



Style persistence, pollen limitation, and edge effects in fragmented *Echinacea angustifolia* populations



James Eckhardt¹, Stuart Wagenius²
¹Gustavus Adolphus College ²Chicago Botanic Garden

Introduction

North American prairies have been highly fragmented since European settlement, and disturbed edges are prevalent.

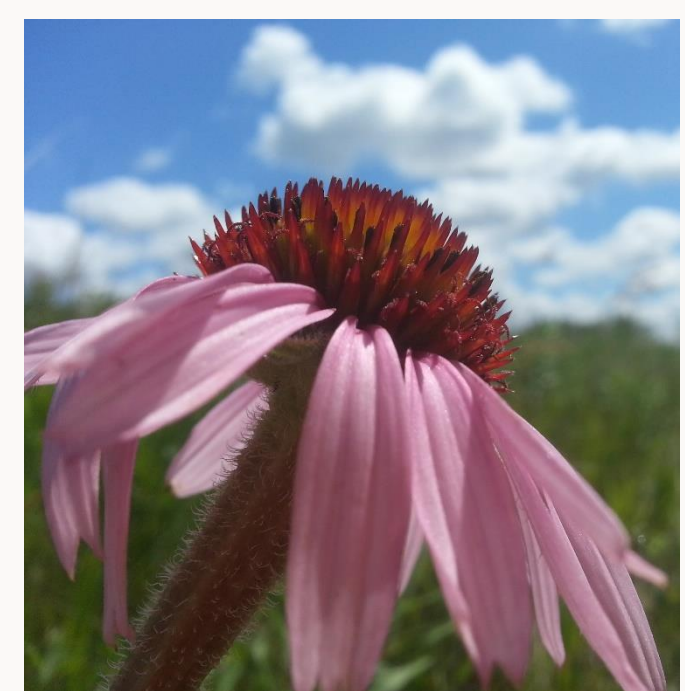
Fragmentation reduces the reproductive success of many native species including *Echinacea angustifolia*.

Pollen limitation reduces reproductive success; limitation increases as individuals are more isolated (Wagenius 2006).

Edge effects also may be responsible for increased pollen limitation.

I investigated the relationship between pollen limitation, measured by style persistence, and distance to habitat edge.

Echinacea angustifolia



Long-lived

Self incompatible

Pollinated by generalist pollinators

Reproduction limited by pollen quality and quantity

Results

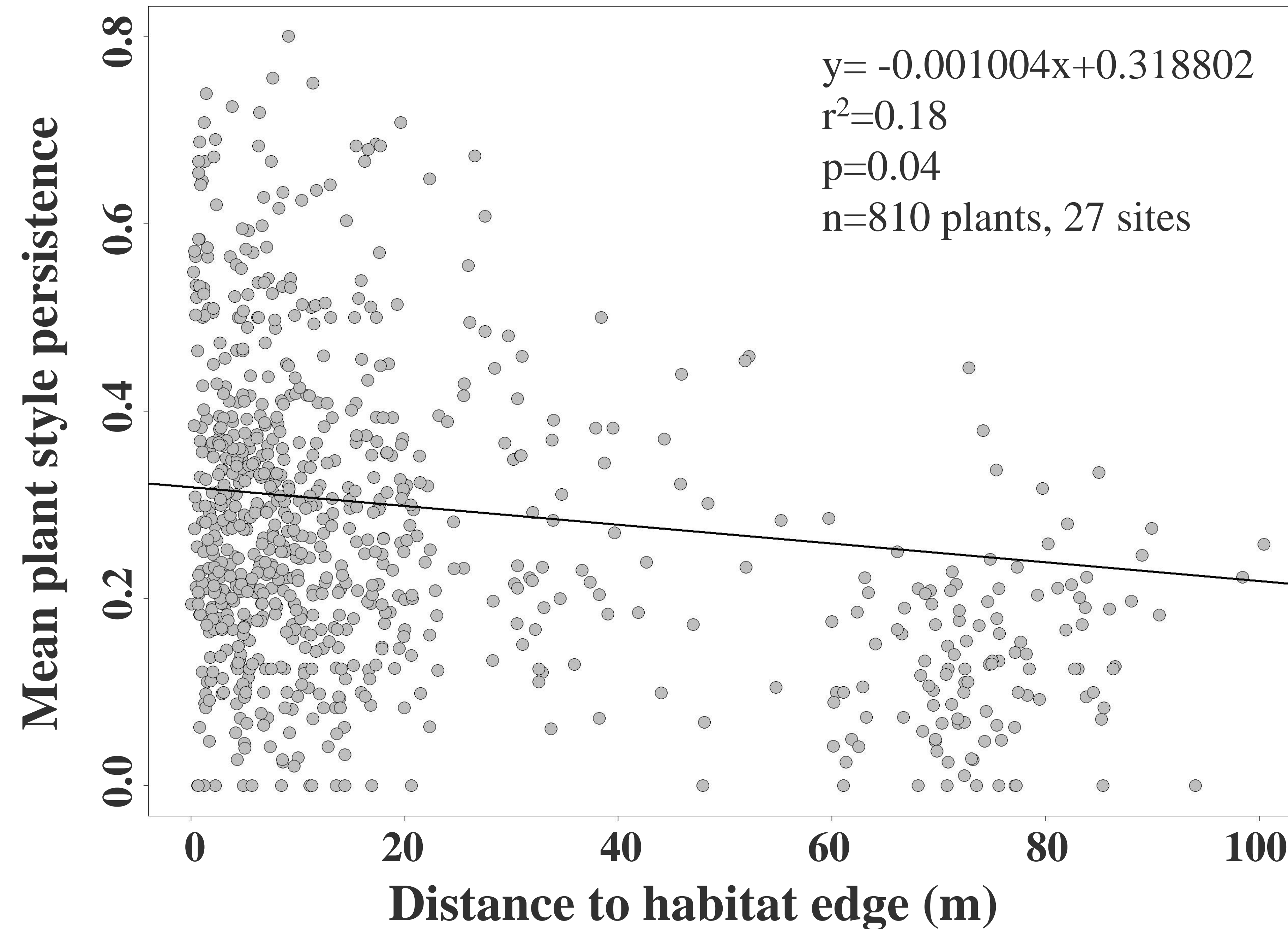


Figure 1. The relationship between style persistence and distance of a plant to edge after accounting for site. **As distance to habitat edge increased, pollen limitation, measured by style persistence, significantly decreased.** In five models tested, distance to habitat edge predicted style persistence. In three cases, an interaction between site and distance to habitat edge also influenced style persistence.

Discussion

Style persistence in *Echinacea* plants decreases as distance to edge increases, indicating that **plants farther from habitat edges experience better pollination**, which could result from greater pollen quality or quantity. Plants with lower pollen limitation tend to have higher seed set and fecundity (Wagenius 2004).

The most important predictor of style persistence was distance to edge, suggesting edge effects increase pollen limitation. Reproductive fitness can decrease as pollen limitation increases (Wagenius 2004).

If *Echinacea* can act as a model for how edge effects limit pollination of other prairie species, then the reproductive fitness of other species may decline with increasing fragmentation.

Spatial patterns, both edge and isolation, influence pollen limitation and reproduction. Future studies could focus on exploring the relative influence of edge versus isolation on pollen limitation. Additionally, experimental manipulations can provide powerful support for observational studies.

Methods

Measured style persistence of 810 *Echinacea* plants during summer 2016 every other day throughout flowering

Mapped habitat edges of 27 remnant sites and positions of 810 study plants

Quantified relationship between distance to habitat edge and style persistence using a linear model

Citations & Acknowledgements

Wagenius, S. 2006. Scale dependence of reproductive failure in fragmented *Echinacea* populations. *Ecology* 87:931–941.

Wagenius, S. 2004. Style persistence, pollen limitation, and seed set in the common prairie plant *Echinacea angustifolia* (Asteraceae). *International Journal of Plant Sciences* 165:595–603.

Acknowledgements:

Thanks to the 2016 members of Team Echinacea for high quality data collection and Dr. Pamela Kittelson, Gustavus Adolphus College. This research has been supported by the National Science Foundation (awards 1355187, 1052165, 1051791, and REU supplements).