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Nitrogen fixation in moss-cyanobacteria associations in boreal forest ecosystems

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Nitrogen (N) limits the productivity in boreal forests. A major source of "new" N for these forests is the fixation of atmospheric N_2 preformed by cyanobacteria living in association with mosses and lichens. Mosses are a dominant feature in boreal forests, accounting for 60-90% of the groundcover in pristine boreal forests and have been found to be colonized by several N_2-fixing cyanobacteria. Given the ubiquitous nature of mosses in these forests, their association with N_2-fixing cyanobacteria could characterize the N cycle in these ecosystems. For instance, the feather moss *Pleurozium schreberi* with its associated cyanobacteria fixes 1-2 kg N ha^{-1} yr^{-1}, which equals the amount that enters northern boreal forests via atmospheric N deposition.

Nitrogen fixation in moss-cyanobacteria associations is affected by numerous abiotic factors that could modulate the N input to the system via the moss-cyanobacteria pathway. For instance, high N availability and dry conditions inhibit N_2 fixation in moss-cyanobacteria associations while phosphorus availability and moist conditions promote N_2 fixation. Further, N_2fixation in moss-cyanobacteria associations is resilient, and can recover from increased N inputs (12 - 15 kg N ha^{-1} yr^{-1}) as well as from drought stress (moss $<$ 9% field moisture) upon removal of these stressors. Nevertheless, the question as to how important the N_2 fixing capability of moss-cyanobacteria associations is as a source of "new" N for the N cycle in boreal forests remains. For instance, mosses can retain acquired N over long periods of time ($>$ 1 year) and the transfer of N from moss to soil in the short-term has so far only been shown to occur after disturbances (e.g. drying rewetting events, fires). I will present results from laboratory as well as field experiments aimed to elucidate the role moss-cyanobacteria associations play for the N cycle in boreal forests and how abiotic factors control the fixation of atmospheric N_2.