South Bay Salt Pond Restoration Project

Restoring the Wild Heart of the South Bay

South Bay Science Symposium 2011: Phase 1 Restoration of the South Bay

February 3, 2011
Abstracts of oral and poster presentations

Oral presentations (in order of appearance)

1. Shellenbarger, Gregory G., Scott A.Wright, and David H.Schoellhamer, U.S. Geological Survey, California Water Science Center, gshellen@usgs.gov

SEDIMENT FLUX IN THE SOUTHERN REACH OF SAN FRANCISCO BAY: IMPLICATIONS FOR HABITAT RESTORATION

The South Bay Salt Pond Restoration Project is restoring about 6,000 hectares of former commercial salt-evaporation ponds to tidal marsh or managed wetlands in the southern reach of San Francisco Bay (SFB). As a result of groundwater overdrafts prior to the 1970s, much of the project area has subsided below sea-level and will require about 32 million cubic meters of sediment to raise the surface of the subsided areas to tidal marsh elevations. However, previous estimates of sediment flux between northern SFB and the southern reach using data from five bathymetry surveys conducted decades apart are insufficient to estimate the natural sediment supply from the bay.

The specific purpose of this study is to quantify the continuous suspended-sediment flux (SSF) past Dumbarton Narrows. Data from two optical turbidity sensors and an acoustic Doppler current profiler mounted in the cross-section are collected every 15-minutes. Water discharge and velocity-weighted cross-sectionally averaged suspended-sediment concentrations (SSC) are measured during monthly site visits. Using the "index-velocity" method for discharge and a combination of turbidity and acoustic backscatter calibrated to SSC, a continuous (15-minute interval) record of SSF at the measurement cross-section is computed. Additionally, a high-accuracy pressure transducer and water-quality sonde are deployed on an adjacent intertidal mudflat to measure wave-height and turbidity, which provide evidence about the physical processes controlling SSF.

Results suggest that, from November 2008 to October 2009, net sediment transport into southern SFB was from the north. Seasonality in SSF shows the largest southerly flux in the spring during periods of high SSC and not during the summer when strong diurnal winds from the north originally were thought to control the annual SSF. Understanding physical controls on sediment flux for this large wetland restoration project can explain how southern SFB and the project are linked to the rest of the estuary.

2. Jaffe, Bruce, Amy Foxgrover, and David Finlayson US Geological Survey, Santa Cruz, bjaffe@usgs.gov

MUDFLAT LOSS DURING SOUTH SAN FRANCISCO BAY SALT POND RESTORATION –REGIONAL AND GLOBAL PERSPECTIVES ON INITIAL POST-RESTORATION CHANGES

Mudflats evolve in response to changes both hydrodynamic forces and sediment supply. To determine whether salt pond restoration in South San Francisco Bay will result in loss of mudflats not only the local (restoration induced) but also the regional (sediment input to and redistribution within the Estuary) and global (sea level rise and storminess) changes to must taken into consideration.
As a step towards improving understanding of the likely response of South Bay mudflats to restoration, long-term and seasonal mudflat changes are being documented and analyzed. A series of bathymetric surveys collected from 1858 to 2005 reveal long-term changes in mudflat area in both space and time that can be used to better understand the pre-restoration system. For example, the mudflat south of the Dumbarton Bridge on the west side of the Bay adjacent to the Ravenswood restoration project narrowed approximately 200 meters from 1858 to 1931. Since then this mudflat has accumulated sediment and is now wider than it was in 1858. At this same site, pre-restoration seasonal bathymetric surveys were collected from 2008 to 2010 using a state-of-the-art interferometric sidescan sonar for swath mapping in extremely shallow water. These high-resolution surveys provide a baseline and indicate that, although the mudflats accrete in the winter and erode in the summer/fall, on average there is little pre-restoration change in mudflat elevation. However, these mudflats continued to widen pre-restoration. Mudflat and channel change detected comparing baseline surveys with surveys of the offshore of the Ravenswood restoration site collected after the opening of the ponds and of Alviso collected after breaching will be presented. These changes will be discussed in light of regional and global change.

3. Fulfrost, Brian[1], David Thomson[2], [1]Design, Community and Environment, brian@dceplanning.com; [2]U.S. Fish and Wildlife Service

USING REMOTE SENSING TO MAP THE EVOLUTION OF MARSH VEGETATION IN THE SOUTH BAY OF SAN FRANCISCO: METHODS AND RESULTS FOR 2009-10

The South Bay Salt Pond (SBSP) Restoration Project is the largest Federal restoration effort outside of the Everglades. The accretion of sediment and subsequent colonization of vegetation by endemic marsh vegetation is crucial to the restoration effort. Classic field mapping of this large project area would be time consuming and costly. In our three year pilot project (2009-11), we have implemented a semi-automated approach to annually map vegetation and sediment using supervised classification (maximum likelihood) of 1 meter Ikonos multispectral imagery. This has been accompanied by an extensive two-step ground truthing process using sub meter GPS. First we characterize vegetation associations found in salt, brackish and fresh water marshes to identify image training sites. We then return to the field to calibrate and validate classification results. In order to normalize annual images to provide effective habitat classification throughout this three year process, we utilize both histogram matching and an iterative review of classification results to modify training sites. Significant effort was taken to accurately characterize the spatial and taxonomic range of vegetation in our habitat classifications so that they meet project needs but are also spectrally and spatially distinct enough to be accurately classified. This semi-automated remote sensing model has great potential to track changes to marsh vegetation with 80% or more accuracy at scales relevant to the larger SBSP adaptive restoration effort. Our presentation will provide an overview of (a) field methods for developing habitat classifications, training sites and validation measures; (b) image processing techniques; (c) the iterative process for reviewing and improving vegetation classifications; and (d) our preliminary results (and lessons learned) for 2009 – 10.

4. Duke, Ron[1], Max Busnardo[1], Donna Ball[1], Ellery Mayence[1], Michelle Orr[2], Nick Garrity[2], Mark Lindley[2], Jeff Haltiner[2] ; [1]H. T. Harvey & Associates, rduke@harveyecology.com; [2]ESA/PWA

COOLEY LANDING TIDAL RESTORATION 10 YEARS AFTER

Cooley Landing is a 122 acre former salt pond on the west Bay shoreline in Menlo Park that is owned by the Mid-Peninsula Open Space District. It was restored to tidal inundation in 2000 by SLLI as mitigation for the loss of habitat and values of a 3.34 acre non-tidal wetland area adjacent to the site. The restoration plan, designed by PWA and HTH, was the first in the SF Bay Area to incorporate ditch blocks and training berms in an attempt to reoccupy as much of the former complex tidal channel network as possible, and to limit flow through the borrow ditches. The outboard levee was lowered, and three breaches were made at the locations of historical channels. Therefore, these results are directly applicable to restoration technique questions being studied at Pond A-6. Monitoring just completed in 2010 shows a strong trend towards success, with approximately 60% of the site now covered with native salt marsh vegetation. An average of 1.4 feet of sediment has deposited on the site, the majority of the restored marshplain is drained at low tide and portions of the deeper channels continue to drain at low tide with shallow water flow (less than 0.5 ft depth). This is similar to many natural marshes in the Bay with broad outboard mudflats. Eight acres comprising the majority of the historical channel system has been reoccupied, and small sections of the borrow ditch that still provide drainage are filling with sediment. Portions of the site were colonized by invasive *Spartina*, but with repeated treatment by the ISP, there are approximately three acres remaining this year, while over 66 acres of pickleweed have successfully developed. California clapper rail pairs have also been detected on the site in the breeding season.

5. Thompson, Jan and Francis Parchaso, U.S. Geological Survey (Menlo Park), jthompso@usgs.gov

PRE- AND POST-SALT POND RESTORATION ASSESSMENT OF BENTHIC COMMUNITIES IN SOUTH SAN FRANCISCO BAY

The South Bay Salt Pond Restoration Project may change the water quality, ecology, and physical habitat of the South Bay. One part of the ecosystem that may reflect these changes is the benthic community. The benthic community functions as an important consumer of phytoplankton, as prey for fish, birds, and invertebrates, and as a critical link in many geochemical processes in the estuary. The benthic community structure (the species that make up the community) and therefore its function may be altered as a result of changes in the physical (substrate, depth), chemical (salinity, oxygen), and biological (food availability) habitat. By using previously collected, spatially-intensive benthic samples collected during three seasons in each of three years prior to the restoration project (1993-1995) and after the restoration activities started (2006-2008) we are examining how this community has responded to restoration activities. We note species shifts in the community and any changes in the function of the community in the ecosystem, e.g. have certain prey species shifted in relative dominance, have benthic species that consume phytoplankton increased or decreased. For example, initial findings show the reductions in the large benthic filter feeders in 2007-2009 coincided with an increase in phytoplankton biomass throughout the period. The decrease in bivalves may be related to an increase in predators which has little to do with the restoration action. This is an example of how shifts in the benthic community must be interpreted within the context of the ecosystem as a whole and that restoration activities are only some of the forces acting on the community. We have also seen a shift to surface deposit feeding worms during years when the bivalves have been absent which reflects the shift of the phytoplankton consumption from the water column to the sediment surface where the phytoplankton settled during phytoplankton bloom periods. The large, mostly surface dwelling bivalves are relatively easy for predators to catch whereas the surface deposit feeding worms tend to be smaller and much deeper in the sediment.

6. Woo, Isa[1], John Takekawa[1], Arriana Brand[1], Bruce Jaffe[2], Greg Shellenbarger[3], David Schoellhamer[3], Ashley Smith[1], William Chan[1], and Amy Foxgrover[2], [1]USGS Western Ecological Research Center, San Francisco Bay Estuary Field Station, Vallejo, CA iwoo@usgs.gov; [2]USGS Pacific Coastal & Marine Science Center, Santa Cruz, CA; [3]USGS California Water Science Center, Sacramento, CA

TEMPORAL AND SPATIAL CHANGES IN BENTHIC INVERTEBRATE PREY AVAILABILITY ON THE SHOALS OFF POND SF2 IN SAN FRANCISCO BAY .

San Francisco Bay (SFB) is a highly urbanized estuary and 80% of historic tidal marshes have been lost to development. Yet SFB is recognized as a site of Hemispheric importance for migratory shorebirds.

Waterbirds forage on benthic invertebrates found within tidal mud flat and shallow water habitats (shoals).
In fall 2008, USGS formed a muliti-disciplinary team of biologists, hydrologists, and geologists, and initiated a comprehensive study on the ecology of mud flats in South San Francisco Bay. Large scale tidal wetland restoration projects may cause geomorphological changes in the shoals due to shifting sediment demands in the estuary, while sea level rise will impact the intertidal and subtidal shoals that are vital macroinvertebrate food resources for bird communities.

To characterize the variation in the benthic invertebrate community over time and elevation, we collected and processed monthly benthic samples over a slight elevation gradient over the past two years. Invertebrate taxa densities were extrapolated from a 10cm diameter core at 10cm depth to a m2 (at 10cm depth) and ash free dry weight was calculated with published conversion factors. Most invertebrate taxa varied by elevation and time, especially bivalves. Bivalve numbers were greatest in the nearshore environment (within 200m from shore), which primarily consisted of Gemma gemma bivalves. Peak monthly density was averaged amongst location for an average of 11,859 bivalves in June 2010. The fewest average bivalve densities were recorded in Jul 2010 (424 bivalves/m2) and Jul 2009 (660 bivalves/m2). The size frequency distribution of bivalves was skewed towards the smaller size classes: 57% of bivalves were <2mm, 33% were 2-4mm, 3% were 4-6mm, 5% were 6-12mm, and 1% were 12-18mm, and <1% were larger than 18mm. 97% of available bivalves are <6mm, the size class that can be consumed by a Western Sandpiper. However, 0-6mm size class only comprised of 19% of total bivalve ash free dry weights (AFDW).

These data can help assess invertebrate prey availabilities for seasonal bird use and relationships between mudflat hydrogeomorphology and biological responses.

7. Hobbs, Jim, Nick Buckmaster, Pat Crain, Norm Ponferrada and Peter Moyle. Wildlife, Fish and Conservation Biology, UC Davis, hobbsja@gmail.com

MONITORING THE RESPONSE OF FISH ASSEMBLAGES TO RESTORATION IN THE SOUTH BAY SALT PONDS.

In South San Francisco Bay, the largest wetland restoration effort in the U.S. was established to restore a diversity of habitats in historic industrial salt ponds. Monitoring the progress of restoration on the fish fauna is a priority goal of the South Bay Salt Pond Restoration Program. However its effects are currently unknown and difficult to predict**.** In this study we are monitoring the effects of restoration on the fish species assemblages and sentinel species health in the Alviso, Eden Landing, SF2 and Bair Island. We are monitoring fish distribution and abundance in restored pond habitats (e.g. A19-21) and adjacent marsh, slough and bay habitats. We are also investigating the "health: of the sentinel species *Gillichthys mirabilis,* using indicators of growth, recruitment, and survival. Sampling began in July of 2009. Thus far, we have found 31 fish species within the restored salt ponds and in adjacent sloughs, with a majority being native species. Several of these species are of regional conservation importance (longfin smelt and bay anchovy), and have declined elsewhere in the bay-estuary. The sentinel species *Gillichthys mirabilis,* was found in high abundance in pickleweed marsh in Alviso Slough and Eden Landing, but was nearly absent in SF2 and Bair Island marsh habitats. We also observed a significant low dissolved oxygen event post first flush rains in October and found many dead fish in Alviso Slough and Coyote Creek. However, by December water quality conditions had returned to normal and fish abundance had increased. Overall fish assemblages appear to be similar between restored ponds (A19-21) and adjacent habitats. In the next year, we will be monitoring, closely, the opening of A8, the recovery of species in the newly opened A6 and beginning survival and indicator studies of the sentinel species *Gillichthys mirabilis*.

8. Brand, L. Arriana [1]**,** John Takekawa[1], Jill Bluso-Demers[2], Eric Mruz[3], John Krause[4], and Cheryl Strong[3], [1] U. S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, arriana_brand@usgs.gov; [2] San Francisco Bay Bird Observatory; [3] U. S. Fish and Wildlife Service, Don Edwards San Francisco Bay National Wildlife Refuge; [4] California Department of Fish and Game

SHOREBIRD AND DUCK RESPONSES TO POND MANAGEMENT IN THE SOUTH BAY SALT PONDS

Given the goal of no net loss in wildlife populations, a primary challenge for the South Bay Salt Pond Restoration Project (SBSPRP) is to restore a mix of habitats that balance needs of marsh species with migrating waterbird populations. We investigated avian response to pond management types that provide insights for strategies to reduce the potential impact of 50-90% pond to marsh conversion on

shorebirds and ducks. We conducted monthly bird counts in three SBSPRP salt pond complexes since 2003 (53 ponds in Alviso, Eden Landing, and Ravenswood). We used zero-inflated Poisson regression models for overdispersed, clustered data with pond as a random effect to assess temporal trends and avian response to pond management types. We found that management efforts during the ISP from 2003-2010 generally increased shorebirds numbers in Eden Landing and dabbling ducks in Alviso, while diving ducks remained stable over the period. Over a later period (2005-2010) of pond management, diving ducks and dabbling ducks were most abundant in intake, circulation, and discharge ponds during fall, winter, and spring seasons, though dabbling ducks were also abundant at breached ponds A19-21 at high tide. Small and medium shorebirds were most abundant in ponds managed as seasonal ponds across seasons, though medium shorebirds were also abundant in intake and breached ponds. Breached ponds maintain high foraging numbers, particularly at low tide. However, these habitats are transitional in nature, likely providing prey resources in newly exposed mudflats as the marshplain is developing. We highlight the importance of different types of open water ponds as well as transitional mudflats, and the potential value in staggering tidal marsh restoration to make mudflat habitat part of the temporal dynamic over the long term.

9. Herzog, Mark and Josh Ackerman; U. S. Geological Survey, Western Ecological Research Center, Davis Field Station, mherzog@usgs.gov

REPRODUCTIVE ECOLOGY OF WATERBIRDS WITHIN THE SOUTH BAY SALT POND RESTORATION PROJECT

The South Bay Salt Pond (SBSP) Restoration Project in San Francisco Bay will restore 50-90% of the 25,000 acres of salt ponds to tidal marsh to reverse the loss (>80%) of tidal marsh. While the restored tidal marsh habitats will benefit many animals, a goal of the SBSP Restoration Project is to maintain current breeding populations of birds that currently use these salt pond habitats heavily. A mechanism to mitigate for this lost nesting habitat is to create additional nesting habitat within the few salt ponds that remain after habitat restoration. Thus, the SBSP Restoration Project is implementing plans to reconfigure and enhance existing salt ponds by increasing foraging opportunities and the number of nesting islands.

In 2005, USGS initiated a long-term research program to monitor the reproductive ecology of waterbirds breeding in the South Bay and track the changes that are occurring during restoration. Waterbird nesting phenology in South San Francisco Bay differs markedly among wetlands, especially for Forster's Terns with more south-western colonies initiating earlier than north-eastern nesting colonies. Nest success for terns, American Avocets, and Black-necked Stilts is highly variable among sites and years, with island nesting habitats within salt pond providing the highest reproductive success. Stilt chicks have higher survival rates (32-56%) than avocet chicks (5-14%), which are depredated heavily by California Gulls. Gulls were responsible for 61% of avocet, 23% of stilt, and 94% of Forster's tern chick depredations. Our results suggest that salt ponds with island nesting habitat will be critical for breeding waterbirds as the SBSP Restoration Project moves forward and that continued, long-term monitoring of waterbird reproductive success is necessary.

10. Robinson-Nilsen, Caitlin[1], Jill Bluso Demers[1], Cheryl Strong[2], and Scott Demers [3]; [1] San Francisco Bay Bird Observatory, crobinson@sfbbo.org; [2] U. S. Fish and Wildlife Service, Don Edwards San Francisco Bay National Wildlife Refuge; [3] HT Harvey and Associates

DETERMINING THE EFFECTS OF HABITAT ENHANCEMENTS AND PREDATORS FOR WESTERN SNOWY

The breeding population of the federally threatened Western Snowy Plover in San Francisco Bay has remained well below the recovery goal of 500 birds for the region since monitoring began in 2003. We tested the effectiveness of habitat enhancements as a method to reduce predation on plover nests by placing 1-hectare oyster shell treatment plots in managed ponds at Eden Landing Ecological Reserve, where 60% of Snowy Plovers nest in the Bay. In 2009, nests in oyster shell plots were more likely to hatch than nests outside of shell plots (χ^2 =4.98, df=1, P=0.03) and only 8% of nests in oyster shell plots were depredated compared to 44% outside the plots. In 2010, more plovers nested in shell plots than in control plots, however there was no difference in the likelihood of nests in shell plots hatching successfully compared to nests outside the shell plots (χ^2 <0.01, df=1, P=0.98). To identify predators of Snowy Plover nests, we deployed nest cameras in 2009 and 2010. California Gulls accounted for 25% of Snowy Plover nest predators captured on camera. Over 25,000 California Gulls nested in a former salt pond (Pond A6) and will be displaced in 2011, as this pond has been breached for tidal restoration as part of the South Bay

Salt Pond Restoration Project. Our results, along with the recent documentation of the first California Gull nest in Eden Landing, suggest that gulls may increase predation on Snowy Plover and other waterbird nests and chicks as they encroach into new areas for nesting.

11. Trulio, Lynne[1] , Caitlin Robinson-Nilsen[2], Jana Sokale[3] and Kevin Lafferty[4] [1] San Jose State University; Lynne.Trulio@sjsu.edu ; [2]San Francisco Bay Bird Observatory; [3] Sokale Environmental Planning; [4] Western Ecological Research Center, US Geological Survey

NESTING SNOWY PLOVER RESPONSE TO NEW TRAIL USE

Providing public access and protecting the abundance and diversity of waterbirds are two potentially competing project objectives of the South Bay Salt Pond Restoration Project. A major focus of the Project's first phase is to develop and enhance a number of trails; many of these trails are located on levees next to ponded habitat used by foraging and nesting waterbirds. Federally threatened western snowy plovers (*Charadrius alexandrinus nivosus*) nest in a number of ponds in the Project area and new trails have the potential to negatively affect nesting plovers.

This study assessed the response of nesting snowy plovers to trail walkers approaching on levees. We compared the flush rates of snowy plovers exposed to experimental trail use versus birds not disturbed by trail use, and measured the distances at which birds flushed. We also compared the flush rate and flush distance of birds in response to researchers (people the birds had seen before) to trail users (people the birds had never seen).

We collected data for 31 trials: 10 trail walker trials, 11 researcher walker trials, and 10 control trials. Our preliminary analyses showed that birds flushed off their nests 76% of the time in response to walkers, but in only 20% of control trials did birds flush. Birds did not respond differently to researchers versus other trail walkers and the average flush distance for birds in response to walkers (n=17) was 146m (SE 19m).

These results indicate that new trails should be at least 150m from plover nesting habitat to avoid disturbance. Managers should close existing trails during the breeding season if the trails bring people close enough to nests to increase disturbance rates to unacceptable levels. Quantifying nesting plover response to existing trails would be useful, as snowy plovers in other areas have become habituated to relatively constant and non-threatening human trail use.

12. Olofson, Peggy R., San Francisco Estuary Invasive *Spartina* Project, prolofson@spartina.org

RESTORATION AND CONTROL OF INVASIVE *SPARTINA* IN THE SAN FRANCISCO ESTUARY

Introduced to San Francisco Bay in the 1970s as a part of a tidal marsh restoration experiment, Atlantic smooth cordgrass (*Spartina alterniflora*) soon hybridized with native Pacific cordgrass (*S. foliosa*), creating a super-prolific marsh invader (hybrid *S. alterniflora* x *foliosa*). Compared to either parent, the hybrid was larger, spread more rapidly, and could grow at lower marsh elevations. It also was extremely fertile, with larger flowers producing more seed and pollen, and it readily cross-pollinated with the parent species and other hybrids. By the late 1980s, some scientists and managers suspected that the hybrid cordgrass was a serious threat to tidal marsh restoration and possibly the ecosystem, and it was clearly a hindrance to flood control and other management objectives. Never-the-less, over the next decade and half, more than three dozen tidal marsh restoration projects, most of them "mitigation" for environmental impacts elsewhere, proceeded. Because of ideal nursery conditions they provided, most of the newly opened sites were soon invaded, and dominated, by robust populations of hybrid cordgrass. Not only did this preclude each projects' ability to advance toward restoration objectives, it also significantly accelerated the spread of hybrid cordgrass throughout the Estuary. At its peak in 2007, hybrid cordgrass covered nearly 1,000 net acres of mash and mudflat, at locations throughout 100,000 acres of the Estuary. Aggressive regional control using aquatic herbicide has now reduced the hybrid population to less than 100 net acres (albeit now distributed through an even greater area), with an objective of eradication within the next 4-8 years. As long-planned restoration projects, such as Pond SF-2 and Knapp Tract, continue to open in areas vulnerable to hybrid cordgrass invasion, the state and federal agencies are challenged to assure this aggressive intruder does not again get the upper hand.

13. Strong, Cheryl, U. S. Fish and Wildlife Service, Don Edwards San Francisco Bay National Wildlife Refuge, cheryl_strong@fws.gov

THE CALIFORNIA GULL: CHALLENGES AND OPPORTUNITIES FOR RESTORATION

An ever-expanding population of California gulls in the San Francisco Bay area is cause for concern due to their predatory and encroachment behaviors. Approximately 46,000 California gulls nest in the south bay, with their numbers and colony locations expanding every year. Gulls are known predators on the nests and young of other waterbirds, including the endangered California least tern and the threatened western snowy plover. Nesting habitat in the form of isolated islands is limited real estate in the south bay, and gulls have encroached into areas once occupied by terns and shorebirds. As the South Bay Salt Pond Restoration Project returns managed ponds to tidal action, the remaining ponds will consolidate nesting birds into a smaller footprint. The Project is creating island habitat for waterbirds in the remaining ponds, but in addition to on-the-ground restoration, we need to find a way to improve the success of non-gull nesting waterbirds and reduce the potential impacts of gulls. In 2011, we will begin hazing and reducing gull nesting habitat in sensitive areas near colonies of other waterbirds to test the efficacy of these methods in reducing impacts by gulls.

14. Marvin-DiPasquale, Mark[1], Josh Ackerman[1], Darell Slotton [2], Mark Herzog[1], Collin Eagles-Smith[1]; [1] U.S. Geological Survey, mmarvin@usgs.gov; [2]University of California Davis

THE EFFECTS OF WETLAND RESTORATION ON MERCURY BIOACCUMULATION IN THE SOUTH BAY SALT POND RESTORATION PROJECT: USING THE BIOSENTINEL TOOLBOX TO MONITOR CHANGES ACROSS MULTIPLE HABITATS AND SPATIAL SCALES

The South Bay Salt Pond Restoration Project's plans to convert salt ponds into tidal marsh habitat may result in changes to the distribution, availability, and bioaccumulation of methylmercury (MeHg) within the region, which is known to already have MeHg levels that exceed wildlife toxicity thresholds. Implementation of a robust monitoring network will allow restoration managers to document these changes simultaneously across multiple habitats, and may guide actions that compensate for unintended outcomes. The planned construction of a tidal breach in Pond A8 provides a unique opportunity to examine this approach. This proposal links benthic MeHg production potential, changes in water and sediment column Hg concentration and speciation with MeHg bioaccumulation in four key biosentinel species. Each biosentinel represents an important component of the local food web in the habitat mosaic, and each will provide direct evidence of Hg bioaccumulation across the landscape. A particular strength of this proposal is the collaboration of researchers involved, all of whom have been leading extensive mercury projects in the South Bay, and their ability to leverage baseline data to clearly demonstrate any changes in MeHg exposure as a result of the A8 management action. This study will provide critical information to ecosystem managers in guiding their future decisions regarding former salt pond management and wetland restoration activities.

15. Takekawa, John[1], Karen Thorne[1], Kyle Spragens[1], Michael Casazza[2], Cory Overton[2], Judith Drexler[3], Dave Schoellhammer[3], Kathleen Swanson[3], [1]USGS Western Ecological Research Center, San Francisco Bay Estuary Field Station, john_takekawa@usgs.gov; [2]USGS Western Ecological Research Center, Dixon Field Station; [3]USGS California Water Science Center

SEA-LEVEL RISE EFFECTS ON SALT MARSHES AND ENDEMIC WILDLIFE OF SAN FRANCISCO BAY

Coastal salt marshes and estuaries are projected to be disproportionately impacted by climate change and sea-level rise, according to the Intergovernmental Panel on Climate Change. Over 80% of wetlands in San Francisco Bay (SFB) estuary have been lost to urban development and landscape modification. Although fragmented and modified, SFB represents one of the largest tidal salt marsh complexes in the western United States and contains important remnant habitats for federal- and state-listed species. Maintenance and restoration of salt marsh habitats is crucial to the successful recovery of endangered species, but it remains unknown how much sea-level rise may affect the amount and quality of their habitats. Our goal is to provide detailed information on threats to tidal marsh species and their habitats at a site-specific scale. Changing water levels, sediment loads, extreme tide and storm events, and salinities will alter the plant community composition and structure. Our studies are beginning to define specific risks and to identify critical thresholds. We will provide examples from high resolution elevation models of specific salt marsh parcels and changes in habitat value for endemic species under scenarios of sea level rise.

Poster presentations (alphabetical by primary author)

1. Ackerman, Josh [1], Collin Eagles-Smith [1], Mark Marvin-DiPasquale [1] , Cheryl Strong [2], Eric Mruz [2] , and Mark Herzog [1]; [1] U.S. Geological Survey, jackerman@usgs.gov; [2] U. S. Fish and Wildlife Service, Don Edwards San Francisco Bay National Wildlife Refuge

MANAGING SALT PONDS TO INCREASE WATERBIRD NESTING HABITAT WHILE MINIMIZING METHYL MERCURY BIOMAGNIFICATION

The South Bay Salt Pond Restoration Project plans to convert 50-90% of salt ponds into tidal marsh. However, salt ponds are currently preferred habitat for many migrating and breeding waterbirds. Wetland managers plan to enhance the remaining salt ponds to maintain current waterbird numbers, yet it is unclear how to manage salt ponds to simultaneously increase waterbird foraging and nesting opportunities while minimizing the deleterious effects of methylmercury production. We conducted a study on the Don Edwards San Francisco Bay National Wildlife Refuge and created numerous nesting islands by lowering the water level in Pond A12 and exposing submerged substrate. In response, we documented nearly 600 waterbird nests in this pond despite it having no prior nesting. Nest success was 29% for avocets and 38% for Forster's terns, which was slightly lower than some neighboring ponds, probably due to California gull depredation of eggs. This generally positive benefit of increased nesting habitat for waterbirds, however, was mediated by the potential increased production of methylmercury. We found that Forester's tern, American avocet, and black-necked stilt eggs had higher mercury concentrations in Pond A12 than in other wetlands monitored. Additionally, we found that fish mercury concentrations in Pond A12 spiked in the summer after water levels were lowered in early spring to expose nesting islands. In contrast, fish mercury concentrations in a control pond (Pond A11) actually decreased throughout the summer. We found similar differences between the manipulated and control ponds' surface water chemistry, with Pond A12 having higher phytoplankton and methylmercury concentrations compared to Pond A11. Our data indicate that although we successfully created nesting habitat for waterbirds, methylmercury production may have been enhanced due to water management actions and methylmercury subsequently biomagnified up the food web. Further study is warranted to determine if these results are common among managed salt pond habitats in San Francisco Bay.

2. Adrean, Lindsay[1], Daniel D. Roby[1], Ken Collis[2], Allen Evans[2], Donald E. Lyons[1], Daniel Battaglia[1], [1]USGS Oregon Cooperative Fish and Wildlife Research Unit, Oregon State University, lindsay.adrean@oregonstate.edu; [2]Real Time Research

CASPIAN TERN CONSERVATION AND RESTORATION IN SOUTH SAN FRANCISCO BAY: POTENTIAL FOR MITIGATING LOSS OF NESTING HABITAT USING ARTIFICIAL ISLANDS

The number of Caspian terns (Hydroprogne caspia) nesting in San Francisco Bay has recently declined by 61%, from 1,350 breeding pairs in 2004 to 520 breeding pairs in 2010. The number of breeding colonies has also declined and currently there are just two colonies located in the Central Bay (ca. 506 pairs at Brooks Island and 2 pairs at Agua Vista) and two colonies in the South Bay (7 pairs at Eden Landing and ca. 5 pairs at Steven's Creek). Brooks Island continues to support by far the largest colony of Caspian terns in the Bay Area, with 97% of the breeding population, but the size of this colony is in steep decline due to a recent and expanding colony of California gulls (Larus californicus) and reductions in available nesting habitat for terns. Concurrent with population decline, Caspian tern nesting success has declined from 0.59 chicks per pair in 2003 to 0.17 chicks per pair in 2009. The two breeding colonies in the South Bay, Eden Landing and Steven's Creek, are severely limited by availability of suitable nesting substrate, as is the Agua Vista colony. The decline in the breeding population of Caspian terns in the Bay Area can be reversed by building sandy islands in the South Bay that offer protection from mammalian predators. Social attraction (decoys and acoustic playbacks) and limited gull control are effective at establishing Caspian tern colonies on suitable nesting islands. Juvenile salmonids accounted for less than 1% of identified prey items at Caspian tern colonies in the South Bay. There is no evidence that restoring the Caspian tern population in the South Bay would conflict with the restoration of ESA-listed fish (i.e., salmonids) or birds (i.e., least tern or snowy plover) in the Bay Area.

3. Archbald, Gavin, San Francisco State University and the Romberg Tiburon Center for Environmental Studies, gavinarchbald@gmail.com

IDENTIFYING *LIMONIUM RAMOSISSIMUM* POPULATIONS USING A SPECIES DISTRIBUTION MODEL AND GROUND SEARCHES IN TIDAL MARSHES OF SOUTH SAN FRANCISCO BAY

Early detection of invasive species is required for cost effective management of plant invasions, but finding nascent populations often requires extensive field surveys. Species distribution models provide a tool to focus field surveys to habitat likely to be invaded, and GPS tracking and mapping can be used to quantify and document search results. A logistic regression based-species distribution model was developed for an invasive wetland plant, *Limonium ramosissimum ssp provenciale*, in South San Francisco Bay salt marshes, and the results ground truthed using field searches. While the model's overall goodness of fit was not significant, many *L. ramosissimum* patches were found during ground searches and these were overwhelmingly located in cells the model predicts as moderate to high probability of potential *L. ramosissimum* habitat. Also, the model assigned high probability habitat with moderate accurately overall (Kappa = .68). These results suggest species distribution models are useful tools for identifying new invasions, even when the populations not in equilibrium are being modeled. This model could be refined using additional presence/absence data generated since model development and alternate predictor variables could be explored to improve model predictive power.

4. Archbald, Gavin, San Francisco State University and the Romberg Tiburon Center for Environmental Studies, gavinarchbald@gmail.com

AN OBJECT BASED IMAGE ANALYSIS APPROACH TO TESTING THE EFFECT OF FLOWERING AND PATCH SIZE ON *LIMONIUM RAMOSISSIMUM* DETECTION USINGCIR AND IKONOS IMAGERY

Remote sensing is a useful tool to detect and map invasive plants, but detection success depends on the spectral properties of individual species, their context, and the imagery used for mapping. Using an object based image analysis (OBIA) approach as well as pairwise correlations and pixel-based unsupervised classifications, the efficacy of two different image sources, 30 cm aerial color infrared imagery and 1 m pan-sharpened multispectral IKONOS satellite imagery, were tested to detect an invasive forb, *Limonium ramosissimum ssp provenciale* during its peak flowering period in salt marshes where it has been previously mapped with GPS. Using a variety of spectral layers, indices, rule sets, and unsupervised classifications parameters, regardless of the patch size, the degree to which patches were in flower at the time of image acquisition, or the imagery source, the invasive was not distinguishable from surrounding high marsh and transitional upland habitat. To integrate remote sensing into a comprehensive weed management program, a systematic review of which invasive species can be detected at what scale by which sources of imagery is recommended.

5. Blueford, Joyce R., Math Science Nucleus, blueford@msnucleus.org

DEVELOPING A MODEL USING HIGH SCHOOL STUDENTS FOR RESTORING, MONITORING AND CONDUCTING RESEARCH AT TULE PONDS AT TYSON LAGOON, FREMONT, CALIFORNIA

Tule Ponds at Tyson Lagoon in eastern San Francisco Bay is one of the largest sag ponds created by the Hayward Fault that has not been destroyed by urbanization. In the 1990's Alameda County Flood Control and Water Conservation District designed a constructed wetland to naturally filter stormwater before it entered Tyson Lagoon on its way to the San Francisco Bay. The Math Science Nucleus, a non profit organization, manages the facility that incorporates high school students through community service, service learning, and research. Students do a variety of tasks from landscaping to scientific monitoring. Through contracts and grants, we create different levels of competency that the students can participate. Engineers and scientists from the two agencies involved, create tasks that are needed to be complete for successful restoration. Every year the students work on different components of restoration. A group of select student interns (usually juniors and seniors) collects and records the data during the year. Some of these students are part of a paid internship to insure their regular attendance. Every year the students compile and discuss with scientists from the Math Science Nucleus what the data set might mean and how problems can be improved. The data collected helps determine other longer term projects.

This journey of the last 10 years has produced a very successful program and will outline the steps necessary to maintain a restoration project. It will also outline the different groups that do larger projects (scouts) and liaisons with schools that allow teachers to assign projects at our facility. The validity of the data obtained by students and how we standardize our data collection from soil analysis, water chemistry,

monitoring faults, and biological observations will be discussed. This joint agency model of cooperation provides high school students with a real research opportunity that benefits the students as well as restoration opportunities.

6. Demgen,Francesca[1], Michael Carbiener[1], David Pecora[1], Karen Taylor[2], Steve Carroll[3], [1]URS Corporation, francesca_demgen@urscorp.com; [2] California Department of Fish and Game; [3]Ducks Unlimited

RESULTS OF TWO YEARS OF FISH AND MACROINVERTEBRATE SAMPLING IN RESTORED SALT PONDS IN THE NAPA RIVER

Two years of fish and invertebrate sampling have been conducted in the Napa Plant Site Restoration Project (NPSRP) and a reference site, Fagan Slough Ecological Reserve, as part of a three year study to monitor fish use of the restored salt processing plant on the Napa River. Within a month of the August 2010 breach, topsmelt (*Atherinops affinis*) were collected with beach seines in the former crystallizer beds restored by the California Department of Fish and Game. The goal of this project is to describe fish community assemblages, distribution, and abundance within specific microhabitat types; and to document year to year changes in assemblages, distribution, and abundance as the site evolves from pre to post breaching and early wetland establishment.

The Napa Plant Site Restoration Project is comprised of three subunits: the North Unit (205 acres) was reconnected to Fagan Marsh Ecological Reserve and the Central (175 acres) and South Units (1080 acres) of the Napa Plant Site comprise the Green Island Unit of the Napa Sonoma Marshes Wildlife Area. Fish and invertebrates were collected using a variety of methods, including beach seine, otter trawl, and block net/ seine in order to sample all habitat types within the project area. Samples were collected in spring, summer, and fall in order to cover all life stages and species that may be utilizing the project area. The poster will discuss species collected during the study, including seasonal population trends and habitat preference data.

7. Elias, Edwin[1], Bruce Jaffe[2], [1]Deltares and US Geological Survey Pacific Coastal and Marine Science Center, eelias@usgs.gov; [2]US Geological Survey Pacific Coastal and Marine Science Center

MODELING THE EFFECTS OF SEA-LEVEL RISE ON WAVES AND CURRENTS IN SOUTH BAY, SAN FRANCISCO, CALIFORNIA

Global warming is expected to result in a sea level rise in San Francisco Bay of about 55 inches (1.4 m) by the end of the century putting an estimated 270,000 people and an estimated $62 billion of infrastructure and buildings at risk from flooding (BCDC, 2009). The effects of sea level rise on tidal propagation, waves, and currents in the South Bay are explored using the Delft3D model system. Validation of the model shows that the main characteristics of the tidal motion are reproduced. Model results for various scenarios of sea level rise illustrate a near-linear response in South Bay water levels for sea level rise scenarios between 0.5 and 5 m. For a 1.40 m sea level rise scenario, large flow velocity increases occur south of Dumbarton Bridge where the effects of inundation were most pronounced. Sensitivity simulations assessing the effects of sea level rise on wave generation, using a range of wind speeds (5-25 m/s) and directions, indicate that wave heights increase up to 0.50 m at key locations. Largest increases are observed on intertidal flats. Besides the well-known problem of inundation, this study points to the possible important effects of increased flow velocities and augmented wave heights, both of which might pose a hazard for recreational and commercial shipping, and could induce (increased) erosion of the intertidal flats.

8. Fonseca, T. [1], D. Moody [1], M. Herzog [2], J. Ackerman [2], L.A. Brand [2], J. Demers [3], J. Takekawa [2], J. Wood [1], G. Ballard [1]; [1] PRBO Conservation Science, gballard@prbo.org; [2] U.S. Geological Survey; [3] San Francisco Bay Bird Observatory

INTEGRATIONG AVIAN DATASETS FOR MANAGEMENT, MODELING, AND VISUALIZATION

The purchase of more than 15,000 acres of salt ponds in San Francisco Bay enabled North America's second largest habitat restoration project. Because it utilizes an adaptive management framework, the South Bay Salt Pond Restoration Project (SBSPRP) requires access to historical and ongoing monitoring data to assess and refine management effectiveness. PRBO Conservation Science (PRBO), U.S. Geological Survey (USGS), and San Francisco Bay Bird Observatory (SFBBO) are collaborating to make all avian data accessible and readily usable by the managers of the SBSPRP. These data represent millions of dollars in

investments spanning decades of fieldwork, and will provide the SBSPRP with accurate baseline estimates of bird numbers, and a measure of progress for ongoing activities. The Integrated South Bay Avian Database (ISBA-DB) utilizes the industry-proven infrastructure of the California Avian Data Center (www.prbo.org/cadc) to organize and facilitate the synthesis and visualization of avian data in the South Bay. Modeling efforts will help set restoration targets and assist the SPBPRP team make informed management decisions. ISBA-DB will provide the information required to determine and prioritize data needs. The system allows new data to be instantly available for managers and restoration assessment, and linkages between ISBA-DB and the existing South Bay Salt Pond Project Database will provide managers with enhanced decision support resources. The current prototype of ISBA-DB already provides access to consolidated shorebird area surveys from 1990-2010, integrating research from USGS, SFBBO, and PRBO into one repository. An online mapping tool provides an easy way to browse this repository for aggregate information such as raw numbers of shorebird species seen in a given pond per year and will soon offer map layers of pond depth and salinity. The ISBA-DB project team is working directly with the SBSPRP project leads to ensure that the population metrics and other data summarizations are the ones most needed for project assessment and planning. In addition, training and support will ensure the tools are immediately used.

9. He, Shaomei[1], Mark Waldrop[2], Lisamarie Windham-Myers[2], Tanja Woyke[1], Susannah G. Tringe[1], [1]DOE Joint Genome Institute, Walnut Creek, CA, sgtringe@lbl.gov; [2]U.S. Geological Survey, Menlo Park, CA Principal Investigator DOE Joint Genome Institute

MICROBIAL COMMUNITY PROFILING OF RESTORED WETLAND SEDIMENTS

Wetland restoration has the benefit of reversing land subsidence on peat islands in areas drained for agriculture, thereby reducing risk of levee failure. In addition, it provides wildlife habitat, and the high primary production and slow decomposition rates found in restored wetlands may result in a net negative carbon flux beneficial for sequestration of atmospheric CO2. Despite these potential benefits, one major concern is the emission of methane that could potentially offset the greenhouse gas benefits of carbon captured due to primary production. In wetland ecosystems, microorganisms play key roles in important processes, such as methane production and oxidization. Therefore, we are interested in the microbes found in restored wetland ecosystems and the processes they mediate. In this preliminary study, we collected belowground samples from a restored wetland largely vegetated with cattails and tules from a U.S. Geological Survey pilot-scale restoration project on Twitchell Island in the Sacramento/San Joaquin Delta. We collected samples at two different depths, and extracted DNA from different plant biomass types. Pyrosequencing of amplified V8 regions of 16S rRNA genes was used to generate microbial community profiles. For all samples analyzed, microbial communities were primarily governed by plant biomass types. For the same plant biomass type, a moderate influence of depth was observed. Archaeal species closely affiliated with characterized methanogens were identified from both sample depths, as well as methanotrophic bacteria. The highest archaeal abundance was observed in a tule rhizome (accounting for ~24% of the total microbial community). Many abundant microbial species were also similar to those previously observed in similar environments, such as peat bogs, marshes, rice paddies, anaerobic digesters, methanogenic consortia, soils and sediments. Many of these microbial species show very high (> 99%) 16S rRNA gene sequence identity to characterized microorganisms that perform lignocellulose decomposition, sugar fermentation, denitrification, Fe(III) reduction, sulfate reduction, sulfur oxidation, methanogenesis and methane oxidation. Therefore, this primary investigation enables a glimpse of the microbial community composition and the likely biological processes that these microbes mediate. Further metagenomic and metatranscriptomic analyses are planned to reveal the microbial functions important for long-term carbon sequestration and nutrient cycling by the restored wetland microbial community.

10. Hogle, Ingrid, San Francisco Estuary Invasive Spartina Project, ibhogle@spartina.org

INVASIVE SPARTINA: >85% REDUCTION IN THE SF BAY

Since full-scale control efforts began in 2005, the State Coastal Conservancy's San Francisco Estuary Invasive Spartina Project (ISP) has coordinated the reduction of over 85% of the cover of invasive Spartina in the Bay. The cover of invasive Spartina throughout the Bay has been reduced from a height of over 800 acres in 2005 to approximately 100 acres in 2010. As the ISP works to coordinate the "end game" of controlling the remaining
invasive Spartina in the Bay, the collaboration between the ISP Monitoring Program's GPS/GIS data and the ISP Control Program's coordination and assistance with treatment activities has necessarily become crucial to project, success. Here we document the monitoring program's data collection and analysis efforts to date, and the direction that the project is taking in using GPS/GIS technology to assist in reaching the "end game" of invasive Spartina control.

11. Holleman, Rusty, Lissa MacVean, Mark Stacey, Contact: Rusty Holleman, UC Berkeley, holleman@berkeley.edu

HYDRODYNAMIC SIMULATIONS OF SALT POND RESTORATION ACTIVITIES IN SOUTH SAN FRANCISCO BAY

Landscape-scale habitat restoration alters local and system-wide hydrodynamics in an estuary. These changes may lead to side-effects such as hindered flood protection, resuspension of contaminated sediments and altered distributions of salt and pollutants.
In order to better understand the effect of restoration activities, such as the Island Pond breaches, on local and embayment scale hydrodynamics, we have developed a high resolution 3D hydrodynamic model focused on the area of the Island Ponds in South San Francisco Bay. Capturing the fine scale dynamics near the restoration requires high resolution (down to 2 meters) in the vicinity of the pond breaches, and an unstructured grid allows seamless coupling with San Francisco Bay and the coastal ocean. The intertidal nature of the study area along with the wide range of spatial scales involved requires novel approaches for both the creation of the bathymetric grid and for maintaining computational stability in the presence of wetting and drying. Salinity and velocity predictions from the simulations are in good agreement with field observations recorded shortly after the ponds were breached, demonstrating that the model will be a powerful tool for evaluating restoration efforts in the future.

12. Latta, Marilyn[1], Kathy Boyer[2], Robert Abbott[3], Susan De La Cruz[4], Ted Grosholz[5], Jeremy Lowe[6], Rena Obernolte[3], Chela Zabin[5], [1]State Coastal Conservancy, mlatta@scc.ca.gov; [2]San Francisco State University, Romberg-Tiburon Center for Environmental Studies; [3]Environ; [4]USGS; [5]UC Davis; [6]PWA/ESA

SAN FRANCISCO BAY LIVING SHORELINES PROJECT: PILOTING CLIMATE CHANGE ADAPTATION TECHNIQUES AND INCREASING LINKAGES BETWEEN TIDAL WETLANDS AND SUBTIDAL HABITATS

The San Francisco Bay Living Shorelines Project is a pilot, multi-habitat, multi-objective restoration project to test new approaches to climate change adaptation planning and test best methods to increase linkages between tidal wetlands and subtidal habitats in the San Francisco Estuary.
This is an interdisciplinary project with physical and biological scientists working together from the State Coastal Conservancy, San Francisco State University, UC Davis, USGS Western Ecological Research Center, Environ, and PWA/ESA Associates. Living Shorelines have been constructed on the east and gulf coasts for two decades, and utilize a suite of bank stabilization and habitat restoration techniques to reinforce the shoreline, minimize coastal erosion, and maintain coastal processes while protecting, restoring, and creating natural habitat for fish and aquatic plants and wildlife. This technique was coined with the term "Living Shorelines" because it provides "living space" for estuarine and coastal organisms, which is accomplished via the strategic placement of native vegetation, sand fill, organic materials, and reinforcing rock or shell for native species settlement. This project will implement 2 acres of oyster, eelgrass, and other subtidal restoration treatments in the subtidal areas at each of three sites: Eden Landing Ecological Reserve, Corte Madera Ecological Reserve and Open Space, and Eastshore State Park. The project's goals are to scale up and further test multiple methods for subtidal restoration; look at the ability of these treatments to soften the shoreline edge, effect flow, and act as a buffer against shoreline erosion and sea level rise; and study their potential benefits to increasing species use (invertebrates, fish, birds) between subtidal and tidal wetland areas. The project is in the design phase, with implementation

tentatively planned for summer 2011, and two years of post-construction monitoring from 2011-2013. This is an interdisciplinary project that helps to implement the new San Francisco Bay Subtidal Habitat Goals recommendations concerning subtidal areas, and integration with critical tidal wetland sites like the South Bay Salt Ponds Restoration Project.

13. Law, Jaslyn, Stanford University undergraduate, jaslyn@stanford.edu

CHARACTERIZING ALAMEDA SONG SPARROW DENSITY AND DISTRIBUTION USING SPATIAL VEGETATION PATTERN ANALYSIS

The restoration and management of San Francisco Bay wetlands have critical implications for many endangered avian species. This research is designed to be a first step towards better understanding the relationship between bird habitat and the naturally-occurring vegetation patterns in salt marshes. Such knowledge could inform improved design of projects to restore or conserve habitat for endangered bird populations. The goal of the project is to determine whether the density and distribution of the endemic Alameda Song Sparrow (*Melospiza melodia pusillula*), a California State Species of Concern, is significantly correlated with specific vegetation patterns at multiple scales. The approach is to use fine-scale (0.3 m) visual-spectrum photography as the basis for analyzing patterns of spatial distribution of vegetation in salt marshes. Statistically-based supervised classification routines were run on individual study sites within the software ENVI 4.7. These classifications were based on training areas selected both through ground truthing in the field and by comparisons with published classified maps. Next, point-count population data for *M. m. pusillula* were overlaid on the classified vegetation maps. A preliminary test on a small subset of point-counts shows reasonable correlation between bird density and a number of spatial patterning landscape metrics calculated with Spatial Analyst 4, including patch isolation and patch size coefficient of variance. In contrast to existing landscape analyses focusing on plant assemblage listing-and-diversity-metric methods, this research aims to quantitatively analyze spatial patterns of vegetation cover.

14. Marriott, Meg, Brian Alfaro, U.S. Fish and Wildlife Service San Francisco Bay National Wildlife Refuge Complex, Meg_Marriott@fws.gov

SOUTH SAN FRANCISCO BAY WEED MANAGEMENT PLAN 2010 INVASIVE WEED INVENTORY

As part of the South San Francisco Bay Weed Management Plan, we initiated an inventory of the 25 priority invasive weeds, "watch list" species and Bay Area Early Detection Network (BAEDN) listed plants within the Weed Management Area. This poster illustrates and describes the data we collected during the first phase of our initial inventory. Between the months of June and November 2010, we began the mapping of the first comprehensive baseline distribution and abundance of invasive weeds, in uplands, transition zones, and wetlands within the Don Edwards San Francisco Bay National Wildlife Refuge. We collected five attributes associated with each weed patch mapped, including; species, habitat type, phenology, diameter of infestation and percent cover. From this data, we generated graduated point features as graphical representation of weed distribution. We were only able to cover approximately half of the Weed Management Area in 2010. However, we plan to complete our initial inventory in 2011, and to conduct subsequent annual monitoring inventories or surveys so that new infestation are found when still small enough to eradicate, and to track changes in documented weed infestations. Data will help us to develop and prioritize weed management decisions and to subsequently augment management action sections of the South San Francisco Bay Weed Management Plan with specific recommendations for weed control.

15. Marvin-DiPasquale[1], M., J.L. Agee[1], E. Kakouros[1], L.H. Kieu[1],Josh Ackerman[2], and Collin Eagles-Smith[2], [1]U.S. Geological Survey, Menlo Park, CA, mmarvin@usgs.gov; [2] U.S. Geological Survey, Western Ecological Research Center, Davis, CA

SEASONAL DYNAMICS OF SURFACE WATER MERCURY SPECIATION AND PARTITIONING IN TWO CONTRASTING SOUTH SAN FRANCISCO BAY SALT PONDS: THE INFLUENCE OF PRIMARY PRODUCTION

One goal of the South Bay Salt Pond Restoration Project (SBSPRP) is to increase wildlife habitat. To this end, and to accommodate planned changes in Pond A8 that would decrease bird nesting habitat, Pond A12 was partially drained to increase interior island habitat for nesting birds. As part of a larger study to investigate the effectiveness of this management action on bird nesting recruitment, we examined water column mercury (Hg) dynamics in Pond A12 and compared and contrasted these to a control pond (A11),

which was not partially drained. The focus was to examine (a) Hg-speciation (total mercury [THg], methylmercury [MeHg] and reactive inorganic mercury [$Hg(II)_R$]) and Hg-partitioning (dissolved vs. particulate) within these two managed ponds, and (b) the extent to which observed Hg dynamics are influenced by temporal/spatial changes in water column primary production (as chlorophyll-a) and total suspended solids (TSS). Surface water was sampled bimonthly, between January and September 2008. Key findings include: (a) the vast majority of both THg and MeHg was associated with the particulate phase (TSS); (b) whole water concentrations for all three Hg species were consistently higher in Pond A12 than in A11, which paralleled the findings for THg concentrations in bird eggs and fish; (c) the partitioning of both THg and MeHg between the filtered and dissolved phases varied more dramatically in Pond A11 than in Pond A12; (d) a significant increase in the percentage of THg that was $Hg(II)_R$, between January and May in Pond A12; (e) this was followed by both filtered and particulate MeHg peaking in Pond A12 during July, which also corresponded to a peak in chlorophyll-a and TSS; (f) salinity, chlorophyll-a and TSS were all consistently higher in Pond A12 compared to A11; and (g) there was a significant positive correlation between surface water salinity and chlorophyll-a (all data). It is unclear if the difference in Hg dynamics between the two ponds was directly due to the partial draining of Pond A12, as no baseline data prior to the draining event was available. However, these results do suggest that pond salinity is linked to phytoplankton density, which in turn affects the concentration and speciation of Hg in the particulate phase, and ultimately Hg concentration in biota.

16. Mayfield, Ryan, City of San Jose, Environmental Services Department, Ryan.Mayfield@sanjoseca.gov

STATUS, TRENDS AND THE FUTURE OF POND A18

Pond A18, the largest of the former Cargill salt ponds, is located next to and operated by the San Jose/Santa Clara Water Pollution Control Plant (Plant). The pond was initially purchased by the City to provide additional buffer for the Plant's operations. After acquiring former salt pond, Pond A18, in 2005, the City of San Jose's (City) continuous flow-through circulation management has improved water quality threshold levels beyond the Waste Discharge Requirement (WDR). This provides opportunities for habitat restoration and flood control as part of the Plant Master Plan.

While the future of Pond A18 will be determined by the long-range facilities and land use plan for the Plant, interim Pond management must protect the water quality of the South San Francisco Bay. To do this, each year from May through October, City staff continuously monitors the discharge of Pond A18 and the receiving water (Artesian Slough) for dissolved oxygen, salinity, temperature, and pH. Staff also takes monthly depth profiles at four monitoring stations in Artesian Slough to analyze the tidal impact on slough water quality. Once per year, sediment samples are taken within the Pond for mercury and methyl mercury analysis as required by the WDR.

Results after six years of monitoring show improvements in water quality in most measured parameters. Dissolved oxygen levels generally remain above threshold levels, as well as salinity, temperature, and pH. Mercury and methyl mercury have decreased since 2005 when samples were first taken. Comparisons between pond and slough water quality have consistently shown that effects of pond water on the receiving water (Artesian Slough) are negligible and that the water quality of the slough is dominated by tidal mixing of Bay water.

Understanding the hydrological function of Pond A18 allows the City to plan for future marsh restoration projects included in the draft Plant Master Plan. These projects will create a terraced habitat in Pond A18 to restore salt marsh, provide habitat for fish and wildlife, and protect the Plant from floods.

17. Moffett, Kevan B.[1]. David A. Robinson[2], and Steven M. Gorelick[1]; [1]Dept. of Environmental Earth System Science, Stanford University, moffett@stanford.edu; [2]Centre for Ecology & Hydrology, Environment Centre Wales, Bangor, Gwynedd

QUANTITATIVE DIFFERENTIAL ELECTRO MAGNETIC INDUCTION (Q-DEMI): MAPPING DYNAMIC SALT MARSH SOIL MOISTURE AND SALINITY PATTERNS AT HIGH RESOLUTION

Salt marsh vegetation zones are thought to correlate with spatial variations in soil water content and salinity, according to abundant literature based on point measurements. Due to the difficulty in creating high resolution maps of soil water content and salinity, however, this theory has so far not been tested over a broad spatial area. A new method was developed to map the magnitude of tidally-induced changes in soil saturation and salinity throughout an intertidal salt marsh at high (2 m)

resolution. The quantitative differential electromagnetic induction (Q-DEMI) method requires three steps. (1) Conduct two rapid surveys of soil electrical conductivity (ECa) during dry and wet conditions using a portable EMI device. (2) Post-process, including temperature correction, and subtract the two surveys' data. (3) Convert the apparent change in ECa to quantitative estimates of salt marsh soil salt loss and soil water gain between dry (pre-flood) and wet (post-flood) conditions.

The results obtained by the Q-DEMI method at a salt marsh site in Palo Alto, CA, were used to test the spatial relationships between vegetation patterns and hydrologic and edaphic variables. Multiple abiotic variables were represented by six metrics: elevation, distance to major tidal channels and to the nearest channel of any size, soil ECa during dry and wet circumstances, and the Q-DEMI soil saturation and salinity change map. Logistic regression statistics suggested that each salt marsh vegetation zone and the habitats of each major plant species were uniquely characterized by different combinations of the six metrics. Based on results from 108 binary logistic regression models of vegetation distribution, the QDEMI map of saturation and salinity change was found to be the most useful metric available for distinguishing the locations of different salt marsh vegetation zones and plant species habitats. We suggest that the Q-DEMI method may be useful for diagnosing spatial patterns in soil conditions before restorations, to assist with restoration planning, or as part of a post-restoration monitoring program of vegetation zone development.

18. Newcomer, Michelle [1], Amber Kuss[1], Tyler Ketron[2], Alex Remar[3], Vivek Choksi[4]; [1]San Francisco State University, DEVELOP NASA Ames Research Center, Michelle.E.Newcomer@nasa.gov ; [2]Stanford University; [3]Cal Poly San Luis Obispo; [4]Gunn High School

MODELING SEDIMENT DEPOSITION FOR PREDICTING MARSH HABITAT DEVELOPMENT

The South Bay Salt Pond Restoration Project (SBSPRP) is the largest tidal wetland restoration project on the west coast of the United States. The purpose of this project was to use *in-situ* and remote sensing measurements to create a GIS model capable of predicting sediment deposition in restored ponds in the Alviso Salt Pond Complex. A sediment transport model, suspended sediment concentration maps, as well as laboratory analyses of *in-situ* sediment data were used to predict sediment deposition. Suspended sediment concentrations from our *in-situ* samples as well as the USGS's continuous monitoring sites were correlated with Landsat TM 5, ASTER, and MODIS reflectance values using three statistical techniques—an Artificial Neural Network (ANN), a linear regression, and a multivariate regression to map suspended sediment concentrations in the South Bay. Multivariate and ANN regressions using ASTER proved to be the most accurate correlation method, yielding R^2 values of 0.88 and 0.87 respectively. Sediment grain size data were collected from Pond A21 to determine particle settling velocities, grain size distribution, bulk densities, and rates of deposition. These data coupled with tidal frequencies and suspended sediment maps were used in the Marsh Sedimentation (MARSED) model for predicting deposition rates for three years. Data from MODIS were used to track sediment transport pathways in the South Bay for further assessing future marsh development. Results from this project were applied to the Regional Ocean Modeling System (ROMS) sediment transport module for understanding sediment dynamics in the South Bay. MARSED results for Pond A21 show an RMSD of 66.8mm (< 1□) between modeled and field observations and can therefore be successfully used to model future wetland restoration efforts.

19. Orr, Michelle[1]**,** Nicholas Garrity[1], John Bourgeois[2], Brenda Buxton[2], [1]ESA PWA**,** morr@esassoc.com; [2]CA State Coastal Conservancy

IMPLEMENTING WETLAND RESTORATION WITHIN A REGIONAL CONTEXT: PHASE 1 OF THE SOUTH BAY SALT POND RESTORATION PROJECT IN SAN FRANCISCO BAY

The South Bay Salt Pond Restoration Project, once complete, will restore 15,100 acres of industrial salt production ponds to tidal wetland and other habitats, making it the largest tidal wetland restoration project on the west coast of the U.S. One of the fundamental restoration questions is the optimal configuration of tidal wetland and managed pond habitats to best meet the project objectives. Since the optimal configuration is not known at this time, the ultimate mix of habitats will be guided by science-based adaptive management as the project is implemented in phases over the next 50 years. This poster will discuss how implementation and monitoring of Phase 1, currently in progress, will inform the larger regional restoration. Phase 1 is designed to restore ecologically-valuable habitat and at the same time experimentally test key uncertainties to guide future implementation. There are six Phase 1 restoration "actions," ranging in size from 230 to 1,400 acres (total 3,200 acres), in design and construction. Two actions are designed to test shorebird use of managed ponds with constructed nesting islands and water

levels managed for shallow water foraging. Island shape and spacing are experimental variables. A third action is designed to test the importance of varying salinity (low to high) on shorebird foraging. A fourth action, located in an area of higher mercury concentration in the sediments, is designed to test the effects of tidal restoration on mercury bioavailability, and is reversible in case any problems are identified. The remaining two actions are tidal wetland restorations.

20. Overton, Cory, Michael Casazza, Vivian Bui, Joel Shinn, and John Takekawa,
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SEASONAL AND TIDAL PATTERNS IN SURVIVAL OF CALIFORNIA CLAPPER RAILS: WILL FLOATING ISLANDS MEDIATE THE EFFECTS OF CRITICALLY LIMITING HIGH TIDE REFUGIA?

The California clapper rail (*Rallus longirostris obsoletus*) remains a critically endangered species over thirty years after its inclusion on state and federal endangered species lists. Populations have recently undergone declines after a decade of increase from historic lows. Management of this species and its habitat is hampered by a poor understanding of the patterns and processes of survival rates. We assessed California clapper rail survival using Kaplan-Meier product limit estimators from Program MARK on 108 radio-marked clapper rails in four South San Francisco Bay salt marshes between January 2007 and March 2010. Survival rates were lower than previously published estimates for any clapper rail subspecies. We found no evidence of transmitter effects in behavior, body mass changes, or duration of transmitter attachment. Survival rates varied seasonally with lowest weekly survival probability in the winter (November through February). Evidence also suggests that maximum weekly higher high water level had a negative correlation with survival probability. We hypothesize that senescence of vegetation results in lower winter survival which is driven by volatility in available refuge habitat by tidal extremes. Subsequently, we have begun investigating conservation measures to recover this endangered species through increasing high tide refugia lost due to habitat management actions. Initial results indicate significantly higher levels of use of artificial island refuge during high tide periods supporting the hypothesis that high tide refuge is limiting. Conservation actions meant to reverse recent population declines and lead to eventual recovery of the species may want to consider addition of artificial refuge islands as a new conservation tool; particularly in light of potential sea level changes and historic and contemporary habitat change.

21. Rastofer, Rob, HNTB, rrastorfer@hntb.com

TRES RIOS ECOSYSTEM RESTORATION PROJECT

Services -Assessments, Planning, Wetland and Bird Habitat Surveys and Restoration, Development of Final Design Plans and Specifications, Environmental Protection Planning, Civil Engineering, Hydraulics and Hydrology, Landscape Design, Storm water Pollution Prevention Plan, and Best Management Practices

Project Overview - The Tres Rios Environmental Restoration Phase III design-build project is located in Phoenix, Arizona within Maricopa County and extends approximately 5.2 miles in length and one mile in width, along the Gila River. The development of the Phase III portion of the project restores critical riparian and wetland habitats within the actual river channel that have been lost in the region as a result of water resources development in the Phoenix metropolitan area and creates a more conducive, sustainable and diverse habitat for the threatened and endangered species in this region. To maintain the vegetative habitat, the project will take the opportunity to utilize various water sources that include natural river flow, low groundwater level and discharge flows from the 91st Avenue wastewater treatment plant located approximately two miles upstream of the project area.

Alternative Grading and Habitat Concept Plan - The features proposed in the Phase III reach of this project include a braided stream design that is flanked by a series of wetland marsh habitats that transition to a mixed cottonwood and willow riparian corridor and finally blends with a native mesquite bosque area along the perimeter of the project area. The braided stream design supports the riparian habitat to allow water to flow adjacent to the cottonwood and willow habitat and continue downstream through a series of connected open water and marsh areas. Also included are several open water/marsh areas with nesting islands and benches, that take advantage of (1) the water continuing through the riparian corridors, (2) the natural flow of the river, and (3) groundwater levels in the area. There are also improved habitat areas to accommodate future trail connections and alignments.

22. Rowan, Aariel[1], Isa Woo[2], James Lovvorn[3], John Takekawa[2], Jerry Davis[1],[1] San Francisco State University, Dept of Geography and Environmental Science, aro@mail.sfsu.edu; [2]U. S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station; [3] Southern Illinois University, Dept of Zoology

EFFECTS OF THE SOUTH BAY SALT POND RESTORATION PROJECT ON MUD FLATS AND THEIR CARRYING CAPACITY FOR SMALL SHOREBIRDS

A major question challenging the South Bay Salt Pond (SBSP) Restoration Project is whether conversion of existing salt ponds will result in decreased numbers of migratory birds supported in the region. The South Bay is renowned for its populations of shorebirds and has been designated as a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Importance. The availability of food resources on the mud flats and their carrying capacity will be a primary concern for conservation of shorebirds as restoration progresses in the South Bay Salt Ponds.

This project uses elevation, water level, invertebrate density and avian abundance data collected by the USGS to estimate the carrying capacity of Western Sandpipers and Dunlin at an intertidal mudflat in South San Francisco Bay. Here, we present our methods and preliminary results as the work is currently in progress. Data collected during the period prior to the breach of pond RSF2 (August 2009 to May 2010) is used to develop a foraging model based on the tidal availability of mudflats and the energetic balance between shorebirds and their invertebrate prey. Once refined, the carrying capacity model will be used to describe the potential impact to foraging small shorebirds given possible scenarios of mudflat change (increased slope, overall loss of elevation, increased channelization).

23. Stoecker, Matt, Beyond Searsville Dam, info@BeyondSearsvilleDam.org

SEARSVILLE DAM REMOVAL: RESTORATION OPPORTUNITY FOR THE SAN FRANCISCO BAY

Owned by Stanford University and located within their Jasper Ridge Biological Preserve, Searsville Dam was completed in 1892 and is the largest dam in the San Francisquito Creek watershed. The concrete dam measures approximately 65 feet in height and 240 feet in length. Fish passage facilities were never built for the historic salmon and steelhead runs to reach spawning and rearing habitat upstream. There are no dedicated bypass flows downstream for habitat and listed wildlife. Approximately 1.5 million cubic yards of sediment have accumulated behind the dam, reducing the original 350 million gallon capacity by approximately 90%. Currently, the dam has limited irrigation water diversion capabilities and provides no electricity or flood protection benefits.

Searsville Dam causes several negative impacts to one of the last wild runs of threatened steelhead trout in San Francisco Bay, including but not limited to: blocking access to miles of former spawning and rearing habitat, reducing downstream spawning gravels and habitat complexity, reducing downstream flows and water quality, and harboring non-native predatory species that compete with and prey upon native wildlife while spreading to downstream habitats. Dam removal could allow for the recovery of steelhead to almost 20 miles of historic habitat upstream in the creeks flowing through Woodside and Portola Valley, restore the submerged valley and riparian habitats of five creeks, reestablish historic wetland ponds currently submerged, eliminate non-native fish and frog species that occur in Searsville Reservoir, and eliminate the safety liability and costs of maintaining this over-a-century old structure adjacent to the San Andreas Fault. In addition, S.F. Bay wetland restoration projects have a need for "clean and local" sediment that could be provided with Searsville Dam removal and natural sediment transport needed to help replenish and protect Bay wetlands in the face of sea-level rise would be restored offering a unique opportunity to preserve Bay wetlands into the future.

Across the country and around the world, dams that have outlived their usefulness are being removed to restore ecosystem health, reduce safety risks, comply with environmental regulations, save money, and revitalize communities. Searsville Dam offers a unique watershed and San Francisco Bay wetland restoration opportunity.

The Beyond Searsville Dam Coalition was recently formed due to the expressed need for an independent group promoting the investigation of removing Searsville Dam. The Coalition is an alliance of thousands of supporters, advocates, environmental groups, resource agencies, and private companies advocating for

restoration of native habitat and species, a free flowing San Francisquito Creek, and revived San Francisco Bay ecosystem through removal of Searsville Dam in a safe manner that is consistent with protecting creekside communities and our regional ecosystem.

24. Swanson, K.M[1]., J.Z. Drexler, D.H. Schoellhamer, K.M. Thorne, K.A. Spragens, and J.Y. Takekawa,
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INTEGRATING BIOLOGICAL AND PHYSICAL PROCESSES TO PREDICT THE IMPACT OF SEA-LEVEL RISE ON TIDAL MARSH HABITAT

The San Francisco Bay Estuary contains the largest extent of tidal marsh in the western United States and is home to several state and federally listed threatened and endangered species. Climate change threatens these habitats through accelerated sea-level rise. These wetlands are sustained when the rate of relative sea-level rise is less than or in equilibrium with organic and inorganic inputs to the marsh surface. The Wetland Accretion Rate Model for Ecosystem Resilience, or WARMER, a 1-D model of elevation at a point representative of wetland habitat that incorporates both biological and physical processes of vertical marsh accretion, is currently being developed in order to better understand the threat of rising sea level on marsh sustainability. Processes included in the model are inorganic sediment deposition and organic matter production, decomposition, and compaction. WARMER builds upon existing wetland vertical accretion models by incorporating more realistic tidal forcing and sediment deposition processes as well as including a more realistic biomass production routine. The model will be applied to marshes across the San Francisco Bay Estuary in conjunction with wildlife monitoring as part of the USGS National Climate Change and Wildlife Science Center Project. Results will be used to evaluate the likely effect of sea-level rise on the elevation of habitat used by endangered and threatened species and the potential for these habitats to be drowned. This poster will present the theoretical framework for the model and describe how the model will be applied to various marsh habitats throughout the San Francisco Bay Estuary.

25. Takekawa, John[1], Isa Woo, Arriana Brand, Monica Iglecia, Erin Flynn, and Tomohiro Kuwae;
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ASSESSING BIOFILM SEASONALITY, DISTRIBUTION, AND CONSUMPTION IN THE SOUTHERN SAN FRANCISCO BAY

Studies suggest that biofilm, a thin, superficial matrix of microphytobenthos, microorganisms, and extracellular polymeric substance that forms on periodically exposed sediment surfaces, constitutes up to 59% of the diet of Western Sandpipers (*Calidris maur*). Unique tongue morphology and recently discovered foraging behaviors elucidate the targeted consumption of biofilm by Western Sandpipers and other Calidris shorebirds. Biofilm grazing has been observed on intertidal sandflats in Japan and mudflats in British Columbia, Canada; however, there is little documentation of the presence of biofilm at other critical stopover sites. In addition, the distribution of this novel foraging strategy throughout the species range is still unknown. Given the importance of the San Francisco Bay as a migratory stopover site for multiple Calidris shorebirds, an understanding of the role of biofilm in shorebird diets will be critical for ensuring quality foraging habitat for these species.

To assess the seasonal and spatial availability of biofilm in the San Francisco bay for foraging shorebirds, we have partnered with international scientists and have incorporated biofilm collection with ongoing monthly benthic invertebrate and bird observations in southern San Francisco Bay tidal flat (RSF2 shoals). Monthly observations of biofilm presence and absence, and ocular estimation of percent cover along an elevation gradient will provide temporal and spatial quantification of biofilm. Stable isotope analyses will assess the potential nutritional contribution of biofilm at this highly used mudflat. This data, paired with future video observations, will allow us to quantify the time allotted to grazing on biofilm compared to consuming invertebrates.

26. Thomson, David, Tidal Marsh Ecotone Restoration Research, d.x.thomson@gmail.com

RESTORING TIDAL MARSH-UPLAND ECOTONES IN SOUTH SAN FRANCISCO

Restoring vegetation adjacent to the tidal marshes of San Francisco Bay at large scales has been an elusive goal. Restoration of one hundred thousand acres of tidal marsh is a regional goal for the estuary, and progress is occurring, but restoring the tidal marsh-upland ecotones and surrounding habitats at such

scales was not within our current capabilities. These habitats immediately above the intertidal zone are a critical component of the tidal marsh ecosystem, but are dominated by nonnative plants that do not provide high quality habitat for native fauna and can exclude native flora. Although one-quarter of the estuary's intertidal marshes were not directly impacted by development, many upland habitat types approach extirpation surrounding the estuary. The remaining plant communities are fragmented, their floristic integrity necessarily weakened, which is likely why they now require active propagation to restore.

We are beginning our 5th year of applied research, with a goal of describing plans and specifications for restoring tidal marsh-upland transitional plant communities feasibly across large acreages. Our methods have progressed to the point that we will begin testing them at other sites, and in particular Pond A6, which was restored to tidal action late last year. Phase I began with pre-seeding weed abatement last fall to prepare for aerial hydroseeding in the fall of 2011.

27. Watson, Ann K.[1], Wei-Chen Hsu[2], Rachael Marzion[2], Krysti Sukita[3], Eve Minkin[4], [1]East Central University, Oklahoma, kristyw94@gmail.com; [2]University of California at Berkeley; [3]Santa Clara University; [4]Los Altos High School

INVENTORY OF VEGETATION SPECTRAL PROPERTIES IN THE SOUTH BAY SALT PONDS: A DATABASE FOR ENHANCING DECISION SUPPORT AND RESTORATION MAPPING

In the past century, more than 85% of the historical marshlands in the San Francisco Bay were converted to salt ponds or filled for urban development, resulting in a loss of biodiversity. The municipalities along the southern margin of the San Francisco Bay are in the process of one of the most extensive tidal wetland restoration projects ever undertaken, the South Bay Salt Pond Restoration Project (SBSPRP). The goal of this project was to perform an analysis of the spectral variation between different salt pond vegetation types and to track the changes in vegetation distribution from 2000 to 2010. These data will be shared with the SBSPRP partners to aid in their three-year classification of vegetation. This project has identified the spectral characteristics of dominant salt marsh vegetation through the use of in-situ spectral measurements and classification of remotely sensed imagery from EO-1 Hyperion and Landsat TM 5. Fieldwork included the use of a handheld spectroradiometer to gather spectral curves for analysis as well as obtaining point vegetation information for image classification. Comparison of the spectral signatures of the dominant vegetation showed little distinction among vegetation species. Field data and IKONOS imagery were used to identify presence of vegetation throughout the study area to aid in the classification of Landsat imagery, and to track the yearly changes in vegetation colonization for the region between 2000-2010. The spectral angle mapper classification algorithm was applied to a July 2010 Hyperion scene to classify pickleweed in the Alviso area. For this study area, it was determined that Landsat is better suited at detecting overall changes in vegetation. Additional field data could improve the classification of Hyperion imagery.

28. Wilson, Alicia M., Dept. Earth and Ocean Sciences, University of South Carolina and Blaustein Visiting Professor, Environmental Earth Systems Science, Stanford University; awilson@geol.sc.edu

CONTROLS ON GROUNDWATER TRANSPORT IN SALT MARSHES: FIELD AND MODELING INVESTIGATIONS

Groundwater flow in salt marshes places key controls on ecological productivity, zonation, and nutrient exchange with adjacent surface water. Previously observed correlations between marsh productivity and mean sea level (MSL) may be groundwater-mediated, and correlations between porewater salinity and tidal amplitude clearly depend on groundwater flow. Here we present (1) numerical models that show how the volume of tidally-driven groundwater exchange, and hence nutrient and salt transport, depend on tidal amplitude and the elevation of a marsh island relative to sea level amplitude and (2) selected field observations from a marsh bordering a forested upland that demonstrate natural groundwater flow patterns within marsh sediments and variability imposed by spring-neap cycles and storms. Low tidal flats or restored marshes that accrete more rapidly than sea level rises will experience increasing tidal groundwater exchange until they reach elevations near mean high water. Sea level rise will likely increase groundwater exchange in marshes that are already equilibrated near mean high water, but further increases would decrease groundwater exchange. Groundwater exchange also increases with tidal amplitude, and field data indicate that groundwater exchange volumes can vary significantly between spring-neap cycles.

29. Wood, Julian K.[1], Gary Page, Lynne Stenzel, Leonard Liu, Matt Reiter, Mike Perlmutter, Caitlin Robinson-Nilsen, Cheryl Strong, John Y. Takekawa, Nils D. Warnock, [1] PRBO Conservation Science, jwood@prbo.org

POPULATION CHANGE IN WINTERING SHOREBIRDS IN SAN FRANCISCO BAY ACROSS TWO DECADES

The results from three comprehensive surveys of wintering shorebirds in San Francisco Bay (including San Pablo Bay, Central Bay and South Bay) in November from 2006 through 2008 indicated stable or increasing populations for most species compared to equivalent surveys conducted from 1990 through 1992. San Francisco Bay totals for 8 of 22 species increased between the two decades based on our criteria for change, but most of these species were less abundant ones (< 4000 individuals). Willet and Least Sandpiper were two exceptions, each exceeding 25,000 individuals on the 2006-08 surveys with 37% and 171% higher numbers in the subsequent decade. Considerable change was indicated within specific regions of the Bay with the Central Bay exhibiting the most change; nine species increased, five decreased and the total number of shorebirds decreased by 32%. The North Bay exhibited increasing numbers for seven species and the total number of shorebirds increased by 46%. In the South Bay two species increased and two decreased. Nineteen of 22 species exhibited change in at least one region of the Bay but the Least Sandpiper was the only species to increase in all regions. Given the expected changes in shorebird habitat due to restoration and management and the effects of climate change, it is ever more important to establish a long-term Bay-wide monitoring program to help separate the effects of these impacts and to provide context for site-specific changes.