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# Plant–microbe Symbioses Preserve Carbon in Peatlands Along a Latitudinal Gradient from Minnesota to Peru

Curtis J. Richardson[1], Hongjun Wang[1], Suzanne Hodgkins[2], Neal Flanagan[1], Bill Cooper[2], Tian Jianqing[1], Mengchi Ho[1], and Jeff Chanton[3]

[1]Duke University Wetland Ctr., Nicholas School of the Environment, Durham, NC
[2]Department of Chemistry & Biogeochemistry, FSU, Tallahassee, FL
[3]Department of Earth, Ocean and Atmospheric Science, FSU, Tallahassee, FL

Contact: curtr@duke.edu

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Peatlands store one-third of soil C in terrestrial ecosystems and have persisted through changing climate over millennia from the arctic to the tropics. Approximately one-third of peat stores are found in subtropical and tropical peatlands (STPs) formed from high-lignin woody biomass. In this project, our questions are: 1) why do these non-*sphagnum* peatlands (STPs) accumulate C under warmer-drier climates and 2) how might insights coming from studying control mechanisms in STPs improve the management and conservation of the vast C stores in boreal peatlands subject to increasing climate forcing. We hypothesized that a dual control or "latch mechanism" reduces decomposition in shrub/tree communities in STPs due to both (1) higher production of polyphenol and aromatic compounds in STPs than found in northern *Sphagnum*/Carex communities and (2) the buildup of recalcitrant organic matter produced by light fire-drought-warming-adapted communities, together leading to a reduction in the microbial decay rate of peat. After three-years of intensive biological and chemical analysis in a series of field and microcosm experiments along our north to south bog gradient from Minnesota to Peru, we show how previously unrecognized biotic factors, particularly dynamic interlinked above- and belowground attributes control C sequestration in peatlands. Our key findings include (1) phenolics-bridged plant-microbe symbioses, principally slow-growing microbes dominated in higher phenolic wooded STPs, preserving C in peatlands under climate change, 2) phenolics are the overarching factor controlling the relative abundance of slow-and fast-growing microbes, the slow-growing microbes in STPs metabolize C slowly and are inherently resistant to disturbance, 3) global data analysis shows that soil respiration does not increase exponentially from boreal to tropical peatlands, suggesting that slow-growing microbes may have become dominant in most non-boreal peatlands, 4) peat chemistry analysis from over 2000 samples show that across peatlands both from the arctic to tropics and from high to low elevation peatlands recalcitrance increases as aromatic content increases, and 5) peat affected by low-severity wildfires displays a similar pattern of higher aromatic content. Our findings all demonstrate links between peat recalcitrance and increased content of phenolics and other aromatic compounds in plants. Thus, linked plant–microbe symbiotic traits are a key to understanding ecological resilience and resistance developed in peatlands under disturbance. New trait-based approaches that can better link above-and below ground processes are needed to advance both the accuracy and precision of current abiotic-factor-based Earth system models in predicting future soil C responses to climate-change feedbacks.