



Attaining High Species Diversity in Prairies with Low Initial Restoration Investment

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Introduction

Prairies were historically one of the most common ecosystems in Minnesota, covering approximately 1/3 of the state. Remnant prairies are valued for their high species diversity, ability to resist nonnative invaders, and herbivore and native pollinator habitat (Barak et al. 2017, Welty et al. 2017, Tonietto and Larkin 2018).

Achieving high plant species diversity in restorations is challenging and expensive (Prairie Restorations 2013). Allowing abandoned agricultural fields to be colonized by native prairie species from a neighboring remnant may be an alternative. Seeding native grasses into and managing preestablished communities was found to produce similar species richness as that of new restorations but with improved seedling recruitment (Link et al. 2017, Woosaree and Otfinowski 2018).

This study compared species composition in remnant prairies, restored prairies, and abandoned agricultural land by using the vegan package in R. This approach focuses on how management might be implemented if only overall species composition was considered.

Methods

I collected species composition data across 27, randomly selected 4x1 meter plots in 3 land use areas at Hegg Lake Wildlife Management Area in Kensington, MN, during July and August of 2017:

- Remnant prairies (9 plots)
- Restored prairies (9 plots)
- Abandoned agricultural land (9 plots)

I identified all species present in each plot. I also grouped grasses together to determine the cover percentages of native and non-native grasses (classes: 0, 5, 25, 50, 75, 95, 99 %) (McCune et al. 2002).

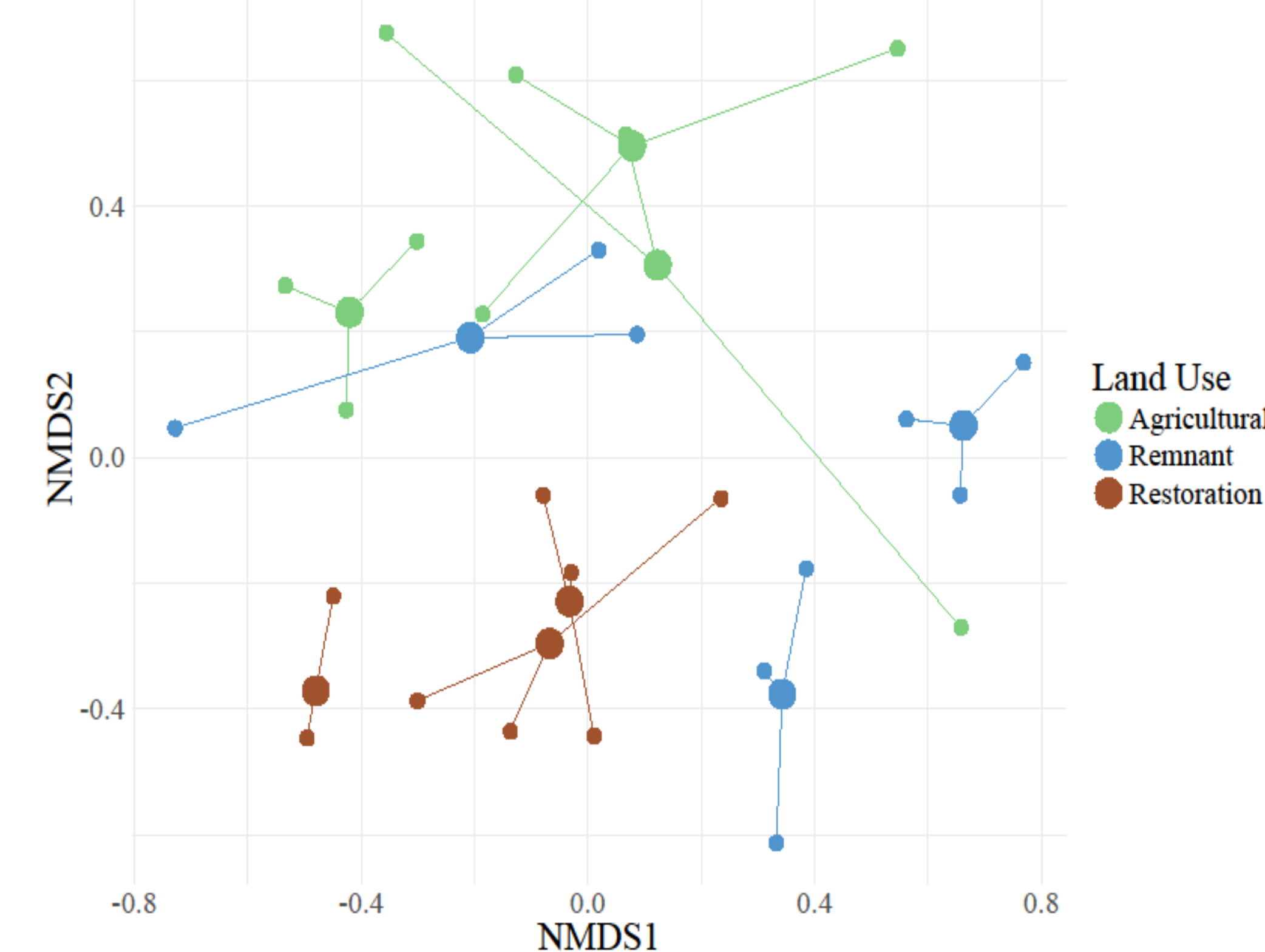
I used the vegan package in R to investigate species diversity across plots in relation to their relative species diversity and native and nonnative grass cover percentages.



Hegg Lake Wildlife Management Area, Kensington, MN, with abandoned agricultural field, remnant prairie, and restored prairie sections.

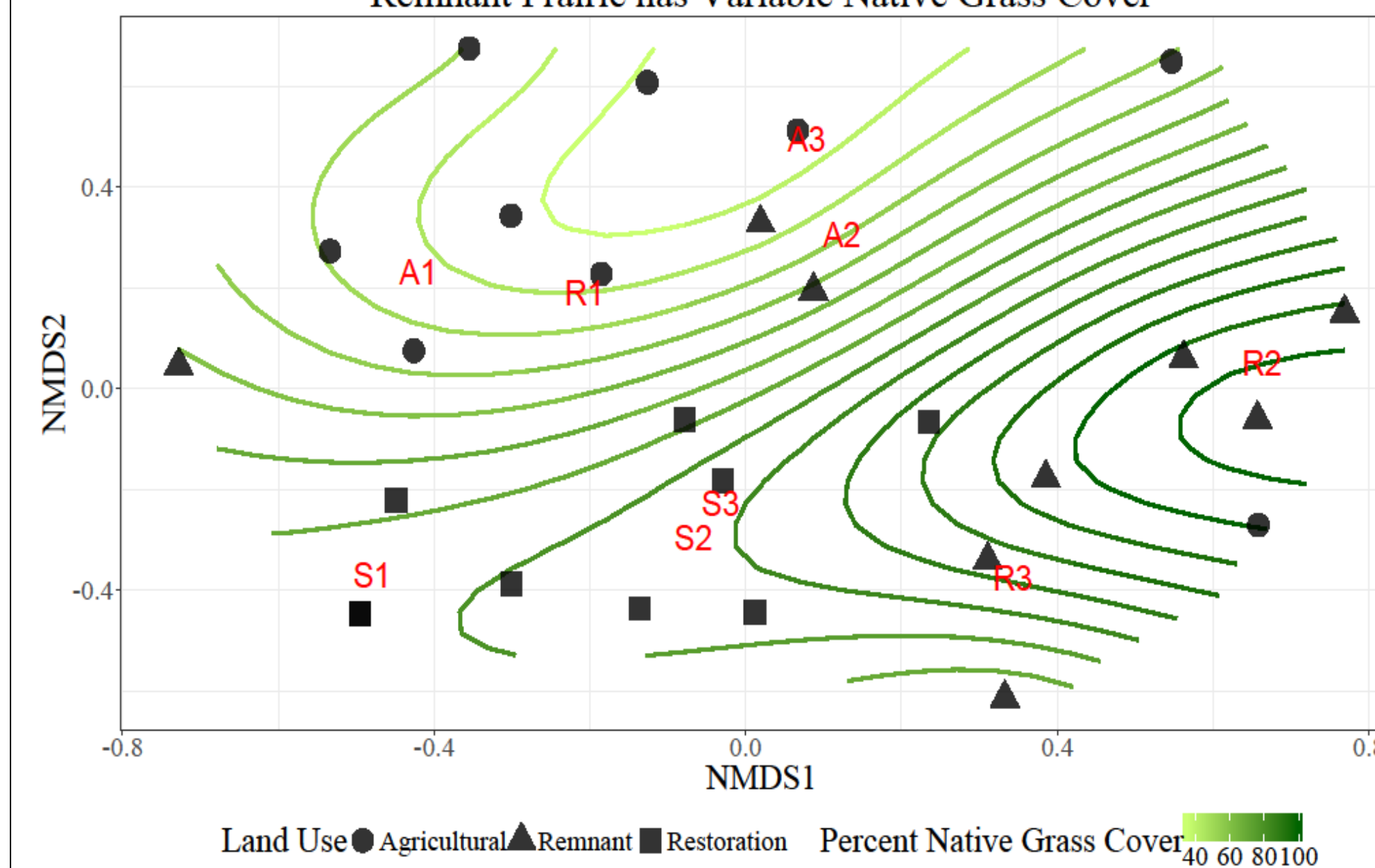
Results

Restored Prairies have Comparatively Low Species Composition



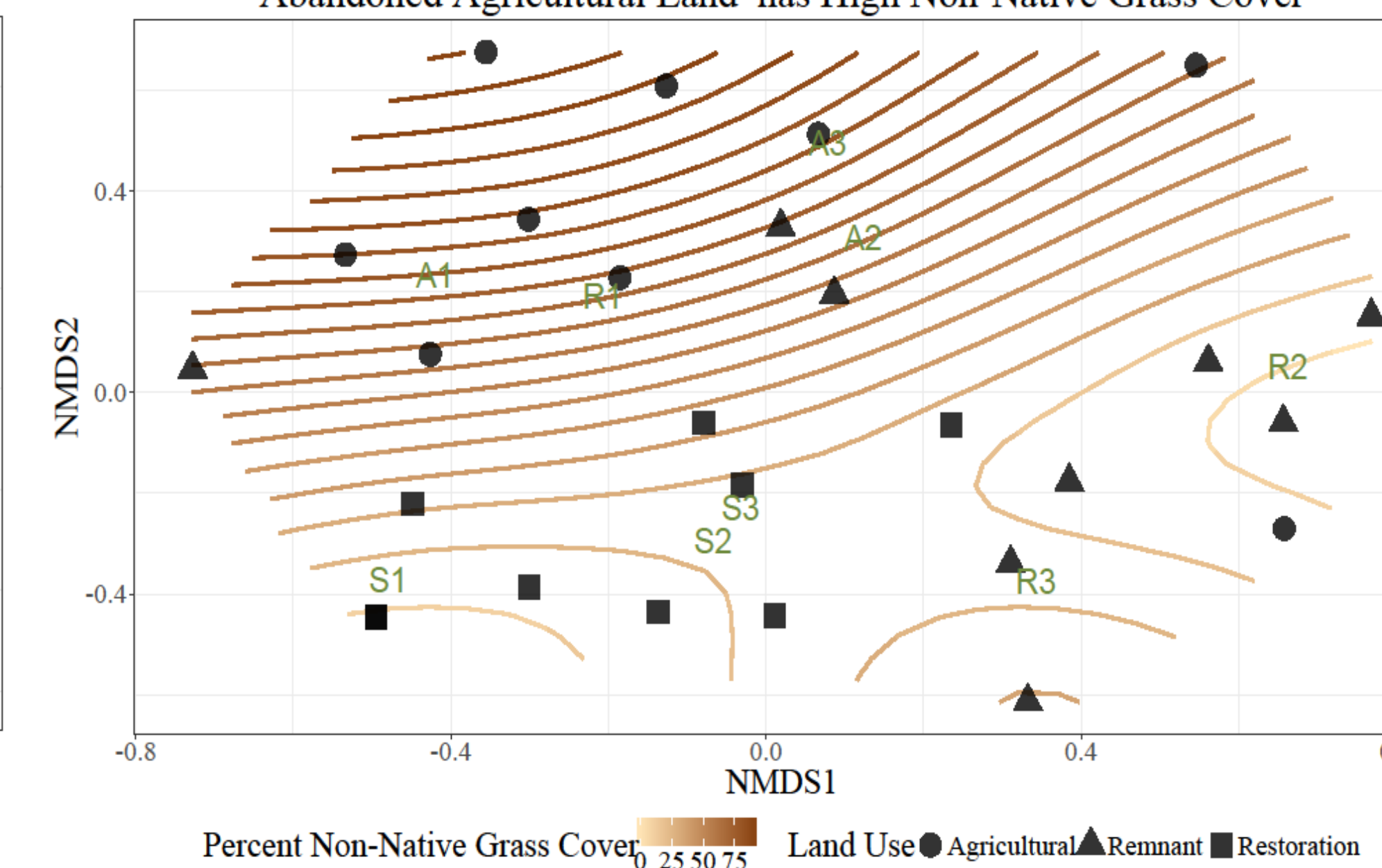
Restored prairie and abandoned agricultural land plots display similar species compositions within their respective land use types, while remnant prairie plots display comparatively higher species composition and display little similarity.

Remnant Prairie has Variable Native Grass Cover



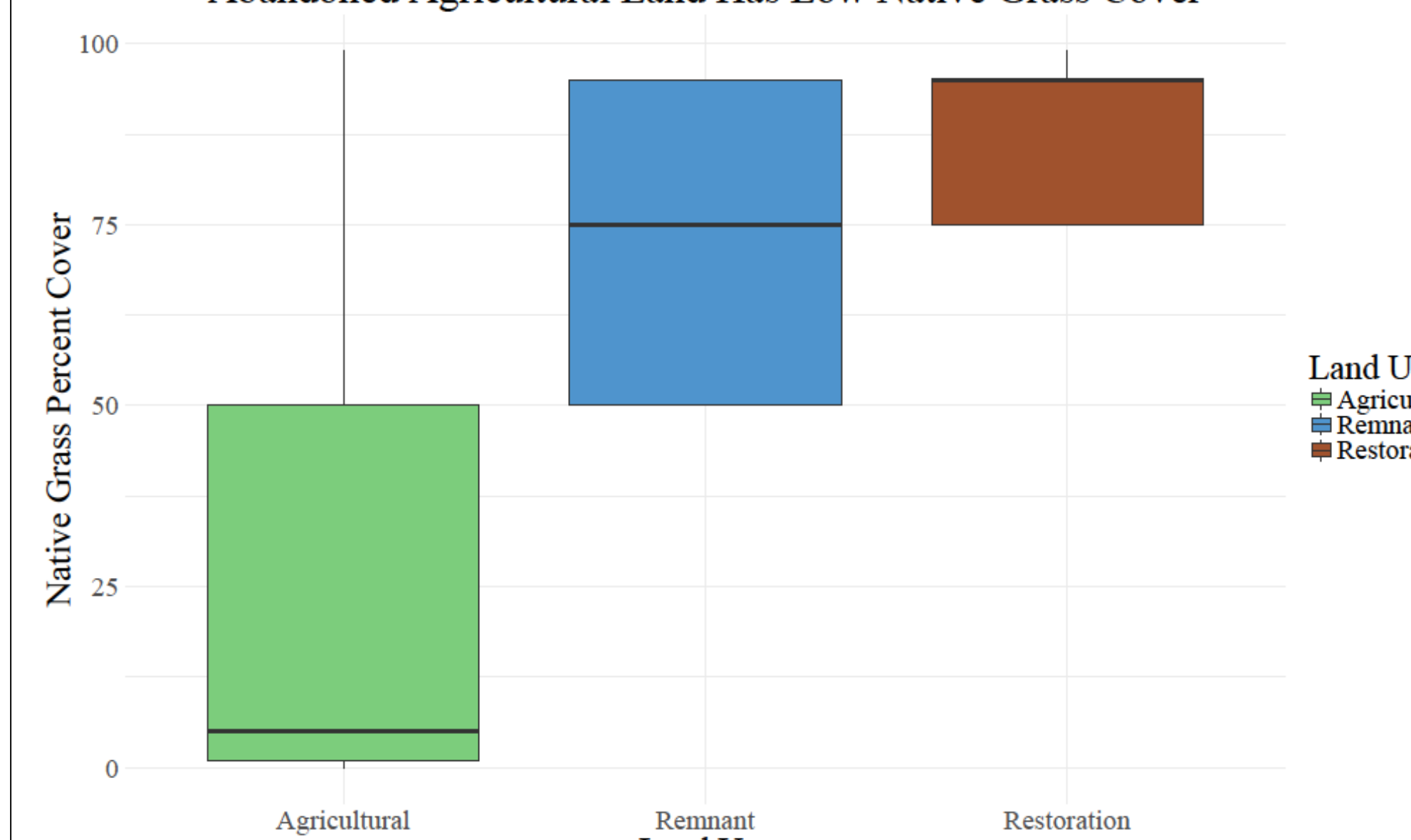
Higher percent native grass cover is associated with remnant prairies and low percent native grass cover is associated with abandoned agricultural land.

Abandoned Agricultural Land has High Non-Native Grass Cover



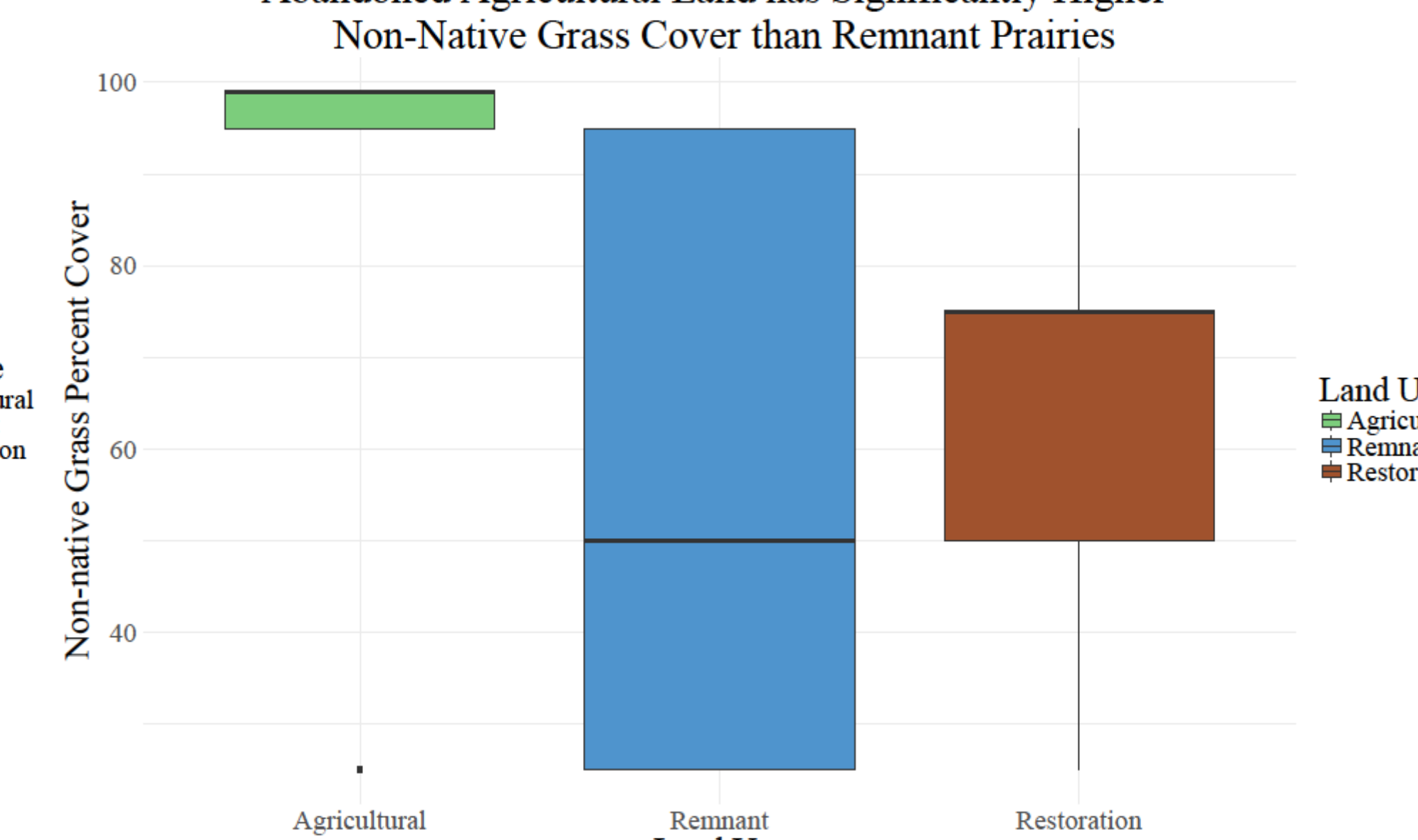
High percent of non-native grass cover occurs in abandoned agricultural land, while restored prairie and remnant prairie share a lower percentage of non-native grass cover.

Abandoned Agricultural Land Has Low Native Grass Cover



Abandoned agricultural land has significantly lower percent native grass cover than remnant and restored prairies (TukeyHSD = Remnant-Agricultural: $p \leq 0.0056$, Restoration-Agricultural: $p \leq 0.0006$).

Abandoned Agricultural Land has Significantly Higher Non-Native Grass Cover than Remnant Prairies



Abandoned agricultural land has a significantly higher percent of non-native grass cover than remnant prairies, but do not differ significantly from that of restored prairies (TukeyHSD = Agricultural-Remnant: $p \leq 0.05$, Agricultural-Restored: $p \leq 0.096$).

Discussion

Results

While not displaying distinct boundaries between land use types, the ordination gives an idea of the general species composition trends in each:

- Remnant prairies have the most diverse species composition amongst land use areas.
- Restored prairies have the least diverse species composition amongst land use areas.
- Abandoned agricultural land species composition is between that of remnant and restored prairies.

Percent cover of native and non-native grasses also differs between land use types:

- Native grass cover in remnant and restored prairies is significantly higher than that in abandoned agricultural land.
- Non-native grass cover in abandoned agricultural land is significantly higher than that in remnant prairies.

Implications

Restored prairies have a high percentage cover of native grasses while plant species composition of abandoned agricultural land overlaps with that of remnant prairies. If our goal is to reach remnant-level species composition, managing abandoned agricultural fields may retain higher species composition than traditional prairie restorations. A major caveat to this approach is that only some ecosystem niches are filled by non-native individuals.

Acknowledgments

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Literature Cited

Barak, R. S., E. W. Williams, A. L. Hipp, M. L. Bowles, G. M. Carr, R. Sherman, and D. J. Larkin. 2017. Restored tallgrass prairies have reduced phylogenetic diversity compared with remnants. *Journal of Applied Ecology* 54:1080-1090.

Link, A., B. Kobiela, S. DeKeyser, and M. Huffington. 2017. Effectiveness of Burning, Herbicide, and Seeding Toward Restoring Rangelands in Southeastern North Dakota. *Rangeland Ecology & Management* 70:599-603.

McCune, B., J. B. Grace, and D. L. Urban. 2002. *Analysis of Ecological Communities*. MjM Software Design.

Prairie Restorations, Inc. 2013. *Cost Estimates for Prairie Restorations, Inc Contracting Services*. Prairie Restorations, Inc.

Tonietto, R. K., and D. J. Larkin. 2018. Habitat restoration benefits wild bees: A meta-analysis. *Journal of Applied Ecology* 55:582-590.

Welty, E., C. Helzer, and A. Joern. 2017. Impacts of plant diversity on arthropod communities and plant-herbivore network architecture. *Ecosphere* 8:14.

Woosaree, J., and R. Otfinowski. 2018. Importance of species diversity in the revegetation of Alberta's northern fescue prairies. *Biodiversity and Conservation* 27:665-680.