

Interspecific Co-Flowering Prairie Plants Compete for Pollinators



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Introduction

Largely due to urbanization and agricultural expansion in the past 150 years since European settlement, less than 1% of native prairie habitat remains, a decline that exceeds any other major ecosystem in North America (Samson and Knopf, 1994). Habitat fragmentation and introduction of invasive species to native habitats are two dominating factors in the threat to pollination systems, a crucial global ecosystem service (Kearns et al, 1998). In a mating scheme dominated by native solitary generalist bees, interspecific co-flowering plants could facilitate pollination by attracting more visits, yet have the potential to reduce reproductive success through competition and/or interference with compatible pollen receipt (Feldman 2008, Mitchell et al 2009). A previous study shows that the frequency of pollinator visits is not an explanation for reduced reproductive success seen in small isolated populations of purple coneflower (*Echinacea angustifolia*): surprisingly, the densest and largest populations of purple coneflower receive fewer pollinator visits yet have greater reproductive success than small isolated populations, which receive more visits but have decreased reproductive success. (Wagenius and Lyon, in press). Are the co-flowering species surrounding purple coneflower impacting pollinator visitation?

Hypothesis: A greater abundance and diversity of plants within the floral neighborhood (i.e. the community of co-flowering species surrounding a plant) of purple coneflower will increase the number of pollinator visits that it receives, and the isolation of an individual purple coneflower plant from other flowering purple coneflower will intensify this increase.

Study Species: a model prairie forb

Purple coneflower (*Echinacea angustifolia*)

- Prominent Family: Asteraceae
- Mating system: self-incompatible, reproduces only by seed
- Life cycle: perennial
- Pollinated by: native solitary generalist bees, butterflies, flies, beetles



Methods

Pollinator Observations:

- We chose 10 tallgrass prairie remnants in Douglas Co., Minnesota with purple coneflower populations
- We randomly chose 8 flowering plants at each prairie remnant as focal plants
- We observed each plant from 8-11am an average of 3.5 times per observation day (4 days total)
- We observed each plant for 8 min segments and recorded whether or not a pollinator visited
- 10 observers*3hrs*4 days=120 hrs of observations

Floral Neighborhood Characterizations:

- Floral neighborhood:** the community of flowering plants in a circle with a radius of 2 m surrounding each purple coneflower focal plant.
 - For each co-flowering species, we identified the species and counted inflorescences within the 2 m radius.
- At each site we recorded all other co-flowering species within 10 m of focal plants.



L-R: Floral neighborhood of purple coneflower at Staffanson Prairie Preserve, Floral neighborhood at roadside prairie remnant

Abstract

Habitat fragmentation of native prairies and the introduction of non-native species threaten populations of native plant and animal species by reducing mating possibilities and increasing interspecific competition. Our objective was to measure the effect that the species that co-flower with purple coneflower (*Echinacea angustifolia*) have on pollinator visitation by honing in on the most abundant native and exotic co-flowering species: alfalfa (*Medicago sativa*) and leadplant (*Amorpha canescens*). Our results show that the presence of alfalfa and purple coneflower within purple coneflower's floral neighborhood both had positive effects on pollinator visitation, while the presence of leadplant had a negative effect. There is no evidence that alfalfa and purple coneflower and leadplant and purple coneflower interact in their effect on pollinator visits.

Results

Fig. 1. More Pollinators Visit Plants with Alfalfa and P. Coneflower in Floral Neighborhood

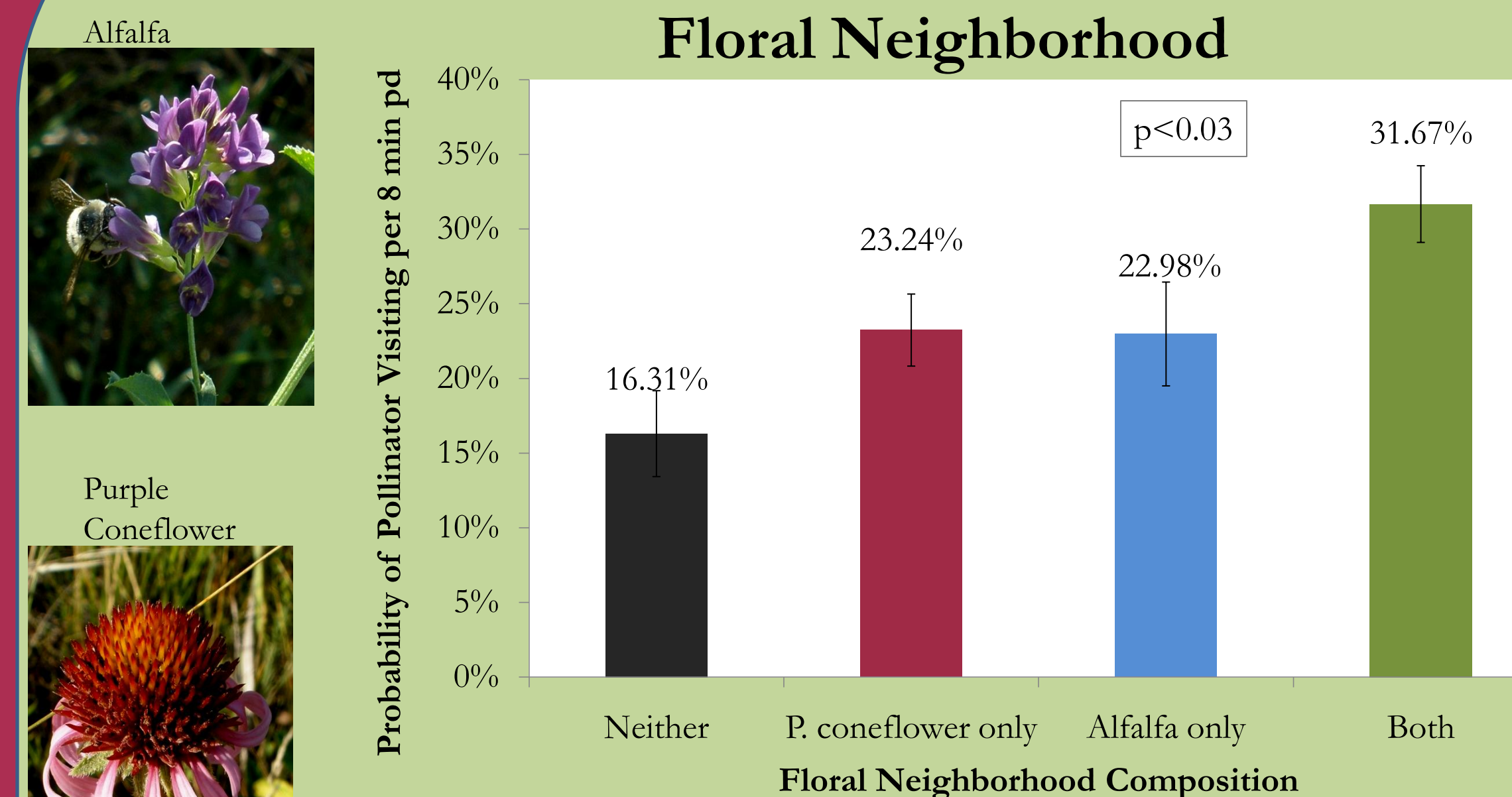


Fig. 2. Fewer Pollinators Visit Plants with Leadplant in Floral Neighborhood

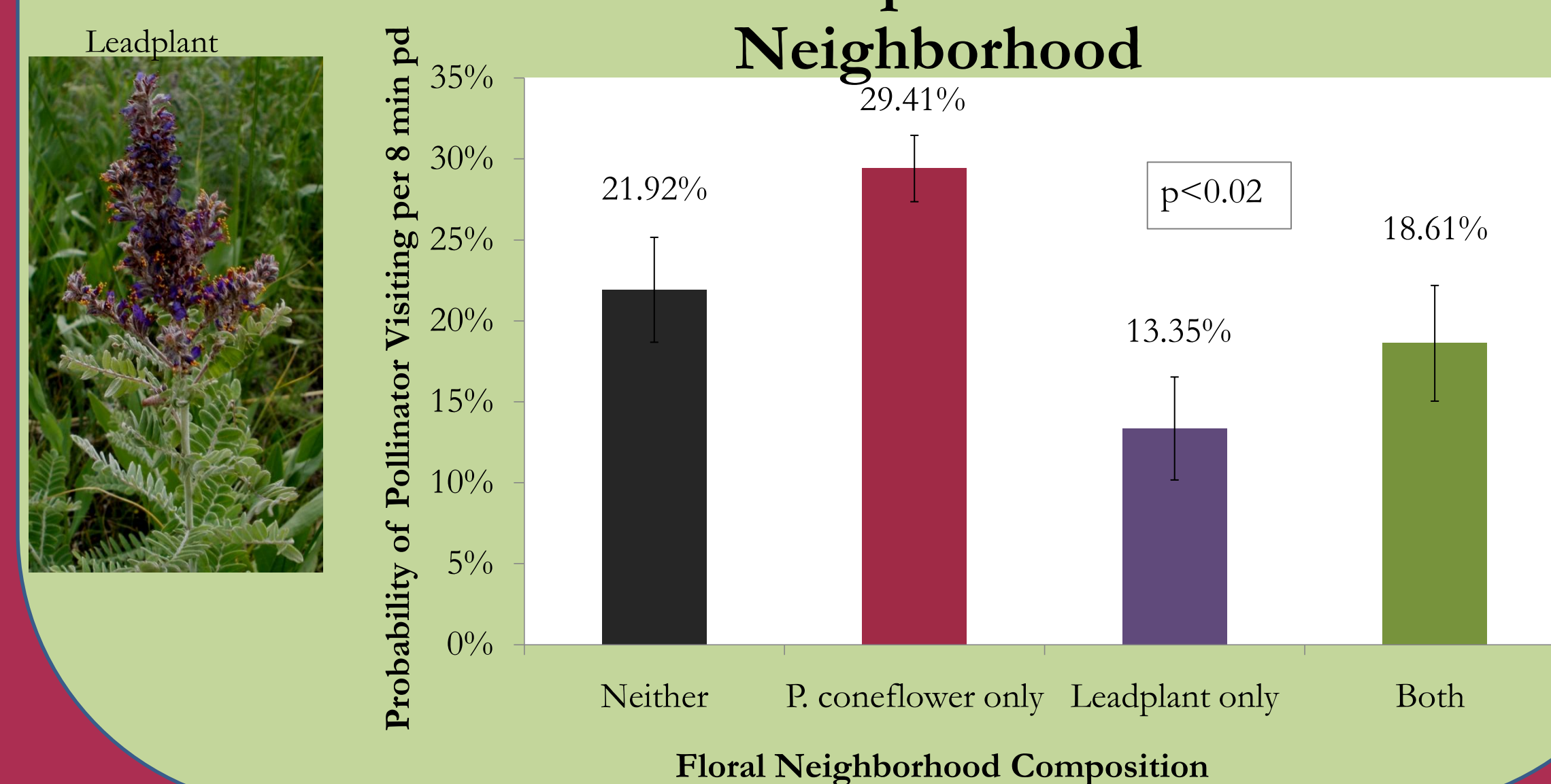
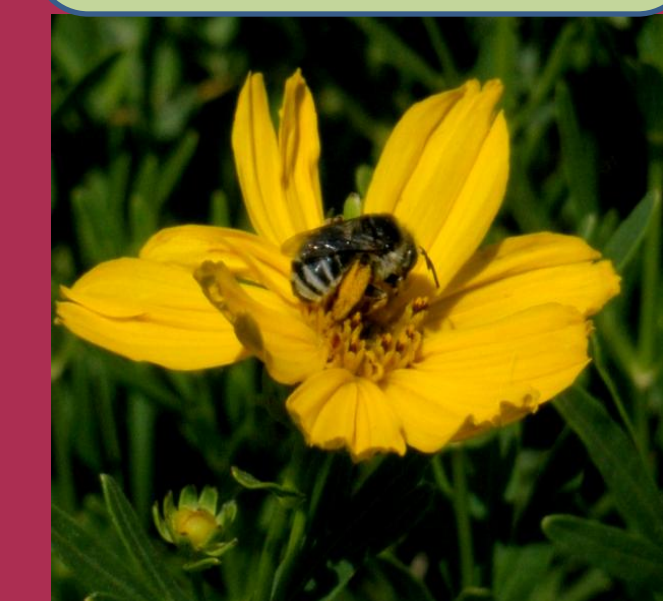


Table 1. Most Common Co-Flowering Species in Floral Neighborhood of Purple coneflower

| Species | Family |
|--|---|
| Native | |
| Leadplant (<i>Amorpha canescens</i>) | Fabaceae (The Bean Family) |
| Common snowberry (<i>Symphoricarpos albus</i>) | Caprifoliaceae (The Honeysuckle Family) |
| Bird's foot coreopsis (<i>Coreopsis palmata</i>) | Asteraceae (The Aster Family) |
| Exotic | |
| Alfalfa (<i>Medicago sativa</i>) | Fabaceae (The Bean Family) |
| Yellow sweet clover (<i>Melilotus officinalis</i>) | Fabaceae (The Bean Family) |
| White sweet clover (<i>Melilotus alba</i>) | Fabaceae (The Bean Family) |

Co-Flowering Species:



bee on bird's foot coreopsis (*Coreopsis palmata*)



bee on wild bergamot (*Monarda fistulosa*)



ant on common snowberry (*Symphoricarpos albus*)



bee on false sunflower (*Helianthus belianthoides*)



beetle on yarrow (*Achillea millefolium*)



Monarch butterfly on purple clover (*Trifolium pratense*)



purple prairie clover (*Dalea purpurea*)

Results

- Purple coneflower plants tend to have *either* leadplant or alfalfa in their floral neighborhood (only 1/224 plants had both)
- Alfalfa:** Purple coneflower plants that had alfalfa, p. coneflower, or both species in their floral neighborhoods were more likely to receive a pollinator visit in an 8 min period than those with neither alfalfa nor p. coneflower
- There is no evidence that alfalfa and p. coneflower interact in their effect on pollinator visits.
- Leadplant:** Purple coneflower plants that had leadplant in their floral neighborhoods were less likely to receive a pollinator visit in an 8 min period than those with other purple coneflower plants or neither species around them.
- There is no evidence that leadplant and p. coneflower interact in their effect on pollinator visits.

Conclusions

- Strong evidence that floral neighborhood composition influences pollinator visitation
- The effects that leadplant and alfalfa have on purple coneflower vary significantly
- If alfalfa and purple coneflower share common pollinators, there is the potential for inhibition of self pollen receipt and thus reduced reproductive success of p. coneflower
- Alfalfa pollen that pollinators are carrying onto p. coneflower could prevent the receipt of compatible self pollen by "clogging" p. coneflower styles
- There may be benefits from the eradication of exotic species that may be "stealing" pollinators from native species, and thus potentially decreasing their reproductive success

Acknowledgments

Thanks to G. Diersen, A. Dykstra, A. Halverson, K. Gallagher, A. Gallinat, M. Jensen, G. Kiefer, D. Rath, C. Ridley, and R. Shaw for their help in the field. Thanks to G. Kiefer, C. Ridley, and D. Rath for helping with database analysis. Thanks to D. Rath for the Staffanson photo. We'd like to thank NSF-REU grant 0648972 for support. Finally thanks to Chicago Botanic Garden REU and L. Egerton-Warburton and N. Zerega for this opportunity.

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