



Species richness protects prairie species from vole herbivory

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Introduction

- Throughout the fall of 2017, 11 species with robust roots were selectively preyed upon by voles in a Morton Arboretum-based experiment examining the effects of biodiversity on prairie restoration.
- The rodents completely removed plants from the 11 targeted species.
- We investigated the vole herbivory from three perspectives: species richness, proximity to vole activity, and the correlation between vole activity and soil disturbance, predicting that:
 - Monocultures have a higher proportion of herbivory than mixed plots.
 - As distance from a site of vole herbivory to a site of vole activity increases, the level of vole herbivory decreases.
 - Soil disturbance within plots as measured by ease of penetration can serve as a useful predictor of vole activity within those plots.



Results

Figure 1. There was significant variation in survivorship for the 11 predated species in their monocultures. 11 species include (from greatest to least herbivory in monocultures): *Liatris aspera*, *Zizia aurea*, *Liatris scariosa nuiwlandii*, *Silphium laciniatum*, *Liatris pycnostachya*, *Silphium terebinthinaceum*, *Eryngium yuccifolium*, *Parthenium integrifolium*, *Zizia aptera*, *Liatris spicata*, and *Allium cernuum*.

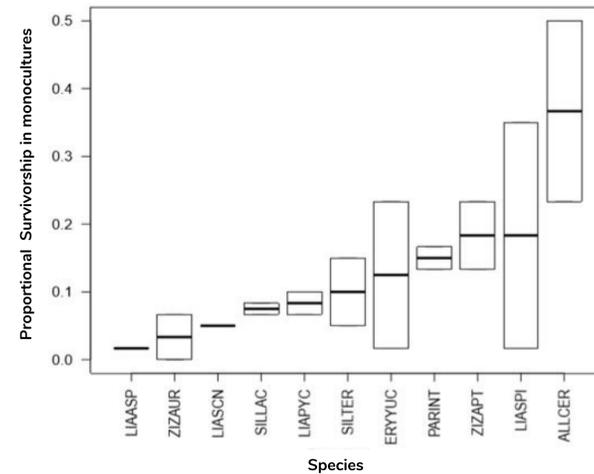
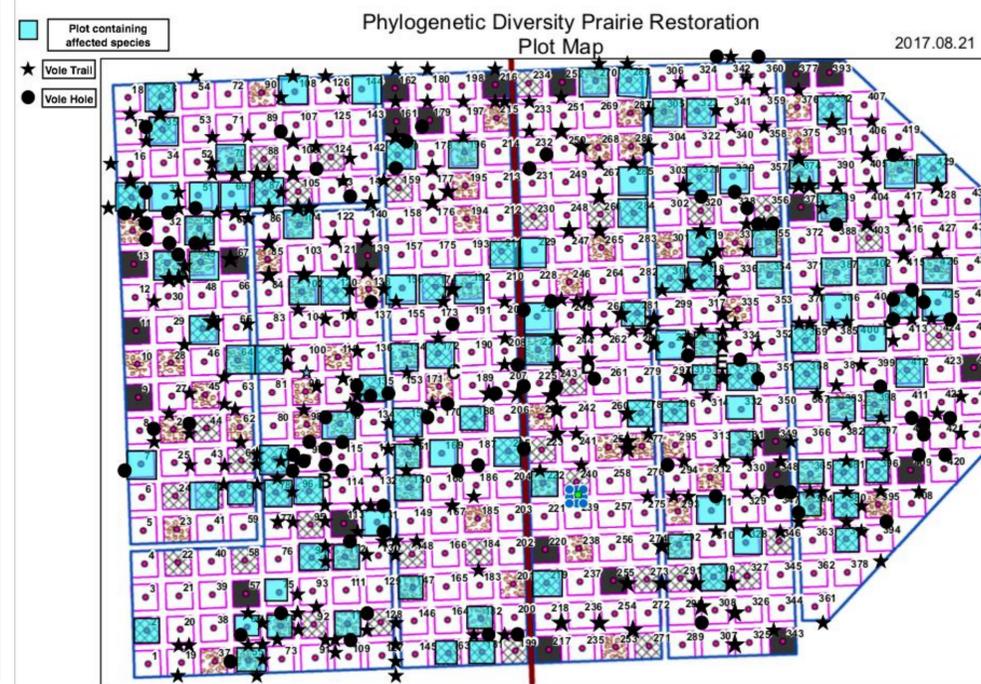


Figure 2. The mean or minimum distance from a targeted species to a site of vole activity does not affect the likelihood of herbivory. (Mean distance: $F = 3.042$, $p = 0.0842$; Minimum distance: $F = 3.374$, $p = 0.0692$)



Results, cont'd

Figure 3. Average difficulty level of “penetrometer” holes, used to measure soil disturbance. Groupings varied in their vole herbivory status and their weed status prior to data collection. Results from ANOVA show there is a significant difference among all groups and that a higher proportion of the total variance in penetrometer readings is explained by vole activity ($F=11.730$, $p=0.0008$) than by weeding times ($F=4.916$, $p=0.0280$). Binning our results into three categories for visualization, the Tukey HSD test demonstrated a significant difference between vole activity plots weeded prior to the penetrometer data collection and no-vole plots weeded after the penetrometer method ($p=0.0008$), but no significant difference in the other two pairwise comparisons between categories.

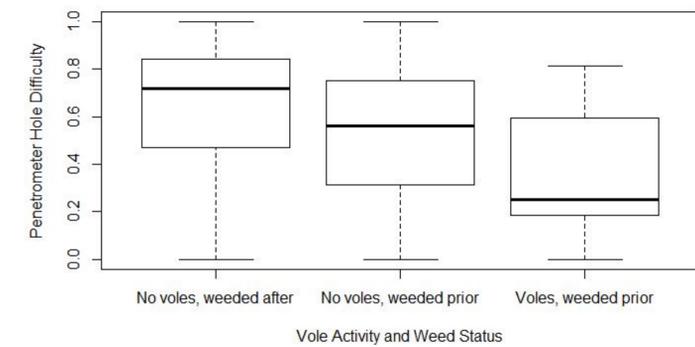
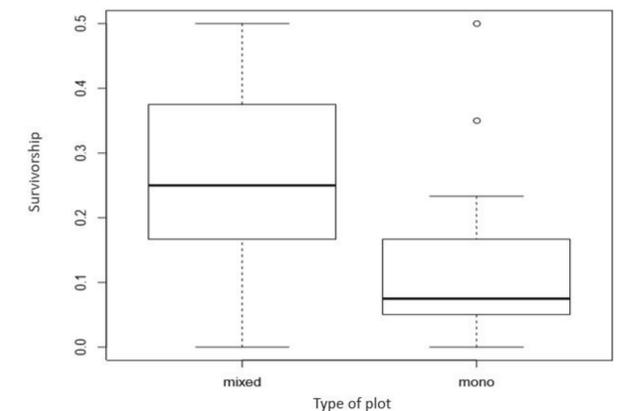


Figure 4. For the 11 species, monocultures (60 individuals) had lower survivorship in comparison to their mixed plot (4 individuals out of 60 plants) counterparts. ($F_{x,x} = 9.637$, $p = 0.00414$, $R^2 = 0.03141$; one-way ANOVA including species as a random effect)



Conclusions

Our study profiles vole herbivory in greater detail so that prairie restorationists can create more operable plans of response to vole activity. When selecting plants and engineering location for a prairie restoration, restorationists should consider that higher species richness can mitigate vole herbivory, but that distance from preexisting vole activity has no effect on the level of herbivory. At any point throughout the experiment, measurements of soil disturbance can serve as a reliable indicator of vole presence/activity. These considerations allow for more robust and detailed plans to both prevent and combat herbivory within restorations.

Methods

- Vegetation Survey:** We identified species selectively targeted by voles by examining monoculture plots. A species classified as suffering from vole herbivory met the following criteria:
 - More than 75% of the original plantings were present in a June 2017 presence/absence survey
 - Fewer than 50% of the original plantings were present in our June 2018 presence/absence survey
 - The species contained vole trails and holes within its monocultures
 - We weeded all targeted species' monocultures of non-target species and counted remaining individuals.
- Vole Activity Survey:** We counted and mapped the number of vole trails and the number of vole holes along walkways within the experiment.
- “Penetrometer” Data:** Youth volunteers utilized “penetrometers” to measure soil disturbance. They made 16 holes in each plot in a 4x4 grid spread evenly across the entirety of the 2x2 meter plot. For each hole, they recorded whether pushing the penetrometer into the ground was easy or difficult. Some plots were weeded before data collection, and some were weeded after.

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