Costa Rica recently announced new commitments for protecting its mangrove forests, including these along the Tarcoles River. Mangroves and other coastal wetlands provide natural protection against climate change and are rich in biodiversity.

Coastal 'Blue Carbon': An Important Tool for Combating Climate Change

Protecting and restoring coastal wetlands can help countries around the globe and U.S. states advance their climate goals

Overview

Coastal wetlands, including salt marshes, mangrove forests, and seagrass meadows, are among the most productive—and threatened—ecosystems on the planet. They provide many benefits to people and nature, such as helping communities adapt to severe storms, flooding, and other climate-related threats and sequestering carbon from the water and atmosphere in their branches, leaves, roots, and underlying soils. These carbon stores are known as "blue carbon" because they are located in places where the land meets the sea. However, these wetland habitats have lost more than a third of their area over the past half-century.

Because coastal wetlands provide carbon sequestration and other important benefits, conservation and restoration of these areas is an important nature-based strategy for mitigating the effects of climate change, and helping communities internationally and across the United States adapt to a changing climate.

Coastal wetlands are among the world's key 'carbon sinks'

Coastal wetlands can store far greater amounts of carbon than they naturally release, which makes them one of the world's most important natural "carbon sinks." Research suggests that, despite occupying less than 5% of global land area and less than 2% of the ocean, they store roughly 50% of all carbon buried in ocean sediments.[1]

The capacity of coastal wetlands to capture and store carbon depends on a variety of chemical and physical factors. But a crucial element is the wet, low-oxygen conditions of tidally influenced and submerged soils characteristic of these ecosystems that slow the decay of plant and other organic material. During photosynthesis, plants absorb carbon dioxide from the air and water and use the carbon to support their growth. When the plants die or shed old leaves or roots, the carbon in that decaying organic matter becomes locked in the soils. Healthy coastal wetlands can keep that carbon stored away for millennia, providing a natural way to prevent it from being released into the atmosphere and contributing to climate change.[2]

However, when coastal ecosystems degrade, those vast stores are released in the form of three major greenhouse gases: carbon dioxide, methane, and nitrous oxide.[3] Worldwide, an estimated 450 million metric tons of carbon dioxide—equivalent to more than 97 million cars' worth—is emitted from the destruction of coastal wetlands each year, accelerating planetary warming and climate change.[4]

Because protection and restoration of coastal wetlands can substantially contribute to achieving climate mitigation and adaptation goals, these areas have been recognized by the United Nations Framework Convention on Climate Change (UNFCCC).[5] To date, coastal wetlands are the only marine ecosystem for which the Intergovernmental Panel on Climate Change, which conducts research in support of the UNFCCC, has developed methodologies for measuring carbon dynamics. But researchers are working to quantify the role that other marine ecosystems such as kelp forests may play in reaching targets by capturing and sequestering carbon.[6]

Blue Carbon Habitat Fast Facts


Chesapeake Bay-Maryland National Estuarine Research Reserve

A high school student canoes against a backdrop of salt marsh along the Patuxent River, a tributary of the Chesapeake Bay in the U.S. state of Maryland. Salt marshes are a vital blue carbon ecosystem.

Carbon sequestration is just one benefit of healthy, intact coastal habitats. They also buffer coastlines against damaging waves during severe storms, absorb excess floodwaters, and stabilize shorelines, all of which help communities adapt and become more resilient to climate-related threats. In addition, some blue carbon ecosystems such as seagrass absorb excess carbon dioxide from surrounding waters, reducing the intensity of ocean acidification, a chemical change to seawater that poses a global threat to marine life.[7] Coastal ecosystems also provide food and refuge for fish and marine invertebrates that drive global fisheries, and they underpin the cultural heritage and food sovereignty of coastal Indigenous peoples worldwide.[8] Here is a brief look at the ecosystem services of the planet's most abundant types of coastal wetlands.

Salt marshes

- Can absorb up to 1.5 million gallons of floodwater—the equivalent of more than 2.25 Olympic-size swimming pools—per acre.[9]
- Significantly reduce the release of pollutants into coastal waterways, potentially saving taxpayers worldwide millions of dollars—including an estimated $124 million in Galveston Bay, Texas—through reduced demand on municipal wastewater treatment.[10]
- Provide essential food, refuge, and nursery habitat for more than 75% of U.S. fisheries species, including shrimp, blue crabs, and many finfish.[11]
- Can sequester approximately 1,940 pounds of carbon per acre per year.[12]

Seagrasses

- Provide nursery, habitat, and feeding grounds for 20% of the world's largest fisheries, including cod, pollock, and herring.[13]
- Provide habitat, erosion control, and other benefits with an estimated global value of nearly $29,000 per hectare per year.[14]
- Can sequester approximately 1,230 pounds of carbon per acre per year.[15]
- Store an estimated 10% of all organic carbon sequestered in the ocean annually.[16]

Mangroves

- Offer important habitat for numerous species that provide economic benefits to local communities, including an estimated value of $37,500 per hectare per year for fisheries in the Gulf of California.[17]
- Boost coastal resilience to storms, helping to protect roughly 200 million people worldwide.[18]
- Provide $65 billion annually in global flood protection benefits.[19]
- Can sequester an estimated 2,016 pounds of carbon per acre per year.[20]

The world needs to act on blue carbon

Although curbing human-caused emissions is essential to reduce the effects of climate change, protecting and restoring natural carbon sinks can complement these efforts. Yet, despite their many other benefits, coastal wetlands rank among the most threatened habitats on Earth.[21] Blue carbon ecosystems have lost an estimated 35% of their global cover just since 1970.[22] Although many countries have regulations that are meant to protect coastal ecosystems, human-driven factors—particularly conversion of wetlands to agricultural use; coastal development; pollution; artificial constrictions on water and sediment flows, such as dams; and sea level rise—continue to destroy these habitats at an alarming rate.

Since 2013, when the United Nations' Intergovernmental Panel on Climate Change (IPCC) first recognized the important role that mangroves, seagrasses, and salt marshes can play in global climate mitigation efforts,[23] momentum has grown to include coastal blue carbon in environmental conservation policies and plans at the national and state/provincial levels.

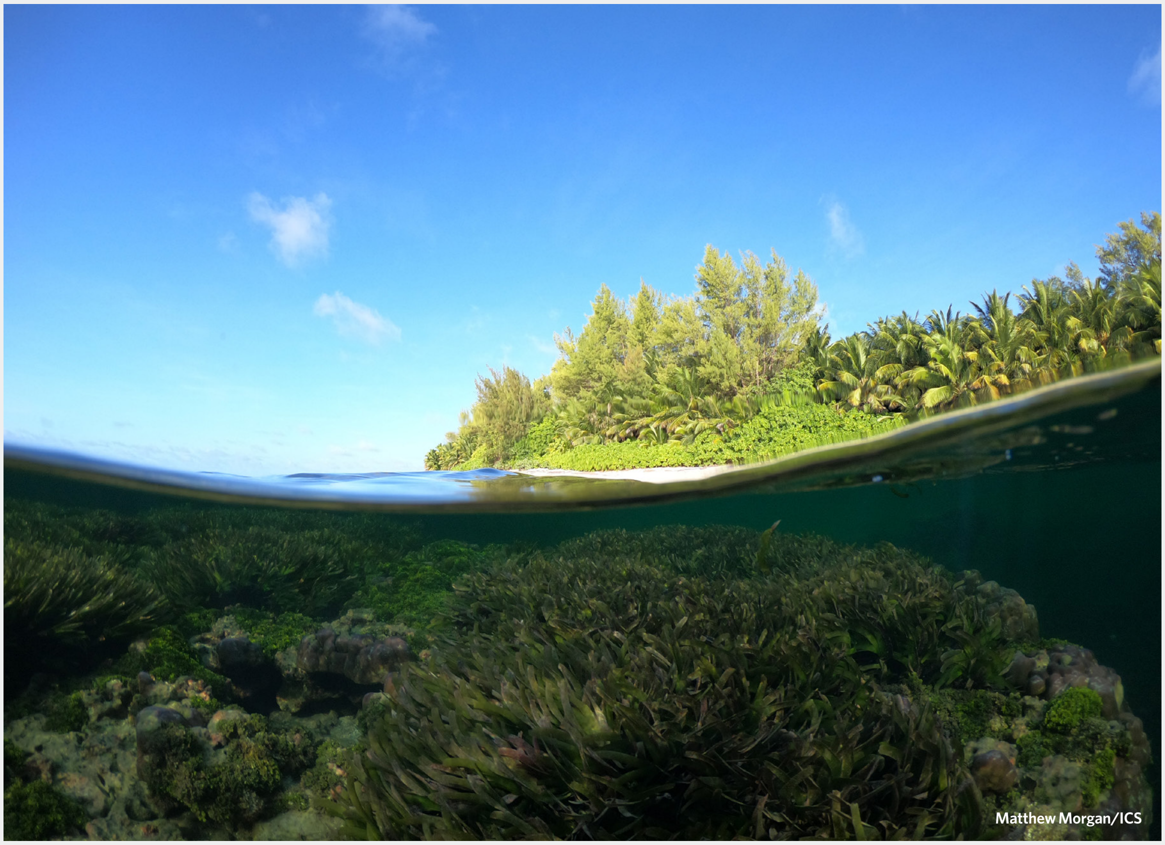
What nations can do

International

Parties to the Paris Agreement can include specific action plans for curbing emissions and measures to protect and restore natural areas in their nationally determined contributions (NDCs). Countries can use the IPCC's standard methods for measuring carbon to quantify the carbon stored in coastal blue carbon ecosystems. Therefore, inventorying these habitats can be the first step in measuring existing carbon stocks and advancing restoration of these ecosystems to increase sequestration, which in turn would allow jurisdictions to meet greenhouse gas and climate adaptation goals.

> "Although many countries have regulations that are meant to protect coastal ecosystems, human-driven factors—particularly conversion of wetlands to agricultural use; coastal development; pollution; artificial constrictions on water and sediment flows, such as dams; and sea level rise—continue to destroy these habitats at an alarming rate."

How Seychelles Is Documenting and Protecting Its Coastal Wetlands



Seagrasses, such as these in Seychelles, are critical ecosystems for marine life and provide a nature-based solution to climate change.

Seychelles is one of several countries assessing the role that blue carbon ecosystems can play in meeting its commitments to goals established in the Paris Agreement. In particular, the island nation has committed in its NDC to protecting 50% of its seagrass and mangrove habitats by 2025 and 100% by 2030.[24] In partnership with The Pew Charitable Trusts and other entities, Seychelles is now advancing the research necessary to deliver on this ambitious commitment.

Because the distribution of seagrass across the country's 115 islands is not well understood,[25] researchers at the University of Oxford and the University of Seychelles, alongside local partners such as the Seychelles Conservation and Climate Adaptation Trust and the Island Conservation Society, are mapping the nation's seagrass beds. The researchers also will make a first-time estimate of carbon stored within seagrass soils. This project not only will directly support Seychelles' NDC commitments, but it also will serve as a model for other countries interested in including seagrass protections as part of a climate response policy.

United States

Since 2017, the U.S. Environmental Protection Agency (EPA) has included coastal wetlands in its annual Inventory of U.S. Greenhouse Gas Emissions and Sinks, which provides a comprehensive accounting of the country's total greenhouse gas emissions from all human-generated sources, including land use.[26] According to the 2021 inventory, coastal wetlands in the lower 48 states sequestered 4.8 million metric tons of carbon dioxide equivalent—and held a total of about 2.9 billion metric tons in their soils—as of 2019.[27] This finding demonstrates the importance of conserving and restoring coastal ecosystems.

Since the U.S. rejoined the Paris Agreement in February 2021, policymakers have a renewed opportunity to leverage the EPA inventory and research conducted by federal agencies, universities, and nongovernmental organizations to help meet the treaty's goals. This robust body of data can inform state, federal, and even local efforts to develop policies and plans focused on conserving and restoring the country's coastal wetlands. By incorporating blue carbon objectives into its NDC, the U.S. can demonstrate international leadership on this vital issue while advancing nature-based solutions that help foster resilient coastal communities.

What U.S. states can do

Because U.S. states and local jurisdictions are largely responsible for governing their coasts, they play a critical role in the protection of key ecosystems. Many coastal states have adopted greenhouse gas reduction goals and plans and are assessing approaches to managing their "natural and working lands"—such as farms, ranches, forests, and wetlands—to help achieve those objectives. These efforts, in turn, have created opportunities to incorporate strategies to enhance carbon sequestration into those plans by quantifying and tracking blue carbon and setting conservation and restoration targets. Including coastal habitats in climate mitigation strategies would also bolster state efforts to manage these areas as nature-based solutions for protecting against sea level rise and flooding.

"Since the U.S. rejoined the Paris Agreement in February 2021, policymakers have a renewed opportunity to leverage the EPA inventory and research conducted by federal agencies, universities, and nongovernmental organizations to help meet the treaty's goals."

Oregon Develops Its First Blue Carbon Strategy

A kayaker paddles through a forested tidal wetland in Oregon's Nehalem River Estuary. This ecosystem is dominated by Sitka spruce, captures carbon at a rate on par with mangrove forests, and is a bountiful haven for salmon, migratory birds, and other wildlife.

The U.S. state of Oregon is developing goals and strategies to help maintain and expand the amount of carbon captured and stored in its natural and working lands. As part of this effort, state governmental entities and researchers, in collaboration with Pew, developed a first-ever blue carbon inventory and potential strategies for maintaining and enhancing carbon storage in Oregon's estuaries. The state's forested tidal wetlands have declined 95% over roughly the past 200 years because of unsustainable land use practices, which have largely been halted in recent decades. In addition to supporting important fisheries, improving water quality, and protecting coastal communities from flooding, forested tidal wetland ecosystems store more carbon per acre than almost any other on Earth, so their restoration could help Oregon meet its carbon sequestration objectives for natural and working lands.

Conclusion

Nations around the globe, along with U.S. states, are increasingly recognizing the potential of protected and restored coastal habitats for responding to climate change and advancing climate commitments and global objectives. Governments at all levels can use targeted policy mechanisms—such as NDCs established under the Paris Agreement and goals for carbon sequestration on state natural and working lands—to incorporate coastal wetlands protections into their climate and conservation strategies. Through collective policy action, international, national, and state leaders can harness the power of blue carbon ecosystems to help address climate change and secure ecological and economic benefits that will extend far beyond the world's coasts.

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Editor's note: This brief was updated on Sept. 29, 2021, to clarify the data on carbon dioxide equivalent sequestered and stored by coastal wetlands in the lower 48 U.S. states in 2019.

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