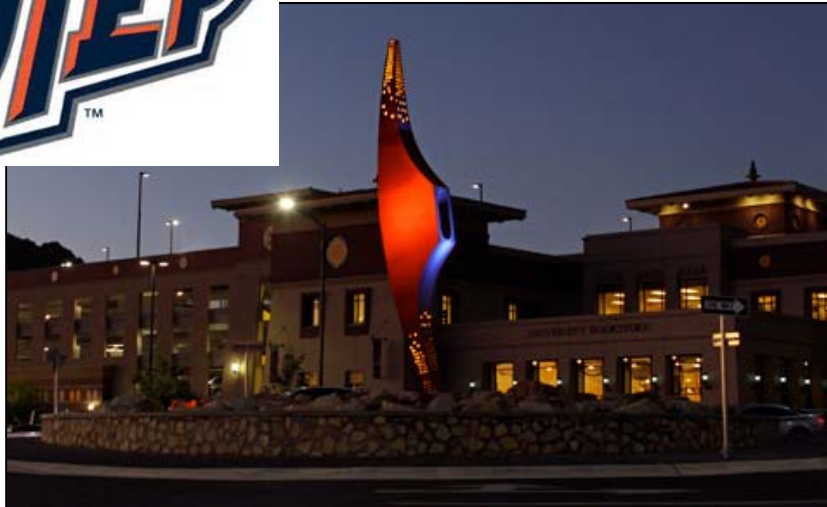


Broadening Perspectives on Controls over Carbon and Nutrient Cycling

Jennie R. McLaren
University of Texas at El Paso



“Broadening Perspectives?”

3 Themes for today:

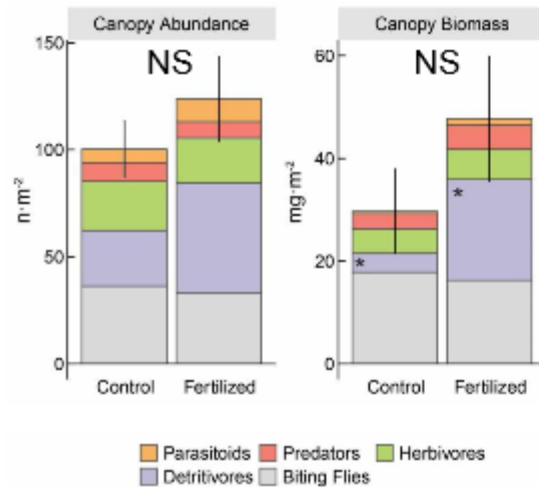
1. Broadening our use of ongoing experiments
2. Broadening the controls/factors we examine
3. Broadening the spatial extent of our exploration

Some example experiments:

1. N and P limitation of carbon and nutrient cycling
2. New vole-plant-soil-atmosphere project in Ak

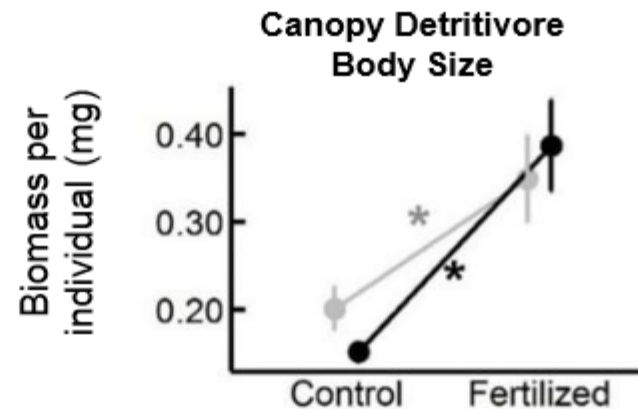


Broadening our use of ongoing experiments



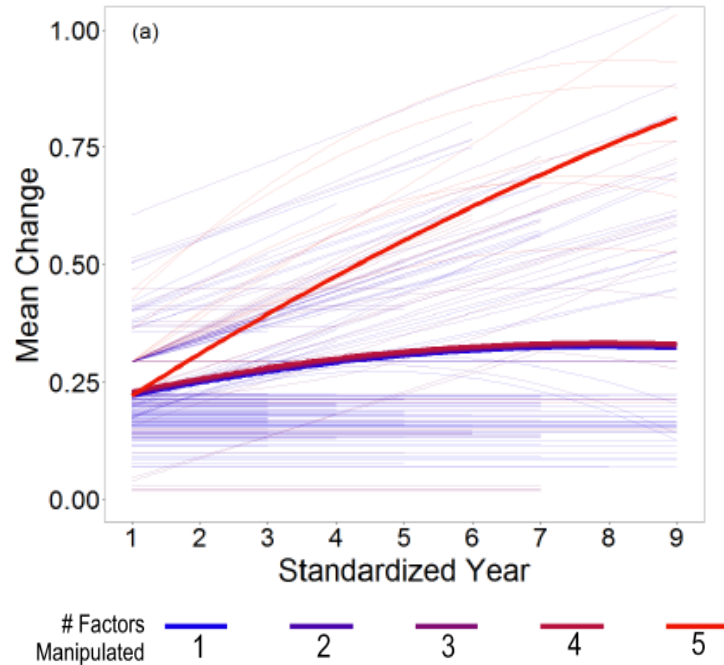
Results: arthropod abundance and biomass

- No effect on total canopy abundance, biomass
 - Fert = greater detritivore biomass, **body size**



Asmus et al. Unpublished

Broadening the controls we consider



Simultaneously
manipulating
multiple 'global
change' factors

La Pierre et al.
unpub



Broadening the spatial extent



Long-term ecosystem level experiments at Toolik Lake, Alaska, and at Abisko, Northern Sweden: generalizations and differences in ecosystem and plant type responses to global change

M. T. Van Wijk, K. E. Clemmensen, G. R. Shaver, M. Williams,
T. V. Callaghan, F. S. Chapin III, J. H. C. Cornelissen, L. Gough,
S. E. Hobbie, S. Jonasson, J. A. Lee, A. Michelsen, M. C. Press,
S. J. Richardson, H. Rueth

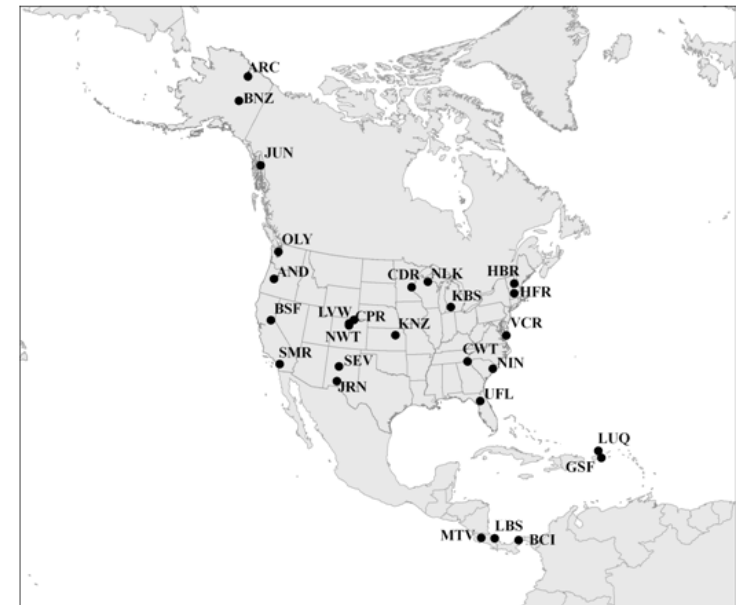
Volume 10, Issue 1
January 2004
Pages 105–123



LIDET

Long-Term Inter-site Decomposition Experiment Team

Meeting the challenge of long-term, broad-scale ecological experiments



2 Projects where I highlight these themes...

1. N and P limitation of carbon and nutrient cycling

“What is the ecosystem-specific responsiveness to N vs P?”

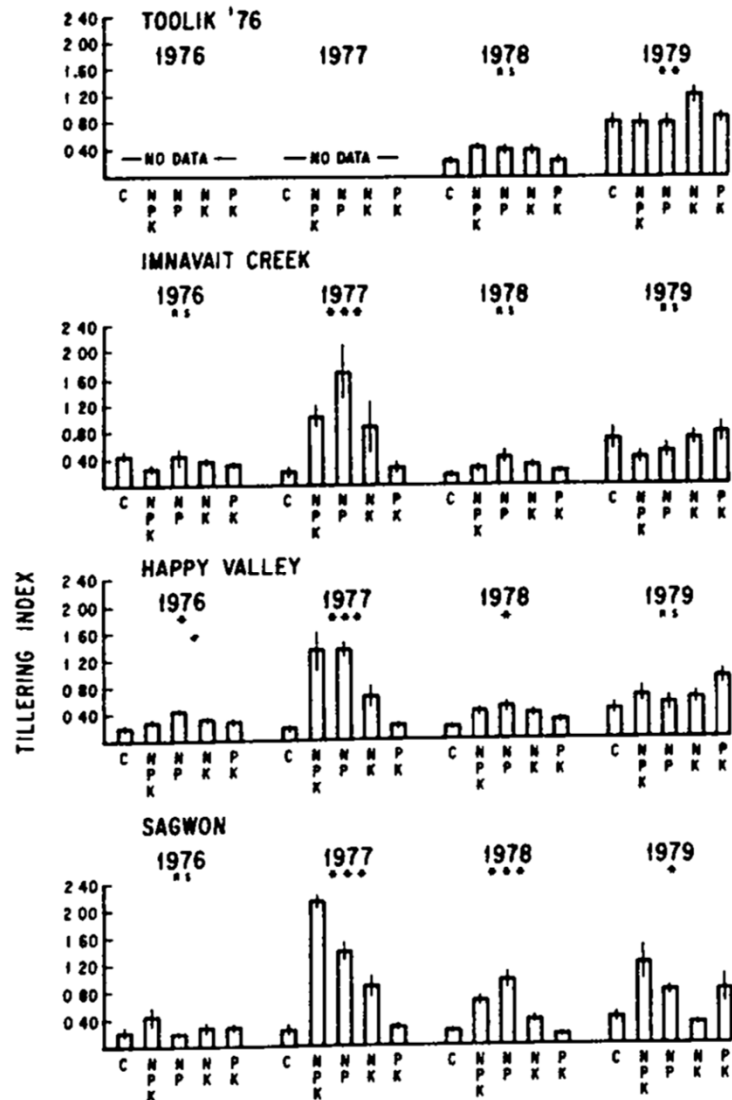
Kate Buckeridge and Jennie McLaren

2. New vole-plant-soil-atmosphere project in Ak

“Quantify and model the impacts of rodents on carbon and nutrient cycling”

Boelman, Gough, Griffin, McLaren, Rastetter, Rowe

Early Studies on N and P Limitation in Alaska

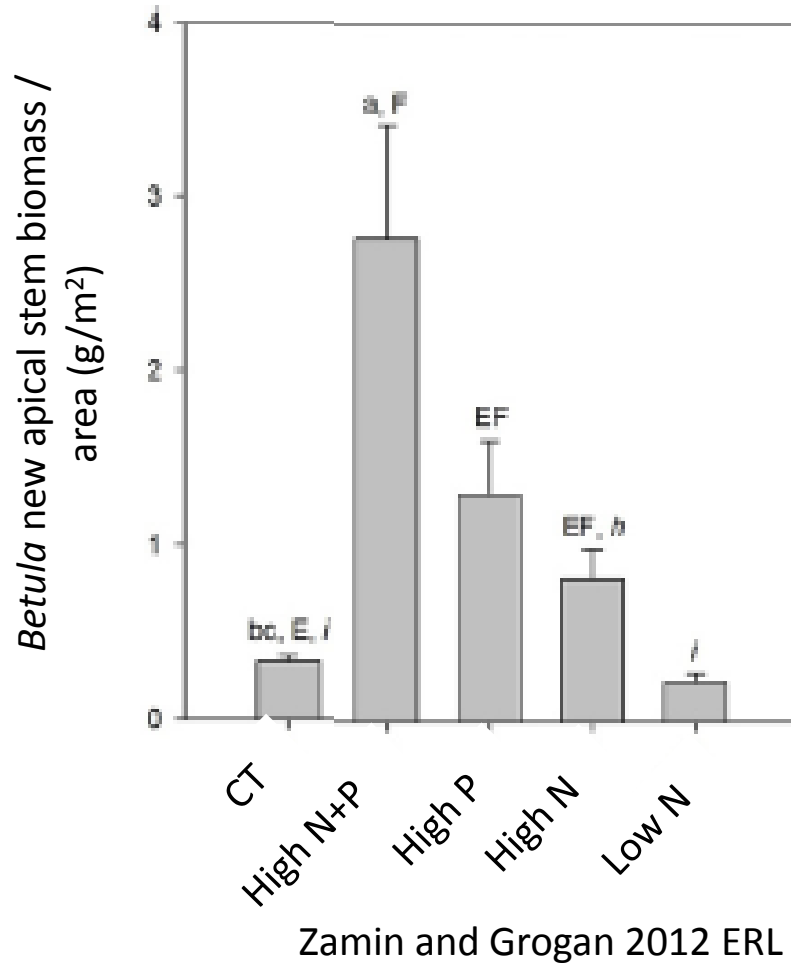


1980's and 90's: Chapin and Shaver

- Factorial fertilization experiments
- Strong responses to N, also responses indicating co-limitation

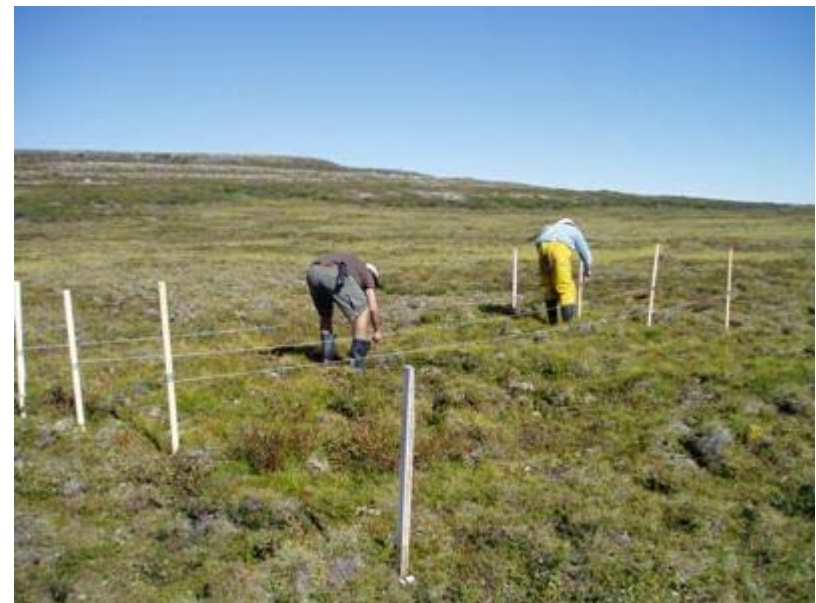
Subsequent focus on N: experimental treatments and responses

NP Fertilization at Daring Lake, NWT



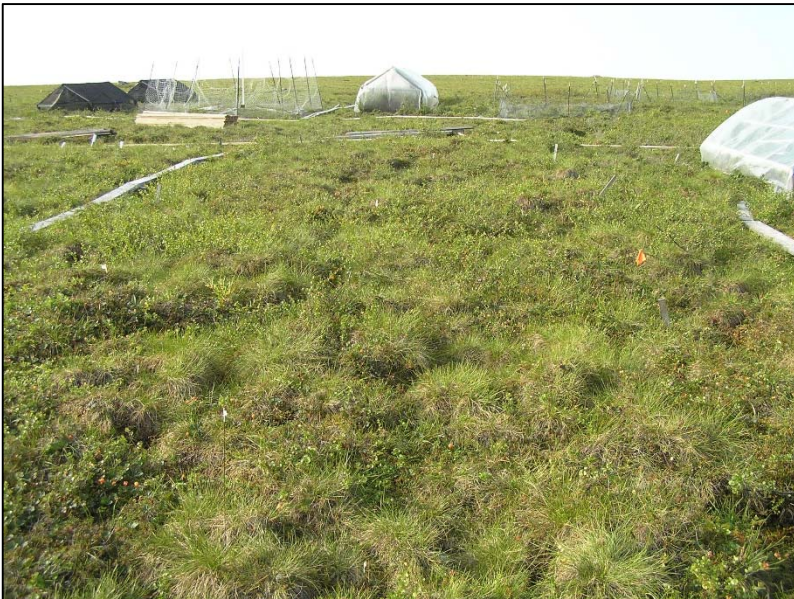
Longer-term N and P Factorial

- Few fully-factorial NP experiments
- Most are short-term
- After 6 years, P at least as important as N for *Betula* growth



NP Fertilization at Toolik Lake, AK

Acidic Tundra



**NP Fertilization: Increase in ANPP
(Driven by *Betula*)**

**Factorial Addition:
No published studies?**

Non-Acidic Tundra



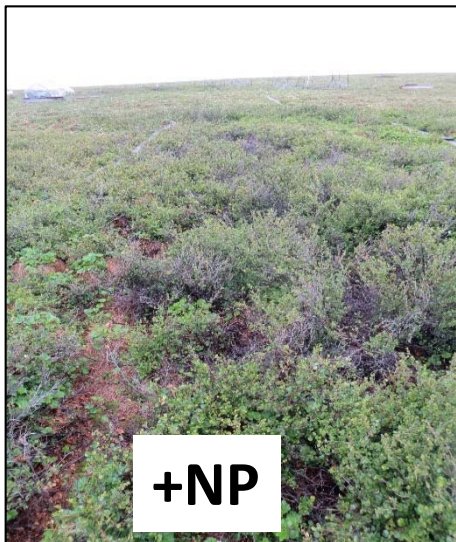
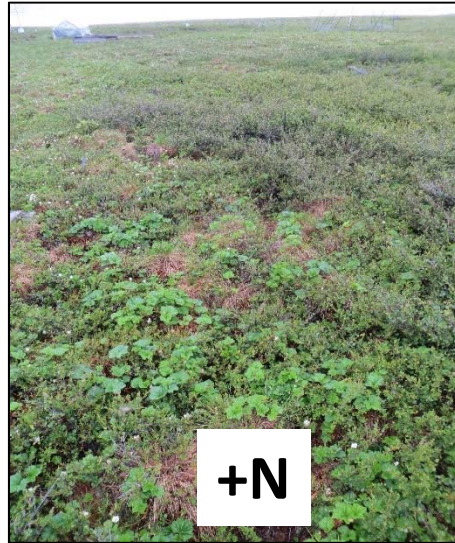
**NP Fertilization: Increase in ANPP
(Driven by many FG)**

**Factorial Addition:
P often enhanced the response to N**

Gough and Hobbie 2003
Hobbie and Gough 2005

Factorial NP Experiments at Toolik Lake, AK

What is the ecosystem-specific responsiveness to N vs P?



2013: Buckeridge and McLaren

MAT and MNT: Full Factorial Trt

Responses:

Vegetation cover

Soils:

Total CNP Pools

Extractable CNP Pools

Microbial CNP Pools

Exoenzyme Activity

Factorial NP Experiments: Vegetation

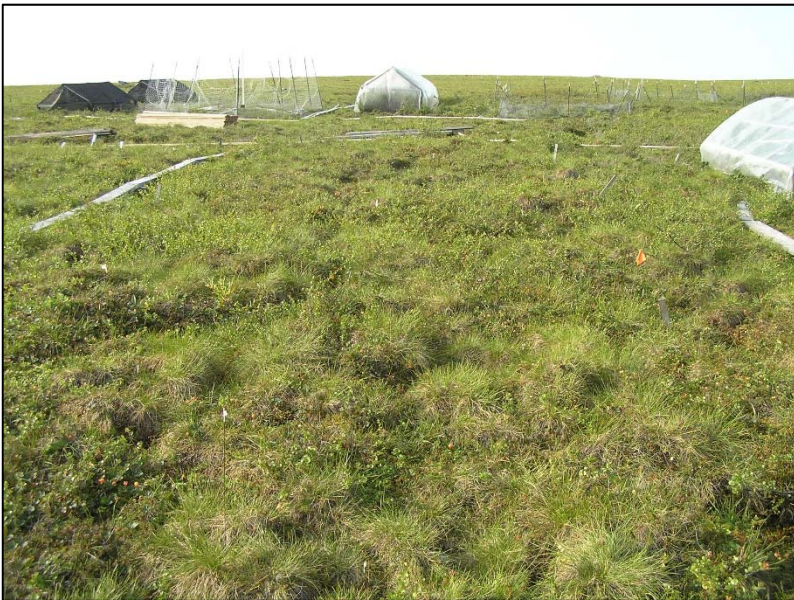
Functional Group	MAT		MNT	
	+N	+P	+N	+P
Moss	-	-		-
Lichen	-			
Evergreen	*	*		
Forb	+	+		
Graminoid	-	-	+	
Deciduous	*	*	-	

Factorial NP Experiments: Soils

Category	Variable	MAT		MNT	
		+N	+P	+N	+P
Soil total pools	C			*	*
	N	+/+		*	*
	P		+	*	*
Soil extractable pools	Organic C		+	*	*
	Total N	+		*	*
	NH ₄ ⁺ -N	+	+	+	
	NO ₃ ⁻ -N	*	*	*	*
	PO ₄ -P	*	*	*	*
Microbial Biomass pools	MBC		-/+		
	MBN	0/-	-/+		
	MBP		0/+		0/+
Extracellular enzyme rates	B-glucosidase			+	
	N- acetyl-glucosidase	*	*	*	*
	Phosphatase	*	*	*	*

Factorial NP Experiments

- On the long-term P may become more important
- Examining more factors informs us about mechanism
- Interactions, and P-specific responses, were common



Animating the Carbon Cycle

Quantify and model impacts of rodents on carbon & nutrient cycling

Collaborative project:

Natalie Boelman

Laura Gough

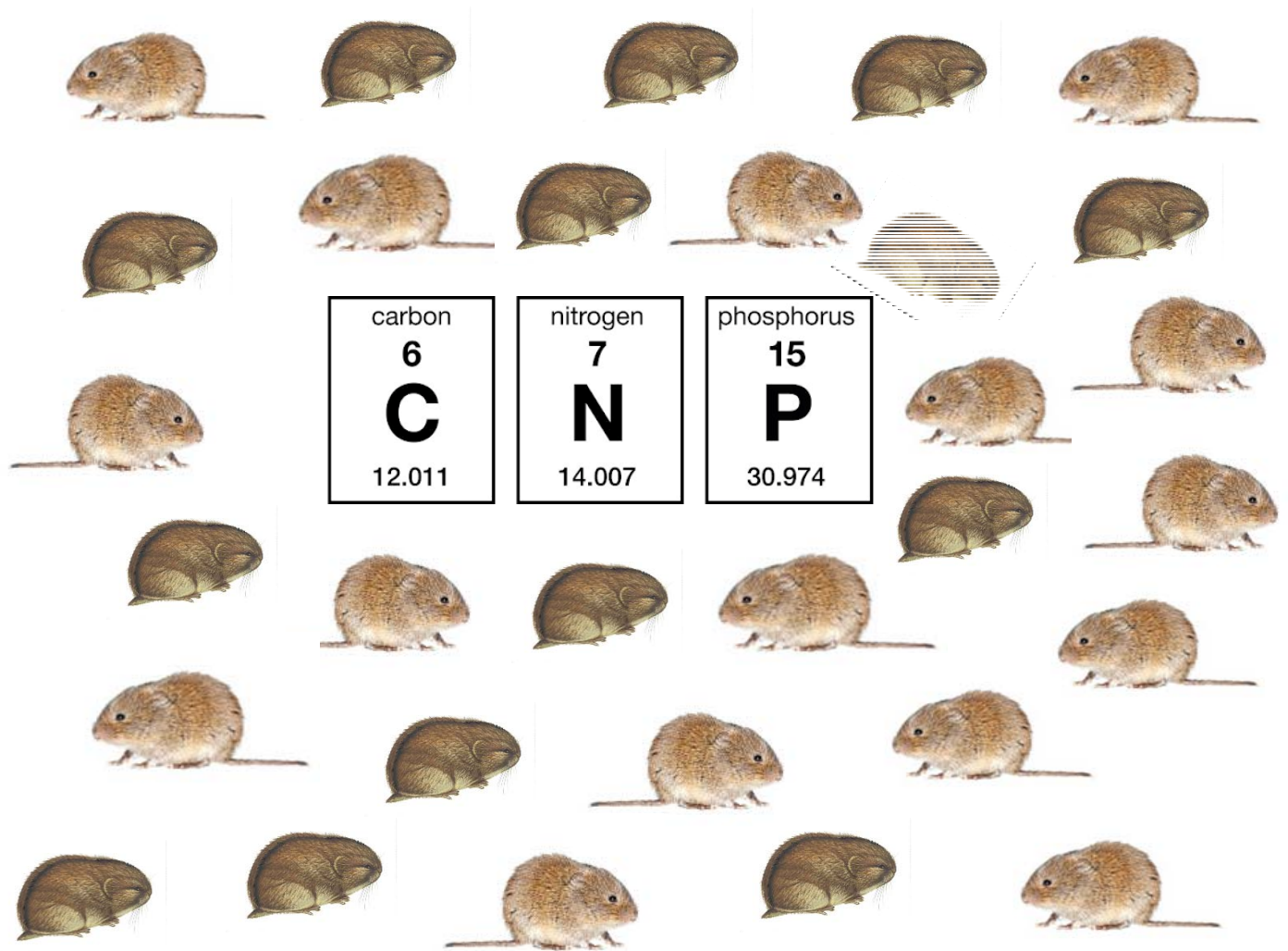
Rebecca Rowe

Kevin Griffin

Ed Rastetter

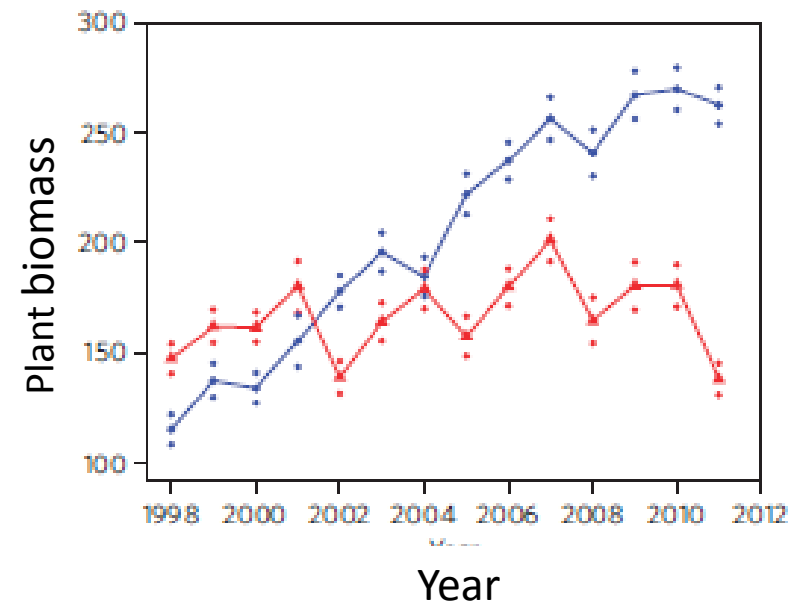
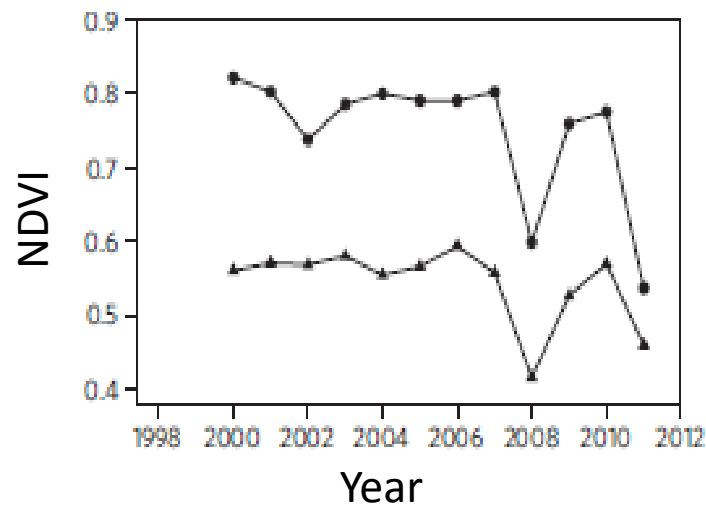
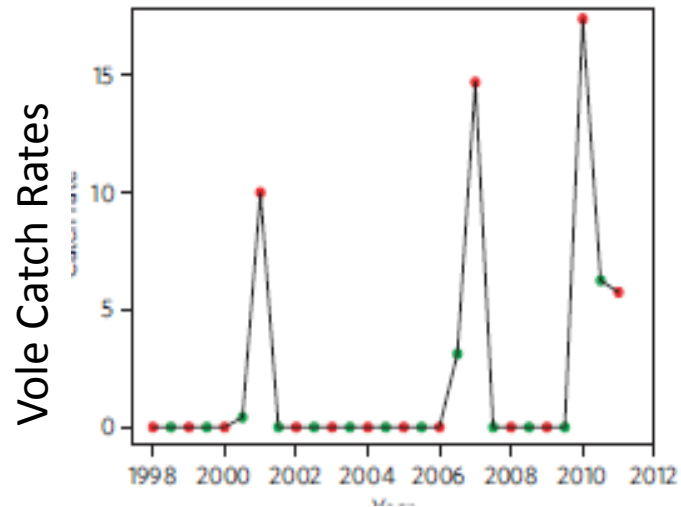


Animating the Tundra Carbon Cycle



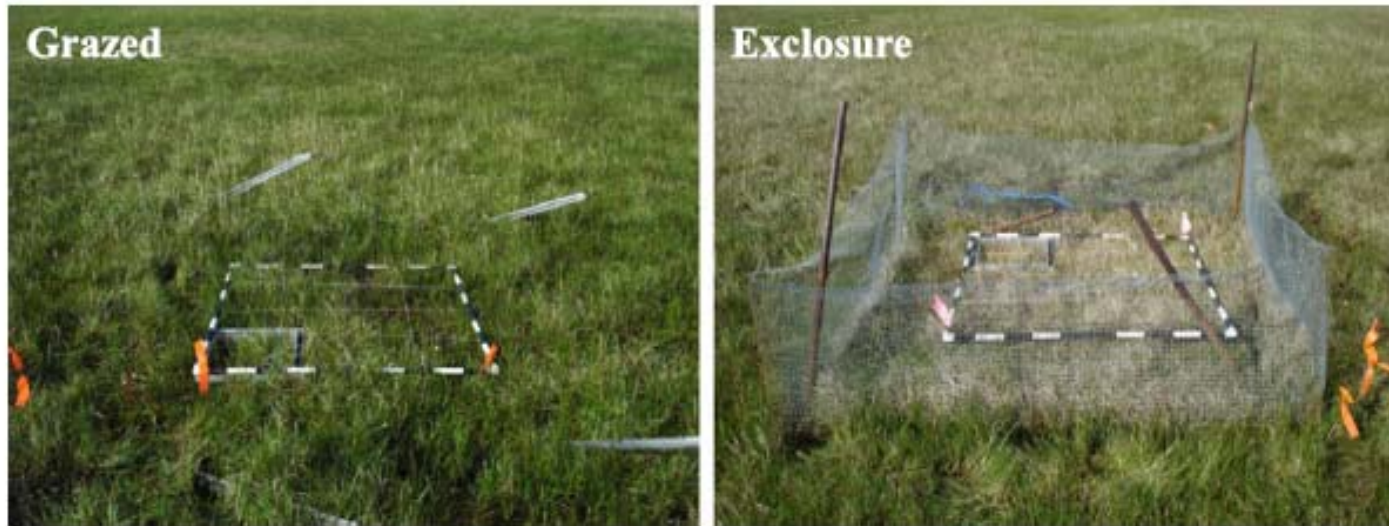
Evidence that rodents affect C-cycling

Abisko Region of Northern Sweden

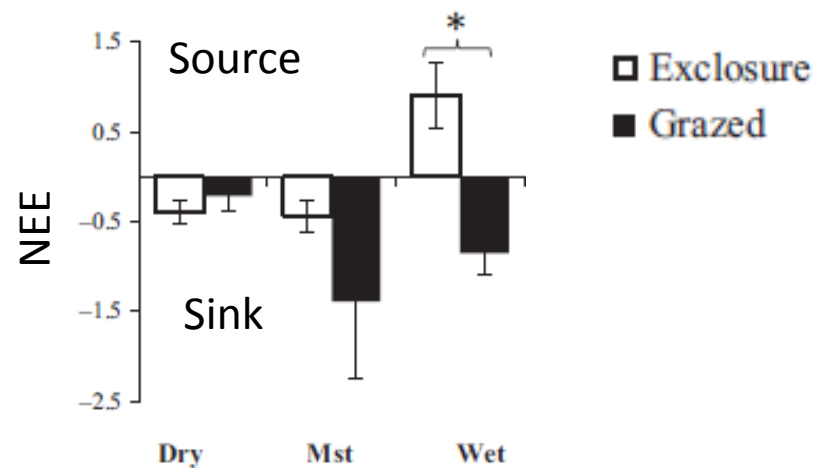


Olofsson et al 2012

Evidence that rodents affect C-cycling

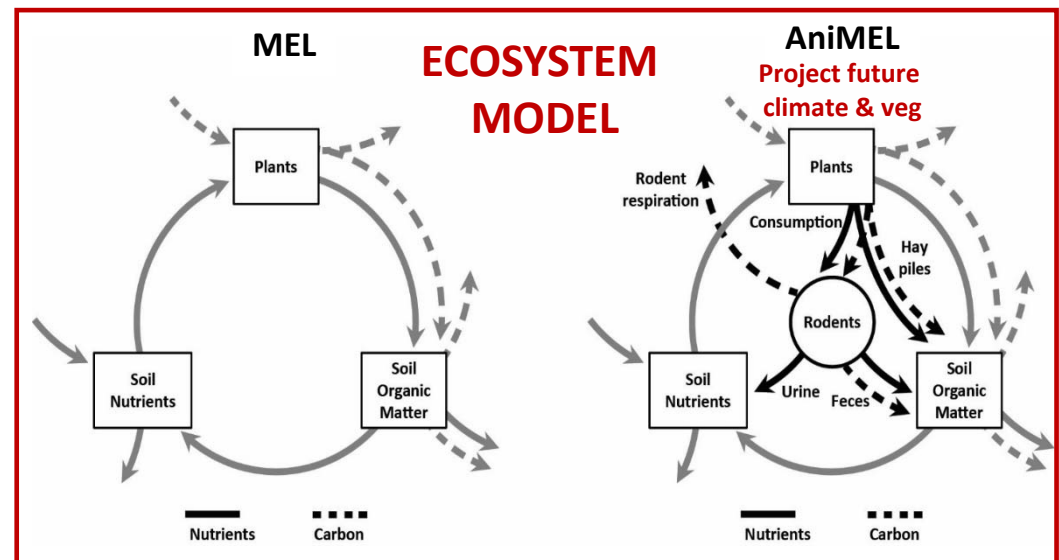
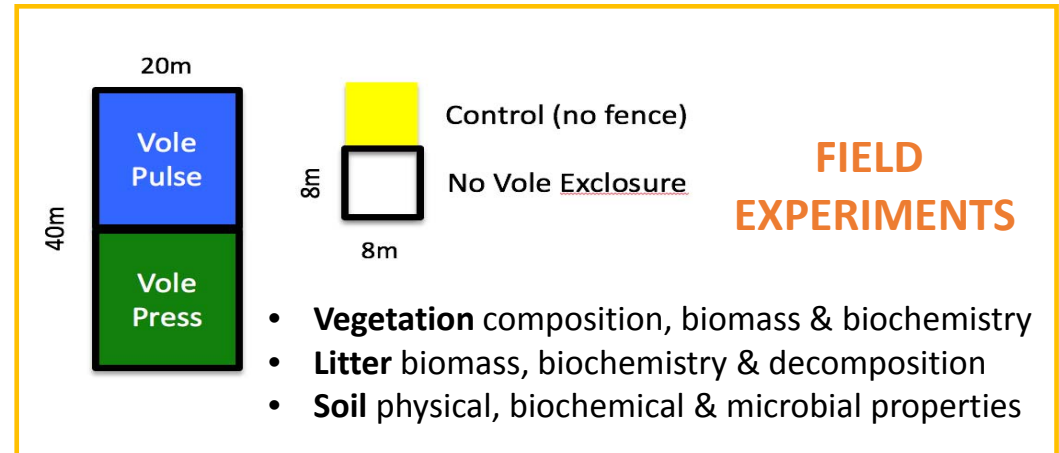
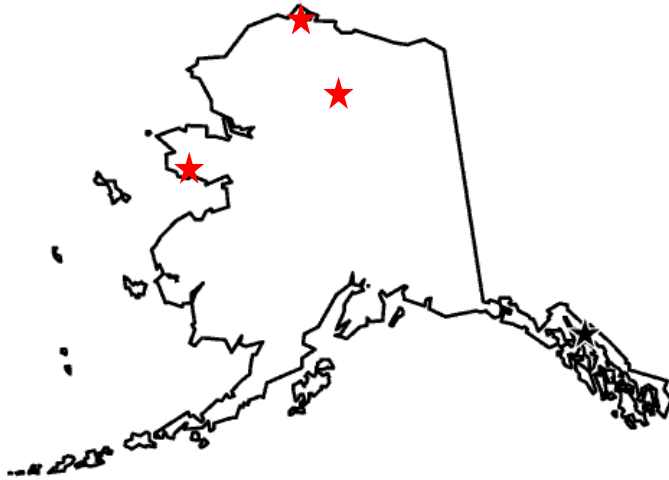


Grazed and Exclosed plots in Barrow, AK

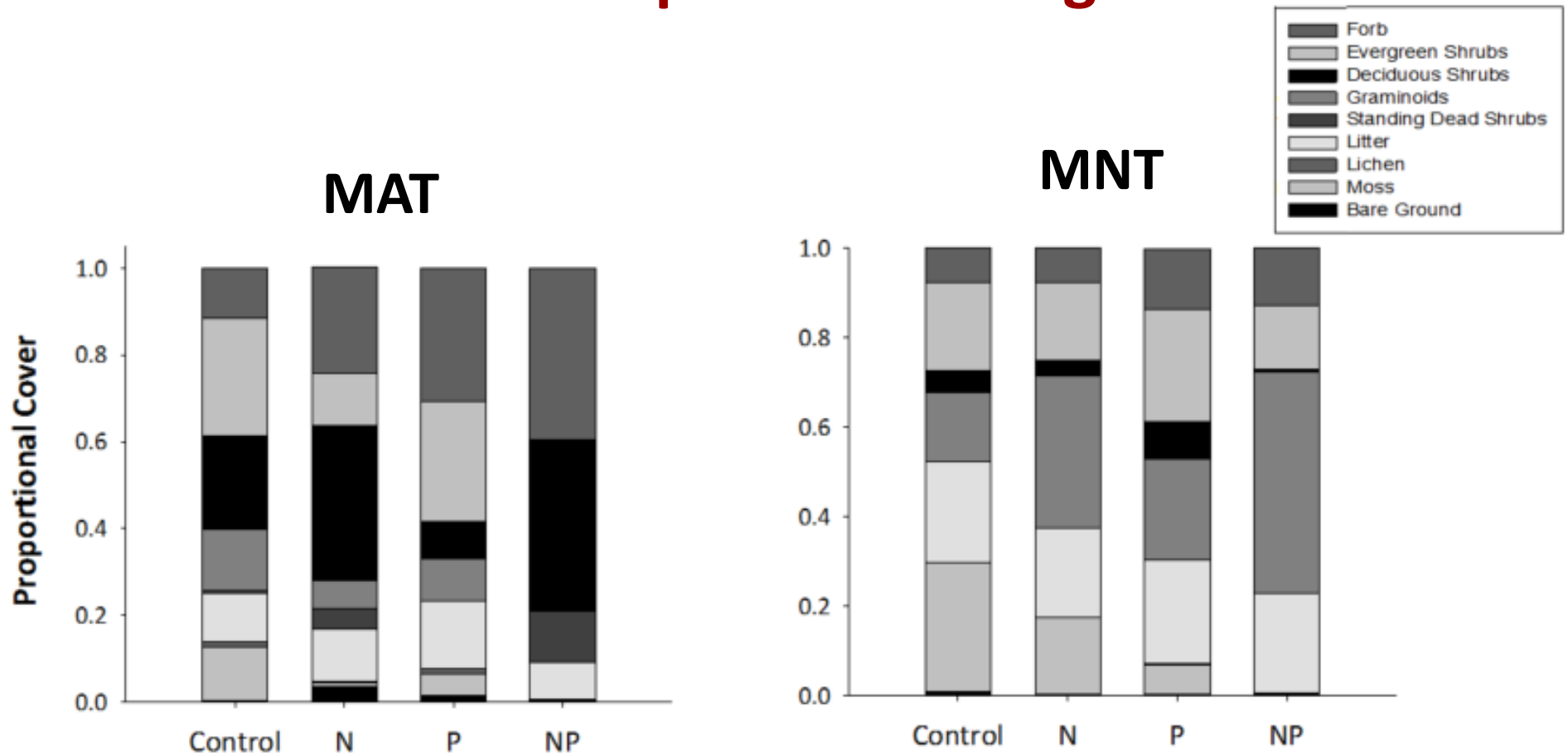


Lara and Tweedie (2016)

“Adding Animals to the Equation”: New Experiment



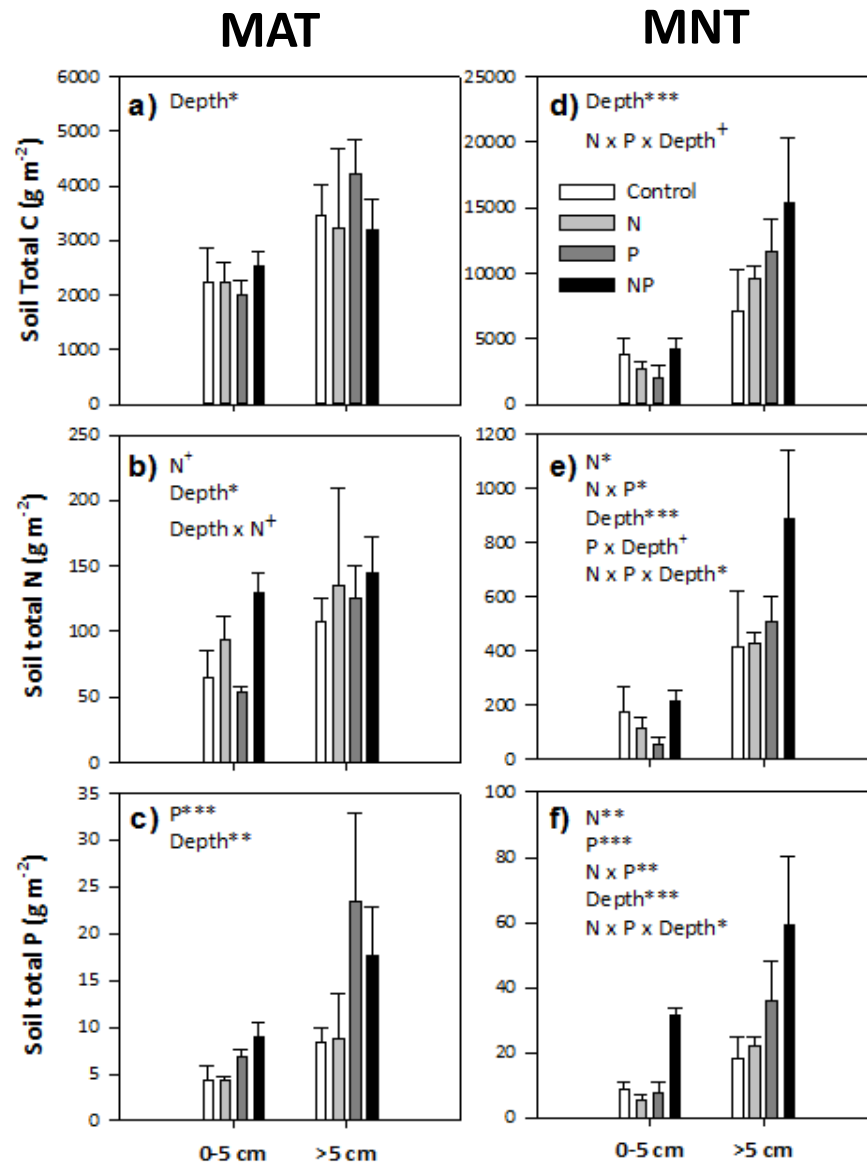
Factorial NP Experiments: Vegetation



N: All Functional Groups
P: All Except Lichen
NP Interaction:
Evergreen & Deciduous shrubs

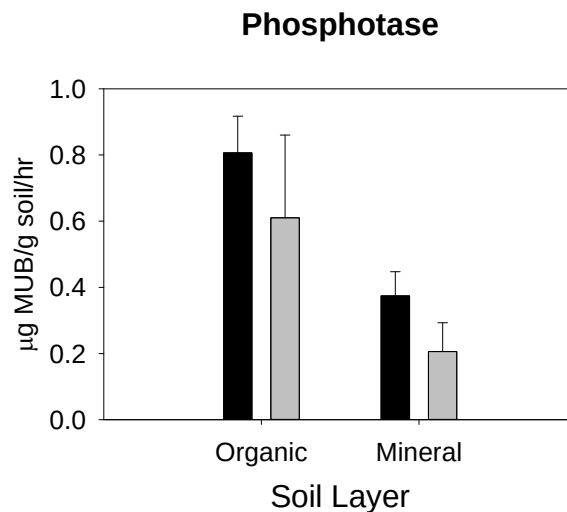
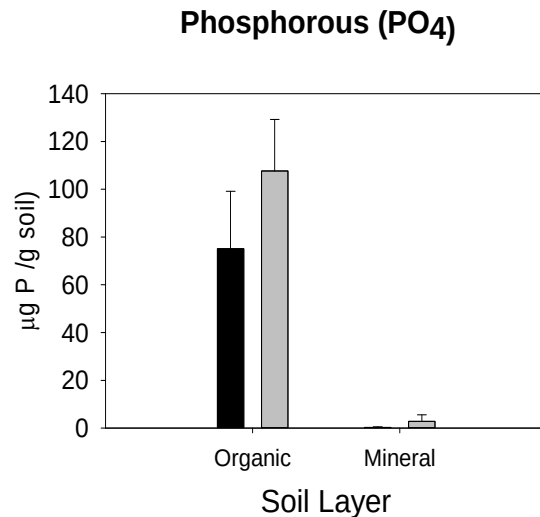
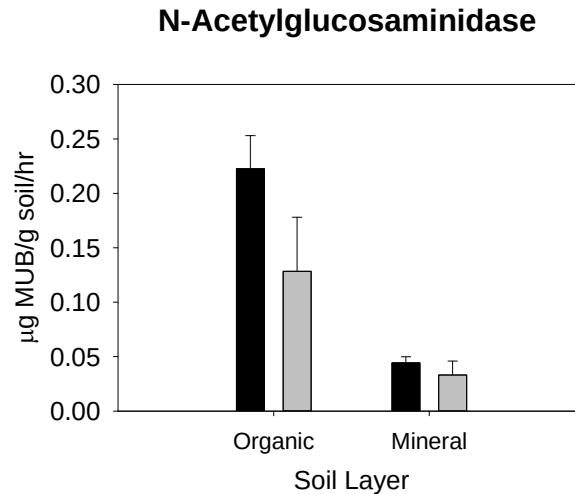
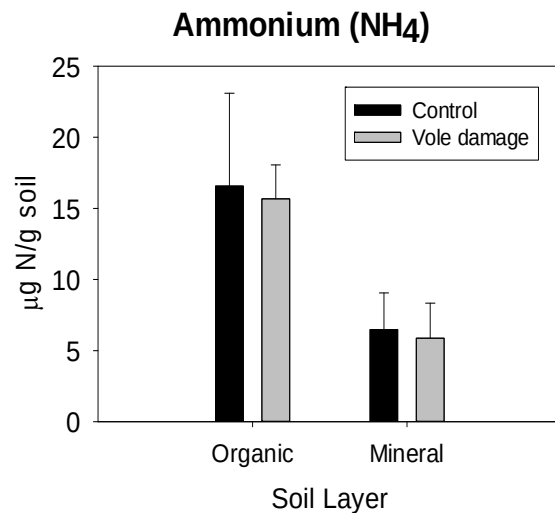
N: Graminoid & Deciduous
P: Moss
NP Interaction: None

Factorial NP Experiments: Soils



Collaborators:

Evidence that rodents affect C (and N and P) -cycling



Control and 'Grazed'
Tussocks
Toolik Lake, AK