

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

ORAL ABSTRACTS

The oral abstracts are listed in the order they will be presented. The session titles are listed below in order that they occur in the program.

DAY 1

The Heat is On

Aquatic Resources: Linking the Ocean, Estuary, and Watershed

Will Our Wetlands Sink or Swim with Climate Change?

DAY 2

Scientists' Perspectives on Managing a Changing Delta

Pollution Solutions

DAY 3: TRACK A

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

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

DAY 3: TRACK B

Ports – Economic Benefits & Effects on the Estuary

Contaminants of Emerging Concern in the Estuary

Trash: Upstream & Downstream Solutions

DAY 3: TRACK C

The Future Delta and its Ecosystem

Sustainable Urban Retrofit Session

Creating a Bay Area Watershed Network

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Global Warming: Is the Science Settled Enough for Policy?

Stephen Schneider, Stanford University

In the Fourth Assessment Report of the UN-sponsored Intergovernmental Panel on Climate Change (which shared the 2007 Nobel Peace Prize), Working Group I states that warming is “unequivocal” and it is “very likely” that human activities are responsible for most of the warming of recent decades. The same report says warming to 2100 is “likely” to be 1.1 -6.4 degrees C. Working Group II says 1.5 – 2.5 degrees C warming could commit 20-30% of known species to extinction (but only assigns this about a 50% chance). So, what is settled? Some projections are well established, some have competing explanations, yet others are speculative. Thus policy is a risk management judgment, just like most other complex socio-technical systems problems.

There is strong consensus that the increasing numbers of people in the world, demanding higher standards of living, and using cheap, available technologies (e.g. burning coal, and driving gas-consuming large automobiles) will double or triple the carbon dioxide content in the atmosphere by 2100. This implies many potentially serious impacts, although not all are negative. However, the distribution of these impacts is uneven, with most severe effects being experienced in poorer, warmer places, coastal regions, high mountains, polar regions, or in “hurricane alley.” Local, regional, and international actions are already beginning and much more could be done if there were political will to substantially reduce the magnitude of the risks by putting in place adaptation strategies to reduce vulnerability to impacts already in the pipeline which can't be avoided and to enact mitigation legislation to lessen the risks of more severe climate impacts that we can't adapt to.

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Sea-Level Rise and the San Francisco Bay

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Over the past century, sea level has risen nearly eight inches along the California coast, and general circulation model scenarios suggest very substantial increases in sea level as a significant impact of climate change over the coming century. Recent research by the Scripps Institution of Oceanography suggests that sea levels along the California coast will rise by 1.4 meters (55 inches) by 2100 under a medium-high greenhouse gas emissions scenario. We estimate that a 1.4 meter sea-level rise will put 270,000 people at risk of a 100-year flood event along the San Francisco Bay, given today's population. Among those affected are large numbers of low-income people and communities of color, which are especially vulnerable. Critical infrastructure, such as roads, hospitals, schools, emergency facilities, wastewater treatment plants, power plants, and more will also be at increased risk of inundation, as are vast areas of wetlands and other natural ecosystems. In addition, the cost of replacing property at risk of flooding along the San Francisco Bay under this sea-level rise scenario is estimated to be \$62 billion (in year 2000 dollars). Continued development in vulnerable areas will put additional areas at risk and raise protection costs. A number of structural and non-structural policies and actions could be implemented to reduce these risks.

Key Words - *climate change, sea level rise, San Francisco Bay*

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Ocean Processes Influencing Seabirds and Their Prey in the Gulf of the Farallones

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The California Current System is one of the most productive regions in the world's oceans and may be drastically impacted by climate change. Impacts may include changes in the timing and strength of wind-driven upwelling, increased sea surface temperature, increased stratification of the water column, and more frequent El Niño events. The effects of these changes are difficult to predict, but will likely lead to an overall reduction in biological production that will affect species at all levels of the marine food web. We assessed effects of ocean conditions on seabirds by (1) evaluating trends in ocean conditions and seabird breeding parameters and (2) examining underlying seabird – ocean climate relationships using 35 years of data from a breeding colony in central California. In addition, we examined relationships between ocean conditions and marine bird prey availability during the breeding season. We assessed the effects of ocean conditions on zooplankton and fish abundance by relating prey abundance in the diet to ocean conditions at the time of prey harvest from the ocean. We compared these results with previous analyses that examine relationships between ocean climate and timing of nesting and reproductive success of marine birds in Central California. This work enhances our understanding of how ocean climate affects seabirds and their prey in the Gulf of the Farallones, improving our ability to make predictions about how climate change may affect prey and predators in the California Current.

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Ocean-Driven Interannual Variability in San Francisco Bay Ecology

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Sustained observations are necessary to detect and understand ecosystem processes that fluctuate over periods longer than a decade. The California Department of Fish and Game Bay Studies Program measured record high abundances of demersal marine fish (e.g. juvenile English sole), crabs (e.g. juvenile Dungeness crab) and shrimp beginning in 1999 and continuing through 2008. The timing and persistence of this biological shift inside San Francisco Bay coincided with a climate-driven oceanic shift that occurred in 1999 when the North Pacific Gyre Oscillation (NPGO) flipped from its negative to positive phase, signaling a strengthening of the California Current and intensification of coastal upwelling. Concurrent sampling by the U.S. Geological Survey documented a trend of increasing phytoplankton biomass in San Francisco Bay that also began in 1999 and persists during the positive phase of the NPGO. Strong coherence of these shifts suggests that decadal oscillations of atmospheric forcing across the Pacific Ocean can generate large changes in the biological communities of San Francisco Bay, but the mechanisms of this linkage are not yet understood. Our discovery of synchronous physical and biological changes after 1998 motivates a new research challenge to discover the processes through which atmosphere-ocean regime shifts propagate into San Francisco Bay to modify its biological communities.

Key Words - *San Francisco Bay; estuary-ocean connectivity; climate variability*

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The Once and Future Kings? Status and Prospects for California's Chinook Salmon.

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As recently as 2002, nearly 1.5 million Sacramento River fall Chinook (SRFC) were caught in fisheries or returned to the Sacramento River basin to spawn. Only 66,000 spawners returned to natural areas and hatcheries in 2008. As a result of this dramatic decline, fisheries for Chinook salmon off California and Oregon were closed to protect SRFC in 2008 and 2009. In this paper, I will show that the proximate cause of this unprecedented collapse was poor feeding conditions for juvenile salmon in the coastal ocean, and argue that the ultimate cause of the collapse is the declining resilience of the Central Valley chinook complex that has been driven by a century and a half of land and water development. A simple conceptual model illustrates how the dynamics of a salmon population supplemented by hatchery production are influenced by trends in freshwater environmental quality, hatchery production, fitness, and climate. The model predicts that SRFC will recover to higher levels of abundance when ocean conditions improve (which may already be happening), only to decline sharply when ocean conditions again turn poor. Improving the sustainability of the Chinook salmon fishery depends on reversing trends in freshwater and estuarine habitat quality and quantity, which should also benefit listed runs of Chinook. Ecosystem-based management and ecological risk assessment will be required to make progress on these challenging problems.

Key Words - *chinook salmon; fisheries; resilience; biocomplexity; ocean climate*

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Changing Habitats, Changing Communities: An Update on the Upper Estuary Pelagic Organism Decline

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Populations of several important pelagic fishes of the upper San Francisco Estuary declined to historically low levels in the early 2000s and have shown little sign of recovery. This collective decline has become known as the Pelagic Organism Decline (POD). These declines are of intense interest to resource managers, scientists, legislators, and the general public because several of the species are protected under state and federal threatened and endangered species legislation. Since 2005, the Interagency Ecological Program has conducted a comprehensive study of the POD with the goal of evaluating potential causes of the decline. Results to date suggest that the declines are multi-causal and that there has been a relatively rapid shift in conditions superimposed on a long term trend of decline. The shift is likely related to multiple factors including water quality, food webs, and water management.

Key Words - *pelagic organism decline; fishes; pelagic fishes*

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Elvis on Sediment Management: “A Little Less Conversation, A Little More Action Please”

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With the recent estimates of global sea level rise (SLR) emerging from the scientific literature and permeating the planning consciousness, we are increasingly recognizing the need to implement on-the-ground adaptation measures. But what do we actually do? Holistic sediment management is a critical component of a SLR adaptation strategy to protect wetland (marsh and mudflat) habitats and infrastructure. We propose that we need to prioritize where to restore wetlands to maximize resiliency, decide where to hold the line for wetlands and infrastructure, and decide where to let the line roll back. We also need to ask and answer difficult questions about the trade-offs between removing sediments from the bay for navigation, flood protection, and water quality, and reusing them – on both marshes and mudflats – to sustain wetland habitats with accelerating SLR. It’s time to reconsider the balance. The alternative is to accept a progressive loss of wetlands.

Key Words - *sea level rise; wetlands; sediment management; adaptation*

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Bay Wetland Plants and Sediments: Inseparable in the Face of Climate Change

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Increases in sea-level rise (SLR) and salinity associated with climate change will be critical factors for the future of tidal wetlands in San Francisco Bay and beyond. Tidal wetlands can compensate for increases in SLR by accumulating sediment, through both allochthonous mineral matter inputs and autochthonous organic matter accumulation. As wetlands build elevation, mineral inputs are reduced due to less frequent inundation. If wetlands can keep pace with SLR, this negative feedback leads to stable wetland elevations, typically around MHW in mature wetlands. By building wetland elevation, sediment inputs directly affect plant distributions because species have relatively narrow distributions across tidal elevations. Reciprocal effects of plants on elevation and sediment inputs also occur: plants build elevation through organic matter accumulation, leading to reductions in mineral matter inputs. These non-linear, complex interactions make it difficult to identify if sediment inputs control plant inputs or if plants control sediment inputs. Accretion rates from mature tidal wetlands across the world range from 1-2 mm/yr to over 1 cm/yr. Most San Francisco Bay wetlands currently accumulate 3-5 mm/yr, although much greater rates of accumulation are found in newly restored sites. Sediment accretion rates at the Island Ponds (part of the South Bay Salt Pond Restoration Project) during the first year post-breach averaged over 10 cm/yr across the lower half of the pond, with even greater rates at individual locations. While accretion rates have slowed over the last two years at the Island Ponds, current rates are still greater than in mature wetlands. Salinity increases associated with climate change will also affect plant distributions, thus presenting implications for elevation and sediment accumulation. Freshwater and brackish wetlands are more productive and accumulate more organic matter than salt marshes, and future salinity increases could inhibit organic matter accumulation rates.

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Wetlands Restoration and Flood Protection: The Essential Symbiosis

Steven Ritchie, State Coastal Conservancy

For decades, we built “hard edge” solutions to flooding, such as levees, flood walls, tide gates, and other constructed elements. At the same time, people began to believe that they were provided complete protection from flooding. We have learned that both of those conclusions are wrong. Simple constructed elements are not sufficient in and of themselves to appropriately mitigate flood risk, and flood risk cannot be eliminated. We began to combine hard edge works with natural floodways and tidal marshes to achieve better results, both for flood risk management and the environment. Now in the face of sea level rise, there seems to be a rising trend of fatalism that wetlands will be drowned and that “hard edge” solutions are society’s only hope. The South Bay Salt Ponds and the South Bay Shoreline Study will be used to show that selective use of hard edges combined with natural processes continue to be superior solutions.

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Making Adaptive Management Work: Examples from Australia with Potential Application to the Delta

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Two major water resource efforts in Australia are substantively building adaptive management into the water management framework. The Healthy Waterways Partnership (<http://www.healthywaterways.org/Home.aspx>) is an ongoing collaboration between government, industry, researchers, and the community to manage and improve catchments and waterways in South East Queensland. Two principles guide the Healthy Waterways Partnership. The first is a working partnership where all partners are heard, and the second is developing strategies based on sound science, rigorous monitoring, and adaptive learning. The adaptive management framework for the Healthy Waterway Partnership emphasizes evaluation, targeted research, and improved understanding as key attributes of successful adaptive management accompanying policy planning, implementation, and monitoring. The Commonwealth Water Act 2007 stipulates a Basin Plan for the Murray-Darling Basin commence in 2011 and authorized the Murray-Darling Basin Authority (<http://www.mdba.gov.au/>) to develop the Basin Plan. Preparation of the Basin Plan is ongoing with a draft for review to be completed in 2009. Environmental monitoring will use adaptive management techniques in which new data and information are considered as they become available. New research and understanding are to be incorporated into the planning process through the Basin Plan. Knowledge generation to identify and address knowledge gaps and inform management actions is an important component of the emerging Basin Plan. As planning for the Delta proceeds in California, these examples from Australia may provide guidance and colleagues for common discussions as water resource management faces the challenges of climate change and increased human population.

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Managing for What We Don't Know, and May Never

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The future is uncertain. No surprise there - yet most of our planning processes for ecosystem management focus on moving towards a future condition which can be described in concrete terms. In New Orleans the transition from describing the effect of levee projects as providing 'protection' to 'risk reduction' importantly recognizes the risk that remains, even with a solid levee system, due to uncertainties that cannot be predicted or in many cases fully described. Louisiana is embarking on a new approach to planning for the future of the coast guided by a stakeholder-developed vision of the future. The vision will be translated into quantifiable targets but the effect of individual projects in meeting those targets will consider a range of future uncertainties – from sea-level rise and subsidence to freshwater and sediment availability to the effects of climate change on the frequency of storms and floods – using simplified models of system dynamics. Using the science we have to better inform planning for the future requires us to more explicitly appreciate what we do not know and develop object and transparent tools that allow decision-makers to explore a range of future possibilities.

Key Words - *Louisiana; ecosystem restoration; planning tools; uncertainty*

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Next Steps in Improving Water Management in California

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There are many important lessons to be drawn from the last decade of experience with California water issues. One is that the development of the goals, strategies and tactics necessary to remodel how we manage water and ecosystems in California is a long-term “journey” in which we should not expect an end-point at which our water problems will be resolved. There exists a consensus that the status quo in the Delta is unacceptable. But Californians also need to think carefully about the benefits, risks and challenges in demanding an immediate fix to today’s perceptions of the problems. The complexity of the issues, a variable mother nature, a changing climate, an ever evolving political environment, and a vastly modified hydrology all suggest a multi-decadal strategy is necessary to progressively move toward sustainable water management. Identification of the ingredients in such a strategy is incomplete, however. For example, stable funding is crucial but not sufficient. An ever-growing knowledge of the complex issues and the response of the system to management and natural changes is essential. Enough water must be “in play” to make a difference in management of both ecosystems and a reliable societal supply. Recognition of the appropriate time scale upon which to expect change is perhaps the greatest challenge. A long-term journey into an uncertain future also requires flexibility. Each choice of tactics should be at least partly judged by how well it allows flexible responses and/or adaptations to surprises. There is political risk, but perhaps ultimately great value in acting systematically, prioritizing flexibility, building on successes and assuming California’s water issues will always require attention, investment and adjustment.

Key Words - *water management, Delta, science program*

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Tackling the Trash Epidemic

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Trash and especially plastic debris continue to present a growing water quality problem in San Francisco Bay and its tributaries. Despite extensive public education campaigns, media attention, and the California Ocean Protection Council's aggressive marine debris reduction strategy, the bay is still under daily assault from trash pollution.

Our bay trash adds to a global problem, flowing through the Golden Gate to join the Texas-sized "Great Pacific Garbage Patch" floating in the Pacific Ocean. Countless seabirds, marine mammals, and fish die annually from eating or getting tangled in marine debris. With the Bay Area population expected to grow to 8.1 million by 2020, bay pollution will increase unless we take bold action.

Solving this trash epidemic requires accelerated and concerted actions at all levels. Federal and state agencies have a crucial role, enforcing U.S. and California laws designed to protect water bodies as a public resource, and imposing tough regulations to achieve water quality standards. In February 2009, The San Francisco Bay Regional Water Quality Control Board voted unanimously to designate large portions of bay and 24 of its tributaries as so choked with trash that they violate the federal Clean Water Act. At the urging of the U.S. Environmental Protection Agency and other stakeholders, the Regional Water Board is now considering significant restrictions on trash discharged by cities and counties in a new Bay Area Municipal Regional Permit for storm water.

New state laws that discourage the production of trash and prevent its discharge into our waters can yield the swiftest progress throughout California. And in the environmentally conscious Bay Area, municipalities also must step up to reduce trash at its source and interdict it before it reaches the bay. Several Bay Area cities have adopted effective programs to reduce trash and other pollution flowing into the bay, and these provide models that can be replicated rapidly throughout the region. These city programs can help the region's seven million residents reduce trash and other toxic bay pollution by making it easier for each of us to prevent it. Some programs cost little or nothing to implement, but they can significantly reduce Bay pollution and protect the bay.

The Bay Area's quality of life and economy depend on a healthy, vibrant bay. Making significant reductions in bay trash is essential to protect the bay for people and wildlife today and for future generations.

Key Words - *trash; pollution; debris*

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A New Era for Pollution Prevention

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Tracking the evolution of Pollution Prevention over the last 50 years takes us through four "ages" and into the modern era of the new millennium. Identifying the successes and remaining work from the BOD, Toxics, Bioaccumulent, and Endocrine Disruption Ages is both encouraging and sobering. It allows us to see the results of four main tactics: Treatment, Product Substitution, Production Stewardship and Product Elimination. Reviewing examples of our efforts in using these tactics gives us good information for the problems of the modern era. Unfortunately some of our newest problems look a lot like the oldest ones, and we won't be able to discard any of our tactics. We will need them all as we go "back to the basics".

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Oil, Sewage, and Estuary Resilience

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Some serious pollution problems in the Bay in recent years – including the 2007 Cosco Busan oil spill, and significant sewage spills – have drawn the attention of regulators, scientists, and the public to our urgent need to develop the Estuary’s resilience to insults both large and small. This is a situation where highlighting the problems can help to build a constituency for solutions that might otherwise be seen as too costly, too labor-intensive, or too long-term to justify public or private investment.

In addition to infrastructure repairs and upgrades and recent legislation aimed at preventing future spills, we can point to wetland restoration projects, which are ongoing in many locations; refuge habitat recovery projects, as at Aramburu Island in Richardson Bay and salt pond restoration areas in both the South Bay and the North Bay; and projects to enhance eelgrass beds, to help minimize the casualties from these types of events. Water Board enforcement actions also call attention to the problems, and our system of penalties for administrative civil liabilities allows us to focus penalties on projects that will help the Estuary. Identifying projects that will enhance the resiliency of the Estuary so that it can recover from any future spills as well as adapt to climate change is a work in progress. But we’re on our way, and increasing public attention to the good news and the bad news can only help us get to where we need to be.

Key Words - *Oil; Sewage*

Session: Pollution Solutions

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Achieving Environmental Goals through Watershed Design

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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.

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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.

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

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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?

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

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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*

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

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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?

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ORAL ABSTRACTS

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

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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*

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

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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*

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

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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*

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

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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*

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

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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.

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

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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*

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

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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*

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

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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,*

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Air Quality Issues at the Port of Oakland

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The Bay Area Air Quality Management District (Air District) is the regional agency in the San Francisco Bay Area charged with ensuring that the Bay Area public breathes healthy air. One of the most pressing air quality impacts in the Bay Area is adverse health effects from breathing tiny particles emitted from diesel engines (diesel particulate matter or diesel PM). The California Air Resources Board (CARB) has identified diesel PM as a toxic air contaminant (TAC). Goods movement by truck, train, ship, and locomotive into, out of and around the Bay Area's ports is a significant source of diesel PM. The Air District initiated the Community Air Risk Evaluation (CARE) Program in 2004 to evaluate and reduce health risks associated with exposure to outdoor toxic air contaminants (TAC) in the Bay Area. The program emphasizes diesel PM which is the primary TAC of concern. The CARE program includes research, analysis, community involvement, interagency collaboration and specific actions to reduce TACs and improve public health. The CARE program analysis indicates that the West Oakland community, adjacent to the Port of Oakland, experiences some of the highest health risks from TACs in the region. In addition, a Health Risk Assessment conducted by CARB, including diesel PM emissions from Port operations, rail yard operations and other sources in West Oakland, indicates that the West Oakland community is exposed to diesel PM ambient concentrations that are almost three times higher than the average background diesel PM in the Bay Area. To reduce the health impacts, the Air District is initiating regulatory enforcement of CARB's emission reduction regulations applicable to cargo handling equipment, drayage trucks, ocean going vessels, and other port-related sources. In addition, the Air District is awarding grant funding to retrofit or replace older, more polluting equipment operating at the Port.

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Benefits & Challenges of Dredging

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Background

The Port of Sacramento (now Port of West Sacramento) first opened in 1963 after the completion of the Sacramento River Deep Water Ship Channel. This ship channel project starts at the town of Collinsville at the foot of Montezuma Hills and proceeds up through the Sacramento River, Cache Slough and for 25 miles in manmade portion of the ship channel. The ship channel varies from 200' to 250' in bottom width and is 30' deep. The Port is not a container port but rather handles bulk (loose, free flowing cargo) and breakbulk (bagged rice and fertilizer, bundled lumber, etc.). Historically the Port has handled mostly agricultural and agriculturally-related cargoes ie woodchips, rice, fertilizer, hay cubes, beet pulp pellets, almonds. It has handled what is term "industrial bulks" ie calcined clay, calcined coke, various raw ores, etc. More recently, as part of a new 'green port' policy, the Port has pursued cargoes that have environmental benefit ie Primafuel Alternative Fuel Import and Production, Enligna Wood Pellet Production and Export, West Coast Metals Recycling. These projects have a broader environmental benefit as well as diversifying the cargo base of the Port.

Sacramento River Deep Water Ship Channel

Dredging- definition: process of excavating materials underwater. It is used to deepen waterways, harbors, and docks.

Dredge materials (sediments) are not inherently bad or contaminated. Each area to be dredged must be sampled and tested to establish the impacts that past exposures have on the dredging operations and placement of the dredged sediments.

Maintenance dredging takes place annually in one or more portions of the ship channel depending on size of rain season and hence river flow and amount of sloughing that occurs in the manmade channel. Typically, 100,000 to 200,000 cubic yards of material is dredged and placed upland along the ship channel on placement sites owned by the Port, Corps or private property that has dredge placement easements. All dredging is performed by cutter head suction dredge which creates a slurry that is pumped to the placement site via dredge pipe.

In the Sacramento River, the ship channel is a relatively small "cut" into the river bottom. The river in the area of Rio Vista might be 2000-3000' wide with a depth of 20-25'. The current ship channel is 250' wide and 30' deep. Even the deepened channel will be 300' wide and 35' deep, so as can be seen, dredging in the natural river portion of the ship channel effects a relatively small portion of the river bottom. This is less true as you

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proceed up into Cache Slough and the manmade portion of the ship channel where the ship channel occupies a greater portion of the overall waterway.

In 1989, a project to deepen the ship channel to 35' was begun. The harbor at the Port and the first 8 miles of ship channel were deepened before the project was suspended due to unresolved issues concerning the relocation of PGE gas lines and the lack of local share to match the federal dollars. These issues have since been resolved and the Port and the Corps of Engineers have been working on a Limited Re-evaluation Report (LRR) for a number of years. This LRR will re-examine the project's economics and will include species that have been listed since dredging was halted. The study is proceeding well, with a draft document projected to be available May 2010. Anticipating an accepted report, the current schedule is to continue the deepening dredging starting in mid-2011 and complete the dredging in Fall 2013. The deepening project has received broad local, regional and federal support and is in the President's 2010 budget as well in the 2010 appropriation bills of both houses of Congress. The channel deepening is projected to produce 6.4M cubic yards of material and be placed upland in current dredge placement sites along the ship channel.

Benefits

- Maintenance Dredging- maintains current project depth to allow complete utilization of the ship channel and Port.
- Deepening Dredging
 - This deepening project is vital to the long term viability of the Port by allowing the ever increasing larger ships to call upon the Port of West Sacramento. This economy of scale of increased tonnage helps to offset the increasing costs of fuel and overall ship operating costs.
 - Provides an environmentally beneficial means of moving cargo to the interior of California. Helps to reduce the number of trucks on congested freeway corridors benefitting air quality and freeway safety.
- Both Maintenance and Deepening Dredging provide dredge material for potential reuse in flood levee repair/upgrade as well as habitat restoration projects. There is a growing number of habitat restoration projects within the Bay, California and the world, where dredged sediments (dredge material) has been used as the principle material in creating these projects.

Challenges

- The ever increasing concern for the health of the Delta, the declining fish populations and the desire for habitat restoration, creates challenges and beneficial opportunities for dredging and dredged sediments.
- The current dredge window is August 1 through October 31 on the Sacramento Ship Channel. This is primarily driven by the issue of Delta smelt and potential entrainment in the dredge suction. Monitoring is conducted by Resource's team and if fish are found in proximity to the dredging site and if fish are impacted, dredging is stopped.

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- Other species (longfin smelt, green sturgeon, salmon) also become factors in the consideration of dredging practices and acceptable operational windows.
- The concern of methylation of sediments placed in wetlands is still being addressed and scientifically analyzed.
- Central Valley Regional Water Quality Control Board working with the Delta Long Term Management Strategy (DLTMS) group, has made significant progress in considering the necessary placement site and sediment testing that is needed to evaluate the beneficial reuse of dredge material. Beneficial reuse is essential to the longterm, continual operation of navigation channels in the Delta to full project depth, so a longterm plan for these dredge materials must be established.

Conclusion

Regulatory and funding challenges make both maintenance dredging and deepening dredging challenging. The environmental and ancillary benefits of moving cargo to the interior of California by the navigation channels needs to be recognized along with responsibly managing the environmental aspects of these operations. An improved, strong and responsible capability to conduct international trade helps to support California's world class economy. A vibrant maritime industry in California helps to provide the jobs and funds and through dredging, the material, to improve the economy, environment and the flood protection of California.

Key Words - *Dredging; reuse;*

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Today's Issues in Dredging and the Use of Dredged Material for S.F. Bay Tidal Wetland Restoration: Port, Regulatory, and Natural Resource Perspectives Session

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The game of dredging and disposal of dredged “spoils” has changed. Once thought of only as way to move the muck out of ship channels and reclaim marshes for development has become a highly orchestrated activity that can provide valuable sediment to restore these same marshes and nourish sandy beaches. As the community realizes the value of this resource, access to Ports and marinas are still maintained, and living resources still needed to protected. New challenges arise associated with getting the sediment to restoration sites, costs of doing the work, and finding innovative techniques that create a viable combination for a wide variety of stakeholders whose cooperation and resources are needed for success. This talk will touch on issues for dredging projects, endangered species, essential fish habitat, beneficial reuse and regional sediment management in the Bay Area.

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Regulating Contaminants of Emerging Concern

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Regulating contaminants of emerging concern (CECs) is a challenge due to the ever increasing number of manufactured new chemicals and products coupled with limited information on the environmental risk of many chemicals. Fortunately, we have a number of regulatory tools available and in use in California, particularly in the Bay Area to respond to the challenge. Several California agencies have a role in regulating CECs including the Department of Toxic Substances Control, the Department of Pesticide Regulation, the Office of Environmental Health Hazard Assessment, and the State and Regional Water Boards. Water Boards' actions that are relevant to CECs in the Estuary include establishing water quality standards that reflect "safe" thresholds of pollutants in water, sediment and/or biota and controlling discharges of pollutants from specific or categorical sources. The Water Boards may also require investigations and assessment of water quality associated with CECs. Regulatory actions depend on the state of our knowledge about CECs and key questions drive investigations to gain knowledge. These include: is a chemical present in the environment (water, sediment, and/or biota), is it present at level that poses a risk to humans or biota, what are its sources, pathways, and loadings, and are they controllable. In the Bay Area, we have the Regional Monitoring Program, which provides a means to investigate CECs. We also have municipalities that have been willing to take proactive actions to address pharmaceuticals and personal care products that end up in the Bay. These and other recent and ongoing efforts to address flame retardants, pesticides (pyrethroids), and pharmaceuticals and personal care products illustrate how CECs are or may be regulated.

Key Words - *Contaminants; CECs; regulations*

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Flame Retardant Chemicals in San Francisco Bay: More than Just PBDEs

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Since the 1970s large volumes of polybrominated diphenyl ethers (PBDEs) have been produced globally and added to consumer products such as furniture, textiles, and electronic equipment to increase their resistance to fire. PBDEs have since become ubiquitous contaminants and studies have documented their potential for adverse impacts on wildlife and human health. Penta- and octaBDE have been phased out and DecaBDE has been banned in a few US states and Europe. As a result of these restrictions, alternative chemicals are being used to meet consumer product flammability standards. Little toxicity and environmental fate information exists for these alternatives and assessments to determine their potential impacts have been challenging because basic information on their use, and in some cases their structural identities, are not readily available. In 2008 a study was conducted to determine the concentrations of several current use flame retardants in harbor seals, cormorant eggs, sport fish, mussels, and sediment collected from San Francisco Bay. In addition to PBDEs, three other chemicals were detected, with most concentrations orders of magnitude below those for PBDEs. Biosolids collected from Bay Area wastewater treatment facilities and house dust samples were also analyzed and provide an indication of the potential for these chemicals to migrate out of consumer products and enter aquatic environments. Tris(1,3-dichloro-2-propyl) phosphate (TDCPP), a chemical phased out of use in children's pajamas in the late 1970s due to health concerns, and the brominated chemicals in Firemaster 550, were detected in dust and biosolids and are known replacements for PentaBDE in furniture foam. Concentrations of these alternatives in biosolids were within range of PBDE concentrations. TDCPP dust concentrations were equal or greater than PBDE concentrations in most samples. TDCPP was also detected in Bay sediments at concentrations equal or greater than concentrations of BDE 209, the main component of DecaBDE.

Key Words - *flame retardants; PBDEs*

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Pyrethroid Pesticides in the Delta: We Can't Just Blame Agriculture any More.

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Over the past ten years, Californians have been in transition from relying on organophosphate insecticides for agricultural and urban pest control, to use of pyrethroids. Though both classes of insecticides are now used in agriculture, urban pest control relies largely on pyrethroids. Recent data has shown pyrethroids to be a concern for toxicity in the water column, not only sediment toxicity as has been known for several years. Some of the environmental toxicity consequences long recognized as associated with organophosphates, are now appearing as a consequence of pyrethroid use, but they are appearing in urban-dominated water bodies, rather than agriculture-dominated water bodies. We have recently found pyrethroid-related toxicity in surface waters following rain events in urbanized water bodies ranging in size from small creeks up to lengthy stretches of the American River. The Sacramento and San Joaquin Rivers do not yet show evidence of effects over considerable distances, but there have been isolated samples of concern in both rivers. Our recent sampling has allowed comparisons among various pyrethroid sources. Agricultural discharges occasionally contain pyrethroids at concentrations acutely toxic to aquatic life, but do so far less frequently and at far lower concentrations than urban stormwater runoff. Urban runoff commonly contains pyrethroids at ten times acutely toxic concentrations, and we find much the same result in every municipality tested. Municipal wastewater treatment effluent can also demonstrate pyrethroid-related toxicity, and is an additional source of the compounds from urban environments.

Key Words - *pesticides; toxicity; water quality*

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The Ubiquitous Distribution of Alkylphenols: The Next Emerging Wave of Endocrine Disruptors along Coastal Waters

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As part of an ecosystem-based management project in Morro Bay, California, we investigated the health of the mud-dwelling arrow goby, *Clevelandia ios*. Due to repeated observations of visible gonadal tumors (about 6%) we examined gobies histopathologically and found a high incidence of gonadal and liver tissue pathologies (100%), including gonadal and liver tumors. Germ cell tumors and severe lipidosis in liver tissue are indicative of exposure to organic pollutants. We analyzed 230 goby livers for levels of more than 60 organic pollutants that are commonly found in estuaries along the Pacific coast of North America. We found moderately high levels of DDE and extremely high levels of nonylphenol (NP). NP is a known endocrine disruptor and the dominant degradation product of alkylphenol ethoxylates, man-made chemicals that are widely used in a number of industrial and household products. Due to its hydrophobic nature NP tends to adhere to organic matter and persist in anaerobic environments. Further analysis of arrow gobies and oyster populations (*Crassostrea gigas*) along the West coast showed that there are high levels of NP in a number of estuaries. In order to detect the source of NP contamination in Morro Bay we also collected water and sediment samples from the bay and two potential point sources. Our findings suggest that NP enters the estuary through the effluent of both waste water treatment plants and septic systems and accumulates in estuarine sediment. In addition, we observed a several-fold bioaccumulation up trophic levels within the fish community in Morro Bay.

Key Words - *emerging pollutants, endocrine disruption, tumorigenesis*

Session: Contaminants of Emerging Concern in the Estuary

ORAL ABSTRACTS

Exposure and Effect Considerations for Pharmaceuticals and Personal Care Products in Aquatic Ecosystems

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Flows of rivers, streams, and riverine zones in reservoirs and estuaries that are dominated by effluent discharges from wastewater treatment plants (WWTP) are generally considered worst case scenarios for studying the environmental impacts of pharmaceuticals and personal care products (PPCPs). PPCPs are considered classes of “emerging” environmental contaminants that in recent years have received unprecedented attention from the media and the scientific and regulatory communities. In addition to being introduced to the environment through centralized and decentralized WWTP discharges, PPCPs may also be transported to aquatic systems following land application of biosolids and effluents from WWTPs, and livestock husbandry practices in agricultural settings. Whereas the majority of research efforts to date have included standardized toxicity screening and developing analytical methodologies with GC/MSMS, LC/MSMS and (more recently) LC/TOF-MS to support environmental monitoring activities, recent studies are focusing on PPCP source tracking, chemical fate, mechanistic and comparative ecotoxicology and ecological risk assessment approaches. PPCPs often possess physiochemical (e.g., ionizable compounds) and biological (e.g., therapeutics are designed to target specific biomolecules, pathways) properties that differ from many historical contaminants, presenting unique challenges to environmental scientists. For example, current efforts are examining how existing models ranging from fugacity based fate predictions to traditional ecotoxicology assays and risk assessment paradigms may need to be modified to define environmental impacts of PPCPs. This presentation will provide current and future perspectives on the state-of-the-science of PPCPs in the environment, including a summary of research needs to support environmental monitoring, fate, effects and risk assessment activities. Compared to inland waters PPCP exposure and effects in estuarine systems are less understood.

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Other Places, Other Approaches

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The accumulation of trash in San Francisco Bay (Bay) and its tributaries is a major concern for municipal stormwater managers and non-governmental organizations. Despite a multitude of resources allocated over the years by local municipalities for trash control and management, it is only recently that trash has come to the forefront of water quality management. Recent evaluations of water quality conditions in local creeks and Bay shorelines by public agencies have resulted in a new emphasis on reducing trash loadings to receiving waters. In 2008, the San Francisco Bay Regional Water Quality Control Board (Water Board) proposed that 26 Bay area water bodies (creeks and shorelines) be placed on the 303 (d) list for trash impairment. Additionally, the Water Board intends to include specific language in the upcoming Regional Municipal NPDES Permit for Stormwater, which will require local municipalities to significantly reduce the current levels of trash discharged to creeks and ultimately the Bay.

In October 2006, the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) developed a *Trash Management and Effectiveness Assessment Strategy* to serve as a guide for conducting urban runoff trash management and assessment activities. A key component of the *Strategy* is the selection and implementation of trash control measures. As a first step in understanding what structural options and institutional approaches exist for controlling trash from being discharged from the urban landscape to urban runoff conveyance systems, SCVURPPP developed the *Trash BMP Tool Box* in September 2007. In an effort to continue to enhance our understanding of innovative and cost effective trash control options and supplement information presented in the *Tool Box*, SCVURPPP staff recently conducted an expanded literature review on trash management approaches implemented around the world. This review revealed several innovative ideas to reduce trash in water bodies from locales outside of California. Case studies summarizing a subset of these novel approaches, including cost-effective institutional controls will be presented.

Key Words - *Trash; Litter; Pollution Prevention; Stormwater; Urban Runoff*

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State and Local Policy Measures for Taking Out the Trash

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Since 85% of marine debris comes from land-based sources and most of the land-based discharges are comprised of packaging and single-use disposable goods, a key solution to trash in marine waters is prevention of packaging waste and other commonly-littered items. Packaging waste comprises approximately 30% of the solid waste management stream in the United States. Reducing this waste stream is perhaps the biggest challenge to solving the marine debris problem, but with this success will come other significant benefits, including significant reductions of greenhouse gas emissions and multiple life cycle benefits associated with preserving natural resources.

To date, California has largely failed at implementing the source reduction goal for solid waste set forth in AB 939, the Integrated Waste Management Act of 1989. Although the Act established the goals of Reducing, Reusing and Recycling (the 3Rs), the regulations have largely focused on diverting waste from landfills and ignored the need to prevent its generation at the outset. Neither has any other state successfully reduced the generation of solid waste. We look to Europe and the 33 nations that have implemented producer take-back programs for packaging waste and find that strict producer responsibility programs can be successful in slowing (but not reversing) the rate of generation of solid waste, better than any system in place in the U.S.

The State of California has recognized prevention needs to be a primary goal of reducing marine litter. First, the California Coastal Commission published an Action Plan for Reducing Discharges of Land-Based Marine Debris (2005). Subsequently, the Ocean Protection Council (OPC) adopted a resolution to reduce marine debris (2007) and followed that with publication of an Implementation Strategy to Reduce Marine Litter (2008). This year, 5 bills were introduced in the California Legislature and sponsored by the Clean Seas Coalition. These bills, as a package, would implement the 3 top priorities articulated by the OPC Implementation Strategy: (1) implement producer take-back for packaging; (2) ban litter-prone items that are significant components of marine debris- where alternative materials exist; and (3) impose fees on litter-prone items.

Much of the impetus for these legislative strategies comes from the local level. Several municipalities have adopted resolutions in support of Extended Producer Responsibility. To date, 33 jurisdictions have adopted bans on polystyrene food take-out containers. Many jurisdictions have opted to ban the distribution of free carry-out bags at the grocery store- although the imposition of fees is currently prohibited by state law. Additional creative strategies to prevent and reduce convenience food and packaging waste are needed and are being created.

Meanwhile, the packaging and plastics industry has launched a formidable opposition, spending millions on Life Cycle Analysis, defining "sustainable packaging," and launching significant lobbying and public education campaigns to convince citizens and

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policy-makers that plastics are "too valuable to waste." In California, the groundswell of support for coastal and watershed protection at the local level is a significant driver of change. What we see repeatedly is that the creative solutions come from the local level and the state eventually, grudgingly, follows.

Key Words - *Marine debris; marine litter; prevention; state and local policy*

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The New Delta, after the Inevitable Transition

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The Sacramento-San Joaquin Delta's fragile levee system is subject to several physical realities that make them increasingly prone to failure. State planners face the challenge of preparing for future Delta flooding. This study presents an economic method for approaching the evaluation of Delta island levee upgrades and repairs. A Levee Decision Analysis Model (LDAM) is applied to the question: How should the state optimally prioritize levee upgrade and repair efforts in the Delta? We focus on 34 major agricultural islands that make up most of the Delta's Primary Zone and include all non-urban subsidized islands. This initial analysis indicates that it is economically optimal for the state to not upgrade all 34 Delta islands examined, mostly due to the high cost of levee upgrades that produce little improvement in levee reliability. When we assume increased effectiveness of upgrades, it becomes optimal to upgrade some islands. Others are never optimally upgraded, even under the most optimistic scenario. Our analysis also suggests that from an economic perspective, taking into account land and asset values, it is not cost effective to repair between 18 and 23 of these islands when they fail. When property values for all islands were doubled in a sensitivity analysis, only four islands of those originally not repaired become cost effective to repair. The LDAM model presented here is a useful approach for Delta policy-makers. It provides a quantitative framework for answering several relevant questions regarding reasonable levee upgrade and repair investments. These initial results may act as a springboard for discussion, and the LDAM model as a working framework for developing an optimal strategy. An important and inescapable conclusion of this analysis is that maintaining the current Delta landscape is unlikely to be economical from a business or land use perspective.

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Variability and Complexity for Improving the Delta for Native

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The San Francisco Estuary is a complex estuarine ecosystem. Variability in environmental conditions, especially in the Delta, once made it highly productive for native biota. Present conditions discourage desirable species, providing a rationale for restoring estuarine variability and complexity. Achieving a variable, more complex estuary requires establishing seaward gradients in salinity and other water quality variables, diverse habitats throughout the estuary, more floodplain habitat along inflowing rivers, and improved water quality. These goals in turn encourage policies which: (1) establish flows that create a tidally-mixed, upstream-downstream gradient in water quality; (2) create slough networks with natural channel geometry; (3) improve flows from the San Joaquin River; (4) increase tidal marsh habitat, including shallow (1-2 m) subtidal areas, in both fresh and brackish zones of the estuary; (5) create/allow large expanses of low salinity (1-4 mg/l) open water habitat in the Delta; (6) create a hydrodynamic regime in which salinities range from near-fresh to 8-10 mg/l on a regular basis to discourage alien species and favor desirable species; (7) create habitat conditions that support higher and more variable site-specific native species diversity; (8) establish abundant annual floodplain habitat, with large areas that flood in less frequent wet years; (9) reduce inputs of pollutants; and (10) improve temperature regimes in large areas so temperatures rarely exceed 20° C during summer and fall. These actions collectively provide a realistic approach to achieving flow and habitat objectives to benefit desirable species. Some of the goals are likely to be achieved as the result of sea level rise, climate change, and levee failures, but habitat, flow restoration and export reduction projects will enhance a return to a more variable and more productive ecosystem. This finding has widespread support in ecological theory and observations from other systems, but making quantitative predictions of change is not yet possible.

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Flooded Island Ecosystems

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The Sacramento-San Joaquin Delta is the heart of California's water supply system and the base of an important, but quickly declining, ecosystem that includes five native fish species listed as threatened or endangered. A number of factors including sea level rise, seismic activity, continued land subsidence and more extreme climate events will increase the frequency and associated costs of Delta island failures. Flooded Delta islands will have a direct and immediate impact on the water quality and ecology of the Delta system. The exact impact will be a function of the island which is breached and the locations and number of breaches. However, with sufficient study, it is possible to manage flooded islands in a way that is beneficial to the ecosystem. In this study, we use a three-dimensional hydrodynamic and water quality model (SI3DWQ) to simulate virtual Delta islands and the surrounding channels. The goal is to explore the location and geometry of flooded islands and the type of food web each potential flooded island can sustain. The model can be used to help guide the configuration and management of flooded islands that will best support a pelagic food web versus islands that will promote growth of invasive species. Using the information from the model simulations, recommendations from an ecological standpoint can be provided, along with other economic and societal factors, to Delta managers on which islands should be saved or remain flooded.

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Estimation of Flow Needs for Native Fishes

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A major issue facing the long-term management of the Sacramento-San Joaquin Delta is the development of flow prescriptions for supporting habitat conditions for desirable fishes in the Delta. In the larger professional literature, much is written on environmental flows for rivers and other water bodies, with little consensus on method (Richter et al. 1997; King and Louw 1998; others). This stems, in part, from the complexity involved (Moyle et al., 2009 in preparation). Estimating human demands for water, both in quantity and quality, is fairly straightforward with well-established methods. Estimating flows for improving habitat conditions, particularly to support fishes with different and often conflicting life history strategies, is much more complex and is hampered by numerous uncertainties. For the Delta, these difficulties are compounded by major geological, biological, and engineering changes and transitions, particularly the return of subsided diked lands to aquatic habitat (subtidal, intertidal and floodplains), changes in water management within and upstream of the Delta, invasive species, and water contamination from upstream and in-Delta uses. These massive ongoing and potential changes cast doubt on the long-term value of empirical relationships often used to establish required Delta flows. As pointed out elsewhere (Lund et al., 2008), we are unlikely to ever resolve all these uncertainties and issues in the Delta before proactive actions are required – since courts are already requiring action. Initial flow prescriptions with a habitat and biological basis need to be developed to move the planning and policy process forward, even knowing that these prescriptions are based on incomplete data and understanding, and will undoubtedly be modified in the future.

To support on-going policy and scientific discussions, we present preliminary methods for estimating fresh water flows needed to sustain viable populations of native fishes in the Delta. Three separate approaches to this problem are explored and (for now) illustrative quantities of water are estimated. While these estimated flows might have some value in furthering discussions in light of the justifications and references provided, the greater value, for the time being, lies in the approach developed and applied here. This approach is developed largely to facilitate more transparent and scientific discussion of desirable freshwater flows and to suggest potential methods for their estimation.

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Components of the UC Davis Delta Solutions Program

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The Delta Solutions Program at the University of California, Davis, Center for Watershed Sciences seeks to develop scientific knowledge in a coherent and focused way to develop insights and information useful for developing solutions to the problems of the Sacramento-San Joaquin Delta. This presentation will present an overview of components of this program and its activities for trying to provide independent scientific information useful for policy-making. It is a challenging and imperfectable goal

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Native Trees and Healthy Neighborhoods

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In recent years there has been growing recognition of the practical contributions trees make to healthy neighborhoods -- from temperature and run off reduction to air quality, aesthetic values, and quality-of-life benefits. Less attention has been directed to the potential incorporation of native trees into the suburban canopy, although remnant or volunteer trees are often an existing component.

In fact, many of the Bay Area's suburban landscapes were formerly oak savannas with a relatively dispersed natural spacing. Their loss is an often overlooked impact to native California habitats. Recent research suggests that elements of the structure and function of the native oak savannas are compatible with contemporary land uses, and could provide significant ecological functions in addition to the other benefits of canopy cover. This presentation explores an approach to strategically reintroducing native trees to suburban California landscapes through coordinated local stewardship, urban forestry, and parkland management programs.

Key Words - *urban ecology; urban forestry; valley oak savanna; Quercus lobata; LID*

Session: Sustainable Urban Retrofit Session

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Converting a Channelized Creek into an Asset: Lower Silver Creek

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Urban creeks represent a common and important ecological interface with humans; an interface that has downstream implications that can affect the health of the San Francisco Bay. Natural creeks provide a host of ecological functions and values that include storm water retention, water temperature regulation and habitat corridors. For many years it has been common practice to direct stormwater into channelized urban creeks which quickly carry surface runoff to the Bay, but this direct conveyance reduces water filtration and local groundwater recharge and sometimes increases downstream flooding. Fortunately, even in a highly developed urban setting, steps can be taken to beneficially retrofit our channelized creeks. The Santa Clara Valley Water District is prioritizing and systematically retrofitting channelized urban creeks to improve water quality, flood protection and habitat values in Santa Clara County.

The Silver Creek Watershed covers approximately 43 square miles in eastern San Jose and unincorporated Santa Clara County. The Lower Silver Creek Flood Control Project, implemented in 2003 and partially completed in 2007, included: broadened floodplain and channel modifications for conveying flood flows; installation of bank protection and new creek maintenance access roads; significant native revegetation within the channel and along the channel banks; improved access and aesthetics, and enhanced public spaces to create a sense of community.

An interdisciplinary team of hydrologists, civil and geotechnical engineers, ecologists and landscape architects worked to develop plans for over 2 miles of Lower Silver Creek. The restoration plans included the planting of native riparian trees and shrubs along the creek banks and channel to provide shaded riverine aquatic habitat. However, there are numerous design constraints in retrofitting a channelized urban creek, including right-of-way and property ownership issues, existing roads and utilities, maintaining flood protection, soils, vandalism, and neighborhood-specific issues. The Lower Silver Creek project provided the necessary flood control while increasing riparian habitat, improving in-stream aquatic habitat and enhancing overall aesthetics.

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Creating a Regional Watershed Voice – Policy Needs

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The Bay Area watershed community includes nonprofits, local government agencies, private firms, landowners, and resource conservation districts. By banding together, we can convincingly convey to decision-makers the societal benefits of our work, and influence policies and decisions that affect our effectiveness.

Key Words - *policy; watershed*

Session: Creating a Bay Area Watershed Network

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Assessment, Restoration and Monitoring Tools Working Group

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The Assessment, Restoration and Monitoring (ARM) Tools Working Group of the Bay Area Watershed Network (BAWN) is intended to develop specific methods and protocols to address practical issues of design and monitoring of creek restoration projects around the Bay Area. The subgroup arose from discussions that current assessment, monitoring, and “watershed health” measures are subject to different interpretations, and are inadequate to allow grant-program funders and agency staff to set priorities for creek restoration. The group, currently in its inception phase, aims to develop better regional and State level communications in setting funding and program priorities by developing (1) a Bay Area framework for watershed stream and floodplain protection and restoration goals, (2) priorities for developing stream restoration tools and methods appropriate to the social and environmental challenges of the Bay Area, and (3) integrating collaborative stormwater monitoring efforts with the State’s Surface Water Ambient Monitoring Program. Early-phase program objectives will be outlined. Requirements include defining unifying principles and clear objectives for monitoring programs to maximize the value of collected data, determining simple universal data needs for solving common issues in watershed management and river restoration, and guidance for appropriate tools and protocols that facilitate different informational needs at different scales, ranging from reaches to watersheds. In addition, the program is anticipated to result in proposals for pilot projects to test the efficacy of ecological engineering methods and low impact development designs in urban settings, and to achieve a broad prioritization of Bay Area watershed management, protection and restoration objectives that consider both environmental and social challenges.

Key Words - *monitoring; assessment; restoration*

Session: Creating a Bay Area Watershed Network

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Welcome to the 21st Century! Creative Media for Outreach and Education

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Caroline Warner, San Francisco Bay Joint Venture

Earth team and the SF Bay Joint Venture are creating visual and audio social media to reach and involve their respective audiences. In this session, Caroline and Lana will share examples of their recent projects and the ways they are being used to help foster a regional community who are aware of and care about the wetland habitat environment.

Key Words - *media; outreach; teen; visual; audio;*

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Creating a Bay Area Watershed Network (BAWN Panel)

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S T R A W

Students and Teachers Restoring A Watershed

A Project of The Bay Institute

The STRAW Project coordinates and sustains a network of K-12 teachers, students, and community members as they plan and implement watershed projects leading to habitat restoration. The STRAW Project works with technical professionals and partners in the North Bay to provide training and support in environmental project-based learning, watershed curriculum, bird research, aquatic insect monitoring, and creek and wetlands restoration. Since 1993, more than 16,000 students have participated in over 275 STRAW restorations on rural and urban creeks, planting over 32,000 native plants and restoring approximately 100,000 linear feet of creek banks. STRAW has the following goals: to empower students, to support teachers, to restore the environment, and to reconnect communities.

The STRAW network consists of many committed, long-term partners, including Prunuske Chatham, Inc., Marin County Stormwater Pollution Prevention Program (MCSTOPPP), Marin Resource Conservation District, PRBO Conservation Science, Conservation Corps North Bay (CCNB), San Pablo Bay National Wildlife Refuge, and more. With our partners we support a variety of watershed studies and implement and design restoration activities.

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