BRINGING WETLANDS to MARKET
Nitrogen & Coastal Blue Carbon

WAQUOIT BAY NATIONAL ESTUARINE RESEARCH RESERVE

Climate Benefits From Salt Marshes: Opportunities for Methane Reductions via Restoration of Tidal Flows

fact SHEET

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Introduction

Healthy salt marshes provide important climate benefits by reducing greenhouse gas (GHG) emissions that contribute to climate change. This occurs through the sequestration or storage of carbon in salt marsh soils (referred to as "blue carbon") or via reductions in emissions to the atmosphere of GHGs like methane. Methane is a powerful GHG with a global warming potential 34 times greater than carbon dioxide. The Bringing Wetlands to Market project (BWM) conducted a screening analysis to evaluate the potential blue carbon GHG benefits of restoring tidal flows to existing brackish and freshwater marshes that were historically tidal salt marsh. Typically these degraded wetlands represent marshes where tidal flows have been restricted by the construction of roads, rail lines and other infrastructure, cutting off the wetlands from the full influence of the tides and reducing salinity in the tidally restricted areas.

Methane Reductions from Coastal Wetlands

The scientific literature on coastal marshes indicates that brackish and freshwater marshes frequently release substantially greater amounts of methane than salt marshes (see Figure 1). Higher salinity in tidally well-connected marshes creates an environment where methane generation is negligible. In some cases, by restoring tidal flows in tidally restricted/degraded marshes and thereby raising the salinity in these ecosystems, we may have an opportunity to realize significant blue carbon benefits from reductions in the amount of methane emitted to the atmosphere. The BWM study considers the potential economic value of methane reductions and the feasibility of marketing the reductions in carbon markets.

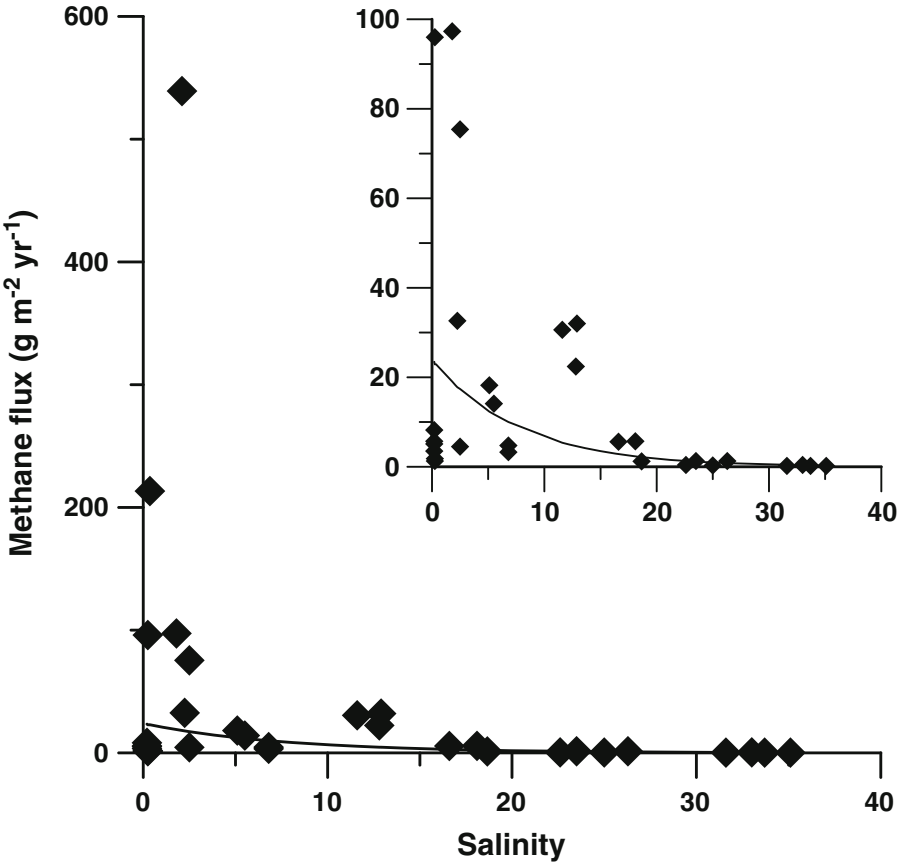

Figure 1:

Methane releases as a function of salinity (Poffenbarger et al., Salinity influence on methane emissions from tidal marshes. Wetlands (2011) 31:831-842.

Blue Carbon and Wetlands Restoration

Restoration practitioners and coastal managers should consider the benefits of tidal restoration from a variety of perspectives (habitat, water quality, recreation, etc.). For climate change, a key measure of project benefits is economic value of the damages avoided by the reductions in GHGs that a tidal wetlands restoration project could provide. This can be estimated using the 'social cost of carbon' (SCC) methodology. The SCC is a dollar value measure of the global damage caused by the release of a ton of carbon in a specific year. For example, release of one ton of methane in 2015 has been estimated to cause $1,084 of damage worldwide over the lifetime of the carbon in the atmosphere (Marten & Newbold, 2011). Applying SCC values to methane reductions from a tidal restoration project provides an indicator of the total societal value associated with GHG emissions reduction from the project. As discussed below, these can be relatively large.

By applying the Verified Carbon System (VCS) methodology for wetlands carbon credits—a first of its kind protocol developed by Restore America's Estuaries as part of the BWM project—restoration practitioners, coastal managers and project developers may be able to sell methane reductions from a tidal wetlands restoration project in carbon markets. This could provide financing for aspects of the project. The feasibility of doing this will depend on market prices for methane credits—typically considerably less than the SCC for methane—and the transaction costs associated with complying with the VCS protocol. Generally project size will be an important determinant of the feasibility of selling credits, with smaller projects less likely to cover transaction costs.

Herring River Case Study

To illustrate the potential value of blue carbon benefits from restoration of tidal wetlands, we conducted a screening level case study of a proposed restoration project on the Herring River in Wellfleet, Massachusetts. The project, under development by the Cape Cod National Seashore and partners, proposes to reintroduce tidal flows to an area of about 1,100 acres of historic salt marsh that was converted to brackish and freshwater wetlands when a dike restricting tidal movements was built across the mouth of the river in the 19th century.

Methane Benefits		
Annual Methane Reductions (tonnes)	SCC/tonne of Methane Reductions (2015)	Herring River Methane Benefits (project life)
119.9	**$1,084**	**$8,472,723**

We applied SCC values to estimated annual reductions in methane from the project, based on emission rates from the wetlands literature. Over the expected life of the project (100 years), the value from mitigating climate change is estimated to be in excess of $8 million (100 years of benefits discounted to 2015 at 3%), a lifetime benefit of $7,700 per acre.

We also conducted an analysis to determine the feasibility of selling these methane reductions in carbon markets. This analysis focused on the transaction costs of complying with VCS rules for establishing and verifying carbon reductions. Transaction costs for packaging, implementing and verifying credits ranged from approximately $300,000 to $700,000 (2014$) over the 100-year life of the project infrastructure. The analysis found that at Herring River, if methane reductions are similar to those estimated in the wetlands literature, sale of credits under VCS would be feasible and could generate net revenues after accounting for the transaction costs. This would reduce the net cost of the project or provide funds for ongoing monitoring and maintenance. We estimated the net revenues to range from approximately $1 million to $6.4 million, depending on actual prices for methane credits in carbon markets and the extent to which use of models that enable reliable predictions of GHG fluxes and carbon storage from tidal wetlands under different environmental conditions—as opposed to conducting site-specific monitoring which is costly and labor intensive—can be used to verify that the project achieves the projected methane reduction.

To assist restoration practitioners and wetland managers who might be considering tidal restoration projects, we also analyzed how project size would affect the ability to bring carbon credits to market. For a carbon market project to be feasible, the revenues from the sale of credits must exceed the transaction costs of packaging and verifying the credits under the VCS protocol. In general, we found that transaction costs are not sensitive to project acreage up to initiatives the size of Herring River. Smaller projects would likely incur absolute transaction costs similar to Herring River, making it more difficult for them to sell their credits without losing money after deduction of their transaction costs. Depending on the assumptions about market prices for credits and the amount of onsite monitoring required to verify credits, we found the breakeven point—the project size where credit sale revenues just equal transaction costs—could range from 57 to 462 acres, with most likely outcome around 190 acres. Projects smaller than this would only find it economic to market credits if they could be grouped with other projects to lower per acre transaction costs. VCS allows project grouping and conceptual approaches for doing this can be found in the guidance document produced by RAE under the BWM project (http://www.v-c-s.org/).

Take Home Messages

- The potential exists for significant GHG economic benefits from tidal restoration projects—but this needs to be verified through further on-site quantification of carbon fluxes for both methane and other carbon pools.
- Sale of methane credits appears promising for larger tidal restoration projects to consider market carbon prices and project transaction costs.
- For smaller projects, where selling credits isn't economically feasible, there's still the potential for significant societal economic benefits from methane reductions and these should be part of any benefit-cost analysis for these types of projects.
- While blue carbon benefits are important to consider and include, the larger incentive to do tidal wetland restoration projects relates to preserving all the important ecosystem services that these wetlands provide for society including habitat for wildlife, flood and storm protection, filtering pollutants, recreation, among others.

Learn More

Climate Benefits From Salt Marshes: Opportunities For Methane Reductions Via Restoration Of Tidal Flows 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, including a full report on the Potential 'Blue Carbon' Benefits from Restoring Tidal Flows in Coastal Marshes of the Northeast U.S. at www.waquoitbayreserve.org/research-monitoring/salt-marsh-carbon-project/

Bringing Wetlands to Market

Nitrogen & Coastal Blue Carbon

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