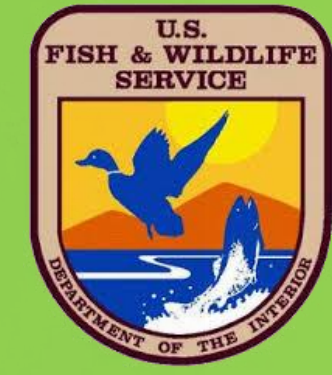


Platanthera leucophaea: an assessment of genetic diversity in relation to pollinator presence and morphological fitness in the federally threatened Eastern Prairie Fringed Orchid



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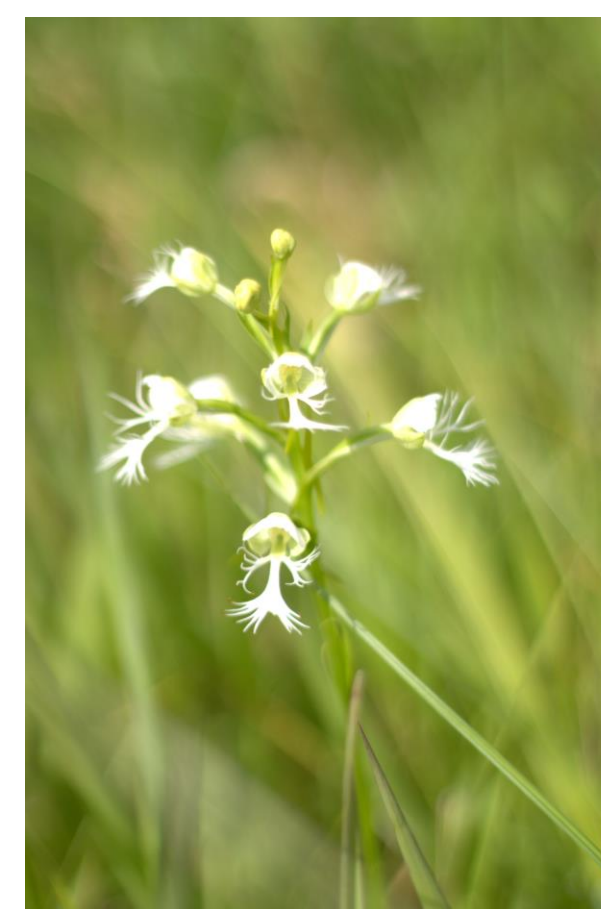
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Introduction

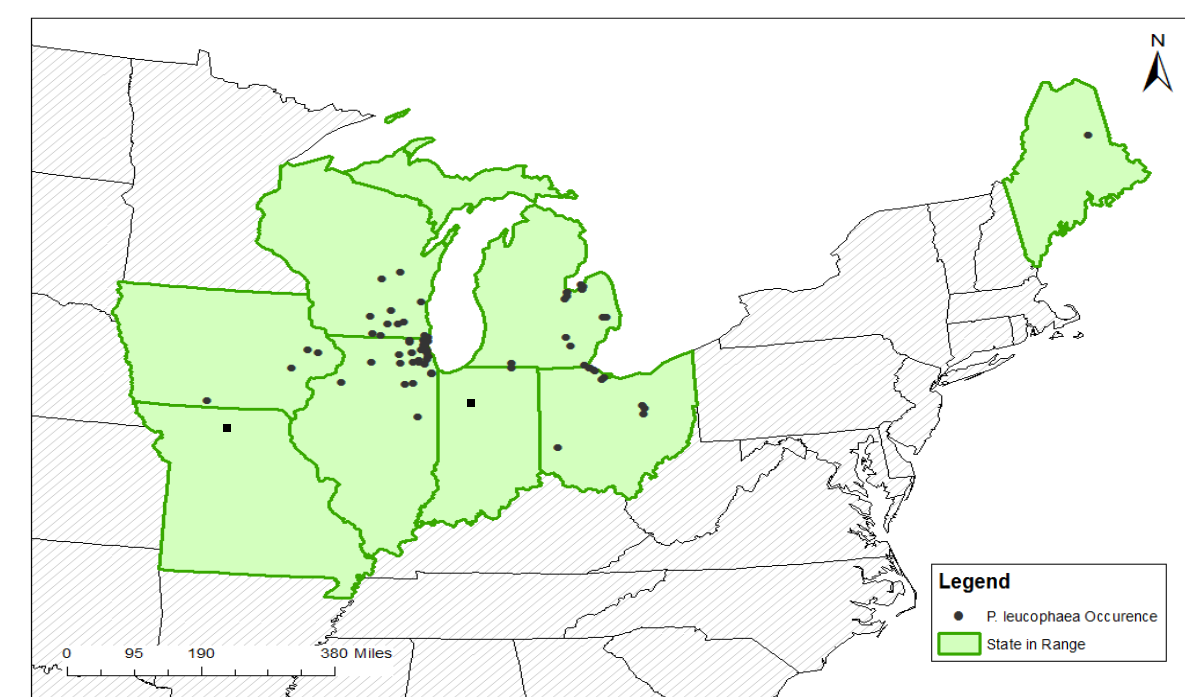
Once ranging across the midwestern United States and southern Ontario, the Eastern Prairie Fringed Orchid, *Platanthera leucophaea*, is now found mostly in small fragmented populations. With these sharp population declines, the U.S. Fish and Wildlife Service implemented a recovery plan to increase orchid success across its range.

Issues *P. leucophaea* faces:

Pollinator presence restricted between sites
 ↓
 Limited gene flow
 ↓
 High levels of inbreeding leading to inbreeding depression
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 Susceptibility to environmental pressures



For this study, we assessed the levels of inbreeding across *P. leucophaea*'s populations. We looked at morphological fitness, presence of the hawkmoth's (*Lintneria* spp.) host plants, and genetic diversity to identify trends that could be used to predict the success of these populations.



Hypothesis:

We hypothesized that populations farther away from each other would have higher levels of inbreeding and sites with greater host plant abundance would have greater morphological fitness and genetic diversity

Methods

Field Work Summer 2015:

- Collected leaf samples from 34 sites across Illinois, Indiana, Iowa, Michigan, Missouri, Ohio, and Wisconsin
- Measured morphological features of each orchid at 19 sites from Illinois, Wisconsin, and Indiana
- Recorded percentage of host plant species in 20 0.5m X 0.5m transects at 10 sites in Illinois
- Looked for signs of herbivory on every host plant found in a transect



Lab Work Summer 2015:

- Extracted DNA from leaf samples collected in 2015 across the 34 field sites
- Used nine working microsatellite primers to amplify neutral loci using PCR analysis
- Scored PCR results using the Beckman Culture CEQ 8000 Genetic Analysis System
- Analyzed morphological features from 2014/2011 census data using ANOVA and linear regressions
- Analyzed molecular variance using GenAlEx

Results

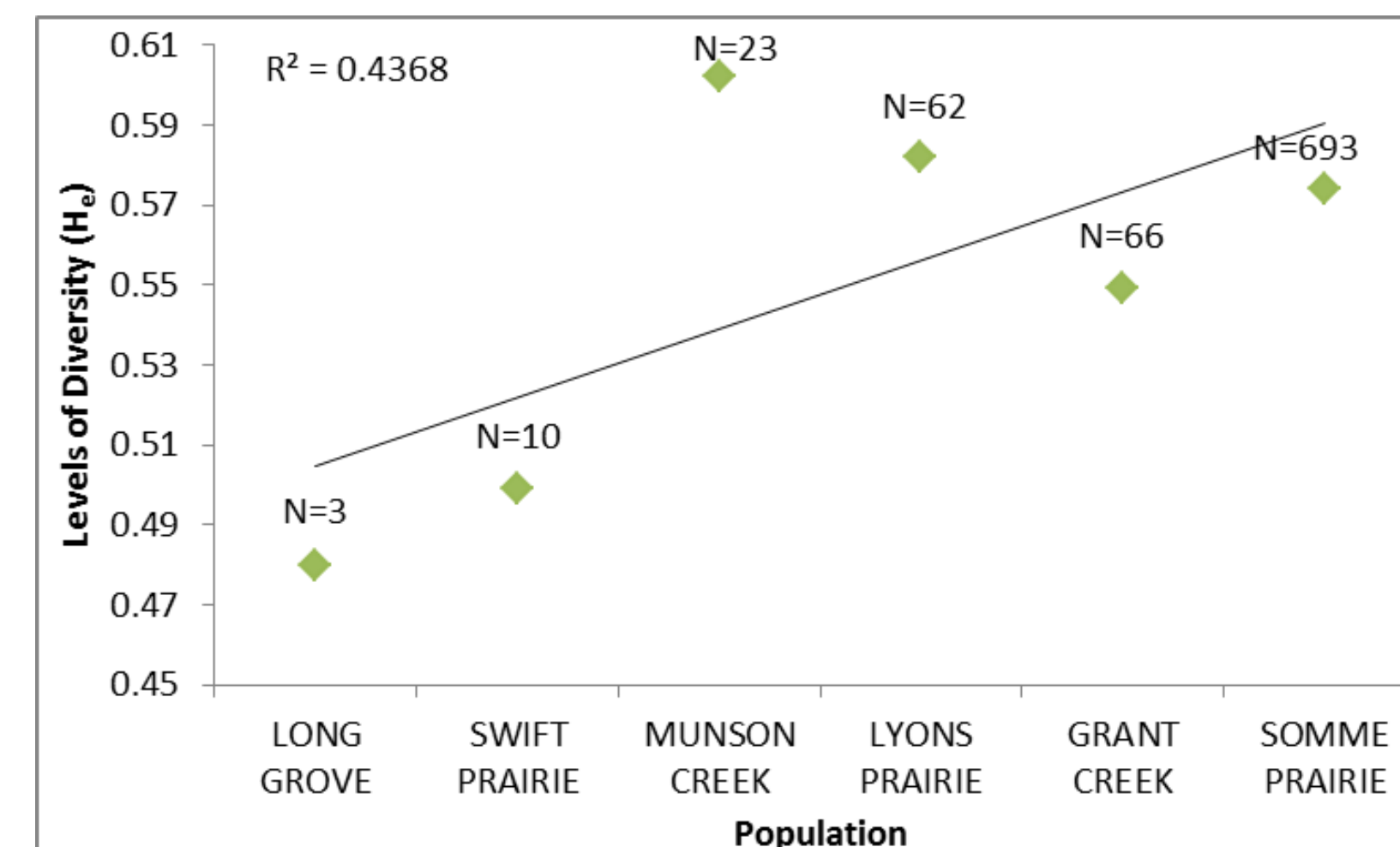


Figure 1. Levels of genetic diversity increased as the size of populations across Illinois increased.

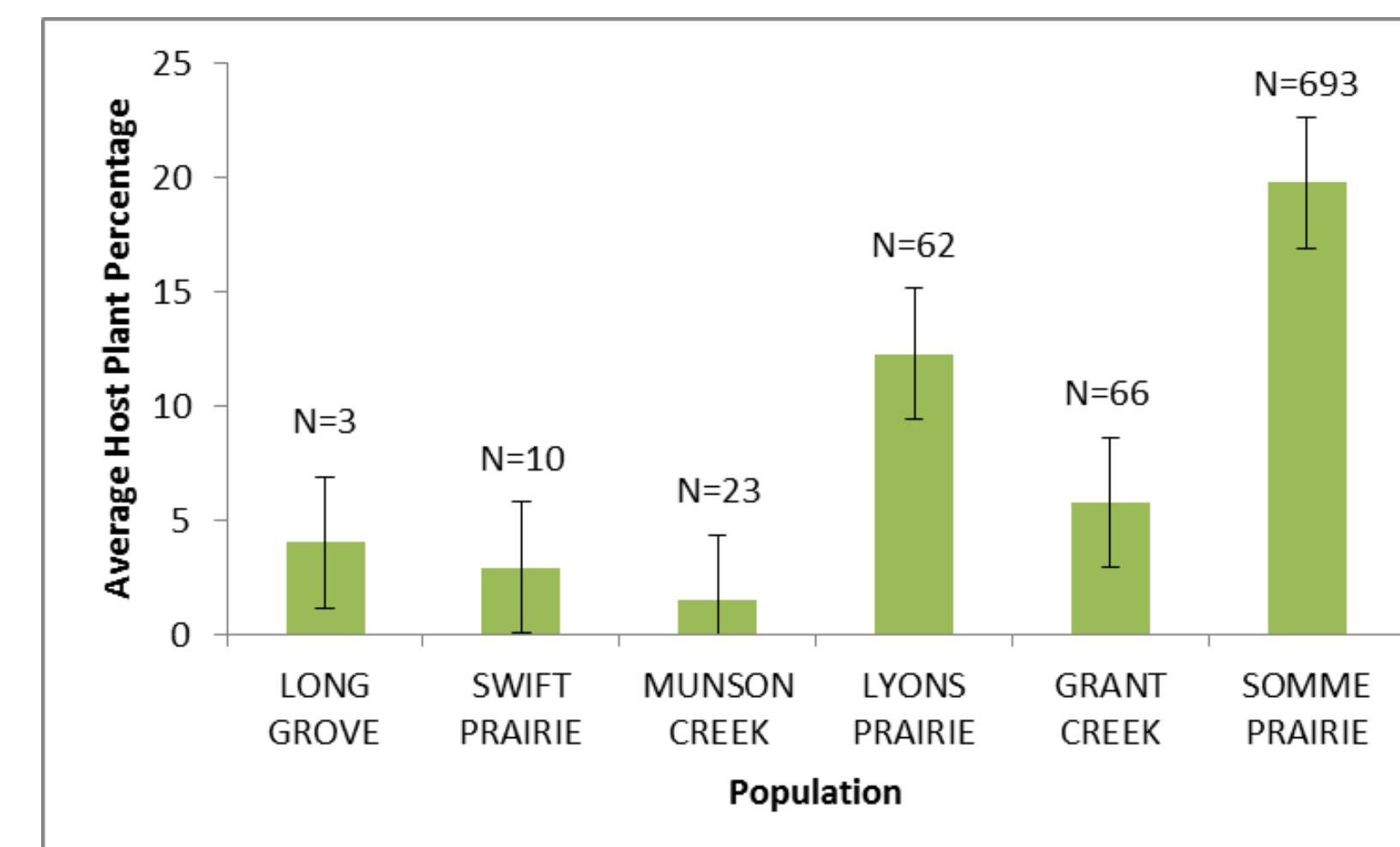


Figure 2. The average percentage of host plants found varied across populations with a trend of greater host plant abundance found in larger populations.

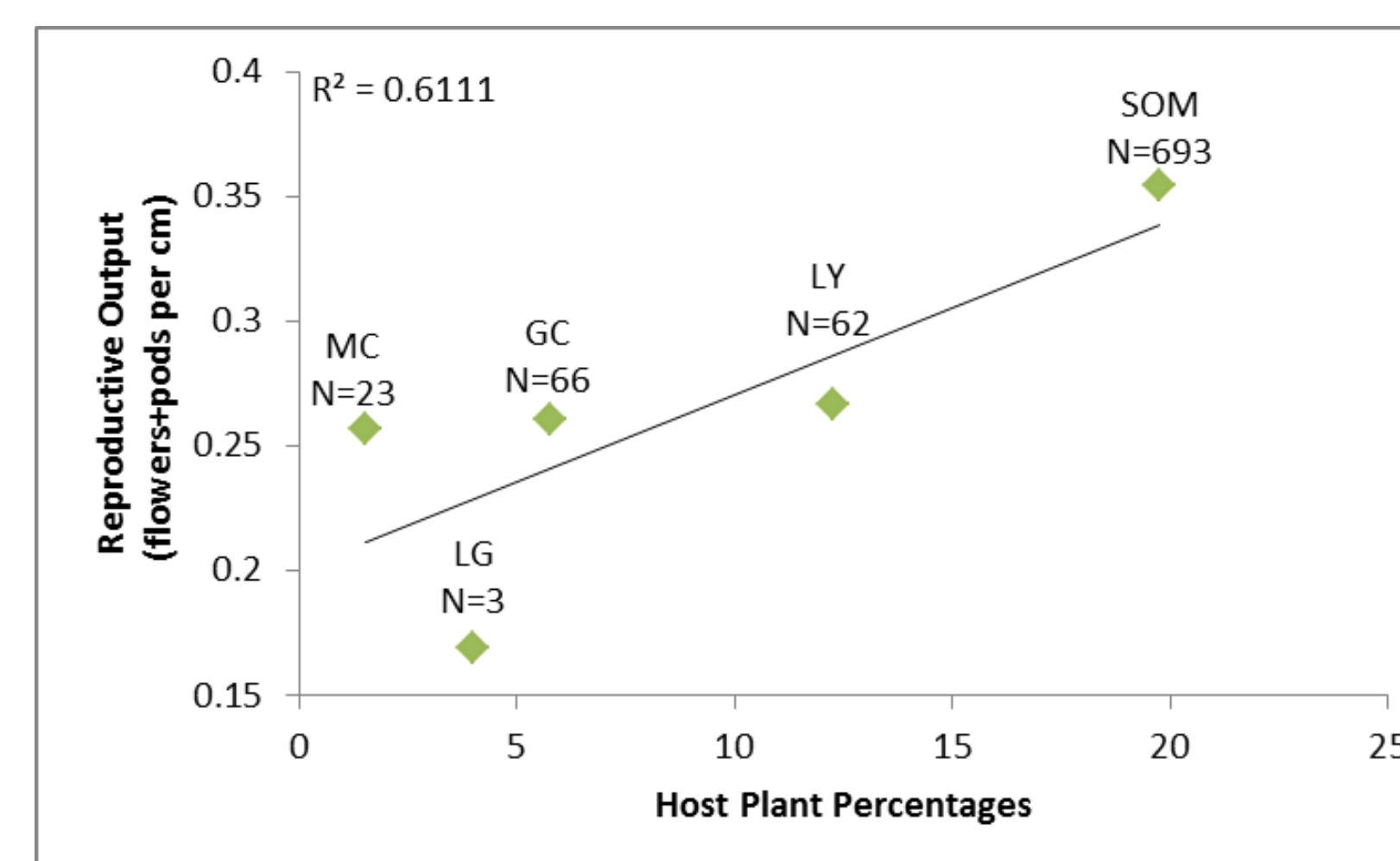


Figure 3. Reproductive output increased across populations that had a higher abundance of host plants.

Range Wide Analysis: No relationship was found among population diversity and distance between sites. However, high levels of inbreeding were found in every population.

Conclusions

- As predicted, *P. leucophaea* populations that had a greater percentage of host plants also had higher reproductive outputs and higher genetic diversity.
- No relationship was found between levels of inbreeding and distance from other populations and all populations showed significant signs of inbreeding.
- Pollinator limitation and habitat degradation are the assumed causes of these high inbreeding levels. Inbreeding could result in greater susceptibility to pressures and increase extinction risks that are already heightened due to the orchid's specialization.

Because it is so specialized, *P. leucophaea* is often one of the first species to disappear in degraded landscapes and can act as a bio-indicator for that habitat. Therefore, continuous land management is important not only for the orchids and host plant species, but will also benefit the prairie community as a whole.



Future Research

- More research is needed on the orchid's pollinator (*Lintneria* spp.) to help evaluate restoration techniques that will benefit the recovery of *P. leucophaea*.
- In order to evaluate *P. leucophaea*'s success over time, average reproductive outputs and population sizes should be determined from past census data.
- Use past and present census data to assess if reproductive output is associated with plant height to better understand relationships within individuals.



Literature cited

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Acknowledgments

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