142. A Bacterial Role in Lignin Decomposition Under Future Rates of Nitrogen Deposition

Zachary Freedman[1]* (zacf@umich.edu) and **Donald R. Zak**[1,2]

[1]School of Natural Resources & Environment and [2]Department of Ecology and Evolution, University of Michigan, Ann Arbor, Michigan, USA 48109

Project Goals: With support from DoE BER, we have been able to study the molecular mechanisms by which experimental N deposition has decreased plant litter decay and increased the accumulation of organic matter in a northern hardwood forest ecosystem located in Michigan, USA. Experimental plots have been exposed of increased NO_3 deposition for 20 years. Using biogeochemical and molecular analyses, we have been able to test our initial hypotheses that ecosystem response to experimental N deposition (i.e., greater soil C storage) is governed by the environmental regulation of microbial gene expression. Here, we present findings that suggests lignin-modifying bacteria, which degrade lignin less efficiently than their fungal counterparts, may be favored under future rates of N deposition.

http://sitemaker.umich.edu/drzak/front_page

Anthropogenic release of biologically available nitrogen (N) has increased dramatically over the last 150 years, which can alter the processes controlling the storage of carbon (C) in terrestrial ecosystems. In a northern hardwood forest ecosystem located in Michigan, USA, nearly 20 years of experimentally increased atmospheric NO_3 deposition has reduced forest floor decay and increased soil C storage. This change occurred concomitantly with compositional changes in Basidiomycete fungi, and *Actinobacteria*, as well as the down-regulation of fungal lignocelluloytic genes.

Recently, laccase-like multicopper oxidases (LMCO) have been discovered among Bacteria. LMCOs participate in lignin decay, wherein lignin is depolymerized to dissolved organic carbon (DOC) with minimal CO_2 production. In this study, we examined how nearly two decades of experimental N deposition has affected the abundance and composition of lignolytic bacteria (*i.e.,* bacteria harboring LMCO genes).

In our experiment, bacterial LMCOs were more abundant in forest floor under experimental N deposition, whereas abundance of Bacteria and fungi were unchanged by this agent of global change. Experimental N deposition also led to less diverse, significantly different bacterial (16S rRNA) and LMCO gene assemblages, with known lignin-modifying bacterial taxa (i.e., Actinobacteria, Bacteroidetes, and Proteobacteria) accounting for the majority of compositional changes. These results suggest experimental N deposition favors bacteria in forest floor that harbor the LMCO gene and represents a plausible mechanism by which anthropogenic N deposition slows decomposition, increases soil C storage, and accelerates the leaching of DOC. In combination, our observations suggest future rates of atmospheric N deposition could fundamentally alter the physiological potential of soil microbial communities.

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