Ambient nitrogen deposition gradients in the Rocky Mountains and the effect on alpine moist meadow ecosystems

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The chronic ambient deposition of nitrogen (N) in alpine ecosystems can have cascading effects on plants, soils and hydrology in both the alpine and areas downstream through leaching and ecosystem export. Nitrogen is traditionally a nutrient limiting for plant growth in the alpine zone and the addition of anthropogenically derived nitrogen has the potential to alter nutrient composition and interactions between soil, plants and hydrology. While deposition is globally widespread its spatial impacts are associated with a proximity to agriculture (fertilizers) and industry (hydrocarbon byproducts), creating gradients of deposition with distance from point sources. Consequently, N deposition levels and potential environmental impacts on ecosystem processes increase in regions with expanding populations and changes in land use. The Rocky Mountains face both enhanced deposition associated with high levels of precipitation at high elevations and increases in anthropogenic sources of nitrogen from conversion of prairie to agricultural fields or development of new roads and housing communities. Our study focuses on linking gradients of ambient nitrogen deposition to responses within the alpine ecosystem, in particular the interactions between plants and soils within moist meadow communities.

Previous studies have focused on the effects of N deposition within alpine dry meadows, as these are abundant and generally higher in elevation than other alpine meadow community types. Within these systems critical loads have been estimated to determine at what level N addition directly alters the ecosystem. Alpine moist meadows, however, also cover a substantial portion of the alpine zone, and support a very different plant community with naturally lower species richness. These areas receive heavier snowfall, and are more dependent on the snowpack for ephemeral water availability making them potentially more susceptible to nutrient loading within the snowpack. Along our ambient N deposition gradient within Colorado we have found a reduction in species richness with latitude, coinciding with a decrease in N deposition. Future work will quantify N deposition loads, and examine potential chemical changes in plant tissue from plants along the gradient.