NATURAL MECHANISM COULD LOWER EMISSIONS FROM TROPICAL PEATLANDS

Scientists have long feared that as Earth warms, tropical peatlands—which store up to 10 percent of the planet’s soil carbon—could dry out, decay and release vast pools of carbon dioxide and methane into the atmosphere, rapidly accelerating climate change.

A new international study headed by researchers at Florida State University and the Duke University Wetland Center, reveals the outlook may not be as bleak.

It finds that these swamps and marshes have a natural biochemical defense mechanism that helps them resist or retard decay—even in warming temperatures and more severe droughts.

“This is good news, because it indicates that scenarios where all this stored carbon in these peatlands goes up into the air as carbon dioxide and methane may not happen quite as rapidly as we originally projected,” said DUWC Director Curtis J. Richardson, John O. Blackburn Distinguished Professor of Resource Ecology at Duke University’s Nicholas School of the Environment.

“It doesn’t solve climate change, but it does suggest these peatlands have some built-in resilience that we didn’t recognize before,” 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 and aromatics that prevent the waterlogged peat from decaying.

Tropical or subtropical peat swamps and marshes hold up to 30 percent of all carbon stored in peatlands worldwide and are widely considered to be at highest risk of drying out as the climate warms and droughts become more severe.

Richardson and his colleagues at 12 institutions published their peer-reviewed paper on Sept. 7 in Nature Communications. Suzanne B. Hodgkins, a postdoctoral researcher at Florida State, was lead author. Duke University Wetland Center researchers Hongjun Wang, Neal Flanagan and Mengchi Ho were also among the coauthors.

To conduct the study, they used infrared spectroscopy to estimate carbohydrate and aromatic content in peat samples collected from high- mid- and low-latitude sites from the Arctic to the tropics. These sites included bogs, fens, marshes and swamps in Sweden, Minnesota, Canada, North Carolina, southern Florida and Brunei.

Their analysis revealed that the top layers of peat in tropical or subtropical swamps and marshes contain lower levels of decay-prone carbohydrates and higher amounts of decay-resistant aromatics than found in near-surface peat from bogs or fens in cooler climates at high latitudes. Aromatic content is comprised of coarse woody material such as fallen trees, branches and dead roots. Because it is high in lignin, it decays more slowly than carbohydrate-rich leaves or grasses. Over time this creates a natural barrier, inhibiting oxidation and protecting the peat below from drying out and decaying.

Continued on Page 2
DUWC Researchers Study Effects of Nanomaterials on the Environment

Two recently published research articles highlight the participation of Duke University Wetland Center members in the research activities of the Center for the Environmental Implications of Nanotechnology (CEINT). Headquartered at Duke University, CEINT is a collaborative effort bringing together researchers from Duke, Carnegie Mellon University, Howard University, Virginia Tech, University of Kentucky, Stanford University, and Baylor. CEINT explores the relationship between a vast array of nanomaterials—natural and manufactured—and their potential environmental impacts.


Silver nanoparticles are increasingly used in consumer products, biotechnology, and medicine. They are released into aquatic ecosystems through wastewater discharge. This study investigated the phytotoxicity of silver nanoparticles to aquatic plants. Initial results suggest that engineered nanoparticles exert more stress on submerged macrophytes than on emergent plants.

Lead author Lin Yuan, a faculty member at The State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, has been a visiting scholar at the Duke University Wetland Center labs in Durham.


The use of nanomaterials in agrochemicals like pesticides and fungicides has increased dramatically over the past decade. They are used to provide more disease protection and better yields for crops, while decreasing the amount of toxins sprayed on agricultural fields. This study investigates how these “nanopesticides”, combined with nutrient runoff from fertilized cropland and manure-filled pastures, could also mean more toxic algae outbreaks for nearby streams, lakes and wetlands.

---

NATURAL MECHANISM COULD LOWER EMISSIONS FROM TROPICAL PEATLANDS

*Continued from Page 1*

Their analysis revealed that the top layers of peat in tropical or subtropical swamps and marshes contain lower levels of decay-prone carbohydrates and higher amounts of decay-resistant aromatics than found in near-surface peat from bogs or fens in cooler climates at high latitudes. Aromatic content is comprised of coarse woody material such as fallen trees, branches and dead roots. Because it is high in lignin, it decays more slowly than carbohydrate-rich leaves or grasses. Over time this creates a natural barrier, inhibiting

“This allows peat in tropical swamps and marshes to persist despite year-round warm temperatures and periods of drought,” Richardson explained.

“We observed similar lower carbohydrate and higher aromatic compositions in deeper peat from high-latitude sites, suggesting these deep-peat reservoirs may also be stabilized in the face of climate change,” he added. “So, pending further study, that’s more good news.”

Richardson conducted the research with colleagues at Florida State; the Smithsonian Institution’s National Museum of Natural History; the University of Potsdam; the University of Minnesota; the Singapore-MIT Alliance for Research and Technology; Ohio State University; and Lebanese University. Other coauthors were from the Max Planck Institute for Biogeochemistry; the Massachusetts Institute of Technology; the University of Arizona; McGill University; and the Université de Montréal.

Primary funding for the research came from the U.S. Department of Energy Office of Biological and Environmental Research’s Terrestrial Ecosystem Sciences program.

The 2018 DUWC Student Research Grant Award

Ben Siegelman (NSOE MEM 2019) is the recipient of the Wetland Center’s 2018 Student Research Grant Award in support of his proposal Assessing Participation in a Community-Based Mangrove Restoration Project. He conducted his research during Summer 2018 while interning for the organization Marine Conservation Philippines in the Filipino province of Negros Oriental.

This is the fourth year for the Duke University Wetland Center Graduate Student Research Grant Program, which supports research focused on a topic in wetland science and management leading towards a graduate degree. Annual grants of up to $5,000 are awarded to Nicholas School students (Master's and Ph.D.) through a competitive application and review process. The program contributes to the Center's goal of increasing sound scientific knowledge leading to sustainable wetland functions and services locally, nationally, and globally.

DUWC’s Curtis Richardson Named to Rockefeller Foundation Residency

DUWC Director Curtis Richardson is the recipient of a 2018 Bellagio Center Academic Writing Residency.

The Rockefeller Foundation's Bellagio Center Residency Program is for university and think tank-based academics, researchers, professors, artists, policymakers, and scientists demonstrating decades of significant professional contributions to their fields. The program brings together these practitioners to foster cross-cultural and interdisciplinary dialogue to shape thinking and catalyze action around the Foundation's strategic goals.

The Rockefeller Foundation strives to promote the well-being of humanity, particularly through issues that have a direct impact on the lives of poor and vulnerable populations around the world. These issues include but are not limited to health, economic opportunity, urban resilience, as well as food and agriculture.

Dr. Richardson will begin his time at the Bellagio Center facilities on the shore of Italy's Lake Como later this year to work on a project concerning transboundary water sustainability issues.
THE MERCHANT’S MILLPOND

We drifted too, 
that Blackwater pavement 
with speckled copper hues. 
For some, the Avenue a dismal maze. 
For us, a spot of muse.

A silent stop 
on fluted shags—
we rest on scaly knees. 
The gleying Millpond’s signature 
a pulse sensed on the trees.

Needles, plates 
around us moved 
peat plumes strike our nose. 
Those bearded strangers looked at us 
on duckweed paths we froze.

Were we lost 
or had we found 
a secret in the swamp? 
Something sacred in the land 
a place we shouldn’t tromp?

That heavy air 
was charged with life 
though time there did stand still. 
Friction felt beneath our boat—
the current brought a chill.

Alex O’Neill

Alex O’Neill (MEM 2019) was awarded a Nicholas School assistantship in the DUWC laboratory for the 2017-2018 school year. He wrote *The Merchant’s Millpond* after a visit to Merchant’s Millpond State Park in Gates County, North Carolina. The poem won the *Eno Magazine* 2018 poetry award and first appeared in that publication’s Issue 7. It is reprinted here by permission of *Eno Magazine.* (http://www.enomag.org/)
DUWC Director Curtis J. Richardson received an honorary Doctor of Science degree from the University of Waterloo in Ontario, Canada. The award was given at the University’s spring graduation convocation in June 2018. Dr. Richardson was the commencement speaker for the event.

The University of Waterloo bestowed the degree in recognition of Richardson’s significant contributions to wetland science and strong advocacy of science-based policy making and wetland protection.

Dr. Richardson is the John O. Blackburn Distinguished Professor of Resource Ecology at Duke University, where he has been a faculty member for forty years. He earned his Ph.D. in Ecology from the University of Tennessee. Dr. Richardson is a fellow in the American Association for the Advancement of Science, the Society of Wetland Scientists, and the Soil Science Society of America. In addition, he has received the Society of Wetland Scientists Lifetime Achievement Award, the National Wetlands Award, and the SUNY Cortland Distinguished Alumni Award.

The University of Waterloo is one of Canada’s major research universities, with a total student population of approximately 36,000. The university has the largest number of faculty involved in wetland and water research and teaching in Canada.

Recent DUWC-related Research Publications


For a complete list of Duke University Wetland Center research articles, visit us online at https://nicholas.duke.edu/wetland/