

## CONTRIBUTED AND INVITED ABSTRACTS for Oral Presentations

Arranged by session and then by presenting authors, in bold, in order of appearance, with their affiliation and email address, and additional authors. Not all presenters are the first authors. You may search by author, presenter, session or title or scroll.

### Session 1: California Plants and Climate Change

#### THE IMPACT OF CLIMATE CHANGE ON SERPENTINE ENDEMIC PLANTS IN CALIFORNIA

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Our ability to predict the effect of climate change depends on our understanding of how abiotic and biotic factors interact to influence the distribution of species, which is currently limited, especially for rare, endemic species. Serpentine endemics, plants that specialize on serpentine soil, are major contributors to California's biodiversity; however many are threatened or endangered. Because these species are narrowly distributed with small, patchy populations, they may be particularly vulnerable to climate change. In addition, serpentine grasslands are often imbedded within a matrix of more fertile, chemically benign grasslands dominated by non-native grasses. These non-native grasses are generally unable to tolerate serpentine soil but are strong competitors off serpentine. To understand how edaphic endemics will respond to climate change, I conducted field experiments to determine how changes in precipitation interact with competition to influence the growth and reproduction of three serpentine grassland endemics. Results from research in northern California grasslands suggest that the response to increases (via water additions) and decreases (via rainout shelters) in spring precipitation may depend on species identity and soil type. For instance, on serpentine soil the effect of competition was lower in experimental drought treatments for one serpentine endemic, *Navarretia jepsonii* (Polemoniaceae), but was greater in the same treatment for another endemic, *Clarkia gracilis* ssp. *tracyii* (Onagraceae); the reverse was observed on non-serpentine soil. The results of this study indicate that climate change may favor some serpentine endemics over others and suggest that endemic responses to climate change may depend on particular species traits.

#### A VEGETATION SHIFT: CLIMATE WARMING, DROUGHT, OR PAST DISTURBANCE

**Jon Keeley**, Dylan Schwilk, Sequoia Field Station, Western Ecological Research Center, USGS, [jon\\_keeley@usgs.gov](mailto:jon_keeley@usgs.gov)

Effects of predicted changes in precipitation and temperature may have complicated and potentially opposing effects. Simple models of plant response to warming climates predict vegetation moving to cooler and/or wetter locations ("marching upslope"). However, the mechanisms explaining species-specific responses to changes in temperature and water availability are most likely much more complex. We re-examined a recently reported vegetation shift in the Santa Rosa Mountains, California, in order to determine the mechanisms behind the reported uphill shift of a plant distribution. Our focus was on a key species, *Ceanothus greggii*, an "obligate seeding" shrub that recruits post-fire from a soil stored seedbank. This life-history allowed us to calculate stand ages and a time series of past per-capita mortality rates by counting growth rings on live and dead individuals. We calculated past mortality rates for six elevations (1280-1870 m). Using a model-selection framework, we tested three alternative

hypotheses explaining the time-series patterns of mortality: H1) mortality increased over time consistent with climate warming, H2) mortality peaked 40-50 years post fire at each site, consistent with self-thinning, and H3) mortality was correlated with past drought. We found that the reported increase in the mean elevation of *C. greggii* was due to higher recent mortality at the lower elevations which were younger sites. The time-series pattern of mortality was best explained by the stand age/self-thinning hypothesis (H2) and poorly explained by either gradual warming or drought. We argue that studies describing vegetation patterns consistent with climate change should include greater consideration of mechanism.

## EFFECTS OF GLOBAL CHANGE ON ECOSYSTEM INVASIBILITY BY *BROMUS TECTORUM* L. IN THE EASTERN SIERRA NEVADA, CA

**Amy Concilio**, Michael Loik, University of California- Santa Cruz, [aconcili@ucsc.edu](mailto:aconcili@ucsc.edu)

The invasive annual grass, *Bromus tectorum*, has displaced native shrub and bunchgrass communities throughout the Great Basin Desert. At higher elevations, *B. tectorum* invasion has been slow, but agents of global change may facilitate its spread. This research tested how changes in timing, type, and magnitude of precipitation events, coupled with increased N deposition, might affect *B. tectorum* spread, and how increased N deposition might affect native plant species in the eastern Sierra Nevada, CA. Snow depth was manipulated with snow fences in high snow years, and increased rain was simulated with spring H<sub>2</sub>O augmentation. Paired plots were established within each precipitation treatment to simulate increased and ambient levels of N deposition. *B. tectorum* growth and fecundity were measured at the end of each season from 2009-2011 and native species cover was measured from 2008-2011. Increased snow resulted in a shift in phenology of *B. tectorum* germination, but had little effect on final biomass or fecundity. Increased levels of N affected *B. tectorum* invasiveness only in combination with H<sub>2</sub>O augmentation. Likewise, native species richness and cover did not change with increased N alone. H<sub>2</sub>O augmentation alone increased *B. tectorum* invasiveness in the low snow year, but only in combination with increased N in a year with higher ambient precipitation. Our results suggest that *B. tectorum* may become more competitive at high elevation with changing climatic and edaphic patterns. Monitoring and control efforts for *B. tectorum* in a future climate should focus on invasion-risk areas at elevations above current occurrence.

## SHRUB ENCROACHMENT OF ALPINE AREAS. AN UPHILL BATTLE?

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Shifting range distributions observed worldwide provide strong evidence of species responses to increasing global temperatures over the past century. Many predictions of species range shifts are based on the climate envelope approach, with the null prediction that species ranges will shift poleward and upward in elevation to track suitable climate. However, observed rates of range alteration vary widely among species, potentially due to both differential dispersal rates and species interactions. In 2010 we conducted a re-survey of plant species distribution and abundance in Eastern-California's White Mountains, in areas originally surveyed by Harold Mooney in 1961. Species presence and abundance data were collected between elevations of 2,900 m and 4,000 m in alpine and sub-alpine habitats. With these data we asked two focal questions: Did all species display similar elevational range shifts? And, was there evidence of shifting species interactions? Differential shifts in abundances were observed across the gradient. *Artemisia arbuscula*, a shrub, increased its elevational range limit 150 m from the

original 1961 survey. Significant declines in abundances of three alpine cushion plants, *Trifolium andersonii*, *Phlox condensata*, and *Eriogonum ovalifolium*, were observed in the belt of *A. arbuscula* encroachment. Above the current range limit of *A. arbuscula*, these three forb species displayed similar abundances to those observed in 1961. These data suggest that the rapid elevational range expansion of *A. arbuscula* could lead to competitive exclusion of *T. andersonii*, *P. condensata*, and *E. ovalifolium*, highlighting the importance of how species interactions, as community assembly processes, are influenced by changing climate.

#### SPECIES-LEVEL VARIABILITY IN CLIMATE-INDUCED TRENDS IN RADIAL GROWTH OF THE CENTRAL SIERRA NEVADA

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The subalpine and alpine vegetation of the Sierra Nevada is expected to shrink by as much as 78% over the next century. Yet, in the species-rich Sierran subalpine, tree species occur in numerous combinations, and the assumption that they will respond as a whole seems tenuous. From 2007-2009, I collected 430 tree cores from seven species over 84 sites throughout the central Sierra Nevada. Analyses were performed on ring widths and regional climate from 1895-2008. By analyzing all species together, I hope to provide more precise estimates of how each species may respond to continued climate change. In general, radial growth of subalpine tree species correlated positively with precipitation and negatively with temperature, especially maximum temperature (Tmax). However, lodgepole pine, western white pine and mountain hemlock were significantly positively correlated ( $r = 0.18$  to  $0.29$ ) with minimum temperature during the spring. Mountain hemlock was the only species showing positive correlations with Tmax, ( $r$  ranging from  $0.18$  to  $0.28$  during the spring) and the only species showing consistent negative correlations with precipitation ( $r$  ranging from  $-0.17$  to  $-0.29$  during winter and spring). These results suggest that mountain hemlock may respond quite differently to climate change than other subalpine species. Warming temperatures and steady or decreasing precipitation may actually improve its growth rates relative to other species. This is a surprising result, considering mountain hemlock is restricted to the snowiest, coolest slopes, and suggests that we have much to learn about how individual species will respond to future climatic change.

#### TAKING THE HEAT: RESPONSE TO EXTREME HEAT EVENTS IN A CALIFORNIA NATIVE SHRUB

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Few studies examine species responses to extreme events such as heatwaves yet the length of the "heatwave season" in California (CA) is predicted to increase. The response of a species may be different across its range and between different life stages. To determine if there was ecotypic variation in growth, as well as variation in water use and photosystem integrity during an artificial heatwave, we examined the responses of 1-year-old and 3-year-old seedlings from a northern (Mendocino County) and southern (San Diego County) population of the widespread near-endemic shrub *Heteromeles arbutifolia*. We imposed the artificial heatwave by elevating air temperature  $10^{\circ}\text{C}$  ( $38^{\circ}\text{C}$ ) for 4 days on half of the 1-year-old seedlings. On day zero and day two of the heatwave there was no significant difference in predawn  $F_v/F_m$  between the two populations. However, during day two of the heatwave, plants from southern CA had extremely low midday  $F_v/F_m$  ( $= 0.2$ ) compared to plants under ambient conditions. This suggests southern plants were more functionally compromised. Before the heatwave we determined plant size and the average leaf conductance of water vapor (site significantly different  $P = <0.001$ ). While these varied in 1-year-old seedlings, there were no significant differences in 3-year-old seedlings.

Results from 3-year-old seedlings suggest the differences between populations decreased over time. Our results show that *H. arbutifolia* exhibits reduced photosystem integrity in response to an artificial heatwave, suggesting that changes in onset of the heatwave season may have important and negative impacts on this native plant species.

#### EXPLORING PLANT TOPOGRAPHIC NICHE: THE EFFECTS OF CLIMATE TOLERANCE, RANGE POSITION, AND SOIL TYPE

**Stella Copeland**, University of California, Davis, [scopeland@ucdavis.edu](mailto:scopeland@ucdavis.edu)

Topography alters microclimates in montane environments by affecting evapotranspiration, snow accumulation, runoff, and wind exposure. Cool topographic microclimates have the potential to create microrefugia for plant species vulnerable to warming climates. Plant species topographic niche, or distribution across topographic gradients, may be related to species characteristics such as biogeographic origin, range limits, and sensitivity to climate. Topographic niches may also tend to be cooler on low-nutrient serpentine soils. We tested the effects of range limit, biogeographic origin, climate sensitivity, and soil type on topographic niches using 4800 vegetation plots on federal land in the Klamath-Siskiyou Mountains. We developed fine-scale species distribution models (MaxEnt) based on topographic variables for common species on serpentine and non-serpentine soils. Soil type significantly affected topographic niche for 10 of the 22 species modeled, with most species occurring in cooler topographic locations on serpentine soils. Species with greater climate sensitivity - measured using AUC for climate model fit - were more sensitive to topography as measured by model fit (AUC) (linear model:  $N = 118$ ,  $R^2 = 0.71$ ). Species at their range limits did not have consistently different topographic niches than non-range limited species. Overall, our results suggest that species geographic and climate distribution can help predict topographic niche, particularly in combination with soils data. This approach could help predict the location of potential topographic microrefugia for California native plant species, and the identity of species that may be conserved therein.

#### CLIMATIC TOLERANCES OF ENDEMIC ANNUAL PLANTS: IMPLICATIONS TO SPECIES DISTRIBUTION MODELS AND BIODIVERSITY MANAGEMENT

**Iara Lacher**, University of California, Davis, [illacher@ucdavis.edu](mailto:illacher@ucdavis.edu)

Narrowly distributed (ND) species occur across a reduced spectrum of climatic conditions than their broadly distributed congeners, a commonly used assumption in distribution modeling (DM). However, if ND taxa are primarily limited by factors other than climate (e.g. habitat specialization and dispersal limitation) they may tolerate a larger range of climatic variation. This suggests that climatic tolerance derived from species occurrences may be insufficient for predicting species distributions. In my research, I tested the assertion that species DMs overestimate extinction risk for narrowly endemic taxa. Using climate-controlled growth chambers, I investigated lifetime fitness responses of both narrowly and broadly distributed *Mimulus* and *Clarkia* species under three temperatures and seven precipitation treatments. Experimental treatments were derived from a combination of nearby meteorological stations, climate models, and IPCC scenarios for the year 2080. Preliminary analyses revealed that target taxa, independent of the distribution, showed a positive and significant response to precipitation treatments with non-significant differences in fitness between some congeners. This supports the hypothesis that narrowly distributed species are not necessarily more sensitive, i.e. less tolerant, to climate than their broadly distributed congeners. These preliminary results may dispel assumptions that occurrence data accurately represent climatic tolerances of rare species for use in species DMs.

This research suggests conservation practitioners should take caution in applying climatic tolerances derived from occurrence data to DMs for the management and triage of rare species.

## CLIMATE CHANGE VULNERABILITY ASSESSMENT FOR RARE PLANTS

**Brian Anacker**, Steve Schoenig, Krystal Leidholm, Department of Fish & Game, University of California, Davis, [blanacker@ucdavis.edu](mailto:blanacker@ucdavis.edu)

The Climate Change Vulnerability Assessment for Rare Plants Project used predictive geospatial distribution modeling and NatureServe's Climate Change Vulnerability Index (CCVI) to assess the risk from various climate change scenarios for rare plants in California. First, we modeled the current and future (2080) distributions of 1124 species using climate and environmental data. Second, we compiled a set of life-history attributes for 156 of the 1124 species using scientific literature and expert opinion for input into the NatureServe CCVI, which assigned species with a vulnerability rank to climate change. Model results predicted that most species will experience a significant decline in climatic suitability where they occur by 2080 (743 of 1124); for the remainder, climatic suitability will significantly increase (296 of 1124) or not change (85 of 1124). For the 156 species subset, the CCVI ranks assigned to date were highly vulnerable ( $n = 5$ ), moderately vulnerable ( $n = 25$ ), and presumed stable ( $n = 10$ ). We identified several species that will be especially vulnerable to climate change - those which will be exposed to the largest declines in climatic suitability and have climate-sensitive life history traits. Our results can guide monitoring, management, and conservation plans for sensitive species and the methods can inform vulnerability assessments being conducted for managers as part of the revised State Wildlife Action Plan.

## CONSERVATION PRIORITY SETTING UNDER CLIMATE CHANGE USING NETWORK FLOW

Patrick Roehrdanz, Lee Hannah, **Oliver Soong**, Makihiko Ikegami, University of California, Santa Barbara, [osoong@bren.ucsb.edu](mailto:osoong@bren.ucsb.edu)

Traditional approaches to conservation are often insufficient in the face of climate change and predicted shifts in species ranges. Mediterranean climates such as California are particularly vulnerable because of their large numbers of endemic and otherwise threatened species. Researchers have begun to examine how to adapt conservation planning to expected climate change, and there are diverse approaches with diverse results. Conservation planning under climate change faces the difficult problem that areas of suitable habitat shift through time, while species are variable in their abilities to disperse. We explore the application of an approach termed network flow, which optimizes conservation parcels while simultaneously meeting minimum area conservation targets and ensuring connectivity of suitable habitat through time incorporating explicit dispersal rules. We have adapted the network flow formulation to identify conservation priority areas to help California adapt to expected shifts in the distribution of several thousand native plants due to climate change. We explore the range of potential futures as well as the sensitivity of the algorithm to uncertainty in climate model used, duration of climate change, size of conservation targets, and dispersal distance. Some 5-10% of species are unable to meet their conservation targets through time, regardless of effort, but another 25-30% can meet their targets with some additional protection. The long-term solutions are able to satisfy conservation targets for fewer species than short-term solutions, suggesting both that short-term plans may underestimate long-term conservation needs and that some connectivity chains in the short-term lose their viability in the long-term.

## Session 2: The Science, Life History, and Population Dynamics of California's Rare and Endangered Plants

### CONSERVATION ECOLOGY OF EXTREMELY RARE PLANTS: *ARCTOSTAPHYLOS* IN SAN FRANCISCO

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Following the discovery in October 2009 of an extant individual of the Franciscan manzanita (*Arctostaphylos franciscana*), San Francisco became home to two manzanita species represented by only a single individual remaining in the wild (with the Presidio manzanita, *Arctostaphylos montana* subsp. *ravenii*, being the second). To preserve these species and their ecological legacies, restoration of functional populations has to occur. The reproductive ecology of *Arctostaphylos* indicates they are principally out-crossing. The first step is to establish additional, genetically different individuals associated with the current plants. Restoring functional populations, however, requires more than planting genetically different individuals; it requires restoring a chaparral community, which is not a well-studied process. Each stage of the plant's life history has to be functional, and large numbers of additional species are suddenly involved. Furthermore, each of those additional populations themselves has to be functional for successful restoration of the manzanitas. This presentation synthesizes together the current status of our knowledge of flowering and fruit set, breeding system, dispersal and seed bank formation as critical stages required to create a successful restoration of the Franciscan and Presidio manzanitas. The focus will be on new data concerning two issues: 1) genetic analyses of both species and the potential for outcrossing; 2) the creation of a persistent soil seed bank by seed-caching rodents in the context of survival of fires required to renew populations of these species.

### THE CALIFORNIA FLORA AND *MIMULUS* (PHRYMACEAE): CENTERS FOR RICHNESS AND RARITY

**Naomi Fraga**, Rancho Santa Ana Botanic Garden, [nfraga@rsabg.org](mailto:nfraga@rsabg.org)

At least 66 species of *Mimulus* are currently listed by U.S. government agencies and native plant societies as sensitive, rare, or endangered, making *Mimulus* a group of conservation concern. However, species delimitation and taxonomic relationships in *Mimulus* remain unclear, with 90 to 150 species recognized. In many recent regional treatments of the group, some previously recognized rare species with limited distributions have been lumped with more wide ranging species. Taxonomic confusion in *Mimulus* persists in part because diagnostic floral characters are often obscured when plants are pressed and dried. These easily obscured characters are informative in understanding species diversity and delimiting species boundaries within the genus. Because previous taxonomic treatments in *Mimulus* have been based primarily on study of herbarium specimens, more field studies are needed. Over the course of my work I have conducted extensive field research, photographing and collecting data from *Mimulus* populations primarily in southern California. As a result I have identified five undescribed species of *Mimulus*. Based on preliminary conservation assessments, four of the five undescribed species would be ranked as Nature Serve G1 (critically imperiled) or G2 (imperiled) species. An evaluation of rare species in *Mimulus* will be presented, with insight from recent taxonomic studies.

## FACTORS INFLUENCING GROWTH AND SURVIVAL OF A CRITICALLY ENDANGERED PLANT, *ARENARIA PALUDICOLA*

**Megan Bontrager**, Ingrid Parker, Kelsey Webster, Mark Elvin, University of California, Santa Cruz, [mgbontrager@gmail.com](mailto:mgbontrager@gmail.com)

*Arenaria paludicola* is a critically endangered wetland plant species that historically grew from Washington to Southern California. It is now known only from a single wild population, making it difficult to predict the range of habitats in which it might succeed. We tested the edaphic and desiccation tolerances of plants in the greenhouse, and followed this with a field outplant experiment in several different habitat types. Plants were grown in soils collected from five wetland habitats with varying levels of saline vs. freshwater input. Although plants had high mortality in soil from a *Salicornia virginica* dominated area (the most saline site), they did well across a range of other soil types. Water stress experiments demonstrated that *A. paludicola* can recover from at least 8 days of desiccation after reaching its wilting point; this is a higher desiccation tolerance than predicted for this wetland species. In December 2010, *A. paludicola* was outplanted into three different habitat types at two different sites in Santa Cruz County, California. We had high initial transplant success, with only 2% mortality in the first three months. Over the first year we have seen varying establishment success and growth across the habitats. The plants have greatest success in plots with mostly open canopies and *Oenanthe sarmentosa* as the dominant vegetation. The effects of local moisture availability and of removal of local competitors seem to depend on habitat. We hope to better understand the needs of this species through further outplant experiments at new sites.

## ECOLOGY AND REPRODUCTIVE BIOLOGY OF TWO RARE SERPENTINE ENDEMIC *MONARDELLA* SPECIES FROM THE NORTHERN SIERRA NEVADA

**Suzie Woolhouse**, Nishanta Rajakaruna, San José State University, [szwoolhouse@yahoo.com](mailto:szwoolhouse@yahoo.com)

The Feather River complex in the Northern Sierra Nevada is a belt of ultramafic derived soils supporting many rare and endangered plant species, including two serpentine endemics in the genus *Monardella* (Lamiaceae), *M. stebbinsii* and *M. follettii*. The purpose of this study is to examine causes of rarity by investigating the ecology and reproductive biology of these two closely related species in order to provide useful information to land managers. Both species are found in the same area and are sometimes sympatric, but *M. follettii* is much more widespread and common throughout its slightly wider distribution (less than 10 square miles for *M. stebbinsii* and over 100 square miles for *M. follettii*). Methods include germination trials, bagging plants in the budding stage to examine reproductive strategies, soil/tissue analysis and pollinator observations. *M. stebbinsii* and *M. follettii* had germination rates of 74% and 62% respectively. Both species are primarily outcrossers, setting a significantly greater amount of seed in un-bagged vs. bagged flower heads. Pollinator observations showed a higher frequency of visits to *M. stebbinsii* sites but a greater diversity of pollinators at *M. follettii* sites. Significant differences were also found in the elemental make-up of the soil and tissue concentrations, pointing to heterogeneity across the serpentine landscape as well as possible physiological differentiation in regards to ion uptake. Gaining a better understanding of the biology and ecology of these rare plants will increase the efficacy of management practices for these species.

## A SCIENCE-BASED APPROACH TO NEW INTRODUCTIONS OF THE ENDANGERED SONOMA SPINEFLOWER AT POINT REYES NATIONAL SEASHORE

**Amelia Ryan**, Lorraine Parsons, Point Reyes National Seashore, [Amelia\\_Byrd\\_Ryan@nps.gov](mailto:Amelia_Byrd_Ryan@nps.gov)

Sonoma spineflower (*Chorizanthe valida*) is a federally endangered plant species with only one known natural population, located on a 3-acre area on Point Reyes National Seashore (Seashore). With only a single population, it is especially vulnerable to the threat of extinction, yet little has been known about the life history and habitat requirements of this species. Experimental reintroductions of this species have been attempted several times over the last two decades with varying success, but without data as to what contributed to the success or failure of each reintroduction. In 2010, with funding from the USFWS, Seashore staff carried out a study correlating plant survival, size and reproductive output to soil and plant community characteristics in the natural population as well as prior reintroduction sites with failure and moderate success. The data was then used to implement five new introduction sites where soil and plant community characteristics most closely resembled the study sites correlated with measures of plant success. After 1 year, four out of five introductions were moderately to highly successful, with an average of 40% seed germination and 70% survival to flowering. These results suggest that a science-based approach can be a powerful tool in species preservation.

#### EFFECTS OF POPULATION SIZE AND HABITAT QUALITY ON REPRODUCTIVE SUCCESS IN THREE DISTURBANCE-DEPENDENT RARE PLANT SPECIES

**Melanie Gogol-Prokurat**, California Department of Fish and Game, [mprokurat@dfg.ca.gov](mailto:mprokurat@dfg.ca.gov)

Allee effects, in which individual fitness is positively related to population size or density have important conservation implications for rare species. Populations that are small or become fragmented could be at greater risk of extinction, and may need more intensive management to sustain their long-term viability. Conservation recommendations for populations exhibiting Allee effects often focus on population size or the availability of mates. However, habitat quality attributes may also play a direct or indirect role in reproductive success through influences on population size or investment in reproduction. Separating the effects of habitat quality and population size on reproductive output can help inform management of small populations. This study used field-collected data to disentangle the effects of population size and habitat quality on reproductive success of three, disturbance-dependent rare plant species in El Dorado County, California: *Calystegia stebbinsii*, *Packera layneae*, and *Wyethia reticulata*. Allee effects were found in all three species. Habitat attributes, including vegetation composition, fire history, and disturbance were found to modulate these effects in all cases. Hence, although individual reproductive success was correlated with population size, habitat attributes were also found to be direct and indirect drivers of reproduction. The results indicate that conservation efforts for these species should focus not only on population size, but also on habitat quality and management. Although mechanical clearing is suggested as a replacement for fire in this system, the findings suggest that the absence of fire may erode the replacement of individuals in these populations over time.

#### INVESTIGATING CAUSES OF RARITY IN AN ENDEMIC WETLAND THISTLE

**Rosa Schneider**, Romberg Tiburon Center for Environmental Studies/San Francisco State University, [rss@mail.sfsu.edu](mailto:rss@mail.sfsu.edu)

The highly urbanized San Francisco Estuary contains 90% of California's remaining coastal wetlands, as well as high concentrations of both invasive and rare species. One rare species, the Federally-listed Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), is restricted to two populations in which the invasive perennial pepperweed (*Lepidium latifolium*) has an increasing

presence. My research aims to understand why the Suisun thistle is so rare and which management actions would be appropriate to protect it. Two hypotheses for the thistle's rarity are being investigated: 1) to address competition with pepperweed, a removal experiment is being conducted and responses of the thistle, other plant species, and soil dynamics are being measured; 2) to describe the thistle's reproductive output, key life history processes including pollination, seed set, dispersal, and germination are being investigated. Results from this research will allow managers to protect the Suisun thistle during vulnerable life stages and/or in critical locations, as well as design restoration plans for Suisun Marsh.

#### FIELD EXPLORATIONS AND DISCOVERIES: A PANEL DISCUSSION ON THE SIGNIFICANCE OF FIELD BOTANY AND HERBARIUM COLLECTING IN CALIFORNIA

**Jon Rebman**, San Diego Natural History Museum, [jrebman@sdnhm.org](mailto:jrebman@sdnhm.org)

The fate of botanical diversity in California relies on an accurate picture of the distribution of California's flora. The backbone of our botanical knowledge continues to be provided by the observations, and more significantly the voucher specimens, of dedicated field botanists. Informed conservation decisions are impossible without the knowledge provided by a concerted effort to document the diversity and distribution of our flora. At the same time, educational institutions place a decreased emphasis on field botany and the importance of herbarium botany. The innumerable recent examples of herbarium specimens contributing to vital advances in taxonomy and conservation planning exemplify the importance of herbarium botany. Furthermore, herbarium specimen collecting provides an excellent opportunity for professional and amateur botanists to connect with the natural environment in addition to contributing to a vital body of scientific knowledge. As participants in the "Field Explorations and Discoveries" panel, we plan to share our experiences as field botanists and herbarium specimen collectors. It is our hope that the discussion will continue to elucidate the importance of this discipline and help to inspire a new generation dedicated to learning about and documenting the richness of California's flora.

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**Dean Taylor**, Consulting Botanist, [deanwmtaylor@gmail.com](mailto:deanwmtaylor@gmail.com)

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**James Andre**, University of California Riverside, Granite Mountains Desert Research Center, [granites@telis.org](mailto:granites@telis.org)

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**Andrew Sanders**, University of California at Riverside, [andrew.sanders@ucr.edu](mailto:andrew.sanders@ucr.edu)

The fate of botanical diversity in California relies on an accurate picture of the distribution of California's flora. The backbone of our botanical knowledge continues to be provided by the observations, and more significantly the voucher specimens, of dedicated field botanists. Informed conservation decisions are impossible without the knowledge provided by a concerted effort to document the diversity and distribution of our flora. At the same time, educational institutions place a decreased emphasis on field botany and the importance of herbarium botany. The innumerable recent examples of herbarium specimens contributing to vital advances in taxonomy and conservation planning exemplify the importance of herbarium botany. Furthermore, herbarium specimen collecting provides an excellent opportunity for professional and amateur botanists to connect with the natural environment in addition to contributing to a vital body of scientific knowledge. As participants in the "Field Explorations and Discoveries" panel, we plan to share our experiences as field botanists and herbarium specimen collectors. It is our hope that the discussion will continue to elucidate the importance of this discipline and help to inspire a new generation dedicated to learning about and documenting the richness of California's flora.

## THE MAPPING AND STATUS OF *SWALLENIA ALEXANDRAE*, *OENOTHERA CALIFORNICA* SSP. *EUREKENSIS*, AND *ASTRAGALUS LENTIGINOSUS* VAR. *MICANS* AT THE EUREKA DUNES IN DEATH VALLEY NAT'L PARK

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Eureka Valley dune grass (*Swallenia alexandrae* [Swall.] Soderstrom & Decker) and the Eureka Valley evening primrose (*Oenothera californica* [Wats.] Wats. subsp. *eurekensis* [Munz & Roos])

W. Klein) are federally listed endangered species found only on three disjunct dune areas within the Eureka Valley of Death Valley National Park. Shining milkvetch (*Astragalus lentiginosus* var. *Hook micans* Barneby) is another rare endemic that is not federally listed but is included in the Eureka Valley rare plant surveys. These three species have been mapped and monitored sporadically since the 1970's. Accurate habitat wide surveys were not possible in the past without modern GPS equipment so direct quantitative analysis of population trends over decades is impossible. This presentation summarizes the history of rare plant population mapping efforts in the Eureka Valley to date and the results of the first habitat-wide survey completed in 2011. Permanent density plot monitoring has not revealed any positive or negative trends over the last four years; however, comparison of photo points at Marble Canyon and on the Main Dune show dramatic declines over the last 25 and 35 years respectively. It is unlikely that visitor impact in recent decades has caused this decline. Other factors such as climate change, competition from invasive species or plant-animal interactions may be contributing to decline and warrant further study. The Eureka Valley dune grass and Eureka Valley evening primrose have both been proposed for delisting by the USFWS, a determination will be made in November 2011. The USFWS has received a petition to delist the Eureka Valley dune grass and Eureka Valley evening primrose and are currently evaluating the petition.

#### RARE PLANT SURVEY RESULTS FOR THE CLEVELAND NATIONAL FOREST MASTER USE PERMIT, SAN DIEGO COUNTY

**Heather Clayton**, Chambers Group, Inc., [hclayton@chambersgroupinc.com](mailto:hclayton@chambersgroupinc.com)

To renew a 50-Year Master Use Permit, San Diego Gas and Electric Company (SDG&E) contracted Chambers Group, Inc. to conduct focused protocol-level rare plant surveys for all of their proposed work spaces within the Cleveland National Forest. The footprint surveyed ranged from the unincorporated area of Warner Springs in north San Diego County to the Lake Morena Village area at the south end of the County. Botanists walked the project footprint during three separate survey periods from April to September 2010 to ensure that surveys would correspond with the optimal blooming times of the targeted plant species. Forty-three native plant species classified as endangered, or rare by the California Native Plant Society (CNPS) were identified, counted, and mapped within the project footprint. Total numbers of individuals observed along the project route per species during the survey varied from one individual of Mexican flannelbush (*Fremontodendron mexicanum*), to more than 15,000 delicate clarkia (*Clarkia delicata*) and long-spined spineflower (*Chorizanthe polygonoides* var. *longispina*) individuals. Many of these data represent new populations not previously recorded by CNPS and will further the distribution knowledge of these species. To verify that species were not overlooked and to account for annual variability, SDG&E will repeat the surveys in 2012. During construction, their primary goal will be to avoid as many rare plants as possible, and to mitigate for any individuals lost in an effort to preserve the diversity of the National Forest and San Diego County as a whole.

#### MONITORING POPULATION SIZE OF THREAD-LEAF *BRODIAEA* (*BRODIAEA FILIFOLIA*: *THEMIDACEAE*): ESTIMATING FROM SEXUAL PRODUCTION AND MODELING ANNUAL VARIATION

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Thread-leaf *Brodiaea* is a federally threatened corm-bearing perennial species that flowers out of sync with vegetative production, and is very difficult to count or to estimate. Due to its cryptic

nature, initial reports of population locations and counts are often taken during late spring when the plants are flowering. Yet the relationship between population size and individuals producing flowers, and the year-to-year variation in this ratio, are unknown. Both could influence the accurate assessment of population viability and persistence, or confuse actual population status with sampling error. The Center for Natural Lands Management manages several occurrences of this species on its preserves in San Diego County, CA. Exhaustive counts of vegetative and flowering response over a four-year period have provided information on the relationship of these measures to population size. This ratio is sensitive to environmental influence and varies from site to site and year-to-year. However, comparisons with available weather data provide evidence of a relationship with winter temperature and previous-year rainfall. By determining these environmental relationships and collecting some initial data at each occurrence site for calibration purposes, the measurement of population dynamics in this (and other species with similar characteristics) species can be much more efficient and more reliably represent population size rather than sampling error.

#### A TALE OF TWO ISLANDS - DIVERGENCE AMONG POPULATIONS OF THE ENDANGERED PLANT *SIBARA FILIFOLIA*; IMPLICATIONS FOR MANAGEMENT AND EX SITU CONSERVATION

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*Sibara filifolia* (Brassicaceae) is a federally endangered, diminutive annual that was presumed extinct until it was rediscovered on San Clemente Island in 1986 and Santa Catalina Island in 2001. It is currently known from several small patches spread over a 700 m area on San Clemente Island, and a 500 m area on Santa Catalina Island. *Sibara filifolia* is capable of selfing, so it was predicted that populations on both islands would have been established from a very small number of founders retained in the seed bank, leading to low levels of genetic diversity. We surveyed genetic variation in five populations on San Clemente Island and three populations on Santa Catalina Island using nine polymorphic microsatellite loci. As predicted, populations on San Clemente Island had very low levels of genetic diversity (mean HE=0.013), indicative of a substantial population bottleneck. In contrast, populations on Santa Catalina Island had very high levels of genetic diversity (mean HE=0.589), indicative of a large and diverse seed bank. Therefore, despite the similarity in population size, dispersion, and recent history, genetic data shows that populations on different islands have very different evolutionary histories, which should result in different conservation strategies. These results raise questions about how best to incorporate the findings from genetic data into plant conservation. It is common for genetic studies to only sample a subset of known populations to guide conservation efforts, which in this case would have resulted in inappropriate conservation recommendations for one island or the other.

#### MONITORING IN THE SANTA MONICA MOUNTAINS AREA: A CASE STUDY WITH THREATENED *DUDLEYA* SPECIES

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This presentation will discuss overcoming the challenges of implementing long term monitoring for five narrow endemic threatened *Dudleya* species that occur in the Santa Monica Mountains area (for a joint National Park Service & U. S. Fish & Wildlife Service project). The following challenges were faced over a two year period while establishing monitoring at 30 locations within 13 sites: 1) the species have limited distributions, half of the sites are privately owned,

and location suitability criteria excluded large areas; 2) monitoring plants growing on rocks often vertical in orientation; 3) optimal data collection at different times of the year; 4) making data collection replicable even if performed by a different person each year; 5) variability in the number of rosettes per individual and inability to determine which rosettes belong to one individual; 6) no fixed frame to measure from when mapping rosettes and accuracy to the millimeter needed; 7) death, recruitment, and variability in the number of rosettes per individual. These challenges were overcome by: 1) establishing plots in key areas instead of randomly chosen ones and using observational monitoring; 2) marking a transect run bordering the rock formation and taking photographs of the plot and surrounding area; 3) collecting some data in winter and other data in spring; 4) keeping protocols simple and decision free; 5) using a rosette as the sampling unit; 6) using a piece of stiff clear plastic with a grid drawn on it; 7) using the grid coordinates of rosettes for identification.

### **Session 3: Central Coast and Central Valley Conservation**

#### ASSESSING RECOVERY OF AN ENDANGERED SPECIES: SANTA CRUZ CYPRESS

Jodie McGraw, **Connie Rutherford**, U.S. Fish and Wildlife Service, Ventura, California, [connie\\_rutherford@fws.gov](mailto:connie_rutherford@fws.gov)

*Hesperocyparis (Cupressus) abramsiana* (Cupressaceae) is a California endemic closed-cone conifer restricted to five stands located on nutrient poor, well-drained soils in the Santa Cruz Mountains in Santa Cruz and San Mateo counties. The taxon was listed as Endangered by the State of California (1979) and Endangered by the U.S. Fish and Wildlife Service (1987) primarily due to habitat threats from logging, development and conversion to vineyards. The Service's recovery plan and recommendations in the five-year review specified that to downlist to Threatened status, protection should be secured for all five populations from the primary threats. Substantial progress has been made through transfer to, and management of lands by, conservation-oriented entities. To delist, we need assurance that all 5 stands will achieve long-term reproductive success. A 2007 demographic study of 3 stands revealed that the potential for 'senescence risk' from fire exclusion may lead to senescence of adult trees such that there is insufficient seed to regenerate the stand during a stand-replacing fire. A study conducted following the 2008 Martin Fire revealed that the wildfire resulted in dense seedling recruitment and created low-canopy conditions that may prove suitable for their growth and survivorship. Attempts to promote seedling establishment in unburned areas using mechanical treatments to remove understory species did not result in substantial seedling establishment. Ongoing monitoring can be used to evaluate population regeneration, particularly in the face of the invasion of exotic plant species in the region, and inform actions to recover this and other fire-dependent endangered species.

#### ECOLOGY AND MANAGEMENT OF OAK WOODLANDS ON TEJON RANCH: RECOMMENDATIONS FOR CONSERVING A VALUABLE CALIFORNIA ECOSYSTEM

**Serra Hoagland**, University of California, Santa Barbara, US Forest Service Eastern Forest Environmental Threat Assessment Center, [serrahoagland@gmail.com](mailto:serrahoagland@gmail.com)

Tejon Ranch is the largest contiguous private property in California encompassing 270,000 acres and is home to some of the most intact oak woodlands remaining in California. In 2008 an agreement was made to protect 240,000 acres of ecologically valuable acres on the Ranch. The goal of this project was to provide the Tejon Ranch Conservancy with analyses and

recommendations to guide the creation of an oak woodland section of their Ranch-Wide Management Plan. Through a combination of field data collection, analyses, and computer modeling, this project found that the three focal oak species, *Quercus lobata*, *Q. douglasii*, and *Q. kelloggii* on the Ranch were currently in good condition. Oak stands on the Ranch are well-stocked and larger in comparison to other oak stands in California. Evidence from a historical photo analysis shows that blue, valley and black oak populations are very slowly declining. Climate change threatens blue, valley and black oak populations on the Ranch, with significant losses of suitable habitat predicted by mid-century, particularly for blue oaks. Current management on Tejon lacks the active oak restoration practices found on nearby conservation properties but with the slow population decline and impacts from climate change, we recommend the Conservancy protect seedlings and saplings in predicted future ranges where the climate will be suitable over the next 50 years. This project successfully established a comprehensive set of baseline data that can be referenced and updated as efforts to understand Tejon Ranch's oak ecosystems evolve.

#### FOREST-ASSOCIATED MANZANITAS: ADAPTATIONS TO CHANGING LIGHT REGIMES

**Jennifer Chapman**, San Francisco State University, [jenniferchapman@comcast.net](mailto:jenniferchapman@comcast.net)

The center of *Arctostaphylos* diversity is found in central California. A recent study indicates that variation in light regimes has contributed to this diversity. Coastal forest-associated manzanitas, including a number of rare species, have long been thought to represent adaptations to more mesic conditions by xeric species which moved into newly forested areas in relatively recent geologic time. Response to experimental light treatments shows significant differences between forest-associated and open chaparral species in the anatomy and physiology associated with photosynthesis. Open chaparral species were found to have greater photosynthetic capacity whereas forest-associated species were found to have lower chlorophyll a/b ratios. Stomatal density was more evenly distributed in open chaparral species between the top and bottom of leaves, whereas forest-associated species had a greater proportion of their stomata on the bottom. Coastal forests and the light regimes associated with them are changing as land use leads to type conversion, climate change alters patterns of precipitation and fog, fire suppression extends periods of late succession, and Sudden Oak Death creates gaps as trees collapse. These changes will potentially create significant environmental pressure for rare forest-associated manzanitas.

#### THE ROLE OF FIRE IN CONIFER AND EXOTIC SPECIES INVASIONS OF CENTRAL SIERRA NEVADA SUBALPINE MEADOWS

**Jim Alford**, Jamie Kneitel, Valerie Hendon, California Department of Fish and Game, Vegetation Classification and Mapping Program, [jim.alford@comcast.net](mailto:jim.alford@comcast.net)

Sierra Nevada subalpine meadows provide critical ecosystem services. In the last century conifers have invaded western meadows. The cause is thought to be human-induced changes to climate, hydrology, and fire regimes. This study examines a U.S. Forest Service prescribed fire in Van Vleck meadows, Eldorado National Forest. The two hypotheses flow from debate among forest managers: (1) Will prescribed fire limit lodgepole pine encroachment? (2) Will the disturbance of the prescribed fire allow Eurasian plants to invade? We established two studies, one for each question. For the first, we compared pre-and post-fire plant populations through survey and analysis of permanent plots. For the second, 56 observation plots were established in areas highly disturbed by the fire. Preliminary results show that fire was patchily successful in limiting lodgepole incursion and invasive plants will not establish. The 2010 sampling found no

non-native plants in plots. Most meadow lodgepole pines were consumed in the fire but persist in patches. The 2011 sampling is underway. We expect analysis of the two year dataset will find: (1) The fire limited lodge pole encroachment in a patchy way, and (2) Invasive plants did not establish. These results suggest that fire can be useful in meadow restoration but repeated application may be necessary.

#### RECOVERY OF SAN BENITO EVENING PRIMROSE (*CAMISSONIA BENITENSIS*; ONAGRACEAE)

**Ryan O'Dell**, Bureau of Land Management, [reodell@ucdavis.edu](mailto:reodell@ucdavis.edu)

San Benito evening primrose (*Camissonia benitensis*; Onagraceae) is a strict serpentine endemic, annual plant species that occurs near San Benito Mountain in the southern Diablo Range. Most San Benito evening primrose populations are located on lands managed by the Bureau of Land Management (BLM). San Benito evening primrose was federally listed Threatened in 1985 due to impacts from Off-Highway Vehicles (OHV) on BLM land. In 1985, only 10 small populations (~3 hectares of occupied habitat) were known within a range of approximately 2,600 hectares and all populations were located within the area of highest OHV impact. Substantial progress has been made with respect to the recovery of San Benito evening primrose since it was listed. OHV impacts have virtually been eliminated, habitat has been restored, and major new population and habitat discoveries have been made increasing the number of known populations to 361 and the total known range of the species to 80,000 hectares. Within the 80,000 hectare range, approximately 250 hectares are known potential (uncolonized) habitat for the species and about 100 hectares total are currently occupied (colonized) by the 361 known populations of the species. Twenty years of plant count data for San Benito evening primrose show long term stability. A recent seed bank study revealed that the species has large, long lived seed banks. Population viability analysis of the current data indicates that San Benito evening primrose now has a low risk of extinction and suggests that delisting of the species may soon be warranted.

#### CONSERVING AND RESTORING HABITAT IN THE PRESIDIO OF SAN FRANCISCO

**Shelley Estelle**, Michael Chasse, Mark Frey, The Presidio Trust, San Francisco, [sestelle@presidiotrust.gov](mailto:sestelle@presidiotrust.gov)

The Presidio is part of the Golden Gate National Recreation Area and home to five listed species and 11 other CNPS rare plants. The Presidio's 1500 acres includes 264 acres of non-native forest, 375 acres of impermeable surfaces, and a dozen distinct plant communities. I will review the collaborative efforts over the last 18 years to protect, enhance, and connect these fragments of natural landscape as it relates to our federally listed species. San Francisco *Lessingia* had dwindled to only 17 individuals. An 11 acre dune restoration project has brought that number way up; it has fluctuated between 80,000 and 1.5 million in the years since restoration began. Presidio *Clarkia* had been reduced to a collection of seed in the desk drawer of James Roof and now, after a decade of intensive restoration we have 100,000 individuals. Over the last two years we have experimentally reintroduced Marin dwarf flax to one of our serpentine grasslands. The Raven's manzanita exists as only one genetic individual. We have established 17 clones and over the last few years have been able to cultivate individuals that are the result of selfing. The Franciscan manzanita was thought to be extinct in the wild for 70 years until it was discovered in October of 2009 in preparation for a major highway renovation project. We only had three months to save the species. After intensive collaboration and

planning the plant was moved to an undisclosed location; clones of all known genetic individuals were planted this winter.

## A CONSERVATION TOOL - THE MONTEREY PINE FOREST, COASTAL CALIFORNIA'S LIVING LEGACY

**Nikki Nedeff**, Ecologist, [nikki@ventanaview.net](mailto:nikki@ventanaview.net)

Native Monterey Pine Forests are rare ecosystems that exist in only five places in the world: the Monterey Peninsula, Waddell Creek/Año Nuevo, Cambria, and two Mexican islands off the western Baja California coast, Guadalupe and Cedros. Although Monterey pines are among the most widely planted plantation trees, supporting robust timber and forest product economies in all hemispheres of the globe, their native populations have been compromised by disease, development and disorganized conservation strategies. Natural forests of Monterey pine are underappreciated and difficult to manage, yet are associated with a variety of rare species and special habitats. Not only do native Monterey Pine Forests provide the raw genetic material for a vast industry of wood products, the Monterey Pine Forest landscape creates the backdrop for world-class real estate, education and recreational pursuits.

There is a new book celebrating the rich natural and cultural history of this habitat. In July 2011 a Carmel-based nonprofit, The Monterey Pine Forest Watch, released *The Monterey Pine Forest, Coastal California's Living Legacy*, a 200-page in-depth study of these singular forests. Funded entirely by grants and donations, and written and published by volunteers, the book was designed to tell the story of the forest (not the trees) and highlight the conservation needs for this diverse ecosystem. The intent of the "Pine Watch" was to publish the book as a conservation tool and share the book with people who make decisions about the long-term disposition of Monterey Pine Forest habitat, particularly in coastal California.

## GRASSLAND HABITATS OF THE SAN JOAQUIN VALLEY AND CARRIZO PLAIN

**Jennifer Buck-Diaz**, California Native Plant Society, [jbuck@cnps.org](mailto:jbuck@cnps.org)

The remaining intact grasslands of the Central Valley are poorly described in the literature and highly threatened by conversion to agriculture, residential development, and non-native plants. The CNPS grassland initiative's primary objective is to establish baseline knowledge of natural grasslands and associated plant communities through inventory, classification, analysis, and mapping. Recently, more than 500 field surveys were compiled and classified to the alliance and association level. This classification defines 4 new herbaceous alliances and 38 new herbaceous associations not previously published in *A Manual of California Vegetation*, second edition. Seasonal analyses provide new insight into the constancy of annual plants in grassland communities, reinforcing the importance of optimally-timed spring sampling to fully characterize the richness of grassland habitats. A rigorous herbaceous classification gives quantifiable methods to recognize and delineate vegetation and allows for the identification of rare, unique, or representative stands, thus enabling the prioritization of sites for conservation. The use of a community level designation as a target for conservation allows for the protection of a broader array of species, habitats, and system functions. This project links local environmental factors such as soils, climate, and grazing to specific management and restoration goals within California's annual grassland communities.

## RESPONSE OF VERNAL POOL PLANTS TO CLIMATE CHANGE IN HARDPAN VERNAL POOLS OF THE CENTRAL VALLEY OF CALIFORNIA

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Hardpan vernal pools support a high diversity of native plant species. Individual pools have unique hydrology due to variation in factors such as soil depth, catchment area, and groundwater discharge, and annual fluctuations in precipitation and evapotranspiration can differentially affect individual pool hydrology and vegetation. A detailed four-year study of hardpan vernal pools in California's Central Valley identified that species respond quickly to changes in pool hydrology. During this period, total seasonal precipitation progressively increased, but timing of precipitation played a large role in determining pool inundation periods. Despite total rainfall amounts exceeding the previous season, late season precipitation in 2009 was not sufficient to balance higher evapotranspiration, and pool inundation periods were shortened by 19-28 days. Perennial species such as *Eleocharis macrostachya*, occurring in wetter pools, declined 25-97% while annual species such as *Lasthenia fremontii*, occurring in drier pools, increased 26-640%. These trends reversed over the following two years as rainfall occurred earlier and in average or higher amounts. These annual dynamics highlight the effects that climate change could have on vernal pool systems. Using a water balance model and climate change estimates for the next 100 years, we have determined that vernal pools in the Sacramento Valley could have longer inundation periods while those in San Joaquin Valley will have decreased inundation periods. Given these projections, there will likely be a shift to more perennial species in Sacramento Valley pools, but more annual species in San Joaquin Valley pools.

#### RECOVERING *ARENARIA PALUDICOLA*: CONSERVATION THROUGH PARTNERSHIPS

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*Arenaria paludicola* (Caryophyllaceae) is plant of perennially mesic habitats that is State and Federally listed as endangered. It historically occurred from southern California to western Washington. Currently there is only one remaining natural population, which is comprised of approximately 10 individuals. Extensive efforts have been undertaken to bring this species back from the brink of extinction. In the mid-1990s we reintroduced it at four historical locations, all of which failed. Since then, we outplanted it at four locations within its historical range and achieved varying degrees of success. Additional outplantings are planned for California and Washington. Some of the challenges we encountered trying to recover this species include finding suitable receptor sites, developing propagation and outplanting programs, complying with appropriate State and Federal laws and regulations, and developing associations with partners that are able to participate in these efforts. While we continue to make advances in these areas, overcoming these challenges and recovering this species is fully dependent on these partnerships and their ability to overcome difficulties as they arise.

### **Session 4: Invasive Non-Native Plants: Multi Scale Management and Assessment from State, to Region, to Local, to Site**

INVASIVE PLANT RISK-MAPPING: A NEW ONLINE TOOL FOR SETTING REGIONAL RESPONSE PRIORITIES

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Maps of invasive plant distribution are essential for planning effective management. However, at the landscape scale, comprehensive distribution data is rarely available, and is not easily captured through field mapping. The knowledge of local experts is often sufficient to provide seamless distribution data at a coarse resolution. Cal-IPC is working with local experts to create maps for 200 invasive plant species throughout California based on USGS 7.5-minute quadrangles as the mapping unit. Through interviews, local experts map abundance, spread-trend, and management-status for each species by quad. The resulting maps show management opportunities based on spatial patterns, such as outliers and leading edges. In addition, Cal-IPC is modeling climatically-suitable range for each species, and examining how this range may change as climate shifts. When overlaid with maps of current distribution, suitability maps help show vulnerability to spread. This "risk mapping" approach has been used to determine priorities for eradication, containment and surveillance in the Sierra Nevada. An online tool in development will allow natural resource managers to generate maps and management recommendations for their area, and to update quad data. The system will be linked to existing online occurrence databases such as Calflora. The quad-based approach can be used by other states, and the tool can be adopted by national online mapping systems to produce national maps. Future steps include: adding layers for conservation values; adding algorithms to model vectors of spread; and increasing capability to use data from outside California in suitability modeling.

#### PRIORITIZING AND CATALYZING INVASIVE PLANT ERADICATION IN THE SAN FRANCISCO BAY AREA

**Mike Perlmutter**, Andrea Williams, Gina Skurka Darin, Daniel Gluesenkamp, Bay Area Early Detection Network, [mike@baedn.org](mailto:mike@baedn.org)

The Bay Area Early Detection Network (BAEDN) coordinates Early Detection & Rapid Response (EDRR) for infestations of invasive plants throughout the nine-county San Francisco Bay Area, using a regional eradication strategy to proactively deal with new outbreaks before they can grow into large and costly environmental threats. BAEDN is completing its second field-season with a number of exciting successes. BAEDN's staff downloaded thousands of plant occurrence reports from the Calflora database, and evaluated distribution of these species across the Bay Area. Risk assessment identified 73 target species, known to have high impacts but not yet widespread in the region. Occurrences of target species were prioritized for treatment using Weed Heuristics: the Invasive Population Prioritization for Eradication Tool (WHIPPET) - which prioritizes eradication targets based on impact, invasiveness, and feasibility of eradication. BAEDN staff obtained status verifications for >800 occurrence records by contacting land managers and asking: Does it still exist? Is it under treatment? Will you please treat it? And do you know of other occurrences? The result is that 1/3 of infestations were found to be under voluntary treatment as of September 2010. In this second field season, BAEDN is providing funding to partners and contractors to ensure treatment of remaining infestations. Efforts are underway elsewhere to build other regional multi-county EDRR networks. BAEDN infrastructure and systems now available to others include: prioritization tools; an integrated mapping platform using mobile phone mapping systems and cloud-based occurrence mapping tools; and important lessons learned over two years of successful EDRR coordination.

#### INVASIVE PLANT IMPACT ASSESSMENT AND PLANNING IN SAN DIEGO

**Jason Giessow**, Patricia Gordon-Reedy, Dendra Inc., [jgiessow@cox.net](mailto:jgiessow@cox.net)

The San Diego region is developing a strategic regional framework for coordinated management and monitoring of NCCP reserve lands that prioritizes funding across different geographies and program areas. As part of this regional program, invasive species have been identified as one of the highest priorities for management. Invasives threaten 26 MSCP covered plant species, including 11 narrow endemics. This project is providing the strategic direction and structure for implementing a coordinated invasive species management program within the County. We are developing (1) guidelines for collecting and reporting data to inform regional management; (2) detailed impact assessments for regionally important invasive plants that may not be priorities at a statewide level; (3) priorities for immediate management actions across the region; (4) an organizational framework for implementation; and (5) a regional database and spatially explicit tools for monitoring status of permitting, treatments, and controls. Such a strategic framework, with coordinated land management, will be more effective in applying for and prioritizing funding that results in the greatest return on investment. This presentation will describe our approach, provide examples of prioritization strategies for mapping invasive plants, illustrate differences between statewide and regional impact assessments and prioritization, and describe elements of the strategic and regional framework plans. This project will provide a long-term approach to invasive plant management at the local level and serve as a model for other NCCP planning regions.

#### A STRATEGIC PLAN FOR *ARUNDO DONAX* TREATMENT AND RESTORATION OF RIPARIAN VEGETATION IN A SEMI-ARID LANDSCAPE: A CASE STUDY FROM THE LOWER SANTA CLARA RIVER, CA.

**Zoey Diggory**, Bruce Orr, Adam Lambert, Tom Dudley, Stillwater Sciences,  
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The lower Santa Clara River (Ventura County, CA) is the last wild river in Southern California, but like other California semi-arid rivers, it has been significantly impacted by levees, water diversions, agriculture, and urbanization that have altered natural geomorphic and hydrologic processes. This has caused riparian habitat loss and degradation, and has facilitated invasion by *Arundo donax*. The California Coastal Conservancy's Santa Clara River Parkway project seeks to ameliorate these impacts in the lower river by protecting existing riparian habitat and acquiring and restoring a 33 mile-long floodplain corridor. As part of this project, we used a multi-layered analysis of vegetation maps and hydrogeomorphic processes, including large El Nino flood events, to improve our understanding of the key drivers affecting riparian vegetation and *Arundo* distribution dynamics. These findings were integrated with recent research on *Arundo* ecology and invasive grass-fire cycles to develop a spatially-explicit strategic plan for prioritizing Parkway parcels in the lower Santa Clara River for *Arundo* control and riparian restoration. We discuss various strategic actions for controlling *Arundo*, including 1) appropriate treatment and restoration methods on higher terraces with low likelihood of reinvasion from upstream sources after large flood events, 2) treatment actions in areas adjacent to fire-prone shrublands, 3) fire- and flood-contingency treatment plans to capitalize on *Arundo* biomass removal through natural processes, and 4) active and passive revegetation approaches following *Arundo* treatment to improve and expand the quality of native riparian habitats.

#### POPULATION EXPANSION AND REGIONAL MANAGEMENT OF RED SESBANIA (*SESBANIA PUNICEA*) IN CALIFORNIA

**Ramona Robison**, California State Parks, [rrobison@parks.ca.gov](mailto:rrobison@parks.ca.gov)

Red sesbania is an invasive South American shrub forming dense stands along California waterways. It can increase flooding, alter hydraulic roughness in shallow channels and decrease biodiversity of riparian corridors. Over the past decade, red sesbania has rapidly expanded its range in California, emphasizing the need to prioritize eradication sites at a regional scale. To accomplish this, we updated baseline location data in summer 2010 using field surveys. The regional survey identified major propagule inputs, upstream and downstream extents for each watershed, and provided data in areas where there was no previous information, such as the Sacramento River between Redding and Verona. We then employed the Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET) to prioritize individual populations for eradication. WHIPPET prioritized small populations isolated from the main infestation, as well as outliers in residential areas. WHIPPET also identified small, upstream populations along riparian corridors that act as sources for seed migration downstream as management priorities. Results from WHIPPET and expert opinion were then used to select a location for a control program. Churn Creek in Redding was selected due to its upstream location, size of infestation and engagement of community groups. Western Shasta Resource Conservation District was engaged to remove red sesbania biomass from Churn Creek and volunteer watershed groups were trained to monitor the creek in the future to look for re-sprouting sesbania plants. This type of community partnership is vital in maintaining long-term control of this highly-invasive plant.

## **Session 5: The Border and Beyond: Baja California, the same but different**

### STATUS OF CNPS PLANTS ON THE PACIFIC ISLANDS OF BAJA CALIFORNIA, MEXICO

**Steven Junak**, Santa Barbara Botanic Garden [sjunak@sbbg.org](mailto:sjunak@sbbg.org)

Eight islands lie off the west coast of Baja California between the United States/Mexico border and Punta Eugenia, which is located about 575 km south of the international border. Ranging in size from 0.4 to 348 square km, these islands share a significant percentage of their native flora with the state of California, and especially with the islands of southern California. Included in these shared plants are 30 special-status taxa that are currently listed by CNPS; half of these are insular endemics. The endemics range from tiny annuals (e.g., *Leptosiphon pygmaeus pygmaeus*) to large trees (i.e., *Quercus tomentella*). Since feral animals have recently been removed from several islands (e.g., goats and burros from Los Coronados Island, goats from Guadalupe Island, rabbits and burros from San Benito Island), primary threats to populations of special-status plant taxa include invasive non-native plants, the potential for frequent accidental fires, and potential land-use changes. This overview presentation will focus on the current status and distribution of the CNPS plants that occur on Baja California's Pacific islands, and the conservation challenges associated with them.

### DISTRIBUTION OF CHAPARRAL "SKY ISLANDS" AND CLIMATE CHANGE IN THE CENTRAL DESERT SINCE THE LAST GLACIAL MAXIMUM IN THE CENTRAL DESERT OF BAJA CALIFORNIA

**Richard Minnich**, Ernesto Vizcaino, University of California, Riverside,  
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Chaparral, the evergreen sclerophyllous scrub characteristic of the Mediterranean-climate region of North America, grows extensively in dense stands from northern California to lat. 30°

N, but thins to a few isolated populations or "sky islands" on the highest mountains in the central desert of Baja California, as well as on the highlands of Isla Cedros. Chaparral also occurs at lower elevations in the central desert in small outlying populations, and as understory in tropical thorn scrub and montane pine-oak woodland, extending nearly to Cabo San Lucas. We present the first detailed maps of chaparral populations in the central and southern peninsula, interpreted from Google Earth™ imagery and botanical collections of the San Diego Museum of Natural History (SDMNH), University of California Riverside ([herbarium.ucr.edu](http://herbarium.ucr.edu)), the Universidad Autonoma de Ensenada, the Flora of North America (<http://www.efloras.org>), and Wiggins (1980), and compare the present distribution of chaparral with available records from Pleistocene-early Holocene packrat middens. We show that chaparral is unexpectedly widespread in the central desert and propose, on the basis of atmospheric physics, that climate change since the last glacial maximum was not as pronounced as has been suggested in studies of packrat middens.

## THE POPCORN FLOWERS OF BAJA CALIFORNIA: COMPARISONS WITH NORTH OF THE BORDER

**Michael Simpson**, San Diego State University, [msimpson@sunstroke.sdsu.edu](mailto:msimpson@sunstroke.sdsu.edu)

The "popcorn flowers," in the broad sense, include the members of the recently diagnosed subtribe Cryptanthinae (Boraginaceae). The nine genera of this complex, including four recently resurrected, have a discontinuity in species richness and endemism between the Baja peninsula and north of the border. *Amsinckia*, *Eremocarya*, *Greeneocharis*, *Harpagonella*, and *Pectocarya* are essentially conspecific in the two regions, but with a few species unique to the Baja California peninsula. *Plagiobothrys* has relatively few species in the peninsula, perhaps a function of vernal pool habitat specialization for a large complex of this genus. Within *Cryptantha* s.l., the resurrected genus *Oreocarya*, with ca. 67 solely perennial species in North America, is completely absent in the Baja California peninsula, perhaps due to historical contingency related to colonization of high elevation montane habitats. The resurrected genus *Johnstonella* is most diverse in the Baja California peninsula with nine of the 11 North American species present, four of which (including two varieties) are endemic. *Cryptantha* s.s. is relatively rare in the Baja California peninsula with only 15 species, compared with 45 species in Alta California. Three species and one variety of *Cryptantha* s.s. are endemic to the peninsula, plus a newly described variety endemic to the San Pedro Martir mountains. *Cryptantha wigginsii* had been collected (in 1931) only once, in coastal northwestern Baja California, and was considered possibly extinct in the wild. The recent discovery of a population of *C. wigginsii* in Carlsbad, San Diego County justifies the need for conservation of this rare taxon.

## PLANTS FOUND ON UNIQUE SOILS IN SAN DIEGO COUNTY AND ADJACENT BAJA CALIFORNIA

**Thomas Oberbauer**, AECOM, [toberbauer@cox.net](mailto:toberbauer@cox.net)

Serpentine is well known to support unique species of plants in California. Gabbro or black granite has also been found in the case of Pine Hill in El Dorado County, to support unique and unusual plants. Within San Diego County and Northern Baja California, gabbro outcrops exist with a suite of unusual plants. Additionally, soils derived from metamorphosed volcanic (metavolcanic) rock share unusual plant species with gabbro but also support other species that appear to be confined to the metavolcanic rock. A number of peaks both north and south of the border are composed of metavolcanic or gabbro rock. Each of these mountains supports a distinct combination of soil endemic species due to variations in elevation, precipitation and

distance from other peaks with unusual soils. This paper analyses the plants and their distribution on these peaks. Some of the more notable plants endemic to unique soil types that are apparently grow on either of these rock types include *Hesperocypris forbesii*, *Chamaebatia australis*, *Clinopodium chandleri* and *Calochortus dunnii*. Examples of species that appear to be confined to gabbro alone include *Hesperocypris stephensonii*, and *Packera ganderi*, and plants that are apparently confined to the metavolcanic rock include *Lepechinia ganderi* and *Fremontodendron mexicanum*. Because of the limited distribution of these species, a number of them qualify as rare, endangered, or otherwise sensitive under state and federal regulations.

## BORDER FIELD STATE PARK RESTORATION SITE

**Phillip Roullard**, California State Parks, [proullard@sbcglobal.net](mailto:proullard@sbcglobal.net)

In 2009, Border Field State Park received a three-year grant from the USEPA to restore a five-acre site of degraded habitat. Ecological integrity of the site had suffered various impacts through the years, including agriculture, military training, sedimentation, and cross-border immigration activity. The restoration site sits within an alluvial system historically occupied by southwestern willow scrub and mulefat scrub associations. These brackish wetland habitat types are characterized by the presence of tall-statured willow trees (*Salix* sp.) occupying the wettest areas and mulefat (*Baccharis salicifolia*) dominating the drier regions. Flows are ephemeral. The focus of restoration has been on the above habitat types, including transformation of a portion of the disturbed habitat to coastal sage scrub. During the restoration process, we have used San Diego community volunteers, thus increasing community involvement in these projects. Restoration timeline: Fall 2009: Created basins and plant with mulefat (*Baccharis salicifolia*); 2010: Restored coastal sage scrub component by planting a suitable plant palette within and around the established mulefat basin; broadcast coastal sage scrub seed mix before rain events; planted ephemeral flow area with mulefat cuttings; removed invasive plants using chemical and cultural methods. 2011: Continued planting coastal sage scrub palette and planted additional basins with mule fat (*Baccharis salicifolia*), *Salix exigua*, *Artemisia palmeri* and *Artemisia dracunculoides*; continued removal of invasive plants using chemical and cultural methods. In nearly three years, mulefat scrub, willow scrub and coastal sage scrub habitats have been successfully established per the restoration plan.

## NEW DISCOVERIES FOR THE FLORA OF BAJA CALIFORNIA

**Jon Rebman**, San Diego Natural History Museum, [jrebman@sdnhm.org](mailto:jrebman@sdnhm.org)

In the last few years, several new plant taxa from the Baja California region including *Ambrosia humi*, *Bursera littoralis*, *B. rupicola*, *Calyptridium parryi* var. *martirensis*, *Distichlis bajaensis*, *Grusonia robertsii*, *Ivesia argyrocoma* var. *moranii*, *Marina brevis*, *M. victoriae*, and *Salvia pachyphylla* ssp. *meridionalis* have been formally described by various authors. However, many more taxa are still undescribed and more are being discovered all of the time. Recent plant collecting expeditions to an island and to remote and botanically unexplored mountain ranges on the peninsula have also yielded new species discoveries. Furthermore, ongoing botanical research projects like the voucher-based Baja California Vascular Plant Checklist and the increased accessibility to herbarium specimen data through digitization efforts in databasing and georeferencing are constantly revealing new plant records for the region. Many of these botanical discoveries have conservation implications because the plants are either rare or the region where they were found is threatened in some way. It is evident that the Baja California peninsula and its adjacent islands continue to be a botanical frontier and an important source of new floristic discoveries.

## THE RARE, ENDANGERED, AND ENDEMIC PLANTS OF THE CALIFORNIA FLORISTIC PROVINCE PORTION OF BAJA CALIFORNIA, MEXICO

**Bart O'Brien**, Jose Rodriguez, Steve Junak, Thomas Oberbauer, Jon Rebman, Hugo Riemann, Sula Vanderplank, Rancho Santa Ana Botanic Garden, [bobrien@rsabg.org](mailto:bobrien@rsabg.org)

This presentation will provide an overview of the new publication (2011) documenting the rare, endangered, and endemic plants of the California Floristic Province (CFP) portion of Baja California, Mexico (CFP Baja): The northwestern portion of the Baja California peninsula from the border with California to the vicinity of El Rosario and up to, and including, the forests and peaks of the Sierra Juárez and the Sierra San Pedro Mártir. Threats to the flora are enumerated, and a summary comparison of the eight lists and three appendices will be shown. Comparisons between various aspects of the rare, endangered, and endemic plants (REE plants) of CFP Baja to those of the state of California will be presented. Current areas of critical conservation concern to native plants in CFP Baja are identified. Major funding for the project was provided by the Jiji Foundation. As of the writing of this abstract (7/27/11), a total of 1426 plant taxa are addressed in the project: 16 are on List 1A (presumed extinct and/or extirpated in CFP Baja); 228 are on List 1B (rare and endangered in CFP Baja and elsewhere); 206 are on List 2A (rare in CFP Baja but are either more common in the California CFP or are only otherwise found within the state borders of California); 381 are on List 2B (rare in CFP Baja but are more common beyond the Baja Peninsula and/or beyond the state of California); 173 are on List 5 (endemic to CFP Baja).

## LAND USE, CLIMATE CHANGE AND CONSERVATION OF ENDEMIC AND ENDANGERED FLORA IN THE BAJA CALIFORNIA FLORISTIC PROVINCE

**Hugo Riemann**, El Colegio de la Frontera Norte, [hriemann@gmail.com](mailto:hriemann@gmail.com)

The Baja California Floristic Province (BCFP), a 26,000 km<sup>2</sup> region located at the southern portion of the California Floristic Province, is well known for its high number of endemic plants. As a consequence of the increasing agriculture, urban and touristic areas as well as the governmental developing projects, the reduction of the natural vegetation represents in the short term a threat to the regional flora. Climatic change increases the conservation concern in a region with less than 5% of protected land. In order to identify those regions more prone to species loss, a database of 12 000 georeferenced records related to 1 079 species previously labeled by a team of experts in relation to their degree of endemism, rareness or endangeredness were assigned to 439 5' × 5' cartographic areas. A residual regression analysis evidenced those areas with significantly high species number for each of the previously defined categories. The natural vegetation remaining and the land use in each cartographic area were obtained by means of satellite images. The distribution of the Taxa located in the critical cartographic areas were modeled by means of the Maxent program using bioclimatic variables for the present and the year 2050. These analyses permit to identify regions prone to conservation programs.

## CHARCAS TEMPORALES EN VALLE DE LAS PALMAS: A FIRST REPORT FROM AN ON-GOING PROJECT TO MAP AND ASSESS THE VERNAL POOLS OF BAJA CALIFORNIA, MEXICO

**Matt Guilliams**, Sergio Mata, Department of Integrative Biology & UC/JEPS Herbaria, University of California Berkeley, [matt\\_g@berkeley.edu](mailto:matt_g@berkeley.edu)

Vernal pool ecosystems and their associated flora and fauna are relatively well-studied in the United States but poorly so in northwestern Baja California, where they might have been historically common. A large percentage of vernal pools in the United States have been destroyed during the conversion of native habitat to other land uses, e.g., to agriculture in the Central Valley of California. A similar loss of vernal pools may have occurred in Baja California as well, although little is currently known about the present and historical distribution of vernal pools in México. Here we make a preliminary report from the first field season of a long-term project to map and assess the vernal pools of Baja California. Aerial photographs have revealed coastal mesas and interior valleys with features consistent with the presence vernal pools prior to agricultural development, as well as numerous sites that appear to presently support vernal pools. On-the-ground efforts focused on the Valle de Las Palmas region between Tijuana and Tecate, an area slated for massive development over the next decade. Many vernal pools in this region were mapped, including some pools that are not described in the literature or elsewhere. High-quality pools were visited in the southeastern portion of the valley, where an undescribed, endemic *Pogogyne* species was observed in great numbers. Near-term project goals include the conservation of the private parcel that supports these high-quality pools in Valle de Las Palmas, and the expansion of fieldwork to the coastal region between Tijuana and Ensenada.

#### DESCRIPTION OF THE COASTAL SUCCULENT SCRUB PLANT COMMUNITIES INFLUENCED BY THE FOG AND SEA SALT SPRAY, FROM EL ROSARIO TO THE VIZCAINO DESERT, BAJA CALIFORNIA.

**Jose Delgadillo**, Francisco Alcaraz, Universidad Autonoma de Baja California, [jdelga.jose@gmail.com](mailto:jdelga.jose@gmail.com)

In this contribution we studied the coastal succulent and desert scrubs plant communities on the pacific coast, along a climatic gradient of aridity, determined by the fog and sea salt spray intensity, and a main gradient, or slope gradient. We argue classification criteria using the phytosociologic method. Three associations were reconnized: *Bergerocacto emoryi-Agavetum shawii* Peinado et al. 1995; *Ferocacto fordii-Euphorbietum miserae* Alcaraz & Delgadillo 2010; and *Atriplici-Yuccetum* valide Alcaraz & Delgadillo 2010; the last one with two subassociations of geographical character, one in the north area of the association (subass. *Agavesotum goldmaniana*) and the typical subassociation with southern distribution.

### **Session 6: Vegetation Mapping, Classification, and Analysis for Conservation**

#### KEEPING VEGETATION MAPPING A POWERFUL, REPEATABLE, AND NIMBLE TOOL

**Todd Keeler-Wolf**, California Department of Fish and Game, [tkwolf@dfg.ca.gov](mailto:tkwolf@dfg.ca.gov)

The usefulness of today's vegetation maps can be judged by the level of detail and accuracy they display using an array of attributes that go beyond simple names of mapping units. Vegetation mapping supported by the Department of Fish and Game's Vegetation Classification and Mapping Program use the national standard vegetation classification system as the basis for depicting GIS polygons. These maps are compatible with other products based on standardized rules for vegetation classification, and they display multiple attributes. The attributes include a uniform set of descriptors such as vegetation type, hierarchical classification level, cover of dominant layers (or cover by life form), and height of dominant strata. This set of

core attributes are maintained to ensure the integrity and global utility of the vegetation map products. Other attributes are defined based on individual project requirements. They typically include human-mediated impacts such as invasive plant component, development, roads/trails, and other site quality descriptors. During project start-up, users and producers of these maps establish a dialog to determine which additional descriptors are useful for answering planning and assessment questions. Examples of this interplay and the results are given from recent mapping projects including the Suisun Marsh, Delta, and Mojave Desert. Improvements in photo interpretation, modeling based on field data, and efficiencies in image processing, analysis, and automation must continue to be explored to increase the value of these maps.

## A NEW VEGETATION CLASSIFICATION FOR WESTERN SAN DIEGO COUNTY

**Jonathan Dunn**, AECOM, [sibara@mac.com](mailto:sibara@mac.com)

Under contract with the San Diego Association of Governments (SANDAG), Biologists from AECOM, Conservation Biology Institute, and the California Department of Fish and Game's Vegetation Classification and Mapping Program (VegCAMP) have collaborated to create a manual of vegetation for 450,000 acres of Habitat Preserve and Conserved Lands in western San Diego County. This classification study was conducted consistent with the methods used in *A Manual of California Vegetation* (MCV), 2nd ed. (Sawyer; Keeler-Wolf; Evens 2009), published by California Native Plant Society, and the classifications in accordance with the MCV. The regional classifications were derived from a study that collected species composition/cover and environmental data for 1,300 stands of vegetation throughout the study area. These data were analyzed using several statistical methods, chiefly an agglomerative hierarchical cluster analysis. Results of these analyses defined the number of distinct vegetation types sampled, and when compared to existing datasets maintained by VegCAMP, allowed the assignment of each stand to a known alliance and association from the MCV. In cases where no known vegetation types agreed with the current analyses, new alliances and associations are defined. The classification for the study area includes 72 alliances and 102 associations. Additional to these alliances and associations, eight special stands and 15 semi-natural stands are included in the classification. We will provide a summary of the methods used to create this vegetation classification manual, review the results, and demonstrate how to use the key to the alliances and associations presented in the manual.

## DISTRIBUTION, COMPOSITION, AND CONDITION OF JOSHUA TREE WOODLANDS AT TEJON RANCH, CA

**Michael White**, Tejon Ranch Conservancy, [mwhite@tejonconservancy.org](mailto:mwhite@tejonconservancy.org)

Tejon Ranch, the largest contiguous private property in California and long a place of conservation interest, is located at the convergence of two major floristic regions, the California Floristic Province and the Desert Province. Thus numerous plant species and community types are at the edges of their ranges on Tejon Ranch. A conspicuous species in the Mojave Desert Region of Tejon Ranch is Joshua tree (*Yucca brevifolia*), where it occurs at the western edge of its range. We have initiated studies of Joshua tree stands in the Antelope Valley portion of Tejon Ranch to better understand their distribution, composition, and condition to inform resource management planning efforts. We have mapped approximately 1,800 acres supporting Joshua tree stands on Tejon Ranch within an elevation range of 3,260–5,080 feet, and measured stand characteristics in random plots within these mapped areas. Shrubs commonly associated with Joshua tree woodlands include *Eriogonum fasciculatum*, *Ericameria nauseosa*, *Ericameria linearifolia*, *Encelia actoni*, and *Ephedra viridis*, but Joshua trees also

occur within other vegetation types such as California juniper woodland and piñon pine forest. The density of Joshua trees in the mapped stands varies significantly and averages 183 individuals/acre. The size structure of Joshua tree stands on Tejon Ranch is diverse, with an abundance of young individuals, some of which are expanding into open areas adjacent to the woodlands. Analysis of distributional changes using aerial photography indicates that Joshua trees have expanded their distribution on Tejon Ranch since the early 1950s.

## NORTHERN SIERRA NEVADA FOOTHILLS STATEWIDE VEGETATION MAPPING PROJECT

Deborah Johnson, **John Menke**, Julie Evens, Aerial Information Systems, Inc., [ais@aisgis.com](mailto:ais@aisgis.com)

California Department of Fish and Game (DFG) selected the California Native Plant Society (CNPS) and Aerial Information Systems, Inc. (AIS) to prepare an accurate vegetation map for the Northern Sierra Nevada Foothills based on the National Vegetation Classification (NVC) and CDFG's state vegetation mapping standards. This project's work is critical to the success of local and regional conservation planning processes currently underway. The study area encompasses 2,618,180 acres in the foothills from Shasta County east of Redding south to Madera County east of Chowchilla. AIS staff, working with CNPS and CDFG ecologists, performed reconnaissance surveys to correlate photo signatures to appropriate vegetation types and ecological conditions. The vegetation interpretations were entered into a database using techniques developed by AIS for the vegetation mapping. The map resulted in approximately 150,000 polygons with an average polygon size of 17.45 acres, and vegetation units were mapped within established NVC classes (65 alliances and higher-level units). Approximately 1,300 field surveys were collected to verify the map. For the assessed vegetation units, the broad distribution of the surveys and resulting accuracy are reliable indicators of the map's validity: overall users' accuracy averaged 85.1% and producers' accuracy averaged 80.2%. The resulting vegetation map provides baseline data with floristic and ecological detail useful for conservation and management in the region. It also assists in wildlife, wildfire and climate change models, including the assessment of areas that have significant wildfire risk and areas that would benefit from prescribed fire.

## USING OBJECT-BASED IMAGE ANALYSIS WITH HIGH SPATIAL RESOLUTION IMAGERY: A REVIEW OF VEGETATION MAPPING APPLICATIONS

**Maggi Kelly**, University of California Berkeley, [maggi@berkeley.edu](mailto:maggi@berkeley.edu)

The recent proliferation in high spatial resolution imagery (~1m) has been a boon for ecologists, who have used a variety of imagery to map vegetation. Object-based image analysis (OBIA) is a relatively new protocol for classification of such imagery with several advantages over traditional pixel-based clustering algorithms. The OBIA approach includes two major steps: first the image is segmented into similar image objects (or segments) and then the objects are classified based on attributes of and interrelations between segmented objects. The basic processing units in OBIA are thus segments and not single pixels, and the process typically transforms a raster image into a vector format: most segments are operationally analyzed as polygons. Once an object is created, meaningful spectral, spatial, and contextual measures can be gathered about each object, and between adjacent objects in one dimension and across scale. The resulting topological network of objects can be used for object classification, or for higher order analysis of pattern and context in an ecological context. The OBIA approach has been used for detailed

mapping of vegetation in a number of cases. This presentation reviews some of the benefits and challenges of the OBIA approach for vegetation mapping.

#### LEVERAGING GEOSPATIAL TECHNOLOGIES AND DECISION TREES TO SUPPORT MEADOW RESTORATION ACTIVITIES IN THE SIERRA NEVADA, CA

**Nathan Amboy**, USDA Forest Service, [namboy@fs.fed.us](mailto:namboy@fs.fed.us)

Meadows in the Sierra Nevada bioregion support diverse assemblages of flora and fauna. Meadows also serve as natural reservoirs for storing water during snowmelt and gradually releasing it during the warm and dry summer. Over the last century, many meadows have been heavily degraded due to local disturbance effects resulting in severe channelization, soil erosion and changes in the hydrologic regime. Fire suppression has also played a role in altering meadows by facilitating encroachment by shrub and conifer species. In order to conduct a 3-year hydrologic assessment of meadows on National Forests and develop an accompanying restoration plan, a complete inventory of meadows was needed. Developing a comprehensive and cost-effective inventory required the use of remote sensing technologies and the randomForest (RF) algorithm, as implemented in R. By leveraging data mining techniques, multiple imagery dates and digital elevation model derived variables; we successfully identified several different types of meadows across a 13,713,845 hectare (33,887,648 acre) project area. We also examined the feasibility of applying RF model predictions developed from a relatively small geographic extent to a much larger extent comprised of several adjacent imagery scenes.

#### RESURRECTING A GHOST: ESTIMATING VEGETATIVE COVER FOR SANTA ROSA ISLAND FROM BEFORE EUROPEAN IMPACT

**Thomas Oberbauer**, AECOM, [toberbauer@cox.net](mailto:toberbauer@cox.net)

Santa Rosa Island is the second largest of the northern Channel Islands. It contains a number of interesting and unique vegetation communities in small, isolated pockets and fragments of woodlands and shrublands including *Pinus torreyana* ssp. *insularis*, *Pinus muricata* and *Quercus tomentella*. The majority of the island is covered with non-native annual grasses, nearly bare rock or sand dunes. It may seem that grasslands were the natural state. However, examination of the slopes, soils, terrain, history and existing remnants of vegetation provide information that the island was much more heavily wooded and that chaparral and sage scrub communities were predominant. Large herds of grazing animals, particularly sheep, and purposeful burning within the last two centuries have taken a tremendous toll on the island vegetation. Mass wasting of soils has occurred in many locations with losses of soil depth of more than a meter. This is evidenced by oaks standing on spindles of roots and eroded slopes with flaking, barren rock surfaces. A theoretical vegetation map estimating vegetative cover has been created through a forensic process of comparing soils and vegetation that still remain in remnants on the island. The process also included interpreting aerial photographs, vegetation and soil from the nearby mainland in western Santa Barbara County. The purpose of this map is to provide a concept for restoration of the vegetation and stabilization of the soils on the island.

#### SCIENCE-BASED DEVELOPMENT OF RESTORATION PALETTES FOR SENSITIVE PLANT COMMUNITIES: A COLLABORATIVE STUDY OF ALLUVIAL SCRUB VEGETATION

**Arlee Montalvo**, Jennifer Buck-Diaz, Jan Beyers, Riverside-Corona Resource Conservation District, [montalvo@rcrcd.com](mailto:montalvo@rcrcd.com)

We selected alluvial scrub vegetation in this pilot study to develop science-based plant lists (“palettes”) for restoration of sensitive native plant communities after applying standardized survey and analysis protocols. Alluvial scrub communities play an important role in stabilizing alluvial fans and axial wash deposits, and they provide habitat for a number of rare plant and animal species. We used CNPS relevé and rapid assessment sampling techniques to collect data on plant community composition and environmental attributes of various forms of alluvial scrub vegetation within the Santa Ana River watershed of southern California. Percent cover was recorded for every plant species present at 47 sample locations. Correlative variables such as soil texture, surface features, elevation above active channel, and slope and aspect were recorded in the field. Geological substrate, fire history, and climate data were extracted for each survey from existing GIS layers. Plant palettes were developed based on community patterns revealed by the vegetation classification analyses. We identified four major plant palettes whose species composition changed depending on geography and exposure to disturbance. In addition, further research is being conducted on seed propagation of species that are important components of the plant palettes but are hard to obtain or not likely to maintain sustainable populations after wildland collection. This type of work should result in improved selection of appropriate species and habitat goals for restoration of important but declining vegetation types.

#### VEGETATION CLASSIFICATIONS AND CONSERVATION PLANNING: THE BAY AREA CONSERVATION LANDS NETWORK

**Ryan Branciforte**, Stuart Weiss, Bay Area Open Space Council, [ryan@openspacecouncil.org](mailto:ryan@openspacecouncil.org)

The Bay Area Upland Habitat Goals project has designed a Conservation Lands Network for the 4.5 million acre region ([www.bayarealands.org](http://www.bayarealands.org)). The central data set is the vegetation map, used as an underlying “coarse filter” for biodiversity. We synthesized available vegetation data into a custom classification and map specifically to support the project, and developed new classes to represent the ecological complexity of the region, including a climatic stratification of annual grasslands and serpentine variants of different physiognomic classes. The 51 target vegetation types were stratified by major mountain ranges and valleys (landscape units) to capture biogeographic diversity. Explicit percentage conservation goals were set for the 500+ vegetation x landscape unit combinations, taking into account global, regional, and local rarity. The conservation planning software Marxan generated local networks within landscape units to meet the goals. At the scale of Napa County, we have applied similar logic to a higher resolution vegetation classification and map based on the 1995 *Manual of California Vegetation*. A similar biogeographic stratification divided the county onto 4 landscape units, and we established local rarity ranks. Vegetation rarity, other biodiversity information (rare plants, fish habitat, etc.), and other conservation values (viewshed, agriculture, etc.) were mapped onto parcels for evaluation by a local land trust. For pragmatic conservation planning at each scale, the combination of a medium-level vegetation classification (~50 classes) with biogeographic stratification made maximal use of existing information and effectively dealt with the inevitable uncertainties of vegetation maps.

#### A VEGETATION CLASSIFICATION AND MAP FOR SANTA MONICA MOUNTAINS NATIONAL RECREATION AREA: AN ESSENTIAL TOOL FOR COOPERATIVE CONSERVATION PLANNING

**John Tiszler**, Robert Taylor, Melanie Beck, National Park Service, [john\\_tiszler@nps.gov](mailto:john_tiszler@nps.gov)

The Santa Monica Mountains NRA is a cooperative conservation effort among public agencies and private landowners. The National Park Service is mandated to preserve and enhance natural values of the NRA, but owns only 17% of the land and has no regulatory authority. We attempt to fulfill our mandate by providing landowners, planners and regulators with scientifically sound, comprehensive data for addressing conservation concerns. In 2007 we completed a vegetation classification and association-level map (122,000 ha) that constitute the first full assessment of our vegetation defined within a regional context, and as such, have been critical to establishing land acquisition and conservation priorities. The map is also an important fire management tool, used to improve fire behavior models, develop hazard assessments, and plan post-fire response actions. Analyzed in conjunction with historic fire and vegetation maps, it is helping us understand drivers of past change and predict future changes. The map is also an important tool for planning and regulatory agencies within the NRA. Los Angeles and Ventura County planning divisions and the Coastal Commission use the map to help identify sensitive habitats and plant communities in the coastal zone and develop proposals for protection of these areas during the land use entitlement process; to assess cumulative and individual impacts of development proposals; to determine losses from unauthorized vegetation removal; and set replacement requirements and identify appropriate locations for compensatory mitigation. Recognizing these multiple uses, perhaps the greatest long-term value may be the survey data collected in creating the map.

## **Session 7: The State of CEQA: Challenges and Opportunities in Uncertain Times**

STREAMLINING CEQA: CHANGES THE ENVIRONMENTAL COMMUNITY CAN SUPPORT

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Since its adoption in 1971, CEQA has periodically been subject to challenge by the business and development communities. It has been amended numerous times, but many of those amendments – including the addition of a substantive mandate in favor of the least damaging alternative - actually strengthened it. In 2008, SB 375, with some environmental support, amended CEQA to encourage “smart growth.” Some worried SB 375 lacked clarity and that the CEQA exemption trade-offs were too risky. Recently, as a result of the recession, there has been a growing out-cry that CEQA is a “job killer.” Despite the lack of evidence to support that claim, Majestic Realty gained labor support in 2010 for a bill that eliminated the judicial review for a pending lawsuit against a proposed NFL Stadium in the City of Industry. As expected, this created a demand for additional exemptions. In 2011, a bill passed eliminating Superior Court review for a competing NFL Stadium in downtown Los Angeles, while a second bill extended the direct Court of Appeal review to an unlimited number of projects as long as they were big, paid living wages, and purported to be green. A bill supported by Governor Brown also granted a greatly streamlined review for in-fill projects. Jan Chatten-Brown has practiced law under CEQA for 40 years. She will give her views on some of the ways that the environmental community could get on the offensive in the CEQA wars and, while working to streamline it, actually strengthen CEQA.

CEQA AT A CROSSROADS – HOW DO WE MAKE IT BETTER AND EASIER TO USE

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Annually, numerous bills are introduced in the State Legislature to reform, streamline, waive or in some other way modify CEQA. The intent is to minimize the perceived hurdle CEQA may place in the way of undertaking projects. Most recently the focus is on "frivolous" enforcement or litigation. Proponents of big projects understandably don't want to deal with months of delay in court. The challenge CEQA faces is to find ways to increase the certainty for preservation of the environment and our neighborhoods while also giving project proponents more certainty. Three pieces of legislation came out of the recent legislative session dealing with CEQA – AB900, SB226 and SB292. AEP offered an opinion letter to the Governor regarding AB900 recognizing the public interest in streamlining the judicial review process for CEQA projects. However the purpose of the letter was to emphasize the importance of improving the efficiency and effectiveness of the CEQA review process for all projects, not just a select few. A joint venture between AEP and the California Chapter of APA formed the Enhanced CEQA Action Team (ECAT). The ECAT goal is to enhance CEQA's efficiency and effectiveness. The ECAT concluded that enhancing five key areas (infill development, NDs and mitigated NDs, tiering provisions, evaluation of cumulative impacts, and evaluation of late comments) is critical to making CEQA work better. Gene Talmadge, President of the CA Association of Environmental Professionals (AEP) will report on the details of the ECAT proposal.

#### CUMULATIVE IMPACTS, SIGNIFICANT EFFECTS, AND WAYS TO OPTIMIZE CEQA PROTECTIONS OF RARE PLANTS AND NATURAL COMMUNITIES IN THE FACE OF CONTINUED LOSSES

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Many of California's rare plant populations and natural communities are threatened by development. Ironically, development projects and their associated environmental review process often provide a final opportunity for plant conservation. However, achieving effective conservation during the project review and permitting process is often challenging, especially for natural communities and non-listed plant species. We suggest ways to utilize the California Environmental Quality Act (CEQA) and other state and local regulations and policies to most effectively protect California's botanical resources during the environmental review process. We highlight two successful examples of forested natural community conservation during CEQA project review: a coastal lodgepole pine stand (*Pinus contorta* ssp. *contorta*) within the Coastal Zone, and a Sitka spruce stand (*Picea sitchensis*) beyond the Coastal Zone.

#### CAN CEQA BE SAVED BY CHANGING IT?

**Cory Briggs**, Briggs Law Corporation, [cory@briggslawcorp.com](mailto:cory@briggslawcorp.com)

California's leading environmental law, the California Environmental Quality Act, has come under sustained attack in recent years by business and development interests, with CEQA supporters scrambling to prevent major legislative rollbacks in environmental protection and too often losing the battle. Anti-CEQA forces have pushed an aggressive agenda. With limited exception, environmentalists have not offered their own vision for reforming CEQA--despite substantial consensus that CEQA needs to be updated. Project proponents can have legitimate concerns about the CEQA-compliance process, especially post-approval litigation. But environmentalists can also have legitimate concerns about the adequacy and fairness of the process as well as the burdens of litigation. The reality is that CEQA as currently written is susceptible to abuse by project opponents and proponents alike. So why is there no widespread effort by the environmental community to give CEQA a major overhaul? Why not put forth an aggressive reform agenda that includes changes that will decrease CEQA's burden on business

and development interests while simultaneously improving the review process and litigation procedures? Is there no possibility for a "new and improved" CEQA that eases regulatory burdens while improving environmental protection? Wouldn't the environmental community be better served by having a substantial reform package to put up against efforts to gut CEQA? Can CEQA be protected if environmentalists are perceived as always being against "reform" and having no serious proposals of their own? Environmental plaintiff's attorney Cory Briggs will discuss some of his ideas for reforms on both sides of the CEQA divide.

## **Session 8: Advances in Plant Science**

### COMPREHENSIVE INTERACTIVE PLANT KEYS FOR CALIFORNIA

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Plant conservation and restoration for any given locality is a complex process which depends on reliable and continually updated information regarding what species are found and where. These critical data often require time-consuming initial and ongoing plant surveys. Computerized interactive keys produced over the past 17 years by the author greatly facilitate plant surveys by reducing the time to key unknown species by 90% or more. The author will demonstrate the use of the plant identification software, to provide the audience with an understanding of the potential applications of this resource. The keys for California include all known vascular plants, both native and introduced, which grow outside of cultivation. Plant characteristics may be selected in any order, with no forced choices. Terms are defined and illustrated, extensive references are included, and color photos are provided for over 99% of species. Synonyms and menus of genera and families are provided to reduce problems of changing nomenclature. The software is continuously updated with name changes, new plant finds, and new photos, with free annual updates. Keys are available by state or larger regions for 18 states and four Canadian provinces. In most cases, descriptive information is provided for separating subtaxa when present. The keys are a powerful, innovative tool to assist in providing timely plant survey data for plant conservation, restoration, and management.

### PRODUCTION OF A LOCAL FLORA: THE YOSEMITE SIERRA

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The process for production of a modern local flora centered on the central Sierra Yosemite region is described. The regional flora consists of about 2700 taxa, with about 1700 of these documented within Yosemite National Park. About 60,000 specimen records for Tuolumne, Mariposa and Madera and a portion of Mono counties were databased. Only 74% of these were available from the Consortium of California Herbaria as of 2010. The remainder were found on-line elsewhere or documented from monographs or literature; 24,200 specimen records are databased from Yosemite National Park (as of July 2011), but only 55% of these were Consortium accessible. Type specimens for 435 taxa originating from the region (60% of these from the Park) were assessed. Collecting for production of the flora documented ca. 1400 of the 2700 regional taxa (51%), but only 477 from the Park (27% of that flora); specimens from the Park were specifically biased towards documenting new records. Documentation of new regional records was facilitated by availability of on-line specimen records: post-2000 collection efficiency (taxa per specimen) has increased. For the Park, new records for 149 taxa were documented in the decade 2000-2010 (a sizable fraction was non-natives). Three new taxa

were discovered in the region: *Carex tiogana*, *Erythronium taylora* and *Platanthera yosemitensis*. True to form, one new taxon was discovered days after the flora was published, a new *Erigeron* from Yosemite Valley. Availability of web based tools greatly facilitates documentation of regional floras and supports biodiversity conservation.

#### DIGITAL TAXONOMIC TOOLS OR HOW DO I DEAL WITH ALL THESE NAME CHANGES!

**Ellen Dean**, University of California Davis Center for Plant Diversity, [eadean@omsoft.com](mailto:eadean@omsoft.com)

Online sites and digital software for plant identification have become an essential part of the California botanist and herbarium curator toolkit. Most California botanists use CalFlora and/or the Consortium of California Herbaria websites in conjunction with CalPhotos to identify plants. Some have been using the Jepson Manual II online keys and plant descriptions. Fewer may be aware of other digital online resources such as Flora North America, online multi-entry keys to sedges and grasses, and sites with excellent photos of hard-to-identify genera. This talk will introduce people to these resources and discuss new nationally-funded projects that will soon be bringing us more and better on-line specimen-based resources. Also included will be a presentation of how to use online tools to transition plant lists from Jepson Manual I plant names to Jepson Manual II names.

#### MOBILE DEVICE FIELD GUIDES - BETTER THAN A BOOK?

**Steven Hartman**, Los Angeles - Santa Monica Mountains Chapter CNPS, [naturebase@aol.com](mailto:naturebase@aol.com)

As computer technology has improved, the dream of a pocket field guide with no limit on number of images is a reality. The author will discuss his experience in creating digital field guides, starting with programming a plant communities BASIC program, to Windows™ CD-based guides, to his current line of iPhone and Android apps. A brief outline of steps in producing an app will be followed by a recap on basic app economics, including number and kinds of images per app, geographic coverage, and use of GPS to capture and transmit location data. The advantages and disadvantages of using digital devices in the field will also be discussed.

#### SAN DIEGO COUNTY PLANT ATLAS: BUILDING RESOURCES TO BETTER UNDERSTAND AND CONSERVE A THREATENED FLORA

**Jon Rebman**, San Diego Natural History Museum, [jrebman@sdnhm.org](mailto:jrebman@sdnhm.org)

The San Diego County Plant Atlas is a multi-year project designed to improve scientific knowledge of regional plants through better documentation of the flora by training volunteers from the community how to properly survey, collect herbarium voucher specimens, and record field data about plants in natural areas throughout the County. With more than 2,500 native and naturalized plants and many new records being discovered each year, San Diego County is a hotspot of botanical diversity that is being threatened by urbanization. Since it began in 2003, the project has trained 600 volunteers and added over 54,000 new specimens to the SD Herbarium (including more than 250 discoveries of new county records and two new taxa) that are fully databased with precise geographic coordinates. This new data set of voucher specimens, along with already databased and georeferenced historic specimens, has made San Diego County the best documented county in California and will provide scientists with a significant baseline record with which to better understand changes in the flora over time. The plant atlas website ([www.sdplantatlas.org](http://www.sdplantatlas.org)) was originally developed to assist parobotanists, but

now provides an important outlet to the public and conservation communities with online resources for mapping plants, visualizing plant diversity, and searching specimen databases in order to know the flora of any part of the County. These online tools and an increased understanding of local floristic diversity through improved specimen documentation are fundamental assets for agencies, land managers, and biological consultants with mounting responsibilities for conservation and informed decision-making.

#### ECOLOGICAL FACTORS CONTRIBUTING TO THE RARITY AND DECLINE OF THE LANE MOUNTAIN MILKVETCH, *ASTRAGALUS JAEGERIANUS* MUNZ.

**Thomas Huggins**, Barry Prigge, Rasoul Sharifi, Philip Rundel, University of California Los Angeles, [huggins@ucla.edu](mailto:huggins@ucla.edu)

The Lane Mountain milkvetch, *Astragalus jaegerianus* Munz (LMMV), is a federally endangered species that exists in small fragmented populations endemic to granite barrens in the central Mojave Desert. A weak-stemmed perennial, the LMMV grows within the canopy of common desert shrubs such as *Thamnosma montana*, *Ambrosia dumosa*, and *Eriogonum fasciculatum*. For the past 12 years, this historically rare plant has undergone alarming population contractions. Since 1999, UCLA-monitored LMMV populations have declined, and by 2011 were less than 20 percent of their original size, leaving a number of populations at critically low levels, and in danger of local extinction. Recruitment of reproductive plants into LMMV populations has been rare; of the 168 seedlings followed during our long-term study, none have survived to maturity. In the last three years (2009-2011), our UCLA research group has conducted extensive research on the ecological and life history factors contributing to these declines. This talk will focus on a review of the salient features of this research including LMMV population dynamics, multi-year phenology, seed production, and intra- and inter-annual variation in the soil seed bank. Also examined are the edaphic factors that act to restrict the LMMV to granite barrens, including the putative role of *Larrea tridentata* allelopathy. In addition, a two year restoration experiment will be described, the results of which support the role of drought in recent population decline, and suggest that seedling herbivory is significant source of seedling mortality and a contributing factor in the recruitment failure of this rare, edaphic endemic.

#### USING SCIENCE TO MANAGE TWO POPULATIONS OF AN ENDANGERED ANNUAL FORB, *CLARKIA FRANCISCANA*

**Christal Niederer**, Lech Naumovich, Stuart Weiss, Jimmy Quenelle, Creekside Center for Earth Observation, [christal@creeksidescience.com](mailto:christal@creeksidescience.com)

*Clarkia franciscana* is a serpentine endemic restricted to the Presidio of San Francisco and the Oakland Hills. In Oakland, we have experimentally used spring mowing to reduce annual grass, fall raking to reduce thatch, and tree removal to increase open grassland habitat. After two years of spring mowing, total annual grass cover decreased by 51.3%, annual forb cover (nearly all native) increased from 5.5 to 19.0%, and thatch decreased from 23.8 to 3.3%. Total *Clarkia* counts in the tree removal plots increased from 184 to 810 in one year due to passive recruitment. Fall raking had little effect on plant guilds but significantly increased bare ground and reduced thatch. These conditions were expected to increase *Clarkia* numbers, but they unexpectedly decreased after two years of treatment. The mechanism for this decline is unknown. Based on these results, spring mowing will be scaled up on a rotational basis. In 2011, five of the site's 28 acres were stringcut. Tree removal continues in the grasslands, and fall raking has been discontinued. Interestingly, experiments at another *Clarkia* population in the

Presidio of San Francisco yielded different results and management recommendations. Spring mowing was not effective in reducing annual grasses, perhaps due to a longer growing season at this coastal site. Post germination tarping, flaming, and scraping were most effective at reducing annual grasses and increasing *Clarkia*. Scraping has been discontinued as too labor intensive, but tarping and flaming continue to be used as pragmatic treatments for increasing *Clarkia* throughout this 15-acre site.

#### LOCAL ADAPTATION AND SPECIATION IN CRYPTIC SPECIES OF *LASTHENIA*

**Jenn Yost**, Kathleen Kay, Nishi Rajakaruna, University of California, Santa Cruz, [jmyost@ucsc.edu](mailto:jmyost@ucsc.edu)

Understanding how adaptation occurs and the ways in which it can contribute to divergence among populations and ultimately speciation are central goals in biology. California is especially ideal for studies of plant speciation due to its diverse flora and high rates of endemism. Adaptation to extreme soil types is thought to be a driver of plant diversity, yet the impact of soil conditions on reproductive isolation is poorly understood. In this study we investigated the degree of habitat isolation across a 60 m serpentine ridge in San Mateo County where two cryptic species, *Lasthenia californica* and *L. gracilis*, have persisted in close parapatry without apparent hybridization. Using reciprocal transplants, we show that both species are uniquely adapted to their native region of the ridge. Temporal changes in the edaphic environment exert different selection pressures throughout the season. Likely drivers of divergence are soil water content, and varying concentrations of calcium, magnesium, sodium, and potassium. This study is significant in that we show that subtle differences in serpentine soils, even at small spatial scales, can maintain species diversity. We further elucidate the importance of serpentine soils in maintaining and promoting diversity in California and highlight the need for conservation of cryptic species in these unique habitats.

#### ANALYSIS OF SEX RATIOS IN *POA ATROPURPUREA* OF THE BIG BEAR VALLEY

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*Poa atropurpurea* is a dioecious native rhizomatous bluegrass of San Bernardino and San Diego counties. In 1979 the species was reported to inhabit less than 100 acres worldwide (Sproul & Beauchamp, 1979). The strongly female skewed populations of San Diego County (Hirshberg, 1994) pose a threat to future reproduction and persistence of the southern extent of the species; the sex ratios of the San Bernardino populations are unknown (Fish and Wildlife, 1998). This study seeks to describe the ratio of male to female individuals of *Poa atropurpurea* populations of Big Bear Valley, CA. Four populations, under differing altitudinal and hydrologic conditions, were studied over a two-week period. The number of male and female individuals was counted within quadrats over two 50-meter transects. Results exhibited male dominance in three population ratios and female dominance within one population. The representation of males increased in the second week of monitoring within three populations, exhibiting higher ratios of males to females later in the season. These results show potential for reproductive success in the future due to coexistence of male and female individuals within a population. The primary threats in the Big Bear Valley range of the species can be confirmed, therefore, as the already described OHV use and hydrologic alteration.

#### *ARCTOSTAPHYLOS GLAUCA*- A LANDSCAPE APPROACH TO ANALYZING DISTURBANCE AND MANAGEMENT EFFECTS ON ITS DISTRIBUTION THROUGH TIME.

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Observation and information gathered both in the field and through personal and geographic sources have indicated that bigberry manzanita has possibly been reduced in extent over the past 100 yrs on the Angeles National Forest. A method for analyzing the historical extent and distribution of this species is presented, along with a method for analyzing the effect of these issues on this species. Addressing this historical change in extent due to these factors may provide an indication of the status of this species on the Angeles National Forest, while providing insight into appropriate and sustainable management actions for the future.

#### VASCULAR PLANT DIVERSITY UNDER EVEN-AGED FOREST MANAGEMENT IN THE SIERRA-CASCADE REGION

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Sierra Pacific Industries utilizes even-aged silviculture over  $\pm 1.7$  million acres of California forestlands. Popular media, common parlance, and legal action criticize even-aged mixed-conifer forest management in generally two ways: “plantations are tree monocultures”, and “plantations are biological deserts”. We sampled vascular plant species richness from 73 plantations in the Sierra Nevada, Cascade Range, and Klamath Range Jepson Manual bioregions. Plantations were paired with adjacent forests for comparison, and were in the 5-7 yr range since planting. Over the entire CA range of ownership, >600 vascular plant taxa were documented within plantations. Rare plant species were equally distributed between plantations vs. forests; 19 CNPS rare plants were documented in plantations. Non-native species richness was variable, with 40 total taxa documented; about one of five plantations had significant cover of non-natives. None of the sampled plantations contained only a single conifer; plantations averaged  $2.5 \pm 0.6$  tree taxa; a total of 21 taxa of trees were documented in the plantations. Differences in species composition (complimentarity) was analyzed using the Marczewski-Steinhaus distance measure based on floristic inventory of paired forests and plantations. There was no significant difference in species richness between plantations and adjacent forests. Plantations tended to be richer in forbs and graminoids, while forests were richer in trees and shrubs. Herbicide applications within plantations significantly reduced only shrub species richness: the effect was short-lived (about 2 yr).

#### ISLANDS OF INVASION: INFLUENCE OF OAK CANOPIES AND COMPETITION WITH ANNUAL GRASSES ON PERENNIAL NATIVE GRASS PERFORMANCE

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Invasive exotic species present significant threats to native plant abundance and diversity, and California grasslands are heavily invaded by Mediterranean species. Oak trees are a common, highly-valued part of many California grasslands, yet vegetation surveys of savannas throughout the state indicate that the oak understory is highly invaded. In particular, non-native annual grasses such as *Bromus diandrus* attain high cover under trees, whereas native perennial grasses are rare beneath isolated oaks despite their presence at the canopy edge. To investigate the mechanisms contributing to the absence of native grasses under the canopy, we performed a factorial transplant experiment with natives *Poa secunda* and *Nassella pulchra*. Seedlings were grown in split plots divided between soil collected from below oaks or from open grassland, and at three different levels of competition with *B. diandrus*. Plots were located under trees and in open grassland. Growth and reproductive output were measured bi-monthly for three growing seasons. Initially, survival of *N. pulchra* was highest under the oak canopy,

although the effect of competition on growth was stronger in that habitat. *Poa secunda* survived well in both habitats but growth was always negatively influenced by competition. Reproductive output of *N. pulchra* was not influenced by the treatments, but *P. secunda* flowered more often in oak soils and under the canopy. These results suggest that the current distribution of native grasses in oak savannas is restricted to the open by competition from *B. diandrus* beneath trees, particularly for *P. secunda*, whose phenology overlaps the annual grasses.

#### BLUEGUM WEEDINESS IN CALIFORNIA IS NOT GENETICALLY BASED

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In the 150 years since their introduction to the state, species in the genus *Eucalyptus* have become the most common non-native trees in California. The most extensively planted species in California, *E. globulus* ssp. *globulus* (bluegum), exhibits different levels of naturalization in similar locations, becoming invasive in some, while rarely reproducing in others. Numerous genotypes and geographical races of bluegum have been identified in its native range in southeastern Australia and Tasmania. We sought to determine whether differing degrees of invasiveness in California were associated with a particular genotype or race, or if invasiveness was more a function of the microhabitat in which the original trees were planted. We genotyped bluegum trees from groves throughout California using microsatellites and chloroplast haplotype genetic markers and compared them with a large genotype database from the University of Tasmania. We have been able to determine the provenance of California's bluegum landraces and the possible number of separate introductions of the species into the state. Our results suggest that there is little genetic diversity in bluegum populations throughout California, and the same genotype varies greatly in invasiveness depending on where trees are located. This study provides a clearer understanding of bluegum genetics and ecological impact in California and can help predict possible future invasions and inform future conservation management strategies.

#### IMPORTANCE OF SOIL MICROBES AND NITROGEN SOURCES FOR NATIVE AND EXOTIC PLANT SPECIES IN COASTAL SAGE SCRUB

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Coastal sage scrub is endemic to Southern California and habitat for many rare taxa. Remaining stands are often fragmented and subject to invasion and disturbance, including changes to the soil community and nitrogen fertilization through atmospheric deposition and runoff. To examine the importance of an intact native soil microbial community and the source of nitrogen for plant growth, seeds of three dominant native shrubs, *Artemisia californica*, *Eriogonum fasciculatum*, and *Salvia apiana*, and three dominant exotic annuals, *Brassica nigra*, *Bromus madritensis* ssp. *rubens*, and *Centaurea melitensis* were grown in individual soil columns in a greenhouse. Species were divided into equal treatments, each planted either into sterilized soil or a mixture of sterilized and field-collected soil, and fertilized exclusively with ammonium, nitrate or glycine. *Artemisia* and *Eriogonum* responded strongly to the soil treatment, growing 50% to 150% larger with native soil than with sterilized. *Salvia* showed a weak trend in the opposite direction. *Brassica* and *Bromus* performed equally well regardless of soil treatment, and *Centaurea* grew 20% larger in sterilized soil. Species tended to grow largest with ammonium and smallest with glycine, though *Artemisia* and *Brassica* were nitrogen generalists. These results show the importance of a native soil community for the establishment and growth of native plants.

Neglecting the soil and fertilization regime could strongly affect the outcome of a restoration project by giving exotics a large advantage in early stages of shrub establishment.

#### INVASIVE HYPERACCUMULATORS USED TO 'PHYTOMINE' NICKEL FROM NATURAL SERPENTINE SOILS ARE A THREAT TO NATIVE FLORA

**Kelly Amsberry**, Maureen Jules, Ken French, Native Plant Conservation Program, Oregon Department of Agriculture, [amsberrk@science.oregonstate.edu](mailto:amsberrk@science.oregonstate.edu)

Southwest Oregon's Illinois Valley contains large areas of peridotite and serpentine soils that support endemic plant species; a total of 15 taxa with conservation status occur there. Although invasive species threaten Oregon's flora overall, the low nutrient levels and toxicity characteristic of peridotite and serpentine soils, combined with the hot, dry summers of the Illinois Valley, have historically prevented most weeds from invading those soil types. Phytoremediation (use of plant hyperaccumulators to extract minerals from mine tailings) reduces the toxicity of discarded ore, and allows contaminated soils to be colonized by local flora. Minerals can be smelted from the foliage of hyperaccumulators, providing a secondary source of economically valuable minerals. In 2003, a project to cultivate hyperaccumulators on naturally-occurring, nickel-containing soils in southern Oregon was initiated, with the goal of developing a nickel-producing industry. This project was soon discontinued, but the hyperaccumulators planted (*Alyssum murale* and *A. corsicum*) escaped from unmanaged farm fields, rapidly colonizing adjacent serpentine soils. By 2009, plants had spread far beyond farm fields, and were poised to infest serpentine soils throughout the region. In response to concerns by agencies and local landowners, the Oregon Department of Agriculture chemically treated all 89 planted acres. Concurrently, natural areas were surveyed by agencies and volunteers, and plants were manually removed from 20 sites. Treatment continued in 2010 and 2011, and self-sown seedlings continue to be discovered in a wide range of habitats. Both *Alyssum* species were designated as Noxious Weeds by the Oregon State Weed Board in 2009.

### Session 9: Rare Plant Communities

#### PATTERNS OF DOMINANCE AMONG MIXED EVERGREEN FOREST TREES IN NORTHERN CALIFORNIA

**Michael Barbour**, Javier Loidi, Gonzalo Garcia-Baquero, Robert Meyer, University of California at Davis, [mjbarbour@ucdavis.edu](mailto:mjbarbour@ucdavis.edu)

Mixed evergreen forest (MEF) occupies 4% of California's area, but <5% of it is in old-growth status. Our objective was to characterize MEF along environmental gradients and to identify gradients most strongly correlated to shifting dominance among conifers and evergreen hardwoods, and between coast redwood and Douglas-fir. Our study focused on the greater Bay Area and in this region we quantified 17 old-growth stands. Biotic measures included tree basal area, density, and frequency. Environmental attributes included geographic location, distance from the ocean, relative site elevation, annual solar radiation, mean annual precipitation, and annual/ seasonal temperatures. Conifer dominance was largely explained by distance to the ocean, relative site elevation, annual solar radiation, and seasonal max/min temperatures. Other factors failed to exhibit significant relationships with dominants, possibly because fog was a confounding factor. Summer fog has often been cited as an important factor for coastal vegetation, but we failed to find any published study of fog at the fine scale of our study. The strongest correlations were with factors that could be surrogates for fog, such as distance to the

sea. In the absence of site-specific historical data on old-growth forests prior to having been logged, our study showed that certain environmental factors can help reconstruct the pre-disturbance forest in terms of dominance by conifers or evergreen hardwoods. Such information is critical for deciding which stands to conserve when only recovering vegetation is present, and for applying management techniques that favor the attainment of a realistic restoration end point.

## THE DECLINE OF THE NORTHERN BISHOP PINE FOREST: SUGGESTIONS FOR CONSERVATION AND RESTORATION

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An in depth understanding of the decline of the rare northern bishop pine forest is complicated by the following; limited distribution; high degree of serotiny in cones, seedling regeneration limited by lack of fire; even aged stands with most populations at the end of their short life span (80-100 years); coastal development fragmenting already limited distribution and high pathogen numbers (western gall rust (*Endocronartium harknessii*) and coastal dwarf mistletoe (*Arceuthobium littorum*) in many populations. Increased planting of Monterey Pine up and down the coast may be providing a corridor for increased pathogen dispersal. One of our studies showed that in one site out of a total of 208 bishop pine trees surveyed only 14% lacked any sign of either pathogen. Potential solutions that will be discussed include controlled burns; protection of extant seedlings; limiting forest conversion; working with local planning agencies and education of private and public land owners and managers. Natural seedling establishment should be encouraged in areas where conditions provide success.

## SOLAR ENERGY AND RARE PLANTS: ASSESSING FIELD ACCURACY OF DISTRIBUTION MODELING FOR RARE DESERT PLANTS

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Extensive solar energy developments are planned throughout California's deserts. We are assessing on-the-ground accuracy of species distribution modeling for rare desert taxa. Species distribution models (SDMs) are widely utilized in plant conservation planning, but the accuracy of model predictions is seldom assessed using field surveys. We are conducting distribution modeling for six rare desert taxa using an approach that involves: 1) building initial models, 2) assessing model accuracy based on field surveys, 3) revising models based on our survey results as well as additional plant occurrences from the Consortium of California Herbaria digitization effort and widespread surveys by consultants and nonprofits, 4) field testing revised models. Here we report on assessment of the accuracy of initial distribution models for four rare plants: *Mimulus mohavensis*, *Eriophyllum mohavense*, *Penstemon albomarginatus*, and *Mentzelia tridentata*. We compare two approaches that have performed well in statistical evaluation of SDMs, Maxent and Random Forests in their ability to predict newly documented occurrences across two scales of environmental data. Field surveys in 2011 resulted in the discovery of new populations of all taxa, including a large (20 mile) extension of the range of *E. mohavense*. We discuss issues encountered in distribution modeling such as varying success across taxa and overfitting of models to highly sampled areas of population ranges.

## ASH MEADOWS RARE PLANT HOT SPOTS AND THEIR ASSOCIATED VEGETATION COMMUNITIES

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Ash Meadows National Wildlife Refuge (Refuge) encompasses more than 23,000 acres of spring fed desert habitat supporting populations of 12 rare plant species. Surveys targeting these species were conducted using transect mapping, population census, individual count census, and negative sampling. When point and polygon data resulting from the rare plant surveys are projected on aerial imagery for the Refuge, distribution patterns for each species become evident. The result of the survey efforts show definite patterns where multiple rare species occur in "hot spots". Vegetation mapping was conducted at a local scale using aerial imagery to identify unique vegetation features in the field using a minimum mapping unit of 0.25 acre. The resulting polygons were classified to the alliance and association level using the National Vegetation Classification System and vegetation classifications from the Mojave Desert Ecosystem Program. Vegetation polygons were also aggregated to form habitat polygons. Analysis of the rare plant data using the vegetation mapping polygons reveals that not only are individual plants associated with specific vegetation communities, but these same communities often support multiple rare species. For example, white bearpoppy (*Arctomecon merriamii*) most commonly occurs on the Refuge within the *Atriplex Confertifolia* Shrubland alliance. This alliance supports all 12 rare species in multiple vegetation associations. Analysis of rare plant distribution patterns associated with vegetation communities may provide an important management tool where by rare plant conservation can be addressed on a vegetation community level.

#### MARINE CORPS AIR STATION MIRAMAR'S VERNAL POOL LONG TERM MONITORING PROJECT

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Marine Corps Air Station Miramar is conducting a long-term vernal pool ecological monitoring project that incorporates data from a number of different vernal pool mitigation and monitoring projects dating from 1988. Permanent vegetation transects in a station-wide range of natural and constructed vernal pools are being sampled for plant species frequencies and abundances along elevational gradients. Rare plant and selected vernal pool weed species population numbers are estimated. Sensitive fairy shrimp population numbers and soil cyst densities are also being measured. A vernal pool vegetation index defined as the ratio [vernal pool plant frequencies]:[frequency of all plant species] showed a strong correlation with total annual precipitation over the past 23 years. Frequencies and abundances of rare vernal pool plant species varied similarly with annual precipitation totals. The vernal pool monitoring project has documented the initial appearance and increase in abundance of, Pacific bentgrass, *Lachnagrostis filiformis* (G. Forst) Trin., a relatively recent invasive weed in San Diego County. and may show the impact of this species on the endangered *Pogogyne abramsii* and other listed vernal pool plant species. The long term vernal pool ecological monitoring project provides a valuable tool for monitoring the success of new and ongoing vernal pool construction and restoration projects, and can be used in modeling the potential effects of climate change on vernal pool ecosystems and their constituent sensitive plant and animal species.

#### RECOVERY STEPS FOR AN ENDANGERED ANNUAL FORB (*ACANTHOMINTHA DUTTONII*)

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San Mateo thornmint (*Acanthomintha duttonii*) is a federal and state endangered annual mint known from only one extant population in Edgewood County Park, San Mateo County, CA. This population had been in decline for years. More than 53,000 individuals were estimated in 1994; only 249 individuals were censused in 2008. In 2008 a restoration project began to enhance existing habitat, which was being thatched over by Italian ryegrass. Small-scale experiments in unoccupied habitat tested scraping, mowing, graminicide, raking, and hand weeding. Post-germination scraping was the most pragmatic and effective treatment to reduce annual grass cover, reduce thatch, and increase bare ground required for thornmint germination. Small-scale seed increase experiments conducted by the UC Berkeley Botanical Garden determined propagation techniques, leading to subsequent large-scale seed increases. In November 2009, 12,500 seeds were placed in 25 1m<sup>2</sup> experimental plots adjacent to the extant population. A 30% germination rate yielded 3,111 seedlings, resulting in 2,885 mature plants in June 2010 (census total 3,135 plants). In December 2010, 9,000 seeds were seeded into 30 new scraped plots, and 1,416 individuals reached maturity. 3,450 plants were censused in June 2011. Mowing and dethatching continues to improve overall habitat. Though the overall population increased only slightly from 2010 to 2011, fecundity nearly doubled from 1.3 to 2.2 whorls per plant. Introductions to additional sites are planned by the end of 2011. An adaptive management plan was created with USFWS with objectives for current and introduction sites, and specific management directions if objectives are unmet.

#### MAPPING PLANT BIODIVERSITY HOTSPOTS AT THE COUNTY SCALE: A NEW TOOL FOR ESTABLISHING LONG-TERM RESOURCE CONSERVATION STRATEGIES

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Dr. Norman Myers identified the world's 25 biodiversity hotspots and pioneered ideas about the usefulness of biodiversity models for establishing conservation priorities. All previous studies using hotspot analyses for biodiversity modeling have used large spatial scales (e.g., the California Floristic Province, which is one of the 25 global biodiversity hotspots). We have created a map of potential plant biodiversity hotspots in San Luis Obispo County, California using GIS technology. This map will serve as a new tool for establishing long-term resource conservation strategies and to assess whether the hotspot approach is applicable to finer-scale biological inventories. This hotspot map is based on existing distribution data within the California Natural Diversity Database, the Consortium of California Herbaria, and newly geo-referenced herbarium specimens of San Luis Obispo County's 212 special-status species contained in Cal Poly's Hoover Herbarium. We anticipate that the overall approach will be applicable for establishing local and regional plant conservation priorities.

#### WHAT IS MARITIME CHAPARRAL? USING ECOPHYSIOLOGY AND MULTIVARIATE ANALYSIS TO BETTER UNDERSTAND A RARE PLANT COMMUNITY

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Maritime chaparral is a protected rare plant community renowned for its local endemism. Yet, protection has been challenged on grounds that maritime chaparral is difficult to discern from interior chaparral. I tested the hypothesis that maritime chaparral has more favorable water relations than interior chaparral because of its exposure to the marine layer that characterizes the California coast during the summer dry season. Ecophysiological studies were carried out on *Arctostaphylos* species arrayed along a coast-to-interior gradient in the central coast region.

These ecophysiological studies revealed that interior species experience extreme evaporative demand due to California's long summer drought whereas evaporative demand is significantly reduced along the lowland coast. Preliminary evidence suggests that fog can supplement water availability. *Arctostaphylos* seeders in the maritime zone are more vulnerable to xylem cavitation than interior seeders. I then tested the hypothesis that extreme drought acts as a strong environmental filter on chaparral composition in the interior whereas more stochastic processes operate on maritime chaparral along the coast. Multivariate analysis of community composition data from 87 plots organized into maritime, transition, and interior groups based on an evaporative demand index confirmed that maritime and transition chaparral have composition patterns consistent with the expectation that interior chaparral is a limited membership community whereas the maritime and transition chaparral have a larger species pool and much higher  $\beta$ -diversity. Implications for the definition of maritime chaparral and its future conservation are discussed.

#### PLANT COMMUNITY CHARACTERIZATION, MAPPING, AND RANKING OF FENS IN THE LAKE TAHOE BASIN, CALIFORNIA AND NEVADA

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The CNPS Vegetation Program in collaboration with USDA Forest Service has produced a vegetation classification, map and quantitative ranking of meadow sites containing fens in the Lake Tahoe Basin of California and Nevada. We augmented existing Forest Service protocols by collecting additional data at meadow and stand levels to better characterize and rank sites. This study contributes to the knowledge of fen vegetation. We identified 10 new associations in our classification analysis, and twenty out of the 30 associations are considered rare. We also recorded new occurrences for three rare mosses, *Bruchia bolanderi*, *Meesia triquetra* and *Tomentypnum nitens*, and two rare vascular plants, *Carex limosa* and *Eriophorum gracile*. This project ranked 49 confirmed fen sites in the Basin based upon eight conservation significance criteria. In our analysis, criteria ranks are based on comparing each site within a continuum of the entire set of sites. These conservation significance rankings recognize diversity and other important environmental characteristics in some smaller and less well-known fens as well as in larger fens. The most highly rated fens for conservation significance are in the southern end of the Basin. The Angora Creek Subwatershed of the Truckee River Watershed had the highest average conservation significance ranks. These Conservation ranks will assist land managers in making restoration and other management decisions, by providing direct comparisons between sites. The eight ranking criteria can also be considered individually when comparing fens and setting priorities, since inherent diversity considerations and management-related criteria are included.

#### AN UPDATE ON THE CURRENT DISTRIBUTION, CONSERVATION, AND RESTORATION OF VERNAL POOL HABITAT AND SPECIES IN SOUTHERN CALIFORNIA AND BAJA CALIFORNIA, MEXICO

**Scott McMillan**, Thomas Oberbauer, Lindsey Cavallaro, Linnea Spears-Lebrun, AECOM, [Scott.McMillan2@aecom.com](mailto:Scott.McMillan2@aecom.com)

A summary of the distribution and historical extent of vernal pools in Southern California was presented at the 1996 CNPS Conference (Bauder and McMillan 1998). This presentation and subsequent paper evaluated the distribution of an array of plant and animal species, soil types, and climate variables to compare vernal pool types across Southern California. This paper also

discussed the estimates of historical distribution of vernal pools in the region and compared these estimates to the status of vernal pools in 1996. Over 15 years later, we update our understanding of vernal pool habitat and species in Southern California and Baja California. Using aerial imagery and other data, a detailed estimate of the historical and current extent of the vernal pool habitat in Baja indicates that over 90% of the vernal pool habitat in Baja California is gone. In Southern California, new pools and pool complexes have been documented since 1996 and the status and distribution of vernal pool species is better understood after 15 years of surveys and monitoring. Now that many areas in Southern California are preserved or protected, the primary threats that were identified in 1996, such as development and off-road vehicle activity, now include large-scale fires, weed invasion, hybridization, and potential climate changes. Over the last 15 years, there have been numerous attempts to restore, reestablish, and create vernal pool habitat in Southern California. Some of these efforts have successfully improved vernal pool habitat and helped to conserve numerous sensitive vernal pool species endemic to the region.

## **Session 10: Using Science to Increase the Success of Restoration Efforts in California**

### **FUNCTIONAL TRAITS OF INVASIVE SPECIES: IMPLICATIONS FOR ECOLOGICAL RESTORATION IN A CHANGING ENVIRONMENT**

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Invasive species represent one of the most serious threats to vegetation community composition and ecosystem function worldwide. Recent theoretical development in the field of invasions biology posits that a trait-based community framework can guide restoration efforts in invaded plant communities. One specific hypothesis is that functional differences among native and invasive species can identify restoration treatments that suppress the growth of invaders while facilitating the growth of natives, such as altering resource availability or competition. I examine this hypothesis using physiological data from a California desert annual community. We found that functional trait data do not support the use of carbon-based soil amendments designed to lower soil nitrogen availability. Instead, functional trait data revealed differences in water use and carbon capture strategies. Functional traits can also be used to predict how invaders and entire communities may respond to climate change and how effective restoration efforts will be under a range of environmental scenarios.

### **INVASION AND RESTORATION: IMPACTING ECOSYSTEMS DIFFERENTLY FROM THE TOP DOWN**

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Impacts of invasive species on both aboveground and belowground ecosystem functioning need to be considered for successful restoration. However, their impacts on soil chemical pools and nutrient cycling may vary across vegetation types. Southern California has experienced invasion of annual Mediterranean plant species for over 200 years leading to great losses native grassland and coastal sage habitat and threatening others. In order to restore these now degraded lands, a clear understanding of the condition of the system and its resources in the degraded state is necessary. In addition, the resilience of the invaded system following restoration from invasion will determine or direct the management decisions associated with

restoration plans. The objective of this study was to assess the impact of a similar suite of exotic annual plants invading southern California grassland, coastal sage scrub (CSS) and chaparral soils and the resilience of these soils following weed removal. We compared soil chemical pools (C, N, P, NO<sub>3</sub> and NH<sub>4</sub>), pH and nutrient cycling rates in native/restored, invaded, hand weeded and weeded plus seeded plots over a two year period. Nutrient pools of total C and N did not differ between treatments in any system. Nitrate was reduced in invaded soils while native and restored soils had similar nitrate levels indicating that invasions altered nitrogen uptake rates during the growing season in each of these systems similarly, but removal of exotics restored or increased NO<sub>3</sub> levels. Grassland soils experienced increased NH<sub>4</sub> in invaded soils and altered nitrogen mineralization and nitrification, CSS soils showed reduced heterogeneity of nutrients across the landscape while chaparral soils remained more resistant to exotic impacts. The variance in responses of ecosystems to invasion of even a similar suite of exotic plant species suggests the continued need for system specific restoration efforts. Furthermore, it highlights that grassland and CSS systems will require more active management strategies than chaparral.

#### RESTORATION OF COASTAL SAGE SCRUB USING ANNUAL HERBICIDE APPLICATIONS

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Little of the Coastal Sage Scrub habitat in Southern California that existed prior to European colonization has escaped human development. Land conservation agencies and organizations acquired some of the remaining lands for preservation. Most of these lands are severely degraded; the native flora has largely been replaced with invasive, non-native vegetation. Competition from these invasive plants is one of the most difficult impediments to re-establishing native vegetation. Our information suggests that restoration practitioners and scientists are failing to undertake measures to consistently reduce the invasive plant seedbank before introducing native plants. We are comparing annual applications of the non-selective herbicide glyphosate for multiple years compared to a no herbicide control in a split-plot design as a simple, low cost method of reducing the non-native seedbank sufficiently to allow native vegetation to establish. The sub-plot treatment consists of sowing seven native species into half of the main plots. The experiment is on a County of San Diego Open Space Park. Herbicide treatments were made in the spring each year from 2006-2010. Data collected annually includes plant cover and species richness by main treatment and subplot treatment. In 2010, native plant cover in treated plots was about 50%, consisting of 43 native species compared to <5% in the control plots. In July 2011, herbicide and sown plots had 29 native shrubs, compared to 3.6 in untreated, sown plots. These methods are being demonstrated on larger sites in southern California.

#### EFFECTS OF SEEDING AND MAINTENANCE TECHNIQUES ON FUNCTIONAL GROUP MIXES OF COASTAL SAGE SCRUB

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Observations of coastal sage scrub restoration projects on the Irvine Ranch Landmark have indicated variation in success related to seeding techniques. In addition, attempts to increase

the diversity of species led to questions about potential competitive interactions among seeded natives and complications in post-seeding weed control due to variation in growth rates among native and non-native species. Within a larger restoration site, we established a field experiment comparing: seeding technique (hand seeding vs. drill seeding); maintenance type (control/no maintenance, wick weed wiper with glyphosphate, and hand weeding/weed-eating); and functional group mix (faster growing, short-lived species, slower growing, long-lived species, and mix of both groups). Maintenance treatments were standardized based on time allocated to work in each plot. Cover, and in most cases, the density of natives was greater in their own group relative to the mixed group. Wicking had a greater effect on controlling density and cover of non-natives compared to hand weeding/mowing, but these treatment differences were not generally realized with respect to native density and cover. Native and non-native density, but not cover, was generally greater in hand vs. drill seeded plots. In plots without maintenance, native cover was greater in hand seeded and cover of non-natives greater in drill seeded plots. Although there were generally no differences in native cover between plots differing in seed and maintenance treatments, it will be important to track differences in non-native cover and native density in subsequent years. Separating species into functional groups can help achieve greater establishment success.

#### RESTORATION AND SCIENCE: A PRACTITIONER/SCIENTIST'S VIEW FROM COASTAL SAGE SCRUB RESTORATION AT A SOUTHERN CALIFORNIAN PRESERVE

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Scientists reexamining the relationship between restoration science and practice suggest “alternative research paradigms” to bridge the measured gap. The coastal sage scrub (CSS) restoration project at Starr Ranch, a 1585 ha Audubon preserve in southern California, combines non-chemical non-native control, restoration, and applied research. Our practices evolve from modified scientific approaches and the scientific literature. Results from experiments with non-optimum replication (on effects of seed rates, soil tamping, and timing of planting) nonetheless had value for management decisions. Challenging nonnative control work during a high rainfall season compromised a test of a removal technique (no replication) that nonetheless provided valuable guidance for how to proceed (control plot 75% nonnative cover vs. 5% cover in treatment plot). Our passive restoration monitoring data show 28 – 100% total native cover after 3 – 5 yrs. Restoration success in semiarid regions is dependent on rainfall, a finding vital for understanding active restoration monitoring results that showed a range of 0 – 88% total native cover at the end of the first season. Variable rainfall and expediency impacted tests of alternate soil preparation techniques and effects of small mammals on nonnative control in restoration sites (no results in low rainfall years, no replication because of time and space constraints). Work progresses through a combination of applied research, ecological intuition, and a watchful eye on the scientific literature.

#### EFFECT OF EXOTIC GRASS REMOVAL AND NATIVE SEED AUGMENTATION ON RE-ESTABLISHMENT OF COMMON OAK UNDERSTORY SPECIES ON SANTA CATALINA ISLAND, CALIFORNIA

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As in many oak ecosystems in California, there is limited recruitment of native oak trees on Catalina Island. Island scrub oak and associated plant species are being replaced by exotic annual grassland. In a transitional oak stand, we tested the effect of two restoration techniques on the recruitment of common native oak understory species. We hypothesized that exotic

annual grass removal and seed augmentation would increase native understory cover and native richness. A two-factorial experimental design was used in which seeds of 8 understory species were added in October, 2008 and grass-specific herbicide was applied in January, 2009. Although there was seasonal fluctuation in the effectiveness of the restoration techniques, overall, these treatments tended to positively affect native species responses and adversely affect annual grass responses. Herbicide treatment significantly increased native cover in 2010. Seed addition significantly increased native cover in both 2009 and 2010 and species richness in 2009. Herbicide treatment reduced exotic annual grass cover in both 2009 and 2010, perhaps facilitating the increased cover of native species in 2010. These findings suggest that land managers faced with the encroachment of exotic annual grasses in areas previously inhabited by a scrub oak ecosystem can restore native understory community structure by the combined use of grass-specific herbicides and seed augmentation of native understory species.

#### TARPING, HERBICIDE, SOIL REMOVAL, AND MULCHING AS METHODS TO REDUCE EXOTIC COVER AND RESTORE NATIVE COASTAL PRAIRIE GRASSES

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We tested different strategies to control exotic forbs and grasses, and reduce competition with planted native grasses as part of coastal prairie restoration efforts. During summer/fall 2010, we set up an experiment comparing several exotic control treatments including one-time (1×) tarping with black plastic, two-time (2×) tarping, topsoil removal (scraping), herbicide, and no treatment crossed with applying mulch and not mulching. Three native grass species (*Nassella pulchra*, *Elymus glaucus*, and *Hordeum brachyantherum*) were outplanted in January 2011. During spring/summer 2011 we monitored native and exotic vegetation. Overall, 1× and 2× tarping were similarly effective in reducing exotic forbs and favoring native perennial grass growth. Herbicide was the most effective method for reducing exotic cover in unmulched plots, but had similar effects to tarping in mulched plots. Native grasses were less robust and one species had lower cover in herbicide than tarped plots, suggesting potential residual effects of herbicides. Scraping was ineffective in reducing exotic cover and resulted in low native grass cover, as the slight change in microtopography caused by soil removal resulted in extensive flooding of scraped plots. Mulching increased soil moisture and was particularly effective in controlling exotic cover in control and scraped plots where exotic cover was high. Our results suggest that tarping once in the fall following the first rains and mulching are effective methods for reducing exotic forbs and grasses during the early stages of coastal prairie restoration. We are continuing to collect data to evaluate long-term efficacy of the treatments.

#### LONG TERM MONITORING AND ECOLOGICAL PERFORMANCE OF HORTICULTURAL RIPARIAN RESTORATION ALONG THE SACRAMENTO RIVER

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The highly altered and managed ecological conditions present on most rivers in California have resulted in the loss of more than 95% of historic riparian forest habitats throughout the state. This has created the need for active horticultural restoration to re-build riparian habitat that supports obligate wildlife populations. It is generally accepted that riparian restoration is beneficial to wildlife populations, however the horticultural performance and successional trajectory of restored plant communities remains largely unknown. This pilot study documents observed vegetation succession following horticultural restoration on 16 sites along the Sacramento River, in two age categories (8 and 15 years following restoration). We examined

plant density, species richness, vegetation structure, and community composition. Our results indicate that while stem density decreases from initial planting for both age categories, species richness does not decrease significantly. Shifts in community composition show mid and late successional species, including cottonwood and valley oak, increase in importance value from 8 to 15 year old sites, while early successional species such as coyote brush show a decrease in importance value. Results show that successional processes (recruitment and shifts in dominance) are underway at these restoration sites, although site-specific conditions are undoubtedly contributing to successional pathways. Future work of the Long-term Monitoring Program will focus on ecological and landscape variables that will provide restoration practitioners with the information necessary to target specific vegetative communities and structural features for target wildlife species.

#### INNOVATIVE TECHNOLOGY TO IMPROVE THE SITE SELECTION, DESIGN, AND IMPLEMENTATION OF HARDPAN VERNAL POOL RESTORATION IN THE CENTRAL VALLEY OF CALIFORNIA

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Over the past 20 years, vernal pools have been enhanced, restored, and created for the purpose of improving or restoring their functioning and meeting regulatory requirements for compensatory mitigation. These projects have had mixed results or "success" in terms of the biota observed and hydrological functioning. Our approach to this problem has been to first identify and measure the physical parameters that affect the hydrology of natural vernal pool ecosystems including soil depth, texture, and presence and extent of a water restricting layer and contributing watershed area and slope. Based on these data we developed simple water balance model to evaluate the effects of rainfall, evapotranspiration, and discharge that have identified the key components for the hydrological functioning of vernal pools. During this process we have introduced innovative technologies to improve the precision and accuracy of vernal pool studies including water pressure transducers for soil and surface water level monitoring, soil moisture sensors, centimeter accuracy global positioning systems, and ground penetrating radar (GPR). Presently, we are able to assess a potential restoration site with GPR and a global positioning system to determine the presence, areal extent, and depth of water restricting layers and identify the contributing watershed to vernal pool basins that could be constructed. Further, we can use our water balance model to predict the hydrologic functioning of restored vernal pools using a range of dry, average, and wet year weather data so that we can predict the potential presence and abundance of plant species.

#### INFORMING LARGE SCALE RESORATION WORK AT THE TIJUANA ESTUARY THROUGH APPLIED RESEARCH

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At NOAA's Tijuana River National Estuarine Research Reserve, there is a long history of incorporating research on coastal wetlands into restoration projects. In 2008, a restoration feasibility and design study was completed for the Tijuana Estuary Friendship Marsh, a large-scale restoration plan for the southern portion of the Tijuana Estuary, located in the southwestern corner of the U.S. in San Diego County, California. The feasibility study used research applied to previous projects, including a 20-acre Model Marsh. Based on this

knowledge and additional analysis, three design alternatives highlighted that only by actively reclaiming what has been lost over decades of filling, diking, and sedimentation, can the southern portion of the Tijuana Estuary survive in the long term. Restoration targets and actionable objectives including material disposal options resulted in a corollary predictive modeling supported by USGS, the "Fate & Transport Study", which examined influence of coastal processes on fine-grained sediment once it enters the nearshore environment to inform future management actions and economic considerations in restoration work at the Tijuana Estuary and other large scale restoration projects along the California coast. Tijuana Estuary, perhaps more than any other southern California estuary, faces immediate, short-term challenges related to sediment deposition in its restoration work, however, as knowledge increases in the area of climate change impacts, including sea level rise, the Tijuana Estuary will serve as a uniquely resilient model for studying adaptive management in these systems and impact on above restoration goals and approaches.

## **Session 11: Land Acquisition for Plant Conservation**

### **PRESERVING OUR NATURAL HERITAGE - AN OVERVIEW OF LAND ACQUISITION IN PRACTICE**

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Preserving our natural heritage in California can be a daunting task given the pressure exerted on the landscape by residential, commercial, and agricultural development, as well as new found pressure associated with some alternative energy projects. The challenging economy has certainly reduced some of this pressure; however, as history has shown development will return in force sooner than we think. As we know, the stronger the economy the greater the threat to our natural heritage; however, good economic times are also well correlated with increased funding for conservation land acquisition. Today, raw land prices are lower than they have been in over a decade and funding sources for acquisition are scarce at best. This presentation will provide an overview and discussion of the tools and funds available to conserve our natural heritage including fee-title acquisition, conservation easement purchase, deed restrictions, etc and will also describe the benefits and risks of each. Additionally, every acquisition project should ask itself early in the process "what happens after the ink dries and the acquisition money is spent". Land ownership and stewardship are very real responsibilities and can be far more costly and time consuming than envisioned. To this end the presentation will also identify and discuss some potential long-term stewardship related pitfalls that should be evaluated during the acquisition process and before money changes hands.

### **ACE II DFG 'S AREAS OF CONSERVATION EMPHASIS**

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The Department of Fish and Game has produced a second, now public, version of a set of data layers and tools – the Areas of Conservation Emphasis (ACE-II). This project endeavored to compile and analyze the best available, statewide spatial information on California's biological and recreational resources and to develop tools to summarize and display this information for use in conservation planning. The ACE-II project team aggregated data on biological richness,

including species diversity, rarity, and sensitive habitats statewide. Information on recreational needs and opportunities, including fishing, hunting and wildlife-viewing throughout the state, was also collected. The data were summarized and analyzed at a consistent scale of 2.5 square mile hexagons. The biological richness data layers were produced by taxonomic group (amphibians, birds, fish, mammals, plants, reptiles) and sensitive habitat type (riparian, wetland, rare natural community, high value salmonid habitat). A weighted-additive model framework was then used to combine these data across taxonomic groups and sensitive habitat types into overall native species richness, rare species richness, “irreplaceability” and sensitive habitat richness layers further summarized into a single “biological index” layer that depicts relative biological richness within each ecoregion of the state. The ACE-II data layers summarize the best available biological and recreational data in California using a standardized scale and methodology, and can be used in a flexible manner to identify areas of potential biological or conservation interest throughout the state. The ACE-II data are dynamic and will be updated periodically as new data warrant.

## CONSERVATION ASSESSMENT OF ORANGE COUNTY

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In 2006, Orange County voters approved the renewal of a transportation sales tax to improve Orange County's transportation system, which included \$243 million to mitigate the environmental impacts of freeway improvements, under the Orange County Transportation Authority's (OCTA) Mitigation and Resource Protection Program (MRPP). Despite being the smallest county in Southern California, Orange County is also one of the state's most populous counties, and land values are among the highest in the country. Therefore, land use and conservation planning decisions require a strategic and integrated approach that is systematic, scientifically defensible, and fully transparent for stakeholder and scientific review. Moreover, acquisition decisions must be prioritized to yield the 'biggest bang for the buck.' The Conservation Biology Institute conducted a science-based conservation assessment to prioritize acquisition of lands that would enhance and connect existing protected areas to improve landscape integrity and connectivity, protect rare species and their habitats, and ensure long-term persistence of natural processes. CBI characterized the conservation value of each property to allow decision-makers to consider specific mitigation needs. CBI also identified “no regrets”; parcels as the focus of initial conservation efforts and a framework for establishing restoration priorities. CBI's efforts provided the foundation for OCTA's habitat conservation program. Approximately 900 acres of high priority lands have been purchased so far (2011) at a cost of just over \$23 million.

## BUILDING ON A BLUEPRINT FOR CONSERVATION SUCCESS IN ALAMEDA AND CONTRA COSTA COUNTIES - A GUIDEBOOK TO BOTANICAL PRIORITY PROTECTION AREAS OF THE EAST BAY

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In 2010, the East Bay Chapter of CNPS published A Guidebook to Botanical Priority Protection Areas (BPPA) of the East Bay. This publication maps and describes 15 areas with unique local and statewide plant resources. The publication calls out threats as well as opportunities for protection of the plant resources. Created with the layperson in mind, the coffee-table style book presents accessible ecological information among large scale maps, personal accounts, and scores of photographs of plants and vegetation. Since the publication of the BPPA text, data

and maps from this publication have been used for numerous planning and conservation purposes on local and regional scales. We will describe the use of the BPPA text in influencing the 1) Bay Area's Upland Habitat Goals project, 2) the Eastern Alameda County Conservation Strategy, and 3) Richmond's Pt. Molate Casino project. One of the clear benefits of creating this document is that it is helping East Bay CNPS meet plant conservation goals in Alameda and Contra Costa Counties. We believe this model could be an effective conservation tool for geographically based conservation groups.

## THE PINE HILL PRESERVE CONSERVATION PROJECT

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The Pine Hill Preserve (Preserve), located in western El Dorado County, CA, was established in 2001 to protect and manage habitat for eight rare plant species growing on gabbro soil. Five of these species are federally and State listed, and four are endemic to the Preserve's area. The Preserve is a cooperative conservation effort among eight Federal, State and County agencies and two private non-profit organizations. The partners work together under an existing agreement to acquire habitat for the rare plants through land exchange, donation, mitigation and purchase processes. The partners also help to direct and fund management activities at the Preserve. Currently, the Preserve staff manages 4,790 acres within several disjunctive parcels in the Cameron Park, Pine Hill, Penny Lane, Martel Creek and Salmon Falls units, and the adjacent Kanaka Valley area. Main vegetation types in the vicinity are chaparral, oak woodland, grassland, and riparian. Almost 10% of California's native flora is represented here. Ownership of the Preserve consists of Federal, State, and County parcels. Land acquisition processes during the last 20 years for lands managed under the Preserve system amount to more than twenty-six million dollars. The Preserve partners continue to determine conservation strategies to ensure long-term survival and habitat functionality for the rare plants. Land protection strategies include assigning priorities for potential acquisitions, establishing funding mechanisms for the acquisitions, and providing management of the protected lands.

## Session 12: Fire and Native Plants

### TO BURN OR NOT TO BURN: THE MANAGEMENT CHALLENGES OF *CEANOTHUS VERRUCOSUS*

Keith Lombardo, **Kevin Cummins**, Dawn Lawson, Department of Family and Preventive Medicine, University of San Diego, [kmcummins@mac.com](mailto:kmcummins@mac.com)

The maritime chaparral and coastal sage scrub communities of southern California are considered endangered ecosystems due, in part, to urban expansion and associated changes to fire regimes. *Ceanothus verrucosus* (CEVE) is an obligate-seeding shrub species restricted to these systems; CEVE shrubs are killed by fire and its seeds germinate in response to wildfire cues. Within 15-20 years post fire, the species is typically a dominant component of the shrub canopy. However, CEVE shrubs do not fruit in first years after germinating, resulting in this species' populations being vulnerable to very short fire return intervals. Conversely, the absence of fire in some systems has prompted managers to consider prescribed burning to ensure its persistence. Here we use dendrochronology to reconstruct historic CEVE population dynamics and data gleaned from an examination of San Diego's Cabrillo National Monument (CABR) seed banks to understand future recruitment and the relationship between this sensitive species

and wildfire. Our results indicate that coastal CEVE populations are long-lived and have characteristics that allow it to tolerate long fire return intervals. The persistence of viable CEVE seed in the patches where adult shrubs have died indicates that stands of CEVE would likely be replaced, should a fire occur, long after the population has been lost from the canopy. However, multiple fire events occurring at short to mid-term time scales in conjunction with an abundance of non-native species in the local seed bank poses a significant management challenge and threatens the existence of CEVE in southern California.

## FIRE HISTORY, SEROTINY, AND SEED DISPERSAL CUING IN A RARE CALIFORNIA CYPRESS

**Chris Mallek**, University of California, Davis, [crmallek@ucdavis.edu](mailto:crmallek@ucdavis.edu)

Our understanding of serotiny, including its expression and functional significance, comes primarily from research on serotinous species in the families Pinaceae (in the northern hemisphere) and Proteaceae (in the southern hemisphere). I examined patterns of variation in the strength of serotiny and seed dispersal cuing among populations of McNab cypress (*Hesperocyparis macnabiana*), a rare and increasingly threatened member of the Cupressaceae family endemic to northern California. I also evaluated the extent to which variation in the degree of serotiny correlated with fire history. Although the strength of serotiny in McNab cypress was high overall, I also found significant variation in the degree of serotiny among populations. Consistent with studies of other serotinous species, strength of serotiny was generally higher in populations comprised entirely of even-aged stands that originated following stand-replacing fires. In contrast, serotiny was generally weaker in populations containing uneven-aged stands where some recruitment had occurred in the long-term absence of stand-replacing fire. One exceptional population contained uneven-aged stands despite strong serotiny. Cones from this population were more necriscent (opening upon tissue death) than those from other populations, suggesting that weak serotiny and strong necriscence may represent alternative adaptations for allowing recruitment in the absence of stand-replacing fires. Overall, it appears that differences in historic fire regimes across the species' range have influenced the evolution of serotiny and seed dispersal cuing which may, in turn, result in differential population response to future alterations in fire regime.

## DOES AERIAL HYDROMULCH AFFECT CHAPARRAL RECOVERY IN COASTAL SOUTHERN CALIFORNIA?

Peter Wohlgemuth, **Jan Beyers**, USDA Forest Service, Pacific Southwest Research Station, Riverside, [jbeyers@fs.fed.us](mailto:jbeyers@fs.fed.us)

Aerially-applied hydromulch is used for erosion control after wildland fire in areas where post-fire sediment movement threatens highways, other high-value infrastructure, and homes, and where high winds would make straw mulch ineffective. Hydromulch consists of wood or paper fiber held together with a tackifier that also binds it to the soil; it is applied by helicopter or fixed-wing aircraft at considerable expense (around \$4000 ac<sup>-1</sup>) to land management agencies. Public concern over the impact of hydromulch on native plant recovery is high, especially in chaparral where a rich native herbaceous flora takes advantage of the light and nutrients available after fire. Post-fire vegetation development was examined on recent urban-interface burns in Orange and Santa Barbara counties, California that were treated with aerial hydromulch (not containing seed). Vegetation recovery was assessed in 1-m<sup>2</sup> plots (associated with silt fences used in concurrent erosion studies) at the end of the spring growing season. Total plant cover, shrub seedling density, and species richness were unaffected by hydromulch

during the first and subsequent years post-fire at all sites. Pre-fire vegetation composition, seed bank contents, and post-fire rainfall influenced plant abundance more than hydromulch. Vegetation regrowth was especially profuse in 2009-2010 on the Jesusita fire site, amounting to essentially 100% cover on many plots. Associated sediment measurements found that hydromulch did reduce sediment movement, predominantly in the first year post-fire. Where values at risk justify its use, aerial hydromulch can be a useful post-fire stabilization treatment in coastal southern California that won't harm chaparral recovery.

HOW DOES FOG AFFECT THE FIRE REGIME?

**Nathan Emery**, University of California, Santa Barbara, [nemery@lifesci.ucsb.edu](mailto:nemery@lifesci.ucsb.edu)

Understanding and predicting patterns of fire occurrence and effects of fire on the landscape is paramount because of the growing urban/wildland interface throughout much of California. There are many abiotic and biotic factors that influence fire and one that has not been explored is how coastal fog may affect the fire regime. Fog can be a significant force in shaping plant communities, particularly in coastal California ecosystems subjected to summertime fog, which has been shown to ameliorate temperature and reduce drought stress (Fischer, D. et. al. 2008). My research explores the relationship between these two physical processes by examining shrubland ecosystems of the central California coast. My initial question is how does fog water contribute to shrubland communities throughout the summer season? In an attempt to answer this question I've monitored six native shrub species in chaparral and coastal sage scrub communities for their live fuel moisture and plant water isotopes. I hope to establish the origin of plant water on a monthly basis to determine when native shrubs may take up fog water and how this corresponds to plant flammability. Ultimately, my research goals are to tease apart the various influences of fog on shrub vegetation and determine how fog influences the flammability of native shrubs in the California coastal regions. This knowledge will inform us how native shrub communities may shift in their distribution under climate change scenarios where the fire and fog regimes may change.

Abstract by **Zach Principe** arriving soon

IMPROVING WILDLAND FIRE MANAGEMENT IN SOUTHERN CALIFORNIA: THE CALIFORNIA FIRE SCIENCE CONSORTIUM - A NEW TOOL FOR OUTREACH AND COLLABORATION

**Marti Witter**, National Park Service, [mwitter@gmail.com](mailto:mwitter@gmail.com)

The Santa Monica Mountains National Recreation Area (SMMNRA) is a model for the wildland fire management issues in southern California. The southern California region is famous for its wind-driven fall wildfires that periodically burn through wildland-urban interface (WUI) communities, destroying hundreds or thousands of homes at one time. Beginning with the Bel Air Fire in 1961, major fire events have produced "Blue Ribbon Committee Reports" that evaluated the causes of the fire losses and made recommendations for changes. However, the thousands of homes that burned in the 2003 and 2007 firestorms are evidence that wildfire management policies have not been effective in stopping losses. The response to increasing wildfires nationally has been to emphasize increased fuels treatments. However, in southern California, the national model for solving the wildfire problem is inappropriate and can do substantial damage to our shrubland ecosystems. Prescribed fire in shrublands is neither a sustainable nor an effective method of providing long lasting hazard fuel reduction in a

landscape that is often over-burned from too frequent fires. Mechanical fuel modification, which thins or removes vegetation, degrades or destroys native plant and wildlife habitat. The California Fire Science Consortium is a new information center that has been established to develop personal relationships and facilitate scientific information transfer to support adoption of the most effective and least damaging wildfire management practices. In the SMMNRA, fire science let us change our fire management practices from landscape level fuel modification to focus on community wildfire safety at the WUI.

#### WHEN NATIVE SHRUBLANDS COLLIDE WITH IDEOLOGY: A CHALLENGE TO PRESERVATION AND RESTORATION

**Richard Halsey**, California Chaparral Institute, [rwh@californiachaparral.org](mailto:rwh@californiachaparral.org)

After the huge 1889 Santiago Canyon Fire in southern California, a regional San Diego newspaper exclaimed, "The menace should be removed by the removal of the brush. It is unsightly and dangerous." After the 2007 Witch Creek Fire, San Diego County's Department of Planning and Land Use developed a plan to remove "invading chaparral shrubs" from thousands of acres of wildland. The California State Park System is currently embarking on a project that will eliminate what they have classified as "unnatural monocultures of *Ceanothus palmeri*" (a common chaparral shrub) in a large state park that is characterized by extensive chaparral plant communities. Due to misunderstandings about Mediterranean-type ecosystems, a bias favoring trees over shrubs, and the large influx of federal money to conduct vegetation management projects, the preservation and restoration of native shrublands in California continues to be challenging. However, new research demonstrating the ecological importance of shrublands, their vulnerability to increased fire frequency, and how humans can live within fire-prone environments without radically compromising habitat values provides hope. Science is also providing a potent legal tool to help protect native shrublands from inappropriate land management strategies based on outmoded paradigms.

#### MONITORING VEGETATION REDUCTION TO CHANGE MANAGEMENT PRACTICES AND RETAIN MORE NATIVE SHRUBS

Anne Fege, **Kay Stewart**, Landscape Architect, [kaytaff@sbcglobal.net](mailto:kaytaff@sbcglobal.net)

Since the wildfires of 2003 and 2007 in San Diego, some "fuelbreaks" have been cleared of all native vegetation, converting large areas to opportunistic, invasive, highly flammable, mostly exotic, annual and perennial weeds. These species eliminate native habitat values, leave high fire risks, and invade adjacent untreated natural areas. CNPS members catalyzed the organization of the Citizens for Responsible Wildfire Risk Reduction (CRWRR) to monitor brush management crews' compliance with the "brush management" ordinance to thin and remove native plant communities along the wildland-urban interface on City and private lands. Eight sites were photographed before and after entry, and compliance with regulations were noted, including distance from structures, species removed and retained, spacing and combustible materials on or near adjacent structures. The CRWRR found wide discrepancies between the guidelines and practices, such as leaving large flammable exotic species and debris while removing relict single native shrubs. Unintended consequences included more weeds aggravating the risk of ignition and rapid spread of fire; increased annual maintenance costs; false sense of public safety; degraded property values and quality of life; and increased exposure to liability from erosion, mud slides, slope destabilization and flooding. The CRWRR recommended ordinances and regulations for existing and new buildings, the developed yard and non-irrigated vegetation to effectively eliminate risk factors as an integrated system. After

meeting with City council members and presenting findings at meetings, the City adapted its management practices to assess each site by a biologist, train crew supervisors, and retain many native shrubs and herbs.

## SCIENCE MEETS POLITICS OF VEGETATION "CLEARING" TO REDUCE WILDFIRE PROPERTY RISKS IN SOUTHERN CALIFORNIA

**Anne Fege**, San Diego Children and Nature Collaborative, [afege@aol.com](mailto:afege@aol.com)

Extensive native vegetation has been replaced by weeds in southern California due to defensible space focused on "clearing" vegetation rather than modifying structures. The science of wildfire risk reduction is often selectively applied, but has been enhanced by state and local CNPS position statements, engagement of CNPS members with managers and polity-makers to address practices that unnecessarily remove natives, and education programs. CNPS members documented native shrub and excessive vegetation removal in City of San Diego open space; met with staff and council members; and achieved greater attention to native habitat retention. CNPS members attended local FireSafe Council and Forest Area Safety Taskforce meetings and clearly articulated the costs and increased fire risks of removing and type-converting native vegetation, and ineffectiveness of large-scale fuelbreaks far from structures. CNPS members uncovered noncompliance of agreement to cover "take" within 100 feet of structures. CNPS members advised Senator Kehoe on AB 1595 (passed in 2008) to limit fuel management areas and focus on structural elements. The local CNPS chapter supported a lawsuit that led to the County of San Diego writing a complete environmental document for funded fuel reduction projects. CNPS members served as instructors in homeowners' classes offered by a community organization, featuring a fire official and landscape architect walking around a house to identify structural and homesite risks, retrofit, and maintenance actions. These contributions demonstrate how science and monitoring can improve local policies and practices to reduce wildfire risks and sustain native habitats.

## FIRE-RESISTANT LANDSCAPING

**Suzanne Schettler**, Greening Associates, [seschettler@gmail.com](mailto:seschettler@gmail.com)

Every year, the dry season raises concern about the risk of wildfires. There are limits to what we can do to prevent loss of property or life, but there are steps we can take. The limitations have to do with the fire environment itself, when temperatures and wind speeds are extreme. Lists of "fire-resistant" plants contradict each other, and even succulent plants like Iceplant can burn. Structures that are specifically designed to resist fire from the outside are nonetheless vulnerable because extreme temperatures can cause spontaneous ignition on the inside. Plants are fuel. We can create horizontal and vertical separations that deprive a fire of fuel, slowing it down or stopping it entirely. State law requires certain vegetative clearances around structures located in areas of CalFire jurisdiction. This does not translate to creating a barren moonscape. It may entail thinning, limbing up, trimming away dead material, and eliminating fire ladders. Creating horizontal and vertical gaps between plants or groups of plants, and between vegetation and structures, turns the landscape aesthetic inside-out. Instead of placing plants where they frame the view toward the house, plants are positioned to frame (or create!) a view from the house. Patios, terraces on a slope, or courtyards are fire resistant landscape features. Chaparral can be broken into discontinuous islands by cutting broad trails. Horticultural practices such as creating shaded fuel breaks or mowing contribute to fire resistance and simultaneously perpetuate rare native plants in their habitat.

## Session 13: Renewable Energy and Conservation in California

### FINDING BALANCE: BLM'S ROLE IN BALANCING CONSERVATION AND RENEWABLE ENERGY DEVELOPMENT IN THE DESERT SOUTHWEST

**Ashley Conrad-Saydah**, BLM, [Ashley\\_Conrad-Saydah@blm.gov](mailto:Ashley_Conrad-Saydah@blm.gov)

The Bureau of Land Management (BLM) manages millions of acres in the desert with solar, wind and geothermal potential. Many of those same acres also provide opportunities for conservation, recreation, and wilderness experiences, among many other uses. Through the Desert Renewable Energy Conservation Plan, the energy-zone based national Solar Programmatic Environmental Impact Statement, and other resource management plans, the BLM aims to provide space for all uses to occur, while ensuring the continued enjoyment and conservation of land in the future. Informed decisions about conservation in the desert are further facilitated by input from stakeholders, results of site-specific and modeling research and engagement with federal and state agency partners. The BLM consistently seeks to find balance in uses in our Desert Southwest.

### THE ENVIRONMENTAL, ECONOMIC, AND ENERGY SECURITY ADVANTAGES OF DISTRIBUTED SOLAR IN THE BUILT ENVIRONMENT OVER UTILITY-SCALE SOLAR PROJECTS ON UNDEVELOPED DESERT SITES

**Bill Powers**, Powers Engineering, [bpowers@powersengineering.com](mailto:bpowers@powersengineering.com)

The Joint Investor-Owned Utility (IOU) California Energy Efficiency (EE) Strategic Plan, places priority on achieving net zero energy residential and commercial buildings. "Net zero" means the structure produces as much energy as it uses over the course of a year. The three IOUs, PG&E, SCE, and SDG&E, would achieve 45% renewable power by 2020 with no new utility-scale wind or solar projects if the 2020 targets in the EE Strategic Plan are achieved. If the IOUs continue to meet EE Strategic Plan goals, they will hit 65% renewable power by 2030, and 80% before 2040. However, California is currently pursuing a renewable energy development strategy that relies primarily on utility-scale remote solar and wind projects. The high cost to ratepayers of utility-scale solar energy projects has become a source of national debate. These utility-scale projects are also typically used to justify high cost, high return-on-investment transmission lines that the utilities own and operate. Distributed generation resources located at the point-of-use provide maximum energy security relative to transmission-dependent remote resources. Mr. Powers will summarize the environmental, economic, and energy security advantages of distributed solar in the built environment over utility-scale solar projects on undeveloped desert sites.

### RENEWABLE ENERGY DEVELOPMENT AND SPECIES CONSERVATION IN CALIFORNIA

**Karen Douglas**, California Energy Commission, [KLdougl@energy.state.ca.us](mailto:KLdougl@energy.state.ca.us)

Karen Douglas, Commissioner at the California Energy Commission, will discuss California's aggressive renewable energy and climate goals, environmental issues associated with project development, and state and federal coordination in the permitting process. Commissioner Douglas will address collaborative efforts undertaken by state, federal, local, and non-governmental entities to minimize the environmental impacts of renewable energy projects. She

will also discuss the Desert Renewable Energy Conservation Plan, a comprehensive effort to plan for the development of renewable energy and environmental conservation in the Mojave and Colorado deserts.

CAN WE REALLY CALL DESERT SOLAR AND WIND “RENEWABLE” ENERGY?

**Chris Clarke**, Desert Protective Council, [coyotl@faultline.org](mailto:coyotl@faultline.org)

Advocates of large solar and wind energy projects in fragile desert landscapes often refer to their projects as “renewable energy” development. The energy transformed into electric power — sun and wind — may be renewable, but what of the projects’ other impacts? If energy companies proposed cutting ancient redwoods for biomass conversion, or filling Yosemite Valley with a reservoir to generate hydroelectric power, most of us would scoff derisively. The redwoods would grow back, and snowmelt would recharge the Yosemite reservoir each year, but few people would limit their assessment of the projects’ “renewable” nature to the specific sources of energy harnessed. Most people would demand that the assessment of the project’s “renewable”-ness address the nature of the habitats destroyed in order to install the power generating capacity. In desert landscapes development of industrial power generating facilities involves damage to the landscape that may take centuries, or millennia, to heal — if it ever does. Damage to ancient vegetative communities, to fossil aquifers and desert pavements, and to rare species — many yet uncatalogued — will not be repaired on a human time scale. Can we really call such projects “renewable”?

## **Session 14: Transmontane Flora: Progress in Our Learning amid Looming Change**

MONARDELLA IN THE MOJAVE - A STATUS UPDATE ON OUR KNOWLEDGE OF THE GENUS

**Mark Elvin**, Andrew Sanders, Jim Andre, US Fish and Wildlife Service, [mark\\_elvin@fws.gov](mailto:mark_elvin@fws.gov)

*Monardella* is an intriguing genus of annuals and subshrubs with over 50 taxa that occur throughout western North America. While many of the species in this genus are difficult to distinguish taxonomically, the perennial taxa in the Mojave Desert are quite distinct, albeit subtly, and have discrete non-overlapping ranges. During our work on *Monardella* over the past fifteen years, we have identified three new perennial taxa that occur in the Mojave Desert, with more yet to be described. These new discoveries demonstrate that the Mojave Desert remains a floristic frontier and that we still have an incomplete understanding of its flora in general. Like the flora of the Mojave Desert, our research with *Monardella* is a work in progress; voids and gaps persist about the identities of its species and their distributions. Amid increasing potential impacts to desert habitats, we need to increase our efforts to research and understand the taxonomy and distribution of the flora in the deserts. Ultimately, conservation is dependent upon sound and robust science.

INSIGHTS FROM A STUDENT OF TRANSMONTANE BORAGES, EMPHASIZING CRYPTANTHA SECTION OREOCARYA

**Ron Kelley**, Eastern Oregon University, [rkelly@eou.edu](mailto:rkelly@eou.edu)

The transmontane region of California encompasses the Sonoran and Mojave Deserts, the eastern Sierra Nevada including the White and Inyo Mountains, and the Modoc Plateau. In the region the family Boraginaceae is well represented by the genera *Cryptantha* and *Plagiobothrys*. Within the genus *Cryptantha*, development and expansion of the dry regions east of the California Floristic Province has promoted multiple speciation events leading to a proliferation of taxa. The warm to hot Desert Province with its short favorable growing season stimulated speciation in the annual *Cryptantha* taxa, while the cooler Great Basin Province, with its longer growing season and summer precipitation supported speciation in the non-annual *Cryptantha* taxa, specifically section *Oreocarya*. Section *Oreocarya*, as defined by, in spite of botanists making plant collections in California for over 100 years, some areas still are virtually unexplored. The Chemehuevi Mountains, just south of Needles in eastern San Bernardino County, is one example. All previous collections (93) were made along roads surrounding the mountains, or along the Colorado River, which runs past the east side of the range. In contrast, a trip in March 2011 penetrated deep into the southwest quarter of the range, tripled the number of plant specimens recorded, and added substantially to our knowledge of the vegetation and flora of this area. Three CNPS listed plants were found (*Parkinsonia microphylla*, *Psoralea fremontii* var. *attenuatus*, and *Pholistoma auritum* var. *arizonicum*), and also eight non-native species. The vegetation within the mountains is primarily Sonoran, but with some prominent Mojave influences (eg. *Yucca schidigera*). Comparison with other floras suggests that the specimens collected to date represent about 43% of the vascular plant diversity in "The Jepson Manual" (TJM), 1st ed., listed ten species, eight of which occur in the Great Basin Province and the two in the Desert Province exist in the desert mountains of the Mojave Desert. After extensive field work in the years prior to release of TJM, 2nd ed., two taxa were resurrected, *C. hoffmannii* I.M. Johnston and *C. subretusa* I.M. Johnston, and two taxa were newly discovered to the State, *C. celosoides* (Eastw.) Payson and *C. schoolcraftii* Tiehm. All these taxa occupied distinctive geologic substrates in the Great Basin Province. Edaphically focused conservation efforts to ascertain the existence of additional *Cryptantha* populations or species are ongoing and the results of this work will be discussed.

#### CALIFORNIA'S DESERT *ESCHSCHOLZIA*: PROGRESS IN OUR LEARNING AND LOOMING CHANGE

**Shannon Still**, Chicago Botanic Garden, [sstill@chicagobotanic.org](mailto:sstill@chicagobotanic.org)

The California poppy (*Eschscholzia*, Papaveraceae) is an iconic California native plant. But while most people are familiar with the common California poppy, *Eschscholzia californica*, the desert taxa have been understudied and are taxonomically confusing. This confusion stems from historical undercollection of plants within the Mojave Desert and a lack of molecular study. Molecular phylogenetic analyses and morphological study within *Eschscholzia* has highlighted the taxonomic issues within these desert taxa but also led to the discovery of new species within the genus. The desert *Eschscholzia* provide a good case study for the limited knowledge of desert taxa within even a well recognized genus and why the preservation of the desert ecosystem is important.

#### FILLING IN THE GAPS - A FLORA OF THE ARICA MOUNTAINS, RIVERSIDE COUNTY, CALIFORNIA

**Duncan Bell**, Rancho Santa Ana Botanic Garden, [dbell@rsabg.org](mailto:dbell@rsabg.org)

Within the California Deserts there are many botanical "black holes," or areas that have received little to no attention by field botanists and collectors, and thus require botanical

exploration and documentation. Because these areas undoubtedly harbor occurrences of plant populations that will contribute to our growing knowledge of the California flora, they must be documented via collection of specimens. The Arica Mountains in Riverside County, California was one of these "black holes," as evidenced by the lack of herbarium specimens collected from the region. The study area covers approximately 90 square miles in the Mojave and Sonoran desert transitional zone. A systematic floristic study has been conducted in the Arica Mountains between 2009 and 2011 resulting in an annotated checklist documenting approximately 200 vascular plants for the region. Nine previously undocumented CNPS-listed plant species were documented in an area where there were no prior records of special status plants.

## THE 2011 CHEMEHUEVI MOUNTAINS EXPEDITION

**Sarah De Groot**, Rancho Santa Ana Botanic Garden Claremont Graduate University, [sarah.degroot@cgu.edu](mailto:sarah.degroot@cgu.edu)

In spite of botanists making plant collections in California for over 100 years, some areas still are virtually unexplored. The Chemehuevi Mountains, just south of Needles in eastern San Bernardino County, is one example. All previous collections (93) were made along roads surrounding the mountains, or along the Colorado River, which runs past the east side of the range. In contrast, a trip in March 2011 penetrated deep into the southwest quarter of the range, tripled the number of plant specimens recorded, and added substantially to our knowledge of the vegetation and flora of this area. Three CNPS listed plants were found (*Parkinsonia microphylla*, *Psoralea fremontii* var. *attenuatus*, and *Pholisma auritum* var. *arizonicum*), and also eight non-native species. The vegetation within the mountains is primarily Sonoran, but with some prominent Mojave influences (eg. *Yucca schidigera*). Comparison with other floras suggests that the specimens collected to date represent about 43% of the vascular plant diversity in the range.

## A DEMOGRAPHIC MODEL OF A RARE PERENNIAL IN THE LIGHT OF SOLAR ENERGY DEVELOPMENT

**Kara Moore**, James Andre, Bruce Pavlik, Alison Stanton, Patrick McIntyre, Section of Ecology and Evolution, University of California Davis, [kmoore@ucdavis.edu](mailto:kmoore@ucdavis.edu)

Proposed utility-scale solar developments across the Mojave and Sonoran deserts of California will significantly impact special status plants. Among these, the herbaceous perennial *Penstemon albomarginatus*, White-margin beardtongue, is restricted in California to a narrow habitat North of the Pisgah Crater in the Central Mojave Desert; the majority of this habitat is slated for solar development in 2012. As part of an ongoing study, we explored the use of a preliminary demographic model based on six years of data on several subpopulations in the Pisgah vicinity to evaluate how the persistence or extinction of *P. albomarginatus* may be influenced by disturbance, herbivore impacts, and/or environmental uncertainty. We constructed a model based on ecological, life history, and demographic data and used it to predict population trajectories over time under two disturbance scenarios. We found strong negative effects of subpopulation disturbance and removal on the persistence of *P. albomarginatus* in California. In addition, herbivores were found to radically impact population persistence by limiting seedling survival and seed production. Protection from herbivory at the establishment and reproductive stages is an important component of a mitigation or restoration plan for this special status species. We discuss the implications of different levels of disturbance and potential mitigation strategies that may promote population viability.

## DISTRIBUTION OF VEGETATION IN A WESTERN MOJAVE DESERT GRASSLAND

**Sheri Spiegel**, Range Ecology Lab at the University of California, Berkeley,  
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In the western Mojave Desert, exotic invasives *Bromus madritensis* ssp. *rubens* and *Erodium cicutarium* are widespread, but despite their success, native herbaceous species are persisting at high cover. We went to the Mojave Desert side of Tejon Ranch to test our hypothesis that soil properties and position on the landscape are driving vegetation abundance and distribution in this native-exotic mosaic. Forty plots were randomly sited and stratified by landform and historical cultivation. At each plot we determined plant cover, collected shallow and deep soils for chemical and physical assays, and qualitatively measured environmental site factors including small mammal and cattle use. We found ten grassland community associations, including *Lupinus bicolor*-*Vulpia microstachys*, *Phacelia ciliata*-*Monolopia lanceolata*, and *Poa secunda*. Site aspect; past cultivation; and soil clay, pH, and nitrogen were correlated with vegetation distribution. Of the seven historically farmed plots, none supported native perennial bunchgrasses and five supported *Lupinus bicolor*-*Vulpia microstachys*. *Erodium cicutarium* and/or *Bromus madritensis* ssp. *rubens* were present in all plots but one, the former in low clay sites and the latter on cooler aspects. Results of this study can inform native plant restoration and weed eradication projects in Mojavean grasslands. *Phacelia ciliata* and *Monolopia lanceolata* should be planted in soils high in clay and pH. Sandy, low nutrient sites and even old agricultural sites are appropriate for *Lupinus bicolor* and *Vulpia microstachys*. Control efforts for *Erodium cicutarium* may be more successful on clay-rich soils, while control efforts for *B. madritensis* ssp. *rubens* may be more successful on warmer aspects.

## USING STABLE ISOTOPES OF N AND OXYGEN IN THE AIR, SOIL, AND VEGETATION OF THE WESTERN SONORAN DESERT TO EVALUATE SOURCES AND SINKS OF ANTHROPOGENIC NITROGEN IN THE ECOSYSTEM

**Michael Bell**, Edith Allen, James Sickman, Andrzej Bytnerowicz, University of California, Riverside, [michael.bell@email.ucr.edu](mailto:michael.bell@email.ucr.edu)

Anthropogenic nitrogen additions to the atmosphere are deposited in the western Sonoran Desert and alter ecosystem nitrogen cycling. Increasing nitrogen loads in the soil increases the presence of the invasive grasses and can lead to annual biomass accumulation capable of carrying fire. We have measured the stable isotopic composition of passively collected atmospheric nitrate to determine the sources of anthropogenic nitrogen. Isotopic analysis was then performed on KCl soil extracts taken from surface soil (5cm cores) to determine the influence of anthropogenic nitrogen on plant available nitrate. Winter annual plant species (*Schismus barbatus*, *Chaenactis fremontii*, and *Malacothrix glabrata*) were collected in December along with leaves from the dominant shrub, *Larrea tridentata*. Atmospheric isotopes measured in the Coachella Valley are consistent with values associated with industrial pollution from Los Angeles, while values within Joshua Tree National Park are associated with automobile exhaust created locally. Soil nitrogen from sites on the eastern edge of the valley have high  $\delta^{18}\text{O}$  values indicating an influence of anthropogenic nitrate. There is an inverse correlation between soil  $\delta^{18}\text{O}$  and  $\delta^{15}\text{N}$  of the *C. fremontii* leaf tissue, which may indicate that in areas of high deposition, the seedling is able to take up excess nitrogen deposited to the soil surface in the summer. Leaf tissue from *L. tridentata* had a similar relationship with summer atmospheric nitrogen concentration. These results indicate anthropogenic nitrate is only evident in the soils in areas of high deposition and that early germinating winter annuals may be used as bioindicators of deposition.

## CAN OLD DOGS LEARN NEW TRICKS? SOME CONSERVATION LESSONS FROM OWENS VALLEY

**Daniel Pritchett**, Conservation Chair, Bristlecone Chapter, CNPS, [skypilots@telis.org](mailto:skypilots@telis.org)

In the early 1900s, the Los Angeles Department of Water and Power (DWP) acquired control of virtually all water on the Owens Valley floor and began exporting it to Los Angeles. Many Owens Valley residents protested, and decades of contention and controversy followed. In 1970, passage of the California Environmental Quality Act provided Owens Valley residents with a new legal basis for action. Following 19 years of CEQA litigation, Inyo County and Los Angeles negotiated a historic agreement in 1991 which attempted to protect the Owens Valley environment while simultaneously providing a reliable water supply to LA. In 1998 Los Angeles began a dust mitigation project of unprecedented size at Owens Lake, which it had dried almost a century before. In 2002, prominent environmentalist Dorothy Greene declared the problem of Owens Valley over-pumping "has been resolved". In 2006, DWP released water down the channel of the lower Owens River for the first time in 80 years. The Sierra Club recently declared Los Angeles is doing a "stellar job of conserving water" while Los Angeles Mayor Antonio Villaraigosa has proclaimed his "absolute commitment" to Owens Valley environmental protection. Has Owens Valley, long a poster child for exploitative management, become a conservation success story? This talk will examine the rhetoric and the reality.

## LARGE-SCALE RENEWABLE ENERGY PROJECTS ON DESERT HABITATS: IMPACTS, ALTERNATIVES AND THE DIRECTION OF CONSERVATION BIOLOGY

**Laura Cunningham**, Author, Biologist, [bluerockiguana@hughes.net](mailto:bluerockiguana@hughes.net)

The last three years have seen an unprecedented rush to carry out industrial renewable energy development in functioning Mojave, Sonoran, and Great Basin Desert ecosystems. Utility-scale solar power plants as large as 7 square miles, as well as wind projects, and associated new transmission lines, present problems involving the destruction, disturbance, and fragmentation of diverse plant communities, as well as blockages to connectivity for genetic flow between populations. Most solar and wind power plants are sited on alluvial fans and low mountain ranges where biodiversity is often high. Many rare plant species are impacted. Invasive weeds may enter on numerous new roads that must be built into relatively undisturbed desert communities. Groundwater in varying amounts is pumped from relict basins for cooling steam turbines, panel washing, dust control, or cement-making for foundations on site. Concern over impacts of lowering of water tables on phreatophytic woodlands of mesquite, palo verde, and desert ironwood have been raised. Impacts to pollinator populations around large solar plants are also questioned. Mitigation for such projects is often weak or untested. Fortunately alternatives exist for future renewable energy projects, involving truly degraded agricultural lands, old mining sites, contaminated lands identified by EPA, abandoned urban lands, as well as distributed generation options in the built environment that have no impacts on desert vegetation.

## **Session 15: Tribal Conservation and Traditional Use of Native Plants**

### COOPERATIVE HABITAT RESTORATION OF A CALIFORNIA GRASSLAND

**Rick Flores**, University of California, Santa Cruz Arboretum, [rflores@ucsc.edu](mailto:rflores@ucsc.edu)

Indigenous peoples throughout the world have been manipulating and shaping terrestrial vegetation to benefit human use. At Pinnacles National Monument an extensive deergrass field (*Muhlenbergia rigens*) and expansive beds of whiteroot sedge (*Carex barbarae*) occupy a site within the recently acquired McCabe Canyon. McCabe Canyon is significant because it maintains a native grassland, oak woodland, and riparian ecosystems. Botanically, large stands of deergrass and whiteroot sedge are extremely rare in California. Culturally, deergrass and whiteroot sedge have deep meanings for past and present California Indian peoples, being highly valued for use in basketry, and traditional ecological knowledge teaches that both deergrass and whiteroot sedge respond favorably to intermediate human disturbance. The application of fire maintains healthy stands of deergrass and encourages new growth and flower stalk production. The process of tending whiteroot sedge helps to produce high quality rhizomes. The combination of permanent water, plentiful food and abundant basketry material provides a probable case that this site was tended by Native peoples. This project partners the Pinnacles park staff with the University of California, Santa Cruz Arboretum and the local Amah Mutsun Tribal Band for the purpose of restoring habitat quality, improving desired traits for traditional weaving, and reintroducing traditional management techniques using a collaborative approach with both traditional ecological knowledge and experiment-based science.

#### THE INTERDEPENDENCY OF NATIVE PEOPLE AND NATIVE PLANTS

**Richard Bugbee**, Ethnobotanist, Kumeyaay Community College, [hunwut@aol.com](mailto:hunwut@aol.com)

When European explorers first set foot in what is now referred to as Southern California, they saw a vast landscape teeming with native plants and wildlife. They also saw the Native People living off the land as hunters and gatherers having little influence in shaping vegetation growth and spatial patterns on a landscape level. Later work by anthropologists and ethnobotanists revealed that Native Americans did influence plant communities by way of traditional harvesting techniques but failed to realize the significance of Native American management influences because they were operating on models which portrayed Native Americans as recent immigrants with insufficient time and tools to significantly make changes within their environment. Further research and discoveries have placed man on the landscape much earlier than first realized. This knowledge has led to a greater understanding that the landscape, viewed by earlier explorers as "pristine wilderness", was actually a human managed landscape; developed over long periods of time. The Native People of Southern California relied heavily on the natural world around them and sought to manage natural resources in a way that would enable them to live as their ancestors have lived for centuries. Traditional ecological knowledge was passed down from one generation to the next; teaching with examples of successful and unsuccessful harvesting and gathering practices. Today Native People continue to pass on this knowledge to younger generations as a way to preserve and revitalize Native culture and resource management practices.

#### USING PLANTS TO TEACH CULTURE

**Stan Rodriguez**, Kumeyaay Community College Santa Ysabel Band Iipay Nation, [stanhatepah@hotmail.com](mailto:stanhatepah@hotmail.com)

The Santa Ysabel Band of the Iipay Nation has overcome many obstacles in keeping our cultural practices and heritage alive. Part of our success has been in using native plants to teach tribal members important aspects of our culture. Plants were used to make hunting and gathering tools such as bows and baskets. Plants were also used to create musical instruments

and toys for the children. Food and medicine also came from a wide array of native plants growing in the region. Teaching younger generations about culture and traditions is most effective when people not only learn the teachings but also develop a sense of pride and belonging that comes when knowledge is passed from the elders to the younger people. Challenges do remain, however, in having access to plants within an urban setting. Many locations have been so altered by urbanization that native plant communities are obliterated or completely changed. Access to intact plant communities is often restricted by private landowners and by various land management agencies. Land management activities such as herbicide spraying and seeding damaged areas with nonnative plant species are examples of practices that differ greatly from land management practiced by the Lipay Nation. Our people have lived in what is now known as Southern California since time immemorial and have learned everything we needed to know from the natural world around us. Our continued cultural and traditional practices rely upon our ability to maintain our connection to our land and the native ecosystems it supports.

## NATIVE ARTISTS AS ADVOCATES FOR PLANT CONSERVATION

**Abe Sanchez**, Promoter in the Revitalization of Indigenous Arts and Foods,  
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Native American artists are native ecologists and ethnobotanists. Traditional artists often take their inspiration from the natural world around them and are astute observers of the natural processes that shape and influence native ecosystems. Native artists know quite well the effects of human influences on the landscape; something that we now call "management". Native artists rely on access to native plants to secure raw materials needed to create traditional items. As others have pointed out, access is often limited due to changes upon the land that have taken place over the last two centuries. Access has been complicated by private land owners forbidding entry, urbanization that has removed or altered not only the native plant assemblages but also the natural processes that created and supported native plant communities. Land management agencies have also created obstacles to Native artists who need not only access to native plants but also need to practice traditional management techniques such as cutting and burning of native plants to influence ideal growth patterns in vegetation that are needed to create traditional items such as basketry, for example. Conservationists and Native artists share mutual goals of maintaining intact native plant communities and natural processes. Both recognize the importance of sustainable harvesting as a way to promote plant health and balance within the larger ecosystem. Native artists are strong advocates for healthy native plant communities and welcome opportunities to join with others who also desire healthy ecosystems.

## GATHERING FOR TRADITIONAL WELLNESS

**Lorene Sisquoc**, Curator, Sherman Indian Museum, [lsisquoc@gmail.com](mailto:lsisquoc@gmail.com)

Native people have relied upon the plants around them to provide shelter, food, clothing and medicine. Often there was more than one use for many of the plants. For example, a gatherer might harvest the seeds of a plant for food while also, at a different time, collect the leaves or roots for tea or for medicine. As a result the plant had to be harvested selectively in such a manner that the plant would be avoided during the flowering stage so as not to damage the future seed crop. The roots of the same plant would be collected in the autumn months after the seed had been harvested. Today it is not as easy to tend and harvest native plants as in the past. A group of local Native Americans have come together to revitalize the traditional use of native plants. Part of this revitalization is ensuring that Native elders have access to traditional

plants. Teams will go out and collect native plants and prepare them so that the elders, who can no longer gather plants on their own, can continue to enjoy native foods, medicines, and raw materials for making traditional items. The teams consist of experienced gatherers and of others with little traditional knowledge who want to learn more about the cultural wisdom of their ancestors. Together this team ensures that plant materials are available to those who want them while at the same time preserving the traditional ecological knowledge of their people.

#### WASHOE TRIBE OF NEVADA AND CALIFORNIA TENDING AND GATHERING GARDEN

**Shana Gross**, USFS - Lake Tahoe Basin Management Unit, [segross@fs.fed.us](mailto:segross@fs.fed.us)

The Washoe Tribe of Nevada and California and the USFS, Lake Tahoe Basin Management Unit (LTBMU) are collaborating to establish a traditional native plants tending and gathering garden. This project restores 0.25 acres (10,800 ft<sup>2</sup>) of land at the USFS Tallac Historic Site on the south shore of Lake Tahoe, CA. Fifteen plant species that are culturally significant to the tribe and native to the Lake Tahoe Basin are being planted in the garden, including *Achillea millefolium* (Yarrow), *Perideridia* spp. (Yampah), and *Ribes nevadense* (Sierra Currant). Planting events will occur with Tribal youth and elders to locally-collect seeds, cuttings, and transplants to be used to establish the plants. This is a significant project for the Washoe Tribe and the LTBMU. The Tribe currently has few places within the Lake Tahoe Basin to practice their traditional land management techniques. By hosting the garden, the LTBMU provides a new education opportunity for Lake Tahoe residents and visitors, by highlighting native plant identification and traditional uses. Volunteer involvement has been key to project success; Tribal members have volunteered time to the project with planning, species selection, and sign development, local high school students helped with initial garden construction (soil amendments, mulching, and path construction), and forest service volunteers are creating interpretive signage and conducting general upkeep. Plants will continue to be established through the spring, and future steps include creation of an interpretive brochure and development of a cooperative garden maintenance plan.

#### TRIBAL AND AGENCY CONSERVATION OF TRADITIONAL GATHERING AREAS AT MONO LAKE, CALIFORNIA

**Dean Tonenna**, Botanist, [dtonenna@blm.gov](mailto:dtonenna@blm.gov)

Mono Lake, California, renown for its natural beauty and biodiversity, is home to the Kootzatukadu, a Native tribal people who traditionally use many of the natural resources found in the area. The Native lifeways were dramatically altered with the arrival of settlers who exploited the area in an unsustainable fashion. Bodie, California, 20 miles to the north was an area of extensive mining, employing people in the Mono Basin to supply timber for the mining industry. Timber was harvested from an area immediately east of the Mono Craters which supported a large stand of Jeffrey pine. This area was also an important site for the Kootzatukadu who harvested peage; a caterpillar that was collected from the Jeffrey pine trees, and served as an important nutritious food source. Long after the Bodie mines closed, the U.S. Forest Service continued harvesting timber from the area. The Kootzatukadu, faced with the continued loss of Jeffrey pine trees, voiced concern over agency management of the area and began working with the agency to protect against over harvesting of the forest. The end result was the creation of a preserve which protects cultural and natural resources and also provides a place of interpretation where the public may visit and learn more about the Kootzatukadu lifeways and natural history of the area. The Kootzatukadu are thus ensured that cultural practices can continue now and into the future. This partnership between the Native American

community and federal agency provides an excellent example of conflict resolution and conservation.

#### GRANDMOTHER'S PRAYER: KEEPING CALIFORNIA INDIAN BASKETMAKING TRADITIONS AND CULTURAL MANAGEMENT PRACTICES ALIVE

**Lucy Parker**, Yosemite Miwok/Mono Lake Paiute, [Lucy\\_basket@yahoo.com](mailto:Lucy_basket@yahoo.com),

California Indians are hunters and gatherers, living off of the land. Basketry is a very big part of the culture. Native California tribes gathered fibers & roots to make baskets to hold water and to carry infants. Basket materials are hand-gathered at different times throughout the year, cured and seasoned. There are two types of basketmaking techniques: coiled & twinning. Dogbane fiber is important for making string which is then used to make nets. Soaproot fibers are used to make brushes for acorn cleaning. Acorn, which is gathered in the fall, is the main source of food for many California Indian tribes. Acorn nutmeats were removed from the shell and then pounded to fine flour. The bitter tannic acid, naturally found in the acorn, is leached away with water. The acorn flour is then placed into a water tight basket and cooked into a soup using hot lava stones to boil the water. This ancient process of acorn preparation has been passed on from generation to generation. Restoration of native plant communities is vital in keeping Native traditions and cultural management practices alive. This film will highlight these important traditions and show how new generations continue to follow the paths of their ancestors.

### **Session 16: Horticulture: Part of Conservation is Growing**

#### CREATING A LOCAL SUSTAINABLE GERMINATION MEDIA: EVALUATING GERMINATION AND GROWTH OF *ASTER CHILENSIS*, *ELYMUS GLAUCUS* AND *MIMULUS AURANTIACUS* IN EXPERIMENTAL MIXES THAT USE EARTHWORM CASTINGS AND RICE HULLS TO REPLACE PEAT MOSS AND PERLITE

**Molly McClary**, Golden Gate National Parks Conservancy, [molly.mcclary@gmail.com](mailto:molly.mcclary@gmail.com)

At the Presidio Native Plant Nursery growing for local restoration is performed with global conservation in mind. Currently, the germination media used contains peat moss and perlite. Peat Moss is harvested at an unsustainable rate and shipped long distances. Perlite is superheated volcanic rock, which is mined, processed and shipped. Testing to create a sustainable germination media began in 2006; past experiments include various blends of leached coconut coir, nitrolized fir bark, and compost. The 2011 trial evaluated the use of earthworm castings and rice hulls produced locally to replace peat moss and perlite. Three native species were tested in four experimental propagation mixes alongside the currently used commercial mix, Sunshine #5. Each flat was monitored to determine days to germination and harvested after six weeks to measure the biomass produced by both shoots and roots. All mixes were evaluated for physical and chemical properties before and after the experiment. Across species, there were 6% fewer germinants and less than one day delay to germination when comparing Mix #4 (peat and perlite-free) to Sunshine mix. Plants grown in Sunshine mix produced at least twice as much biomass as any other experimental mix. Soil lab results show Mix #4 became nitrogen depleted during the trial, which we speculate was caused by nitrogen drag from the rice hulls (high in carbon) and the reason for low biomass production. With follow-up experimentation, focused on improving nitrogen availability and fine-tuning the overall texture, Sunshine mix could be replaced with a sustainable media.

## EMULATING NATIVE ECOLOGY IN THE RESIDENTIAL LANDSCAPE

**Greg Rubin**, California's Own Native Landscape Design, Inc., [greg@calowndesign.com](mailto:greg@calowndesign.com)

Those who choose to landscape their homes with California native plants are often confronted with severe mortality, maintenance and appearance issues not found in nature. Mortality rates of 25 to 60% are common, especially in stressful locales. Many of these problems stem from the application of popularly accepted ornamental horticultural techniques to the design and installation of these gardens. Organic soil amending, fertilization, soil disturbance, misapplication of irrigation, improper grouping of plants, inappropriate plant selection, and unsuitable mulches are all examples of bad protocols that are fostered by the classic ornamental approach but which often lead to native garden failure. By contrast, much better results are experienced by emulating the most basic ecological conditions while eschewing inputs that are known not to exist in natural settings. This becomes especially critical for highly drought-tolerant upland species. Some of the approaches to be discussed include: avoidance of any organic soil amendments and fertilizer (excepting highly organic northern forest or wetland plantings); utilizing overhead based irrigation rather than drip systems; grouping plants by symbiotic plant community rather than haphazard mixing of species based solely on appearance; selecting the right plants/plant community for the soil type and irrigation schedule; and utilizing mulches that are of high quality and appropriate to the plant community. Using these techniques has dropped mortality rates to around 5% while enhancing the appearance and popularity of these types of gardens.

## DEVELOPING AND MAINTAINING A NATIVE PLANT NURSERY FOR LOCAL RESTORATION

**Deanna Giuliano**, Acterra, [drosegiuliano@yahoo.com](mailto:drosegiuliano@yahoo.com)

The Acterra Native Plant Nursery was started 15 years ago as a backyard project to supply plants for revegetation efforts on San Francisquito Creek. Today the nursery produces nearly 35,000 plants annually to support local restoration and landscaping activities performed by many public agencies and private landscapers. Based on a low budget business model, the nursery makes extensive use of donated and recycled materials and volunteer skills and labor to create high quality, healthy plants. Experience has shown that the entire process, including seed collecting, record-keeping, plant propagation, plant maintenance, and facilities construction and upkeep, can be done in a professional manner with a nominal financial investment. This presentation will discuss these topics, show photos of the low-cost operation, and present tips and techniques for minimizing your financial outlay while developing a viable and successful native plant nursery.

## IMPROVING NURSERY PRODUCTION OF 15 CALIFORNIA NATIVE PLANT SPECIES: HOW IMPORTANT IS HIGH AIR-FILLED POROSITY?

**Juliet Braslow**, University of California Davis Horticulture and Agronomy M.S. Student, [jnbraslow@ucdavis.edu](mailto:jnbraslow@ucdavis.edu)

The demand for native plants to supply restoration projects is on the rise. Native plant nurseries face challenges to produce sufficient healthy plant material. Anecdotal evidence indicates that many California native plant species are difficult to grow under typical nursery practices. This may in part be due to sensitivity to limited air-filled porosity ( $V_a$ ), limited aeration, and waterlogging. Nurseries often use a single container mix that can support a wide range of species. However, the optimum  $V_a$  for each species may vary. This is a grower-driven inquiry with the hypothesis that waterlogging symptoms experienced by California native plants is due to a lack of sufficient air-filled porosity in the container mix. The objectives are to determine the container media aeration needs of California native species and whether  $V_a$  is affecting their growth and yield. 15 representative species including grasses, forbs, and shrubs were selected (based on nursery surveys) and tested under two air-filled porosity treatments (10% and 22%) and two irrigation treatments (1x and 2x/day). Height, stem diameter, and appearance were measured regularly and varied within treatments. After two months, shoot dry weights were analyzed with one-way ANOVA. Results showed little significant difference between  $V_a$  and irrigation treatments for most (13), but not all species. An air-filled porosity of 10 - 22% should yield similar results for most of the 15 species tested in a nursery setting, but container aeration needs for California native plants should be tested on a species basis for optimal growth and highest success of out-planting for restoration projects.

## CONSERVATION GARDENS - A NEW STRATEGY FOR CONSERVING COASTAL DIVERSITY

**Brett Hall**, President CNPS and Director, University of California at Santa Cruz Arboretum, [brett@ucsc.edu](mailto:brett@ucsc.edu)

The central coast of California is renowned for extraordinary local endemism. In patches of chaparral, prairie, coastal dunes, scrub, wetlands, and forest, species grow in associations that are unique to their geographic setting. Many of these biodiversity hotspots are in decline because of historic and present-day land-use practices of our ever-expanding human population, and potentially as a result of a changing climate. A fascinating approach is to develop Conservation Gardens where many species that occupy a biodiversity hotspot are grown together in landscaped settings. Conservation gardens could emphasize communities from selected places along the California coast. This strategy would contribute genetic material of rare endemics available for habitat restoration in new settings if and when that becomes necessary, feasible, and desirable. The plants would be adapted to a variety of local conditions and potentially produce viable seeds and cuttings for future use. As additional benefits, the conservation gardens would appeal to wildlife and provide beautiful and interesting water-conserving landscapes for viewing. The UCSC Arboretum is developing central coast maritime chaparral collections where natural plant associations include suites of rare and endemic species that are targets for conservation gardens. Several population based displays are underway from Santa Cruz, Monterey and San Luis Obispo Counties. Examples from the Lockheed Chalks of Santa Cruz Co. (*Arctostaphylos ohloneana*, *A. glutinosa*), Fort Ord, Monterey Co. (*Arctostaphylos pumila*, *A. montereyensis*, *A. hookeri*, *Fremontodendron californicum*) and Cuesta Grade and Indian Knob, San Luis Obispo Co. (*Arctostaphylos obispoensis*, *A. lucida*, *A. pilosula*, *Trichostema lanatum*) among several others that will be presented to promote the concept.

## CONTINUITY IN IMPLEMENTATION AND MAINTENANCE ON 220 BIODIVERSE ACRES ON THE UCSB CAMPUS

**Wayne Chapman**, Cheadle Center for Biodiversity and Ecological Restoration UCSB,  
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Restoration projects are often designed, implemented, and maintained by separate entities, which often have some degree of unfamiliarity with or lack of access to the local environments and habitats of restoration projects. Similarly, plant material for restoration projects is often grown under contract far from the restoration site or is difficult to obtain. The Cheadle Center for Biodiversity and Ecological Restoration (CCBER) on the UCSB campus provides long-term stewardship on campus natural areas and implements restoration projects on a variety of ecosystems there. Tens of thousands of locally sourced, organically propagated plants are also grown by CCBER for these projects annually. The acquisition of local genotypes, locally rare and novel species, and the development of adaptive restoration methods can be more closely applied to campus lands in ways that outside contractors might find unfeasible. Through research, publication, and restoration seminars and workshops open to the community, CCBER can share lessons learned for improving protocols on performing restoration in this region.

#### THE ROLE OF LONG-TERM EX-SITU SEED COLLECTIONS IN THE CONSERVATION OF THE CALIFORNIA FLORA.

**Dieter Wilken**, Santa Barbara Botanic Garden, [dwilken@sbbg.org](mailto:dwilken@sbbg.org)

Seed collections play an important role in conservation efforts and their storage is a critical component of most conservation strategies. Protocols for ecological restoration and endangered species recovery, for example, now include methods designed to ensure genetic diversity and use of site-specific genotypes. Such "short-term" seed collections are clearly useful for propagation and as insurance against potential failure of initial restoration and recovery attempts. However, efforts to secure long-term storage collections are currently inadequate to provide insurance against extirpation or extinction of all members of the California flora. With appropriate preparation and storage conditions, some seeds can be stored for 100+ years, but not all taxa are amenable to long-term storage. Current efforts pursued by the Millenium Seed Bank project at Kew, BLM Seeds of Success program, and member institutions of the Center for Plant Conservation focus primarily on ecologically important species, and those currently listed by state and federal agencies, but not all such taxa are represented. For those species amenable to long-term storage, attention needs to be given to expand representation of at least all California endemics, ecological and geographic variation within them, including disjunct populations and those unlisted taxa that are threatened by the consequences of climatic change.

#### BEES AND FLOWERS: A LOVE AFFAIR THAT CONTINUES

**Gordon Frankie**, Robbin Thorp, Marris Ponder, Rollin Colville, Barbara Ertter, University of California at Berkeley, [gwfrankie@berkeley.edu](mailto:gwfrankie@berkeley.edu)

The bee labs at UC Berkeley and UC Davis collaborated in a statewide survey (2006-2011) of native bees and their host flowers in ~40 diverse urban gardens in 10 cities, ranging from Redding to Palm Springs. Several ecological patterns emerged from the survey including: a) diversity of native bees visiting garden flowers in most cities was higher than expected; b) most plant types attracted predictable taxonomic groups/species of bees; c) native bees preferred native plants, but also used some non-natives; d) non-native plants from South Africa, Australia, and Central/South America were largely ignored by native California bees. The survey also revealed that every public garden offered no or poorly prepared information on the role that bee

pollinators have played in the evolution of the 5000+ angiosperm plants in California. The Living Desert in Palm Desert provides an exception to the lack of information on bee-plant coevolution and serves as a model for other public gardens.

## THE CRITICAL ROLE OF HORTICULTURE IN THE CONSERVATION AND RESTORATION OF CALIFORNIA NATIVE PLANT INDIVIDUALS, POPULATIONS, AND ECOSYSTEMS

**Bart O'Brien**, Rancho Santa Ana Botanic Garden, [bobrien@rsabg.org](mailto:bobrien@rsabg.org)

As conservation and restoration of California native plant species and ecosystems becomes a more critical concern in California, many of our NGOs and governmental agencies and systems are recognizing that they are unprepared to address, evaluate, and to meaningfully provide for the horticultural needs and requirements of our diverse native flora. Horticulture, the art and science of growing plants, is often a weak link in our plans to conserve or restore sustainable populations and ecosystems of rare and endangered native plants in a dynamic environment. This presentation will provide an overview of some of the major horticultural issues and how to resolve them in a productive manner. Both exemplary and cautionary case studies highlighting horticultural practices and consequences (both in situ and ex situ) relating to the conservation of California native plants will be presented. California native taxa in this presentation include: *Arctostaphylos densiflora*, *Arctostaphylos franciscana*, *Astragalus pycnostachyus* var. *lanosissimus*, *Calystegia sepium* ssp. *binghamiae*, *Cercocarpus traskiae*, *Clarkia franciscana*, *Clarkia imbricata*, *Eriastrum densifolium* ssp. *sanctorum*, *Eriogonum ovalifolium* var. *vineum*, *Nolina interrata*, *Pinus radiata*, and *Pogogyne abramsii*). The case of *Deppea splendens* (formerly from Chiapas, Mexico) will also be discussed.

## NATIONAL INTERAGENCY NATIVE PLANT MATERIALS DEVELOPMENT PROGRAM: ENSURING OPTIONS FOR THE FUTURE IN A CHANGING CLIMATE

**Peggy Olwell**, Christina Lund, Plant Conservation Program Lead, Bureau of Land Management, [polwell@blm.gov](mailto:polwell@blm.gov)

The Bureau of Land Management (BLM) is leading over 500 partners across the country working on the National interagency Native Plant Materials Development Program (NPMDP). Wildland native seed collections and propagation are the foundation of this program. Through partnerships with other Federal agencies, state agencies, academic institutions, botanic gardens, and others, the NPMDP works to supply the quality and quantity of native plant materials needed for restoration after fire, energy development, recreation, and grazing. Currently within the NPMDP there are four ecoregional programs, which focus on the Great Basin, Pacific Northwest, Colorado Plateau and Mojave Desert. These ecoregional efforts allow partners to focus on specific issues and threats facing the native plant communities unique to their ecoregional area. For example, since 2005, more than one million acres of the Mojave Desert have burned illustrating a need for native plant materials for restoration and rehabilitation. Climate change and energy development are particularly large forces impacting the southwest. Though solar and wind development offer renewable energy resources, the installation of their infrastructure could affect the native flora. Additionally, current climate predictions show that the temperatures and drought are predicted to increase in the southwest which could lead to increased fire cycles and invasion from non-native species. These challenges facing California's native flora, though great, can be aided with the help of this long-term program to develop genetically appropriate native plant materials for restoration and as an adaptation strategy under a changing climate.

## **Session 17: The Vital Role of Education in the future of Conservation**

### CALIFORNIA'S NEW ENVIRONMENTAL EDUCATION INITIATIVE

**Judy Sanregret**, Santa Barbara Botanic Garden, [jsanregret@sbbg.org](mailto:jsanregret@sbbg.org)

Using Science Education to change attitudes and behaviors: The new California Education and the Environment Initiative (EEI) represents a fundamental change in the expectations for K-12 environmental literacy skills and knowledge. Beginning with AB 1548 (Pavley, Chapter 665, Statutes of 2003) and AB 1721 (Pavley, Chapter 581), Statutes of 2005), this ambitious landmark effort mandated the development of the EEI curriculum to bring education about California's native plant and animal communities to K-12 students by 2010. This engaging and colorful curriculum teaches selected science and history-social science standards to mastery, and will help students better understand how they influence the environment and how it influences them. The goal of the grade-level units is to help students be better informed when they make choices that affect their own health and the future of a healthy environment. This presentation will introduce participants to the vital role that formal and informal native plant organizations can play in the implementation of this new curriculum, which is currently being introduced into classrooms across California. After a review of the topics covered such as sustainability, global climate change, waste, water, energy, and resource conservation, we will look in depth at two units: 2nd grade unit, "Flowering Plants in Our Changing Environment" and 4th grade unit, "Plants: the Ultimate Energy Resource." We have a unique opportunity to support the schools in ways that are both innovative and fun and will result in students who are better informed about native plants and their fragile ecosystems.

### MAKING THE VALUES OF PLANT CONSERVATION AND RESTORATION INCLUSIVE TO DIVERSE (HUMAN) COMMUNITIES

**Jack Shu**, Private Consultant, [jkshu@cox.net](mailto:jkshu@cox.net)

For decades, agencies and non-profits, focused on natural resources, have tried to recruit members and seek support from non-white communities. This is particularly important in California, where the great ethnic and racial diversity of the population continues to increase. Most of the efforts of these organizations have had limited results. Yet there is mounting data from polling information to surveys indicating that people of color support environmental causes, natural parks and conservation more than the average white population. Why then, are the membership and support of organizations like CNPS predominately white? This presentation will review some recent information from polling data and surveys on Hispanic, black and Asian American views on the environment and related issues, then comment on the limitations of using an assimilation model to recruit non-whites, and its effect on organizational diversity. An alternative approach will be presented using the "product of the product" concept, a way to make an issue more relevant and valued. This requires a shift away from resource centric ways of thinking to community centric strategies. It does not affect the core mission, values or interests of the organization. Instead it will enhance and broaden them, opening the door to new partnership opportunities and expanding community support.

### EMPOWERING YOUNG PEOPLE, FROM DIVERSE BACKGROUNDS, TO BECOME TOMORROW'S ENVIRONMENTAL LEADERS

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There is a critical need to build students' understanding of conservation and to prepare them to fill the roles of future decision-makers and the environmental workforce. In particular, efforts are needed to reach the underserved communities, which represent the fastest growing demographic in the nation. In order to build future leadership in this arena, we must employ innovative approaches that generate young peoples' interest and develop their capabilities early in their education so that an increased number will understand the natural world and how they can develop the solutions for today's and tomorrow's challenges. We will share lessons learned from over ten years of experience in building environmental knowledge, transforming behaviors, and developing local and future leadership. We will describe best practices tested, successful approaches, and the challenges still underway. Ocean Discovery Institute's model uses authentic discovery to generate the spark that makes young people, from the most urban and diverse backgrounds, eager to learn and act as stewards. As these young people discover the world around them, they discover themselves and their future as environmental leaders. The success of this model includes increasing students' science performance, attendance in college, selection of science and conservation majors, and contributions directly to the field of environmental science. Content assessments, surveys, interviews, and tracking data demonstrate 73% of student graduates declaring majors in science and conservation fields, higher scores on standardized tests relative to their peers, and contributions to environmental science research including 10 publications and more than 30 scientific presentations.

#### COLLABORATING ON CONSERVATION EDUCATION FOR NATIVE HABITATS IN SAN DIEGO

**Anne Fege**, James Absher, Leta Bender, Crystal De Soto, Leanne Teiper, San Diego Children and Nature Collaborative, [afege@aol.com](mailto:afege@aol.com)

Extensive research has shown that significant nature-related life experiences contribute to commitment to conservation of natural areas, yet the decades-long trend of declining nature experiences for children and adults challenges both public and political appreciation of conservation. Established in 2009, the San Diego Children and Nature Collaborative promotes public awareness, support, and participation in nature-based learning and play, focused on school, youth, and family experiences in "nearby nature." Since an inventory of educational materials showed that locally-dominant chaparral shrublands were largely unrepresented, the Collaborative developed and piloted a fourth-grade curriculum, nearby nature field trip guidebook, and Pocket Naturalist Guide for chaparral shrublands. Efforts are now focused on encouraging teachers to use this chaparral curriculum and arranging for naturalist guides to walk with classes and after-school groups to nearby natural areas. As the Collaborative recognized that adults decide whether to schedule nature-based activities in school and non-school settings, it undertook a research project in 2011 to interview after-school program providers and parents to assess decision-making processes, institutional factors, and awareness and attitudes of these adults about nature experiences for children. Key factors were alignment with after-school program goals and structure, adults' perceptions of student's experiences, and beliefs in the values of nature experiences to child development. The development of locally-relevant educational materials and the systematic identification of factors affecting awareness, attitudes, and actions relating to nature-based experiences are expected to enhance the Collaborative's contributions to public and political support for native habitat conservation.

#### OPENING THE WORLD THROUGH NATURE JOURNALING

**John Muir Laws**, [johnmuirlaws@gmail.com](mailto:johnmuirlaws@gmail.com)

The California Native Plant Society has created an exciting new curriculum that teaches children to become keen observers of the natural world by drawing and writing about the plants and animals in situ. Keeping a field journal develops and reinforces the most important science process skills; observation and documentation. All other parts of the process of science depend on these skills. We assume that we are naturally good observers, but learning to really see is a skill that must be learned and developed. Journal activities tie directly to the State of California science framework content standards and the visual and performing arts framework content standards. In a set of nested exercises, students use games to gain confidence in drawing and writing as a way to gather information. Later, they employ these skills to put together a field guide, make treasure maps, and to write short stories and poems.

#### THE CALIFORNIA NATIVE PLANT SOCIETY'S RARE PLANT TREASURE HUNT: PROMOTING RARE PLANT CONSERVATION THROUGH CITIZEN SCIENCE

**Danny Slakey**, California Native Plant Society, [dslakey@cnps.org](mailto:dslakey@cnps.org)

California is a botanically rich state, and its rare plant flora is no exception, with over 2000 California Rare Plant ranked plants. Maintaining records of these plants in the California Natural Diversity Database is a difficult task, as almost half of the state's 32,000+ rare plant occurrences were documented 20 or more years ago. As climate change, development, groundwater depletion and invasive exotics threaten many of these known populations, current data is important for their conservation. Also, many remote portions of California have seen little botanical exploration, with an estimated 6-10% of Mojave Desert flora remaining un-described. To address these issues CNPS formed the Rare Plant Treasure Hunt, a citizen-science program in which volunteers gather data on California's rare plants while learning about rare plant conservation. Volunteer groups are provided with maps, occurrence data, and plant identification materials to search historically populated locations or potential rare plant habitat. Participants have diverse backgrounds and include CNPS members, consultants, conservation groups, and botany enthusiasts. Groups have at least one experienced botanist, which helps ensure reliable data and provides teaching opportunities. Participants are introduced to or learn more about botanical principles and field methods, including keying out plants, botanical and ecological terminology, and survey techniques. An estimated 908 rare plant occurrences have been updated since the program began in 2010. In 2011, 47% of occurrences were new and 29% were historical. Volunteers have contributed over 4800 hours to the project. This talk will give an overview of the program and highlight projects undertaken by volunteer groups.

#### NATIVE PLANT PHENOLOGY PROJECT ENGAGES CITIZEN SCIENTISTS IN CLIMATE CHANGE RESEARCH

**Mary Ann Hawke**, Anne Fege, Debbie DeRoma, Geodactics, [hawkema@gmail.com](mailto:hawkema@gmail.com)

Continuing the legacy of naturalists observing and documenting natural phenomena, the San Diego County Phenology Project trains volunteers to document the flowering trends of local plants. Scientists worldwide have documented an advancement in the onset of spring, along with biological responses to climate change. Species that cannot adapt to a shift in "nature's calendar" experience asynchrony in their seasonal patterns, potentially affecting ecological balance. In San Diego County's specialized mediterranean climate, it cannot be assumed that changes in climate and phenology will be similar to those documented in other regions. While the USA National Phenology Network (NPN) and Project Budburst collect phenology data

nationwide, only a few species on their list are native to southern California. Therefore one focus of this project is to identify key plants to monitor in San Diego. Another is to make climate change more locally relevant. By training citizen scientists to document plant phenophases we sharpen their focus on what is happening in their own back yards, and the real-world impacts to our community. Most importantly, regional data are generated and the records submitted to the NPN database can be extracted and analyzed with local climate data. As an internationally recognized biodiversity hotspot, San Diego needs to identify potential threats to regional flora and fauna; otherwise how can locally relevant conservation measures, or climate change adaptation and mitigation be developed? Citizen science projects increase scientific literacy and skills, encourage people to connect with nature, and contribute to local decision-making and conservation.

#### THE CALIFORNIA PHENOLOGY PROJECT: TRACKING NATURE'S PULSE TO ASSESS CLIMATE CHANGE RESPONSE ACROSS CALIFORNIA LANDSCAPES AND NATIONAL PARKS

Sylvia Haultain, **Liz Matthews**, Christy Brigham, Janet Coles, Angela Evenden, Sue Fritzke, Kathy Gerst, Brian Haggerty, National Park Service, [matthews@lifesci.ucsb.edu](mailto:matthews@lifesci.ucsb.edu)

Phenology is the study of seasonal or periodic biological events such as flowering, leaf-out, insect emergence, and animal migration. The dynamic seasonal status of plants and animals is closely linked to ecological and climatic variables, and provides an integrative signal of environmental quality. Compelling to observe and simple to record (through a standardized system developed by the USA National Phenology Network), phenology offers a framework for professional and citizen scientists of all ages to connect with the dynamic pulse of our planet through direct engagement in scientific observation, thereby providing an accessible platform from which to educate the public about climate change. This talk will describe the process used for selecting target species from California's diverse flora, the pilot projects in place in six California national parks, the underlying research questions being addressed by the program, and what resources are available for engaging citizen and professional scientists throughout California. The California Phenology Project is incorporating public education and outreach with sound scientific practices through the establishment of phenological monitoring protocols in National Park Service and UC Natural Reserve System units in California. With funding from the National Park Service Climate Change Response program and the UC Office of the President, project collaborators (including the Phenology Stewardship Program at the University of California, Santa Barbara, the US Geological Survey, and the USA National Phenology Network) are laying the groundwork for phenological monitoring in plant communities throughout California.

#### CONSERVATION OF THE CALIFORNIA FLORA: THE ROLE OF HERBARIA

**Staci Markos**, Richard Moe, Jepson Herbarium, University of California Berkeley, [smarkos@berkeley.edu](mailto:smarkos@berkeley.edu)

Herbaria provide an increasing diversity of support and information to the conservation community. Much herbarium activity centers on the collection, identification, and curation of specimens and the sharing of data that comes from them. Specimens housed in herbaria and online resources that serve specimen data, such as the Consortium of California Herbaria, allow for the integration of historical and present day data. Some of the most data-informed tools include those developed for geographic mapping applications which are widely used to document and evaluate the status of both rare and weedy taxa, focus floristic projects in under-

collected areas, document new taxa for the state, and expand documented taxon ranges within the state. In addition to the traditional focus on plant specimens, many herbaria also have active teaching and outreach programs that engage and support CNPS members, who in turn provide valuable contributions to the collections and are an integral part of the continued success of herbaria. If we are to ensure the longevity of both specimen collections and the electronic resources that result from them, continued support is needed to maintain the physical collections in herbaria and to digitize (and publish online) the associated information.

## CONSERVATION PLANS FOR NON-LISTED SPECIES

**Gary Wallace**, Research Associate Rancho Santa Ana Botanic Garden and U.S. Fish and Wildlife Service, [Gary.Wallace@cgu.edu](mailto:Gary.Wallace@cgu.edu)

Conservation plans for non-listed species can illustrate the conservation needs of rare plants and provide land managers with an early alert to the identification of species at risk. Graduate students in the Botany Department, Claremont Graduate University prepare the plans. Students select a plant from among those on the CNPS list 1B and look into its biology and distribution. They are encouraged to acquire information from a variety of sources including species experts, resource agencies, databases, landowners, and managers. Students assess species vulnerabilities, and occurrences for threats and potential remedies. The plans provide an independent assessment of the conservation needs of the species, information gaps, and recommendations of conservation actions. Students receive input and guidance from a variety of sources, gain real world experience, and for some, garner a publication.

## Session 18: Student Session

### ANATOMICAL AND MORPHOLOGICAL EVIDENCE FOR A NEW TAXON OF *CALYSTEGIA* (CONVOLVULACEAE)

**Sandra Namoff**, Emily Schultz, Rancho Santa Ana Botanic Garden, [snamoff@gmail.com](mailto:snamoff@gmail.com)

Recently, a group of CNPS members found a population of *Calystegia* R.Br in the Sierra Nevada Foothills that was not immediately diagnosable to a particular species. Based on habit, habitat, and indumentum characteristics the new taxon aligns closely with *Calystegia stebbinsii* R.Br, a narrowly distributed edaphic endemic. However, *C. stebbinsii* has a distinctive, palmately divided lamina. The leaf shape of the new taxon is triangular/hastulate, which is similar to SNF taxon *C. occidentalis* ssp. *fulcrata* (Gray) R.Br. To determine the taxonomic placement of this new form of *Calystegia*, leaf anatomy was investigated. In addition to *C. stebbinsii* and *C. occidentalis* ssp. *fulcrata*, four species of *Calystegia* with hastulate leaf morphology were included. Leaf blade material was embedded in paraffin wax, sectioned and stained. Micromorphological characteristics were compared using scanning electron microscopy. Results confirm the close alliance of the new taxon with *C. stebbinsii* and *C. occidentalis*. These three taxa have isobilateral leaf symmetry. The other taxa included in the study have bifacial leaf anatomy with the typical arrangement of palisade and spongy mesophyll. These three taxa are also united by the presence of unicellular glandular trichomes. These results support that the new form is closely related to *C. stebbinsii* and *C. occidentalis* ssp. *fulcrata*, but the intermediacy in leaf morphology of the new taxon invokes the possibilities of hybrid or allopolyploid origin. These possibilities, which have taxonomic and management implications, will be investigated further.

## FROM SEA LEVEL TO MOUNTAIN PEAKS: THE EVOLUTION AND BIOGEOGRAPHY OF THE RARE POLEMONIUMS (POLEMONIACEAE)

**Rebecca Stubbs**, Paul Stevens, San Francisco State University, [stubbsrl@gmail.com](mailto:stubbsrl@gmail.com)

In 1828 Lindley remarked about *Polemonium* that "the whole genus and order are in a miserable state of confusion. Since then several taxonomists have studied the genus, but questions remain about relationships, identities, and ranges among several species of *Polemonium*. In particular, three California species continue to be sources of ambiguity. *Polemonium chartaceum*, a primarily White Mountain species, has a disjunct population on Mt. Eddy in the Klamath Range. Previous researchers have suggested that the Mt. Eddy population of *P. chartaceum* in Klamath National Forest may be a distinct species. *Polemonium pulcherrimum* has had infraspecific taxa recognized, but these have not been included in recent phylogenetic studies, despite their distinct appearance. *Polemonium carneum* had not been scientifically documented in California since the 1950s; however, we have recently found that it is not extirpated from California as was commonly thought. I am using molecular sequence data for the nine taxa found in and near California, with multiple populations sampled for the three focus species. With these data I am able to further resolve phylogenetic relationships in the genus. Results support the taxonomic distinction of the Mt. Eddy population of *P. chartaceum*, *P. carneum*, and a reinstatement of *P. pulcherrimum* var. *pilosum*. Resolution of these issues allows for a clearer sense of the conservation needs of these taxa.

## A GEOGRAPHIC ANALYSIS OF LOCALLY RARE PLANT SPECIES OF SONOMA COUNTY

**Eliza Shepard**, San Francisco State University, [shepardeliza@gmail.com](mailto:shepardeliza@gmail.com)

Currently there are systems in place to give protection to rare taxa. Taxa are classified as rare on a global, national, state, and local level; however, there are no universal criteria used to classify locally rare taxa. These are taxa that are rare or infrequent within a smaller geographic boundary, like a county, but common in other areas. Using Geographic Information Systems (GIS) to analyze area occupancy based on existing plant distribution maps, taxa were classified as locally rare in Sonoma County, which has a long and rich floristic history. Many species have small, peripheral populations in Sonoma County but are common elsewhere in California. The ability to quantify these peripheral populations is important from a conservation standpoint, because they may be genetically distinct from the core populations, and may warrant protection. In 2008, the "L-Rank" system, for Locally Rare, was applied to Napa County to identify and assess locally rare species. By applying the L-Rank protocol and criteria to Sonoma County, a larger, more floristically and ecologically diverse region, we show that this system is a feasible and successful technique for rapid assessment of local rarity. Using the L-Rank system, a floristic list of the species found to be locally rare in Sonoma County has been developed. This method of assessing locally rare species has the potential to be particularly useful for conservation of peripheral populations on a county level.

## A POPULATION VIABILITY ANALYSIS OF THE LASSICS LUPINE

**Helen Kurkjian**, Erik Jules, Sydney Carothers, Humboldt State University, Dept of Biological Sciences, [hmk15@humboldt.edu](mailto:hmk15@humboldt.edu)

The Lassics lupine (*Lupinus constancei*) is a rare forb of limited distribution, restricted to two occurrences in Humboldt and Trinity Counties in the Lassics Botanical Area of the Six Rivers National Forest. The vitality and endurance of this population face numerous challenges,

including heavy seed predation and encroachment of surrounding plant communities on the lupine's preferred habitat. Analysis of historical photographs indicates that the adjacent Jeffrey pine forest and chaparral have been extending their ranges up Mount Lassen over the past several decades. We used herbivory exclosures and seed trays to investigate the relationships of seed production and predation by small mammals to proximity to these adjoining habitat types. Plants that were closer to the forest produced fewer seeds, while seeds closer to the chaparral experienced heavier predation pressure. We combined this information with ten years of demographic monitoring data collected by the US Forest Service, which we used to build transition matrices, approximate the population growth rate and estimate the probability of extinction in 50 and 100 years. Results indicate that continued monitoring is warranted and management actions should be modified. Finally, we used all of these elements together with sensitivity and elasticity analyses to make management recommendations for how best to support the persistence of the Lassen lupine.

#### EFFECTS OF INTRODUCED HERBIVORE CONTROL ON RARE AND ENDEMIC PLANTS OF SANTA ROSA ISLAND, CALIFORNIA: CHANGES IN SPECIES ABUNDANCE

Diane Thomson, Jennifer Phillips, **Acadia Tucker**, W.M. Keck Science Department, Pitzer College, [acadia.tucker@gmail.com](mailto:acadia.tucker@gmail.com)

Island communities are important to biodiversity conservation due to their high degree of rarity and endemism. However, island diversity is also especially threatened by factors such as introduced herbivores and climate change. Santa Rosa Island (SRI), California, was historically home to several species of introduced herbivores which threatened endemic plant diversity. In 1994-5, cattle were removed and elk and deer numbers reduced, but the effects on rare plants are not yet well documented. From 1994-96, a survey was conducted for 55 of the threatened plant species on SRI. A subset of canyon and coastal bluff habitat on SRI was systematically searched, the locations of occurrences mapped and their total abundances recorded. In 2010-11, we began a resurvey of this habitat. We present a preliminary analysis from Cow Canyon, documenting changes in species diversity and abundances. Our results show a 240% increase in the number of rare and endemic plant species since herbivore removal began. For the nine species present in both surveys, the abundance increased by 1172% on average. In 1996, none of the focal species had populations over 1000, and 5 of the 9 observed species showed abundances of fewer than 100; the 2011 survey recorded abundances between 1000 and 10,000 plants for 5 species, and of 100-1000 for 5 others. Our findings suggest that removal of herbivores substantially reduced extinction risk for these populations. Additional analysis and continued monitoring are needed to determine which species are now secure, and which will require further intervention.

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**Jennifer Phillips**, Acadia Tucker, Emily Schultz, Kathryn M. McEachern and Diane M. Thomson, Scripps College, [JPhillip7402@ScrippsCollege.edu](mailto:JPhillip7402@ScrippsCollege.edu)

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## VEGETATIONAL CHANGES FOLLOWING THE RELEASE FROM FERAL GRAZING PRESSURE: SAN CLEMENTE ISLAND

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In this study, we accumulated vegetation data on San Clemente Island from 1986-2011 with the goal of assessing the compositional changes that have taken place since feral goats were removed. San Clemente Island, Channel Islands, California, USA. Fourteen 50-meter transects were sampled in 1986, 1988, 1990, 1992 and 2011, eight in grasslands, and the remaining six in coastal sage scrub. We examined the differences in percent cover of several categories (Non-native/native herbs/sub-shrubs/grasses/vines) amongst grassland and coastal sage scrub transects using a repeated measures ANOVA. Grassland communities showed significant increases in multiple species of non-native grasses (*Avena fatua*, *A. barbata*, *Bromus hordeaceus*, etc.) which now dominate these areas in addition to decreases in native bunch grasses (*S. lepida* and *S. cernua*). Native sub-shrubs showed significant increases in coastal sage scrub transects, most notably in boxthorn (*Lycium californicum*) and island silver lotus (*Lotus agrophyllus* var. *argenteus*). Native herbaceous cover also increased over non-native cover in coastal sage scrub. The native vine (*Calystegia macrostegia*) increased in cover most profoundly in both vegetation communities, being non-existent through 1992. Only one species of the native bunch grasses showed a slightly significant increase in cover (*S. pulchra*), which was overshadowed by tremendous increases of non-native grasses. Grasslands on San Clemente Island possess severe obstacles in restoration to pre-herbivore conditions. The coastal sage scrub community has shown trends in succession that support a more native assemblage.

## CAN CONSERVATION PLANNING AREAS HELP ENDEMIC PLANTS IN CALIFORNIA'S SOUTHWEST ECOREGION UNDER CLIMATE CHANGE?

**Bray Beltran**, Environmental Life Sciences, Arizona State University, [bray.beltran@asu.edu](mailto:bray.beltran@asu.edu)

Climate change is one of the main threats to biodiversity, and biodiversity conservation requires that we understand the potential impacts of projected climate change on species distributions. Species Distribution Models (SDMs) are recognized as a key tool for assessing the impacts of climate change on species, are widely used to analyze the impact of climate change on biodiversity, and are increasingly being used for habitat management, restoration, and as decision-making tools. We predicted climate change impacts on suitable habitat and distribution

of 19 endemic plant species, eight of them rare, in the southwest ecoregion of the California Floristic Province. We used three different SDMs to create consensus habitat suitability maps for each species and compared two statistically downscaled (100m) climate models using two emission scenarios (A2 (medium-high) and B1 (low)) to characterize a range of possible climate futures. Although we predicted average extent of suitable habitat for all species to increase slightly, we also projected a loss of habitat for up to 79% of the species under the driest and warmest future conditions. We propose that under climate change Natural Community Conservation Planning areas in this region will be ineffective for the protection of the rare species as we predicted the suitable habitat for six of them to decrease within designated habitat conservation areas. This information is critical for reserve managers as it provides knowledge on the status and threats of the system to aid in the creation of effective ecological monitoring plans for conservation areas in this region.

#### IMPLICATIONS OF CLIMATE CHANGE FOR A THREATENED PLANT COMMUNITY, THE CALIFORNIA SAGE SCRUB

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Climate change during this century is predicted to cause the contraction of habitats with Mediterranean-type climates in southern California and northwestern Baja California. Within this region, California sage scrub's high levels of diversity, endemism, and threatened status make it a conservation priority. We assess the threat which future climate change poses to California sage scrub using an approach that integrates freely available data and analysis resources: online databases of species locality data, GIS environmental data, climate data, and free species distribution modeling tools. Using the modeling algorithm MAXENT, we model the current and future (to year 2080) distributions of 25 characteristic California sage scrub species and varieties. Our models suggest that sage scrub communities in coastal regions of southern California and northwestern Baja California will experience greatest changes under future climate scenarios. The majority of species considered in our study are predicted to undergo significant contraction of the southern portion of their ranges. Species restricted to San Diego County and Baja California, such as *Rosa minutifolia* and *Salvia munzii*, are predicted to undergo significant range losses. Some more widely ranging species are predicted to expand current northern and/or interior range limits. These changes will have implications for sage scrub community composition as well as its future protection in existing reserves and protected areas. Given the high conservation priority of California sage scrub and large monetary expense associated with its protection in California, incorporating predictions of future distribution will be crucial for effective conservation planning.

#### WHAT'S UP IN THE ALPINE ZONE? AN ASSESSMENT OF 25 YEARS OF VEGETATION CHANGE IN HIGH-ELEVATION AREAS OF SEQUOIA NATIONAL PARK

**Catherine Bell**, University of Vermont, [cathy.bell@uvm.edu](mailto:cathy.bell@uvm.edu)

Alpine zones in the northern hemisphere are predicted to experience significant changes in temperature, precipitation, and timing of snowmelt over coming decades, but little is known about the potential effects of these changes on vegetation. Difficulty of access and a short field season make baseline data on distribution and abundance of vascular plants scarce. However, between 1986 and 1996, the Natural Resource Inventory (NRI) project in Sequoia and Kings Canyon National Parks established more than 600 permanently-marked vegetation survey plots using a randomized systematic sampling approach. Located at 1 km UTM grid intersections,

these 0.1 ha circular plots represent a rich dataset for characterizing vegetation throughout the parks. 341 NRI plots are located in the parks' subalpine and alpine zones (above 2500 m elevation); finding and resurveying them would permit resource managers to detect and characterize change. This study represents the first systematic attempt to find and resurvey a subset of the high-elevation NRI plots. The Boreal Plateau and Siberian Outpost areas of Sequoia National Park are located along the Sierra Crest near the southeastern boundary of the park, and are the site of 32 NRI plots at elevations ranging from ~2800 m to ~3600 m. 27 of these plots were searched for, and 26 were successfully found and re-surveyed according to the methods in the original protocol. Preliminary results suggest changes in herbaceous ground cover and species composition across an array of plot types. No invasive non-native plants were detected.

## EVALUATING TREE ENCROACHMENT IN THE LITTLE BALD HILLS (REDWOOD NATIONAL & STATE PARKS) USING HISTORICAL PHOTOS AND DENDROECOLOGICAL TECHNIQUES

**April Sahara**, Humboldt State University, Department of Biological Sciences,  
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Ongoing changes in the structure and composition of western North American forests have been well documented over the past several decades. In particular, open-canopy woodland systems have experienced a decline in area due to encroachment by surrounding woody vegetation. One unique woodland type undergoing rapid afforestation is restricted to serpentine soils in the Klamath Mountains of Oregon and California. This woodland type is primarily composed of Jeffrey pine (*Pinus jeffreyi*) in the canopy and Idaho fescue (*Festuca idahoensis*) and herbaceous plants in the grassland understory. The focus of this study is the Little Bald Hills, Jeffrey pine/Idaho fescue woodland located in the north section of Redwood National and State Parks (RNSP). Using dendroecological techniques, I have compiled a record of tree establishment dating from the 1850s. A four-fold increase in the number of Douglas-fir (*Pseudotsuga menziesii*) and Jeffrey pine trees began establishing in the Little Bald Hills in the 1940s and remained fairly constant at the increased level, until an even larger increase in establishment occurred in the 1980s and 1990s. Analysis of historical aerial images has shown a >50% reduction in grassland area since 1942 with a concomitant increase in woody vegetation cover. The results of this study are intended to project future forest characteristics under a scenario of no-management intervention, and to utilize historical anecdotal, climate, and fire records to propose causes of tree encroachment and offer management strategies to maintain this unique woodland system.

## COAST LIVE OAK (*QUERCUS AGRIFOLIA*) RECRUITMENT AND GROWTH DYNAMICS IN THE FOOTHILLS OF THE SAN GABRIEL MOUNTAINS

**Matt O'Neill**, California State Polytechnic University, Pomona, [moneill3@yahoo.com](mailto:moneill3@yahoo.com)

As urban development encroaches on native foothill habitats, an understanding of recruitment and growth dynamics has become crucial to effective management and restoration initiatives for coast live oak (*Quercus agrifolia*) woodlands. By establishing the age structure of a natural stand we sought to determine whether individuals present were recruited in large numbers in a synchronous manner reflective of rare events, or more frequently but in fewer numbers. Standard dendrochronological techniques, coring and trunk cross sectioning, were employed in concert with morphological measures to identify significant predictors of age, growth patterns

through time and stand age composition. Our analyses identified bole diameter as the most accurate morphological predictor of age, and proximity to nearest neighbor, a metric for intraspecific competition, as the most accurate negative predictor of age. Secondary growth patterns were found to vary within individuals through time, but did not differ at the population level. The pattern of recruitment at the level of the entire stand was consistent with the hypothesis of large numbers in a synchronous manner, whereas the pattern of adult recruitment was generally consistent with the few but frequent successful offspring hypothesis. Taken together these results suggest a sequence of establishment and competitive release, followed by canopy dominance in the life history of *Q. agrifolia*. This study highlights the fact that a thorough understanding of canopy health and dynamics is essential to effective management and restoration of oak woodlands.

## DESIGNING AN EXPERIMENTAL STUDY TO INVESTIGATE IMPACTS OF UTILITY-SCALE SOLAR DEVELOPMENT ON DESERT ANNUALS

Patrick McIntyre, **Karen Tanner**, Kara Moore, Bruce Pavlik, Alison Stanton, Mills College, [karen.e.tanner@gmail.com](mailto:karen.e.tanner@gmail.com)

Utility-scale solar development in California's Mojave Desert may impact more than 350 CNPS-listed taxa. Potential effects of solar installations include changes to shade and water regimes, which may affect plant growth and reproduction. A 4-year experimental study was designed to investigate effects of shading and water runoff on two desert congeners, the rare *Eriophyllum mohavense* and common *E. wallacei*. Several preliminary experiments inform design of the study to maximize relevance of results in determining effects of solar panels on plant populations. 2'x2' shading structures were constructed with an angle and orientation that mimic solar industry standards. Characterizations of shade cast by the experimental structure and a full-size panel show similar reductions in photosynthetically active radiation (~85%, to levels well below 800  $\mu\text{E}/\text{m}^2\text{s}$ ). We employ three treatments to evaluate the effects of shade and water runoff from these structures. One group has a solar shield installed year-round. A second treatment examines the effect of shading only after sufficient rainfall has been received to promote germination. Analyses of climatological data suggest solar shields for this later treatment should be installed in January. To track effects of soil temperature on plant germination and growth, Maxim iButton temperature loggers are deployed. An installation methodology was developed to yield reliable measurements in different substrates, and units will track treatment and control groups annually. Analysis of plant response to light, water, and soil temperature regimes may provide insight into requirements for rare and common desert annuals, and suggest strategies for minimizing impacts from solar development.

## TREE MORTALITY IN A CALIFORNIA COASTAL FOG FOREST

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Recent increases in tree mortality have been observed across the globe. This has been attributed to drought stress induced by regional warming. Tree mortality has primarily been studied in regions with continental climates. Much less is known about mortality in coastal forests. Widespread mortality occurred in a Bishop pine (*Pinus muricata*) forest on Santa Cruz Island in Channel Islands National Park following the 2007-2009 drought. Bishop pine is a relict and endemic species restricted to the fog-belt of coastal California and Baja California. Our ability to predict shifts in the distribution of this and other coastal tree species in a warmer, drier, and perhaps less foggy climate requires a mechanistic understanding of how this species

utilizes available moisture. In this research, we addressed these questions: 1) Does summertime fog alleviate drought stress and reduce the risk of mortality of Bishop pine? 2) Does fog impact Bishop pine water status similarly across age classes? To quantify the physiological response of trees to fog, we measured xylem pressure potential and leaf-level function before, during, and after fog events at two sites representing the ends of a coastal-inland moisture gradient. Water stress was greater at the dry, inland site ( $p < 0.001$ ), and fog water had a disproportionate effect on alleviating water stress at this site. Adults experienced a greater improvement in water status following fog events ( $p < 0.001$ ) than saplings ( $p = 0.05$ ). This research will increase understanding of the response of trees to fog, and improve predictions of the distribution of coastal forests.

## ASSESSING THE IMPACT OF INVASIVE ANNUAL GRASSES ON SEED PRODUCTION AND SEED VIABILITY OF TWO NATIVE CALIFORNIAN GRASSES

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The ability of a population to persist depends on adult survival and the production of viable offspring. Invasive plants can exert strong competition over native plants but do not always displace them, particularly if the native plants are perennial. However, in the long run, if the invasive affects reproductive output of the native, the native population will decline. The goal of this study was to evaluate how the presence of invasive annual grasses affects seed production and viability of two native Californian grasses - *Bromus carinatus* and *Elymus glaucus*. *B. carinatus* and *E. glaucus* were grown in monoculture and a mixed invasive and native grass/forb community. *E. glaucus* seed production and viability was additionally assessed in a mixed native community. *B. carinatus* and *E. glaucus* seed germination success and seed size did not decline when invasive grasses were present, although invasive grasses substantially reduced native biomass and total seed production. C:N ratio of *B. carinatus* seeds was higher in the presence of invasives. However, per gram of biomass, seed output increased in mixed communities relative to monocultures, regardless of mixture composition. The effect of neighborhood differed between *B. carinatus* and *E. glaucus* indicating that native grasses do not respond to invasion in the same way. Creating islands of native populations in invaded areas is an increasingly popular restoration strategy for building native seed banks. Understanding the effect of neighborhood on reproductive output is critical to the success of this technique and will help target invasive control where invasives most suppress reproductive output.

## STRUCTURAL AND COMPOSITIONAL DIFFERENCES BETWEEN NATIVE AND NON-NATIVE DOMINATED GRASSLANDS

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Non-native annual grasses are dominant features in many of California's grasslands and these non-native dominated grasslands often contain or abut small patches of grassland dominated by native perennial bunchgrasses. We used neighboring non-native and native-dominated grasslands to evaluate how the shift in dominance from the native perennial bunchgrass, *Nassella pulchra*, to the non-native annual grass, *Bromus diandrus*, affects habitat structure and plant community composition. We hypothesized that grasslands dominated by *B. diandrus* would have more continuous vegetation and leaf litter cover, resulting in lower light availability and that this would have an impact on community composition. Our findings supported our hypothesis that *B. diandrus* grasslands were structurally unique from grasslands dominated by *N. pulchra* and surveys in two separate rain-years revealed that grasslands dominated by *B.*

*diandrus* had lower total and native diversity than those dominated by *N. pulchra*. Native herbs including *Navarretia jaredii*, *Plantago erecta*, *Micropus californicus* and *Crassula connata* were more abundant in *N. pulchra* grasslands, while *Amsinkia menziesii* and *Plagiobothrys nothofulvus* were more abundant in *B. diandrus* dominated sites. Given these compositional differences, we investigated whether species traits were related to species prevalence in the two grassland types. Using occurrence data from our plant surveys, we found species with late season flowering phenology to be more abundant in *N. pulchra* grasslands and taller species to be more abundant in *B. diandrus* dominated grasslands. These findings elucidate the potential species changes that are likely to follow the conversion of native-perennial to non-native annual-dominated grassland.

## COMMUNITY FACTORS AFFECTING GIANT REED ESTABLISHMENT WITHIN THE RIPARIAN PLANT COMMUNITY OF SOUTHERN CALIFORNIA

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Giant reed (*Arundo donax*) is a riparian clonal grass and considered one of the world's worst invasive weeds. Although much is known on how to control the species, very little is known on what factors affect plant establishment. During spring 2010, three sites along the Santa Ana River (Riverside, CA) were planted with *A. donax* rhizome fragments under mature riparian canopies to test two factors hypothesized to affect plant establishment: a) woody canopy composition and b) rodent herbivory. Four canopies were tested, including mixed riparian woodland, mulefat, sandbar willow, and no woody canopy (control). Each of the four canopy types were planted with 20 rhizomes, and half of these were caged to prevent rodent herbivory. It was predicted that canopy composition and herbivory would negatively affect plant establishment. Out of 240 propagules, 21 (9%) survived until harvest; 14 were caged and 7 were uncaged. Survival analysis showed that both canopy type and herbivory were significant factors in plant survival in several treatment locations, with grazing found to be most prevalent under shrub canopies. These results indicate that established riparian communities are resistant to invasion by small rhizome propagules, whereas sites with no woody canopies may be prone to invasion. Soil moisture was found to be the best predictor of plant survival. One recommendation for land managers is to restore moist open areas with native shrub species to optimize the habitat value for wildlife and decrease the likelihood of invasion.

## Session 19: Land Management and the Conservation of Plants and Communities

### CONSERVATION GRAZING: GRAZING MANAGEMENT PLANNING, MONITORING, AND PLAN ADAPTATION FOR ENDANGERED SPECIES HABITAT IN CALIFORNIA ANNUAL GRASSLANDS

**Lawrence Ford**, Devii Rao, LD Ford Rangeland Conservation Science, [fordld@sbcglobal.net](mailto:fordld@sbcglobal.net)

Livestock grazing is often the most efficient and effective means for extensive management of endangered species habitat in California grasslands that are dominated by aggressive annual grasses and forbs from the Mediterranean region. Left unmanaged during normal and above-normal precipitation years, the quality of such grassland habitats is often degraded. Grazing management planning should include grazing prescriptions to maintain habitat quality for the special species and natural communities, control pest plants and fire fuels, and protect water quality. Such plans explain how grazing can achieve the desired conditions in a complex

ecosystem where it will cause the least impacts while maximizing the positive effects and providing for a sustainable livestock operation. The planning process relies on the assessments of specialists and discussions with them to "translate" their information into terms that fit a grazing management prescription. Plans should identify appropriate performance standards, monitoring, and decision steps for plan adaptation. Plans should use (and cite) the best available research literature, or expert workgroups when the literature is not available. Plans should identify special management areas, infrastructure requirements, how to accommodate feasible and profitable grazing operations, and personnel requirements. Effective results are dependent on a functioning and profitable livestock industry and network of private ranches in the region to provide the grazing services, and appropriate incentives for cooperation between the lands manager and the livestock operator. Case examples from the authors' planning projects will illustrate these points. Sources of information and planning expertise will be presented.

#### STRADDLING THE FENCE: ACHIEVING CONSERVATION SUCCESS WHILE MAINTAINING A VIABLE BUSINESS

**Becky Waegell**, Tiessen and Waegell Ranch, [becky@calbotany.com](mailto:becky@calbotany.com)

Livestock as a tool to manage natural areas continues to evolve as land managers monitor and assess the impacts of grazing animals on weed species, biological diversity, water quality and other resource objectives. Working effectively with livestock operators is essential to continued progress in natural resource management. Understanding the management decisions facing livestock operators can assist land managers in developing adaptive management strategies that will achieve resource objectives. Livestock operators must assess the class of animal they have and the current condition of that animal to determine if the available forage and water is adequate to achieve their production goals. Predation pressure can require the need for onsite herders, livestock guardian dogs, corrals or other strategies to minimize risk. Additionally, changes in the market can impact the size and type of livestock operation available in a particular area. These and other business decisions that livestock operators make while attempting to achieve conservation goals will be addressed from the unique perspective of a speaker who transitioned from managing natural lands for The Nature Conservancy to managing an integrated farming and sheep operation.

#### INTERACTIONS BETWEEN NITROGEN DEPOSITION AND GRAZING INFORM INVASIVE AND NATIVE SPECIES MANAGEMENT IN A SERPENTINE GRASSLAND

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In the native-rich, nitrogen-limited serpentine grasslands of the San Francisco Bay Area, the most widely cited threat to native species is the fertilizing effect of nitrogen (N) deposition and the most widely recommended management strategy is cattle grazing. Despite the perceived primacy of N deposition as a threat and grazing as the solution, no one has experimentally-manipulated both factors to confirm their importance in this system. We manipulated grazing and N at Coyote Ridge, the largest serpentine grassland in California, from 2007-2011. We used camera trap technology to precisely quantify grazing intensity, and low fertilization levels to mimic possible increases in N deposition and accumulation. We found that grazing maintained native species richness and reduced exotic grass cover under current N levels, but may not manage exotic cover as effectively under future, increased levels of N deposition and accumulation. While grazing benefited most native forbs, it also reduced native grass cover, suggesting both positive and negative grazing effects on native species conservation. Huge

differences in measured levels of grazing intensity within a single stocking rate suggest that more intensive management might be required to better distribute the conservation benefits of grazing in this system.

#### IN THE CROSSHAIRS: NAVY TARGETS ONLY KNOWN STAND OF BARB GOATGRASS (*AEGILOPS TRIUNCIALIS*) IN SAN DIEGO COUNTY FOR ERADICATION

**Christy Wolf**, Vanessa Shoblock, Dawn Lawson, Naval Weapons Station Seal Beach Detachment Fallbrook, [christy.wolf@navy.mil](mailto:christy.wolf@navy.mil)

A barb goatgrass (*Aegilops triuncialis*) infestation estimated to cover 50% of a 1.6 acre area was discovered on Naval Weapons Station Seal Beach Detachment Fallbrook (San Diego County) in 2006. This State Listed Noxious Weed forms dense monocultures and is generally unpalatable to livestock, not only impacting native biodiversity but also threatening valuable rangeland. Not known to occur elsewhere in southern California, this invasive was targeted for full eradication. Initial treatment by focused hand spraying with 2% Roundup solution proved promising as the density of barb goatgrass was progressively reduced. By 2010, however, the fallibility of hand treatments was evident: as the density of goatgrass plants decreased, so did their detectability. Full eradication requires 100% treatment coverage to ensure no new seeds are being added to the seedbank. This presentation (1) provides a cautionary tale for the efficacy of hand treatments under certain circumstances, (2) exemplifies the importance of early detection and adaptive management, and (3) presents a revised monitoring and treatment approach.

#### THE EFFECTS OF FUSILADE II AND DETATCHING ON POPULATION NUMBERS AND FLOWERING IN THREAD-LEAF BRODIAEA (*BRODIAEA FILIFOLIA*), A STATE AND FEDERALLY LISTED PLANT SPECIES

Patrick McConnell, **Jessica Vinje**, Markus Spiegelberg, Center for Natural Lands Management, [jvinje@cnlm.org](mailto:jvinje@cnlm.org)

Exotic grasses are a major threat in some restricted soils that harbor rare plant species. The Center for Natural Lands Management manages several sizeable localities of thread-leaf brodiaea (*Brodiaea filifolia*), a cryptic corm-bearing perennial member of the Themidaceae. We investigated effects of treatment with Fusilade II® grass-specific herbicide on non-native grass density and vegetative and flowering response of thread-leaf brodiaea. This treatment was also compared with herbicide plus dethatching, dethatching only, and a control. After two years of herbicide application and four years following the initial dethatching of dry, non-native grasses, Fusilade II significantly reduced non-native grass and appears to have no negative effect on the vegetative or flower production of thread-leaf brodiaea. Although differences are not significant, there are some increases in these measures in the herbicide versus dethatch and control plots. Annual variation in flower and vegetative production provide reason to continue to monitor these plots to fully assess the long-term effects to thread-leaf brodiaea of removing non-native grasses and thatch.

#### OVERVIEW OF SPECIAL-STATUS PLANT MANAGEMENT IN STATE PARKS

**Ramona Robison**, California State Parks, [rrobison@parks.ca.gov](mailto:rrobison@parks.ca.gov)

The 279 California State Parks comprise approximately 1.5 million acres, from coastal dunes to high Sierra coniferous forests. Seven percent of the total number of CNDDDB plant occurrences

intersect with Parks' boundaries and 2.4 percent (248 species) are completely contained within Parks. State Parks' resource management is generally focused on protecting and restoring ecosystem processes and communities, rather than single species management; however, restoration of these processes often benefits listed plants. Special-status plants are managed by Environmental Scientists at the District level, using resources from the Department as well as numerous partners. The talk will highlight specific examples of special-status plant management partnerships, as well as tools developed to track and manage special-status plant populations. Among the many threats to special-status plants in State Parks, invasive plants are one of the most prominent. In one location, restoration has been going on for over 30 years and special-status plant populations are thriving. Partnerships for Mt. Diablo buckwheat management and establishment of new Ventura Marsh milk-vetch populations – both species formerly considered extinct – will be among the examples presented. A statewide grasslands characterization study prepared by UC Berkeley in 2008 and a new grasslands classification effort underway in coastal Sonoma County will also be highlighted. State Parks has a long history of habitat restoration benefitting rare plants and welcomes partnerships designed to utilize this information for the benefit of the conservation community.

#### PACIFIC GAS & ELECTRIC COMPANY'S USE OF SAFE HARBOR AGREEMENTS TO ENHANCE HABITAT FOR ENDANGERED SPECIES IN THE SAN FRANCISCO BAY AREA

**Peter Beesley**, Pacific Gas & Electric Company, [pmb7@pge.com](mailto:pmb7@pge.com)

Appropriate management is key to long-term persistence of native plant populations. A land manager's ability to provide conservation is limited when protected species are on site. Pacific Gas & Electric Company has implemented two Safe Harbor Agreements (SHA) with the U.S. Fish and Wildlife Service. SHAs contribute to species protection and habitat enhancement while balancing certain land use activities, such as ranching, timber harvesting, or in PG&E's case, operations at critical utility facilities. With this tool, PG&E is assured that no added restrictions will be imposed as a result of carrying out activities expected to provide a net benefit to protected species. In Contra Costa County, PG&E is partnering with the Antioch Dunes National Wildlife Refuge to protect and enhance critical habitat for three endangered species: Lange's metalmark butterfly, Antioch Dunes evening primrose, and Contra Costa wallflower. The approved SHA, allows PG&E to use herbicides and equipment to reduce invasive plants near listed species. Recent survey results indicate a 13% decrease in invasive plant cover. PG&E is also partnering with the Silicon Valley Land Conservancy to protect and enhance habitat for the threatened bay checkerspot butterfly in Santa Clara County. This SHA incorporates cattle grazing as a management strategy to reduce invasive grasses and enhance endemic serpentine plants that provide nectar for the butterfly. Recent surveys indicate a significant reduction in invasive annual grass cover. The use of SHAs has proven to be a valuable tool and management strategy for conservation and restoration at these sites.

#### MONITORING MOST BEAUTIFUL JEWELFLOWER, SMOOTH LESSINGIA, AND SANTA CLARA VALLEY DUDLEYA IN A SERPENTINE GRASSLAND

**Clinton Kellner**, Roger Harris, LSA Associates, [Clint.Kellner@Lsa-Assoc.com](mailto:Clint.Kellner@Lsa-Assoc.com)

Stands of Santa Clara Valley dudleya (*Dudleya abramsii* ssp. *setchellii*), most beautiful jewelflower (*Streptanthus glandulosus* ssp. *glandulosus*), and smooth lessingia (*Lessingia micradenia* var. *glabrata*) were monitored on a serpentine reserve, dominated by annual grasses, in San Martin, Santa Clara County, California. The purpose of monitoring was to determine the effects of grazing and rainfall on these Rare Plant Rank 1B species; the dudleya

is also federally endangered. Grazing was used as a management tool to enhance native plants and was timed to begin after smooth lessingia finished flowering in the fall and ceased before these plants grew large enough in the spring to provide forage. Permanent sample plots were established on different exposures in 2004, when monitoring was initiated for the jewelflower and the dudleya. Monitoring of smooth lessingia began in 2006 and monitoring ceased for all species in 2009. Changes in the number of jewelflower and lessingia plants, both annuals, appeared to be correlated with rainfall; dudleya numbers remained fairly constant as would be expected for a perennial. An increase in jewelflower numbers was also noted with the reduction of thatch in response to grazing. The effect of seasonal grazing, besides reducing thatch, did not appear to result in significant changes in plant abundance. In sum, rainfall best explained between-year variance in annual rare plant numbers, which fluctuated widely.

#### KEEPING OUR LIVING SCENERY: CONSERVING NATIVE PLANTS AS COMMON ROADSIDE MANAGEMENT PRACTICE

**Jim Hanson**, Craig Thomsen, California Department of Transportation, [jimhmail@sonic.net](mailto:jimhmail@sonic.net)

The forms, textures, aromas, and colors of California's diverse native flora are elemental to the State's scenic open spaces and natural landscapes. Scenic landscapes add to the quality of California life, attract businesses, and are the basis of a significant tourism economy. The roads that provide access to these areas inevitably require construction, repairs, and ongoing Right-of-Way maintenance work. While a small percentage of plant species listed for Federal and State protection may receive special attention, most publicly-overseen roadwork lacks specific policies and management practices necessary to protect non-listed plants and native plant assemblages. Without protection, and appropriate management, the scenic and ecological values supplied by California's native flora are at risk of being unnecessarily degraded or lost. A set of guidelines is provided for public agencies to use during planning, construction, and long-term land management to protect native plants along roadsides. Examples are provided that integrate native plant conservation within common State transportation operations, where native plant assemblages are recognized and mapped, planned for in contract specifications, managed, and protected in the field with signage at minimal cost.

#### LONG-TERM VEGETATION TRENDS AND RESPONSES TO DISTURBANCE PATTERNS ON SAN CLEMENTE ISLAND 1992-PRESENT

Scott Snover, **Elizabeth Kellogg**, President Tierra Data, Inc., [liz@tierradata.com](mailto:liz@tierradata.com)

The composition of San Clemente Island's natural communities has been greatly influenced by the island's long history of land use and disturbance patterns, including overgrazing by goats and altered fire regime tied to human occupation of the island dating back 8000 years. The cumulative effect of these disturbance patterns included altered species composition, especially in the grasslands, and a general loss of trees and shrubs. In order to better understand the recovery of the island's ecosystems after goat removal in the context of military land uses, the U.S. Navy implemented a long-term vegetation monitoring program in 1992–1993. The program goals were to establish a baseline description of the island's vegetation communities, track plant community characteristics along environmental and use gradients, document and evaluate vegetation changes with respect to management goals, and to track the status of sensitive plant species. The current plot inventory includes 117 plots. Since 1992-93, a subset of plots has been surveyed across nine years through 2010. Data collected includes aerial cover, ground cover, shrub/rare plant density, and species diversity. Since the Navy's long-term ecological trend monitoring program was initiated, numerous changes have been observed across the

island. Several sensitive plant species have increased in abundance and cover, while on the upper plateaus shrubs have increased in range and density in some areas. Findings from this program help guide and establish metrics for adaptive management strategies implemented through the Navy's resource and fire management plans to ensure the long-term viability of the island's habitats.

## **Session 20: Southern California Botany – Vibrant Flora Vibrant Folks**

### MAKERS AND MILESTONES OF SOUTHERN CALIFORNIA BOTANY

**Gary Wallace**, Research Associate Rancho Santa Ana Botanic Garden and U.S. Fish and Wildlife Service, [Gary.Wallace@cgu.edu](mailto:Gary.Wallace@cgu.edu)

Countless persons have made contributions to our knowledge of plants in southern California. Thomas Nuttall and Thomas Coulter visited as part of extended trips. There were visitors who made several trips to the area, Parry, Lemmon, Brewer, and Palmer. Finally there were resident plant collectors, Orcutt, Trask, Parish, Davidson, Gander, Grant, Peirson, Abrams, Wolf, Munz, and many others. These collectors wrote several seminal systematic treatments and floristic treatments. The collections and publications of these early workers have served as a basis for our data-rich region. Without an atmosphere of interest and a supportive population the state of our flora could be quite different. Hittel and Cronise describe the botanical wealth of southern California in the mid-1800s while J. Smeaton Chase and Charles Saunders published a series of books highlighting areas of southern California. USC was among the first University to support a strong botany program. Natural history clubs include San Diego Society of Natural History, Southern California Academy of Sciences, Riverside Botanical Club, Southern California Botanists, Nature Club of Southern California, and California Native Plant Society. The makers and milestones of southern California Botany illustrate the past and ongoing support and interest of the public in finding, studying, and conserving our native flora.

### SURVEY AND PHENOLOGY IN A HIGH ALTITUDE REGION OF THE SAN GABRIEL MOUNTAINS

**Jane Tirrell**, Walter Fidler, Jane Strong, Graham Bothwell, San Gabriel Mountains Chapter, CNPS, [jgtirrell@hotmail.com](mailto:jgtirrell@hotmail.com)

We repeated a phenology study conducted by Wayne Sawyer in 1981 and published in *Crossosoma* 13(1): 5-10, 1987. The study area is approximately 360 acres in the San Gabriel Mountains, Los Angeles County, California, consisting of primarily north-facing slopes. It is bounded by California State Route 2 on the north and by the Pacific Crest Trail and crests of the ridges on the south. Elevations range from 7200 to 8600 feet above sea level. While we did not observe significant differences in the onset of flowering for the species present in 2011 as compared to those present in 1981, we noted twelve rare plants, four classified as 1.B and eight classified as 4.2 or 4.3. We also observed 130 angiosperm species whereas Sawyer listed 100 in his *Crossosoma* paper. The increased number of species in 2011 is attributed in part to the presence of fire followers such as *Turricula parryi* and *Hulsea heterochroma* resulting from the Curve Fire of 2002 which burned over 90% of the study area and to the presence of non-native species such as *Melilotus albus* and *Sonchus oleraceus* that were not listed in the original study. In addition, re-examination of some taxa revealed divisions into other species and subspecies. We noted 17 angiosperms that are either new to the area or were previously overlooked. These taxa may in some cases indicate range extensions.

## THE STORY OF SOUTHERN CALIFORNIA WILD FLOWERS 1928-1955, AN ACCOUNT OF CAROLL DEWILTON SCOTT'S MANUSCRIPT.

**Fred Sproul**, Member CNPS, [fred.sproul@aecom.com](mailto:fred.sproul@aecom.com)

The "Story of Southern California Wildflowers" by Carroll Dewilton Scott, 1928-1955, is a story of what our San Diego flora was like before much of it had been urbanized and overwhelmed by nonnative weeds. This is an account of the botanical bounty of our local neighborhoods, such as Las Flores, Crown Point, La Jolla, Ocean Beach, Pacific Beach, Encinitas, and Tecolote Arroyo's "Last Sanctuary." This presentation includes historic photos, many elaborate descriptions of the wildflower displays, and accounts of plant species that were found in San Diego County during this early era. This rich historic account offers an opportunity to reinterpret our botanical history and guide our standards for its future.

## ON THE BRINK - THE 10 MOST ENDANGERED PLANTS OF SAN DIEGO COUNTY

**Vince Scheidt**, CNPS Board of Directors, [vince.scheidt@gmail.com](mailto:vince.scheidt@gmail.com)

San Diego County, near the southern end of the California Floristic Province, has long been recognized as one of the world's biodiversity hotspots. The County's rich botanical diversity includes an extraordinary number of rare plant species, some of which have become critically endangered due to the region's extreme growth during the 20th Century. This presentation will describe the ten most endangered plants in San Diego County, all of which are near extinction in the wild. The presentation reflects an analysis of relevant data sources and the author's thirty years of local field experience.

## THE RELATIONSHIP OF *MONARDELLA VIMINEA* TO CLOSELY RELATED TAXA BASED ON ANALYSES OF ISSRS AND CHLOROPLAST DNA SEQUENCE DATA

**Linda Prince**, Rancho Santa Ana Botanic Garden and Claremont Graduate University, [lprince@rsabg.org](mailto:lprince@rsabg.org)

Willow Monardella (*Monardella viminea*) is a federally listed species restricted to San Diego County, California, and adjacent Baja California, Mexico. This taxon was recently raised to species rank based on careful examination of morphological characters. Further, another taxon, *Monardella stoneana*, was carved out of *Monardella viminea sensu lato*, with *M. viminea sensu stricto* being restricted to coastal regions, and *M. stoneana* inhabiting more inland localities. The change in rank and circumscription has resulted in pressing management issues. The narrower circumscription (and hence distribution) of *M. viminea* implies a more perilous future for this species due to fewer populations, intense development pressure throughout its range, and the limited area of suitable habitat designated for conservation. *Monardella viminea* is restricted to the vicinity of Marine Corps Air Station, Miramar. Using both population genetic (ISSRs) and phylogenetic (comparative DNA sequencing) methods, I assessed relationships between *Monardella viminea* and its closest known relatives. Both ISSRs and chloroplast DNA sequence data analyses indicate a clear separation between *M. viminea* and *M. stoneana*, supporting the recent segregation and elevation of these taxa to the species rank.

## IS IN SITU OR ON SITE CONSERVATION ENOUGH? EX SITU CONSERVATION: WORKING WITH SEEDS IN PLANT CONSERVATION

**Genevieve Arnold**, Michael Wall, Theodore Payne Foundation, [genny@theodorepayne.org](mailto:genny@theodorepayne.org)

Ex situ conservation actions can greatly enhance our options in the long-term management and recovery of rare plants and native plant communities. While the first goal in plant conservation is identifying and protecting at risk species, their populations, and habitats, this is not always achievable. Some factors that may influence this process are: recreational land use, military training, mitigation failure, documented or anticipated decline in population vigor and recruitment due to factors such as altered fire cycles, inbreeding depression, degraded or altered habitats, the presence of invasive species, and climate change. One of the most frequently used ex situ conservation actions is seed collection for reintroduction or seed banking. This presentation will encompass information on working with seeds in ex situ conservation and the role of seed banks as a conservation tool.

#### HITTING THE GROUND RUNNING: SEEDS OF SUCCESS EFFORTS IN THE CALIFORNIA DESERT DISTRICT MAKE MAJOR HEADWAY

**Thomas Stoughton**, Rancho Santa Ana Botanic Garden, Claremont Graduate University, [tstoughton@rsabg.org](mailto:tstoughton@rsabg.org)

As climate change, invasion of non-native plant species, altered fire regimes and increased fire severity continues to threaten healthy native plant communities across the nation, the demand for native plant materials to restore wildlands is on the rise, especially in the arid Southwest. The Bureau of Land Management Seeds of Success program in the California Desert District is still in its infancy, but major progress has been made in recent years toward meeting the demand for genetically appropriate restoration materials to be made commercially available. This presentation will discuss the progress made by Seeds of Success collecting teams across the California Desert District in the Mojave and Sonoran deserts, challenges faced in collecting native seeds in desert wildlands, goals and objectives for future work in the California Desert District, and opportunities for collaboration.

#### THE GENUS *CEANOOTHUS* IN SAN DIEGO COUNTY: THREATS AND ENDEMISM

**Jim Rocks**, San Diego Natural History Museum - Botany Department Associate, Independent Biologist, [jim@rocksbio.com](mailto:jim@rocksbio.com)

*Ceanothus* is a diverse North American genus in the Rhamnaceae whose members occur in habitats ranging from sub-tropical rainforests to snow covered ridgelines. California, with its climatic, edaphic, and topographical diversity, is the center of the distribution of *Ceanothus* with more than 80% of known taxa. The remarkable variety of habitats in San Diego County support 17 *Ceanothus* taxa, several of which are endemic to the region. The ecological complexity of the genus and its distribution within the County will be discussed followed by a focus on the endemic and near-endemic *Ceanothus* taxa within the region (*C. cyaneus*, *C. otayensis*, *C. verrucosus*, *C. sp. nov.*). These species have unique distributions and life histories and face challenges and threats due to urbanization and population growth.

#### SAN DIEGO RARE PLANT TREASURE HUNT: THOUGHTS ON A "BREAKABLE SURVEY"

**Frank Landis**, California Native Plant Society, San Diego Chapter, [franklandis03@yahoo.com](mailto:franklandis03@yahoo.com)

The San Diego Chapter of CNPS has participated in the CNPS Rare Plant Treasure hunt for the last two years. Since there are insufficient resources and people to survey all the sensitive

plants in the County, we have attempted to identify species that are "falling through the cracks," that have not been surveyed recently or thoroughly, and to survey these plants. This work illuminates a bigger idea, which I call "the breakable survey." Surveys are vulnerable to failures in survey protocols, loss of institutional memory through personnel turnover, and simple lack of communication among interested parties. The idea of a "breakable survey" is to design a survey that will survive such vulnerabilities. I will use the details of the survey, including survey design, data collection, and data distribution, to discuss what has worked and what has not. Information sharing and organization have been critical to our success. Given the increasing limits on conservation resources, fail-safe survey protocols will be an increasingly useful part of monitoring rare and endangered plant populations.

#### CONSERVATION THROUGH COMMUNITY-BASED RESTORATION IN CITY HEIGHTS' SWAN CANYON

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In collaboration, RECON Environmental, Ocean Discovery Institute (ODI), and other partners have begun to increase community awareness of the value of natural resources at Swan Canyon in City Heights, a San Diego neighborhood. The project involves removal of over 2 acres of giant reed (*Arundo donax*) from Swan Canyon drainages. Swan Canyon is surrounded by a residential community, an elementary, and a middle school. Encroachment of urban life on remnant canyons like Swan Canyon, combined with lack of awareness of the importance of natural resources, has contributed to illegal dumping and homeless encampments. Located near the historical base of the Chollas Creek watershed, Swan Canyon receives an influx of trash with each rainstorm. Giant reed, historically planted for erosion control, has become established in dense thickets throughout the canyon. Because of its enormous mass, density, and decrease of canyon visibility, giant reed provides haven for illegal activities and chokes out native plant species. ODI is using removal of giant reed and canyon restoration with native species as an opportunity to educate local students and residents by involving them in the restorative process. This talk provides a glimpse into how this collaborative project has become a focal point for community improvement, built around native habitat restoration.

### **Session 21: Botanical Wonders of Northern California**

#### SAN FRANCISCO'S RARE ENDEMIC MANZANITAS: PROSPECTS FOR RECOVERY THROUGH RESTORATION

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San Francisco is home to two extremely rare serpentine endemic manzanitas, the Franciscan manzanita (*Arctostaphylos franciscana*) and Raven's manzanita (*A. montana* subsp. *ravenii*). Both taxa historically occurred on serpentine outcrops throughout San Francisco but are each currently limited to one remaining wild individual. The recovery plan for Raven's manzanita recommends introducing both taxa together to several locations within its historic range. This study examines the feasibility of recovery through restoration, particularly the evaluation of suitable introduction sites and the identification of ex situ propagation sources. Results show that despite significant losses to native plant communities in San Francisco, several locations persist that are similar in vegetation and soil characteristics to historic locales, thus presenting

opportunities for experimental plantings that may aid in the recovery of these extremely rare manzanitas.

#### PROBLEMS WHEN THE CONSERVATION TARGET IS A SUBSPECIES: *CORDYLANTHUS TENUIS* SUBSP. *PALLESCENS*

Barbara Wilson, Richard Brainerd, Nick Otting, **Julie Nelson**, Shasta-Trinity National Forest, [jknelson@fs.fed.us](mailto:jknelson@fs.fed.us)

Populations of subspecies tend to interbreed when in close proximity, producing mixed or morphologically intermediate offspring. If one of the subspecies is a listed rare plant, how should these populations and individuals be treated? *Cordylanthus tenuis* subsp. *pallescens*, a rare plant with a very limited range near Mount Shasta, provides a case study. More and more populations of the listed subspecies were reported outside that range, but the populations seemed to consist mostly of members with characteristics of subspecies. We recorded morphological traits of the plants in pure and mixed populations, to assess their identification. We provide recommendations for evaluating the identity of individuals and populations of *C. tenuis* subsp. *pallescens*, and by implication other rare subspecies.

#### REPRODUCTIVE ISOLATION AMONG MEMBERS OF THE *PYROLA PICTA* SPECIES COMPLEX (MONOTROPOIDEAE: ERICACEAE) A CASE STUDY FROM NORTHERN CALIFORNIA

**Diana Jolles**, Rancho Santa Ana Botanic Garden and Claremont Graduate University, [diana.jolles@gmail.com](mailto:diana.jolles@gmail.com)

The *Pyrola picta* species complex (Monotropeoideae: Ericaceae) of western North America has intrigued botanists for more than a hundred years because variation in leaf morphology and physiology, used to identify putative taxa, is associated with a transition to obligate mycoheterotrophy. Despite these differences, both floral morphology and phenology among the same putative taxa are remarkably similar. I tested the hypothesis that variation in leaf morphology observed among *P. picta* subsp. *picta*, *P. picta* subsp. *dentata*, and *P. picta* form a aphylla has an underlying genetic component that can be detected through phylogenetic analysis of DNA sequences. I then examined potential mechanisms of reproductive isolation by observing pollinators, measuring flowering times, and performing experimental crosses among plants with different phenotypes in multiple northern Californian populations. My findings suggest that the *P. picta* species complex is composed of three phylogenetic species that undergo low levels of hybridization in sympatry. In sympatric populations, species have statistically significant flowering time durations. Slight overlap in flowering times among sympatric species and decreased seed set in heterospecific crosses may explain why hybrids occur only at low frequencies in sympatric populations despite the fact that species share similar floral morphology and pollinators.

#### RARE *ERYTHRONIUM* SPECIES ON GREEN DIAMOND RESOURCE COMPANY (GDRCO) PROPERTY: ADDRESSING PROBLEMATIC CHARACTERISTICS PRESENT IN NORTHWESTERN CALIFORNIA POPULATIONS

**Cheri Sanville**, Bianca Hayashi, Green Diamond Resource Company, [csanville@greendiamond.com](mailto:csanville@greendiamond.com)

Two *Erythronium* (fawn lily) species encountered on GDRCo property with a California Rare Plant Rank (RPR) of 2.2 are *Erythronium revolutum* and *E. oregonum*. Although some populations exhibit diagnostic characteristics, others exhibit traits intermediate between the species and/or between the endemic but unranked *E. californicum*. While *E. oregonum* has white tepals, in *E. revolutum* tendency towards albinism becomes more pronounced toward the south end of the range in coastal northern California (Applegate, 1935). While a few element occurrences (EOs) of *E. oregonum* are rated as good or better in the California Natural Diversity Database (CNDDDB), in contrast *E. revolutum* is less common, and closer to the threshold for status review. The EOs of both species overlap and considerable uncertainty exists regarding identification. Because of the difficult nature of making conclusive identifications, it is likely that some of the occurrences identified as *E. revolutum* are *E. oregonum*. The identity of these occurrences should be resolved prior to a status review. GDRCo botanists collected flower and leaf samples from fifteen *Erythronium* populations in 2011. Flowers were disassembled and used to conduct a morphometric analysis focusing on diagnostic characters, following methods used by others investigating *Erythronium*. A complimentary genetic analysis will be performed on leaf samples that were dried in silica. The authors hope this initial investigation garners interest by others familiar with these species and propose a collaborative effort to assess all known populations in California.

#### BUILD IT AND THEY WILL COME? DIFFERENCES IN FREQUENCY AND ABUNDANCE OF POLLINATORS OF ENDANGERED PLANTS IN NATURAL AND CONSTRUCTED VERNAL POOLS ON THE SANTA ROSA PLAIN

**Kandis Gilmore**, Sonoma State University, [gilmokan@seawolf.sonoma.edu](mailto:gilmokan@seawolf.sonoma.edu)

The Santa Rosa Plain in Sonoma County, California, harbors vernal pool ecosystems home to three endangered endemic annual plants: *Blennosperma bakeri*, *Limnanthes vinculans*, and *Lasthenia burkei*. Recently, constructed wetlands in mitigation banks now afford additional habitat these species to buffer against habitat loss. For effective endangered species management and recovery, it is essential to know whether the transplanted plant populations in mitigation banks are receiving adequate pollination services. To determine main pollinators, I conducted timed pollinator observations and collected insect visitors at target plant flowering patches in natural and constructed vernal pools. Solitary bees were the primary visitors of *B. bakeri* and *L. vinculans*. For all three plant species, a significant difference was observed solitary bee visits between natural and constructed vernal pools (*B. bakeri* df=1, Chi2=468.4, p<0.0001; *L. vinculans* df=1, Chi2=252.0, p<0.0001; *L. burkei* df=1, Chi2=13.6, p=0.002). *Andrena pulverea*, the specialist solitary bee on *L. vinculans*, was found at every site examined and was five times as abundant as the other specialist bees. *Blennosperma bakeri* attracted the greatest number of bee species ( $\bar{x}$ ,=4.6 ± 3.9 [st. dev.] species per site). The *L. burkei* specialist bee was found at only one constructed and three natural sites, but its primary visitor was the Bombyliid fly, *Conophorus cristatus*. Having detailed information on the ecological relationship of these endangered plants and their pollinators allows assessment of whether the remaining natural and created ecosystems can sustain these populations through successive generations, or whether additional restoration for pollinators is warranted.

#### FOREST SERVICE 101: THE BASICS OF WHAT YOU NEED TO KNOW TO WORK EFFECTIVELY FOR NATIVE PLANT CONSERVATION ON NATIONAL FORESTS AND GRASSLANDS

**Julie Kierstead Nelson**, Forest Botanist, Shasta-Trinity National Forest, [jknelson@fs.fed.us](mailto:jknelson@fs.fed.us)

Whether you want to join the Forest Service as an employee, or work as a citizen advocate for native plant conservation on national forest lands, knowing the structure and function of this bureaucracy will help you achieve your conservation goals more easily and congenially. The essentials will be explained: Who makes the decisions? What laws and policies govern national forest management? When is the best time to make a project proposal or comment on an agency action? What kinds of comments are likely to produce positive results? How can you develop a productive relationship with your local national forest? This presentation will help you to be a better informed and more effective advocate for the native flora of our national forests.

#### DEVELOPMENT AND EVALUATION OF A REGIONAL NATIVE SEED MIX FOR SIERRA NEVADA SKI SLOPE RESTORATION

**Jennifer Burt**, Shana Gross, AECOM Sacramento, [jennifer.burt@aecom.com](mailto:jennifer.burt@aecom.com)

Downhill ski areas occupy large expanses of mountainous lands where restoration of ecosystem function is of increasing importance and interest. Because ski slopes are managed for recreation, ski slope revegetation mixes must consist of low-stature or herbaceous plants that can tolerate typical environmental conditions on ski slopes (for example high elevation, disturbed soils, open, and steep slopes). The most appropriate reference communities for selecting ski slope revegetation species are thus successional, or seral, plant communities in similar environments (i.e. other ski slopes). Using results from a broad-scale analysis of plant species naturally occurring on ski slopes, we developed a planting palette of 21 low-growing or herbaceous native species appropriate for ski slope restoration. We then implemented a pilot experimental study to evaluate the seed mix, along with soil amendments, and established a total of 67 experimental plots across eight ski resorts. Native seed was locally collected by the UC Berkeley Botanical Garden, and soil amendments were implemented by the ski areas. Seeding of experimental plots took place following collection of baseline data in the fall of 2010. Due to late season snow, many seedlings had only developed cotyledons by July 2011. Five of the 20 species planted were recognizable in July and had germinated at high rates, and it is anticipated that additional species will be identified as seedlings develop. This study describes an ecological (and potentially cost-effective) approach to developing and testing regional restoration palettes for managed lands, and the results will inform future ski slope restoration efforts.

#### ASSESSING STATUS AND TRENDS OF GRASS LAKE RESEARCH NATURAL AREA, LAKE TAHOE, CALIFORNIA: USING TWO GENERA OF BRYOPHYTES (*SPHAGNUM* AND *MEESIA*) AS INDICATORS OF ECOSYSTEM HEALTH

**Shana Gross**, Wes Christensen, USFS - Lake Tahoe Basin Management Unit, [segross@fs.fed.us](mailto:segross@fs.fed.us)

Grass Lake was designated as a "Research Natural Area" by the U.S. Forest Service to preserve a representative *Sphagnum* bog type in the Northern Sierra Nevada physiographic province of California. The Forest Service is tasked with managing this unique community to maintain ecosystem health. Hydrologic change is predicted to be the largest threat to this community; climate change may exacerbate the effects of hydrologic changes. Bryophytes are good indicator organisms due to their relatively simple structures and their sensitivity to environmental change. In order to quantify the status and trend of this community, aerial cover (using Braun-Blanquet cover classes) of *Sphagnum* spp. (peat moss) and *Meesia triquetra*

(three-ranked hump moss) was recorded at 13 meter intervals along parallel transects throughout the entire 250-acre site. These two species were selected because Grass Lake is recognized as the largest and best example of a *Sphagnum* bog, and *Meesia triquetra* is a Region 5 Forest Service sensitive species. Baseline data was collected in 2004 and 2005; repeat monitoring occurred in 2009 and 2010. Geostatistical analysis quantified spatial patterns of *Sphagnum* and *Meesia* population structure and quantified inter-annual changes in the population structure. The area occupied by both *Sphagnum* and *Meesia* declined by approximately 30% between 2004/2005 and 2009. In addition, a 1-25% decline in cover was observed in areas occupied by these species. These declines may be correlated with hydrologic variability; 2005 had greater peak discharge and base flow compared to 2004 and 2009.

## SERPENTINE FLORA CONSERVATION IN THE CENTRAL MAYACAMAS MOUNTAINS

**Sheherezade Adams**, Audubon Canyon Ranch, [sherry@egret.org](mailto:sherry@egret.org)

Serpentine outcrops host unique assemblages of plants including rare endemics. Relative to surrounding grasslands in the North Coastal Range of California, these habitats are a refuge for native species, further elevating their conservation value. We inventoried the serpentine flora of the Modini Ingalls Ecological Preserve in northern Sonoma County. In addition to documenting this unusual habitat for management purposes, we are interested in understanding how and why individual serpentine patches differ from each other. We used GIS and field measurements to assemble abiotic data about the 36 serpentine outcrops on the 1,700 acre preserve. We have found a positive relationship between the size of a serpentine patch and the number of serpentine endemic species it contains. In general, the more isolated and larger patches contain more plants that are unique on the preserve. While these patches are dominated by native species, introduced species are also present. All of the introduced species are annuals, and half of the introduced species present on the serpentine outcrops are grasses. In contrast, less than 10% of the native species found on serpentine outcrops are grasses, and over half are perennials. In summary, large and isolated patches are particularly important in preserving plant diversity on serpentine outcrops. While serpentine outcrops are traditionally regarded as being relatively immune to invasion due to harsh growing conditions, some introduced annuals, particularly grasses, are capable of surviving on these outcrops.

## CONSERVATION STATUS OF THE ENDEMIC FLORA OF THE SIERRA AND CASCADE FOOTHILLS

**John Hunter**, AECOM, [john.hunter@aecom.com](mailto:john.hunter@aecom.com)

To evaluate the conservation status of 101 plant taxa endemic to the Sierra and Cascade foothills, I analyzed habitat and range descriptions from the CNPS Online Inventory and available GIS data layers for elevation, geology, land cover, conserved lands, housing density, and parcel size. In the foothills, less than 5% of the land has been converted to developed land cover or inundated by reservoirs. The housing density and conservation status of remaining land is approximately 20% urban-exurban unconserved, 46% rural unconserved, and 34% conserved areas. Conserved areas are concentrated in the northern and southern regions, at higher elevations, and in montane vegetation types. Urban-exurban areas and projected housing density increases are concentrated in the central portion of the foothills (Butte to Mariposa counties), at lower elevations, and in foothill-lower montane vegetation. Foothill endemics are concentrated in the same region, elevations, and some of the same vegetation types as urban-exurban areas and projected housing increases. For example, woodlands in Nevada to El Dorado counties include habitat for nearly 40% of all foothill endemics. Of this

habitat, 14% is conserved, and 50% is in urban-exurban areas. Endemics also are associated with distinctive substrates: nearly 30% are associated with serpentine, gabbro, or lone Formation substrates. Nearly one-third of serpentine landscapes are conserved, but this is true of less than an eighth of gabbro and lone Formation landscapes. Overall, this evaluation indicates a substantial range in the conservation status of endemic taxa, and provides a basis for identifying endemic species at greater risk.

## **Session 22: Planning Tools for Rare Plant Conservation**

### **MULTIPLE SPECIES CONSERVATION PLANNING IN SAN DIEGO COUNTY**

**Thomas Oberbauer**, Bobbie Stephenson, AECOM, [toberbauer@cox.net](mailto:toberbauer@cox.net)

The Endangered Species Act for both the State of California and the Federal Government provides for listing of species as endangered, threatened, or rare. Listing of species under these acts and the California Environmental Quality Act frequently results in long battles over land development projects and conservation concepts. This may occur case by case and often the best mitigation that is achieved is a small patch of open space for sensitive habitats. However, there is an alternative. Under section 10 of the federal Endangered Species Act and the California Natural Communities Conservation Planning Act, coordinated plans can be created to address not only needs of individual species but an entire suite of species. In the County of San Diego, the federal and state permits for the South County Multiple Species Conservation Program plan were received in 1998 after a seven-year generation period. Since then, the plans have been the focal point of conservation funds from bond acts and federal funding legislation. More than 40,000 acres of land have been acquired as a result of the plan efforts and significantly more land has been set aside as exactions for land development projects. The creation of these plans is a difficult process involving collaboration with scientists, stakeholders from the environmental, land development and agricultural viewpoints as well as the wildlife agencies. Furthermore, there must be a strong will in the government agencies to complete these plans. However, they are very much worth the effort.

### **SAN DIEGO MULTIPLE SPECIES CONSERVATION PLAN & VERNAL POOLS: LESSONS LEARNED?**

**David Hogan**, California Chaparral Institute, [director@chaparralconservancy.org](mailto:director@chaparralconservancy.org)

The San Diego Multiple Species Conservation Plan was approved in 1998 and lauded by politicians, developers, and one environmental group as a regional solution to balance urban development with habitat and species preservation. Some planning and preservation benefits of the MSCP can't be denied. But the MSCP is woefully inadequate to protect the most imperiled species such as those dependent on vernal pools. Fourteen environmental groups won a lawsuit against the MSCP highlighting problems with the plan related to vernal pools and the judge wrote, "The species are left in a 'heads I lose, tails you win' position." Instead of strengthening the MSCP, the City of San Diego admitted defeat, dropped vernal pools from the plan, and relinquished endangered species permitting authority to state and federal wildlife agencies. The City is now preparing a new vernal pool-specific Habitat Conservation Plan/Natural Communities Conservation Plan that could improve vernal pool species preservation but only if the political will exists to accept the lessons of the original failed MSCP and to include real and binding preservation measures.

## THE DESERT RENEWABLE ENERGY CONSERVATION PLAN

**Stephanie Dashiell**, Bren School of the Environment, University of California at Santa Barbara, [sdashiell@bren.ucsb.edu](mailto:sdashiell@bren.ucsb.edu)

The California desert comprises more than 25 million acres of fragile ecological resources, including habitat for the threatened desert tortoise. The desert is also home to more than 360 rare plant taxa, including the Barstow woolly sunflower and white margined beard tongue. Currently, there are more than 100 wind and solar applications for renewable energy development covering nearly one million acres in the California desert. As part of the effort to protect the California desert while providing for responsible renewable energy development, state and federal agencies and other stakeholders have initiated a desert-wide Natural Community Conservation Plan (the Desert Renewable Energy Conservation Plan or DRECP). This presentation will discuss the current status of the DRECP and the challenge to assemble a conservation plan that balances species conservation with energy development. Specifically, this presentation will focus on the problem of how to overcome lack of adequate data, including vegetation data; the challenge of planning over millions of acres and several counties as well as federal lands; and the diverse values and views of the stakeholders.

## PRESERVING THE WHOLE: RARE PLANT CONSERVATION IN THE DESERTS OF SOUTHERN CALIFORNIA

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The deserts of southern California are lands of spectacular beauty and tremendous biological diversity. To preserve this dynamic landscape in one of the fastest growing areas of the state, the Coachella Valley Multiple Species Habitat Conservation Plan/Natural Community Conservation Plan was completed in 2008. At the western edge of the Sonoran Desert, the Coachella Valley was once a vast sea of sand dunes fed by desert washes and erosion from surrounding mountains. It is home to plants such as the Coachella Valley milkvetch, a federally listed species adapted to a blowsand environment. The CVMSHCP includes a 1.1 million acre area and covers 27 species and 27 natural communities. The CVMSHCP focuses on conservation of essential ecological processes including hydrological regimes and sand transport to maintain the sand dune ecosystem. The Plan conserves habitat for 2 federally listed plants and several narrow endemic plant species, as well as natural communities including native fan palm oases, desert dry wash woodlands, and mesquite hummocks. Early management efforts focus on invasive species and adaptive management. A comprehensive biological monitoring program tracks habitat stressors and community dynamics. Reserve design principles used in the CVMSHCP have already helped provide insight in evaluating impacts of solar projects in other desert areas. We will explore the reserve design, land acquisition successes, and conservation challenges of assuring long term protection of plants and plant communities through a landscape level conservation plan.

## RARE PLANT CONSERVATION IN NORTHERN CALIFORNIA REGIONAL CONSERVATION PLANS

**John Hopkins**, Institute for Ecological Health, [ieh@cal.net](mailto:ieh@cal.net)

Local governments are preparing or implementing large scale Natural Community Conservation Plans (NCCPs) and Habitat Conservation Plans (HCPs) in 10 northern California counties in the

Bay Area, Central Valley and Sierra Nevada Foothills. The species covered by these plans include 67 plant taxa. Most of these taxa are either federally or state listed or on the CNPS 1b list. These large-scale plans achieve conservation through the establishment of large, connected, preserve systems that both mitigate for development impacts and have additional conservation to provide for species recovery. Many of the plant taxa occur in very few known locations, with assumed additional locations since it is not possible to survey most of a plan's area. For some taxa, such as *Orcuttia viscida*, plans do not permit any take and require conservation of all known occurrences, as well as any occurrences found in the future. In some cases, a plan will allow take of a plant once all known occurrences are protected and a stated number of unknown occurrences are found and protected. There are also measures to introduce some taxa, such as *Lasthenia conjugens*, to additional locations. The plans also address long-term management, monitoring and adaptive management, including invasive species management.

## Session 23: Impacts and Mitigation

CONSERVATION OF ORCUTT'S YELLOW PINCUSHION (*CHAENACTIS GLABRIUSCULA* DC. VAR. *ORCUTTIANA* (GREENE) HALL) AT BALLONA LAGOON, HABITAT RESTORATION BY THE CITY OF LOS ANGELES.

**William Jones**, City of Los Angeles, Department of Public Works, Bureau of Engineering, Environmental Management Group, [william.jones@lacity.org](mailto:william.jones@lacity.org)

Orcutt's Yellow Pincushion (*Chaenactis glabriuscula* DC var. *orcuttiana* (Greene) Hall), a CNPS-designated rare plant taxon, is an herbaceous annual that occurs on predominantly sandy soils along the west bank of Ballona Lagoon. Located in a densely populated residential area, Ballona Lagoon is designated as an Environmentally Sensitive Habitat Area (ASHA) that covers about 6.5 hectares (16 acres) in area, of which 0.6 hectares (1.5 acres) are vegetated by intertidal, coastal strand or coastal dune habitats. Elevation ranges from zero to about 2 meters (6 feet) above mean sea level. The City of Los Angeles (City) is currently implementing a habitat restoration project along an undeveloped portion of the west bank, where habitat has been fairly degraded, and has been dominated by mostly exotic, ruderal plant species, well-adapted to frequent ground disturbance. The project includes barrier fencing, trails and educational areas. In light of the pincushion's discovery during construction in the winter of 2010, the City proactively modified aspects of its original design, including planting and irrigation plans to conserve and protect this rare taxon. Modifications were based upon research, consultations with public agencies, along with other restoration ecologists, professional botanists, and staff from the Rancho Santa Ana Botanic Garden. Construction is to resume with the implementation of its conservation plan in the fall of 2011. Nevertheless, as confirmed by regular monitoring, several factors, including limited access and weed removal, may have contributed toward an increase in the population size and territory beyond its 2010 distribution.

CONSTRUCTING VERNAL POOLS FOR ECOLOGICAL FUNCTION: A HISTORICAL STUDY OF TEN VERNAL POOL CREATION SITES IN THE NORTHERN CENTRAL VALLEY, CALIFORNIA

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Urban expansion and agricultural conversion have modified or destroyed > 95% of historic wetlands in California, including ephemeral wetlands such as vernal pools. Where avoidance of

wetland impacts is not feasible, mitigation through careful restoration, enhancement, and /or creation of replacement habitat can serve the goal of wetland conservation and protection. However, vernal pool creation will not succeed if the complex processes of pool design and construction are not well understood. The purpose of this research is to identify the design, construction and monitoring methods that have produced the most ecologically functional vernal pools using 10 vernal pool creation projects implemented over the past 20 years in the Sacramento Valley, CA. We summarize the key findings from the first year of this two-year study, including results from document review, practitioner and expert interviews, physical features survey (n = 457 pools), and residual dry matter measurements. First, although the vast majority of created pools (= 90%) across 10 study sites met their own success criteria after required monitoring, practitioners often considered these criteria inadequate to ensure ecological function in created vernal pools. Second, 70% of pools surveyed were statistically different from natural reference pools in at least one physical attribute (length, slope, area, or perimeter). These preliminary findings were investigated with intensive biological monitoring (i.e., hydrology, invertebrates, vegetation by Barbour et al. (2007) methods, and site quality/conditions by CRAM) in the second year. In summary, preliminary results suggest that true habitat replacement may not be occurring in created vernal pools.

#### ACTING TO SAVE PLANTS FROM CLIMATE CHANGE: BENEFITS, RISKS, AND TOOLS FOR MANAGEMENT SUCCESS.

**Daniel Gluesenkamp**, The Calflora Database, [conservation@gluesenkamp.com](mailto:conservation@gluesenkamp.com)

Californians have managed their plant communities for ten millennia, employing relatively simple tools to favor desirable plants and select against unwanted taxa. Contemporary natural resource management is significantly more complicated, as we manage to protect an expanding list of sensitive species and a growing diversity of unwanted taxa in a changing environment. Recently, conservationists have begun talking about ambitious new tools for adapting to climate change: assisted migration, breeding neo-natives or selecting for change-tolerant traits, and aggressive management of invasive species. While scientists debate the risks and benefits of these interventions, individual managers have already begun to act. How can we ensure that these actions lead to enhanced protection and not increased regret? This talk reviews the various climate change adaptation strategies available to managers of native plants, with brief evaluation of potential benefits and risks. We then present examples of analogous actions (such as identifying climate change refugia, translocating species, and hybridizing lineages) and the consequences for the target species (such as *Arctostaphylos franciscana*, *Cupressus lawsoniana*, *Sequoia sempervirens*, and *Yucca brevifolia*). Next, we outline the resources, approaches, and tools available to support managers in taking effective action. These resources include recent research that can guide action and exciting technological tools for planning and tracking action (including Calflora's integrated occurrence information and management modules). Finally, we review some fundamental principles derived from scientific and policy literature that can guide and improve this important work.

#### THE EFFECT OF SEASONALITY ON CRAM SCORES FOR VERNAL POOLS IN EASTERN SACRAMENTO COUNTY

**Debra Sykes**, Eric Stitt, Tara Collins, Daria Snider, Peter Balfour, ECORP Consulting, Inc., [dsykes@ecorpconsulting.com](mailto:dsykes@ecorpconsulting.com)

The California Rapid Assessment Methodology (CRAM) is used to collect repeatable measurements of a wetland or wetland system over time. CRAM data are used to monitor changes in wetland function at a restoration site or to detect changes in wetlands due to changes in nearby land use. CRAM assesses four attributes shared among all wetlands: buffer and landscape context, hydrology, physical structure, and biotic structure. These attributes are important determinants of wetland function, giving insight into water storage capacity, groundwater discharge and flow, dissipation of energy, and nutrient cycling, among other parameters. In order to accurately score biotic structure, CRAM assessments are timed to occur during the peak of the floristic bloom period, which is typically April or May for vernal pools in the Sacramento Valley. The limited timeline within which surveys are recommended poses a significant constraint to researchers and planners. However, if it is determined that CRAM assessment scores do not vary significantly between early- and late-season surveys, CRAM assessments can be performed within a longer timeframe and need not conflict with other time-sensitive surveys or planning efforts. To determine whether seasonality affects vernal pool CRAM scores, we conducted a CRAM assessment on 60 randomly selected pools in the spring (peak flowering period) and in the late summer (post-bloom period). We compared overall CRAM scores and individual attribute scores to determine whether any significant difference exists between seasons and whether late summer vernal pool CRAM assessments provide defensible data to planning and agency personnel.

## SMOG IS NITROGEN FERTILIZER: CHEMICAL CLIMATE CHANGE THREATENS CALIFORNIA NATIVE PLANT DIVERSITY

**Stuart Weiss**, Creekside Center for Earth Observation, [stu@creeksidescience.com](mailto:stu@creeksidescience.com)

Emissions of nitrogen oxides and ammonia from combustion, agriculture, and soils are transported and chemically transformed in the atmosphere and deposit onto land and water. This atmospheric nitrogen deposition is a form of "chemical climate change" that effectively delivers high quality nitrogen fertilizer to ecosystems. In California, 20% of the land surface receives greater than 5 kg-N ha<sup>-1</sup> year<sup>-1</sup>, with hotspots receiving greater than 50 kg-N ha<sup>-1</sup> year<sup>-1</sup>. This profound ecological change enhances growth of invasive weeds, and is an acute and immediate threat to native biodiversity that has not received appropriate attention from the conservation community. Documented effects of N-deposition include increased growth of annual grass and other invasives in coastal sage scrub, serpentine grasslands, vernal pools, and deserts, altered nutrient cycling and fuel accumulation of montane forests, enhanced fire cycles, nitrate leaching into surface and groundwater, and eutrophication of montane lakes such as Lake Tahoe. This talk will review the scope of the N-deposition problem in California, using case studies and regional and statewide assessments of exposure and sensitivity of habitats, and will explore some policy responses, including CEQA, critical loads, mitigation fees to support Weed Management Areas, Endangered Species Act consultations, and Habitat Conservation Plans.