



SERCAL 2020

Shedding Light in Challenging Times

A Webinar-Style Conference in September 2020

Visit sercal.org to register

Welcome! And thank you for joining us.

A standing ovation to our intrepid Conference Chair, **Thor Anderson**, who has now imagined and created two conferences in just one year.

Great appreciation to our Fall Session Chairs who have co-navigated Zoom with us, and to our Spring Session Chairs who crafted these sessions and will, we all hope, lead them next Spring.

Many thanks to all of our presenters, Spring and Fall, who are sharing their work for a better understanding of this work we do.

And to our Sponsors, a deep bow of gratitude for your support. This has been a challenging year for all of us to negotiate, but your generosity made it possible for our organization to keep on keeping on.

And now without further ado, the schedule and abstract for our 8 sessions, Tuesday and Thursday afternoons, in the month of September...

Tuesday September 1st — Plenary Speaker and Managing Invasive Plants

Plenary Speaker and Session Chair: Bruce Delgado, Bureau of Land Management



1:00 Session Welcome

1:10 Plenary Presentation by Bruce Delgado: Creativity in Challenging Times to Sustain Wildland Resource Protection

1:40 Ashley Zavagno: Evaluation of Invasive Weed Approach in Large-scale Restoration

2:05 Tom Reyes: Blurring Imaginary Lines: Collaborative Land Management Through WMAs

2:30 Emily Zefferman: Progress of Passive Restoration in Former *Arundo donax* Stands along the Salinas River

2:55 Session Closes

3:00 Meet and Greet with Session Sponsor: Burleson Consulting



Evaluating Invasive Species Management Approaches in Large-scale Restoration Projects

Ashley Zavagno, MESM, Senior Restoration Ecologist, CERP, CE

WRA, Inc. zavagno@wra-ca.com

Invasive species are a challenging and pervasive problem in restoration projects, particularly in California. Management approaches vary based on numerous factors including target species, financial cost, efficacy, potentially deleterious environmental effects, and practicality. This presentation will explore the costs and benefits of several approaches to invasive species control in the context of specific restoration projects from both Northern and Southern California. It will cover approaches and topics such as conservation grazing, targeted versus general chemical treatments, grow-kill treatments, and how irrigation can affect invasive species. Example projects and approaches will include a variety of species and ecosystems that present unique challenges and discuss the factors that should be considered when selecting an approach.

Thank you to our Sponsor Host:



Burleson Consulting Inc.

Woman-Owned Small Business

Environmental Puzzle Masters

Blurring Imaginary Lines: Collaborative Land Management Through Weed Management Areas

Tom Reyes^{1*} and Nancy Poss (npos@smcgov.org)

¹Integrated Pest Management Coordinator, Midpeninsula Regional Open Space District, treyes@openspace.org

Weed Management Areas (WMA) are collaborative stakeholder groups that help bring together the land management community to share resources, ideas, expertise, outreach programs, and encourage collaborative invasive plant management projects. Participants of WMAs are government agencies, non-profit organizations, and private partners. By working together, WMA partners can build off of the progress of one another, and encourage thinking about ecological issues at a regional scale.

Originally developed by the California Department of Food and Agriculture (CDFA) in 1999, there are now 48 WMAs throughout California, covering all areas of the state. In the first few years of the WMA program, CDFA helped fund the eradication of more than 2,000 high-priority weed infestation, and the treatment of over 128,000 acres throughout the State. Funding for WMAs lapsed in 2004, but with the help of advocacy from the California Invasive Plant Council, CDFA was able to acquire additional funding in 2018 which has been distributed in grants throughout the State. Despite the lapse of funding, some groups such as the San Mateo WMA have remained active continuously since inception. The San Mateo WMA has a lively cohort of 19 signatories who participate in regular bimonthly meetings and have accomplished several collaborative projects over the years.

The collaborative framework of WMAs has been successful in accomplishing cooperative invasive plant management projects, and can be used as a model to address many different land management issues, including ecological restoration, rare plant conservation, and wildlife management.

Passive Restoration in Former *Arundo* Stands: Who is Filling the Vacuum?

Emily Zefferman^{1*}, PhD Ecologist, and Sarah Gaffney²

¹Resource Conservation District of Monterey County, emily.zefferman@rcdmonterey.org ²University of California Davis, Graduate Group in Ecology, sagaffney@ucdavis.edu

The Resource Conservation District of Monterey County has been conducting a large-scale *Arundo donax* (arundo) control program along the Salinas River since 2014. Arundo is an invasive non-native bamboo-like plant that has invaded over 1,500 acres of the Salinas River riparian corridor. Arundo reduces habitat quality, transpires large amount of water, and exacerbates flood risk. Typical treatment includes mowing in year 1, followed by spraying re-growth in year 2, and spot-treating in year 3 and as needed in subsequent years. To-date, the RCDMC has initiated treatment on 700 acres of arundo along 47 river miles.

Due to the scale of the project, and the fact that the work is conducted almost entirely on private property with limited access, we have been relying on natural recruitment to revegetate treated arundo stands. To assess the results of this approach, we began conducting annual plant community surveys in spring 2017 on arundo mowed in 2016. Three years of data show a dramatic decrease in the density of arundo in treated stands: on average, after two years of spraying, the number of arundo canes decreased 99% while arundo cover decreased to just 0.3%. While percent cover of native grasses, forbs, and woody plants have all increased, non-native forbs and annual grasses are increasing in cover at a faster rate. In light of this, we are considering a pilot project to assess the effectiveness of actively planting seed and/or plugs in former arundo stands.

Thursday September 3rd — Grassland Ecosystems, Part 1

Session Chair: J.P. Marié, California Native Grasslands Association and UC Davis



1:00 Session Welcome

1:10 Taraneh Emam: “Translocation” of Mature Needlegrass: It works!

1:25 Sarah Gaffney: Temporal Priority Leads to Native Grass Resistance of Noxious Weeds

1:45 Christopher Hart: A Partnership to Manage Coastal Grasslands Using Goats

2:05 Julia Michaels: Grazing Affects Vegetation Diversity and Heterogeneity in California Vernal Pools

2:25 Brianne Palmer: Vegetation and Biological Soil Crust Communities Differ in Resilience to Grassland Fires

2:45 Session Closes

2:50 Meet and Greet with Session Sponsors: S & S Seeds, Habitat Restoration Sciences, and Dudek



“Translocation” of Mature Needlegrass — It Works!

Taraneh Emam

ECORP Consulting, Inc. temam@ecorpconsulting.com

Restoration of native bunchgrasses within existing non-native grassland can be challenging and often requires extensive site preparation and management to allow seeding or plug planting to be successful. One option that has not been well-documented in restoration literature is to ‘translocate’ existing, mature bunchgrasses from other areas.

ECORP Consulting, Inc., translocated mature purple needlegrass (*Stipa pulchra*) into existing grassland from several sites planned for development within preserved areas. We will present qualitative findings showing initial success (1–3 years post-translocation) of this approach, when implemented correctly, and will discuss recommended methods and considerations.

Thank you to our Sponsor Hosts:



Temporal Priority Leads to Native Grass Resistance of Noxious Weeds

Sarah Gaffney* (sagaffney@ucdavis.edu), Carolyn Malmstrom (carolynm@msu.edu), and Valerie Eviner (veviner@ucdavis.edu)

A central challenge to restoration is providing long-term suppression of invasive species. Planting native species that are functionally similar to invaders can be an effective approach. In California, established native perennial grasses can suppress invasion of the noxious weeds goatgrass (*Aegliops triuncialis*) and medusahead (*Elymus caput-medusae*), as they can successfully compete for late-season soil moisture. However, dynamics at patch edges are unknown and may allow goatgrass and medusahead persistence in restored native patch edges; therefore to fully understand long-term native suppression of noxious weeds, we must explicitly study patch edges.

In this study, we investigated a) the importance of priority effects for native grass establishment and suppression of noxious weeds, b) the spatial patterns of noxious weeds in these native-planted communities, and c) how long-term precipitation treatments affect these outcomes. We performed a spatially explicit composition sampling (centers vs edge) of eleven-year-old experimental grassland plots. These plots were originally seeded with various mixtures of native, naturalized, and noxious weed plants and later placed under normal, wet, and drought conditions. Plots were allowed to be naturally invaded by species included in the study.

In native-only planted plots, natives had high cover 11 years after seeding, as well as low noxious weed cover in the edge and the core. These results were similar across precipitation treatments. Our study shows that seeding natives in the absence of noxious weeds results in priority effects that allow long-term persistence and invasion resistance across precipitation patterns, and patch spatial dynamics do not create spatial refuges for invaders.

A Partnership to Manage Coastal Grasslands Using Goats

Christopher Hart

Bureau of Land Management, chart@blm.gov, 760.508.6931

Since 1960, sheep have been used to reduce fuel accumulation on Fort Ord National Monument (FONM) grasslands. In 2014, the Bureau of Land Management (BLM) determined that passive sheep grazing was not being effective at reducing fuel loads, and transitioned into using targeted goat grazing as a management tool. Goats R Us provide BLM livestock to graze grasslands from October to April. Grazing objectives are 1) reduce encroachment of Coyote Brush Scrub into Coastal Grassland, 2) reduce residual dry matter (RDM) to 1200 lb/acre, and 3) increase abundance of native grasses and forbs. BLM has relied extensively on community partnerships such as faculty and university students from California State University at Monterey Bay to assist in both data collection and analysis. Since 2014, BLM has determined that goat grazing can reduce the encroachment of Coyote Brush Scrub, however there has been a concurrent increase in abundance of non-native forbs and annual grasses. BLM and its partners are experimenting with new techniques of goat grazing to reduce biomass of non-native grasses and to promote native grassland diversity. One technique being evaluated is targeted goat grazing select areas of coastal grassland 2–3 times per year. Preliminary results suggest that this reduces the cover of non-native grasses, and creates open ground for forb and bunchgrass abundance to increase. This active grazing regime gives the BLM an opportunity to manage coastal grassland to both reduce fuel accumulation and increase native plant abundance in FONM Coastal Grassland.

Grazing Affects Vegetation Diversity and Heterogeneity in California Vernal Pools

Julia Michaels^{1*}, E. Batzer(ebatzer@ucdavis.edu), S. Harrison (spharrison@ucdavis.edu) and V.T. Eviner (veviner@ucdavis.edu)

¹University of California, Davis

California vernal pools have high spatial heterogeneity at multiple scales: (1) within pools (as inundation changes with topography), (2) between pools (as pool differences in soil type, topography, and hydrology alter communities), and (3) across the landscape due to management (e.g. pastures) and variability in soil type and hydrology. We measured grazing impacts on plant communities and found that grazing increased species evenness at all three scales by reducing the abundance of dominants. This reduction in competition increased the abundance of sub-dominants, increasing species at the zone and pool scale, without any change in species richness at the pasture level. Colonization by sub-dominants was limited to uplands and the zone that lies at the transition between the uplands and the pool bottoms, but there was no effect of grazing on the pool bottom, where inundation is the key factor determining vegetation. Spatial heterogeneity across zones within pools (vertical β diversity) was driven by dominant species varying from an inundated to upland gradient, and rare species did not play a role in this zonation. Grazing did not alter the vegetation zonation within pools — the inundation gradient effect remained as the key controller within pools. Due to the increase in the number of rare species with grazing (alpha diversity), there was a decrease in between pool diversity (horizontal β diversity), but the dominant species remained constant. We can conclude that, in our vernal pool study system, grazing increased diversity by altering competitive dynamic without disrupting the heterogeneity that is structured by abiotic constraints.

Vegetation and Biological Soil Crust Communities Differ in Resilience to Grassland Fires

Brianne Palmer^{1,2} (bpalmer@ucdavis.edu), David Lipson¹ (dlipson@sdsu.edu), Dawn Lawson^{3,4} (dmlawson@spawar.navy.mil), and Jon Keeley⁴ (jon_keeley@usgs.gov)

¹San Diego State University ²University of California, Davis ³US Navy ⁴US Geological Survey

Grasslands harbor diverse vegetation and biological soil crust (biocrust) communities which interact but may have different responses to disturbance, sending the communities on separate successional trajectories. We used field surveys and microbial techniques to assess how a wildfire and prescribed fire altered the plant and biocrust community composition in grasslands on San Clemente Island. After a fire, there is a shift in the overall plant community driven primarily by the decline in nonnative grass abundance and an increase in nonnative forbs. Native grasses and forbs remained in low abundance, with a slight increase one year after the fire. Trends were similar between the wildfire and prescribed fires. However, the biocrust community did not respond in the same way as its vascular counterparts. Biocrust cover increased and maintained high levels of cover up to least 6 years after the fire. Based on shotgun metagenomic DNA sequences, fire had no effect on the overall community composition or composition of functional genes, rather the microbial community and function were determined by site characteristics. Nevertheless, key biocrust functions were altered by fire and have the potential to influence the plant community. For example, the number of genes involved in nitrogen fixation were lower after fire. Although there is no correlation between nitrogen fixation and plant abundance, this warrants further exploration of the relationship between biocrust functions and vascular plant communities. Biocrusts may mediate the recovery of vascular plants after fire by maintaining high microbial diversity and functional diversity after fire.

Tuesday September 8th — Restoration for Wildlife, Part 1

Session Chair: Cara Clark, Central Coast Wetlands Group



1:00 Session Welcome

1:10 Kelly Santos: Factors Affecting Endangered *Suaeda californica* Establishment and Use as High Tide Refuge in San Francisco Bay

1:40 Robert Freese: Arthropods as Indicators of Restoration Success

2:10 Courtney Casey: Otoy River Restoration Project: Building a Better Future for Least Bell's Vireo

2:40 Session Closes

2:45 Meet and Greet with Session Sponsor: SWCA



Factors Affecting Endangered *Suaeda californica* Establishment and Use as High Tide Refuge in San Francisco Bay

Kelly Santos^{1*} (kellyannhickman@gmail.com), Melissa Patten¹ (mypatten@sfsu.edu), Peter Baye² (botanybaye@gmail.com), and Katharyn Boyer¹ (katboyer@sfsu.edu)

¹Estuary & Ocean Science Center, San Francisco State University ²Annapolis Field Station, Annapolis, CA

Suaeda californica is a federally endangered coastal wetland shrub that occurs in a narrow high tide zone along salt marsh edges or estuarine beaches. The original native San Francisco Bay (SF Bay) population became extirpated around 1960. Plant material from Morro Bay was used to propagate and reintroduce *S. californica* to SF Bay in 1999, and roughly 30 total plants have survived until now. As these low numbers hardly represent a restored population of *S. californica*, and the plants have not successfully self-recruited from seed, research is needed to understand the best methods to restore *S. californica* populations. The objectives of this project were to 1) determine the effects of abiotic conditions, including freshwater availability and organic matter, on the germination of *S. californica*; and 2) evaluate the efficacy of “arbors” (various configurations of wooden branches as support) to enhance height growth of *S. californica*, which might enhance high tide refuge for endangered animals such as the Ridgway's rail and the salt marsh harvest mouse. Results show that *S. californica* seeds have a higher germination rate when exposed to fresher water conditions and that experimental arbors do increase the height and size of plants in an SF Bay salt marsh. Understanding factors that promote *S. californica* reproduction, germination, and growth will aid future larger scale reintroduction efforts for this endangered plant while capitalizing on its potential to provide high tide cover for endangered and other wildlife in the face of sea level rise.

Thank you to our Sponsor Host:

SWCA

**100%
Employee
OWNED**

Arthropods as Indicators of Restoration Success

Robert Freese^{*1}, Nicole Tamura¹, Collin Raff¹, Jutta Burger², and Rachel Kenny¹

¹Irvine Ranch Conservancy, (rfreese@irconservancy.org) ²California Invasive Plant Council

Arthropod richness and diversity can be good indicators of ecological function. Irvine Ranch Conservancy uses pitfall and yellow pan traps to sample arthropod communities of restored habitats over the course of several years. These data are used as one measure to evaluate restoration success. Arthropod communities exhibit high levels of interannual variability. Therefore, it is advisable to have more than one year of baseline data and end-of-project data. Different habitat types show different trajectories in arthropod community development. Species richness and diversity of functional and taxonomic groups (measured by Simpson's evenness index) increased for CSS and oak woodland habitats but grassland restoration areas showed little or no gains in arthropod diversity. This may be due to increased vegetation structure and niche availability in habitats with woody vegetation. Herbivore numbers were greater in transects with high native cover. Other functional groups such as detritivores, scavengers, predators, and parasitoids were proportionally more important in transects with high nonnative cover. Various measures of arthropod diversity are considered. Argentine ants (*Linepithema humile*) and other non-native ant species may pose a threat to native arthropod diversity. Care should be taken to ensure that restoration practices such as irrigation and truck traffic do not increase their distribution.

Otay River Restoration Project: Building a Better Future for Least Bell's Vireo

Courtney Casey, Restoration Biologist

ICF, 884 Sapphire Street San Diego, CA 92109, 714.604.8064, Courtney.Casey@icf.com

The Otay River Restoration Project involves the removal of invasive species such as tamarisk and the restoration of approximately 100 acres of channel, floodplain, and upland buffer. Historically, least Bell's vireo (*Vireo bellii pusillus*) have occupied the Otay River. However, reductions in their population and distribution is associated with widespread loss of riparian habitats throughout California in addition to brood parasitism by the brown-headed cowbird (*Molothrus ater*) (USFWS 1994). Pre-restoration survey efforts conducted throughout the Otay River Restoration boundary demonstrated that vireo were extensively using mature upland shrubs as nesting habitat which is likely due to the lack of quality riparian habitat. The first phase of the Project has restored over 60 acres of floodplain habitat that was previously dominated by tamarisk scrub. Restored vegetation communities support shrub communities such as willow scrub, mulefat scrub, and elderberry scrub as well as riparian forest. Restoration efforts have also connected patchy riparian habitat that was limiting the use of the floodplain in the middle of the site. Survey efforts conducted during and after the restoration phase show that vireo territories were undisturbed during restoration activities and most territories remained the same as pre-restoration territories. However, as the restored and enhanced vegetation communities are ideal for vireo, it is anticipated that their populations will expand throughout the restoration site as the vegetation matures. Survey efforts will continue in order to document post-restoration population and distribution.

**Thursday September 10th — Landsat, Drones, and Ferries:
Novel Techniques to Improve Management, Restoration and Monitoring**

Session Chair: Eric Donaldson, Balance Hydrologics



1:00 Session Welcome

1:10 Andy Lyons: From Images to Information — An Overview of Drone Data Processing, Analyses, and Tools

1:40 Andrew Fox: Invasive Plant Species Mapping Using Drones in the Santa Ana River Watershed

2:10 Christine Albano: Assessing the Effects of Climate and Management on Meadow and Riparian Vegetation Using the Landsat Archive and Cloud Computing — Tools and Applications

2:40 Brandon Sackmann: Ferries for Science + Internet of Things — Developing a Low-cost Environmental Monitoring Solution for Vessels of Opportunity

3:10 Session Closes

3:15 Meet and Greet with Session Sponsor: Westervelt Ecological Services



From Images to Information: An Overview of Drone Data Processing, Analyses, and Tools

Andy Lyons* (andlyons@ucanr.edu) and Sean Hogan (sdhogan@ucanr.edu)

Informatics and GIS Statewide Program, University of California Division of Ag & Natural Resources

Advances in drone hardware and data processing have made drones a standard data collection tool for environmental planning and monitoring. The ability to collect extremely fine resolution RGB and multi-spectral imagery, on-demand, and at modest cost has resulted in new streams of 2D and 3D data of increasing quality and frequency. Drone data is commonly used to classify vegetation, generate high quality topographic models, rapidly identify and count features, and measure change over time. The pipeline from images to information however tends to be long, unfamiliar, and rapidly evolving as new data processing tools and platforms are developed. This session will review the workflow in converting raw drone images into useful 2D

Thank you to our Sponsor Host:



and 3D data products, and review the software options at each step. Both proprietary and open source options will be discussed, with an assessment of the hardware requirements and learning curves. Linking the various steps together requires data quality checks and a sound data management system. We discuss the data management protocols and automation tools developed by a drone services unit within the University of California Cooperative Extension system, developed over 3 years of drone mapping projects for agriculture and natural resources. Drones give us the ability to view landscapes at an unparalleled level of detail and accessibility, but tapping this power requires a sophisticated set of tools to transform data into information once the flight is over.

Invasive Plant Species Mapping Using Drones in the Santa Ana River Watershed

AJ Fox^{1*}, Sloane Seferyn¹, Greg Kaganyuk¹, Varren Anacleto¹, and James Law²

¹HANA Resources, Inc., ajfox@hanaresources.com, 949.648.4988, 20361 Hermana Circle, Lake Forest, CA 92630

²Santa Ana Watershed Association

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

Assessing the Effects of Climate and Management on Meadow and Riparian Vegetation Using the Landsat Archive and Cloud Computing — Tools and Applications

Christine Albano* (christine.albano@dri.edu), Britta Daudert, Mark Hausner, Dan McEvoy, Ken McGwire, Blake Minor, Charles Morton, Chris Pearson, and Justin Huntington

Desert Research Institute

Ecological restoration activities are often focused on meadows and riparian areas given the important ecosystem services they provide, but assessing the long-term effectiveness of these activities can be challenging due to high costs, lack of long-term monitoring data, and confounding influences of climatic variability on ecological conditions. Recent advances in cloud computing can now help to address these challenges, by

allowing efficient and cost-effective processing and analysis of multiple decades' worth of satellite remote sensing and climate datasets over large geographic extents. In this presentation we demonstrate the application of these data to better quantify the roles of climate variability and management on meadow and riparian vegetation, using examples from the Sierra Nevada and Great Basin. In addition, we introduce the Climate Engine tool (<https://climateengine.org/>) — an easy-to-use web-based application that enables customized visualization and access to satellite remote sensing and climate data that can be used to gain insights into site-specific responses of vegetation to management actions

Ferries for Science + Internet of Things: Developing a Low-cost Environmental Monitoring Solution for Vessels of Opportunity

Brandon Sackmann, Ph.D.^{1*} (bssackmann@gsienv.com), Kenia Whitehead, Ph.D.¹ (kwhitehead@gsienv.com), Hannah Podzorski¹ (hpodzorski@gsienv.com), and Christopher Krembs² (ckre461@ecy.wa.gov)

¹GSI Environmental Inc., 611 Columbia Street NW, Suite 2C, Olympia WA 98501 ²Washington State Department of Ecology, 300 Desmond Drive SE, Lacey WA 98503

Increasingly, platforms of opportunity (e.g., ferries) that can be equipped with adaptive and reliable sensor networks to collect environmental data have become indispensable and cost-effective alternatives for providing real-time information in undersampled areas. The Washington State Department of Ecology's Ferries for Science program is currently expanding with a new sensor suite and data management system that will be installed on the Victoria Clipper V (VC-V) passenger ferry that runs between Seattle and Victoria, B.C. The new system will continuously collect water quality measurements (e.g., temperature and salinity) along the main axis of Puget Sound and include a flowing seawater system so that georeferenced water samples can be collected while the ship is en route. Sensors placed throughout the ship will broadcast data to a central onboard server using a publish/subscribe messaging system that will make it easy to integrate new sensors into the system as needs evolve. The sensor suite incorporates both wired and wireless sensor nodes to accommodate physical and electrical constraints that limit where equipment can be installed. The types of data collected will include both continuous sensor data and imagery, and all data will be logged to an onboard relational database to overcome challenges associated with intermittent cellular internet coverage. Data will be transmitted daily to a cloud-based data management system for post-processing, evaluation, dissemination to end users (including regional data repositories), and visualization through a custom web portal being developed using the open source R/Shiny framework.

**Tuesday September 15th — Greenspaces and Trails:
Restoring Landscapes for Wildlife and People**

Session Chairs: Ron Unger and Vicky Monroe, CDFW



1:00 Session Welcome

1:10 Ron Unger: Overview of Challenges, Successes, and Suggestions for Trails on Conservation Lands

1:30 Vicky Monroe and Dr. Alex Heeren: California Department of Fish and Wildlife's Conflict Programs

1:50 Lindsay Teunis: River Restoration, Mitigation, and Public Trails — Finding Balance for All

2:10 Fred Watson: A Trail and Greenway System as a Means of Facilitating Ecological Corridors

2:20 Q&A Panel

2:35 Justin Suraci: Quantifying the Impacts of Human Activity on Wildlife Behavior

2:55 Susan Townsend: Wildlife Response to Human Access to Public Open Space

3:15 Milan Mitrovich: Know Your Audience — Importance of Including the Public in Restoration

3:35 Q&A Panel

3:50 Session Closes

3:55 Meet and Greet with Session Sponsor: H. T. Harvey & Associates



Thank you to our Sponsor Host:



H. T. HARVEY & ASSOCIATES

Ecological Consultants

50 years of field notes, exploration, and excellence

Overview of Challenges, Successes, and Suggestions for Trails on Conservation Land

Ron Unger

California Department of Fish & Wildlife, PO Box 944209, Sacramento, CA, 94244-2090,
ronald.unger@wildlife.ca.gov, 916.376.8686

Conservation and mitigation efforts in California often result in the establishment of conservation and mitigation lands dedicated to the protection of species and their habitats. These lands are typically managed by open space districts, local parks departments, land trusts, federal or state agencies, and others. Recreationists often see these lands as valuable for recreation, especially due to their open space or pristine qualities. Conversely, land managers often struggle to protect the conservation values of the land from being lost or adversely affected by recreation uses or from being “loved to death”. This presentation will provide a brief overview of some of the management challenges and success stories in planning for recreation trails on conservation land. It will provide some advice on how to address this issue, tools available to determine the types and extent of recreation access that should be allowed, and potential ways that conservation and recreation interests can work together to achieve future land use planning for both interests.

California Department of Fish and Wildlife’s Conflict Programs

Victoria Monroe* and Alex Heeren

California Department of Fish and Wildlife (1701 Nimbus Rd., Rancho Cordova, CA, 95670)

A key component of understanding the effects that recreation may have on wildlife is the human dimensions of wildlife conservation. Understanding how people perceive and value greenspaces and recreation can help guide conservation and land use planners, managers, and practitioners in ensuring that restoration efforts are supported by local users and recreationists. The California Department of Fish and Wildlife (CDFW) has two programs that provide research expertise in this area. The Human Dimensions of Wildlife Conservation uses social science to examine how people perceive and make decisions about wildlife issues. The Human-Wildlife Conflicts Program examines how people and wildlife interact and how to more effectively mitigate conflicts. Both CDFW programs offer tools and resources to help conservation partners develop socially acceptable, sustainable restoration projects.

River Restoration, Mitigation, and Public Trails: Finding the Balance for All

Lindsay Teunis, Principal Restoration Ecologist

ICF, 619.917.1872, lindsay.teunis@icf.com

It is not uncommon to have competing management objectives for open space areas, and the Otay River Restoration Project has been navigating all them for the last 5 years. The 250-acre project has evaluated and balanced conflicting objectives for natural and cultural resources, sensitive species, mitigation needs, public recreation, access, and infrastructure including incorporating 6+ miles of future public trails within the project limits. Currently, miles of informal, often redundant trails and utility access routes litter the project site with little thought for public use, natural resource protection, and long-term maintenance. The project team designed a trail network to complement the Project while also meeting a series of objectives including (1) access for U.S. Border Patrol, land managers, and local utilities (gas, electric, water); (2) maximizing the trail user

experience (pedestrian, equestrian, and bike); (3) complementing existing trail planning documents; (4) creating educational opportunities and unique nature-based experience; and (5) balancing natural and cultural resource constraints. The design process included input from local partners, regulatory agencies, and community groups coupled with the ecological restoration design needs and natural and cultural resource constraints. The final 6+ mile network of formal trails is currently moving through environmental review and permitting. Over 10 acres (2.3 miles) of existing trails and road shoulders have been identified as redundant and will be reclaimed and revegetated or enhanced to include vernal pool creation. Installation is expected to begin in 2021 along with the Otay River Restoration Project.

A Trail and Greenway System as a Means of Facilitating Ecological Corridors

Fred Watson* and Scott Waltz

California State University Monterey Bay

Trails in natural areas are often studied as potential causes of adverse ecological impacts. But we argue that trail systems can also function as political catalysts to protect natural areas and habitat corridors that might otherwise be destroyed, degraded, or blocked. In the former Fort Ord army base in central California, the ecological fate of thousands of acres of strategically located special-status species habitat lies in a complex political balance as the base is re-used by four cities, one county, and three universities and colleges. The 31-mile Ford Ord Regional Trail and Greenway was proposed as a system of interconnected multi-purpose trails surrounded by greenways that are intended to serve as open space recreation areas and habitat corridors. The proposal includes four road underpasses designed to facilitate both human and ecological connectivity. Without the trail system, the underpasses would not be built and several of the corridors would not be preserved as open space. The political will would not exist to preserve these connections solely for habitat purposes. Trails and corridors will exist in an imperfect mutualism.

Quantifying the Impacts of Human Activity on Wildlife Behavior

Justin P. Suraci* (justin.suraci@gmail.com) and Christopher C. Wilmers (cwilmers@ucsc.edu)

Center for Integrated Spatial Research, Environmental Studies Department, University of California, Santa Cruz, CA 95064

Humans are a source of real or perceived risk for many wildlife species and there is growing evidence that even benign human activity (e.g., recreation) can substantially affect animal behavior and habitat use. However, human activity is highly varied, and the degree to which different sources of anthropogenic “disturbance” (e.g., human presence in wildlife habitat, domestic dogs in protected areas, low-density development) differentially impact wildlife species and communities, remains understudied despite its relevance to management decisions. Here we present a series of experimental and observational studies conducted in the Santa Cruz Mountains of central California quantifying how the immediate presence of human activity in wildland areas affects mammal species and communities, and how the impacts of human presence compare to those of human footprint on the landscape (i.e., rural and exurban development). We used experimental playbacks of vocalizations at both the local and landscape scale to show that (1) the immediate presence of humans (but not their dogs) leads to substantial reductions in feeding time by pumas (*Puma concolor*), and (2) that fear of humans suppresses the activity levels of several mammalian carnivore species, which in turn benefits their rodent prey. We then used camera traps deployed across the region to show that human presence predominantly affects the activity

patterns of mammalian carnivores, and that human presence is therefore distinct from human footprint, which predominantly impacts space use. Thus, considering both the type and intensity of anthropogenic activity is critical when managing human presence in wildlife habitat.

Wildlife Response to Human Access to Public Open Space

Susan E. Townsend

Wildlife Ecology & Consulting (suetownsend@earthlink.net)

Open space is enjoyed by recreationalists that use trails for hiking, biking, and walking dogs, among other things. We also know that wildlife preferentially use trails for movement and that wildlife may reduce trail use when humans are present. By combining a camera array across an open space preserve along with cameras spaced evenly along trails, we can answer questions about wildlife abundance and trail use while also gathering data on the intensity of human use on trails. Results from a Sonoma County study — where a newly constructed trail and surrounding open space were monitored for a year prior to being opened to public access — and then a year following, indicated that carnivores had a mixed response to human presence; mesocarnivores appeared largely undisturbed, while the largest carnivore, *Puma concolor*, initially decreased trail use and abundance. Diurnal species, such as the deer, *Odocoileus hemionus*, and the gray squirrel, *Sciurus griseus*, altered trail use specifically with no change in abundance in the surrounding landscape. Interestingly, one year after the park opened to the public, most species recovered to pre-opening detection rates and occupancy. In addition, study design and possible preliminary results from a before/after-control impact study in Santa Cruz County on how trail construction may affect wildlife occupancy and trail use will be presented.

Know Your Audience — Importance of Including the Public in Restoration

Milan Mitrovich, Senior Conservation Biologist

ICF, 49 Discovery, Suite 250, Irvine, CA. 92618, 949.333.6671, milan.mitrovich@icf.com

In deciding when, where, and how to employ restoration for the benefit of both people and wildlife, knowing one's audience is as important as understanding the natural systems one is looking to recover. Through interviewing thousands of visitors to conserved lands to understand their motivations, desires, and perceptions, we refined our understanding of what people value. For many, the preferred experience is one of nature immersion. People want to be part of the story, learning about and contributing to the recovery of natural systems. Restoration work undertaken over the last decade in urban-proximate wildlands of Orange County, California reinforces these findings and provides new insight into how best to accomplish stated goals. Whether work is centered on creation of an urban wildlife corridor, novel breeding habitat for one of two target bird species of the Southern California NCCP Program, or creation of seasonal ponds to address forecast impacts of increased aridity to native amphibians, employing full-circle thinking when advancing ecological design of a project is paramount. Be inclusive when working with community groups, municipalities, and private enterprise. Seek out and foster relationships needed to create and sustain multi-stakeholder partnerships, never miss an opportunity to educate. Know progression of neighboring development to create ecological structure from salvageable materials. Recognize the role of science in planning. Partner with universities and federal and state agencies to study impacts of restoration from an ecological and recreational perspective, capturing progression of activities through digital media to be able to share the story with a wider audience.

Thursday September 17th — Grassland Ecosystems, Part 2

Session Chair: JP Marié, California Native Grasslands Association and UC Davis



1:00 Session Welcome

1:10 Erin McDermott: Restoration of Rare Plant and Serpentine Grassland Habitat — Utility Infrastructure, Soils and Endemic Biodiversity

1:30 Angie Harbin: Re-Establishment of Threatened Otay Tarplant Population in San Diego County

1:50 Ben Drescher: Composition of Broadcast Seed May Determine Loss to Granivores

2:10 Jake Schweitzer: Captive Propagation and Reintroduction of Large-flowered Fiddleneck (*Amsinckia grandiflora*)

2:30 Five-minute break

2:35 Madeline Nolan: Identifying Effective Restoration Approaches to Maximize Plant Establishment in California Grasslands Through a Meta-Analysis

2:55 Travis Stoakley: Impacts of Gophers and Drought on California Grassland Restoration Success

3:15 Elizabeth Reikowski: Targeted Grazing — A Promising Tool for Grassland Management and Restoration

3:35 Session Closes

3:40 Meet and Greet with Session Sponsor: Rocky Mountain Bio Products



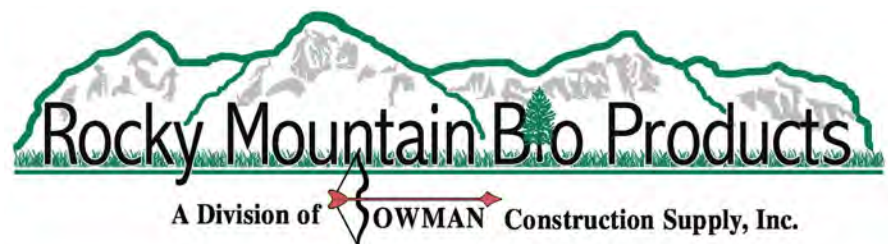
Restoration of Rare Plant and Serpentine Grassland Habitat: Utility Infrastructure, Soils and Endemic Biodiversity

Erin McDermott^{1*}, Jaclyn Inkster¹, Robert Vogt², Amy Hiss³, and Lynne Hosley³

¹Nomad Ecology, LLC, 822 Main St, Martinez, CA, 925.229.1027 emcdermott@nomadecology.com ²Pacific Gas & Electric ³Jacobs

Serpentine grassland is a sensitive natural community prized as habitat for endemic and special-status plant species and their beautiful wildflower displays. High-quality serpentine grasslands persist on the San Francisco

Thank you to our Sponsor Host:



Peninsula along San Francisco Public Utilities Commission-owned watershed lands with ongoing watershed operations and maintenance, nearby residential development and highway construction, and use as a gas and electric utility right-of-way. To bring an existing natural gas pipeline up to current safety standards, Pacific Gas & Electric Company (PG&E) replaced a portion of their natural gas pipeline (originally installed in 1936) located beneath this serpentine grassland. Nomad Ecology, Jacobs, and PG&E partnered to restore serpentine grasslands on-site after construction was complete. Initial restoration activities were conducted prior to the start of construction. These included collecting extensive baseline and reference site data in the project area, salvaging and storing a rare native bulb species (*Fritillaria liliacea*), collecting seed of a locally endemic and rare annual plant, collecting and amplifying locally collected seed for use in a serpentine seed mix, mapping and marking of serpentine soils, and weed control. During construction, restoration specialists worked with crews to minimize environmental impacts, including physical effects on the soils, and the thin serpentine topsoil was mapped, salvaged, and stored separately. Following construction, restoration included carefully backfilling and scarifying the stored serpentine topsoil, hand-seeding with the locally collected native seed mix, replanting the rare bulbs, and invasive weed control. Precautions were also taken to minimize the spread of soil-borne pathogens including *Phytophthora*. We discuss the challenges and successes of this project, and the technical strategy used to restore serpentine grassland and rare plants following construction of this pipeline replacement project.

Re-Establishment of Threatened Otay Tarplant Population in San Diego County

Angie Harbin-Ireland, Biology Group Manager

Wood, Technical Consulting Solutions, www.woodplc.com, Direct: 858.300.4338, Mobile: 858.243.1505, angie.harbin-ireland@woodplc.com

A clean-up action was carried out by the U.S. Air Force in San Diego County that required removal of soils characterized by native grassland and scrub habitats. Grassland habitats supported a robust population of the federally threatened Otay tarplant. The Project was required to restore areas occupied by the species which totaled 1.09 acre upon completion of the remediation. Mitigation monitoring and reporting must document that the population has become reestablished by the end of the 5-year period.

During the summer prior to vegetation removal, Otay tarplant seed was collected from the population on-site. Otay tarplant was hand-seeded and planted from small containers in the grassland restoration areas. Plant protectors were installed shortly thereafter as many of the Otay tarplant plants and seedlings showed heavy herbivory. By April 2018, there was 90% survivorship of the seedlings that were planted from containers. By September 2018 (Year 1), percent cover overall for Otay tarplant in the native grassland area was approximately 20% (approx. 0.33 acre). By June 2019 (Year 2), the total population was estimated to be 28,220 Otay tarplant plants, which covered approximately 0.81 acre. Substantial weed control is necessary at the site to maintain the native revegetation areas. The goal is 1:1 replacement of the Otay tarplant population by Year 5, which the site is quickly trending towards. However, if weed maintenance is removed, the tarplant population may not persist, as this has been observed in adjacent areas that are not managed where tarplants once thrived.

Composition of Broadcast Seed May Determine Loss to Granivores

Benjamin Drescher^{1*}[1], Madeline Nolan², and Carla D'Antonio³

¹Department of Environmental Studies, UC Santa Barbara. 429 Cayuga St., Santa Cruz, CA, 831.239.9504. bennytheforager@gmail.com ²Department of Ecology, Evolution, and Marine Biology, UC Santa Barbara, Santa Barbara, CA, 93106, USA. madeline.nolan@ucsb.edu ³Department of Environmental Studies Program and Department of Ecology, Evolution and Marine Biology, UC Santa Barbara, Santa Barbara, CA, 93106, USA. dantonio@es.ucsb.edu

Two adjacent sites in an invaded California grassland were direct-seeded for experimental restoration in both 2016 and 2017. Only one of the sites had successful establishment. One possible explanation is that there was greater seed predation at the site that had a lack of establishment. This could either be explained by a greater presence of seed predators at the failed site or differences in the seed mixes used to restore each site. We conducted a follow-up study in order to 1) quantify differences in seed predation between the two sites, and 2) explore if seed predation is dependent on the seed mix. We designed a factorial experiment featuring caging treatments (small [0.25 sq. m] enclosures, cage controls and open plots) crossed with seeding treatments (2 mixes), to investigate if a larger and more diverse mix of native seeds influences the effect of vertebrate seed foragers. In addition to confirming this hypothesis, results provided insight into which plant species were highly, moderately, or not at all sought-after by foragers. Future grassland restoration projects that involve broadcast seed may be able to adapt their seeding plans using these classifications for improved results.

Captive Propagation and Reintroduction of Large-flowered Fiddleneck (*Amsinckia grandiflora*)

Jake Schweitzer¹, Holly Forbes², and Roger Raiche³

¹Vollmar Natural Lands Consulting, jake@vollmarconsulting.com, 510.559.9603 ²University of California Botanical Garden at Berkeley ³Planet Horticulture

A team of botanists and horticulturists from Vollmar Natural Lands Consulting, the University of California Botanical Garden, and Planet Horticulture has received a grant from the Central Valley Project Conservation Program to reintroduce large-flowered fiddleneck (*Amsinckia grandiflora*) into its historical range. This federally and State-endangered annual wildflower is known from only one extant natural population, located in southwestern San Joaquin County. The species is associated with grassland habitats with fairly neutral, rich, clay loam soils, and it therefore suffers from competition with introduced annual grasses that thrive in such habitats. It is also a relatively tall species that features shallow roots, and its affinity for excessively steep slopes increases its susceptibility to trampling and soil erosion by livestock. As such, large-flowered fiddleneck is emblematic of the vulnerability of native grassland forbs to historical and ongoing habitat change as well as habitat management. The current reintroduction effort is showing some promise, thanks to the availability of modern spatial analysis tools as well as increasing scientific documentation on the benefits and drawbacks of livestock grazing. The use of sophisticated GIS software to analyze high-resolution data has enabled the development of a precise habitat model, which in turn has facilitated the identification of optimal reintroduction sites. Additionally, strategic grazing regimes are being employed to reduce introduced grasses without the associated trampling or erosion. By refining the reintroduction methods for an extremely rare and highly vulnerable grassland species, the team seeks to more generally improve methods for reintroducing and sustaining rare grassland plant species.

Identifying Effective Restoration Approaches to Maximize Plant Establishment in California Grasslands Through a Meta-Analysis

Madeline Nolan^{1*} (m_nolan@ucsb.edu) and Carla D'Antonio^{1,2} (dantonio@es.ucsb.edu)

UC Santa Barbara, Santa Barbara, CA, 93106. ¹Department of Ecology, Evolution, and Marine Biology

²Department of Environmental Studies Program

One reason restoration fails is a lack of native plant establishment. Establishment failure can occur due to a lack of dispersal into the site, inappropriate abiotic conditions for plant survival, or biotic interactions that reduce germination rates or seedling survival. Understanding what is limiting establishment is critical for restoration success. Unfortunately, there has been little synthetic work to identify which restoration practices (e.g., direct seeding, weeding, irrigation) are most likely to improve plant establishment. Here we used a meta-analytical approach to determine what practices are most likely to enhance establishment success in grassland communities in California. We explored the impact of these practices on whole communities and on different functional groups (grass, forb, and shrub). We categorized techniques by the constraint they addressed (dispersal, abiotic, or biotic) to determine which restoration practices are more likely to improve plant establishment. We found that addressing the dispersal filter is the best way to improve plant establishment regardless of functional group. This suggests that most native plants targeted in restoration are seed limited. While we were able to identify restoration techniques that improve plant establishment, our synthesis revealed that there were insufficient numbers of studies and a lack of uniformity between treatments that hampered efforts to make broad conclusions. If we can expand research to more ecosystems, and use standardized treatments within each ecosystem, the restoration community could synthesize research more efficiently, which would inform our ultimate goal of increasing the success of restoration.

Impacts of Gophers and Drought on California Grassland Restoration Success

Travis Stoakley* (tstoakley@ucsb.edu) and Maddie Nolan (maddie.nolan@ucsb.edu)

University of California, Santa Barbara

Pocket gopher responses to climate change have yet to be sufficiently studied. Our three-year field experiment at Sedgwick Reserve aimed to answer (1) how water availability in restored grasslands is affected by gopher activity, and (2) how gopher activity impacts the growth and reproduction of native bunchgrasses. We found that as pocket gopher activity increases, both growth and reproduction of native bunchgrasses decreases. Gopher activity was more than two times higher in the drought treatment compared to ambient and watered treatments, which suggest that gopher activity increases during dry years causing additional stress for plants. Since the gopher activity was higher in the drought plots, it is not possible to tease apart the independent effects of drought and gophers with this experiment, but our results suggest that gopher activity is likely to have a particularly negative impact on reproductive success as drought alone did not decrease reproduction but increasing gopher activity did. Our results highlight the importance of incorporating native animals into restoration planning, especially when considering how climate change will impact restoration success in the future. As we move forward with restoration ecology as a discipline, we need to do a better job at incorporating animals and animal behavior into restoration planning in order to successfully restore native ecosystems. Only when we start thinking about the relationships between native animals and plants, and how to facilitate positive interactions between these species, will we be able to restore resilient, self-sustaining communities in the future.

Targeted Grazing: A Promising Tool for Grassland Management and Restoration

Elizabeth Reikowski

Willow Creek Land and Cattle, LLC, 7740 Willow Creek Rd., Paicines, CA 95043, ereikowski95@gmail.com, 831.902.9512

California's Mediterranean grasslands are internationally recognized biodiversity hotspots and play an important role in nutrient, carbon, and water cycling throughout the state. However, these grasslands have declined dramatically over the last few centuries due to introductions of nonnative species, agricultural intensification, and urban expansion. To address the need to develop cost-effective methods of managing and restoring grasslands, Willow Creek Land and Cattle, LLC, began partnering with landowners in 2018 to implement targeted grazing (grazing at a determined season, frequency, intensity, and duration to accomplish defined vegetation or landscape goals) on 800 acres of Central Coast grasslands. We have developed a targeted grazing system in which we utilize early season grazing (December–March) to reduce nonnative annual grass biomass, thereby providing a competitive advantage to native perennial grasses and native forbs. We then utilize late-season grazing (April–June) to remove the apical meristems of invasive forbs, thereby reducing invasive plant vigor and seed set. We couple our targeted grazing systems with annual data collection on plant community composition and with extensive field observations and photo documentation. Collectively, scientifically rigorous data and on-the-ground observations allow us manage within the inherent variability of California's climate and to adapt and improve our practices over time. Field observations as well as preliminary results from our work suggest that adaptively managed grazing can effectively reduce invasive plant populations and enhance conditions for the establishment and growth of native grasses and forbs.

Tuesday September 22nd — Hindsight is 2020

Session Chair: Kari Dupler, WRA Inc.



1:00 Session Welcome

1:10 Brian Bartell: Adaptive Management as a Tool for Habitat Restoration

1:30 David Shaw: Perazzo Meadows Restoration Part 1: A Decade of Data and Lessons Learned from a Sierra Meadow Complex

1:45 Beth Christman: Perazzo Meadows Part 2: Applying 10 years of Data to Restoration Design

2:10 Brian Wardman: Tule Red Tidal Restoration: Lessons Learned During Construction

2:30 Jan Novak: Middle Harbor Enhancement Area: Refining the Edges via Design Charrette

2:50 Session Closes

2:55 Meet and Greet with Session Sponsor: Balance Hydrologics and ICF



Adaptive Management as the Tool for Habitat Restoration

Brian Bartell

WRA, Inc., bartell@wra-ca.com, 415.524.7588

The current process of restoring habitats largely follows a pattern similar to that of the building and landscape trades. Despite the fact that significant advances have been made in the science and engineering behind restoration, the process of attempting to restore a natural condition with a single discrete implementation action has not changed significantly over the past 40 years. One change that has been made is the introduction of adaptive management as a tool to maintain restoration sites, though it is usually employed as a corrective or after-the-fact action to help attain minimum performance standards. The presentation will explore breaking out of the traditional restoration project mold by approaching the entire ecological restoration process as adaptive management. This concept of holistic adaptive management relies on the integration of a “living” assessment and design process with phased implementation over multiple seasons and active site management. We will discuss the basis for using this approach, several potential scenarios for phased

Thank you to our Sponsor Hosts:



**Balance
Hydrologics**



implementation in varied settings, the value of setting realistic expectations, and how to integrate this holistic adaptive management approach into the existing regulatory and funding framework. The goal of this presentation is to educate practitioners, regulators, project funders, and land managers on the benefits of using a holistic adaptive management approach for ecological restoration projects.

Perazzo Meadows Restoration, Part 1 – A Decade of Data and Lessons Learned from a Sierra Meadow Complex

David Shaw^{1*}, Beth Christman¹, and Benjamin Trustman¹

¹Balance Hydrologics, 12020 Donner Pass Rd., Truckee CA 96161, dshaw@balancehydro.com, 530.550.9776

²Truckee River Watershed Council, P.O. Box 8568, Truckee CA, 96162, bchristman@truckeeriverwc.org, 530.550.8760 x1

Over the past two decades, agencies and non-governmental organizations have worked to restore degraded mountain meadows in California's Sierra Nevada, with goals and objectives often related to increasing groundwater storage and late summer baseflow, improving floodplain connectivity, and/or re-establishing wetland and riparian functions and habitat. Balance Hydrologics, the Truckee River Watershed Council, the U.S. Forest Service, and other cooperating agencies have conducted a long-term program to monitor system response to restoration approaches that were employed at Perazzo Meadows on the Tahoe National Forest in Sierra County, California. Prior to restoration, the incised, single thread channel meandered through the meadow with limited connectivity to the adjacent floodplain. The restoration approach blocked the channel at numerous points throughout the meadow to spread flows across the valley floor and re-activate relict channels. Hydrology and biologic data collected over the 10 years following implementation has improved our understanding of variability in system response associated with this method, and we have learned that a) increases in seasonal groundwater storage associated with this method are variable, averaging approximately 0.6 acre-feet per acre of restored meadow; b) summer release of stored groundwater can increase late season baseflow by nearly 0.5 cfs or 1 ac-ft/day, c) channel and meadow equilibration over the decade following implementation can reduce some of these more immediate effects, d) most summertime and some wintertime flood events are attenuated by the modified meadow form, and e) biologic communities respond to the changed channel form and hydrology, with wetland communities becoming more vigorous.

Perazzo Meadows, Part 2 — Applying 10 Years of Data to Restoration Design

Beth Christman^{1*}, David Shaw², and Benjamin Trustman²

¹Truckee River Watershed Council, P.O. Box 8568, Truckee CA, 96162, bchristman@truckeeriverwc.org, 530.550.8760 x1

²Balance Hydrologics, 12020 Donner Pass Rd., Truckee CA 96161, dshaw@balancehydro.com, 530.550.9776

The Perazzo Meadows system presents an interesting case study for applying monitoring data to advance the field of restoration. A long history of human disturbance in the Upper Little Truckee River watershed (Sierra County, CA) resulted in severe degradation of several meadows including Upper, Middle, and Lower Perazzo Meadows. Streams were channelized to accommodate dairying, logging, road-, and railroad-building, converting former multi-threaded dynamic meadow channels into incised, eroding, and widening single-thread channels. Groundwater levels dropped 3–6 feet below the ground surface during the growing season, no longer supporting lush wet meadow vegetation. Overbank flow only occurred on 5–10 year return intervals instead of

the 1–2 year intervals expected. Restoration planning began in 1999. The Upper and Middle Meadows were restored 2009–2010. The Truckee River Watershed Council, U.S. Forest Service, and Balance Hydrologics began hydrologic monitoring of the meadows at this time (see Shaw, Part 1). Based on data collected and the evolution of the Upper and Middle Meadows, we selected a novel approach for restoring the Lower Meadow. The goals were similar: restore natural hydrologic function — including increased floodplain connectivity, elevated groundwater levels, and multi-threaded planform. Hydrologic restoration then drives vegetation conversion leading to improved wildlife habitat. The selected approach restored the natural braided channel system through near-complete fill of the existing degraded channel. The reasons for choosing this alternative, challenges presented by the approach, and expected results will be discussed. Restoration was completed in 2019.

Tule Red Tidal Restoration-Lessons Learned During Construction

Brian Wardman^{1*} (bwardman@nhcweb.com), Chris Holland², and David Carr³

¹Northwest Hydraulic Consultants 2600 Capitol Ave, Suite 140, Sacramento CA, 95816, 916.371.7400

²Westervelt Ecological Services ³KSN, Inc.

The Tule Red Tidal Restoration Project opened 420 acres of tidal marsh habitat to natural diurnal tidal inundation. The Tule Red site is located on the eastern shoreline of Grizzly Bay with the project site having over 1.5 miles of shoreline. Much of the site has elevations below typical daily high tide elevations creating a challenging construction environment. Nonetheless, the project site was constructed without significant change to the final designs. Construction included excavation and on-site placement of over 300,000 cy of material to create over 8 miles of tidal channels, while reinforcing existing flood reduction berms and producing upland habitat with fill placement. This talk summarizes the lessons learned during implementation, including what was expected, what wasn't expected, what worked, and what could have worked better.

Middle Harbor Enhancement Area: Refining the Edges Via Design Charrette

Jan Novak^{1*} and Eric Jolliffe²

¹Port of Oakland ²United States Army Corps of Engineers

The Port of Oakland (Port) operates the third-largest container port on the West Coast. The Middle Harbor Enhancement Area (MHEA) is a restoration site associated with the -50 Foot Project, a joint Army Corps of Engineers and Port project completed in the early 2000s. As part of the agreement with regulatory agencies, the MHEA, a former 40-foot deep dredged naval harbor, was restored to create shallow subtidal and intertidal habitat. The creation of MHEA utilized 5.8 million cubic yards of dredged material to create the 189-acre restoration site. A primary goal of the MHEA was to create subtidal habitat, with the goal of increasing avian and fish diversity. The project area has been identified as a birding hotspot by the Golden Gate Audubon Society, providing foraging habitat for many bird species, including the endangered California Least Tern and formerly threatened Brown Pelican. While the project has achieved its primary goal of creating open space and wildlife habitat at the urban/nature interface of an industrial container port, ancillary features have not met target goals. In order to address these features, the Port has organized a design charrette to provide preliminary design options. This presentation focuses on how to maximize the value provided by a design charrette, as well as lessons learned for future restoration projects, including setting achievable schedules and habitat targets, complicating effects of inter-agency collaboration, and meaningful public engagement.

Thursday September 24th — Restoration for Wildlife, Part 2

Session Chair: Cara Clark, Central Coast Wetlands Group



1:00 Session Welcome

1:10 Cassie Pinnell – Aquatic Invertebrate Response to Restored Eelgrass and Oyster Reefs in a Living Shorelines Project

1:40 Austin Parker – Restoration Success Story for the Endangered El Segundo Blue Butterfly

2:10 Robert Cooper – Can Managing Pond Hydroperiod Promote California Tiger Salamanders and Reduce Non-Native Hybridization?

2:40 Cara Clark – Restoring Breeding Ponds and Terrestrial Habitat for Santa Cruz Long-toed Salamanders

3:10 Session Closes

3:15 Meet and Greet with Session Sponsor: Wildlands



Aquatic Invertebrate Response to Restored Eelgrass and Oyster Reefs in a Living Shorelines Project

Cassie Pinnell^{1*}, Melissa Patten², Geana Ayala², and Dr. Kathryn Boyer²

¹Vollmar Natural Lands Consulting, cpinnell@vollmarconsulting.com, 916.758.6928 ²San Francisco State University, Estuary and Ocean Science Center, katboyer@sfsu.edu, 415.338.3751

Living shorelines are restoration design approaches that create intertidal and subtidal habitat while achieving physical shoreline protection goals. A multi-partner collaboration of researchers and managers installed the first San Francisco Bay living shorelines project in 2012. This project tested the use of eelgrass and native oyster reefs as living offshore structures to mitigate wave impacts and flooding related to sea level rise. Among other benefits, eelgrass beds and oyster reefs provide a structured habitat for invertebrate species; however, the relative value of restored habitat types and combinations in supporting these species was not known. Here, we report the results of quarterly monitoring of these restored habitats by epifaunal invertebrates over three years. Results

Thank you to our Sponsor Host:



indicate an early response of invertebrate species reliant on physical structure. Sampling of epibenthic invertebrates showed that community composition became distinct between eelgrass, oyster, combination (eelgrass + oyster), and intertidal mudflats. Notably, epifauna assemblages on the restored eelgrass sites did not converge with natural reference sites over time; two native species known to benefit eelgrass growth by removing algae from the plant's leaves continue to be absent or very rare at the restored site. Our results provide a comprehensive assessment of aquatic invertebrate communities in a variety of restored habitats and suggest that eelgrass and oyster reefs together maximize invertebrate diversity. Further, our finding that restored eelgrass fell short in matching community composition of target, natural systems highlights recruitment limitation of some species and suggests management intervention is needed to incorporate their important functions into restoration projects.

Restoration Success Story for the Endangered El Segundo Blue Butterfly

Austin Parker

Palos Verdes Peninsula Land Conservancy, aparker@pvplc.org, 760.409.4460

The Alta Vicente Reserve is a 50-acre public open space reserve within the larger 1,400-acre, Palos Verdes Nature Preserve in Rancho Palos Verdes, California. Since 2009, the Palos Verdes Peninsula Land Conservancy's restoration of the coastal sage scrub habitat has been focused on our four wildlife species found in the Nature Preserve and covered by the Natural Communities Conservation Plan (NCCP), including the coastal cactus wren (*Campylorhynchus brunneicapillus*), California gnatcatcher (*Polioptila californica californica*) (FT), Palos Verdes Blue Butterfly (*Glaucopsyche lygdamus palosverdesensis*) (FE), and El Segundo Blue Butterfly (*Euphilotes battoides allyni*) (FE). During our recent monitoring surveys, the Federally Endangered El Segundo Blue Butterfly was observed flying in the restored habitat as well as ovipositing and in a larval state on their host plant, *Eriogonum parvifolium* (Seacliff Buckwheat). This presentation will tell the story of how after decades of grazing, agriculture, and neglect, PVPLC is restoring this beautiful site — including restoration methods and challenges, and how the years of effort with thousands of volunteers have drawn this endangered butterfly into the newly established habitat, as well as our plans for this site with emerging challenges and opportunities to enhance this reserve's habitat for all of the local and sensitive species to utilize.

Managing Pond Hydroperiod for Threatened Amphibians

Robert D. Cooper^{1,2*} and H. Bradley Shaffer^{1,2}

¹Department of Ecology and Evolutionary Biology, University of California, Los Angeles, CA, robert.cooper@ucla.edu ²UCLA La Kretz Center for California Conservation Science, Institute of the Environment and Sustainability, University of California, Los Angeles

The California tiger salamander (*Ambystoma californiense*) is an endangered species at risk of genomic extinction due to hybridization with non-native salamanders throughout its range. Efforts to reduce hybridization have been largely ineffective, necessitating research into novel methods of management. Previous mesocosm experiments coupled with field observations suggest that artificially long pond duration (hydroperiod) may promote hybrid genotypes, therefore reducing hydroperiod may remove or even reverse the hybrid advantage. We constructed 18 experimental ponds to evaluate this potential management strategy. Here we present data on two facets of this ongoing project. First, we present phenotypic and genetic data from

salamanders raised in these naturalistic ponds across a range of hydroperiods. We evaluate the effects on survival and mass at metamorphosis and predict demographic consequences in wild populations. We present genomic data to identify potential shifts in non-native allele frequency as a result of the hydroperiod treatments. Second, we present hydrologic data from the ponds which are used to parameterize a predictive model for pond hydroperiod based on weather and pond geometry. These results allow us to evaluate the effectiveness of managing pond hydroperiod to reduce the spread of non-native tiger salamander genes in the California landscape.

Restoring Breeding Ponds and Terrestrial Habitat for Santa Cruz Long-toed Salamanders

Cara Clark* (cclark@mlml.calstate.edu) and Sarah Stoner-Duncan (sstoner@mlml.calstate.edu)

The North Monterey County Amphibian Habitat Restoration Project created and enhanced upland and wetland habitat for Santa Cruz long-toed salamanders (SCLTS) at a 25-acre site near Castroville, CA. The site is extremely important for the species as it is isolated from other known breeding locations and is under immense pressure from urban activities. This project created migration corridors by increasing tree and shrub cover along the route from the adjacent Moro Cojo wetlands to the breeding ponds. The four ponds were enhanced through planting of native vegetation, clearing of dense bulrush to facilitate salamander breeding, and construction of a berm at the outlet of one pond to extend the hydroperiod. More than 11,000 native plants were installed, while non-natives were removed through mechanical and manual methods. Public education is another key component, with a new 4,900-foot trail system, interpretive signs, and partnership with the adjacent high school. We monitored the site using the California Rapid Assessment Method (CRAM) for wetlands, point-intercept vegetation surveys, and photo monitoring. Results after 3 years of monitoring indicate that native plant cover increased in the migration corridor areas, from 9% in 2017 to 28% in 2019. Non-native plant cover decreased slightly from 73% to 70%. CRAM scores did not change significantly, however the buffer category improved due to weed management activities. These measures are important, but the true benchmark is the presence of SCLTS in the pond in spring of 2019, the first sighting since 2007. We built it, and they came.