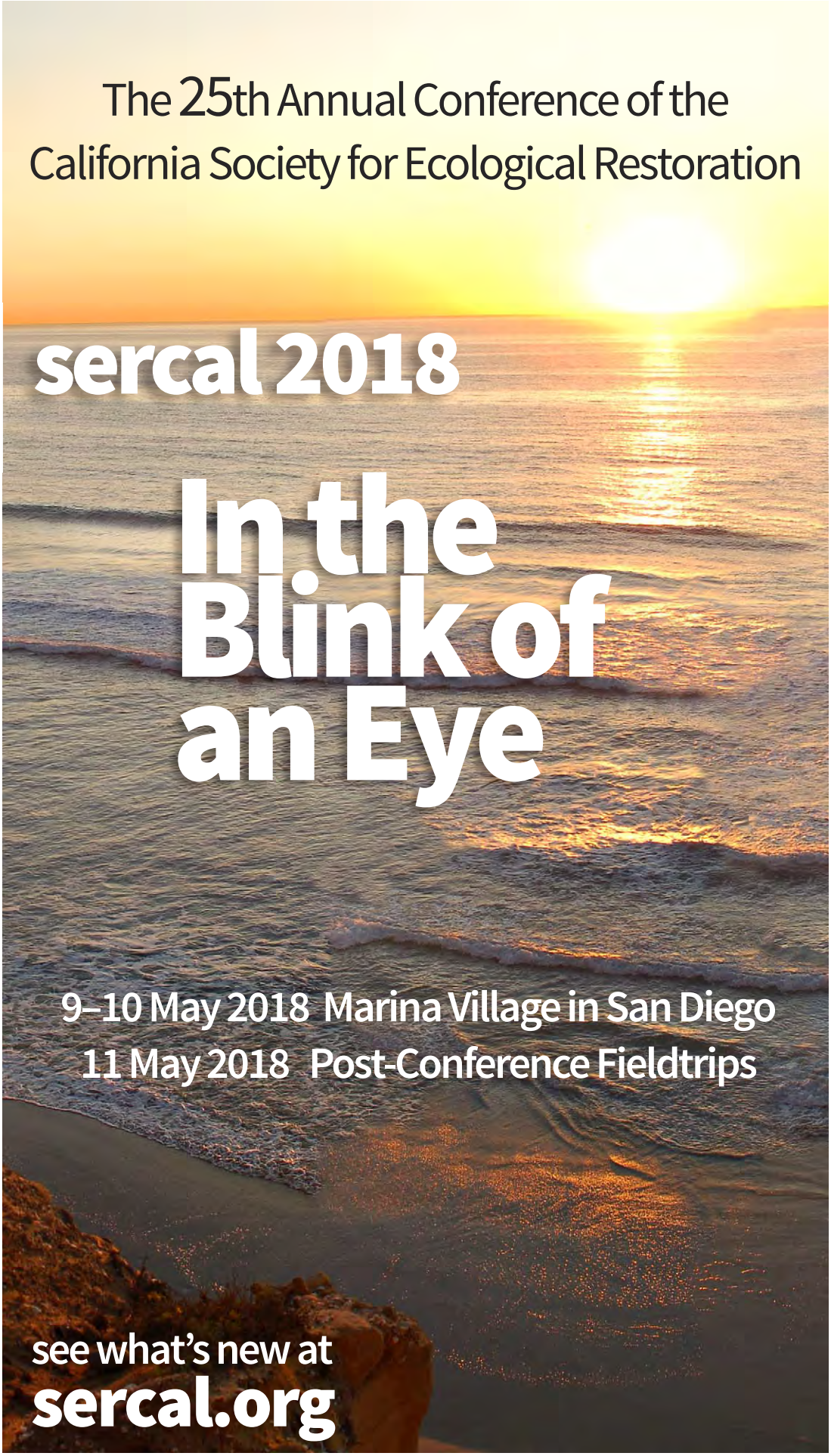

INSIDE

SCHEDULES

ABSTRACTS

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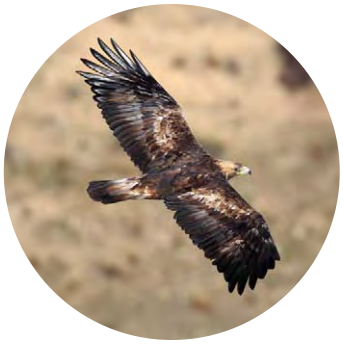

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Wednesday, May 9 Day One: Conference

7:30–9am **Registration Check-in** | **Sponsor & Poster Set-up** | **Hosted Breakfast Buffet**

9–10am **Welcome** SERCAL President & Conference Chair Ralph Vigil, HRS
Plenary Session Conservation and Management for San Diego's Changing Climate

10–10:30am **Hosted Coffee Break**

10:30–Noon **Concurrent Technical Sessions**
Adaptive Management | Native Habitat Design | Grassland Ecosystems

Noon–1:30pm **Hosted Buffet Lunch**

1:30–3pm **Concurrent Technical Sessions**
Adaptive Management | Native Habitat Design | Grassland Ecosystems

3–3:30pm **Hosted Coffee Break**

3:30–5pm **Concurrent Technical Sessions**
Adaptive Management | Native Habitat Design | Grassland Ecosystems

5–7pm **Poster Reception** | **Hosted Appetizers** | **Craft Brews**

Sponsor Booths Open

Posters on Display

Raffle Items on Display
Proceeds benefit Student Scholarship fund.

Thursday, May 10 Day Two: Conference

8–9am **Hosted Breakfast Buffet**

9–10am **Plenary Panel** In the Blink of an Eye: Looking Back and Looking Forward

10–10:30am **Hosted Coffee Break**

10:30–12pm **Concurrent Technical Sessions**
Adaptive Management | Native Habitat Design | Impact of *Phytophthora*

12–1:30pm **Hosted Buffet Lunch** | **SERCAL Member Announcements** | **Raffle Drawing**

1:30–3pm **Concurrent Technical Sessions**
Adaptive Management | Native Habitat Design | Urban Forestry Mgmt | Impact of *Phytophthora*

3–3:30pm **Hosted Coffee Break**

3:30–5pm **Concurrent Technical Sessions**
Storm Water and Erosion Control | Urban Forestry Mgmt | Impact of *Phytophthora*

Raffle Items on Display
Drawing at Lunch

Sponsor Booths Open

Posters on Display

Friday, May 11 Day Three: Post-Conference Fieldtrips

Attendance is limited; pre-registration by May 10 required. See registration table for more information.

Wednesday, May 9 Day One: Conference

9-10 **Welcome, Announcements, and Plenary Presentation**

Conservation and Management for San Diego's Changing Climate

Megan Jennings, Ph.D.

Co-Director, Institute for Ecological Monitoring and Management, San Diego State University

Science Program Manager, Climate Science Alliance-South Coast

Amber Pairis, Ph.D.

Director, Climate Science Alliance-South Coast

California Department of Fish and Wildlife & Center for Climate Change Impacts and Adaptation at Scripps Institution of Oceanography

San Diego County is a particularly unique part of Southern California, considering the region's complex topography, highly variable precipitation, and other climatic factors, which play important roles in determining the resident biological palette in this biodiversity hotspot. Although home to a major metropolitan area, San Diego County still hosts expanses of native and preserved habitats where management and conservation action could be greatly enhanced through science-based assessments and planning for climate change and increased climate variability. Some of this work is already underway, but a recent assessment of the impacts of climate change on San Diego's ecosystems, led by a unique collaboration of local ecologists and climatologists, can further guide action in the region. This assessment presents the state of the science on the projected climatic changes in temperature, precipitation regime, fire weather, and coastal low clouds and fog and the likely effects of these climatic shifts on the region's diverse ecosystems, habitats, plants, and animals. This effort is a model of how science-based assessments can serve as a baseline for guiding future research, management, and planning efforts, highlighting knowledge gaps to be filled and providing opportunities for supporting resilience through adaptation.

10:30–Noon **Concurrent Technical Sessions**

Starboard

Adaptive Management: Building Resiliency in a Changing Environment Cecilia Meyer Lovell, AECOM *Chair*

10:30 J KALANSKY | Precipitation and Drought Impacts on Ecosystems in San Diego County

11:00 C HOLLAND | Challenges Meeting Habitat Restoration Performance Objectives in a Changing Environment

11:30 J GROEBNER | A Study of Long-term Restoration Success in Southern California

Terrace

Native Habitat Design and Restoration in a Rapidly Changing Environment Jeannine Ross, RECON Environmental *Chair*

10:30 S FREED | Evaluating Wetland Restoration Projects using the California Rapid Assessment Method

11:00 S ADLEBERG | Stadium Wetland Mitigation Project: Urban stream restoration

11:30 S INNECKEN | North San Diego County Multi-Watershed Enhancement & Restoration for Resiliency

Dockside

Restoration of Native Grassland Ecosystems JP Marié, California Native Grasslands Association *Chair*

10:30 JP MARIÉ | Establishing Functional California Native Grasslands

11:00 P REYNOLDS | Production of Native Local Ecotype Seed for Grassland Restoration Projects

11:30 R FREESE | Management Challenges in Restoring Native Grassland Habitats in Southern California

Wednesday, May 9 Day One: Conference

1:30–3pm **Concurrent Technical Sessions**

Starboard

Adaptive Management *continued*

1:30 M MAGGIO | Habitat Restoration Within an Urban Water Quality Improvement Project: Competing project goals and challenges of the Machado Lake Project

2:00 J PRINE | Resilient Design Considerations and Post-Installation Adaptive Management Actions for Riverine Restoration

2:30 M TYNER-VALENCOURT | Restoring Together: Strategic alignment for successful restoration planning and permitting

Terrace

Native Habitat Design *continued*

1:30 G SMICK | Restoration of Disturbed Habitats: Technical design approach and field test results

2:00 H CLAYTON | 100 Acres of Coastal Habitat Restoration in San Clemente, California

2:30 R ATIK | Maritime Succulent Scrub Restoration, Otay Ranch University Villages Project

Dockside

Native Grassland Ecosystems *continued*

1:30 M LULOW | Variation in Soil Properties Related to Moisture Availability Across and Within Sites Characterized by Grassland and Coastal Sage Scrub

2:00 J ROSENCRANZ | Best Practices for Restoring Purple Needlegrass (*Stipa pulchra*)

2:30 E GEVIRTZ | Native Grassland Restoration Using Sheep for the Sake of Breeding Birds

3:30–5pm **Concurrent Technical Sessions**

Adaptive Management *continued*

3:30 G PLATENKAMP | Resilient Designs for Tidal Marsh Restoration

4:00 T ANDERSON | Still Alive at Year Five: Utilizing monitoring to guide corrective measures at Fort Ord

4:30 C LIEBERMAN | Controlling the Nonnative Algerian Sea Lavender (*Limonium ramosissimum*) in Coastal Salt Marshes

Native Habitat Design *continued*

3:30 J BAIR | Developing a Quantitative Basis for Concept Level Revegetation Designs

4:00 J BACCEI | Un-Pave Paradise, Take out a Parking Lot: Adaptive wetland restoration & mitigation monitoring

4:30 M MAJOR | Restoration Design and Implementation in a Dynamic Alluvial Riparian System in Southern California.

Native Grassland Ecosystems *continued*

3:30 B HANSON | Habitat Restoration and Recovery of the Endangered San Diego Thornmint

4:00 B PALMER | Response of Biological Soil Crusts to Prescribed Burns on San Clemente Island

4:30 R OLLIFF-YANG | Mismatch Managed? Strategies for buffering the impacts of phenology shifts

Our gratitude to Balance Hydrologics, Ecological Concerns, ESA, and Habitat West for providing full scholarships to student presenters. In addition, our raffle proceeds from 2017 — a combination of 1) gifted items from sponsors and the SERCAL Board, and 2) your purchase of raffle tickets —provided full scholarships to 10 students! Thank you, everyone!

9-10 **Announcements and Plenary Panel**

In the Blink of an Eye: Looking Back and Looking Forward

Moderated by **Harry Oakes**, Restoration Ecologist at ICF, and Past President, Conference Chair, and Regional Board Representative of the California Society for Ecological Restoration. Panelists will begin by looking at advancing the field of Ecological Restoration, SERCAL's role in moving the field forward, bringing diversity to and promoting the profession, and our role in "looking back" —monitoring, analysis, and success criteria changes. An open mike Q&A will follow.

Gigi Hurst is a project manager and habitat specialist, is President and CEO of Habitat West, Inc. Ms. Hurst established Habitat West in 1993 with the exclusive agenda of providing the highest quality native habitat restoration and management services. She has 32 years' experience in the habitat restoration, horticultural, and irrigation fields. She has focused the last 28 years on implementing and maintaining the numerous long-term native habitat contracts for most types of Southern California mitigation sites. Ms. Hurst has overseen the installation and maintenance of over 8500 acres of Southern California Native Habitats. Gigi is a hands-on manager and participates directly in the coordination of the staff with all projects. When not working, she can be found riding horses and arraigning flowers at her ranch.

Kevin MacKay is a senior restoration ecologist at ICF with more than 20 years of experience conducting site assessments, developing mitigation strategies, and preparing conceptual and detailed designs, construction documents, and monitoring plans for wetland, riparian, and upland restoration/mitigation projects throughout the western United States. Kevin has taught courses on habitat restoration planning and design through the University of California, Davis and San Jose State University, and has presented papers and moderated technical sessions at conferences of SERCAL, the Society for Ecological Restoration, the National Conference for Ecosystem Restoration, and the Floodplain Management Association. He is a Regional Director and Past-President of the California Society for Ecological Restoration. Kevin lives in San Jose with his wife and daughter, and enjoys fly fishing, hiking, and backpacking in his spare time.

Dr. Ted St. John is a plant ecologist who studied the biological components of ecosystem function. After years of funded research on mycorrhizal fungi and plant-soil interactions, he developed restoration methodology that leads to ecosystem function rather than maintained gardens. The ecosystem approach has successfully produced mycorrhizal networks, plant diversity, and natural resistance to weeds. Dr. St. John is largely responsible for introducing mycorrhizal inoculation and land imprinting into common restoration practice in southern California.

Christina Schaefer has been active in SERCAL almost since the beginning, with a brief hiatus while she raised her two sons. She received a Master degree in Landscape Stewardship from the University of Munich, Germany, and a Master degree in Landscape Ecology from the University of Arizona, Tucson. After conducting habitat restoration research in Europe, Mexico, and the Middle East, she arrived in San Diego in 1992 to work on her first vernal pool restoration project with Dr. Ellen Bauder; since then, vernal pool restoration has become her specialty. However, Christina has planned and implemented restoration projects in many other habitat types, including shrublands, grasslands, riparian and freshwater wetlands, creeks, and salt marshes.

Peter Tomsovic, a restoration ecologist by trade, is currently serving as the Chief Operating Officer of RECON Environmental, Inc. a consulting firm headquartered in San Diego. Mr. Tomsovic's responsibilities include working with Team Leaders, and managing RECON Environmental's San Diego office for financial performance, strategic planning, and day-to-day operations. Prior to COO, Mr. Tomsovic served as the Team Leader for RECON's Habitat Restoration Team, where he planned and implemented large-scale habitat restoration projects within a variety of native habitats throughout the Southwest. SERCAL was fortunate to have Pete serve as both President (2014–2015) and Conference Chair of SERCAL 2015.

Thursday, May 10 Day Two: Conference

10:30–Noon **Concurrent Technical Sessions**

Starboard

Adaptive Management *continued*

10:30 A GERSHUNOV | Wildfire in a Warming Southern California: Climatic drivers of change

11:00 J MCGEE | A Case Study: Applied adaptive management following significant wildfire events

11:30 E GEVIRTZ | Tamarisk Eradication: 40 miles in the wilderness

Terrace

Native Habitat Design *continued*

10:30 J SHERMAN | Role of Drones in Lagoon Restoration: A case study

11:00 J ROSENCRANZ | A Conceptual Model of Pacific Cordgrass (*Spartina foliosa)* Restoration in California with Thin-layer Sediment Augmentation (TLSA)

11:30 E SMITH | Whole-Landscape Restoration of a Leveled California Vernal Pool Terrain

Dockside

The Impact of *Phytophthora* on Restoring Native Habitats Kevin MacKay, ICF *Chair*

10:30 T SWIECKI | Invasion of Northern California Native Plant Communities by Soil-borne *Phytophthora*: Pathways and risk factors

11:00 L SIMS | *Phytophthora* Isolated from Restorations in Marin, San Francisco, and San Mateo Counties

11:30 S FRANKEL | Are *Phytophthoras* a Threat to Arid Southern California Restoration Sites?

1:30–3pm **Concurrent Technical Sessions**

Adaptive Management *continued*

1:30 L MORETON | Smooth Tarplant is not Smooth, but Translocating it can be

2:00 C SCHEIDLINGER | Habitat-based Adaptive Management Approach for CWC §1211 Recycled Water Petitions

2:30 A JACKSON | Resilient Reefs: A solution to re-purpose California's offshore oil platforms

Native Habitat Design *continued*

1:30 M OLSON | Establishing Vernal Pool Vegetation in a Rainfall-dependent Community

SESSION TRANSITION:

Urban Forestry Management in a Changing Environment Christopher Kallstrand, DUDEK *Chair*

2:30 D LEE | New Guidelines Benefit Urban Wildlife and Habitat Projects

Impact of *Phytophthora* *continued*

1:30 A SHOR | Full Steam Ahead: Managing *Phytophthoras* in nursery operations and fieldwork

2:00 C MCCLAIN | Minimizing Threats Posed by Exotic *Phytophthora* Species to Natural Communities

2:30 J GARREN | How to Reduce the Risk of *Phytophthora* Introductions and *Phytophthora*-induced Mitigation Failure in Restoration Projects

3:30–5pm **Concurrent Technical Sessions**

Storm Water and Erosion Control Allegra Bukojemsky, ICF, and Aaron Andrews, AECOM *Chairs*

3:30 G ANDREW | Treatments and Conflicts of Stream Habitat Enhancement and SWPPP Compliance

4:00 M KEDZIORA | Unique Restoration Methods and Resource Use to Pursue Interdisciplinary Project Goals: A case for cactus

4:30 A ANDREWS & S HOWARD | Agua Hedionda Creek Stream Bank Stabilization

Urban Forestry Management *continued*

3:30 J DEWOLF | Urban Forests: From Eucalyptus to riparian woodland in a highly urbanized ecological reserve

4:00 D ABEYTA | Urban Forest Program Continuum for Sustainable Growth

4:30 J MORGAN | Changing the Rules: Expanding and reimagining urban restoration

Impact of *Phytophthora* *continued*

3:30 L FEELY | Life after *Phytophthora*: An approach to restoration via direct seeding at Sheep Camp Creek, Sunol CA

4:00 K MACKAY | Dealing with *Phytophthora*: Approaches for restoring habitat without container plants

4:30 Panel Discussion

Adaptive Management: Building Resiliency in a Changing Environment

Chair: Cecilia Meyer Lovell, AECOM

Wednesday 9 May, 10:30am–5pm and Thursday 10 May, 10:30am–3pm — *Starboard*

Abstracts listed alphabetically by presenter (*)

Still Alive at Year Five: Utilizing Monitoring to Guide Corrective Measures at Fort Ord

Thor Anderson, M.S.*[1], and Julia Fields, M.S.[2]

Burleson Consulting, Inc.
[1]**ta@burlesonconsulting.com**
[2]**jf@burlesonconsulting.com**

The restoration of 62 acres of rare central coast maritime chaparral habitat began in 2010 at Fort Ord National Monument. Year 5 data was collected in 2017 as part of a 13-year monitoring program. We will discuss five years of monitoring, compare monitoring results to the success criteria, and share corrective measure strategies we plan to implement. The following corrective measures are under consideration to move Fort Ord restoration towards success: Additional planting, additional seeding, irrigation, application of native vegetative mulch, application of slow release fertilizer and mycorrhizae, and re-evaluation of success criteria.

Wildfire in a warming Southern California: Climatic drivers of change

Alexandra D. Syphard[1], Alexander Gershunov*[2], Dawn M. Lawson[3], Hiram Rivera-Huerta[4], Janin Guzman-Morales[5], and Megan K. Jennings[6]

[1]Conservation Biology Institute, **asyphard@yahoo.com** [2]Scripps Institution of Oceanography, UC San Diego, **sasha@ucsd.edu** [3]Navy and Marine Corps in Southern California **weedprincess@gmail.com** [4]Universidad Autonoma de Baja California, Mexico **hiram@uabc.edu.mx** [5]Scripps Institution of Oceanography [6]San Diego State University, **mjennings@mail.sdsu.edu**

Climate research highlights less frequent but more intense precipitation in Southern California's warmer future. Anomalous recent warmth spanning years of historic drought (2012-2016), followed by a record wet winter in 2016-2017 and a bone-dry fall/early winter (2017-2018) created conditions that contributed to the recent large fires in December 2017 and exemplify potential vulnerabilities to heightened climate volatility. Southern California's characteristic Mediterranean summer drought creates low fuel moisture and extreme fire conditions in autumn when the Santa Ana wind season starts before the first significant rains of the cool/wet season. The changing precipitation regime, however, suggests that vegetation may more often remain dry well into the traditional wet season (i.e. into December and January) coinciding with the peak of the Santa Ana wind season. The changing precipitation regime, therefore, will potentially lengthen Southern California's fire season. The actual occurrence of a large wildfire depends upon synchronous timing and location of an ignition during severe fire weather. Continued urban development, bringing more potential ignition sources into wildland vegetation, is therefore a major concern with regards to wildfire and a lengthening fire season. In addition, long-term drought can contribute to substantial dieback and mortality of native shrublands, which could facilitate the propagation of large wildfires under severe wind conditions. Moreover, when extreme precipitation falls on a burned-out landscape, runoff (besides being more often associated with mudslides) can inject exceptionally dangerous toxicants, e.g. mercury, into the environment.

Tamarisk Eradication: 40 miles in the wilderness

Elihu Gevirtz

Channel Islands Restoration, 928 Carpinteria Street, Suite 3, Santa Barbara, 93103, 805.448.4175, **elihu@cirweb.org**

We surveyed for Tamarisk in and along 40 miles of the Sisquoc River and tributaries in the wilderness of the Los Padres National Forest in Santa Barbara County. Working in the Wilderness presents a multitude of logistical challenges such as no motorized vehicles are allowed to transport herbicide, and no motorized equipment such as chain saws are allowed. In addition, working in a federally-protected area means we are not allowed to work during the nesting season which is when the trees are most evident and when the weather is most cooperative. We faced washed-out roads and trails, flooded streams, dry streams, heat, cold, no water, too much water, and trees with no leaves. Nevertheless, so far, we've treated nearly 500 adults with herbicide using a basal bark method and we've pulled out by hand more than 50,000 seedlings.

A Study of Long-term Restoration Success in Southern California

Julia Groebner

Restoration Ecologist, AECOM, **julia.groebner@aecom.com**, 619.610.7590

Despite many advances in the field of restoration ecology, little is known about the long-term effectiveness of restoration efforts. It is often assumed that restored habitats follow a reliable trajectory towards the desired ecological state, but very few studies have addressed this topic. This study examines the long-term effectiveness of upland and wetland habitat restoration efforts in San Diego County, California, by comparing the current ecological conditions (vegetation community composition, diversity, structure, and quality of surrounding habitat) of 25 restoration sites that had not been actively managed for at least 5 years to each sites' conditions at the conclusion of active

restoration. I analyzed whether current site conditions are related to historic site conditions or surrounding habitat quality and examined the factors that may contribute to restoration site resiliency. I found significant differences between upland and wetland restoration sites. Upland restoration sites were more variable in condition and less resilient to surrounding disturbances, particularly if they were of lower habitat quality at the end of active restoration. Wetland restoration sites were less variable in condition and more successful long-term, as long as the proper wetland hydrology was established. However, both upland and wetland restoration sites may be declining in habitat quality with time elapsed since the end of active restoration. The study provides several suggestions for promoting long-term restoration sustainability and resiliency. It also serves as a valuable baseline for future studies of restoration success in San Diego County.

Challenges Meeting Habitat Restoration Performance Objectives in a Changing Environment

Chris Holland

Restoration Designer, Westervelt Ecological Services, 600 North Market Blvd., Suite 3, Sacramento 95834, 916.646.3644, **cholland@westervelt.com**

It is said that beauty or art is in the eye of the beholder. In the field of habitat restoration a site may be beautiful and possess high ecological value, but may not function correctly in terms of performance criteria. For many projects, especially in the arena of mitigation banking, not hitting the benchmark on predetermined performance goals can lead to failed restoration. It is the role of the designer and land stewardship team to understand a site's vulnerabilities, to produce realistic goals when establishing a site, and having plans in place on how to accommodate for the unknown. As our climate continues to disrupt understood natural rhythms, it has become increasingly challenging to design and implement a site plan, and manage it to meet habitat goals. With forecast sea level rise, irregular flood events becoming more frequent, and prolonged droughts, it has stretched the status quo on the traditional approach of how a site is developed. This presentation will provide case studies on the design, outcome, and adaptive management steps implemented on a number of Westervelt projects that have been resilient in the face of our changing climate.

Resilient Reefs: A solution to re-purpose California's offshore oil platforms

Amber Jackson, MAS[1]*, and Emily Callahan, MAS[2]

Ecologists, Great Ecology.
[1]**ajackson@greatecology.com**
[2]**ecallahan@greatecology.com**

California's oil and gas industries have entered a new era of outer continental shelf activity. According to the United States Department of the Interior, 23 of the 27 drilling platforms in waters off the California coast are expected to reach the end of their useful production lifetimes and be decommissioned between 2017 and 2030. The traditional decommissioning process entails sealing the well, removing the drilling rig and associated infrastructure, and restoring the seabed to its original condition. However, California's complex platforms offer an artificial rocky substrate for a variety of economically and ecologically valuable fishes, including several threatened species. While nearshore habitats are degraded by anthropogenic run-off, pollution, and overfishing, offshore platforms may provide a refuge for vulnerable marine species. Decommissioning of California's offshore facilities into artificial reefs is becoming a priority issue of public concern, scientific study, and policy debate. As offshore oil wells approach the end of their production lifecycles, California policy-makers must decide whether rig conversion serves ecological and economic goals better than the status quo of complete rig removal. This presentation evaluates the economic and ecological efficiency of a Rigs-to-Reefs program in California. Our principal findings are that a well-designed and implemented program would result in three major benefits: sustained fisheries, by preserving a network of offshore compensatory habitats for nearshore degraded systems; mitigated environmental impacts, through the repurposing of existing materials; and a permanent source of funding for projects and programs that will safeguard California's open coastal and marine resources, established through the creation of the California Endowment for Marine Preservation.

Precipitation and Drought Impacts on Ecosystems in San Diego County

Julie Kalansky*[1], Dan Cayan[1], Dawn M. Lawson[2], Eric D. Stein[3], and David W. Pierce[1]

[1]Scripps Institution of Oceanography, UC San Diego, **jkalansky@ucsd.edu** [2]Space and Naval Warfare Systems Center Pacific (SSCPAC) [3]Southern California Coastal Water Research Project

San Diego region's Mediterranean climate features cool wet winters and warm dry summers, as well as high spatial variability in large part due to the large topographic gradients in the region. Year-to-year variability is very high, greater than almost any other U.S. region, and the variability is dependent on the absence or occurrence of a few large events. Future projections indicate that the precipitation regime will become more variable with more dry years punctuated by a few extreme precipitation events. Drought problems could worsen. Drought may occur more frequently due to increased occurrence of dry days and drought could intensify because of warmer temperatures. Because drought targets some species more than others, these projected changes may cause structural changes to ecosystems. Projected drying of spring and fall will lengthen and intensify the summer drought with possible impacts to riparian systems and plant biomass. More analysis of available data and new monitoring may be necessary to better understand these impacts. The most extreme events are projected to produce more precipitation than historical extreme events, having the largest impacts on riparian ecosystems. Monitoring gaps

include soil moisture monitoring at various levels and cohesive stream monitoring, including upland habitat important for species.

Controlling the Nonnative Algerian Sea Lavender (*Limonium ramosissimum*) in Coastal Salt Marshes

Carolyn Lieberman*[1], Stephen Schroeter, PhD[2], Mark Page, PhD[3], Kyle Lunneberg[4], and Paul Hormick[5]

[1]U.S. Fish and Wildlife Service, **Carolyn_Lieberman@fws.gov**, 760.431.9440 ext 240, 2177 Salk Avenue, Suite 250, Carlsbad 92008 [2]University of California Santa Barbara, Marine Science Institute, **schroete@gmail.com**, 760.438.5953 [3]University of California Santa Barbara, Marine Science Institute, **mark.page@lifesci.ucsb.edu**, 805.893.7568 [4]Agua Hedionda Lagoon Foundation, **kyle@aguahedionda.org**, 760.804.1969 [5]Living Coast Discovery Center, **phbb@pacbell.net**

Algerian Sea Lavender, *Limonium ramosissimum*, is a non-native plant capable of invading coastal salt marshes. If left unchecked, it creates dense mats that displace native vegetation. We conducted several experiments comparing the efficacy of different methodologies to control *L. ramosissimum*. First, we compared hand removal to tarping with black plastic (solarization) at the Agua Hedionda Lagoon Ecological Reserve and Carpinteria Salt Marsh Reserve in 2014–2015. At both locations, solarization and selective hand removal significantly reduced percent cover of *L. ramosissimum*. We then compared solarization to applications of herbicide, specifically chlorsulfuron benzenesulfonamide (TELAR®), at the Agua Hedionda Lagoon Ecological Reserve in 2016–2017. Solarization reduced the percent cover of *L. ramosissimum* to near zero and was significantly lower compared to herbicide and control treatments. While solarization negatively affected native species, percent cover of native species recovered within one month and was ultimately greater than in control or herbicide plots. We observed that *L. ramosissimum* in the herbicide plots and at the outside edge of solarization plots flowered while no flowering was observed in control plots. Based on this study, we recommend the use of solarization to control large, dense stands of *L. ramosissimum* with additional hand removal of flowering *L. ramosissimum* at the plot's edge to avoid production of seeds. This study highlights the effectiveness of solarization to control infestations of *L. ramosissimum* in southern Californian coastal salt marshes and suggests it may be more effective than control by herbicide, while avoiding potential pitfalls of introducing herbicides into the environment.

Habitat Restoration within an Urban Water Quality Improvement Project: Competing project goals and challenges of the Machado Lake Project

Marissa Maggio*[1] and Kristen Klinefelter[2]

Wildlife Biologists, ICF, 1 Ada, Irvine, 92618. [1]**Marissa.Maggio@icf.com**, 714.421.1943 [2]**Kristen.Klinefelter@icf.com**

The Machado Lake Ecosystem Rehabilitation Project was implemented by the City of Los Angeles to improve water quality, enhance habitat, and promote recreation within Ken Malloy Harbor Regional Park in Los Angeles, California. The Machado Lake Project site is covers 45 acres with the lake itself holding more than 70 million gallons of water. The overall goals of the project were to reduce trash and improve water quality in Machado Lake in an effort to meet the total maximum daily load (TMDL) requirements for multiple receiving waterbodies in the Dominguez Watershed. Over 20-square miles of heavily developed land drains directly into Machado Lake, where pollutant and trash-filled water would then sit semi-stagnant as a result of no direct and efficient flow path to the harbor and heavy sedimentation. Hydrology improvements focused on dredging of the lake, removal of riparian vegetation in channels, and re-contouring to create flow paths. Additional project goals included enhancement of public recreation as well as native habitat restoration with a focus on riparian habitat, rare plants, and sensitive wildlife species. Project goals often resulted in conflicts that were further exacerbated by limited funding, time constraints, complex contractor relationships, and homeless encampments. All of these variables effected the projects ability to comply with permit conditions while meeting the different mitigation requirements. These challenges and competing objectives forced the restoration team to adjust their philosophical understanding of "restoration" for this project. It also required the team to evaluate each situation against competing priorities and implement adaptive management decisions in an effort to provide management recommendations and allocate efforts to maximize ecological outcomes.

A Case Study: Applied adaptive management following significant wildfire events

Jenny McGee*[1] and Kevin MacKay[2]

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Adaptive management is a fundamental tool for the dynamic science of habitat restoration. As demonstrated in 2017, the extent, frequency and intensity of wildfires is an increasing threat to recovering habitats throughout California. Wildfires change environmental conditions that drive a need for multiple adaptive management responses. Implementation of habitat restoration on Southern California Edison's Tehachapi Renewable Transmission Project (TRTP) overlapped with two significant wildfire events since its beginning in 2009. This presentation will look at these two separate wildfire events, and the resulting adaptive management strategies to address the changed environmental conditions. We explore how these wildfire events affected restoration through limiting sources of local seed/plant materials, requiring protection of sites surrounded by unstable soils, creating

disturbance from fire control practices, and stimulating conditions for invasive species. We discuss adaptive management strategies such as seed bulking, harvesting wild plants before construction, employing unique site stabilization materials, and aggressive weed control techniques. We conclude with the results of each adaptive management strategy and how they collectively worked to respond to challenges from these wildfire events.

Smooth Tarplant is not Smooth, but Translocating it can be

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In urban southern California, conservation of rare plant populations often conflict with development. When those conflicts are unavoidable, lead agencies may require relocating the plant populations. Smooth tarplant (*Centromadia pungens* ssp. *laevis* [Asteraceae]) is an annual herb that is considered rare, threatened, or endangered in California and elsewhere (CNPS List 1B.1). This species' range extends south to Santee, in San Diego County. It is in Santee's town center that the last remnant of smooth tarplant's southernmost population was to be impacted by development. The translocation of this population was done with seed collection and soil salvage. Associated species were also installed in the restoration area. After four years, the translocation effort appears successful. Weeding was performed for the first three years of the five-year monitoring period. Annual monitoring includes examining seed viability, soil pH, plant height, and population size. The population size criteria varies based on annual rainfall; population success criteria were determined during monitoring of the source population for three years prior to project implementation. The restored tarplant population has surpassed the success criteria for population size in all years since being translocated. Challenges — including weed cover and human intrusion from cyclists and transients — have not prevented the project from meeting the population size criteria. Rare plant mitigation at this location is regarded as provisionally successful. This success is from thorough planning, including soil requirements, hydrology, and researching successful and unsuccessful translocation attempts of this species.

Resilient Designs for Tidal Marsh Restoration

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Climate change poses a number of challenges for tidal marsh restoration including sea level rise, salinity changes, variable sediment inputs, species distribution shifts, invasive species colonization, and possibly others. Resilient designs, backed up by adaptive management where needed, may be used to address these challenges. Resilient designs anticipate environmental change and allow for nature to take its course. A resilient design can reduce the need for adaptive management actions with associated cost savings. When climate change consequences are relatively predictable, as with sea level rise, resilient designs will be most effective. We provide examples of resilient designs that accommodate sea level rise from several tidal marsh restoration projects in the San Francisco Estuary. Designs developed for the Lower Walnut Creek Restoration Project are consistent with the Baylands Ecosystem Habitat Goals Project (2016), and establish hydrologic connections between the estuary and upland areas by removing or relocating approximately two miles of dikes and levees. By preserving existing lowland and upland terrestrial habitats in areas adjacent to existing or restored tidal marsh, and grading gently sloping transition zones, the project anticipates the gradual succession of these terrestrial habitats to tidal marsh habitats overtime as sea levels rise. A similar approach is taken for the design of the Bay Point Restoration Project, which also includes elevational gradients for upslope tidal marsh expansion. Although some adaptive management may be required, for more predictable aspects of climate change, such as sea level rise, resilient designs may reduce the need for future site modifications.

Resilient Design Considerations and Post-Installation Adaptive Management Actions for Riverine Restoration

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Hydromodification on-site and upstream, and climate change pose a number of challenges for riverine habitat restoration. A design that addresses these challenges in conjunction with post-implementation adaptive management measures can support a resilient and successful restoration project. A resilient design coupled with an adaptive management plan anticipate environmental change — so that field modifications can be implemented to support establishment of habitat compositions ecologically suited for existing and future site conditions. We present here design and site management actions for the California Department of Water Resources Perris Dam Remediation Project Oak Valley Mitigation Site in Riverside County, California, which includes 20.0 acres of wetland habitat and cismontane alkali meadow, and 16.0 acres of upland habitats. The site within the Santa Ana River watershed was formerly a commercial nursery that had been graded to contain the channel with earthen berms which prohibited flows from accessing the floodplain. We used groundwater data, regional regression equations for channel geometry, and a HEC-RAS hydraulic analysis to determine appropriate grade modifications and design of a meandering channel system. Since installation in January 2016, the site has experienced large storm events and drought conditions during the establishment period of the

mitigation habitats. A number of adaptive management actions have been implemented over the last two years including measures to stabilize channel segments in response to large storm events, amendments to reduce soil salinity, and adjustments in species selection as part of supplemental seeding and planting. The project is meeting success standards and intends to phase out temporary irrigation use in 2018 (Year 3 of the program) and is tracking weather, groundwater data, soil moisture, and plant health to determine appropriate monthly irrigation schedules. We conclude with 'lessons learned' and recommendations for other restoration programs.

Habitat-Based Adaptive Management Approach for CWC §1211 Recycled Water Petitions

Carla Scheidlinger

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Amec Foster Wheeler is involved with a wastewater change petition with the State Water Resources Control Board pursuant to Water Code Section 1211. The petition seeks authorization to reduce treated wastewater discharged in a river that would be occasioned by the diversion from its current discharge in the river in favor of water reuse by the local communities. Such actions throughout California assist in reducing the reliance of urban areas on imported water. The proposed project area potentially affected by the change in point of discharge includes habitat for Least Bell's vireo (LBV) where nesting pairs have been historically present. Our challenge is to develop an Adaptive Management Plan (AMP) that would allow for the detection of any impacts to the habitat used by LBV in such a way as to implement adaptive management strategies before any changes to habitat become irreversible. The proposed AMP includes monitoring of stem water potential (SWP), soil moisture, canopy condition, and various metrics that indicate habitat sustainability such as recruitment into the populations of species required by the LBV and species richness in the monitored areas. Importantly, the AMP presumes close and ongoing interaction with resource agencies to determine actions that may be triggered by the monitoring results. This is a quantitative approach to adaptive management that could be important in the ongoing discussions about the use of recycled water in California.

Restoring Together: Strategic alignment for successful restoration planning and permitting

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Wetland restoration in southern California exists at the intersection of science and design, land use policy, and economic development. This is especially nuanced in floodplains and floodways in San Diego County, where restoration projects aimed at enhancing ecological functions and values may compete with land use policies designed to protect the public from flooding hazards. By planning for restoration together with the public agency, project proponents may find a mutually beneficial resolution to potential conflicts. This session will highlight a case study in which public agency staff and the project's technical team collaborated effectively to advance a local wetland mitigation bank through the regulatory process. In this case, the team identified a shared goal of minimizing risk while maximizing public benefit through restoring a vacant golf course into a sustainable and resilient riparian system. For the proposed Moosa Creek Wetland Mitigation Bank project, Great Ecology and the County of San Diego worked together to align restoration goals with strategic priorities and initiatives to develop consensus regarding project design and construction. We will demonstrate a communications framework that aligns the benefits of restoration with agency priorities to ensure positive outcomes and streamlined permitting. This framework can be applied to any strategic planning initiative to achieve a win-win solution.

Native Habitat Design and Restoration in Rapidly Changing Environments

Chair: Jeannine Ross, RECON Environmental

Wednesday 9 May, 10:30am–5pm and Thursday 10 May, 10:30am–2pm — *Terrace*

Abstracts listed alphabetically by presenter (*)

Stadium Wetland Mitigation Project: Urban stream restoration

Summer Adleberg[1] and Sean Paver[2]

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The City of San Diego (City) Public Utilities Department implements a number of habitat restoration projects located throughout San Diego County. These restoration projects are designed to provide habitat mitigation credits to offset impacts from Public Utilities projects. The Stadium Wetland Mitigation Project is located along the San Diego River in central San Diego and is working to restore approximately 56 acres of native habitat. The project will provide the City with approximately 54 acres of wetland mitigation credit that will be used to off-set impacts from essential public projects. The location of the project within central San Diego, towards the bottom of the watershed, provides a unique set of challenges not faced elsewhere. The project area was highly disturbed with extensive anthropogenic use (illegal encampments) and heavily invaded by large monotypic stands of invasive species such as Brazilian pepper (*Schinus terebinthifolius*) and giant reed (*Arundo donax*). Adaptive management strategies are being implemented to handle constant changes to the environment such as fire, flooding, illegal encampments, and new development. Project activities have included the removal of invasive vegetation, trash and debris removal, re-contouring to reestablish secondary channels, installation of a temporary irrigation system, installation of fencing, and installation of native plant material. To date, the project has removed monoculture stands of invasive species from 27 acres, removed over 196,000 pounds (98 tons) of trash, and removed and cleaned up 60 illegal encampments. Approximately 19,000 native container plants have been installed and 41 acres have been hydroseeded.

Maritime Succulent Scrub Restoration, Otay Ranch University Villages Project

Raquel Atik*[1] and Matt Kedziora[2]

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The Otay Land Company (OLC) is pursuing mitigation efforts for the impacts to sensitive habitats in the Otay River Valley, as a part of Ranch University Villages Project and the Otay Ranch General Development Plan. Approximately 20 acres were identified for restoration, based on a designation of open space (City of Chula Vista MSCP Subarea Plan) and parcels owned by OLC. This discussion will focus on site selection and restoration methods and techniques used to mitigate in a region with historical disturbances, such as mining and ranching. ICF, functioning as the planning and monitoring consultant, has developed the Maritime Succulent Scrub (MSS) Restoration Plans for Village 3 and 8. These plans are guiding the restoration and preservation of MSS habitat and associated sensitive flora. RECON is now implementing and maintaining the MSS sites, as the restoration maintenance consultant. Primary tasks completed prior to construction included: rare plant surveys, identification of plant materials that could be salvaged and biological resources for aiding in restoration of sensitive plant communities. Restoration site preparation for receipt of salvaged, sensitive biological resources included a large effort to treat and remove weed biomass, incorporating manual, chemical and mechanical treatments of non-native vegetation. Cactus, succulents, special-status bulbs and yucca trees were planted according to natural community assemblage patterns. The restoration site also incorporated upland soil inoculation, to encourage native annual recruitment from introduced "soil-islands".

Un-Pave Paradise, Take-Out a Parking Lot: Adaptive wetland restoration & mitigation monitoring

Joy Baccei*[1] and Erin Dickman[2]

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Ecological restoration of wetland habitat in a rapidly changing climate can be a challenge. In Yosemite National Park, the re-design of the Yosemite Village Day Use Parking Area, as identified in the Merced Wild & Scenic River Plan, included re-location out of river floodplain, increased parking spaces, and improved traffic flow. However, this re-design effort resulted in impacted or lost wetland habitat. Hence, to mitigate for lost wetlands, we restored two acres of palustrine emergent wetland habitat in a former parking area within a river floodplain. Restoration efforts involved road pavement and fill material removal, topographic re-contouring, and over 1,000 hours of staff and volunteer work to plant over 10,000 propagated wetland plant plugs, apply native seed and mulch, and install a temporary irrigation system. Rapidly changing climatic conditions post-restoration included prolonged flooding due to an abnormally wet winter, followed by dry conditions and high temperatures. We present the results

of year 1 of restoration success and mitigation monitoring, where we depict quantitative data that indicate the success of our restoration efforts for establishing wetland habitat. These results include assessment of groundwater hydrology (depth to water table), native wetland plant establishment (wetland prevalence index), percent native vs. non-native plant coverage, and percentage of surviving planted vegetation. We conclude with lessons learned from our analysis, which can be used to inform adaptive management of our restoration efforts, and help us meet our restoration goals within the project timeframe identified, in the face of rapidly changing conditions in an arid Mediterranean climate.

Developing a Quantitative Basis for Concept Level Revegetation Designs

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Vegetation zonation created by hydrologic and physical gradients within riparian corridors has been used previously as a basis of revegetation design. To describe existing vegetation zonation prior to rehabilitation of a site, the relationship between existing vegetation and the ground surface height above fall baseflows is developed. A high-resolution, field-based vegetation map described existing land cover types within the Trinity River riparian corridor between Lewiston Dam and the North Fork Trinity River. Lewiston Dam releases 12.7 cms baseflows in summer/early fall to maintain suitable water temperatures for fishery resources. The 12.7 cms baseflow elevation was converted to a Digital Elevation Model (DEM) using HEC-RAS hydraulic model output and then subtracted from existing ground topography to create a Detrended Digital Elevation Model (dtDEM) representing height above the fall baseflow elevation. Existing vegetation maps were overlaid onto the dtDEM and summary statistics of dtDEM pixel values within each cover type were calculated. Land cover types were ranked from lowest to highest elevation. Four vegetation zones and one in-channel zone were defined based on asymptotes in ascending means. The beginning and ending height above river of existing vegetation zones were applied to detrended design topography, and the area of individual vegetation zones was tabulated to quantify revegetation associated with each design alternative.

100 Acres of Coastal Habitat Restoration in San Clemente, California

Heather Clayton*[1] and Joanna Kipper[2]

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The Sea Summit at Marblehead Preserve is a diverse native habitat with an array of unique and protected species along 4 miles of walking trails interspersed among more than 300 homes. What was once a tomato field and a water reclamation plant in the 1960s, Sea Summit sat for many years as the dumping ground for locals and became thoroughly overrun with weeds. Restoration ecologists have since focused their efforts on exhaustive site preparation techniques (e.g., grow/kills, chemical mowing, and soil testing and remediation) and have spent countless hours placing pin flags that would strategically position the plant species in specific microclimates throughout the site. It took a keen eye and careful experimentation to understand the hydrology and soil characteristics, despite nutrient deficiencies, to know which canyons would support wetland species and riparian vegetation, and which canyons would be more prone to support coastal sage scrub (CSS) and coastal bluff scrub (CBS) vegetation. Currently, the 100-acre Preserve has met many of the habitat performance objectives, with 80 percent native absolute wetland cover, 96 percent native grassland cover, 90 percent native CSS cover, and 51 percent native CBS cover. With only small patches of disturbed CSS that scarcely supported two coastal California gnatcatcher pairs in 2001, the Preserve is now residence for six rare plant species and 24 breeding gnatcatcher pairs. Successful habitat restoration takes an aggressive approach, where close communication among the resource agencies, client, contractors, and restoration ecologists is a necessity.

Evaluating Wetland Restoration Projects using the California Rapid Assessment Method

Stephanie Freed

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The California Rapid Assessment Method (CRAM) is a scientifically defensible methodology used to monitor regional and statewide conditions of wetlands that can be used to track restoration efforts throughout California over time. CRAM will be introduced and the basic tenants will be covered as well as constraints and its application to improve restoration design and monitor restoration efforts. Case studies will be presented on how CRAM has been successfully used in Southern California to monitor baseline wetland conditions and determine how restoration improved wetland ecosystem services and functions.

North San Diego County Multi-Watershed Enhancement & Restoration for Resiliency

Shirley Innecken

San Elijo Lagoon Conservancy

The San Elijo Lagoon Conservancy will implement a multiple-benefit watershed enhancement and restoration project that will improve habitat resiliency and support federal and state-listed species vulnerable to habitat loss due to projected sea level rise (SLR). Enhancement and/or restoration practices applied at selected

sites will ultimately achieve the following goals: 1) Maximize water availability in drainages by reducing water loss associated with transpiration by invasive species such as tamarisk (*Tamarix* spp.) and giant reed (*Arundo donax*); 2) Reduce fire hazard associated with volatile invasives such as gum trees (*Eucalyptus* spp.); 3) Ensure project sustainability by targeting known upstream source populations of invasive species; 4) Reduce flooding by restoring current and projected floodplains; 5) Improve habitat corridors and connectivity to improve resiliency to projected climate change; and 6) Provide quality habitat for the federal and state endangered least Bell's vireo (*Vireo bellii pusillus*) and southwestern willow flycatcher (*Empidonax traillii extimus*), as well as other special-status species.

Restoration Design and Implementation in a Dynamic Alluvial Riparian System in Southern California

Matthew Major*, Jutta Burger, and Collin Raff

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The long-term goal of the Irvine Ranch Conservancy's Landscape-scale Restoration Program is to facilitate large-scale habitat restoration and enhancement for the purpose of increasing ecosystem resilience in the face of disturbance and environmental change. The Lower Silverado Canyon Orange County Transportation Authority-funded restoration encapsulates this approach by implementing both high-intensity restoration across 29 acres of highly degraded habitat as well as targeted invasive species control throughout the surrounding subwatershed. The habitat types restored include mulefat scrub, alluvial scrub, and willow riparian woodland. This presentation will summarize the process of site assessment, planning & design, and implementation across habitat types while also considering an economical use of resources and considering the need for a resilient and diverse final target community. The importance of having flexibility to adapt implementation plans to conditions will be described. Year 1 monitoring results for native vegetation cover, diversity and overall structure will be presented. Lastly, enabling conditions as well as methodologies for implementing successful restorations will be highlighted based on the Conservancy's experience.

Establishing Vernal Pool Vegetation in a Rainfall-dependent Community

Meagan Olson

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The establishment of dense and diverse vernal pool vegetation can be one of the most challenging aspects of vernal pool restoration. The ephemeral nature of vernal pools coupled with unpredictable rainfall patterns in southern California further enhance these challenges. Vernal pools are already a rapidly changing environment, but with the highly variable weather patterns from year to year, establishing target vegetation becomes even more difficult. Through discussion of several vernal pool restoration projects and their challenges, different methods of vernal pool vegetation establishment will be examined.

A Conceptual Model of Pacific Cordgrass (*Spartina foliosa*) Restoration in California with Thin-layer Sediment Augmentation (TSLA)

Jordan Rosencranz*[1], Michael Josselyn[1], Richard Ambrose[2], Karen Thorne[3], Christine Whitcraft[4]

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Without intervention, and mainly due to a lack of sediment, high sea-level rise rates will drown Pacific cordgrass (*Spartina foliosa*) salt marsh habitats along the Pacific Coast by the end of the century. Loss of this habitat will likely result in decreased carbon storage, reduced storm surge protection, loss of fish foraging and nursery functions, as well as extirpations of Ridgway's Rails (*Rallus obsoletus*). Although the approach is in the experimental phase on the Pacific Coast, opportunities exist for the beneficial reuse of sediment (e.g., thin-layer sediment augmentation [TLSA]) to raise low elevation salt marshes in full tidal basins, ultimately promoting cordgrass growth, which will have multiple benefits for people and the environment. In this talk, we review the vulnerability of Pacific cordgrass to sea-level rise and present a conceptual model of cordgrass restoration with dredged sediment that can help managers and restoration practitioners plan and design future cordgrass restoration projects, as well as communicate realistic restoration trajectories.

Role of Drones in Lagoon Restoration: A case study

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Current applications for utilizing Unmanned Aircraft Systems (UAS) (e.g., drones) for restoration have only scratched the surface of the potential. There are many opportunities for the application of UAS in active restoration projects. AECOM is utilizing UAS on a Southern California Edison project in the San Dieguito Lagoon in Del Mar, California to inform the design and adaptive management approach for this project. We utilize UAS for monitoring elevation before and after earthwork to ensure continuity of marsh classification type. By subtracting the post-activity Digital Elevation Model (DEM) by the pre-activity DEM, we are able to generate geospatial magnitude of change data. Additionally we measure vegetative cover and categorize vegetative cover into a project specific classifications set using

supervised image classification. Relating the generated categorized vegetative type cover to the success criteria, we are able to determine if our restoration efforts have brought the project to success. The beauty of UAS is it allows us to sample site condition as a whole relative to traditional methods that utilize site sub-sampling methods. This eliminates estimation of site vegetative cover through subsite extrapolation or vegetative cover estimations with a direct measure of vegetation from above. We strive to incorporate new techniques to improve the data accuracy and repeatability. We have found that UAS is an inexpensive tool that raises the quality of our data used in the decision making process. Future uses of UAS for restoration projects could include: plant health (NIR), subsurface detection (magnetometer), and wildlife monitoring (LIR).

Restoration of Disturbed Habitats: Technical design approach and field test results

Geoff Smick

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Heavily disturbed upland habitats such as remediation sites and quarries pose some of the greatest challenges to restoration practitioners. They often have very poor soil conditions (or lack of topsoil altogether) and are magnets for weeds, which makes restoring them more difficult. This presentation discusses a GIS planning 'toolkit' design approach in combination with results from actual test-plot treatments. The GIS-based design approach correlates the existing native habitats in the surrounding lands to solar radiation zones based on slope and aspect. The location of various target communities in the restoration design planting plan are then based on a comparable solar radiation analysis at the project site. While solar radiation is not the only driver of phytogeography, it is a good proxy for explaining the distribution of habitat types at the local scale. Another strong driver is soil type and depth. Therefore we also present results from a 5-year, field-based test plot program informing which seed (and in turn community) perform best in several different planting medium blends. These results allow us to better define soil characteristics in the various solar radiation zones to achieve the target vegetation communities. This unique design approach not only increases initial success but also decreases long term maintenance costs since the appropriate species are provided the best chance of survival. These results can be easily replicated and directly applied to a variety of upland restoration efforts.

Whole-Landscape Restoration of a Leveled California Vernal Pool Terrain

Eric Smith* and John Vollmar

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Vernal pool creation has traditionally happened in one of two contexts: adding pools to an existing vernal pool landscape, or excavating new pools into a flat terrain lacking any existing pools. The first approach changes the distribution, density, and hydrology of existing pools, while removing upland habitat from an intact system. The second approach tends to create disconnected "bathtubs" that lack the connectivity and complex shaping of natural vernal pool landscapes. We present a novel project to restore an entire topography of vernal pools, mounds, and both wetland and non-wetland swales on a leveled site with partially modified subsurface soils. By using high- and low-tech data gathering including LiDAR, historical aerial photography, landowner interviews, and soil pit analysis, we designed a complete replacement terrain to expand neighboring intact landscapes and provide biological, hydrologic, and aesthetic values. GPS-controlled earth-moving equipment and drone-based elevation surveys were used to bring the design to life with 1-inch accuracy. Year-1 hydrologic monitoring indicated 95% hydrologic success; vegetation monitoring is now underway.

Restoration of Native Grassland Ecosystems

Chair: J.P. Marié, California Native Grasslands Association

Wednesday 9 May, 10:30am–5pm — *Dockside*

Abstracts listed alphabetically by presenter (*)

Management Challenges in Restoring Native Grassland Habitats in Southern California

Robert Freese*, Matt Major, and Jutta Burger

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Irvine Ranch Conservancy (IRC) manages 29,000 acres of natural and degraded habitats in the foothills of the Santa Ana Mountains. As part of a landscape-scale restoration program, IRC is restoring over 60 acres of native grasslands. Grasslands and scrub habitats often occur in close proximity, which presents a challenge in determining which sites are most appropriate for grassland restoration. Depending on extent of degradation, either active or passive restoration approaches are employed. Our two greatest challenges in grassland management are: 1) Maintaining long-term viability of needlegrass stands, and 2) Increasing species diversity through forb introductions. IRC has successfully established needlegrass stands through successive years of site preparation and multiple herbicide applications. However, cover and vigor of needlegrass stands declines over time. Periodic removal of thatch may be a key management strategy for rejuvenating established needlegrass stands. IRC is managing thatch by both mechanical means and selective grazing of restored grasslands. Various techniques are being tried for introducing forbs. Options include either seeding them along with needlegrass or introducing them later into established stands. Grasslands are highly dynamic systems that require a greater degree of long-term management than many scrub habitats.

Native Grassland Restoration Using Sheep for the Sake of Breeding Birds

Elihu Gevirtz

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The San Marcos Foothills Preserve on the edge of Santa Barbara presents an opportunity to restore more than 80 acres of native grassland with native grasses, forbs and open ground in between. The objective of the project is to restore breeding and foraging habitat for grassland dependent birds including grasshopper sparrow, burrowing owl and others as well as small mammals. Our plan is to use intensive, controlled sheep grazing. We will present our plan and ask for your feedback before we begin implementation next winter.

Habitat Restoration and Recovery of the Endangered San Diego Thornmint

Bruce Hanson*[1], Scott McMillan[1], Cecilia Meyer Lovell[1], and Lance Criley[2].

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San Diego thornmint (*Acanthomintha ilicifolia*) is an annual plant that occurs in clay soils associated with coastal sage scrub, chaparral and native grassland habitats of San Diego County and Baja California, Mexico. Thornmint is state and federally listed as endangered due to declining populations throughout its range over the last thirty years. Since 2014, AECOM has been conducting habitat restoration for the Back Country Land Trust on a population of thornmint at Wright's Field in Alpine, California. This population was once estimated to be at least 600 plants, but in recent years was down to less than 25 plants. The restoration program includes site protection, weed control, seed bulking, and container planting in an effort to re-establish the thornmint population at Wright's Field. This restoration effort has been very successful, with over 3,000 thornmint plants at Wright's Field in 2017. AECOM is also conducting habitat restoration of a second threatened thornmint population on Poser Mountain for the U.S. Forest Service. The Poser Mountain population once numbered in the thousands, but is now also facing extirpation. The habitat restoration of these two populations has tested the different methods of weed control (hand weeding, mowing, Fusilade and glyphosate), and has demonstrated the importance of conducting this weed control in tandem with an aggressive program of seed bulking. The methods and lessons learned from these two projects are not only helping to recovery these two populations, but can be used as a template for the recovery of other thornmint populations on the decline.

Variation in Soil Properties Related to Moisture Availability Across and Within Sites Characterized by Grassland and Coastal Sage Scrub

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In southern California, grasslands and coastal sage scrub communities co-occur as a mosaic across the landscape. Coarse level patterns in the distribution of these communities have been observed including environmental characteristics such as slope aspect and soil drainage within areas of similar land use history. Variation in their distribution also occurs at finer scales, however, and there is often fine scale variation in establishment success within the areas they are seeded as part of

ecological restoration, even when managed in the same way. There are few datasets that quantitatively explore these differences with respect to soil properties, even though this is one of the more common explanations given when explaining patterns in plant community distribution. Here, we present analyses of soil properties known to influence plant available soil moisture from multiple grassland and coastal sage scrub sites across Orange County. In addition, we present data from two restoration projects seeded across multiple sites in which there was high spatial variation within a field or hillside in the success of *Stipa pulchra* establishment in response to seeding. Measured soil properties included: particle size, field soil moisture, bulk density, and organic matter content. We found that soils under coastal sage scrub had significantly larger particle size than those under grassland. Preliminary analyses showed no significant relationship between most measured soil characteristics and the cover of *S. pulchra*, suggesting that other site characteristics had a greater effect on its establishment.

Mismatch Managed? Strategies for buffering the impacts of phenology shifts

Rachael L. Olliff Yang*[1], Thomas Gardali[2], and David D. Ackerly[1]

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As the climate changes, organisms are altering their behaviors in response to changing abiotic conditions. Species-specific shifts in phenology (the timing of yearly life cycle events) are expected to occur, leading to changes in species interactions within and among trophic levels. Phenology duration and complementarity will be important in the resilience of ecosystems to these shifts; hence considering these when managing or restoring ecosystems may be critical for maintaining important species interactions (i.e. pollination and seed dispersal), mitigating invasions, and maintaining ecosystem function. Restoration projects are beginning to incorporate phenology into planning, but there is a limited understanding of what techniques might

be implemented. Extended flowering and fruiting time may allow for system resilience by buffering the impacts of timing shifts and allowing for both intraspecific and interspecific adaptive capacity. We explore potential strategies that could extend flowering resources, and discuss results from experiments testing these techniques in California grassland communities.

Response of Biological Soil Crusts to Prescribed Burns on San Clemente Island

Brianne Palmer*[1,2] and David Lipson[1]

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Biological soil crusts (BSCs) are communities of microorganisms on the top layer of soil that perform a variety of ecosystem functions. In California, BSCs grow in areas with changing fire regimes. Fire may impact soil crusts in a variety of ways. High intensity burns may scald the surface of the soil where the BSCs live and may influence the resulting microbial community. On San Clemente Island, prescribed burns are used to re-establish native bunch grasses. Additionally, these burns allow us to assess the succession of BSCs after fire and the resulting change in community structure. In 2012 and 2017, twenty sites were burned each year, and the results indicate a resurgence of native bunch grasses and a decrease of annual non-natives. Beginning in April 2018, we will visit each burn plot and its adjacent unburned plot, collect BSC samples and quantify the cover of BSCs, native, and non-native plant species. We will assess the nitrogen fixation, carbon fixation, and respiration rates between successional states and treatments. These measurements will indicate the ecological function of each BSC state. Using shotgun metagenomics, we will determine the differences in functional genes and community composition between plots. Finally, in the greenhouse, we will determine if BSCs help or hinder the germination of native and non-native grasses and nitrogen cycling in different successional states. It is our hope, that understanding the diverse functions of BSCs, the effects of managed fire, and the interactions with vascular plants, will further our knowledge on best practices for grassland restoration.

Production of Native Local Ecotype Seed for Grassland Restoration Projects

Patrick Reynolds

General Manager, Hedgerow Farms, **preynolds@hedgerowfarms.com**, 530.662.6847

Use of native seed of local genetic origin is key to the long-term success of habitat restoration projects. Local ecotypes are adapted to the region's soils, climate, insects and diseases and tend to perform better than seed whose genetic origin is unknown. Production of local ecotypes is a complex endeavor that involves wildland seed collection, planting nursery or seed stock into production fields, field maintenance, cleaning, testing, and storage. Many considerations go into the production of local ecotypes including isolating fields to avoid cross-pollination, control of weeds, specialized seed harvesting, drying, cleaning seed to remove inert matter and non-target species, testing purity and germination and storage and delivery. Each process involves a specialized approach developed through years of trial and error and requires detailed record keeping. The California Crop Improvement Association (CCIA) recently reintroduced certification of local ecotypes which involves verifying wildland collection sites, inspecting fields and use of certified seed samplers during cleaning and seed testing. Hedgerow Farms is currently working with the CCIA to certify new ecotypes and species. For projects that require local ecotypes or species that are not commercially available, Hedgerow Farms contracts with individual entities to grow these ecotypes using the same process described above. To aid landowners and restoration designers in identifying commercially available ecotypes, Hedgerow Farms' website offers a fully sortable database that identifies the county of origin of all species offered. Use of this powerful tool significantly reduces the level of effort necessary to ensure that seeding specifications accurately reflect available ecotypes.

Best Practices for Restoring Purple Needlegrass (*Stipa pulchra*)

Jordan Rosencranz*, Amanda McCarthy, Phil Greer, Nate Bello, Ingrid Morken, and Kari Dupler

WRA, Inc, **rosencranz@wra-ca.com**

Restoring and maintaining purple needle grass (*Stipa pulchra*) remains a challenge for project proponents who are required to mitigate for impacts. First, fast growing non-native annual grass species out compete and preclude the establishment and re-sprouting of slow growing perennial bunchgrasses. Second, maintenance of the restored habitats may require specific actions such as controlled burns and flash grazing, which are not always feasible in urbanized regions. In this talk, we describe lessons learned from recent restoration projects, as well as proposed maintenance activities that allow native grasslands to persist. We propose a conceptual framework for restoring and maintaining purple needle grasslands in small habitats, so that performance criteria are met. We also assess strategies for local-scale, long term success and persistence of this misunderstood habitat.

Storm Water and Erosion Control

Chairs: Allegra Bukojemsky, ICF, and Aaron Andrews, AECOM

Thursday 10 May, 3:30–5pm — *Starboard*

Abstracts listed alphabetically by presenter (*)

Treatments and Conflicts of Stream Habitat Enhancement and SWPPP Compliance

Gregory Andrew, MS

Marin Municipal Water District, 220 Nellen Avenue, Corte Madera 94925, 415.945.1191, **gandrew@marinwater.org**

During the summer of 2017, we constructed five of ten project sites for the State grant-funded Lagunitas Creek Winter Habitat and Floodplain Enhancement Project. The purpose is to improve Lagunitas Creek salmonid populations by increasing the winter habitat carrying capacity for coho salmon and steelhead. It is also meant to improve water quality to benefit the sediment Total Daily Maximum Load (TMDL) goals for the creek. Large wood structures as Bar Apex Jams and Log Debris Retention Jams were installed at four sites and a 1,000-foot floodplain channel was excavated through the riparian corridor at a fifth site. These projects are designed to modify hydrology, reconnect the stream to its floodplain, and enhance floodplain and instream habitat. The project size warranted compliance with a Stormwater Pollution Prevention Plan (SWPPP). Erosion control treatments included: hydroseeding, hydromulching, erosion control fabric, fiber rolls, and placement of wood slash. The wood slash was generated when the floodplain channels the projects are designed to engage were cleared of riparian trees and shrubs with a masticator. The SWPPP guidelines do not have a BMP for wood slash but it has proved to be very effective at preventing runoff from disturbed soils. The erosion control fabric and hydromulch was placed in the floodplain channels to address a concern over SWPPP compliance but the fabric directly conflicted with the design goal for high flows to modify and shape the floodplain channels. I will discuss this conflict between the SWPPP and the intended stream restoration.

Storm Water and Erosion Control Thursday, 3:30–5p *Starboard*

Agua Hedionda Creek Stream Bank Stabilization

Aaron Andrews*[1], Sherri Howard*[2], and Daniel Zimny[3]

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The Agua Hedionda Creek Stream Bank Stabilization Project is a self-mitigating project that has restored a failed stream bank and stabilized the streambed at the confluence point with an existing storm drain outlet. The existing outfall system consisted of a headwall with wing walls and grouted riprap energy dissipater and was located at a point on the stream that experiences a flow of 8,000 cubic feet per second in the 100-year storm event. The existing system was failing, resulting in substantial erosion to the streambed, stream bank and adjacent private property. At the request of the City of Carlsbad, the consultant team collaborated on, and executed a bioengineered solution to repair the existing outfall. The solution that was implemented included the removal of grouted riprap and the installation of two stilling pools at the point of discharge. Bank stabilization was accomplished with log crib walls along the eroded stream bank that were backfilled with rip rap and soil and planted with native vegetation. Early engagement with Resource Agencies by the City of Carlsbad, and the multi-disciplinary team of consultants, created an environment of co-operation that allowed the development of this unique, self-mitigating, bio-engineering design. This project was implemented during the 2016/2017 rainy season which included 100 year storm events that helped demonstrate the design's ability to withstand higher than expected storm events.

Unique Restoration Methods and Resource Use to Pursue Interdisciplinary Project Goals: A case for cactus.

Matt Kedziora

ICF, 525 B Street, Suite 1700, San Diego 92101, **matt.kedziora@icf.com**

The Tule Wind Project (Project) is located in eastern San Diego County in desert transitional habitats. Fifty-seven wind turbines and infrastructure generating up to 200 megawatts (MW) of electricity was recently constructed. Approximately 350 acres are categorized as temporary impacts, which will be re-vegetated during a five-year post construction maintenance and monitoring effort. Implementation of the Tule Wind Habitat Restoration Plan (HRP) and requirements of the Construction General Permit will re-vegetate the temporary impacts. We discuss restoration techniques designed to build resiliency and control storm water runoff, with goals of achieving post-construction revegetation success criteria. Prior to construction, the ICF team coordinated the salvage of over 40,000 cacti from the permitted footprint. The ICF team secured six acres of on-site cactus storage areas, establishing a "resource farm" where cactus was planted for the duration of construction. The effort minimized needs for extensive materials movement and utilized local soil and environmental conditions for the restoration resource. Following construction, the ICF team replanted cacti in reclaimed temporary impacts, blending adjacent, undisturbed landscape features with restoration sites. The ICF team also identified unique opportunities to manage erosion and blend with SWPPP revegetation requirements for site stability. Cacti also was planted horizontally in chains to mimic a wattle installation along contours. The unique method functions as an erosion control device on steep slopes, maximizes rooting zone and slows water flow crossing the slopes. The adaptive management effort of Habitat Restoration Plan requirement sought innovative materials management approaches when constructing this renewable energy project.

Urban Forestry Management in a Changing Environment

Chair: Christopher Kallstrand, DUDEK

Thursday 10 May, 2:30–5pm — *Terrace*

Abstracts listed alphabetically by presenter (*)

Urban Forest Program Continuum for Sustainable Growth

Dorothy Abeyta

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California will continue to become increasingly urbanized in the coming decades. As a result urban forests have become essential to counteract the negative impacts of nature-poor environments. Urban forest managers and allied partners will be the front line for protecting and growing this critical resource in ways that ensure that communities are equitable, livable places into the future. Increasing research efforts in climate change, stormwater capture, urban forest human health and ecosystem benefits and human health show that the urban forest value is significant. A 2016 i-Trees study shows a value of more than $1 billion dollars in carbon storage air pollution removal, stormwater capture, energy saving and increased property values can be attributed to the street trees in California's cities. A separate 2016 study shows urban forests provide vital social services such as improved mental and physical health, improved quality of life, increased social cohesion, improved academic performance, and reduction in crime. The value of these urban forest social services is yet to be quantified. The Urban Forest Program Continuum developed by Davey Resource Group outlines the steps that urban forest programs should take to create and maintain the healthiest and most resilient urban forest possible. Each step builds on the one before, creating a strong foundation of strategic planning, program funding, and community support which results in thriving urban forests.

Urban Forests: From Eucalyptus to riparian woodland in a highly urbanized ecological reserve

Joe DeWolf

San Elijo Lagoon Conservancy, 777 S. Hwy 101, Solana Beach CA 92075, **joe@sanelijo.org**

Despite being non-native and highly invasive, the removal of eucalyptus (*Eucalyptus* spp.) trees can often be a contentious issue. In the fall of 2017, San Elijo Lagoon Conservancy began the restoration of a riparian woodland on the eastern end of the 980 acre San Elijo Lagoon Ecological Reserve. A total of 88 red gum eucalyptus trees (*Eucalyptus camaldulensis*) were selected for removal from the 0.5–acre site. The size of the trees ranged from 5 to 30+ inches diameter at breast height (DBH). Due to a popular trail that traverses the site, public safety and visibility were serious factors in the planning and execution of the tree removal. All of the trees were safely felled and removed from the site over a two month period, but not without vocal concerns and objections from a number of trail users and neighboring residents. Native plant installation started immediately after the removal of the eucalyptus biomass, with volunteers planting over 1,000 native riparian plants over the next two months. Although the eucalyptus trees have been removed, additional invasive plant species such as wild radish (*Raphanus sativus*) and bristly ox-tongue (*Helminotheca echiodes*) still provide challenges to restoring the site. Volunteers will play large role in invasive species control and the ultimate transformation of the site to a native riparian woodland. Once established and mature, this site will provide valuable habitat for the federally endangered Least Bell's vireo (*Vireo vellii pusillus*) and southwestern willow flycatcher (*Empidonax traillii extimus*).

New Guidelines Benefit Urban Wildlife and Habitat Projects

David N. Lee

Davey Resource Group, **david.lee@davey.com**, 805.946.1700

A new group recently released guidelines for managing wildlife habitat in California's Urban Forests. Tree Care for Birds and Wildlife released their Best Management Practices earlier this year. The BMPs are the result of a two-year effort by the tree care industry, wildlife agencies and advocates to standardize compliance and protection of nesting birds and other protected wildlife of the urban forest. This presentation summarized the new BMPs and provides helpful advice on their implementation. Using examples from recent case studies, Mr. Lee will illustrate how tree care and habitat restoration activities can be carried out so that our urban wildlife are not harmed, but actually benefit from well planned projects.

Changing the Rules: Expanding and reimagining urban restoration

Justin Morgan

School of Forest Resources and Conservation, 136 Newins-Ziegler Hall, University of Florida, Gainesville, FL 32611, **justin.morgan@ufl.edu**

As urban expansion continues, there is a greater need for urban restoration. However, urban restoration faces significant challenges in the form of: limited land availability, disagreement over land use, and negative public opinion. In re-examining the purpose of ecological restoration — understanding what we are trying to accomplish - we can better focus our efforts to achieve our goals. In doing so, we see that by including concepts of discordant harmonies, multiple use lands and urban forestry, we can expand urban restoration, decrease habitat fragmentation, overcome disagreement, and create more stable habitats.

The Impact of *Phytophthora* on Restoring Native Habitats

Chair: Kevin MacKay, ICF

Thursday 10 May, 10:30am–5pm — *Dockside*

Abstracts listed alphabetically by presenter (*)

Life after *Phytophthora*: An approach to restoration via direct seeding at Sheep Camp Creek, Sunol CA

Leanne Feely*[1], Scott Chenue[2], Ellen Natesan[2], Mia Ingolia[2], and Scott Simino[2]

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Sheep Camp Creek (SCC) is a 441-acre large-scale restoration site situated among the San Francisco Public Utilities Commission (SFPUC) watershed lands in Alameda County. This site is part of the SFPUC's Bioregional Habitat Restoration Program, which compensates for unavoidable impacts to habitats and species associated with various water system improvement projects. Within the large-scale restoration site, riparian, woodland, wetland and native grassland habitats have been re-established with a total of 21,000 plantings of 40 native species, making up 14 acres. Local native seeds were collected within the Alameda watershed, propagated in a greenhouse environment, and transplanted onto the restoration site. Despite extensive bio-sanitation protocols, in 2014 multiple *Phytophthora* species were discovered on several container plantings shortly after installation in the field. Upon this discovery, all planting efforts were halted, and the infected areas were quarantined. In order to meet mitigation success criteria requirements, the restoration effort was re-configured to shift to a direct-seeding and rhizome-division revegetation approach. Direct seed planting was conducted in 2015 and 2016, and on-site amplification beds were developed to propagate select divisions and cuttings in 2016. Several challenges became apparent with this new approach, including the need for seed viability testing, modifications to the planting palette based on viable seed or local plant material availability, dividing and distributing seeds of all sizes throughout 14 acres, developing new onsite propagation techniques, maintaining soil surface moisture during drought conditions, and recognizing the challenge of implementing a planting plan and meeting mitigation success criteria that were developed for container plantings. Thorough data was collected over the two year period of direct seed planting to monitor the germination and survivorship rates of these new planting methodologies. Along with identifying seed germination and survival rates, we have identified several successes and failures from the on-site seed and rhizome-division planting efforts.

Are *Phytophthoras* a Threat to Arid Southern California Restoration Sites?

Susan J. Frankel*[1], Katie VinZant[2], Tedmund J. Swiecki[3], and Elizabeth A. Bernhardt[3]

[1]USDA Forest Service, Pacific Southwest Research Station, Albany, **sfrankel@fs.fed.us** [2]USDA Forest Service, Angeles National Forest (currently on the Coronado NF), **kvinzant@fs.fed.us** [3]Phytosphere Research, Vacaville, **phytosphere@phytosphere.com**

Surveys for root-rotting *Phytophthora* species were initiated in 2014 following the detection of *P. tentaculata* and other species on infested nursery stock in Bay Area restoration sites and native plant nurseries. Those surveys in the greater San Francisco Bay Area revealed that root-rotting *Phytophthora* species, including undescribed species not previously known to occur in the U.S., were common in native plant nursery stock used for habitat restoration. Botanists on the Angeles National Forest became concerned that *Phytophthora* pathogens could also be present in southern California native plant nurseries. If so, these pathogens might be introduced into native habitats via infected container stock used to revegetate areas disturbed by special uses, fire, and recreation. In 2016–2017, testing was conducted on stock from several southern California native plant nurseries. Plants were being grown for restoration plantings or were already outplanted at field sites. *Phytophthora* was detected in stock from all the source nurseries. At least seven root-rotting *Phytophthora* species, including an undescribed species or hybrid, were detected. *Phytophthora* species were also recovered from field-planted nursery plants that were dead, dying, or showing other symptoms associated with root rot. These preliminary results show that nursery stock constitutes a high-risk pathway for introduction of pathogens into Southern California wildlands. Multiple *Phytophthora* species survived in arid chaparral ecosystems on outplanted stock that was irrigated to enable plant establishment. On many sites, *Phytophthora*-infected restoration plantings are in close proximity to native vegetation, increasing the risk that the introduced pathogens could spread to native ecosystems.

How to Reduce the Risk of *Phytophthora* Introductions and *Phytophthora*-induced Mitigation Failure in Restoration Projects

Julie Garren*[1], Charles McClain[2], Janell Hillman[3], Cindy Roessler[4], and Susan J. Frankel[5]

[1]Vegetation Ecologist, AECOM, **julie.garren@aecom.com** [2]Restoration Ecologist, H.T. Harvey & Associates [3]Biologist, Santa Clara Valley Water District [4]Senior Natural Resources Specialist, Midpeninsula Regional Open Space District [5]Plant Pathologist, USDA Forest Service, Pacific Southwest Research Station, Albany

Impact of *Phytophthora* Thursday, 10:30a–5p *Dockside*

Phytophthoras are pathogens responsible for the Irish potato famine (*Phytophthora infestans*), sudden oak death (*P. ramorum*) and potentially other less-known serious plant die-offs. Between 2014 and 2016, well over 50 *Phytophthora* taxa were identified in native plant nurseries and restoration sites, including taxa new to the USA and new taxa still being described. The incidence and number of new taxa detected raises concerns about outplanting of nursery stock, particularly in locations where the plants can serve as an introduction pathway of *Phytophthoras* into wildlands. The inadvertent spread of *Phytophthora* species into natural ecosystems threatens environmental, social, and economic resources. Once an area is contaminated, it is difficult to eradicate the pathogen and restore lands. The Working Group for *Phytophthoras* in Native Habitats, with input from restoration professionals and regulators, developed guidance for reducing the risk of *Phytophthora* introduction and spread through restoration sites and for adapting common mitigation success criteria to facilitate both successful mitigation and habitat restoration. These guidelines include recommendations such as direct seeding, outplanting container stock grown in nurseries with *Phytophthora* prevention accreditation, reducing planting densities, limiting imported products and soil movement, and maintaining phytosanitary best management practices throughout the life of the restoration project. If direct seeding or reduced planting densities are utilized, then success criteria thresholds for cover and survivorship should be reduced or replaced with target densities. Additionally, including multiple years of direct seeding and credit for natural recruitment can compensate for high direct seeding mortality and create age structure within the site.

Dealing with *Phytophthora*: Approaches for restoring habitat without container plants

Kevin Mackay*[1] and Jenny McGee[2]

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In recent years, a number of restoration sites where container plants were installed have tested positive for *Phytophthora* species. Because of concerns about the spread of *Phytophthora* into adjacent native habitats, efforts are underway to understand the potential impacts. Southern California Edison's (SCE) Tehachapi Renewable Transmission Project (TRTP) was a large renewable transmission project consisting of new/upgraded substations and a total of 175 miles of transmission line. Traversing several geographical and ecological zones, TRTP requires restoration of approximately 335 acres of native vegetation ranging from mixed chaparral to conifer forest. SCE planned to install contract-grown container plants to restore areas to pre-disturbance conditions but installation was prevented due to positive *Phytophthora* test results. Without container plants, SCE was forced to develop and implement alternative approaches to promote establishment of native cover including: 1) Applying additional native seed; 2) Installing acorns in areas where oak container plants had been planned; 3) Constructing and applying seed to basins where irrigation bubblers had been installed for planned container plants; 4) Reconfiguring existing irrigation systems to water re-sprouts and natural recruits; 5) Using irrigation systems to regularly water seeded basins, re-sprouts, and natural recruits; and, 6) Increasing weeding frequency to reduce nonnative cover and promote germination, establishment, and growth of native species. This presentation will explore these methods and present an overview of the results.

Minimizing Threats Posed by Exotic *Phytophthora* Species to Natural Communities

Charles McClain*, Matt Wacker, and Debra Bishop

H. T. Harvey & Associates, 1331 Garden Highway, Suite 300, Sacramento 95833, **cmcclain@harveyecology.com**

Phytophthora is a highly contagious plant pathogen that threatens plant nurseries, restoration sites, and natural communities. The pathogen can spread rapidly and be lethal to dozens of susceptible native plant hosts. In California, introduced *Phytophthora* species have affected a number of plant communities in a variety of soils and climates. Their range is thought to be restricted to coastal areas with cool, wet climates. However, *Phytophthora* can be lethal even in dry habitats. Accurate and early detection is critical to managing and preventing its spread; however, disease symptoms are difficult to diagnose reliably, and eradication over large areas is considered impossible. Planting infected live plants and using contaminated equipment are primary pathways for spreading the infection. Restoration sites, and areas with woody vegetation and susceptible hosts, should be considered at high risk of being infested. Best practices to help prevent the introduction and spread of *Phytophthora* include locating restoration sites away from sensitive sites that have rare or endangered plants or high-quality wildland habitat; preventing contaminated nursery stock from being planted at restoration sites; cleaning and sanitizing tools, clothing, shoes, equipment, and vehicles; minimizing soil disturbance and movement; and planting locally-collected seeds or cuttings.

Full Steam Ahead: Managing *Phytophthoras* in nursery operations and fieldwork

Alisa Shor*[1], John Doyle[1], Alison Forrestel[2], Christa Conforti[3], Lew Stringer[3], Jessica Peters[1], and Daniel Franco[1]

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In recent years, species of the plant pathogen, *Phytophthora*, have been discovered in native plant nurseries and restoration sites at an alarming rate. *Phytophthora* has become part of the vocabulary of restoration, and managing for it is part of the cost of responsible restoration. This session presents a frontline perspective of the operational shifts and ongoing management decisions of the Golden Gate National Parks in response to the elevated concerns of *Phytophthora*. Discussion will include the development and institution of best management practices in nursery operations and fieldwork. In particular, the Park Nursery Program has invested significant resources in retooling and improving growing practices to produce uninfected nursery container stock. In parallel, Park restoration and field crews have adopted BMPs to reduce the risk of introducing or moving *Phytophthora* in field sites. This session will include an overview of operational shifts, the personnel and financial resources invested, monitoring data of nursery container plants pre/post implementation of BMPs, preliminary survey results of *Phytophthora* detections in the field and restoration sites, discussion of the intended approach moving forward, and why this matters to conservationists and restorationists at all levels.

Phytophthora Isolated from Restorations in Marin, San Francisco, and San Mateo Counties

Laura Sims*[1], Matteo Garbelotto[1], and Alison Forrestel[2]

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Restoration nurseries can be a significant source of pathogens; introductions threaten California ecosystems, and *Phytophthora* species in recent evaluations of nursery plants were found in many novel combinations suggesting the potential for many new diseases. Here we examined *Phytophthora* species persistence in wildlands focusing on areas that were restored with plants grown in nurseries and with known infestations on that particular species based on recent surveys. Wildland plants were evaluated in Marin, San Francisco, and San Mateo Counties for *Phytophthora* species. A total of 9 plots, 3 in each county were evaluated and sampled. Each plot was evaluated for 3 area types: (1) Restoration areas, (2) Human-impacted areas surrounded by trails/ roads or shared with restoration and stream flooding or trail/road drainage, and (3) Unaffected, unplanted control areas. If there were between 3 and 10 plants of plant species of interest present within each area type, then they were systematically sampled. Data were collected on plant health, rhizosphere samples were collected from each plant, and stem samples were collected in the presence of symptoms. Plots with areas with enough plants of interest were as follows: 7 contained restored areas, 4 contained affected areas, and 4 contained control areas. The *Phytophthora* species found will be shared including the hosts they were found on, symptoms present, and the area types and plots they were found within.

Invasion of Northern California Native Plant Communities by Soil-borne *Phytophthora*: Pathways and risk factors

Tedmund J. Swiecki* and Elizabeth A. Bernhardt

Phytosphere Research, 1027 Davis Street, Vacaville 95687, **phytosphere@phytosphere.com**

In 2002, we determined widespread mortality of the rare and threatened Ione manzanita (*Arctostaphylos myrtifolia*) was caused by the exotic water mold *Phytophthora cinnamomi*. We and others have subsequently documented numerous soil-borne *Phytophthora* invasions in California native plant communities. Most of these are associated with obvious plant decline and mortality. Cryptic invasions have also been detected, in which symptoms may be limited to reduced growth or may not appear until plants are stressed. To develop effective strategies to prevent further introductions and spread from existing infestations, land managers need to understand routes of introduction and factors that increase the risk of spread. We have developed a framework for assessing the risk of introduction and spread based on pathogen epidemiology, vegetation, site factors, and land uses. Introduction risk is modelled as a multiplicative function of inoculum density, contamination mass/volume, and site receptivity. Other host, pathogen, and environmental factors are coupled with this risk function to develop risk ratings specific to sites or activities. *Phytophthora* sampling across many locations supports the validity of the risk framework. Based on extensive research and field sampling, conventional nursery stock used in restoration and urban landscapes poses a high risk for initial Phytophthora introductions. Site history factors that may not be documented or observable are associated with *Phytophthora* infestations. Unassisted spread of *Phytophthora* occurs more rapidly downslope and along watercourses. The risk framework can be used to both efficiently detect existing infestations and select appropriate management practices to minimize the risk of introduction and spread.

Poster Session & Student Poster Competition

Chair: Gavin Archbald, H. T. Harvey & Associates

Reception: Wednesday 9 May, 5–7pm — *Baja Stage*

Abstracts listed alphabetically by presenter (*).
*Presenters in **bold** are students who have received scholarships from the proceeds of last year's Raffle..*

Propagating Two Key Species for the Mojave Desert Ecoregion

Dakota Brooks

Student Researcher, Victor Valley College, **mrXbrooks09@gmail.com**, 760.646.6098 (m)

In order to address the continued degradation of the nation's ecological resources in the face of global climate change and human population expansion the U.S. Federal Government, in 2015, initiated a multi-organizational program titled "The National Seed Strategy" (NSS). The goal of the NSS is to secure a stable source of regional specific, native seed for the use of future restoration efforts. This project, in partnership with the NSS, seeks to test propagation techniques for two Mojave Desert species: *Prosopis pubescens* (Screwbean Mesquite) and *Achnatherum hymenoides* (Indian Ricegrass), with each plant having their own unique problems to address. In the case of *P. pubescens*, the species has a high germination rate, but reportedly poor survivability. Therefore, the hypothesis was developed: Will the application of an organic, liquid fertilizer improve plant growth and survivability from seed to outplanting? Current results are limited, however flats that have been treated with the liquid fertilizer have had faster germination than the control, as well as more seedling emergence. Regarding the species *A. hymenoides*, the crux of the issue is a persistent physical and embryonic dormancy. This portion of the study focuses more on replicating the reported successes of various papers studying the germination of *A. hymenoides*, and seeing which of those might be a more viable for commercial propagation of the species. Early results show promise for one of the five treatments attempted, with three showing a need for retrial under a slight modification to better address the seeds physical dormancy.

Germination and Survivability of *Eriogonum fasciculatum* and *Grayia spinosa*

Jeremy Byrne

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A student research team at Victor Valley College (VVC) has embarked on a study to aid the Bureau of Land Management with the National Seed Strategy and restoration techniques in the Mojave Desert. The National Seed Strategy and our team has a goal to conduct research that will provide propagation techniques that will allow for maximum native seed production for restoration projects. This project is designed to provide the best results in the germination and survivability rates of *Eriogonum fasciculatum* and *Grayia spinosa*; two Mojave Desert native plants which are widely used in restoration. Within this project, eight separate flats have been planted (discluding replications) with 200 seeds each. The medium used contains two parts sand, two parts perlite, and 1.5 parts "native soil mix" from Lowes. Three specific variables were tested on each species with the first being scarification. The second variable was the use of a germination chamber which resulted in very quick germination rates. The third variable was the combination of scarification and the germination chamber. This had the most radical results with 180 out of 200 *E. fasciculatum* seeds that germinated within one week of planting; four times that of the controlled flat. This experiment has encompassed the goal of the National Seed Strategy and has served the Agriculture and Natural Resource Department of VVC. These three tested variables of *E. fasciculatum* and *G. spinosa* have built upon a solid foundation of plant science and serve as possibilities in the world of restoration.

Pond Draining to Enhance Native Amphibian Breeding Habitat: Lessons learned

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A major impediment to the recovery of California tiger salamander (*Ambystoma californiense*) and California red-legged frog (*Rana draytonii*) populations is the influx of nonnative predators in their breeding ponds. One management tool used to enhance habitat for imperiled native amphibians is periodic draining of perennial ponds where bullfrogs and nonnative fish are present. This poster presents lessons learned during four consecutive years of pond draining efforts at two ponds on an SFPUC Bioregional Habitat Restoration site in Alameda County, California. Successful pond draining efforts require advance planning and strategic use of equipment to reduce the level of effort and minimize impact to native species. This poster summarizes challenges we have encountered and solutions we have developed to inform future restoration efforts.

Partnering with Water: Restoring hydrology in Yosemite Valley

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Yosemite Valley's hydrologic systems are in the rare position of being fed by a relatively intact and protected watershed while being impacted by considerable local human

activities. Since the late 1800s, the Merced River and its tributaries in Yosemite Valley have been modified by actions including the removal of almost all large wood from the river, placement of extensive riprap, construction of undersized bridges, and trampling of riparian vegetation and subsequent bank erosion. The Merced River has widened by up to 120% in the valley since 1919, and management of streams in the valley has trended towards confinement and straightening. A warmer future climate is expected to shift precipitation from snow towards rain, increasing the incidence of rain-driven winter flooding, and reducing sustained snowmelt runoff into summer, causing drier conditions. Efforts to build resiliency in this system focus on increasing complexity in the river channel, restoring riparian vegetation, reconnecting the river channel to its floodplain, and restoring the water-holding capacity of adjacent meadow systems. In the past three years, National Park staff have installed 500 linear feet of floodplain-building log structures in the Merced River that precipitate increased channel complexity and a decrease in channel width. Park staff have also filled and/or plugged linear ditch features and removed old roadbeds and trails from nearby meadows, encouraging water to slow and spread out. Atmospheric river precipitation events and a record snowpack in 2017 jump-started the geomorphic and biological response to these actions, providing visible evidence of a system moving towards recovery.

Larrea tridentata and *Ericameria linearifolia* for Restoration

Maria Guzman-Ramos

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Victor Valley College and the BLM have partnered in order to decide the best methods to propagate selected California native plant species for the National Seed Strategy. *Larrea tridentata* is a very drought-tolerant plant that lives in the Mojave Desert. *Ericameria linearifolia* is another native plant found in the Mojave Desert and prefers rocky parts near creeks and other water sources. For this project, I conducted four different experiments including a control for *L. tridentata*, whereas there were two different experiments and a control for *E. linearifolia*. Per each *Larrea* experiment there were 200 seeds planted and an average of 60% to 70% survival rate to this present date. There was an experiment in which *L. tridentata* was left in a germination chamber in the dark and the result was a 70% to 80% germination rate. For *E. linearifolia* one experiment was done with ½:1:2 perlite, sand, and cocopeat ratio. After five days, the *E. linearifolia* resulted in an 80% germination rate. The second experiment of the *E. linearifolia* was done in 1:1 sand and gravel ratio. The germination rate after seven days was 60%. This increased to 80% within the next four days. Sandy, gritty soil its a native soil, but in this case, *E. linearifolia* did much better in a greenhouse soil mix. Alternatively, *L. tridentata* had better results by using the germination chamber which gave the seeds a dark environment to grow in.

Linking Herbaceous Plant Growth and Soil Recovery after Fire in California Shrublands

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Restoration strategies that target soil quality can drive revegetation efforts, enhance soil-based ecosystem services, and increase resilience to future disturbance. However, a challenge in implementing soil-based restoration goals is the lack of research linking above-ground and below-ground ecology. I investigated how naturally occurring herbs drive the recovery of post-fire soils in California chaparral shrublands. After fire, bare soil is coated with ash rich in mineral nitrogen, which provides fertilizer for recovering plants, but can also be washed away from soils, polluting nearby bodies of water and slowing shrub growth. Luckily, burnt chaparral soil is rapidly colonized by abundant and diverse native herbaceous plants. While these herb communities may only live for the two years after fire, they play a potentially important role in retaining ash nitrogen in soil and rebuilding soil organic matter. To test the impact of herb functional diversity on post-fire soil N-cycling, microbial activity, and organic matter formation, I introduced a landscape-scale herb-manipulation experiment (Mendocino County, CA). I weeded 2m x 3m plots so that they contained: (1) all naturally occurring herbs, (2) non-N-fixers only, (3) N-fixers only, or (4) no herbs. In tandem, I established fenced plots to exclude mammalian herbivores, which are predicted to accelerate soil recovery. Preliminary results show that post-fire soil restoration is driven by a mix of N-fixing and non-N-fixing herbs, and that herbivores stimulate sol recovery, especially where herb cover is naturally low. These results will help managers improve disturbed soils through strategic revegetation and grazer introduction.

Assisted Colonization of an Endangered Chaparral Shrub is Confounded by Exotic Root-rotting *Phytophthora* Species

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The endangered Coyote Ceanothus (*Ceanothus ferrisiae*), a serpentine chaparral endemic, is known from only three populations in Santa Clara County, CA, USA. In order to mitigate impacts to the largest population of Coyote *Ceanothus* from a planned seismic retrofit of Anderson Dam, a new population must be created proactively. A potential introduction site has been selected on

Coyote Ridge, north of the reservoir. In 2014, nursery stock planted at the introduction site was discovered to be universally contaminated by *Phytophthora cactorum*, a root-rotting pathogen. Planting basins were treated via solarization to remove the pathogen. Solarization was most effective in areas of full sun. Partly shaded basins remain infected and are currently under evaluation for other treatment methods, including heat treatment of soil by other means. Subsequent planting efforts at the site utilized a direct seeding method rather than nursery stock, with mixed results of seedling establishment. The past two years of planting have involved a combination of direct seeding and nursery material grown and installed via strict phytosanitary procedures. So far this method has resulted in healthy and vigorous plants establishing at the introduction site. This saga illustrates the complexity of conducting translocation and recovery activities in sensitive habitats and endangered species without the inadvertent introduction of pathogens, and requires new considerations in how such projects are designed and implemented.

Response of Wet Meadow Vegetation along a Hydrological Gradient after Passive Restoration

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We examined the vegetation community and structure of a wet meadow from 2013 to 2017 across ecological, temporal and spatial scales, immediately following hydrologic restoration. We set out to determine if the natural seedbank can act as a primary source for passive revegetation. We collected soils from 20 vegetation plots across a hydrologic gradient and germinated potential seeds in a greenhouse. Obligate (OBL) and facultative wetland (FACW) species germinated in all plots along the hydrological gradient. We compared seedbank composition with emergent vegetation using Sorensen's similarity index and found a higher similarity with OBL and FACW species (35–55%) than with facultative upland (FACU) and upland (UPL) species (17–29%) across all years. Annual vegetation surveys demonstrated that FACU species cover decreased gradually in drier plots by 2017, whereas the wettest plots were dominated exclusively by OBL and FACW species across all years. FACW species cover increased in plots between the hydrological extremes, while UPL and facultative (FAC) species cover decreased. The regeneration of OBL and FACW species was not constrained to seed producing species. The relative frequency of rhizomatous species *Carex simulata* and *Juncus balticus* remained stable throughout 2013–2017, and both species were able to propagate across a wide-range of hydrological conditions. Vegetation community composition was driven predominantly by depth to water (r2 = 0.444), soil moisture (r2 = 0.231), organic matter (r2 = 0.408), and organic carbon (r2 = 0.414). Our results provide evidence that passive revegetation can be a successful strategy after hydrologic restoration.

Are there Limits to Passive Restoration Following Non-native Grazer Removal? Long-term change (1929–2012) on the bare and denuded ridgelines of Santa Rosa Island, California

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Over 150 years of non-native ungulate grazing induced severe gully erosion and landsliding on Santa Rosa Island, California. In many cases, ridgelines were denuded down to the bedrock or regolith. All sheep, cattle, and feral pigs were removed from the island by 1998, and non-native mule deer and Roosevelt elk were removed by 2011. This allowed vegetation to recover, with dramatic increases in scrub, chaparral, and woodland vegetation. However, approximately 5.4 km^2 of bare ground remains. Long-term changes in bare ground were evaluated from 1929, 1964, and 2012 aerial photos and justified the need for active ecosystem restoration in order to establish vegetation on bare ridgelines. Restoration is required if Santa Rosa Island is to qualify for and become a proposed wilderness area. Representative 1 km^2 bare ground areas were selected on Soledad Ridge and Black Mountain and analyzed in a GIS. Results indicate that bare areas have changed very little from 1929, indicating that active restoration of these areas is necessary. Active restoration is currently occurring on the island that includes installing wattles, check dams, leaf litter traps, and fog capture screens, to build soil resources to prepare areas for reforestation. The bare ground delineations and current restoration efforts are helping Santa Rosa Island build a strong case as it moves towards transitioning from potential to proposed and eventually designated wilderness areas.

Can Ecological Scent-detection Dogs be Trained to Screen for *Phytophthora*?

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Phytophthora is a lethal and contagious plant pathogen. Introduced species have resulted in massive die-offs of native plants. Eradication is considered impossible. Early detection is critical. Current detection techniques require laboratory tests. In 2017, H. T. Harvey & Associates and U.C. Berkeley Forest Pathology and Mycology

Lab conducted a study to train dogs for scent recognition in a range of media, including two aqueous mixtures (pea broth and soil/water mixture), potting soil, and locally collected soil. *Phytophthora* species (*P. cactorum*, *P. cinnamomi*, *P. nemorosa*, and *P. ramorum*) were cultured in pea broth media to facilitated sporulation. The dog was led along a row of eight identical ventilated plastic containers. Four containers held *Phytophthora* species in one of the four media. Four containers held the same medium but without the *Phytophthora* propagule (control containers). Positive detections were immediately rewarded to "imprint" the target scent. Eventually, the dog displayed anticipatory, or "alert," behavior when she smelled the target odor. After the dog displayed recognition of the target odor, a scent recognition test was performed in which the dog-handler team was required to successfully indicate one randomly placed target container among seven control containers. The handler was unaware of the placement of the target container. The dog-handler team passed each test on its first attempt, achieving a positive alert to the target container in each of the 10 tests. Ecological scent-detection dogs may offer an innovative and reliable method to survey for *Phytophthora* in a variety of settings.

Santa Rosa Island Ironwood (*Lyonothamnus floribundus* ssp. *floribundus*) Demography and Grove Delineation: Is passive restoration following removal of non-native deer and elk browse enough?

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The island ironwood (*Lyonothamnus floribundus* ssp. *floribundus*) is a clonal endemic tree species with a relictual distribution on Santa Rosa Island, California. Ironwoods provide habitat and are an important component of Santa Rosa Island's unique island biogeography. Santa Rosa Island is situated in the middle of the Channel Islands and experienced significant anthropogenic degradation due to ranching and recreation. In particular, the island ironwood was affected by browse from Roosevelt elk and mule deer that were introduced for recreational hunting. The last remaining Roosevelt elk and mule deer were removed by 2011. We conducted a stand demography study to determine the conservation status and extent of passive restoration of *L. floribundus* ssp. *floribundus* following removal of non-native ungulates. We found seventeen groves growing in mid-elevation steep and rocky ravines. We measured DBH (diameter at breast height), total number of stems (including dead stems), height class, health class, reproductive status, and number of basal sprouts. We examined historic air photos and to a GPS track of the current extent of each grove to map stand distribution. We evaluated stand dynamics by landform type, slope percent, aspect, elevation, and history of browse. Results indicate there is a high density of dead stems but there is an abundance of clonal regeneration (basal sprouts) in the *L. floribundus* ssp. *floribundus* groves following removal of non-native ungulates from the island. These results indicate that passive restoration following removal of an ecosystem stressor is effective.

Large-scale Tamarisk Removal in Anza Borrego Desert State Park

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Located on the eastern boundary of Anza Borrego Desert State Park, Carrizo Marsh was a regionally important wetland and wildlife resource prior to 1976. In September 1976, a flash flood from Hurricane Kathleen created runoff that carried several feet of sedimentation into the marsh. This event changed the landscape and hydrology of the marsh and within in a few years the marsh was taken over by tamarisk scrub. As part of the mitigation for a renewable energy project, 318 acres of tamarisk is being eradicated from the marsh. This poster reports on the preliminary outcomes of the eradication effort, which consisted of prescribed burns, mechanical mastication, and herbicide treatment. Preliminary data analysis (vegetation transects, piezometer measurements, and vegetation community mapping) compares the recovery of native vegetation communities and depth-to-groundwater throughout the marsh in relation to the different treatment methods that were implemented. The data analysis compares baseline data prior to tamarisk removal with the data through the initial two years of maintenance. Qualitative comparisons related to observations of wildlife use throughout the marsh will also be presented to summarize avian point counts, focused surveys, and observations captured on wildlife cameras. The preliminary results of this regionally important effort are discussed with a focus on the benefits of conducting restoration on a large scale.

Monitoring Short- and Long-term Vegetation Changes Following Wet Meadow Restoration

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Historic and recent modifications have altered the hydrologic processes that sustain montane fens and wet meadows. Over the past 25 years much progress has been made in fen and wet meadow restoration, but few long-term studies exist evaluating restoration success. We examined the long-term restoration

success of Drakesbad Meadow, a fen-wet meadow complex in Lassen Volcanic National Park. In summer 2017, we re-sampled 25 vegetation plots and monitored groundwater monitoring wells established in 2002, prior to the 2003 phase one of hydrologic restoration. Results were mixed as some plots shifted their dominance towards more facultative species while others shifted towards more obligate wetland species. These shifts were correlated with changes in the depth to groundwater. In 2012, phase two of the hydrologic restoration occurred when ditch networks were filled with sediment and sedges were sporadically planted. We examined short-term (5 years) differences in vegetation functional groups between the new fill areas in restored ditches and adjacent wetland. By 2017, within the filled ditches, the mean percent cover of sedges was lower while the mean percent cover of forbs was higher compared with adjacent meadow plots. Monitoring both the long term and short-term changes in vegetation after hydrologic restoration gives a more complete assessment when evaluating restoration success.

The Effectiveness of Erosion Control Structures and Fog Capture Screens at a Cloud Forest Restoration Site, Santa Rosa Island, California

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Santa Rosa Island (SRI) is the second largest island in Channel Islands National Park. Although local plant species evolved without ungulate grazers, non-native grazers were present at high densities for over 150 years. Overgrazing led to deforestation, severe gully erosion, and landsliding beginning in the late 1800s. Some ridgelines were denuded down to the bedrock or regolith, and require active soil-building before vegetation can be restored. The National Parks Service and the U.S. Geological Survey is currently conducting island oak (*Quercus tomentella*) woodland restoration project on Soledad Ridge. Island oaks are unique in that they depend on fog drip for summer soil moisture. Fiber wattles, rock wattles, check dams, leaf litter traps, and fog capture screens were placed on Soledad Ridge to restore soil and water resources and prepare for active tree and shrub planting. We evaluated the effect of fiber wattles, rock wattles, leaf litter traps, and fog capture screens on soil and vegetation. We established nine slope profiles in areas where erosion control structures and fog capture screens were built and in areas where no treatment had occurred. We measured the change in slope over three years by taking annual elevation measurements at slope inflection points with a Total Station. We also measured annual changes in vegetation cover by establishing point-intercept transects along the slope profiles. Data indicates that the erosion control structures are effective at trapping a thin layer of soil and promoting grasses and forbs within the first three years. Some woody tree and shrub recruitment was observed, though it is likely that woody species establishment will be slow and active planting will be necessary.

Automated Mapping of Specific Plant Species Using High Resolution Drone Imagery

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At a 93-acre tidal marsh site located within the Snohomish River estuary in Everett, Washington, monitoring has been performed since restoration began in 2006 with a dike-breaching project. Collection of data by traditional methods (e.g., walking transects and documenting conditions) was time-consuming with potential safety risks due to the size of the site and surficial soil characteristics. To reduce time and cost required for monitoring, as well as improve safety for the monitors, a new technique was used for data collection in 2017. Using a DJI Phantom 4 Advanced Unmanned Aerial Vehicle (UAV, or drone) we collected roughly 2,600 high-resolution images of the site over the course of four hours. These images were stitched together, orthorectified and fed into the QGIS Semi-Automatic Classification Plugin. Training classes were defined for our target invasive species (purple loosestrife) in order to distinguish it from two other similarly colored plants on the site. The algorithm was applied to the entire site, identifying pixels with hues similar to that of purples loosestrife. Results were checked against the imagery, and validated existing knowledge of the site. This technique allowed us to rapidly assess the entire site in less than a week, and in half the time it would have taken using traditional methods. Furthermore, we were able to collect the data with a precision equal to or greater than the previous methods. The successful implementation of this method will be of benefit to upcoming vegetation monitoring work in California.

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Hedgerow Farms specializes in producing high quality seed of origin-known, wildland collected California native grasses, forbs, sedges and rushes. We offer seeds in single species or custom seed mixes, plug containers and native grass straw. We provide free seed mix consultation services for customers who buy our seed. Our seeds and plants are used in wildlife habitat restoration projects, agricultural revegetation projects, for erosion control and urban and rural landscaping.

Contact: Patrick H. Reynolds, General Manager — 530.662.6847
preynolds@hedgerowfarms.com

ICF

www.icfi.com

Environmental planning, natural resource management, habitat restoration.

Contact: Lindsay Teunis, Southern California Restoration Team Manager —858.444.3906 **lindsay.teunis@icf.com**

525 B Street, Suite 1700, San Diego, CA 92101

Masters in Conservation and Restoration Science UC Irvine

mcrs.bio.uci.edu

The Masters in Conservation and Restoration Science (MCRS) is a professional degree program designed to provide the graduate with the skills and knowledge base necessary to hold leadership and management positions in environmental fields related to conservation, restoration, and sustainability. This is a highly collaborative program, portions of which will embed students into real-world conservation and restoration settings through community partnerships.

Contact: Marni Falk, Academic Coordinator —
uciconresscience@uci.edu

SERCAL 2018 Sponsor Exhibitors

Booths located in the Baja Room

Moosa Creek Nursery

www.moosacreeknursery.com

Moosa Creek Nursery is an experienced native plant grower offering over 400 species of California native trees, shrubs, grasses and groundcovers grown to ensure a high survivability rate on your project. Past projects include CSS, riparian, saltmarsh, wetland and desert species. Select from our extensive inventory or use our contract growing services. Our IPM practices and bio-control methods produce hardy, naturally grown, disease-free plants. Small Business Certification SB(micro) # 61858.

Contact: Su Kraus — **nursery@moosacreek.com** 760.749.-3216

Pacific Coast Seed

www.pcseed.com

California Native grasses, wildflower and forbs; Site-specific seed collection.

Contact: David Gilpin, General Manager — 925.373.4417
info@pcseed.com

533 Hawthorne Place, Livermore 94550

RECON Environmental, Inc.

www.reconenvironmental.com

Environmental Consulting and Habitat Restoration Services .

Contact: Robert Hobbs, Principal — 619.308.9333
rhobbs@reconenvironmental.com

1927 Fifth Avenue, San Diego 92101

Rocky Mountain Bio Products

www.RockyMtnBioproducts.com

Supplier of organic fertilizers and soil amendments.

Contact: Tom Bowman Division President — 303.696.8964
Tom@bowmanconstructionsupply.com

10801 E. 54th Avenue, Denver, CO 80239

S&S Seeds, Inc.

www.ssseeds.com

S&S Seeds, Inc., is a full-service provider of seeds for reclamation and revegetation projects. We also offer site collection, cleaning, conditioning, and increase-growing services to ensure the availability of the right seed from the right source at the right time..

Contact: Jody Miller — 805.684.0436 **info@ssseeds.com**

Stover Seed

www.stoverseed.com

Independent seed company with 96 years of experience. We have earned our reputation by exceeding our customer's needs with every opportunity. We inventory Native Grass, Shrub, Wildflower and forbs seed for reclamation, erosion and restoration projects. Assets; source specific / Site specific seed collections, seed conditioning, storage, packaging and delivery.

Contact: Stephen Knutson, CEO — 800.621.0315
stephen_k@stoverseed.com

Westervelt Ecological Services

Wesmitigation.com

Westervelt Ecological Services specializes in creating mitigation and conservation projects and provides environmental mitigation and habitat planning services to landowners, businesses, and government agencies. Through their work, Westervelt has restored over 8,000 acres of wetland and endangered species habitat on over 18,000 acres of preserved properties nationwide.

Contact: Travis Hemmen, Vice President — 916.646.3644
themmen@westervelt.com

Many thanks to SERCAL's 2018 Sponsor Exhibitors

Wildlands

www.wildlandsinc.com

Description: Wildlands is a national leader in establishing wetland mitigation banks, special-status species conservation banks, and project-specific habitat mitigation preserves that protect wetlands and wildlife habitat in perpetuity. Dedicated to the restoration and preservation of wetlands and special-status species habitats, Wildlands focuses on procurement, habitat development, and long-term management of projects throughout the western United States, providing robust mitigation solutions. Wildlands is based in Rocklin, California and has a regional offices in Portland, Oregon.

Contact: Julie Maddow, Inside Sales Manager — 916.435.3555
jmaddox@wildlandsinc.com

3855 Atherton Road, Rocklin 95765

WRA, Inc.

www.wra-ca.com

WRA, Inc. provides professional consulting services in plant, wildlife, and wetland ecology, regulatory compliance, mitigation solutions, environmental planning, GIS, and landscape architecture. Formed in 1981, we are a certified small business with nearly 80 professionals who collaborate with public agencies, non-profit, and private organizations on restoration projects large and small. WRA is a leader in the restoration and enhancement of California's natural ecosystems including diverse tidal, riparian, and aquatic habitats, critical to many endangered and threatened plant and wildlife species endemic to each region. For more than 35 years, WRA's multidisciplinary staff has successfully managed complex projects from initial feasibility and planning stages through project implementation and long-term monitoring. WRA is also a leader in design and implementation of wetland and species conservation banks throughout the stat.

Contact: Liz Agraz, Marketing Director — 415.524.7245
agraz@wra-ca.com

We're Looking for a Few Great Volunteers!

Want to take a more active role in California's restoration community? SERCAL has some opportunities for you:

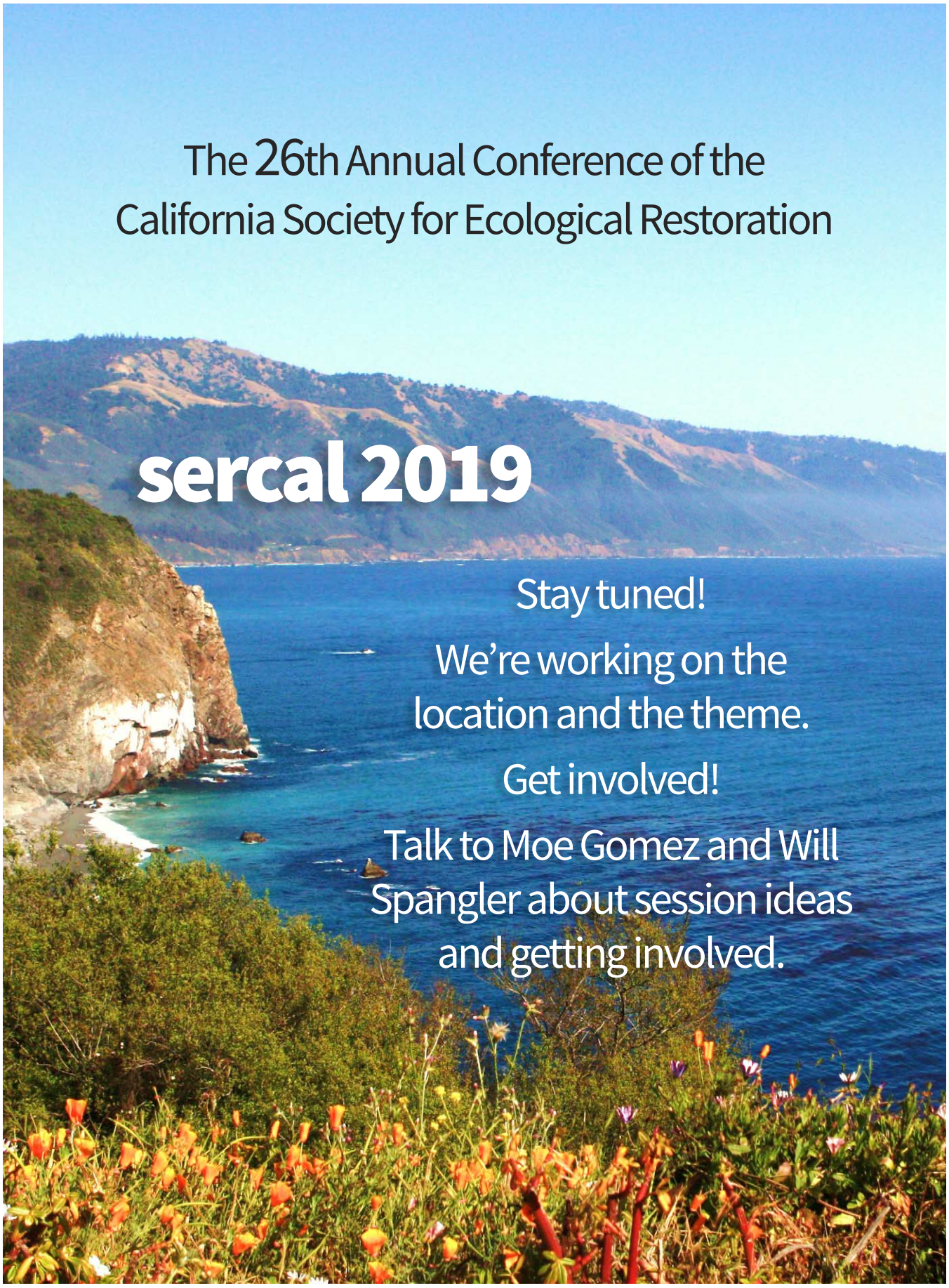
Join a Committee! Communications and **Budgeting & Marketing** both have openings.

Write an article for Ecesis! Our Communications Committee is developing upcoming issues on mitigation, technology, habitat design, rare plants, large-scale invasive species control, restoration or habitat design for threatened wildlife, vernal pools, watershed restoration, andmonitoring to inform future project development.

Join the SERCAL Board! Ask one of our Board members about opportunities. Elections are held in the Fall of each year.

Lastly, the SERCAL Board of Directors is seeking a Treasurer for our organization.

We are looking for an individual who is ideally a CPA, or at least well conversant in financials. If you are interested, please talk with one of our Board members at the conference or email julie.sercal@gmail.com.


The 26th Annual Conference of the
California Society for Ecological Restoration
sercal 2019
Stay tuned!
We're working on the
location and the theme.
Get involved!
Talk to Moe Gomez and Will
Spangler about session ideas
and getting involved.