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Association between wild bee communities and floral resources in the Conservation Reserve Program

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ASSOCIATION BETWEEN WILD BEE COMMUNITIES AND FLORAL RESOURCES IN THE CONSERVATION RESERVE PROGRAM

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Abstract

Due to the significance of the plant-pollinator relationship, the loss of pollinators may impose widespread effects on plant communities. Pollinator declines raise questions for the future of agricultural productivity, food security, and human health. Due to the large diversity of the wild bee population and their essential role as pollinators of natural land and agricultural crops, implementing conservation practices are necessary to preserve decreasing populations. Previous conservation efforts have been limited to planting native flowering forbs in unused fields or hedgerows bordering farms and roadsides in order to establish sufficient floral resources. However, restored prairies have the ability to support bee richness and abundance to the level a remnant prairie can. Therefore, small patches of restored prairies may be a sanctuary and offer refuge to the diminishing bee population. Large scale habitat restoration, such as the Conservation Reserve Program (CRP) Pollinator Initiative, could increase not only the quantity of habitat for wild bees, but also the quality of the resources the bees have access to.

In this study, I examined the relationship between floral resources and the wild bee community in young CRP fields. I particularly focused on finding correlations between bees and flowering plants in the CRP program. In addition, I examined the wild bee community from year to year in response to changing floral resources. Fields planted in 2015 were selected to be surveyed in 2018, and fields planted in 2016 were selected to be surveyed in 2019. Altogether, 19 CRP sites were surveyed. For each site surveyed, bees were collected, vegetation density, and floral resource abundance was measured. No apparent relationship was exhibited between the bee community and floral resources. A positive correlation was discovered between the density of sown flowers and the density and richness of bees, which suggests further usage of seed mixes by farmers enrolling in the CRP programs. The data showed sown floral resources are supporting

the bee community while unsown floral resources were not utilized as heavily as the sown resources. A large variation was found between the bee community and floral resources when comparing 2018 and 2019 sites. Cause of this variation may be linked to nonuniform seed mixes as well as weather conditionings during seeding. Floral variability may be the cause of the variation in the bee community composition. Further development of restored prairies and implementation of recommended seed mixes including a high yield of bee friendly flowering plants offer a chance to sustain and rehabilitate the bee community.

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Introduction

On a global scale, bees are renowned as crucial pollinators. Over 90% of flowering plants are believed to be pollinated by animals, including principal agricultural crops (Geroff, Gibbs & McCravy, 2014). Due to the significance of the plant-pollinator relationship, the loss of pollinators may impose devastating effects. Bee species, such as the European Honeybee and North American *Bombus* species, have suffered a decline throughout recent decades (Tonietto, Ascher & Larkin, 2017). However, documentation on other bee species is scarce, and wild bees' conservation status is unknown. Pollinator declines raise questions for the future of agricultural productivity, food security, and human health. In the United States alone, insect pollination has a $15 billion dollar value based on the pollination of crops by bees (Otto, Zheng, Gallant, Iovanna, Carlson, Smart & Hyberg, 2018). Without the bee populations, humans would have to manually pollinate crops rather than relying on natural processes. Humans rely heavily on bee populations despite their drastic decline due to the expansion of cropland, unsuccessful restoration programs, pesticides, pathogens, and decreasing floral resources.

As a result of the pollinator decline, the need for insect pollination of crops has tripled, thus generating the fear of a "pollinator crisis" (Goulson, Nicholls, Botias & Rotheray, 2015). An observational study performed in Illinois discovered that over a 120 year period, 50% of the wild bee species have gone extinct (Goulson et al. 2015); thus, leaving scientists concerned of what may occur if the bee species continue to dwindle.

Habitat and environmental alteration may be one of the root causes at blame for this population loss. More complex landscapes were found to support more abundant communities and more species because of an increased number of wild flowering species (Scheper, Reemer, Van Kats, Ozinga, Van der Linden, Schaminée & Kleijn, 2014). Decreasing the available habitats diminishes the amount of resources such as pollen, nectar, nesting sites, and host plants available. Bee reproduction was found to be positively related to the amount of habitat available (Scheper et al. 2014). In addition, environmental conditions were found to contribute to 48% of the variation in the bee community in the early season (Villalobos & Vamosi, 2018). Native prairies and forests are merely fragments of what they once were, as they are being converted into agricultural cropland or urbanized areas. In North America alone, the loss of prairie habitat is at a high level of 95% of tall grass prairies in the Central Plains and 63% of the mixed grass prairies east of the Rocky Mountains (Hatten, Looney, Strange & Bosque-Pérez, 2013). In addition to habitat reduction, reduced spring rainfall and drought were found to be associated with declining floral resources and limiting the food supply of the bee species (Thomson, 2016). Bumblebees are especially susceptible to this habitat loss due to their limited range of flight, nesting requirements, and specific food (Grixti, Wong, Cameron & Favret, 2009). Bumblebee species are exceedingly effective pollinators due to their ability to forage at low temperatures, various tongue lengths, and their ability to "buzz pollinate", or expel pollen from a flower's anther (Grixti et al. 2009). However, these abilities do not offer anything to the bumblebee species if there is a lack of habitat for them to pollinate. Therefore, habitat quantity and quality are connected to several important aspects of the bee community and pollination.

A second factor contributing to the declining bee diversity is the intense use of insecticides by the agricultural community and exposure to natural pathogens in the environment. University of Minnesota entomologists discovered beekeepers lose 30% - 40% of their bees due to agricultural insecticides (Marcotty, 2012). In addition, one of the neonicotinoid chemicals, Clothianidin, has been found on 90% of genetically modified corn in the United

States (Marcotty, 2012). Clothianidin was originally viewed as a more “eco-friendly” insecticide because the corn absorbs the chemical during adolescence and contains it within the plant (Marcotty, 2012). Despite the internal trapping of the chemical, some of the Clothianidin powder blows across the crops and dusts the flowers bees pollinate. Exposure occurs when the bees come to pollinate the flower, and results in bee confusion and inability to provide sufficient food supplies to their hive (Marcotty, 2012). In addition to chemicals such as Clothianidin, the decline of *Bombus* species has been linked to a fungal pathogen, *Nosema bombi* (Cameron, Lim, Lozier, Duennes & Thorp, 2016). Researchers discovered that the pathogen was introduced from Europe via a commercial colony of bumblebees (Cameron et al. 2016). Insecticides and fungal diseases are linked to declines in biodiversity and pose risks to ecosystems.

Due to the large diversity of the wild bee population and their essential role as pollinators of natural land and agricultural crops, implementing conservation practices are necessary to preserve the decreasing population. Previous conservation efforts have been limited to planting native forbs in “out of practice” fields or hedgerows bordering farms and roadsides. The main concern of previous conservation efforts has been aimed at establishing sufficient floral resources. While these conservation approaches have been effective, results show that they largely support more generalist species rather than specialist species (Tonietto et al. 2017). Therefore, restoring prairies may offer the most potential for a bee community to diversify and repopulate.

Restored prairies have the ability to support a diverse bee community, but even old or unmanaged fields still have the ability to provide suitable habitat for bees (Tonietto et al. 2017). Older fields may be composed of lower quality forbs and to combat that, conservation efforts restore the site by planting a designed pollinator friendly seed mix to maximize the amount of support a site can offer. As the restoration site ages, differences between the bee communities grow smaller and the community begins to resemble reference prairies (Tonietto et al. 2017). The community composition of bees at young, restored sites was found to be similar to remnant prairies within a timeframe of 5-7 years (Griffin, Bruninga-Socolar, Kerr, Gibbs & Winfree, 2017). Therefore, restored prairies can support bee richness and abundance to the level a remnant prairie can; thus, demonstrating that restored prairies may be a sanctuary and offer refuge to the diminishing bee population. An example of this was seen in small hill prairies in Iowa found with similar diversity to larger preserved prairies (Hendrix, Kwaiser, & Heard, 2010). In addition to old or unmanaged sites, in field wetlands may support pollinator populations by offering habitat as a resting stop in between miles of cropland (Vickruck, Best, Gavin, Devries & Galpern, 2019). Farmers should be encouraged not to plow or drain these wetland areas as they are supporting the bee community. Overall, any unused field offers the potential to undergo restoration and support a diverse bee community.

Large scale habitat restoration, such as the Conservation Reserve Program (CRP) Pollinator Initiative (CP-42), could increase not only the quantity of habitat for wild bees, but also the quality of the resources the bees have access to. The USDA Farm Service Agency (FSA) created the CRP program in 1985, with the passing of the Food Security Act. This program acts as a voluntary enrollment program for agricultural producers. To be eligible for the CRP program, the land must be agricultural cropland that has been planted for four of the six years between 2008 and 2013 and meet erosion criteria (“Conservation Reserve Program,” 2015). The land enrolled into the CRP program is taken out of rotation, meaning it is not ranched or farmed, but used for conservation purposes instead. FSA contracts for the CRP program are usually 10 to 15 years and participants are monetarily compensated (“Conservation Reserve Program,” 2015).

Farmers must establish long term cover on the land or plant a recommended seed mix. The land enrolled in CRP helps clean nearby lakes and rivers by improving groundwater and the vegetation increases wildlife populations. Plantings include “resource conserving” plants and trees used to improve the quality of water, control soil erosion, reduce runoff of chemicals, sequester greenhouse gases, and improve the habitat for wildlife (FAPRI 2007).

At the peak of the program, the Conservation Reserve Program had more than 14.6 million hectares of land enrolled. However, future Farm Bills reduced the amount of land allowed in the program to 9.7 million hectares (Otto et al. 2018). Typical tracking of the CRP’s progress involves monitoring the total number of acres enrolled. However, this tracking technique offers limited insight to the benefits of the CRP program and is an insufficient way to measure the success of this program. Some fields may offer better wildlife habitat than others, while others may be better at reducing soil erosion. This causes a dilemma because there is no proper method to assess the full benefits of the program or ways to make recommendations for improvement.

Despite the lack of proper CRP records, maintaining records of bee species composition has proven to be a valuable resource in understanding the bee community in a specific geographic area. Pollinator composition is driven by three primary factors: floral resources, nesting site availability provided by the habitat, and tolerance to temperature, humidity, and wind (Villalobos et al. 2018). In this study, I examined the relationship between floral resources and the wild bee community in young CRP fields. I particularly wanted to focus on discovering if there was any correlation between bees and the type of vegetation (forbs) in the CRP program. If a correlation was found, I wanted to discover if bees have a higher preference for some forbs over others at the CRP sites. Lastly, I wanted to examine changes in the wild bee community from year to year in correspondence to changing floral resources.

Research Questions

- ❑ What is the association between bees and the vegetation (forbs) in the CRP program?
- ❑ Are there preferred forbs that should be included in the seed mix for bees?
- ❑ Are there changes of the wild bee community from one year to another, if the floral resources change??

Hypotheses

- ❑ Hypothesis One: There is a positive correlation between the density of forbs and the density of bees at a site.
- ❑ Hypothesis Two: The bee community composition is influenced by floral sources in the CRP field.
- ❑ Hypothesis Three: There are preferred “bee friendly” forbs that are most attractive to generalist bees.

Methods

Study Sites

The datum for this research were collected by University of Northern Iowa Summer Undergraduate Research Program (SURP) students in the summers of 2018 and 2019. Sites were selected after information about participation in the Conservation Reserve Program Pollinator Initiative had been obtained from USDA. Initial surveys were sent through the mail to landowners to track interest. Upon return of the survey, CRP fields were selected for surveying if the landowner provided a list of the seed mix that had been planted on their land and if their land was within a 60 minute driving radius of the University of Northern Iowa. Based on the availability and quantity of fields, fields were surveyed on their third growing season. Therefore, fields planted in 2015 were selected to be surveyed in 2018, and fields planted in 2016 were selected to be surveyed in 2019. Altogether, 19 CRP sites (8 in 2018 and 11 in 2019) were surveyed (Table 1).

Table 1: Selected Sites and Locations

Site Name	City	County
Site 1	Hudson	Black Hawk County
Site 2	Conrad	Grundy County
Site 3	Dunkerton	Black Hawk County
Site 4	Hudson	Black Hawk County
Site 5	Traer	Tama County
Site 6	New Hall	Benton County
Site 7	Ames	Story County
Site 8	Gladbrook	Tama County
Site 9	Hudson	Black Hawk County
Site 10	Dundee	Delware County
Site 11	Independence	Buchanan County
Site 12	Shell Rock	Butler County
Site 13	Littleton	Buchanan County
Site 14	Cedar Falls	Black Hawk County
Site 15	Nashua	Chickasaw County
Site 16	Allison	Butler County
Site 17	Sumner	Bremer County
Site 18	Lester	Lyon County
Site 19	Cedar Falls	Black Hawk County

Bee Collection Methods

Pollinator sampling was conducted monthly in each site, during June, July, and August of the survey year. The sampling took place within four 2500 m^2 plots that were randomly generated with the ArcGIS computer program. Within each plot, bees were collected by a sweep netting technique for a duration of 15 minutes (15 minutes per plot *4 plots per site = 60 minutes per site). During the 15 minutes, each plot was patrolled by one researcher. All visible bees were captured using a sweep net. When a bee was caught, the timer was paused, so the time used for processing the bee was not included in the 15 minutes. The bee was then placed into an ethyl acetate kill jar. If bees were caught on a live flower, then that flower was identified and recorded (except during the June 2018 survey where the flower source was not recorded). At the end of the survey, the bees were transported to the laboratory, where they were washed, pinned, and identified to the species level.

Vegetation Density

Vegetation density was sampled once in each site during the study year. The survey was conducted by establishing five randomly located 100m transects. Along each transect, a total of fourteen 1 m^2 quadrats were laid down every seven meters on both sides of the transect. All species taller than 20 cm within each quadrant were identified, counted, and recorded. Species in the transect were recorded regardless of whether they were in bloom. This information allowed us to gather information about what vegetation was present at each site.

Floral Resource Survey

Floral resource sampling occurred during June, July, and August of 2018 and 2019, on the same day when the bees were collected (with the exception of June 2018 when the floral resources were not surveyed). The survey was conducted by establishing four transects, 50 meters long, at each site. The location and direction of the transects were determined randomly using ArcGIS computer program. Along the transect, a total of twenty-five 1 m^2 quadrats were laid down every two meters alternating right and left sides. Within the quadrant, all blooming flowers were counted and recorded. This survey allowed us to analyze the flowering species available to pollinators each month.

Data Analysis

For each study site, the total density (number of bees), richness and Shannon diversity index of the bees was calculated. Similarly, the density, richness and Shannon diversity index of the total planted vegetation and floral sources were also calculated. In data analysis software R Software (R Core Team, 2018), linear regressions were conducted to examine the correlation between the bee indices, vegetation indices and floral indices.

To examine the floral and bee community composition of each study site, Non-metric Multidimensional Scaling (NMDS) were conducted due to the non-normal nature of the data. A stress level (<10 is excellent; between 10 and 15 is good) was used to determine the number of NMDS axes. Stress calculated below 15 were considered acceptable in this study (Kruskal, 1964). The correlation between the NMDS axes and the floral and bee species was examined, to determine which species contributes the most to each axis. The Permutational Multivariate Analysis of Variance was applied to quantify the difference between the bee and floral community composition as suggested by the NMDS analysis. All NMDS and Adonis analyses were conducted in using the vegan package in R (Oksanen, Guillaume, Friendly, Kindt, Legendre, McGlinn, Minchin, O'Hara, Simpson, Henry, Stevens, Szoecs, & Wagner, 2019).

Results

The plant survey yielded overall 23 species of sown plants and 65 species of unsown plants. Similarly, the floral resource survey also demonstrated that there were many unsown species blooming in each site during each survey (Table 2).

Table 2: Summary of the total number sown floral species compared to the total number unsown floral species for 2018 and 2019 sites.

Site Name	Survey Year	Number of Sown Floral Species	Number of Unsown Floral Species
Site 1	2018	10	16
Site 2	2018	12	11
Site 3	2018	18	24
Site 4	2018	16	12
Site 5	2018	18	15
Site 6	2018	7	31
Site 7	2018	20	20
Site 8	2018	14	21
Site 9	2019	9	24
Site 10	2019	15	28
Site 11	2019	14	37
Site 12	2019	11	34
Site 13	2019	16	31
Site 14	2019	10	19
Site 15	2019	10	50
Site 16	2019	9	48
Site 17	2019	10	26
Site 18	2019	12	33
Site 19	2019	15	31

Overall, 750 bees were collected from the 19 study sites, which belong to 24 genera and 73 species (Table 3).

Table 3: Summary of the total number of bee species collected compared to the total number of bees collected for 2018 and 2019 sites.

Site Name	Survey Year	Number of Bee Species	Number of Total Bees
Site 1	2018	11	41
Site 2	2018	5	19
Site 3	2018	11	27
Site 4	2018	25	59
Site 5	2018	7	26
Site 6	2018	14	41
Site 7	2018	14	46
Site 8	2018	13	38
Site 9	2019	14	26
Site 10	2019	13	38
Site 11	2019	11	22
Site 12	2019	11	24
Site 13	2019	18	40
Site 14	2019	15	33
Site 15	2019	12	21
Site 16	2019	7	35
Site 17	2019	15	35
Site 18	2019	11	18
Site 19	2019	16	38

Linear regression analysis showed there was no significant correlation between the bee community indices (density, richness, and Shannon diversity) and the planted vegetation indices (density, richness, and Shannon diversity) (Figure 1, 2 & 3). However, even though there was not a significant correlation between the bee community indices and the overall floral indices, there is a significant correlation between bee density and sown floral density ($p = 0.01$, Figure 4). Figure 5 depicts a slight, marginally significant ($p = 0.055$) positive correlation between bee richness, measured as the quantity of bee species collected, and sown floral density.

When similar analyses were conducted using bees collected from unsown floral sources and the indices of unsown flowers, no significant correlations as shown in the sown floral sources were found (Figure 6).

A NMDS ordination with two axes (stress=15.0) demonstrated that there was a strong difference of the sown floral community composition between sites surveyed in 2018 and sites surveyed in 2019 (Figure 7, Adonis p=0.0001). A NMDS ordination with three axes (stress=11.2) also demonstrated that the bee community composition changed between the two years (Figures 8&9, Adonis p=0.009).

Lastly, a network analysis using the bee and floral resource data demonstrated the majority of bees were found to be associated with a few key flower sources, such as *Monarda fistulosa*, *Chamaecrista fasciculata*, *Ratibida pinnata*, *Rudbeckia hirta*, *Heliopsis helianthoides* and *Echinacea purpurea*. The strong dominance of *Monarda fistulosa* as the floral source was stronger in 2018, compared to 2019, where there were more floral sources utilized by the bee community (Figure 10, 11&12).

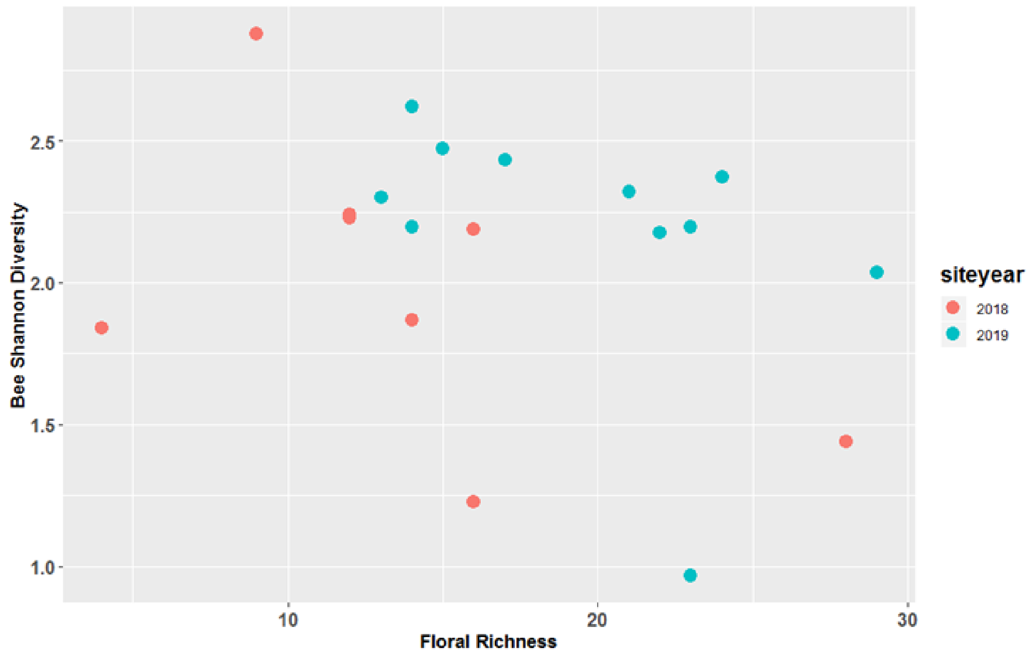

Figure 1: Correlation between the bee Shannon Diversity and transect floral richness from 19 study sites. There is no significant correlation between the two indices.

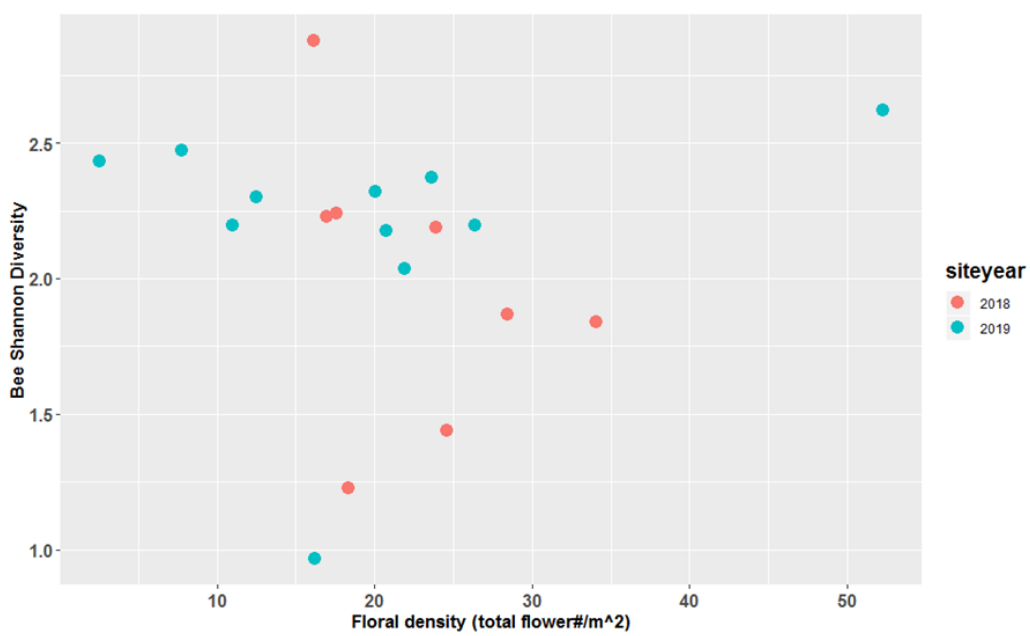

Figure 2: Correlation between the bee Shannon Diversity and transect floral density from the 19 study sites. There is no significant correlation**.**

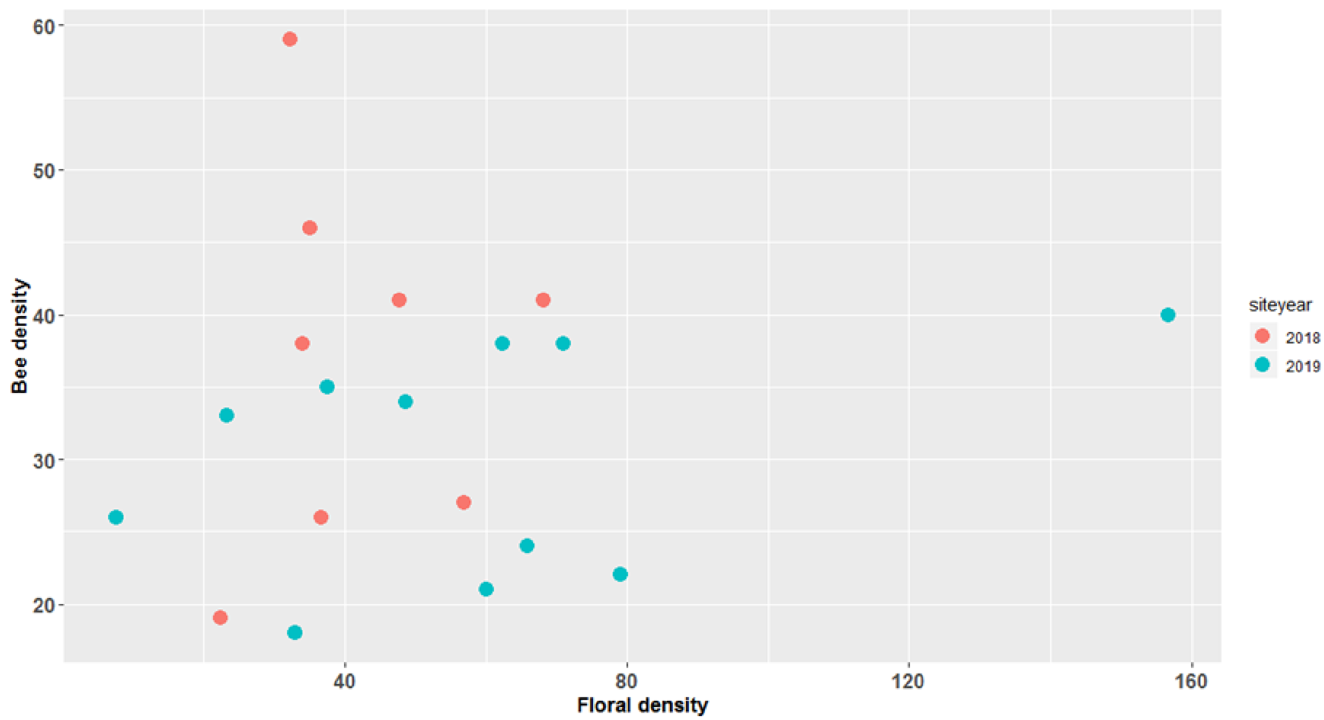

Figure 3: No correlation between bee density and transect floral density.

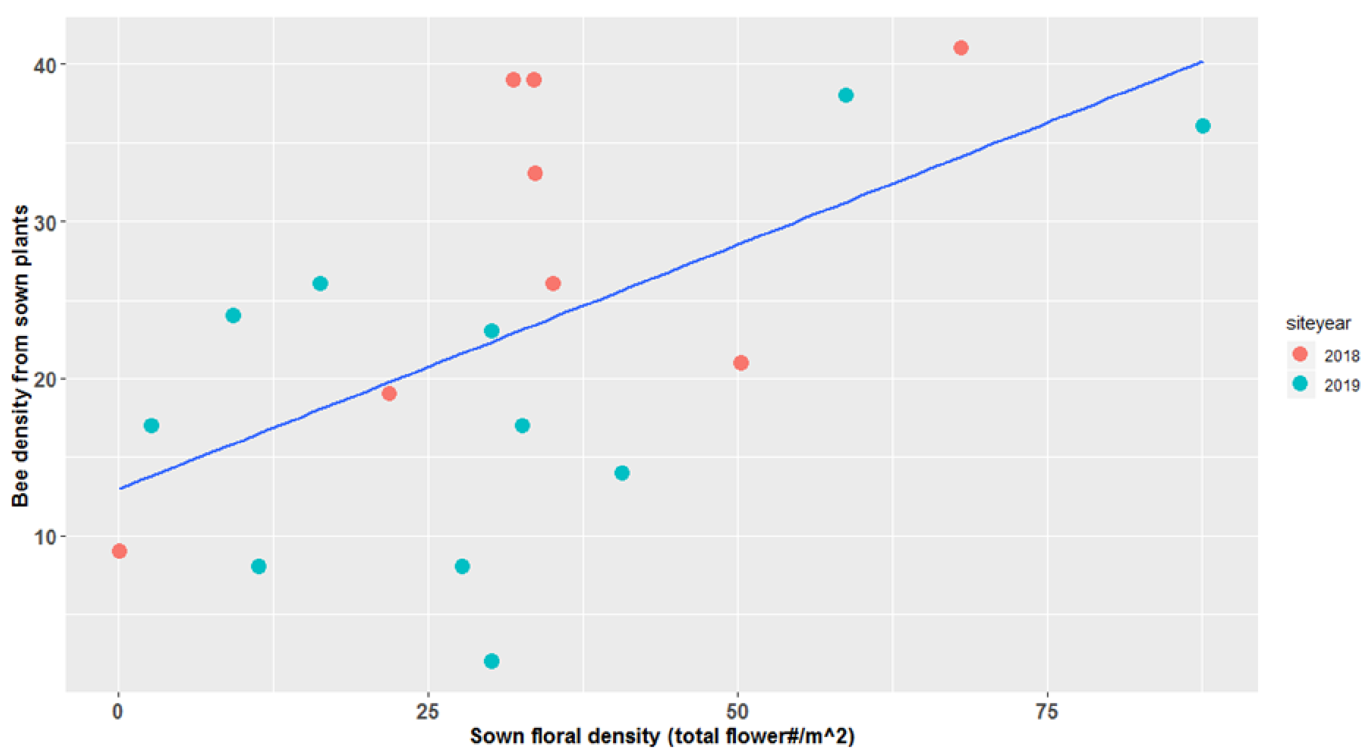

Figure 4: There is a significant correlation between bee density and sown floral density ($p=0.01$).

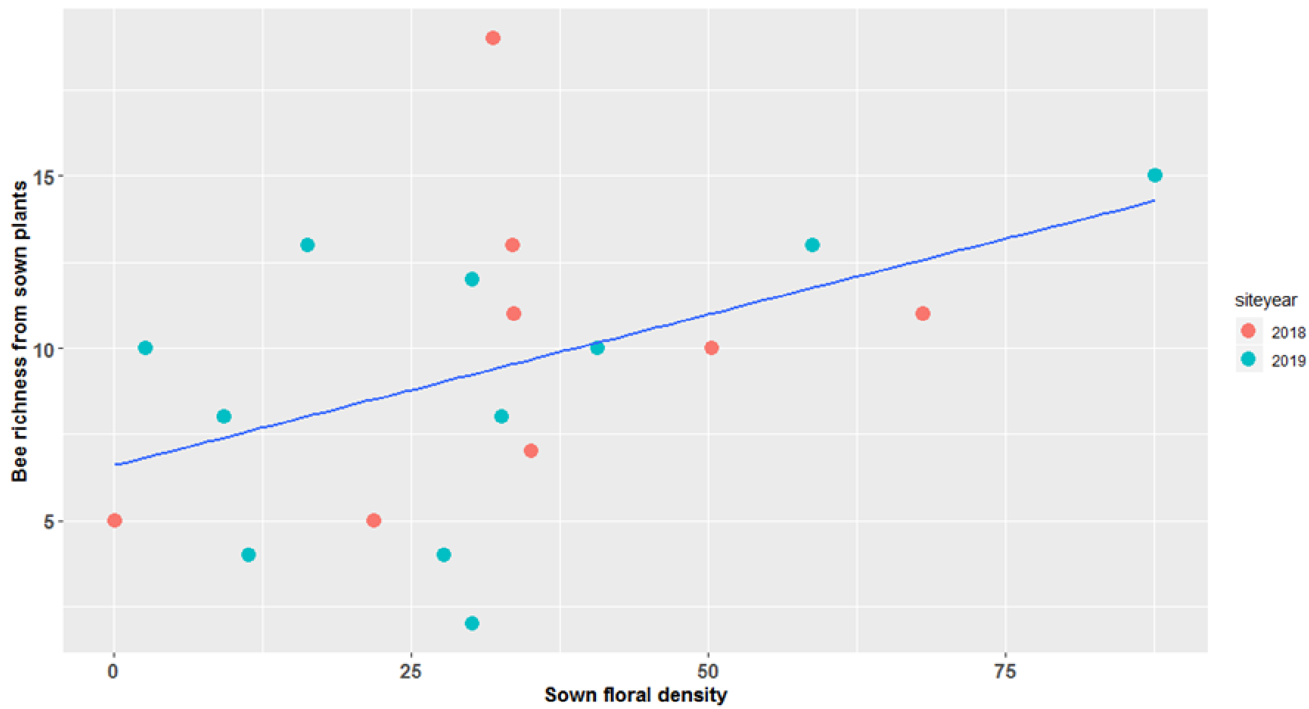

Figure 5: There is a borderline significant correlation between bee richness and sown floral density (p=0.055).

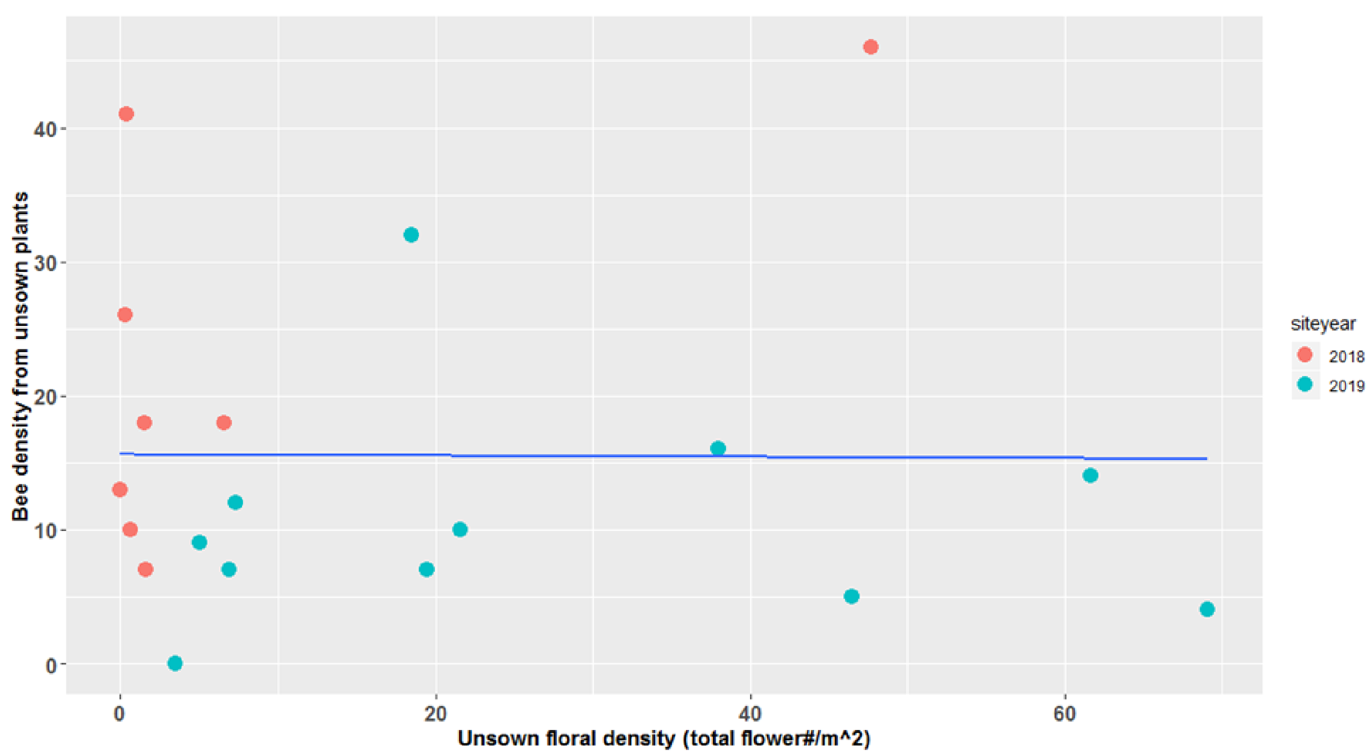

Figure 6: No significant correlation between bee density and unsown floral density.

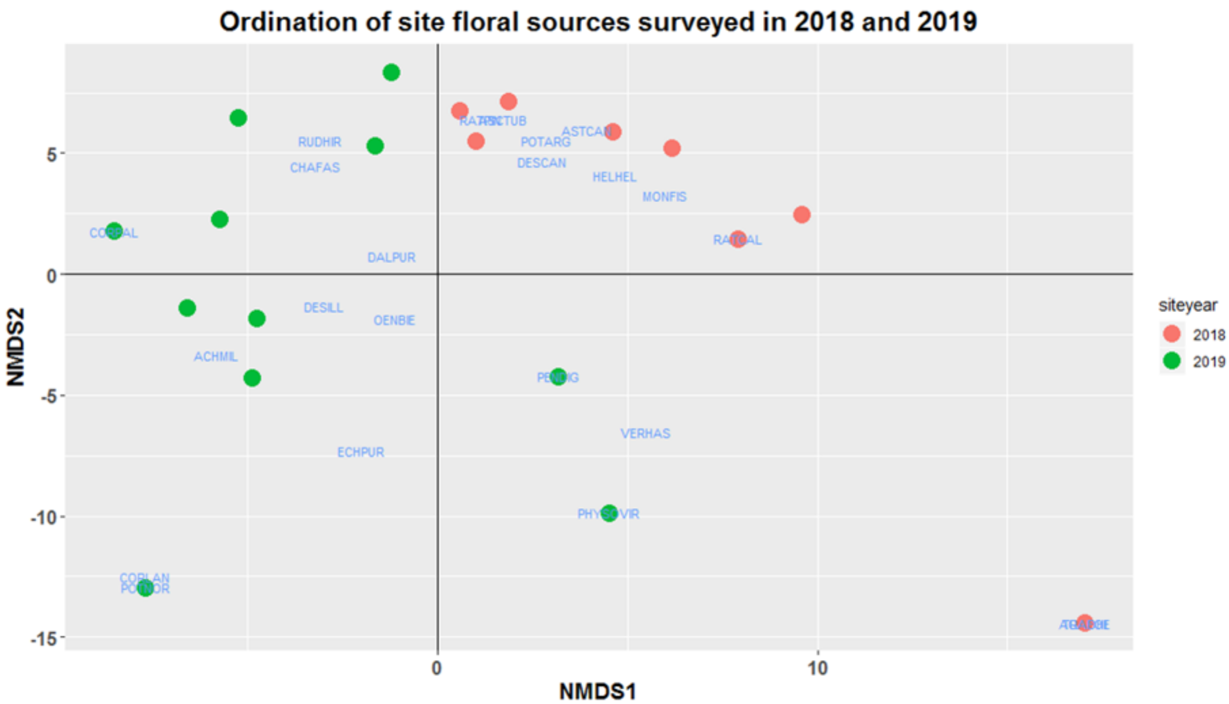

Figure 7: Non-metric Multidimensional Scaling (NMDS) shows the sown floral communities had different composition in 2018 and 2019

Table 4: Floral Source Code Name for Figure 7

Code Name	Scientific Name	Common Name
ACHMIL	*Achillea millefolium*	Common Yarrow
ASCTUB	*Asclepias tuberosa*	Butterfly Weed
ASTCAN	*Astragalus canadensis*	Canadian Milkvetch
CHAFAS	*Chamaecrista fasciculata*	Partridge Pea
CORLAN	*Coreopsis lanceolata*	Lanced Leaved Tickseed
CORPAL	*Coreopsis palmata*	Stiff Tickseed
DALPUR	*Dalea purpurea*	Purple Prairie Clover
DESCAN	*Desmodium canadense*	Showy Tick Trefoil
DESILL	*Desmodium illinoense*	Illionis Tick Trefoil
ECHPUR	*Echinacea purpurea*	Purple Coneflower
HELHEL	*Heliopsis helianthoides*	False Sunflower
MONFIS	*Monarda fistulosa*	Wild Bergamont
OENBIE	*Oenothera biennis*	Common Evening Primrose
PENDIG	*Penstemon digitalis*	Foxglove Beardtongue
PHYSOVIR	*Physostegia virginiana*	Obedient Plant
POTARG	*Potentilla arguta*	Prairie Cinquefoil
POTNOR	*Potentilla norvegica*	Norwegian Cinquefoil
RATCAL	*Ratibida columnifera*	Long Headed Coneflower
RATPIN	*Ratibida pinnata*	Grey Headed Coneflower
RUDHIR	*Rudbeckia hirta*	Black Eyed Susan
VERHAS	*Verbena hastata*	Blue Vervain

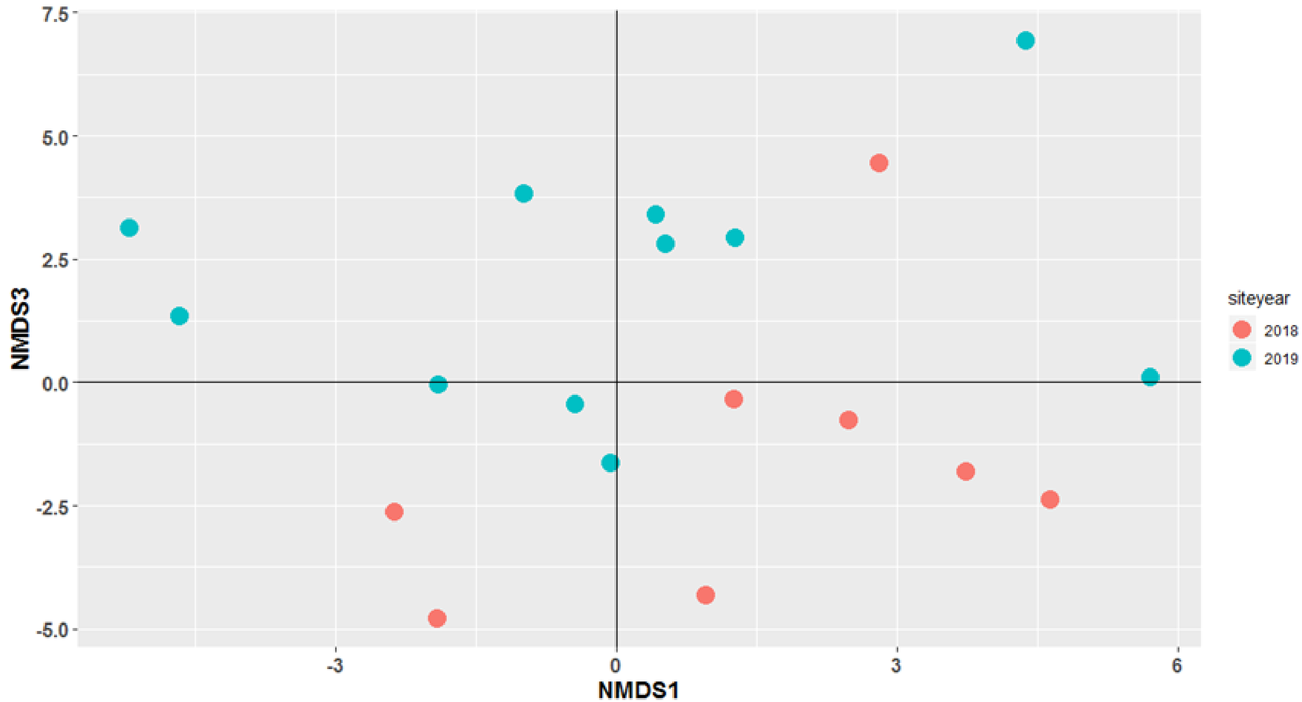

Figure 8: Non-metric Multidimensional Scaling (NMDS) ordination of Bees collected from each site in 2018 and 2019 (NMDS axis 1 and 3)

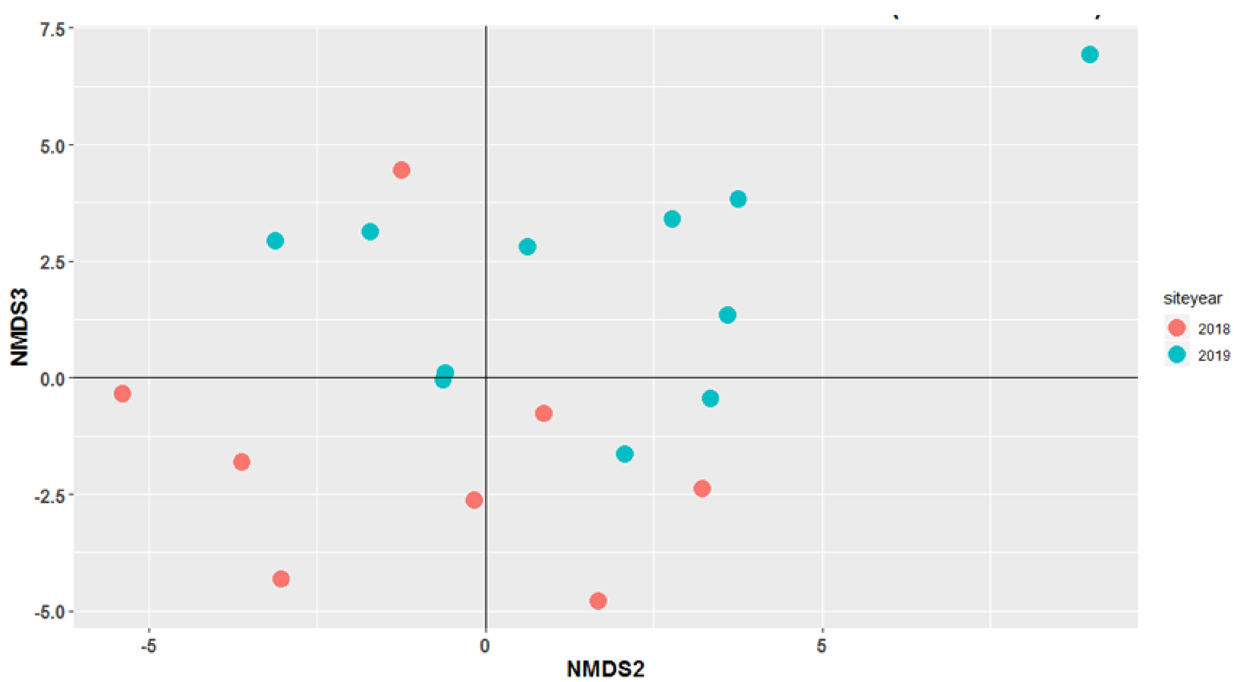

Figure 9: Non-metric Multidimensional Scaling (NMDS) ordination of Bees collected from each site in 2018 and 2019 (NMDS axis 2 and 3)

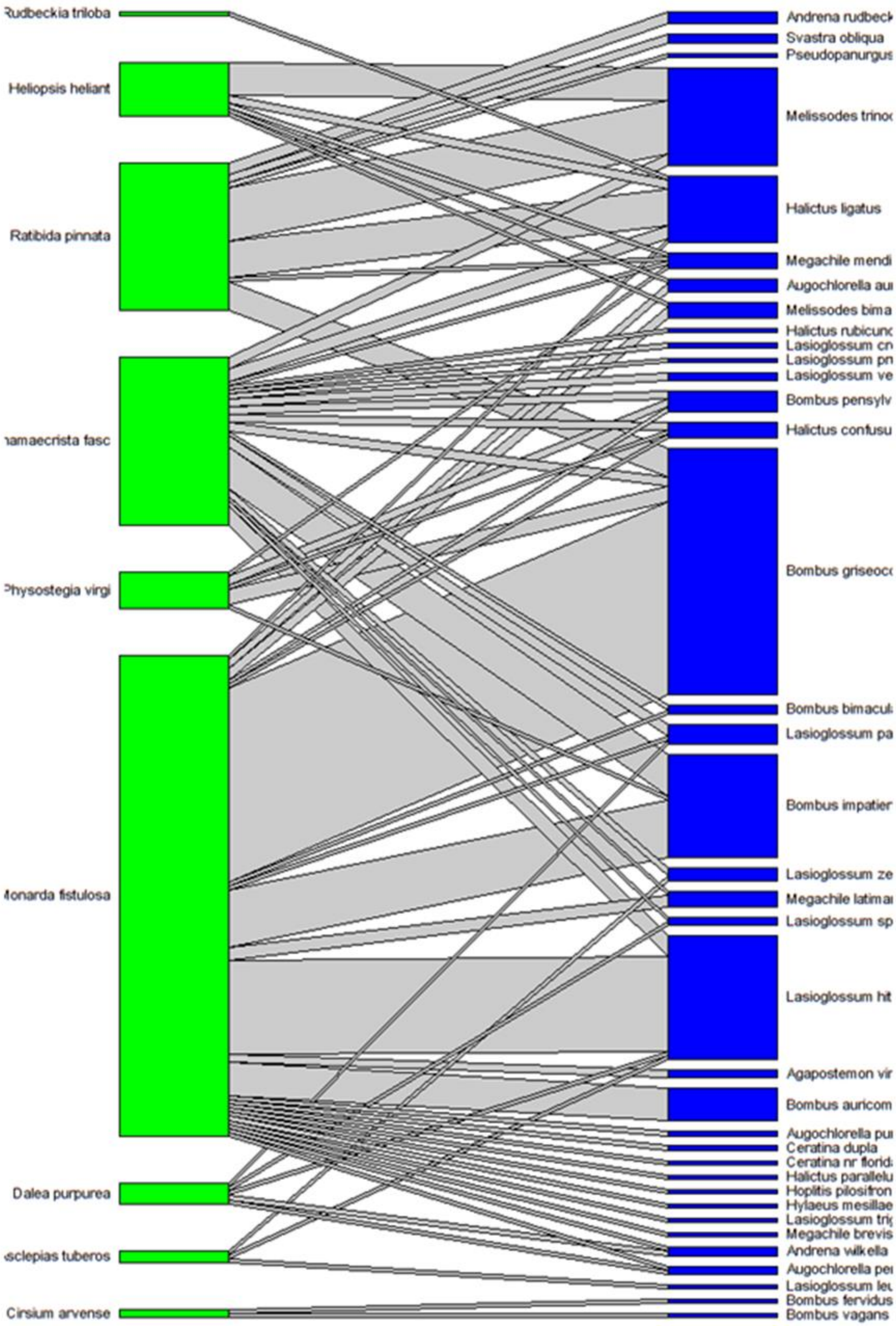

Figure 10: Bee and Sown Floral Resources Interactions from 2018

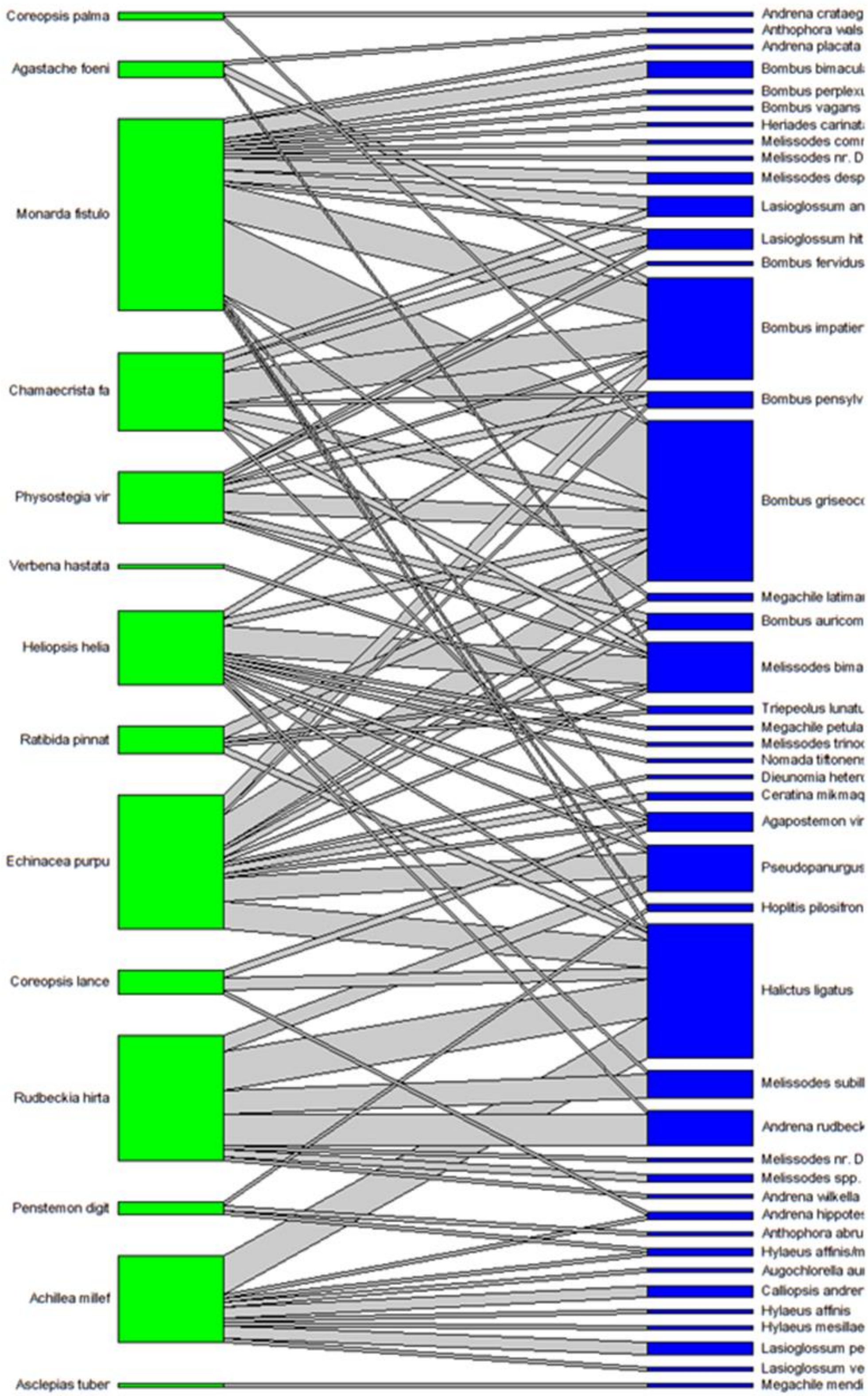

Figure 11: Bee and Sown Floral Resources Interactions from 2019

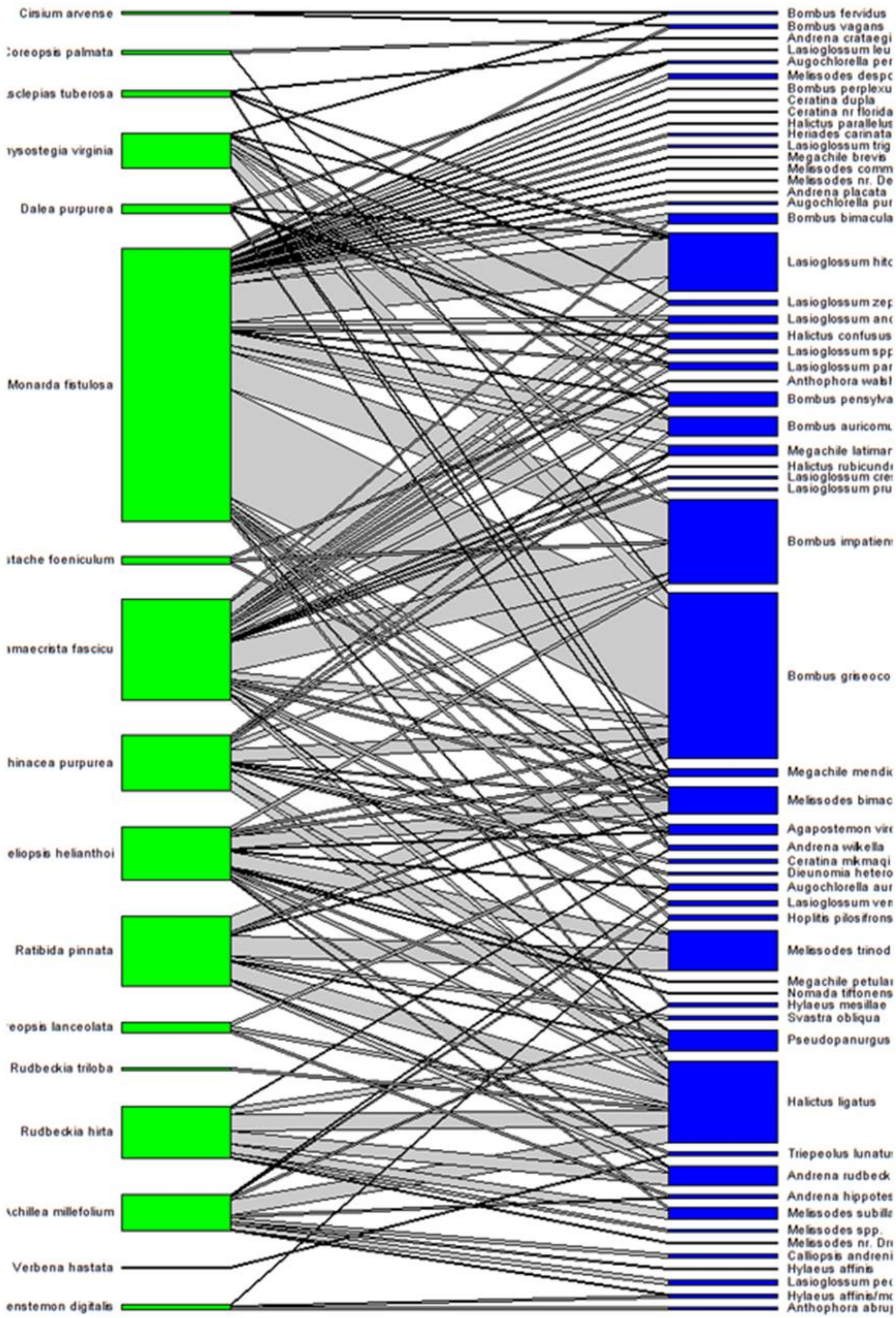

Figure 12: Bee and Sown Floral Resources Interactions from 2018 and 2019

Discussion

As seen in Figure 1, there was no correlation found between bee diversity and floral richness. In addition, there was no correlation found between bee diversity and floral density (Figure 2) as well as bee density and floral density (Figure 3). All findings refute our initial hypotheses.

A strong correlation between bee density and sown floral density was discovered (Figure 4). This demonstrates the effectiveness of CRP plantings on the bee community--the sown species and their blooming can indeed increase the number of bees utilizing the floral sources. In addition, this correlation suggests the floral resources being selected for the sown seed mix are doing their intended job--supporting the bee community. There is a lack of significant correlation between unsown floral resources and the bee community using unsown flowers (Figure 6). While a select amount of unsown floral resources may be supporting bees, there was no direct correlation between the two variables. This information again highlights the need to increase the quantity of sown floral resources planted.

A slight positive correlation between bee richness, measured as the quantity of bee species collected, and sown floral density was also found (Figure 5). This further indicates the support offered by sown floral resources available at each site. Therefore, increasing the density of sown floral resources in restored prairies has the ability to support an increased number of wild bees.

There is an evident variance in floral resource composition between 2018 and 2019 sites (Figure 7). Sown flowers found from the three surveyed in 2018 were composed mostly of *Monarda fistulosa, Agastache foeniculum, Ratibida columnifera, Ratibida pinnata, Tradescantia ohiensis, Asclepias tuberosa*, and *Heliopsis helianthoides*. In comparison, the communities in

2019 were largely driven by flowers from *Coreopsis lanceolata, Rudbeckia hirta, Chamaecrista fasciculata*, *Achillea millefolium*, *Penstemon digitalis*, *Potentilla norvegica, Physostegia virginiana*, and *Coreopsis palmata*.

Similarly, the NMDS ordination depicting the variety of bees collected over the course of two years demonstrates significant changes in the bee species composition (Permanova, p = 0.009; Figure 8 & 9). Sites in 2018 were favored by the *Lasioglossum* genus while 2019 sites had a higher *Andrena* genus composition.

The relationship between wild bees and their preferred floral resources were analyzed (Figure 10, 11, 12). Commonly visited floral species in 2018 were *Monarda fistulosa, Chamaecrista fasciculata,* and *Ratibida pinnata*. In comparison with 2019*, Monarda fisutlosa* was again the most highly selected floral resource by the bee community. Other highly selected floral resources in 2019 were *Echinacea purpurea*, *Rudbeckia hirta*, and *Chamaecrista fasciculata*. An obvious pattern emerges amongst the mostly commonly available and selected floral resources. Our hope is for these forbs to be included in high quantity in future restored prairie seed mixes.

Due to Nobel Prize winner Karl von Frisch's research, bee's sensory sensations are now more understood; bees have the capacity for olfaction and color vision, contrary to the common belief of colorblindness (Leonard & Masek, 2014). These two sensory abilities have been studied at great length but are often studied independent of each other. Further research should center on understanding the bee's multisensory stimuli, integration systems, and its benefits. The coevolution between the plants, such as floral displays and how they manipulate bee behavior, is also an area needing further research (Leonard et al. 2014). By analyzing the bee's sensory systems and the bee-flower relationship, scientists may be able to discover why certain flowers are chosen over others. This may explain why there was a correlation discovered between bee density and sown floral density but not unsown floral density.

In summary, this study was conducted to assess the connection between wild bee species and floral resources in planted CRP fields. Emphasis was placed on examining if some floral resources were favored over others and determining if the bee community varied as the floral resources did. A significant positive correlation was discovered between the density and richness of bees with the density of sown flowers. This relationship was masked by the presence of unsown flowers. By separating the flowers into sown and unsown categories, this association was able to be discovered. This correlation suggests further utilization of seed mixes by farmers enrolling in the CRP programs as sown floral resources are supporting the bee community. While unsown floral resources are available and contribute to some extent, they are not utilized as proportionally as the attractive sown resources. Contrasting 2018 and 2019 sites in terms of the bee community and floral resources, there was a large amount of variation. Variation may be due to the nonuniform seed mixes given to farmers as well as weather conditionings during seeding. Floral variability may be the variable affecting the bee community composition as a result. This study yielded that further development of restored prairies and implementation of recommended seed mixes including a high yield of bee friendly forbs offer a chance to sustain and rehabilitate the bee community.

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