Factors influencing the abundance of non-native species in restored prairies

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Introduction

Prairie restoration is a topic of growing concern in the Midwest where prairie was once the dominant ecosystem but now is one of the most endangered in the country[1]. Restoration practitioners want restorations with high diversity and ecosystem functions[2,3], but restoring sites to the quality of remnant prairies is difficult[1]. A successful restoration is dependent upon removing non-native species from native communities[4], especially ecologically invasive species. Using new concepts of diversity such as phylogenetic diversity (PD) – a measurement of how related different species are – have the potential to improve the quality of restored prairies[5]. Native communities with high PD could outcompete non-native species that could invade[6], due to a higher competitive environment[6] or when niche occupation excludes non-native species[4]. A phylogenetic tree is usually used to quantify this measurement, but proxies, such as the number of families or genera at each site, can be more feasible when high levels of specificity are not required. To examine the relationship between diversity and invasibility, we sampled restored prairies in the Chicago region to determine if high diversity sites were correlated with a low percentage of non-native species.

Hypothesis

As a site's diversity increases, the percentage of non-native species will decrease because the native plant communities can better resist invasion (Fig. 1).
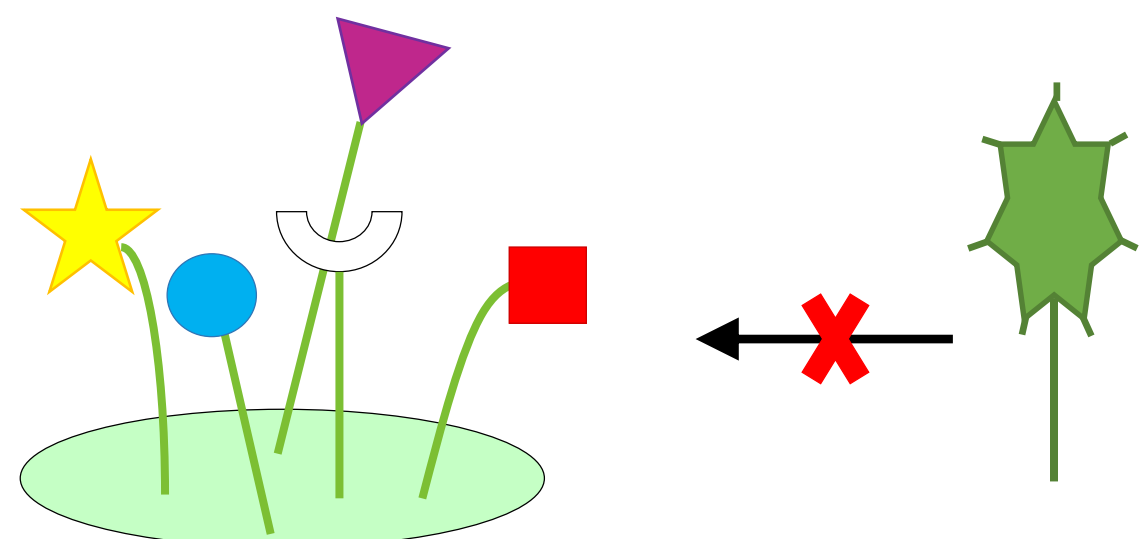
Fig. 1: **Hypothesized results.** Highly diverse native plant communities are able to resist invasion by non-native species.

Methods

We sampled sixteen restored prairie sites larger than one acre in the Chicago region using two 50 meter transects (Fig. 2). Most of these sites were restored by the same company. We placed ten ¼ meter^2 plots at random distances between two and seven meters on either side of each transect (20 plots per site). We recorded the presence of each species in the field. I used the USDA Plant Database[7] to find the most recent accepted scientific name, whether the plant species was native or non-native (introduced, naturalized, and/or invasive) and its family classification. Introduced species are native to regions other than North America. Naturalized species have escaped and are found throughout most habitats in a given region. Invasive species inhibit native species from thriving. For each site, I counted the total number of native species, families, and genera, as well as calculated the percent of non-native species and the Shannon-Weiner diversity (SWD) index (incorporates both presence and abundance). I then used Excel to graph the 12 possible comparisons and calculated the R^2 values.

Fig. 2: **Site sampled.** The most diverse prairie we sampled. We would expect this prairie to have few invasive species. *(Photo G. Carr)*
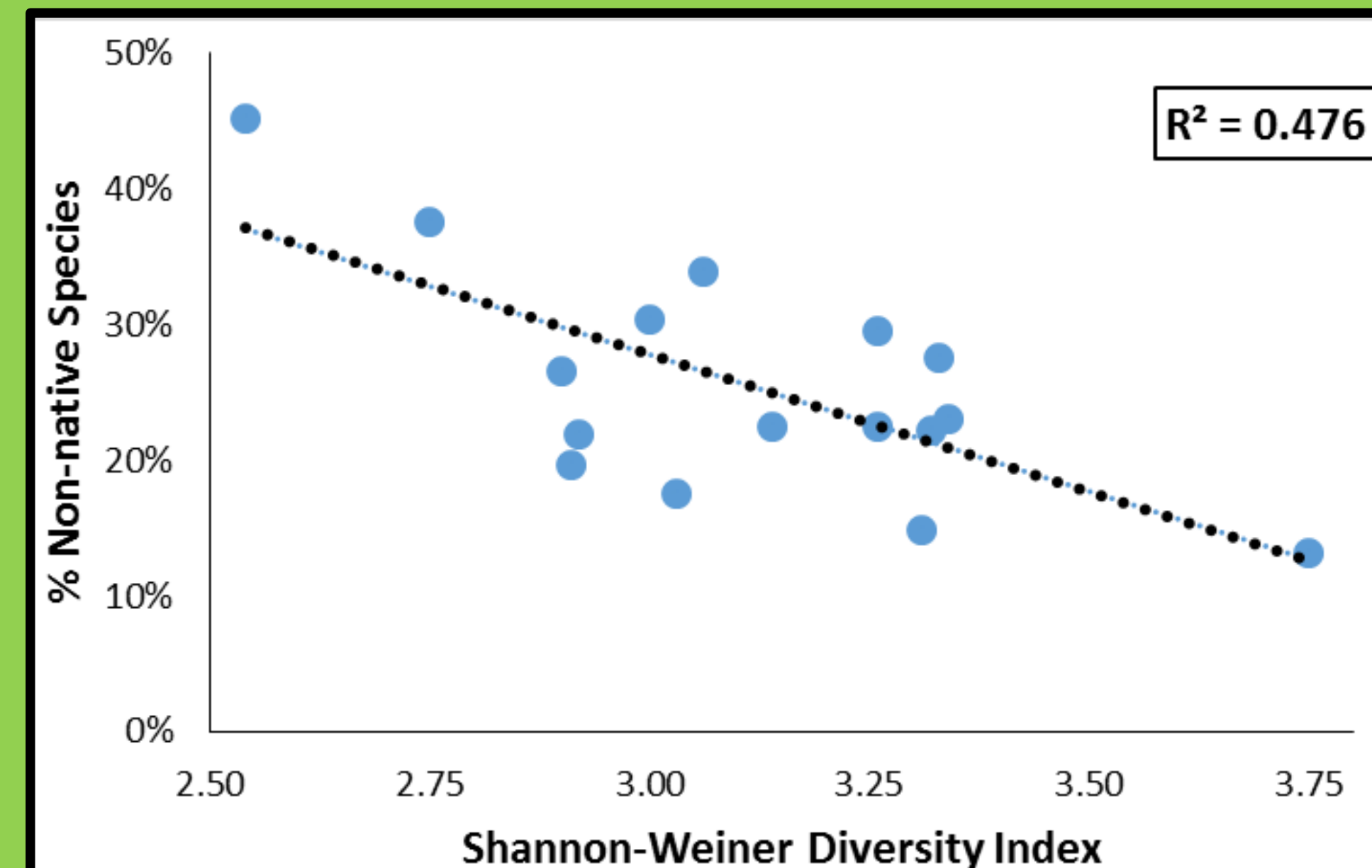

Fig. 3: **The correlation between Shannon-Weiner Diversity Index of native species and the percentage of non-native species at each site.** There is a weak correlation between high diversity (high SWD) and relatively fewer non-native species at a site.
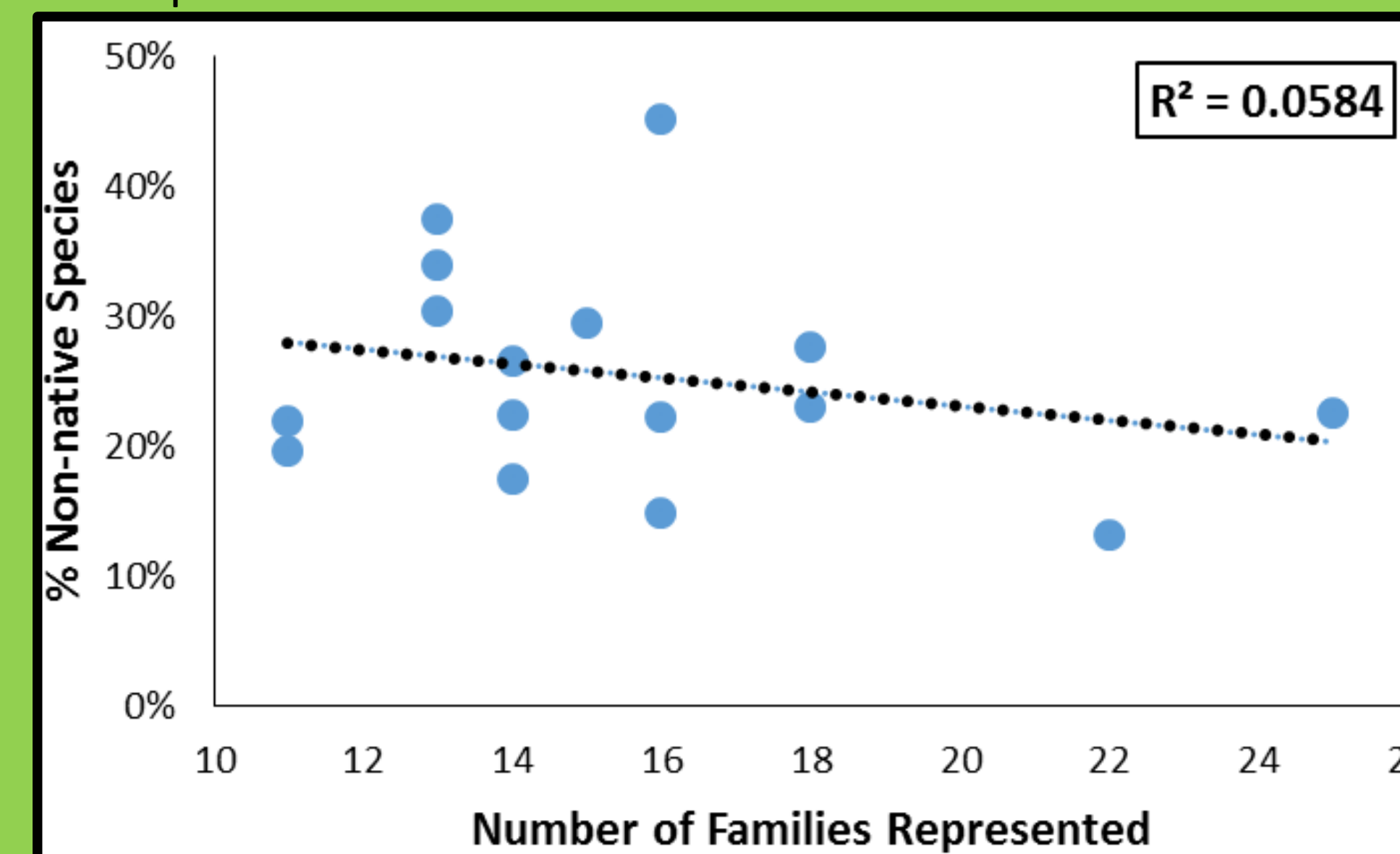

Fig. 4: **The correlation between the number of native families represented and the percent of non-native species at each site.** There is a weak correlation between the number of families represented and the percent of non-native species at a site.
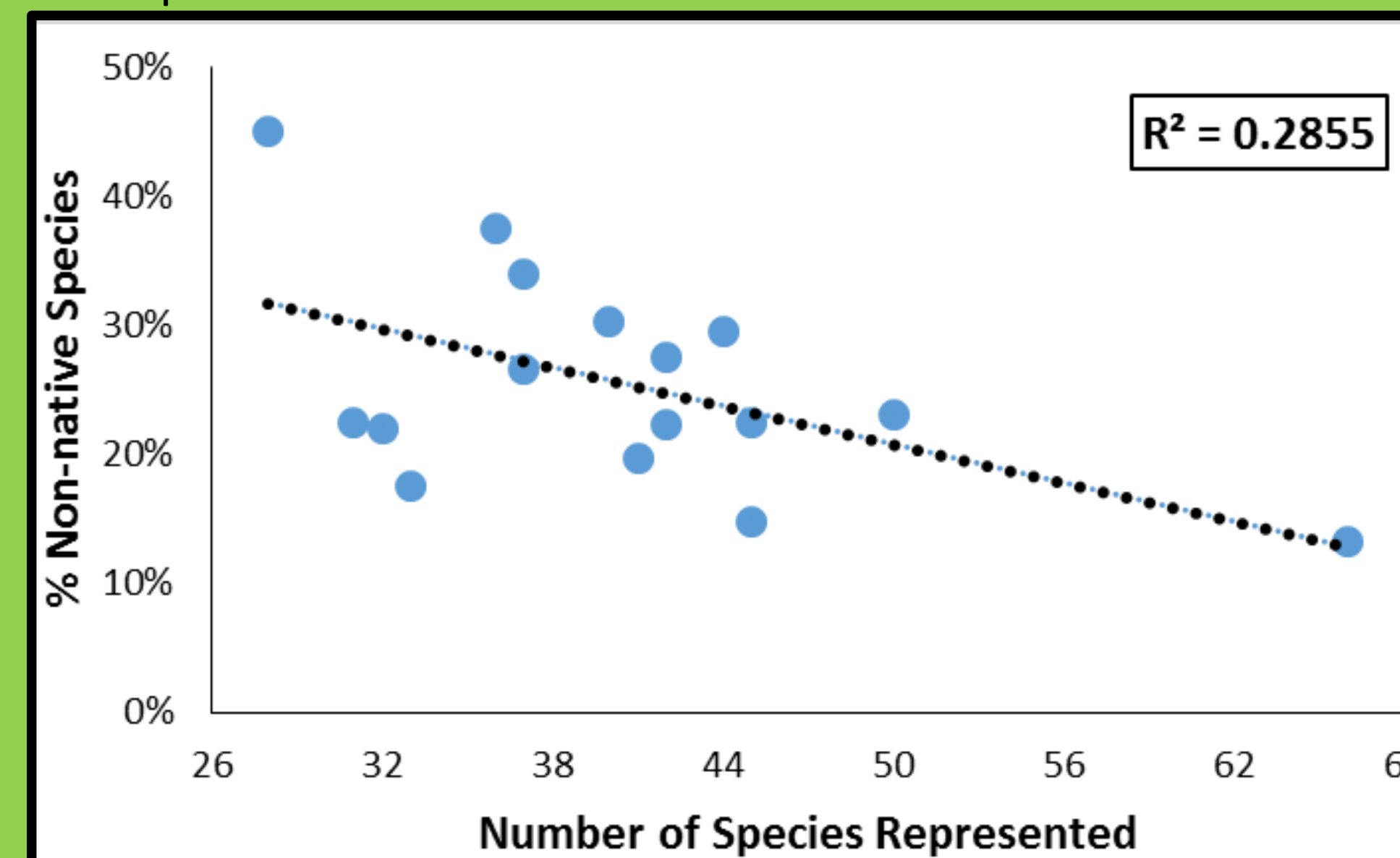

Fig. 5: **The correlation between the number of native species represented and the percentage of non-native species at each site.** There is a weak correlation between species richness (number of species) and relatively low percentages of non-native species.

Results

A weak relationship was found between SWD and the percent of non-native species (R^2=0.476, Fig. 3). All other comparisons had low correlations (R^2 < 0.3, Fig. 4, 5).

Discussion

Contrary to our hypothesis, higher diversity in restored prairies is not consistently correlated with low percentages of non-native species. Partial support was provided to our hypothesis since high SWD, indicating high diversity, was correlated with fewer non-native species. No other measure of diversity was strongly correlated with the percent of non-native species, but our proxies may not have been the best substitute for PD. The sites sampled were previously disturbed ground, such as farmland or dredged sediments, which could have had a history of established invasive species. Instead of invading, non-native species may have already been present in the seed bank. Previous studies have found that native plant communities are able to resist invasion, especially with no other contributing factors[8], but also shows that sites beginning with poor quality can easily return to poor-quality sites, even after a restoration[9]. It is possible that non-native species were well-established at our sites before restoration, and the native plant community could not repel them[10] (Fig. 6). Future research will use a more accurate measure of PD and investigate if including high PD seed mixes can suppress non-native species. This research indicates that site management before a restoration begins is important.
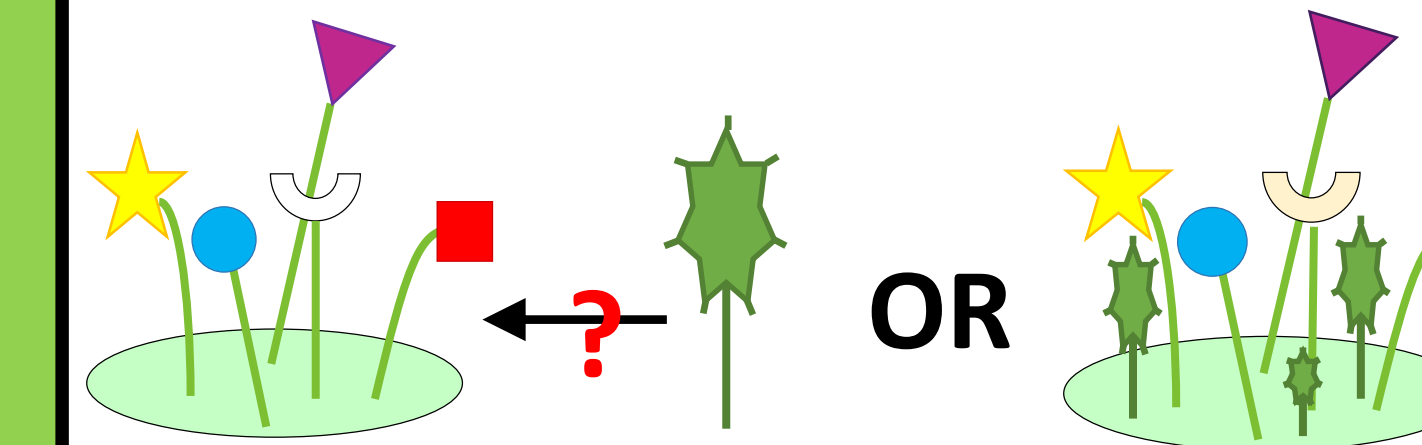
Fig. 6: **Possible explanations.** There were no consistent results on the effect of diversity on invasibility, possibly because the non-native species were already present at the time of restoration.

Conclusion

Restored prairies with high diversity are not consistently correlated with fewer non-native species, perhaps due to factors such as site history.

References and Acknowledgements

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