Impacts of Varying Water and Nutrient Conditions on Species Richness in a Grassland Plant Community: The Influence of Brome

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Introduction

- Grasslands play a crucial role in maintaining ecological balance and biodiversity.[1]
- Due to climate change, variability in precipitation will increase, resulting in more severe drought and flooding events.[2]
- *Bromus inermis* (Brome) is successfully invasive in Ontario grasslands due to its drought tolerance and ability to outcompete other species by shading and modifying soil conditions.[3]
- Interacting belowground controls on grassland ecosystem structure have not yet been explored in a long-term study.



Figure 1. *Bromus inermis.*

Research Questions

1. Does species richness change in response to water variation, nutrient addition, or their interdependent effect?
2. Does Brome's competitive dominance and drought tolerance in Ontario grasslands drive changes in species richness?

Methods

- The experiment was set up in 2010 at Bracken Tract, an old-field meadow grassland near Newboro, Ontario. It includes watering (rainout, ambient, added) and nutrient (control, added NPK fertilizer) factorial treatments each year.
- Plants were harvested aboveground from 120 1 m^2 plots in July 2023 and analyzed for richness and relative biomass abundance.
- Brome plants were counted individually, dried, and weighed to analyze mean mass per plot.



Figure 2. A harvested plot.

Results

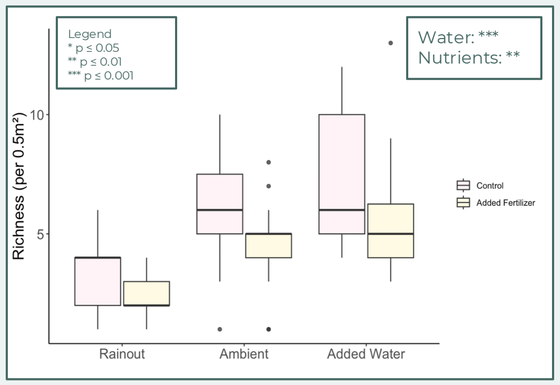


Figure 3. Water addition increased species richness for all treatment conditions, while nutrient addition decreased richness (n = 105).



Figure 4. Rainout shelter treatment to simulate enhanced summer drought in the Bracken Tract old field meadow.

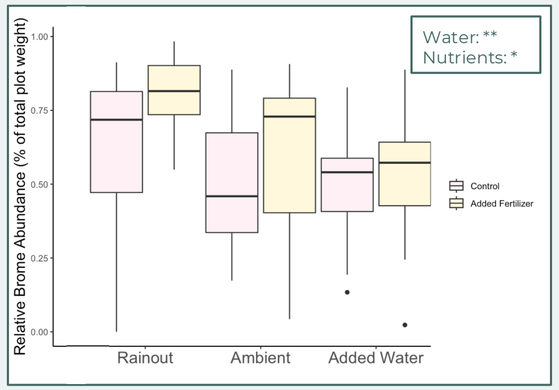


Figure 5. Relative Brome abundance was increased in rainout compared to ambient and added water conditions, while nutrient additions also had a positive but much smaller effect (n = 79).

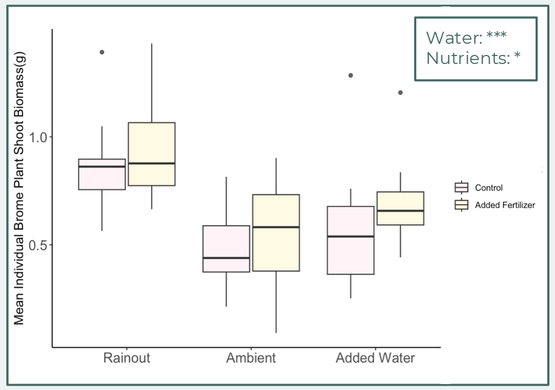


Figure 6. Mean Brome shoot biomass per plot was increased in rainout conditions compared to ambient and added water conditions, while nutrient additions also had a positive but much smaller effect (n = 89).





Figure 7. The Bracken Tract old field meadow (left).

Figure 8. Paul Grogan and Kira Henders harvesting a rainout shelter in 2023 (right).

Key Findings

1. Species richness is increased by water additions and decreased by summer drought and nutrient additions.
2. Increased Brome abundance and size in rainout conditions may drive changes in species richness under drought and high nutrient conditions.

Conclusions

- Long-term studies are more representative of changes over time, allowing for observation of realistic ecosystem responses to environmental change.
- While Brome abundance rose in rainout and added nutrient plots, the size of individual Brome plants also increased, indicating higher competitive success.
- Atmospheric nitrogen deposition and runoff from fertilizer can cause enhanced nitrogen in grassland ecosystems which could increase Brome's success, leading to plant community composition changes.[4]
- Increasing drought and nitrogen inputs may therefore favor invasive species such as Brome, reducing biodiversity.[2]
- Diversity of species is important to ensure ecosystem resilience. Because grasslands are essential for pollination and herbivores, preserving their richness is crucial to biodiversity, water, and climate regulation.[3]

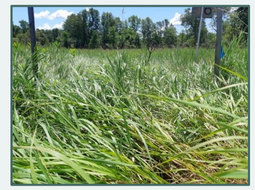


Figure 9. A plot dominated by Brome.

Literature Cited and Acknowledgements

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