Subalpine ecosystem nutrient budgets, 1982-2004, Lexen Creek, Fraser Experimental Forest, Colorado

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Abstract. At the Fraser Experimental Forest (FEF), Colorado, we have continuously studied subalpine nutrient cycling and budgets in watersheds since 1982. Here we examine relationships between hydrologic factors, soil processes, and stream water solute concentration and flux in the 124-ha alpine/subalpine FEF Lexen Creek watershed. No trends in annual precipitation, snowpack peak water equivalent (PWE), or stream discharge occurred. Snowpack PWE and annual stream discharge were correlated ($p < 0.001$). The Lexen precipitation NO_3^- and SO_4^{2-} concentrations were lower ($p < 0.05$) and deposition similar to high elevation Central Rocky Mountain NADP stations. Since 1990, SO_4^{2-} deposition has declined 50%. During snowmelt alpine stream solute concentrations changed little. Dissolved inorganic nitrogen (DIN) concentrations exceeded organic nitrogen (DON). Conversely, subalpine stream water Ca^{2+}, Mg^{2+}, NO_3^-, and HCO_3^- concentrations declined 40 - 90%, there was little change in K^+ and SO_4^{2-}, and dissolved organic carbon (DOC) concentrations increased >100%. Stream water DON concentrations exceeded DIN. Watershed Ca^{2+}, Mg^{2+}, and HCO_3^- outputs exceeded inputs by 20-fold, >99% of H^+ and 95% of inorganic N was retained, SO_4^{2-} outputs exceeded inputs by 70%, and Cl^- outputs were 90% of inputs. Differences in alpine and subalpine stream chemistry indicated the relative importance of biotic and abiotic processes regulating nutrient budgets. In the alpine, physical factors as wind redistribution of snow, soil freeze-thaw cycles, and rapid meltwater movement into deeper soils occurred. The higher alpine stream DIN concentrations were associated with lower soil C:N ratios, larger soil inorganic N pools, higher DIN concentrations in both winter and summer resin bags, and greater net N mineralization rates than in the subalpine. In the subalpine, unfrozen soils beneath the snowpack resulted in the over-winter accumulation of mineralized compounds. Shallow lateral subsurface flow prevailed during snowmelt, and input chemistry was altered by soil exchange and biotic uptake.