IOWA STATE UNIVERSITY
Department of Ecology, Evolution, and Organismal Biology

Jordann Bickley, Brent Mortensen, and Lori Biederman

Symposium on Undergraduate Research and Creative Expression

April 2017

Effects of Nitrogen Addition Timing and Herbivory on Plant Diversity

INTRODUCTION

- Nitrogen (N) addition generally decreases plant diversity[1]
- Herbivore activity generally intervenes with these effects by maintaining diversity
  - Herbivores accomplish this by relieving the competition for ground-level light and nutrients[2]
  - Little is known if temporal variation in N addition changes these effects

RESEARCH QUESTIONS

1. What are the effects of adding nitrogen at different temporal scales?
2. Does herbivory alter these effects?

HYPOTHESIS AND PREDICTIONS

- H1: **An intense, quick addition of N reduces diversity more than small, consistent additions spread out over time due to the prolonged exposure**
  - P1: Quick N levels will cause species diversity to decline faster in the absence of herbivory
- H2: **Herbivore activity reduces the differences by limiting growth**
  - P2: Herbivory will increase species diversity by the same amount for both N treatments

METHODS

- Planted 6 tallgrass prairie species (Table 1) at near constant densities after controlling for live seed percentage
- Applied the same amount of N to all pots but when they received N differed (n=50 pots/treatment)
  - Fast N treatment received entire amount (1.6mL N + 98.4mL H_2O) in beginning, then received an additional 100mL of H_2O weekly to match with Slow treatment
  - Slow N treatment received partial amounts (0.4mL N + 99.6 mL H_2O) weekly for 4 weeks
- 25 pots in each N treatment received simulated herbivory
  - Simulated herbivory consisted of cutting plants at the soil surface
- Percent coverage was measured before and after N treatments
- Final biomass was collected at the end
- ANOVA done through RStudio (1.0.136)

METHODS (cont.)

Table 1. *Common and scientific name of all tallgrass prairie plant species used, arranged by functional group.*

Tallgrass Prairie Plant Species Used		
Legumes	**Forbs**	**Grasses**
Partridge Pea (*Chamaecrista fasciculata*) 	Health Aster (*Aster ericoides*) 	Indian Grass (*Sorghastrum nutans*) 
Showy Tick Trefoil (*Desmodium canadense*) 	Grayheaded Coneflower (*Ratibida pinnata*) 	Virginia Wildrye (*Elymus virginicus*) 

REFERENCES

1. Schrijver et al. 2011. Cumulative nitrogen input drives species loss in terrestrial ecosystems. Global Ecol Biogeogr. 20(6):803-816.
2. Borer et al. 2014. Herbivores and nutrients control grassland plant diversity via light limitation. Nature. 508(7497):517-520.
3. Olff H, Ritchie ME. 1998. Effects of herbivores on grassland plant diversity. TREE. 13(7):261-265.

ACKNOWLEDGEMENTS

Funding for this project was provided by NSF (DEB-1353092)

RESULTS

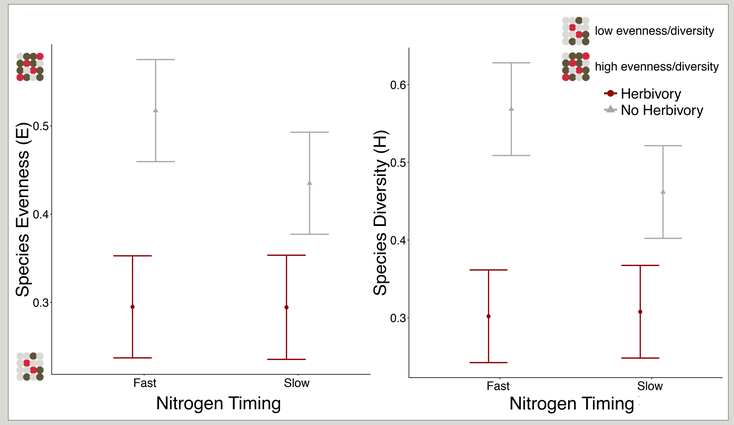

Figure 1. *Fast N treatment with **no herbivory had greater evenness** compared to Fast N treatment with herbivory ($p<0.05$).*

Figure 2*. Fast N treatment with **no herbivory had greater species diversity** compared to Fast N treatment with herbivory ($p<0.05$).*

CONCLUSIONS

- There was a significant difference between herbivory and no herbivory
- There was no significant differences between N treatments
- **Data showed opposite effects of original predictions**
- Time appears to be an important factor
  - Shorter term studies might have weak or negative herbivory effects because of relatively few disturbances to the soil (which is what was found in our study)[3]
  - Also depends on the environmental characteristics and size of the herbivore species
- Limitations would include uncontrollable factors such as environmental temperature and watering amount between soil pots

FUTURE RESEARCH

- Use same species
- Add additional species from each functional group to mimic natural conditionals
- Simulate large grazing herbivory
- Change the temporal patterns to biannual and monthly