Do Nutrient Additions Affect Sap Flow in Sugar Maple Trees?

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Introduction

•The majority of water in a watershed is lost through stream discharge (e.g. outflow). The second-most significant loss is through transpiration (Barbour et al. 2004; Ford et al. 2007).

• Tree transpiration is essential for photosynthesis and nutrient uptake, but the role of nutrient availability on transpiration has yet to be determined.

• Recent studies have suggested that forests are co-limited, leading to a constraint on available nutrients for biomass accumulation (Elser et al. 2007)

•Transpiration has been shown to increase in pine plantations with an increase in nitrogen (Samuelson et al. 2008)

•Several studies have shown that Ca additions increase transpiration rates, but none have been able to determine a P effect (de Silva et al. 2008; Green et al. 2013).

•Sugar maple was chose because of its abundance in the study site, as well as its ecosystem and economic values.

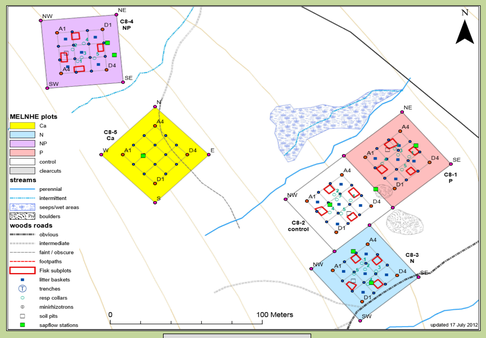
Objectives

•Determine if the addition of nutrients N, P, and NP affect sap flow in sugar maples. I expect to see an increase in sap flow with the addition of NP.

•Determine if transpiration is affected by the addition of Ca six years after treatment. I expect to see an increase in sap flow.

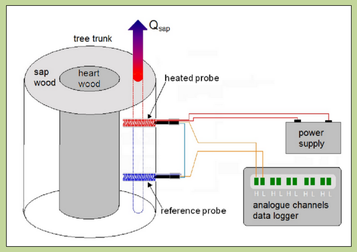
Study Site

This study was conducted in the White Mountain National Forest in Bartlett, NH. Since 2011, 9 stands, each divided into subplots have received treatments of N (30 kg ha^{-1} yr^{-1}) as ammonium nitrate, P (10 kg ha^{-1} yr^{-1}) in the form of monosodium phosphate, N+P, and a control. Three of these stands have a fifth plot that recieved a one-time applciation of calcium. C8 is the stand that this study was conducted in because of it's presence of a calcium addition plot. Sugar maple sap flow was monitored from July-August of 2017.

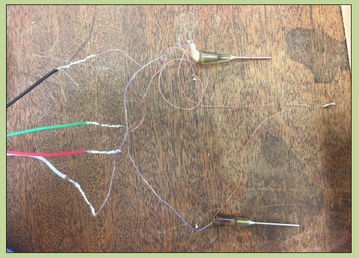


Study Site C8

Methods



Xylem Sap flow measurements were made using the Granier (1987) temperature differential technique.



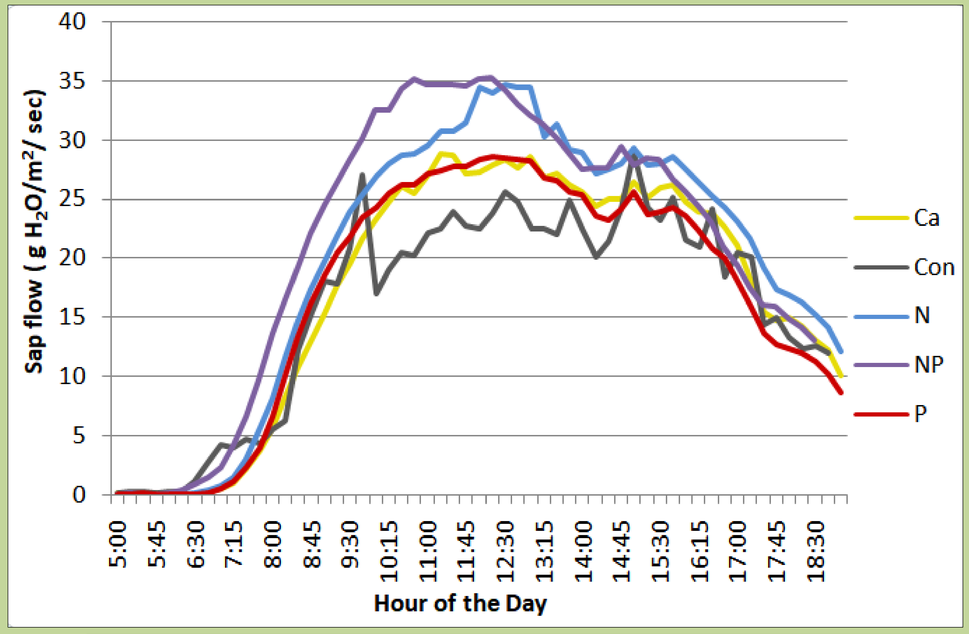
This method uses a heating probe that releases a constant rate of heat, and a reference probe.

The probes are inserted into the tree 10cm apart with the reference probe below the heated.

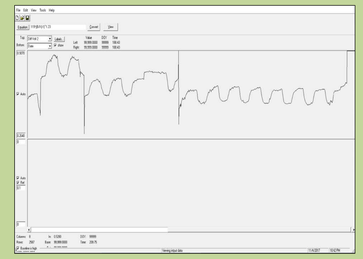
The inserted probes are then covered with a plastic cup that is sealed with silicone to seal out water. A reflective material is stapled over the cup to prevent sun interference.

The wires from the probes are connected to a battery operated data logger and measurements are taken every 15 minutes.

Results



•N addition increases sap flow (p=0.010)
•NP increase sap flow (p<0.0001)
•No treatment effect: Ca (p=0.93) and P (p=0.96)



Data are converted from temperature difference to sap flow using the software BaseLiner (version 3.0.10, developed by Ram Oren, Duke University). This program uses manually determined points as a baseline for sap flow for each day and scales the other measurements for the day to this.

What's Next?

1. Determine a conversion method that does not require BaseLiner. This will allow for consistent conversions between samples.
2. Use SAS to run ANCOVA test between the plots with time as the covariate. This will test whether there truly is a treatment affect or not by taking time into consideration.
3. Determine through multiple statistical analyses if there is a treatment effect on sap flow. Conducting multiple analyses will determine if there is truly a treatment effect as well as analyze possible influential variables.

Works Cited

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