PROGRAM

Evolving Management Perspectives in a Changing World

Overview

Tues., Oct. 15	9:00 – 12:00 pm	Statewide WMA Meeting	
	1:00 – 5:00 pm	Trainings:	1. Calflora Mapping Tools for Tracking Invasive Plants & Management
			Concurrent tracks for Calflora's Online Weed Database and Observer Pro Tool *and* Calflora's Weed Manager System
			2. Invasive Plant Management Planning for Your Organization
	6:30 – 8:30 pm	Herbicide Laws & Regulations	
Weds., Oct. 16	8:00 am		Update on Invasive Plant Management in California
	8:20 – 9:20 am	Plenary 1:	Riverside: Leadership in Invasive Species Research and Management
	9:40 – 10:40 am	Concurrent:	1. Wildfire and Invasive Plants
			2. Grassland Management
	11:00 am – noon	Concurrent:	3. Grazing as a Management Tool
			4. Public Mapping Tools for Tracking Plants & Management
	1:20 – 2:20 pm	Plenary 2:	Invasive Species Management at National Wildlife Refuges across the Western United States and Beyond
	2:40 – 3:40 pm	Concurrent:	5. Soil Effects and Interactions with Invasive Plants
			6. Communication Strategies for Land Managers
	3:40 – 5:00 pm	Poster Session	
	5:00 – 6:30 pm	Social Hour, Silent Auction and Raffle	
	6:30 – 8:30 pm	Awards Banquet	
Thurs., Oct. 17	8:00 – 9:00 am	Concurrent:	7. Management Tools and Techniques
			8. Wetland and Aquatic Habitat Management
	9:20 – 10:20 am	Concurrent:	9. Invasive Plant Traits and Community Effects
			10. Coastal Sage Scrub Management
	10:30 – 11:45 am	Discussion Groups	
	1:15 – 1:40 pm		Student Competition Results and Weed Alerts 2019
	1:40 – 2:40 pm	Plenary 3:	New Perspectives on the Interface between Research and Management
	2:50 – 3:50 pm	Concurrent:	11. Lessons Learned: Collaborating on Invasive Plant Management
			12. Invasive Plant Management with the Conservation Corps
	4:00 – 5:00 pm	Concurrent:	13. Management Tools and Techniques
			14. Invasive Species Impacts on Rare Plants
Fri., Oct. 18	8:00 am	Field Trips (2 half day and 2 full day)	

Tuesday, October 15

8:00 – 9:00 am Registration and Coffee

9:00 am – 12:00 pm Statewide WMA Meeting

Room: *MR1&2.* Chairs: *Doug Johnson, Cal-IPC; Michelle Dennis, CDFA.*

Weed Management Areas (WMAs) across the state bring local partners together for strategic projects. With new state funding, we will share lessons learned, CDFA program updates, information on new weeds, guidelines for successful projects, tips on tracking success and ideas for funding projects. Several WMAs will present their work, and attendees will discuss approaches and challenges in their WMA's projects.

12:00-1:00 pm Registration and Lunch on your own

1:00 – 5:00 pm Training 1: Calflora Mapping Tools for Tracking Invasive Plants and Management

Room: *MR3&4.* Instructors: *Cynthia Powell, Michelle Tollett & Pete Frye, Calflora; Ron Vanderhoff, OC-CNPS.*

Calflora is an online mapping platform for plants in California. You can use the publicly accessible Calflora interface to track weed work, or you can subscribe to the powerful Weed Manager suite of applications. Calflora's Observer Pro phone app enables you to map weeds in the field. This training will have two concurrent tracks: one for new users and one for current and future users of Weed Manager tools.

1:00 – 5:00 pm Training 2: Invasive Plant Management Planning for Your Organization (Room: *TBD*)

Room: *MR1&2.* Instructors: *Giselle Block, USFWS; Jutta Burger & Doug Johnson, Cal-IPC; Jason Giessow, Dendra, Inc.; Brent Johnson, NPS; Tom Reyes, Midpeninsula Regional Open Space District; Steve Schoenig, CDFA and CDFW, retired; Andrea Williams, Marin Municipal Water District.*

Through interactive exercise and real-life reports from land management professionals that have developed and implemented plans, you will learn the basics needed to generate and communicate an effective plan. All participants will receive a copy of the recently published "Land Manager's Guide to Developing and Invasive Plant Management Plan," co-published by the USFWS and Cal-IPC.

5:30 - 6:30 pm Registration and Reception on the Patio

6:30 – 8:30 pm Herbicide Laws & Regulations

Room: *Ballroom.* Chair: *Chris McDonald, UC Dept. of Agriculture and Natural Resources*

6:30 Pesticide Jeopardy! *Lisa Blecker, Pesticide Safety Education Program, UC Statewide IPM Program*

7:00 Noxious weed laws and regulations. *Bob Muherin, Riverside County Agricultural Commissioner's Office*

7:30 What's wrong with this picture? Pesticide safety. *Cheryl Wilen, UC Dept. of Agriculture and Natural Resources*

8:00 Following pesticide laws and regulations to reduce applicator exposure. *Chris McDonald, UC Dept. of Agriculture and Natural Resources*

7:00 – 9:00 pm Student/Early Professional Mixer – *Location: Riverside Food Lab, 3605 Market St.*

Wednesday, October 16

7:00 - 8:00 am Registration and Coffee

8:00 – 8:20 am **Opening Plenary** Update on Invasive Plant Management in California**.** *Doug Johnson, Executive Director, Cal-IPC*

8:20 – 9:20 am **Plenary 1. Riverside: Leadership in Invasive Species Research and Management**

Room: *Raincross*. Chair: *Heather Schneider, Santa Barbara Botanic Garden*

8:20 Restoration, invasive species, and conservation challenges in a region with extraordinarily rapid changes. *Arlee Montalvo, Riverside Corona Resource Conservation District*

8:40 Something wicked this way comes: California's perennial problem with invasive arthropod pests. *Mark Hoddle, Center for Invasive Species Research, UC Riverside*

9:00 Cross-training and curiosity: The interaction of interdisciplinarity and an open mind. *Norm Ellstrand, UC Riverside*

9:20-9:40 am Break

9:40 – 10:40 am Session 1. Wildfire and Invasive Plants

Room: *Ballroom*. Chair: *Joseph Algiers, Santa Monica Mountains National Recreation Area*

9:40 Weeds after Woolsey: Did a decade of weed control pay off following the largest fire in the Santa Monica mountains? *Joseph Algiers, Santa Monica Mountains National Recreation Area*

10:00 Determining potential drivers of chaparral conversion in a southern California fire scar. *Shane Dewees*, UC Santa Barbara*

10:20 Integrating weed control and trait-screened seed mixes to reduce the risk of postfire type conversion from coastal sage scrub to annual grassland. *Noah Teller*, UC Riverside*

9:40 – 10:40 am Session 2. Grassland Management

Room: *MR7-10*. Chair: *Andrea Williams, Cal. Native Grasslands Association, Marin Municipal Water District*

9:40 Investigating the effects of small mammals and plant competition on native and exotic species within annual grassland communities. *Lachlan Charles, UC Riverside*

10:00 Project 467: Restoring and enhancing native plant diversity and the coefficient of beauty at Edgewood Natural Preserve. *Stuart Weiss, Creekside Science*

10:20 Do *Oncosiphon piluliferum* soil legacy effects post-removal inhibit restoration success? *Stuart Schwab*, UC Riverside*

** Student Contest entrant*

10:40-11:00 am Break

11:00 am – 12:00 pm Session 3. Grazing as a Management Tool

Room: *Ballroom*. Chair: *Brian Shomo, Western Riverside County Association of Governments*

11:00 Targeted grazing as a method of controlling non-native grasses for Stephen's kangaroo rat management. *Brian Shomo, Western Riverside County Association of Governments*

11:20 Prescribed goat grazing for wildland management. *Alyssa Cope, Sage Environmental and Robert Freese, Irvine Ranch Conservancy*

11:40 Can ecological theory help us develop better targeted grazing systems for invasive plant management? *Carlos de la Rosa, San Diego Zoo Global*

11:00 am – 12:00 pm Session 4. Public Mapping Tools for Tracking Plants and Management

Room: *MR7-10*. Chair: *Lynn Sweet, UC Riverside Center for Conservation Biology*

11:00 EDDMapS One: Integrated platform and program for tracking invasive species management in North America. *Chuck Bargeron, University of Georgia*

11:20 iNaturalist for invasive species mapping. *Ken-ichi Ueda, iNaturalist*

11:40 Using Calflora to map and track invasive species in California. *Cynthia Powell, Calflora*

12:00 - 1:20 pm Lunch (*Room: Raincross*)

Career Panel Lunch, organized by the Cal-IPC Student Section (Room: *MR1&2*)

1:20 – 2:20 pm Plenary 2. Invasive Species Management at National Wildlife Refuges across the Western United States and Beyond

Room: *Raincross*. Chair: *Giselle Block, USFWS Region 8, California*

1:20 The USFWS "Strategic and Adaptive Invasive Plant Management Model." *Giselle Block, USFWS Region 8, California*

1:30 Invasive plant workshops in the Pacific Region: Benefits, challenges and adaptations. *Jess Wenick (Washington), USFWS Region 1*

1:40 Use of species distribution modeling to support early detection and rapid response to invasive plants in the Mountain Prairie Region. *Lindy Garner, USFWS Region 6, Montana*

1:50 How tracking treatments is supporting success in the field in the Southwest Region. *Edward Spriggs (New Mexico) and Bethany DeRango (Arizona), USFWS Region 2*

2:00 Adaptive management of invasive plants: A case study from National Wildlife Refuges in the Midwest Region. *Joshua Booker, USFWS Region 3, Ohio*

2:20 – 2:40 pm Break

2:40 – 3:40 pm Session 5. Soil Effects and Interactions with Invasive Plants

Room: *Ballroom.* Chair: *Amanda Swanson, Newport Bay Conservancy*

2:40 Identifying the microbial legacy effects of invasive grasses for restoration. *Brooke Pickett*, UC Riverside*

3:00 Evolutionary drivers of the invasion of stinkwort (*Dittrichia graveolens*) in California. *Nicky Lustenhouwer, UC Santa Cruz*

3:20 Below-ground effects of organic and chemical herbicides used in invasive plant management. *Mia Maltz, UC Riverside*

2:40 – 3:40 pm Session 6. Communication Strategies for Land Managers

Room: *MR7-10.* Chair: *Josie Bennett, Laguna Canyon Foundation*

2:40 Speak to be remembered: Science communication and the art of storytelling. *Sue Gardner, Golden Gate National Parks Conservancy*

3:00 Deconstructing the stories we share about weeds: Strategies for creating meaningful communication with the public. *Josie Bennett, Laguna Canyon Foundation*

3:20 Taking the call: The importance of empathy and listening to the community. *Jennifer Greene, Golden Gate National Parks Conservancy*

3:40 – 5:00 pm Poster and Exhibitor Session (Room: *Exhibit Hall C*)

5:00 – 6:30 pm Social Hour, Raffle & Silent Auction (Room: *Exhibit Hall D*)

6:30 – 8:30 pm Awards Banquet (Room: *Raincross*)

Thursday, October 17

7:00 am Registration and Coffee

8:00 – 9:00 am Session 7. Management Tools and Techniques

Room: *Ballroom.* Chair: *John Knapp, The Nature Conservancy*

8:00 Maximizing the efficiency of invasive plant control with a phenology-based timing approach to management. *Guy Hernandez*, Cal Poly Pomona*

8:20 Big projects, small monitoring budgets: Using basic data to assess treatment effectiveness for control of *Cortaderia jubata. Ellen Hamingson, National Park Service*

8:40 No more comparing apples to oranges: Comprehensive invasive plant data management methodology using Collector for ArcGIS within a nested grid system. *Morgan Ball and Katrina Olthoff, Wildlands Conservation Science.*

8:00 – 9:00 am Session 8: Wetland and Aquatic Habitat Management

Room: *MR7-10.* Chair: *Drew Kerr, Invasive Spartina Project*

8:00 High salinity exposure does not preclude germination of invasive *Iris pseudacorus* from populations along a Delta-San Francisco Estuary salinity gradient. *Morgane Gillard, UC Davis*

8:20 Finding balance when you are stuck in a marsh: Navigating the complexities of Upper Newport Bay for effective invasive plant management. *Amanda Swanson, Newport Bay Conservancy*

8:40 Striking a balance: Selecting strategy levels for a startup invasive *Limonium* project based on eradication stage and budget. *Drew Kerr, Invasive Spartina Project*

9:00 – 9:20 am Break

9:20 – 10:20 am Session 9. Invasive Plant Traits and Community Effects

Room: *Ballroom.* Chair: *Noah Teller, UC Riverside*

9:20 *Mesembryanthemum crystallinum* reduces ecosystem function on San Nicolas Island. *Denise Knapp, Santa Barbara Botanic Garden*

9:40 Vegetation types at risk from Sahara mustard invasion: using Maxent to inform early detection and conservation targets with climate change. *Lynn Sweet, UC Riverside.*

10:00 Interactions between invasive *Schinus molle* (Peruvian pepper tree) with six plant species commonly found in southern California nature reserves. *David Banuelas*, UC Irvine*

9:20 – 10:20 am Session 10. Coastal Sage Scrub Management

Room: *MR7-10.* Chair: *Chris McDonald, UC ANR*

9:20 Challenges and success of ten years managing the highly invasive Ward's weed (*Carrichtera annua*) in Carlsbad, San Diego County, California. *Sarah Godfrey, Center for Natural Lands Management*

9:40 Adaptive management of stinknet (*Oncosiphon piluliferum*), an annual weed in a coastal sage scrub preserve in North County, San Diego. *Emily Burson, San Diego Zoo Global*

10:00 Testing the effects of site selection and artificial shelters on native plant recruitment from seed in degraded coastal sage scrub. *Marlee Antill*, Cal Poly Pomona*

10:20 – 10:30 am Break

10:30 – 11:45 am Discussion Groups (concurrent)

1. Impacts of invasive plants on native flora and fauna

Room: *MR1.* Moderator: *Heather Schneider, Santa Barbara Botanic Garden, with Naomi Fraga, Rancho Santa Ana Botanic Garden; Denise Knapp, Santa Barbara Botanic Garden; David Mazurkiewicz, Channel Islands National Park; and Lynn Sweet, UC Riverside.*

Invasive plants impact wildland communities at all levels. From disrupting soil microbial communities and nutrient cycling, to competing with native plants, altering forage availability for pollinators and impacting habitat for animals, invasive plants effect not just individual species but ecological networks. We'll hear from four experts about their experiences measuring and mitigating the impacts of invasive plants on rare plants and other vegetation, arthropods and pollinators, and birds. Share lessons learned from you own experience and ask questions of the panelists.

2. Mapping, monitoring and metrics

Room: *MR2.* Moderators: *Andrea Williams, Marin Municipal Water District and Dana Morawitz, Cal-IPC; with John Knapp, The Nature Conservancy; Katrina Olthof, Wildlands Conservation Science.*

Tracking progress is essential to effective weed management. Rarely is it simple. How do you map and with what goals for that mapping? What is your goal for a given population (and how do you define what constitutes a "population"?) What do you do with an annual plant that pops up in different places each year? Come discuss your thorny mapping issues and we'll have experts on hand to serve as resources for your various goals, such as early detection, population inventories, efficacy tracking through time or spread monitoring. Discuss how we might track "acres protected" rather than just "acres treated."

3. Storytelling and other techniques for engaging communities in effective stewardship

Room: *MR3*. Moderators: *Sue Gardner, Golden Gate National Parks Conservancy, and Josie Bennett, Laguna Canyon Foundation.*

Data make something credible, but stories make it memorable. Learn how to take the raw material of your work and craft it into a story that will inspire others to support—or join—you! Share the stories that have worked in your own experience and hear what has worked for others.

4. Non-chemical techniques for weed management

Room: *MR7*. Moderators: *Jutta Burger, Cal-IPC, and Cheryl Wilen, UC Cooperative Extension/UC-IPM*.

What's your favorite non-chemical tool—Pruning saw? Weed wrench? String trimmer? Goats? Under what conditions do these tools work best and when are they ineffective? Come hear about (and weigh in on) the pros and cons of various non-chemical weed management tools. This discussion group will be contributing to a Cal-IPC project in collaboration with UC Cooperative Extension to compile best practices on non-chemical methods and build an online decision-support tool to help land managers assess their options.

5. Herbicide effectiveness: Observations from the field

Room: *MR8*. Moderator: *Drew Kerr, Invasive Spartina Project, with Morgan Ball, Wildlands Conservation Science; Bill Neill, Riparian Repairs*.

Most every herbicide treatment is an experiment, in which we find out exactly how effective the treatment will be for that particular situation. Timing, rate, active ingredient, weather conditions, application approach, plant phenology, surrounding vegetation—dozens of factors contribute to the effect of a given treatment. What we learn over time in the field goes beyond what can be easily documented in reference guides. Come share your observations and hear from others.

6. Equity, diversity and inclusion: Cal-IPC and the conservation field

Room: *MR9*. Moderator: *Alene Spindel, Cal-IPC, with Jen Greene and Yakuta Poonawalla, Golden Gate National Parks Conservancy*.

Last year the Cal-IPC Board of Directors approved a statement committing Cal-IPC to take action to address issues of equity, diversity and inclusion within our immediate Cal-IPC community and within the conservation community at large. Come hear what we have been working on and contribute your ideas, then learn from an organization that has been working on this for years, the Golden Gate National Parks Conservancy. What does it look like for an organization to work on these issues? Does it cost money and staff time? What does it change? Join our discussion and lend your voice.

7. Communicating effectively as a land manager: Glyphosate as a case study

Room: *MR10.* Moderator: *Rachel Kesel, One Tam, with Doug Johnson, Cal-IPC and Julia Parish, American Conservation Experience.*

Communicating the need for controlling invasive plants remains a challenge with some audiences, and the current public concern (and legal settlements) over glyphosate add a new twist. Ideally, communicating across different perspectives can be a positive thing—how do we help it become that when it can easily become unproductive? What are the salient points that may help someone understand the work we do, the tools we use, and the nature of risk? Who are "trusted messengers" that we might engage?

11:45 am – 1:15 pm Lunch (on your own)

1:15 – 1:35 pm New Weed Alerts

Room: *Raincross.* Presenters: *Jutta Burger (Cal-IPC) and Bob Price (CDFA)*

1:35 – 1:40 pm Announce Student Contest winners

1:40 – 2:40 pm Plenary 3. New Perspectives on the Interface between Research and Management

Room: *Raincross.* Chair: *Jutta Burger, Cal-IPC*

1:40 Managing for dynamic and unpredictable species invasions. *Jeff Diez, UC Riverside*

2:00 Invasive species management and ecosystem restoration: Two sides of the same coin. *Loralee Larios, UC Riverside*

2:20 Evolving our thinking on the knowing-doing gap in managing invasive species. *Ingrid Parker, UC Santa Cruz*

2:40 – 2:50 pm Break

2:50 – 3:50 pm Session 11. Lessons Learned: Collaboration in Invasive Plant Management

Room: *Ballroom.* Chair: *Anna Dirkse, UC Cooperative Extension*

2:50 Containing and reducing the spread of *Volutaria* acros southern California: lessons learned when managing novel weed species. *Chris McDonald, UC ANR*

3:10 Communicating the threat of Japanese knotweed (*Fallopia japonica*) to private landowners along San Geronimo Creek. *Anna Dirkse, UC Cooperative Extension*

3:30 Successes, failures, and lessons from the Orange County CNPS Emergent Invasive Program. *Ron Vanderhoff, OC-CNPS*

2:20 – 3:50 pm Session 12. Invasive Plant Management with the Conservation Corps

Room: *MR7-10.* Moderator: *Jonathan Appelbaum,* San Dieguito River Valley Conservancy

2:50 The organizational ecosystem of conservation corps groups in California. *Dan Knapp, Long Beach Conservation Corps*

3:10 Successful invasive plant management with the conservation corps. *Ty Stearns, Urban Corps San Diego County*

3:30 Opportunities for funding your weed control project through the conservation corps. *Rhody Soria, California Conservation Corps, Riverside/San Bernardino Satellite*

3:50 – 4:00 pm Break

4:00 – 5:00 pm Session 13. Management Tools and Techniques

Room: *Ballroom.* Chair: *Julia Parish, American Conservation Experience*

4:00 Biological control of Dalmation toadflax by the weevil *Mecinus jenthiniformis* at Hungry Valley. *Lincoln Smith, USDA-ARS*

4:00 – 5:00 pm Session 14. Invasive Species Impacts on Rare Plants

Room: *MR7-10.* Moderator: *Heather Schneider, Santa Barbara Botanic Garden*

4:00 Quantifying the impacts of invasive plants on California's imperiled flora: A review. *Heather Schneider, Santa Barbara Botanic Garden*

4:20 Invasive plant species mapping using drones in the Santa Ana River watershed. *A.J. Fox, HANA Resources* 4:40 Partnering with the California Conservation Corps on large scale weed removal in the Oroville Wildlife Area. *Holly Ferrera, River Partners*	4:20 Impacts of annual invasive species to the rare annual *Erythranthe shevockii* (Kelso Creek monkeyflower). *Naomi Fraga, Rancho Santa Ana Botanic Garden* 4:40 Challenges growing California's rare plants amongst a diverse assemblage of *Phytophthora* species in the Regional Parks Botanic Garden. *Michael Uhler, East Bay Regional Parks*

5:00 pm Adjourn (Field Trip participants meet)

Friday, October 18

All field trips meet at 8:00 am at Riverside Convention Center. Departure at 8:15/8:30 depending on trip. Arrive early if you need DPR CEUs.

Field Trip 1: Trials, Research and Control efforts at Motte Rimrock Reserve and Santa Rosa Plateau. (Full-day, 8:30 am-5:00 pm).

Experience a unique ecological mosaic caused by basaltic soil beneath perennial grasslands, oak woodland, coastal sage scrub, and vernal pools, with discussion of Native American history and current grassland management tools. We will start at Motte Rimrock Reserve, hiking 1.4 miles to an overlook along which we will discuss the Reserve's management challenges, including managing habitat for the endangered Stephens' kangaroo rat, ongoing trials to reduce annual grasses to restore coastal sage scrub and perennial grass habitat, and investigating a variety of chemicals/timing to control stinknet (*Oncosiphon piluliferum*) as well as measuring its seed bank longevity and germination. After lunch, we will drive to the Santa Rosa Plateau and hike the Adobe Loop Trail, winding through a diverse array of habitats including oak woodland, chaparral, grassland, and riparian woodland. Discussion will cover perennial/woody species' control history and techniques focused on olives (cutting, tarping, herbicide), *vinca* (herbicide), and blackberry (cutting and herbicide). Coordinator: *Zach Principe, The Nature Conservancy*

Field Trip 2: Santa Ana River, Tributaries, and Uplands: Navigating Urban Issues. (Full-day, 8:30 am-5:00 pm).

From wild pigs to homeless sites, urban rivers face unique challenges for restoration. Tamarisk, *Arundo*, fountaingrass, and Saharan mustard are being controlled along tributaries and higher in the watershed. The first stop is the 30-acre Angelus Block property, owned and stewarded by Rivers & Lands Conservancy to benefit the federally endangered Delhi Sands flower-loving fly (*Rhaphiomidas teminatus abdominalis*) and associated sand dune ("Colton Dunes") flora and fauna. Most of the Colton Dunes sites are highly invaded by several invasive plant species, including Sahara mustard, shortpod mustard, golden crownbeard, tocalote, stinknet, and a variety of annual grasses. Our second stop is Ryan Bonaminio Park, where construction required mitigation for the increasingly rare inland alkali meadows dominated by saltgrass (*Distichlis spicata*), yerba mansa (*Anemopsis californica*), and trailing wild rye (*Elymus triticoides*). Riverside City Parks contracted RCRCD to restore an alkali meadow that was overrun with 5-hook bassia, kochia, salt cedar, Johnson grass, Bermuda grass, and other non-native weeds. A stop at the Lower Tequesquite Creek Restoration site will explore how difficulties with proximity to urban area, homeless encampments, and feral pigs were overcome to restore the site, including a demonstration of the "green climber," a machine operable from of a series of remote-controlled grinders which are some of the newest tools available to fight *Arundo donax*. The green climber is much smaller than the typical grinders, can operate on slopes up to 60 degrees, limits potential hazards for its operators, and allows greater visibility in the field. Our third site, Martha Mclean-Anza Narrows Park, will discuss the Santa Ana River Trust (SART) program, created to help establish the Santa Ana River and to connect the Santa Ana River Trail as an inviting, healthy, and vibrant open space for the community. Through ongoing volunteer clean up and trash services, the native plant garden transformed a dirt slope into an ecologically rich garden that provides a huge visual

improvement for both trail and park users, while helping to curb erosion issues that otherwise would impact the river and trails. The final stop is UC Riverside's Herbarium and Coyote Hill, where we will discuss some of the species invasions that have been a part of the type conversion from coastal sage scrub to domination by non-native grasses and forbs. Coordinator: *Arlee Montalvo, Riverside Corona Resource Conservation District*

Field Trip 3: Partnership in Mill Creek Watershed for Invasive Species Extirpation. (Half-day, 8:30 am-1:00 pm)

Partners working together to control tree-of-heaven and Spanish broom, support successful post-fire recovery, and collaborate with the community. We will be touring restoration sites along Mill Creek, a major tributary of the Santa Ana River with its headwaters in the San Bernardino Mountains. Mill Creek runs for 18 miles out of the mountains until it joins the main stem of the Santa Ana River. The canyon cut by Mill Creek leads through some of the tallest peaks in southern California and is surrounded by steep mountain ridges on both sides. Invasive plant extirpation has been a goal in this area since 2010 and active control efforts are ongoing. We will talk about efforts to control tree-of-heaven (*Ailanthus altissima*), Spanish broom (*Spartium junceum*) and giant reed (*Arundo donax*) using physical and chemical approaches. Stops will include a short walk down to the creek to see a recovering flood plain, a tour of the Mountain Home Village residential community where tree-of heaven-once dominated yards, and a short hike to a Big Falls waterfall. See how the Inland Empire Resource Conservation District, US Forest Service, the Santa Ana Watershed Association and many other partners including residents have come together to extirpate invasive species from this uppermost section of the Santa Ana River watershed. Coordinator: *Aaron Echols, Inland Empire Resource Conservation District*

Field Trip 4: How to Bait for *Phytophthera* using Pears. (Half-day, 8:30am-12:00pm) Coordinator: *Billy Sale, Rancho Santa Ana Botanic Garden*

Are you worried about *Phytophthera* in your nursery or your restorations? Learn how to set up an easy test for your plants at this three-hour field trip-workshop! This workshop will provide information on how to build your own testing station and catchment vessel as well as what supplies are needed for testing. It will cover all steps of testing, which include: selection of plants in the nursery; best pears to purchase; test set-up and procedures; amount of water for testing based on container size; plant, soil, and water temperatures; and post pear handling. Two tests will be performed in real time where select participants will be able to get hands on experience administering a test. Following testing, we will look at pear lesions from previous tests and assess them for possible *Phytophthora* lesions. The workshop will also discuss topics related to record keeping, data management, *Phytophthora* positive detections, plant quarantine, and where to send samples for lab analysis. Afterwards, we will tour the Riverside Corona Resource Conservation District's 3-acre Land Use Learning Center demonstration garden and learn about innovative methods to steward natural resources in natural, urban, and agricultural settings.

Posters

Alphabetical by lead author. Poster titles are listed here for quick reference. Poster abstracts start on page 43.

Has yellow starthistle (*Centaurea solstitialis*) recently adapted to serpentine soils? *Katherine Brafford* and Mohsen Mesgaran. Department of Plant Sciences, University of California, Davis, CA.*

ACE'ing new statewide maps for conservation planning. *Elizabeth Brusati[1], Dana Morawitz[2]*, Melanie Gogol-Prokurat[1], and Sandra Hill[1]. [1]California Department of Fish and Wildlife, Sacramento, CA. [2]California Invasive Plant Council (Cal-IPC), Berkeley, CA.*

European sea lavender (*Limonium duriusculum*) impact on salt marsh bird's beak (*Chloropyron maritimum* subsp. *maritimum*) flower visitors. *Stephanie Calloway*, Denise Knapp. Santa Barbara Botanic Garden, Santa Barbara, CA.*

Rapid assessment photo points and plots for assessing annual diversity and fire risk in Joshua Tree National Park. *Valeria Cancino[1,2]*, Nick Graver [1,2], Neil Frakes [2]. [1]Great Basin Institute, [2]Joshua Tree National Park, CA.*

Investigating non-native plant diversity and native plant seedbanks to assess the potential recovery and restoration of fuel breaks. *Robert Fitch[1]*, Carla D'Antonio[1], and Nicole Molinari[2]. [1]Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara. [2]United States Forest Service.*

Plant health assessments using drones in the Prado Basin. ***AJ Fox[1]****, *Sloane Seferyn[1], Kathy Eung[1], Varren Anacleto[1], and Richard Zembal[2]. [1]HANA Resources, Inc., Lake Forest, CA. [2]Orange County Water District, CA.*

Exploring the germination ecology of *Iris pseudacorus* populations invading California wetlands. *Morgane B. Gillard[1]*, Jesús M. Castillo[2], Mohsen Mesgaran[3], Caryn J. Futrell[1], Brenda J. Grewell[1]. [1]USDA-ARS Invasive Species and Pollinator Health Research Unit, Albany CA. [2]Departamento de Biología Vegetal y Ecología, Universidad de Sevilla, Sevilla, 41080, Spain. [3]Department of Plant Sciences, University of California, Davis, CA.*

Enlisting community scientists to study a range-expanding plant, *Urospermum picroides* (L.) F.W. Schmidt, yielding a revised distribution map and recommendations for public engagement through iNaturalist. *C. Matt Guilliams[1]*, Kristen Hasenstab-Lehman[1], Adam J. Searcy[2], and Casey H. Richart[1]. [1]Santa Barbara Botanic Garden, Santa Barbara, CA. [2]California* Urospermum *Working Group, Santa Barbara, CA.*

Measuring change in a changing world: the power of statistics and statistical power. *Tyler Hanson*. WRA, Inc., San Diego, CA.*

Environmental effects of the seed growth on germination traits of invasive *Ulex europaeus*. *Mika Hozawa* and Eiji Nawata. Kyoto University, Japan.*

Environment and diet influence the entire bacterial microbiome of *Lehmannia valentiana*, an invasive California slug. *Denise Jackson[1]*, Mia Maltz[2], Emma Aronson [1,2]. [1]Department of Microbiology and Plant Pathology, Riverside, CA. [2]Center for Conservation Biology, University of California, Riverside, CA.*

Investigating shifts in post-fire plant regeneration strategies and functional traits in Southern California shrublands. *Meg Kargul* and Loralee Larios. Department of Plant Biology, University of California, Riverside, CA.*

Measuring grass invasion through aerial photographs. *Stephanie A. Ma, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA.*

Using plastic tube tree shelters to increase seedling establishment for ecological restoration of California native plant communities. *Mark Mazhnyy*, Marlee Antill, and Erin Questad. Department of Biological Sciences, California State Polytechnic University, Pomona.*

** Student Contest entrant*

Restoring native plant communities and control of invasive plants on Scorpion Rock to enhance nesting habitat for burrow and shrub-nesting seabirds in the California Channel Islands. *David Mazurkiewicz[1]*, Josh Adams[2], Catherine Carter[3], Amelia J. Duvall[3], James A. Howard[3], Peter T. Larramendy[3], Andrew A. Yamagiwa[3], Annie Little[1], and A. Laurie Harvey[5]. [1]Channel Islands National Park, CA. [2]U.S. Geological Survey-Western Ecological Research Center, Santa Cruz Field Station, Santa Cruz, CA. [3]California Institute of Environmental Studies, Ventura, CA.*

Google search behavior for Invasive alien species. *Moleseng C. Moshobane*. Biological Invasions Directorate, South African National Biodiversity Institute, South Africa.*

Managing the Goldspotted Oak Borer in Orange County, CA. *Nicole Tamura, Kalee Koeslag, and Isaac Ostmann*. Irvine Ranch Conservancy, Irvine, CA.*

Environmental factors and herbicide effect on germination rates of stinknet (*Oncosiphon piluliferum*), an invasive weed in Southern California. *Zara Perez-Ochoa[1,2]*, Carlos A. de la Rosa[1]. [1]Institute for Conservation Research, San Diego Zoo Global, Escondido, CA. [2]University of California, Merced, CA.*

Pre-planting to preclude persistent pest plants. *Jorge Luis Renteria Bustamante[1], Gina Darin[2]*, Edwin Grosholz[1], Jamie Silva[2], Rhiannon Mulligan[2], Krista Hoffmann[2], Bayan Ahmed[2]. [1]Department of Environmental Science and Policy, University of California, Davis, CA. [2]California Department of Water Resources, West Sacramento, CA.* Evaluating the efficacy of herbicides for management for *Oncosiphon piluliferum* (stinknet). *Clarissa Rodriguez[1]*, Travis Bean[1], Christopher J. McDonald[2], Loralee Larios[1]. [1]Botany and Plant Sciences, University of California Riverside, CA. [2]UC Cooperative Extension, San Bernardino, CA.*

Effects of abiotic and biotic constraints on invasion in restored vernal pools. *Joanna Tang*, Madeline Nolan. University of California, Santa Barbara, CA.*

UAV applications for invasive plant monitoring. *Rob Thoms, Megan Keever, Karley Rodriguez, Chris Lyle. Stillwater Sciences, Berkeley, CA.*

Restoration fusion: the utilization of a young, diverse membership, and unique partnerships to accomplish wildland recovery throughout California. *Ian Torrence*, Julia Parish, Eric Robertson, Jessica Plance, and Susan Jardine. American Conservation Experience, Dulzura, Boulder Creek, and South Lake Tahoe.*

Invasive plant patrol in Orange County; Early detection and rapid response training for volunteers. *Adam Verrell. Laguna Canyon Foundation, Laguna Beach, CA.*

Adapting treatment methods for *Ailanthus altissima* adjacent to sensitive fish habitat. *Rachel Wing*, Andrew Castro, Naomi Fraga, Billy Sale, Kristy Snyder and Alejandra Soto. Rancho Santa Ana Botanic Garden, Claremont, CA.*

** Student Contest entrant*

Talk Abstracts

*(Poster abstracts follow in a separate section; List is alphabetical by lead author. * Student Contest entrant.)*

Weeds after Woolsey: Did a decade of weed control pay off following the largest fire in the Santa Monica Mountains? Joseph Algiers, Jr. Santa Monica Mountains National Recreation Area, CA. Joseph_algiers@nps.gov

The 2018 Woolsey Fire burned close to 90% of National Park Service land in the Santa Monica Mountains National Recreation Area. No other fire has burned so much of the recreation area, demanding an emergency response from the park's resource managers to treat invasive plant species. Fire provides opportunity for invasive species as they quickly colonize open substrate, potentially changing native plant communities and preventing the re-establishment of sensitive habitat. A pre-fire (2017) analysis covering close to ten years of treatment data showed high reductions in the cover of target weeds. Park biologists have revisited treatment areas in 2019 to evaluate the post-fire response. Post-fire assessments and more than a decade of data have shown promising results, as cover of target weeds remain low and an above-average rainfall year has increased native cover. Park biologists will continue to spend the next several years surveying burn areas for invasive species that threaten sensitive habitat. In this talk, I'll share our ideas, our findings, and the work we've done in the year following the largest fire in the Santa Monica Mountains.

Testing the effects of site selection and artificial shelters on native plant recruitment from seed in degraded coastal sage scrub. Marlee Antill* and Erin Questad. California State Polytechnic University, Pomona, CA. marleelantill@gmail.com

Slope and aspect are important factors in determining where plant species occur in dry climates and are underrepresented in locating restoration sites in semiarid ecosystems. Habitat Suitability Models (HSM) with Remote Sensing have the potential to identify high priority sites over large areas with more favorable abiotic conditions for native plant recruitment. High suitability sites have been found to have improved moisture and soil conditions, supporting faster native plant establishment and competition with invasive species. However, these sites are often inaccessible due to urban development and other land restrictions. In these cases, plastic tube tree shelters may improve abiotic conditions for native plant recruitment by mimicking the effects of high suitability sites. In this project, an HSM was created to identify high and low suitability plots based upon topography in a sample of degraded Coastal Sage Scrub (CSS) habitat. A two-year seedling survival experiment was established to test for differences in native plant recruitment in high vs low suitability sites, and in and out of artificial shelters. Seeds of four common CSS species were sown directly in the field in the Winter of 2018, and survival and growth data was collected weekly along with abiotic data for solar radiation, soil moisture, leaf wetness, soil compaction, and sediment erosion. Perennial seedlings demonstrated a preference for high suitability sites during both the 2018 and 2019 growing seasons, and the use of shelters in low suitability sites resulted in similar abiotic conditions and plant responses to those in high suitability sites. In addition to higher seeding success rates for native species in the field, protecting reintroduced plants within shelters could allow for the chemical and/or mechanical treatment of invasive species to occur simultaneously to native species addition, reducing the timing of restoration projects and helping practitioners meet funding schedules.

State and local Conservation Corps: A cost-effective option for invasive plant management. Jonathan Appelbaum[1]*, Dan Knapp[2], Rhody Soria[3]. [1]San Dieguito River Valley Conservancy, San Diego, CA. [2]Long Beach Conservation Corps, Long Beach, CA. [3]California Conservation Corps-Riverside/San Bernardino Satellite, CA. jonathan@sdrvc.org

California Conservation Corps and Local Conservation Corps offer unique services for implementing invasive plant management projects, and now there is state funding available through these organizations that can help make your projects happen! An expert panel will present the ways in which corps groups have worked successfully and cost-effectively with a range of partners on a range of projects, and how new bond funds through Prop. 1 and Prop. 68 (and potential future bond measures) are changing the way grantees work with the corps. Some funds from these propositions are directed through the corps for projects, making it possible for you to engage the corps in your project at no cost to you. Learn about the professional services offered by state and local corps, their qualifications and certifications pertaining to invasive species removal services, their compliance with statutes and regulations (including State Resources code, labor code, transportation code, etc.), and project benefits of engaging disadvantaged communities. Finally, understand the range of programs available in addition

the conservation corps, such as American Conservation Experience and Student Conservation Association. All these programs provide cost-effective options for invasive plant management that are important for land management agencies to know about.

No more comparing apples to oranges: Comprehensive invasive plant data management methodology using Collector for ArcGIS within a nested grid system. Morgan Ball[1,2]* and Katrina Olthof[1,2]*. [1]Wildlands Conservation Science, Lompoc, CA. [2]ManTech SRS Technologies, Lompoc, CA. morgan@wildlandscs.org and katrina@wildlandscs.org

Recent developments in mobile geospatial technologies allow both land managers and field technicians to more efficiently communicate treatment strategies, track invasive plant infestations, assess treatment success, and document field effort. The question is, what is the best methodology to track and compare infestations that continually morph through time? We have developed a data management workflow utilizing Collector for ArcGIS that allows field technicians to easily document current treatments while collecting data in a comparable manner to past efforts. This system requires data to be communicated to a scalable and spatially explicit grid rather than applying an assortment of irregularly overlapping points and polygons. Attributing data to a "nested grid system" allows land managers to properly compare long-term datasets and field technicians to readily access historical treatment data in real-time, thereby promoting adaptive management practices. This presentation reviews our workflow to achieve the goals of 1) collecting spatial treatment data quickly and effectively (reducing data entry and improving data integrity); 2) allowing for a more accurate comparison of the extent and cover of invasive plant infestations through time and space; and 3) providing field technicians real-time historical context on both mapped infestations and past treatments.

Interactions between the invasive *Schinus molle* (Peruvian pepper tree) with six plant species commonly found in Southern California nature reserves. David C. Bañuelas[1]*, Erin J. Questad[2], Edward G. Bobich[2]. [1]University of California, Irvine, CA. [2]Department of Biological Sciences, CalPoly Pamona, CA. dbanuela@uci.edu

Since *Schinus molle* (Peruvian pepper tree) was brought to Southern California, the dioecious tree has been widely adopted in urban forests and has become invasive. While *S. molle* is known to be allelopathic on crops and associated weeds, the effect of allelopathy on native plant species is poorly understood. One prior study demonstrated that soil and leaf litter of *S. molle* inhibited the germination and growth of succulents native to the Chihuahuan desert. Thus, it was unknown whether *S. molle* influences plant species in its understory through allelopathy in Southern California. The present study sought to determine if *S. molle* has negative effects on three native and three non-native, invasive understory species. For two separate experiments seeds of six plant species were sown in mulch (leaf litter) and soil collected from both genders of *S. molle*. Both male flowers and the female fruits of *S. molle* have different chemical properties that could influence allelopathy. Because a prior study showed that native succulents were most inhibited by males, we expected mulch and soil from males would affect native and invasive species more than that of females; however, this prediction was not supported. Leaf litter from males stimulated the shoot biomass for *Amsinckia intermedia*, *Bromus madritensis*, *Brassica nigra*, and *Stipa pulchra*. Although soils collected from male trees reduced the shoot emergence of *B. madritensis* by 34%, both genders of soil did not influence the root and shoot biomass of any species. Additionally, field observations in three urban nature reserves recorded 20 native and 10 invasive plant species beneath *S. molle* canopies. The present study showed *S. molle* did not have the same effects on grasses and annuals as previously reported for native succulents. Therefore, *S. molle* can play a role in restoration by introducing and maintaining a native understory in Southern California.

EDDMapS One: Integrated platform and program for tracking invasive species management in North America. Chuck Bargeron*, Rebekah Wallace, and Joseph LaForest. Center for Invasive Species and Ecosystem Health, University of Georgia, Athens, GA. cbargero@uga.edu

EDDMapS has been a resource for invasive species occurrence data since 2005. In this time, EDDMapS has grown from a citizen science database focused on invasive plant data in the southeast to an aggregate database soliciting data on all invasive species taxa and biological control agents across the US and into Canada. As technology has advanced, it has allowed for more features and tools to be developed and made available to EDDMapS' partners. Whereas previous iterations of the EDDMapS website and smartphone applications focused on regional needs and, thus, regional versions of each existed, we have now launched EDDMapS One. EDDMapS One is the unification of the regions into one collective. Instead of having many websites and apps that all do very similar functions, but were separate due to the available technology at time of creation, they can now be brought into one website and one app. Concurrent to this, the EDDMapS API has also been redesigned for improved performance, increased usability, and easier implementation with a broader user base. This will allow

for easier and more precise data sharing among individual users and aggregate databases alike.

Deconstructing the stories we share about weeds: Strategies for creating meaningful communication with the public. Josie Bennett, Laguna Canyon Foundation, Laguna Beach, CA. josie@lagunacanyon.org

The future success of conservation is dependent on the willingness and commitment of communities to take care of local open space. Simply stated, if people do not care about nature, they will not be willing to fight to protect it. The first step towards creating a connection between the public and nature is meaningful communication. A major challenge in communicating ideas about weeds and habitat restoration is that often the message that we are sharing is complex and may be hard for the public to understand. The words and concepts that we use to communicate might not be understood, and people tend to disregard ideas that they don't understand. In general, people tend to spend most of their time talking to others with shared opinions and passions. To successfully create a lasting connection with the public, it is imperative that we take the time to understand our audience and cultivate strategic messaging that will stay with them. As a group that is deeply connected to the land and have dedicated our lives to protecting it, we have an understanding of ecology, the importance of native plants to the health of an ecosystem, and what needs to be done in order to protect open space. By deconstructing the stories that we regularly share about biodiversity and the invasion of non-native plants, we can find effective strategies for communicating to a broader audience.

Adaptive management of invasive plants: A case study from National Wildlife Refuges in the Midwest region. Josh Booker, U.S. Fish and Wildlife Service National Wildlife Refuge System Region 3, Oak Harbor, OH. joshua_booker@fws.gov

Invasive plant species affect approximately 2.5 million acres of U.S. Fish and Wildlife Service National Wildlife Refuge (NWR) System. It is estimated that only about 5-10% of infested acres are treated annually on NWRs, primarily due to limited funding and staff. To tackle this problem, multiple National Wildlife Refuges in southern Indiana, Illinois, and Missouri collaborated in 2009-2010 to develop a comprehensive invasive plant adaptive management project that would gather key information about infestations and strategically employ limited resources to management. This project includes a refuge-wide inventory component, a spatially explicit invasion prioritization model, an effectiveness monitoring protocol, an adaptive management model, a shared online database, and a data collection mobile app. This presentation will summarize the results to date of a multiyear inventory effort and how the adaptive management project has been implemented over time.

Adaptive management of stinknet (*Oncosiphon piluliferum*), an annual weed in a coastal sage scrub preserve in North County San Diego. Emily Burson*, Carlos A. de la Rosa. Institute for Conservation Research, San Diego Zoo Global, Escondido, CA. eburson@sandiegozooglobal.org

Vouchered or reported in seven counties in Southern California to date, stinknet (*Oncosiphon piluliferum*) is also an established invasive plant in the San Dieguito watershed of San Diego's North County. Stinknet covers roughly 200 acres of the San Diego Zoo Safari Park's Biodiversity Reserve, an 800-acre coastal sage scrub preserve in the San Pasqual Valley, near the City of Escondido. In the reserve, stinknet readily colonizes arid, south-facing cactus scrub, critical habitat for the coastal cactus wren (*Campylorhyncus brunneicapillus*), a California Species of Special Concern. To prioritize stinknet treatments, we identified areas where stinknet overlapped with cactus wren habitat that was also within 300 feet of a road, to make access to equipment easier. The decision-making process resulted in three high-priority areas totaling 20 acres. We spot-treated stinknet in these areas with a mix of Transline and Gallery SC in the spring of 2019. Although some stinknet patches responded well to treatments, others initially appeared damaged, but later flowered. To adapt our management strategy in 2020, we propose hypotheses explaining the variation in treatment success, and experiments to test them.

Investigating the effects of small mammals and plant competition on native and exotic species within annual grassland communities. Lachlan S. Charles[1]*, John L. Maron[2] and Loralee Larios[1]. [1]Department of Botany and Plant Sciences, University of California, Riverside, CA. [2]Division of Biological Sciences, University of Montana, Missoula, MT. lachlanc@ucr.edu

Across California, many annual grassland systems are under increasing pressure from invasive species. Upon invasion, many exotic species competitively exclude native species and can structure these communities in favor of either conspecifics or other exotic species. While there is a general acknowledgement that these plant-plant interactions play an important role in grassland community composition, there is growing evidence to suggest that plant-consumer interactions may alter these processes. Small mammals can influence plant community composition via granivory and herbivory pressure, which can alter soil seed bank dynamics and seedling recruitment, yet the link between these

processes and plant competition remains unclear. Using invaded annual grassland communities within the Sierra Foothills, we examined whether the impacts of small mammals and competition on seedling recruitment differs between native and exotic species over a temporal gradient. In 2014, we established eight experimental sites in which the presence of mammals was manipulated. Using a split-plot design within each site, one plot was fenced to exclude small mammals and one unfenced control to allow small mammals access. To assess the effects of small mammals and competition on seedling recruitment, within each plot, we established subplots containing a factorial combination of three fixed factors: Seed addition (seed added or control), origin of seed (native, exotic or mix species) and resident vegetation (removed or intact). Here we present results that highlight variation in species recruitment between native and exotic species in the presence of small mammals and how the strength of these effects varies with competition. We will then discuss how our findings can inform both management and restoration approaches within invaded grasslands.

Prescribed goat grazing for wildland management.
Alissa Cope[1]*, Robert Freese[2]*. [1]Sage Environmental. [2]Irvine Ranch Conservancy.
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Prescribed grazing involves targeting undesired plants for removal while preventing overgrazing through close monitoring and adaptive management. Sage Environmental Group (Sage) owns an in-house herd of goats used to suppress invasive plants and remove fire fuel load. Herd ownership is unique for an environmental planning firm and an advantage to land managers who can rely on grazing activities that are planned and implemented from a scientific and regulatory compliance perspective in accordance with local conservation plans. Irvine Ranch Conservancy (IRC) manages 30,000 acres of wildlands in Orange County and practices landscape-scale restoration with the goal of creating resilient and diverse habitats. Priority is given to restoring ecosystem processes whenever possible. IRC has collaborated with Sage to explore two applications of goat grazing in habitat restoration. The first study involves prescribed grazing to reduce thatch cover, selectively remove annual grasses, and increase vigor of purple needlegrass (*Stipa pulchra*) in a native grassland restoration project. Response of native grasslands to grazing relative to mowing and control plots is examined with respect to cover, density, and vigor (e.g. numbers of inflorescences) of purple needlegrass. Cover of annual grasses and thickness of the thatch layer are also examined. The second study involves intensive, multi-year grazing to deplete the weed seedbank and prepare sites for direct seeding with native species. This latter project is a recent experiment being tried in locales where synthetic herbicides are not an option. Preliminary data include percent removal of annual grasses and broadleaf weeds, thatch reduction, and presence of viable seeds within fecal pellets. Results will be compared with data from adjacent mowed plots. In both projects, the timing, duration, and frequency of grazing with respect to grass and weed phenology need to be carefully considered.

Determining potential drivers of chaparral conversion in a southern California fire scar.
Shane L. Dewees*, Carla M. D'Antonio and Nicole Molinari.
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An increased fire frequency in southern California is thought to lead to the demise of chaparral with eventual type conversion to grassland. Most studies supporting type conversion, however, have been limited in spatial and temporal scales. Here, we used historic aerial images from 1930 and 2009 to quantify chaparral conversion to sage scrub and non-native annual grassland within a discrete area of Ventura County (the 2003 Piru Fire scar) where fires have been common, and chaparral predominated in 1930. Our analysis showed a persistence of chaparral despite many fires, and a higher transition of chaparral to sage scrub than to grassland. Sage scrub was dynamic, with approximately one third of what was present in 1930 converting to grass but an equal amount converting to chaparral. We used hierarchical partitioning analyses to determine which variables contributed most to conversion over the 79-year interval. Southwestness, distance from roads, and maximum January vapor pressure deficit (VPD) were shown to have the highest independent contribution in chaparral conversion with more southwest facing sites, closer to roads, and higher January VPDs showing the most conversion to sage scrub or grass. Conversion of sage scrub to grass was more likely if sites had a higher number of both short-interval (<10years) fires and number of fires since 1930. The observed vegetation fluxes in this analysis, suggest a stepwise process for chaparral conversion. The chaparral to sage scrub step appears primarily driven by winter site aridity, whereas the sage scrub to grass step appears largely driven by fire.

Can ecological theory help us develop better targeted grazing systems for invasive plant management?
Carlos A. de la Rosa. Institute for Conservation Research, San Diego Zoo Global, Escondido, CA.
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As an independent and uniquely motivated labor force, herbivores, especially livestock, are a tempting alternative to land managers faced with acres of edible weeds. However, many managers are discouraged by the

practical difficulties and potential pitfalls of using animals to control invasive plants. Rules of thumb — for example, stating that certain ecosystems can or can't be grazed — can help managers decide when to use targeted grazing and browsing, but ultimately do not communicate why the technique may or may not be successful. Here, I discuss invasive plant management using targeted herbivory through the lens of evolutionary biology and behavioral ecology. By understanding the ecological and evolutionary relationships between herbivores and plant traits, we can better understand our management successes and failures, and identify new, creative approaches to invasive plant management.

Managing for dynamic and unpredictable species invasions. Jeff Diez, Department of Botany and Plant Sciences, University of California, Riverside, CA. jeffreyd@ucr.edu

Along with climate change, human-assisted movements of species are dramatically reshuffling the composition of communities around the globe. These changes offer unique opportunities to test ecological theory but also demand careful thinking about how we manage our landscapes and ecosystems under rapidly changing conditions. In the past few decades, conservation efforts have begun evolving to meet the challenges of rapid change, but likely not fast enough. Species invasions and climate change are highly dynamic and will interact to shape our future communities, with or without active management. The decades of research investigating the causes and consequences of species invasions have revealed important rules of thumb for prioritizing management decisions. Nonetheless, the onslaught of known and unknown factors, along with ever-rising propagule pressure, leave future management looking bleak. In this talk, I review some of the recent lessons learned about the causes and consequences of species invasions, but in the context of larger unknowns, and discuss implications for future research and management opportunities.

Communicating the threat of Japanese knotweed (*Fallopia japonica)* to private landowners along San Geronimo Creek. Anna Dirkse* and Steven Swain, University of California Cooperative Extension, Marin County. acdirkse@ucanr.edu

Japanese knotweed (*Fallopia* japonica) was first discovered in Marin County in 2011 alongside the Lagunitas Creek. Japanese knotweed is an invasive non-native plant that has the potential to convert the riparian ecosystem of Lagunitas Creek from a willow-bay overstory to solid knotweed, thereby entirely changing the functioning of this important and productive system for endangered Coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*). Over time, Japanese knotweed's ability to suppress seedling regeneration will prevent the formation of overstory shade along the creek, potentially increasing water temperatures, exacerbating erosion, and eliminating the cyclic introductions of woody material that support Lagunitas Creek as a salmonid bearing stream. While Lagunitas Creek is managed by agencies such as the National Park Service and California State Parks, Japanese knotweed has also been found in the main stem and tributaries of upstream San Geronimo Creek, which is mostly owned by private landowners. Because of Japanese knotweed's ability to spread vegetatively through flood events, management efforts need to take a holistic, watershed approach. The Marin Knotweed Action Team (MKAT) was formed in 2018 in part to help incorporate private creekside landowners into regional Japanese knotweed eradication efforts. Difficulties of working with private landowners include the sheer number of properties and owners involved, the public's lack of familiarity with Japanese knotweed and knowledge of invasive plant biology, and resistance to using herbicides as a management tool. This presentation will focus on MKAT's outreach strategy and the methods used to successfully reach private landowners along San Geronimo Creek and persuade them to adopt herbicide management on their property.

Cross-training and curiosity: The interaction of interdisciplinarity and an open mind. Norm Ellstrand, Department of Botany and Plant Science, University of California, Riverside, CA. ellstrand@ucr.edu

UC Riverside is an institution that encourages interdisciplinarity and an open mind. As an example, the winding path of my own career that eventually lead to my research on invasive species provides an illustration of this academic approach. Each component — research on evolutionary genetics, gene flow, conservation biology, risks of genetically engineered plants, applied crop plant evolution, and conducting science to inform policy — was essential in leading to the research theme of my group now: ground-breaking work on whether and how invasiveness evolves in plants. We must recognize that the process is continuous; there is no end to cross-training and curiosity. And that it is an essential approach to solving the complex challenges we face in the 21st century.

Partnering with the California Conservation Corps on large scale weed removal in the Oroville Wildlife Area. Holly Ferrara*, Ruben Reynoso and Michael Rogner. River Partners. hferrara@riverpartners.org

As part of a large-scale floodplain reconnection project on the 1,500-acre D-Unit of the Oroville Wildlife Area (OWA), River Partners has been using a combination of ground and drone-based mapping techniques to track treatment effectiveness on target invasive species. River Partners partnered with the California Conservation Corps to perform weed control activities for approximately three years prior to levee removal, which creates a permanent connection to the Feather River. In addition to levee removal, a network of canals — relics from construction of the Oroville Dam — will be re-graded to create positive drainage for fish passage. These canals will be re-planted with native vegetation as part of a 150-acre habitat restoration effort. More than 70 acres that were once dominated by tree-of-heaven (*Ailanthus altissima*) and giant reed (*Arundo donax*) will be replanted with native riparian species. More than 30 acres of re-graded canals will be planted along 3-to-1 slopes, and 50 acres where soil conditions are poor will be planted with species such as naked buckwheat (*Eriogonum nudum*), vinegar weed (*Trichostema lanceolatum*), Fitch's spikeweed (*Centromadia fitchii*) and gumplant (*Grindelia camporum*). The results of the weed control and restoration efforts are being summarized in an *Upstream Management Plan* to guide future implementation on the 7-mile stretch between OWA and Diversion Dam at the Feather River Fish Hatchery.

Invasive plant species mapping using drones in the Santa Ana River Watershed. AJ Fox[1]*, Sloane Seferyn[1], Kathy Eung[1], Varren Anacleto[1], and James Law[2]. [1]HANA Resources, Inc.; [2]Santa Ana Watershed Association. ajfox@hanaresources.com

Removing invasive giant cane or giant reed (*Arundo donax*) from the Santa Ana River Watershed has been a long-time goal for many resource conservation and habitat restoration entities for decades now. For land managers, its towering size and impenetrable volume has made its biomass extremely difficult to quantify. HANA Resources, Inc. (HANA) and the Santa Ana Watershed Association (SAWA) partnered using the latest unmanned aerial vehicle (UAV) technology to establish *Arundo* concentration for a 211-acre project site along the Santa Ana River in Norco, California. This plant species recognition flight consisted of a UAV drone flight to obtain high-resolution aerial images and then processing those images through a computer vision algorithm to identify the plant species. HANA utilized a deep learning neural network that implemented vision-based classification to recognize, identify, and geographically map the *Arundo* plant species. SAWA was able to take the multispectral imagery depicting *Arundo* acreages and make timely, informed land management decisions affording them the ability to calculate out the estimated cost and amount of *Arundo* removal. This cost-effective technology also allowed for the long-term monitoring of this site using ultra-high resolution aerials to compare *Arundo* growth over time and to detect changes in vegetation on a habitat landscape scale. Limitations associated with conventional methodologies have been overcome by rapidly advancing technology. Remote sensing at a much larger scale removes issues associated with point-based monitoring methods, such as quadrats or transects, and is more representative of the area of interest's performance.

Impacts of annual invasive species to the rare annual *Erythranthe shevockii* (Kelso Creek monkeyflower). Naomi Fraga[1]*, Julie Finzel[2]. [1]Rancho Santa Ana Botanic Garden, Claremont, CA. [2]UC Cooperative Extension Kern, Tulare and Kings Counties, Bakersfield, CA. nfraga@rsabg.org

Competition with invasive species is one of the primary threats to rare threatened, and endangered plants, but there are few studies that monitor the impacts of invasive species on rare plant populations. *Erythranthe shevockii* (Kelso Creek monkeyflower) is a diminutive annual in the lopseed family (Phrymaceae) that is endemic to eastern Kern County in the southern Sierra Nevada. Threats to this species include housing development, agriculture, water diversion (creation of Lake Isabella), cattle grazing, and competition with invasive species. A long-term monitoring study was established in Cyrus Canyon in 2014 on land owned and managed by the Bureau of Land Management. The selected site had been previously grazed rotationally. Two 20m^2 plots were established in a localized area where *Erythranthe shevockii* is known to occur. In one plot *Erythranthe shevockii* occurs in relatively high density (target plot), while it is absent in the second plot (control plot). The control plot was placed in an area where the aspect, soil and vegetation community are similar to the target plot. We have found similar species composition in both plots. However, species richness is overall greater in the target plot. Invasive species make up the predominant annual plant cover in both plots with *Erodium cicutarium* (red stemmed filaree), *Bromus madritensis* subsp. *rubens* (red brome), and *Bromus tectorum* (cheat grass) being the most abundant annual species. In this study we examine habitat suitability for *Erythranthe shevockii* as it relates to the presence or absence of invasive species and competition with other annuals.

Speak to be remembered: Science communication and the art of storytelling. Sue Gardner, Golden Gate National Parks Conservancy, San Francisco, CA. SGardner@ParksConservancy.org

"We are, as a species, addicted to story. Even when the body goes to sleep, the mind stays up all night, telling itself stories."— Jonathan Gottschall. Have you ever tried explaining a basic ecological concept to someone and received a blank stare? Ever shared your work in a classroom and noticed a gaggle of glazed eyes? As ecologists and scientists, the work we undertake is critical and core to the health of the environment (and humanity) — and yet, communicating about it in a way that is easily understood can be very difficult. The challenge is not in the information but in the communication. Research on brain processing has revealed fascinating details on why storytelling is one of the most powerful ways to communicate. Why is this, and how can we, as scientists, learn to incorporate the basics tenants of storytelling into the information we share? This session will explore the science behind storytelling, thoughts for how to improve the information we share, and examples of recent storytelling workshops that are being used to better understand the future of land stewardship.

Use of species distribution modeling to support early detection and rapid response to invasive plants in the Mountain Prairie Region. Lindy Garner, Region 6 Division of Biological Resources, U.S. Fish and Wildlife Service, Great Falls, MT., Lindy_Garner@fws.gov

Invasive plant species continue to be a significant threat to the National Wildlife Refuge System conservation targets, biological integrity, and landscape partnerships. Operational capacity to address this threat is extremely limited. Meanwhile, new invaders continue to colonize, and existing invasions spread into new areas. Early detection and rapid response to new invasions and identification of habitats at high risk is therefore a high priority, and this work is supported with species distribution models and development of a prioritization process that defines cost-effective management objectives. Prevention, early detection, and rapid response are then prioritized and implemented to prevent additional management burden. Partnerships are sought at local and landscape level to build trust, increase accountability and leverage resources for a common vision of invasive species management priorities and measures of success within ecological conditions and social needs of partners.

High salinity exposure does not preclude germination of invasive *Iris pseudacorus* from populations along a Delta – San Francisco Estuary salinity gradient. Morgane B. Gillard[1]*, Jesús M. Castillo[2], Mohsen Mesgaran[3], Caryn J. Futrell[1], Brenda J. Grewell[1]. [1]USDA-ARS Invasive Species and Pollinator Health Research Unit, Department of Plant Sciences, University of California, Davis, CA. [2]Departamento de Biología Vegetal y Ecología, Universidad de Sevilla, Sevilla, Spain. [3]Department of Plant Sciences, University of California, Davis, CA. mgillard@ucdavis.edu

The wetland species *Iris pseudacorus* (L.) (yellow flag iris) recently spread from tidal wetland populations in the Sacramento – San Joaquin Delta to multiple sites from Suisun Marsh to the Carquinez Straits in the San Francisco Estuary, which represents a concern considering the invasiveness of the species and the vulnerability of the ecosystem. Estuaries present a wide range of aqueous salinity concentrations and increasing salinity that has been shown to alter the germination of tidal wetland plant species, depending on their sensitivity. Among future global changes, sea-level rise will broadly impact tidal wetlands, through the overall increase of salinity and inundation regimes. Thus, it appears necessary to explore to what extent salinity levels, water level and their interaction can affect the germination of *I. pseudacorus*. We explored the germination responses of seeds from two invasive populations from extreme points of the salinity gradient of the Delta tidal wetlands by exposing them to four salinity levels ranging from freshwater to seawater (0, 10, 20, 35 psu), and to two hydrological conditions (moist and flooded) in dishes placed in greenhouse conditions. Our results showed that germination was limited above a salinity level of 10 psu. Nonetheless, the seeds exposed to seawater salinity (35 psu) for 55 days were able to quickly germinate when exposed to freshwater. Hydrological conditions had no impact on the germination fraction, and there was no evidence of local adaptation of the two studied populations. Thus, we highlighted that a prolongated period of exposure to seawater will not impede the germination capacities of seeds in invasive populations of *I. pseudacorus*, allowing colonization of new sites following potentially long-distance dispersal of buoyant seeds with tidal currents. These results will help managers to better appreciate the risk of the invasive spread of *I. pseudacorus* in freshwater and saline tidal environments.

Challenges and successes of ten years managing the highly invasive Ward's weed (*Carrichtera annua*) in Carlsbad, San Diego County, California. Sarah Godfrey. Center for Natural Lands Management, Temecula CA. sgodfrey@cnlm.org

The first infestation of Ward's weed (*Carrichtera annua*) found in the United States was identified by botanist Jessie Vinje on the Center for Natural Lands Management's (CNLM) Rancho La Costa Habitat Conservation Area (HCA) in Carlsbad, CA, in 2008. Since that time, it has been found in multiple locations across San Diego County, and it is currently a high alert species given the destruction that it has wreaked on Australia's wildland biodiversity. Various control strategies have been attempted to stop this terribly invasive species over the last ten years on the HCA, and they have varied in efficacy until the last two years that a broadleaf-specific, pre-emergent herbicide has been successful in decreasing the amount of time and money spent on this weed. This herbicide, Gallery (active ingredient Isoxaban) has been the only herbicide to effectively allow native coastal sage scrub habitat to flourish while suppressing the seeds of the noxious weed. This presentation will evaluate the control methods, time spent, efficacy of methods, lessons learned from these approaches, and delve into the reasons that chemical control is the only option for controlling and eradicating this species.

Taking the call: The importance of empathy and listening to the community. Jennifer Greene*, Director, Community Engagement and Partnerships, Golden Gate National Parks Conservancy, CA. JGreene@ParksConservancy.org

Community members who share our love of the landscape and natural resources sometimes need more than scientific rational for invasive plant species treatments. More than often, they need empathy and someone to listen to their concerns. In this presentation, we will share examples of challenging exchanges with community members we have experienced during our restoration field work, trail construction, and other projects in our park over the last 10 years. These scenarios will illustrate ways to communicate with empathy and how to listen to build relationships, trust, and an understanding of the bigger picture behind resource protection. Audience members will have a chance to share their experiences and learn ways to: (1) take time to listen while getting the work done, (2) empathize with the person expressing their concerns, and (3) support our colleagues in the field.

Big projects, small monitoring budgets: Using basic data to assess treatment effectiveness for control of *Cortaderia jubata*. Ellen Hamingson, Point Reyes National Seashore, National Park Service, Point Reyes, CA. Ellen_Hamingson@nps.gov

Larger-scale weed control projects may have to measure results with less-than-ideal datasets. Point Reyes National Seashore received 2016-2018 National Park Service funding to bring over 3,000 acres invaded by jubata grass (*Cortaderia jubata)* within a 16,000-acre wilderness region to maintenance level and eradicate small infestations. The region is dominated by challenging topography and dense coastal scrub and chaparral with interspersed Bishop pine stands and riparian corridors. The known "jubata grass hotspots" had been identified, but control had to be implemented without knowledge of most patches' locations. In a situation familiar to many land managers, we did not have a balanced experimental design with treatments (including controls) assigned randomly to plots in advance. However, with pre-treatment jubata grass cover documented at each of over 250 patches, monitoring can still provide important clues about how best to apply scarce resources to control this species in less degraded but otherwise challenging sites. We will analyze results among the 250 patches treated across 3,300 acres. Of these patches, about 85% were initially removed manually and the balance treated chemically. Most plants were treated a single time with a minority receiving two treatments over three years. We assigned a unique identifier to each patch encountered (less than a square meter to almost two acres, depending on plant distribution across the landscape). The patch code linked spatial data with patch traits and treatment details recorded in an Access database; a random sample of patches varying in possible explanatory factors to be monitored for percent cover in summer 2019. Analysis will help to determine overall effectiveness and to answer questions: Does effectiveness differ between manual versus chemical treatments? What variability can we expect overall and within each treatment type? What factors (grouped into patch characteristics, treatment specifics, and treatment timing) explain the most variability in treatment effectiveness?

Maximizing the efficiency of invasive plant control with a phenology-based timing approach to management. Guy Gabriel Hernandez[*1] and Erin J. Questad[2]. [1]Don B. Huntley College of Agriculture, Plant Science Department, [2]College of Science, Department of Biological Sciences, California State Polytechnic University, Pomona, CA. gghernandez@cpp.edu

The control of invasive plants has been the primary concern in ecological and agricultural systems alike for many years. Factors such as increased management cost

and herbicide resistance have contributed to invasive species' widespread success. There is a need for integrated weed management (IWM), which integrates multiple control methods to develop the most efficient management program. Plant phenology, the timing of events in the plant life cycle, is an important concept that may help explain the opportunistic and competitive nature of invasive species, which can in turn provide insight to potential management strategies. Greenhouse and field experiments are underway on the campus of California State Polytechnic University, Pomona to investigate which stage of growth and development is best to implement mechanical control of *Brassica nigra, Bromus diandrus,* and *Centaurea melitensis*. The field experiment consists of sixteen plots per plant species randomly assigned one of four mechanical treatments. Treatments include an uncut control and three cutting treatments at three stages of development: early, flowering, and late. The greenhouse experiment consists of the same mechanical treatments with an additional watering treatment. Thirty-two pots per species were assigned either a wet treatment where soil moisture was kept at 30% volumetric water content (VWC) or a dry treatment at 15% VWC. For each plant, we measured maximum height and dry weight before and after each treatment. We also estimated the number of seeds per test plant during senescence. Field results show the ideal treatment time for *B. diandrus* was during the flowering or late stage, and during any stage for *B. nigra*. This research can provide an effective form of mechanical control for the restoration and agriculture community, providing additional tools in the creation of an IWM program.

Something wicked this way comes: California's perennial problem with invasive arthropod pests. Mark Hoddle, Department of Entomology, University of California, Riverside, CA. mark.hoddle@ucr.edu

Each year, on average, about nine new non-native macro-arthropod species establish in California. Of these, about three or so, usually insects or mites, will become pests that may require some level of management because they cause significant economic or ecological damage. Scientists at the University of California Riverside (UCR) pioneered the pest management sciences of Biological Control and Integrated Pest Management as sustainable methods for managing invasive species in agricultural crops. These foundational underpinnings continue to evolve at UC Riverside through faculty working on the biology and management of invasive species in the College of Natural and Agricultural Sciences and their research contributions to UCR's Center for Invasive Species Research. The basic principles underpinning these pest management tactics have been extended to tackling invasive weeds and arthropods afflicting wilderness areas. This presentation will focus on classical biological control for the management of invasive arthropod pests. The discussion will briefly touch on the historical development of biological control in California and safety concerns over deliberate introductions of non-native species for pest control. The talk will cover recent successes in California where populations of high-profile insect invaders have been suppressed with natural enemies. Details will be given on a success in controlling a pest of California citrus over 130 years ago — a success that was then translated to the Galapagos Islands, where the target had become a pest of conservation importance. Finally, new and emerging threats will be highlighted.

Striking a balance: selecting strategy levels for a startup invasive *Limonium* project based on eradication stage and budget. Drew Kerr*, State Coastal Conservancy's Invasive Spartina Project, CA. drew@spartina.org

In 2016, Cal-IPC began managing a project in the San Francisco Estuary (Estuary) focused on Algerian sea lavender (*Limonium ramosissimum;* LIRA) and European sea lavender (*Limonium duriusculum;* LIDU), funded by the National Fish and Wildlife Foundation. LIRA studies by two graduate students in the Boyer lab at San Francisco State University have demonstrated the rapid spread of this new invader, which was first identified in the Estuary in 2007 and can produce up to 130,000 seeds per m^2. With its ability to compete successfully with native plants in the upper intertidal and estuarine-terrestrial transition zones, especially in disturbed and restored marsh areas, LIRA is the top plant species of concern in the Estuary's tidal marshes after non-native *Spartina* species. Approximately 75 infestation sites have been identified through expanded inventory mapping efforts in 2018-2019, ranging from trace levels up to 13,323 m^2 net cover. All the moderate to large infestations have now been treated for two to four seasons using various methods including herbicide, manual removal, and even propane flaming. Several of the original infestations from pilot treatment in 2016 have been reduced by over 90%. This progress resulted from a feedback loop of implementing lessons learned during the pilot years. Some strategies we found to be key to success were expensive, necessitating measures not foreseen in the initial years, which required balancing with other aspects of the project to continue making progress on multiple fronts. These various levels of effort and our tolerance thresholds for maintaining progress will be discussed, along with comparisons to a larger, well-funded endeavor, the Coastal Conservancy's Invasive *Spartina* Project. Cal-IPC's *Limonium* work highlights the importance of collaboration to find innovative ways to leverage available sources of information and other resources to augment the budget of a small, fledgling project.

***Mesembryanthemum crystallinum* reduces ecosystem functions on San Nicolas Island.** Denise Knapp[1]* and Fritz Light[2]. [1]Santa Barbara Botanic Garden, Santa Barbara, CA. [2]Independent Consultant, CA. dknapp@sbbg.org

A better understanding of how and why plant invaders impact native communities will better equip land managers to prioritize conservation actions and effectively restore these communities. *Mesembryanthemum crystallinum* (MECR) is a South African annual which invades the southern California coast and California Islands. We investigated MECR's impacts on insects and other arthropods at three sites on San Nicolas Island, where it covers hundreds of acres. Arthropods are excellent habitat indicators, because they respond quickly, sensitively, and locally to environmental changes and perform key ecosystem functions. Pitfall trapping of ground-active arthropods revealed that either their species richness or functional diversity (or both) was significantly lower in MECR-dominated plots than native comparison plots at all three sites. In addition, arthropod composition was altered by MECR in all three sites, with flies, beetles, ants and wasps, moths, and true bugs all but disappearing in MECR plots in favor of smaller-bodied arthropods such as springtails, barklice, and mealybugs. The larger arthropods supported by native-dominated habitat are key in the diet of the island fox, which is at-risk. These results have negative implications for ecosystem functions, stability, and resilience to global environmental change where MECR invades. We conducted a restoration experiment to seek cost-effective, large-scale techniques to regain plant diversity. Our experiment compared herbicide and grow-kill treatments to control MECR, with and without applying diverse native seed with a portable hydroseeder. Herbicide achieved the greatest reduction in MECR cover, but negatively affected plant species richness. Hydroseeding natives had minimal benefit, due to extremely low precipitation in the year following application. Achieving greater gains in plant diversity would require more time and labor inputs than is feasible. Biological control is recommended to reduce MECR cover on the island and regain the diversity and functions of both plants and animals on the island.

Invasive species management and ecosystem restoration — two sides of the same coin. Loralee Larios, Department of Botany and Plant Sciences, University of California, Riverside, CA. loralee@ucr.edu

Ecosystem restoration is becoming a prominent component in the efforts to conserve ecosystem functioning and mediate the impacts on our planet. These efforts are often implemented in tandem with management for invasive plant species. Therefore, as we seek to tackle the future challenges of restoration such as determining when to intervene, improving efficacy, and ultimately managing for resilience, we must bear in mind that invasive species management and restoration are often intertwined. In this talk, I will review the past and evolving challenges with restoring areas post invader removal, including the spatial and temporal context dependency of invasion dynamics and invader impacts and discuss implications for prioritization and future research in restoration.

Evolutionary drivers of the invasion of Stinkwort (*Dittrichia graveolens*) in California
Nicky Lustenhouwer*, Miranda K. Melen, and Ingrid M. Parker. Department of Ecology and Evolutionary Biology, University of California, Santa Cruz. nlustenh@ucsc.edu

In order to mitigate the impacts of invasive species, it is critical to understand how rapidly invasive populations will spread and how they will impact native communities. Recent work has shown that spreading populations can rapidly evolve, which can lead to invasions that accelerate in velocity over time or spread into novel habitats. Here, we study evolutionary drivers of the spread of *Dittrichia graveolens*, a Mediterranean annual plant that was first observed in California in 1984 and has since spread rapidly across the state along roadsides. We sampled seeds from populations in the San Jose area, near the site of first introduction, and from populations along several parallel highways into the Sierra Nevada mountains, representing the current invasion front. We are using greenhouse common garden studies and population genomics to explore evolutionary change during invasion. We study three main selective factors: (i) adaptation to higher altitude conditions, in particular in phenological traits, (ii) novel biotic interactions with native plant species and soil pathogens, and (iii) selection for increased dispersal and capacity to self-fertilize at the invasion front. We aim to use our results to both improve our fundamental understanding of the invasion process, and to assist land managers with specific information that will help them manage invasive *Dittrichia* populations in an efficient way. We focus on the potential of *Dittrichia* to spread away from roadsides and invade valuable restoration habitat and rangelands.

Below-ground effects of organic and chemical herbicides used in invasive plant management. Mia Maltz[1]*, Isaac Ostmann[2], Amanda Swanson[3], Jutta Burger[2,4], Natalie Rodriguez[5], Lilliana Garcia[5], Lauren Dagan[5], Danielle Stevenson[6,7], and Emma Aronson[1,5]. [1]Center for Conservation Biology, University of California, Riverside, CA. [2]Irvine Ranch Conservancy, Irvine, CA.[3]Newport Bay Conservancy, Newport Beach, CA. [4]California Invasive Plant Council, Berkeley, CA. [5]Department of Microbiology and Plant Pathology, University of California Riverside, CA. [6]Department of Environmental Toxicology, University of California Riverside, CA. [7]CoRenewal, Irvine, CA. maltz@ucr.edu

Herbicides are often used in restoration to systemically control invasive plants. Although synthetic herbicides are highly effective, organic herbicides are increasingly being recommended and prescribed in response to concerns about potential health risks of glyphosate. Although our previous work comparing glyphosate and mowing illustrated glyphosate-induced changes in soil microbial community composition and mycorrhizal abundance across these treatments, little is known about the effects of organic herbicides on soil microbial communities or mycorrhizal fungi. In Bommer Canyon, Irvine, we compared the soil effects of four contact organic herbicides: Suppress® and FinalSanO® (strong acids), Fiesta® (chelated iron product), and Avenger® (orange oil-based) to mowed and untreated controls. We collected soils pre- and post-treatment to assess changes in plant cover and microbial communities. Herbicide plots were treated in February, March, and early May while mowed plots were treated in April. Microbial communities shifted with herbicide treatment, which may influence native plant recruitment. This suggests that acid-based organic herbicides are somewhat effective but timing and weed context are critical. Below-ground effects are more complex, and mowing may still be a preferable management tool for controlling invasive plants when synthetic herbicide use is restricted.

Containing and reducing the spread of *Volutaria* across Southern California: lessons learned when managing novel weed species. Christopher McDonald[1]*, Steve Schoening[2], Pat Matthews[3], Joe Woods[4], Amanda Swanson[5], Jason Giessow[6]. [1]University of California, Cooperative Extension, [2]California Invasive Plant Council, [3]Volunteer, [4]Independent Contractor, [5]Newport Bay Conservancy, Newport Beach, CA. [6]Dendra Inc., Encinitas, CA. cjmcdonald@ucanr.edu

Volutaria tubuliflora was first recorded in Orange County near the Southern California coast in 1987. However, its discovery went nearly unnoticed until a new population was discovered in the small desert community of Borrego Springs in 2010. Since then, volunteers and land managers have been working to determine the extent of each population, to remove individuals, and to prevent the spread of this species across California and the southwestern US. *Volutaria* is found in a variety of arid and semi-arid habitats across North Africa, the Mediterranean and the Middle East, potentially indicating it could thrive in a variety of locations in North America. In Southern California, four populations have so far been discovered with marked variations in size of infestation and habitat type. With repeated monitoring and mapping, *Volutaria* populations in the smaller, more coastal infestations are declining, but a few new patches have been discovered adjacent to known locations. An update on the management of each of the *Volutaria* infestation will be presented. In Borrego Springs, where the largest *Volutaria* infestation occurs, additional monitoring and mapping efforts have led to significant discoveries of this noxious weed beyond where it was originally thought to occur. With the above average precipitation in the desert this year, *Volutaria* has been more abundant than during the drought. In addition, several new infestations have been discovered miles from Borrego Springs, including in Imperial County. This indicates that *Volutaria* was likely spreading during the recent drought. With the discovery of new patches far from established populations in Borrego Springs, the amount of work needed to contain this species is becoming increasingly more difficult. The effort to remove *Volutaria* has been wide ranging, from professional land managers, to weekly volunteer weed removal efforts, to out-of-town volunteers from across the US.

Restoration, invasive species, and conservation challenges in a region with extraordinarily rapid changes. Arlee Montalvo. California Native Plant Society, Riverside-San Bernardino Chapter, Riverside-Corona Resource Conservation District, and University of California, Riverside, CA. montalvo@ucr.edu

The Inland Empire Region is wonderfully rich in topography, geologic substrates, habitat niches, and the organisms that occupy them. We fall within the Southern California Mountains and Valleys Ecological Section, a section that contains the headwaters to the Santa Ana River Watershed with San Gorgonio Mountain in the San Bernardino Mountains approaching 11,500 feet, and the elevation at the boundary of Riverside and Orange Counties dropping to 500 feet within 51 miles. Precipitation gradients from the high mountains to the valleys below are as precipitous as the elevation gradients. More variation is provided by the unique west to east running Transverse Range and the more north to south running Peninsular Ranges that parallel the coast. From downtown Riverside, amazing natural places ranging from coastal estuaries, to high mountains, to desert are only a 45-minute to one-hour drive. However,

this rich region is faced with rapid increases in temperature, development, traffic, air pollution, homeless populations, invasive species, and shifts in fire regimes that threaten habitats, native biodiversity, and our ability to protect and restore wildland habitat. The correlated declines in species and habitat quality can be shattering. At the same time, the region is packed with talented and dedicated people who are working together to build capacity to face the challenge. We aim to achieve success through cooperatively sharing information and resources among agencies, universities, non-government organizations, businesses, and the general public. This is how we can harness solutions to counter declining biodiversity. I will highlight a few of these efforts from the local area.

Evolving our thinking on the knowing-doing gap in managing invasive species. Ingrid Parker, Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, CA. imparker@ucsc.edu

As a 'Boundary organization', Cal-IPC has a unique role to play in generating, facilitating, and guiding research that bridges the gap between academic science and the needs of practitioners on the front lines of invasive plant management. In her landmark 2015 paper, Virginia Matzek explored the "knowing-doing gap" — when scientific knowledge does not translate into meaningful action — for plant invasions. How have our thoughts and actions changed since the publication of that paper? What are the characteristics of productive collaboration between academic scientists and practitioners? Where are the small adjustments that could reap disproportionately large benefits? How can we reduce barriers and reward successes? In my talk, I will invite the community to revisit this vital discussion of the role of research in invasive plant management.

Identifying the microbial legacy effects of invasive grasses for restoration. Brooke Pickett[1]*, Irina Irvine[2], Emma Aronson [1]. [1]Department of Microbiology and Plant Pathology, Riverside, CA. [2]National Park Service, Pacific West Region, San Francisco, CA. brookepic22@gmail.com

In California, invasive grasses have displaced native plants, transforming much of the endemic coastal sage scrub (CSS) to nonnative grasslands. This has occurred for several reasons, including increased competitive ability of invasive grasses and long-term alterations to the soil environment, called legacy effects. Despite the magnitude of this problem, however, it is not well understood how these legacy effects have altered the soil microbial community and, indirectly, native plant restoration. We assessed the microbial composition of soils collected from an uninvaded CSS community (uninvaded soil) and a nearby 10-ha site from which the invasive grass Harding grass (*Phalaris aquatica* L.) was removed after 11 years of growth (post-invasive soil). We also measured the survival rate, biomass, and length of three CSS species and *P. aquatica* grown in both soil types (uninvaded and post-invasive). Prior to this experiment, native species recruitment into the bare ground where invasive *P. aquatica* had previously grown was minimal, despite intact CSS bordering the treatment areas. This suggests soil legacy effects of *P. aquatica*. Our findings indicate that *P. aquatica* may create microbial legacy effects in the soil that likely cause soil conditions inhibitory to the survival rate, biomass, and length of *A. californica*, but not the other two native plant species. Specifically, *A. californica* growth was lower in the post-invasive soil, which had more *Bacteroidetes*, *Proteobacteria*, *Agrobacterium*, *Rhizobium* (*R. leguminosarum*), and rhizophilic arbuscular mycorrhizal fungi, and fewer *Planctomycetes*, *Acidobacteria*, *Nitrospira*, and *Rubrobacter* compared with the uninvaded soil. Shifts in soil microbial community composition such as these can have important implications for restoration strategies in post-invasive sites.

Using Calflora to map and track invasive species in California. Cynthia Powell, Calflora, Berkeley, CA. cpowell@calflora.org

The Calflora platform provides an excellent early detection rapid response tool for invasive plants in the state of California. For 20 years, the 501(c)3 non-profit Calflora Database has been providing information about California plant biodiversity for use in education, research, and conservation. Every plant species that grows wild in California will be found within Calflora, a list of more than ten thousand species. Of these ten thousand, about two thousand are not native and about 300 are on the Cal-IPC invasive list. Tracking and mapping this distribution in addition to any treatments is vital for controlling invasives and preventing them from entering new regions.

Quantifying the impacts of invasive plants on California's imperiled flora: A review. Heather E. Schneider* and Sean A. Carson. Santa Barbara Botanic Garden, Santa Barbara, CA. hschneider@sbbg.org

California is a global biodiversity hotspot. With more than 6,500 different kinds of native plants, California supports a more diverse flora than any other state in the nation. However, more than one third of those plants are considered rare due to intrinsic and/or extrinsic factors. The negative impact of invasive plants is often cited as a major threat to California's rare flora, second only to habitat loss. But how often do researchers and land managers measure those negative impacts or the response of rare plant populations to invasive plant removal? In this literature review, we attempted to

summarize the existing peer-reviewed literature addressing the impacts of invasive plants on rare plants in California. Our goals for this work were three-fold: 1. To provide an informational resource for land managers and conservationists who work to manage and protect California's rare plants; 2. To provide justification for funding invasive plant removal as an important component of rare plant conservation; and 3. To encourage future research to increase our understanding of how invasive plants threaten rare plant populations and to document recovery following invasive plant removal.

***Do Oncosiphon piluliferum* soil legacy effects post removal inhibit restoration success?** Stuart Schwab*, G. Darrel Jenerette, Loralee Larios. Department of Plant Biology, University of California, Riverside, CA. stuart.schwab@email.ucr.edu

Oncosiphon piluliferum is an aggressive invasive forb from South Africa that has rapidly expanded its range and dominance in Southern California. Invasives, such as *Oncosiphon piluliferum*, may alter local soil conditions which inhibit the establishment of native species even after the invasive has been removed. These legacy effects can be prominent, where soil conditioning by invasive species can inhibit the establishment or performance of native species by degrading the beneficial soil microbial and fungal communities that native plants often require. Assessing the presence of soil legacies, the time at which they may develop, and if there are species that can tolerate this conditioning will be key to successful future restoration efforts post invader removal. We are conducting a greenhouse study, where we test the response of six native species to *Oncosiphon piluliferum* soil conditioning along an invasion gradient. Soils were collected from three sites, where land managers helped to identify the introduction point and invasion patterns to acquire soil that varied in time of *Oncosiphon piluliferum* invasion. We are measuring plant growth, functional traits, and mycorrhizal colonization to parameterize plant performance, identify competitive ability and stress tolerance, and the degree of plant investment in symbiosis. We predict that species with obligate symbioses will have lower performance than plants with facultative symbioses if the degraded mutualisms legacy is present. Species with high resource use traits may be more vulnerable than species with low resource use and stress tolerant traits to the effects of degraded soil communities. These data will help identify the mechanisms of *Oncosiphon piluliferum* dominance and identify management requirements for additional next steps — such as soil or mowing treatments — and successful species pallets to enhance the success of restoration efforts.

Targeted grazing as a method of controlling non-native grasses for Stephens' kangaroo rat management. Brian Shomo*, Riverside County Habitat Conservation Agency, Riverside, CA. bshomo@wrcog.us

Increasingly, targeted grazing prescriptions are used by land managers as a tool to reduce non-native weeds in their efforts to manage habitat for rare species. However, many have reported mixed results and varying levels of success. The Riverside County Habitat Conservation Agency has experimented with targeted grazing for more than 10 years in managing habitat for the Federally endangered Stephens' kangaroo rat (*Dipodomys stephensi*) (SKR). SKR require approximately a 50:50 ratio of bare dirt to grass in order to move, eat, and dust bath. In most of the SKR's range, non-native grasses grow too dense for the SKR to thrive. Other methods of grass reduction, including mowing, burning, and herbicide application, were limited by cost, scale, and or environmental concerns. The RCHCA experimented with various grazing prescriptions as a cost-effective control of grasses on a landscape scale by mimicking native herbivore behavior with modern day domestic livestock. The process requires close coordination and some compromises between the grazer and the land manager to carefully target the grasses while minimizing impacts to native forb species. Practical considerations for establishing a targeted grazing program were evaluated and tested, including timing, number of animals, movement patterns, and stacking of treatments, that eventually demonstrated a formula with a high probability for success. Grazing in this manner, the non-native grasses have substantially decreased on RCHCA lands and populations of SKR have increased substantially.

Biological control of Dalmatian toadflax by the weevil *Mecinus janthiniformis* at Hungry Valley. Lincoln Smith[1]*, Patrick J. Moran[1], Dale M. Woods[2], and Michael J. Pitcairn[2]. [1] USDA-ARS, Albany, CA. [2]CDFA, Sacramento, CA. link.smith@ars.usda.gov

Dalmatian toadflax (*Linaria dalmatica*, Plantaginaceae) is a perennial forb that has invaded grasslands in parts of California. The weevil, *Mecinus janthiniformis* (Coleoptera: Curculionidae), has been released as a classical biological control agent in the western U.S. and Canada. Releases generally have not been performed in California because of possible feeding on some native snapdragons (*Antirrhinum* spp.). However, adventive populations of *M. janthiniformis* occur in northeastern California. In 2008, this weevil was released for biological control of Dalmatian toadflax at the Hungry Valley State Vehicle Recreation Area (above 4,600 ft. elevation) in southern California. Weevils were released at three sites and were monitored along with additional 'control' sites. Weevil populations increased at the release sites to an average of

18 weevils per stem in 2012, and 99% of Dalmatian toadflax stems were infested. The weevil also spread to the three control sites (44% infestation). A wildfire in May 2013 destroyed the weevil population, but the weed recovered by 2014, and new weevil releases were made. By May 2018, the weevil population had again increased, with 5 to 10 weevils per stem and 70% of stems infested. Weevils were found at equal densities at the release and control sites, and had dispersed 1 km. Weevils overwintered well (40 to 70% survival) at this location. Dalmatian toadflax stem abundance declined 25%. Plant biodiversity was assessed annually. A native moth (*Penstemonia* sp.) (Lepidoptera: Sesiidae) was found feeding on Dalmatian toadflax roots. The weevil, *M. janthiniformis*, appears to be reducing Dalmatian toadflax in southern California.

How tracking treatments is supporting success in the field in the Southwest Region. Edward Sprigg[1]* and Bethany DeRango[2]*, [1]Region 2 New Mexico Invasive Species Strike Team, National Wildlife Reserve System, U.S. Fish and Wildlife Service. [2]Region 2 Arizona Invasive Species Strike Team, National Wildlife Reserve System, U.S. Fish and Wildlife Service. edward_sprigg@fws.gov and Bethany_derango@fws.gov

Tracking management actions is an integral component of the Strategic and Adaptive Invasive Plant Management Model. In 2018-19, the Southwest Region Refuges Biology Program created a tracking management actions application in ESRI Collector, commonly referred to as "TrackMan". The TrackMan app is used to track invasive plant treatments with mobile devices. The TrackMan tool allows FWS staff, volunteers, and collaborators to mark where and how invasive plants are treated, and instantly submit the data to a centralized location (ArcGIS Online). As soon as the invasive plant treatment information is submitted from the mobile device, the information is available in real-time to the Southwest Region through a dashboard web page. This dashboard shows live instant updates of invasive treatment progress, on-the-ground descriptions, and photos of the treatment areas for use by FWS staff. The TrackMan app is the first time FWS staff can see all the invasive plant treatments and invasive plant locations in one place and in real-time. TrackMan has been quickly adopted by refuge field staff as it is easy to use, centralizes the information, and reduces data calls. Another benefit of TrackMan is the standardization and centralization of this invasive information, thereby allowing the Southwest Region to easily integrate our invasive data with BLM and NPS invasive data sets under a unified command approach, as well as share the data with our conservation partners. With TrackMan, staff are trained in less than an hour. The TrackMan app can be accessed from multiple smartphones or mobile devices at the same time and can be used by collaborators like ACE crews.

Finding balance when you are stuck in a marsh: Navigating the complexities of Upper Newport Bay for effective invasive plant management. Amanda C. Swanson[1]*, Josie Bennett[1,2]. [1]Newport Bay Conservancy, Newport Beach, CA; [2]Laguna Canyon Foundation, Laguna Beach, CA. amanda.swanson@newportbay.org

Upper Newport Bay (UNB) is the largest remaining estuary in southern California, making it an invaluable resource that provides critical habitat for wildlife and numerous ecosystem services to the public. While much of the remaining habitat within UNB is now protected, several challenges still exist that greatly impact the management and monitoring of hundreds of invasive plant species found within the Bay. Among the many challenges affecting targeted invasive control efforts are the complexity in land ownership, its location within a highly urbanized environment, and that it is the final destination for surface water flows from the surrounding 154 square-mile watershed. Working across boundaries is a challenge experienced by many doing targeted invasive control. The purpose of this presentation is to offer a framework for how we are working to break down such challenges and develop solutions to balance limited resources for managing invasive plants in UNB. This framework will incorporate various partner and stakeholder relationships, the intricacies of the public realm, and some of the specific environmental pressures UNB faces in relation to its position within a highly urbanized landscape. We will interweave elements of the following ongoing projects: 1) management of *Limonium ramosissimum* (Algerian sea lavender) and *L. duriusculum* (European sea lavender); 2) control of *Volutaria tubuliflora* (Egyptian knapweed); and 3) the restoration of a 60-acre canyon area dominated by *Schinus terebinthifolius* (Brazilian peppertree). By considering all the different components that impact invasive plant management in an organized, cohesive framework, we hope other land managers may glean insights as to the challenges and potential solutions associated with targeted invasive control efforts in an urban wildland.

Vegetation types at risk from Sahara mustard invasion: using Maxent to inform early detection and conservation targets with climate change. Lynn C. Sweet*, Scott A. Heacox, Melanie Davis, Cameron W. Barrows. Center for Conservation Biology, University of California, Riverside, CA. lynn.sweet@ucr.edu

Within the southwestern arid lands, including the Coachella Valley, California, Sahara mustard, (*Brassica tournefortii*) is among the weeds with the greatest potential to erode biodiversity. Because highly dispersible

species such as Sahara mustard may show expansions into new areas due to climate change faster than perennial vegetation types, this species may shift into new vegetation types as part of an overall shuffling of annual and perennial communities with climate change. In order to better target detection and control efforts, modeling of species distribution may be performed that can show which areas and vegetation types may be vulnerable to invasion in the future. Locations of Sahara mustard occurrences were drawn from an iNaturalist and Calflora, which the Low Desert Weed Management Area is using to map the species. These data were used to create a model of the current suitable habitat as well as the future suitable habitat under a moderate end-of-century emissions scenario (MIROC 4.5). The abundance of observations per habitat type, the current habitat suitability value as well as future suitability values were compared to mapped NVCS alliance-level vegetation types across the Coachella Valley. Current suitable habitat was associated with several lowland vegetation types in flatter, open areas, which differed from types that tended to have the most detections of the species, which could indicate observer bias or differences in invasibility. Future suitable climate projections indicated that this species may move into new vegetation types, underscoring the importance of widespread early detection and reporting.

Integrating weed control and trait-screened seed mixes to reduce the risk of postfire type conversion from coastal sage scrub to annual grassland. Noah Teller*, Travis Bean, Elise Gornish, Loralee Larios. University of California, Riverside. ntell001@ucr.edu

Wildland firefighting often facilitates plant invasions through native plant removal, soil disturbance, and moving invasive propagules, putting native plant communities and the broader ecosystems they support at risk. Individually, weeding and seeding natives have each proven inconsistent for mitigating postfire invasion, but research is needed to understand if integrated treatments could improve outcomes. Here we present a study conducted at Chino Hills State Park, where bulldozer fuel breaks for the Canyon wildfires (2017) facilitated an increased abundance of invasive annual grasses in what was previously coastal sage scrub. Our objective was to evaluate the effectiveness of an integrated approach combining mowing and seeding of two functionally distinct seed mixes to suppress invasives and promote native plant establishment. We hypothesized that (A) a seed mix of native species with similar traits to invasive grasses would initially suppress invaders, but (B) a seed mix of native species with maximum functional diversity would have superior native survival in the second year, and (C) mowing in combination with seeding would improve performance of native species by reducing competition with invasive grasses. In a greenhouse trial, we assayed specific leaf area, specific root length, and seed mass of native and invasive species from the project area to create two seed mixes with varying levels of functional diversity and similarity to dominant invasives. Within 5 fuel breaks, we conducted a factorial experiment that manipulated mowing at peak biomass during the first spring after the fire and seeding in the fall. Within these experimental plots, we measured abundance of all species. From these data, we found that seeding increased native establishment in the bulldozer lines, but we did not detect a strong difference between mixes at suppressing invasives. Mowing during annual grass flowering provided superior invasive grass suppression and native survival to seeding alone.

iNaturalist for Invasive Species Monitoring. Ken-ichi Ueda, iNaturalist, Oakland, CA.

iNaturalist is a global, public platform for sharing observations of wild organisms and crowdsourcing their identification. It produces large quantities of data that could be used by land managers for a number of purposes, from monitoring plant and animal species at a site to early detection of invasive species. iNaturalist is not specialized for the purpose of finding new occurrences of invasive species, so considerations must be made when using it as an early detection tool.

Challenges growing California's rare plants amongst a diverse assemblage of *Phytophthora* species in the Regional Parks Botanic Garden. Michael Uhler, Gardener, Regional Parks Botanic Garden, East Bay Regional Park District. MUhler@EBParks.org

The Regional Parks Botanic Garden is 80 years old and one of three California public gardens devoted solely to growing wild-collected plants native to the state. Included in our diverse assemblage of wild collected taxa are many plants considered as rare and or endangered. Recent reports of soil borne pathogens, (particularly *Phytophthora ssp.*) entering the wildlands of California via nursery grown container plants piqued my interest in sampling the grounds of our botanic garden's living collection. Despite being an extremely beautiful and awe-inspiring collection of some of our state's finest plant species, we are challenged by a significant diversity of these vexing pathogens. For the past four years, I have worked with pathologists from the private sector as well as both the state and federal level to develop the testing and sampling skills necessary to detect these organisms in the garden. With their advice, we are working towards implementing best management practices that not only minimize the introduction of novel *Phytohpthora* species, but also allow us to maintain a world-class collection of California native plants in the presence of these organisms. I have successfully employed the use pears as

traps (in a method referred to as pear baiting) as well as the more rapid field tests done using Agdia *immunostrips* to detect soil borne *Phytophthora*. Results obtained using these methods are mapped on a satellite image of the garden that we utilize in order to make horticultural and land use decisions. It is certainly more difficult to manage our collection of plant taxa in the presence of *Phytophthora* and the consequences for us often includes significant dieback and mortality of individuals. Through observations of our collection, I have been trained to notice symptoms that warrant testing for the presence of *Phytophthora*. However, there are examples, especially in container grown natives, where the above ground symptoms are not readily apparent while the root system is significantly infested with *Phytophthora*. It is now generally understood that planting container stock into wildlands is a major pathway for *Phytophthora* introductions. Once established, *Phytophthora* is extremely difficult, if not impossible to eradicate. My work in a botanic garden with native taxa infested and/or infected with these root rot organisms has enforced the notion that it is much better to prevent introduction rather than to manage infestations.

Successes, failures, and lessons from the Orange County CNPS Emergent Invasive Program. Ron Vanderhoff, CA Native Plant Society-Orange County Chapter, CA. invasives@occnps.org

Early Detection and Rapid Response (EDRR) is the primary management approach to most effectively eradicate invasive plant populations, when they are still small. Through EDRR, well-informed surveillance and a quick and effective response can avoid costly long-term control efforts. In 2016 CNPS Orange County initiated an Early Detection program, specifically focused on new, emergent invasive plant species. This comprehensive approach involves identifying the highest priority emergent invasive plant species through a data-driven process, informing and training volunteers, citizen scientists and professional, providing identification tools, establishing simple reporting options and other resources. CNPS Orange County works with the regions' land managers and its own members and amateur naturalists to bring these groups together for more effective approaches to emergent invasive plant species in our region. Successes begin with early detections. The more trained eyes on the ground, the more successes we will have. Our program uses the Calflora database to report and track invasive plant occurrences and to notify our management partners. Trainings and field reference tools give people the confidence they need to be effective and get involved. Success with invasive plants is often an impermanent status, but several examples of our Early Detection efforts have shown encouraging results.

Invasive plant workshops in the Pacific Region: Benefits, challenges, and adaptations. Jess Wenick, Region 1 Branch of Refuge Biology, U.S. Fish and Wildlife Service, jess_wenick@fws.gov

Collecting information and managing all non-native plants everywhere is not feasible (or necessary). Refuge managers understand this reality and make decisions about where to focus limited resources, but they may not be the most strategic and are often not well documented. To help address this problem, the Pacific Region Branch of Refuge Biology offers invasive plant prioritization workshops for National Wildlife Refuges (refuges) across OR, WA, ID, and the Pacific Islands. The workshops help refuges and their partners reflect on invasive plant management priorities using the Invasive Plant Inventory and Early Detection Prioritization Tool (Tool). The Tool incorporates characteristics of distinct management areas within a given spatial scope, as well as distribution and ecological impacts of invasive plant species within areas are considered. The prioritization process provides a transparent, repeatable, and defensible framework for deciding which species should be a focus of management and where. The results of the prioritization process can help inform more efficient and effective allocation of limited resources and promote collaboration with conservation partners. We highlight some of the benefits of using the workshop format, as well as implementation challenges and adaptations we have made to apply the Tool to our region. We will share some the preparation work, issues we've overcome, and future challenges that we face in meeting the invasive planning needs in our region.

Project 467: Restoring and enhancing native plant diversity and the coefficient of beauty at Edgewood Natural Preserve. Stuart B. Weiss[1]*, Creekside Science, Menlo Park, CA. [2]Redwood City, CA. stu@creeksidescience.com

How can weed management and ecological restoration become sustainable? Controlling target weeds often leads to a "weed of the month" cycle; unless the newly available space is occupied long-term by native plants, sustainability is doubtful. Friends of Edgewood (FOE) is developing a long-term approach to managing grasslands within the 467-acre preserve. While Edgewood is famous for its flower-filled serpentine grasslands, grasslands on richer soils support great biodiversity and beauty as well. Over the past three decades, the Edgewood Weed Warriors have controlled many macroweeds such as yellow-star and Italian thistle to early detection levels. But "micro-weeds" — non-native annual grasses and forbs — still dominate non-serpentine grasslands. We are inventorying grassland plant biodiversity using CNPS Rapid Assessment methodology to document plant distributions and abundances across

edaphic and topoclimatic gradients, and to set reasonable restoration goals. We found that Hydromechanical Pulverization (HMP, a pressure washer applied post-germination) provides excellent initial control of non-native annuals, allows extant native perennials to vegetatively expand, and creates an excellent seed bed for natives. We are pursuing an "indigenous" seed production strategy, where small lots of seeds from many species are increased in *ex situ* gardens and seeded into intensively managed "showcase sites" that are then used for *in situ* seed production, and further expansion into adjacent areas. This strategy builds on existing native stands, especially perennials that can occupy space long-term, and uses the high capacity FOE volunteers for "tending the wild" using a variety of ancient and modern techniques. While all native species are candidates for seeding, we are especially interested in showy wildflowers that increase "the coefficient of beauty" and draw attention to the restoration of native plant biodiversity.

Poster Abstracts

*(List is alphabetical by lead author. * Student Contest entrant)*

Has yellow starthistle (*Centaurea solstitialis*) recently adapted to serpentine soils?
Katherine Brafford* and Mohsen Mesgaran. Department of Plant Sciences, University of California, Davis, CA. kebrafford@ucdavis.edu

Yellow starthistle (*Centaurea solstitialis*) is a highly invasive noxious weed that has caused widespread environmental and economic damage in California and the western United States. In the past, starthistle has not invaded serpentine soil habitats as it has invaded otherwise similar non-serpentine soil habitats. Serpentine soils, which present chemical and physical difficulties for plant growth, are relatively common in California, have produced large numbers of endemic species, and have largely not been invaded by non-native plants. However, in recent years, yellow starthistle has been noted increasingly often on California's serpentine soils. The purpose of this experiment is to test if some yellow starthistle populations have developed genetic-based adaptations that allow them to grow and successfully compete in serpentine habitats. Four pairs of otherwise similar serpentine and non-serpentine sites with starthistle present were selected from a wide geographical area within California, soil and seed samples were collected from each site, the average heights of the starthistle plants in the populations at each site were calculated, soil samples from each site were tested to determine their "serpentine character", and a germination test was conducted on seeds from each site. Reciprocal transplant experiments to test if seeds from the different populations perform differently on the different soil types and genetic testing will be performed in the future. Our findings will help inform the actions of land managers, whose land includes areas of serpentine soils, to reduce/prevent the presence of yellow starthistle and advance the understanding of weed invasion into difficult environments.

ACE'ing new statewide maps for conservation planning.
Elizabeth Brusati[1], Dana Morawitz[2]*, Melanie Gogol-Prokurat[1], and Sandra Hill[1]. [1]California Department of Fish and Wildlife, Sacramento, CA. [2]California Invasive Plant Council (Cal-IPC), Berkeley, CA. dfmorawitz@cal-ipc.org

Cal-IPC and the California Department of Fish and Wildlife (CDFW) created two statewide maps of invasive plant impacts for CDFW's Areas of Conservation Emphasis (ACE) project. ACE analyzes spatial data to summarize biodiversity, significant habitats, habitat connectivity, and climate change resilience. Its maps provide information used for conservation decisions, ecological research, and land-use planning. Our invasive plant maps join several others showing ecological stressors. Following the format of ACE's biodiversity maps, we separated the invasive plant map into terrestrial and aquatic habitats. We used statewide data from CalWeedMapper and Calflora for 225 Cal-IPC Inventory species with High, Moderate, or Limited ratings. The Terrestrial layer includes terrestrial and riparian species, as determined within the Inventory plant assessments. The Aquatic/Riparian map includes all species with a National Wetland Plant List wetland indicator status of Obligate or Facultative-Wetland. This method keeps the maps consistent with ACE's biodiversity maps, which also repeat riparian species in the terrestrial and aquatic versions. The two maps are intended to be viewed separately. In contrast to CalWeedMapper, which displays maps for individual species, the ACE data layers combine all species in a USGS quadrangle ("quad"). The ACE invasive maps show a score for each quad, calculated by summing the Cal-IPC rating and distribution for every species in that quad. These maps can be useful for large-scale planning efforts that need to see invasive species impacts and determine where more restoration is needed, such as a Habitat Conservation Plan or CDFW's Regional Conservation Investment Strategies.

European sea lavender (*Limonium duriusculum*) impact on salt marsh bird's beak (*Chloropyron maritimum* subsp. *maritimum*) flower visitors.
Stephanie Calloway*, Denise Knapp. Santa Barbara Botanic Garden, Santa Barbara, CA. scalloway@sbbg.org

The salt marsh bird's beak, *Chloropyron maritimum* subsp. *maritimum* (CHMAMA), is a state and federally endangered plant occupying coastal salt marshes from Monterey to Baja California. Land managers are grappling with the many threats CHMAMA faces, including habitat loss, sea-level rise, and invasive species competition. One such invasive species is European sea lavender, *Limonium duriusculum* (LIDU). Channel Islands Restoration is undertaking a LIDU removal project in the Carpinteria Salt Marsh Reserve (CSMR), Carpinteria, CA, providing us with a unique opportunity to document how LIDU may impact the pollination ecology of CHMAMA. The Santa Barbara Botanic Garden is looking at the insect floral visitors of CHMAMA and LIDU at CSMR before and after LIDU

removal. Our three main questions are: 1) which floral visitors utilize LIDU? 2) how do these floral visitors compare to those needed by CHMAMA?, and 3) how does the floral visitor response differ by LIDU abundance in the system? We began data collection in 2017, prior to LIDU removal, by conducting timed observations of floral visitation within quadrats throughout the CHMAMA population at CSMR. Preliminary data show that LIDU attracts a low diversity of European floral visitors that are not shared by CHMAMA. In addition to direct competition between the two plant species, this may be a sign that LIDU is indirectly impacting CHMAMA by changing the floral visitors present in this system, potentially decreasing pollination services. We will revisit our quadrats after LIDU removal in 2020 to compare pre-removal data to the post-removal response by floral visitors. This will help land managers understand how LIDU presence may impact CHMAMA pollinators and the broader ecological context of LIDU's presence in this system.

Rapid assessment photo points and plots for assessing annual diversity and fire risk in Joshua Tree National Park. Valeria Cancino[1,2]*, Nick Graver [1,2], Neil Frakes [2]. [1]Great Basin Institute, [2]Joshua Tree National Park, CA. valeria_cancinohernandez@partner.nps.gov

Annual plants comprise up to half the plant species at Joshua Tree National Park (JOTR); however, native annuals face strong competition with non-native, invasive plants. These plants are also short-lived, and thus difficult to study. The majority of non-native, invasive plants at JOTR are members of the families *Brassicaceae* or *Poaceae,* the latter of the two creating a concern regarding fire. The introduction of non-native invasive grasses, such as cheatgrass (*Bromus tectorum)* and red brome (*Bromus madritensis* ssp. *rubens*), to the Mojave and Sonoran deserts has increased biomass and continuity, allowing fire to spread in a landscape where fire was once restricted to isolated patches. Non-native annual grasses can shorten the fire interval from 30-100 years to as little as a 5-year fire return interval. These fires change environmental characteristics that result in an increased competitive advantage to the invasive grasses and can convert highly diverse shrublands to lower diversity non-native grasslands. To gain a better understanding of the community assemblages in JOTR, the potential effects of non-native annual plant presence, and fire risk, staff implemented a study consisting of rapid assessment photo points and permanent plots.

Investigating non-native plant diversity and native plant seedbanks to assess the potential recovery and restoration of fuel breaks. Robert Fitch[1]*, Carla D'Antonio[1], and Nicole Molinari[2]. [1]Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara. [2]United States Forest Service. robertfitch@ucsb.edu

Fuels breaks are often constructed using a bulldozer, scraping the land to remove all aboveground vegetation. Therefore, the first plant species to recolonize fuel breaks are frequently invasive, non-native annuals. Repeated disturbance to maintain vegetation clearing could remove native species from the seed bank, meaning native species will have to recruit from the edges of the fuel break where the intact vegetation remains. Classic ecology demonstrates that gap size is important for recolonization so, wider fuel breaks should take longer to recolonize with native plants than thinner ones. Likewise, recruitment by native species should be greater in sites that have experienced less disturbance, and thus, have more intact seedbanks. However, the persistence of native seedbanks within fuel breaks has not been assessed, nor has the effect of fuel break size on the recolonization ability of native plants. Additionally, non-native species can limit native species recruitment to varying degrees based on the density and identity of the invader; however, such data is lacking for these areas. Therefore, understanding these factors that limit native plant recovery will glean important insight for future restoration efforts within these disturbance corridors. Our goal is to quantify the native seed bank composition and determine the most important factors for native plant recovery on fuel breaks. We are surveying fuel breaks of varying widths; measuring percent cover within quadrats placed along transects longitudinally and laterally from the edge to the center of the fuel break. Soil cores are being collected within plots to sample the seedbank. We will be analyzing percent cover and seedbank samples in regard to width of the fuel break, disturbance history, invasive cover, and abiotic factors. We hope to inform future management decisions for restoration by identifying the areas that are the most invaded, and which have the greatest potential for recovery.

Plant health assessments using drones in the Prado Basin. AJ Fox[1]*, Sloane Seferyn[1], Kathy Eung[1], Varren Anacleto[1], and Richard Zembal[2]. [1]HANA Resources, Inc., Lake Forest, CA. [2]Orange County Water District, CA. ajfox@hanaresources.com

Factors that can affect plant health are fire, insect infestation (polyphagous shot hole borer), pathogen outbreaks, drought, flood, etc. Tracking the progress or decline of plant health can help land managers determine management strategies. For example, in Prado Basin, the Orange County Water District (OCWD) is attempting to quantify the effects of water retention on sensitive riparian habitat occupied seasonally by endangered least Bell's vireos (*Vireo belli pusillus*). HANA Resources, Inc. (HANA) and OCWD partnered using the latest unmanned

aerial vehicle (UAV) technology to evaluate the conditions of the riverine resources across an elevational gradient affected by inundation for water conservation. Using a UAV drone platform to transport both a multispectral camera and an ultra-high resolution 4K digital camera, HANA mapped a 408.5-acre project site within the Prado Basin. The system processed the images to create an Orthomosaic image of the land, where each pixel in the Orthomosaic image was associated with the NDVI value. The system then used plant species to NDVI value mappings and the Orthomosaic image to identify current plant growth. Vegetation health at each layer (herb, shrub, and tree) was calculated. The exact flight path can be replicated to compare the plant health over time. Limitations associated with conventional monitoring methodologies have been overcome by this rapidly advancing technology. Remote sensing at a much larger scale removes issues associated with point-based monitoring methods, such as quadrats or transects, and is more representative of the area of interest's performance.

Exploring the germination ecology of *Iris pseudacorus* populations invading California wetlands. Morgane B. Gillard[1]*, Jesús M. Castillo[2], Mohsen Mesgaran[3], Caryn J. Futrell[1], Brenda J. Grewell[1]. [1]USDA-ARS Invasive Species and Pollinator Health Research Unit, Albany CA. [2]Departamento de Biología Vegetal y Ecología, Universidad de Sevilla, Sevilla, 41080, Spain. [3]Department of Plant Sciences, University of California, Davis, CA. mgillard@ucdavis.edu

Seed germination is largely influenced by environmental factors. The dispersal and germination of sexual propagules can contribute to the invasiveness and spread of plant species. Therefore, having knowledge about the germination ecology of the species is of importance for improving management strategies. Recent finding showed that populations of *Iris pseudacorus* (yellow flag iris) invading freshwater wetlands in the northwestern US reproduce mostly through sexual reproduction and spread via buoyant seeds. However, existing literature about the germination requirement of this species is limited, and extant information is largely from studies of populations from freshwater wetlands in the native European range. Thus, we evaluated the germination requirements of invasive seeds of intertidal *I. pseudacorus* populations in Petri dishes placed in incubators under different conditions of stratification, light, and temperature. We also tested the impact of the presence or absence of seed coat on germination under greenhouse conditions. We found that stratification is not needed for these populations to germinate, and that the seeds of *I. pseudacorus* can germinate without light. Germination rate increased with temperature. In addition, at constant temperatures, seeds germinated little below +24°C but they were able to germinate quite well up to 36°C. Nonetheless, experiencing alternating temperatures seems necessary for this species to maximize its germination fraction. Finally, the presence or absence of the seed coat did not impact the germination fraction or germination velocity. This work allowed us to determine requirements necessary for seeds of *I. pseudacorus* to germinate. These findings will help managers to predict the germination potential of the existing populations, with the aim to control and prevent further spread of the species in California wetlands.

Enlisting community scientists to study a range-expanding plant, *Urospermum picroides* (L.) F.W. Schmidt, yielding a revised distribution map and recommendations for public engagement through iNaturalist. C. Matt Guilliams[1]*, Kristen Hasenstab-Lehman[1], Adam J. Searcy[2], and Casey H. Richart[1]. [1]Santa Barbara Botanic Garden, Santa Barbara, CA. [2]California *Urospermum* Working Group, Santa Barbara, CA. mguilliams@sbbg.org

iNaturalist has created an online community of 750,000+ people who use the application to document the world's biodiversity. With over 23 million observations made since launching in 2008, iNaturalist has tremendous potential to capture meaningful biological information useful to biodiversity scientists. This poster describes an iNaturalist project initiated in 2019 to increase public awareness of the non-native annual plant *Urospermum picroides* (L.) F.W. Schmidt (Asteraceae; Cichorieae) and to better document its current distribution. Native to the Mediterranean, it was first collected in North America in the San Francisco Bay Region in 1915. In 1965, it was documented in Santa Barbara, a second center of distribution. A final center of distribution is in Butte County, where it was first collected in 1985. *Urospermum* is morphologically distinctive among members of *Cichorieae* in having capitula with a single series of phyllaries and cypselae that are flattened and with a hollow, distal beak. Reports of increased prevalence in California in 2019 prompted the rapid deployment of an iNaturalist project. The project was announced through social media and direct correspondence with iNaturalist users who had previously observed the taxon. Through the project, 47 users contributed 287 observations, which is approximately 6-fold greater than the number of herbarium specimens gathered since 1915. Once apparently uncommon, iNaturalist observations have demonstrated the low-density ubiquity of the species in parts of the Bay Area and the Santa Barbara region. Project members also documented dozens of new localities, including a new county record for San Luis Obispo and a new country record for Mexico. Although iNaturalist was an ideal for this project, it may not be suitable in all cases. Appropriate conditions for the successful deployment iNaturalist projects such as this are discussed with respect to species detectability, species diagnosability, species range size, and distance to population centers.

Measuring change in a changing world: the power of statistics and statistical power. Tyler Hanson*. WRA, Inc., San Diego, CA. hanson@wra-ca.com

As our environment continues to change, the increased risk associated with invasive species will cause management decisions to become more challenging. Improved sampling design has the potential to aide land managers when faced with consequential management decisions. By incorporating sampling objectives into the design process, land managers can have more certainty when making decisions based on sampling results. First, the poster will examine fundamental sampling principles, confidence and power, as well as their relationship. The poster will build on these principles by discussing their relationship to the process of developing sampling objectives, offering managers an increased ability to define critical thresholds which may impact management decisions when funding is limited. In addition, the poster will discuss how to use sampling objectives to create a sampling design, including sampling intensity and technique, which maximizes confidence and power.

Environmental effects of the seed growth on germination traits of invasive *Ulex europaeus*. Mika Hozawa* and Eiji Nawata. Kyoto University, Japan. hozawa.mika.82m@st.kyoto-u.ac.jp

The objective of this study was to investigate the seed germination traits of *Ulex europaeus* in relation to climatic factors across their introduced range. Seeds were collected in Hawaii Island, Maui Island, California (USA) and New Zealand. Their germination rates and speed were tested under alternative light and temperature condition in the incubator after being kept at 4 °C for 4 months. Germination rate and speed differed significantly among mother trees; it suggested the variability of seed germination traits of *U. europaeus* is inherited. In addition, the relationships between climatic factors such as mean monthly air temperature and rainfall during the seed growth and seed germination traits were analyzed. Seed germination rates were significantly negatively correlated with mean monthly temperature and rainfall, and germination speed showed significant negative correlation with mean monthly air temperature. These results showed that *U. europaeus* seeds grown in lower temperature and rainfall germinate well, and that lower temperature during seed development promoted seeds to germinate fast. In addition, there was an optimal range in temperature and precipitation that promoted the germination rate and speed of *U. europaeus*: a mean monthly air temperature of up to 12 °C and mean monthly rainfall range of approximately 70 to 110 mm. These results can be used as a warning for the land managers of conditions that may favor rapid invasion by *U. europaeus*.

Environment and diet influence the entire bacterial microbiome of *Lehmannia valentiana*, an invasive California slug. Denise Jackson[1]*, Mia Maltz[2], Emma Aronson [1,2]. [1]Department of Microbiology and Plant Pathology, Riverside, CA. [2]Center for Conservation Biology, University of California, Riverside, CA. denisejackson654@gmail.com

The invasive terrestrial gastropod, the slug *Lehmannia valentiana,* is distributed throughout California. It originates from Europe and is a serious pest of gardens and greenhouses. Slugs and other terrestrial gastropods are agriculturally damaging and have been linked to the spread of human and plant pathogens. Most slug research has focused on a variety of potential biocontrol methods; however, whole intact slug bacterial

microbiome studies are absent in current slug research. Here, we have evaluated the bacterial microbiome of whole slugs to capture a more detailed picture of bacterial microbiome diversity and composition. We concentrated on the influences of diet and environment on the core bacterial microbiome of *Lehmannia valentiana* as a starting point for obtaining valuable information that will aid in future slug microbiome studies. *Lehmannia valentiana* were collected from two environments (a garden nursery and reared from eggs in a laboratory). The bacterial microbiomes of these slugs were extracted and 16S sequencing was performed. The microbiome was found to differ between the slug origin (nursery vs. lab reared) and changed after being exposed to a sterile diet and environment. The core microbiome of this host species was found to contain *Citrobacter*, *Erwinia* and, *Rhodococcus fascians.*

Investigating shifts in post-fire plant regeneration strategies and functional traits in Southern California shrublands. Meg Kargul* and Loralee Larios. Department of Plant Biology, University of California, Riverside, CA. mkarg001@ucr.edu

With more frequent wildfires and decreased precipitation in Southern California, native shrublands are more susceptible to plant invasions and type conversions post fire. The dominant post-fire regeneration strategies — obligate seeders, obligate resprouters, and facultative seeders — differ in their ability to withstand limited water availability. Environmental change can interact with these regeneration strategies to increase environmental stress, leading to patchy recovery across the landscape. Maximizing post-fire recovery in this changing climate necessitates a better understanding of the key plant regeneration traits and variation in those traits within and across these dominant regeneration strategies. Therefore, we are conducting an observational study across three fire scars that occur along a precipitation gradient to investigate how dominant plant regeneration strategies and functional traits change across precipitation and topographical gradients and assess how functional traits are ontogenetically conserved. Within each of three 2018 fire scars, we are assessing the dominant life strategies and functional traits associated with resource use and competition, along Northern and Southern aspects. To assess ontogenetic trait conservation, the same functional traits were measured for adult plants in nearby unburned habitat. We predict the dominant strategy will change such that facultative seeders will be dominant at low precipitation, and at high precipitation the dominant strategy will be dependent on aspect, where resprouters are common on Northern aspects while seeders are common on Southern aspects. We predict aspect type to create intraspecific variation in dominant functional traits and regeneration strategy to influence ontogenetic trait conservation. Quantifying the intra- and interspecific variation for dominant regeneration strategies across precipitation and topographical gradients can identify species vulnerable to loss and potential candidate species for restoration under changing climate conditions, to improve post-fire recovery.

Measuring grass invasion through aerial photographs. Stephanie A. Ma, Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA. sama@ucsb.edu

Chaparral shrubs are expected to be eliminated from the landscape following a short-interval fire (2 fires within 5 years) because seedlings from the first fire will be killed by the second fire before they reach reproductive maturity or can replenish their carbohydrate stores. Exotic annual grasses are hypothesized to exacerbate shrub elimination by outcompeting shrub seedlings for water. If twice-burned locations are near points of access, monitoring the post-fire community is feasible. When the location is farther away, monitoring can be challenging. Additionally, invasion rates near roads may be different than invasion rates in the middle of an intact stand. To address these challenges, I will use aerial photographs, taken from 1950s-2000s, to observe ground cover (chaparral, sage scrub, tree, grass, bare ground/rock) before and after fire. At least eight 50 x 50 m (50 x 50 pixel) plots will be placed within 12 paired fire scars (once-burned and twice-burned) in Ventura or Los Angeles County. Vegetation recovery between once-burned and twice-burned locations will be compared to determine if twice-burned areas are more likely to have greater grass cover post-fire. Results will be correlated with elevation and minimum vapor pressure deficit (the amount of moisture in the air). Researchers found grass invasion is more likely at lower elevations and when there is less moisture in the air. This study will determine the likelihood of grass invasion (chaparral → grass, sage scrub → grass), grass persistence (grass → grass), and chaparral conversion (chaparral → grass, chaparral → sage scrub) at the landscape level. Quantifying these rates of change will inform land managers of the risk of grass invasion and the persistence of chaparral and is an important step in managing shrublands and protecting habitat.

Using plastic tube tree shelters to increase seedling establishment for ecological restoration of California native plant communities. Mark Mazhnyy*, Marlee Antill, and Erin Questad. Department of Biological Sciences, California State Polytechnic University, Pomona. mvmazhnyy@cpp.edu

As wildfires in California are becoming larger, more frequent, and more severe, many native plant communities are experiencing increased invasion by non-

native grasses and therefore, are in need of restoration. Southern California shrubland communities, such as chaparral and coastal sage scrub, are particularly at risk due to the aridity of their environments, which can slow the process of native plant growth following fire, thus reducing ecosystem resiliency to non-native plant invasions. For these reasons, restoration methods that are rapid, relatively low-cost, and that can improve native plant recruitment are needed to improve restoration outcomes. Plastic tube tree shelters are typically used to protect seedlings from herbivory, but they have also been shown to improve plant growth. Given the variety of tree shelters available commercially, two greenhouse studies were set up to test the effect of six different tree shelters on seedling germination and establishment. The first study focused on measuring abiotic conditions important for plant growth inside tree shelters, including air temperature, photosynthetically active radiation, and soil volumetric water content. The second study focused on observing germination, establishment, and survival of California natives *Eriogonum fasciculatum*, *Amsinckia intermedia*, and *Stipa pulchra* inside tree shelters. The goal of these studies is to use the results to select a shelter type that alleviates stressful conditions for seedlings and maximizes seed germination and seedling establishment. This shelter type can then be used to improve the success of ecological restoration efforts in California and beyond.

Restoring native plant communities and control of invasive plants on Scorpion Rock to enhance nesting habitat for burrow and shrub-nesting seabirds in the California Channel Islands. David Mazurkiewicz[1]*, Josh Adams[2], Catherine Carter[3], Amelia J. Duvall[3], James A. Howard[3], Peter T. Larramendy[3], Andrew A. Yamagiwa[3], Annie Little[1], and A. Laurie Harvey[5]. [1]Channel Islands National Park, CA. [2]U.S. Geological Survey-Western Ecological Research Center, Santa Cruz Field Station, Santa Cruz, CA. [3]California Institute of Environmental Studies, Ventura, CA. david_mazurkiewicz@nps.gov

Invasive, non-native plant species introduced to California's Channel Islands can affect seabird nesting habitat quality and threaten population growth and recovery. Scorpion Rock, located off the northeast end of Santa Cruz Island in Channel Islands National Park, is an important seabird nesting and roosting location. A legacy of human use and visitation allowed the spread of invasive, non-native plant species on Santa Cruz Island and adjacent Scorpion Rock. The altered vegetative cover contributed to decreased abundance and quality of nesting habitat for the burrow-nesting Cassin's Auklet (*Ptychoramphus aleuticus australis*) and crevice- and shrub-nesting Scripps's Murrelet (*Synthliboramphus scrippsi*). The removal and control of non-native vegetation and outplanting of more than 9,000 native plants from 2008 to 2019 has dramatically changed the landscape of Scorpion Rock. In 2008, vegetative cover was initially 94% invasive weeds (6 exotic species, mostly crystalline iceplant [*Mesembryanthimum crystallinum*]). Since 2011, percent native plant cover has remained consistent at ~60% cover, up from only 6% since 2007. Removal of non-native, invasive vegetation and the restoration of a native perennial Coastal Sage Scrub community on Scorpion Rock is providing better soil structure, nesting conditions, and cover for burrow- and shrub-nesting nesting seabirds, as well as new habitat for invertebrates and passerines. Lessons learned, evaluation of project methods and the development of remote-site-restoration-techniques from this effort have also benefited other habitat restoration projects on the California Islands for seabirds and other vegetation communities.

Google search behavior for invasive alien species. Moleseng C. Moshobane*. Biological Invasions Directorate, South African National Biodiversity Institute, South Africa. moshobanemc@gmail.com

Invasive alien species are considered one of the major threats to biodiversity. In order to mitigate the negative impacts of biological invasions, it can be particularly useful to integrate peoples' values on invasive species and to understand public perception. Although considerable progress has been made in the past decades in understanding perceptions on invasive species, what the public wants to know in relation to invasive alien species has not been explored in detail yet. This study aims to investigate the global public interest in invasive alien species by evaluating search term popularity changes over time. This study analyzed global search queries for eight terms related to invasive alien species between 2004-2019 using Google Insights for Search (GIFS). Overall, relative searches volume for the term "invasive species" steadily increased from 2004 to 2019. Search volume for the search term "How are invasive species introduced?" sharply increased for the same period. In conclusion, the evidence from Google Insights for Search (GIFS) analysis demonstrates mixed trends. Based on our results and importance of search terms used, we can safely conclude that the public interest in invasive alien species is growing.

Managing the Goldspotted Oak Borer in Orange County, California. Nicole Tamura, Kalee Koeslag, and Isaac Ostmann*. Irvine Ranch Conservancy, Irvine, CA. ntamura@irconservancy.org

At the urban-wildland interface in southern California, oak woodlands are important habitat for many species of plants and animals, but they are being threatened by the goldspotted oak borer (*Agrilus auroguttatus*), an invasive pest that has caused significant tree mortality and thus

habitat loss. This beetle was first detected in San Diego in 2004. It has spread through the transportation of infested firewood to other counties, including Orange County, where it was confirmed in Weir Canyon in 2014. In response, the Irvine Ranch Conservancy has been tracking and managing this infestation by conducting intensive field surveys on approximately 1,000 trees per year. Highly infested trees are removed and chipped before adult emergence while minimally infested trees are treated with a contact insecticide, carbaryl (Sevin SL). Weir Canyon is one of the first satellite outbreaks for which eradication is being attempted, so it is important to measure treatment effectiveness to improve management practices and minimize impacts. From five years (2014-2019) of data collection, we are able to determine the change in infestation levels of individual trees and the approximate rate of spread of the infestation. Thorough monitoring and analysis will inform the adaptive management of this anthropogenic threat.

Environmental factors and herbicide effect on germination rates of stinknet (*Oncosiphon piluliferum*), an invasive weed in Southern California
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Stinknet (*Oncosiphon piluliferum*), an aromatic annual Asteraceae native to southern Africa, is invasive in Australia, Arizona, and parts of Southern California. Despite its invasiveness, there are no published studies documenting stinknet seedling germination rates. At the San Diego Zoo Safari Park's Biodiversity Reserve in San Diego County, stinknet is abundant in some areas, but patchy or absent in others. Spraying stinknet with a combination of pre- and post-emergent herbicides in 2019 had mixed results in terms of effectiveness of killing above ground plants. To understand the influence of light, precipitation, and soil nutrients on stinknet seed germination, and to understand the effect of herbicide treatments on seed mortality, we designed a set of experiments testing seedling germination under different environmental conditions. We also compared germination rates of seeds still on plants that were sprayed with herbicide in the spring of 2019 to unsprayed seeds. The findings from our germination trials, and future research on stinknet, will help researchers and land managers better anticipate the spread of stinknet, and possibly help to control or slow it.

Pre-planting to preclude persistent pest plants.
Jorge Luis Renteria Bustamante[1], Gina Darin[2]*, Edwin Grosholz[1], Jamie Silva[2], Rhiannon Mulligan[2], Krista Hoffmann[2], Bayan Ahmed[2]. [1]Department of Environmental Science and Policy, University of California, Davis, CA. [2]California Department of Water Resources, West Sacramento, CA. gina.darin@water.ca.gov

Managing invasive plants is a major component of natural ecosystem restoration. Dominant invasive plant establishment is a major stressor on tidal wetlands and may result in significant changes to native plant community structure and the potential decline of other organisms associated with these habitats. Tidal wetland restoration projects typically include initial invasive plant removal and rely on passive revegetation to facilitate native species recovery. Studies looking at active revegetation techniques in tidal wetlands to manage aquatic or semiaquatic invaders are scarce. Therefore, we are conducting active revegetation studies using dominant native aquatic plant species as a restoration technique in the SF Bay-Delta Estuary. The studies examine the planting success of four native species (*Schoenoplectus acutus, Schoenoplectus americanus, Persicaria amphibia*, and *Typha latifolia*) against two invasive plant species (*Phragmites australis* and *Ludwigia peploides*) at Bradmoor Island and Dutch Slough. Our hypothesis is using active revegetation with native plant species can effectively inhibit invasive plant species establishment. Implementation has been completed and we are currently in the monitoring phase of these studies. Potential implications include effective integrated invasive plant management on tidal wetland restoration sites for improved long-term restoration site function and decreased maintenance costs.

Evaluating the efficacy of herbicides for management for *Oncosiphon piluliferum* (stinknet).
Clarissa Rodriguez[1]*, Travis Bean[1], Christopher J. McDonald[2], Loralee Larios[1]. [1]Botany and Plant Sciences, University of California Riverside, CA. [2]UC Cooperative Extension, San Bernardino, CA. rodr087@ucr.edu

Oncosiphon piluliferum, also known as stinknet, is an herbaceous winter annual native to South Africa. Recently, stinknet has been identified as an invader of concern in Riverside County due to its rapid expansion within Western Riverside. Stinknet can be inconspicuous during the early stages of the growing season, which can make it difficult to detect and treat effectively with herbicide during the growing season. An alternate strategy may be to reduce germination and prevent plant establishment. In an effort to develop more effective chemical management options for this species, we initiated field trials to evaluate the efficacy of reducing initial establishment with pre-emergent herbicides vs. reducing seed production in the spring with post-emergent herbicides. In addition, we aim to identify within a given strategy, post or pre-emergent, which herbicide is most effective in reducing stinknet cover. Herbicide trials were replicated at three sites within

Riverside County: Lake Mathews Preserve, Lake Perris State Recreation Area, and Motte Rimrock Reserve. We sampled stinknet cover and overall species composition in the spring following herbicide applications. After this first year of treatment, we observed that pre-emergent herbicides were more effective at reducing stinknet cover compared to post-emergent herbicides. However, the pre-emergent herbicides also reduced overall vegetative cover in the plots, potentially impacting future recruitment of desirable species into treatment areas. Our findings will be used to identify suitable herbicide treatment recommendations for land managers to minimize ecological impacts of stinknet and control its spread.

Effects of abiotic and biotic constraints on invasion in restored vernal pools. Joanna Tang*, Madeline Nolan. University of California, Santa Barbara, CA. joannatang@ucsb.edu

Ninety-five percent of California's vernal pool ecosystems have been lost, resulting in a growing effort to restore these ecosystems and their associated endemic flora and fauna. However, because restored vernal pools often exist within a grassland matrix, they are prone to invasion by exotic annual grasses. We hypothesize that restored vernal pools are particularly susceptible to exotic invasion because restoration projects often have frontloaded short-term invasive species management. Long-term budget limitations often result in the application of biotic constraints, i.e. intensive weeding, only 1-3 years after restoration. Abiotic site conditions are also manipulated upfront, with created pools having deeper topography to impose the abiotic constraint of longer inundation periods in order to preclude exotics. However, these abiotic and biotic constraints may not be sufficient in restricting exotic invasion in the long run. We assessed species abundance and diversity after intensive weeding had ceased in a set of restored vernal pools in southern California. We found that the depth of the pool did not significantly affect the total exotic cover and richness. Instead, we found that the exotic species cover and richness increased over time, particularly around the edges of the pools. Further, we found that the ratio of total native cover to total exotic cover decreased around the pool edges. These findings indicate that the native communities in our study's restored vernal pools are not resistant to exotic invasion, despite the abiotic and biotic constraints imposed on them. We thus propose the employment of other long-term invasive species management strategies, such as annual exotic thatch removal and annual native seed supplements. We propose testing these strategies on our study site pools to determine if they provide effective and cost-efficient management methods for restoration practitioners.

UAV applications for invasive plant monitoring. Rob Thoms, Megan Keever, Karley Rodriguez, Chris Lyle. Stillwater Sciences, Berkeley, CA. rob@stillwatersci.com

Traditional methods for monitoring and mapping invasive plant populations have severe limitations in some habitats associated with California's bays, estuaries, and deltas. Tidal influence, soft sediments in mudflats, dense emergent vegetation, and diffuse channels often pose field access challenges. To improve data quality and allow for more accurate extrapolation and classification in these relatively inaccessible environments, Stillwater Sciences has developed methodologies using remotely sensed aerial imagery tools. Methods include collecting oblique and/or nadir-perspective imagery at low altitudes via unmanned aerial vehicles (UAVs), establishing georeferenced ground-control points, ground-truthing in accessible places with comparable signatures, and creating a surface on which to conduct visual interpretation using heads-up digitizing techniques. Results from several projects have included 1) the detection of a new occurrence of an invasive plant rated High by Cal-IPC; 2) pre-restoration baseline data to inform planning and design; 3) documentation of post-implementation performance goals for maximum allowable percent cover of invasive species; and 4) cost-savings from easily-repeatable flights.

Restoration fusion: the utilization of a young, diverse membership, and unique partnerships to accomplish wildland recovery throughout California. Ian Torrence*, Julia Parish, Eric Robertson, Jessica Plance, and Susan Jardine. American Conservation Experience, Dulzura, Boulder Creek, and South Lake Tahoe. itorrence@usaconservation.org

American Conservation Experience (ACE), a non-profit service organization, creates meaningful wildland restoration career-building opportunities for its young and diverse members, including an international program, by partnering with like-minded federal, state, local, and non-profit land agencies and organizations. During the summer of 2018, ACE crews controlled Himalayan blackberry, Canada thistle, yellow star thistle, and French broom by mechanical and chemical means within the Storrie-Rich and Moonlight Fire scars for the Plumas National Forest. Crews also conducted hazardous fuels reduction in the forest around rare native plants, like Webber's Milkvetch. Since 2018, ACE crews worked alongside the Back Country Land Trust, an Alpine, California-based, non-profit organization, to eliminate encroaching *Arundo* stands — preserving open space and protecting the small mountain community from potentially catastrophic wildfire. ACE teams work to eradicate invasive plants and revegetate with native species on several Land Trust of Napa County (LTNC) properties, including Missimer-Snell Wildflower Preserve,

Dunn-Wildlake Ranch, Linda Falls, Archer Taylor, Wantrup, Wragg Ridge, and Dimmick Preserves. Invasive plants controlled include: medusahead, yellow starthistle, jointed goatgrass, Himalayan blackberry, velvetgrass, periwinkle, and vetch. For the past three years, ACE has collaborated with Pinnacles National Park to control yellow star-thistle, summer mustard, and Italian thistle for the purpose of reducing hazardous fuels around important park infrastructures and critical natural resources. It is this work, with these partners, that broaden youth's land-based restoration experience, knowledge, and skill levels through hands-on opportunities. This poster will demonstrate how meaningful partnerships provide youth from diverse backgrounds the opportunity to engage in successful restoration projects with a focus on invasive species management.

Invasive plant patrol in Orange County; Early detection and rapid response training for volunteers. Adam Verrell. Laguna Canyon Foundation, Laguna Beach, CA. adam@lagunacanyon.org

Many are surprised to hear that, second only to direct habitat destruction, invasive species pose the greatest global risk to biodiversity. The timeline in which an invasive species establishes itself in a novel environment directly affects how well it can be controlled. While local containment is the only realistic possibility for most of the common weeds in California, full eradication of emergent species is possible if they are detected early enough. Teaming with the Orange County chapter of CNPS, we offer our long-term volunteers an Early Detection and Rapid Response (EDRR) training where participants learn how to effectively survey for, identify, and communicate the presence of emergent weeds to local land managers. Using Calflora, observations are shared with all interested parties with the aim of better understanding the distribution of weeds and to better develop an effective management strategy. This poster board will focus on the successes and difficulties we have had in engaging volunteers, many of which with limited botanical background, to survey for often cryptic species that in most cases they have only seen photos of. Because, after all, when early detection is our most effective weapon in combating emergent species, training those that frequent and recreate in our open spaces the most may be our best tool.

Adapting treatment methods for *Ailanthus altissima* adjacent to sensitive fish habitat. Rachel Wing*, Andrew Castro, Naomi Fraga, Billy Sale, Kristy Snyder and Alejandra Soto. Rancho Santa Ana Botanic Garden, Claremont, CA. rwing@rsabg.org

We present findings from a three-year restoration project where we attempted to eradicate an infestation of *Ailanthus altissima* (tree of heaven) in the Angeles National Forest, within the San Gabriel Mountains, Los Angeles County, California. A particular challenge of this project was the need to protect sensitive fish species in the adjacent Big Tujunga Creek by using only aquatic-labeled pesticides. While effective aquatic-labeled products are available for use in foliar, hack-and-squirt and cut-stump applications, this is not the case for basal bark applications; these generally use an oil-based carrier and an oil-soluble herbicide, which were not acceptable because of potential harm to fish. Yet we had a need for basal bark applications because many stems were too narrow for hack-and-squirt and too tall (or close to desirable plants) for foliar spraying, causing us to develop novel basal bark treatments that used only aquatic-labeled pesticides. Over the course of the project we completed several rounds of retreatments, using both Garlon 3A (triclopyr triethylamine) and Habitat (imazapyr), in a combination of methods, including hack and squirt, foliar spray, basal bark, cut stump, drill-stem injection, and cut-resprout-spray. The results of our work yielded substantial control and reduction of the infestation, but fell short of actual eradication, indicating that continued monitoring and treatment will be required. Our success varied over the site, based on both the treatment methods we used and the initial conditions. Our methods and discussion of the varying conditions leading to successful treatment will help inform future treatment at this and similar sites.