Mating compatibility of *Echinacea angustifolia* in prairie remnants of western Minnesota

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Introduction

Commercial agriculture divides Western Minnesota prairie populations into remnants, increasing the risk of extinction of native prairie forbs and limiting their ability to reproduce within each remnant (Wagenius 2006). *Echinacea angustifolia,* a long-lived self-incompatible prairie plant, depends on the availability of mates to reproduce, and reproduction rates could be lower in smaller remnant populations (Wagenius et al, 2007). There is evidence that the mating of genetically similar individuals in a population can lead to inbreeding depression, which is signified by decreased fitness (Price and Waser 1979).

Smaller remnant populations of *E. angustifolia* have lower fitness because of a lack of potential mates. Whether the style accepts pollen or not is determined by the plant's genetics, and genetically similar plants are less likely to be compatible. I hypothesize that closer plants are more likely to mate and share an S-allele or two, therefore resulting in closer crosses being more incompatible than farther crosses.

Methods

- Chose 2 prairie remnants in Douglas County, MN based on the number of flowering plants
- Randomly chose 3-5 focal plants at each remnant
- Assigned close-, medium-, and far-proximity crosses for each focal
- 3-day cross schedule
- Determined compatibility ranking
- Performed statistical analysis of generalized linear models with ANOVA

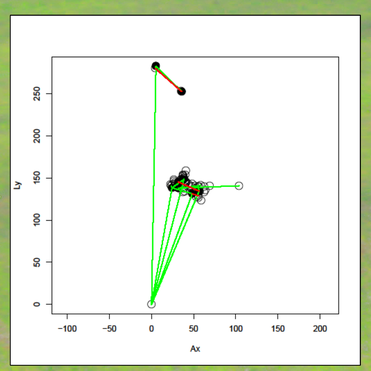


Figure 1. Site ALF crosses

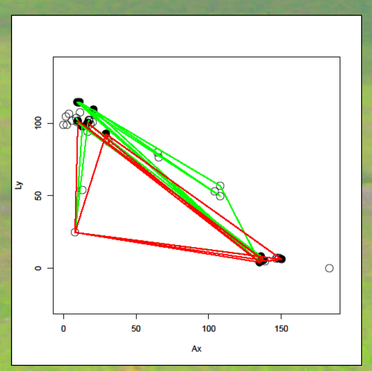


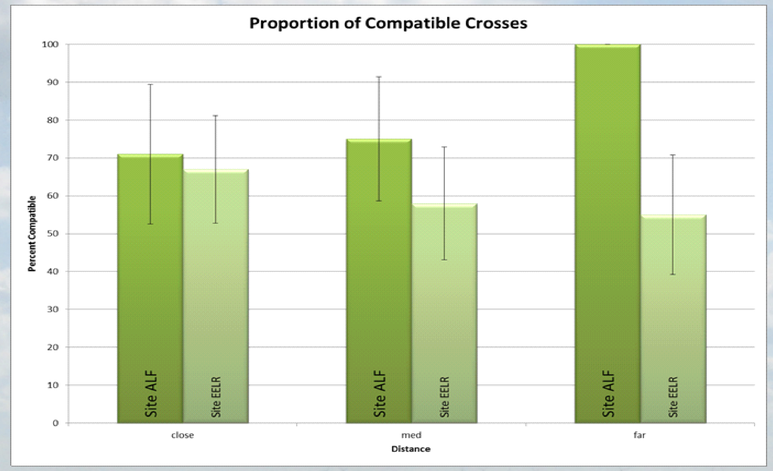
Figure 2. Site EELR crosses

Site	Close	Med	Far
ALF	0-8 m	17-43 m	72-283 m
EELR	0-7 m	59-132 m	148-167 m

Figure 3. Ranges of distance categories

Results

- Out of 21 usable crosses at Site ALF, 4 definitely not compatible, 17 definitely compatible
- Out of 38 usable crosses at Site EELR, 14 definitely not compatible, 21 definitely compatible
- Performed ANOVA tests comparing two generalized linear models
  - No evidence for a difference of compatibility between physical distances (p=0.87), no evidence for a difference when including ambiguous data (p=0.76)
  - Similar trend for the difference between distance categories (p=0.90) and difference including ambiguous data (p=0.73).
  - Evidence for a marginal difference of compatibility between locations when including ambiguous data (p=0.06), less marginal when excluding ambiguous data (p=0.09)



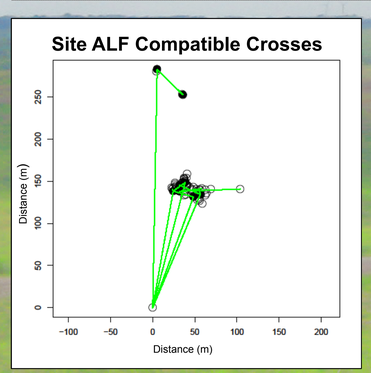


Figure 4

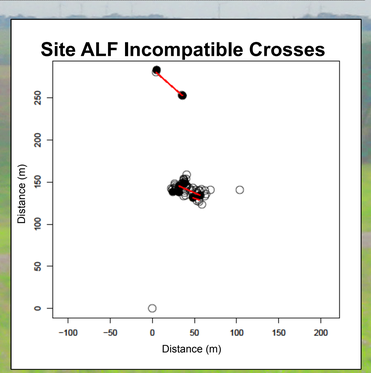


Figure 5

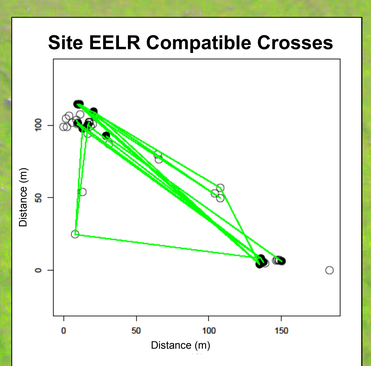


Figure 6

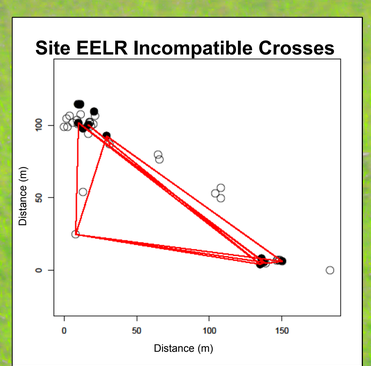


Figure 7

Figure 8. Placing pollinator exclusion bags

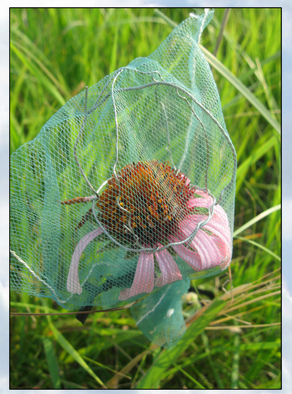


Figure 9. Pollinator exclusion bags eliminate contamination

Conclusions

- Although it has been hypothesized that habitat fragmentation will decrease the ability for plants to successfully reproduce (Wagenius et al 2007):
  - The data indicate there is no statistically significant evidence that fragmentation affects the plants' ability to cross.
  - Though nearest neighbors tend to be incompatible (Wagenius 2006), in this experiment about 70% of nearest-neighbor crosses were compatible in both remnants
  - Compatibility proportions at Site ALF followed expected trends while those at Site EELR were the exact opposite
  - Some crosses were difficult to analyze (e.g. styles eaten, strangely-shaped, etc.), so there could be some error

Figure 10. Painted bracts on an *E. angustifolia* head

References and Acknowledgments

Price, M.V., and Waser, N.M. (1979). Pollen dispersal and optimal outcrossing in *Delphinium nelson*. *Nature, 277,* 294-297

Wagenius, Stuart. (2006). Scale Dependence of Reproductive Failure in Fragmented *Echinacea* Populations. *Ecology, 87(4),* 931-941.

Wagenius, Stuart, Lonsdorf, Eric, and Neuhauser, Claudia. (2007). Patch Aging and the S-Allee Effect: Breeding System Effects on the Demographic Response of Plants to Habitat Fragmentation. *The American Naturalist, 169(3),* 383-397.

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