Scientist: Temperate freshwater wetlands are 'forgotten' carbon sinks

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A new study comparing the carbon-holding power of freshwater wetlands has produced measurements suggesting that wetlands in temperate regions are more valuable as carbon sinks than current policies imply, according to researchers.

The study compared several wetlands at two Ohio wetland sites: one composed of mostly stagnant water and one characterized by water regularly flowing through it. The study showed that the stagnant wetland had an average carbon storage rate per year that is almost twice as high as the carbon storage rate of the flow-through wetland.

In addition, the scientists came up with measures of carbon storage in the stagnant wetland that exceed carbon measurements recorded in recent years in various types of wetlands, suggesting to the researchers that temperate freshwater wetlands may have a significant role in worldwide strategies to offset greenhouse gas emissions.

All types of wetlands deserve more credit than they receive as carbon sequestering systems in global carbon budgets, the researchers say. However, they also say that boreal peatlands – wetlands containing deep layers of organic matter in subarctic regions – should not be the only wetlands favored in policy considerations.

"These numbers are a lot higher than those often used to determine policy about wetlands. All of our numbers are, in general, considerably higher than average rates of carbon sequestration for boreal peatlands,

but the boreal peatland numbers rule the roost in climate change," said William Mitsch, senior author of the study and an environment and natural resources professor at Ohio State University. "Wetlands make up 6 to 8 percent of the landscape, but they hold much more than 6 to 8 percent of the world's carbon. They are the forgotten carbon sink."

Mitsch completed the study with Blanca Bernal, a graduate student in Ohio State's School of Environment and Natural Resources. The research appears online and is scheduled for future print publication in the journal *Global Change Biology*.

Mitsch and Bernal collected soil core samples from a forested wetland in Gahanna, in central Ohio, and from Old Woman Creek, a freshwater wetland near Lake Erie in northern Ohio. The Gahanna wetland is called a depressional wetland, or a swamp that remains saturated year-round. Old Woman Creek is part of a state park connecting an agricultural watershed with the lake that experiences pulses of water from both entry points.

They analyzed both the carbon content of the soil as well as the depth of the sediment that had stored carbon over the past 50 years.

The depressional wetland community as a whole sequestered an average of 317 grams of carbon per square meter per year (2,750 pounds of carbon per acre per year), compared to the average 140 grams per square meter per year (1,215 pounds per acre per year) stored by the flow-through wetland area. By comparison, boreal peatlands in Canada and Siberia sequester much less, at 15 to 25 grams carbon per square meter per year (130 to 220 pounds of carbon per acre per year).

Because the depressional wetland is just 59 acres, compared to the flow-through wetland's coverage of 138 acres, the total annual carbon storage for each is similar: almost 85 tons of carbon per year.

In the study, Mitsch and Bernal noted other measurements taken since 1993 in wetlands, most located in North America. In the depressional or forested wetlands in particular, the average carbon-storage measurement in this new study exceeded those other readings in every case. To Mitsch, this suggests that determining the carbon storage in swamps, and forested pools in particular, should be a priority.

"Few studies have been done in temperate wetlands other than ours, and even fewer have been done in forested wetlands like our Gahanna Woods wetland, where we measured the highest rates," Mitsch said.

In almost all cases the measurements were taken using the same methods. To determine the age of the sediments in wetlands – and therefore the rate of carbon storage per year – researchers use radiometric dating with cesium-137. Above-ground nuclear testing in the mid-20th century left behind the cesium-137 compound as a marker in sediments throughout the world. Based on how deep cesium-137 was detected in the soil cores, the researchers were able to date sediment from each wetland that has built up since 1964, the year the concentration of the compound reached its peak.

A backup method to determine sediment age by assessing the level of Pb-210, a radioactive form of lead, is used when cesium-137 is not a reliable marker.

The highest carbon sequestration rate – 473 grams per square meter per year (4,100 pounds per acre per year) – was found in the most heavily forested area of the stagnant wetland.

This suggests that the leaves, bark and wood from the trees in these areas might be less likely to decompose than are marsh plants that populate many wetland communities, Mitsch said, noting that those forest remnants dropping into the water lead to the collection of more carbon

in the soil. Plants in a wetland are the key to carbon storage – they absorb carbon dioxide from the atmosphere through photosynthesis. And the standing water in wetlands reduces the amount of respiration of that carbon dioxide back into the air.

"In an ecosystem that's terrestrial, especially a forest, plant life falls to the floor but the forests don't fill up with leaves because they're decomposing, returning some of that carbon dioxide back into the atmosphere," Mitsch said. "Wetlands tend to accumulate this litter over centuries, maybe over thousands of years, and they have plants and are productive systems, but they tend not to decompose everything. So carbon builds up in the soil for a long time."

Mitsch is making the case for wetlands as carbon sinks in an effort to foster preservation of wetlands, which are also coastal protection systems, buffer zones between land and waterways, and filters of chemicals in water that runs off from farm fields, roads, parking lots and other surfaces. He, Bernal and other Ohio State graduate students are conducting similar research to gauge carbon sequestration rates in wetlands based in tropical areas.

Provided by The Ohio State University

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