

Insect diversity in old field and newly restored prairies at Pierce Cedar Creek Institute, Barry County, Michigan.

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Abstract

Cercopidae and Cicadellidae are diverse families that can indicate the ecological quality of a prairie by community composition (Dunn et al., 2003, 2007). Lepidoptera also can be used as ecological indicators. I surveyed the Cicadellidae and Cercopidae as well as the Lepidoptera of Pierce Cedar Creek Institute in Hastings Michigan to assess the quality of their prairies. Cercopidae and Cicadellidae were surveyed using sweep nets and identified using appropriate keys. Lepidoptera were identified to species and counted in the field. Cercopidae and Cicadellidae richness did not differ among old field prairies and newly restored prairies. Lepidopteran species composition was also not significantly different between prairie types. These insects will likely take many years to colonize Pierce Cedar Creek Institute. To speed the colonization process, species may need to be introduced or corridors may be created to facilitate natural insect dispersal from nearby native prairies.

Introduction

Cercopidae and Cicadellidae are diverse taxa in prairie ecosystems and their community composition allows their use as an index of the ecological quality of grassland flora (Dunn et al., 2003, 2007). Both nymphs and adults of these families are herbivorous and they form close associations with their food plants (Hamilton 1995, 2005). They are also easy to sample and collect (Hamilton 1995, 2005). Lepidoptera can also form associations with food and are easily identified; this allows their use as bioindicator species for prairies (Lomov et al., 2006).

There are 19 species of Cercopidae (Hanna and Moore 1966, Hanna 1970) and 208 species of Cicadellidae (Taboada 1964) in Michigan with several designated as a rare or threatened species. Although species lists for these two families exist for Michigan (Taboada 1964, Hanna and Moore 1966, Hanna 1970) there have been few recent surveys of the species on Michigan prairies and none so far on the prairies of Pierce Cedar Creek Institute.

Pierce Cedar Creek Institute is nature center and biological station in Barry County, Michigan. The institute is on 661 acres and all of the fields they own were fallow farm and hay fields (Figure 1). Recently, an effort has been made to plant these prairies to create native Michigan grassland habitat. Old field prairies were dominated by grasses such as *Phleum pratense* (Timothy), *Bromus inermis* (Smooth brome), *Festuca pratensis* (Meadow fescue), and *Elytria repens* (Quack grass). These prairies often contained invasive species such as *Centaurea maculosa* (Spotted knapweed) as well. Prairies went through burning, mowing, and planting to cultivate native grassland (Table 1). Restored prairies were planted with *Andropogon gerardii* (Big bluestem),

Schizachyrium scoparium (Little bluestem), *Sorghastrum nutans* (Indian grass), *Elymus Canadensis* (Canadian wild-rye), *Asclepias tuberosa* (Butterfly Weed), *Rudbeckia hirta* (Black-eyed Susan), *Rudbeckia pinnata* (Grey-headed coneflower) and other prairie grasses and wildflowers. These restored prairies are home to many insects and wildlife that inhabit Pierce Cedar Creek Institute. Knowledge of the species that populate a habitat may be important in ecosystem management, and several important ecological functions are related to species richness (Tilman and Downing 1994, Kinzig et al. 2001). My objective was to quantify the Lepidoptera, Cercopidae, and Cicadellidae present in these prairies to see if there was a significant difference in species richness between the healthier planted prairies and those that were fallow fields. I did not intend to create a complete species inventory of the sites, rather to rank the quality of the sites by comparing species richness and ecological indices. I predicted that the planted prairies would have higher species richness than unplanted fields.

Materials and Methods

Three samples of Cicadellidae and Cercopidae were collected by sweeping, with a 38 cm diameter net, through the plant canopy along transects approximately 50 meters apart. Sampling occurred on June 6, 2007, July 12, 2007, and August 8, 2007. All days were warm and sunny and collections occurred between 1000 and 1600 hours.

Cicadellidae were identified first to genera by the regional key of Hamilton (unpublished), then to species by the keys of Hamilton (1995, 1998). Cercopidae were determined to species using the keys of Hanna and Moore (1966) and Hamilton (1982).

I conducted butterfly surveys for prairies every other week starting the week of June 4, 2007 for the first group and June 11, 2007 for the second group. Prairies were

surveyed by crossing the prairies about every 50 meters and identifying all species that were viewed within about a five meter radius in front of the observer. Occasionally a butterfly could not be identified or collected due to rapid flight and it was not counted. Butterflies flying overhead were also not counted. Butterflies were identified to species using Nielsen (1999).

Results and Discussion

Eleven species of Cicadellidae (Table 2) were collected. There is little difference from prairie to prairie in the number of species present; however, some have very different species compositions. The old field prairies were almost entirely inhabited by species that feed upon a variety of plants, including agricultural plants, which dominate these sites.

Two species of Cercopidae (Table 2) were collected. Only one individual of *Lepryonia quadrangularis* was found and the rest were *Philaneus spumarius* which are a very abundant species in Michigan. No threatened species were found. *Philaneus spumarius* feeds on a wide variety of plants and could be present in both healthy prairies and abandoned fields (Hanna and Moore, 1966). *Philaneus spumarius* is the most commonly collected spittlebug in Michigan (Hanna and Moore, 1966). *Lepryonia quadrangularis* is the second most collected spittlebug in Michigan and it inhabits weedy fields, as it is associated with ragweed, poison ivy, poverty grasses, and golden rod (Hanna and Moore, 1966). The one specimen of *L. quadrangularis* found was collected in North prairie, which was the weediest of the eight prairies surveyed.

Invasive species of leafhoppers were collected, including *Athysanus argentarius* at all sites, *Doratura stylata* at five sites, and *Commellus comma* at six sites. Most of these species were highly dominant. Several of them are known agricultural pests and do not specialize on one particular plant, so they have been able to live in both the newly planted prairies as well as the abandoned fields.

Species richness of Cercopidae and Cicadellidae among the sites ranged from nine species in North prairie to six species at Southwest and Midwest prairies. Organism counts per field ranged from 689 at Southwest prairie to 127 at Green Trail prairie.

Lepidopteran species richness was also similar between prairies (Table 3). There were 17 species at Pierce Cedar Creek Institute. The main difference between planted and unplanted prairies was the difference in numbers of generalist butterfly species. Green trail prairie, for example, was made up of 80.95% *Pieris rapae*, which can thrive in weedy, abandoned fields. However, Middle Yellow which was one of the healthiest prairies had only 8.47% *P. rapae*.

Overall, species richness of the prairies was low and there was not much difference between the habitats of high and low quality. Cicadellidae and Cercopidae are both relatively sessile families. These insects do not travel far, and spend most of their time feeding and resting on host plants. The reason for the low species richness could be because Pierce Cedar Creek Institute is located within several miles of agricultural land and there are no direct routes through natural prairies to allow native species to travel to newly diversified land. Bomar (2001) showed that proximity to a long restored or native prairie is essential for dispersal of many less common Orthopteran species. Pierce Cedar Creek Institute is proximate to old fields and farm land, thus facilitating dispersal of

agricultural pests and generalist species. To remedy this problem, Pierce Cedar Creek Institute should work to establish connections to stable prairies or release native Cicadellidae and Cercopidae species in their prairies.

It has been shown that establishing corridors, such as restoring roadsides to native prairies species is beneficial for butterfly species that are sensitive to disturbed habitats (Ries et al., 2001). If a plan to convert roadsides stretching from Pierce Cedar Creek to the nearest native or older restored prairies to native prairies plant species could be devised, this may facilitate butterfly dispersal to Pierce Cedar Creek Institute's restored prairies.

Springtails (Collembola) have also been shown to also be good indicators of ecological quality (Brand and Dunn, 1998). In Brand and Dunn's (1998) study there was not a marked difference between prairies restored in a close expanse of time, but there were differences between prairies restored less than six years prior to the study and native prairies. There was also a difference between prairies restored less than six years prior to the study and prairies restored 17 to 24 years prior to the study (Brand and Dunn, 1998).

In conclusion, efforts to restore a healthy insect population at Pierce Cedar Creek Institute will take time because adding the plants does not always guarantee the insects will arrive at the site, particularly if they are less mobile species. Future studies may determine how long it takes for Cicadellidae, Cercopidae, and even some rare lepidopterans to colonize Pierce Cedar Creek Institute and the types of corridors or introductions that may be feasible to add to management practices.

Table 1. Prairies of Pierce Cedar Creek Institute surveyed for Cicadellidae and Cercopidae on June 6, 2007, July 12, 2007, and August 8, 2007.

Site letter code	Name	Botanical Description
A	North Prairie	Unsuccessfully planted in 2005. Contains agricultural plants and some natives
B	Green Trail Prairie	Almost all brome grass, old agricultural field
C	Southwest Prairie	Successfully planted in 2002. Mainly native grassland species
D	Northwest Prairie	Successfully planted in 2004. Mainly native grassland species
E	Middle Yellow Prairie	Successfully planted in 1999. Mainly native grassland species
F	Midwest Prairie	Successfully planted in 2001. Mainly native grassland species
G	South Yellow Prairie	Not planted, contains mostly weeds and agricultural plants
H	Southeast Prairie	Successfully planted in 1999. Mainly native grassland species

Table 2. Number of each Cercopidae and Cicadellidae species collected by sweep net sampling from eight prairies of Pierce Cedar Creek Institute on June 6, 2007, July 12, 2007, and August 8, 2007. Site Letter codes: A = North Prairie, B = Green Trial Prairie, C = Southwest Prairie, D = Northwest Prairie, E = Middle Yellow Prairie, F = Midwest Prairie, G = South Yellow Prairie, and H = Southeast Prairie.

Prairies	A	B	C	D	E	F	G	H
a. Cicadellidae								
<i>Chloratettix unicolor</i> (Fitch)	3	1	196	128	82	121	53	81
<i>Athysanus argentarius</i> (Fabricus)	5	87	210	5	13	2	70	56
<i>Commellus comma</i> (Van Duzee)	1	11	25	0	0	1	155	4
<i>Doratura stylata</i> (Boheman)	2	2	0	0	0	2	1	3
<i>Jikradia olitorius</i> (Say)	1	0	0	0	1	2	0	0
<i>Aphrodes costata</i> (Panzer)	50	2	1	27	21	4	21	9
<i>Aceratagallia sanguinolenta</i> (Provancher)	5	0	0	3	4	0	1	3
<i>Diplocolenus configuratus</i> (Uhlur)	0	3	0	1	1	0	0	0
<i>Draeculacephala antica</i> (Walker)	11	1	2	6	0	0	6	3
<i>Scaphytopius frontalis</i> (Van Duzee)	1	0	1	3	2	0	1	3
<i>Neokolla heiroglyphica</i> (Say)	0	0	0	12	1	0	7	0
b. Cercopidae								
<i>Philaneus spumarius</i> (Linnaeus)	589	20	254	349	351	158	234	239
<i>Lepryonia quadrangularis</i> (Say)	1	0	0	0	0	0	0	0
Total individuals	669	127	689	534	476	290	549	401

Table 3. Number of lepidopteran species identified in eight prairies of Pierce Cedar Creek Institute from June through August 2007. Site Letter codes: A = North Prairie, B = Green Trail Prairie, C = Southwest Prairie, D = Northwest Prairie, E = Middle Yellow Prairie, F = Midwest Prairie, G = South Yellow Prairie, and H Southeast Prairie.

Prairies	A	B	C	D	E	F	G	H
<i>Epargyreus clarus</i> (Silver Spotted Skipper)	3	0	0	1	0	1	0	0
<i>Anatrytone logan</i> (Delaware Skipper)	36	11	2	10	10	15	7	8
<i>Cupido comyntas</i> (Eastern Tailed Blue)	5	0	5	1	7	4	2	10
<i>Pieris rapae</i> (Cabbage White)	101	51	23	79	5	33	8	5
<i>Colias eurytheme</i> (Orange Sulphur)	109	0	3	1	9	4	6	18
<i>Phoebis sennae</i> (Clouded Sulphur)	66	0	5	5	13	5	1	22
<i>Euphydryas phaeton</i> (Baltimore)	14	0	7	0	0	11	25	3
<i>Danaus plexippus</i> (Monarch)	3	1	2	0	1	1	0	0
<i>Limenitis archippus</i> (Viceroy)	1	0	0	0	0	0	0	0
<i>Speyeria cybele</i> (Great Spangled Fritillary)	4	0	2	0	0	3	0	3
<i>Phyciodes tharos</i> (Pearl Crescent)	0	0	2	9	14	3	4	5
<i>Lycaena phlaeas</i> (American Copper)	2	0	0	1	0	0	2	0
<i>Vanessa virginiensis</i> (American Painted Lady)	1	0	0	0	2	0	0	2
<i>Papilio polyxenes</i> (Black Swallowtail)	1	0	2	1	2	2	0	4
<i>Papilio glaucus</i> (Tiger Swallowtail)	3	0	0	1	0	0	0	2
<i>Limenitis arthemis</i> (Red Spotted Purple)	0	0	0	0	1	0	1	0
<i>Papilio cresphontes</i> (Giant Swallowtail)	0	0	0	0	1	1	0	0
Total individuals	349	63	51	106	59	80	53	74

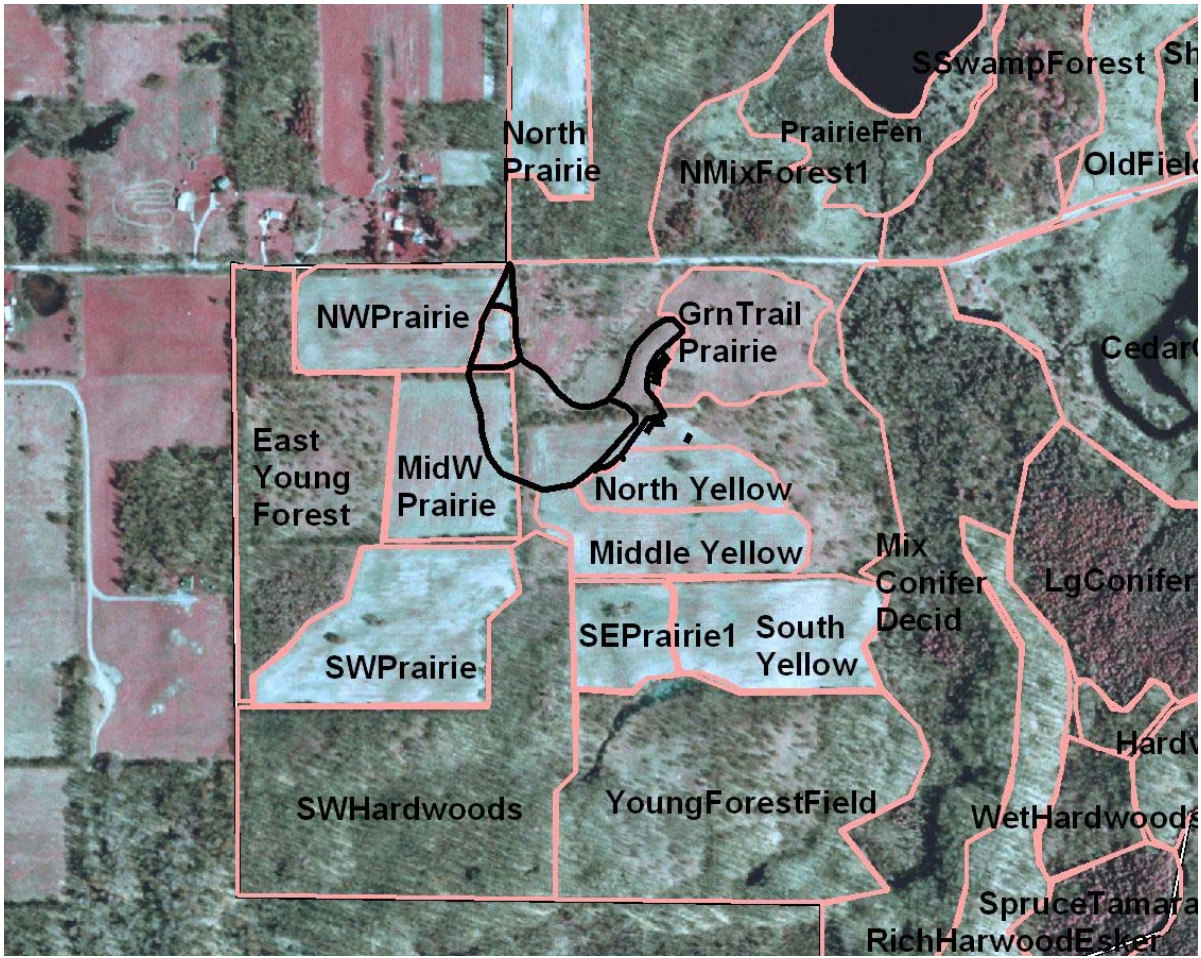


Figure 1. Map of prairies at Pierce Cedar Creek Institute. North Yellow was not sampled.

Appendix A. List of Cicadellidae collected at Pierce Cedar Creek Institute, Barry County, Michigan. All records were in 2007. Site Letter codes: A = North Prairie, B = Green Trail Prairie, C = Southwest Prairie, D = Northwest Prairie, E = Middle Yellow Prairie, F = Midwest Prairie, G = South Yellow Prairie, and H Southeast Prairie.

Aceratagallia sanguinolenta (Provancher)

Collected in A: June 6
D: June 6, August 8
E: June 6, July 12
F: July 12
G: August 8
H: July 12, August 8

Aphrodes costata (Panzer)

Collected in A: June 6, August 8
B: June 6
C: June 6, July 12
D: June 6, July 12, August 8
E: June 6, August 8
F: August 8
G: June 6, July 12, August 8
H: June 6, July 12

Athysanus argentarius (Fabricius)

Collected in A: June 6, August 8
B: July 12, August 8
C: June 6, July 12
D: June 6, August 8
E: June 6
F: June 6, July 12
G: June 6, July 12, August 8
H: June 6, July 12, August 8

Chlorotettix unicolor (Fitch)

Collected in A: June 6, August 8
B: July 12
C: June 6, July 12, August 8
D: June 6, July 12, August 8
E: June 6, July 12, August 8
F: June 6, July 12, August 8
G: June 6, July 12, August 8
H: June 6, July 12, August 8

Commellus comma (Van Duzee)

Collected in A: June 6
B: June 6, July 12
C: June 6, July 12, August 8
F: June 6
G: June 6, July 12, August 8
H: June 6, July 12

Doratura stylata (Boheman)

Collected in A: June 6
B: June 6, July 12
F: June 6, July 12
G: July 12
H: June 6, July 12

Diplocolenus configuratus (Uhlur)

Collected in B: July 12
D: July 12
F: July 12

Draeculacephala antica (Walker)

Collected in A: June 6, August 8
B: August 8
C: August 8
D: June 6, August 8
G: August 8
H: July 12, August 8

Jikradia olitorius (Say)

Collected in A: August 8
E: August 8
F: August 8

Neokolla heiroglyphica (Say)

Collected in D: June 6, August 8
E: August 8
G: August 8

Scaphytopius frontalis (Van Duzee)

Collected in A: June 6
C: August 8
D: June 6, July 12
E: June 6, July 12
G: June 6
H: June 6, August 8

Appendix B. List of Cercopidae collected at Pierce Cedar Creek Institute, Barry County, Michigan. All records were in 2007.

Philaneus spumarius (Linnaeus)

Collected in A: June 6, July 12, August 8
B: June 6, July 12, August 8
C: June 6, July 12, August 8
D: June 6, July 12, August 8
E: June 6, July 12, August 8
F: June 6, July 12, August 8
G: June 6, July 12, August 8
H: June 6, July 12, August 8

Lepryonia quadrangularis (Say)

Collected in A: August 8

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