California Invasive Plant Council 2020 Symposium

Event Schedule

(Abstracts start on p. 17)

Tue, Oct 27, 2020

9:00am

Statewide WMA Meeting
9:00am - 1:00pm, Oct 27

The annual meeting of the state's Weed Management Areas, with updates from CDFA, presentations on WMA projects, and training on IPM, planning, mapping, and reporting. Stick around from 12:00 to 1:00 for regional breakout discussions over lunch!

DPR CE credit: 2 hours "Other"

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9 Subsessions

- **Welcome, WMA Roll Call, Introduction**
  9:00am - 9:20am, Oct 27
- **CDFA Weed Program Updates**
  9:20am - 9:40am, Oct 27
- **CACASA Weed Management Updates**
  9:40am - 10:00am, Oct 27
- **California's RCDs**
  10:00am - 10:20am, Oct 27
- **New Weeds in California**
  10:20am - 10:50am, Oct 27
- **Regional Strategies for Weed Management**
  10:50am - 11:20am, Oct 27
- **Calflora Training on Mapping Weeds**
  11:20am - 11:50am, Oct 27
- **WMA Project Reports**
  11:50am - 12:20pm, Oct 27
- **Regional Breakouts**
  12:20pm - 1:00pm, Oct 27

2:00pm

Herbicide Laws and Regulations
2:00pm - 4:00pm, Oct 27

Updates and training on laws and regulations concerning herbicide use in California, designed to provide 2 hours of continuing education credit for DPR licensed applicators. Moderated by LeeAnne Mila, El Dorado County Dept. of Agriculture.
DPR CE credit: 2 hours "Laws and Regs"
ISA CE credit: 2 hours

Speakers

LeeAnne Mila El Dorado and Alpine County Agricultural Commissioners Office

Scott Oneto Farm Advisor, UC Cooperative Extension El Dorado, Amador, Calaveras and Tuolumne counties

Krista Hoffmann California Department of Fish and Wildlife

Sam Sandoval Associate Professor, Cooperative Extension Specialist, UC Davis

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4 Subsessions

- **Laws and Regulations that Inform Invasive Weed Treatment Strategies**
  2:00pm - 2:30pm, Oct 27
- **Obtaining Selectivity in Wildland Areas Using a Low-Volume Directed Spray Herbicide Application**
  2:30pm - 3:00pm, Oct 27
- **The Safe and Effective Application of Aquatic Herbicides**
  3:00pm - 3:30pm, Oct 27
- **Best Practices to Keep Pesticides out of Water**
  3:30pm - 4:00pm, Oct 27

Wed, Oct 28, 2020

9:00am

Opening Session 1: Managing Invasive Species into the Future
9:00am - 10:30am, Oct 28

ISA CE credit: 1 hour

Speakers

Doug Johnson Executive Director, California Invasive Plant Council (Cal-IPC)

Dan Simberloff University of Tennessee

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3 Subsessions

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Welcome!
9:00am - 9:15am, Oct 28

- **California Update**
  9:15am - 9:30am, Oct 28
- **Keynote Address: Invasive Species Denialism and the Future of Invasion Management**
  9:30am - 10:30am, Oct 28

11:00am

Session 2: Fire, Weeds, and Forest Pests

11:00am - 12:30pm, Oct 28

Moderated by Susan Frankel, USDA Forest Service, Pacific Southwest Research Station.

DPR CE credit: 1 hour "Other"
ISA CE credit: 1 hours
Click chat at end of session for DPR CE quiz.

Speakers

Jon Keeley Research Ecologist, U.S. Geological Survey / UCLA

Chris Fettig Pacific Southwest Research Station

Yana Valachovic University of California

Beatriz Nobua-Behrmann Urban Forestry Advisor, University of California Cooperative Extension

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5 Subsessions

- **Perturbation in Fire-prone Ecosystems Resulting in Exotic Plant Invasion**
  11:00am - 11:20am, Oct 28
- **Interactions Among Insects and Invasive Weeds in the Western U.S. Forests**
  11:20am - 11:40am, Oct 28
- **Cleaning and Sanitation of Heavy Equipment for Pathogens and Weeds**
  11:40am - 12:00pm, Oct 28
- **Lessons Learned (the Hard Way) on How to Manage Invasive Shothole Borers in Southern California**
  12:00pm - 12:20pm, Oct 28
- **Panel Discussion**
  12:20pm - 12:30pm, Oct 28

1:00pm

Session 3: Tools and Techniques for Invasive Plant Management

1:00pm - 2:00pm, Oct 28

Moderated by Sarah Godfrey, Center for Natural Lands Management.
DPR CE credit: 1 hour "Other"
ISA CE credit: 1 hours

Speakers

J

John Takekawa Operations Manager, Suisun Resource Conservation District

S

Stephen Enloe Associate Professor, University of Florida Center for Aquatic and Invasive Plants

C

Collin Raff Project Manager, Irvine Ranch Conservancy

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3 Subsessions

- **The Sky is Not the Limit: Controlling Invasive Plants with Survey and Spray-drones**
  1:00pm - 1:20pm, Oct 28
- **Scaling up Brazilian Peppertree (Schinus terebinthifolia) Management Research with Contractors in South Florida**
  1:20pm - 1:40pm, Oct 28
- **Effective Use of Low-dose Herbicide Application to Control Weed Seedlings in a Restoration Context**
  1:40pm - 2:00pm, Oct 28

2:30pm

Session 4: Ecological Implications of Invasive Plants and Their Management + New Weed Alerts

2:30pm - 4:00pm, Oct 28

Moderated by Jennifer Funk, University of California-Davis, Department of Plant Sciences.

DPR CE credit: 1 hour "Other"
ISA CE credit: 1.5 hours

Speakers

Ben Bloodworth Program Coordinator, RiversEdge West

Deedee Soto Pollinator Conservation Planner & NRCS Partner Biologist, Xerces

Sarah Hoyle Xerces Society for Invertebrate Conservation

Christopher McDonald Advisor, University of California Cooperative Extension

Jutta Burger Science Program Director, California Invasive Plant Council

Robert Price California Department of Food and Agriculture

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4 Subsessions

- **Distribution and Spread of Tamarisk Beetles (Diorhabda spp.) and Their Known and Predicted Effects on Riparian Ecosystems**
  2:30pm - 2:50pm, Oct 28
- **Restoration to Benefit Pollinators: Plant Selection and Herbicide Impacts**
  2:50pm - 3:10pm, Oct 28
- **Some Insights on the Seed Bank Dynamics of Stinknet, a Difficult Weed to Contain**
  3:10pm - 3:30pm, Oct 28
- **Weed Alerts and other Invasive Plant Highlights for 2020**
  3:30pm - 4:00pm, Oct 28

4:00pm

Poster and Lightning Talk Session 1

4:00pm - 5:30pm, Oct 28

Posters and pre-recorded lightning talks can be viewed at your own pace. See live stream associated with each presentation to speak with the author.

DPR CE credit: 1 hour "Other"
Credit is only available for attendees that have visited all presentations coded *DPR Credit* during the session time and subsequently completed the quiz.

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23 Subsessions

- **Poster: ACE'ing New Statewide Maps of Invasive Plants for Conservation Planning**
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  4:00pm - 5:30pm, Oct 28

5:45pm

BIPOC Gathering
5:45pm - 6:45pm, Oct 28

This after-hours session provides a space for individuals who identify as BIPOC (Black, Indigenous, and People of Color) only. Connect with others, celebrate your victories, share your frustrations, and discuss how Cal-IPC and conservation organizations can do better.

Thu, Oct 29, 2020

8:00am

Session 5: Invasive Plant Management in Grasslands
8:00am - 9:00am, Oct 29

A special session hosted by the California Native Grassland Association (CNGA) and moderated by Tanya Meyer, Yolo County Resource Conservation District.

DPR CE credit: 1 hour "Other"

Speakers

Don Hankins

Valerie Eviner Researcher, University of California Davis

Tom Getts Weed Ecology and Cropping Systems Advisor, UC Cooperative Extension

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3 Subsessions

- **Ecocultural Considerations for Invasive Species and Grassland Stewardship with Fire**
  8:00am - 8:20am, Oct 29
- **Evaluating Control of Late-season Noxious Grassland Invasives with Multiple Approaches: Wildfire, Prescribed Fire, Grazing, Native Grass Restoration, and**

Organic Herbicides
8:20am - 8:40am, Oct 29

- **Long-term Effects of Indaziflam Applications for Medusahead Control on the Modoc Plateau**
  8:40am - 9:00am, Oct 29

9:30am

Session 6: Fire and Invasive Plant Management I

9:30am - 10:30am, Oct 29

Moderated by Noah Teller, Dept. of Botany & Plant Sciences, UC Riverside.
ISA CE credit: 1 hours

Speakers

Jon Keeley Research Ecologist, U.S. Geological Survey / UCLA

Martin Hutten Ecologist California IPMT liaison, NPS

Garrett Dickman Botanist, Yosemite National Park

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3 Subsessions

- **Fuel Treatments Leading to Non-native Plant Invasions**
  9:30am - 9:50am, Oct 29
- **Reducing the Risk of Invasive Plant Spread Before and During Wildland Fire Incidents**
  9:50am - 10:10am, Oct 29
- **How to Prepare for Fire and Evaluate the Risk of Invasive Plants after Fire**
  10:10am - 10:30am, Oct 29

11:00am

Career Panel

11:00am - 12:15pm, Oct 29

Moderated by Noah Teller, UC Riverside.
Designed for students and early-career professionals. Hear from people in field work, consulting, agencies, nonprofits, academia and conservation corps.

Speakers

Steven Addison Job Training Center Coordinator , Civicorps

Marko Bey Executive Director and Lomakatsi's Co-Founder, Lomakatsi Restoration Project

Kari Dupler Senior Biologist, WRA, Inc.

Valerie Eviner Researcher, University of California Davis

Chris Fettig Pacific Southwest Research Station

Jennifer Funk UC Davis

Aidona Kakouros Botanist/ Ecologist SF Bay NWR Complex, U.S. Fish and Wildlife Service

Loralee Larios Assistant Professor, Loralee Larios

Poster and Lightning Talk Session 2

11:00am - 12:15pm, Oct 29

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  11:00am - 12:15pm, Oct 29

12:30pm

Session 7: Managing Invasive Grasses

12:30pm - 2:00pm, Oct 29

Moderated by Virginia Matzek, Dept. of Environmental Studies and Sciences, Santa Clara University.

DPR CE credit: 1 hour "Other"

Speakers

Joanna Tang PhD student, University of California, Santa Barbara

Charlie Clements Rangeland Scientist, USDA-ARS

Virginia Matzek Associate Professor, Department of Environmental Studies and Sciences, Santa Clara University

Sandra DeSimone Director research and education, Audubon Starr Ranch

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5 Subsessions

- **Positive Feedback Loops of Invasive Grasses: Breaking the Cycle**
  12:30pm - 12:50pm, Oct 29
- **Effectiveness of Pre-emergent Herbicides in Rangeland Rehabilitation**
  12:50pm - 1:10pm, Oct 29
- **Non-herbicidal Measures of Control for Slender False Brome (Brachypodium sylvaticum)), an Invasive Perennial Grass**
  1:10pm - 1:30pm, Oct 29
- **Invasive Grasses Can be Your Friends: Use of Songbirds and other Observable Wildlife as Metrics for Selective Acceptance of Non-natives in Restoration**
  1:30pm - 1:50pm, Oct 29
- **Discussion**
  1:50pm - 2:00pm, Oct 29

2:30pm

Session 8: Fire and Invasive Plant Management II

2:30pm - 3:30pm, Oct 29

Moderated by Joey Algiers, National Park Service, Santa Monica Recreation Area.
ISA CE credit: 1 hours

Speakers

Devyn Friedfel Natural Resource Specialist, Pepperwood Preserve

Joey Algiers Restoration Ecologist, National Park Service

Jeffrey Morisette Chief Scientist, National Invasive Species Council, U.S. DOI

M

Mike Zupko Wildland Fire Leadership Council

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3 Subsessions

- **A Tale of Two Wildfires: Post-fire Weed Management at Pepperwood Preserve, Sonoma County, California**
  2:30pm - 2:50pm, Oct 29
- **Two Years After the Fire: Accomplishments in Invasive Plant Control Following the 2018 Woolsey Fire**
  2:50pm - 3:10pm, Oct 29
- **Considerations for Better Coordination Between Fire and Invasive Species Management**
  3:10pm - 3:30pm, Oct 29

4:00pm

Session 9: Mapping, Modeling & Prioritization

4:00pm - 5:00pm, Oct 29

Moderated by Elizabeth Brusati, California Department of Fish & Wildlife.
DPR CE credit: 1 hour "Other"
ISA CE credit: 1 hour

Speakers

Steve Taylor Program Leader (Invasive Plants), ACT Parks - Invasive Plants Program | Environment, Planning and Sustainable Development | ACT | Australia

Nicky Lustenhouwer Postdoctoral Scholar, Department of Ecology and Evolutionary Biology, UC Santa Cruz

Rachel Kesel Conservation Management Specialist, Golden Gate National Parks Conservancy

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3 Subsessions

- **Integrated Prioritisation of Post-fire Invasive Plant Management in the Australian Capital Territory (ACT)**
  4:00pm - 4:20pm, Oct 29
- **Using Climate Niche Modeling to Map Areas at Risk of Invasion by Stinkwort (Dittrichia graveolens)**
  4:20pm - 4:40pm, Oct 29
- **Using WHIPPET to Prioritize One Tam's Widespread Weeds in Marin County**
  4:40pm - 5:00pm, Oct 29

5:15pm

Allyship Gathering

5:15pm - 6:15pm, Oct 29

Being an "ally" means actively standing up for the rights of marginalized communities (see, for instance, this guide to allyship). Cal-IPC's working group on JEDI (justice, equity, diversity and inclusion) hosts this gathering for those working to educate themselves about the workings of privilege and inequity in the conservation field. We will build our shared vocabulary, discuss ways to amplify voices from marginalized communities, and share resources for strengthening our ability to listen, speak up, and take responsibility for sharing our privilege. Whether you are new to this work or steeped in it, come support each other in making the conservation community stronger, one person at a time.

Fri, Oct 30, 2020

8:00am

Session 10: Restoration and Invasive Plants

8:00am - 9:00am, Oct 30

A special session hosted by SERCAL and moderated by Kari Dupler, WRA, Inc.

DPR CE credit: 1 hour "Other"

Speakers

Ruben Reynoso jr River Partners, Inc.

Naomi LeBeau Restoration Manager, Golden Gate Parks Conservancy

Scott McMillan Dudek

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3 Subsessions

- **Weed Control in Riparian Habitat Restoration: Three Design Recommendations for Scaling up Implementation Efficiency**
  8:00am - 8:20am, Oct 30
- **Challenges and Lessons Learned in the Muir Beach Wetland Restoration Project**
  8:20am - 8:40am, Oct 30
- **Herbicide Use in Habitat Restoration: Organic Versus Outcome**
  8:40am - 9:00am, Oct 30

9:30am

Session 11: Wetland and Aquatic Invasives

9:30am - 10:30am, Oct 30

Moderated by Drew Kerr, San Francisco Estuary Invasive Spartina Project.

DPR CE credit: 1 hour "Other"

Speakers

Michael Kwong Environmental Scientist, California State Parks - Division of Boating and Waterways

Sean Hastings Policy, Information and Management Officer, NOAA / Channel Islands National Marine Sanctuary

Elizabeth Crook Assistant Professor of Teaching, UC Irvine

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3 Subsessions

- **Continued Management and Monitoring of Alligator Weed (Alternanthera philoxeroides) in the Sacramento-San Joaquin Delta and Suisun Marsh**
  9:30am - 9:50am, Oct 30
- **When Control is Constrained to Containment - Undaria pinnatifida at the Channel Islands**
  9:50am - 10:10am, Oct 30
- **Limonium ramosissimum Distribution Models and Effective Treatment Types in the Upper Newport Bay of Orange County, California**
  10:10am - 10:30am, Oct 30

11:00am

Discussion Groups
11:00am - 12:30pm, Oct 30

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6 Subsessions

- **1. Weed Control Using Herbicides**
  11:00am - 12:30pm, Oct 30
- **2. Non-Chemical Techniques for Weed Control**
  11:00am - 12:30pm, Oct 30
- **3. Using Calflora for Tracking Weeds**
  11:00am - 12:30pm, Oct 30
- **4. Calflora Weed Manager: Advanced Tools and Tips**
  11:00am - 12:30pm, Oct 30
- **5. Developing a Program for Weed-Free Materials**
  11:00am - 12:30pm, Oct 30
- **6. Building Justice, Equity, Diversity, and Inclusion into Conservation Work**
  11:00am - 12:30pm, Oct 30

1:00pm

Session 12: Early Detection and Rapid Response: Effective Weed Control at the Landscape Level
1:00pm - 2:30pm, Oct 30

Moderated by Sharon Farrell, Golden Gate National Parks Conservancy and California Landscape Stewardship Network.

DPR CE credit: 1 hour "Other"

Speakers

Sharon Farrell Golden Gate National Parks Conservancy

Jesse Patterson Chief Strategy Officer, League to Save Lake Tahoe

Rachel Kesel Conservation Management Specialist, Golden Gate National Parks Conservancy

Christy Brigham Chief of Resources Management and Science, Sequoia and Kings Canyon National Park

Nathan Gregory Vice President and Chief Programs Officer, Irvine Ranch Conservancy

Leah Gardner senior environmental scientist (specialist), CA State Parks

3:00pm

Session 13: Innovations in Tracking Invasives; plus Closing Remarks

3:00pm - 4:30pm, Oct 30

Moderated by Jutta Burger, California Invasive Plant Council.

DPR CE credit: 1 hour "Other"

Speakers

Theresa Culley Professor and Head, University of Cincinnati

Rachel Meyer Assistant Adjunct Professor, University of California Santa Cruz

Aimee Hurt Working Dogs for Conservation

Doug Johnson Executive Director, California Invasive Plant Council (Cal-IPC)

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4 Subsessions

- **The Role of Public Gardens as Sentinels of Plant Invasion**
  3:00pm - 3:20pm, Oct 30
- **Invasive Species Holobiomes as Bioindicators? Environmental DNA Metabarcoding from Community-collected CaleDNA Samples Makes Holobiomes Available for Common Invasive Plants**
  3:20pm - 3:40pm, Oct 30
- **Using Detection Dogs to Enhance Invasive Plant Management Strategies**
  3:40pm - 4:00pm, Oct 30
- **Closing Remarks**
  4:00pm - 4:30pm, Oct 30

Talk Abstracts

(Poster Abstracts follow in a separate section. List is alphabetical by lead author.)

Two years after the fire: accomplishments in invasive plant control following the 2018 Woolsey fire.

Joseph Algiers, Jr. Santa Monica Mountains National Recreation Area, CA. Joseph_Algiers@nps.gov

In November 2018, the Santa Monica Mountains suffered a wildfire that burned close to half of the mountain range. The Woolsey Fire destroyed 96,494 acres, including 88% of National Park Service land. Since the fire, the National Park Service has been devoted to controlling weeds that threaten native recovery in burn areas on federal and partner lands within the National Recreation Area. Federal funds have supported a crew to carry out the most demanding invasive plant control project the park has ever attempted. In 2019, technicians surveyed more than 1,800 acres and treated 27 invasive species on more than 570 acres (46.6 net acres). Technicians maintained momentum in 2020, cleaning up known infestations and finding new areas to charge. A 2017 assessment of more than a decade of invasive plant control efforts showed great reductions in the cover of target weeds. These pre-fire treatments had mitigating effects on target weeds, as problem infestations from the past have not rebounded in the post-fire environment. In this talk, I'll share the work we've done over the past two years and our plans for moving forward following the largest fire in the Santa Monica Mountains.

Distribution and Spread of Tamarisk Beetles (*Diorhabda* spp.) and Their Known and Predicted Effects on Riparian Ecosystems.

Ben Bloodworth, Program Coordinator, RiversEdge West. bbloodworth@riversedgewest.org

This presentation will discuss the release and spread of tamarisk beetles across the west and their expected movements within California. We will also touch on the short- and long-term effects beetle defoliation has on tamarisk plants as well as certain species often dependent on tamarisk (i.e. the endangered southwestern willow flycatcher). If time allows, we will also discuss tamarisk-beetle interactions with wildfire and secondary invasive species.

Weed Alerts and other Invasive Plant Updates for 2020.

Jutta C. Burger, California Invasive Plant Council, jburger@cal-ipc.org; Robert Price, California Department of Food and Agriculture, robert.price@cdfa.ca.gov

New species that have been introduced from other parts of the world are regularly found growing wild in California. Some of these spread quickly and impact native habitat, waterways, and agricultural lands. Others do not. Each year we select a handful of the species that are newly discovered in the state or a cause for concern because of spread within the state to highlight as our "Weed Alerts". This year, Cal-IPC and CDFA are again joining together to showcase our selection of new and notable non-native plant species for 2020, chosen from nominations provided by regional land managers and botanists across the state. We will also provide an overview of the Cal-IPC inventory and CDFA rating system. Lastly, we will review what is known to date about the mystery seed shipments that some residents have been getting from China this year and that provide yet another novel way for new species to become established here.

Effectiveness of pre-emergent herbicides in rangeland rehabilitation.

Charlie D. Clements and Dan Harmon. USDA, Agricultural Research Service, Great Basin Rangelands Research Unit, Reno, NV. charlie.clements@usda.gov.

Arid western rangelands of the United States face one of the greatest environmental challenges of the 21st century. The accidental introduction and subsequent invasion of cheatgrass onto millions of acres of Great Basin rangelands has resulted in catastrophic and the conversion of formerly big sagebrush/bunchgrass communities to rangelands dominated by cheatgrass. In an effort to minimize the negative effects of wildfires and habitats converted to cheatgrass dominance, the USDA-Agricultural Research Service, Great Basin Rangelands Research Unit has been conducting research on the use of pre-emergent herbicides to control cheatgrass and reduce the cheatgrass seedling/perennial grass seedling competition that

results in perennial grass seedling mortality and ensures cheatgrass dominance. The establishment of perennial grasses is critical in reducing cheatgrass densities and associated fuels. To control cheatgrass and other associated annual weeds we applied sulfometuron methyl chlorsulfuron, Landmark XP®, @ 1.75 oz/acre rate, and imazapic, Plateau®, @ 6oz/acre rate then fallowed the treated plots for 1-year and seeded desirable native and introduced perennial grasses. Each treated plot received 3 seed mixes; 1) Native, 2) Introduced, and 3) Native/Introduced. The Landmark XP application reduced cheatgrass above-ground densities by 99.3% while Plateau reduced it by 98.6%. This level of cheatgrass control significantly increased available mineral nitrogen and soil moisture for seedlings of seeded species. Perennial grass establishment into the second-year averaged 3.3/ft² in the introduced and native seed mix plots while the native/introduced seed mix plots averaged 2.4/ft². The introduced plots yielded 1 cheatgrass/ft² showing promising suppression of cheatgrass, while the native and introduced plots recorded 3x as much cheatgrass, 3.6 and 3.4 cheatgrass/ft², respectfully. The control plot averaged 22.2/ft² which results in as much as 96% reduction in cheatgrass above-ground densities. This study demonstrates that if we use the best tools in the toolbox including pre-emergent herbicides and adaptable plant species and apply them correctly using proper timing, rates and seeding depths we can be successful and make progress towards a more productive and sustainable rangeland future. It is not prudent to limit your chance of success by seeding without an active weed control program (reducing cheatgrass competition) or applying pre-emergent herbicide at the wrong time (post-emergent) as well as using plant materials that will limit your success and increase the failure rates.

***Limonium ramosissimum* distribution models and effective treatment types in the Upper Newport Bay of Orange County, California.** Elizabeth Crook, Assistant Professor of Teaching, UC Irvine. E.crook@uci.edu.

Algerian sea lavender, *Limonium ramosissimum*, is an invasive plant found in numerous estuaries throughout California, including the Upper Newport Bay of Orange County. As sea lavender is likely allelopathic and has the potential to severely impact native plant populations, its removal is particularly critical for the rare and endemic plants in the region. Using occurrence data of sea lavender in Newport Bay, in conjunction with vegetation alliance and sea level data, we describe the optimal current growing conditions for sea lavender and project regions where the invasive plant is most likely to be found. Using these distribution models, we then project the impact of sea lavender in Upper Newport Bay by the year 2100, assuming unchecked growth. We also address the effectiveness of different treatment types after 1 year of removal. These models will provide a data-driven approach to protecting the biodiversity of Upper Newport Bay.

The Role of Public Gardens as Sentinels of Plant Invasion. Theresa Culley[1], Kurt Dreisilker[2], M. Clair Ryan[3], Hans Landel[4], Jessica Arcate Schuler[5], Nadia Cavallin[6], Roger Gettig[7], Kayri Havens[8], and Brittany Shultz[9]. [1]University of Cincinnati, OH; [2]The Morton Arboretum, Lisle, IL; [3]The Midwest Invasive Plant Network, Lisle, IL; [4]Lady Bird Johnson Wildflower Center, Austin, TX; [5]The New York Botanical Garden, Bronx, NY; [6]Royal Botanical Gardens, Ontario, Canada; [7]Holden Arboretum, Kirtland, OH; [8]Chicago Botanic Garden, Glencoe, IL; [9]Missouri Botanical Garden, St. Louis, MO. theresa.culley@uc.edu, kdreisilker@mortonarb.org

Public gardens can harness their expertise to help prevent future invasive species, particularly since many woody invasive plants in the US have a historical or present horticultural use. As institutions which plant and monitor non-native species of ornamental value, public gardens collect valuable data on plant growth, survival, and reproduction of species over time. Public gardens often maintain collections of different cultivars of given species planted together (which is associated with spread in some invasive species). Furthermore, many public gardens also maintain natural areas and have active management plans to eradicate invasive plant species. Since 2016, several North American public gardens and affiliated nonprofits have been working together to create a communication network to share information about non-native plants that may be escaping from cultivation. We summarize our efforts to create a shared database, and present preliminary results based on information from seven

public gardens in the Midwestern US. We found that 774 species were listed as problematic by one or more of the gardens. Seven species (*Acer platanoides*-Norway maple, *Celastrus orbiculatus*-Oriental bittersweet, *Euonymus alatus*-winged burning bush, *Frangula alnus*-glossy buckthorn, *Lonicera japonica*-Japanese honeysuckle, *L. maackii*-Amur honeysuckle, and *Rhamnus cathartica*-common buckthorn) were identified as problematic across all gardens, even though they were not always listed as invasive or regulated within the states and provinces in which the gardens occurred. This project indicates that public gardens have great potential to help prevent the introduction of invasive species in North America and therefore should be included in efforts to address plant invasions.

Invasive grasses can be your friends: Use of songbirds and other observable wildlife as metrics for selective acceptance of non-natives in restoration. Sandra A. DeSimone[1], Mickie Tang[2], and Scott Gibson[3]. [1]Audubon Starr Ranch Sanctuary, [2]University of California, Davis, [3] Utah Division of Wildlife Resources. sdesimone@audubon.org.

A fundamental goal in restoration is to limit nonnative species. However, some researchers advocate an impact-based assessment to prioritize *established* nonnative plant species for either control or "acceptance" into otherwise native ecosystems. We provide vegetation and wildlife monitoring results from two southern Californian habitats to demonstrate use of a measure of ecosystem function, habitat provision, to assess impacts of nonnative plant species. If monitoring indicates positive or neutral effects, we accept a nonnative into a "hybrid ecosystem" composed of native and nonnative species. We monitored vegetation in restored needlegrass grasslands and coastal sage scrub (CSS). We trapped small mammals in both habitats over three consecutive nights per winter and spring annually. We surveyed birds using spot mapping (CSS) and did qualitative surveys of two songbird indicators of habitat provision (grasslands). In CSS restoration sites small mammalian herbivory of nonnative annual grasses created bare areas for native shrub colonization which transformed annual grass-dominated areas into shrub-dominated over time. Trends of increasing native bird and small mammal species richness and abundance indicated that, without active management (annual grass control), increasing shrub cover provided improved native wildlife habitat. In needlegrass grasslands in which only nonnative forbs were targeted for control, grasslands became comprised of mixed native and nonnative grasses but Western Meadowlark and Grasshopper Sparrow populations remained stable over time. Wildlife activity and subsequent monitoring in restoration sites has stimulated us to view nonnative species through a new lens to reduce workload and meet our goal of providing habitat for native fauna.

How to prepare for fire and evaluate the risk of invasive plants after fire. Garrett Dickman, Yosemite National Park. Garrett_dickman@nps.gov

Recently burned areas provide opportunity for early successional species to establish. This includes both native fire-following species, and non-native species. Early detection and rapid response of non-native species can be one of the most effective techniques to help ensure native plant communities establish and prevent habitat type conversion. Fires across the West are increasing in size requiring land managers to prioritize areas for survey and treatment post-fire. Land managers can prepare for fire now by organizing their data into geospatial databases and compiling BMPs to hand off to fire operations managers when the fire starts. After the fire, invasive plants surveys should target vectors; such as areas impacted during fire management operations and road corridors; known invasive plant infestations; and sensitive natural, cultural, historic or other high value areas. Using targeted early detection surveys and rapid response techniques post-fire can decrease the overwhelming feeling of 'now what' that can occur after fire and can help native plant communities recover.

Reduced herbicide stem treatments for woody weeds: Scaling Up Brazilian peppertree (*Schinus terebinthifolia)* management research with contractors in south Florida. Stephen Enloe[1], Kenzie Bell[1], [1]University of Florida, Gainesville, FL. sfenloe@ufl.edu

Brazilian peppertree (*Schinus terebinthifolia* Raddi) is a small tree or shrub that is invasive in Florida, Texas, California, Hawaii, and Australia. It forms multi-stemmed trunks with lateral branches that create impenetrable thickets, a growth form similar to other woody invaders in California such as tree tobacco (*Nicotiana glauca*). State agencies in Florida manage peppertree at a cost of over three million dollars annually. The current approach for treating peppertree involves basal bark application with triclopyr ester in an oil carrier. While this is effective, high stem densities result in applications approaching or exceeding the triclopyr ester maximum label rate. Newer herbicides approved for natural areas such as aminocyclopyrachlor, aminopyralid, and triclopyr acid have shown promise to reduce herbicide use for peppertree management through modified application techniques such as reduced hack and squirt. While small plot research with these has been promising, no larger scale tests have been conducted. Utilizing two contractor crews, we tested the efficacy of novel individual plant treatments on replicated 0.5- acre plots. Treatments included reduced hack and squirt (RHS) with aminocyclopyrachlor or aminopyralid, basal bark treatment with a triclopyr acid formulation, and the standard basal bark approach with triclopyr ester. We found that compared to the standard basal bark approach, the RHS approach took a similar amount of time to apply, provided a similar amount of control for aminocyclopyrachlor, and significantly reduced the total herbicide applied. The novel triclopyr acid formulation also preformed comparably to triclopyr ester and reduced herbicide use by almost half. These results indicate that there are novel herbicide treatments and techniques that could improve control efforts on Brazilian peppertree (and likely for similar woody weeds). In addition, this contractor-based research approach has accelerated our understanding of novel treatment strategies and implementation in the field.

Evaluating control of late-season noxious grassland invasives with multiple approaches: wildfire, prescribed fire, grazing, native grass restoration, and organic herbicides. Valerie Eviner[1], Sarah Gaffney[1], Carolyn Malmstrom[2], Mary Cadenasso[1]. [1]University of California, Davis; [2]Michigan State University, East Lansing. veviner@ucdavis.edu

Noxious invasives such as goatgrass (*Aegilops triuncialis*), medusahead (*Elymus caput-medusae*) and yellow starthistle (*Centaurea solstitialis*) are aggressive grassland invasive species, which decrease grassland diversity, forage biomass, and forage quality. Control of goatgrass and medusahead is particularly challenging, since herbicides that control these grasses also kill their grass competitors. However, the late-season phenology of these 3 species provides potential for controlling them through a variety of approaches. For example, the small stature of these late-season species in early spring, provides a window for their control by organic herbicides. Early spring application of capric and caprylic acid decreased cover of medusahead and goatgrass from 80% to 18%. While it also decreased cover of non-target grasses, it increased the cover of wildflowers, while a similar timing of glyphosate eliminated the wildflowers. Wildfire killed far more goatgrass than prescribed burns, with 90% seed mortality in wildfire, and 59% in prescribed fire. Spring grazing decreased wildfire intensity, and thus decreased seed mortality in response to wildfire. Pastures grazed in the spring also had 4-fold higher goatgrass seed than ungrazed pastures. For medusahead, both wildfire and prescribed fire killed more than 99% of seeds. Late-spring grazing on its own reduced medusahead seeds by 75%, but also decreased fire-induced seed mortality. Annual weather conditions can lead to high variation in the cover of noxious weeds from year to year. However, once native grasses are established, they suppress the cover of noxious weeds to under 20%, even in wet years that generally cause large increases in their cover.

Early Detection and Rapid Response: Effective Weed Control at the Landscape Level. Sharon Farrell[1], Rachel Kesel[1], Nathan Gregory[2], Jesse Patterson[3], Christy Brigham[4], Leah Gardner[5]. [1]Golden Gate National Parks Conservancy, CA. [2] Irvine Ranch Conservancy, CA. [3] League to Save Lake Tahoe, CA. [4]Sequoia and Kings Canyon National Parks, CA. [5] California State Parks. sfarrell@parksconservancy.org

Stopping the spread of invasive plants before they have become widespread – a weed control approach known as early detection and rapid response, or EDRR – requires multiple land management partners to work in close coordination. In regions across California, groups are partnering with each other to strengthen their weed control (and other stewardship work) by collaborating at the landscape scale. The California Landscape Stewardship Network formed in 2016 so that these regional collaborations can share resources and pursue collective goals at the statewide level. In this session we will hear about from a range of these regional partnerships, including California State Parks, the One Tam Initiative in Marin County, the Orange Coast Collaborative, the Lake Tahoe Environmental Improvement Program, and the Southern Sierra Leadership Forum. Presenters will cover a range of topics: setting up a systematic EDRR approach for weed control; lessons learned from cross-jurisdictional EDRR work; EDRR as a restoration tool; EDRR for aquatic weed control; EDRR for invasive forest plant pathogen control; and development of State Parks' EDRR program for weed control. We will also present a new white paper on EDRR for invasive plant control that addresses opportunities for strengthening efforts at both regional and statewide levels.

Interactions among insects and invasive weeds in western U.S. forests. Christopher J. Fettig[1], Justin B. Runyon[2], Leif A. Mortenson[1], and Jared A. Trilling[2]. [1]Pacific Southwest Research Station, USDA Forest Service, Davis, California; [2]Rocky Mountain Research Station, USDA Forest Service, Missoula, Montana. chris.fettig@usda.gov

Insects are essential components of forest ecosystems representing most of the biological diversity and affecting virtually all ecological processes. Most insect species are beneficial yet others periodically become so abundant that they threaten ecological, economic, social and/or aesthetic values at local to regional scales. During the last three decades, the amount of tree mortality attributed to bark beetles (Coleoptera: Curculionidae) in the western U.S. has exceeded that of wildfire, and several recent outbreaks are among the most severe in recorded history. During endemic populations, bark beetles create small gaps in the forest canopy by killing trees stressed by age, drought, defoliation or other factors. In this context, few negative impacts are observed. This differs from the impacts associated with outbreaks, which may negatively affect timber and fiber production, water quality and quantity, fish and wildlife populations, aesthetic values, and carbon sequestration and storage, among other factors. Herein, we discuss our understanding of the impacts of bark beetle outbreaks on invasive weeds in western forests, and share novel data concerning mountain pine beetle (*Dendroctonus ponderosae*) outbreaks in lodgepole pine (*Pinus contorta*) forests and western pine beetle (*D. brevicomis*) outbreaks in ponderosa pine (*P. ponderosa*) forests. Furthermore, we explore interactions among bark beetles, invasive weeds and wildfires.

A Tale of Two Wildfires: Post-fire Weed Management at Pepperwood Preserve, Sonoma County, California. Devyn Friedfel, Michelle Halbur, Michael Gillogly, Sonja Barringer, and Tosha Comendant. Pepperwood Preserve. dfriedfel@pepperwoodpreserve.org

In October 2017, the Tubbs Fire burned through 90% of Pepperwood's 3,200-acre biological field station. In October of 2019, the Kincade Fire reburned 60% of the preserve. Each of these fires presented unique challenges and opportunities. Here, we share our observations on how invasive plant distributions and abundances differed each year following the Tubbs Fire, and outline some differences and our expectations for how invasive plants will respond to the Kincade wildfire along with the actions we are taking. In general, the wildfires have given us an advantage controlling some invasive plant species such as Himalayan blackberry (*Rubus armeniacus*) and barbed goatgrass *(Aegilops triuncialis)*, while increasing the spread and productivity of others such as stinkwort (*Dittrichia graveolens*), French Broom

(*Genista monspessulana*), oblong spurge (*Euphorbia oblongata*), and bull thistle *(Cirsium vulgare)*.

Long term effects of indaziflam applications for medusahead control on the Modoc plateau. Tom Getts, Weed Ecology and Cropping Systems Advisor in Lassen, Modoc, Sierra, and Plumas Counties, UC Cooperative Extension. tjgetts@ucanr.edu

Medusahead (*Elymus caput-medusae L.*) is an invasive winter annual grass listed as a noxious weed in six states due to its ability to create monocultures displacing desirable vegetation. Indaziflam is a seed germination inhibiting herbicide that has been shown to provide multi-year control of cheatgrass (*Bromus tectorum*), with good safety to many established perennial plants (Sebastian et. al 2017). This research project investigated applications of indaziflam at multiple sites to test the effect on medusahead in California. Indaziflam applications were made with a broadcast sprayer at two rates (73 g ai/ha and 102 g ai/ha) to four replications of small plots laid out in a randomized complete block design at each site. Medusahead control and plant community response were monitored for three growing seasons following application. Two of the study sites were drill-seeded with perennial grass species to assess the ability to reseed into areas following indaziflam treatment. Stand counts and biomass following seeding were conducted for select grass species. Two growing seasons after application, indaziflam gave 85-95% control of medusahead at most of the test sites. Three growing seasons after treatments, medusahead control was lost at some sites, but others still had over 80% control. At drill-seeded sites, perennial grass species only established where medusahead was controlled with indaziflam applications. Indaziflam has the potential to provide effective control of medusahead, effectively releasing established perennial species from competition. In areas without established perennials, seeding may be necessary, otherwise bare ground can result from indaziflam applications.

Ecocultural considerations for invasive species and grassland stewardship with fire. Don Hankins, California State University, Chico. dhankins@csuchico.edu

California native grasslands are among the rarest ecosystems in the state. While fire is an integral part of many grassland ecosystems, the dynamics of fire frequency, seasonality, and species among other factors can contribute to their enhancement or degradation. Many California grassland ecosystems co-evolved with frequent fires set as part of traditional cultural practices of Indigenous California populations for which complex ecocultural relationships had been established. The curtailment of these cultural practices due to colonization and subsequent spread of non-native invasive grasses and forbs has disrupted the processes best suited to ensure resilience to environmental change. While many studies have looked at the relationship between non-native grasses and forbs relative to wildfires and prescribed fires, few studies have approached the topic through a cultural lens. Understanding cultural parameters of fire including the timing, frequency, and intent, are among key points to achieve desirable outcomes within many ecosystems where composition of grasses and forbs are significant. Applied research integrative of Indigenous burning practices, knowledge, and/or engagement demonstrate opportunities to enhance native species cover and reduce the diversity and cover of non-native and invasive species (e.g., ripgut brome [*Bromus diandrus*] and yellow star-thistle [*Centaurea solstitialis*]). The ability to manipulate the fire timing and frequency in grass and forb dominated systems through cultural applications can help enhance native species and ensure ecocultural resilience and services.

When Control is Constrained to Containment - *Undaria pinnatifida* at the Channel Islands, CA. Sean Hastings, NOAA's Channel Islands National Marine Sanctuary. Sean.hastings@noaa.gov, (805) 705-1790

Marine invasive species can have dramatic ecological and economic consequences, and pose a major threat to the sustainability of natural resources within national marine sanctuaries. *Undaria pinnatifida* has spread to the Channel Islands

National Marine Sanctuary (sanctuary), first at Anacapa Island in 2016 and then Santa Cruz Island in 2019. While eradication is highly unlikely, preventing the re-introduction of *Undaria* to the sanctuary is critical to limit its potential spread and impact. Educating and engaging professionals and mariners operating in infested harbors about marine invasive species is critical to limiting their spread and their impacts. Several outreach products have been developed and distributed to raise awareness about *Undaria* and other invasive algae among mariners, and provide guidance on what to do when they encounter it. Workshops hosted at local harbors help sanctuary staff learn more about where in the harbors *Undaria* is growing and raise awareness about the issue among professionals who operate in the harbors. Research and monitoring efforts are needed to understand the impacts of *Undaria* in southern California and improve methods of removal and control. Genetic sampling and processing from the four closest infested mainland harbors and the island population are currently being analyzed to determine if a source population can be identified and management targeted. The sanctuary is partnering with the National Park Service to conduct annual monitoring dives at the infested sites, and with other institutions to develop research aimed at predicting the impacts of *Undaria* invasion to the native ecosystem.

The Safe and Effective Application of Aquatic Herbicides. Krista Hoffmann, California Department of Fish and Wildlife, West Sacramento, CA. Krista.Hoffman@wildlife.ca.gov

Aquatic invasive species are of great concern in California because they significantly impact the ecological function of natural waterways as well as human industries, including water distribution, commerce, and recreation. Aquatic vegetation treatments include certain considerations and complexities that can make these treatments more challenging than terrestrial weed applications. These include accounting for tides and flows, water depth, water chemistry, legal protections of Waters of the U.S., and aquatic-specific label requirements, among others. This presentation will provide a review of considerations and best practices for the safe and effective use of aquatic herbicides, including the laws and regulations around aquatic herbicide use, some useful practices to enhance efficacy and safety, and the relative toxicities of the commonly used herbicides and adjuvants.

Using detection dogs to enhance invasive plant management strategies. Aimee Hurt, Working Dogs for Conservation, Missoula, Montana Aimee@wd4c.org

Conservation detection dogs have become an increasingly common and effective tool in management and research of endangered, threatened, and invasive species populations. We'll take a closer look through the through the lens of invasive/nuisance plant management and discuss examples of species that dogs have worked on to date, and the protocols used to meet varying management objectives. Attendees will gain insight into whether detection dogs might be an appropriate methodology to incorporate into their programs. Specifically, we'll address what types of objectives are well suited for dogs, when they are best incorporated, general characteristics about plants that are likely to be the strong candidates, and a sense of cost and scale when working with detection dogs. Presented by Aimee Hurt, co-founder of Working Dogs for Conservation, one of North America's oldest and most accomplished conservation dog organizations, attendees will have the opportunity to ask individual questions and Aimee will be available outside of presentation time.

Reducing the risk of invasive plant spread before and during wildland fire incidents. Martin Hutten, U.S. Forest Service, Wrangell Ranger District. **martin.a.hutten@usda.gov**

Wildland fire, fire suppression and suppression repair activities can exacerbate the spread of invasive species. Commonly recurring adverse effects can be anticipated and addressed ahead of time. For example, it is difficult to find an appropriate place for a large fire camp and suitable sites are often reused. Invasive plant workers can work with fire managers to pre-identify potential camp locations and staging areas, heli-bases etc., and keep these areas free of priority invasive plants. While life and property concerns always rank first, the potential and capability to mitigate resource

issues during incidents is growing. On federal incidents, resource specialists work side by side with firefighters to help prevent resource damage. One of the jobs of the so-called Resource Advisor (READ) is to evaluate invasive plant concerns and advise on appropriate mitigation measures. During incidents, it is obviously important for READs to have access to well prioritized infestation data. One of the ways critical concerns are tracked (during pre-planning) is by fire managers in the Wildland Fire Decision Support System (WFDSS). It can track avoidance areas such as 'no dip' waterbodies with aquatic invasive species. The efficiency by which invasive plant concerns are mitigated during incidents depends in part on such detailed pre-incident planning by invasive plant managers in collaboration with landowners and fire managers.

Perturbations in fire-prone ecosystems resulting in exotic plant invasion. Jon E. Keeley[1,2], [1] U.S. Geological Survey, Western Ecological Research Center, Sequoia-Kings Canyon Field Station, Three Rivers, CA. [2] Department of Ecology and Evolutionary Biology, University of California, Los Angeles. *jon_keeley@usgs.gov*

Fire is a necessary ecosystem process in many biomes and is best viewed as a natural disturbance that is beneficial to ecosystem functioning. However, increasingly we are seeing human interference in fire regimes that alter the historical range of variability for most fire parameters and result in vegetation shifts. Such perturbations can affect all fire regime parameters. Here we provide a brief overview of examples where anthropogenically driven changes in fire frequency, fire pattern, fuels consumed and fire intensity constitute perturbations that greatly disrupt natural disturbance cycles and put ecosystems on a different trajectory resulting in type conversion. These changes are not due to fire per se but rather anthropogenic perturbations in the natural disturbance regime.

Fuel Treatments Leading to Non-Native Plant Invasions. Jon E. Keeley [1,2] and Kyle E. Merriam [3]. [1]U.S. Geological Survey, Western Ecological Research Center, Sequoia-Kings Canyon Field Station, Three Rivers, CA. [2] Department of Ecology and Evolutionary Biology, University of California, Los Angeles, Los Angeles, CA. [3] U.S. Forest Service, Sierra Cascade Province Ecologist, Quincy, CA. *jon_keeley@usgs.gov*

Understanding the relationship between fuel treatments and nonnative plants is becoming increasingly important as federal and state agencies are currently implementing large fuel treatment programs to reduce the threat of wildland fire, and near the southern border, to enhance homeland security. We have examined fuel breaks across California and found that non-native plant abundance was many times greater on fuel breaks than in adjacent wildland areas. Vegetation type, mode of construction and past fire history were important determinants of invasive cover. In some cases, fuel breaks provide establishment sites for nonnative plants that invade surrounding untreated landscapes.

Using WHIPPET to prioritize One Tam's widespread weeds in Marin County. Rachel Kesel and David Greenberger. Golden Gate National Parks Conservancy, CA. rkesel@onetam.org

One Tam, a partnership of four public agencies and a non-profit support partner in Marin County, surveys nearly 40,000 acres of open space for a suite of 62 invasive plants. The early detection program includes 39 widespread weeds in order to manage new outlier patches, and also to provide more comprehensive mapping of those species. Following the first cycle of the cross boundary early detection program, One Tam used the Weed Heuristics: Invasive Population Prioritization for Eradication Tool (WHIPPET) to inform where to target future treatment resources for widespread weeds. WHIPPET helps land managers prioritize weed populations for eradication. While eradication of widespread weed populations is rarely a realistic goal, patch-level eradication of outliers and successful containment are common management strategies. The results indicate that while One Tam is actively working on several high priority patches of

widespread weeds, other projects are less likely to succeed in patch-level eradication. In the One Tam context, WHIPPET provides a neutral perspective on likelihood of treatment success to jumpstart conversations about prioritizing across boundaries. This talk will cover technical aspects of this analysis, particularly steps for data preparation, as well as the implications for prioritizing weed treatments in a partnership environment. Species results will highlight the utility of using WHIPPET, as well as the judgment calls that remain after its application.

Continued management and monitoring of alligator weed (*Alternanthera philoxeroides*) in the Sacramento-San Joaquin Delta and Suisun Marsh.
Michael Kwong[1], Brenda Grewell[2], Leslie Earl-Gould[1], and Jose Martinez[1]. [1]California State Parks – Division of Boating and Waterways, Sacramento, CA; [2]U.S. Department of Agriculture – Agricultural Research Service, Davis, CA. Michael.Kwong@parks.ca.gov

The California State Parks Division of Boating and Waterways (DBW) is the lead agency for conducting invasive aquatic plant management in the Sacramento-San Joaquin Delta, its southern tributaries, and the Suisun Marsh (Delta). The Aquatic Invasive Plant Control Program (AIPCP) under DBW utilizes a strategic and adaptive Integrated Pest Management (IPM) approach in the Delta, including herbicide treatments supported by physical, mechanical, and biological control methods. The AIPCP currently targets nine invasive aquatic plant species – including the recent invader, alligator weed (*Alternanthera philoxeroides*) – to protect California's environment, economy, and public health. Alligator weed is a highly invasive aquatic and terrestrial weed that has spread throughout many parts of the world. It was first detected in the Suisun Marsh in August 2017. The AIPCP obtained permits and initiated herbicide treatments of this new weed in 2018 to eradicate it from the Delta. However, in conjunction with the weed's ability to easily spread through fragments, jurisdictional, regulatory, and resource limitations have made eradication and control efforts difficult with over 586 detections as of August 2020. In partnership with various federal, state, and local agencies, the AIPCP continues to track and control new detections, monitor treated populations, and adaptively plan. This presentation will provide an overview of the current status of alligator weed in the Delta, the AIPCP's management and monitoring efforts, next steps, and how to get involved.

Challenges and Lessons Learned in the Muir Beach Wetland Restoration Project.
Naomi LeBeau, Restoration Manager, Golden Gate Parks Conservancy, CA.
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Muir Beach wetland restoration began in 2009 with a large scale, multi-partner construction project that re-routed the terminus of Redwood Creek. The project's goals included improved hydrological function and improved habitat for threatened and endangered species. Restoration was performed without herbicides, during specific seasons to reduce impacts on threatened and endangered species, and while preserving erosion control measures. This presentation will focus on a few specific challenges encountered and lessons learned resulting in a landscape you'd never know had been a construction site.

Using climate niche modeling to map areas at risk of invasion by Stinkwort (*Dittrichia graveolens*).
Nicky Lustenhouwer and Ingrid M. Parker. Department of Ecology and Evolutionary Biology, University of California, Santa Cruz.
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Niche models (also known as habitat suitability models), predicting species' future ranges based on the climate of the area they currently occupy, are a valuable tool in Early Detection and Rapid Response (EDRR) to invasions. We applied this approach to map suitable habitat in California for *Dittrichia graveolens*, a Mediterranean annual plant that was first observed in 1984 and has since spread rapidly across the state. We compiled >10,000 native range occurrence records from data sources including GBIF, iNaturalist, herbaria, standard floras, and botanical journals. Our data show that *Dittrichia* is undergoing a spectacular range expansion in Europe, which has shifted the species' range limit northward by about 500 miles. We found that this range expansion represents a significant climatic niche shift into cooler, more temperate climates with higher rainfall. We then used occurrence and climate data to project the distribution in the introduced

range. Our model shows that the current distribution of *Dittrichia* has - unfortunately - not yet come close to reaching all suitable areas in California. Based on *Dittrichia* occurrences reported by Calflora, 63% of the potential suitable habitat is currently unfilled. Recent niche evolution during the European range expansion suggests that potential suitable habitat is even more extensive than it would be in the absence of evolution. Our data also highlight the importance of the road network as a major vector for the spread of *Dittrichia*. We are anxious to discuss how this information might be useful for invasion risk assessment of this increasingly common weed.

Non-herbicidal measures of control for slender false brome (*Brachypodium sylvaticum*), an invasive perennial grass. Virginia Matzek, Santa Clara University; Coty Sifuentes-Winter, Midpeninsula Regional Open Space District. vmatzek@scu.edu

Slender false brome (*Brachypodium sylvaticum*) is a European perennial grass that invades the understory of redwood forests of the Pacific Northwest. Because its distribution in California is restricted to a few small populations in the Santa Cruz Mountains, it is a good candidate for containment and eradication. At present the Midpeninsula Open Space District (MROSD) successfully controls slender false brome (SFB) with herbicide on its own properties, but the grass also occurs on adjacent private parcels whose owners object to the use of pesticides. In 2016, MROSD initiated an experiment to test non-herbicidal methods of SFB control to respond to this stakeholder need. We tested three types of mulch--weed-free hay, wood chips, and black plastic tarps--in combination with annual mowing of SFB, against two control treatments, one a true control and the other a mow-only (no mulch) treatment. We found that after two years of treatment, all three mulches were highly effective at reducing the abundance of SFB, measured as cover class and total stem number. Mowing alone was insufficient to reduce SFB abundance versus the control. Potential germination from the seedbank declined in all treatments over the two-year period, but only the wood chip mulch performed significantly better than the control at reducing seedbank viability. Because mulches were equally effective over the two-year trial, other practitioner and stakeholder concerns, such as cost, aesthetics, and durability, take precedence in determining which approach to use.

Some insights on the seed bank dynamics of stinknet, a difficult weed to contain. Christopher McDonald[1], Alex Douglas[2]. [1]University of California, Cooperative Extension. [2]Department of Primary Industries and Regional Development, Government of Western Australia. cjmcdonald@ucanr.edu

Stinknet (Oncosiphon piluliferum) was first recorded in North America in the early 1980's near Perris, California. Since then, it has spread to nearly every county in Southern California. It has also been spreading north into the Central Valley and a small population was recently located in the Bay Area. It was first recorded in Phoenix, Arizona in the late 1990's and has since aggressively spread across the southern and central portions of Arizona. Small populations have also been recently discovered in Mexico and Nevada. Stinknet is also invading Western Australia, where it is a problem weed in pastures and in small grain crops. Land managers in California, Arizona and Australia have been having a difficult time trying to control this weed. One aspect of its biology that makes it difficult to contain is that the seeds are extremely small. This allows the seeds to be easily and accidentally transported with animals, people, tools, shoes, heavy equipment and as a contaminant in materials. Stinknet is also difficult to contain because of several aspects of its seed bank. Stinknet germinates multiple times a year creating several cohorts that can grow after initial treatments. Likewise, in Western Australia stinknet seeds easily germinated after being buried at a variety of depths. Stinknet in Western Australia also germinated at a variety of moderate temperatures and had moderately high germination rates after being buried. These results can help to refine best management practices for managers hoping to reduce stinknet on their properties.

Herbicide Use in Habitat Restoration: Organic Versus Outcome. Scott McMillan (smcmillan@dudek.com), Cindy Thompson (cthompson@hrs.dudek.com), Kyle Matthews (Kmatthews@hrs.dudek.com)

For over 25 years in Southern California, herbicide application has been one of the most effective and efficient weed control tools available to habitat restoration ecologist. Highly trained habitat restoration implementation crews use herbicide successfully and appropriately on general restoration efforts, as well as highly sensitive habitats with rare and endangered species. The use of herbicide for weed control has been an important tool in habitats that support sensitive species like vernal pool plants and animals, sensitive bird and butterfly species, and desert species like the desert tortoise. This tool has helped achieve the success criteria goals and requirements of the regulatory agencies on projects for mitigation, targeted species recovery, and long-term management. Recently, the use of herbicide for habitat restoration and management efforts has come under increasing scrutiny. Many cities, counties, and other land managers now require organic herbicides, or restrict herbicide application entirely. Safe and effective use of natural or organic herbicides is relatively untested around sensitive resources. Natural herbicides result in more time intensive and costly weed control, with less confidence of success. Where herbicide application is completely restricted, other weed control methods like hand weeding or mowing can be implemented successfully, but they often fall short of herbicide in effectiveness. This resulting reduction in effective weed control must be taken into account in future plans for habitat restoration and management, and our existing programs will have to re-evaluate the proposed efforts, cost of those efforts, and expectations for success, both short and long term.

Invasive species holobiomes as bioindicators? Environmental DNA metabarcoding from community-collected CALeDNA samples makes holobiomes available for common invasive plants. Rachel S Meyer[1], Miroslava Munguia Ramos[2], Anna Worth[1], Wai-Yin Kwan[2], Kim Ballare[1], Chloé Orland[1], Beth Shapiro[1] and Robert Wayne[2]. [1]University of California, Santa Cruz. [2]Univeristy of California, Los Angeles. rameyer@ucsc.edu

Molecular methods to monitor and study invasive species present incredible opportunities. DNA signatures in soil, sediment, or water (eDNA) can indicate a species is present or nearby before the species becomes observable by traditional methods. Probing eDNA for a target species has been successful in tracking plant and animal invasion fronts. We present an opportunity to use DNA signatures associated with an invasive species as candidate 'holobiome' bioindicators. eDNA bioindicators not only provide additional metrics to determine the likelihood a species is in an area, but they can illuminate a holobiome that can generate hypotheses for why an invasive species has high fitness in certain environments, and how an invasive species makes environments difficult for native species to thrive in. The plant holobiome can consist of microbiomes, and various symbionts, pathogens, members of the same trophic web, or functional guild that robustly co-occur with an invasive species. Holobiomes may also reflect an entire community that assembles on a plant.
The CALeDNA program has over 1000 community science collected samples from California with metabarcoding results available to the public. Plant species in our database observed in over >30 eDNA samples allows us to calculate a candidate holobiome using the SPIEC-EASI ecological co-occurrence network method. Here, we show how networks from terrestrial plants (e.g. *Rubus*), and aquatic plants (e.g. *Ludwigia*) have candidate holobiomes that provide insight into their ranges, their ecological fitness, their potential predators, and their destructive capacity. We discuss the interest of holobiome biodindicators for the natural areas management community.

Laws and Regulations that Inform Invasive Weed Treatment Strategies. LeeAnne Mila, Deputy Agricultural Commissioner/Sealer of Weights and Measures, Counties of El Dorado and Alpine. Leeanne.mila@edcgov.us

This talk will give an overview on current laws and regulations in California and their implications for invasive weed treatments. Working in wildland settings can make it hard to comply with legal requirements. Utilizing real world experience and examples from the regulatory and invasive weed treatment sides, we will give you guidance on ways to be in compliance. Topics covered will be employer/employee responsibilities, personal protective equipment requirements, and best management practices.

Lessons learned (the hard way) on how to manage invasive shot hole borers in Southern California. Beatriz Nobua-Behrmann, University of California Agriculture and Natural Resources. benobua@ucanr.edu

The invasive shot hole borers (ISHB; *Euwallacea* spp.) include two species of ambrosia beetles –the polyphagous and Kuroshio shot hole borers– that are responsible for the death of thousands of trees in southern California. The beetles are vectors of symbiotic fungal pathogens (*Fusarium euwallacea* and *F. kurosium*) that cause general tree decline, branch dieback, and, eventually, tree death. Susceptible tree species include willows, sycamores, cottonwoods, oaks, maples, and many other common trees in urban landscapes and wildland environments. Managing this pest-disease complex has proven to be challenging, since options for control have been somewhat limited. However, in the last few years, new research on potential ISHB control methods has been carried out, and we gained experience from applying these new methods to large scale land management projects. Here we present several key lessons from this work that are worth sharing with land managers confronting this pest. Specifically, we will summarize the latest recommendations on ISHB monitoring, best management practices (including cultural practices and available treatment options), and proper disposal of infested wood to reduce the prevalence and prevent the spread of this dangerous pest.

Interpreting Herbicide Labels to Make Directed, Low-Volume Application Techniques in Wildland Settings – A Case Study. Scott Oneto, University of California Cooperative Extension, El Dorado, Amador, Calaveras and Tuolumne Counties. sroneto@ucanr.edu

Controlling invasive weeds in wildland areas can be challenging. Often these weeds begin as small incipient populations where there grow amongst natives and/or desirable vegetation. These weeds can be found growing in sensitive habitats including riparian areas or where endangered and/or threatened species coexist. Accessibility can also be a factor as these plants can be growing in hard-to-reach areas including steep slopes, ridge tops and canyon bottoms. All these factors make controlling invasive weeds in wildland areas not only difficult but expensive and sometimes dangerous. Obtaining any type of selectivity using an herbicide in these environments can be a challenge. In this case study we will examine how to interpret an herbicide label for making a low-volume, directed application for controlling the invasive weed oblong spurge (*Euphorbia oblongata*) to reduce the threat of hitting non-target species and reducing runoff.

Effective use of low-dose herbicide application to control weed seedlings in a restoration context. Collin Raff, Isaac Ostmann, Shawn Thorin, Alan Blake. Irvine Ranch Conservancy. craff@irconservancy.org

Selective control of weed seedlings interspersed with native species can be expensive and time consuming especially at a large scale. Irvine Ranch Conservancy (IRC) uses low-dose herbicide application in certain situations to control weeds within restoration areas in Southern California. This approach targets weeds at the seedling stage within an area with established native species; the low concentration and timing can target weed seedlings while leaving established native plants unharmed. This strategy can limit competition with natives early in the growing season and reduce the amount of weed control needed later in the season. IRC has experience using both broad-spectrum (0.3-0.5% solution of glyphosate) and grass-selective (0.2-0.4% solution of fluazifop) herbicides with this approach depending on the habitat type and weeds present. IRC has had success with low-dose application of

fluazifop to control non-native grass seedlings in native perennial grasslands. Additionally, low-dose application of glyphosate has effectively controlled both non-native grass and black mustard (*Brassica nigra*) seedlings within perennial grasses and shrubs. Generally, the effectiveness of this approach depends heavily on precise timing and application rates. Overspray can cause damage to desirable species and improper timing can leave target weeds unharmed. Additionally, spraying low-dose fluazifop can facilitate native forb establishment from the seedbank or sown seed in areas that may have otherwise been dominated by non-native grass. However, using this approach without previous broadleaf weed control can inadvertently open the area for further invasion. We will discuss the benefits and limitations of low-dose herbicide application in these various scenarios.

Weed Control in Riparian Habitat Restoration: 3 design recommendations for scaling up implementation efficiency. Ruben Reynoso (rreynoso@riverpartners.org), Stephen Sheppard (ssheppard@riverpartners.org), Julie Rentner (jrentner@riverpartners.org), Michael Rogner (mrogner@riverpartners.org)

In riparian and wetland ecosystems, weed control is the most important restoration intervention for long-term habitat provision and low maintenance costs for land managers. River Partners will share 3 primary design recommendations based on lessons learned from the field from over 20 years of experience in large-scale riparian and wetland habitat restoration. 1) For projects over 5-10 acres in size, mechanized weed control methods are facilitated in the design process by laying out planting plans in strategic patterns and installing low-cost plant protectors to allow the use of ride-on tractors and all-terrain vehicles to mow and apply herbicides without harming the desired vegetation. 2) Selecting perennial and biennial herbaceous species for establishment in some zones, and annuals in other zones allows for the use of repeated mowing as an effective cultivation tool. 3) Regarding chemical weed control, monocotyledons and dicotyledons can be arranged distinctly in the planting design to allow for the use of broadcast applications of herbicides that specifically select for the desired plant types. Monocot or dicot zones can be interspersed across the site in arrangements that facilitate vehicular applications of either broadleaf-specific herbicides, or grass-specific herbicides. At the Dutch Slough Habitat Restoration Project, a blend of grasses and broad-leaved herbs were planned along levee slopes, and a custom tow-behind wicking approach was required to apply herbicides to the dense dicot weeds while preserving the desirable flowering herbs and grasses. By incorporating these 3 design considerations in the restoration plan, project performance and cost will be dramatically improved.

Best Practices to Keep Pesticides out of Water. Samuel Sandoval Solis, University of California Cooperative Extension, U.C. Davis. samsandoval@ucdavis.edu
This presentation will explain basic concepts and provide resources for preventing chemical pesticides from reaching any water body, rivers, aquifers, or both. These concepts are available online in English and Spanish.

Invasive Species Denialism and the Future of Invasion Management. Daniel Simberloff, University of Tennessee. tebo@utk.edu

Scientific inquiry, including invasion biology, grows through open debate, sometimes to the point of controversy. Critiques of invasion biology from outside the scientific community can help frame the field within the context of human values. When perspectives attack the validity of scientific consensus on invasive species and the goals of management efforts, they stray into denialism. As with climate change denialism, the stakes are high. Although the term "invasive species denialism" was coined in 2017, a few denialist publications appeared in the 1990s, and antecedents stretch back to the late 19th and early 20th centuries, often associated with charges of xenophobia. A substantial increase in such antecedents occurred in the 1980s just as modern invasion biology was catalyzed by the SCOPE Programme on the Ecology of Biological Invasions. Almost all antecedents were outside the biological sciences – mostly in the social sciences and humanities. This was also true of the early denialists, who also included journalists and popular writers attracted to the subject by the increasing

prominence of invasion biology and accounts of invasion impacts even in the popular press. A major uptick in denialism arose in the new century, still dominated by non-scientists. Beginning ca. 2010, they were joined by some scientists, and today denialism is one aspect of a multi-faceted controversy about invasion impacts, management, and policy. A mini-controversy concerns objections by some critics of invasion biology to being termed "denialists." An increasing but covert contribution to denialism comes from the new discipline of "compassionate conservation." The key threat of denialism is the denial of impacts of invasive populations, or denial that net impacts are negative. To the extent that policymakers often seek rationales not to act and not to expend resources, the existence of denialism and especially denial of impacts provides such a rationale. To date the actual influence of denialism on policy and management appears minimal, but the increasing drumbeat in both scientific and popular media is ominous. Invasive species are, and will remain, a major ecological stressor. We will need to invest significant resources, but much can be accomplished through strong prevention, collaborative management, wide-ranging research, and focused policy initiatives.

Restoration to benefit pollinators: plant selection and herbicide impacts. Deedee Soto and Sarah Hoyle, Xerces Society for Invertebrate Conservation. deedee.soto@xerces.org

Critical pollinator species are declining throughout California, so creating and augmenting pollinator habitat is a key goal for restoration projects. The Xerces Society restores and installs pollinator habitat throughout the state in a variety of landscapes. This presentation will discuss the value of native plants for pollinators as well as how to minimize impacts of herbicide use. Native plants play a key role in maintaining pollinator diversity because plants and pollinators have coevolved over millennia. While introduced plant species can be of some value to pollinators, the negative impacts outweigh any of the benefits. We will discuss the importance of using native plants in restoration, their benefits to native pollinators, and the implications of non-native species on pollinators and their habitat. Choosing the right site preparation method for a restoration project is essential to its success. Herbicides are a common tool in restoration projects, but they can negatively impact pollinators. We will review the research on herbicide impacts to pollinators, including both indirect effects (forage removal) and emerging evidence of direct toxicity.

The sky is not the limit: controlling invasive plants with survey- and spray-drones. John Y. Takekawa[1], Tim Edmunds[1], Bill Reynolds[2], Christopher Potter[3], Steven Chappell[1]. [1]Suisun Resource Conservation District, Suisun City. [2]Leading Edge Aerial Technologies, Waynesville, NC. [3]CASA Systems 2100, Los Gato, CA. jtakekawa@suisunrcd.org

Wetland managers in Suisun Marsh are struggling to control non-native plant invasions that reduce the quality and quantity of preferred habitats. Managers use herbicides to control invasions, but it may be difficult to find effective application methods. Manned aircraft cover large patches, but aerial use is limited by high costs, weather conditions, and overspray. Many studies indicate detecting and controlling small patches provides better control and faster regrowth of preferred plants. Ground applications from vehicles or on foot may target smaller patches, but effectiveness may be limited by accessibility, labor costs, and applicator health concerns. We are applying herbicide with a spray-drone in managed wetlands of Suisun Marsh. With a payload of 3.5 gallons and coverage of 5-20 feet, the spray-drone flies at low elevation (10-20 feet) and applies chemicals with surgical precision. We applied Telar® to control small patches of *Lepidium latifolium*. We first flew a survey drone with a 4K camera to detect emerging plants. We used color imagery analysis and assisted classification to detect invasive patches. We then flew the spray-drone along pre-determined transects to apply herbicide. Finally, we examined success with survey drone imagery and ground transects and assessed costs. Our results indicated that the spray-drone is an effective means to control invasive plants with reasonable costs after methods are fully developed. Our ultimate goal will be developing a spray-drone method to immediately identify and treat invasive plants during a single overflight.

Positive feedback loops of invasive grasses: breaking the cycle. Joanna Tang*, Carla D'Antonio. University of California, Santa Barbara. joannatang@ucsb.edu

Only 5% of California's historic endemic vernal pool ecosystems are still extant. A major threat to these seasonally-flooded wetlands is invasive exotic grasses, as vernal pools often exist within a grassland matrix. Climate change is exacerbating this invasion, with increased variation in precipitation patterns disrupting the distinct hydrologic regime that these rainfed wetlands rely upon and increased drought favoring invasive species. Even restored vernal pools suffer reinvasion in the long run, as budget constraints of restoration projects often preclude continual long-term intensive weeding to prevent reinvasion. New cost-effective management techniques must be developed to safeguard vernal pools in the long run. The mechanisms of invasion and reinvasion are not well understood. We explored the positive feedback loops of invasive exotic grasses as a mechanism promoting invasion and reinvasion. We hypothesize that the dead exotic thatch is creating a positive feedback loop wherein the year-to-year build-up of exotic thatch further promotes the germination of exotic species while suppressing the germination of native species. We experimentally manipulated the thatch layer in a set of 15 South Coast vernal pools that had been restored in the late 1980s, but had subsequently become reinvaded by exotic annual grasses such as *Festuca perennis*. We found that annual summer removal of the thatch layer successfully reduced the total amount of exotic cover. These findings indicate that simple annual summer removal of thatch effectively breaks the cycle of exotic thatch perpetuating exotic populations, and thus presents a viable cost-effective long-term weed management strategy for vernal pools.

Integrated prioritization of invasive plant management in the Australian Capital Territory (ACT).
Steve Taylor, Australian Capital Territory, Environment, Planning and Sustainable Development Directorate. Steve.Taylor@act.gov.au

The ACT has a diverse range of native vegetation - from Snow Gum woodland at 1,855m (6,086ft) elevation, to lowland grassy woodland vegetation at an elevation of 590m (1,936ft) (35 degrees South). Invasive plants disrupt many of these native plant communities by smothering native plants and degrading the habitat of our unique wildlife. Mitigating such threats requires thorough mapping of infestations and integrated prioritization (invasive plant species risks, pathways of spread, and biodiversity triage) of management actions. In the ACT we use the latest invasive plant ecology research to inform integrated prioritization and measure the success of threat abatement and restoration. This approach helps our post-fire invasive plant control which aims to improve the resilience of native vegetation and select areas that require active restoration. Details of management objectives, priority setting, and outcomes are available as a publicly available Story Map - ACT Parks Invasive Plants Program 2020-25.

Cleaning and sanitation of heavy equipment for pathogens and weeds. Yana Valachovic[1], Brendan Twieg[1], David McLean[1], Madeline Lueck[1], and Christopher Lee[2]. [1]UC Cooperative Extension Humboldt and Del Norte Counties, Eureka, CA. [2]CAL FIRE, Fortuna, CA. yvala@ucanr.edu

Heavy equipment has long been recognized as a potential vector of weed seeds and pathogen propagules. Following wildfire, there are detailed equipment demobilization and washing strategies to reduce accidental movement of seeds, spores, and soil that may harbor these items. Efficiently washing equipment is known to be time intensive and requires wastewater disposal systems that can be hard to come by in remote settings. In comparison with forest management activities, some agencies have deployed standards or best management practices (BMPs) to prevent transportation. For example, in California counties infested with the *Phytophthora ramorum,* the plant pathogen that causes sudden oak death, a registered professional forester is required to identify feasible means to reduce the potential movement of the pathogen to other areas via soil and vegetative debris that adheres to equipment with little guidance. The BMP's that were developed around this issue were time sensitive and were based on limited research. As a result, there has been a growing demand for information about 1) what cleaning methods are

adequate and feasible in the field for large equipment and 2) whether use of a chemical sterilant would be beneficial, in addition to physical removal of soil and debris from equipment, to eliminate the pathogen from equipment. We present the result of field and laboratory trials to answer these questions for *P. ramorum* and explore what lessons can be learned from other large equipment cleaning and sanitation strategies in both wildfire and other land management settings.

Considerations for better coordination between Fire and Invasive Species management activities. Mike Zupko, mike@zup-co-inc.com, and Jeff Morisette, Jeffrey_morisette@ios.doi.gov, Joint U.S. Wildland Fire Leadership Council/National Invasive Species Council Fire and Invasive Species task team

In early 2020, the Wildland Fire Leadership Council (WFLC) and the National Invasive Species Council (NISC) sought to build efficiencies in ongoing complimentary work in the invasive/wildland fire arena and convened a joint task team. WFLC is an intergovernmental committee of Federal, state, tribal, county, and municipal government officials convened by the Secretaries of the Interior, Agriculture, Defense, and Homeland Security dedicated to consistent implementation of wildland fire policies, goals, and management activities. NISC provides national leadership on coordinating, sustaining, and expanding federal efforts to manage invasive species. The NISC annual Work Plan specifies core activities that build on the mechanisms and responsibilities of NISC. The 2020 Work Plan includes a core activity on developing better coordination between the fire and invasive species management communities. Similarly, the WFLC developed the National Cohesive Wildland Fire Management Strategy (Cohesive Strategy) as a framework for working on wildland fire and land management issues, of which invasive species is clearly identified as a challenge and need for continuous investment to address. Due to the clear synergies and mutual interest, the work is proceeding as a joint NISC-WFLC activity. This talk will summarize this activity, the relationship between the two organizations and the ongoing coordinated efforts. It will provide an update around key questions, gaps, and coordination opportunities related to five themes: 1) preparing for wildfire, 2) response to wildfire, 3) recovery following wildfire, 4) coordination on information management, and 5) research and development.

Lightning Talk Abstracts

Is yellow starthistle (*Centaurea solstitalis*) adapting to serpentine soils? Katherine Brafford[1*], Mohsen Mesgaran[1], and Jennifer Funk[1]. [1]University of California, Davis. kebrafford@ucdavis.edu

Yellow starthistle (***Centaurea solstitalis***), a highly invasive noxious weed in California and the western United States, was largely not found in habitats with serpentine soils. Serpentine soils, which present chemical, physical, and biological barriers to plant growth, are relatively common in California, have produced numerous endemic species, and are largely free of invasive plants. However, based on nonsystematic observations, starthistle is seemingly becoming more common on supposed serpentine soils. Our objective is to examine whether some starthistle populations are developing genetic adaptations which allow them to grow and compete on serpentine soils. We selected otherwise similar serpentine and non-serpentine site pairs with starthistle present from four geographically disparate areas within California, measured starthistle plant height, and collected soil and seed samples. We performed germination tests at different water potentials and measured seedling emergence and plant growth in a reciprocal common garden experiment. No significant height difference was found between serpentine and non-serpentine sites. We hypothesize that seeds originating from serpentine populations will have consistently higher germination and emergence rates, but lower survival and growth rates indicating potential genetic differences. Our findings will provide pertinent information to land managers, whose land includes areas with serpentine soils, and advance the understanding of weed invasion into environments which present challenges to plant growth.

Klamath Alliance for Regional Invasive Species Management: Working together to manage invasive species in California's remote NW corner. Tanya Chapple, Plants Program director, Mid Klamath Watershed Council. tanya@mkwc.org

Rooted in invasive plants management, the Klamath Alliance for Regional Invasive Species Management (Alliance), has been active since 2006, addressing invasive species concerns that cross political boundaries of Humboldt and Siskiyou Counties, Six Rivers and Klamath National Forests, and the ancestral territories of the Karuk, Yurok and Hoopa Tribes. Partners include the Mid Klamath Watershed Council, Salmon River Restoration Council, Six Rivers National Forest, Klamath National Forest, Karuk Tribe, Yurok Tribe, Hoopa Tribe, Scott River Watershed Council, Quartz Valley Indian Reservation, and the Siskiyou Resource Conservation District. The Klamath region of California warrants its own invasive species management area due to considerations unique to the Klamath Mountains such as remote location, ecological diversity, rugged terrain, tribal sovereignty, and committed community opposition to herbicide use. Momentum has built in the past year around the need to draft a regional strategy for the management of invasive plants. This strategy will specifically address integration of prescribed fire with manual or mechanical invasive plants control. This strategy will strengthen partnerships and cooperative management of invasive plants across political boundaries. Not restricted to weeds management, the Alliance aims to increase public awareness of invasive plants and forest pathogens to the tribal, rural, remote mountain communities in the Klamath region. The Alliance seeks to prevent the introduction/increase of invasive species with public involvement, heightened awareness, and effective management strategies.

Edible Fig Removal from Trabuco and Holy Jim Canyons, Orange County - Cleveland National Forest. Lance Criley, Rangeland Management Specialist, US Forest Service, Cleveland National Forest. lance.criley@usda.gov.

The Cleveland National Forest received funding from California Proposition 84 to test methods for killing edible fig (*Ficus carica*) and managing biomass in Trabuco and Holy Jim Canyons in Orange County, CA. The riparian areas of these canyons are home to a localized, but very severe infestation of Edible fig. This infestation had been expanding rapidly to the point that it made up nearly 25% cover of the riparian area in some stretches and was even replacing stands of *Arundo donax*. Not much literature is published on treatment methods for edible fig. Other efforts in California found success with basal bark applications of triclopyr. However, because we also needed to remove biomass due to fire concerns, we tested cut stump treatments using triclopyr and also imazapyr, and also tried limited areas of foliar glyphosate applications. We also tried different methods of biomass removal (hauling of cut green biomass and chipping). After the first year's treatments, the canyon bottoms were impacted by severe flooding in the winter of 2018/19. This opened up a lot of riparian vegetation and it became clear that edible fig would be able to rapidly expand. Additional funding was secured from the Boeing Corporation through the National Forest Foundation, to expand the work areas to include all of the edible fig infestation. Through these efforts it has become clear that basal bark applications of triclopyr followed by chipping on site of dead biomass is the most effective and efficient treatment combination.

The role of soil bacterial mutualisms in legume invasion in California. Metha Klock[1,2], Kyle E. Harms[2], Peter H. Thrall[3], and Luke G. Barrett[3.] [1]Department of Environmental Studies, San Jose State University, San Jose, CA. [2]Department of Biological Sciences, Louisiana State University, Baton Rouge, LA. [3]CSIRO Agriculture Flagship, Canberra, Australia. metha.klock@sjsu.edu

Mutualistic interactions play an important role in species invasions. In particular, the symbiotic relationship between legumes and nitrogen-fixing soil bacteria (*i.e.*, rhizobia) is influential in invasion success. Legumes, including Australian *Acacias*, have been introduced around the world including in California, with many becoming highly invasive in novel ranges. The specificity with which *Acacia* species form associations with different rhizobial strains may play a role in determining which species are successful invaders. To better understand the mechanisms by which these species establish and

colonize areas abroad, we examined the host-specificity of a suite of *Acacia* species. Highly specific hosts associate with few rhizobial strains, whereas promiscuous hosts associate with a wider range of symbionts. We examined host-specificity/promiscuity of *Acacia* species that vary in invasiveness in California (*i.e.*, invasive, naturalized, and non-invasive species). We compared plant growth, survival, and nodulation response of *Acacia* species when paired individually with live soil inoculants from both their native (Australia) and introduced (California) ranges. We also examined whether there was a difference in soil bacterial community composition associating with acacias in different invasiveness categories. We found that host promiscuity generally did not differ among acacias varying in invasiveness within California. Additionally, rhizobial community richness did not vary among acacias that differ in invasiveness. Our study suggests that acacias introduced to California are all promiscuous hosts, regardless of invasive status and indicates that promiscuous legumes in general should be targeted for eradication in natural areas due to their invasion potential.

Measuring survival of resprouting eucalypts through a planned burn in south-eastern Australia. Isaac Kreger*, University of Melbourne. ikreger@student.unimelb.edu.au

Prescribed burning is used heavily in contemporary land management to meet goals of reducing wildfire hazard. Fire is an ancient force of nature that existed on terrestrial landscapes for millennia. How increased fire frequency will impact plant populations is a major concern for Mediterranean ecosystems that are becoming more flammable due to climate change. Plants persist through reoccurring fire regimes because of specialized traits to enhance resistance and resilience through fire. Resprouting is an example of a fire-related trait that allows plants, like eucalypts to return quickly after a fire from protected buds stored inside protected plant parts. I tested the responses of six resprouting eucalypts in south-eastern Australia before and after a planned burn to understand how different plant attributes and fuel characteristics influence chance of survival. It is potentially problematic to apply fire to plants with similar functional attributes and assume they will have a similar response. This research seeks to inform management as to how different species with similar functional attributes respond to applied fire. Understanding the impacts of prescribed fire as a method for hazard reduction and biodiversity management requires ongoing evaluation of species' responses.

Floodplains restoration post-infestation on the North Fork Salmon River. Deja Malone-Persha, Salmon River Restoration Council. weeds@srrc.org

First observed at Kelly Bar in 1997, spotted knapweed (*Centaurea stoebe, =c. maculosa*) had already quickly spread in a recent flood throughout the riparian zone of the North Fork Salmon River. Treatments on the Class-A species commenced soon thereafter, but not prior to significant deliberation. The community-driven Cooperative Noxious Weeds Program had recently formed in an effort to mitigate the negative consequences of herbicide application. Community members were determined to demonstrate the efficacy of manual treatments and have successfully done so. Within 10 years the program reduced the population at Kelly Bar, the origin site of spotted knapweed in the watershed, over 99%. Since its discovery spotted knapweed has been significantly reduced or eliminated from over 260 sites throughout the watershed through this persistent grassroots effort. Once recognized as the site of the largest infestation of spotted knapweed in California, the Salmon River watershed is also home to world-renowned biodiversity. In 2006 a riparian habitat assessment identified Kelly Bar as a priority reach for in-stream restoration to improve habitat for threatened salmonids. After substantial analysis and planning the Salmon River Restoration Council undertook the implementation of an in-stream habitat restoration project at Kelly Bar. Initial results indicate that actions taken during construction have activated the historic seedbed and effectively mitigated the introduction of additional high-priority noxious weeds. After more than 22 years of consistent manual treatments, some ground disturbance, and active revegetation, the process of restoring habitat at Kelly Bar on the North Fork Salmon River is well underway.

Biocontrol of yellow starthistle: Mass-rearing the newly approved agent, *Ceratapion basicorne*, for release. Ikju Park[1,2], Lincoln Smith[1]. [1]USDA-ARS, Albany, CA. [2]Department of Entomology and Nematology, University of California, Davis, CA. ikju.park@usda.gov

Yellow starthistle (*Centaurea solstitialis*, Asteraceae) is a winter annual forb that has invaded about 17 million acres of rangeland in California. The existing insect biological control agents reduce seed production, but they do not affect plant growth or survival. The rosette weevil, *Ceratapion basicorne*, is a new biological control agent that was permitted in 2019 for release in California. Adults feed on rosette leaves, and larvae damage the upper root. However, the weevil has only one generation per year, which makes it slow to multiply for release. We are developing methods to artificially shorten the diapause (adult dormancy period) to permit rearing multiple generations per year in the laboratory. This involves using artificial environmental conditions for summer aestivation and winter hibernation, and hormones to induce females to lay eggs out of season. Rearing two generations per year would increase the production of adults by about 35 fold. The weevil was first released in Solano county in April 2020.

Assessing chemical management options for the control of stinknet (*Oncosiphon piluliferum)* Clarissa Rodriguez[1*], Travis Bean[1], Christopher J. McDonald[2], Loralee Larios[1]. [1]Botany and Plant Sciences, University of California Riverside. [2]UC Cooperative Extension. Crodr087@ucr.edu

Stinknet (Oncosiphon piluliferum) is an herbaceous annual native to South Africa. Concern for stinknet as an invader continues to grow in Southern California as its distribution is expanding rapidly, creating dense stands and altering plant composition. Land managers are in need of an herbicide strategy that accounts for the mixed results that may arise from differences among sites and years. Here, we initiated field trials aimed at evaluating the efficacy of reducing initial establishment with pre-emergent herbicides applied in the fall vs reducing seed production with post-emergent herbicides applied in the spring. We also evaluated multiple herbicides within a given strategy (post- or pre-emergent), to identify which herbicide is most effective in reducing stinknet cover. To account for potential differences in outcomes due to site and years, we conducted the herbicide trials at three sites within Riverside county: Lake Mathews Preserve, Lake Perris State Recreation Area and Motte Rimrock Reserve, in both 2018 and 2019. We sampled stinknet cover and overall species composition in the spring following herbicide applications. We found that post-emergent plots treated in 2019 reduced stinknet cover less compared to plots treated in 2018, suggesting that annual conditions may be influencing the efficacy of the herbicides. Overall, pre-emergent herbicides were more effective at reducing stinknet compared to post-emergent herbicides ($p<0.0001$), however pre-emergent herbicides also reduced overall vegetation which may promote the establishment of other invasive species. Our talk will identify specific treatments that worked well to control stinknet cover and their associated impacts on plant composition.

Habitat Enhancement through Community Engagement. Tania Romero, Audubon Center at Deb Park, tromero@audubon.org

While habitat enhancement through community engagement can be a challenge, it also a great way to teach the public about the importance of native plants, habitat, sharing land with wildlife, and developing their own environmental stewardship. At the Audubon Center at Debs Park, community engagement is at the forefront of all restoration projects. All restoration projects waiver in size and location all over Los Angeles from the Los Angeles River pocket parks, to Rio de Los Angeles State Park, and Ernest E. Debs Regional Park. Come learn tips, tools, and stories on how to effectively implement small restoration projects with the help of the general community-- from forming partnerships, to volunteer recruitment, to what volunteer days look like. All of our restoration projects are also non-herbicide treated.

Intact stands of stinknet *(Oncosiphon piluliferum),* providing possible refugia post prescribed burn.
Stuart Schwab*, Darrel Jenerette, Loralee Larios. University of California, Riverside. sschw005@ucr.edu

Prescribed burns are a common management technique to reduce litter buildup and seedbanks of annual non-native grasses; however, they may not work as well for non-native forbs such as *Oncosiphon piluliferum*. Invasive forbs have differences in phenology and life form compared to grasses which result in incomplete consumption. These differences in consumption can cause small refugia from which invasive forbs may spread, as they may retain greater amounts of seed, provide a favorable microclimate, and reduce the efficacy of seeding treatments. In the Lake Perris State Recreation Area, a prescribed burn was performed in July of 2019 to control litter buildup and non-native grasses. However, partially burned stands of *Oncosiphon* were left behind after the burn. To examine the effects of these stands, we initiated a field experiment. To examine the effects of *Oncosiphon* seed availability, we paired bare plots in the burn with singed stands, to test effects of litter microclimate we added shelters or removed litter, and we added a native seed mix to determine effects of singed stands on native plant recruitment. Based on our first year, singed stands had an average of 36% more *Oncosiphon* cover. Additionally, singed stands had significantly lower native plant Shannon (H) diversity even with the addition of native seeds ($p=0.0018$). These initial results suggest that prescribed burn practices may not be effective for *Oncosiphon* control, where remaining singed stands may both act as refugia for *Oncosiphon* to spread from within the treatment areas, and reduce the recruitment of native plants.

Poster Abstracts

ACE'ing new statewide maps of invasive plants 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. elizabeth.brusati@wildlife.ca.gov; [2]California Invasive Plant Council (Cal-IPC), Berkeley, CA.

The California Department of Fish and Wildlife (CDFW) and Cal-IPC created two statewide maps of invasive plants for CDFW's Areas of Conservation Emphasis (ACE). ACE analyzes spatial data to summarize biodiversity, significant habitats, habitat connectivity, and climate change resilience. Its maps can be used to provide information used for conservation decisions, ecological research, and land-use planning. The 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 the CalWeedMapper and Calflora databases 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 distribution and inform where more restoration is needed, such as a Habitat Conservation Plan or CDFW's Regional Conservation Investment Strategies.

Arizona joins California in battling stinknet.
Michael Chamberland, Maricopa County Cooperative Extension, University of Arizona.
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Stinknet, also known as globe chamomile (*Oncosiphon piluliferum*), is native to South Africa and was first detected in the United States in Riverside County, California in 1981. It has been recognized as an invasive plant of concern for southern California. Stinknet is a relatively new weed in Arizona that has quickly spread since the first herbarium collection was made in the state in 1997. By 2019 the plant had risen to public attention due to its conspicuous presence around the Phoenix metro area. Stinknet has advanced more rapidly in Arizona's Sonoran Desert than it has in California, prompting its addition to the Arizona State Noxious Weed List in 2020. The life history of stinknet in Arizona has been studied to understand its behavior and impact. Stinknet displays a comparatively slow development to reproductive age, providing opportunity for mechanical control measures on small residential properties. Herbicide trials have identified glyphosate with an adjuvant (methylated seed oil) for chemical control. A challenge remains for battling stinknet in larger infestations that are mixed with native vegetation. Stinknet promotes a cycle of wildfire which is damaging to Sonoran Desert ecology, in addition to creating a fire danger in urban areas.

Preventing invasive plants by creating a weed-free aggregate program. Garrett Dickman[1], Amelia Ryan[2]. [1]Yosemite National Park. [2]Pinnacles National Park. Garrett_dickman@nps.gov, Amelia_Ryan@nps.gov

Weed prevention is a critical component of a comprehensive invasive plant management program. Imported sand and gravel (aggregate) used in road construction is often contaminated with weeds and provides an all-too-common avenue for dispersal and establishment of weeds. Contaminated material can create infestations that stretch for miles. Creating a quarry inspection and certification program to prevent contaminated aggregate prior to purchasing it, is one of the most cost-effective approaches to preventing invasive plant introductions. Sharing botanical skills, mitigation measures, and expertise necessary for effective weed control can help quarry operators create a weed-free product. Successful participation in this program by quarries allows the sale of aggregate to other land managers and provides a marketable certificate that can increase the value of their aggregate. This presentation will highlight how to develop and implement a weed-free aggregate program. We will also discuss mitigation measures when developing a weed-free aggregate program is not feasible. We use the well-established program at Yosemite and the more nascent efforts of Pinnacles National Park as examples.

Who exactly are you? How multiple ploidy levels within the same species can mislead invasion science & management. Jeffrey Firestone
FirestoneBio@gmail.com

Species are usually pictured as either polyploid or diploid, and one species is expected to be relatively similar, related organisms. In practice, some species have one scientific name but contain populations with different ploidy levels. Ploidy affects many important invasion traits, including reproductive mode, habitat preferences and biocontrol susceptibility. Here I show that many common invasive species have different ploidy levels – known as cytotypes – including more than 30% of Cal-IPC's assessed plants rated High. I have identified more than 150 invasive species or species complexes worldwide that have multiple ploidy levels between the native & invasive ranges. Consequences of differing ploidy levels under one species' name include: flawed species risk assessments, potential biocontrol failure but also a chance to improve biocontrol search range, and a challenge for genetic tools. Ploidy variation can cause trait variation, making it desirable for importing horticultural variety, but increasing invasion risk beyond predictions based upon conspecifics. I'll show how to tell if your species is known to have cytotypes, and provide tentative recommendations for when to worry about ploidy variation affecting research, planning and risk assessment. I am also seeking feedback about impacts it could have on different aspects of our invasion work, and what research would be needed to support the IPC communities.

***Iris pseudacorus* germination resilience to high salinity exposure supports risk of invasive spread in tidal wetlands.** Morgane B. Gillard[1], Jesús M. Castillo[2], Mohsen B. 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, 41080, Spain. [3]Department of Plant Sciences, University of California, Davis, CA. morgane.gillard35@gmail.com

Sea-level rise is broadly impacting tidal wetlands, through alteration of salinity and inundation regimes. The potential for invasive glycophytes to colonize tidal wetlands with higher salinity raises concerns about maintenance of native biodiversity and ecosystem services. Improved understanding of recruitment processes is central to invasive plant management to reduce the ecological impacts on threatening native taxa. The wetland glycophyte *Iris pseudacorus* (L.) (yellow flag iris) recently spread from freshwater tidal wetlands in the Sacramento – San Joaquin Delta to sites with higher brackish salinity in San Francisco Estuary. We explored germination responses of seeds from two invasive populations from freshwater and brackish tidal sites in this ecosystem. We tested germination dynamics under salinity levels ranging from freshwater to seawater (0, 12.5, 25, 45 $dS \cdot m^{-1}$) and two hydrological conditions (moist; flooded). Salinity levels >12.5 $dS \cdot m^{-1}$ inhibited germination of seeds from both populations. However, seeds exposed to seawater for 55 days germinated once exposed to freshwater. Germination velocity differed between populations, likely due to thicker seed coats produced in the maternal environment with higher salinity. Our results suggest invasive populations of *I. pseudacorus* can colonize new sites following potentially long-distance dispersal of buoyant seeds with tidal currents. Prolonged exposure to seawater will not impede the germination capacity of their seeds. Our results confirm concerns regarding the ability of *I. pseudacorus* to spread in sensitive coastal wetland habitats, and provide important details to improve risk assessments and management to prevent further spread of *I. pseudacorus* in vulnerable tidal wetlands.

A Review of CalFire's 20 million acre Vegetation Treatment Program and What You Can Do Locally on the Wildland Interface to Reduce Wildfire Risk. Georgia Goldfarb and Sandra Glover, Malibu, CA. georgia.goldfarb@healthequality.net

CalFire's Vegetation Treatment Program (VTP) proposes treatment of 20+ million acres of wildland habitat, at the rate of 250,000 to 500,000 acres per year across the state. The program currently has no assessment of efficacy, cost-effectiveness of measures or prioritization of projects. Justifications of projects often include generic language such as "dead and dying trees", "fuels reduction", "vegetation clearing", "prevent destructive wildfires", often without identification and documentation of specific sites within a treatment area which might benefit. House hardening, habitat restoration and undergrounding utilities are essential elements in wildfire risk reduction. Local home owners along the urban-wildland boundaries can be integrally involved in reducing fire risk in an ecologically sensitive manner. Restoration can involve as little as invasive plant removal early in the spring. Here, we provide a review of the VTP program and a case study for local land owners living on the urban-wildland interface. For many years, our backyard habitat of approximately 12,000 sq ft adjacent to chaparral/coastal sage scrub was cleared by summer weed trimming. In 2019, we cleared the site earlier than previously, in mid-April. In addition to the long-standing sumac and ashy leaf buckwheat present, lupine, morning glory, *Encelia*, deerweed and yucca emerged. In 2020, native cover increased significantly from starting conditions and five additional native plant species were observed. Native plants are now approximately 15% cover. We suggest that continued careful, well-timed clearing of non-native plants will lead long-term to better habitat value, lower site flammability, and restoration of this site back to a native-dominated landscape.

Complexity, constraints and challenges of herbicidal and biological tamarisk treatment in the Mojave River watershed. Ken Lair[3], Chuck Bell[1], Jackie Lindgren[1], Tom Dudley[2]. [1]Mojave Desert Resource Conservation District, Victorville, CA. [2]Marine Science Institute, University of California - Santa Barbara, Santa Barbara, CA. [3]Lair Restoration Consulting, Apple Valley, CA. klair1968@gmail.com

Treatment of tamarisk (*Tamarix* spp.) along the Mojave River is constrained by complex interactions of biotic, abiotic, land ownership, and agency policy variables. In concert with climatic and hydrologic extremes, multiple tamarisk species – *Tamarix ramosissima, T. parviflora,* and *T. chinensis*, with possible hybridization – present challenges to effective treatment because of disparate maturation and seasonal treatment timing. Unique plant morphology – widely spaced, large clonal plants with layered, dense canopies – result in increased time, labor, and materials regardless of treatment method. Fine sandy soils, resulting from flow dynamics and high wind erosion deposition, severely limit water availability for native understory recovery. Effective tamarisk treatment is also affected by effluent discharge and aquifer recharge along the river, and multiple land ownerships that must be coordinated for cross-boundary treatment. This joint effort by the Mojave Desert Resource Conservation District, Mojave Weed Management Area, and the Mojave Water Agency employs sound Integrated Ecosystem Pest Management, applying multiple approaches to achieve best control for invasives like tamarisk. The tamarisk leaf beetle, *Diorhabda carinulata*, was released at multiple sites along the lower Mojave River. Since 2018, the beetle has shown rapid expansion, with uniform plant injury downstream from Helendale, decreasing need for herbicidal treatment. One welcome development is that *D. carinulata*, normally less effective on *Tamarix parviflora*, is apparently producing uniform injury on all three species of *Tamarix*, resulting in greater potential water salvage and native plant community recovery. Impacts of this biocontrol agent and its coordination with past and current herbicidal treatment will be described.

Characteristics of plant communities invaded by *Dittrichia graveolens* (Asteraceae), as it spreads away from roadsides in Santa Clara County. Andrew Lopez*, Miranda K. Melen[1], Nicky Lustenhouwer[1], and Ingrid M. Parker[1]. [1]Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, California. mkmelen@ucsc.edu

Knowing the abiotic conditions and plant communities that are most susceptible to invasion can help direct our time and money more effectively. *Dittrichia graveolens* (stinkwort) is an annual plant in the Asteraceae family native to the Mediterranean Basin. *Dittrichia* is a relatively new invader to California and is found primarily along roadsides and in disturbed soils. Since *Dittrichia's* arrival in California in the mid-1980s, it has spread across the state and is now in about three-quarters of California counties (40+ counties). Recently, the species has been observed spreading away from roadsides into vegetated areas. Which plant communities are vulnerable to *Dittrichia* invasion? Land managers will need to know where to target resources for management and prevention. We surveyed 30 populations of *Dittrichia* in Santa Clara County to assess the vegetation it associates with. We selected samples of off-road sites invaded by *Dittrichia* each paired with the nearest roadside site, the most likely source of *Dittrichia* invasion. Using quadrats, we measured percent cover of *Dittrichia*, other vegetation, and bare ground, and identified species found within the population of *Dittrichia*. I will present information about the structure of plant communities in Santa Clara County where *Dittrichia* invades, providing preliminary insights into the community ecology and species interactions of this invader.

Does drought and non-native competition affect California coastal prairie plants? J. C. Luong*, K. D. Holl, M. E. Loik. University of California, Santa Cruz, CA. jluong4@ucsc.edu

Plant functional traits can provide insight into how species respond to environmental conditions by showing how traits co-vary with survival. Phylogenetics can inform competitive dynamics between species and determine if traits show a phylogenetic signal. We planted 12 native species

under 60% rain-out (drought) shelters in Santa Cruz, CA to see if restoration planting outcomes differed after four years. We annually censused survival and species-specific biometrics, quantified plant community composition and measured the traits of all planted species and the 12 most abundant species (9 invasive, 3 native) in 2018 and 2019. Plant mortality risk and species composition on droughted plots, did not reflect ambient rainfall conditions. We found that there was greater cover of native species and lower invasive species cover in drought treatments. Changes were driven by increases native perennial species and invasive forbs and decreases in invasive annual grasses. Droughted plants had lower leaf C:N, lower total nitrogen, and higher leaf lobedness. Planted species with more resource conservative traits like higher leaf $\delta^{13}C$, leaf lobedness, and lower growth rate, had lower mortality risk. Phylogenetics indicated that seedlings were more likely to survive when more related to their neighbors and that leaf C:N exhibited a phylogenetic signal. In summary, functional leaf traits and phylogenetics can be useful for selecting ideal restoration species in a changing climate. Furthermore, because some predictive traits (leaf C:N) exhibit a phylogenetic signal, it may be able to expand trait-based selection for species with trait data on closely related relatives.

Using careful site selection and plastic tree shelters to improve post-fire ecological restoration of highly invaded California native plant communities. Mark Mazhnyy[1]* and Erin Questad[1]. [1]California State Polytechnic University, Pomona. mvmazhnyy@cpp.edu

Southern California shrubland communities are experiencing increased invasion by non-native grasses due to increasing fire frequency and slow recovery of native shrubs following fire. Recovery tends to be even slower on steep slopes and south-facing aspects due to the aridity of these areas and higher levels of invasion. For these reasons, restoration methods that are rapid, relatively low-cost, and that can improve native plant recruitment are needed to improve restoration outcomes in these communities. Plastic tree shelters, typically used to protect seedlings from herbivory, have been shown to ameliorate physical stresses experienced by seedlings and provide them with a favorable growing microclimate. This study examined how tree shelters affect seedling germination and establishment in a restoration of a highly invaded California native mixed chaparral and coastal sage scrub community in the Copper Fire area of the Angeles National Forest. The study incorporated 30 sites, which were selected to encompass the broadest range of slopes and aspects available in order to test the effectiveness of tree shelters across the various growing conditions exhibited by these landscape features. We hypothesized that sheltered plots would experience higher germination, growth, and survival rates than exposed control plots. We expected the difference in establishment between shelter and exposed plots to be greatest on steep, south-facing slopes because they experience the harshest environmental conditions in the study area. By combining the use of tree shelters for growing perennial shrubs with site selection criteria, we hope to create a cost-effective restoration method for highly invaded burned areas.

A Flora of the Native and Invasive Species of the Chiquito Basin, Santa Ana Mountains, Peninsular Ranges of Southern California. Harrison McGowan*, Dr. Amanda E. Fisher. California State University Long Beach. hmcgowan128@gmail.com

In August 2018, the Holy Fire began in the Trabuco Canyon of the Santa Ana Mountains, resulting in the burning of 23,136 acres. The burned area contained special status taxa listed by the US Forest Service. Though containing several important taxa and facing fire threats, the Santa Ana mountains remain understudied with the last comprehensive flora taking place in 1978. Since 1978, the population of Lake Elsinore has increased from around 5,000 to 69,000. With this increase, the Santa Ana Mountains have seen increased road traffic bring with it increased fire risk and invasive plants. For instance, in the ravines of Hotsprings Canyon and San Juan Creek, Scotch broom (*Cytisus scoparius*) has been collected but only three collections have been made in that area as a part of my Flora. If these invasive species are unknown, fire suppression can spread germinated invasive seeds to areas with special status natives. One way to handle these challenges is to have up-to-date Flora of native and invasive species. My project will provide an updated flora of the Chiquito springs area in the Santa Ana

mountains. After two field seasons, I have documented 96 families and 750 taxa, from 2014 newly collected and historic voucher specimens. I will compare historical and recent herbarium specimens to determine if there have been any local extinctions or new arrivals since the last flora was taken in 1978. This data could be valuable to recovery and restoration efforts in containing invasive species and ensuring the native flora's survival.

Biological control of *Arundo* with the Arundo wasp in the Central Valley. Patrick J. Moran[1], Ellyn L. Bitume[1,2], Dylan Valle Rogers[1,3]. [1]U.S. Department of Agriculture-Agricultural Research Service, Invasive Species and Pollinator Health Research Unit, Albany, CA. [2] U.S. Department of Agriculture-U.S. Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry, Hilo, HI. [3]University of California-Berkeley, Department of Environmental Science, Policy and Management, Berkeley, CA. Patrick.Moran@usda.gov

Arundo or giant reed (*Arundo donax* L.) has invaded over 2,200 acres of riparian habitats in California's Central Valley. *Arundo* consumes water, blocks flood control channels and creates fire hazards. In 2017, USDA-ARS scientists released a proven biological control agent, the shoot tip-galling wasp *Tetramesa romana,* at nine sites. Three plots per site were pre-cut to ground level, 1 m height, or left uncut, and cut plots allowed 1 month to regrow. In 2018, Arundo shoot exit holes, made by wasps emerging from galls, were 25-fold more abundant in ground-cut plots. Surveys in 2019 found exit holes at 56% of 99 survey points at a site on Stony Creek near Orland in the northern Sacramento River watershed, and at 90% of 30 points at a site on Cottonwood Creek near Madera in the southern San Joaquin River watershed. Wasps dispersed 200 m from release plots, and young main shoots were galled, suggestive of emerging wasp impact. Observations in 2020 found wasps at two additional sites in Madera and in the Delta. Moisture was important in wasp establishment. Death of *Arundo* shoots due to seasonal drought hindered establishment, and humidity level in greenhouse cages influenced wasp reproduction. Impact monitoring is ongoing and requires five years. The Arundo wasp can be a key biological control tool in integrated management of *Arundo* in the Central Valley. Its use is best combined with pre-cutting of release plots, and it is most likely to establish populations at sites with year-round water supply.

A Test of the herbicide Weed Slayer for the control of invasive plants. Don Thomas, San Francisco Public Utilities Commission, Division of Natural Resources. dethomas@sfwater.org

Glyphosate is the most widely used herbicide for the control of non-native invasive plants in North America because of the broad spectrum of plants that it controls, its systemic action and its high relative cost effectiveness. Recently, many practitioners have been seeking alternatives because of a number of problems with glyphosate use. These include the growing number of weeds that have developed genetic resistance, the determination by the International Agency on Research on Cancer that glyphosate is a probable carcinogen, and regulatory constraints on its use, such as in red-legged frog habitat. Other synthetic herbicides can be used as substitutes, but these also have some limitations. In addition, many of the synthetic alternatives to glyphosate have also aroused concerns about human health risks, especially in public areas. Therefore, there is growing interest in the use of natural products that are perceived to be much safer and less toxic. However, most of these are "burn-down" agents that kill the foliage but do not translocate to the roots and kill the entire plant. A new formulation of the natural essential oil eugenol combined with proprietary additives, Weed Slayer®, is purported to have systemic activity lacking in other natural herbicides. This study involves a test of Weed Slayer® on a number of invasive plants, and preliminary results indicate that it may have good efficacy in controlling them, possibly comparable to that of glyphosate when applied as a foliar spray. Application of Weed Slayer® as a cut-stump treatment is also being tested.