



Measuring the effect of drought on water use in mid-canopy tree species

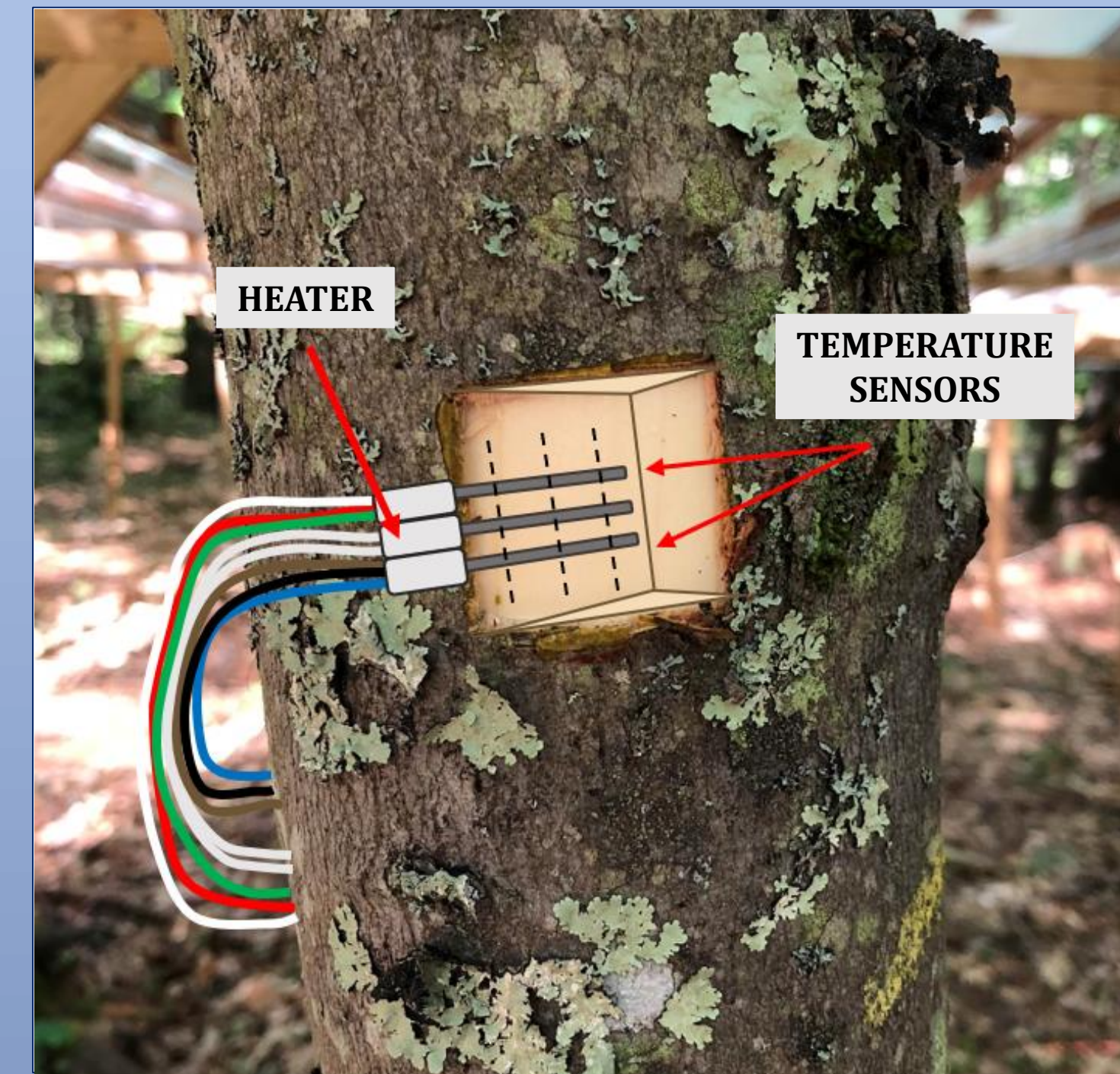
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Objective

The main objective of this project was to understand the dynamics of mid-canopy tree water use in a simulated summer drought. This study utilized sapflow methods to measure water use in red maple (*Acer rubrum*) trees, a mid-canopy tree species. The project built upon the current Northern Forest DroughtNet study, which conducts a variety of measurements on canopy trees, including net primary production, water use, water-use efficiency, and photosynthesis. Another objective was to compare the drought response of mid-canopy red maples to the dominant white pine (*Pinus strobus*) in the same plots.

Sap Flow Sensors



I used the Heat Ratio Method (Burgess et al. 2001) to measure tree water use. Two temperature sensors are spaced at equal distances above and below a heater probe. A heat pulse is sent out every 15 minutes and a data logger records the change in temperature at each probe after 60 seconds.



Effects of Drought

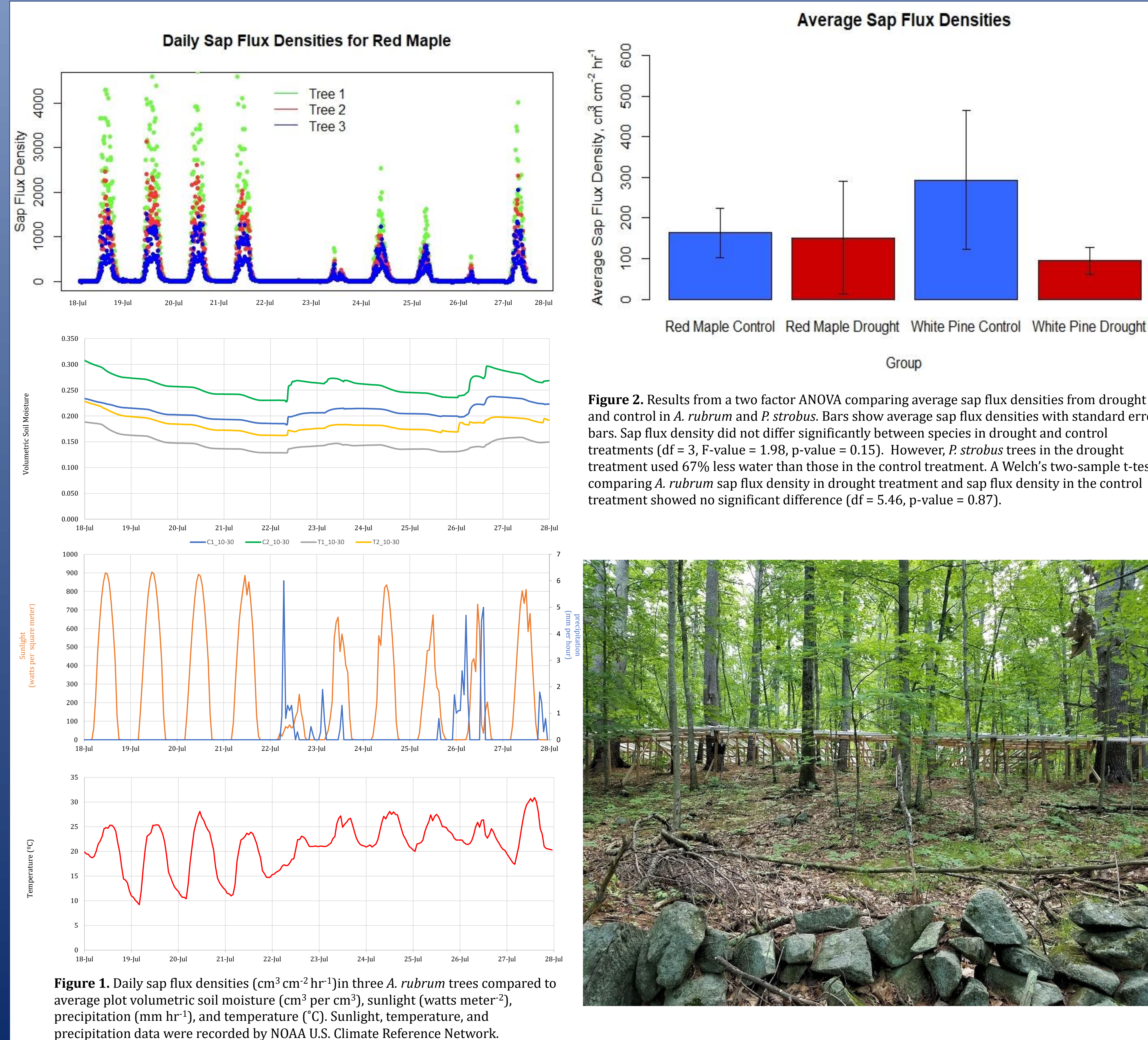
Global climate change is an increasing threat to ecosystems worldwide and may alter long-term temperature and precipitation patterns. An increase in summer drought frequency, duration, and severity is a likely part of the future northeastern climate (Allen et al. 2010). Droughts effect forest productivity as trees lose water when leaf pores (stomates) open to allow carbon uptake for photosynthesis. In the northeast, droughts are historically uncommon, therefore native tree species may lack mechanisms to adapt and persist through intense drought events (Coble et al. 2017). It is important to gain a comprehensive understanding of physiological drought responses in forest tree species.

Study Design



The study site was located at UNH's Thompson Farm in Durham, NH. Treatment trees were located in existing throughfall exclusion plots, reducing water inputs to the soil by 55% to simulate a 1-in-100-year drought. These structures measure 30 meters on each side, with a 5-meter buffer to reduce edge effects. Control trees were located nearby in areas with similar slope, soil type, and species composition, in efforts to hold everything constant except for soil moisture.

Results



Conclusions

- Water use did not vary significantly between species or treatments. However average *P. strobus* water use was 67% lower in the drought treatment than in the control. In *A. rubrum* the difference was only about 7%.
- Although these differences were not significant, the drought responses of these species appear to differ greatly. These water reductions suggest that *P. strobus*, a canopy tree, had to restrict water use by more than *A. rubrum*, a mid-canopy tree species in these plots.
- Light, temperature, and humidity differences in the upper vs. lower canopy may drive these differences in water use.
- A. rubrum* in the mid-canopy may be less susceptible to drought stress than canopy species, in contrast to what was found in a similar experiment in Tennessee (Wulschleger et al. 1998).
- An increased sample size and wider replication of these methods would be beneficial to further understand water use and drought dynamics among species.

Acknowledgements

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