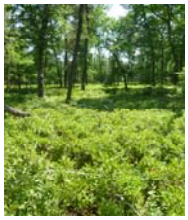

Analyzing Tree Regeneration as an Indicator of the Health of the Long Island Pine Barrens

Lyndsay McCabe (Hofstra University, Hempstead, NY 11549
Timothy M. Green (Brookhaven National Laboratory, Upton, NY 11973)

Abstract

The Long Island Central Pine Barrens Region is the largest mostly contiguous natural area on Long Island, making it a valuable resource to study to better understand how forests change over time. To analyze the health of a forest, it is critical to monitor the regeneration of tree species through counts of seedlings and saplings while also considering the presence of fully grown trees. In 2005 and 2006, 93 permanent plots were established throughout the pine barrens, and in 2011, seven of the plots on Brookhaven National Laboratory (BNL) property were revisited. Data was collected using the Forest Health Monitoring Protocols for the Long Island Central Pine Barrens set forth by the Foundation for Ecological Research in the Northeast (FERN). In each of the 25 meter by 16 meter plots, half of the plot was divided into four belt transects by running transect tapes at two meter intervals along the 16-meter side, thus creating two-meter by twenty-five-meter belts. Each belt was then visually scanned for seedlings and saplings, and the total counts for each species was recorded and compared to data from the first time the plot was monitored. This comparison was also made with counts of each species of live tree within the plot. A significant increase in scarlet (*Quercus coccinea*) and white oak (*Q. alba*) seedlings was found compared to the data taken in 2005 and 2006. The first set of data did not show any saplings in the plots studied, but in 2011, three oak saplings were found, which signifies that very few seedlings are surviving to become more mature trees. Furthermore, the only plot that had a significant amount of pitch pine (*Pinus rigida*) seedlings was one in which there had been a prescribed fire in 2006. This likely occurred because the fire burned away the leaf litter so that the seeds could reach the mineral soil in which they take root. As dense populations of white-tailed deer (*Odocoileus virginianus*) also have a profound impact on tree regeneration, plots with fences to prevent the entry of deer were established this year as counterparts to three of the plots studied so that future research can be done on the effect of deer browsing on seedling survival. Overall, the tree regeneration data taken from the plots at BNL may suggest a move toward the Central Pine Barrens becoming oak-dominated, illustrating what may be a late stage in the succession of the forest.

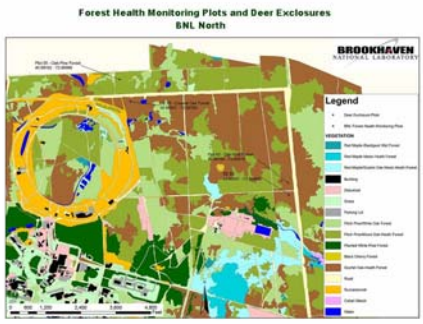

Figure 1: Vegetation Map of the North Side of BNL

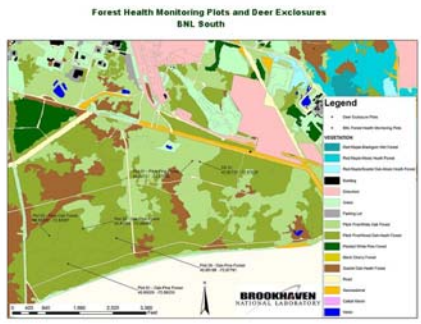

Figure 2: Vegetation Map of the South Side of BNL

Figure 3: Belt Transects Established to Count Seedlings and Saplings

Introduction

The Long Island Central Pine Barrens is a mosaic of terrestrial forest types, or sub-targets, including dwarf pine plain and pitch pine scrub shrubland, as well as pitch pine, pine-oak, oak-pine, and coastal oak forests, which are differentiated by the degree to which pitch pine is present, as well as the canopy cover and the presence of other vegetation (1, Fig.1, Fig. 2). Because of the unique composition of this forest and the key role of pitch pines in the ecosystem, the Pine Barrens is dependent on active management by humans in order to sustain its natural biodiversity, which many suggest should come in the form of prescribed fires (2). Fire is beneficial for the propagation of pitch pines, so it is important to see how its suppression contributes to the natural succession of an undisturbed Pine Barrens forest by monitoring the amount and species of seedlings, saplings, and mature trees within the established plots.

Materials and Methods

Forest plots were analyzed using the Forest Health Monitoring Protocols for the Long Island Central Pine Barrens set forth by FERN, which take into consideration many aspects of the area, including the vegetation composition. The corners and center point of each plot were established using a global positioning system (GPS) unit and permanently marked with stakes and aluminum caps.

For the tree regeneration study, half of the plot was divided into four belt transects by running transect tapes at two meter intervals along the 16-meter side, which created two-meter by twenty-five-meter belts (1, Fig. 3). The belt transect method was used because it is a relatively quick and efficient way to gather data, it can be applied to large areas, and it is a robust method to use with researchers with varying observational skill levels so as to avoid significant differences in data (8). To collect data, the researcher walked slowly down each of the four belts and visually searched for tree seedlings and saplings, as well as full-grown trees. Each tree in the plot was categorized by species, as well as if it was alive or dead, and was tallied

Three new plots were established as counterparts to three of the existing plots to be used as deer exclosures. These exclosures were within the same vegetation subtarget as their twin forest health plot in an area with similar understory, overstory, and canopy cover. These deer exclosures will have fences around the perimeter to prevent deer from entering the plot and browsing the vegetation. Using the baseline data collected when these plots were established, researchers will be able to see which plants may be preferred by deer, as well as the rate of growth of undisturbed vegetation.

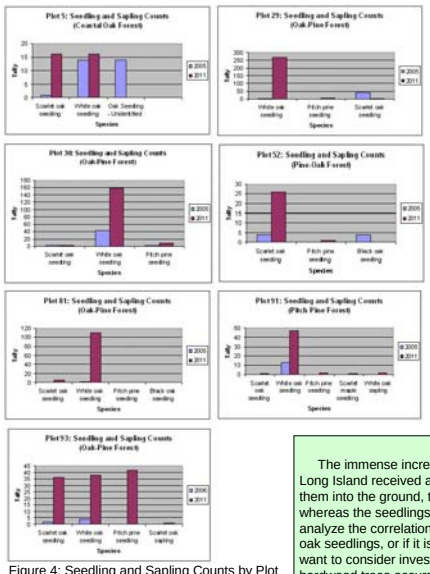

Figure 4: Seedling and Sapling Counts by Plot

Results

After comparing the data taken this year to the data gathered in 2005 and 2006, a significant increase in white oak and scarlet oak seedlings was found in each plot. In the four oak-pine forest plots studied (Plot 93, 29, 84, and 30), a massive increase in white oak seedlings was found compared to data collection in 2005 or 2006, Plots 93, 29, and 84 each contained between two and four white oak seedlings, and Plot 30 contained 43 seedlings (Fig. 4). In 2011, Plots 93, 29, and 84 each contained between 38 and 158 white oak seedlings, and Plot 30 contained 267 seedlings.

The rise in scarlet oak seedlings was notable in Plot 93 (oak-pine), Plot 5 (coastal oak), and Plot 52 (pine-oak). Plot 93 did not encompass any adult scarlet oaks, though Plot 5 was shown to have a very healthy scarlet oak population, as the number of full-grown scarlet oak trees has risen from six to nine since 2005. Plot 52 has also increased by one scarlet oak tree since 2006.

The only plot in which pitch pine seedlings were abundant was Plot 93, which was located in an oak-pine forest, an ecosystem in which the typical tree population is 11-49% pitch pine (1). Within this plot, pitch pines make up approximately 35.9% of the total amount of seedlings, whereas in all other plots, pitch pine seedlings accounted for no more than 4.7% of the total (Fig. 4).

Out of the seven plots surveyed, only two plots had saplings within the belt transects studied – one scarlet oak sapling in Plot 93, and two white oak saplings in Plot 91 (Fig. 4). No pitch pine saplings were found within the belt transects.

The seedling and sapling counts in the three deer exclosures that were established to correspond with three particular plots (Plot 93, 91, and 5) were found to vary only slightly between the deer exclosure and its twin in two sets of plots (Fig. 5), but there was a large difference in Plot 5, which was exactly half scarlet oak seedlings and half white oak seedlings, whereas the deer exclosure was made up of nearly 75% pitch pine with the remaining 25% consisting of white oak and scarlet oak.

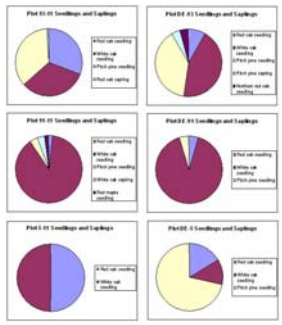

Figure 5: Comparisons of Plots and Corresponding Deer Exclosures

Discussion

The immense increase in oak seedlings in these plots may be a result of the weather that the Central Pine Barrens has experienced within the past year. In the winter of 2010 into 2011, Long Island received approximately 61.9 inches of snow – the most it has had since the winter of 1995-1996 (3). The large amount of snow blanketed the acorns and pine seeds compacted them into the ground, thus hiding the seeds from animals like white-tailed deer and gray squirrels. The seeds were able to survive through winter and spring, and were thus able to sprout, whereas the seedlings in the winters of 2004-2005 and 2005-2006 had 41 and 40 inches of snow, respectively, and were more likely to be uncovered and eaten. It would be interesting to analyze the correlation between the amount of snow in the winter and the amount of seedlings found the following summer to see how viable this explanation is in explaining the abundance of oak seedlings, or if it is the litter and soil combined with plenty of canopy cover that is providing the perfect environment for oak seedlings to grow. As a study for the future, researchers may want to consider investigating how climate change is affecting acorn production and germination, and if a change causing more snow in the winter would quicken the rate at which succession to hardwood trees occurs in the pine barrens.

The large amount of pitch pine seedlings in Plot 93 stands in stark contrast to the pitch pine seedling counts in the other plots, and is likely the effect of a prescribed fire in 2006 that took place in the section of the forest where the plot is located. As opposed to the other plots, the litter layer was burned away to expose the mineral soil and the overstory opened, providing excellent conditions for pitch pine seeds to germinate.

The data regarding sapling counts in the plots revisited suggest that white oak and scarlet oak species are slowly becoming more abundant as a few seedlings were able to reach the sapling stage. One reason for this small amount of saplings may be the large population of deer browsing scarlet and white oak seedlings, so it would be interesting to see if more seedlings in the deer exclosure plots reach the sapling stage than those in the unfenced twin plot. When looking for these changes, it will be important to note that the baseline data for the deer exclosures were not found to be exactly the same as their twin plot, so careful attention must be paid to these differences.

Overall, the data collected from the plots at BNL show that oaks are faring better in the conditions of this part of the Central Pine Barrens than pitch pine seedlings, which appears to support the transition model of a pine barrens forest moving towards becoming a hardwood forest.

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[3] National Weather Service Forecast Office, "Monthly and seasonal snowfall at Central Park," 2011, http://www.erh.noaa.gov/okx/climate/records/monthseasonsnowfall.html

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