

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?

Recently, we have added projects on belowground biomass and decomposition. We expect that belowground biomass contributes significantly to accretion in all marshes but that the relative importance of this contribution is correlated with salinity, inundation, plant species composition and diversity, and N and P nutrient dynamics in wetlands. Specifically, we hypothesize that belowground biomass contributes a greater amount to accretion in lower salinity or freshwater wetlands because (1) belowground biomass and productivity is greater in lower salinity wetlands than in salt or brackish marshes and (2) rates of decomposition are slower in lower salinity wetlands due to the freshwater effects on decomposition and nutrient cycling.

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. Belowground productivity will be assessed at three of these sites along with above and belowground decomposition rates.

Experimental data will fill in gaps in conceptual models developed from previous work. These data will be used to model sedimentation dynamics in conjunction with existing data from SETs, marker horizons, and dated sediment cores. Results will be combined with data on aboveground biomass, productivity, and decomposition to determine overall system productivity and organic matter cycling rates between different wetland plant communities. This will form the basis of interpreting overall impacts of global climate change on productivity, diversity, and long-term stability of these tidal wetlands.