Reconstruction of Pollinator Communities on Restored Prairies in Eastern Minnesota

Final Report to the Minnesota Department of Natural Resources Nongame Wildlife Program

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Abstract

I observed and collected insects visiting flowers on 4 relatively undisturbed prairie sites and 4 reconstructed prairies (farm fields recently replanted to prairie plants) in south central Minnesota during the summers of 1991 and 1992. Bees, flies, wasps, Lepidoptera and beetles visited flowers. Over 1100 observations of insects per flower revealed no consistent differences between the native prairie sites and the reconstructions over all, although insects per flower varied among forb species. A total of 279 insect species were identified among the 4000 insects collected; 83 species were found on native sites only, 68 on reconstructions only, and 128 species on both native sites and reconstructions. Species richness of sites ranged from 40 to 111 flower-visiting species per site; both the highest and the lowest value were observed on reconstructions. All sites contained both specialist and generalist insects.

Bee species richness of sites was related to forb species richness, not to site area, reconstruction age or total number of flowers or inflorescences in bloom. Reconstructions and native sites were comparable in their bee species richness, but bee distribution was quite patchy. Only 8 of 125 bee species were found on all 8 sites, and each site had at least one unique bee species found on no other site.

These results imply that prairie reconstructions can be valuable sites for insect conservation; to increase this value, managers should plant a wide variety of forbs from several families, and include forbs which bloom early and late as well as mid-season species. Native prairie sites can support many insect species; even small remnants should be preserved.

Areas of greatest interest for further research include the adequacy of pollination by various insect groups for plant reproduction; the distribution of bees over larger areas including the protected sites; and the interactions among plants, their pollinators, and the other factors which allow high pollinator diversity on some sites.

The objectives of the project were

1. To determine what insect pollinator species become established in prairie reconstructions, and to compare the reconstruction pollinator communities with those of relatively undisturbed native prairies.

2. To identify factors which affect pollinator density and species richness in prairie reconstructions.

Rediscovery of the practical and esthetic values of native plants and animals has stimulated replanting of prairies on former agricultural lands. We must discover how to manage these reconstructions so they can become self-sustaining communities. The value of native plants in roadside land management for reduction of mowing and herbicide use is being increasingly recognized. Native insects are being considered as crop pollinators due to their resistance to parasitic mites and diseases, and due to the threat of Africanization of honeybees (Torchio 1990).

Though much is known about plant establishment in prairie reconstructions, little attention has been paid to prairie insects; at present, our knowledge of pollinator species presence and functioning is inadequate for management decision making. Most prairie plants require insect pollination for seed production, so pollinators are essential for the long-term functioning of preserves and of reconstructed prairies. Yet insects, including pollinators, are prone to population decrease and extinction when their habitats are altered. If pollinator populations are maintained, prairie preserves and reconstructions can serve as reservoirs for insects which also pollinate crops and other plants outside the prairie areas.

The tallgrass prairie community includes many insects which are pollination specialists (oligoleges) visiting only single plant families, genera, or even single species (Schemske 1983). The pollinator community also contains many generalists (polyleges); they visit and pollinate many plants, and shift their hosts as new flowers come into bloom (Evans 1984; Heinrich 1979).

Plants vary in the number of insects they attract and support: specialists (oligotrophs) are visited by only a few insect species (which may also visit other plants). Generalists (polytrophs) are visited by many insects (which may vary in their effectiveness as pollinators), and can support many different insect species.

Normally many pollinators are present in an area; bumblebees tend to be highly mobile generalists, small native bees are frequently more specialized in the flowers they visit, and honeybees utilize dense flower clusters, especially of alien plants (Ginsberg 1983). Honeybees are rarely seen on prairie plants in Minnesota (Dickinson and McKone 1992). Not much is known about flies and wasps as pollinators. Likewise, Lepidoptera are considered to be important pollinators in many cases, but definite evidence is lacking on this except for a few plant species (Courtney 1982; Wiklund et

al. 1982).

Are pollinators common in prairie remnants? Prairie management studies have emphasized plants: recent work on insects (Opler 1989; Nekola, in press) suggests that current management techniques, especially frequent burning, may in fact be harmful to native insect populations. Panzer (1981) reports that even areas as small as two hectares can support rare prairie insects if properly managed, including restrained burning and the removal of unnatural habitat features including weedy trails.

In historic times the prairie has become increasingly fragmented. Insect specialists dependent on prairie plants may have shifted their resource use to become more generalized (Janzen 1974; Feinsinger 1983; Estes et al. 1983), persisted in small populations, or become extinct. Extinction is an increasingly likely prospect as populations become smaller (Dempster 1991). Have species been lost from the prairie insect community? Can prairie species become established and increase on reconstructions? Two aspects of insect biology must be understood: the insects' colonizing ability and their ability to become established when they reach the reconstuctions.

Prairie reconstructions are early successional systems, or new areas to be colonized, from the insects' point of view. Theory gives some clues as to expectations regarding pollinator colonization of prairie reconstructions: opportunistic generalists are likely to be more important than specialists in early successional habitats (Feinsinger 1986). Specialized pollinators may have greater difficulty than generalists both in maintaining their populations in the absence of prairie (Kevan 1975) and in colonizing new habitats even where they are present nearby (Johnson 1969). However, the prairie itself is a young habitat by geological standards; it has been colonized by insects since the last glaciers (Lemkuhl).

Can prairie reconstructions be made more attractive to colonizing insects? Alternative views of pollinator-plant interactions lead to different management implications:

1. Pollinator presence depends on specific plants and their interaction with specialist insects.

Insect specialists can colonize only areas which contain their host plants. For example, the sweat bee Dufourea monardae (Halictidae) requires Monarda species (Labiatae: Monarda fistulosa on my sites) and is not found in sites where this plant genus is absent. Highly specialized pollinators have short flight seasons as they can forage only when their host plants are in

flower. Other long-lived insects, such as many bumblebees, visit a variety of plants from many families and are not dependent on single plant species.

If these specialist-based interactions are occurring on prairie reconstructions, we can expect to influence pollinator communities by introducing certain plants. If the plant species themselves, not the overall community species richness or diversity, which determine how many and what pollinators are present, we can add insect species by introducing their plants. We would need to identify what plant species would be most successful in maintaining pollinator biodiversity and bring in insect specialists by bringing in their plants: the more plants, the more specialist insects.

2. Pollinator presence depends on the habitat resource level: how many flowers are present, and whether there is a dearth period during the summer when no flowers are available.

Many researchers have found resource limitation among pollinators. Bowers (1985) found bumblebee populations in meadows were limited by resources, and many colonies became extinct in the course of the summer due to lack of pollen and nectar. Ginsberg (1981) described higher bee populations on expanded resources as settlement occurred in New York State. Introduced fruit trees and weeds (all generalist plants) provided insect forage. Heinrich (1976) observed bumblebees in undisturbed bogs and in disturbed habitats in Maine. The bogs had the greatest degree of overlap in flowering periods (ie no dearth period), and the greatest bumblebee species richness. Heinrich also observed that some introduced plant species such as clovers supported bees when few other flowers were blooming. Prescott-Allen and Prescott-Allen (1986) described work by Bohart indicating that wild bees have become more abundant in the western US due to increased weeds replacing forests, among other factors.

If these interactions dominate the plant-pollinator relationship, plant species choice in reconstruction planning would be unimportant provided plants were present at high density and flowered throughout the summer.

3. Some plants have disproportionate effect on the insect community as a whole. These are keystones, or plants which provide critical support for other species, especially as food sources during times of scarcity (Gilbert 1980; Soule and Kohm 89). These plants when present can increase the species richness of the insect community.

If this keystone-based dynamic is occurring, we need to identify keystone plants and plant them.

The studies cited above suggest several hypotheses.

A. Hypotheses related to pollinator colonization of prairie reconstructions:

1. Reconstructions will have lower insect density than native prairies.

2. Pollinator species richness will decrease with distance from sources of colonists.

B. Hypotheses related to pollinator establishment on reconstructions

3. pollinator species richness will increase with forb species richness as more plants add more specialists

4. Pollinator species richness will increase with resource levels, ie flower number

5. Certain plant species (keystones) will be associated with greater pollinator species richness wherever they are found.

C. Hypotheses based on succession theory:

6. Pollinator species richness will increase with reconstruction area

7. Pollinator species richness will increase with age of reconstruction

8. Reconstructions will have more insect generalists, and fewer specialists, than native prairies.

Materials and Methods

I observed and collected insects in 4 native prairie sites and 4 prairie reconstructions during 1991 and 1992. I counted insects on known numbers of flowers or inflorescences and made timed collections from flowers blooming in these sites.

In 1992 we made 90 visits to study sites between May 27 and September 19, 1992 and made 826 insect density observations on a total of 55 plant species. We collected 2001 insects from flowers and counted or estimated the number of flowers at each site on each visit. High school and elementary teachers assisted me in the field and lab as part of the Research Experiences for Teachers program developed by the U of M Continuing Education and Extension programs. In 1991 we made 283 density observations during 52 visits and collected 1400 insects. In 1990 I made limited collections; insects collected in 1990 are included on the species lists.

Site	Type	Total Visits
AREM (Afton remnant)	Native Prairie	12
ASP (Afton reconstruction	Reconstruction	12
CARP (Carpenter Nature Ctr)	Reconstruction	27
CC (Cedar Creek Nat Hist area)	Native	21
CEM (Point Douglas Cemetery)	Native	21
CHR (Crow Hassan Park Res)	Reconstruction	23
LLRP (Long Lake Reg. Park)	Reconstruction	12
LV (Lost Valley SNA)	Native	21

Survey Methods

I surveyed insects visiting the flowers of a total of 60 forb species blooming in the sites listed above. I counted the flowers of each forb species blooming on each sampling date using quadrat and line transect methods. Insect observations were made for each forb species with at least 500 flowers open. The first observation was May 27 and the last observation was September 24, 1992; in 1991, June 5 and September 20.

Insects were observed and counted on all the flowers or inflorescences present, or on 1500 flowers or inflorescences, whichever was more. Insects were identified to field identification categories of bumblebees, small bees, green bees, long-tongued bees, honeybees, syrphids, sphinx moths, other Lepidoptera, goldenrod soldier beetles (Chauliognathus pennsylvanicus), black blister beetles (Epicauta pennsylvanica), wasps, ambush bugs (Phymata fasciata) and other insects. Observations were made between 9 am and 4 pm on sunny or partly cloudy days when the temperature was between 20 and 35 degrees Celsius.

A fifteen-minute collection was made at the end of each sampling day in each site from each forb species with at least 100 flowers or inflorescences blooming on that day. Insects were collected by sweeping from flowers. I attempted to minimize overlap in collecting to avoid depleting the insect populations on the sites. I made 216 collections from all native sites combined, and 280 collections from all reconstructions combined. Each specimen was labelled with the site, date, and plant on which it was collected. All specimens were identified or confirmed by specialists, as shown:

Bees: Andrenidae and Anthophoridae: Wallace Laberge, Illinois Natural History Survey

Halictids: George Eickwort, Cornell University

Megachilids and Colletids: Terry Griswold, USDA/ARS Bee Lab
Bumblebees: Robbin Thorp, UC Davis
Flies: Wilford J. Hanson, Utah State University
Wasps: John Luhman, University of Minnesota
Lepidoptera: the author, using the U of M Collections
Beetles: Phil Clausen, University of Minnesota

Study Sites

Prairie Reconstructions

Crow Hassan Park Reserve (CHR) in northwestern Hennepin County (MN) includes 243 hectares of reconstructed prairie replanted in former agricultural fields over the last 15 years. Forbs have been planted densely in a small part of the prairie area. The area is managed by controlled burning of parts of the area in different years. The soil is very sandy.

Afton State Park (ASP), Washington County, MN contains several reconstructions. I sampled a 4.8 hectare field containing prairie grasses and 4 forb species planted 9 years ago and managed by controlled burning. The soil is deep and loamy.

Carpenter Nature Center (CARP) in Washington County (MN) contains a 32.4-hectare reconstructed prairie. One-quarter of the area was planted in 1988, one-quarter in 1989, one-quarter in 1990 and the remaining area in 1991. The reconstructions are managed by mowing in the early stages, followed by regular burning. The soil is deep and loamy.

Long Lake Regional Park in Ramsey County (MN) contains a 2.8-hectare prairie reconstruction planted in 1987. This area is managed by burning. The soil is sandy with some clay.

Native Prairies

Afton Remnant (AREM) is a 1.6 hectare remnant located on the bluff top in Afton State Park. It was relatively overgrown but has recently been managed by brush cutting and burning. The soil is deep and loamy.

Point Douglas Cemetery (CEM) is a 0.4 hectare pioneer cemetery directly adjacent to the Carpenter Nature Center Reconstruction. It has never been plowed and is managed by burning the entire site. the soil is deep and loamy.

Lost Valley State Natural area (LV) is located near the othe Washington County sites. The protected area is 40.5 hectares including bluff prairie, shrubs, old field vegetation, and a small area still cultivated. Management of the area began in 1991 with brush cutting and burning of part of the site; this was continued extensively in 1992. In the prairie areas there is very shallow soil over limestone.

Cedar Creek Natural History area (CC), Anoka County, MN, contains a 60.7 hectare oak savanna area containing many prairie plants. Sections of the area are burned in different years. The soil is very sandy.

Forbs on Sites

Sixty forb species were present in high enough numbers for pollinator collection (at least 100 flowers present on at least one sampling date). Forb species number ranged from a low of 7 species at Afton State Park to a high of 32 species at Crow Hassan Park Reserve. Complete species lists are given in the Appendix, and the forb species number for each site is shown in Table 5 .

Results and Discussion

Insects per Flower by Plant Species

I compared overall insects per flower for native and reconstructed prairies by dividing the number of insects observed (total and for each field ID category), by the number of flowers on which they were counted and multiplied by 100. This value is defined as insect density. I took the mean of these values for all sites, dates and plants in each type, native or reconstructed (Table 1).

Table 1. Insects per flower in native and reconstructed Prairies, x100, means for all sites, dates and plants

Type	N	Minimum	Maximum	Mean	Std. Dev.
Native	298	0	147.20	7.21	14.90
Reconstr	528	0	106.75	6.39	13.06

The difference between means was not significant (P=0.30) based on Wilcoxon's nonparametric T-test. In addition, to remove the possible effects of different plant density, forb species number, attractiveness of certain forb species, date of sampling and number of observations on the difference (if any) in insect density between native and reconstructed sites, I calculated density means for all plants on each date, and for all dates at each site, then calculated a site mean from these. I compared these by t-test, assuming that the site means (N=8) are from a normally distributed population of such means, based on equal or unequal variances as appropriate.

The effect of this means-of-means procedure was to reduce the effect of extreme values on the means. This method gave no significant differences between insect densities in native and reconstructed sites for any

of the field id groups for either year; a conclusion from this would be that once we remove the effects of different attractiveness of plant species, numbers of samples and date of samples, there are no differences left that are due to native vs. reconstruction nature of the site.

Next I compared insect densities on plants which were present in at least one native site and one reconstruction. Twenty-one of the 60 plant species observed could be paired. I compared mean insects per flower for each type (combining all sites and dates) for each of these plant species. Eleven of the 21 had higher mean insects per flower values in the native prairie sites, while 10 species had higher values in the reconstructions.

Insects per Flower by Insect Field Identification Group

I calculated the mean density of each field identification group for native prairies and reconstuctions, and did pairwise comparisons of mean insect densities of specific flowers, as described above, for each group of insects identified in the field. I tested the pairwise differences for statistical significance using the Wilcoxon signed ranks test. Densities of honeybees, long-tongued bees and syrphids showed no differences between native sites and reconstructions on either total density comparisons or pairwise comparisons. Sphinx moths, black blister beetles and other insects were seen so rarely that there were too few observations to compare statistically.

Bumblebee means showed no significant differences by type, (native vs. reconstruction), but the pairwise comparisons showed higher mean bumblebee densities on reconstructions than on native prairie for 18 of the 21 plant species compared, a highly significant difference ($p = 0.0002$, Wilcoxon Signed Rank Test).

In contrast, small bee densities were significantly higher on the reconstructions than on the native prairie, but pairwise comparisons showed no significant difference between the two types. This discrepancy appears to be due to the presence of several plant species with high small bee densities which were found in reconstructions but not in native prairie; these could not be included in the pairwise comparisons. Similarly, green bee density was significantly higher in reconstructions, but pairwise comparisons showed no significant difference, again possibly related to the presence of attractive plant species on the reconstructions. (Attractiveness of plant species is discussed below under Plants).

Wasps, Lepidoptera and goldenrod soldier beetles showed significantly higher densities on native prairie sites than on reconstructions, but the pairwise comparisons showed no significant differences.

When I improved the sign test to include only those plants found in at least 2 native and 2 reconstructed sites (Aster ericoides, Rudbeckia hirta, Ratibida pinnata, Amorpha canescens, Monarda fistulosa, Solidago canadensis, Solidago speciosa, Solidago rigida = 8 plants), the sign test gave no significance for native-reconstruction differences in 1992. There

were only 5 plants meeting the criteria in 91--not enough for a sign test.

In summary, reconstruction vs native prairie status in itself does not seem to influence the number of insects per flower; the plant species present appear to be more important in influencing the number of insects present on a per-flower basis. The reconstructions over all do not lack flower visitors compared to the native sites.

Seasonal Patterns in Insect Populations

I multiplied insects per flower values by the number of flowers on each site and summed the results for all flower species to calculate total insects for each site and date. Insect numbers changed frequently and suddenly as insects left the sites, entered diapause, or died when their plants finished blooming. Patterns varied from site to site and between the two years; generally the number of insects increased somewhat throughout the summer and declined as the fall flowers finished blooming.

Bumblebee numbers started low, and usually peaked on sites when the midseason flowers, especially Monarda fistulosa bloomed, and again late in the season when the goldenrods and asters were in full bloom. Bumblebees are especially mobile and forage over a larger area than any of these study sites. Honeybees are also mobile and opportunistic; they were generally rare on the prairie but visited the white and yellow sweetclovers early in the season, Verbena stricta and occasionally M. fistulosa in midseason, and the goldenrods and asters in the late summer.

The small bees and green bees, mainly halictids, tended to fluctuate in numbers from year to year and site to site. They were more common early in the season. The long-tongued bee field id category included andrenids, anthophorids and some megachilids. Most of them were spring or fall specialists and were abundant for short periods only.

The sphinx moths were always rare on my sites. I saw them only during the mf blooming season, with few exceptions.

Syrphid flies showed few definite patterns. Some seemed to have spring or fall peaks in numbers. Wasps peaked in the late summer; in some sites wasp numbers were also high in midsummer on the mmint.

Goldenrod soldier beetles and black blister beetles ncreased rapidly in early August to peak in late August. They persisted into early September.

Lepidoptera varied from site to site; each species has its own flight period and mobility patterns.

Insect Species Richness of Native Prairies and Reconstructions

Table 2 shows the number of species collected, exclusive of beetles, true bugs and a few other groups not considered to be pollinators.

Table 2. Number of Insect Species on Native Prairies and Reconstructions

	Bees	Wasps	Flies	Leps	Total*
Native	99	47	45	20	211
Reconstr.	97	38	48	15	198

*Listed groups only

I listed species according to the types of sites they were found on: native prairie only, reconstruction only, or both (Table 3).

Table 3. Insect Species Numbers on Native and Reconstructed Prairies

	Present in Both Types	Native Only	Rec Only	Total
Bees				
Colletidae	3	4	7	14
Andrenidae	11	5	8	24
Halictidae	24	9	5	38
Megachilidae	8	7	3	18
Anthophoridae	12	3	2	17
Apidae (exc. Apis)	14	0	0	14
Total Bee Species	72	28	25	125
Flies	25	21	21	67
Wasps	24	22	14	60
Lepidoptera	7	12	8	27
Total Insect Species	128	83	68	279

Estimates of Total Flower-Visiting Species

I estimated the total species number for all native sites and all reconstuctions using two methods described by Krebs (1989). The jacknife estimate is based on the number of unique species found, ie those species

found in only one collection. This method yielded an estimate of 275.75 plus or minus 10.358 species for the native prairie sites, and 262.8 species, plus or minus 10.34 for the reconstructions, ie a 95% confidence interval of 265.39 to 286.11 species for the native sites and 252.45 to 273.14 species for the reconstructions.

The lognormal estimate is based on the assumption that the species are distributed among abundance classes so that a normal curve will be formed when the species are placed into geometric classes. The species richness data form a truncated curve in this case; sources disagree on the validity of using the lognormal estimate under these conditions (Krebs 1989). The lognormal estimate yields 273.31 species for the native sites and 265.00 species for the reconstuctions. No confidence intervals can be made with this estimate.

All measures indicate that more insect species are present on flowers in native sites than in reconstructions. To determine whether whether approximately the same proportion of species present were collected in both both cases, I constructed species-accumulation curves for the native sites and the reconstructions (Figures 1 and 2). To do this I listed the species found in each collection; listed collections randomly, and graphed the cumulative number of species for each collection (ie the new species added by a collection plus all the species in previous collections). As more collections are made, the rate at which new species are found will decrease as we approach the actual number of species present on the site. The graphs do not flatten out, since it is impossible to collect all the species present; but the graph for all reconstructions is flatter than that for all native sites, suggest that a higher proportion of the total species have been collected on the reconstructions than on the native sites.

Figure 1.

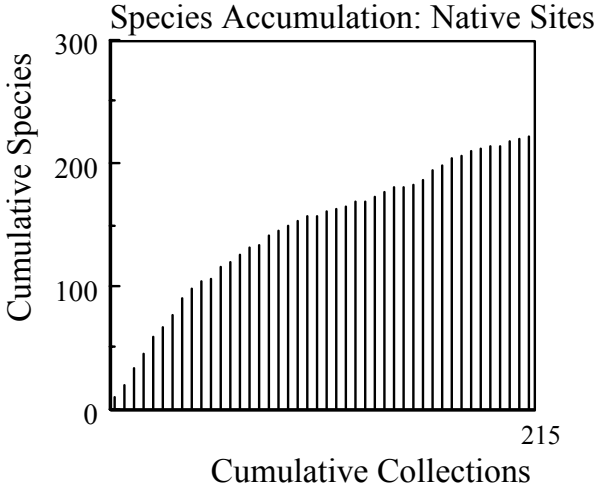


Figure 2.

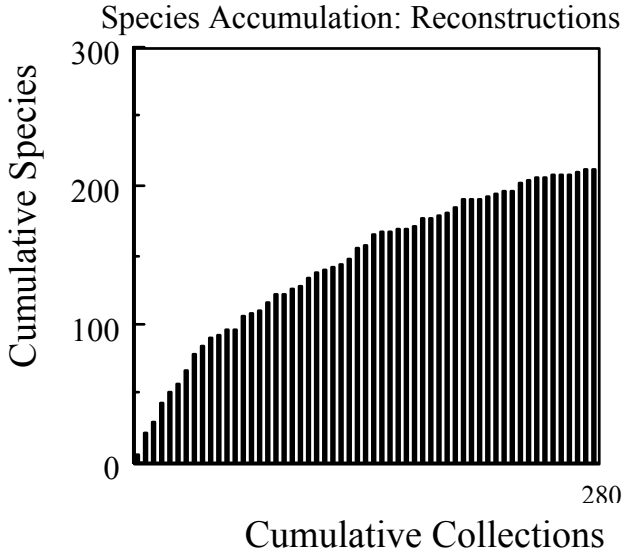


Table 4. Number of Insect Species on Sites

	Native Sites				Reconstructions				
	AREM	CC	CEM	LV	ASP	CARP	CHR	LLRP	Total
Bees									
Andrenids	6	6	10	6	2	14	8	7	24
Anthophorids	4	7	9	8	4	10	8	6	17
Colletids	3	4	1	4	2	4	5	8	14
Halictids	16	17	16	18	7	17	17	11	38
Megachilids	8	8	3	4	3	3	6	8	18
Apids	7	11	9	8	6	11	9	9	14
Total Bee Spp.	44	43	48	48	24	59	53	49	125
Flies	7	24	14	25	9	23	28	26	67
Wasps	21	25	9	13	1	21	14	21	60
Leps	11	12	8	4	6	8	10	3	27
Total Insect Spp.	83	104	79	90	40	111	105	99	279

Insect Species Richness of Sites

Table 4 lists the number of insect species present at each site.

The Carpenter Nature Center reconstruction had nearly 3 times as many insect species as the Afton State Park Reconstruction, the highest and lowest values respectively. The differences in insect species richness seem to be most closely related to forb species richness, as discussed below.

There are more insect species over all on the native sites than the reconstructions, but the individual sites are comparable in their species richness. To determine whether the native sites were more different from each othe than the reconstructions I calculated Sorenson's Similarity index for all site combinations (Krebs 1988). This index compares the species composition of sites based on the number of species common to both sites and the number of species unique to each site. CEM showed the highest similarity values to other sites, while ASP showed the lowest values. There were no obvious differences among the native-native comparisons, the reconstruction-reconstruction comparisons, and the native-reconstruction comparisons; in fact, no definite patterns were observed. It does not appear that the native sites are more different from each other than the reconstructed sites, despite the greater number of species found on only native sites than on only reconstructions (Table 3).

Bees

Plants which attract bees: plant species from which 20 or more bee species were collected (total for all samples) were these: Helianthus rigidus, Solidago nemoralis, Zizia aurea, Aster ericoides, Amorpha canescens, Penstemon grandiflorus, Solidago canadensis, Solidago rigida, Agastache foeniculum, Pycnanthemum virginianum, Aster oolentangiensis, Monarda fistulosa, and Dalea purpurea.

Bees from 6 families were collected.

A total of 15 species of Anthophorids were collected on the 4 native prairie sites, and a total of 13 Anthophorid species were collected on the reconstructions; at least 17 species overall (see Appendix for species list). Plants with an average of 1 or more Anthophorids per collection were Aster oolentangiensis, Verbena hastata, Ratibida pinnata, Stachys palustris and Teucrium canadense, Vernonia fasciculata, Liatris aspera, Helianthus tuberosus, Penstemon grandiflorus, Vicia americana, Rubus occidentalis, Helianthus rigidus, Cirsium discolor and Aster ontarionis.

A total of 24 Andrenid species were collected. Plants with an average of 1 or more Andrenids per collection were Aster eriocoides, Galium boreale, Aster lanceolata, Helianthus tuberosus, Lupinus perennis, Vicia americana, Sysirinchium campestre, Solidago nemoralis, Solidago rigida, Helianthus rigidus, and Zizia aurea.

Among the Apidae there were 12 species of Bombus (bumblebees) and 2 species of Psithyrus (cuckoo bees or parasitic bumblebees). The honeybee

Apis mellifera was seen on all sites--because it is an alien imported from Europe it is not included on the species lists. Plants with an average of 2 or more bumblebees per collection were Aster lanceolata, Stachys palustris and Teucrium canadense, Agastache foeniculum, Vernonia fasciculata, Liatris aspera, Liatris punctata, Monarda fistulosa, Dalea purpurea, Dalea villosa, Solidago speciosa and Cirsium discolor. Plants with more than 1 bumblebee per 100 flowers or inflorescences were (in order of increasing attractiveness) Aster lanceolata, Agastache foeniculum, Dalea purpurea, Monarda fistulosa, Verbena hastata, Liatris aspera, Nepeta cataria, Solidago speciosa, Vernonia fasciculata, and Cirsium discolor in 1991, and Amorpha canescens, Monarda fistulosa, Grindelia squarrosa, Agastache foeniculum, Stachys palustris and Teucrium canadense, Liatris pycnostachya, Solidago canadensis, Liatris aspera, Dalea purpurea, Aster lanceolata, Solidago speciosa, Dalea villosa and Cirsium discolor in 1992. (Vernonia fasciculata was not observed in 1992; Grindelia squarrosa, Stachys palustris and Teucrium canadense, Liatris pycnostachya, and Dalea villosa were not observed in 1991).

Honeybees were generally rare on prairie plants, even though there were many hives in the area, especially in Washington county where many of the nearby orchards contain hives. We did not collect honeybees, but counted them in the density observations. Plants with one or more honeybees per flower or inflorescence were Nepeta cataria, Solidago canadensis, Cirsium arvense, Rubus occidentalis and Solidago speciosa in 1992; 5 plants of 57 observed.

Halictids (sweat bees) constitute a large fraction of the insect species diversity here (41 species). The group contains extreme generalists, extreme specialists and everything in between. Attractive plants: plants with an average of 3 or more Halictids per collection were Aster ericoides, Aquilegia canadense, Chrysopsis villosa, Campanula rotundifolia, Vernonia fasciculata, Amorpha canescens, Lupinus perennis, Potentilla recta, Dalea purpurea, Rubus occidentalis, Sysirinchium campestre and Zizia aurea.

Megachilids (leafcutter bees) included 19 species. They are stem nesters. Plants with an average of 0.5 or more Megachilids per collection were Grindelia squarrosa, Campanula rotundifolia, Amorpha canescens, Aster sericeus, Lupinus perennis, Penstemon grandiflorus, Allium canadense, Dalea purpurea, Solidago speciosa, Cirsium discolor, and Aster ontarionis.

There were 14 species of Colletidae. Plants with an average of 1 or more Colletids per collection were Campanula rotundifolia, Penstemon grandiflorus, Allium canadense, Potentilla recta, Dalea purpurea, Rosa blanda, Sysirinchium campestre, and Zizia aurea.

Bee Phenology

I charted the phenology of all the bee species for which eight or more individuals were collected, a total of 57 species, by listing the first and last dates of collection. The majority of the species fell into 4 groups:

1. Early season bees. These were the first species seen starting with the first collection date (May 29) and were not seen after mid-June. They were associated on my sites with certain early plant species, though they are recorded in the literature as visiting other plants. Andrena wilkella, A. cressonii, and A. crataegi were mainly on Zizia, Tetralonia dubitata, and Hoplitis pilosifrons on Penstemon grandiflorus.

2. Mid season bees were Andrena rudbeckiae, Colletes susannae, Dufourea monardae, and Heriades carinata.

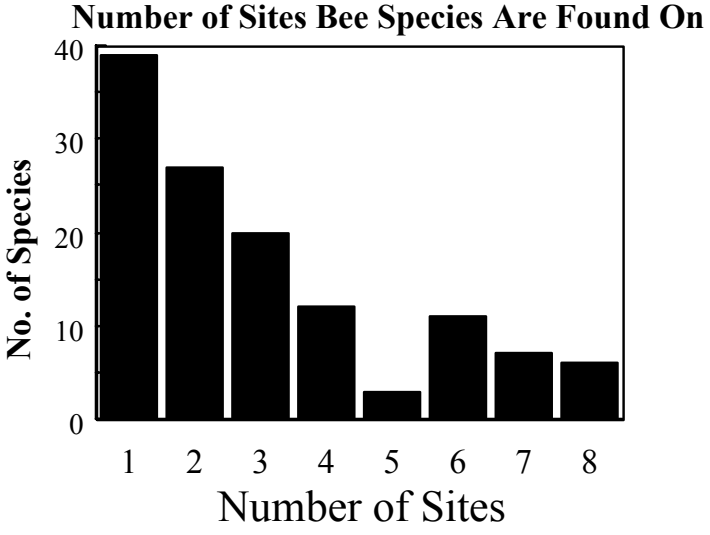
3. Late season bees included Andrena placata, A. helianthi, A. hirticincta, A. simplex, A. nubecula, A. asteris, Melissodes agilis, M. rustica, M. desponsa, M. dentiventris, and Colletes simulans armatus. Most of these species are Asteraceae specialists.

4. Long season bees were collected from June through August. All Bombus species were long season bees, as were many Halictids. All these species are generalists and shifted from plant to plant as the season progressed.

Distribution of Bee Species Among Sites

Bee distribution was extremely patchy. Of the 125 bee species, 39 were found on only one site, while only 6 were found on all 8 sites (see graph). Each site had at least one unique species found on no other site.

Figure 3.



Site Factors Related to Bee Species Richness

Factors which could influence species richness include area of site, resource level of site (number of flowers), age of reconstruction, plant species diversity, presence of keystone plant species (if there are any), presence of plant species which have specialized pollinators, site phenology (having flowers in bloom throughout the season), sources of colonists nearby, and other bee-biology factors such as nesting sites, absence of parasites or disease. Some of these factors are listed in Table 5.

Table 5. Area, Maximum Flower Number, Age and Forb Species Number of Sites

Site	Area, Hectares	Maximum Flower Number 1992	Age, Years	Forb Species*
ASP	4.8	113,618	9	7
CARP	32.4	93,223	3-6	25
CHR	243.1	40,562	1-15	32
LLRP	2.8	35,490	4	29
AREM	1.6	11,380	--	13
CEM	0.4	22,800	--	15
LV	40.5	16,193	--	22
CC	60.7	9,396	--	17

* Includes only those species with at least 100 flowers or infloresences blooming on at least one sampling date

Site area

I determined area based on information from site managers or by measuring on maps. I included all areas that were definitely prairie, or the entire area of the site where prairie plants were found among other plants. "Area" per se does not directly measure the amount of bee habitat as the bees' resources (flowers and nesting sites) are distributed in an extremely patchy and variable manner among and within sites. Given these considerations, it is not surprising that there is no correlation between area of site and bee species number.

Resource Level (flower number)

Maximum flower number is the total number of flowers at the peak of the blooming season. There was no correlation between flower number and bee species number.

Age of Reconstructions

Age of reconstruction is difficult to determine; I did not attempt any analysis of this factor. The Afton State Park and Long Lake Regional Park reconstructions were planted all at once (as far as I can determine), while new forb species are constantly being added to the Carpenter and Crow Hassan sites. Crow Hassan was planted to prairie grasses in the late 1970's, with the forbs added later as seeds and plants became available commercially. All the sites are invaded by weeds to some extent, both aliens such as Cirsium arvense and weedier native plants such as Solidago canadensis; weed populations vary but tend to diminish with the age of the reconstruction. Thus the classical succession process of increased plant species richness as succession progresses may not necessarily be occurring in these sites.

Distance from Sources of Colonists

Distance from sources of colonists must be stated in terms of the ability of insects, especially reproductive members of the species, to travel that far, either on their normal foraging trips or when blown around by strong winds. Some references indicate a "veritable rain of insects" (Johnson 1969), including bees, but few records are available for our area.

I also considered the possible sources of colonists near my study sites. The Washington County map shows many prairie and oak savanna remnants large enough to be mapped; as estimated from the DNR map, the smallest ones shown are about 8000m^2, or 90X90 meters. There are at least 125 remnants this size or larger in the county (Source: Minnesota County Biological Survey Map Series no 1 (1990) Washington County). Presumably there are many more remnants too small to map, yet not too small to support bees, especially along the river bluffs and the railroad tracks. These remnants seem to be the only possible nearby sources of bees to colonize the reconstructions, at least for those specialists which can't survive in the woods, roadside weeds, ag fields and suburban gardens which have replaced most of the prairie and savanna.

The rural/suburban Hennepin county (CHR) and Anoka county (CC) locations are probably similar to the Washington County sites in having many remnants not too far away. Northwest Hennepin county is both more agricultural and more developed than the area near Cedar Creek.

The LLRP site seems much more isolated by 4-lane highways, heavy and light industry, trucking companies and a few suburban developments, but it is separated by only a few hundred meters of woods from a remnant containing some prairie plants. Also, the railroad track runs through and contains some prairie plants.

None of these possible colonization sources have yet been sampled for bee presence.

Bee Species Richness and Forb Species Richness

Each forb species is a resource for bees: it can be used by specialists, if any are present, or by generalists. In reconstructions, addition of plant species which bloom at different times than those already present will increase the resources for long-lived generalists on that site.

The positive correlation between bee species number and forb species number for the study sites (Figure 4) appears to be based on two factors; more resources for specialist bees and increased resources early and late in the season for generalists.

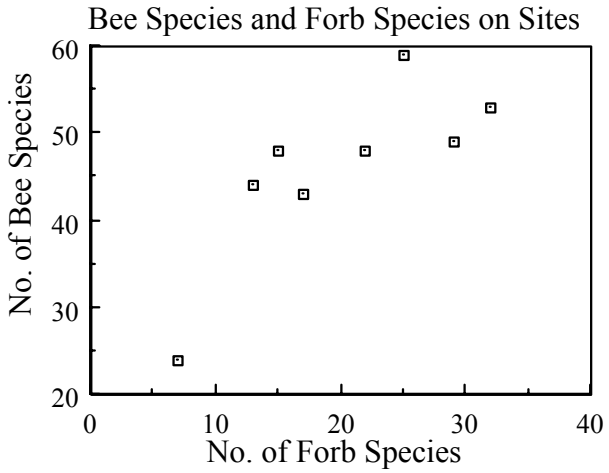
Species-by-species examination of collections from forbs shows that there are definite insect specialists which are not found on sites without their plants (eg Tetralonia and Osmia spp on Penstemon and Andrena helianthi on Helianthus). The Afton State Park site is rich in resources during the middle of the season, but is poor in generalist insects even then, probably due to the limited resources available for generalists early and late in the season.

Early season bees are found only on sites with early season plants; and the late season situation is similar. For example, CARP has high Andrenid species richness based on spring flowers, while AREM is low in Anthophorid species due to its lack of fall flowers (Table 4).

More analysis of these patterns could be done: some bee species show preferences without definite specialization. For example, Bombus griseocollis visits Ratibida pinnata whenever that plant is present on a site; on other sites, B. griseocollis visits other plants. Thus the effect that plant species diversity might have on B. griseocollis is not easily predictable.

A possible problem with the forbs pecies-bee species correlation is that both forb and bee species number are correlated with the number of collections made (the more forb species on a site, the more collections on that site). I am continuing to test this analysis by developing species-accumulation curves for plant species to determine whether collections are complete for certain species (collections range from one to 57 collections per plant). I am also developing a statistic to calculate the probability of an insect being found on a site where it is known to occur, based on the percent of collections in which it is found.

Figure 4.



Keystone Plants

There were no obvious keystones in this study. Certain plants (eg Dalea purpurea) supported many bee species, while others (eg Heliopsis helianthoides) were rarely visited by bees; yet it does not appear that absence of any one of the most attractive plants would have a major effect on bee species diversity given the variety of alternative plants available to all but the most extreme specialists. Experimental work involving controlled planting will be needed to identify keystones, if any exist. The high plant species diversity of the presettlement prairie makes it seem unlikely that a single plant species could have exercised a dominant role in this way; but where plant species number is limited, as in species-poor reconstructions, plant choice may be important in allowing insect use.

Other Bee Biology Factors

Bees are subject to many diseases and parsitic infections, incluing bacterial diseases and mites. Diseases of honeybees are being studied but much remains to be learned about diseases of wild bees.

There are also many bee species which are cleptoparasites on other bees; they move into a nest, kill the queen and lay eggs which the workers care for (parasites of social bees). Invasion by Psithyrus has been shown to have destroyed wild bumblebee colonies in Europe, and members of this genus are present on some sites here. Other parasitic bees include Coelioxys , which are parasitic on Megachilids, laying eggs in the stem-bored nests; it is not known whether these parasites control their host populations.

Predators on bees include ambush bugs and many wasps as well as

birds and some mammals (see below under Wasp discussion). Their effect on bee species richness differences among sites is hard to predict times.

Diptera

The 521 flies collected represented 14 families; there were at least 72 species present; 67 species were identified, as shown. Some adult flies consume nectar and pollen, others are found in flowers as predators on other visitors, and some adults are apparently chance visitors to flowers. They do not feed their larvae.

Syrphidae made up the majority with 379 individuals in 29 species, followed by Bombyliidae with 67 individuals in 14 species and Tachinidae with 20 individuals in 8 species. Syrphid and bombyliid distribution among sites appears to be based on the presence of flowers at the time when the adults are active (generally late in the season for bombyliids). For the syrphids, proximity of larval habitats may be important in influencing their presence on sites. Most members of the Syrphinae prey on aphids as larvae; in general the Chrysogastrini larvae live in clean water, the Eristalini in dirty water, and the Milesiini in dung.

Bombyliid larvae are parasitic on immature stages of other insects, or parasitic on grasshopper eggs; very little is known of their life history.

Most Anthomyiids are plant feeders as larvae.

The calliphorid Bufolucilia sp is a screwworm which infests toads, frogs and salamanders, as a larva.

The Conopidae (thick-headed flies) have larvae which are parasitic on adult bumblebees and wasps; the adults oviposit on their hosts during flight. The adults feed at Compositae, Labiatae and Umbelliferae. Some members of the genus Zodion are parasitic on honeybees.

Dolichopodid adults are predatory on smaller insects; larvae vary.

Milichiidae larvae are found in decaying animal or plant materials; the adults are found in flowers where some species are commensals with predatory insects, riding on them and sucking the juices from their prey.

The Muscids in this collection are common farm flies.

Sarcophagidae adults feed on nectar, sap, fruit juices and honeydew, The larvae vary, including parasites of beetles, grasshoppers and vertebrates as well as cleptoparasites of bee and wasp nests.

Tabanidae adult males feed on pollen and nectar (females bite vertebrates). Most larvae are aquatic and predaceous.

Tachinid larvae are parsitic on other arthropods. The adults require daily sugar and are found on Aster and Solidago, though they prefer honeydew.

Tephritid larvae feed on living plant tissue.

Therevid larvae live in soil where they are voracious predators on earthworms and beetle larvae. The adults are not predaceous.

Fly phenology; I charted dates of first and last collections for the 17 species having 8 or more individuals collected. The majority of the species

were present for 8 weeks or more. There were no apparent patterns related to subfamilies. In general there were more flies late in the season.

Fly species richness on sites: ASP and AREM had few species, probably due to their lack of fall flowers.

Plants preferred by flies: nine of the 60 plant species had at least 2 flies per collection: Achillea millefolium, Aster lanceolata, Aster oolentangiensis, Aster sericeus, Berteroa incana, Cirsium arvense, Galium boreale, Potentilla recta and Rudbeckia hirta. These plants had 33% of the flies collected (172 of 521 flies), 12.6 % of the total insects collected (508 of 4002) and had 15 % of the total collections (79 of 525 collections). Seven of these plants had < 7.62 individuals/collection (7.62=the overall average insects/coll).

Wasps

Wasps were found at all sites (see the species list in the Appendix).

Wasps are anatomically similar to bees and are closely related; taxonomically, bees and wasps do not form 2 distinct groups. Both bees and wasp adults visit flowers and consume nectar; bees collect pollen, while wasps supply insect prey to their larvae or are parsitoids. Since the wasps are predatory, we expect them to be fewer in number than bees, which are herbivores, on any site. Like bees, predatory wasps may be more or less specialized in the resources that they use.

Parasitoids in the collection include members of the Braconidae, Chrysididae and Pteromalidae.

Predatory wasps include the Pompilidae, which prey on spiders; Scoliidae and Tiphiidae whose larvae are external parasites of Scarabeid larvae in soil or debris, Vespids, which prey on caterpillars and Sphecids, which prey on a variety of insects. Those wasps known to prey on insect species collected from these sites include Bembix spp, which prey on syrphids; the Cercerinae, some of which prey on bees and wasps; Ectemnius lapidarius which preys on syrphids, including 4 of our species; Oxybelus preys on Thereva spp; the Philanthus species present on these sites prey on Halictids, including several of the species collected.

Wasp phenology based on collections: only 5 species had 8 or more individuals. Most were around during most of the season.

Attractive plants: plants having an average of1 or more wasps per collection were Aster ericoides, Aster lanceolata, Cirsium arvense, Pycnanthemum virginianum, Solidago canadensis, Solidago nemoralis, Solidago speciosa, Solidago rigida and Zizia aurea. The mountain mint, P. virginianum, is especially noted for attracting many wasp species, and this

seems to hold true wherever this plant is growing.

Lepidoptera

Not many butterflies and moths were collected; 125 individuals in 30 species. Many of the species collected are widespread and common, including the Monarch Danaus plexippus, Colias sp, Vanessa cardui, Speyeria aphrodite, and Alypia octomaculata (eight-spotted forester). Other leps are relatively restricted by their larval or adult food resources. The Hesperiinae (grass skippers) feed on grasses or sedges as larvae, while many of the adults nectar on white, pink or purple flowers including many common prairie plants. Satryium edwardsii (scrub-oak hairstreak) larvae feed on oak leaf buds during the day; they spend the nights in litter chimneys built by ants. This species is found only on sites containing oaks (AREM and CC). The clearwing sphinx moths (Hemaris spp) visit Monarda fistulosa on our sites and are rarely seen on other plants.

Some Lepidoptera are visiting plants which are unattractive to bees (Verbena stricta and Heliopsis helianthoides); these could be further studied as potential pollinators.

Phenology: only 5 Lepidoptera species had 8 or more individuals (my minimum for phenology charting). Only Vanessa cardui was seen early in the season; the remaining species were first seen in early- to mid-July. Cisseps fulvicollis and Colias sp persisted into mid-September, while Satyrium edwardsii and Atrytone delaware were not seen after early August.

Attractive plants: plants with an average of 0.5 or more leps per collection were: Rudbeckia hirta, Cirsium arvense, Verbena stricta, Liatris aspera, Liatris punctata, Aster sericeus, Phlox pilosa, Lithospermum canescens, Trifolium pratense, Solidago speciosa, and Aster ontarionis.

Attractiveness of Forbs to Insects

Flower visitors for each plant species are listed in the appendix, based on collections. Goldenrod soldier beetles, honeybees, and Monarch butterflies were not collected, (except occasionally by mistake) and I attempted to minimize the collection of duplicate specimens on each sampling date, leading to over-representation of hard-to-identify and small insects in the collections. The mean number of insects collected per 15 minute sampling period was 7.6.

Plants with 7.0 or more insect species per collection (total species for all samples) were Aster oolentangiensis, Aster ericoides, Aster lanceolata, Agastache foeniculum, Lupinus perennis, Pycnanthemum virginianum, Penstemon grandiflorus, Allium canadense, Potentilla recta, Dalea purpurea,

Solidago canadensis, Sysirinchium campestre, Solidago nemoralis, Solidago speciosa, Solidago rigida, Cirsium discolor, and Zizia aurea.

Plants with 7.0 or more insects per 100 flowers or inflorescences baed on counts (insects per flower or inflorescence including all species present) were Dalea purpurea, Melilotus alba, Liatris cylindracea, Aster oolentangiensis, Amorpha canescens, Pycnanthemum virginianum, Helianthus tuberosus, Liatris aspera, Verbena hastata, Aster lanceolata, Cirsium discolor, Helianthus rigidus, Solidago nemoralis, Solidago speciosa, Allium canadense, Vernonia fasciculata, Solidago rigida, and Solidago canadensis in 1991; 18 plant species out of 30 observed in 1991. In 1992 Liatris pycnostachya, Rubus occidentalis, Amorpha canescens, Grindelia squarrosa, Penstemon grandiflorus, Lupinus perennis, Helianthus tuberosus, Aster lanceolata, Solidago nemoralis, Cirsium discolor, Helianthus rigidus, Rosa blanda, Solidago canadensis, Solidago speciosa, and Solidago rigida had 7.0 or more individual insects per flower or inflorescence; 15 species out of 60 observed. Large flowers or inflorescences tended to have higher values than smaller infloresences as the large ones had more space and probably more resources for insects.

Forbs and their Visitors

Achillea millefolium had 10 collections yielding 7 bee species, mostly Halictids, 4 flies, 3 leps and 4 wasps for a total of 18 species. It's an early season, somewhat weedy, alien plant.

Agastache foeniculum is known as a good honeybee plant. It had 31 collections yielding 7 fly species and 28 bee species including 6 bumblebees and 15 Halictids. Sphinx moths and other lepidoptera visit this plant, and beetles are occasionally found in the flowers. This is a midseason plant, blooming from mid July to mid August; it is widely planted in reconstructions and found at lower densities on native sites.

Allium canadense is a small midseason plant. Four collections yielded 3 bumblebees and several small Halictids, Megachilids and Colletids. This plant is small and not very numerous on these sites; it is a resource for small bees, not large ones.

Amorpha canescens is a distinctive prairie plant more common on native sites than in reconstructions. Ten collections yielded 5 fly species, 3 wasps, 2 leps and 27 bee species representing all families; none of them appear to be specialists to Amorpha canescens or to legumes. An early to mid-season plant.

The Aster species are among the lastest prairie plants to bloom, at a time when few other resources are available to flower visitors, and their disc-shaped flowers allow all insects access to pollen and nectar. Though they are widely visited, they may not be as important to insect reproduction

as plants which bloom earlier. Collections on asters yielded flies, wasps and many bee species, including several late-season Andrenids which are composite specialists, generalist Halictids, and Megachile sp.

One collection on Anemone canadensis yielded only one syrphid. This plant is uncommon on the study sites, and my impression is that it is rarely visited by insects anywhere I have seen it.

Aquilegia canadensis is a very early flower, and as such is a resource for early insects, especially bumblebee queens. It is more common on rocky bluffs than in the tallgrass prairie. One collection yielded one bumblebee and a few Halictids.

Baptisia leucantha is not common on my sites and I was unable to collect from it; I did observe bumblebees visiting. The flower shape makes nectar accessible to long-tongued bees only.

Berteroa incana is an alien weed which has invaded some of the reconstructions. Three collections yielded mainly syrphids.

Campanula rotundifolia is an early season flower especially in rocky areas, following Aquilegia canadensis. One collection yielded many small bees; I have also seen bumblebees visit this plant.

Chrysopsis villosa blooms mid-season. Five collections from this relatively uncommon plant yielded mainly syrphids and generalist Halictids.

Cirsium arvense is an alien weed invading the reconstruction at Carpenter Nature Center and blooming early in the season. Two collections yielded a few each of flies, wasps, bees and leps.

Cirsium discolor is a native thistle which blooms late in the season. It is a rich resource for bumblebees, Anthophorids (especially Melissodes sp) and Megachilids (especially Megachile latimanus). Nine collections. I found no wasps on this plant despite its late bloom.

Coreopsis palmata blooms early to mid-season at Crow Hassan Park Reserve. It is unusual to find an insect visitor on this plant.

Crepis tectorum is an alien weed blooming in the prairie restoration at Long Lake Regional Park during the early part of the season to mid-season. Five collections yielded mainly bumblebees and Halictids.

I observed no visitors on Dalea candida. In contrast, Dalea purpurea yielded 37 bee species in 19 collections, more bee species than any other plant species. All bee families were collected from this plant, including both rare and common species (though apparently no Dalea specialists), plus a few wasps and flies. I found no leps on Dalea purpurea. Dalea villosa was found only at Long Lake Regional Park: two collections yielded many bumblebees.

Delphinium virescens was visited only by bumblebees in the one collection I was able to make. This plant rarely grows in dense clusters and does not appear to be an important resource for bees on my site.

Insects rarely visited Desmodium canadense. Halictids, bumblebees and flies were found in the 4 collections made.

Erigeron strigosus, a weedy early season plant, received few visits. Three collections yielded flies and Halictids.

Galium boreale bloomed early at Point Douglas Cemetry. Two collections yielded mainly flies.

Grindelia squarrosa flowered early in the season at Long Lake Regional Park until mowed down. Two collections yielded 4 bee species and 2 flies.

Helianthus rigidus and H. tuberosus flowered late in the season. Thirty-four collections (total for both species) yielded composite specialist bees including late-season Andrena spp and Melissodes spp, as well as generalist bumblebees and Halictids. Flies also visited sunflowers, but relatively few wasps and leps were seen.

Heliopsis helianthoides was rarely visited by insects except for early season syrphids. Honeybees, bumblebees, Halictids and occasionally leps were found in 15 collections.

Liatris aspera, L. cylindracea, L. punctata and L. pycnostachya bloom near the end of the season. I made one collection on L. punctata and 10 collections on L. aspera. These plants support flies, generalist bees and leps (especially the common Ctenuchid Cisseps fulvicollis), but are not very attractive to wasps. I found no specialists. The Liatris species are attractive to Monarch butterflies.

Lithospermum carolinense is common and very showy at Cedar Creek, and L. incisum has recently been planted at Crow Hassan. They bloom early in the season while few other flowers are out, yet they receive very few visitors. Only 2 collections yielded any insects at all: 2 small bees and one skipper. In 1993 for the first time I saw bumblebees visiting this plant.

Lupinus perennis was not present on any of my native sites (though there are a few plants in other areas at Cedar Creek, and a lupine population will soon be restored there as larval food for the endangered Karner Blue butterfly), but it has been planted at Long Lake and at Crow Hassan. Lupine is among the first plants to bloom, starting a bit earlier than Penstemon grandiflorus; it supports early season Andrenids and Colletids and may be an important resource for queen bumblebees shortly after they emerge. I made only 2 collections on Lupinus perennis and look forward to more study on ways this plant competes for or shares pollinators with Penstemon grandiflorus. So far I haven't found any flower visitors which are lupine specialists.

The white and yellow sweetclovers, Melilotus alba and M. offincinalis are alien weeds unwelcome in reserves and reconstructions, where they persistently invade roadsides, trail edges and other open areas. They do support a variety of generalist bumblebees and Halictids and a few wasps during their early blooming season. They also are visited by honeybees and are considered good nectar plants. I made 16 collections from sweetclovers, mainly from Crow Hassan.

One collection from Mirabilis nictaginea yielded 2 Halictids and a fly. This is not a common plant in the study sites.

Monarda fistulosa was the only plant found in all 8 study sites, and is a common plant in prairie remnants and roadsides in the southern part of the state. I made 57 collections from this plant, the earliest July 8, the latest August 14. Collections from Monarda fistulosa yielded 33 bee species including 9 bumblebees and 16 Halictids. One Halictid, Dufourea monardae is a Monarda fistulosa specialist; it is found only during the Monarda fistulosa blooming period and remains in diapause during the rest of the year. Honeybees were rarely seen. Ten fly species, five wasp species and 12 leps also visited this plant. The lovely sphinx moths Hemaris thysbe and H. diffinis are found primarily on Monarda fistulosa; I very rarely observed them on any other plant, although they were found at all 8 sites. This plant is definitely a very important resource for bees and other visitors on the mid-season prairie.

Nepeta cataria (catnip) is an alien mint blooming early to mid-season at the Afton Remnant and Lost Valley. Six collections yielded mainly bumblebees and generalist Halictids. Honeybees also visited catnip.

Penstemon grandiflorus is relatively uncommon in central Minnesota, the northeastern edge of its range, and is of special interest due to its rarity and beauty. It is among the earliest prairie forbs to bloom, usually during the first two weeks of June, so it is a resource for queen bumblebees when they come out of diapause. Fourteen collections yielded 27 bee species, including 4 that seem to be Penstemon grandiflorus specialists on my sites. Bumblebees and hornets rob nectar by biting into the base of the corolla and removing nectar without entering the flower. Hummingbirds visit Penstemon grandiflorus.

Phlox pilosa is abundant at some sites but is rarely visited by insects. Only 4 collections yielded any insects at all: these were mainly the skipper Atrytone delaware. Although it blooms early in the season, Phlox pilosa does not seem to be an important resource for flower visitors. Current research by Hendrix et al. (1993) in Iowa indicates that this plant is not being pollinated adequately in small prairie remnants and is suffering from reduced seed set.

Potentilla arguta is widespread but sparse in the study areas. Two collections yielded small bees and Syrphids.

Potentilla recta flowered early to mid-season at Afton State Park and Carpenter Nature Center. Three collections yielded mainly common Syrphids and Halictids.

Pycnanthemum virginianum (mountain mint) is common on the native sites but found in only one reconstruction (Long Lake). Although this plant is relatively small and inconspicuous, its flowers are very attractive to flies, bees, leps and especially to wasps. Twenty-six collections yielded 30 bee species including some rare ones, and 31 wasp species, or almost half the wasp species collected during the entire study. Pycnanthemum virginianum flowers during the middle of the prairie season.

Ratibida pinnata is common in native prairies and widely planted in reconstructions. It is visited by Goldenrod Soldier Beetles (Chauliognathus pennsylvanicus), common Syrphids, common Halictids, the Composite specialist Andrena rudbeckiae, the Anthophorids Melissodes subillata and M. trinodis and Svastra obliqua obliqua. The bumblebee Bombus griseocollis visits other plants but prefers Ratibida pinnata; conversely, B. griseocollis made up 97% of the bumblebees collected from this plant. Six wasp species were collected. There were 30 collections during Ratibida pinnata's midseason blooming period; it flowers at the same time as Monarda fistulosa and Agastache foeniculum.

Rosa blanda and other prairie wild roses, are scattered on most of the sites. Their flowers usually shatter by noon on sunny days; I was able to make 4 collections containing mainly small bees, especially the Colletid Hylaeus affinis. Syrphids, Halictids and the occasional bumblebee also visited Rosa. Roses bloom early to mid-season.

Rudbeckia hirta is an easy to grow, showy wildflower planted in all the prairie reconstructions, frequently in large numbers; it blooms early to mid-season. It is not very attractive to flower visitors: 30 collections yielded only 140 individuals including 16 bee species. Visitors were mainly Syrphids and generalist bees, especially Halictids. The Edwards Hairstreak Satyrium edwardsii visited Rudbeckia hirta at Cedar Creek.

Rubus occidentalis (black raspberry) is found in low numbers early in the season. I made one collection which contained 4 small bee species. Honeybees were also very numerous on this plant.

Goldenrods are the most common late-season flowers on the study sites, and their flat flowers make nectar and pollen accessible to all types of flower visitors. The flower structure also makes them arenas for aggregation and mating by Goldenrod Soldier Beetles and other beetles, and the flowers are stalking areas for crab spiders, ambush bugs and assassin bugs which prey on other flower visitors. Bee visitors include generalist Halictids and bumblebees, and late-season Asteraceae specialists such as Andrena asteris, A. hirticincta, A. nubecula, A. placata, A. simplex, Melissodes and Megachile species. Honeybees visit goldenrods as do many wasps; Solidago canadensis had an especially large number of wasp visitors, including the common

wasps Polistes fuscatus and Myzine quinquecincta. Solidago canadensis is widespread in roadsides and waste areas, so it may serve as a source of insects to colonize prairie reconstructions when these are planted.

Sysirinchium campestre, the blue-eyed grass, is an early, small and ephemeral flower. It is found in sparse populations on most of the sites: one collection yielded small bees and a Syrphid.

Stachys palustris and Teucrium canadense, hedge nettle, were found at Carpenter Nature Center and Cedar Creek during the early to mid-season. Four collections yielded mainly bumblebees and the large Anthophorid Anthophora furcata terminalis (Cedar Creek only).

The alien red clover, Trifolium pratense, was planted at Carpenter Nature Center and the Lost Valley agricultural area as a cover for areas awaiting planting. One collection yielded Bombus bimaculatus and the painted lady butterfly Vanessa cardui.

The blue vervain, Verbena hastata flowered in mid to late July at Afton State Park, in the remnant and the reconstruction. It was visited mainly by bumblebees and Halictids. The hoary vervain, Verbena stricta was unusual among prairie plants in receiving many visits from honeybees, while surrounding plants in bloom at the same time received virtually no honeybee visits. A few leps and bumblebees also visited Verbena stricta.

The one very large Vernonia fasiculata at Lost Valley was visited by 7 bee species on the one day I was able to collect. The short blooming season of this plant may limit its value as a resource for insect visitors.

One collection from Vicia americana at Point Douglas Cemetery yielded small bees and a bumblebee.

Zizia aurea blooms very early in the season. Eight collections yielded many early Andrenids including the reputed Zizia specialist Andrena ziziae. The small flowers of this plant did not attract bumblebees (only the large queens are out at this time), but some small wasps visited Zizia aurea.

Conclusions

1. Insect densities are comparable on reconstructed prairies and native sites on an insects per flower basis. This indicates that insects are able to colonize, or at least visit, reconstructions and presumably pollinate the flowers on them at a rate which is probably not signigicantly lower than that observed in native prairies. Though it appears that all of the native plant species which were common enough for me to study were receiving at least occasional insect visits in all the sites where they occurred, some forbs

received very few visits.

2. Insect species richness is slightly higher on native sites overall than on reconstructions. Sites varied in species richness; of the eight sites, those with the highest and lowest species richness values were reconstructions.

2. Bee species richness is comparable on reconstructed sites overall to native sites overall. All sites supported specialists and generalists; generalists, especially bumblebees, may make up a greater proportion of the bee community on reconstructions than on native sites. Many bee species were strongly seasonal. Many plant species and plant families were visited by specialists as well as generalists.

3. Bee species richness on sites is related to flower species richness, not related to site area, and not related to resource levels in terms of number of flowers.

4. It was not possible to test age of reconstruction, distance from sources of colonists, or the possible effects of predation, parasitism, disease and nesting site availability on insect species richness.

5. Bee distribution is patchy: many species are restricted to only one site, and the majority of species were found on only a few sites. Only 6 of the 125 bee species were found on all 8 sites.

Recommendations

Management

Even small prairie remnants should be preserved as insect conservation sites to preserve the unique insect species on them. Likewise, prairie reconstructions, even if small, can provide habitat for a wide variety of flower visiting insects. Reconstructions show relatively high insect species richness, but cannot replace the remnants as overall reconstructions contain fewer unique species. Bees are highly mobile and may use other areas in addition to the sits on which they are found; their conservation requires landscape-level considerations.

To enhance the value of prairie reconstructions as insect conservation sites, managers should plant a variety of forb species, including mints, legumes, and composites. Plants should be selected for bloom throughout the season. Early season plants which support queeen bumblebees such as columbines and lupines, and Penstemon grandiflorus where it can be grown, are valuable; so are the asters and goldenrods late in the summer. Plants which are especially attractive to insects include Monarda fistulosa for bees

and sphinx moths, Pycnanthemum virginianum for wasps, Agastache foeniculum, Dalea purpurea and D. villosa for bees.
Sunflowers (Helianthus spp) are visited by interesting late season bees. The Liatris species are attractive to butterflies as they pass through. The widely planted Rudbeckia hirta (blackeyed Susan) and Heliopisis helianthoides (oxeye), though attractive to human beings, are not of particular value for insect conservation.

Insect visitation of prairie plants in our area appears to be adequate for pollination, with some exceptions noted above. There is no reason to import honeybees for native plant pollination as these bees do not visit native plants frequently.

Further Research

The present study has answered some questions regarding flower visitors to prairie plants, and has raised other questions. Plants are being visited in reconstructed prairies, but are the visitors effective pollinators of these plants? Are forbs which receive only rare visits capable of self-pollination, or are they suffering from reduced seed set and inadequate outcrossing due to the absence of their former pollinators?

Are our sites adequate to conserve bees, or are these insects also dependent on other areas which lie outside protected sites? Is the patchiness of bee distributions a normal feature of their population biology, or is this patchiness due to habitat fragmentation?

Species richness on native sites and reconstructions over all was comparable within the limits of this study. Is this an encouraging result, ie does this indicate that bee species are being conserved on reconstructions? Similar species richness on native prairie and reconstructed prairie could occur in 2 ways:

1. Bee species are so highly mobile and generally well-adapted that they have been able to persist on fragmented sites and colonize new sites; or,

2. The native prairies have lost many species during the course of prairie destruction and fragmentation over the past century, and the remaining species are only a fraction of the pre-settlement bee community.

At present I do not have the information to decide to what extent each of these possibilities may be correct. The prairie is considered to be a rather species-poor bee habitat due to its short geological life (approximately 10,000 years since the last glaciation; Lehmkuhl 1980). After the prairie's formation it was colonized by plants and animals from the southeast--presumably a relatively highly mobile sample of the organisms which lived in those habitats. To develop some model or picture of the presettlement prairie one can look for old records and/or compare insect species richness

on less disturbed areas which are not so fragmented.

Several insect-insect interactions are of interest for further study, including the lack of invasion of the prairie by honeybees and the tendency for bumblebees to be more dense on reconstructions than in native prairie. The more general ecological questions regarding the interactions of plants and their pollinators which allow or prevent high pollinator diversity on sites (especially the relationships between insect generalists and specialists) could also be studied more, both by further analysis of the data already collected and by manipulative projects based on such analysis.

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Voucher Specimens

Voucher specimens are currently in the author's collection and will soon be deposited in the University of Minnesota Insect Museum and Herbarium.

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Appendix

Insect Species Lists

- Bees
  - Anthophoridae
    - Anthophora furcata terminalis Cres.
    - Ceratina calcarata
    - Epeolus scutellaris Say
    - Melissodes agilis Cresson
    - Melissodes bimaculata bimaculata (Lep.)
    - Melissodes dentiventris Smith
    - Melissodes desponsa F. Smith
    - Melissodes gelida LaBerge
    - Melissodes illata Lovell
    - Melissodes rustica (Say)
    - Melissodes subillata LaBerge
    - Melissodes trinodis Robertson
    - Nomada spp.
    - Svastra obliqua obliqua
    - Tetralonia dubitata Cres.
    - Tetralonia hamata Bradley
    - Triepeolus spp
  - Andrenidae
    - Andrena asteris Robertson
    - Andrena carlini
    - Andrena commoda
    - Andrena crataegi
    - Andrena cressonii
    - Andrena erythrogaster
    - Andrena helianthi Robertson
    - Andrena hirticincta Provancher
    - Andrena miranda
    - Andrena nubecula Smith
    - Andrena placata Mitchell
    - Andrena rudbeckiae Robertson
    - Andrena simplex Smith
    - Andrena virginiana
    - Andrena wilkella
    - Andrena wilmattae
    - Andrena ziziae
    - Heterosarus parvus
    - Perdita albipennis palidipennis
    - Perdita perpalpis citronellis

Perdita swenki
Protandrena bancrofti Dunning
Pterosarus albitarsus
Pterosarus nebracensis

Apidae
Apis mellifera
Bombus affinis Cresson
Bombus auricomus (Robertson)
Bombus bimaculatus Cresson
Bombus borealis Kirby
Bombus fervidus (Fabricius)
Bombus griseocollis (Degeer)
Bombus impatiens Cresson
Bombus pennsylvanicus (Degeer)
Bombus perplexus
Bombus ternarius
Bombus terricola Kirby
Bombus vagans Smith
Psithyrus ashtoni (Cresson)
Psithyrus citrinus (Smith)

Halictidae
Agapostemon sericeus (Forster)
Agapostemon splendens (Lepeletier)
Agapostemon texanus Cresson
Agaspostemon virescens (Fabricius)
Augochlora pura (Say)
Augochlorella striata (Provancher)
Augochloropsis metallica (Fabricius)
Dialictus albipennis (Robertson)
Dialictus anomalus (Robertson)
Dialictus coeruleus
Dialictus cressonii (Robertson)
Dialictus heterognathus Mitchell
Dialictus illinoensis (Robertson)
Dialictus imitatus (Smith)
Dialictus lineatulus (Crawford)
Dialictus near rowheri
Dialictus nymphaearum (Robertson)
Dialictus near paramirandus Knerer and Atwood
Dialictus perpunctatus (Ellis)
Dialictus pictus (Crawford)
Dialictus pilosus (Smith)

Dialictus pruinosus (Robertson)
Dialictus rowheri (Ellis)
Dialictus supraclypeatus Mitchell
Dialictus tegularis (Robertson)
Dialictus vierecki (Crawford)
Dialictus zephyrus (Smith)
Dialictus spp.
Dufourea monardae (Viereck)
Evylaeus cinctipes (Provancher)
Evylaeus pectoralis (Smith)
Evylaeus truncatus (Robertson)
Halictus confusus Smith
Halictus ligatus Say
Halictus parallelus Say
Halictus rubicundus (Christ)
Lasioglossum acuminatum McGinley
Lasioglossum athabascense (Sandhouse)
Lasioglossum coriaceum (Smith)
Lasioglossum leucozonium (Schrank)
Lasioglossum paraforbesii McGinley
Sphecodes spp

Megachilidae
Anthidium psoraleae
Coelioxys alternata
Coelioxys modesta
C. octodentata
C. rufitarsus
Heriades carinata
Hoplitis cylindrica
Hoplitis pilosifrons
Hoplitis producta
Megachile brevis
M. gemula
M. latimanus
M. mendica
M. montivaga
M. pugnata
M. relativa
Megachile sp.
Osmia distincta
Osmia simillima

Colletidae

Colletes aberrans
Colletes americanus
Colletes brevicornis
Colletes kincaidii
Colletes mandibularis
Colletes robertsoni D. T.
Colletes simulans armatus
Colletes susannae
Colletes willmattae
Hylaeus affinis
Hylaeus illinoensis
Hylaeus mesillae cressoni (=H. m. m.)
Hylaeus modestus
Hylaeus verticalis

Diptera
Anthomyiidae
Hylemya sp

Bombyliidae
Anastoechus sp
Chrysanthrax sp
Exoprosopa caliptera
Exoprosopa dorcadion
Exoprosopa sp
Hemipenthes sinuosa
Lepidophora sp
Paravilla sp
Phthiria sp
Poecilanthrax sp
Sparnopolius sp
Systoechus sp
Villa sp1
Villa sp2

Calliphoridae
Bufolucilia sp

Conopidae
Physocephala tibialis
Physoconops brachyrhynchus
Physoconops obscuripennis
Thecophora sp
Zodion sp1

Zodion sp2

Dolichopodidae
? genus

Milichiidae
Eusiphona sp

Muscidae
? genus
Musca autumnalis
Stomoxys calcitrans

Sarcophagidae
? genera and species

Stratiomyidae
Hedriodiscus vertebratus
Odontomia pubescens
Stratiomys obesus

Syrphidae
Subfamily Syrphinae
Tribe Syrphini
Allograpta obliqua
Metasyrphus sp
Sphaerophoria contigua
Sphaerophoria sp
Syrphus sp
Toxomerus germinatus
Toxomerus marginatus
Tribe Melanostomatini
Platycheirus sp
Tribe Chryotoxini
Chrysotoxum sp
Tribe Pipizini
Neocnemodon sp

Subfamily Eristalinae (=Milesiinae)
Tribe Chrysogastrini
Orthonevre sp
Tribe Milesiini
Spilomyia quadrifasciata
Syritta pipiens

Tropidia sp

Tribe Eristalini

Epistrophella emarginata (?)
Eristalis arbustorum
Eristalis bardus
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Eristalis sp1
Eristalis sp2
Helophilus fasciatus
Helophilus latifrons
Lejops stipatus
Mallota bautias
Parhelophilus laetus
Parhelophilus sp

Tabanidae

Chrysops sp

Tachinidae

Archytas sp
Cylindromyia binotata
Dinera sp
Gymnoclytia sp1
Gymnoclytia sp2
Leucostoma sp
Ptilodexia incerta
Ptilodexia sp
? genus

Tephritidae

Orellia ruficauda

Therevidae

? genus

Wasps

Superfamily Ichneumonoidea

Braconidae

Cardochiles sp

Chelonus sericeus
Rogas terminalis
Ichneumonidae
Ceratogastra ornata Say
Exetastes angustoralis
Superfamily Chalcidoidea
Pteromalidae
Perilampus hyalinus
Superfamily Chrysidoidea
Chrysididae
Ceratochrysis kansensis
Superfamily Sphecoidea
Sphecidae
Subfamily Ammophilinae
Ammophila urnaria
Podalonia mickeli
Subfamily Crabronidae/Oxybelini
Ectemnius continuus
Ectemnius lapidarius (Panzer)
Ectemnius maculatus (=singularis)
Ectemnius sp.
Oxybelus sublatus Robertson
Subfamily Crabronidae/Crabronini
Anacrabro ocellatus
Subfamily Larridae/Larrinae
Tachytes crassus
Tachytes pennsylvanicus
Subfamily Nyssonidae/Bembicinae
Bembix belfragei
Bembix sayi
Bembix americana spinolae
Bicyrtes quadrifasciata
Bicyrtes ventralis
Subfamily Nyssonidae/Gorytinae
Subfamily Philanthidae/Cercerinae
Cerceris clypeata
Cerceris deserta (now includes C. fulvipedicula)
Cerceris nigrescens
Cerceris sp 1
Cerceris sp 2
Cerceris sp 3
Cerceris sp 4
Cerceris sp 5
Subfamily Philanthidae/Philanthinae

Philanthus bilunatus
Philanthus gibbosus
Philanthus politus
Philanthus sanbornii
Philanthus ventilabris
Subfamily Sphecinae
Chlorion attratum (not in Krombein)
Sphex ichneumoneus
Sphex pennsylvanicus
Sphex aureonotatus (not in Krombein)

Superfamily Tiphioidea
Tiphiidae
Tiphiinae
Myzinum maculatum
Myzinum quinquecincta
Paratiphia texana Cameron

Superfamily Pompiloidea
Pompilidae
Anoplius Anoplius illinoensis (Robertson)
Anoplius Pompilinus marginatus (Say)
Anoplius sp
Episyron biguttatus biguttatus (Fab)

Superfamily Scolioidea
Scoliidae
Campsomeris plumipes confluenta
Campsomeris ephippium
Scolia bicincta

Superfamily Vespoidea
Eumenidae
Subfamily Eumeninae
Ancistocerus catskill (3 subspecies in Krombein)
Ancistocerus catskill albophaleratus
Ancistocerus antilope antilope
Ancistocerus adiabatus adiabatus
Eumenes crucifera nearcticus
Eumenes fraternus
Euodynerus foraminatus foraminatus
Parancistroceras vagus vagus (Saussure)
Vespidae

Subfamily Polistinae
Polistes fuscatus
Subfamily Vespinae
Vespula arenaria
Vespula maculata
Vespula vidua

Lepidoptera
Pyraloidea
Pyralidae
? genus
Phylctanodes sp?

Hesperioidea
Hesperiidae
Hesperiinae
Atrytone delaware
Euphyes conspicua
Euphyes vestris
Hesperia leonardus
Hesperia pawnee
Polites coras (=peckias)
Polites origines
Polites themistoclas
Wallengrenia egeremet
Pyrginae
Epargyreus clarus
Thorybes pylades

Papilionoidea
Pieridae
Coliadinae
Colias sp.
Lycaenidae
Lycaeninae
Polyommatini
Celastrina argiolus
Theclini
Satyrium edwardsii
Callophrys gryneus g.
Harkenclenus titus
Nymphalidae
Numphalinae
Phyciodes tharos

Nymphalini
Nymphalis milberti
Vanessa cardui
Argynnini
Speyeria aphrodite
Speyeria cybele
Satyrinae
Cercyonis pegala
Apaturinae
Asterocampa celtis
Danainae
Danaus plexippus
Sphingoidea
Sphingidae
Hemaris diffinis
Hemaris thysbe

Noctuoidea
Noctuidae
Heliothinae
Alypia octomaculata
? genus
Arctiidae
Ctenuchidae
Ctenuchinae
Cisseps fulvicollis

Plants

Scientific Name	Common Name
Achillea millefolium*	Yarrow
Agastache foeniculum	Anise Hyssop
Allium canadense	Prairie Onion
Amorpha canescens	Leadplant
Aster ericoides	Heath Aster
Aster lanceolata	
Aster oolentangiensis	Sky-Blue Aster
Aster ontarionis	
Aster sericeus	Silky Aster
Anemone canadensis	Canada Anemone
Aquilegia canadensis	Wild Columbine
Baptisia leucantha	White Indigo
Berteroa incana*	Hoary Alyssum
Campanula rotundifolia	Harebell

Chrysopsis (= Heterotheca) villosa	Golden Aster
Cirsium arvense*	Canada Thistle
Cirsium discolor	Field Thistle
Coreopsis palmata	Prairie Coreopsis; Tickseed
Crepis tectorum*	Narrow-leaved Hawksbeard
Dalea candida	White Prairie Clover
Dalea (= Petalostemon) purpurea	Purple Prairie Clover
Dalea villosa	Silky Prairie Clover
Delphinium virescens	Prairie Larkspur
Desmodium canadense	Showy Tick-trefoil
Erigeron strigosus	Daisy Fleabane
Galium boreale	Bedstraw
Grindelia squarrosa	Gumweed
Helianthus rigidus	Stiff Sunflower
Helianthus tuberosus	Jerusalem Artichoke
Heliopsis helianthoides	Oxeye
Liatris aspera	Rough Blazing Star
Liatris cylindracea	Cylindric Blazing Star
Liatris punctata	Dotted Blazing Star
Liatris pycnostachya	Prairie Blazing Star
Lithospermum carolinense	Hoary Puccoon
Lithospermum incisum	Narrow-leaved Puccoon
Lupinus perennis	Lupine
Melilotus alba*	White Sweetclover
Melilotus offincinalis*	Yellow Sweetclover
Mirabilis nyctaginea	Four O’clock
Monarda fistulosa	Beebalm, Horsemint, Bergamot
Nepeta cataria*	Catnip
Penstemon grandiflorus	Large-flowered Beardtongue
Phlox pilosa	Prairie Phlox
Potentilla recta*	Rough-fruited Cinquefoil
Potentilla arguta	Tall Cinquefoil
Pycnanthemum virginianum	Mountain Mint
Ratibida pinnata	Gray-headed Coneflower
Rudbeckia hirta	Blackeyed Susan
Rubus occidentalis	Black Raspberry
Rosa blanda	Prairie Rose
Solidago canadensis	Canada goldenrod
Solidago nemoralis	Grey Goldenrod
Solidago rigida	Stiff Goldenrod
Solidago speciosa	Showy Goldenrod
Sysirinchium campestre	Blue-eyed Grass
Stachys palustris	Hedge Nettle
Teucrium canadense	Germander, Wood-sage

Trifolium pratense*	Red Clover
Verbena hastata	Blue Vervain
Verbena stricta	Hoary Vervain
Vernonia fasiculata	Ironweed
Vicia americana	Purple Vetch
Zizia aurea	Golden Alexanders

* Alien species

Identifications confirmed by Anita Cholewa, University of Minnesota; nomenclature follows Flora of the Great Plains 1986. Only plants which had at least 100 flowers or inflorescences on at least one sampling date are included.

Flower-Visiting Insects, by Plant Species

Achillea millefolium (10 collections; 39 individuals; 18 species)
- Agapostemon texanus
- Agapostemon virescens
- Ceratina calcarata or dupla
- Dialictus perpunctatus
- Dialictus pilosus
- Ectemnius continuus
- Eristalis bardus
- Euphyes vestris
- Evylaeus pectoralis
- Halictus confusus
- Halictus ligatus
- Oxybelus sublatus Robertson
- Perilampus hyalinus (Say)
- Philanthus politus
- Phyciodes tharos
- Satyrium edwardsii
- Stratiomys obesus
- Toxomerus marginatus

Agastache foeniculum (31 collections; 228 individuals; 48 spp)
- Allograpta obliqua
- Anthidium psoraleae
- Apis mellifera
- Augochlorella striata
- Bombus affinis
- Bombus bimaculatus
- Bombus fervidus
- Bombus griseocollis
- Bombus impatiens
- Bombus vagans
- Celastrina argiotus
- Ceratina calcarata or dupla
- Cercyonis pegala
- Chauliognathus pennsylvanicus

Cisseps fulvicollis
Dialictus albipennis
Dialictus cressonii
Dialictus heterognathus
Dialictus illinoensis
Dialictus imitatus
Dialictus n laevissimus
Dialictus near rowheri
Dialictus pictus
Dialictus pilosus
Dialictus pruinosus
Dialictus rowheri
Dialictus sp
Dialictus tegularis
Dialictus zephyrus
Dufourea monardae
Epargyreus clarus
Epicauta pennsylvanica
Exoprosopa sp
Halictus rubicundus
Hemaris diffinis
Heriades carinatus
Hylaeus affinis
Hylaeus mesillae cressoni
Hylaeus modestus
Lasioglossum paraforbesii
Megachile latimanus
Orthonevre sp
Perilampus hyalinus (Say)
Sphaerophoria contigua
Syrphus sp
Systoechus sp
Thorybes pylades
Toxomerus marginatus
Vanessa cardui

Allium canadense (4 collections; 28 individuals; 13 species)
Bombus griseocollis
Bombus impatiens
Bombus vagans
Chrysotoxum sp
Colletes kincaidii
Colletes robertsoni
Dialictus pilosus
Eristalis latifrons
Heriades carinatus
Hylaeus affinis
Lasioglossum athabascense
Megachile relativa
Toxomerus germinatus

Amorpha canescens (10 collections; 106 individuals; 41 species)
Andrena commoda
Andrena helianthi
Andrena miranda
Andrena virginiana
Augochlorella striata
Bombus affinis
Bombus bimaculatus

Bombus griseocollis
Bombus impatiens
Bombus ternarius
Bombus vagans
Ceratina calcarata or dupla
Cerceris sp 2
Chrysops sp
Cisseps fulvicollis
Dialictus anomalus
Dialictus heterognathus
Dialictus illinoensis
Dialictus imitatus
Dialictus lineatulus
Dialictus n laevissimus
Dialictus pilosus
Dialictus sp
Dialictus tegularis
Eristalis latifrons
Evylaeus cinctipes
Halictus confusus
Halictus rubicundus
Heterosarus parvus
Hoplitis cylindrica
Hylaeus affinis
Lasioglossum coriaceum
Megachile latimanus
Megachile mendica
Philanthus sanbornii
Physocephala tibialis
Polalonia mickeli Murray
Polistes fuscatus
Satyrium edwardsii
Sphaerophoria sp
Systoechus sp
Thecophora sp
Toxomerus marginatus

Anemone canadensis (1 collection; 1 individual; 1 species)
Toxomerus marginatus

Aquilegia canadensis (1 collection; 4 individuals; 3 species)
Bombus fervidus
Dialictus cressonii
Dialictus sp

Aster ericoides (11 collections; 114 individuals; 46 species)
Agapostemon sericeus
Agapostemon virescens
Ancistocerus tigris
Andrena asteris
Andrena hirticincta
Andrena nubecula
Andrena placata
Andrena simplex
Andrena ziziae
Apis mellifera
Archytas sp
Augochlorella striata
Augochloropsis metallica

Bombus impatiens
Ceratina calcarata or dupla
Cerceris fulvipediculata
Chauliognathus pennsylvanicus
Chlorion attratum
Colletes americanus
Colletes simulans armatus
Diabrotica sp
Dialictus anomalus
Dialictus lineatulus
Dialictus pilosus
Dialictus rowheri
Dialictus sp
Episyron biguttatus b. (Fab)
Eristalis dimidiatus
Eristalis latifrons
Exetastes angustoralis
Gymnoclytia sp1
Halictus ligatus
Halictus parallelus
Helophilus fasciatus
Helophilus latifrons
Hylaeus affinis
Hyleaus mesillae mesillae
Lasioglossum acuminatum
Leucostoma sp
Megachile latimanus
Melissodes rustica
Polistes fuscatus
Sphaerophoria contigua
Syritta pipiens
Syrphus sp
Toxomerus marginatus

Aster lanceolata (5 collections; 54 individuals; 25 species)
Agapostemon splendens
Agapostemon texanus
Agapostemon virescens
Ancistocerus tigris
Andrena asteris
Andrena hirticincta
Andrena simplex
Archytas sp
Augochlorella striata
Bombus affinis
Bombus griseocollis
Bombus impatiens
Bombus vagans
Ceratina calcarata or dupla
Colias sp.
Dialictus pilosus
Eristalis dimidiatus
Eristalis latifrons
Eristalis sp2
Halictus ligatus
Hylaeus mesillae cressoni
Lasioglossum paraforbesii
Megachile relativa
Melissodes subillata

Polistes fuscatus
Sphecodes spp
Toxomerus marginatus

Aster ontarionis (3 collections; 20 individuals; 13 species)
Agapostemon sericeus
Agapostemon virescens
Bombus affinis
Bombus vagans
Ceratina calcarata or dupla
Colias sp.
Helophilus fasciatus
Hylaeus mesillae cressoni
Megachile brevis
Megachile latimanus
Melissodes dentiventris
Metasyrphus sp
Nymphalis milberti

Aster oolentangiensis (20 collections; 178 individuals; 57 species)
Agapostemon sericeus
Agapostemon texanus
Agapostemon virescens
Ancistocerus tigris
Andrena asteris
Andrena hirticincta
Andrena nubecula
Andrena simplex
Archytas sp
Augochlorella striata
Augochloropsis metallica
Bombus affinis
Bombus fervidus
Bombus impatiens
Bombus vagans
Ceratina calcarata or dupla
Cisseps fulvicollis
Coelioxys rufitarsus
Colias sp.
Colletes simulans armatus
Diabrotica sp
Dialictus lineatulus
Dialictus pilosus
Dialictus pruinosus
Dialictus rowheri
Dialictus vierecki
Epicauta pennsylvanica
Epistrophella emarginata
Eristalis arbustorum
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Evylaeus pectoralis
Exoprosopa caliptera
Formicinae ?genus
Halictus confusus
Halictus ligatus
Helophilus fasciatus

Helophilus latifrons
Lasioglossum sp
Luperaltica fuscula
Megachile latimanus
Megachile relativa
Melissodes dentiventris
Melissodes rustica
Melissodes subillata
Metasyrphus sp
Pterosarus nebrascensis
Sparnopolius sp
Sphaerophoria sp
Svastra obliqua obliqua
Syrphus sp
Zodion sp2

Aster sericeus (4 collections; 27 individuals; 17 species)
Agapostemon sericeus
Agapostemon texanus
Bombus affinis
Bombus impatiens
Bombus vagans
Coelioxys rufitarsus
Colias sp.
Eristalis dimidiatus
Eristalis latifrons
Exetastes angustoralis
Helophilus latifrons
Lasioglossum leucozonium
Lejops stipatus
Megachile latimanus
Megachile relativa
Melissodes dentiventris
Syrphus sp
Systoechus sp

Berteroa incana (3 collections; 18 individuals; 13 species)
Bombus terricola
Dialictus lineatulus
Dialictus pilosus
Eristalis dimidiatus
Eristalis transversus
Helophilus fasciatus
Lejops stipatus
Megachile latimanus
Metasyrphus sp
Orthonevre sp
Parhelophilus laetus
Parhelophilus sp
Philanthus politus

Campanula rotundifolia (1 collection; 6 individuals; 4 species)
Augochlorella striata
Colletes brevicornis
Megachile latimanus
Toxomerus marginatus

Chrysopis villosa (5 collections; 27 individuals; 12 species)
Bombus fervidus

Bombus griseocollis
Bombus impatiens
Dialictus pilosus
Eristalis transversus
Megachile latimanus
Melissodes illata
Myzine quinquecincta
Systoechus sp
Toxomerus marginatus
Vanessa cardui
Villa sp1

Cirsium arvense (2 collections; 10 individuals; 8 species)
Agapostemon virescens
Andrena commoda
Atrytone delaware
Cerceris sp 3
Cerceris sp 4
Hylemya
Stomoxys calcitrans
Toxomerus marginatus

Cirsium discolor (9 collections; 83 individuals; 21 species)
Anthophora furcata terminalis
Bombus auricomus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus vagans
Ceratina calcarata or dupla
Dialictus lineatulus
Dialictus rowheri
Dialictus zephyrus
Epistrophella emarginata
Hesperia pawnee
Hylaeus sp
Megachile latimanus
Megachile relativa
Melissodes agilis
Melissodes desponsa
Svastra obliqua obliqua
Temelucha ferruginea
Toxomerus marginatus

Coreopsis palmata (3 collections; 5 individuals; 4 species)
Agapostemon texanus
Bembix spinolae
Cerceris sp 1
Toxomerus marginatus

Crepis tectorum (5 collections; 20 individuals; 8 species)
Bombus affinis
Bombus fervidus
Bombus impatiens
Dialictus lineatulus
Dialictus pilosus

Dialictus sp
Lejops stipatus
Megachile latimanus
Megachile relativa

Dalea (Petalostemon) purpurea (19 collections; 209 individuals; 53 species)
Agapostemon sericeus
Agapostemon splendens
Agapostemon texanus
Agapostemon virescens
Andrena commoda
Augochlorella striata
Augochloropsis metallica
Bembix sayi
Bombus affinis
Bombus auricomus
Bombus bimaculatus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus ternarius
Bombus vagans
Chlorion attratum
Coelioxys rufitarsis
Colletes aberrans
Colletes susannae
Colletes willmattae
Diabrotica sp
Dialictus albipennis
Dialictus cressonii
Dialictus lineatulus
Dialictus n paradmirandus
Dialictus nymphaearum
Dialictus perpunctatus
Dialictus pictus
Dialictus pilosus
Dialictus rohweri
Dialictus sp
Dialictus tegularis
Dialictus vierecki
Eristalis tenax
Halictus confusus
Helophilus latifrons
Hylaeus affinis
Megachile latimanus
Melissodes agilis
Melissodes bimaculata bimaculata
Melissodes illata
Metasyrphus sp
Myzine quinquecincta
Neocnemodon sp
Perdita perpalpis citronella
Philanthus sanbornii
Philanthus ventilabris
Sphaerophoria contigua
Syrphus sp

Toxomerus germinatus
Toxomerus marginatus
Villa sp2

Dalea (Petalostemon) villosa (2 collections; 13 individuals; 7 species)
Bombus affinis
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Chlorion pennsylvanicus
Colletes aberrans
Sphecodes sp

Delphinium virescens (1 collection; 8 individuals; 3 species)
Bombus auricomus
Bombus fervidus
Bombus vagans

Desmodium canadense (4 collections; 14 individuals; 8 species)
Allograpta obliqua
Bombus pennsylvanicus
Bombus vagans
Chauliognathus pennsylvanicus
Dialictus near rowheri
Dialictus pilosus
Halictus confusus
Toxomerus marginatus

Erigeron strigosus (3 collections; 7 individuals; 5 species)
Dialictus albipennis
Dialictus n paradmirandus
Orellia ruficauda
Toxomerus germinatus
Toxomerus marginatus

Galium boreale (2 collections; 9 individuals; 5 species)
Andrena carlini
Andrena wilmattae
Gorytini ?genus
Hylemya
Mallota bautias

Grindellia squarrosa (2 collections; 7 individuals; 6 species)
Ceratina calcarata or dupla
Dialictus lineatulus
Dialictus pilosus
Eristalis latifrons
Megachile latimanus
Systoechus sp

Helianthus rigidus (27 collections; 127 individuals; 39 species)
Agapostemon splendens
Agapostemon virescens
Ancistocerus catskill
Andrena helianthi
Augochlorella striata
Bombus fervidus
Bombus griseocollis
Bombus vagans

Ceratina calcarata or dupla
Chelonus sericeus
Colias sp.
Diabrotica sp
Dialictus anomalus
Dialictus spp.
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Eusiphona sp
Exoprosopa dorcadion
Halictus ligatus
Halictus sp
Heterosarus sp.
Luperaltica fuscula
Megachile montivega
Megachile pugnata
Melissodes agilis
Melissodes subillata
Melissodes trinodis
Nomada sp
Perdita albipennis
Perdita albipennis pallidipennis
Perdita swenki
Phthiria sp
Sparnopolius sp
Syrphus sp
Systoechus sp
Toxomerus germinatus
Toxomerus marginatus

Helianthus tuberosus (7 collections; 45 individuals; 13 species)
Andrena asteris
Andrena helianthi
Bombus griseocollis
Eristalis tenax
Eristalis transversus
Evylaeus cinctipes
Halictus confusus
Megachile latimanus
Melissodes agilis
Melissodes trinodis
Nomada sp
Pterosarus nebrascensis
Syrphus sp

Heliopsis helianthoides (15 collections; 55 individuals; 18 species)
Agapostemon virescens
Apis mellifera
Augochlorella striata
Bombus griseocollis
Bombus vagans
Ceratina calcarata or dupla
Dialictus pilosus
Dialictus rohweri
Eristalis latifrons
Eusiphona sp

Halictus confusus
Halictus ligatus
Megachile latimanus
Melissodes subillata
Nomada sp
Systoechus sp
Toxomerus marginatus
Vanessa cardui
Zodion sp1

Liatris aspera (10 collections; 70 individuals; 27 species)
Agapostemon splendens
Agapostemon virescens
Anastoechus sp
Anthophora furcata terminalis
Bombus auricomus
Bombus bimaculatus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus pennsylvanicus
Bombus vagans
Ceratina calcarata or dupla
Chelonus sericeus
Cisseps fulvicollis
Colias sp.
Dialictus pilosus
Eristalis dimidiatus
Eristalis tenax
Exoprosopa sp
Harkenclenus titus
Hesperia leonardus
Megachile latimanus
Melissodes subillata
Psithyrus citrinus
Speyeria aphrodite
Vanessa cardui

Liatris punctata (1 collection; 4 individuals; 3 species)
Bombus griseocollis
Colias sp.
Melissodes gelida

Liatris pycnostachya (1 collection; 3 individuals; 3 species)
Bombus fervidus
Platycheirus sp
Villa sp2

Lithospermum canescens (2 collections; 3 individuals; 3 species)
Dialictus pilosus
Evylaeus pectoralis
Hesperia leonardus

Lupinus perennis (2 collections; 19 individuals; 7 species)
Andrena wilkella
Dialictus pictus
Dialictus pilosus
Hoplitis pilosifrons

Hylaeus affinis
Polistes fuscatus
Tetralonia hamata
Bombus fervidus
Platycheirus sp
Villa sp2

Melilotus alba (9 collections; 39 individuals; 19 species)
Apis mellifera
Bombus affinis
Bombus bimaculatus
Bombus fervidus
Bombus impatiens
Bombus pennsylvanicus
Bombus ternarius
Bombus vagans
Cerceris sp 1
Colias sp.
Colletes kincaidii
Dialictus lineatulus
Dialictus pilosus
Hylemya
Megachile brevis
Myzine quinquecincta
Polistes fuscatus
Ptilodexia incerta
Toxomerus marginatus

Melilotus officinalis (7 collections; 35 individuals; 15 species)
Alypia octomaculata
Andrena wilkella
Augochlorella striata
Bombus bimaculatus
Bombus fervidus
Dialictus pilosus
Evylaeus pectoralis
Halictus confusus
Halictus ligatus
Hoplitis producta
Hylaeus mesillae cressoni
Nomada sp
Philanthus politus
Stratiomys obesus
Tropidia sp

Mirabilis nyctanginea (1 collection; 3 individuals; 3 species)
Agapostemon virescens
Dialictus lineatulus
Orthonevre sp

Monarda fistulosa (57 collections; 397 individuals; 60 species)
Agapostemon virescens
Agapostemon sericeus
Agapostemon texanus
Allograpta obliqua
Anacrabro ocellata
Andrena hirticincta
Anthophora furcata terminalis
Apis mellifera

Asterocampa celtis
Atrytone delaware
Augochlora pura
Augochlorella striata
Bombus affinis
Bombus auricomus
Bombus bimaculatus
Bombus borealis
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus perplexus
Bombus vagans
Cardochiles sp
Ceratina calcarata or dupla
Cerceris clypeata
Chauliognathus pennsylvanicus
Dialictus anomalus
Dialictus imitatus
Dialictus near rowheri
Dialictus pictus
Dialictus pilosus
Dialictus pruinosus
Dialictus rowheri
Dialictus spp.
Dialictus supraclypeatus
Dufourea monardae
Epigyreus clarus
Eristalis latifrons
Euphyes vestris
Halictus confusus
Halictus rubicundus
Hemaris diffinis
Hemaris thysbe
Hemipenthes sinuosa
Heriades carinatus
Hoplitis producta
Hylaeus mesillae cressoni
Hylemya
Lasioglossum paraforbesii
Melissodes bimaculata bimaculata
Metasyrphus sp
Odynerus rugosus
Perilampus hyalinus (Say)
Physocephala tibialis
Platycheirus sp
Polistes themistoclas
Polites origines
Protandrena bancrofti
Speyeria aphrodite
Speyeria cybele
Sphaerophoria contigua
Syritta pipiens
Syrphus sp
Toxomerus germinatus
Toxomerus marginatus
Vespula maculata
Wallengrenia egeremet

Nepeta cataria (6 collections; 33 individuals; 18 species)
- Allograpta obliqua
- Apis mellifera
- Augochloropsis metallica
- Bombus affinis
- Bombus bimaculatus
- Bombus impatiens
- Ceratina calcarata or dupla
- Chauliognathus pennsylvanicus
- Dialictus imitatus
- Dialictus rowheri
- Dialictus tegularis
- Dufourea monardae
- Heriades carinatus
- Hylaeus modestus
- Megachile latimanus
- Odynerus rugosus
- Syritta pipiens
- Toxomerus marginatus

Penstemon grandiflorus (14 collections; 126 individuals; 36 species)
- Agapostemon virescens
- Anthophora furcata terminalis
- Augochlorella striata
- Bombus affinis
- Bombus auricomus
- Bombus fervidus
- Ceratina calcarata or dupla
- Dialictus cressonii
- Dialictus nymphaearum
- Dialictus pictus
- Dialictus pilosus
- Dialictus pruinosus
- Dialictus rowheri
- Hoplitis pilosifrons
- Hylaeus affinis
- Hylaeus mesillae cressoni
- Hyleaus mesillae mesillae
- Hylemya
- Lasioglossum acuminatum
- Lasioglossum coriaceum
- Lasioglossum paraforbesii
- Osmia distincta
- Osmia simillima
- Polites coras=peckias
- Sphaerophoria sp
- Tetralonia dubitata
- Tetralonia hamata

Phlox pilosa (4 collections; 9 individuals; 6 species)
- Atrytone delaware
- Dialictus pictus
- Dialictus pilosus
- Euphyes conspicua
- Syrphus sp
- Systoechus sp
- Thorybes pylades

Potentilla arguta (2 collections; 18 individuals; 8 species)
- Dialictus nymphaearum
- Dialictus perpunctatus
- Dialictus pilosus
- Halictus confusus
- Heriades carinatus
- Hylaeus affinis
- Sphaerophoria sp
- Toxomerus marginatus

Potentilla recta (3 collections; 33 individuals; 15 species)
- Allograpta obliqua
- Andrena commoda
- Andrena cressoni c.
- Ceratina calcarata or dupla
- Dialictus albipennis
- Dialictus n laevissimus
- Dialictus n paradmirandus
- Dialictus pruinosus
- Dialictus rohweri
- Dialictus sp
- Halictus confusus
- Halictus ligatus
- Halictus parallelus
- Hylaeus affinis
- Hylaeus mesillae cressoni
- Toxomerus marginatus

Pycnanthemum virginianum (26 collections; 231 individuals; 87 species)
- Agapostemon sericeus
- Allograpta obliqua
- Ammophila urnaria Dahlbom
- Anacrabro ocellata
- Ancistocerus albophaleratus
- Ancistocerus capra
- Andrena hirticincta
- Anoplius (A) illinoensis (Robt)
- Anoplius (Pompilinus) marginatus (Say)
- Archytas sp
- Augochloropsis metallica
- Bembix belfragei
- Bicyrtes quadrifasciata
- Bombus affinis
- Bombus auricomus
- Bombus bimaculatus
- Bombus griseocollis
- Bombus impatiens
- Bombus ternarius
- Bombus vagans
- Callophrys gryneus g.
- Campsomerus plumipes confluenta
- Ceratina calcarata or dupla
- Ceratochrysis kansensis
- Cerceris clypeata
- Cerceris deserta
- Chauliognathus pennsylvanicus
- Chlorion ichneumoneum
- Chlorion pennsylvanicus

Chrysanthrax sp
Climaciella brunnea
Coelioxys modesta
Dialictus heterognathus
Dialictus imitatus
Dialictus pictus
Dialictus pilosus
Dialictus rowheri
Dialictus spp.
Dialictus vierecki
Ectemnius continuus
Eristalis latifrons
Eumenes fraternus
Eumenes globulosus
Euphyes vestris
Evylaeus cinctipes
Evylaeus truncatus
Exoprosopa caliptera
Gymnoclytia sp2
Halictus confusus
Halictus rubicundus
Harkenclenus titus
Heriades carinatus
Hylaeus modestus
Hylaeus verticalis
Hyleaus affinis
Luperaltica fuscula
Megachile gemula
Megachile mendica
Megachile relativa
Myzine maculata
Myzine quinquecincta
Odynerus rugosus
Parancistroceras vagus v. (Saussure)
Paratiphia texana Cameron
Philanthus bilunatus
Philanthus gibbosus
Philanthus politus
Philanthus ventilabris
Physoconops brachyrhynchus
Physoconops obscuripennis
Polalonia mickeli Murray
Polistes fuscatus
Psithyrus ashtoni
Psithyrus citrinus
Satyrium edwardsii
Scolia bicincta
Sphaerophoria contigua
Sphecodes spp
Sphex aureonotatus
Syritta pipiens
Syrphus sp
Systoechus sp
Tachytes crassus
Tachytes pennsylvanicus
Toxomerus marginatus
Vespula arenaria
Villa sp2

Ratibida pinnata (30 collections; 180 individuals; 38 species)
- Agapostemon virescens
- Allograpta obliqua
- Andrena rudbeckiae
- Augochlorella striata
- Bembix belfragei
- Bembix sayi
- Bembix spinolae
- Bicyrtes ventralis
- Bombus auricomus
- Bombus griseocollis
- Cerceris sp 1
- Chauliognathus pennsylvanicus
- Cisseps fulvicollis
- Dialictus albipennis
- Dialictus perpunctatus
- Dialictus pilosus
- Dialictus rowheri
- Eristalis transversus
- Halictus confusus
- Halictus ligatus
- Luperaltica fuscula
- Megachile brevis
- Megachile latimanus
- Melissodes rustica
- Melissodes subillata
- Melissodes trinodis
- Musca autumnalis
- Paravilla sp
- Philanthus ventilabris
- Phthiria sp
- Poecilanthrax sp
- Pterosarus nebrascensis
- Sphaerophoria contigua
- Svastra obliqua obliqua
- Syrphus sp
- Toxomerus marginatus
- Triepeolus sp
- Zodion sp1

Rosa blanda (4 collections; 27 individuals; 8 species)
- Agapostemon texanus
- Agapostemon virescens
- Bombus griseocollis
- Ceratina calcarata or dupla
- Halictus confusus
- Hylaeus affinis
- Hylaeus mesillae cressoni
- Hylaeus sp
- Toxomerus marginatus

Rubus occidentalis (1 collection; 7 individuals; 4 species)
- Augochlorella striata
- Ceratina dupla
- Evylaeus pectoralis
- Halictus confusus

Rudbeckia hirta (30 collections; 140 individuals; 40 species)
- Agapostemon texanus
- Agapostemon virescens
- Andrena rudbeckiae
- Archytas sp
- Atrytone delaware
- Augochlorella striata
- Bembix spinolae
- Bicyrtes ventralis
- Bombus griseocollis
- Bombus impatiens
- Ceratina calcarata or dupla
- Chrysanthrax sp
- Cisseps fulvicollis
- Coelioxys altennata
- Colias sp.
- Dialictus perpunctatus
- Dialictus pilosus
- Dialictus pruinosus
- Dialictus rohweri
- Eristalis latifrons
- Eristalis sp1
- Eristalis transversus
- Euphyes vestris
- Eusiphona sp
- Evylaeus pectoralis
- Exoprosopa caliptera
- Halictus ligatus
- Hedriodiscus vertebratus
- Lepidophora sp
- Megachile pugnata
- Melissodes subillata
- Melissodes trinodis
- Paravilla sp
- Poecilanthrax sp
- Ptilodexia incerta
- Satyrium edwardsii
- Sphaerophoria sp
- Syrphus sp
- Systoechus sp
- Toxomerus marginatus

Sisyrinchium campestre (1 collection; 8 individuals; 5 species)
- Dialictus pictus
- Dialictus pilosus
- Hylaeus affinis
- Lasioglossum paraforbesii
- Sphaerophoria sp

Solidago canadensis (20 collections; 181 individuals; 62 species)
- Ammophila urnaria Dahlbom
- Ancistocerus albophaleratus
- Ancistocerus capra
- Ancistocerus catskill
- Ancistocerus tigris
- Andrena asteris
- Andrena hirticincta
- Andrena nubecula
- Andrena placata

Andrena simplex
Anoplius (Pompilinus) marginatus (Say)
Apis mellifera
Augochlorella striata
Bombus affinis
Bombus griseocollis
Bombus impatiens
Bombus ternarius
Bombus vagans
Ceratogastra ornata Say
Cerceris deserta Say
Cerceris nigrescens
Cisseps fulvicollis
Colletes simulans armatus
Cremastus hyalinipennis
Cylindromyia binotata
Dialictus lineatulus
Dialictus near rowheri
Dialictus pilosus
Dialictus rowheri
Dialictus spp.
Ectemnius lapidarius (Panzer)
Ectemnius singularis (Smith)
Ectemnius sp
Epistrophella emarginata
Episyron biguttatus b. (Fab)
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Eumenes globulosus
Evylaeus pectoralis
Halictus ligatus
Helophilus fasciatus
Hylaeus affinis
Hylaeus mesillae cressoni
Lasioglossum leucozonium
Lasioglossum paraforbesii
Megachile mendica
Megachile relativa
Melissodes illata
Myzine maculata
Myzine quinquecincta
Odynerus rugosus
Philanthus bilunatus
Platycheirus sp
Polistes fuscatus
Psithyrus citrinus
Ptilodexia sp
Rogas terminalis
Sphecodes sp
Spilomyia quadrifasciata
Syritta pipiens
Tachytes crassus
Toxomerus marginatus
Vespula vidua

Solidago nemoralis (10 collections; 88 individuals; 40 species)
Ancistocerus tigris

Andrena hirticincta
Andrena placata
Andrena simplex
Anoplius sp
Augochloropsis metallica
Bombus affinis
Bombus griseocollis
Bombus impatiens
Bombus ternarius
Bombus vagans
Ceratina calcarata or dupla
Cerceris deserta
Chelonus sericeus
Cisseps fulvicollis
Colias sp.
Colletes mandibularis
Colletes simulans armatus
Dialictus coeruleus
Dialictus lineatulus
Dialictus pilosus
Dialictus vierecki
Ectemnius lapidarius (Panzer)
Epeolus scutellaris
Eristalis dimidiatus
Exoprosopa caliptera
Megachile latimanus
Megachile pugnata
Melissodes rustica
Myzine maculata
Myzine quinquecincta
Odynerus rugosus
Philanthus politus
Philanthus bilunatus
Phylctanodes sp?
Polistes fuscatus
Pterosarus nebrascensis
Sphecodes sp
Syritta pipiens
Vespula vidua

Solidago rigida (20 collections; 220 individuals; 62 species)
Adelphicornis lineatus
Ammophila urnaria Dahlbom
Ancistocerus catskill
Andrena asteris
Andrena helianthi
Andrena hirticincta
Andrena nubecula
Andrena placata
Andrena simplex
Andrena sp
Apis mellifera
Augochlorella striata
Bombus affinis
Bombus auricomus
Bombus griseocollis
Bombus impatiens

Bombus vagans
Ceratogastra ornata Say
Chauliognathus pennsylvanicus
Chlorion ichneumonium
Chlorion pennsylvanicus
Cisseps fulvicollis
Colias sp.
Colletes simulans armatus
Cylindromyia binotata
Danaus plexippus
Diabrotica sp
Dialictus pilosus
Dialictus rowheri
Dialictus sp
Epicauta pennsylvanica
Eristalis bardus
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Euchistus
Halictus confusus
Halictus ligatus
Helophilus fasciatus
Hylaeus mesillae cressoni
Lasioglossum coriaceum
Luperaltica fuscula
Megachile latimanus
Megachile relativa
Megacyllene robiniae
Melissodes dentiventris
Melissodes illata
Melissodes rustica
Myzine quinquecincta
Odynerus rugosus
Philanthus ventilabris
Phymata pennsylvanica
Polistes fuscatus
Psithyrus ashtoni
Pterosarus nebrascensis
Scolops
Sinea diadema
Sphaerophoria sp
Sphecodes sp
Syritta sp
Toxomerus germinatus
Toxomerus marginatus

Solidago speciosa (11 collections; 103 individuals; 30 species)
Andrena hirticincta
Andrena nubecula
Andrena placata
Apis mellifera
Archytas sp
Bombus affinis
Bombus griseocollis
Bombus impatiens
Bombus vagans
Chelonus sericeus
Cisseps fulvicollis

Coelioxys octodentata
Colletes simulans armatus
Dialictus heterognathus
Dialictus pilosus
Dialictus spp.
Epeolus scutellaris
Eristalis dimidiatus
Eristalis latifrons
Eumenes globulosus
Helophilus fasciatus
Megachile latimanus
Myzine maculata
Polistes fuscatus
Psithyrus ashtoni
Pterosarus nebrascensis
Scolia ephippium
Vanessa cardui
Vespula arenaria
Vespula vidua

Stachys palustris (4 collections; 27 individuals; 12 species)
Allograpta obliqua
Anthophora furcata terminalis
Bombus bimaculatus
Bombus borealis
Bombus fervidus
Bombus griseocollis
Bombus perplexus
Bombus vagans
Dialictus n paradmirandus
Hylaeus mesillae cressoni
Sphaerophoria sp
Toxomerus marginatus

Trifolium pratense (1 collection; 2 individuals; 2 species)
Bombus bimaculatus
Vanessa cardui

Verbena hastata (5 collections; 25 individuals; 13 species)
Agapostemon sericeus
Apis mellifera
Augochlorella striata
Bombus bimaculatus
Bombus griseocollis
Bombus vagans
Bufolucilia sp
Ceratina calcarata or dupla
Halictus confusus
Halictus ligatus
Megachile brevis
Melissodes trinodis
Sphaerophoria contigua

Verbena stricta (5 collections; 14 individuals; 10 species)
Apis mellifera
Atrytone delaware
Augochlorella striata
Bombus affinis
Bombus griseocollis

Chauliognathus pennsylvanicus
Colias sp.
Hemaris diffinis
Melissodes agilis
Vanessa cardui

Vernonia fasciculata (1 collection; 10 indviduals; 7 species)
Bombus bimaculatus
Bombus vagans
Ceratina calcarata or dupla
Dialictus imitatus
Dialictus sp
Melissodes trinodis
Phthiria sp
Triepeolus sp

Vicia americana (1 collection; 5 individuals; 4 species)
Andrena wilkella
Bombus fervidus
Ceratina dupla
Halictus confusus

Zizia aurea (8 collections; 92 individuals; 34 species)
Ancistocerus albophaleratus
Ancistocerus catskill
Ancistocerus tigris
Andrena crataegi
Andrena cressoni c.
Andrena erythrogaster
Andrena wilkella
Andrena ziziae
Anoplius (Pompilinus) marginatus (Say)
Augochlorella striata
Campoplex sp
Ceratina cal or dup
Chrysops sp
Dialictus albipennis
Dialictus imitatus
Dialictus lineatulus
Dialictus pictus
Dialictus pilosus
Dialictus pruinosus
Dialictus rohweri
Dialictus vierecki
Evylaeus pectoralis
Gymnoclytia sp2
Halictus confusus
Halictus ligatus
Hylaeus affinis
Hylaeus illinoensis
Hylaeus mesillae cressoni
Lejops stipatus
Nomada sp
Odontomia pubescens
Odynerus rugosus
Polistes fuscatus
Sphecodes sp

Insects and Plants on Sites

AREM

Insects	Plants
Agapostemon sericeus	Achillea millefolium
Allograpta obliqua	Agastache foeniculum
Ammophila urnaria Dahlbom	Amorpha canescens
Ancistocerus albophaleratus	Cirsium discolor
Ancistocerus tigris	Monarda fistulosa
Andrena hirticincta	Nepeta cataria
Andrena nubecula	Pycnanthemum virginianum
Andrena simplex	Rudbeckia hirta
Andrena virginiana	Solidago canadensis
Anoplius (A) illinoensis (Robt)	Solidago nemoralis
Anoplius (Pompilinus) marginatus (Say)	Solidago speciosa
Anthidium psoraleae	Verbena hastata
Apis mellifera	
Augochlorella striata	
Augochloropsis metallica	
Bombus affinis	
Bombus auricomus	
Bombus bimaculatus	
Bombus borealis	
Bombus griseocollis	
Bombus impatiens	
Bombus vagans	
Bufolucilia sp	
Callophrys gryneus g.	
Celastrina argiotus	
Ceratina calcarata or dupla	
Cerceris clypeata	
Cerceris sp 2	
Chauliognathus pennsylvanicus	
Cisseps fulvicollis	
Climaciella brunnea	
Coelioxys modesta	
Colletes simulans armatus	
Dialictus cressonii	
Dialictus heterognathus	
Dialictus illinoensis	
Dialictus imitatus	
Dialictus n laevissimus	
Dialictus pilosus	
Dialictus rohweri	
Dialictus tegularis	
Dialictus zephyrus	
Dufourea monardae	
Epargyreus clarus	
Epeolus scutellaris	
Eumenes fraternus	
Eumenes globulosus	
Euphyes vestris	
Evylaeus cinctipes	
Halictus confusus	
Halictus ligatus	
Halictus rubicundus	
Helophilus fasciatus	
Hemaris diffinis	
Hemaris thysbe	

Heriades carinatus
Hesperia pawnee
Heterosarus parvus
Hoplitis cylindrica
Hoplitis producta
Hylaeus affinis
Hylaeus modestus
Luperaltica fuscula
Megachile brevis
Megachile latimanus
Megachile relativa
Melissodes desponsa
Melissodes illata
Metasyrphus sp
Myzine maculata
Myzine quinquecincta
Odynerus rugosus
Paratiphia texana Cameron
Philanthus bilunatus
Physocephala tibialis
Polistes fuscatus
Polites origines
Pterosarus nebrascensis
Satyrium edwardsii
Scolia ephippium
Sphaerophoria sp
Sphex aureonotatus
Thorybes pylades
Toxomerus marginatus
Vespula arenaria
Vespula vidua

ASP

Agapostemon virescens
Allograpta obliqua
Andrena rudbeckiae
Apis mellifera
Atrytone delaware
Augochlorella striata
Bembix spinolae
Bombus auricomus
Bombus bimaculatus
Bombus griseocollis
Bombus vagans
Ceratina calcarata
Cisseps fulvicollis
Colias sp.
Colletes susannae
Dialictus rowheri
Dufourea monardae
Epargyreus clarus
Euphyes vestris
Halictus confusus
Halictus ligatus
Hemipenthes sinuosa
Heriades carinatus
Megachile latimanus
Melissodes subillata
Melissodes trinodis
Dalea purpurea
Monarda fistulosa
Penstemon grandiflorus (1990 only)
Potentilla recta
Ratibida pinnata
Rudbeckia hirta
Verbena hastata

Pterosarus nebrascensis
Ptilodexia incerta
Sphaerophoria contigua
Syrphus sp
Toxomerus germinatus
Toxomerus marginatus
Wallengrenia egeremet

CARP

Agapostemon sericeus
Agapostemon splendens
Agapostemon virescens
Allograpta obliqua
Ancistocerus albophaleratus
Ancistocerus capra
Ancistocerus catskill
Ancistocerus tigris
Andrena asteris
Andrena commoda
Andrena crataegi
Andrena cressoni c.
Andrena erythrogaster
Andrena helianthi
Andrena hirticincta
Andrena nubecula
Andrena placata
Andrena rudbeckiae
Andrena simplex
Andrena wilkella
Anoplius (Pompilinus) marginatus (Say)
Anthophora furcata terminalis
Apis mellifera
Archytas sp
Asterocampa celtis
Atrytone delaware
Augochlorella striata
Bombus affinis
Bombus auricomus
Bombus bimaculatus
Bombus borealis
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus perplexus
Bombus vagans
Ceratina calcarata or dupla
Ceratogastra ornata Say
Cerceris deserta Say
Cerceris sp 3
Cerceris sp 4
Cerceris sp 5
Chauliognathus pennsylvanicus
Chlorion ichneumonium
Chlorion pennsylvanicus
Cisseps fulvicollis
Colias sp.
Colletes aberrans
Colletes susannae

Achillea millefolium
Agastache foeniculum
Aster ericoides
Aster lanceolata
Cirsium arvense
Cirsium discolor
Dalea purpurea
Erigeron strigosus
Helianthus rigidus
Helianthus tuberosus
Heliopsis helianthoides
Melilotus offincinalis
Monarda fistulosa
Potentilla arguta
Potentilla recta
Ratibida pinnata
Rosa blanda
Rudbeckia hirta
Solidago canadensis
Solidago rigida
Solidago speciosa
Stachys palustris
Trifolium pratense
Verbena stricta
Zizia americana

Cremastus hyalinipennis
Diabrotica sp
Dialictus albipennis
Dialictus lineatulus
Dialictus n laevissimus
Dialictus n paradmirandus
Dialictus near rowheri
Dialictus nymphaearum
Dialictus pilosus
Dialictus pruinosus
Dialictus rohweri
Dialictus zephyrus
Dinera sp
Dufourea monardae
Ectemnius singularis (Smith)
Ectemnius sp
Epicauta pennsylvanica
Epistrophella emarginata
Episyron biguttatus b. (Fab)
Eristalis dimidiatus
Eristalis latifrons
Eristalis sp2
Eristalis tenax
Eristalis transversus
Euchistus
Exoprosopa dorcadion
Gymnoclytia sp2
Halictus confusus
Halictus ligatus
Halictus ligatus
Halictus parallelus
Helophilus fasciatus
Hemaris diffinis
Heriades carinatus
Heterosarus sp.
Hylaeus affinis
Hylaeus mesillae cressoni
Hylemya
Lasioglossum acuminatum
Lasioglossum paraforbesii
Leucostoma sp
Luperaltica fuscula
Megachile latimanus
Megachile mendica
Megacyllene robiniae
Melissodes agilis
Melissodes desponsa
Melissodes illata
Melissodes rustica
Melissodes subillata
Melissodes trinodis
Myzine quinquecincta
Nomada sp
Odynerus rugosus
Orellia ruficauda
Perilampus hyalinus (Say)
Philanthus ventilabris
Phymata pennsylvanica
Platycheirus sp

Polistes fuscatus
Psithyrus ashtoni
Pterosarus nebrascensis
Scolops
Sinea diadema
Speyeria aphrodite
Sphaerophoria contigua
Sphaerophoria sp
Sphecodes sp
Spilomyia quadrifasciata
Stomoxys calcitrans
Svastra obliqua obliqua
Syrphus sp
Tachytes crassus
Temelucha ferruginea
Toxomerus germinatus
Toxomerus marginatus
Vanessa cardui
Wallengrenia egeremet

CC

?Chilo sp
Agapostemon sericeus
Agapostemon splendens
Agapostemon virescens
Anacrabro ocellata
Anastoechus sp
Ancistocerus tigris
Andrena asteris
Andrena helianthi
Andrena hirticincta
Andrena placata
Anoplius (A) illinoensis (Robt)
Anthophora furcata terminalis
Apis mellifera
Archytas sp
Atrytone delaware
Augochlora pura
Augochlorella striata
Augochloropsis metallica
Bembix belfragei
Bembix spinolae
Bicyrtes quadrifasciata
Bicyrtes ventralis
Bombus affinis
Bombus bimaculatus
Bombus borealis
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus ternarius
Bombus terricola
Bombus vagans
Campsomerus plumipes confluenta
Ceratina calcarata or dupla
Cerceris deserta
Chrysanthrax sp
Amorpha canescens
Aster oolentangiensis
Dalea purpurea
Helianthus rigidus
Liatris aspera
Lithospermum carolinense
Monarda fistulosa
Penstemon grandiflorus
Phlox pilosa
Pycnanthemum virginianum
Rudbeckia hirta
Solidago canadensis
Solidago nemoralis
Solidago rigida
Stachys palustris
Solidago speciosa

Chrysops sp
Cisseps fulvicollis
Coelioxys altennata
Colias sp.
Colletes simulans armatus
Dialictus coeruleus
Dialictus cressonii
Dialictus lineatulus
Dialictus pictus
Dialictus pilosus
Dialictus vierecki
Ectemnius continuus
Ectemnius lapidarius (Panzer)
Epistrophella emarginata
Eristalis dimidiatus
Eristalis transversus
Eumenes globulosus
Euphyes conspicua
Euphyes vestris
Evylaeus pectoralis
Exoprosopa caliptera
Formicinae ?genus
Gymnoclytia sp2
Halictus ligatus
Harkenclenus titus
Hedriodiscus vertebratus
Helophilus fasciatus
Hemaris thysbe
Heriades carinatus
Hesperia leonardus
Hylaeus mesillae cressoni
Hylaeus modestus
Hylaeus verticalis
Hyleaus mesillae mesillae
Lasioglossum acuminatum
Lasioglossum coriaceum
Lasioglossum paraforbesii
Lepidophora sp
Luperaltica fuscula
Megachile gemula
Megachile latimanus
Megachile montivega
Megachile pugnata
Megachile relativa
Melissodes agilis
Melissodes bimaculata bimaculata
Melissodes dentiventris
Melissodes subillata
Melissodes trinodis
Metasyrphus sp
Myzine maculata
Myzine quinquecincta
Neocnemodon sp
Odynerus rugosus
Osmia distincta
Perdita albipennis pallidipennis
Philantus bilunatus
Phylctanodes sp?
Physoconops brachyrhynchus

Poecilanthrax sp
Polalonia mickeli Murray
Polistes fuscatus
Polistes themistoclas
Psithyrus ashtoni
Psithyrus citrinus
Pterosarus nebrascensis
Ptilodexia sp
Rogas terminalis
Satyrium edwardsii
Scolia bicincta
Speyeria aphrodite
Sphaerophoria sp
Sphecodes sp
Syrphus sp
Systoechus sp
Tachytes pennsylvanicus
Thorybes pylades
Toxomerus germinatus
Toxomerus marginatus
Vespula maculata
Vespula vidua
Zodion sp2

CEM

?Chilo sp
Adelphicornis lineatus
Agapostemon sericeus
Agapostemon texanus
Agapostemon virescens
Allograpta obliqua
Ammophila urnaria Dahlbom
Ancistocerus tigris
Andrena asteris
Andrena carlini
Andrena helianthi
Andrena helianthi
Andrena hirticincta
Andrena nubecula
Andrena rudbeckiae
Andrena simplex
Andrena wilkella
Andrena wilmattae
Andrena ziziae
Apis mellifera
Atrytone delaware
Augochlorella striata
Bembix spinolae
Bombus affinis
Bombus auricomus
Bombus bimaculatus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus perplexus
Bombus vagans
Cardochiles sp
Ceratina calcarata or dupla
Aster ericoides
Aster lanceolata
Aster oolentangiensis
Desmodium canadense
Galium boreale
Helianthus rigidus
Helianthus tuberosus
Heliopsis helianthoides
Monarda fistulosa
Ratibida pinnata
Rosa blanda
Solidago canadensis
Solidago rigida
Solidago speciosa
Vicia americana

Cerceris fulvipediculata
Chauliognathus pennsylvanicus
Chlorion attratum
Cisseps fulvicollis
Colias sp.
Cylindromyia binotata
Diabrotica sp
Dialictus near rowheri
Dialictus pilosus
Dialictus pruinosus
Dialictus rohweri
Dufourea monardae
Epicauta pennsylvanica
Episyron biguttatus b. (Fab)
Eristalis arbustorum
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Evylaeus cinctipes
Evylaeus pectoralis
Exetastes angustoralis
Gorytini ?genus
Gymnoclytia sp1
Halictus confusus
Halictus ligatus
Halictus parallelus
Hemaris diffinis
Heriades carinatus
Hylaeus mesillae cressoni
Hyleaus mesillae mesillae
Hylemya
Lasioglossum coriaceum
Lasioglossum leucozonium
Lasioglossum paraforbesii
Mallota bautias
Megachile brevis
Megachile latimanus
Megacyllene robiniae
Melissodes agilis
Melissodes bimaculata bimaculata
Melissodes rustica
Melissodes subillata
Melissodes trinodis
Melissodes trinodis
Metasyrphus sp
Nomada sp
Philanthus ventilabris
Polistes fuscatus
Pterosarus nebrascensis
Svastra obliqua obliqua
Syrphus sp
Toxomerus marginatus
Triepeolus sp
Vanessa cardui
Zodion sp1

CHR

?Chilo sp

Achillea millefolium

Agapostemon sericeus
Agapostemon texanus
Agapostemon virescens
Allograpta obliqua
Alypia octomaculata
Andrena asteris
Andrena helianthi
Andrena hirticincta
Andrena placata
Andrena wilkella
Apis mellifera
Archytas sp
Atrytone delaware
Augochlorella striata
Augochloropsis metallica
Bembix sayi
Bembix spinolae
Bicyrtes ventralis
Bombus affinis
Bombus auricomus
Bombus bimaculatus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus pennsylvanicus
Bombus ternarius
Bombus vagans
Cerceris nigrescens
Cerceris sp 1
Cercyonis pegala
Chauliognathus pennsylvanicus
Chelonus sericeus
Chlorion attratum
Cisseps fulvicollis
Coelioxys rufitarsus
Colias sp.
Colletes kincaidii
Colletes simulans armatus
Colletes susannae
Colletes willmattae
Diabrotica sp
Dialictus albipennis
Dialictus lineatulus
Dialictus nymphaearum
Dialictus perpunctatus
Dialictus pictus
Dialictus pilosus
Dialictus pruinosus
Dialictus tegularis
Dialictus vierecki
Ectemnius continuus
Epicauta pennsylvanica
Eristalis bardus
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Eusiphona sp
Evylaeus pectoralis
Agastache foeniculum
Allium canadense
Amorpha canescens
Anemone canadensis
Aster ericoides
Aster oolentangiensis
Aster sericeus
Chrysopsis villosa
Coreopsis palmata
Dalea purpurea
Helianthus rigidus
Helianthus tuberosus
Heliopsis helianthoides
Liatris aspera
Lupinus perennis
Melilotus alba
Melilotus offincinalis
Mirabilis nyctaginea
Monarda fistulosa
Penstemon grandiflorus
Phlox pilosa
Potentilla arguta
Ratibida pinnata
Rosa blanda
Rudbeckia hirta
Solidago canadensis
Solidago rigida
Solidago speciosa
Sysirinchium campestre
Lithospermum inscisum

Exoprosopa caliptera
Exoprosopa sp
Halictus confusus
Helophilus fasciatus
Helophilus latifrons
Heriades carinatus
Hoplitis pilosifrons
Hylaeus affinis
Hylaeus mesillae cressoni
Hylemya
Lasioglossum paraforbesii
Megachile brevis
Megachile latimanus
Megachile pugnata
Melissodes agilis
Melissodes dentiventris
Melissodes subillata
Melissodes trinodis
Metasyrphus sp
Musca autumnalis
Myzine maculata
Myzine quinquecincta
Nomada sp
Orthonevre sp
Paravilla sp
Perdita perpalpis citronella
Perdita swenki
Philanthus politus
Philanthus sanbornii
Philanthus ventilabris
Philanthus bilunatus
Phyciodes tharos
Platycheirus sp
Poecilanthrax sp
Polistes fuscatus
Polites coras=peckias
Protandrena bancrofti
Ptilodexia incerta
Speyeria cybele
Sphaerophoria contigua
Sphaerophoria sp
Stratiomys obesus
Svastra obliqua obliqua
Syrphus sp
Systoechus sp
Tetralonia dubitata
Tetralonia hamata
Toxomerus germinatus
Toxomerus marginatus
Vanessa cardui
Villa sp2
Wallengrenia egeremet

LLRP

Agapostemon texanus
Ammophila urnaria Dahlbom
Anacrabro ocellata
Ancistocerus albophaleratus
Achillea millefolium
Agastache foeniculum
Allium canadense
Amorpha canescens

Ancistocerus tigris
Andrena asteris
Andrena commoda
Andrena helianthi
Andrena hirticincta

Andrena placata
Andrena ziziae
Anoplius (Pompilinus) marginatus (Say)
Archytas sp
Augochlorella striata
Bombus affinis
Bombus bimaculatus
Bombus fervidus
Bombus griseocollis
Bombus impatiens
Bombus terricola
Bombus vagans
Campoplex sp
Ceratina calcarata or dupla
Cerceris deserta
Cerceris sp 1
Cercyonis pegala
Chelonus sericeus
Chlorion ichneumoneum
Chlorion pennsylvanicus
Chrysops sp
Chrysotoxum sp
Cisseps fulvicollis
Coelioxys rufitarsus
Colletes aberrans
Colletes kincaidii
Colletes mandibularis
Colletes robertsoni
Colletes simulans armatus
Danaus plexippus
Dialictus cressonii
Dialictus imitatus
Dialictus lineatulus
Dialictus pictus
Dialictus pilosus
Dialictus vierecki
Ectemnius lapidarius (Panzer)
Ectemnius singularis (Smith)
Eristalis bardus
Eristalis dimidiatus
Eristalis latifrons
Eristalis sp1
Eristalis transversus
Evylaeus pectoralis
Helophilus fasciatus
Heriades carinatus
Hoplitis cylindrica
Hoplitis pilosifrons
Hoplitis producta
Hylaeus affinis
Hylaeus illinoensis
Hylaeus mesillae cressoni
Lasioglossum athabascense

Aster ericoides
Aster lanceolata
Aster oolentangiensis
Aster sericeus
Berteroa incana
Chrysopsis villosa
Dalea purpurea
Dalea villosa
Crepis tectorum
Desmodium canadense
Erigeron strigosus
Grindelia squarrosa
Helianthus rigidus
Heliopsis helianthoides
Melilotus alba
Melilotus offincinalis
Monarda fistulosa
Penstemon grandiflorus
Pycnanthemum virginianum
Rudbeckia hirta
Solidago canadensis
Solidago nemoralis
Solidago rigida
Solidago speciosa
Zizia americana

Lasioglossum coriaceum
Lasioglossum sp
Lejops stipatus
Megachile latimanus
Megachile pugnata
Megachile relativa
Melissodes agilis
Melissodes dentiventris
Melissodes illata
Melissodes rustica
Metasyrphus sp
Myzine quinquecincta
Nomada sp
Odontomia pubescens
Odynerus rugosus
Orthonevre sp
Oxybelus sublatus Robertson
Parhelophilus laetus
Parhelophilus sp
Perdita albipennis
Philanthus politus
Philanthus sanbornii
Philanthus ventilabris
Polistes fuscatus
Psithyrus citrinus
Sphaerophoria sp
Sphecodes sp
Stratiomys obesus
Syritta pipiens
Syrphus sp
Systoechus sp
Tachytes crassus
Tachytes pennsylvanicus
Toxomerus germinatus
Toxomerus marginatus
Tropidia sp
Vanessa cardui
Villa sp1

LV

Agapostemon sericeus
Agapostemon virescens
Allograpta obliqua
Ancistocerus catskill
Andrena asteris
Andrena commoda
Andrena helianthi
Andrena hirticincta
Andrena miranda
Andrena rudbeckiae
Andrena ziziae
Apis mellifera
Archytas sp
Augochlorella striata
Augochloropsis metallica
Bembix belfragei
Bombus affinis
Bombus auricomus

Achillea millefolium
Amorpha canescens
Aquilegia canadensis
Aster ericoides
Aster ontarionis
Aster oolentangiensis
Aster sericeus
Campanula rotundifolia
Cirsium discolor
Helianthus rigidus
Liatris aspera
Liatris punctata
Monarda fistulosa
Nepeta cataria
Pycnanthemum virginianum
Ratibida pinnata
Rubus occidentalis
Solidago canadensis

Bombus bimaculatus
Bombus fervidus
Bombus impatiens
Bombus vagans
Callophrys gryneus g.
Ceratina calcarata or dupla
Ceratochrysis kansensis
Cerceris sp 1
Chauliognathus pennsylvanicus
Coelioxys octodentata
Colias sp.
Colletes americanus
Colletes brevicornis
Diabrotica sp
Dialictus anomalus
Dialictus cressonii
Dialictus imitatus
Dialictus n laevissimus
Dialictus pilosus
Dialictus rohweri
Dialictus supraclypeatus
Dufourea monardae
Epistrophella emarginata
Eristalis arbustorum
Eristalis dimidiatus
Eristalis latifrons
Eristalis tenax
Eristalis transversus
Eusiphona sp
Evylaeus cinctipes
Evylaeus pectoralis
Evylaeus truncatus
Exetastes angustoralis
Halictus confusus
Halictus ligatus
Halictus rubicundus
Helophilus fasciatus
Helophilus latifrons
Hylaeus mesillae cressoni
Hyleaus affinis
Hylemya
Lasioglossum leucozonium
Luperaltica fuscula
Megachile brevis
Megachile latimanus
Megachile mendica
Melissodes agilis
Melissodes desponsa
Melissodes gelida
Melissodes rustica
Melissodes subillata
Melissodes trinodis
Metasyrphus sp
Myzine quinquecincta
Nymphalis milberti
Odynerus rugosus
Parancistroceras vagus v. (Saussure)
Philanthus gibbosus
Philanthus bilunatus
Solidago rigida
Solidago speciosa
Vernonia fasciculata
Zizia americana

Phthiria sp
Phymata pennsylvanica
Physocephala tibialis
Physoconops obscuripennis
Platycheirus sp
Polistes fuscatus
Psithyrus ashtoni
Sparnopolius sp
Speyeria aphrodite
Sphaerophoria contigua
Syritta pipiens
Syrphus sp
Thecophora sp
Toxomerus germinatus
Toxomerus marginatus
Triepeolus sp
Vespula vidua
Villa sp2