Investigating the effects of tallgrass prairie restoration and plant diversity on pollinator communities in northeast Kansas

Anna Tatarko*[1], Kathy Roccaforte[2], and Bryan L. Foster[2]

[1]*Environmental Studies Program, University of Kansas*

[2]*Department of Ecology & Evolutionary Biology, University of Kansas*

*Corresponding author: atatarko@ku.edu

Fig. 1: Surveying pollinator communities at a northeast KS prairie remnant.

Introduction

Almost 90% of flowering plants rely on animal-mediated pollination (Ollerton *et al*. 2011), and, unfortunately, pollination services are being threatened by habitat destruction and fragmentation (Potts 2010). Although there has been significant effort to restore prairies on degraded lands by replanting native grasses and forbs (wildflowers), little is known about the effects of habitat restoration on pollinator communities. In addition, few comparative studies of bee assemblages on tallgrass prairies have been conducted (Hendrix 2010), despite the fact that bees are key pollinators in ecosystems worldwide, including tallgrass prairies (Cane 2006). To address these knowledge gaps, we surveyed plant and pollinator communities on tallgrass prairies in northeast Kansas in 2013. Specifically we asked:

1. How do flowering plant diversity and community composition compare between remnant prairies and restorations?

2. Is site-scale floral diversity associated with pollinator (particularly bee) diversity?

3. How do pollinator (particularly bee) diversity and composition compare between remnants and restorations?

Methods

We surveyed plant and pollinator communities in northeast Kansas prairie remnants (n = 5) and restorations (n = 5) from May 20th through July 31st, 2013 (Figure 1, 2).

❖ ***Survey Methods:*** Each site was surveyed 3-4 times. For each sampling bout we: (a) walked haphazardly through a 1 ha sampling plot for 60 minutes, recording every plant-pollinator interaction we observed, then (b) walked each of four parallel belt transects (20 m x 2.6 m) twice, recording all plant-pollinator interactions observed within each transect, then (c) recorded the species identity and the size of the floral display (cm^2) of every currently flowering plant in each belt transect.

❖ ***Handling and Storage:*** Insects were collected into individual vials, labelled with host plant species identity, and stored at -20˚ C prior to pinning.

❖***Statistical Analyses:*** We used a 1-tailed t-test to assess whether forb diversity was higher on remnants than on restorations. We used linear regressions to assess the relationship between site-scale floral diversity and pollinator (and bee) diversity. We used 2-tailed t-tests to assess whether pollinator (and bee) diversity differed between remnants and restorations. We used non-metric multidimensional scaling (NMDS; Gower's dissimilarity measure) to visualize differences in forb, bee, and pollinator community composition between remnant and restorations, and we tested the statistical significance of these differences using PERMANOVAs (n=999 iterations).

Fig. 2: Map of study sites in northeast Kansas. Purple dots indicate remnant sites, and yellow dots indicate restoration sites. All study sites were approximately 9 ha and were located >5 km apart.

Results

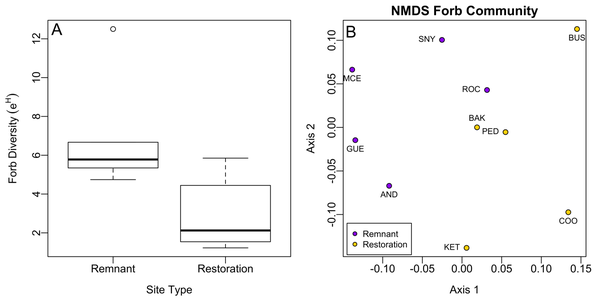

Fig. 3: A) Forb diversity was significantly higher on remnants than on restorations (P = 0.036). Forb richness (not displayed) was also significantly higher on remnants (P = 0.044). B) Remnants and restorations had significantly different forb community compositions (P = 0.018).

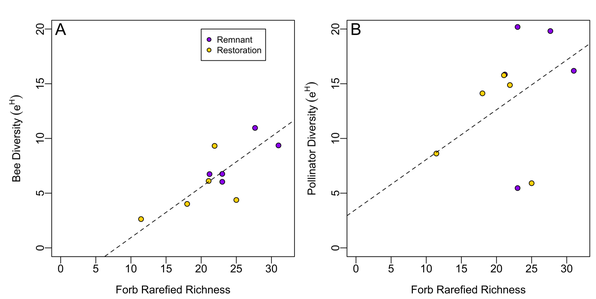

Fig. 4: A) Bee diversity was significantly positively associated with forb richness on remnants and restorations (P = 0.020). However, the diversity of the entire pollinator community B) was not significantly associated with site-scale forb richness (P = 0.23).

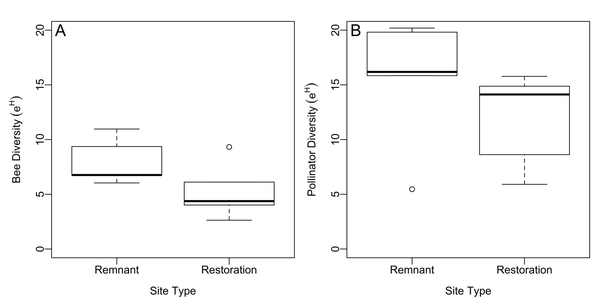

Fig. 5: There were no significant differences in the diversity of A) the bee community (P = 0.31), or B) the entire pollinator community between remnants and restorations (P = 0.24).

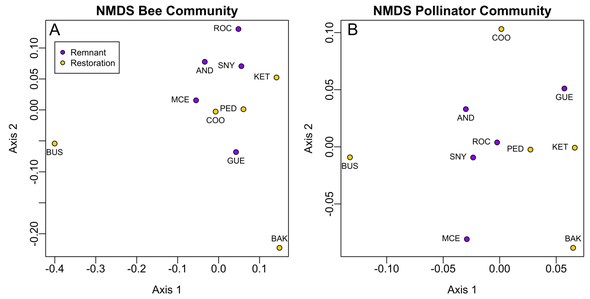

Fig. 6: Neither the composition of A) the bee community (P = 0.83), nor B) the entire pollinator community (P = 0.92) differed between remnants and restorations.

Discussion

Remnant prairies had greater forb diversity than restorations, and the forb community differed significantly between remnants and restorations. In addition, we found that site-scale floral diversity was positively associated with bee diversity. Bees require both foraging and nesting resources (Roulston and Goodell 2011). Forb diversity may be positively associated with the diversity of these resources, such that sites with greater forb diversity can support more diverse bee assemblages. However, we did not find a significant association between forb diversity and the diversity of pollinator assemblages as a whole. Furthermore, neither the diversity nor composition of pollinator communities differed between remnants and restorations. These results suggest that other factors, such as management regime, nest site accessibility, dispersal ability, and landscape-scale resource availability, may strongly regulate pollinator diversity and composition on prairies.

Citations

Cane, JH. 2001. Habitat fragmentation and native bees: a premature verdict? Conservation Ecology 5(1): 3.

Hendrix, SD., Kwaiser, KS., & SB. Heard. 2010. Bee communities (Hymenoptera: Apoidea) of small Iowa hill prairies are as diverse and rich as those of large prairie preserves. Biodiversity and Conservation 19(6): 1699-1709.

Ollerton, J., Winfree, R., & S. Tarrant. How many flowering plants are pollinated by animals? Oikos, 120 (3): 321-326.

Potts, SG., Biesmeijer, JC., Kremen, C., Neumann, P., Schweiger, O., & WE. Kunin. 2010. Global pollinator declines: trends, impacts and drivers. Trends in Ecology & Evolution 25(6): 345-353.

Roulston, TH. & K. Goodell. 2011. The role of resources and risks in regulating wild bee populations. Annual Review of Entomology 56: 293-312.

Acknowledgements

The authors gratefully acknowledge the land owners of the study sites for granting us permission to sample. We also thank Christopher Rogers, Zack Falin, Jennifer Thomas, Charles Michener, Mike Arduser, and Kelly Kindscher for assistance with insect and plant identifications. Financial support was provided by the KU Field Station, the Grassland Heritage Foundation, Prairie Biotic Research, Inc., the Nature Conservancy, and the Kansas Native Plant Society.