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Horticulture Research

Baseline Bee Data Collection at Two Farms

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Funding By:
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In a Nutshell

- Pollinators are a critical component of agricultural production, and the populations of bees are declining. Some farms are implementing bee-friendly pollinator habitat, and are curious what effect their efforts have on local populations.
- Pollinators were collected in bee bowls from different habitats on two farms.

Key Findings

- Nearly 1,300 pollinators were collected.
- The most common species at each farm were from family Halictidae (*Lasioglossum Dialictus* and *Agapostemon virenscens*).
- The prairie garden and unburned prairie habitats had the most diversity of pollinators (number of species) at each farm (26 and 17 species, respectively).
- The largest number of pollinators (404) were collected in the pepper field at Mustard Seed Farm.

Project Timeline:

May – September 2014

Bee bowl set up for collection (left); Insects caught in a dishwater solution in a fluorescent yellow bee bowl (right).

Background

Pollinators are essential to the production of fruiting crops grown around the world, and in Iowa. The effect of landscape and agricultural crop diversity on pollinator diversity and abundance are often studied (Brittain et al., 2010; Carvalheiro et al., 2011; Batary et al., 2011; Garibaldi et al., 2013; Kennedy et al., 2013), and neonicotinoid insecticides used in commercial crop production and lawn care are under scrutiny as pollinator populations decline (Grixti et al., 2009; Potts et al., 2010; Krupke et al., 2012; Henry et al., 2012; Whitehorn et al., 2012; Gill et al., 2012).

As concern about health gains headlines (Zimmer, 2012; Mayer, 2014a; b; Office of the Press Secretary, 2014), farmers are looking at their own fields, curious if their farm practices and habitat offerings are supporting native pollinators. "We assume we have good diversification of pollinators on our farm but want to confirm that and learn about the variety of pollinators," says Sean Skeehan of Blue Gate Farm. Blue Gate has several prairie plantings (recently burned and un-burned), in addition to wooded areas, vegetable gardens, fruit trees, and nearby corn and soybean fields. The surrounding landscape is fairly rolling and has a heterogeneous mix of wooded areas, pasture, and conventional agriculture (**Figure 1a**).

Will Osterholz, a volunteer at Mustard Seed Farm, expressed a similar sentiment. "I've noticed fewer bumble bees and am interested in what other native pollinators are present on the landscape. I am curious about which species are utilizing habitat at Mustard Seed Farm." Like Blue Gate Farm, Mustard Seed Farm has planted pollinator-friendly prairie around the farm. The farm is bordered on the east by conventional corn and soybeans, and on the west by a wooded area and Squaw Creek. Except the creek bed, most of the surrounding land is in corn and soybeans (**Figure 1b**).

Though the main goal of this study was to determine a baseline pollinator abundance and diversity measurement for two Iowa

Figure 1

Figure 1: Aerial view of Blue Gate Farm (A) and Mustard Seed Farm (B).

Agapostemon virescens was the most commonly caught bee at Blue Gate Farm (photo from USGS Bee Inventory via Wikimedia Commons).

Calliopsis andreniformis was caught in the prairie garden and prairie seeding at Mustard Seed Farm (photo from the Packer Lab at York University via Wikimedia Commons).

vegetable farms, differences in abundance and diversity based on habitat at each farm are also of interest. We hypothesize the highest diversity of pollinators will be collected in natural areas (prairie), while the highest abundance of pollinators will be collected in agricultural habitats.

Method

Blue Gate Farm is the small, family operation of Jill Beebout and Sean Skeehan. Blue Gate Farm is Certified Naturally Grown, producing chemical-free fruits and vegetables, free-range eggs, raw honey, alfalfa hay, alpaca fiber and hand spun yarn. They run a limited membership CSA and are regular vendors at the Des Moines Downtown Farmers Market.

Mustard Seed Community Farm near Ames is a diversified vegetable farm with a mission of healthy food accessible to everyone. Members of the farm grow vegetables and herbs to supply their CSA and food donations. They incorporate farming practices such as cover crops, permaculture, perennial crops, beneficial insects and animal habitats as they try to create a farming system that closely mimics nature.

Joe Wheelock, graduate student in the Department of Entomology at Iowa State University, assisted with pollinator identification for this project.

At each farm, four habitats were selected for sampling. At each habitat, nine bee bowls (three each of blue, yellow, and white) were set out at canopy height. The bee bowls were set out for four days each month (May – September), and samples were collected every 24-hours. Farmer-researchers tried to choose four consecutive days each month (or near consecutive) where conditions were favorable to pollinator activity: clear, calm, ideally sunny. (Note: at Blue Gate Farm no bowls were set out in August.)

The bee bowls were painted with fluorescent blue, fluorescent yellow, or white paint to attract a range of pollinators. Bowls were held in PVC tubes painted red and affixed to 1-m steel garden stakes to adjust height. Bees were trapped in the bowls using a blue Dawn® dish soap solution. At collection, bees were strained, rinsed, labeled, and shipped to Iowa State University Entomology for identification. Bees were categorized by family and identified to genus or species (see **Table 1** for brief family descriptions). Pollinating flies, bee mimics, and other insects in the traps were not counted for this study.

Table 1

Bee Families	
Family	**Defining Characteristics of Bee Families on Mustard Seed Farm and Blue Gate Farm**
Andrenidae	Other common names include: Andrenid Bee, Solitary Bee, Burrowing Bee and Ground-nesting Bee. Family Andrenidae contains 1,200+ species in 11 genera in North America. Mining bees are small (<20 mm) brown to black in color, and nest in a burrow, preferring areas of sparse vegetation, old meadows, dry road beds and sandy paths. Many species are active in March and April when they collect pollen and nectar from early spring blooming flowers.
Apidae	Family Apidae includes three subfamilies, with ~1,000 species in 50 genera in North America. The three subfamilies are: Apinae (Honey, Bumble, Long-horned, Orchid and Digger Bees), Nomadinae (Cuckoo Bee), and Xylocopinae (Carpenter Bee). All three subfamilies were represented on the two farms.
Chrysididae	Family Chrysididae contains five subfamilies, with 227 species in 30 genera in North America. Because they parasitize nesting sites for their eggs, they are called the cuckoo wasp. They are metallic blue or green.
Colletidae	Family Colletidae includes 160 species from six genera and four subfamilies in North America. The collection from the two farms included only two subfamilies: Colletinae (Cellophane Bee) and Hylaeinae (Masked Bee).
Halictidae	Family Halictidae are the Sweat Bees. Bees are small to medium-sized, usually black or brownish, and a few have metallic greenish or bluish highlights. Halictidae includes three subfamilies with 520 species in 18 genera in North America. The collection included two subfamilies. In family Halictinae, species in two tribes were represented: Augochlorini and Halictini. One species of subfamily Nomiiane was caught (*Dieunomia heteropoda*).
Megachilidae	Family Megachilidae contains 630 species in 18 genera and two subfamilies. Most are of moderate size with stout bodies. Only one subfamily was represented in the collection: Megachilinae (Leaf-cutter Bee from genus *Megachile* and Mason Bee from genus *Osmia*).
Taxonomic information from BugGuide.Net, hosted by Iowa State University Entomology	

At Blue Gate Farm, the four habitats were: conventional corn, a squash bed (squash bed was among 12, 3-ft wide beds of various vegetables with grass buffers between each), un-burned restored prairie, and restored prairie burned April 2014 (**Figure 2a**: aerial of Blue Gate Farm). At Mustard Seed Community Farm, the four habitats were: a lawn area, a pepper field, a prairie garden, and a new prairie seeding (**Figure 2b**: aerial of Mustard Seed Farm).

Results and Discussion

Blue Gate Farm

Though sample sizes were not adequate for statistical analysis, the data provides an interesting baseline of information. At Blue Gate Farm, 345 bees were collected representing at least 24 species of bee (**Table 2**). This community was dominated by native, solitary, ground nesting bees; very few social bees (i.e., *Bombus species* or *Apis meliffera*) were captured despite the proximity of honey bee hives to the sampling sites. *Agpostemon virescesns* was the most frequently captured bee at Blue Gate accounting for nearly 45% of the total catch.

Based on the location (small, diversified farm), we expected that the total number of species captured at Blue Gate Farm would have been higher. Sampling intensity may have been a factor (August sampling was missed due to illness). Additionally, to fully describe the community of bees visiting this farm a more intensive systematic approach to sampling could

Figure 2

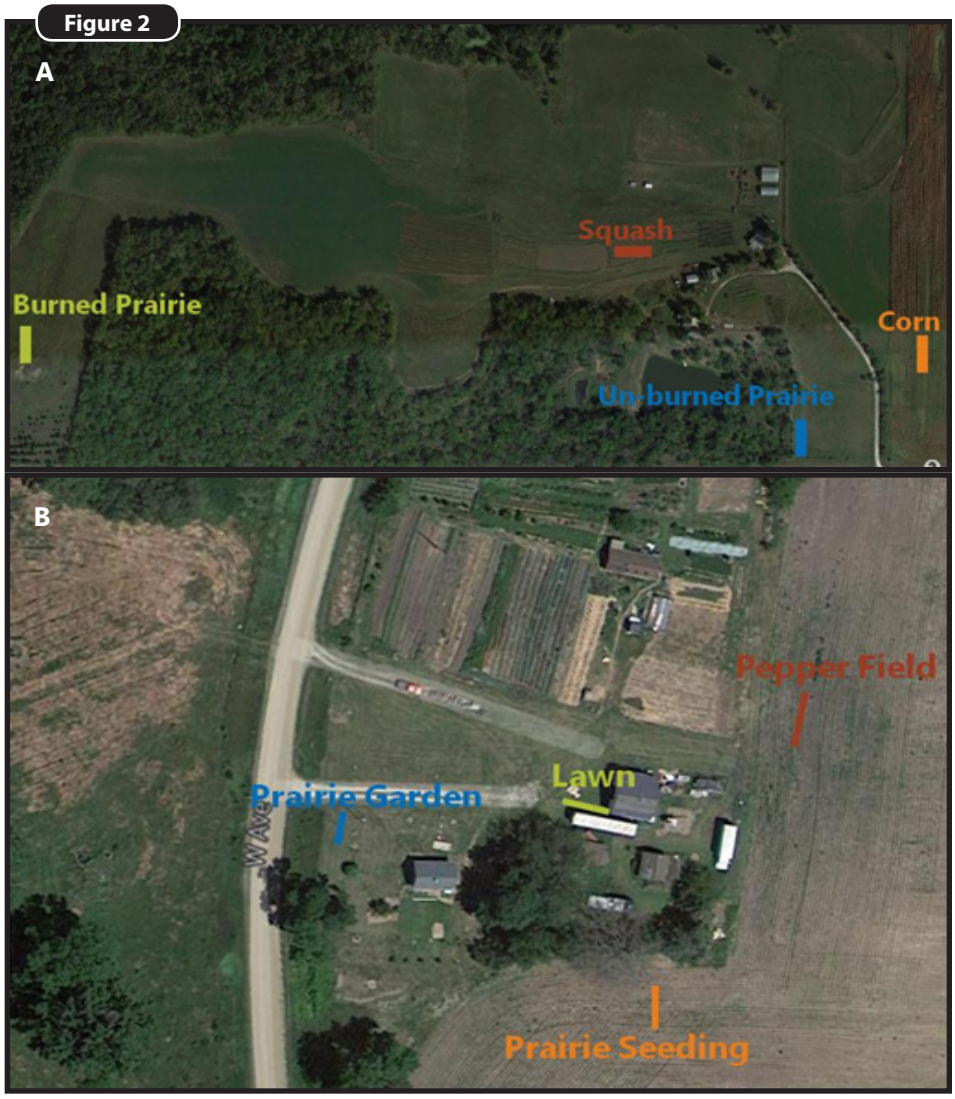

Figure 1: Aerial view and sample plots of Blue Gate Farm (A) and Mustard Seed Farm (B).

have been required. Despite this, a robust community was captured. The species composition is similar to Iowa State Entomology Department work in Iowa corn and soybean fields (Wheelock and O'Neal, 2014).

Mustard Seed Farm

During the collection period at Mustard Seed Farm a total of 953 individuals representing at least 27 bee species were collected (**Table 3**). Like Blue Gate Farm this community was dominated by native solitary ground nesting bees. Stem nesting and social bees were rarely captured in the bee bowls. Lasioglossum were the most abundantly captured bee at Mustard Seed Farm making up nearly 50% of the bees captured. This genus is very diverse and hard to accurately ID species. Therefore these were grouped according to sub-genus and likely represent more species than we account for here.

Mustard Seed Farm captured nearly 3x the individuals than were captured at Blue Gate Farm (953 vs. 345). The species richness at both farms is comparable and the most abundant species are similar. The goal of this project was to gain a better understanding of what pollinator species are present on these farms and how they might differ based on different habitat types. At Mustard Seed Farm more species of bee were captured in the prairie garden habitat type than any other habitat (26 species), but the most abundant community came from the pepper fields (404 individuals). Similarly, the prairie garden provided the most diversity of six families (**Table 2**). Blue Gate Farm had a slightly different distribution with the most abundant and species-rich group being captured in the unburned prairie. The corn habitat had nearly the same number of bees, but were represented by fewer families (only two families) and fewer species (12 species) (**Table 2**).

Table 2

Bee species observed at Blue Gate Farm, May-September 2014

Species	Corn	Squash	Unburned Prairie	Burned Prairie
ANDRENIDAE				
Andrena spp.	0	0	1	0
APIDAE				
Apis meliffera	2	4	4	7
Bombus affinis	0	3	0	0
Bombus griseocollis	0	1	0	0
Ceratina dupla	3	0	1	2
Melissodes agilis	2	0	0	3
Melissodes bimaculata	5	2	1	1
Melissodes communis	0	1	0	1
Melissodes trinodus	3	5	2	0
COLLETIDAE				
Hylaeus affinis	0	1	0	1
HALICTIDAE				
Agpostemon texanus	0	0	3	0
Agpostemon virescens	80	24	24	21
Augochlorella aurata	7	3	3	4
Augochloropsis metallica	0	0	2	1
Augochlora pura	0	0	2	1
Dieunomia heterpoda	2	0	3	0
Halictus confuses	0	0	1	0
Halictus ligatus	8	3	16	4
Halictus rubicundus	3	3	1	3
Lasioglossum Dialictus	3	4	55	0
Lasioglossum Evalaeus	2	0	1	0
MEGACHILIDAE				
Megachile brevis	0	0	0	1
Osmia spp.	0	0	1	0
Total Individuals	**120**	**54**	**121**	**50**
Total Species	**12**	**12**	**17**	**13**

Conclusions and Next Steps

This was the first year Practical Farmers Cooperators have collected data on bees. Because of the time, expertise, and equipment needed to identify insects caught in the bee bowls, this project was labor and capital intensive. It may be worthwhile to look at these farm populations again in several years, or to use more basic collection and identification methods (sweeps, ID to family, or restrict the sampling time).

Osterholz and Skeehan are interested in participating again, as is Loyd Johnson, who did a companion project with the University of Northern Iowa. Says Osterholz, "We gained some insight into the native bee species present in the various habitats on the farm, and we were able to demonstrate some positive impact from the more mature native prairie plantings on pollinator diversity." He continued, "Pollinator population health is of major concern to diversified farms that rely on pollination, like Mustard Seed Farm. We learned from this study that we have cultivated a relatively robust bee community at Mustard Seed farm, which encourages further work to improve bee-friendly pollinator habitat. In future years, we would like to continue monitoring the development of the pollinator community in our newly seeded prairie."

Table 3

Bee species observed at Mustard Seed Farm, May-September 2014

Species	Lawn	Pepper field	Prairie Garden	Prairie Seeding
ANDRENIDAE				
Andrena spp	0	1	3	1
Calliopsis andreniformis	0	0	3	2
APIDAE				
Apis meliffera	0	1	2	2
Bombus affinis	1	0	2	0
Eucera spp	0	2	0	0
Ceratina calcarata	1	0	2	0
Ceratina dupla	1	0	2	1
Melissodes agilis	4	7	13	10
Melissodes Bimaculata	10	21	8	16
Melissodes communis	2	5	6	7
Melissodes drurilla	0	1	1	0
Melissodes trinodus	0	4	5	12
Nomada spp.	0	0	1	0
Svastra Obliqua	0	0	1	2
COLLETIDAE				
Colletes brevicornis	0	2	1	0
Hylaeus affinis	0	0	2	0
HALICTIDAE				
Agpostemon texanus	14	59	17	25
Agpostemon virescens	27	52	29	24
Augochlorella aurata	0	1	0	2
Augochloropsis metallica	0	0	2	1
Dieunomia heteropoda	3	4	2	6
Halictus Confuses	9	8	5	5
Halictus ligatus	3	6	11	6
Halictus rubicundus	0	0	5	0
Lasioglossum Dialictus	46	230	53	120
MEGACHILIDAE				
Megachile brevis	0	0	6	0
Megachile parallela	0	0	3	0
CHRYSIDIDAE	0	0	1	0
Total Individuals	**121**	**404**	**186**	**242**
Total Species	**12**	**16**	**26**	**17**

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