FY 2014-15 NRS Annual Report
NEW RESEARCH PROJECTS

Campus: UC Riverside
Reserve: Sweeney Granite Mountains Desert Research Center
Prepared by: Tasha La Doux

New Projects (12):

Project Title: Niche, adaptation and phylogeography in California *Eriogonum*, subgenus *Eucyla*
Researcher(s): Peter Pearman, Travis Columbus, Jim André
Affiliation(s): University of the Basque Country, Rancho Santa Ana Botanic Garden, GMDRC
Funding: none
Description: Faculty Research. The goals of this study are to address the phylogeography and genomic structure within the subgenus *Eucyla*, of the genus *Eriogonum* (Polygonaceae), and ultimately to address the question how perennial species acquire and maintain a broad environmental niche. By testing which factors affect the tempo and mode of evolution of the species niche and of the plant traits associated with it, this research will contribute to a better understanding of niche architecture and adaptation within *Eriogonum*. Previous work has shown that environmental niche optimum and breadth can be related to the growth habit of *Eriogonum* species, namely the perenniality/annuality dichotomy. Perennial species have broader environmental niches than do annuals, and niche breadth evolves more rapidly in perennials as well. In contrast, the niche optimum of annuals tends to evolve more rapidly than perennial species. The study of niche evolution in *Eriogonum* is complicated by the fact that most perennial *Eriogonum* species are likely polyploid. Thus, the first step of this research will identify the nature of ploidy within *Eriogonum*. Further, because *Eriogonum* has diversified during the late Pleiocene and continuing through the Pleistocene, evolutionary history within *Eriogonum* will also be examined. Initial efforts will focus on *Eriogonum umbellatum*, a species complex with a large number of infra-specific taxa.

Project Title: Pollination syndrome as a driver of variation in petal number: evidence for adaptation to pollinators
Researcher(s): James Mickley
Affiliation(s): University of Connecticut
Funding: University of Connecticut - Department of Ecology and Evolutionary Biology, $1,460
Description: Ph.D. Dissertation. Many eudicot lineages have become more or less fixed on pentamerism (five petals), and historically this idea has been attributed to selection by pollinators. However, like many adaptationist ideas this has been poorly tested. This project aims to address the genetic and evolutionary implications of variation in merosity by comparing species of *Saltugilia* and *Gilia* within the family Polemoniaceae, which is known to be 5-merous but also to have natural variation in petal number. Both *Saltugilia* and *Gilia* are clades containing autogamous species that are closely related to outcrossing species of various pollination modes (e.g. bee, fly, beefly, hummingbird). This study will compare the standing variation in merosity between these various pollination modes. If selection really plays a role in restricting lineages to pentamerism, then a release from that selection in the autogamous species would be expected, leading to more variation in merosity in autogamous taxa. In addition, this study will quantify levels variation in merosity between populations and between species, which has rarely been done.

Project Title: The Tenebrionidae of California
Researcher(s): Rolf Aalbu, Aaron Smith, Andrew Johnston
Affiliation(s): Cal Academy Sciences, Northern Arizona Univ., Arizona State Univ.
Funding: NSF DEB-1258154, $458,103; NSF DEB-1523605, $290,526
Description: Faculty research. This project focuses on Tenebrionidae systematics, with special emphasis on *Eleodes*, a flightless genus of darkling beetles (Coleoptera: Tenebrionidae) endemic to western North America. Commonly called stink beetles, *Eleodes* are known for their "headstanding" behavior and the noxious chemicals they eject when threatened. This project will open the genus to other disciplines by addressing century-old systematic challenges through a comprehensive phylogenetic research strategy. Other members of the Tenebrionidae will also be collected for the purpose of generic and tribal revisions, as well as improved species distribution and ecological information.

Project Title: Scent-mediated diversification of evening primrose (Onagraceae) flowers and moths across western North America
Researcher(s): Tania Jogesh, Krissa Skogen
Affiliation(s): Chicago Botanic Garden
Funding: NSF: Dimensions of Biodiversity, $1,459,382
Description: Postdoctoral Research. The role of floral scent in the diversification of a model plant-pollinator-enemy system will be explored in the western North American evening primroses (Onagraceae), where floral scent shows discrete variation at population and species levels and is amenable to experimental manipulation. The primary biotic drivers impacting plant fitness include legitimate pollinators (hawkmoths, bees) and floral and seed predators (Mompha moths). It is known or likely that these groups are attracted to flowers in part by their scent. This proposal focuses on how chemically-mediated interactions between flowering plants, pollinators, and enemies affect diversification at population, species, and higher levels; more specifically, it integrates geographic variation in the most species-rich group of night-blooming plants in North America (*Oenothera*), their widespread pollinators, and a species-rich lineage of floral enemies.

Project Title: Decoupling the direct and indirect pathways of basal plant facilitation: A test of the double magnet hypothesis for pollinators
Researcher(s): Ally Ruttan, Chris Lortie
Affiliation(s): York University
Funding: Ontario Graduate Scholarship, Government of Ontario
Description: Master's Thesis. *Larrea tridentata* has been documented for its positive effects on the surrounding community through stress amelioration, water retention, and soil nutrient concentration, resulting in an increase in flowering plants within its understory. This interaction is ecologically relevant to pollinators because it provides an island of concentrated floral resources for them to exploit. Using *L. tridentata* as a model, this study will test the capacity for these shrubs to act as magnets for the pollination of understory annual plants as well as contrast the direct and indirect effects they have on desert pollinator communities and annual plant reproductive traits. This research is an important step forward in determining if dominant plants can be used as a tool for maintaining and restoring declining desert pollinator communities, as well as managing the effects of desertification in light of climate change.

Project Title: Carabid Beetles of California and the phylogeny of Hypherpes
Researcher(s): Kipling Will, David Maddison

Affiliation(s): University of California, Berkeley; Oregon State University
Funding: none
Description: Faculty Research. This project is a combination of a distributional survey of carabid beetles of California and a phylogenetic study of the subgenus Hypherpes. The main focus will be on the diverse clade of species in Pterostichus (Hypherpes). There is little, perhaps no, knowledge of the carabid diversity at the Sweeney Granite Mountains Desert Research Center and surrounding region. Although this is not a habitat that typically has a large diversity of carabid beetle species, those that may be found there are likely to be of great interest and potentially new to science. As an example, field surveys on GMDRC lands found several Pterostichus (Hypherpes) species, which are known to be winter active in the region. In addition, Dr. Will vouchered a new species to science, which is currently being described by Dr. Maddison; the GMDRC voucher will likely be used as the type specimen in the taxonomic description. All beetle specimens will be deposited and databased in the Essig Museum of Entomology; the GMDRC insect checklist will also be reviewed and updated with their findings.

Project Title: Biogeographic responses of desert birds to rapid 20th century climate change
Researcher(s): Kelly Iknayan, Steve Beissinger
Affiliation(s): University of California, Berkeley
Funding: National Geographic Society, $19,921
Description: Ph.D. Dissertation. This project aims to quantify the effects of climate and land-use change on avian species and communities by resurveying birds at 61 sites in the California Mojave Desert; these sites were sampled for avian diversity in the early 20th century by Joseph Grinnell and colleagues at UC Berkeley's Museum of Vertebrate Zoology. The Grinnell surveys were performed from 1904 to 1945 on protected lands and provide a snapshot of desert ecosystem health prior to human-induced warming. The proposed work will be the first phase of Grinnell resurveys of terrestrial vertebrates in the Desert Southwest. The resurvey will occur primarily in sites under National Park Service jurisdiction: Joshua Tree National Park, Death Valley NP, and Mojave National Preserve. Identifying how community- and species-level factors impact biogeographic responses will help direct conservation decisions in the face of global climate change. Quantifying the changes in avian composition over the past century can help to validate projections of species response to future warming. This research aims to elucidate the relative importance of physiological limits, life history traits, species interactions, and habitat change on site-level turnover. More specifically, the questions being addressed include: 1) To what degree are differences in site-level turnover among bird species driven by physiological limitations, climatic variation, habitat change, species interactions, and species traits?; and 2) Has recent warming resulted in individualistic or community shifts in species composition?

Project Title: Overcoming the nematode taxonomic impediment through integration of novel tools for species discovery and phylogeny: Cephaloboidea as a case study
Researcher(s): James Baldwin, Steve Nadler
Affiliation(s): University of California, Riverside; University of California, Davis
Funding: NSF DEB-1257331 $646,300
Description: Faculty Research. Nematodes of the genus *Acrobeles* are relatively common inhabitants of organic poor soils, including deserts. An advantage of working with this genus is that specimens are readily recognizable by low magnification microscopy in extracts of soil samples. Relatively little is known about the species diversity of *Acrobeles*, although

molecular approaches for delimiting nematode species appear promising. Even less is known about the genetic structure of nematode populations, with virtually no work having been done on microbivores living in soil. The twin goals of this research are to use molecular sequences to investigate the number of *Acrobeles* species resident in selected regions of the GMDRC as well as the Kelso Dunes area. For one or more of these species (depending on abundance and distribution), molecular markers will be used to assess the genetic structure of natural populations. This study has the potential to reveal the diversity of a single genus over a relatively small spatial scale, and provide data on the genetic diversity of one or more species at the intraspecific level.

Project Title: Natural History of the Mojave Desert
Researcher(s): Lawrence Walker, Fred Landau
Affiliation(s): University of Nevada Las Vegas
Funding: unknown
Description: Faculty Research. The authors are beginning to research a book project focused on the natural history of the Mojave Desert aimed at a general audience.

Project Title: Conservation and landscape genomics of the Desert Tortoise
Researcher(s): Gideon Bradburd, H. Brad Shaffer
Affiliation(s): University of California, Davis; University of California, Los Angeles
Funding: California Department of Fish and Wildlife, $155,000
Description: Faculty Research. The Mojave population of the desert tortoise is a widespread resident of the Mojave and Sonoran Deserts. Potential future renewable energy development under the Desert Renewable Energy Conservation Plan (DRECP) and other planning processes may substantially influence future population trajectories of this species. Anticipated increases in direct mortality, habitat loss, and habitat fragmentation from renewable energy development within the DRECP Planning Area need to be considered in combination with other population stressors in the desert tortoise range. Listed under both the federal and California Endangered Species Acts, the Mojave population of the Desert Tortoise is and will continue to be a significant driver of the reserve design for the DRECP. Gaining more precise knowledge about how and where population and genetic linkages function for this widespread, patchily distributed species will contribute to a comprehensive conservation strategy for this and other species covered by the plan. It will also inform the delineation of an ecologically meaningful reserve in California's deserts and facilitate siting of viable zones for renewable energy that best accomplish the goals of energy development and minimize impacts on current and future tortoise population dynamics.

Project Title: The link between ontogenetic changes in locomotor mechanics, escape behavior, and survivorship in the Zebra-tailed Lizard, *Callisaurus draconoides*.
Researcher(s): Tim Higham, Clint Collins
Affiliation(s): University of California, Riverside
Funding: The Community Foundation Desert Legacy Fund, $2,851
Description: Faculty Research, Ph.D. Dissertation. Locomotion is a fundamental link between an animal, its environment, and fitness because it is essential for acquiring prey and evading predators. Despite the robust body of literature supporting the hypothesis that natural selection favors faster lizards, little evidence supports a specific sprint-enhancing mechanism on which selection may act. While enhancing elastic energy storage and muscle power output can serve to increase speeds, sprinting represents suites of

integrated physiological and biomechanical traits. Thus, quantifying specific traits that lead to faster sprints in-vivo is difficult. This project will identify the population level variation in locomotor mechanics in the lizard *Callisaurus draconoides* and how they change through ontogeny. Understanding variation in mechanics and locomotion through ontogeny will enable the identification of traits and their relationships that enhance survivorship.

Project Title: Phylogenomic insights into the evolution and domestication of squashes and pumpkins
Researcher(s): Heather Kates, Doug Soltis
Affiliation(s): University of Florida
Funding: U.S. Department of Agriculture, $5,994
Description: Ph.D. Dissertation. There are 14 native *Cucurbita* species in North and South America, one third of which have populations in the United States. In addition to specific concerns regarding domestication traits and species conservation, this research will contribute to a greater understanding of the domestication history of squash. Interestingly, it is thought that the domesticated squash *C. pepo* subsp. *ovifera*, along with sunflower, represent the only two widely cultivated plants originally domesticated in what is now the United States. The cucurbit research community is interested in new sources of disease resistance, drought tolerance, and herbicide resistance for domesticated squash and is therefore interested in obtaining the full genetic diversity of wild *Cucurbita* species. In addition to maintaining germplasm in the National Plant Germplasm System, there is also great interest in maintaining wild populations of *C. palmata*, as it is resistant to many of the diseases that affect economically important cucurbits, including the cucumber mosaic virus, powdery mildew, and squash mosaic virus. Analysis for these useful traits requires available germplasm, therefore *C. palmata* collections made as a part of this project will aid in the discovery of the genetic basis of these useful traits in *Cucurbita*.