Abstract:
Anthropogenic nitrogen (N) emissions have been increasing in the Snake River Plains of southern Idaho due largely to agricultural sources, especially confined animal feeding operations and possibly a fertilizer factory. CMAQ (Community Multiscale Air Quality) model simulations show that the region has N deposition in excess of 10 kg ha\(^{-1}\) yr\(^{-1}\). Several National Park Service reserves and monuments are downwind of agricultural sources of reduced N, including Craters of the Moon National Monument and Preserve (CRMO), Hagerman Fossil Beds National Monument, Minidoka National Historic Site, and City of Rocks National Reserve. Highest levels of N deposition are modeled for BLM land near the town of Shoshone, and historic high levels are known from the region around a fertilizer factory in Pocatello. These high levels of N may be impacting the diverse native vegetation in sagebrush grassland, including some 700 species at CRMO alone. There is increasing evidence that N deposition may increase the invasion of non-native cheatgrass (*Bromus tectorum*), that is now found even in isolated and undisturbed areas of CRMO. The overall objective of this project is to evaluate the effects of atmospheric N deposition on the extent of cheatgrass invasion of the sagebrush steppe ecosystems of the Upper Columbia Basin Network monuments through a combination of field measurements of N inputs in bulk deposition collectors and passive samplers (both Ogawa samplers and Radiello samplers for comparative analyses), soil/plant N concentrations and stable isotope \((^{15}N)\) analyses, vegetation composition, and MODIS image analysis. The study is designed to provide feedback to regulatory agencies and land managers to help protect sensitive natural resources including biodiversity of sagebrush-steppe. We report on the first stage of this project, analyses from a network of passive samplers that were set up in June 2010 to determine air quality at 10 NPS, BLM, and university field sites.

Background Info:
- The Snake River Plains have been affected by N deposition for decades with the increases in agriculture, including croplands, confined animal feeding operations, and expansion of the fertilizer industry. The levels of N deposition in southeastern Idaho and northern Utah are 6-12 kg N ha\(^{-1}\) yr\(^{-1}\), most coming as dry deposition in the form of ammonium (Fenn et al. 2003b).
- The ecological effects of N deposition have been studied to some extent in other areas of the western U.S., including forests, shrublands and deserts of southern California, Colorado alpine and grasslands, and lichens of the Pacific Northwest (Fenn et al. 2003a).
- The invasion of cheatgrass into the Great Basin and adjacent plateaus and basins has been documented since the early 1930’s (Mack 1981), and began well before large-scale anthropogenic N deposition occurred. This invasion may be related to a combination of disturbances such as grazing and fire, and natural fertility levels of these soils that are sufficient for cheatgrass growth. However, cheatgrass is spreading into areas with no recent history of disturbance and is becoming locally more productive (Chambers et al. 2007).
- Based on ongoing work documenting the relationship between N deposition, N fertilization, and alien grass invasion at Joshua Tree National Park (Allen et al. 2009), we hypothesize that a similar relationship exists between N deposition and cheatgrass invasion across the Snake River Plains.
Measuring Nitrogenous Air Pollutants at Upper Columbia Basin Network Parks, Idaho

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Methods:

- We established 10 atmospheric collection sites across southeastern Idaho encompassing Craters of the Moon National Monument, City of Rocks National Monument, Minidoka National Historic Site, and Hagermann Fossil Beds National Monument.

- At each site we erected a passive sampling array with 47mm nylon filters to collect HNO₃ and Ogawa filters to collect NH₃, NO₂, and NOₓ. The filters will be installed for six 2 week exposures between June 2010 and June 2011. The first exposure was installed June 17, 2010.

- Alongside the passive sampler, five bulk deposition collectors we installed at each site. These consist of a 3’ tube to collect snow in the winter affixed to a large funnel connected to an ion exchange resin column. As water passes through the column, both cations and anions are stripped from the solution and bind to the resin. The resin tubes will be exposed for a 6 month exposure during the summer and fall before being switched out for a 6 month winter and spring exposure period. This will continue for two years for a total of 4 exposure periods.

- Soil and vegetation data were also collected at each site to evaluate biological responses to nitrogen additions. These will be analyzed and reported on at a later date.
Discussion:

• NH₄⁺ is the dominant atmospheric species of nitrogen across southeastern Idaho. Concentrations are highest in the Snake River Plains near Twin Falls where there is a high concentration of confined animal feeding operations and agricultural land.

• Higher concentrations of HNO₃ are located on the eastern end near the city of Pocatello.

• When compared to the 2002 model, our initial data expands the area under influence by high concentrations of atmospheric nitrogen. We need to analyze the bulk deposition collectors in order to determine how much of the atmospheric nitrogen is being deposited to the ecosystem.

• The modeled nitrogen concentration maps need to be enhanced to include land cover classification to increase the influence of the agricultural region that exists between Twin Falls and Pocatello.

• The upcoming analysis of soil and vegetation patterns at each site will assist in the determination of the effects of anthropogenic nitrogen on the natural ecosystem.

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References:


