Gas exchange of sugar maple and bur oak populations under warming and drought

Colleen R. Ritter1, Kerrie M. Sendall2, Artur Stefanski3, Raimundo Bermudez Villanueva3

1Rider University, Department of Geology, Environmental, and Marine Sciences, 2Rider University, Department of Biology and Behavioral Neuroscience, 3University of Minnesota, Department of Forest Resources

Introduction

Understanding tree species’ responses to climate change is integral for the continued success of forest ecosystems. Boreal Forest Warming at an Ecotone in Danger (B4WarmED) is a long-term ecological experiment in Minnesota examining the effects of experimental warming, drought, and their combined effect on temperate and boreal species. Gas exchange is one aspect of plant physiology that is affected by changing climate conditions, and can be used as a proxy for estimating future growth of forests under different climate scenarios.

Data Collection

Gas exchange was measured in early August 2023, using a Li-COR 6400XT on randomly-selected individuals of species in each of 24 plots (n = 6 per treatment). Measurements were taken between approximately 9:00 AM and 3:00 PM; leaves measured were exposed to the following conditions: CO2 concentration of 400 ppm, relative humidity between 40 and 80%, PAR of 1200 \( \mu \text{mol m}^{-2} \text{s}^{-1} \), and temperature varied but generally stayed between 25 and 30°C.

Photosynthesis Data

We found that photosynthetic rates of both sugar maples and bur oaks varied depending on source (p < 0.05). For maples, northern populations generally had reduced photosynthetic rates and southern populations had increased photosynthetic rates in the warmed plots relative to locally-adapted populations (p < 0.05; Figure 1).

Conclusions

These findings suggest that both warming temperatures and changes in precipitation patterns will impact photosynthetic rates under future climate change. We predicted that species moved from warmer, southern locations would respond most positively to warming, but this was not the case for bur oak seedlings, suggesting that assisted migration of common tree species from populations located further south in their ranges may be beneficial for the long-term success of some, but not all, species under future climate conditions.

References


