



Flowering Phenology of the Prairie Forb *E. angustifolia* in Fragmented Populations

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Introduction

In Western Minnesota, large-scale agriculture has encroached upon native prairie, creating isolated remnants. This fragmentation may alter the flowering phenology (timing and duration of flowering) and decrease fitness of prairie flora. Isolation may disrupt the continuity of environmental conditions (i.e. most of the remnants are on hillsides too steep for agriculture) and inhibit gene dispersal between remnants, two factors that play important roles in determining flowering phenology. Burning could also alter the flowering phenology and/or synchrony patterns of remnants. All of these conditions may cause plants at different remnants to flower asynchronously, making them less likely to cross-pollinate (Ison, 2010). This study seeks to discover any differences in phenology and synchrony between and within remnant prairies.

Research Questions

- Is there a difference between the flowering phenology of *E. angustifolia* at different prairie remnants? Furthermore, is there a correlation between the size of a remnant and its flowering phenology?
- Does burning have an effect on the flowering synchrony of plants within a burned site as well as between burned and unburned sites?

Materials & Methods

- Six prairie remnants of different sizes (located in Douglas County, MN) were chosen during the 2012 growing season and all flowering plants were located. (For the largest remnant, Staffanson Prairie Preserve, a random subset of 40% of all flowering plants was selected)
- Flowering heads were evaluated every two days.
- The first and last day of flowering for each head was recorded.

Study Species:

Echinacea angustifolia

- Long-lived herbaceous plant
- Native to Western tallgrass prairie
- Self-incompatible (cannot produce viable seeds using self-pollen)

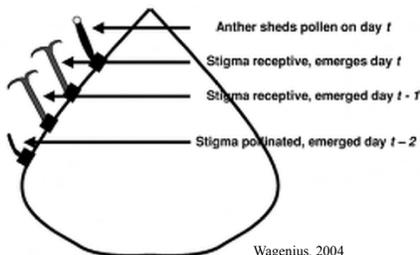


It's my first day of flowering!

How do *Echinacea* flower?

- Heads flower in concentric rows starting from the base and proceeding upward.
- Each floret produces a pollen-shedding anther on the first day of flowering and pollen-collecting style on its second day.
- Styles persist until compatible pollen is received.

First day of flowering - First appearance of pollen-shedding anthers
Last day of flowering - Last day of anther production



Wagenius, 2004

Figure 1. A cross section of flowering *Echinacea*.

Results

Key:

- East Elk Lake Road
- Around Landfill
- Northwest of Landfill
- North-northwest of Landfill
- Staffanson Prairie Preserve (unburned)
- Staffanson Prairie Preserve (burned)

grey = 2011 data
black = 2012 data

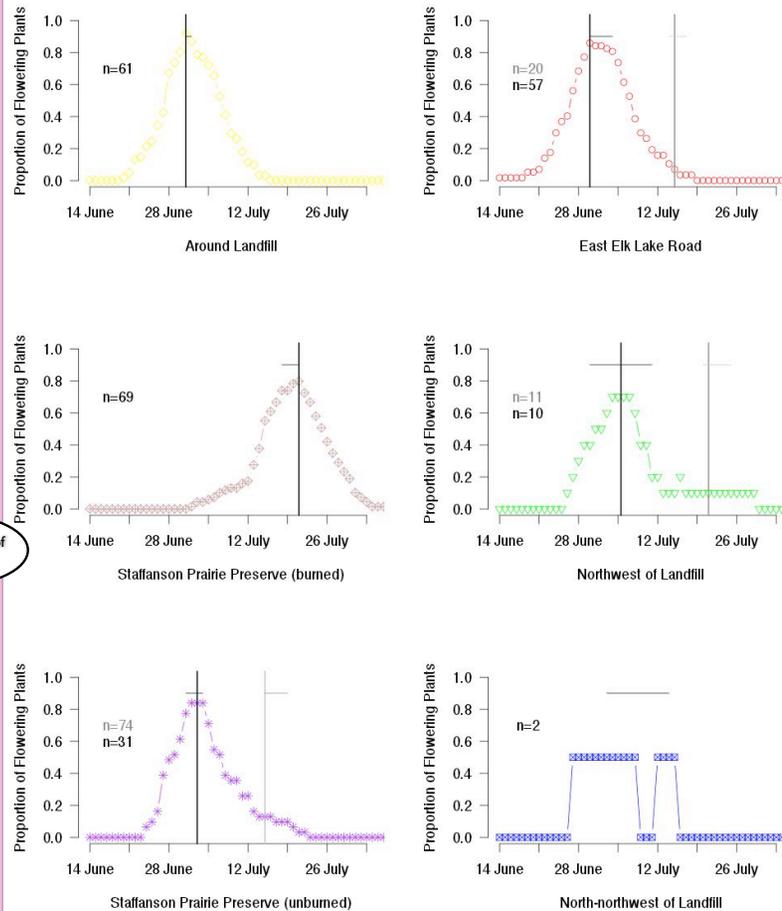


Figure 2. Flowering phenology curves appear similar for all remnants with the exceptions of North-northwest of Landfill (which contained only two flowering heads) and the burned portion of Staffanson Prairie Preserve. Vertical lines mark peak flowering based on the greatest proportion of flowering plants. Horizontal lines mark the 95% confidence interval based on a bootstrap resampling method with 100,000 repetitions. Each tick mark represents a 7-day span. A total of 230 flowering *E. angustifolia* heads were observed.

Results Continued

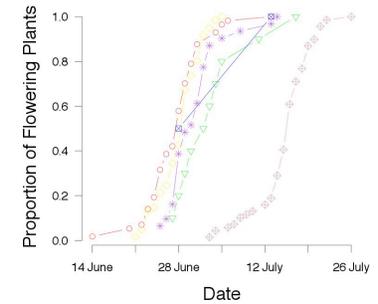


Figure 3. The flowering accumulation curves, which depict the proportion of *E. angustifolia* that had begun flowering on a given day, appear similar for all remnants with the exception of the burned portion of Staffanson Prairie Preserve, which was burned on May 21, 2012, relatively late in the growing season.

Conclusions

- Fire can alter the flowering phenology of remnant prairies. The burned portion of Staffanson Prairie Preserve peaked 19-20 days after the other remnants. The lack of synchrony between burned and unburned remnants suggests temporal isolation, possibly leading to a lack of cross-pollination between asynchronous remnants.
- Phenology and accumulation patterns were similar between remnants within the 2012 season.
- Peak flowering was an average of 15 days earlier in 2012 than 2011.
 - Possibly due to variation in weather patterns between years. Further study is needed to correlate weather patterns and flowering phenology.

Further Analysis

- Combined analysis of 2011 & 2012 data
- Comparison between remnant phenology and phenology of the offspring of remnant plants planted in a common plot
- Evaluation of flowering synchrony within and between remnants
- Evaluation of burning on flowering synchrony (data from 2009 & 2012)

Literature Cited

- Ison, J. 2010. Pollination of *Echinacea angustifolia*: Effects of Flowering Phenology and Spatial Isolation. Doctoral dissertation. University of Illinois at Chicago. Chicago, Illinois.
- Wagenius, S. 2004. Style Persistence, Pollen Limitation, and Seed Set in the Common Prairie Plant *Echinacea angustifolia* (Asteraceae). *International Journal of Plant Sciences* Vol. 165, No. 4 (July 2004), pp. 595-603
- Zahler, A. 2012. Flowering Phenology and Seed Set in Fragmented Populations of the Prairie Plant *Echinacea Angustifolia*. Lake Forest College Senior Thesis.

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