

# SERCAL 2014



## Working Collaboratively for Successful Restoration

13-15 May 2014 at the Wells Fargo Center for the Arts, Santa Rosa  
50 Mark West Springs Road, Santa Rosa 95403  
[wellsfargocenterarts.com](http://wellsfargocenterarts.com)



### **INSIDE:**

MAP OF WELLS  
FARGO CENTER  
PAGE 1

WEDNESDAY  
PAGES 2-7

THURSDAY  
PAGES 8-13

SPONSORS  
PAGES 14-16 & 42-46

### **ABSTRACTS**

COASTAL WETLANDS  
RESTORATION  
PAGES 17-20

RESTORATION FOR  
SPECIAL-STATUS FISH &  
WILDLIFE SPECIES  
PAGES 21-23

UPLAND HABITAT  
RESTORATION &  
MANAGEMENT  
PAGES 24-27

RIPARIAN RESTORATION  
PAGES 27-30

INTEGRATING  
RESTORATION &  
OTHER LAND USES  
PAGES 30-33

PROJECT  
IMPLEMENTATION &  
MONITORING  
PAGES 33-36

POSTERS  
PAGES 36-41

# Conference Program

[www.sercal.org](http://www.sercal.org)

**WELCOME  
TO SANTA  
ROSA!**

Name \_\_\_\_\_

# In Appreciation *SERCAL gratefully acknowledges...*



## 2014 Sponsors

Snowy Plover—\$2,000

**Dudek/Habitat Restoration Sciences, Inc.**  
*Sacramento & Encinitas*

**H.T. Harvey & Associates** *Los Gatos*

**ICF International** *San Jose*

**Sonoma County Water Agency** *Santa Rosa*

Reception Sponsors—\$1,500

**Balance Hydrologics** *Berkeley*

**Westervelt Ecological Services** *Sacramento*

Belted Kingfisher—\$1000

**Hedgerow Farms, Inc.** *Winters*

**Prunuske Chatham, Inc.** *Sebastopol*

**RECON Environmental, Inc.** *San Diego*

**Wildlands** *Rocklin*

Marsh Wren—\$500

**ACS Habitat Management** *Oceanside*

**AG-Renewal, Inc.** *Weatherford, OK*

**Burleson Consulting, Inc.** *Folsom*

**California Invasive Plant Council** *Berkeley*

**California Native Grasslands Association** *Davis*

**Cardno ENTRIX** *Concord*

**cbec, inc.** *West Sacramento*

**Cornflower Farms** *Elk Grove*

**DriWater** *Santa Rosa*

**Ecological Concerns, Inc.** *Santa Cruz*

**GreenHeart Farms** *Arroyo Grande*

**Horizon Water and Environment** *Oakland*

**Pacific Coast Seed, Inc.** *Livermore*

**S & S Seeds, Inc.** *Carpinteria*

**The Watershed Nursery** *Richmond*

## CONFERENCE PROGRAM CHAIR

**Kevin MacKay** *SERCAL President, ICF International*

## CONFERENCE COORDINATORS

**Susan Clark Coy** *SERCAL Administrative Director*

**Julie St. John** *SERCAL Publications Director*

## TECHNICAL SESSION CHAIRS

**Michelle Orr, P.E.** *ESA PWA*

**Ross Taylor** *Ross Taylor & Associates*

**Chad Aakre** *Olberding Environmental & CNGA*

**Andrew Rayburn, PhD** *River Partners & CNGA*

**Gregory Andrew** *Marin Municipal Water District*

**Carol Presley, P.E.** *Community Alliance with Family Farmers*

**Harry Oakes** *ICF International*

## FIELD TOUR LEADERS

**Gregory Andrew** *Marin Municipal Water District*

**Phyllis Faber**

**Tom Gandesbery** *California Coastal Conservancy*

**Michael Gillogly** *Pepperwood Preserve*

**Eric Jolliffe** *U.S. Army Corps*

**Mark Lindley** *ESA PWA*

**Cassandra Liu** *Sonoma Ecology Center*

**Julian Meisler** *Sonoma Land Trust*

**Lisa Micheli** *Pepperwood Preserve*

**Bob Neale** *Sonoma Land Trust*

**Mark Newhouser** *Sonoma Ecology Center*

**Michelle Orr, P.E.** *ESA PWA*

**Lorraine Parsons** *National Park Service*

**Ryan Pedrotti** *Sonoma County Water Agency*

**Barbara Salzman** *Marin Audubon Society*

**Ross Taylor** *Ross Taylor & Associates*

# COASTAL WETLAND RESTORATION

Chair: **Michelle Orr, P.E.** ESA PWA

Wednesday 14 May 10:30a – 12:00p, 1:30p – 3:00p and 3:30p – 5:00p Conference Room A

## Creating High Tide Refuge Islands for the California Clapper Rail

Gavin Archbald<sup>\*1</sup>, Max Busnardo<sup>1</sup>, Joe Howard<sup>1</sup>, Ron Duke<sup>1</sup>, and Marilyn Latta<sup>2</sup>

<sup>1</sup>H. T. Harvey & Associates, 983 University Avenue, Building D, Los Gatos 95032; gavinarchbald@harveyecology.com <sup>2</sup>California State Coastal Conservancy, 1330 Broadway, 13th Floor, Oakland 94612-2530

Recovery of the endangered California clapper rail (*Rallus longirostris obsoletus*) is threatened by a lack of high tide refuge habitat in San Francisco Estuary marshes. To decrease predation on California clapper rail, the California Coastal Conservancy constructed six pilot “high tide refuge islands” in winter 2012/2013, strategically located in tidal marshes lacking high tide refuge habitat. We designed these islands to mimic slough channel berms dominated by natural gumplant (*Grindelia sticta*), then monitored them during the first growing season to incorporate lessons-learned into subsequent island construction. Islands were constructed at Bair Island, Bird Island, Cooley Landing and MLK Marsh to an elevation of ~1 foot (ft) above MHHW using either excavated sediment from a nearby slough channel edge or imported terrestrial soil. Islands were then covered with marsh sod dominated by pickleweed (*Salicornia pacifica*) and planted with gumplant and saltgrass (*Distichlis spicata*). Five months after construction, we monitored topography, vegetation and soil properties. We found that islands settled approximately -0.3 ft, in line with our estimates. Gumplant survival averaged 63% across islands and was positively correlated with the elevation of island tops above MHHW ( $R^2 = 0.78$ ;  $P = 0.02$ ). Few gumplant plantings installed below -0.2 ft MHHW survived. Island soil pH averaged  $6.4 \pm 0.1$  and remains suitable for gumplant. We anticipate that 2-4

growing seasons will be needed for gumplant to provide good cover for rails, however, pickleweed currently provides 40-70% cover. Based on lessons learned, 16 additional islands were constructed in Winter 2013/2014.

## South Bay Salt Pond Restoration Project: Adaptive Management in Action

John Bourgeois<sup>\*1</sup> and Laura Valoppi<sup>2</sup>

<sup>1</sup>California State Coastal Conservancy, 1330 Broadway 13th Floor, Oakland 94612-2530; jbourgeois@scc.ca.gov <sup>2</sup>USGS, 6000 J St, Placer Hall, Sacramento 95819

The South Bay Salt Pond Restoration Project ([www.southbayrestoration.org](http://www.southbayrestoration.org)) is the largest wetlands restoration project on the West coast of the United States. It is unique not only for its size— over 15,000 acres—but that it is located adjacent to one of the nation’s largest urban areas, home to over 3 million people. The Project is intended to restore and enhance wetlands in South San Francisco Bay while providing for flood management and wildlife-oriented public access and recreation. We have identified long-term alternatives for the Project, each representing a continuum toward different end-states: one end-state at 50% of the existing ponds converted to managed ponds for waterbirds and 50% restored to salt marsh habitat, and the other end of the continuum at 10% of the existing ponds converted to managed ponds and 90% restored to marsh habitat. The final ratio of managed ponds to salt marsh habitat will depend on the outcome of the Adaptive Management Plan, which will be implemented over the next 50 years. The Plan will allow for lessons learned from earlier phases and applied studies to be incorporated into subsequent stages as management objectives and designs of future actions are revised and implemented. The

Project has completed many of the Phase 1 studies, and much has been learned about key uncertainties. This presentation will summarize the results of several studies and how managers have revised management actions and restoration designs in response to scientific research.

## California Rapid Assessment Methodology (CRAM) for Bar-built Estuaries

Ross Clark

Moss Landing Marine Laboratories, 8272 Moss Landing Rd, Moss Landing 95039; rclark@mlml.calstate.edu

Connecting marine, freshwater and terrestrial ecosystems, bar-built estuaries are complex and dynamic systems that provide a great diversity of habitat and ecosystem services. These unique but widespread systems provide critical habitat for many commercially important and endangered species. With a growing population, often centered on coastal confluences, these habitats experience varying degrees of alteration. Future alterations, increasing demand for freshwater, and climate or sea-level change all further threaten bar-built estuaries and the services they provide. In order to ensure the long-term health and productivity of these critical habitats, we need an increased understanding of their ecological functioning. An assessment methodology that is standardized throughout California is challenging for such complex and dynamic habitats, yet necessary to ensure comparable data and consistent direction of appropriate management. We developed the California Rapid Assessment Methodology (CRAM) for bar-built estuaries — a cost-effective, state-wide standardized manner of assessing bar-built estuary condition. We

# 1 Coastal Wetland Restoration *continued*

used a combination of GIS watershed-scale measures of landscape stressors, and site-level focal assessments (i.e. nutrient and vegetation data) on bar-built estuaries throughout California to validate CRAM. We found combinations of landscape (GIS), and local (CRAM, and focal data) metrics to not only assess the condition of the bar-built estuary, but elucidate the scale at which stressors were influencing bar-built estuary condition.

## The “T-zone” of San Francisco Bay: Types and Conservation Strategies

Josh Collins<sup>\*1</sup>, Donna Ball<sup>2</sup>, Peter Baye<sup>3</sup>, and Roger Leventhal<sup>4</sup>

<sup>1</sup>San Francisco Estuary Institute; josh@sfei.org <sup>2</sup>Save The Bay; dball@savesfbay.org <sup>3</sup>Coastal Ecologist; baye@earthlink.net <sup>4</sup>Marin County Public Works; roger.leventhal@gmail.com

The “T-zone” of San Francisco Bay is the area of transition that physically extends between the landward limits of the effects of tidal processes on fluvial and terrestrial conditions, and the bayward limits of the effects of terrestrial and fluvial processes on tidal conditions. The T-zone exists everywhere around the Bay, but varies in width due to topographic slope and terrestrial runoff. The T-zone is widest where active floodplains of the largest local streams adjoin gently sloping lands with abundant groundwater near the land surface due to shallow saltwater intrusion. The T-zone is narrowest along rocky cliffs and artificial sea walls that intercept the intertidal zone. No other major habitat type in the Bay Area has suffered as much from historical and modern land use. Only a few disturbed remnants of the historical T-zone remain, and the total of all existing T-zone areas is a small fraction of its historical amount. Based on setting and a few key characteristics, seven types of T-zone have been defined. Ecosystem services vary by degree and kind among

these types. The most common kinds of service include providing refuge for intertidal wildlife during high tide, providing accommodation space for estuarine transgression, storing flood waters, providing outdoor recreation, and supporting biodiversity. Some rare and endangered plants and animals are endemic to the T-zone. Since the T-zone encompasses the limits of tolerance to physical stressors for many species, it can serve as a venue for their adaptation to environmental change. The regional experience with stream and tidal marsh restoration has led to a general recognition that the T-zone is an important and neglected component of the Bay ecosystem. Forecasts of sea level rise in the context of the built environment indicate that restoration or creation of healthy new T-zone areas will require a concerted effort to implement a variety of landscape design concepts and management techniques that have been identified for each T-zone type. However, regardless of type, the most important action to take now and into the future is to protect through public ownership or easement as much existing T-zone areas and minimally developed future T-zone areas as possible. Other important actions include managing existing T-zone areas to enhance their ecosystem services, building T-zone areas into intertidal restoration and compensatory mitigation projects, and beginning to adjust public policies to permit filling some Bay shallows to create T-zone areas where they are critically important and no other means of their creation are feasible.

## Restoring Tidal Marsh in Elkhorn Slough

Monique Fountain

Elkhorn Slough Foundation, 1700 Elkhorn Rd, Watsonville 95076; monique@elkhornslough.org

The Elkhorn Slough estuary, containing California’s second largest tract of salt marsh, is currently facing unprecedented rates of tidal wetland loss and degradation. Fifty percent of the tidal salt

marsh in Elkhorn Slough has been lost in the past 70 years. This habitat loss is a result of diking and draining, increased tidal flooding which “drowns” the vegetation, and bank erosion which causes the marsh to collapse into the channel. The Elkhorn Slough Reserve is currently undergoing an effort to restore 40 acres of upland and 100 acres of ecotone/tidal marsh. This project is a part of our ecosystem-based management initiative for the estuary, the Tidal Wetland Project, which has for ten years successfully brought together diverse stakeholders to jointly plan for and implement a sustainable future for Elkhorn Slough’s estuarine ecosystem.

## Tidal Marsh Revegetation by Design: Site Specific Habitat Enhancement to Benefit California Clapper Rail (*Rallus longirostris obsoletus*)

Jeanne Hammond\*, Jeff Lewis, Whitney Thornton, and Katy Zaremba

OEI Environmental, Inc., 1830 Embarcadero Cove, Suite 100, Oakland 94606; jlhammond@spartina.org

The California Coastal Conservancy and U.S. Fish and Wildlife Service San Francisco Estuary Invasive *Spartina* Project (ISP) are implementing a five-year program to rapidly improve habitat for California clapper rail (*Rallus longirostris obsoletus*) in areas affected by non-native *Spartina* invasion. After successful removal of non-native *Spartina*, natural recruitment of some native species has been very successful (e.g., perennial pickleweed, *Sarcocornia pacifica*). However, two key components of rail habitat, *Grindelia stricta* and native *Spartina foliosa*, are still missing at some sites. Revegetation focusing on these two key species aims to rapidly enhance existing clapper rail habitat. ISP developed site-specific planting plans that are designed to rapidly establish dense, strategically-located patches of vegetation that will benefit nesting, foraging and roosting rails as well as provide high tide refuge. *Spartina foliosa* is planted on marsh channel banks and

on open mudflats to provide cover for foraging rails that is currently largely absent. *Grindelia stricta* is planted along marsh channel edges to provide nesting cover and on berms to provide high tide refuge. In addition, several upland transition zone plant species were planted at several sites to provide extreme high tide refuge. Example sites where planting has occurred include restored marshes that are part of the Hayward Regional Shoreline (East Bay Regional Park District) and the Eden Landing Ecological Reserve (California Department of Fish and Wildlife).

### **Living Shorelines with Oysters and Eelgrass in San Francisco Bay**

Marilyn Latta, Project Manager<sup>1\*</sup>, Katharyn Boyer<sup>2</sup>, Robert Abbott<sup>3</sup>, Susan De La Cruz<sup>4</sup>, Doug George<sup>5</sup>, Edwin Grosholz<sup>6</sup>, Stephanie Kiriakopoulos<sup>2,6</sup>, Jeremy Lowe<sup>2</sup>, Jen Miller<sup>2</sup>, Rena Obornolte<sup>7</sup>, Cassie Pinnell<sup>2</sup>, Kevin Stockmann<sup>2</sup>, Elena Vandebroek<sup>2</sup>, Chela Zabin<sup>6</sup>

<sup>1</sup>CA State Coastal Conservancy, 1330 Broadway, Suite 1300, Oakland 94162; latta@scc.ca.gov <sup>2</sup>Romberg Tiburon Center, San Francisco State University <sup>3</sup>ENVIRON Corporation <sup>4</sup>USGS Western Ecological Research Center <sup>5</sup>ESA PWA <sup>6</sup>University of California, Davis <sup>7</sup>Isla Arena Consulting

The San Francisco Bay Living Shorelines Project is a multi-objective habitat restoration pilot project with the overarching goal to create biologically rich and diverse subtidal and low intertidal habitats, including eelgrass and oyster reefs, as part of a self-sustaining estuary system that restores ecological function and is resilient to changing environmental conditions. Such habitat features have the potential to positively influence physical processes (such as waves and sediment transport) that determine shoreline morphology. In this project constructed in July 2012, we are further testing restoration methods, restoring eelgrass and oyster habitat, testing the individual and interactive

effects of restoration techniques on habitat values, and beginning to evaluate effects on shoreline processes. Plots (32 x 10 m) of oyster substrate alone (shell-bag mounds), eelgrass alone, or the two together in an additive design, are being compared to un-manipulated control plots along the San Rafael shoreline. Preliminary data show that restored habitat structure at this site promotes increased abundance of numerous organisms relative to bare sediment, with a number of native invertebrates reproducing on the oyster substrates. Native oysters have recruited in large numbers to the shell bag mounds, particularly on north-facing, vertical, or lower-elevation surfaces that likely minimize thermal stress. Two large wind-wave events in March and April 2013 led to preliminary findings of reduced waves in plots with added structure. This project will advance our understanding of restoration methodologies with an eye towards habitat creation and shoreline protection in an era of rising seas and increasing storm surges.

### **Hamilton Wetland Restoration Project – Design Approach and Construction Challenges**

Mark Lindley<sup>\*1</sup>, Eric Jolliffe<sup>2</sup>, Blair Jackson<sup>2</sup>, Nicholas Malosavage<sup>2</sup>, Tom Gandesbery<sup>3</sup>, Steve Crooks<sup>1</sup>, and Robert Battalio<sup>1</sup>

<sup>1</sup>ESA PWA, 550 Kearny Street Suite 800, San Francisco 94108; mlindley@essoc.com <sup>2</sup>U.S. Army Corps of Engineers, 1455 Market Street #16, San Francisco 94103 <sup>3</sup>California State Coastal Conservancy, 1330 Broadway Suite 1300, Oakland 94612

The Hamilton Wetland Restoration Project will restore approximately 390 acres of tidal wetlands and 70 acres of seasonal wetlands and transitional ecotone habitat along San Pablo Bay. Construction of the project is nearing completion with breach of the site scheduled for Spring 2014. The design approach uses dredged materials to raise subsided baylands at the site to elevations

suitable for tidal marsh, high tide refugia, and seasonal wetland ponds for shorebird foraging. The restoration includes: a network of cells to manage the placement of dredge material, shaping of the dredged materials to create seasonal wetlands and an upland-transitional habitat surrounding the tidal wetlands, excavation of tidal channels within the site and through the outboard levee and adjacent marsh/mudflat to convey tidal exchange and stormwater, the creation of low marsh islands, and revegetation. This presentation will review the restoration design approach and some of the challenges encountered during implementation of the project related to handling low-density, desiccated dredged materials, excavation of tidal channels, and the beneficial use of the materials onsite to support early establishment of marsh vegetation.

### **Restoring Salmon Creek's Tidal Processes to Create a Diversity of Estuarine Habitats within a Diked and Subsided Landscape**

Michael Love<sup>\*</sup> and Rachel Shea

Michael Love & Associates, Inc., PO Box 4477, Arcata 95518; mlove@h2odesigns.com

Salmon Creek is the largest tributary to South Humboldt Bay. Over a century ago the complex network of tidal channels and marshes was diked and drained for cattle grazing. Salmon Creek was ditched and the channel isolated from tidal influence of the bay using tide gates. In following years the drained marsh plains subsided and the salmon runs plummeted. In the mid-1980s the lower portions of these diked lands were incorporated into the Humboldt Bay National Wildlife Refuge. Beginning in 2001, restoration planning began for a portion of the estuary on the refuge. The plan worked within the multi-species objectives of the Refuge and the infrastructure constraints (i.e. adjacent Highway 101) to create a project that benefits a diversity of freshwater and marine species. It included reintroducing

# 1 Coastal Wetland Restoration *continued*

limited tidal waters to Salmon Creek through use of tidal-muting gates, reconstructing meandering slough channels, raising subsided lands to support native saltmarsh vegetation, constructing off-channel brackish and tidal freshwater ponds in the upper ecotone of the estuary, placement of complex large wood structures, and connecting non-tidal wetlands in the Refuge to Salmon Creek for use by foraging salmonids. After eleven years of planning, design, permitting, and construction, this multi-phased project has reached completion and post-project effectiveness monitoring continues. This presentation will focus on the design process, with an emphasis on lessons and insights learned through construction and physical monitoring of the project.

## **How do Restoration Site Characteristics, Plant Caging, and Parental Source Affect Native Pacific Cordgrass (*Spartina foliosa*) Establishment?**

W.J. Thornton<sup>\*1,2</sup> and K.E. Boyer<sup>1</sup>

<sup>1</sup>Department of Biology, San Francisco State University, 1600 Holloway Ave, San Francisco 94132; Whitney@spartina.org  
<sup>2</sup>Olofson Environmental Inc., State Coastal Conservancy San Francisco Estuary Invasive *Spartina* Project, 1830 Embarcadero Cove, Suite 100, Oakland 94606

A key programmatic goal of the San Francisco Estuary Invasive *Spartina* Project's restoration program is to reestablish native Pacific cordgrass (*Spartina foliosa*). This foundation species provides critical habitat to the endangered California clapper rail and offers important ecosystem functioning. Five large-scale experiments conducted from 2010-2013 have tested how restoration site characteristics, plant caging, and parental source of *S. foliosa* transplants have effected establishment rates of native cordgrass. Throughout all experiments, outplanting location (e.g., geographic location, substrate, elevation)

and caging were strong predictors of planting success. Establishment rate of native cordgrass was highest on uniform mudflats and wide channel banks (62%) with lower establishment rates occurring in second-order channels and bayfront habitat (15%). Cage effects varied by marsh, with the strongest cage effects occurring at sites with nesting Canada goose (7% survivorship in uncaged plots, 78% survivorship in caged plots). In a separate experiment, parental source was a strong predictor of planting establishment. Plants were collected from eight widespread marshes, genetically tested using microsatellites, and grown in identical nursery conditions. After 10 months, source populations differed in terms of culm height and density. Following nursery growth, 300 plants from each donor source were outplanted into two marshes and monitored quarterly. Sources varied significantly in terms of survivorship, flower production, and culm density. Field performance was not predictable from nursery bed performance. Successful restoration of native cordgrass requires understanding site-specific conditions including marsh hydrology, elevation, substrate, and herbivores. Continuing research will determine long-term effects of transplant source.

## **San Francisco Estuary Invasive *Spartina* Project Tidal Marsh Restoration Program in Support of California Clapper Rail: Programmatic Overview**

K. Zaremba<sup>\*1</sup>, J. Hammond<sup>1</sup>, W. Thornton<sup>1</sup>, J. Lewis<sup>1</sup>, S. Chen<sup>1</sup>, J. McBroom<sup>1</sup>, T. Roemer<sup>1</sup>, and D. Kerr<sup>2</sup>

<sup>1</sup>Olofson Environmental, Inc., 1830 Embarcadero Cove, Suite 100, Oakland 94606; katy@spartina.org <sup>2</sup>Independent Consultant, 1830 Embarcadero Cove, Suite 100, Oakland 94606

In 2011, the California Coastal Conservancy and U.S. Fish and Wildlife Service San Francisco Estuary Invasive *Spartina* Project (ISP) established a five-year program to rapidly improve habitat for California clapper rail (*Rallus*

*longirostris obsoletus*) in tidal marshes of the San Francisco Estuary. Program components include: artificial floating islands, constructed high tide refuge islands, rapid intensive revegetation, predator control actions, and Bay-wide eradication of invasive *Spartina*. A primary objective of the program is to intensively plant native marsh vegetation — primarily marsh gumplant (*Grindelia stricta*) and Pacific cordgrass (*Spartina foliosa*) — in strategic locations at invasive *Spartina* treatment sites, with the goal of rapidly enhancing cover, nesting, and high tide refuge habitat for rails. ISP treatment sites were selected for revegetation primarily where there were existing clapper rail populations that would benefit in the near term from habitat enhancement. As an additional enhancement at some sites, high tide refuge islands are being constructed and densely planted (H.T. Harvey). In the first three seasons, the Program has installed over 255,000 plants at 36 ISP treatment sites. In the first planting season, 2011-2012, *S. foliosa* mean survivorship was 46%, surpassing the Program's target goal of 40% (at one site it was 94%). Marsh plain *G. stricta* mean survivorship varied greatly among sites, overall survivorship was 35% and at several sites was over 50%. Monitoring results of the 2012-2013 plantings indicate higher overall survivorship than 2011-2012. Planting designs continue to be adapted each season.

# RESTORATION FOR SPECIAL-STATUS FISH & WILDLIFE SPECIES

Chair: **Ross Taylor** *Ross Taylor & Associates*

Wednesday 14 May 10:30a — 12:00p, 1:30p — 3:00p and 3:30p — 5:00p *Conference Room B*

## **Alviso Ponds A16/A17 Restoration and Habitat Enhancement**

Chris Boyd<sup>\*1</sup>, John Bourgeois<sup>\*2</sup>, and Dan Axness<sup>1</sup>

<sup>1</sup>McMillen, LLC, 1401 Shoreline Dr., Boise ID 83702; chris.boyd@mcmillen-llc.com <sup>2</sup>California State Coastal Conservancy, 1330 Broadway, 13th Floor, Oakland 94612

San Francisco Bay has lost an estimated 85 percent of its historic wetlands to fill or alteration. This dramatic decline in tidal marsh habitats has caused populations of marsh-dependent fish and wildlife to dwindle. Restoration of the South Bay salt ponds provides an opportunity to begin reversing these trends, improving the health of San Francisco Bay for years to come. The Pond A16/A17 restoration project on the Don Edwards National Wildlife Refuge includes the connection of 125 acres of Pond A17 to the tidal waters of Coyote Creek, providing new tidal marsh. It also includes the construction of a new screened intake structure, 16 new habitat islands in Pond A16 for nesting waterbirds, and more than 3.5 miles of public trails. The project design balanced the habitat goals with the available funding, multiple program partners, and a challenging construction environment. The project was completed in early 2013 despite construction challenges, which included Snowy Plovers attempting to nest near construction equipment, challenging cofferdam dewatering conditions, and construction using unstable bay muds. The ponds have been operational for approximately one year. As anticipated, the islands experienced drying settlement cracks, so a unique farming method was developed using an amphibious vehicle called a “Land Tamer.” The first season has produced rapid sedimentation rates in the restored tidal areas, high bird use numbers

including successful nesting in Pond A16, and a highly productive ecosystem producing food — large quantities of shrimp — for native fishes.

## **Restoring Salmon Habitat on the Sacramento River through Conservation Banking**

Allegra Bukojemsky\* and Mahala Guggino\*

Wildlands, 3855 Atherton Rd., Rocklin 95765; allegrab@wildlandsinc.com, mguggino@wildlandsinc.com

Wildlands constructed the 100-acre Fremont Landing Conservation Bank in 2013 as part of the Central Valley Anadromous Salmonid Umbrella Conservation Bank Agreement. This restoration project included the construction of over 2,000 linear feet of oxbow-type channels, connecting the river to existing levee-side borrow ditches which had been trapping fish for several decades. In addition, the floodplain and channel banks were planted with 9,000 riparian trees and shrubs. The presentation will give an overview of the restoration project planning process, from agency approval and permitting through construction, and how it has performed through its first two winters.

## **The NOAA Habitat Blueprint, Russian River Habitat Focus Area**

Natalie Cosentino-Manning

NOAA Fisheries Restoration Center, 777 Sonoma Ave, Suite 219-Am, Santa Rosa 95404; Natalie.c-manning@noaa.gov

Protecting our natural infrastructure—our global life support systems—is vital to protecting our communities and their economies as well as fisheries and

recreational opportunities along our coasts. With continued widespread loss and deterioration of coastal and marine habitats, we are in danger of losing this infrastructure. Congress has charged the National Oceanic and Atmospheric Administration (NOAA) with protecting habitat for fish, threatened and endangered species, marine mammals, and other natural resources within the coastal zone. Recognizing the need for more concerted efforts to conserve (protect and restore) habitat, we developed the NOAA Habitat Blueprint to build on existing programs, prioritize our activities, and guide our future actions. The Habitat Blueprint provides a forward-looking framework for NOAA to think and act strategically across programs and with partner organizations to address the growing challenge of coastal and marine habitat loss and degradation. As the first Habitat Focus Area under NOAA’s Habitat Blueprint, the Russian River has been identified as a place where NOAA and partners can work to meet multiple habitat conservation objectives on a watershed scale. The objectives of the Russian River Habitat Focus Area are to: 1) Rebuild endangered coho and threatened Chinook and steelhead stocks to sustainable levels through habitat protection and restoration; 2) Improve frost, rainfall, and river forecasts in the Russian River watershed through improved data collection and modeling; and 3) Increase community and ecosystem resiliency to flooding and drought through improved planning and water management strategies. My talk will describe these efforts and our vision for implementation.

*continued*

### Enhancing Salmonid Habitat on the Lower American River, California

Tarick Abu-Aly<sup>1</sup>, Chris Hammersmark<sup>\*1</sup>, Julie Zimmerman<sup>2</sup>, John Hannon<sup>3</sup>, Joe Merz<sup>4</sup>, and Tom Gohring<sup>5</sup>

<sup>1</sup>cbec inc. eco engineering, 2544 Industrial Boulevard, West Sacramento 95691; c.hammersmark@cbecoeng.com, t.abu-aly@cbecoeng.com <sup>2</sup>U.S. Fish and Wildlife Service, 650 Capitol Mall, Suite 8-300, Sacramento 95608; julie\_zimmerman@fws.gov <sup>3</sup>U.S. Bureau of Reclamation, 801 I Street, Suite 140, Sacramento 95814; jhannon@usbr.gov <sup>4</sup>Cramer Fish Sciences, 3300 Industrial Boulevard, Suite 100, West Sacramento 95691; jmerz@fishsciences.net <sup>5</sup>Sacramento Water Forum, 2831 G Street, Suite 100, Sacramento 95816; tgohring@waterforum.org

The Lower American River is a local treasure running through the highly urbanized region of Sacramento and its neighboring communities. Hydrologic regulation of the river by upstream dams, the corresponding blockage of sediment supply to the river downstream, and blockage of fish passage to the historically available habitat upstream have had deleterious consequences to populations of Chinook salmon and steelhead trout that depend on the American River Watershed for spawning and rearing. In the last five years, concerted efforts by agencies including the U.S. Bureau of Reclamation, U.S. Fish & Wildlife Service, California Department of Fish and Game, NOAA Fisheries, Sacramento County Parks, and the Sacramento Water Forum have resulted in several fisheries enhancement projects in the Lower American River, focusing on the creation and enhancement of spawning and juvenile rearing habitat. The projects have involved feasibility, design, and implementation of gravel augmentation as well as side-channel construction and rehabilitation. Details of the main components of the feasibility and design of these projects are provided. Experiences gained through the

construction of the projects are discussed. Physical and biological monitoring data are highlighted to demonstrate the success and lessons learned for each project.

### Restoration Success for the Special Status Western Burrowing Owl

Anita M. Hayworth, Ph.D.

Dudek, 605 Third Street, Encinitas 92024; ahayworth@dudek.com

California supports one of the largest populations of burrowing owls (*Athene cunicularia*) in the U.S. However, in the coastal southern California region, populations have declined or been extirpated. Passive relocation has been used, when appropriate, to avoid take of occupied nests. The success rates and demographic consequences of relocation methods have not been adequately evaluated or reported. There are limited examples of successful restoration within the region. Habitat Restoration Sciences, Inc. (a Dudek subsidiary) implemented the restoration of burrowing owl habitat, and has continued to provide vegetation management to promote the long-term viability of burrowing owls on a site in Los Angeles County. Tasks include the maintenance of vegetation parameters conducive to burrowing owl presence, planting of native vegetation, and removal of invasive species. Burrowing owl use of the Mitigation Area was confirmed within the first year of installation even though the site had been previously unoccupied. To support the success of this restoration site as well as restoration focused on other special status species, matrix analyses have been conducted to provide detailed species requirements. This matrix analysis has been used on this burrowing owl mitigation site as well as for other species-specific restoration including that for the Salton Sea Species Conservation Habitat project and restoration for cactus wren in preserve lands. By implementing consistent field data collection, monitoring, and reporting protocols, we can analyze species site fidelity,

reproductive success, and survival. This will improve the future success of relocations for establishing or augmenting special status species populations.

### Navigating Obstacles to Restoring Fish Passage in Marin County, CA

Kallie Kull\* and Joanna Dixon\*

Marin County Department of Public Works, San Rafael 94913-4186; kkull@marincounty.org, jdixon@marincounty.org

In 2005, the County of Marin committed to restoring fish passage and ecological connectivity at high priority stream and road crossings. The County has completed 8 projects since 2005 and has 4 more in design. This presentation focuses on some of the seen and unforeseen obstacles encountered during the design and construction phase of Marin's projects. The talk will include strategies for working with endangered species, negotiating with landowners and regulatory agencies, navigating around utilities, and securing funding and resource agency support. The presentation will also provide the background for understanding the complexity of several projects included on the SERCAL field tour in West Marin.

### Dry Creek Habitat Enhancement: Linking Habitat Conditions to Salmonid Ecology

Neil Lassetre<sup>\*1</sup>, David Manning<sup>1</sup>, Gregg Horton<sup>1</sup>, and Robert Coey<sup>2</sup>

<sup>1</sup>Sonoma County Water Agency, 404 Aviation Boulevard, Santa Rosa 95403 <sup>2</sup>NOAA Fisheries West Coast Region, 777 Sonoma Avenue Rm 325, Santa Rosa 95404; neil.lassettre@scwa.ca.gov

Habitat characteristics that affect salmonid freshwater life stages include conditions such as physical (habitat quantity and quality), chemical (water quality and temperature), and biological (predator abundance, food availability).



While the links between habitat condition and salmonid ecology are well known, the biological response to changing a specified condition can be difficult to detect, requiring a robust monitoring program that adapts to clear signals detected in the data. The Sonoma County Water Agency's Dry Creek Habitat Enhancement Project used information on current conditions to inform the design of projects for enhancing juvenile coho salmon and steelhead habitat along a one-mile reach, thus demonstrating potential techniques for future project phases. Enhancement approaches target off-channel areas (constructed backwaters and side-channels), stream banks (bioengineered bank stabilization structures and engineered logjams), and in-channel areas (boulder fields and constructed riffles) to create hydraulic and escape cover for coho and steelhead juveniles and promote macroinvertebrate production. Sonoma County Water Agency is monitoring the ecological and physical effectiveness of the enhancement features, and validating juvenile salmonid usage following a monitoring plan that integrates data to evaluate enhancement measures. The project will be evaluated at multiple scales: feature (e.g., backwater or constructed riffle), site (collection of features), enhancement reach (collection of sites), and project reach (collection of enhancement reaches) against performance measures, and evaluation outcomes will guide future actions. The project is being carried out as part of the Reasonable and Prudent Alternative of the Russian River Biological Opinion, which outlines habitat goals as well as other potential alternatives.

### **Mattole Integrated Watershed Management: A Rural Community's Approach to Restoration**

Cassie Pinnell<sup>1</sup>, Sungnome Madrone<sup>2</sup>, and Tasha McKee<sup>3</sup>

<sup>1</sup>Mattole Restoration Council, PO Box 160, Petrolia 95558; cassie@mattole.org

<sup>2</sup>Mattole Salmon Group, PO Box 188, Petrolia 95558 <sup>3</sup>Sanctuary Forest, PO Box 166, Whitethorn 95589

The Mattole River drains 300 square miles of northern California's Lost Coast region, and is included on the federal Clean Water Act's list of impaired water bodies due to sediment and high temperature. Its wild runs of coho, steelhead, and Chinook are threatened by historic timber harvest practices, as well as current land use and climate conditions. In response to the rapid decline in fish numbers, the Mattole community acted in the early 1980s to form one of the first community-based, watershed restoration efforts in the Pacific Northwest. The Mattole River and Range Partnership today includes three non-profit watershed restoration groups that partner to implement restoration efforts from the headwaters to the Pacific. In the last 10 years alone we have improved fish habitat by making 21 miles of stream accessible to fish (29 fish barriers removed and 790 stream crossings improved); restoring 47 miles of riparian corridor (over 347,000 plantings); decommissioning or upgrading 65 miles of roads to reduce sediment loading; and saving over 1 million cubic yards of sediment from reaching streams. In addition, we have worked to improve flow by creating a forbearance program that encourages landowners to reduce summer creek domestic use by 1 million gallons. We have also implemented fuels reduction and prairie restoration on public and private lands, and developed educational and stewardship programs. The Mattole River and Range Partnership provides a model that combines community efforts with agency and foundation funding to effectively address the ecological challenges of rural watersheds.

### **Design and Construction of Large Woody Debris Habitat Enhancements**

Stephen Reynolds\* and Cheryl Hayhurst

California Geological Survey, 801 K Street, Suite 1200, Sacramento 95814; Stephen.Reynolds@conservation.ca.gov

Soquel Creek, a designated coho stream, flows through Soquel Demonstration State Forest (SDSF) in Santa Cruz, California. Prior to creation of SDSF (1990), Soquel Creek was routinely gleaned of large woody debris (LWD). SDSF is undertaking long-term habitat rehabilitation by reintroducing LWD to Soquel Creek. This presentation discusses the methodology used at SDSF for resilient and effective LWD features without the use of cables, bolts, or other hard engineering features. Successful LWD features integrate biologic, hydrologic, and geomorphic goals. For biologic benefit, LWD needs a residency time meeting the needs of target organisms. LWD residency requirements (e.g., five years) drive selection of peak design storm (PDS) and its associated flow, which in-turn drives sizing and configuration of LWD. During geomorphic assessment, appropriately configured stream reaches, (e.g., grade less than three percent) and potential LWD sources (such as undercut bank trees) are mapped. Selected sites are mapped in detail and cross-sections developed. Using a combination of excavated whole trees with root wad and appropriately-sized logs, LWD is placed at geomorphically appropriate localities. Following installation, LWD mapping provides a base-line for performance monitoring. Biologic and geomorphic monitoring is being performed for the next five years. LWD installations have experienced two PDS resulting in 15-, 200-, 230-percent increases in sinuosity, number of pools, and pool volume, respectively.

# UPLAND HABITAT RESTORATION & MANAGEMENT

Co-Chairs: **Chad Aakre** *Olberding Environmental & CNGA*  
**Andrew Rayburn, PhD** *River Partners & CNGA*

Wednesday 14 May 10:30a — 12:00p, 1:30p — 3:00p & 3:30p — 5:00p *Conference Room C*

## Lessons Learned While Restoring Grassland-Scrub Mosaics through Coyote Brush Management

Kelsey Barbella\*, Jessica (Shors) Appel, and Don Thomas

San Francisco Public Utilities Commission, Natural Resources and Land Management Division, 525 Golden Gate Ave, 10th Floor, San Francisco 94102; kbarbella@sfgwater.org

Grassland-scrub mosaics provide important habitat for several rare species, but because of urbanization and subsequent decreases in the use of grazing and fire for management, native coyote brush has been converting grassland-scrub mosaics into large coyote brush monocultures within fog-influenced areas such as the SFPUC Peninsula watershed. Although it can provide ecosystem functions, coyote brush's increasing extent has begun to threaten endangered plant species populations and degrade rare species' habitats such as San Francisco garter snake (SFGS) basking habitat. Through its Bioregional Habitat Restoration program, the SFPUC is enhancing basking habitat for SFGS on the Peninsula watershed by restoring nearly 32 acres of scrub monoculture to a grassland-scrub mosaic. Although the project has been successful, we would like to highlight three lessons learned. First, the initial design involving a 10% scrub / 90% grassland random arrangement throughout the site may be facilitating coyote brush re-sprouting in areas intended to be grassland vegetation. One follow-up strategy may be to consolidate the scrub within the site's several swales. Second, the project used a "brontosaurus masticator" for initial treatment because minimal re-sprouting occurred when used on a pilot study.

However, this tool was not quite as effective as predicted when applied on a large scale, possibly due to the subtle changes in blade configuration. Third, re-sprout management has been challenging and little is known about methods that avoid herbicide use; thus, we will discuss our pilot project to test the effectiveness of potential methods such as hand-held stump-grinding, hand-held mastication, and tarping with clear or black plastic.

## Native Grassland Restoration in a Large-Scale Levee Improvement Project

Jennifer Williamson Burt<sup>\*1</sup>, Peter Buck<sup>2</sup>, Vance Howard<sup>1</sup>, and Steve Chainey<sup>1</sup>

<sup>1</sup>AECOM Design and Planning, 2020 L Street, Sacramento 95819; jennifer.burt@aecom.com <sup>2</sup>Sacramento Area Flood Control Agency, 1007 7th Street, Sacramento 95814

The Sacramento Area Flood Control Agency (SAFCA) began implementing the Natomas Levee Improvement Program (NLIP) Landside Improvement Project in 2007 to correct levee deficiencies in the Natomas Basin. The comprehensive conservation strategy developed to offset impacts of this program included the seeding and management of approximately 600 acres of native perennial grasslands, which are intended to provide erosion control, habitat diversity, and foraging habitat for the State-threatened Swainson's Hawk. Starting in 2010, native grasses were seeded on engineered levee slopes, landside seepage berms, operations and maintenance corridors, and understories of extensive planted landside woodlands. Steep, engineered levee slopes present a particular suite of obstacles to successful revegetation that were partly overcome by the development of a specialized piece of seeding equipment called the "Ridger-

Roller-Seeder" or RRS; this piece of equipment has significant potential for wider use in a variety of situations where steep slopes limit the utility of standard drill seeding equipment (including for example: other levees, roadsides, ski slopes, and canal or sediment pond banks). Weed control strategies employed on this project range from timed mowing and prescribed burning to applications of general pre-emergent and targeted broadleaf herbicides. As might be expected in a seeding project of this scope and magnitude, some portions of the project area have been highly successful while others have not. Successful implementation and maintenance approaches (and lessons learned) from this large-scale native grassland restoration effort will be presented.

## Soil Treatments for Rainfall Harvesting on Harsh Sites and Substrates

Vic Claassen

2446 Bucklebury Rd, Davis 95616; vpclaassen@gmail.com

Lack of adequate plant available moisture is a common cause of poor revegetation performance on upland sites and substrates, especially in California's summer-dry Mediterranean climate. The situation is made worse on degraded sites or substrates with compacted, dispersive soils, excessively fine or coarse textured substrates, steep slopes, or materials with high rock content. These conditions tend to reduce infiltration rates that are needed for erosion resistance during common rainfall events or they result in insufficient moisture retention for growth in dry periods. Several treatment options are available for modifying field conditions to improve precipitation capture (i.e. 'rainfall harvesting') on harsh wildlands sites. An example will be

presented from the San Jose, CA area in which a cobbly, compacted substrate occurs at a highway interchange site. Native plants and horticultural accessions were planted either in conventional augered holes several feet in size, or in 3-4 ft deep by 1 ft wide contour trenches. Both treatments were backfilled with a mixture of yard waste compost and the existing substrate. After a year with no irrigation or significant rainfall, different degrees of hardiness in these conditions were observed for the selected plantings, some of which grew vigorously and flowered. Basic components of soil hydrologic function are discussed in relation to plant growth and field-observable substrate characteristics and cues.

### Soil Inoculation Benefits Native Grass Restoration, but Method Matters

Taraneh M. Emam

Department of Plant Sciences, University of California, Davis, 1210 PES Mail Stop 1, Davis 95616; tmemam@ucdavis.edu

Using soil inocula, such as mycorrhizal fungi products, can produce mixed results in restoration. Many factors may affect the outcomes of using these products, such as characteristics of the site, plant species, inoculum type and application method. A brief overview of considerations for the use of inocula in restoration will be presented, followed by results from a field study. At a grassland mine restoration site, the effect of a commercial mycorrhizal inoculum on aboveground biomass of a grassland community was compared with using local native grassland soil as a source of inoculum and a control. In addition, greenhouse-grown seedlings of a native grass (*Stipa pulchra*) were subjected to similar treatments, and then transplanted into field plots. When inocula were applied directly to field plots, local soil had variable effects on native grass, non-native grass, non-native forb, and total biomass throughout the three years of study, while commercial inoculum had no detectable effects. When *S. pulchra*

seedlings were inoculated during initial growth and then transplanted into the field, the local soil treatment resulted in greater N content, biomass, and mycorrhizal colonization of *S. pulchra* relative to controls. Commercial inoculum increased mycorrhizal colonization of *S. pulchra* roots relative to controls, but did not significantly affect performance of *S. pulchra*. Findings indicate that at this site, use of local soil as an inoculum was more effective in increasing plant biomass than the commercial product used, but in order to increase native grass performance inoculation of transplanted plugs was necessary.

### Impacts of Native vs. Exotic Grasslands on Multiple Ecosystem Services

Valerie Eviner <sup>\*1</sup>, Joanne Heraty<sup>1</sup>, Jill Baty<sup>1</sup>, Carolyn Malmstrom<sup>2</sup>, and Kevin Rice<sup>1</sup>

<sup>1</sup>Department of Plant Sciences, 1210 PES, Mail Stop 1, University of California, Davis 95616; veviner@ucdavis.edu

<sup>2</sup>Department of Plant Biology, Michigan State University, East Lansing, MI 48824

California's grasslands are invaded by exotic species to such an extent, that it is not currently feasible to restore all impacted sites to native communities. Ecosystem services are a potential criteria to prioritize areas for restoration and weed control. We planted three community types: naturalized exotic species (which have dominated California's grasslands for 200-300 years), invasive weeds (goatgrass and medusahead), and native species (common restoration mix in California's Central Valley). After 3 years, we assessed the impacts of vegetation type on multiple ecosystem services. When comparing natives to naturalized species, natives increased soil nitrogen availability and were much better at suppressing invasive weeds. However, the naturalized plots provided better erosion control, mitigation of soil compaction, water quality, and soil water storage. This suggests that restoration of

natives will be most beneficial in areas with high invasive weed pressure, but could be detrimental in areas where erosion, compaction, and water quality are of concern. Invasion of noxious rangeland weeds into the naturalized community did not enhance any ecosystem services, and greatly decreased palatable spring forage quantity. However, there is a tradeoff between invasive weeds and native species. Invasion of noxious weeds into native communities decreased spring forage availability and decreased soil nitrogen availability, but enhanced soil water storage, compaction alleviation and water quality. This suggests that sites that are less vulnerable to soil degradation would be best to prioritize for invasive weed control.

### Upland Desert Restoration Program: SCE's Eldorado-Ivanpah Transmission Project

Cecilia Meyer Lovell<sup>\*1</sup>, Scott McMillan<sup>1</sup>, and Linda Robb<sup>\*2</sup>

<sup>1</sup>AECOM, San Diego 92101;

Cecilia.MeyerLovell@aecom.com

<sup>2</sup>Southern California Edison, Brea 92821; Linda.Robb@sce.com

Over the past 2 years, Southern California Edison (SCE) and AECOM have been focused on implementing upland habitat restoration for 244 acres across 35-miles in the Mojave Desert along the California/Nevada border near Las Vegas, NV. Construction of the Eldorado-Ivanpah Transmission Project — a 230 kV transmission line conveying electricity from renewable energy facilities that traverses desert tortoise (*Gopherus agassizii*) and big horn sheep (*Ovis canadensis*) habitats — was completed in June 2013. For restoration to be successful, restoration activities began prior to commencement of construction. In 2012, AECOM conducted pre-construction surveys to document baseline conditions for restoration performance criteria and orchestrated salvage of more than 9,000 succulents from planned work areas into

### 3 Upland Habitat Restoration and Management *continued*

temporary nurseries. In early 2013, practices that minimized soil and vegetation disturbance were used during construction, including the avoidance of special-status plants; and implementation of a native seed collection program. In addition, restoration ecologists worked alongside construction and SWPPP contractors to oversee decompaction and re-countouring at the end of construction. In fall/winter 2013/2014, succulents were transplanted back to restoration areas, the entire 250+ acres, encompassing 232 restoration areas, were seeded with native seed mixes tailored to pre-existing vegetation, and special-status plant seed was applied in appropriate restoration areas. Seeding was conducted by hand and by imprinting, with an innovative imprinter developed by Gothic Landscape, Inc. Preliminary results from data collected in March 2014 for succulent survival rates, native and nonnative vegetation cover and special-status plant germination will be presented for Year 1 of the restoration program.

#### **Selective Control of Velvet Grass in Coastal Prairie Restoration**

Lewis Reed\* and Suzanne Olyarnik

University of California Davis Bodega Marine Reserve, 2099 Westside Rd, Bodega Bay 94923; lkreed@ucdavis.edu, svolyarnic@ucdavis.edu

Non-native invasive species present a major challenge in coastal prairie restoration and, in sites with existing native cover; managing non-native species may be the primary restoration action. Management of non-native invasive species is particularly vexing when invaders are functionally similar to native members of the affected community. As part of a broader study comparing different strategies for controlling velvet grass (*Holcus lanatus*) at five sites, we evaluated the effectiveness of the grass-specific herbicide Poast® as a selective

management tool for controlling velvet grass in coastal prairies at the Bodega Marine Reserve (Sonoma County). All plots had similar velvet grass cover during baseline surveys but we observed reductions by 41%, 42%, and 81% in the three years following initial application when comparing treatment plots to reference sites. Native cover was sustained in treatment plots throughout the study period but some exotic species (other than velvet grass) increased after the application. Cover of monocots other than velvet grass varied between years but there was generally no difference between treatment plots and reference sites for this parameter with the exception of the second post treatment year in which herbicide plots had higher monocot cover than reference sites. The results indicate that carefully timed application of grass-specific herbicide may be an effective way to selectively reduce velvet grass while sustaining native cover in coastal prairie restoration.

#### **Effects of Nitrogen Deposition on Coastal Sage Scrub Reestablishment**

Justin M. Valliere\* and Edith B. Allen

Botany and Plant Sciences, University of California, Riverside, 900 University Ave., Riverside 92501; jvall007@ucr.edu

Coastal sage scrub (CSS) of southern California has been reduced to a fraction of its historic range due to grazing, development, altered fire regimes, and invasion. High levels of anthropogenic nitrogen (N) deposition, a consequence of fossil fuel combustion, may also pose a significant threat to this ecosystem. We investigated the effects of four levels of simulated nitrogen deposition on the establishment of native and nonnative seedlings at two sites in the Santa Monica Mountains in an effort to identify critical loads for invasion and reestablishment. We hypothesized that N addition would favor nonnative plant species over native shrub seedlings, resulting in decreased native seedling establishment. We also hypothesized that N addition would alter mycorrhizal diversity and abundance,

which may also favor nonnatives over native mycorrhizal shrub species. After one year of experimental N fertilization, we observed a significant reduction in mycorrhizal fungal spore density with increasing N availability. After two years of N addition, native seedling density was significantly lower in fertilization plots, possibly due to increased standing biomass of nonnative species. While effects on mature stands of CSS may be minimal, our preliminary results indicate that increased N availability due to anthropogenic N deposition may have strong negative effects on the establishment phase of this community through changes in nonnative plant abundance and cover. This in turn could have important implications for CSS succession and long-term vegetation dynamics in this system, as well as invasive species management and ecological restoration.

#### **Can Summer Watering to Flush Annual Weeds Reduce Percent Cover of Exotics in Restored Grasslands?**

Kristina Wolf\* and Truman P. Young

Department of Plant Sciences, 2227 PES, Mail Stop 1, University of California, Davis, 95616; kmwolf@ucdavis.edu

California's native grasslands have been largely replaced by exotic annual grasses. "Flushing of weeds" is a common practice in restoration plantings to reduce annual seedbanks and competitive pressure on perennial grasses in the subsequent growing season. I applied five summer watering treatments of different frequencies and timing to restored native grass pasture in Davis, CA in August 2012. Exotic grass seedlings emerged in all plots as a result of watering treatments, but only the twice-daily watering treatment was significantly different from the control. Most grass seedlings subsequently died, thereby reducing the seedbank; however, seeds may also germinate beneath the soil surface and die prior to emergence. To determine if the seedbank was reduced in other treatments, exotic

seedlings were counted after commencement of natural rains. Two treatments exhibited reduced germination: watering twice daily for 4 days, and once daily for 4 weeks. Nevertheless, annual grass cover in the following growing season was not significantly different between treatments and controls. This has several

potential management implications: 1) watering for longer periods, or adding more water, may not be as effective as more frequent and directed watering over shorter periods; 2) keeping the soil moist between watering periods may be more important for inducing an annual flush than the total amount of water applied; and 3) watering may produce a

short-term weed flush that could potentially reduce competition with desirable perennial species, but may not produce long-term results in terms of percent cover of weedy annual plants in the following growing season.

## RIPARIAN RESTORATION

Chair: **Gregory Andrew** *Marin Municipal Water District*

Thursday 15 May 8:30a – 10:00a, 10:30a – 12:00p, and 1:30p – 3:00p *Conference Room A*

### **Revegetation Outcomes at Previous Channel Rehabilitation Projects on the Trinity River, California**

John H. Bair

McBain Associates 980 7th, Arcata 95521; john@mcbaintrush.com

Revegetation on the Trinity River in northern California is conducted within channel rehabilitation sites to accelerate recovery of riparian habitat and ensure that target riparian woody species are emphasized. Over 30,000 hardwood riparian plantings have been installed. Vegetation maps are used to determine riparian vegetation baseline area, impacts, and recovery associated with restoration activities. However, the time required for revegetated plants to be visible on aerial photography is approximately five years. To ensure that revegetation efforts are successful, the survival of revegetated plants is also quantified for the first three years after planting. By five years, most sites have recovered riparian vegetation area that is equal to or greater than what was impacted during rehabilitation, although sites have lost riparian vegetation post project through natural riverine process (e.g., scouring during high flow events) or through wildfire and landowner clearings. Early sites were revegetated using a Stinger and plant materials were

hardwood pole cuttings. Survival of pole cuttings planted using a Stinger ranged from 0% to 100% depending on where a patch was located, depth to groundwater, and the species planted in a patch. Arroyo willow had the highest survival, black cottonwood and shiny willow generally had a 50% survival rate, and red willow performed the worst. For the last two years, only nursery container stock has been planted and a minimum survival rate of 70% is targeted. The first growing season after planting revegetated materials experienced the driest year on record and mortality may be higher than 70%.

### **Lessons Learned from a Decade of Restoration on the Napa River**

Jorgen Blomberg\* and Andy Collison

ESA PWA, 550 Kearny Street, Suite 800, San Francisco 94108; jblomberg@esassoc.com

In 2002, the Rutherford Dust Society (grape growers and vineyard managers) of the Rutherford Reach of the Napa River formed the Rutherford Dust Restoration Team (RDRT) and initiated a plan to restore four miles of the river. Construction started in 2009 and will be complete at the end of the 2014 construction season. Plans are now being

developed to restore significant sections of the nine-mile Oakville to Oak Knoll Reach just downstream of Rutherford, resulting in one of the largest river restoration projects in California. The projects include rededication of over 30 acres of vineyard areas to the riparian corridor which allows for berm setbacks, creation of inset floodplains in the incised reaches, biotechnical bank stabilization, creation of instream aquatic habitat, and the recreation of secondary channels. Working on a project of this scale and duration has given us the opportunity to experiment and refine many ideas in riparian restoration. An example of this 'design evolution' is the transition from creating relatively linear but narrow 'restoration corridors' to more concentrated and expansive 'restoration nodes' where geomorphic and ecological processes can sustain each other more comprehensively. We have also drawn on research by staff members at UC Davis to refine design approaches to floodplain benches and to sustain riffle-pool habitat. Finally, the design approach has benefited greatly from historical ecology studies conducted by the San Francisco Estuary Institute that provide an understanding of channel trajectory, and that point to potential restoration approaches.

## 4 Riparian Restoration *continued*

### **Integrating Dendochronology and Channel Migration Zone Mapping to Date Channel Evolution and Delineate Potential Riparian Restoration Areas**

Andy Collison<sup>\*1</sup>, Brian Haines<sup>1</sup>, Gretchen Coffman<sup>2</sup>, and Devin Barry<sup>2</sup>

<sup>1</sup>ESA PWA, 550 Kearny Street, San Francisco 94108; [acollison@esassoc.com](mailto:acollison@esassoc.com)

<sup>2</sup>Department of Environmental Science, University of San Francisco, 2130 Fulton Street, Harney 140B, San Francisco 94123 [gcoffman@usfca.edu](mailto:gcoffman@usfca.edu)

Many of California's creeks are incised — confined and isolated from their floodplains — and a typical restoration approach is to 'speed up' natural channel widening by grading a new inset floodplain hydrologically connected to the incised creek channel. This approach is expensive and impacts existing habitat, so it is critical to understand the optimum width of inset floodplains in order to restore ecological processes without prohibitive cost and impacts. It is also helpful to know how fast this process would take if left to nature, so that no action alternatives and passive restoration approaches such as managed bank top retreat can be evaluated. As part of a recent study at the Muir Woods National Monument in Marin County for the Parks Conservancy and the National Parks Service, we conducted geomorphic mapping of floodplain surfaces and used dendrochronology to date the surfaces. This allowed us to develop a timeline of channel incision and widening for Redwood Creek over the last 150 years. Using Channel Migration Zone delineation methods developed in Washington, we were able to map the envelope of likely channel migration over the next 100 years. This information helps us understand how rapidly Redwood Creek has evolved, how rapidly it might create its own floodplain if unconstrained by bank stabilization, and how wide such a natural floodplain might be. Combining dendrochronology with geomorphic interpretation provides a valuable tool for restoration and

landuse planning around riparian corridors.

### **Updated Regional Curves of Hydraulic Geometry for Creek Restoration Design for Marin and Sonoma Counties of the San Francisco Bay Area**

Roger Leventhal, P.E.<sup>\*1</sup>, and Laurel Collins<sup>2</sup>

<sup>1</sup>Marin County Flood Control District, 3501 Civic Center Drive, #304, San Rafael 94903; [rleventhal@marincounty.org](mailto:rleventhal@marincounty.org) <sup>2</sup> Watershed Sciences, 1128 Fresno Ave, Berkeley 94707; [laurelgene@comcast.net](mailto:laurelgene@comcast.net)

This talk will present the results of a multi-year EPA-funded project to collect field data and prepare updated regional curves of hydraulic geometry for Marin and Sonoma Counties of the San Francisco Bay Area. The concept of regional curves and hydraulic geometry was originally developed by Luna Leopold in the 1950s through the 1970s. Approximately 58 data points were collected and analyzed under this project scope. These curves include the traditional plots of stable bankfull characteristics (width, depth, and area) as a function of drainage area. However, additional data was collected for this project and analyzed to further segregate the results by stream geomorphic characteristics and to evaluate additional controls on stream morphology. The new dataset now includes both steeper creeks and creeks with smaller drainage areas than the original dataset, showing significant deviations from the original Leopold regional curve published in *Water in Environmental Planning* (1978) for these stream types, both of which represent streams that are commonly the focus of restoration efforts. This talk will provide an introduction on both the background and history of regional curves and present the new datasets along with specific examples of their use in creek restoration design projects.

### **Carbon Pools and Carbon Credits in a 20-Year Riparian Restoration Chronosequence**

Virginia Matzek

Santa Clara University, 500 El Camino Real, Santa Clara 95053; [vmatzek@scu.edu](mailto:vmatzek@scu.edu)

Habitat restoration is increasingly called upon to provide ecosystem services—the material and non-material benefits to humans derived from ecosystem functions — such as carbon sequestration, erosion control, and water quality. At the same time, economic incentives to pay for such ecosystem services have provided a possible alternative funding mechanism for restoration activities. This study characterizes the trajectory of carbon sequestration in biomass and soils as a result of 20 years of riparian restoration along the Sacramento River, with an eye toward understanding how carbon payments under California's cap-and-trade scheme could potentially pay for future restorations of this habitat. Carbon credits earned by the restoration could represent a significant portion of the cost of restoring the habitats, but do not compete well with income from current land-uses, such as almond and walnut cultivation, in the Sacramento River floodplain.

### **Ecological Constraints of Willow Growth at a Restored Riparian Corridor**

Jacqueline McCrory<sup>\*</sup>, Brian Piontek<sup>\*</sup>, and Gretchen Coffman

Environmental Management Program, Environmental Science Department, University of San Francisco, San Francisco 94117-1080; [jacquelinemccrory@gmail.com](mailto:jacquelinemccrory@gmail.com), [bpiontek@gmail.com](mailto:bpiontek@gmail.com)

Recently, many stream restoration efforts in the Western U.S. have focused on restoration of habitat for anadromous fish populations. Effective, rapid revegetation of riparian trees is critical to the restoration process, providing

shading necessary to cool stream temperatures. This study investigated stunted growth of arroyo willow (*Salix lasiolepis*) cuttings planted along the banks of Redwood Creek in riparian ecosystems restored as part of the National Park Service's Muir Beach restoration to support the southernmost coho salmon population in California. We hypothesized that deer herbivory and soil characteristics were potential stressors limiting willow growth along the 1,200 foot (366m) long restored riparian corridor. To test our hypothesis, we measured the change in willow growth from the beginning to the end of the 2013 growing season. Our study design consisted of two treatments: exclusionary deer fencing (versus not fenced) and willow age (1- and 2-year old). Soil moisture, compaction, and texture were sampled next to each of 10 willows measured in all treatments. Mean height, volume, and canopy width were all significantly greater for willows grown inside the exclusionary fencing. The largest effect of fencing on willow growth was for the height of younger, one-year old cuttings (fenced,  $99.4 \pm \text{SE } 8.6\text{cm}$ , unfenced,  $38.5\text{cm} \pm \text{SE } 6.9\text{cm}$ ). Soil characteristics were also found to influence willow growth, but to a lesser degree. Results suggest that exclusionary fencing should be used to reduce the stress of ungulate herbivory on willow growth in restored riparian systems in the Western U.S.

### **Large-scale, Multi-benefit Riparian Restoration at Dos Rios Ranch**

Andrew P. Rayburn\*, Julie Rentner, Jeff Holt, Stephen Sheppard, and Trevor Meadows

River Partners, 912 11th Street, Suite LL2, Modesto 95354;  
arayburn@riverpartners.org

We report project background, restoration design, progress-to-date, and future directions of collaborative, multi-benefit riparian restoration efforts at the 2,100-acre Dos Rios Ranch located at the confluence of the San Joaquin and

Tuolumne Rivers in Stanislaus County, CA. Adjacent to the 8,000-acre San Joaquin River National Wildlife Refuge, the property was acquired by River Partners through cooperation with 12 private, local, state and federal funding programs in addition to other regional non-funding stakeholders. The property is being developed as a landscape-scale model for strategic habitat restoration, threatened and endangered species recovery, transient floodwater storage, conservation funds leveraging, and public engagement. The first restoration phase, including approximately 40,000 native trees and shrubs, was planted in spring 2013 and included 198 acres of wetlands, floodplains, and uplands. The second restoration phase, including an additional 100,000 trees and shrubs, began in late 2013 and includes approximately 400 acres of additional habitat. Additional phases are planned over the next decade. The property includes the entire federal levee within Reclamation District 2092, and plans to breach the levee to provide river-floodplain connectivity are in development. Additional innovative design features include high-water refugia for endangered mammals, habitat mosaics to benefit specific T&E species, expansion and connection of existing habitat corridors, diverse native overstory and understory plant communities, and fish screens for water diversion infrastructure. The project benefits a wide array of stakeholders through ancillary benefits to water supply (e.g., the permanent retirement of >11,000-acre-feet of riparian water diversions), flood protection, recreation, education, and water quality.

### **Kick-starting Riparian Restoration in a Disturbed Riverscape**

Gary Reedy\* and Rachel Hutchinson

South Yuba River Citizens League. 313 Railroad Ave. Nevada City 95959;  
gary@syrcl.org

The lower Yuba River is highly disturbed from a history of hydraulic mining

debris, dredger mining, upstream dams, and an altered flow regime. Riparian enhancement has been identified as an important action for recovery of spring-run Chinook and steelhead trout. The Hammon Bar pilot project involved the planting of 6,389 large cottonwood and willow cuttings in 2011 and 2012 for the purpose of increasing vegetation cover and structural complexity, and increasing the local production of large woody material to enhance salmonid habitat. Project results suggest an economically feasible method of establishing additional riparian forest. Results from monitoring the 5-acre project site include different survivorship by species and planting method. Deposition of fine sediment and accumulation of organic material in the project site during floods revealed hydraulic interactions and outcomes beneficial to natural processes. Monitoring and evaluation of the project is accompanied by several initiatives to plan a riparian restoration program, including: riparian mapping, seed dispersal surveys, structural surveys, hydrodynamic modelling, depth-to-water mapping, and ecological flow modeling. Additionally, a study associated with the Federal Energy Regulatory Commission has analyzed flow recession rates under current hydrology compared to historic hydrology and the results are applicable to restoring riparian condition through flow regulation.

### **Identifying Stream Restoration Opportunities with a Fluvial Audit Methodology**

Jai Singh\*, Hamish Moir, and Chris Bowles

cbec eco engineering, 2544 Industrial Blvd., West Sacramento 95691;  
j.singh@cbecoeng.com

Many stream restoration projects employing a form-based geomorphic assessment and design fail to improve stream function or establish sustainable habitat. Process-based approaches to restoration have become increasingly

## 4 Riparian Restoration *continued*

popular as they target the root causes of ecosystem degradation and help identify restoration actions that can persist in dynamic riverine environments. In the fall of 2013, cbec eco engineering conducted a fluvial audit of Dry Creek in Roseville, California, as part of the city's greenway trail project. The fluvial audit methodology is a process-based tool (co-developed by Hamish Moir of cbec) for assessing a stream's or river's existing geomorphic regime and identifying restoration opportunities. cbec's geomorphic assessment informed potential interactions between the creek

and proposed trail and guided development of mitigative measures for areas where the creek's trajectory would impact the trail. Field assessments characterized sediment supply and storage, vegetation influences and existing river engineering at the sub-reach scale. Coupling this work with a watershed-scale analysis, cbec classified reach types and morphological units, characterized sediment transport capacity, and established an understanding of the system's geomorphic processes and controls. By employing this fluvial audit approach,

cbec met the city's objectives for the long-term sustainability of the trail while simultaneously identifying the sources of ecosystem degradation and potential actions to restore process and improve habitat. Such a methodology is particularly valuable in multi-objective projects as it determines the underlying physical drivers of a riverine system and what combinations of human and ecological benefits can be sustainably obtained within the existing reach and watershed context.

## 5 INTEGRATING RESTORATION & OTHER LAND USES

Chair: **Carol Presley** *Community Alliance With Family Farmers*

Thursday 15 May 8:30a — 10:00a, 10:30a — 12:00p, and 1:30p — 3:00p *Conference Room B*

### **Habitat Restoration Challenges and Solutions on Remediated Landfills at the Presidio of San Francisco**

Max Busnardo\*<sup>1</sup>, Dan Stephens<sup>1</sup>, Joe Howard<sup>2</sup>, and Eileen Fanelli<sup>2</sup>

<sup>1</sup>H. T. Harvey & Associates, 983 University Avenue Building D, Los Gatos 95032 <sup>2</sup>Presidio Trust Remediation Department; [mbusnardo@harveyecology.com](mailto:mbusnardo@harveyecology.com)

The Presidio of San Francisco has been shaped by many influences from the Ohlone, Spanish, and Mexican people, to the U.S. Army. Today the Presidio Trust and National Park Service are managing and restoring the natural, historic, and cultural resources of this 1,500-acre urban park which contains numerous Army landfills. Since 1999, the Trust has designed and implemented 11 large landfill remediation projects that have integrated multiple Trust goals of remediation, habitat restoration, natural and cultural resource protection, and public recreation and education. The

Trust will complete the vast majority of remediation construction in the Presidio in 2014. This presentation will focus on habitat restoration design solutions and post-construction lessons learned regarding the following challenges: 1) reconciling multiple stakeholder goals of remediation, restoration, historic forest management, public use, and aesthetics; 2) developing suitable soils for native habitat establishment; and 3) designing revegetation to minimize maintenance and weed invasion. We will review highlights of the planning, design, and construction processes and qualitative habitat establishment monitoring for several landfill remediation projects in the context of those 3 challenges. The projects focus primarily on restoring coastal scrub habitat at Upper Tennessee Hollow (Fill Site 1/Landfill 2/ Landfill E), the upstream end of Lobos Creek (Landfill 10), and Baker Beach coastal bluffs (near the approach to the Golden Gate Bridge).

### **Using Soils Data to Map "Natural" Floodplains for Restoration Planning**

Kevin G. Coulton, P.E., CFM

cbec, inc. eco engineering, 2544 Industrial Boulevard, West Sacramento 95691; [k.coulton@cbecoeng.com](mailto:k.coulton@cbecoeng.com)

Natural Resource Conservation Service (NRCS) soils map data were utilized as part of an effort to visualize natural flooding on the landscape to guide basin-scale floodplain restoration planning. The soils data included flooding frequency classes indicating the spatial extent and an associated frequency of occurrence of flood-prone soils. The soils flooding frequency classes of "rare", "occasional", and "frequent" were mapped for Sacramento County, California, using ArcMap Geographic Information System (GIS) software to define the spatial extent of flood-prone soils having a flood frequency up to a 1.0% Annual Chance Event (ACE), or "100-year" flood event. These spatial areas were then compared to FEMA data also depicting one-percent-annual-chance floodplains. This



analysis indicated about 370 mi<sup>2</sup> of FEMA floodplains and 286 mi<sup>2</sup> of “natural” floodplains are present within the county, with about 252 mi<sup>2</sup> of land area where both types of floodplains overlap. NRCS and FEMA GIS floodplain data are readily available over the Internet for GIS applications. NRCS flood frequency classes generally coincide with the flood frequency of FEMA floodplain data; i.e., 0.2%, 1.0%, 2.0%, 5.0%, 10%, and 50% ACE. Since FEMA floodplains are a mapping product of flood insurance studies, these floodplains are focused in areas with population and insurable properties and may not cover areas of interest for restoration. Therefore, soils data should be routinely used in floodplain restoration projects. The high spatial resolution of these datasets enable their application from the reach scale to the watershed scale, and larger spatial scales if desired.

### **Flood Control 2.0: Restoring Habitat through a New Vision for Flood Control Channel Design and Management**

S. Dusterhoff<sup>1</sup>, R. Grossinger<sup>1</sup>, L. McKee<sup>1</sup>, J. Beagle<sup>1</sup>, S. Pearce<sup>1</sup>, C. Doehring<sup>1</sup>, and C. Sweeney<sup>2</sup>

<sup>1</sup>San Francisco Estuary Institute; scott@dsefi.org <sup>2</sup>San Francisco Estuary Partnership

Throughout the San Francisco Bay region, flood control channels built at the fluvial-tidal interface are aging and in need of replacement. In many instances, the building of these channels decades ago resulted in fragmentation, disturbance, or complete destruction of important aquatic and wetland habitats as well as disruption of the geomorphic processes that maintained these habitats. Flood control managers currently have a rare opportunity to redesign new flood control projects in these areas that can decrease flood risk and improve resident species habitat, provided they have the right tools and knowledge base to develop resilient, multi-benefit designs. Flood Control 2.0 is an EPA-funded project involving several agency partners

that is aimed at developing an innovative framework for designing multi-benefit flood control channels at the fluvial-tidal interface. This presentation will provide an overview of the key Flood Control 2.0 project components, a detailed description of the process and tools used to develop a multi-benefit restoration vision for an example flood control channel at the fluvial-tidal interface, and a blueprint for developing multi-benefit restoration concepts for flood control channels at fluvial-tidal interface around San Francisco Bay.

### **Integrated, Multi-objective, Landscape-Scale Conservation: Data, Policy, Actions**

Karen Gaffney\*, Misti Arias, Sheri Emerson, and Tom Robinson\*

Sonoma County Agricultural Preservation and Open Space District, 747 Mendocino Ave., Suite 100, Santa Rosa 95401; kgaffney@sonoma-county.org

Effective conservation of habitats and ecosystems has progressively focused on landscape-scale processes and functions, requiring data, policies, and implementation actions at multiple temporal and spatial scales. Funding and policies supporting conservation are increasingly focused on achieving and integrating multiple objectives, many of which fall outside of the traditional constructs of conservation and ecological restoration. These include societal goals related to climate change resiliency and mitigation, economic vitality, environmental justice, sustainable communities and the integration of built infrastructure objectives with conservation. This trend requires the intentional collaboration of non-traditional partners and the formation of diverse, multi-disciplinary teams. The Sonoma County Agricultural Preservation and Open Space District (District) and its partners have been successful in developing foundational data regarding the habitats and ecosystems of Sonoma County by incorporating multiple societal objectives

— such as mapping carbon sequestration potential, quantifying the benefits of conservation in avoiding GHG emissions, evaluating the economic and climate adaptation values of conservation and natural capital, and analyzing habitat connectivity. Incorporating these diverse elements allows conservation and restoration organizations and agencies to relate their data development work to the broader concerns of the public, elected officials, and funders. The District and its partners have developed data at a scale to support decision-making for land acquisition, land management, restoration and monitoring, as well as to educate the public and policymakers regarding the multiple benefits of conservation. We present a range of multi-objective data development strategies and link them to a diverse array of policy and on-the-ground conservation outcomes.

### **Working Collaboratively to Modify Reservoir Operations and Restore Aquatic Habitat**

Jeff Micko<sup>1</sup> and Jonathan Ambrose<sup>2</sup>

<sup>1</sup>MC Water Resources Engineering, San Jose; jmicko@sbcglobal.net <sup>2</sup>NOAA Fisheries, Santa Rosa

New operating rules for Pacheco Reservoir are being developed which will improve steelhead habitat downstream in Pacheco Creek with minimal impact to farmers and other local water users. Pacheco Creek originates in the Diablo Range in southeastern Santa Clara County and flows into Monterey Bay via the Pajaro River. For several decades through the 1980s, Pacheco Creek supported steelhead. For the past 20 years or so, steelhead have been absent. One of the limiting factors has been reservoir operation during that period. Pacheco Reservoir is owned and operated by the Pacheco Pass Water District (PPWD). The PPWD has limited resources and cannot independently fund analysis and additional instrumentation to improve operations. NOAA’s National Marine Fisheries Service (NMFS) has

## 5 Integrating Restoration & Other Land Uses *continued*

coordinated the assembly of a multidisciplinary group to work with the PPWD and other local Water Districts. The team is developing simple operating strategies for Pacheco Reservoir that will improve habitat for steelhead in Pacheco Creek. (Several members of the working group participated in successful development of balanced multi-objective operating rules, which are now being implemented, for other water supply facilities in sub-watersheds of the Pajaro River.) The project is funded by a grant from the DFW Fisheries Restoration Grant Program. The rules will include releases for Spring outmigration, Summer rearing and Fall and Winter flow. Instrumentation for remotely monitoring reservoir levels and releases and equipment to facilitate reservoir releases are also being installed as part of this project.

### **Integrating Habitat Restoration with Stormwater Management and Flood Control**

Mark Newhouser\*, Cassandra Liu\*, Connor Ross, and Trace McKellips

Sonoma Ecology Center, P.O. Box 1486, Eldridge 95431; mark@sonomaecologycenter.org

Urban streams have been treated like ditches and have become our stormwater conveyance systems. Historic stream channelization and past flood control management practices denuded riparian habitat, increased erosion and incision, introduced invasive species, and diminished critical fish and wildlife habitat. The rapid runoff from the built environment leaves urban streams flood-prone and difficult to restore. Current incompatible land management and stream maintenance practices further hamper riparian restoration efforts. Therefore, the success of urban stream restoration depends on the integration of ecological restoration with flood control, water use, and other adjacent land uses. The evolution of stream maintenance and stormwater best management practices has increased the compatibility

of habitat enhancement with urban stream management. For example, we now have approved guidelines for revegetation in flood-prone areas that maintain flood conveyance, enhance fish and wildlife habitat, suppress invasive weeds, prevent erosion, improve water quality, and reduce future maintenance requirements. Low Impact Design (LID) and other passive stormwater management features can also be incorporated into habitat restoration projects to reduce runoff, prevent erosion, and improve water quality. Expanded implementation of integrated stormwater management projects that infiltrates urban runoff also has the potential to reverse groundwater decline. This presentation will discuss the current challenges and future prospects of habitat restoration in urban creeks, emerging criteria for restoration in flood prone areas, and how collaborative partnerships and multi-benefit projects elevate ecological restoration as a complementary component of public works projects as well as improve funding prospects, and contribute to overall project success.

### **Wetland Restoration Design through Comprehensive Site Assessment and Community Participation**

David Shaw<sup>1</sup>, Jeannette Halderman<sup>2</sup>, and Robie Litchfield<sup>3</sup>

<sup>1</sup>Balance Hydrologics, PO Box 1077, Truckee 96160; dshaw@balancehydro.com <sup>2</sup>Truckee River Watershed Council, PO Box 8568, Truckee 96162 <sup>3</sup>L&P DesignWorks, 12020 Donner Pass Road, Truckee 96161

A comprehensive landscape assessment was completed and used to develop site-appropriate conceptual wetland restoration designs for lands owned and managed by six public agencies and adjacent to numerous private parcels in the Town of Truckee, California. The Truckee River Watershed Council partnered with several of these entities to establish the 'Truckee Wetlands Restoration Partnership' at the beginning

of the planning process so that existing and anticipated land uses could be maintained and incorporated into the design. The comprehensive landscape assessment was carried out to evaluate the feasibility of restoring wetland and meadow processes and functions while maintaining existing land and water uses, and included detailed soils and hydrology investigations, along with review of archival resources such as historical maps, aerial photography, and several wetland delineations on file with the Town of Truckee. The outcome of the investigations identified particular conditions and locations where existing wetlands are impaired and restoration or enhancement opportunities exist, allowing for the development of a conceptual restoration design that restores hydrologic and ecologic continuity across the fragmented wetland complex. Findings of the assessment, the conceptual design, and approaches to maintaining current and potential future uses, were presented to a range of interested parties with various levels of technical expertise. Tailoring communications for this range of audiences has been vital in developing public support for the restoration project.

### **Grazing to Benefit California Red-legged Frogs and California Tiger Salamanders**

Pete Van Hoorn\* and Dr. Lawrence Ford

LD Ford Rangeland Conservation Science, 5984 Plateau Drive, Felton 95018; petevanhoorn@gmail.com

California red-legged frogs (CRLF) and California tiger salamanders (CTS) occur primarily on rangelands, and livestock ponds have become a vital source of breeding habitat. Grazing and associated management practices can positively or negatively impact habitat conditions in breeding ponds, dry season refuges, and the surrounding uplands. Pond restoration and other CRLF- and CTS-oriented habitat enhancement projects need to incorporate sound rangeland management into their planning and

long-term management. The available guidance on grazing to benefit these species was scarce and contradictory, which increased uncertainty and disagreement among the regulators, planners, and land managers involved. We and our co-authors have created science-based guidelines using the existing literature, interdisciplinary expertise, and extensive review. Our guidelines define habitat objectives and corresponding management practices. We identify desirable targets for percent cover of emergent pond vegetation, hydroperiod, and other pond variables, and strategies that can be used to meet these targets. We provide recommendations for the enhancement of streams, springs, and seeps to provide dry-season refugia for CRLF. Among the other topics addressed are desirable grassland conditions, non-native predators and hybrid CTS, rodent control, landscape-scale issues such as dispersal and connectivity, and research needs. The guidelines creation process illuminated several broader points concerning the successful use of grazing and other land management tools to meet species-oriented goals.

### The Multiple Benefits and Surprising Complexity of On-Farm Habitat

Kurt Vaughn, PhD

Working Waterways Program Audubon California, Davis 95616;  
kvaughn@audubon.org

Although the conversion of wildlands to agriculture has caused, and continues to cause, widespread habitat loss, degradation and fragmentation, the conservation entities partnering with farmers see ample opportunities for habitat restoration within the heavily transformed and highly homogeneous agricultural regions of California. The implementation of well-designed restoration projects within the agricultural matrix (e.g., along field edges, in unutilized margins, and along water transport channels) has been successful at increasing on-farm habitat heterogeneity while minimizing reductions in agricultural production. While the inherent spatial limitations and special challenges of working within the agroecological landscape often means these types of on-farm projects are relatively small and highly-managed

compared to more traditional types of wildland restoration projects, there is evidence that they provide substantial advantages. I will discuss several research projects — led by teams at Audubon California, University of California Davis, Berkeley and Cooperative Extension — which are investigating the multiple environmental, ecological, economic, and agronomic benefits of establishing on-farm habitat in the Sacramento Valley. These investigations are beginning to demonstrate the potential benefits for agricultural landowners including soil conservation, water quality, ground-water recharge, pest control, and pollination services. Additionally, studies focusing on the habitat quality of these projects often show improvements in not only simple measures of habitat value (e.g. bird species diversity) but also demonstrate dramatic effects on measurements of ecosystem complexity (e.g. increased guild diversity in birds). Overall, these on-farm projects demonstrate that in highly altered and homogenous landscapes even small improvements in habitat availability can provide disproportionate benefits for farmers and wildlife.

## PROJECT IMPLEMENTATION & MONITORING

Chair: **Harry Oakes** *ICF International*

Thursday 15 May 8:30a — 10:00a, 10:30a — 12:00p, and 1:30p — 3:00p *Conference Room C*

### Current Revegetation Design Approaches on the Trinity River, California

John H. Bair

McBain Associates 980 7th, Arcata 95521; john@mcbainassociates.com

The Lorenz Gulch site on Trinity River in northern California is channel rehabilitation project that was designed in 2012 and implemented in 2013. The site revegetation design builds on previously successful design approaches and revegetation goals and objectives when the first channel rehabilitation sites

were built — mimicking vegetation patterns found on alluvial landforms of less disturbed regional streams and similar to designs developed using a zonation approach. Plant species were assigned to different riparian or upland patches using proportional values from a systemic riparian vegetation inventory. Patches of existing riparian vegetation were identified and avoided to provide immediate cover and a readily available seed source while also providing structural diversity over the long term. Different riparian plant clusters — each with a different combination of plants — were placed, depending on the depth-to-

groundwater, soil type, design element, or existing conditions. Upland plantings were developed using open forest, woodland and shrub patches growing adjacent to the Trinity River in 1944 aerial images. Seasonal wetlands were opportunistically constructed and revegetated. Trees, shrubs, forbs, herbs, and live willow clumps were planted along side channels and islands of remnant riparian vegetation to immediately improve the complexity of aquatic habitats, and to cover areas where non-native plants could grow. Over the next ten years, revegetation

*continued*

## 6 Project Implementation & Monitoring *continued*

should provide cover for wildlife and fish, shade the channel, speed riparian vegetation recovery, and increase woody plant and age class diversity.

### **Buckhorn Safety Project Builds Complex Habitat for Threatened Coho Salmon**

Brandt Gutermuth\* and D.J. Bandrowski

U.S. Bureau of Reclamation, Trinity River Restoration Program, PO Box 1300, Weaverville 96093; bgutermuth@usbr.gov

The Bureau of Reclamation's Buckhorn Dam was built to prevent decomposed granite from reaching the Trinity River. The toe drains had been submerged for years, preventing measurement of dam leaks and safety assessments. In 2012, the Trinity River Restoration Program (TRRP) assisted Reclamation by designing a project with dual purposes — meeting safety needs and creating juvenile coho rearing habitat that emulates historic off-channel beaver marshes. The TRRP obtained required permits to work in-stream in this creek, home to threatened Southern Oregon Northern California Coasts (SONCC) coho salmon. During construction, vegetative techniques were applied to stabilize and revitalize the adjoining denuded decomposed granite work zone, and wood structures were added for habitat creation. Vegetated soils lifts, crib walls, and brush mattresses were installed, side slopes laid back, erosion mats staked in, willow clumps planted, wood slash added, and large wood placed throughout the reach. Then riparian and nearby upland zones were planted to shade the site and restore ecological function. In the period since construction, rehabilitation efforts have included irrigation to enhance plant survival. Monitoring has found good plant survival and extensive juvenile fish occupation; however, adult use has been more variable and appears linked to flow management. Opportunities to ensure annual attraction of spawning adults to the reach are now being evaluated.

### **Restoring Processes and Riparian Functions on the Trinity River, California**

James C. Lee

Hoopa Valley Tribe and Trinity River Restoration Program, P.O. Box 1300, Weaverville 96093; james.chris.lee@gmail.com

The Trinity River in northwestern California historically sustained abundant runs of salmon and steelhead. The runs declined after the completion of Lewiston and Trinity Dams in the early 1960s. A series of studies in the decades following project completion pointed to a loss of ecosystem processes as a primary cause of declining salmon and steelhead runs. In the early 2000s, a plan was implemented to restore these processes. Restoration of the Trinity River includes the involvement of the Hoopa Valley and Yurok Tribes, government agencies, private landowners, contractors, and other stakeholders who live, work, and play in the river and its riparian corridor. Restoration actions include managing dam releases and placing gravel to achieve geomorphic and biological effects, and reconstructing the channel and floodplain so that they can respond to these drivers. The Lorenz Gulch Channel Rehabilitation Project, implemented during 2013-2014, demonstrates the suite of actions and tools involved in restoration. This presentation focuses on the ecological processes and riparian functions addressed by the restoration program, including floodplain inundation, riparian plant initiation and scour, sediment transport and storage, and large woody debris production.

### **Seasonal Wetland Creation in Diked Agricultural Baylands: Lessons in Disturbance Ecology**

Julian A. Meisler

Sonoma Land Trust, 822 Fifth Street, Santa Rosa 95404

Great efforts are underway throughout the San Francisco Bay Estuary to reverse

the historic loss of nearly 85% of its tidal wetlands. Considerably less attention is given to the 70% loss of seasonal wetlands that surrounded the bay's upland borders. These freshwater wetlands provide important habitat for shorebirds and waterfowl among myriad other functions. In 2003, Sonoma Land Trust (SLT) and partners created more than 160 acres of seasonal wetlands on a 280-acre property near the Petaluma River estuary. Originally tidal wetlands before large-scale agricultural reclamation in the late 1800s, this site has undergone radical land use changes (disturbances) over time including the engineering and water management required to create and maintain the new wetlands. Our efforts attracted tens of thousands of bird visits to the new pools but also a highly invasive species, Australian bentgrass (*Agrostis avenacea*). The invasion ultimately overshadowed the project's success and in 2011 all water management ceased until the invasion can be brought under control. This talk will discuss the successes and unintended outcome of wetland creation at the site and how we are responding to the ongoing management challenges.

### **Community Involvement and Long-Term Mitigation Success**

Barry Nerhus\*<sup>1</sup> and Matt Yurko<sup>2</sup>

<sup>1</sup>Endemic Environmental Services, Inc., 17202 Gothard Street, Unit 9, Huntington Beach 92647; bnerhus@endemicenvironmental.net <sup>2</sup>California Coastal Commission: Community-Based Restoration and Education Program, 600 Shellmaker Road, Newport Beach 92660; myurko@coastal.ca.gov

Mitigation projects are often left to fend for themselves after success criteria have been met. Without funding or volunteer efforts to continue land management, mitigation project degradation can result due to reinvasion of non-native perennials, vandalism, and trash accumulation. Integrating the local community into a mitigation project can offer an avenue to long-term project success. Community volunteers are often

experienced with land stewardship including maintenance and monitoring activities. Volunteers tend to look after projects in which they're involved, increasing ownership and reducing the chances for damage from vandalism. Through careful planning and some training, you can amplify the positive results of your project beyond its end date. In this presentation, we'll discuss the challenges and opportunities of involving the community in mitigation projects.

### **Lessons Learned from Channel Margin Enhancement Projects Along Leveed Rivers**

Gerrit A. J. Platenkamp

ICF International, 630 K Street, Suite 400, Sacramento 95814;  
gerrit.platenkamp@icfi.com

Riparian trees and shrubs occur on the levees along the Lower Sacramento and American Rivers, especially in areas where the levees have eroded. This vegetation is a component of "shaded riverine aquatic cover" which is considered an important resource for native salmonid fishes. The riparian vegetation and associated instream woody material provide shade, cover, organic inputs, and insect food for outmigrating Chinook salmon and Central Valley steelhead. When eroded levees have been repaired, and riparian trees and shrubs were removed, the planting of riparian vegetation at the water-side toe of levees was frequently required as mitigation. Sometimes these plantings were installed on constructed benches. This study evaluated the success of channel margin enhancement mitigation sites. Mitigation sites along the Lower American and Sacramento Rivers were evaluated based on available monitoring reports and field observations. Vegetative cover of riparian trees and shrubs, instream woody material, and evidence of regeneration, erosion, and herbivory were recorded in the field and from aerial photographs. Sites were stratified by river, geomorphic location (e.g., inside or

outside bends), bank treatment type, and age. Several sites showed evidence of erosion and removal of instream woody material. Sites that were not protected from animals showed substantial herbivory by beavers. Regeneration of riparian trees and shrubs by seed was generally absent. The potential long-term value of these channel enhancement sites for outmigrating salmonid fishes was generally considered limited.

### **Mono Basin Stream Restoration Settlement Agreement**

Geoff McQuilkin, Lisa Cutting, and Greg Reis\*

Mono Lake Committee, P.O. Box 29, Lee Vining 93541; greg@monolake.org.

The Mono Basin Stream Restoration Settlement Agreement represents three years of intense collaborative negotiations with the Los Angeles Department of Water and Power (DWP) to improve its aqueduct infrastructure and operations in order to restore stream habitat and recreational brown trout fisheries destroyed in four decades of excessive water diversions. In 2010, after 12 years of Water Board-ordered study, scientists Dr. Bill Trush and Ross Taylor produced a Synthesis Report recommending a new stream flow release pattern intended to maximize the success of the decades-long stream restoration effort; however the 1930s-era infrastructure designed to maximize water exports was an obstacle to implementation. The Settlement Agreement negotiations began in 2011 as a series of facilitated meetings between the Mono Lake Committee, DWP, the California Department of Fish and Wildlife, and California Trout. After two years of fact-finding meetings and a year of intense negotiations, the four parties signed a settlement agreement in August 2013 that will implement the Synthesis Report's recommendations and set the stream restoration program on the path towards completion. Some physical instream projects will be completed, but the essence of the Mono Basin Stream Restoration Settlement Agreement is to

amend the water rights licenses with new stream flow requirements that will mimic the natural hydrograph, and to construct a new outlet to Rush Creek from Grant Lake Reservoir. It also includes an innovative cost-sharing component to fund the outlet construction, and a creative contracting-administration component to fund ecological monitoring and facilitate adaptive management.

### **Hydrologic Monitoring of the Perazzo Meadows Restoration Project**

David Shaw<sup>\*1</sup>, Randy Westmoreland<sup>2</sup>, and Beth Christman<sup>3</sup>

<sup>1</sup>Balance Hydrologics, PO Box 1077, Truckee 96160; dshaw@balancehydro.com <sup>2</sup>U.S. Forest Service Tahoe National Forest, 10811 Stockrest Springs, Truckee 96161 <sup>3</sup>Truckee River Watershed Council, PO Box 8568, Truckee 96162

A number of agencies and organizations are increasingly interested in the range of benefits that alpine and subalpine meadow restoration projects may offer, but to-date only a limited number of studies have been conducted to quantify these benefits. During 2009 and 2010, the U.S. Forest Service employed a 'plug and pond' restoration approach at Perazzo Meadows in the Tahoe National Forest in Sierra County, California. Prior to restoration, the channel meandered through the meadow and in most locations flow was largely contained within a single-thread channel. The restoration project has blocked the channel at numerous points throughout the meadow in order to spread water across the valley floor and reoccupy multiple relic channels. A hydrologic monitoring program was developed and implemented to compare and document pre- and post-restoration groundwater level fluctuations and evaluate changes in water storage and streamflow. This program includes a network of shallow monitoring wells (piezometers), stream-stage monitoring stations, and

## 6 Project Implementation & Monitoring *continued*

streamflow gauging stations. Preliminary findings, based on three complete years of data collection over a range of wetter-than-normal and drier-than-normal years, indicate that the effects of restoration on groundwater levels is variable, and may be minimal in some areas, depending on ambient hydrogeomorphic conditions. Streamflow data implies that restoration has caused increases in the duration and magnitude of late season flows, especially when late spring and summer precipitation recharges the meadow. The monitoring program demonstrates the importance of multi-year, pre-project monitoring data in comprehensive evaluation of restoration success.

### Revegetation Implementation Approaches Used on the Trinity River, California

Ralph D. Vigil\*<sup>1</sup> and James Chris Lee\*<sup>2</sup>

<sup>1</sup>Restoration Resources, 3888 Cincinnati Ave., Rocklin 95765; r.vigil@restoration-resources.net <sup>2</sup>Hoopa Valley Tribe, PO Box 417, Hoopa 95546; james.chris.lee@gmail.com

Revegetation of channel rehabilitation sites on the Trinity River in northern California consists of planting a mixture of plant species using a variety of installation methods. Substrate within a project site may consist of sand overlaying large cobbles with interstitial fines; bedrock may also be present in some locations. Revegetation tasks vary by plant species and location within the project, but may include installing hardwood poles, herbaceous plugs, bare-root plants, nursery grown trees and shrubs, fertilizer tablets, weed mats, tree protectors, broadcasting seed, and applying mulch. A contractor may

propose to use a combination of nursery grown plants, hardwood cuttings, and/or bare-root plants. Plant materials consist of nursery container stock supplied in the species, containers, and quantities specified in the revegetation designs or approved equivalents. Plant material is installed using the appropriate layout indicated on the revegetation design sheets whether a bank toe zone, bank slope zone, infill, or riparian wetland. A contractor may elect to use bare root material and live hardwood poles if planting can be delayed until November 15. If the contractor elects to use live hardwood cuttings, then poles must be planted into the fall ground water. A Stinger device attached to an excavator has been used to install hardwood poles where the groundwater was estimated to be within 5 feet of the constructed ground surface. Backhoe and hand planting is currently used to install plant materials regardless of a constructed surface's height above the groundwater. Backhoe and hand plantings are irrigated using contractor-proposed methods.

## P

### POSTER SESSION

Wednesday 14 May 9:00a — Thursday 15 May 3:00p *West Atrium*  
with Hosted Reception Wednesday 14 May 5:00–7:00p

#### Mono Basin Stream Restoration Settlement Agreement

Geoff McQuilkin, Lisa Cutting\*, and Greg Reis

Mono Lake Committee, P.O. Box 29, Lee Vining 93541; lisa@monolake.org.

The Mono Basin Stream Restoration Settlement Agreement represents three years of intense collaborative negotiations with the Los Angeles Department of Water and Power (DWP) to improve its aqueduct infrastructure and operations in order to restore stream habitat and recreational brown trout fisheries destroyed in four decades of excessive water diversions. In 2010, after

12 years of Water Board-ordered study, scientists Dr. Bill Trush and Ross Taylor produced a Synthesis Report recommending a new stream flow release pattern intended to maximize the success of the decades-long stream restoration effort; however the 1930s-era infrastructure designed to maximize water exports was an obstacle to implementation it. The Settlement Agreement negotiations began in 2011 as a series of facilitated meetings between the Mono Lake Committee, DWP, the California Department of Fish and Wildlife, and California Trout. After two years of fact-finding meetings and a year of intense negotiations, the four parties signed a settlement agreement in August 2013 that will implement the Synthesis

Report's recommendations and set the stream restoration program on the path towards completion. Some physical in-stream projects will be completed, but the essence of the Mono Basin Stream Restoration Settlement Agreement is to amend the water rights licenses with new stream flow requirements that will mimic the natural hydrograph, and to construct a new outlet to Rush Creek from Grant Lake Reservoir. It also includes an innovative cost-sharing component to fund the outlet construction, and a creative contracting-administration component to fund ecological monitoring and facilitate adaptive management.

## Habitat Restoration and Enhancement for Two Rare Clay Endemic Plants

Mark Dodero\* and Anna Bennett

RECON Environmental Inc. San Diego 92101; mdodero@reconenvironmental.com

Otay tarplant (*Deinandra conjugens*) and San Diego thornmint (*Acanthomintha ilicifolia*) are federally-listed threatened and state-listed endangered annual species. Both species are clay soil endemics with a limited range in San Diego County and northern Baja California. Populations of both species are substantially declining throughout San Diego County due to urban development, habitat disturbance, and invasion of non-native species. Our goals for this grant-funded restoration and enhancement project, located in the City of Chula Vista, include: intensive control to reduce non-native annuals and perennial weeds that are invading the native grassland and clay lens habitat, planting native grasses in areas of low native cover, and collecting and dispersing seeds of the target species to increase the size of Otay tarplant and San Diego thornmint populations and other sensitive plants species. Restoration methods we have selected for the project include the use of weed whips to cut and then remove dried weedy thatch and follow-up herbicide spraying during the growing season to reduce the dominance of non-natives. Our monitoring program includes performing annual relevé vegetation sampling to assess changes in non-native and native cover, conducting population estimates and detailed mapping of tarplant and thornmint, and observing and photographing potential pollinators. Through the second year of this three-year project, populations of Otay tarplant and San Diego thornmint have increased over the baseline condition. In both relative and absolute terms, non-native cover has decreased and native cover has increased, showing positive results of our restoration and enhancement program.

## Restoration Preparation Methods at a California Coastal Sage Scrub Site

Bradley Fessenden, Biology Department, Kwantlen Polytechnic University, Surrey, BC V3W 2M8; brad.fessenden@kwantlen.ca

In order to prepare a site for restoration, weed eradication is one of the first steps to ensure native species have a fighting chance in re-establishing themselves in a degraded ecosystem. Determining the most effective method of eradicating weeds is important in order to increase the effectiveness of restoration efforts, saving both time and money. This study documents the success of different restoration approaches at a 3.5-acre coastal sage scrub restoration site in Irvine, California. In this study, I used two different methods of weed eradication: manual weed eradication using weed eaters and flail mowers, and weed eradication using a herd of goats. In order to sample each treatment area, I deployed quadrat sampling. From these quadrat samples, I measured species abundance, recorded percent cover, and took soil samples. In conclusion, I found no significant difference in native species abundance between restoration method areas. This result suggests that the method of weed eradication was less significant than other factors in restoring this degraded site. However, I found differences in native species abundance according to slope position and degree of soil compaction. The results of this study provide a general assessment on the possible effect of weed eradication site preparation on native species success throughout the restoration site.

## Central Valley Flood System Conservation Strategy

Terri Gaines\*, Heidi Hall, and Monique Wilber

California Department of Water Resources, 901 P Street, Room 411, Sacramento 95814; tgaines@water.ca.gov

The Conservation Strategy is an integral part of the Central Valley Flood

Protection Plan (CVFPP), an integrated approach to flood management that provides public safety, environmental stewardship, and economic stability. While improving flood risk management is the primary goal of the CVFPP, four secondary goals have been identified for this program. These include: improving operations and maintenance; promoting ecosystem functions; improving institutional support; and promoting multi-benefit projects. The Conservation Strategy supports these goals and provides more specific ecological goals including: improving and enhancing dynamic hydrologic and geomorphic processes; increasing and improving the quantity, diversity, quality, and connectivity of riverine aquatic and floodplain habitats; contributing to the recovery and sustainability of native species populations and overall biotic community diversity; and reducing stressors related to the development, operation, and maintenance of the flood management system that negatively affect at-risk species. The Conservation Strategy includes: improved science and planning information; a regional permitting approach; an improved approach to vegetation management; and ecological targets and measurable objectives. Implementation of the Conservation Strategy will be through multiple-benefit flood improvement projects, integrated planning, coordination with other conservation planning efforts, and agricultural stewardship. The Conservation Strategy builds upon the Conservation Framework that was adopted by the Central Valley Flood Protection Board as part of the 2012 CVFPP. A draft Conservation Strategy will be completed in December 2014 and integrated into the 2017 update of the CVFPP.

*continued*

**Design and Construction of Large Woody Debris Habitat Enhancements**

Stephen Reynolds and Cheryl Hayhurst\*

California Geological Survey, 801 K St., Suite 1200, Sacramento 95814; Stephen.Reynolds@conservation.ca.gov, Cheryl.Hayhurst@conservation.ca.gov

Soquel Creek, a designated coho stream, flows through Soquel Demonstration State Forest (SDSF) in Santa Cruz, California. Prior to creation of SDSF (1990), Soquel Creek was routinely gleaned of large woody debris (LWD). SDSF is undertaking long-term habitat rehabilitation by reintroducing LWD to Soquel Creek. This presentation discusses the methodology used at SDSF for resilient and effective LWD features without the use of cables, bolts, or other hard engineering features. Successful LWD features integrate biologic, hydrologic, and geomorphic goals. For biologic benefit, LWD needs a residency time meeting the needs of target organisms. LWD residency requirements (e.g., five years) drive selection of peak design storm (PDS) and its associated flow, which in-turn drives sizing and configuration of LWD. During geomorphic assessment, appropriately configured stream reaches, (e.g., grade less than three percent) and potential LWD sources (such as undercut bank trees) are mapped. Selected sites are mapped in detail and cross-sections developed. Using a combination of excavated whole trees with root wad and appropriately-sized logs, LWD is placed at geomorphically appropriate localities. Following installation, LWD mapping provides a base-line for performance monitoring. Biologic and geomorphic monitoring is being performed for the next five years. LWD installations have experienced two PDS resulting in 15-, 200-, 230-percent increases in sinuosity, number of pools, and pool volume, respectively.

**Evolution of Community-based Restoration Techniques for Transition Zone Habitat at Eden Landing Ecological Reserve**

Nissa Kreidler\*, Jon Backus, Jack States, and Donna Ball

Save The Bay, 1330 Broadway, Suite 1800, Oakland 94612; nkreidler@savesfbay.org.

The transition zones between the coastal marshes and upland areas of San Francisco Bay are critical habitat for hundreds of species, some of which are threatened or endangered. Transition zones are integral habitat for wildlife as they move between marshes and uplands during high tides and storm surges. These areas provide a food source for insects, birds, reptiles, and small mammals. A vast majority of coastal marshes have been filled in for development or converted into salt ponds and agricultural lands, and adjacent transition zones have become severely degraded and condensed into fragments of their historic ranges. Save The Bay has used community volunteers to remove non-native and invasive species and to restore transition zone habitat on narrow levee slopes of the Bay for over 13 years. Using Eden Landing Ecological Reserve as a model, we demonstrate how we have adapted our restoration approach over time to meet restoration goals and to increase transition zone habitat in the Bay. Save The Bay managed three separate transition zone projects over a six-year period at Eden Landing Ecological Reserve. Over this period, Save The Bay has expanded our strategy from restoring narrow levee slopes to include restoring transition zone habitat on broad, gentle slopes and shifting to an emphasis on site-specific plant diversity. We use a mix of native annual and perennial grasses and native plants to create a dense habitat mosaic. This recent work can be applied to existing and future transition zone restoration designs.

**Optimal Control of Restoration – The Role of Economic Threshold**

Adam Lampert\* and Alan Hastings

Department of Environmental Science and Policy, University of California, Davis 95616; alampert@ucdavis.edu

A variety of ecological systems around the world have been damaged in recent years, either by natural factors such as invasive species, storms, and global change, or by direct human activities such as overfishing and water pollution. Restoration of these systems to provide ecosystem services entails significant economic benefits. Thus, choosing how and when to restore in an optimal fashion is important, but has not been well studied. Here we examine a general model where population growth can be induced or accelerated by investing in active restoration. We show that the most cost-effective method to restore an ecosystem dictates investment until the population approaches an ‘economic restoration threshold’, a density above which the ecosystem should be left to recover naturally. Therefore, determining this threshold is a key general approach for guiding efficient restoration management, and we demonstrate how to calculate this threshold for both deterministic and stochastic ecosystems.

**Evaluating Approaches to California Grassland Restoration on a Landscape Scale**

Sarah Kimball<sup>1</sup>, Megan Lulow<sup>\*2</sup>, Quinn Sorenson<sup>2</sup>, Kathleen Balazs<sup>1,2</sup>, Isaac Ostmann<sup>2</sup>, and Travis Huxman<sup>1</sup>

<sup>1</sup>Center for Environmental Biology, University of California, Irvine 92627  
<sup>2</sup>Irvine Ranch Conservancy, 4727 Portola Pkwy., Irvine 92620

California grasslands are one of the most challenging plant communities to restore. Controlling for interference from non-native annuals during plant establishment has been demonstrated to be especially important and challenging.



Spatial variation in aspect and weed species, and variability in weather patterns are also important in establishment success. We present results from an 18-acre restoration project that was designed to provide data useful to making decisions in an adaptive management context. We evaluated each phase of restoration with respect to approach or intensity across different slopes and aspects. For site preparation, total abundance of germinating non-native species varied more by year than the number of years of weed control, but the identity of species did change with control over time. For the seeding phase, more native grasses established in areas drill-vs. broadcast-seeded. Seeding native grass and forb groups in a single mix vs. separate mixes did not result in significantly greater cover or density of either group. For the maintenance phase, weeding on a 4- or 6-week vs. an 8-week schedule resulted in significantly greater cover of native grasses, but not forbs. Applying a broadleaf specific herbicide benefited native grass strips, but applying a grass-specific herbicide did not benefit native forb strips compared to strips with hand-weeding and spot-wicking alone. Patches of *Bromus distachyon* (purple false brome) were difficult to control and decreased establishment of native grasses and forbs. Cover and density of natives was greater on northern vs. southern aspects.

### **Watershed-Scale Riparian Restoration Assessment and Implementation, Mattole River Watershed**

Hugh McGee\*, Monica Scholey, and Cassie Pinnell

Mattole Restoration Council, PO Box 160, Petrolia 95558; hugh@mattole.org

The Mattole River watershed is located along the remote northern California Lost Coast in Humboldt County. This small, rural watershed (300 square miles) supports wild runs of coho, steelhead, and Chinook. These runs are threatened by historic timber harvest practices and historic flood events, as well as current

land use and climate conditions. To address these threats and improve habitat conditions, the Mattole Restoration Council launched a watershed-wide riparian ecosystem restoration project in 2003 that relied heavily on landowner support and collaboration. Within the last 10 years, project staff and volunteers have systematically assessed and treated over 70% of the tributaries and main stem in the Mattole watershed on public and private lands. Work to-date includes riparian assessments on 55 tributaries covering over 200 miles; local collection of over 650 pounds of riparian seed; propagation of plant materials at our native plant nursery; installation of over 400,000 native plants throughout 40 tributaries and the main stem Mattole River; and the completion of 3,000 ft. of bank stabilization treatments. Project efforts complimented watershed-wide upslope sediment reduction projects that included landslide stabilization, road decommissioning, culvert replacement, road storm-proofing, and road upgrades. After 10 years of implementation, monitoring is underway to determine project effectiveness for enhancing riparian habitat, decreasing sediment inputs, increasing bank stability, and reducing localized water temperatures.

### **Innovative Imprinter Developed for SCE's Eldorado-Ivanpah Transmission Project**

Scott McMillan<sup>1</sup>, Ciro Benitez<sup>2</sup>, Cecilia Meyer Lovell<sup>1</sup>, and Linda Robb<sup>3\*</sup>

<sup>1</sup>AECOM, San Diego, CA 92101; Scott.McMillan2@aecom.com <sup>2</sup>Gothic Landscape, Inc., Las Vegas NV 89118; CBenitez@gothiclandscape.com

<sup>3</sup>Southern California Edison, Brea 92821; kingfisherfan1@cox.net

Over the past 2 years, Southern California Edison (SCE) and AECOM have been focused on implementing upland habitat restoration for over 250 acres across 35-miles in the Mojave Desert along the California/Nevada border near Las Vegas, NV. The remote mountain setting — accessed primarily along dirt roads — and distance between

restoration areas required an innovative solution for seeding. Gothic Landscape, Inc., developed a barrel imprinter specifically designed for this unique setting. Unlike traditional imprinters that are pulled behind a tractor or bulldozer, this new imprinter is attached on the back of a skip loader, allowing it to be raised and lowered as the sites are imprinted. This new design greatly improves the ability to imprint sites that are too small, or too difficult to work in for traditional imprinters, especially when there is recovering native vegetation that must be avoided. In addition, this imprinting method has practical applications to erosion control and soil stabilization, a benefit when working on project sites with SWWP requirements. Over 40 acres of the 244-acre project were seeded and imprinted in November and December 2013. Preliminary results for the imprinted sites collected in March 2014, during Year 1 of the restoration program, will be presented. A comparison to adjacent areas where hand-seeding occurred will also be included.

### **Practical Solutions for Wind Erosion associated with Desert Restoration**

Aaron Andrews<sup>1</sup>, James Prine<sup>1</sup>, Marc Doalson<sup>2</sup>, and Cecilia Meyer Lovell<sup>\*1</sup>

<sup>1</sup>AECOM, San Diego 92101; Cecilia.MeyerLovell@aecom.com <sup>2</sup>San Diego Gas and Electric, San Diego 92123

Over the past 3 years, San Diego Gas and Electric (SDG&E) and AECOM have been involved in the restoration of temporary impacts to sensitive habitat due to construction of the Sunrise Powerlink Transmission Project, a split 230kV and 500kV transmission line which extends from the deserts of Imperial County over the mountains to western San Diego County conveying electricity from renewable energy facilities. Within the desert section of the Sunrise Powerlink, near the town of Ocotillo CA, is the 29.5-acre site of a former construction yard that was used



## Poster Session *continued*

during construction activities. This site is referred to as S-2 Construction Yard (S-2). S-2 has been affected by localized drought conditions that have restricted the return of native vegetation. Due to reduced precipitation and lack of vegetation, soil loss due to wind erosion is now also impacting restoration efforts at the S-2. A number of methods have been implemented to reduce the loss of soil from the site, including installation of windbreaks built out of local material, windbreaks constructed from jute netting, and the installation of fiber rolls to protect existing vegetation that was avoided during construction. In most cases, windbreaks are proving successful in keeping finer soil materials onsite, but germination of native species is still needed. This poster will illustrate the methods employed to date at the S-2 and how these techniques may be applicable to other projects experiencing similar challenges.

### **Restoring Special-Status Plants for SDG&E's Sunrise Powerlink Transmission Project**

Eric Piehel<sup>1</sup>, Cecilia Meyer Lovell<sup>\*1</sup>, Marc Doalson<sup>2</sup>, and James Prine<sup>1</sup>

<sup>1</sup>AECOM, San Diego 92101; Cecilia.MeyerLovell@aecom.com <sup>2</sup>San Diego Gas & Electric, San Diego 92123

Restoring special-status plants requires constant adaptive management and innovation due to their rarity and often specific habitat requirements. San Diego Gas & Electric's (SDG&E) Sunrise Powerlink, a split 230kV and 500kV transmission line which extends from the deserts of Imperial County over the mountains to western San Diego County conveying electricity from renewable energy facilities. The project is responsible for restoring special-status plants within appropriate habitat associated with the project's 232 restoration areas, totaling 308 acres. Six special-status plant species are being restored in the temporary impact areas: Jacumba milk-vetch (*Astragalus douglasii* var. *perstrictus*), Payson's caulanthus

(*Caulanthus simulans*), sticky geraea (*Geraea viscida*), San Diego gumplant (*Grindelia hirsutula* var. *hallii*), desert beauty (*Linanthus bellus*), and hairy stickleaf (*Mentzelia hirsutissima*). For these species, the mitigation requirement is to replace the number of individuals that were planned to be impacted at a 1:1 ratio. Methods have included selecting restoration areas with appropriate soil and microclimatic conditions, seed collection, seed cleaning and storage, hand seeding, maintenance of nonnative species, establishing enhancement areas near existing populations, erosion control, and restricting unauthorized access, as needed. Seed bulking is also being initiated this year. After Year 1, substantial progress has been made toward restoring these 5 special-status species. The success rates range from 63% to 82% of the individuals that were planned to be impacted. Data from Year 2 (spring 2014) will also be presented. Restoration of special-status plants provides a unique opportunity to understand specific habitat requirements, germination rates, etc. about these rare plants.

### **Late Summer Native Establishment**

Joseph Paternoster

DRiWATER, 1042 Hopper Avenue, Santa Rosa 95403; joe@driwater.com

When is the best time of year to plant for both optimum survival rates & minimal water use? Can a time-release water gel (TRWG) provide enough moisture to establish a plant with reduced costs and less maintenance than hand-watering? Is there substantial difference in the growth (both root mass and upper body) when established using a time-release water gel with the micronutrient zinc and glacial acetic acid (IAA), over hand-watered plants. When plants feed, or photosynthesize, they grow and increase their carbohydrate storage (energy). If plants are given adequate time and moisture to grow and develop roots prior to the dormant season, assuming the roots have more capacity to increase

carbohydrate storage. By having this "food" available when spring comes the plants have a head start to better uptake spring moisture and nutrients. Spring may be the only time that plants have to develop and strengthen before summer drought, the extra push the plants have received from carbohydrate reserves, the better prepared they are to handle dryer climatic conditions. Findings: Late summer planting allow sufficient photosynthesis resulting in ample carbohydrate storage for spring plant growth. That the addition of zinc and glacial acetic acid contributes to the production of essential growth over potable water with no nutrients. That using TRWG-Z significantly lowers water use while efficiently establishing plants. The study shows August plants with a 139% average increase in root mass, and a 68% increase in upper plant growth for plants established with TRWG-Z over hand-watered plants.

### **Large-Scale Propagule Collection for Habitat Restoration in the Alameda Creek Watershed**

Dina Robertson, URS Corporation, 1333 Broadway, Suite 800, Oakland; Dina.Robertson@urs.com

The San Francisco Public Utilities Commission (SFPUC) is undertaking several mitigation projects as a result of infrastructure repair and replacement activities, including the replacement of the Calaveras Dam in the SFPUC-owned portion of the Alameda Creek Watershed (Watershed) near Sunol, CA. One goal of the mitigation projects includes the restoration of upland, wetland, and riparian habitats, requiring the propagation of over 400,000 native plants. SFPUC natural resource managers are working with contractors and consultants to locally source propagules from the Watershed and surrounding area in order to maximize plant success and avoid introducing plant stock that is genetically not local to the area. Due to the number of mitigation projects requiring plants and the ongoing nature of maintaining the mitigation

sites, several tools were used to track collection and avoid over-collection of any given target plant population. Tools utilized include a GIS based propagule collection database, propagule collection guidelines that outline amounts and techniques that are permissible to use in collection, and standard forms to be carried by individuals who observe new, suitable collection locations while conducting activities in the field for the SFPUC. In addition, the SFPUC worked collaboratively with The Nature Conservancy to source seeds for species that were needed for the projects but could not be located on SFPUC lands. The goal of sourcing and growing plants in a sustainable way from the Watershed and surrounding lands was successful for almost all target plant species.

### Natural Predation for Controlling Burrowing Mammal Populations on Restoration Sites

Terressa Whitaker<sup>1</sup>, Pete Tomsovic<sup>1\*</sup>, Marc Doalson<sup>2</sup>, Cecilia Meyer Lovell<sup>3</sup>, and James Prine<sup>3</sup>

<sup>1</sup>RECON Environmental, Inc., 1927 Fifth Avenue, San Diego 92101;

twhittaker@reconenvironmental.com

<sup>2</sup>San Diego Gas and Electric, San Diego 92123 <sup>3</sup>AECOM, 1420 Kettner Boulevard, Suite 500, San Diego 92101

Since application of chemical and mechanical pest control methods often have deleterious side effects to ecosystem health and non-target wildlife, an alternative method is being utilized at one 17-acre restoration site in San Diego County. The restoration site is associated with San Diego Gas and Electric's Sunrise Powerlink Transmission Project, a split 230kV and 500kV transmission line that conveys electricity from renewable energy facilities. It is located on National Forest System Lands in the mountains east of San Diego, California. Burrowing mammal populations increased rapidly at the site after project implementation in December 2012; soil disturbance and subterranean herbivory were causing undue stress to young vegetation.

Although the long-term ecological effects of burrowing mammals can be very positive, the short-term effects can greatly reduce vegetation biomass, especially when mammal population density is high and plants are in early stages of development. To solve this problem, project managers agreed to capitalize on natural predation by raptors in lieu of standard pest control methods. Two raptor perches were erected onsite to provide accessible hunting platforms and barn owl boxes were installed in a wooded area near the site to increase the local population of nocturnal predators. The project is currently being monitored for occupancy in the boxes, use of the perches, and a reduction in on-site soil disturbance.

### Establishing Vegetation in the Hottest Driest Desert in U.S.

Steve Wathen

John Muir Center of the Environment, University of California, Davis 95616; sfwathen@gmail.com.

Establishing vegetation in the Coachella Valley near Palm Springs, California, is difficult due to high temperatures (routinely reaching 120°F in the shade), low and sporadic rainfall (average = 3"), and saline or alkaline soils. Tree seeds or tree seedlings were planted out in the open, within seed balls, within Groasis Waterboxxes, or within fenced cages. The seeds within the seed balls were eaten by rodents and any sprouts failed to penetrate the substrate and died early in the summer. The waterboxxes supplied insufficient and unpredictable amounts of water and failed to supply enough water for seedlings to grow. Five gallons of water supplied once a month was sufficient for all of the seedlings planted within fenced cages to survive and grow through the summer. Established seedlings were given different amounts of water, fertilizer, shade, and protection from plant predators in order to gauge how many resources were needed to establish desert vegetation.

### Refugia for Sensitive Fish and Frog Species in Las Vegas

Von K. Winkel, Ph.D.

Springs Preserve, 333 S. Valley View Blvd., Las Vegas NV 89107; von.winkel@snwa.com

Ten small habitat ponds have been constructed at the Springs Preserve in Las Vegas, Nevada. The Springs Preserve is located on land that once boasted several large springs and a creek that formed a lush oasis in the center of the Las Vegas Valley. The springs and creek dried up in the 1960s. The ponds were constructed to replace the lost wetland habitat, provide refugia for the endangered Pahrump poolfish (*Empetrichthys latos*) and the relict leopard frog (*Lithobates onca*), and provide an educational experience for the public. The ponds were constructed in the original Las Vegas Creek channel in 2012-13. The excavated ponds were lined with rubber fabric. Soil was placed on top of the liners to protect them from the weather and to support vegetation. The ponds were vegetated with beaked spike rush (*Eleocharis rostellata*), yerba mansa (*Anemopsis californica*), alkali sacaton (*Sporobolus airoides*), saltgrass (*Distichlis spicata*), and clustered field sedge (*Carex prigracilis*). Water for the ponds is supplied from a distribution system that pumps waste water from a nearby floodwater detention basin. Tests indicate that the water from the basin is of sufficient quality for the fish and frog species. To date, three of the ponds have been stocked with White River springfish (*Crenichthys baileyi moapae*). This test species will help ensure that the ponds (water and vegetation) are ready for the Pahrump poolfish and relict leopard frog when agreements with the U.S. Fish and Wildlife Service are completed in the near future.