Investigating Interactions between Carbon, Nitrogen, and Calcium Cycles in the Woods Lake Watershed, Adirondack Park

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ABSTRACT:
Nutrient availability in Northeastern forests has been dramatically altered by human activities. Acid deposition has increased nitrogen (N) in soils, but has also been linked to soil acidification, base cation loss, and declines in forest health. Depletion of soil base cations has been extensive, and slow weathering rates combined with a decrease in atmospheric inputs of base cations may further constrain forest recovery as rates of acid deposition decrease. We are investigating long-term changes in carbon (C), N, and calcium (Ca) cycling following an experimental Ca addition in the Woods Lake Watershed, Adirondack Park, NY. In 1989, calcium carbonate (lime) was added to half of this watershed to assess whether forest liming could be an effective strategy to reduce acidification of surface waters. Now, nearly 20 years later, the Woods Lake experiment provides a unique opportunity to study the long-term effects of increased Ca on forest health, as well as C and N pools and fluxes. We are currently quantifying stocks of C, N, and Ca within the soils and vegetation of control and Ca-amended plots. In addition, we are studying processes which may influence soil C and N stocks, including rates of leaf litter input and decomposition, Ca-organic matter binding, and gross N mineralization and nitrification rates. Preliminary results suggest that the forest floor mass in limed plots is greater than that in the controls.

O horizon in control subcatchment 3.

PRELIMINARY RESULTS:

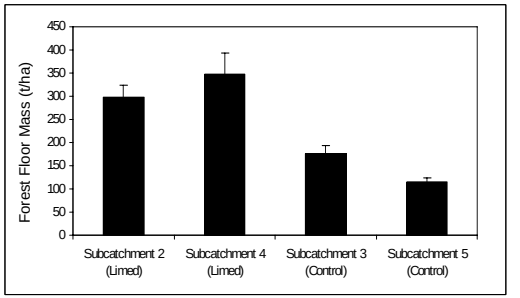

FIGURE 1. Mean forest floor mass for plots sampled summer 2007. Each subcatchment consists of 5 plots, with 5 sampling locations per plot (n=25). Error bars indicate standard error.

•Results suggest that the forest floor mass in limed plots is greater than that in controls.

Soil sampling, summer 2007.

All trees >5 cm dbh in the plots under investigation were tagged prior to liming.

Forest floor sampling, summer 2007. Engine-driven, diamond-bit corer in foreground.

METHODS:

During summer 2007 soil and forest floor samples were collected from 10 Ca-amended and 10 control plots established in 1989 by Peter Smallidge (summarized in Smallidge and Leopold 1994).

• Five 15 cm x 15 cm forest floor blocks were taken within each plot
•Within each block, 9.5 cm diameter cores were taken in 10 cm increments to a depth of 40 cm

•Ongoing analyses include:
- •Measure of exchangeable Ca and total C, N, and Ca content
- •Physical fractionation of light and heavy C pools

•Future work include:
- •Quantification of annual leaf litter inputs
- •Assessment of tree growth (I have obtained dbh data from 1989)
- •Measure of forest floor decomposition rate
- •Measure of gross N mineralization and nitrification

HYPOTHESES:

We expect that Ca may increase NPP as well as rates of decomposition and N cycling in the forest floor. However, Ca-facilitated, organo-mineral binding may lead to greater stability of C in the mineral soil, leading to slower rates of decomposition and N cycling, and larger C and N stocks in limed sites. More specifically, we hypothesize:

H1: Ca amendment will decrease C and N stocks in the forest floor, and increase stocks in the mineral soil.

H2: The percent of mineral-associated C within the mineral soil will be a function of the abundance of exchangeable Ca.

H3: Ca fertilization will aid in forest recovery from acidification, resulting in increased tree growth and litter production relative to untreated plots.

H4: Ca amendment will increase rates of gross N mineralization and nitrification in the forest floor and will decrease these rates in the mineral soil.

WORKS CITED:
P. J. Smallidge and D. J. Leopold, *Bulletin of the Torrey Botanical Club* **121** (4), 345 (1994).

AKNOWLEDGEMENTS:
This research is being funded by the Biogeochemistry and Environmental Biocomplexity NSF IGERT Small Grants Program and the Kieckhefer Adirondack Fellowship.