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Summer Project 2013

Soil moisture in Ca plots

**Introduction:**

One environmental consequence of heightened industrialization in the twentieth century has been acid deposition due to acid rain. In northern North America, as in many other parts of the world, this has resulted in a continuous depletion of base cations in soils, including calcium (Ca2+) (Driscoll et al 2001). Experimental re-addition of calcium to northern hardwood forests at the Hubbard Brook Experimental Forest in 1999 was shown to significantly increase the growth and survival of sugar maples, though the physiological mechanisms behind these results are poorly understood (Juice et al 2006, Driscoll et al 2001). Runoff from the fertilized forest was also significantly lower following fertilization compared to a control watershed with similar characteristics, indicating that evapotranspiration increased by 18-25% in the three years immediately after fertilization (Green et al 2013).

The Multiple Element Limitation in Northern Hardwood Forests (MELNHE) project has fertilized six experimental plots with calcium in order to replicate some of the experiments first performed at Hubbard Brook in other sites in the White Mountains of New Hampshire. Three plots at the Bartlett Experimental Forest are generally nutrient poor compared to Hubbard Brook, while two plots at Jeffers Brook are nutrient rich. Three of these plots are considered mature forest, one is considered young forest, and two are considered intermediate. Previous research in the White Mountains has demonstrated that soil calcium content may be higher in younger stands than in mature forests (Hamburg et al 2003). This experiment will take advantage of all six calcium plots and their paired control to see if all a decline in soil moisture as a result of fertilization occurs at the plot level.

**Question:**

Does calcium fertilization result in a reduction of soil moisture in northern hardwood forests of various ages?

**Hypothesis:**

In older forest stands, where calcium is most likely to be limiting, fertilization will facilitate an increased uptake of water by plants, resulting in a reduction of soil moisture.

**Materials and Methods:**

EM50 data loggers have been placed in the calcium and control plots at stands C1, C6, C8, HBO, JBO and JBM, connected to three EC-5 soil moisture probes at depths of 10, 30 and 50 cm. The monitors should have soil moisture data stored at fifteen-minute intervals for most of 2012 and 2013, which I will use as the basis for my analysis.

Because soil moisture is predicted to be heterogeneous and influenced by more than just treatment, I will also take multiple additional soil moisture measurements from around the plot. I will use soil moisture data from germinant microplots where they are available and collected data myself where they are not.

**Analysis:**

I will test for difference between the soil moisture of all calcium plots versus control plots, of calcium versus control plots in each age category, and of each calcium plot versus its corresponding control plot. I will also test controlling for season and time since fertilization as well as soil hydrologic group if necessary.

**Conclusions:**

A significantly lower average soil moisture in fertilized plots than in control plots would indicate that calcium fertilization has facilitated an increased uptake of water by plants. A more pronounced difference in a certain age category, site or stand would indicate that depletion has been a greater stress in that age category, site or stand.

**References:**

* Green, Mark B., et al. "Decreased water flowing from a forest amended with calcium silicate." *Proceedings of the National Academy of Sciences* 110.15 (2013): 5999-6003.
* Hamburg, Steven P., et al. "Biotic control of calcium cycling in northern hardwood forests: acid rain and aging forests." *Ecosystems* 6.4 (2003): 399-406.
* Juice, Stephanie M., et al. "Response of sugar maple to calcium addition to northern hardwood forest." *Ecology* 87.5 (2006): 1267-1280.
* Zahor, Lily E., et al. “The Impact of Calcium on Transpiration in an Acid Rain Impacted Forest**. “** Plymouth State University Office of Research & Engagement Student Showcase, April 27, 2013.