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Drivers of spatial heterogeneity of biological nitrogen fixation in northeastern Canadian boreal forest.

Romain Darnajoux (1), Robert Bradley (2), Pauline Le Monier (3), Daniel Houle (4,5), and Jean-Philippe Bellenger (3)

(1) Department of Geosciences, Princeton University, Princeton, USA (romaind@princeton.edu), (2) Centre Sève, Département de Biologie, Université de Sherbrooke, Sherbrooke, Canada , (3) Centre Sève, Département de Chimie, Université de Sherbrooke, Sherbrooke, Canada , (4) Direction de la Recherche Forestière, Ministère des Forêts, de la Faune et des Parcs, Canada, (5) Ouranos, Montreal, Canada

Moss-associated cyanobacteria (MAC) are important source of new N into high latitude ecosystems. Our poor understanding of the drivers controlling the spatiotemporal variability that affects BNF activity limits our ability to produce reliable N input estimates and to predict their evolution with global environmental changes. In this study, we evaluate the role of moss color phenotypes (green versus yellow), canopy gaps and moss species in structuring the spatial heterogeneity of BNF.

Over 3 years, we collected 592 samples of the four dominant moss species (Pleurozium schreberi, Ptilium crista-castrensis, Hylocomnium splendens and Dicranum polysetum) in 35 black spruce forests covering a 500 km south-north transect in northeastern Canada. N2 fixation activity was assayed using the acetylene reduction assay. Moss color and canopy openness were characterized, and species coverage and meteorological data were also collected.

Pleurozium schreberi and Ptilium crista-castrensis contributes an average of 48% to total BNF in boreal forest. Yellow phenotype shows more than twice the BNF activity of the green phenotype. Canopy openness correlates positively with BNF at the stand level ($0.2 < r^2 < 0.8$ in P. schreberi) and it also impacts the relative abundance of species within the moss carpet. Overall, around 50% of the total variance in moss carpet BNF is explained with moss species, color phenotypes and canopy gaps.

Based on these results, we argue that sylvicultural practices (e.g. stand thinning) and natural disturbances (e.g. windfall) that alter canopy openness could positively impact N input via BNF. In addition, because it integrates local variation in temperature, precipitation, light, and deposition (N, micronutrient), canopy openness represents a good candidate to predict BNF activity in remote sensing application.