CALFED Progress Report
California Sea Grant College Program

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ProjectYear_2A 3rd **ProjectNo_2C** R/SF-28

TypeQuestionnaire_2B Interim Questionnaire

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Project Information

ProjectNo_2C R/SF-28 **StartDate_3a** 9/1/2007 **EndDate_3b** 7/31/2011
ProjectTitle_4 Tidal wetland vegetation response to climate change in the San Francisco Bay: predictive modeling for species distributions in a changing environment

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Additional Research Mentors and Community Mentors

Additional Research Mentors_8

Dr. Matt Ferner, San Francisco Bay National Estuarine Research Reserve research coordinator

Additional Community Mentors_9

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Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.

ProjectObjectives_10

Objective 1. Through intensive vegetation sampling tied in with elevation surveys and measures of inundation depth and duration, I plan to determine the lower elevation limits of dominant plant species across all habitat types and document patterns in inundation regime and salinity ranges within monospecific and assemblages of dominant species.

Objective 2. Through field transplant experiments, I will examine how dominant species from freshwater, brackish, and salt marshes respond to increases in salinity and inundation when transplanted to marshes with higher salinity and into low marsh regions both within its current site and sites with higher salinity.

Objective 3. Through a greenhouse experiment, I will measure the performance of individual dominant species and one common invasive species from salt, brackish, and freshwater marshes under a variety of salinity and inundation regimes. Inundation regimes will be based on current and predicted water levels under climate change scenarios. Data collected will provide parameters for species and habitat distribution models.

Objective 4. Using existing spatially explicit species distribution models, I will model the potential niche of each of the target species, conditioned by salinity, inundation, elevation, and land use parameters derived in Objectives 1 through 3 for current Bay-Delta conditions and predicted climate change scenarios.

Summary of progress in meeting each of these goals and objectives

ProgressSummary_11

Objective 1. Vegetation and elevation surveys began in September 2007 and were completed during the summer of 2010. Water level monitoring stations have been installed at all six field sites in the summer of 2008; however, not all sites have complete data sets due to vandalism and equipment malfunction. Data collection stopped in October 2011. Average monthly water salinity was calculated for all sites with data and tidal data were converted to meters NAVD88. Common tidal metrics (ie: mean high water, mean higher high water) were calculated for all sites.

Objective 2. A preliminary transplant experiment was initiated in March 2008. The experiment was not successful due to a variety of reasons. A new methodology was employed in March 2011. I installed planters called 'marsh organs' in channels at two of my field sites that differed in salinity: Rush Ranch and Browns Island. The planters allowed me to grow two dominant plant species at 5 elevations that were lower than current distributions to simulate sea-level rise effects. I also incorporated a competition treatment to examine how competition affects biomass along an inundation gradient. The experiment was run from March 2011 to October 2011. All above and below-ground biomass was harvested, rinsed, separated by species, roots, and rhizomes, and dried. I'm currently writing the manuscript that will be submitted to the journal Ecology this month.

Objective 3. The greenhouse experiment was not conducted due to time and funding constraints.

Objective 4. All spatial and field data have been collected. I am using a point-based marsh accretion model called the Marsh Equilibrium Model (MEM). MEM incorporates both physical and biotic inputs to model marsh surface elevation given a certain sea-level rise. I have collected and consolidated all of the biotic and physical data for salt, brackish, and oligohaline marshes. I am currently waiting to receive the most updated version of MEM so that I can run the model under a variety of sea-level rise and suspended sediment concentration scenarios across the three marsh types. Given the model outputs, I will extrapolate results across tidal wetlands using a high accuracy digital elevation model of San Francisco Bay. Modeling efforts will be completed by June 2012 and the manuscript will be submitted to Estuaries and Coasts in July 2012.

PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and how they were resolved. Describe any ancillary research topics developed.

Modifications_12

The proposed transplant experiment was determined to not be the most effective way at measuring the effects of increased salinity and inundation on tidal wetland plants species in the field based on a preliminary experiment that was initiated in Spring 2008. A modification to the experiment was implemented in Spring 2011, which incorporated the methodology of Dr. James Morris called the 'marsh organ'. The marsh organ is a PVC planter that is installed in a marsh channel and allows the researcher to grow plants at specific elevations. I positioned the marsh organs at low elevations to simulate the effect of sea-level rise. Every organ had 5 rows, each row 15cm lower than the one above, and each row had three 6 inch PVC pipes. The top row was positioned at the lower end of the elevation distribution of Schoenoplectus acutus, one of my study plant species. I installed 7 replicate organs at Browns Island, an oligohaline marsh in the western Delta and 7 replicate organs at Rush Ranch Open Space Preserve, a brackish marsh in the Suisun Bay, and filled the PVC pipes with surrounding mud flat sediment. I collected rhizomes of two dominant plant species, Schoenoplectus americanus and Schoenoplectus acutus, from Browns Island. I implemented three species treatments in every organ row: each species was grown individually and each species was grown together in one pipe in order to implement a competition treatment. SEE ADDITIONS SECTION FOR MORE TEXT.

BENEFITS AND APPLICATIONS: Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see http://science.calwater.ca.gov/pdf/soemgmtcues.pdf).

BenefitsApplic_13

The results from this proposed research will be many. First, a greater understanding of edaphic factors driving current species distributions will be produced. I will document species distributions along salinity, elevation, and inundation gradients, which will aid in restoration planning for resource managers and policy makers. Second, comprehensive data on species responses to altered salinity and inundation regimes will be produced, which will provide critical parametization of climate change models for the Bay-Delta and other Pacific coast watersheds. Additionally, understanding how species respond to changes in their physical environment is critical for predicting changes in species assemblages. Third, I will collaborate with my faculty and community mentors to generate scientifically valid models of dominant plant species occurrence and predicted habitat changes throughout the Bay-Delta under various climate change scenarios. The model outputs will benefit multiple agencies. Fourth, I will actively promote and disseminate the findings of this research to policy makers, resource managers, academics, and the general public in order to raise awareness of how predicted climate change will affect local tidal marsh communities.

PUBLICATIONS: List any publications, presentations, or posters that have resulted from this funded research. Give as many

details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

Publications_14

No publications have resulted from the research thus far. I am in the process of revising a manuscript on the effects of sea-level rise on plant productivity and the paper will be submitted to the journal Ecology this month. I attended the State of the Estuary conference in 2009 and presented a poster, but the research was not from my dissertation project. In September 2010, I presented a poster on the effects of salinity on tidal marsh vegetation diversity and abundance at the CALFED Science Conference. In September 2011, I presented a poster at the State of the Estuary conference on preliminary results from my marsh organ experiment and was given the best student poster award. In June 2012, I will attend the Society for Wetland Scientists/INTECOL conference in Orlando, Florida and will present a talk on the sea-level modeling results that I am currently working on. I also intend to give a talk at the 2012 CALFED Science Conference on a combination of my field and modeling results.

COOPERATING ORGANIZATIONS: List those agencies and/or persons who provided financial, technical or

other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz_15

I have received logistical support for field work from faculty and staff at San Francisco State University and University of San Francisco. Staff at PRBO Science have assisted me with planning and initiating the spatial modeling aspect of my project. The Northern California Botanists society awarded me a small research grant in 2008 that support a small field work campaign in 2009 to maintain the water level stations installed at my field sites. Drs. Wayne Sousa, Whendee Silver, John Callaway, and Katharine Suding have assisted me in designing legitimate experimental designs, analyzing the results, and providing feedback on the manuscripts.

AWARDS: List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards_16

I was awarded the Best Student Poster at the 2011 State of the Estuary conference. I also was awarded a Wetland Foundation travel grant in order to attend the Society for Wetland Scientists/INTECOL conference in June 2012 in Orlando, Florida.

KEYWORDS: List keywords that will be useful in indexing your project.

Keywords_17

San Francisco Bay Estuary, climate change, tidal wetland vegetation, inundation regime, species distribution modeling

PATENTS: List any patents associated with your project.

Patents_18

There are no patents associated with this project.

Additions: Additional information can be added here. Please begin the text with the number of the question you are adding to.

Additions_19

CONTINUED FROM PROJECT MODIFICATIONS: I initiated the experiment in March 2011 and harvested all biomass in October 2011. During the experiment, I measured pore-water salinity, redox-potential, inundation rates, channel water salinity, and measured all plants on a monthly basis. I am currently writing the manuscript. I was unable to conduct the greenhouse experiment due to lack of time and lack of appropriate facilities. The marsh organ experiment took an entire year to construct and install, which was considerably longer than I had anticipated and cost more than I was expecting. However, the results from the marsh organ experiment provide key insight to how two dominant plant species respond to sea-level rise and competition.
One of my community mentors, Dr. Drew Talley, has left his position as research coordinator at the San Francisco Bay NERR. The current research coordinator, Dr. Matt Ferner, is assisting me in the community mentor duties, as Dr. Talley is no longer in a position to do so.