Adaptation Strategies for Reducing Susceptibility of Northeastern Pitch Pine Barrens to Southern Pine Beetle Impacts

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BACKGROUND

Southern pine beetle (SPB; *Dendroctonus frontalis*) is a bark beetle capable of causing extensive ecological and economic damage to *Pinus*-dominated ecosystems. Winter temperatures have historically confined SPB outbreaks in the US to the Southeast but warming temperatures in the last two decades have facilitated range expansion into novel forests (Lesk et al., 2017; Tran et al., 2007; Weed et al. 2013). One such forest is the northeastern pitch pine barrens, a globally rare ecosystem characterized by sandy soil and open stand conditions dominated by pitch pine (Jordan et al., 2003). With climatic conditions becoming more suitable for SPB, this insect poses a serious threat to these ecosystems (Dodds et al. 2018; Lesk et al. 2017). Forest management is an important tool for reducing SPB susceptibility in the southeast (Nowak et al. 2008), but there is much to learn about how management can be used to reduce SPB impacts in northeastern forests.

OBJECTIVES

1. Further characterize pine barrens and identify stand conditions that may increase susceptibility to SPB
2. Develop a hazard rating model that predicts stand-level susceptibility
3. Compile results into a management guide for pitch pine barrens in relation to SPB

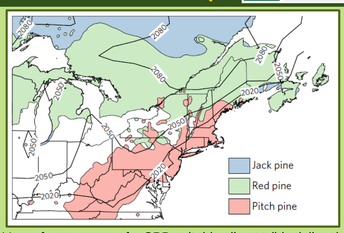
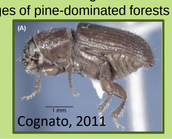


Fig 1. Year of emergence of a SPB suitable climate (black lines) and ranges of pine-dominated forests (Lesk et al., 2017).



METHODS

Data collection:
Stand inventory data were collected from:
- Infested and uninfested stands on Long Island, NY
- Uninfested stands in the Albany Pine Bush (APB), NY
- Uninfested stands in the Ossipee Pine Barrens (OPB), NH

Additional data were provided by Heuss et al. 2019 and the NYS DEC.

Stand condition analyses:
Stand conditions were analyzed by region, community type, and management history using ANOVA. Conditions that may have predisposed stands to attack were then incorporated into a hazard rating model.

Hazard rating model:
A fixed effects logistic regression that predicts stand-level hazard rating is being built using data collected from uninfested and infested stands on Long Island. The model will be applied to uninfested stands in the APB and OPB (Table 1).

Model output	Corresponding hazard rating	Management recommendation
0 – 0.25	Low-hazard stand	Not needed
0.26 – 0.5	Moderate-hazard stand	Lower priority
0.51 - 1	High-hazard stand	Highest priority

Table 1. Example of how to use a hazard rating model to prioritize stands for SPB prevention management

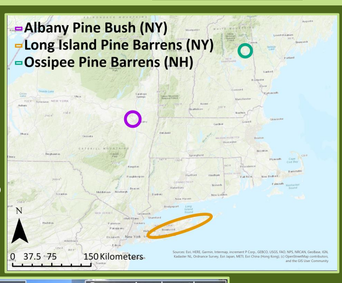


Fig 2. Locations of study areas. The first SPB outbreak on Long Island occurred in 2014. There have been no outbreaks in the APB or OPB.

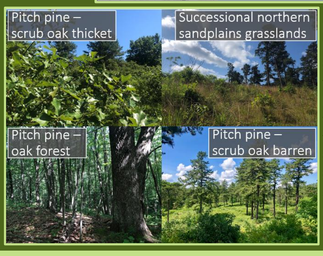


Fig 3. Natural communities of the Albany Pine Bush. Data were collected from a variety of pine barren communities and management regimes.

RESULTS: STAND CONDITION ANALYSES

Fig 4. Total basal area by region.
The APB was significantly less dense than the Long Island pine barrens.
APB: n = 50, OPB: n= 25, Long Island: n = 366.

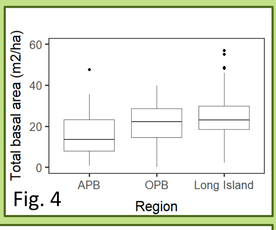


Fig. 4

Fig 5. Total basal area by community type and management strategy at the APB.
Community type: Basal areas of PP-SOT, SNSG, and PP-SO stands were significantly lower than PP-O stands.
Management: Basal areas of burned and thinned and just burned stands were significantly lower than unmanaged and just thinned stands.

PP-SOT: pitch pine - scrub oak thicket
SNSG: successional northern sandplains grasslands
PP-SO: pitch pine - scrub oak barren
PP-O: pitch pine - oak forest

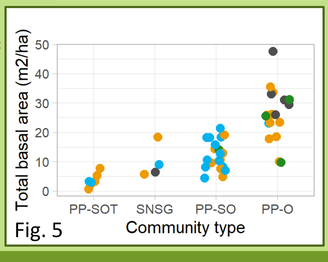


Fig. 5

RESULTS: HAZARD RATING MODEL

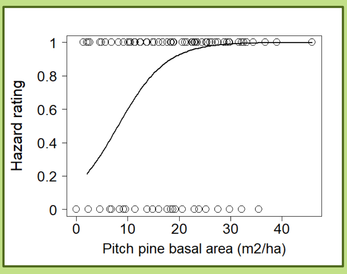


Fig 6. Preliminary hazard rating model. This model predicts hazard rating (y-axis) based on pitch pine basal area (x-axis) and number of infestations within 3.2 km. Developed using stand condition data from 296 SPB infested stands and 70 uninfested stands on Long Island, NY.

CONCLUSIONS SO FAR

Stand conditions:

1. Pine barrens are diverse ecosystems characterized by natural communities that vary in structure
2. Management regimes affect the structure of pine barren communities

Hazard rating model:

1. Pitch pine basal area and number of neighboring infestations are important predictors of SPB susceptibility
2. Management strategies for increased SPB resistance and resilience align with pine barren conservation objectives

TO LEARN MORE…

The Albany Pine Bush Preserve's website
Northern Woodland piece about pine barrens, by Laurie Morrissey
The NYS DEC's Southern Pine Beetle Factsheet
The USFS Southern Pine Beetle Hazard Rating Maps

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