DIVERSE ENVIRONMENTS:

HOW PLANTS SUCCEED in NORTHERN CALIFORNIA

THE EIGHTH SYMPOSIUM
PRESENTED BY

NORTHERN CALIFORNIA BOTANISTS
at California State University, Chico
9-11 January 2017

Diverse Environments:
How Plants Succeed in Northern California

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Cover photo courtesy of John Dittes. Ash Creek Wildlife Area (California Department of Fish and Wildlife), Modoc County. Emergent wetland along a tributary of Ash Creek, looking north to Fox Mountain with western juniper woodland in the distance. June 21, 2008.

WELCOME!

Northern California Botanists

welcomes you
to our eighth symposium

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

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

MONDAY, 9 JANUARY 2017

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

ALL DAY **Posters on display** – Bell Memorial Union second floor Mezzanine
See also Session 6, Poster Session, Tuesday at 8:30 a.m.

Opening Remarks

8:45 a.m.

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

8:50 a.m.

David Hassenzahl, Dean, College of Natural Sciences, California State University, Chico

Session 1: Special Soil Endemics

9:00 – 10:20 a.m.

Session Chair: Barbara Going, Department of Integrative Biology, University of Texas, Austin

2. **Jason Sexton**
   Some questions we need answered about California plants and climate change
3. **Dylan Burge**
   Gabbro and beyond: Are chemically unusual soils an engine of plant diversification or a waiting room for extinction?
4. **Steve Schoenig**
   Carbonate substrates: Plant associations, and climate impacts
5. **Melanie Gogol-Prokurat**
   Rare endemic plants and climate change: Using geospatial models to inform management decisions

10:20 – 10:40 a.m. **Break**

Session 2: Great Basin

10:40 a.m. – 12:00 p.m.

Session Chairs: Christina Lund, Bureau of Land Management

6. **Fred Edwards**
   Great Basin BLM Ecoregional Native Plant Development Program
7. **Francis Kilkenny**
   A new vision of seed transfer: Synthesizing the science of seeds and the future of restoration in the Great Basin
8. **Sarah Kulpa**
   Designing native seed mixes to repair and create ecosystem services in the Great Basin
9. **Beth Leger**
   Great Basin ecosystem function and annual forbs

12:00 – 1:20 p.m. **Lunch**

Session 3: Influence of Summer Fog on Patterns of Plant Diversity

1:20 – 2:40 p.m.

Session Chair: Michael Vasey, San Francisco Bay National Estuarine Research Reserve and San Francisco State University

10. **Emily Burns**
    Varied species responses to fog in the coast redwood ecosystem
11. **Sara Baguskas**
    Impact of historic drought on the population dynamics of a fog-influenced coastal forest on Santa Cruz Island, California
12. **Shelly Benson**
    Lichens in the mist: Investigating California's fog lichens
13. **Michael Vasey**
    Influence of coastal fog on endemism and beta diversity in chaparral along the Central Coast of California

2:40 – 3:00 p.m. **Break**

Session 4: Insects on Plants

3:00 – 4:20 p.m.

Session Chair: Barbara Castro, California Department of Water Resources

14. **John Whittlesey**
    Flies—the forgotten pollinators
15. **Louie Yang**
    The timing of milkweed-monarch interactions in Northern California
16. **Kathy Schick**
    Gallwasps on California oaks—Hymenoptera: Cynipidae interactions with Quercus species
17. **Steve Seybold**
    Pines and pine bark beetles in California: A legacy of diversity and damage

Session 5: Lightning Talks

4:20 – 5:00 p.m.

Session Chair: Samantha Hillaire, Garcia and Associates

18. **Michael Uhler**
    In search of alpine rarity: A Rare Plant Treasure Hunt in Yosemite National Park
19. **Dylan Burge**
    The spicebush and the wasp
20. **Ann Willyard**
    Pinus ponderosa: A checkered past obscured four species
21. **Russell Huddleston**
    Jepson Prairie Preserve: 35 years of conservation, research, and public education
22. **Nick Jensen**
    Biogeographical wanderings in the Streptanthus howellii alliance
23. **Sue Sims**
    To create a botanic garden
24. **Jane Van Susteren**
    Presenting for Cynthia Powell
    Calflora: Tools and tricks

* * * * *

5:15 – 7:00 p.m. **Reception** – Colusa Hall
No-host bar with complimentary hors d'oeuvres.

6:30 p.m. **Banquet** – Bell Memorial Union Auditorium
Dinner tickets required. Banquet will be east Indian cuisine and will include vegetarian dishes.

Keynote Speaker

7:30 p.m. Bell Memorial Union Auditorium – EVERYONE IS WELCOME

25. **Dr. Hugh Safford**, US Forest Service Pacific Southwest Region and
    Department of Environmental Science and Policy, University of California, Davis
    Fear and loathing in the Sierra Nevada: confronting a wicked problem

TUESDAY, 10 JANUARY 2017

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

ALL DAY **Posters on display** – Bell Memorial Union second floor Mezzanine
See also Session 6, Poster Session, Tuesday at 8:30 a.m.

Session 6: Poster Session

(Abstracts of posters start on page 19; index to authors on page 35)

8:30 – 10:00 a.m. Poster Session – Bell Memorial Union second floor Mezzanine

Session Chair: Barbara Castro, California Department of Water Resources

Poster presenters will be available to answer questions.

Second Day Opening Remarks

10:00 – 10:10 a.m. Opening Remarks – Bell Memorial Union Auditorium

Linnea Hanson, President, Northern California Botanists

Session 7: Now the Good News

10:10 – 11:30 a.m.

Session Chair: Teresa Sholars, Professor Emeritus, College of the Redwoods

26. **Janel Johnson**
Year of the Monkey: A rare "super bloom" for Carson Valley monkeyflower
27. **Robin Kent**
A place for plants in FERC licensed hydropower projects
28. **Alison Stanton**
We did it!: 14 years of collaboration and adaptive management precludes Federal listing of Tahoe yellow cress
29. **David Campbell**
Fire followers of Yosemite National Park: Discovering new populations of special-status plants and implementing early detection and rapid response to invasive species in burned areas

11:30 a.m. – 12:50 p.m. **Lunch**

Raffle, Auction, and Awards

12:50 – 1:20 p.m. Raffle, Auction, and Awards – Bell Memorial Union Auditorium

Session 8: Soil Seed Banks of California Native Plant Species

1:20 – 2:40 p.m.

Session Chair: Ryan O'Dell, Bureau of Land Management

30. **Ryan O'Dell**
    Soil seed banks of a federally listed Threatened annual plant, Camissonia benitensis (Onagraceae)
31. **Marina LaForgia**
    The response of soil seed banks to drought in California annual grasslands
32. **Josie Lesage**
    Seed banks of native and exotic forbs in restored and reference northern coastal prairies
33. **Tom Parker**
    Chaparral seed banks: Not just for plants anymore

2:40 – 3:00 p.m. **Break**

Session 9: New Discoveries

3:00 – 4:20 p.m.

Session Chair: Lawrence Janeway, The Chico State Herbarium and Plumas National Forest

34. **Adam Schneider**
    Cryptic host-specific diversity in the newly resurrected parasitic genus Aphyllon
35. **Lawrence Janeway**
    Carex xerophila – a new sedge hiding in the chaparral
36. **Susan Kephart**
    Stalking California Camassia: Unusual pollination and range disjunctions in northern forest glades
37. **James R. Shevock**
    New bryophyte discoveries in California: The frontier remains

Closing Remarks

4:20 – 4:30 p.m.

Linnea Hanson, President, Northern California Botanists

4:50 p.m. **Tour of the Chico State Herbarium** (optional)

Meet outside of the Bell Memorial Union Auditorium to walk across campus

POST-SYMPOSIUM WORKSHOPS

WEDNESDAY, 11 JANUARY 2017

Workshop 1: Field Data Collection using Esri Collector

9:00 a.m. – 1:00 p.m. Bell Memorial Union, room TBA
Instructor: **Jaime Ratchford**, Vegetation Program, California Native Plant Society

There are several options available for collecting data in the field. In this workshop we will demonstrate how to use mobile devices, such as smartphones and tablets, to collect data in the field with a focus on Esri's Collector App for ArcGIS. Collector is a free app available for Android or iOS that is used in conjunction with ArcGIS Online. Using the app, you can collect points, lines, and polygons as well as enter attribute data all while using your mobile device in the field and without an internet connection. Data can be collected offline and stored on the device to be synced with ArcGIS Online at a later time. We will demonstrate the process for building geodatabases and maps in ArcGIS for publishing online, how to build web maps for use in Collector, and how to access those maps in Collector and add and edit data in the field. There will be an opportunity to gain hands-on experience using the app on your own device.

Workshop 2: Preparing for Consulting Botanist Certification Exams

9:00 a.m. – 1:00 p.m. Bell Memorial Union, room TBA

Instructors: **David L. Magney**, Rare Plant Program Manager, California Native Plant Society
Heath Bartosh, Senior Botanist and Rare Plant Specialist, Nomad Ecology

The California Native Plant Society (CNPS) is administering the new Consulting Botanist Certification program, which provides a formal process by which qualified and knowledgeable field and consulting botanists working in California can prove their competence, knowledge, and experience, by becoming a Certified Field or Consulting Botanist. The certification program began in 2016.

The program is administered, through CNPS, by the Board of Certification, which is made up of Certified Consulting Botanists. Details about the certification program can be found on the CNPS website under the Education Program.

To become certified at either the Field or Consulting Botanist level, the botanist must pass a set of examinations, which include: sight identification of 100 plants, keying about a dozen plants using dichotomous keys, questions about botanical terminology, survey methods, environmental laws and regulations, biogeography, floristics, bio statistics, vegetation classification and mapping, species-status plant species, documentation methods, impact assessment methods and techniques, restoration ecology, and related topics, those things a professional consulting botanist does on a regular basis.

This workshop will go over the details of what you need to know to successfully pass the examinations and how to get ready to take the examinations to become a certified botanist.

Workshop 3: Native Plant Propagation -- CANCELLED

ABSTRACTS OF TALKS

Abstracts in chronological order; index to authors on page 35
See also the List of Common Acronyms on page 34

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

Welcome to our Eighth Northern California Botanists Symposium

I'd like to welcome all of you to our eighth symposium, *Diverse Environments: How Plants Succeed in Northern California*. We hope you will enjoy the program that we have organized for you this year with great speakers and posters. Our keynote speaker, Hugh Safford, will address *Fear and Loathing in the Sierra Nevada: Confronting a Wicked Problem.* Seven lightning talks are scheduled for Monday afternoon before our reception. We again hope to provide botanists with a forum to listen to talks on a variety of subjects and time to spend 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. The poster session is Tuesday morning to provide ample time to view the many varied posters that have been submitted. Northern California Botanists is a cooperative association of federal, state, academic, consulting and other botanists in the Northern California Region, with the purpose of increasing knowledge and communication about botanical issues concerning science, conservation, education and professional development. Have a great symposium.

2. SEXTON, J.P.
School of Natural Sciences, University of California, Merced, 5200 North Lake Road, Merced, CA 95343. jsexton2@ucmerced.edu

Some Questions We Need Answered about California Plants and Climate Change

California is highly diverse because of its spectacular habitat heterogeneity, among other attributes. However, will that heterogeneity be enough for the diverse flora to hide in under global change? I discuss the following questions with examples, and often in experimental contexts: 1) Does "local" environmental heterogeneity provide space to hide from climate change? 2) Do seed banks provide time to hide from climate change, and for how long and under how much change? 3) With the significant habitat conversion that has occurred in California, and is anticipated to occur, what is the extinction debt we can expect and where are extinctions likely to occur? 4) What is the extinction toll from invasive species likely to be on California plants? 5) What capacity do endemic species have to adapt to global change, and what determines the likelihood of adaptation? Given its size and heterogeneity, California is likely to remain diverse under global change, but the resilience of its endemic flora is a critical unknown.

3. BURGE, D.O.
University of California, Los Angeles, Department of Ecology and Evolutionary Biology, Los Angeles, CA 90095. dylan.o.burge@gmail.com

Gabbro and Beyond: Are Chemically Unusual Soils an Engine of Plant Diversification or a Waiting Room for Extinction?

Chemically unusual soils have long been recognized as an important driver of adaptation, speciation, and community formation in plants. A great variety of chemically unusual soils have been studied. However, the bulk of our knowledge is derived from studies on serpentine, which is found world-wide, and is widely acknowledged to have a strong influence on plants through a very unusual chemistry. Unfortunately, as in many model systems, the focus on serpentine has led to a much poorer understanding of how other kinds of soil affect plant life, and whether the patterns observed in serpentine may be generalized across chemically unusual soils. I present a review of our understanding of how different kinds of chemically unusual soils affect plant life, especially in the California Floristic Province, the most significant hotspot of plant endemism in western North America, a place where as much as 10 percent of plant taxa can be considered edaphic endemics. I then discuss the question of whether soil specialization, in the form of

edaphically-driven geographic disjunction, local adaptation, and speciation, is an ecological or evolutionary dead end. I argue, based on the data that are now available from a large number of studies, that chemically unusual soils drive the accumulation of diversity and endemism by 1) harboring populations of generalist species in locations far outside their "normal" climatic niche, 2) driving local adaptation that boosts the species resilience as a whole, and 3) providing an ecological driver of speciation.

4. SCHOENIG, S.E.
Research Associate, UC Davis Center for Plant Diversity, 1026 Sciences Laboratory Building, 505 Hutchison Drive, Davis, CA 95616. seschoenig@gmail.com

Carbonate Substrates: Plant Associations, and Climate Impacts

Limestone and other allied carbonate substrates such as marble, dolomite, gypsum, travertine and caliche are actually fairly wide-spread throughout California as smaller isolated outcrops, and in certain areas, they occur as the dominant geologic parent material. Hundreds of plant species are found exclusively or primarily on these substrates within the state. Many of these plants are endemic to California and are designated as rare plants. A recent search of California plant data sources (The Jepson Manual II, CNDDB, Calflora, CNPS Inventory of Rare and Endangered Plants) has, for the first time, created a provisional list of California plants which seem to be obligate on, or tolerant of, carbonate substrates, based on edaphic attribution by plant experts. Regardless of future mitigation behaviors, California's climates will be warming, and likely drying, to a significant level above recent historic levels. This talk will speculate and discuss various hypotheses regarding differential impacts to carbonate endemics compared to plants of wider and more tolerant edaphic affinities. Three important factors will be considered: 1) difficulties of migration to distant cooler/wetter edaphic islands, 2) inherent tolerance of harsh soil inhabitants, and 3) evidence of tolerance to hotter past Holocene millennia (Hypsithermal) as an indicator of future resilience.

5. GOGOL-PROKURAT, M.
California Department of Fish and Wildlife, Biogeographic Data Branch, 1416 9th Street, 12th Floor, Sacramento, CA 95814. melanie.gogol-prokurat@wildlife.ca.gov

Rare Endemic Plants and Climate Change: Using Geospatial Models to Inform Management Decisions

Species distribution modeling is a rapidly developing field that uses complex statistical and geospatial analysis to identify potentially suitable habitat in the landscape for a species based on habitat values present at known occurrence locations. This information, which is increasingly used in conservation planning, can be used to help understand the environmental variables shaping species distributions, and to extrapolate potential future habitat suitability under projected climate change scenarios. The more than 800 soil endemic plants in California represent a special case because their distributions are largely driven by substrate. However, species distribution models can still be an important tool to explore other variables driving their distributions, and to predict the potential impacts of climate change on the species. I examined the climate vulnerability of *Calystegia stebbinsii*, *Packera layneae*, and *Wyethia reticulata*, three gabbro and serpentine rare soil endemic plants of the Sierra Nevada foothills, using geospatial models. Although the species co-occur and have similar habitat requirements, the degree of potential climate change impacts as shown by the models differed by species. The rapidly changing nature of modeling methods, and the uncertainty in future climate models, present challenges for applying models to policy and management. However, looking for agreement among multiple models can help overcome uncertainty and aid in management decisions.

6. EDWARDS, F.S.
Great Basin Ecoregional Coordinator, Bureau of Land Management, 1340 Financial Boulevard, Reno, NV 89502. fsedwards@blm.gov

Great Basin BLM Ecoregional Native Plant Development Program

The National Seed Strategy provides a coordinated approach for stabilization, rehabilitation, and restoration of public and private lands that seeks to balance managing for locally adapted native seed while still

securing seed on a scale capable of restoring millions of acres of degraded public lands. The Seed Strategy provides a framework for actively working with land managers and private industry to respond appropriately to disturbances and other stressors that threaten important native plant communities and the ecosystem services they provide. BLM implementation of the Seed Strategy includes stepping it down to the ecoregional level. This talk provides an overview of how BLM's implementation of the Seed Strategy in the Great Basin of California, Nevada, Oregon, Idaho, and Utah, and discusses current progress and the practical aspects of combining scientific knowledge with land management and developing the business practices to yield "the right seed in the right place at the right time."

7. KILKENNY, F.F.
USDA Forest Service, Rocky Mountain Research Station, 322 East Front Street Suite 401, Boise, ID 83702-7373. ffkilkenny@fs.fed.us

A New Vision of Seed Transfer: Synthesizing the Science of Seeds and Future of Restoration in the Great Basin

Seed transfer guidelines are tools that help ensure that seed used in reforestation and restoration is "genetically appropriate" – adapted to local environmental conditions and compatible with remnant local populations. These tools have been used to guide reforestation practice for nearly a century in forestry and have recently been adopted for use in the restoration and conservation of non-forest ecosystems around the world. In the last 10-15 years, seed transfer guidelines have been constructed for a number of restoration workhorse species in the Great Basin. One of the primary goals of the Great Basin Native Plant Project, a partnership between USFS, BLM and over 25 other cooperating groups, is to continue producing seed transfer guidelines for the Great Basin. This talk discusses the current state of seed transfer in the Great Basin, with an emphasis on generalities, challenges and a vision for the future of seed transfer in a rapidly changing world.

8. KULPA, S.M.
Restoration Ecologist/Botanist, Reno Fish and Wildlife Office, 1340 Financial Boulevard Suite 234, Reno, NV 89502. sarah_kulpa@fws.gov

Designing Native Seed Mixes to Repair and Create Ecosystem Services in the Great Basin

The ecological integrity of the Great Basin's sagebrush-steppe ecosystem is threatened by the accelerated invasion of non-native, annual grasses, such as *Bromus tectorum* (cheatgrass) and *Taeniatherum caput-medusae* (medusahead), altered historical fire regimes, drought, and climate change. Recent initiatives, like National Pollinator Health and Secretarial Order 3336, highlight the need to use native plant materials to restore these degraded ecosystems. This presentation will discuss steps we are taking to the Great Basin to provide and design seed mixes to repair and create ecosystem services for species like sage-grouse, monarch butterflies, and other pollinators.

9. LEGER, E.A.[1], DE QUEIROZ, T.A.[2], and GOERGEN, E.M.[3]
[1]University of Nevada, Reno, Department of Natural Resources and Environmental Science, 1664 North Virginia Street, MS 186, Reno, NV 89557. ealeger@gmail.com
[2]University of Nevada, Reno, Department of Natural Resources and Environmental Science, 1664 North Virginia Street, MS 186, Reno, NV, 89557. taradeq@gmail.com
[3]St. Petersburg College, P.O. Box 13489, St. Petersburg, FL 33733-3489. goergen.erin@spcollege.edu

Great Basin Ecosystem Function and Annual Forbs

Although they can be patchy in distribution, diminutive in stature, and fluctuate in abundance from year to year, annual forbs can play an important role in the functioning of Great Basin ecosystems. Annual forbs serve as food resources for sensitive wildlife, including sage-grouse and pygmy rabbits, and provide important resources for pollinators and other insects. Additionally, annual forbs can be disturbance-oriented, increasing in abundance after fire or physical disturbances, and thus potentially providing resistance to invasion by exotic annual species. Here, we present evidence that annual forbs can be competitive with exotic annuals, including results of competition studies between native species of *Amsinckia, Collinsia,* and *Mentzelia*, among others, competing with exotic annual weeds including *Bromus tectorum*,

Ceratocephala testiculata, and *Salsola iberica*. We also present our ongoing efforts to assess the propagation requirements and feasibility of increasing seeds of eleven annual forb species in an agricultural setting, with the goal of making seeds of these species available for field trials in arid, invaded systems of the Great Basin.

10. BURNS, E.B.
Save the Redwoods League, 111 Sutter Street, 11th Floor, San Francisco, CA 94104
eburns@savetheredwoods.org

Varied Species Responses to Fog in the Coast Redwood Ecosystem

Maritime fog is a distinctive feature of coast redwood (*Sequoia sempervirens*) forest climate that supplies moisture, moderates light availability, and changes forest air temperature. The physiological influence of fog on coast redwood forest plants has been studied for decades and revealed that both understory and canopy species in the coast redwood forest use fog water as a seasonal water resource. The discovery of sapflow reversal in coast redwood crowns during fog events showed that foliar uptake of fog was an important mechanism for plant hydration. Interestingly, new research shows that wood production rates in coast redwood have increased dramatically in recent decades, especially since the 1970s, as fog frequency was declining. This recently documented coast redwood growth surge in the twentieth century begs the question, what is the long term benefit to coast redwood growth from frequent fog exposure? The short-term benefits of fog exposure for increasing plant water status and delivering nitrogen are not refuted; however the negative consequences of fog inundation have not been adequately studied to date.

11. BAGUSKAS, S.A.[1], VOELKER, S.[2], STILL, C.J.[3], GAO, L.[2], GREER, B.[3], MILLER, R.A.[3], RASTOGI, B.[3], and ARCE, R.[3]
[1]Department of Environmental Studies, University of California—Santa Cruz, 1156 High Street, Santa Cruz, CA 95064. baguskas@ucsc.edu
[2]Department of Plants, Soils and Climate, Utah State University
[3]Department of Forest Ecosystems & Society, Oregon State University

Impact of Historic Drought on the Population Dynamics of a Fog-influenced Coastal Forest on Santa Cruz Island, California

The recent California drought offered a rare opportunity to address how extreme drought impacts growth and population dynamics of a coastal tree, Bishop pine (*Pinus muricata* D. Don), in a fog-influenced ecosystem on Santa Cruz Island (SCI). Scientific and anecdotal evidence indicate that drought induces widespread mortality of Bishop pine trees; however, the vulnerability of age classes of trees to drought is unknown. In 2014, we randomly established 24 forest inventory plots and quantified the sizes and densities of all live and dead adult trees, saplings and seedlings. Increment cores were collected from a subset of live and dead trees at each plot, from which tree rings were measured and cross-dated. The survey found that the dead trees died between 2012-2014, and the highest mortality rates occurred for those individuals that established between 1980 and 1986, which was just prior to the last severe drought period (1987-1991) that drove widespread Bishop pine mortality on SCI. Approximately 75 percent of the seedlings that likely established during the 2012-2014 drought survived. These results suggest that established seedlings and saplings are relatively resistant to drought, whereas older trees are more prone to drought-induced mortality. We also observed canopy die-back across the stand, which can reduce fog interception and fog water inputs during the summer months. Our study provides baseline information about the vulnerability of Bishop pines at different life stages to drought-induced mortality, which has implications for the future influence of fog in coastal forest ecosystems in the future.

12. BENSON, S.
P.O. Box 658, Woodacre, CA 94973. Shelly.Benson@yahoo.com

Lichens in the Mist: Investigating California's Fog Lichens

Along the California coast, atmospheric and hydrologic forces interact to create a unique habitat known as the maritime fog zone, which is characterized by frequent summer fog. A distinctive group of lichens called fog lichens (*Niebla* species) is restricted to rock outcrops within the fog zone. These lichens require

reliable summer moisture supplied by fog drip. In the face of climate change, the frequency of summer fog will diminish and fog lichens, as well as other fog-dependent species such as coast redwoods, will be negatively affected. I conducted a pilot study to evaluate the use of fog lichens as biological indicators of changing climate in the maritime fog zone. Pilot data were supplemented with herbarium records and iNaturalist citizen science observations to map the distribution of California's fog lichen community. *Niebla homalea* was the most frequently documented fog lichen along the California coast. I found this species farther from the ocean than expected, extending the range eastward in Marin County. *Niebla homalea* occurrences coincided with summer fog, following the path of fog as it flows inland through breaks in the topography. Distribution of *N. homalea* appears to be strongly associated with the amount of summer fog (hours/day), suggesting that this species has potential as an indicator of climate change in California's coastal fog zone. Biological indicators, in comparison to mechanical instruments, measure the point at which environmental stressors first affect the ecosystem's inhabitants, and lichens are considered one of the most sensitive organisms in many ecosystems.

13. VASEY, M.C.
Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132. mvasey@sfsu.edu

Influence of Coastal Fog on Endemism and Beta Diversity in Chaparral along the Central Coast of California

The central coast of California has long been recognized as one of the most important "hot spots" of local endemism in the state. In particular, so-called maritime chaparral is renowned for its diversity. Various factors have been invoked to explain this phenomenon; however, the possible influence of the summer marine layer (coastal fog) has only recently been considered. In this study, I investigated the potential relationship between coastal fog and chaparral diversity along the central coast. At regional scales, high concentrations of local endemism translate into high levels of so-called *beta* diversity (i.e., increased rates of turn-over in species composition among different stands of similar vegetation). I tested the idea that coastal chaparral will have enhanced water relations during the dry season associated with coastal fog and that it will also demonstrate higher levels of *beta* diversity than interior chaparral. Evidence suggests that summer fog does enhance water relations in chaparral shrubs, particularly in lowland coastal environments. Further, coastal chaparral presents significantly greater *beta* diversity than interior chaparral. However, upland coastal chaparral stands had similar levels of *beta* diversity as lowland coastal chaparral and, during the entire year, similar levels of water use efficiency compared to interior chaparral. Significantly greater winter precipitation in coastal uplands most likely offsets the diminished role of summer fog in ameliorating the effects of the long dry season on chaparral in these uplands. I conclude by speculating on the evolutionary implications of this study using the hyper-speciose genus *Arctostaphylos* as an example.

14. WHITTLESEY, J.
Canyon Creek Nursery & Design, Butte Valley, CA 95965. johnccnd@gmail.com

Flies—the Forgotten Pollinators

As a photographer and observer of flower visitors, it has become clear to me that flies are active participants in the pollination of many flowers. From vernal pools of the valley floor to high mountain habitats they are ubiquitous and regular visitors to many flowers, with a number of families represented, including Syrphidae, Bombyliidae, Rhagionidae, Acroceridae, and Tachinidae. While not widely studied compared to other pollinators, Diptera are common flower visitors that have an understudied role in pollination. Current research such as Flies and Flowers: Ecology of Foraging and Pollination by David W. Inouye et al. in the Journal of Pollination Ecology (2015), is providing more data in this field, along with studies presented in the book *Pollination and Floral Ecology* by Pat Willmer. Flies are amazingly diverse, adaptable, and have a more important role in pollination than we may realize.

15. YANG, L.H.
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The Timing of Milkweed-Monarch Interactions in Northern California

I present data from recent observational and experimental studies describing the temporal ecology of milkweed-monarch interactions in California. These studies identify windows of opportunity that maximize the developmental success of larval monarchs in early summer and early fall. The fall window of opportunity is now commonly observed for caterpillars developing on *Asclepias fascicularis*, but not for those developing on *A. speciosa*. A greenhouse experiment aimed at isolating the effect of age-varying plant traits in these two species suggests that the defensive traits of *A. speciosa* increase rapidly over development, and likely preclude successful larval development on older *A. speciosa* plants. In general, caterpillars on younger plants developed more quickly, but also showed higher levels of mortality late in development after a large proportion of the plant biomass was consumed. A subsequent field experiment manipulated milkweed-monarch phenology and patch size independently, and showed that larger patches allow successful larval development earlier in the season. A further field experiment independently manipulated the presence/absence of the mid-summer biotic community (primarily predaceous jumping spiders) with a 7-10 day shade treatment in order to examine the separate and combined effects of natural enemies and high summer temperatures on caterpillar survival and growth. The results of this experiment suggest that the effects of natural enemies are likely to be stronger than the effects of summer heat. Finally, I present emerging data from the Monitoring Milkweed-Monarch Interactions for Learning and Conservation Project, a research-mentorship project aimed at collecting a large dataset on the joint phenology of milkweeds and monarchs in California.

16. SCHICK, K.N.
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Department of Entomology, California Academy of Sciences, San Francisco, CA 94103

Gallwasps on California Oaks—Hymenoptera: Cynipidae Interactions with *Quercus* Species

I review current literature on the Cynipidae (gallwasps) and their host species of California oaks. The Cynipidae are one of just two families of insects found only in plant galls. Cynipid galls are unique among insect galls in having organized tissue layers and individual central chambers in which the larva develops through all its instars and pupates into an adult. The Cynipini tribe of gallwasps induce galls on the leaves, floral organs, stems, and roots only on Fagaceae, most abundantly on the genus *Quercus*. Additionally, Cynipini have a heterogonous life cycle, producing galls ranging from large, showy, and colorful to those that are tiny and inconspicuous. Fossil evidence shows that these wasps coevolved with their oak hosts prior to the Miocene in our western region.

17. SEYBOLD, S.J.
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Pines and Pine Bark Beetles in California: A Legacy of Diversity and Damage

Pines (*Pinus*) are a large and diverse genus of conifers, with about 94 species in the Northern Hemisphere, 59 species in North America, and 19 species in California (including 11 that are endemic to California and/or surrounding states). Bark beetles (Coleoptera: Scolytidae) are a group of subcortical insects that feed as larvae and adults in the phloem of trees and woody shrubs. They are closely allied with another group of beetles, ambrosia beetles, which tunnel into the xylem and derive nutrition from associated fungi. Nearly 6,000 species of Scolytidae occur worldwide, forming one of the most formidable groups of endophytic parasites known to mankind. Over 500 species of scolytids likely feed on or in various microhabitats in pine trees worldwide, whereas around 90 species feed on pines in California. In addition to spatial patterns of colonization related to gross anatomy of pines (roots, stems, branches, twigs, cones), these beetles also partition themselves temporally, with certain genera (e.g., *Dendroctonus*, *Ips*) preferring

to colonize and kill recently declining or even healthy trees, and other genera prefer to colonize trees in a more advanced state of biodeterioration (e.g., *Hylurgops* or *Hylastes*, the so-called sour cambium beetles). Pine bark beetles have served as models for research on insect behavior guided by host attractants (kairomones) and aggregation pheromones, as well as for the development of the principles of integrated pest management and population dynamics. Historically, California bark beetle populations are infamous for massive expansion during drought cycles: since 2010, aerial surveys have detected over 102 million trees of all species that have died on 7.7 million acres of California's drought-stricken forests.

18. **UHLER, M.**
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In search of Alpine Rarity: A Rare Plant Treasure Hunt in Yosemite National Park

19. **BURGE, D.O.**
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The Spicebush and the Wasp

20. **WILLYARD, A.**
Hendrix College. willyard@hendrix.edu

***Pinus ponderosa*: A Checkered Past Obscured Four Species**

21. **HUDDLESTON, R.**
CH2M HILL. russell.huddleston@ch2m.com

Jepson Prairie Preserve: 35 Years of Conservation, Research, and Public Education

22. **JENSEN, N.**
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Biogeographical Wanderings in the *Streptanthus howellii* Alliance

23. **SIMS, S.**
Oroville Botanic Garden and Educational Center. tree-rx@simstlc.com

To Create a Botanic Garden

24. **VAN SUSTEREN, J.**
California Department of Water Resources
Presenting for Cynthia Powell
Calflora. cpowell@calflora.org

Calflora: Tools and Tricks

25. **SAFFORD, H.**
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Department of Environmental Science and Policy, University of California, Davis, CA 95616.
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Fear and Loathing in the Sierra Nevada: Confronting a Wicked Problem

This talk will cover the major environmental threats facing Sierra Nevada forests, focusing on climate change, the negative effects of fire suppression, and invasive species and pest outbreaks. It will explain how interaction between these threats will likely lead to major changes in Sierra Nevada forests, and will describe what sorts of management actions – both active and passive – can be employed in Sierra Nevada forests to increase ecosystem resilience to future change.

26. JOHNSON, J.
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Year of the Monkey: A Rare "Super Bloom" for Carson Valley Monkeyflower

The Carson Valley Monkeyflower (*Erythranthe carsonensis*), endemic to three valleys in northern Nevada and California, was described by Naomi Fraga in 2012 as separate from *Mimulus montioides*. Surveys from 2010 to 2015 had only found small, fragmented populations at the fringes of urban development around Carson City, but those were years of moderate to severe drought. The weather in 2016 was particularly favorable for this annual species and intensive surveys, combined with public response to a press release, yielded several large new populations in better protected areas. The new information will help us revise the status of the species from Critically imperiled (G1) to Imperiled (G2) or Vulnerable (G3).

27. KENT, R.M.
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A Place for Plants in FERC Licensed Hydropower Projects

The Federal Energy Regulatory Commission (FERC) issues licenses for most hydropower projects (including associated transmission lines and facilities) throughout the United States. All FERC licensed projects must adhere to federal and state environmental laws, including those pertaining to botanical resources. When a license expires, a project must go through relicensing to get a new license. This is a minimum five-year process where the licensee determines their project's impacts on environmental resources and develops protection, mitigation and enhancement measures as part of the license application. During relicensing, the licensee consults with federal and state agencies, as well as non-government organizations, all of whom comment on studies and license measures. FERC makes the final decision on measures included in the new license, and those must be complied with during the license term of 20-50 years. California, has over 210 FERC hydropower projects, many of which have just received a new license or are in the process of getting one. HDR has worked on over 30 of these projects, implementing botanical studies on hundreds of previously unsurveyed square miles, documenting hundreds of occurrences of special-status species, compiling complete plant lists which contain up to thousands of species, eradicating non-native invasive plants, and developing and implementing management and monitoring measures and plans. This talk describes the relicensing and license implementation process as it relates to botanical resources, including special-status plants located during studies, invasive species management during license compliance, and other positive impacts on the plants of California.

28. STANTON, A.E.
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We Did It! 14 Years of Collaboration and Adaptive Management Precludes Federal Listing of Tahoe Yellow Cress

Tahoe yellow cress (*Rorippa subumbelata*, TYC) is a rare member of the mustard family known only from the shores of Lake Tahoe in California and Nevada. TYC is endangered in both states and was placed on the federal Endangered Species Act candidate list in 1999. The first Conservation Strategy emphasized preventing the federal listing of TYC and was finalized in 2002 and implemented through a Memorandum of Understanding among 13 stakeholder entities. Since 2002, the TYC Adaptive Management Working Group (AMWG) has been meeting quarterly. The strategy was revised in 2015 to incorporate a significant expansion of TYC information generated by the AMWG in four areas: 1) a lake-wide survey record (1979-2014) was used to prioritize management of 45 TYC survey sites according to a numeric ranking index that integrates persistence, abundance, and variability; 2) field outplantings of container-grown TYC over 8 years informed restoration and mitigation with a suite of best management practices; 3) translocation of naturally occurring TYC within and among field sites over five years expanded options for avoiding, minimizing, and mitigating impacts to TYC and its habitat; and 4) implementation

of the TYC Stewardship Program recognized the critical role of private landowners in ensuring the long-term survival of TYC and offers a suite of AMWG-developed conservation practices including outplanting of container-grown TYC. Based on the successful implementation of the Conservation Strategy over 12 years, the US Fish and Wildlife Service removed TYC from the ESA candidate list in October, 2015. The AMWG continues to meet and is now working to integrate TYC conservation into the regional process to update the Lake Tahoe Shoreline Plan.

29. CAMPBELL, D.M.
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Fire Followers of Yosemite National Park: Discovering New Populations of Special-status Plants and Implementing Early Detection and Rapid Response to Invasive Species in Burned Areas

Surveys for rare and invasive plants have been ongoing in Yosemite National Park since the 2013 Rim Fire, the third largest in California history. Newly discovered rare and special status plant populations have been documented amid fantastic floral displays in recently burned areas. Many species are triggered by environmental cues from fire to germinate and rapidly expand. Documenting them before they go dormant in the seed bank, as those cues dissipate and later successional species establish, is necessary to understand their true range. Several invasive weed fire followers have also been discovered. Implementing a rapid response to treat invasive species has led to successful control at the critical early stages of establishment. Timely surveys to document the true extent of these species and managing the threat of invasive species will help ensure their long term success.

30. O'DELL, R.E.
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Soil Seed Banks of a Federally Listed Threatened Annual Plant, *Camissonia benitensis* (Onagraceae)

Soil seed banks are the foundation of all annual plant species populations, buffering them from extirpation against unpredictable environmental conditions (e.g., drought, habitat disturbance). If a plant is "born" when a seed (dormant embryo) is produced, annual plants live most of their lives (years to decades) in the soil seed bank and only several months as an emerged plant. If the soil seed bank is viewed as the population and emerged plants simply serve only to produce seeds and replenish the seed bank, then parameters of the soil seed bank including size, demography, and longevity are the critical components of annual plant species population viability analysis. A study was conducted to determine the soil seed bank distribution by soil depth of four large populations of *Camissonia benitensis* on alluvial terraces that varied by degree of habitat stability (susceptibility to burial by alluvium). Although the majority (> 60 percent) of the viable soil seed bank of each population was distributed within 4 cm (1.5 in) of the soil surface, small quantities of viable seeds were detected at depths up to 52 cm (20 in). Populations with greater levels of susceptibility to burial by alluvium exhibited distinct, viable seed peaks at depth in the soil profile, likely representing historic habitat burial events. In addition to having large, long-lived soil seed banks, the distribution of viable seed deep in the soil profile represents a further buffer for *Camissonia benitensis* as the populations are well-anchored against extirpation from erosion of the soil seed bank.

31. LAFORGIA, M.[1], CASE, E.[2], SPASOJEVIC, M.[3], LATIMER, A.[1], and HARRISON, S.[4]
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[4]Environmental Science and Policy Department, University of California,1 Shields Avenue, Davis, CA 95616. spharrison@ucdavis.edu

The Response of Soil Seed Banks to Drought in California Annual Grasslands

Climate change is expected to increase aridity and frequency of droughts. This aridification has been linked to a shift towards more drought tolerant plant assemblages with lower Specific Leaf Area (SLA; g/mm^2 dry mass). For example, in our annual grassland site in northern California, we have found both a declining trend in winter precipitation and in community weighted SLA of native annual forbs. However, many of these species maintain seed banks which might be buffering aboveground changes. Additionally, these grasslands have a dominant cover of exotic grasses, which are thought to be strong competitors with relatively high drought tolerance but short term seed longevity. To assess how the seed banks of these groups respond to drought, we collected soil samples from our annual grassland site in 2012 before the drought, and in 2014 after two years of drought. We induced germination with watering and identified each seedling that emerged. SLA was measured on each species in 2010. We hypothesized that seed banks of grasses and of high SLA forbs would be depleted. We found that although seed banks of invasive grasses declined, seed banks of forbs increased in abundance. Moreover, the community weighted SLA of the seed bank also declined. This study provides evidence that longer term drought would negatively affect grasses, while benefiting low SLA natives. Although the seed bank is buffering high SLA native forbs against short term change, it's likely that longer term drought would exceed the capacity of this buffering mechanism.

32. LESAGE, J.C. and HOLL, K.D.
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Seed Banks of Native and Exotic Forbs in Restored and Reference Northern Coastal Prairies

Northern coastal prairies are highly diverse ecosystems with a high native annual forbs richness, but are threatened by conversion to agriculture and coastal development. Efforts to preserve and restore coastal prairie have focused on aboveground vegetation, omitting the critical role that seed banks can play in controlling diversity, especially of annual forb species. We collected soil seed banks from two restoration sites, a degraded grassland, and a reference coastal prairie in a preliminary study to examine the effects of restoration on germinable seed banks of forb species. Soils were collected in September 2015, before the first fall rainstorm, and grown over sterile media in the greenhouse for nine months. Germinating forbs were identified, tallied, and removed. Native species represented between 25-37 percent of the total forb species richness germinated from each site, and native species were between 4-51 percent of the overall number of germinating individuals tallied. Native annual forbs were rare or absent in soil samples from all locations. Native perennial forbs represented a larger portion of the germinable seed bank in restoration sites (25-35 percent) than in reference (0.92 percent) or degraded sites (5.4 percent), suggesting that restoration practices overemphasize the establishment of native perennial forb species relative to reference habitats. Future studies will collect seed from a greater number of restored, degraded, and reference sites to determine whether these preliminary patterns exist across multiple northern coastal prairie restoration sites.

33. PARKER, V.T.
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Chaparral Seed Banks: Not Just for Plants Anymore

Seed banks are clearly a critical aspect of the ecology of the dominants of chaparral. Many species are characterized by persistent soil seed banks, which are stimulated to some degree by fire. I discuss the interactions between the chaparral plant and animal communities as they influence soil seed bank dynamics. Many animals in chaparral are principally seed predators and many rodents scatter-hoard seed for later consumption. Focusing just on three genera, *Adenostoma, Ceanothus*, and *Arctostaphylos*, a range of seed predators impact the potential density of persistent soil seed banks. These genera differ in the degree to which insects impact seed viability, whether or not birds are important seed predators, and the role of mammals, especially scatter-hoarding rodents, in the development and sustainability of persistent soil seed banks. These relationships, especially in *Arctostaphylos*, appear to be the result of very long-term diffuse co-evolutionary interactions, with most adaptive shifts occurring on the plant lineages.

34. SCHNEIDER A.C.[1], and COLWELL, A.E.L.[2]
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Cryptic Host-specific Diversity in the Newly Resurrected Parasitic Genus *Aphyllon*

Recent studies support a narrower generic circumscription for the parasitic genus *Orobanche,* in which species native to the New World are recognized as *Aphyllon*. A recent phylogenetic study of this clade has revealed substantial undescribed diversity associated with various host-races. This finding was foreshadowed by several recently described segregates that are host-specific, including the coastal Californian *Aphyllon robbinsii,* which is a specialist of *Eriophyllum staechadifolium*. Efforts are underway to describe these lineages morphologically and taxonomically, beginning with a particularly distinct and widespread species parasitizing *Galium* species in montane California and Oregon. Aside from host preference, this species is distinctive in its 2 to 4 yellow flowers per stem and long (10-30 cm) pedicels. Other, more cryptic, host races include: 1) *A. purpureum* (formerly *O. uniflora* subsp. *occidentalis*) parasitic on *Sedum* and Saxifragaceae, 2) *A. purpureum* parasitic on Apiaceae, 3) *A. purpureum* parasitic on *Antennaria* and *Senecio*, and 4) *A. fasciculatum* parasitic on *Eriogonum, Eriodictyon, Eriophyllum,* and *Phacelia*.

35. JANEWAY, L.P.
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Carex xerophila – a New Sedge Hiding in the Chaparral

Carex xerophila Janeway & Zika (chaparral sedge), CRPR 1B.2, was recently described from serpentine- and gabbro-derived soils in Butte, Yuba, Nevada, and El Dorado counties, where plants are always associated with or growing under manzanita and/or McNab cypress. Collections of this species had been made as early as 1969 and 1973 from a couple of easily accessed sites in Butte and Nevada counties, but even when the collector was the same the identifications varied: *Carex* sp., *Carex brainerdii*, *Carex rossii*, or *Carex brevicaulis*. Later annotations of these specimens also varied: *Carex brainerdii*, *Carex rossii*, or *Carex globosa*. More recent collections met similar identification fates, with these and the earlier collections most commonly identified as *Carex brainerdii*. All of these species are closely related within *Carex* section *Acrocystis*, and determinations using existing keys has not always been easy. In 1992, I wrote that although the plants in Butte County were best identified as *Carex brainerdii*, they differed in several obvious ways from that species and also from other related species known from northern California. When I brought these plants, and others that I had seen later in Yuba, Nevada, and El Dorado counties, to the attention of the Carex Working Group in 2009, immediate interest from these experienced individuals led to the publication of this new species in 2014.

36. KEPHART, S.R.
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Stalking California *Camassia*: Unusual Pollination and Range Disjunctions in Northern Forest Glades

Most of Northern California and southwest Oregon lie within the globally diverse California Floristic Province, a hotspot of endemism. *Camassia* Lindl. (Agavoideae, Asparagaceae), or camas "lily," forms an important spring-flowering geophyte in its diverse environments, from summer-dry vernal pools and oak savannas to montane fens and forest glades of the Siskiyou-Klamath, Cascade, and Sierra Nevada ranges. Species undergoing radiation in such varied, isolated habitats often pose difficult taxonomic challenges. *Camassia* is no exception, yet its rare and common taxa have been little-studied despite high cultural-conservation value and close ties to soaproot (*Chlorogalum*), rush "lilies" (*Hastingsia*), and other *Agave* relatives. Of interest are three taxa, great camas (*C. leichtlinii*) and common camas (*C. quamash*) with historically contentious circumscriptions in California. *In-situ* field data linked to morphogenetic, ecological, and pollination studies now reveal hidden complexity within these two taxa, unveiling a new range disjunction for rare Howell's camas (*C. howellii*), a narrow endemic in southwest Oregon. Principal component analyses of morphological and microsatellite data as well as phylogenetics now support three species in California, with *C. howellii* supplanting *C. quamash* subsp. *breviflora* in several Butte and Yuba county sites including within the Plumas National Forest. Moreover, these populations differ markedly from other camas species in floral life span and other traits leading to an unusual vespertine pollination mode similar to *Chlorogalum*, in contrast to largely diurnal pollination in congeneric species of *Camassia.* These discoveries have implications for conservation, species delimitation, and the nature of ecological and evolutionary factors driving diversification in these lineages.

37. SHEVOCK, J.R.
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New Bryophyte Discoveries in California: The Frontier Remains

Bryophyte inventory and floristic study in California has lagged far behind efforts invested among vascular plants. Several recently described moss and liverwort species have been recognized in California since the discovery of the monospecific moss genus *Dacryophyllum*. These new discoveries further support California as having the richest bryophyte flora among the states. The moss families Bryaceae, Grimmiaceae, Orthotrichaceae and Pottiaceae are species-rich in California and are likely to yield additional new taxa with continued exploration and critical examination of collections residing in herbaria. The California moss flora has increased nearly 10 percent since 2009 with the publication of *California Mosses*. This increase in bryophyte diversity in such a short time span is rather remarkable considering that only a handful of bryophyte collectors are active within the state. Many bryophytes that are now being discovered in California will represent rare taxa: either localized endemics to be described as new to science or taxa viewed as relictual where they will be far removed from their next occurrence, in some cases, continents away. Bryophyte distribution and rarity in California is therefore at a completely different scale compared to our understanding of vascular plant endemics, especially within the California Floristic Province. Many bryophytes are known in the state from one or only a few occurrences. The importance of developing bryofloras at a county, watershed, or administrative unit cannot be underestimated. Through the acquisition of voucher herbarium specimens, additional bryological discoveries will be made.

ABSTRACTS FOR POSTERS

Abstracts in alphabetical order by primary author name; index on page 35
See also the List of Common Acronyms on page 34

1. AKULOVA-BARLOW, Z., and CREER, S.
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Natural Mutations of California Plants

Different types of natural plant mutations were observed during field work in California: fasciation, albinism, phyllody, variegation, homeosis, curled leaves, and whorled phyllotaxy. The most common type of abnormal growth is fasciation; it was recorded for many native and non-native species in California. Fasciation is when the apical meristem (growing tip) becomes elongated perpendicular to the direction of growth, producing flattened, contorted tissue. Other mutations observed in California include albinism (a lack of pigmentation), phyllody (the abnormal development of the floral parts into leafy structures), variegation (the appearance of different colored zones on the leaves), homeosis (the transformation one organ to another, e.g. petal to sepal), curled leaves, and whorled phyllotaxy (e.g. three leaves per node instead of usual two). Plant mutations can have hormonal, genetic, bacterial, fungal, viral, and environmental causes, and they provide interesting material for genetic studies.

2. ARTHUR, A., RICHMOND, M., and KORHUMMEL, R.
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Mitigating Impacts to Coast Lily (*Lilium maritimum*): A Case Study of Transplanting an Endangered Bulb

As part of a mitigation plan, we transplanted 28 bulbs of coast lily (*Lilium maritimum*, CRPR 1B.1) from an imperiled site in Bishop pine forest to a nearby site in contiguous habitat. Using a shovel, we excavated approximately 5 gallons around the bulb to maintain integrity of any soil mycorrhizae which may be associated with the roots of the bulb. Each transplanted bulb was marked with a flag for easy identification during the monitoring years. Three years of monitoring were conducted starting the summer following the transplanting (2013). Data recorded during monitoring included presence/absence of vegetative shoots and vigor. After three years of annual monitoring, it was determined only two individuals did not recover. The remaining 26 bulbs have successfully produced shoots and/or flowers each year after transplanting. The success of the transplanting demonstrates the necessity of appropriate host sites and maintaining soil integrity.

3. BAMFORD, M.J.[1], and KINZY-REISCHE, G.L.[2]
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[2]College of Agriculture-Interdisciplinary Studies, California State University, Chico, 400 West 1st Street, Chico, CA 95929-0310

Field Survey of a Rare Endemic Plant Population: *Fritillaria pluriflora* (Adobe lily)

Many rare California endemics are under threat from anthropogenic sources. Any protection measures require a thorough knowledge of population biology of these species to identify threats and vulnerabilities. No current population counts or habitat monitoring has been completed on a population of *Fritillaria pluriflora* (Adobe lily), occurring on public land in Lake County, California. *F. pluriflora* is currently listed on the *CNPS Inventory of Rare and Endangered Plants*. This study provides free public data on population density, life stage forms, and reproduction rates of the surveyed population. Several risks to the population were also identified. Some of these risks, such as drought and competition from invasive species were observed; most concerning was the evidence of direct OHV damage in the area. The authors suggest

future anthropogenic impacts should be monitored and prevented in order to curtail further population degradation.

4. BELSHER-HOWE, J., and GARCIA, H.
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Mt. Hough Ranger District, Plumas National Forest, 39696 Highway 70, Quincy, CA 95971

Wildfire Effects on Populations of *Cypripedium fasciculatum*

Cypripedium fasciculatum is a rare understory herb whose populations are highly vulnerable to wildfire. While much of the native California flora requires or tolerates periodic wildfire, *C. fasciculatum* is among a small portion of the flora that is adversely affected by wildfire. Post-fire monitoring of forty-six populations in the upper North Fork Feather River watershed found large declines in both population size and density. High-severity burns extirpated populations, while low-severity burns had mixed impacts on populations but still were correlated with an overall decline. Adverse effects to populations were more closely tied to post-fire estimations of soil burn severity rather than vegetation burn severity. This is likely due to the importance of mycorrhizal fungi, the plants' association with well-developed duff layers, and their relatively shallow root crowns and rhizomes. Historic fire regimes of smaller less intense fire were likely more compatible with the populations that tend to consist of low plant densities over large areas. Pre-settlement likely had mixed impacts similar to low-severity burn areas. *Cypripedium fasciculatum*'s susceptibility to lethal impacts from wildfire raises management concerns for the species. Active management of populations and habitat is preferable to total avoidance. Actively managing stands surrounding populations, aiming at reducing fire intensity while maintaining stand characteristics necessary for the species, is the best option for long-term viability.

5. BJERKE, J., and BURTON, C.
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Do I Need a Plant Permit from the State of California?

With various agencies involved, determining if you need a permit for activities that affect native plants in California can be difficult. Authorization from the State of California for scientific, educational, or conservation activities involving native plants is typically only required if the work involves state-listed rare, threatened, endangered, or candidate species, or the work is on state-owned lands. Plant research, surveys, voucher specimen collection, seed banking, propagation, reintroduction, recovery actions, operations of herbaria and botanic gardens, and similar activities require a California Endangered Species Act/Native Plant Protection Act permit from the California Department of Fish and Wildlife (CDFW) if the activities could result in the take (killing) or possession of a state-listed rare, threatened, endangered or candidate species, or any part or product thereof. Permission is also required to conduct research and other activities on CDFW and other state-owned lands. Work on federally owned lands is regulated by the appropriate federal agency. The California Desert Native Plants Act regulates the harvest of certain native plants in Imperial, Inyo, Kern, Los Angeles, Mono, Riverside, San Bernardino, and San Diego counties; however, permits are issued by the county, not the State of California.

6. BORG, M.A., and SIMONIN, K.A.
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Long-term Effects of CO_2 Enrichment on Plant Genome and Cell Size

A major unanswered question in plant biology, ecology, and conservation centers on identifying the structural and functional characteristics of plants that ultimately determine species and community responses to environmental change. Of particular importance is the response of individual plants and communities to long term enrichment of atmospheric carbon dioxide (CO_2). In general, plant species respond to increased CO_2 by building leaves with fewer, large stomata and decreased overall surface conductance. However, the underlying cellular mechanisms for these observed changes are poorly understood, as are

the larger-scale effects on plant species distributions and community dynamics. Previous research suggests coordinated changes in cell size and genome size can occur in response to changes in atmospheric CO_2. Together these changes result in the down-regulation of maximum potential leaf surface conductance to CO_2 and water vapor. Here we evaluated the influence of long-term atmospheric CO_2 enrichment on a native California grassland at Stanford University, conducted in collaboration with the Jasper Ridge Global Change Experiment. Plant samples were collected and analyzed from both experimental plots with sustained elevated CO_2 for 18 years and control plots with ambient CO_2 levels. The objectives of this study were to determine 1) the extent to which individual plant species' genome size changes when subjected to long-term increased CO_2, and 2) response of individual plant species' guard cell sizes when subjected to long-term increased CO_2. The results of this study will provide valuable insight into plant community responses to environmental change.

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Noxious Weed *Dittrichia graveolens* (Stinkwort) Reduces Biomass and Species Richness of other Plants, but *Salvia* spp. May Provide a Mechanism for Suppression

Dittrichia graveolens (stinkwort; Asteraceae), a noxious weed that is toxic to livestock and may cause contact dermatitis in humans, is expanding aggressively in disturbed habitats in California. We observed the effect of increasing *D. graveolens* cover on herbaceous biomass and species richness on mesic soil types in Glenn and San Diego counties. Relative percent cover was sampled along 10-m transects, each with 10 regularly spaced 0.5-square-meter quadrats, for a total of 100 quadrats included. Aboveground biomass was also sampled destructively from five of the ten transect locations. Within all transect locations, the diversity of all non-stinkwort species was reduced significantly when *D. graveolens* comprised at least 25percent of relative cover ($n = 200$, p-value < 0.001 with *D. graveolens* cover as the intercept). Increasing cover of stinkwort in quadrats significantly reduced the total biomass of local plants ($n = 100$, p-value < 0.001 with *D. graveolens* as intercept). In quadrats not sampled destructively, *D. graveolens* significantly reduced detritus present (deceased plants and leaf cover, mostly graminoids, $n = 100$; p-value < 0.001 with like intercept conditions) as well. Despite these strong effects on herbaceous species, stinkwort appeared unable to infiltrate adjacent coastal chaparral and sage stands (*Salvia* spp.) containing unoccupied bare ground. Further work will establish whether previously-demonstrated allelopathic soil-infiltrating sage compounds (camphene, cineol isomers) may impede invasion into chaparral habitats, and perhaps provide a non-toxic, organic means of controlling this pest.

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The Central Valley Flood Protection Plan Conservation Strategy's Invasive Plant Management Plan

Invasive plant species present in the State Plan of Flood Control (SPFC) contribute to the loss of key habitats, displace native species, and impair ecosystem processes. Invasive plants also significantly increase the costs and difficulty of operations and maintenance activities on flood control infrastructure. The Invasive Plant Management Plan (IPMP) was developed as a component of the Central Valley Flood Protection Plan (CVFPP) Conservation Strategy and is meant to help reduce the impact of invasive plants as a stressor on conservation targets and as an impediment to SPFC operations and maintenance. The IPMP describes current Department of Water Resources (DWR) vegetation management practices, DWR's proposed approach for managing invasive plants, general methods for prioritizing invasive plant infestations for treatment, monitoring methods that could be used to detect new infestations of invasive plants, assessments of how well prior invasive plant treatment efforts have met defined goals and objectives, and potential organizations and funding programs that DWR could work with to maximize the effectiveness of invasive plant treatment efforts. The IPMP is meant to increase the resources available for invasive

plant treatment actions by fashioning an approach that meets multiple needs and therefore may take advantage of funding sources not previously available for these actions. The IPMP is Appendix E of the CVFPP Conservation Strategy and can be found on the DWR website: www.water.ca.gov/conservationstrategy/cs_new.cfm.

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Breeding Systems and Hybridization Potential of Native Grassland Species

Ecological restoration in California is still a young field, both in terms of theory and practical application. Implementation methods and strategies are still being tested as ecologists strive to rehabilitate California's ecosystems using materials that do not adversely alter the genetic structure of a site's existing or historical plant populations. Materials for projects in California often come from native seed/transplant producers within the state. Producers strive to provide materials that are genetically true to a species and to the geographic distribution in which it was collected (i.e., ecotype). In seed production, growers take precautions to reduce the chances of hybridization between species and cross-pollination between ecotypes, while also maximizing genetic diversity of seeds during the harvest and cleaning processes. My literature review focused on answering two questions: 1) what are the breeding systems of the species grown in large-scale production? and 2) with which other species and/or genera does the species hybridize? The information presented here is a combination of observational data gathered at two well-known California native seed production farms which have grown various species in largescale production for more than 20 years, and information from existing literature on the breeding mechanisms of California native species and their propensity for hybridization. These data were compiled to best recommend how to maintain genetic diversity in large-scale production taking into account hybridization, pollination mechanisms, and insect movement.

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Phenotypic Responses of a Sierra Nevada Monkeyflower to Climate Variation and Severe Drought

Concurrent with climate change, California recently experienced an exceptional drought from 2012 to 2014. To investigate the potential for an adaptive response to this event, I conducted a "resurrection" study of the cutleaf monkeyflower (*Mimulus laciniatus*), an annual plant, comparing trait responses of ancestral seed collections ("pre-drought") with contemporary descendant collections ("drought"). Plants were grown in a common garden to test whether this geographically-restricted species has the capacity to respond to climate stress across its species range. My research examined if traits shifted in predicted ways in response to recent, severe drought and if the responses varied by geographic range position. Days to emergence (i.e. seedling emergence from soil) in the drought generation were significantly fewer than in the pre-drought generation. Additionally, trait variation was reduced in the drought generation, which may suggest that a selective event occurred. Days to first flower differed significantly by region and increased with elevation, suggesting local adaptation across the species range. The drought generation plants were larger, as estimated by several morphological traits, as compared to the pre-drought generation, which may be attributed to earlier germination of these populations in the greenhouse. My results demonstrate that rapid shifts in trait means are possible within populations, including peripheral populations of a plant species with a relatively restricted range. This study highlights the need for better understanding of rapid adaptation as a means for plant communities to withstand climate change.

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Assessing the Rarity Status of the Newly Described Shasta County Endemic, *Adiantum shastense*, by Employing Innovative Tools in Geographic Information Systems

In the past, assessing the rarity status of California Rare Plant Rank (CRPR) 4 plants has been problematic. Employing the same detailed methods that are used for assessing the rarity of CRPR 1B or 2B species is extremely time-consuming when applied to plants that have dozens or up to hundreds of records, yet this has been the practice for nearly fifteen years. Consequently, some plants have remained on CRPR 4 without evaluation for deletion, while others have yet to have been reviewed for addition even though they may have been proposed years ago. Current technologies, along with the advancement of newly available public database repositories, have allowed CNPS and CNDDB to develop new tools that estimate a total number of occurrences for these uncommon, yet not rare, plant taxa. The recently described Shasta County endemic, *Adiantum shastense*, was put through our new assessment tools in October of 2016, and provided us with an estimate of 51 total occurrences from the initial 116 collections and observations known. These automated tools substantially aided us in the review process by turning about a weeks' worth of manual occurrence delineation work into roughly ten minutes of time. Upon completion of our assessment using the output of our new tools, *Adiantum shastense* was promptly put through the public review period of our status review process in mid-October, and added to CRPR 4.3 of the CNPS Inventory on November 18, 2016.

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Response to Damage in *Cucurbita foetidissima* Kunth: Just Add Water

Induced responses to damage result from an interaction with plant physiology and resource availability. *Cucurbita foetidissima* Kunth, the buffalogourd, is a native perennial and drought-tolerant root succulent that induces growth in response to damage, even following months of severe drought. In a *C. foetidissima* common garden, we performed a full-factorial experiment of biomass removal (50 percent of vines cut at base) and water addition (1-gal/week) to test hypotheses of damage-induced growth responses and their interaction with water addition. The design consisted of control plants (n=8) not cut or watered (NCNW), cut-not watered plants (CNW, n=7), not cut but watered (NCW, n=7), and cut and watered plants (CW, n=8). Vine length and physiological parameters were measured weekly for six weeks. Plants with only water addition (NCW) had the lowest growth among treatments. Plants with both treatments (CW) grew twice as long as NCW plants, but similar to that of NCNW. The CW treatments had the highest photosynthetic rate, but not significantly higher than that of NCW plants. Water use efficiency was lowest in the CNW treatment, with the other treatments having a nearly 25 percent higher Water Use Efficiency value, but not significantly different than each other. Across treatments, plant regrowth was proportional to the mass of the vines removed. Furthermore, control plants had nearly the same growth as the CW plants. These results indicate that the ability to induce growth after severe damage results from the interaction of plant resource availability with plant ability to photosynthesize and reallocate resources.

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Genetic Diversity in Morro Bay Eelgrass: A System in Collapse

Seagrass populations are in decline worldwide. California's native seagrass, *Zostera marina* (eelgrass) is no exception to this trend. In the last eight years, the estuary in Morro Bay, California has lost 95 percent of its eelgrass. Eelgrass is an important ecosystem engineer, providing important ecosystem services such as sediment stabilization, nutrient cycling, and nursery habitats for fish. The loss of eelgrass is likely to have rippling community effects and expensive, large scale restoration efforts have been unsuccessful in

Morro Bay. The failure of these restoration projects necessitates a better understanding of the causes of eelgrass decline in this particular estuary. Previous research on eelgrass in California has demonstrated a link between population genetic diversity and eelgrass bed health, ecosystem functioning, resilience to climate change, and tolerance of disease and grazing pressure. The genetic diversity of Morro Bay eelgrass populations has not been assessed until now. We characterize the genetic diversity of Morro Bay eelgrass by conducting fragment length analysis of 12 microsatellite loci. Low genetic diversity could mean this population is on the brink of extirpation. However, knowledge of the genetic composition of the beds will also direct future restoration projects. The Morro Bay population could be an excellent candidate for genetic rescue, whereby the planting of individuals from other California populations could boost the genetic diversity of the system. Conversely, the Morro Bay eelgrass population could represent a locally adapted population that should be preserved, and that might suffer outbreeding depression if new genes were introduced.

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Patterns of Seasonal Drought in Three Populations of *Arctostaphylos glauca*: A Latitudinal Comparison

The big berry manzanita (*Arctostaphylos glauca,* Ericaceae), is recognized as a resilient chaparral species. Its range extends from Mt. Diablo, near the San Francisco Bay, south to Baja California, Mexico. On its eastern limit, it is found farther inland than any other coastal *Arctostaphylos*. We are comparing three *A. glauca* populations, growing along a latitudinal gradient in the northern half of its range, in order to observe differences in water stress and mortality. We observed very low pre-dawn water potential measurements and dormant stomatal behavior in plants across all sites, followed by a rapid response to precipitation, starting in October 2016. After collecting data through late spring of 2017 – 12 months in total – we will have an informed story of ecophysiological responses to seasonal drought across its latitudinal range. Our study will offer insight into predictions for individual and range-wide responses in *A. glauca*, in light of climate change and drought in California.

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Citizen Scientists Monitor Climate Effects on Phenology of Four Native Oaks at Pepperwood Preserve

The importance of climate change has been highlighted by California's recent four-year drought from 2012 to 2015. Climate models suggest that Northern California will become increasingly arid, with summer temperatures increasing by 6-8 °F by end-of-century, and an increased probability of extreme events such as drought and flooding. The timing of plant life cycles (phenology) is closely linked to climate. Since 2013, citizen scientists at Pepperwood Preserve have been tracking the effects of climate on California native plant life cycles through the National Phenology Network and the California Phenology Project. Here, we compare the phenology of four oak species—blue oak (*Quercus douglasii*), California black oak (*Q. kelloggii*), coast live oak (*Q. agrifolia*), and Oregon oak (*Q. garryana*)—in a drought year (Water Year 2014–2015, 24.4 in. rain) and an El Niño year (Water Year 2015–2016, 31.3 in. rain). We also compare phenophase onset date with growing degree-days and cumulative precipitation. We found that in 2015 all four oak species had an earlier onset of breaking leaf buds, flowers and flower buds, and fruits compared to 2016 (with the exception of blue oaks fruiting at the same time and coast live oaks fruiting later). Long-term monitoring of these oaks will inform how climate change may impact their phenology and thereby affect the critical habitat, food, and biodiversity oaks provide in California.

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Predicting Changes in California's Diverse Environments: Introducing the ORIDE Climate Change Experiment

Climate change models predict that the duration and intensity of drought in the western United States will increase in future climate regimes. As water is the primary driver of community structure and ecosystem processes in grasslands and shrublands worldwide, these climate change predictions indicate that grass- and shrub-dominated ecosystems may be particularly sensitive to changes in climate. In summer 2016, we initiated a multi-year experiment to investigate the impacts of intense, long-term drought on the western Great Basin sagebrush ecosystem, near the border of California and Oregon. Over the next four years, we will track changes in species composition, forage and root production, sagebrush seedling recruitment, and plant stress of the dominant sagebrush species at our two sites: *Artemisia cana* and *A. arbuscula*. In summer 2016 we collected baseline data. Although our two sites are located within close proximity to each other, initial species composition, diversity, and aboveground net primary production differed markedly between the sites. We found no differences in midday and predawn xylem pressure potentials (XPP) between the treatments at the site where *A. cana* was dominant. As expected, individuals had lower midday XPP in late August compared with late July, but most individuals were able to recover overnight. This experiment will provide insight into the resilience of the Great Basin sagebrush ecosystem to current and future predicted shifts in climate, and will also inform species conservation and land management decisions by the Bureau of Land Management and other groups.

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Implications of Water Storage Variations in Three Herbaceous Asteraceae in the Sierra Nevada Mountains, California

In the near future California is projected to experience more frequent droughts. How California flora will respond is not well understood. Prolonged droughts could impact species differently depending on their ability to store water. In addition to water storage in stems and leaves, which has been well-characterized, root water storage may also provide substantial amounts of water particularly in locations where environmental conditions aboveground can be harsh. Three Asteraceae species that occur in Sierra Nevada meadows have varying thick tuberous root systems and appear to be thriving even in the current drought. In this experiment I will determine if these species have root water storage, the ability to use it at a later date, and if photosynthesis is occurring because of this. I will measure water potential of the plants using a psychrometer and water content using stable isotope methods to find the source of water in the plant, as well as measure photosynthesis of the plant. I expect to see more root water storage in the species with thicker roots, and that the plants will continue to conduct photosynthesis well into periods of low soil water availability.

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How Vegetation Classification Can Inform the Status and Trends of Floristic Patterns of the Modoc Plateau, Northeast California

In 2016 we collected approximately 400 vegetation samples across 1.1 million acres of public lands on the Modoc Plateau. The purpose was to develop a vegetation classification and inventory, ultimately leading to a floristically and structurally detailed vegetation map. Prior to completion of the map (expected fall 2018), the results of quantitative analysis of the vegetation data tell us many things about the ecological vulnerability and rate of change of regional vegetation types. Samples were allocated through random stratification of GIS layers and interpretation of the most recently available aerial imagery. Teams divided the area into three ecological subsections and sampled each in order of their floristic phenology from May through August. Of the 87 floristic types of vegetation sampled, eight alliances made up 53 percent of all samples. The three most common alliances (*Artemisia tridentata, Artemisia arbuscula*, and *Juniperus occidentalis*) comprised about 26 percent of all samples. Cluster analysis revealed ecological relationships among several vegetation patterns: 1) recent shifts between native dwarf low sagebrush shrub-steppe and type-converted annual grasslands, 2) influences of recent juniper establishment on historic basin sagebrush/blue-bunch wheatgrass associations, and 3) interplay between native and semi-natural wetlands. Managers and conservation planners can use cues from the interactions among different vegetation types to determine where and how to manage for long-term native biodiversity of the Modoc Plateau. For example, they may specifically target appropriate management in landscape settings where a high correlation exists between vegetation type and recent colonization of juniper or non-native grass expansion.

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Plant Rarity in the Bay-Delta: A Status Update on Five Special-Status Plants

The Sacramento-San Joaquin Delta covers over 1,150 square miles and receives approximately 50 percent of California's stream flow, with its waterways and wetlands forming the West Coast's largest estuary. The Delta provides critical habitat for many plant, fish, and wildlife species; however, as a result of the massive reclamation that began in the late 1800s, the physical transformation of the Delta has resulted in a loss of 98 percent of freshwater emergent marsh habitats. Due to continued threats including increasing water diversions, loss of habitat, invasive species, and impaired water quality, over a third of the Delta's indigenous fish species are extinct or are threatened with extinction. A variety of endemic special-status plant species are similarly threatened; baseline data on existing populations is essential to understanding future population declines of these species. We focus on five rare plants that are endemic to Sacramento-San Joaquin Delta and surrounding regions: woolly rose-mallow (*Hibiscus lasiocarpus* var. *occidentalis*), Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*), Mason's lilaeopsis (*Lilaeopsis masonii*), Delta mudwort (*Limosella australis*), and Suisun Marsh aster (*Symphyotrichum lentum*). For each of these species, we explore current and historical occurrence information, key identification characteristics, and any taxonomic changes to help examine the status of each species and existing information gaps, threats to species' persistence, and management implications of predicted future sea level rise and salinity changes.

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Summer Root and Soil Water Distribution under Annual Grasses and *Stipa pulchra*

The interaction between plant roots and soil water under drought conditions is poorly understood. California grasslands provide an opportunity to examine the effects of two contrasting drought avoidance strategies on soil moisture profiles under drought conditions. In August 2016 at Hastings Natural History Reserve, we collected soil samples under patches of the native perennial grass *Stipa pulchra,* and under

adjacent patches of invasive annual grasses and forbs, to a depth of 155 cm on paired plots. Results indicate that under both annual and perennial stands, root mass had a strong inverse relationship with water content (R^2 = 0.48, p-value = 0.0004) and that *S. pulchra* had higher root densities ($t_{(\alpha=.05,5)}$= -2.1, p-value = 0.04). Soil water content was higher on average under *S. pulchra* than under annual grasses and forbs, although only by about one percent ($t_{(\alpha=.05,5)}$= 2.8, p-value = 0.0064). Under both annual and perennial stands the inverse relationship between soil water and root mass held true until root mass fell below 0.00034 g/cm^3, below which soil water content decreased. Our results indicate that under some circumstances the presence of plant roots is consistent with higher summer soil moisture content.

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Using tRNA Class Informative Features to Determine the Phylogenetic Placement of Gnetophyta

Gnetophyta is a small gymnosperm clade of about 90 species of tropical evergreen trees, shrubs, and lianas that have been one of the most enigmatic problems in seed plant phylogenetics. Molecular phylogenetic and phylogenomic studies have converged on two conflicting hypotheses: 1) the Gnecup hypothesis that unites Gnetophyta with Cupressophyta conifers and 2) the Gnepine hypothesis that unites Gnetophyta with Pinaceae. Interestingly, the Gnecup hypothesis is supported by plastid phylogenomic data, whereas nuclear phylogenomic data and certain partitions of plastid data support the Gnepine hypothesis. To address this conflict I used a new phylogenetic method currently being developed in my lab based on the putative tRNA-protein interaction determinants called tRNA class informative features (CIFs). CIFs are a set of structural features (e.g., Cytosine at position 7) on a tRNA that promote recognition by its cognate aminoacyl-tRNA synthetase. These sets of structural features that determine a tRNA's class are not static and have been shown to vary widely across the tree of life providing a slowly evolving phylogenetic marker. To test between the Gnecup and Gnepine hypotheses, all publicly available chloroplast genomes of gymnosperms, angiosperms, and ferns were used to determine tRNA CIFs. From the chloroplast tRNA CIFs I reconstructed a phylogenetic tree using the neighbor-joining method with a distance metric calculated from tRNA CIFs. The resulting tree supports an older hypothesis that Gnetophyta is sister to all other conifers.

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Digitizing and Imaging Local Herbaria to Improve Accessibility

Herbaria contain a significant and irreplaceable source of information pertaining to the natural history of our planet. They are an essential component in comparative studies in fields such as taxonomy, systematics, morphology, conservation biology, and biodiversity and are regularly used by educators and the public. Digitizing local herbaria allows for little known and rarely accessed collections to become accessible by publishing specimen images and label records. Collaboratively, the Klamath National Forest and Sierra Pacific Industries have begun the process of imaging and digitizing the specimens in our respective herbaria. A Nikon D610 camera with 60mm lens captures images of our collected specimens that are linked to their associated label data. We manage the images and label record data of our collection through the North American Network of Small Herbaria open access portal provided by Symbiota. Data is published to the Integrated Digitized Bio Collections and the Consortium of California Herbaria sites and is accessible to the public through numerous search engines. Approximately 3,500 specimens will be imaged and digitized on the Klamath National Forest before equipment is passed along to Sierra Pacific Industries for its 1,800 records. The equipment is available for circulation to other interested small herbaria throughout our region.

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California Botanist Certification: Purpose, Status, and Goals

For many years botanists have been actively involved in setting environmental policy and assisting in science-based decision-making in California. Private environmental consulting, engineering firms, and public natural resource agencies offer employment opportunities for botanists in field surveys and environmental impact assessment and document preparation, but until now there has not been an organization to offer professional certification to these practitioners. An organizational structure and broad collaborative effort has been formed called California Botanist Certification (CBC). The CBC is run by a Board of Certification (BOC) composed of certified botanists and is administered by California Native Plant Society. The goals of the CBC are to establish standards of proficiency and professionalism that guide the training, development, and performance of botanists, and to facilitate relevant professional training. Certified botanists will receive an annual newsletter and be listed on a Register of California Certified Botanists. Certification will be granted through examinations, and is designed for those with five or more years of experience. Prior to becoming certified, an applicant will submit a testing fee and take and pass the examinations. After successfully passing the examinations, certified botanists will be required to pay an annual fee and submit evidence of continuing education every five years, and agree to abide by a Code of Ethics. Botanist Certification provides the public and larger environmental community with a way of identifying qualified botanists and will serve as an organizing force to direct future botanists toward the profession. More information is available at www.cnps.org/cnps/education/botanist_certification/.

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Redistribution of Soil-Water by Coyote Brush in a Shrub-Grassland Ecotone

Coyote brush (*Baccharis pilularis* DC, Asteraceae) is an important successional native evergreen shrub species. Seedling establishment requires prolonged spring soil moisture, and one-or-more-year-old shrubs can withstand low soil water potentials of -2 MPa (MPa= megapascal, a unit of internal pressure). Beyond this, little is known about coyote brush soil-water dynamics. Hydraulic redistribution within the soil profile by roots has been demonstrated in numerous plant species and may help inform landscape-scale hydrological and carbon-cycling models. Electrical resistivity tomography (ERT) captures electrical conduction by soils, a parameter largely related to moisture levels. While increasingly used in precision agriculture settings, ERT is new to ecological applications. The study site is a grassland-shrub mosaic on a coastal marine terrace west of Santa Cruz, California. Preliminary measurements across this ecotone revealed overnight moisture reallocation possibly localized around coyote brush roots. ERT and leaf water potential were measured at intervals during shrub covering in order to evaluate hydraulic redistribution. Data were compared with non-covered intervals to observe coyote brush water redistribution patterns. Resistivity changes were significantly different than changes recorded without the covering. Leaf water potential changes suggested shunting of deep soil water away from above-ground growth. Together these results imply that coyote brush roots redistribute water within the soil profile.

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Assessing the Morphological Distinctiveness of Two Endangered California Shrubs: *Eriodictyon altissimum* and *Eriodictyon capitatum*

Eriodictyon Benth. (Namaceae) is a western North American genus of 13 shrubs and perennial herbs. Several taxa are narrowly distributed, including the endangered Central Coast endemics, *E. altissimum* Wells and *E. capitatum* Eastwood. In the original description of *E. altissimum*, Wells noted that it has features of both *E. capitatum* and the widespread *E. californicum* Hook. & Arn. He speculated that *E. altissimum* may have resulted from a historical hybridization event between ancestors of these two species. Here, we measure morphological characters of these three *Eriodictyon* taxa to evaluate the distinctiveness of *E. altissimum* and *E. capitatum*; describe the morphological features that distinguish *E. altissimum* from *E. capitatum*; and assess Wells' hypothesis regarding the hybrid origin of *E. altissimum*. We measured several inflorescence and flower characters. We examined these data using ANOVA with post hoc comparisons, student's t tests, and PCA (Principal Component Analysis). *Eriodictyon altissimum* and *E. capitatum* differ significantly in several characters and form non-overlapping clusters in PC scatterplots. We consider this strong evidence that *E. altissimum* and *E. capitatum* are morphologically distinct. They differ in internode length, calyx length, sepal lobe length, corolla tube length, corolla throat length, corolla throat width, trichome density, and trichome length. Regarding Wells' hypothesis, the three species differ significantly in all pairwise combinations. In PC scatterplots however, *E. californicum* occupies an intermediate position between *E. altissimum* and *E. capitatum*. We therefore feel that these data and results offer little to elucidate the origin of *E. altissimum*.

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Circadian Regulation of Stomatal Conductance in Green and Albino Redwoods and Other Gymnosperms

Transpiration, or the evaporation of water from plants, is estimated to account for up to 90 percent of all terrestrial water flux. Yet important aspects of how and why plants transpire remain unclear. Transpiration is regulated through pores called stomata, which open during the day and take in carbon dioxide for photosynthesis and simultaneously lose water vapor. Surprisingly, many plants also transpire at night when photosynthesis is impossible. One explanation is that nighttime transpiration is part of a circadian rhythm that enables a plant to anticipate daylight and photosynthesize more effectively. While there are correlations between circadian patterns of transpiration and faster carbon assimilation in angiosperms, gymnosperms have not been investigated, and no direct link between photosynthesis and nocturnal stomatal conductance has been shown in either. In this project, I am measuring nighttime water use in the coast redwood (*Sequoia sempervirens*), including both green photosynthetic redwoods and heterotrophic albino mutants, as well as in two other gymnosperm species (*Pseudotsuga menziesii, Pinus ponderosa*). I anticipate finding that gymnosperms experience circadian-regulated stomatal conductance, although to a lesser degree than angiosperms. In coast redwoods, I expect that loss of photosynthesis is associated with the loss of circadian stomatal conductance. I am also investigating physiological changes in albino coast redwoods that stem from facing different challenges in regulating water use. An improved understanding of nighttime water use in gymnosperms will contribute to conservation efforts as water becomes more limited under climate change.

27. O'CONNELL, G.
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Thick in the Mud and High in the Sky: A Synopsis of Eelgrass Aerial Mapping in Arcata Bay, CA

Recent Cessna airplane-based aerial imagery of intertidal mudflats in Arcata Bay was used to map the spatial distribution of eelgrass (*Zostera marina*). Imagery from Cessna airplane flight elevations (flown at 2,000 feet) produced an average 75 millimeter pixel size over nearly 3,000 acres of georeferenced aerial imagery. Supervised GIS classification of Cessna dataset pixel color was used to create a raster layer indicating presence/absence of eelgrass within each pixel. A second dataset produced by Unmanned Aerial Vehicles (UAVs) flying at 40 feet elevation over a subset of the Cessna coverage resulted in very high resolution (3 millimeter pixel size) imagery. The georeferenced UAV dataset was then used to conduct an accuracy assessment of the Cessna-based classification. Based on criteria established in the California Eelgrass Mitigation Policy and Implementing Guidelines, the positive detection accuracy assessment resulted in a 95 percent user's accuracy and an 89 percent producer's accuracy.

28. PICKLUM, D.A.[+], and LEONARD, A.S.
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Floral Visitation and Pollen Deposition of *Bombus*-pollinated *Dodecatheon alpinum* and *Pedicularis groenlandica* in the Sierra Nevada

Pollinators provide reproductive services to flowering plants by carrying pollen between individuals while collecting nutritional resources. In diverse flowering communities, a bee's ability to distinguish between different species has direct consequences for plant fitness, as hetero-specific pollen export represents a cost in lost male gametes and its import can prevent subsequent pollination via stigmatic loading. Here, we investigate the reproductive biology of two flowering species with multi-sensory similarity. *Dodecatheon alpinum* (alt. *Primula tetrandra*, alpine shooting star) and *Pedicularis groenlandica* (elephant head lousewort) share similar color, pollen rewards, specific behavioral requirements (buzz pollination), habitat preferences, and pollinators (*Bombus*). In order to understand if an overlap in multiple floral traits provides a benefit or cost to individual plants, we investigate the fates of *D. alpinum* and *P. groenlandica* pollen moved by *Bombus* pollinators where they co-occur. We first show that bees move between these species by combining observational data and microscopic analysis of pollen deposited on bees' bodies during foraging and packed into corbicula. We investigate how bee behavioral patterns translate to pollen deposition on plant reproductive structures by analysis of stigmas collected both from populations where plants are interspersed, and where they occur in discrete patches. Together these data will illuminate the extent to which these species are co-pollinated, and will set the groundwork for further understanding the evolution of floral traits.

29. PRESTON, R.
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Not Another Damn Name Change! Why Blue Dicks is not a *Dichelostemma*

Figuring out the relationships among the members of the Brodiaea Family (Themidaceae) has been a struggle that has taken over 200 years and is an ongoing process. One example is blue dicks, which has long been considered to be a member of *Dichelostemma* (*D. capitatum*) due to its similarity to *D. congestum* and *D. multiflorum*. However, multiple lines of evidence (morphology, embryology, genetics) indicate that these similarities are superficial – they share some ancestral traits (symplesiomorphies), not derived traits (synapomorphies). The blue dicks lineage diverged much earlier than the rest of the *Brodiaea-Dichelostemma* lineages, which is reflected in its much broader range and its high level of ecotypic diversity. The genus name *Dipterostemon*, first proposed by Per Axel Rydberg, should be resurrected for blue dicks.

30. SERKANIC, S., and PARKER, V.T.
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Patterns of Polyploid Formation in Manzanitas

Genome duplication is a profound mechanism for reproductive isolation and hybrid speciation in sympatry. The formation of polyploid species through genome duplication is widely recognized and is considered to have occurred numerous times during the evolutionary history of flowering plants. The genus *Arctostaphylos* contains 105 minimum rank taxa and is primarily distributed throughout the California Floristic Province, with 104 taxa occurring within the region's boundary. Of this large number, 37 taxa are documented polyploids, indicating a strong relationship between genome duplication and species richness in the group. The Sierra Nevada is home to two widely distributed diploid manzanita species, *A. patula* and *A. viscida*. A third sierran species, *A. mewukka*, was demonstrated as the resulting allopolyploid from hybridization between *A. patula* and *A. viscida*. Two subspecies of *A. mewukka* are currently recognized, and may have arisen from separate and independent hybridization events, as recurrent formation of polyploid taxa through repeated hybridization events is the commonly observed trend in plant evolution. In addition, maternal and paternal input may not be consistent at each event, and reciprocal parentage may be occurring among progenitors. Our goal is to determine parentage of *A. mewukka* at locations throughout its distribution, with the use of maternally inherited cpDNA and regions of nrDNA undergoing concerted evolution. Results will illustrate patterns of hybridization and polyploid formation in manzanitas.

31. SIERRA PACIFIC INDUSTRIES BOTANY PROGRAM
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Rare Plant Habitats on Sierra Pacific Industries Timberlands

Sierra Pacific Industries (SPI) is California's largest private landowner, managing over 1.7 million acres of forestlands. Varied habitats are found across SPI's ownership, which often harbor unique rare plants. 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 California Department of Fish and Wildlife (CDFW) 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 (CalFire). SPI has documented and submitted over 3,000 CNDDB forms for 184 taxa since 2001. Each new sensitive plant finding increases our knowledge of the species' life cycle, habitat, and geographic range, resulting in SPI practicing better forest management.

32. SMITH, A.J.[1], KACZYNSKI, K.M.[1], and ROGNER, M.[2]
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Monitoring Native Forb Restoration at a Sacramento River Gravel Bar Site: Improving Methods for the Future

Anthropogenic alterations to hydrologic processes are resulting in broad impacts to ecosystems which are intrinsically dependent on these processes. In the Central Valley of California, many floodplains which were once regularly inundated prior to the construction of major dams have now transitioned to drier conditions in the absence of a frequent flooding regime. Gravel bars are common features along rivers and under historic hydrologic conditions these sites would be colonized by *Salix* spp. and *Populus* spp. In the absence of natural flooding regimes, these xeric locations are better suited for restoration of a plant community dominated by upland native forbs. In early 2013, River Partners initiated restoration of a gravel

bar site through seeding of eight upland forb species in predominantly single species bands. River Partners sampled the site in 2014 and again in Fall 2016. The goal of our study is to investigate the success of eight planted forb species by comparing densities and dispersal throughout the gravel bar and over time. We sampled 49 plots stratified by planting band. *Calycadenia* sp. density increased from 4.5 plants/m^2 in 2014 to 12.4 plants/m^2 in 2016. *Centromadia fitchii* also increased in density from 2 plants/m^2 in 2014 to 12.2 plants/m^2 in 2016. *Grindelia camporum*, *Eriogonum nudum*, and *Heterotheca grandiflora* dispersed the farthest from their original planting sites. Future work will examine additional dispersal dynamics of these species into surrounding restored riparian habitat. Our results will be used by River Partners to guide further restoration of similar sites that require transitioning assistance.

33. TAYLOR, D.W., and SIMS, A.E.
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Herbarium Specimen Voucher Rates for Endangered Plants in California

Each field season, California botanists conduct field surveys for rare/threatened/endangered (R/T/E) plants, discovering dozens of new occurrences. How often are these new discoveries being vouchered with herbarium specimens? We reviewed a subset of California Natural Diversity Database and Consortium of California Herbaria records for >14,000 occurrences (drawn randomly, or all records for 10 large genera) for 616 R/T/E taxa, tracking the historical pattern of voucher collection. Overall, about 48 percent of occurrences are vouchered. Since 1975 (i.e. just after the first CNPS Inventory), the rate at which vouchers are being obtained has STEADILY DECLINED, even though the number of new occurrences being documented has increased annually (e.g., in the 2000-2010 period, an average of 250 new occurrences were documented yearly, but only 29 percent were vouchered). Vouchered occurrences are more probable at southerly latitudes, from larger plant populations, or from lower elevations. One geographic pattern is noted: the Bay Area has an overall high density of CNPS listed plants, but has a comparably poor record of vouchering newly discovered occurrences. Overall, northern California occurrences are not being vouchered comparable to those in southern California. Draft California Native Plant Society collecting guidelines and objectives are summarized as 1) collect ethically and under permit; 2) obtain herbarium voucher specimens suitable for research, biochemical/DNA assay, anatomical study, for educational materials, or for incorporation of plants, seeds, or cuttings in botanic gardens/arboreta; and 3) voucher in a manner that does not impact population viability.

34. WHEELER, J.
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King Range Native Perennial Bunchgrass Program

Limited stands of historically abundant California native perennial bunchgrass remain in California wild landscapes. Many of these wild landscapes have been subject to a century or more of livestock grazing and decades of fire suppression. The Bureau of Land Management (BLM), in partnership with the Mattole Restoration Council (MRC), has inventoried, mapped, collected, and propagated seed of 11 native perennial bunchgrasses in order to generate enough seed and standing nursery capacity for on the ground restoration projects. Through partnership, the BLM has utilized native perennial bunchgrass material to 1) create an in situ seed bank for study and future seed collection; 2) develop and provide sufficient local seed supply for a hydroseeding project following the 2008 Paradise Fire; and 3) produce nursery capacity to thus far transplant 33,040 plugs of prairie Junegrass (*Koeleria macrantha)*, leafy reed grass (*Calamagrostis foliosa)*, Pacific hairgrass (*Deschampsia cespitosa* ssp. *holciformis*), California melic (*Melica californica*), and Idaho fescue (*Festuca idahoensis*), following the 2007 Spanish Fire, and also in November of 2009 as part of Paradise Ridge and Prosper Prairie native perennial grass enhancement projects. The BLM is committed to actively managing events responsible for resuming successional processes that may favor colonial establishment of transplanted perennial grasses. The King Range Native Perennial Bunchgrass Program has demonstrated that successful establishment of new native perennial bunchgrass colonies can be accomplished through the propagation of locally collected seed followed by transplantation of plugs.

35. WILLIAMS, A.[1], WHELAN, S.[1], YOUNG, A.[2], GOSLINER, T.[2], and KLEIN, J.[1]
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Species Lost, Found, and on the Edge of Gone from Mt. Tamalpais

Mt. Tamalpais in Marin County is a well-botanized site with a legacy of thousands of specimens since the mid-1800's. The Marin Municipal Water District (MMWD) has stewarded most of the land in the Mt. Tamalpais Watershed over the past 100 years. Marking its centennial anniversary in 2012, MMWD partnered with the California Academy of Sciences on a series of botanical bioblitzes to document the flora of the Mt. Tamalpais Watershed using teams of citizen science volunteers and professionals. Over five collection years and 28 events, over 200 volunteer participants made roughly 2,400 observations of nearly 850 taxa, including collecting over 1,400 specimens documenting more than 800 species of vascular plants. Records from this and other surveys form the foundation of three pivotal lists: 1) species added (110), 2) species thought to be extirpated (72), and 3) species with three or fewer populations (210). Loss/invasion of wetland and grassland habitat, as well as climate change, appear to be responsible for more extirpations than lack of fire; many locally rare species cluster in few high-diversity sites.

36. XU, S., FREYMAN, W.A., SCHNEIDER, A.C., and BALDWIN, B.G.
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Biogeography and Chromosome Number Evolution of Linaceae

Linaceae is a diverse family of flowering plants, containing 13 genera and approximately 260 species, including 3 genera and 16 species native to California. For our study, a fossil calibrated phylogeny of Linaceae was used to examine historical biogeography and chromosome evolution and test previously published biogeographic and ancestral chromosome number hypotheses. We utilized maximum likelihood models of geographic range evolution to test different biogeographic scenarios. We also used Bayesian phylogenetic models of anagenetic and cladogenetic chromosome number evolution to estimate both the mode of chromosome evolution and ancestral chromosome numbers. Our results show that the observed biogeographic distribution of Linaceae is best explained using a model that allowed for both vicariance and long distance dispersal. We found support for a jump-dispersal origin of Hugonoidaeae in South America approximately 45 million years ago and a North America founder speciation event for *Linum* sect. *Linopsis* from Europe about 35-40 million years ago. We find evidence that all yellow-flowered flax in North America represents a single colonization from Europe or the Mediterranean region approximately 11.8 million years ago. The estimated ancestral chromosome number for *Linum* sect. *Linum* is n=8 or 9 and *Linum* sect. *Dasylinum* is n=10, supporting previously proposed hypotheses of ancestral chromosome numbers. Our results also show that 21 percent of all speciation events in Linoideae are associated with dysploid chromosome gains, while only 7 percent of all speciation events are associated with polyploidy. These results suggest that cladogenetic dysploidization played a greater role than cladogenetic polyploidization during the diversification of Linaceae.

LIST OF COMMON ACRONYMS

Found in Abstracts of Talks (starting on page 7)
and Abstracts for Posters (starting on page 19)

ANOVA - Analysis of variance
BLM - Bureau of Land Management
CDFW - California Department of Fish and Wildlife
CNDDB - California Natural Diversity Data Base
CNPS - California Native Plant Society
CRPR - California Rare Plant Rank
DWR - California Department of Water Resources
ESA - Endangered Species Act
GIS - Geographic Information System(s)
n - sample size
OHV - off-highway vehicle
NEPA - National Environmental Policy Act
THP - Timber Harvest Plan
USDI - United States Department of the Interior
USFS - United States Forest Service (USDA Forest Service)

INDEX OF AUTHORS

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

EXHIBITORS

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

California Native Grasslands Association
Representative: Michele Hammond
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Established in 1991, the California Native Grasslands Association's mission is to promote, preserve, and restore the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship. They work towards increasing public understanding and appreciation of the value of native grassland ecosystems through workshops, presentations, advocacy, their website and their quarterly journal, *Grasslands*. They offer a variety of workshops on topics such as grass identification, grazing practices that promote native grassland diversity, and appropriate practices and techniques to evaluate, prepare, and plant native grasses and other grassland plants. Our conservation committee members strive to ensure that threatened native grasslands are protected from conversion or degradation. Stop by the CNGA exhibitor booth to pick up a brochure and chat with Michele Hammond, CNGA Board Member.

California Invasive Plant Council
(510) 843-3902 • www.cal-ipc.org • email: info@cal-ipc.org
The California Invasive Plant Council (Cal-IPC) protects California's environment and economy from invasive plants. We provide leadership for partners across the state working to stop the spread of wildland weeds. Access our resources, network with other professionals and volunteers, and support our advocacy for strong policy and programs. Learn more at www.cal-ipc.org

California Native Plant Society – State Office
Representatives: Greg Suba and Julie Evans
(916) 447-2677 • www.cnps.org • email: cnps@cnps.org
The California Native Plant Society (CNPS) has been the leading native plant conservation, advocacy, and education organization in California since 1965. A grassroots organization, CNPS has 35 chapters serving 10,000 members all over the state of California and Baja California, Mexico. CNPS maintains an online *Inventory of Rare and Endangered Plants* as well as *A Manual of California Vegetation*, the standard vegetation classification reference. CNPS also has an active horticulture program, supporting chapter native plant sales and demonstration gardens.

Carex Working Group
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carexworkinggroup.com • email: cwg@peak.org
The Carex Working Groups is a small consulting firm dedicated to researching plant taxonomy and providing tools to help botanists identify difficult plant groups. We teach identification classes, write identification keys and field guides, and research patterns of variation in plants. We also apply what we have learned by preforming rare plant surveys and habitat evaluations.

EXHIBITORS

F.M. Roberts Publications
Representative: Fred Roberts.
www.FMRPublications.com • email: FMRPublications@cox.net
FM Roberts Publications originated as a self-publishing source for botanical guides and checklists in southern California but has expanded to include T-shirts, prints, and note cards based on gouache water color and acrylic paintings rendered by Fred M. Roberts. This year, the centerpiece will be a northern California themed *Calochortus* T-shirt and an oak trees of California T-shirt. There will also be *Diplacus* and *Erythranthe* T-shirts and other designs that were displayed last year.

Friends of the Chico State Herbarium
Representative: Elena Gregg
(530) 898-5381 • www.friendsofthechicostateherbarium.com • email: friendsoftheherbarium@gmail.com
The Friends of The Chico State Herbarium is an all-volunteer organization that promotes botanical education and community outreach. Our mission is to provide support for the Chico State Herbarium and demonstrate and publicize the value of the Herbarium to the community.

Garcia and Associates (GANDA)
Representatives: Samantha Hillaire and Susan Dewar
(530) 823-3151 • www.garciaandassociates.com • email: dkelly@garciaandassociates.com
Garcia and Associates is a natural and cultural resources consulting firm specializing in cultural and paleontological resources compliance, state-of-the-art aquatic and terrestrial ecology, and natural resources policy and planning. Garcia and Associates' staff is committed to meeting our clients' needs with the highest professional standards. We have completed projects that range from multi-year, multi-million-dollar planning and impact studies for large facilities to small, focused studies with short deadlines and limited budgets. Headquartered in San Anselmo, we also have regional offices at Auburn, Oakland, San Francisco, Los Angeles, Lompoc, Oceanside, Palm Springs, Bozeman, Guam, and Honolulu.

Hedgerow Farms
Representative: Sylvia Delfino
(530) 662-6847 • www.hedgerowfarms.com • email: info@hedgerowfarms.com
Hedgerow Farms is a native seed production farm specializing in California native grasses, sedges, rushes, and wildflowers. We offer seed for more than 100 grass, forb, sedge species, including many bioregional ecotypes. We also provide native grass transplants, native straw, project design assistance, and contract growing.

Native Orchid Conference
Representative: Linnea Hanson
www.nativeorchidconference.info • email: neorchid@yahoo.com
The Native Orchid Conference is dedicated to the study, conservations, and enjoyment of the native orchids of the United States and Canada. It was started in 2002 by a group of enthusiasts who shared a common interest in natural history in general and orchids in particular. The NOC has over 500 members representing most U.S. states and Canadian provinces as well as 18 other countries. Membership is open to anyone who has an interest in North America's native orchids.

Nevada Native Plant Society
Representative: Janel Johnson
nvnps.org • email: president@nvnps.org
The Nevada Native Plant Society was founded in 1975 to advocate for the preservation and enjoyment of native plants and their habitats. We have monthly meetings in northern and southern Nevada and a variety of field trips and volunteer activities. Members enjoy access to our monthly newsletter and discounts on publications.

EXHIBITORS

Shasta-Trinity National Forest
Representatives: Lusetta Sims, Rhonda Posey, Twyla Miller, Martin Lenz, and Brenna Montagne
(530) 226-2500 • www.fs.usda.gov/stnf
The Shasta-Trinity National Forest is the most beautiful National Forest: it has 2.1 million acres of Klamath and Cascade Range geography full of the best plants in California. Our display will showcase our native plant restoration program, including plants for native pollinators, rare plant conservation and invasive plant control activities, and public education. We will have posters, brochures, plastic rulers, and other things to give away.

Stillwater Sciences
Representatives: Megan Keever and Nicole Jurjavcic
(510) 848-8098 • www.stillwatersci.com • email: megan@stillwatersci.com
Stillwater specializes in science-based, technical approaches to environmental issues. By integrating geomorphic and biological research to understand critical ecosystem processes, we work to identify effective measures for restoring and managing rivers and their floodplains as functioning ecosystems. Our areas of expertise include fish and aquatic ecology, geomorphology, botany and riparian ecology, water quality, wildlife, and spatial analysis/GIS. Our botanical services include rare plant surveys and monitoring; revegetation, restoration, and habitat planning; planting plan design/implementation; riparian habitat mapping; modeling of riparian-vegetation dynamics; development of invasive weed control measures; and jurisdictional wetland delineation and Section 404 permitting.

University and Jepson Herbaria, UC Berkeley
Representative: Allyson Ayalon
(510) 643-7008 • http://ucjeps.berkeley.edu/uc/ • email: alayalong@berkeley.edu
The mission of the Jepson Herbarium is to understand and conserve the California flora through systematic, floristic, and conservation biology studies and to communicate knowledge of the flora through publications and instructional programs. Through all of the programs of the Herbarium, we strive to be a liaison between the scientific community and the interested public and support conservation efforts around the state. Primary resources include the Jepson eFlora and the Consortium of California Herbaria. Educational opportunities for both amateurs and professionals are available through the Jepson Workshop Series.

Wildlands
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Wildlands is a wildlife mitigation company that services California, Oregon, and Washington. They've been in business for 25 years and have established seventy-plus banks and preserves along the West Coast.