PROJECT SUMMARY

OVERVIEW

Predicting how ecosystems will respond to climate change depends on our understanding of the microbial communities that release carbon through plant litter decomposition. Studies that test the effect of warming or drought on microbial communities tend to focus on the responses of free-living fungi in the soil because they are major decomposers of plant cell walls, producing enzymes that cause litter to lose mass. Mounting evidence suggests that foliar fungal **endophytes** (fungi living within the healthy leaf tissues) can also significantly decompose plant litter, yet models that predict how changes in climate affect endophyte-induced decomposition remain undescribed. I propose to address this by transplanting endophyte communities from two pine species across desert to subalpine ecosystems in southern California to understand how changes in climate influence how endophytes decompose plant litter over the course of one year. I will test three hypotheses that predict how (1) climate, (2) the endophyte community and (3) their interaction influence litter mass loss, a measure of decomposition. To do this, I will leverage various molecular methods to characterize the endophyte community (biomass, species composition, enzyme activity, gene expression) and the chemical composition of litter. I will then correlate precipitation and features of the endophyte community to the loss of litter mass or specific carbon compounds to identify the factors that best explain differences in litter decomposition rate across the climate gradient. My proposed work will support my academic career development in fungal ecology by broadening my training in biogeochemistry and metatranscriptomics. I will receive mentorship from Dr. Kathleen Treseder at the University of California, Irvine, a leader in fungal ecology, functional genomics and global change biology. I will visit Dr. Alejandra Vázquez-Lobo at the Universidad Autónoma del Estado de Morelos and Dr. Bruno Chávez-Vergara at Universidad Nacional Autónoma de México to cultivate international collaborations and receive direct mentoring related to the characterization of endophyte gene expression and litter chemistry, respectively. This project will also continue the development of my mentoring skills as I support the broader participation of underrepresented scholars in the field, lab and classroom.

INTELLECTUAL MERIT

Ninety percent of all living plant biomass on land is decomposed by microbial communities - a crucial pathway that moves carbon from terrestrial environments to the atmosphere. Field and lab experiments have shown that endophytes produce enzymes that degrade plant cell walls. Yet it is not clear how this function may change under future environmental scenarios. Therefore, I will test three hypotheses that predict how (1) climate, the (2) endophyte community and (3) their interaction contribute to changes in litter decomposition with high throughput techniques that characterize the endophyte community and the chemical composition of litter. First, I will correlate endophyte function (e.g., litter mass loss) to precipitation with statistical models that also consider litter chemistry. Second, I will correlate features of the endophyte community (biomass, species composition, enzyme activity, gene expression) with the loss of litter mass and specific carbon compounds. Finally, I will consider whether endophyte function is associated with the historical environment endophytes originated from. By testing these hypotheses, I will identify genetic, ecological or biogeochemical factors that govern how endophytes - ubiquitous symbionts of the plant kingdom - decompose plant litter and contribute to the terrestrial carbon cycle.

BROADER IMPACTS

I have proposed three ways to broaden participation among underrepresented groups at UC Irvine and middle school students. I will directly mentor five undergraduate students from underrepresented backgrounds that will receive training in ecological field work, molecular biology and data science that will be leveraged to conduct independent research projects through the UCI Undergraduate Research Opportunities Program. I will lead coding workshops that increase the participation of underrepresented scholars in computer programming by collaborating with UCI's California Alliance for Minority Participation. To support climate science outside of academia, I will teach an interactive climate change

curriculum at local middle schools that centers how fungi contribute to the terrestrial carbon cycle. These activities, in combination with my interdisciplinary research project, will prepare me as a future faculty member by teaching and collaborating with students in the field, lab and classroom settings.