Prioritizing Tidal Marsh Conservation and Restoration Efforts Given High Uncertainty due to Future Environmental Change

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Uncertainty surrounding the effects of sea-level rise and climate change on tidal marsh habitats, and the species that depend on them, exacerbates the difficulty in planning effective conservation and restoration efforts. To help conservation practitioners address this uncertainty, we projected the distribution and abundance of tidal marsh bird species in the San Francisco Estuary in twenty-year intervals, from 2010 to 2110. To assess the sensitivity of models to uncertainty in future conditions, we considered four future scenarios, with assumptions of low or high suspended sediment concentrations and two rates of sea-level rise (0.52 m or 1.65 m/100 yr). We used the projections of bird populations to prioritize current and future marsh sites for conservation and restoration using Zonation conservation planning software. We evaluated whether the ranking of the top 25% of proposed restoration projects changed based on which future scenario we used in the prioritization. We ranked the potential restoration projects under six scenarios: the four future scenarios, one scenario representing current conditions, and one scenario including all future scenarios. We found that ranking restoration projects based on current conditions only consistently resulted in fewer tidal marsh birds protected under all scenarios, suggesting that ignoring future forecasts because of high uncertainty can lead to inefficient use of resources and high biological costs. Ranking the restoration sites based on only one of the four future scenarios showed variable performance depending on which future scenario was used. Ranking restoration projects using the combined scenario consistently performed as well as or better than rankings using individual scenarios regardless of what future scenario was used to assess performance. Our results demonstrate the value of using models of different scenarios to ensure that climate change adaptation plans are robust to the uncertainty in future conditions.

Keywords: Uncertainty, Conservation Prioritization, Tidal Marsh Birds, Sea Level Rise

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Restoration in the North Delta

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In the north-eastern Delta, where sea level rise, increased frequency of large flow events, and the potential to remove or set back levees are at hand, restoration needs to proceed in the face of uncertain and likely changing hydrologic conditions. Using a case study from Grizzly Slough near Thornton California, we discuss how restoration can be implemented in the face of environmental and funding uncertainties. The DWR-owned land parcel is located between Grizzly and Bear Sloughs, near the confluence of the Cosumnes, Mokelumne and Sacramento rivers, which historically hosted distributary channels in a landscape of emergent wetland and mixed riparian vegetation. Currently leveed and farmed, the parcel floods approximately every 10 years. Our restoration design, being implemented in 2011 and 2012, accommodates future variable hydrologic conditions while incorporating existing volunteer riparian vegetation and addressing weed control. We took advantage of 'natures' gifts' by developing a unique swale design and supplying water using an innovative method of puncturing an aquiclude and using the release in hydrostatic pressure to flood historic low elevation distributary channel surfaces. We also took advantage of existing volunteer riparian cottonwood and willow cohorts and local seed sources for natural recruitment. In addition, the planted vegetation types include species with wide hydrologic tolerance ranges that can accommodate future changes in conditions (e.g. sea level rise, full or partial levee removal). Results from two monitoring seasons indicate the viability of this design and suggest maintenance approaches. Vigorous growth of native woody and herbaceous plants was observed (>85% survival in most instances) but extensive control of invasives was necessary. This project is part of a broader planning effort to link multiple high quality riparian forests and wetlands throughout the northeast Sacramento-San Joaquin Delta in order to create a landscape scale corridor for anadromous fish, migratory birds, and other wildlife.

Keywords: riparian, restoration, recruitment, landscape ecology, north Delta, monitoring, weed control

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Scaling Restoration Strategies to Ecosystem Processes

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Recent empirical studies have demonstrated that, at a regional scale, strong environmental filters limit species diversity in more stressful, less productive ends of a gradient whereas stochastic processes (such as dispersal limitation and priority effects) are more important in less physically stressful, more productive environments. To test this theoretical premise, we investigated within- and among-tidal wetland plant species diversity patterns along a broad gradient from freshwater to salt marshes. Our six study sites focused on remnant tidal wetlands with minimal anthropogenic influence: China Camp, Petaluma Marsh, Coon Island, Rush Ranch, Browns Island, and Sand Mound Slough. We found that, as predicted, salt marshes with high salinity levels have significantly reduced species diversity compared to species diversity in brackish and freshwater marshes. Similarly, we found fewer differences among plots at the stressful end of the gradient (using multivariate analysis of dispersion) compared to the Delta site. These findings suggest that restoration strategies based on predictable, deterministic responses of species in salt marshes may be relatively successful in restoring Bay wetlands, but a strategy attuned to more stochastic processes is critical for restoration of biodiversity in the Delta. This implies that assisted migration and other restoration methods emulating random processes will be necessary to sustain diversity in the upper portion of the Estuary. In reality, deterministic and stochastic processes are inherent in community assembly mechanisms throughout the estuary but differ in degree of importance at any particular site. In the Bay, specialized habitats such as brackish upland-wetland transition zones probably require a similar stochastic approach to restoration. Ultimately, the key is to incorporate the appropriate ecosystem processes to match the restoration strategy that best takes into account these different scales of community dynamics.

Keywords: Deterministic, Stochastic, Environmental Filters, Dispersal Limitation, Tidal Wetland, Salinity Gradient

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Communicating Bay-Delta Science to the Public: Envisioning the Delta as it Was

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Earlier this year KQED's science program "Quest" collaborated with the San Francisco Estuary Institute and Stanford University's Bill Lane Center for the American West to produce an interactive, multimedia online application based on SFEI's research on the historical ecology of the Sacramento-San Joaquin Delta. The online feature enabled the public to explore the sources, methods, and findings of the scientific and historical research in a compelling, user-friendly format enriched by narratives, maps, photographs, and historical documents. The online application accompanies a radio feature story that aired on Morning Edition on KQED and on the California Report statewide and was part of a series of stories exploring the history, science, and future of the Delta. The entire effort was based on a deep collaboration between scientists, scholars, and journalists. This special oral presentation will feature a panel that will tell the story of this collaboration, discuss its significance and the necessary ingredients for success in such collaborations, and explore the lessons learned for future efforts to enrich public understanding of science and its implications for the Bay-Delta.

Keywords: Multimedia online application, Public, Quest

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