

TITLE: *Understanding the effects of climate change on carbon sequestration and forest resilience in southern Appalachian forest system*

OVERVIEW:

Natural forests are some of the most biodiverse habitats in the United States and with recent climate change, the southeastern forests of Appalachia are predicted to be under threat from increased temperatures and rapid conversion to savanna. Due to exploitative logging and wildfires at midelevations, these forests have become less complex over time, converted from historically mixed-oak stands to more homogenized stands. Climate change coupled with rapid land-use change is resulting in the creation of gaps of varying size within forest canopies. These gaps are introducing a mosaic of microclimatic conditions within an ecosystem but the effects of these gaps on forest recruitment and resilience are not fully understood and more research is needed. By working with Dr. Leggett, Dr. Doherty, Dr. Keyser and Dr. Kalies, I will gain valuable scientific and mentoring skills in a unique and understudied ecosystem.

INTELLECTUAL MERIT:

Experiment 1: I will investigate the effects of gap size and canopy closure on species composition, seedling and sapling recruitment and fitness. Under the mentorship of Dr. Leggett and Dr. Keyser, I will evaluate the intra- and interspecific variation in tree fitness and mortality across each site and record carbon sequestration. This approach will give me new techniques and experiences that will allow me to develop my future career goals of forest restoration by investigating forest diversity and recruitment. Our understanding of how canopy closure coupled with climate change affects dominant tree species has been largely unexamined but has critical implications, especially at vulnerable southern, mid-elevation habitats.

Experiment 2: I will assess the effects of drought and increasing nighttime temperatures on the dominant tree species of the southern Appalachian mountains and how drought tolerance varies across the gap and closed-canopy sites. Using the same focal individuals from Experiment 1, I will take cuttings from each individual and perform a full factorial experiment of three levels of increased nighttime temperatures with three levels of drought treatments to investigate mortality and canopy development. I will gain experience alongside Dr. Doherty on investigating the stress of increasing nighttime temperatures in controlled environments using North Carolina State University's Phytotron facility which houses 60 growth chambers and four greenhouses including chambers suitable for examining heat and drought stresses. This experiment will examine the effects of predicted disturbance of climate change under various warming scenarios and offer insight into tree resilience under warming.

Experiment 3: I will examine the variability in soil temperature, moisture and nutrients across closed canopy and gap sites. Using the sites identified from Experiment 1, I will record hourly soil temperature, soil moisture and light availability. I will also collect soil cores for each field season and evaluate the soil nutrients and microbial community. I will greatly develop my skills under Dr. Leggett's expertise in soil community structure, which is essential for my career path in forest restoration as I have little experience in belowground systems. This experiment is essential for understanding the entire ecosystem and the effects of climate change on forests to better maintain our carbon sinks.

BROADER IMPACTS:

The proposed project will help inform climate models, global forecasts and forest management plans to reduce the impact of climate change. Additionally, I intend to increase diversity at the postdoctoral level through various teaching, mentoring and public outreach initiatives. First, I plan to offer a 1-credit course for PhD candidates for two semesters on how to develop grant proposals for NSF, USDA, NOAA and other agencies and also assist students with securing a host advisor. I will then use this course material to develop a webinar series to broadcast the material globally. I will also implement a mentorship pipeline program in the Leggett lab where I will teach graduate students field skills and mentoring skills, graduate students will then train undergraduates and undergraduates will teach high schoolers. This will further prepare students with the essential skills to be successful postdoctoral fellows. I will advertise the course and pipeline program through the NC chapters of MANRRS and SEEDS to recruit BIPOC students. Finally, I will work alongside and learn from Dr. Leggett on increasing diversity and inclusion at both the university and community level through an NSF funded project (UNIDE) and a citizen science program focused on urban tree cover and BIPOC communities.