

Phenology of *Echinacea angustifolia* and other co-flower species



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Introduction

The grassland prairies of North America once covered nearly 162 million ha of land. However, approximately 99.9% has been destroyed and the .1% of native prairies that still remain are highly fragmented which can lead to reproductive problems such as pollen limitation (Samson and Knopf, 1994). A study conducted on the model species *Echinacea angustifolia*, the purple coneflower, found that highly isolated plants that received greater pollinator visits had increased pollen limitation and decreased seed set when compared to more densely populated plants receiving fewer pollinator visits (Wagenius and Lyon, 2010). A plausible explanation for this result is pollen interference from co-flowering plants. It was found that pollen from *Heliopsis helianthoides* has a 70% chance of interfering with *E. angustifolia* pollen, while two other co-flowering species with similar pollen only had a less than 20% chance of interfering (Halverson and Wagenius, 2010). This leads to the question of: What are the chances that this foreign pollen will be deposited onto the *E. angustifolia* plant? Many factors could contribute, one of the most important is how synchronous the phenology of these species are. This study will look at the phenology of *E. angustifolia* and compare it to *Heliopsis helianthoides*, *Careopsis palmata*, and *Carduus acanthoides*.

Objectives

- Discover the phenology of *E. angustifolia*, *H. helianthoides*, *C. palmata*, and *C. acanthoides*
- Determine and quantify how synchronous the species are with *E. angustifolia*
- How does the phenology vary among remnants

Methods

- Seven remnants in Douglas co, MN of various sizes and disturbance were selected that contained *E. angustifolia* and at least one other co-flowering species.
- The sites were surveyed in the morning while pollen was shedding every 2-4 days.

E. angustifolia and *H. helianthoides*

- Each individual plant was flagged and numbered.
- First day of flowering was considered first day of pollen shed, and assessed by how many rows of styles and or anthers were present (one row/day)
- Last day was determined by last day of pollen shed.

C. palmata and *C. acanthoides*

- The total number of flowering heads of each species was counted for each site on the surveying day.



H. helianthoides



E. angustifolia



C. palmata



C. acanthoides

Abstract

Highly fragmented prairie habitats have led to many problems involving the prairies ability to reproduce and maintain a healthy and diverse biota. The objective of this study was to determine if some species of plants have a significant amount of phenological overlap to potentially cause pollen interference. Various remnants were visited on a regular schedule and the flowering times of three co-flowering species were recorded and compared to the model species *E. angustifolia*. The Results showed *E. angustifolia*, *H. helianthoides*, and *C. palmata* overlapping significantly enough in phenology to have the potential of pollen interference with each other. This could result in lower seed set in more isolated plants that receive a greater number of pollinator visits.

Results

H. helianthoides

- On average an earlier starting and peak flowering time when compared to *E. angustifolia*.
- The greatest difference in synchrony occurred between Staffenson prairie preserve, a 95 acre (384,451m²) prairie restoration, and Nessman's, a 4,072m² roadside ditch next to corn fields.
- The sites significantly differ with a 95% confidence interval.

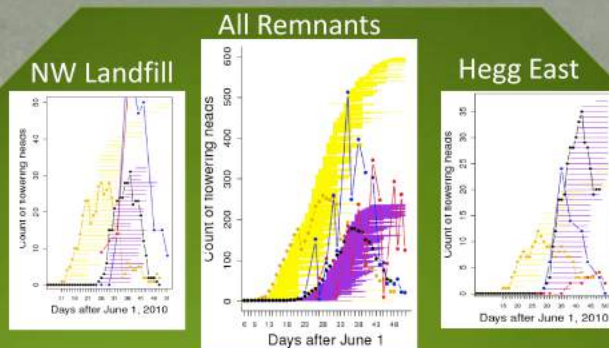
C. palmata

- mean difference in peak flowering dates with *E. angustifolia* in remnants where they both occur is indistinguishable from zero. With the exception of one remnant that peaked 7 +/- 2 days before.

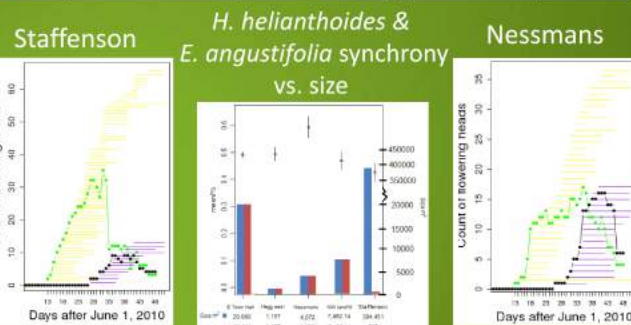
C. acanthoides

- Flowering times differed widely.
- Is mowed down frequently by human activities.

Results



● *E. angustifolia* flowering duration of individual head
 ● # flowering *E. angustifolia* heads each day
 ● # flowering *C. acanthoides* heads each day
 ● *H. helianthoides* flowering duration of individual head
 ● # flowering *H. helianthoides* heads each day
 ● # flowering *C. palmata* heads each day



Discussion

- E. angustifolia* and *H. helianthoides* overlap in phenology to have the potential of pollen interference with each other resulting in lower seed set in more isolated plants that receive more pollinator visits.
- C. palmata* has the greatest potential to interact with *E. angustifolia* because they flower so synchronously. It may not thrive as much, but since it's so synchronous, it might. Also, *C. palmata* & *E. angustifolia* may compete for pollinators or facilitate visitation.
- C. acanthoides* ability to flower at the same time as Echinacea depends directly on human activities--namely mowing.
- Larger and more diverse remnants would have less potential for pollen interference due to their less synchronous phenology.
- The next step towards proving pollen interference as a justifiable reason for lower seed set in smaller remnants would be to determine the type of pollinators visiting each species and their pollinating efficiencies.

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References

- Samson, F. B., and F. L. Knopf. 1994. Prairie conservation in North America. *Bioscience* 44:418-421.
- Wagenius, S.W., S.P. Lyon. 2010. Reproduction of *Echinacea angustifolia* in fragmented prairie is pollen-limited but not pollinator-limited. *Ecology* 91:733-742.
- Halverson and Wagenius. 2010. Pollen interference in *Echinacea angustifolia* from three co-flowering species in the Asteraceae. *ESA Abstract*. 2 August 2010, Pittsburgh, PA.