

4-21-2014

Temporal and Spatial Variation of Nitrogen in Wyoming Big Sagebrush

Stephanie Williams

College of Arts and Sciences, Boise State University

Jordan Nobler

College of Arts and Sciences, Boise State University

Kristina Gehlken

College of Arts and Sciences, Boise State University

Janet Rachlow

University of Idaho

Lisa Shipley

Washington State University

Temporal and Spatial Variation of Nitrogen in Wyoming Big Sagebrush

Steph Williams¹, Jordan Nobler¹, Jennifer Forbey¹, Kristina Gehlken¹, Janet Rachlow², and Lisa Shipley³

¹Boise State University, ²University of Idaho, ³Washington State University



Background

What animals eat and why are fundamental questions linked to habitat quality and use. Pygmy rabbits (*Brachylagus idahoensis*, Fig. 1) are a sagebrush specialist that are known to eat individual Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) that are high in nitrogen¹. As such, the temporal and spatial heterogeneity of dietary quality of food may influence habitat use by this species of concern². We propose that nitrogen in sagebrush will vary among morphotypes within and among different seasons.

We hypothesize that morphotypes that are larger in size and occur in deep soils (on mounds)³ will have higher nitrogen than morphotypes in shallow soils (off mounds, Fig. 2). In addition, we hypothesize that spring and summer sagebrush, which is comprised of new growth, will have more nitrogen than winter sagebrush.



Fig. 1. The pygmy rabbit (*Brachylagus idahoensis*) is an indicator species for the health of sagebrush-steppe, a threatened ecosystem.

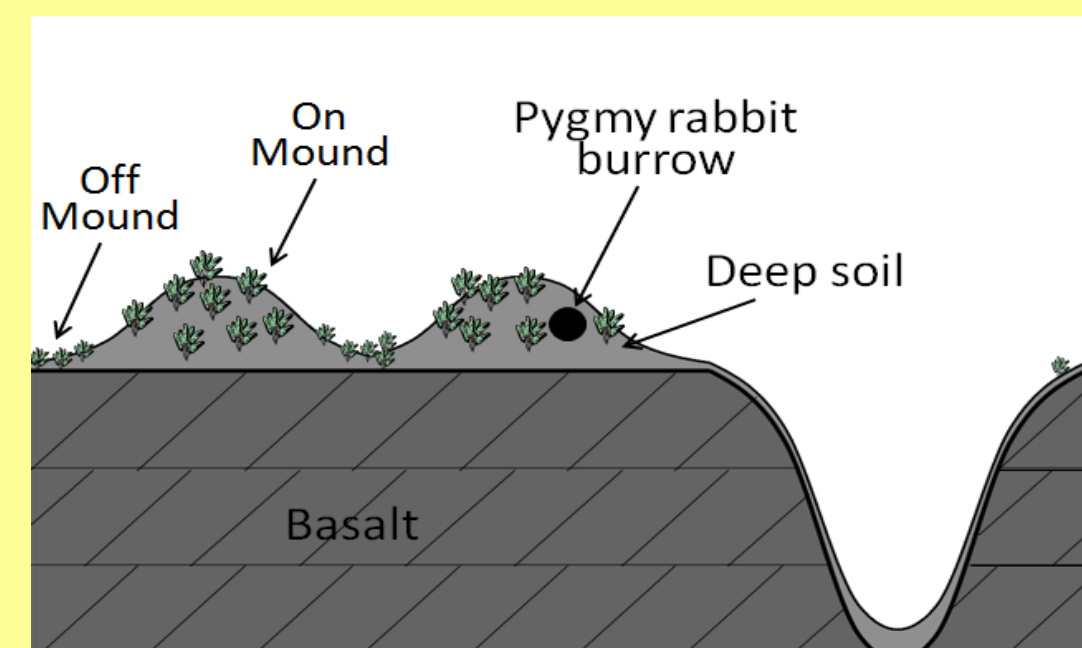


Fig. 2. Schematic of spatial heterogeneity in pygmy rabbit habitat. Deep soils of mounds produce larger plant morphotypes than off-mound plants (diagram by Peter Olsoy).

Objectives

1. Compare nitrogen between on- and off-mound morphotypes within winter
2. Compare nitrogen between months and between seasons

Study Site

- Selected a site in Idaho with pygmy rabbits (Fig. 3)
- Pygmy rabbits and habitat have been studied here for over five years

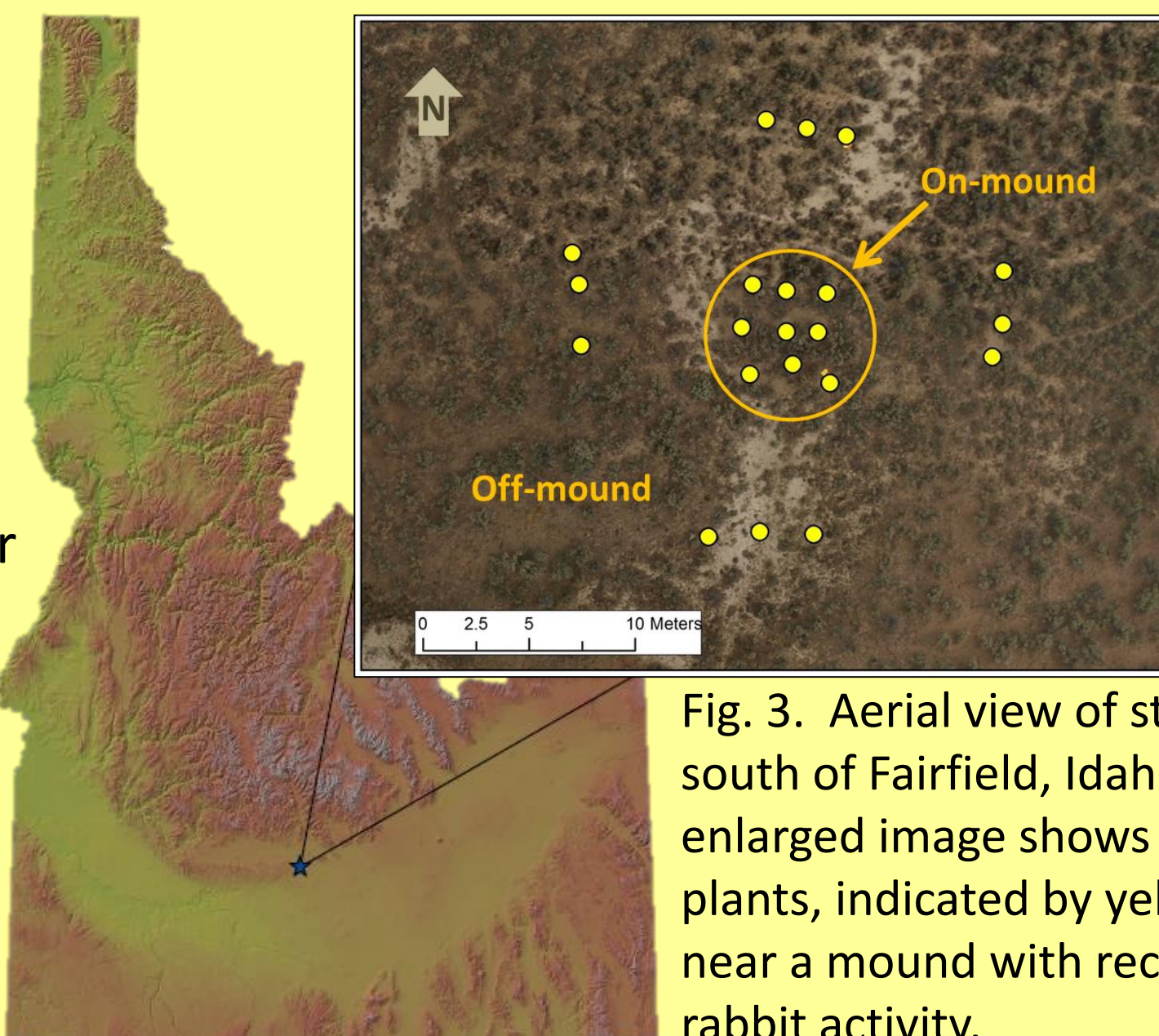


Fig. 3. Aerial view of study site south of Fairfield, Idaho. The enlarged image shows sampled plants, indicated by yellow dots, near a mound with recent pygmy rabbit activity.

Methods

- Identified 20 mounds with recent pygmy rabbit activity
- Collected stems and leaves from randomly selected on-mound and off-mound plants per mound (Fig. 3) in:
 - May and June = summer
 - November, January, and March = winter
- Quantified nitrogen of sagebrush using the Kjeldahl method
- Compared nitrogen between on-mound versus off-mound during winter, and between winter and summer using multivariate analysis of variance

Nitrogen varies in sagebrush

- On-mound morphotypes have more nitrogen than off-mound (Fig. 4, 5)
- Nitrogen is higher in March than November (Fig. 4)
- Nitrogen is higher in summer than winter (Fig. 5)

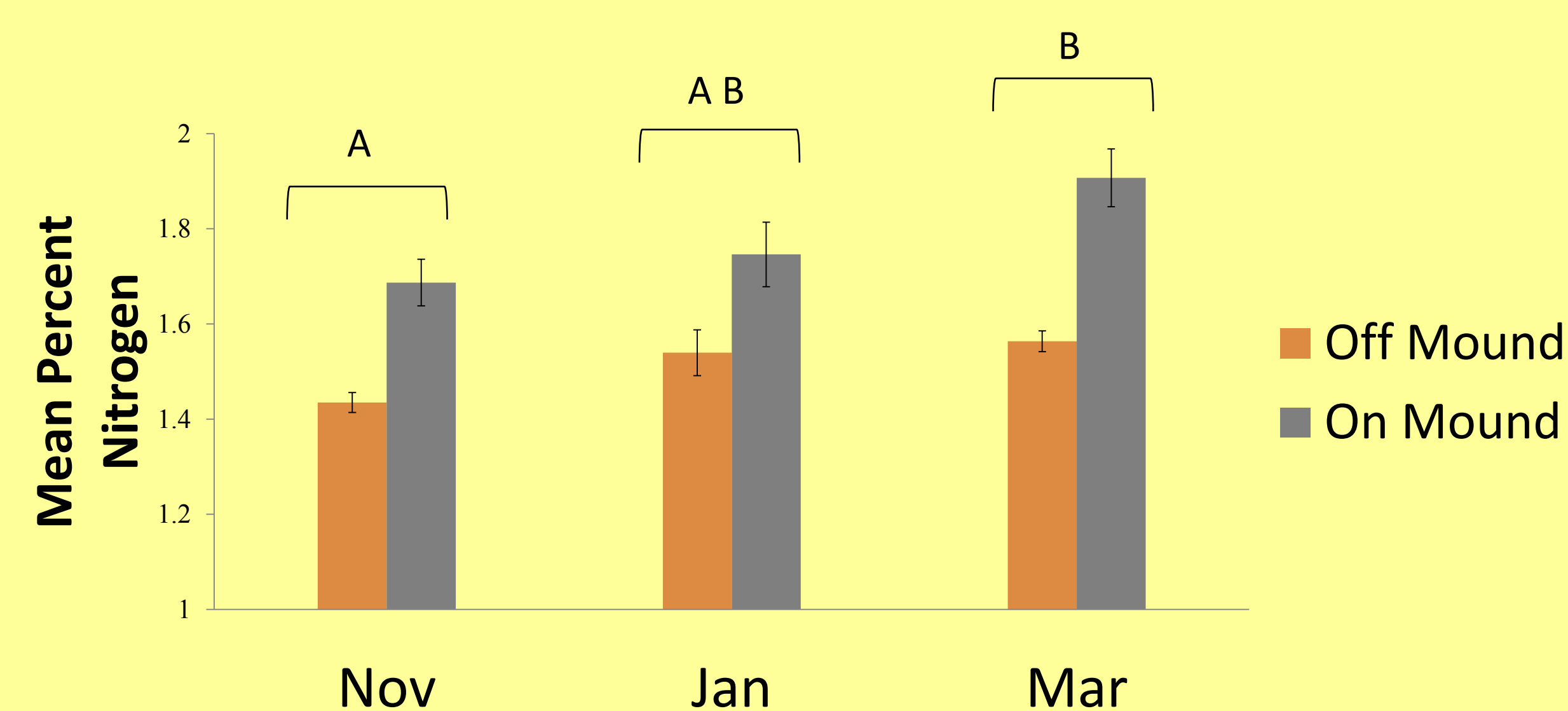


Fig. 4. Mean nitrogen variation within winter. Morphotypes on mounds (n=62) have higher nitrogen than off mound plants (n=57), $p < 0.0001$. March plants (n=40) have more nitrogen than November plants (n=37), $p = 0.0037$, and samples in January (n=42) are similar to November and March samples (Tukey's LSD test, different letters represent significant differences among months).

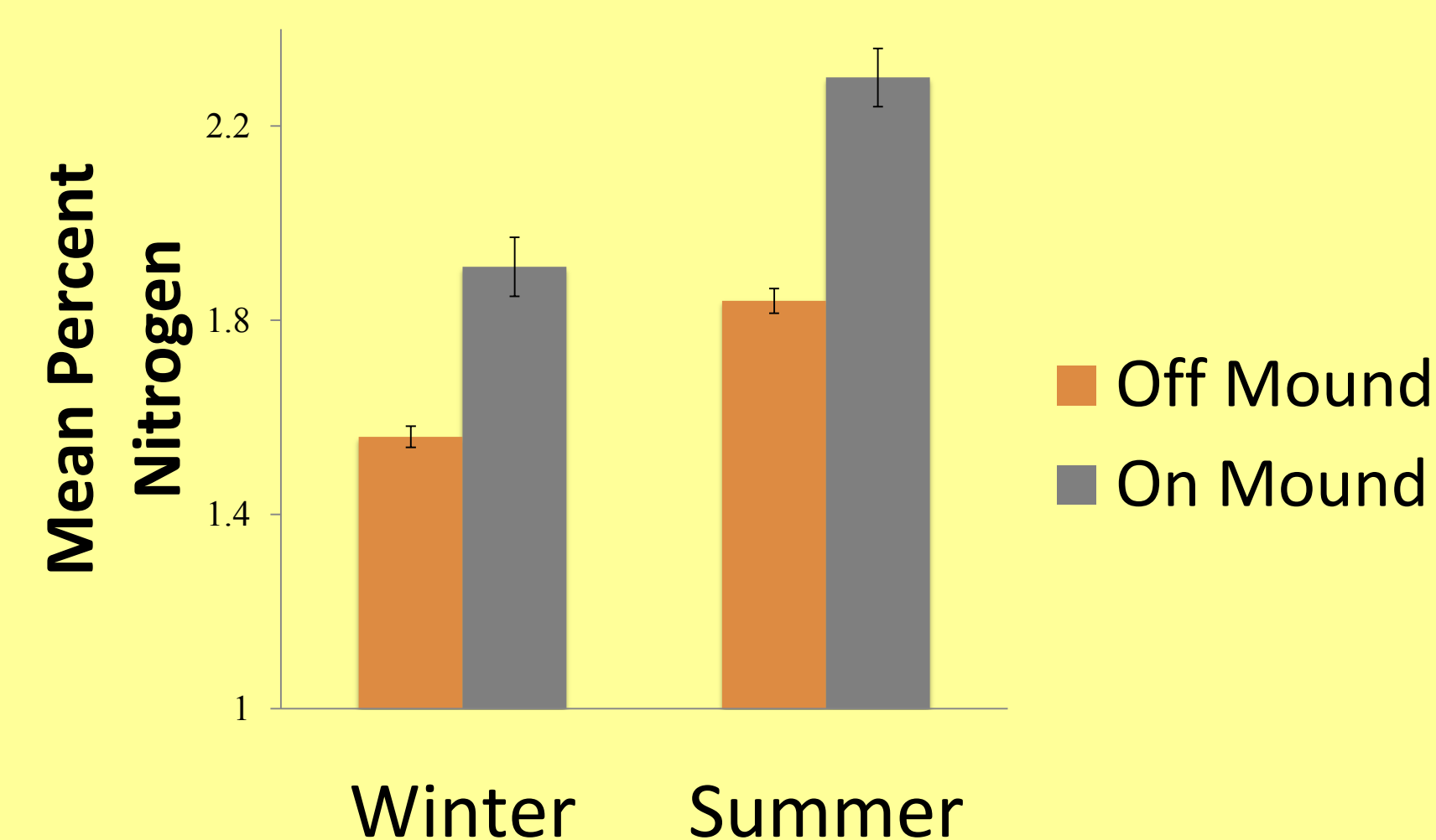


Fig. 5. Mean nitrogen variation between seasons. Morphotypes on mounds (n=47) have higher nitrogen than off mound plants (n=47), $p < 0.0001$. Summer plants (n=54) have more nitrogen than winter plants (n=40), $p < 0.0001$.

Conclusions and Significance

More nitrogen on-mounds than off-mounds

- Proposed mechanism: large roots in deep soils increase nitrogen uptake
- Prediction: more sagebrush consumed by rabbits on-mounds

More nitrogen in summer than winter

- Proposed mechanism: plant protein peaks when photosynthesis is maximized
- Prediction: more sagebrush consumed in summer, but does not account for presence of other higher quality forage

Testing predictions of foraging related to nitrogen

- Measure use of plants with known nitrogen (Fig. 6)
- Conduct feeding trials with high and low nitrogen plants (Fig. 6)



Fig. 6. Pygmy rabbit tracks in snow (left), subnivean tunnel with pellets (center), and feeding trial setup with three sagebrush sprigs of varying nitrogen content (left).

Understanding the phenology and spatial heterogeneity of nitrogen content will help ecologists better assess and manage diet quality for pygmy rabbits and other sagebrush specialists within and among landscapes and seasons.

Literature Cited

1. Shipley, L.A., et al. (2006) *J. Chem. Ecol.*
2. Ulappa, A.C., et al. (In press) *J. Mamm.*
3. Hill, J.P., et al. (2005) *Plant Ecol.*

Acknowledgements

Many thanks to Brecken Robb, Peter Olsoy, Karli Graski, and to all Forbey Lab alumni who made this work happen. This research was supported by the National Science Foundation grants NSF-DEB1146194 and NSF-IOS1258217, and by the Idaho Department of Fish and Game grant BLMCCSLO9AC16253.

