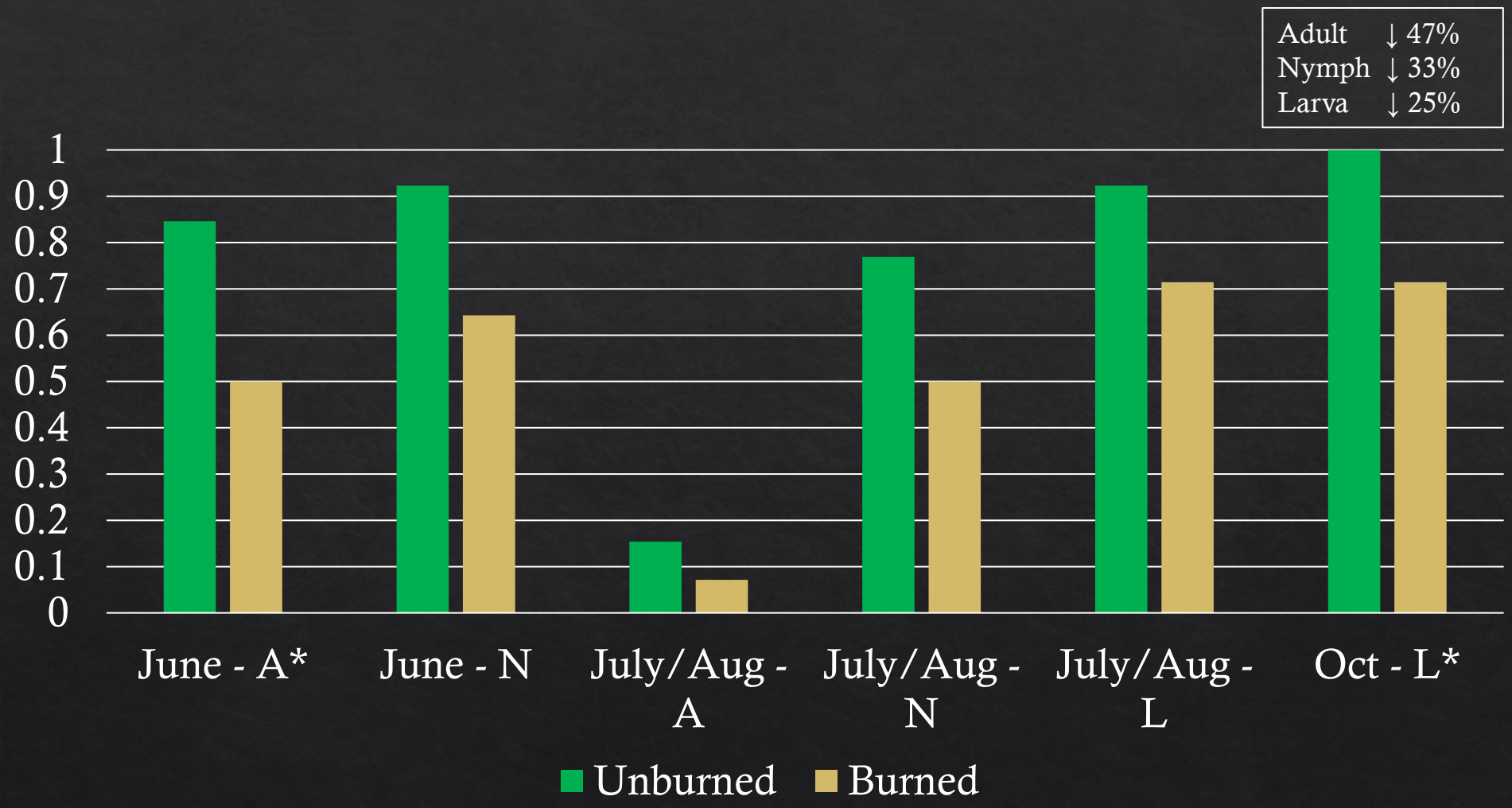
- Trees
- Shrubs
- Litter
- Duff



- Temp
- RH

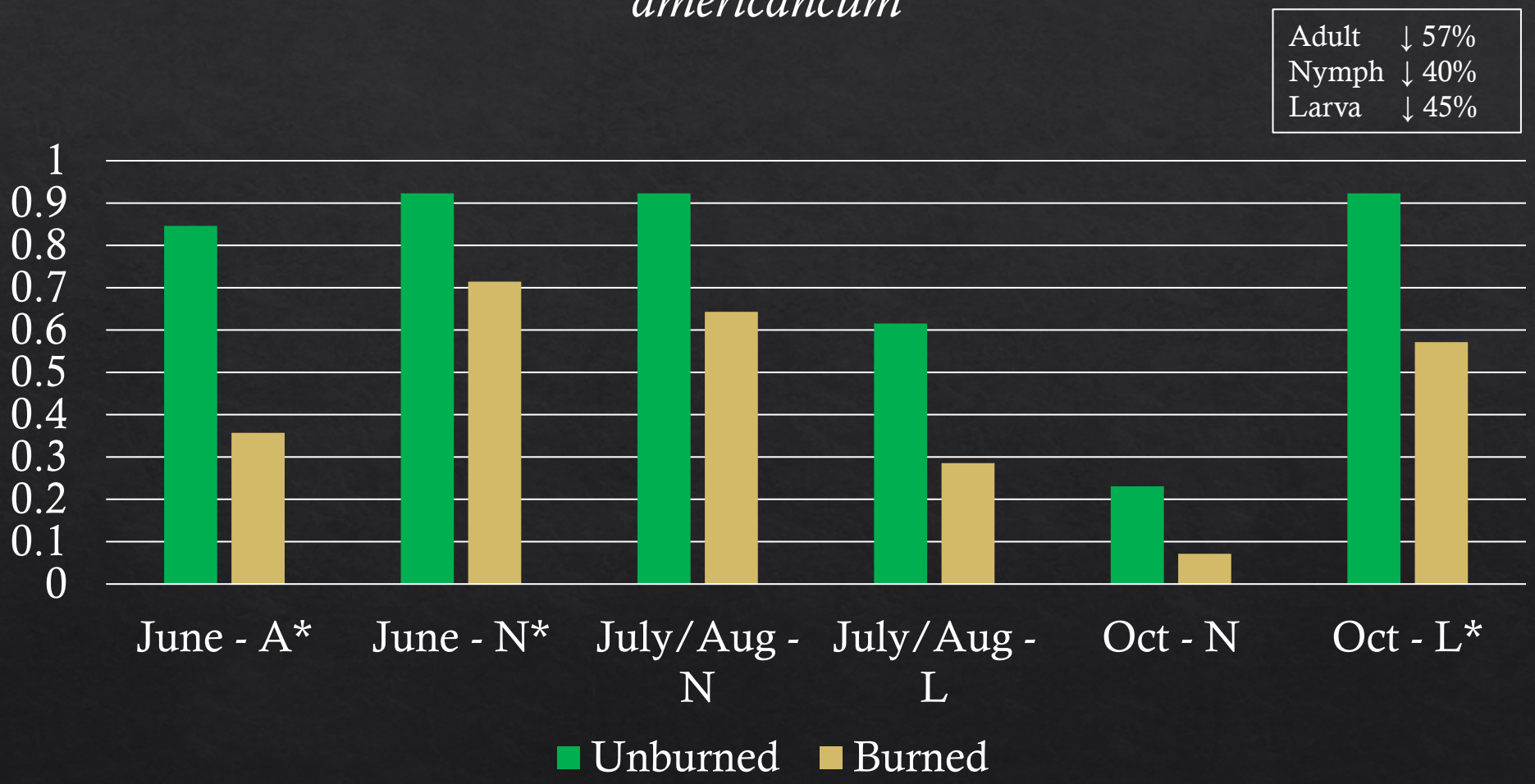

June
A. americanum - Nymph
A. americanum -…
A. americanum…
Other
D. varibilis - Adult Female
I. spp. -…
I. spp. - Nymph
August
A. americanum - Larva
Other
A. americanum..
A. americanum…
I. spp. - Nymph
I. spp - Larva
October
A. americanum - Larva
Other
A. americanum - Nymph
D. albapictus - Larva
I. spp. - Nymph
ONLY IN FIRE EXCLUDED PLOTS

2019 - Probability of encountering 1 or more *A. americancum*

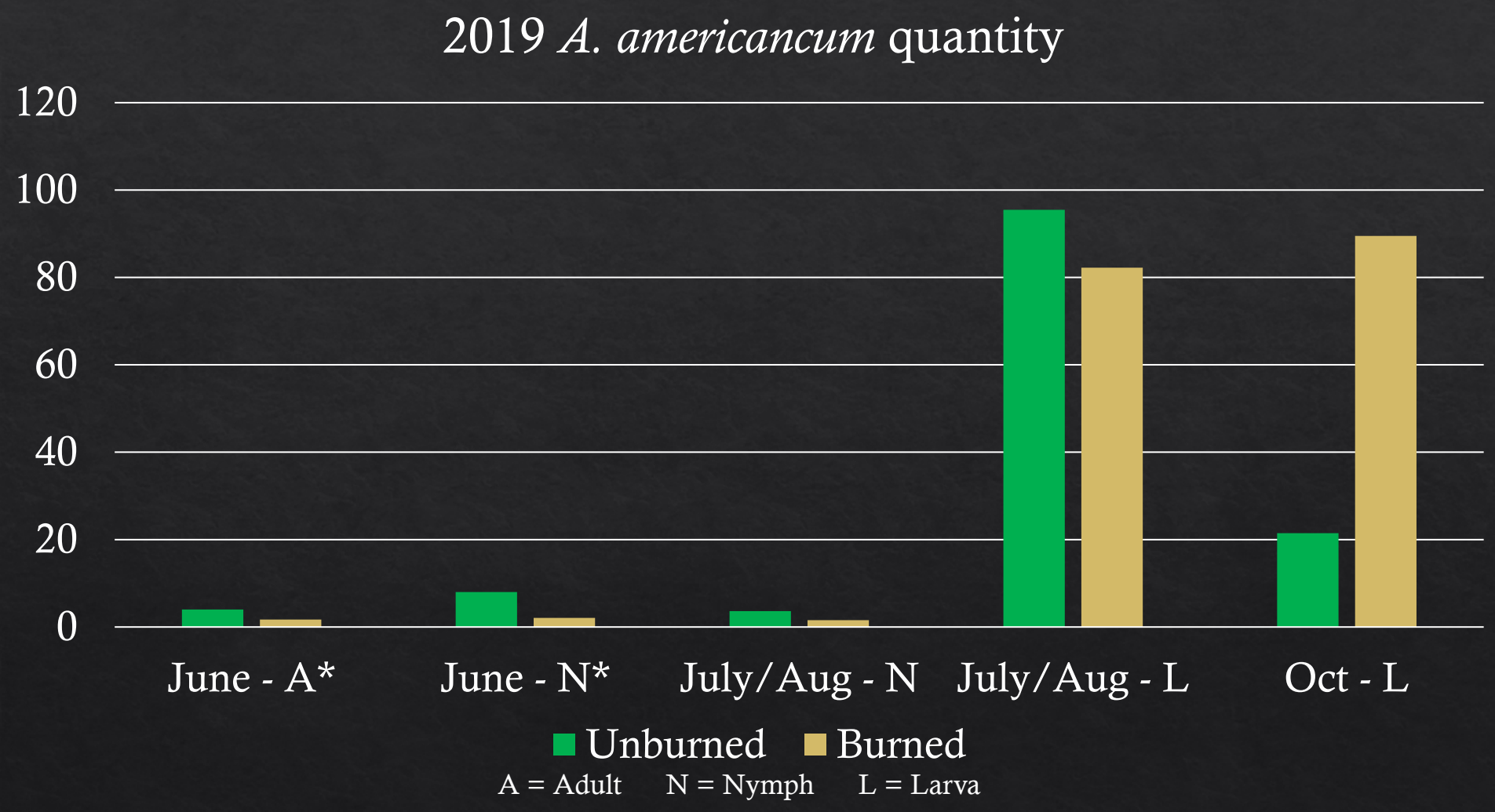


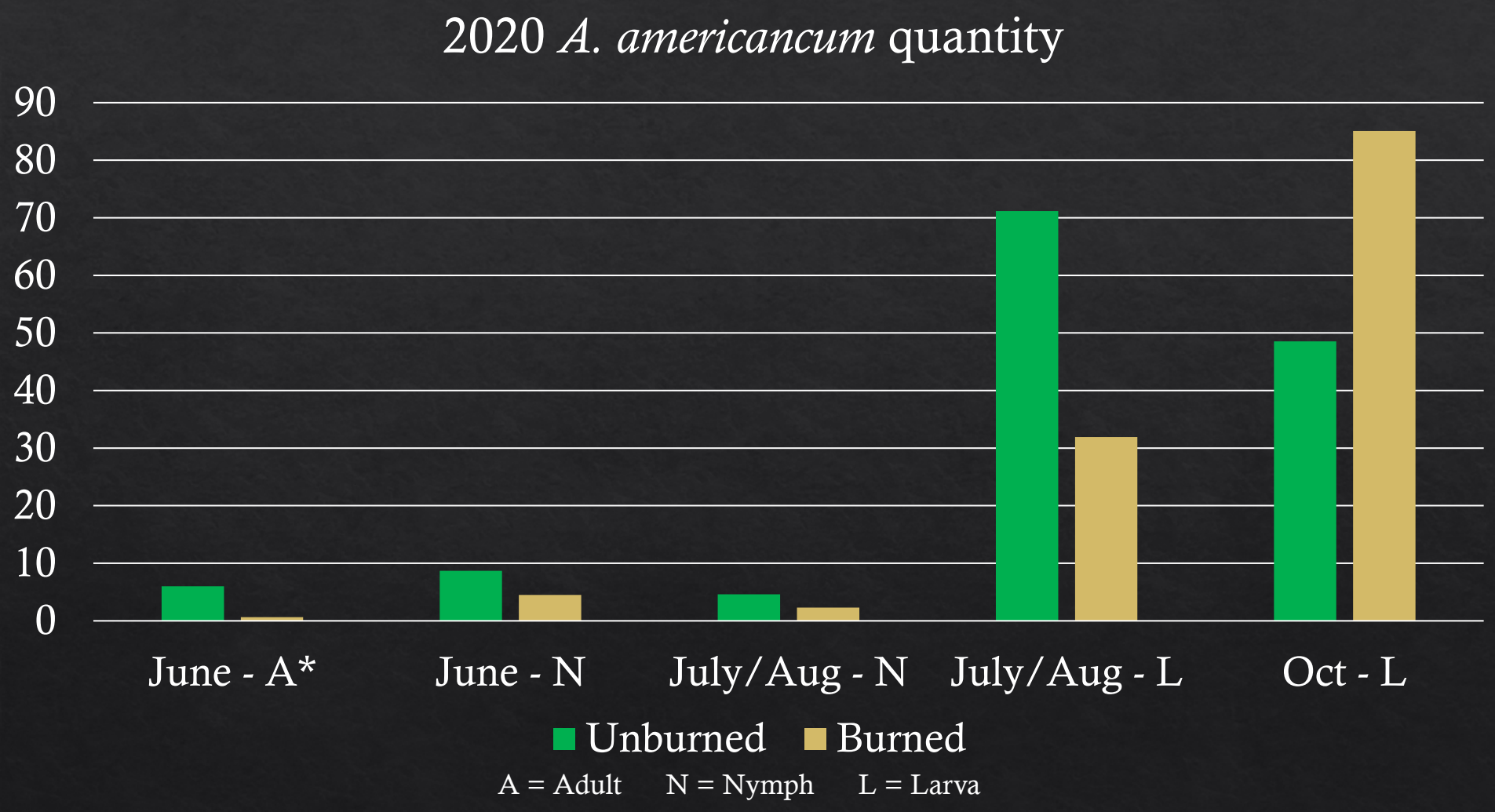
A = Adult N = Nymph L = Larva

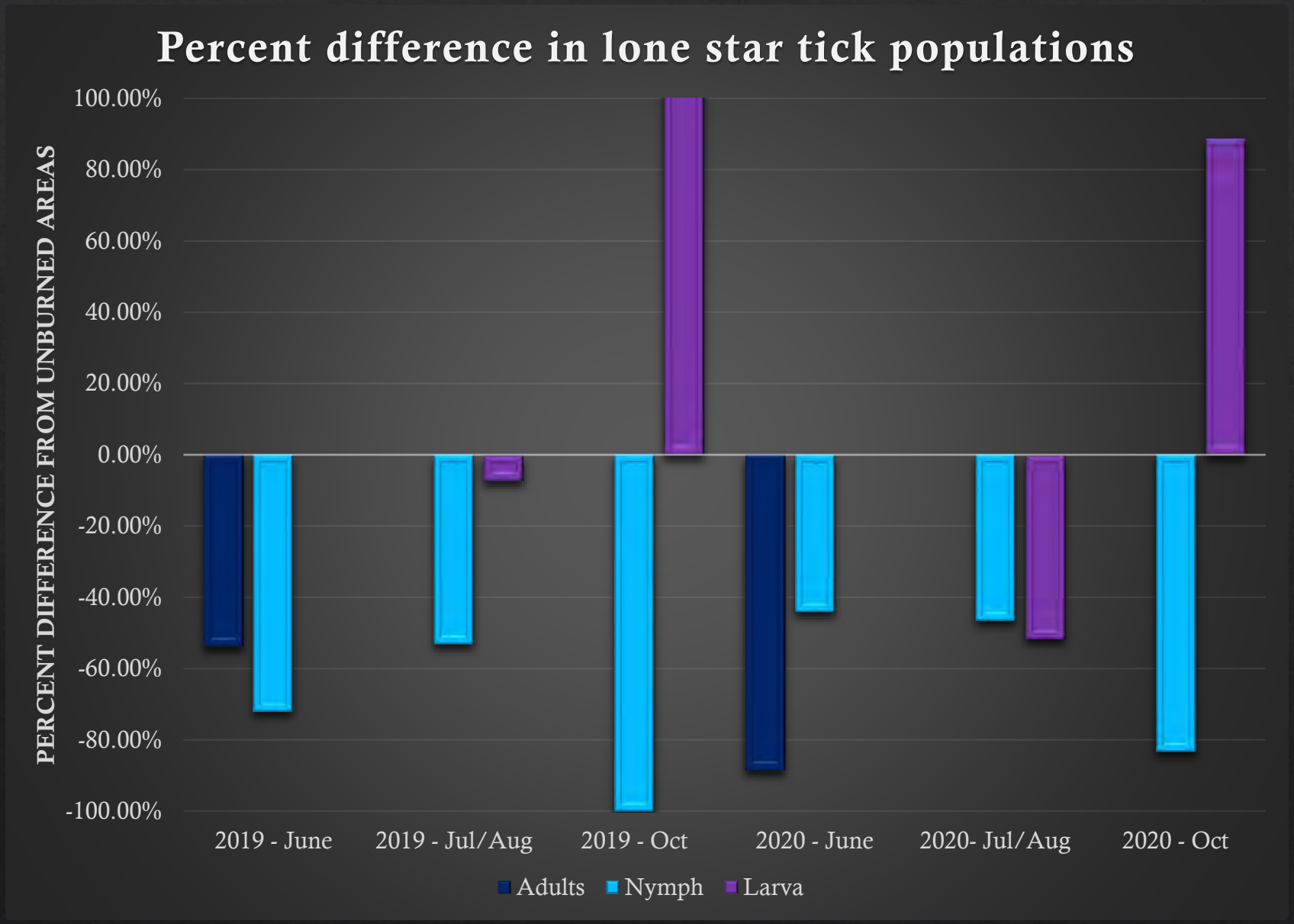
2020 - Probability of encountering 1 or more *A. americancum*



A = Adult N = Nymph L = Larva


2019 A. americancum quantity
120
100
80
60
40
20
0
June - A*
June - N*
July/Aug - N
July/Aug - L
Oct - L
Unburned
Burned
A = Adult
N = Nymph
L = Larva


2020 A. americancum quantity
90
80
70
60
50
40
30
20
10
0
June - A*
June - N
July/Aug - N
July/Aug - L
Oct - L
Unburned
Burned
A = Adult
N = Nymph
L = Larva

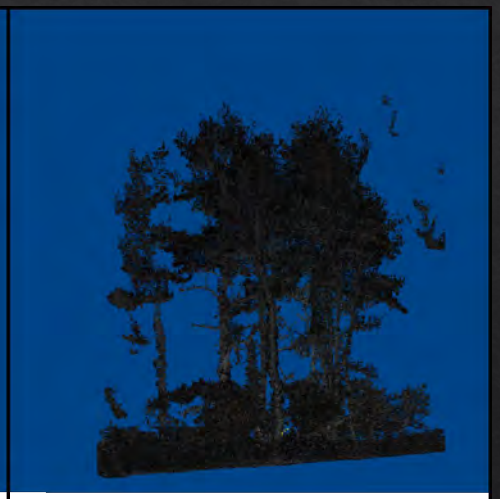

Percent difference in lone star tick populations
PERCENT DIFFERENCE FROM UNBURNED AREAS
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
-20.00%
-40.00%
-60.00%
-80.00%
-100.00%
2019 - June
2019 - Jul/Aug
2019 - Oct
2020 - June
2020- Jul/Aug
2020 - Oct
Adults
Nymph
Larva

Forest Structure Differences

Quoexin - Annual Burn Plot

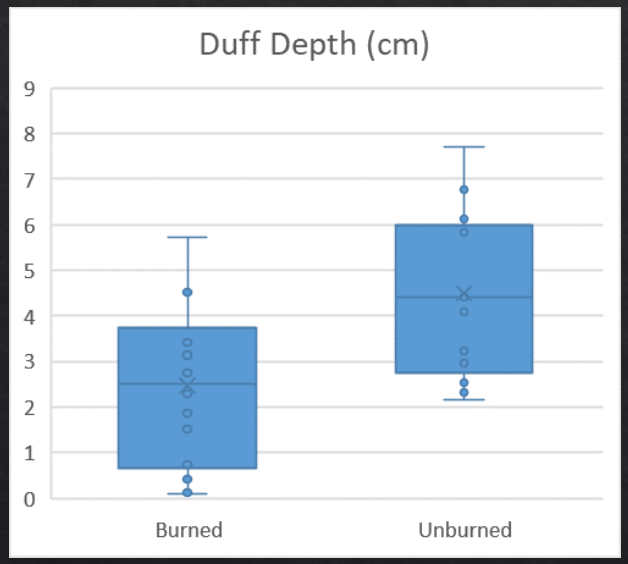
Quoexin – Fire Excluded

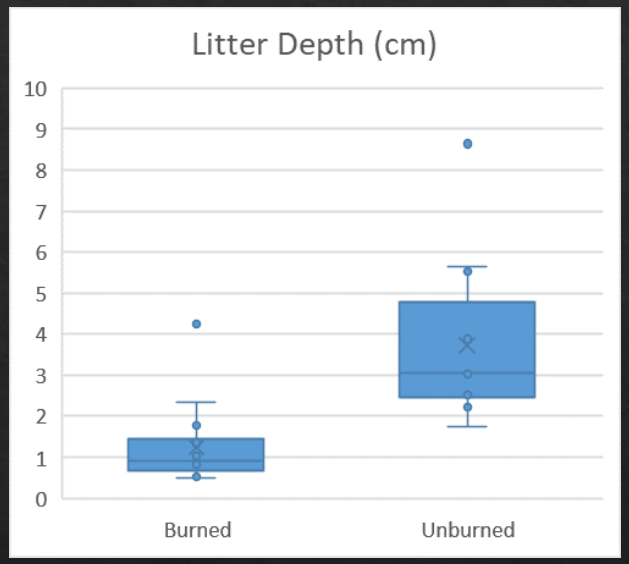
Lee Bros - Annual Burn Plot

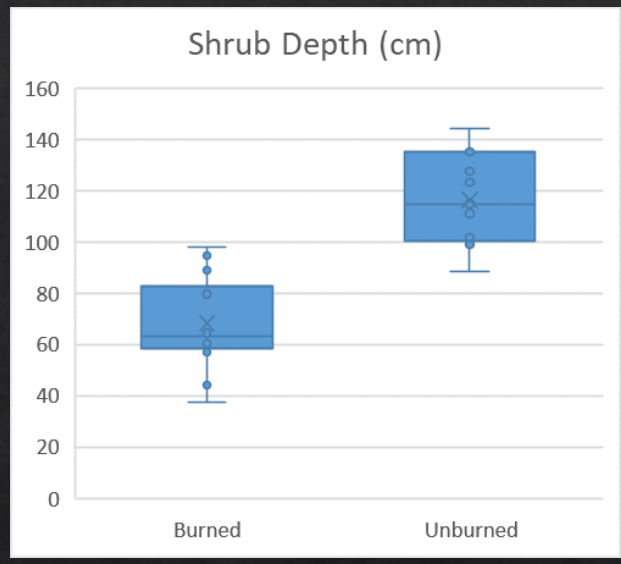


Eagle – Fire Excluded

Significant Differences in Habitat Structure

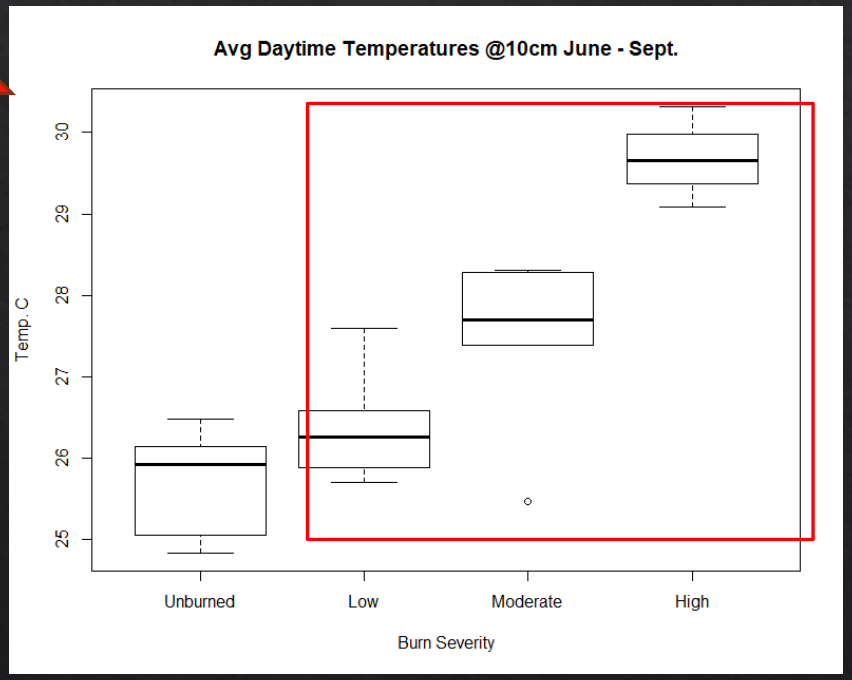




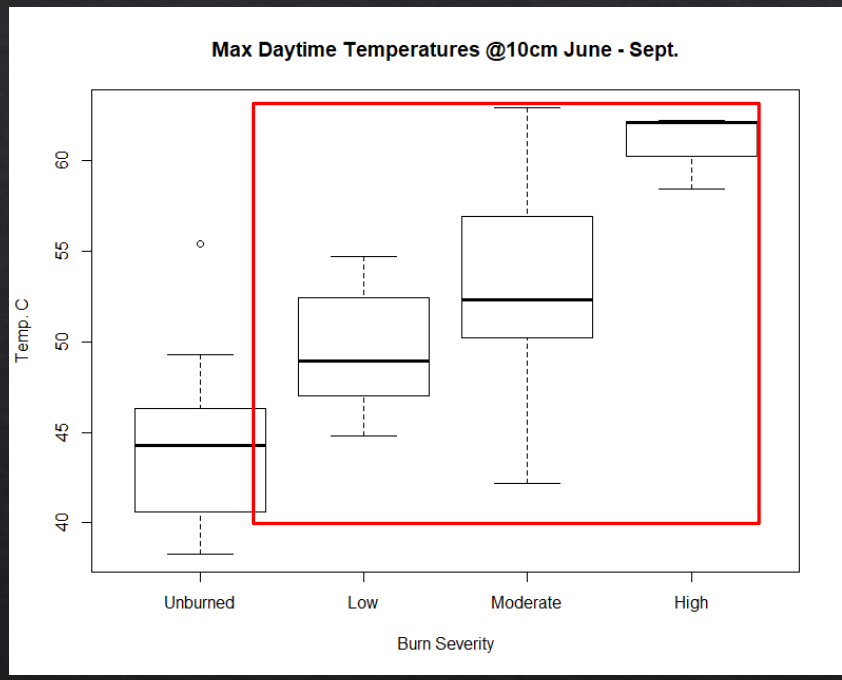


Temperature

DAYTIME TEMP.

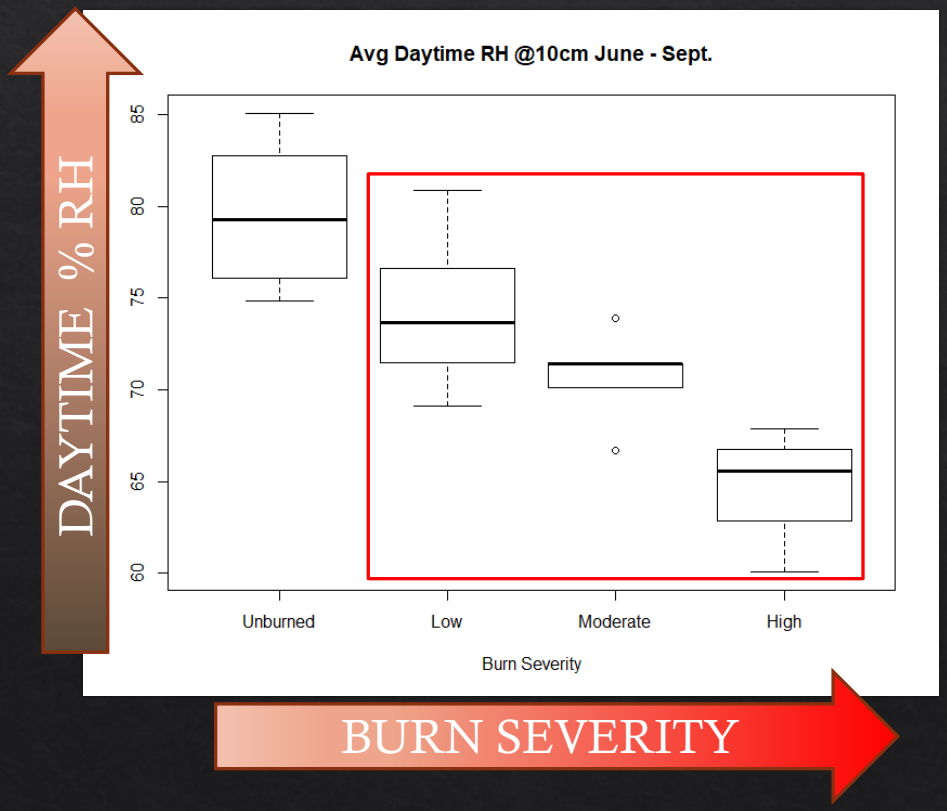


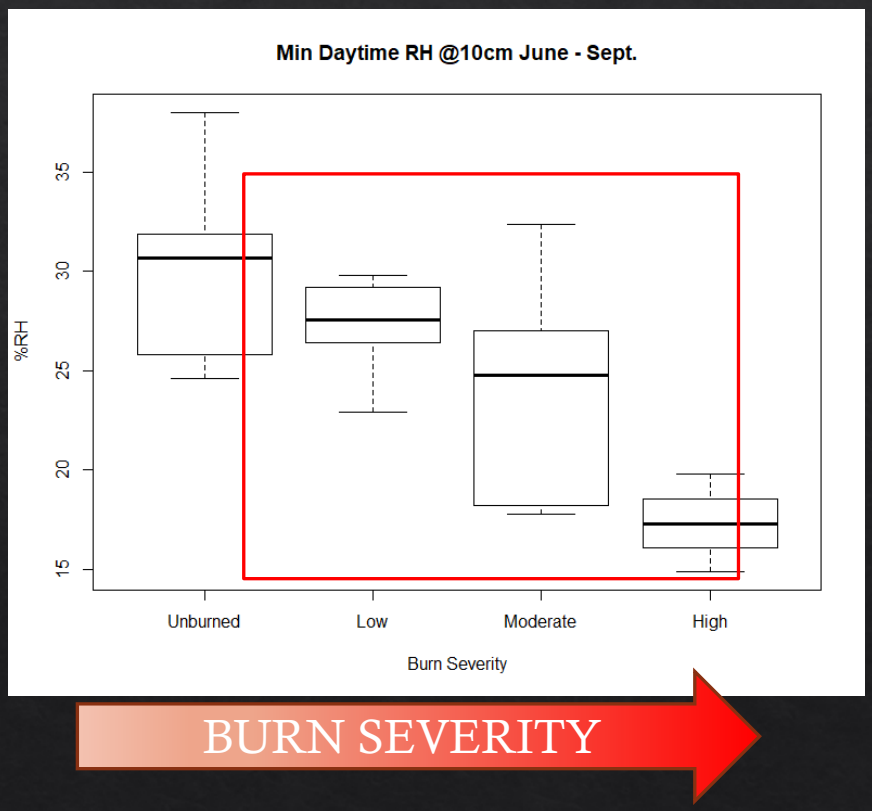
BURN SEVERITY



BURN SEVERITY

Relative Humidity



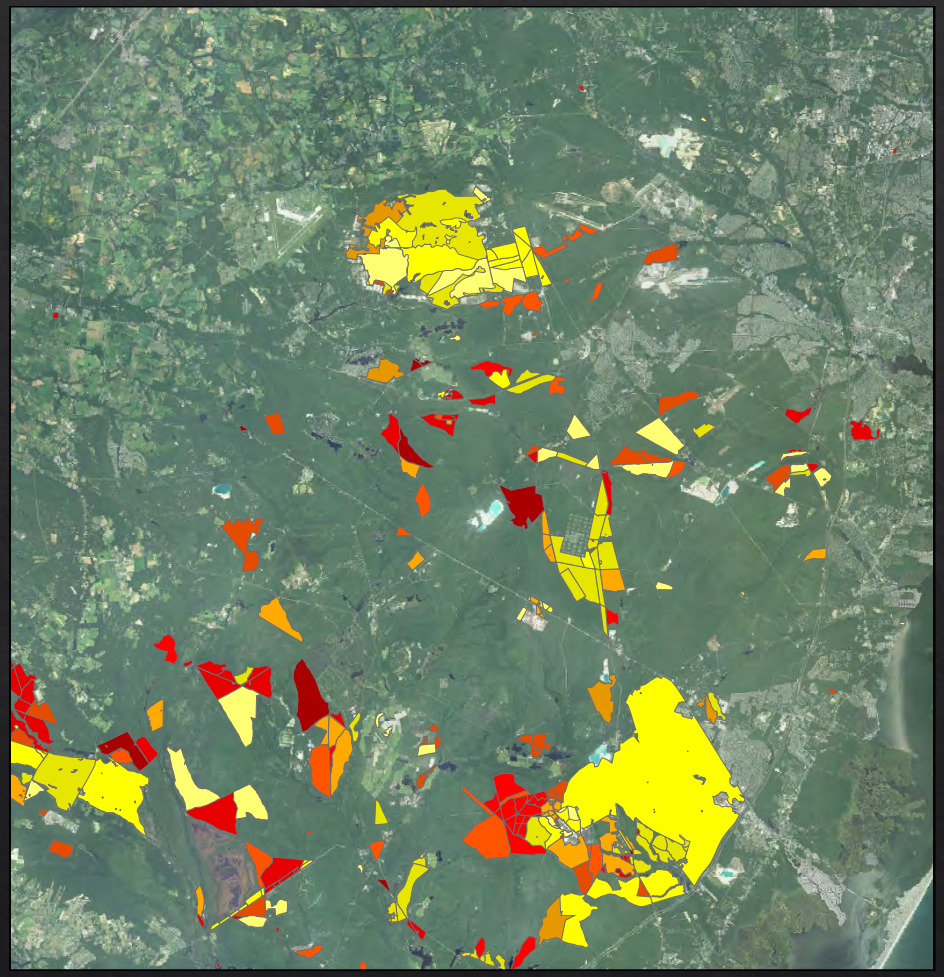


PCR Results 2019

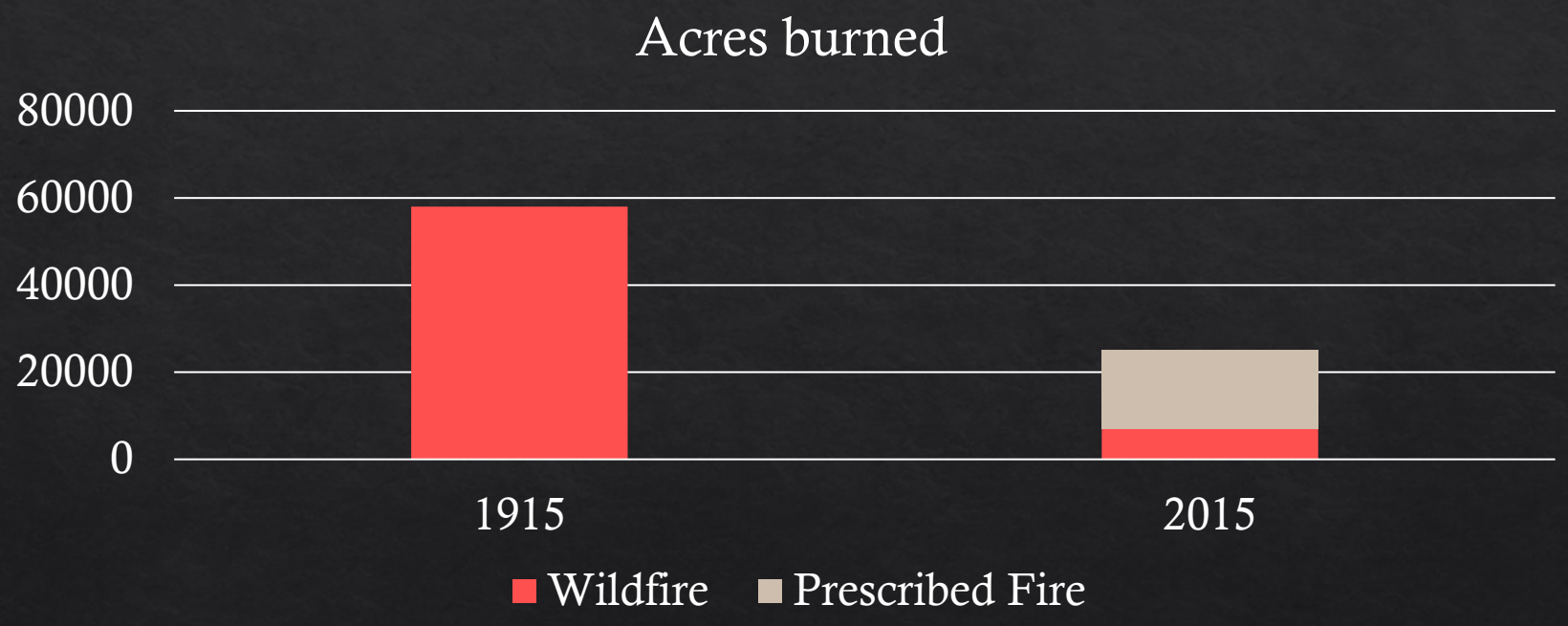
		N	R. ambly	E. chaff	E. ewing
Adult		78	35.8%	2.5%	16.6%
Nymph		208	30.2%	3.3%	2.8%
All AA		286	31.8%	3.1%	6.6%

Summary

- Prescribed fire generally reduces ticks for at least 2 growing seasons
- Lone star ticks appear to dominate in forest environments and carry different diseases than black-legged ticks
- Prescribed fire changes tick habitat, potentially impacting their lifecycle strategies



Change in Fire in NJ 1915-2015



At a landscape scale…

1.4 million acres in the Pinelands

62% is upland forest = 860,000 acres

In 1915, 65,000 acres burned annually

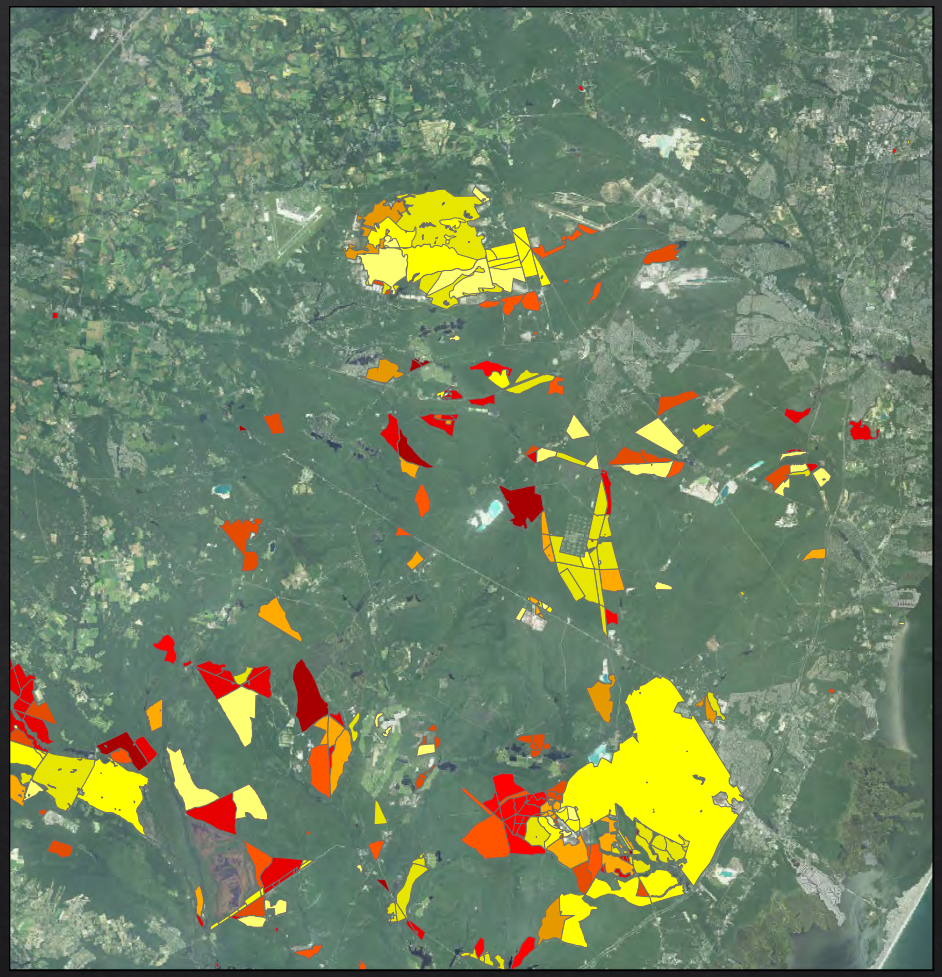
Most managers feel fire effects last for 4-8 years

This would mean to 26,000-560,000 acres of tick habitat impacted at a time during historic burning conditions (or 30-60% of the landscape).

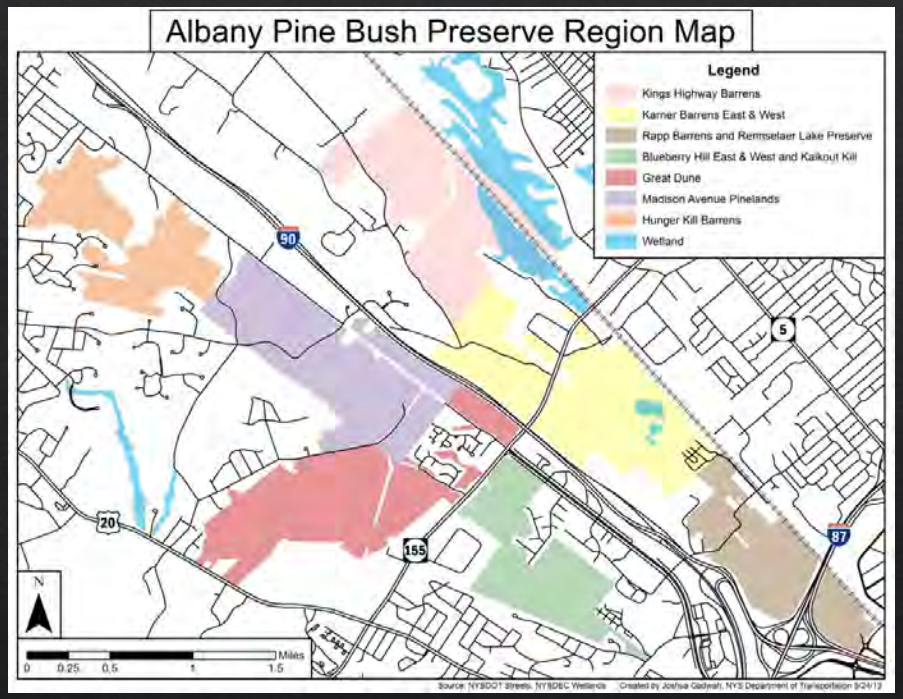
A 50% reduction rate in ticks would mean 15-30% decreases in *A. americanum*.

100% reduction for *I. scapularis* would mean a 30-60% reduction.

2015



Albany, NY


Albany Pine Bush Preserve Region Map
Legend
Kings Highway Barrens
Karner Barrens East & West
Rapp Barrens and Rensselaer Lake Preserve
Blueberry Hill East & West and Kaikout Kill
Great Dune
Madison Avenue Pinelands
Hunger Kill Barrens
Wetland
90
5
20
155
87
N
Miles
0
0.25
0.5
1
1.5

Medford, NJ

Tallahassee, FL

What role do wildlife play?

Contributors

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Erika Matchinger
Nathaniel Schmidt

Lexi Everland

Andrea Egizi
Julia Defeo

Greg McLaughlin
Jeremy Webber
Tom Gerber
Ben Brick

Quoexin Cranberry Company
Lee Brothers, Inc.
Moores Meadows
NJ Fish and Wildlife Service
Brendan T. Byrne State Forest
Bass River State Forest
NJ Conservation Foundation
New Jersey Natural Lands Trust