CLIMATE CHANGE

Western Ecological Research Center, San Francisco Bay Estuary Field Station **June 2014**

Introduction

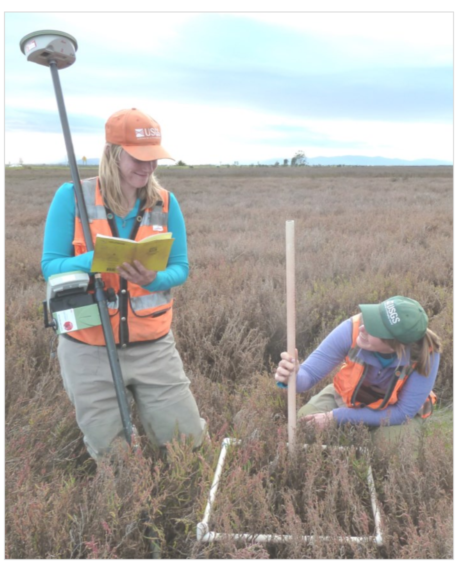
The USGS Coastal Ecosystem Response to Climate Change (CERCC) began in 2008 to deliver sea-level rise ecological response models at a scale relevant for resource managers. Work was originally focused on the San Francisco Bay estuary and then expanded to encompass other Pacific coast sites. Our goal is to provide site specific measurements and results that land managers, planners, and those concerned with the conservation of near-shore habitats can use to make well-informed climate change adaptation strategies and decisions.

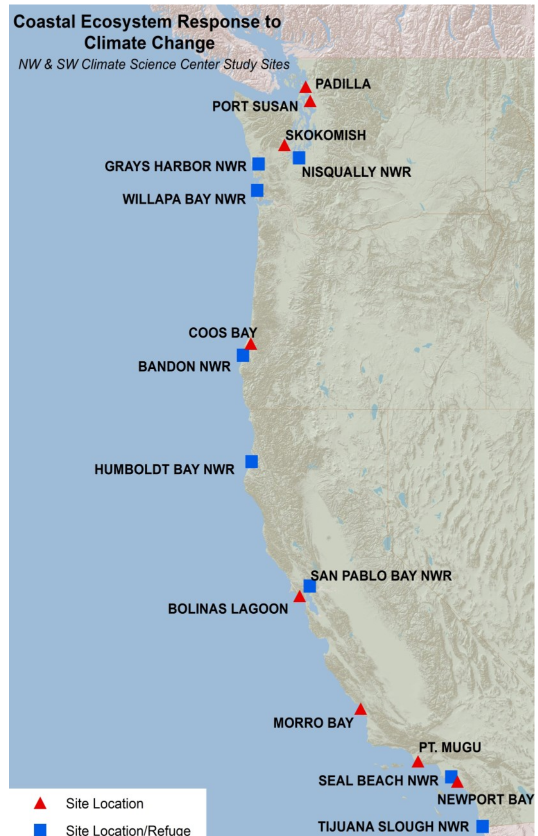
Nearshore ecosystems will be affected by climate change through accelerating sea-level rise (Holgate and Woodworth, 2004; Kemp and others, 2011), shifting precipitation patterns (Hamlet and Lettenmaier, 2007; Bengtsson et al. 2009), erosion (Leatherman et al. 2000), and changing frequency and intensity of storms (Emanuel, 2005; Webster et al. 2005).

Nearshore ecosystems that include tidal salt marshes, shoals, and eelgrass beds are highly productive ecosystems that are particularly vulnerable with variation in tidal depth and duration, which can play a major role in structuring plant and wildlife communities. In salt marshes and nearshore ecosystems, wildlife habitat diversity can vary because of the physiological conditions created by high salinity levels, tidal flooding, and low plant diversity. Studies have shown that wildlife populations in many ecosystems around the world are already responding to climate change effects and establishing studies now will improve our understanding of ecosystem change.

Our studies use a bottom-up local approach to assess sea-level rise and storm effects at the parcel scale (however relevant at a landscape scale) to provide baseline data sets and processes modeling to be used to evaluate resiliency of marshes to changing ocean and atmospheric conditions into year 2100.

The main objectives are: to (1) develop high resolution digital elevation models (DEMs) by collecting ground elevation data using a RTK GPS, (2) deploy local water level loggers to monitor tidal inundation cycles and extreme storm events, (3) inventory plant community composition in relation to elevation and water inundation, (4) measure vertical accretion for tidal salt marshes and suspended sediment availability, and (5) determine and develop sea -level rise response models for nearshore ecosystems (tidal marshes and shoals) and its effects on wildlife and their habitats. This detailed local data collection allows the development of vulnerability assessments for coastal ecosystems and their wildlife species.





Current sixteen research sites along the Pacific coast represent a gradient of tidal range, age, species diversity, size, and anthropogenic impacts.

Elevation (left), vegetation (left), and water level monitoring (top left) data collection is key in understanding ecosystem response from climate change. Surface elevation ables (top right) are long term monitoring stations that measure long term trends in elevation change.

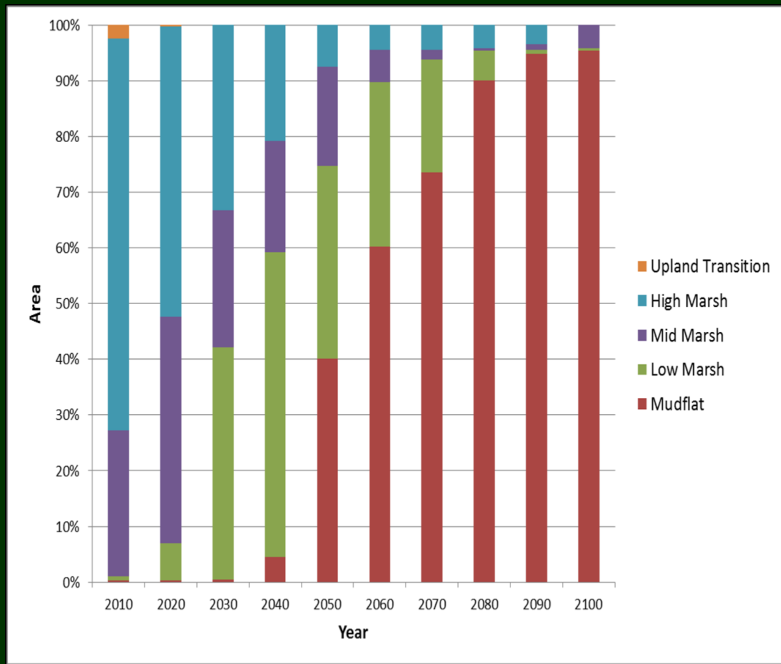


Figure 1. Sea-level rise modeling results for San Pablo Bay NWR. Results are displayed by habitat type to help inform listed species management decisions.

USFWS Refuge Results

- Sea-level rise modeling has been completed for Tijuana NWR, San Pablo Bay NWR, and Humboldt Bay NWR. Analysis for the remaining refuge study sites is in progress.
- Tijuana sea-level rise models indicate that elevation will decrease through 2100 under the mid (+93 cm) and high (+166 cm) sea-level rise scenarios, but maintain elevation under the low (+44 cm) scenario.
- For San Pablo Bay NWR results indicated that it will not keep pace with sea-level rise through this century, showing a gradual reduction in elevation relative to MHW over time, with a more dramatic decline after 2060. By 2090, the marsh was projected to be under MSL (Fig. 1,2).
- Once analysis is complete, comparisons along a latitudinal gradient can be made to assess vulnerability of refuges and endangered and migratory species.

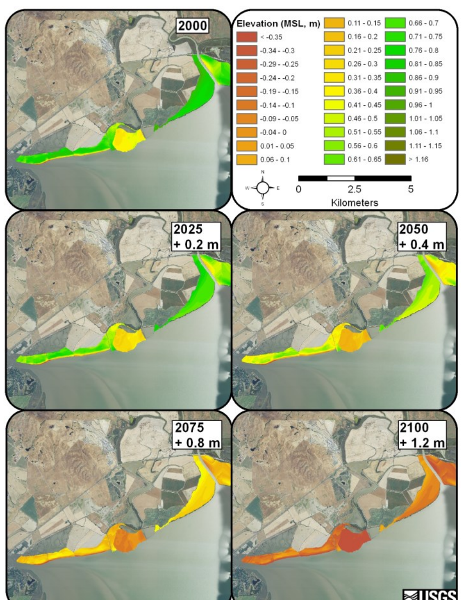


Figure 2. San Pablo Bay NWR Sea-level rise modeling results.

Future work

Our program recognizes that improved integration of physical, biological and climate data can facilitate a greater understanding of coastal ecosystems response to climate change.

A better understanding of the spatial variability of available suspended-sediment and deposition rates would greatly improve these site-specific results, and is a future goal of the program.

In addition, little is understood about the response of migratory and nearshore species, including many listed species, to climate change. Needs include population viability analysis, habitat requirements, movements, nesting and food requirements.

Partners

This work has been supported by R8 U.S. Fish & Wildlife Service Inventory and Monitory program, California Landscape Conservation Cooperative, North Pacific Landscape Conservation Cooperative, USFWS Refuges, USGS Northwest Climate Science Center, USGS Southwest Climate Science Center, and the USGS National Climate Change Wildlife Science Center. Multiple partners and land managers have assisted with access and other support, they include NOAA NERR, Tribes, California Department of Fish & Wildlife, California State Parks, East Bay Regional Parks, Department of Defense, and many others.

Technicians deploying a current profiler to better understand site specific sediment dynamics.

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