Longleaf Pine Savanna Restoration Increases Native Bee Diversity

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Abstract

Native bees are important pollinators that are crucial for terrestrial ecosystem functioning. The longleaf pine savanna is a highly threatened, fire-maintained ecosystem unique to the southeastern US. In the absence of fire, savannas become closed canopy woodlands. Harvesting trees is one method used to restore longleaf pine savannas to an open canopy state. We explore how historical land use and current restoration practices affect diversity of native bees in longleaf pine savannas. We found significantly greater abundance and richness of native bees in restored plots, but no effect of historical land use. Reduction of canopy cover in restoration treatments was the best predictor of native bee diversity suggesting that savanna restoration will also restore bee communities.

Introduction and Methods

- Bees are the most important pollinators of flowering plants[1].
- Longleaf pine savannas are an endangered ecosystem in the southeastern US[2].
- A large diversity of plants occupy the longleaf savanna, many of which depend on bees for pollination services[3].

Hypothesis 1: Harvesting trees to restore savannas will increase native bee diversity

Hypothesis 2: Remnant plots will have greater bee diversity than former agricultural sites

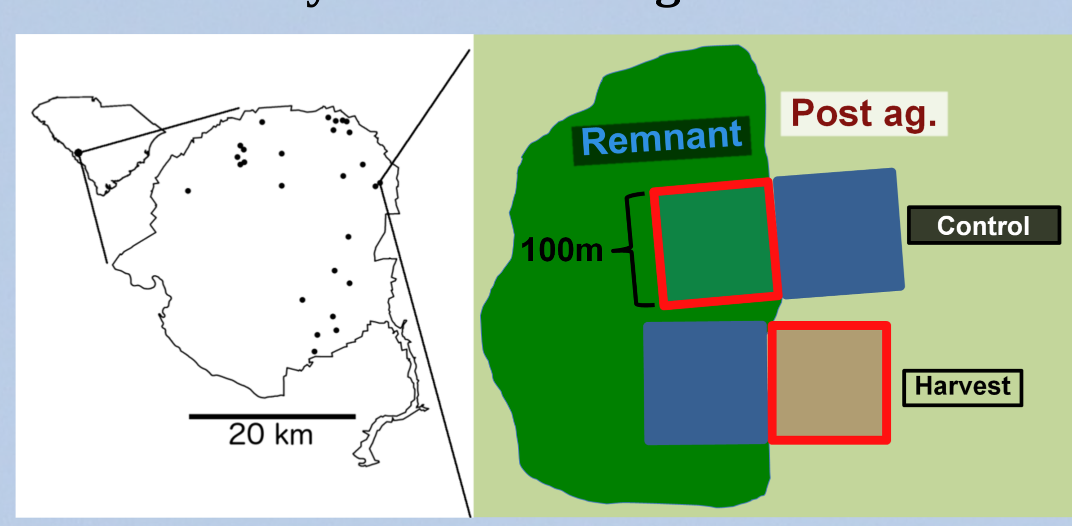

Figure 1: Map of sites and plots within with in each site, at the Savannah River Site, a National Environmental Research Park each site

- **Remnant** = Undisturbed longleaf pine stands
- **Post ag.** = Former agricultural lands, planted with longleaf pines
- **Control** = no restoration treatments
- **Harvest** = trees removed to restore savanna

- Bees were collected using elevated colored bowls[4].
- All statistical analyses were done in R[5].

Results

Effects of restoration treatment on native bee abundance and species richness

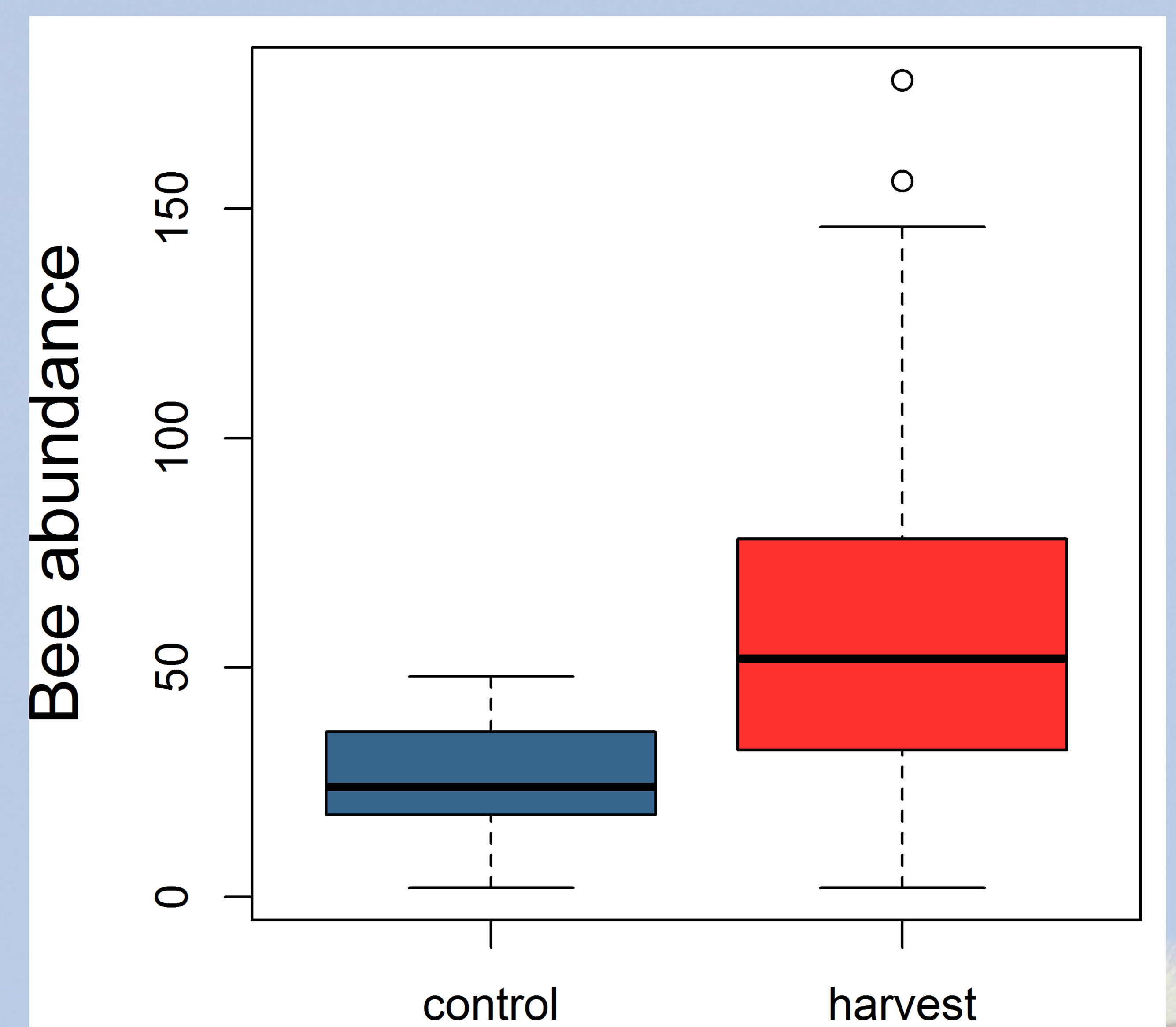

Figure 2. Box plot of bee abundance in restored (harvest) and unrestored (control) plots. Bee abundance is significantly greater in restored plots (Wilcoxon test: U =153, p-value < 0.0001). Land use history did not significantly affect bee abundance.

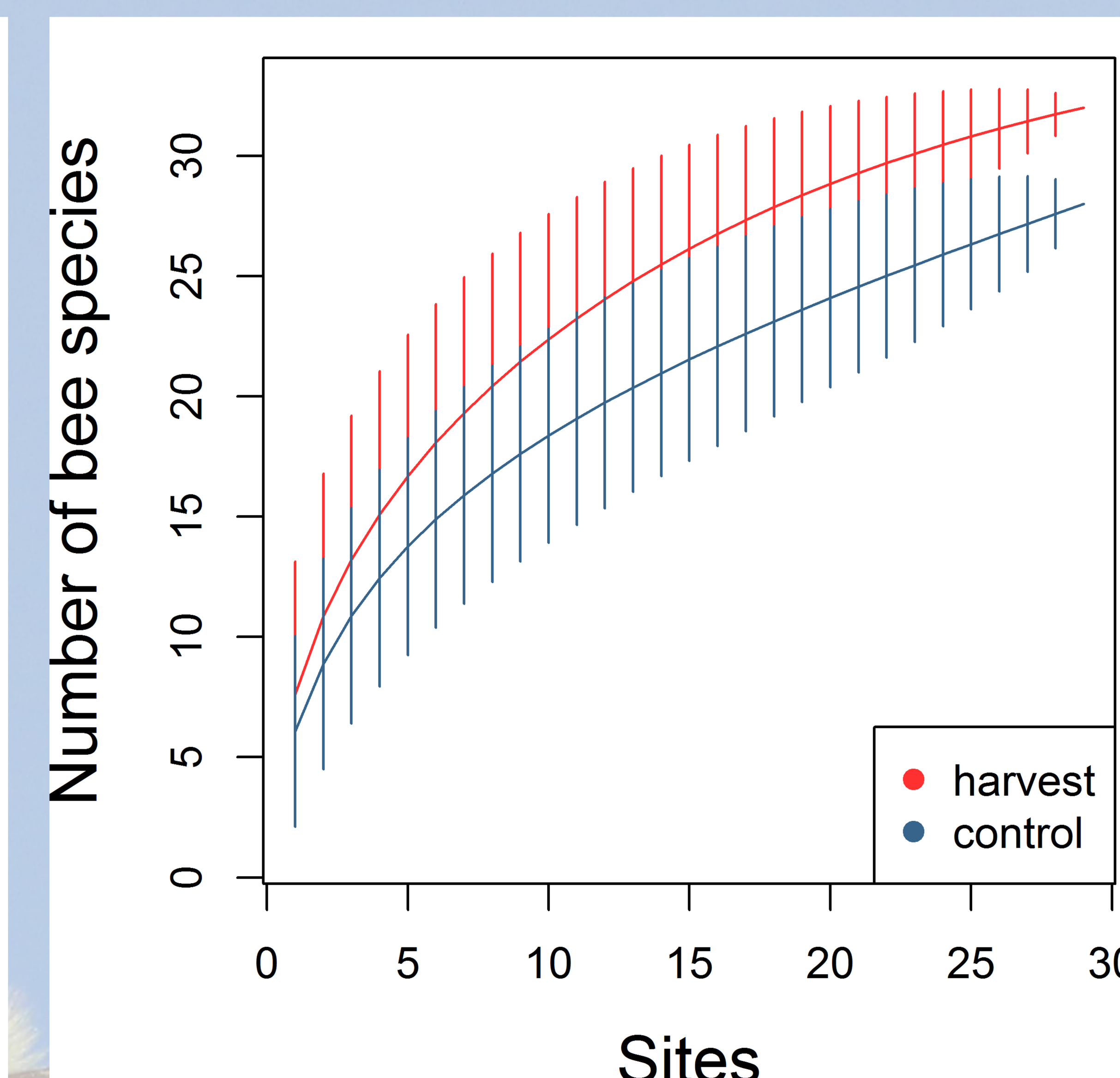

Figure 3. Species accumulation curve of bees in restored (harvest) and unrestored (control) plots. Species richness is significantly greater in restored plots (Wilcoxon test: U = 287, p-value = 0.037). Land use history did not significantly affect native bee species richness.

Community composition

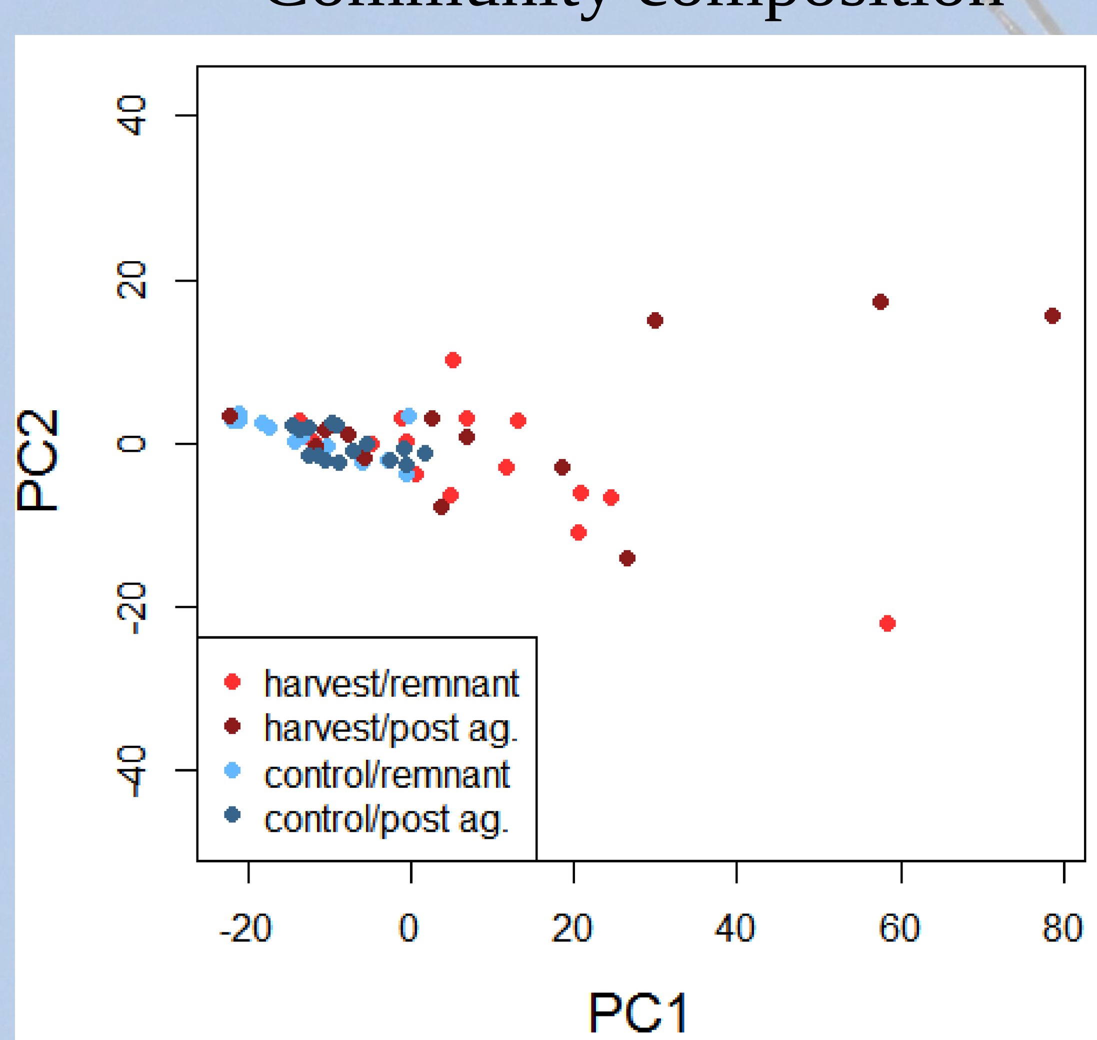

Figure 4. Principal components analysis of bee communities from each plot shows strong separation of control and harvest treatments in the first axis, but not of historical land use.

Factors affecting native bee abundance

	Estimate ± SE	z value	*p*-value
(Intercept)	**4.75 ± 1.71**	**2.73**	**0.0064 ***
% canopy closed	**-0.014 ± 0.002**	**5.53**	**< 0.0001 ***
% sand	-0.007 ± 0.019	0.34	0.73
% vegetation	0.002 ± 0.005	0.31	0.76
Litter depth (cm)	0.005 ± 0.048	0.094	0.92

Figure 5. Results of negative binomial generalized linear model of site features expected to have the most impact on native bee foraging and nesting. Percent canopy cover was the sole explanatory variable in the best model selected using the Akaike Information Criterion and the only significant variable in model averaging. * Bold type indicates significant factors.

Conclusions

- **Long leaf pine savanna restoration increases wild bee species richness and abundance.**
- **Restoration alters the community composition of native bees.**
- **Land use history had no effect on bee abundance or richness.**
- **The percent of canopy cover has the most significant effect on the abundance of native bees.**

Future Directions

- Increase sample effort by adding additional sites.
- Perform net collections to document plant-pollinator interactions.
- Conduct experiments using wild and sentinel plants to measure pollination service across restoration treatments.

References

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Acknowledgments

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