

Achieving Environmental Goals through Watershed Design

Josh Collins, San Francisco Estuary Institute, josh@sfei.org

Public investments in ecosystem restoration and the number of projects continue to grow throughout the San Francisco Estuary and its watersheds. The stress on ecosystems likewise continues to increase, due to land use and climate change. As a result, restoration practitioners may not be able to keep pace with the rate of landscape degradation, potentially increasing species losses and compromising vital ecosystem services.

Looking at the problem from the ground up reveals a basic fact: Project-by-project environmental planning and review leaves too little time and money for regulatory, conservation and development communities to adequately plan and assess land and water use. This approach also fails to leverage project costs or account for their cumulative effects. Monitoring is generally inadequate to compare one project to another, forecast problems, or trigger adequate corrective actions to prevent unnecessary costs. Looking down from the landscape level reveals a path toward problem reconciliation: multi-scale project design and evaluation using common tools that can assess achievement of explicit, long-term, large-scale ecological goals that integrate across our real needs for safe water, flood control, land development, and essential ecological service. We need consensus, regional, landscape-scale ecosystem management goals to guide our interventions coupled with monitoring for goal-based adaptive management of interventions over time.

Landscape ecology, ecological risk assessment, ecosystem modeling, and information technology have matured together as powerful approaches to landscape analysis and goal setting. Conceptually, the conservation of natural processes is the ecological foundation of restoration planning, implementation, and the evaluation of project success at every scale. A common assessment framework and planning toolkit including a shared geographical information system (GIS) are used to analyze and visualize alternative landscape designs. A preferred design can then be translated into a set of community-based ecological goals. The adopted goals guide restoration projects that can inform each other through the common assessment frameworks and monitoring methods.

The following presentations are examples of efforts to develop and implement landscape goals for restoring benthic habitats, the beneficial reuse of dredged material, restoration of the intertidal habitats and upland ecotones, and for upland open space. They highlight progress and the need for further coordination and collaboration among these major planning efforts leading to comprehensive overall ecosystem health care. Climate change and especially sea level rise are common health risks that unite these efforts. They will all need to adjust their goals to accommodate climate change as it occurs. It cannot be predicted exactly, and the uncertainties about climate change put a premium on adaptive coordination among the efforts, which in turn requires capacity and willingness to plan together and objectively compare outcomes.

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

There are significant practical initiatives in the offing to help us all meet the challenges of climate change as we move forward together with multi-scale ecological restoration actions. For example, the recently revised federal guidelines for mitigation set the stage for permitting aquatic and wetland projects in the watershed context. With input from all affected federal and California state agencies, the State Water Resources Control Board is drafting policy for standardized monitoring of wetlands, streams, and riparian areas through coordinated regional monitoring programs. Regional data centers using common base maps to track projects and their performance in the context of ambient change are important features of the monitoring program that is envisioned. The Wetland Tracker information system born from the Bay Area Baylands Goals Project is being expanded to include other aquatic resources and has been adopted statewide as part of the data center construct. The Bay Conservation and Development Commission and many partners are beginning to develop a toolkit for helping local communities assess the economic and ecological risks and opportunities related to climate change. This toolkit and other important inputs will be used to help adjust the baylands goals based on alternative scenarios for sea level rise. These are a few of the regional, state, and federal efforts to build capacity among local communities to set long-range, large-scale ecological goals that integrate across our needs for safe water, flood control, land development, and essential ecological service.

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Upland Goals and Bayland Goals: Making Connections in a Fragmented Landscape

Stuart Weiss, Creekside Center for Earth Observation, stu@creeksidescience.com

Ryan Branciforte, Bay Area Openspace Council, ryan@openspacecouncil.org

Nancy Schaefer, Land Conservation Services, nschaefer1@comcast.net

The successes of the Bayland Ecosystems Goals led the Bay Area Open Space Council to initiate the Bay Area Upland Habitat Goals in 2004. The Upland Goals project (<http://www.uplandhabitatgoals.org/>) covers all land above the Baylands, and begins with a systematic analysis of biodiversity conservation needs in the 9 Bay Area counties, including vegetation, rare plants, mammals, birds, fish/riparian, amphibians, reptiles, and invertebrates. These conservation needs are the basis for designing a Biodiversity Lands Network that builds on >1.1 million acres of currently protected lands, as well as broad needs for stewardship. Connectivity within the network, to the Baylands, and to the rest of California is a critical component of the design. Connections from uplands to baylands include direct linkages and riparian corridors. Direct linkages are limited to a few high priority areas in Sonoma, Napa, and Solano Counties where semi-continuous landscapes (interrupted by a few 2-lane roads) from the Bay to the uplands and mountains can be protected. Riparian corridors, some relatively intact, others heavily modified, provide linkages through urban and agricultural landscapes, and provide habitats for many species, passage for fish, and hydrologic connections to the Bay. The fish/riparian conservation strategy recognizes that all riparian corridors have value, but that certain stream systems are absolutely critical. Fish survey data have been digitized, and high priorities have been set for the healthiest runs of anadromous fish and intact assemblages of native fish. Consideration of watershed integrity include population density, urban and agricultural cover, road density, timber harvest plans, water quality, percentage protected lands, and other factors. The overall Biodiversity Lands Network includes broad swaths of upland habitats, and a network of riparian management zones where local planning must account for site-specific details of feasible buffer width and restoration opportunities.

Key Words - *Habitat Goals; Biodiversity; connectivity; linkages; riparian;*

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Vegetation at the Rising Bay's Edge: Reviving Dynamic Terrestrial-Tidal Ecotones

Peter Baye, baye@earthlink.net

The Goals Report (1999) explicitly recommended restoration of “marsh-upland transition zones” and “upland buffers” for habitat benefits in nearly all segments of the Estuary, as did most Focus Teams. It did not, however, foresee current dramatic revised estimates of sea level rise, and their implications for restoration design, management, and future landward “accommodation space” needs of tidal-terrestrial ecotones or upland buffers. Specific restoration design recommendations for new tidal-terrestrial ecotone habitat goals were in primordial development in 1999. Recent restoration design and management approaches for tidal-terrestrial ecotones grew out of Goals Project recommendations, and are now in testing or design stages. These include: variable natural plant ecotone community models, featuring dominant clonal perennial grasses, rushes, sedges, and Aster family species; weed management methods involving soil salinization, managed competition, and succession to closed-cover native perennial vegetation; artificial sediment nourishment and hydraulic construction of terrestrial ecotone landforms (bay beaches, alluvial/dredge fans); and soil salinization (salt water irrigation) for habitat-compatible, short-term weed control. Potential benefits of new ecotone restoration approaches include: increased shore erosion resistance and buffering with wildlife habitat benefits; improved post-storm regeneration and self-maintenance of terrestrial ecotone habitats; reduced need for active long-term management, and increased resistance to weed invasions. Adapting existing or restored bay habitats to accelerated sea level rise, comparable with earlier Holocene estuarine transgression rates, will require re-evaluation of terrestrial ecotone dynamics and management at the rising bay edge.

Key Words - *terrestrial ecotone; upland transition zone; buffer, accelerated sea level rise; bay beaches; alluvial fans; clonal perennial grass; saline irrigation; sediment nourishment*

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Getting to the Bottom of It: Connecting Submerged Habitats, Wetland Design, and Climate Change.

Marilyn Latta, State Coastal Conservancy, mlatta@scc.ca.gov

Tidal wetland restoration projects are being successfully implemented at many diverse sites, but most projects to date have not specifically considered enhancing functional connections with key aquatic resources that exist within wetlands and in adjacent areas. Subtidal habitats are fully submerged areas that occur below the Mean Water Line, and are intrinsically connected to mudflats, wetlands, creeks, and uplands. This “hidden underbelly of the bay” is often considered to be a featureless mud bottom in our urbanized estuary. Despite multiple anthropogenic alterations to the estuarine floor, the bottom of the bay still includes a suite of unique habitats that provide diverse three-dimensional structure including: sand waves more than three meters high; eelgrass and shellfish beds that act as ecosystem engineers and provide reproductive substrate and food resources for species such as herring and salmon; rocky outcrops covered in seaweeds and invertebrates; and the mixed sediments in shoals and channel banks utilized by a variety of species. Many practitioners designing tidal wetland restoration projects struggle to find adequate information to incorporate meaningful enhancements to the subtidal areas of their projects, and the issue of shoreline-tidal-subtidal connectivity is becoming increasingly pertinent in light of predicted climate change impacts, sea level rise, and the potential for increased scouring of wetland and shoreline edges. I will discuss specific subtidal resources in the bay and design considerations for climate change, including Living Shorelines, a soft shoreline multi-habitat project approach that uses natural bioengineering techniques to increase subtidal diversity, stabilize sediment, and provide a buffer for wetland protection. These concepts are being further developed as part of the San Francisco Bay Subtidal Habitat Goals Project, an interagency effort working to complement the Baylands and Uplands Goals projects to establish a comprehensive and long-term vision for research, management, and restoration of subtidal habitats in San Francisco Bay.

Key Words - *subtidal; restoration; eelgrass; native oysters; climate change; living shorelines*

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Assessing the Baylands Goals in Sonoma County: Are we there yet?

John Brosnan, Sonoma Land Trust, john@sonomalandtrust.org

The 1999 *Baylands Ecosystem Habitat Goals Report* provided a solid roadmap for restoration of Sonoma County's Baylands and Sonoma Land Trust has been working with numerous partners to implement the report's recommendations since its publication. Prior to the *Goals Report*'s publication, these broad coalitions of public agencies, nonprofit conservation organizations, corporations, and foundations have been working to protect and restore the Baylands of Sonoma County for over 20 years. Major past and current restoration projects include Sonoma Baylands, North Parcel, Carl's Marsh, Tolay Creek Ranch, and the Sears Point Restoration Project, all of which have contributed to implementation of the *Goals Report*'s specific guidance. These projects span Sonoma County's Baylands region and include restoration of connected tidal wetlands, seasonal wetlands, and upland habitats. The *Goals Report* has not only been effective in targeting and designing restoration projects, but also in defining success in restoring interconnected Baylands habitats. Tens of millions of dollars have been spent to protect and restore this landscape and restoration practitioners, including Sonoma Land Trust, have developed rigorous, science-based monitoring and adaptive management plans, which are key to achieving the *Goals Report*'s objectives of restoring ecosystem functions. This presentation will review the *Goals Report*'s recommendations for Sonoma County, discuss the projects that have implemented the *Goals Report* to date, and highlight the remaining opportunities that will more fully achieve the *Goals Report*'s vision.

Key Words - *Baylands; Goals; Sonoma; wetlands; uplands; restoration*

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Future Scenarios for Tidal Marsh Plant and Bird Communities: Implications for Restoration and Conservation

Diana Stralberg, PRBO Conservation Science, dstralberg@prbo.org

Julian Wood, PRBO Conservation Science, jwood@prbo.org

Dennis Jongsomjit, PRBO Conservation Science, djongsomjit@prbo.org

Leonard Liu, PRBO Conservation Science, lliu@prbo.org

Lisa Schile, UC Berkeley, lschile@nature.berkeley.edu

Maggi Kelly, UC Berkeley, maggi@berkeley.edu

John Callaway, University of San Francisco, callaway@usfca.edu

Tom Parker, San Francisco State University, parker@sfsu.edu

Steve Crooks, Philip Williams & Associates, s.crooks@pwa-ltd.com

Climate change will affect tidal wetlands in the San Francisco Bay-Delta through sea level rise (SLR) and changes to the estuarine salinity gradient, resulting in altered distribution patterns of tidal marsh habitats. The anticipated changes—primarily from high to low marsh and from fresh or brackish to more saline conditions—are likely to cause local distribution shifts and a rearranging of plant communities, in addition to the potential net loss of marsh habitat. Such changes can cascade throughout animal communities via food webs and habitat structure. Based on species occurrence data and GIS-based environmental data for elevation/inundation, salinity, and other physical factors, we have developed empirical models of species distribution for several dominant, special status, and invasive plant species. We have also developed preliminary models of bird abundance with respect to vegetation and physical factors using data from bay-wide point count surveys (data collected over the past 13 years at 70 marsh sites). For a range of feasible climate change scenarios, we are using Bay-Delta-specific projections of SLR and salinity to project changes in species distribution and abundance, as well as community composition. Model projections will help identify species and geographic areas of conservation concern, and inform restoration priorities. The selection and implementation of tidal marsh restoration is more likely to be successful if a range of potential future scenarios is considered.

Key Words - *climate change; sea level rise; salinity; tidal marsh; birds; plants*

Session: The Baylands Goals Report at 10 Years: Where Are We Now?

Population Status and Recent Trends of California Clapper Rail and Other Marsh Birds of Concern

Julian Wood, PRBO Conservation Science, jwood@prbo.org

Extensive habitat loss and degradation in San Francisco Bay have likely resulted in decreases in populations of tidal marsh breeding birds in the past 150 years. PRBO Conservation Science conducted marsh bird surveys at restored and remnant sites in order to assess bird abundance, species richness and to describe population trends for California Clapper Rail, California Black Rail, Saltmarsh Common Yellowthroat, and tidal marsh Song Sparrow subspecies. We analyzed Clapper Rail call count data collected by PRBO and numerous partners. We estimated annual site-specific density estimates using distance sampling and detected a negative short-term trend of 20.6% ($\pm 3.8\%$) from 2005 through 2008 for the Estuary. The population appeared relatively stable from 2005 to 2007 but from 2007 to 2008, a dramatic decrease in South San Francisco Bay ($-57.4\% \pm 5.0\%$) was observed. Trends for the other species of concern differed among species and among Bay subregions. Song Sparrows have been relatively stable since 1996, but a negative trend may be manifest in Suisun and San Pablo Bays in recent years. Common Yellowthroats have shown strong increases in South and Central San Francisco Bay and in San Pablo Bay, but not in Suisun Bay. Black Rails have shown increases in San Pablo Bay but not in Suisun. The trajectory of response by marsh birds to restoration differed among marsh sites and differed among study species: Song Sparrows showed the quickest response following levee breaching. Ongoing monitoring will help determine if the steep drop in Clapper Rail population from 2007 to 2008 is sustained. Analysis of the effects of invasive *Spartina* treatment and other potential environmental factors may help identify the causes of apparent population changes.

Key Words - *trends; clapper rail; song sparrow; common yellowthroat; black rail; restoration*

Session: Species of the San Francisco Estuary: Status, Trends and Impacts

Increase of the California Gull Population in San Francisco Bay since the Early 1980s and Potential Impacts on Other Species of Nesting Waterbirds

Jill Demers, San Francisco Bay Bird Observatory, jdemers@sfbbo.org

California Gulls (*Larus californicus*) first bred in the San Francisco Bay in 1980, when less than 12 nests were found on a dry salt pond in the South San Francisco Bay. Since then, breeding California Gull populations have increased exponentially, to over 43,000 in 2009. This range expansion and subsequent population increase may be related to their use of landfills and other anthropogenic sources of food. Additionally, this California Gulls population increase may have negative effects on other ground-nesting waterbirds, including threatened and endangered species, through harassment, encroachment on nesting sites, and predation on eggs and chicks. In 2009, we deployed nest cameras to determine nest predators on the Federally Threatened Western Snowy Plover (*Charadrius alexandrinus nivosus*) at Eden Landing Ecological Preserve, and captured footage of California Gulls, as well as other predators, depredating nests and chicks. Furthermore, the South Bay Salt Pond Restoration Project is initiating plans to restore 16,000 acres of salt ponds into tidal marsh or other habitats, and may cause a portion of the 43,000 breeding gulls to move to new nesting sites, displacing other breeding waterbirds and potentially increasing predation rates.

Key Words - *California Gull, population growth, salt pond, predation*

Session: Species of the San Francisco Estuary: Status, Trends and Impacts

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

San Francisco Estuary as an Invasion Hub for Western North America: Is Vessel Hull Transport of Biota Important?

Gregory Ruiz, Smithsonian Environmental Research Center

California plays a dominant role in the invasion dynamics for non-native marine species in western North America. For invertebrates, algae, and microorganisms (excluding plants and vertebrates), 290 non-native species are considered established for the entire region, from California to Alaska. Of these, 81% were first documented in California, and San Francisco Estuary is the first recorded location for the largest number of any estuary in the region. Most of the non-native species first reported in California are present in multiple estuaries, suggesting secondary spread is common. Historically, ships and oysters were the dominant transfer mechanisms (vectors) of species into the state, and the number of invasions attributed to ships has continued to increase over time. Despite the clear role of ships, the relative contribution of ballast water versus hull fouling (two subvectors) is poorly resolved. For example, hull fouling is a possible source (alone or in combination with other vectors) of >60% of all established marine invasions to California, but < 20% of all non-native species are attributed solely to hull fouling. It is clear that hull fouling contributes to initial introductions, and also recent coastwise spread of many species, such as the recent incursion of the Asian kelp *Undaria* in San Francisco Bay. However, there remains uncertainty about the strength of this vector overall, and the relative contribution of commercial versus recreational vessels is poorly resolved. To estimate the potential for species transfers associated with hulls of recreational and commercial vessels, current research is aimed at characterizing vessel flux and associated hull-fouling communities in San Francisco Bay and central California.

Session: Species of the San Francisco Estuary: Status, Trends and Impacts

Eelgrass in San Francisco Bay: Conservation and Restoration of a Habitat Forming Species

Katharyn Boyer, Romberg Tiburon Center, SFSU, katboyer@sfsu.edu

Losses of seagrasses worldwide have resulted in intensive efforts to protect and restore these plants and the important habitat and water quality functions they provide. Following a long history of very limited study of eelgrass (*Zostera marina*) habitats in San Francisco Bay, a flurry of recent work has led to advances in our understanding of eelgrass restoration potential and constraints. A convergence of several factors has contributed to these advances: 1) incentive—the need to mitigate damages resulting from the Oakland-San Francisco Bay Bridge earthquake retrofit; 2) leadership—the foresight of key resource agency staff to recognize the need for better understanding of eelgrass resources before launching into large-scale restoration; and 3) collaborations in science—mapping and modeling of eelgrass distribution, surveys of extant beds to help set goals for structure and function of restored sites, a series of field and mesocosm experiments to inform restoration site selection, donor choice, and restorative techniques, and early and continued inclusion of genetic measures to inform restoration choices. Results of these studies are influencing plans for scaling up eelgrass restoration in San Francisco Bay and continue to promote collaboration among scientists and resource managers tasked with setting goals for restoration and conservation of subtidal habitats.

Key Words - *eelgrass; restoration; seagrass; subtidal*

Session: Species of the San Francisco Estuary: Status, Trends and Impacts

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Benefits of Oyster Reef Restoration on Selected Native and Special Status Species

Robert Abbott, ENVIRON International, rabbott@environcorp.com

Our estuaries are highly degraded due to shore line modifications to accommodate industrial and residential development. Vertical structures in the water column such as rocky outcroppings have been removed as hazards to navigation. The vertical edge of natural wetland drainage channels that surrounded our bays and estuaries has been filled. These lost structural elements are essential habitat for numerous fish and invertebrates that are not adapted to living on a soft mud that constitutes the benthic habitat of most of San Francisco Bay. Replacing vertical structural elements to increase habitat complexity, and edge habitat needs to be seen in the context of total watershed restoration. The Marin Rod and Gun Club habitat restoration project near San Rafael has used bags of oyster cultch to create mounds that are functionally equivalent to a tropical reef coral head with numerous interstices that greatly increase the habitat for numerous sessile invertebrates that require a hard surface. They are observed to be spawning habitat for gobies and Pacific herring and the nursery habitat for numerous species of invertebrates that contribute to the Bay food web. They have proved to be exceptionally successful for restoring native Olympia oyster habitat with over 600,000 native oysters colonizing the reefs as of June 2009. An alternative to the mounds of shell which are not sourced from San Francisco Bay is the construction and deployment “reef balls” made primarily from material dredged from San Francisco Bay. These small projects that are from 1/10 of an acre, up to one acre in extent are the focus of broad community participation involving over 100-volunteers, and extensive media coverage because they are hands-on and the community sees them as “interesting and different”. The mounds and reef balls are presently being used as part of a study on how to increase elements of the estuary food web that are essential foraging habitat for salmonid smolts. The reefs increase species diversity and the abundance of larval fish compared to mudflat control areas. Acoustic receivers at the reefs and in the control area show that acoustically tagged salmon smolts, steelhead and green sturgeon linger in the reef area and do not linger in the control area. The data from the reef mound studies will be used to model an increment of vertical habitat contribution to the aquatic food web so that policy decisions can be made as to the quantity and distribution of sub-tidal aquatic reef like structures required to improve foraging opportunities for salmon, steelhead, sharks and sturgeon.

Key Words - *Habitat restoration; native oysters; salmon smolts; acoustics*

Session: Species of the San Francisco Estuary: Status, Trends and Impacts

Our Actions, Our Estuary
9th Biennial State of the San Francisco Estuary Conference

ORAL ABSTRACTS: Day 3 – Track A

Trends in Bivalve in the bay - How Important is Predation on *Corbula* and *Company*?

Janet Thompson, USGS, jthomps@usgs.gov

Bivalves have always been a component of the Bay ecosystem. However, based on the paleontological record they likely played a smaller role in the bay food web dynamics prior to the increase in introduced species to the system following the Gold Rush. The long term trend in bivalves in the system has been the increase in species number and increase in biomass of introduced filter-feeding bivalves throughout the system. These new bivalves have proven to be important in their ability to remove and control phytoplankton biomass and in their ability to accumulate and trophically transfer contaminants that accumulate within the phytoplankton. We have observed seasonal variability in bivalves in San Pablo and South Bays due to annual predation by migratory birds and fish. This predation is a critical factor in allowing the annual spring phytoplankton blooms to occur. We have also observed longer term, interannual variability in filter-feeding bivalve biomass, which can be attributed to offshore processes (upwelling) that increase demersal fish and invertebrate predators in the bay. These increased bivalve predation periods during good upwelling years have resulted in the release of phytoplankton in the South Bay from bivalve grazing control and thus in higher phytoplankton biomass.

Key Words - *benthos, bivalve, predators,*

Session: Species of the San Francisco Estuary: Status, Trends and Impacts