FROM THE REDWOODS TO THE SAGEBRUSH
BOTANY RANGING FAR AND WIDE

THE FIFTH SYMPOSIUM
PRESENTED BY

NORTHERN CALIFORNIA BOTANISTS

California State University, Chico
14-16 January 2013

From the Redwoods to the Sagebrush – Botany Ranging Far and Wide

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Cover photo of redwood forest courtesy of Linnea Hanson. Along the Eel River on the Avenue of the Giants in Humboldt Redwood State Park. An old-growth coast redwood grove with western sword fern. 12 November 2012.

Cover photo of sagebrush country courtesy of Daria Snider. Big sagebrush and fall colors after an early season snowstorm along the McGee Creek Trail in the Inyo National Forest. 12 October 2012.

WELCOME!

Northern California Botanists

welcomes you
to our fifth 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

Bell Memorial Union Auditorium, California State University, Chico

(Abstracts of talks start on page 7; index to authors on page 39)

Monday 14 January 2013

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

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: Biogeography

9:15 – 10:35 a.m.

Session Chair: Diana Jolles, Claremont Graduate University, Rancho Santa Ana Botanic Garden

2. **Barbara Fernandez-Going**
   Climate Interacts with Soil to Produce Beta Diversity Patterns in Californian Plant Communities
3. **Craig Barrett**
   Morphology, Molecules, and Fungal Associations Identify a Distinct Californian Variety of the Mycoheterotrophic Corallorhiza striata *Species Complex (Orchidaceae)*
4. **Diana Jolles**
   What Can the Dispersal History of Multiple Pyrola picta *Lineages (Ericaceae) Tell Us about Habitat Corridors throughout the Ages?*
5. **Kristi Haydu**
   Mapping Plant Biodiversity Hotspots at the County Scale: A New Tool for Establishing Resource Conservation Strategies

10:35 – 10:55 a.m. **Break**

Session 2: Restoration and Recovery

10:55 a.m. – 12:20 p.m.

Session Chairs: Joe Silveira, U.S. Fish and Wildlife Service, Sacramento National Wildlife Refuge Complex, and **Jessi Hammond**, University of California, Santa Cruz

6. **Andrea Pickart**
   Integrating Dune Restoration and Management with Climate Change Adaptation at the Lanphere Dunes, Humboldt Bay National Wildlife Refuge
7. **Nadine R. Kanim**
   *Yreka Phlox (*Phlox hirsuta*) Recovery: Can We Be Successful?*
8. **Lorraine Parsons**
   Can we Turn Back Time? Restoring Salt Marsh and Rare Plant Habitat through Large-scale Wetland Restoration

9. **Erin Gottschalk Fisher**
   Evaluating Introduction and Restoration for Two Rare Vernal Pool Grasses, Neostapfia colusana *(Colusa Grass) and* Tuctoria greenei *(Greene's Tuctoria)*

12:20 – 1:40 p.m. **Lunch**

12:35 – 1:30 p.m. **Student Career Panel** (optional)
Discussion Leaders: Matt Guilliams, University and Jepson Herbaria, University of California, Berkeley, and **Julie Nelson**, Shasta-Trinity National Forest

Session 3: Redwood and North Coast Botany and Ecology

1:40 – 3:00 p.m.
Session Chair: Michael Mesler, Humboldt State University

10. **Michael Barbour**
    Distance Inland Explains Low-Elevation Shifts of Dominance between Redwood and Douglas-fir along the Central Coast
11. **Ayzik Solomeshch**
    Classification of the Forest Plant Communities of Redwood National Park
12. **Frank Shaughnessy**
    Marine Floristics from Cape Blanco to Cape Mendocino: Surprises, Changes, and Relevance
13. **Michael Mesler**
    The Taxonomy and Pollination of the Silene hookeri *Complex*

3:00 – 3:20 p.m. **Break**

Plenary Presentation

3:20 – 4:00 p.m.

14. **Todd Dawson**, University of California, Berkeley
    From a Redwood Forest to a Sagebrush Steppe? What Coast Redwoods Face under a Changing Climate

Session 4: Poster Presentations

4:00 – 5:00 p.m. 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 39)

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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. **Dinner** – Bell Memorial Union Auditorium
Tickets required. Buffet dinner will include fish, meat, and vegetarian entrees. Complimentary wine served with dinner.

Keynote Speaker

7:00 p.m. Bell Memorial Union Auditorium

15. **Barbara Ertter**, University and Jepson Herbaria, University of California, Berkeley
    People, Plants, and Politics: The Early Years of California's Botanical Institutions

Tuesday 15 January 2013

7:30 – 8:00 a.m. **Check-in for one-day registrants**

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

Introduction

8:00 – 8:15 a.m.
Linnea Hanson, President, Northern California Botanists

Session 5: Non-Seed Plants

8:15 – 9:45 a.m.
Session Chair: Samantha Hillaire, Garcia and Associates

16. **Teresa Sholars**
    Connections: Forest Relationships with Non-plants
17. **Benjamin Carter**
    Cryptic Speciation in the California Moss Genus Scleropodium *(Brachytheciaceae)*
18. **Emily Burns**
    Redwood Forest Plants Absorb Fog Aboveground
19. **Tom Carlberg**
    Notes on Hyper-maritime Foliicolous Lichen Communities of Northern California

9:45 – 10:05 a.m. **Break**

Session 6: Propagule Biology of Northern California Seed Plants

10:05 – 11:45 a.m.
Session Chair: Matt Guilliams, University of California, Berkeley

20. **Tom Parker**
    New Insights on the Origin of Persistent Soil Seed Banks in Arctostaphylos
21. **Hal Mackey**
    Seed Production and Phenological Patterns for Dicentra uniflora *in Northern California*
22. **Charles Knight**
    Measurement of the Pressures Generated during Seed Germination and Early Growth
23. **Matt Guilliams**
    The Importance of Nutlets in Plagiobothrys *and Relatives for Taxonomy and Divergence Time Estimation in the Cryptanthinae (Boraginaceae)*

11:45 – 1:20 p.m. **Lunch**

12:00 – 1:00 p.m. **Discussion: What to Make of Walnuts** (optional)
Discussion Leaders: John Hunter, AECOM, and **Paul Kirk**, North State Resources

Session 7: Great Basin / Eastern Sierra Botany

1:20 – 2:40 p.m.

Session Chair: Daria Snider, ECORP Consulting, Inc.

24. **Meredith Gosejohan**
    Effects of Hydrologic Regime on a Rare Vernal Pool Grass, Orcuttia tenuis *(Slender Orcutt Grass), in the Modoc Plateau – East Cascades Ecoregion*
25. **Janel Johnson**
    Modeling the Impacts of Climate Change in Rare Plant Habitats of the Great Basin
26. **Christopher Moore**
    Seed Dispersal of Great Basin Plants
27. **Kyle Merriam**
    An Overview of Vegetation Types in the Modoc Plateau and Northwestern Basin and Range Bioregion

2:40 – 3:00 p.m. **Break**

Session 8: New Discoveries

3:00 – 4:20 p.m.

Session Chair: Julie Nelson, Shasta-Trinity National Forest

28. **Eva Buxton**
    *A New Meadowfoam (*Limnanthes*) Taxon Found in an Agricultural Field in San Mateo County*
29. **Barbara Wilson**
    More Endemics – New Names in California Carex
30. **Robert Preston**
    Solving the Mystery of Brodiaea X
31. **John McRae**
    Discoveries and Un-discoveries, Six Rivers National Forest

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 16 January 2013

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

CANCELLED

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 Game, 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: Field Methods using Calflora Tools – Tools to Help Identify, Map, and Explore Wild Diversity
9:00 a.m. – 4:00 p.m. Bell Memorial Union, room TBA

Field Trip Leader: **John Malpas**, Calflora

Recent years have seen a burst of innovation in tools that give professional botanists and amateur naturalists new ability to identify plants in the field, precisely map plants, report beautiful or important discoveries, and explore diversity and distribution from mountaintop, desktop, or laptop. These tools include mobile apps, web-based applications, and GPS cameras -- together they make new botanical field methods possible. Over the past few years, Calflora has developed a suite of tools to support collecting and managing botanical observations.

This workshop introduces participants to Calflora's tools, including 1) the many ways to collect observations, 2) how to manage and share observations among a group of people, 3) how to prepare summaries and reports about collected observations, and 4) how to get observations out in various electronic formats. We'll review how other individuals and groups have used the tools, including casual observations by individuals, group efforts to produce a well-documented checklist of a natural area, and group efforts to monitor invasive plants in an area.

During the exercise period, participants will work in teams of four to collect new observations, upload them to the system, and then explore the management, reporting and sharing possibilities. We provide equipment for each team so that everyone has a chance to use the tools and go through the process. By the end of the class you'll be ready for your best spring wildflower season ever!

John Malpas has been on Calflora staff since 2003, and is responsible for developing many of the Calflora tools (with a great deal of help from others). For more information about the workshop content please contact John Malpas at jmalpas@calflora.org or (510) 883-3148.

Workshop 3: Introduction into Mushroom Foraging and Identification
8:30 a.m. – 5:00 p.m. Big Chico Creek Ecological Reserve Conference Center (we will meet in Chico at the Municipal Parking Lot at 2nd and Flume Streets at 8:30 a.m. to carpool to the BCCER Conference Center)

Field Trip Leader: **Phil Carpenter**

This workshop will be useful for rank beginners as well as for people with some knowledge of mushrooms. Once we assemble at the BCCER Conference Center 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 to the Center from gathering mushrooms we'll get into the identification part of the workshop using the field guide Mushrooms Demystified by David Arora. The process of identifying mushrooms will be described with the variety of mushrooms that were gathered in the field. 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).

For more information about workshop content, please contact Philip Carpenter at philandmac@sbcglobal.net.

ABSTRACTS OF TALKS

(Abstracts in chronological order; index to authors on page 39)
(* denotes the speaker if not the first author)

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

Welcome to our Fifth Northern California Botanists Symposium

I'd like to welcome all of you to our fifth symposium, *From the Redwoods to the Sagebrush – Botany Ranging Far and Wide*. We hope you will enjoy the program that we have organized for you this year with great speakers and posters. Our plenary speaker, Todd Dawson, will focus on *From a Redwood Forest to a Sagebrush Steppe? What Coast Redwoods Face under a Changing Climate* and our keynote speaker, Barbara Ertter will address *People, Plants, and Politics: The Early Years of California's Botanical Institutions.* 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 to talk about the various types of botany job opportunities, so please attend. We also added a discussion on black walnuts for the Tuesday lunch time to provide another avenue to interact with each other. 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. FERNANDEZ-GOING, B.[+1], HARRISON, S.[2], ANACKER, B.[3], and SAFFORD, H.[4]
[+]NCB 2010-2011 Research Scholarship Awardee
[1]Department of Ecology, Evolution, and Marine Biology, University of California, Santa Barbara, CA. 93106 going@lifesci.ucsb.edu
[2]Department of Environmental Science and Policy, University of California, Davis, CA 95616
[3]Department of Evolution and Ecology, University of California, Davis, CA 95616
[4]USDA Forest Service, Pacific Southwest Region, 1323 Club Drive, Vallejo, CA 94592

Climate Interacts with Soil to Produce Beta Diversity Patterns in Californian Plant Communities

Spatially distinct communities can arise through interactions and feedbacks between abiotic and biotic factors. We suggest that, for plants, patches of infertile soils such as serpentine may support more distinct communities from those in the surrounding non-serpentine soils where the climate is more productive (i.e., warmer and/or wetter). Where both soil fertility and climatic productivity are high, communities may be dominated by plants with "fast-growing" functional traits, whereas where either soils or climate impose low productivity, species with "stress-tolerant" functional traits may predominate. As a result, both species and functional composition may show higher dissimilarity (beta diversity) across soil boundaries in productive climates. This pattern may be reinforced by positive feedbacks, in which higher plant growth under favorable climate and soil conditions leads to higher soil fertility, further enhancing plant growth. For 96 pairs of sites across a 1200-km latitudinal gradient in California, we found that the species and functional dissimilarities between communities on infertile serpentine and fertile non-serpentine soils were higher in more productive (i.e., wetter) regions. Woody species in these communities had more stress-tolerant functional traits on serpentine than non-serpentine soil, and as rainfall increased, woody species functional composition changed toward fast-growing traits on non-serpentine, but not on serpentine soils. Soil organic matter increased with rainfall, but only on non-serpentine soils, generating a fertility difference between soils that increased with rainfall and was positively correlated with plant community dissimilarity. These results illustrate a novel mechanism wherein climatic productivity is associated with higher species-, functional-, and landscape-level beta diversity.

3. **BARRETT, C.**
Department of Biological Sciences, 214 LaKretz Hall, California State University at Los Angeles, 5151 State University Drive, Los Angeles, CA 90032 Craig.Barrett5@calstatela.edu

Morphology, Molecules, and Fungal Associations Identify a Distinct Californian Variety of the Mycoheterotrophic *Corallorhiza striata* Species Complex (Orchidaceae)

Corallorhiza striata Lindley comprises a rare, widespread, mycoheterotrophic orchid species complex, inhabiting North American boreo-temperate/montane forests. This complex displays extensive floral morphological variation, correlated with variation in reproductive mode. It is represented by three species: *C. bentleyi*, a federally endangered species known from populations in the southern Appalachians; *C. involuta*, another autogamous species native to southern Mexico; and *C. striata* (sensu stricto), a widespread North American species (as currently recognized) with a variably allogamous/autogamous reproductive mode. Traditionally within the latter were two varieties: the large flowered *C. striata* var. *striata* (northern USA, Canada), and the smaller-flowered *C. striata* var. *vreelandii* (southwestern USA, Mexico). Californian populations of *C. striata* display an "intermediate" floral morphology between vars. *striata* and *vreelandii*. More recent morphological and molecular research has revealed a more complex scenario. Morphometrically, Californian populations are intermediate in overall floral size compared to the aforementioned varieties. Plastid DNA, however, displays a pattern in which Californian populations occupy a distinct clade, sister to a clade of var. *striata* + *vreelandii*. Nuclear data suggest largely divergent but unsorted gene lineages for each. Molecular co-analyses of *C. striata* and fungal symbionts reveal distinct sub-specificity among Californian populations, towards a single fungal clade/genotype. Morphology, plastid/nuclear DNA, and fungal host associations identify Californian *C. striata* populations as a distinct variety (var. *californica*), and argue for its recognition as an evolutionarily significant unit for conservation purposes. Additional population sampling in western California and genomic approaches will be undertaken to test specific hypotheses regarding Californian *C. striata* in future research.

4. **JOLLES, D.D.**
NCB 2011-2012 Research Scholarship Awardee
Claremont Graduate University and Rancho Santa Ana Botanic Garden, 1500 N. College Avenue, Claremont, CA 91711 diana.jolles@gmail.com

What Can the Dispersal History of Multiple *Pyrola picta* Lineages (Ericaceae) Tell Us about Habitat Corridors throughout the Ages?

Members of the mycoheterotrophic *Pyrola picta* species complex (Pyroleae: Monotropoideae: Ericaceae) inhabit a wide range in western North America, characterized by montane, coniferous forests from British Columbia to Baja California. The latitudinal center of this range is in northern California, and dispersal (by seed or pollen propagules) of *P. picta* among floristic subregions over time is evident from both (1) patterns of gene flow among several populations in the region and (2) our current understanding of geologic history for the region. Complex dispersal patterns for species and lineages suggest that *P. picta* dispersed to California multiple times from regions in the north; that several areas of northern California, like the Warner Mountains, are now relatively isolated genetically whereas other regions, like Medicine Lake Highlands, are experiencing ongoing gene flow. Given the constraint of mycoheterotrophy, I will discuss what historical gene flow may have been like in the region and how current habitat dimensions may influence lineage diversification in the future.

5. **HAYDU, K.**
NCB 2011-2012 Research Scholarship Awardee
Department of Biology, California Polytechnic State University, San Luis Obispo, CA 93407-0414
kristiehaydu@gmail.com

Mapping Plant Biodiversity Hotspots at the County Scale: A New Tool for Establishing Resource Conservation Strategies

Norman Myers first identified the world's 25 biodiversity hotspots and pioneered innovative ideas about the usefulness of biodiversity models for establishing long-term resource conservation strategies at global scales. Since Myers, most of the subsequent studies using hotspot science for biodiversity modeling have

used large spatial scales like countries, provinces or states, and other biogeographic regions. The California Floristic Province continues to be one of the recognized global biodiversity hotspots. Our study site, San Luis Obispo County, is within this hotspot and we created a map of plant biodiversity hotspots at the county scale using Geographic Information Systems (GIS) technology. We wanted to determine the effectiveness and applicability of biodiversity hotspot mapping at this scale with anticipation that the map will serve as a new tool for establishing long-term resource conservation strategies in the County. Our plant biodiversity hotspot map is based on distribution data collected from herbarium specimens of San Luis Obispo County's rare flora. These data were extracted from the Hoover Herbarium at Cal Poly and manually digitized into GIS. We used GIS to identify, locate, and quantify the resultant hotspots from the data. Our results are applicable for establishing local and regional plant conservation priorities at more fine scale resolutions, which is frequently where land acquisition and reserve establishment occurs.

6. PICKART, A.J.
U.S. Fish and Wildlife Service, Humboldt Bay National Wildlife Refuge Complex, 6800 Lanphere Road, Arcata, CA 95521 andrea_pickart@fws.gov

Integrating Dune Restoration and Management with Climate Change Adaptation at the Lanphere Dunes, Humboldt Bay National Wildlife Refuge

At the Lanphere and Ma-le'l Dunes Unit of Humboldt Bay National Wildlife Refuge, ecological restoration and monitoring have been ongoing for nearly three decades to keep pace with refuge expansion into previously degraded sites. Methods of restoration have been fine-tuned through adaptive management and yield a high degree of success as measured by multiple parameters. Coastal dunes are, by nature, dynamic systems that exist at the fluctuating boundary of aquatic and terrestrial biomes, and are therefore inherently resilient. However, the accelerated rate of sea level rise and other changes anticipated during the coming decades will test the ability of these ecosystems to adapt and thrive, and the role of management will become even more critical. With these changes comes the need to conceive of and test new paradigms, and to potentially decouple desired outcomes from historic measures of ecological health. A greater focus on process and function, with more flexible expectations of community composition is called for. New restoration projects provide the opportunity to begin testing these paradigms in an adaptive context. At the Refuge, monitoring targets have shifted to provide a greater emphasis on abiotic processes in order to track changes in important ecosystem drivers like sediment budget and geomorphic change. At the same time, upcoming restoration projects will re-evaluate targeted species composition and genetic source material in anticipation of species migrations. Finally, we are attempting to facilitate refuge expansion to incorporate the available accommodation space needed for the migration of the dunes as sea level rises.

7. KANIM, N.
U.S. Fish and Wildlife Service, Yreka Fish and Wildlife Office, 1829 S. 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. Preliminary results indicate that all monitored occurrences have increased in size over the past five years. Seeds have been accessioned at Rancho Santa Ana Botanic Garden. Approximately 443 hectares of potential habitat were surveyed in 2006. Research on breeding system, the effect of pollination distance on fruit set, 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.

8. PARSONS, L. and RYAN, A.

Point Reyes National Seashore, 1 Bear Valley Road, Point Reyes Station, CA 94956
Lorraine_Parsons@nps.gov

Can We Turn Back Time? Restoring Salt Marsh and Rare Plant Habitat through Large-scale Wetland Restoration

Wetlands play many important functions for both wildlife and humans. However, these functions are lost when wetlands are developed or altered. Tomales Bay lost 50% of its wetlands in the 1940s when a large marsh was leveed for a dairy ranch operation, converting historic salt marsh to pasture. In 2007-2008, the National Park Service implemented a 613-acre wetland restoration at the southern end of the bay. One of the issues that tidal wetland restoration managers face is how to restore native vegetation communities and rare plants after decades of habitat degradation and loss. Ecologists now acknowledge that removing adverse management practices and infrastructure or even reshaping the landscape may not be enough to re-set the ecological clock, given that the physical and biological processes that once governed assembly of species within historic marshes have changed dramatically. An example of this can be seen in San Francisco Bay, where restored marshes are often dominated by only a few species and lack the unique or even rare species that once thrived there. To determine success of restoration, the Park Service developed an innovative pre- and post-restoration monitoring program that includes reference wetlands. The vast volume of water that now flows in and out with the tides has quickly transformed the former pastures into a complex mosaic of salt marsh, brackish marsh, and freshwater marsh that supports a number of uncommon and even rare plant species. Species diversity has increased considerably, although it is still lower than in natural marshes.

9. GOTTSCHALK FISHER, E.E.[+1], SILVEIRA, J.G.[2], GRIGGS, F.T.[3], and HATFIELD, C.A.[1]

[+]NCB 2009-2010 Research Scholarship Awardee

[1]Department of Biological Sciences, California State University, Chico, Chico, CA 95929-0515
egottschalkfisher@mail.csuchico.edu
[2]U.S. Fish and Wildlife Service, 752 County Road 99W, Willows, CA 95988
[3]River Partners, 580 Vallombrosa Avenue, Chico, CA 95926

Evaluating Introduction and Restoration for Two Rare Vernal Pool Grasses, *Neostapfia colusana* (Colusa Grass) and *Tuctoria greenei* (Greene's Tuctoria)

Vernal pool habitats have been significantly reduced by conversion to incompatible agriculture and urbanization. As a result, a number of vernal pool-dependent species have become rare, including *Neostapfia colusana* (Colusa grass) and *Tuctoria greenei* (Greene's tuctoria) [Poaceae]. The goal of our research is to examine the potential for introductions of the rare grasses into vernal pool habitats. To this end, we established four study sites – two introduction sites with restored or created vernal pools and two reference sites with extant populations of the rare grasses. Prior to introductions, we documented environmental site parameters to inform introduction success. In January 2011, we introduced seeds into the introduction and the reference pools. We monitored the pools, collecting germination and reproduction information. For Greene's tuctoria, results show at the introduction pools a range of 51-65% germination with upwards of 80% of these producing an inflorescence. In contrast, at the reference pools 24-44% germinated with 77-100% producing inflorescences. For Colusa grass, there was 8-19% germination at the introduction pools but only one Colusa grass plant survived to reproduce, compared to an average 23% germination and 39% reproduction at the reference pools. To assess persistence, we monitored second generation Greene's tuctoria at the introduction pools in 2012. Despite relatively low rainfall and only partial pool filling in the second year, over 2,000 reproductive plants were counted. The results of this research help inform restoration efforts for Colusa grass and Greene's tuctoria populations as well as for other rare vernal pool plants.

10. BARBOUR, M., LOIDI, J., GARCIA-BAQUERO, G., and MEYER, R.
Plant Sciences Department, MS 1, University of California, Davis, CA 95616 mgbarbour@ucdavis.edu

Distance Inland Explains Low-Elevation Shifts of Dominance between Redwood and Douglas-fir along the Central Coast

Changing climates have perpetuated shifts in the biogeographic distribution of flora and fauna across landscapes for millennia. It is therefore important to consider how future environmental changes may affect the survival [INCORRECT ABSTRACT -- SEE PAGE 41 FOR CORRECT ABSTRACT] n Mountains are harbingers of change. Botanical diversity has been fostered in this ancient meeting ground as climatic conditions have shifted throughout the Cenozoic. We will explore the rare, spatially restricted, high elevation microsites of the Klamath Mountains where relict foxtail pine (*Pinus balfouriana*) and whitebark pine (*Pinus albicaulis*) still survive today. We will discuss how these species have been, are being, and may be affected as our climate continues to change. This review will be based on various studies from across the West and on recent, first-hand observations in the Klamath Mountains.

11. SOLOMESHCH, A.
Department of Plant Sciences, University of California Davis, 2231 PES Building, Davis, CA 95616
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Classification of the Forest Plant Communities of Redwood National Park

The overview of North California coastal forests of *Sequoia sempervirens, Pseudotsuga menziesii, Picea sitchensis, Pinus jeffreyi, P. attenuata, P. monticola, P. contorta* var. *contorta, Tsuga heterophylla, Chamaecyparis lawsoniana, Lithocarpus densiflorus, Quercus chrysolepis, Q. garryana,* and *Arbutus menziesii* is provided based on 180 releves (1000 m^2) from Redwood National Park, Prairie Creek State Park, Del Norte Coast State Park, Jedediah Smith State Park, and Mill Creek Acquisition Area (Del Norte County). Plot data were entered into the database TURBOVEG (Hennekens and Schaminee 2001), transferred in JUICE (Tichy 2002) for data analysis, and classified using TWINSPAN (Hill 1979) as provided in JUICE and cluster analysis utilizing Euclidean distance and the average linkage method in PC-ORD (McCune and Mefford 2001). Groups of releves derived from this analysis were assigned to 29 associations based on their ecological and floristical interpretation. These associations were placed within 3 formations, 3 divisions, 5 macrogroups, 9 groups, and 22 alliances on U.S. National Vegetation Classification. Most alliances in Redwood National Park are represented by a single association. Two alliances, *Sequoia sempervirens* and *Alnus rubra*, are the most diverse and contain 4 and 3 associations respectively, each of which is relatively wide spread. The least common association is *Picea sitchensis/Lysichiton americanus*, which belongs to the *Picea sitchensis* Saturated Forest Alliance from North Pacific Lowland Riparian Forest and Woodland Group. It was only found in two locations within the study area. It is very likely that in Redwood National Park this association reaches the southern limit of its geographical range.

12. SHAUGHNESSY, F.[1], AUGYTE, S.[2], and COLOGUE, C.[1]
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Marine Floristics from Cape Blanco to Cape Mendocino: Surprises, Changes, and Relevance

Estuarine, bay, and rocky reef habitats from Cape Blanco, Oregon south to Cape Mendocino, California may have a unique marine flora due to the combination of upwelling, wave energy, and watershed effects (lower salinities, high sediment loads) they experience. The biogeographic and community characteristics of the marine flora from this region are poorly described even though Cape Mendocino could be as important to the evolution of marine floras as Point Conception, California, and management of Marine Protected Areas would benefit from knowing where biodiversity hotspots are located. Based on previous studies of the NE Pacific by other authors, we tested the hypotheses that 1) there is a gradual rather than abrupt latitudinal transition of seaweed species; 2) structurally complex seaweed functional groups are more common on headlands than between them; and 3) vertically, within rocky intertidal habitats, the seaweed species richness is greater in the mid intertidal than higher or lower zones. Random transect sampling within rocky intertidal sites from Cape Blanco to Cape Mendocino supported all three of these

hypotheses. As an expansion of these studies, we used parts of existing floras and our own collections to develop the first comprehensive (all marine habitats) cape to cape seaweed flora that contains 322 rhodo-, phaeo- and chlorophyte species. This converts to 134 species / degree latitude which, when imperfectly compared to larger scale seaweed floras of this coast, is surprisingly high considering the intensity of the watershed effects. There was only one endemic species between the capes and so the high richness may be due to a larger number of range limits as has been described by S. Lindstrom for *Mastocarpus* and *Porphyra*. Our results indicate that the latitudinal and vertical patterns of species richness between the capes is typical for the NE Pacific but that the potentially high richness may be exceptional.

13. MESLER, M.[1], MAYER, M.[2], CAROTHERS, S.[1], BENCIE, R.[1], and WAYMAN, K.[3]
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The Taxonomy and Pollination of the *Silene hookeri* Complex

Thomas Nuttall described *Silene hookeri* in 1838. Since then, this name has been applied broadly to a group of closely related day-blooming taxa endemic to western Oregon and northwestern California. Based on differences in glandularity, flower size, petal color and lobing, +/- corona appendages, and stamen exsertion, subsequent authors described five additional species for the group. These species have been variously accepted, placed in synonymy, or reduced to subspecies in recent floristic treatments. Our goal has been to resolve these differences of taxonomic opinion in light of extensive field surveys and molecular phylogenetic analysis. To date our work has revealed (a) a series of potentially useful traits (corolla shape, androecium symmetry, and anthophore length) that are difficult or impossible to evaluate using herbarium material, and (b) strong morphological and chloroplast gene support for an additional species, here tentatively named "S. nelsoni" in honor of the late Thomas W. Nelson. This taxon, which is restricted to the immediate vicinity of the Trinity River and its tributaries, is currently treated as part of *S. bolanderi* A. Gray (The Jepson Manual 2) or *S. hookeri* Nuttall ssp. *bolanderi* (A. Gray) Abrams (Flora of North America). In addition, we have found that, with the exception of the hummingbird-pollinated *S. serpentinicola*, members of the *S. hookeri* complex are pollinated primarily by flies in the genera *Bombylius* and *Eulonchus*. These long-proboscid flies probe through distinct gaps between petal and filament bases ("nectar windows") for droplets of nectar that accumulate on the anthophore. Corresponding gaps are not present in *S. serpentinicola*.

14. DAWSON, T.
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From a Redwood Forest to a Sagebrush Steppe? What Coast Redwoods Face under a Changing Climate

I will take a look back in time to what Redwoods have "seen" in the past environs they have occupied, what they are "seeing now" and how current climate conditions shape their biology, and then finally explore what future climate change projections hold for the future of Coast Redwoods and the ecosystems they compose.

15. ERTTER, B.
University and Jepson Herbaria, University of California, Berkeley, CA 94720-2465 ertter@berkeley.edu

People, Plants, and Politics: The Early Years of California's Botanical Institutions

The second half of the nineteenth century witnessed the almost overnight transformation of a remote outpost into the bustling metropolis of San Francisco, situated in the midst of an undescribed wealth of biological diversity. This period accordingly also saw the founding and development of most of the major scientific institutions of California: the California Academy of Sciences, the California Geological Survey, the University of California, and Stanford University. As demonstrated by a focus on the botanical component, the early histories of these institutions are tightly intertwined, with overlapping casts of colorful personalities whose feuds and alliances had seminal influences. Those who exerted the greatest influ-

ence on botany during this period were Albert Kellogg, Hans Hermann Behr, Josiah Dwight Whitney, William Henry Brewer, Henry Nicholas Bolander, Mary Katharine Layne Curran Brandegee, Edward Lee Greene, Harvey Willson Harkness, William Russel Dudley, and Townshend Stith Brandegee.

16. SHOLARS, T.
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Connections: Forest Relationships with Non-plants

Ecological relationships among plants and non-plants are important. Two forest types are examined in terms of some of their relationships. The extensive mycorrhizal mushroom populations in a mixed redwood-Doug fir-hemlock forest are examined. Mycorrhizal mushroom abundance data are presented at weekly intervals at a location known as "mushroom corners" in Mendocino County. Populations of mushroom species at this site start in September with 14 species seen (10 lignicolous/saprobic and 4 mycorrhizal) and increase to 80 species (27 lignicolous/saprobic and 57 mycorrhizal) in November. Mycorrhizae have been known to help species survive changes in climate and moisture regime. Global climate change is providing these changes in terms of higher temperatures and dryer conditions. Cryptogamic crusts of lichens, mosses, green algae, and cyanobacteria cover the ground in pristine Mendocino cypress forests (Pygmy Forests). This assemblage of species keeps the top 2 cm depth of top-soil intact. Impact from walking on this fragile crust destroys it and starts the erosion process. This creates fertilizing sediment that stimulates tree growth and changes the stunted character of the system. Our view of plant communities based on dominant vegetation leaves out the relationship part of ecosystems. Since humans are impacting ecosystems we need to continually keep in mind the connections between species.

17. CARTER, B.
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Cryptic Speciation in the California Moss Genus *Scleropodium* (Brachytheciaceae)

Diversification has been well studied in the California flora, but has focused heavily on vascular plants. Mosses have a distinctly different physiology and reproductive biology than vascular plants, and so provide an interesting system within which to further understand how California's varied climate and topography promote diversification. Data from a molecular study will be presented which clarify species circumscriptions and demonstrate the presence of a new species in the moss genus *Scleropodium*. The new species is common in California but has been previously overlooked due to its similarity with another common species. This and other molecular studies of mosses in California suggest that there remain many species to be described from the region.

18. BURNS, E.
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Redwood Forest Plants Absorb Fog Aboveground

Summertime fog provides water to the coast redwood forests of Northern California when rainfall is largely absent. Fog drip wets plant crowns and provides a water resource during the driest time of year. In a frequently fog-inundated redwood forest in Sonoma County, I found that *Polystichum munitum*, *Umbellularia californica*, and *Sequoia sempervirens* in the understory exhibited less drought stress during the summer when they received frequent fog exposure. *P. munitum* became most hydrated in response to fog in this forest and had water potentials approaching 0 MPa during fog events. In a separate study, I found that 80% of redwood forest species absorb fog water directly into their leaves and *P. munitum* exhibited the highest foliar uptake capacity of all the trees, shrubs, herbs, and ferns evaluated. The capacity of *P. munitum* to absorb fog varies between redwood forests and is highest in the center of the coast redwood range. These findings show that redwood forest species readily acquire fog water directly through their leaves and thereby become hydrated even when soil water availability is low. With less fog exposure during the summer dry season, water limitation could reduce the growth potential and even survival of redwood forest plants in the future.

19. VILLELLA, J.[1] and CARLBERG, T.*[2]
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Notes on Hyper-maritime Foliicolous Lichen Communities of Northern California

Hyper-maritime foliicolous lichen communities were investigated at several locations in Northern California. The composition of a 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.

20. PARKER, V.T.
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New Insights on the Origin of Persistent Soil Seed Banks in *Arctostaphylos*

Persistent soil seed banks are well known in manzanita species. Less well known is that the seeds are too large for persistent soil seed banks with respect to seed bank theory. Data on scatter-hoarding rodents indicates that they bury manzanita fruit to sufficient depth to provide a fire adaptation in high intensity wildfires; the proportion of seedlings arising from rodent caches increases with fire intensity. Burial by scatter-hoarders would be a necessary process in the origin of dormancy in manzanita seeds. *Arctostaphylos* is the only genus with seed dormancy and obligate seeding in their subfamily, the Arbutoideae. A conceptual model is provided to suggest the origin of these processes. Contrasts are provided with *Ceanothus*, the only other shrub genus in California with persistent soil seed banks and obligate seeding.

21. MACKEY, H.E. Jr.[1] and SCHLISING, R.[2]
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Seed Production and Phenological Patterns for *Dicentra uniflora* in Northern California

Dicentra uniflora is a small, showy geophyte that appears soon after snow banks melt. It persists aboveground for 4 to 6 weeks at elevations of 1200 m to 2500 m in Northern California. It is easily recognized, but little is known concerning its basic biology and reproduction. Field observations and plantings of seeds and bulbils were conducted in Butte County from 2008 through 2011 at 5 locations on Carpenter Ridge (1372 m), at Scotts John Creek (1770 m), and at Humbug Summit (2000 m); observations were also made on Brokeoff Trail in Lassen Volcanic National Park (LVNP) (1900 m to 2500 m) in 2009 and 2010. Leaf-out, flowering, and seed production showed a 3 to 4 week delay with increase in elevation between the Butte County sites from late April to mid-June, and from late June to mid-July in LVNP. Seed production averaged about 70 seeds per flower regardless of site, but with only about 90% of the seeds maturing fully. Seed plantings showed better germination in cooler, more protected locations with longer winter snow cover. Small bulbils were produced in about one-fourth of the seedlings and are necessary for survival through the summer and winter until the following spring. Plantings of harvested first-year bulbils resulted in the production of plants with both bulbils and small tubers. Several years are required to produce sufficiently large tubers for flower production. Permanent transects and long term seed and bulbil plantings were established in 2011 to evaluate population trends over the next 5 to 10 years, especially on the warmer, lower elevation sites at Carpenter Ridge.

22. KNIGHT, C.A.[1] and LEUBNER-METZGER, G.[2]
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Measurement of the Pressures Generated during Seed Germination and Early Growth

We studied dormancy, germination, and early radicle growth in *Lepidium sativum* (cress). Our goal was to measure the pressures necessary for germination (testa rupture, endosperm rupture, and radicle growth). We used a modified pressure chamber with a Plexiglas viewing window and time-lapse image analysis to

measure the pressures that would inhibit testa rupture, endosperm rupture, and radicle growth. We compared the amount of time necessary to achieve these growth milestones when pressures from 0 MPa to 3.8 MPa were applied at 0.1 MPa increments. We assume that this external application of pressure to the seed is equivalent to the pressures generated internally for normal germination processes. Interestingly, testa rupture, and the time to testa rupture was not significantly different between 0.1 and 3.8 MPa. Higher pressures would be necessary to inhibit testa rupture. Endosperm rupture and radicle growth was inhibited at 1.2 MPa but unaffected at pressures from 0.1 to 1.1 MPa. Paradoxically, testa rupture and endosperm rupture was significantly faster (by 4.8 hours) at 0.1 MPa than it was at 0 MPa. We suspect that either an experimental effect of the compressed air supply we used (we used compressed air, not nitrogen) or changes in oxygen availability at 0.1 MPa may have caused this phenomenon. Imbibition was affected at 3.8 MPa – seeds were significantly smaller at testa rupture (20% smaller). Our goal now is to apply greater pressures to see if we can inhibit testa and endosperm rupture, and to test native species from the Northern California flora.

23. GUILLIAMS, C.M.[+] and BALDWIN, B.G.
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The Importance of Nutlets in *Plagiobothrys* and Relatives for Taxonomy and Divergence Time Estimation in the Cryptanthinae (Boraginaceae)

Plagiobothrys and close relatives *Amsinckia*, *Cryptantha s.s.*, *Eremocarya*, *Greeneocharis*, *Harpagonella*, *Johnstonella*, *Oreocarya*, and *Pectocarya* comprise subtribe Cryptanthinae (Boraginaceae). With approximately 320 minimally-ranked taxa, the subtribe is exceptionally diverse in western North America, and also has many members in western South America. Taxa in the Cryptanthinae can appear similar morphologically, as there are relatively low levels of vegetative and floral trait variation across the subtribe. However, the fruits of Cryptanthinae are highly diverse, and taxonomy in the subtribe at all ranks has relied heavily on morphological characters of fruits. In many Boraginaceae, the fruits are schizocarps of four mericarps or nutlets. Nutlets can differ in shape, size, and ornamentation, as well as shape and size of the attachment scar. This talk focuses on the use of nutlet morphology in taxonomy of the Cryptanthinae, primarily at the genus-level, as well as how nutlet morphology has permitted divergence time estimation in the subtribe. Recent phylogenetic studies have demonstrated that older taxonomic concepts based upon certain features of the nutlets (e.g., attachment scar length) have resulted in non-monophyletic groupings of taxa in both *Cryptantha* and *Plagiobothrys*, which together comprise 90% of the taxa in the subtribe. Beyond use in taxonomic studies, morphometric study of nutlets in the subtribe has allowed the placement of fossil *Cryptantha* taxa in a DNA-based phylogenetic tree. Two different fossil placement methods have resulted in estimates of divergence times in the subtribe, which in most cases suggest recent and rapid diversification of these genera (< 5 Ma) in North America.

24. GOSEJOHAN, M.C.[+1 2], WEISBERG, P.J.[1], and MERRIAM, K.E.[2]
[+]NCB 2011-2012 Research Scholarship Awardee
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Effects of Hydrologic Regime on a Rare Vernal Pool Grass, *Orcuttia tenuis* (Slender Orcutt Grass), in the Modoc Plateau – East Cascades Ecoregion

Vernal pools are exceptional hotspots of biodiversity that provide habitat for many highly specialized plant and animal species, some of which are trending toward extinction. One of these is *Orcuttia tenuis* (slender Orcutt grass), an annual amphibious grass species federally listed as threatened and state listed as endangered. In its northern geographic range, primary threats to *O. tenuis* conservation are thought to be livestock grazing and changes in vernal pool hydrology; however, little is known of the effects of these processes. A unique combination of approaches including remote photography of stage gauges, vegetation sampling along hydrologic gradients, and a detailed topographic survey were used to recreate vernal pool hydrology and map vegetation community responses. Further, we utilized generalized linear models and

ordinal regression analyses to determine optimal hydrologic conditions for *O. tenuis* occurrence, abundance, height, and reproductive output which all increased with increasing maximum depth and inundation length. An upper limit for *O. tenuis* response to hydrologic metrics could not be determined because deeper and longer-inundated areas were not measured or did not exist in the modeled vernal pools. Further, *O. tenuis* occurred in both deep tolerant and long-term inundated community groups, indicating a fundamental ecological niche wider than previously anticipated. Our research highlights a low-cost monitoring approach that will be valuable in locations that are difficult to monitor throughout the year due to climate extremes, lack of accessibility, or time limitation and provides recommendations for future hydrologic restoration of vernal pools supporting *O. tenuis*.

25. CAICCO, S.[1], KULPA, S.[2], JOHNSON, J.*[3], and TORREGROSA, A.[4]
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[2]U.S. Fish and Wildlife Service, Nevada Fish and Wildlife Office, Reno, NV
[3]Nevada Natural Heritage Program, Carson City, NV jdjohnson@heritage.nv.gov
[4]U.S. Geological Survey, Western Geographic Science Center, Menlo Park, CA

Modeling the Impacts of Climate Change in Rare Plant Habitats of the Great Basin

Endemic plant species are expected to be at far greater risk of extinction from climate change than plant species with less restrictive distributions. The Great Basin of the western United States provides habitat for over 200 endemic plant species, many of them with highly restricted geographic ranges. Most of these taxa are also restricted ecologically, often to highly specialized edaphic habitats, which poses significant constraints on their ability to migrate in response to climate change. The primary goal of this study is to enhance rare plant conservation by integrating predictive models into the identification of priority conservation targets and long-term monitoring efforts in the Great Basin. The approach is to develop predictive multivariate landscape-level models that show the effect of climate change on rare plant distribution and abundance using existing occurrence data from a selected set of Great Basin endemic plant species. The modeling will help us predict how much habitat and climate variability each plant species occupies and the potential for expansion into other areas. It will also help us predict future climate conditions in known plant habitats to identify populations that are most at risk from climate change. High-risk areas may be most valuable as monitoring sites while lower-risk areas may be more valuable as conservation areas.

26. MOORE, C.M.[1,2] and VANDER WALL, S.B.[1,2]
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[2]Department of Biology, University of Nevada, Reno, 1664 North Virginia Street, Reno, NV 89557

Seed Dispersal of Great Basin Plants

Following Eugene Munroe (1948) and MacArthur and Wilson's (1963, 1967) independent formulations of a theory of insular species richness as functions of geographic structure and biological dispersal, great interest was taken in applications in insular-like systems. The Great Basin's characteristic basin-and-range landscape was subsequently studied under the insular model and served as a showcase for early work in the field of biogeography. At a symposium in 1976, a paper by the late Kimball T. Harper et al. entitled "The flora of Great Basin mountain ranges: diversity, sources, and dispersal ecology," has served as the region's most prominent source on dispersal ecology. In this talk we (i) revisit Harper et al.'s synthetic work, (ii) highlight how our understanding of dispersal ecology has changed in the past three decades, and (iii) generate new hypotheses to be tested in the future. Harper et al.'s work was exemplary and convincingly showed that Great Basin interior mountaintops are consistent with patterns of species richness found on islands. With many of the dispersal classes he assigned, however, subsequent studies have reclassified dispersal mode and we can thusly reinterpret some of their findings. Further, our understanding of historical climatic patterns sheds light on unanswered questions in the paper, such as why many of the mountaintop endemics lacked apparent long-distance dispersal mechanisms. Last, we deduce hypotheses about (i) endemic patterns across latitude that can be tested using modern molecular techniques and (ii) a trade-off between dispersal distance and effectiveness that emerges from Harper et al.'s findings.

27. MERRIAM, K.E.
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An Overview of Vegetation Types in the Modoc Plateau and Northwestern Basin and Range Bioregion

The Modoc Plateau and Northwestern Basin and Range bioregion is located in the northeastern corner of California at the western edge of the Great Basin. The vegetation of the bioregion represents a unique combination of both Great Basin species and California endemics, forming a transition zone between the two floristic provinces found nowhere else. This talk will provide an overview of the vegetation of the bioregion, which is loosely segregated along elevational gradients. At the lowest elevations, pluvial lakebeds form habitat for alkaline scrub species. Above the pluvial basins the bioregion is dominated by sagebrush steppe. Western juniper is found in the transition zone between the sagebrush and mixed conifer zones. Montane and subalpine vegetation can be found in the mountain ranges of the bioregion, and a wide variety of perennial bunchgrasses occur throughout the bioregion in the understory of shrub and open conifer forest vegetation types. Wetland, spring, meadow, vernal pool, riparian, and aspen communities are scattered across the bioregion and support diverse communities of wildlife. Fire-adapted stands of Baker cypress (*Hesperocyparis bakeri*) and knob cone pine (*Pinus attenuata*) can be found on the basalt flows of Timbered Crater. This talk will feature photographs by a number of northern Californian botanists.

28. BUXTON, E.
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A New Meadowfoam (*Limnanthes*) Taxon Found in an Agricultural Field in San Mateo County

Limnanthes douglasii R. Br. subsp. *ornduffii* E. G. Buxton (Limnanthaceae) is a narrowly endemic meadowfoam from Moss Beach (Half Moon Bay) in San Mateo County, California. Although it shares the morphological trait of being tetramerous with *Limnanthes macounii* Trel., an endemic species in British Columbia, it is not a sister taxon to *L. macounii* based on molecular sequence evidence. *Limnanthes douglasii* subsp. *ornduffii* appears in an unresolved group with other *L. douglasii* populations/subspecies. Molecular data coupled with morphological distinctiveness and geographical endemism provide a credible basis for recognizing the Moss Beach population as a *L. douglasii* subspecies. Data suggest that tetramerism in the genus has arisen more than once.

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

More Endemics – New Names in California *Carex*

California has approximately 150 *Carex* sedge species, and that number is increasing despite the recent discovery that certain rare sedges (*C. albida, C. amplectens,* and *C. constanceana*) do not merit species status. California endemic species that are recently published or in process include one from high elevations in the White Mountains and two from moderate elevations on the western slopes of the Sierra Nevada. A fourth new species grows from the northern Sierra Nevada to southwest Oregon. In addition, a split in *C. multicostata* makes that species a California endemic ranging from the southern Sierra Nevada to the San Bernardino Mountains, distinct from *C. pachycarpa* that ranges from the southern Sierra Nevada to Washington. More species may lurk unrecognized in *Carex* sections *Acrocystis* and *Ovales*. The taxonomic changes reported here result from research done in preparation for writing a field guide to California sedges. The process of finding new species will be discussed.

30. PRESTON, R.E.
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Solving the Mystery of Brodiaea X

The circumscription of *Brodiaea coronaria* has remained in a state of flux over the past 200 years. That species name has been applied to a morphologically diverse assemblage of populations that range from northern California to coastal southern British Columbia. I used a morphometric analysis to test the hypothesis that these populations represent several discrete taxonomic groups. I measured ten floral characters and the length of the longest pedicel in the inflorescence of 10-50 plants from 67 populations, then segregated the populations into five a priori groups based on range, habitat, and the morphology of stamens and staminodes. I used discriminant analysis, principal components analysis, and cluster analysis to determine whether the groups differed significantly and to identify which characters contributed the most towards differentiating between the groups. The results of the analysis support formal taxonomic recognition of four of the five groups. *Brodiaea rosea*, which has been treated as *B. coronaria* subsp. *rosea*, is returned to species rank with two new subspecies. Other California populations indistinguishable from populations of *B. coronaria* from the Pacific Northwest are provisionally assigned to that species, although further genetic and molecular data are needed to assess whether morphologically cryptic polyphyletic lineages may be present.

31. McRAE, J.
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Discoveries and Un-discoveries, Six Rivers National Forest

1) Discovery of a new disjunct population of *Lewisia kelloggii* on Six Rivers National Forest in Humboldt County. *Lewisia kelloggii* is endemic to California and was previously known to occur only from an area extending from the Southern Cascade Range to the Southern Sierra Nevada range where it grows on granite and slate substrates. It was first noted in Humboldt County growing on ultramafic substrate by a forester who, sensing that it was unusual, brought it to the attention of botanists working on Six Rivers National Forest, who in 2009, identified it as *Lewisia kelloggii.* This population of approximately 400 plants in the outer coastal range northwest of the town of Orleans at 3900 feet is significantly disjunct from populations occurring inland. Isozyme genetic analysis was performed by the National Forest Genetics Laboratory on leaf tissue from 29 plants from the Humboldt County site in the Spring of 2012. Results of the analysis indicated that all individuals in the Six Rivers population had the same genotype (measured at 21 isozyme loci), and no genetic difference exists among any of the plants analyzed indicating that the population went through a genetic bottleneck sometime in the past. 2) The Un-discovery of *Epilobium oreganum* in Humboldt County. While developing a Conservation Strategy for five serpentine wetland species it became apparent that there is uncertainty regarding the number of occurrences of *Epilobium oreganum* in Humboldt County. The Consortium of California Herbaria contains 12 records for Humboldt County, but past changes in nomenclature have cast doubt as to the identity of a number of these records. The taxonomy became confused when *Epilobium oreganum* was re-described in 1889 as *Epilobium exaltatum*, which represented the typical California material of *Epilobium oreganum*. The taxonomic confusion increased when Willis L. Jepson expanded the concept of the species in 1925 (Jepson 1925) to include characters of the more widespread *Epilobium ciliatum*. Munz (1959) carried this confusion on, with the inclusion of *Epilobium exaltatum* as a species in the California Flora. The taxonomic treatment in the 1993 Jepson Manual of Higher Plants of California (Hickman 1993) cleared up much of the confusion with the addition of the 4-lobed stigma as a key step in separating it from look-alikes, particularly *Epilobium ciliatum*. We field-visited 10 of the 12 sites noted in the Consortium. Of these 10 sites, plants from only one proved to be *Epilobium oreganum*. At the other 9 sites we found only *Epilobium ciliatum*. Other observers have noted that four of the *Epilobium oreganum* sites in the Sierra Nevada Range are also mis-identified and are also *Epilobium ciliatum*. *Epilobium oreganum* is a very rare taxon and is currently greatly over-represented numerically. There is a need to correct erroneously identified specimens in herbaria. The difficulty in doing so is that the determination cannot be made based on the specimen, because in most cases the diagnostic feature, the 4-lobed stigma, has not curated well and is either obliterated or gone. As these specimens reach old age, the stigma is one of the first things to go. Are field visits to historic sites combined with the history of problems with nomenclature enough to re-determine the erroneous vouchers in order to provide a more accurate representation of the rarity of *Epilobium oreganum*?

ABSTRACTS FOR POSTERS

(Abstracts in alphabetical order by primary author name; index on page 39)

1. **AKULOVA-BARLOW, Z.**
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Polymorphism of California Plants

Field observations of plant polymorphism are important for taxonomic and genetic studies. Numerous photographs of polymorphism of different plant species were taken in the field in many California counties by the author during the last three years. Observations show that: 1) some plants species are more variable than others, 2) some structures can be more polymorphic than other structures for any given species, and 3) related species and genera are characterized by similar homologous series in their genetic variability (Vavilov's law of homologous series). Homologous series are shown for two California plant species: *Rubus parviflorus* and *Fragaria vesca.*

2. **BAER, T.E., WALDEN, G.K., and BALDWIN, B.G.**
Department of Integrative Biology and Jepson Herbarium, University of California, Berkeley, CA 94720

Systematics of *Romanzoffia* (Boraginaceae: Hydrophylloideae)

Romanzoffia is a small [5 spp., 2 var.] group of annual and perennial herbs, with a distributional range extending throughout western North America, from northern California to British Columbia and Alaska. Plants occur on wet cliff faces or wet rocky areas, and can be confused with co-occurring members of Saxifragaceae in the field. The genus has had limited revisional work and requires systematic investigation of previously described taxa. Our project is a study of evolutionary relationships in *Romanzoffia* (Boraginaceae: Hydrophylloideae) in a dataset of sequences from the internal transcribed spacer region (ITS-1, ITS-2, and 5.8S gene) of nuclear ribosomal DNA (nrITS). We sampled throughout documented ranges for recognized taxa. Phylogenetic analyses [maximum parsimony, maximum likelihood, and Bayesian inference] recovered similar tree topologies for nrITS. Discussion includes comparison of patterns of diversification between annual taxa and perennial taxa. Future work is anticipated with plastid markers, with subsequent publication of taxonomic changes based on results from the different lines of phylogenetic evidence.

3. **BOVEE, K.[1] and TROCK, D.[2]**
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[2]California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118

Rediscovering Milo Baker's *Packera indecora*: Tapping 21st-Century Databases and 19th-Century Maps to Relocate a Rare Plant Occurrence after 118 Years

Milo Baker (1868-1961), a teacher and noted California botanist, collected and pressed thousands of specimens on walks through northern California in the late 19th century. In 1894 he collected a species that was unknown to him. He sent it to E.L. Greene at Berkeley, who published it under the name *Senecio indecorus*. Baker's collection is the likely type for this name (now *Packera indecora*, with a California Rare Plant Ranking of 2.2). The collection location, however, was a long-standing mystery because the annotation on the herbarium specimen read simply, "Pine Creek, Lassen County." A systematic survey of Pine Creek would be impracticable, as the creek begins near the Caribou Wilderness, then journeys 30 miles northeast to its outlet at Eagle Lake. Baker's collection site had never been relocated, and no additional occurrences had been found within Lassen County. To streamline our search, we utilized the wealth of information contained in the California Consortium of Herbaria database and General Land Office maps from the 1870s. We pieced together Milo Baker's journey of 118 years ago with the aid of GIS technologies, then walked straight to a population of this species in July 2012. This rediscovered *Packera* illustrates how creative database queries coupled with scrutiny of primary documents can help to focus searches for historic plant occurrences.

4. **BRUSATI, E., MORAWITZ, D., and JOHNSON, D.**
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Setting Regional Strategies for Invasive Plant Management Using CalWeedMapper

Cal-IPC is working with partners to develop consensus strategies based on CalWeedMapper, our online mapping tool. We are charting a strategic course to help regions be shovel-ready to apply for funding. Regions include national and state parks, national forests, wildlife refuges, counties, Weed Management Areas (WMAs), watersheds and ecoregions. Six regions are in progress, with more coming in 2013. CalWeedMapper produces a Management Opportunity Report of surveillance, eradication and containment opportunities in a selected region based on the current distribution of those species. This report is used in conjunction with local knowledge and information on that species' resiliency to climate change to deduce a strategy for surveillance and eradication targets in a region. In each region, Cal-IPC staff facilitates several meetings with local stakeholders to evaluate the priorities suggested through CalWeedMapper and scope top priority actions. We focus on regionwide priorities for eradication and surveillance while recognizing that local priorities and containment efforts can exist separately from this. The goal is to provide each region with a list of species for surveillance and a regional work plan (with budget) for addressing top priority eradication targets. We are working with two regions in Northern California: Shasta/Siskiyou/Trinity Counties and Del Norte/Humboldt Counties. We have drafted strategic plans for both regions and will hold meetings this winter to review work plans. A goal is to assist the Trinity National Forest to improve its Wilderness Score. Another goal is for WMAs to do outreach and training so more people will look for these early detection species.

5. **CHEN, P.[1], GUILLIAMS, C.M.[+1], CARTER, B.[2], and BALDWIN, B.G. [1]**
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Phylogenetic Relationships in the 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 phylogenetic analyses 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 *psb*A-*trn*H and *trn*L-*trn*F regions of the chloroplast genome. Sequence variation is moderate in the nuclear dataset, but low in the chloroplast dataset. 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. There is strong support at the species level for some taxa, e.g., *R. cereum* and *R. malvaceum*; however, no groupings by infraspecific taxon are recovered. Future work will focus on gathering additional sequence data, integrating molecular and morphological datasets, and incorporating fossil *Ribes* taxa for divergence time estimation.

6. **CRAYDON, E.[1], TERAOKA, E.[1], and DAINS, V.[2]**
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Monitoring Restored Wetlands at the Buhne Point Wetlands Preserve, Humboldt County, California

The 6-acre Buhne Point Wetlands Preserve was established in 2008 to mitigate impacts to U.S. Army Corps of Engineers and California Coastal Commission wetlands resulting from construction and de-

commissioning activities at Pacific Gas & Electric Company's Humboldt Bay Power Plant. The preserve is a mosaic of created, restored, and enhanced wetlands divided into ten mitigation sub-units. Habitats created in the preserve include riparian, seasonal/perennial wetlands, Coastal Commission wetlands, and drainage swales. Salt marsh and riparian forest were enhanced by removing invasives and/or replanting with natives. Each mitigation area has a required set of goals and success criteria related to vegetation, wildlife, and wetland restoration. We have monitored annually in the spring and fall of 2008–2012 to measure success of the restoration activities in each mitigation area, using quadrat-intercept, line-intercept, shrub count and canopy measurement, and visual relevé methods. These methods were used to measure percent cover, growth, survival, and vigor of planted vegetation, as well as percent cover of native and non-native wetland and invasive plant species. Annual monitoring results are being used to inform management activities in the preserve, including additional invasive plant removal and replanting native species. To date the habitat enhancement has shown success, providing valuable habitat for wildlife, increased growth of native vegetation, and a natural benefit to the local community.

7. CREER, S.L. and PARKER, V.T.

Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132

Sub-Family Reunion! Will the North American *Arbutus* (Ericaceae) be Invited?

The Arbutoideae subfamily contains five genera, and is 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 are testing this finding by examining two non-coding regions of the chloroplast genome. From these regions, we will construct a cpDNA phylogeny to compare with that of Hileman's. We have used most of the Hileman vouchers, along with several additions, and have extracted and amplified cpDNA from nine individuals within the Arbutoideae, representative of each genus. This study will confirm previous research supporting the non-monophyly of *Arbutus*, which will require recognition of the North American species of *Arbutus* as a distinct genus.

8. DARRACH, M.[1], BARBER, A.[2], BERGSTROM, E.[3], and MILLAR, C.[4]

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Rare Plants and GLORIA Climate Change Monitoring in the Alpine Sweetwater Mountains of Mono County, California

The GLORIA climate monitoring program is a global effort aimed at documenting vegetation changes in climate-sensitive alpine settings using permanent monumented plots installed across an elevational gradient. Several GLORIA stations are established in the California Sierra Nevada target region. Now included is a newly-established station in the Sweetwater Mountains of Mono County. These mountains comprise a suite of alpine summits that offer the opportunity to observe the temporal progression of climate-induced modifications to vegetation on a unique geological substrate. The alpine Sweetwater Mountains are unusually botanically diverse and harbor a regionally significant concentration of rare vascular plants. The novel geologic setting of geothermally argillized acidic volcanic rocks allows for the presence of a robust clay component in soils throughout the alpine portion of the range in a setting where typical surficial rock weathering processes are kinetically limited. This clay component, with attendant enhanced water retention capacity, provides for an alpine flora that is of importance for understanding how vegetation responds to climate modification in this unusual setting. The Sweetwater Mountains vegetation presents challenging conservation issues from both direct human impacts and indirect anthropogenic climate-induced perspectives.

9. ENGLAND, J.
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Vascular Flora of the Upper Rock Creek Watershed, Eastern Sierra Nevada, California

The goal of my project is to inventory the vascular plant taxa of the upper Rock Creek watershed in the eastern Sierra Nevada and produce a voucher-based checklist of species. Fieldwork is underway to survey the watershed throughout the growing season and collect voucher specimens for each taxon encountered. The first of two seasons of fieldwork has been completed, with 601 samples collected in 2012. The study area covers ca. 30 sq. miles, with an elevation range of ca. 7000–12000 ft., located within the Inyo National Forest in Mono and Inyo Counties. Although a large number of historical vouchers exist, sampling of the watershed to date has been uneven and significant portions have never been inventoried. My study will address this knowledge gap by providing widespread sampling. My study is important because (a) the south-to-north orientation of the upper Rock Creek watershed is atypical for the eastern Sierra Nevada (usually west-to-east), creating potentially rare habitats, (b) a contemporary, georeferenced inventory of the vascular plant taxa growing throughout the watershed will be developed and published, which greatly extends earlier exploration, (c) the existence of a large number of old collections allows for comparisons with the present-day flora (both native and non-native species) in context of ongoing rapid climate change and its particular threat to high-elevation plant taxa, (d) the inventory will provide a point-in-time reference for future researchers of alpine taxa, and (e) the findings will better inform the U.S. Forest Service in management/conservation decisions.

10. FARMER, J.[1], LILITTHAM, T.[1], WORMSER, V.[1], RODDY, A.B.[1], GUILLIAMS, C.M.[+1,2], and DAWSON, T.E.[1]
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Independent Evolution of Vein Density in Flowers and Leaves: Support for Developmental and Physiological Modularity of Vegetative and Reproductive Functions

Since the first flowering plants appeared in the understories of wet, tropical forests over 100 million years ago, they have diversified and spread to dominate ecosystems globally. Angiosperm success has been traditionally attributed to specialized plant-pollinator interactions and, more recently, to increased capacity for water transport to leaves. In particular, increased leaf vein densities (vein length per surface area) increased rapidly among early angiosperms. Innovations in floral physiology leading to reduced water requirements may have led to more efficient and less costly pollinator attraction and may have also contributed to angiosperm expansion from everwet environments into hotter and drier climates. Because of its importance to the evolution of leaf water balance, vein density (Dv) may have been critical to the evolution of floral water balance. Here we hypothesized that (1) flowers have lower Dv than leaves, indicative of more hydraulically efficient pollinator displays, (2) more recently derived angiosperm flowers have lower Dv than basal species, consistent with increased hydraulic buffering between reproductive and vegetative organs, and (3) selection for increased leaf Dv and decreased floral Dv has resulted in independent evolution of Dv throughout the plant bauplan [body plan or "blueprint" of essential body elements]. Results from our survey of 124 species from 48 families, predominantly from Northern California, support our first and third hypotheses and suggest that flowers and leaves are developmentally and possibly also physiologically modular. This work may be useful in guiding future studies on floral water balance and linkages between floral morphology and function.

11. 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. Thus far we have identified

four fundamentally different exine patterns: 1) a *Leptodactylon* type, found in the perennial taxa plus the night-blooming taxa (*L. arenicola, L. bigelovii, L. dichotomus, L. pungens, L. californicus)*; 2) a bellus type (*L. bellus*); 3) an orcuttii type (*L. orcuttii, L. dianthiflorus*); and 4) a demissus type (*L. demissus, L. killipii*). 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*.

12. FRANCIS, R. and HATFIELD, C.
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Assessing Ecological Integrity of Montane Sierra Nevada Meadows across a Disturbance Gradient

Meadows in the Sierra Nevada are typically defined as wet, heterogeneous communities that are often biodiversity hot spots. These meadows not only provide a variety of resources for wildlife but also filter and store snowmelt, providing a sustained water source for both wildlife and Californians. Combinations of meadow importance and degradation through human disturbances have led resource managers and scientists to implement restoration efforts to improve hydrologic connections and biotic health within these meadows. The goal of this research is to assess the relationship between the plant community and the hydrologic status of montane meadows along a disturbance gradient in the Sierra Nevada. Less-disturbed meadows in the Tuolumne watershed will provide a reference for assessing the ecological integrity of restored and disturbed meadows in the Stanislaus watershed. We are documenting soil moisture and plant community composition, emphasizing species diversity and invasive species extent, across this disturbance gradient. Preliminary results suggest less disturbed meadows have lower patch heterogeneity in soil moisture and species richness compared to disturbed and restored meadows. Results also indicate disturbed sites have more invasive and non-native species as they tend to have more patches with lower moisture values. Further analysis will indicate relative abundances of non-native and invasive species, plus overall community composition changes between both meadows and patches to allow for a better understanding of the ecological status of these sites. Understanding how meadow plant communities correlate with hydrologic changes and site status is important for current and future management decisions for restoration and conservation initiatives.

13. GRACE, C.L. and PARKER, V.T.
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Does *Pinus radiata* or its Ectomycorrhizal Counterparts Invade Northern Coastal Scrub First?

Ectomycorrhizal fungi spore banks are of particular importance to plant invasion dynamics because of their propensity to facilitate invasive plant establishment and, in some systems, bring about dynamic vegetation shifts. Specifically, ectomycorrhizal fungi have been shown to be critical to the establishment of *Pinus* spp. in non-native environments. The establishment of *P. radiata* in the northern California coastal scrub plant communities is of particular concern and interest because the invasion of these diverse communities, which host primarily arbuscular mycorrhizae, may be facilitated by ectomycorrhizal fungi via spore dispersal and spore banks. This research examines this process, assesses what species of ectomycorrhizal fungi associate with *P. radiata* in various parts of the coastal scrub, and determines whether spore banks aid in *P. radiata* recruitment. Spore banks of soil samples taken along a gradient starting in a stand of *P. radiata* and ending fifty meters into the scrub will be assayed by diluting them with a sterile sand-soil mixture, splitting them into small “cone-tainers” (planting tubes), growing *P. radiata* seedlings in them for 6 months, and then sequencing the resultant ectomycorrhizal root tips. In the field, *P. radiata* seedlings will be planted under a mature pine stand and in old-growth scrub with and without soil taken from the pine stand. The findings of these studies will further develop understanding of both spore bank contents and function. Furthermore, they will illustrate the nature and degree of spore bank facilitation of the invasion process by non-native species such as *P. radiata*.

14. GROSSENBACHER, D.[+1] and TAYLOR, D.W.[2]
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Joseph W. Congdon – The Ivy League Botanical Export to California

Joseph Whipple Congdon (1834-1910), a lawyer by trade, contributed significantly to early botanical exploration in California, particularly in the Yosemite region, where he resided in Mariposa from 1882 until 1905. Congdon was born in Pomfret, Connecticut and graduated Brown University with the class of 1855. He was admitted to the bar in Providence, Rhode Island in 1860. He served a term in the Rhode Island legislature for 1878–79. His 1855 publication, as Senior classmen, of the "Analytical Class-Book of Botany," coauthored with his aunt, [Francis Harriet Whipple Green McDougall, carrying the epigram "Science is the only interpreter of Nature"] antedated by two (2, count them, two) years the first edition of the classic Class Book of Botany, by Asa Gray (often considered the standard early textbook for botany). Congdon correctly diagnosed the re-discovery of the long-lost *Shortia galacifolia* (Diapensiaceae), a relict Appalachian herb that had been sought in the field, without success, by Gray, after Gray had seen a scrap of a specimen in Paris in 1838. Congdon discovered over ±30 new species of plants, many of which are rare and endemic to the Yosemite region, including *Lewisia congdonii, Eriophyllum congdonii, Garrya congdonii, Lomatium congdonii, Monolopia congdonii*, and others. Congdon's collection in Yosemite National Park form an important record of that flora: he was the first botanist to collect the rare Yosemite bog-orchid (*Platanthera yosemitensis*) in 1895, a species that was not recognized as distinct until 2007. The genus *Congdonia* (Crassulaceae), collected only once, 100 years ago, has not been seen by any living person. *Cirsium praeteriens*, collected by Congdon in the salt-marsh bordering Palo Alto, has not been seen since 1901 and is presumed extinct.

15. HOLLAND, R.F.[1], WITHAM, C.W[2], and VOLLMAR, J.[3]
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Mapping Great Valley Vernal Pool Distribution in the 21st Century

We mapped vernal pool distribution within a 21.4 million acre area surrounding the Great Valley from 2005 National Agricultural Imaging Program (NAIP) county photomosaics using ESRI ArcMap 9.x in a double-blind protocol. Each mapped polygon was scored for classes of habitat cover, habitat density, habitat diversity, disturbance cover, and disturbance intensity. We ground-truth sampled 25% of the polygons we drew: the double blind protocol lowered our error rate to about 2 percent. We mapped 807,820 acres of vernal pool landscape in 1,909 polygons and present various tabular summaries of polygon number and acreage by recorded attribute. We overlaid our results with a map of Core Recovery Areas, finding 452,012 acres within the CRAs, and an additional 120,137 acres immediately contiguous to the CRAs. We remapped Placer, Sacramento, and Merced counties using 2010 NAIP imagery to calculate rates of habitat loss and gain in the five years since the Vernal Pool Recovery Plan was released. Direct losses in these three counties totaled 9,515 acres (~1,900 acres/year), primarily converted to orchards and vineyards. These losses are partially off-set by newly constructed habitat. For example, in Sacramento County 1,261 acres of low cover, low density natural habitat were converted to high cover, high density mitigation banks, and 838 acres of newly built habitat appeared on lands formerly under intensive agriculture.

16. JANG, T., GUILLIAMS, C.M.[+], and BALDWIN, B.G.
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Phylogenetic Relationships in the Combseeds and Grappling-Hooks (*Pectocarya* and *Harpagonella*, Boraginaceae)

Pectocarya and *Harpagonella* are putative 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 the first phylogenetic study of these two genera. Our primary goals were to evaluate the monophyly of each genus as well as the monophyly of sections of *Pectocarya*. We gathered DNA sequence data from the internal and external transcribed spacer regions of the nuclear genome as well as *psb*J-*pet*A, *rpl*16, *trn*K-*rps*16, and *trn*L-*trn*F regions of the chloroplast genome. Our analyses confirm the close relationship between *Pectocarya* and *Harpagonella*, with these genera recovered together in a strongly supported clade. A monophyletic *Harpagonella* is nested within *Pectocarya*, however, rendering the latter paraphyletic. *Pectocarya* sect. *Pectocarya* is monophyletic, but sect. *Gruvelia* is non-monophyletic. Within *Harpagonella*, we find strong support for two taxa, and based on the strength of the evidence, *H. palmeri* var. *arizonica* may warrant recognition at the species level. Within *Pectocarya*, at least three long-distance dispersal events are necessary to explain the observed biogeographic patterns based on the phylogeny, a relatively large number given the size of the genus.

17. JORDON-THADEN, I.[1,2] and KOCH, M.A.[2]

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[2]University of Heidelberg, Center for Organismal Biology, Biodiversity and Plant Systematics, Im Neuenheimer Feld 345, 69120 Heidelberg, Germany

Evolutionary Genetics of Alpine Mustards, *Draba* L. (Brassicaceae): Exploration of Polyploid Plant Speciation in the North American Cordillera

The research presented here aims to explore questions regarding speciation processes in high arctic and alpine polyploid plant species. The study system is *Draba* L., (Brassicaceae), a highly diverse polyploid complex distributed in the arctic, subarctic, and alpine habitats. These habitats are in immediate danger for destruction due to the effects of global warming. Alpine species are dependent upon annual snowfall and respective gradual snow-melt during the warm months. The accelerated melting of glaciers and the instability of the soil threaten their habitat. Continuation of research with *Draba* can shed light on the formation of species under environmental stresses, such as glaciation cycles and habitat fluctuations, as well as the evolution of traits such as apomixis, polyploidy, and perennial life-history as survival mechanisms in harsh arctic and alpine ecosystems. There are more than 96 *Draba* species found within the North American Cordillera, with many of them found in California. The species chosen for initial investigation is *Draba oligosperma* Hook, few-seeded *Draba*. It has an unusual distribution for *Draba*, found from Alaska to Arizona. Preliminary results indicate it might be an allopolyploid, and is an apomictic. Has this allopolyploid apomict formed multiple times, or only once? We propose to identify the possible parents of the allopolyploid, and understand the role of apomixis in speciation. We will use NGS methods (next-generation sequencing) of genome skimming at the individual level and GBS (Genotyping by Sequencing) at the population level. Focus on the conservation of the *Draba* habitat will underlie all aspects of this research.

18. JURJAVCIC, N.[1], KEEVER, M.[1], and STENSHOEL, K.[2]

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Population Variability of Northern Adder's Tongue and Adaptive Management Implications: Lessons from Oregon

As part of re-licensing for Eugene Water & Electric Board's Carmen-Smith Hydroelectric Project, Stillwater Sciences conducted a five-year, annual survey of *Ophioglossum pusillum* (northern adder's tongue). Information gained from this study of annual variability will be utilized to inform long-term management of the species. In Year 1, permanent belt transects were established such that data collected and variables analyzed between years could be compared across a controlled area. Several discrete auxiliary patches were also surveyed and mapped. Variables collected include number of individuals (fertile

and vegetative), plant associates, hydrologic characteristics, and soil information. Climatic data (snowpack, precipitation, and temperature) was also collected each year and in Year 2, groundwater wells were installed and monthly readings of general hydrologic conditions and depth to groundwater were recorded. This summer, the fifth and final year of monitoring was conducted at the site. Results indicate a fluctuation in population size from year to year; the variability is most pronounced within the understory of a *Carex angustata* patch (along the transect) as compared to patches located off the transect in areas with more diverse plant associates and less canopy cover. Variability likely is largely explained by *Ophioglossum pusillum*'s unique biology; however, annual differences in precipitation and duration of inundation at the site – and resultant soil moisture – also contribute to the overall variation in population size. This information will be utilized in creating an adaptive management strategy for the species.

19. KELLEY, D.[1], MACDONALD, R.[1], and TALLEY, S.[2]
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A Detailed Comparison of the Vegetation Growing during Hydrological Year 2010-2011 in Natural and Constructed Vernal Pool Habitat in the Tuscan Preserve, on the Wurlitzer Ranch, Northern Butte County, California

We tested a monitoring method to document the extent (acreage) and composition (all species, each with rated cover value) of wetland vegetation types within both Natural (NAT) and constructed vernal pools (CVP). The constructed habitat was prepared in 1993-1995. We sampled ponding weekly in all units. Several times during the season we used GPS to record ponded perimeters. Experienced botanists identified "patches" of similar vegetation (GPS recorded perimeters). The vegetation was sampled using the standard survey procedure developed by Barbour, *et al.* for their statewide vernal pool studies. Our data match up with the statewide dataset (now in its tenth year, with 5000 samples on file). The vegetation was sampled in 10 square-meter plots (GPS relocatable). The compositional data are statistically arranged into a master Vegetation Table. The location and extent of the ponding perimeters and vegetation patches are mapped onto ARCMAP software, and printed out. The result we produced reveals that smaller NAT units consist primarily of wet grassy edge communities. Larger NAT units contain typical Northern Hardpan vernal pool bottom vegetation. The CVP units follow the same pattern. The vegetation types we document show great similarity in NAT and CVP. The ponding perimeters allow a comparison between prolonged ponding and the type of vegetation which develops. 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.

20. LAWRENCE, T. and DATWYLER, S.
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Testing the Hypothesis of Allopolyploidy in the Origin of *Penstemon azureus* (Plantaginaceae)

Polyploidy has played a significant role in the evolutionary history of many groups of plants, but the phylogenetic relationships among polyploid species remains difficult to untangle because of both incomplete lineage sorting and reticulate evolution in allopolyploid species. *Penstemon* sect. *Saccanthera* (Plantaginaceae) contains 24 species of which four are documented as polyploids (4X, 6X, and 8X). The purpose of this study is to test the hypothesis of an allopolyploid origin of *P. azureus*, a hexaploid species. Previous studies have suggested that *P. azureus* is an allopolyploid derivative of *P. parvulus* (4X) and *P .laetus* (2X). Multiple accessions from across the geographic ranges of *P. azureus*, and six closely related species (*P. laetus* [2X], *P. filiformis* [2X], *P. heterophyllus* [2X, 4X], *P. parvulus* [4X], and *P. neotericus* [8X]), are being sequenced for two chloroplast intergenic spacer regions (rpl32-trnL, rpoB-trnC) and two nuclear loci (Adh and NIA). Parsimony and Bayesian analyses of the combined cpDNA dataset indicate that species-level patterns are not apparent within the species complex. However, the cpDNA data show a pattern consistent with the geographic localities of collections, suggesting extensive hybridization and introgression within the species complex. Parsimony and Bayesian reconstruction of the individual nuclear datasets were subjected to network analysis using the program PADRE. The preliminary Adh analysis supports *P. heterophyllus* (2X, 4X), *P. laetus* (2X), and *P. parvulus* (4X), as possible progenitors of *P. az-*

ureus. Additional taxon sampling and further analysis of the NIA dataset will provide additional evidence and support for potential progenitors of *P. azureus*.

21. LEE, D., GUILLIAMS, C.M.[+], and BALDWIN, B.G.
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A Comparative Study of Traditional and Geometric Morphometric Approaches, with a Focus on the Prickly-Nutleted Popcorn Flowers (*Plagiobothrys*, Boraginaceae)

Plagiobothrys (Boraginaceae) is a predominantly New World genus of 87 annual and perennial taxa. Nutlet morphology has received considerable attention from popcorn-flower taxonomists and has historically informed species circumscription. Molecular analyses suggest that North American species of *Plagiobothrys* section *Allocarya* possessing relatively large nutlets with stout prickles (*P. acanthocarpus*, *P. austiniae*, *P. greenei*, *P. hystriculus*) form a monophyletic group. Here we examine species circumscriptions in this group by gathering morphometric data from the nutlets of these taxa using two different approaches: traditional and geometric morphometrics. Traditional morphometrics entails the use of measurements such as lengths, angles, and areas. Geometric morphometrics attempts to capture shape data of target features, with size explicitly removed from the measurements. Both approaches are amenable to standard multivariate statistical analyses such as principal components analysis (PCA) and canonical variates analysis (CVA). Beyond assessing species circumscriptions, this study also compares the apparent strengths and weaknesses of these morphometric techniques when applied to a common dataset. Both approaches support present taxonomic circumscriptions in the target clade. Preliminary results indicate that geometric morphometrics yields slightly better groupings of species in the PCA and CVA when compared to traditional morphometrics. However, traditional morphometric analyses have the advantage of operating upon logical and easy to interpret variables such as those employed in standard dichotomous keys (e.g., nutlet length). Therefore, traditional morphometric analyses may be more useful than geometric morphometric analyses in certain instances, e.g., when attempting to isolate standard morphological characters that could be used to discriminate one taxon from another.

22. LI, G.[1], CARTER B.[2], and GUILLIAMS, C.M.[+1]
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Evolution of Leaf Morphology in *Ribes* (Grossulariaceae), Section *Calobotrya*, with a Focus on Species Delimitation in *Ribes malvaceum*

Ribes, commonly known as gooseberries and currants, is the only genus in family Grossulariaceae. The genus has about 150-200 species of perennial shrubs distributed primarily in eastern Asia, western North America, and the South American Andes. Recent phylogenetic work on the genus has indicated that several of the subgenera in this genus are monophyletic, including sect. *Calobotrya*, which is made up primarily of Californian currants. However, one study suggests that some species (for example, *Ribes malvaceum*) may not be monophyletic. Here, we use morphometric data to examine morphological variation within and among *Ribes malvaceum,* as currently circumscribed, and its close relatives. We measured 17 leaf characters for 99 specimens and 8 floral characters for 72 specimens using ImageJ and high resolution photos of herbarium specimens. The floral and leaf datasets were analyzed using regression trees to explore variation and assess the relative utility of these characters for species delimitation. The analyses produced results that indicate that leaf data are less useful than floral data in delimiting currently defined species across sect. *Calobotrya*. However, leaf data may be useful within narrowly defined groups such as the clade containing *R. malvaceum*. These results will be used in ongoing studies of leaf and flower evolution in *Ribes*, especially with respect to placing *Ribes* leaf fossils accurately in a phylogenetic context.

23. McCUBBIN, L.L. and PARKER, V.T.
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Got Fog? Functional Leaf Traits of *Arctostaphylos* (Ericaceae) in Contrasting Environments

Functional leaf traits impact a species' fitness for a given set of environmental conditions. Ecological water resource strategies of plants can be predicted using functional leaf traits such as specific leaf area (SLA), stomatal pore area per leaf area index (SPI), and theoretical hydraulic conductivity (THC). Coastal California is an ideal area for climate change and functional leaf trait studies because climate change will be rapid due to the strong climatic gradient associated with fog and the mountainous terrain. Fog plays an important role in the water systems of many endemic plants along the coast and likely dictates a plant's water resource strategy which can be represented using functional leaf traits. *Arctostaphylos* (Ericaceae) is a model genus because there are many restricted endemic species in central California. Coastal *Arctostaphylos* species appear to be fog dependent and because of their endemism and rarity, predicting their responses to potential shifts in climate and breakdown of fog is of critical conservation concern. Only kilometers away from coastal fog influences, closely related interior species are subject to summer drought and high temperatures. Measuring various functional leaf traits of closely related species along the fog gradient will test the hypothesis that functional leaf traits are highly correlated with local climatic conditions.

24. McDADE, L.[1], WALLACE, G.[2], and CRAWFORD, J.[3]
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Graduate Course on Preparing Rare Plant Conservation Plans at Rancho Santa Ana Botanic Garden Serves as Model for Other Universities in California

Rare plant conservation plans are important management tools; they can summarize existing information on a given taxon, point to additional data that are necessary to document the biology and conservation status of the plant in question, and provide recommendations that can subtend management decisions by agencies and individuals. At Rancho Santa Ana Botanic Garden (RSABG), we teach a course as part of the graduate curriculum that guides students through preparation of such a plan. Beginning with selecting a plant that is listed by CNPS as 1B (i.e., rare, threatened or endangered in California and elsewhere) but is not officially listed by either the state or the federal government, students are guided through acquiring the skills necessary to undertake these kinds of projects. Perhaps most importantly, they are strongly encouraged to seek and establish working partnerships with the federal, state and local agencies and NGO stakeholders that are instrumental to their search for relevant data. As illustrated by our poster, students undertake further research (e.g., field work to document up-date information on all known occurrences and sometimes to seek others based on habitat and / or associated species) and go on to publish their conservation plans, usually in the Occasional Publications series of RSABG. The plans feed new, high quality data to the California Natural Diversity Database (CNDDB) and provide guidance to those responsible for managing our rare plant resources. CNPS will promote this course model for other universities to adopt throughout California to support student skills-training and rare plant conservation.

25. MILLER, D.G., HATFIELD, C.A., and HOLDEN, R.M.
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Colonization of *Arctostaphylos* Host Plants by *Tamalia* Galling Aphids during Succession Following Wildfire

Fire is a major mode of disturbance maintaining chaparral ecosystems in California. The heat and smoke characterizing fires act to stimulate germination of manzanita (*Arctostaphylos)* shrubs, which constitute a major element of the chaparral. As succession proceeds in the wake of fire, young shrubs are colonized first by gall-inducing *Tamalia* aphids, followed closely by congeneric inquiline (gall-invading) aphids. Following a 1999 wildfire at the Big Chico Creek Ecological Reserve, we have tracked the appearance of young plants and their colonization by *Tamalia* aphids beginning in 2008. We are currently evaluating a

hypothesis of minimum dispersal distance to predict relative rates of host plant colonization by gall-inducers and inquilines. Results suggest inquilines can disperse and colonize newly-available *Arctostaphylos* host plants efficiently, in synchronization with their gall-inducing host aphids. Our long-term ecological study has implications not only for insect-plant dynamics, but also for patterns of evolutionary diversification in aphid gall-inducer and inquiline lineages.

26. PETERSON, N.B. and PARKER, V.T.

San Francisco State University, Thornton Hall 323, 1600 Holloway Avenue, San Francisco, CA 94132

Predators and Mutualists: Rodent Caching and Post-Fire Recruitment of *Arctostaphylos* Species

Understanding seed bank structure and the processes that shape them are key to understanding the ecology, evolution, and management options of fire adapted chaparral systems. This research is investigating the relationship between rodent caching and survival of *Arctostaphylos* seeds after a fire. Rodents have long been seen as predators of *Arctostaphylos* seed, but recent studies have suggested that they are mutualists as well. Roughly two thirds of *Arctostaphylos* species die during a fire event where the remaining one third has the ability to resprout after a fire. Both types rely on seed banks to maintain their long term populations. Seed germination is stimulated by the fire. However, extreme temperatures in high intensity fires also cause significant seed mortality in the top layers of the soil. Rodent behavior of seed caching helps seeds reach depths that help them survive high intensity fires at a greater rate than they would by other processes. To discover how *Arctostaphylos* seeds tolerate heat in the context of a seed bank, experiments will be done in the lab using an infra-red heating block placed above an artificial soil seed bank. Seeds will be placed at different levels in the seed bank and temperatures will be monitored at those levels. After each treatment the seeds will be tested for viability. We will be investigating the relationship of surface temperature, seed depth, and seed survival. Additionally we will be looking at the ability of seed caches to reduce the flow of heat, potentially increasing survivability of seeds in caches.

27. ROSENGREEN, L.T. and LAMBRECHT, S.C.

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Why Are Two Colors Better Than One? Exploring the Physiological Ecology of a Flower Color Polymorphism in True Baby Stars (*Leptosiphon bicolor*, Polemoniaceae)

Flower color polymorphisms, where a single population consists of individuals with two or more different flower colors, are not an uncommon occurrence within California's flora. What role does selection play in maintaining these polymorphisms? *Leptosiphon bicolor* is a small winter annual common in many lower elevation areas of California. Populations of *L. bicolor* are often polymorphic for flower color, consisting of a mixture of white-flowered and pink-flowered individuals. In a field study of two polymorphic *L. bicolor* populations in central California's Diablo Range, we found that peak flowering for white morphs was 7 days earlier than for pink morphs. Using seeds collected from near one of our study populations, we grew individuals under controlled greenhouse conditions. White morphs began flowering on average 7.4 days earlier (counting from the date seeds were sown; $p<0.001$), than pink morphs. By flowering earlier, white morphs may experience more mesic conditions during peak reproduction than pink morphs. We suspect that pollinators are not a major selective agent in this system. *L. bicolor* is known to be highly self-compatible and in 86 hours of field observation, pollinators were never seen visiting focal flowers. We are preparing an additional greenhouse experiment to examine if morphs may differ in specific leaf area, reproductive success or $\delta^{13}C$ water-use efficiency when grown under varying levels of experimentally induced drought stress. In combination, our work should provide a better understanding of the evolutionary and ecological factors that maintain flower color polymorphisms in *L. bicolor* and, more broadly, in related taxa.

28. RYAN, S.[+] and SIMPSON, M.G.

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Molecular Phylogeny and Character Evolution of *Fritillaria* Subgenus *Liliorhiza* (Liliaceae)

Fritillaria subgenus *Liliorhiza* (Liliaceae) is an attractive group of mostly North American geophytes whose evolutionary history has not been fully explored. A majority of species are distributed in central and northern California, several are CNPS listed, and most have restricted geographic distributions. Abundant synonymy and inconsistent species delimitation need to be addressed in order to make appropriate conservation decisions regarding rare taxa in the group. The most extensive molecular phylogenetic study to date included only 12 of the approximately 20-25 species in the subgenus and showed little interspecific resolution, probably due to recent rapid speciation. The two most recent morphology-based classifications need to be supplemented with further morphological and molecular study. Our study aims to determine phylogenetic relationships of all described taxa in the group, to evaluate the two most recent morphological classifications, evaluate the validity of dubious species and varieties, and to explore morphological character evolution. To accomplish these goals, we have collected several specimens per taxon, sequenced the chloroplast rpl16 intron and nuclear ribosomal ITS and ETS. We will present the results of several molecular phylogenetic analyses and ancestral character state reconstructions of bulbs, floral characteristics, and leaf arrangement.

29. SANVILLE, C. and HAYASHI, B.
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Rare *Erythronium* Species on Green Diamond Resource Company (GRDCo) Property: Addressing Problematic Characteristics Present in Northwest California Populations

Two *Erythronium* (fawn lily) species encountered on GDRCo property with a California Rare Plant Rank (RPR) of 2.2 are *Erythronium revolutum* and *E. oregonum*. Although some populations exhibit diagnostic characteristics, others exhibit traits intermediate between the species and/or between the endemic but not rare *E. californicum*. While *E. oregonum* has white tepals, tendency towards albinism in *E. revolutum* becomes more pronounced toward the south end of the range in coastal northern California (Applegate, 1935). There are few element occurrences (EOs) of *E. oregonum* rated as good or better in the California Natural Diversity Database (CNDDB); however, *E. revolutum* is close to the threshold for status review. Protection measures will no longer be required if the RPR is adjusted downward. Because of the difficult nature of making a conclusive identification, it is likely that some of the occurrences of *E. revolutum* are *E. oregonum*. There are overlapping EOs of both species and considerable uncertainty regarding identification. The identity of these species needs to be resolved prior to a status review. GDRCo botanists collected flower and leaf samples from fifteen *Erythronium* populations in 2011. Flowers were disassembled and used to conduct a morphometric analysis focused on diagnostic characters, following methods used by others investigating *Erythronium* species. Leaf samples were dried in silica and will be used in a complimentary genetic analysis. The authors hope this initial investigation garners interest by others familiar with these species and a collaborative effort can be made to assess all known populations in California.

30. SCHNEIDER, R.S.[+1,2] and BOYER, K.E.[1]
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Investigating Causes of Rarity in an Endemic Wetland Thistle

The urbanized San Francisco Estuary contains 90% of California's remaining coastal wetlands, as well as many invasive and rare species. One rare species, the Federally-listed Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), is restricted to two populations in which the invasive perennial pepperweed (*Lepidium latifolium*) has an increasing presence. This research explores why the Suisun thistle is rare and which management actions would be appropriate to protect it. We investigated two potential limitations: competition with pepperweed, and intrinsic constraints during specific life history stages. To address competition with pepperweed, a removal experiment was conducted and plant and soil responses assessed. To identify key life history stages, seed set, dispersal, and germination were quantified under various environmental conditions. Monthly pepperweed removal increased cover of native species; Suisun thistle growth and recruitment showed positive non-significant trends. Soil salinity increased following

pepperweed removal, indicating that the invasive may be modifying its soil environment. Seed set varied by location and with the presence of a larval seed predator. In the lab, seeds germinated readily with an inverse salinity response. Wind dispersal was limited, though the potential for water dispersal exists, as seeds remained viable after two weeks in tanks. This research will allow managers to protect the Suisun thistle during vulnerable life stages and in critical locations, and will inform restoration plans for Suisun Marsh with information on a sensitive but understudied species.

31. SIKES, K.[1], TAYLOR, S.[1], EVENS, J.[1], and IKEDA, D.[2]
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Vegetation Assessment and Ranking of Meadow and Fen Sites Reflecting Watershed Condition in the Plumas and San Bernardino National Forests, California

The California Native Plant Society working in collaboration with the USDA Forest Service assessed the vegetation and meadow habitat conditions in the San Bernardino National Forest (SBNF) and the Plumas National Forest (PNF). Field sites were selected with records of rare plants, invasive plants, or meadow/fen habitats. In both Forests, data were collected in two adjacent watersheds that differed in the Forest Service's Watershed Condition ratings. A primary project objective was to provide specific landscape-level data to allow the Forests to strategically prioritize future land management activities including restoration concerning plant communities. In the SBNF, 18 meadow sites were assessed with 3 new vegetation types sampled. Both watersheds had on average 9 different meadow community types and an average stream condition score of 92%. The Big Bear Watershed (BBW) had a comparatively higher seral score by functional group (meadow community type) than the Deer Creek Watershed, and the BBW sites assessed had relatively lower non-native plant cover. In the PNF, 12 meadow/fen sites were assessed with 2 new vegetation types sampled. Both watersheds had on average 8 different meadow community types and an average stream condition score of 86%. The Bucks Creek Watershed had a comparatively higher seral score by functional group than the Silver Creek Watershed and both had very low non-native plant cover. With regard to Wetland Prevalence Index (WPI), the PNF had an average value of 1.3 (saturated soils) and the SBNF a value of 2.3 (less saturated soils).

32. SIMONO, S.
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Where in the World is *Silene californica*? The Mysterious Vanishing Cabinet of Taxonomic Revisions

In 2005 a new taxonomy for the genus *Silene* in North America was published and became widely accepted. New combinations were created that lumped the red flowered *S. californica* into *S. laciniata* as *S. laciniata* subsp. *californica*, while recognizing the segregate *S. serpentinicola*, a red flowered taxon described in 2004 and endemic to a small area of the Smith River near Gasquet, Del Norte County. Based on observations of flower color, floral anatomy, and plant morphology from my field and herbarium research in northern California, circumscriptions of *S. laciniata* and *S. serpentinicola* leave many populations of red flowered *Silene* undescribed. Molecular data from a recent study does not support a close relationship between the infraspecific groups now recognized in *S. laciniata* but the study does not define an identity for the former *S. californica* nor the relationship of *S. serpentinicola* to the other California taxa. My preliminary research suggests that *S. californica* is a valid species that may prove to be part of a relationship that includes the populations known as *S. serpentinicola* and the pink flowered *S. hookeri,* and not a close relationship to *S. laciniata*. Populations have been sampled throughout northern California for morphological and molecular data to help define the taxonomic identity of, and more completely describe, the red flowered *Silene* in California.

33. SLAKEY, D.
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The California Native Plant Society's Rare Plant Treasure Hunt: Promoting Rare Plant Conservation through Citizen Science

California is a botanically rich state, and its rare plant flora is no exception, with nearly 2300 CNPS-ranked rare plants. The California Natural Diversity Database (CNDDB) tracks over 1600 of these rare plants in a geographic format; over 34,000 rare plants occurrences have been mapped to date. Maintaining current records of those occurrences is extremely challenging: nearly half (47%) of the CNDDB occurrences are considered historical (last documented 20+ years ago). A number of threats have reduced or eliminated many occurrences, and remote portions of the state remain under-surveyed, so more current data are needed for effective conservation. To address these issues CNPS formed the Rare Plant Treasure Hunt (RPTH), a citizen-science program in which volunteers gather data on California's rare plants while learning about rare plant conservation. CNPS staff, chapters, and other volunteers (consultants, conservation groups, other botany enthusiasts) lead trips to search for historical rare plant occurrences and potential rare plant habitat, then submit their findings to the CNDDB. To date, data on over 1450 occurrences have been submitted to the CNDDB, over 500 of which have come from northern California. We provide summary data on the first three years of the project, and highlight different approaches to the project employed by CNPS Chapters. Data gathered on the RPTH have been particularly helpful in the rare plant status review process and have resulted in rank changes for two Northern California plants so far. We also discuss future directions and goals for the RPTH.

34. SMITH, H. and PATTERSON, R.
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Cleaning up *Navarretia* (Polemoniaceae) to One Lineage per Taxon

Our research focuses on resolving the relationship between two species in Shasta County with the intent of understanding the genetic lineages and evolutionary significance of observed variation. *Navarretia intertexta* and *N. propinqua* co-occur in vernal pool and moist seasonal environments. Preliminary data suggest that allopolyploidization in *N. propinqua* may have occurred multiple times, possibly with *N. intertexta* serving as the paternal parent in some cases and the maternal parent in other cases. In most populations the molecular data support *N. intertexta* as the paternal and *N. saxamontana* the maternal parent for *N. propinqua*. Sequencing of nuclear and chloroplast DNA from plants gathered in Shasta County shows an unexpected pattern that appears confined to this region. The *intertexta* chloroplast type occurs in plants that resemble *N. propinqua*, while the *propinqua* type occurs in plants that resemble *N. intertexta*; this is opposite of expected when compared to other regions inside and outside of California. We have collected from eight populations and will be comparing our data to plants outside Shasta County. This will provide the information to determine the evolutionary history of Shasta County *Navarretia* species.

35. STEERS, R., CASWELL-LEVY, C., and SPAULDING, H.
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Dwarf Oaks of the Marin Headlands

Dwarfism in trees can result from numerous causes. For example, the pygmy forests of Mendocino County, California are composed of dwarfed conifers whose growth is limited by acidic soils. Montane environments, like the sub-alpine, are also associated with dwarfed trees, such as "krummholz," which are genetically controlled, and "cripple-trees," which are morphologically similar to krummholz but are climatically controlled. In coastal areas, salt spray can prune trees resulting in dwarfed plants. Here we report on the morphology and distribution of dwarfed oak trees found among the coastal slopes of the southern Marin Headlands where tree-less communities, like grasslands and coastal scrub, dominate the landscape. Intermixed in the grassland and scrub are several oak species that were mapped and measured. Approximately 500 patches of oaks were mapped; 48% of the patches contained *Quercus wislizeni*, 27% contained *Q. agrifolia*, 21% contained *Q. chrysolepis*, 3% contained *Q. kelloggii*, 6% contained *Q.* x *morehus*, and < 1% contained *Q.* x *chasei*. Mean height of the oak patches mapped was 1.81 m (± 0.07 m SE)

with the shortest patch measuring 0.28 m and the tallest patch measuring 10.4 m. When the oak patches were overlain on a geologic map they were found to be closely associated with chert-derived soils from the Cretaceous-Jurassic-Franciscan complex. It is unclear how much the soil properties of the chert, the high winds, or the exposure to salt-spray contribute to the stunted growth form of these various oak species.

36. SYKES, D. M., SNIDER, D.M., COLLINS, T.L., STITT, E., and BALFOUR, P.
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The Effects of Seasonality on CRAM Scores for Vernal Pools

The California Rapid Assessment Methodology (CRAM) is used to collect repeatable measurements of a wetland or wetland system over time. CRAM data are used to monitor changes in wetland function or to detect changes in wetlands due to changes in nearby land use. CRAM assesses four attributes shared among all wetlands: buffer and landscape context, hydrology, physical structure, and biotic structure. These attributes are important determinants of wetland function. In order to accurately score biotic structure, CRAM assessments are timed to occur during the peak of the floristic bloom period which is April or May for vernal pools in the Sacramento Valley. The limited timeline within which surveys are recommended poses a significant constraint to researchers and planners. We compared CRAM scores and attribute scores from two seasons, May and August, to determine whether any difference exists between seasons and whether late summer vernal pool CRAM assessments provide defensible data to planning and agency personnel. Of the four attributes, only the biotic structure score was significantly higher in May than in August. However, when averaged with the other attributes, the Overall Assessment-Area (AA) Scores were only two points higher in May than in August, which is likely within the range of allowable variation for a vernal pool, and does not represent a considerable difference in wetland function.

37. TAYLOR, D.W. and JAMES, C.
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Do Clearcuts Promote Weeds That Displace Native Plants?

Homogenization is an emerging topic in ecology: the replacement model of biotic homogenization states that, for each addition of a non-native species, a decrease in abundance or proportional increase in local extirpation probability of a native species results. Do clearcuts in northern California mixed-conifer forests promote invasive weeds, resulting in homogenization? We conducted detailed floristic inventory of >100 established forestry plantations (5-8 yr old) in northern California. Two tests for biotic homogenization were applied. McKinney's test (holding floristic similarity constant based on correcting for geographic distance decay, then testing for an effect on non-native species richness on the residual) was conducted for all 5,356 pair-wise comparisons of the 104 plantations using Jaccard's index. A second test was using NMS ordination, testing for covariance in vectors of non-native and native herb richness. The top 10 non-native weeds occurring in our plantation data (frequency of sites): *Cirsium vulgare* (79%), *Lactuca serriola* (70%), *Verbascum thapsus* (61%), *Bromus tectorum* (48%), *Tragopogon porrifolius* (42%), *Rumex acetosella* (38%), *Tragopogon dubius* (37%), *Bromus catharticus* (29%), *Vulpia bromoides* (24%) and *Cirsium arvense* (23%). Using the McKinney test, the residual plots of unexplained variance indicate that higher non-native weed richness is correlated with greater native herb species richness. Using NMS ordination, the richness vectors for native vs. exotic herb richness were indistinguishable. The analysis failed to support the replacement model of homogenization: floristic simplification is not evident in clearcuts based on these data.

38. TERAOKA, E. and CRAYDON, E.
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Eelgrass Restoration in Humboldt Bay, California: Restoration Techniques and Results from Two Years of Monitoring

An idle fuel oil pipeline was removed from Humboldt Bay shoreline and mudflats by Pacific Gas and Electric Co. in 2009, resulting in the temporary disruption of eelgrass beds. Working in coordination with local and state agencies to ensure that appropriate mitigation was incorporated into the project, portions of

the disturbed eelgrass bed were replanted in March–May 2010 using over 11,000 eelgrass plugs collected from nearby eelgrass beds. Plugs were planted in 324 planting circles spaced 3 m apart. The restoration area was monitored before project implementation in 2009, immediately following implementation in 2010, and in each year following (2011, 2012). Prior to pipeline removal, eelgrass density averaged 104 turions (eelgrass shoots)/m^2, or 100% cover. Following replanting, eelgrass density averaged 20 turions/m^2, or 15% cover in 2010; 17 turions/m^2, or 15% cover in 2011; and 100 turions/m^2, or 90% cover in 2012. Planted eelgrass plots had a considerably higher density than unplanted regions between the plots in 2010 and 2011, although by 2012, ingrowth made the two areas indistinguishable. Planted eelgrass survival was high compared with other eelgrass restoration projects recently completed throughout California. Based on the monitoring results, eelgrass density within the restoration area is on track to reach predisturbance densities by the end of the five-year monitoring period. Natural eelgrass recruitment and use of the restoration area by native marine invertebrates were seen immediately following replanting efforts. Replanting of eelgrass beds in Humboldt Bay using local plugs appears to be an effective, although labor-intensive, approach to restoration.

39. TRUONG, T. and DATWYLER, S.
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Phylogeography of the Woody Penstemons (Subgenus *Dasanthera*)

Penstemon subgenus *Dasanthera* comprises a group of nine species and seven varieties in the family Plantaginaceae, found mostly at high elevations on rock outcrops or basalt lava flows. Species are woody subshrubs, have long, wooly hairs on anthers and either pink or purple corollas. Species within this subgenus are visited by pollinators such as a variety of bees, bee flies, and hummingbirds. It is hypothesized that subgenus *Dasanthera* first originated in the northern Rocky Mountains and subsequently migrated and diversified in the Cascade Range. *P. newberryi* var. *berryi* is unique in that it has intermediate floral characteristics relative to both pink and purple flowered species which suggest that *P. newberryi* var. *berryi* may be a homoploid hybrid variety. Plant tissue was collected from 152 individuals and DNA was extracted from all species in subg. *Dasanthera*. To investigate the origin of *P. newberryi* var. *berryi* and explore the phylogeography of subgenus *Dasanthera,* DNA sequence data were obtained from a chloroplast intergenic spacer. DNA sequence data were used to build a maximum parsimony haplotype network. Twelve unique haplotypes were identified, two of which are represented largely in the Klamath region. The haplotype network revealed that a refugium event may be responsible for the genetic diversity seen in subg. *Dasanthera*, and *P. newberryi* var. *berryi* may represent a transitional species. Furthermore, evidence shows that species and varieties in this complex are more closely related to one another based on geographic proximity.

40. VAN SUSTEREN, J.
San Francisco State, 1600 Holloway Avenue, San Francisco, CA 94132

Cliff Notes on California *Sedum* (Crassulaceae)

California *Sedum* includes twelve taxa within the subgenus *Gormania*. 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 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. I intend to construct a molecular phylogeny and project observed morphological characters onto it. 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*.

41. WALDEN, G.K.[1], OROZCO, J.M.[2], and BALDWIN, B.G.[1]
[1]Department of Integrative Biology and Jepson Herbarium, University of California, Berkeley, CA, 94720
[2]Claremont Graduate University Department of Botany, Rancho Santa Ana Botanic Garden, 1500 North College Avenue, Claremont, CA 91711

Collections from California Indian Country in the Consortium of California Herbaria

Our project was motivated to bring attention to documented botanical diversity on California Indian lands, where native plants can have great cultural significance, and to help direct future collecting to improve understanding of plant resources on those lands. We identified herbarium collections with metadata associated with Indian Country in California databased in the Consortium of California Herbaria in summer 2012. Indian Country in California was mapped as polygons in GoogleEarth from the 2010 U.S. Census maps for federally recognized Indian Reservations, Indian Rancherias, and off-reservation tribal trust lands in California. Georeferenced Consortium records were mapped in BerkeleyMapper and exported into GoogleEarth; non-georeferenced Consortium records were mapped manually in GoogleEarth. We examine patterns of plant specimen collections accessioned into the Consortium within currently defined Indian Country boundaries; future work will include comparisons across historical boundaries of Indian Country in California. Future work also includes annotation of these collections in the Consortium as an ongoing digital curation project.

42. WARZECHA, B.T. and PARKER, V.T.
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Extreme Soil Seed Bank Dynamics Explain Extreme Post-fire Success of *Ceanothus papillosus*

Ceanothus papillosus (Rhamnaceae) is a widespread but often locally uncommon obligate seeder shrub of the California chaparral. We found it to be capable of extreme post-fire success. This success is expressed in extreme growth rates (~4,500 g/m^2 in 4 years) and stem densities (~36 stems/m^2), even relatively soon after fire. The Normalized Difference Vegetation Index (NDVI) shows that *C. papillosus* out-performs any other vegetation cover at the burn site at Bonny Doon Ecological Reserve, Santa Cruz County, even though it was rare prior to the burn. *Ceanothus papillosus* relies solely on a dormant soil seed bank in order to avoid local extinction through wildfire. Consequently, its post-fire success is a function of seed bank dynamics. While a few individuals set seed in the third year, the fourth post-fire year was the first with significant seed production. We monitored seed bank density, seed production, seed viability and rodent predation for the fourth fruiting season after fire. We found that high seed production (~17,000 seeds/m^2), high seed viability (>90%), and the absence of seed predation during fruiting season might render *C. papillosus* the chaparral species with the highest potential for post-fire regeneration. In a follow-up study, we want to determine if this shrub's high potential for regeneration can be used as a cheap, native way of counteracting or reversing type-conversion of chaparral to alien grassland.

43. WILLIAMS, A.[1], YOUNG, A.[2], GOSLINER, T.[2], KLEIN, J.[1], and WHELAN, S.[1]
[1]Marin Municipal Water District, 220 Nellen Avenue, Corte Madera, CA 94925
[2]California Academy of Sciences, 55 Music Concourse Drive, Golden Gate Park, San Francisco, CA 94118

Snapshots and Specimens: A Volunteer Botanical Bioblitz on Mt. Tamalpais

Mt. Tamalpais in Marin County is a well-botanized site with a legacy of hundreds of specimens since the mid-1800's. The Marin Municipal Water District (MMWD) has stewarded most of the land in the Mt. Tamalpais Watershed over the past 100 years. To mark its centennial anniversary this year, MMWD partnered with the California Academy of Sciences on a series of "bioblitzes" to document the flora of the Mt. Tamalpais Watershed using teams of citizen science volunteers and professionals. From five collection events, over 80 volunteer participants made over 650 observations of over 350 species, including collecting over 450 specimens documenting over 200 species of vascular plants. Observations made serve as a snapshot in time of the flora of the mountain, and combine centuries-old herbarium specimen collection and preparation with modern-day GPS camera and website data upload. Records from this effort can be

used to compare against historic records, and as a benchmark against which future change may be measured. Methods presented avoid and reveal the bias in previous collection efforts: "new records" for the mountain skew to tiny annuals and weeds.

44. WILSON, B.L., OTTING, N., BRAINERD, R., and ZIKA, P.
Carex Working Group, 1377 NW Alta Vista Drive, Corvallis, OR 97330

Field Guide to the *Carex* Sedges of California (Planned)

Carex is one of the most diverse genera in California. Its members include community dominants in diverse habitats as well as listed rare species. Therefore, land managers often need to manage sedge populations, but identification of species can be difficult. Our planned field guide to California's *Carex* will help land managers figure out what species are present, and will present some information on each species' ecology and management. The book will include an identification key. Each species treatment will include a page of photographs as well as a page of text that covers description, similar species, and interesting aspects of ecology. In preparation for writing the guide, two undescribed *Carex* have been named and another three species are under study.

45. WITHAM, C.W.
1141 37th Street, Sacramento, CA 95816

Status Surveys for Seven Federally Listed Vernal Pool Grasses and *Chamaesyce hooveri* in the Sacramento and San Joaquin Valleys (Great Valley), California

The last comprehensive field surveys for eight federally listed vernal pool plant species were conducted in 1986-1987 by Biosystems Analysis (Stone et al. 1988). Since that time, over 100,000 acres of vernal pool habitat have been lost to conversion (Holland 2009). This project updates 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 poster highlights some of the results of this two-year study to update our knowledge on the distribution and status of these rare plant species.

46. YUNKER, C. and PARKER, V.T.
San Francisco State University, Department of Biology, 1600 Holloway Avenue, San Francisco, CA 94132

Flowering Phenology and Potential Pollinators in *Arctostaphylos*: Implications for Reproductive Isolation and Monitoring

Chaparral stands in central California are often defined by *Arctostaphylos* species (manzanitas). Investigating the phenology and ecology of these foundational, native plants can offer insight into the stability of these ecosystems. A common misunderstanding is that manzanitas readily form hybrids, but this is not always the case. *Arctostaphylos* has two distinct evolutionary lineages and if co-occurring species are from different lineages they produce no or few, viable hybrids – demonstrated since the first study about hybridization by Dobzhansky. We are exploring how flowering phenology, potential pollinators and self-fertilization may influence reproductive isolation. We are utilizing three research sites that contain diploid species from each clade (lands of the Elkhorn Slough Foundation, Napa Land Trust and Big Basin Redwoods State Park). The species studied are *Arctostaphylos pajaroensis* (clade 2) and *A. hookeri* (clade 1) near Moss Landing, *A. canescens* (clade 2) and *A. stanfordiana* (clade 1) near Napa and *A. andersonii* (clade 2) and *A. sensitiva* (clade 1) near Boulder Creek. Preliminary data collected last winter indicate different periods of flowering between the two lineages. Each field site has unique management concerns for

which reproductive ecology can provide usable information. Two contain local, endemic species and are near extensive agriculture. Managers are interested in these remnant areas of chaparral and even the possible linkage between the pollinators we are observing and the agricultural landscape. We are also curious about the application of flowering phenology as a monitorable indication of the health of manzanitas and their communities in a changing climate.

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ADDENDUM

CORRECTED ABSTRACT FOR TALK

in Session 3: Redwood and North Coast Botany and Ecology

10 BARBOUR, M.[1], LOIDI, J.[2], GARCIA-BAQUERO, G.[2], and MEYER, R.[3]
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Distance Inland Explains Low-Elevation Shifts of Dominance between Redwood and Douglas-fir along the Central Coast

The presence of summer fog is often thought to have a major role in the distribution of forest types along the California coast, but measurements are rare, especially at the landscape scale. Three forests supposedly affected by fog are *Sequoia sempervirens*-dominated forest, and mixed evergreen forest with or without *Pseudotsuga menziesii*. Our aim was to identify the drivers of dominance by redwood vs Douglas-fir or by conifers vs broad-leaf evergreens. Dominance was analyzed by non-metric multi-dimensional scaling (NMS), regression, and Canonical Analysis of Principal Coordinates (CAP), a combination of statistical techniques powerful enough to identify patterns in a small dataset. Site traits tested for correlation with vegetation were: latitude, distance inland from the sea, slope aspect and steepness, precipitation, solar radiation, minimum/maximum temperatures, and elevation. Most traits were weakly correlated with vegetation; the strongest was distance from site to sea. The most parsimonious regression model that explained conifer dominance was a cubic function based only on distance from site to sea (R^2 = 68%). We conclude that distance inland has such an over-whelming correspondence with dominance that it could be a surrogate for fog intensity. Testing that would require measures of fog drip at the community scale, data (and standard methods) that do not yet exist.

[This abstract was substituted after the 2013 Symposium to replace the incorrect abstract printed in error on page 11 of the Symposium booklet (the title was correct).]