



Exploring Applications of Ecosystem Service Conceptual Models for Coastal Habitats

Overview

Project Location

Southeast U.S.

Project Duration

September 2018 to January 2020

Project Lead

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Project Type

Catalyst – Targeted investment for advancing collaborative science

Project Partners

- Duke University
- North Carolina National Estuarine Research Reserve
- Rookery Bay National Estuarine Research Reserve

Project Webpage

nerssciencecollaborative.org/project/Olander18

People receive numerous benefits from nature, such as water purification, coastal protection, and food production. These ecosystem services are an increasingly important consideration for coastal managers as they design management interventions to protect coastal habitat. This includes coastal managers within the National Estuarine Research Reserve System, who are working to better understand the ecosystem services across the reserve system.

However, without a standardized approach it has been difficult for coastal managers to consistently incorporate ecosystem services into programs or projects. In response to this need, researchers with Duke University's National Ecosystem Services Partnership developed Ecosystem Services Conceptual Models for estuarine habitats that diagram the way a management intervention cascades through an ecological system and provides benefits to people. The Duke team built on previous work that created an ecosystem services modeling approach for salt marsh. In partnership with the Rookery Bay and North Carolina National Estuarine Research Reserves and their stakeholders, the team led a series of workshops to produce site-specific and generalized Ecosystem Services Conceptual Models for mangrove and oyster habitat restoration in the Southeast region of the United States.

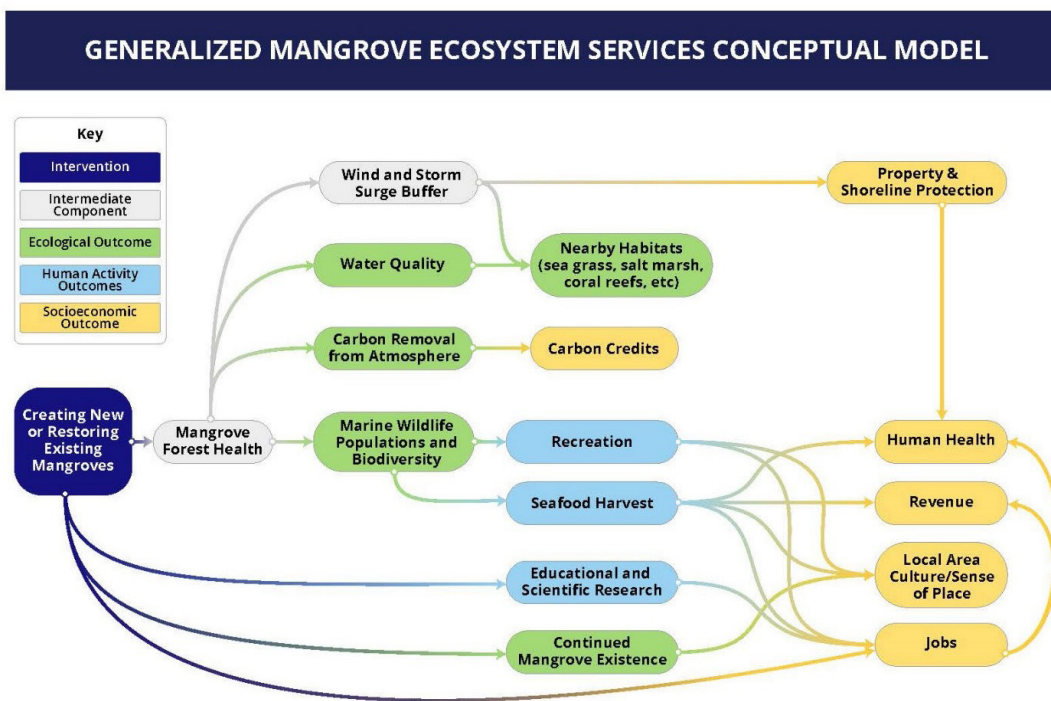
This project created a framework for coastal managers to streamline the integration of ecosystem services into their programs. Ecosystem Services Conceptual Models offer a foundation for managers to identify and anticipate ecosystem service outcomes of projects and to communicate with stakeholders and the public about these benefits. These models also provide an entry point to identify socio-economic metrics to monitor, assess, and value coastal ecosystems.

Project Approach

The project team engaged with local stakeholders to design and test site-specific Ecosystem Services Conceptual Models for two estuarine habitat types: mangrove at the Rookery Bay Reserve in Florida, and oyster reef at the North Carolina Reserve. The team developed draft Ecosystem Services Conceptual Models based on literature reviews and phone interviews with researchers and habitat managers.

In North Carolina, this information was compiled into an extensive evidence library for oyster reef restoration (modeled on the related Duke University [Gulf of Mexico Ecosystem Service Logic Models and Socio-Economic Indicators](#) project to provide standardized metrics for oyster restoration in the Gulf).

The team then convened one-day collaborative workshops for groups of 10 to 15 stakeholders with expertise in each habitat type. Workshop facilitators guided participants through the development of the draft Ecosystem Services Conceptual Model for their site and its accompanying socio-economic metrics. Stakeholders discussed how well the model captured their understanding of the flow of ecosystem services and suggested revisions to the model. Following the workshops, the project team conducted semi-structured interviews with individuals suggested by workshop participants whose professional and personal lives were linked to restoration sites. Stakeholder feedback was used to revise and finalize site-specific models for Rookery Bay and North Carolina, as well as generalized mangrove and oyster reef Ecosystem Services Conceptual Models. To share information about the project and ecosystem services within the National Estuarine Research Reserve System, a Duke Master's student worked with reserve staff to develop a package of outreach and education materials.



This generalized Ecosystem Services Conceptual Model can be applied to any mangrove restoration project.

To further explore additional types of ecosystem services, the project developed a cultural services Ecosystem Services Conceptual Model in partnership with the Heʻeia National Estuarine Research Reserve in Hawaiʻi. Cultural services are inherently hard to identify and quantify, as they represent the non-material benefits provided by ecosystems. The project team worked with Heʻeia Reserve staff to create an Ecosystem Services Conceptual Model that highlighted specific links between culture and the ecosystems that exist at the site.

Results

The model development process revealed significant benefits for nature and people as a result of habitat restoration. In North Carolina, oyster reef restoration projects were shown to be highly valuable, given the rarity of this habitat today compared to past centuries. North Carolina participants highlighted the importance of sharing information about ecosystem services and benefits to communities in order to grow public demand for healthy habitats. In contrast, Florida's mangroves remain relatively abundant, but there is a risk that many of today's healthy mangroves may be lost to future die-offs and development. This suggests that an ecosystem services model may be more relevant in some cases when designed around expected habitat losses rather than restoration project benefits.

The project also generated insight into the value and limitations of ecosystem services modeling. The process of building a model gave a holistic overview of a coastal region's socio-ecological system and revealed local gaps in knowledge about connections within the system. It also showed that some major impacts to ecosystem services happen outside of the scope of restoration projects. In both Florida and North Carolina, water quality was of great concern to all stakeholders, but water quality impacts occurred upstream of habitat restoration projects and could not be completely ameliorated by them.

Through its assessment of ecosystem services metrics, the project identified six high-priority ecological and socio-economic metrics common to both sites. Ecological outcomes such as fish population density or habitat size were understandably easier to monitor and attribute to restoration activities. Social and economic outcomes, such as changes in property value, jobs, and income, were more difficult to measure and attribute at a project scale, but the project did identify several other social and economic metrics that can be standardized and incorporated into habitat restoration project monitoring.

Products

- [Generalized Ecosystem Services Conceptual Models](#) for mangrove and oyster habitat
- Case studies describing the use of Ecosystem Services Conceptual Models for considering ecosystem services for
 - A mangrove restoration project at [Rookery Bay National Estuarine Research Reserve](#), including a site-specific Ecosystem Services Conceptual Model for mangrove restoration at Fruit Farm Creek, Florida
 - Oyster reef restoration projects at [North Carolina National Estuarine Research Reserve](#)
 - Cultural services at [He'eia National Estuarine Research Reserve](#)
- North Carolina oyster reef evidence library with details of the available evidence for each component of the Ecosystem Services Conceptual Model
- Assessment of ecosystem services metrics by priority, relevance, and monitoring feasibility
- [Outreach materials](#) and [middle school educational activities](#) related to estuarine ecosystem services
- [Workshop facilitation guide](#) that can be used by coastal managers to convene stakeholders to build Ecosystem Services Conceptual Models in a workshop setting, or to discuss social and economic aspects of coastal habitat management
- [Ecosystem Services Toolkit for Natural Resource Management](#)

Benefits

- Coastal managers and restoration practitioners gained tools to identify ecosystem service-related outcomes of management interventions for common coastal habitats. Working together to develop an ecosystem services model also provided an entry point to add relevant socio-economic measures to monitoring plans that typically only focus on biophysical and ecological outcomes.
- Ecosystem Services Conceptual Models and their associated metrics offer the National Estuarine Research Reserves a framework to integrate ecosystem services into decision-making and compare socio-economic indicators across sites, projects, and habitat types. The reserve system can build on this foundation to develop greater consistency in how it approaches ecosystem services projects and monitoring.
- The stakeholder engagement process created opportunities for discourse among different groups and helped normalize ecosystem services thinking across stakeholders.

What's Next

To build on the Ecosystem Services Conceptual Model framework and make this approach easier to implement, the project team is moving this work forward by

- Working with partners on a National Academies of Science grant to expand the library of generalized Ecosystem Services Conceptual Models to include all common coastal habitats in the United States, such as salt marsh, seagrass, and beaches and dunes;
- Exploring the development of additional evidence libraries for common coastal habitats to accompany generalized Ecosystem Services Conceptual Models;
- Building a [collection of use-cases](#) to document the creation of new Ecosystem Service Conceptual Models using the project's facilitation guide to evaluate the models' adaptability and utility; and
- Developing a half-day training on Ecosystem Services Conceptual Models for a new [NOAA ecosystem services training course](#) to be held in winter 2020.

About the Science Collaborative

The National Estuarine Research Reserve System's Science Collaborative supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is managed by the University of Michigan's Water Center through a cooperative agreement with the National Oceanic and Atmospheric Administration (NOAA). Funding for the research reserves and this program comes from NOAA. Learn more at nerssciencecollaborative.org or coast.noaa.gov/nerres.