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

Colorado
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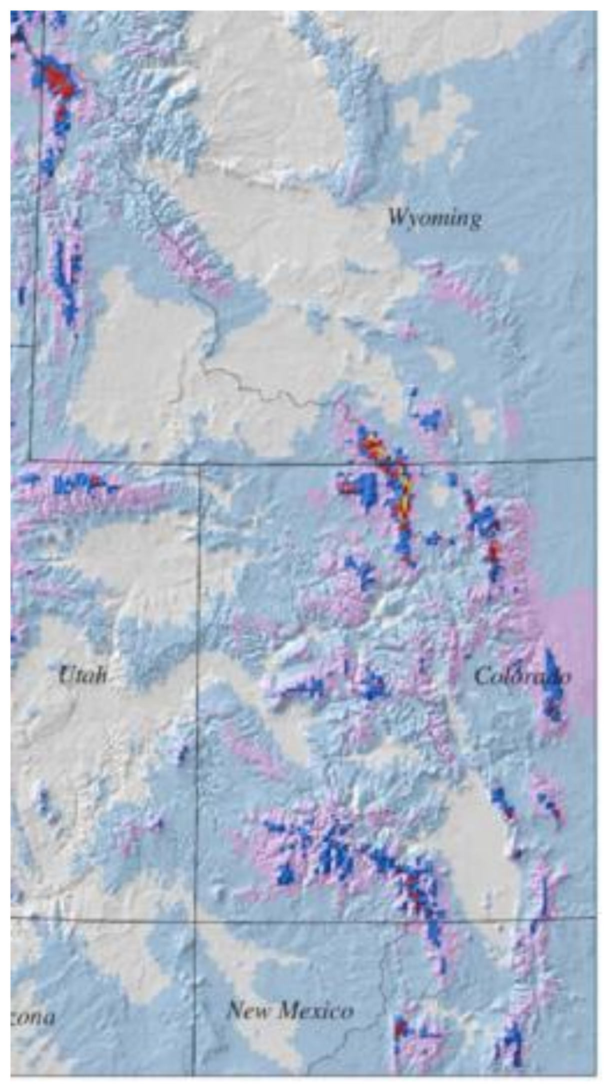
A. Introduction



Adapted from Nanus et al., 2003

- N deposition is enhanced at high elevations due to higher precipitation
- Ambient levels of N deposition in some areas of the Rocky Mountains have been shown surpass thresholds[1]
- Levels of N deposition from anthropogenic sources increases with proximity to sources (industry, cars, agriculture)[2]
- Due to differences in proximity to sources of N the Rocky Mountains have a number of ambient deposition spatial gradients[3]

Main question: how does the alpine moist meadow community vary in plant-soil feedbacks along gradients of N deposition in the Rocky Mountains?

B. Methods

Measurements 2012
- Sites were located based upon access to alpine moist meadow communities following N deposition gradients in Colorado and WY (Figure 1; Table 1)
- Species composition measurements were determined using the point intercept method with 100 points in a 1 m by 1 m sampling area
- Aboveground biomass was clipped in 0.01m2 quadrats adjacent to composition surveys
- N deposition was estimated using passive ion-exchange resin columns (Figure 2)
- Soil and plant species C:N ratios using EA

Proposed additional measurements 2013
- Soil water NO_3^- concentrations using vacutainers attached to microlysimeters
- Available N using resin bags installed for the duration of the growing season

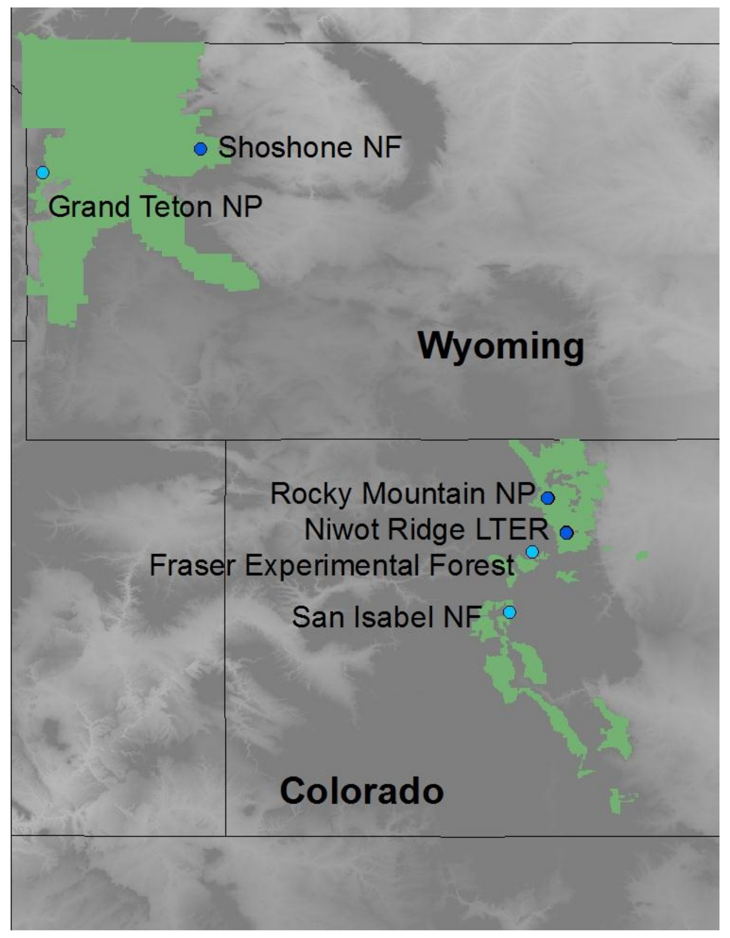


Figure 1. Spatial distribution of sites included in the ambient N deposition gradient. Sites established in 2012 are in red, while proposed sites for adding in 2013 are in blue

Figure 2. Passive ion-exchange resin column sampler measuring N deposition at Niwot Ridge LTER

Table 1. Site locations and estimated levels of N deposition

Site	N Deposition (kg N $ha^{-1}yr^{-1}$)	Year Established
Niwot Ridge LTER	8	2012
ROMO NP	6	2012
GRTE NP	3.0-4.0	2013 goal
Isabel NF	2.0-3.0	2013 goal
Fraser Experimental NF	1.0-2.0	2013 goal
Shoshone NF	1.0-2.0	2012

C. Results

Table 2. Moist meadow community structure along a gradient of ambient N deposition where Niwot> ROMO> Shoshone. Different letters indicate significant difference, n = 60 for richness and Shannon index.

Site	Richness	Shannon Index	B_w
Niwot Ridge LTER	12.23 ± 0.38^b	0.70 ± 0.02^b	2.76
ROMO NP	10.87 ± 0.37^c	0.56 ± 0.02^c	1.76
Shoshone NF	14.03 ± 0.31^a	0.80 ± 0.01^a	1.64

- No species composition trend in richness or diversity with decreasing ambient N deposition
- Significant differences in species richness and diversity between Niwot Ridge LTER, ROMO NP and Shoshone NF
- Highest species turnover or difference in species between sampling units within a plot at Niwot Ridge LTER

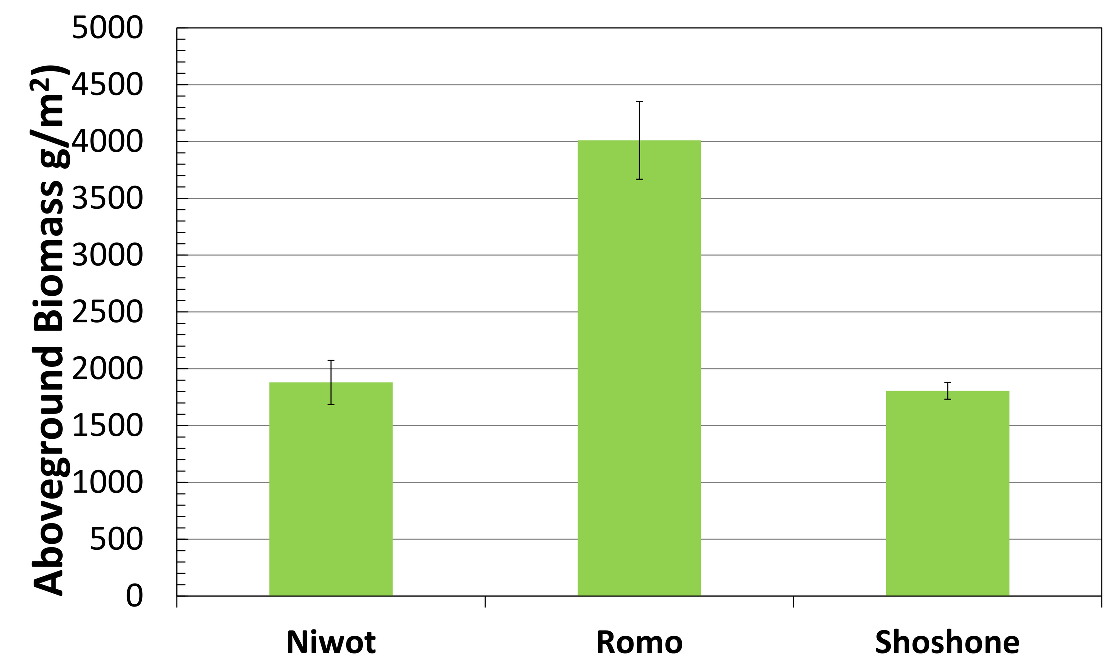


Figure 3. Mean aboveground biomass (living and dead) for each site along the ambient N deposition gradient. Samples were collected after plant senescence, and may therefore underestimate total annual growth. Includes plants that are biennials. Columns are means ± SE.

- Aboveground biomass was collected along with soil samples, and shows the highest biomass at the ROMO site
- Similar biomass between Niwot Ridge LTER and Shoshone is interesting considering the differences in species richness, but high species turnover at Niwot Ridge may explain this trend

Figure 4. Pictures of A. Niwot Ridge LTER moist meadow, B. Rocky Mountain National Park moist meadow, and C. Shoshone National Forest.

D. Discussion and future directions

- High species turnover at Niwot Ridge LTER may help explain overall higher species richness and diversity relative to ROMO NP
- Other environmental factors may be contributing to observed vegetation community responses
- Aboveground biomass differences between sites requires closer examination of possible causes
- Future work will include species tissue C:N and composition comparisons as well as ecosystem estimates of N saturation including soil C:N, porewater NO3-, and available extractable N
- Results from passive ion-exchange resin columns will also verify local variations in ambient N depositions relative to model predictions for areas further away from long-term monitoring stations

E. Acknowledgements

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F. Works Cited

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