Preliminary Results of the Bobcat Flat Rehabilitation Project, Post-Implementation Monitoring Plan, Lower Tuolumne River, CA

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The downward trend in anadromous salmonid populations in California has been attributed to the loss and degradation of existing spawning and rearing habitat. In-channel habitat rehabilitation (gravel augmentation) targeting fall-run Chinook salmon spawning and rearing habitat enhancement was carried out in two phases (2005 and 2011) at river mile 43 ("Bobcat Flat") within the lower Tuolumne River below La Grange Dam. The Bobcat Flat Rehabilitation Project is authorized by the Central Valley Project Improvement Act (CVPIA; Public Law 102-575, 1992), funded by the United States Fish and Wildlife Service's (USFWS) Anadromous Fish Restoration Program (AFRP), and administered by the Friends of the Tuolumne (FOT). Two years (2013 and 2014) of a 3-5 year monitoring plan to evaluate post-rehabilitation effectiveness has been completed. Preliminary results from year 1 young-of-the-year (YOY) rearing surveys revealed that the restored reach supported higher numbers of rearing YOY fall-run Chinook salmon than unrestored reaches (restored = 58.9 fish/50 ft; unrestored = 51.0 and 34.3 fish/50 ft). However, variation in fish density increased when viewed at successively smaller scales (i.e. site, mesohabitat, and microhabitat). Mean combined habitat suitability index (HSI) scores (0-1.0) developed from observed depth, velocity, and cover data at 170 cfs, ranked the restored reach (0.17 median HSI; n=92) just below the upstream reference reach (0.20 median HSI; n=71) and higher than the downstream reach (0.13 median HSI; n=64). Overall, the HSI analysis revealed that fish utilized expected velocity ranges, though preferred a wide range of depths and demonstrated very high preference for instream woody cover. Interim interpretation of results suggest that: (1) rearing YOY fall-run Chinook salmon may be over-crowded within the selected study reaches; and (2) gravel augmentation projects should target sites having intact, quality riparian woody vegetation, as this can provide more suitable rearing habitat than sites lacking such conditions.

Keywords: Anadromous salmonids, rearing habitat rehabilitation/restoration, effectiveness monitoring, habitat suitability

Poster topic: Sustainable Habitats and Ecosystems

Habitat Restoration and Adaptive Management: How the Delta Plan Can Help

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Effective habitat restoration requires using the best available science and learning from project implementation by following a three-phase adaptive management cycle. To ensure continued public support for restoration, it is also essential to be able to show that the restoration community is using funds efficiently to meet short-term acreage targets while gaining knowledge that will lead to effective landscape-scale restoration in the future. Adaptive management includes setting clear restoration goals; conducting a baseline assessment to determine initial conditions and long-term monitoring to assess project effectiveness; and making management adjustments as needed. The Delta Stewardship Council is addressing this need in three main ways. First, the Council adopted the Delta Plan, which includes a policy (G P1) that requires significant habitat restoration projects to document the use of best available science, have an adaptive management plan, and document access to adequate resources and authority to implement the plan. Council staff has provided early consultation to restoration project managers to help them prepare to certify their projects as consistent with these Delta Plan requirements. Second, the Delta Science Program, a division of the Council, has developed the Delta Science Plan, which calls for a framework for more integrated restoration project monitoring, sharing of results, and translation of scientific information into knowledge that can inform management decisions. Finally, the Council, in partnership with other state and federal agencies, is required to track the Delta Plan's performance measures of progress toward restoration acreage targets and trends in the occurrence of native species in protected and restored habitats and migratory corridors. Over time, Council staff hopes to encourage the adoption of performance measures that include landscape metrics, such as such as connectivity among habitats, linked to expected ecological functions.

Keywords: habitat restoration, Delta Plan, adaptive management, performance measures, implementation

Poster topic: Sustainable Habitats and Ecosystems

Interacting and Changing Ecological Constraints on Riparian Restoration Success: Insights from the Merced River

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The draft Bay Delta Conservation Plan calls for the restoration of 5,000 acres of riparian forest and scrub, but the complexity of Bay Delta conditions will limit the extent of process-based restoration, and the physical conditions upon which restoration will need to occur is likely to be uncertain in many instances. The long-term success of this riparian restoration will be controlled by both abiotic and biotic factors, and can be maximized by incorporating lessons from other riparian restorations in the region. We conducted an experiment on a floodplain along the Merced River that was degraded by gold mining dredge spoils but was slated for restorative recontouring, to test the influence of distance to groundwater, irrigation (two abiotic factors), initial plant size, and weed competition (two biotic factors) on seedling survival of four dominant native tree species: Fremont cottonwood (*Populus fremontii*), box elder (*Acer negundo*), Oregon ash (*Fraxinus latifolia*), and valley oak (*Quercus lobata*). The most important factor controlling tree survival shifted over time since planting, from initial plant size in the first year, irrigation duration in the second year, and distance to groundwater in the third year. These results indicate that the factors driving riparian restoration success can vary through time and can be used to improve the success of floodplain revegetation in degraded areas. The experiment is applicable to restoration efforts in the Bay Delta, and throughout much of arid west, where teasing apart multiple ecological constraints on vegetation establishment will be critical to restoration design and ultimate success.

Keywords: riparian, floodplain, restoration, tree survival, abiotic factors, biotic factors

Poster topic: Sustainable Habitats and Ecosystems

San Francisco Bay Transition Zone Conservation and Management Decision Support System

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A GIS based dcision support system (DSS) to identify and prioritize marsh-upland ecotonal habitats (transitions) to assist land managers in restoring and protecting San Francisco Bay's (estuary) tidal marsh ecosystem will be presented. The DSS takes a strategic approach towards decision support, by accounting for the landward migration of high marsh and other transitional habitats in response to predicted sea level rise (SLR). Current documents do not adequately describe ecotonal habitats, quantify the amount needed to aid listed species recovery while allowing for SLR, nor prioritize specific sites for protection and restoration. The DSS combines definitions bioassessment protocols, GIS models of the distribution of TZH using interpolated tidal data and Lidar, site specific criteria for ranking sites for restoration or protection, and parcels level maps for prioritizing TZH throughout the SF estuary. This toolkit will help managers allocate limited resources on site prioritization, alternative/scenario evaluation, and will include considerations for the influence of future climate change and land-use scenarios. Project findings will be made available on the web through an interactive mapping tool.

Keywords: Transition Zone, Sea Level Rise, GIS, tidal marsh, Decision Support

Poster topic: Sustainable Habitats and Ecosystems

The Effect of Stocking Density on Length and Gut Fullness of larval Delta Smelt Reared in Small Vessels

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Following the 2009 Endangered Species Act list - Delta Smelt (DS), a genetically monitored captive refuge population was established at the Fish Conservation and Culture Laboratory (FCCL), UC Davis. The refuge population serves as a genetic bank in case of species extinction in the wild and a source of DS for research purposes. In addition to large tanks (≥70 L) that the FCCL have been used to conduct research projects, we are developing a new recirculating system for larval and juvenile DS holding using small rearing vessels (18 L) to increase the flexibility and opportunity for more biological replications. To determine the fish stocking density level for the new system and its effect on growth and gut fullness, larvae are stocked in three densities: low, medium, and high (20, 40, and 60 larvae/L, respectively; n = 3). Larvae were sampled at 10 and 20 days post hatch (dph) and length and gut fullness were measured 15 minutes after feeding. A one-way ANOVA was used to test performance differences among fish stocking densities. At 10 dph, no significance differences of larval length (8.83, 8.88, and 8.62 mm, respectively) ($P>0.18$) and gut fullness (52.83, 41.04, 41.04 %, respectively) ($p>0.03$) was found among densities. Similarly, at 20 dph, no significance difference was found in larval length (10.5, 10.36, 10.20 mm, respectively) ($p>0.5$) and gut fullness (55.64, 58.22, 50.22%, respectively) ($p>0.6$) among densities. These results indicate that DS cultural density at their early stages (to 20 dph) doesn't have a significance effect on the growth and gut fullness. This finding ensures the feasibility in using small rearing vessels for future applications. The experiment will be extended to 40 dph, and the data of survival rate will be obtained at the end of the experiment.

Keywords: Delta Smelt, density, larvae, small rearing vessel

Poster topic: Sustainable Habitats and Ecosystems

CRAM: New Online Management Tools for Uploading and Accessing Wetland Condition Information

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The California Rapid Assessment Method (CRAM) is a cost-effective and scientifically proven tool for assessing the health of wetlands and riparian habitats. It is designed for assessing ambient conditions within watersheds, regions, and throughout the state. Adopted by state and federal agencies and NGOs, CRAM is actively in use to inform wetland condition. CRAM can also be used to assess compensatory mitigation and restoration projects, and to help evaluate the performance of wetland and riparian protection policies and programs.

Developed under the direction of the CRAM Steering Committee and California Wetland Monitoring Workgroup of the Water Quality Monitoring Council, the new online management tools include a robust database, improved data-entry functionality, multiple ways to access results, and a redesigned website. The new database was designed to store data from different versions of CRAM assessments, support future updates and changes to the methodology, track the various training courses and reference sites, and dynamically render the metric and attribute information in the data entry forms. In addition to being easier to maintain, the new entry forms enable better tracking of practitioners' assessments and uploads of photos and documents. The greatly improved mapper functionality allows for versatility in data entry. Practitioners can digitize a new polygon, upload a KML or shapefile, or edit an existing polygon. They can also access and download CRAM data in several ways: generate a pdf summary report for an assessment, download the individual metric and attribute scores, or view all public CRAM assessments in EcoAtlas. Additionally, the redesigned website provides training information, CRAM resources and documents, and the ability to search for trained practitioners.

The open source tools were developed with regular input from a large and multi-interest user group to ensure the developed functionality met the needs of users, while also focusing on easier tool maintenance.

Keywords: wetland condition, rapid assessment method, online data entry tools

Poster topic: Sustainable Habitats and Ecosystems

What Do We Have Now? Species Specific Floodplain Habitat in the Sacramento Basin

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There are particular reaches in the Sacramento system that, on average, have less than four feet of floodplain width on each side of the river channel. Meanwhile, the majority of the existing habitat for all species is believed to exist in the Yolo Bypass. We use the EAH method (Matella and Jagt, 2013) for measuring floodplain habitat to quantify the suitability of periodically inundated floodplains for nine riparian and aquatic species in the Sacramento Valley. The estimated annual habitat (EAH) method generates a single value that represents the long term average amount of periodically inundated floodplain that occurs (1) within the specific timing window that the species is present and (2) for the minimum length of time an individual needs to benefit. This talk will speak briefly about the relationships between the species and the physical and hydrologic components of the Sacramento system followed by reach by reach EAH values for the key species. The presentation will conclude with an analysis of the most vulnerable and robust parts of the system, and potential restoration strategies to increase values throughout the system.

Keywords: Floodplain Habitat, Baseline Conditions, Restoration Strategies, Estimated Annualized Habitat

Poster topic: Sustainable Habitats and Ecosystems

The 2015 State of the Estuary Report

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The San Francisco Estuary Partnership (SFEP) intends to produce a *2015 State of the Estuary Report*. The purpose of the report is to provide a well-reasoned synthesis of the ecological health of the Bay Delta system. SFEP sees this document as part of a series, as we completed our second *State of the Bay* report in 2011; the first health assessment was completed in 1992. SFEP is aiming for a document, like the 2011 report, that is built on a scientifically credible foundation that can continue to be reassessed and improved in coming years.

The findings will be synthesized and presented in a manner that is easily understood by the public and accessible to the mainstream media (such as a "report card"). The primary audience for this report will be the agency and organizational decision makers and managers who have a primary role in: 1) deciding what issues will receive time and money expenditures, and 2) in developing policy and programs that address the health of the Bay Delta. Secondarily, the audience is the general public and their elected representatives. The report is not intended to be of primary value to the scientific, engineering, or research community.

An effort will be made to include key ecological health indicators for the Delta – a new element for the 2015 report. This will require strong integration and assistance from the Delta scientific community, Delta Science Program, Delta Stewardship Council, Interagency Ecological Program, and the California Estuary Monitoring Workgroup to determine what indicators and benchmarks (publically or scientifically derived markers of progress toward a defined heath measurement) can be included in the 2015 Report. In addition, all 2011 report indicators and benchmarks are being reviewed, will be updated, revised or discarded depending on the outcome of the review.

Keywords: ecological report card, status and trends, indicators, benchmarks, ecosystem health

Poster topic: Sustainable Habitats and Ecosystems

Effect of Flow and Water Year (WY) Type on Nutrient and Organic Matter Sources and Biogeochemical Processes in the San Francisco Estuary: Use of a Multi-Isotope Fingerprinting Approach for Habitat Characterization during the Fall and Spring 2006-2014

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We have monthly or more frequent multi-isotope and chemistry data for 8 of the 9 falls 2006-2014 and 7 of the 8 spring/summers 2007-2014. The years with isotope data include 6 dry or critically dry WYs, 1 below normal WY, and 2 wet WYs. The entire dataset (projected through the end of 2014) consists of ~50 transects of the North Bay and Delta; ~40 transects of the Sacramento River, Delta, and Cache Slough region; ~20 transects of the lower SJR; and ~30 DFG "trawl" sample sets. The entire sample set has been analyzed for POM isotopes and most of the pre-2013 transect samples for nutrient isotopes. Hence, this dataset is ideal for an independent assessment of spatial and seasonal changes in characteristics and quality of the main fish habitats using our multi-isotope and multi-fingerprinting tools approach. For example, the C-N-S isotopes of the POM are sensitive to changes in salinity, nutrient sources, extent and type of C-N-S cycling, geographic sources of the POM, quality of the organic matter, etc. And nutrient isotopes are sensitive to changes in flow, effluent amount, nutrient ratios, extent of nitrification, etc. Hence, the isotopic and other data can be used to identify spring and fall fish habitat characteristics.

The average C-N-S isotopic compositions of POM and the N isotopes of nutrients from different seasons show relatively consistent trends with river mile. However, there often are large seasonal and downstream differences in POM sources and quality, and nutrient isotope trends, for different WYs with similar flows. Thus far, it appears that aggregating data by seasons and WY type is not a particularly useful way of evaluating controls on habitat quality. Instead, the specific flow of each transect usually appears to be the main control on isotopic compositions. This is a work in progress!

Keywords: LSZ, nutrients, habitat, organics, POD, isotopes

Poster topic: Sustainable Habitats and Ecosystems

Challenges and Approaches to Natural Resource Mitigation in a Changing Environment

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Current policies and practices address natural resource impact mitigation through replacement of lost services (including "take"), when impacts are unavoidable or deemed necessary. The approach has involved acquisition of "in-kind" services commensurate with anticipated losses, including measures intended to preserve the services "*in perpetuity*." In practice, these concepts are typically implemented via a service accounting scheme that quantifies the services lost, reconciles them with those acquired and ultimately generates or contributes to monetization of the transaction, sometimes including an "endowment" for long-term preservation. Various methodological tools/concepts have been employed to assess/quantify services and guide management (e.g., ecosystem service identification, habitat equivalency analysis, ecological and restoration risk assessment, net environmental benefit analysis, adaptive management, etc.). Monetization approaches have included direct restoration/replacement costing and mitigation credit transactions. The presumption that the ecology of such mitigation sites is always characterized by static processes (or "dynamic equilibria") is dubious and recent experience at some mitigation sites does not support such a presumption. Looming environmental alterations resulting from global climate change appear to be accelerating and are likely to further erode the validity of this presumption. Such changes likely would generate in the future qualities and quantities of services different from those envisioned under current conditions. This outcome would invalidate the concept of a site's current (or prospective) palette of service provision as existing "*in perpetuity*." Substantial intellectual and financial capital is being invested in large-scale plans for mitigation of impacts in the Delta ecosystem. This presentation will discuss the inadequacies of current service accounting and propose adjustments (e.g., clarification of "*in perpetuity,"* linking monitoring results to services, use of a dynamic accounting system, etc.) that will facilitate responding to future conditions. Pro-actively addressing future variability and uncertainty will reduce investment risk and enhance our ability to achieve long-term sustainability of these biological systems.

Keywords: mitigation, compensation, HEA, NEBA, restoration, climate change, natural resource services

Poster topic: Sustainable Habitats and Ecosystems

Formation and Erosion of Tidal Wetland near Martinez from 1850 to Present

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In 2003, Solvay USA, launched the Peyton Slough Remediation and Restoration Project in Martinez to remedy legacy contamination and restore diked historic tidelands. Construction was completed in 2007. Shoreline erosion was noted during post-construction monitoring in 2011. To aid in the evaluation of whether the erosion is a long or short term condition, a review of historical information near the site was conducted including historic maps, aerial photographs, and estimates of historic sediment loading. Information was available from1860 to present including aerial photographs from 1928 to present. Each map or photo was geo-referenced relative to the shoreline. The first charts of the area showed that the embayment between Bulls Head Point and Point Edith was a large mud flat. By 1928, the shoreline had moved seaward about 2,000 feet compared with 1860 due to filling of the shallow mudflats. The shoreline continued to move outward, reaching its maximum extent between 1959 and 1980. This area probably filled in with sediment washed down from the Sierra Nevada as a result of hydraulic mining in the mid-1800s. The area became erosional between1951 to 1983, and since that time, the shoreline has retreated about 60 feet. The data on the change in shoreline was compared with U. S. Geological Survey estimates of sediment load to the Bay. A correlation between the decrease in sediment load and the reduction in rate of growth of the wetland was observed. By the mid-1900s, sediment load no longer seemed sufficient to maintain the wetland extent, and it started to contract. Recently, the sediment load seems to have stabilized, and as a consequence, shoreline erosion appears to have stabilized to a constant rate. If this trend continues there will be a conversion from wetland to mudflat in the study area.

Keywords: wetlands, erosion, sedimentation, hydraulic mining, historic

Poster topic: Sustainable Habitats and Ecosystems

McCormack Williamson Tract and Grizzly Slough: New Analyses for Floodplain and Tidal Marsh Restoration

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The North Delta Project focusses on flood control and habitat improvements where the Mokelumne River, Cosumnes River, Dry Creek, and Morrison Creek converge. Flood flows and high water conditions in this area threaten levees, bridges, railways, and roadways that affect human safety and the economy. The project will reduce flooding and provide contiguous aquatic and floodplain habitat along the downstream portion of the Cosumnes River Preserve by modifying levees on McCormack-Williamson Tract (MWT) and at Grizzly Slough (GS).

The MWT Element (1500 acres) provides flood flow and stage attenuation in the area of the tract by lowering the crest of selected levees. The reduction in crest height of some levees on the tract will allow flood flows to enter and then drain in a controlled manner, creating fresh water tidal wetlands and food production for native species. The GS Element (400 acres) will modify Grizzly and Bear Slough levees on DWR's Grizzly Slough property upstream of MWT to attenuate peak flood flows and create floodplain habitat to benefit native fish species.

The Department of Water Resources is funding and coordinating these independent planning processes with local Reclamation Districts and The Nature Conservancy. Building on existing conceptual models, preliminary designs, and hydrologic models for both sites, new analyses (GIS and modeling) are yielding important lessons, thoughts for streamlining planning/construction, and ways to ensure consistency with new planning processes including the Delta Plan, Bay Delta Conservation Plan and the Fish Restoration Program Agreement. Example analyses covering a wide range of restoration planning topics are presented: GIS analysis, land title analysis, environmental permitting, recreation planning, and tidal inundation modeling. These analyses illustrate how existing data sources can be combined to establish and connect restoration priorities, screen restoration sites, select appropriate restoration designs and reduce project costs.

Keywords: floodplain, riparian, tidal marsh, restoration, GIS, modeling, planning, permitting, Delta

Poster topic: Sustainable Habitats and Ecosystems

Delta Riparian Habitat Restoration on Rock Stabilized Levee Repair Sites

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Following the devastation to New Orleans caused by levee failure during Hurricane Katrina in 2005, California's levee system in the Sacramento-San Joaquin River Delta was closely scrutinized by the Department of Water Resources for similar weaknesses. The key obstacle that prevented an immediate engineered repair of the levees was the presence of valuable natural resources at the eroded sites. Because of the very high cost of mitigation land acquisition, and habitat creation, it was determined that repaired levee sites would be ecologically restored in place and in kind with similar habitats. This created an enormous challenge for the ecologists -- a viable, riparian ecosystem sustained by a high water table had to be re-created to accommodate phraetophytic vegetation on top of massive piles of large crushed rock. In response to this challenge, the URS Restoration Group developed an innovative soil-filled rock slope protection (RSP) technique. The soil-filled RSP guaranteed survival of riparian plants on heavily armored levee banks by providing capillary fringe via loamy soil fill. URS ecologists also eliminated a non-permeable geotextile from the design and replaced it with a more environmentally-friendly, well-graded, gravel filter to prevent piping of the erodible substrate (sugar sand) while maintaining an elevated water table. Restoration plans were developed for fifteen Delta levee repair sites on the banks of Sacramento and San Joaquin Rivers, and Steamboat, Sutter, and Cache Sloughs. URS worked closely with DWR experts and staff from other resource agencies (CDFW, NOAA NMFS, USFWS, and USACE) to meet the demanding Standard Assessment Methodology riparian restoration criteria. The key ecological goal to fully restore the sites and mitigate in-kind and in-place for any environmental impacts was deemed successful by the regulatory and permitting agencies two years after the planting was completed.

Keywords: riparian, restoration, levee, repair, phraetophytic, water table, piping, soi-filled RSP

Poster topic: Sustainable Habitats and Ecosystems

Effect of Light and Turbidity in Larval Delta Smelt Rearing Trials

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Understanding how environmental factors influence first feeding success is critical for the conservation-oriented larval culture of Delta Smelt (DS). We conducted 40-day rearing trials to investigate the effect of light intensity and algae concentration on the survival, feeding, and growth of cultured DS larvae. Turbidity, which is algae in this case, is thought to be a predictor of DS in the wild, and characterizing the interaction of these two factors may be important to managing smelt in the field, and may provide a practical reduction of algae for culture conditions.

The experiment was designed based on current rearing conditions (9 µmol m-2 s-1, PPF, @ 9 NTU) to test the effects of changing one or both parameters on the survival, feeding, and growth of the larvae. To complete the study two separate trials were run. Four replicates were done for each condition, and each trial included the current rearing condition as a control. In the first trial we looked at low turbidities (2 NTU) with both high-light (9 µmol) and low-light conditions (0.5 and 4.5 µmol). In the second trial higher turbidities were looked at (5.5 and 9 NTU) in low light conditions (6.5 and 2 µmol, respectively).

The results from the first trial show that the fish with low-light and low-algae did not start feeding on day five while fish under other two conditions started feeding on day three. The survival rates for control, low-light and high-algae, and low-light and low-algae are 71.4%, 51.4%, and 53.4%, respectively. The findings show that a significant percentage of larvae surviving with low turbidity, which may be relevant to the wild fish. In the field, and in the lab, it will be important to monitor both parameters and at several life stages to determine a more optimal habitat for feeding, growth, and survival.

Keywords: Delta Smelt, larvae, light, turbidity, algae

Poster topic: Sustainable Habitats and Ecosystems

Adaptive Management in Action: The South Bay Salt Pond Restoration Project

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The South Bay Salt Pond Restoration Project www.southbayrestoration.org is the largest wetlands restoration project on the West coast of the United States. It is unique not only for its size-- over 15,000 acres—but for its location adjacent to one of the nation's largest urban areas, home to over 3 million people. The Project is intended to restore and enhance wetlands in South San Francisco Bay while providing for flood management and wildlife-oriented public access and recreation.

We have identified long-term alternatives for the Project, each representing a continuum toward different end-states: one end-state at 50% of the existing ponds converted to managed ponds for waterbirds and 50% restored to salt marsh habitat, and the other end of the continuum at 10% of the existing ponds converted to managed ponds and 90% restored to marsh habitat. The final ratio of managed ponds to salt marsh habitat will depend on the outcome of the Adaptive Management Plan, which will be implemented over the next 50 years. The Plan will allow for lessons learned from earlier phases and applied studies to be incorporated into subsequent stages as management objectives and designs of future actions are revised and implemented.

The Project has completed most of the Phase 1 studies, and much has been learned about key uncertainties. This poster will summarize the results of the studies on mercury bioaccumulation, steelhead smolt, Chinook salmon, and shallow mound habitat for foraging birds, and how managers have revised management actions and restoration designs in response to scientific research.

Keywords: Adaptive Management, wetland restoration, mercury, steelhead, Chinook salmon, birds

Poster topic: Sustainable Habitats and Ecosystems

Future San Francisco Bay Tidal Marshes: An Improved Climate Smart Planning Tool

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Unprecedented efforts to restore tidal marsh habitat in San Francisco Bay are being planned. To prioritize these and other conservation actions, decision-makers and resource managers need better information on the anticipated impacts of climate change on tidal marsh ecosystems. To address this need, Point Blue developed an innovative Decision Support Tool (DST) that synthesizes diverse information for evaluating the potential effectiveness of conservation actions. The Future San Francisco Bay Tidal Marshes Tool (Future Marshes Tool; www.pointblue.org/sfbayslr) is based on a mechanistic marsh accretion model and incorporates spatial variation at scales relevant to conservation and restoration decision-making to produce maps of current and future tidal marsh habitat. Models of current and projected bird distributions and abundance were developed by synthesizing the accretion modeling results with physical conditions at a fine scale (50 m). The user-friendly web-based DST was created to allow managers to examine scenarios of future marsh geomorphology and maps of modeled tidal marsh bird distribution, density, and conservation prioritization in relation to anticipated sea-level rise and marsh accretion. Point Blue has promoted the use of the Future Marshes Tool by conducting training workshops, demonstrations and presentations, and by working one-on-one with users. After synthesizing extensive feedback from land managers and decision-makers the tool has been improved with revised elevation projections based on a new Digital Elevation Model (compiled multibeam bathymetry and topographic LiDAR), updated organic accretion rates, site-specific summaries of projected habitat and bird population change, and conservation prioritization. The DST now provides enhanced information to guide restoration and management actions and the development of vulnerability assessments and adaptation plans aimed at maximizing tidal marsh resilience in the face of accelerating sea-level rise.

Keywords: Sea-level rise, resilience, vulnerability, bird abundance and distribution, accretion

Poster topic: Sustainable Habitats and Ecosystems