BRINGING WETLANDS to MARKET
Nitrogen & Coastal Blue Carbon

WAQUOIT BAY NATIONAL ESTUARINE RESEARCH RESERVE

Policy & Management Applications of Blue Carbon

fact SHEET

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Coastal Blue Carbon - An Important Wetland Ecosystem Service

Coastal Blue Carbon refers to the carbon stored in coastal ecosystems, including salt marshes, mangroves, seagrasses and other tidal wetlands. Blue carbon is a newly recognized ecosystem service and as such can provide a new incentive to prioritize the restoration and conservation of these coastal ecosystems. Maintaining ecosystem services is critical to supporting coastal ecologies and communities. Recognizing the value of blue carbon provides an additional important component to help meet the challenges of reducing greenhouse gas (GHG) emissions but also supports climate change adaptation and protection of coastal communities.

The Science of Coastal Blue Carbon

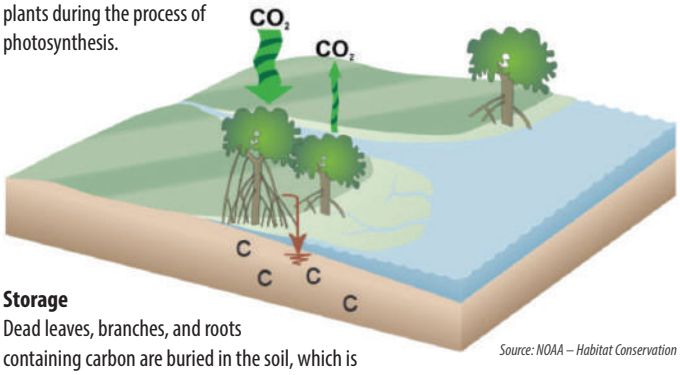
There are three GHGs that are cycled through wetlands: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). To help assess management options that may have GHG benefits, the following summary of emissions, potential emission reductions, and atmospheric removals, is provided:

Carbon Dioxide (CO_2)

Tidal marshes, mangroves and seagrasses extract CO_2 from the atmosphere and store carbon within plant biomass. Over time this carbon is transferred to the soil carbon pool, and plant material, particularly root material, decays in situ. Coastal wetlands continuously sequester carbon in soils as wetlands build with sea level rise, burying old soil beneath new. Carbon sequestration benefits accrue when a functioning wetland habitat is conserved and maintained, when a former or degraded wetland is restored, and when a wetland is created where none existed prior to creation. Conditions that are favorable to carbon sequestration are a functional wetland with native plants and appropriate hydrology and sediment conditions.

Sequestration
Carbon dioxide in the atmosphere is taken in by trees and plants during the process of photosynthesis.

Some carbon is lost back to the atmosphere through respiration, The rest is stored in the leaves, branches, and roots of the plants.



Storage
Dead leaves, branches, and roots containing carbon are buried in the soil, which is frequently, if not always, covered with tidal waters. This oxygen-poor environment causes very slow break down of the plant materials, resulting in significant carbon storage.

Source: NOAA – Habitat Conservation

The long term sequestration of carbon within wetland soils has resulted in enormous stocks of carbon building up beneath coastal wetlands (Pendleton et al., 2012). Wetland soils are rich in carbon compared to other ecosystem types. If undisturbed, these stocks will remain buried. Drainage of wetlands results in a rapid emission of CO_2 through oxidation (Crooks et al., 2011, Pendleton et al., 2012). Climate mitigation benefits occur when wetlands at risk of drainage or disturbance are protected. And restoring hydrology to a drained wetland that is emitting CO_2 can reduce emissions as well.

Methane (CH_4)

Low salinity wetlands naturally produce CH_4, a GHG with a global warming potential 34 times greater than CO_2. CH_4 emissions are insignificant where water salinity is greater than half that of ocean waters (35 parts per thousand), as salinity inhibits methane production. Barriers in coastal areas, such as road construction, often result in impaired drainage behind, causing degradation of wetlands and increasing CH_4 emissions. Removing barriers could potentially be one of the more significant opportunities on a per area basis for reducing GHG emissions in coastal areas.

Nitrous Oxide (N_2O)

N_2O has a global warming impact 310 times that of CO_2. It is derived as a byproduct of human released nitrogen into the environment. Occasionally wet soils, such as agricultural lands, are significant sources, while soils which are permanently wet, as found in many coastal wetlands, are minimal sources. Reducing nitrogen pollution directly reduces N_2O emissions as well as indirectly as improving water quality aids the recovery of seagrass which extract nitrogen from the water column.

Using Coastal Blue Carbon to Reduce GHG Emissions

There are a number of key coastal wetland management activities that can reduce or reverse GHG emissions from coastal systems by preserving blue carbon.

Protect existing coastal wetlands. Coastal wetlands hold stocks of carbon that may have accumulated over thousands of years. Storage occurs because the soils are wet, an unfavorable condition for decomposition of organic material. Once drained and exposed to oxygen these stocks are rapidly released back to the atmosphere as CO2 within a matter of years or decades. Protecting wetlands and maintaining moist soil conditions prevents this release. On drained soils improved water management and rewetting soils can reduce rates of emissions of any remaining carbon stocks.

Reconnect impaired water bodies. Ponded freshwater in degraded wetlands behind artificial barrier, such as culverts and dams that truncate coastal inlets, are likely a significant source of CH4. Reconnecting impaired and impounded water to tidal saline water bodies reduces CH4 emissions, as soil microbes switch to utilizing sulfate as a preferred energy source. The coastline of New England, like many coastlines hosts numerous impaired waters behind coastal barriers. Reconnecting these to tides will likely have a net global warming benefit as well as restoring other ecosystem services when coastal wetlands recover.

Restoration of coastal wetlands. A range of wetland restoration activities can provide co-benefits including net GHG benefits and protection of ecosystem services. Activities seek to restore the combination of native plants, hydrology, and sediment, which leads to a self-sustaining productive wetland. Some examples are: lowering of water levels on impounded former wetlands, removing tidal barriers; rewetting of drained wetlands (for restoration purposes); raising soil surfaces with dredged material; increasing sediment supply by removing dikes or levees; restoring salinity conditions; improving water quality, revegetation; and combinations of the above. The results of these activities include improved ecological function in coastal wetlands and beneficial climate adaptation outcomes.

Capturing the Blue Carbon Values of Coastal Habitat - Opportunities for Managers and Policymakers

There are a number of opportunities that managers and policymakers can tap into to advance the conservation or restoration of blue carbon ecosystems.

Improved policies: Adjusting existing policies that reduce climate change impacts through management of wetland or organic soils or redirecting financing from subsidies for practices that increase emissions to those that reduce emissions are two low-hanging opportunities for policymakers. Additionally, with climate change playing a bigger role in state and federal policymaking, coastal decision-makers can seek opportunities to link blue carbon and climate change policy. For example, a state may consider incorporating management of organic soils in their annual accounting of GHG emissions and sinks. States and local permitting agencies might also require consideration of net GHG impacts of a proposed development during review (much like impact on endangered species or even traffic impacts must be taken into account) and offer GHG mitigation options or offsets, such as wetlands restoration or conservation. Communities seeking nature based approaches to storm protection might also explore the inclusion of wetlands within the landscape, which will provide additional blue carbon and wider ecosystem benefits in addition to reducing flood protection costs.

Improved perceptions: Publicizing the GHG values of tidal wetlands could improve public perception about the value of tidal wetland restoration and conservation, especially if put into the context of additional ecosystem service benefits. Resource managers, project proponents, funding agencies, and others are encouraged to communicate the GHG benefits of wetland activities at the project, landscape, and/or estuary scale.

Improved land management: Improved practices for the management of wetland and organic soils can reduce the emissions of GHGs. Improving the hydrological condition of degraded wetlands with impaired hydrology can reduce CH_4 emissions and stimulate carbon sequestration, for example. There is an opportunity to review existing land management practices and identify any simple adjustments that may improve GHG emissions and sinks.

Incentives for new projects: Coastal wetland habitat restoration projects provide numerous ecological and economic benefits, including jobs, fisheries, climate and other benefits. Further work is needed to document the climate mitigation benefits of wetland restoration. The imperative of mitigating for climate change could lead to the prioritization of projects that provide climate mitigation benefits, if such policies are adopted.

Carbon finance: The issuance and sale of carbon credits generated by wetland habitat restoration or conservation may be an attractive financing option for some projects. The costs of GHG monitoring, reporting, and verification must be weighed against the potential value of carbon credits. In many cases, additional project funding sources will be required. For example, carbon finance might be used to pay for the long-term maintenance and management of a restored area, an aspect of projects typically under-funded, as a cost share for funds provided for project development.

Putting It Into Action

There are several steps policymakers and coastal managers can take to integrate coastal blue carbon considerations in their work.

- ***Learn more about coastal blue carbon.*** There is a growing body of resources available to help managers, policymakers and the public understand, evaluate, and apply coastal blue carbon in their own settings.
- ***Integrate.*** Coastal managers and policymakers can integrate carbon aspects of wetlands, along with other criteria, into their wetlands and other project and policy evaluation (e.g. transportation or mitigation projects). Consideration of the blue carbon or GHG impacts of a project could lead to more restoration and conservation of vital coastal wetland ecosystems. For example, the Commonwealth of Massachusetts, under the Global Warming Solutions Act is currently investigating the inclusion of land use change involving wetlands on the state's GHG footprint. This analysis may inform future planning of restoration activities.

Taking the Lead

In 2013 the Intergovernmental Panel on Climate Change released guidance to nations on approaches for accounting for GHG emissions and reduction associated with wetlands management. Included in this document are procedures for accounting on coastal wetlands as well as inland peatlands and inorganic soils. This year the State of Massachusetts and the U.S. EPA are taking a global lead in being the first to bring wetlands into their GHG emissions accounts. Through this process the benefits of improved wetland management will be accounted for and recognized.

- ***Demonstrate***. Explore and demonstrate market and non-market blue carbon projects that improve carbon sequestration and reduce GHG emissions through wetland management. While this is still an emerging concept, the scientific tools are available to apply to quantify benefits, including tools developed under the BWM project. Early adopters are needed to demonstrate to the world the value of blue carbon. For example, across the Commonwealth of Massachusetts some 40 tidal barriers have been removed, restoring wetlands, with potential for many more to come. Quantifying the GHG benefits of these actions will raise attention within regions as to the value of similar activities within in their jurisdiction.

Learn More

Potential Policy & Management Applications of Blue Carbon is part of a series of informational resources developed under the Bringing Wetlands to Market Project (BWM), which was led by the Waquoit Bay National Estuarine Research Reserve (WBNERR), The BWM Project examined the relationship between salt marshes, climate change, and nitrogen pollution and provided cutting edge science and tools to help coastal managers and policy makers leverage blue carbon to achieve broader wetlands management, restoration, and conservation goals through verified carbon markets and climate and conservation policy avenues. Learn more about the project and other available resources at: Bringing Wetlands to Market – Project Webpage: https://www.waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/

Bringing Wetlands to Market

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Waquoit Bay National Estuarine Research Reserve

National Estuarine Research Reserve System Science Collaborative

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Restore America's Estuaries

NERRA National Estuarine Research Reserve Association

USGS science for a changing world

FIU Florida International University

MBL Biological Discovery in Woods Hole
Founded in 1888 as the Marine Biological Laboratory

Manomet Center for Conservation Sciences

Waquoit Bay National Estuarine Research Reserve

The University of Rhode Island