Will Salt Pond Restoration in South San Francisco Bay Cause Erosion of Mudflats and Sloughs?

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A key question for the ongoing South Bay Salt Pond Restoration project is: How do sediment sinks created by opening ponds to tidal exchange alter local mudflat and tidal channel morphology? If sediment supply is insufficient, existing mudflats will erode. A decrease in mudflat area and the associated altered inundation regime may negatively impact the food web structure on the mudflats, reducing their value for migratory birds. In addition, scour of tidal sloughs, which is expected because of the increased currents generated by the greater post-restoration tidal prism, has the potential to remobilize buried legacy contaminants, such as mercury.

Future morphologic changes to mudflats and sloughs in South San Francisco Bay are being evaluated using long-term, seasonal, and initial post-restoration data. A series of bathymetric surveys collected from1858 to 2005 reveal long-term geomorphic changes in both space and time that give insight into the pre-restoration morphodynamic system. Our analyses indicate that mudflat change is related to north-to-south sediment redistribution and to new sediment input. To quantify intra-annual variability and to document initial post-restoration changes, swath bathymetric surveys were collected from 2008 to 2012 using state-of-the-art interferometric sidescan sonar. On average, there is little seasonal change on the mudflats in the study area. However, the surveys indicate scour of mudflats and tidal sloughs occurred after the initial restoration, with up to a meter of scour adjacent to breeches in Alviso ponds.

The next logical step to strengthen the assessment of future geomorphic change is to model the hydrodynamic/sediment transport/geomorphic system to improve our understanding of the effects of sediment input and redistribution within the Bay. This will allow us to separate restoration effects from regional effects and help in managing restoration of South San Francisco Bay salt ponds.

Keywords: mudflat sediment slough sea level rise restoration salt ponds

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Sediment Dynamics in Restored Salt Ponds and Tidal Wetlands in San Francisco Bay

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Problem statement: There is large-scale interest in restoring tidal wetlands in the San Francisco Bay Estuary, and many of these restoration sites have subsided substantially, including those within the South Bay Salt Pond Restoration Project. When levees are breached at subsided sites, significant sediment accumulation is necessary to reach threshold elevations for plant establishment.

Approach: We measured sedimentation rates at a number of restored wetlands across the Bay using sediment pins at two restored salt ponds (Pond A21 in the Island Ponds and Pond A6) and feldspar marker horizons and Surface Elevation Tables (SETs) at Muzzi Marsh and Crissy Field.

Results: Highly subsided salt ponds within the South Bay have the potential for very rapid accumulation, as they are frequently inundated and suspended sediment rates within the South Bay are relatively high. More than 20 cm of sediment accumulated in the first three years post-breach at the Island Ponds in the South Bay, with a gradual reduction in sediment accumulation over time as the site increased in elevation. Vegetation established rapidly at the site once suitable elevations were reached. Pond A6 was breached in December 2010 and started at elevations substantially below the Island Ponds; even more rapid rates of sediment accumulation occurred during the first year post-breach at Pond A6. Muzzi Marsh and Crissy Field have not accumulated sediment as rapidly as the subsided salt ponds in the South Bay, likely due to higher initial elevations and restrictions in tidal flow.

Conclusions: On-going monitoring of sediment dynamics across a range of wetlands within the Bay will allow for the development of models which can be used to predict the development of future restoration projects, as well to understand long-term sustainability of natural and restored wetlands under scenarios of increased sea-level rise and reduced suspended sediment concentrations.

Keywords: restoration, sedimentation, tidal wetland, salt ponds

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Balancing Act: Protecting Waterbirds and Providing Public Access

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Projects throughout the Bay-Delta, such as the South Bay Salt Pond Restoration Project in the south San Francisco Bay, seek to achieve the potentially-competing goals of improving wildlife habitat while increasing public access. Science-based management of habitat and people is essential to balancing these goals. Of particular concern is the effect of trail use on migratory shorebirds and waterfowl that spend the winter foraging in ponds and tidal wetlands around the Bay, as well as impacts on the western snowy plover (*Charadrius nivosus nivosus*), a threatened shorebird that nests in dry ponds. As part of the adaptive management approach for the South Bay Salt Pond Restoration Project, we studied the effect of trail use on waterbirds around the Bay and found bird responses were both species and situation dependent. The abundance, species richness and proportion of foraging migratory shorebirds showed little difference between sites adjacent to existing trails versus non-trail use sites. However, nesting snowy plovers and migratory waterfowl reacted strongly when exposed to new trail use. Plovers flushed off nests in response to trail users at distances averaging 145m (SE 14m) and flushed at rates seven times that of nests not exposed to trail use. Waterfowl moved away from trails in response to trial use, maintaining buffer distances of approximately 100m or more. To understand the human side of this interaction, we combine these results with our study of people's satisfaction with their trail experience. Public demand for bay-side recreation continues to grow. This research integrates social and avian science to provide managers with information useful in protecting birds from trail use disturbances while allowing people to enjoy the beauty of the wetlands.

Keywords: Migratory waterbirds, western snowy plovers, trails, public access

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Effects of Wetland Management on Carrying Capacity of Duck and Shorebird Benthivores in a Coastal Estuary

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With global loss of natural wetlands, managed wetlands increasingly support energy requirements for wintering shorebirds and waterfowl. Despite numerous studies of energetics in freshwater systems, little is known of estuarine systems. Managed ponds in San Francisco Bay form part of the largest wetland restoration on the Pacific coast of North America. We compared energy requirements and availability for eight shorebird and four diving duck species during winters of 2007-2010 in 4 types of managed ponds - shallow seasonal and deeper circulation ponds in two salinity classes. We applied a daily-ration model to evaluate carrying capacity of managed ponds as potential bird-days that a site can support. We estimated diving duck abundances of 35,450 in average and 45,458 in peak years with > 95% in circulation ponds, and shorebird abundances of 64,253 in average and 108,171 in peak years with > 64% in seasonal ponds. Macroinvertebrate energy density was highest in mesohaline (5-30 ppt) circulation ponds and low in seasonal ponds for both guilds. Greatest energy requirements by diving ducks in mesohaline followed by low-hyperhaline (30-80 ppt) circulation ponds were mostly supported by available prey energy. Available energy for shorebirds was substanitally less than required in seasonal ponds but exceeded that required in mesohaline circulation ponds, which supported an average of 9,443 +/- 1,649 shorebird bird-days per ha of available habitat and 2,297 +/- 402 diving duck bird-days per ha of available habitat. This was about twice that of low-hyperhaline circulation ponds for both guilds and > 5 times than seasonal ponds. Our results indicate that salinity reduction to mesohaline levels and alteration of depth to increase accessiblity would substantially increase energy available for wintering waterbirds.

Keywords: benthic macroinvertebrates, carrying capacity, shorebirds, diving ducks, salinity, waterdepth

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Examining Fish Usage of Recently Restored Saltmarshes

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The effects of tidal marsh restoration on fish species and aquatic communities remains one of the largest enigmas in the San Francisco Estuary; however, marsh restoration also remains one of the most viable options for improving the current state of the estuary's ecosystem. The South Bay Salt Pond Restoration Program is the largest wetland restoration program in the United States and has breached several shallow intertidal salt ponds adjacent to South San Francisco Bay. This restoration has provided an excellent venue to assess the initial impacts of tidal restoration on fish and aquatic communities. We have developed a flexible and comprehensive monitoring program that has assessed abundances and composition of fish communities in restored salt ponds, historic marshes, managed wetlands, and adjacent sloughs. Because of the dynamic nature of these novel habitats, we have been using several complementary gear types to compare breached habitats with adjacent areas. Additionally, we have been investigating the health of a resident intertidal sentinel species, longjaw mudsucker (*Gillichthys mirabilis),* by using growth, recruitment, and survival to further determine the function and quality of the restored habitats. Fish abundance in restored habitats has been seasonal and has been highest in summer, while diversity within the ponds has been highest in spring. Fish moved from the sloughs into the ponds during spring and summer months, resulting in a high degree of similarity between the species assemblages observed in the breached salt ponds and the adjacent sloughs. Sentinel species have also been colonizing the salt ponds and condition factors have been better in the pond habitat than in adjacent areas.

Conclusions/Relevance: This study provides information about the potential of tidal restoration to shallow, off-channel habitats to fish communities in the Bay-Delta, which can be used by management to guide future.

Keywords: Tidal marsh, restoration, fish communities, sentinel species, salt marsh

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