Species Response to Habitat Restoration and Management in San Francisco Bay

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San Pablo Bay and Don Edwards San Francisco Bay National Wildlife Refuges are managed by the U.S. Fish and Wildlife Service for the benefit of federally-listed species, migratory birds, and other native wildlife and plants. Refuge actions focus on habitat restoration and management to improve nesting, roosting, and foraging opportunities for target species, and on reduction of negative impacts to these species from threats such as predation, habitat degradation, and climate change. Working in cooperation with many agencies, public, and private partners, we plan and implement recovery actions for tidal marsh dependent species and other listed species, and work toward habitat restoration and species population goals defined in regional plans.

Recent large-scale wetland restoration projects, such as the South Bay Salt Pond Restoration Project in the South San Francisco Bay, and numerous wetland restoration projects in San Pablo Bay are already showing benefits to species such as the California Ridgway's rail, salt marsh harvest mouse, waterfowl, and shorebirds. Two marsh restoration sites that have recently developed into functioning tidal marsh are Sonoma Baylands in San Pablo Bay and Pond A21 in the South Bay, both of which now support populations of Ridgway's rail. Populations of waterfowl and shorebirds are thriving in the South Bay Salt Ponds and in newly breached tidal marsh restoration projects such as Cullinan Ranch.

The Refuge is working within an adaptive management framework to learn from these past efforts, and considering potential climate change impacts in planning future restoration projects to increase species resilience in an uncertain future. Tidal marsh restoration design incorporates features such as marsh-upland transition zones and high tide refuge islands, as well as considering sediment re-use to accelerate the restoration process. Pond management includes managing water levels to provide adequate waterbird foraging opportunities, and managing nesting islands.

Keywords: tidal marsh, restoration, endangered, migratory birds, San Francisco Bay

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Speaker Biography: Joy Albertson is the Supervisory Wildlife Biologist for the San Francisco Bay National Wildlife Refuge Complex, leading a team of biologists on seven diverse refuges throughout the San Francisco Bay area. She earned a bachelor degree in Zoology-Wildlife Biology from North Dakota State University, and a graduate degree in Conservation Biology from San Francisco State University. Joy studied California Ridgway's rail ecology for her master's thesis, and has worked as a biologist in the San Francisco Bay area for more than 25 years. Her expertise is endangered species management and tidal marsh restoration.

Waterbird Nesting Ecology and Management in San Francisco Bay

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The South Bay Salt Pond Restoration Project faces several challenges in maintaining waterbird populations in San Francisco Bay, including loss of island nesting habitat, an expanding population of predatory California Gulls, and widespread mercury contamination. The number of colonies and overall population sizes of American Avocets, Black-Necked Stilts, and Forster's Terns have decreased over the past decade. The majority of Avocets and Terns nest on islands within managed wetland habitats, yet these managed ponds along the Bay's margins are being lost to tidal marsh conversion. Using a series of habitat selection studies, we developed a recipe for island design to maximize bird use of new nesting islands being installed by managers within remaining managed ponds. Additionally, we implemented social attraction techniques (decoys and electronic call systems) to establish nesting colonies of Caspian Terns (>300 nests) within two managed ponds containing 46 newly constructed nesting islands (Ponds SF2 and A16). The nesting population of California Gulls has expanded rapidly, and they are the predominant predator of waterbird eggs and chicks, accounting for 55% of Avocet, 54% of Forster's Tern, and 15% of Black-Necked Stilt chick deaths. The managed relocation of the largest California Gull colony in the estuary (Pond A6: 24,000 gulls) substantially increased Forster's Tern chick survival (by 900%) in the nearby tern colony compared to a more distant reference tern colony. Finally, habitat management actions can result in increased mercury contamination of the food web. We found that conversion of a former salt pond to muted tidal marsh habitat (Pond A8) resulted in a short-term (1-2 years) spike (by 70%) of mercury concentrations in Forster's Tern eggs above toxicity benchmarks, but that restored ponds returned to reference levels within 3 years. Together our results indicate that management can have substantial effects on waterbird nesting populations in San Francisco Bay.

Keywords:

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Speaker Biography: Dr. Josh Ackerman is a Principal Investigator with USGS and an Associate in the Department of Wildlife, Fish, and Conservation Biology at the University of California, Davis. His research specialty is in behavioral and community ecology, and his research program focuses on waterbird ecology, avian reproduction, contaminant bioaccumulation, and effects of contaminants on avian reproduction. He received his Ph.D. in Ecology from the University of California, Davis in 2002.

Evaluating Tidal Wetland Restoration: 20 years of Physical and Biological Monitoring at the Sonoma Baylands Restoration

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In 1996, a 120-ha (300-acre) site in San Francisco Bay received 1.5 M cubic meters (1.9 M CY) of dredged material, becoming one of the first to beneficially reuse dredged material to create coastal wetlands. We present 20 years of physical and biological monitoring data showing how the site, the Sonoma Baylands Restoration, has evolved and lessons learned that can be applied to current restoration efforts.

Summary of findings:

• The decision not to excavate larger outboard channels meant that tidal exchange to the site was initially very limited. Tidal scour of these channels accelerated after 4-7 years, resulting in a 50-fold increase in channel size (from approx. 2 m^2 to 100 m^2). Monitoring and adaptive management were used to identify and remove erosion-resistant barriers to outboard channel evolution.

• The site has converted from open water to intertidal flats and emergent marsh. With placement of dredged material and 0.3 – 0.6 m of estuarine sedimentation, much of the site is at elevations suitable for colonization by emergent vegetation. Marsh vegetative cover is 72% of the tidal area.

• Tidal channel erosion into the placed dredged material has resulted in an interior channel system similar in extent to natural reference marshes. Channel down-cutting into the former agricultural surface (beneath the dredged material) has been slower.

• 25 species of fish and 83 species of birds use the site; this number increased over time as tidal exchange improved. With open water converting to tidal flats over time, avian use has shifted away from waterfowl towards shorebirds (as expected), which now comprise 87% of avian use of the site.

The Sonoma Baylands Restoration was funded by the U.S. Army Corps of Engineers and the California State Coastal Conservancy.

Keywords: salt marsh restoration, wetland restoration, beneficial reuse, dredged material, monitoring

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Speaker Biographies:

Michelle Orr: Michelle Orr is a water resources engineer with Environmental Science Associates who has been restoring wetlands in San Francisco Bay and along the West and Gulf coasts for over 20 years.

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Ridgway's Rail Response to Adaptive Tidal Marsh Restoration

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The California Ridgway's Rail, a federally endangered species dependent on tidal marsh habitat in the San Francisco Bay Estuary, is the target of conservation investments designed to increase their population size and their resilience to the impacts of climate change, including increasingly frequent extreme flooding events. To date, there has been no rigorous assessment of the efficacy of these innovative enhancement strategies, designed to directly benefit Ridgway's Rails. Through a multi-agency stakeholder process, working with the U.S. Fish and Wildlife (USFWS) and the State Coastal Conservancy's (SCC) Invasive Spartina Project (ISP), we developed a framework for assessing the impact of novel restoration and enhancement strategies on target populations through field surveys and rigorous analyses. We assessed the impact of two different tidal marsh enhancement strategies: marsh revegetation, planting of native *Grindelia stricta* (gumplant) and construction of high tide, in-marsh refugia mounds. Using a multi-partner, 12-yr dataset, comprising 157 marsh sites, with and without enhancement, we analyzed changes in rail density over time and in response to tidal restoration and innovative marsh enhancement. We compared these changes to the trends in density at different spatial scales and different marsh types. Ridgway's Rail density trends continue to increase in both San Pablo and San Francisco Bays and are similar to densities before the steep decline in 2008. This increase is due in part to evolving restoration sites, such as Sonoma Baylands, providing quality habitat. In the coming years, the results of this ongoing study, the assessment framework being developed, and the ensuing science-based recommendations will lead to improved tidal marsh enhancement strategies that benefit tidal marsh-dependent bird populations.

Keywords: Ridgway's Rail, tidal marsh, adaptive restoration, climate change

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Speaker Biography: Julian is the San Francisco Bay Program Leader at Point Blue Conservation Science. He works to advance wetland-dependent bird conservation by leading innovative research and informing on-the-ground restoration and management. He also assists agencies and organizations in understanding and preparing for the negative impacts of climate change on wildlife and human communities. His current areas of interest include bird response to innovative and adaptive habitat restoration, impacts of human land use and working with stakeholders in developing and using decision support tools to assist with climate change adaptation in San Francisco Bay.

Evaluating Tidal Marsh Benefits through the (Fish) Eye of the Beholder: Understanding How Fish Communities Respond to Wet and Dry Periods in the Upper Estuary

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Management and conservation of listed species requires an understanding of the ecological processes that drive recruitment. Previous research in the San Francisco Estuary emphasized the importance of spring freshwater outflow to support the fish populations, in part, because abundance of many pelagic species increases by an order of magnitude during periods of higher spring outflow to the estuary. Mechanisms underlying why fish respond favorably to higher flow conditions remains unclear for many estuarine species. During 2016 and 2017, we surveyed larval fish communities in tidal marsh and offshore habitats in the upper San Francisco Estuary to determine what factors affect larval rearing distribution and abundance. Our results suggest that marshes in Suisun Bay and San Pablo Bay are important nursery habitats for Pacific Herring and Northern Anchovy during periods of lower outflow into the estuary. In contrast, during wet years with higher outflow, tidal marshes and shallow areas in San Pablo Bay are important rearing habitats for Longfin Smelt and other native fish. Overall, fish abundance was higher in tidal marsh and shallow offshore habitats compared to channel habitats. These changes in community composition appear to be largely driven by differences in water quality, prey availability, hydrodynamics, and ocean conditions. We encourage managers and scientists to consider spatially dynamic ecosystem objectives that span fixed geographic boundaries when designing targeted management and restoration actions for species of concern in the San Francisco Estuary.

Keywords: Longfin Smelt, Estuary, restoration, larval fish, Herring

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Speaker Biography: Lenny Grimaldo works for ICF in San Francisco, California. He has been conducting fisheries research in the San Francisco Estuary for over 20 years, primarily focused on delta smelt, longfin smelt, and tidal marsh studies. Lenny Grimaldo received his PhD in Ecology from UCD and his M.S. in Marine Science from SFSU RTC.

Does Loss of Estuary Surf Scoters Indicate Declining Subtidal Habitats?

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In the highly urbanized estuary of San Francisco Bay, the Richardson Bay shoals support dense eelgrass beds (*Zostera marina*) that provide structure and habitat for spawning Pacific herring (*Clupea pallasii*). Adult herring and their roe contribute to the diet of many wintering waterbirds in the estuary including the largest southernmost concentration of surf scoters (*Melanitta perspicillata*) in the Pacific Flyway. However, over the past 3 decades, the extent of historic eelgrass beds have decreased, the herring spawn and its fishery has declined, and the midwinter index for scoters has plummeted 90% from 30,000 to 3,000 birds in the estuary. Threats associated with growth of the human population have included increasing disturbance, contaminants, and oil spills (including the 2007 Cosco-Busan spill when a large number of scoters were killed). Yet, the Bay Area and its conservation community have had little direct response to these alarming declines, primarily because there is a lack of understanding of the underlying ecology of these species and their shoal habitats, including the critical contribution of the shoals to the overall biodiversity of the estuary. Here, I will discuss how Audubon California is seeking to motivate actions to benefit wintering scoters and other sea ducks by recruiting grassroots community involvement through participation in science-based conservation efforts. I will summarize information needed to better understand the eelgrass-herring-scoter relationships, the importance of the shoals, and the potential effects of emerging threats. Finally, I will discuss the challenges of integrating participation by community members in science-based conservation and the critical role participation serves in leading to conservation action.

Keywords: sea ducks, Richardson Bay, Audubon, community

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Speaker Biography: Dr. John Y. Takekawa is Audubon California's Director of San Francisco Bay Programs. His research specialty has been on the ecology of waterbirds with expertise in telemetry to study movement ecology. His research work has included examining wetland habitat preferences and potential effects of climate change and sea-level rise on waterbirds. He has a B.S. in Forestry and Wildlife Science from the University of Washington, a M.S. in Wildlife Ecology from the University of Idaho, and a PhD in Animal Ecology from Iowa State University.

Humpback Whales Foraging in San Francisco Bay

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In spring/summer 2016, we observed an unprecedented influx of humpback whales (*Megaptera novaeangliae*) into San Francisco Bay (SF Bay). In contrast to previous rare sightings in the bay east of the Golden Gate Bridge, including disoriented individuals, in 2016 multiple humpback whales entered the bay to feed on northern anchovy (*Engraulis mordax*). Whales were sighted in SF Bay from 28 April to 24 August, recorded by several observers either in the bay or entrance to the bay on 44 days. Peak numbers were 24 in the entrance west of the bridge to Pt. Bonita (10 July) and 15 inside the bay east of the bridge (12 July). The whales were not resident in the bay during this four-month span, rather they transited to and from the coast in a tidally-dependent pattern, usually entering the bay on the flood and leaving on the ebb. Comparisons of fluke images from SF Bay with the North Pacific catalog matched at least 4 animals. Photos also showed the same individual whales using the bay in successive months. The cessation of humpback whale activity in SF Bay in August 2016 coincided with an increase in their numbers on the continental shelf/Farallon Islands area where they had access to krill. Preliminary results from the 2017 season indicate a return of multiple humpbacks to SF Bay beginning 23 April, including a known whale from the 2016 season, and a whale photo-identified on its breeding grounds in southern Mexico. Conservation implications for the endangered and threatened "distinct population segments" using the bay include the potential for human interactions. As whales enter the narrow congested Golden Gate Strait, the risk of ship strikes increase, in addition to disturbance by recreational users making close approaches. Annual intensive feeding humpback whales may play a significant role in the bay ecosystem.

Keywords: Humpback whale, San Francisco Bay, foraging, endangered species

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Speaker Biography: William Keener co-founded the non-profit Golden Gate Cetacean Research in 2010 to focus scientific research on the porpoises, dolphins and whales in San Francisco Bay and along the Northern California coast. Current projects include a study of the social behavior of harbor porpoises, the feeding behavior of humpback whales in San Francisco Bay, and a photo-ID catalog documenting the northern range extension of coastal bottlenose dolphins. His work with marine mammals began in 1977 at The Marine Mammal Center in Marin County, California, a facility dedicated to the rehabilitation of sick and injured pinnipeds. From 1980-1982, he served as Executive Director of the Center. As a boat-based field observer, he recorded marine mammals and seabirds in support of Cordell Bank's status as a National Marine Sanctuary, and conducted baseline population surveys of harbor porpoises in the Gulf of the Farallones National Marine Sanctuary for Cascadia Research Collective.