Project Summary, Updated June 2017

Rangelands are the most diverse and expansive working landscapes, supporting a broad range of ecosystem services. These systems—and the agricultural, economic, environmental, and social benefits they provide—are at risk due to multiple, interacting threats, including species invasions and an increasingly variable climate. The combined effects of policy decision-making and large changes in environmental factors can increase management uncertainty and trigger potentially irreversible ecosystem change. Invasive species are a widespread, major threat to rangeland ecosystem productivity and biodiversity. In particular, long-term effects of invasive woody species management are complex, not well understood, and still not easily predictable—particularly for California's Modoc Plateau and Great Basin. Additionally, rapidly changing environmental conditions have led to an increased frequency and severity of rangeland wildfires, which will only be compounded by extreme drought and continued climate change.

Adaptive management is a well-established approach to these types of complex problems of managing for landscape resilience to environmental change. This systematic approach, characterized as plan-do-evaluate-learn-adjust, can empower land managers to meet challenges in managing uncertainty and responding to change. However—due to system complexity, a lack of technical expertise, and resource limitations—the "evaluation" step is often not executed, or is curtailed in the long-term. This is a critical gap given the important role data (or, conversely, lack of data) plays in informing public lands management and policy decision-making, as well as private lands stewardship and restoration.

Support tools and best practices that provide cost-effective monitoring methods, streamline data collection, and assist in data interpretation will vastly improve managers' abilities to make defensible, evidenced-based decisions. New technologies like remote data collection open up tremendous opportunities for adaptive management and decision-making for both public and private land managers; however, in order to capitalize on these new technologies, managers need accessible decision support tools to aid in processing and interpreting "big data".

Our overall goal is to provide a science-management framework to assess rangeland ecosystems service responses to management actions and extreme disturbances—as well as inform decision-making (close the adaptive management loop). This work, which leverages existing field data, agency partnerships, and ongoing collaborations among this interdisciplinary network of UC scientists, addresses high-priority management challenges to sustaining California's working rangelands. This project will address the following objectives: 1) conduct a chronosequence study to examine how rangeland restoration (juniper control, range seedings), site variables, and time since treatment affect long-term rangeland health attributes; 2) conduct a chronosequence study to examine trends in rangeland ecosystem services following extreme disturbances (wildfire, drought); 3) develop best practice methods to link ecosystem service field metrics with UAV and satellite remote sensing imagery; and 4) conduct a capstone Extension field workshop to bring together collaborative research findings and experiential knowledge, as well as showcase best practice methods and decision support tools.

We will build upon an existing on-the-ground sampling network, as well as deploy new sample sites. We will target 60 juniper control sites across a chronosequence of 15 years, and 20 existing range seeding sites across a chronosequence of 20 years (Obj. 1). We will also target a cross-section of 20 wildfire sites ranging from <1–15 years of age (Obj. 2). Field metrics will include key rangeland health measures (i.e., diversity, herbaceous productivity, hydrologic function). Developing best practice methods for linking field and remotely collected data (Obj. 3) will aid managers in effective, adaptive management decision-making, as well as have relevant outcomes for other agricultural-environmental challenges across California. Project progress and results will be shared with agency partners, private land managers, and other stakeholders via outreach materials and the capstone workshops (Obj. 4). These research and extension activities will support science-based decision-making by rangeland managers and policymakers.