# Assessing Demographic Impacts of Climate Change on Tidal Marsh Birds: Population Modeling and Viability Analysis

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Tidal marsh habitat is of high concern because of: severe loss and degradation of habitat; endemic species, many of them threatened or endangered, depend on this habitat; and vulnerability of these species to climate change as a result of sea-level rise, changes in salinity, and the risk of extreme storms that will inundate vital habitat. To provide specific management guidance to reduce species' vulnerability and recover depleted populations, we developed interactive population dynamic models for four key marsh species: Black Rail, Clapper Rail, Common Yellowthroat, and Song Sparrow. The models can be used to assess known and potential risks, and to evaluate the efficacy of proposed management actions that may counteract threats to long-term viability. For tidal marsh Song Sparrows, available demographic information enabled us to also develop a stochastic model to project effects of changes in temperature, precipitation, and tides on future population viability. Under a high sea-level rise scenario, nest failure rates will increase and populations are expected to show strong declines (about 75% over 50 years); in contrast, populations are expected to increase assuming low sea-level rise. Extreme high tides associated with storms, which may become more common in the coming decades, were the most significant factor threatening long-term viability of Song Sparrows. However, a small reduction in predation on marsh bird nests (e.g., through predator control) can be sufficient to counteract expected population declines and exemplifies how increasing current survival and reproductive rates enhances species resilience to rapid climate change. Improvement in nest survival represents a realistic management action that can modify population trends, leading to, or enhancing population recovery. The demographic models presented quantify the expected benefits to affected species of potential management actions, integrate the impacts of environmental influences that may have opposing effects on target species, while revealing the long-term consequences to viability.

**Keywords:** Climate Change, Tidal Marsh, Modeling, Population Viability, Nest Survival, Flooding

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# The California Climate Commons

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Problem statement: There are countless projects generating climate change related datasets, as well as many ways of accessing and interpreting these data. Many of these products are highly technical in nature and based on a rapidly evolving set of assumptions and analytical methods, and are therefore accessible only by users with specialized skills. At the same time, natural resource managers are now required to consider climate change adaptation. Managers responsible for these efforts are faced with an untenable task of locating current, relevant data products and using them with confidence.

Approach: The California Climate Commons (climate.calcommons.org) is an initiative to help resource managers quickly find and get climate change related data and information from multiple sources, communicate with each other and with the researchers producing it, support one another in analyzing and interpreting the data for their projects, and then share lessons learned. The Commons provides technical and community support services that will result in a greater shared understanding about the best uses of climate change science toward improved conservation outcomes.

Results: In its first year the Climate Commons project created:
- an online library of climate-related data, tools, websites, and literature;
- hosting and download services for model outputs and ecological data products;
- an online environment for communication among the conservation and research/modeling communities.

In the second year we plan to engage the partners of the California Landscape Conservation Cooperative, both conservation managers and researchers, and create an active community of practice that uses the latest scientific findings in conservation planning and decision-making.

Conclusions: The California LCC provides an ideal framework for creating a shared and constantly improving understanding of the implications of climate science to natural resource management in the Bay-Delta and throughout California. The Commons is designed to maximize the potential of this framework.

**Keywords:** Informatics, climate change data, data access, digital library

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# Projected Impacts of Climate Change, Urbanization, and Water Management Scenarios on Habitats and Ecology of Waterfowl and Other Waterbirds in the Central Valley of California

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The Central Valley (CV) of California contains some of the most important habitats for waterfowl, shorebirds, and other waterbirds in North America. Most waterbird habitats in the CV, which include wetlands, flooded rice fields, and other agricultural lands rely on managed surface water supplies stored in reservoirs and delivered via a complex system to a wide array of competing water users. Water supplies vary with snow pack, temperature, and precipitation, all of which are projected to change substantially under some global climate models; land use and water management can also greatly impact water supplies. Waterbird food availability, which varies with the area, timing, and productivity of habitats, is a key factor limiting waterbirds during migration and winter affecting body condition and other aspects of their ecology. Thus, the Central Valley Joint Venture (CVJV) uses a food energy (bioenergetics) modeling approach to establish habitat conservation objectives for each CV basin. We developed necessary data and adapted a CV Water Evaluation and Planning (WEAP) model to investigate impacts of various climate, urbanization, and water management scenarios on waterbird habitats and ecology. For each scenario, we modeled water supplies and demands in the adapted WEAP model and estimated resulting landscape change. The area and timing of supported waterbird habitats based on WEAP results was then included in a bioenergetics model to quantify potential waterfowl food deficits. Initial modeling results focusing on Butte Basin indicate that under some scenarios, water supplies will not be adequate to maintain habitat at the levels necessary to support CVJV goal populations of waterfowl and result in late-winter food deficits for waterfowl. We are currently evaluating additional water management scenarios and expanding our efforts into other CV regions.

**Keywords:** bioenergetics, Central Valley, climate, model, scenario, urbanization, water, waterbird, WEAP

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# Updating the San Francisco Baylands Ecosystem Habitat Goals for Climate Change

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The San Francisco Baylands Ecosystem Habitat Goals report is being updated to assess the likely effects of climate change on wetlands at the edge of the Bay and to provide science-based recommendations for management actions to reduce negative impacts. A group of public agency, private, and non-profit partners produced the Goals report in 1999, and it has been an inspiration for wetlands restoration and enhancement around the Bay for over a decade. Scientific guidance from the Goals report has attracted funding for a wide range of acquisition and restoration projects, contributing to the protection of 40,000 acres of baylands. The technical update will consider how climate change, including sea-level rise, extreme weather events, precipitation patterns, and temperature changes, will impact the extent, location and ecological functions of the Baylands. The ways that tidal marshes, mudflats, managed ponds and other wetland habitats will likely evolve will be explored for different future scenarios of high and low climate change for shorter (2030) and longer (2100) time horizons. Special attention will be devoted to the transition zone between wetlands at the Bay edge and adjacent upland, as well as to how climate-based changes in the Bay will affect the wetlands. Impacts to wildlife, including changes in key wetland habitat functions, will also be assessed, as will carbon sequestration in marshes. This scientific assessment of the projected impacts will provide an essential foundation for considering associated adaptation strategies. Scientific and managerial experts from across the region will develop the content of the Update, under the oversight of an independent science review panel, similar to the process for the original Goals report. The Update is a BAECCC project supported by the Coastal Conservancy and the Gordon and Betty Moore Foundation.

**Keywords:** Baylands, habitat goals, climate change, sea level rise, management recommendations,

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# Predicted Sea-Level Rise Negatively Affects Tidal Wetland Distribution and Plant Productivity

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Sea-level is expected to rise between 70 and 180 cm in the next century and is likely to have significant effects on the distribution and maintenance of tidal wetlands; however, little is known about the effects of increased sea level on Pacific coast tidal marshes. These marshes comprise the majority of existing tidal wetland habitat in the San Francisco Bay Estuary and are particularly susceptible to increased sea-levels due to lack of upland habitat for future marsh migration. The development and calibration of a model that incorporates both physical and biological parameters is critical for investigating the predicted effects of sea-level rise. We examined the applicability and accuracy of the Marsh Equilibrium Model (MEM). MEM is a zero-dimensional model that models organic and inorganic accretion rates under a given rate of sea-level rise. MEM was calibrated using data collected from salt and brackish marshes in the San Francisco Bay Estuary. Above- and below-ground biomass from dominant marsh vegetation collected along an elevation gradient combined with results from a large field experiment simulating sea-level rise on two cosmopolitan tidal marsh species were used to calibrate the biological inputs. Both above and below-ground productivity decreased dramatically with increased inundation in one species but little to no response with the other. Under current sea-level rise conditions, MEM accurately modeled both organic and inorganic contributions to marsh accretion and the model then was run for each marsh type altering century sea-level rise and suspended sediment concentrations. Early results suggest that changes inthe contribution of plant biomass had more of an influence on marsh accretion rates than changes in the suspended sediment concentration and that marsh area decreases with increased sea-level rise. Few upland areas remain for marsh migration.

**Keywords:** sea-level rise, tidal wetlands, marsh accretion, vegetation

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