**Intellectual merit:**

Recent major climate change coupled with rapid land-use change has increased interest in forest resilience and droughts, which affect plant performance, survival and shape species distributions. Here, we propose to research how increasing temperatures and decreasing levels of precipitation coupled with exploitative logging, clearcutting, grazing and wildfires at mid-elevation forests impact tree and shrub diversity, richness and recruitment as well as drought tolerance and soil nutrients and microbial community structure. We plan to investigate both the intra- and inter-specific variation in fitness and mortality across microhabitats within a forest system in the southern Appalachian mountains. Disturbance from climate change is causing greater tree mortality and the creation of gaps within a forest canopy, resulting in a mosaic of microclimates within an ecosystem. By investigating tree diversity, health and drought tolerance and soil temperature and nutrient levels across these microclimates, we will unravel the interplay of increasing daytime and nighttime warming with decreasing precipitation on forest resilience and carbon sequestration.

***Experiment 1:* I will investigate the effects of gap size and canopy closure on species composition, recruitment, fitness and phenology.** I will study 10 different woody plant tree and shrub species in the southern Appalachian mountains across closed canopy and varying size gap sites. For each individual, I will evaluate percent herbivory, quantify the number of seedlings and saplings of each dominant tree species within the site to evaluate recruitment, monitor early and late season phenology (i.e., budburst, leafout, budset and leaf drop) and record carbon sequestration measurements. I have assisted with similar research investigating the effects of climate change across a latitudinal gradient but this research is especially crucial and timely because our understanding of how canopy closure and microclimates coupled with climate change affects dominant tree species diversity and recruitment has been largely unexamined, especially at vulnerable southern, mid-elevation habitats. The proposed project will help inform climate models and global forecasts.

***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, canopy development and damage to the shoot apical meristem. I have run various experiments using phytotron and growth chamber experiments assessing the effects of late spring freezing events on seedling and sapling development. In combination with my experience, North Carolina State University houses 60 growth chambers and four greenhouses under Biosafety Level 3 in their new NCSU Phytotron facility. 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 at the soil surface across closed canopy and gap sites.** Using the sites identified from Experiment 1, I will record hourly soil temperature, light availability and volumetric soil moisture. I will also collect soil cores from 0-10cm and 10-20cm for each field season and evaluate the soil microbial community structure. I have experience recording soil temperature, light availability and soil moisture but I will greatly benefit from Dr. Leggett’s expertise in finalizing and developing the methods for this project. This experiment is essential for understanding the entire ecosystem and thoroughly evaluating the effects of climate change on forest systems across various microhabitats.

**Broader Impacts:**

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 BIPOC PhD candidates in the Spring 2022 and Spring 2023 to teach graduate students how to develop postdoctoral grant proposals for NSF, USDA, NOAA and other agencies and also assist students with securing a host advisor and/or university. I will then use this course material to develop a website and webinar series to broadcast the material nationally. In addition to training students about postdoctoral proposals, I will 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 undergraduate students and undergraduate students will teach high school students. This will further prepare BIPOC students the essential skills to be successful postdoctoral fellows. Finally, I will work alongside and learn from Dr. Leggett on increasing diversity and inclusion at both the university and community level through the Undergraduate Network for Increasing Diversity of Ecologists and a citizen science program focused on urban tree cover and BIPOC communities.