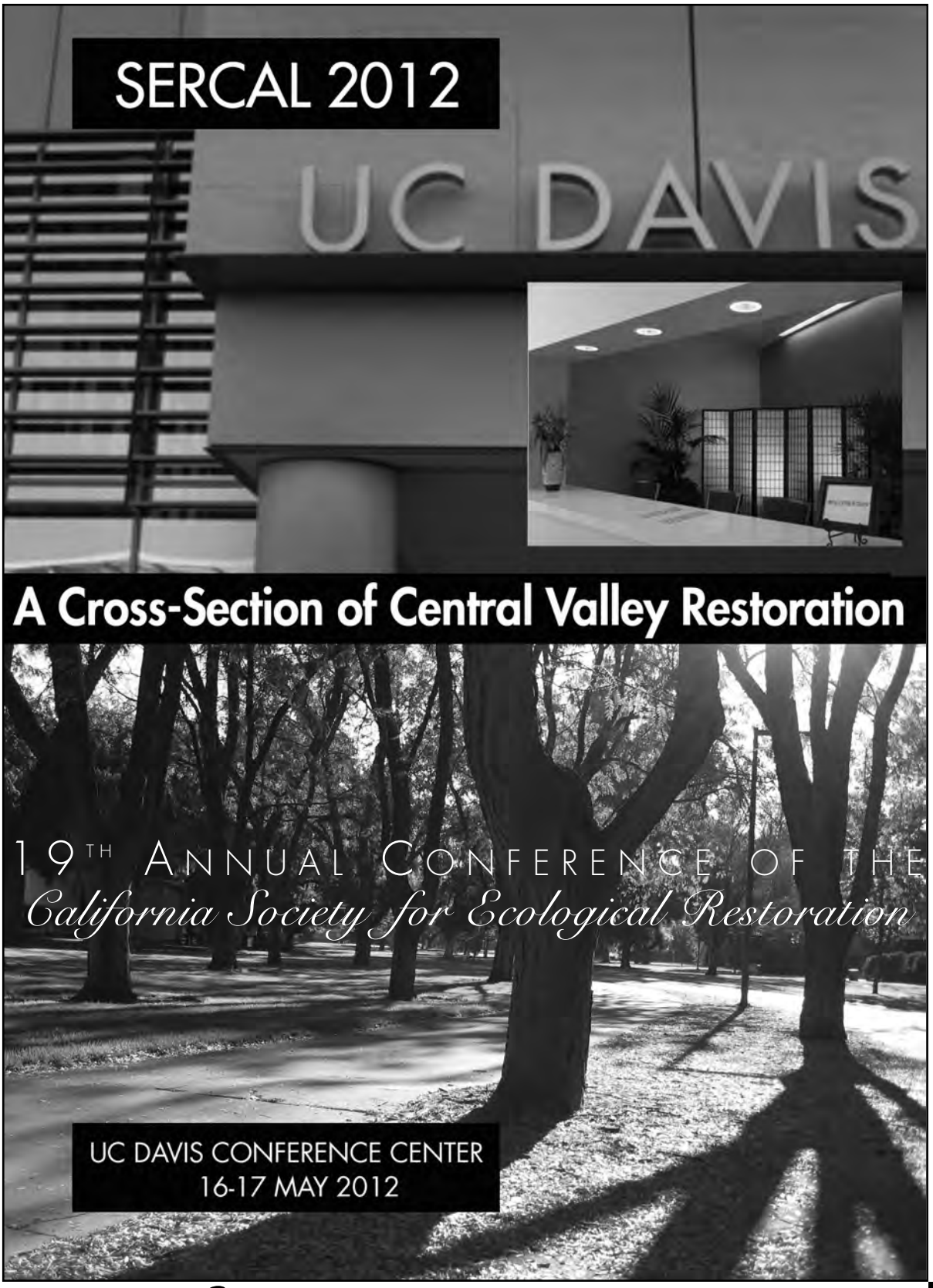

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session 1 Wednesday 16 May 1:30p — 3:00p *Ballroom A*
& Thursday 17 May 8:30a — 10:00a *Ballroom A*

DELTA RESTORATION

The Confluence of Water, Science & Politics

Chair: **Trevor Burwell, PhD** *Senior Ecologist / Biology Group Leader, URS Corporation*

Land Suitability Analysis Models for Choosing Programmatic Habitat Mitigation Sites in the Delta.

Robert Capriola

Westervelt Ecological Services, 600 North Market Boulevard, Suite #3, Sacramento, CA 95834-1257. *rcapriola@westervelt.com*

In January of 2009, Westervelt Ecological Services was chosen by the California Departments of Water Resources (DWR) and Fish & Game (DFG), respectively, to develop a GIS-based land suitability analysis model to help in selecting the locations of potential programmatic mitigation sites within the 408,578-acre Sacramento – San Joaquin Delta (Delta) that may be used to offset impacts to habitats caused by levee improvements carried out under the Delta Levee Flood Protection Program (AB360). The use of programmatic mitigation (e.g., advanced habitat creation) is seen as the primary tool and first step in planning for development of a scientifically-based model for choosing sites for restoration and protection. The model is based on GIS data layers grouped in categories such as biological, physical, legal, land use planning, and historic uses. These data layers were chosen for their applicability to the establishment and protection of the target habitat types. Data layers were processed and rated for suitability to the restoration and protection of the target habitat types. The model allows DWR and DFG to create outputs that emphasize certain categories of information over others in order to better choose sites for AB360. The GIS model emphasizes natural processes and long-term sustainability in order to accommodate environmental changes such as sea-level rise and climate change.

Tidal Wetland Restoration — What Worked And What Didn't? Lessons Learned From 10+ Years of Monitoring At Two San Francisco Bay Restoration Sites.

Mark Lindley*[1], Michelle Orr[1], Lindsey Sheehan[1], Stephen Crooks[1], Ron Duke[2], Michael Rafferty[3], Eric Jolliffe[4]

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This paper presents lessons learned from restoration of two San Francisco Bay tidal

continued

wetlands, Sonoma Baylands and Cooley Landing. The two restoration projects have the same objectives — vegetated tidal marsh with a channel network comparable in ecology and function to natural reference sites — but different starting conditions and design approaches. We synthesize 10+ years of post-project monitoring to assess project performance and draw lessons that can be applied to the future restoration projects. The Sonoma Baylands project, breached in 1996, was a subsided agricultural site. The project is the first restoration where dredged material was placed to raise the site grade to target elevations intentionally below natural marshplain elevations to jump start marshplain development while allowing for natural tidal channel development. The restoration includes berms to create topographic diversity and sheltered conditions to foster sedimentation. Early rates of site evolution were defined by a decision not to excavate the connecting outboard channel. Inside the site, the former agricultural surface near the breach is influencing channel formation. The Cooley Landing project, breached in 2000, was the first restoration in the Bay Area to incorporate design features (ditch blocks and training berms) to steer forming tidal channels to reoccupy remnant historic tidal channels, and to limit flow through borrow ditches. Monitoring showed rapid reestablishment of the remnant channel system, within several years, and substantial deposition in the borrow ditches within 10 years. Based on the monitoring results, we recommend minor modifications to the layout of features for use in future restorations.

Restoration and Management for a Changing Delta.

Amy Merrill*, Megan Keever, Bruce Orr

Stillwater Sciences, 2855 Telegraph Ave. Berkeley, CA 94720. *amy@stillwatersci.com*

More than other landscapes, restoration in the Delta must accommodate mean sea level (MSL) rise. In the western Delta, where a levee breach would have the greatest impact on water salinity and conveyance, levees will be maintained and interior lands restoration should target subsidence reversal and improved (non-fisheries) habitat. In contrast, restoration in the eastern Delta should accommodate increased inundation. Using case studies from Bradford Island (western Delta), and New Hope Tract (eastern Delta), we discuss how different restoration approaches can help create a Delta minimally impacted by MSL rise while also supporting increased ecosystem services. The New Hope restoration project, located near the Mokelumne - Sacramento confluence, historically hosted distributary channels and a landscape of emergent wetland with mixed riparian vegetation. Currently leveed and farmed, the parcel floods every ~10 yrs; MSL rise and potential plans for the broader Grizzly Slough area could dramatically increase flood frequency of the parcel. Our restoration design accommodates these variable conditions while also incorporating existing volunteer willow and cottonwood cohorts and addressing weed control. The interior Bradford Island site is strategically located adjacent to an existing scour pond and riparian forest. Here we also took advantage of 'natures' gifts' by locating restored riparian forests adjacent to seed sources and by using a sand splay produced during the earlier levee breach to create rare dune scrub communities. In this most vulnerable part of the Delta, peat soils supported amazing growth rates, suggesting high carbon sequestration and possibly reduced subsidence rates in restored riparian areas.

Bird Response to Delta Restoration.

Anitra Pawley* and Ron Melcer

FESSRO, North Delta Restoration Program, Department of Water Resources, P.O. Box 942836, Sacramento, CA 94236. *apawley@water.ca.gov*

Despite fairly extensive studies of bird populations along the Sacramento and Cosumnes Rivers in the Central Valley, studies of bird populations and their responses to habitat and landscape attributes at interior Sacramento-San Joaquin Delta restoration sites (Grizzly Slough, Decker, Sherman, and Twitchell Islands) are limited. We conducted point count and vegetation surveys at 12 restoration sites (n = 50) located within the west and north Delta during May and June, 2011. Sites included various habitat types including shrub scrub, riparian, and freshwater marsh. We evaluated bird species composition and richness, and also tested regression models that related these variables to 1) fine-scale habitat attributes (tree and shrub species richness, tree and shrub percent cover, herb cover and non-native species richness), 2) landscape attributes (area, area to perimeter ratio, and age), and 3) adjacent land cover (grassland, crop, riparian, wetland and water). Our results indicate low species richness when compared to Sacramento and Cosumnes sites, but a fairly high percentage of native species. Though songbird communities were prevalent, cowbird populations were a particular concern. Bird species abundance and richness were also significantly lower at sites we sampled that were linear versus non-linear, smaller versus larger, younger versus older, and at sites with non-native versus native species. We found fine-scale habitat and landscape attributes to be useful in predicting species abundance and richness, however, adjacent land cover had little effect. These findings are used to provide guidance for restoration design (of interior island and setback levees) to enhance bird populations/ communities and also to suggest further research.

Restoring Prospect Island.

Stuart Siegel*[1], Melissa Carter[1] and Dan Gillenwater[1], Dennis McEwan[2], Ling-ru Chu[2], Pamela Lindholm[2] and Gina Benigno[2]; Bruce Orr[3], Noah Hume[3]

[1]Wetlands and Water Resources, 818 Fifth Avenue, Suite 208, San Rafael, CA 94901; [2]Department of Water Resources, 3500 Industrial Boulevard, West Sacramento,

CA 95691; [3]Stillwater Sciences, 2855 Telegraph Ave., Berkeley, CA 94720. *stuart@swampthing.org*

The Department of Water Resources is planning the 1,600-acre Prospect Island restoration in the northwest Delta. Restoration to tidal marsh and tidal aquatic will partially fulfill DWR's obligations under the delta smelt and salmonid biological opinions on State Water Project and Central Valley Project operations for 8,000 acres of tidal restoration, by providing food web productivity and rearing habitats in a region established as important to these and many other species. Restoration will also fulfill larger restoration targets of the Bay Delta Conservation Plan. Restoration faces intriguing opportunities and challenges for how to provide fisheries benefits given (1) site topography (about one-third resides below emergent marsh vegetation heights), (2) site land cover (it is mostly emergent wetland and riparian vegetation nearly 15 years after agricultural use discontinued, unlike nearby Liberty Island that was essentially a barren field when it breached), and (3) possible constraints on locating levee breaches along the Deep Water Ship Channel and/or Miner Slough. Restoration planning will apply the fruits of recent years' efforts advancing the science for Delta restoration, recovery of the many species and natural communities at great risk, and potentially interfering stressors, using that science in combination with site conditions to generate and evaluate a wide range of design options. In addition to providing target ecological functions, the restoration needs to avoid or minimize problems with invasive species, adapt to climate change, and examine potential impacts to water quality, navigation, access to an adjacent property, flood conveyance, seepage onto Ryer Island, and levee erosion.

Benefits of Comprehensive Plant Community Restoration.

David Thomson*, Aidona Kakouros

Habitats Program, San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA 95035. *dthomson@sfbbo.org*

Revegetation during habitat restoration often consists of introducing only some of the plant community, and usually just a few of the dominant native perennials found on reference sites. In areas where centuries of human impacts have severely damaged habitats, once common species are now rare enough to impair their ability to compete with non-native species. Such areas are better viewed as habitat creations so planning is thorough enough to facilitate the development of plant communities that provide the habitat functions and values required within their ecosystem. For the past five years we have been performing applied research on *creating* native plant communities in high marsh and upland ecotone (aka upland transitional zone) habitats of the tidal marsh ecosystem on the San Francisco Bay National Wildlife Refuge Complex. Our goal is to describe plans and specifications for establishing plant communities on large, severely damaged sites with minimal resources. During this multi-year demonstration research project we found many native forbs, particularly pioneer and disturbance-oriented species: (1) amenable to direct seeding, (2) able to colonize highly disturbed sites, (3) provide robust direct competition year-round with non-native species, (4) create nursery conditions for slower growing natives, and also (5) create what appear to be positive trajectories, although we are only in our third monitoring year. We are currently testing these findings across 20 acres on several new sites utilizing a variety of methods to seed 21 forb and 7 grass species.

Restoring a Floodplain in the Delta.

Mark Young

Westervelt Ecological Services, 600 North Market Boulevard, Suite #3, Sacramento, CA 95834-1257. *myoung@westervelt.com*

The second phase of the 493-acre, tidally-influenced Cosumnes Floodplain Mitigation Bank (Project) was completed in 2011 with the breaching of the farm berm to the Cosumnes River. Both seasonal flooding of the former floodplain and summer tidal backwatering into constructed channels allows the site to become essential fish habitat (ESH) for the federally-listed threatened Central Valley steelhead and for fall-run Chinook salmon. Opening the site up to an unrestricted hydrological regime will allow a natural-process restoration of freshwater riparian, perennial, and seasonal wetland habitats. During the design development, surveyed cross-sections were made through undisturbed riparian areas along the Cosumnes River to correlate dominant woody vegetation with elevation and river hydrology. The hydrological analysis provided the optimal channel dimensions to allow for complete tidal-cycle backwatering into the site as well as understanding the duration of inundation (storm water) events. The post-construction vegetation, fish and water quality sampling program was begun in 2011. After the first season of plant establishment, the native woody vegetation and the 270 acres of native grass have exceeded the performance standards. Fish sampling following the breach showed use of the site by both native and non-native species.

RIPARIAN/WETLANDS RESTORATION

Healing the Valley's Arteries

Chair: **John Zanzi** *Landscape Architect*

Dry Creek Wastewater Treatment Plant Levee Relocation Restored Floodplain Revegetation.

Ed Armstrong*, RLA

Foothill Associates, 590 Menlo Drive, Suite 1, Rocklin, CA 95765. *ed.armstrong@foothill.com*

In 2010, the City of Roseville relocated the levee of its Dry Creek Wastewater Treatment Plant, providing approximately 200 feet of additional floodplain width along Dry Creek and increasing the 100-year flood protection for the Treatment Plant. Revegetation of the restored floodplain was conducted according to a California Department of Fish and Game approved Riparian and Oak Woodland Habitat Mitigation Plan designed to reduce ecological impacts and enhance riparian and floodplain habitat. Restoration design incorporated first and second terrace riparian plantings with open areas comprised of swales and grassland revegetation to meet flood conveyance and Central Valley Flood Protection Board requirements while improving habitat. Following construction, the site experienced comparatively heavy rains in winter and spring of 2011, and the restored floodplain was inundated to a depth of several feet. Despite concerns, however, less than 10% of the overall planted vegetation was lost and erosion was primarily limited to a small area where floodwaters entered the new floodplain. This presentation will discuss the planning, design, installation, and first-year of monitoring of this project.

Inundation Depth, Duration, and Temperature Influence Fremont Cottonwood Seedling Survival.

Lisa C. Auchincloss*[1], James H. Richards[1], Charles A. Young[2], Michael K. Tansey[3]

[1]Department of Land, Air and Water Resources, University of California, Davis, CA 95616; [2]Stockholm Environment Institute, 133 D Street, Davis, CA 95616; [3]Bureau of Reclamation MidPacific Region, 2800 Cottage Way, Sacramento, CA 95825; *lauchincloss@ucdavis.edu*

Fremont cottonwood (*Populus fremontii*) is an early successional species which serves as a foundation for riparian ecosystems in the North American Southwest. Along rivers the upper limit of the seedling establishment zone depends on proximity of seedling roots to the declining water table. The lower limit is a function of the maximum elevation of inundation or scour. Under both natural and human-influenced hydrologic regimes, Fremont cottonwood seedlings are likely to experience short-term (one to five week) inundation during their first year of growth. Previous studies show that inundation can account for more than 70% of seedling mortality during this time. Using controlled inundation experiments, we found that seedlings of Fremont cottonwood have high tolerance of inundation to the soil surface and a reasonable tolerance of complete shoot submergence for a duration of one or two weeks (22 and 50% mortality respectively). Mortality increased linearly with days of complete submergence (mortality percentage = 4.6 + (2.5 × days of submergence)). Warm water temperature (25/18°C day/night) during complete submergence adversely affected seedling biomass and survival, resulting in 64% mortality versus 39% with cooler water temperatures (18/11°C day/night). Our results indicate that establishment of new Fremont cottonwood populations in the riparian corridor will be more successful when flows do not completely cover the shoots of seedlings for more than two weeks and if water temperatures during inundation are cool. From the perspective of the management of river flows for cottonwood recruitment, deep, prolonged, late season (warm water) inundations are the most detrimental.

Experiences with Enhancing Salmonid Habitat on the American River.

Chris Bowles*, PhD, PE, Sam Diaz, PE, Chris Hammersmark, PhD, PE

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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 Folsom Dam, 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 four 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.

Vernal Pool Restoration — Research Tool for Endangered Species Reintroductions.

John Gerlach

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Solano grass is known from two playa pools in Solano County and two connected vernal pools in Yolo County. It was extirpated from one of the playa pools, the population in the other playa pool is generally in the tens of individuals, and the combined population of the vernal pools is generally in the hundreds to thousands of individuals. Its vernal pool habitat is not secure as it exists in the clay delta of Putah Creek and the floods that created that dynamic habitat were eliminated by the construction of Monticello dam in 1957. In contrast, the playa pool habitat is extremely stable and has persisted for 20,000 to 450,000 years. Because of the tenuous nature of the vernal pool habitat, Solano grass survival depends on its reintroduction into Olcott Lake and other playa pools. Reintroduction feasibility was determined by: 1) population monitoring for 11 years; 2) physical and chemical characterization of its habitat, biology, and ecology; 3) focused experiments; 4) on-site restoration and reintroduction, 5) invasive species effects and control (*Crypsis* and *Lepidium*), and; 6) grazing effects. This work was conducted in parallel on *Neostapfia colusana*, and in hard-pan vernal pools with *Orcuttia viscida* and the invasive species *Glyceria declinata*. Spring/early summer evapotranspiration rates and not ponding duration were found to be directly correlated with population size and fecundity, surface effects of the cracking clay soil (spring/early summer/fall) are secondary considerations, and grazing severely negatively impacts this species. Reintroduction of Solano grass into Olcott Lake is the next step.

California Red-legged Frog Habitat Design Criteria and Adaptive Management in a Sediment Laden System.

Lynn B. Hermansen*[1], David Katzev[2], and Dave Shaw[3]

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Habitat design for special-status species requires careful consideration of site-specific environmental conditions to create features that will develop into optimal habitat. In 2010, the East Bay Municipal Utility District constructed six wetlands, interconnected swales, and bioengineered grade control structures and installed native plants to enhance three drainages within the 42-acre Pavon Creeks watershed located in east Contra Costa County, California. Restoration of Pavon Creeks was implemented to mitigate for wetland and special-status species impacts associated with the seismic upgrade of San Pablo Dam. Two of the wetlands at Pavon Creeks were designed to provide breeding habitat for the California red-legged frog (*Rana aurora draytonii*). In addition to creating California red-legged frog breeding and dispersal habitat, restoration goals at Pavon Creeks included improving water quality, and reducing sediment loads to the larger Pinole Creek watershed. The sediment laden Pavon Creeks watershed presented unique design challenges. Restoration designs had to incorporate an increase in water storage, reduction in erosion, and retention of sediment while providing self-sustaining habitat for California red-legged frog. Despite a well thought-out design, adaptive management measures were required after the first wet season of monitoring to prevent sediment influx to the California red-legged frog ponds. This presentation reviews the design criteria for California red-legged frog habitat, design considerations in a sediment laden system, and adaptive management measures required to remediate effects of sediment on habitat.

Floodplain Restoration Opportunities in the Sacramento and San Joaquin Valleys.

John C. Hunter*[1], Kevin G. Coulton[1], Ray McDowell[2], Stacy Cepello[2], Matt Wacker[3], Lee D. von Gynz-Guethle[1], Jonathan D. McLandrich[1], Eryn Pimentel[1], Stephen Blanton[1]

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Floodplain restoration opportunities were analyzed to support development of the Central Valley Flood System Conservation Strategy in conjunction with the Central Valley Flood Protection Plan (CVFPP). This GIS-based analysis considered floodplain inundation potential (FIP) and other opportunities and constraints. It was conducted for 2-mile-wide corridors along the Sacramento and San Joaquin rivers and their major tributaries. Outside of urban areas, there were more than 320,000 acres of floodplain that has FIP for inundation by a 2-year event. Less than 40% of this floodplain remains hydrologically connected to the river system. Riparian and wetland vegetation covers only about a third of this connected floodplain, and the majority of this floodplain is bounded by levees whose physical condition is of higher concern. These results indicate that floodplain

continued

restoration opportunities are widespread and the potential exists to integrate restoration into the flood management actions of the CVFPP.

Do natural Plant Communities Occur in Created Vernal Pools?

Virginia Meyer

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Evidence of long-term, sustainable natural plant communities is necessary to confirm ecological function in created vernal pools. We classified plant communities in created and natural vernal pools at three Central Valley project sites, and compared them to all known natural vernal pool communities in the region. Data were collected over two successive years when created pools were at least twelve years old, using protocols developed by Barbour and others (2003). Communities were classified using the key developed by these researchers. At the site within the Livermore Vernal Pool Region, one community keyed to a natural vernal pool association; other communities keyed to non-vernal pool communities. Dominance of exotic species in these pools may be due to dry conditions, loss of hydrologic function, and cessation of cattle grazing. Lack of grazing and changes to hydrology appear to have contributed to invasion by exotics also at the Southeastern Sacramento Valley Region site. Pools at the Northeastern Sacramento Valley Region site were less invaded, reflecting higher annual precipitation, lack of land use change, and moderate grazing. Communities of created and natural pools at Sacramento Valley sites keyed to natural associations with similar floristic composition and species constancies to regional vernal pool communities. Created pool associations were generally those of deeper, longer-inundated vernal pool habitats compared to natural vernal pool associations at the same site.

Physical Constraints on Floodplain Restoration along the Middle Sacramento River.

Gerrit A. J. Platenkamp*[1], Eric W. Larsen[2], Lee D. von Gynz-Guethle[1], Stacy Cepello[3], Marc Hoshovsky[3], Ray McDowell[3], John C. Hunter[1]

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The California Department of Water Resources is assessing habitat restoration potential within the Sacramento–San Joaquin River Flood Management System as part of development of the Central Valley Flood Protection Plan. One area of interest is the middle Sacramento River (Red Bluff to Colusa), because it is one of the few major river reaches in California that is actively meandering. Channel dynamics determine habitat diversity in this reach by creating a patchwork of successional stages of riparian vegetation. However, bank revetment and near–channel levees limit the meander cutoffs and channel migration that promote structural habitat diversity. Existing meander potential, i.e., the area where the river could migrate with current bank restraints was mapped and compared to the area where the river could migrate *without* bank restraints, i.e., the hypothetical "natural" meander potential. Upstream of Colusa where the levees are relatively wide, the existing potential varies between 50 and 75% of the natural potential, and downstream of Colusa, where the levees are relatively narrow, the existing potential ranges between 10 and 25% of the natural potential. The ratio of existing to natural meander potential is a useful tool to identify areas where revetment removal or levee setbacks could be considered to restore meandering and riparian habitat diversity. These relationships are demonstrated with several examples on the middle Sacramento River.

Using Wetland Functional Assessments to Optimize Restoration Design

Lauren Alleman, Erin Hathaway, Jessie Quinn*, Ph.D

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Wetland restoration is often driven by compensatory mitigation requirements in compliance with the Clean Water Act (CWA). Initial CWA goals focused primarily on the quantity of wetland acres maintained; however, CWA goals have been expanded to consider quality as well through the stated objective of "no net loss of function". Wetland functional assessments are developed and used widely to quantify the fulfillment of this goal in restoration and compensatory mitigation projects. Wetland functional assessments measure and score habitat attributes that contribute to a site's ecological functions of interest. The combined scores of these attributes provide a quantitative index of the site's ecological function relative to either defined "optimal" conditions, or reference site "target" conditions. Here, we present methods developed to use wetland functional analysis to calculate the uplift in ecological function provided by a proposed restoration plan. We also use sensitivity analysis to determine which habitat attributes contribute most to the overall functional index, determine how these attributes can be enhanced by design elements, and calculate the cost of these enhancements. Through an iterative process, we are able to compare various restoration scenarios to determine the most cost-effective means of adjusting design elements to maximize functional uplift. This method is especially applicable to situations in which opportunities for increasing wetland acreage are limited, and provides a framework for determining the best use of a restricted budget.

Tassajara Creek Riparian Corridor Restoration and Monitoring Using Multiple Methods.

Patrick Reynolds

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Riparian habitat restoration and monitoring can be successfully accomplished using multiple methods. Over the last 15 years, H.T. Harvey & Associates has designed, implemented and monitored riparian habitat restoration within 25 acres and 5,000 linear feet of the Tassajara Creek riparian corridor in Dublin California. Lessons learned from earlier restoration phases were applied to later phases. A large suite of restoration techniques and monitoring methods were implemented. Livestock exclusion, debris removal, stream channel restoration, grading of unstable banks, container plant and cutting installation and maintenance, foliage protection of naturally recruited valley oak (*Quercus lobata)* seedlings, control of invasive exotic pest plants and coarse woody debris installation were used to restore the riparian corridor. Monitoring methods including successive years of canopy mapping, photodocumentation and quantitative data collection documented a substantial increase in riparian canopy and an increase in the structural complexity of riparian vegetation. Monitoring results showed a 38% increase in riparian canopy 7 years after long-term monitoring began. The 3.59 acre riparian canopy expansion primarily occurred on active floodplains from natural recruitment spurred by livestock removal. Riparian vegetation expansion has been limited in the non-planted portions of Tassajara Creek's banks. In the absence of grazing, non-native pest plants including poison hemlock (*Conium maculatum)* and blessed milk thistle (*Silybum marianum*) have expanded necessitating implementation of control measures as part of an adaptive approach to riparian corridor restoration. Overall, results demonstrate that application of multiple methods of riparian habitat restoration can be very successful.

Sediment Source Control and Wetland Mitigation Design through Comprehensive Site Assessment.

David Shaw*[1], Lynn Hermansen[2], David Katzev[3]

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A comprehensive site assessment was completed and used to design and implement wetland and channel restoration measures at the Pavon Creeks and Scow Canyon sites in Contra Costa County on lands owned managed by the East Bay Municipal Utility District. The outcome of the investigations identified particular conditions and locations where existing wetlands are impaired and restoration or enhancement opportunities exist. Considering prior studies, existing soils and geologic mapping, field observations of soils, groundwater conditions, peak streamflow, sediment transport, and appropriately-scaled hydrologic modeling, design plans were developed for wetland creation, enhancement, and restoration at both Pavon Creeks and Scow Canyon. Initial reconnaissance and review of historical data at Pavon Creeks in the Pinole Watershed suggested that stream channels in this sub-basin are a significant source of sediment to Pinole Creek. As a result, the restoration and enhancement features were designed to reducing sediment loads. Groundwater monitoring and streamflow gaging allowed for identification of areas suitable for creation of new wetlands and ponds to serve as habitat for California Red-Legged Frog (CRLF). Investigations at Scow Canyon in the San Pablo Watershed indicated a high potential for wetland creation due to its isolated areas of existing seeps. Overall design goals for each area included: 1) restoration of sediment storage functions in channels, 2) excavating broad depressions to form seasonal wetlands and ponds, and 3) enhancing natural seeps and springs through horizontal well drilling.

Restoring Giant Garter Snake Habitat: Challenges and Solutions at the Capital Conservation Bank.

Matt Wacker*[1], Debra Bishop[1], Eric Hansen[2], Dustin Smith[3], Tony Frayji[4], Chris Campbell[5]

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The Capital Conservation Bank (CCB) will be constructed to restore perennial marsh habitat within the Yolo Bypass for the federal and California listed as threatened giant garter snake (*Thamnophis gigas*). The design for the habitat restoration project, which is located within an area formerly used for rice cultivation, incorporates several unique features to increase habitat suitability for giant garter snake and reduce ongoing maintenance needs, including construction of elevated upland habitat above Yolo Bypass flood elevations interspersed with wetland habitat to facilitate low-impact habitat maintenance. The importance of these design features for regional giant garter snake populations within the Yolo Bypass and their potential applicability to other wetland restoration projects will be discussed. Construction of the restoration project also requires the approval of numerous federal and California regulatory agencies. To secure the approval of these various agencies, the project incorporates novel habitat design features, species-specific performance criteria, and other approaches that could be applicable to other habitat restoration projects.

session 3 Wednesday 16 May 3:30p — 5:30p *Ballroom A*

AGRICULTURAL LAND RESTORATION

Farming with Nature

Chair: **Carol Presley, PE** *Santa Clara Valley Water District, and Community Alliance with Family Farmers, Board of Directors*

Market and Regulatory Trends Influencing Resource Management and Sustainability in California's Agricultural Landscape

Melanie Beretti*, Dawn Mathes*

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This presentation explores the regulatory and market trends affecting the agricultural industry today, with an emphasis on those developments that significantly influence environmental protection and restoration efforts. Key regulatory developments in the areas of labor, public health, and environmental protection converge on California's agricultural landscape. Global food safety and sustainability initiatives within the food production, distribution, and retail sectors provide a key opportunity to integrate and manage social and environmental objectives. For professionals working within the agricultural landscape, successful resource management strategies rest on a solid understanding of the regulatory and market framework influencing California's food system.

Would you Like Salmon with that Wine? A Grape Grower-initiated Restoration Project for the Napa River.

Andy Collison

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The Napa River, like many lowland California rivers in agricultural settings, has become degraded over the last 150 years due to encroachment, changes in the watershed, and historic channel maintenance activities. Channel downcutting has impacted the salmonid population and degraded the riparian corridor, while causing bank erosion of surrounding vineyards and contributing to fine sediment loading that triggered a TMDL process for the river. In 2002 the Rutherford Dust Society, a grape growers group in the Napa Valley, came together to initiate a river restoration plan to address these problems. The project involved a diverse group of private landowners and growers who teamed with Napa County Flood Control and Watershed District, Napa County RCD and a number of Federal and State agencies in what became one of the largest public-private restoration initiatives in California. Four miles of the Napa River are currently being restored, with a combination of voluntary levee setbacks, a widened riparian corridor, and channel restoration to improve habitat for Chinook salmon and steelhead trout, as well as other riparian and aquatic species. The project is also integrated into the Napa River TMDL, providing a vehicle for landowners to meet erosion and sediment reduction requirements. Landowners on an additional nine miles of river downstream have developed a similar project, and further efforts are proposed upstream. As the project has developed and been implemented over the last few years many lessons have been learned about both the social and technical aspects of restoration in a working agricultural environment. This presentation gives an overview of the project and attempts to tease out some of those lessons.

Planting Habitat on Farms: Design, Techniques, Issues.

Sam Earnshaw

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Hedgerows and grassed waterways are increasingly being planted on farms and can have multiple functions: they can serve as habitat for beneficial insects, pollinators and other wildlife; provide erosion protection and weed control; stabilize waterways; serve as windbreaks; reduce non-point source water pollution and groundwater pollution; increase surface water infiltration; buffer from pesticide drift, noise, odors, and dust; act as living fences and boundary lines; increase biodiversity; and provide an aesthetic resource. Many plants attract native bees and other pollinators, and some hedgerow and windbreak plants, such as citrus or other fruit trees and herbal plants, can have economic returns. As with any planting, problems and issues can be dealt with through management practices. Most growers use plants that they individually like and report that they are pleased with the benefits that farmscaping brings to their farms. The presentation will show a diversity of projects, focusing on established practices.

Hedgerows Enhance Beneficial Insects on Farms in California's Central Valley.

Rachael F. Long*[1], Lora Morandin[2]

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Hedgerows of native California shrubs and perennial grasses bordering field crops were examined for the abundance of beneficial and pest insects compared with adjacent weedy areas. During two years of sampling in the Sacramento Valley, hedgerows attracted more beneficial than pest insects, while weedy areas showed the opposite trend, attracting significantly more pest than beneficial insects. We conclude that replacing weedy areas at field crop edges with managed hedgerow plantings will sustain or increase beneficial rather than pest insects on farms.

Quantifying Ecosystem Services to Incentivize Sustainable Land Practices

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Ecosystem services, or benefits humans obtain from functioning ecosystems, are not recognized in most aspects of our economy. In order to incorporate these services into our economic accounting system, tools are needed that accurately and transparently quantify ecosystem services being provided by a particular landscape. Working with our partners in Sustainable Conservation, PRBO Conservation Science, and the Xerxes Society, we developed a draft model for quantifying increases ('uplift') in three ecosystem services associated with improved farmland management for the Central Valley: 1) pollinator habitat, 2) riparian bird habitat, and 3) riparian shade. The project goal is to develop a quantification tool that is robust, flexible, and provides sufficient resolution and accuracy to support market or government supported valuation of ecosystem service gains through site-specific restoration projects. The tool uses simple data gathered on-site and is run using a combination of Microsoft Excel, Google Earth, and ArcGIS software. Both land owners and field technicians alike can quantify changes in ecosystem services that accompany changes in land management, which might include restoring riparian vegetation, planting hedgerows, or planting ground cover in an orchard. Preliminary field testing of this tool indicates that modeled predictions of service uplift matched observed changes moderately well, with predicted changes falling within 10 to 30% of observed changes over time. We will present the model structure, review preliminary results of the field testing effort, and discuss possible applications and potential services in the Central Valley as well as other agricultural landscapes, including the Delta and Sierra meadows.

Restoring Key Floral Resources for Native Pollinators in Agricultural Landscapes.

Kimiora Ward*, Neal Williams, Katharina Ullmann

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The sustainability of agriculture is fundamentally tied to pollinators. Approximately 75% of global food crop species benefit from animal-mediated pollination. Meanwhile, pollinator declines are increasingly evident worldwide. Parasitic mites, disease and Colony Collapse disorder profoundly challenge sustainable use of domestic honey bees and highlight the vulnerability of crop production heavily reliant on this single pollinator. Wild native bees can provide significant pollination service to crops; however, their ability to do so declines with isolation from natural habitat and increasing agricultural intensification. A contributing factor is the lack of persistent floral resources in such highly modified landscapes. We are developing and testing mixtures of herbaceous flowering plants for their establishment success, attractiveness to bees, and compatibility with conventional agricultural practices in California. Our goal is to develop recommended native plant mixes and guidelines for establishment of functional pollinator habitat within agricultural landscapes. In 2009 we seeded experimental plots with five seed mixtures of annual vs. perennial plants at high vs. low diversity at three spatially independent locations. We quantified native plant establishment, floral resources, and pollinator response to individual plant species within experimental mixes for two growing seasons. Annuals and perennials bloomed in the first year of establishment. Both annual and perennial plots re-established themselves in the second year, although relative abundance shifted and diversity declined because of competitive dominance of some species. Individual plant species rather than whole mixes were most important for supporting diverse bee communities. Future plantings will combine the best-performing plants from both annual and perennial mixtures.

If You Plant It, They Will Come: Avian Use of Hedgerows in Central California Agricultural Landscapes.

Hillary M. White*, Rachael F. Long

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Hedgerows provide valuable ecosystem services including air and water quality protection, soil erosion control, promotion of pollinators and other beneficial insects, and biodiversity. Planting hedgerows at field margins is an increasingly common conservation measure in heavily transformed agricultural regions of California. Hedgerows may also provide critical habitat for numerous avian species that utilize the small, linear, wooded patches for resting, foraging, wintering and

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breeding. However, avian usage of hedgerows in Central California has not been well studied. More complex vegetation structure and composition attract numerous songbirds that frequent field edges, but there is little information about the degree to which hedgerows are used by wintering and breeding birds. We used a paired study design to 1) evaluate the degree to which hedgerows are used by birds relative to nearby unenhanced fields and/or field margins and 2) determine if hedgerows in agricultural landscapes increase avian diversity and abundance relative to landscapes without hedgerows. The pilot phase of our study was conducted during winter 2011-12 to determine wintering bird abundance and diversity. The second study phase will commence during spring and summer 2012 to assess breeding bird use. Preliminary data analyses indicate that more than twice as many bird species and approximately four times as many individual birds use habitat created by native-planted hedgerows as opposed to unenhanced field margins. We anticipate that survey efforts will continue and expand in 2012 and beyond, including vegetation measurements to understand the role that hedgerow vegetation structure and composition plays in structuring avian communities.

session 4 Wednesday 16 May 1:30p — 5:30p *Ballroom C*

Preserving and Restoring our Iconic FOOTHILL OAK WOODLANDS

Chair: **Ralph Vigil** *Director of Habitat Management, Restoration Resources, and SERCAL Region 1 Director*

Oak Conservation and Mitigation at the State and Local Level.

Loren E. Clark

Associate Director of Community Development Resource Agency, County of Placer, 3091 County Center Drive, Auburn, CA 95603. *lclark@placer.ca.gov*

Oak-dominated landscapes are prominent in Placer County and throughout the State and development has forced citizens and legislators alike to make hard choices with regard to impacts and mitigation. Senate Bill 1334 established Public Resources Code Section 21083.4 which provided the first oak woodlands conservation standards for California Environmental Quality Act (CEQA) processes. State and local ordinances consider impacts to a single tree and the whole stand through concepts such as forest fragmentation and individual tree ecological services. There are opportunities and constraints to landscape conservation in Placer and its neighboring counties and concepts such as land conservation and good stewardship vs. compensatory mitigation must be considered at all levels of the process. Placer County has established standards for oak woodland mitigation and conservation through policies and the development of Placer Legacy and the Placer County Conservation Plan (PCCP).

Establishing Oak Plantings as Mitigation for Transportation-Related Impacts.

Scott Eckardt

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Mitigation for native oak tree removal associated with transportation projects can be constrained to small, linear planting areas with unique social and ecological site constraints and pressures. During the past four years, we have successfully managed and maintained a 300-tree oak mitigation project in the Sierra Nevada foothills adjacent to a major thoroughfare. Created as a result of a road widening effort, the mitigation project includes a five-year maintenance period with a required minimum tree survival total at the end of that period. While routine maintenance efforts are critical to a native oak tree establishment project, the ability to adjust maintenance and management techniques and schedules over time has been necessary to ensure tree survival. The non-uniformity of site conditions, irrigation system extent, and seedling container size throughout the mitigation area has required an adjustment of management efforts within sub-sections of the mitigation area and over the entire management timeframe. Management techniques, maintenance schedules, irrigation procedures, and tree protection efforts were all adjusted over the course of the project to minimize tree mortality. These adjustments helped to minimize tree stress and promote survival. The lessons learned over the course of this project are applicable to other oak mitigation projects and can inform future oak mitigation planning, site design, and installation efforts. The project is in its final stages and successful completion is expected in early 2012.

Using Comprehensive Data and Innovative Tools to Conserve Woodlands, Wetlands, and Rangelands in California.

Dan Gluesenkamp

The Calflora Database, 1700 Shattuck Ave. #198, Berkeley, CA 94709. *dan@calflora.org*

In 2006 Calflora began working with the Bay Area Early Detection Network (BAEDN) in creating tools to help conservation professionals report and manage harmful invasive plants. Through this collaboration and with additional support from organizations including CNPS, Calflora began building a toolbox that provides land managers and scientists with improved ability to map, manage, and understand our changing flora. This talk will review the current state-of-the-science recommendations for climate change adaptation and biosecurity, and discuss their implications for land managers. We will then present important resources, approaches, and tools that are currently available to support managers in effective action. Resources include recent research that can guide action, citizen science partnerships, regional prioritization efforts, and exciting technological tools for planning and tracking action. Finally, we will discuss upcoming projects, how these tools and information can be applied to solving growing conservation challenges, and what it will mean when we know where all California's plants can be found.

Private Lands Oak Woodland Conservation and Restoration in the Klamath-Siskiyou Bioregion.

Iris Koski,* Alison O'Dowd

Department of Environmental Science and Management, Humboldt State University, Arcata, CA 95521. *iek1@humboldt.edu*

Oak woodland restoration is increasingly prioritized in the Klamath-Siskiyou bioregion of northern California and southern Oregon. More than 80 percent of oak woodlands occur on private lands, and are unique from a restoration perspective in that they require regular disturbance regimes and active management in order to sustain them. Few studies have systematically evaluated the methods by which land managers and owners plan for and implement oak woodland restoration at the landscape scale and individual parcel scales, and the barriers that are presented to each of these groups in the restoration process. The purpose of this study is to determine the extent of management of private oak woodlands in the study area, the characteristics of landowners who do and do not engage in restoration on their properties, and the regional management needs of oak woodlands according to resource managers. This study employed a combination of social science and GIS methodologies to survey 400 landowners and 150 land managers regarding their perceptions of and management activities in oak woodlands. Survey respondents were mailed or emailed questionnaires comprised of ~70 questions regarding land stewardship and oak woodland management. The response rate was 31% for the landowners, and 44% for the land managers. Survey responses indicate that significant predictors for management of oak woodlands may be parcel size, involvement in conservation organizations, and percentage of income derived from landholdings. These findings may inform managers' and landowners' ability to plan for and implement oak woodland conservation and restoration on private lands.

Restoring Oak Woodlands in California.

Douglas D. McCreary

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Oak woodlands are an iconic landscape of California. For the past 30 years, however, there has been concern that significant acreages of woodlands were being lost from development, agricultural conversions and firewood harvesting. In addition, inventories have revealed that three species of white oaks — blue oak (*Quercus douglasii)*, valley oak (*Q. lobata)* and Engelmann oak (*Q. engelmannii*) — are not regenerating adequately, primarily because of failure of seedlings to develop into saplings. As a result, a number of public and private entities sought to develop techniques to artificially regenerate native oaks. At UC's Sierra Foothill Research and Extension Center, the University of California has been conducting artificial regeneration research since the mid-1980s. The primary thrust of this research was to find out what was limiting natural regeneration and develop procedures so that blue and valley oaks could be established in locations where they once grew but have been eliminated. Studies have focused on mitigating the major barriers to successful natural regeneration including weed competition and herbivory from animals. Results to date indicate that artificially regenerating woodland oaks is possible, but requires substantial inputs including weed control within 1.3 m of planted acorns or seedlings for 3 years, and protection from animals until plants are around 2 meters tall. Recent research has examined whether weed control and animal protection can also be used to hasten the growth of natural or "volunteer" seedlings. Results from this recent research are promising, suggesting that this lower-cost alternative may help conserve California's oak woodlands.

Conservation Easements: A Tool for Protecting Oak Woodlands.

Patrick J. Shea

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A conservation easement is a legally binding, voluntary agreement that allows a landowner to prohibit the type of development (commercial or residential) from taking place on the land. Most often the purpose is to protect the resources, natural or man-made, on the property. Importantly, the ownership of the land does not change. Granting an easement

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assures the landowner that the property will be protected forever (in perpetuity) regardless of who owns the land in the future. The easement is signed by the Grantor (easement donor/landowner) and the Grantee (third party entity/land trust) and then recorded with the County recorder. The Grantee accepts the easement with the understanding that it must enforce the terms of the easement in perpetuity. In most instances the Grantor is responsible for creating and donating a management endowment for which the Grantee uses to redeem its responsibilities set forth in the conservation easement language. If an easement is granted as a charitable gift certain state, federal and estate tax advantages may accrue.

session 5 Thursday 17 May 8:30a — 12:00p *Ballroom B*

Rescue and Restoration of VALLEY GRASSLANDS

Chair: **Andrew Rayburn, PhD** *Dept. of Plant Sciences, University of California, Davis*

Seeding Native Tarplant to Reduce Yellow Starthistle in Grassland Restoration.

Paul Aigner*[1], Kris Hulvey[2], Cathy Koehler[1]

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Invasion by non-native plants, particularly yellow starthistle (YST), is often the major impediment to restoring California valley and foothill grasslands. A promising technique for providing invasion resistance to restored grasslands is to select native species for planting that compete strongly for the same resources as likely invaders. Native tarplants are among the grassland species most similar to YST in the timing of growth and seed set. We tested whether including the native tarplant *Hemizonia congesta* in a seed mix with native perennial grasses increased the resistance of the resulting community to YST invasion compared to seeding grasses alone. As part of a project to reclaim an abandoned road, we established four types of plots including a control (no seeding) and seeding with a native grass mix, a mixture of native grass and tarplant, and native grass followed by two seasons of broad-leaf herbicide application. Over three years tarplant abundance remained high, and YST abundance was 18 to 63 percent lower in plots with tarplant+native grass compared to plots with native grass alone. Although tarplant initially depressed establishment of native grass seedlings, after three years native grass abundance was identical in grass+tarplant and grass-only plots. Nevertheless, native grass establishment was highest and YST abundance lowest in plots treated with herbicide, suggesting a particularly effective strategy to exclude YST may be to establish native grasses first and add tarplant seed after two seasons of YST chemical control.

Defining Grassland Vegetation Assemblages in the Great Valley.

Jennifer Buck-Diaz*, Julie Evens

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The remaining intact, natural grasslands of the Great Valley are poorly described in the literature and highly threatened by

conversion to agriculture, residential development, and non-native plants. The primary objective of the CNPS Grassland Initiative is to establish baseline knowledge of natural grasslands and associated vegetation assemblages though inventory, classification, analysis, and mapping. Recently, more than 1,000 field surveys were compiled and classified to the alliance and association levels. This classification defines at least 5 new herbaceous alliances and 40 new herbaceous associations not previously published in *A Manual of California Vegetation, second edition.* Other seasonal analyses provide new insight into the constancy of annual plant species in grassland communities, reinforcing the importance of optimally-timed spring sampling to fully characterize the richness of grassland habitats. A rigorous herbaceous classification gives quantifiable methods to recognize and delineate vegetation and allows for the identification of rare, unique, or representative stands, thus enabling the prioritization of sites for conservation. The uses of community-level data as the reference targets for restoration projects enable the recovery of a broader array of species, habitats, and system functions. This project links local environmental factors such as soils, climate, and grazing to specific management and restoration goals within California's annual grassland communities.

Effects of Soil Inoculation and Topsoil Addition on Grasses at a Mine Restoration Site.

Taraneh Emam*, Valerie Eviner, Kevin Rice

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Former mine sites can be particularly challenging to restore, as they are often contaminated with heavy metals and devoid of sufficient topsoil, nutrients, and soil biota. I applied two treatments used in mine restoration, topsoil addition and soil inoculation, to a grassland site containing tailings from a former mercury mine. Varying depths of stockpiled topsoil were placed atop mine tailings to simulate possible reclamation practices. Subplots containing the topsoil depth gradient were then inoculated with either arbuscular mycorrhizal (AM) inoculum from a commercial source, rhizosphere soil from nearby native grassland, or were left uninoculated as a control. Results to date show that commercial inoculum had little effect on grass biomass and density, and non-native grasses were more responsive to both inoculum types than native grasses. Colonization of grasses by AM fungi was highest at both shallow and deep extremes of the topsoil depth gradient, but did not significantly differ by inoculum type. These findings indicate that caution must be used when selecting a mycorrhizal inoculum source for restoration purposes. In addition, topsoil depth may affect interactions between native plants, non-native plants, and the soil community in complex ways.

Vernal Pool Soil Properties and Their Role in Restoration Success.

Akasha M. Faist*[1], Sharon K. Collinge[2]

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Due to extensive vernal pool habitat loss, constructing new pools and restoring existing pools are critical aspects of vernal pool recovery. One little-studied aspect of vernal pool ecology is the role of soil properties in limiting restoration success. We used a long-term vernal pool restoration experiment (Solano Co.) to compare how soil properties differed among three functional pool types (constructed for restoration, naturally occurring pools dominated by native species and naturally occurring pools dominated by invasive species). Using field collected soil samples from the three pool types we measured soil microbial biomass, pH, moisture, and carbon:nitrogen content. Tukey's HSD test results showed significantly lower microbial biomass in constructed pools than in invasive dominated reference pools and a marginally significant difference between constructed pools and native species dominated pools. Little variation occurred between the two naturally occurring pool types with only a slight microbial biomass increase in invasive dominated pools. Constructed pools displayed more homogenous soil moisture and pH than the highly variable naturally occurring pools. Although carbon:nitrogen ratios remained constant among pools there were significantly lower amounts of both carbon and nitrogen in constructed than naturally occurring pools. With strong trends toward lower microbial biomass, nutrient content and soil moisture the data suggest that constructed pool success may be limited by microbial activity and nutrient availability. Finding no significant differences in these parameters between the naturally occurring invaded and native pools suggests that plant invasions are most likely driven by other factors such as pool environment or seed bank characteristics.

Active and Passive Techniques in Valley Grassland Restoration.

Bobby Kamansky

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Past and present land disturbances degraded California grasslands and exotic flora and fauna species dominate many grasslands today. Cost-effective restoration techniques often include a combination of process-based and structural-based active and passive restoration. We restored native grassland, seasonal wetland and riparian woodland flora and fauna on three areas with distinct past management and disturbances, utilizing a combination of process-based, structural-based and active and passive restoration techniques. Cost effective techniques included restoring stream channels for flooding process-

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based, passive restoration and prescribed fire for active, process-based techniques followed by planting key species for structural-based, active restoration. Exotic species were controlled and native species favored when process-based, active restoration techniques were utilized on the least disturbed areas while success was best achieved on heavily-disturbed ground with a combination of process and structural-based, active restoration. Thus, the greater the previous land and native biodiversity disturbance, the greater the restoration cost and the great the number of techniques and active restoration actions required. We recommend a tiered restoration approach utilizing greater resources and both active and passive management to the most disturbed areas to cost-effectively restore degraded grasslands natural and process-based passive and active management for less-disturbed areas.

Collaborative Regional Advance Mitigation Planning (RAMP) by California's Largest Infrastructure Agencies.

Helen Birss[1], Debra Bishop[2], Vance Howard[3], Patrick Huber[4], Brenda Johnson[1], Natasha Nelson*[5], Liz O'Donoghue[6], Susan Sanders[3], Andrea Williams[7]

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The California Department of Water Resources (DWR) and the California Department of Transportation (Caltrans), in cooperation with state and federal resource agencies, are developing an innovative statewide approach to mitigating biological resource impacts associated with flood management and transportation projects using tools created under the Regional Advance Mitigation Planning (RAMP) initiative. A pilot project in a 1,500-square mile area in the Central Valley is demonstrating the applicability of using RAMP to mitigate infrastructure project impacts on several sensitive habitat types. The concepts behind RAMP are being tested in this region in part because unavoidable impacts to riparian and wetland habitat and associated species are a recurring issue. By supporting restoration and mitigation efforts that integrate with regional conservation priorities, DWR and Caltrans hope to enhance ecosystem function and the biological resource value of mitigation by creating essential habitat connections and expanding existing conservation areas. Securing mitigation before construction begins allows habitats to become established prior to impacts, minimizes permitting and regulatory delays, allows infrastructure agencies to more consistently and efficiently manage their project delivery, enables conservation planning principles to be included in design of mitigation sites, and fosters engagement and collaboration of regional agency staff and local conservation interests. When fully functioning, the pilot project in the Central Sacramento Valley will serve as a template for similar efforts throughout the state. The development of the RAMP initiative offers a valuable case study of a multi-agency process that supports advance investments in mitigation while promoting regional restoration efforts and conservation priorities.

Spatial Methods for Low-cost Restoration of Rangeland Ecosystem Services.

Andrew P. Rayburn[1*], Toby O'Geen[2], Mel George[1], Emilio A. Laca[1]

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Rangelands constitute 50% of California and produce 70% of the forage for a livestock industry with gross value > $3 billion. Rangelands also convey much of the water used by humans and provide habitats for thousands of species. These valuable ecosystems are heavily degraded by invasive exotic species. Rangeland restoration is hindered by high costs and low private returns. We aim to promote restoration by using spatial selection and seeding methods to reduce cost and improve success. First, in an observational large-scale study, we are surveying restoration projects to determine the relationship between restoration and selected ecosystem services (forage production, plant and arthropod biodiversity, weed abundance, nitrogen cycling, carbon sequestration and water filtration and storage). Restoration success will be modeled as a function of pre-restoration state, history of seeding, management, biophysical site and landscape characteristics, weather and cost. Second, at an intermediate scale we apply strip-seeding treatments with various levels of area coverage. An economic analysis will compare cost per area and per unit ecosystem service. Third, we are applying strip-seeding treatments in runoff plots and measuring hydrologic function and water quality as further inputs for the comparison of costs/service. An advisory committee and working group composed of ranchers, agency personnel, extension agents, and faculty will guide the project and disseminate results.

Can Planting Mono-specific Patches Increase Diversity in California Prairie Restoration?

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During community assembly, intraspecific aggregation may delay interactions between more and less competitive species, and thus create opportunities for priority effects to facilitate long-term coexistence. We investigated (1) impacts of aggregation and priority effects on the assembly of eight-species communities over three years, (2) the scale-dependence of these impacts, and (3) implications for California prairie restoration. We planted eight native species in each of 19 five-meter wide octagonal plots. Species were either interspersed throughout the plot or aggregated into eight wedge-shaped monospecific sectors. Over three years, species diversity declined more quickly in interspersed plots than intraspecifically aggregated plots. Within aggregated plots, aggressive species expanded beyond the sector in which they were originally seeded. Areas near plot centers were representative of smaller aggregation patches, since species were planted closer to heterospecific neighbors. Two subordinate species had lower cover near plot centers than near plot edges. Moreover, two subordinate species had higher cover when seeded in sectors further away from aggressive species. These results suggest that initial intraspecific aggregation can facilitate species coexistence for at least three years, and that larger aggregation patches may be more effective than smaller ones in the face of dispersing dominants. We suggest that the creation of temporal priority effects via initial intraspecific aggregation represents an underappreciated pathway by which aggregation can increase species coexistence. Restorationists may be able to maintain more diverse communities by planting individual species in a mosaic of monospecific patches.

session 6 Thursday 17 May 8:30a — 12:00p *Ballroom C*

COMMUNITY-BASED RESTORATION

Building and Strengthening Natural Systems and Human Communities

Chair: **Matt Yurko** *Restoration Education Program Manager, California Coastal Commission*

Designing for Community-Based Ecological Restoration and Education.

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Coastal estuaries are productive bio-diverse environs that actively filter storm water runoff. Population growth and associated development has vastly reduced these landscapes with only three percent of Southern California's coastal estuaries remaining intact today. The California Coastal Commission's Upper Newport Bay Community-Based Restoration and Education Program (CBREP) is working to enlist community support for habitat restoration by engaging the public in hands-on restoration and teaching them why this work is important. As a graduate student in Landscape Architecture, I worked with the CBREP to create a multi-phase design and installation plan to facilitate communication and understanding between local governing entities, ecological consultants and the public. The visual graphics and technical AutoCAD drawings produced during the multi-phase project have been successfully implemented for project budgeting, marketing, education, and installation purposes. Due to the success of this project, design has become an integral part of the CBREP education program and will serve as a model for developing coastal restoration education programs throughout California.

CalWeedMapper: Setting Regional Management Priorities for Invasive Plants.

Doug Johnson, Elizabeth Brusati*, Dana Morawitz, Falk Schuetzenmeister, Cynthia Powell, Suzanne Harmon, Tony Morosco

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Land managers need to devise strategic management plans in order to address invasive plants effectively with limited funding. The California Invasive Plant Council (Cal-IPC) interviewed experts throughout California on the abundance, spread and current management of 204 invasive plant species. These expert knowledge data are linked to existing online databases and displayed in a new online mapping tool, CalWeedMapper. This website is designed to increase the effectiveness of invasive plant

continued

management by providing landscape-scale maps that serve as the basis for setting regional priorities, tracking progress and justifying funding. Land managers can see management opportunities for their region divided into surveillance, eradication or containment targets. These reports are derived from maps of current distribution combined with projected suitable range for 2010 and 2050 climate conditions. In addition to providing recommendations for regional management opportunities, CalWeedMapper allows land managers to generate maps of individual species distribution and to explore and update USGS quadrangle data, through an update interface or by submitting occurrence information. We are working with stakeholder groups and agencies to apply CalWeedMapper to their invasive plant management. Check us out at *calweedmapper.calflora.org*!

Implementation of Youth Leadership Models for Teaching Wetland Restoration.

Seth Chanin*, Dylan Chapple

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How can youth be empowered to take responsibility for their local estuary? Recognizing that our typical half-day education program only provides an introduction to restoration science, Save The Bay has pioneered three new multiple-session program models, two of which will be discussed here. The *Bay Environmental Stewardship Training (B.E.S.T.)* program guides high school mentors through the design and delivery of wetland restoration programs to an audience of younger learners and seeks to foster a deep-seated stewardship ethic through leadership experience. The *Digging Into Restoration Technology (D.I.R.T.)* program engages students in hands-on soil data collection and encourages critical analysis of the restoration process. These multiple session programs allow more exposure to education content, develop a local place-based conservation ethic, and leverage the experience of returning students with regards to restoration techniques. Currently concluding their second year of implementation, B.E.S.T. and D.I.R.T. have reached over six hundred students in eight Bay Area schools. The programs have developed over time to address the complex challenges inherent in undertaking multiple-session curricula. This presentation examines the major hurdles and successes encountered during the early stages of the B.E.S.T. and D.I.R.T. programs and how these lessons are informing the future of each program. Session participants will be provided a framework of best practices and recommendations to consider when creating similar programmatic offerings at their organization or school.

Integrating Compatible Wildlife Habitat into California's Agricultural Landscape: Lessons Learned from a Decade of Implementing On-Farm Habitat.

Miles DaPrato

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There are over 10 million acres of irrigated farmland in the Great Central Valley, making California the fifth largest agricultural economy in the world. Along with this unrivaled productivity have come incredible impacts to the diverse native plant communities and the wildlife populations the landscape once supported. Over the last 13 years, Audubon California's Landowner Stewardship Program has partnered with over 100 farmers and ranchers to integrate compatible and functional wildlife habitat projects back into the working farmscape. I will discuss key features to the design, implementation and ongoing management of on-farm habitat projects including native plant hedgerows, riparian corridors, native perennial grasslands and forb establishment.

Community-Based Restoration of Giant Kelp Forests, Santa Monica Bay.

Tom Ford, MA

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The loss of top-down control in the giant kelp forest ecosystems off southern California has allowed for the formation and persistence of sea urchin barrens. These "urchin barrens" are areas of rocky reef that are dominated by high densities of sea urchins (*Strongylocentrotus purpuratus and S. franciscanus*). The persistence of these urchin barrens leads to the widespread loss of giant kelp (*Macrocystis pyrifera*) and other macroalgae and associated 3 dimensional structure. For the past twelve years volunteer SCUBA divers have been recruited and trained to assist professional biologists to reduce urchin densities in urchin barrens off the Coast of Los Angeles County. This results in the rapid resettlement and growth of giant kelp and a natural community comprising up to 716 species. (Graham 2004) Twelve acres have been restored to date off of Malibu and the Palos Verdes Peninsula. SCUBA based surveys in 2010 identified more than 100 acres of rocky reef in a barren state off of Palos Verdes. The upcoming phase of this project is a 3.5 year effort to restore 100 acres of spatially and temporally stable kelp forests. A commensurate expansion of community participation has been developed to meet this expanded scope of operations; including commercial and recreational fishermen, scientific divers, university researchers, public aquaria and government scientists.

U.S. Fish & Wildlife Service Schoolyard Habitat Project Guide and Program.

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The Schoolyard Habitat Program partners with schools to create native wildlife habitat on school grounds. The new Schoolyard Habitat Project Guide takes readers through the process of transforming school grounds into a place that engages the entire school community while creating natural habitats. The authors will walk through the steps of the Project Guide to familiarize you with the process of creating restoration projects at schools and building long lasting community partnerships and wildlife habitat.

Conservation through Community-based Restoration in City Heights' Swan Canyon.

Jeannine Ross*[1], Lindsay Goodwin[2], Carla Pisbe[2]

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In collaboration, RECON Environmental, Ocean Discovery Institute (ODI), and other local partners have begun to increase community awareness of the value of natural resources at Swan Canyon in City Heights, a San Diego neighborhood. The project involves removal of over 2 acres of giant reed (*Arundo donax*) from the canyon's drainages. Swan Canyon is surrounded by a residential community, an elementary, and a middle school. Encroachment of urban life on remnant canyons like Swan Canyon, combined with lack of awareness of the importance of natural resources, has contributed to illegal dumping and homeless encampments. Located near the historical base of the Chollas Creek watershed, Swan Canyon receives an influx of trash with each rainstorm. Giant reed, historically planted for erosion control, has become established in dense thickets throughout the canyon. Because of its enormous mass, density, and decrease of canyon visibility, giant reed provides haven for illegal activities and chokes out native plant species. ODI is using removal of giant reed and canyon restoration with native species as an opportunity to educate local students and residents by involving them in the restorative process. This talk provides a glimpse into how this collaborative project has become a focal point for community improvement, built around native habitat restoration.

Student and Landowner Education and Watershed Stewardship (SLEWS)

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Habitat restoration projects have the potential to offer young people unique opportunities to learn about nature, to witness environmental challenges, and to participate in addressing those challenges in a meaningful and satisfying way. When designed as an educational experience in partnership with restoration experts, private landowners, teachers and volunteer mentors, habitat restoration projects provide more than on the ground results. If planned and executed carefully, these projects can also enhance classroom learning and teach students more about where they live. This combination of local knowledge and direct, meaningful experiences in nature can provide the foundation for a lifelong appreciation and caring for both the local environment and the natural world in general. But in order to realize the potential of restoration projects, project organizers must construct field days not merely as work events, but as integrated experiences that include formal or informal teaching and opportunities for reflection. This integrated, experiential approach to restoration projects has been the cornerstone of the Student and Landowner Education and Watershed Stewardship (SLEWS) program since we began it in 2001. Our program evaluation substantiates that our students can improve environmental quality and restore wildlife habitat while learning about biological concepts and local ecosystems. With eleven years of experience developing and running this successful model, we are now serving 500 students a year in eight counties in California.