Pitch Pine Mortality and Regeneration from Southern Pine Beetle Across Restoration Treatments in the Central Pine Barrens

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Abstract

This project determined the effects of the southern pine beetle (*Dendroctonus frontalis*; SPB) on overstory vegetation and regeneration in the fire-adapted and globally rare pitch pine (*Pinus rigida*) Central Pine Barrens. Damage from the beetle was assessed in eight stands and six different disturbance histories, including fire and mechanical treatments. Stand health was assessed through tree diameter measurements, canopy density, pitch pine mortality rates and infestation presence. Pitch pine regeneration was tallied if in a belt transect. Stands that underwent multiple forms of treatment methods were found to have the lowest percentages of SPB infestation (20-35%), mortality (0-5%) and highest regeneration counts (175+) of the stands surveyed. This study aligned with BNL's climate science emphasis and may help confirm that active forest management through varied restorative treatments (fire and thinning) can mitigate the negative effects of SPB as climate change continues to solidify their habitat expansion in the northeast.

Stand RHIC Ring: Summer 2017 vs. Summer 2024

Introduction

Brookhaven National Laboratory (BNL) lies within the fire-adapted and globally rare Central Pine Barrens. Pine barrens are fire dependent ecosystems, frequent fire (3 to 10 years) ensure that leaf litter and duff remain at low enough levels to keep fires low intensity while cycling nutrients back into the soil.[1] The barrens have been largely unmanaged over this past century, causing them to become severely overstocked, inhibiting pitch pine regeneration and decreasing stand resiliency.[1,2] Since 2014 the barrens have become infested with the southern pine beetle, leading to high rates of pitch pine mortality. SPB will enter a suitable pines and burrow through the phloem, for nutrition and as an egg laying location for future generations.[3] SPB can host multiple generations per year, the infestation can spread rapidly, particularly in overstocked stands.[3] Restorative treatments such as prescribed fires and thinning can act as a controlled form of necessary disturbance for the barrens, and may help mitigate current pitch pine erasure, increasing SPB resiliency.[3,4,5]

Hypothesis: Pine stands with multiple or frequent forms of restorative treatments (fire, thinning) will have lower rates of SPB damage and higher rates of regeneration.

Stand North F: Summer 2017 vs. Summer 2024

Methods

Study Area: The Central Pine Barrens within Brookhaven National Laboratory, Upton, New York. Eight stands were selected based on disturbance and management history (Figure 1, Table 1). In ArcGIS six points were randomly selected to serve as plot center for each stand, at least twenty meters apart, totaling forty-eight plots surveyed.

Study Period: June-July 2024

Stand	Disturbance history	Size (ha)
East A	Wildfire: 2012	8.66
East CD	Prescribed burn: 2017 & 2018	15.30
North E	No management (control)	9.06
North F	Low intensity prescribed burn: 2022	9.45
North H	Wildfire: 2012, mechanically treated: 2023	9.43
North I	Wildfire: 2012, mechanically treated: 2021, prescribed burn: 2023	9.51
Saddle East	Prescribed burn: 2023	5.54
RHIC Ring	No management (control), significant SPB damage	52.61

Map 1: Map of the Eight Stands and Plot Distribution, **Table 1:** Disturbance History and Hectares Per Stand

Field Methods: At every plot center, stand health was assessed in four stages. A spherical densitometer found canopy cover and a 10 BAF (Basal Area Factor) prism was used at plot center to determine which trees are within the variable radius, the species was identified, and diameter was measured at breast height. Pitch pine crown mortality was assessed for each tree on a scale from 1 to 5: 1 = 0% mortality…5 = dead, 100% mortality.[5] Any signs of Ips infestation such as frass, pitch tubes and holes on the bole were noted.[5] Regeneration was tallied in a two meter by twenty-five belt transect, seedlings being less than half a meter and saplings being in between a half to two meters tall.[6]

Results

- Total Trees Surveyed: 362
- Total Regeneration Counted: 1153
  - Seedlings: 1092
  - Saplings: 61
- Total Pitch Pines Assessed: 201 (56% of total trees)
  - 36% Healthy
  - 50% Dead
- Pitch Pines Dominated 50% of Stands
  - East A, North H, North I, and RHIC Ring

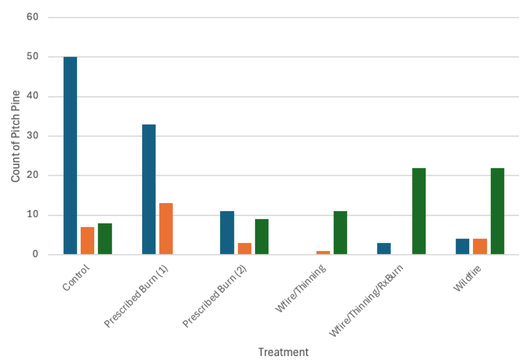

Figure 1: Pitch Pine Health Assessment Per Treatment

- Stand Conditions:
  - Stand Infestation Range: 20% to 100%
  - The RHIC Ring has the highest rate of mortality (93%)
  - North H has the lowest rate of mortality (0%)
  - North I has the highest regeneration count (461)
- Treatment:
  - Control stands had the highest rate of mortality (77%)
  - Wildfire + Rx fire + Thinning has the highest rate of healthy trees and regeneration of seedlings
  - Wildfire + Thinning has highest rate of sapling regeneration

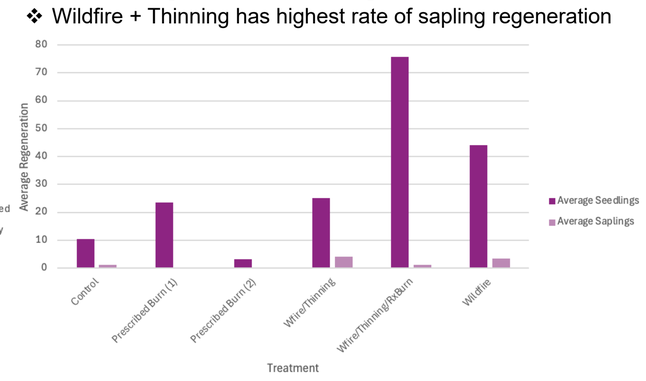

Figure 2: Average Regeneration Counted Per Treatment, Kruskal-Wallis p-value 0.0002691

Discussion

A correlation between pitch pine resiliency from SPB and treatment methods was found, with multi-method treatments having low infestation rates and high regeneration. The addition of thinning in conjunction with fire may be vital in lowering stand density which may delay or eliminate SPB's spread. An inverse relationship between average canopy cover and regeneration values was noted.[7] Unmanaged stands had the highest rates of pitch pine mortality. Stands with a single prescribed fire were found to remain overstocked and suffering the effects of SPB with high rates of mortality and 100% infestation rates among surveyed pines.

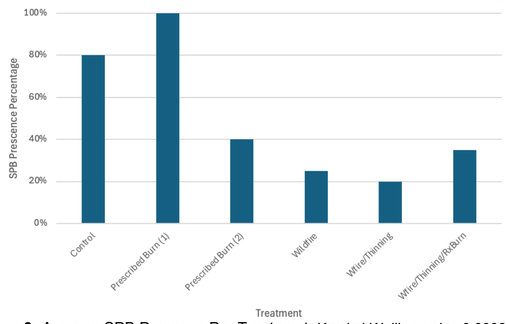

Figure 3: Average SPB Presence Per Treatment, Kruskal-Wallis p-value 0.0008526

A larger sample size and long-term study is necessary before confirming these results and to ensure significance. Time since fire, prescribed or wildland, as well as fire intensity, severity and frequency should be noted and further studied for stand resiliency against SPB and regeneration rates. Further assessment is needed to confirm if SPB is directly affecting regeneration. Or if thinning alone could contribute to high resiliency, regeneration and low infestation values. Research of a stand that has only been thinned is necessary to determine the validity of this, which does not exist at the BNL campus.

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