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Tidal marsh sustainability in the face of sea-level rise

Results from extensive modeling based on long term data warn that up to 93% of San Francisco Bay's tidal marsh could be lost during the second half of the century as sea-level rise (SLR) accelerates. Future tidal marsh habitat can be maximized by breaching levees to create new marsh, placing clean dredge material at subsided or at risk sites, and helping marshes adjacent to natural uplands move upslope as sea levels rise. PRBO partnered with researchers from ESA PWA, University of San Francisco, UC Berkeley, and San Francisco State University to publish these results in the journal PLoS ONE. The team also created an online decision support tool (www.prbo.org/sfbayslr), which is being used by land managers and decision makers to explore results for a range of potential future conditions at multiple scales in an accessible map-based format and to strategically implement our recommended actions.

We developed a hybrid modeling approach that includes marsh growth processes and incorporates spatial differences at a scale relevant for conservation and restoration decision-making. We applied this model to all baylands and adjacent uplands in San Francisco Bay, using high-resolution elevation data and best estimates of sediment supply. Accretion models were run over 100 years to evaluate eight climate change scenarios (combinations of sediment supply and rates of SLR).

Bay-wide projections of marsh habitat area varied substantially, depending primarily on SLR and sediment assumptions. Across all scenarios the model projected an increase in marsh area over the next 40 years but for 6 out of 8 scenarios, a net loss was projected during the second half of the century as the rate of SLR accelerates.

The model also projected a shift in the mix of intertidal habitats, with a loss of high marsh and gains in low marsh and mudflats. Successful restoration may still be achieved over the next century in sediment-rich regions.

Key Findings

- 93% of mid and high tidal marsh in the Estuary could be lost by 2100 under the most pessimistic scenario.
- Up to 32,000 ha (80,000 ac) of marsh could be formed by 2100 if diked baylands are breached.
- Up to 3,300 ha (8,000 ac) of low-lying uplands could become marsh by 2100.
- Up to 16,000 ha (40,000 ac) of would-be marsh are currently urbanized.
- The use of clean dredge materials may be needed raise elevations and sustain marshes.
- Sediment-rich areas such as the Petaluma River and South San Francisco Bay have the best prospects for long-term marsh sustainability,
- The web-based decision support tool (www.prbo.org/sfbayslr) can help plan restoration and conservation actions.

Stralberg, D., M. Brennan, J.C. Callaway, J.K. Wood, L.M. Schile, D. Jongsomjit, M. Kelly, V.T. Parker, and S. Crooks. Evaluating tidal marsh sustainability in the face of sea-level rise: a hybrid modeling approach applied to San Francisco Bay. PLoS ONE.

<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0027388>.