Latitudinal differences in the flowering phenology of common milkweed

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Background

- **Phenology**, the timing of life cycle events such as leafing out or flowering, is a major life-history trait for plants.
- Latitudinal population differentiation in phenology has been shown in a variety of plant taxa (e.g. purple loosestrife[1], ornamental jewelweed[2], common ragweed[3]). This pattern supports phenological adaptation to local conditions, namely growing season, across the range of a species.
- Flowering phenology directly influences when and how nectar resources are available to pollinators. Shifts in phenology have been found to impact reproductive success in some plant taxa, especially those with specialist pollinators or limited flowering periods[4-5].

Objective

Quantify variation in phenology among 3 sources of *Asclepias syriaca* collected along a latitudinal gradient and grown in a common garden (Glencoe, IL).

Methods

- Fall 2013: Seed was collected from three natural populations of *Asclepias syriaca* along a latitudinal gradient. Populations were located in Minnesota, Illinois, and Missouri and all originate from distinct ecoregions (fig. 1).
- Spring 2014: 144 plants were propagated from each population and planted out into a common garden at Chicago Botanic Garden (Glencoe, Illinois). (fig. 5).
- Summer 2016: Phenology data was collected for each individual twice weekly. Twelve phenophases were defined, four of which refer to flowering stages (fig. 2).

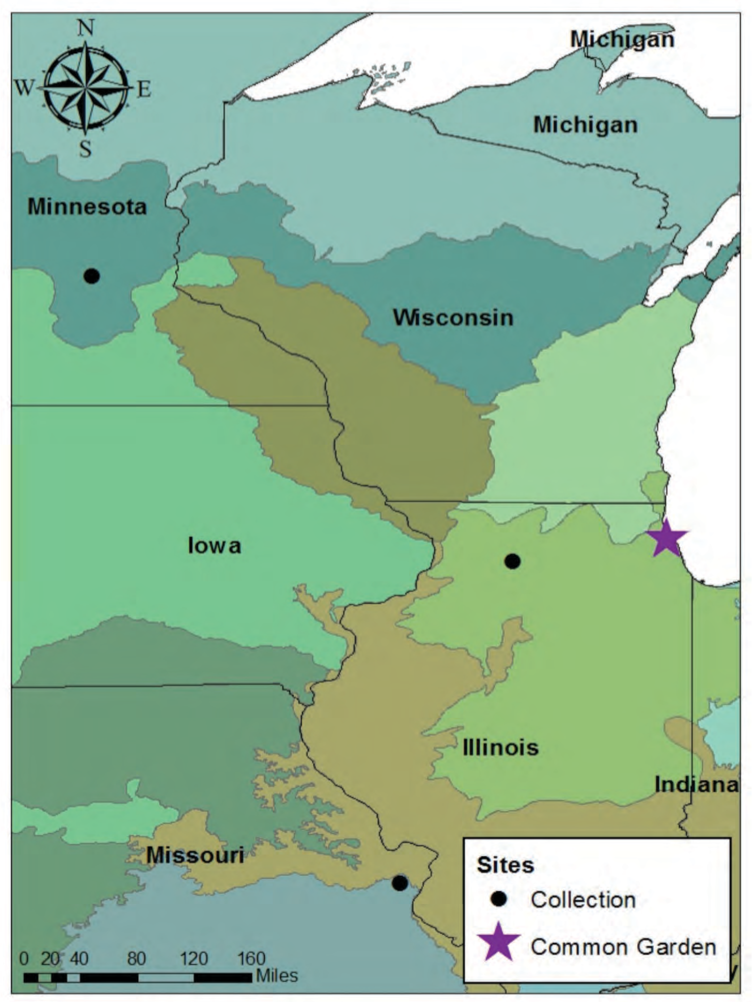
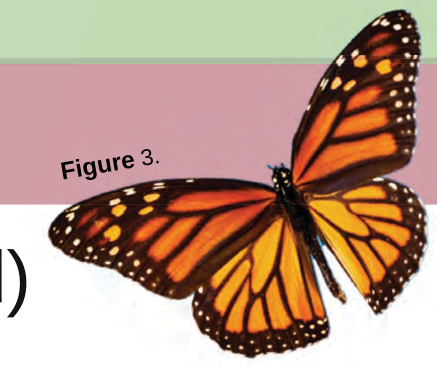


Figure 1. Map of seed collections and common garden location over EPA Level III Ecoregions.

Figure 2. Bud and flowering phenophases for common milkweed.

Study Species



Asclepias syriaca (common milkweed)

- Family: Apocynaceae
- Perennial plant native to the majority of the U.S and southern Canada
- Obligate host genus for monarchs (fig. 3) & important general nectar resource
- Reproduces sexually (wind-dispersed seeds) and asexually (rhizomes)
- Common in prairies, woodland edges, old fields, vacant lots, fence rows, and along railroads and roadsides

Results

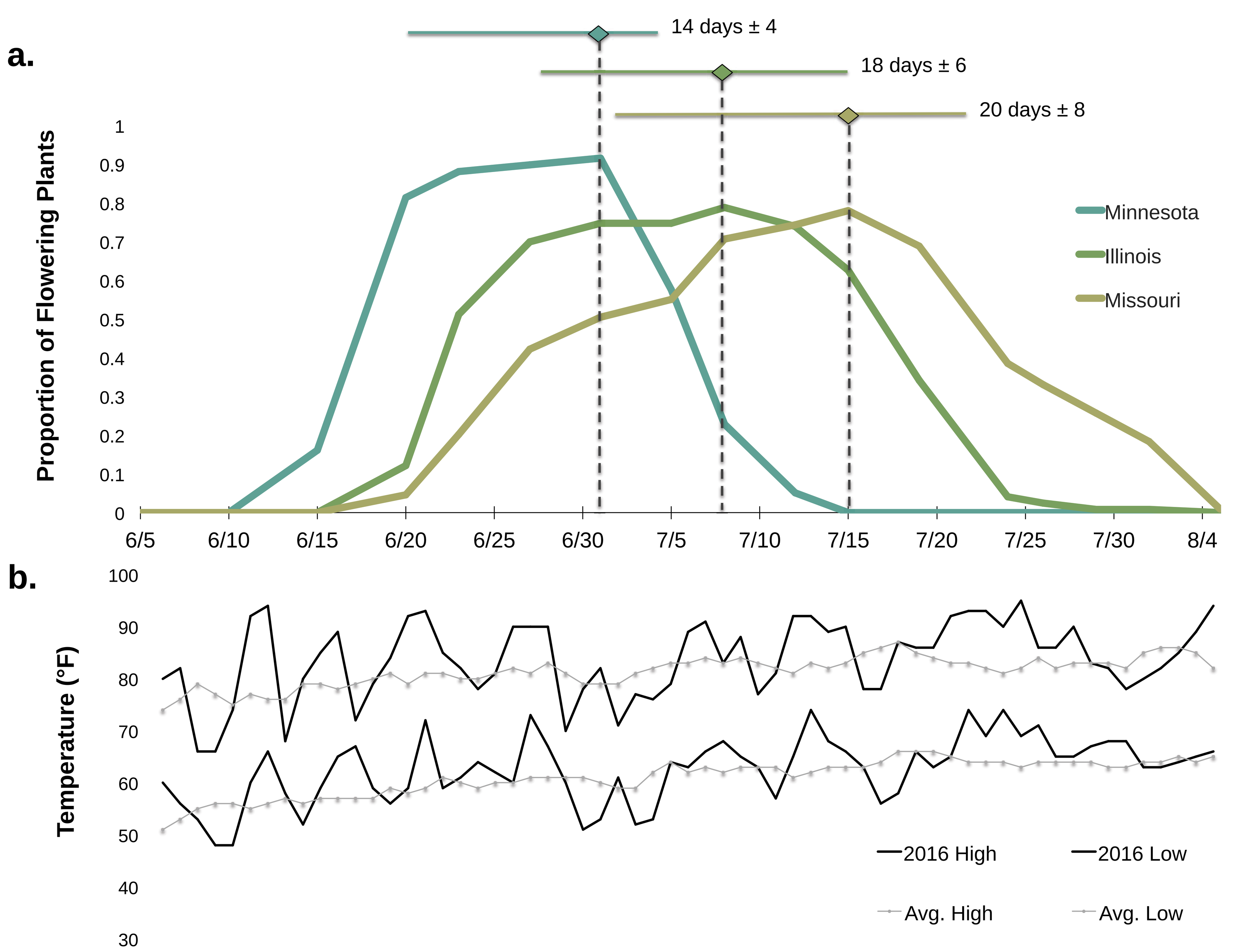


Figure 4. a. Proportion of flowering plants per population (June 5-Aug. 5, 2016) with horizontal bars indicating length of flowering period (mean days ± SD) and diamond marking date of peak flower. Northern populations flowered significantly earlier, but for a shorter period, than southern populations ($p < 0.05$). The Minnesota population had significantly more plants in flower at peak flower than the two southern populations ($p = 0.01$). **b.** Daily high and low temperatures for 2016 and historic averages (1987-2016; Glencoe, IL).

Table 1. Timing of flower (average date ± SD), proportion of flowering individuals, and survival per population. Total = % of plants that flowered; peak = % of flowering individuals at peak flower.

	Flower			Date of Flowering Event		
Population	**Total**	**Peak**	**Survival**	**First**	**Last**	**Length**
Minnesota	92.3%	92.3%^{a}	81.25%	6/20/16 ± 4^{a}	7/4/16 ± 3^{a}	14 days ± 4^{a}
Illinois	93.3%	80.8%^{b}	83.33%	6/27/16 ± 7^{b}	7/15/16 ± 4^{b}	18 days ± 6^{b}
Missouri	92.5%	79.6%^{b}	75.00%	7/2/16 ± 8^{c}	7/22/16 ± 7^{c}	20 days ± 8^{c}

^{abc} Values within a column with different superscripts are different ($p < 0.05$; equality of proportions test or one-way ANOVA)

Discussion

Figure 5. Common garden at Chicago Botanic Garden (left) and common milkweed close-up (right).

- Common milkweed plants propagated from wild-collected seed retain flowering phenology adapted to the source site, resulting in significantly different timing of flowering, length of flowering window, and nectar resource availability (fig.4a and table 1).
- Our results expand on a prior finding of accelerated phenology in northern populations of common milkweed (based on early season height measurements[6]).
- The recent monarch decline has resulted in unprecedented demand for genetically-appropriate milkweed for habitat creation efforts in the priority migratory corridor of the Midwest U.S. Our results highlight the need to consider phenological variation when making seed sourcing decisions.

Conclusion

Populations of common milkweed collected along a latitudinal gradient display clear differences in phenology, including timing, length of flowering window, and proportion of flowering plants.

Future Research

- How do phenological differences effect monarch utilization and oviposition?
- Does a longer flowering window create more pollinator activity?
- How quickly can a population adjust it's phenology to a new ecoregion?
- Does timing and length of flowering window impact reproductive success? (fig. 6)

Figure 6. Aborted and viable fruits

Acknowledgments

I would like to thank Jessa Finch, Kayri Havens-Young, and Victoria Lason, as well as Courtney Hughes and her staff and volunteers.

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