PROJECT SUMMARY

Overview:

Microbiome science is an emergent discipline recently recognized as a critical pursuit for understanding ecosystem function. The challenge of simultaneously feeding a growing population, sustaining agriculture, maintaining soil quality, and minimizing greenhouse gases and water contaminants requires new data-driven solutions based in a fundamental understanding of the role and dynamics of Microbiomes of Aquatic habitats, Plants, and Soils (MAPS). MAPS mediate disease and productivity of plants, control the quality of water, and moderate edaphic characteristics and greenhouse gas production. We will create an observational and experimental network across the strong precipitation gradient in agriculturally-dominated Kansas, using both agricultural and native sites. The project extends traditional scientific approaches to work at scales ranging from genes to ecosystems, and across habitats (terrestrial to aquatic). Our vision is to use fundamental microbiome research to illuminate how MAPS can be invoked to enhance productivity, mitigate environmental problems in agriculturally-dominated landscapes, and conserve native grasslands and their ecosystem functions. Our goals are to: 1) elucidate MAPS-mediated ecosystem functions useful for predicting ecosystem responses to a variable and changing precipitation regime, 2) develop best practices for promoting MAPS for desired ecosystem services (e.g. plant productivity, soil and water quality), and 3) use MAPS research to enrich educational and outreach opportunities. We have assembled a diverse team of investigators (across institutions, areas of expertise, and career stages) and will supplement it with three faculty hires. This project is based on the generation of a nuanced, mechanistic understanding of the drivers of MAPS structure and function. We specifically aim to quantify how climate and land-use legacies govern MAPS as a means of predicting the resistance and resilience of multiple ecosystem properties to long-term (e.g. contemporary climate change) and punctuated (e.g. extreme climate events, land use changes) perturbations.

Intellectual Merit :

We will create a synergistic interdisciplinary research network with common interests in the role of microbiomes and the combined expertise to tackle these challenging, vitally important issues. We will create databases to link metagenomic data to environmental parameters that will allow us to realize our vision of using MAPS to address productivity and environmental issues in agriculturally-dominated landscapes while conserving native grasslands. While previous efforts have focused on plant, soil and aquatic microbiomes individually, our novel, integrated investigation across these natural biomes can inform best management practices to curb terrestrial resource losses and maximize agricultural productivity, while controlling pollutants. We do this by coupling coordinated sampling and experimental manipulations of terrestrial and aquatic environments across Kansas' precipitation and land-use gradients. These results will be important in Kansas and beyond, informing basic research relevant to myriad agricultural landscapes globally.

Broader Impacts :

The broader impacts of this project include the contributions of the findings as part of a broader societal goal of realizing sustainable food production while protecting soil, water, and human health. MAPS science underpins the function and supply of freshwater ecosystem services that are so crucial to Kansas' water needs. We have developed an integrated group of educational and outreach programs that focus on hypotheses, approaches, and findings that are foundational to our disciplines, and also emphasize the sense of excitement and relevance inherent in scientific problem-solving. Our programs will reach individuals of all ages and levels: K-12 students and teachers; undergraduate and graduate students; faculty members at tribal colleges and four year institutions; and adults interested in broadening their knowledge. These initiatives will not be limited to the classroom, but will fully utilize field stations at the University of Kansas, Kansas State University, and Wichita State University, as well as other venues for outreach. Haskell Indian Nations University (HINU) is an integral part of this project. The proposal supports undergraduate programs at HINU, as well as underrepresented minority students and community colleges across Kansas.