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

STATEMENT OF RELEVANCE:

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 mid-elevations, 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.

Experiment 1: Using the NOAA daily climate data, I will investigate the effects of gap size and canopy closure on species composition, seedling and sapling recruitment and fitness under climate change. 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: Using historic extreme event and drought data from the NOAA database, 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. 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: Again, using historic extreme event and drought data in combination with current soil temperature and moisture data, 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. This experiment is essential for understanding the entire ecosystem and the effects of climate change on forests to better maintain our carbon sinks.

FUTURE INTERACTIONS:

The proposed project will help inform climate models, global forecasts and forest management plans to reduce the impact of climate change. My project plan will help generate new regional predictive models to better understand the effects of climate change on southern Appalachian forests, which are also highly valued recreational areas, thus these forecasts could provide crucial information on socioeconomic impacts. In addition, I will attend the American Geophysical Union and present my findings after my first year and try to give public lectures throughout my postdoctoral fellowship to various NOAA laboratories. Also, by using many types of climate data from the NOAA National Centers for Environmental Information database, I will be able to leverage the wealth of weather data to enhance my proposed project and further augment the importance and value of the climate forecasts being produced in this work.