Transition in the size class distribution of pitch pine (*Pinus rigida)* versus oak (*Quercus spp.*) in pine-dominated and oak-dominated forest communities within the Long Island Pine Barrens

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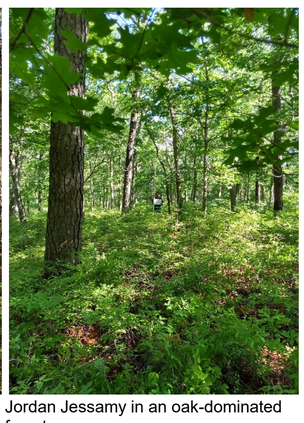
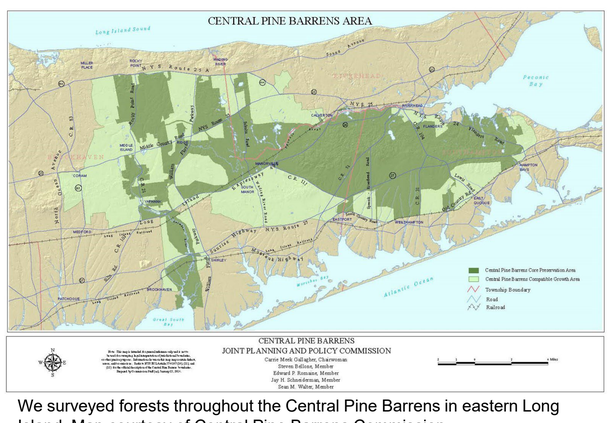
Abstract

The Long Island Central Pine Barrens (LICPB) is an Atlantic coastal pine barren ecosystem, one of only three of its kind in the world. As the home to endangered and threatened species, and the aquifer that supplies Long Island's drinking water, this ecosystem is protected under the Long Island Pine Barrens Protection Act. Nevertheless, forest health and tree population demography in LICPB have likely been impacted by invasive species, climate change, fire suppression, human development, and a lack of active management. This study aims to achieve a better understanding of the trajectory of pitch pine and oak populations in both pine- and oak-dominated communities by comparing their current size class structure to that documented in the previous survey in 2005/2006. We resurveyed 41 of the 93 plots in the summer of 2019 and collected data on the abundance of trees at different size classes ranging from 1 (seedling) to 5 (mature). Using Tukey's Test, we found no significant difference in the abundance of size classes compared to 2005/6, although currently oak seedlings are in greater abundance than pine seedlings in pine-dominant communities. Additionally, we found that a small number of seedlings of oak and pine in both communities are maturing to the sapling stage, warranting concern for future forest development. We recommend that the analysis be repeated in 2020 after data has been collected for all 93 plots to verify the observed trends from the 2019 data. Additionally, future attention should be given to monitoring both future oak dominance in pine forests and seedling success rates for both species, with future forest management efforts focusing on increasing pine seedling recruitment rates.

Jordan Jessamy in a pine-dominated forest



Jordan Jessamy in an oak-dominated forest



We surveyed forests throughout the Central Pine Barrens in eastern Long Island. Map courtesy of Central Pine Barrens Commission

Introduction

The LICPB has six forest types that can be grouped into two main forest community types, pitch-pine (*Pinus rigida*) dominated and oak-dominated *(Quercus* spp.). Our objectives were to (1) Determine the size class structure of pitch-pine and oak in each forest type and (2) Determine the changes in size class structure over time. Three hypotheses (Figure 1) suggest different forest trajectories based on potential changes in the abundance of stems in 5 size classes: 1 (seedlings <0.5 m tall), 2 (saplings >0.5 m to 2 m), 3 (saplings >2 m tall and <2.5 cm DBH), 4 (trees > 2.5 cm and <10 cm DBH) and 5 (mature trees > 10cm DBH).

- Hypothesis 1: Ecosystem collapse (increased mortality and decreased recruitment)
- Hypothesis 2: Increased mortality and increased recruitment
- Hypothesis 3: Dense canopies and decreased recruitment

We hypothesize that pitch pine in both forest types is best represented by the "Ecosystem Collapse" hypothesis, due to mortality from southern pine beetle, and decreased regeneration due to fire suppression and increased canopy cover from hardwoods. In oak dominated communities, we hypothesize that oak best fits the "Increased Mortality and Recruitment" hypothesis.

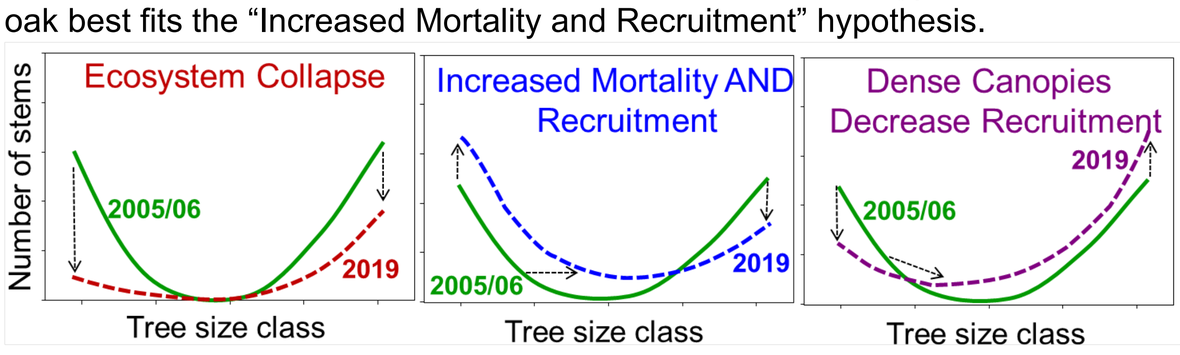


Figure 1: Three hypotheses regarding possibilities for change in size class distribution. Dovciak et al. 2018

Methods

Study area: 41 plots throughout the 105,000 acre Long Island Central Pine Barrens in Suffolk County, Long Island, NY
Study Period: June to August 2019

Field Methods:

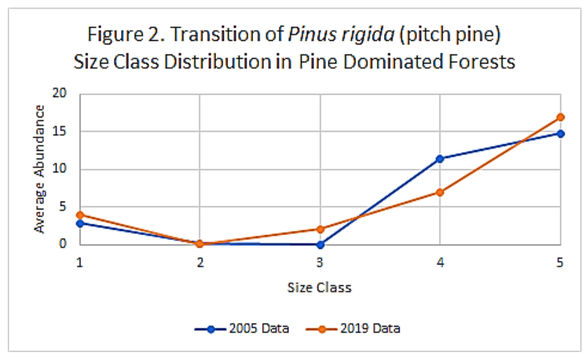
- DBH (diameter at breast height, at 1.3 m above ground) was measured for mature trees with DBH greater than 2.5 cm.
- The numbers of seedlings and saplings were recorded in four two-meter wide belt transects in each plot.

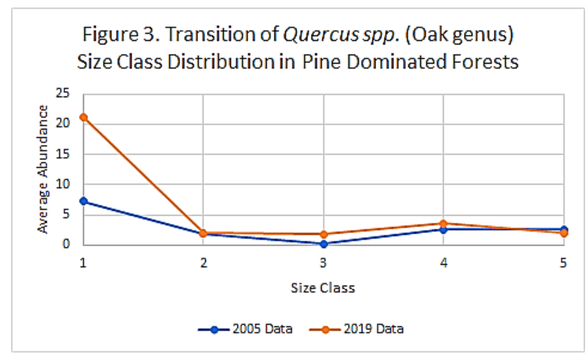
Data Analysis

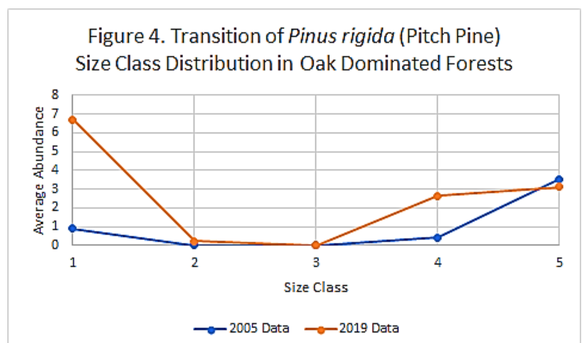
- Average abundance of each size class was calculated for each species in each community type for each year.
- Tukey's Test (95% confidence interval) tested for differences between 2005/6 and 2019 abundance values, and between community types.

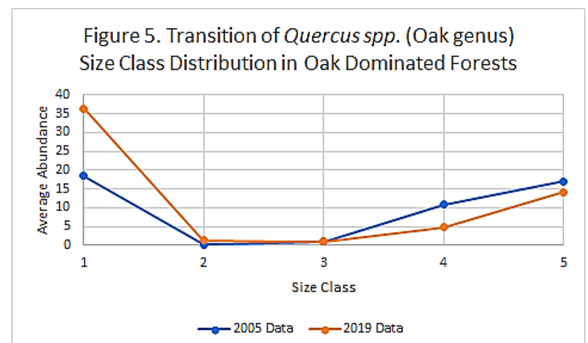
Results

- In pine-dominated forests, there were no significant differences between 2005/6 and 2019 for all species and size classes, but oak seedling abundance was significantly greater than pine (Figs. 2 and 3).
- In oak-dominated forests, oak seedling abundance was significantly greater in 2019 than 2005/6 (Figure 5).
- As expected, oak and pine trees within size class 5 (>10 cm DBH) were significantly more abundant in oak and pine dominated forest respectively.









Discussion

In oak-dominated communities there was a significant increase in oak seedling recruitment (size class 1, <0.5 m tall) compared to 2005/6, but otherwise there are no statistically significant changes over time. As expected, seedling abundance is greatest. However, survival to sapling stage (size classes 2 and 3) continued to be low, suggesting the possibility of a decline in mature pine and oak trees in the future.

Management Implications

- The LICPB needs active management to promote the regeneration and recruitment of pine into the canopy in pine-dominated communities. Prescribed burning, oak thinning, and deer population control may be beneficial management strategies.
- We recommend collaborating with Elders and knowledge holders in the Shinnecock Nation to learn about traditional methods of controlled burning.

Problems Encountered and Future Research

- Data suffers from zero inflation, due to frequency of plots where zero trees of a certain size class were found.
- Species not included in analysis could impact dynamics of demography.
- Small sample size, so repeat analysis after data is collected in all 93 plots.
- What is inhibiting seedling survival? Herbivory, competition, allelopathy?
- Repeat survey in 2030 to observe patterns of change over time.

Acknowledgements

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