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Biological Nitrogen Fixation: Is it shuts down under chronic atmospheric reactive nitrogen deposition in peatlands?

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Under natural conditions, mosses (*Sphagnum spp*) rely on peat diazotrophic community to provide bioavailable/reactive nitrogen (Nr) through Biological Nitrogen Fixation (BNF) to meet plant demands for Nr. However, excessive atmospheric Nr deposition on land including peatlands due to agricultural intensification and nitrogen oxide emissions from vehicles is fertilizing peatlands as well. In Britain alone, Nr deposition ranges from $\sim$6 in Scotland to $>$25 kg N $ha^{-1}y^{-1}$ in England. BNF is an energy intensive process requiring more allocation of organic carbon per mole of Nr being fixed by the diazotrophs; therefore, it is not clear if BNF slows and/or even shuts down in moss associated diazotrophs because of the availability of Nr is no longer restricted. In this research we evaluated the impact of Nr deposition on BNF in peatlands across Britain, which has been exposed to decades of excessive Nr deposition and in a peatland site in northern Sweden (Degero peatland) under an experimental N fertilization. Using the $^{15}N_2$ direct assimilation and acetylene reduction assay (ARA) methods, BNF associated with dominant *Sphagnum spp* (*S. fallax, S. fuspidatum, S. capillifolium, S. papilosum, and S. balticum*) was quantified. According to the results the correspondence of BNF rates measured with $^{15}N_2$ assimilation and ARA methods were highly variable (conversion ratios of $<$1 to $>$39 between the two methods) suggesting that ARA method may under or overestimate BNF in peatlands. Based on the $^{15}N_2$ assimilation methods, BNF across the British and the experimentally fertilized peatlands plots was relatively lower on average than under the non-fertilized controls plots in the Degero site. However, our results suggests that BNF does not shuts down completely in peatlands exposed to Nr deposition as previously assumed in N budget models of peatlands and thus BNF input need consideration when modelling the N economy of peatlands.