Flowering schedules of *Echinacea angustifolia*

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INTRODUCTION

Echinacea angustifolia, the narrow-leaved purple coneflower, is a model prairie flower.

Most of the prairie has been destroyed, leaving only small, isolated populations intact.

Echinacea produce one flowering head called a solo head, or multiple heads called ensemble heads per year.

Each head contains rows of florets that produce anthers one row at a time from bottom to top.

Echinacea are also self-incompatible, so plants maximize the probability of being pollinated when they align their flowering schedules with those of nearby *Echinacea*.

HYPOTHESES

Flowering schedules of solo and ensemble heads differ.

Flowering schedules do not differ between different populations when grown in a common environment.

METHODS

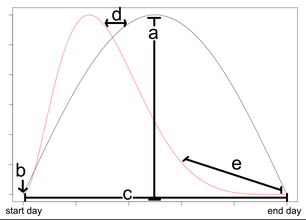
212 *Echinacea* were planted in randomized locations within an experimental plot.

In 2005, flowers on each of the 348 heads were counted daily except on July 12.

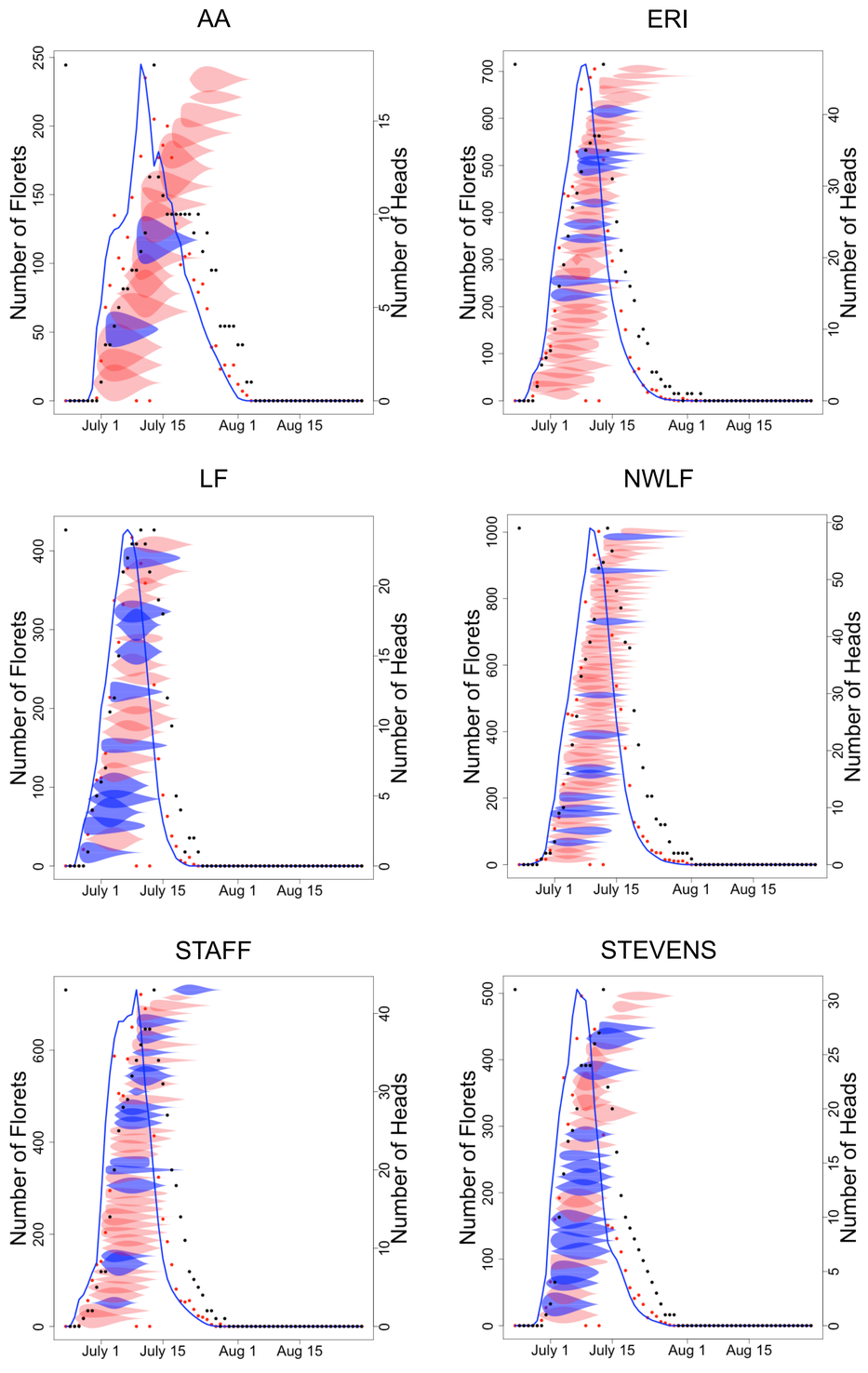
The flowering schedule of *Echinacea* can be modeled by:

$$\mathbf{a[\sin(\pi(\frac{t-b}{c})^{d})]^{e}}$$

- a = maximum
- b = start day
- c = duration
- d = lateness
- e = length of tails



Flowering schedules of heads in 6 populations:



KEY:
- Solo Head
- Ensemble Head
- Flowering Schedule of Population
- Open Florets per Day
- Flowering Heads per Day

RESULTS

Solo vs Ensemble Heads:

Flowering schedules do not differ between head types (one-way MANOVA: $F_{(1,345)} = 0.50$, $p = 0.773$, Wilk's $\Lambda = 0.99$).

Comparing Populations

Flowering schedules differ by population (one-way MANOVA: $F_{(5,216)} = 2.54$, $p<0.001$, Wilk's $\Lambda = 0.72$).

Populations' flowering schedules differ by:

- Start Date (one-way ANOVA: $F_{(5,216)} = 5.89$, $p<0.001$)
- Duration (one-way ANOVA: $F_{(5,216)} = 2.31$, $p=0.045$)
- Lateness (one-way ANOVA: $F_{(5,216)} = 4.21$, $p=0.0011$)

CONCLUSIONS

The difference in flowering schedules between populations planted in a common environment indicates genetic divergence in the natural populations which has implications for conservation biology.

Because flowering schedules do not differ between solo and ensemble heads, all heads contribute equally to the the population flowering schedule which is important for pollinators.

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REFERENCES

Ison, J.L. & Wagenius, S. (2014). Both flowering time and distance to conspecific plants affect reproduction in Echinacea angustifolia, a common prairie perennial. *Journal of Ecology*. **102**, 920-929.

Malo, J.E. (2002). Modelling unimodal flowering phenology with exponential sine equations. *Functional Ecology*. **16**, 413-418.