California Society for Ecological Restoration

SERCAL's Thirteenth Annual Conference

Shovels to Science:

A Full Range of Restoration Practice in California

Conference Program

University Center (UCEN) at UC Santa Barbara
26-28 October 2006

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Our Session Chairs:

Session 1. David W. Martin, Ph.D., Watershed Resource Specialist, *Los Angeles Dept. of Water & Power, Bishop*

Session 2. Harry Oakes, Restoration Planner, *Jones & Stokes, Sacramento*

Session 3. Lisa Stratton, Ph.D., Ecosystem Manager, *Cheadle Center for Biodiversity & Ecological Restoration (CCBER), University of California, Santa Barbara*

Session 4. Michael Hogan, Principal Owner, *Integrated Environmental Restoration Services, Inc., Tahoe City*

Session 5. Mark Tucker, Principal Owner, *Tucker & Associates, San Diego*

Session 6. Margot Griswold, Principal, Senior Restoration Ecologist, *EARTHWORKS Restoration, Inc., Los Angeles*

Session 7. Carol Presley, PE, CPESC, *Santa Clara Valley Water District, Coyote, Uvas, Llagos Watersheds Division, San Jose*

Our Field Session Leaders:

Session A: Campus Restoration Sites
Lisa Stratton, Ph.D., Ecosystem Manager, *Cheadle Center for Biodiversity & Ecological Restoration (CCBER), UCSB*; **Darwin Richardson**, Land Steward Manager, *CCBER, UCSB;* **George Thomson**, Restoration Coordinator, *CCBER, UCSB;* **Bree Belyea**, Restoration Assistant, *CCBER, UCSB*

Session B & E: Coal Oil Point Reserve
Dr. Cristina Sandoval, Resident Director, *Coal Oil Point Reserve*

Session C: Isla Vista Vernal Pools
David Hubbard, President, *Coastal Restoration Consultants, Santa Barbara*

Session D: Goleta Slough
Matthew James, Vice President, *Coastal Restoration Consultants, Santa Barbara*

Session F: Carpinteria Salt Marsh Reserve
David Hubbard, President, *Coastal Restoration Consultants, Santa Barbara;* **Andrew J. Brooks, PhD,** Director, *Carpinteria Salt Marsh Reserve*

Session G: Vineyards
Thomas R. Lockhart, Soil Scientist, *Cachuma Resource Conservation District, Santa Maria*

Session H: Sedgwick Reserve
Michael Williams, PhD, Sedgwick Reserve Resident Director, 1999 – July, 2006

Our Sunday Field Trip Leaders:

I. Guadalupe-Nipomo Dunes / Chevron-Unocal Oilfield Restoration Site / Oso Flaco Lake Natural Area
Kathie L. Matsuyama, Watershed and Natural Resources Manager, *Guadalupe-Nipomo Dunes Center;* **Gonzalo F. Garcia,** Policy, Government, and Public Affairs Manager, *Central California Coast Area, Chevron Corporation;* **Mark Skinner,** Restoration Project Manager, *Land Conservancy of San Luis Obispo County*

II. Santa Cruz Island
Ken Owen, Executive Director, *Channel Islands Restoration;* **Sarah Chaney**, Restoration Ecologist, *Channel Islands National Park;* **Dr. Coleen Cory**, Santa Cruz Island Project Ecologist, *The Nature Conservancy*; **Rachel Wolstenholme**, Santa Cruz Island Project Ecologist, *The Nature Conservancy*

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1 Mono Basin Restoration ~ Ten Years Later

CHAIR: *David W. Martin, Los Angeles Dept. of Water & Power* *Thursday afternoon & Friday morning*

Seed Release Periodicity and Snowmelt Hydrograph as Restoration Tools. *John H. Bair[1]* and David W. Martin[2]. [1]McBain and Trush Inc., P.O. Box 663, Arcata, CA 95518; [2]Los Angeles Dept. of Water & Power, 300 Mandich Street, Bishop, CA 93514*

A restoration tool being evaluated along Rush and Lee Vining creeks is timing the release of peak snowmelt flows and controlling the recession rate to coincide with different seed release periods. Timing streamflows to coincide with a broad range of seed dispersal periods facilitates willow and cottonwood germination and seedling growth floodplains and gravel bars. Long-term self-sustainability of riparian vegetation may be achieved by managing snowmelt hydrographs to take advantage of woody riparian life history strategies. Currently streamflows are released to promote geomorphic processes; by assuring the timing of these releases coincides with willow and cottonwood seed dispersal, riparian recruitment can be enhanced. We studied the overlap between the snowmelt hydrograph and seed dispersal periods of three hardwoods, and how this influenced seedling germination location and success through the first season. In 2005, yellow willow (*Salix lutea* Nutt.), narrowleaf willow (*Salix exigua* Nutt.) and black cottonwood (*Populus balsamifera* L. ssp. *trichocarpa* Torrey and A. Gray) seed dispersal periods were quantified. Each species released seeds over slightly different time periods and therefore at distinct streamflows within the snowmelt hydrograph. Yellow willow dispersed seeds June 1 through August 10, over the complete snowmelt hydrograph; black cottonwood dispersed seeds June 15 through August 4, from the snowmelt peak through recession into summer baseflows; narrowleaf willow dispersed seeds June 20 through August 20. The natural variation in snowmelt timing between wet and dry years historically ensured that different species could potentially be recruited every year in different channel locations.

Mono Basin History. *Jim Canaday, Senior Environmental Scientist. FERC Relicensing Team, State Water Resources Control Board, Division of Water Rights, 1001 I Street, 14th Floor, Sacramento, CA 95814*

A presentation about the historic and legal context in the Mono Basin — the Audubon decision and the court and State Water Board actions that led to the restoration efforts.

The Mono Lake Committee and Restoration in the Mono Basin. *Lisa Cutting. Mono Lake Committee, PO Box 29, Highway 395 & Third Street, Lee Vining, CA 93517*

It has been twelve years since the California State Water Resources Control Board's precedent setting Decision 1631 (D1631) to limit Mono Lake water diversions by the Los Angeles Dept. of Water and Power (DWP). Included in the State Water Board's renowned decision was a mandate for DWP to develop and implement restoration plans in order to repair over 50 years of damage caused by excessive water diversions. The restoration plans were formally adopted in 1998 when the Water Board issued Orders 98-05 and 98-07. These two orders identified specific physical actions and monitoring required of DWP to fulfill its restoration obligation in the Mono Basin. While some interim restoration activities had already taken place prior to D1631 and Orders 98-05 and 98-07, the current era of the restoration work began in 1998. The Mono Lake Committee (MLC) is a member-supported environmental advocacy organization formed in 1978 to protect the Mono Basin ecosystem. MLC is active in planning, overseeing, and implementing Mono Basin restoration projects. After nearly two decades of litigation, MLC and DWP have developed a mutual respect for each other's mission and work in good faith to achieve the ecosystem restoration required by the State Board.

Flood Duration Effects on Sediment Transport and Floodplain Deposition Rates. *Geoff Hales[1]*, Scott McBain[1], Cort Pryor[2], and Mark Hanna[3]. [1]McBain and Trush Inc., P.O. Box 663, Arcata, CA 95518; [2]Graham Matthews & Associates, P.O.Box 1516, Weaverville, CA 96093; [3] Los Angeles Dept. of Water & Power, 111 North Hope Street, Los Angeles, CA 90012*

Stream Restoration Flows (SRFs) released from Grant Lake Reservoir into Rush Creek should accomplish several geomorphic processes necessary for the recovery and maintenance of Rush Creek. Two of these geomorphic processes are to: (1) mobilize and transport coarse bed material; and (2) build floodplains by depositing sand and silt onto emerging floodplains. The role of peak flow release magnitude in accomplishing these functions is much better understood than is the role of peak flow release duration. Is a flow release of 450 cubic feet per second (cfs) for 10 days twice as "effective" as a 450 cfs release for five days? To help evaluate the SRF's for Mono Basin tributaries, we measured mainstem sediment transport rates, as well as fine sediment transport and deposition rates on floodplains during a near constant eight-day flow release of 400 cfs. Mainstem bedload transport measurements showed fine and coarse sediment transport rates dropping nearly 50% after two to three days. Likewise, fine sediment transport rates on floodplains appeared to decrease with duration, but typically after three to four days. A depositional equilibrium was reached on the floodplains in one to four days, depending on location. Results suggest that as duration increases past one to four days, peak flow releases transport and deposit less sediment. Sediment transport and floodplain deposition processes may therefore be accomplished with two to four day peak releases, though other functions of the SRFs may require a longer duration.

Balancing Water Diversions and Ecological Sustainability. *Mark Hanna. Los Angeles Dept. of Water & Power, 111 North Hope Street, Los Angeles, CA 90012*

Water projects have varying effects on ecosystems. Reservoir operations alter the hydrology to which the ecosystem evolved by flooding the upstream channel and altering the downstream hydrograph. Consider hydropower facilities and their effect on the timing and magnitude of streamflows through regulation. The effects of streamflow regulation can be compounded by downstream water diversions. However, by diverting water in an environmentally sustainable manner, the detrimental effects can be minimized and perhaps actually reversed through streamflow "re-regulation". This re-regulation of streamflows actually reversing some detrimental effects is especially true in the Mono Basin, where the Los Angeles Dept. of Water and Power (LADWP) operates several facilities. On Rush Creek, for instance, LADWP releases streamflows that much more closely mimic the "natural" hydrograph than that which is delivered from upstream sources. Flow releases are better timed to coincide with biological lifecycles present along the Rush Creek corridor; flood peaks are often higher; and ramping rates are much less "flashy". LADWP's diversion facility on Lee Vining Creek provides another possibility of beneficial re-regulation. As an example, this facility has the ability to release lower winter flows than are delivered from upstream sources when adult trout habitat may be lacking. It is true that LADWP's operations in the Mono Basin did not happen overnight. As well, they are not yet finalized. Close cooperation between LADWP's engineers and biologists, along with collaboration between LADWP, stakeholders, and independent scientists alike, the streams in the Mono Basin are well on their way to balancing the public trust.


photo courtesy Julie St. John

Restoration of the Riparian Breeding Bird Community at Mono Lake, California. *Sacha K. Heath*, Leah A. Culp and Chris McCreedy. PRBO Conservation Science, 3820 Cypress Dr. #11, Petaluma, CA 94954*

The riparian breeding bird community dependent on vegetation supported by Mono Lake's tributary streams is showing signs of recovery, sixteen years after the cessation of complete stream diversions and fourteen years after initiation of a livestock grazing moratorium. We have documented this recovery during eight years of bird monitoring on Lee Vining and Rush Creek (1998–2005). We have recorded the densest population of Species of Special Concern Yellow Warbler (*Dendroica petechia)* documented in the state, as well as the return of the State Endangered Willow Flycatcher (*Empidonax traillii*). Densities of ground and shrub nesters were three times as high as those of cavity and canopy nesters, indicating the recovery of early successional stage vegetation, but a lack of available cavities or canopy trees. Mayfield nest survivorship ranged from very low (3%, Red-winged Blackbird (*Agelaius phoeniceus*)) to moderate (28%, Yellow Warbler) to as high as 74% for cavity nesting species. Nest survivorship varied by species, stream and year. Breeding bird density and diversity and estimates of nest survivorship provide good measures of the success (or failure) of riparian restoration activities. Associating bird population numbers and nest survivorship with riparian vegetation attributes provide restoration practitioners with quantifiable goals for habitat use and vegetation community characteristics.

Spatial Distribution and Use of Mono Lake by Waterfowl During Fall Migration. *Deborah House. Los Angeles Dept. of Water & Power, 300 Mandich Street, Bishop CA 93514*

Waterfowl populations are being monitored at Mono Lake and two nearby reservoirs in order to evaluate the response of waterfowl to changes in the elevation of Mono Lake. Since 2002, total fall waterfowl detections at Mono Lake ranged from 22,000 to 50,000, or between 13% and 35% of all detections at Mono Lake and the two reservoirs. The peak number of waterfowl detected at Mono Lake on any one survey has increased significantly since 1996. Northern Shovelers and Ruddy Ducks comprise close to 90% of all detections. Comparison counts indicate that waterfowl species abundant at the reservoirs during fall migration either bypass Mono Lake in migration, or have a high rate of turnover. Data suggest there has been a shift in the spatial distribution of waterfowl at Mono Lake as compared to pre-diversion times. Currently, fall use at Mono Lake during fall by Northern Shovelers and other dabbling duck species is confined to small bays at creek mouths, or ephemeral habitat features of the lake such as brackish lagoons or

continued

mudflats that may be inundated as the elevation of Mono Lake increases. The shift in spatial distribution can be explained at least partly on the basis of past and current water management practices. Some recommendations in the Restoration Plan, namely prescribed burning of lake-fringing wetlands or jackpot burning in riparian areas proved unfeasible, and would likely have provided limited benefits to waterfowl, given the distribution and patterns of habitat use by waterfowl at Mono Lake.

Recovery Monitoring of Trout Populations in Mono Basin Tributaries. *Ken Knudson[1*] and Ross Taylor [2], Chris Hunter[3] and Brad Shepard[3]. [1]KNK Aquatic Ecology; [2]Ross Taylor and Associates; [3]Chris Hunter and Associates, 1254 Quail Run Court, McKinleyville, CA 95519*

Pursuant to State Water Resources Control Board (SWRCB) Decision #1631, nine years of fish population monitoring has occurred in Rush, Lee Vining, Parker, and Walker creeks in the Mono Basin. Pilot studies conducted in 1997 and 1998 determined appropriate methods for generating valid population estimates. Mark-recapture electro-fishing techniques were utilized to estimate trout populations in four sections of Rush Creek and two main stem sections of Lee Vining Creek. Fish population estimates for Lee Vining Creek side-channels and Parker and Walker creeks were made using electrofishing depletion methods. Scale samples and otoliths were collected to estimate fish ages. After six seasons of average to below-average snow pack and relatively mild spring run-off, Rush and Lee Vining creeks have experienced three straight years of high peak run-offs (2004–2006). Trout populations have responded with overall drops in young of the year production in both Rush and Lee Vining creeks; however numbers of age 2+ and older trout in Rush Creek showed increases in 2004 and 2005. In contrast, numbers of age 2+ and older trout in Lee Vining have decreased. Relative conditions of brown trout captured during 2005 were similar to those found in 2002–04 in Upper and Lower Rush Creek sections. Condition factors for brown trout in three Lee Vining Creek sections were slightly higher than the previous three to four years. Condition factor for brown In Parker Creek dropped slightly in 2005, while condition factor improved in 2005 to the highest value computed for Walker Creek.

Rush Creek 3D Floodplain Restoration: A Collaborative Effort. *David W. Martin[1*], John Bair[2], and Darren Mierau[2]. [1]Los Angeles Dept. of Water & Power, 300 Mandich Street, Bishop, CA 93514; [2]McBain &Trush, Inc., PO Box 663, Arcata, CA 95518*

The 10 acre 3D Floodplain Restoration Project, the largest restoration project implemented on Rush Creek removed approximately 35,000 cu yds of sediment deposited on the floodplain in 1967. The project, completed in 2003, was a collaborative effort involving a gravel plant operator, and scientists and construction personnel from LADWP and McBain and Trush. The objectives of the project were to re-grade the right bank floodplain to allows inundation at approximately 250 cfs, raise the groundwater elevation across the floodplain, and reduce channel confinement along the main channel to encourage geomorphic processes. Following excavation, large woody debris, large boulders and overflow channels were added to create topographic diversity and encourage natural vegetation establishment. Monitoring is being conducted to observe restoration treatment effects on the groundwater elevation, channel dynamics, and to evaluate natural recruitment and establishment. Woody riparian initiation in 2003 consisted of black cottonwood, yellow willow, and shiny willow, with more than 100 seedlings/sq ft observed throughout the site. Black cottonwood seedlings were present in 100% of the plots sampled on bar surfaces in 2004. In spite of desiccation mortality, many seedlings survived and initiated on bars and along channel margins. In 2005, three hundred fifty-eight riparian hardwood plants were sampled in 16 quadrats. The areas surrounding gravel bars and channel edges showed the best regeneration of riparian hardwoods. No riparian hardwoods were documented on high spots in any monitoring event. Increased riparian vegetation on the floodplain will ensure that vegetation recovery goals are met for this reach of Rush Creek.

Understanding Rush Creek Fish Movement Patterns and Habitat Use. *Ross Taylor[1*] and Ken Knudson[2]. [1]Ross Taylor & Associates; [2]KNK Aquatic Ecology, 1254 Quail Run Court, McKinleyville, CA 95519*

A radio telemetry-movement study of brown trout in Rush Creek was initiated in September of 2005. The objectives of the study are to; 1) develop an understanding of the movement patterns of brown trout, especially larger (> 350 mm) fish, in the Rush Creek system below Grant Lake, and 2) document habitats used by adult brown trout in Rush Creek. Radio tags were implanted in a total of 54 brown trout. Fourteen tags were implanted in larger brown trout captured in the Mono Gate One Return Ditch (MGORD), 15 tags in the Upper Rush section, 11 tags in the County Road Rush section, and 13 tags in the Lower Rush section. The final tag deployed was in a large male brown trout captured between the County Road and Lower Rush sections. A fixed receiving station was installed at the lower end of the MGORD and became fully operational in September 2005. This receiving station continuously monitors the four frequencies of the tags and is able to detect and record when specific fish move past the antenna array, as well as the direction of travel. Monthly relocations have been made since October of 2005 to document seasonal habitat usage as well as movement of larger brown trout from the MGORD to lower sections of Rush Creek. We detected movement out of the MGORD by more than 50% of the brown trout tagged in this reach. Forty


photo courtesy Julie St. John

additional tags will be implanted in MGORD trout in September of 2006.

Mono Basin Stream Restoration Insights 1982 to Present. *Brian Tillemans* and Dave Martin. Los Angeles Dept. of Water & Power, 300 Mandich Street, Bishop CA 93514*

Although the State Water Resources Control Board issued their decision regarding Mono Lake and restoration efforts to be undertaken for its tributaries in 1996, actual recovery of the stream systems began in the early 1980s when flows were reintroduced back into Lee Vining and Rush creeks. Interim restoration efforts in the late 1980s and early 1990s followed a heavy intervention approach to facilitate recovery of the streams through channel manipulations and artificial plantings. This approach resulted in limited success and produced habitats that were non-sustainable when subjected to high flow events. Subsequent refinement of flow regimes coupled with removal of livestock (which began in the late 1980s / early 1990s) expedited recovery trends in the Mono Basin tributaries. After reviewing a chronology of photo points through time, and having a first hand knowledge of restoration treatments and timing, it becomes apparent the most important factors contributing to the successful recovery of Mono Lakes' tributaries is improved flow and land management. These two significant management tools have greatly facilitated riparian recovery. The interaction of that vegetation with stream hydraulics initiated processes that transformed shallow unconfined streams to conditions of today; exhibiting channel and riparian features indicative of healthy streams. This succession from heavily degraded streams in the early 1980's to vastly improved streams of today can only be appreciated through a look back in time. The lessons learned can be applied to other stream restoration efforts as many different treatments have been tested and monitored through time.

Managing the Snowmelt Signature in Rush Creek's Floodplain. *William J. Trush. McBain and Trush Inc., P.O. Box 663, Arcata, CA 95518*

The valley floors of Rush and Lee Vining creeks are composed of alluvial and lacustrine sediment layered above glacial deposits and topped with a delicate soil veneer. A basic function of Rush Creek's Stream Restoration Flow (SRF) releases is shallow groundwater and soil moisture recharge across the valley floor to sustain existing woody riparian vegetation and encourage its expansion. The annual snowmelt hydrograph once provided this function, leaving its 'signature' of elevated floodplain soil moisture content after snowmelt streamflows gave way to summer baseflows. How fast snowmelt water finds its way out onto (and into) the adjacent floodplain has significant management implications. Two basic pathways have been quantified. Before snowmelt begins, Rush Creek's shallow groundwater table slopes sharply downward away from the main channel. As snowmelt streamflows rise, this sloping groundwater table rises and is slowly 'righted' as it recharges. A much faster pathway conveys snowmelt water across the floodplain via surface flow, then has it percolate downward. Rush Creek accomplished this through overbank flood flows, facilitated by small side-channels and former main channels. The first pathway may require weeks before the shallow groundwater table or its capillary fringe (extending approximately 15 inches above the groundwater table) rise to intersect the floodplain surface, whereas the second pathway may only require a couple days. The efficiency of the annual snowmelt hydrograph, and of annual Rush Creek SRF releases as their surrogate, for leaving an ecologically relevant snowmelt signature are critical to restoring and sustaining a healthy, dynamic alluvial stream.

2 Integrating Wildlife into Ecological Restoration

CHAIR: *Harry Oakes, Jones & Stokes* *Thursday afternoon*

Revegetation from Wildlife's Point of View. *Dayan Anderson[1]*, Jeff Crouse[2], Jennifer Hinojosa[3], Kirsten Johnson[1], Ali Kelti[4], Sarah Leisenfelde[5], Lili Santilli[6]. [1]Specialty Minerals Inc., Lucerne Valley; [2]Mojave Sustainability Project–Restoration Collaborative; [3]JJ Restoration Services; [4]Victor Valley College Dept. of Agriculture & Natural Resources; [5]Victor Valley College Ecological Sustainability Club; [6]Mojave Sustainability Project–Bighorn Collaborative*

With well over 100 species to choose from, a diverse spectrum of revegetation palettes are available to the limestone quarries along the north slope of the San Bernardino Mountains. From performing diet composition analysis for a local herd of Nelson Bighorn Sheep, to identifying plant species that share common pollinators, to logging behavioral observations of granivores, insectivores, nectivores and soil microorganisms, the Mojave Sustainability Project is focusing on r*evegetation from wildlife's point of view.* A team of students, biologists, soil scientists, restoration contractors and mine professionals are compiling a site-specific ecological database and field guide to identify all known ecological relationships between species within the limestone operations and adjacent habitats of Lucerne Valley. By leveraging the natural life histories and relationships between species within the study area, the objective of this analysis is to develop not just a traditional revegetation palette, but an *ecological palette* that will promote and presumably accelerate the successful restoration of lands disturbed by mining.

Designing and Implementing Restoration of Riparian Vegetation Structure for Wildlife Habitat. *Tom Griggs*, Helen Swagerty, Dan Efseaff, and Tamara Sperber. River Partners, 580 Vallombrosa Ave., Chico, CA 95926*

Riparian restoration on the large rivers in the Central Valley of California typically targets wildlife species' structural habitat needs. Over ten years of monitoring the usage of restoration plantings by riparian focal bird species has revealed preferences for certain structures composed of favored species of plants, demonstrating that the composition and arrangement of plants are critical to provide key habitat features for wildlife. In order to translate individual wildlife species' habitat needs into site-specific riparian restoration designs, River Partners has developed a design approach to integrate habitat features for targeted wildlife species. The approach provides a testable framework for evaluating wildlife response and is feasible for implementation over large-scale projects. Specifics of the plant design, such as the arrangement and proportion of trees to shrubs, are incorporated into a database that generates planting labels to translate the design onto the landscape. We will present examples of project design considerations and rationale for the plant association selected for installation. The success of these designs will be presented along with recommendations for further design improvements.

Napa River Rutherford Reach Restoration Project: Incorporating Riparian Buffers into Restoration Planning in an Agricultural Landscape. *Kevin MacKay[1] and Ellie Insley[2]. [1]Jones & Stokes, 2841 Junction Ave., Suite 114, San Jose, CA 94134; [2]E. Insley & Associates, PO Box 2044, Glen Ellen, CA 95442*

Historic changes in land use and management in the Napa River Watershed have resulted in confinement of the river into a narrow channel, loss of riparian and wetland habitats, accelerated channel incision and bank erosion, and a reduction in water quality. Because of this ongoing degradation, properties along the Rutherford Reach have been subject to bank instability and failure leading to the loss of valuable vineyard land, and costly repairs. In 2002, the Rutherford Dust Society initiated a landowner-driven planning and design process for the 4.5-mile Rutherford Reach that focused on working collaboratively with neighbors and agencies to stabilize river banks, reduce the impacts of flooding, protect and enhance fish and wildlife habitat, reduce Pierce's disease pressure on vineyards, and provide ongoing education about the river and the watershed. A key objective of the project is to establish a vegetated buffer between the river and adjacent land use to enable the river to allow for future channel widening, reduce disturbance to native wildlife, and encourage wildlife movement. This presentation will provide an overview of existing studies, policies, and regulations that describe the minimum buffer widths necessary to maintain riparian functions, and will describe how these guidelines were incorporated into the restoration design developed for the Rutherford Reach of the Napa River.

Wildlife Monitoring of a Desert Wetland: Measuring Habitat Restoration Success. *Darin Busby, Melissa Busby, Doug Willick, Braden Hogan, Julie Simonsen-Marchant and Tito Marchant*. EcoSystems Restoration Associates, 8954 Rio San Diego Drive, Suite 610, San Diego, CA 92108*

Seepage from the All American Canal has led to the establishment of wetlands within California's Imperial Valley. Due to anthropogenic factors, over 60% of the vegetation cover within these wetlands is composed of the non-natives Tamarisk and Pampas Grass providing limited habitat value for wildlife species. Within a 2,000-acre highly disturbed wetland complex area, EcoSystems Restoration Associates has designed and is implementing a 44-acre, 10-year wetland restoration project that includes the removal of exotic / invasive species as well as enhancement, restoration, and creation of native riparian and freshwater marsh vegetation communities. The project's main objective is to improve habitat for native

desert wetland wildlife species, including the federally and state-listed Yuma clapper rail and the state-listed black rail; two species currently present in the study area. We have developed a 10-year wildlife monitoring study that focuses on bird and mammal monitoring within the restoration site and an adjacent control area. The goal is to determine the effectiveness of habitat restoration to apply adaptive management during the life of the project. Ten bird point counts and 10 mammal tracking stations were established both within the wetland restoration and control areas. Three surveys efforts will be carried out each year to capture temporal variations. Surveys will be conducted in years 1, 2, 4, 6, 8 and 10. Results from this study will be used to determine changes in species diversity and evenness as a result of restoration efforts and to assess the overall effectiveness of management on wildlife use of the project area.

Fish Creek Restoration Project – Successful Habitat Creation for the Santa Ana Speckled Dace. *Todd Chapman[1]*, Tom Keegan[1]*, Mari Schroeder[1]*, and Doug Sprague[2]*. [1]ECORP Consulting, Inc., 1801 Park Court Place, Bldg B, Ste 103, Santa Ana, CA 92701; [2]Vulcan Materials Company,Western Division, 3200 San Fernando Road, Los Angeles, CA 90065*

Vulcan Materials Company's (Vulcan) ongoing quarry operation near the City of Azusa required relocation of a portion of Fish Creek, the primary drainage of Fish Canyon in the San Gabriel Mountains. This project involved the reconstruction of the creek's pre-mining morphology and restoration of its biological and hydrological functionality, which included riparian habitat for listed bird species and aquatic habitat for the Santa Ana speckled dace (*Rhinichthys osculus* ssp.). The Santa Ana speckled dace is a California Species of Special Concern with a very limited distribution in southern California. In 2001, Vulcan Materials Company resituated an approximately 710-foot long segment of the Fish Creek channel. The creek location was returned to its 1954 historical position and the restoration was designed to provide high-quality aquatic and riparian habitats. Aquatic restoration components included the placement of tons of boulders and smaller rocks to develop riffle-pool and boulder-bar complexes and other in-stream features designed to improve the habitat quality for fishes and aquatic invertebrates. In addition, riparian habitat was planted along the creek banks and chaparral habitat was planted on the slopes of the restored areas. In the four years since planting, the riparian and chaparral habitats have achieved the performance criteria set forth in the restoration plan. Prior to 2005, the aquatic habitat was beginning to show signs of use by small numbers of speckled dace. The heavy rains of 2005 redistributed the boulders and created shallow sandy pools that have now become ideal breeding habitat. As a result of the 2005 floods, the restored creek has taken on a more natural-looking appearance and natural recruitment of native plants has significantly improved the cover and diversity of plant species. In addition, the numbers of speckled dace in the creek have increased significantly. Fish and benthic macroinvertebrate sampling was conducted in June of 2006 to compare numbers of fish and functionality of the stream habitat to pre-project conditions. Sampling was conducted in the naturalized creek located upstream of the restoration site, in the restored portion of the creek, and downstream of the restored section in the areas disturbed by mining. The results indicate that the restored portion of the creek supports a dense riparian community and it is supporting comparable numbers of fishes and numbers/diversity of macroinvertebrates to those in the upstream, undisturbed portion of Fish Creek.

Responses of Fresno Kangaroo Rats to Habitat Improvements in an Adaptive Management Framework. *K. Shawn Smallwood* and Michael L. Morrison. Eastern Sierra Institute for Collaborative Education, 3000 East Line, Bishop, CA 93514*

Lack of human activity over the previous decade resulted in Russian thistle and Mediterranean bromes dominating a 106-acre grassland at Naval Air Station, Lemoore, California, crowding out open spaces traditionally used by Fresno kangaroo rats. We developed an adaptive management plan to phase in vegetation and soil treatments intended to reverse the declining trend of kangaroo rats. Our goal was to increase the number and spatial extent of kangaroo rats in the grassland, while giving precedent to conserving the species over scientific control of the management prescriptions. Another challenge was high uncertainty of what conditions provide adequate habitat, and another was implementation of treatments at spatial scales enabling detection of treatment effects. Pursuing our goal, we monitored the distribution of kangaroo rats with intensive ground searches for active burrow systems, which we mapped using GPS. Areas receiving experimental treatments were also mapped using GPS, including vegetation clearing, controlled burns, plantings of selected species, soil disking to simulate soil conditions where kangaroo rats previously thrived, and placement of wood pallets as cover. We used chi-square terms to measure responses of kangaroo rats to experimental treatments. Fresno kangaroo rats increased substantially in number and spatial extent from fall 1999 through spring 2004, and responded most strongly to vegetation removal, controlled burning, soil disking resulting in smooth, crust-covered depressions caused by temporary pooling of rainfall, and to pallets. Adaptive management worked, though not as ideally as conceived due to unanticipated constraints on application of prescriptions and due to the precedent of species conservation over scientific progress.

3 Sustainable Restoration and Ecosystem Function

CHAIR: *Lisa Stratton, PhD, UCSB Center for Biodiversity & Ecological Restoration* *Thursday afternoon*

Success of Wetland Mitigation Projects in California. *Richard F. Ambrose[1]*, Steven Lee[1] and John Callaway[2]. [1]Dept. of Environmental Health Sciences, Box 951772, University of California, Los Angeles, CA 90095-1772; [2]Dept. of Environmental Science, University of San Francisco, 2130 Fulton St., San Francisco, CA 94117*

We evaluated wetland condition at 129 mitigation projects (consisting of 204 separate mitigation sites) throughout California. Permits for these projects were issued between 1992 and 2002. Mitigation sites were largely represented by low gradient riverine (46%) and depressional (36%) wetland classes; vernal pool, estuarine, lacustrine, seep and spring, high gradient riverine, and lagoon wetland classes were also included. Wetland condition was assessed using the California Rapid Assessment Method (CRAM), which consists of 15 different metrics under the general attributes of landscape context, hydrology, physical structure and biotic structure. For comparison to mitigation wetlands, we also assessed condition at 47 reference sites. Most mitigation sites were not optimally functioning wetlands. In comparison to reference sites, only 19% of the mitigation files were classified as optimal, with just over half sub-optimal and approximately one-quarter marginal to poor. For the biotic structure attribute (consisting of organic matter accumulation, biotic patch richness, vertical structure, interspersion/zonation, % non-native plant species, and native plant species richness metrics), 62% of projects were optimal, 26% were sub-optimal, and 12% were marginal to poor. There was no relationship between CRAM score and year the permit was issued. There was no indication that younger sites had poorer condition than older sites, with one possible exception: CRAM scores for 2002 do not range as high as earlier years, which could be because these younger sites did not have enough time to develop sufficiently to score highly on CRAM.

Native vs. Commercial Mycorrhizal Inoculum to Promote the Establishment of *Calochortus weedii* var. *intermedius*. *Lea Corkidi[1]*, Jeff Bohn[1], John Ko[2] and Margot Griswold[3]. [1]Tree of Life Nursery, 33201 Ortega Highway, San Juan Capistrano, CA 92675; [2]EDAW/AECOM, 240 East Mountain Ave., Fort Collins, CO 80524; [3]EARTHWORKS Restoration, Inc., 2116 Arlington Ave., Los Angeles, CA 90018*

One of the soil components which may enhance the establishment of rare species such as *Calochortus weedii* var. *intermedius* (intermediate mariposa lily), is the presence of arbuscular mycorrhizal (AM) fungi. The symbiotic association of plants with AM fungi improves their ability to cope with environmental stress by facilitating nutrient uptake; by increasing tolerance to drought, and resistance against soil pathogens; and by enhancing soil aggregation. However, since there are different levels of functional compatibility between plant hosts and AM fungi, the selection of appropriate isolates is a crucial step for effective mycorrhizal inoculation. We compared the growth response of bulbs of *C. weedii* var. *intermedius* that were inoculated with native AM fungi, a commercial mycorrhizal inoculum and sterile soil (nonmycorrhizal control). Inoculation of intermediate mariposa lily bulbs with native AM fungi increased the proportion of plants that produced flowers, but the response was influenced by the bulb size. The incorporation of native versus commercial mycorrhizal inoculum for rare plant propagation is discussed.

Sustainability and Land Use on the UCSB Campus: The Relationship between Resource Use and Function. *Casey Peters and Lisa Stratton. Center for Biodiversity and Ecological Restoration, UCSB, Santa Barbara, CA 93106*

The UCSB campus contains a variety of managed landscapes. The management of these areas is the responsibility of three independent departments: Housing and Residential Services (HRS), Physical Facilities (PF), and the Center for Biodiversity and Ecological Restoration (CBER). These three departments share a commitment to making UCSB a more sustainable campus, but otherwise have different land-use goals predicated by the purposes their land's serve. For example, HRS manages their land to make a safe and aesthetically pleasing living environment, while CBER strives to restore the ecological function of natural areas. To better understand the role each department plays in making UCSB sustainable we study the land-use goals set by each department, and how each serves the University, students, community, and environment. We ask how these goals are met, and what resources are used. We determine the most important indicators of sustainability are water, fuel, fertilizer and herbicide/pesticide, and whether each department monitors the uses of these resources. Finally, we ask how the results of the monitoring can be used to set sustainability goals, and chart progress as our campus becomes more sustainable. Linking the resource use to the landscape types is the first step towards making more informed decisions about landscaping around the campus. The answers will help guide us along the path towards sustainability making explicitly incorporating resource use issues as well as aesthetics and tradition into landscape decisions.

Sustainable Restoration: Regenerating Hope. *Mark Stemen, Coordinator. Environmental Studies Program, Dept. of Geography, California State University, Chico*

Sustainability is a buzzword in our society today. Often referred to as the "triple bottom line" sustainability has ecological, economic, and social dimensions. While restoration must make ecological and economic sense, to be truly sustainable, it must transform

the community, as well as the landscape. Restoration has the ability to provide more than the typical social activity. Rather than being "less bad," restoration has the possibility of being regenerative, for the participant as well as the landscape. For the past four years, researchers at the Butte Creek Ecological Preserve have been developing models of citizen involvement that can restore people's connection to the land while also getting trees in the ground. In addition to discussing the various aspects of sustainability, this presentation will offer practical advice for project managers on involving volunteers in restoration projects and tips on how to make it a manageable and meaningful experience.

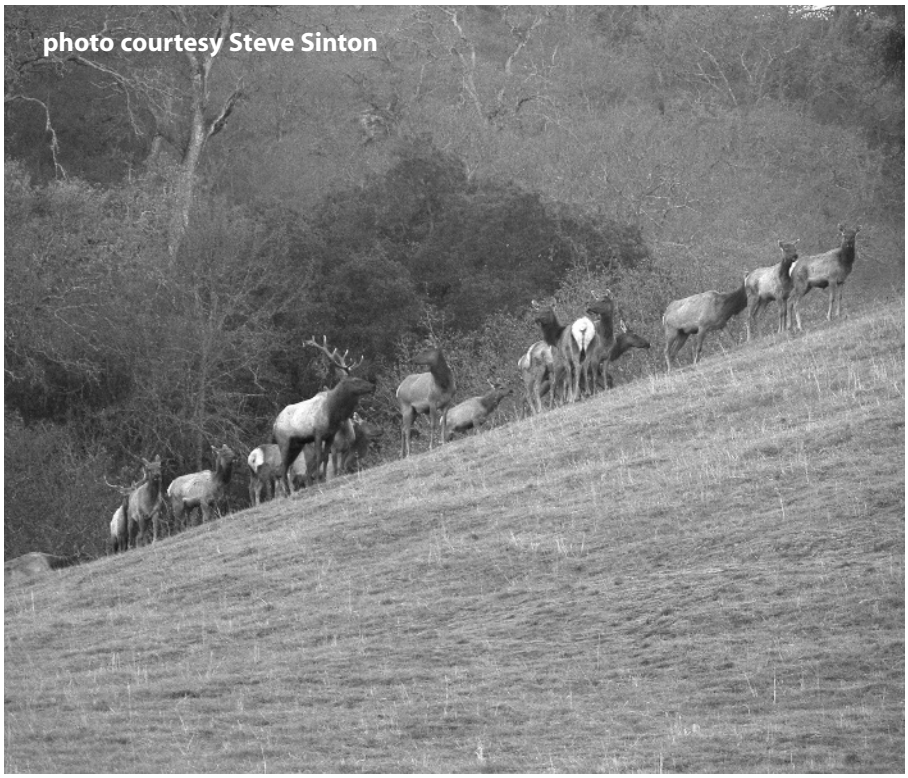
photo courtesy Steve Sinton

Vernal Pools: Ecological Goals Determine Long-term Management Strategies. *Lisa Stratton, Melanie Powers, George Thomson*, and Bree Belyea. Center for Biodiversity and Ecological Restoration, UCSB, Santa Barbara, 93106*

Vegetation, invertebrate and hydrological monitoring of five vernal pools created in 2002 (Manzanita pools) two pools created between 10 and 20 years ago (Del Sol/Camino Corto) and 2 natural pools (Del Sol and Ellwood) provide an opportunity to compare the long term sustainability of restored coastal vernal pools in an urban landscape. While overall percent native plant cover averaged 60% across all pools, the richness, relative native cover and hydrological function (depth and inundation period) of the newer and highly managed pools were greater in 2006. The depths of the Manzanita pools have been more stable over the past four years than the older pools: the standard deviation of the mean depth is 6.5% versus 30.4% for the older pools. Inundation periods were also longer (155 versus 100 days) and less variable in the newly created pools possibly due to a higher clay content and lower annual grass cover. The longer and more stable pool depths and inundation durations better support diverse invertebrate and aquatic animal populations. 2006 invertebrate and tadpole sampling results will be presented. Across all pools the percent native cover was higher within the pools (below the mean water level) than in the edge zone, above mean water level; however that difference was only significant for the older, less managed pools where the edge vegetation was significantly weedier (80% versus 40% non-native cover). This indicates that pool hydrology alone can help sustain relatively high native plant cover within vernal pools even within a veritable sea of weeds.

Sustainable Riparian Restoration: Surviving Drought, Fire, and Flood at the Rancho Jamul Mitigation Bank. *Mark Tucker, President. Tucker and Associates, San Diego, CA 92120*

Wildlands' Rancho Jamul Wetland Mitigation Bank is located in southern San Diego County on the California Dept. of Fish and Game's 3700-acre Rancho Jamul Ecological Preserve. In Phase 1A, Wildlands installed 38.5 acres of emergent and riparian wetland, oak riparian forest, and sycamore woodland along Dulzura Creek in 2000/2001. The site has faced serious climatic and stochastic events including drought, fire, and floods. The restoration grade was designed to intersect the groundwater table at a depth appropriate for establishing riparian vegetation without the use of artificial irrigation. At implementation the site was characterized by perennial flow and high groundwater. The prolonged post-installation drought resulted in a decrease in groundwater elevation by 5-10 feet in the Phase 1A area and extensive mortality of cuttings. Natural recruitment in response to large storms in February 2003 appeared to be replacing many of the lost cuttings until the Otay fire in October 2003 burned large portions of the site destroying most of the natural recruitment that had occurred. Some areas recovered well from the fire demonstrating that the riparian vegetation is well-connected to the groundwater table. Beginning in the fall of 2004 the site received extensive overbank flooding and a dramatic rise in groundwater levels during the third rainiest rainfall year on record resulting in additional natural recruitment. The site is responding like a natural floodplain environment. Differences in establishment and growth appear to be related to spatial variability of soil and groundwater conditions. Active remediation of approximately 8.7 acres is in progress.

4 Restoration Site Monitoring A to Z

CHAIR: *Michael Hogan, Integrated Environmental Restoration Services, Inc.* *Saturday morning*

Functional Monitoring for Erosion Project Assessment and Policy Application in the Arid West. *Michael Hogan[1], Mark Grismer[2], David Stienfeld[3]. [1]Soil Scientist, Principal, IERS, Inc., Tahoe City, CA 96145; [2]UC Davis Civil Engineering and Hydrology, Davis CA 95616; [3]Soil Scientist, USDA USFS Rogue River National Forest, Central Point, OR 97502*

Monitoring and research level assessment has typically been used to determine the extent to which a project or treatment is performing (performance monitoring). Such information may also be used to determine if the project has met pre-determined success criteria. While this monitoring application is useful and important, other needs exist that are not typically met and in which research level assessment can play a crucial role. These include: 1) testing of long-standing treatment approaches that may not perform as assumed, 2) identification of background or baseline levels of erosion potential, sediment yield and infiltration/runoff rates, specifically as applied to watershed modeling efforts and TMDL (Total Maximum Daily Load) allocations and 3) development and assessment of landscape treatment performance associated with TMDL studies/implementation. This paper describes a variety of assessment tools that are currently being developed and used in California and Oregon to attempt to address these needs. We use simulated rainfall to measure infiltration and runoff rates as well as sediment yield in real time, penetrometer measurements to determine soil density/potential for sediment movement, soil nutrient analysis as a measure of site potential to support sustainable soil microbial communities and vegetation, cover-point monitoring to accurately measure vegetation and soil cover as well as a number of other site assessment tools. This suite of monitoring tools are being used to inform TMDL models, measure effects of ski area expansion and to assess a variety of treatments on drastically disturbed highway road cuts/fills and ski runs. While basic in concept, we believe this approach is filling a crucial need that will help design more cost effective erosion control and restoration projects and offer real time, on-the-ground data driven approaches to setting and meeting TMDL limits.

Alkali Sink Restoration Using GIS. *Ali Kelpy*, Samantha Delgadillo, Sara Leisenfelder. Natural Resource Dept., Victor Valley College, 18422 Bear Valley Road, Victorville, CA 92395*

We are community college students who are using the Geographical Information System to map an alkali sink area in the Mojave Desert. Using GIS, we are overlaying past and present maps from various agencies in order to make comparisons and demonstrate relationships between hydrology and fault lines that created this unique area. The GIS mapping is enabling us to demonstrate how weather patterns and human activity is affecting the water table that supplies the alkali sink. We are using this system to spatially relate endemic species in the area such as the Parrish's popcorn flower and Parrish's alkali grass. These species are not found in any other habitat and are extremely rare. We are currently researching all other plant and animal species in the immediate area. We have created a GIS database that incorporates our photo journal, soil and water test results, and weather pattern information. This project has enabled us to bring together federal and local agencies such as the Mojave Water Agency, Dept. of Agriculture, Natural Resource Conservation Services, Dept. of Fish and Game and local private company landowners. Our GIS project has allowed us to highlight a desert region filled with unique geological characteristics and we continue to pursue this project with science and passion.

Incorporating Applied Research into an Ongoing Watershed-based, Riparian Enhancement Project. *Sean McNeil. Center for Ecological Restoration and Stewardship, Circuit Rider Productions, Inc., 9619 Old Redwood Hwy, Windsor, CA 95492*

Since 1997, we have engaged in a programmatic approach to *Arundo d*onax eradication and revegetation in the Russian River watershed — one that integrates ongoing invasive species mapping, GIS database development, giant reed removal, riparian vegetation restoration, landowner outreach, community education, volunteer opportunities, and applied research. Using a question-driven approach to *Arundo* removal and the restoration of invaded sites, we have focused on a range of research needs with our program. Current research elements include descriptive assessments of landscape-level characteristics, experimental evaluations of *Arundo* physiology, and investigation of community-level impacts. Future research includes landscape scale spatial modeling of *Arundo* population expansion, study of site-specific responses to removal and habitat restoration, and evaluation of ecosystem level effects of *Arundo* invasion. Our research program is iterative — developing new questions in response to the needs of local and regional efforts to remove *Arundo* and restore invaded sites.

Monitoring Data Informs Management Approach in the Santa Monica Mountains N.R.A. *Christy Brigham and Randy Philips*. National Park Service, Santa Monica Mountains National Recreation Area, 401 West Hillcrest Dr., Thousand Oaks, CA 91360*

The National Park Service manages over 20,000 acres of wildlands in the Santa Monica Mountains National Recreation Area. We use monitoring data from a wide range of projects to

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5 Coastal & Marine Environments Restoration

CHAIR: *Mark Tucker, Tucker & Associates* *Friday morning*

Sediment Deposition in Newly Restored San Francisco Bay Salt Marshes. *John Callaway[1]*, V. Thomas Parker[2], Lisa Schile[2]. [1]Dept. of Environmental Science, University of San Francisco, 2130 Fulton St., San Francisco, CA 94117; [2]Dept. of Biology, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94123*

Sediment accumulation is a critical factor driving the development of restored salt marshes as they build elevation to a point suitable for vegetation establishment. This issue is particularly important for highly subsided restoration sites (including salt ponds) that may be up to 200 cm below target elevations for vegetation. We are evaluating sediment dynamics at the Island Ponds, the first salt ponds to be restored through the South San Francisco Bay Salt Pond Restoration Project. We are measuring sediment accretion within Pond A21, using the sediment pin method (PVC pipes set 3 meters into the sediment). The dense gypsum layer (up to 25 cm) and the lack of vegetation preclude the use of other methods. For short-term, mass-based accumulation rates, we are using a modification of the "filter paper method", with sample discs that are deployed over a two-week tidal period. There has been substantial sediment accumulation within Pond A21 since breaching in March 2006, with approximately 2 cm of sediment accumulating over the first two months in many areas and even greater accumulation in some locations. Rates at higher locations are variable but lower. Short-term, mass-based measurements of accumulation reflect similar spatial variability across the pond. In adjacent, existing mudflats and marshes, mudflat stations are highly dynamic, while marsh stations indicate minimal deposition. Further measurements will be completed at 3, 6 and 12 months following breaching. These results give an indication of potential sediment dynamics during the critical initial restoration period for subsided tidal marshes.

Restoration Site Monitoring

adapt our management strategies and select the most efficient use of limited resources in managing our lands. Specifically, I will describe how monitoring of an endangered plant habitat restoration project altered habitat management, how plant survivorship data influences plant palette selection in our restoration plantings, and finally, how monitoring of invasive plant eradication projects has changed the park's management focus from eradicating the worst weeds to maintaining the best habitats. These examples will highlight the uses of different monitoring techniques (permanent research plots, photopoints, and temporary plots) to accomplish different goals.

Disturbance for Endangered Plant Restoration Facilitates Salt Marsh Invasion. *Brenda J. Grewell, USDA-ARS Exotic & Invasive Weeds Research, Dept. of Plant Sciences MS-4, UC Davis, 1 Shields Ave., Davis, CA 95616*

I present results of an experimental reintroduction of an endangered parasitic plant to a restoration site in the San Francisco Estuary. In four years of field experiments, I tested disturbance management methods for enhancement of rare plant establishment and fitness. I identified critical life stages and used failure time survival analysis models for a demographic comparison of restored and reference populations. Demographic monitoring revealed seedling life stage vulnerability that can influence population growth and persistence. High seedling mortality was strongly correlated with the presence of exotic plant species that are unsuitable hosts for endangered root hemiparasites. Results demonstrate that successful restoration requires a unique productive host community to support the introduced parasite load. Disturbance-gap creation is a successful restoration technique that will enhance rare plant establishment and fitness, but benefits can be offset by exotic plant invasions. Applied conservation significance of the study points to a critical need for regional invasive plant control as the first step in salt marsh restoration efforts.

Guadalupe-Nipomo Dunes Collaborative Facilitates Ecosystem Restoration. *Kathie Matsuyama. Guadalupe-Nipomo Dunes Center, P. O. Box 339, Guadalupe, CA 93434*

The 22,000 acre (2,000 square mile watershed) Guadalupe-Nipomo Dunes is one of the last American coastal dunes systems. The dunes stretch 18 miles from Santa Barbara County's Point Sal to Pismo Beach in San Luis Obispo County. Designated a Dept. of the Interior National Natural Landmark, the dunes are National Seashores. The dunes transition between northern and southern California plant and animal communities resulting in great habitat diversity (over 1,000 species including 18 rare or endangered plants), a number of local endemics, and susceptibility to disturbance. The dune ecosystem, including habitat for the federally listed Western snowy plover, are threatened by several invasive plants. The Guadalupe-Nipomo Dunes Collaborative ecosystem-based management approach minimizes effects of invasive species on natives and improves invasive eradication. The Collaborative uses rapid assessments and inventories to prioritize projects. The work results in improved research, data collection and educational outreach. The Collaborative members working to protect the dunes from invasive exotic plant species include; the California State Parks and Recreation, Center for Natural Lands Management, Santa Barbara County, San Luis Obispo County, U.S. Fish and Wildlife Service – National Wildlife Refuge, Dunes Center and San Luis Obispo Land Conservancy. Where to restore and how to prioritize weed removal in the erosive and wind-blown sand dunes is difficult. Weed infestations

continued

and restoration efforts are mapped and monitored using GPS/GIS. The dunes were divided into 100 Landscape Management Units. Units were evaluated for weed type, infestation, presence of sensitive species, geomorphology and habitats. Units were prioritized by threat and defensibility.

Response of Salt Marsh Bird's Beak to Native and Non-Native Hosts.
Regine Castelli Miller[1], David M. Hubbard[2], Henry M. Page[2], Jenifer E. Dugan[2]. [1]2006 SERCAL President, P.O. Box 245, Downieville, CA 95936; [2]Marine Science Institute, UC Santa Barbara, CA 93106-6150*

Salt marsh bird's beak (SMBB), *Cordylanthus maritimus* ssp. *maritimus*, is an endangered annual hemiparasitic plant that uses a variety of native host plants in high marsh habitats in southern California. In Carpinteria Salt Marsh, the habitat of SMBB has been invaded by a non-native sea lavender (*Limonium ramosissimum*) that attains high cover and alters the diversity and composition of high marsh vegetation. This invasive species has the potential to negatively affect SMBB populations by occupying high marsh habitat and displacing native host plants. To investigate interactions of SMBB with native and non-native hosts, we examined the effects of host presence and type on growth, flowering and heterotrophic carbon acquisition of SMBB in greenhouse and field experiments. In the greenhouse, SMBB plants grown with native saltgrass (*Distichlis spicata*) attained twice the shoot length, 40x the dry biomass, and produced 25x as many flowers, as plants without hosts. Growth of SMBB with invasive sea lavender was similar to that observed with the native host, but flower production was reduced. In the field experiment, SMBB responded to these hosts similarly but did not survive to flowering without hosts. Using the stable C isotope values of greenhouse and field-grown individuals, we estimated that native hosts contributed ~30-36% of the carbon content of SMBB. Although our results indicate that the invasive sea lavender is a potential host for SMBB, field manipulations suggest that recruitment of SMBB may be reduced by high cover of this species.

Tidal Marsh Restoration on Former Tidelands Surrounding Humboldt Bay, CA.
Darren Mierau[1], John Bair[1], Jeff Anderson[2]. [1]McBain & Trush, Inc., PO Box 663, Arcata, CA 95518; [2]Jeff Anderson & Associates, PO Box 841, Arcata, CA 95518*

The bottomlands surrounding Humboldt Bay were once a huge tidal and freshwater wetland complex. Estimates from 1854-55 township plat and meander survey maps suggest approximately 9,623 acres of marsh were converted to agricultural use. Only 880 acres (8%) of the original marshes remain today. In addition to this dramatic loss of wetlands, extensive networks of tidal slough and creek channels were cutoff from their connection to the estuary. These tidal channels provided habitat for a multitude of invertebrate, fish, bird, and wildlife assemblages. Within one segment of the bottomlands, we estimated conversion of 815 acres of marsh, loss of 5.2 miles (equating to 57 acres) of 3rd order tidal sloughs, and as much as 67 miles of 1st and 2nd order tidal creeks. Several restoration projects have been completed or are underway to reconnect tidal channels to the estuary and restore fish passage so salmon and steelhead can reach their ancestral spawning grounds and other native fishes can access high quality rearing habitat. The Rocky Gulch project completed in 2005 (with funding from CDFG and FWS) rehabilitated 4,000 ft of tidal and stream channel, installed a fish-friendly tidegate that also maintains a 20-acre brackish marsh, and brought back coho salmon for the first time since the early 1960s. Pastures behind the dikes were also protected. The Wood Creek project, planned for 2007, will remove a tidegate, restore tidal channels, and restore 35 acres of Lyngbye's sedge (*Carex lyngbyei* Hornem.) and Tufted Hairgrass (*Deschampsia caespitosa* L. ssp. *holciformis* C.Presl.) marsh.

Ecology of the Exotic Sea Lavender, *Limonium ramosissimum*, in the Salt Marshes of Southern California.
Henry M. Page, Steve Schroeter, Jenny Wolf, David Hubbard. Marine Science Institute, University of California, Santa Barbara*

Limonium ramosissimum, an exotic sea lavender, is one of the few invasive plants that invades tidal marsh habitat. This plant is abundant in areas of Carpinteria Salt Marsh and Agua Hedionda Lagoon and also occurs in San Elijo Lagoon and drainages entering San Dieguito and Buena Vista Lagoons. In Carpinteria Salt Marsh, this invasive plant co-occurs with the Federally-listed endangered plant, Salt Marsh Bird's Beak. In this ongoing study, we are examining 1) the recovery rate of native species following removal of *L. ramosissimum* and 2) interactions between *L. ramosissimum* and native plants, including the role that native plant cover and nutrient enrichment play in mediating these interactions. Native species occur in higher cover following removal of the exotic from experimental plots, but recovery is taking several months in both Carpinteria Salt Marsh and Agua Hedionda. Preliminary results suggest that the effect of nitrogen enrichment on the growth of the invasive *Limonium* and its ability to displace native species varies with location. In locations with a high cover of native species, nitrogen enrichment resulted in decreased cover of *L. ramosissimum*, the likely mechanisms being stimulation of the vertical growth of native canopy. In contrast, in an area where cover of *L. ramosissimum* was higher and more similar to that of native species, nitrogen enrichment initially stimulated the growth and expansion of the invasive *Limonium*. These preliminary results suggest that native plant cover and composition may be important factors influencing the expansion of this invasive plant under conditions of anthropogenic nutrient inputs.

6 Oak Woodland & Native Grassland

CHAIR: *Margot Griswold, EARTHWORKS Restoration, Inc.* *Saturday morning*

Sudden Oak Death: Implications for Forest Health and Restoration. *Janice Alexander, Sudden Oak Death Outreach Coordinator. California Oak Mortality Task Force, University of California Cooperative Extension, 1682 Novato Blvd. Ste. 150B, Novato, CA 94947*

Since the introduction of the plant pathogen *Phytophthora ramorum* into California's wildlands, an estimated 1 million oaks and tanoaks have succumbed to the disease commonly known as Sudden Oak Death. The pathogen continues to spread in these natural areas, infecting many common native forest plants, and leaving land managers and researchers desperate for treatments and management protocols that may save the most susceptible trees. Current research projects aim to model the forest distribution of the pathogen, predict its potential range, slow its spread to new areas, and preventatively treat high-value trees. The possibility of restoring severely impacted forest systems is unknown.

Review of Fire Effects on California Grassland Vegetation. *Susan Bainbridge[1] and Carla D'Antonio[2]. [1]Jepson Herbarium, University of California, Berkeley, CA 94720-2465; [2]Ecology, Evolution & Marine Biology, University of California, Santa Barbara, CA 93106-9610*

For more than twenty years, land managers and ecologists have been testing and applying prescribed fire as a method of restoring native vegetation and suppressing non-native species in California grasslands. Although some studies show at least short-term positive results, overall success has been variable. Practitioners need a better understanding of situations in which fire is beneficial towards these goals. Species composition, regional and annual climate and burn conditions are some of the factors that influence results. These factors are difficult to modulate or replicate in a single study, and thus most burns are single variable studies. In addition, funding and logistical constraints limit the number of burns in which study design and data collection are adequate for statistical analysis. We conducted meta-analysis on more than twenty studies of prescribed and natural fire in California grasslands. We derived general fire effects by life form/origin groups and for selected species, and we investigated factors influencing burn outcomes across these studies. Results show that native and exotic forbs typically increase, and non-native annual and native perennial grasses temporarily decrease after fire. Except for non-native forbs, these effects last only a couple of years, suggesting that an increase in non-native forbs may be the most long-term effect of fire. However, data for native perennial grasses is too limited draw conclusions about long-term outcomes. Repeated annual fire and post-fire use of livestock grazing show the greatest promise for sustaining increases in native forbs beyond a couple of years past an initial burn.

Restoration of Native Grasslands and Forb Lands in Southern California: The Importance of Soils and Landscape Position. *Margot Griswold[1], Melissa Riedel-Lehrke[1] and David Kelley[2]. [1]EARTHWORKS Restoration, Inc., 2116 Arlington Ave., Ste 301, Los Angeles, CA 90018; [2]David Kelley & Associates, 216 F Street #51, Davis, CA 95616*

Perennial grasslands in Orange County and generally in southern California are not well defined historically because of alterations to the natural landscape by human based disturbance, mainly from cultivation and a combination of grazing and periodic drought as well as loss to development. Even less is known about Orange County forb lands, an often over looked plant community. Although the precise distribution, and certainly the composition of California's pre-settlement grasslands is still debated, recent evidence strongly suggests that it cannot be assumed that all of what is now naturalized annual grassland was once native perennial grasslands, especially in southern California. Therefore, it is important to evaluate potential restoration sites based on factors such as soil, landscape position, the presence of remnant native species or the exotic weedy forbs, rather than just the presence of naturalized annual grasses to avoid habitat type conversion. We present data from sites disturbed mainly from grazing as well as highly disturbed sites (e.g. sites that have been cultivated historically) comparing general soil characteristics and existing plant species to outline some general soil and plant community relationships in southern California. Data from seven- and three-year old restoration test plots is compared, and the usefulness of extensive soil investigations prior to restoration discussed as a way to implement appropriate and site-specific habitat restoration.

Effects of Herbivory on the Experimental Establishment of *Quercus agrifolia*. *Matthew L. James* and David M. Hubbard. Coastal Restoration Consultants, 808 California St., Santa Barbara, CA 93103*

Most oak seedlings do not survive their first year in natural habitats or restoration sites. Establishment is known to be restricted by competition with non-native plants, water stress and herbivory. We isolated the effect of herbivory on establishment of Coast live oak, *Quercus agrifolia*, on a restoration site in Goleta, California by controlling non-natives and providing supplemental water through the first summer. We planted 300 acorns in two treatments into two-year old restored coastal sage scrub. Half of the acorns were planted with solid plastic tree shelters (10 cm diameter x 60 cm, installed to a depth of 15 cm), and half were planted without tree shelters. Tree shelters protected seedlings from mammalian and insect herbivory in the critical first growing season, and through years two and three. All unprotected oaks died or lost

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height (stems nipped) at some point in their first season because of herbivory. Survival of oaks was higher in shelters at the end of each growing season (86 vs. 20% year one, 78 vs. 8% year two, 63 vs. 3% year three). Average heights were greater in shelters (30 vs. 5cm, 46 vs. 8cm, 74 vs. 22cm). Our condition index indicated less insect herbivory (e.g. leaf miners) on leaves in the shelters (0.4 vs. 1.5, 0.4 vs. 0.6). Stem height per acorn planted was 78 times greater with tree shelters by year three which may justify the extra time and expense of installing tree shelters on sites with intense herbivory.

Managing Sudden Oak Death on Public Lands. *Cindy Roessler, Midpeninsula Regional Open Space District, 330 Distel Circle, Los Altos, CA 94022-1404*

Sudden Oak Death (SOD) is a disease that has killed over one million native oak and tanoak trees and infests many other forest species in one Oregon and 14 coastal California counties. The Midpeninsula Regional Open Space District (District) manages 55,000 acres of undeveloped land in the Santa Cruz Mountains of the San Francisco Peninsula. Hundreds of dead tanoak trees and other symptoms of the SOD pathogen, *Phytophthora ramorum*, are commonly seen on the District's 25 preserves. There currently is no cure for SOD, and as with other extensive forest diseases, a strategy may take decades to develop. The District has adopted a ten-year plan to slow the spread of SOD, collaboratively study impacts on wildland ecology and recreation, and develop a restoration strategy for heavily infested forests. District practices include: submittal of symptomatic tree samples for diagnosis; inclusion of confirmed SOD locations and infested areas in a statewide database at **www.suddenoakdeath.org**; cleaning equipment and containing infected vegetation and soil; and installation of educational signs and brushes to instruct recreational users when visiting infested preserves. Researchers are utilizing District land to understand how the pathogen spreads and to identify resistant trees. GIS-based vegetation maps have played a key role in identifying research sites. Sanitation and effects of SOD on forest ecology need to be considered when propagating for and designing restoration projects in coastal California oak-dominated forests.

Non-Invasive Methods for the Restoration of Native Grasslands in Southern California. *Trish Smith[1], Melissa Ervin[1], and Margot Griswold[2]. [1]The Nature Conservancy, 1400 Quail Street, Newport Beach, California 92660; [1]EARTHWORKS Restoration, Inc., 2116 Arlington Ave. Ste 301, Los Angeles, CA 90018*

Much of the research on restoring native perennial grasslands has focused on grasslands in northern and central California. Restoration of grasslands at the Santa Rosa Plateau in southern California has been successful using repeated burns. However, repeated burning may not be the most efficient or desirable method in degraded grasslands that are interspersed in coastal sage scrub. For this study, we are testing several cost-effective methods for the restoration of native grassland on degraded lands at five separate sites in Orange County, California. Restoration strategies selected for this project were aimed at restoring dominant native grasses as well as herbaceous annuals and soil flora associated with healthy native grassland ecosystems. Specifically, the study is investigating several "reverse fertilization" methods aimed at abating weed competition, including application of mycorrhizae, rice straw mulch, native algae, and native nurse crop. We targeted methods that are least invasive in restoring perennial grasslands by utilizing pre-treatment and seeding methods that have the least negative impact on the soil. Repeated mowing, thatch removal and selective herbicide treatment were selected as pre-treatment methods; drill-seeding as the method for seed application. At each of the five sites, each treatment was replicated five times with all possible combinations of treatments, for a full factorial design. We will discuss the first year of results within and across all sites. Although some treatments appear to be more effective than others, site conditions, rather than treatments, appear to have the greatest influence on results.

7 Integrating Agriculture with Restoration

CHAIR: *Carol Presley, Santa Clara Valley Water District* *Friday & Saturday mornings*

Restoring Stream Bank and Riparian Function to Irrigation Canals and Drainages in California Agricultural Landscapes. *John H. Anderson[1*], Chris Rose[2], and Tim O'Halloren[3]. [1]Hedgerow Farms, 21740 Co. Rd. 88, Winters, CA 95694; [2]Audubon California, 5265 Putah Creek Rd., Winters, CA 95694; [3]Yolo County Flood Control and Water Conservation District, 34274 State Hwy 16, Woodland, CA 95695*

A vast array of irrigation canals, drainages, and sloughs wind through the landscapes of California's agricultural valleys. The standard management practice used to maintain canal banks and levee berms is to keep them free of vegetation. Since 1990 we have been establishing and evaluating various native streamside plants (grasses, sedges, rushes, and a few forb species) on approximately 2.5 miles of a major irrigation distribution canal operated by the Yolo County Flood Control and Water Conservation District (YCFCWCD) for their use in reconstructing a perennial dominated edge similar to a natural stream or riverbank. Establishment techniques include direct seeding native grasses and forbs and planting plug transplants of native grasses, sedges, rushes and perennial forbs. After 2-5 years of spot weed control native perennials prevail. The beneficial outcomes include: Domination of perennial plants, which prevent invasion of weeds thus eliminating blanket herbicide applications, greater stabilization of canal banks and resistance to erosion provided by foliage and massive root systems, bioremediation of non point source pollutants by plant root systems, and restored native biodiversity with the provision of food and cover for a variety of wildlife species. The most successful species include: creeping wildrye (*Leymus triticoides*), deergrass (*Muhlenbergia rigens*), purple needlegrass (*Nassella pulchra*), baltic rush (*Juncus balticus*), barbar's sedge (*Carex barbarae*) common rush (*Scirpus americanus*), slender sedge (*Carex praegracilis*), and torrent sedge (*Carex nudata*). Useful forbs include goldenrod (*Euthamia occidentalis*), gumplant (*Grindelia camporum*), and evening primrose (*Oeneothera hookeri*). Critical to success of this program is a working partnership with local agencies, conservation organizations, and the landowners whose property the canals and drainages pass through.

Wildlife-Friendly Restoration Practices for Organic and Conventional Farms. *Jo Ann Baumgartner, Wild Farm Alliance, PO Box 2570, Watsonville, CA 95077*

Agriculture is responsible in a large part for the biodiversity crisis. However, with its dominant footprint on the landscape, it has an inordinate ability to support wild Nature. Both organic and conventional agriculture can profit from and provide for biodiversity conservation. Protecting water quality is starting to become a standard concern of all California farmers. Moreover, conserving biodiversity is beginning to be an important issue on organic farms across the country. These positive changes are due to recent state water quality regulations and national organic program rules. Restoration practices that address these concerns include re-contouring and establishing native grasses in ditches, planting natives in non-cropped areas of the farm, allowing native vegetation to prosper in marginal areas and augmenting it when possible, restoring natural areas on the farm invaded by non-native species, installing sediment basins replete with native plants, and planting structurally diverse habitat along springs, ponds, creeks, and rivers. Tall trees and midsized shrubs provide habitat for native pollinator and natural enemy insects, rodent-eating predators, and riparian dependent wildlife, while stabilizing soils. The shorter grasses help to slow water and filter out sediments and some nutrients. The riparian soils themselves break down many types of toxins. Farms can provide beneficial habitat within their borders, feed our local communities healthy food, and ultimately support connections to wildlands beyond – through the conservation and restoration of riparian buffers and corridors for clean water and the safe passage of animals to clear and free flowing watersheds.

Habitat Restoration on Private Lands Using a Comprehensive Approach. *Miles DaPrato*, Jaime Hartman*, Chris Rose and Vance Russell. Audubon California Landowner Stewardship Program, 5265 Putah Creek Road, Winters, CA 95694*

Approximately 70 percent of the land mass of the contiguous United States is in private lands with 50% of this total in row crop or rangelands. Audubon California's Landowner Stewardship Program works with farmers and ranchers on conservation and restoration projects in a manner compatible with existing agricultural operations. Audubon's program has worked with over 50 farmers and ranchers in the counties of Yolo, Solano, and Imperial Counties particularly on riparian, oak woodland and native perennial grassland restoration. Audubon's Landowner Stewardship Program restoration technicians will discuss the use of a comprehensive approach to achieve habitat restoration goals. Case studies will be used to illustrate specific project elements such as; student education, landowner training, monitoring, and research and how they are incorporated into project sites.

Farmscaping: Design Considerations, Techniques, Issues. *Sam Earnshaw, Community Alliance with Family Farmers (CAFF), P.O. Box 1766, Watsonville, CA 95077*

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

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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 most report that they are pleased with the benefits that farmscaping brings to their farms.

Regulation of Irrigated Agriculture to Improve Water Quality on the Central Coast. *Alison Jones, Central Coast Regional Water Quality Control Board, 895 Aerovista Place, Suite 101, San Luis Obispo, CA 93401*

A panel of agricultural and environmental groups from across the Central Coast Region developed the "Conditional Waiver of Waste Discharge Requirements for Discharges From Irrigated Lands" (Ag Waiver) to regulate discharges from agricultural lands that irrigate and sell their crop. The state of California's non-point source implementation and enforcement policy requires regional water quality control boards to regulate all NPS discharges through Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan prohibitions. The Ag Waiver promotes clean water through education, on-farm management practices and monitoring. Education allows growers to gain knowledge, improve existing management practices and learn new management practice techniques that protect surface and groundwater from agriculture related pollution. An industry-led cooperative monitoring program collects and analyzes data for water toxicity, sediment toxicity, and benthic macro-invertebrate assemblages.

Riparian and aquatic habitat trajectory on north coast ranches. *Michael Lennox[1]*; R. Jackson[2]; D. Lewis[1]; D. Stokes[3]; J. Harper[1]; S. Larson[1], and K. Tate[4]. [1]University of California Cooperative Extension, 133 Aviation Blvd. Suite 109, Santa Rosa, CA 95403; [2]University of Wisconsin-Madison; [3]Sonoma State University; [4]University of California-Davis*

We are researching the efficacy and trajectory of riparian restoration on the north coast of California. Livestock exclosures are commonly used in an effort to recover aquatic habitat and watershed functions from degraded riparian corridors. We measured biophysical attributes at 102 riparian sites that varied with respect to age since restoration and revegetation technique. Project sites were located along tributary stream reaches in Marin, Sonoma, and Mendocino Counties of California ranging from 4 to 40 years since revegetation. A common riparian revegetation objective was the establishment of tree cover to sustain watershed functions that are resistant to hydrologic disturbance and stochastic events. What is the long-term fate of these efforts and how do sites change over time? Preliminary results indicate improvements in aquatic habitat metrics over time. For example, woody debris, stream shade, and pool depth increased while bankful width-to-depth ratio decreased over time. Plot scale results show an effect of revegetation method by landform class or similar geomorphic features. The long-term abundance of tree species functional groups was affected by both the decision to plant that species and the presence of relict seed source at the project site. The revegetation effect, or percent change from nonrestored sites, has a negative relationship with diaspore mass. Unanticipated results include an increase in exotic shrub cover over time. Vegetation management over multiple decades may be necessary to encourage further participation in restoration efforts by agricultural producers and other private land owners.

Disconnect between Water Quality Management Practices and Food Safety Good Agricultural Practices. *Kay Mercer, San Luis Obispo/Santa Barbara Counties Agricultural Watershed Coalition, Santa Maria CA 93456*

Cool-season vegetable producers in California are caught in a vice between Water Quality protections and Food Safety requirements. In 2004, The Central Coast Regional Water Quality Control Board adopted the Conditional Ag Waiver for Irrigated Lands. The Waiver regulates discharges from irrigated lands to ensure water quality is not detrimentally impacted and growers are required to implement management practices in order to comply. In 2005, The US Food and Drug Administration (FDA) sent a letter to the California lettuce industry expressing concern about a series of outbreaks of microbial illnesses associated with the consumption of fresh lettuce and leafy greens. Currently, FDA is investigating regulatory options and enforcement actions against firms and farms that grow, pack, or process produce that results in microbial illness. There is a zero-risk attitude. The FDA stated the Produce Industry should immediately address this issue. Consequently, The Produce Industry has responded with development of Food Safety Good Agricultural Practices (GAPs). Growers must comply with GAPs in order to sell their produce. The result is a conflict over the use of management practices such as grassy waterways, filter strips, and water containment basins. These are simultaneously perceived as beneficial to Water Quality and as potential harmful microbial reservoirs under existing GAPs. Currently, there are multiple efforts underway to bring together leading scientists, key industry professionals, and regulators to identify industry assumptions, data gaps, and research needs surrounding this issue.

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Poster Reception: Thursday, 26 October 5:30–7:00 pm in Corwin Pavilion. Posters will be on display for duration of conference.

Incorporating Science into the South Bay Salt Pond Restoration Project. *Ron Duke[1], Steve Rottenborn[1], John Bourgeois[1], Donna Ball[1]*, Lynne Trulio[2], Steve Ritchie[3]. [1]H.T. Harvey & Associates, San Jose, CA 95118; [2]Dept. of Environmental Studies, San Jose State University, CA 95192-0115; [3]California Coastal Conservancy, Oakland, CA 94612*

The State of California and the Federal government are embarked on the restoration of 15,100 acres of Cargill's former salt ponds in South San Francisco Bay. Acquisition of the South Bay salt ponds provides an opportunity for landscape-level wetlands restoration, improving the physical, chemical, and biological health of the San Francisco Bay. The Project will restore and enhance a mosaic of wetlands, creating a vibrant ecosystem. Restored tidal marshes will provide increase habitat for the endangered California Clapper Rail and the salt marsh harvest mouse substantially. Large marsh areas with extensive channel systems will also increase South Bay habitat for fish and other aquatic life and haul-out areas for harbor seals. Managed ponds will be enhanced to maximize their use as feeding and resting habitat for migratory shorebirds and waterfowl traveling on the Pacific Flyway. Restoration at this scale has generated a number of uncertainties for the South Bay, including: 1) Will a decrease in high salinity and overall pond area reduce migratory shorebird use of South San Francisco Bay? 2) To what extent can waterbird use of managed ponds be enhanced by reconfiguration and targeted management of ponds? 3) Will mercury methylization significantly increase due to tidal restoration and/or pond management? The project's Science Team, Project Management Team and Consultant Team are working collaboratively on an Adaptive Management process to address these uncertainties. The first step of that process is taking place in the design process, via the incorporation of experiments built into Phase 1 of the restoration, which is slated to commence in 2008.

Integrating Agriculture

Agricultural Easements Can Raise Interesting Issues Regarding Habitat Restoration. *Tom Scharffenberger, Principal, Scharffenberger Land Planning & Design, 523 17th Ave., San Francisco, CA 94121*

Conservation easements over agricultural properties are sometimes in conflict with sensitive habitats both within and adjacent to agricultural properties. This seminar will discuss issues that conservation organizations sometime encounter when working with farmers to protect both agricultural and biological resources, and to reserve opportunities for future restoration. Tom Scharffenberger is a conservation planner who has assisted national, state and local conservation organizations, as well as individual landowners, in the negotiation and closing of easement and fee transactions. He has also prepared baseline documentation reports and assisted in the ongoing monitoring of conservation easements.

Active Restoration and Monitoring: Hand Seeding to Bulldozers. *Michelle Cox* and Louise Johnson. Lassen Volcanic National Park, POB 100, Mineral, CA 96063*

Restoration activities within Lassen Volcanic National Park vary from downhill ski facilities to Federal Lands Highway Program (FLHP) mitigation to campsites. Each project requires an individual approach and is monitored at the appropriate level determined by project cost and time constraints. Campsites, pullouts and similar scale projects may only merit Level I monitoring. Hand tool and seeding efficacy would be tracked with permanent photopoints. FLHP mitigation has included hydromulching with seed, hand mulching/seeding, and outplanting nursery stock and usually requires Level 2 monitoring. Sulphurworks road mitigation includes 12 permanent photopoints, a species lists, and ocular cover estimates. The cover estimates have not been significantly different one year post-restoration. The Ski Slope Restoration Project used bulldozers to remove ski lift foundations and recontour access roads. At Level III, this project has nineteen permanent photopoints and three100m line transects with nested quadrats in which species frequency and ground cover are recorded. From 2003 to 2005, the number of known species decreased from 89 to 64. The frequency of forbs and trees has not changed significantly, but graminoids have decreased slightly. The frequency of each lifeform did decrease with the increase in elevation. We discovered *Wyethia mollis* is less effective as mulch compared to *Juncus* and *Carex spp* which remained longer in riparian areas compared to the open slope.

How Nature Affects an Artificial Water Source. *Jeff Crouse*, Robert Bennett, Paul Cook, Jennifer Hinojosa, Ali Kelpy, Cheryl Vermette. Agriculture/ Natural Resources Dept., Victor Valley College, Victorville, CA 92395-5850*

In 1947, The Mojave River State Fish Hatchery started to discharge a portion of its affluence into the ground via a concrete conduit. The sources of this water were two production wells used by the hatchery as a water supply for fish production. This runoff water created a channel down to the Mojave River and underground. The Mojave River has no surface water most of the year except during periods of extensive rainfall. This case study illustrates how nature, in its own way, adapted to the harsh desert environment and created a wetland out of a simple discharge. Since 2004 a GIS has been developed to track the seasonal expansion and contraction of this wetland. Not only water volume but vegetation expansion and contraction were tracked. Within these boundaries are contained species of flora and fauna not native to the Mojave River watershed.

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RECIPE: A Novel Research Program at Palos Verdes Peninsula Land Conservancy. *Ann Dalkey. Palos Verdes Peninsula Land Conservancy, 916 Silver Spur Road #207, Rolling Hills Estates, CA 90274*

Having completed the acquisition of 1800 acres of coastal sage scrub contained within the greater Los Angeles metropolitan region, the Palos Verdes Peninsula Land Conservancy found itself in a position to promote a standard of excellence for restoring and sustaining native habitat, and for documenting ongoing changes as the habitat improves. Management at the Land Conservancy knew that scientific research was essential for providing feedback to the restoration staff, but also recognized that greater good could be realized through a broad-based community effort. This forward-thinking approach led to the creation of the Research, Education, and Community Involvement Program for the Environment (RECIPE), which is designed to coordinate the development of scientific research and management information to be communicated to the restoration community and public at large. Supported by a grant from Alcoa Foundation, RECIPE is intended to reach students from elementary through university level work to foster sound scientific education for youth as well as research opportunities for academia. By disseminating research results via newsletters, conferences, and peer-reviewed journal articles, we can assure that all will benefit from the work conducted on the Land Conservancy's preserves. Although RECIPE is new (the program began in June 2006) we have already sponsored high school and undergraduate students, plus developed collaborative relationships with local southern California universities.

Alkali Sink Restoration Using GIS. *Ali Kelp, Samantha Delgadillo, Sara Leisenfelder. Natural Resource Dept., Victor Valley College, 18422 Bear Valley Road, Victorville, CA 92395*

We are community college students who are using the Geographical Information System to map an alkali sink area in the Mojave Desert. We have a series of posters illustrating how the GIS program is enabling us to show correlations between hydrology, fault lines, geology, and human interaction that contribute to this unique area. Our posters highlight the GIS database capabilities as well as the alkali sinks' unique properties.

Invasive Plant Management and Restoration at the Landscape Scale. *Sean McNeil*, Greg Fisher*, Noelle Johnson*, and Elizabeth Lotz*. Center for Ecological Restoration and Stewardship, Circuit Rider Productions, Inc., 9619 Old Redwood Highway, Windsor, CA 95492*

Invasive plants pose a significant threat to riparian and wetland habitats. The remaining riparian and wetland habitat in the Russian River watershed is undergoing a rapid transformation as plant invasions modify various ecological processes within these biologically diverse areas. In collaboration with our partners and funders, we have developed a landscape-scale program to reverse the impacts of *Arundo donax* in the Russian River riparian corridor. This watershed approach to invasive plant management is unique, in that it comprehensively addresses the entire infestation in the Russian River basin (100 miles of waterways draining 1,485 square miles of land in two counties interspersed with 300 acres of Arundo infestation) by integrating scientific research, landscape-scale mapping and GIS analysis, landowner investment and engagement, community education and active riparian habitat restoration. Mapping consists of an initial screening assessment via aerial flight and low-level photography, followed by detailed ground reconnaissance using ArcPad technology. All information is then entered into a GIS database. In collaboration with Sotoyome and Mendocino Resource Conservation Districts, we have developed a broad partnership of supportive landowners, natural resource agency staff, and funders. Together, we have made a long-term commitment to removing this highly invasive exotic plant and restoring native riparian habitat in the Russian River watershed.

Shovels for Students: Connecting Students with Restoration Ecology. *Lech Naumovich, Director. Golden Hour Restoration Institute, PO Box 3057, Berkeley, CA 94703*

The key to conserving our biological heritage is educating the public about the value of restoration ecology. One of the most effective mechanisms in building support for a project is by hosting a series of events where participants are able to begin to develop a relationship with the landscape. Restoration projects are ideal venues for fostering this type of relationship. Although there are many technical aspects to restoration projects, a student's retention of principles and theories is much greater when there is a physical action that exemplifies the idea. Golden Hour Restoration Institute is a new non-profit whose mission is to provide quality, engaging, and pragmatic instruction in restoration ecology in California through participating in restoration projects. Golden Hour courses range from a few hours to several weeks in length. College, high school, and professional students are engaged in the technical aspects of restoration ecology, community service, and recreation associated with our Californian landscape. Most importantly, our learning curriculum utilizes current and past projects to help aid in the design of new, more effective projects. Golden Hour is searching for new land managers, beyond the Bay Area, with projects and mentors that would host on-site restoration courses that offer technical training to aspiring restoration ecologists. In coordination with service work, Golden Hour is currently putting together a textbook, *California Restoration Manual,* describing about fifty significant and innovative restoration projects in California.

Geomorphic Processes in the Santa Clara River Watershed: Implications for Floodplain Restoration Planning. *Peter W. Downs, Scott R. Dusterhoff, Cliff S. Riebe, William A. Sears, Bruce Orr*. Stillwater Sciences, 2855 Telegraph Ave, #400, Berkeley, CA 94705*

In 2000, the California Coastal Conservancy proposed the establishment of the Santa Clara River Parkway, a 20-mile long corridor along the lower Santa Clara River in Ventura County, California. The parkway project aims to acquire and restore historical floodplain lands to enhance habitat for endangered and threatened species while providing flood control benefits—an effort that requires an understanding of the hydrogeomorphic processes that define the river. The Santa Clara River watershed is dynamic, experiencing significant annual and inter-year flow variability resulting from its semi-arid, Mediterranean-type climate. Intense rainfall events and highly erodible bedrock in combination with significant episodic sediment supply generated by landslides, earthquakes, and wildfires result in large floods that carry some of the highest sediment concentrations in the world. Further, the periodicity of sediment delivery is distinctly correlated to ENSO climate forcing, making popular restoration concepts such as "equilibrium" and "bankfull flow" largely inapplicable. The morphodynamics of the lower river are influenced strongly by the relative magnitude of flood events from the contributing sub-watersheds, and may have been impacted by flow regulation. Consequently, some floods result in net aggradation while others cause net incision within the lower river. Reach-level channel changes are conditioned by levees, legacy effects from flow diversions, aggregate mining and, possibly, the 1928 St. Francis Dam break. In the future, they may become increasingly influenced by urban growth. Human activities may have also affected the balance of sediment delivery processes to the near-shore zone, potentially causing changes to estuary morphology and regional longshore processes.

Zinc Increased Rooting by 280% in Transplants. *Joseph Paternoster, President/CEO. DriWater, Inc., 600 East Todd Road, Santa Rosa, CA 95407*

Zinc is the most common deficient micronutrient in soil. Zinc is essential to many enzyme systems in plants with three main functions including catalytic, co-catalytic, and structural integrity. Zinc contributes to the production of important growth regulators, which affect photosynthesis, new growth, and development of roots. Quick root development is key to the survival of new plants. Zinc promotes the cell growth needed for increasing root development, formation of new leaves and vigorous shoot growth. Zinc improves stress tolerance. If zinc is in short supply, plant utilization of other essential plant nutrients such as nitrogen will decrease. In the plant growth hormone, indole-3-acetic acid (IAA), is a naturally occurring auxin. It also occurs in many bacteria, fungi, and algae. To maintain plants normal growth, IAA must be produced and regulated by the plant. Zinc is the co-factor in the transformation of the amino acid trytophan to the auxin IAA. Zinc will help maintain IAA levels in the plant and promote growth, rooting, and health. The selection of zinc sulfate as the source of zinc was based on it being the most readily available form for plants. Zinc sulfate also contains a sulfate ion. The sulfate ion (SO42) is a beneficial nutrient and occurs naturally in soils. Sulfur is used to bind amino acids together by sulfide bridging to create enzymes and proteins, the building blocks of life. Research indicates that the presence of acetic acid will improve uptake minerals. Greenhouse tests show transplants watered with slow release water containing zinc acetate increase root mass by up to 284% in 30 days. Delivering water and the zinc acetate over 90 days enables the plant to uptake this vital micronutrient.

Sustainability and Land Use on the UCSB Campus: The Relationship between Resource Use and Function. *Casey Peters and Lisa Stratton. Center for Biodiversity and Ecological Restoration, UCSB, Santa Barbara, CA 93106*

The UCSB campus contains a variety of managed landscapes. The management of these areas is the responsibility of three independent departments: Housing and Residential Services (HRS), Physical Facilities (PF), and the Center for Biodiversity and Ecological Restoration (CBER). These three departments share a commitment to making UCSB a more sustainable campus, but otherwise have different land-use goals predicated by the purposes their land's serve. For example, HRS manages their land to make a safe and aesthetically pleasing living environment, while CBER strives to restore the ecological function of natural areas. To better understand the role each department plays in making UCSB sustainable we study the land-use goals set by each department, and how each serves the University, students, community, and environment. We ask how these goals are met, and what resources are used. We determine the most important indicators of sustainability are water, fuel, fertilizer and herbicide/pesticide, and whether each department monitors the uses of these resources. Finally, we ask how the results of the monitoring can be used to set sustainability goals, and chart progress as our campus becomes more sustainable. Linking the resource use to the landscape types is the first step towards making more informed decisions about landscaping around the campus. The answers will help guide us along the path towards sustainability making explicitly incorporating resource use issues as well as aesthetics and tradition into landscape decisions.

Direct Seeding of *Larrea tridentata* on Arkose Substrate in the Western Mojave Desert. *Carlos Ruiz, Stefan Szalkowski. Agriculture and Natural Resources, Victor Valley College, Victorville, CA 92395*

Being one of the principle shrubs of the Mojave Desert ecosystem, *Larrea tridentata* (Creosote Bush) which is ubiquitous within the natural desert landscape proves very difficult to establish in revegetation efforts of severely disturbed sites. Conducted through the Mojave Sustainability Project in partnership with Rio Tinto Minerals, our research focuses on direct seeding methods of *Larrea tridentata* on Arkose

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soil substrates in the Western Mojave Desert. We compare three different soil surface treatments available to mine operators to promote seedling germination, these soil texturing treatments include soil imprinting, furrows, and flat raked surfaces. Also included were seed treatments consisting of leached and unleached seed. In addition, climatological factors such as air and soil temperature in relation to germination are considered. Our results show that seedling germination and survival was greatest in the flat racked surface treatment. On the other hand, seed leaching had no significant effect on germination. Although our data shows no significant correlation, the greatest periods of germination occurred during September to October, and again in April and May during warmer temperature trends. We believe that further insight into the weather data will be able to confirm a significant trend between germination and some key weather factors. From our observations, we surmise that the reason why germination did best in the flat racked plots is because they were less likely to be buried by soil debris during precipitation periods.

Addressing Restoration-Related Regulatory Constraints and Pest Crop Damage on Neighboring Farms.

Kristen Strohm[1], Greg Golet[2], Gregg Werner[2], Ron Unger[1]. [1]EDAW, Inc., 2022 J St., Sacramento, CA 95814; [2]The Nature Conservancy, 500 Main St., Chico, CA 95928*

Neighboring landowner concerns about environmental regulations and wildlife-caused damage to crops often generate opposition to habitat restoration. EDAW, The Nature Conservancy and the Sacramento River Conservation Area Forum's Advisory Workgroup of farmers, landowners, and natural resource agency personnel are collaborating in a CALFED-funded project to characterize and provide solutions to potential regulatory constraints and crop damage on neighboring farms that may be caused by the restoration of riparian habitat along the Colusa Subreach of the Sacramento River. Relevant regulations examined to the project include state and federal Endangered Species Acts; California Fish and Game Code; Bald and Golden Eagle Protection Act; International Migratory Bird Treaty Act; California Environmental Quality Act; National Environmental Policy Act; Federal Insecticide, Fungicide, and Rodenticide Act; and pesticide label restrictions. Pest issues include the key wildlife, insect, and fungal species known to damage crops in the Subreach. We are analyzing the potential for agricultural impacts to change as a result of riparian habitat restoration; comparing self-mitigating restoration design elements such as buffer strips and specific planting protocols which may reduce the risk of transboundary conflicts with both legally protected wildlife and species that cause damage to crops; and evaluating a spectrum of 6 regulatory agreements such as Good Neighbor Policies and Safe Harbor Agreements that may enable restoration and neighboring landowner goals to be met. Our findings may be applied to increase community support for ecosystem restoration projects and to implement these projects in ways that are consistent with local agricultural success.

Effects of Soil Preparation Treatments on Restoration of Native Perennial Grasslands.

Andrea Michelle Vona, Senior Project Manager. Palos Verdes Peninsula Land Conservancy, 916 Silver Spur Road, Suite 207, Rolling Hills Estates, CA 90274

California grasslands have been subject to a large-scale invasion by non-native annual grasses. Understanding soil preparation techniques prior to seed addition of native plants is desired by practitioners seeking to improve grassland restoration projects. Several soil preparation techniques were applied to a coastal, degraded grassland in Los Angeles, California to determine the optimal preparation approach. Disking, scraping, herbicide application and a control treatment were compared for their effect on the establishment of native perennial grasses and for their ability to reduce and/or control the abundance of non-native annual grasses. Scraping and disking were most successful in establishment of the native perennial grass *Nassella pulchra*. Scraped plots had significantly less non-native annual grasses than the control. Seeding and removal of live and dead plants were found to be crucial components for successfully reestablishing *Nassella pulchra* in this grassland. Results of this field experiment on soil preparation techniques are applicable to other grassland restoration projects in California.

Grassland restoration impacted by herbivore-mediated apparent competition with *Brassica nigra*.

Marti Witter[1], John Orrock[2] and O. J. Reichman[2]. [1]National Park Service, Santa Monica Mountains National Recreation Area, Thousand Oaks, CA; [2]National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, Santa Barbara, CA

Recent work has suggested that consumer-mediated indirect effects may play an unappreciated role in the dynamics of biological invasions. We examined the hypothesis that the restoration of native grasslands in California that have been invaded by an exotic forb (*Brassica nigra*) may be compromised because *B. nigra* increases the impact of native consumers on native plants (i.e. apparent competition). We tested this hypothesis by seeding a native grass, *Nassella pulchra*, into forb-dominated communities without *B. nigra* and into communities dominated by *B. nigra*. In each community type, experimental exclosures were used to control consumer access. We found that native *N. pulchra* may be unable to invade communities dominated by exotic *B. nigra* because consumer pressure on natives is substantially greater in *B. nigra*. In addition, we find a gradient of consumption whereby consumer impact on native *N. pulchra* decreases with distance to the nearest patch of *B. nigra*, suggesting that the protective cover offered by *B. nigra* may affect the spatial extent of consumer-mediated apparent competition. Our results offer evidence that restoration and natural regeneration of native grasses may be limited by the way non-native plants increase the impact of native consumers on native plants.