Welcome to the 2017 Cal-IPC Symposium!

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, and see their profiles and contact information in this program.

Raffle and Auction: Join us for a social hour after sessions end on Wednesday and check out all the donated items for our annual raffle and silent auction fundraiser. Tickets are available at the Sales table during the day and at the social hour itself. Raffle prizes will be distributed after the awards banquet Wednesday evening.

Awards Banquet: Join us Wednesday evening to honor some of our community's heroes!

Career Panel Lunch: The Cal-IPC Student Section invites all students (and others thinking about careers) to join them for lunch Thursday as an opportunity to talk to invasive plant professionals. Lunch provided for students.

Meals: Continental breakfast is provided Wednesday and Thursday. Lunch and dinner are provided Wednesday only. (If your meal type is other than omnivore, you will be provided with a card to identify your meal type to servers for Wednesday dinner.) Thursday lunch is on your own – hit one of the joints at the Riviera or cross the street for Rick's Desert Grill, Rick's Bakery Café, or JJ's Mexican Restaurant. On Friday, box lunches are provided for the full-day field trip.

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

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

Sales: Come check out books, digital resources, boot brushes and Cal-IPC gear!

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 #CALIPC2017.

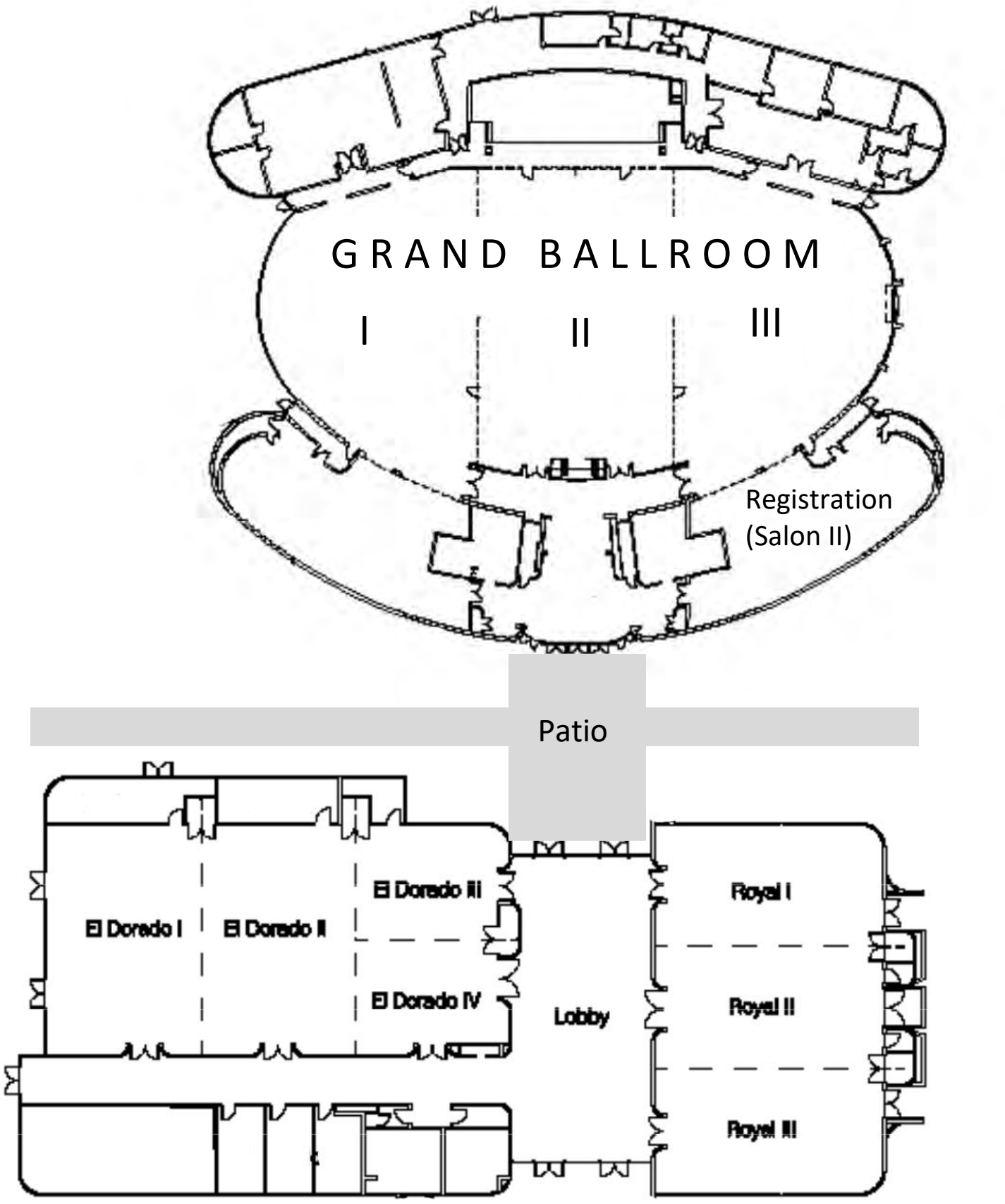
Presentations Online: PowerPoint slides and posters will be posted on the Cal-IPC website.

Continuing Education Credits: California Dept. of Pesticide Regulation CEUs are available for each part of the Symposium (see below). Check in and out 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.

Tuesday (Oct. 24)		
Training: Invasive Plant Management 101	M-1002-17	3.0 Other
Session: DPR Laws and Regulations	M-1004-17	2.0 Laws
Wednesday (Oct. 25)	M-1005-17	4.0 Other
Thursday (Oct. 26)	M-1006-17	2.5 Other

Video/Photo Release: We take photos and video at the Symposium, and by your participation we reserve the right to use these (for instance, in our promotions for the Symposium). The full legal statement can be found at the end of this program.

Around Town: Take the free Buzz shuttle to VillageFest Thursday 6:00-10:00 pm in the heart of Palm Springs!


GRAND BALLROOM
I
II
III
Registration
(Salon II)
Patio
El Dorado I
El Dorado II
El Dorado III
El Dorado IV
Lobby
Royal I
Royal II
Royal III

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.

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.

B&J Trading, LLC
PO Box 3356
Central Point, OR
Contact: Benjamin Lambrechtsen at 541-878-5074 or bjtrading@embarqmail.com

Our Intelli-Spray premium quality remote-controlled retractable hose-reel systems are used throughout the world. Intelli-Spray spraying systems have been developed and built to suit customer's individual requirements. This includes different sizes and capacities of pumps, motors and tanks.

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 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: David Kratville at 916-654-0768 or david.kratville@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 Department of Water Resources
Sacramento, CA
www.water.ca.gov/
Contact: Gina Darin at 916-376-9825 or gina.darin@water.ca.gov

The Department of Water Resources (DWR) is responsible for managing and protecting California's water resources. DWR works with other agencies to benefit the State's people and to protect, restore and enhance the natural and human environments.

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
(Los Angeles/Santa Monica Mountains, Orange County, Riverside-San Bernardino, San Diego, and Yerba Buena 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.

California Wildlife Conservation Board
Sacramento, CA
wcb.ca.gov
Contact: Don Crocker at 916-651-7866 or don.crocker@wildlife.ca.gov

The Wildlife Conservation Board protects, restores and enhances California's spectacular natural resources for wildlife and for the public's use and enjoyment in partnership with conservation groups, government agencies and the people of California.

Channel Islands Restoration
Santa Barbara, CA
cirweb.org
Contact: Tanner Yould at 805-448-6203 or tanner@cirweb.org

Channel Islands Restoration is a 501(c)(3) non-profit organization specializing in invasive plant removal, native plant propagation and installation, erosion control, botanical surveys and environmental education throughout the Central Coast and the Channel Islands. We have worked on 91 restoration projects throughout the region for the U.S. Navy, National Park Service, and for many private groups, companies and local government agencies.

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.

Exotic and Invasive Weeds Research Unit, USDA Agricultural Research Service
Albany, CA
www.ars.usda.gov/pacific-west-area/albany-ca/wrrc/eiw/

Contact: Paul D. Pratt at 510-559-6127 or paul.pratt@ars.usda.gov

The mission of the Exotic and Invasive Weeds Research Unit is to develop and transfer integrated, biologically based approaches for the management of invasive species and improvement of pollinator health.

Habitat West, Inc.
Escondido, CA
www.habitatwest.com
Contact: Gigi Hurst at 760-735-9378 or habitatgal@habitatwest.com

Habitat West was founded by Gigi Hurst in 1993 with the specific agenda of providing the highest quality native habitat restoration and management services. Habitat West¿s project team has a reputation and track record of providing quality native habitat restoration and management services and getting projects signed off. Our expertise in implementation of quality habitats and our long term maintenance strategies give native vegetation the optimum opportunity to flourish over non-native species.

Hedgerow Farms
Winters, CA
www.hedgerowfarms.com
Contact: Patrick Reynolds at 530-662-6847 or preynolds@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
Corte Madera, 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.

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.

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 Barbara Botanic Garden
Santa Barbara, CA
www.sbbg.org
Contact: Flannery Hill at 805-682-4726 x132 or
fhill@sbbg.org

The Santa Barbara Botanic Garden fosters the conservation of California's native plants through our gardens, research, and education, and serves as a role model of sustainable practices.

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.

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 conservation service, youth leadership, and career development in conservation. Founded 60 years ago, SCA has engaged well over 80,000 youth and young adults in service to nature.

Westervelt Ecological Services
Sacramento, CA
wesmitigation.com
Contact: Matt Gause at 916-646-3644 or
mgause@westervelt.com

Westervelt Ecological Services (WES) creates mitigation banks and provides environmental mitigation and habitat planning services to landowners, businesses, government agencies, and land trusts. Our established industry leaders excel in the field of wetland and endangered species mitigation services, to create a nationwide habitat mitigation company.

2017 CAL-IPC SYMPOSIUM

Working Across Boundaries

PROGRAM

Tuesday, October 24

1:00 pm – 5:00 pm **Training 1: Invasive Plant Management 101** (Room: *Royal I*)

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.

1:00 – 5:00 pm **Training 2: Calflora Weed Manager** (Room: *Royal II*)

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

Room *Grand Ballroom III*. Chair: *Joel Trumbo, California Dept. of Fish & Wildlife*

6:00 Is glyphosate a human carcinogen? *Joel Trumbo, Cal. Dept. of Fish & Wildlife*

6:30 Protecting surface water from pesticide contamination in California. *Kean Goh, Dept. of Pesticide Regulation, Environmental Monitoring*

7:00 Respiratory protection requirements for herbicides. *Emma Wilson, Dept. of Pesticide Regulation*

7:30 What to expect from your pesticide inspection. *Robert Mulherin, Deputy Agricultural Commissioner, Riverside County Agricultural Commissioner's Office*

7:00 – 9:00 pm **Student Mixer**

The Landing

Wednesday, October 25

7:00 am Registration and Continental Breakfast

8:00 – 9:40 am **Session 1. Invasive Plant Management in the California Desert**

Room: *Grand Ballroom*. Chair: *Heather Schneider, Rare Plant Biologist, Santa Barbara Botanic Garden*

8:00 Invasive plant management programs update. *Doug Johnson, Executive Director, Cal-IPC*

8:20 California desert invaders: Threats and opportunities to conserve a vast ecosystem. *Naomi Fraga, Director of Conservation Programs, Rancho Santa Ana Botanic Garden*

8:40 Not all weeds are equal: Effects of weeds on desert biodiversity. *Cameron Barrows, Research Ecologist, UC Riverside Center for Conservation Biology*

9:00 Managing invasive plants at Joshua Tree National Park. *Neil Frakes, Biologist, Joshua Tree National Park*

9:20-9:40 am Break

9:40 – 10:40 am Session 2. Biological Control

Room: *Grand Ballroom II*
Chairs: *Ellyn Bitume and Scott Portman, USDA-ARS*

9:40 New biocontrol releases and integrated control targeting *Arundo* and Cape-ivy in riparian areas. *Ellyn Bitume and Scott Portman, USDA-Agricultural Research Service*

10:00 Past, present, and future: Saltcedar (*Tamarix* spp.) and biological control in California. *Nicole Norelli, Riparian Invasion Research Lab, UCSB*

10:20 Weed biological control in California: Review of the past and prospects for the future. *Michael J. Pitcairn, Cal. Dept. of Food and Agriculture*

9:40 – 10:40 am Session 3. Tools & Techniques

Room: *Grand Ballroom III*
Chair: *Mark Newhouser, Sonoma Ecology Center*

9:40 The hoe isn't the only thing scuffling: Testing non-chemical control techniques for *Brachypodium distachyon* in serpentine and non-serpentine grasslands. *Andrea Williams, Marin Municipal Water District*

10:00 Aerial lifts and *Arundo donax* control in the Sacramento-San Joaquin Delta. *Mark Newhouser, Sonoma Ecology Center*

10:20 Completing the knowledge cycle: Deriving IPM knowledge directly from practitioners on working landscapes. *Tracy Schohr, UC Davis*

10:40-11:00 am Break

11:00 am – 12:00 pm Session 4. Biology

Room: *Grand Ballroom II*
Chair: *Amanda Swanson, UC Riverside*

11:00 am – 12:00 pm Session 5. Federal Programs

Room: *Grand Ballroom III*
Chair: *Bobbi Simpson, National Park Service*

11:00 Native and invasive in the same region: Determining the above and belowground impacts of invasion for Monterey pines in California. *Briana Boaz, UC Berkeley (student contest)*

11:20 Restoration of invaded walnut woodlands using a trait-based community assembly approach *Sierra Lauman, Cal Poly Pomona*

11:40 Changes to plant functional traits and seed production in response to drought in native and invasive annuals of California. *Justin Valliere, UCLA*

11:00 Planning constraints to IPM adoption by National Forests in California. *Philip Brownsey, Consulting Rangeland Ecologist*

11:20 BLM's Mojave Desert native plant restoration following wildfires and weed treatments: The right seed in the right place. *Judy Perkins, Bureau of Land Management*

11:40 Effectiveness of non-native plant treatments across the U.S. National Park system: A synthesis. *Scott Abella, University of Nevada, Las Vegas*

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

1:40 – 2:40 pm Session 6. Soils

Room: *Grand Ballroom II*
Chair: *Amanda Swanson, UC Riverside*

1:40 Mycorrhizae, invasions, and the temporal dynamics of mutualism disruption. *Sara Grove, UC Santa Cruz*

2:00 Restoring soil microbial conditions after grass invasion for improved restoration. *Brooke Pickett, UC Riverside (student contest)*

2:20 Argentine ants may be significantly contributing to the spread of numerous invasive weeds. *Greg Rubin, California's Own Native Landscape Design*

1:40 – 2:40 pm Session 7. *Volutaria*: Attempt at Early Eradication

Room: *Grand Ballroom III*
Chair: *Chris McDonald, UC Cooperative Extension*

1:40 Overcoming challenges: Managing the highly invasive *Volutaria* across California. *Chris McDonald, UC Cooperative Extension*

2:00 Management of *Volutaria tubuliflora* at Anza-Borrego Desert State Park – A community effort. *Mason Hyland, California State Parks*

2:20 *Volutaria* detection and management at Upper Newport Bay, Orange County. *Ron Vanderhoff, California Native Plant Society, Orange County Chapter*

2:40 – 3:00 pm Break

3:00 – 4:00 pm Session 8. SF Bay/Delta

Room: *Grand Ballroom II*
Chair: *Drew Kerr, Invasive Spartina Project*

3:00 Mapping, prioritization, and eradication of *Arundo donax* in the Sacramento-San Joaquin Delta. *Alex Young, Sonoma Ecology Center*

3:20 Assessing spatio-temporal changes of invasive *Limonium ramosissimum* in San Francisco Bay wetlands. *Kerstin Kalchmayr, CSU San Francisco (student contest)*

3:00 – 4:00 pm Session 9. Grasslands

Room: *Grand Ballroom III*
Chair: *Andrea Williams, Marin Municipal Water District (Session organized by the California Native Grasslands Association)*

3:00 Weed management and habitat restoration in Southern California grassland and forbland. *Travis Brooks, Land IQ*

3:20 Barb goatgrass management: Interactive effects of grazing, glyphosate rate, application timing,

3:40 Controlling Algerian sea lavender in San Francisco Estuary tidal marshes. *Drew Kerr, Invasive Spartina Project*

and restoration seeding. *Travis Bean, UC Riverside*

3:40 Grassland restoration and invasive weed management in Southern California: Medusahead as a case study. *Chris McDonald, UC Cooperative Extension*

4:00 – 5:00 pm Session 10. Poster Session & Sponsor Exhibits

(see list of posters on page 14)

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

6:30 – 8:30 pm Awards Banquet

9:00 – 10:30 pm Campfire Circle with Ken Layne of Desert Oracle

Thursday, October 26

7:00 am Registration

8:00-9:00 am. Session 11. Engaging Diverse Communities in Invasive Plant Management

Room: *Grand Ballroom*

Chair: *Antonio Solorio, Santa Monica Mountains National Recreation Area*

Panelists: *Ammy Baez, Bio-Science Tech & Youth Program, Santa Monica Mountains Nat'l Recreation Area*

Fernando Villalba, Park Biologist & Youth Program, John Muir National Historic Site

Gaby Jimenez, Case & Transition Program Manager, Los Angeles Conservation Corps

9:00 – 9:20 am Break

9:20 – 10:20 am Session 12. Coastal

Room: *Grand Ballroom II*
Chair: *Doug Gibson, San Elijo Lagoon Conservancy*

9:20 – 10:20 am Session 13. Desert

Room: *Grand Ballroom III*
Chair: *Cameron Barrows, UC Riverside*

9:20 Native riparian revegetation success in controlled tamarisk and non-tamarisk sites in

9:20 Invasive plant management on the Farallon Islands National Wildlife Refuge. *Jonathan Shore, U.S. Fish and Wildlife Service*

9:40 Modeling the control of invasive fennel (*Foeniculum vulgare*) on San Clemente Island. *Emma Havstad, CSU San Diego*

10:00 Carlsbad Hydrologic Unit Invasive Plant Species Control Program. *Barry Lindgren, San Elijo Lagoon Conservancy*

the Mojave River watershed, California. *Kenneth Lair, Lair Restoration Consulting*

9:40 Effects of renewable energy development on demography of *Brassica tournefortii*. *Karen Tanner, UC Santa Cruz (student contest)*

10:00 The good with the bad: When ecological restoration facilitates non-native plants. *Scott Abella, Univ. of Nevada, Las Vegas*

10:20 – 10:40 am Break

10:40-11:40 am. Session 14: Discussion Groups

1. **Tools & Techniques: Ask the Invasive Plant Management Experts** – Whether you're curious about ways to control a particular plant, need to know how to plan for an unusual situation, or need guidance on strategy, come learn from your peers and get your specific control questions answered by our expert panel of seasoned land managers. *(*Room: *El Dorado II)*
2. **Aquatic and Estuarine Weeds** –Water is precious in California, and not only to humans. Water supports wildlife, and aquatic and estuarine environments are especially rich habitats. Come discuss the latest invasive plant management efforts in the Delta, Lake Tahoe, San Francisco Bay and elsewhere. *Led by Drew Kerr, Invasive Spartina Project, Gina Darin, Cal. Dept. of Water Resources, and David Kratville, Cal. Dept. of Food & Agriculture (*Room: *Royal I)*
3. **UAVs and Helicopters** – Come discuss what land managers need to know about incorporating these flying tools into their management programs. *Led by Julia Parish, Catalina Island Conservancy and Morgan Ball, Wildlands Conservation Science. (*Room: *Royal II)*
4. **Communications Strategies** – Whether communicating with volunteers, decision makers, the media or the public, we need to ensure that our message is as effective as possible. Studies find some counterintuitive things about how people understand issues. We'll talk about communication planning for invasive plant management programs, including hot-button issues like use of herbicides and tree removal. *Led by Doug Johnson, Cal-IPC and Rachel Kesel, OneTam. (*Room: *El Dorado II/IV)*
5. **Non-Chemical Approaches to Invasive Plant Management** – Much of invasive plant management is done without the use of herbicides, but there are few comprehensive guides to best practices for using the wide range of non-chemical approaches. Managers need to know which techniques work—and don't work—in which situations, and so do decision makers who face public scrutiny. Come hear about the current effort to compile best practices for non-chemical approaches and share your expertise and perspectives. *Led by Andrea Williams, Marin Municipal Water District, and Cheryl Wilen, University of California Cooperative Extension. (*Room: *Royal III)*

11:40 am – 1:00 pm Lunch (on your own)

Career Panel Lunch, organized by the Cal-IPC Student Section (Room: *Royal I*)

1:00-2:00 pm Session 15. Collaboration

Room: *Grand Ballroom II*
Chair: *Rachel Kesel, OneTam*

1:00 Building partnerships: Tribes and invasive plant management for habitat restoration. *Kurt Broz, Pala Band of Mission Indians*

1:20 Erasing imaginary lines: Working collaboratively across state and national park lines to combat invasive plants. *Tom Reyes, National Park Service- Golden Gate National Recreation Area*

1:40 Early detection of invasive plants across boundaries. *Rachel Kesel, OneTam*

1:00-2:00 pm Session 16. Botanic Gardens

Room: *Grand Ballroom III*
Chair: *Heather Schneider, Santa Barbara Botanic Garden*

1:00 Thinking beyond the garden: How the Santa Barbara Botanic Garden confronts invasive plants via horticulture, education and research. *Heather Schneider, Santa Barbara Botanic Garden*

1:20 Out of the garden and into the wild: Rancho Santa Ana Botanic Garden's role in plant conservation and invasive species management. *Naomi Fraga, Rancho Santa Ana Botanic Garden*

1:40 Re-introducing introduction: Renewed relevance of public gardens' traditional role and preventing invasive plant introductions. *Frank McDonough, Los Angeles County Arboretum & Botanic Garden*

2:00 – 2:20 pm Break

2:20-3:20 pm Session 17. Restoration

Room: *Grand Ballroom II*
Chair: *Gina Darin, Cal. Dept. of Water Resources*

2:20 Management of a coastal bluff community invaded by *Oxalis pes-caprae* with low concentrations of glyphosate. *Lewis Reed, UC Davis, Bodega Marine Reserve*

2:40 Coastal strand enhancement, invasive plant management and restoration – North San Diego County. *Shirley Innecken, San Elijo Lagoon Conservancy*

3:00 Forest health and watershed improvement through noxious weed management. *Susie Urie, Tahoe National Forest*

2:20-3:20 pm Session 18. State Programs

Room: *Grand Ballroom III*
Chair: *Steve Schoenig*

2:20 100 years of statewide coordination and eradication of Invasive weeds in California: A brief history. *Steve Schoenig*

2:40 Utilizing California's State Wildlife Action Plan 2015 Update (SWAP 2015) as a collaborative invasive species management tool. *Junko Hoshi, Cal. Dept. of Fish & Wildlife*

3:00 Aquatic invasive plant management across California. *David Kratville, Cal. Dept. of Food & Agriculture*

3:20 – 3:40 pm Break

3:40 – 5:00pm. Session 19. Invasive Plant Management in California and Hawaii

Room: *Grand Ballroom.* Chair: *Doug Johnson, Cal-IPC*

3:40 New weeds in California: An update. *Dean Kelch, California Dept. of Food & Agriculture*

4:10 Hawaii's Interagency Biosecurity Strategy: Protecting what matters in a global invasion hotspot. *Joshua Atwood, Program Supervisor, Hawaii Invasive Species Council*

5:00 pm Closing Remarks

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

Friday, October 27

Meet ready-to-go at 7:00 am at the location discussed at the Thursday 5:00 pm meeting!

Field Trip 1: Joshua Tree National Park (Full-day, 7:30 am-4:30 pm)

We will travel through Joshua Tree from south to north, following the transition from the Colorado Desert to the Mojave Desert. NPS staff will describe management approaches for historic plantings of non-natives that the park is preserving. We will visit research plots assessing the effects of atmospheric nitrogen deposition on invasive annual brome grasses. Joshua tree woodland sites that have burned in wildfires fueled by invasive annual grasses provide an opportunity to discuss the future of this iconic species given the threats of global climate change and additional wildfires. Participants will only walk a short distance from our vehicles.

Field Trip 2: Whitewater Preserve (Half-day, 7:30 am-12:30 pm)

Hike the Whitewater River canyon, a candidate for National Wild & Scenic designation, where intact riparian habitat is home to the endangered Southwest willow flycatcher and Bell's vireo. The site is enclosed within BLM's San Gorgonio Wilderness between the San Bernardino and San Jacinto Mountains, and provides range for bighorn sheep, deer and bear. Hear about how management of invasive plants has been a part of the Wildlands Conservancy's restoration work to protect this special desert place. The visit will involve approximately 4 miles of easy walking. Participants should be prepared for warm weather, with sturdy shoes and water.

Field Trip 3: Coachella Valley Preserve (Half-day, 7:30 am-12:30 pm)

Visit the Coachella Valley National Wildlife Refuge to view one of the last and largest remnants of a unique sand dune system in the Coachella Valley. This system, home to the endemic, endangered Coachella Valley fringe-toed lizard and Coachella Valley milkvetch, as well as the rare flat-tailed horned lizard, is under threat due to the invasion of Sahara mustard, and has been the focus of annual citizen weed pull efforts to reduce the abundance of the mustard. Also within the Preserve, we will visit a series of palm oases along the San Andreas earthquake fault, a scenic riparian system that was restored from a formerly highly-invaded state by the reduction of tamarisk, which has had implications for the water table, soil salinity, and growth of native species. The visit will involve approximately 3 miles of easy walking. Participants should be prepared for warm weather, with sturdy shoes and water.

Posters

(alphabetical by lead author)

1. Joshua Tree National Park Invasive Plant Patrol. *Rose Alvarez* and Neil Frakes, Joshua Tree National Park*
2. Allelopathic impacts of *Schinus molle* on exotic and native plant communities in southern California. *David Bañuelas, Cal Poly Pomona.*
3. Northward expansion of invasive shot hole borers (*Euwallacea*spp. nr. *Fornicates* [*Curculionidae*]) in riparian systems of central California. *Shelley Bennett and Tom Dudley, University of California, Santa Barbara*
4. They're back: Discovery of an established nutria population in California's Central Valley. *Valerie Cook Fletcher, Invasive Species Program, California Department of Fish and Wildlife*
5. Japanese Dodder, *Cuscuta japonica*, control and eradication efforts in Alameda County 2015 to 2017. *Edmund Duarte, Alameda County Department of Agriculture/Weights and Measures*
6. Assessing vegetation cover metrics through the use of unmanned aerial vehicles (UAVs) and image analysis software for use in habitat restoration. *Alex Fromer, Mike Nieto, Karyl Palmer, and Frank McDermott, RECON Environmental*
7. Competition from native perennial grasses decreases overall fitness in field bindweed (*Convolvulus arvensis). Breahna Gillespie[1], Helen Holmlund[2], and Elise Gornish[1]. [1]Restoration Ecology at University of California, Davis. [2] Department of Ecology and Evolutionary Biology University of California, Santa Cruz*
8. Complexity, constraints and challenges of tamarisk treatment in the Mojave River watershed. *Kenneth Lair[1], Chuck Bell[2], and Jackie Lindgren[2], [1]Lair Restoration Consulting, Apple Valley, CA and [2]Mojave Desert Resource Conservation District*
9. Development of desert panicgrass (*Panicum urvilleanum* Kunth.) for use in southwestern desert river channel and riparian restoration. *Kenneth Lair [1], Matthew Huffine [2], Lyn Shirley [3], Heather Dial [4], and Chuck Bell [5]. [1]Lair Restoration Consulting, Apple Valley, CA, [2] Lewis Center for Educational Research, Apple Valley, CA, [3]Department of Agriculture and Natural Resources, Victor Valley College, Victorville, CA, [4]Tucson Plant Materials Center, Natural Resources Conservation Service, Tucson, AZ, [5]Mojave Desert Resource Conservation District*
10. Investigating allelopathy and soil moisture as factors determining community composition of a Southern California black walnut woodland. *Jose Marfori and Dr. Erin Questad, Biological Sciences Department, California State Polytechnic University*
11. Effects of fire on herbicide. *Jessica Morrison[1], Noreen Murano[1], Sam Lantz[1], and Laura Riege[2], [1]Resource Conservation Partners, Ventura, [2]The Nature Conservancy*
12. Implementing an Early Detection Program on Catalina Island: Prioritizing landscaped grasses. *Julia Parish. Catalina Island Conservancy*
13. Weed vs. crop differentiation using crop marking systems. *HannahJoy Pheasant[1], Steve Fennimore[2], and John S. Rachuy[2], [1]UC Davis, Dep. of Plant Sciences, Davis, CA, [2]UC Davis, Dep. of Plant Sciences*
14. Facilitative effects of nurse shrubs on growth and survival of California sage scrub native plants. *Lauren H. Quon and Dr. Erin J. Questad. Biological Sciences Department, Cal Poly Pomona*
15. Managing *Egeria densa* and other invasive aquatic plants as part of the Delta Smelt

Resiliency Strategy. *Nick Rasmussen[1]*, Heather Green[1], Shruti Khanna[2], Jeffrey Caudill[3], Eli Ateljevich[1], and Louise Conrad[1], [1]California Department of Water Resources, West Sacramento, CA, [2]University of California-Davis, Davis, CA, [3]California State Parks, Division of Boating and Waterways*

16. Effects of manual and mechanical *Ammophila arenaria* removal techniques on coastal dune plant communities and dune morphology. *Monique Silva Crossman and Alison O'Dowd, Humboldt State University*

17. Waste not, want not: A pilot study on direct seeding over straw mulch as a means of revegetation. *Rachel Stump and Maria Alvarez, National Park Service, Golden Gate National Recreation Area*

18. Using functional trait analysis to improve revegetation outcomes. *Noah Teller and Travis Bean, UC Riverside Cooperative Extension*

19. Management of Bermuda buttercup (*Oxalis pes-caprae*) in the Peninsula Watershed of the San Francisco Public Utilities Commission. *Don Thomas, San Francisco Public Utilities Commission*

20. Large-scale riparian restoration in the Santa Clara River. *Jared Williams[1]*, Adam M. Lambert[1], and Tom L. Dudley[2]., Marine Science Institute and Cheadle Center for Biodiversity and Ecological Restoration, University of California, Santa Barbara*

21. Mapping, prioritization, and eradication of *Arundo donax* in the Sacramento-San Joaquin Delta. *Alex Young and Mark Newhouser, Sonoma Ecology Center*

Talk Abstracts

(poster abstracts follow; alphabetical by lead author)

Effectiveness of non-native plant treatments across the U.S. national park system: A synthesis. Scott R. Abella. University of Nevada Las Vegas, School of Life Sciences, Las Vegas, NV. scott.abella@unlv.edu

The United States created national parks to conserve indigenous species, ecological processes, and cultural resources unimpaired for future generations. Curtailing impacts of non-native species is important to meeting this mission. This synthesis identified 56 studies reported in 60 publications that evaluated effects of non-native plant treatments on National Park Service lands. Studies encompassed 35 parks in 20 states and one U.S. territory and included 157 non-native plant species. Eighty-seven percent of studies reported that at least one treatment reduced focal non-native species. Of 30 studies evaluating response of native vegetation, 53% reported that natives increased, 40% reported neutral responses, and 7% reported that natives decreased. For at least some of the neutral cases, neutrality was consistent with management objectives. In other cases, insufficient time may have elapsed to thoroughly characterize responses, or restoration might be needed. Non-focal non-native species increased in 44% of the 16 studies evaluating them, but the other 56% of studies reported no increase. Results suggest that: (1) a range of non-native species spanning annual forbs to trees have been effectively treated; (2) developing effective treatments often required extensive experimentation and balancing non-target impacts; (3) presence of multiple non-native species complicated treatment efforts, highlighting the importance of preventing initial and secondary invasions; and (4) placing treatment objectives and outcomes in context, such as pretreatment condition of native vegetation, is important to evaluating effectiveness. Attaining the goal in national parks of conserving native species and ecological processes minimally influenced by non-native species will likely require comprehensive management strategies inclusive of treatment interactions with focal non-native species, other potential invaders, and native species.

Hawaii's Interagency Biosecurity Strategy: Protecting what matters in a global invasion hotspot. Joshua Atwood. Hawaii Invasive Species Council, Honolulu, HI. joshua.p.atwood@hawaii.gov

Hawaii has the dubious distinction of being one of the world's top invasion hotspots. The impacts to life in Hawaii from invasive species are substantial and diverse, including species extinctions, loss of agricultural production, lost tourism income, negative impacts to human health, and permanent changes to Hawaii's unique way of life. Addressing these impacts is not the work of any one agency or industry. Hawaii's approach to invasive species and biosecurity has become, by necessity, interagency in scope and dependent on strong partnerships. Working with the Hawaii Department of Agriculture, the Hawaii Invasive Species Council assisted in developing the new Hawaii Interagency Biosecurity Plan (HIBP, 2017-2027). The HIBP describes Hawaii's comprehensive set of biosecurity programs across multiple agencies and partnerships, including roles related to pre-border compliance, border interdiction, and post-border response and management. By identifying gaps across sectors, the HIBP is able to recommend a coordinated, cohesive direction for biosecurity and invasive species management over the next decade. From policy changes to major infrastructure investments, the HIBP assigns over 150 prioritized action items on a specific implementation timeline. This talk will review the breadth of the invasive species problem in Hawaii, some of our current management and partnership strategies, and the highlights from our 10-year roadmap to better protecting Hawaii's agriculture, environment, economy, human health, and way of life.

Not all weeds are equal; effects of weeds on desert biodiversity. Cameron Barrows, University of California Riverside, Center for Conservation Biology. cbarrows@ucr.edu

Second only to habitat loss, invasive weeds are one of the main stressors affecting native biodiversity. Removing, controlling or eliminating invasive weeds are typical management objectives; however, there is rarely just a single weed species to deal with, and resources to manage weeds are finite and never enough. So how do managers prioritize which weeds to control? Here I present a series of case studies that have allowed desert land managers to focus weed management efforts. These are still works in progress, but rather than frustration-based immobility or lack of sufficient appreciation for the weeds' impacts, there has been progress. Starting with tamarisk, I present a rogue's gallery of weeds that plague our desert habitats, including Russian thistle, Sahara mustard, and invasive grasses. A first step is to understand the

weeds' effects on valued natural biodiversity. Sometimes these are direct species-species interactions, but more often, the real problem is a disruption of ecological processes, and so impacts are at a community and landscape scale. When placed in this community and landscape scale, and then quantifying the impacts to biodiversity, prioritizing weed management objectives becomes much clearer. In some case the answer is that, we can "live with" or accept a particular weed invasion because the impacts are negligible (or even positive). In other cases the losses to biodiversity are abundant and clear, and so require immediate action. Then there are invasive annual plants which have a clear impact during "wet" years (a relative term in desert environments), but then all but disappear during the more typical drought conditions. These present the greatest strategic challenge. Understanding their long-term impacts may take multiple wet-dry cycles.

Barb goatgrass management: Interactive effects of grazing, glyphosate rate, application timing, and restoration seeding. Elise S. Gornish[1], Travis M. Bean[2*], Josh Davy[3], and Guy Kyser[4]. [1]School of Natural Resources and Environment, University of Arizona, Tucson, AZ. [2]Department of Botany and Plant Sciences, University of California, Riverside, CA. [3]University of California Cooperative Extension Glenn, Colusa and Tehama Counties, CA. [4]School of Plant and Environmental Sciences, University of California, Davis, CA. travis.bean@ucr.edu

Conventional management of barb goatgrass (*Aegilops triuncialis*), has been largely unsuccessful. Selective removal of invasive annuals from habitats dominated by native and more desirable annual species presents a common challenge in Mediterranean climates. Barb goatgrass has been observed to mature later than desirable species, and to leverage this apparent separation in phenology we implemented a field experiment at the University of California Hopland Research and Extension Center in Hopland, CA. In March through May of 2016, we applied glyphosate (Roundup WeatherMax ®) to specific barb goatgrass phenological phases (tillering, boot, heading) at high and low rates in combination with targeted grazing by sheep at the boot stage. Our first objective was to evaluate the efficacy of these treatments in minimizing seed production of barb goatgrass. In the fall of 2016, a forage species mix and restoration species mix were seeded into the plots, leaving a portion unseeded, to test a second objective of evaluating the interactions of all treatments and the potential for seeding to reduce goatgrass reinvasion. Plots were surveyed for seedhead densities of barb goatgrass in June 2016, and for goatgrass and seeded species cover in May 2017. Initial results (2016 data) indicate grazing reduced overall barb goatgrass density by 68%. Herbicide reduced barb goatgrass density by 60% overall, but no differences in density were found between rates. Spraying goatgrass at the tiller stage resulted in a 99% decline in density compared to other phenological phases. No interactions were found among grazing and herbicide rate or herbicide rate and phenological stage at the time of herbicide application. Analysis of 2017 data is underway.

New biocontrol releases and integrated control targeting Arundo and Cape-ivy in riparian areas. Ellyn Bitume*, Scott Portman*, and Patrick Moran. U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weeds Research Unit, Albany, CA. Ellyn.Bitume@ars.usda.gov; Scott.Portman@ars.usda.gov

The giant grass known as arundo (*Arundo donax*, Poaceae), and vine-like Cape-ivy (*Delairea odorata*, Asteraceae), form dense stands in riparian areas in the Central Valley and California coast, respectively. Common control techniques include herbicide application, mowing, or ground-cutting; hand-removal is often used against Cape-ivy. These control techniques are often not effective. Three biological control agents could both complement these methods and reduce their use. The Arundo shoot tip-galling wasp (*Tetramesa romana*) was released in 2017 at six locations in the northern Central Valley subjected to one of three physical control treatments: topping at 1m height, ground-cutting, or no cutting. Prior evidence suggested that the percent of new lateral shoots galled was elevated 4x when the plants were topped. The Arundo armored scale (*Rhizaspidiotus donacis*) was also released at these six sites. Previous releases led to successful establishment of the scale in California. The Cape-ivy shoot tip-galling fly (*Parafreutreta regalis*) was released at seven sites in the San Francisco Bay Area in the fall of 2016. Seventeen galls were observed at four sites by the spring of 2017, and the presence of exit holes indicated that the insects survived the winter as immatures and emerged in the spring. New releases were made at four of these sites in 2017. Releases are ongoing or planned at additional sites from Humboldt to Santa Barbara Counties. Prior to release, all three of these biocontrol agents showed high host specificity, and significant impact on Arundo or Cape-ivy under greenhouse or field conditions. As the biological controls establish permanent populations in California, they will become available for redistribution, and our results will facilitate integration of biocontrol with physical, mechanical and chemical control methods. Successful biocontrol of Arundo and

Cape-ivy will improve the protection and preservation of water resources and native habitats.

Native and invasive in the same region: Determining the above and belowground impacts of invasion for Monterey pines in California. Briana Boaz*. University of California Berkeley. beboaz@berkeley.edu

While Monterey pine (*Pinus radiata*) is native to restricted locations in coastal California, it is also becoming invasive in other regions of the state where it has been introduced. Planted cultivars of Monterey pine have been invading coastal scrub and chaparral ecosystems within the Marin Headlands. It is important to understand Monterey pine spread because they are a different genotype from the native populations, displacing native species in these communities, and potentially altering ecosystem functions. Monterey pines have significantly different characteristics than the native species in this region, including their rapid woody growth, litter inputs, and associated soil microbial communities. In paired invaded and noninvaded plots within the Marin Headlands, I will study the above and belowground impacts of Monterey pines to better inform management and restoration efforts. I will measure both the plant and soil microbial communities, as well as key soil environmental variables, to determine the impact of these introduced pines. I will also assess the efficacy of cutting as a management strategy for this invader in restoring both the above and belowground diversity.

Grassland and forbland habitat restoration in Southern California. Travis Brooks, Land IQ. tbrooks@landiq.com

Land managers face significant challenges managing and restoring native grassland and forbland habitat in southern California: many landscapes that have been type-converted by past land use practices from a mosaic of native grassland, forbland and shrubland habitat types to non-native, Mediterranean annual grass dominated vegetation appear stable without active intervention (e.g. weed management, seed addition) to restore native cover and function; despite good conceptual models that identify appropriate environmental conditions for grassland, forbland and shrubland habitat types, there is uncertainty in identifying site-specific habitat restoration targets at the level of project implementation; the selection of cost effective weed management techniques (e.g. mowing, herbicide application) is, in part, dependent upon identifying appropriate site-specific habitat management/restoration targets; the success of the weed management is dependent upon the timing of weeding events with growing conditions; and increasing soil aridity associated with climate change is changing the composition and distribution of native grassland communities. Given these challenges, I will present an overview of best management practices in development for the management and restoration of grassland and forbland habitat in southern California. The recommendations are based on Land IQ's experience with habitat restoration using natural rainfall and seed-based methods in southern California, and based on results from an on-going experimental study of grassland and forbland restoration methods supported by SANDAG in collaboration with Conservation Biological Institute (CBI), The Nature Conservancy (TNC), Earth Discovery Institute (EDI), and the South San Diego County Land Managers, including BLM, CDFW and USFWS.

Planning constraints to IPM adoption by National Forests in California. Philip Brownsey*. Consulting Rangeland Ecologist, Sacramento, CA. pb3@airpost.net

The USDA Forest Service has formal policies in place to manage invasive plants on lands that the agency manages, including the adoption of early-detection/rapid-response strategies (EDRR) and integrated pest management (IPM) approaches to treatments. These policies are meant to guide management of invasive plants on the 20 million acres managed by this agency in California. In this talk, I will discuss the degree of adoption by management units of National Environmental Policy Act (NEPA) planning documents authorizing early-detection/rapid-response approaches to invasive plant management by the Forest Service in California (Region 5) that allow for integrated pest management approaches to treatments that include herbicide. Units within the state vary greatly in their willingness or ability to adopt IPM approaches. Commonly cited reasons for the inability to complete NEPA authorizing IPM approaches include lack of funds or personnel to complete the planning process; lack of Forest Service leadership support or prioritization; stakeholder opposition, particularly from people practicing traditional uses of forest resources; and concerns regarding effects of herbicide on wildlife, particularly amphibians. Management units that have successfully completed NEPA either didn't face these challenges or found ways to overcome them. These management units have then found opportunities for partnerships and funding to implement IPM treatments on a greater scale than base funding for invasive plant treatments would otherwise allow. Region 6 of the Forest Service (Idaho, Oregon, and Washington) has taken a different approach to planning strategies that may offer a more efficient and effective path to

successful adoption of IPM, compared to the decentralized approach in California.

Building partnerships: Tribes and habitat restoration. Kurt Broz. Pala Band of Mission Indians. Pala, CA. kbroz@palatribe.com

Building partnerships across agencies and jurisdictions can be hard, especially when it comes to working with Tribes or other governments. Ongoing restoration work and other habitat management decisions will be used to illustrate the best ways to partner with Tribes and other groups on a watershed scale. The Pala Band of Mission Indians are located along the San Luis Rey River in Pala, CA, in the northern part of San Diego County. The Pala Environmental Department has worked with agencies and organizations including the NRCS, USFS, USFS, CNPS, and Audubon Society to build partnerships and seek help or funding to management lands, including restoration and habitat conservation with a focus on promoting native plants and other culturally important wildlife.

The good with the bad: When ecological restoration facilitates non-native plants. Lindsay P. Chiquoine*, Scott R. Abella. University of Nevada Las Vegas, School of Life Sciences, Las Vegas, NV. lindsay.chiquoine@unlv.edu

A fundamental component of restoring natural desert ecosystems is reestablishing "fertile islands" as protected microsites of heightened biological activity below the canopies of perennial plants. This presents a potential conundrum, however, because southwestern deserts are now pervasively invaded by non-native annual plants that thrive in fertile island microsites. To evaluate how the native and non-native annual plant community responded to the restoration treatments of outplanting native perennials and vertical mulching on disturbed sites in Joshua Tree National Park, we conducted a nine-year study between 2009 and 2017. Cover of native annual and perennial plants was higher on restoration sites than on disturbed and unrestored controls by the ninth year. However, restoration treatments also increased non-native annual plants: by the third year after restoration, non-native annual plant cover (e.g., red brome [*Bromus rubens*]) was three times greater within restoration treatments compared to controls. Ecological restoration treatments have been effective at increasing native species diversity and cover, including restoring fertile islands, but this has come with the tradeoff of also increasing non-native species. To try to counteract this, future restoration could test planting native perennials that require little maintenance (e.g., little supplemental water to avoid inadvertently facilitating non-natives) or do not readily form fertile islands, seeding native annuals that might compete with non-native annuals, or conducting weed control as part of restoration. The creation of fertile islands, which are natural features of desert ecosystems, poses a major conundrum for desert restoration in areas susceptible to non-native plant invasions.

California desert invaders: Threats and opportunities to conserve a vast ecosystem. Naomi Fraga. Rancho Santa Ana Botanic Garden, Claremont California. nfraga@rsabg.org

The desert ecosystem in California is vast and diverse, stretching across 29 million acres, or 28% of California's landmass. There are nearly 2,000 plant taxa (native and non-native) documented from California's two southern deserts; the Mojave and Sonoran (this analysis excludes the Great Basin Desert) with 131 non-native taxa represented. Naturalized non-native plant species make up only 7% of the desert flora, compared to 15% for the entire state of California. The grass family, Poaceae is overwhelmingly the most diverse plant family for naturalized non-native species with nearly 50 non-native species represented in California's desert, or 37% of the total non-native plant diversity. The grass family is followed by Brassicaceae (mustards; 12), Asteraceae (sunflowers; 11), and Chenopodiaceae (goosefoot family, 12). In this presentation I will give an overview of California's two major southern deserts the Mojave and Sonoran, including the diverse habitats that occur here, plant species diversity, including rare and endemic plants, common and emerging non-native plant species, threats, and ways in which we can working across boundaries to advance conservation.

Out of the garden and into the wild: Rancho Santa Ana Botanic Garden's role in plant conservation and invasive species management. Naomi Fraga. Rancho Santa Ana Botanic Garden, Claremont California. nfraga@rsabg.org

Plant Conservation is growing at Rancho Santa Ana Botanic Garden (RSABG); this vital program is central to our mission and is a natural extension of our rich history in research and horticulture. Conserving biodiversity is challenging, as we face catastrophic drought, wildfires, invasion of exotic species, and expanding urbanization and development. RSABG has been a cornerstone in the world of California native plant conservation and, as our challenges grow, RSABG will continue to work at the front lines. RSABG has active programs in conservation, research, and horticulture; these three programs provide RSABG staff with the resources and facilities to operate active programs in restoration, and invasive species management. In this presentation, I will provide case studies that focus on our work tohorticulture to

research and demonstrate how RSABG is working in partnership with a diversity of agencies and organizations to ambitiously achieve a world in which California's plant diversity is well documented, understood, and conserved for future generations.

Managing invasive plants at Joshua Tree National Park. Neil Frakes. National Park Service, Twentynine Palms, CA. neil_frakes@nps.gov

Joshua Tree National Park is home to over 750 species of vascular plants, of which 58 are non-native. Some non-native plants within the park were intentionally planted, and these populations are preserved as part of our heritage. However, many of the non-native plant species in the park are highly invasive, and the park actively monitors and controls them in order to preserve biodiversity. Invasive annual plants, especially grasses and mustards, are large drivers of change in the desert ecosystems of Joshua tree National Park. Invasive *Schismus* and B*romus* grasses can create high fuel-loads in wet years, generating unnaturally large, high severity wildfires. Native species such as blackbrush and Joshua tree are very slow to recover following fire. Invasive mustards such as Sahara mustard and London rocket can outcompete natives, possibly hindering rare plants and reducing the abundance of spring wildflower blooms, a major draw for visitors. Managing invasive annual plants is especially challenging for managers, as their distribution and abundance can change drastically from one year to the next, dependent on rainfall patterns. The escaped ornamental fountain grass is a major focus for control efforts. This wind dispersed perennial is hard for crews to reach, colonizing in steep rugged terrain. Collaboration with local governments and landowners is necessary to reduce the source in communities adjacent to the park. In 2017, the park launched an Invasive Plant Patrol program in which a team of trained volunteers report and control satellite infestations to keep invasive plants from colonizing new areas. With a limited budget, the park relies on these dedicated volunteers to assist in control efforts. Despite best intentions, invasive plants can present overwhelming challenges, and prioritization is necessary to ensure efficient use of funds, staff time and protection of the most important resources.

Protecting Surface Water from Pesticide Contamination in California. Kean S. Goh, California Department of Pesticide Regulation, Sacramento, CA. Kean.Goh@cdpr.ca.gov

The mission of the California Department of Pesticide Regulation's Surface Water Protection Program (SWPP) is to protect surface water from pesticide contamination caused by the use of pesticides in agricultural and urban environments. The Program relies on both preventive and response components to prevent adverse impacts of pesticide residues to humans and aquatic organisms. To achieve its mission, the program integrates the following key components: (a) evaluation of pesticide products submitted for registration in California, (b) monitoring of surface water and sediment for high use pesticides with high aquatic toxicity potential, (c) modeling of fate and transport of pesticides to predict environmental concentrations and assess environmental risk, (d) evaluation of the effectiveness of best management practices to mitigate the offsite movement of pesticides, (e) outreach to pesticide users to implement best management practices, and (f) implementation of regulatory measures. To implement the program mission, our scientists and analytical chemists work collaboratively with pesticide registrants, county agricultural commissioners, water boards, agencies, pesticide users, and university researchers.

Mycorrhizae, invasions, and the temporal dynamics of mutualism disruption. Sara Grove[1&2*], Karen Haubensak[2], Ingrid Parker[1] and Catherine Gehring[2]. [1]University of California, Santa Cruz, CA., [2]Northern Arizona University, Flagstaff, AZ. sgrove@ucsc.edu

An increasingly recognized impact of plant invasions is the disruption of positive interactions between native plants and their mutualistic mycorrhizal fungi. Mycorrhizal fungi are ubiquitous and important to plant survival and growth. These fungi plant roots and greatly improve plant nutrition, drought tolerance, and pathogen resistance. We reviewed 112 studies from 61 publications that report the impacts of invasive plants on mycorrhizal fungi. We describe emerging patterns on the frequency of negative, neutral and positive invader effects on mycorrhizal fungal abundance, richness and community composition. We evaluate how these outcomes vary with invasion age and characteristics of the invader, particularly its mycorrhizal status.

We also describe the evidence for three mechanisms of mutualism disruption: 1) plant-plant competition that alters host quantity or quality, 2) changes in soil properties such as nutrient availability, and 3) allelopathy. We note how the mycorrhizal status of an invader contributes to the impact that the invader has on the recipient plant community. Invasive species that are non-mycorrhizal (e.g. garlic mustard and tamarisk) consistently have large negative impacts on mycorrhizal fungi associated with native plants. In contrast, the effects of invasive species that are themselves mycorrhizal can have negative, neutral or even positive effects on native plant communities,

depending on whether the invasive and native plants host the same or different fungal species. Invaders that enrich soil nutrients can cause declines in mycorrhizal abundance, shifts in fungal community composition, and reduction in the dependence of native plants on mycorrhizas. Invaders that produce allelopathic compounds cause mycorrhizal abundance to decrease and alter community composition because fungi vary in their sensitivity to toxins. Invasion age is not clearly associated with extent of disruption, and the timing of recovery following invader removal is highly variable.

Modeling the control of invasive fennel (*Foeniculum vulgare*) on San Clemente Island. Sarah Sheldon[1] and Emma Havstad[2]*. [1]California State University, San Marcos. [2]San Diego State University Research Foundation, Soil Ecology and Restoration Group. Current email: emma@sanelijo.org

The control of invasive fennel populations is a vital component of native vegetation restoration on San Clemente Island, CA and has included annual removal and herbicide application within the known population boundaries for many years. In order to evaluate the impact and efficiency of this long-standing and resource-intensive program, a stage-structured population growth model was created, which took into account both the life-history traits of this species and the ongoing treatment strategies. The model was then applied to seventeen fennel populations, defined by watershed boundaries, in order to forecast population sizes after an additional five years, assuming that during that period the control program would continue with no changes. Within the projected five year period, the model predicted that ten populations would decline, six would grow, and one would remain the same size. Only populations with an initial population size of fewer than 38 vegetative individuals were predicted to decline, suggesting a useful parameter for potential modifications to control methods. Furthermore, while nine of the seventeen populations went extinct over the course of the simulation, none experienced a greater than 30% probability of extinction. In addition to evaluating overall program success, calculated model parameters provide valuable insight into potential improvements to the control program; two such alternative control strategies were also modeled to evaluate their relative impact, in order to guide future resource allocation.

Utilizing CA State Wildlife Action Plan 2015 Update (SWAP 2015) as a collaborative invasive management tool. Junko Hoshi. California Department of Fish and Wildlife (CDFW), Sacramento CA. junko.hoshi@wildlife.ca.gov

The California State Wildlife Action Plan 2015 Update (SWAP 2015) is a recent CDFW publication developed to address the highest conservation priorities of the state, providing a blueprint of actions necessary to sustain the integrity of diverse California ecosystems. After less than two years of implementation, the plan has already proven its potency as a tool to direct and integrate conservation activities occur in the state – from grant project selection, land/easement acquisition and conservation planning, to developing priorities for collaborative actions across boundaries, within and beyond the department.

SWAP 2015 recognizes invasive species as one of the most serious impacts to CA ecosystems, and accordingly, it recommends the highest number and variety of strategies to meet the diverse challenges from the introductions. All the 7 provinces and 97% of the conservation units under SWAP 2015 have strategies addressing invasive impacts. An appendix describes the impacts as well as approaches taken to address them, by including selected invasive species and key policies/organizations in CA. Further, the plan links invasive strategies to the priorities/recommendations under the National Invasive Species Management Plan and the state's equivalent, clarifying how SWAP implementation will contribute to the greater efforts embracing invasive issues.

During the presentation, Junko will introduce SWAP 2015, update the implementation status, and explore its potentials as a collaborative conservation tool for invasive species management. As a concrete example, she will illustrate how the capacity development to analyze eDNA has been identified as a CDFW's priority in its operational level, for defining baseline conditions and for monitoring and assessing the health of CA streams consistently across the state, including evaluating the extent and severity of invasive species impacts.

Management of *Volutaria tubuliflora* at Anza-Borrego Desert State Park – a community effort. Mason Hyland*, Gina Moran, and Larry Hendrickson. California State Parks, Colorado Desert District, Borrego Springs, CA. mason.hyland@parks.ca.gov

In late 2010, a discovery was made of a new, then unidentified weed near Alcoholic Pass in Anza-Borrego Desert State Park. In the following months, there were more plants discovered in the town of Borrego Springs, a community ringed by the State Park. The importance of invasive plant management was nothing new to the park or the community, all of whom rely in part on the existence of protected natural areas which support high levels of diversity, and which attract large numbers of visitors seeking

the splendor of desert annual wildflower blooms. Eventually the new weed was identified as *Volutaria tubuliflora*, along with two other know populations on the continent – one in Newport Bay, and one in Chula Vista. The plant was added to the agenda of the existing Sahara Mustard Eradication Taskforce – a group of volunteer community members and local land managers who focus on controlling Sahara Mustard (and now *Volutaria*) populations in the Borrego Valley, on both Parks lands, and privately held properties around the community. In 2016, the group of dedicated partners received some much-needed assistance from Cal-IPC, who received a grant to work on control of *Volutaria*, focusing efforts on the populations in the Borrego Valley. The effort has developed into a shining example of the necessity of community education, partnerships, and of Early Detection Rapid Response. The many challenges that we continue to face have highlighted the need for innovative detection and management techniques, grass roots community efforts, and the value of mapping tools and prioritization of management areas across lands managed by a wide variety of stakeholders.

Coastal strand enhancement and restoration – North San Diego County. Doug Gibson, Barry Lindgren, David Varner and Shirley Innecken*. San Elijo Lagoon Conservancy, Solana Beach, CA. shirley@sanelijo.org

San Elijo Lagoon Conservancy's (SELC) North County Dunes Restoration Project (Project) addresses rehabilitation, protection and enhancement of a vanishing habitat in southern California – coastal strand. Invasive species control is a focal point for all of the disturbed sites including encroaching monotypic stands of native arrow-weed, sea rocket and freeway iceplant. The collective goals of the project partners are to reduce threats to and improve the quality of nesting habitat for western snowy plover and California least tern and to increase the frequency and size of Nuttall's acmispon and coast wooly-heads populations.

A multi-phase project, Phase I delivered an inventory and site prioritization of 19 potential sites, mapped 589 polygons of 16 special-status plant species and 979 polygons of 51 invasive plant species, collected two years of avian use data, collected seed and initiated seed bulking for five coastal strand plant species, conducted multiple years of habitat enhancement/restoration efforts at the Seaside Terrace and San Elijo Lagoon Ecological Reserve West Basin sites including invasive species control and sand import, collected salinity and recreational impacts data, initiated a Coastal Development Permit and acquired a California Department of Parks and Recreation right-of-entry agreement, and drafted three site-specific restoration plans for Phase II of the Project.

This presentation will focus on invasive species control methods, coastal strand projects in a regional planning context, the results of site inventory and prioritization, project constraints, successes and lessons learned, and a brief summary of the Phase II trajectory. Funding for Phase II was granted in summer 2016.

Assessing spatio-temporal changes of invasive *Limonium ramosissimum* in San Francisco Bay wetlands. Kerstin Kalchmayr*, Barbara Holzman, Ellen Hines and Kathy Boyer. San Francisco State University. kerstin.kalchmayr@gmail.com

Limonium ramosissimum (LIRA) was first discovered growing in San Francisco Bay wetlands in 2007. Early research showed the species had the potential to negatively impact local marsh ecosystems. This study extends the monitoring period to investigate changes over the last eight years. The current study included 1) Bay-wide mapping of LIRA populations and 2) mensurate surveys at three established study sites in San Francisco Bay assessing changes in LIRA, three native species and soil properties by repeating previous research methods. Bay-wide mapping found that LIRA populations increased from 15,000 m^2 in 2008 to 32,000 m^2 in2016. LIRA was found at an additional 45 locations. LIRA significantly increased in cover in study plots with initial low LIRA cover. However, in plots where LIRA was well-established, all native species and LIRA decreased in cover. This decrease is likely attributable to a five year drought that began in 2011. Evidence suggests that native species *Distichlis spicata* (DISP) and *Sarcocornia pacifica* (SAPA) were most affected by expanding LIRA populations coupled with drought conditions. LIRA's potential long-term impacts to soil properties include an increase in bulk density and lower soil organic matter, which could negatively affect marsh community structure. LIRA has proven to be a hardy, drought tolerant species and has maintained its dominance at the marsh level. LIRA has the potential to become a much larger problem in Bay wetlands, particularly, in light of climate change. A concerted, reinvigorated effort to eradicate this species from San Francisco Bay wetlands should be initiated.

Controlling Algerian sea lavender in San Francisco Estuary tidal marshes. Drew Kerr[1]*,Simon Gunner[1], Dana Morawitz[2], and Doug Johnson[2], [1]San Francisco Estuary Invasive *Spartina* Project, [2]California Invasive Plant Council, Berkeley, CA. drewkerr@comcast.net

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 estuarine-terrestrial ecotone. These anthropogenic impacts increase the vulnerability of these systems to further degradation by invasive species, as well as the threat of lost marsh acreage due to sea level rise.

Algerian sealavender, *Limonium ramosissimum* (LIRA), as well as *Limonium duriusculum* (LIDU), are invasive plants spreading in tidal marshes of both northern and southern California. Two students in Katharyn Boyer's lab at San Francisco State University, Gavin Archbald and Kerstin Kalchmayr, have studied these invasives since their discovery in San Francisco Bay in 2007. LIRA was found to produce up to 130,000 seeds per m^2, excluding native marsh vegetation by forming carpets of rosettes that don't provide the vertical structure needed by wildlife for high tide refugia, including the endangered Ridgway's rail and salt marsh harvest mouse. In addition, it 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 the spring of 2016 and 2017, Cal-IPC began a two-year pilot project, treating invasive *Limonium* at 15 sites in Alameda, Marin, and San Mateo Counties using chemical and manual control methods. Test plots were also established to evaluate the efficacy of imazapyr, glyphosate, and a combination of both active ingredients.

Early detection across boundaries. Rachel Kesel[1*] and Andrea Williams[2]. [1]One Tam, San Rafael, CA.[2] Marin Municipal Water District, Corte Madera, CA. rkesel@onetam.org

With common goals to effectively manage priority weeds across boundaries, the invasive plant managers of the Tamalpais Lands Collaborative (TLC) have emphasized early detection and rapid response (EDRR) of invasive plants. By focusing on areas of common interest, the TLC is able to overcome differences in staff capacity and agency policies around invasive plant management. Each organization brings a suite of resources and talent, fostering the development of innovative approaches to the technical and logistical challenges that arise when working across boundaries.

By developing a flexible protocol, the TLC is able to accomplish collaborative goals, as well as some which are agency-specific. The protocol is underpinned by a consensus list of 61 species with two priority ranks: List 1, map and treat all populations; and List 2, map small populations in detail and note larger unmapped populations. The Conservation Management Team vets the list and an Early Detection subgroup resolves protocol issues and guides data management and sharing efforts.

A team with responsibilities in inventorying plants and treating weeds throughout the area of focus provides added capacity for EDRR to ensure that each agency's land is covered, as well as adding efficiency for roads and trails which span multiple jurisdictions.

A robust communication structure supports decision making and data sharing to facilitate rapid response efforts. Feedback loops among weed managers in the busy field season have thus far been iterative. Cementing those structures to ensure effective prioritization will require further effort. As the collaborative matures, questions of survey return intervals also await. Despite the unknowns, the successes of the TLC early detection program are demonstrated in the increase in miles surveyed and coordinated treatments each season.

Aquatic weed across California: an overview. David Kratville, California Department of Food and Agriculture, Sacramento, CA. david.kratville@cdfa.ca.gov

The California Department of Food and Agriculture has housed the Hydrilla Eradication Program since 1977. Eradication 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. 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. While conducting Hydrilla surveys and eradication projects staff regularly encounter and map aquatic weeds. This presentation will focus on identification of the common aquatic plants in California and the unique control techniques and permitting required for aquatic weed control.

Native riparian revegetation success in controlled tamarisk and non-tamarisk sites in the Mojave River watershed, California. Kenneth Lair [1*], Bruce Kenyon [2], Lance Eckhardt[3], and Chuck Bell [4]. [1*]Lair Restoration Consulting, Apple Valley, CA. [2]Quail Forever, Camp Cady Wildlife Management Area, Newberry Springs, CA.[3] Mojave Water Agency, Apple Valley, CA.[4] Mojave Desert Resource Conservation District, Victorville, CA. klair1968@gmail.com

Dense stands of saltcedar (*Tamarix* spp.) within the boundaries of Camp Cady Wildlife Management Area (CCWMA), along the lower Mojave River in San

Bernardino County, California, have been recently reduced in cover and density through occurrence of wildfire, river flooding, and/or application of active saltcedar control programs (herbicidal and mechanical) under the auspices of the Mojave Desert Resource Conservation District (MDRCD), the Mojave Water Agency (MWA), and the California Department of Fish and Wildlife (CDFW). A riparian revegetation and habitat recovery demonstration study was designed and implemented to evaluate optimum species selection across remnant riparian habitat types, in order to develop and apply best management practices (BMP's), plant materials, and techniques. Of 13 transplanted and drip-irrigated native species, overall pooled-species survival means were 79.8% in the controlled saltcedar planting site, and 88.6% in the open wash planting site one year after planting. Highest survival across both planting sites was shown by Goodding's willow, desert willow, honey mesquite, fourwing saltbush, and Anderson wolfberry – at or near 100% survival. Additional species exhibiting greater than 80% survival on one or both planting sites included Fremont cottonwood, yellow paloverde, and desert broom. Reduced survival of most species (except for Goodding's willow, desert willow, and fourwing saltbush) in the controlled saltcedar planting site suggests possible sensitivity to the higher soil salinity and sodicity characteristic of this site (EC_e of 7.8dS/m vs. 0.4dS/m, and ESP of 13.0% vs. 3.6%, for the saltcedar and open sites, respectively). Increased canopy height for the cottonwood, willow, and desert willow species on the saltcedar control planting site, however, is possibly due to their increased response to higher organic matter and nutrient levels documented for this planting site. Impacts from soil salinity may be compensated by increased soil nutrient availability, evidently promoting increased biomass in terms of canopy height for surviving species.

Restoration of invaded walnut woodlands using a trait-based community assembly approach. Sierra T. Lauman[1*] and Erin J. Questad[1].[1]Biological Sciences Department, California State Polytechnic University, Pomona, 3801 West Temple Ave, Pomona, CA 91768. stlauman@cpp.edu

Non-native plant invasions have been cited as a cause of decline of numerous plant communities, including Southern California walnut woodlands. These woodlands are dominated by *Juglans californica*, the California black walnut, which is a rare, endemic, allelopathic tree. Barriers to native community assembly in walnut woodlands include abiotic filters, such as light and water availability, and biotic filters, including competition with invasive plant species, and allelopathy, due to the chemical juglone. Here we present two experiments designed to assess how these abiotic and biotic environmental filters affect the establishment, growth, and reproduction of native and non-native annual plant species, with a focus on developing a trait-based restoration approach for this ecosystem. A laboratory experiment was conducted to observe the effects of five juglone concentrations (from 0 to 0.5mM) on the germination of several native and invasive species. A field experiment was conducted to examine native and non-native annual plant recruitment with respect to microclimate and competition. Phenology, plot cover, and plant functional traits were measured in plots containing seeding treatments of native only, invasive only, or a mixture of both species types, all nested within canopy and exposed plot locations. Germination rates for all species between canopy and exposed locations were similar. Native *Amsinckia intermedia* and invasive *Brassica nigra* displayed similar phenology, being the first species to germinate, and had the highest germination rates across all canopy and seeding treatments. Preliminary functional trait results showed a significant reduction in leaf size in both species when grown in exposed areas, compared to areas under the walnut canopy ($\beta = -25.0$, $p<0.001$). Results show that native, compared to invasive, species tolerate higher concentrations of juglone during germination, and that the microclimate under walnut canopies may facilitate the growth of early-germinating species.

Carlsbad Hydrologic Unit Invasive Plant Species Control Program. Doug Gibson,Barry Lindgren*, David Varner and Shirley Innecken. San Elijo Lagoon Conservancy. barry@sanelijo.org

We discuss a multi-watershed-based invasive species control program (Program) established in 2004 in the 211 sq. mi. Carlsbad Hydrologic Unit (CHU), in northern San Diego County. The CHU is comprised of six distinct watersheds, and includes four unique coastal lagoons. It is a multi-jurisdictional, urban environment that is nearly 70% developed, yet continues to support important habitat for numerous sensitive plant and animal species. The original Program was initiated by a local consortium, the Carlsbad Watershed Network (CWN), implemented by San Elijo Lagoon Conservancy (SELC) and funded by the CA State Water Resources Control Board.

Exotic plants inhabit large areas of CHU watersheds, significantly degrading essential functions and beneficial uses. The Project focused on restoring vegetation communities that provide habitat for special-status species including light-footed clapper rail, Belding's savannah sparrow, southwestern willow flycatcher, wart-stemmed ceanothus, Encinitas baccharis, and Nuttall's scrub oak. Target invasive

species were those recognized as particularly damaging on local and regional levels. The utilization of an ArcGIS geodatabase and Microsoft Access database were crucial in mapping efforts, prioritizing sites within the CHU, and tracking monitoring efforts. This scale of work could not have been conducted without obtaining programmatic permits from all relevant regulatory agencies. Similarly, securing land access agreements throughout the CHU was a critical component to implementing this program. Continual public outreach fostered a supportive and educated community. Currently, the Program has treated over 500 acres, obtained permissions for over 3,000 parcels, mapped over 3,000 acres of invasive species, and contacted over 35,000 community members.

A long-term program of this scale is a study in adaptive management. This discussion will focus on lessons learned and what the future holds.

Grassland restoration and invasive weed management in Southern California: Medusahead as a case study. Christopher McDonald* University of California, Cooperative Extension. cjmcdonald@ucanr.edu

Medusahead (*Elymus caput-medusae* syn. *Taeniatherum caput-medusae*) is a highly invasive annual grass that can be found in many states in the Western US. It infests over 2 million acres and at least 1 million acres in California. Most medusahead populations in California are in the northern and central parts of the state, yet a small and growing outbreak can be found in San Diego County. San Diego County is home to a significant portion of Southern California grasslands with approximately 150,000 ac. of grasslands in the county. The distance between the San Diego grasslands and the central and northern California grasslands has provided a barrier to the invasion of several key weed species commonly found in the northern part of the state. Despite this barrier, medusahead was first documented in San Diego County in the early 2000s, but was likely introduced earlier. The majority of medusahead seeds disperse relatively close to the parent plant, however a small portion of seeds can attach to wildlife, livestock, humans and vehicles and disperse long distances. This long-distance dispersal can explain why several populations of medusahead in San Diego County are spread over a long distance. In this study the abundance of medusa head was significantly reduced using a combination of strategies including herbicide use. On one ranch medusahead populations have been reduced from several acres of infestation to small patches and are declining every year. Medusahead is also found in several preserves that are used for different types of outdoor recreation. This increases the risk it will spread to other preserves and suburban neighborhoods as it attaches to visitors in the infested areas. To reduce this threat a program of trailside management was initiated to reduce the possibility of medusahead attaching to recreationists.

Overcoming challenges: Managing the highly invasive Volutaria across California. Christopher McDonald* University of California, Cooperative Extension. cjmcdonald@ucanr.edu

In 2010 a population of *Volutaria tubuliflora* was discovered in the small desert town of Borrego Springs, CA. The initial sightings were spread across several sites in Borrego Springs separated by a few miles. During the same year Sahara mustard (*Brassica tournefortii*) dominated several key wildflower fields in Borrego Sprigs. This eventually limited the number of tourists visiting these wildflower hotspots and served as a reminder to the community of the effects of invasive species. In the following years volunteers in Borrego Springs began to organize and remove Sahara mustard in key areas. This work served as an opportunistic prelude to managing Volutaria, which had been continuing to spread despite the 5 year-long drought in Southern California. Volutaria has also been recently re-discovered in Newport Beach in Orange County and another population was found in Chula Vista in coastal San Diego County. Volutaria has also been reported in the Atacama Desert in Chile where it is spreading, despite the fact that the Atacama is more arid then the California Desert. This is the first introduction of this species to North America. Several key lessons have been learned from the invasion of Volutaria. Determining the correct identification for this species had been problematic as it is not very abundant in its home range and there are few Volutaria experts. Volutaria is growing in a wide variety of communities in its home range and in California including desert scrub, coastal sage scrub, and disturbed areas including roadsides and abandoned agricultural fields. Volutaria in Borrego Springs occurs on at least 50 different private properties, which limits the ability to treat this noxious weed. In addition, many landowners in Borrego Springs leave during the summer or are vacant landowners, which limits the ability to provide a coordinated response.

Re-introducing introduction: renewed relevance of public gardens' traditional role. Frank McDonough. The Los Angeles County Arboretum & Botanic Garden, Arcadia, CA. Frank.McDonough@arboretum.org

The Los Angeles County Arboretum and Botanic Garden has a long history of introducing climate-appropriate plants for the Southern California horticultural palette. From its inception in 1948 until the late 1970s the Arboretum served an important role

in introducing plants into the horticultural trade and influencing the landscaping choices of local governments. The program was virtually eliminated due to Prop. 13 budget cuts. Today, however, with our prolonged drought compounded by dozens of harmful insect introductions, the need to guide introduction of climate-appropriate plants is huge. And we know it's critical to avoid plants that could become invasive in California. Can we 're-introduce' the Arboretum's historic introduction program? PlantRight's Plant Risk Evaluation (PRE) tool for assessing potential for future invasiveness gives us a framework from which to start, and helps lessen our chances of introducing catastrophically invasive plants into the environment. We are using the PRE tool to assess a set of plants, and will use the pilot study to guide future work on evaluating horticultural introductions.

What to expect from your pesticide inspection. Robert Mulherin, Riverside County Agricultural Commissioner's Office, Riverside, CA. rmulherin@rivco.org

Pesticides are an important tool in the toolbox of pest control, along with Integrated Pest Management, and they must be applied in a careful and effective manner in order to protect the handler and the surrounding environment. Following the requirements listed on the pesticide label and complying with laws and regulations pertaining to pesticides, are the basis for assuring that pesticides are applied in a careful and effective manner. The California Department of Pesticide Regulation regulates the registration, sale and use of pesticides in California. The Agricultural Commissioner's Office in each County is the regulatory agency responsible for enforcement of pesticide sales and use at the local level. As part of its enforcement activities, the Agricultural Commissioner's Office performs pesticide use monitoring inspections to assure that the handler/employer or pest control business is complying with the requirements of handling (applying, mixing, loading) pesticides according to the requirements of the label, and laws and regulations. Occasionally, violations are observed by inspectors during these inspections. These have been compiled into a list of the Most Common Violations Found During Inspections in Riverside County.

Aerial lifts and *Arundo donax* in the Sacramento-San Joaquin Delta. Mark Newhouser. Sonoma Ecology Center, Eldridge, CA 95431. mark@sonomaecologycenter.org

The Sonoma Ecology Center (SEC) is currently implementing Arundo control work in the Cache Slough Complex of the Delta, targeting infestations, primarily along leveed waterways. To date, SEC has controlled over 5 acres of dispersed strands of Arundo along 44,000 linear feet of Delta levees. Due to steep and dangerous riprap slopes along many of the levees, SEC pioneered aerial boom lift foliar spray application methodology to effectively control large infestations at the base of levees and on flood plains. This presentation includes the pros and cons of aerial lift control methodology and other methods under consideration for control work in the Delta. The Delta Arundo Eradication project is funded by the Department of Water Resources and administered by the Sacramento-San Joaquin River Conservancy as a collaborative partnership between the Delta Conservancy, Solano Resource Conservation District and Sonoma Ecology Center.

Past, present, and future: saltcedar (*Tamarix* spp.) and biological control in California. Nicole Norelli[1]*, Tom Dudley[1], Adam Lambert[1], and Dan Bean[2]. [1]Riparian Invasion Research Laboratory, Marine Science Institute, University of California, Santa Barbara, CA. [2]Palisade Insectary, Colorado Department of Agriculture, Palisade, CO.nicole.norelli@ucsb.edu

Since its introduction, the tamarisk leaf beetle (*Diorhabda spp.*) has proven successful in suppressing tamarisk in many western states. The northern tamarisk beetle (*D. carinulata*) has expanded from Utah via the Virgin River into the lower Colorado River Basin where it established downstream of Parker Dam in late 2016; other populations are now present through the Bill Williams River system and on the Mojave River near Barstow. This expansion has involved evolution of new developmental cues for over-wintering, as currently being documented in experimental incubator trials at the Colorado Palisade Insectary.

Now that beetles are well established within the state boundaries, the California Alliance for Tamarisk Biocontrol (CATB) has been formed to facilitate acceptance and implementation of tamarisk biocontrol in California and to document the dispersal and effectiveness of *Diorhabda* across the state. The program is supported by Cal-EPA Department of Pesticide Regulation in an effort to reduce herbicide use in California by promoting the use of classical biological weed control (biocontrol) in the state. CATB is comprised of experts in the fields of biocontrol, invasive species management, endangered species protection, and ecosystem restoration. CATB connects with interested stakeholders to provide education and resources on the biocontrol of tamarisk and to implement new beetle releases in areas where the biocontrol agent would be useful. With the beetles now naturally moving into California, it is important to establish a comprehensive monitoring program

quickly and provide guidance on sensitive sites and planning resources for restoration where necessary ahead of the beetles' movement.

Mojave Desert native plant restoration following wildfires and weed treatments: the right seed in the right place. Judy Perkins[1]*, Lesley A. DeFalco[2], Dan Shryock[2], Loraine Washburn[3], Sarah DeGroot[3], and Heather Dial[4]. [1]Bureau of Land Management, Palm Springs, CA. [2]U.S. Geological Survey, Western Ecological Research Center, Henderson, NV. [3]Rancho Santa Ana Botanic Garden, Claremont, CA. [4]NRCS-Tucson Plant Materials Center, Tucson, AZ. jlperkins@blm.gov

Increasing large-scale wildfires, interacting with invasive species such as red brome, cheatgrass, and Sahara mustard, along with expanding renewable energy development, continue to negatively impact large acreages across the Mojave Desert Ecoregion. Restoring native plant communities can help prevent and reduce weed infestations, and mitigate wildfire and energy development impacts. However, harsh growing conditions, periodic drought, heavy granivore pressure on seeded sites, and lack of commercial native seed producers for Mojave species make restoration in this ecoregion challenging. Through implementation of the National Seed Strategy for Rehabilitation and Restoration 2015-2020, the Mojave Desert Native Plant Program (MDNPP) is coordinating interagency efforts to prioritize restoration species and improve success of restoration projects. Multi-faceted research supporting native plant restoration is underway to: 1) develop empiric seed transfer zones based on genetic analysis and common garden tests, 2) develop restoration decision-making tools for land managers, 3) develop seeding strategies to circumvent granivory on restoration sites, 4) develop Mojave Desert germplasm releases and species-specific growing techniques of use to commercial growers, and 5) support increased container stock production capability for the Mojave Desert Ecoregion. A major emphasis of the MDNPP is restoration of habitat for the Federally threatened Mojave Desert tortoise (*Gopherus agassizii*). Desert tortoise habitat has been heavily impacted by wildfires and subsequent annual brome infestations. Priority restoration species include those important for desert tortoise forage and cover, as well as species of value for pollinators.

Restoring soil microbial conditions after grass invasion for improved restoration. Brook Pickett[1]*, Irina Irvine[2], and [1]Emma Aronson.[1]University of California Riverside, Riverside, CA.[2]National Park Service, Thousand Oaks, CA. brookepic22@gmail.com.

Phalaris aquatica is an invasive bunchgrass that was removed from 2006–2013 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 significantly 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 the same abiotic conditions in the field. Both treatments contained microbes from the post-invaded site, but only one treatment contained native soil microbes. These two treatments were created to compare plant growth and survivorship to soil microbial composition. Over seven months, soil cores were taken for nitrogen and microbial composition analysis (16S genes were sequenced using an Illumina MiSeq), 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. These 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. For the first two months of growth, the microbial community composition between soil treatments were the same, but different than intact CSS and post-invasive grasscontrol soils. In the last month of growth, rhizosphere soil from destructively sampled native plants had different microbial composition between treatments. More microbial results will be discussed during the presentation. This study can improve the growth of native plants in restorations and increase our understanding of plant/microbe symbioses in invaded habitats.

Weed biological control in California: Review of the past and prospects for the future. Michael J. Pitcairn, California Department of Food and Agriculture, Sacramento, CA. mike.pitcairn@cdfa.ca.gov

The first release of an herbivorous organism for control of a weed in North America occurred in California in 1940 when Prof. Harry S. Smith, University of California, Riverside, collected a native scale insect in southern California and released it on native *Opuntia* spp. on Santa Cruz Island, offshore from Santa Barbara. The first release of an exotic agent to control an exotic weed occurred in 1945 with the release of a leaf-feeding beetle on Klamath weed in northern California. Since then, a total of 75 organisms have

been released on 37 weed species in California. Of these, 74% established; 22% failed to establish; 4% are too early to determine. Qualitative assessment of weed control following release suggests that 40% of the projects were a complete or partial success. Perennial and biennial weeds showed the highest rate of success; annual weeds, the lowest. Several new biocontrol agents are under review by USDA-APHIS including those that attack *Arundo donax*, hoary cress, and Dalmatian and yellow toadflaxes. The current permitting process for new biological control agents is reviewed and status of pending permits for new agents will be presented.

Management of a coastal bluff community invaded by *Oxalis pes-caprae* with low concentrations of glyphosate. Lewis Reed[1]*, Suzanne Olyarnik[1], and Tim Hyland[2].[1]University of California Davis, Bodega Marine Reserve, [2]California State Parks, Santa Cruz District. lkreed@ucdavis.edu

Oxalis pes-caprae is a South African geophyte that has become extremely invasive in coastal communities in California. Management of this species is particularly challenging on sites where this invader co-occurs with desirable native vegetation. In this study we evaluate the potential of low concentration applications of glyphosate as a control method for *O. pes-caprae*. Specifically, we sought to determine an effective application rate that would be low enough for some non-target species to survive. Using a randomized block experiment with repeated measures we compared the response of *O. pes-caprae* and its neighbors to three levels of glyphosate application (0.13%, 0.26%, and 0.52% active ingredient) and a control (0%). Plant community composition and species abundances were estimated using a $1m^2$ point intercept grid with 49 sampling points. In plots that received herbicide *O. pes-caprae* abundance was reduced by 92% from the baseline year to one year after the application with no significant difference between any of the herbicide levels and no significant change in control plots. During year two (post treatment) *O. pes-caprae* was an average of 88% lower in herbicide plots as compared to controls. Most non-target species in the community were negatively affected by the herbicide application however there were some positive responses and many non-target species were less severely impacted as compared to *O. pes-caprae*. These preliminary results indicate that *O. pes-caprae* is particularly vulnerable to glyphosate and may be substantially reduced by application rates that some non-target species can tolerate.

Erasing imaginary lines: working collaboratively across state and national park lines to combat invasive plants. Tom Reyes, National Park Service-Golden Gate National Recreation Area. Thomas_reyes@nps.gov

The Redwood Creek watershed in Marin County is a hotbed of biological diversity- home to over 600 plant species and at least four federally listed wildlife species. While many people are familiar to this watershed as home to Muir Woods, it consists of a patchwork of old-growth redwood forest, native perennial grassland, serpentine grassland, coastal scrub, and coastal dunes ecosystems.

The 5,000-acre watershed is also a patchwork of jurisdictions, containing National Park Service, California State Parks, water district, and private lands. Over the years, management has proven to be challenging because each jurisdiction has had different priorities, regulations, treatment histories and methods. Even though invasive plants do not observe political boundaries, land managers have been required to, making it extremely difficult to tackle invasive plant issues at a watershed scale.

In order to manage the watershed holistically and unite the goals and priorities of each jurisdiction, the Tam Lands Collaborative and OneTam were created, which has given rise to the inter-agency Redwood Creek Vegetation Program. This program allows national park, state park, and non-profit staff to work collaboratively across jurisdictional lines to implement landscape-level invasive plant management strategies. The program focuses on eradicating high priority target species throughout the watershed and increasing the capacity for revegetation efforts in and around Muir Woods. Over the next few years, the program will continue to grow to work towards a healthier and more botanically diverse Redwood Creek watershed.

Argentine ants may be significantly contributing to the spread of numerous invasive weeds. Greg Rubin, President & Founder, California's Own Native Landscape Design, Inc. greg@calowndesign.com

Far from being an aggravating nuisance, Argentine ants may pose enormous hidden dangers to native horticulture and along the Wildland-Urban Interface (WUI). Their support for Hemipteran infestation of root systems and studies indicating their spread of pathogens like Phytophthora spp. are possibly some of the primary causes leading to native plant mortality. Most pertinent to this conference, observational data would indicate that Argentine ants also sow and spread a huge variety of invasive plant species (and even some natives) within their radius of infestation. Because Argentine ants eat only the fleshy attachment point of the seeds and not the seeds themselves, they effectively spread these plants as a byproduct of their feeding. Their relationship to *Euphorbia spp.* (spurge) is

well documented; however, many other species have been observed at high concentrations in close correlation to ant trails and nests. These include some of our most aggressive weeds, like *Ehrharta spp.* (veldt grass), *Anagallis arvensis* (scarlet pimpernel), *Stellaria media* (chickweed), *Portulaca olearacea* (purslane), *Cotula spp.* (brass buttons), etc. This presentation will detail observations of the most common invasive (and native) species associated with Argentine ant infestations and how these plants can be used to indicate ant location. The current state of control methodology and its ultimate relationship to reduction in invasive weed concentrations will be explored. Areas of potential scientific research to test the validity of these observational hypotheses will be identified.

Thinking beyond the garden: how the Santa Barbara Botanic Garden confronts invasive plants via horticulture, education and research. Heather E. Schneider**.** Santa Barbara Botanic Garden, Santa Barbara, CA. hschneider@sbbg.org

Botanic gardens are uniquely situated to be powerful participants in the fight against invasive plant species. Representing the convergence of horticulture, public education, research and conservation, botanic gardens can address the issue from multiple angles. This talk will open with a philosophical discussion of the role that botanic gardens can play in the fight against invasive plants. For example, botanic gardens can facilitate connections between the horticultural industry, citizens and scientists. Next, I will offer examples of how the Santa Barbara Botanic Garden (SBBG) addresses invasive species issues both within and beyond the Garden via the Horticulture, Education and Conservation and Research Departments. For instance, we manage weeds within the Garden itself, interact with the gardening public, promote the use of native alternatives to invasive cultivars, reach out to schools and citizens, and conduct research and restoration projects in wildlands. We recognize that a major component to the long-term conservation of California's biodiversity is contingent on understanding, mitigating and, when possible, eliminating the threats imposed by invasive plants. The diversity of knowledge and skills at SBBG enable us to act as practitioners, advocates and researchers working toward conservation of California's native plants.

100 years of county coordination and statewide eradication of noxious and invasive weed species in California: a brief history. Steve Schoenig. California Department of Food and Agriculture, Sacramento, CA. seschoenig@gmail.com

The California Department of Food and Agriculture (CDFA) maintained a statewide program to eradicate terrestrial noxious weeds in California starting in 1910 (as the State Bureau of Horticulture) and ending in 2012, due to severe funding shortages. This program worked together with county Agricultural Commissioners, USDA, UC Cooperative Extension and others. Almost all listed CDFA noxious weeds are non-native and were predominantly brought to California (or America) *accidentally*, as agricultural contaminants or *intentionally*, through the activities of horticulture and agriculture. In the early decades of the program, there were not fully effective weed eradication tools. Therefore, motivation to prevent and quickly eradicate incipient infestations was paramount. Often local eradication success required decades of manual and harsh chemical control. Coordinated control efforts were focused on prevention, suppression and eradication mainly at the local level.

With the advent of modern herbicides in the 1940's weed eradication tools were cheaper and more effective. Ambition and program scope increased. Great success was achieved in eradicating 13 species completely from California, and locally eradicating hundreds of weed populations at the county and local level.

Despite the continued success of the statewide program into the later decades of the 20th century, there were challenges: 1) sustaining program efficacy, and 2) demonstrating the importance of the program to the agricultural industry, government decision makers and the citizenry of California. As economic downturns repeatedly hit California, CDFA and the County Ag Departments faced funding cuts and weed programs were disproportionately downsized due to assignment of low relative priority. A number of ideas are discussed for why the program "fell out of grace".

Luckily, many Agriculture Commissioners and other organizations still run local eradication programs. Cal-IPC fills some of the role in fostering statewide and regional coordination and continues to advocate for renewed state government leadership and funding.

Completing the knowledge cycle: Deriving IPM knowledge directly from practitioners on Working landscapes. Tracy Schohr[1*], Leslie Roche[1*], Julea Shaw[1*], Kenneth Tate[1,] and Elise Gornish[2*]. [1]University of California, Davis, [2]University of Arizona. tkschohr@ucdavis.edu

Practitioners hold one of the most voluminous caches of field-tested integrated pest management (IPM) experience. However, this information is generally not available in a synthesized, organized format for researchers and other managers to learn from. In one of the first coordinated efforts in the state, our

research team has analyzed decision making surveys of practitioners from across California and conducted semi-structured interviews with ranchers and agencies, to mine knowledge from over 200 IPM practitioners on rangelands. Survey and interview findings elucidate factors that realistically contribute to IPM adoption and success, and showcase field-tested best management practices to control invasive species with managed grazing, seeding, herbicides and prescribed fire. There are many stakeholders who are vested in re-establishing ecosystem health and productivity on rangelands. Results from this work will inform on-the-ground management strategies with case studies from dozens of practitioners. The project assessed the effectiveness of different pest management tools and provides a data-driven description of IPM practices that maximize cost effectiveness while conserving diversity, and promote productivity.

Invasive plant management on the Farallon Islands National Wildlife Refuge. Jonathan Shore*. U.S. Fish and Wildlife Service, Farallon Islands National Wildlife Refuge, San Francisco Bay National Wildlife Refuge Complex, Fremont, CA. Jonathan_shore@fws.gov

The Farallon Islands are an island group, 30 miles off the coast of San Francisco. Management occurs on Southeast Farallon Island at 121 acres. The islands are a breeding ground for 12 seabird species. The island is infested with a variety of invasive weeds that degrade the value of habitat to wildlife. *Tetragonia tetragonioides* and *Malva* spp. have been the focal point of control efforts. The prevention of infestation of certain parts of the island is achieved by removal of any outlier weeds, limiting human foot traffic, installing boot brushes at key access points to assist in removing invasive seeds and thus preventing spread. Limited accessibility prevents the use of any heavy equipment or motorized vehicles. All application efforts are conducted with manual labor, primarily herbicide application with backpack sprayers. However, by utilizing volunteers this has been achievable with limited funding. Since the island is essentially an isolated ecosystem, eradication is a realistic and achievable goal. Historic management activities that focused primarily on controlling the spread of invasive plants did nothing to prevent invasives from contributing to the well-established seed bank. However, in order to achieve the long-term goal of eradication, a new strategy has been implemented. Two concerted efforts per year involving groups of up to 7 volunteers are organized by Refuge staff. These efforts are timed so that the majority of plants are not seeding when the herbicide is applied. Generally, these efforts are able to treat most focal species on the island. In addition, the eventual goal of eradication includes periodic weed mapping surveys, (conducted in 2016), efficacy monitoring, and the implementation of a bio-security plan (pending). With these efforts and the development of a habitat management plan, the goal of eradicating invasive plants from this sensitive island ecosystem will be realized.

Effects of renewable energy development on demography of *Brassica tournefortii*. Karen E. Tanner[1]*, Kara A. Moore[2], Ingrid M. Parker[1], Rebecca R. Hernandez[3]. [1]University of California, Santa Cruz. [2]U.S. Fish & Wildlife Service. [3]University of California, Davis. karen.e.tanner@gmail.com

Renewable energy infrastructure changes natural light and water regimes in ways that may strongly affect plant performance. Annual species may be most sensitive to these effects, because persistence depends on regeneration from a seed bank. Of particular concern is the response of invasive species, because infestations may increase if altered abiotic conditions favor their success – yet little is known about how changes imposed by infrastructure will affect weed performance. Effective weed control requires understanding how altered conditions affect belowground seed reserves as well as aboveground life stages. We ask how vital rates of the invasive Sahara mustard (*Brassica tournefortii*) are affected by experimental shading. Desiccation-sensitive seedlings may benefit from shading, but work in other systems has shown higher seed mortality with decreasing light and increasing moisture, abiotic shifts likely to occur under arrays. We track plants through aboveground life stages, and use artificial seed banks to assess survival and germination rates for seed in control and shade plots. Because moisture is known to negatively affect seed survival in other systems, possibly by facilitating fungal attack, we subject half of our seed banks to a fungicidal treatment. We incorporate empirical vital rates into matrix models to explore effects at the population level, asking how performance differs between control and shade locations. This work will generate findings that can inform control strategies for Sahara mustard, contribute to understanding of microhabitat effects on seed bank dynamics, and shed light on population-level impacts of solar development.

Is glyphosate a human carcinogen? Joel Trumbo. California Department of Fish and Wildlife, Sacramento, CA. Joel.Trumbo@wildlife.ca.gov

Glyphosate, the active ingredient in RoundUp herbicides, is one of the most used—and most studied—herbicides in the world. It is also one of the most used herbicides by land managers controlling invasive plants in wildlands. Ratings by international,

national and state agencies have been in flux in the last several years, and it is important that land managers stay informed about the current status. In 2015, the World Health Organization's International Agency for Research on Cancer (IARC) classified glyphosate, the active ingredient in RoundUp herbicide, as "probably carcinogenic to humans." But in 2016, the World Health Organization concluded that "glyphosate is unlikely to pose a carcinogenic risk to humans from exposure through the diet." The US Environmental Protection Agency (EPA) re-examined all pertinent scientific studies and disagreed with the IARC conclusion, concluding that glyphosate is "not likely to be carcinogenic to humans" at doses relevant to human health risk. More recently, a Scientific Advisory Panel convened by the US EPA during a 4-day meeting was split in their expert opinion: Some agreed with the US EPA Issue Paper's conclusion that glyphosate is not likely to be carcinogenic to humans, especially at reasonably foreseeable dose-rates, while other panel members thought it would be more accurate to say that there is "suggestive evidence of carcinogenic potential." In California, the IARC classification triggered the California Office of Environmental Health and Hazard Assessment (OEHHA) to mandate that products containing glyphosate receive a Prop. 65 warning label as a "known carcinogen." This went into effect on July 7, 2017. OEHHA has proposed the establishment of a "no significant risk level" for glyphosate. The initial proposed level was 1100 micrograms/day, and peer review and public comment have been solicited. A final rule is pending. Meanwhile, citizens concerned about pesticides in the environment are confronting land management agencies about the use of herbicide, so it is important for land managers to know that glyphosate is legal and extremely low-risk.

Forest health and watershed improvement through noxious weed management. Susan Urie[1]*, Joel Trumbo[2], Matt Freitas[3]. [1]Tahoe National Forest, Truckee, CA. [2]California Department of Fish and Wildlife, Sacramento, CA. [3]Truckee River Watershed Council, Truckee, CA. surie@fs.fed.us

The goal of this project is to improve the long-term health of recently completed forest health and watershed improvement projects in the Sierra Nevada Mountains by managing and preventing the spread of noxious weeds. This is a collaboration between a local non-profit, Truckee River Watershed Council (TRWC); federal agency, Tahoe National Forest (TNF); and state agencies, California Department of Fish and Wildlife (CDFW) and the California Conservation Corp (CCC).

Watershed Improvement projects often end with restoration construction. Forest health projects end with thinning and fuels management. In both cases, soils are disturbed and vulnerable to weed infestations. Musk thistle (*Carduus nutans*) is an A-rated noxious weed which was found to be present in 1994, on the east side of the Tahoe National Forest. Since musk thistle is a noxious weed, spread by wind-dispersed seed, it has been spreading across the landscape and developing concentrations in disturbed areas, such as landings and underburned sites.

The collaborative group applied to the Sierra Nevada Conservancy for Proposition 1 to fund noxious weed management. Activities include repeating cycles of survey, treatment, monitoring and native seed sowing to establish plant cover. Surveys will be conducted to discover new infestations across 6,000 acres per year, of previously completed forest health and watershed improvement projects, for 3 years. Infestation treatments will be done by manual methods on 350 acres of federal lands per year and by herbicide spraying on 100 acres of state lands, across 118,000 acres of TNF and CDFW system lands. The affected Sierra Nevada Mountain plant communities are Eastside Pine with bitterbrush, sagebrush, snowbrush and manzanita.

Changes to plant functional traits and seed production in response to drought in native and invasive annuals of California. Justin Valliere*, Evelin Escobedo, Jacqueline Zhang and Philip Rundel. University of California, Los Angeles. valliere@ucla.edu

Phenotypic plasticity – the ability of a plant to adjust traits in response to environmental fluctuations – has often been invoked as an important mechanism of nonnative plant invasion. However, most studies explore plastic responses of only vegetative traits, and few have measured plasticity of reproductive traits in invasive plants. Furthermore, it is unknown how plasticity of seed production and seed traits may differ between invasive species and the native species they displace. We asked how drought influences plant vegetative and reproductive traits and plasticity in common native and invasive plant species of California. We grew 8 species of native annuals and 8 species of invasive annuals under well-watered and drought-stressed conditions on rooftop benches at the University of California, Los Angeles. Plants were grown to reproductive maturity, at which point seeds and plant biomass (both roots and shoots) were collected. We also measured plant growth and vegetative traits throughout the experiment. We then compared traits and trait plasticity in response to drought across species. Exposure to drought initially resulted in a slowed growth and a reduction in plant biomass. We also observed alterations to plant functional traits in response to drought, but these responses were largely species-specific. Seed production and seed mass differed greatly across

species, and while drought generally resulted in reduced biomass and seed output, the magnitude of this effect was quite variable. Further research is necessary to determine potential impacts on seed viability and other traits. The seeds from this experiment will also be grown in future experiments to test transgenerational effects of drought in native and invasive plant species. By exploring differences in reproductive plant traits between native and invasive plant species and how these traits are impacted by drought, we hope to better understand the mechanisms of nonnative plant invasion under environmental change.

***Volutaria* detection and management at Upper Newport Bay, Orange County.** Ron Vanderhoff. California Native Plant Society, Orange County Chapter. rvanderhoff@sbcglobal.net

In March of 2015 a native plant and bird enthusiast noticed an unusual plant growing along a trail in the Big Canyon portion of Upper Newport Bay, Orange County. Uncertain of what it was, its location and photographs were sent to the Orange County (OC) CNPS Emergent Invasive Plant Committee. It was identified as *Volutaria*. The next day a field check revealed a modest population. Within days, the coordination of a Rapid Response was underway, with numerous land managers and agencies working collaboratively. After only a few weeks the area was surveyed and aggressive management had begun. In an interesting twist, about two years later, some old records were uncovered of *Centaurea muricata* at another location in the bay. Online photos and a herbaria check revealed that these records were actually of *Volutaria tubuliflora* and dated back to at least 1987. On 8 Jan 2017 a field check by OC CNPS to the area of this earlier record revealed a second large *Volutaria* colony about a mile from the Big Canyon infestation. This second colony has also received a Rapid Response. These Orange County infestations will illustrate the importance of communication and collaborative efforts, when faced with a new invasive species and the value of a Rapid Response. It now appears that Newport Beach was the entry point for this species to California, further underlining the value of an early detection network, proper identification, an engaged public and a facility for the reporting and communication of possible new invasive plant species.

The hoe isn't the only thing scuffling: Testing non-chemical control techniques for *Brachypodium distachyon* in serpentine and non-serpentine grasslands

Andrea Williams*, Raphaela Floreani Buzbee, Chris Qian, and Leslie Fisher-Sanders. Marin Municipal Water District, Corte Madera, CA. awilliams@marinwater.org

The Marin Municipal Water District (MMWD) stewards 22,000 acres of watershed lands, including nearly 1,500 acres of grasslands, serpentine grasslands, and serpentine barrens. These habitats support over half the rare plant diversity, and are being overrun by false brome, *Brachypodium distachyon*. The district does not use herbicide, and has had difficulty in implementing prescribed burning. To assess effectiveness of available techniques, the district tested the following weed control methods: mowing with a string trimmer, propane flaming, hand-pulling, and scuffle hoeing (hula hoeing) at three sites with paired serpentine and non-serpentine grasslands. MMWD also partnered with Marin County Parks and Open Space to test an organic herbicide (*d*-limonene) at an additional site. Monitoring showed a reduction in both cover and frequency of false brome for all control techniques, with hand-pulling and flaming the least damaging to native species. Organic herbicide was the fastest but least effective of control techniques (small sample size warning); mowing and flaming took similar amounts of time and were similarly effective, but flaming was the only method that resulted in an increase in rare serpentine annuals.

Respiratory protection requirements for herbicides. Emma R. Wilson. California Department of Pesticide Regulation, Sacramento, CA. emma.wilson@cdpr.ca.gov

The requirements for respiratory protection when handling commonly applied herbicides for invasive plants are determined by the label, regulations, permit conditions, and employer policies. Unlike other industries that require respirator selection logic when determining a respirator type, pesticide handlers can look at the label to ascertain what kind of respirator they should be using. In addition, regulations for respiratory protection include those developed by DPR (3 CCR 6739) which is specifically for handlers of pesticides. Many of the products that are commonly used for invasive plant control do not require respirators, which can be due to the toxicity of the chemical, the vapor pressure, and the application method used. DPR offers many resources on the website (http://cdpr.ca.gov) to help mitigate inhalation exposure to pesticides, including the Pesticide Safety Information Series (PSIS).

Mapping, prioritization, and eradication of *Arundo donax* in the Sacramento-San Joaquin Delta. Alex Young*, Mark Newhouser. Sonoma Ecology Center, Eldridge, CA 95431. alex@sonomaecologycenter.org

It is generally accepted by the invasive plant control community that there is not enough funding to eradicate all problem weeds, and the work of invasive species control must be strategically focused. For many years, Team Arundo del Norte and the Sonoma Ecology Center have been working on the control of riparian invader *Arundo donax* (giant reed). With funding from the California Department of Water Resources and leadership of the Sacramento-San Joaquin Delta Conservancy, the Sonoma Ecology Center (SEC) mapped the distribution of Arundo donax within the boundary of the Legal Delta. Infestations were digitized in GIS using 1-ft resolution aerial imagery along the riparian corridors of all navigable channels within the Sacramento-San Joaquin Delta. To determine eradication priorities, habitat suitability data for a suite of representative riparian species were assigned threat indices to derive an Index-based Multi-species Conservation Value (IMCV). The IMCV metric is a measure of habitat value and indicates a priority for eradicating invasive species threats to that habitat. These rankings are weighted by threatened or endangered listing status to give greater weight to listed species. Delta specific as well as threatened and endangered species were selected with the help of biologists at CDFW, CDWR, Delta Conservancy and Sonoma Ecology Center. 23 species from 7 taxa were considered for the IMCV. The results of this mapping and prioritization process are guiding our current selection of Arundo eradication sites in the Delta.

Poster Abstracts

Joshua Tree National Park Invasive Plant Patrol. Rose Alvarez* and Neil Frakes. Joshua Tree National Park, Twentynine Palms, CA. rmalvarez91@gmail.com

The Joshua Tree National Park Invasive Plant Patrol is both a citizen science and early detection rapid response approach to monitor and combat invasive plant infestations. The mission of the Invasive Plant Patrol is to supplement the Exotic Plant Management Team by monitoring invasive plants' reproductive cycle and focusing treatment on emerging populations in Joshua Tree National Park. The Invasive Plant Patrol is a volunteer system that has the potential to limit invasive plants from spreading into new locations. Volunteers participate on their own time and choose whether they work individually or in groups. Only satellite populations of 100 plants or less may be treated as the goal of the program is to limit infections in new areas. Treatment is defined explicitly as cutting and removing sections of the plant. Any pulling or removal of the root system is prohibited as it may disrupt the soil structure and preservation of historical artifacts. If an invasive plant is an annual, the plant is cut below the basal rosette of leaves. However if it is a perennial, the reproductive parts, such as the flowering or fruiting structure, are cut and removed. In May 2017, the first month of the program, over 3,000 square meters of the park were surveyed, and 172 invasive plants were treated.

Allelopathic impacts of *Schinus molle* on exotic and native plant communities in southern California. David Bañuelas*. Cal Poly Pomona. dcbanuelas@cpp.edu

Schinus molle (California pepper tree) was first introduced to California in 1840. Since then it has naturalized throughout the state, with its impact on native plant communities still largely unknown. However, in South Africa and other regions the species has severely impacted native plant communities. The pepper tree is also allelopathic, producing chemicals that inhibit the growth of competing plant species. To understand how chemical inhibition might impact plant communities in southern California, three native and three exotic species were sown in soil collected beneath the canopies of male and female pepper trees. The species may potentially alter the soil microbiota and can impact restoration efforts when specimens are removed or cutback. Additionally, an allelopathic mulch from female and male trees was applied to test species in potting soil to determine the impacts of allelopathic mulch. Previous research has shown staminate flowers have the most potent allelopathy. The results of this study will be the first step in elucidating how pepper trees impact both native and exotic plant communities. If native species can withstand soil effects and allelopathic mulch, while exotic species cannot, allelopathy may serve as a viable restoration technique.

Northward expansion of invasive shot hole borers (*Euwallacea*spp. nr. *Fornicates* [*Curculionidae*]) in riparian systems of central California. Shelley Bennett* and Tom Dudley. University of California, Santa Barbara. michelle.bennett@lifesci.ucsb.edu

The Polyphagous and Kuroshio shot hole borers (*Euwallacea*spp. nr.*fornicatus* [*Curculionidae*]) are recent invaders of southern Californian riparian

habitats. These beetles have a broad host range of many invasive woody plant species, like castor bean (*Ricinuscommunis*[Euphorbiaceae]), as well as native, dominant riparian species, including sycamores (*Platanus* spp. [Platanaceae]), oaks (*Quercus* spp. [Fagaceae]), willows (*Salix* spp. [Salicaceae]), cottonwoods (*Populus* spp. [Salicaceae]) and maples (*Acer* spp. [Sapindaceae]). The shot hole borers carry obligate fungal symbionts that are inoculated into host trees and often grow into the host's xylem, leading to branch dieback and mortality. The distribution of shot hole borers (SHB) in riparian habitats is not well known in the northern extent of their expanding range. Aside from two singletons detected in Santa Cruz and San Luis Obispo Counties in 2014 and 2016, respectively, the most northern known infestation was detected in Santa Barbara County in September 2016. To better characterize SHB distribution in central California, I deployed detection traps in Ventura and Santa Barbara Counties. Bottle traps baited with a chemical attractant (Quercivorol) were monitored bi-weekly. I found SHB in previously undetected areas in both Ventura and Santa Barbara Counties, indicating that the species' range is continuing to expand from initial detection locations, either due to natural or human facilitated dispersal. Future surveys (2017-2018) will be expanded both northward and into desert regions to better understand the rate of population expansion and potential limits to SHB establishment, as well as to evaluate host plant use in more mesic and xeric ecosystems than those currently infested in Southern California.

They're back: Discovery of an established nutria population in California's Central Valley. Valerie Cook Fletcher, Invasive Species Program, California Department of Fish and Wildlife, Sacramento, CA. Valerie.Cook-Fletcher@wildlife.ca.gov.

Nutria (*Myocastor coypus*) are large, semi-aquatic rodents that strongly resemble beavers and muskrats; adult nutria are approximately 1/3 the size of adult beaver and over 5 times the size of a muskrat. Native to South America, nutria were introduced in the U.S. for the fur-trade in 1899 and later successfully farmed in California during the 1940s-60s. Once the fur market collapsed, nutria were released into the environment and established feral populations, primarily in the Central Valley. Nutria consume up to 25% of their body weight in above- and below-ground plant material each day; due to their feeding habits, up to 10 times the amount of plant material consumed is destroyed. The loss of plant cover and soil organic matter (roots, rhizomes, tubers) results in severe erosion of soils and denuded wetlands, often leaving behind open water. However, through subsequent control efforts, nutria were declared eradicated from California by 1978. In March 2017, a female nutria carrying 7 fetuses was incidentally trapped on a private duck club in Merced County. Since that time, 16 additional nutria have been taken from the private property's wetlands, the San Joaquin River, and a pond adjacent to the Merced River, with captures 17 linear-miles apart. Additional observations, damage, and sign have been reported within a 20-mile radius. The California Department of Fish and Wildlife and its project partner agencies have declared rapid response efforts are imperative for successful eradication and prevention of significant environmental and agricultural impacts in the Sacramento-San Joaquin River Delta watershed. The Nutria Interagency Response Team is currently pursuing local outreach, efforts to delineate the population, long-term survey and trapping efforts, and long-term project funding.

Japanese Dodder, *Cuscuta japonica*, control and eradication efforts in Alameda County 2015 to 2017. Edmund Duarte, Alameda County Department of Agriculture/Weights and Measures, Hayward, CA. edmund.duarte@acgov.org.

Over the last decade, Alameda County along with other regions of California have experienced recurring sporadic infestations of *Cuscuta japonica*, Japanese Dodder. Japanese Dodder is a parasitic plant of foreign origin with purported medicinal uses used by certain south-east Asian cultural communities. The plant is spread by direct movement of strands by people or wildlife, which attaches to a susceptible host and rapidly grows and overtakes the host. Japanese Dodder is CDFA A-rated and is subject to quarantine enforcement action. Infestations of Japanese Dodder are mechanically removed by affected property owners under departmental supervision. Disposal by deep burial of infested host material at the landfill is required by quarantine regulation resulting in labor-intensive removal projects. To date, Japanese Dodder has been found primarily in urban residential neighborhoods and associated parklands, but this pest poses a serious threat to natural resource areas if spread occurs to remote or inaccessible areas or other high value sites. State eradication funding for Japanese Dodder was terminated in 2011. Local agencies have worked cooperatively since then with affected property owners to maintain control of the pest locally. In 2015 the Alameda County Department of Agriculture was awarded funds by the US Forest Service and CDFA to support ongoing eradication efforts in Alameda County. During this period over 20 infestations have been removed by departmental staff in cooperation with agency collaborators and affected property owners. During this work, *In-situ* control of the pest with herbicides with successful host recovery

has been observed. Alternative control strategies are also proposed to assist affected owners greater flexibility for disposal and treatment.

Assessing vegetation cover metrics through the use of unmanned aerial vehicles (UAVs) and image analysis software for use in habitat restoration.
Alex Fromer*, Mike Nieto, Karyl Palmer, and Frank McDermott. RECON Environmental, San Diego, CA. afromer@reconenvironmental.com

In habitat restoration various methods are used to quantitatively assess the success of restoration projects. Often, these methods require the visual estimation of the percent cover of target species within the restored areas compared to those of reference sites in the form of vegetation transects or relevé plots. These metrics are typically acquired from the extrapolation of several visual samples from smaller sub-sets and/or averaged to get an approximate representation of the vegetation stand. Alternatively, a UAV can collect aerial imagery of a site and later use image analysis software to estimate percent cover. This study compares the estimation of vegetative percent cover between two methodologies: visual estimation and digital image analysis on stands of riparian vegetation within the San Luis Rey River in coastal Southern California. It is hoped that a comparison of the precision and accuracy of methodologies will allow for a more efficient and accurate way to assess the success of restoration areas.

Competition from native perennial grasses decreases overall fitness in field bindweed (*Convolvulus arvensis*).
Breahna Gillespie[1]*, Helen Holmlund[2], and Elise Gornish[1]. [1]Restoration Ecology at University of California, Davis. [2] Department of Ecology and Evolutionary Biology University of California, Santa Cruz. bgillespie@ucdavis.edu.

Field bindweed (*Convolvulus arvensis*) is one of the most serious and persistent perennial weed in North American agricultural areas. It is often found in highly disturbed areas, and is able to resist extirpation attempts because of its extensive root system. Perennial grassland species provide competition for light and water resources to native and desired plant species. Despite resistance to removal in agricultural areas, field bindweed is difficult to establish in sites with consistent and stable vegetation. We compared field bindweed individuals found in three microhabitats: near roadsides on bare ground, in a matrix of ungrazed native seeded grasses, and in a matrix of grazed native seeded grasses. Fitness will be defined under several ecophysiological parameters. Data will be collected in the summer of 2017 and results will be forthcoming.

Complexity, constraints and challenges of tamarisk treatment in the Mojave River watershed.
Kenneth Lair[1*], Chuck Bell[2], and Jackie Lindgren[2*] [1]Lair Restoration Consulting, Apple Valley, CA and [2]Mojave Desert Resource Conservation District, Victorville, CA. klair1968@gmail.com.

Effective treatment of tamarisk (*Tamarix* spp.) in the Mojave River watershed (CA) is challenged and constrained by a complex interaction of biotic, abiotic, land ownership, and agency policy variables. Treatment approaches to these constraints will be discussed.

Multiple tamarisk species, with two (possibly three) species – *Tamarix ramosissima, T. parviflora, T. chinensis* – and possible hybrids between these species, present challenges to effective overall treatment. The climatic and hydrologic environment along the Mojave River watershed is characterized by extremes in heat, aridity, and wind prevalence during much of the year. These extremes adversely affect optimum treatment timing (diurnally and seasonally) for foliar spraying. Relatively unique plant morphology also affects treatment efficacy using herbicides. Individually large, clonal plants with numerous stems, layered canopies, and very dense, high canopy volume (laterally and vertically) result in Increased time, labor, materials, and need for higher-pressure sprayer technology for full canopy coverage with foliar techniques. Likewise, it is extremely difficult to conduct basal bark treatment due to limited access to plant interiors within the dense canopies. There also requires significantly increased time, labor, and materials required for full coverage with cut-stump techniques.

Extremely sandy streambed and riparian soils, resulting from stream flow dynamics and particularly high wind erosion deposition effects, limits equipment access. These porous soils also severely increase water infiltration and deep percolation, lowering water holding capacity in the root zone. Potential Southwestern willow flycatcher (SWF) habitat exists at several locations along the Mojave River system (e.g., Lower Narrows, Oro Grande, and Camp Cady). Effective tamarisk treatment is directly affected by occasionally conflicting water conservation and salvage, effluent discharge, and aquifer recharge issues. Effluent and aquifer recharge discharge into the river system at various locations increase prevalence of incipient tamarisk establishment and encroachment. There are also multiple land ownership types that must be coordinated for effective, cross-boundary treatment.

Development of desert panicgrass (*Panicum urvilleanum* Kunth.) for use in southwestern desert river channel and riparian restoration. Kenneth Lair [1*], Matthew Huffine [2], Lyn Shirley [3], Heather Dial [4], and Chuck Bell [5]. [1]Lair Restoration Consulting, Apple Valley, CA, [2] Lewis Center for Educational Research, Apple Valley, CA, [3]Department of Agriculture and Natural Resources, Victor Valley College, Victorville, CA, [4]Tucson Plant Materials Center, Natural Resources Conservation Service, Tucson, AZ, [5]Mojave Desert Resource Conservation District, Victorville, CA. klair1968@gmail.com.

Groundwater depletion from irrigation pumping, alteration of river flows, and severe drought have accelerated wind erosion events to severe, historically unprecedented levels along the lower Mojave River. Migrating sand is now quickly moving, covering endemic landscapes, and in essence producing a localized "desertification" effect along the river. The Mojave Desert Resource Conservation District, Mojave Water Agency, Lewis Center for Educational Research, Victor Valley College, and the Natural Resources Conservation Service are working to investigate and develop desert panicgrass (*Panicum urvilleanum* Kunth.) as a revegetation species for the moving sands and adjacent sandy riparian sites, to prevent further sand dune encroachment. Desert panicgrass is a native, perennial, rhizomatous grass that is adapted to unique Southwestern desert riparian environments, particularly sandy channels and aeolian dunes in dry-to-ephemeral river channels and floodplains in the lower Mojave and Colorado River drainages. Desert panicgrass along the lower Mojave River system is found in typical association with saltcedar (*Tamarix* spp.), mesquite (*Prosopis* spp.), Indian ricegrass (*Achnatherum hymenoides*), and native forbs such as desert twinbugs (*Dicoriacanescens*).

Desert panicgrass holds great promise as a key native grass that will fill a vacant niche for a vigorous, rhizomatous, perennial grass species for revegetation applications in extreme southwestern desert riparian ecosystems. Desert panicgrass can provide a potentially important herbaceous component of seed or plant mixtures that address erosion control, channel / riparian area stabilization, and habitat recovery in the Mojave River and similar river systems. The project partners have collected seed; conducted germination testing across soil texture, seeding depth, and stratification treatments; and have started seed increase fields and local regional field trials -- all in hopes of having it ready as a source-identified release by 2018.

Investigating allelopathy and soil moisture as factors determining community composition of a Southern California black walnut woodland. Jose Marfori* and Dr. Erin Questad.

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Soil moisture and allelopathy, the chemical inhibition of one plant by another, can both affect plant germination and establishment. Understanding their interaction can help explain the distribution of native and invasive plant species and provide methods for cultural control of invasive plants. *Juglans californica*, a Southern California endemic tree, produces juglone. Juglone's allelopathic effects have been studied on agriculturally significant crops but not on how it could affect invasive and native species occurring under the canopy of *Juglans californica*. *Brassica nigra* is an invasive forb that produces allelopathic mustard oils and is also a dominant member of some walnut woodland communities. Since these allelochemicals are typically abundant during times of high soil moisture, it is likely both species' allelopathic potentials are most influential in winter than in summer. Invasive dominance in the walnut woodland may be due to invasive species' higher tolerance of allelopathy than native species. Our ongoing greenhouse experiment tests the tolerance of invasive and native species to allelochemicals from *J. californica* and *B. nigra* under dry and wet soil conditions. Three native and three invasive species are being treated with the following treatments: *J. californica* mulch, *B. nigra* mulch, hay mulch, allyl isothiocyanate, juglone, or tap water. To examine how soil moisture and allelopathy interact, each plant is also given a moisture regime: dry or wet. Each treatment combination is replicated four times. By studying the tolerance of these species to allelopathy, we can better understand why invasive species are more abundant in this ecosystem. We can also determine if mulch derived from walnut litter can be useful in the management of invaded areas. This study will also help determine if walnut- or mustard-derived natural herbicides could be effective in controlling invasive plant species.

Effects of fire on herbicide. Jessica Morrison[1]*, Noreen Murano[1], Sam Lantz[1], and Laura Riege[2]. [1]Resource Conservation Partners, Ventura, CA, [2]The Nature Conservancy, CA. jmorrison@resourceconservationpartners.org.

The Santa Clara River is one of the most dynamic river systems in southern California. The river drains the coastal mountains ranges north of Los Angeles by flowing west onto the Oxnard Plain and into the Santa

Barbara Channel. The Nature Conservancy owns 146 acres of floodplain in the Santa Clara River in the City of Santa Paula. On June 22, 2015, a wildfire burned approximately 100 acres of riparian vegetation including strands of giant reed (*Arundo donax*). Only one week after the fire giant reed was sprouting within the burn area. In August 2015, The Nature Conservancy awarded Resource Conservation Partners the contract for Arundo treatment on the Banman property in the Santa Clara River.

The site is now full of diversity boasting many species that have not been seen in bloom in quite a while, including Mexican elderberry and sandbar willow. Spring rain and heat greatly supported native growth and provided a nesting site for least Bell's vireo.

The critical lessons learned that will be valuable expertise in future post-fire Arundo treatment projects are: fire creates nitrogen and nutrient rich ash; ash creates a barrier netting and lower herbicide efficacy; ash dust on plants bound with glyphosate decreased efficacy and recommended calibration of herbicide was ineffective for given scenario.

Implementing an Early Detection Program on Catalina Island: Prioritizing landscaped grasses. Julia Parish. Catalina Island Conservancy, Avalon, CA. jparish@catalinaconservancy.org.

Invasive species pose a significant threat to native plant species by increasing the risk of wildland fires, displacing native species, and altering native habitat. Recent trends in Southern California landscaping have increased the demand for drought resistant grasses, and often these are non-native species. Catalina Island Conservancy's Catalina Habitat Improvement and Restoration Program's invasive plant project developed an early detection and rapid response project, the Avalon Grasses Initiative, in 2016 to address recent introductions of three highly invasive grass species installed in landscaping. The Avalon Grasses Initiative implements "target-based" early detection methodology created by previous research and early detection efforts conducted on mainland California. Roadside surveys detect populations, staff walks through the community going door to door to request permission to remove target species and offer native plants as replacement. Initial surveys detected 30 populations of *Cortaderia selloana*, *Pennisetum setaceum*, and *Stipa tenuissima*. Control and survey efforts are on-going, but more than 1,000 plants have already been removed and replaced with native Catalina Island plant species grown in the Conservancy's native plant nursery.

Weed vs. crop differentiation using crop marking systems. HannahJoy Pheasant[1*], Steve Fennimore[2], and John S. Rachuy[2]. [1]UC Davis, Dep. of Plant Sciences, Davis, CA, [2]UC Davis, Dep. of Plant Sciences, Salinas, CA. hpheasant@ucdavis.edu.

Increasing weed control costs threaten vegetable crop grower profitability due to labor shortages, rising labor expense, as well as lack of and loss of herbicides. Automated weed control systems can help to contain or decrease weed control costs. Traditional inter-row mechanical cultivation is not sufficient, as it does not remove weeds within the seed line at early growth periods when competition for nutrients, water and light is critical. Thus, intra-row hand weeding is necessary, but increasingly expensive. Current intra-row weeders commercially available do not differentiate between crops and weeds, but rather rely on row pattern recognition. The row-pattern recognition systems are problematic where weed populations are high and the row pattern cannot be detected. In these weedy situations, the machines cease to function or cause damage to the crop. We are testing four methods to mark crops to make them distinct from weeds and detectable by a mechanized weeder: 1) Systemic Markers, 2) Topical Markers, 3) Plant Labels, and 4) Biodegradable RFID tags. The goal of the project is to develop automated weed control systems that achieve significant reductions in need for hand weeding and herbicides while maintaining a practical and cost-effective weed control system.

Facilitative effects of nurse shrubs on growth and survival of California sage scrub native plants. Lauren H. Quon* and Dr. Erin J. Questad. Biological Sciences Department, Cal Poly Pomona, Pomona, CA. Lhquon@cpp.edu.

Recent and significant environmental changes have greatly affected native recruitment and re-establishment in chaparral and sage scrub plant communities. Larger, established shrubs of these water-limited environments may play important roles in facilitation, where neighboring plants may benefit from shared resources and protection from herbivory. Indeed, living plants strongly influence community structure and interactions; however, there is little information suggesting that dead shrubs and trees in drought-affected landscapes may also provide similar services as live shrubs. We conducted an experiment in the Cal Poly Pomona Voorhis Ecological Reserve (VER) to determine whether seedling survival depends on abiotic factors (microclimate conditions nurse plants create), or on biotic factors (herbivory). Two native woody shrubs (*Artemisia californica* and *Salvia mellifera*) and four annual native species (*Amsinckia intermedia, Deinandra fasciculata, Phacelia distans,* and *Pseudognaphalium californicum*) were outplanted and sown, respectively, in five blocks with three nurse treatments (live shrub, dead shrub, and exposed

areas), and a nested caged and uncaged treatment in each. Environmental sensors and trail cameras were installed to measure abiotic factors and capture and estimate herbivore occupancy. Leaf water potential, plant height, and abiotic data were analyzed to determine abiotic and biotic effects on growth and survivorship under nurse shrub and caged treatments. We found that cage treatments significantly affected *A. californica* growth, ($F_{1, 584}$= 194.751, p< 0.001) and *S. mellifera* growth ($F_{1, 584}$= 12.8186, 1 df, p< 0.001) in 2016. Cages deterred herbivory by small mammals in all blocks. Collection and analysis of annual seedling germination and growth is ongoing, and we expect to see similar patterns in annual species as those observed in shrub seedlings.

Managing *Egeria densa* and other invasive aquatic plants as part of the Delta Smelt Resiliency Strategy. Nick Rasmussen[1]*, Heather Green[1], Shruti Khanna[2], Jeffrey Caudill[3], Eli Ateljevich[1], and Louise Conrad[1]. [1]California Department of Water Resources, West Sacramento, CA, [2]University of California-Davis, Davis, CA, [3]California State Parks, Division of Boating and Waterways, Sacramento, CA. Nicholas.Rasmussen@water.ca.gov.

The San Francisco Estuary (SFE) is plagued by a suite of aquatic macrophyte invaders. *Egeria densa* is one of the most dominant of these invaders, comprising >80% of the submerged vegetation biomass in some regions of the estuary. Research in lentic systems has shown that *Egeria* acts as an ecosystem engineer by slowing water velocities, limiting sediment re-suspension, outcompeting native plants, and reducing phytoplankton productivity. However, relatively little work has been done on the impacts of *Egeria*invasions in estuarine systems. This is a critical knowledge gap because the hydrology of estuaries is dynamic relative to most lentic systems, implying potential differences in ecological impacts of macrophyte invaders and for how best to manage them. Recently, the California Natural Resources Agency adopted the Delta Smelt Resiliency Strategy (DSRS), which includes an action for enhanced control of invasive aquatic vegetation to improve habitat for Delta Smelt *(Hypomesus transpacificus),* an endangered species endemic to the SFE. To fulfill the DSRS action, the California Department of Water Resources, California Department of Fish and Wildlife and State Parks Division of Boating and Waterways are collaborating to increase herbicide application in Delta Smelt habitat and monitor the ecological impacts of treatment and vegetation reduction. This pilot project involves treating submerged aquatic vegetation with Fluridone, a plant-specific herbicide. The study will evaluate the effects of these treatments on vegetation biomass, water quality, the plankton and fish communities, and local hydrodynamics. Preliminary data suggest that maintaining effective herbicide concentrations in estuarine habitats is challenging, requiring frequent monitoring and application. Differences in water quality metrics between plant beds and open water habitats are surprisingly small, likely swamped by the stronger effect of tidal dynamics. Findings will be used to develop adaptive management strategies to improve the control of aquatic weeds and restore habitat for the endangered Delta Smelt.

Effects of manual and mechanical *Ammophila arenaria* removal techniques on coastal dune plant communities and dune morphology. Monique Silva Crossman* and Alison O'Dowd. Humboldt State University, Arcata, CA. mrs75@humboldt.edu.

Coastal sand dunes are dynamic systems subject to a variety of natural and anthropogenic stresses including impacts from invasive species. Native populations decline when *Ammophila arenaria* invades and stabilizes the foredune. The California State Parks North Coast Redwood District manages three sand dune ecosystems where they have conducted *A. arenaria* removal efforts: Little River State Beach, Gold Bluffs Beach in Prairie Creek Redwoods State Park, and Tolowa Dunes State Park. Two removal treatments are utilized at these sites: mechanical, which utilizes bulldozers to bury *A. arenaria*, and manual, digging the plant up with shovels. Sixty-nine previously surveyed 25 meter^2 plots were measured for vegetation cover of native and non-native plants. In order to measure dune morphology at restored and unrestored sites, a Real Time Kinematic Global Positioning System device was used to measure the elevation of the dunes at each site and in each treatment, along with a control unrestored site. An Unmanned Aerial Vehicle (UAV) was utilized to take photos of the dunes in the treatment and control sites. These photos were analyzed with Structure for Motion software to characterize dune morphology. Finally, measurements of each transects elevation was taken with a tape measure at established waypoints along each transect. These three dune morphology measurements will be compared for accuracy and evaluated for the easiest and most accurate device. The objective of the research is to examine the effects that manual and mechanical removal techniques of *A. arenaria* have on sand dune morphology, and vegetative cover and composition over time. The analysis will provide a comprehensive look at long term recovery of native dune mat species, and point to any potential problems with new invasive species. A 3D elevation model of the dunes will be created to compare the

two treatment types ability to restore the natural sand movement.

Waste not, want not: A pilot study on direct seeding over straw mulch as a means of revegetation. Rachel Stump* and Maria Alvarez. National Park Service, Golden Gate National Recreation Area, San Francisco, CA. rhstump@ucdavis.edu.

This pilot study aims to test mulch conditions necessary for successful establishment and growth of native species, comparing age, cardboard prevalence, and depth of straw over the course of the 2017 growing season. Habitat restoration specialists of the Golden Gate National Recreation Area (GGNRA) utilize sheet mulching with salvaged cardboard and rice straw to suppress invasive plant biomass and protect bare soil from further invasion following ground disturbance by invasive plant removal. California native species are consequently also prevented from immediately recolonizing the mulched area due to the lack of sunlight and space. Regularly purchasing nursery grown native plants for revegetation becomes expensive, varies in successful establishment, and requires increased active management. Successfully direct seeding over mulch may allow for quick, cost effective revegetation within a large area, and may create a seed bank after establishment. After fourteen 1 m^2 plots were randomly selected using mulching data from previous years, each were hand seeded with 2.26 g/m^2 (20 lb/acre) of seed mix between two treatments: seven receiving a full broadcast, and seven receiving a half broadcast followed by a second half broadcast 28 days later. The cleaned seed mix included nine shade-tolerant, perennial herbaceous and grass species and was sourced from seed stock collected in watersheds adjacent to the site by GGNRA personnel. All seed was broadcast over the top of existing mulch. Monthly surveys have shown a preliminary increase in both monocot and dicot seedlings within the plot as opposed to minimal change in outlying mulched area. Although gross observed seedlings decreased by the three month post-broadcast survey, many native survivors have grown to identifiable size. Surveys will continue until early fall 2017 at the conclusion of the expected growing season.

Using functional trait analysis to improve revegetation outcomes. Noah Teller* and Travis Bean, UC Riverside Cooperative Extension, Riverside, CA. ntell001@ucr.edu.

Plant functional traits are one of the best tools managers have today to predict ecosystem function and interactions of different plant species. Invasive plant removal is frequently an insufficient long-term solution to restore ecosystem function and services, as invasive plants are often excellent colonists and tend to reinvade disturbed areas. Revegetation of treated sites with desirable species can improve outcomes, but it is expensive and strategies are highly site-specific. This project investigates how functional trait analysis may be used to inform species selection in revegetation projects to favor multiple management objectives like invasive plant control, invasion resistance, and resilience to disturbance, ideally allowing for a better return on investment from revegetation and reducing the need for re-treatment of invasive plants. I will test locally-collected native species' competitive ability against *Holcus lanatus* and *Bromus tectorum* in pairwise seedling competition trials in a greenhouse, measuring the rooting depth, seed mass, phenology, and specific leaf area of each species. I will then create three seed mixes along a gradient of functional similarity to the invasive in question but with similar phylogenetic dispersion, and measure the competitive effects of planting these seed mixes in association with *H. lanatus* and *B. tectorum* in an agricultural field at UC Riverside as well as in a wilderness setting in the Kern Canyon of Sequoia National Park. I will additionally apply various disturbance treatments to determine how well these species mixes competitively suppress invasive plants after fire, grazing, and soil disturbance. I expect that species with lower seed mass, lower specific leaf area, earlier phenology, and shallower rooting depth will compete best against both invasives.

Management of Bermuda buttercup (*Oxalis pes-caprae*) in the Peninsula Watershed of the San Francisco Public Utilities Commission. Don Thomas. San Francisco Public Utilities Commission, Burlingame, CA. dethomas@sfwatr.org.

Bermuda buttercup (*Oxalis pes-caprae*) is an invasive plant native to South Africa rated as a moderate threat to wildlands by the California Invasive Plant Council. Because the clone present in California does not produce seeds, it is only spread by the movement of bulbs. In spite of this, it has been found to be an aggressive weed of landscapes and agricultural fields. Because of its limited capacity for dispersal, in the past it was not considered a major threat to natural areas. However, it is now increasingly encroaching into wildland areas also. Control has been challenging because bulbs may not be susceptible to some herbicides, and some control techniques actually spread the bulbs.

The present study is a preliminary test of several herbicides and herbicide combinations for the control of *Oxalis pes-caprae*. These herbicide trials seem to indicate high efficacy of imazapyr for control of Bermuda buttercup, including suppression of

sprouting of bulbs. Furthermore, combinations of herbicide with different modes of action appear to be more effective in controlling *O. pes-caprae* than applications of single herbicides.

Large-scale riparian restoration in the Santa Clara River. Jared Williams[1]*, Adam M. Lambert[1], and Tom L. Dudley[2]. Marine Science Institute and Cheadle Center for Biodiversity and Ecological Restoration, University of California, Santa Barbara, CA. jaredwilliams@ucsb.edu

UCSB's Riparian Invasion Research (RIVR) Lab studies the ecology and integrated management of invasive plants in western riparian systems. We are conducting a large-scale Arundo (*Arundo donax*; giant reed) control and habitat restoration program on over 250 acres in the Santa Clara River (SCR) floodplain (Ventura and LA Counties). The SCR watershed is an extensive and biologically rich region at the junction of five of California's 10 identified Bioregions. The SCR is one of the few remaining major river systems in the State that retains much of its natural hydrology, providing habitat for 18 endangered species. The goals of the program are to: 1) implement riparian restoration at a sufficient scale to re-establish the ecosystem structure, function, and processes necessary to recover sensitive and listed species, 2) establish a long-term and scientifically-based monitoring program to measure wildlife responses to restoration, and 3) evaluate biological data to document successful strategies, identify unsuccessful restoration practices, and inform future projects in the region. Riparian restoration projects (and restoration in general) routinely evaluate only the first trophic level and are conducted at temporal scales (five years or less) that are insufficient to evaluate population-level responses in the organisms that these projects are intended to benefit. Our goal is to promote riparian restoration as a science-based and data driven endeavor that uses long-term data sets to evaluate trends and trajectories in target species. We are measuring biotic and abiotic ecosystem components (vegetation diversity and phenology, plant water use, insects, birds, mammals, and sub-surface water dynamics) to construct a holistic framework to evaluating the restoration process.

Mapping, prioritization, and eradication of *Arundo donax* in the Sacramento-San Joaquin Delta. Alex Young* and Mark Newhouser. Sonoma Ecology Center, Eldridge, CA. alex@sonomaecologycenter.org.

It is generally accepted by the invasive plant control community that there is not enough funding to eradicate all problem weeds, and the work of invasive species control must be strategically focused. For many years, Team Arundo del Norte and the Sonoma Ecology Center have been working on the control of riparian invader *Arundo donax* (giant reed). With funding from the California Department of Water Resources and leadership of the Sacramento-San Joaquin Delta Conservancy, the Sonoma Ecology Center (SEC) mapped the distribution of Arundo donax within the boundary of the Legal Delta. Infestations were digitized in GIS using 1-ft resolution aerial imagery along the riparian corridors of all navigable channels within the Sacramento-San Joaquin Delta. To determine eradication priorities, habitat suitability data for a suite of representative riparian species were assigned threat indices to derive an Index-based Multi-species Conservation Value (IMCV). The IMCV metric is a measure of habitat value and indicates a priority for eradicating invasive species threats to that habitat. These rankings are weighted by threatened or endangered listing status to give greater weight to listed species. Delta specific as well as threatened and endangered species were selected with the help of biologists at CDFW, CDWR, Delta Conservancy and Sonoma Ecology Center. 23 species from 7 taxa were considered for the IMCV. The results of this mapping and prioritization process are guiding our current selection of Arundo eradication sites in the Delta.

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