Carbon Sequestration through Wood Accumulation in Wetland and Upland Coniferous Forests

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BI/ES 430 Forest Ecology

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Introduction

When trees take in carbon dioxide (CO_2) to photosynthesize they are effectively removing the gas from the atmosphere and storing it within their wood and leaves. The process of carbon storage is known as carbon sequestration. Carbon dioxide is the most important greenhouse gas in the atmosphere today that is actively contributing to global climate change. Many studies are now investigating how different factors, such as forest age or forest type (Munger et al., 2004) affect carbon sequestration rates, because theoretically forests that sequester more carbon could slow atmospheric CO_2 increases and combat the effect of global climate change.

Research Question:

- How does carbon sequestration in upland coniferous forests compare to carbon sequestration in wetland coniferous forests?

Research Area Map

Figure 1. Map of study plots on the FPU Rindge campus. "C" plots are within upland coniferous forests and "E" plots are within forested wetlands

Methods

A tag on a marked trees used in the study.

- I utilized 20mx20m sampling plots and baseline tree data from 2008 from a long term buckthorn study. For each of the five field sites the three sampling plots had been previously established.
- I recorded tree dbh to establish current tree diameter.
- An online tree biomass calculator was used along with wood-carbon percentage values to calculate total average annual sequestration over the four year period.
- I used a series of t-tests and an Anova to determine sequestration differences by forest type, and data analysis led to further inquiry.

Results

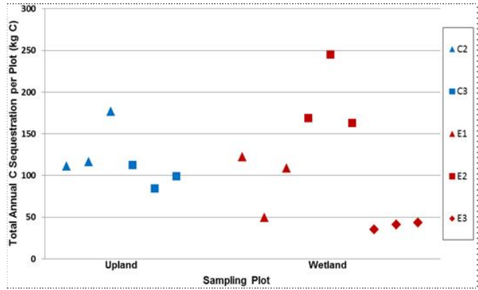

Figure 2. Total carbon sequestration for each of the 15 sampling plots. Although there was no significant difference between carbon sequestration of upland coniferous forest and wetland coniferous forest, an Anova revealed significant variation among the wetland plots (p= 0.0048)

- No significant difference was found between upland and wetland coniferous forests. A high degree of variability was noted among wetland plots.

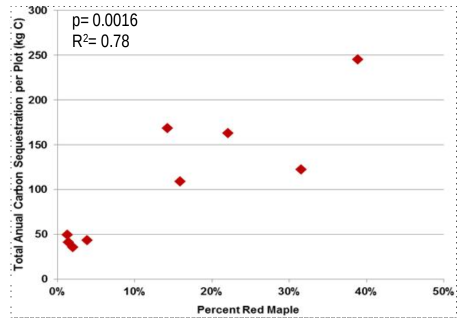

Figure 3. During data analysis it was noted that red maple took in more carbon annually than spruce. This led to an analysis of how the composition of red maples in each plot relates to the total plot sequestration. This scatterplot shows the significant relationship resulting from the analysis, which explains some of the variation found within the wetland plots in Figure 2.

- Variability in sequestration within wetland plots is partly due to the amount of red maple found among the plots.

Discussion

Natural processes such as carbon sequestration within forests are affected by more than just the hydrology of the forest. Two different forest types dominated by coniferous trees did not show to have different total annual sequestration, but the percentage of red maples within wetlands had a moderate influence on the total carbon sequestration of those plots. In terms of carbon sequestration, This finding places a higher value on wetlands (and potentially all coniferous forests) with a greater percentage of red maples, and could help to guide decision making within the university to create the most climate-neutral campus possible.

References

Munger, J. W., C. Barford, and S. Wofsy. 2004. Exchanges between the Forest and the Atmosphere. Pages 202-230 *in* D.R. Foster and J.D. Aber (eds.), *Forests in Time*, Yale Univeristy Press, New Haven.

Additional Photos and Results

Figure 4. A photograph of field site C2. C2 was dominated by hemlock but also featured red maple, white pine, and balsam fir. Upland plots had lower tree density, but a higher average tree diameter. It was determined that average sequestration per tree was greater within upland plots.

Figure 5. A photograph of field site E1. The wetland field sites were all dominated by spruce trees and featured red maple, which was more prominent in some than others. Other tree species found in the wetlands included paper birch, balsam fir, white pine, and tamarack. This photograph captured the flooding that occurred within the wetlands following Hurricane Sandy.

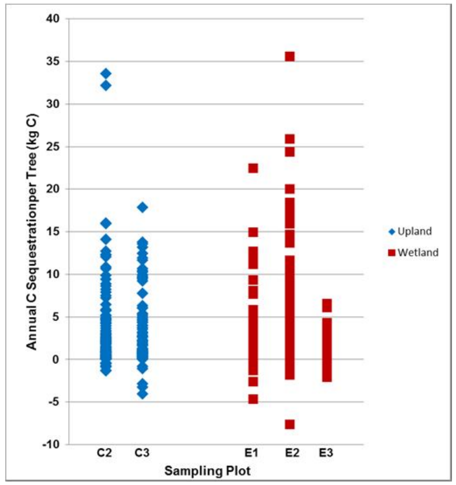

Figure 6. Annual carbon sequestration of each individual tree studied (n= 751). Negative values indicate dead trees that are no longer photosynthesizing, but are instead decomposing and releasing CO_2 into the atmosphere. Carbon release through decomposition was quantified by the assumption that trees would take 50 years to fully release all of their accumulated carbon back into the atmosphere as CO_2.