

Predicting tidal marsh plant community response to climate change: A Pacific coast perspective using field experiments

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We propose to use newly collected and existing data to examine the influence of salinity and tidal inundation on the distribution, diversity, and establishment of tidal marsh plant species. In tidal wetlands, plant communities will rapidly change due to shifts in inundation and salinity associated with sea-level rise and changing watershed run-off. These changes will cascade into terrestrial or pelagic animal communities due to changes in food webs or habitat structure.

We will address the following questions for a Mediterranean-climate region: 1) How are species currently distributed within the San Francisco Bay-Delta system along a salinity-inundation gradient? 2) To what extent do salt marsh and brackish marsh species disperse up-river within tidal regions (a measure of their potential to invade as climate change increases salinity upriver)? 3) How do salinity and inundation influence establishment patterns for mixtures of freshwater, brackish and salt marsh species arising from seed banks? Using these data and existing information, we can begin to interpret which species and what parts of their distributions are most likely to be initially threatened by climate change?

Research will be conducted within the San Francisco Bay-Delta tidal wetlands. Six locations (two salt marshes, two brackish marshes, two freshwater tidal marshes) will be used as intensive study sites, while other locations will be investigated for additional data. These secondary sites will be concentrated in the northern San Francisco Bay, the tidal portions of the Petaluma and Napa Rivers, and the western San Joaquin/Sacramento River Delta.

Across these study sites, we will determine plant species diversity and species-area relationships in relation to a regional salinity gradient in the estuary. At intensive study sites and in the greenhouse, we will complete a series of experiments to evaluate plant establishment from the seed bank across a range of salinities and inundation conditions. We will deploy seed traps across a series of brackish to freshwater tidal sites to assess dispersal potential, abundance and distance, especially in the upriver direction where shifts in recruitment are most likely to occur with changing climate.

Experimental data will identify underlying mechanisms that will shift individual plant species distributions and performance. These will form the basis of conceptual models to interpret and assess the differential influence of factors likely to change these tidal systems. Structural equation models (SEM) will test the strengths of linkages among the conceptual models.