Carbon emissions from peatlands may be less than expected

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Duke University scientists have discovered a previously unknown dual mechanism that slows peat decay and may help reduce carbon dioxide emissions from peatlands during times of drought.

"This discovery could hold the key to helping us find a way to significantly reduce the risk that increased drought and global warming will change Earth's peatlands from carbon sinks into carbon sources, as many scientists have feared," said Curtis J. Richardson, director of the Duke University Wetland Center and professor of resource ecology at Duke's Nicholas School of the Environment.

The naturally occurring mechanism was discovered in 5,000-year-old pocosin bogs in coastal North Carolina. Preliminary field experiments suggest it may occur in, or be exportable to, peatlands in other regions as well.

"When we took peat extracts from the southern peatlands and put them into Canadian peatlands, they slowed down decomposition there, too," said Richardson.

Peatlands are wetlands that cover only 3 percent of Earth's land but store one-third of the planet's total soil carbon. Left undisturbed, stored carbon can remain locked in their organic soil for millennia due to natural antimicrobial compounds called phenolics that prevent the waterlogged peat from decaying.

If the peat dries out, however, many scientists have theorized peatlands would switch from storing carbon to pumping it out instead.

"The accepted scientific paradigm is that prolonged drought, coupled with global warming and increased drainage of peatlands for agriculture and forestry, will lower water levels. This could cause peatlands to dry out, decay and release massive amounts of carbon back into the atmosphere," Richardson said. "Our research supports a less dire scenario. It finds that moderate long-term drought might have less impact on the release of carbon dioxide from peatlands than expected."

The reason, he said, lies buried in the peatland soil itself.

By comparing the chemistry of soil from pocosin bog peatlands in North Carolina with soil from boreal peatlands in Canada, Richardson and his team discovered a significant and previously unrecognized difference between the two.

"Southern wooded peatlands are up to 5,000 years old and have more complex plant-derived compounds that have allowed them to adapt to drought through a mechanism that regulates the buildup of phenolics and helps slow down decomposition," said Hongjun Wang, a research scientist at the Duke Wetland Center.

This natural adaptation, which was not found as abundantly in soil from boreal peatlands of the north, protects stored carbon directly by reducing decay-promoting phenol oxidase activity during short-term drought. The mechanism also indirectly protects stored carbon by spurring a shift in the peatlands' plant cover in response to moderate long-term drought. As water levels drop, plants that contain low levels of phenolics, such as sphagnum moss, ferns and sedges, are replaced by trees and shrubs, which are high in the decay-retarding compounds.

"This dual mechanism helps peat resist decay and adapt to climate change," Wang said.

He believes high-phenolic shrubs could naturally expand into northern peatlands or be introduced there as water levels drop, offering hope that scientists might be able to reduce the risk of large carbon releases.

"We still need to identify the specific aromatic components or groups of phenolics that are responsible for the decay-retarding mechanism," Richardson said. "Plants produce and contain thousands of compounds, so this may take time. But it will be worth the effort. What we learn will provide us with new approaches for managing storage and losses of carbon from millions of acres of peatlands worldwide."

More information: "Dual-Controls on Carbon Loss During Drought in Peatlands," Hongjun Wang, Curtis J. Richardson, Mengchi Ho. *Nature Climate Change*, May 11, 2015. DOI: dx.doi.org/10.1038/nclimate2643

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