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Bee and Butterfly Response to Floral Resources in Central Iowa Prairie Restorations

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Background:

In Iowa, 92% of land is used for cultivated row crops and pasture. The conversion of tallgrass prairie to farmland has caused a decline in habitat and biodiversity for many bee and butterfly species. In order to regenerate lost ecosystems and pollinator diversity, many landowners have dedicated private land to be converted to CP42 plantings, motivated by the Conservation Reserve Program (CRP). Throughout the summer, we have developed methods for assessing CP42 plantings to determine the quality of habitat it provides by collecting bee and butterfly abundance data and available floral resources in each field. With the data collected, we ask the following research questions:

1). Does age of a plot affect bee and butterfly abundance and species richness, as well as floral resource availability?
2). How does floral resource abundance within a site affect bee behavior and abundance?
3). Are bee and butterfly abundance related?
4). Does the amount of milkweed present affect the abundance of monarch butterflies at a site?

Methods:

Pollinator Surveying: We surveyed bee and butterfly communities and floral resource availability in 16 Central Iowa prairie restorations from July 7-18, 2017. At each site, we visually surveyed pollinator communities in four strip transects. Butterflies were surveyed in 50x6 meter transects walked at a pace of 10 meters/min. Bees were surveyed in 50x2 meter transects at a pace of 4 meters/min. Throughout these transects we recorded individual bee and butterfly counts, behavior, and floral association. Bees were recorded as 10 separate groups, instead of at a species level for ease of identification in the field. The protocol used for bee surveying was modified from "Xerces Society Citizen Science Native Bees Monitoring Guide" protocols. Our surveys took place on days with suitable weather conditions between 10 AM and 2 PM when bees and butterflies are most active.

Floral Resource Surveying: We started floral resource surveying on July 7th and ended on July 18th. In order to record abundance and diversity of flowers for pollinator use, four 50 meter transects were laid out in each plot. Twenty-five 1x1 meter quadrats were placed randomly on either the right or left side of the transect every 2 meters. All flowers that appeared in the quadrat that were able to be pollinated were counted.
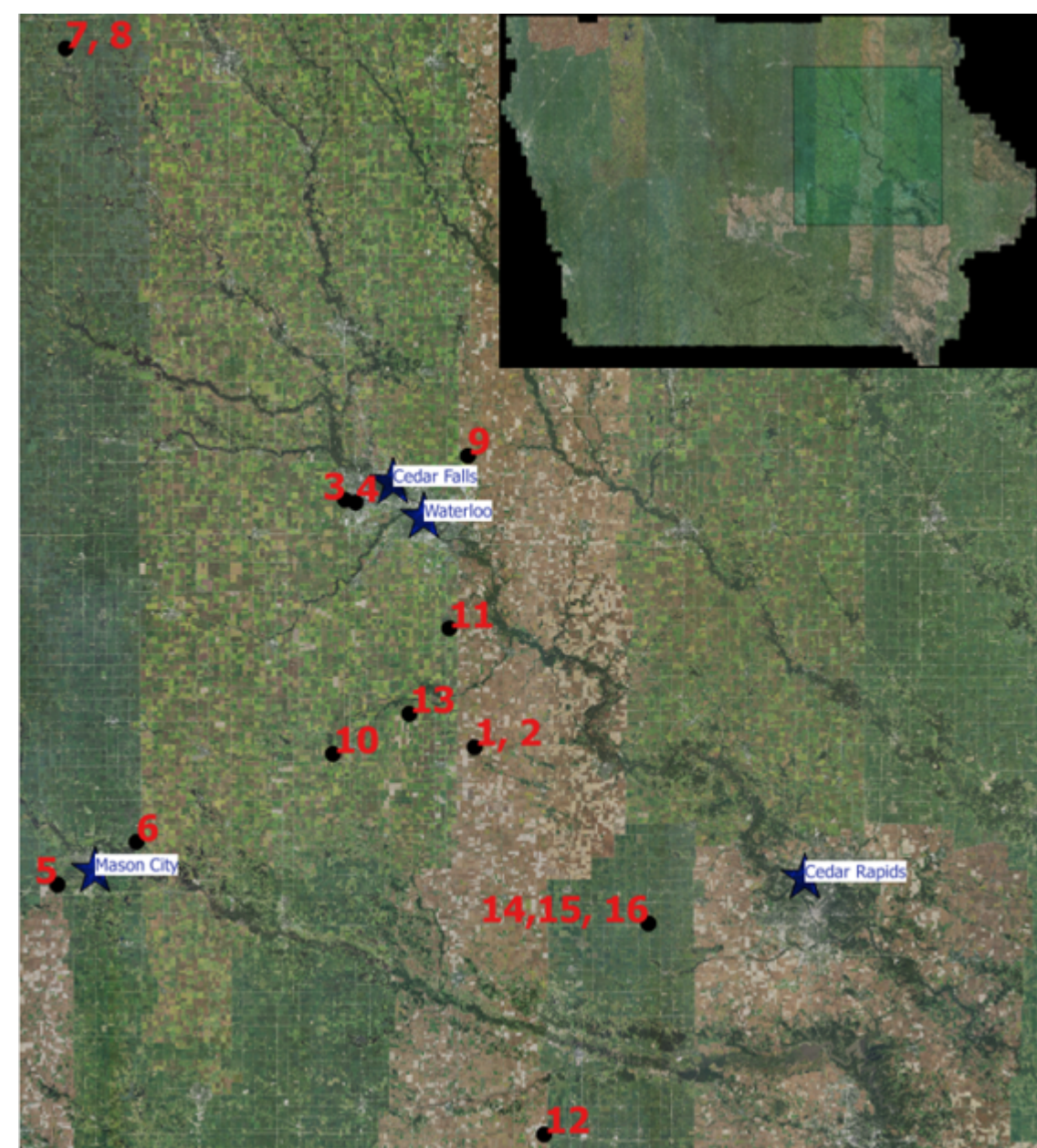
Site Number	Year Seeded	Seed Mix	Site Type	Acre
1	Spring 2015	Diversity	-	0.9
2	Spring 2015	Pollinator	CP-42	0.9
3	2003	-	-	6
4	2013	-	-	14
5	Spring 2016	Pollinator mix	CP42	162
6	Summer 2014	Diversity mix	CP25	13.4
7	Fall 2013	Pollinator	CRP	7
8	Fall 2013	Pollinator	CRP	4
9	Fall 2015	Diversity	-	0.7
10	Early Spring 2016	Carl Kurtz prairie mix	STRIP (CP15A_contour buffer strip)	5.5
11	Fall 2015	Diversity	-	4
12	April 2016	Pollinator	CP42	0.65
13	Spring 2016	Pollinator	CP42	7.5
14	Spring 2016	Pollinator mix from Pheasant Forever (with 3 "bump up" additions)	CP42	2.9
15	Spring 2016	Pollinator mix from Pheasant Forever (with 3 "bump up" additions)	CP42	2.9
16	Spring 2016	Pollinator mix from Pheasant Forever (with 3 "bump up" additions)	CP42	2.9

Figure and Table 1: Mapped locations and site details of the sixteen sites surveyed. CP42 is a site that is designed to enhance pollinator habitat. CRP = Conservation Reserve Program. Pollinator seed mix = 3:1 forb:grass ratio seeded. Diversity seed mix = 1:1 forb:grass seed mix.

Resources:

Hosen, Kim. Eastern-tailed blue. *Prince William Conservation Alliance*, 2009.
Gitig, Diana. Monarch butterfly. *Ars Technica*. 30 April 2017.

Black-eyed susan

Eastern tailed blue

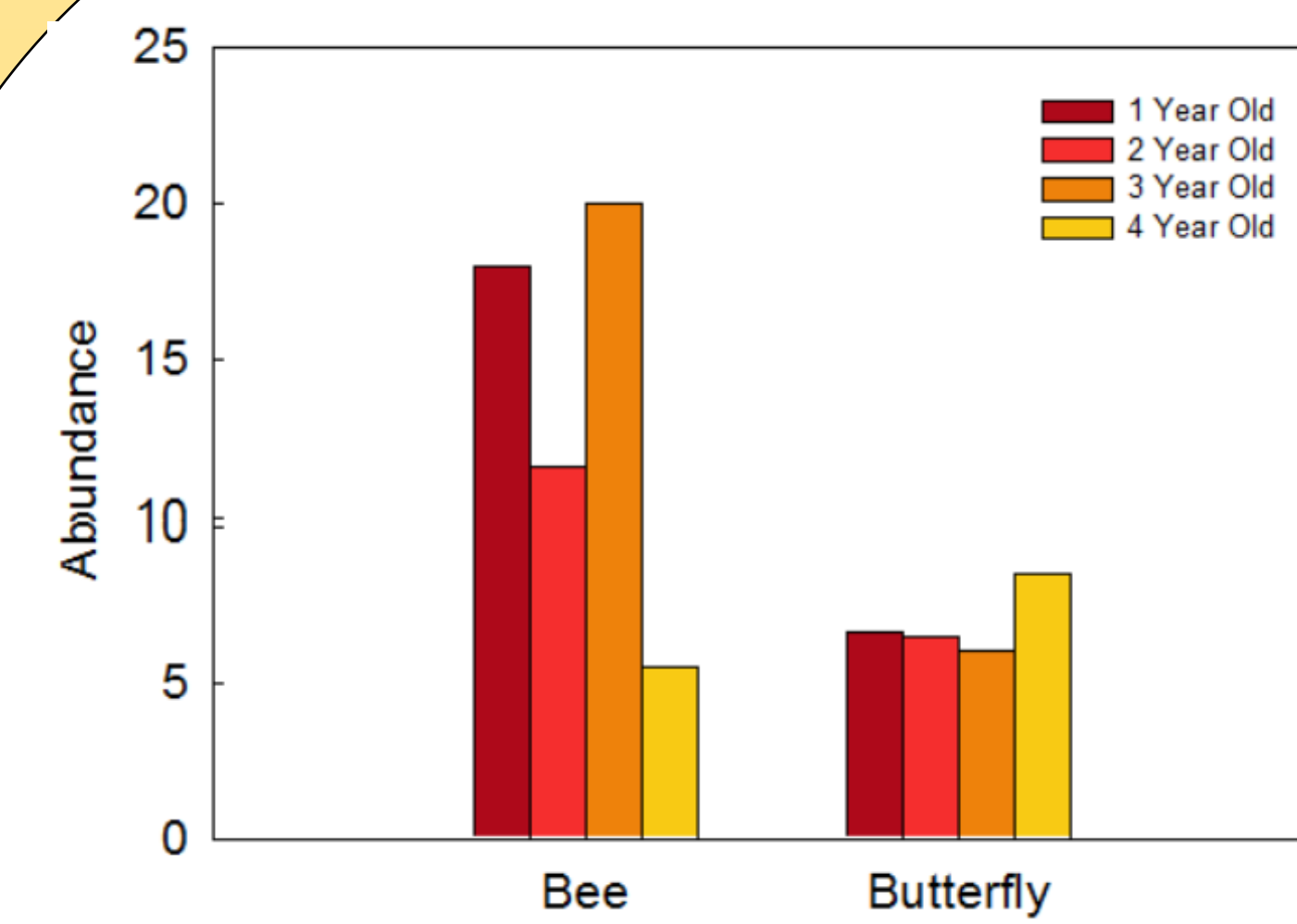Bee balm

Results and Data:

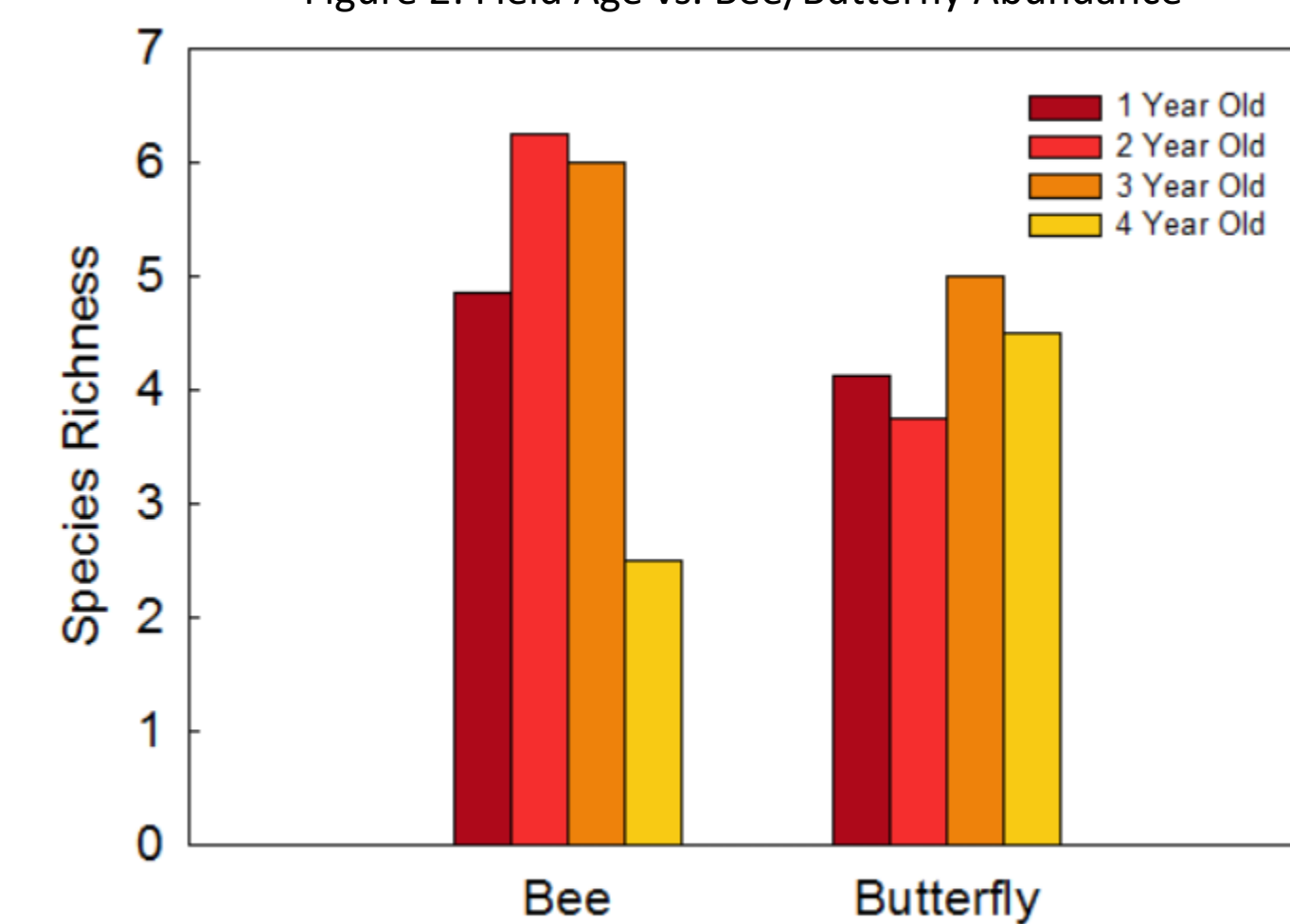Figure 2: Field Age vs. Bee/Butterfly Abundance

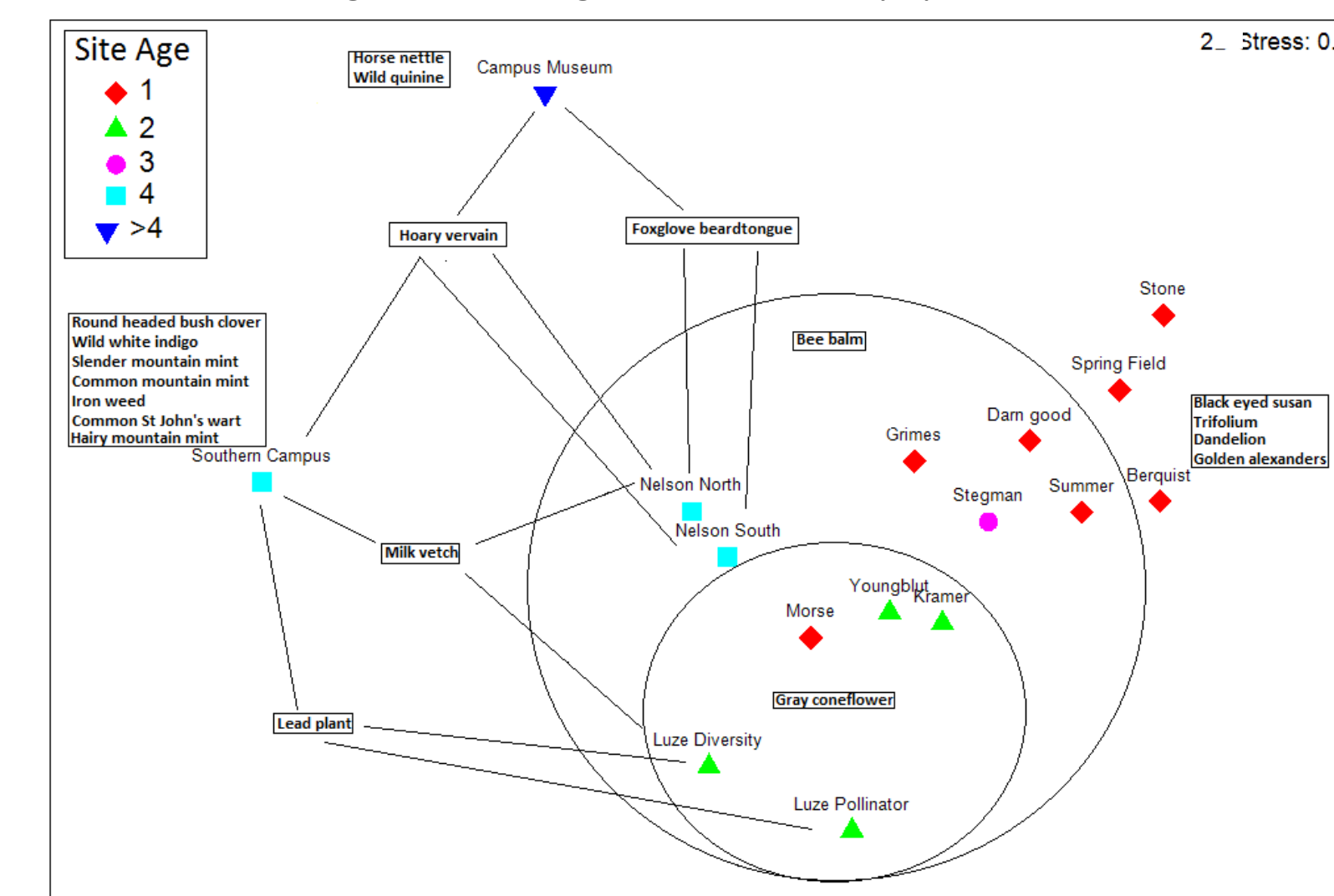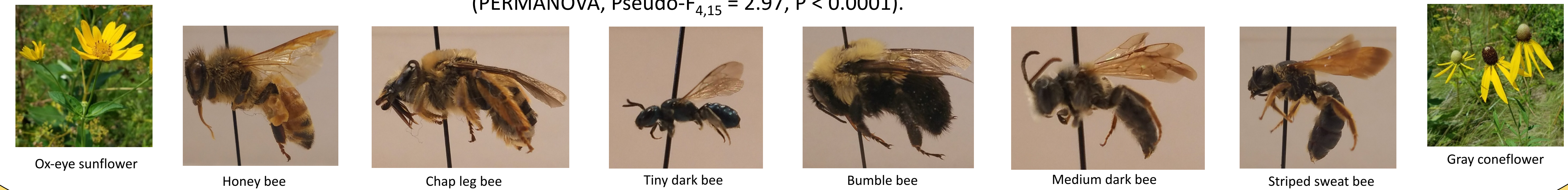Figure 3: Field age vs. Bee/Butterfly Species Richness

Figure 4: Site age and floral resources availability comparison. Fields are grouped based on similarity in floral resource diversity and abundance. Points that are closer together, are more closely related.

Eastern tiger swallowtail feeding on bee balm

Butterfly milkweed

Monarch butterfly feeding on common milkweed

- The year a site was planted has no significant effect on bee species richness, but there was a higher total of bees found in the younger sites, one to three year old, than in the oldest four year old sites.
- The age of a site has no significant effect on butterfly abundance or species richness. The results are nearly identical in both categories. No matter the age of a site, the abundance and species richness of butterflies will not be significantly different.
- A total of 220 bees were surveyed within the 16 sites. 195 of the total number of bees were surveyed on four main prairie plant species: *Monarda fistulosa, Ratipida pinnata, Rudbeckia hirta,* and *Heliopsis helianthoides*. The most commonly surveyed bees were the honey, chap leg, tiny dark, and bumble groups. Bee balm had the highest number of bee visitors.
- Bee balm had a higher amount of bees observed than the expected number with respect to floral abundance, showing a preference for bee balm by bees compared to black-eyed susan which had a lowered number of bees observed (X^2=168.6, df= 3, p<0.001).
- 115 individual butterflies were observed representing 15 species. 21 of the 115 were monarch butterflies. At least one monarch butterfly was recorded in 11 of the 16 fields. The top 3 butterfly species recorded were: *Everes comyntas, Danaus plexippus,* and *Colias philodice*.
- The total number of milkweed stems does not affect the abundance of monarch butterflies.
- We compared flowering forb species richness to butterfly abundance and species richness. The results we found showed no correlation between the two.
- 46 individual species of flowering forbs were recorded throughout the growing season. Of the 46 individuals, 16 of them were weeds. The top 5 most abundant flowers were: Black-eyed susan, ox-eye sunflower, bee balm, gray coneflower, and *Medicago sativa* (alfalfa).
- Floral resource composition varied among sites of different ages (PERMANOVA, Pseudo-$F_{4,15}$ = 2.97, P < 0.0001).
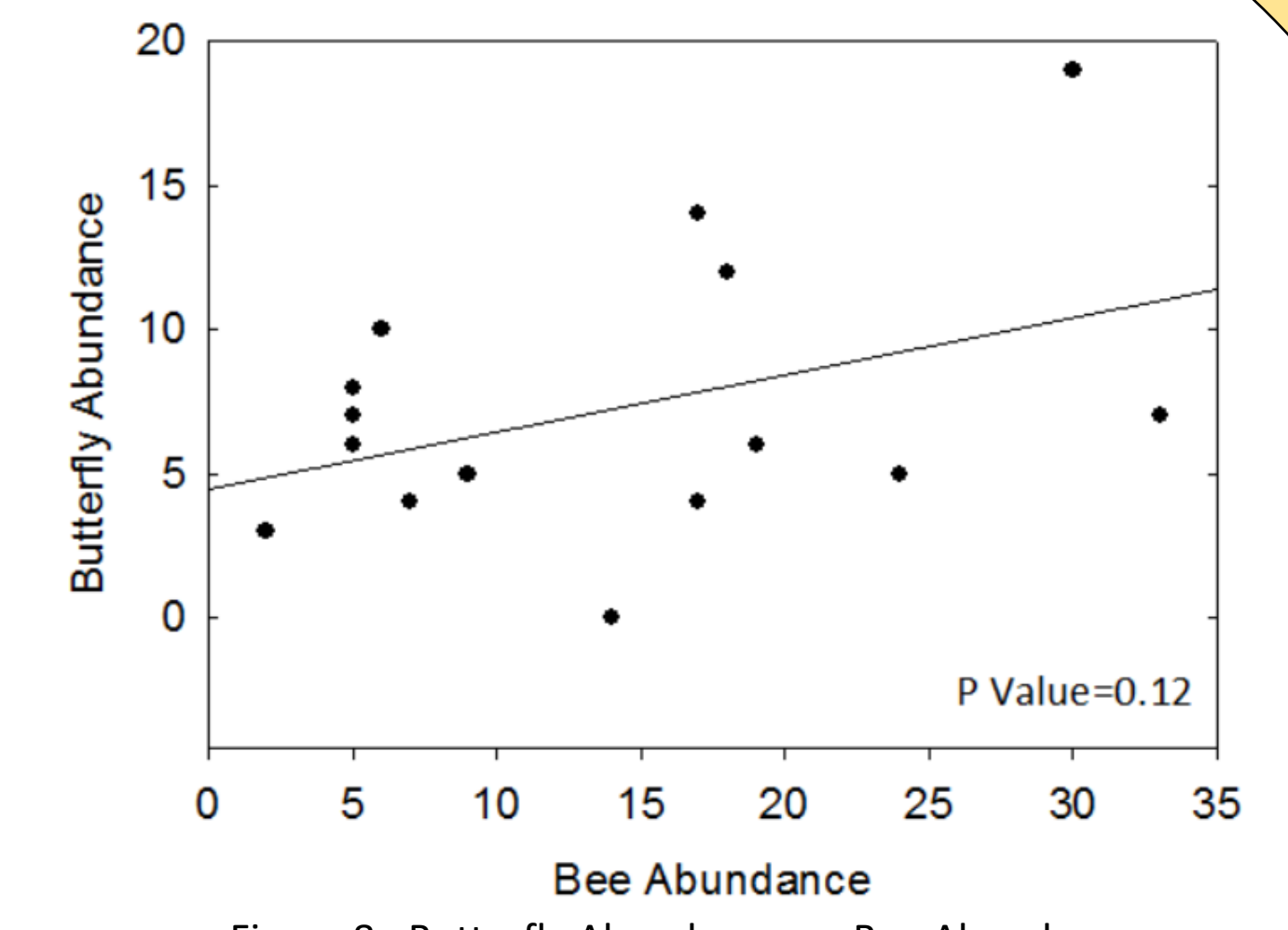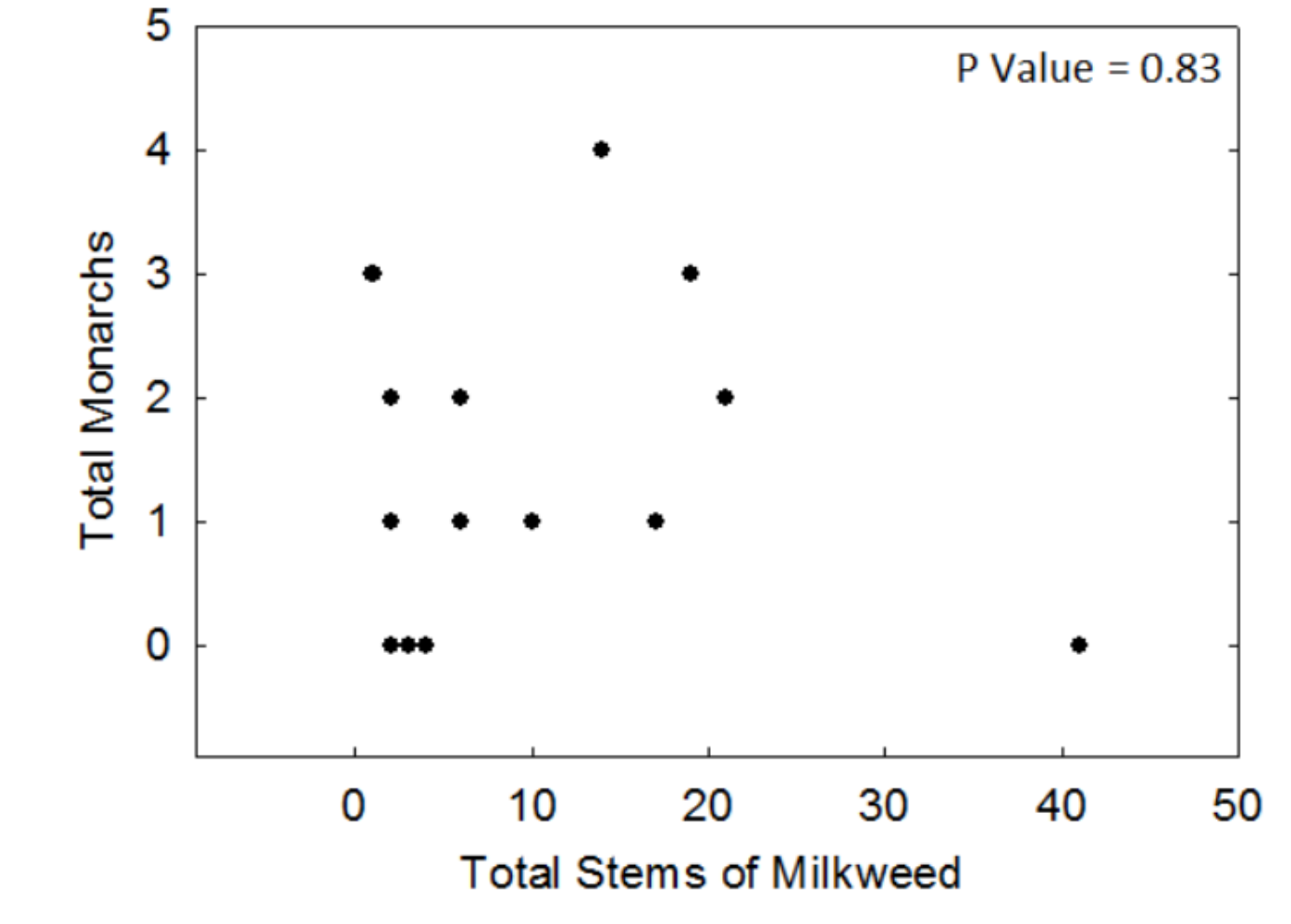

Figure 8: Butterfly Abundance vs. Bee Abundance

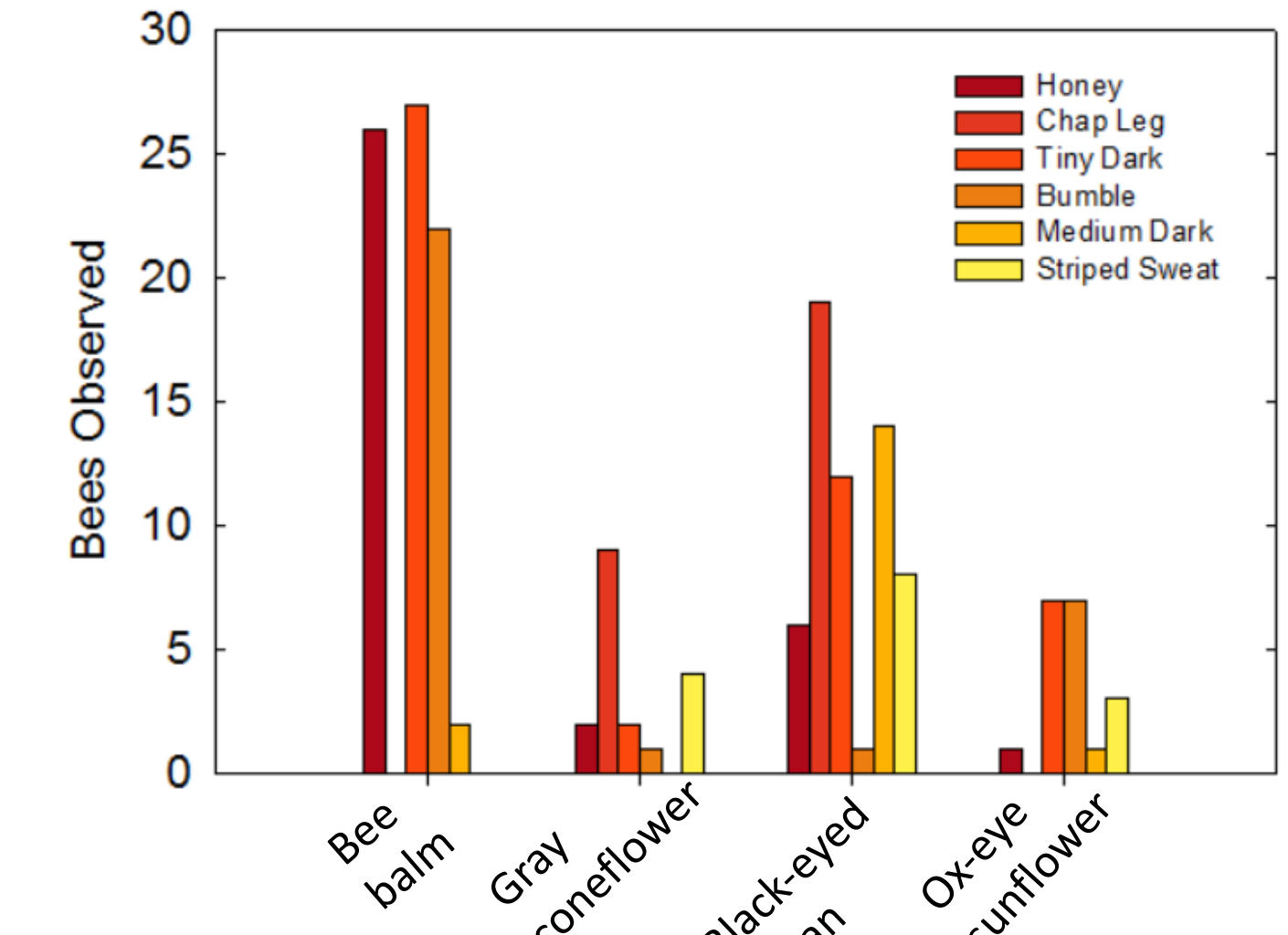Figure 9: Total Monarch Abundance vs. Total Milkweed Stems

Figure 4: Total number of bees found on four focus plants in all 16 sites

Ox-eye sunflower

Honey bee

Chap leg bee

Tiny dark bee

Bumble bee

Medium dark bee

Striped sweat bee

Gray coneflower

Conclusion:

Floral abundance affect on bees:
- Flower preference among the ten groups of bees is most apparent in the honey, tiny dark, and bumble groups that were most commonly surveyed on bee balm, as well as the chap leg, medium dark, and striped sweat groups that were most commonly surveyed on black-eyed susan. Expected values compared to observed values shows that bee balm is over performing as a nectar plant, where as black-eye susan is underperforming.

Plot age effect on bees and butterflies:
- Age of the plot had no real significant result. To conduct future experimentation, a larger sample size of varying aged sites and surveying bees and butterfly multiple times at each site could make relationships more apparent.

Monarch butterflies and milkweed:
- We found that there is no relationship between abundance of milkweed stems and monarch butterfly abundance, although a positive relationship has previously been discovered and documented. The result of this could be because we simply did not have enough data to show a true relationship. In a future experiment, a larger sample size should be taken for counting milkweeds at an individual site. Also surveying butterflies multiple times at a site could show more positive correlation between milkweeds and monarchs.

Bee and butterfly relationship:
- While there is not a significant relationship between bee and butterfly abundance, the data we collected results in a low P-value when compared. This shows that there is a slight positive relationship between bee and butterfly abundance. With a more detailed and focused experiment, there is a possibility that a true relationship could be shown between the two pollinators.