Welcome to the 25th Annual Cal-IPC Symposium!

Dear California land management community,

Twenty-five years ago a small band of energetic folks passionate about protecting California open spaces from invasive species got together and decided to create this organization—and then did the hard work to actually make it so. A lot has changed over the years. Our tools for mapping and managing invasive plants have grown stronger and more versatile. General awareness has grown in kind and federal and state policies have evolved to recognize the importance of preventing and strategically controlling invasive plants. Concurrently, the complexities of both funding and implementing our work have increased. We've made a lot of amazing progress—and there's so much more to do.

One thing that has not changed is the spirit of the people doing this work. Land managers, researchers, volunteers, conservation corps members and students that are involved with this issue have particular qualities. They are dedicated to a vision of the future where the diverse array of life around us is able to thrive; they are pragmatic about the complexities entailed; and they are working tirelessly to meet the challenges that face us. This spirit is the essence of Cal-IPC.

Whether we are sharing reports of new weeds, providing resources to land managers, coordinating regional projects, training workers or advocating for policy, we will always be looking for innovative ways to strengthen the work of this community. Thank you for your work in this field and your involvement in Cal-IPC!

Jutta Burger, President, Board of Directors

Doug Johnson, Executive Director

Our new look

The 2016 Symposium marks the unveiling of our brand new logo, thanks to a "visual identity" grant from the Taproot Foundation. Keep your eyes out for our new full-color newsletter *Dispatch* in your mailbox soon, and a new website early next year!

General Information

Sponsors: Our sponsors help offset the cost of the Symposium while providing information and services to Cal-IPC members. Visit them at breaks and during the poster/sponsor session. See their profiles and contact information at the end of this program.

Raffle and Auction: Join us for a social hour after sessions end on Thursday, and check out all the donated items for our annual raffle and auction fundraiser. The raffle features books, wine, artwork, tools and more, while the auction highlights travel packages and other special items. Tickets ($1 each or 25 for $20) are available at the Sales table during the day and at the social hour itself. Raffle prizes will be distributed after the awards banquet Thursday evening.

Awards Banquet: Join us Thursday evening to honor some of our community's heroes and to honor Cal-IPC's 25th anniversary and the National Park Service's centennial.

Student Networking Lunch: The Cal-IPC Student Section invites all students to join them for lunch Friday and an opportunity to talk to invasive plant professionals. Lunch provided.

Meals: Continental breakfast is provided Thursday and Friday. Lunch and dinner are provided Thursday only. Box lunches are provided for full-day field trips. If your meal type is other than omnivore, you will be provided with a card to identify your meal type to servers for Thursday lunch and dinner.

Field Trips: Meet at the podium after Friday's final session to plan for Saturday morning.

Photo Contest: Vote for your favorite! The winner will be announced Friday afternoon.

Sales: Our Sales table offers books and Cal-IPC gear, with proceeds supporting Cal-IPC's programs. We accept cash, checks, and credit cards. Check out the boot brushes!

Social Media: Cal-IPC encourages attendees to share their enthusiasm for invasive plant management and Cal-IPC by using social media to spread the word. Share @cal_ipc with #CALIPC2016.

Presentations Online: PowerPoint slides and posters will be posted on the Cal-IPC website.

Continuing Education Credits: California Dept. of Pesticide Regulation CEUs are available for each part of the Symposium (see below). Check in at the Continuing Ed table in the Foyer for attendance sheets and Scantron forms. Please take a Verification of Attendance form for your records each day.

Wednesday (Nov.2)		
Training: Invasive Plant Management 101	M-0909-16	4.0 Other
Training: Weed-Free Forage and Mulch	M-0911-16	4.5 Other
Training: Calflora Weed Manager	M-0910-16	3.5 Other
Session: DPR Laws and Regulations	M-0912-16	2.0 Laws
Thursday (Nov. 3)	M-0913-16	5.5 Other
Friday (Nov. 4)	M-0914-16	6.0 Other

Thank You to our Sponsors!

ACS Habitat Management
Oceanside, CA
www.agrichemical.com
Contact: Tracy Omori at 760-757-1840 or tracyo@agrichemical.com

ACS Habitat Management is one of the leading wildland non-native, invasive species control and habitat restoration and enhancement companies in the southwestern United States. With a highly qualified, staff, versatile. Labor force, and state of the art equipment, we provide a full range of professional services to successfully execute large-scale invasive weed control and habitat restoration projects.

Aquatic Environments, Inc.
Concord, CA
www.aquamog.com
Contact: Eli Kersh at 415-307-0943 or ekersh@aquamog.com

We use the latest environmental management techniques to meet our goal of 100% client and regulatory agency satisfaction. Our staff has extensive experience in wetland construction, development consulting, project planning, and management. From day one of your project and years into the future, AEI will be there to help you achieve your goals.

Bureau of Land Management
Sacramento, CA
www.blm.gov/ca/st/en.html
Contact: Jack Hamby at 916-978-4633 or jhamby@blm.gov

The Bureau of Land Management (BLM) is an agency within the U.S. Department of the Interior and currently manages approximately 261 million acres across the western United States. Management and control of plants on public lands is done for resource and habitat enhancement.

Calflora
Berkeley, CA
www.calflora.org
Contact Cynthia Powell at cpowell@calflora.org

The Calflora website is where you can learn about plants that grow wild in California (both native and non-native). Our suite of Weed Manager applications are designed to support the work of land managers controlling invasive plants. Information on the Calflora website comes from many sources: public agencies, non-profits, scientists, private donors, and you!

California Assn. of Local Conservation Corps
http://calocalcorps.org
Contact: calocalcorps@gmail.com

CALCC supports collaboration between California's Local Conservation Corps and provides a forum for advancing the Corps movement in California and nationally. The 13 certified Local Conservation Corps that are members of CALCC share a common mission to develop young adults, primarily ages 18-25, through conservation, education and community service.

California Assn. of Resource Conservation Districts (CARCD)
Sacramento, CA
www.carcd.org
Contact: Karen Buhr at 916-457-7904 or karen-buhr@carcd.org

CARCD represents the state's 99 RCDs, leaders in on-the-ground conservation efforts in their communities. RCDs accomplish thousands of practical, hands-on conservation projects every year while bringing millions of dollars to local communities through grants and private contributions. RCD conservation projects often involve agriculture and private land, but we accomplish much more, from watershed restoration to fire protection, hedgerows to fish passage.

California Coastal Conservancy
Oakland, CA
http://scc.ca.gov
Contact: Sam Schuchat at 510-286-1015 or sam.schuchat@scc.ca.gov

The Coastal Conservancy acts with others to preserve, protect, and restore the resources of the California coast, ocean, and the San Francisco Bay Area. Our vision is of a beautiful, restored, and accessible coastline, ocean and San Francisco Bay Area.

California Conservation Corps
Sacramento, CA
www.ccc.ca.gov
Contact: Melanie Wallace at 916-341-3153 or Melanie.wallace@ccc.ca.gov

The California Conservation Corps (CCC) provides young women and men the opportunity to work hard responding to fires, floods and other disasters, restoring California's environment, and installing clean energy and energy conservation measures at public facilities throughout the state. Through their service, the members of the CCC gain life, work, and academic skills to become strong workers and citizens.

California Department of Food and Agriculture
Sacramento, CA
www.cdfa.ca.gov
Contact Dean Kelch at 916-403-6650 or dean.kelch@cdfa.ca.gov

CDFA is the lead state department in noxious weed management, tasked with preventing the introduction and spread of noxious weeds. It does this through border enforcement, nursery inspections, weed risk analysis, permit restrictions, public and agency outreach, and (as funds become available) funding of local weed management programs.

California Native Grasslands Association
Davis, CA
www.cnga.org
Contact: Diana Jeffery at 530-902-6009 or admin@cnga.org

Founded in 1991, CNGA promotes, preserves, and restores the diversity of California's native grasses and grassland ecosystems through education, advocacy, research, and stewardship.

California Native Plant Society
(El Dorado, Kern County, Los Angeles/Santa Monica Mountains, Marin, Mount Lassen, Napa Valley, North Coast, Orange County, Riverside-San Bernardino, , Sacramento Valley, San Gabriel Mountains, San Diego, and Santa Cruz County Chapters)
Sacramento, CA
www.cnps.org
Contact: Dan Gluesenkamp at 916-447-2677 or cnps@cnps.org

CNPS is a statewide non-profit organization of nearly 10,000 professional and amateur members that works to protect California's native plant heritage. Working through our 33 local chapters and statewide programs, CNPS seeks to increase understanding of California's native flora and to preserve this rich resource for future generations.

California Society for Ecological Restoration (SERCAL)
Tucson, AZ
www.sercal.org
Contact: Julie St John at 520-791-9514 or julie.sercal@gmail.com

SERCAL is a non-profit, membership-based organization dedicated to bringing about the recovery of damaged California ecosystems.

California State Parks – Off-Highway Motor Vehicle Recreation Division
Sacramento, CA
ohv.parks.ca.gov
Contact: Ryan Miller at 916-445-9152 or Ryan.Miller@parks.ca.gov

The OHMVR Division works to ensure that quality recreational opportunities remain available for future generations by providing education, conservation, and enforcement efforts that balance OHV [Off-Highway Vehicle] recreation impact with programs that conserve and protect cultural and natural resources. The Division plays an important role in protecting diverse natural and cultural resources throughout the state.

Chapman University – Schmid College of Science & Technology
Orange, CA
www.chapman.edu/scst
Contact: 714-628-7318 or schmidcollege@chapman.edu

Our interdisciplinary School of Earth and Environmental Sciences incorporates faculty with expertise in chemistry, biology, environmental science, food science, earth science and remote sensing. Faculty conduct internationally recognized research and teach undergraduate and graduate students about how to analyze, understand, and ultimately sustain and conserve earth's interconnected systems.

Dendra, Inc.
Encinitas, CA
Contact: Jason Giessow at 760-943-6924 or jgiessow@cox.net

We assist a wide range of groups (RCDs, Counties, NGOs, and other consultants) to plan and implement invasive plant control projects. Specializations include: grant writing, permitting, mapping, and program development.

Golden Gate National Parks Conservancy
San Francisco, CA
Contact: Sharon Farrell at 415-561-3065 or sfarrell@parksconservancy.org

The Golden Gate National Parks Conservancy's mission is to preserve the Golden Gate National Parks, enhance the park visitor experience, and build a community dedicated to conserving the parks for the future. We are a community-supported nonprofit organization transforming places—and people—through conservation and improvement of parks and public lands.

Hedgerow Farms
Winters, CA
www.hedgerowfarms.com
Contact: Tanya Meyer at 530-662-6847 or tmeyer@hedgerowfarms.com

Hedgerow Farms specializes in producing high quality seed of California native grasses, sedges, rushes and wildflowers from known origins. We offer seed for over 120 species and for some we have multiple ecotypes available. We also provide native grass transplants, native straw, project design assistance and contract growing.

Irvine Ranch Conservancy
Irvine, CA
www.irconservancy.org
Contact: Mike O'Connell at 714-508-4757 or moconnell@irconservancy.org

Irvine Ranch Conservancy is a non-advocacy, non-profit organization established to ensure the protection, restoration, and enhancement of the natural resources of the Irvine Ranch natural landmarks in perpetuity. The conservancy's programs provide diverse opportunities for compatible public enjoyment by conducting and supporting scientific, recreational, and educational initiatives and programs.

Marin Municipal Water District
Irvine, CA
marinwater.org
Contact: Andrea Williams at 415-945-1184 or awilliams@marinwater.org

Marin Municipal Water District stewards 22,000 acres of watershed lands in Marin County, including most of Mt. Tamalpais, and supplies drinking water to 190,000 residents.

National Park Service, California Exotic Plant Management Team
Point Reyes, CA
Contact: Bobbi Simpson at 415-717-0471 or bobbi_simpson@nps.gov

Invasive plant species dominate more than 2.6 million acres of National Park Service lands. In 2000, NPS created the Exotic Plant Management Program that now supports 16 teams working in over 225 park units. The California Exotic Plant Management Program provides invasive species support in 14 national park units. We work with volunteers, contractors, and service organizations to meet the agency's mission: preservation of native habitats for the enjoyment of future generations.

Natures Image
Lake Forest, CA
www.naturesimage.net
Contact: AJ Fox at 714-878-8804 or ajfox@naturesimage.net

Natures Image is a full-service native habitat restoration/mitigation company serving both private and public clients throughout the West. Since the early 1990s, we have successfully restored and maintained hundreds of habitat communities, representing thousands of acres, including riparian, coastal sage scrub, freshwater and saltwater marsh, desert, chaparral, oak woodlands and native grasslands. We offer our clients a full range of construction and maintenance services for all their habitat restoration and mitigation needs.

PlantRight/Sustainable Conservation
San Francisco, CA
www.PlantRight.org
Contact: Stephanie Falzone at 415-977-0380 x350 or sfalzone@suscon.org

Since 2005 PlantRight has been working to stop the sale of horticultural invasive plants in ways that are good for business and environment. PlantRight unites leaders from California's nursery and landscape industries, conservation groups, academia, and government agencies to find common ground and cost-effective solutions. Check out our list of California-friendly alternatives to today's priority invasive garden plants, at www.PlantRight.org.

RECON Environmental, Inc. / RECON Native Plants, Inc.
San Diego, CA
www.reconenvironmental.com; www.reconnativeplants.com
Contact: Peter Tomsovic at 619-308-9333 or ptomsovic@reconenvironmental.com

RECON Environmental, Inc. is an employee-owned environmental consulting firm with offices in San Diego, Goleta and Berkeley, California and Tucson, Arizona. In addition to environmental planning expertise, RECON offers a full line of habitat

restoration services including planning, implementation, maintenance and monitoring throughout the Southwest. We also have a wholesale nursery, RECON Native Plants, offering restoration-quality native plants and seed material.

RMD Systems
San Luis Obispo, CA
www.rmd-systems.com
Contact: Brian Riskas at 805-458-6844 or brian@rmd-systems.com

RMD manufactures small unmanned aerial systems for use in surveying, disaster relief, and precision agriculture.

Santa Ana Watershed Association
Riverside, CA
www.sawatershed.org
Contact: James Law at 949-683-0194 or jlaw@sawatershed.org

Since 1997, the Santa Ana Watershed Association has been promoting a healthy watershed for wildlife and people. With a veteran staff of habitat restoration specialists and biologists, it has removed over 4,700 acres of invasive plant species and restored over 1,000 acres natural plant and streambed to promote indigenous plants and wildlife.

Santa Monica Mountains Fund
Thousand Oaks, CA
www.samofund.org
Contact: Arthur Eck at 805-370-2341 or aeck@samofund.org

The Santa Monica Mountains Fund promotes and assists the park agencies of the Santa Monica Mountains National Recreation Area in accomplishing their missions. Together they foster the protection and enjoyment of park resources by the public through education, research, improved facilities, citizen engagement, and stewardship.

S&S Seeds
Carpinteria, CA
www.ssseeds.com
Contact: Jody Miller at 805-684-0436 or jodymiller@ssseeds.com

S&S Seeds extensive wildland collections of native seed and our expanding field production allows us to offer seeds of more than 1,000 plant species, including wildflowers, reclamation grasses and shrubs. Our large inventory of source identified seeds can be utilized by planners to identify species from an appropriate location to satisfy the needs of the project.

Sierra Nevada Conservancy
Mariposa, CA
www.sierranevada.ca.gov
Contact: Michael Pickard at 209-742-0487 or michael.pickard@sierranevada.ca.gov

The Sierra Nevada Conservancy is a California state agency that initiates, encourages, and supports efforts that improve the environmental, economic, and social well-being of the Sierra Nevada Region, its communities, and the citizens of California.

Student Conservation Association
Oakland, CA
www.theca.org
Contact: Jay Watson at 510-832-1966 x5301 or jwatson@thesca.org

The Student Conservation Association is a national non-profit organization dedicated to youth development, conservation service, and career development in conservation**.**

The Nature Conservancy
San Francisco, CA
www.nature.org
Contact: Brynn Pewtherer at 415-609-0519 or brynn.pewtherer@gmail.com

The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives.

Yosemite Conservancy
San Francisco, CA
Contact: Jerry Edelbrock at 415-434-8446 x314 or jedelbrock@yosemiteconservancy.org

Providing for Yosemite's future is our passion. We inspire people to support projects and programs that preserve and protect Yosemite National Park's resources and enrich the visitor experience.

PROGRAM

CAL-IPC SYMPOSIUM 2016

Wednesday, November 2

11:00am – 5:00pm Training 1: Invasive Plant Management 101 (Forest View Room)

Are you new to the field of invasive plant management? Or have gaps in your understanding about how everything ties together? Here's your chance to get a solid foundation and learn about: how land managers identify, map and prioritize weeds; how weed biology affects weed control methods; the range of control tools at our disposal as part of the Integrated Pest Management toolbox; strategic approaches for program success; and more. Taught by experienced Cal-IPC field course instructors.

11:00am – 5:00pm Training 2: Weed-Free Forage and Mulch (Madera Room)

Straw mulch is commonly used in restoration projects, but it can introduce weed seeds to the land you manage. So can hay used for horses or livestock. This training will help you understand what it means for a bale of hay or straw to be certified weed-free. You'll come away with the ability to specify, source, and inspect hay or straw for use in wildlands. Learn from recent experiences mulching after the Rim and King fires, and ongoing work in National Parks and National Forests with hay for pack stock. Certification is a work in progress in California -- this workshop will bring you up to speed on all the current and evolving resources. *Instructors from the US Forest Service, National Park Service, County Agriculture Commissioners and the California Dept. of Food and Agriculture.*

1:00pm – 5:00pm Training 3: Calflora Weed Manager (Mariposa Room)

Did you know you can map weeds on your smartphone, using a custom interface designed for your organization? That you can record details each time you treat a population? Calflora's Weed Manager suite of tools is designed to do this and more. Calflora staff and current users will show you how it all works.

6:00 – 8:00pm DPR Laws & Regulations: Updates on pest control regulations

Salon 1. Chair: *Joel Trumbo, California Dept. of Fish and Wildlife*

6:00 PRESCRIBE: An online database for protection of endangered species from pesticides. *Richard Marovich, California Dept. of Pesticide Regulation*

6:30 Chemical resistant glove selection. *Lisa Blecker. University of California, Dept. of Agriculture and Natural Resources, Statewide IPM Program*

7:00 Substantial drift… a legal perspective. *Robert Davies, Donahue Davies LLP*

7:30 CEQA and pesticides. *Joel Trumbo, California Dept. of Fish and Wildlife*

Thursday, November 3

7:30am Registration

8:30 – 10:15 am Session 1. A Century of Park Stewardship

Grand Ballroom. Chair: *Bobbi Simpson, National Park Service, California Exotic Plant Management Team*

8:30 Welcome. *Garrett Dickman, Yosemite National Park*

8:45 The evolution of park stewardship. *Jan van Wagtendonk, Emeritus, National Park Service*

9:15 Invasive plant management in today's National Parks. *Terri Hogan, NPS Invasive Plant Program Manager*

9:45 Invasive plant management in California State Parks. *Jay Chamberlin, Chief, Natural Resources Division, California State Parks*

10:15-10:40am Break

10:40am – 12:00pm. Session 2. Grazing, Weeds, and Rangeland Management

Salon 2. Moderator: *Elise Gornish, UC Davis*

10:40 Plant community responses to cattle grazing in a noxious weed-dominated rangeland. *Leslie Roche and Ken Tate, UC Davis, and Josh Davy, UC Cooperative Extension*

11:00 Integrating grazing and herbicide treatments. *Joe DiTomaso, UC Davis*

11:20 The art of targeted grazing: A practitioner perspective. *Dan Macon, UC Davis and Andree Soars, Star Creek Land Stewards*

11:40 Range seeding for weed management. *Morgan Duran, UC Cooperative Extension*

10:40am – 12:00pm. Session 3. Successful Invasive Plant Management Projects

Salon 3. Moderator: *Jason Giessow, Dendra, Inc.*

10:40 The Salinas River Watershed *Arundo* control program—lots of farmers, lots of *Arundo*, 12 miles in two years. *Emily Zefferman, Monterey County Resource Conservation District*

11:00 From prevention to treatment: Yosemite's suite of invasive plant management efforts. *Garrett Dickman, Yosemite National Park*

11:20 From biosecurity to control on the ground: Invasive plants on San Nicolas Island. *William Hoyer, US Navy*

11:40 Fifteen years of community restoration projects: The lessons of working on invasive plants at a small scale. *Shawn Kelly, Southern California Wetlands Recovery Project*

12:00 - 1:30pm Lunch (provided)

Cal-IPC Update
Doug Johnson, California Invasive Plant Council

Including Diverse Californians in Park Stewardship
Antonio Solorio, Park Ranger and Youth Program Manager

Santa Monica Mountains National Recreation Area

1:40 – 2:40 pm Session 4. Gimme the Dirt: Plant Invasion and the Soil Microbiome

Salon 2. Moderator: *Irina Irvine, Santa Monica Mountains National Recreation Area*

1:40 *Brachypodium* invasion in California is facilitated by rhizosphere microbes. *Emma Aronson, UC Riverside*

2:00 The role of the soil microbiome in medusahead invasion in open grassland and oak woodland habitats. *Elise Gornish, UC Davis*

2:20 Remediating the microbial legacy effects of invasive grass for restoration. *Brooke Pickett, UC Riverside (Student Paper Contest)*

1:40 – 2:40 pm Session 5. Do No Harm: Managing Restoration's Unintended Consequences

Salon 3. Moderator: *John Knapp, The Nature Conservancy*

1:40 The risks *Phytophthora* species pose to restoration goals and protocols to reduce the inadvertent introduction of these pathogens. *Diana Benner, The Watershed Nursery*

2:00 New technique for restoration of deeply eroded mountain wetlands: Risks and benefits. *Athena Demetry, Sequoia/Kings Canyon National Park*

2:20 Protecting wildlife when controlling invasive plants. *Mark Heath, Shelterbelt Builders*

2:40 – 3:00pm Break

3:00 – 4:00 pm Session 6. Early Detection: How NPS Keeps on Top of Invasive Plants in the High Country

Salon 2. Moderator: *Athena Demetry, Sequoia/Kings Canyon National Parks*

3:00 Staying ahead of the invasives spread: Early detection surveys in Yosemite and Sequoia/Kings Canyon National Parks. *Tom Reyes, Yosemite National Park*

3:20 Treating alpine invaders: prioritizing high elevation non-native species to protect Yosemite's alpine meadow ecosystems. *Heather Smith, Yosemite National Park*

3:40 Invasive and special status plant early detection and management, following Yosemite's wildfires: Strategies for the landscape level. *Steven Del Favero, Yosemite National Park*

3:00 – 4:00 pm Session 7. Aerial Tools for Mapping and Treatment

Salon 3. Moderator: *Valerie Cook-Fletcher, CA Dept of Fish and Wildlife*

3:00 Look, up in the sky! It's a bird, it's a plane, it's… an unmanned aerial vehicle mapping weeds! *Sundaran Gillespie, WRA Environmental Consultants*

3:20 Finding the best approach for detecting small quantities of invasive plant species with hyperspectral remote sensing data. *Sandra Skowronek, FAU Erlangen-Nürnberg, Germany and Carnegie Institution for Science (Student Paper Contest)*

3:40 Aerial treatment of invasive buffelgrass to build fire-resilient landscapes in southern Arizona. *Dana Backer, Saguaro National Park*

4:00 – 5:00pm Poster Session & Sponsor Exhibits

5:00 – 6:30pm Social Hour, Raffle & Silent Auction

6:30 – 8:30pm Awards Banquet

Friday, November 4

7:00am Registration

8:00-9:30 am. Session 8. Finding Common Ground in Resource Management

Grand Ballroom. Chair: *Brent Johnson, Pinnacles National Park*

8:00 Friday announcements

8:10 Controlling invasive plants in designated wilderness. *Mary Beth Hennessy, Inyo National Forest*

8:30 The Wildland Fire Resource Advisor position: Communication strategies for bridging invasive plant management, resource values and fire response. *Jun Kinoshita, Yosemite National Park*

8:50 Preserving cultural resources while protecting natural resources from invasive plants. *Steve Hilton, Cultural Resources Division, California State Parks*

9:10 Matching restoration tools to rare plant recovery needs in invaded Channel Island landscapes. *Kathryn McEachern, Ecologist, US Geological Survey*

9:30 – 10:00am Break

10:00-11:30 am. Discussion Groups..

1. **Tools & Techniques: Ask the Invasive Plant Management Experts** – Learn from your peers and get your specific control questions answered by our expert panel of seasoned land managers. (Salon 2)
2. **Grazing, Weeds and Rangeland Management** – How can you incorporate grazing into your management regime? *Chair: Morgan Duran, UC Cooperative Extension* (Madera/Mariposa Rooms)
3. **Using Weed-Free Materials** – What land managers need to know about using weed-free mulch and feed. *Led by Joanna Clines, Sierra National Forest*. (Evergreen/Ponderosa Rooms)
4. **Integrating Biocontrols into Your Work** – We know biocontrol agents can be powerful, but how can land managers deploy existing agents for their lands? *Led by Mike Pitcairn, CA Dept. of Food & Agriculture.*(Sugarpine Room)
5. **Non-Native Plants in Restoration** – Recognizing that non-native plants are part of the landscapes we manage, and that climate change is shifting vegetation communities, what role might non-native plants play in meeting stewardship goals? *Led by Elise Gornish, UC Davis*. (Salon 3)

11:30am – 1:00pm Lunch (on your own at Tenaya Lodge)

Student Chapter Networking Lunch (Salon 1)

1:00-2:00 pm Session 9. Invasive Plant Research I

Salon 2. Moderator: *Jennifer Funk, Chapman University*

1:00 Biocontrol of Sahara mustard: An update on exploration in the native range. *Rene Sforza, USDA Agricultural Research Service*

1:20 Using population genomics to uncover the rapid colonization of Sahara mustard (*Brassica tournefortii*) in the United States. *Daniel E. Winkler, UC Irvine (Student Paper Contest)*

1:40 The susceptibility of strip-seeded restoration sites to invasive species. *Julea A. Shaw, UC Davis (Student Paper Contest)*

1:00-2:00 pm Session 10. Productive Partnerships for Invasive Plant Management

Salon 3. Moderator: *Shawn Kelly, Southern California Wetlands Recovery Project*

1:00 PlantRight update: 2016 nursery survey results, trends, and horticultural partnerships. *Stephanie Falzone, Sustainable Conservation*

1:20 Advanced resource management stewards provide extra ARMS for weed control. *Ellen Gartside, Midpeninsula Regional Open Space District*

1:40 Hydrilla eradication challenges, partnerships and lessons learned. *David Kratville, California Dept of Food & Agriculture*

2:00 – 2:20 pm Break

2:20-3:20 pm Session 11. Invasive Plant Research II

Salon 2. Moderator: *Justin M. Valliere, UCLA*

2:20 The interactive effects of nitrogen and topography on the distribution of *Stipa pulchra*. *Robert Fitch, Cal Poly Pomona*

2:40 Canopy phenology and the coexistence of invasive species in a walnut woodland understory. *Joshua J. Paolini, Cal Poly Pomona*

3:00 Exploring traits and tradeoffs in native and nonnative plant species of California's coastal sage scrub. *Justin M. Valliere, UCLA*

2:20-3:20 pm Session 12. What Are We Learning?

Salon 3. Moderator: *Andrea Williams, Marin Municipal Water District*

2:20 Can we successfully manage weeds on a landscape scale without herbicides? Lessons learned 10 years into MMWD's zero-use Vegetation Management Program. *Janet Klein, Marin Municipal Water District*

2:40 Three decades of effort in undoing a mistaken policy of introducing a weedy non-native as forage. *Denis M. Kearns, Bureau of Land Management*

3:00 Restoring ecosystem function and diversity through cost-efficient hazardous fuel removal. *Sarah Godfrey, Center for Natural Lands Management*

3:20 – 3:40 pm Break

3:40 – 5:00pm. Session 13. Invasive Plant Management: Past, Present, and Future.

Grand Ballroom. Moderator: *Steve Schoenig, California Dept. of Fish and Wildlife, retired*

3:40 2016 new weed alerts. *Dean Kelch, California Dept. of Food & Agriculture*

4:00 25 Years of Cal-IPC and invasive plant management in California. *Steve Schoenig, California Dept. of Fish and Wildlife, retired*

4:20 The future of invasive plant management: Voices from the field:

Juan de Dios Villarino, Natural Resource Management Crew Leader, California State Parks, Santa Cruz District

Justin Valliere, UCLA Post-Doctorate Researcher

Rachel Kesel, Conservation Management Specialist, One Tam

4:40 Park stewardship, invasive plant management, and the next 25 years. *Jay Goldsmith, Natural Resources Division Director, Pacific West Region, National Park Service*

5:00pm Adjourn

(Field trip participants meet in the front of the room to plan for Saturday.)

Saturday, November 5 – Field Trips

Field trip participants meet at 8am.

Field Trip 1: Merced River Canyon (Full-day, 8:30 am-4:30 pm))

Visit sites along the Merced River where an exciting multi-agency campaign has knocked back dense infestations of yellow starthistle, Italian thistle and tree-of-heaven. At the Merced River Recreation Area visitor center we'll get the lay of the land, then visit the Willow Placer Campground, Good Gulch, Railroad Flat, an old suspension bridge, and Incline Road, where the US Forest Service partnered with National Park Service crews to conduct extraordinary treatments on steep rocky slopes using rope systems and high-powered truck-mounted spray rigs. Finally, at El Portal we'll discuss efforts to keep invasive plants from moving into Yosemite National Park.

Field Trip 2: Yosemite Valley – Weeds and Waterfalls (Full-day, 8:30 am-4:30 pm))

See the weedy side of Yosemite Valley through the lens of three species. Himalayan blackberry, planted by early settlers, took over 120 acres of riparian habitat. Decades of manual control barely reduced the population, but recent herbicide treatments have been much more effective. Velvet grass is a perennial that's well established in the valley's wetlands and meadows. We'll discuss what has worked and not worked. Finally, hear about our work controlling annual grasses on dry sites and testing perennial grasses and flowers from lower elevations to see if particular genotypes may be especially resilient to climate change. Along the way, we'll stop at: Tunnel View with an overlook of the Valley; Bridal Veil Falls, The Fen by Happy Isle; Ahwahnee Meadow; and El Capitan Meadow.

Field Trip 3: Sierra National Forest (Half-day, 8:30am-12:30 pm))

Join Forest Service natural resource managers on a driving tour from Fish Camp south to see the leading edge of yellow star thistle and medusahead moving up into the mountains. We'll travel up Sky Ranch Road to a meadow to discuss recently discovered sulphur cinquefoil and a challenging medusahead problem. Our trip will end with a short walk in the Nelder Grove of Giant Sequoias, where bull thistle is the primary weed to date.

Posters

1. The working group for *Phytophthoras* in native habitats: Working collaboratively to prevent invasive species introductions in California wildlands. *Janice Alexander, UC Cooperative Extension*
2. After all this time and money, are the weeds getting better or worse? *Joseph Algiers, Jr., Santa Monica Mountains National Recreation Area*
3. Birdseed induced invasion of non-native grasses millet (*Panicum miliaceum*) and sorghum (*Sorghum bicolor*) into Joshua Tree National Park, CA. *Laura Ashfield, Joshua Tree National Park*
4. Species interactions of a heavily invaded ecosystem: The role of competition among California exotics. *Julia Battisti, University of Montana (Student Poster Contest)*
5. Spatial patterns of diversity in California grasslands. *Evan Batzer, UC Davis (Student Poster Contest)*
6. Assessing emerging invasive plants in California. *Elizabeth Brusati, California Dept. of Fish & Wildlife, Dana Morawitz and Doug Johnson, California Invasive Plant Council, and Mona Robison, CalBotany*
7. Fire followers of Yosemite National Park. *David Campbell, Yosemite National Park*
8. The continuing history of weeds eradication in the Salmon and mid-Klamath watersheds. *Tanya Chapple, Mid Klamath Watershed Council*
9. Assessing aquatic plant invasiveness to facilitate management in the Sacramento-San Joaquin Delta. *Valerie Cook Fletcher, CA Dept of Fish and Wildlife*
10. Enhancing the wildlife value of farms in the Central Valley: A team effort. *Matthew Danielczyk, Audubon California*
11. Early detection and control of invasive plants following the Rim Fire. *Steven Del Favero, Yosemite National Park*
12. Scale of landscape conservation: Finding common ground between management and the weeds. *Kathleen Dickey, San Mateo Resource Conservation District*
13. Seeding Functional Redundancy for Multiple Ecosystem Service Goals. *D.J. Eastburn, L.M. Roche, M.P. Doran, E.S. Gornish*
14. Prescribed fire in the vernal pool grasslands of Prairie City State Vehicular Recreation Area. *Lora Elsom, California State Parks*
15. Uses of Southern California black walnut *(Juglans californica*) in landscaping and restoration. *Eliza Hernández, Cal Poly Pomona*
16. Controlling *Linaria dalmatica* at Hungry Valley State Vehicular Recreation Area. *Chris Hon, California State Parks*
17. Controlling Algerian sea lavender and assessing marsh vulnerability. *Drew Kerr, San Francisco Bay Invasive Spartina Project*
18. Caltrans: Protecting travelers and wildlife from invasive weeds. *Conrad L. Kiernan, Caltrans*
19. Development of a regional aquatic weeds project (DRAAWP). *Guy Kyser, UC Davis*
20. The indirect effects of invasive grasses on native forb persistence. *Marina LaForgia, UC Davis (Student Poster Contest)*
21. New challenges in the eradication strategy for Russian wheatgrass (*Elymus farctus*) populations found in the Guadalupe-Nipomo Dunes, San Luis Obispo County. *Nancy La Grille, California State Parks*
22. Effects of juglone on the germination of Southern California native and invasive plant species. *Sierra Lauman, Cal Poly Pomona*

23. Response of invasive *Tamarisk* to chemical controls in a southern California desert. *Danny McCamish, California State Parks*
24. Effects of nitrogen and phosphorus on the growth and reproduction of *Pennisetum setaceum*, African fountain grass. *Glen Morrison, Cal Poly Pomona*
25. Do invasive grasses employ different water use and rooting strategies than a native chaparral shrub? *Michala Phillips, UC Riverside (Student Poster Contest)*
26. Using native woody shrubs as nurse plants for seedling establishment in Coastal Sage Scrub. *Lauren H. Quon, Cal Poly Pomona*
27. Controlling Harding grass *(Phalaris aquatica*) in a grassland setting – the final report. *Stassia Samuels and Laura S. Julian, Redwood National and State Parks*
28. Light tools for removing jubata grass. *Mark Skinner, Coastal San Luis Resource Conservation District*
29. Investigating anthropogenic stressors and the relationship with *Schismus barbatus* for the threatened Little San Bernardino Mountains *Linanthus. Lynn C. Sweet, UC Riverside*
30. A test of reduced rates of glyphosate for the control of invasive plants. *Don Thomas. San Francisco Public Utilities Commission*
31. Square pupils: Goats as alternative fuel and weed reduction workers. *Andrea Williams, Marin Municipal Water District*

Abstracts

Wednesday, November 2

DPR Laws and Regulations Session

PRESCRIBE: An online database for protection of endangered species from pesticides. Richard Marovich, California Department of Pesticide Regulation, Sacramento, CA. rmarovich@cdpr.ca.gov

For over 20 years, the California Department of Pesticide Regulation (DPR) has worked with local stakeholders to develop an endangered species protection program that is comprehensive in scope and includes all federal- and state-listed species and all pesticides registered in California. The core of DPR's program is a free, Web-based database application that allows pesticide applicators and others to identify local habitat for endangered animals and plants, and advises applicators on required use limitations when necessary. The system is called PRESCRIBE, for "Pesticide Regulations Endangered Species Custom Real-time Internet Bulletin Engine."

PRESCRIBE (http://cdpr.ca.gov/docd/es/prescint.htm) replaced more than 2,500 pages of endangered species protection bulletins for the state's 58 counties. It contains location records for over 1,000 endangered, threatened, and other special status species, encompassing almost 80,000 unique land sections. It also can search for 30,000 pesticides by brand name, as opposed to paper bulletins that listed only the name of an active ingredient.

In a PRESCRIBE query the user selects the county-township-range-section(s) where he/she intends to apply pesticides and selects the pesticide he/she intends to use. The database application looks up the species that occur in the selected section(s) and the active ingredients in the selected pesticides and generates a report of what listed species occur in the area and what use limitations may apply to the selected pesticides for protection of those species.

These use limitations were derived from biological opinions developed by the U.S. Fish and Wildlife Service (USFWS) in consultation with the U.S. Environmental Protection Agency (USEPA) and reviewed by USFWS. The endangered species section-habitat index is derived from the Department of Fish and Wildlife (DFW) Natural Diversity Database, as well as maps obtained from USFWS and National Marine Fisheries Service (NMFS).

The use limitations are voluntary, unless required by pesticide labeling or pesticide use permits. At the same time, DPR provides pesticide users with training that includes educational materials to help them identify endangered species habitats and pesticide-specific use limitations. PRESCRIBE Mobile, a new mobile application (http://mobile.cdpr.ca.gov/prescribe) also yields protective measures and adds a feature that uses a smart phone's geographic locator function to identify a user's current location and proximity to listed species' habitat.

Through the years, DPR's Endangered Species Project continues to evolve, always looking for more innovative and proactive measures for the protection of endangered species. Our commitment is to serve the public and protect endangered species through multidisciplinary analysis and multi-agency collaboration; where both the needs of endangered species and pesticide applicators are taken into consideration.

Chemical resistant glove selection. Lisa Blecker. University of California Agriculture and Natural Resources Statewide IPM Program, 2801 Second Street #157, Davis, CA 95618-7774. lblecker@ucanr.edu.

Chemical resistant gloves are commonly used personal protective equipment (PPE) worn by pesticide handlers – those who mix, load and apply pesticides. The U.S. Environmental Protection Agency (U.S. EPA) Chemical Resistance Category Selection Chart for Gloves is used to determine the type of gloves to be listed on pesticide labels, based on glove material resistance to solvents used in pesticide formulations. Pesticide product labels are required to reference the different glove materials on labels, and they do so either by specifying by name (e.g., nitrile, butyl, etc.) or by code (A through H). California regulations require employees to wear chemical resistant gloves for most pesticide handling tasks, even if the label does not require them. The consequences of not wearing gloves and other required PPE can be great. For example, a query of the California Pesticide Illness Surveillance Program (PISP) database from 1992-2011 showed that 33% of reported handler pesticide illnesses that involved skin or systemic symptoms corresponded to a failure to wear required PPE. Participants in this session will be asked to identify 10 different gloves – each made of one of the eight resistant materials– to demonstrate some of the impediments to selecting and wearing the appropriate chemical-resistant gloves. Those include: unclear or missing pesticide label statements, difficulty in distinguishing among different glove materials, and lack of identifying information on the

gloves. Participants will be instructed how to use the Glove Category Selection Key (California Department of Pesticide Regulation) to better understand label statements, and will be shown how to use product information to make more informed decisions. The overall message of the presentation is: wear chemical resistant gloves for all handling activities; consult the label and California requirements for the appropriate glove material, and check manufacturers' specifications for details that may affect the safety of the glove.

Thursday, November 3

Session 1. A Century of Park Stewardship

Invasive plant management in today's National Parks. Terri Hogan, National Park Service, Natural Resource Stewardship and Science Directorate, Biological Resources Division, Fort Collins, CO. terri_hogan@nps.gov

The Organic Act of 1916 is the significant management-related provision guiding the National Park Service (NPS). It directs the NPS to preserve park resources and to provide for the public enjoyment of these while leaving them unimpaired for future generations. There are many challenges to fulfilling that mandate including the threat invasive plant species pose to the remarkable places that are conserved within the National Park System. The NPS's understanding and approach to the control of invasive plant species has changed over time. By the late 1990s, the threat posed by invasive plants to park resources was clear and funding was secured to begin a unique program that resulted in the development of Exotic Plant Management Teams across the NPS. Today, parks and NPS Regions contribute to the management of invasive plants, and Exotic Plant Management Teams continue to play a key role within the NPS. The NPS also works in collaboration with others (e.g., agencies, weed boards, non-governmental organizations) to address issues on a landscape scale. The NPS continues to adapt its approach to invasive plant management in the face of factors such as climate change, increased habitat fragmentation, and globalization of trade and travel.

Invasive plant management in California State Parks. Jay Chamberlin, Chief, Natural Resources Division, California State Parks. jay.chamberlin@parks.ca.gov

From a majority of the acreage of remaining old growth redwoods to hundreds of miles of the California coastline, and from northwestern CA rainforests to southeastern CA deserts, the 1.6 million acre California State Park System contains many significant landscapes of the Golden State. While the system's broad resource base is well known, less well known is that vegetation management has been a major emphasis of the stewardship of park resource managers for decades. This talk will trace the legal, philosophical and practical foundations of natural resource management in the State Park System and summarize its accomplishments and recent innovations. It will also highlight current efforts to transform the department to help managers better tackle the big questions of resource management going forward.

Session 2. Grazing, Weeds, and Rangeland Management

Plant community responses to cattle grazing in a noxious weed-dominated rangeland. Leslie M. Roche*[1, 2], Kenneth W. Tate[1, 2], and Josh Davy[2]. [1]UC Davis Department of Plant Sciences, [2]UC Cooperative Extension. lmroche@ucdavis.edu

Invasive weed species in California's rangelands can reduce herbaceous diversity, forage quality and wildlife habitat. Small-scale studies (5 acres or fewer) have shown reductions of medusahead and yellow starthistle using prescribed grazing on rangelands, but little is published on the effects of pasture-scale (greater than 80 acres) prescribed grazing on weed control and plant community responses. We report the results of a 6-year collaborative study of manager-applied prescribed grazing implemented on rangeland that had not been grazed for 4 years. Grazing reduced medusahead but did not alter yellow starthistle cover. Medusahead reductions were only seen in years that did not have significant late spring rainfall, suggesting that it is able to recover from heavy grazing if soil moisture is present. Later season grazing appears to have the potential to suppress medusahead in all years. In practice, however, such grazing is constrained by livestock drinking water availability and forage quality, which were limited even in years with late spring rainfall. Thus, we expect that grazing treatments under real-world constraints would reduce medusahead only in years with little late spring rainfall. After 10 years of grazing exclusion, the ungrazed plant communities began to shift, replacing medusahead with species that have little value, such as ripgut and red brome.

Integrating grazing and herbicide treatments. Joseph M. DiTomaso, University of California, Davis, CA. jmditomaso@ucdavis.edu

Proper grazing with cattle, sheep, or goats has been shown to be an effective method for the management of many invasive plants, including herbaceous annuals and perennials such as Italian ryegrass, yellow starthistle, medusahead, and leafy spurge, as well as shrubs, including Himalaya blackberry and multiflora rose. Similarly, there are numerous examples where herbicides alone can control many different invasive plants. While integrated pest management (IPM) strategies are often recommended to give more sustainable invasive plant management, the combination of grazing and herbicides is not typically used. However, there are a number of situations where both practices can be integrated to give greater long-term invasive plant management and more sustainable forage production. For example, goat grazing in leafy spurge infestations followed by herbicide treatment was a very effective control combination, and better than either technique alone. Similarly, multiple years of herbicide use can reduce the population of an invasive plant to a point where intensive grazing can further prevent re-infestation. In another example, herbicide treatment of yellow starthistle gave excellent control, but proper grazing timing later in the season favored perennial grasses which further suppressed starthistle the following year. Timing of herbicide application in rangelands can be very important to forage production. For example, an early season treatment of clopyralid for yellow starthistle control resulted in far more annual grass forage production compared to a late season treatment. This increased forage, if grazed properly, could further suppress the subsequent germination and establishment of starthistle. Finally, low, sublethal rates of glyphosate and other herbicides were shown to suppress seed production in medusahead and Japanese brome, yet leave some forage for livestock grazing. These low rates did not damage desirable native plants, and when used in combination with grazing provided both forage production and invasive annual grass control.

The art of targeted grazing: A practitioner perspective. Dan Macon[1] and Andree Soares[2], [1]Flying Mule Farm and UCD Plant Sciences Department, Auburn, CA., and [2]Star Creek Land Stewards, Los Banos, CA. dmacon@ucdavis.edu, asoares@sbcglobal.net

Targeted grazing can be an effective tool for managing invasive weeds and reducing fuel loads. Managing targeted grazing projects requires knowledge, management skills and communication abilities that differ from traditional grazing management. Flying Mule Farm and Star Creek Land Stewards have managed large and small scale targeted grazing projects throughout northern California. This talk will address the logistical challenges, management techniques and knowledge base necessary for successful targeted grazing projects.

Session 3. Successful Invasive Plant Management Projects

The Salinas River Watershed Arundo control program—lots of farmers, lots of Arundo: 12 miles in two years. Paul Robins* and Emily Zefferman, RCD of Monterey County, Salinas, CA; Jason Giessow, DENDRA, Inc., Encinitas, CA. paul.robins@rcdmonterey.org

The Salinas River is the second-most Arundo-invaded watershed in the state with over 1,470 infested acres. The Salinas River meanders past vast tracts of intensively-farmed lands, as well as rural towns and cities. Arundo causes severe flooding and fluvial modification of invaded riverine systems, particularly when stands reach the size of those found on the Salinas River. The Resource Conservation District of Monterey County (RCDMC), the Monterey County Ag Commissioners office (MCAC), the Monterey County Water Resources Agency (MCWRA), the Wildlife Conservation Board (WCB), and The Nature Conservancy (TNC) came together to work with local landowner and ag groups to address this issue collaboratively.

With WCB grant funding and local government and landowner resources, RCDMC oversaw the first two years of Arundo treatments on nearly 150 acres of river floodplain in 2014-15. This took three years to initiate and represented two separate but complimentary programs. The first program, led by RCDMC and MCAC, is based on a watershed-scale approach with programmatic permits to start work at the top and work downstream. RCDMC and MCAC engaged with Dendra, Inc. to design the program, get mapping data (Cal-IPC), get permits, and get funding. The RCD is currently funded into 2020 to conduct $4.5 Million of work over ~450 acres.

The second program, the Salinas River Stream Maintenance Program, is focused on improving channel flows with managed secondary channels and Arundo control, in coordination with the RCD's program. This program, funded and implemented by landowners (with permits and planning funded by TNC and MCWRA), involves a collaboration of TNC, MCWRA, Conservation Collaborative, the Salinas River Channel Coalition (landowners) and the Grower

Shipper Association. Working together, the two programs are poised to expand to cover the entire river at a faster rate than has ever been achieved by an Arundo control program.

From prevention to treatment: Yosemite's suite of invasive plant management efforts. Garrett Dickman, Yosemite National Park. garrett_dickman@nps.gov

Yosemite National Park contains less than 1% of the California land mass and protects 23% of the state's plant species. One of the biggest threats to Yosemite's native plants may be non-native invasive plants. Thus, Yosemite National Park implements an integrated, comprehensive and adaptive framework to protect the park's natural and cultural resources from the impacts of non-native invasive plants. The invasive plant management program has six goals 1) Inventory: Initiate a comprehensive and systematic invasive plant inventory to establish a baseline to measure progress and change. 2) Prioritization: Assess how individual invasive plants or populations affect natural systems and focus management on those that pose the greatest threat. 3) Prevention and early detection: Prevent and monitor conditions that can bring in new seed or reproductive material, follow best management practices, and conduct periodic and systematic inventory 4) Treatment: Treat invasive plant populations that pose the greatest threat. 5) Monitoring: Ensure that the invasive plant program is regularly monitored, improved and supported by science and research 6) Education, outreach and research: Educate, inform, consult and collaborate with all interested parties.

Through the adoption of Integrated Pest Management strategies, Yosemite has been able to substantially reduce established populations of highly invasive species such as Himalayan blackberry, spotted knapweed, and yellow-star thistle. Early detection surveys have detected dozens of new species; most novel infestations were detected near park operation facilities. Detections such as these have led to further development and implementation of best management practices, collaboration between agencies, and outreach.

From biosecurity to control on the ground: Invasive plants on San Nicolas Island. William Hoyer, Naval Base Ventura County, San Nicolas Island, CA. william.hoyer@navy.mil

San Nicolas Island (SNI) is a remote but biologically unique island under management by the US Navy with a robust non-native plant management program. Managed as federal land and as an island, SNI is posed with many challenges as well as advantages to biosecurity and non-native plant programs. This talk will cover: federal drivers used for obtaining funding, history and future actions of the non-native plant program, as well as a review of logistical and biological constraints the program faces and overcomes.

Fifteen years of community restoration projects: The lessons of working on invasive plants at a small scale. Shawn Kelly, Southern California Wetlands Recovery Project. 805-984-9531, skelly@scwrp.org

The Southern California's Wetlands Recovery Project's Community Wetland Restoration Grant Program provides funding for community-based restoration projects in watersheds and coastal wetlands in the southern California region. The Program's purpose is to support community based wetland restoration projects, and by doing so, to build local capacity to plan and implement wetland restoration projects, promote community involvement in wetland and stream restoration activities, and foster education about wetlands ecosystems. Most of this Program's projects conduct restoration efforts that significantly entail the removal of invasive vegetation and the subsequent planting of native vegetation. For the purposes of this presentation, the Program's wetland focus will be de-emphasized, and the presentation will focus more on the benefits and lessons of invasive plant removal by numerous small projects in a programmatic context. Small scale restoration efforts being implemented on sometimes significantly degraded habitats can be an important social process to increase awareness and value of these habitats to society. They are an avenue to get people connected to their local habitats and foster a sense of place, to educate the community about these habitats, to plant the seeds of future environmental stewards and professionals, and to build capacity within a non-profit project lead, etc. One can surmise that there are numerous beneficial feedbacks, some obvious and others more complex and long-term. Peoples' perspectives that large projects accomplish large things is a "given". Less obvious to many people, including, in particular, proponents and practitioners of large projects, is the value of small projects, small projects bound together in a programmatic framework with their achievements summed across 100's of projects.

Session 4. Gimme the Dirt: Plant Invasion and the Soil Microbiome

***Brachypodium* invasion in California is facilitated by rhizosphere microbes.** Emma L. Aronson*[1], Chelsea Carey[1], Jon Botthoff[2], and Pilar Catalan[3].

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In order to understand how invasive grasses interact with the soil microbial communities of invaded lands and how the microbiome may facilitate or hinder invasive grass spread, we sampled species of two grass genera in their native and invaded ranges. We collected *Brachypodium* species and co-located *Bromus* and other grass species, and soils in Spain (the native range), and California (the invaded range). We sampled grass roots, rhizosphere soils containing roots (herein called 'rhizosphere'), and surrounding bulk soil, in six locations each within Mediterranean mesic environments and extracted whole meta-genomic DNA. We found that the microbial communities of the roots, rhizosphere, and bulk soils, are distinct. Analysis also showed that most locations had distinct soil and root microbial communities. While root endophyte microbial communities were distinct between *Brachypodium* spp. and *Bromus* spp., the rhizosphere and bulk soil communities overlapped. There were almost twice as many overlapping microbial species between the rhizosphere and root communities in the *Brachypodium* samples as there were in the *Bromus* samples. These findings lead to the initial conclusion that grass roots select from their surrounding rhizosphere communities, and that *Brachypodium* spp. roots may be less selective than *Bromus* spp. It is possible that this minimal selectivity of rhizosphere microorganisms into the root system has facilitated the use of beneficial rhizosphere microorganisms in the process of *Brachypodium* invasion. This understanding may help us identify beneficial or detrimental root endophytes, and ultimately help in the understanding of, and biocontrol for, these grasses, as both genera studied are invasive in California.

Associations between an invasive plant *Taeniatherum caput-medusae*, medusahead) and soil microbial communities. Elise S. Gornish[1]*, Noah Fierer[2], Albert Barberán[1,2]. [1]University of California Cooperative Extension, [2]University of Colorado, Boulder. egornish@ucdavis.edu

Background: Understanding plant-microbe relationships is important for developing reliable management strategies for invasive plants. This is particularly important when these relationships interact with underlying variables, such as habitat type and seedbank density, to mediate control efforts. In a field study located in Yuba County, California, we investigated how soil microbial communities differ across the invasion front of *Taeniatherum caput-medusae* (medusahead), an annual grass that has rapidly invaded most of the western USA.
Methods: Plots were installed in areas where medusahead invasion is typically successful (open grassland habitat) and typically not successful (oak woodland habitat). Medusahead was seeded into plots across a range of densities (from 0-50,000 seeds/m^2) to simulate different levels of invasion. Bulk soil was sampled from each plot two years after medusahead seeds were sewn and microbial diversity was assessed using high-throughput sequencing methods.

Results: We did not find an effect of medusahead density on soil microbial communities across the simulated invasion front. However, both bacterial and fungal soil community composition (particularly, mycorrhizae and fungal pathogens) were significantly different between oak woodland and open grassland habitats.
Conclusions: Medusahead might enhance its invasion success in open grasslands by accumulating soil pathogens and by establishing non-specific interactions with arbuscular mycorrhizae. Our results suggest that future medusahead management initiatives should explore plant-microbe interactions.

Remediating the microbial legacy effects of invasive Harding grass for restoration. Brooke Pickett[1]*, Irina Irvine[2], and [1]Emma Aronson.
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[2]National Park Service, Thousand Oaks, CA
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Phalaris aquatica (Harding grass) is an invasive bunchgrass that was removed from a 25-acre field site in the Santa Monica Mountains National Recreation Area. We conducted a greenhouse study, which demonstrated that soil legacy effects due to *P. aquatica* were associated with reduced native plant growth. We hypothesized that the inhibition of native plant growth in this post-invaded soil was due to compositional shifts in the soil microbial community. To test this, we grew native plants in two soil treatments with similar abiotic field conditions. Both treatments contained microbes from the post-invaded site, but only one treatment contained native soil microbes. Over seven months, soil cores were taken for nitrogen and microbial composition analysis and plant growth metrics were recorded. Two of three native plant species had reduced mortality and two showed increased growth after being grown in the soil with native microbes added as whole soil inoculum. Our results suggest that a lack of native microbes in post-invaded soil may be the cause for decreased native

plant growth. The nitrogen concentration under plants inoculated with native microbes more closely matched that of the native soil than the surrounding post-invaded soil. The microbial population has been sequenced and the results will be discussed. This study provides information for improving native plant establishment in post-invaded sites. It includes suggestions for optimal native species selection for revegetation and offers a greater understanding of plant/microbe symbioses in invaded habitats to improve restorations.

Session 5. Do No Harm: Managing Restoration's Unintended Consequences

The risks *Phytophthora* species pose to restoration goals and protocols to reduce the inadvertent introduction of these pathogens. Diana Benner*, Susan J. Frankel, Janice Alexander and Alisa Shor. The Watershed Nursery, diana@thewatershednursery.com

Restoration projects and other activities in wildlands may serve as an inadvertent pathway for the introduction of invasive *Phytophthora* pathogens. Recent surveys have detected multiple *Phytophthora* species in restoration sites, wildland areas, purchased plants, and native plant nurseries. These organisms, whose genus name comes from the Greek meaning "plant destroyer", may cause significant damage to the habitats we are trying to benefit. Over the past 20 years we have observed the damage from the introduction of the sudden oak death pathogen, *P. ramorum,* which has killed millions of trees along the Pacific Coast. The potential risks to restoration sites from these organisms came into a new light in the Bay Area in 2014 when plant material installed for a restoration project was identified as being infected with *P. tentaculata,* a pathogen that had only been detected once before in California and is listed by USDA APHIS Plant Epidemiology and Risk Analysis Laboratory (PERAL) in the top 5 priority *Phytophthora* species of concern for introduction in the US. To develop a coordinated response to the threat posed by these pathogens, a group of plant pathologists, restoration nurseries, restoration contractors, and regulatory entities have formed the Phytophthoras in Native Habitats Work Group (CALPHYTOS.org). This group is collaborating to develop strategies and protocols to reduce the risk of introduction of these pathogens in habitat restoration projects and minimize the chance of doing harm in our efforts to enhance habitat. This talk will give a brief history on this new phase of *Phytophthora* awareness in the local Bay Area restoration nursery community, highlight steps identified to reduce risk of introduction of these organisms, and share additional measures planned to reduce the risk of the introduction of these pathogens in restoration projects.

New technique for restoration of deeply eroded mountain wetlands: Risks and benefits. Athena Demetry[1]*, Evan Wolf[2], David Cooper[2], and Joel Wagner[3]. [1]Sequoia and Kings Canyon National Parks, [2]Colorado State University Fort Collins, [3]NPS Water Resources Division. athena_demetry@nps.gov

Halstead Meadow is a 21-acre wetland bisected by the Generals Highway in Sequoia National Park. The meadow had developed severe erosion gullies, lowered water tables, dried wetland soils, and wetland plant dieback due to historic grazing and water channelization through culverts. Past efforts to restore the meadow using check dams and willow planting were unsuccessful. In 2005, the park began work on a new approach: restore wetland topography, hydrology, and vegetation to pre-disturbance conditions by filling the erosion gullies and converting the incised channel system to a natural sheet flow system. This new approach offers an alternative to the "pond and plug" technique, which introduces novel landforms into meadows and is being applied broadly in the Sierra Nevada. National parks can serve as experimental laboratories for innovative techniques that more fully restore pre-disturbance conditions. However, these experiments may come with increased risks, in this case of introducing non-native organisms and sustaining flood damage. At Halstead Meadow, two phases of restoration are complete and a bridge has replaced the filled roadway, restoring 7 acres of wetland and protecting 9 acres from further degradation. 24,000 cubic yards of fill soils have been placed and 155,000 native wetland plants installed. High water tables are restored and native wetland plants are thriving. However, at least 5 plant species were introduced with nursery materials, requiring at least 3 years of treatment, and flood damage to an early phase had to be repaired. Taking a phased approach has allowed the team to learn from mistakes, improve restoration methods, and reduce risk.

Human systems in weed management: How our practices may do more harm than good. Mark Heath, Shelterbelt Builders, San Francisco, CA. mark@shelterbeltbuilders.com

Weed management projects are planned, designed, coordinated and implemented under a framework subject to the constraints of human systems—everything from tax collection and distribution, risk management, public disclosure, equality and fairness, fossil fuel-based energy, daylight working times, and Christian holidays. If native plants were responsible for planning and designing weed management

projects to protect their own well-being, they may well approach things in a different way. Reviewing a selection of successful and unsuccessful weed management projects, we'll forget for a moment whether tarps or herbicides are better for controlling invasive trees and instead consider how we can implement better budgeting, planning and project structuring to accomplish our weed management goals. Our ultimate success in managing natural environments requires elements that often diverge from our human systems and priorities. If we do not find ways to make our approach less constrained by common human systems, we run the risk of doing more harm to the environment versus not doing anything at all. This dilemma is why we should be managing our projects as if we were native plants.

Session 6. Early Detection: How NPS Keeps on Top of Invasive Plants in the High Country

Staying ahead of the invasives spread: Early detection surveys in Yosemite and Sequoia/Kings Canyon National Parks. Tom Reyes* and Garrett Dickman, Yosemite National Park, Vegetation and Ecological Restoration. PO Box 700, El Portal CA, 95318. Thomas_reyes@nps.gov

Yosemite and Sequoia/Kings National Parks contain extraordinary biodiversity that includes more than 2,100 plant taxa- about 30% of California's flora. As some of the most iconic parks in the country, these parks host well over 5 million visitors a year annually, providing many opportunities for the introduction invasive plants. Exhaustive invasive plant surveys around developed areas of Sequoia National Park were completed as a part of a 2003 USGS study, but locations in Yosemite were only sampled, leaving large portions of the park unsurveyed. Upon completion of comprehensive surveys throughout Yosemite and the low elevations of Sequoia, more than 30 new non-native plants were discovered in Yosemite, and more than 10 in Sequoia, including numerous Cal-IPC rated weeds and one new species to California. Without these data, resource managers have not been fully aware of the extent and distribution of invasive plants within the parks, and therefore have not had the information required to prioritize and treat invasive plant populations effectively and efficiently.

Based upon the context in which new exotic plants were found, we were able to decipher the most likely source of its introduction. We categorized infestations based on associated sources e.g. road, trail, construction site, stock, fire operations, campground, unknown, etc. Our results indicate infestations are most closely related to park operations (employee housing and facilities), stock use, roads, and concessionaire buildings. Besides stock use, few infestations were associated with visitor activities. As such, future survey and prevention efforts may be best targeted at park management operations as staff and operations appear most associated with the introduction of invasive plants.

Treating alpine invaders: prioritizing high elevation non-native species to protect Yosemite's alpine meadow ecosystems. Heather Smith, Yosemite National Park, El Portal, CA. heather_smith@nps.gov

High alpine meadows are some of the most ecologically important and scenic habitats in the alpine ecosystem. They host a large segment of flora and fauna and are notable habitat of two of Yosemite's threatened and endangered species, the Yosemite toad (*Anaxyrus canorus*) and the Sierra Nevada yellow-legged frog (*Rana muscosa*). Non-native invasive plants appeared in high elevation meadows in recent years, and have since spread. In 2015, Yosemite's invasive plant management program instituted a systematic park-wide effort to treat and eradicate non-native plant populations in high elevation areas. The project goals are to protect irreplaceable alpine habitats by eradicating known populations of non-native plants and survey for more populations.

In Yosemite, species treatment priority is based upon elevation as well as invasiveness, access for control and distribution. Above 7000 feet, all non-native species are targeted for control because this is a unique opportunity to protect relatively intact ecosystem. Of the park's 275 invasive plant species, 91 occur in high elevation areas and 29 have only one known population above 7000 feet. Treating these populations will significantly increase the likelihood of eradication, reduce risk of habitat degradation and increase resiliency in the face of climate change. In the first year of this program we found the highest diversity of non-native species concentrated in stock facilities and construction staging areas. Prior to the project, dandelion (*Taraxacum officinale*) was one of our most extensive invasive plants. This species is already proven to be highly invasive at high elevations. We mapped several new populations, greatly expanding the previously known distribution. We also discovered remote populations of a few highly invasive species, cheat grass (*Bromus tectorum*) and velvet grass (*Holcus lanatus*).

Invasive and special status plant early detection and management following Yosemite's wildfires: strategies for the landscape level. Steven Del

Favero, Yosemite National Park. Yosemite, CA. steven_delfavero@nps.gov

Wildfire is an integral ecosystem process. Fire promotes the spread of many native species, including some rare, endemic "Fire Followers," but can also facilitate the introduction and spread of invasive plants. Fire creates disturbance and suppression operations can act as invasive plant vectors. In response, Yosemite resource managers implement targeted early detection surveys for non-native and special status plants. Early detection of non-native plants is followed by a rapid response to control invasive species. Areas with the highest probability of invasive plant occurrence are targeted based on previously known infestations, fire management operations, and habitat suitability.

Our methods developed over several years, working on fires smaller than 7,000 acres. After the 2013 Rim Fire burned 78,000 acres in the park, we had the opportunity to apply our strategy for three years, on a landscape level. As the scale and severity of fires across the region are predicted to increase due to a changing climate and a resetting of the fire return interval, prevention and early detection post-fire procedures and adaptive management in and around special status plants will be increasingly vital. Yosemite has developed a successful toolset and strategy to implement post-fire invasive plant survey and treatments that are ready for implementation by other land managers.

Session 7. Aerial Tools for Mapping and Treatment.

Look, up in the sky! it's a bird, it's a plane, it's… an unmanned aerial vehicle mapping weeds! Sundaran Gillespie* and Geoff Smick. WRA, Inc.; 2169-G East Francisco Blvd. San Rafael, CA 94901; gillespie@wra-ca.com

The explosion of commercially available, unmanned aerial vehicles (i.e., 'drones') in the marketplace provides a novel tool to the ecologist. With both fixed wing and copter style drones large enough to carry high-resolution cameras that can produce georeferenced, orthorectified mosaic imagery, new approaches to habitat mapping are available at a relatively inexpensive cost. Traditionally, conducting field surveys for invasive plant mapping over large areas requires substantial person hours at a relatively high cost. Before the advent of UAV aerial photography, high resolution aerial photographs were only available from manned aircraft at extremely high costs. I present the results of three test cases – artichoke thistle, arundo, and perennial pepperweed – utilizing a combination of inexpensive, high-resolution aerial imagery from drones in conjunction with limited field ground-truthing to create accurate maps of weed infestations in endangered species habitat. Two methods of aerial-based desktop mapping will be discussed: 1) hand-digitizing polygons around clearly visible areas of target weed species; and 2) using eCognition, a remote sensing software, to segment an image into thousands of similarly sized polygons and then classifying them into unique, user-defined bins (vegetation communities or individual species in this case) based on pixel color, texture, etc. eCognition then merges all adjacent polygons of the same type into a larger polygon. The product is exported into GIS where the polygons can be measured and a formal figure is made. Once the distribution and density of target weed species has been mapped, treatment programs can be better defined and implemented. Since high resolution aerial imagery can be produced so inexpensively, it can be flown multiple times over the year to capture the appropriate subject matter (phenology, pre/post treatment, seasonality, etc.).

Finding the best approach for detecting small quantities of invasive plant species with hyperspectral remote sensing data. Sandra Skowronek*[1,2], Gregory P. Asner[2], and Hannes Feilhauer[1]. [1] FAU Erlangen-Nürnberg, Germany [2] Carnegie Institution for Science, Stanford, CA. Sandra.Skowronek@fau.de

Reliable distribution maps are crucial for the monitoring and management of invasive plant species. Remote sensing can provide such maps for larger areas. However, most remote sensing approaches focus on species that cover large areas or have characteristic features; few studies have evaluated approaches to detect smaller amounts of the invasive target species in mixed stands. In this study, we used hyperspectral remote sensing data to detect the invasive grass *Phalaris aquatica* and the invasive herb *Centaurea solstitialis* in a pre-flowering stage in the Jasper Ridge Biological Preserve in California.

We collected presence-only data (66 plots for *Centaurea solstitialis*, and 30 plots for *Phalaris aquatica*) to calibrate a distribution model and additional presence-absence data (166 plots) to validate model performance. The hyperspectral remote sensing imagery was acquired using the Carnegie Airborne Observatory (CAO) visible to shortwave infrared (VSWIR) imaging spectrometer (400-2500 nm range) in May 2015 with a ground sampling distance (pixel size) of 1 m x 1 m.

To find the best approach for mapping these species, we compared the performance of two different state-of-the-art classifiers working with presence-only data:

Maxent and biased support vector machines. Results show that, for both species, Maxent slightly outperforms the biased support vector machine approach, with overall accuracies of up to 71% for *Centaurea solstitialis*, and up to 82% for *Phalaris aquatica*.

In this presentation we will show our results and discuss the potential and practical challenges of using hyperspectral remote sensing data for mapping smaller quantities of invasive plant species.

Aerial treatment of buffelgrass to build fire-resilient landscapes in southern Arizona. Dana Backer, Saguaro National Park. dana_backer@nps.gov

Southern Arizona receives funding from the US Dept. of the Interior's "Wildland Fire Resilient Landscapes Program," which supports a collaborative approach to building fire resiliency and restoring public lands. Coordination and planning across jurisdictions helps reduce the risk of catastrophic fire while enhancing protection of critical natural resources and watersheds. The Southern Arizona Collaborative is focusing on fuel reduction of invasive buffelgrass (*Pennisetum ciliare*) in the lower elevation ecosystems of the Sonoran Desert. Aerial surveys and herbicide applications are used to complement ground-based mapping and treatment. These methods have proven successful in reducing the invasive buffelgrass. A vegetation monitoring protocol was established to evaluate treatment effectiveness and impact on native vegetation, such as the saguaro cactus (*Carnegiea gigantea*) and the palo verde tree (*Parkinsonia microphylla*). Current partners include federal agencies (National Park Service, Forest Service, Fish & Wildlife Service, Bureau of Land Management, and US Geological Survey), local government (Pima County), tribal nations (Tohono O'odham), universities (Northern Arizona University, University of Arizona), and NGOs (Arizona-Sonora Desert Museum, Southern Arizona Buffelgrass Coordination Center).

Friday, November 4

Session 8. Finding Common Ground in Resource Management

Controlling invasive plants in designated wilderness areas. Mary Beth Hennessy, USDA Forest Service, Pacific Southwest Regional Office. mhennessy@fs.fed.us

Non- native invasive plant species can have long term effects on wilderness character. Planning, monitoring and response (treatment options) in designated Wilderness areas are guided by various tenets of the 1964 Wilderness Act. Balancing the need to maintain ecological integrity of the areas while respecting and preserving the untrammeled goal of the Act is the challenge facing managers. Forest Service policy, and examples of non-native invasive plant action in designated wilderness will be discussed.

The Wildland Fire Resource Advisor position: Communication strategies for bridging invasive plant management, resource values and fire response. Jun Kinoshita* Resources Management and Science, Yosemite National Park, CA. jun_r_kinoshita@nps.gov

The Wildland Fire Resource Advisor position serves as a single point of contact between fire managers and resource managers. As the position continues to evolve, objective or intent-based communication strategies used in incident management are making their way into project management. Understanding the spread and control of invasive plants illustrates the evolution of this position and many of the emerging communication strategies.

Preserving cultural resources while protecting natural resources from invasive plants. Steve Hilton, California State Parks, Sacramento, CA. steve.hilton@parks.ca.gov

Avoiding damage to cultural resources during invasive plant management is paramount. Cultural resources come in many different shapes and sizes, and understanding what cultural resources are and how they can be impacted allows invasive plant removal to be planned and implemented in ways that avoid impact. The need for this coordination is experienced throughout the California State Parks system, which is dedicated to protecting both cultural and natural resources. This presentation will draw from examples in State Parks to identify the range of cultural resources we work to protect. It will also describe some Native American perspectives, legal obligations and best management practices.

Matching restoration tools to rare plant recovery needs in invaded Channel Island landscapes. Kathryn McEachern, Research Ecologist, U. S. Geological Survey-WERC, Channel Islands Field Station, Ventura, CA. kathryn_mceachern@usgs.gov

Like much of the nearby mainland, the northern California Channel Islands were used as ranches throughout the past two centuries, resulting in the conversion of native scrub vegetation to barrens and non-native annual grasslands. Unlike the mainland

however, ranching has ceased, feral livestock have been removed, and conservation for recovery of native ecosystems is the main management goal. The islands are home to many rare and endemic plants spanning a range of life histories, and research shows that they are responding individually to the cessation of grazing. Some are recovering well while others are not. Population growth and expansion is limited by factors ranging from poor seed set among individuals to competition with invasive plants at population boundaries, or even altered fire and fog regimes. Consequently, recovery actions can range from very small-scale, at the level of individual plants, to large-scale, at the level of ecosystem processes. A useful tool for planning recovery actions is a "constraints model" – an organizational approach focused first on identifying the factors constraining recovery, and then on matching the conservation action to those factors. In the Channel Islands this means taking recovery activities including exploring tissue culture, invasive plant control within populations, planting seeds and seedlings in new populations, adding plants to existing occurrences, and augmenting soil moisture by harvesting fog drip. The Channel Islands provide an excellent laboratory for monitoring the long-term effectiveness of such varied recovery actions as the islands rebound from ranching practices of the past.

Session 9. Invasive Plant Research I

Biocontrol of Sahara mustard: An update on exploration in the native range. Sforza RFH[1], Augé M[2], Marini F[2], Bon MC[1], Winkler DE[3], Cristofaro M[2] and Smith L[1]. [1]USDA-ARS-European Biological Control Laboratory, France; [2]BBCA, Roma, Italy. [3]Ecology & Evolutionary Biology, University of California, Irvine, Irvine, CA. Contact: rsforza@ars-ebcl.org

Sahara mustard, (*Brassica tournefortii*, Brassicaceae) is a winter annual crucifer that became invasive in the USA since the early 1900's. It favors sandy and arid soils and now invades several deserts in southern states, e.g. California, New Mexico, Arizona, Nevada, Utah, and Texas. This short-lived weed was first identified in 1927 in California and is believed to have been introduced by contamination of date palms exported from the Middle East. The first step of a biocontrol program was initiated in 2015 to determine the geographic origin and identify possible candidate biological control agents. Explorations during the winter and spring of 2016 were conducted in Morocco, France, Italy, Israel, Jordan, Turkey, and Qatar. Genetic analysis is being conducted in order to determine the origin of invasive populations in North America using next-gen genotyping such as single nucleotide polymorphisms (SNPs) detected by a double digest RAD sequencing (ddRADseq) approach

Maps of historical and current distribution in Eurasia will be presented. Field surveys in spring 2016 allowed us to identify several natural enemies belonging to Coleoptera and Lepidoptera, mainly root galling weevils, a stem galling midge, a flea beetle and a stem mining moth. Each candidate will be presented with its potential as a biocontrol agent in regards to damage to the target host. Little is currently known about the arthropods associated with Sahara mustard in its native range indicating a high likelihood of making new discoveries.

Using population genomics to uncover the rapid colonization of Sahara mustard (*Brassica tournefortii*) in the United States. Daniel E. Winkler*[1], Kenneth J. Chapin[2], David Garmon[3], Travis E. Huxman[1]. [1]Ecology & Evolutionary Biology, University of California, Irvine, Irvine, CA, [2]Ecology & Evolutionary Biology, University of California, Los Angeles, [3]Tubb Canyon Desert Conservancy. winklerde@gmail.com

Sahara mustard (*Brassica tournefortii*) has successfully colonized semi-arid regions eastward from California to Texas and northward into Nevada and Utah since its introduction in California in the early 20th century. The dispersal and genetic mechanisms that have enabled its success remain unexplored and are a major hurdle in the successful control of the species. The recent, rapid invasion of this species provides an opportunity to address hotly debated questions in invasion biology. We used a next-gen genotyping by sequencing technique to generate reduced representation genomics for 943 individuals from 55 locations and six states across the species' invaded range to identify population structure and invasion history. Further, we hypothesized that human-mediated dispersal is driving colonization in the US. To address this, we tested for roadways as dispersal corridors as an alternative to isolation by distance models. We used STRUCTURE to infer discrete populations and an analysis of molecular variance to calculate the hierarchical genetic structure within and among locations. Last, we identified introduction, expansion, and admixture events in the species' history. We identified 1164 single nucleotide polymorphisms across the 55 locations sampled. We found no evidence of isolation by distance among locations, revealed a significant amount of genetic variation across and within locations, and found evidence for distinct genetic clusters of Sahara mustard in the US. Overall genetic diversity was low across sites, perhaps due to the species dispersal modality and natural history. Surprisingly high heterozygosity across the species range likely indicates admixture of multiple introduction sites after

initial invasions. Overall, we found moderate to low levels of genetic structure supporting human-mediated migration along roadways. We present Sahara mustard as an eminently-suited study system to understand invasion evolutionary biology, and discuss our next steps aimed at genomic analyses in the species native range.

The susceptibility of strip seeded restoration sites to invasive species. Julea A. Shaw[1]*, Leslie M. Roche[1], Travis Bean[2], Emilio A. Laca[1], Andrew P. Rayburn[3], and Elise S. Gornish[1]. [1]Department of Plant Sciences, University of California, Davis, Davis, CA, [2] Botany & Plant Sciences, University of California, Riverside, CA, [3] River Partners, Modesto, CA. jashaw@ucdavis.edu

Spatially patterned seeding of natives has recently been suggested to reduce seed costs in management and restoration efforts. One such method is strip seeding in which native species mixtures are seeded in linear patches across a site and allowed to naturally disperse into unseeded areas. Strip seeding provides the benefits of concentrating seeding effort, increasing establishment, and reducing costs. However, habitat characteristics such as patch size and configuration can directly affect the dynamics of invasive plant populations. Therefore, using strip seeding methods could make sites more susceptible to invasive plant establishment. In order to determine how restoration patch size and configuration alter grassland communities and presence of invasive species, we examined plant communities on a strip-seeding experiment in Davis, CA. Fields were seeded in 2012 with native perennial bunchgrass mixes in different strip widths and configurations (seeding coverage from 0% - 100% of experimental plots). We measured the community diversity and abundance across transects in the middle of the strip, the edge of the strip, and in the unseeded between-strip area. We used PERMANOVA to understand how patch size affected community dynamics across the seeded strips. We found that native species successfully established in all strip seeded treatments and that unseeded control plots were dominated by non-native and invasive species. Invasive species such as *Hordeum marinum* and *Bromus hordeaceus* were common in all treatments. *B. hordeaceus* was more prevalent in the 50% treatment and in treatments with wide unseeded areas. *H. marinum* cover was significantly lower in all strip seeded treatments compared to the unseeded control. Therefore, while strip seeding is an effective method to establish native species in grasslands, the effect that initial strip configuration has on invasion success varies by species and should be taken into consideration when making management decisions.

Session 10. Productive Partnerships for Invasive Plant Management

PlantRight update: 2016 nursery survey results, trends, and horticultural partnerships. Stephanie Falzone, Sustainable Conservation, San Francisco, CA. sfalzone@suscon.org

PlantRight, a project of the non-profit organization Sustainable Conservation, unites leaders in California's horticultural industry to stop the sale of invasive garden plants and promote non-invasive alternatives. This presentation describes the very latest findings from PlantRight's annual nursery survey, invasive plant trends at retail, the process behind the Plant List, and the power of voluntary partnerships (including big box stores like Lowe's and The Home Depot). PlantRight is equally proud and grateful to count Cal-IPC as a partner since its inception.

PlantRight's approach to tackling invasive plant problems in ways that make economic sense is science-based, voluntary, and collaborative. PlantRight's Plant List, identifying the highest priority invasive garden plants, is the cornerstone of the program. First released in 2006 featuring 19 invasive ornamental plants, the list was updated in 2014, resulting in the "retirement" of seven species and addition of three species, including an emerging invasive species, Mexican feathergrass (*Stipa/Nassella tenuissima*). Since 2014, the list has been updated annually and today features seven invasive species and dozens of non-invasive alternatives.

Advanced resource management stewards provide extra ARMS for weed control. Ellen Gartside, Midpeninsula Regional Open Space District. egartside@openspace.org

Established by voters in 1972, the Midpeninsula Regional Open Space District has protected over 62,000 acres of land, designated into twenty-six open space preserves. This protected open space provides sanctuaries for native wildlife and vegetation. These natural resources are rapidly disappearing as human activities encroach into natural areas. Resource management strategies are implemented by the District to minimize human-caused and accelerated impacts including invasion by non-native species. The District utilizes volunteers to assist with the management of invasive plants and the stewardship of natural resources through several different volunteer programs: Preserve Partners, Crew Leaders, and Advanced Resource Management Stewards (ARMS). The ARMS program is the most recently developed resource management volunteer program and has grown to twenty-five active volunteers

working in over twelve open space preserves. ARMS volunteers manage their own resource management site(s) and work independently on their own schedule. They also work together as small, mobile invasive weed strike teams. Coordinating and working with volunteers is extremely rewarding and can also be quite challenging. This talk will present the features of the District's resource management volunteer programs, such as recruitment, site selection, reporting, safety, and the incorporation of volunteer resource management into the District-wide Integrated Pest Management Program that was implemented in 2015.

Hydrilla eradication challenges, partnerships and lessons learned. David Kratville, Michelle Dennis and Jonathan Heintz, California Department of Food and Agriculture, Sacramento, CA. dkratville@cdfa.ca.gov

The California Department of Food and Agriculture has housed the Hydrilla Eradication Program since 1977. Control of hydrilla is a cooperative state effort, sharing resources between several sister agencies including the Department of Water Resources and the Department of Parks and Recreation Division of Boating and Waterways. Other partnerships include the Delta Conservancy and Delta Area-wide Aquatic Weed Management effort, California Department of Fish and Wildlife, United States Bureau of Reclamation, and United States Geological Survey. Each lead agency has unique but complementary roles and are now strategic partners in the fight against aquatic weeds in the state. Since the Hydrilla Eradication Program's inception it has achieved some of the Department's greatest successes by keeping California effectively free of this destructive weed. One of the Program's greatest challenges has been 43,000-acre Clear Lake. Hydrilla was initially found in 1994, herbicide treatments reduced the population to only a single plant find in 2003. Per previous protocol all treatments ceased in 2006 but the population quickly rebounded in the lake in 2007. Plant finds reached a high of 196 in 2008 which have been brought down to only 4 plants in 2015. Infestations in the counties of Shasta and Nevada are approaching eradication, with no plants for up to nine years. Eradication in those counties would leave Lake and Yuba Counties with the only active hydrilla infestations in the State. CDFA also provides guidance for other states when they are encountering hydrilla for the first time. In 2015, CDFA was approached for advice on aquatics by representatives from the states of Michigan and New York, and were also called to testify at a Senate hearing regarding aquatic weeds within the California Delta.

Session 11. Invasive Plant Management II.

The interactive effects of nitrogen and topography on the distribution of *Stipa pulchra*. Robert Fitch* and Erin Questad, California State Polytechnic University, Pomona, CA. rlfitch@outlook.com

Increased nitrogen deposition favors invasive plant species. Evidence suggests that invasion of non-native annual grasses occurs more abundantly in valleys and lowlands and less abundantly on the steeper slopes where native species, such as *Stipa pulchra*, appear to be more prevalent. A possible explanation for this pattern is the fact that nitrogen strongly covaries with water; therefore, during rainfall events, water carries nitrogen off the slopes in runoff where it collects in the valleys/lowlands.

The objectives of this experiment were to 1) analyze the differences in soil moisture and soil nitrogen created by a topographical gradient and 2) to determine the areas within the topographical gradient that are the most suitable for the native perennial bunch grass, *Stipa pulchra*. Plots were established along three different slope classes within four canyons in the Voorhis Ecological Reserve, part of the Cal Poly, Pomona campus. Three nitrogen treatments (ambient, addition, and removal) were replicated and five individuals of *Stipa pulchra* were planted in each plot with all invasive species continually being removed while allowing native species to persist.

Soil nitrogen and soil moisture were highest in the low slope plots and were lowest in the steepest positions, suggesting that topography effects the soil nitrogen content at small spatial scales due to covariance with water and soil movement. The leaf water potential of *Stipa* in the lowest slope plots was sometimes lower and sometimes higher than other positions, suggesting that there may be shifting limitations on plant water status in low-lying areas. Nitrogen did not have an effect on plant growth or measures of plant performance during the first four months of the study. Further research is being conducted analyzing soil temperature and solar radiation along the same topographical gradient.

Canopy phenology and the coexistence of invasive species in a walnut woodland understory. Joshua J. Paolini* and Erin J. Questad, California State Polytechnic University, Pomona, Ca. jjpaolini@cpp.edu

Spatio-temporal heterogeneity of environmental conditions allows for the coexistence of competing plant species in a community. The vegetative phenology of deciduous trees leads to environmental differences that competing understory plant species experience. Some species of canopy trees exude allelopathic compounds as well, which can fluctuate

spatially and temporally throughout the year. This study examines how the phenology and allelopathy of the deciduous tree *Juglans californica* (Southern California black walnut) causes spatio-temporal heterogeneity in the understory that promotes the coexistence of the invasive plant species *Brassica nigra* and *Carduus pycnocephalus*. Field and greenhouse competition experiments were conducted in which light transmittance was manipulated using shade structures. Pots were seeded with three treatments of invasive species in order to account for inter- and intraspecific competition differences. The growth and physiological performance of each species were measured. An additional greenhouse experiment was conducted to determine the germination rates of the two invasive species under different treatments of light transmittance and soil concentration of juglone, an allelopathic compound produced by *Juglans spp*. Italian thistle exhibited greater rates of germination than black mustard at all concentrations of juglone, while black mustard germination was inhibited by increasing juglone concentration throughout all treatments of light. In full sun treatments, Italian thistle exhibited reduced photosynthesis and transpiration rates when grown with black mustard, compared to when grown alone. Black mustard exhibited the lowest values of predawn chlorophyll fluorescence in dark shade treatments and the presence of thistle resulted in even lower values in the dark shade treatment. These results suggest that black mustard has a competitive advantage in full sun environments in which juglone concentrations are low; whereas Italian thistle has a competitive advantage under walnut canopies. Thus, the walnut canopy creates the opportunity for coexistence of these two species due to spatial separation of their niche requirements.

Exploring traits and tradeoffs in native and nonnative plant species of California's coastal sage scrub. Justin M. Valliere*[1], Edith B. Allen[2]. [1]La Kretz Center for California Conservation Science, University of California, Los Angeles; [2]Botany and Plant Sciences, University of California, Riverside. valliere.justin@gmail.com

California's native ecosystems are increasing threatened by multiple drivers of global environmental change, including anthropogenic nitrogen (N) deposition, climate change and associated extreme climatic events, and the invasion of nonnative plant species. A growing body of evidence suggests that both drought and elevated N deposition may favor nonnative annual species over native coastal sage scrub species in southern California, potentially contributing to increased invasion and vegetation-type conversion. Differences in plant functional traits, or trade-offs among traits, may underlie these dynamics. We explored the effects of N availability and drought on growth and functional traits of five native coastal sage scrub perennials and five nonnative annuals in a full factorial greenhouse experiment at the University of California, Riverside. Results demonstrate that growth and trait expressions of both native and nonnative species is influenced by N and water availability, yet overall nonnatives exhibited increased biomass across treatments, relative to natives. Contrasting life history strategies and differences in growth rate and plant functional trait expression may help to explain the success of these invaders under global change.

Session 12. What Are We Learning?

Can we successfully manage weeds on a landscape scale without herbicides? Lessons learned 10 years into MMWD's Zero-Use Vegetation Management Program. Janet Klein, Marin Municipal Water District, Corte Madera, CA. jklein@marinwater.org

The Marin Municipal Water District (MMWD) Board of Directors suspended use of all herbicides on its 21,000 acres of watershed lands in 2005. Over the ensuing decade, MMWD experimented with alternative control measures including goats, sheep, mulch, tarp, propane flamers, hot foam applicators, pressure washers, formulated organic herbicides and prescribed burns. MMWD also increased its operational budget for all vegetation management activities by 150%, from $225,000 per year to $565,000. During this same period, the number of acres infested with French broom (*Genista monspessulana*) expanded by 140%, from 600 to over 1450 acres. Similar expansions were observed with yellow starthistle (*Centaurea solstitialis*) and goat grass (*Aegilops cylindrical*).

Acknowledging that weed control efforts have not been successful in the first decade of its zero-herbicide program, the MMWD Board has committed to significant increases to the vegetation management budget in the coming years, with a goal of incrementally scaling up to $3,000,000 per year by 2022. Approximately 30% will be used exclusively for non-chemical weed control and the remainder will be directed to other vegetation-related needs including fuelbreak construction and maintenance, remediation in Sudden Oak Death devastated forests, and grassland restoration. MMWD staff have discontinued use of non-scalable and/or ineffective tools in favor of tried and true methods included hand pulling and containment mowing. Staff will be using budget increases to add truly meaningful tools to the weed

control toolbox: better mapping technology, real time analysis of labor costs relative to outcomes, and more labor performed by trained professionals. Staff are also adding a heavy dose of realism to the toolbox by explicitly delineating a 750-acre zone on Mt Tamalpais where weeds will go unmanaged for the foreseeable future. Staff will evaluate the success of this new approach at the end of 5 years.

Three decades of effort in undoing a mistaken policy of introducing a weedy non-native as forage. Denis M. Kearns, Bureau of Land Management, Bakersfield, CA. dkearns@blm.gov

In 1970, *Salsola damascena* (Mediterranean saltwort) was introduced as forage into the Temblor Range as a PhD research project by a UC Davis graduate student in Rangeland Management. The student, from the Middle East, was familiar with the plant at home as good feed for camels. His research plots were subsequently abandoned and the *Salsola* expanded into the surrounding habitat. The species is on both California's and the Federal Noxious Weed Lists. In the mid-1980s, eradication measures were instituted by CDFA and USDA/APHIS, assisted by BLM. By 2015, we thought that only a few shrubs were left, hard to find and widely scattered across the steep canyons of the Temblors. Unfortunately, two new populations were recently discovered outside of the search area, consisting of many large individuals and thousands of seedlings. Eradication measures have been initiated and the search area much expanded. The difficulty of completely eliminating *Salsola damascena* is compounded by its visual similarity to other co-occurring chenopod shrubs, by its potential spread by livestock, by a search area consisting of rugged topography across a mix of private and public land, and by a current lack of funds and interest within government agencies. Information on seed longevity is needed. Current eradication methods are primarily based on visual surveys and hand removal. Herbicides are proposed for treating the thousands of seedlings in the two new populations. Because the species has a distinctive reddish color signature during the fall season, the use of drones is proposed as a tool to locate any remaining *Salsola damascena*.

Restoring ecosystem function and diversity through cost-efficient hazardous fuel removal. Sarah Godfrey, Center for Natural Lands Management, Temecula, CA. sgodfrey@cnlm.org

The Center for Natural Lands Management (CNLM) owns and manages a nature preserve (Copper Creek Preserve) in San Diego County, California, that had been severely impacted by non-native species including eucalyptus (*Eucalyptus globulus*) at the time of acquisition. The trees were suffering mortality from the eucalyptus longhorned borer (*Phorocantha recurve*), and woody debris was filling the creek, further prohibiting native species growth or wildlife movement, as well as increasing hazardous fuel load. Increasing risk of wildfire as an indirect result of climate change and increasing rarity of this habitat type in southern California created a sense of urgency for restoration that would not be satisfied by a gradual approach, but budgets were limited. CNLM staff worked with California Department of Forestry and Fire Protection (CALFIRE) and their program using California Department of Corrections' inmates for conservation projects. By utilizing CALFIRE camp crews, CNLM has commenced removal of eucalyptus from Copper Creek in a cost-efficient way using all hand removal. One of the great successes is that native flora and fauna have already returned to the site, and the stream shows great promise for restoration.

Posters

The working group for *Phytophthoras* in native habitats: working collaboratively to prevent invasive species introductions in California wildlands. Janice Alexander[1]*, Diana Benner[2], Susan J. Frankel[3], and Alisa Shor[4]. [1]U.C. Cooperative Extension, [2]The Watershed Nursery, [3]USDA-Forest Service, Pacific Southwest Research Station, [4]Golden Gate National Parks Conservancy. jalexander@ucanr.edu

Recent detections of exotic *Phytophthora* species in native plant habitats and nurseries have prompted the formation of a work group to prevent pathogen movement on native nursery plants. The group coalesced in response to a first-in-the-USA detection of the plant pathogen *Phytophthora tentaculata* in several California native plant nurseries and restoration areas. Follow-up investigations have since identified more than 30 *Phytophthora* taxa in native plant nurseries, while a number of rare or threatened native species have been recognized as dying from *Phytophthora* infestations that have been introduced into their habitats. Planting *Phytophthora*-infected nursery stock into native habitats may be the most direct means of introducing these pathogens into wildlands. Furthermore, many of these *Phytophthora* species appear to have wide host ranges, capable of causing disease on plants across many families.

Native plant nurseries and vegetation ecologists in California have reached out for assistance to state

plant health regulators, plant pathologists and others. The Working Group for Phytophthoras in Native Plant Habitats formed in spring 2015 to determine steps needed to protect wildlands and assist the restoration industry. We have since: (1) held a webinar and hands-on training session for practitioners, (2) assembled a webpage and mailing list, (3) conducted an online Research Needs Assessment survey, and (4) drafted guidance documents for sanitation practices along the entire restoration pathway, and (5) created briefing papers and other outreach materials. The group is currently working towards consistency in Best Management Practices (BMPs) and a possible accreditation program for restoration nurseries.

We invite the native plant nursery and restoration community to engage with the Working Group to help address the complex issue of *Phytophthora* species in native plant nurseries and restoration sites. For more details and to join the group, contact Janice Alexander (jalexander@ucanr.edu; 415-473-3041). See calphytos.org for more resources and information.

After all this time and money, are the weeds getting better or worse? Joseph Algiers, Jr.* and Irina C. Irvine. National Park Service, Santa Monica Mountains National Recreation Area, CA. joseph_algiers@nps.gov

The pervasive nature of invasive species can overwhelm the resource managers who typically address infestations with limited staff and resources. At the Santa Monica Mountains National Recreation Area, multiple target species have been treated for multiple years at various sites and we are often asked if weeds in the park are getting better or worse. In the dataset as a whole, we see a linear trend in reduction of net percent cover over the years but gross area is increasing, which can be confusing to the public and management. This comes from having more work than can feasibly be accomplished. We approach this problem in several ways. If an area looks under control (>90 % reduction) it is not prioritized solely for data collection. This frees labor resources and allows us to work in new areas. In recent years even greater limited labor have caused trade-offs, prioritizing resource protection over detailed data collection. There are two ways this negatively affects our ability to communicate the reductions we observe: 1) by recording the distribution of larger infestations in a coarser manner (fewer detailed polygons), and 2) new areas are lumped into the gross infested area making it appear that the infestations are getting worse. We have examples that clear this confusion when we analyze the individual projects within the dataset. Though annual visitation is not always necessary for treatment, it should be prioritized with detailed data collection to provide a long-term dataset that can accurately show these trends.

Birdseed induced invasion of non-native grasses millet (*Panicum miliaceum*) and sorghum (*Sorghum bicolor*) into Joshua Tree National Park, CA. Laura Ashfield* and Neil Frakes. [1]Student Conservation Association, [2]National Park Service. Joshua Tree National Park, 74485 National Park Dr, Twentynine Palms, CA 92277.

In September 2015, following a moisture-laden summer monsoon season, we discovered an 80 acre infestation of two non-native grasses, millet and sorghum, along Joshua Tree National Park's boundary near the West Entrance. Seeds of these species are two of the most common ingredients used in commercial birdseed, and this invasion was likely induced by prolific use of birdseed in a neighborhood adjacent to the park boundary. Park staff and partners, hand pulled over 50,000 stems of millet and 5,000 stems of sorghum from the infested area. Density of these species was highest closest to the park boundary and probable seed source. Following the invasion, we tested germination of treated and non-treated birdseed. We found that baking birdseed in an oven at 300 degrees for 15 minutes is an effective way to inhibit germination. Outreach and partnership with private landowners are integral in preventing future invasions.

Species Interactions of a heavily invaded ecosystem: the role of competition among California exotics. Julia Battisti* and Loralee Larios [1]University of Montana, Missoula, MT. julia1.battisti@umconnect.umt.edu

Plant ecologists have long recognized the importance of species interactions, such as competition, in structuring plant communities. However, the role of plant-plant interactions in communities dominated by non-native, exotic species is poorly understood. To date, we lack a clear understanding for when interactions among co-occurring exotic species may be positive (facilitation) or negative (competition). In this study we asked if an exotic dominated ecosystem operates under the same rules as a naturally occurring native ecosystem. Specifically, we addressed two main questions: 1) Are interactions among exotic species primarily negative (competitive) or do some exotics facilitate other exotic species? and 2) If we find evidence for competitive hierarchies among exotic species, are the differences or similarities in the plant functional traits of those species (e.g., seed size, specific leaf area (SLA), or leaf water content) a good predictor of which species is the better competitor? Five common exotics species of Northern California grasslands- *Elymus caput-medusae, Festuca perennis,*

Bromus hordeaceus, Hypochaeris glabra, and Erodium botrys- were planted individually and pairwise in a greenhouse. After 6-8 weeks, biomass and leaf traits were collected for each species grown individually and in the presence of another individual. Species grew similarly alone or with a neighbor, suggesting neutral interactions among these exotics, except for *Elymus,* which had a negative response to the presence of another grass species with similar SLA. The negative competitive response of *Elymus* to other grasses suggests that its ability to increase in abundance is due to other ecological mechanism. Furthermore, the neutral response among other species suggests these exotics may coexist via equalizing fitness processes. Understanding the processes that allow exotic species to coexist in the invading range is key to providing insights to how to manage noxious invaders.

Spatial patterns of diversity in California grasslands. Evan Batzer**,** Department of Plant Sciences, University of California, Davis**,** ebatzer@ucdavis.edu

Spatial aggregation, the tendency of vegetation to self-organize into locally similar patches, is an often observed, yet rarely quantified feature of plant communities. Dependent on the area and frequency of sampling, spatial pattern can be described at a series of scales, which range from broad fluctuations occurring across the landscape, to finer shifts within coarsely-defined patches.

Comparison of these variable patterns may yield insights into the key mechanisms structuring plant communities, and how these processes may interact with known factors influencing species diversity, such as exotic plant invasion. California grasslands, in particular, are noted for both a high proportion of exotic species cover and exceptional diversity—analysis of spatial pattern in these communities may help explain how overall species richness is maintained despite repeated introductions of nonnative taxa.

In April-July of 2016, I conducted community sampling at three University of California research stations in the North Coast, Central Valley, and Sierra Foothill ecoregions. At each site, I evaluated species diversity and cover in a series of nested plots, ranging in area from .04m^2 to 64m^2. To assess spatial pattern, plot position in a coordinate grid was recorded and used to compare similarity in community structure as a function of distance between observations.

In all sites, communities exhibited significant spatial patterning; native and exotic species appeared to occupy distinct patches within the landscape, in which native-dominated patches contained more fine-scale variation in species diversity than their exotic-dominated counterparts. These findings suggest that environmental heterogeneity and the presence of favorable microhabitats may play a key role in the maintenance of overall species diversity, and form a platform on which to examine the role of other human-derived stressors, such as nitrogen deposition, on community structure.

Assessing emerging invasive plants in California. Elizabeth Brusati, Dana Morawitz, and Doug Johnson*, California Invasive Plant Council, Berkeley, CA, and Mona Robison, CalBotany, Sacramento, CA. dwjohnson@cal-ipc.org.

The Cal-IPC Watchlist contains >300 non-native plant species that land managers have reported as potential concerns. Many of these have not yet shown enough impacts to rate inclusion on the Cal-IPC Invasive Plant Inventory. Which of these species pose the greatest threat to California's wildlands in the near future, and which are less likely to ever become a problem? With funding from the US Forest Service, Cal-IPC is assessing 200 Watchlist species using PRE, the Plant Risk Evaluation developed by UC Davis, the University of Washington, and PlantRight. PRE uses 20 questions on the plant's biology and its behavior in other regions of the world, to determine potential invasiveness in California. Based on scoring for the 20 questions, species are rated as "Reject" (invasive), "Accept" (not likely to be invasive), or "Evaluate Further" (analysis not definitive). Each assessment includes literature citations and undergoes review by experienced botanists. This presentation will show results on species reviewed. Final results will be posted online in late 2016. The results will help land managers focus mapping and control efforts on species most likely to cause serious harm. Results will also help the PlantRight program identify ornamental species that are becoming invasive and inform communication with the horticulture industry. California's effort will provide a model for other states to use to identify emerging invasive plants.

Fire followers of Yosemite National Park. [1]David Campbell* [1]Steven Del Favero, [2]Dena Grossenbacher, and [1]Alison Colwell. [1]Yosemite National Park. Yosemite, CA. [2]Dept. of Biology, Washington State University, Pullman, WA. David_M_Campbell@nps.gov

While Yosemite wildfires receive national media coverage and are a major concern of the public, many people remain unaware of the large segment of our flora that benefits from fire. We call these species "Fire Followers," and the recent fires, such as the Rim Fire, have played a key role in their survival. While many are common, some are California Native Plant Society rare species and Yosemite National Park Special Status Plants.

In 2015 and 2016, botanists surveyed large tracts of land seeking to determine the rare and special status plants' true ranges, document their population sizes, and gather the location-specific data to ensure their long term protection and inform invasive species management. Many of these species have a limited spatial and temporal distribution and surveys must be accomplished before the environmental cues that induce them to germinate subside, and later successional species take over. This poster celebrates these seldom seen, unique and charismatic species, and presents the results from our surveys.

The continuing history of weeds eradication in the Salmon and mid-Klamath watersheds. Tanya Chapple, Mid Klamath Watershed Council, Orleans, CA and Emily Ferrell, Salmon River Restoration Council, Sawyer's Bar, CA. tanya@mkwc.org, weeds@srrc.org

The Salmon River Restoration Council (SRRC) has led an inspiring effort towards the eradication of targeted weeds with the younger Mid Klamath Watershed Council (MKWC) following suit. The mid-Klamath and Salmon River are located in a remote and ultra-rural portion of Northern California. The small isolated communities are located along the wild and scenic rivers and bordered by the Klamath Mountains and five wilderness areas. Our organizations successfully utilize manual or mechanical removal of invasive plants with an emphasis on community and youth involvement. Due to over application of herbicides and associated health impacts in the 1970s and 1980s, the community and Karuk Tribe are opposed to using herbicides to control invasive weeds. We have found that thoroughly removing each plant is the most effective method of control for our unique situation for the following reasons: the small size of our sites, the remote locations and long distances between many sites, the need for frequent passage across the wild and scenic river, and the active participation of volunteers. We have come to recognize that the best way to get ahead of invasive species is to cultivate an actively involved and educated community across generations.

Assessing aquatic plant invasiveness to facilitate management in the Sacramento-San Joaquin Delta. Valerie Cook Fletcher*, Martha Volkoff. California Department of Fish and Wildlife, Sacramento, CA. Valerie.Cook-Fletcher@wildlife.ca.gov

The California Department of Parks and Recreation's Division of Boating and Waterways (Division) is the lead agency of the state for the purpose of cooperating with other state, local, and federal agencies in identifying, detecting, controlling, and administering programs to manage, control, and when feasible, eradicate invasive aquatic plants in the Sacramento-San Joaquin Delta (Delta), its tributaries, and the Suisun Marsh. However, until 2015, the Division was authorized to treat only 3 aquatic plant species, *Egeria densa*, *Eichhornia crassipes*, and *Limnobium laevigatum*, with each species having required legislation to do so. Recent legislative action (AB763; 2013) has reformed the mechanism for granting the Division the authority to treat additional invasive aquatic plant species in the Delta, now requiring that the California Department of Fish and Wildlife (CDFW), in consultation with partner agencies, conduct a risk assessment determining whether the aquatic plant is to be considered invasive. CDFW utilizes the U.S. Aquatic Weed Risk Assessment tool to assess the species' ecology, reproductive potential, dispersal mechanisms, competitive ability, resistance to management, and actual and potential impacts, including impacts to navigation and recreation, health and stability of fisheries, bird habitats, native plants, water quality, the economy, and human health, as specified in Harbors and Navigation Code (HNC) §64.5. To date, the Division has requested assessments of six aquatic plant species: *Potamogeton crispus*, *Myriophyllum spicatum*, *Ludwigia hexapetala*, *Ceratophyllum demersum*, *Cabomba caroliniana*, and *Hydrocotyle ranunculoides*. Each species was determined to be an invasive aquatic plant, per the invasive aquatic plant definition provided in HNC, and authorized for treatment within the Delta. Accuracy of the assessment tool, assessment questions, species scores, and overall findings will be presented.

Enhancing the wildlife value of farms in the Central Valley: a team effort. Matthew Danielczyk*, Reyn Akiona[2], Cindy Lashbrook[3], [1]Audubon California, Sacramento, CA, [2]USFWS, Los Banos, CA, [3]East Merced RCD, Merced, CA. mdanielczyk@audubon.org

We bring together farmers, government agencies, other NGOs, students, and other volunteers to establish woody vegetation on farms, simulating riparian forest to benefit migrating riparian songbirds and other wildlife. Most farms have a small percentage of unused or marginal land that could be put to use as wildlife habitat, which could partially ameliorate the effects of the decline of riparian habitat in California's Central Valley, including the impact on listed species. These restoration projects also provide opportunities to engage the community in conservation. We typically work with five to ten different organizations, which each lend a particular expertise to the overall effort. This cross-fertilization has led not only to successful restoration projects, but also to strategic collaboration beyond the scope of the projects.

Early detection and control of invasive plants following the Rim Fire. Steven Del Favero* David

Campbell. Yosemite National Park. Yosemite, CA. steven_delfavero@nps.gov

Wildfire is an integral ecosystem process, but can also facilitate the introduction and spread of invasive plants; fire creates disturbance and suppression operations can act as invasive plant vectors. In response, Yosemite resource managers implement targeted early detection and rapid control of invasive plants post-fire. Areas with the highest probability of invasive plant occurrence are targeted based on previously known infestations, fire management operations, and habitat suitability. We honed our methods over several years, working on fires smaller than 7,000 acres. After the 2013 Rim Fire burned 78,000 acres in the park, we had the opportunity to apply our strategy for three years, on a landscape level. This poster presents the results of our efforts in the Rim and other recent fires.

Scale of landscape conservation: finding common ground between management and the weeds. Kathleen Dickey* and Coty Sifuentes-Winter; Kathleen@sanmateoRCD.org

PARTNERSHIPS play a big role in successfully eradicating and containing invasive weeds. The partnership between Midpeninsula Regional Open Space District (MROSD) and the San Mateo County Resource Conservation District (RCD) has been key to the successful implementation of a treatment and containment plan for Slender False Brome, an invasive perennial Eurasian grass which threatens the redwood forest in San Mateo County (and which does not distinguish between public and private lands!)

The capacity and technical expertise of a large district such as MROSD, combined with the understanding of the local resident culture, the nimbleness and institutional knowledge of a small organization such as the RCD, together forge a partnership greater than the sum of its parts.

"Intervention ecology" such as weed management operates in an environment with many variables, including physical and biological changes, as well as personnel changes in staff and property owners. In this talk we describe our collaborative approach to meeting the challenges posed by a tenacious foe.

Seeding Functional Redundancy for Multiple Ecosystem Service Goals. D.J. Eastburn*, L.M. Roche, M.P. Doran, E.S. Gornish. djeastburn@ucdavis.edu

California annual rangelands are some of the most highly invaded systems in the world. The widespread invasion of these systems, by a multitude of invasive plant species, has led to significant losses in multiple economic and ecological benefits. In order to assess if rangeland seeding can enhance multiple ecosystem services in heavily invaded rangeland plant communities, we conducted an 11 year study to investigate long-term management outcomes of seeding of annuals, natives, and non-native perennial forage species, including (1) occurrence of three dominant invasive plants—Medusahead (*Taeniatherum caput-medusae*), jointed goatgrass (*Aegilops cylindrica*), and yellow starthistle (*Centaurea solstitialis*); and (2) response of species diversity and native richness. We used a randomized complete block design with four blocks and five seeding treatments per block. We found differences in the responses of multiple ecosystem service metrics across seeding treatments and controls. For example, exotic perennial and mixed exotic-native perennial seeding treatments provided more resistance to invasion of *C. solstitialis* than the annual, native perennial, or control groups. All seeding treatments were resistant to *T. caput-medusae* while, contrastingly, all treatments provided little resistance to *A. cylindrica*. We observed greater diversity in native and mixed seeding treatments relative to controls, and greater establishment of native species over the course of the study. The findings of this study will be beneficial to support land manager decision making and goal setting.

Prescribed fire in the vernal pool grasslands of Prairie City State Vehicular Recreation Area. Lora Elsom*, Max Heitner. California State Parks, Off-Highway Motor Vehicle Recreation Division. Sacramento, CA. Lora.elsom@parks.ca.gov

California State Parks manages 280 park units throughout California, ranging from State Historic Parks to State Beaches to State Recreation Areas. Twenty miles east of Sacramento, one will find Prairie City State Vehicular Recreation Area (SVRA), a park unit designed to balance off-highway vehicle (OHV) recreation with cultural and natural resource management.

Within the boundaries of Prairie City SVRA are almost 200 acres of vernal pool grasslands, a California prairie ecosystem that includes both upland grasslands and the seasonal wetland vernal pools, which are home to many native species of flora and fauna. Within this Vernal Pool Management Area, State Parks exclude OHV recreation and provide educational opportunities such as at the annual springtime annual Vernal Pool Tour led by State Park scientists and Interpreters.

In 2013, a prescribed burn was implemented on 176 acres of vernal pool grasslands. The burn was managed as a partnership between State Parks and California Department of Forestry and Fire Protection (Cal-Fire). The burn plan's main objective was the

reduction of reduce invasive grasses to increase native plant diversity, and restore the structural integrity restore the hydrologic cycle of the vernal pools.

Monitoring of the prescribed burn indicates some goals met and others not. Native species richness has not increased, however the dominance of invasive species has declined, and the sampled plots are indicating a more even distribution of plant species, both native and not native to the grasslands of California. These results are promising, and monitoring will continue at Prairie City SVRA to help determine a proper frequency for further prescribed burns or whether management should be shifted to another method for invasive species control in the vernal pool grasslands.

Uses of Southern California Black Walnut (*Juglans californica*) in landscaping and restoration. Eliza Hernández[1*], Erin Questad[1], Edward Bobich[1], and Kristin Bozak[1]. [1]Biological Sciences Department, California State Polytechnic University, Pomona. elizah@cpp.edu.

The economic effects of the prolonged drought in California extend to industries such as agriculture, water supply, and ornamental horticulture, with estimated economic losses up to $1.8 billion in 2015. Because water supplies are at record lows, water conservation has never been more important in California's recent history. Currently, most landscaping plants in Southern California require substantial irrigation. Hence, the use of arid-adapted plants in landscaping is essential for regional water conservation and is already a popular approach to reducing water needed for irrigation. The best candidates for low water-use landscapes are native plants that are adapted to Southern California's long-term changes in the rainfall regime. A rare native tree that shows promise for landscaping is the deciduous *Juglans californica* (Southern California black walnut). In addition to being drought-tolerant and deciduous, *J. californica* is allelopathic and produces a compound known as juglone that chemically inhibits other species. Determining which species can co-occur with *J. californica* and be used as companion plantings can increase the use of this drought-tolerant tree in landscaping and aid in its restoration. In order to determine companion plantings for *J. californica*, we established a field experiment by planting several native shrubs and a native bunchgrass underneath the canopy, along the dripline, and outside of the canopy of eight different *J. californica* trees at Cal Poly Pomona's Lyle Center for Regenerative Studies. Preliminary trends show that *Artemisia californica* and *Heteromeles arbutifolia* are least stressed by conditions underneath the canopy and along the dripline, respectively. *Eriogonum fasciculatum*, on the other hand, experiences stunted growth underneath the canopy and along the dripline of *J. Californica* trees. Our study will contribute greatly to the regional understanding of how to better use native California walnut trees in landscaping.

***Linaria dalmatica* project at Hungry Valley SVR.** Chris Hon, California State Parks, Christopher.Hon@parks.ca.gov

Dalmatian toadflax (*Linaria dalmatica*) was found in Hungry Valley SVRA in the spring of 2004. Since then, an ongoing war on this invasive species has been conducted every spring within the boundaries of Hungry Valley. Dalmatian toadflax has been contained in the North Grassland Management of the park. Originally, the infestation spanned approximately 1000 acres. An invasive management plan was put together to combat this exotic species in 2005 and we have been diligently working to eradicate this species. Eradication started off with ATV spraying and now can be done by spot spraying the area. The infestation has been greatly reduced in the park, but the same 1000 acres needs to be monitored due to the 15 year viability of seed in the ground.

In 2008, CDFA contacted the park in regard to a biological release and test plot in the park. With a permit from the EPA, a test plot of the *Mecinus janthinus* (MEJA) weevil in the park on toadflax began. This plot was originally started by CDFA, but has since been transferred over to USDA. The MEJA weevil is a stem boring weevil that will eventually reduce the toadflax to a non-flowering plant. The weevil was spreading throughout the toadflax infestation in the park and reductions in size of plants were being noted.

In May of 2013, the Grand Fire burned approximately 850 acres inside of Hungry Valley. It unfortunately burned over the MEJA release site, test plots, and weather collection equipment set in place for this study. In spring of 2014, USDA determined this pilot test was important and started fresh with new weevils and test plots in the park. USDA continues to monitor the progress of the MEJA weevil in Hungry Valley visiting twice a year to determine the progress of this study.

Controlling Algerian sea lavender and assessing marsh vulnerability. Drew Kerr[1*], Simon Gunner[1], Jeanne Hammond[1], Dana Morawitz[2], Doug Johnson[2], [1]San Francisco Estuary Invasive Spartina Project, [2]California Invasive Plant Council, Berkeley, CA. dwkerr@spartina.org

San Francisco Estuary tidal marshes serve many important functions, including providing habitat for endangered plants and animals. However, more than

85% of the Estuary's marshes have been lost to development, and the remaining marshes are often fragmented from one another and lack a significant high marsh component and upland transition zone. These anthropogenic impacts increase the vulnerability of these systems to further degradation by invasive species, and loss of marsh acreage from sea level rise.

Aside from the Invasive Spartina Project's cordgrass eradication, there has not been a coordinated regional program to address invasive plants in the Estuary's tidal marshes. Our two-year pilot project has two primary activities: (1) removing high-priority populations of invasive sea lavender and (2) assessing the vulnerability of the Estuary's tidal marshes to invasive plant damage.

Algerian sea lavender, *Limonium ramosissimum* (Poir.) Maire, as well as *Limonium duriusculum* (Girard) Fourr., are invasive plants spreading in tidal marshes of both northern and southern California. *Limonium* was identified as one of three "Highest Concern" invasive plants by Don Edwards National Wildlife Refuge and the South Bay Salt Ponds Restoration project. In summer 2016, *Limonium* was treated at 13 sites in Alameda, Marin, and San Mateo Counties using chemical and manual control methods, with follow-up treatment planned for 2017.

In a complementary effort, a team of local marsh ecologists utilized the USFWS Invasive Plant Inventory and Early Detection Tool (IPIEDT) to assess vulnerability of 40 large marshes based on current invasive plant presence, ecological integrity, and vectors of dispersal. Rankings were used to prioritize weed mapping at ten sites, two having been completed in September 2016, that will test and refine our IPIEDT criteria, while providing a baseline evaluation and template for future assessments. Our results benefit Estuary management through systematic prioritization, allowing for regional coordination of invasive plant treatment to maximize benefits to high-value tidal marshes.

Caltrans protecting the travelers from invasive weeds. Conrad L. Kiernan, Landscape Specialist District 07. South and West Regions. CalTrans. Office (213) 897-2583 Cell (213) 304-6994. Conrad.kiernan@dot.ca.gov, newton.wong@dot.ca.gov

Caltrans is responsible for controlling noxious weed all over California's freeways. We manage weeds to reduce the occurrence wild fires, sight clearance, infrastructure integrity, and wildlife habitat. We partner with the US Forest Service, Cal Fire, County Ag, and local communities. We are striving to reduce herbicide application to achieve an 80% reduction of active ingredient from our 1998 levels with our innovative team of engineers, biologist, arborist, and landscape workers.

Development of a regional aquatic weeds project (DRAAWP). Guy Kyser[1]*, John Madsen[2], and Patrick Moran[2]. [1]Department of Plant Sciences, University of California, Davis; [2]USDA-ARS Western Regional Research Center. gbkyser@ucdavis.edu

The Delta Region Areawide Aquatic Weed Project (DRAAWP) is a collaboration of agencies, academic researchers, and stakeholders organized to address the problem of invasive aquatic plants in the Sacramento-San Joaquin Delta. The Delta hosts many unique ecosystems and forms the hub of California's water supply. The invasion of aquatic weeds threatens Delta ecosystems, impedes restoration efforts, and is economically and sociologically detrimental. This project is funded by USDA-ARS and includes components such as weed mapping, aquatic weed management techniques, biological control agents, effects of weeds on Delta ecosystems, and impacts of weeds on mosquito populations. In addition to basic and applied research projects, outcomes from DRAAWP will include an informational website, stakeholder meetings, and other outreach products.

The indirect effects of invasive grasses on native forb persistence. Marina L. LaForgia*[1], Susan P. Harrison[2], and Andrew M. Latimer[1]. [1]Department of Plant Sciences, University of California, [2]Department of Environmental Science and Policy, University of California, Davis. marina.laforgia@gmail.com

In California annual grasslands, water is the primary limiting resource, with a significant amount of work showing strong correlations between grassland composition and productivity with variability in precipitation. Whether these responses are mediated by interactions with other species however remains to be understood. Some evidence supports a strong role for indirect effects of climate mediated by invasive grass competition (Levine and Rees 2004, Suttle et al. 2007), but other evidence supports a greater role for the direct effects of climate (Levine et al. 2010, Harrison et al. 2015). By looking more closely at the forb population response across life history strategies, these seemingly disparate results can be better understood. This study uses a manipulative field experiment that alters rainfall and exotic grass presence to understand how population growth rates of native annual forbs with contrasting life-history strategies respond to climate extremes both directly and indirectly via competition. We hypothesize that a forb population's response to climate variability will vary by life history strategy. Specifically, the direct effects of climate will be more important for stress

avoiding forbs, which typically have a persistent seed bank, low yearly germination, and high relative growth rates, while the indirect effects of climate through competition with grasses will play a larger role in stress tolerant forbs, which have less persistent seed banks and lower relative growth rates. By linking life history strategies with important environmental variables we can better understand how species groups will respond to increased climate variability and create better management strategies for dealing with both climate change and invasive annual grasses. Data on the first year of this study is just now being completed and preliminary results will be shared.

New challenges in the eradication strategy on Russian wheatgrass (*Elymus farctus*) populations found in the Guadalupe-Nipomo Dunes, San Luis Obispo County. Nancy La Grille, California State Parks and Recreation, Oceano, CA, Mark Skinner, Coastal San Luis Resource Conservation District, Morro Bay, CA. Nancy.Lagrille@parks.ca.gov

California State Parks and Recreation (CDPR) first documented the presence of Russian wheatgrass (*Elymus farctus*) in the Guadalupe-Nipomo Dunes in 1997. In 2010, an eradication strategy was initiated based on the herbicide application formula for European beachgrass (*Ammophila arenaria*). The current herbicide mix consists of glyphosate (2%) and Imazapyr (1%). Several treatments are required to be fully effective; followed with maintenance spot treatment in the treated areas.

New challenges for Oceano Dunes State Vehicular Recreation Area include: permitting and monitoring under the SWRCB requirements for aquatic application; restoration of rapidly eroding foredunes with resource constraints; and discovery how new populations are becoming established outside the treatment areas.

Effects of juglone on the germination of Southern California native and invasive plant species. Sierra Lauman*, Kevin Chung, Daisy Hernandez, Dr. Kristin Bozak, Dr. Edward Bobich, Dr. Erin J. Questad. Biological Sciences Department, California State Polytechnic University, Pomona, 3801 West Temple Ave, Pomona, CA 91768, stlauman@cpp.edu

The Southern California black walnut, *Juglans californica*, is an endemic, native deciduous tree that commonly occurs in chaparral, coastal sage scrub, riparian communities, and woodlands throughout San Bernardino and Los Angeles County. Other species in the genus *Juglans* produce the compound juglone (5 hydroxy-1,4-napthoquinone), which has been shown to inhibit the growth of understory plant species due to an allelopathic effect; however the effects of juglone have not been explored in California plant communities. We examined how juglone affects the germination of several invasive and native species including: *Bromus diandrus, Hirschfeldia incana, Deinandra fasciculata,* and *Artemisia californica.* Seeds were sown in groups of 100 in petri dishes. They were exposed to 4mL of five concentrations of juglone: 0mM, 0.01mM, 0.05mM, 0.1mM, and 0.5mM, with four replicates per concentration. Germination was monitored daily and average radicle length was measured weekly. Preliminary results show a decline in germination for the invasive species *B. diandrus* and *H. incana* as well as the native *A.californica* between juglone concentrations of 0.01mM and 0.05mM. Preliminary results also show an increase in germination for the native species *D. fasciculata* when exposed to juglone concentrations up to 0.1mM. Future invasive species to be tested include *Silybum marianum, Carduus pycnocephalus, Cirsium vulgare, Bromus madritensis,* and *Salsola tragus.* Future native species include *Heteromeles arbutifolia, Diplacus longiflorus, Amsinckia menziesii,* and various other commonly occurring herbaceous and woody species.

Response of invasive Tamarisk to chemical controls in a southern California desert.
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Tamarisk (*Tamarix* spp.) is a non-native species of tree or large shrub that is considered extremely invasive and found in increasing numbers throughout the arid southwest. The California State Park, Ocotillo Wells State Vehicular Recreation Area (OWSVRA), located in east San Diego and Imperial counties, has high densities of tamarisk within several of its eastern washes. Through a cooperative effort with the Department of Parks and Recreation's Southern Service Center, OWSVRA was engaged in a 3-year Capital Outlay contract to manage and eradicate tamarisk.

In 2011, a private contractor was awarded a contract to begin treatment of tamarisk infestation areas. Methods for removing tamarisk included the use of various broadcast foliar herbicides, in conjunction with some physical/mechanical (cut-stump) removal. The OWSVRA's Geographic Information System (GIS) department created a database that allows staff to document tamarisk locations, prioritize infestations for treatment, and track tamarisk response to herbicide applications. Tamarisk infestations were treated and monitored every year for 3 years.

The project area consists of approximately 2,813 acres in which 630 locations were identified as having tamarisk present. Following the first year's application,

93% of areas treated with Imazapyr showed a favorable response. As of 2013, all known occurrences had been treated with the outlined eradication methods.

After the conclusion of the contract, since 2013, no chemical treatment has been re-applied to the major remaining tamarisk stands, and mechanical/physical removal of new growth/saplings has been the major treatment method. Crews continue to survey for tamarisk in previous and new locations to determine the effectiveness of treatment methods, look for regrowth and update the status of infection areas.

While the physical/mechanical methods proved to be most effective at deterring local long term regrowth of target stands, both methods have been successful. The remaining invaded area has been reduced down to ~200-250 acres of infested riparian corridor and many of the surviving target plants have mutated or hybridized after the last foliar herbicide application in 2013.

Current projected goals plan to move back to aggressive physical removal of the remaining invasive stands and controlling new growth with foliar broadcast herbicide. Crews will continue to monitor for tamarisk growth and help determine effectiveness of herbicide use on mutated/hybridized species.

Effects of nitrogen and phosphorus on the growth and reproduction of *Pennisetum setaceum*, African fountain grass. Glen Morrison* and Erin Questad, PhD. California State Polytechnic University, Pomona.

Pennisetum setacuem (Forssk.) Chiov., commonly known as African fountain grass, is a perennial C4 bunch grass native to Africa. The species is widely naturalized outside of its native range and is invasive in Hawaii, South Africa and the American Southwest. This project tests whether nitrogen or phosphorus is more limiting to its growth and reproduction. A nutrient addition greenhouse experiment was devised, wherein forty fountain grass individuals were assigned to one of four groups: added phosphorus, added nitrogen, added phosphorus and nitrogen, and a control group. Fertilization treatments began in March of 2016 and will continue into June 2016. Measures of growth and chlorophyll fluorescence were taken and flowering was continually monitored as a measure of reproductive health. Adding nitrogen, but not phosphorus, increased plant growth, chlorophyll fluorescence, and flowering. These findings suggest that soil phosphorus availability does not have a strong effect on the vegetative health or flowering of fountain grass, though soil nitrogen availability does.

Do invasive grasses employ different water use and rooting strategies than a native chaparral shrub? Michala Phillips and Edith Allen. University of California at Riverside, Botany and Plant Sciences Department, Riverside CA. Michala.phillips@gmail.com

Global change contributes to shifts in vegetation composition and one important example is terrestrial plant invasion by exotic species. Invasion often leads to vegetation community type conversion, such as conversion from native shrubland to invasive grassland. Chaparral was previously thought to be resilient to disturbance, yet has recently undergone invasion in some areas. Invasive species often have life history traits with flexible resource acquisition strategies. Invasive annual grasses are drought escapers that may have short-lifespan, fine roots for rapid nutrient and water uptake. Alternatively, drought tolerant shrubs may possess long-lived relatively less efficient fine roots. Flexible responses to precipitation could make invasive species stronger competitors in a changing climate when compared to natives. I hypothesized that an invasive grass (*Ehrharta calycina*) would produce fine roots and mycorrhizal hyphae more rapidly, resulting in a greater depletion of soil moisture relative to a native chaparral shrub (*Adenostoma fasciculatum*). I tested this hypothesis using paired plots equipped with integrated sensor arrays to track soil moisture, shrub transpiration and weekly belowground imagery using a manual minirhizotron. These plots were monitored from December 2015 until May 2016. Preliminary data indicate a lag in the upregulation of transpiration of *A. fasciculatum* behind early season peaks in soil moisture. Preliminary soil moisture data do not show strong trends for differences in surface soil moisture between vegetation types while soil is moist, but patterns in moisture depletion by shrubs and grasses may change as soil dries. Root and hyphal imagery is currently being processed and preliminary analyses suggest that *E. calycina* is producing more fine roots and hyphae than *A. fasciculatum*. This research will provide information to land managers about ecosystem impacts of type conversion and possible barriers to restoration, as well as advise on the extent of grass removal required for shrub survival and establishment.

Using native woody shrubs as nurse plants for seedling establishment in Coastal Sage Scrub. Lauren H. Quon*[1] Dr. Erin J. Questad[1], [1] Biological Sciences Department, Cal Poly Pomona, *Lhquon@cpp.edu

The use of nurse plants is a common revegetation approach used to improve the survival, growth, or fitness of a neighboring plant species by sharing limited resources such as water and nutrients.

However, there is little information suggesting that dead shrubs may also provide similar services as live shrubs. Another benefit of nurse plants that is little studied is their ability to protect seedlings from herbivory pressure. We explored the effect of nurse plants on seedling survival by determining whether survival depends on abiotic factors (microclimatic conditions), or on biotic factors (protection from herbivory). The experiment, located on the Cal Poly Pomona Voorhis Ecological Reserve, included five blocks with three different nurse levels (live *Artemisia californica* shrub, dead *A. californica* shrub, and exposed areas), and within each nurse level, a cage treatment (+/- cage), to test for herbivory. Wildlife cameras were installed in every block to monitor herbivore activity. Seedlings of *A. californica* and *Salvia mellifera* were planted in each plot in January 2016. Results during the first growing season indicated that there is no significant effect of nurse shrub type or cage treatment on plant growth in either species; however, there was a significant effect of date on *A. californica* chlorophyll fluorescence ($p=0.00758$). There were observed differences in abiotic conditions of each nurse level; exposed areas had higher solar radiation, higher soil temperatures, and lower soil moisture compared to areas under live or dead shrubs. We will continue to monitor seedlings and expect to see greater differences among treatments during the summer, when abiotic stress and herbivory rates are high.

Controlling Harding grass (*Phalaris aquatica*) in a grassland setting – the final report. Samuels, Stassia[1] and Laura S. Julian[2]*. Redwood National and State Parks, P.O. Box 7, Orick, CA 95555. [1]stassia_samuels@nps.gov; [2]Laura_Julian@nps.gov

This is the third and final installment of our report on controlling Harding grass (*Phalaris aquatic*) in the Bald Hills grasslands of Redwood National Park.

Harding grass was introduced in the Bald Hills grasslands during the sheep ranching era in the early 20th century. In the early 2000's Vegetation Management staff recognized that it was spreading beyond the stock pond outflow where it was first detected and in 2005 we initiated a three-phase control program using a glyphosate-based herbicide.

After 11 years of control, in 2016 we have seen a dramatic reduction in cover and distribution of this species and hope to consider the project in a "maintenance" stage after the 2016 treatments. This poster will discuss our monitoring results, as well as techniques and challenges in controlling Harding grass.

Light tools for removing jubata grass. Mark Skinner, Restoration Specialist II, Coastal San Luis Resource Conservation District.

I will demonstrate in this poster how to remove Jubata grass with a lopper and a curved tree saw. One of the best ways to manually remove small groups or individual Jubata grasses is to use loppers and trash bags for the seed heads and a curved tree saw to cut the plant out belowground. In a photographic display I'll show how:

1. Flowers are removed and bagged,
2. To push the leaves away in order to have access to the base of the plant,
3. To plunge the saw into the ground at the base of the plant and cut the roots around the edge of the base,
4. To lift the severed plant from the ground and leave in place for decomposition.

The advantage of this method is the ease with which you can remove Jubata grass with light tools. It is useful in loose sandy or silty soils. This technique will not work in hard clay or rocky soils. This technique is a good way to dispatch small population where there are only one or two people available to work on weed removal.

Investigating anthropogenic stressors and the relationship with *Schismus barbatus* for the threatened Little San Bernardino Mountains Linanthus. Lynn C. Sweet*, James G. Heintz, Cameron Barrows. Center for Conservation Biology, University of California, Riverside, CA. Lynn.sweet@ucr.ed

Little San Bernardino Mountains Linanthus (*Linanthus maculatus*) is a minute annual herb endemic to the western edge of the southern California deserts, threatened by multiple pressures including invasive species, climate change, urban development and OHV recreation. Over the last few decades the habitat preferences of *Linanthus* have become better understood and researchers have noted an increase in *Schismus barbatus* density in the areas containing endemic *Linanthus* populations. Within its restricted distribution in Sonoran and Mojave Desert scrub and Joshua tree woodland communities, it grows in loose, well-aerated sand flats on low sandy benches at the margins of washes, dry canyons and alluvial fans. This study sought to quantify the degree to which *Linanthus* populations may be negatively impacted by *Schismus* and other stressors. First, historic areas of *Linanthus* occurrence were mapped, and a species distribution model was created to predict suitable habitat in the region, and maps of known stressors were overlain. Large areas of the mapped suitable range coincided with increased atmospheric nitrogen

deposition (NO_x), *Schismus* presence and off-highway vehicle operation. Subsequently, a plot study was performed within predicted suitable habitat in which transects were run through patches of *Linanthus* of varying density (high- vs. low-density), but of similar habitat (e.g., slope, aspect, associated species, soil characteristics, hydrology characteristics). Areas supporting *Linanthus* were characterized by lower cover of *Schismus*, indicating possible interference between the species in areas dominated by *Schismus*. Surprisingly, a few areas supporting higher *Linanthus* density were correlated concave microtopography caused by OHV tracks. Further investigation will be necessary to determine whether *Schismus* may be impacting *Linanthus* via resource competition or alteration of micro-hydrologic regimes, and under what circumstances OHV use may promote or negatively impact *Linanthus*.

A test of reduced rates of glyphosate for the control of invasive plants. Don Thomas. San Francisco Public Utilities Commission. Burlingame, CA. dethomas@sfwater.org

After the World Health Organization International Agency for Research on Cancer (IARC) determined that the herbicide glyphosate is a probable carcinogen, many public agencies have either restricted or suspended its use. The City of San Francisco, for example, has limited its use within the city limits to critical applications, such as protection of sensitive species and habitats, where alternatives are not available. Furthermore, the City has requested that its departments develop a plan to reduce or eliminate the use of this herbicide in the future.

Several studies have indicated that with cut-stump applications the rate of application of glyphosate can be reduced without losing efficacy. This study is a test of the efficacy of reduced rates of glyphosate for the control of three non-native invasive plants: blue gum eucalyptus (*Eucalyptus globulus*), jubatagrass (*Cortaderia jubata*) and French broom (*Genista monspessulana*). Reduced rates of glyphosate were also tested for the management of coyote brush (*Baccharis pilularis*), a native plant that invades serpentine grassland. It was found that 5%, 10% and 20% of glyphosate product (Aquamaster), equivalent to 2.7%, 5.4% and 10.8% active ingredient, were all as effective as the conventional rate of 50% product or 26.9% active ingredient. The results of this study suggest that it may be possible to substantially reduce the amount of glyphosate applied and the associated worker exposure risks without entirely losing the use of this valuable tool for the management of invasive plants.

Square pupils: Goats as alternative fuel and weed reduction workers
Williams, Andrea* and Matt Sagues, Marin Municipal Water District, Corte Madera, CA. awilliams@marinwater.org

The Marin Municipal Water District (MMWD) maintains over 400 acres of linear fuelbreak, an additional 400-plus acres of wide area fuel reduction zones, and several hundred acres of broom species (primarily French broom, but also Scotch and Spanish broom) removal—almost entirely through mechanical means. Faced with such Sisyphisean toil, the district often experiments with alternative weed control methods. In 2014 and 2015, MMWD partnered with Marin County Parks and Open Space to test goat grazing as a fuels and weed reduction method. Costs included pen and water setup, daily guard dog feeding, and post-grazing fence removal. Monitoring showed an initial reduction in brush cover followed by recovery of target species, and less than 10% mortality of broom. Goat grazing results will be compared to humans brushcutting and hand-pulling in terms of cost and effectiveness in reaching targets.