Baseline pH and the Variability of pH within Plots and Community Types of the Central Pine Barrens.

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The Long Island Central Pine Barrens (CPB) is a valuable natural resource for its beauty, natural water aquifer and for being the habitat of many endangered and threatened species of plants animals and insects. The Foundation for Ecological Research in the Northeast (FERN) is an organization committed to the preservation of the Pine Barrens ecosystem by maintaining or improving the health of the forests located in the CPB. To maintain and improve the health of the forest FERN in conjunction with other organizations, funded a ten-year longitudinal study on the health of the CPB. Data collected on the pH of the soil will provide a piece of the baseline health record for this ten-year longitudinal study. To establish a baseline health record for each forest type, several 16 x 25m plots were set up, according to established protocols, within each forest community type. Using a Kelway HB-2 Soil pH meter / moisture tester the pH of the soil was taken at eight points within each plot. The average pH of the forest types were 6.3 for Coastal Oak, Pitch Pine 5.9, Pine-Oak 6.0, Oak-Pine 5.9, Pitch Pine Scrub Oak 6.1, and 6.1 for Dwarf Pine. Analyzing this data and data collected at the end of the ten-year study will be valuable in determining the long-term health of the forest as well as the effects of human intervention such as acid rain pollution.

INTRODUCTION

In 2005 the Foundation for Ecological Research in the Northeast (FERN) began research with funding provided by The Central Pine Barrens Joint Planning and Policy Commission to collect and monitor the forests in the CPB. The research was continued in 2006 to ensure enough data was collected to establish a baseline health record. In ten years the research will be repeated at the same plots that were studied in 2005 and 2006. This ten year longitudinal study is expected to provide enough data to detect small changes in the forests health.

There are several measures of forest health including, but not limited to, flora and fauna diversity, litter, canopy cover and pH of the soil. Soil pH is important because it has a role in determining what is able to survive in the soil. The pH of the soil will vary within a single plot, between different plots of the same community type and within different forest community types. Soil acidity will vary within a plot because of the flora that provide the canopy and the organic matter on the ground [1].

The purpose of this research was to establish baseline pH levels for the CPB and to determine the correlation between pH and the surrounding environment such as flora and fauna. This research will help gain insight into both the reasons for changes in forest community types as well as helping to determine a timeline for the changes.

A map of the Central Pine Barrens. Courtesy of http://www.pb.state.ny.us.

MATERIALS AND METHODS

Plots were located using Geographic Information System (GIS) software, orthophoto quad maps of Long Island and GPS units. The plot was established according to protocols [2], with ten transects bisecting the 16 x 25 meter plot.

Measurements taken included; canopy cover, ground cover, litter depth, duff depth, number of trees and saplings, size of trees, and pH of the soil. Within the plots a total of eight pH measurements were taken, four near the edges of the plot and four near the center to ensure comprehensive data (illustrated in Figure 1.)

The data used was collected from 90 plots; 18 from Pitch Pine, 18 Coastal Oak, 31 Oak-Pine, 12 Pine-Oak, 4 Dwarf Pine and 7 Pitch Pine Scrub Oak.

Using Microsoft Access and Excel, the data was analyzed to find the average pH for the community type, average pH for the plots in a community type (min/max plot avg. pH), min/max pH readings within a community type, standard deviation of average pH, variance between plots in a community type and variance between community types were all found.

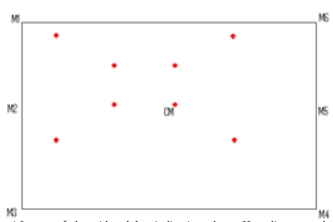

Figure1 Layout of plot with red dots indicating where pH readings are taken

RESULTS

Community Type	Pine-Oak	Oak-Pine	Pitch Pine	Coastal Oak	Pitch Pine Scrub Oak	Dwarf Pine
Avg. pH	6.0	5.9	5.9	6.3	6.1	6.1
St. Dev.	0.39	0.34	0.27	0.3	0.10	0.25
Min pH	5.2	4.4	4.2	5	5.4	5.3
Max pH	6.8	6.9	6.8	7	6.8	7
Min Plot Avg. pH	5.7	5.5	4.7	5.6	5.7	5.7
Max Plot Avg. pH	6.0	6.5	6.5	6.8	6.6	6.4

Table 1 The Avg. pH, Standard Deviation, Min pH, Max pH, Min Plot Avg. pH and Max Plot Avg. pH for each community type.

Community Type	Pine-Oak	Oak-Pine	Pitch Pine
Avg. pH under Oak	5.9	5.7	-
Avg. pH under Pine	5.2	5.8	6
Edge of Tree	-	5.8	5.7
Sky	-	-	5.8

Table 2. Average soil pH in relation to canopy type for different canopy community types.

The average pH values for the different community types are shown in Table 1 with Pine-Oak 6.0, Oak-Pine 5.9, Pitch Pine 5.9, Coastal Oak 6.3, Pitch Pine Scrub Oak 6.1 and Dwarf Pine 6.1. Also in Table 1 are the minimum and maximum pH values measured in the different community types and the standard deviation of the pH. The max pH value observed was 7 and the min 4.2.

Within the three community types with canopies greater than 5 meters (Pitch Pine, Oak-Pine and Pine-Oak), the pH values are consistent with variability in plot averages.

The three remaining community types, Coastal Oak, Dwarf Pine and Pitch Pine-Scrub Oak, all have very similar pH readings. The greatest difference in readings is the max plot average pH

Below oak trees in Pine-Oak forests the soil pH was 0.2 higher than soil under oak trees in Oak-Pine forests while under pines the difference was 0.6. Also listed are the pH values of the soil in relation to the canopy cover for the point. For Pitch Pine the pH range was from 6.0 under the trees to 5.7 at the edge and 5.8 under no canopy. With Oak-Pine the pH average was 5.8 under the tree and at the edge.

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DISCUSSION AND CONCLUSIONS

The average pH values measured in this research are higher than averages measured in other forests with the same tree species present [3], [4].

Possible reasons for the differences:

- The unique location of the CPB, soil make-up and method of testing. Location could play a role in varying pH because Long Island has many different natural features not present in other Pine Barren locations such as the Atlantic Ocean, Long Island Sound, topography, geographic location, soil type, etc.
- The method of testing appears to have a large variability.

Within plots in a community type the pH was variable.

Possible reasons for the differences:

•The litter and duff depth vary within each plot [5].

•Canopy cover varies within a plot from oak to pine.

•The pH of rain falling off different parts of the tree will have different pH and cause a change in soil pH [6].

Reasons for error in pH readings:

- According to J. Peters, the Kelway HB-2 provided accurate results on soils close to pH 7.0 with an error involved using this tester of 0.2 pH [7].
- pH readings may vary due to soil texture, rainfall and manure. Litter depth, duff, mineral soil, wild animals and proximity to farms using fertilizer varied from plot to plot.
- Soil moisture varied.

Possible ways to improve accuracy.

- Other methods exist to test pH including those discussed by Cedar McKay in his article about controlled burning [8] in which samples are dried and a constant amount of water is added to the sample.
- To improve the quality of the data collected by the pH meter it may be beneficial to take the soil moisture content and compare only the data with similar moisture content.

Future Projects and Research.

- Collect samples under particular trees to determine the effect of canopy cover on soil pH.
- Consider the use of a new method of testing pH in which the testing method is more consistent and less field dependant.
- Connect research on seedling and sapling quantities to pH and other soil properties to determine if conditions can be altered to assist seedling viability.
- Repeat this study in ten years to see how soil pH has changed.

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