Forest Susceptibility to Southern Pine Beetle in the New Jersey Pinelands

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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

Mites ride to new trees on beetles

Mite

Mites feeds on antagonistic fungus

Antagonistic fungus

Antagonistic fungus invades tree and can outcompete beneficial fungus. It has no nutritional value for beetle larvae.

Beneficial fungus

Galleries are colonized by the beneficial fungus which the larvae feed on

Larva

Beetle galleries in pine

Adult females lay eggs & deposit fungal & bacterial spores here. Larvae develop.

Beneficial bacterium

Antagonistic fungus competes with beneficial fungus. Beneficial bacterium suppresses antagonistic fungus.
Southern Pine Beetle in New Jersey
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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
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!
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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
“Spot” plots
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.
Spot plots measured adjacent to suppressed area
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

Selected nearest tree to each of 5 equidistant sampling points
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North vs. South: Basal Area

[Bar chart showing basal area comparison between North and South regions. The chart indicates that the North region has a higher basal area compared to the South region, with error bars indicating variability. The chart also distinguishes between total basal area and basal area including only pine species.]
North vs. South: Height, DBH, tree distance
North vs. South: Height, DBH, tree distance

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?

![Bar chart comparing rotin and phloem dry weight between upland and wetland types.](image-url)
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)
• 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?
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