• NORTHERN CALIFORNIA PLANT LIFE •
BOTANY FOR A CHANGING WORLD

THE SIXTH SYMPOSIUM
PRESENTED BY

NORTHERN CALIFORNIA BOTANISTS
California State University, Chico
13-15 January 2014

• Northern California Plant Life •
Botany for a Changing World

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THANK YOU TO ALL OF THE SYMPOSIUM SPONSORS!!

Cover photo courtesy of Stuart Weiss. View looking north to White Mountain (14,246 ft. elevation), across areas of dolomite, with *Eriogonum gracilipes*, raspberry buckwheat or White Mountains wild buckwheat, in the foreground. Some interesting aspects of our conference theme, about a changing world, are included in this photo, since plant communities in alpine environments are particularly vulnerable to a warming climate. 26 July 2010 at 8:50 a.m.

WELCOME!

Northern California Botanists

welcomes you
to our sixth symposium!

MISSION STATEMENT: Northern California Botanists is an organization with the purpose of increasing knowledge and communication among agency, consulting, academic, and other botanists about botanical issues concerning science, conservation, education, and professional development.

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PROGRAM OF PRESENTATIONS BY INVITED SPEAKERS
Bell Memorial Union Auditorium
(Abstracts of talks start on page 7; index to authors on page 35)

Monday 13 January 2014

7:30 – 9:00 a.m. **Check-in for registered participants, late registration, and poster set-up**

ALL DAY **Poster Session** – Bell Memorial Union second floor Mezzanine
Also Session 4, Poster Presentations, at 3:00 p.m.

Welcome

9:00 a.m.

1. **Linnea Hanson**, President, Northern California Botanists

9:05 a.m.

Frederika (Fraka) Harmsen, Dean, College of Natural Sciences, California State University, Chico

Session 1: Alpine Ecology

9:15 – 10:35 a.m.

Session Chair: Connie Millar, U.S. Forest Service, Pacific Southwest Research Station

2. **Connie Millar**
   Alpine Environments in California: An Overview, Introduction, and Sidelight on Talus Meadow Vegetation
3. **Jim Bishop**
   Watching our Alpine Flora for Signs of Climate Change – a Decade of Expanding the GLORIA Network
4. **Christopher Kopp**
   Examining Direct and Indirect Impacts of Environmental Change on Alpine Plant Communities in California's White Mountains
5. **Stuart Weiss**
   Up, Down, and Sideways: Species Range Shifts in the White Mountains under Climate Change

10:35 – 10:55 a.m. **Break**

Session 2: Rare Plants

10:55 a.m. – 12:15 p.m.

Session Chair: Carol Witham, Consulting Botanist

6. **Nadine R. Kanim**
   *Yreka Phlox (*Phlox hirsuta*) Recovery: Can We Be Successful?*
7. **Jessica O'Brien**
   Sierra Pacific Industries Botany Program
8. **Janel Johnson**
   An Introduction to the Climate Change Vulnerability Index
9. **Carol Witham**
   The Status of Orcuttieae a Quarter Century Later

12:20 – 1:30 p.m. **Lunch**

12:35 – 1:30 p.m. **Student Lunchtime Discussion** (optional)
Bell Memorial Union Auditorium
Discussion Leaders: Matt Guilliams, University and Jepson Herbaria, University of California, Berkeley, and **Julie Nelson**, Shasta-Trinity National Forests

Session 3: Flower Visitors

1:30 – 2:50 p.m.

Session Chair: Joe Silveira, U.S. Fish and Wildlife Service

10. **Gretchen LeBuhn**
Bumble Bees of the Sierra Nevada: Emergence Patterns and Community Structure and the Effects of Climate Change
11. **Arthur Shapiro**
What Did Sacramento Valley Butterflies Do for a Living before Yellow Star Thistle?
12. **Neal Williams**
Responses of Pollinator Communities to Riparian Restoration along the Sacramento River
13. **Robbin Thorp**
Bumble Bee Declines and Conservation in Northern California and Southern Oregon

2:50 – 3:00 p.m. **Break**

Session 4: Poster Presentations

3:00 – 5:00 p.m. Poster Session – Bell Memorial Union second floor Mezzanine

Session Chair: Barbara Castro, California Department of Water Resources
(Abstracts of posters start on page 19; index to authors on page 35)

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5:00 – 6:00 p.m. **Reception** – Bell Memorial Union second floor Mezzanine
No-host bar and complimentary hors d'oeuvres – adjacent to the Poster Display area

6:00 p.m. **Banquet** – Bell Memorial Union Auditorium
Dinner tickets required. Buffet dinner will include fish, meat, and vegetarian entrees.

Keynote Speaker

7:00 p.m. Bell Memorial Union Auditorium – everyone is welcome

14. **David Ackerly**, University of California, Berkeley
Climate Change and Conservation: Visualizing Our Future

Tuesday 14 January 2014

8:00 – 8:30 a.m. **Check-in for one-day registrants**

ALL DAY **Poster Session** – Bell Memorial Union second floor Mezzanine

Introduction

8:30 – 8:45 a.m.

Linnea Hanson, President, Northern California Botanists

Session 5: Wetlands

8:45 – 10:05 a.m.

Session Chair: Daria Snider, ECORP Consulting, Inc.

15. **Brenda Grewell**
    Sea Change under Climate Change: Case Studies in Rare Plant Conservation from the Dynamic San Francisco Estuary
16. **Lisa Schile**
    Modeling Tidal Wetland Resiliency in the Face of Predicted Accelerated Sea-level Rise
17. **Lorena Torres-Martinez**
    Germination and Dormancy Variation in Fremont's Goldfields: Implications for Vernal Pool Plant Responses to Climate Change
18. **Sarah VonderOhe**
    Pool of Dreams: If You Build It, Will They Come?

10:05 – 10:25 a.m. **Break**

Session 6: Fungi

10:25 – 11:25 a.m.

Session Chair: Jessi Hammond, University of California, Santa Cruz

19. **Sharifa Crandall**
    Fungal Spore Dynamics and Diversity in Coastal California Ecosystems
20. **Else Vellinga**
    Mushroom Inventories in Northern California
21. **Nhu Nguyen**
    Ten Years of Dormancy: Fungal Spores and Their Ability to Form Long-term Sporebanks in a Northern California Coastal Pine Ecosystem

Plenary Presentation

11:25 a.m. – 12:00 p.m.

22. **Kabir Peay**, Stanford University
    Island Biogeography and the Assembly of Ectomycorrhizal Fungal Communities Across a Northern California Landscape

12:00 – 1:20 p.m. **Lunch**

Session 7: Horticultural Restoration

1:20 – 2:40 p.m.

Session Chair: Brett Hall, Arboretum, University of California, Santa Cruz

23. **Betty Young**
    Growing Plants for Habitat Restoration that are Resilient in the Face of Climate Change – Perspective from One National Park
24. **Mike Uhler**
    The Regional Parks Botanic Garden's Role in Conservation/Restoration Through Horticulture
25. **Martin Grantham**
    Where There's Smoke, There's Germination! The Story of Smoke in Seed Germination and the Research that Exposed It
26. **Brett Hall**
    Forward Looking Conservation of Maritime Chaparral

2:40 – 3:00 p.m. **Break**

Session 8: New Discoveries

3:00 – 4:20 p.m.

Session Chair: Clare Golec, California Department of Fish and Wildlife

27. **Tom Carlberg**
    Notes on Hypermaritime Foliicolous Lichen Communities of Northern California
28. **Kathy Van Zuuk**
    Calystegia *"vanzuukiae" A Remarkable New Species from Central California*
29. **Barbara Wilson**
    The Rocky Road of Stonecrop Taxonomy in Northern California
30. **Pete Figura**
    Antennaria sawyeri*, a New Species from the Trinity Alps of Northwestern California*

Closing Remarks

4:20 – 4:30 p.m.

Linnea Hanson, President, Northern California Botanists

4:30 – 5:30 p.m. **Chico State Herbarium Tour** (optional)

POST-SYMPOSIUM WORKSHOPS

Wednesday 15 January 2014

Workshop 1: Resources for Beginning Professional Botanists
9:00 a.m. – 4:00 p.m. Bell Memorial Union, room TBA

Instructor: **Samantha Hillaire**, Garcia and Associates

This workshop is intended to familiarize the beginning or aspiring professional botanist with a basic overview of State and Federal agency laws, regulations and practical applications as they relate to botany and the environment, including the National Environmental Protection Act (NEPA), the California Environmental Quality Act (CEQA), the Federal Endangered Species Act (ESA), and the California Endangered Species Act (CESA). We'll cover the general regulatory framework of several State and federal agencies including the U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, Army Corps of Engineers, and the U.S. Forest Service. Each agency operates independently, yet often in parallel on one project, so key permits and processes for working with these agencies is helpful and very important to understand. Topics such as Biological Assessments, Biological Evaluations, Initial Studies, and wetland delineations will be introduced, with a focus on the practical working information for a beginning botanist. Workshop materials will include a collection of government and other public references for your further use.

Workshop 2: Introduction into Mushroom Foraging and Identification
9:00 a.m. – 4:00 p.m. Location: TBA **CANCELLED**

Field Trip Leader: **Phil Carpenter**, president, Santa Cruz Fungus Federation

This workshop will be useful for rank beginners as well as for people with some knowledge of mushrooms. We will start the day with an hour or so of introduction to the subject – how to get started, what you need to be concerned about in doing identifications, and a question and answer period. After that, we will go into the field to gather mushrooms, following the advice provided in the introduction. When we return from gathering mushrooms we'll get into the identification part of the workshop using the field guide Mushrooms Demystified by David Arora. After an introduction to the process of identifying mushrooms, participants will be guided through hands-on use of the book with actual mushrooms to practice the process of identification. The class may close with taste testing of the edibles we find to give participants an idea of how to start cooking with them. With some extra planning, perhaps we can have some bread, cheese and wine to round out the tasting. Participants should dress for being both indoors and outdoors in field exploration mode – i.e. with boots, hat, and rain gear if conditions require. Bring lunch and water. If possible, please also bring a copy of Mushrooms Demystified and collecting containers (baskets, etc, but no plastic bags).

CANCELLED DUE TO LACK OF RAIN

Workshop 3: Biology, Ecology, and Conservation of Whitebark Pine in California
9:00 a.m. – 4:00 p.m. Bell Memorial Union, room TBA

Instructors: **TBA**
Coordinated by: **Diane Ikeda**, Regional Botanist, U.S. Forest Service, Pacific Southwest Region (Region 5)

This workshop on whitebark pine will consist of 13-14 people who will give talks emphasizing "field studies" of the pine. Talks will be grouped according to geographic regions of California: 1) southern Sierra Nevada, 2) northern Sierra Nevada, and 3) Klamath, Cascade and Modoc areas, each area with a separate moderator (chair) for the presentations. Speakers represent various federal, state, and private affiliations, including the California Native Plant Society. The emphasis is to get people from these different areas "to know what others are doing with whitebark pine." Workshop attendees will receive a workshop program that will contain abstracts from all of the speakers.

ABSTRACTS OF TALKS

(Abstracts in chronological order; index to authors on page 35)
(* denotes the speaker if not the first author)

1. HANSON, L.
2837 Mariposa Avenue, Chico, CA, 95973. linneachanson@gmail.com

Welcome to Our Sixth Northern California Botanists Symposium

I'd like to welcome all of you to our sixth symposium, *Northern California Plant Life, Botany for a Changing World.* We hope you will enjoy the program that we have organized for you this year with great speakers and posters. Our plenary speaker, Kabir Peay, will focus on *Island Biogeography and the Assembly of Ectomycorrhizal Fungal Communities Across a Northern California Landscape* and our keynote speaker, David Ackerly, will address *Climate Change and Conservation: Visualizing Our Future*. We again hope to provide botanists with a forum to listen to talks on a variety of subjects and to spend time socializing with each other. We have encouraged students to attend, so please be sure to take time to meet them and for them to meet you. We have added a student forum Monday at lunch for students to learn about the various types of botany job opportunities, so please attend. We have expanded the time for the poster session on Monday afternoon to make sure all have time to spend with the posters that are submitted. Northern California Botanists is a cooperative association of Federal, State, Academic, Consulting and Other Botanists in the Northern California Region, with the purpose of increasing knowledge and communication about botanical issues concerning science, conservation, education and professional development. Have a great symposium.

2. MILLAR, C.I.
USDA Forest Service, Pacific Southwest Research Station, 800 Buchanan Street, Albany, CA 94710.
cmillar@fs.fed.us

Alpine Environments in California: An Overview, Introduction, and Sidelight on Talus Meadow Vegetation

As introduction to this session, I summarize the Californian alpine zone with information taken from an alpine chapter under development (Rundel and Millar) for the forthcoming volume, *Ecosystems of California* (UC Press). Alpine ecosystems of California represent a special case in the global perspective by having a Mediterranean climate regime, which adds stresses unlike those in many other alpine areas, and has contributed to emergence of unique biota. The lower elevation of the California alpine zone (upper treeline) varies with latitude and substrate, ranging from 4300 m in the south (White Mountains) to 2300 m in the north (Klamath Ranges). Community structure is influenced by geomorphic structures and their relationship to degree of soil development, erosion, snow accumulation, and snow melt. Life forms are dominated by broad-leaved herbaceous perennials, followed in importance by graminoid perennials and mats and cushions, annuals, and woody shrubs. The proportion of annual species is relatively high in the Sierra Nevada and White Mountains compared to other continental alpine regions. The alpine zone of the Sierra Nevada includes 385 species of native vascular plants, only a small number of which are high elevation specialists. Over half of Sierran alpine species occur in 6 families, including Asteraceae (55 species), Poaceae (39 species), Brassicaceae (34 species), and Cyperaceae (39 species). The largest genus is *Carex* (29 species), followed by *Draba* (14 species), and *Lupinus* (11 species; Rundel 2011). As a focal community, I review the wetland vegetation supported by rock-glacier and talus springs, which my research group has been studying.

3. **BISHOP, J.**
1144 Mount Ida Road, Oroville, CA 95966. cjbishop1991@sbcglobal.net
California and Nevada GLORIA (Global Observation Research Initiative in Alpine Environments)

Watching our Alpine Flora for Signs of Climate Change – a Decade of Expanding the GLORIA Network

The alpine flora is a well-chosen system to watch for biological signs of climate change. It is a very climate-sensitive environment, spans the globe and samples maritime/continental, polar, mid-latitude, and tropical climate regions. An international protocol, GLORIA was established to provide scientifically valid and globally comparable data. California was the site in 2004 of the first GLORIA Target Regions (a group of summits spanning from treeline to the highest peak) in the Western Hemisphere. The network in California (and a bit in Nevada) has been expanded to include eight Target Regions encompassing 29 summits, ranging from the northern to the southern Sierra, into the White Mountains, Sweetwater Mountains, Panamint Mountains, and Snake Range (Nevada). The environments vary from classic high alpine at 14,000 feet elevation to desert alpine. The basic data from each summit assesses all plant species present, their abundance, and the nature of the substrate, at several spatial scales. Temperature loggers are placed at 10 cm depth on each major aspect. The sites are resurveyed every 5 years, to monitor for change. In the White Mountains the GLORIA summit surveys have been supplemented by downslope surveys that provide much better elevational resolution between the summits and the subalpine woodland. It will take about two decades for changes to be attributable to global climate change. However, interesting results are visible even in the baseline data and in the first 5-year resurveys.

4. **KOPP, C.W., and CLELAND, E.E.**
University of California-San Diego, Division of Biological Sciences, 9500 Gilman Dr. #0116 La Jolla, CA 92093. ckopp@ucsd.edu

Examining Direct and Indirect Impacts of Environmental Change on Alpine Plant Communities in California's White Mountains

Shifting range distributions observed worldwide provide some of the best evidence of plant species responses to climate change. These shifts in distribution can result in significant modification of plant community composition and stability. Over the past half-century in California's White Mountains, sagebrush (*Artemisia* sp.) has increased in abundance at the upper reaches of its elevational distribution while several cushion plant and grass species have experienced significant declines. These shifts occurred during a period when there was a significant increase in temperature and decline in precipitation at this location. Further, experimental evidence at this location indicates that increases in temperature have a direct negative effect on cushion plant species but not on grass species. With sagebrush encroaching into the alpine zone we wanted to understand how this shrub affects the alpine plant community. To do this we conducted a survey of alpine plant species in recently encroached and nearby un-encroached areas as well as a sagebrush removal experiment to determine how sagebrush interacts with plant species in the alpine zone. We found that sites that have experienced recent sagebrush encroachment have significantly lower cover of grass species than sagebrush-free sites. There is no difference in the cover of forb species between sites. When sagebrush is removed, grasses respond positively but forb species are unaffected. These results suggest that with continued rises in temperature and encroachment by sagebrush, alpine plant communities in the Great Basin could be transformed to sagebrush steppe.

5. **WEISS, S.B.**
Creekside Center for Earth Observation, 27 Bishop Lane, Menlo Park, CA 94025.
stu@creeksidescience.com

Up, Down, and Sideways: Species Range Shifts in the White Mountains under Climate Change

Species distributions are affected by underlying geology and soils and by climate at multiple scales. Species' range shifts in response to climate change occur on local scales across topoclimatic gradients – the effects of solar exposure and topographic position on temperatures and moisture. The White Mountains of California, with their 3000 m elevational gradient, complex topography, and diverse geology (dolomite,

limestone, metasedimentary, and granitic), provide an excellent arena for investigating and predicting range shifts at local levels. More than 600 rapid assessment vegetation plots were analyzed using multivariate methods, and species distribution models on a scale of ~50 m were developed for dozens of species, including bristlecone pines. Warming scenarios were simulated by changing the effective elevation. While there is a general upward movement of species, local topoclimatic effects lead to lateral shifts from south- to north-facing slopes and downward movement into cold air sinks when frost limitations are relieved. Geologic limitations can prevent upward movements to track warming climate. The complex and individualistic range shifts can be seen in existing patterns of mature and recruiting plants, and the study highlights how local topoclimatic variability allows for short distance migration of plant populations to readjust to a changing climate.

6. KANIM, N.
USFWS Yreka Fish and Wildlife Office, 1829 South Oregon Street, Yreka, CA 96097.
nadine_kanim@fws.gov

Yreka Phlox (*Phlox hirsuta*) Recovery: Can We Be Successful?

In 2000, *Phlox hirsuta* was listed as endangered under the Endangered Species Act of 1973, as amended. A serpentine endemic, *Phlox hirsuta*, is known from only five locations in and around the City of Yreka (City), Siskiyou County, California. At the time of listing, the primary direct threats were residential development and extirpation from random events due to the small number of populations. The *Recovery Plan for Phlox hirsuta (Yreka phlox)*, published in 2006, outlines a recovery strategy that includes protecting population occurrences, population and threat monitoring over 10 years, creating a seed bank, surveying for undiscovered occurrences, conducting biological research, and increasing public participation in recovery actions. The U.S. Fish and Wildlife Service is working with many partners to implement these actions. The City now owns 74 percent of occupied habitat on China Hill for conservation in perpetuity. Monitoring results indicate that the total number of plants in transects was greater in 2013, than in 2008, for all occurrences. Seeds have been accessioned at Rancho Santa Ana Botanic Garden. Approximately 443 hectares of potential habitat were surveyed in 2006. Research on breeding system, reproductive success, and evolutionary relationships has been carried out on China Hill. In 2009, the City adopted the Yreka phlox as its official flower. To address an increasing threat, the Siskiyou County Department of Agriculture has been treating invasive weeds around occurrences. Delisting will depend on the continuing effective collaboration with our partners. Climate change may represent the greatest challenge to our recovery goal.

7. O'BRIEN, J.
Sierra Pacific Industries, P.O. Box 496014, Redding, CA 96049. botany@spi-ind.com

Sierra Pacific Industries Botany Program

Sierra Pacific Industries (SPI) is a large California forest landowner. In an effort to protect botanical resources on SPI timberlands a scientifically-based Botany Policy was developed to guide how sensitive plants are addressed in timber harvest plans (THPs). The company lands are broken down into 8 districts. A list of rare plants that potentially could occur on SPI lands was created for each district with the help of Dr. Dean Taylor. Botanical scoping reviews are completed for each THP by using the district rare plant list, conducting a 9-Quad search, and considering BIOS and herbarium records. A list of rare species that potentially could occur in the THP area is created from these scoping reviews. The Botany Policy calls for field surveys in suitable habitat for any THP with the potential to contain sensitive plant species. When a rare plant is found, it is documented by standard professional practice and sent to the Department of Fish and Wildlife to be added to the California Natural Diversity Database (CNDDB). All surveys and findings along with plant protection measures are submitted with the THP to the California Department of Forestry and Fire Protection. Each new sensitive plant finding increases our knowledge of the species life cycle, habitat, and geographic range, resulting in SPI practicing better forest management. Projects outside the scope of THP surveys have also been conducted. Since the botany program began, 152 sensitive species have been found and over 2,000 reports have been submitted to CNDDB.

8. JOHNSON, J.

Nevada Natural Heritage Program, Carson City, NV 89701. jdjohnson@heritage.nv.gov

An Introduction to the Climate Change Vulnerability Index

This talk will introduce California botanists to the NatureServe Climate Change Vulnerability Index that was developed by Bruce E. Young, Kimberly R. Hall, Elizabeth Byers, Kelly Gravuer, Geoff Hammerson, Alan Redder, and Kristin Szabo. Biologists from the Nevada Natural Heritage Program assisted with the development of this tool to assess the relative vulnerability of species to predicted changes in climate. From *Guidelines for Using the NatureServe Climate Change Vulnerability Index* (Young et al., 2011): "Motivated by the need for a means to rapidly assess the vulnerability of species to climate change, NatureServe developed a Climate Change Vulnerability Index. The Index uses a scoring system that integrates a species' predicted exposure to climate change within an assessment area and three sets of factors associated with climate change sensitivity, each supported by published studies: 1) indirect exposure to climate change, 2) species-specific factors (including dispersal ability, temperature and precipitation sensitivity, physical habitat specificity, interspecific interactions, and genetic factors), and 3) documented response to climate change. Assessing species with this Index facilitates grouping taxa by their relative risk to climate change, and by sensitivity factors, which we expect will help users to identify adaptation options that could benefit multiple species." (Young, B., E. Byers, K. Gravuer, K. Hall, G. Hammerson, A. Redder, J. Cordeiro and K. Szabo. 2011. Guidelines for Using the NatureServe Climate Change Vulnerability Index, Release 2.1. https://connect.natureserve.org/science/climate-change/ccvi)

9. WITHAM, C.W.

1141 37th Street, Sacramento, CA 95816. cwitham@ncal.net

The Status of Orcuttieae a Quarter Century Later

In 1986-1987, Biosystems Analysis conducted a Great Valley wide survey for seven grasses in the Orcuttieae tribe and Hoover's spurge (Stone et al. 1988). Partially because of that status report, these plants were listed under both the state and federal Endangered Species Acts. And since the surveys were conducted, over 100,000 acres of vernal pool habitat have been lost to conversion (Holland 2009). During the summers of 2010-1011, I updated our knowledge of the distribution and status for Colusa grass (*Neostapfia colusana*), San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), hairy Orcutt grass (*Orcuttia pilosa*), slender Orcutt grass (*Orcuttia tenuis*), Sacramento Orcutt grass (*Orcuttia viscida*), Greene's tuctoria (*Tuctoria greenei*), Solano grass (*Tuctoria mucronata*), and Hoover's spurge (*Chamaesyce hooveri*) in the Great Valley. Through a combination of field surveys and aerial photography interpretation, this project reports on the current status of 288 occurrences including 15 populations previously unreported and 11 erroneous or duplicate records. Agricultural conversion still threatens many of these species in portions of their range and particularly in Stanislaus and Madera Counties. New extirpations occurred or were documented during the 2010-2011 field surveys. On the positive side, vast areas of vernal pool landscapes containing multiple occurrences of these species are protected in many areas of the Great Valley. This talk will highlight some of the data collected and observations made during two summers of road trips in the Great Valley.

10. LEBUHN, G.

Department of Biology, San Francisco State University, 1600 Holloway Ave, San Francisco, CA 94132. lebuhn@sfsu.edu

Bumble Bees of the Sierra Nevada: Emergence Patterns and Community Structure and the Effects of Climate Change

11. SHAPIRO, A.M.

Department of Evolution and Ecology, University of California, Davis, CA 95616. amshapiro@ucdavis.edu

What Did Sacramento Valley Butterflies Do for a Living Before Yellow Star Thistle?

With the exception of riparian tree-feeders, the extant Sacramento Valley butterfly fauna appears very poorly-adapted to a Mediterranean climate and is today heavily dependent on naturalized exotic host

plants, which in turn depend on irrigation. The conventional wisdom concerning a pre-European perennial grassland does not match the biological characteristics of this fauna, nor is it well-adapted to the ephemeral late winter-spring forb-field flora—with the sole exception of the migratory Painted Lady, *Vanessa cardui.* It is proposed that the fauna is largely recruited from the tule marshes and gravel bars, where a succession of summer generations was possible, while some species underwent seasonal altitudinal migration to track the availability of larval host plants. Many widespread "weedy" butterflies in the region have probably benefitted greatly from habitat conversion and weed introductions. The "summer deserts" occupying much of the Valley uplands were virtually butterfly-free before the second half of the 19th Century, while today they support a thriving fauna.

12. WILLIAMS, N.M.
Department of Entomology, University of California, Davis CA 95616. nmwilliams@ucdavis.edu

Responses of Pollinator Communities to Riparian Restoration along the Sacramento River

Despite increasing concern about declines of native pollinators throughout North America, native bees and other species are seldom the targets of restoration. Such non-target species, even those serving important functions like pollination, have generally been assumed to return on their own following restoration of structural vegetation. Surprisingly little is known about how pollinators respond to large scale restoration actions. The Sacramento River provides an excellent opportunity to explore such responses. To quantify the impact of habitat restoration on native bees, we surveyed bees and flowering vegetation at five restored sites and five paired sites within remnants of riparian habitat along the northern Sacramento River during 2003 and again during 2012. Remnant sites represent a "target" of restoration. All restored sites had been almond or walnut orchards and were planted with native trees and shrubs in 2003. At each site we sampled bees using nets and water-filled pans every six weeks between March and August. Restoration dramatically enhanced bees especially during initial years after restoration. Ten years later bee species richness had declined at restored sites relative to remnants; however, community composition was more similar to the target. Persistent differences between communities at restored sites and the target communities were partly explained by differential responses of bees with certain ecological traits. Specifically, there were fewer above-ground nesters in restored sites compared to target sites. Results suggest that restoration can enhance native bee communities, but differences remain even 15 years later.

13. THORP, R.
Department of Entomology and Nematology, University of California, One Shields Avenue, Davis, CA 95616. rwthorp@ucdavis.edu

Bumble Bee Declines and Conservation in Northern California and Southern Oregon

Rapid and severe declines of two western bumble bees in the subgenus *Bombus*, occurred in populations west of the Sierra Cascade during the past 15 years. Many bumble bee species in other subgenera persisted and even thrived in this area. Thus, general causes of declines such as habitat alteration, pesticides, and climate change are unlikely. At the same time, two common eastern North American species of the subgenus *Bombus* declined, again where species of different genetic lineages persisted. Thus, declines in these four close relatives are likely due to more specific causes. My hypothesis for these sudden declines is disease, most likely due to exotic pathogens or their strains, to which many North American populations of the subgenus *Bombus* are susceptible. How could exotic pathogens get here? Between 1992-1994 queens from North America were exported to Europe and colonies produced from them were returned to North America. Evidence from recent studies test and support my hypothesis including: historic and recent pathogen occurrences and strain types; and presence of pathogens in commercially produced and exported bumble bee colonies. Resistance and recovery may be occurring in one western species based on recent sightings in areas where they had not been seen for several years. Most of our western bumble bees are not being monitored for long-term population trends. But recent databasing of museum collections provides historic ranges and most recent records give insights as to population losses, gains or stability.

14. ACKERLY, D.D.

Department of Integrative Biology and Jepson Herbarium, University of California, Berkeley CA 94720. dackerly@berkeley.edu

Climate Change and Conservation: Visualizing Our Future

Climate change is a ubiquitous element of earth history, shaping the evolution and distribution of the world's flora and fauna. Yet, the rapid changes projected for the next century and beyond threaten the fabric of the natural world as we have come to know it in recent history. Conservation biology has been largely focused on preserving or restoring a 'natural world', protected from human influence. Our challenge moving forward is to visualize and embrace a future that may be different from our recent past. The choices we make as a society, in terms of greenhouse gas emissions and new approaches to species conservation and land management, represent choices among different futures. Facing these choices, there are (at least) three critical issues we will need to address: 1) as species move in response to climate change, the distinction between native and exotic will fade, forcing us to more consciously evaluate which species we find desirable and which have undesirable impacts on natural systems and human welfare, regardless of their origins; 2) a shift to conservation of ecological and evolutionary processes that can persist even as individual species and floristic communities come and go; and 3) in a rapidly changing American society, we will need to embrace social and biological diversity, to build sustained support for conservation of biodiversity.

15. GREWELL, B.J.[1], and FIEDLER, P.L.[2]

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[2]Natural Reserve System, University of California, Office of the President, 1111 Franklin Street, 6th Floor, Oakland, CA 94607. peggy.fiedler@ucop.edu

Sea Change under Climate Change: Case Studies in Rare Plant Conservation from the Dynamic San Francisco Estuary

We present case studies supporting management of two rare plant species in tidal wetlands of the San Francisco Estuary. We used empirical demographic analyses to identify factors to enhance population establishment and survival of *Chloropyron molle* subsp. *molle* (Orobanchaceae; soft birds's-beak), an annual hemiparasite, and to compare reintroduced with natural populations. Twelve years after outplanting, the reintroduced population persists but is in decline; impediments to success include the lack of adaptive management response to weed invasions and muted variance in hydrology. Transplantation of *Lilaeopsis masonii* (Apiaceae; Mason's lilaeopsis), a rhizomatous perennial herb, failed to meet success criteria for mitigation at local project scale, but dispersal and establishment of metapopulation patches indicated persistence at the landscape scale. This species has been found to be genetically indistinct from a widespread congener, and has few threats to persistence so long as suitable habitat is present. Looking forward, we project how wetland flora may respond to rising sea level and suggest conservation actions. These two examples demonstrate the need for integrated conservation management strategies that prioritize habitat connectivity and maintain physical processes to support dispersal in response to sea level rise. For the hemiparasite, assisted colonization may sustain populations threatened by sea level rise, but only if a strong commitment to effective stewardship is realized.

16. SCHILE, L.[+1], CALLAWAY, J.[2], and KELLY, M.[3]

[+]NCB 2008-2009 Research Scholarship Awardee

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Modeling Tidal Wetland Resiliency in the Face of Predicted Accelerated Sea-level Rise

Tidal wetland ecosystems are dynamic coastal habitats that, in California, often occur at the complex nexus of aquatic environments, diked and leveed baylands, and modified upland habitat. Because of their prime location and rich peat soil, many wetlands have been reduced, degraded, and/or destroyed, and yet

their important role in carbon sequestration, nutrient and sediment filtering, and as habitat requires us to further examine their sustainability in light of predicted climate change. Predictions of climate change effects for the San Francisco Bay Estuary present a future with reduced summer freshwater input and increased sea levels. We examined the applicability and accuracy of the Marsh Equilibrium Model (MEM), a zero-dimensional model that models organic and inorganic accretion rates under a given rate of sea-level rise. MEM was calibrated using data collected from salt and brackish marshes in the San Francisco Bay Estuary to examine wetland resiliency under a range of sea-level rise scenarios. At sea-level rise rates 100 cm/century and lower, wetlands remained vegetated. Once sea levels rise above 100 cm, marshes begin to lose ability to maintain elevation, and the presence of adjacent upland habitat becomes increasingly important for marsh migration. Results from this study emphasize that the wetland landscape in the Bay is threatened with rising sea levels, and there are a limited number of wetlands that will be able to migrate to higher ground as sea levels rise.

17. TORRES-MARTINEZ, L., and EMERY, N.

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Germination and Dormancy Variation in Fremont's Goldfields: Implications for Vernal Pool Plant Responses to Climate Change

Delayed germination can be a phenotypically plastic response that is adaptive in variable environments. Yet, few studies have examined the implications of germination responses for the evolutionary potential of plants to respond to climate change. We evaluated if adaptive plasticity in germination timing exists in *Lasthenia fremontii,* a winter annual adapted to the variable environments of Californian vernal pools. We compared the timing and fraction of germination in response to alternative hydrological conditions among six populations that collectively span the geographic range of *L. fremontii*. We varied the amount and timing of water available during the germination period by subjecting seeds to saturated and flooded conditions at four, six or eight weeks after exposure to summer temperatures. Results indicated that populations varied in the timing and fraction of germination under different precipitation regimes. Most populations had a higher germination fraction when completely flooded. Furthermore, the germination fraction was positively correlated with the average historical precipitation levels for November at each site. These results suggest that *L. fremontii* germination depends on early winter flooding in vernal pools, but this response may vary among sites. We also found evidence that populations varied in the fraction of viable seeds that remained dormant through the experiment. Taken together, our results indicate that *L. fremontii* germination will likely decline in drier winters, and populations may vary in the degree to which dormancy buffers their response to increased variability in precipitation.

18. VONDEROHE, S.

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Pool of Dreams: If You Build It, Will They Come?

The success of vernal pool restoration and creation efforts has been debated for the last two decades. As more quantitative data become available regarding vernal pool plant communities and their species composition, we will be better able to gauge the success of restoration in replacing these natural assemblages of species. A subset of species within the known vernal pool plant communities are considered rare and it may be more challenging to replicate suitable habitat for these species. This talk will focus on multiple sites throughout northern California where rare vernal pool plants have been located during monitoring efforts, if certain species seem more likely to establish in restored or created vernal pools, and if known populations have persisted in the long-term (if data are available).

19. CRANDALL, S., and GILBERT, G.

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Fungal Spore Dynamics and Diversity in Coastal California Ecosystems

Airborne spores are important for fungal dispersal and infection of plant shoots, yet few studies examine the spatio-temporal dynamics and diversity of airborne spores in natural systems. We measured aerospora

abundance, local site microclimate, and diversity at varying spatial and time scales in coastal California ecosystems. In our first study, we asked: 1) is there a difference in total airborne spore concentration between ecosystem types, 2) when do we see peak spore counts, and 3) do spore densities correlate with microclimate conditions? Fungal spores were caught from the air with a vacuum spore trap at mixed-evergreen forest and coastal prairie sites. Spores were collected at 3-hour intervals for a 120-hour period and 2400 images were analyzed under a light-microscope. We found at least twice as many spores in mixed-evergreen forests than in coastal prairies. Airborne spore abundance closely tracked temperature in both ecosystems, with notable peaks in the mornings and evenings. In our second study, we collected spores in redwood forest, mixed-evergreen forest, and maritime chaparral. We asked: 1) if airborne spore abundance differed across ecosystem type, 2) do spore densities correlate with local microclimate conditions, 3) when do we see peak spore counts, and 4) is fungal community diversity clustered across space? Vacuum and rainwater spore traps were deployed and collected once a week during the wet season in 2013 and again in 2014. Fungal spore diversity will be estimated using next-generation DNA sequencing methods on the Illumina MiSeq platform.

20. VELLINGA, E.C., and BRUNS, T.D.
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Mushroom Inventories in Northern California

Yosemite National Park (YNP) in the central Sierra Nevada range and Point Reyes National Seashore (PRNS) are icons of western landscapes and biodiversity. Their fungal diversity is presently under investigation. Five large scale inventories, so-called mycoblitzes, have been held in PRNS; small group forays have been organized for YNP from spring 2010 to fall 2013. Collections have been photographed (mushroomobserver.org; http://pmb.berke-ley.edu/~bruns/tour/mycoblitz1.html), vouchered, and identified by experts in their field, and nrITS sequence data produced. In PRNS we have recorded over 500 species of macrofungi, with a CHAO estimate of 900. The numbers for YNP are lower, because of less inventory intensity, and a short growing season. Each park has its own distinctive fungal composition. These inventory projects have only been possible because of the input by many collectors and identifiers, amateurs and professionals, and the general public. Sequence data revealed high levels of cryptic diversity: e.g. the commonly found "*Pluteus cervinus"* represents in fact six taxa in northern California alone. It also appeared that many of the European names currently in use for western species are wrong, e.g. the Elfin saddle *(Helvella lacunosa)* does not occur in California, and so far two new species have been described, each with a distinctive ecology. This led us to the slogan: "without a sequence it is a rumor."

21. NGUYEN, N.H.[1], and BRUNS, T.D.[2]
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[2]University of California, Berkeley, CA, 94720. pogon@berkeley.edu

Ten Years of Dormancy: Fungal Spores and Their Ability to Form Long-term Sporebanks in a Northern California Coastal Pine Ecosystem

Fungal spores vary in their viability in the soil, and some species have the ability to remain viable after many years of dormancy. Ectomycorrhizal fungal spores have been thought to have long dormancy periods and rest in the soil, waiting for the seeds of host plants to land and germinate. We experimentally tested the idea that ectomycorrhizal spores could last many decades in the field by burying spores of ectomycorrhizal fungi in field conditions, then harvesting them at designated intervals. After 4 years, we found that the spores of some species became more active, supporting the idea that many spores start out dormant and break that dormancy over time. After 10 years, some species could no longer be found active whereas other species remained as active as year 0. We will continue to monitor this experiment for the next 90 years and determine when spore activity drops to zero.

22. PEAY, K.G.
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Island Biogeography and the Assembly of Ectomycorrhizal Fungal Communities Across a Northern California Landscape

Ectomycorrhizal fungi are incredibly diverse and are among the primary agents of carbon and nutrient cycling in temperate soils. As the primary mechanism for plant nutrient uptake they contribute immensely to shaping the plant communities that define our natural ecosystems. While ecology has made great progress in recognizing the importance of positive interactions in structuring natural communities, fundamental questions remain unanswered about the ecology of even the most common forms of symbiosis. In addition, research on most microbial communities has tended to focus on small-scale, deterministic processes. In my work, I apply an island biogeography framework to study landscape scale processes affecting the structure of ectomycorrhizal fungal communities. I use "tree islands", patches of host vegetation embedded in a non-host matrix, to investigate how island size and isolation shape the diversity and composition of ectomycorrhizal fungi. I characterize fungal communities using DNA-based molecular tools that allow for accurate identification of fungi in the absence of diagnostic fruiting structures. Consistent with other island systems, the diversity of ectomycorrhizal fungi decreases on smaller habitat islands and with increasing isolation. Through a manipulative experiment I also demonstrate that many of these patterns are driven by dispersal limitation of fungal propagules. Together these results demonstrate that large-scale processes play an important role in structuring ectomycorrhizal fungal communities. The importance of landscape context in determining the nature of the ectomycorrhizal fungal community has important consequences for the ecology of their plants hosts.

23. YOUNG, B.
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Growing Plants for Habitat Restoration that are Resilient in the Face of Climate Change – Perspective from One National Park

This talk will discuss how we put science into action in our 6 park nurseries. Do we need to plant natives at all? If so, which species? Seed or cuttings? From what area and how large an area do we collect to provide ecotypes adapted for our conditions that will ensure-short term success and survival? How many individuals do we collect from which will also contain sufficient genetic diversity to allow for continuing evolution or gene flow? How do we provide pre-germination treatments of seed, then grow these plants in the nursery to avoid artificial selection? In this national park spanning 80 linear miles along the Marin coast and Mount Tamalpais to Half Moon Bay in the south, we take a conservative approach, collecting only within the watershed of the project, but from at least 50 individuals. We cold-stratify some species that typically are not given cold treatment and continue transplanting late germinators, even after enough have been potted up to satisfy the needs of the project. As climate change becomes a major factor in our work, these questions become ever more critical, and we are revisiting some of these guidelines.

24. UHLER, M.
Regional Parks Botanic Garden, Wildcat Canyon Road at South Park Drive in Tilden Regional Park, Berkeley, CA 94708. M_Uhler@sbcglobal.net

The Regional Parks Botanic Garden's Role in Conservation/Restoration Through Horticulture

The Regional Parks Botanic Garden is a living museum devoted entirely to the display of California's botanical heritage. Established in 1940, our 10-acre garden serves as a haven for a substantial and diverse quantity of the states' beleaguered plant taxa. Our databased collection currently contains over 6,000 viable accessions with more than 600 of these listed as rare (according to the 2010 California Native Plant Society's Rare and Endangered Plant Inventory) and we are stewards of nine taxa that are part of the Center for Plant Conservation's National Collection of critically imperiled plants. All of our plants are wild collected and are displayed in engaging naturalistic settings endeavoring to replicate the communities in which these plants occur. The Regional Parks Botanic Garden has provided both plant material and prop-

agation advice on many occasions to entities involved with restoration and played a seminal role in the formation of one of California's premier conservation organizations, the California Native Plant Society.

25. GRANTHAM, M.
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Where There's Smoke, There's Germination! The Story of Smoke in Seed Germination and the Research that Exposed It

26. HALL, B.
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Forward Looking Conservation of Maritime Chaparral

The UCSC Arboretum has started a new approach to preserve coastal plant diversity through developing living conservation banks and protocols for conserving rare maritime chaparral, which in turn will be available for reintroduction into identified *ideal* "candidate locations" (assisted migration). The Central Coast region of California contains high biological diversity. For example, 30% of all of California's manzanitas (28 of 94) *Arctostaphylos* species are restricted to this coastal region. Increased average temperatures, changes in precipitation patterns, particularly summer fog, make these communities vulnerable. Because many plants have limited ability to disperse and woody plants of maritime chaparral rarely germinate without fire, survival of populations may require land-manager assistance. Despite efforts to preserve local biodiversity through land acquisitions and legal protection, theorists predict that as the climate changes, these habitats will become unsuitable because species may not adapt or migrate quickly enough. A fascinating and positive alternative is the creation of *Conservation Gardens* in which many species that occupy the same biodiversity hotspot are grown together in landscaped settings. Conservation gardens could emphasize habitat communities from selected places along the California coast. This strategy would make ample 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 able to adjust to a variety of local conditions and potentially produce viable seeds for future use. As additional benefits, the conservation gardens would appeal to wildlife and provide beautiful and interesting water-conserving landscapes for viewing.

27. VILLELLA, J.[1], and CARLBERG, T.*[2]
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[2]California Lichen Society, 1959 Peninsula Drive, Arcata, CA 95521. tcarlberg7@yahoo.com

Notes on Hypermaritime Foliicolous Lichen Communities of Northern California

Hypermaritime foliicolous lichen communities were investigated at several locations in Northern California. The composition of foliicolous lichen community was found to be species-depauperate when compared to tropical foliicole communities, but resembling them in several ways. Observations of species rarely encountered in California are given and their known distribution in coastal California and the Pacific Northwest is discussed. Novel substrates for some species are discussed and several lichens are recorded as new to California.

28. VAN ZUUK, K.
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Calystegia "vanzuukiae" A Remarkable New Species from Central California

A new species of *Calystegia* has been discovered in central California that closely resembles the federally listed, *Calystegia stebbinsii*. *Calystegia stebbinsii* and *C.* "vanzuukiae" are both found on serpentine or gabbro soils. Preliminary molecular evidence indicates that *C.* "vanzuukiae" is a species of hybrid origin with parent species identified as *C. stebbinsii* and *C. occidentalis*. Although it may have a hybrid origin, it

is considered a naturally, ecologically cohesive population that successfully produces seed. A brief discussion regarding how the new species was discovered and named and its identifying features is provided.

29. WILSON, B.L.[1], BRAINERD, R.[1], OTTING, N.[1], and ZIKA, P.[2]
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[2]Herbarium, University of Washington, Seattle, WA 98195

The Rocky Road of Stonecrop Taxonomy in Northern California

Sedum section *Gormania* consists of several species including *S. laxum* and *S. obtusatum*. It is endemic to the California Floristic Province, except for *S. oregonense* (which extends north). Taxonomy of this group has been confused. Available identification keys give inconsistent results. Some taxa thought to be rare have recently been found more often than expected, and some plants do not fit existing taxonomic categories. The confusion results from basic biology of *Sedums,* which often form small populations isolated on discontinuous rock outcrops. For three field seasons, we have researched patterns of variation in these *Sedum.* We have clarified the type specimen and name that belongs with each morphological variation, which should help stabilize nomenclature. We have determined names for all the distinct forms we have found. In the process, we have named some previously undescribed species and recognized some subspecies at the species level. This group of plants is still holds some mysteries; more research is needed.

30. FIGURA, P.[1], and BAYER, R.[2]
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Antennaria sawyeri, a New Species from the Trinity Alps of Northwestern California

Antennaria sawyeri is a new species of pussytoes from Trinity County, California. *Antennaria sawyeri* is characterized by its mat-forming growth pattern, tomentose leaves and stems, and short inflorescences containing relatively few, closely-spaced heads. Although initial collections were tentatively included within *A. lanata,* the new species differs from *A. lanata* in its leaf and phyllary traits. It also occurs in different ecological settings. *Antennaria sawyeri* is apparently restricted to ultramafic soils at high elevations and is currently known from approximately 2.5 km^2 in the uppermost reaches of Deep and Stoney Creeks in the Trinity Alps Wilderness. Due to its limited distribution, *A. sawyeri* merits consideration for inclusion in CDFW and CNPS rare plant inventories.

ABSTRACTS FOR POSTERS

(Abstracts in alphabetical order by primary author name; index on page 35)

1. **AKULOVA-BARLOW, Z., and KELLNER, C.**
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Tendrils of California Plants

Field observations of morphology and polymorphism of different plant organs are important for plant identification and taxonomic and genetic studies. A photographic study of tendrils was conducted in the field in many California counties and in the Regional Parks Botanical Garden at Tilden Regional Park in Berkeley, California, during the last three years. Tendrils in different families originate from different organs and they are good examples of convergent evolution. Observations show that: 1) tendrils occur in native California plants only in certain genera of Cucurbitaceae, Fabaceae, Vitaceae, and Smilacaceae, 2) some tendrils are so distinctive that they can be used to identify family, genera, or species of plants, and 3) tendrils in related genera and species have a similar variability of branching pattern.

2. **ALVAREZ, J., JOSEPH, S., McDERMOTT, J., SALCIDO, A., SINGH, G., ULM, K., and WOOLEY, S.C.**
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Department of Biological Sciences, California State University, Stanislaus, 1 University Circle, Turlock, CA 95382

Genetic Variation in Aspen (*Populus tremuloides*) between the Eastern and Western Slopes of the Sierra Nevada Mountains

Aspen exhibits striking genetic variation in morphology, phenology and chemistry across its range, including in the Sierra Nevada mountains of California. The majority of research on aspen has been performed in the Intermountain West, with much less research on aspen in the Sierra Nevada. Because the eastern slope of the Sierra Nevada is in the rain shadow it receives less precipitation, but conifer cover is much lower, allowing aspen to persist, despite less precipitation. We evaluated 20 stands of aspen, 9 on the western side and 11 on the eastern side of the Sierra Nevada. We measured leaf area and specific leaf area (SLA) and are measuring microsatellites from aspen clones along our transect. While SLA was not different among aspen clones on either side of the Sierra Nevada, leaf area was nearly 60% greater in western-slope aspen. This result suggests that the cost of leaves is the same on both sides, but that western-slope aspen grow larger, thinner leaves. This may occur because of the competition with conifers for light on the western slope. This study is part of a long-term project to understand aspen genetic variation within the Sierra Nevada mountains.

3. **ARTHUR, A., and SMICK, G.**
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A Sustainable Development Preserves Sensitive Habitats and Rare Species in Santa Clara County, California

Coyote Ridge has long attracted botanists with its spring wildflower show supported by its extensive serpentine outcrops. A central focus in the USFWS serpentine recovery strategy, Coyote Ridge supports several endangered plant species in addition to the endangered Bay Checkerspot butterfly (*Euphydras editha bayensis*). Young Ranch, one of the largest private holdings on Coyote Ridge, supports large expanses of serpentine grassland that support the butterfly and six other endangered/rare plant species. Botanical surveys between 2009 and 2013 have resulted in the documentation of an estimated 30,000 individuals of Metcalf Canyon jewelflower (*Streptanthus albidus* ssp. *albidus*) spread across 40 acres. Likewise, 18,000 individuals of Santa Clara Valley dudleya (*Dudleya setchellii*) have been documented in the rocky outcrops spanning 42 acres. Other noteworthy rare plants observed on site are smooth lessingia (*Lessingia micradenia* var. *glabrata*), fragrant fritillary (*Fritillaria liliacea*), Hall's bush mallow (*Malacothamnus*

hallii), woodland monolopia (*Monolopia gracilens*), and Mt. Hamilton thistle (*Cirsium fontinale* var. *campylon*). Additionally, six years (2008-2013) of Bay Checkerspot butterfly surveys at the Ranch have noted fluctuations in populations with an overall trend of increased numbers. Here we present the results of several years of studies on the property, and how those results have formed the basis for the preservation of 1,950 acres (approximately 90 percent of the property) and guided sustainable development that will allow the conservation of the on-site endangered species and the habitats upon which they depend.

4. CASTRO, B.

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Monitoring Riparian and Wetland Restoration in DWR Flood-Control Channel at Sycamore Creek, Chico, California

Sediment removal in 2010 from the levied Sycamore Creek channel by the California Dept. of Water Resources (DWR) has been followed by planting of native riparian and wetland species, both woody and herbaceous, into gravel/sand surfaces laid bare by total excavation of the channel bottom. The overall project objective is to restore the floodwater conveyance capacity established by 1950s-era levees on this local stream at the northern edge of Chico in Butte County. The 45-acre site is bordered by urban residential development, a major local road, and Chico Municipal Airport. The habitat restoration, required by the USACE as mitigation, is intended to restore the excavated riparian and wetland vegetation (which had accumulated in the channel prior to 2010) in a way that allows floodwaters to flow unimpeded by excessive "roughness". Over the last 3 years, DWR botany staff has monitored the maintenance of riparian and emergent marsh plantings, working with landscape contractor crews to keep plantings irrigated and weed-free. Despite issues encountered – water supply over very hot summers, weed control, erosion and debris from stormwater flows – the plantings have proved mostly successful. DWR botanical expertise was applied in coordinating with project engineers and inspectors on 1) pre-project wetland delineations and most permitting; 2) post-project seed mix and planting species lists; 3) monthly and annual restoration monitoring; 4) weed control strategies; and 5) ongoing identification of native volunteers vs. non-native invaders. A color photo manual to aid crews in distinguishing weeds from native volunteers (and planted species) has been compiled by DWR botany staff and provided to all crew teams. Specimens of unusual weeds or native volunteers are vouchered at Chico State Herbarium; natives new to the channel include *Cordylanthus pilosus* ssp. *hansenii*, and new weeds include *Trifolium vesiculatum*.

5. CHANG, T., and MILLER, D.G.

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Temporal Separation of Galls on Valley Oaks (*Quercus lobata*) by the Gall-Inducers, California Gallwasps (*Andricus quercuscalifornicus*)

The mechanism underlying diversification of gall traits on plants has an implication for fitness of gall-inducers. Therefore, a change in phenology or morphology of gall development could ultimately enhance the survival and reproduction of gall-inducers. In this study, we investigated the primary driving force that was responsible for temporal separation (spring and summer cohorts) of galls on valley oak (*Quercus lobata;* Fagaceae) in Northern California. Both cohorts were induced by California gallwasps (*Andricus quercuscalifornicus*; Cynipidae). We hypothesized that this temporal separation of gall development was associated with either 1) an escaping mechanism which prevented the attack of gall-inducers by natural enemies (parasitoids) and by gall-invading competitors (inquilines), or 2) minimization of competition for plant resources among gall-inducers, which then indirectly influenced the sizes of galls. The results revealed that both inquilines and parasitoids were more prevalent in the spring than in the summer cohort. The sizes of galls were not detectably different between two cohorts ($P=0.086$). Thus, the phenology of gall development was not mainly mediated by the competition for the plant resource among gall-inducers. Our study provides an explanation for why California gallwasps develop in a distinct temporal pattern, and ultimately enhances our understanding of trophic interaction within microenvironments.

6. CHEN, P.[1], GUILLIAMS, C.M.[+1], CARTER, B.[2], and BALDWIN, B.G.[1]
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[2]Department of Biology, Box 90338, 137 Bio Sciences Building, 130 Science Drive, Duke University, Durham, NC 27708

A Fossil-Calibrated Phylogeny Supports the Paleogene Origin of Major Clades of California Currants (*Ribes* section *Calobotrya*)

The genus *Ribes* (Grossulariaceae) comprises between 150 and 200 species of perennial shrubs, with one of the centers of diversity in western North America. This large genus includes the cultivated currants, traditionally placed in subgenus *Ribes*, and the gooseberries of subgenus *Grossularia*. With four phylogenetic studies focusing on different suites of taxa having been completed to date, *Ribes* has enjoyed considerable attention from systematists. These studies collectively suggest that currently accepted taxonomy requires revision so that only monophyletic groups are recognized. One group requiring additional study is *Ribes* sect. *Calobotrya.* Here we present results of a fossil-calibrated phylogenetic analysis of a subset of the Californian currants of *Ribes* sect. *Calobotrya*. To date, we have obtained sequence data from the internal transcribed spacer and external transcribed spacer regions of nuclear ribosomal DNA, as well as *psbA-trnH* and *trnL-trnF* regions of the chloroplast genome. Sequence variation is low in the nuclear dataset and negligible in the chloroplast dataset. Simultaneous inference of tree topology and divergence times was accomplished in BEAST using two Miocene fossils as calibrations: *R. barrowsae* (Buffalo Creek Flora, ca. 18 Ma) and *R. webbi* (Stuart Valley Flora, ca. 15 Ma). Our preliminary results find strong support for two main clades in the study group, one of samples of *R. malvaceum* varieties with *R. canthariforme* and *R. indecorum*, and the other of samples of *R. cereum* varieties, *R. erythrocarpum*, *R. nevadense*, *R. sanguineum* varieties, and *R. viscosissimum* varieties. Despite low levels of sequence variation, divergence time estimation based upon strong fossil evidence suggests a late Paleogene origin of these clades. Future work will focus on improving phylogenetic resolution in *Calobotrya* and in *Ribes* in general, as well as exploring novel methods for including fossils as terminals in phylogenetic analyses.

7. CREER, S. L., and PARKER, V.T.
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Addressing Paraphyly in *Arbutus* (Ericaceae): When Should Tradition Bow to Data?

The Arbutoideae subfamily contains five genera, and can be found in the Mediterranean Basin as well as North America. Two of the genera, *Arctostaphylos* and *Arctous*, have a circumboreal distribution. Hileman et al. (2001, *Syst Bot*, 26:131) constructed a nuclear ribosomal molecular phylogeny of the Arbutoideae comparing the genera found in North America to those found in the Mediterranean Basin. Monophyly was found in all of the genera, except for *Arbutus*. The five monophyletic Arbutoid genera appear to be more closely related to the species of *Arbutus* that occur in the Mediterranean Basin, with the western *Arbutus* falling out as sister to these two groups. We tested this finding by examining two regions of the chloroplast, *psbA-trnH* and *rbcL*. From these regions, we constructed a cpDNA phylogeny to compare with that of Hileman's. Most of the specimens used were Hileman's vouchers, supplemented with several additions. Successful cpDNA extraction and amplification was completed for fifteen taxa within the Arbutoideae and included representatives from each genus. We then ran parsimony and maximum likelihood analyses on the cpDNA as well as on Hileman's data. Separate analyses of the two datasets produced no significant differences, so the final analysis was conducted on a combined dataset. The final analysis further supports Hileman's findings that *Arbutus* does not form a monophyletic group. We propose a new combination to match our new understanding of the group, which will require recognition of the species that occur in the Western Hemisphere as a distinct genus.

8. **CROWE, R.E., and PARKER, V.T.**

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Patterns on the Prairie: Investigating the Role of Environmental Variation on the Dormancy Requirements of *Neostapfia colusana* (Colusa Grass)

Neostapfia colusana is a rare annual grass that grows in large vernal pools and playas throughout the Central Valley. Twenty-four years of monitoring the frequency of *N. colusana* at the Jepson Prairie, and observations of other populations for decades, indicate that plant abundance fluctuates between years and can often be predicted by the amount of rainfall received during the previous year. However, anomalous responses to rainfall have been recorded. The purpose of our study is to investigate the environmental conditions of anomalous years and the dormancy mechanisms that influence *N. colusana* response to patterns in pool inundation and inundation length. We will investigate the persistence of the soil seed bank and the influence of inundation depth and length on *N. colusana* germination; we will also quantify the permeability of the seed coat, and seed loss due to predation by birds and rodents, with a series of field and greenhouse experiments. The anticipated result of the study is a better understanding of the factors that contribute to the persistence of *N. colusana* in a variable environment – specifically the response of seeds that are held in the soil seed bank. A deeper understanding of the processes that control dormancy in one species, *N. colusana*, will vastly increase knowledge of the ecology of vernal pools. The results of this study will help inform management and restoration of vernal pool systems.

9. **DeSIERVO, M.H.[1], JULES, E.S.[1], and SAFFORD, H.F.[2, 3]**

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Post-Fire Vegetation Response on Serpentine and Nonserpentine Soils in the Sierra Nevada, California

Wildfire has a significant impact on the diversity and structure of many plant communities in California; however, there is little understanding of how fire may differentially impact plant communities across a gradient of soil productivity. We examine the relationship between soil productivity and fire by looking at post-fire vegetation response in the Northern Sierra Nevada in adjacent stands of mixed conifer forests on serpentine (low productivity) and nonserpentine substrate. In summer 2013, we collected soil samples, measured total tree basal area and surveyed vegetation in 65 plots burned by the 2008 Rich Fire, and 40 unburned plots directly outside the fire perimeter. Fuel loading was estimated using Brown's fuel transects for a subset of plots. We hypothesized that serpentine sites would have less tree basal area and a lower fuel load, and as a result, would experience a less pronounced change in community diversity and composition after burning. The results revealed that serpentine sites had fewer trees and lower total basal area; however, fuel loading did not vary significantly by soil type. Fire had a similar impact on species richness, diversity and evenness in serpentine and nonserpentine sites; however, post-fire differences in community composition were significantly positively correlated with soil productivity. There was a greater overlap in species composition between burned and unburned serpentine sites and fire-associated taxa (such as resprouting shrubs) were less abundant. Our results show support for the hypothesis that disturbances may have a less pronounced effect on plant communities in low-productivity ecosystems.

10. **FEELY, L. K., and PATTERSON, R.**

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Pollen Exine Diversity in *Linanthus* (Polemoniaceae)

Linanthus consists of twenty-four species distributed throughout western North America in primarily drier habitats. We are examining pollen exine patterns across the genus, as pollen differences have proven to

be a valuable source of taxonomic information in other genera of the family. Pollen samples were collected from herbarium collections, and examined by scanning electron microscopy. Thus far we have identified five fundamentally different exine patterns based on shape, size, aperture distribution, and surface sculpture: 1) a dichotomus type, found in the perennial taxa plus the night-blooming taxa, (*L. arenicola, L. bigelovii, L. caespitosum, L. dichotomus, L. pungens, L. californicus)*; 2) a bellus type (*L. bellus*); 3) an orcuttii type (*L. orcuttii, L. dianthiflorus*); 4) a demissus type (*L. demissus, L. killipii, L. filiformis L. parryae*); and 5) an uncialis type (*L. uncialis)*. Pollen types were mapped onto the molecular phylogeny of *Linanthus*, which included members of *Leptosiphon* (Bell and Patterson 2000). To date our pollen survey places certain exine patterns exclusively within single clades, while other patterns appear distributed across more than one clade. Additionally, several species of *Leptosiphon* we surveyed showed only one common exine pattern, which was unlike any found in *Linanthus*.

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What's Left to Test? Whole Chloroplast Genome Sequencing of *Arctostaphylos* (Ericaceae)

Arctostaphylos is the most diverse and widespread woody plant genus in the California floristic province, found in 53 of the 58 counties that span the state of California. Our study will attempt to decipher the evolutionary history of *Arctostaphylos* (Ericaceae) using phylogenies constructed from whole chloroplast genomes. Morphological characters as well as chloroplast, and nuclear markers have all proven inadequate in delimiting species relationships. Furthermore, recent studies have shown that complete chloroplast genome sequences can be used to successfully resolve evolutionary relationships (2010, *Molecular Ecology* 19:100-114). In order to resolve the species relationships within *Arctostaphylos*, we have undertaken a project to sequence the complete chloroplast genome of twelve species. The species selected span the evolutionary and ecological range in California. To date, chloroplasts from multiple species have been isolated from fresh leaves using a combination of differential centrifugation and density gradients. Chloroplast genomes will be sequenced, assembled, and annotated to identify conserved regions of high sequence diversity between all sampled taxa. These regions of increased diversity will then be used to construct phylogenetic trees and resolve the relationships within *Arctostaphylos*. This resolved phylogeny will serve as a scaffold for future evolutionary and ecological studies.

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Functional Ecology of Buffalo Gourd *Cucurbita foetidissima*

The buffalo gourd, *Cucurbita foetidissima*, is a perennial gourd native to California and other parts of the southern United States. The size of the plant is impressive, but because the gourd must allocate limited photosynthate to both growth and reproduction, certain tradeoffs must exist between stems and leaves, all while receiving no supplemental water. We hypothesized that plants with longer vines would have more leaves and photosynthetic rates would be higher on plants with larger leaves. We measured vine number, length and leaf number, leaf area and CO_2 fixation rate and transpiration among buffalo gourd plants in a common garden to determine allocation patterns in this long-lived xerophyte. We found that longer vines also had more leaves. Plants with long vines had larger leaves than shorter vines. Larger plants also had higher photosynthetic rates. The photosynthetic rates were very high, despite the plants receiving no water during the entire summer. As a result, water use efficiency was very high. The buffalo gourd seems to be able to grow to an impressive size by allocating photosynthate to grow both long vines and large leaves, all the while using water efficiently.

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Phylogenetic Inference in *Pectocarya* and *Harpagonella* (Boraginaceae) Reveals Sectional Non-monophyly and Supports Recognition of a Forgotten Taxon

Pectocarya and *Harpagonella* are close relatives in subtribe Cryptanthinae (Boraginaceae). *Pectocarya*, or combseed, is a small genus of 14 diminutive annual herbs distributed amphitropically between western North America and South America. *Pectocarya* taxa are placed in two sections: sect. *Gruvelia* and sect. *Pectocarya*. *Harpagonella* is a monotypic North American genus containing only *H. palmeri*, or Palmer's grappling hook, although early 20th century treatments recognized two geographically non-overlapping infraspecific taxa: *H. palmeri* var. *arizonica* of Arizona and *H. palmeri* var. *palmeri* of southern California and adjacent Baja California, Mexico. Here we present an updated phylogenetic study of these two genera. Our primary goals were to evaluate the monophyly of each genus, the monophyly of sections of *Pectocarya,* and to examine species circumscriptions. We gathered DNA sequence data from the nuclear ribosomal internal and external transcribed spacer regions as well as *psbJ-petA*, *rpl16*, *rps16*, *trnK-rps16*, and *trnL-trnF* regions of the chloroplast genome. Separate analyses of the nuclear and chloroplast DNA data each show a monophyletic *Harpagonella* nested within a non-monophyletic *Pectocarya*. *Pectocarya* sect. *Pectocarya* is monophyletic in both analyses, but sect. *Gruvelia* is non-monophyletic. Within *Harpagonella*, we find strong support for two taxa, which may be best treated at species rank. Within *Pectocarya*, samples are often recovered in clades by minimum-rank taxon, supporting some but not all current species circumscriptions. At least three long-distance dispersal events are necessary to explain the observed biogeographic patterns in *Pectocarya* based on the phylogeny, a relatively large number given the size of the genus.

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A Process for Establishing Pack Stock Grazing Capacities for Wilderness Meadows in Yosemite National Park

Land managers have long managed rangelands to support large ungulate grazing but largely in the context of livestock production where the objective is to maximize production while sustaining rangeland condition for continued use. Recreational pack stock have been set out to graze mountain meadows historically and contemporarily in the Sierra Nevada including in designated Wilderness of Yosemite National Park (YOSE). National Park Service and Wilderness management goals differ from those of livestock production in that they are to maintain ecological integrity while providing for some level of visitor use. We have developed a model to generate preliminary grazing capacities and are investigating areas for refinement. Somewhat unique to YOSE, we had data from surveys that characterized meadow vegetation which allowed for site-specific capacity development. For each of 34 grazed sites, we estimated foragable vegetation production as a product of meadow area, elevation, dominant plant species, and meadow condition. Meadow condition was determined from total vegetation cover, plant functional group composition, bare soil cover and litter cover. We then applied a constant of animal consumption and a range of suggested allowable utilization levels to calculate capacity. We are currently exploring the inclusion of model inputs to account for grazing efficiency and annual variation in productivity based on weather. A final model will be completed this year. These capacities are only a starting point and therefore we intend to adjust capacities based on monitoring of residual biomass and meadow condition indicators.

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Seeking Answers in the Ground: How Fossil Taxonomy Can Support Current Phylogenetics

Ribes (Grossulariaceae) comprises 150-200 species of shrubs distributed primarily in eastern Asia, western North America, and the South American Andes. In addition to extant diversity, *Ribes* has a rich fossil record, especially in North America. As part of a systematics project targeting all extant *Ribes*, we study fossil *Ribes* to calibrate phylogenetic estimates to absolute time. Here we present a pilot study examining species circumscriptions among the fossil *Ribes* taxa from the Creede formation of Colorado. Taxonomists disagree on the number of taxa in this flora, with Axelrod recognizing five species and Hermsen recognizing only a broadly circumscribed *R. lacustroides*. We use geometric and traditional morphometric data to characterize the wealth of morphological variation within *R. lacustroides* sensu Hermsen. We gathered both geometric and traditional morphometric data using high-resolution photos of 46 *Ribes* leaf fossils. The geometric morphometric data comprise 10 landmarks and the traditional morphometric data comprise 14 measurements. Both datasets were analyzed using multivariate statistics. We find moderate evidence for three or possibly four of Axelrod's five taxa, and conclude that this study illustrates the utility of morphometrics in the analysis of *Ribes* fossils. These data will be applied to our study of extant *Ribes*, particularly in the California where the genus has diversified extensively. Previously, we have used other *Ribes* fossils to demonstrate a Paleogene origin of major clades of California currants. Adding the fossil taxa from this study to our analyses may further inform divergence time estimates, biogeography, and tempo of diversification in California.

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Understory Plant Community Response to Restoration in *Quercus garryana* Woodlands

Quercus garryana woodlands and coastal grasslands in the Pacific Northwest are fire-dependent communities, threatened by encroachment from the native conifer *Pseudotsuga menziesii* in the absence of fire. In the Bald Hills of Redwood National Park in California, prescribed fire and conifer removal are used to restore and maintain woodlands. Understory vegetation was compared in four categories: encroached woodlands; formerly encroached woodlands treated with conifer removal; formerly encroached woodlands treated with conifer removal and prescribed fire; and never encroached and burned woodlands. At the site level no difference was found in mean native species richness ($p = 0.155$). When sites were combined by treatment category, the two categories that included fire had the greatest number of unique native species. Encroached woodlands had significantly lower richness ($p < 0.001$), and lower Shannon Diversity ($p < 0.01$), compared to the three other categories. The two categories that included fire also had a significantly greater number of mean non-native species compared to encroached woodlands ($p < 0.001$). These results suggest prescribed fire has benefits to understory plant communities; however, the abundance of exotic species in the Bald Hills complicates the restoration of these ecosystems.

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A Detailed Comparison of Ponding and Hydrology Patterns during Hydrological Year 2010-2011 in Natural and Constructed Vernal Pool Habitat on the Tuscan Preserve, Northern Butte County, California

We conducted weekly monitoring of the size and hydrologic characteristics (depth of pool, duration of ponding, and depth to water table) on vernal pools in soils under and adjacent to wetlands within both Natural (NAT) and constructed vernal pools (CVP). The Tuscan Preserve was established on the Wurlitzer Ranch in 1990. In order to characterize soil, hydrologic conditions, and depth of pool features, prior to construction, we made detailed investigations of all natural wetlands and drainage connections in 170 soil trenches throughout the Preserve. The soil landscape has distinct horizonations that were identified in our investigations. We recorded the elevations of the local (perched) water tables in these soil pits weekly through the humid season (September to May) and developed a quantitative baseline understanding of hydrologic conditions throughout the undisturbed system. We developed detailed construction plans to create individual pools designed for each unique site (77 total units) in the landscape. Many different techniques were applied to create an intentional mix of wetland types, from flashy hardpan pools (5 cm soil over hardpan) to deep Anita clay wetlands (1.5 meter deep soil). The constructed habitat was prepared in 1993-1995. We here compare the actual 2010 ponding results to the design ponding dimensions. All constructed units exceeded target criteria. Vegetation response and hydrologic performance were successful in more than 6.6 acres of constructed habitat. The pattern recorded (2010-11) was produced by a wet year and as such is a best performance result. Each year produces a unique pattern.

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Does Chaparral Shrub Species' Specific Leaf Area (SLA) Correlate with Local Climatic and Soil Conditions in a Manner that would Permit Modeling with Future Climatic Changes?

Functional leaf traits are morphological and physiological characteristics that impact a species' fitness for a given set of environmental conditions and have been widely used in ecological research due to their predictive power. Ecological water and nutrient resource strategies of plants can be predicted using functional leaf traits such as specific leaf area (SLA). SLA could be a key aspect of modeling plant response to accelerated climate change, which may be an important tool for conservation. I hypothesize that functional leaf traits associated with water and nutrient resource strategies are highly correlated with local climatic and soil conditions, at both the species and community levels. Central California coastal chaparral provides an excellent model system because climate change will be more rapid in areas with strong climatic gradients, such as those associated with fog and mountainous terrains with variable soils. Also, there are many local endemic species and physiological differences along the fog-interior gradient and among soil types. I plan to compare SLA responses in chaparral shrub stands, modeling against soil characteristics using pH and mineral assays, and against climate using climate models from PRISM and BIOCLIM. I also will use smaller-scale environmental variation, such as slope, aspect, and proximity to ravines, as features to model against. How SLA responds at these two scales will inform conservationists of the nature of potential chaparral shifts in the context of climate change.

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Using Experimental Demography to Project Plant Range Stability in a Warmer, Drier Future

A mechanistic understanding of the population-level effects of a changing climate is critical to enhance predictions of future contractions and expansions of species' ranges. Empirical studies on range shifts often focus on a single size class or demographic rate, assume no demographic differences between populations, and rarely consider climate drivers other than temperature (*e.g.,* snowpack in alpine systems). Demographic transition models begin to address these issues, but are challenged if environmental conditions are predicted to change through time. In order to incorporate both stochastic rates and a changing mean climate conditions in a demographic model, I will combine short-term observational demography with a life table response experiment (LTRE) and projected climate time series data. This model will examine the effects of both increasing temperature and reduced snowpack on the population dynamics of an alpine perennial (*Ivesia lycopodioides* var. *scandularis,* Rosaceae) across its arid altitudinal range in the White Mountains, CA. In 2013, I established twenty plots across six sites that span this species' elevation range. Preliminary data show a significant increase in size and decrease in density at higher elevations, potentially signifying a complex interaction between environmental conditions and population dynamics. Next season I plan to establish 100 additional plots across all sites and follow marked individuals through 2016 to assess demographic rates with the landscape-scale LTRE experiment. Population sensitivity to climate will be quantified and compared across this species' range, allowing a novel inference of the probability and direction of range shifts in a warmer, drier future.

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A Question of Synchrony: Phenological Cuing in *Lathyrus littoralis* and one of its Important Pollinators, *Habropoda miserabilis*

Phenology (timing of recurring life cycle stages) is an important part of ecology that is often overlooked. It determines how and when species interact with each other in time, which, in turn impacts their life histories. The phenology of plants and their pollinators has become an important conservation concern in light of climate change. Plants and insects often rely on abiotic cues in their environment as signals for when to bloom and emerge from their nests. As abiotic factors like temperature and moisture are altered, species-specific shifts in phenology may occur. As a result, there is a strong potential for phenological mismatch to occur between plants and their pollinators due to climate change. Climate change will have the greatest effect if the phenological cues for plants and their pollinators differ. In this study I characterize the current blooming phenology of *Lathyrus littoralis* (Silky beach pea) and the flight season phenology of one of its main pollinators, *Habropoda miserabilis* (Dune Silver Bee), in the north spit of Humboldt Bay. I also investigate potential phenology cues in these species by correlating observed spatial variation in the phenological timing with measured abiotic factors. Results of this study, and continued citizen science observations, will inform land managers about potential phenology mismatch issues that may face not only *L. littoralis*, but other coastal dune flora.

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Ecology and Management of an Invasive Veldt Grass, *Ehrharta erecta*

Ehrharta erecta is a highly invasive perennial grass that is found in eighteen counties in California and threatens the understory community of redwood forests. Despite its wide spread and tolerance to novel environments, there is no published research on its impacts or control. Our research focuses on identifying the effects of *E. erecta* invasion on redwood understory communities and finding tech-

niques to reduce *E. erecta* cover and reestablishment. On the University of California, Santa Cruz campus we are currently comparing the efficacy of herbicide and manual removal as control methods for *E. erecta*. In a pilot study, six months after treatment, percent cover of *E. erecta* was reduced in herbicide plots by nearly 100%, in manual removal plots by 89%, and in control plots by 24%. In another experiment, we evaluated how planting native *Clinopodium douglasii* into treated plots affects the effectiveness of our treatment methods. To investigate if *E. erecta* alters mychorrhizal associations, we compared percent colonization of arbuscular mycorrhizal fungi in *Stachys bullata* and *C. douglasii* roots in invaded and non-invaded sites. We found both natives had significantly less percent colonization at invaded sites compared to non-invaded sites. Finally, we assessed whether there were physiological effects of *E. erecta* on native species by comparing photosynthetic rates of native species before and after manual removal of the invader.

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Two Colors, One Species: Exploring a Flower Polymorphism in Skunky Monkeyflower (*Diplacus mephiticus*; Phrymaceae)

Diplacus mephiticus (Greene) Nesom ("skunky monkeyflower") is a diminutive summer annual found at higher elevations in the Sierra Nevada mountain range and the western Great Basin of California and Nevada. The species has at least two distinct flower color morphs: a yellow corolla form and a magenta form. In some cases populations are polymorphic and consist of a mixture of yellow-flowered and magenta-flowered plants. Based on herbarium collections, the magenta form tends to be found at higher elevations than the yellow form. Is the magenta form better able to tolerate the greater abiotic stress at high elevation? Do the two forms otherwise differ in distribution, morphology or ecology? A combination of field surveys and a statistical analysis of herbarium collections are currently being used to answer these questions. Herbarium records suggest that there has been a progressive shift in *D. mephiticus* flowering phenology over the years, with specimens being collected on average three weeks earlier in recent years than was the case a century ago. The two color forms tend to grow in different regions of the Sierra Nevada with the magenta form predominant on the eastern slope and the yellow form more common to the west. Polymorphic populations are generally found between these regions, roughly paralleling the Sierra crest. Magenta flowers are also significantly larger than yellow flowers, both in monomorphic and polymorphic populations (31.2% and 28.6% larger, respectively). Based on the observed differences in distribution and morphology, some degree of taxonomic separation between color forms may be warranted.

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Species Relationships in *Hesperolinon* (Linaceae) Inferred from ITS and Chloroplast Sequence Data

Hesperolinon (Linaceae) is a genus of dwarf flax nearly endemic to the California Floristic Province. It consists of 12-13 species, with a center of diversity in Lake and Napa counties, California. Nested within the paraphyletic genus *Linum*, *Hesperolinon* has been historically treated as either a section of *Linum* or a standalone genus based on its petal attachment and appendages, and an ecological affinity to serpentine soils. Recent studies employing a phylogenetic approach have focused on disease ecology and edaphic associations in the genus or its placement within the Linaceae. However, the need for a well-resolved species-level phylogeny warrants additional study. Here, we present a preliminary ITS phylogeny based on

the same set of DNAs as previously published chloroplast data. We include exemplars of multiple populations sampled from each recognized species, including *H. sharsmithiae,* a taxon described in 2006 but considered synonymous with *H. bicarpellatum* in the second edition of *The Jepson Manual*. Consistent with previously published data, *H. drymarioides* was recovered sister to the rest of the genus. Our results also support species circumscriptions for *H. breweri, H. californicum, H. drymarioides,* and the federally and state listed *H. congestum.* Lack of phylogenetic resolution along the backbone of the tree and within a clade of morphologically diverse taxa found predominantly in Lake and Napa counties may indicate rapid diversification. Future work will focus on achieving broad geographic sampling for widespread taxa, and adding additional nuclear loci to improve phylogenetic resolution.

24. SCHWEIGKOFLER, W.[1], KOSTA, K.[2], HUFFMAN, V.[1], PASTALKA, T.[1], SHARMA, S.[1], and SUSLOW, K.[1]
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Environmentally-Friendly Control Methods can Inactivate the Invasive Plant Pathogen *Phytophthora ramorum*, Causal Agent of Sudden Oak Death, in Nursery Soils

Sudden Oak Death, caused by *Phytophthora ramorum*, is among the most important forest diseases of Coastal California, and responsible for the death of tens of thousands of Tanoaks (*Notholithocarpus densiflorus*) and Coast Live Oaks (*Quercus agrifolia*). In addition, *P. ramorum* causes minor leaf lesions on a large number of native and non-native plants, including some important ornamentals. The nursery trade of symptomless but infected plant material plays an important role in the long-distance spread of the pathogen. In nurseries, *P. ramorum* can survive on plant debris, potting mix, soil, nursery equipment and in water for extended periods of time. According to the federal quarantine program, nursery soil which tested positive for *P. ramorum* has to be treated to eliminate the pathogen and minimize the risk for further dispersal. The National Ornamentals Research Site at Dominican University of California (NORS-DUC; www.dominican.edu/norsduc) was established to study threats posed by plant trade and develop environmentally-friendly management options for the nursery industry. NORS-DUC invites researchers from other institutions to conduct semi-field studies on *P. ramorum* and other regulated plant pathogens in collaboration with the NORS-DUC team. First experiments on the inactivation of *P. ramorum* from soils using steam sterilization, solarization and bio-control with *Trichoderma asperellum* were effective. Heating up the top soil layer (0-30 cm) to 50 °C for 120 minutes resulted in complete thermal inactivation of *P. ramorum*. Steaming was also used to treat soil at a commercial nursery found positive for *P. ramorum*, and consequently the nursery was released from federal quarantine.

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Fine-scale Vegetation Mapping of the Central Valley of California

Landscape-scale vegetation mapping provides an understanding of the spatial structure and distribution of vegetation across a landscape. It also provides a baseline condition useful in the future evaluation of changes in these metrics. In an effort to better inform the development and implementation of the Central Valley Flood Protection Plan and Central Valley Flood System Conservation Strategy, wetland and riparian vegetation types were mapped from Keswick Dam near Redding, California to the Kings River in the Tulare Basin. Vegetation was digitized at a resolution of 1:2,000 with a minimum mapping unit of 1.0 acres, and was classified using A Manual of California Vegetation Second Edition (Sawyer et al.) and Vegetation Alliances and Associations of the Great Valley Ecoregion, California (Buck-Diaz and Evens). Prior to the creation of this map, no riparian vegetation map had been made at this scale to quantify vegetation of the Great Valley. This map documents existing conditions for the vegetation present in the Great Valley during 2009, and using geographic information systems (GIS) can be overlaid with other data sets such as soils, hydrology, or sensitive species, for future modeling. The map has been incorporated in strategic planning efforts related to flood control, mitigation, habitat conservation, and invasive species control. Future mapping could entail mapping to the association level, mapping areas that are outside the cur-

rent map boundary, and revisiting the same level of mapping in future years to compare trends and changes.

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The Unique Identity of Red Flowered *Silene* (Caryophyllaceae) in California

In 2005 a new taxonomy for the genus *Silene* in North America was published and became widely accepted. New combinations were created that lumped a California endemic, the red flowered *S. californica* Durand, into *S. laciniata* Cavanilles, a taxon with a center of diversity in central Mexico. Based on observations of flower color, floral anatomy, and plant morphology from my field and herbarium research in California, this circumscription of *S. laciniata*, and specifically *S. laciniata* subsp. *californica* (Durand) J.K. Morton, along with the newly recognized western Del Norte County endemic, the red flowered *S. serpentinicola* Nelson, leaves many populations of red flowered *Silene* in California undescribed. Molecular data does not support a close relationship between the infraspecific groups now recognized in *S. laciniata* in California. Most California *Silene* are allopolyploid taxa that likely formed recurrently from separate hybridization events. Thus it is possible that different populations, and even different members of a population, represent separate evolutionary lineages. An analysis of DNA from populations of red flowered *Silene* throughout California explores whether these populations form a monophyletic group or represent unique taxa or lineages in need of recognition and protection, and will add to the description of phylogenetic and morphological patterns of allopolyloid plant lineages which are redefining views on hybrid speciation and polyploidy, species concepts, and evolution.

27. SPAETH, R.
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Character Mapping Morphologies on Molecular-Based Phylogenies using Cryptanthinae (Boraginaceae) Pollen

The Angiosperm Phylogeny Group (APG III) lists the Boraginaceae among ‘unplaced or barely placed taxa.’ Phylogenetic classification at the species level in this family is notoriously difficult when relying solely on morphological data. Studies are currently in progress to generate a well-supported phylogenetic tree of this family using molecular data. A molecular based phylogeny may reveal the characters that evolved slowly enough to have the same state in closely related taxa found in some key palynological traits used in previous classifications. Pollen attributes were collected on eighty-two species across six genera in the subfamily Cryptanthinae using Scanning Electron Microscopy (SEM). These data exhibit features which are taxonomically informative including shape, aperture type, sculpturing, and size. Cyrpthanthinae pollen encompasses three of the nine Erdtman shape categories, and eight of the eleven Faegri and Iversen sub-shape categories. Their aperture types include heterocolpate, zonoporate, and zonocolpate forms. They are sculpted with fossulate, foveolate, echinate, reticulate, and gemmate clavate surfaces. They range in size from 4.85µm long and 1.92µm wide to 40.85µm long and 25.60µm wide. Some of them have complete waist constrictions and others do not. The same is true for a presence or absence of polar apertures. These characters were mapped on a molecular phylogeny to observe evolutionary trends and tested for phylogenetic signal.

28. STEERS, R.[1, 2]
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Estimating Plant Cover in Herbaceous Vegetation: A Comparison of Visual and Point Quadrat Techniques

The purpose of this study was to assess differences among two common techniques used to measure herbaceous plant cover within one meter squared quadrats: visual estimation of cover versus point quadrat intercept. Cover values generated by these different methods were compared in four different habitat types. In two of the four habitats, the time it took to sample the vegetation using both methods was also recorded. The results indicate that both methods produce very similar values of cover for herbaceous plant species, especially for the most abundant species or composite variables (e.g. native graminoids or exotic plants). When comparing the time it took to complete the measurements among the methods, there were no differences between visual estimates of cover and point quadrat intercept using 100 points per quadrat; however, point quadrat intercept using 50 or 30 points per quadrat were both substantially faster. The primary benefits of using point quadrat sampling are high precision and low observer bias. For situations involving long-term monitoring of herbaceous plant cover where multiple observers with less experience and varying skill levels are utilized, I recommend using a point quadrat technique. For most other situations, visual estimation of cover may be optimal although observers should always calibrate among themselves using visual aids to minimize observer bias. Lastly, if the goal of monitoring is primarily to track the most common species or composite variables, then a point quadrat technique using as little as 30 points per square meter is sufficient and will save considerable time.

29. TAYLOR, D.W., ENGSTROM, T., JAMES, C., PUENTES, S., and O'BRIEN, J.
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Arctostaphylos klamathensis: A Geographically Restricted Klamath Range Endemic

Arctostaphylos klamathensis (ARKL) is a moundiform subshrub restricted to ultramafic substrates in upper elevation forest settings of the western Klamath Ranges, California. About 40 occurrences totaling about 1,400 ha are presently documented. ARKL lacks a basal burl, but shares with *A. knightii* and *A. pacifica* in having epicormic, dormant basal meristems which can resprout. Burls and epicormic meristems are intimated as a plesiomorphy within *Arctostaphylos.* ARKL plants were observed to resprout after herbicide application for silvicultural brush control. Niche occupancy overlap of ARKL is greatest with its sister species *A. nevadensis* (350 sampled plots, multidimensional scaling volume estimation), and less so with *A. viscida* (of the same clade), but intermediate with *A. patula* (in unrelated clade, Wahlert et al. 2009). A 1900 m elevation, 7 ha plantation at near Panther Rock, Trinity County was logged prior to 1998: all logging debris, thus any surviving shrubs were dozed into piles; then the site was planted to conifers, treated in October 1998 with herbicides, and re-treated with herbicides again in October 2001. By 2013, ARKL is now the dominant shrub in the plantation, with a cover >50%: density (derived from plot sampling) is approximately 0.9 shrubs per m^2 – the total plantation population is estimated at 60,667 individuals (95% CI 50,313-70,242 plants). A dozer-piled salvage logging site (clearcut to control 'cytospora' canker) on gabbro at 1600 m in Flume Creek, Shasta County, situated in *Abies magnifica* forest, was estimated (by quadrat sampling in 2012) to support 3.7 ± 6.1 seedlings per m^2 in 1-3 yr age cohorts, equating to ~6,061 seedlings per ha. Overall endangerment status of ARKL is illuminated in the context of such data.

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How Do Site, Transplant Material, and Herbivory Affect Pacific Cordgrass (*Spartina foliosa*) Establishment?

Pacific cordgrass (*Spartina foliosa*) forms the foundation of native low tidal saltmarsh in San Francisco Bay. Reestablishment of *S. foliosa* is critical to restoring ecosystem functioning following eradication of invasive hybrid cordgrass. Restoration attempts have been complicated by a paucity of *S. foliosa* populations available for transplant, altered marsh characteristics following hybrid invasion and removal, and Canada Goose herbivory. In 2011-2012, we explored the relationship between restoration site characteristics, parental source of *S. foliosa* transplants, and plant caging. We transplanted plugs from four donor marshes into five restoration sites, pairing caged and uncaged material, and monitoring growth responses monthly. Cage effects varied by marsh, with the strongest cage effects occurring at sites with nesting geese (7% survivorship in uncaged plots, 78% survivorship in caged plots). Transplant source had strong effects on initial survivorship and culm density at three restoration sites. In 2011-2013, we further explored the interaction between source of transplant material and edaphic conditions. Plants were collected from eight widespread marshes, genetically tested using microsatellites, and grown in identical nursery conditions. After 10 months, source populations differed in terms of culm height and density. Following nursery growth, 300 plants from each donor source were outplanted into two marshes and monitored quarterly. Sources varied significantly in terms of survivorship, flower production, and culm density. Field patterns were not predictable from nursery bed performance. We recommend goose exclusion, and transplant source selection should be considered in ongoing native cordgrass restoration efforts.

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California *Sedum* Subgenus Gormania

California native *Sedum* includes twelve taxa within the subgenus Gormania – primarily in the groups Eugormania and Rosulata. Six of these taxa are rare. These succulents are difficult to identify; some characters used to separate species, such as rosette internode length and petal color, are continuous. Others are only present for a very brief window; cauline leaf shape and petal length are both essential characters, but each trait is only present for a few weeks – weeks that barely overlap. Their cliff habitat makes accessing populations during the bloom period a formidable task. I intend to construct a molecular phylogeny of this group and project observed morphological characters onto it. I have either collected or accessed collections from the type localities of each Californian species and subspecies as well as other locations throughout the range and gathered material for molecular analysis. The resulting species boundaries will be tested against previous collections. My goal is the production of a more robust key for California's rare and common *Sedum*.

32. WADE, C.[+], and LOIK, M. E.
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Impacts of Snow and Rain Change on Native vs. Invasive Species and Fire Fuel Properties in a Sagebrush Steppe Ecosystem

Sagebrush steppe is one of the most widespread ecosystem types in the western U.S., yet also one of the most vulnerable to large-scale ecosystem conversion due to a positive feedback between the non-native species *Bromus tectorum* (cheatgrass) and fire. One of the most ubiquitous invasive species in the western

U.S., *B. tectorum* rapidly colonizes bare ground amid native steppe vegetation, completes an unusually early phenological cycle, and subsequently becomes a serious fire hazard. The continued rapid spread of *B. tectorum* throughout the West and into upper elevations is alarming and may be exacerbated by changing climatic conditions. This study examines effects of the type and timing of precipitation on *B. tectorum* and native species, using snow fences to simulate changes in snowpack (increased, decreased, and ambient depth) and irrigation to simulate increased frequency and magnitude of spring and summer precipitation. In spring 2013, the trend in *B. tectorum* phenology was advanced in the "minus" snow zone relative to the "plus" snow zone, while phenology of native species monitored did not respond to snowpack manipulations or had different patterns. Species richness, percent cover, and leaf area index did not differ by snow zone. *Bromus tectorum* physiological responses (CO_2 assimilation, stomatal conductance, quantum yield of Photosystem II, electron transport rate) to spring rainfall additions were more pronounced than those of native species. Native species physiology did not respond to summer rainfall additions (after *B. tectorum* senescence). Overall, results indicate that *B. tectorum* may be more sensitive than native vegetation to precipitation change.

33. WARZECHA, B., and PARKER, V.T.
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Granivorous Birds are a Major Driver of the Seed Bank Dynamics of the Fire-Dependent Obligate Seeder Shrub *Ceanothus papillosus* (Rhamnaceae)

Faunal community structure influences plant community structure in many ways; among these are varying post-dispersal seed predation rates by different, sometimes distantly related animal taxa. In fire-prone mediterranean-climate vegetation, such as the Californian chaparral, granivorous rodents are commonly assumed to be the most effective post-dispersal seed predators. This would render rodents the main driver for soil seed bank dynamics, as most woody species of the chaparral rely solely on dormant, persistent soil seed banks to regenerate after wildfires. Here, we used a series of exclusion experiments in combination with close video observation to show that granivorous birds are more effective than rodents in removing seeds of *Ceanothus papillosus*, a fire-dependent obligate seeder shrub of the California chaparral. We furthermore used seed traps and germination experiments to show that *C. papillosus* can have extremely high seed production, and expresses strong intra- and inter-annual seed bank dynamics. We conclude, in contrast to other studies, that granivorous birds, not rodents, are major determinants of *C. papillosus* seed bank densities. We also found that seed bank density increased between years, despite high seed predation rates. We conclude that high seed production in combination with small and dark seed design may help some seeds to stay undetected, thus helping *C. papillosus* to build a seed bank dense enough to regenerate after wildfire. Our results indicate that the ratio of granivorous birds to rodents has the potential to play a major role in shaping chaparral community structure by differentially impacting soil seed bank densities.

34. YUNKER, C., and PARKER, V.T.
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Is Timing Everything? Flowering, Potential Reproductive Isolation and Pollinators in *Arctostaphylos*

Arctostaphylos (manzanita) stands in central California can be remnant islands of native vegetation in a developed landscape. Investigating the reproductive ecology of foundational manzanitas could offer insight into the stability of these chaparral ecosystems. The most recent phylogeny of *Arctostaphylos* by Wahlert et al. (2009) separates the diploid species into two distinct evolutionary lineages. Previous hybridization studies in manzanitas have shown that when these clades coexist, they rarely produce viable hybrids. I am exploring if flowering phenology and potential pollinators may influence this reproductive isolation. I am utilizing three research sites that each contain species from both clades (1) and (2): lands of the Elkhorn Slough Foundation, Napa Land Trust and Big Basin Redwoods State Park. The species studied respectively are *Arctostaphylos pajaroensis* (2) and *A. hookeri* (1)*, A. canescens* (2) and *A. stanfordiana* (1) and *A. andersonii* (2) and *A. sensitiva* (1). My records of the flowering phenology from late 2011 through spring of 2013 indicate that lineages at each site demonstrate peak bloom at different times

and with some to no overlap. My preliminary findings also indicate that honeybees and a diverse group of native pollinators abundantly use manzanita flowers, but that visitations differ among lineages and sites. These field sites have management concerns for *Arctostaphylos* such as threatened species and local endemics, closeness to extensive agriculture, and all species studied are obligate seeders. Monitoring flowering phenology may provide useable information for vulnerable manzanitas and their larger, chaparral communities.

INDEX OF AUTHORS

(Talk abstract page numbers in **bold**; poster abstract page numbers in *italics*)

EXHIBITORS

Bureau of Land Management
Representatives: Michael Dolan and Graciela Hinshaw
www.blm.gov/ca/st/en.html
The Bureau of Land Management (BLM) manages 15.2 million acres of public lands in California (nearly 15% of the state's land area) and 1.6 million acres in northwestern Nevada. It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations. Among its many programs and policies, BLM works to conserve and/or recover ESA-listed species and the ecosystems on which they depend so that ESA protections are no longer needed for these species.

California Botanical Society
Representative: Andrew Doran
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Since 1916, the Society has published the peer-reviewed scientific journal *Madroño*, the leading source of research articles on the natural history of western American botanical organisms (including those of Mexico, Central America, and South America). The Society welcomes membership by all interested individuals worldwide and encourages members to submit manuscripts on original research to the Editor of *Madroño* for consideration as publications in the journal. Articles and notes (in English or Spanish) on ecology, systematic, floristics, conservation biology, and other areas of organismal botany are routinely published in *Madroño*, in addition to noteworthy collections. The Society sponsors annual and biennial graduate student meetings and an annual banquet at various locations in California.

California Invasive Plant Council (Cal-IPC)
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The California Invasive Plant Council's (Cal-IPC) mission is to protect California's land and waters from ecologically-damaging invasive plants through science, education, and policy. Our website provides information on invasive plant biology and impacts, publications, and training resources. View maps of invasive plants, including project changes with climate change, at calweedmapper.calflora.org. Find new resources for preventing the spread of invasive plants, including videos and guides with Best Management Practices, at www.cal-ipc/ip/prevention.

California Native Plant Society – Mount Lassen Chapter
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The Mount Lassen Chapter (MLC) of the California Native Plant Society (CNPS) is one of 33 statewide chapters, plus a newly created chapter in Baja California. CNPS is a non-profit dedicated to the preservation and enjoyment of California's native plants and their habitats. MLC is based in Chico, but covers Butte, Glenn, Plumas, and Tehama counties.

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The California Native Plant Society (CNPS) is a statewide non-profit organization of amateurs and professionals with a common interest in California's native plants. Our 10,000 members work to promote native plant appreciation, research, education, and conservation through our six statewide programs and 34 regional chapters in California.

Carex Working Group
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Carex Working Group is a botanical consulting firm specializing in taxonomy, plant identification workshops, rare plant surveys, and natural resource planning. We came together in 1993 to map the distribution of Oregon's sedges and incorporated in 2002. After years of gathering data in the field and herbarium, we published *The Atlas of Oregon Care*x in 1999.

EXHIBITORS

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E2 Consulting Engineers, Inc. is a minority-owned certified Small Disadvantaged Business. Founded in 1988, E2 currently has a staff of over 300 engineers, scientists, and technical specialists at offices and project sites throughout the United States serving the private sector, public utilities, and clients in Federal, State, and local agencies. In 2012, E2 expanded its corporate capabilities by establishing the Ecology, Permitting, and Planning (EPP) business line. The EPP business line integrates biological resources and planning services into our existing environmental services to provide a well-rounded, full service consulting experience. Our EPP team combines expertise in ecology, permitting and environmental planning with strategic thinking and solution-focused project delivery. Our services include botanical surveys, arborist surveys, vegetation classification and mapping, wetland delineation, functional assessments, permitting, and environmental planning

ECORP Consulting, Inc.
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ECORP Consulting, Inc. offers a full suite of environmental services, including special-status species surveys and wetland delineations; cultural resource studies and documentation; restoration, permitting, environmental compliance and land management; CEQA and NEPA documentation; water resources analyses; and a full service technical drafting and GIS department. ECORP staffs nearly 100 full-time environmental consulting employees in five offices throughout California. Our botanical expertise ranges from general vegetation surveys and field vegetation mapping to rare plant surveys, arborist surveys, floristic monitoring, rapid assessment studies, and invasive species identification and mapping. We routinely conduct botanical surveys throughout California and have experience working within a wide range of vegetation communities throughout the state.

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Flora of North America is a project to coordinate the work of hundreds of botanists to provide scientifically reliable information on native and naturalized plants of North America. It has published 16 volumes and is working to complete the remaining 14 volumes in the next three years. All published content is available on our website and through JSTOR

Friends of The Chico State Herbarium
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The Friends of The Chico State Herbarium is a non-profit group whose goal is to provide community support for the Herbarium and to help demonstrate and publicize the value of the Herbarium. The group focuses on scientific and academic pursuits. Activities include raising funds for items that are not covered under the University budget, offering workshops on a variety of botanical based subjects, publication of a biannual newsletter, and supporting the Jim Jokerst Botany Award to encourage student research involving field aspects of botany and ecology.

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Garcia and Associates is a natural and cultural resources consulting firm specializing in cultural and paleontological resources compliance, state-of-the-art aquatic and terrestrial ecology, and natural resources policy and planning. Garcia and Associates' staff is committed to meeting our clients' needs with the highest professional standards. We have completed projects that range from multi-year, multi-million-dollar planning and impact studies for large facilities to small, focused studies with short deadlines and limited budgets. Headquartered in San Anselmo, we also have regional offices at Auburn, Oakland, San Francisco, Los Angeles, Lompoc, Oceanside, Palm Springs, Bozeman, Guam, and Honolulu.

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Hedgerow Farms is a seed production farm specializing in California native grasses, sedges, rushes, and wildflowers. With approximately 500 acres under cultivation, we offer seed for nearly 100 species, including many bioregional ecotypes. We also provide consulting and planning services, native grass transplants, native straw, and custom growing.

Mattole Restoration Council
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The Mattole Restoration Council (MRC) is a 501(c) 3 non-profit organization that was formed in 1983 after community members of the Mattole watershed noticed a drastic decrease in Mattole salmon and recognized the need for an organization that focused on the restoration and conservation of human and ecological communities within the watershed. Since its inception, the MRC has been at the forefront of community based watershed restoration and have been featured in numerous articles, books, and videos on ecological restoration, both locally and internationally. The story of the Mattole restoration movement is known as the first community-based restoration effort in the state of California. Today, the MRC is actively working on multiple watershed wide restoration projects including sediment reduction, riparian restoration, grasslands restoration, oak woodland restoration, invasive plant removal, fuels reduction, Sudden Oak Death monitoring, sustainable timber harvest, public outreach, ecological education through internships and in-class education with local schools, and water conservation. The council includes a staff, board of directors, and volunteers including ecologists, hydrologists, foresters, farmers, ranchers, professors, students, and community members. The Council is persistently working towards their vision, "a time when restoration is no longer needed."

Southern California Botanists
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Southern California Botanists is a non-profit organization founded in 1927 and is devoted to the study, preservation, and conservation of the native plants and plant communities of southern California. The journal *Crossosoma*, is published twice a year and carries articles of interest to amateur and professional botanist. The newsletter, *Leaflets of the Southern California Botanists*, published quarterly, contains notices of field trips, symposia, and other events interest. Southern California Botanists sponsor an annual symposium and have three grant programs that support botanical research in southern California.

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The University and Jepson Herbaria of the University of California at Berkeley are two collections of pressed plants housed together along with research labs, libraries, and archives. Together the Herbaria hold about 2,200,000 specimens, one of the largest collections in North America.

Western Chapter International Erosion Control Association
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The Western Chapter-International Erosion Control Association (WC-IECA) unites consultants, contractors, engineers, agencies, developers, manufacturers, suppliers, academics, and other practitioners interested in effective and economical methods of erosion and sediment control leading to improved water and air quality; environmental restoration; and land stewardship. This chapter serves members located in Arizona, Hawaii, Nevada, and California.

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ADDENDUM

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ADDITIONAL TALK ABSTRACT

in Session 3: Flower Visitors

10. LeBUHN, G., NICHOLS, A., and COLLORAN, B.
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Bumble bees of the Sierra Nevada: Emergence Patterns and Community Structure and the Effects of Climate Change

The relationship between emergence and competitive ability has important implications for community structure of montane bumble bees, especially under climate change. Using a simple model of competition and emergence, we show that late emerging species may be more negatively affected by climate change. We then use field data to look for differences in the population dynamics of early and late emerging species and in meadows at different elevations. Understanding the basic ecology of species in a community may be critical for predicting the response to climate change.