

Sponsoring Scientists Statement (PI: Austen Apigo)

Lead Sponsoring Scientist: Dr. Kathleen Treseder, University of California, Irvine

International Sponsor: Dr. Alejandra Vázquez-Lobo, Universidad Autónoma del Estado de Morelos

International Sponsor: Dr. Bruce Chávez-Vergara, Universidad Nacional Autónoma de México

Research projects in the lab of the lead sponsor Dr. Kathleen Treseder: The Treseder Lab's research broadly addresses the role of fungi in mediating ecosystem responses to global change. Our overarching goal is to improve predictions of future trajectories of global change, by incorporating feedbacks governed by fungi. This topic is challenging to study, because fungi operate at the microscopic scale, yet elicit consequences for biogeochemical functions at the global scale. Thus, our research targets scales ranging from the molecule to the globe. Concurrently, we develop conceptual frameworks to link these scales, specifically by suggesting how ecosystem models can better incorporate microbial ecology to predict future environmental conditions. **Current and Pending Treseder Lab Support:** Currently, I am the sole PI on a NSF grant through the OPUS program (\$260,392): "Trade-offs among fungal traits that influence responses to the environment and effects on ecosystems". This work will analyze how thousands of fungal species across ten years of Treseder lab experiments in Alaska, California, and Costa Rica respond to the environment, and will link those species to their impact on ecosystem function. This information will be used to improve the predictive role of Earth System Models. In addition, I am also the co-PI on a DOE grant (\$2,699,278 with 20% share of \$539,855 to Dr. Treseder), "Biogeochemical consequences of microbial evolution under drought". This project aims to understand and predict how evolution in fungi affects carbon and nutrient cycling under environmental change. Both of these funding sources will complement Apigo's research expenses, including field supplies and molecular analyses to increase sample sizes and extend the impact and generality of his project.

Research projects in the lab of secondary sponsor Dr. Alejandra Vázquez-Lobo: The Vázquez-Lobo lab investigates the evolution of conifers, particularly in the genus *Pinus*, and other plant groups. We aim to use genetic data from exome capture and genotyping by sequencing to delimit species and infer evolutionary processes. We recently found through differential expression analysis of genes that early ontogeny changes in pines are related to the ability to produce lignin. We are continuing to study this process through transcriptome analysis and morpho-anatomical analysis. **Current and Pending Vázquez-Lobo Lab Support:** Not applicable. RNA-seq will be funded by PI Apigo and Lead Sponsoring Scientist Treseder.

Research projects in the lab of secondary sponsor Dr. Bruce Chávez-Vergara: The Biogeochemistry and Soil Organic Matter Laboratory (BiogeoMOS) at the Universidad Nacional Autónoma de México (UNAM) studies biogeochemical processes in natural and managed soils, primarily investigating the transformation, availability, and stabilization of soil organic matter (SOM). The BiogeoMOS lab studies the mechanisms that regulate the chemical composition and the interaction of SOM in soils (1) to identify how resource management and climate change influence the dynamics of SOM and nutrients (N and P) and (2) to develop soil management proposals to maintain ecosystem functions and their services. **Current and Pending Chávez-Vergara Lab Support:** For the year 2022, the Chávez-Vergara laboratory has \$28,000 USD in funding through UNAM. Proposed spectroscopy analyses will be funded by PI Apigo and Lead Sponsoring Scientist Treseder.

Apigo's Research and Training Plan: Apigo's research is highly complementary to ongoing research in the Treseder lab, while bringing a new perspective: the role of foliar fungal endophytes on ecosystem function. Apigo's previous work has shown that endophytes can significantly decompose plant litter at a rate comparable to soil fungi. Now, Apigo is seeking to understand how this function may vary in response to changes in climate by employing a suite of techniques that characterize features of the endophyte community (biomass, composition, enzymatic activity, gene expression) and the litter environment. Apigo's research is distinctive in that our lab group has not yet explored how endophytes contribute to ecosystem functioning and the carbon cycle. His research is complementary in that the proposed project is motivated by fungal responses to climate change and will employ techniques with well-established methods in my lab (DNA and RNA sequencing, enzymatic analyses, carbon fractionation assays). My mentoring goal for Apigo during his tenure in the Treseder lab is to expand his existing expertise in fungal ecology to include skills that are key to his future research agenda as an NSF Postdoctoral Fellow and a future faculty member. Specifically, he will learn new high-throughput methods by analyzing RNA-sequencing data in collaboration with myself and Dr. Alejandra Vázquez-Lobo. He will also learn how to perform Fourier-transform infrared spectroscopy and analyze the resulting data under the guidance of Dr. Bruce Chávez-Vergara.

Diversity, equity and inclusion are central to my work at UCI, in the local community, and within academia. Our lab has been highly dedicated to make the science community a more inclusive and safe space. The Treseder lab and Apigo share an enthusiasm for issues related to supporting underrepresented students in STEM fields. The Treseder lab is actively involved in various initiatives in increasing diversity, equity, and inclusion in the sciences. For example, I financially supported the UCI Society for the Advancement of Chicanos/Hispanics and Native American Scientists chapter. Within my lab group, one of my PhD students founded QT-STEM (Queer and Trans in STEM), a campus organization that works to build support systems for LGBTQ+ people within the UCI community. Additionally, two PhD students in the Treseder lab created an initiative, ReclaimingSTEM, to provide science communication and science policy training for marginalized scientists (LGBTQ+, POC, Womxn, disabled people, first-generation, etc). Apigo's thoughtful and ambitious plan to engage underrepresented students through mentorship and coding workshops as well as outreach to local middle schools will be well-supported within the Treseder lab. Apigo's background as an underrepresented scholar in STEM and quality mentorship practices strongly indicate that he is well-equipped and experienced to accomplish the goals set forth in his broader impacts statement. For example, he has already collaborated with many underrepresented scholars in STEM through direct mentorship (Broader Impact 1) and has already developed a coding club with inclusive teaching practices (Broader Impact 2). His goal to perform outreach to local middle schools in climate science (Broader Impact 3) is a new avenue that will complement his proposed research activities on fungal decomposition, providing an opportunity to further develop his science communication skills.

Role of Mentors in Apigo's Research, Teaching, and Career Development Skills: My central goal is to support Apigo's research, teaching and professional development activities in this fellowship that will support his future goal of securing a tenure-track faculty position. We will create independent development plans to visualize and track short and long-term research and career goals. We will have weekly meetings to check in on research, teaching and outreach activities and continue to revise the development plans to meet changing needs as his skills, experience and career progresses. During these meetings Apigo will receive extensive feedback on experimental design and field implementation of his

transplant study, technical training on analyzing sequence data and data analysis, and detailed feedback on manuscript drafts and materials for job applications. I will encourage Apigo to be fully involved in all aspects of the Treseder lab (lab meetings, journal clubs, collaborative research activities, lab outreach) and the larger microbial ecology group here in the Department of Ecology and Evolutionary Biology at UCI (Dr. Steve Allison, Dr. Jennifer Martiny, and Dr. Adam Martiny, Dr. Katrine Whiteson, and Dr. Alejandra Rodriguez-Verdugo). These activities will create spaces and opportunities to receive outside feedback on research goals and expand his collaborative network with other professors at UCI. For example, Apigo will present at the microbial group's seminars to discuss and receive feedback on his research ideas and experiments. I will also provide advice related to Apigo's service work in diversity, equity, and inclusion to support Apigo's commitment to promoting diversity in STEM. Specifically, we will reach out to the UCI Office of Inclusive Excellence for feedback and guidance on Apigo's outreach curricula. I also will share teaching resources and pedagogical strategies that he will be able to use in the coding or middle school outreach programs and in his future career as a faculty member.

To strengthen Apigo's academic and professional network, I am encouraging multiple collaborations with other scientists in his field and attendance at scientific conferences. Outside of UCI, he will be collaborating with Dr. Alejandra Vázquez-Lobo on the sequencing related aspects to his work. This connection is not redundant to the sequencing-based training he will receive at UCI because Dr. Vázquez-Lobo has specific expertise analyzing plant and endophyte metatranscriptomic data with specific pipelines tailored to the genetic annotations of those specific groups. He will also be collaborating with Dr. Bruce Chávez-Vergara on the biogeochemical aspects of his study design (e.g., enzymatic analysis) and learning Fourier-transform infrared spectroscopy to characterize the broad spectrum of carbon compounds that exist in decomposing litter. I will support Apigo in attending professional meetings (Mycological Society of America, Ecological Society of America, Phyllosphere, Minority Postdoctoral Conference) that will provide opportunities to expand his collaborative network and build support that will last beyond the tenure of this fellowship.

Role of Sponsors and Other Institutional Resources: There are many exceptional opportunities for Apigo to develop professionally and as an independent researcher within the Treseder Lab and at the University of California, Irvine. We have a vibrant, active, and supportive microbial ecology research community in the Department of Ecology and Evolutionary Biology at UCI that will support Apigo's research and professional development. The group is very active and supportive and we often write grants together and co-lead research projects. They also cover various expertise related to Apigo's proposed research and, thus, will be a valuable resource as his research develops and prepares his findings for publication. The Treseder lab along with the rest of the microbial group are also part of the Microbiome Initiative at UCI, a campus-wide initiative that brings researchers across multiple disciplines together at monthly seminars, provides consulting and workshops in microbiome research techniques, and provides access to a number of cutting-edge facilities for microbial and genomic work. Therefore, Apigo will have unparalleled access to a microbial research community that will support Apigo's research aims.

Limitations Placed on Apigo

No restrictions will be placed on Apigo to continue his proposed research following the conclusion of the fellowship. I will continue to support Apigo's future independent research program that will work at the interface of fungal ecology, molecular ecology, biogeochemistry and global change. This project will initiate a strong network of support to launch future research and continue our scientific collaboration.