Late Holocene marsh expansion in Southern San Francisco Bay, California: implications for the use of historic baselines as restoration targets

Elizabeth Burke Watson[1]
Roger Byrne[2]

[1] U.S. Environmental Protection Agency, ORD-NHEERL, Narragansett, RI
[2] Geography Department, University of California, Berkeley

Currently, the largest tidal wetlands restoration project on the US Pacific Coast is being planned and implemented in southern San Francisco Bay; however, knowledge of baseline conditions of salt marsh extent in the region prior to European settlement is limited. Here, analysis of 24 sediment cores collected from ten intact southern San Francisco Bay tidal marshes were used to reconstruct spatio-temporal patterns of marsh expansion to provide historic context for current restoration efforts. A process-based marsh elevation simulation model was used to identify interactions between sediment supply, sea-level rise, and marsh formation rates. A distinct north-south age gradient was found: expansion of marshes in the central portion of southern San Francisco Bay dated from 500 to 1500 calendar years before present, while expansion of marshes in southernmost San Francisco Bay dated from 200 to 700 calendar years before present. Thus, much of the tidal marsh area mapped by US Coast Survey during the 1853–1857 period were in fact not primeval tidal marshes that had persisted for millennia but were recently formed landscapes. Marsh expansion increased during the Little Ice Age, when freshwater inflow and sediment influx were higher than during the previous millennium. Marsh expansion also increased during European-American settlement, when land use changes, such as the introduction of livestock, led to increased watershed erosion, and sediment delivery. These results provide a valuable perspective on salt marsh restoration and sustainability in South San Francisco Bay. Generally turbid conditions, the large acreages of salt marsh mapped in the late 1800s, and positive response to rapid sea level rise in the mid-twentieth century (due to groundwater overdraft) have built a perspective of South Bay salt marshes that suggest a very robust sediment supply, and thus a strong capacity for re-vegetation and sustainability. However, our results suggest that during the prehistoric past, conditions may have been more challenging, and may caution against extremely ambitious acreage restoration goals.