

# Use Case: Using ESCMs as a Framework for Ecosystem Service Quantification

<http://bit.ly/NI-ESCM>

## CONTEXT

A group of community partners in Marin County, California, have been considering various restoration options for the McInnis marsh site for many years. Levees built in the early 1900s cut off this 180-acre complex of tidal wetlands from natural tidal flows, resulting in loss of native vegetation. The marsh site is adjacent to the San Francisco National Estuarine Research Reserve (NERR), and the NERR initiated an exploration into how ecosystem services might be affected by different restoration scenarios. It was determined that mathematical modeling to quantify and value potential ecosystem services outcomes might be a useful tool to aid in restoration decisions and outreach. A salt marsh Ecosystem Services Conceptual Model (ESCM) was used as a framework on which to build that predictive mathematical model.

## PROCESS

A virtual workshop was hosted for expert and practitioner stakeholders to specify a generalized salt marsh ESCM to the specific aspects of restoration at the McInnis marsh site. Stakeholders at the virtual workshop included natural resource specialists from local government, members of local environmental organizations, local environmental consultants, academics, and employees of the San Francisco NERR. The stakeholder group specified the wildlife species and recreational activities expected to be affected by restoration, added a pathway for rainwater holding capacity of the marsh, removed irrelevant services from the model, and clarified restoration scenario options.

This specified ESCM (Figure 1) was then used as the framework for developing a Bayesian network model for quantification, and in some cases valuation, of changes in significant ecosystem services under varying restoration scenarios. To do this, mathematical relationships were developed for each link (arrow) in the ESCM built for the site. Each service (except one) was ultimately quantified in monetary terms, and thus the monetary benefits of each restoration scenario could be compared. For a detailed description of the Bayesian network model developed, methods used, and results see [Calder et al. \(2019\)](#).

## RESOURCES USED

[Salt Marsh ESCM](#). A general salt marsh ESCM was adapted to the proposed restoration site.

[Workshop Guide](#). Techniques from Sections 2 and 3 of the Workshop Guide were used to facilitate the virtual stakeholder session.

## APPLICATIONS

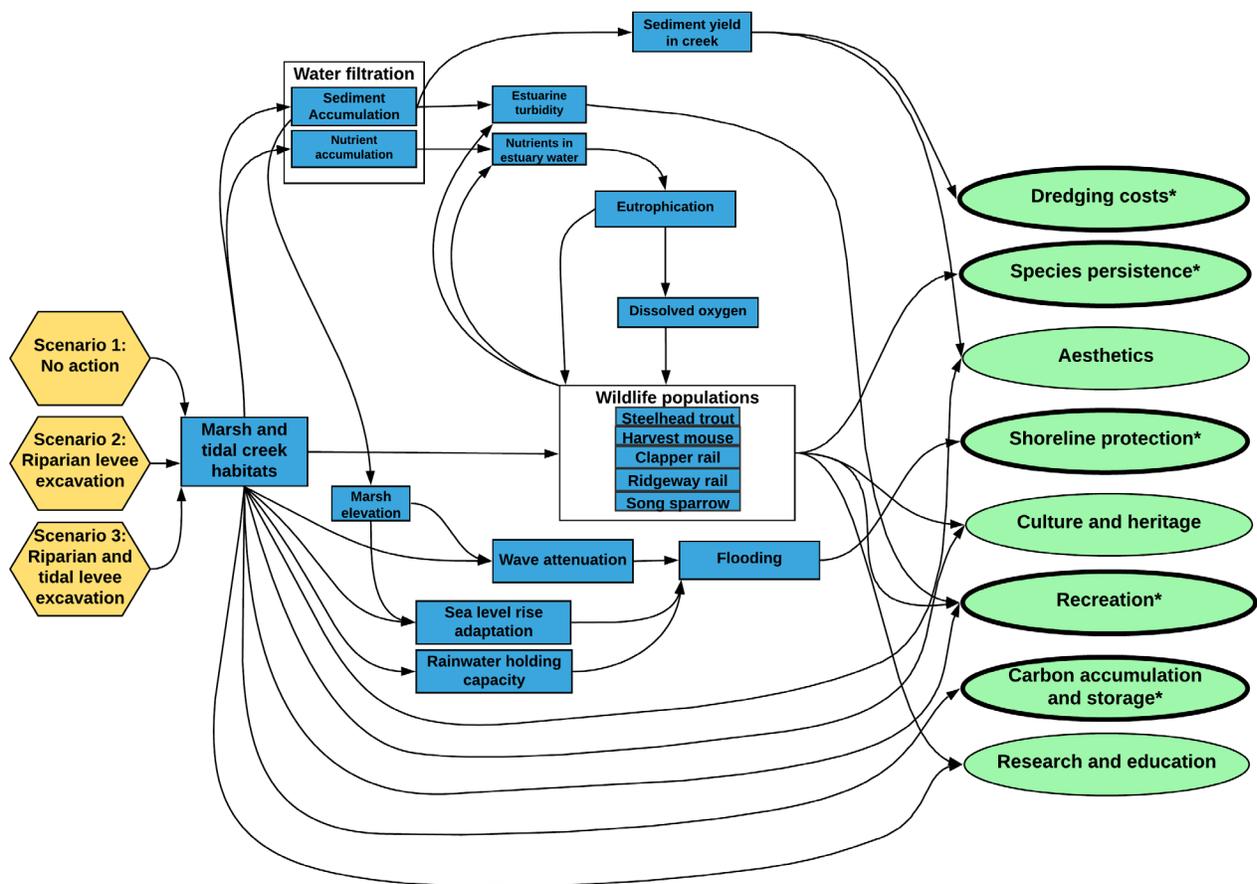
*Comparing ecosystem services outcomes for restoration scenarios.* Ecosystem services outcomes for flood risk, water quality improvement, recreational value, carbon sequestration, sediment

management, and endangered species conservation were quantified using the Bayesian network model developed from an ESCM framework. The levels of ecosystem services provided and their monetary value for each restoration scenario could then be compared. The model creators hope that these results will be used as a decision aid for managers making choices about restoration.

**Putting a monetary value on ecosystem services.** Monetary values of each ecosystem service outcome (except endangered species conservation) were calculated. It is not always possible, and not always appropriate, to place monetary values on ecosystem services. However, in this case, the quantified services were used to assess the relative costs and benefits of each restoration scenario, and thus monetary values were deemed appropriate. In this case, economic valuation demonstrated that all restoration scenarios were very cost-effective, and that non-flood-related ecosystem services (e.g., recreation), accounted for an important share of benefits.

**Figure 1. Salt Marsh ESCM Specified to the Marsh Site in Marin County, California**

This ESCM framework was used to build a quantitative Bayesian network model. Ecosystem services outcomes (green circles) that were quantified are shown with bolded outlines and an asterisk.



## ADDITIONAL RESOURCES

- Calder, R.S.D., S. Congjie, S.A. Mason, L.P. Olander, and M.E. Borsuk. 2019. "[Forecasting Ecosystem Services to Guide Coastal Wetland Rehabilitation Decisions.](#)" *Ecosystem Services* 39 (October): 101007.
- Mason, S., and L. Olander. 2018. "[Ecosystem Services Conceptual Model Application: Testing General Model Adaptability.](#)" National Ecosystem Services Partnership Conceptual Model Series No. 4. Durham, NC: Duke University.