Pollinator Floral Resources in Response to Extreme Drought in Mesic Successional Old-Field Grasslands

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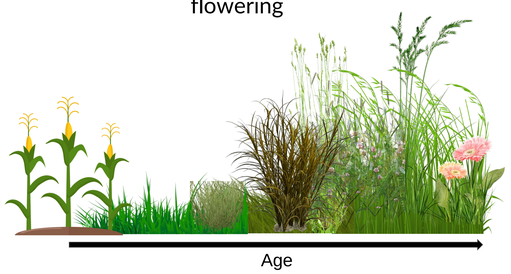
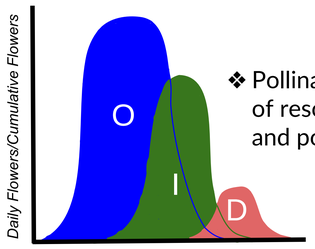
United States Department of Agriculture National Institute of Food and Agriculture

National Science Foundation LTER Network Long Term Ecological Research

Introduction

- *Secondary succession*: Disturbance (i.e. abandoned agriculture field) → Regrowth of biological community
- Links between climate change and flower-pollinator interactions have been heavily studied - *drought* as a subset has not
- Secondary succession is known to cause differential effects in flowering





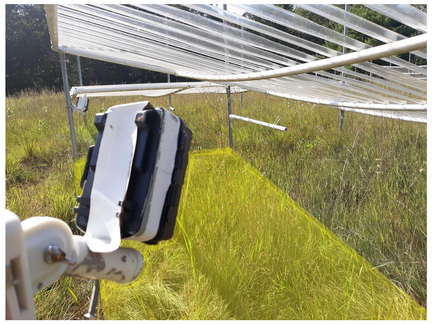
- Pollinators depend heavily on timing and abundance of resources that in turn influence flower reproduction and pollinator survival

In this experiment, we examined the effects of shading and drought on plant communities to evaluate the effects these have on flowering potential of different communities across fields of varying ages

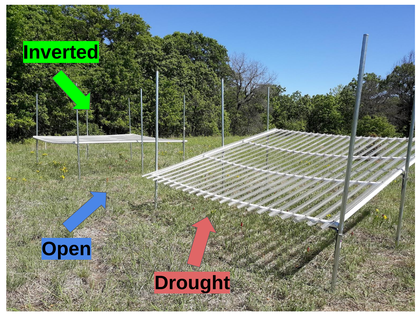
Methods

- All plots were randomly assigned treatments within blocks amongst the five fields at Cedar Creek

Cedar Creek Ecosystem Science Reserve, University of Minnesota



- Highlighted section: Total area that was surveyed for flower counts in one plot

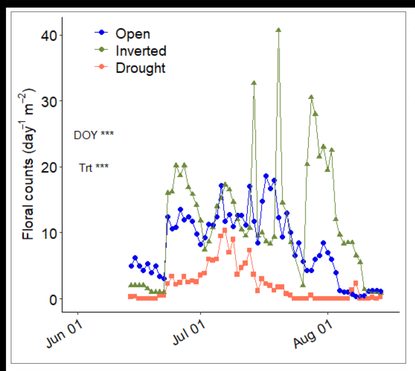


- Open: Control
- Inverted: 100% Precipitation & shading
- Drought: ~43% precipitation

- Fields vary in age - youngest to oldest ------ 601 10 41 4 72

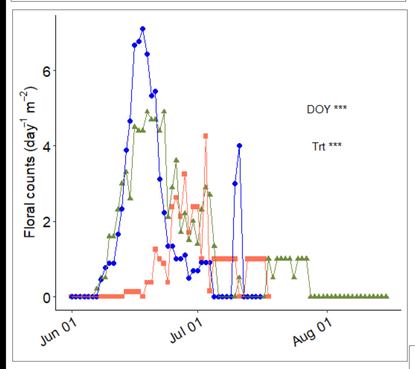
Succession will be different in each field!

Results 1:Daily Change



We found a significant difference between the three treatment groups in **2021** (Linear Mixed Effects Model: $F_{(2,980.54)}$ = 44.589, p < 0.001).

- Inverted reached a higher peak flowering than open or drought
- Drought reached decline faster than the other two treatments

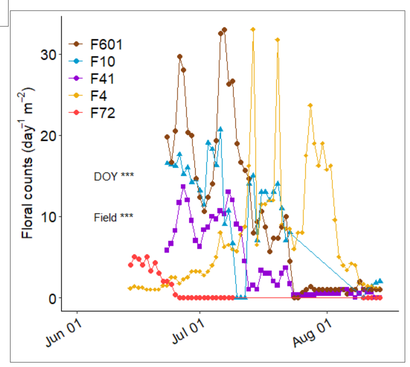


There was a significant difference between the three treatment groups in **2022** (Linear Mixed Effects Model: $F_{(2,994.82)}$ = 44.289, p < 0.001).

- Open had a much higher peak in flowering than inverted or drought now
- Drought was delayed in peak flowering

The five fields of different age and succession in **2021** had a significant difference (Linear Mixed Effects Model: $F_{(4,968.73)}$ = 62.198, p < 0.001).

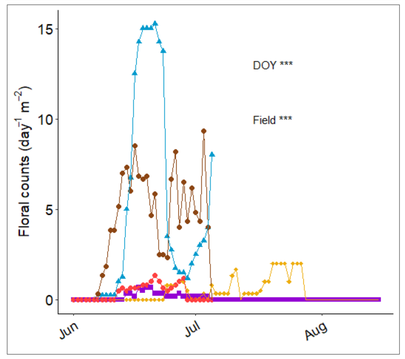
- F601 and F4 had the highest peak flowering abundance
- F72 had a few blooms in mid June but none from late June to mid August



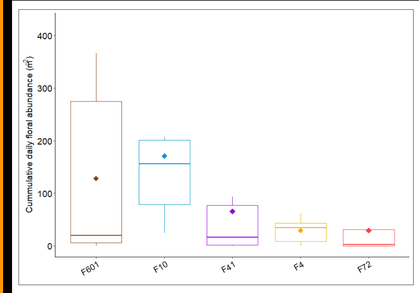
We also found a significant difference between the five fields of different age and succession in **2022** (Linear Mixed Effects Model: $F_{(4,968.73)}$ = 62.198, p < 0.001).

- F10 had the highest peak abundance now
- F4 now had a delayed peak, but it was much lower than in 2021

*Data for 2022 is incomplete from early - mid June and onwards

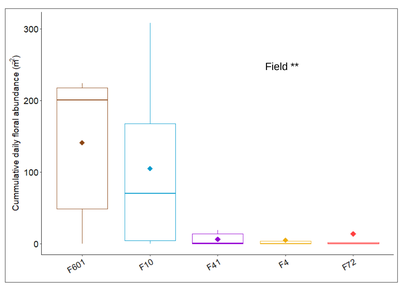


Results 2: Cumulative Change



The five fields of different age and succession in **2021** were not significantly different (Linear Mixed Effects Model: $F_{(2,22.152)}$ = 2.2169, p = 0.1325).

- F601 had the greatest spread in data
- F10 had the greatest mean
- F4 and F72 had the lowest average cumulative floral abundance



There was a significant difference in the five fields of different age and succession in **2022** (Linear Mixed Effects Model: $F_{(4,23)}$ = 4.4726, p = 0.008).

- F601 and F10 had the largest spread and means
- F41, F4, and F72 had the lowest means (<10)

Discussion & Future Directions

Discussion:

- Drought causes a delay in the time of peak flowering
  - May shift when pollinators migrate for resources
- Significantly decrease in the amount of flowers produced during the flowering season during drought
  - Less flowers → lower amount of resources → decreased biodiversity and community interactions

Future Directions:

- Examine field characteristics (i.e. soil pH/moisture, nutrients, age, etc.) to identify conditions that are sustainable long-term
- Investigate how humans can counteract these shifts caused by drought
  - Restoration will likely be multifaceted in terms of solutions and methodologies