Forest Susceptibility to Southern Pine Beetle in the New Jersey Pinelands

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Outline

I. SPB Background

II. Forest structure and susceptibility

III. Data Methods

IV. Pinelands, North and South

V. Infested vs. uninfested stands

VI. SPB in wetland stands

Southern Pine Beetle

Dendroctonus frontalis Zimmerman (Coleoptera: Curculionidae)

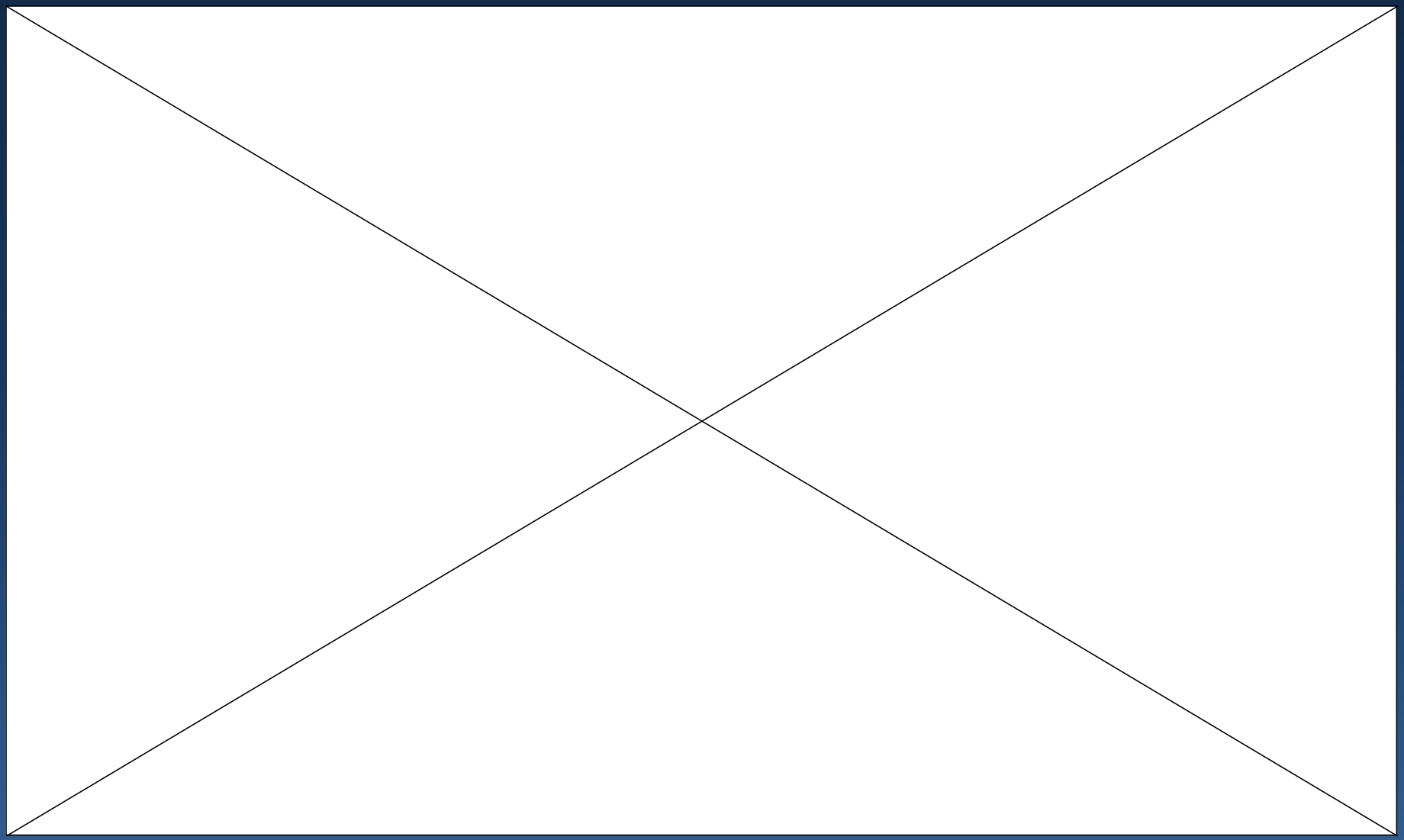
Southern Pine Beetle

Dendroctonus frontalis Zimmerman (Coleoptera: Curculionidae)

- A native insect pest historically occurring across the southern states
- Last recorded occurrence in New Jersey in the 1930s
- Current New Jersey outbreak began ~2002
- Few outbreaks in the south since the late 90s

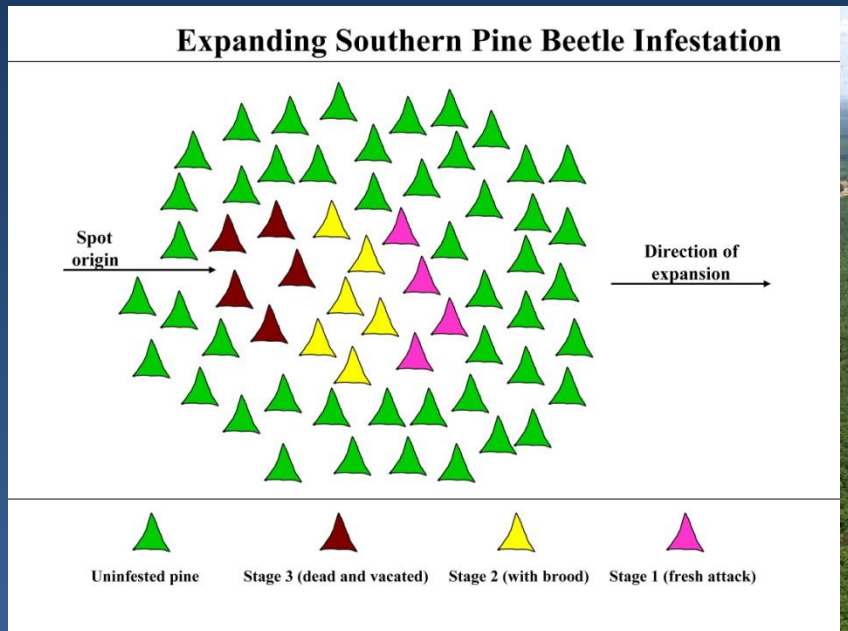
A Story About A Beetle

An excerpt from a video by Milo Johnson

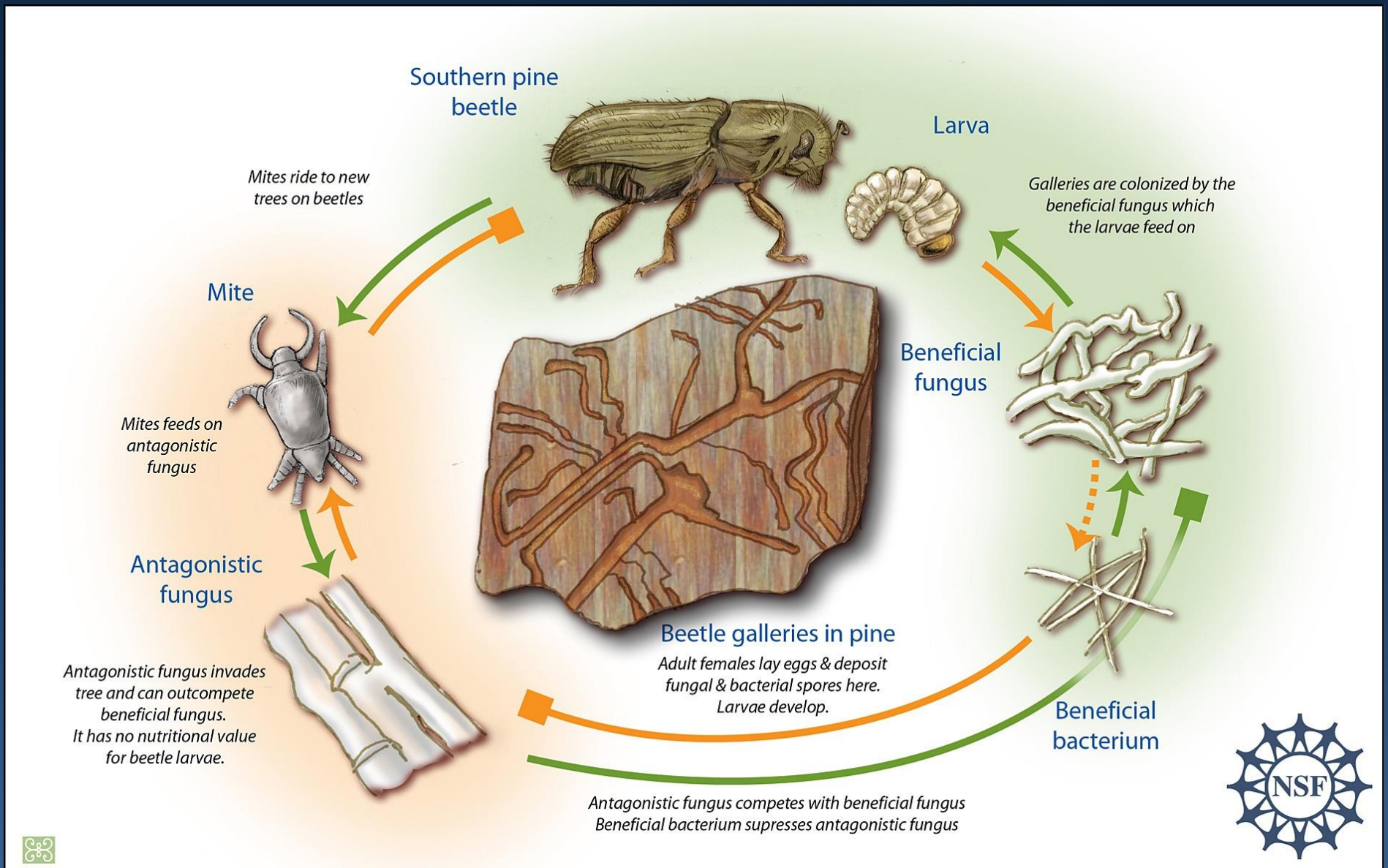


Southern Pine Beetle

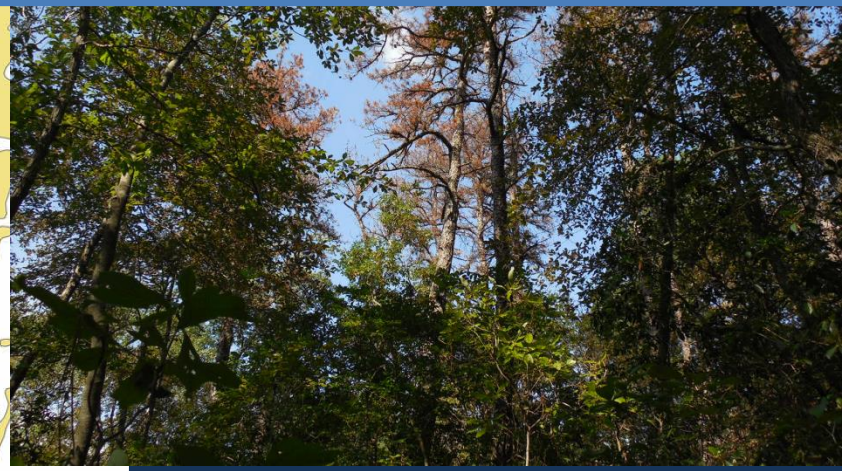
- Weakened tree enables beetles to get established
- SPB pheromones + pine tree volatiles = more beetles
- Mass attack strategy enables beetles to eventually overcome healthy trees
- Infestations occur in discrete “spots”
- Multiple generations during a summer enable spots to grow
- An “outbreaking” pest



Southern Pine Beetle Community

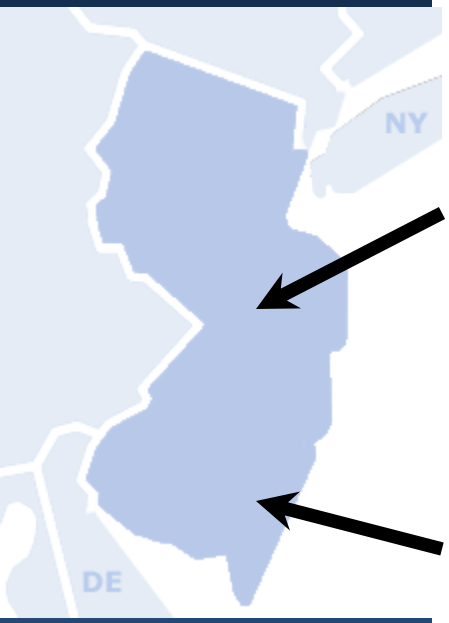


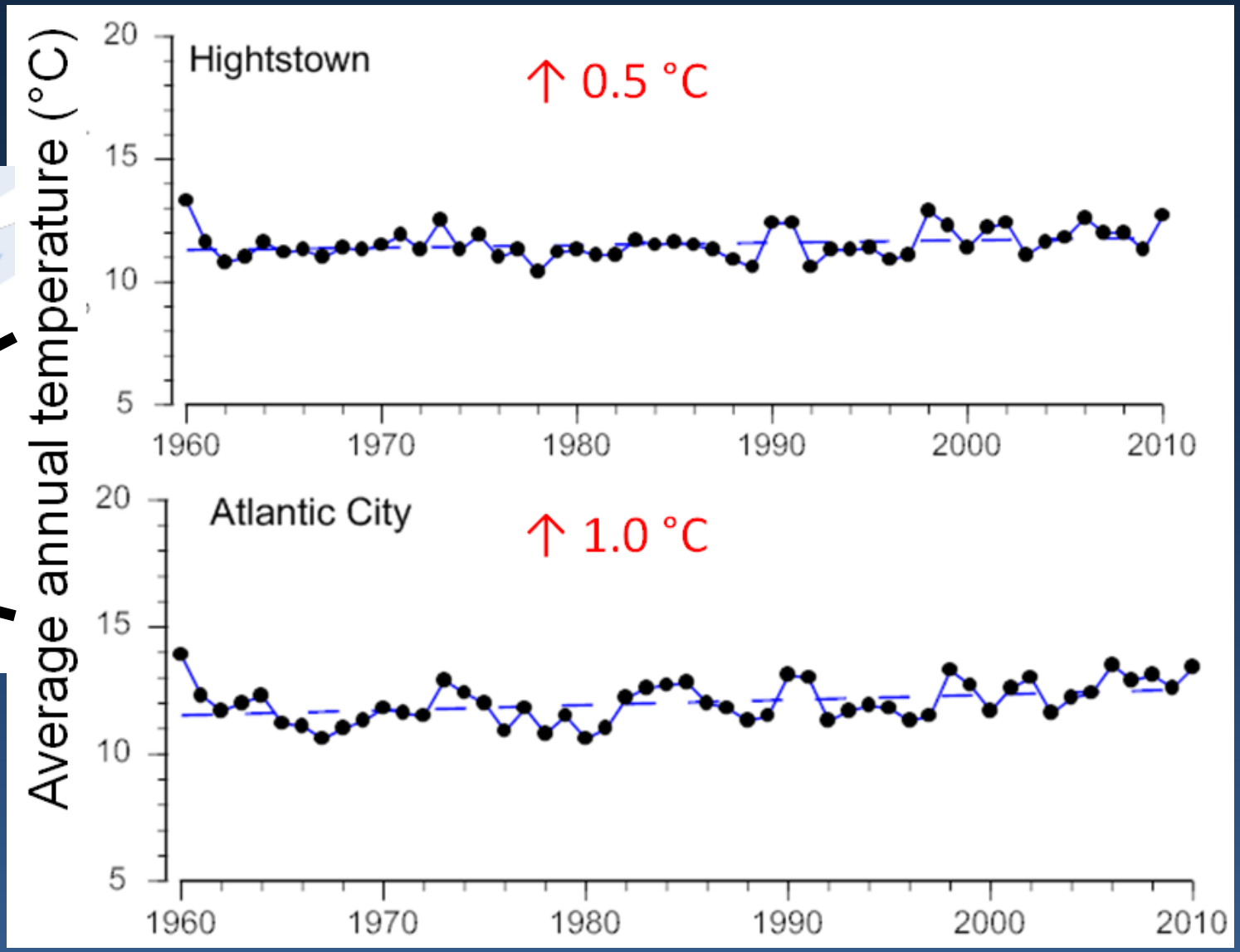
Southern Pine Beetle in New Jersey



2002

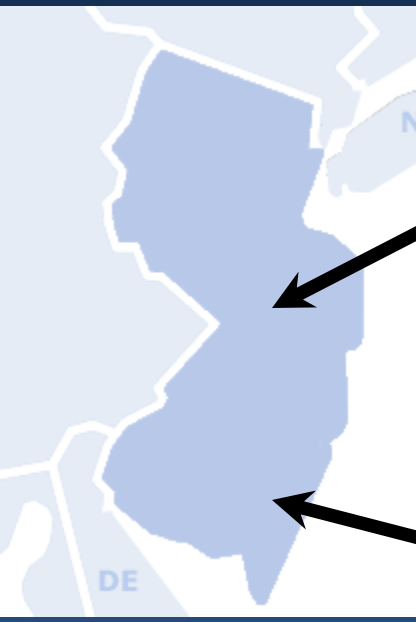
Southern Pine Beetle in New Jersey

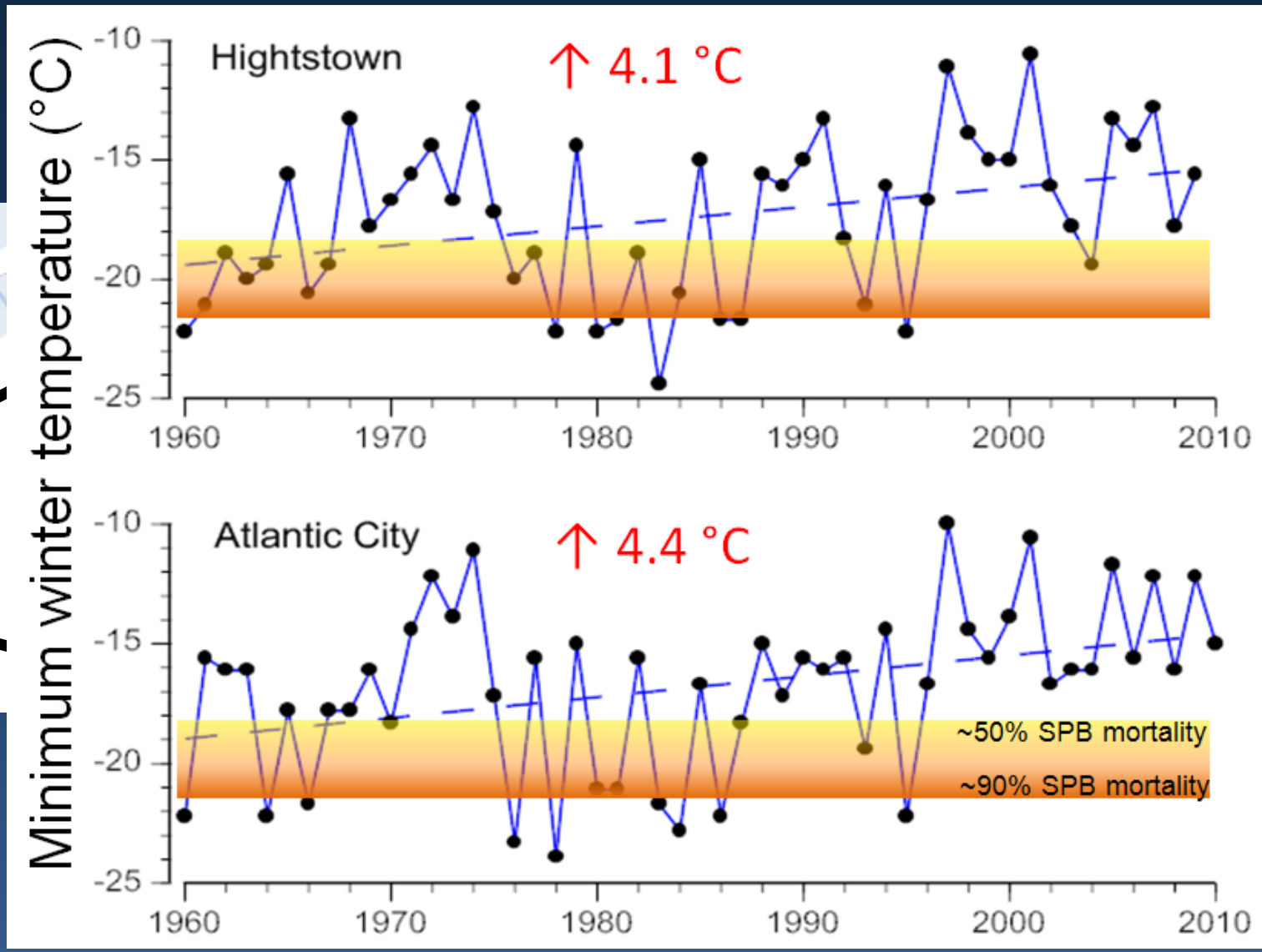




Adapted by Matt Ayres from Weed et al. 2013; data from NOAA National Climate Data Center

Southern Pine Beetle in New Jersey





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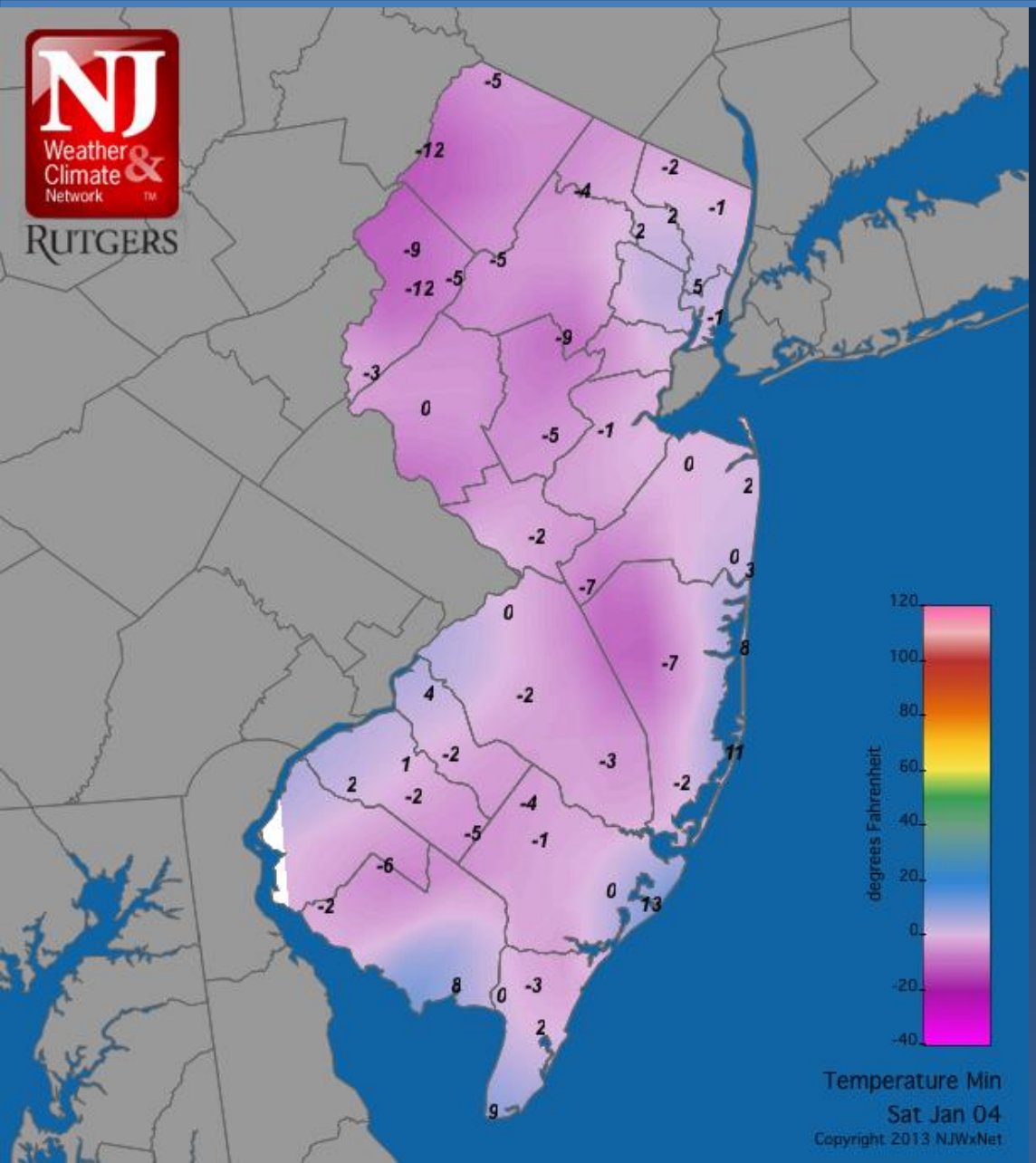
The Polar Vortex in New Jersey



Overnight minimum temperatures
January 4-5, 2014

Image courtesy of David Robinson
New Jersey State Climatologist

The Polar Vortex in New Jersey

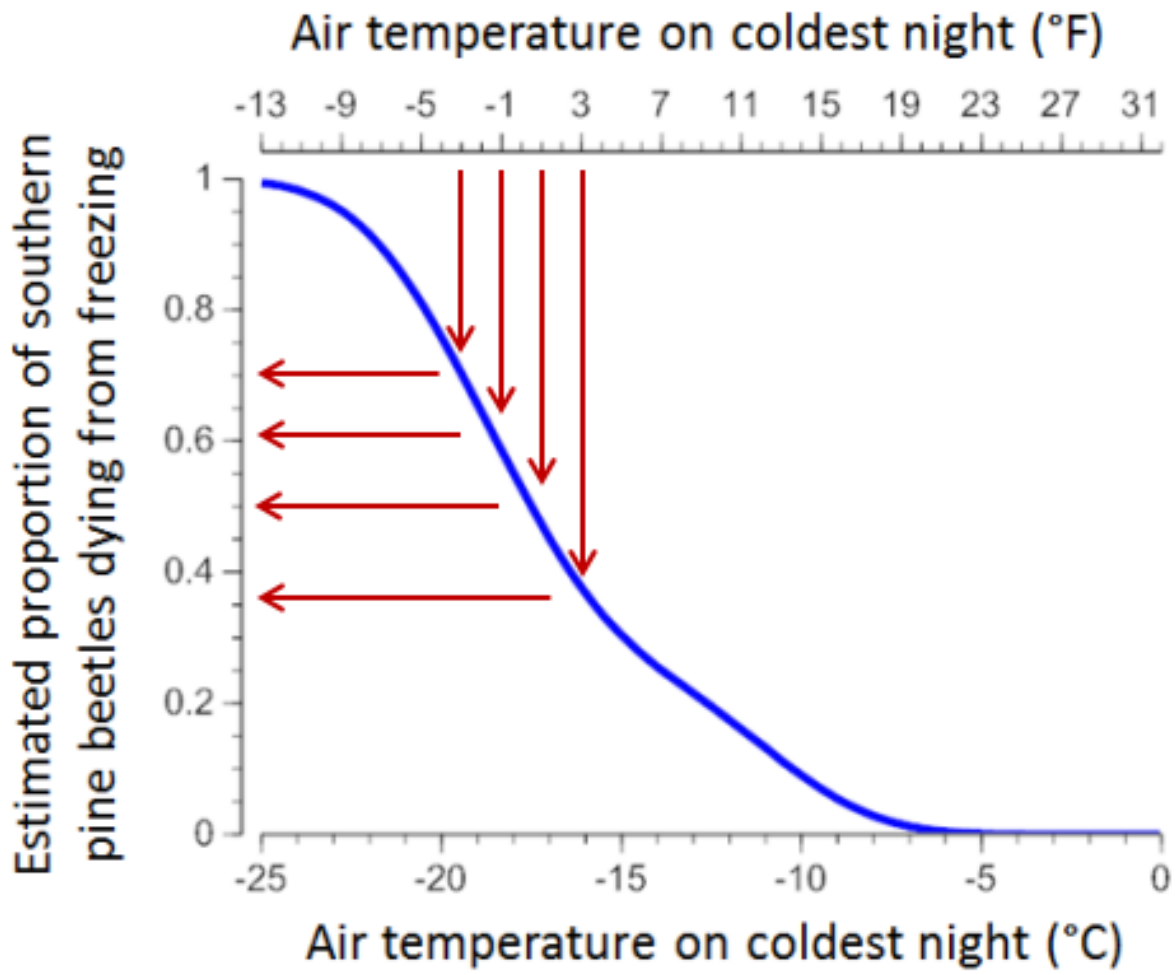
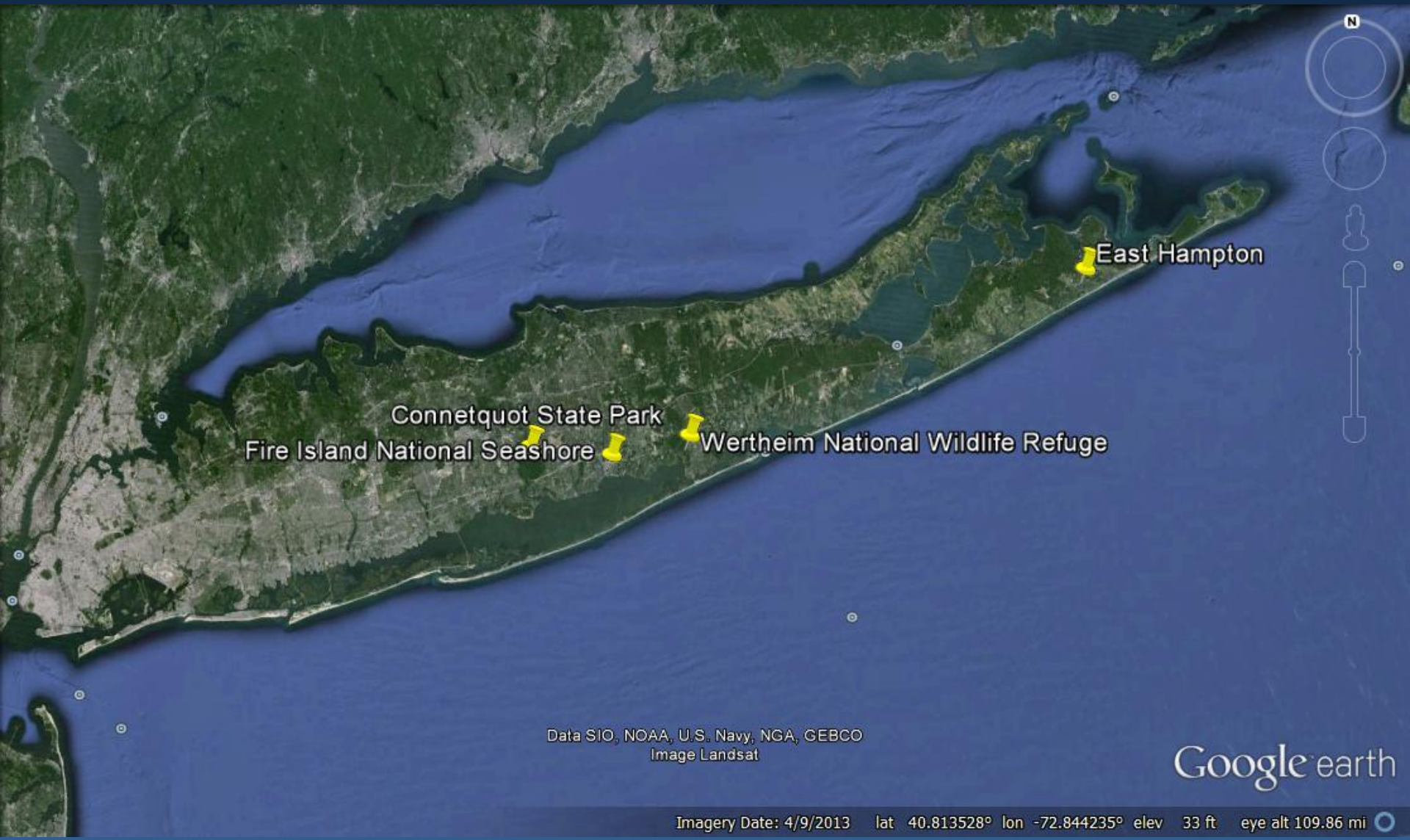


Figure 2. Expected mortality of southern pine beetles from the corresponding air temperature. Simplified from Equation 5 and Figure 7 in Tran et al. (2007).

Southern Pine Beetle on Long Island!



Outline

I. SPB Background

II. Forest structure and susceptibility

III. Data Methods

IV. Pinelands, North and South

V. Infested vs. uninfested stands

VI. SPB in wetland stands

Why do stand characteristics matter?

I. Beetle ability to overcome defenses (resin flow data)

II. Host searching behavior:
Stand density (basal area, nearest neighbor distance), %Pine within stand

III. Host quality (for reproductive success)
Age/DBH, height, radial growth

IV. Pheromone plume maintenance
Canopy closure, canopy base height, understory structure, stand density/basal area

Knowledge from southern forests

- Different pines species have different susceptibility due to resin flow differences
- Stands with higher density have higher rates of spot initiation and growth
- Thinning is an effective strategy for SPB prevention (recommendation is to thin stands >27.5 m2/ha to <18.3 m2/ha)
- Susceptibility has a parabolic relationship with stand age

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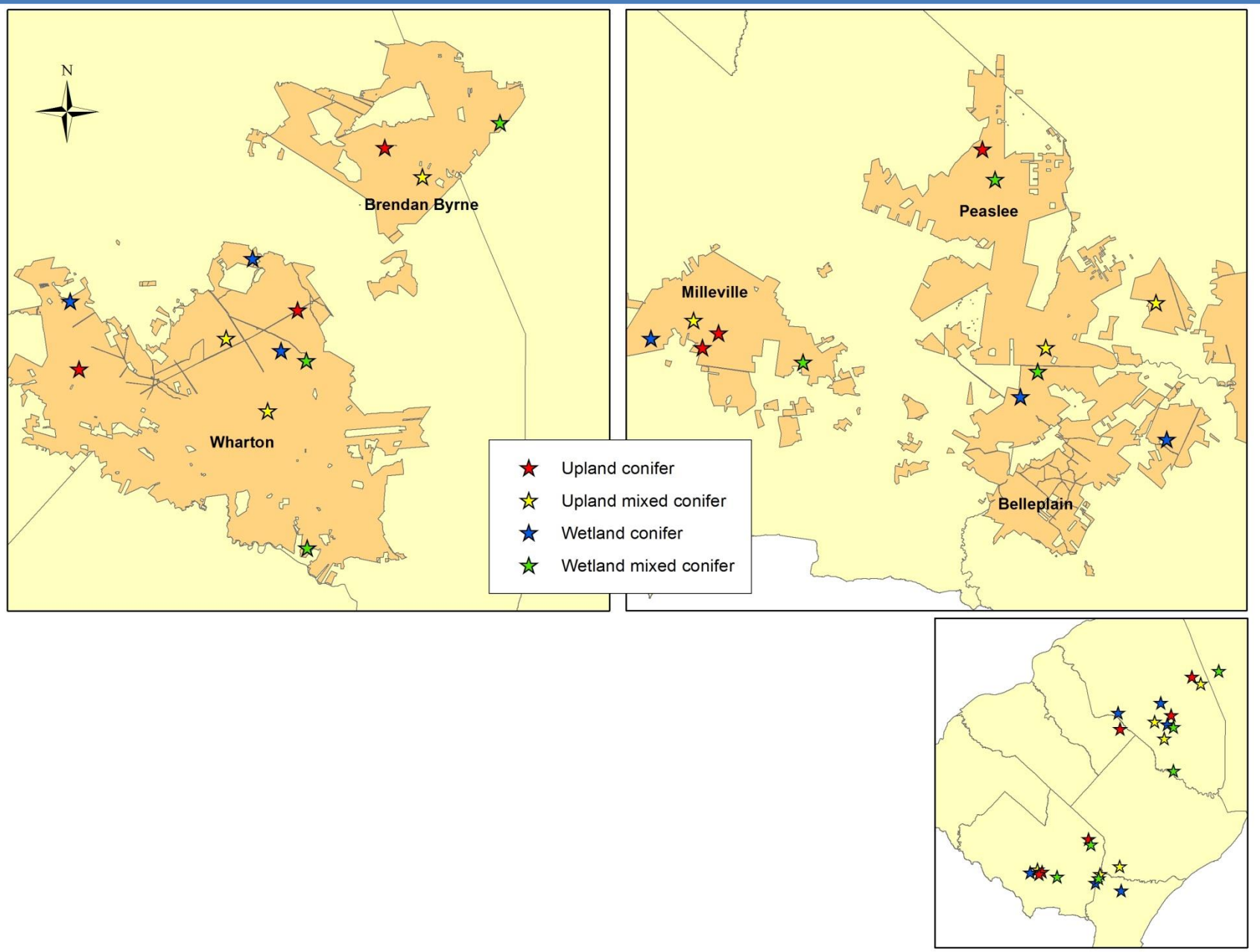
Control Plots



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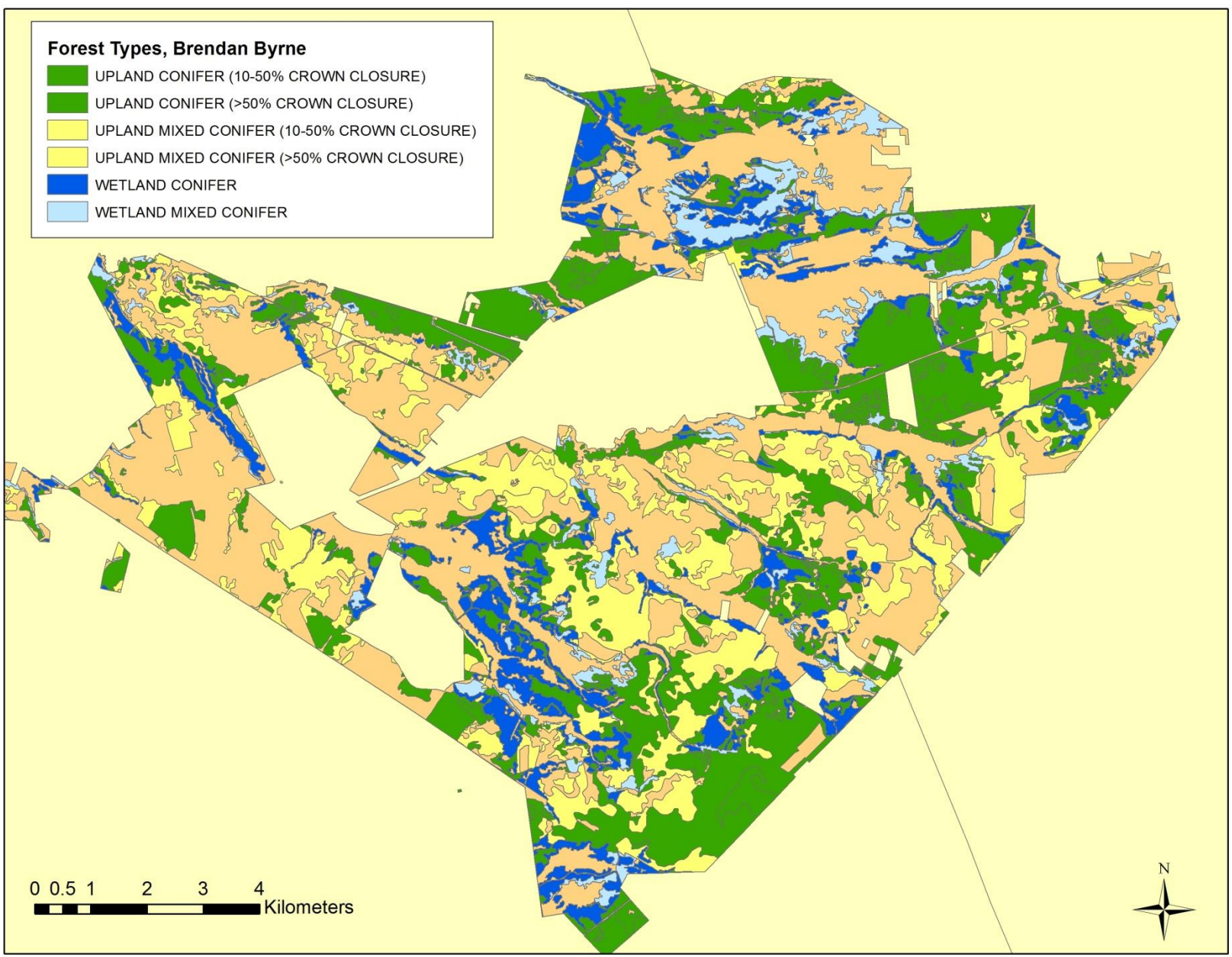
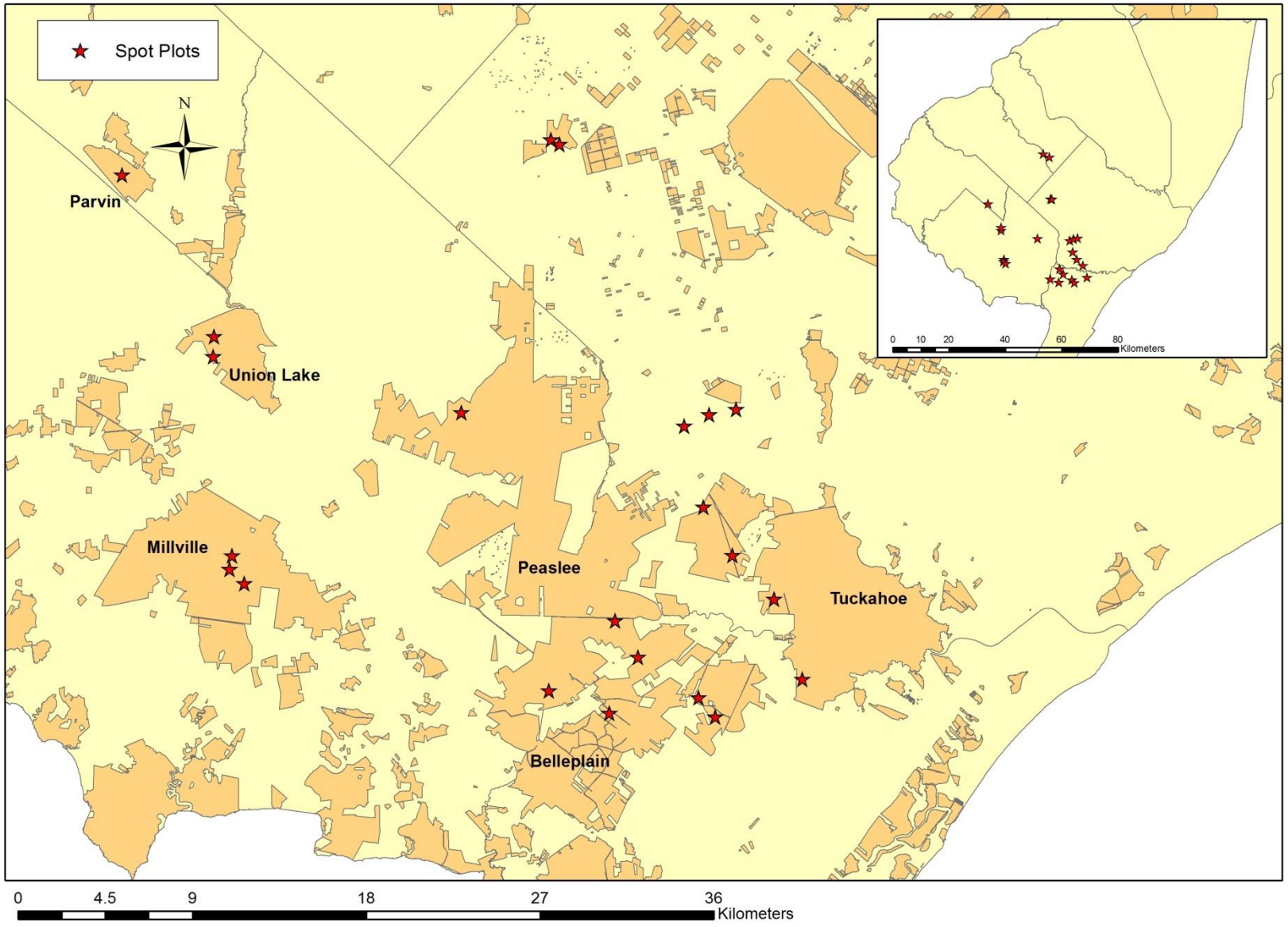


“Spot” plots


Spot Plots
N
Parvin
Union Lake
Millville
Peaslee
Tuckahoe
Belleplain
0 10 20 40 60 80
Kilometers
0 4.5 9 18 27 36
Kilometers

Spot Suppression

Figure 10-2 – Application of cut-and-leave requires felling those trees that contain SPB broods, plus a buffer strip of uninfested trees.

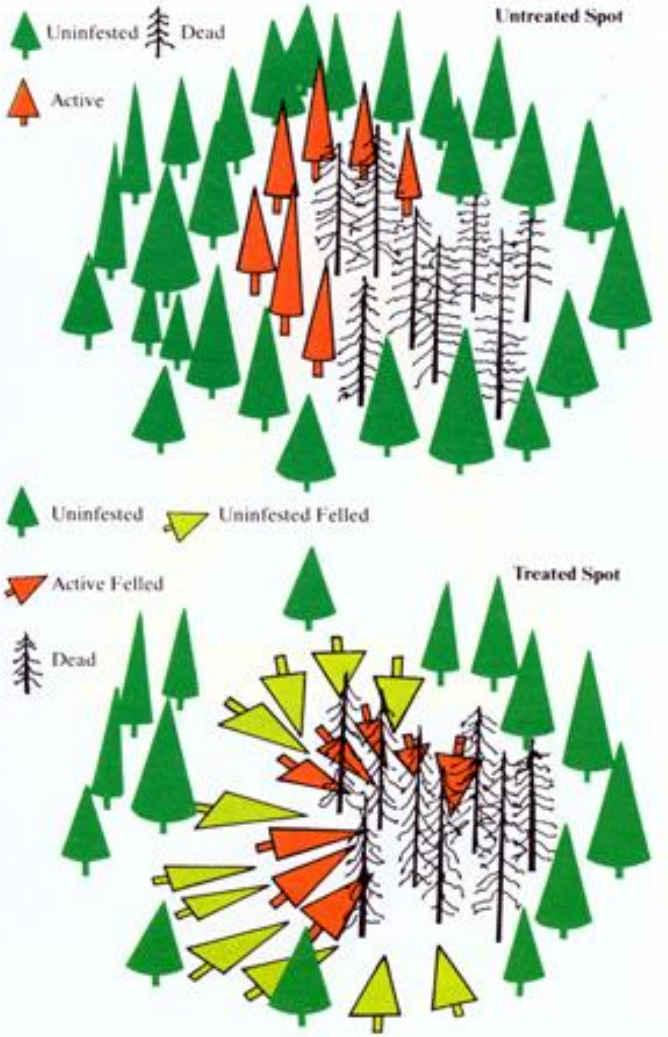
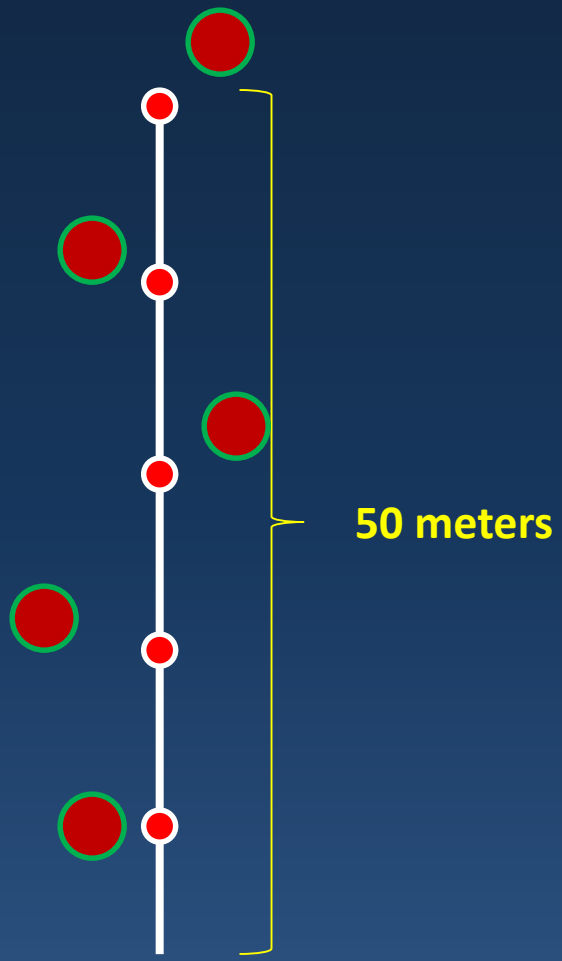


Figure 10-3 – Procedure for controlling southern pine beetle infestations by means of cut-and-leave.

Thatcher et al., eds. 1980. The Southern Pine Beetle.

Spot plots measured adjacent to suppressed area

Plot Samples



Selected nearest tree to each of 5 equidistant sampling points

Focal tree sampling

5 samples/50 m transect; 3 transects/plot:

- Hemispherical photo (transect 1 only)
- Age of focal tree
- Focal tree DBH
- Focal tree BA pine
- Focal tree BA hardwood
- Focal tree height
- Focal tree crown base
- Focal tree crown class
- Distance FT to nearest neighbor
- NN DBH and NN BA pine and BA hw
- Distance FT to 2nd nearest neighbor
- SNN DBH and SNN BA pine and BA hw

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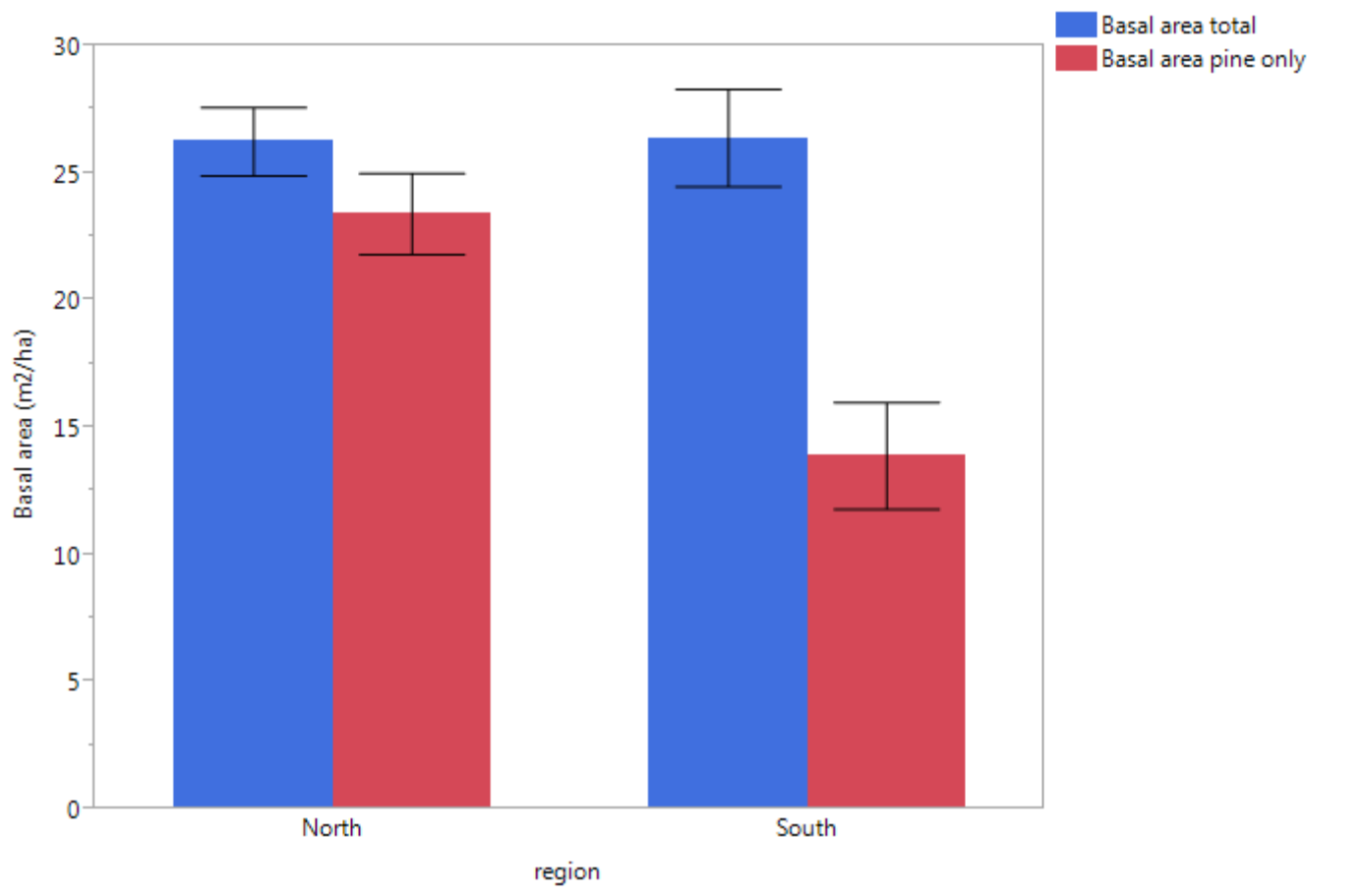
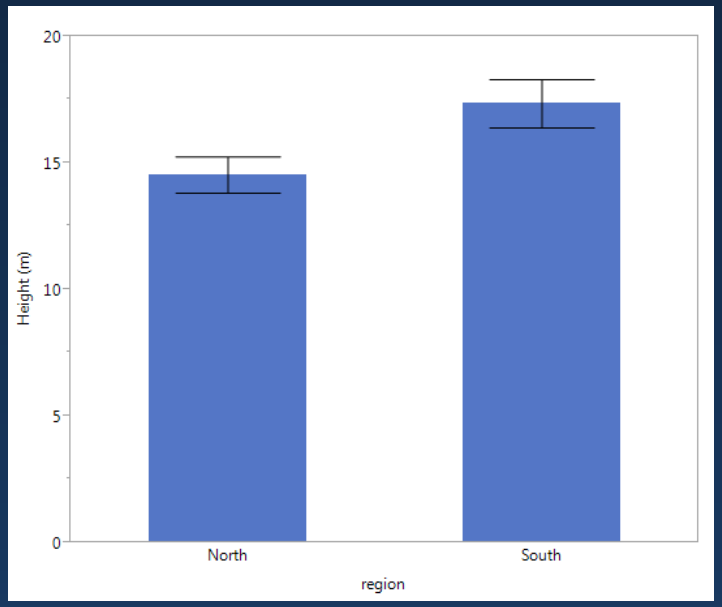
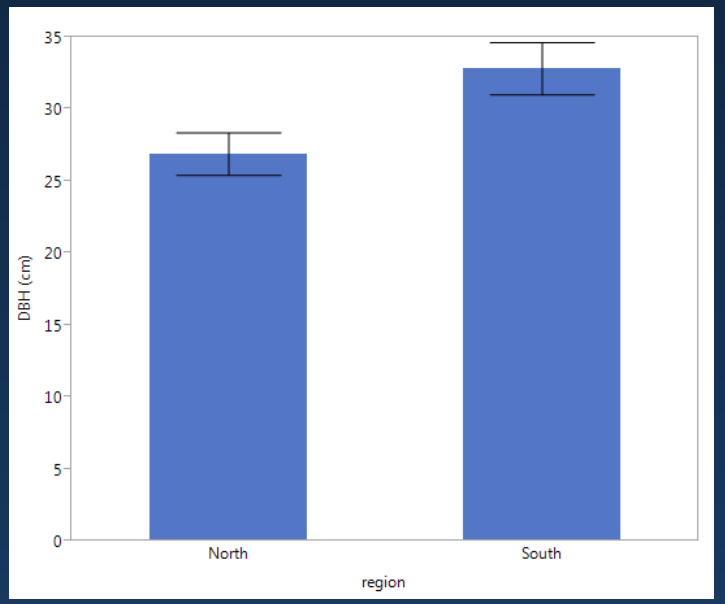
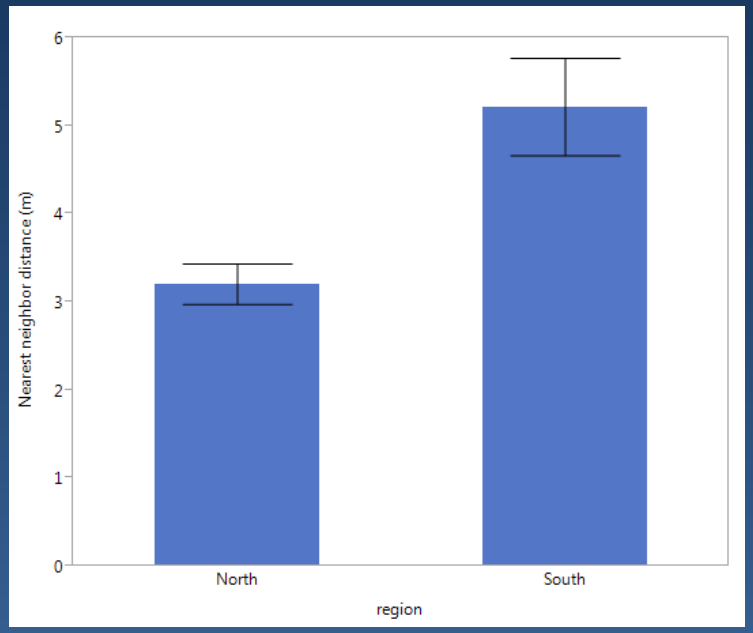
North vs. South: Basal Area



North vs. South: Height, DBH, tree distance







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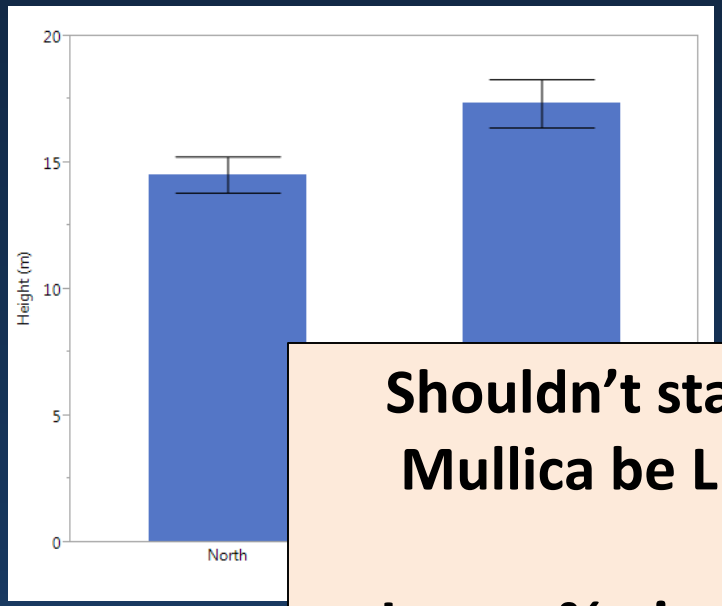
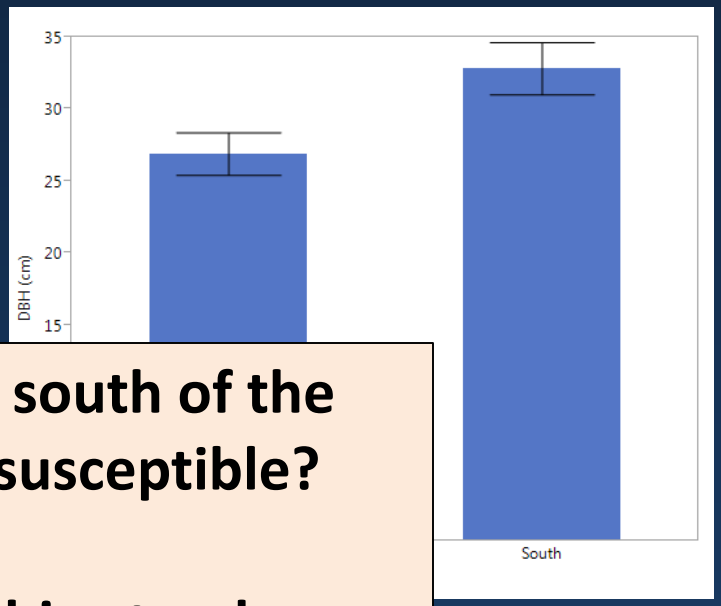
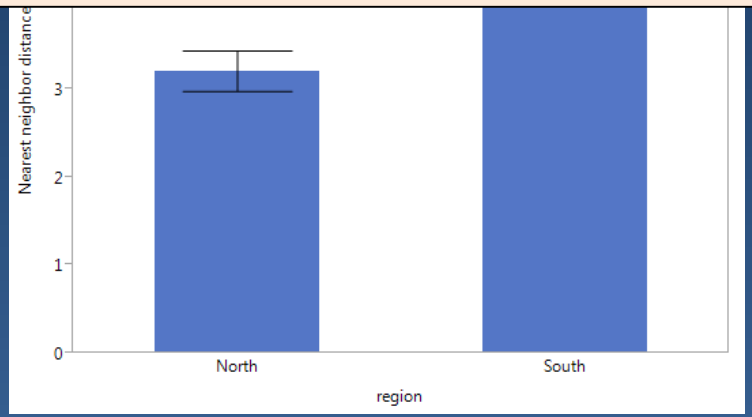


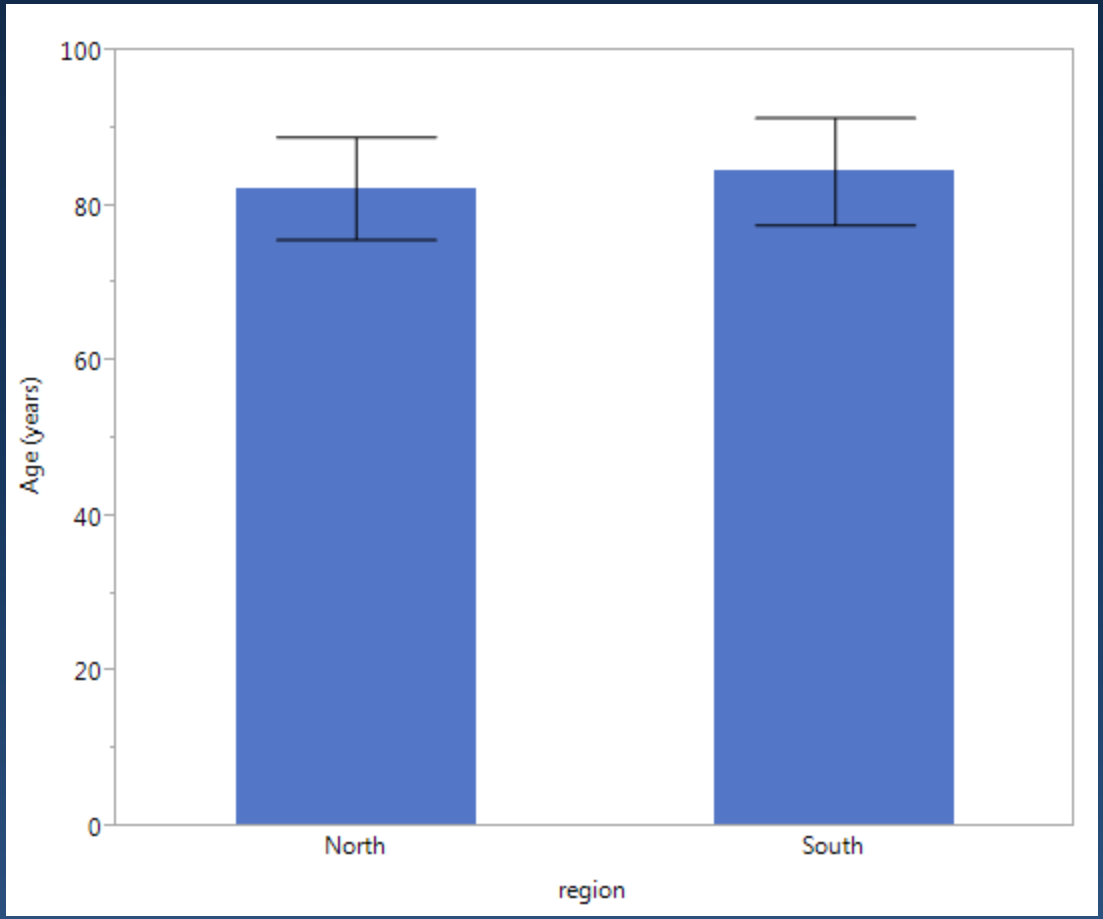


Shouldn't stands south of the Mullica be LESS susceptible?

- **Lower % pine within stands**
- **Lower pine basal area**
- **Trees farther apart**



North vs. South: Tree age



Site quality?

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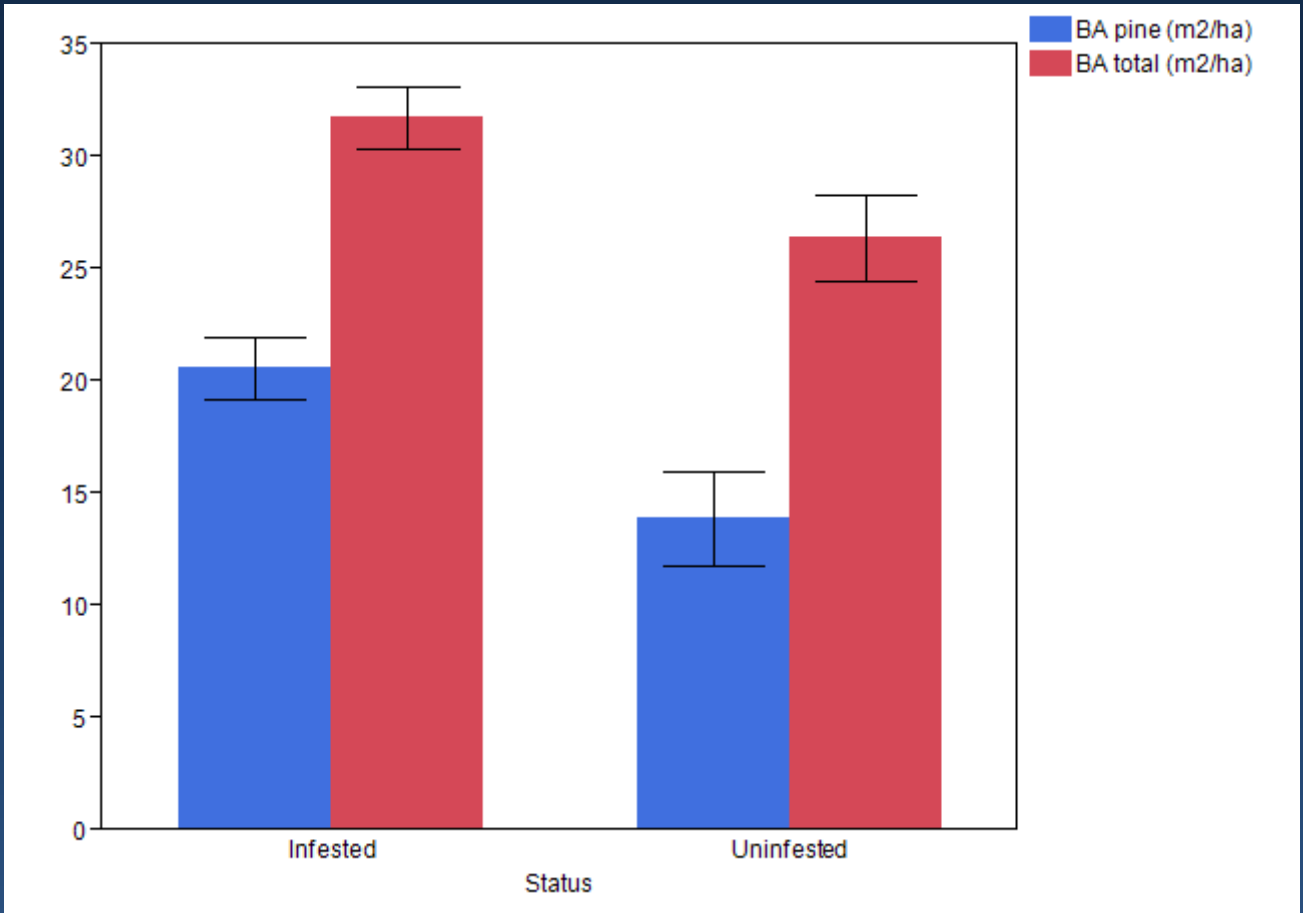
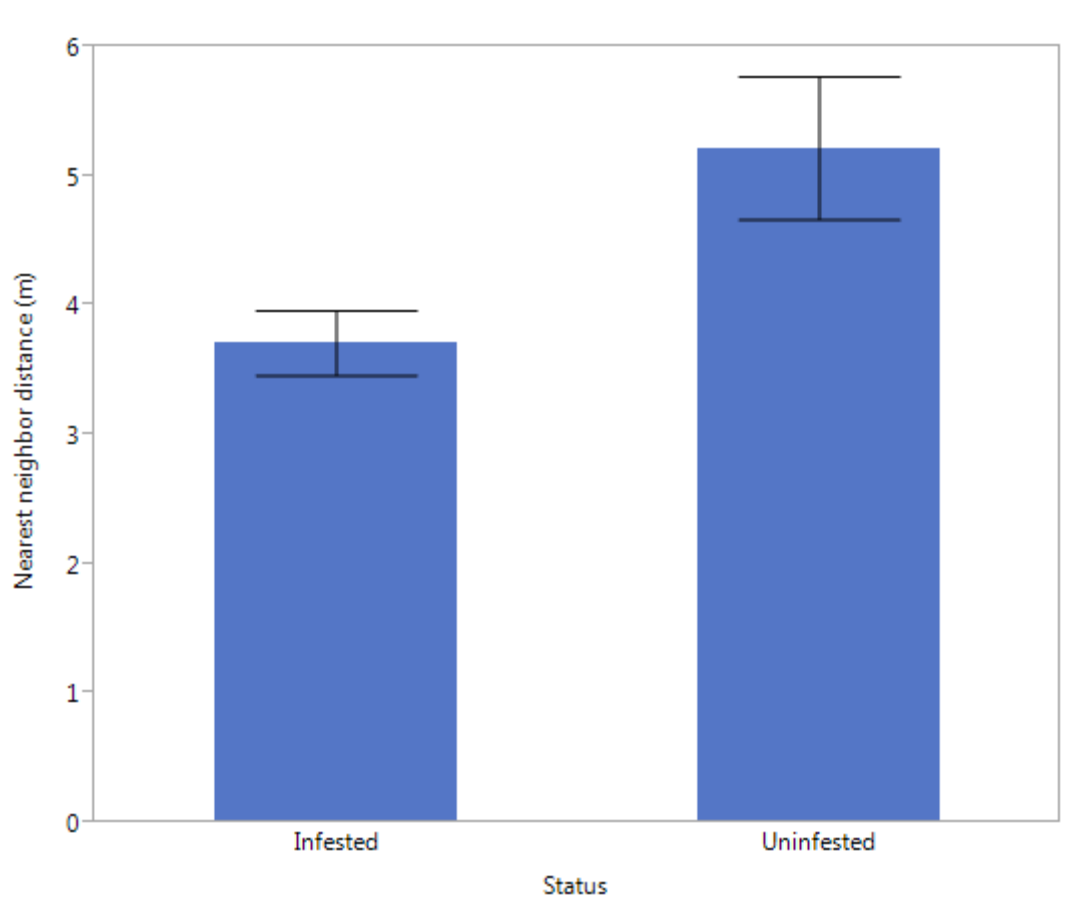
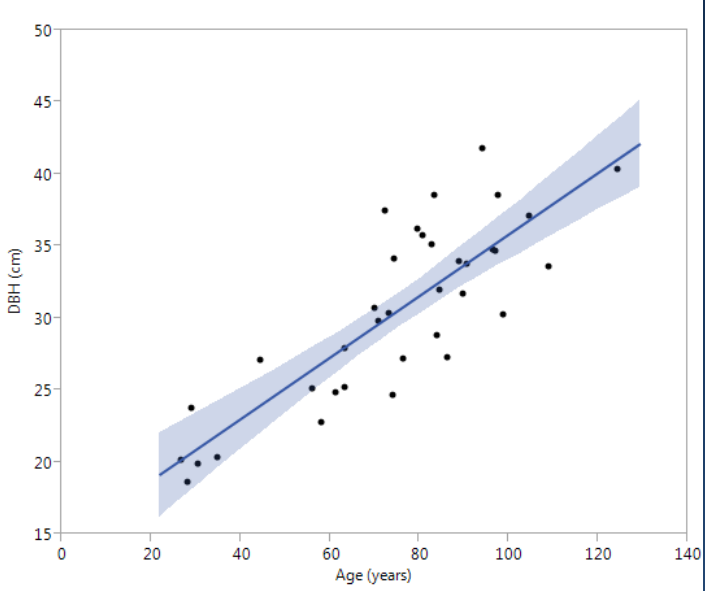
Basal area (pine and total)

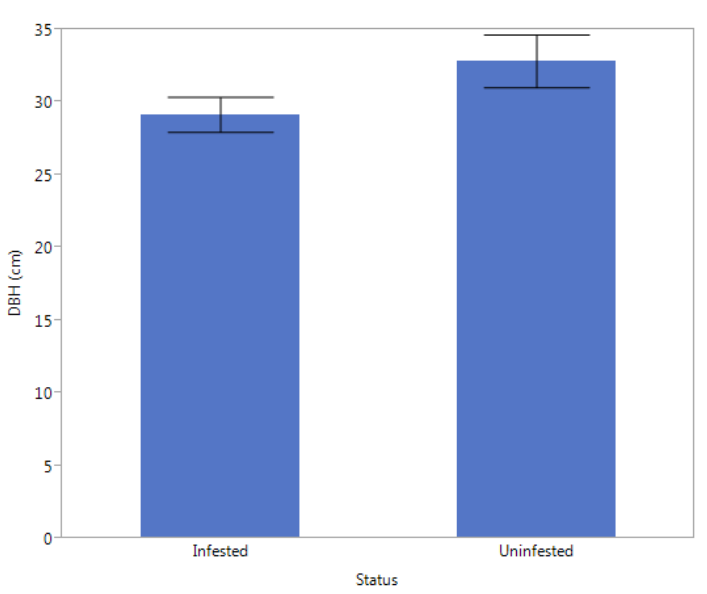


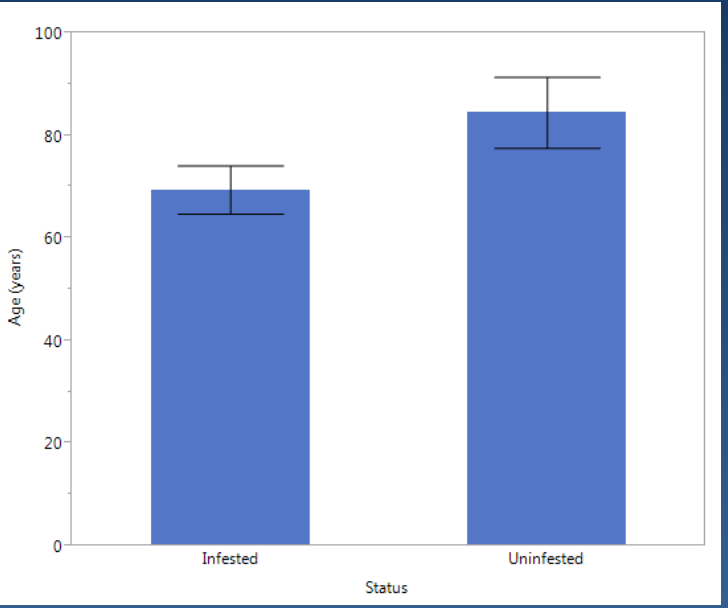
Distance between trees



Tree age and diameter







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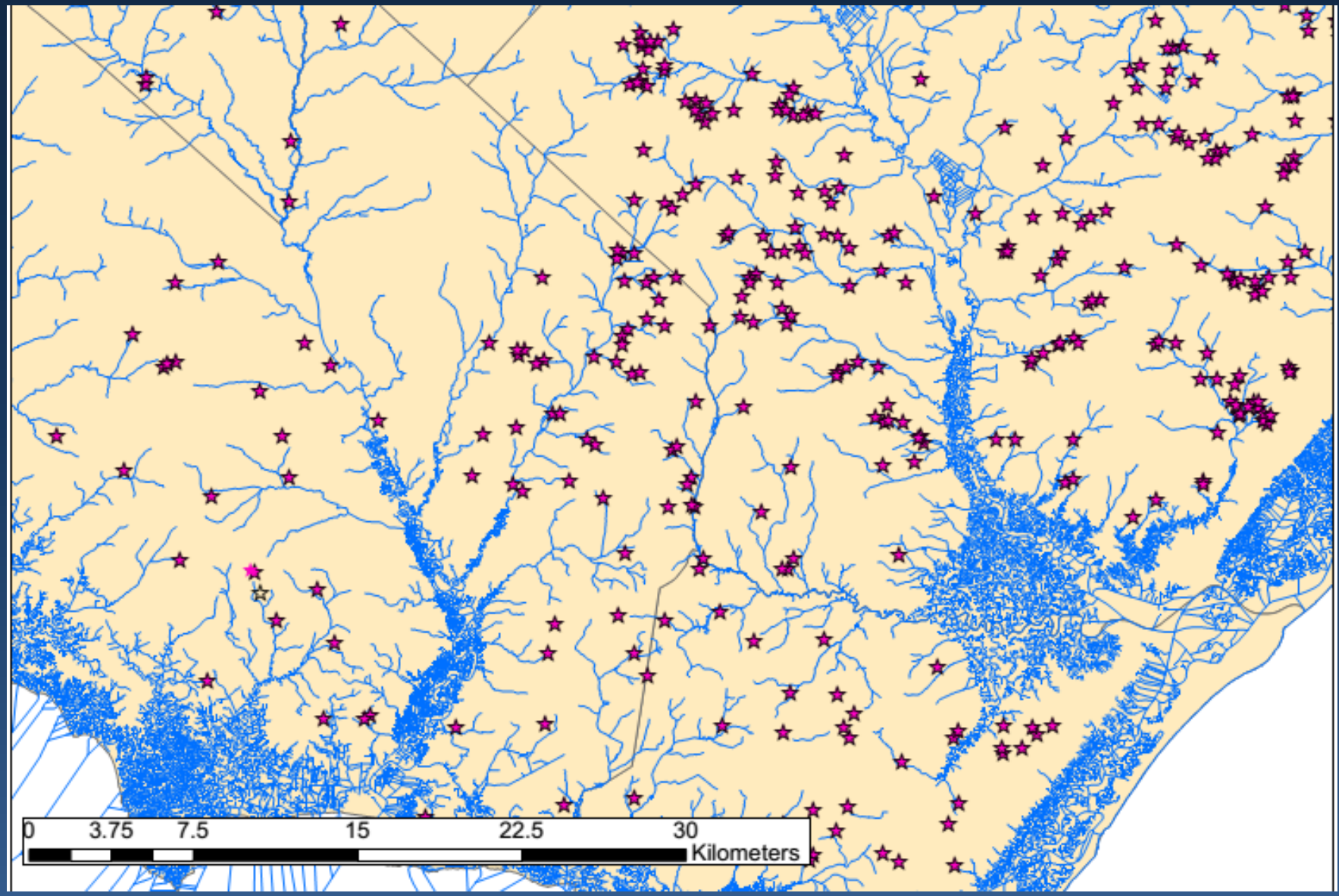
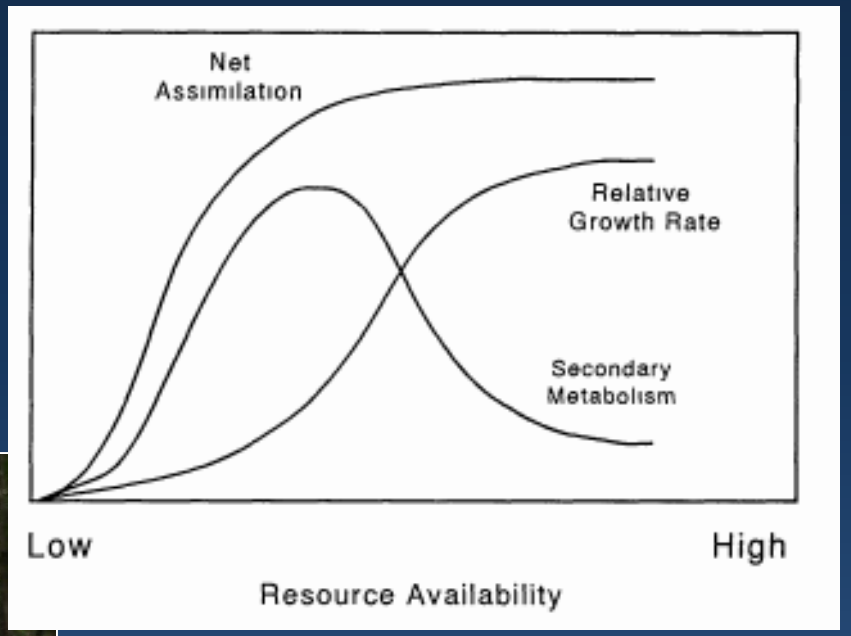
A Southern Pine Beetle Mystery in NJ



SPB Spots from Flight Data, August 2013

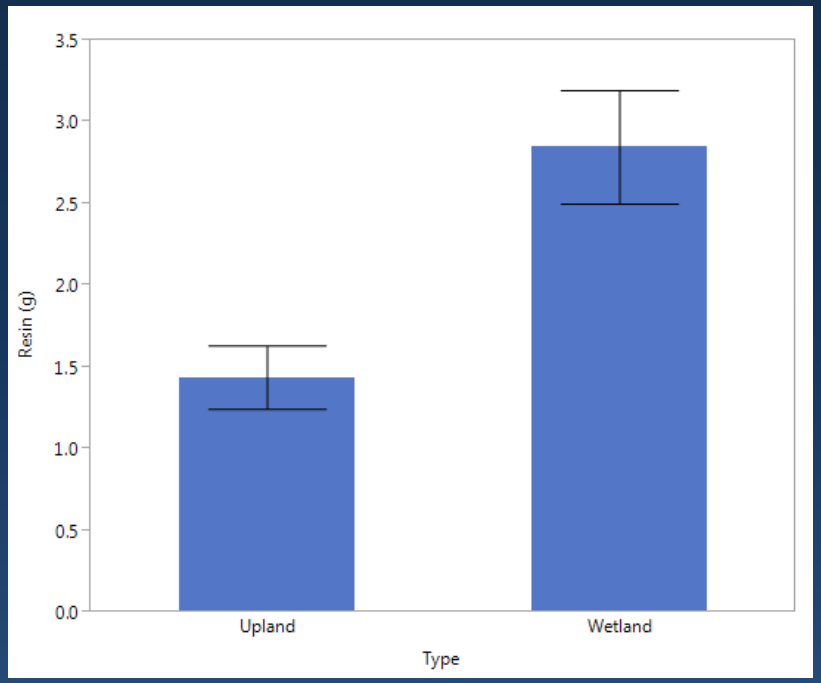
Tree defenses?

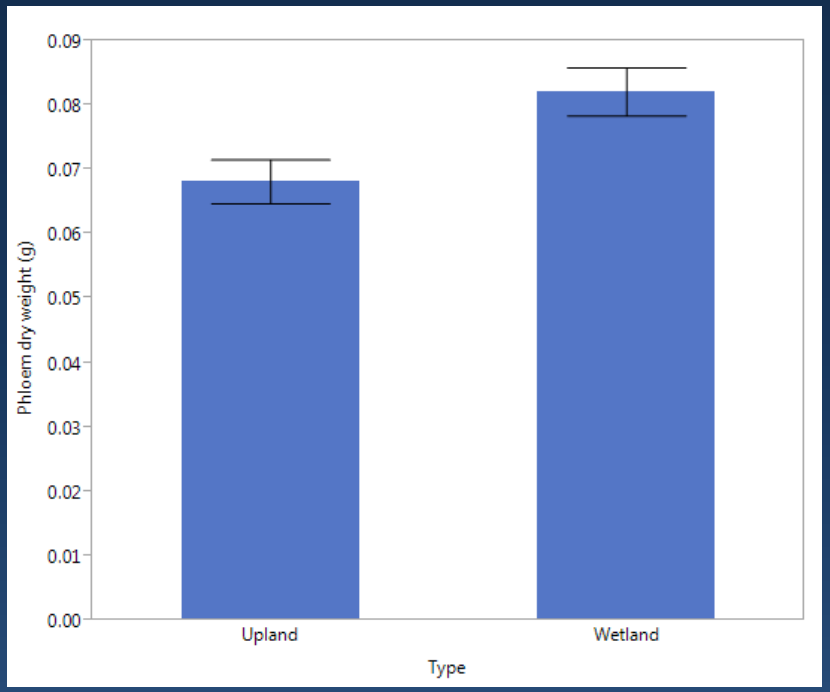
The Growth Differentiation Balance Hypothesis (Loomis 1932, Lorio and Sommers 1986)



Herms and Mattson 1992

Tree defenses?





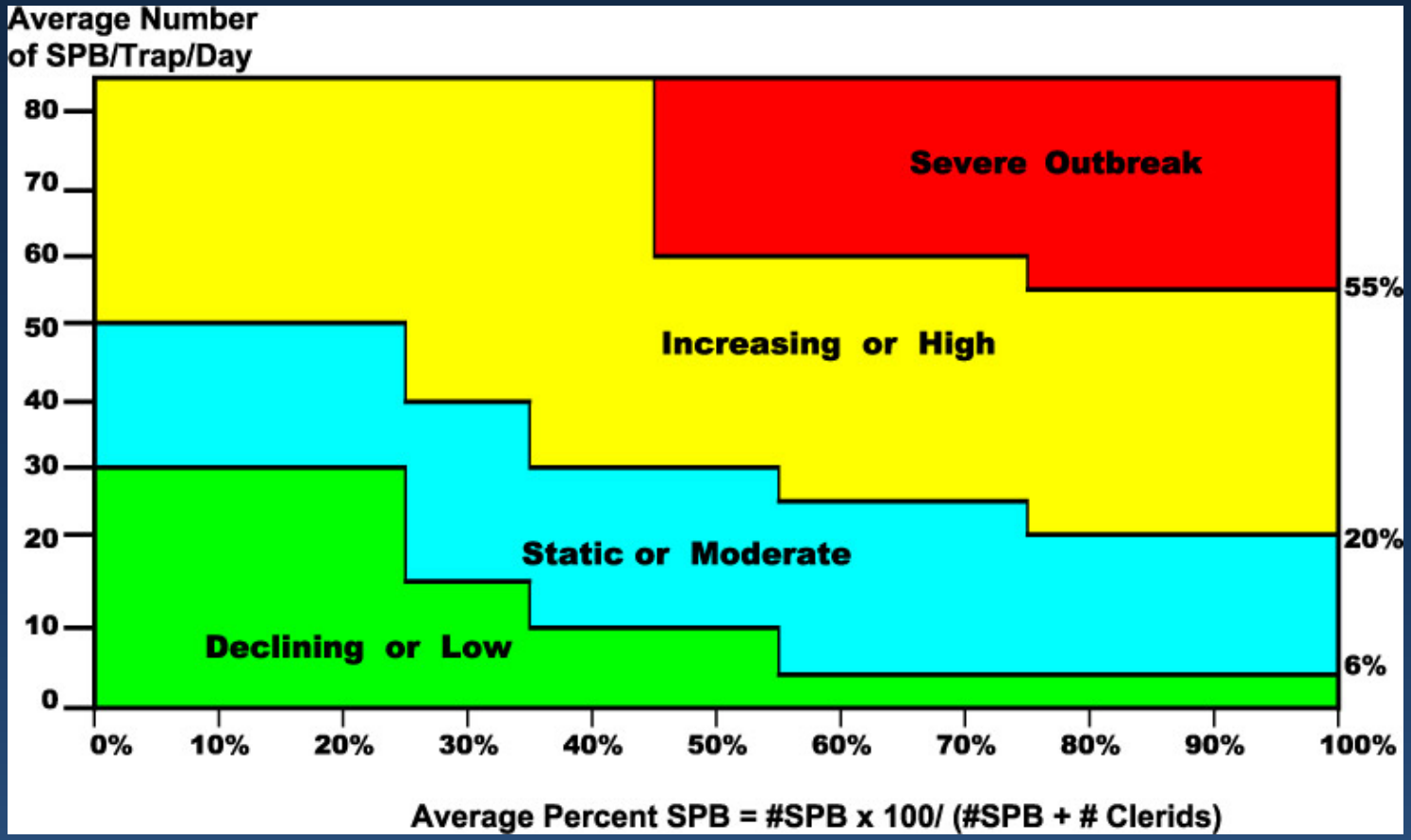
Next steps

- Risk model
- Landscape-scale simulation models (management, fire, climate scenarios)
- Post-beetle fuels modeling: Ken Clark

Related project: southwide data

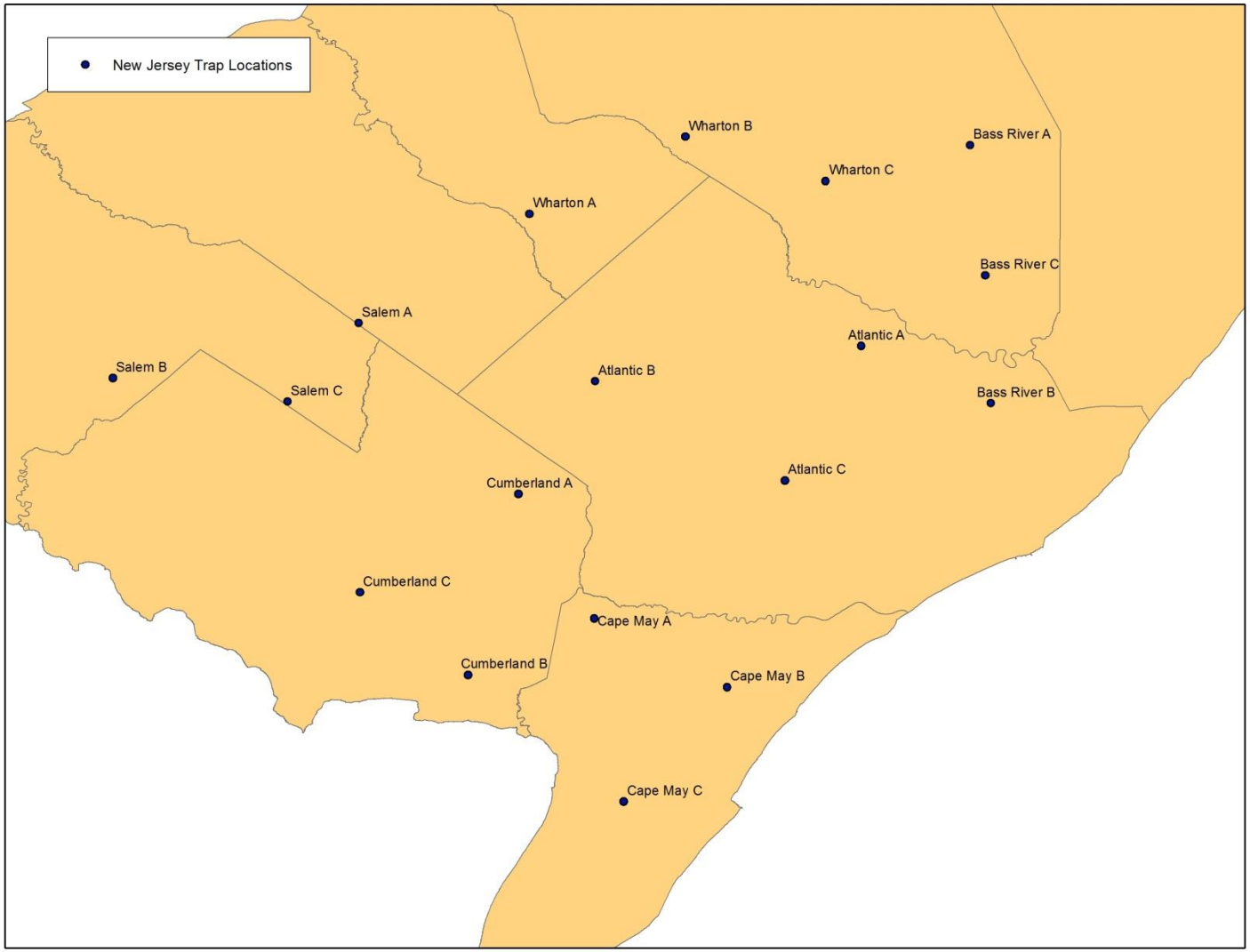
- Annual monitoring of SPB and its predator (*T. dubius*, checkered beetle)
- Began in 1987
- By 2005, at least 7 years of data for 133 forests over 13 states from Texas to Virginia
- Up to 24 years of continuous data per forest
- Basis for prediction system (spring trapping for summer outbreak prediction)

Related project: southwide data



- **Can predictions be improved?**
- Can predictive models include economic and other non-market values to help managers make good choices?
- Bayesian framework

Related project: southwide data



QUESTIONS?

Acknowledgments

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