

UCI MCRS Capstone Project

The mission of the MCRS Program is to prepare leaders in the fields of environmental science, conservation, restoration, and sustainability by engaging them in active adaptive management experiences.

Active adaptive management refers to the process of managing natural resources by (1) collaboratively developing a model for how the system works; (2) developing trials with replication and controls to experimentally evaluate multiple management actions; and (3) modifying future management activities based on results. The idea of active adaptive management provides a coherent link between coursework, fieldwork, and the capstone project.

Capstone Projects

All Capstone projects must prepare students to produce meaningful solutions to today's environmental problems. To this end, group projects must be:

- 1) Solution oriented – Projects should yield specific policy or management recommendations, contain multidisciplinary elements, and align with student and partner interests.
- 2) Active Adaptive Management – Group project will be nested within an active adaptive management framework, described above.

The team project topics for 2020-2021 are:

Coastal and Inland Seed Sources for Local Restoration in a Changing Climate

Restoration projects typically aim to use local seed sources to ensure that species are adapted to local conditions and to preserve local adaptations. In Orange County, remaining natural areas occupy coastal and inland patches, with the City of Irvine creating an urban barrier to movement. The UCI Ecological Preserve is in the coastal region, consisting of a mosaic of shrubland, native prairie with perennial bunchgrasses, and degraded annual grassland dominated by non-native annual grasses and forbs. Local practice is to use only coastal seed sources for coastal restoration efforts, and inland sources for inland restoration efforts, but without any data we are unsure whether this restriction introduces unnecessary costs and project delays, and whether it is the best action for restoring sustainable communities given rapidly changing environmental conditions. Some suggest that the success of plant establishment in restoration in a changing climate may be improved by including seeds or plants sourced from non-local, arid locations. Drought Net is a network of paired study plots throughout the southwest looking utilizing rainfall enclosures to test the effects of drought on plant communities over time. UCI Nature and CEB are establishing a drought-net experiment crossed with a seed source experiment in a degraded grassland within the UCI Ecological Preserve. Results will inform whether populations of species growing in warmer, inland areas are better adapted to drought than populations from cooler, coastal areas. Seeds of species common to coastal sage scrub and native grassland have been collected from throughout the Nature Reserve of Orange County. The MCRS capstone project will focus on the establishment phase of plants in the experimental plots. We will answer the following questions: 1. Are there genetic differences between coastal and inland populations for several local species? 2. How does seed source (coastal versus inland) influence the success of restoration? 3. Are inland seed sources better able to survive experimentally induced drought than coastal seed sources?

Oak Woodland Conservation and Restoration

Oak woodlands are the most biologically diverse vegetation type in California, providing habitat to many different organisms, including several threatened and endangered species. In

Orange County, the canopy species is *Quercus agrifolia*, the coast live oak, and the understory consists primarily of annual herbaceous species, along with some shrubs and perennial bunchgrasses. In favorable environments, it can take 60-80 years for *Q. agrifolia* individuals to reach maturity, and they are thought to live for 125-250 years. While adult oak trees are fairly resistant to a wide variety of pests, pathogens, and disturbances, the seedling phase is more vulnerable and characterized by high mortality. Oaks of all ages have experienced high mortality in response to human-introduced pests such as the Gold Spotted Oak Borer and *Phytophthora ramorum*, which causes sudden oak death. Although *Phytophthora ramorum* has not been found in Orange County, the Gold Spotted Oak Borer has been detected in Weir and Gypsum Canyons. The Irvine Ranch Conservancy has been carefully responding to these outbreaks and monitoring to evaluate spread. Bot cankers, which are found in Orange County, are known to cause mortality in *Q. agrifolia* seedlings. Additional stressors, such as extended drought, wildfires, and the Invasive Shot-Hole Borer, pose additional threats to Orange County oak woodlands. San Diego State University worked with The Nature Conservancy to develop one method for monitoring oaks in Orange County. The Center for Environmental Biology began monitoring these same oaks in 2015, and worked with ecologists at The Nature Conservancy, Irvine Ranch Conservancy, and UC Riverside to slightly modify the SDSU protocol to include some additional information collected within 50 m plots around each tree.

The MCRS capstone project will compile existing data, collect new data, and conduct analyses to make management recommendations. We are specifically interested in identifying oak woodlands in which mortality is greater than recruitment and developing plans for restoration of these woodland areas. Another team goal would be to increase collaboration and sharing of monitoring outcomes amongst agencies to promote rapid responses to new and existing stressors as they are identified. There is flexibility in the scoping of this project due to the large amount of existing data and the number of potential partner organizations.

Restoration Plan for Sentenac Cienega

Sentenac Cienega is a critically important desert wetland area of the San Felipe Creek watershed in Anza-Borrego Desert State Park. From Sentenac Cienega, San Felipe Creek flows east toward the Salton Sea, inclusively supporting key habitat for some 30+ critical species and other ecosystem services. From 2002-2007, California State Parks undertook removal of tamarisk (*Tamarix ramosissima*), in an effort to restore native vegetation in the Sentenac Cienega with mixed results. The initial attempt at restoration was implemented to help improve the quality of the riparian habitat, with an expectation of increase in water availability and the natural recruitment of native riparian vegetation upon the removal of tamarisk. However, surface water has continued to diminish since the removal of tamarisk, resulting in not only a lack of recruitment of native vegetation, but also mortality of some of the larger cottonwoods and willows. Additionally, local populations of invasive annual ground cover have grown in the area.

Center for Environmental Biology, UCI NATURE, Anza Borrego Desert State Park, and the Anza Borrego Foundation are collaborating to develop a restoration plan for the site. A comprehensive plan will include incorporating the results of assessments of past and current hydrology, soil characteristics, and vegetation composition. Understanding how these factors interact to drive patterns across the landscape will be important to setting realistic goals for desired plant community states. Furthermore, how competitive hierarchies change along environmental gradients and with the control of invasive species will inform mechanisms necessary to guide plant community change. The MCRS capstone project will compile existing data, collect new data, and conduct analyses to develop the basis of a conceptual restoration plan. Due to the large scope of the overall project, there is some flexibility for team members to select specific aspects of the project on which to focus based on interests (i.e. outreach to local tribes and other community members, drone data, analyzing data, researching restoration techniques etc.). Working together with UCI Nature and the Center for Environmental Biology

staff, the MCRS team will contribute to a restoration plan as a deliverable to State Parks for this project.

Population Restoration of Endangered Abalone in Southern California

Abalone are large, long-lived marine snails that live in rocky nearshore environments along the Pacific coast. Southern California populations crashed in the late 1980s as a result of overharvest and an outbreak of Withering Syndrome, an El Niño-associated bacterial infection that resulted in a 99% decline in populations many abalone species. The white abalone, *Haliotis sorenseni*, was the first marine invertebrate to be listed under the Endangered Species Act in 2000, and the black abalone (*Haliotis cracherodii*) was listed in 2010. Today, the two species are in different stages of NOAA Fisheries Recovery Plans – white abalone are in the implementation phase, which involves captive breeding and out-planting to restore populations, while a recovery plan for black abalone is pending final approval. This year's MCRS capstone project will be developed in collaboration with NOAA fisheries and build upon last year's capstone project, which developed a detailed habitat assessment protocol and applied it to several pilot sites in Orange County. Students on this project will assess more field sites to identify index sites for future restoration and develop a sustainable monitoring program. Depending on interests of MCRS participants and knowledge needs from NOAA, the project may also involve studies on facilitating/inhibiting species interactions, analysis of long-term datasets such as MARINE, GIS shoreline inventories, and climate and environmental data, and science communication/education and coordination of volunteer surveyors. Any project will produce a formal report with management recommendations based on results.