Cathance Preserve Forestry Plot Survey

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Purpose:

How can soil health, composition, and nutrient quantity of two different plots affect different tree species' growth as measured in those plots by Diameter Breast Height (DBH)?

Hypothesis:

Different tree species will grow better than other species depending on soil conditions.

Procedure:

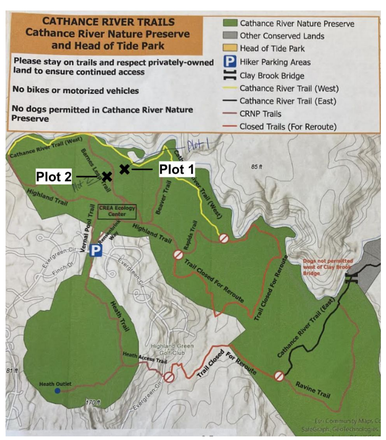
1. Plot #1 and #2 can be located just off Barnes Leap trail. Once there, find the center of the plots.

For each plot:

2. Identify; tree species, DBH, and general tree health starting at the northernmost tree and moving clockwise around the plot.
3. Take 4 soil samples from different soil horizons around the plot. Moisten them with distilled water, then test for pH with pH strip.
4. Soil moisture content (%): Measure the mass of soil from each layer, then place it in an incubator to evaporate the water. Measure its mass again, and subtract it from the original mass to calculate how much of the soil's mass is water. Once you have the soil's water mass, divide it by the original water mass and multiply by 100, to find the moisture percentage of the soil.
5. For each plot take one soil sample consisting of a mix of soil from all over the plot. Send the sample to the University of Maine at Orono Soil Lab for in-depth testing.

Key Background:

-The Maine Forest Ecology Research Network (FERN) is a forestry program created for the purpose of teaching students about the forest. The students are partnered with local forestry professionals to educate them on how to gather data. Each FERN site is a 1/10 acre plot of forest (37.2-foot radius) used to collect and analyze data about how trees develop over time.
-Diameter breast height (DBH) is a way to approximately measure the diameter of a tree. It's used to measure the size and growth of trees.
- All soil has many different layers. These layers are called horizons. Depending on the soil's health and maturity there may be different horizons present in the soil.
-Soil holds water, important minerals, and nitrogens that keep trees in good health. Different soil textures can also affect tree health. An example of this is soil with large amounts of clay in it. The clay suffocates the roots, there is not enough room for water to make it to the roots and be absorbed by the tree.
-There are several important elements for plant/tree growth found in soil; Nitrates, Phosphorus, Potassium, Calcium, Magnesium, Sulfur, Boron, Copper, Iron, Manganese, and Zinc.
-Trees in the plot include; Eastern Hemlock, American Beech, Eastern White Pine, Red Spruce, Northern Red Oak, and Balsam Fir.



Locations of the forest plots at the Cathance River Nature Preserve ÏÏ

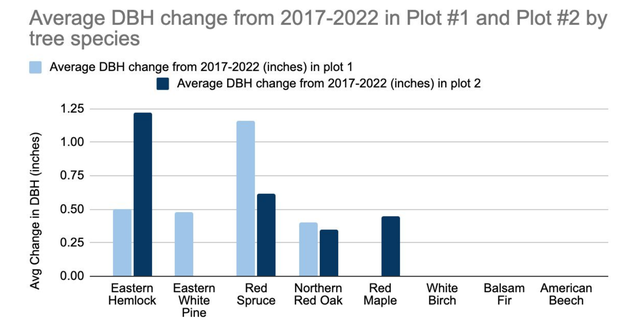
Thermometer measuring soil temperature in Plot #1

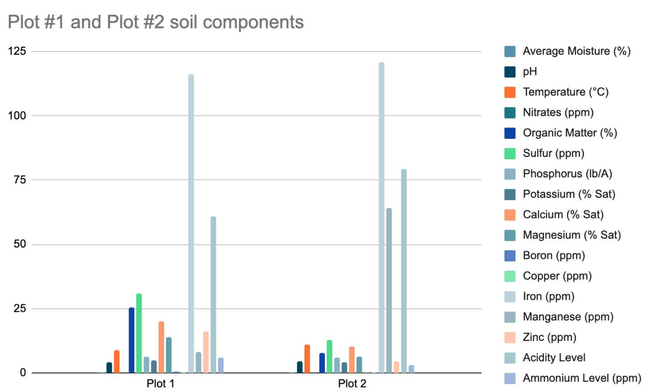
Data Table: Plot #1 and #2 Soil Components Summary Data:

(Data from pH - Ammonium from UMaine Orono Soil Test Lab.)

Nutrients:	Plot 1: (more mature plot near the river)	Plot 2: (less mature plot away from the river)
Soil Type (Sandy, loamy, clay, silty):	Loamy soil	Loamy soil
Color:	Dark brown at 3in, tan/orange at 6in, copper w/ hints of gray at 9in	Brown at 3in, tan/yellow and gray at 6in, bedrock at 9in
Texture:	Soft/roots/spongey	Gritty/roots/sandy/bedrock
Average Moisture (%)	17%	13%
pH	4.1	4.4
Temperature (°C)	9	11
Nitrates (ppm)	0	0
Organic Matter (%)	25.3	7.8
Sulfur (ppm)	31	13
Phosphorus (lb/A)	6.3	5.8
Potassium (% Sat)	5.0	4.2
Calcium (% Sat)	20.2	10.4
Magnesium (% Sat)	13.9	6.2
Boron (ppm)	0.5	0.3
Copper (ppm)	0.34	0.36
Iron (ppm)	116	121
Manganese (ppm)	8.1	64
Zinc (ppm)	16	4.4
Acidity Level	60.9	79.3
Ammonium Level (ppm)	6	3

Graphs:





Charles measures a trees DBH at Plot #2.

Nouvelle and Charles observing a tree core with their mentor Shane Duigan at Plot #1

Conclusions:

Results/findings about hypothesis

-The results suggest that the hypothesis that soil conditions will impact tree growth is true, but only for certain species.
-The majority of soil components measured were higher in Plot #1; it had a more nutrient rich soil. For example in Plot #1 there is a 25.3 percentage of Organic matter, while in Plot #2 the percentage of Organic Matter is only 7.8%. In all of the examples, Plot #1 has a higher content of several specific soil nutrients.
-Red Spruce did much better in Plot #1 than in Plot #2. This could be because Red Spruce prefers moist soils that contain Calcium (Ca), and Magnesium (Mg). In Plot #1 there was a higher moisture content (17% vs 13%), and higher percentages of Ca (20.2% vs 10.4%) and Mg (13.9% vs 6.2%). Northern Red Oak also did slightly better in Plot #1, the average growth difference is 0.1 DBH inches in Plot #1 compared to Plot #2.
-Plot #2's Hemlock trees had more growth from 2017 to 2022 than plot #1's Hemlock trees. This might be because Plot #2's pH level of 4.4 was better within the parameters that a Hemlock typically prefers, which is acidic soil between 4.2 to 5.7. The less Hemlock growth in Plot #1 from 2017 to 2022 could be because the soil pH level of 4.1 was slightly below the preferred level for Hemlock trees.
-Conifers including Eastern Hemlock and Red Spruce generally showed more average DBH growth than hardwoods like Northern Red Oak in each of the plots studied. Eastern Hemlocks grew 0.5 and 1.22 DBH inches from 2017 to present in Plots #1 and #2 respectively. Similarly, Red Spruce grew 1.16 and 0.62 DBH inches from 2017 to present in Plots #1 and #2 respectively. Northern Red Oak grew only 0.4 and 0.3 DBH inches from 2017 to present in Plots #1 and #2 respectively.

Sources of error

-A measurement of nutrient content in 1/10 of an acre of soil is not exact, the more samples that are measured the more reliable the data is.
-The DBH of a tree could be recorded incorrectly because it is measured at 4 feet, and if the ground is not level, the 4 feet marking could also be inaccurate.
-Some trees in past years were misidentified, skipped (for various reasons), or died which could have thrown off data. To compensate, only trees that were living in both 2017 and 2022 were compared for this report.

Improvements and additions

-Use the 2019 report rather than the 2017 report to make future growth comparisons as the 2017 report has some measurement and identification errors.
-In order to mitigate the inconsistencies of soil measurements it would be beneficial to take more samples evenly dispersed throughout each plot.
-The DBH mark on each tree should be at four feet, though it may differ slightly from tree to tree, groups should measure at the existing mark to maintain consistency.

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