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Changes in plant biomass allocation and mycorrhizal performance in peatlands under nitrogen load

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Increasing atmospheric nitrogen (N) deposition may endanger the carbon (C) sink in peatlands. This may partly arise from a shift in C inputs from fungal biomass with low decomposability to above ground plant biomass. As plant available inorganic N increases, C allocation to mycorrhizal fungi, in exchange for organic N may decrease. To study how nutrient addition affects plant-fungal feedbacks on C and N cycling, we investigated plant biomass allocation and the extent to which plants rely on ericoid mycorrhizal N uptake at three of the longest-running nutrient addition experiments on peatlands: Whim Bog (United Kingdom), Mer Bleue Bog (Canada) and Degerö Stormyr (Sweden). We determined the peak growing season aboveground plant abundance using the point intercept method, and measured fine root production rates using the ingrowth core method. We also analyzed isotopic δ15N patterns in leaves of dominant ericoid mycorrhizal shrubs as well as the non-mycorrhizal sedge Eriophorum vaginatum under the different nutrient addition treatments. The treatments receive an additional load of 0.8-6.4 N g m^{-2} y^{-1} either as ammonium (NH_{4+}), nitrate (NO_3-), or NH_4NO_3 and with or without phosphorus (P) and potassium (K), alongside unfertilized controls. After 11-22 years of nutrient addition, the vegetation structure had changed remarkably. Most nutrient addition treatments increased up to 60% in total vascular aboveground plant abundance, but a few treatments also decreased as much as 50% in the relative proportion of ericoid mycorrhizal shrubs to total vascular plant abundance. Biomass allocation to above and belowground compartments also revealed inconsistent trends. The differing responses to nutrient load may be explained by differences in the water table depth, the form of N added and whether N was added with PK. Shrubs were strong competitors at the dry Mer Bleue Bog while sedges gained in abundance at the wetter Whim Bog and Degerö Stormyr. Long-term fertilization increased foliar δ15N values, presumably owing to a shift in the N source and diminished role of ericoid mycorrhizal fungi in plant N uptake under high inorganic N availability.