

# North America's Blue Carbon



*Salt marshes, tidal wetlands, seagrasses and mangroves are distributed around North America*

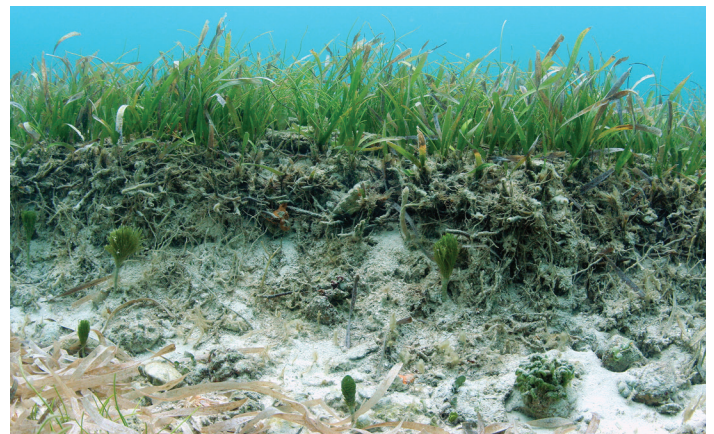
Over the past eight years, scientists and policy-makers have increasingly focused on the impressive ability of coastal marine ecosystems to sequester, store and, when disturbed, even emit carbon. In 2009, coastal ecosystem carbon—the carbon captured and stored in salt marshes, tidal wetlands, seagrasses and mangroves—was first grouped under the term “blue carbon” in a United Nations Environment Programme (UNEP) report.

It is now recognized that these “blue carbon ecosystems” provide a great service in combatting climate change by capturing and storing carbon. The degradation and loss of these ecosystems, however, result in a double impact: not only is their capacity to capture carbon from the atmosphere lost, but their stored carbon is also released, contributing to increasing levels of greenhouse gases in the atmosphere and the acidification of coastal waters.

When these ecosystems are properly protected or restored, they play an important role in climate change mitigation and provide one of the Earth's few natural mechanisms for counteracting ocean acidification. Other key benefits of coastal protection and restoration include food security, buffering coastal zones from storms, and supporting fish and wildlife populations.

## Carbon Accumulation

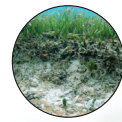
Blue carbon ecosystems accumulate carbon in multiple ways. First, carbon is sequestered and stored in plant biomass. This includes aboveground (branches and leaves), belowground (roots) and non-living (dead wood) biomass. The amount of carbon stored in biomass can range from relatively high in mangrove forests to relatively low in seagrass meadows. Second, carbon is stored in the sediments (soil) underlying coastal ecosystems. For most blue carbon ecosystems, carbon storage in sediments far exceeds storage in biomass. In the case of salt marshes and tidal wetlands, carbon is stored in the sediments that continuously gather and settle as freshwater travels into marshes and wetlands and experiences a drop in velocity. This allows marshes to trap carbon from large drainage areas and accrete in sediments vertically over time, keeping pace with sea-level rise up to a point. The anaerobic nature (lack of oxygen) of these sediments enables the burial of carbon for thousands of years (e.g., 3,000–8,000 years). Lastly, seagrasses are a unique ecosystem in that they are a completely submerged community composed of underwater flowering plants. Seagrasses occur in coastal areas with low wave energy and they provide important habitat for a variety of marine



species. Seagrass systems have low aboveground biomass and associated carbon when compared to other coastal ecosystems. Belowground, however, seagrasses have immense root structures that accrete carbon vertically as sediments build up around them: thus the roots and sediment that develop beneath seagrass meadows can store large quantities of sequestered carbon. Seagrasses also promote sedimentation by slowing water currents and stabilizing the seabed through the growth of their roots and rhizomes.



- Blue carbon is the carbon captured and stored in salt marshes, tidal wetlands, seagrasses and mangroves.
- Current studies suggest that, compared with mature tropical forests, blue carbon ecosystems annually sequester carbon at a rate two to four times greater than mature tropical forests and store three to five times more carbon per equivalent area.
- When degraded or lost, these ecosystems not only lose their ability to capture and store carbon, but also release their stored carbon—sometimes up to 8,000 years' worth—back into the atmosphere.



**Seagrass**  
Carbon mass =  
120 Mg/ha



**Salt Marsh**  
Carbon mass =  
400 Mg/ha



**Mangrove**  
Carbon mass =  
980 Mg/ha



Aboveground 2%

Belowground  
**98%**



Aboveground 10%

Belowground  
**90%**



Aboveground 20%

Belowground  
**80%**

## Blue Carbon Ecosystems

Blue carbon ecosystems cover less than 2% of the area of the world's oceans and sequester at least 50% of the carbon stored in ocean sediments. Furthermore, blue carbon ecosystems, on average, store carbon for thousands of years, compared with forests that only store carbon for up to hundreds of years.



## Threats

Key drivers of blue carbon ecosystem loss include coastal development, pollution, oil spills, erosion, extreme weather events, and conversion to aquaculture (e.g., fish and shellfish farms). If these ecosystems are degraded or converted to another use—i.e., if mangroves are deforested, salt marshes are drained, or seagrass beds are dredged—the carbon stored in the sediments can be oxidized and released, causing large emissions to the atmosphere of carbon dioxide and other greenhouse gases, as well as loss of biodiversity and other services. We know that the greenhouse gas emissions due to the removal or conversion of mangroves are very high, accounting for nearly one-fifth of emissions from global deforestation.

Roads and other coastal infrastructure can create another problem. When salt marshes and tidal wetlands accrete vertically to account for sea-level change, they sometimes expand inward, away from the shoreline, effectively enlarging the coastline. Building roads and other developments within these ecosystems can cause a “coastal squeeze”—limiting the inward expansion of these ecosystems.

## New Directions for Blue Carbon

There are now hundreds of blue carbon projects underway across North America. These are advancing our understanding and management of blue carbon ecosystems and encouraging us to include these ecosystems in the protocols for national and regional carbon accounting. Reporting standards have already been developed by the Intergovernmental Panel on Climate Change (IPCC) for some blue carbon ecosystems in the 2013 Supplement to the 2006 *IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands*. A new, comprehensive set of methods to assess and measure blue carbon emission factors has also been developed by the Blue Carbon Initiative.

Carbon markets globally are beginning to incorporate blue carbon projects into carbon credit schemes. The Verified Carbon Standard (VCS), the world's leading voluntary greenhouse gas program, included its first Wetlands Restoration and Conservation project for carbon credits in 2013 and published a Methodology for Tidal Wetland and Seagrass Restoration in 2015. The Commission for Environmental Cooperation (CEC) supported the development of a set of methods for monitoring greenhouse gas emissions and removals related to tidal wetland restoration and conservation activities, which was submitted in 2017 for VCS validation.

## The CEC and Blue Carbon

The CEC conducted two projects from 2013 through 2017 to improve blue carbon data, mapping, and approaches to reduce emissions and protect current blue carbon sequestration and storage across the continent. These two projects also facilitated a North American community of practice through workshops, meetings and the exchange of information. Project activities included compiling and developing coastal blue carbon maps; establishing criteria for and developing a greenhouse gas offset methodology for tidal wetland conservation; and supporting ten research projects in the three countries that will improve estimates of carbon storage, sequestration and flux/emissions, including impacts of natural and human-caused disturbances and restoration of carbon processes.



## Work done under the CEC has enhanced blue carbon knowledge in several ways:

- 1 Established a North American blue carbon **community of practice** to increase collaboration and knowledge exchange between experts in the three countries regarding blue carbon science, policy and mapping.
- 2 **Mapped** more than 48,300 km<sup>2</sup> of seagrass, saltmarsh and mangrove habitats across North America, of which seagrass area represents the largest proportion (more than half the total area mapped). This information will be displayed through the CEC North American Environmental Atlas.
- 3 Developed criteria and procedures for a **greenhouse gas offset methodology** for tidal wetland conservation in North America and other coastal areas, compliant with the Verified Carbon Standard (VCS). The Greenhouse Gas Offset Methodology Criteria for Tidal Wetland Conservation was published in the CEC virtual library and the methodology was submitted to the VCS for validation.
- 4 Identified **policy and market-based opportunities** for applying blue carbon science and tools to better conserve and restore coastal and marine habitats, and to improve management and resiliency of coastal areas in North America.
- 5 Gathered **baseline information** regarding blue carbon accounts and sequestration and emissions potential, as well as documented methods, data and results. This represents new information and methods from several scientific studies that filled gaps in our knowledge of the carbon dynamics in blue carbon habitats, including both healthy and disturbed sites.

These scientific studies are:

- Response of soil carbon accumulation rates in marshes and their response to sea-level rise on the Atlantic and Pacific coasts of Canada and the United States
- Blue carbon in northern marshes: assessing processes, stocks and rates in undisturbed, drained and restored marshes
- Estimation of carbon stocks from mangroves and wetlands in Mexico's Pantanos de Centla—the largest wetland in Mesoamerica
- Seagrass carbon stocks in the Gulf of Mexico across a range of environmental conditions and seagrass bed types to determine the quantity of carbon deposition and loss
- Quantification of soil organic carbon in marshes in eight National Estuarine Research Reserves (NERR) in the United States: a comparison of methodologies and coastal regions
- Blue carbon in tidal wetlands of the Pacific coast of Canada: examples from Pacific Rim National Park Reserve and the Clayoquot Biosphere Reserve, British Columbia
- Blue carbon storage variability in eelgrass meadows on the Pacific coast of Canada: an assessment of the variability between and within subtidal and intertidal portions of three meadows in the southern Clayoquot Sound, British Columbia
- Blue carbon seagrass mapping in Canada and the United States (British Columbia, Washington and Oregon): developing an algorithm and quantifying eelgrass extent
- Seagrass sediment sampling protocol and field study in British Columbia, Washington and Oregon
- Mapping seagrass meadows that capture and store blue carbon in Mexico

Results from the above work are improving our understanding of the current and future role of coastal ecosystems in the North American carbon cycle. They are also stimulating improved management of these systems by identifying the best available approaches to reduce emissions and/or protect current carbon storage and sequestration to achieve climate change mitigation objectives in all three countries.



**For more information about the CEC's project, please contact:**

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**About the CEC**

*The Commission for Environmental Cooperation (CEC) was established by the governments of Canada, Mexico and the United States through the North American Agreement on Environmental Cooperation, the environmental side agreement to NAFTA. An intergovernmental organization, the CEC is composed of a Council of cabinet-level environmental officials from the three countries, a Joint Public Advisory Committee, and a Secretariat that provides operational support for cooperative work between the three countries. The organization brings together citizens and experts from governments, nongovernmental organizations, scientists, researchers and businesses to seek solutions to protect North America's shared environment while supporting sustainable economic development. Find out more at: [www.cec.org](http://www.cec.org).*

*CEC initiatives are undertaken with the financial support of the Government of Canada, through the federal Department of the Environment, the Government of the United States of America, through the Environmental Protection Agency, and the Government of the United States of Mexico, through the Secretaría de Medio Ambiente y Recursos Naturales.*