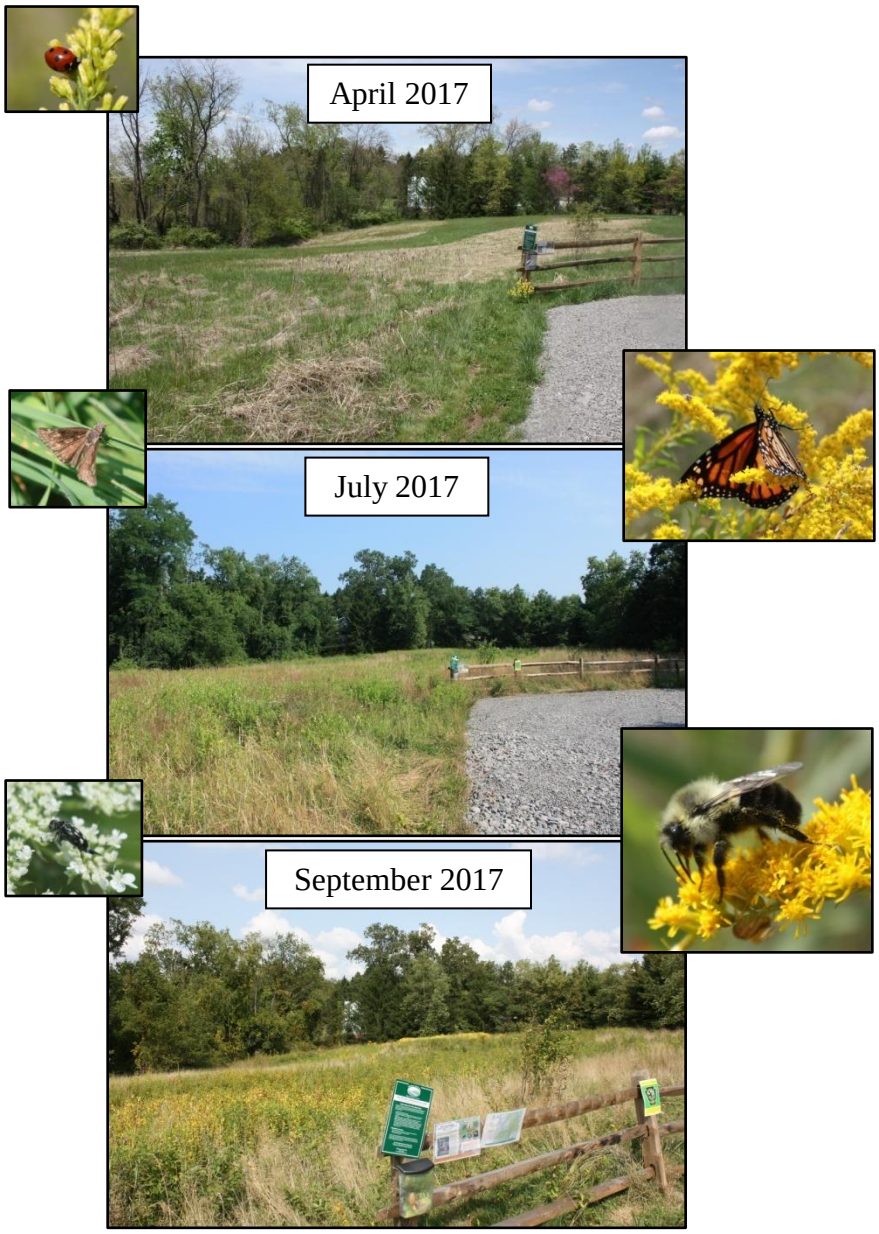
AUDUBON GREENWAY POLLINATOR STUDY

2017 RESEARCH SUMMARY



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ABSTRACT

The decline of pollinators around the world has potential negative consequences for agriculture and ecological health. In agricultural areas such as the Midwest, studies have reported that nearly half of native bee species have disappeared from their historic ranges in the past century. Habitat protection and wildflower restoration is critical to prevent the further lose of pollinators. In a joint effort to establish habitat and food for pollinators, Allegheny Land Trust is leading the way in restoring tall grass and wildflower meadows at Audubon Greenway in southwestern Pennsylvania. As part of the restoration, three acres have been set aside for research. This year is the first survey of pollinators and wildflowers at the research site. The 3-acre site is subdivided into two types of transects, in which half are sprayed with herbicides and seeded and the other half are left unplanted and receive no herbicide. The overall density of pollinators in the study increased from April to September, with considerably more pollinators visiting the unplanted transects. In April, 259 pollinators per acre were observed in the unplanted transects compared to 36 in the planted transects. In September, the densities increased to 2,972 pollinators per acre in the unplanted transects compared to 1,093 pollinators in the planted transects. Wildflower preference had the most significant impact on the overall density of pollinators, as well as, the density of five taxa specifically chosen to monitor changes in the pollinator communities. The preferred wildflowers included garden yellowrocket (*Barbarea vulgaris*) in April; Queen Anne's lace (*Daucus carota*) and spreading dogbane (*Apocynum androsaemifolium*) in July and calico aster (*Symphyotrichum lateriflorum*), goldenrod (*Solidago sp.*) and Queen Anne's lace in September. The total number of taxa observed during the sampling in April, July and September was 18. The most consistent taxa in abundance and presence throughout the study were European honey bee (*Apis mellifera*), bumble bee (*Bombus sp.*) and sweat bees (Halictidae). Through continued research, this study will provide important information on pollinator density and diversity to help assess the community population at Audubon Greenway and provide recommendations for attracting pollinators to the meadow areas.

INTRODUCTION

This report summarizes the first pollinator and plant surveys conducted as part of a pollinator study at Audubon Greenway. Audubon Greenway consists of 161 acres of rolling hills and woodlands located in Sewickley Heights Borough in southwestern Pennsylvania. Audubon Greenway was purchased in parts by Allegheny Land Trust between 2003 and 2014 (**Fig. 1**). Starting in 2016, Pennsylvania Game Commission sprayed and seeded approximately 15 acres of abandoned meadow adjacent to Magee and Audubon Roads. The meadows were seeded with a tall grass and wildflower mixture to enhance the wildlife potential of the site. Three of those acres along Magee Road were converted into a research site for studying pollinators, with treatments consisting of alternating transects either sprayed and planted with a tall grass and wildflower mixture or not sprayed and left unplanted.

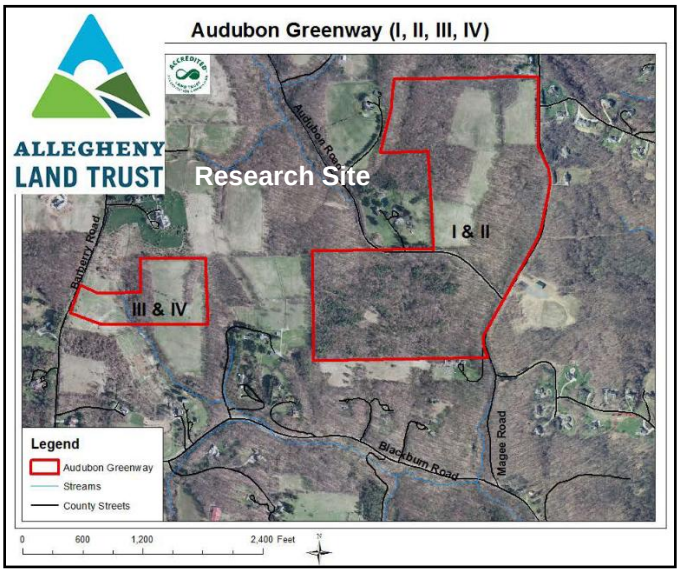

Figure 1. Satellite image of Audubon Greenway.

. In 2017, Matthew Opdyke, Associate Professor at Point Park University, began the pollinator study to investigate the abundance and diversity of pollinators associated with open meadows at Audubon Greenway. The motivation behind the study is best summarized in an article written by Gwen Pearson in Wired, title "You're worrying about the wrong bees." Nearly half of Midwestern native bee species have disappeared from their historic ranges in the past century and several bumble bee species are facing extinction. The European honey bee (*Apis mellifera*), which receives most of the attention in media, is a domesticated species that supplement the work of native pollinators, not the other way around. Solitary bees face a greater threat from pesticides and environmental changes, and yet, receive little attention. This study includes both pollinator and plant surveys to assist Allegheny Land Trust in managing their habitat for pollinators and provides valuable information for assessing the status of pollinators in southwestern Pennsylvania, as well as, providing educational material.

MATERIALS AND METHODS

Pollinator and Wildflower Survey

The 3-acre research site is subdivided into alternating transects of planted and unplanted treatments (**Fig. 2**). The planted transects were mowed and sprayed with herbicide in September and October 2016; and was seeded in July 2017 with a tall grass and wildflower mixture. The unplanted transects were mowed but neither sprayed nor seeded. The entire site is mowed each year in October to prevent woody plant growth.

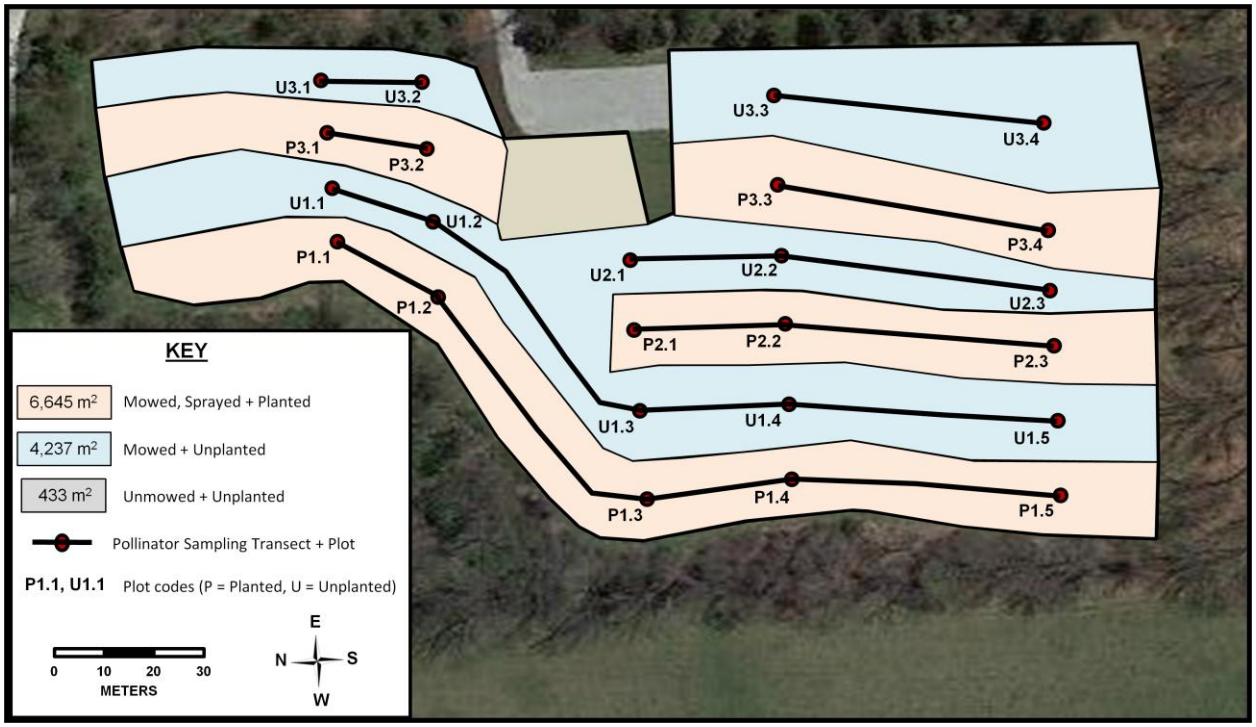

Figure 2. Planted and unplanted treatment transects at the 3-acre research site.

Pollinators are surveyed by meandering through a 5-meter band in each transect, observing, identifying and recording the presence of all insects on flowers. This method is more humane than pan traps and provides a more reliable count of pollinators, as well as, a better mapping of their distribution compared to stationary surveys. **Table 1** lists the length of each transect and the surface areas of the individual 5-m bands in each transect. The distribution of insects within transects is determined by recording their location in reference to the plot points. When insects cannot be identified in the field, they are captured and returned to the laboratory for identification. All insects reported in this study are considered to be pollinators regardless of their primary feeding strategy.

Table 1. Length of transects and the surface areas of the 5-m bands in each transect surveyed for pollinators and wildflowers.

Transect	Transect Length (m)	Surface Area of 5-m Band Surveyed for Pollinators and Wildflowers (m^2)
P1.1 to P1.5	158	790
P2.1 to P2.3	78	390
P3.1 to P3.4	68	340
U1.1 to U1.5	148	740
U2.1 to U2.3	76	380
U3.1 to U3.4	61	300

Sampling occurs three times a year in April, July and September. During each sampling period, surveys are conducted in the morning between 9:00 and 11:00 AM

and in the afternoon between 1:00 and 3:00 pm. The average time spent in each transect is 30 minutes.

Upon completing the pollinator surveys, each transect is then walked following the same path as that taken to record pollinators to identify and count all wildflowers in bloom. This information is used to calculate the density and diversity of wildflowers to determine which wildflowers are preferred by pollinators.

Plant Survey

In addition to wildflower surveys, plant surveys are conducted in April, July and September to determine the dominant type of vegetation growing in the planted and unplanted transects. Twelve randomly chosen permanent sampling plots, with six per treatment (planted vs. unplanted), are established throughout the site. Each plot is two square meters in size. All forbs within the plots are identified and their percent cover is estimated. The percent cover of graminoids is also estimated but individual species are not identified. The results are not provided in this report because they provide no additional insight.

RESULTS AND DISCUSSION

Pollinator and Wildflower Survey

In all sampling periods, there was a greater density of pollinators in the unplanted transects compared to the planted transects (**Table 2**). Overall flower density and diversity had little impact on the density of pollinators. Instead, the determining factor was the abundance of preferred wildflowers. In April, garden yellowrocket (*Barbarea vulgaris*) was the preferred wildflower visited by pollinators, with nearly 100% of all pollinators visiting the flower in the afternoon. The density of garden yellowrocket was 366 per acre in the unplanted transects compared to 5 per acre in the planted transects. In July, Queen Anne's lace (*Daucus carota*) and spreading dogbane (*Apocynum androsaemifolium*) were the preferred wildflowers visited by pollinators, with 91% of all pollinators visiting the flowers in the afternoon. The density of the two flowers were 2,952 per acre in the unplanted transects compared to 2,629 per acre in the planted transects. In September, calico aster (*Symphyotrichum lateriflorum*), goldenrod (*Solidago sp.*) and Queen Anne's lace were the preferred wildflowers visited by

Table 2. Abundance and diversity of pollinators and wildflowers in the planted and unplanted treatment transects. Results are from afternoon sampling in April, July and September 2017.

	April		July		September	
	Unplant.	**Plant.**	**Unplant.**	**Plant.**	**Unplant.**	**Plant.**
Pollinator Density per Acre	259	36	1,467	783	2,972	1,093
Pollinator Taxa Richness	7	3	12	14	14	14
Shannon Diversity Index	2.6	1.0	2.6	2.8	2.7	2.8
Flower Density per Acre	1,252	2,268	7,852	3,188	2,487	2,193
Flower Taxa Richness	5	4	9	12	12	20
Shannon Diversity Index	2.0	1.4	2.0	1.9	2.3	2.5

pollinators, with 99% of all pollinators visiting the flowers in the afternoon. The density of the flowers were 1,639 per acre in the unplanted transects compared to 1,453 per acre in the planted transects.

Pollinator density also increased from April to September. Overall flower density, again, had little impact on the density of pollinators, whereas, flower diversity, determined by taxa richness and Shannon diversity index, did have an impact. The April sampling period had six wildflowers in bloom compared to an average of 18 wildflowers in July and September. The greater abundance of wildflowers likely attracted more pollinators. Another reason for the increase in pollinator density is the quality of flowers. While the preferred wildflower in April was a non-native species, spreading dogbane in July is a native species and both calico aster and goldenrod are native species that bloomed in September. Goldenrod is also known as an important nectar source for pollinators in the fall.

The diversity of pollinators, determined by taxa richness and Shannon diversity index, generally increased from April to July with little change between July and September. This is likely a response to the greater number of wildflowers in July and September compared to April. A complete list of pollinators is provided in the appendix.

In addition to studying overall pollinator density and diversity, five taxa have been identified to serve as indicators of change among pollinators. These taxa have been chosen based on their abundance and differences in sociality and nesting (**Table 3**). The European honey bee and the bumble bee are two of the most common and easily identified pollinators that visit the research site, accounting for 32% of all pollinators. The sweat bee, which is identified by its small, gnat-sized body and greenish coloration, is another common pollinator, accounting for 15% of all pollinators. The white, sulfur and skipper butterflies are the most common butterflies that visit the research site, accounting for 3% of all pollinators.

Table 3. Characteristics of pollinator taxa used as indicators of change among pollinators.

Common Name	Order	Taxa	Native (N) or Introduced (I)	Sociality	Nesting	Diet
European Honey Bee	Hymenoptera (insect)	Apidae (*Apis mellifera*)	I	eusocial	artificial hives/trees	pollen/ nectar
Bumble bee	Hymenoptera (insect)	Apidae (*Bombus sp.*)	N	eusocial	ground	pollen/ nectar
Sweat Bee	Hymenoptera (insect)	Halictidae	N	eusocial/ semisocial/ communal/ solitary	ground	pollen/ nectar
Whites + Sulfurs	Lepidoptera (butterfly+moth)	Pieridae	N/I	solitary	-	pollen/ nectar
Skippers	Lepidoptera (butterfly+moth)	Hesperiidae	N	solitary	-	pollen/ nectar

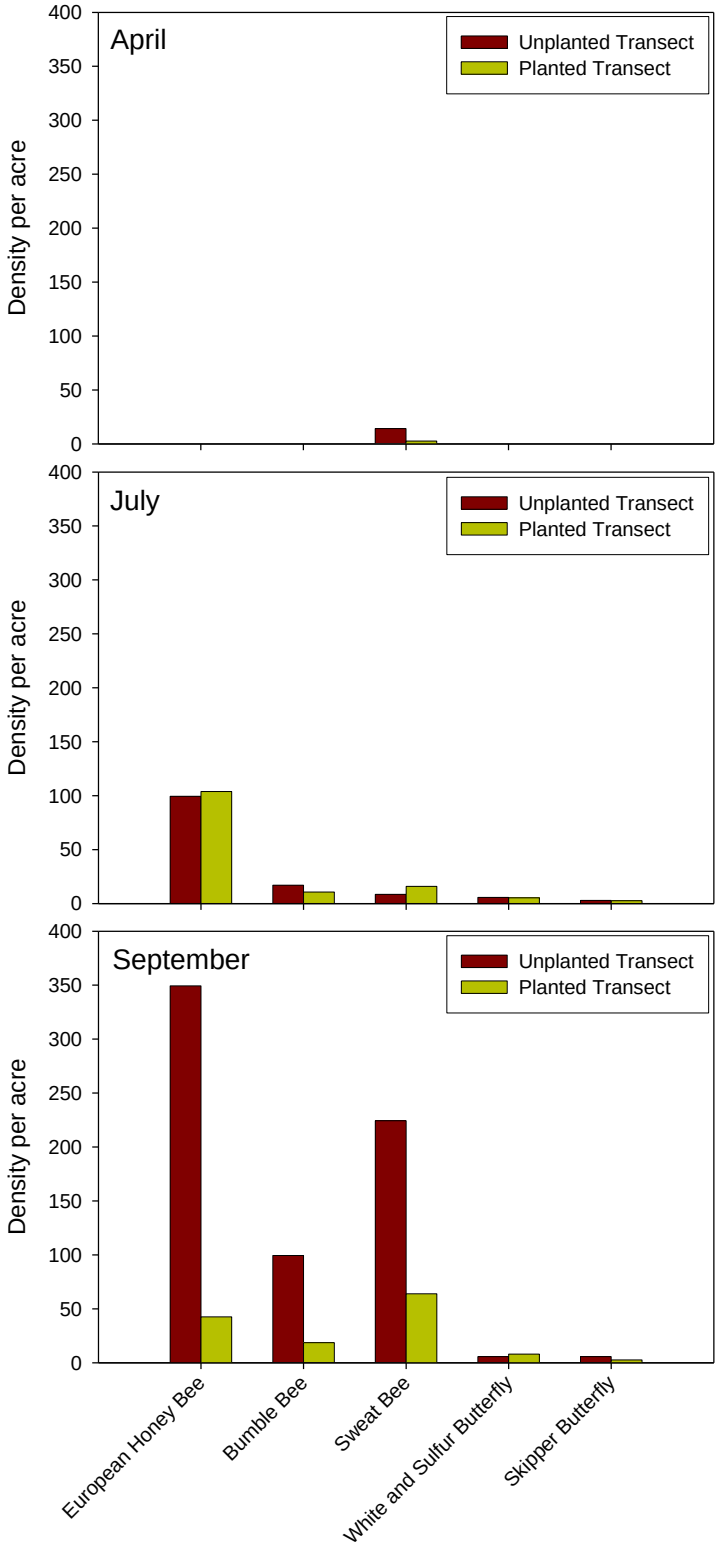

Figure 3 compares the five indicator taxa between planted and unplanted transects during the afternoon sampling conducted in April, July and September. Only sweat bees were present in April. In July, none of the taxa displayed a significant preference between the planted and unplanted transects. This was also true for butterflies in September. European honey, bumble and sweat bees did show a preference for the unplanted transects in September. This is a result of greater density of preferred wildflowers (calico aster, goldenrod and Queen Anne's lace) in the unplanted transects.

Figure 3. Comparison of five indicator taxa between planted and unplanted treatment transects during the afternoon sampling conducted in April, July and September.

Table 4 lists the dominant wildflowers in the planted and unplanted transects that account for more than 75% of all wildflowers per sampling period. The wildflowers preferred by pollinators were garden yellowrocket in April, Queen Anne's lace and spreading dogbane in July and calico aster, goldenrod and Queen Anne's lace in September.

Table 4. Dominant wildflowers that account for more than 75 percent of all wildflowers per sampling period and treatment transect. Density of wildflowers is given in units of flowers per acre.

April			
Unplanted		**Planted**	
Ground Ivy (*Glechoma hederacea*)	514	Pennsylvania Bittercress (*Cardamine pensylvanica*)	1,684
Garden Yellowrocket (*Barbarea vulgaris*)	366	Common Blue Violet (*Viola sororia*)	575
Common Blue Violet (*Viola sororia*)	355		
July			
Unplanted		**Planted**	
Crownvetch (*Securigera varia*)	4,381	Spreading Dogbane (*Apocynum androsaemifolium*)	2,473
Spreading Dogbane (*Apocynum androsaemifolium*)	2,551	Queen Anne's Lace (*Daucus carota*)	156
Canada Thistle (*Cirsium arvense*)	443	Carolina Horsenettle (*Solanum carolinense*)	133
Queen Anne's Lace (*Daucus carota*)	401	Canada Thistle (*Cirsium arvense*)	131
		Common Milkweed (*Asclepias syriaca*)	37
September			
Unplanted		**Planted**	
Calico Aster (*Symphyotrichum lateriflorum*)	1,179	Queen Anne's Lace (*Daucus carota*)	1,118
Crownvetch (*Securigera varia*)	658	Calico Aster (*Symphyotrichum lateriflorum*)	273
Queen Anne's Lace (*Daucus carota*)	242	American Burnweed (*Erechtites hieraciifolius*)	269
Goldenrod (*Solidago sp.*)	218	Wild Basil (*Clinopodium vulgare*)	131
		Cosmos (*Cosmos sp.*)	97
		Goldenrod (*Solidago sp.*)	62
		Common Selfheal (*Prunella vulgaris*)	44

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APPENDIX

List of all pollinators found on wildflowers during the morning and afternoon sampling times in April, July and September.

Order Coleoptera (Beetles)	
Family Chantharidae	
Chauliognathus marginatus	Margined Leatherwing
Chauliognathus pensylvanicus	Goldenrod Soldier Beetle
Family Chrysomelidae	
Chrysochus auratus	Dogbane Beetle
Family Coccinellidae	
Coleomegilla maculate	Spotted Lady Beetle
Zilus horni	Eastern Velvethead
Family Mordellidae	
Mordella sp.	Tumbling Flower Beetle
Family Scarabaeidae	
Trichiotinus sp.	Bee-like Flower Scarab
Order Diptera (True Flies)	
Family Asilidae	Robber Fly
Family Syrphidae	
Platycheirus scutatus	Hover Fly
Order Hemiptera (True Bugs)	
Family Reduviidae	
Phymata erosa	Jagged Ambush Bug
Order Hymenoptera (Insects)	
Family Andrenidae	
Calliopsis sp.	Mining Bee
Perdita sp.	Mining Bee
Family Apidae	
Apis mellifera	European Honey Bee
Bombus sp.	Bumble Bee
Family Colletidae	
Hylaeus modestus	Modest Masked Bee
Family Formicidae	
Formica sp.	Field Ant
Family Halictidae	
Agapostemon sp.	Metallic Green Bee
Augochlorella sp.	Sweat Bee
Family Ichneumonidae	Ichnuemon Wasp
Family Megachilidae	
Anthidium manicatum	European Wool-Carder Bee
Anthidium sp.	Mason Bee
Family Vespidae	
Monobia quadridens	Four-toothed Mason Wasp
Polistes fuscatus	Northern Paper Wasp
Vespula squamosa	Southern Yellowjacket

Order Lepidoptera (Butterflies and Moths)

Family Erebidae	
Cisseps fullvicolis	Yellow-Collared Scape Moth
Family Hesperiidae	
Epargyreus clarus	Silver-Spotted Skipper
Euphyes vestries	Dun Skipper
Pholisora catullus	Common Sootywing
Family Nymphalidae	
Danaus plexippus	Monarch
Phyciodes tharos	Pearl Crescent
Family Papilionidae	
Papilio triolus	Spicebush Swallowtail
Family Pieridae	
Colias philodice	Clouded Sulfur
Pieris rapae	Cabbage White Butterfly
Family Syphingidae	
Hemaris thysbe	Hummingbird Clearwing