Study Finds That Coastal Wetlands Excel at Storing Carbon

11 April 2017

Shoreline environments show more promise than other marine ecosystems for mitigating climate change, the analysis shows.

The ocean’s ability to soak up carbon like a sponge is well known, but researchers are now taking a fresh look at ocean shores. Our planet has about 620,000 kilometers (372,000 miles) of coastline, long enough to wrap around Earth almost 15 times.

In a recent paper "Clarifying the role of coastal and marine systems in climate mitigation" in Frontiers in Ecology and the Environment, researchers analyzed multiple ways in which nature captures carbon in marine ecosystems, a reservoir known as blue carbon. They found that coastal mangroves, seagrasses, and tidal marshes, or coastal blue carbon, provided particularly effective and long-lasting carbon storage.

The 2016 Paris Agreement has intensified pressure on nations that signed the pact to meet carbon goals and find better ways to sequester carbon. There are many solutions, but deciding which is most effective—oceans, forests, mangroves, or kelp farming, for example—can be daunting. In addition, many studies use different timescales or measurements, further muddying carbon storage comparisons.

“The goal of the paper was to try and compare apples to apples,” said Jennifer Howard, lead author of the paper and marine climate change director at Conservation International in Arlington, Va. On 1 February, she and her colleagues published their detailed report online, which compares carbon storage by coastal blue carbon ecosystems to storage by algae and marine animals.

Carbon Storage Powerhouses

Plants take carbon out of the atmosphere, storing it in leaves, roots, and branches. On land, when vegetation falls to the ground, the bits break down quickly, releasing carbon back into the atmosphere. Not so in coastal wetlands. There, Howard explained, tidally driven salt water saturates soil twice a day in mangrove forests and tidal marshes and continuously in seagrass ecosystems, which are perpetually submerged. Saltwater inundation
A mangrove newly planted last February 5, 2016 along the coastline of Glan, Sarangani Province in the Philippines. Behind it are the tetrapod placed to protect these mangrove from big waves. Inhibits the microbial breakdown of plant debris, trapping it in the soil. The authors note that 50% to 90% of coastal blue carbon storage occurs in the soil, not the plants. “You can still see intact leaves 3 meters down,” said Howard. “The carbon is stable.”

Vegetation trapped in coastal blue carbon soils can be hundreds of years old and meters thick. By contrast, kelp, which also grows in coastal forests, lacks the extensive root systems that collect debris and sediment that become carbon-rich soils typical of coastal wetlands and traps carbon only a short time in living kelp plants because of their relatively short life spans.

Howard said that kelp and other ways to trap carbon—phytoplankton, corals, and fish—always come up at international meetings. She and her colleagues scoured recent research on the abilities of those organisms and coastal wetlands to hold onto carbon. They consolidated the findings and used the same units of measurement and timescales to compare coastal blue carbon to other ecosystems like phytoplankton and kelp. Howard notes that although all ocean ecosystems are important, coastal blue carbon is the standout, not only in how long it can retain carbon but also in how much it can trap.

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Manageable Natural Storage

The study confirms that “these [coastal blue carbon systems] are hot spots for carbon storage,” said Patrick Megonigal, associate director of research at the Smithsonian Environmental Research Center in Edgewater, Md., who was not an author of the study. In addition, those coastal ecosystems have the ability to be managed to preserve and extend their boundaries and therefore their impact on carbon emissions, Megonigal noted. How readily ecosystems respond to human management strongly affects their value in climate mitigation, he said.

The study found that annually, coastal mangroves, tidal marshes, and seagrasses each trap and store 2 to 35 times more carbon than ocean phytoplankton. The large range results from the challenges in mapping these ecosystems. Coastal blue carbon areas are often identified using remote sensing, which takes satellite scans of Earth and divides the surface into pixelated blocks. In those images, “it’s very hard to distinguish a marsh from a field and sometimes even bare ground,” said Megonigal. “It’s partly a matter of [needing] higher resolution data,” he said.

Mapping by remote sensing is next to impossible for seagrasses because they live underwater. “Most people would be surprised that we don’t know where they are,” said Howard. “We rely on awesome remote sensing, but it only gets you so far with water” in the way.

Mangrove forest rehabilitation program in Zamboanga City on World Wetlands Day 2017.
Blue Carbon Benefits

The researchers noted that nations counterbalancing their emissions by fostering coastal blue carbon ecosystems could also get other benefits. These ecosystems help strengthen biodiversity, tourism, fisheries, and storm protection.

According to the Blue Carbon Initiative, a global program focused currently on coastal ecosystems as a bulwark against climate change, 50% of the world’s mangrove forests have vanished over the past 50 years. The mangrove disappearance allows the trapped, thick, blue carbon soils to be washed away, releasing carbon back into the system. It also eliminates storm buffering, leaving communities much more vulnerable to harsh weather. Managing and restoring mangroves helps offset carbon emissions while providing valuable habitat, ecosystem health, and land conservation.

Coastal blue carbon systems are also adaptable to sea level fluctuations, as long as the changes aren't too fast. “They can build themselves up over time, increasing soil height,” said Howard.

Howard noted that 150 countries that signed on to the Paris Agreement have coastal wetlands, but only 29 are currently talking about coastal mitigation. Now that the new study is out, she hopes it will awaken greater interest in that option. “If countries knew how big a sink [coastal blue carbon] is,” Howard said, “they might be excited.”

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