A Comparison of Litter Densities in Four Community Types of the Long Island Central Pine Barrens

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ABSTRACT

The condition of the Long Island Central Pine Barrens has been an area of ecological concern for the past three decades. In 2003, the Foundation for Ecological Research in the Northeast (FERN) was founded to support scientific research in the Pine Barrens. FERN's groundbreaking project is the Central Pine Barrens Monitoring Program, for which field research began during the summer of 2005 at Brookhaven National Laboratory. The purpose of this research is to determine the current status of forest health in order to promote longevity and conservation in the Pine Barrens, as well as to learn what research should be done in the future. Specifically, litter densities from Pitch Pine, Pine-Oak, Oak-Pine, and Coastal Oak habitats were compared in order to justify the succession of the Pine Barrens and prepare for future prescribed forest fires. Using Geographic Information System (GIS) and Global Positioning System (GPS) technology, random plots of land were selected throughout eastern Long Island. These twenty-five by sixteen meter plots of land were then thoroughly surveyed. As part of the protocol, litter and duff depth data were collected at twenty points along each of the ten line transects in the plot. Pitch Pine forests were found to have the most litter, with an average depth of 8.5844 centimeters. Pine-Oak forests have an average litter depth of 4.4079 cm. Oak-Pine and Coastal Oak forests have comparable litter depths. Oak-Pine forests have an average litter depth of 4.8086 cm while Coastal Oak forests have an average litter depth of 4.4057 cm. A comparison of the vastly different litter densities of the four community types yields results that are consistent with the previously determined succession of the Pine Barrens and shows that litter density plays a key role in aiding forest succession. In the future, data collected under the Central Pine Barrens Monitoring Program can be used to determine a threshold for litter density in order to prescribe forest fires at appropriate times and preserve the Pine Barrens in the most effective manner.

Figure 1. A map of the Central Long Island Pine Barrens indicating the core preservation area [5]

INTRODUCTION

The Long Island Pine Barrens Society was founded in 1977 in order to bring attention to the depleting natural resources of the Pine Barrens. Initial preservation attempts to provide core or "greenbelt" areas, shown in Figure 1, during the late 1970's and early 1980's did not alleviate threats to the Pine Barrens ecosystem [1].

In 2003 the Foundation for Ecological Research in the Northeast (FERN) was founded to fund ecological and environmental research at Brookhaven National Laboratory [1]. The primary project of FERN is the Central Pine Barrens Monitoring Program. The goal of this project is to track the current and future health of the Pine Barrens so that future research needs and priorities can be identified [2].

It is anticipated that the results of this research will provide data relevant to the determination of appropriate timing for prescribed forest fires. Properly timed wildfires benefit the Pine Barrens. Reduction of litter (which is composed of leaves, twigs, pine needles, and other dead vegetation) and canopy cover in the forest provides for direct sunlight on the soil and triggers new tree growth. Melting of the pine cones' resin coating enables the cone to burst open and scatter seeds directly on bare soil [3].

Baseline data for this longitudinal study were collected during the summer of 2005 at Brookhaven National Laboratory. Pitch Pine, Pine-Oak, Oak-Pine, and Coastal Oak forests were targeted at this time. Pitch Pine forests commonly have a canopy cover of nearly 100 percent pitch pine trees while Pine-Oak and Oak-Pine forests have a canopy of mixed pitch pine and oak trees. All these community types include a shrub layer consisting of huckleberry, blueberry, and scrub oak. Coastal Oak forests typically contain a canopy of various tree oaks and little to no pitch pines in addition to "a nearly continuous shrub layer of huckleberry and blueberry" [2].

In order to validate the succession of the Pine Barrens, litter was measured in each of the four community types.

MATERIALS AND METHODS

Plots in the Central Pine Barrens throughout eastern Long Island were randomly selected using Geographic Information System (GIS). Each plot was first located using Global Positioning System (GPS) to insure that it was in the targeted community type. Next, shrub, tree, and herbaceous cover was recorded at twenty points, each one meter apart, along each of twenty transects. A densitometer was used at each point to determine an exact reading of the canopy cover. Litter and duff depths were measured to the nearest millimeter at points 3, 8,13, and 18 along each transect.

Belt transects were completed following the line transects. Tapes were placed at two, four, six, and eight meters along the sixteen-meter edge of the plot so that seedling and sapling data could be collected for four belt transects. Next, data on trees, snags, and downed logs were collected. .

Before leaving the plot, we estimated the percent cover and average height of each stratum including trees, shrubs, vegetation, and epiphytes. The edges and center of the plot as well as a witness tree were marked so that the plot can be located in the future.

A total of 40 plots were measured, however 10 were excluded from the study due to the vagueness of the actual community type. The breakdown of the 30 plots included for data analysis is noted in Table 1. Litter depth data for each plot (the forty points sampled) was averaged to create a mean litter depth for each plot. This data was then sorted by community type and graphically analyzed [2].

Plant Community	Number of plots
Pitch Pine	4
Pine-Oak	4
Oak-Pine	11
Coastal Oak	11

Table 1. The community type breakdown of the 30 plots used in this research.

Dana Tievsky measuring the litter depth of an Oak-Pine Forest.

RESULTS

	Pitch Pine	Pine-Oak	Oak-Pine	Coastal Oak
Litter Depth (cm)	8.5844	7.48	4.8086	4.4057
Standard Deviation	1.9448	1.0448	0.8151	0.8181
Variance	3.7822	1.0915	0.6644	0.6692

Table 2. The average litter depth of each community type (the mean of the average litter depth for each plot by community type). Standard deviation and variance of each mean is also displayed

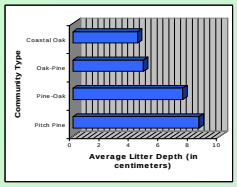


Figure 2. A comparison of average litter depth by community type.

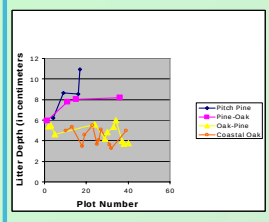
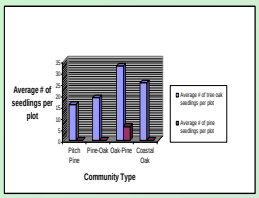


Figure 3. The average litter depth of each plot graphed to show variation in results for each community type.



Community Type	Average Number of Tree Oaks seedlings per plot	Average # of Pine seedlings per plot
Pitch Pine	15.75	<1
Pine-Oak	18.75	<1
Oak-Pine	32.82	6.1
Coastal Oak	25.36	<1

Figure 4. A comparison of the average number of tree oak seedlings to pine seedlings for each community type (in table and graph form).

To the left is a picture of a road along an Oak-Pine Forest in Rocky Point.

Kathryn Gutleber and Andrew Siefert measure the dbh of hardwood trees in a Pine-Oak Forest

DISCUSSION AND CONCLUSION

By comparing the data in Figure 1 to the forest succession diagram in Figure 4, it is evident that litter depth plays an important role in the transitions of forest succession. The early stages of succession, Pitch Pine and Pine-Oak, have a high average litter depth per plot whereas the later stages of succession, Coastal Oak and Oak-Pine forests have lower litter depths. This data can be considered statistically significant since the data for each community type is within two standard deviations of its' corresponding mean.

Furthermore, this research demonstrates better regeneration in the later stages of succession. The likely explanation is that relatively shallow litter depth permits sunlight to directly reach the soil for better tree regeneration [4]. In fact, the tree oaks most common to the Pine Barrens (Quercus alba, Quercus velutina, and Quercus coccinea) require light litter cover and full to partial sun for seedling establishment.

Similarly, pine (Pinus rigida) requires exposed mineral soil i.e., absence of litter, and partial to full sun for seedling growth. However, it should also be noted that pitch pine cones can require exposure to fire in order to spread the pine seeds for growth. After a period of 10 to 20 years without occurrence of fire, the oak canopies close, restricting the soils' access to sunlight. The pine trees in the canopy can persist, but pine seedlings cannot germinate with the excessive litter and lack of sunlight [4].

Therefore, it is sometimes necessary to prescribe forest fires and establish and maintain them safely and correctly[4]. In the near future, researchers should use the data findings of the Central Pine Barrens Monitoring Program to determine a litter depth threshold. This would enable prescribed fires to be properly timed for maximum conservation efforts.

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