The Effectiveness of Wildflower Habitat Enrichment in Boosting Wild Bee Abundance in the Coastal Plain of Georgia.

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Abstract

Humans depend on honeybees for the pollination of fruits and vegetables. Bees pollinate 1/3 of the human food supply. They pollinate nearly every fruit, nut, and vegetable. The main bee pollinator, the honeybee, has been in decline for several decades due to CCD. Finding alternative pollinators that could supplement or replace the declining honeybee would be a wise safeguard. Wild bees (including wasps) are already a source of sustainable pollination, contributing more than $3 billion in pollination services each year. Regional studies are essential in gathering accurate information on the wild bees present in each region to determine the types of wild bees and which habitat enrichments are most effective in recruiting and keeping target wild bee species in agricultural areas. In the current study, we focused on the poorly studied coastal plain areas of Central Georgia. Previous studies have indicated lower native bee diversity and abundance in the coastal plain areas of Georgia compared with the Piedmont region. A survey of native bee abundance was performed near Hephzibah Georgia (coastal plain soil type) to assess the wild bee community. The most common native bee pollinators observed were sweat bees (*Lasioglossum* species), Southeastern blueberry bees (*Habropoda laboriosa*), mining bees (*Andrena* species), and carpenter bees (*Xylocopa virginica*). The most important wasp pollinators were the large hairy flower wasps (Scoliid species). To boost native pollinator populations, wildflower patches were planted next to several blueberry plots on a blueberry farm. A wildflower mix of several regional specific wildflowers were used. Several wildflower species consistently recruited the most bees to the blueberry plot. Spotted Beebalm (*Monarda* punctata) and Indian Blanket (Gaillardia pulchella) were the most effective wildflowers. Blueberry plots associated with wildflower patches had larger abundance and diversity in each target pollinator group and recruited less common bee species (e.g. bumblebees).

Introduction

Background:

- Honeybees are nature's greatest pollinators for most crops [1]. Each year, honeybees contribute $15 - $20 billion in pollination services to US agriculture [2].
- One out of three bites of food is pollinated by a bee. Nearly every fruit, nut, and vegetable must be pollinated by a bee [3].

The Problem:

- Honeybee populations are in sharp decline due to Colony Collapse Disorder [4]. The U.S. Congress has documented a significant decrease in honeybee colonies since the 1970's [5-7].
- A lack of honeybee hives has resulted in increased food production costs for farmers (e.g. honeybee hive rentals), which results in higher food costs for the general public [1].
- Alternative pollinators that can either replace or supplement the honeybee need to be explored. Honeybee losses could put the global food supply at risk and significantly impact the global economy.

Possible Solutions:

- The best alternative to honeybees is the native bees already present in the local environment. Each year, it is estimated that native bees already provide $3 billion worth of pollination services to US agriculture [8-9].
- Many native bees are excellent pollinators; a few species have been documented to be more than 20 times as efficient as the honeybee in pollinating flowers [8]. However, the greatest challenge for farmers is to recruit large numbers of the "excellent pollinating" native bees to their farms and orchards [1-2].

Possible Challenges:

- Farms and orchards typically consist of a large monoculture of a single crop. This can cause a real challenge for native pollinators. Since many crops (e.g. flowers or blooms) last for only a short amount of time (3-5 weeks) during the year, there is a great abundance of pollen and nectar for only a short period of time. No other food resources are available for most of the year. This results in most pollinators leaving farms and orchards to secure food and nesting elsewhere.
- There are two main methods that can be used to boost native bee abundance in agriculture areas. These methods include: (a) providing nesting habitat and (b) providing food resources [10,11].

Objectives and Hypothesis

There are 3 objectives in this project:

(1) to recruit more native bees to the farm to pollinate the target crop (e.g. blueberries).
(2) to determine which wildflowers are the best at recruiting native bees to the farm.
(3) to encourage bees to stay and nest in the farm, so that their offspring will be available in future seasons.

Hypothesis

It is hypothesized that by providing additional flora resources (e.g. wildflowers), the abundance of native bee populations will increase during the current growing season.

Acknowledgement

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Table 1: This table shows the 590 native bees and honeybees collected in 2022 at the Pinefield Ecofarm in Hephzibah, GA.

Genera	Number	%
Agapostemon	1	0.2%
Andrena	14	2.4%
Apis	2	0.3%
Augochlora	2	0.3%
Augochlorella	0	0.0%
Bombus	4	0.6%
Ceratina	0	0.0%
Eucera	1	0.2%
Habropoda	10	1.7%
Halictus	17	2.9%
Lasioglossum	528	89.5%
Megachile	8	1.4%
Melissodes	0	0.0%
Nomada	1	0.2%
Osmia	1	0.2%
Sphecodes	1	0.2%
Triepeolus	0	0.0%
Xylocopa	0	0.0%
Total	**590**	**100.0%**

Table 2: This table shows the 510 native bees and honeybees collected in 2023 at the Pinefield Ecofarm in Hephzibah, GA.

Genera	Number	%
Agapostemon	13	2.5%
Andrena	37	7.3%
Apis	27	5.3%
Augochlora	1	0.2%
Augochlorella	7	1.4%
Bombus	35	6.9%
Ceratina	1	0.2%
Eucera	1	0.2%
Habropoda	39	7.6%
Halictus	13	2.5%
Lasioglossum	297	58.2%
Megachile	7	1.4%
Melissodes	4	0.8%
Nomada	2	0.4%
Osmia	8	1.6%
Sphecodes	7	1.4%
Triepeolus	4	0.8%
Xylocopa	7	1.4%
Total	**510**	**100.0%**

Table 3: This table shows the 1161 native bees and honeybees collected in 2024 at the Pinefield Ecofarm in Hephzibah, GA.

Genera	Number	%
Agapostemon	45	3.9%
Andrena	218	18.8%
Apis	8	0.7%
Augochlora	9	0.8%
Augochlorella	6	0.5%
Bombus	7	0.6%
Ceratina	3	0.3%
Eucera	9	0.8%
Habropoda	207	17.8%
Halictus	11	0.9%
Lasioglossum	585	50.4%
Megachile	7	0.6%
Melissodes	6	0.5%
Nomada	1	0.1%
Osmia	12	1.0%
Sphecodes	1	0.1%
Triepeolus	1	0.1%
Xylocopa	25	2.2%
Total	**1161**	**100.0%**

Table 4: This table shows the difference in bees collected in the control plots (no wildflowers) and experimental plots (with wildflowers) in year 2 (2023) and year 3 (2024) after wildflowers were seeded at the farm.

Genera	2023 Plots w/o added Flowers	2023 Plots with Flowers	2024 Plots w/o added Flowers	2024 Plots with Flowers
Agapostemon	3	10	1	44
Andrena	12	25	50	168
Apis	2	25	0	8
Augochlora	1	0	2	7
Augochlorella	7	0	1	5
Bombus	3	32	0	7
Ceratina	0	1	0	3
Eucera	0	1	3	6
Habropoda	9	30	50	157
Halictus	0	13	0	11
Lasioglossum	101	196	160	425
Megachile	2	5	2	5
Melissodes	1	3	3	3
Nomada	2	0	0	1
Osmia	0	8	0	12
Sphecodes	5	2	0	1
Triepeolus	1	3	0	1
Xylocopa	2	5	2	23
Total	**151**	**359**	**274**	**887**

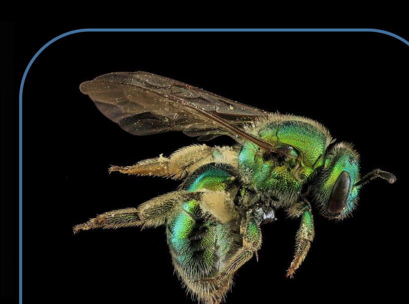
Table 5: This table shows the difference in bees collected in the experimental plots from year 1(2022) to year 2 (2023), and year 3 (2024). Change from year 1 to year 3 is listed in the last column.

Genera	2022	2023	2024	Change
Agapostemon	1	13	44	**44 X**
Andrena	10	25	168	**17 X**
Habropoda	8	30	157	**20 X**
Lasioglossum	370	196	425	**---**
Xylocopa	0	7	23	**23 X**
Other genera	10	60	81	**8 X**
Total	**415**	**359**	**887**	**2 X**

Table 6: This table lists the most effective wildflower species that recruited native bee species.

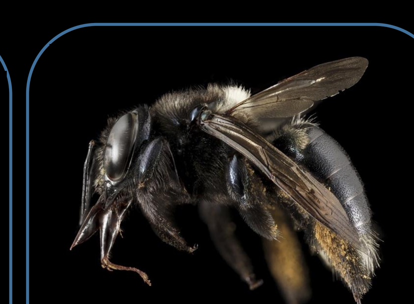
Wildflower Species	Observations
Spotted Beebalm (*Monarda* punctata)	> 50 bee observations
Indian Blanket Flower (*Gaillardia aristata*)	> 50 bee observations
Lanceleaved Tickseed (*Coreopsis lanceolata*)	> 50 bee observations
Crimson Clover (*Trifolium incarnatum*)	> 50 bee observations
Cosmos Sensation (*Cosmos bipinnatus*)	> 50 bee observations

Habropoda laboriosa
Southeastern Blueberry Bee



Agapostemon sp.
Green Sweat Bee

Andrena sp.
Mining Bee



Xylocopa virginica
Carpenter Bee

Photographs were taken by Sam Droge (USGS Bee Lab at Eastern Ecological Science Center). Public Domain

Methods

- Pinefield Ecofarm in Hephzibah, Georgia was the site of the on-farm research experiments. On the farm, there were six plots of blueberry bushes surveyed (3 control blueberry plots and 3 experimental blueberry plots). Wildflower patches of perennial and annual wildflowers were introduced to the experimental blueberry plots in the summer of 2022 (after the blueberry bloom).
- Wildflower species seeded were: Cosmos Sensation *(Cosmos bipinnatus)*, Lance Leaf Tickseed *(Coreopsis lanceolata)*, Plains Coreopsis (*Coreopsis tinctoria*), Purple Coneflower *(Echinacea purpurea)*, Siberian Wallflower *(Erysimum allionii)*, Buckwheat *(Fagopyrum esculentum)*, California Poppy Orange *(Eschscholzia californica)*, Indian Blanket Flower *(Gaillardia pulchella)*, Sunflower Lemon Queen *(Helianthus annuus)*, Gayfeather *(Liatris spicata)*, Sweet Alyssum Tall White *(Lobularia maritima)*, Wild Perennial Lupine *(Lupinus perennis)*, Bee Balm *(Monarda didyma)*, Spotted Beebalm (*Monarda punctata*), Baby Blue Eyes *(Nemophila menziesii)*, Evening Primrose *(Oenothera biennis)*, Red Corn Poppy *(Papaver rhoeas)*, Lacy Phacelia *(Phacelia tanacetifolia)*, Mountain Mint *(Pycnanthemum muticum)*, Yellow Prairie Coneflower *(Ratibida columnifera)*, New England Aster *(Symphyotrichum novae-angliae)*, and Crimson Clover *(Trifolium incarnatum).*
- Each experimental day at the farm (12 per year; March – September), bee observers watched wildflower patches for up to two hours per day. Wildflower effectiveness was defined as a floral visit by a native bee. Video cameras were also used to measure bee visitations. However, in-person bee/flower counts yielded much higher counts of bee- flower interactions.
- Bees were sampled using blue, yellow, and white bowl traps, malaise traps, and sweep netting.

Results & Discussion

- In 2022 (Control Year), 590 wild bees and honeybees were sampled. Small sweat bees (*Lasioglossum* species) (89.5%) dominated the sample (Table 1). In 2023 and 2024 (Experimental Years – Wildflowers were present all season), 510 wild bees and honeybees (2023) and 1161 (2024) were sampled (Tables 2-3). Small sweat bees dropped in abundance; while large-size bees (e.g. *Xylocopa*) and medium-size bees (e.g. *Andrena* and *Habropoda*) significantly increased in abundance (Table 5).
- The wildflowers that recruited the most bees were Indian Blanket (*Gaillardia aristata*), Spotted Beebalm (*Monarda punctata*), Lanceleaf Tickseed (*Coreopsis lanceolata*), and Red Clover (*Trifolium pratense*). Each of these flowers had 50 or more visits (bee- flower interactions) (Table 6). Spotted Beebalm and Indian Blanket were *visited by the widest range of bees and had the greatest bee visitation rate.*
- The results suggest that certain species of wildflowers such as Spotted Beebalm, Indian Blanket, and Lanceleaf Tickseed can significantly alter and boost the wild bee abundance and diversity in agricultural areas. It should be noted that the large-size bees (e.g. *Bombus* and *Xylocopa*) and medium-size bees (e.g. *Andrena* and *Habropoda*) have been linked to boosting agricultural yield across a wide range of commercially important crops [8,9]. The pollination value of the small sweat bee has been questioned due to their small size. Thus, if wildflower patches can boost large and medium size bee abundance, then improved agricultural yield should follow.

SCOLIID WASPS

- The sandy soils of the Coastal Plain of Central Georgia has large numbers of the Scoliid wasps. There were 44 Scoliid wasps collected in the sample in 2022 (control year), 108 Scoliid wasps in 2023, and 408 Scoliid wasps in 2024. The addition of wildflower plots are likely to have increased (10x) the abundance of these large wasps at the farm. These wasps were observed interacting with both the wildflowers and blueberry flowers. Other studies have documented Scoliid wasp usefulness as both pollinators and predators of pest insects (e.g. beetle larvae). High abundance, large size, and beneficial behaviors of Scoliids could have significant impacts on target crops. The most common species (over 90% of the Scoliids in the sample) was *Campsomeris plumipes fossulana.* It is recommended that this species should be investigated more to determine its value in commercial agricultures as both a beneficial predator and pollinator.

SIGNIFICANCE: Why should the public care about boosting native bee populations in agriculture?

- Increasing the number of wild bee pollinators in commercial agriculture will result in: (1) lower production costs (e.g. fewer honeybee hives rented), (2) increased food production, and (3) lower food costs for the general public.
- Food security will also be improved by recruiting wild bees. One-third of the human food supply will no longer be completely dependent on the honeybee. We will have alternatives.

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Butterfly Milkweed | Crimson Clover | Bee Balm | Blanket Flower | Cosmos Sensation | Dwarf Sunspot Sunflower | Lance Leaved Coreopsis | Mexican Hat | Partridge Pea | Plains Coreopsis | Purple Coneflower | Arroyo lupine | Spotted Bee Balm | Dwarf Lupine Pixie | Lacy Phacelia | Swamp Sunflower | Perennial Lupine