NORTHERN CALIFORNIA PLANT LIFE – WONDER, DISCOVERY, CONCERN

THE FOURTH SYMPOSIUM
PRESENTED BY

NORTHERN CALIFORNIA BOTANISTS

California State University, Chico
10-12 January 2011

Northern California Plant Life – Wonder, Discovery, Concern

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Cover photo courtesy of Joe Silveira. Eddy Lake, a Sacramento River Oxbow at Llano Seco Rancho; Sacramento National Wildlife Refuge, Llano Seco Unit. There are some interesting aspects of our conference theme, wonder, discovery and concern, in this photo. Rare plant communities (Valley Oak Woodland/Riparian Forest, and generally with no rare plants in this community); poorly understood or emerging taxonomy (*Ludwigia*; *Hibiscus*), and threats from invasive species (the effect of *Ludwigia* invasions on aquatic and terrestrial ecosystems). 28 July 2006.

WELCOME!

Northern California Botanists

welcomes you
to our fourth symposium!

MISSION STATEMENT: 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.

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PROGRAM OF PRESENTATIONS BY INVITED SPEAKERS

Bell Memorial Union Auditorium

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

Monday 10 January 2011

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 – 9:15 a.m.

1. **Linnea Hanson**, President, Northern California Botanists
   Welcome to the Fourth Northern California Botanists Symposium

Session 1: Managing Rare Plants on Public Lands

9:15 – 10:35 a.m.

Kyle Merriam, Session Chair, Plumas National Forest

2. **Kyle Merriam**
   Effect of Grazing on Orcuttia tenuis *on the Modoc Plateau*
3. **Michelle Coppoletta**
   Monitoring the Effects of Forest Management Practices on Rare Plant Species in the Northern Sierra Nevada
4. **Erin Rentz**
   Conservation of Baker Cypress: A Rare Conifer Endemic to Northern California and Southern Oregon
5. **Graciela Hinshaw**
   Enhancing Habitat for Several Rare Plants Growing on Gabbroic Soils in Western El Dorado County, California

10:35 – 10:55 a.m. **Break**

Session 2: Pollination Biology of Common Plants in Northern California

10:55 a.m. – 12:20 p.m.

Barbara Castro, Session Chair, California Department of Water Resources

6. **Rob Schlising**
   Beeflies in Prettyface (Bombyliids Nectaring in Triteleia ixioides*)*
7. **Ryan Briscoe Runquist**
   Pollinator-mediated Competitive Interactions Between Two Vernal Pool Annuals, Limnanthes douglasii *subsp.* rosea *and* L. alba
8. **Michael Mesler**
   *Metallic Sword-tongue Flies (*Eulonchus*) as Pollinators of* Iris tenuissima *and Other Plants in Northwestern California*
9. **Dena Grossenbacher**
   Bee Pollinators Cause Selection for Flower Color Displacement in Two Sympatric Monkeyflowers

12:20 – 1:40 p.m. **Lunch**

Session 3: Climate Change – Plants on the Edge

1:40 – 3:00 p.m.

Samantha Hillaire, Session Chair, Garcia and Associates

10. **Michael Kauffman**
    The Past, Present, and Future: Climate Change and High Elevation Pines of the Klamath Mountains
11. **John Dittes**
    *Into a Rain Shadow: Biogeography and Ecology of Two Narrow-endemic Perennials (*Ivesia aperta *var.* aperta *and* Ivesia sericoleuca*, Rosaceae)*
12. **Len Lindstrand III**
    Genetics of the Shasta Snow-wreath and Updates on its Distribution and Habitat
13. **Dean Taylor**
    Sky Island Vegetation in Yosemite National Park: Extent, Vascular Plant Diversity, and Fate under Climate Change

3:00 – 3:20 p.m. **Break**

Plenary Presentation on *Arctostaphylos franciscana*

3:20 – 4:00 p.m.

Mike Williams, Session Chair, Butte College

14. **Mark Frey**
    Saving the Franciscan Manzanita – a Plant Extinct in the Wild
15. **Tom Parker**
    Saving the Franciscan Manzanita

Session 4: Poster Presentations

4:00 – 5:00 p.m. Bell Memorial Union second floor Mezzanine

Barbara Castro, Session Chair, 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

16. **Bob Patterson**, San Francisco State University
    A Tale of Two Trees: The History (Natural and Otherwise) of the Phlox Family

Tuesday 11 January 2011

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: Using Fire to Restore Ecosystem Health

8:15 – 9:45 a.m.
Alison Stanton, Session Chair, BMP Ecosciences

17. **Alison Stanton**
    Vegetation and Fuel Response to Fuel Reduction Treatments in the Lake Tahoe Basin
18. **Eric Knapp**
    Restoring Understory Diversity in Forests with Thinning and Fire
19. **Scott Dailey**
    Fire Effects in Fuel Treatments and Protected Habitat on the Moonlight Fire, Plumas National Forest
20. **Chris Christofferson**
    Old Growth Forest Restoration: The Management Conundrum and Collaborative Opportunity

9:45 – 10:05 a.m. **Break**

Session 6: Field Implications of Jepson Manual Changes

10:05 – 11:45 a.m.
Barbara Ertter, Session Chair, University and Jepson Herbaria, UC Berkeley
David Keil, California Polytechnic University, San Luis Obispo
Introduction

21. **Barbara Ertter**
    Changes in Potentilla *and Relatives: Disjunct Novelties, Resurrected Oldies, One Extinct on Arrival, and a Wood-Beauty Makeover*
22. **Dean Kelch**
    Familial Realignment of the Lilies in the New Jepson Manual
23. **Travis Columbus**
    Changing Concepts of Grass Genera in California
24. **David Keil**
    Major Changes in the Asteraceae in the Jepson Manual Second Edition

11:45 – 1:20 p.m. **Lunch**

12:30 p.m. **Optional Chico State Herbarium Tour and Brown Bag Lunch**

Session 7: Four Aspects of California Lichenology

1:20 – 2:40 p.m.

Tom Carlberg, Session Chair, California Lichen Society

25. **Justin Shaffer**
    Antifungal Activity of Lichen Extracts: Exploring the Potential for Indirect Protection of Woody Plants from Pathogenic Fungi
26. **Eric Peterson**
    Mixing of Floristics in California – the Lichen Perspective
27. **Sarah Jovan**
    Using Lichen Communities to Shape Air Pollution Policy in California
28. **John Villella**
    Lichen Species of Conservation Concern in Northern California

2:40 – 3:00 p.m. Break

Session 8: New Discoveries

3:00 – 4:20 p.m.

Lawrence Janeway, Session Chair, The Chico State Herbarium

29. **Carol Witham**
    The Discovery of Juncus digitatus
30. **Julie Nelson**
    Genetics, Distribution, and Habitat of a Disjunct Huckleberry from Western Shasta County
31. **Joanna Clines**
    A New Understanding of Rare Botrychium *Ferns (Moonworts, Ophioglossaceae) and their Habitat Requirements in California Resulting from Targeted Studies over the Past Decade*
32. **Daniel Harder**
    New Species of Violets from the Santa Cruz Mountains

Closing Remarks

4:20 – 4:30 p.m.

Linnea Hanson, President, Northern California Botanists

POST-SYMPOSIUM WORKSHOPS
Cosponsored by
Northern California Botanists
and
Friends of The Chico State Herbarium

Wednesday 12 January 2011

Workshop 1: Resources for Beginning Professional Botanists
9:00 a.m. – 4:00 p.m. Holt Hall room 125.

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 will 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: Landforms, Soils, and Vegetation of Bidwell Park
9:00 a.m. – 3:00 p.m. Meeting location to be announced.

Field Trip Leaders: **Andrew Conlin** – Natural Resources Conservation Service
Joe Silveira – Sacramento National Wildlife Refuge

Have you ever wondered why certain plants occur where they do on the land, or what underlies the patterns of vegetation throughout certain landscapes? The distribution and vigor of plants and vegetation results, in large, from an intricate association with the soil, sometimes referred to as the edaphic effect. After all, at least half the plant lives in the soil.

Stretching from the eastern edge of the northern Sacramento Valley and raising to the southern Cascade foothills and northern Sierra Nevada, Chico's Bidwell Park is one of the largest city parks in the nation. It is diverse and scenic and provides a great outdoor experience to explore the relationships between landforms, soils, vegetation, and wildlife habitat. The geological processes that form soils, create landforms, and provide the foundation for plant and vegetation patterns will be revealed by trekking through this inspiring landscape. A big picture overview at Horseshoe Lake will set the stage for a hike along the Big Chico Creek Canyon where we will explore a diverse terrain and discuss soil forming processes associated with discrete landforms and their influence on vegetation.

This field trip will take approximately five hours. Bring hiking boots, warm clothing, including rain gear, camera, hand lens, and binoculars. Bring your own sack lunch and water. Glass bottles, etc. are not permitted in the park. Light refreshments will be provided.

Andrew Conlin has worked as a Soil Scientist for the Natural Resources Conservation Service for over 20 years. He currently works at the Cooperative Soil Survey Office in Chico. He co-authored the recently completed Soil Survey of Butte County and has also completed the Soil Survey of Lassen Volcanic National Park. **Joe Silveira** has worked for the U.S. Fish and Wildlife Service for 20 years. He is stationed at Sacramento National Wildlife Refuge Complex where he is involved with riparian floodplain, grassland, vernal pool and wetland restoration and management. He wrote the wildlife habitat section for the Butte County Soil Survey.

Workshop 3: Exploring for Lichens

9:00 a.m. – 3:00 p.m. Meeting location to be announced.

Field Trip Leader: **Tom Carlberg** – California Lichen Society

We plan to go out in the field and explore for lichens in upper Bidwell Park, Chico. There are ten miles of undeveloped parklands paralleling Big Chico Creek. This park is contiguous with the Big Chico Creek Ecological Reserve. Habitat ranges from riparian hardwood to oak woodland and open mixed hardwood/conifer forest. Since lichens are substrate- and microhabitat-driven, there is ample opportunity to look at a good diversity of epiphytic communities, saxicolous and corticolous crusts, and terricolous species.

Lichens are frequently distinguished by characters that are on the order of 1mm in size, so be prepared to think small! Bring, beg, buy or borrow a reasonable-quality hand lens (10X-14X), otherwise the trip will be much less informative. Bring a knife for scraping lichens off of bark or rocks.

The trip facilitator will be **Tom Carlberg**, who has been studying lichens for the past 10 years. He is an active member of the California Lichen Society, is the past Editor of the Bulletin of the California Lichen Society, and is especially interested in the range and distribution of rare lichen species in California.

This field trip will take approximately five hours and is limited to 20 participants. Bring hiking boots, warm clothing, including rain gear, camera, and a hand lens. Bring your own sack lunch and water. Glass bottles, etc. are not permitted in the park. Light refreshments will be provided.

ABSTRACTS OF TALKS

(Abstracts in chronological order; index to authors on page 39)

1. **HANSON, L.**

Feather River Ranger District**,** Plumas National Forest, 875 Mitchell Avenue, Oroville, CA 95965

Welcome to the Fourth Northern California Botanists Symposium

I'd like to welcome all of you to our fourth symposium. We hope you will enjoy the program that we have organized for you this year. 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. 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. **MERRIAM, K.E.*[1] and GOSEJOHAN, M.C.[1,2]**

[1]USDA, Plumas National Forest, 159 Lawrence Street., Quincy, CA 95971
[2]Natural Resources and Environmental Science, University of Nevada – Reno, 1000 Valley Road, MS 186, Reno, NV 89512

Effect of Grazing on *Orcuttia tenuis* on the Modoc Plateau

Orcuttia tenuis (slender Orcutt grass) is a federally listed species endemic to northern California vernal pools. On the Modoc Plateau, one threat to *O. tenuis* conservation is thought to be livestock use. However, little is known about the response of *O. tenuis* to grazing. Data collected at actively grazed and ungrazed vernal pools on the Lassen National Forest during the summer of 2009 showed that *O. tenuis* abundance was more strongly related to large-scale geographic patterns than to grazing. To evaluate the effect of grazing at local scales, temporary fences were installed within eleven populations of *O. tenuis* on the Modoc National Forest. Data collected at these paired grazed and ungrazed plots in 2010 indicated that *O. tenuis* density was significantly higher in grazed plots. *O. tenuis* was most abundant in plots with more exposed bare ground and rock cover. However, grazing did not affect these variables. Herbaceous plant and litter cover was significantly lower, and the number of hoof prints was higher, in grazed plots. These results suggest that grazing may benefit *O. tenuis* by reducing competition or by providing favorable microsites; however, the mechanism for this effect is unclear. One variable we have not measured is vernal pool hydrology, an important habitat element for most vernal pool species. Additional research planned for 2011 to address the interactive effects between livestock use and hydrology should improve our understanding of the habitat requirements of *O. tenuis* to develop appropriate management recommendations for this species on the Modoc Plateau.

3. **COPPOLETTA, M.,*[1] DILLINGHAM, C.,[2] and MERRIAM, K.[2]**

[1]Mt. Hough Ranger District, Plumas National Forest, 39696 Hwy 70, Quincy, CA 95971
[2]Plumas National Forest. Supervisor's Office, 159 Lawrence Street, Quincy, CA 95971

Monitoring the Effects of Forest Management Practices on Rare Plant Species in the Northern Sierra Nevada

With over 400 rare plant species on Forest Service lands in California, it is imperative that land managers have a solid understanding of how rare plants respond to resource management activities. In 2004, botanists and ecologists from the Lassen, Plumas, and Tahoe National Forests recognized a unique opportunity to gather relevant quantitative data; they initiated a monitoring program aimed at investigating the response of rare plants to prescribed fire, fuel reduction, and timber harvest activities implemented under the Herger-Feinstein Quincy Library Group Pilot Project. So far, data have been collected and analyzed for eight species and four different treatment types. A number of lessons have emerged from this effort. First, the response of individual species is often linked to the intensity of the treatment and the species' ecology. The species monitored naturally inhabit open sites and/or have evolved with fire, which could

explain why moderate to low intensity fire and timber harvest treatments had negligible (and in some cases beneficial) effects. In contrast, the response to high intensity fire or group selection harvest was variable, causing significant declines in two disturbance intolerant species and having no effect on those species that appear to thrive in disturbed sites. Second, measuring environmental variables (such as canopy cover, fuel loads, duff depth, etc.) is important when trying to explain a plant's response to specific treatments. Third, monitoring should occur over a long enough time period to capture any initial population declines, potential recovery to pre-treatment numbers, and natural variability.

4. MERRIAM, K.[1] and RENTZ, E.*[2]

[1]USDA Forest Service, Sierra Cascade Province, P.O. Box 11500, Quincy, CA 95971
[2]USDA Forest Service, Klamath National Forest, P.O. Box 377, Happy Camp, CA 96039

Conservation of Baker Cypress: A Rare Conifer Endemic to Northern California and Southern Oregon

Baker cypress (*Hesperocyparis bakeri*) is a rare conifer that depends on fire for seed dispersal and requires post-fire conditions to germinate. Fire has been excluded from many populations and as a result, many sites are densely crowded with shade-tolerant species while adult cypresses are dying with almost no evidence of regeneration. The intent of our research was to provide land managers with information to manage cypress by determining if fire management is necessary, and if prescribed burning can successfully promote regeneration. We also investigated factors that affect cypress vigor and canopy seed storage. We collected information at 10 Baker cypress sites and found almost no evidence of regeneration in cypress populations that had not recently burned. While young stands do not have sufficient canopy seed storage to regenerate the population, very old stands of over 150 years of age still possessed very high numbers of viable seed. Baker cypress canopy seed storage was most strongly influenced by site conditions, particularly soil type; however, stand density and height of cypress relative to other species were also strong predictors of canopy seed storage. This suggests that management measures such as selective thinning of competing species could be used to promote canopy seed storage of Baker cypress populations.

5. HINSHAW, G.

Bureau of Land Management, 5152 Hillsdale Circle, El Dorado Hills, CA 95762

Enhancing Habitat for Several Rare Plants Growing on Gabbroic Soils in Western El Dorado County, California

The Bureau of Land Management (BLM) manages about 4,700 acres of habitat for eight gabbro soil rare plants at the Pine Hill Preserve, in western El Dorado County, California. Five of the eight rare plants are federally listed as threatened or endangered and four are endemic of the 25,000-acre Pine Hill area, where more than 10% of California's native flora is represented. Chaparral and woodland habitat types and the rare plants at the Preserve have evolved under the influence of fire. Because of the proximity of Preserve lands to densely populated areas, management activities include the mechanical treatment of fuels loads as a surrogate for fire to decrease the possibility of catastrophic wildfire events and to enhance habitat for the rare plants. Preliminary analysis of data from monitoring plots evaluated during 2005-2010 for *Ceanothus roderickii, Galium californicum* ssp. *decumbens* and *Wyethia reticulata*, and from field observations for *Calystegia stebbinsii, Chlorogalum grandiflorum, Fremontodendron californicum* ssp. *decumbens, Helianthemum suffrutescens*, and *Packera layneae*, suggest that the rare plants can benefit from fuels reduction activities that eliminate competition by opening spaces in the habitat previously occupied by shrubs.

6. SCHLISING, R.*[1] and KANNELY, A.[2]

[1]Department of Biological Sciences, California State University, Chico, CA 95929
[2]California Department of Transportation, 703 B Street, Marysville, CA 95901

Beeflies in Prettyface (Bombyliids Nectaring in *Triteleia ixioides*)

The cormous geophyte, *Triteleia ixioides* (Themidaceae), with four subspecies, is widespread in California. Studies were done in the field (2004-2009), on phenology, growth and reproduction in three popula-

tions of ssp. *anilina*, in conifer forests within Butte County. Features of the flowers documented for one or more of the populations at 1440, 1750 and 1790 m elevations, indicate the plants are cross-pollinating. Flowers produce nectar, and are frequently probed by one species of long-tongued beefly (*Bombylius facialis*, Bombyliidae). Over 5 years number of ovules (X±SE) per flower (e.g., at 1750 m) was the same (range 11.4±0.4 to 13.3±0.4; $p>0.05$), although ANOVA+TukeyHSD tests showed seeds per fruit varied (range 3.3±0.3 to 4.5±0.5; $p<0.05$). The pollen:ovule ratio for 26 plants was 905±70. Bagging of inflorescences before flowers opened showed plants, at best, were weakly self-compatible: mean fruit set was significantly higher in bagged than in paired unbagged plants ($p<0.0001$; $n=32$). Numerical documentation of flower visitors (probable pollinators) were made with 10-minute observations of insects visiting flowers in 197 1-m-square plots. On days when plants were heavily visited (by *Bombylius* and very few other insects) up to 100% of the plants and up to 100% of their flowers were probed by *B. facialis* in a single plot in only 10 minutes, indicating possible abundant visitation during an entire day. Visits varied with time of flowering season, time of day, and air temperature, suggesting beefly effectiveness as pollinators varies in *T. ixioides* ssp. *anilina* populations from year to year – and probably from place to place within the wide range of the plant.

7. RUNQUIST, R.D.B.* and STANTON, M.L.
University of California, Davis, One Shields Avenue, Davis, CA 95616
Center for Population Biology, University of California, Davis, CA 95616

Pollinator-mediated Competitive Interactions between Two Vernal Pool Annuals, *Limnanthes douglasii* subsp. *rosea* and *L. alba*

Pollinator-mediated interactions can potentially be a potent force in structuring communities and may lead to competitive exclusion of a species. *Limnanthes douglasii* subsp. *rosea* and *Limnanthes alba* broadly co-occur in a large geographic area in the Sierra Nevada foothills, but are rarely found together on a fine-scale in a vernal pool complex. We used hand-pollinations and natural pollinator arrays to show that pollinator-mediated competition, specifically through heterospecific pollen transfer, can lead to decreases in seed-set. We also used a replacement design of mixed species arrays to show that the effect is highly density dependent, with minority species within the array experiencing 50-70% decreases in fecundity. This mechanism may be important in preventing the establishment of an invading *Limnanthes* to an area already occupied by a *Limnanthes* species and could have important implications for restoration and mitigation.

8. MESLER, M.
Department of Biological Sciences, Humboldt State University, Arcata, CA 95521

Metallic Sword-tongue Flies (*Eulonchus*) as Pollinators of *Iris tenuissima* and Other Plants in Northwestern California

Patches of *Iris tenuissima* are common in the understories and along the edges of inland forests of northwestern California. Its most important pollinators are fast-flying long-proboscid flies in the genus *Eulonchus*, whose larvae parasitize ground-dwelling mygalomorph spiders (e.g., California Turret Spider) that hunt in these forests. The flies, which can be abundant, carry large numbers of *Iris* pollen grains and regularly contact stigmas as they walk inward along sepals to drink nectar. Marking experiments reveal that flies often move between patches, in some cases traveling more than 100 meters. Pollen-foraging bees (*Andrena, Halictus, Osmia*) also pollinate flowers, but may function largely as pollen robbers ("ugly pollinators") when *Eulonchus* is present. Other species pollinated by *Eulonchus* in NW California include *Clarkia concinna, Hackelia bella, Lewisia cotyledon, Silene bolanderi, and Polemonium chartaceum*. These unheralded little flies provide high-quality pollination service for this morphologically diverse guild of plants, and may be especially important in habitats where floral resources for larger pollinators are patchy and scarce. Effective conservation of *Eulonchus* will require a deeper understanding of the impact of habitat alteration on the abundance of its spider hosts.

9. GROSSENBACHER, D.
NCB 2009-2010 Research Scholarship Awardee
Population Biology Graduate Group, University of California, One Shields Avenue, Davis, CA 95616

Bee Pollinators Cause Selection for Flower Color Displacement in Two Sympatric Monkeyflowers

The process of character displacement occurs when competitive interactions between species select for divergent characters that reduce competition, ultimately resulting in a pattern of increased divergence in sympatry. Coflowering plant species that share pollinators may experience pollinator-mediated competition and potentially selection for divergent floral characters. One such character that plays a role in pollinator attraction is flower color. In the central Sierra Nevada of California, *Mimulus bicolor* co-flowers with *Mimulus guttatus* and occurs in mixed populations containing two color morphs. Notably, in mixed patches the two species are visited by the same small bee pollinators, *Dialictus* sp. Here, I show an overall geographic pattern consistent with character displacement whereby the similarly colored yellow *M. bicolor* morph is less frequent compared to the divergent white colored morph when *M. guttatus* is present. Furthermore, in naturally occurring mixed patches the yellow morph has significantly lower relative fitness compared to the white morph when *M. guttatus* is present. Using experimental arrays, there is a significant effect of petal color similarity on pollinator-mediated competition and selection for flower color varies in the presence of *M. guttatus* – the similarly colored yellow *M. bicolor* morph has significantly lower relative fitness (0.70) in the presence of *M. guttatus*. These results are consistent with pollinator-mediated competition driving flower color displacement in *M. bicolor*.

10. KAUFFMANN, M.E.
Humboldt State University, Department of Biological Sciences, 1 Harpst Street, Arcata, CA 95521

The Past, Present and Future: Climate Change and the High Elevation Pines of the Klamath Mountains

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 of species – both globally and regionally. The conifers of the Klamath 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. DITTES, J.
Dittes & Guardino Consulting, P.O. Box 6, Los Molinos, CA 96055

Into a Rain Shadow: Biogeography and Ecology of Two Narrow-endemic Perennials (*Ivesia aperta* var. *aperta* and *Ivesia sericoleuca*, Rosaceae)

Post-Pleistocene climate change correlates with evolution of *Ivesia* (Rosaceae) in western North America. Sierra Valley Ivesia (IVAPA) and Plumas Ivesia (IVSE) are associated with Quaternary-Age lake basins at the western margin of extinct Lake Lahontan. They persist in a narrow mesic zone in the Sierra-Cascade rain shadow maintained by moist air funneling eastward into Sierra Valley through the canyons of Middle Fork Feather and Yuba Rivers. IVAPA trends along the more-arid eastern edge of their ranges, IVSE along the more-mesic west. GIS modeling of habitat constraints shows differences in their distributions and divergence of potential ranges. How might these closely-related "xeric-adapted" species that evolved in response to past climate change be affected by future climate change, particularly on anthropologic time-scales? They occupy vernally-mesic "edges" within larger meadow basins. Field observations suggest that physiological stress, competitive interactions with rhizomatous perennials, and disturbance differentially affect seedling survival and recruitment at opposite ends of topographic-moisture gradients. If meadow ecotones shift in response to climate change, Ivesia populations will have to keep pace. The two species may respond differently. Field observations suggest that IVAPA might be more r-Selected,

with smaller seeds, earlier reproductive maturation, greater seed production at maturity, higher seedling densities, and potentially denser, larger populations. IVSE in contrast, appears more K-Selected and perhaps "deeply adapted" to vernal pool-type hydrologic cycles. Landscape fragmentation, invasive species, and livestock grazing are new factors potentially affecting how IVAPA and IVSE cope with future climate change.

12. LINDSTRAND III, L.*[1] and NELSON, J.[2]
[1]North State Resources, Inc., 5000 Bechelli Lane, Suite 203, Redding, CA 96002
[2] Shasta-Trinity National Forest, 3644 Avtech Parkway, Redding, CA 96002

Genetics of the Shasta Snow-wreath and Updates on its Distribution and Habitat

Shasta snow-wreath (*Neviusia cliftonii*) is a rare plant endemic to the southeastern Klamath Mountains in the vicinity of Shasta Lake, Shasta County, California. The 1992 discovery provided California with a new genus, and the species was originally thought to be associated with limestone substrates. Of the ten populations known by 1996, eight were located in limestone habitat. Since 2003 we have found 13 new populations, most in non-limestone habitats. There are currently 23 known populations; 10 are associated with limestone substrates and 13 from non-limestone substrates. During 2009 and 2010 we performed an analysis to determine genetic relationships between the Shasta snow-wreath populations. The overall goal of the study is to provide information critical for project impact analysis and planning related to potential propagation and restoration mitigations. We sampled 21 of the 23 known Shasta snow-wreath populations and conducted an electrophoretic analysis of multiple enzymes using fresh leaf tissue to estimate levels of genetic diversity within and among populations. The analysis showed low overall levels of genetic diversity in Shasta snow-wreath. Significant allele frequency variation showed high levels of differentiation among populations. Multivariate analysis identified three clusters of genetically similar populations, one of which was distinct. The distribution of populations does not correspond to several geographic or ecological factors, indicating other factors may influence the genetic structure of this species. Effects of climate change to Shasta snow-wreath are unknown; however, there are several potential direct and indirect factors worth consideration for conservation and management planning.

13. TAYLOR, D.W.,*[1] COLWELL, A.E.L.,[2] and GROSSENBACHER, D.[3]
[1]3212 Redwood Drive, Aptos, CA 95003
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[3]Population Biology Graduate Group, University of California, 2320 Storer Hall, Davis, CA 95616

Sky Island Vegetation in Yosemite National Park: Extent, Vascular Plant Diversity, and Fate Under Climate Change

As climate warms, ecosystems limited to the coldest climates will likely change markedly in direct response to temperature. In California, the alpine zone of the Sierra Nevada disappears entirely under some climate projection models. We have undertaken to document poorly-known alpine vegetation in Yosemite National Park by conducting a floristic inventory of key sites. For our 3-year study, we chose to focus on alpine unglaciated surfaces (termed 'sky islands' by John Thomas Howell in 1947). The study began in 2010, using 100m^2 plots from a UTM grid, supplemented by subjectively chosen relevés, attempting to balance detail of data with speed of assessment in these hard-to-access sites. Rarefaction curves were used to estimate completeness of floristic sampling for each site. We used the relatively well-known flora of the Dana Plateau as a test site, where specimen records exist for 140 species of vascular plants; our sampling method documented 130 species in 2009; "missing" taxa may have become extirpated, or were overlooked in the sampling. Comparison of current data with historical data for this site does not indicate a directional shift in floristic composition during the last three decades. However, damage and death to perennial plants occurring in the low snow-cover years of 2007-2008 and 2008-2009 was observed to be widespread at most sites visited to date, with regeneration and recruitment observed in 2010. Increased frequency of low snow-cover events could lead to a sudden change in composition and/or cover of alpine vegetation in the near future.

14. FREY, M.*[1] and CHASSE, M.[2]
[1]Presidio Trust, 34 Graham Street., San Francisco, CA 94129
[2]National Park Service, Fort Mason, Building 201, San Francisco, CA 94123

Saving the Franciscan Manzanita – a Plant Extinct in the Wild

In October 2009, the exciting discovery of an individual plant of *Arctostaphylos franciscana* (Franciscan manzanita) was made in the Doyle Drive corridor of the San Francisco Presidio. This discovery was significant because the Franciscan manzanita has been considered extinct in the wild for over sixty years. This discovery created the opportunity to bring *Arctostaphylos franciscana* back into the wild as a viable, reproducing, and self-sustaining species. Construction for the highway in the area of discovery was scheduled to begin in January 2010 leaving only twelve weeks to save the plant without delaying construction. Representatives from the Presidio Trust, the National Park Service, CalTrans, U.S. Fish and Wildlife Service, California Department of Fish and Game, and the Golden Gate National Parks Conservancy (five government agencies and one non-profit) all met and drafted a plan to save the plant. The plan had three primary objectives; first, to preserve for posterity the individual (mother plant) discovered in October 2009; second, to allow for the establishment of offspring from the mother plant (clones from rooted cuttings and rooted layers, as well as plants raised from seedlings) both in the wild through reintroduction and ecological restoration and through *ex situ* preservation of the mother plant offspring in botanical gardens and special nursery environments so that it can serve as an on-going source of genetic material for this purpose; and third, to propagate other known genotypes of the Franciscan manzanita so that at least three wild, self-sustaining populations of the Franciscan manzanita can be established utilizing this diversity of genotypes to promote the long term viability of this species in the wild. Generally, biodiversity conservation strives to protect rare species *in situ*, that is, in historic wild locations whenever possible. Following this principle, the ideal approach would be to preserve the mother plant in its current location. However, because retention at the discovery location was deemed infeasible because of undue risks associated with that location, the mother plant was translocated to an environmentally appropriate location within the Presidio. Between the discovery and construction in the area seeds, cuttings, and the plant itself were all salvaged. On January 23rd the 10-ton mother plant (with root ball) was moved to a new home in the Presidio.

15. PARKER, V.T.
Department of Biology, San Francisco State University, 1600 Holloway Ave, San Francisco, CA 94132

Saving the Franciscan Manzanita

Following the discovery in October 2009 of an extant individual of the Franciscan manzanita (*Arctostaphylos franciscana* Eastwood), agency representatives and biologists specialized in manzanitas or rare plants became involved in a process to determine how to preserve this plant. Realizing the inadequacy of the current location, plans were made to move the plant to a better site. This was accomplished in January 2010, to another serpentine location in the Presidio. Now the plant is there, what is next? To preserve the plant and its legacy, restoration of a functional population has to occur. Chaparral restoration is not a well-studied process. To restore a functional population and chaparral community, a number of steps are critical. Each stage of the plant's life history has to be functional and large numbers of species are suddenly involved. Furthermore, each of those additional populations has to be functional for successful restoration of the Franciscan manzanita. This presentation focuses on the steps required to create a successful restoration of the Franciscan manzanita, to "save" it beyond the gardening stage.

16. PATTERSON, R.
Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132

A Tale of Two Trees: The History (Natural and Otherwise) of the Phlox Family

Exploring the Polemoniaceae reveals two distinct yet related trees: the one that describes the evolutionary relationships of genera within the family, and the other that highlights those botanists who have contributed to our understanding of the family. With its center of diversity in western North America the Polemoniaceae is an iconic California plant family. Learned early on by every student of California plants,

its beauty, diversity of floral form, and utter omnipresence in the state has made it an attractive study subject. Early botanists such as Asa Gray, E. L. Greene, Willis Linn Jepson, and Herbert Mason contributed to the taxonomy within the family. Then beginning in the middle of the last century the work of Verne Grant launched a new phase of the role of the Polemoniaceae, this time as a model system for studying evolutionary pattern and process. In the 1960s a new crop of plant systematists were using new approaches to answering "who is related to whom" in the family. In the 1980s the revolutionary use of molecular sequence data analyzed via phylogenetic inference had begun to revise our understanding of relationships and taxonomic entities in the family, often with unexpected findings. Today the family of botanists who study this family of plants continue to make new discoveries, and continue to demonstrate that the family is a quintessential example of plant evolution in California.

17. STANTON, A.E.
BMP Ecosciences, 3170 Highway 50, Suite #7, South Lake Tahoe, CA 96150

Vegetation and Fuel Response to Fuel Reduction Treatments in the Lake Tahoe Basin

A large scale effort is underway to reduce fuels and the risk of catastrophic fire in the Lake Tahoe basin. However, vegetation and fuel response to the fuels treatments currently being implemented in the specific forest types in Lake Tahoe is essentially unknown. Two ongoing studies address a full range of treatment types and both short and long-term response. The first study is focused on response to prescribed fire after ten years at Sugar Pine Point California State Park on the west shore of Lake Tahoe. We used a new monitoring software tool called FFI (FEAT/FIREMON Integrated) (www.frames.nbii.gov/ffi) to investigate the effects of prescribed fire on forest composition and structure, fuel loading, and understory species richness and cover in 20 treatment plots and 7 controls. Mean pre-fire tree density declined by 68% and snag density was 25% lower by the tenth year. Although mean tree diameter increased slightly, the units were still heavily dominated by small white fir ten years later. Total surface fuel loads were dramatically reduced in the first year following fire, but have accumulated to 75% of pre-fire loading. Significant changes in understory vegetation cover were not detected. The second study is focused on vegetation and fuel response to mechanical and hand thin treatments. Beginning in 2006, eight paired treatment/control sites were installed on the west and east shores of Lake Tahoe using a Before-After-Control-Impact (BACI) design. Post-treatment vegetation response indicate that in general hand treatments reduced mean canopy cover by <5% while the mechanical treatment reduced it by over 20%. The majority of trees removed in all units were small diameter and, because the treatments focused on small trees, total mean tree density declined by >80% in both hand and mechanical treatments. In both treatment types, the average mature tree size increased slightly but not enough to change wildlife habitat classification. Surface fuel loads were not reduced significantly in any of the treatment units. Treatment effects on crown fire risk, canopy base height, and understory species richness and cover were also assessed. The results of this work, though still preliminary, suggest that hand and mechanical treatments have different effects on forest structure, wildlife habitat, and key fuel parameters, but their effects are not as predictable as expected.

18. KNAPP, E
U.S. Forest Service, Pacific Southwest Research Station, 3644 Avtech Parkway, Redding, CA 96002

Restoring Understory Diversity in Forests with Thinning and Fire

The spatial complexity of historical forests in California helped to create many different microhabitats, which led to a diverse understory. This spatial complexity also broke up surface and ladder fuels and made crown fires a rarity. In order to both improve the resilience of current forests to wildfire and restore understory diversity, we developed a thinning prescription designed to produce more variability than most standard thinning prescriptions used today. This new prescription is based on our understanding of the scale of organization and patchiness from historical data of mapped stands from the 1920's, as well as the structure of remnant old-growth forests where fire still plays an active role. The outcome will be stands that have more of a group and gap arrangement, with a high degree of variation in canopy cover from dense areas with interlocking tree crowns to openings. It is predicted that this microhabitat variability will maintain or promote understory species that have a broad range of light requirements. Following the thinning with prescribed fire should also promote species that benefit from occasional disturbance.

19. DAILEY, S.
U.S. Forest Service, Adaptive Management Service Enterprise Team, 10811 Stockrest Springs Road, Truckee, CA 96161

Fire Effects in Fuel Treatments and Protected Habitat on the Moonlight Fire, Plumas National Forest

The Moonlight Fire of 2007 burned 64,997 acres, mainly on the Plumas National Forest. The fire burned through areas protected for California spotted owl and goshawk habitat (Protected Activity Centers and home range core habitat), hazardous fuels treatments, silvicultural treatments, untreated areas, private land, and up to the wildland urban interface. Dry conditions, steep topography, large areas of heavy fuel loadings, and frontal winds contributed to intense fire behavior with severe fire effects. The emphasis of the post-fire survey of the Moonlight Fire was on quantitative evidence of fire behavior and effects. Post-fire data sets were compiled from field plots, and satellite imagery. For each data set, various questions were addressed, including: How did evidence of fire behavior and effects differ between broad categories of land status (including owl and goshawk habitat), recent wildfires, treated areas, and untreated areas? Analysis revealed that fire behavior was more intense with greater canopy cover reduction in untreated areas, including protected owl/goshawk habitat, compared to treated areas. Although canopy cover reduction in untreated areas protected as owl/goshawk habitat was not statistically different from other untreated areas, the data illustrate a strong trend toward greater canopy cover consumption in untreated areas protected as owl/goshawk habitat.

20. CHRISTOFFERSON, C.
USDA Forest Service, Plumas National Forest, Feather River Ranger District, 875 Mitchell Avenue, Oroville, CA 95965

Old Growth Forest Restoration: The Management Conundrum and Collaborative Opportunity

Sierra Nevada old growth forests are very rare ecosystems. In 1996, late successional old growth (LSOG) areas were quantified as part of the Sierra Nevada Ecosystem Project. Late successional old growth areas contain the structural forest components which provide habitat for old growth-dependent species. These components include: large diameter trees, large snags, large woody debris, and multilayer canopies. These forests are critically important to wildlife and society as they provide important habitat, aid in ground water recharge, and act as carbon sinks, helping mitigate the effects of greenhouse gasses. On the Lassen and Plumas National Forests, there were approximately 161,105 acres classified as have having old growth properties in 1996. However, since 1996, five percent of these old growth areas have been destroyed by high intensity wildfire. Furthermore, approximately 80% of the old growth areas are at risk from high intensity, stand replacing wildfire. Reducing further loss of these forests is a land management goal in the Northern Sierra Nevada Forests. However, rugged terrain, regulatory issues, and a lack of funding create a "management conundrum."

21. ERTTER, B.
University and Jepson Herbaria, University of California, 1001 VLSB #2465, Berkeley, CA 94720-2465

Changes in *Potentilla* and Relatives: Disjunct Novelties, Resurrected Oldies, One Extinct on Arrival, and a Wood-Beauty Makeover

Work on a revised Jepson Manual has coincided with both preparation of the Rosaceae volume of *Flora of North America* and the publication of molecular phylogenies for *Potentilla* and related genera. As a result, nearly the full gamut of possible changes to these genera will be reflected in the new Manual. This includes the addition of two native species not previously known from California, *Potentilla basaltica* and *P. pulcherrima*. Some previously described entities have been resurrected from synonymy, notably *P. jepsonii* (= *P. pensylvanica* var. *ovium*) and the extremely rare *Horkelia daucifolia* var. *indicta*. *Potentilla uliginosa,* in manuscript for decades, has finally been published for presumed-extinct plants from Sonoma County previously included in *P. hickmanii.* Some other species-level changes include the replacement of *P. diversifolia* with *P. glaucophylla* and the return of *P. breweri* and *P. bruceae* to full species. Molecular-supported generic realignments, a defining feature of the new Manual in general, effectively recapitu-

late the last continent-wide revision of Potentilleae in 1910, resulting not only in *Comarum palustre* and *Dasiphora fruticosa* but also *Drymocallis* (wood-beauties) for *P. glandulosa* and its North American and Eurasian relatives. Rather than simply transferring the subspecies of *P. glandulosa,* the overhauled treatment of *Drymocallis* in the new Jepson Manual consists of six species and an additional six varieties: *Drymocallis cuneifolia* (with var. *ewanii*), *D. glandulosa* (with four varieties), *D. hansenii, D. lactea* (replacing subsp. *nevadensis,* with var. *austineae* replacing misapplied subsp. *ashlandica*), *D. pseudorupestris* (including vars. *crumiana* and *saxicola*), and *D. rhomboidea.*

22. KELCH, D.G.
CDA Herbarium, California Department of Food & Agriculture, 3294 Meadowview Road, Sacramento, CA 95832

Familial Realignment of the Lilies in the New Jepson Manual

Changes are occurring in the familial taxonomy of vascular plants. In the Jepson Manual 2 (TJM2) and other important botanical references, most familial treatments of genera will remain the same. Some families are being merged and a few others divided. Perhaps the most significant changes are in the dissection of the artificial family Liliaceae *sensu lato*. Plants treated in Liliaceae in the TJM1 will be treated in 15 families in TJM2: Agavaceae, Alliaceae, Amaryllidaceae, Asparagaceae, Asphodelaceae, Hyacinthaceae, Laxmanniaceae, Liliaceae, Melanthiaceae, Nartheciaceae, Ruscaceae, Tecophilaeaceae, Themidaceae, Tofieldiaceae, and Smilacaceae. These segregate families are based on phylogenies derived from DNA sequence data. Nevertheless, most were proposed previously based on cryptic morphological characters.

23. COLUMBUS, J.T.*[1] and SMITH JR., J.P.[2]
[1]Rancho Santa Ana Botanic Garden and Claremont Graduate University, 1500 North College Avenue, Claremont, CA 91711
[2]Department of Biological Sciences, Humboldt State University, Arcata, CA 95521

Changing Concepts of Grass Genera in California

Guided by the principles of monophyly and ease of identification (diagnosability), major changes in taxonomic circumscriptions of grass (Poaceae) genera were made for the upcoming revision of The Jepson Manual. Notably, the circumscription of *Stipa* was enlarged to include *Ampelodesmos* and all California species historically treated in tribe Stipeae. Most of the seven Stipeae genera in the first edition of The Jepson Manual are not monophyletic in molecular phylogenetic studies. Given remaining uncertainties about relationships within Stipeae, and taking into account the morphological characters uniting the needlegrasses, we believe reducing the number of genera in the tribe to one (*Stipa*) is the best taxonomic solution. As well, the circumscription of *Festuca* was expanded to include *Lolium* and *Vulpia*. Although *Lolium* is monophyletic in molecular studies, it is nested within *Festuca*, and intergeneric hybridization is known. *Vulpia*, considered a synonym of *Festuca* in the past, is polyphyletic and also nested within *Festuca*. *Lolium* is set apart from *Festuca* by its spicate inflorescence and undeveloped lower glumes (except in the terminal spikelet), whereas *Vulpia* is distinguished by longevity (annuals) and reduction in stamen number. Otherwise, however, spikelets of these two genera are like those of *Festuca*. Other changes include broader circumscriptions of *Distichlis*, *Elymus*, *Hilaria*, and *Muhlenbergia*. In other instances narrower generic circumscriptions were needed. *Vahlodea* is segregated from *Deschampsia* because species in these two genera do not form a clade in phylogenetic analyses. For the same reason, *Dasyochloa* is segregated from *Erioneuron*.

24. KEIL, D.J.
Biological Sciences Department, California Polytechnic State University, San Luis Obispo, CA 93407

Major Changes in the Asteraceae in the Jepson Manual Second Edition

Users of the new Jepson Manual will note many changes from the first edition. Minor modifications in terminology are designed to make keys and descriptions clearer and more accurate. Several Asteraceae genera and species are new additions, as weeds from afar and escapes from cultivation have joined California's flora. A few taxa that were included the first edition are missing from the second; these plants

are apparently not naturalized in California. Nomenclatural corrections have replaced a few familiar names. Major differences between the old and new Jepson Manual Asteraceae treatments have resulted from molecular phylogenetic investigations across the Asteraceae. Revisions in generic circumscription, including some large and well-known groups, have resulted in many new or resurrected names. Some familiar genera are gone entirely or greatly revised. Although the framework of the keys to genera will be familiar to first edition users, all of the keys have been revised to accommodate the many generic changes.

25. SHAFFER, J.P.

University of California, Santa Cruz, 1156 High Street, Santa Cruz, CA 95064

Antifungal Activity of Lichen Extracts: Exploring the Potential for Indirect Protection of Woody Plants From Pathogenic Fungi

Lichens must defend themselves from invasion by microorganisms such as fungi and bacteria. Their evolutionary success has been attributed to the production of secondary metabolites that exhibit antibiotic, antiherbivore, and allelopathic properties. Nevertheless, the ecological impacts of many of these chemicals for lichens or other organisms have seldom been characterized. The possibility that corticolous lichen species could indirectly protect woody plants from plant pathogens through production of inhibitory chemicals is high where lichen coverage of host plants is extensive. Water and acetone extracts of six abundant, corticolous lichen species (*Parmotrema perlatum, Flavoparmelia caperata, Evernia prunastri, Hypogymnia physodes, H. imshaugii,* and *H. tubulosa*) were tested for their inhibition of the growth of a plant pathogenic fungus. In addition to being abundant, these six lichen species synthesize secondary metabolites known to have bioactive properties. Extracts from *F. caperata* were found to be inactive at all concentrations, while extracts from all other lichens successfully inhibited fungal growth. Species' extracts varied in the minimum effective concentration. Water extracts were more effective than the acetone extracts.

26. PETERSON, E.B.

Trinity River Restoration Program, 1313 South Main Street, Weaverville, CA 96093

Mixing of Floristics in California – the Lichen Perspective

We commonly hear that California floristics are a mix of northern, southern, and other elements and what some of the causes might be for this mix. California's lichens are also known to be a mix of geographical elements, though both the patterns and the causes of the mix are less well known than in the case of vascular plants. Resolution of lichen distributions is low and only slowly being clarified by the limited number of lichenologists exploring the region. However, some big-picture patterns are visible. Additionally, molecular phylogenetics of some lichens (mainly outside of California) is beginning to reveal the evolution of lichen species and populations, including timescales that can shed light on patterns in California. Emerging concepts of lichen biogeography at the species and population level even suggest ways to prioritize lichen conservation.

27. JOVAN, S.*[1] and GEISER, L.[2]

[1]Forest Inventory and Analysis Program, USDA Forest Service, Portland Forestry Sciences Lab, 620 SW Main, Suite 400, Portland, OR 97205
[2]US Forest Service, Pacific Northwest Region Air Program, P.O. Box 1148, Corvallis, OR 97330

Using Lichen Communities to Shape Air Pollution Policy in California

Lichens are among the most promising terrestrial receptors for developing conservative critical loads (CL) for North American forests. CLs define the maximum amount of an air pollutant that a bioindicator can tolerate before being harmed. As such, CLs provide benchmarks of ecological harm that may be used to guide pollution permitting and regulation. Over a decade of federally funded research in the west provides us with an increasingly nuanced understanding of how nitrogen (N) impacts the composition of epiphytic lichen communities. Epiphytic lichen communities are by nature highly N-sensitive, which means lichen-based CLs identify deposition targets that convey ecosystem-wide protection. Moreover, the loss of N-sensitive lichen species has broad ecological implications given their dominant role in nutrient cycl-

ing and use by wildlife as nesting material, and winter forage for rodents and ungulates. Lichen communities under N-stress generally experience an influx of small weed-like species ("eutrophs") and loss of native "mesotrophs" and the highly N-sensitive "oligotrophs." The first lichen-based CLs defined for North America, covering mixed conifer forests of the Sierra Nevada and oak/chaparral communities of the Central Valley, are based on this ecologically harmful community shift. We determined a CL of 3.1 kg N/ha/yr was for mixed conifer forests; managing N deposition to beneath this threshold would preempt major loss of the most sensitive oligotrophic lichen, including species utilized by wildlife. Similarly, a CL of 5.5 kg N/ha/yr was determined by Pardo *et al*. (in press) for lichen communities of oak forests; higher deposition sites become dominated by weedy eutrophs.

28. VILLELLA, J.
Siskiyou BioSurvey, 324 Avery Street. Ashland, OR 97520

Lichen Species of Conservation Concern in Northern California

Northern California has a very rich diversity of lichen species and lichen habitats. This talk will focus on the factors that contribute to species rarity in Northern California such as substrate specificity, moisture regimes, forest structure, and lichen biogeography. An overview of the process for designating rarity used by the California Lichen Society will be presented as well as an overview of the species that have been identified as being of conservation concern.

29. WITHAM, C.W.*[1] and ZIKA, P.F.[2]
[1]1141 37th Street, Sacramento, CA 95816-5415
[2]Herbarium, Box 355325, University of Washington, Seattle, WA 98195-5325

The Discovery of *Juncus digitatus*

During rare plant surveys along a pipeline expansion project in 1991-1993, a new annual *Juncus* (Juncaceae section Caespitosi) was collected from two locations in Shasta County. The section Caespitosi is comprised of 16 delicate annuals primarily from South Africa and North America. Eleven members are indigenous to California, including four endemics. A fifth California endemic, *Juncus digitatus*, was described in 2008 (Witham and Zika). This newly discovered species is unique in both being one of the smaller annual *Juncus*, but yet having the longest seed capsules of any Juncus worldwide. Given that only two populations are known to exist, despite years of searching for additional localities, this narrowly endemic species must be considered for a high level of conservation protection.

30. NELSON, J. K.*[1] and LINDSTRAND III, L.[2]
[1]Shasta-Trinity National Forest, 3644 Avtech Parkway, Redding, CA 96002
[2]North State Resources, Inc., 5000 Bechelli Lane, Suite 203, Redding, CA 96002

Genetics, Distribution, and Habitat of a Disjunct Huckleberry from Western Shasta County

An unusual dark-fruited form of *Vaccinium parvifolium* (red huckleberry) is known from several locations in the southeastern foothills of the interior Klamath Ranges, along tributaries to Shasta Lake in western Shasta County, where it often is found associated with old mining activity and extremely acid mine drainage. These inland populations are disjunct from the nearest known extant red huckleberry populations by approximately 40 miles, with the Trinity Alps and other Klamath Ranges lying between them. The inland plants grow in a distinct, much less mesic habitat than does the coastal red huckleberry. In order to determine whether these Shasta County populations of *Vaccinium* are genetically distinct from typical red-fruited coastal *V. parvifolium*, a total of 20 populations were sampled for microsatellite analysis. Samples were collected from the focal populations in western Shasta County; typical red-fruited *V. parvifolium* from the neighboring coastal areas of northwest California, the Coast Range of Oregon, and the Puget Trough of Washington; and from distant populations of anomalous dark-fruited *V. parvifolium* in the Sierra Nevada, and one population of *V. deliciosum* from Shasta Bally, the nearest *Vaccinium* to the Shasta Lake populations. Analysis of five microsatellite loci identified high levels of genetic differentiation between populations in the coastal areas and Sierra Nevada mountains. The Shasta County populations of *Vaccinium* were distinct from both geographic regions, but more similar to the Sierra Nevada collections and *V. deliciosum* than to the coastal collections.

31. CLINES, J.,*[1] COLWELL, A.E.L.,[2] and FARRAR, D[3]
[1]USDA Sierra National Forest, 57003 Road 225, North Fork, CA 93643
[2]Yosemite National Park, Resources Management & Science, 4053 Foresta Road, El Portal, CA 95318
[3]Iowa State University, Department of EEOB, 253 Bessey Hall, Ames, IA 50011

A New Understanding of Rare *Botrychium* Ferns (Moonworts, Ophioglossaceae) and their Habitat Requirements in California Resulting from Targeted Studies over the Past Decade

The USDA Forest Service began working with Dr. Donald Farrar of Iowa State University and Dr. Cindy Johnson-Groh of Gustavus-Adolphus College in 2001 to conduct a Conservation Assessment for rare moonworts in the National Forests of California. In 2002, the Forest Service assembled a comprehensive database of all historic *Botrychium* locations in California, including the common *Botrychium simplex*, and then attempted to visit as many of these sites as possible to determine whether other, rare species were present but had been overlooked. Working with state, federal, and private partners across property ownerships, many additional locations of rare species have been confirmed as well as several species previously unknown in California. From this exercise, an improved understanding of the distribution, rarity, and habitat requirements of moonworts has emerged: the rare moonworts are found almost exclusively on substrates derived from carbonates, volcanics, or occasionally on granitics where there is mineralized seepage, whereas *B. simplex* is common on granitics. Furthermore, although these tiny ferns are more frequent in montane habitats of California than previously supposed, concern for their viability remains an issue, due to the low number of documented occurrences, low number of individuals per occurrence, and small size of known sites. Furthermore, they occur in tiny, mixed species patches that would be overlooked in the course of a standard botanical survey. A protocol for finding rare moonworts will be presented, using geologic maps, aerial photos, and associated plant species.

32. HARDER, D.K.
Santa Cruz Museum of Natural History, 1305 East Cliff Drive, Santa Cruz, CA 95062
California Academy of Sciences, 55 Concourse Drive, San Francisco, CA 94118

New Species of Violets from the Santa Cruz Mountains

Recent field studies have uncovered and verified the existence of at least a pair of new species in the genus *Viola* from the Santa Cruz Mountains. Ray Collett, professor emeritus and founding director of the UCSC Arboretum, first recognized the occurrence of these new taxa in early 2006. Collett has provided extensive information on these species online yet has not legitimately published their names and descriptions. Extensive field surveys over the past two years suggest at least two new taxa exist within coastal ranges in remnant populations often at the base of steep canyons under shade of mixed forest types of evergreen hardwood, redwood, and Douglas fir. Remarkably, despite the widespread occurrence of these species locally in more than a dozen localities and under considerable historic collecting activity, recent collections of these plants represent the first known specimens for California herbaria. The combination of characters of the stigma and style, the extent of bristle/hairs on lateral petals at the throat, leaf shape, stipule morphology, petal shape and position, caulescent stems, and strong fragrance distinguish these new taxa from known species. These, yet unnamed, taxa need protection as both are rare and endangered. Oral reports of life-long residents within the range of these species suggest these violets were once more widespread following the opening of the forests through logging and grazing activities. Two endemic butterfly species from the Santa Cruz Mountains, *Speyeria coronis coronis* (Coronis Fritillary) and *Boloria epithore epithore* (Western Meadow Fritillary) require species of *Viola* as a larval food plant. Modern observations show that these two butterfly species have become increasingly rare within the ranges of these *Viola* species. The author is completing the descriptions and moving towards publication of these new *Viola* species while also investigating the possibility of possibly two other species of *Viola* and other taxa from the Santa Cruz mountains.

ABSTRACTS FOR POSTERS

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

1. AKULOVA-BARLOW, Z.

LSA Associates, Inc., 157 Park Place, Pt. Richmond, CA 94801

A Diversity of Fruit and Seed Dispersal Methods in California *Asteraceae*

A large photo collection of Asteraceae fruit that occur in California was created to help identify the members of the family and better understand the morphological structure of the fruit. Photos were taken during 2006-2010 either through a dissecting scope in the lab and in the field throughout California, including the University of California Botanical Garden and the Tilden Regional Parks Botanic Garden, both at Berkeley. Seed dispersal methods are important for a species ability to colonize new areas. Seeds of California Asteraceae disperse mostly by wind, but sometimes by water, birds, or animals. The technical term of the fruit is cypsela, or achene. The cypsela is variable; it may have tubercles, ribs, hairs, or other characteristics. Often the fruit has a pappus, a modified calyx attached to the fruit, which helps the fruit to disperse. A pappus of bristles is the most common type. Awns, or large bristles, also form the pappus of some Asteraceae. A pappus of scales occurs in many Pacific Northwest endemics. Sometimes the scales are reduced to a crown. A combination of scales, awns, or bristles can occur on the same cypsela. Some species have two different types of pappi on the same head.

2. ALLEN, G.A.[1] and HARTWELL, G.W.[2]

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Out of the Ashes: A Novel, Distinctively-Colored Fawn Lily from a Serpentine Habitat in Butte County, California

Although the California fawn-lilies are a well-known and showy group of plants, field exploration in California over the last two decades continues to turn up new species and races. A new form of *Erythronium* closely related to *E. multiscapideum* is reported here. It was found on serpentine soils near the Butte County community of Concow in the first winter following the 2008 Butte Lightning Complex Fire. The plant resembles *E. multiscapideum* in most features, including branching pattern of the inflorescence, but is distinguished by pinkish to purple anthers, pinkish style and stigma, and pink-tinged tepals. We compared DNA sequence data (the nuclear ITS region, 625 base pairs in length; and three chloroplast spacer regions, with a combined length of 1959 base pairs) from this new race with that of other western North American *Erythronium* species. In molecular characters it closely resembles *E. multiscapideum*, diverging from this species by only 1 or 2 differences in our analyses. This new race has a distinct combination of floral features and may merit description as a new variety of *E. multiscapideum*.

3. AYRES, D.,[2] WILSON, J.L.,[1] STEINMAUS, S.,[3] and BAAD, M.[4]

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Vegetation and Flora of a Biodiversity Hotspot: Pine Hill, El Dorado County, California, USA

Pine Hill lies near the center of a gabbrodiorite intrusion in the foothills of the Sierra Nevada mountain range in El Dorado County, CA. We assembled an extensive flora, examined the distribution and associations of vascular plant taxa, and specifically focused on associations of six rare plant taxa on soils derived from gabbro, serpentine, granite and metamorphic substrates within and adjacent to the intrusion. The in-

fluence of environmental variables on plant distribution was investigated using a stratified random plot sampling technique and applying canonical correspondence analyses. The site contained over 10% (741 plants) of the flora of the entire state of California including seven rare species. Species segregated into chaparral, oak woodland, and grassland communities. In chaparral and woodland, and on serpentine sites, over 75% of the flora was comprised of native species. The non-serpentine grassland community was dominated by exotic species (64% exotic) and contained no rare species. Shrub and tree cover were the most important biotic factors associated with plant species distribution. The most important abiotic factors were serpentine substrate, elevation, soil texture, and degree of disturbance. Five rare species were restricted to gabbro soils. Our analyses identified two types of chaparral which we termed "Xeric Seeding" and "Mesic Resprouting" to reflect the environmental conditions and the fire regeneration strategy of the vegetation. Significantly, each chaparral type contained a different assemblage of rare species whose regeneration strategies were concordant with chaparral regeneration type. This has important implications for preservation of the rare taxa.

4. BRUSATI, E., JOHNSON D., POWELL, C., and SCHUETZENMEISTER, F.

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Predicting the Spread of Invasive Plants with Climate Change

The Sierra Nevada is likely to be heavily impacted by climate change. Invasive plants are predicted to spread into the region and to higher elevations. Land managers need to know where to focus their work to produce the most effective ecosystem restoration. Predictive models can help early detection by showing where invasive plants may spread and predicting the effects of changing conditions under global climate change scenarios. Such predictions are especially important in light of research showing that 66% of California's native plants could lose 80% of their ranges due to climate change (Loarie *et al*, 2008). Land managers can also use these data to justify projects to funding agencies. In 2006-08, we examined 36 invasive plants statewide. We are currently studying 30 additional plants of concern in the Sierra region and improving the resolution of the results using new methods. This project will be completed in 2011.

5. CALLAHAN, K.I.

Redbud Chapter, California Native Plant Society, 13896 Jesse Lane, Grass Valley, CA 95945

What Grows Here? Building a Local Flora for Nevada and Placer Counties, California

Gordon H. True (1908-1984) wrote The Ferns and Seed Plants of Nevada County, California, which was published by the California Academy of Sciences in 1973. His checklist included 1,762 species, with over 700 voucher collections at the Academy. Fortunately for those following in his footsteps, True recorded the plants' locations, generally to a natural feature or crossroad. Gordon True's checklist was invaluable as the basis for Wildflowers of Nevada and Placer Counties, California co-published by Redbud Chapter, California Native Plant Society (CNPS) with CNPS Press in 2007. The flora of Placer County was added to the original checklist from field surveys, regional books, herbarium records, information from public agencies (Forest Service, State Parks, BLM), and Internet research. *Shrubs, Trees, and Woody Vines of Nevada and Placer Counties* is the working title for the second volume from Redbud Chapter. The second book will have an updated plant list and add new information about plant distribution over the 2,262 square miles of our two northern Sierra Nevada counties. Photography is an important part of documenting our local flora. I am one of the twelve volunteer authors and editorial board members. A gallery of my photographs of selected shrubs is presented here as a preview of the upcoming Redbud book.

6. CHRISTIAN, C.E.,[1] PARISH, M.J. ,[2] and CARLETON, A.[2]

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[2]Department of Biology, Sonoma State University, Rohnert Park, CA 94928

Community-Level Responses of Grassland Assemblages to Mowing and Herbicide Treatments to Control a Perennial Grass Invasion

The dramatic invasion of California grasslands by non-native annual plants has been studied extensively. However, recent attention has turned to managing the growing number of invasive perennial grasses that

further threaten California's grasslands. Using a factorial experiment, we are evaluating effects of fall and spring mowing and late-season herbicide (glyphosate) application on the performance of Harding grass (*Phalaris aquatica*) and co-occurring native and exotic forbs. Our data show that forb richness is negatively associated with Harding grass invasion, but control efforts have mixed outcomes for the resident community. Fall mowing resulted in a 22% increase in frequency of exotic annual forbs and 28% decrease in native annual forbs. Mowing produced a trend towards increased richness in exotic forbs, but had no effect on native forb richness. Mowing did not affect the frequency of Harding grass, although herbicide increased mortality rates. In a separate greenhouse study, we are evaluating life history differences between Harding grass and wild rye (*Elymus glaucus*), a native perennial grass often used in restoration, to evaluate the hypothesis that priority effects may be a factor limiting establishment of this native plant species. Results indicate both species have similar germination rates, but wild rye has significantly greater growth rates at this life cycle stage. After transplanting seedlings into experimental plots, future research will measure demographic responses of Harding grass and wild rye to seasonal mowing and herbicide, and continue to evaluate community-level responses.

7. DEAN, E.,[1] THOMSEN, C.,[2] HARRINGTON, G.,[1] and ALDERSON, J.[3]
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Initial Floristic Prospecting in the BLM Cache Creek Wilderness, Lake County, CA

The Bureau of Land Management's Cache Creek Wilderness is a roadless natural area in Lake County with unexplored botanical resources. In 2010, with funding from the National Landscape Conservation System, preliminary surveys for special-status plants were conducted during eight visits to the Wilderness. We mapped eight CNPS list 1B and five CNPS list 4 plants in the Wilderness and encountered many rare plant communities and fascinating landscapes. Most of the special-status plants that we mapped were on serpentine influenced substrates. A large serpentine barren with waterfalls and serpentine riparian vegetation is present near the southern border of the Wilderness, one of many areas in the Wilderness that need further exploration.

8. DE GROOT, S.
Rancho Santa Ana Botanic Garden and Department of Botany, Claremont Graduate University
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Morphometric Analysis of the *Eriastrum tracyi – E. brandegeae* Species Complex (Polemoniaceae)

Eriastrum tracyi is a California State-listed Rare plant thought to be restricted in and around Trinity County, California. Recently, it was proposed that this species also occurs in Santa Clara County, Shasta County, and the southern Sierra Nevada. Additionally, it is frequently confused with *E. brandegeae*, which also occurs in the North Coast Ranges. Field observations suggest that there is more variation than can be described by only two species. In an attempt to discern how many species there could be in this complex, this study employed morphometric data sampled from 26 sites across the range of the species complex. Data were analyzed with standard multivariate statistics and GIS. Preliminary results suggest that each site is morphologically unique, but otherwise there is no apparent geographic or taxonomic pattern.

9. DORAN, A., KASAMEYER, A., and BEIDLEMAN, R.
University and Jepson Herbaria, University of California, Berkeley, 1001 Valley Life Sciences Building, Berkeley, CA 94720

Cataloging Hidden Archives of Western American Botany and Beyond: The On-line Archives of the University and Jepson Herbaria

The end result of this project will be a searchable, online database of our archives, one of the primary resources for the history of western American botany from the 1860's on. The archives of the Herbaria con-

tain letters and field books of at least 200 individuals in addition to documents, photographs, slides and correspondence. This collection fills in gaps in the history of the California Academy of Sciences, whose records were destroyed in the 1906 earthquake. The geographic scope of the archives is world-wide, including seven trips to South America. Highlights from the archives include renowned botanist Willis Jepson's papers including 62 field books, research books and 25,533 letters in 52 volumes; John and Sarah Lemmon's correspondence, field books and manuscripts, including veteran J. Lemmon's sketches of Confederate prisons; and Dr. Lincoln Constance's extensive correspondence with university faculty and botanists world-wide. Our correspondents range from Asa Gray and William Hooker, to John Muir. Subjects encompass the formation of Sierra Club and Save-the-Redwoods League. The image collection represents an historical record of people, plants and ecological sites and is being made available on-line. This poster documents our progress to date in improving digital and physical access to these unique resources.

10. ESTES, B.L.,[1] KNAPP, E.E.,[1] PERKINS, J.L.,[2] and SKINNER, C.N.[1]

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Effects of Prescribed Fire and Season of Burn on *Cypripedium montanum* Habitat

Cypripedium montanum is a rare plant that occupies a wide range throughout the Northwest, but is found in isolated populations. Because of its shallow rhizome, it is potentially vulnerable to high-severity fire. As a result, fuels management including prescribed fire is often avoided. However, the presence of fire-scarred trees in close proximity to *C. montanum* plants suggests that populations were once resilient to fire. In order to determine the effect of fire on the plants, prescribed burning treatments were conducted in plots (≈78.5 m²) in June 2010 (spring) and September 2010 (fall). Pre- and post-fire and fuel characteristics were observed. Temperature and residence time were measured using thermocouples at the surface and 2.5, 5 and 10cm from the top of the forest floor. Fuel loading and duff consumption were greater in the spring burns, although more large-diameter fuels were consumed in the fall burns, due in part to lower fuel moisture. No differences in peak temperature were noted at the surface, but residence time that exceeded 60°C (threshold for cellular death) was greater in the spring burns. Maximum temperature was higher and residence time longer in the forest floor during the spring burns, which correlated with lower duff moisture content. No differences in the heat pulse into the soil at either 5 or 10cm were noted, as soil moisture was nearly equivalent. In order to determine the effects of both seasons of prescribed fire on the plants, survival and growth will be assessed in 2011.

11. FISCHER, R.D.

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Bidwell Park, Chico's Botanical Heritage

This presentation is an outreach poster highlighting Bidwell Park, an original 1905 land grant to the people of Chico. The park is now 3670 acres, nearly 11 miles long, and the 14th largest city owned park in the United States*. Big Chico Creek runs the length of the park and on through the heart of Chico. "Upper Park," where all poster photographs were taken, begins at the northeast edge of Chico and winds five miles into the southern Cascade Range foothills. Elevations for this portion of the park go from nearly 250 feet to 1550 feet. Vegetation types are largely supported by soils derived from volcanic mudflow. Increasing the park's vegetative expression are exposures of an older basalt flow and deposits of marine sediments. Upper Park habitats range from vernal pools on the alluvial floodplain, to deep-soil Valley oaks, Blue oak savannas, steep canyon riparian, canyon terraces with dry, wet or northwest aspects supporting Gray pine, Black oak, and Big leaf maple respectively, and ending with thin, rocky soil on upper slopes and ridges supporting Buckbrush-Scrub-oak chaparral. Nine percent of all species to be listed in the Jepson Manual's 2nd Edition can be found in the five square miles of Upper Bidwell Park. The floral diversity quoted in the poster reflects only the taxa identified for this upper portion of the park, and not the lower, more urban, green belt.

(*Trust for Public Land, Center for Park Excellence, www.tpl.org/ccpe).

12. FRAGA, N.S.

Rancho Santa Ana Botanic Garden and Claremont Graduate University. 1500 North College Avenue, Claremont, CA 91711

An Overview of the *Mimulus montioides* and *Mimulus palmeri* Species Complexes (Phrymaceae)

At least 66 species of *Mimulus* are currently listed by U.S. government agencies and native plant societies as sensitive, rare, or endangered, making *Mimulus* a group of conservation concern. However, species delimitation and taxonomic relationships in *Mimulus* remain unclear, with 90 to 170 species recognized. In many recent regional treatments of the group, some previously recognized rare species with limited distributions have been lumped with more common species. Taxonomic confusion in *Mimulus* persists in part because diagnostic floral characters are often obscured when plants are pressed and dried for preservation as museum specimens. These easily obscured characters are informative in understanding species diversity and delimiting species boundaries within the genus. A primary objective of my dissertation research is to resolve taxonomic issues and identify taxa that are in need of conservation. Because previous taxonomic treatments in *Mimulus* have been based primarily on study of herbarium specimens, more field studies are needed. Over the course of my work I have conducted extensive field research and photographed and collected data and plant material from more than 60 populations. As a result, I have identified five undescribed species of *Mimulus*.

13. GOSEJOHAN, M.C.,[1] [2] WEISBERG, P.J.,[1] and MERRIAM, K.E.[2]

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[2]USDA Forest Service, Plumas National Forest, 159 Lawrence Street, Quincy, CA 95971

Effects of Livestock Use and Hydrology on *Orcuttia tenuis* and Vernal Pool Plant Communities

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 grass federally listed as endangered and state listed as threatened. In its northern range on the Modoc Plateau, primary threats to *O. tenuis* conservation are thought to be livestock use and changes in vernal pool hydrology; however, little is known of the effects of these processes. In 2009, we began data collection to determine the effects of grazing on *O. tenuis*, but preliminary analyses found that grazing alone did not explain *O. tenuis* density or seed production. Therefore, an evaluation of vernal pool hydrology and its potential interaction with grazing practices may be critical in determining the habitat requirements of *O. tenuis.* Our research examines the effects of livestock use and hydrology in vernal pools by evaluating interactions among: 1) pool inundation length and drawdown rate; 2) intensity and seasonality of livestock use; 3) plant community distribution; and 4) population dynamics and seed distribution of *O. tenuis*. We use a combination of approaches covering a range of spatial scales, including a field experiment involving paired exclosure and control plots, an extensive landscape-level survey of vegetation composition and surface soil characteristics, and remote photography to quantify pool hydroperiod and livestock use patterns. Our research will provide recommendations for grazing management and hydrological restoration to promote habitat for *O. tenuis* and other specialized vernal pool species.

14. GOTTSCHALK-FISHER, E.,[1] SILVEIRA, J.G.,[2] GRIGGS, F.T. ,[3] SCHIERENBECK, K.A.,[1] and HATFIELD, C.A.[1]

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[3]River Partners, 580 Vallombrosa Avenue, Chico, CA 95926

Evaluating Introduction Approaches for *Neostapfia colusana* and *Tuctoria greenei* at the Sacramento National Wildlife Refuge Complex

Vernal pool habitats and associated plant and animal taxa have been significantly reduced by conversion to agriculture and urbanization. As a result, a number of vernal pool-dependent species have become

rare; this is true for several grasses, including *Neostapfia colusana* (Colusa grass) and *Tuctoria greenei* (Greene's tuctoria). The goal of this research is to examine the potential for introductions of rare grasses into vernal pools. The purpose of the first year (spring and summer 2010) was to gather physical and biological data on the study/restored and reference sites to inform the species introductions. We measured dry-down to compare hydrology, mapped the locations of Colusa grass and Greene's tuctoria in the reference pools, conducted surveys of the vegetation communities in each of the pools, and observed general phenological trends. We will use this knowledge of the two species and habitats, along with pool topography and greenhouse experiments, to inform our introductions so that we can identify the most suitable habitats for the species introductions. The results of this project will increase knowledge and guide restoration efforts for recovery activities for these species, as well as contribute to vernal pool restoration efforts in general.

15. HAMMOND, J.E.[1] and GRIGGS, F.T.[2]
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Long Term Monitoring of Horticultural and Ecological Performance of Riparian Restoration Plantings along the Sacramento River, California, USA

The loss of much of the historic riparian habitat in the western United States has resulted in the decrease and extirpation of many once-common species, and has stimulated large-scale restoration efforts in this region to preserve and enhance remaining biodiversity and ecosystem function. Current ecological conditions on most rivers in this region, where the historic hydrographs are altered and flows are highly regulated, no longer support the natural establishment of many native species and instead promote the establishment of non-native species that provide limited wildlife value. Horticultural restoration of riparian forests uses an active restoration approach that promotes the rapid establishment of native tree and shrub species to create self-sustaining and resilient habitat for target wildlife species. While monitoring documents the success of these efforts during the period of active management (i.e. weed control and irrigation), little has been done to evaluate the horticultural performance of these plantings years after the project management period is over. This study begins to answer this question by examining structural and vegetative community composition change through time at several restoration sites on the Sacramento River. Our results indicate that restored forests are demonstrating successional processes in as little as 8 years, documenting recruitment of new species and changes in plant community structure and composition.

16. HANSON, T.,[1*] CASTRO, B.,[2] SCHLISING, R.,[1] WOOD, D.,[1] and HATFIELD, C.[1]
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Presence of Invasive Species Results in Significant Decrease in Reproductive Output of a Rare California Endemic Plant

Although the negative effects of invasive plant taxa on native plant diversity are widely recognized, many details about these ecological interactions remain unknown. The effect of invasive species on rare native plant taxa is of special importance due to the precarious position many of these plants hold in their respective communities. In this research, we study the effect of invasive plants on the growth and reproductive output of the rare California endemic *Monardella venosa.* In order to assess this interaction, a split plot design was used consisting of an invasive removal sub-plot and a control sub-plot. Invasive plant removal resulted in a significant decrease in growth rate and a significant increase in reproductive output of *M. venosa* when compared to control plots. These results are indicative of plants competing for light resources, which is evident in this system by the overgrowth of *M. venosa* by invasive taxa. This research serves as an important step in understanding the relationships between native and invasive plants and helps to inform conservation efforts of rare plant taxa such as *Monardella venosa.*

17. HA, M. and IVEY, C.
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The Influence of Flowering Time on Pollinator-Mediated Interactions between *Clarkia unguiculata* (Onagraceae) and its Neighbors

Competition and facilitation between plants can be mediated by pollinators, and these interactions can shape selection for reproductive traits such as flowering time. *Clarkia* (Onagraceae) congeners may facilitate their pollination through synergistic attraction and maintenance of their specialist pollinator bees. Earlier flowering species may attract and support populations of specialist pollinators, thereby ameliorating the pollination environment of later flowering *Clarkia* plants. Because the later-flowering *C. unguiculata* enjoys efficient pollination by specialist bees, we hypothesize that competition with plants visited primarily by generalist pollinators exerts little selection on its flowering time. We will employ factorial experiment in which early- and late-flowering *C. unguiculata* plants are grown in one of three conditions: (a) alone, (b) with the generalist bee-pollinated *Monardella lanceolata* (Lamiaceae), or (c) with *Clarkia purpurea* ssp. *purpurea*. To evaluate indirect interactions among plants in the arrays for access to pollinators, we will compare seed production in open-pollinated *C. unguiculata* plants with plants that have received supplemental pollen (i.e., whole-plant pollen limitation for seed set). Decreased pollen limitation in arrays containing the congener *C. p.* ssp. *purpurea* would suggest that shared pollinators facilitate increased seed set in these species. Greater pollen limitation in early-flowering *C. unguiculata* arrays regardless of the presence of *M. lanceolata*, a potential competitor for generalist pollinators, would support the hypothesis that interspecific competition for generalist pollinators exerts weak selection on flowering time in species that employ specialist pollinators. In addition to exploring *Clarkia*'s distinctive ecology, this study will broaden understanding of how biotic interactions select for reproductive traits.

18. HARTOONI, N.,[1] GUILLIAMS, C. M.,*[2] and BALDWIN, B.G.[2]
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Phylogenetic Relationships and Chromosome Evolution in the Genus *Lewisia* (Montiaceae), Based on DNA Sequence Data (ITS, ETS, *rps16*, *trnL-trnF*)

The genus *Lewisia* comprises between 25 and 30 taxa of perennial flowering plants in the Montia family, or Montiaceae. This variable, western North American genus has been the subject of three recent monographic treatments, each of which has proposed slightly different infrageneric classifications. Molecular phylogenetic data have been lacking to resolve evolutionary relationships and evaluate these classifications, however. Here we examine evolutionary relationships in the genus *Lewisia* using DNA sequence data from the internal and external transcribed spacer regions of the nuclear genome as well as *rps16* intron and *trnL-trnF* intergenic spacer regions of the chloroplast genome. Sequence data have been obtained for nearly all recently recognized *Lewisia* taxa and for many outgroups in the Montiaceae, including *Calandrinia*, *Calyptridium*, *Cistanthe*, *Claytonia*, *Lenzia*, *Lewisiopsis*, *Montia*, *Montiopsis*, and *Phemeranthus*. Hypotheses of relationships in *Lewisia* resulting from phylogenetic analyses are congruent with some elements of each of the previous classifications. *Lewisia* is recovered as a monophyletic group with strong support in all analyses, and several clades within the genus are resolved. Chromosome base number was evaluated using ancestral character state reconstruction. Although some chromosome counts are missing for terminal taxa, a base number of x = 14 appears likely, with decreasing dysploidy and multiple polyploidization events evident. Increased taxon sampling within *Lewisia* and inclusion of additional DNA regions in analyses are likely to improve phylogenetic understanding and allow for a more definitive evaluation of previous classifications.

19. HUSSEY, R. and LAMBRECHT, S.
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Floral Variability in *Leptosiphon androsaceus* across a Moisture Gradient

Understanding the range of biotic and abiotic selection pressures on plant morphology and physiology elucidates the evolution of biological diversity. Selection pressures may be antagonistic; for example, the optimal flower size for pollinators may actually decrease fitness in some environments due to the transpiration costs of flowering. Field measurements of *Leptosiphon androsaceus* (Polemoniaceae) from 2005 to 2008 along a naturally-occurring moisture gradient in Henry Coe State Park indicate a positive correlation between flower size and moisture availability. Results also suggest variation in flower size is heritable, but the degree of heritability is in need of further investigation. The objective of this study is to examine the degree to which floral variation across this moisture gradient is heritable by conducting a greenhouse experiment. *Leptosiphon androsaceus* seeds collected from field sites in May of 2010 will be germinated in the greenhouse. Plants will be hand-pollinated to create family lines to observe heritability of floral size and other morphological and physiological traits. Individuals from each of the families will be grown under either moist or dry conditions to observe within-family response to moisture availability. We expect larger flowers on plants grown under moist conditions compared to those in dry conditions. Field measurements indicate greater plasticity in plants growing in dryer areas. So, even though there seems to be a genetic component to the variation in flower size between wet and dry climates, greater plasticity is observed in environments where fitness is compromised by greater fluctuations in water availability.

20. KEEVER, M.E.,[1] FIEDLER, P.L.,[2] and SARROW, J.[3]
[1]Stillwater Sciences, 2855 Telegraph Avenue, Suite 400, Berkeley, CA, 94705
[2]UC Natural Reserve System, 1111Franklin Street, 6th Floor, Oakland, CA 94607
[3]Napa County Flood Control and Water Conservation District, 804 First Street, Napa, CA 94559

Mason's Lilaeopsis: Ten Years Monitoring a Metapopulation on the Napa River

Beginning in 2000, Napa County Flood Control and Water Conservation District initiated a long-term rare plant monitoring effort to investigate the effects of flood protection construction in the lower Napa River ecosystem, and to mitigate for impacts of the Flood Protection Project on populations of the rare *Lilaeopsis masonii* (Mason's lilaeopsis). From 2001–2010, annual *Lilaeopsis masonii* monitoring in all impacted stream reaches was conducted and population trends were analyzed. Final 2010 results indicate a very robust *Lilaeopsis masonii* metapopulation; this rare plant species colonized and flourished in the newly created habitat on the restored Napa River floodplain, primarily within depositional areas with greater hydraulic complexity and slower velocities. The final 2010 monitoring year documented 118 *Lilaeopsis masonii* occurrences with total combined square footage of 8,963 ft^2, well above the targets established by CDFG of 69 occurrences across 4,036 ft^2. This represents a 74% increase in the number of occurrences and a 13% increase in areal extent compared to baseline (2001) measurements. In addition to the annual population monitoring, molecular genetic studies conducted revealed that *Lilaeopsis masonii* is not sufficiently genetically distinct from its most closely related sister taxon, the common *L. occidentalis*, to warrant a separate taxonomic status. Over the ten years, large inter-annual fluctuations in the number of populations and areal extent were documented; small patch populations established and extinguished in what appeared to be an unpredictable pattern. This demonstrates the importance of conducting long-term monitoring when trying to understand the population dynamics of a metapopulation.

21. KIDDER, A.G.*, DAWSON, T.E., and MCBRIDE, J.R.
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Water Relations of *Baccharis pilularis* DC. within the Northern Central Coast of California

Woody plant encroachment into grasslands is a worldwide phenomenon. *Baccharis pilularis* DC. (or baccharis), a woody perennial shrub native to California, is invading rare coastal grasslands found along the

northern central coast. We hypothesize coastal fog helps ameliorate the effects of California's summer drought, thereby aiding baccharis seedling establishment into coastal grasslands. In this first of several experiments we investigated the physiological response of baccharis seedlings to drought stress by exposing baccharis seedlings to contrasting watering treatments. Half the plants were watered and half were allowed to "dry down" over time to mimic California's rainless summer drought. For both sets of plants we measured transpiration and performed a series of pressure-volume curves for information about baccharis seedling bulk tissue relations under drought stress. Seedlings reduced their transpiration with increased drought, most likely to stem photosynthetic activity to prevent water loss. As expected in drought tolerant plants, we found that baccharis seedlings osmotically adjust their cell solutes to maintain adequate turgor pressure in response to drought, as both the osmotic potential at full hydration and the turgor loss point decreased during the course of the experimental drought treatment. Further, the bulk modulus of elasticity (cell wall elasticity) decreased with increasing drought as expected to maintain turgor pressure with less water. These results are guiding further experiments of baccharis seedling response to drought stress and a fog water subsidy, both alone and in the presence of perennial grasses. These experiments should aid in better understanding baccharis' success as an invader in coastal grasslands.

22. KLEINHESSELINK, A. and CUSHMAN, J.H.
Department of Biology, Sonoma State University, Rohnert Park, CA 94928

Influence of a Native Moss on the Germination and Growth of Two Exotic Grasses along an Environmental Stress Gradient

The stress-gradient hypothesis (SGH) proposes that facilitative interactions among plants are more likely as environmental stress increases. This could be particularly important for non-native plant invasion in harsh environments. We evaluated the hypothesis that a native bryophyte, *Syntrichia ruralis*, facilitated two non-native annual grasses, *Vulpia bromoides* and *Bromus diandrus*, in a northern California coastal dune using a moss-removal experiment (moss present, moss removed, or naturally absent). We also tested the SGH by replicating this experiment at the endpoints of an environmental stress gradient driven by wind and soil moisture (low and high stress). We found that moss significantly increased the germination rate of both species, with the beneficial effects on *Bromus* being greater with increasing environmental stress, as predicted by the SGH. At low stress moss had opposing effects on biomass of the two species, increasing *Vulpia* biomass, but reducing *Bromus* biomass. At high stress, however, moss had no effects on biomass of either species. Surprisingly, instead of finding higher biomass at low stress, there was a trend for both species to have higher biomass at high stress. Our results provide mixed support for the SGH, but show that mosses, common but often overlooked components of native vegetation, can have important positive and negative effects on the process of invasion by non-native vascular plants.

23. KNIGHT, M.[1] and KANIM, N.[2]
[1]U.S. Forest Service, Klamath National Forest, 11263 N. Highway 3, Fort Jones, CA 96032
[2]U.S. Fish and Wildlife Service, Yreka Office, 1829 S. Oregon Street, Yreka, CA 96097

Conserving the Siskiyou Mariposa Lily: Dyer's Woad Management

Dyer's woad (*Isatis tinctoria*), a State of California B-rated Noxious Weed, is the major threat to the Siskiyou mariposa lily (*Calochortus persistens*), a species that is restricted to three locations in NW California and SW Oregon. *Calochortus persistens* is designated as a candidate species by the U.S. Fish and Wildlife Service (FWS), a sensitive species by Region 5 of the U.S Forest Service (USFS), a rare species by the State of California, and a critically imperiled species by the State of Oregon. The FWS' Yreka office and the Klamath National Forest have drafted a Conservation Agreement to remove or reduce the threats to *C. persistens*. A partnership with the Siskiyou County Department of Agriculture and the California Conservation Corps has been formed to implement the strategy to control the dyer's woad infestation. Roadside non-chemical treatment was initiated the first year concurrently with the experiment to test the effectiveness of various treatment methods in unoccupied habitat. Three replicates of four different treatments (hand digging, clipping, herbicide application [Telar*/2,4-D mix], and untreated control) were repeated over 3 years, on plots 20 by 25 ft. The results, measured by visual estimation, indicate that chemical methods are very effective, averaging 98% control of dyer's woad. Hand digging achieved 90% control and clipping averaged 33% control over the time period of the experiment. Based on these re-

sults, chemical treatment of dyer's woad on private lands within the *C. persistens* management area boundaries has begun.

(*The mention of trade names or commercial products is solely for providing specific information and does not imply recommendation or endorsement by the USFS or FWS.)

24. LAZZERI-AERTS, R. and RUSSELL, W.

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Resistance and Resilience to Fire in the Coast Redwood Forests of the Santa Cruz Mountains, California

Fire plays a central role in determining structure, composition, and recruitment in many forest types. In coast redwood forests, the role of fire is not well understood, particularly in the southern part of the range. We collected data on survivorship and post-fire regeneration in order to determine how *Sequoia sempervirens* responds to fire. Additionally, we were interested in how the coast redwood forests fare compared to adjacent forest types in terms of mortality and regeneration. We collected data using randomly selected ten-meter diameter sample plots located on three sites in the Santa Cruz Mountains that experienced fire in 2008 or 2009. Data collected included mortality, tree height, DBH, scorch height, percent residual and regenerated canopy cover by species, and the number of basal sprouts and seedlings by species, as well as environmental factors such as slope and aspect. Coast redwood trees had the lowest mortality levels, highest crown survival, and greatest regeneration. Overall, redwood basal sprouts and redwood seedlings far outnumbered those of associate tree species. However, there was high variability between sites. This variation may be attributed to differing soils, distance from the ocean, different land uses, or a combination of factors.

25. LINDSTRAND III, L., VAN SUSTEREN, J., and YOUNGBLOOD, G.

North State Resources, Inc. 5000 Bechelli Lane, Suite 203, Redding, CA 96002

2010 Shasta Eupatory (*Ageratina shastensis*) Resurvey Project, Shasta-Trinity National Forest

Shasta eupatory (*Ageratina shastensis*) is a rare plant endemic to the southeastern Klamath Mountains in Shasta County, California. This species is protected by the Shasta-Trinity National Forest (STNF) Land and Resource Management Plan and currently holds a California Rare Plant Rank of 1B.2. Between 15 and 18 historically documented Shasta eupatory populations occur, and most have not been revisited or monitored for 15 to 35 years. Recent surveys in the known species range have resulted in only one new documented population. To inform management decisions, the STNF needs current information regarding the status of the Shasta eupatory populations. We revisited 12 historical Shasta eupatory populations during 2010. At each site we documented the species' presence/absence, completed standard plant occurrence reports, and provided herbarium and photographic vouchers. Shasta eupatory was found at 10 of 12 sites visited. Two additional sites were found during this and other recent surveys. Collectively these survey efforts and review of other existing data show that Shasta eupatory is now known from 16 general populations, and considerable additional information regarding the species' habitat characteristics has been recorded. Once considered a limestone obligate, Shasta eupatory is now also known from metasedimentary and metavolcanic substrates on exposed mountain ridges, peaks and cliffs, forested rock outcroppings, and among bedrock river canyon substrates. The historic Shasta eupatory populations seem generally stable and new populations have been found. However, this species is still narrowly endemic and requires appropriate planning and conservation measures to ensure an overall healthy population.

26. LOUGHRAN, C. and MILLER, T.
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Ethnobotanical and Horticultural Considerations for Restoring Black Oak (*Quercus kelloggii*) Communities in the McCloud Flats/Shasta-Trinity National Forest

A 2010 summer internship on the Shasta-Trinity National Forest prompted an investigation of cultural and horticultural considerations for restoring California black oak (*Quercus kelloggii)*. Like many species of hardwoods in California, this species, is experiencing a population decline. In the McCloud Flats of the Shasta-Trinity National Forest, wildlife biologists have identified a virtual lack of the sapling size class of California black oak. This decline is alarming, as the oaks provide important community diversity and wildlife habitat. Many black oak populations in California are likely to be experiencing a similar phenomenon. For thousands of years, Native American tribes of the area managed oak stands, primarily by burning, to maintain a healthy forest and provide ample acorn crops. Effective management and propagation techniques are being considered for the black oak restoration on the McCloud Flats of this forest, as well as studying Native American practices, to provide land managers with methods for maintaining dwindling extant oak populations. New methods and strategies for propagating oak offer the possibility of restoring these communities, specifically the propagation of oaks by directly out-planting acorns. The methods identified in this paper include acorn collection, storage, planting, and supporting oak seedling establishment.

27. MACDONALD, R., KELLEY, D., and TALLEY, S.
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Impact of Climate on Capsule Production by Butte County Meadowfoam, *Limnanthes floccosa* subsp. *californica* in Butte County, California

We are maintaining a complete yearly count (2000 to 2010) of capsule production for Butte County meadowfoam (BCM) on the Doe Mill Preserve in the City of Chico, and the Tuscan Preserve, on the Wurlitzer Ranch, 12 miles north of Chico. We document populations that expand and contract greatly. We believe that direct climatic input is a significant driver for the strongly varying success of seed bank replenishment. Under present conditions, most years do not afford abundant growth and seed bank recharge. A small shift in climate may affect the infrequent "superior" seed-set years (such as those the populations experienced in 2000, 2002, and 2005). Hydrology year 2009-2010 is an example of how BCM population and seed production are severely impacted by climate input pattern. Early winter rain was good, but prolonged drought during seedling stage cut population numbers and forced early maturity of stunted plants in both the natural (Doe Mill) and introduced (Tuscan) populations. Doe Mill capsule production was 18% of the recent 7-year average, while Tuscan production was 9% of average. We can correlate the linkage of climate input and seed bank performance for each of the years in a decade of research. The survival of BCM may be impacted if climate patterns change from present conditions. We provide impact calculations for alternative climate states.

28. MAGNOLI, S.M.*, KLEINHESSELINK, A., and CUSHMAN, J.H.
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Community-Level and Facilitative Impacts of Iceplant in a Coastal Dune Ecosystem

Few ecosystems in California are untouched by invasive plant species, and these invaders often alter the habitats they invade, with detrimental impacts on native species. In order to best conserve native flora, we need to understand how invaders impact and shape the communities they invade. We are conducting experimental and comparative studies to assess the community-level impacts of iceplant (*Carpobrotus edulis*), an exotic invasive species native to South Africa, on a coastal dune ecosystem in northern California. Our comparative study suggests that iceplant decreases the cover and density of native plants and increases the cover and density of exotics. Most of the latter result can be attributed to increased abundance of *Bromus diandrus*, a dominant exotic annual grass. An iceplant-removal experiment is currently underway, and has already corroborated some of these findings and will be continued for a second year.

In summary, our research documents that iceplant has large impacts on a coastal plant community and may be facilitating the invasion of other exotic taxa into this imperiled landscape.

29. MASHAYEKHI, S. and COLUMBUS, J.T.
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Leaf Anatomy of *Allium* (Alliaceae) in North America

The genus *Allium* (Alliaceae) is distributed over mid-latitude regions from the dry subtropics to the boreal zone. It includes close to. 750 species total, with 84 species in North America. The main center of diversity extends from the Mediterranean Basin to central Asia and Pakistan. A second center of diversity occurs in western North America. Thirteen subgenera are recognized. Subgenus *Amerallium* is divided into two clades: New World and Old World. Most of the New World species are in subgenus *Amerallium,* and occur in California (approx. 50 species) and Texas (approx. 14 species). New World species have been placed into eight alliances based on morphological similarities. Characteristics of subgenus *Amerallium* include one-nerved tepals, one row of vascular bundles in the leaf, absence of leaf palisade parenchyma (if present, secondarily evolved from spongy mesophyll), and the presence of subepidermal leaf laticifers. Thus far we have sampled 50 New World species for transectional leaf anatomy. Permanent slides of sections from the middle of the blade were examined. The sections reveal a surprising amount of variation in both round and flat leaves in terms of arrangement of mesophyll cells, laticifer cells, and vascular bundles. A separate ongoing study involves the molecular phylogenetics of New World *Allium*. The anatomical variants of the leaves will be discussed in context of the phylogeny.

30. OHLSON, D.,[1] PAULUS, J.,[1] KRAMER, N.,[1] and BOGGS, C.[2]
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Botanical Resources of Valadeao Ranch: Fitting Data Collection Goals to Project Needs

Live Oak Associates completed a map and inventory of botanical resources for the 10,861-acre Valadeao Ranch in San Benito County. Reconnaissance was completed at the plant association scale to assess the suitability of the ranch as a mitigation area for resources that will potentially be impacted by projects in the region. The sparse, saline soil-tolerant scrub vegetation dominant over much of the ranch is conducive to classification errors using remote sensing means. To avoid misclassification, every association present on the site was mapped, an effort requiring 150 person hours. Post-field processing of the dominant species' relative frequency data from 645 vegetation polygons yielded twelve shrublands association types, one non-native grasslands type, two barrens types, and four locally rare types dominated by phreatophytes. Thirty-nine occurrences of six rare plant species were documented. Descriptive data were used to identify vegetation types where additional rare plant species occurrences may be detected during future survey work. These vegetation types tend to be the locally rarest types, very small, and at locations identified as being more inaccessible to long-standing livestock grazing uses. Developing this understanding was the direct result of visiting the entire range of habitat parameters present onsite for each vegetation type. Remote sensing methodology often relies on ground-truthing a subset of pre-classified occurrences; gradient response subtleties and smallest-grained vegetation types are more likely to be omitted from the data. On-the-ground surveying and post-field classification embraces this important insight as necessary for the fair judgment of botanical resource similarity and, thus, mitigation area suitability.

31. OWENS, C.,[1] BARVE, N.,[1] ROBISON, R.,[1] and DARIN, G.[2]
[1]ICF International, 630 K Street, Suite 400, Sacramento, CA 95814
[2]Department of Water Resources, Division of Environmental Services, 3500 Industrial Blvd., West Sacramento, CA

Expansion of Red Sesbania in California from 2005 to 2010 and Planning for Regional Management

Red sesbania (*Sesbania punicea*) is an invasive shrub, native to South America, which forms dense stands along waterways. This can lead to increased flooding, altered hydraulic roughness in shallow channels and a decrease in the biodiversity of riparian corridors. This species has rapidly expanded its range in

California since 2000, and it is now critical to prioritize sites for management on a regional scale. This project updated baseline data using field surveys throughout California in summer 2010. Existing data from multiple sources (e.g. CDFG, Calflora, CDFA and others) was compiled for field verification and then regionally expanded along areas of likely spread (e.g. upstream and downstream extents). GPS locations and relevant attribute data for prioritization and management were recorded. These attributes included percent cover for each mapped population, mode of survey (e.g. walking trail, road or watercraft) and land ownership. All existing and new data was put into ArcGIS 9.3 and represented on a California-wide scale. This regional survey identified major propagule inputs, upstream extents for each waterway, extent of spread on major and minor waterways and provided data in areas where there was no previous information, such as the Sacramento River between Redding and Verona, and collected data relevant to weed management for each population. Further analysis will involve using the Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET) to prioritize populations for eradication. This model was originally developed for multiple species but red sesbania will provide a case study of its use for one species on a regional scale.

32. PEAK, J. and PATTERSON, R.
Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132

Why Am I Rare? A Case Study of a Rare Serpentine Endemic

Calochortus (Liliaceae) contains 75 species of bulbiferous geophytes admired by amateur botanists and academics alike for its gorgeous flowers and hyper-variable species. Hyper-variability is characteristic of numerous *Calochortus* species and occurs multiple times within the phylogeny. Despite the popularity of this genus among the botanical community, only one phylogeny has been published. To date, relationships and species boundaries within *Calochortus* remain largely unresolved. My research focuses on two groups within *Calochortus*: sect. *Cyclobothra*, subsect. *Weediani* and the *Calochortus clavatus* complex. Within these groups, integration and overlap occurs both in distribution and morphological characters including floral color and pattern. We are conducting a molecular phylogenetic analysis using molecular markers from chloroplast (*psb*A – *trn*H) and nuclear regions (ITS). The goal of this study is to use molecular data to try to tease apart any difficulties intrinsic to interpretation of characters in floral color and pattern and to develop more useful keys for these taxa. Nine of the twelve taxa included in this study are considered rare and fairly endangered in California. Nearly all exhibit significant variation and are often difficult to identify accurately in the field. Resolution within these groups will aid in conservation efforts and will have regulatory implications in several California counties.

33. PICKART, A., DAVENPORT, D., HAWK, K., GRAFF, J., RICARD, H., LAGARDE, L.,* and MITCHELL, M.
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Spartina densiflora Control and Salt Marsh Restoration at Humboldt Bay National Wildlife Refuge (HBNWR)

Since 2004 staff at HBNWR has carried out research, pilot studies, and finally full-scale restoration of salt marshes invaded by *Spartina densiflora*. The implementation phase was carried out from 2006-2010, with successful conversion from high density *Spartina densiflora* to native low- and mid-elevation salt marsh. Methods consisted of metal-bladed brushcutters used to "grind" aboveground biomass, root crowns, and shallow rhizomes. Quantitative monitoring tracked the recovery of native vascular plants. Revegetation with native species was tested but unnecessary as native plants colonized rapidly. Research on the *Spartina* seed bank revealed the presence of a persistent seed bank, primarily in low marsh areas colonized by *Spartina*. Restoration activities boosted rare plant populations and preliminary research indicates positive impacts to invertebrate communities.

34. PORENSKY, L.M., VAUGHN, K.J., and YOUNG, T.P.
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Spatial Priority Effects Facilitate Coexistence of California Native Grassland Species

How can competitively inferior species coexist with superior competitors? This long-debated ecological question has applied relevance for restorationists trying to establish diverse native communities. In California grassland restoration, some planted species can be so successful that other planted species are quickly eliminated. We investigated "spatial priority effects": competitive advantages gained by inferior competitors due to initial intraspecific aggregation. By decreasing interspecific competition, aggregation during establishment may allow inferior competitors to coexist with competitive dominants over the long-term. Modeling studies suggest that intraspecific aggregation should facilitate species coexistence, but few empirical studies have tested these predictions, especially in a restoration context. We investigated (1) impacts of spatial priority effects on community assembly, (2) the scale-dependence of these impacts, and (3) implications for California grassland restoration. We planted eight native grassland species in 19 plots. Species were either interspersed throughout the plot, or aggregated by species into eight wedge-shaped monoculture subplots. After three years, intraspecifically aggregated plots had higher diversity than interspersed plots. Two aggressive species had higher cover in interspersed plots, while four nonaggressive species had higher cover in aggregated plots. Within aggregated plots, aggressive species had begun to spread into adjacent subplots. Three of four non-aggressive species had higher cover in locations that were farther away from the two aggressors. These results suggest that spatial priority effects can facilitate species coexistence for at least three years. Restorationists may be able to achieve and maintain more diverse communities by planting individual species separately in a mosaic of relatively large monoculture patches.

35. PRESTON, R.E.
ICF International, 630 K Street, Suite 400, Sacramento, CA 95814

A New Species from Shasta County, California: *Brodiaea matsonii* (Asparagaceae: Brodiaeoideae)

Brodiaea matsonii is a newly recognized endemic species restricted to a single extended population along Sulphur Creek, in Redding, Shasta County, California (Preston, in press). It appears to be most closely related to *B. nana*, *B. minor*, and *B. pallida*, all of which are characterized by small flowers (generally <2.5 cm long) with a perianth tube narrowed above the ovary. *Brodiaea matsonii* is a diploid species (n=6) most similar morphologically to the more widespread *B. minor*, a polyploid species (n=12, 24), from which it differs by the slightly smaller pink flowers. A preliminary phylogenetic analysis based on ITS sequences indicates that *B. matsonii* is grouped with a clade that is basal to the clades containing *B. minor*, *B. pallida,* and *B. nana*, suggesting that it is a relatively ancient lineage. *Brodiaea matsonii* grows within foothill woodland on outcrops of amphibolite schist within the stream channel and along the banks, a habitat similar to that in which *B. pallida* occurs. In contrast, *B. minor* occurs across a wide range of habitats, including grassland, vernal pool, seep, meadow, and chaparral, often on substrates of volcanic origin, but also on serpentine and gabbro, and *B. nana* is found primarily in or adjacent to vernal pools. Like *B. pallida, B. matsonii* blooms later (June) than either *B. nana* or *B. minor* (April to early May).

36. RYAN, S.P.
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Molecular Phylogenetic Relationships and Character Evolution in *Fritillaria* Subgenus *Liliorhiza*

Phylogenetic relationships within *Fritillaria* subgenus *Liliorhiza* have not been resolved. Ronsted et al. (2005) determined the circumscription of *Fritillaria*, but included only 12 of the approximately 20-25 species in the subgenus. Recent classifications based on morphology (Santana, 1984; Rix, 2001) are in conflict and may be resolved by a comprehensive molecular study. My study aims to determine phyloge-

netic relationships of as many described taxa in the group as possible, to evaluate taxonomic classifications (including questionable species and varieties), and to explore morphological character evolution. To accomplish these goals, I have initiated acquisition of specimens and sequences from two chloroplast regions and nuclear ribosomal ITS and ETS. Preliminary results of phylogenetic studies using Bayesian phylogenetic inference, species tree estimation, and ancestral character state reconstruction, will be presented. Previously hypothesized subdivisions based on morphology are partially supported in my molecular analysis, but a complete molecular data set must be obtained before any definitive reclassification can be made. One moderately supported clade (pp=0.73) corresponds with Subsection *Affines* (Santana, 1984) and Section B1 (Rix, 2001), with a few exceptions. Another clade, though not supported, corresponds with Subsection *Liliorhiza* (Santana, 1984) and Section B2 (Rix, 2001). With regard to character evolution, rice-grain bulbils appear to be the ancestral state for the group, and have been lost once in a weakly supported clade of four species. Whorled leaf arrangement appears to be the ancestral state for the group, and appears to have changed to alternate leaf arrangement a minimum of three times, with one reversal.

37. SANVILLE, C. and HAYASHI, B.
Green Diamond Resource Company, PO Box 68, Korbel, CA 95550

Identifying Rare *Erythronium* Species on Green Diamond Resource Company (GDRCo) Property: Addressing Problematic Characteristics Present in Local Populations

GDRCo has been collecting information regarding *Erythronium* species present on its ownership for several years. Two species encountered on the property with a Rare Plant Rank (RPR) of 2.2 are *Erythronium revolutum* and *E. oregonum*. These two species qualify for protection measures under CEQA. Although some populations exhibit characteristics considered diagnostic for the species, others exhibit traits intermediate between the two species and/or between the common *E. californicum*. This makes conclusive identification difficult. Furthermore, authoritative sources have questioned whether or not *E. oregonum* exists in California and suggest they may just be a white form of *E. revolutum*. The California Natural Diversity Database (CNDDB) currently has 47 occurrences of *E. revolutum* that have been rated as good or better, bringing the plant close to the threshold for status review. Protection measures will no longer be required if the RPR is adjusted downward. In contrast, *E. oregonum* has only 3 occurrences rated as good or better. Because of the difficult nature of making a conclusive identification, it is likely that some of the occurrences of *E. revolutum* are *E. oregonum*. CNDDB reports overlapping occurrences of both species at the same geographic locality. Additional field work during the blooming season is necessary to sort out the identity of these species and remedy any misidentifications in CNDDB. GDRCo botanists are preparing to visit all significant populations on the ownership in 2011 to collect the data necessary to rank traits within a species matrix and prepare material for a genetic analysis.

38. SHAFFER, J.P.
University of California, Santa Cruz, 1156 High Street, Santa Cruz, CA 95064

Antifungal Activity of Lichen Extracts: Exploring the Potential for Indirect Protection of Woody Plants from Pathogenic Fungi

Lichens must defend themselves from invasion by microorganisms such as fungi and bacteria. Their evolutionary success has been attributed to the production of secondary metabolites that exhibit antibiotic, antiherbivore, and allelopathic properties. Nevertheless, the ecological impacts of many of these chemicals for lichens or other organisms have seldom been characterized. The possibility that corticolous lichen species could indirectly protect woody plants from plant pathogens through production of inhibitory chemicals is high where lichen coverage of host plants is extensive. Water and acetone extracts of six abundant, corticolous lichen species: *Parmotrema perlatum, Flavoparmelia caperata, Evernia prunastri, Hypogymnia physodes, H. imshaugii,* and *H. tubulosa,* were tested for their inhibition of the growth of a plant pathogenic fungus. In addition to being abundant, these six lichen species synthesize secondary metabolites known to have bioactive properties. Extracts from *F. caperata* were found to be inactive at all concentrations, while extracts from all other lichens successfully inhibited fungal growth. Because water extracts were more effective than the acetone extracts, a second round of assays was conducted to determine the lethal doses of the four most effective water extracts. This study confirms that water-extractable

lichen compounds can inhibit the germination and growth of a fungal pathogen however, the ecological implications of the polar fraction of the species' extracts are yet unknown.

39. SHEPHARD, E. and PATTERSON, R.
Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132

A Geographic Analysis of Locally Rare Plant Species of Sonoma County

Currently there are systems to give protection to rare taxa. Taxa can be classified as rare on a global, national, state, or local level. The levels of these classifications are based on man-made, political, jurisdictional, or geographic boundaries. Currently there are no universal criteria used to classify locally rare taxa. These are taxa that are rare or infrequent within a smaller geographic boundary, like a county, but common in other areas. By using Geographic Information Systems (GIS) to analyze area occupancy, taxa can be classified as locally rare. Sonoma County with its long and rich floristic history is ideal for studying local rarity, where many species occur in small peripheral populations but are common in other parts of California. The ability to quantify these peripheral populations is important from a conservation standpoint. Many of these populations are genetically distinct from core populations, and as such an argument can be made for conservation of these locally rare plants. A similar project was conducted in Napa County in 2008 using a ranking system for assessing locally rare species, based on area occupancy within a county. We are applying these protocols and criteria for ranking local rarity to a larger, more floristically and ecologically diverse region (Sonoma County). We are field-checking hotspots that appear during the analysis. This method of assessing locally rare species will be particularly useful for conservation of peripheral populations.

40. SIKES, K.,[1] COOPER, D.,[2] WEIS, S.,[3] KEELER-WOLF, T.,[4] BARBOUR, M.,[5] IKEDA, D.,[3] STOUT, D.,[1] and EVENS, J.[1]
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[2]Colorado State University, Department of Forest, Rangeland and Watershed Stewardship, Fort Collins, CO 80523
[3]U. S. Forest Service, Department of Agriculture, Pacific Southwest Region, 1323 Club Drive, Vallejo, CA 94592
[4]California Department of Fish and Game, Biogeographic Data Branch, 1807 13th Street, Suite 202, Sacramento, CA 95811
[5]Plant Sciences Department, University of California Davis, 1 Shields Avenue, Davis, CA 95616

Fen Conservation and Vegetation Assessment in the National Forests of the Sierra Nevada and Adjacent Mountains, California

The California Native Plant Society (CNPS), U.S. Forest Service (USFS), and collaborating partners have prepared a report summarizing the current knowledge of fens throughout 11 National Forests of the Sierra Nevada and adjacent areas. The report reviews existing literature and unpublished studies, summarizes USFS efforts to inventory fen resources, analyzes data compiled from over 800 fen surveys, and identifies gaps in available data. In the past decade, standardized procedures have been developed to survey and monitor fens; these procedures are further revised in this report based on work conducted by CNPS and USFS in 2009-2010. Our analysis includes a classification and key to fen vegetation types at both the alliance and association levels, expanding our existing knowledge of wetland vegetation in California. The report discusses important habitat factors, such as pH and geomorphology, and identifies impacts and threats related to fens. Comparisons are made to other types of peat-forming wetlands in California and to fens elsewhere in North America. Other results of our analysis include a comprehensive listing of rare plant species associated with fens, as well as a determination and listing of rare fen vegetation. This assessment highlights the floristic biodiversity and rarity of fens, provides a framework for future management decisions, and identifies research and monitoring priorities.

41. SIERRA PACIFIC INDUSTRIES Botany Program
Sierra Pacific Industries, P.O. Box 496014, Redding, CA 96049

2010 Botanical Survey Results from Sierra Pacific Industries' Timber Harvest Plans

Sierra Pacific Industries (SPI) is California's largest private landowner, managing over 1.7 million acres of forestlands. In an effort to protect botanical resources on SPI timberlands, a scientifically based Botany Policy was developed to guide how sensitive plants are addressed in timber harvest plans (THPs). The Botany Policy calls for botanical field surveys in suitable habitat for any THP with the potential to contain sensitive plant species. When a rare plant is found, it is documented by standard professional practice and sent to the Department of Fish and Game (DFG) to be added to the California Natural Diversity Database (CNDDB). All surveys and findings are submitted with the THP to the California Department of Forestry and Fire Protection (Cal Fire). Botanists and foresters conducted rare plant surveys on about 40 THPs throughout California in 2010. Rare plant species were found on 31 of the THPs surveyed. In 2010, 231 rare plant occurrences were identified, and since 2002 over 1000 sensitive plant occurrences have been reported. Each new sensitive plant finding increases our knowledge of the species' life cycle, habitat, and geographic range, resulting in SPI practicing better forest management.

42. STUBBS, R. and PATTERSON, R.
San Francisco State University, 1900 Holloway Avenue, San Francisco, CA 94132

From Sea Level to Mountain Peaks: The Evolution and Biogeography of the Rare California *Polemonium*s (Polemoniaceae)

In 1828 Lindley remarked about *Polemonium* that "the whole genus and order are in a miserable state of confusion." Since then several taxonomists have studied the genus, but questions remain about relationships, identities, and ranges among species of *Polemonium*. In particular, three California species continue to be sources of ambiguity. Following a prolific collecting season, we are focusing on resolving relationships of *Polemonium chartaceum*, *P. pulcherrimum,* and *P. carneum.* Previous research on the Mt. Eddy population of *P. chartaceum* in Klamath National Forest suggests that this population may be a distinct species. Secondly, the varieties of *P. pulcherrimum* need to be addressed due to nomenclatural uncertainties and lack of any study in some of these varieties. And finally, it can be established that *P. carneum* is not extirpated from California as was commonly thought. We are analyzing gene regions that have been utilized in resolving relationships among the genera of Polemoniaceae as a whole but never to produce a phylogenetic sequence for this group of *Polemonium* species. We will sample twenty-four individuals representing up to ten species of *Polemonium*. At present we have examined DNA from the *psbA-trnH*, *trnL-trnF*, and *trnS-trnG* regions. We will use data from three distinct regions to contribute to a more robust phylogeny of the genus. With this data we will be able to resolve the questions surrounding *Polemonium.* A thorough assessment of *P. chartaceum*, *P. pulcherrimum,* and *P. carneum* will have ramifications for conservation of both these uncommon California species.

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Interactions between Two Exotic Plant Species Invading a California Grassland Ecosystem

Plant invasions are a major issue in ecology and numerous studies have examined the impacts of exotic taxa on native plant species and communities. Despite this attention, fewer studies have focused on how interactions between exotic taxa influence the invasion process. This study evaluated interactions that occur between two dominant invaders of California grasslands, Harding grass (*Phalaris aquatica)* and yellow starthistle (*Centaurea solstitialis*), and how soils dominated by each species influenced seedling growth and survival. In a two-factor greenhouse experiment, we grew established seedlings in two neighborhood types – in monocultures (four seedlings of same species) or in mixture (two seedlings of each species) – and crossed these with two soil types (soils from Harding-grass patches and yellow starthistle patches). Analysis of log-response ratios revealed height and leaf number of starthistle seedlings was greater when grown with Harding grass than in monoculture, and this effect was greater for plants grown in Harding grass soils. In contrast, height and leaf number of Harding grass seedlings was greater

in monoculture than in mixture, and this effect was greater in starthistle soils. In a comparative study of seed banks, not unexpectedly, soils from patches dominated in the field by Harding grass contained significantly more Harding grass seedlings than starthistle seedlings. However, surprisingly, Harding grass seeds were more abundant in soils from starthistle patches. These results suggest that starthistle is a superior competitor to Harding grass, but that Harding grass may overcome this disadvantage by having larger and more extensive seed banks. Our work also suggests that important plant-soil feedback may also mediate the outcome of interactions between these dominant invaders.

44. WILLIAMS, M.,[1] CHRISTOFFERSON, C.,[2] and HATFIELD, C.[1]
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The Environmental and Physiological Constraints of a Rare California Serpentine Endemic

Many rare and threatened California plant species are endemic to ultramafic serpentine soils. Understanding what specifically makes these species rare is of high value to conservation and management efforts statewide. While there is no one definition of what makes a plant rare, there are many characteristics that are thought to contribute to a species' rarity. This study focuses on environmental and reproductive attributes of a rare serpentine endemic to evaluate their contribution to the plant's rarity. *Packera layneae*, or Layne's Butterweed, is a federally threatened and state listed rare species occurring in small, fragmented populations on serpentine soils in the northern California Sierra Nevada. We propose to evaluate environmental factors that define its restrictive habitat, including elevation, aspect, light availability and soil characteristics. We have collected data on these parameters in the field, which will be analyzed and used in conjunction with geology maps and known associate species as inputs for a species distribution model. The focus for this current work is to evaluate the role of dispersal limitation as a contributing factor to this species' limited distribution. This was done by constructing two seed dispersal arrays in the field, and measuring dispersal distance from these centers. Determining why this species is so patchily distributed and understanding its unique habitat requirements will be vital to its conservation and long-term success. This work will also contribute to our understanding of plant rarity and help guide management efforts.

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Ecology and Reproductive Biology of Two Serpentine Endemic *Monardella* Species from Plumas National Forest

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

46. WRUBEL, E. and PARKER, V.T.
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A Gradient Analysis of Coastal Shrublands in the San Francisco Bay Area Ecoregion

Coastal shrublands in the San Francisco Bay Area Ecoregion (SFBA) show a wide range of variability in composition, structure, physiognomy and species richness. The purpose of this study is to describe and classify soft-leaved (malacophyllous) coastal shrublands (coastal scrub) of the region, and to suggest environmental factors influencing vegetation patterns. We conducted a survey of coastal scrub in the SFBA along gradients of maritime influence (coast-inland) and topographic position. Ordination results suggest that gradients in salt deposition and dry-season soil moisture are the primary local drivers of composition and structure in coastal scrub of the Bay Area. In this model graminoids, herbs and subshrubs are increasingly dominant as exposure to salt spray increases or as dry season water balances decrease, while shrubs and trees are favored in relatively mesic settings at inland locations or sheltered coastal sites. Local species richness is highly variable, but is significantly higher on coastal bluffs than at inland locations. A preliminary classification and description of regional coastal scrub alliances and associations is presented here.

47. YOST, J.,[1] BONTRAGER, M.,[1] MCCABE, S.,[2] KAY, K.,[1] and RITTER, M.[3]
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A Classification of California's Diploid *Dudleya* Species Based on Molecular Phylogenetic Data

There are 48 recognized species of *Dudleya* in California, including eight rare species, one threatened species, and two endangered species. In Northern California, this includes *D. cymosa* subsp. *costafolia* and *D. setchellii*. Taxonomic classification of *Dudleya* has proven to be difficult due to diverse morphology, polyploidy, and hybridization within the genus. We sought to understand the evolutionary relationships between species of *Dudleya* by first building a molecular phylogeny of the diploid taxa. We used nucleotide sequence data from the nuclear ribosomal internal transcribed spacer (ITS), the external transcribed spacer (ETS), and the *trn* region of the chloroplast (*trn*L-F) from all obtainable diploid *Dudleya* in California. Our results indicate that the current subgenera distinctions within the genus are polyphyletic and that the endangered Santa Clara live-forever (*D. setchellii*) is distinct from the *D. abramsii* clade. We further elucidate the relationships within the subspecies of the *D. virens* clade and show that *D. virens* ssp. *extima* is not included in the *D. virens* clade and may require taxonomic reclassification. This study potentially has important conservation implications because of the rarity and locally endemic nature of the taxa involved.

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ADDENDUM

ADDITIONAL ABSTRACTS FOR POSTERS

48 HABECKER, N., BERGMANN, JP W., and IVEY, C.
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Reproductive Isolation in *Mimulus*

Reproductive isolation between recently diverged species is often accomplished by a suite of ecological and physiological factors. As a component of an ongoing study, we report on three potential prezygotic barriers to hybridization between the closely related *Mimulus glaucescens* and *M. guttatus*: geoedaphic affinity ("ecological" isolation), floral morphological differences ("mechanical" isolation), and differences in pollen tube growth rate ("gametic" isolation). A Northern California range map based on collection records was constructed with Geographic Information Systems (GIS), and this was used to compare their geoedaphic distributions. *Mimulus glaucescens* occurs more frequently on the Jepson subecoregion of the Cascade Range foothills, whereas *M. guttatus* ranges more broadly, and is not restricted to the Sierra-Cascade interface. Floral traits relevant to pollen transfer were compared between taxa, and no significant differences were found in any trait. Finally, we compared pollen tube growth rate *in vivo* using hybrid and conspecific hand-pollinations among multiple allopatric populations, and found no significant differences among crosses. Based on results from these three factors, ecological isolation, as conferred by geological affinity, appears to be important for limiting hybridization between these species. This result mirrors other recent studies exploring boundaries between closely related plants, in which species distributions have been found to confer substantial reproductive isolation.

49 ROGNER, M. and GRIGGS, F.T.
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Ecological Resilience: Performance of Large Scale Riparian Restoration Projects

The concept of resilience in ecological systems was first introduced by the Canadian ecologist C.S. Holling in order to describe the persistence of natural systems in the face of changes in ecosystem variables due to natural or anthropogenic causes. In 2004 he described ecological resilience as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks." In California, where roughly 95% of riparian habitat has been destroyed, the level of disturbance has pushed the habitat beyond a threshold that – even if abandoned of their current use – the habitat will not recover for at least several decades, if ever. Thus, their capacity to be resilient has been lost, and a different regime of processes and structure will dominate without active restoration. Here, River Partners presents the 338 acre Wilson Landing Riparian Restoration Project, located in Glenn County, California as a case study for how horticultural restoration can create a resilient, functioning riparian system. We examine three potential perturbations – fire, flooding, and invasion by non-native plant species – and provide evidence from on-the-ground monitoring that this project has the capacity to retain ecological functionality after disturbance events.