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## Modeling climate change impacts on tidal marsh birds: Restoration and conservation planning in the face of uncertainty

Effective climate-smart conservation planning requires that we address uncertainty about future environmental conditions. In some cases, improving our understanding of the physical and biological process involved will reduce the uncertainty of future forecasts, but often our uncertainty is also dependent on factors which scientific knowledge cannot address. We evaluated several methods for prioritizing tidal marsh restoration projects within the San Francisco Bay Estuary while incorporating potential effects of sea-level rise and climate change to determine the best means to contend with future uncertainty.

We used spatially explicit models of the abundance of five species of tidal marsh birds for four future scenarios at six different time periods to evaluate the effectiveness of six prioritization strategies. The six prioritization strategies included a “head in the sand” approach where we prioritized restoration projects using only current (2010) conditions, four variations of an “I feel lucky” approach where we used each future scenario individually to prioritize restoration projects, and a “combined” approach which used models for current and each of the future scenarios together while discounting areas of highest uncertainty among the future models.

We found striking differences in the abilities of the strategies to rank projects according to which would support greater numbers of tidal marsh birds. We found that the “head in the sand” strategy resulted in the fewest numbers of tidal marsh birds. The “I feel lucky” strategies performed well when the matching future scenario was used to prioritize, but poorly under one or more of the other three future scenarios. We found that restoration projects chosen using the

“combined” strategy consistently added as many birds as other strategies no matter which future scenario was used to evaluate the strategy. Our results demonstrate that when future uncertainty is high, considering a plausible range of future conditions for decision-making can lead to robust conservation and restoration actions.

### Main Points

- We evaluated tidal marsh restoration prioritization strategies using five species representing a range of ecosystem characteristics as indicators of habitat response to climate change.
- Considering a range of plausible future conditions to prioritize restoration projects led to robust adaptation plans despite high uncertainty in future conditions.
- Ignoring uncertain future projections and prioritizing restoration projects solely using current conditions was the least effective strategy for selecting high priority tidal marsh restoration projects.
- The effectiveness of considering a range of future conditions for conservation planning increased through time along with the uncertainty in future conditions.
- High uncertainty in future environmental conditions should not prevent us from developing climate-smart adaptation plans.

Veloz, S. D., N. Nur, L. Salas, D. Jongsomjit, J. Wood, D. Stralberg, and G. Ballard. 2013. Modeling climate change impacts on tidal marsh birds: Restoration and conservation planning in the face of uncertainty. *Ecosphere* 4(4):49. <http://dx.doi.org/10.1890/ES12-00341.1>. PRBO publication #1922