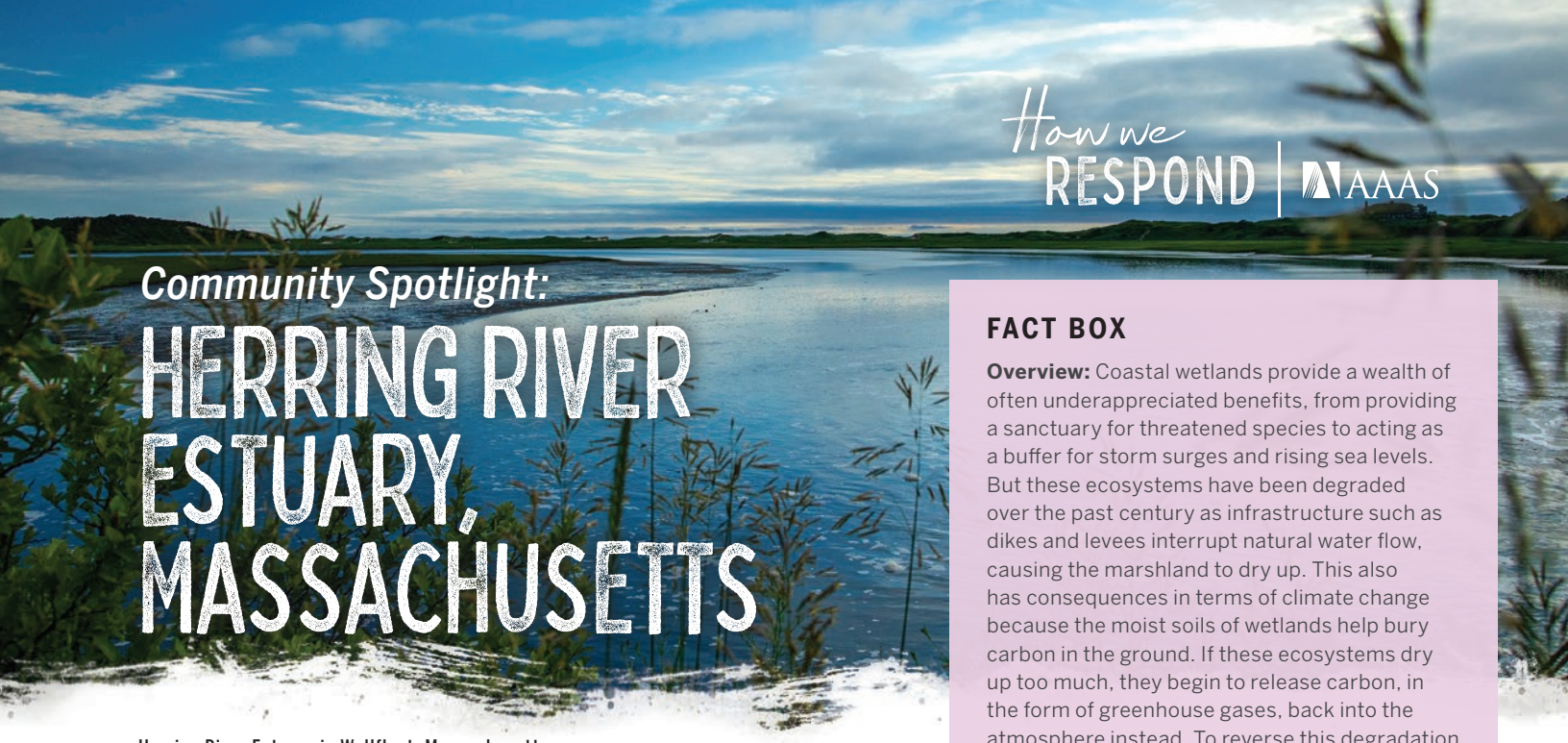
Community Spotlight:

HERRING RIVER ESTUARY, MASSACHUSETTS



Herring River Estuary in Wellfleet, Massachusetts.

Credit: Impact Media Lab / AAAS

Herring River Illustrates the Value of Wetlands in Reducing Greenhouse Gas Emissions

More than 100 years ago, a dike was installed at the mouth of the Herring River in Massachusetts to control mosquitos and create arable land. The simple structure had a profound effect on the surrounding saltwater marsh. By blocking the tidal inflow of saltwater, it caused the marsh to dry up significantly and become less saline. In terms of greenhouse gas emissions, this alteration of the landscape – and many similar projects that have degraded coastal wetlands over the past two centuries – has been detrimental.

Saltwater marshes act as powerful sponges that soak up greenhouse gases. For example, these ecosystems lining the coast can remove 10 times more carbon dioxide per hectare from the atmosphere than forests. This is in part because of the dampness of wetlands. When plants die along the surface of dry land and are exposed to the air, bacteria break down the material and some of the carbon within the plant matter is released back into atmosphere. But in wetlands, the cool and moist conditions help to slow decomposition and the release of carbon, resulting in a net sequestration of carbon into the

FACT BOX

Overview: Coastal wetlands provide a wealth of often underappreciated benefits, from providing a sanctuary for threatened species to acting as a buffer for storm surges and rising sea levels. But these ecosystems have been degraded over the past century as infrastructure such as dikes and levees interrupt natural water flow, causing the marshland to dry up. This also has consequences in terms of climate change because the moist soils of wetlands help bury carbon in the ground. If these ecosystems dry up too much, they begin to release carbon, in the form of greenhouse gases, back into the atmosphere instead. To reverse this degradation and halt the resulting emission of greenhouse gases, organizations like Restore America's Estuaries are working to include wetlands in carbon emissions trading programs intended to limit total emissions. They have also developed ways to quantify greenhouse gas emissions from wetlands, so that coastal communities can include wetland management in their climate action plans.

Location: Herring River Estuary near Wellfleet and Truro, Massachusetts (Cape Cod)

Community characteristics: Small coastal fishing and tourist towns

Goals: Replace dike at mouth of Herring River with new bridge to restore saltwater wetlands for ecosystem and climate change benefits

Responses: Multiple assessments of the Herring River (including social costs of carbon), long-term greenhouse gas emissions monitoring, development of standardized ways to measure greenhouse gas emissions from wetlands

Project status: Project design, permitting and fundraising phase underway

Key stakeholders: Friends of Herring River, Massachusetts Division of Ecological Restoration, National Park Service-Cape Cod National Seashore, Natural Resource Conservation Service, NOAA Fisheries, Restore Americas Estuaries, Town of Wellfleet, MA, U.S. Fish & Wildlife Service, Verra, Waquoit Bay Reserve

Key resources: Friends of Herring River, Massachusetts Division of Ecological Restoration, National Estuarine Research Reserve System Science Collaborative, National Park Service (incomplete list)

ground. Across North America, wetlands help store approximately 49 million tons of carbon per year.

Whereas maintaining these ecosystems is beneficial for managing greenhouse gas emissions, losing them is costly. "When that soil is no longer wet, the carbon can be released back into the atmosphere at a relatively quick rate compared to how long it took to get captured. Once you drain the system, you could be releasing hundreds, even millions of years of stored carbon in a matter of decades," explains Stefanie Simpson, a previous employee of Restore America's Estuaries (RAE),[1] a national alliance of 10 coastal conservation groups.

Tonna-Marie Surgeon-Rogers, Project Lead for the Bringing Wetlands to Market (BWM) initiative. BWM is a collaborative effort between multiple organizations to have the contribution of wetland ecosystems more widely included in the carbon economy.

Credit: Impact Media Lab / AAAS

Importantly, saltmarshes can also prevent the release of methane – a greenhouse gas that is 25 times more potent than carbon dioxide – into the atmosphere. This is because saltmarshes contain bacteria that feed on sulfates, which then outcompete the microorganisms that produce methane. This elimination of methane-producing bacteria results in a permanent removal of methane from the atmosphere. For example, carbon trapped in soil and buried plants could potentially be released back into the atmosphere if a storm churns the soil and exposes it to air; however, the elimination of methane-producing bacteria in wetlands means the methane is never even produced. For this reason, and for the many other benefits that can be reaped from wetlands, various groups have been lobbying to restore these critical habitats.

One way to have wetlands better recognized for their value could be by incorporating them into carbon markets, where greenhouse gas emissions from these ecosystems are given monetary value. Companies that are emitting excess greenhouse gas emissions can buy carbon credits from organizations restoring wetlands, which helps to mitigate the pollution. This is one goal that RAE, Waquoit Bay Reserve and several other organizations have been aiming to achieve as part of the Bringing Wetlands to Market (BWM) initiative. But first data are needed to quantify the greenhouse gas contributions of wetlands. In 2015, with funding from the National Estuarine Research Reserve System Science Collaborative, a team of researchers installed greenhouse gas chambers at strategic points at Herring River, to quantify emissions from the 1,100-acre site. Based on the data they collected, it's estimated that the transformation of the Herring River into a drier, less saline marsh is equivalent to the carbon dioxide emissions from 857 cars on the road, for every year the dike has been in place since 1909.

The data will be helpful in supporting the wider acceptance of wetlands into carbon markets and for understanding the social impacts of restoring wetlands. Greenhouse gas emissions can impact our health and economy in ways that result in extra costs, such as additional healthcare costs or lost wages. These can be subtle but are still important and costly to society. This is called the "social cost of carbon" (SCC). Before the data at Herring River were collected, Waquoit Bay Reserve coordinated a prospective SCC analysis for the site, which attributes a dollar value to reflect the

[1] Restore America's Estuaries (2019). *Protecting & Restoring Our Nation's Coasts & Estuaries*. https://estuaries.org/

global damage caused by the release of a ton of carbon in a specific year. The social cost of one ton of methane in 2015, for example, is equivalent to $1,084 worth of damage caused by climate change. The initial SCC assessment found that the Herring River Restoration project, if it resulted in an annual reduction of 119.9 metric tonnes of methane, would yield social benefits to society exceeding $8.4 million (over the course of the project's 100-year lifetime). The analysis also found that, if the restoring Herring River could be included in a methane market, it could yield net revenues ranging from $1 million to $6.4 million, depending on actual prices for methane credits and the models used to estimate the offsets. Now that the group has more specific data on greenhouse gas emissions from Herring River, they are conducting a more detailed SCC analysis.

To restore the saltmarsh, the Town of Wellfleet, the National Park Service, and other federal, state and local partners have proposed replacing the old dike at the mouth of the river with a bridge and a modern, state-of-the-art water control structure. "The new bridge will have these tidal gates that can be taken up and down, which will slowly increase tidal flow into the wetlands and will help it revert back into a marsh wetland," explains Simpson, the former director of RAE's Blue Carbon Program. "As salinity is restored, methane emissions will halt."

The Chequessett Neck Road dike at Herring River. Dikes, including this one, can block tidal flow between the ocean on one side and a marsh on the other. As part of the Herring River Restoration Project, conservation organizations and local stakeholders are working to remove the dike to restore tidal flow and stem the release of methane back into the atmosphere.

Credit: Impact Media Lab / AAAS

The bridge itself will cost $15 million, while the entire wetlands restoration project, bridge included, will cost between $40 million and $50 million. Although including wetlands like Herring River in the carbon market would not completely cover the costs of restoring them, it would help generate a stream of money that would otherwise not be available for restoration.

The project team notes that restoration could also aid the local tourism and shellfish industries. They cite several other reasons to support the project, noting how marshes help with the accumulation of sediments, which help protect against stormwater surges and rising sea levels.

"[The accumulation of sediments] is what makes these healthy systems more resilient to rising sea levels, storms and flooding. It allows the wetland to provide shoreline protection, and fisheries habitat and water filtration, and all those wonderful things," Simpson says.

To help gather wider support for wetland restoration, organizations like RAE are hoping to have wetlands more widely recognized and included in both voluntary carbon markets and cap-and-trade programs for greenhouse gas emissions. In cap-and-trade programs, companies can buy credits from environmentally-beneficial projects to help them meet laws that limit their company's pollution levels. Currently, there are only two mandatory cap-and-trade programs in the United States: California's Cap and Trade Program, which was launched in 2013, and the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort launched in 2009 that includes

Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont. Neither of these mandatory cap-and-trade markets include methane emissions from wetlands yet.

"Typically the compliance markets, like California and RGGI, look for success with new project categories before adopting them," explains Simpson. "So we are working [on developing] pilot coastal restoration project[s] in the voluntary carbon market in order to encourage adoption of the methodology by those mandatory compliance markets."

These pilot projects are still in the early stages of conception. But RAE has been working hard to support the acceptance of wetlands in the broader, voluntary carbon market in other ways. For example, the organization helped develop a standard methodology for quantifying greenhouse gas fluxes between wetlands and the atmosphere. These fluxes can vary greatly from one site to another, making it very labor-intensive to get specific estimates for each wetland. In 2011, RAE led a technical working group to develop a standard methodology for calculating methane emissions for wetlands. The group then reached out to Verra, an environmental organization. Verra's Verified Carbon Standard (VCS) Program is the most widely used voluntary carbon market program in the world. By 2012, the methodology for wetlands that RAE developed was formally accepted by the VCS program.

An aerial view of coastal marshes in Cape Cod. Coastal marshes are gaining recognition for the role they play in burying carbon and mitigating climate change.

Credit: Impact Media Lab / AAAS

Another tool called the Blue Carbon Calculator,[2] developed by Massachusetts's Executive Office of Energy and Environmental Affairs and the Division of Ecological Restoration, can be used by communities to determine the greenhouse gas emissions of their wetlands.

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Simpson notes that coastal wetlands are critical habitats that have been undervalued for a long time – a problem that RAE is hoping to fix. She emphasizes that, although coastal wetlands are at the forefront of climate change impacts, such as rising seas and more intense and frequent storms, these ecosystems can also be part of the solution; they can be used to help mitigate the underlying cause of climate change by reducing greenhouse gas emissions and help increase our resiliency to climate change by reducing the impacts of storms, floods and sea level rise.

"On top of all this, we know that coastal wetlands are critically important for many fish and marine species, water quality, and our economy. As communities think strategically about climate change, those communities on the coast – where roughly half our population lives – should have a vested interest in including wetlands into their plans, for all the benefits these habitats provide," she says.

[2] Commonwealth of Massachusetts (2019). *Blue Carbon Calculator.* https://www.mass.gov/blue-carbon-calculator