

Interactive effects of environment and management on multiple ecosystem services: decision-support for site-specific rangeland management

Effective rangeland management is limited by our inability to account for site-specific effects of management on the provisioning of multiple ecosystem services. In order to provide site-specific management recommendations, we must understand: (1) the controls over each ecosystem service; (2) tradeoffs and synergies across multiple services; and (3) local to regional, and annual to long-term variations in how management impacts ecosystem services. Diverse stakeholders have identified that their priority for research is to improve the effectiveness of management practices by learning from past projects—bringing together information from thousands of research and management trials to determine which management practices are successful under a given set of conditions.

In this integrated research and extension project, our team of AES faculty, CE specialists, farm advisors, agencies (e.g. water districts, parks, NRCS, RCDs), NGOs, ranchers and restoration managers will:

1. Develop an online database of management impacts on ecosystem services, which will link to existing GIS databases to provide site-specific information on soils, topography, land cover, and weather. This database will provide land managers with easy access to the successes and failures of other management trials, searchable based on location, environmental conditions, goals, and management practices. Our collaboration with diverse stakeholder groups will provide a suite of sites that differ in environmental conditions and focal services for management (e.g. forage production on ranches, plant diversity and invasion control in parks, and water quality and supply in water management districts).
2. A meta-analysis of this database will improve our understanding of how multiple services are influenced by the interaction of environment and management. Data that spans California's steep spatial precipitation gradient, coupled with long-term data across variable weather conditions, will allow us to understand variation in production and other services in response to California's high weather variability. This will provide critical insights into managing for resilience of agricultural production and other services under climate change. This synthesis will be used to: (a) develop a site-specific decision support tool for managing multiple services across current and future climate variability, and (b) develop maps that identify areas that provide a service, areas where management is more or less likely to affect a service, and areas that must be managed differently for a given service.
3. Improve our decision support tool and understanding of environment x management interactions by identifying database gaps, and address these gaps by sampling multiple ecosystem services on under-represented sites and replicated field trials across environmental gradients.
4. Enhance the availability of information and analytical tools for improving management plans, outreach programs, and policy (web-available: database, maps, decision support tool, handbook and toolkit for measuring services, and factsheets on ecosystem services and climate variability). The spatial mapping of

service provision will allow ranchers, conservation groups, and policy makers to efficiently target areas that are most likely to provide a given service.

Understanding the relative impacts of management and environmental factors on ecosystem services can guide regulations, replacing a “one size fits all” approach with a spatially-explicit framework that identifies areas that require different practices to achieve the same ecosystem service, and areas where management practices have greater or lesser potential to enhance or degrade services. Elucidation of tradeoffs in managing for multiple services can also inform payment for ecosystem services programs—compensating landowners for potential decreases in production as they manage for a balance of multiple services.

This project’s key strength is that it will continue long after this initial funding period. The searchable database of management practices, the decision support tool, and training in ecosystem service measurements, provide the infrastructure for a self-sustaining and self-improving process. Access to this information, as well as the ability to monitor their own trials, allows managers to improve the effectiveness of their practices. As these improved practices are entered in to the database, they will further improve the site-specific recommendations provided by the decision support tool.

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