Pacific Northwest Carbon Stocks and Blue Carbon Database Project

Project Location

Pacific Northwest

Project Duration

November 2016 to December 2019

Project Lead

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Project Type

Collaborative research – Generating science that informs decisions

Project Partners

The project involved members of the Pacific Northwest Blue Carbon Working Group, including

- California Coastal Conservancy
- Institute for Applied Ecology
- Oregon State University
- Pacific Northwest National Laboratory
- Padilla Bay National Estuarine Research Reserve
- Portland State University
- Puget Sound Partnership
- Restore America's Estuaries
- Silvestrum Climate Associates, LLC
- South Slough National Estuarine Research Reserve
- The Climate Trust
- U.S. Geological Survey
- Verified Carbon Standard
- Washington State Department of Natural Resources

Project Webpage

nerrssciencecollaborative.org/project/Cornu16

Overview

Tidal wetlands are recognized for their important role in carbon sequestration, and for their potential to become significant sources of greenhouse gas emissions when converted to other land uses. The substantial quantities of carbon captured and stored by tidal wetlands—termed "blue carbon"—is an ecosystem service of great interest to those developing regional, national, and global climate change adaptation and mitigation strategies, including those developing carbon offset projects. To quantify the carbon sequestration potential of tidal wetlands, carbon stocks data have been collected in various U.S. and international coastal regions, but there is a scarcity of such information in the Pacific Northwest. In this project, the Pacific Northwest Blue Carbon Working Group conducted the first ever comprehensive blue carbon assessment in Pacific Northwest tidal wetlands and generated a user-friendly database of regional blue carbon data. Input from end-users guided the design, scope, outputs, and outcomes of the project. This project will contribute to national and international efforts to incorporate blue carbon science into coastal management and climate change mitigation and adaptation.

Project Approach

The project convened a growing collaborative team of biophysical, social, and economic scientists, coastal planners, land managers, restoration practitioners, state and federal agency representatives, academic institutions, consulting firms, and nonprofit organizations from Washington, Oregon, and California. These end-users formed a Science Team and Steering Committee that worked to develop and refine research questions and identify data needs.

The project quantified carbon stocks and ecosystem driver data from 34 sites, including six least-disturbed/disturbed site pairs, representing the full range of Pacific Northwest tidal wetland classes (seagrass, low marsh, high marsh, and forested tidal wetlands) and geographically distinct coastal regions (Salish Sea/Puget Sound, Columbia estuary, and outer coast estuaries from Washington to northern California). This included the collection of 50-centimeter carbon sequestration rate cores at all but eelgrass and disturbed sites, and the collection of organic matter decomposition data at a subset of project sites.

This project also developed the Pacific Northwest Blue Carbon Database, which includes carbon stocks, sequestration rate, and associated environmental variable data from as many Pacific Northwest blue carbon datasets as possible (including this project), and can continue to be expanded to include additional blue carbon data (e.g., greenhouse gas emissions, above and belowground biomass). The Pacific Northwest Blue Carbon Database is incorporated into the Smithsonian Environmental Research Center's Coastal Carbon Research Coordination Research Network *Coastal Carbon Atlas*.

Results

An analysis of the project's comprehensive regional carbon stock data helps to answer key research questions related to Pacific Northwest blue carbon.

What is the range and variability of carbon stocks in intact tidal wetlands?
The data showed significant differences in carbon stocks across wetland types. Forested tidal wetlands held nearly twice as much carbon as marshes and five times as much carbon as seagrass. Variation also exists within marshes and seagrass meadows.

How do Pacific Northwest carbon stocks compare with other North American wetlands?
In general, the team found that the total ecosystem carbon stocks present in Pacific Northwest coastal wetlands exceeded expectations suggested by mean global estimates reported elsewhere. Global estimates predicted seagrass carbon stocks 65 percent lower than those found at project sites, and high marsh carbon stocks half of those found at project sites. Based on these results, Pacific Northwest wetlands present a significant source of carbon storage in soil and biomass that will continue to sequester additional carbon if conserved.

How do environmental variables such as tidal inundation, salinity, and soil texture affect carbon sequestration?
The data showed that higher elevation marshes tend to have greater soil carbon content, density, and stocks compared to lower elevation marshes. The data also suggest that site-level variation in groundwater salinity may affect carbon storage. Preliminary analyses of data from forested tidal wetland sites suggest that higher soil carbon stocks may be correlated with lower salinity in woody wetland ecosystems (such as those in the lower Columbia estuary).

How do carbon stocks of converted coastal wetlands (e.g., pastures) compare with least disturbed habitats?
The conversion of wetland to pasture results in denser soil with lower salinity, leading to increased methane emissions. The changes to soil conditions are especially pronounced in the conversion of forested tidal wetland and tidal marsh.

What potential greenhouse gas emissions could arise from tidal wetland loss?
The conversion of tidal ecosystems results in significant greenhouse gas emissions. By comparing converted agricultural land to adjacent intact tidal forest and marsh, the team found a loss of 507 Mg CO2 equivalent per hectare for marsh and 2,237 Mg CO2 equivalent per hectare for tidal forest. This represents a social cost of carbon of $9,000 to $35,000 per hectare for marsh conversion and $80,000 per hectare of tidal forest loss, demonstrating the social and economic benefits of including coastal wetlands in climate change mitigation and adaptation strategies.

Products

- This project produced journal articles that discuss key aspects of blue carbon research in the Pacific Northwest including:
  - *Total ecosystem carbon stocks at the marine-terrestrial interface: blue carbon of the U.S. Pacific coast*
  - Carbon losses from conversion of salt marsh and tidal forest to pasture in the U.S. Pacific Northwest (in development)
  - The effect of sediment grain size on carbon stocks (in development)
  - Organic matter decomposition in tidal wetlands (in development)
  - Variability in carbon stocks and accumulation rates on the U.S. Pacific coast (in development)
- Pacific Northwest Blue Carbon Database, available at the Smithsonian Environmental Research Center *Coastal Carbon Atlas*
- A needs assessment of Pacific Northwest conservation policy stakeholders

Benefits

- The project helped expand the membership of the Pacific Northwest Blue Carbon Working Group, whose diversity continues to include a variety of professional disciplines and end-users.
- Regional decision-makers have more complete information about potential carbon stocks for coastal and estuarine habitat classes across the Pacific Northwest. These carbon stock data can help guide coastal restoration efforts and climate change adaptation and mitigation projects.
- Researchers and decision-makers improved their understanding of data used to evaluate blue carbon projects and identified remaining data gaps.

What's Next

- Several journal articles are in development to analyze carbon stocks data and address key research questions related to carbon stock variability, land use, sediment grain size, and coastal hydrology.
- The Pacific Northwest Blue Carbon Working Group will continue to build on this project's results and expand the Pacific Northwest Blue Carbon Database. This will include new research to fill greenhouse gas emissions and carbon sequestration rate data gaps for major Pacific Northwest tidal wetland classes and land uses, and to examine related blue carbon-ecosystem driver relationships.

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 nerrssciencecollaborative.org or coast.noaa.gov/nerrs.