

List of Insect Species which May Be Tallgrass Prairie Specialists

Final Report to the USFWS Cooperating Agencies

July 1, 1996

Catherine Reed
Entomology Department
219 Hodson Hall
University of Minnesota
St. Paul MN 55108

phone 612-624-3423
e-mail reedx012@umn.edu

This study was funded in part by a grant from the USFWS and Cooperating Agencies.

Table of Contents

Summary.....	2
Introduction.....	2
Methods.....	3
Results.....	4
Discussion and Evaluation.....	26
Recommendations.....	29
References.....	33

Summary

Approximately 728 insect and allied species and subspecies were considered to be possible prairie specialists based on any of the following criteria: defined as prairie specialists by authorities; required prairie plant species or genera as their adult or larval food; were obligate predators, parasites or mutualists of prairie specialist insects; were found in collections from prairie sites but not from nearby woodland sites; were limited to states and provinces in the northern tallgrass region. Lepidoptera, Homoptera and Orthoptera contained the most obligate species, due to the attention given to these orders by prairie entomologists. Selected families of Diptera, Coleoptera, Hymenoptera and Hemiptera will probably be shown to contain numerous specialist species when adequate prairie collections are made. Spiders are also recommended for further collections and study.

Introduction

The goal of this literature review was to develop a list of insect species which are likely to be prairie specialists. The objectives of the Prairie Insect Project as a whole are to discover the extent and status of prairie specialist insects and their responses to management activities. If prairie specialists can be identified, we can focus conservation efforts on them. Although prairie obligacy alone does not imply extinction risk, specialists may be in danger of extinction due to the habitat loss, habitat fragmentation and changes in habitat factors such as fire frequency, invasion of alien species and loss of native species which have occurred in all prairie areas. Specialists may have essential functions in prairie ecosystems which can't be performed by widespread species. Knowledge of these species and their special attributes can increase our understanding of ways the prairie functions as a unique ecosystem, and knowledge of certain arthropod taxonomic groups or ecological assemblages may be valuable for conservation planning and restoration evaluation (Kremen et al. 1993; Williams 1993).

Ample information exists to indicate that prairie specialist insects may be present on our sites. Studies of the insect fauna of single native plant species or groups reveals

specialist species which are restricted to that plant (Charlet et al. 1987; Schwitzgebel and Wilbur 1942a,b). Natural sites usually contain diverse insect assemblages including widespread generalist species, species which are weakly to strongly habitat-restricted, species endemic to that community type, and “conservative” species which are present in natural areas but excluded from degraded sites. Ballard and Greenlee (1994) described this situation for Missouri Orthoptera, and similar observations have been made on prairie sites for butterflies (Swengel 1995), leafhoppers (Hamilton 1995), and flower-visiting insects (Reed 1995b). On a larger scale, while the prairie itself has few endemic insect species, and is a young biome, observations of beetles, grasshoppers, caddisflies, stoneflies, leafhoppers and specialist bees show at least some species in each group which are geographically restricted to plains and prairie areas (Lehmkuhl 1980; Ross 1970; Moldenke 1979 regarding bees).

Methods

I located information using on-line catalogs, indexes such as the AGRICOLA biology and agriculture index, citations in the literature and suggestions of specialists. I had planned to restrict the study to the northern tallgrass prairie region, including the Dakotas, Minnesota, Wisconsin, and Iowa, but extended the search to include studies in Illinois, Missouri, Ohio, Indiana, Michigan, Kansas, Nebraska and prairie provinces of Canada to take advantage of available information. I searched using keyword combinations including prairie, tallgrass, insect, arthropod, the states and provinces noted, and the names of all insect orders plus those families listed in Watts et al. (1989) or suggested by the USFWS cooperators at the 1994 meeting in Dubuque.

Species are listed as possible prairie specialists if they met any of the following criteria: if they were defined as prairie specialists by authors; if they required prairie plant species or genera (listed by the Great Plains Flora Association 1986) as their adult or larval food; if they were obligate predators, parasites or mutualists of prairie specialist insects; if they were found in collections from prairie sites but not from nearby woodland sites; or if they were limited to states and provinces in the northern tallgrass region. I updated some names but did not check all synonyms and authorities. I used the subspecies definitions given in the original references.

Results

I surveyed about 300 books and articles and located 728 species and subspecies of insects and relatives which may be prairie specialists.

The taxonomy given follows Borror et al. (1989); general information is taken from that text unless otherwise referenced. Arthropod groups considered in this report and noted in bold below, include the spiders and mites (orders Araneae and Acari in class Arachnida), classes Diplopoda (millipedes), Chilopoda (centipedes), order Isopoda in Malacostraca (sowbugs and pillbugs), and Class Hexapoda (insects and their close relatives). Borror et al. (1989) classify Hexapoda into 31 orders, with a total of 88,090 species in 659 families in the US and Canada. The hexapod orders vary greatly in their species richness and ecological significance, but all are mentioned here.

The order **Protura** contains minute fungus-associated hexapods. There are 19 species in the US and Canada. The order **Collembola** has 677 species in the US, most of which live in soil, in litter or under bark. Watts et al. (1989) listed the Entomobryidae

(Collembola) as important in grasslands. The **Diplura** are also found in moist habitats; there are 64 species in the US and Canada.

The **Microcoryphia**, jumping bristletails, and the **Thysanura**, silverfish, are primitive wingless insects with 38 species total in the US and Canada. They are poorly known and found in moist habitats. The USFWS cooperators suggested more study of the Collembola and Microcoryphia, but habitat information was inadequate to identify prairie specialists.

The **Ephemeroptera** (mayflies), **Odonata** (dragonflies and damselflies), and **Plecoptera** (stoneflies) are aquatic in their larval stages. None of these orders is considered to be an important grassland component by Watts et al. (1989), and the USFWS cooperators did not emphasize them. Panzer et al. (1995) noted 3 Odonata species as probable prairie remnant-dependent species:

Species	Family	Location
Amphiagrion saucium Burm.	Coenagrionidae	IL IN WI
Somatochlora hineana Williamson	Corduliidae	IL IN WI
Nanothemis bella Uhler	Libellulidae	IL IN WI

The order **Grylloblattaria**, “last of an ancient line” live among rocks at high altitudes. This order is not a concern for prairie conservationists.

In contrast, the **Orthoptera** (grasshoppers, crickets and katydids) are very important in grasslands worldwide. Most species are plant feeders, and a few are predators or scavengers. There are 1080 species in 10 families in the US and Canada. The Acrididae, Gryllidae and Tettigoniidae are noted by Watts et al. (1989) as important grassland groups, and the USFWS cooperators included Acrididae and Tettigoniidae (grasshoppers and crickets) in their “must do” list. Orthoptera have been widely studied based on their economic importance as consumers of crops and range grasses, and a number of species have received conservation attention as well. Individual species have distinct microhabitat requirements (Ballard and Greenlee 1996, Haarstad 1990), and they are of special conservation interest in the northern tallgrass as some species apparently tolerate or even require annual burns (Ballard and Greenlee 1994; 1996). Sixty-four species and subspecies which may be prairie specialists are listed below:

Species	Family	References	Location
Arphia pseudonietana (Thomas)	Acrididae	Panzer et al. 1995	IL IN WI
Arphia sulphurea	Acrididae	Hebard 1934	IL
Arphia xanthoptera	Acrididae	Wilbur and Fritz 1940	KS
Boopedon auriventris McNeill	Acrididae	Ballard and Greenlee 1996; Bragg 1939	MO
Chorthippus longicornis (Latreille)	Acrididae	Froeschner 1954	IA
Dichromorpha viridis (Scudder)	Acrididae	Bragg 1939	OK
Encoptolophus palidus subgracilis Caudell	Acrididae	Bragg 1939	OK
Encoptolophus sordidus	Acrididae	Hebard 1934	IL
Hesperotettix speciosus (Scudder)	Acrididae	Ballard and Greenlee 1996; Ross 1970	MO
Hesperotettix viridis brevipennis (Thomas)	Acrididae	Vickery and Kevan 1985	
Hesperotettix viridis pratensis Scudder	Acrididae	Haarstad 1990; Panzer et al. 1995	MN
Hippiscus rugosus	Acrididae	Hebard 1934	IL
Hypochlora alba (Dodge)	Acrididae	Bragg 1939; Haarstad 1990; Ross 1970	OK
Melanoplus b. bowditchi Scudder	Acrididae	Bragg 1939	OK

<i>Melanoplus d. differentialis</i>	Acrididae	Cantrall and Young	IN
<i>Melanoplus dawsoni</i> (Scudder)	Acrididae	Panzer et al. 1995	IL IN WI
<i>Melanoplus fasciatus</i> (F. Walker)	Acrididae	Bragg 1939	OK
<i>Melanoplus flavidus</i>	Acrididae	Haarstad, J. 1990	MN
<i>Melanoplus flavidus flavidus</i> Scudder	Acrididae	Panzer et al. 1995	IL IN WI
<i>Melanoplus impudicus</i> Scudder	Acrididae	Bragg 1939	OK
<i>Melanoplus packardii</i> Scudder	Acrididae	Ballard and Greenlee 1996	MO
<i>Melanoplus ponderosus viola</i> (Thomas)	Acrididae	Bragg 1939	OK
<i>Melanoplus punctulatus</i> (Scudder)	Acrididae	Bragg 1939	OK
<i>Melanoplus scudderii</i> latus	Acrididae	Wilbur and Fritz 1940	KS
<i>Melanoplus borealis junius</i> (Dodge)	Acrididae	Panzer et al. 1995	IL IN WI
<i>Mermiria bivittata</i> (Serville)	Acrididae	Bragg 1939	OK
<i>Mermiria picta</i> (Walker)	Acrididae	Ballard and Greenlee 1996; Bragg 1939	MO
<i>Metator pardalinus</i> (Saussure)	Acrididae	Froeschner 1954	IA
<i>Opeia obscura</i> (Thomas)	Acrididae	Froeschner 1954; Vickery and Kevan 1985	
<i>Orphulella pelidna</i>	Acrididae	Haarstad 1990	MN
<i>Orphulella pelidna pelidna</i> (Burmeister)	Acrididae	Ballard and Greenlee 1996	MO
<i>Orphulella speciosa</i>	Acrididae	Cantrall and Young	IN
<i>Pardalaphora haldemanii</i> (Scudder)	Acrididae	Ballard and Greenlee 1996; Panzer et al. 1995; Ross 1970	IL IN WI
<i>Paroxya atlantica atlantica</i> (Scudder)	Acrididae	Panzer et al. 1995	IL IN WI
<i>Phoetaliotes nebracensis</i> (Thomas)	Acrididae	Ballard and Greenlee 1996; Panzer et al. 1995; Wilbur and Fritz 1940	MO
<i>Pseudopomala brachyptera</i> (Scudder)	Acrididae	Froeschner 1954; Panzer et al. 1995	IA
<i>Psinidia fenestralis</i>	Acrididae	Haarstad, J. 1990.	MN
<i>Psoloessa texana</i> Scudder	Acrididae	Bragg 1939	OK
<i>Schistocerca emarginata</i>	Acrididae	Haarstad, J. 1990.	MN
<i>Spharagemon equale</i> Say	Acrididae	Froeschner 1954	IA
<i>Stethophyma celata</i> Otte	Acrididae	Ballard and Greenlee 1996	MO
<i>Stethophyma lineatum</i> (Scudder)	Acrididae	Panzer et al. 1995	IL IN WI
<i>Syrbula admirabilis</i> (Uhler)	Acrididae	Hebard 1934; Woodruff 1937	KS
<i>Trachyrhachis kiowa fuscifrons</i>	Acrididae	Cantrall and Young	IN
<i>Trimerotropis cincta</i> (Thomas)	Acrididae	Bragg 1939	OK
<i>Trimerotropis maritima-interior</i>	Acrididae	Haarstad 1990	MN
<i>Trimerotropis saxatilis</i> McNeill	Acrididae	Bragg 1939	OK
<i>Xanthippus corallipes-latefasciatus</i>	Acrididae	Haarstad, J. 1990.	MN
<i>Conocephalus saltans</i> (Scudder)	Conocephalidae	Vickery and Kevan 1985	
<i>Nemobius f. fasciatus</i>	Gryllidae	Cantrall and Young	IN
<i>Gryllotalpa major</i> Saussure	Gryllotalpidae	Ballard and Greenlee 1996; Figg 1986	MO
<i>Amblycorypha parvipennis</i> Stal	Tettigoniidae	Ballard and Greenlee 1996	MO
<i>Arethaea c. constricta</i> Brunner	Tettigoniidae	Froeschner 1954	IA
<i>Conocephalus saltans</i> (Scudder)	Tettigoniidae	Ballard and Greenlee 1996; Panzer et al. 1995	MO
<i>Neoconocephalus bivocatus</i> Walker, Whitesell & Alexander	Tettigoniidae	Ballard and Greenlee 1996	MO
<i>Neoconocephalus ensiger</i> (Harris)	Tettigoniidae	Froeschner 1954; Hebard 1934	IA
<i>Neoconocephalus lyristes</i> (Rehn and Hebard)	Tettigoniidae	Panzer et al. 1995	IL IN WI
<i>Neoconocephalus nebrascensis</i> (Bruner)	Tettigoniidae	Froeschner 1954	IA
<i>Orchelimum bullatum</i> Rehn & Hebard	Tettigoniidae	Ballard and Greenlee 1996	MO
<i>Orchelimum gladiator</i> Bruner	Tettigoniidae	Froeschner, R. C. 1954.	IA
<i>Orchellimum concinnum</i> Scudder	Tettigoniidae	Panzer et al. 1995	IL IN WI
<i>Orchellimum delicatum</i> Bruner	Tettigoniidae	Panzer et al. 1995	IL IN WI
<i>Pediocetes nigromarginata</i> (Caudell)	Tettigoniidae	Ballard and Greenlee 1996	MO
<i>Scudderia pistillata</i> Brunner	Tettigoniidae	Panzer et al. 1995	IL IN WI

The **Phasmida**, walkingsticks and leaf insects, are widely distributed worldwide but have few species in the northern US. There are 29 species in 4 families in the US and Canada. Two species may be prairie specialists.

Species	Family	References
Diapheromera velii velii Walsh	Heteronemiidae	Froeschner 1954; Vickery and Kevan 1985
Diapheromera blatchleyi blatchleyi (Caudell)	Heteronemiidae	Panzer et al. 1995

Like the phasmids, the **Blattaria**, cockroaches, are primarily tropical. One species may be an obligate in Kansas:

Species	Family	Reference
Parcoblatta bolliana	Blattellidae	Walkden and Wilbur 1944

The **Isoptera**, termites are noted by Watts et al. (1989) as an important grassland group, but I found no records of termites in the northern tallgrass region. There are 42 species in 4 families in the US and Canada; almost all are in southern states (Arnett 1993).

The **Dermaptera**, earwigs, are represented by 20 species in 6 families in the US and Canada, including a few species in the northern tallgrass region (Hebard 1934), but none could be identified as possible prairie specialists.

The small and poorly known orders **Embiidina** (web-spinners) and **Zoraptera** (angel insects) had no records of prairie specialists.

The **Psocoptera** (psocids, or barklice and booklice) have 340 species in 26 families in the US and Canada. Psocids are minute and inconspicuous. They are most often found on or under bark, stones or dead leaves, and on leaves, and are usually scavengers of dead material. No psocid species were identified as possible prairie specialists.

The **Phthiraptera**, lice, are wingless ectoparasites of birds and mammals. Their conservation, should this be desired, would require conservation of their host species.

The **Hemiptera**, true bugs have 3,587 species in 42 families in the US and Canada. Many species are aquatic, and the terrestrial species include plant feeders, predators and blood suckers. Watts et al. (1989) list the Lygaeidae (seed bugs), Miridae (plant bugs), and Tingidae (lace bugs) as important grassland groups; the USFWS cooperators included Miridae and Scutellaridae (shield-backed bugs) as groups which might contain specialists. Only 13 Hemiptera species from 4 families were identified as possible prairie specialists from the literature:

Species	Family	References	Location	Host
Ischnodemus falicus (Say)	Lygaeidae	Panzer et al. 1995	IL IN WI	
Conostethus americanus Knight	Miridae	Kelton 1980		
Lopidea amorphae Kngt.	Miridae	Froeschner 1949	MO	Amorpha
Polymerus chrysopsis Knight	Miridae	Kelton 1980		Chrysopsis
Trigonotylus canadensis Kelton	Miridae	Kelton 1980		
Trigonotylus coelestialium (Kirkaldy)	Miridae	Kelton 1980		
Trigonotylus flavicornis Kelton	Miridae	Kelton 1980		
Rhytidolomia belfragii Stal	Pentatomidae	Panzer et al. 1995	IL IN WI	
Acanthomedia denticulata (Stal)	Scutellaridae	Panzer et al. 1995	IL IN WI	
Homaemus aeneifrons (Say)	Scutellaridae	McPherson 1982		

Homaeus bijugis Uhler	Scutellaridae	McPherson 1982	
Vanduzeeina borealis Van Duzee	Scutellaridae	Panzer et al. 1995	IL IN WI

In contrast to the Hemiptera, the **Homoptera** (cicadas, hoppers, psyllids, whiteflies, aphids and scale insects) supplied 166 potential prairie specialist species. There are 6,359 species in 38 families in the US and Canada; all of them feed on plant juices. Watts et al. (1989) list the Cicadellidae (leafhoppers) and Pseudococcidae (mealybugs) as important grassland insects from an economic perspective, and the USFWS cooperators suggested study of the Cercopidae (froghoppers), Fulgoroidea (planthoppers) and Aphididae (aphids). In some cases, plant host species or genera are listed below insect species names.

Species	Family	References	Location
Atarsos Gillette	Aphididae	Footit and Richards 1993	
Grindelia spp			
Cacryphora Oestlund	Aphididae	Footit and Richards 1993	Solidago
spp			
Microparsus Patch	Aphididae	Footit and Richards 1993	
Desmodium spp			
Aphelonema simplex	Caliscelidae*	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Bruchomorpha jocosia	Caliscelidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Bruchomorpha keidensia	Caliscelidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Bruchomorpha oculata	Caliscelidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Burchomorpha beameri	Caliscelidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Peltonotellus histrionicus	Caliscelidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Lepyronia gibbosa Ball	Cercopidae	Ballard 1992; Hamilton 1995;	
		Panzer et al. 1995	IL IN WI
Paraphilaenus parallelus (Stearns)	Cercopidae	Panzer et al. 1995	IL IN WI
Philaenarcys killa Hamilton	Cercopidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Propsapia ignipectus (Fitch)	Cercopidae	Comer et al. 1995; Panzer et al. 1995	IL IN WI
Diceroprocta vitripennis (Say)	Cicadadae	Panzer et al. 1995	IL IN WI
Okananga balli Davis	Cicadadae	Panzer et al. 1995	IL IN WI
Aceratagallia uhleri (Van Duzee)	Cicadellidae	Cwikla and Blocker 1981	KS OK
Acertagallia nanella	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Aflexia rubranura (DeLong)	Cicadellidae	Baker 1994; Hamilton 1995;	
		Panzer et al. 1995.	IL IN WI
Amblysellus punctatus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Amplicephalus kansiensis (Tutthill)	Cicadellidae	Panzer et al. 1995	IL IN WI
Amplicephalus osborni (Van Duzee)	Cicadellidae	Panzer et al. 1995	IL IN WI
Athysanella acuticauda Baker	Cicadellidae	Panzer et al. 1995	IL IN WI
Athysanella attenuata	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Athysanella occidentalis	Cicadellidae	Ballard 1992	MI
Athysanella terebrans	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Athysanella texana (Osborn)	Cicadellidae	Cwikla and Blocker 1981	KS OK
Attenuipyga vanduzeei (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Auridius helvus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Balclutha neglecta (DeLong and Davidson)	Cicadellidae	Cwikla and Blocker 1981	KS OK
Chlorotettix attenuatus Brown	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix borealis Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix brevidus DeLong	Cicadellidae	Hamilton 1995;	
		Panzer et al. 1995	IL IN WI
Chlorotettix dentatus Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix fallax Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix fumidus Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix limosus DeLong and Cartwright	Cicadellidae	Panzer et al. 1995	IL IN WI
Chlorotettix spatulatus Osborn and Ball	Cicadellidae	Cwikla and Blocker 1981; Hamilton 1995;	

		Panzer et al. 1995	KS OK
<i>Cicadula ciliata</i> (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cicadula cyperacea</i> (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cicadula saliens</i> Hamilton	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cicadula smithii</i> (Van Duzee)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Comellus colon</i> (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Commellus sexvittatus</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Commellus comma</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Cosmotettix beirnei</i> (Hamilton)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cosmotettix lineatus</i> (Gilette and Baker)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cosmotettix luteocephalus</i> (Sanders and DeLong)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cribrus shingwauki</i> (Beamer and Tuthill)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Cuerna sayi</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Deltocephalus caperatus</i> Ball	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Deltocephalus gnarus</i> Ball	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Dikraneura arizona</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Diplocolenus configuratus</i>	Cicadellidae	Ross, H. H. 1970.	
<i>Dorycara platyrhynchus</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Dorychara minor</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Dorydiella kansana</i> Beemer	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Draculacephala mollipes</i> (Say)	Cicadellidae	Cwikla and Blocker 1981	KS OK
<i>Driotura robusta</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Elymana inornata</i> (Van Duzee)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Endria inimica</i> (Say)	Cicadellidae	Cwikla and Blocker 1981	KS OK
<i>Exitianus exitiosus</i> (Uhler)	Cicadellidae	Cwikla and Blocker 1981	KS OK
<i>Extrusanus oryssus</i> Hamilton	Cicadellidae	Hamilton 1995; Panzer et al. 1995.	IL IN WI
<i>Flexamia abbreviata</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Flexamia albida</i> (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Flexamia areolata</i> (Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Flexamia atlantica</i> (DeLong)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Flexamia dakota</i>	Cicadellidae	Hamilton 1995; Ross 1970 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Flexamia decora</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Flexamia delongi</i> (Ross & Cooley)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Flexamia graminea</i>	Cicadellidae	Hamilton 1995; Opler 1981 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Flexamia pectinata</i> (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Flexamia picta</i> (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Flexamia prairiana</i> DeLong	Cicadellidae	Cwikla and Blocker 1981; Hamilton 1995; Panzer et al. 1995	KS OK
<i>Flexamia pyrops</i> (Crumb)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Flexamia reflexa</i> (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Flexamia rubranura</i>	Cicadellidae	Opler, P. A. 1981.	
<i>Flexamia serrata</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Flexamia stylata</i>	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
<i>Graminella aureovittata</i> Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Graminella mohri</i> DeLong	Cicadellidae	Cwikla and Blocker 1981; Hamilton 1995;	
<i>Graminella oquaka</i>	Cicadellidae	Panzer et al. 1995 Hamilton 1995; Opler 1981	KS OK
<i>virgatum</i>			Panicum
<i>Graminella oquaka</i> DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Graminella pallidula</i> (Osborn)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
<i>Graphocephala hieroglyphica</i> (Say)	Cicadellidae	Cwikla and Blocker 1981	KS OK

Gypona contana DeLong	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Gyponana vincula	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Hebecephalus cruciatus (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Hebecephalus signatifrons	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Hecalus flavidus (Signoret)	Cicadellidae	Panzer et al. 1995	IL IN WI
Hecalus grandis Shaw	Cicadellidae	Panzer et al. 1995	IL IN WI
Hecalus major Osborn	Cicadellidae	Panzer et al. 1995	IL IN WI
Hecalus viridus (Uhler)	Cicadellidae	Hamilton 1995; Panzer 1995	IL IN WI
Laevcephalus acus Sanders and DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Laevcephalus minimus (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Laevcephalus orientalis D. & D.	Cicadellidae	Panzer et al. 1995	IL IN WI
Laevcephalus poudris	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Laevcephalus pravus DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Laevcephalus sakatchewanensis	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Laevcephalus unicoloratus (Gilette and Baker)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Laevcephalus vannus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Limotettix bisoni Knull	Cicadellidae	Panzer et al. 1995	IL IN WI
Limotettix cuneatus (Sanders and DeLong)	Cicadellidae	Panzer et al. 1995	IL IN WI
Limotettix elegans	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Limotettix nigrax Medler	Cicadellidae	Panzer et al. 1995	IL IN WI
Limotettix pseudospagneticus Hamilton	Cicadellidae	Panzer et al. 1995	IL IN WI
Limotettix truncatus Sleesman	Cicadellidae	Panzer et al. 1995	IL IN WI
Limotettix urnura (parallelus) Hamilton	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Lonatura megalopa	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Lonatura salsura	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Lonatura teretis	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Macrosteles fascifrons (Stal)	Cicadellidae	Cwikla and Blocker 1981	KS OK
Macrosteles portoria (Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Mesamia ludoviciana	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Mesamia nigradorsum Ball	Cicadellidae	Opler 1981; Panzer et al. 1995	IL IN WI
Helianthus annuus			
Mesamia straminea (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
Mocuellus americanus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Neohecalus lineatus (Uhler)	Cicadellidae	Panzer et al. 1995	IL IN WI
Orocastus perpusillus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Paraphlepsius altus (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Paraphlepsius carolinus (Lathrup)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius fulvidorsum (Fitch)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius lobatus (Osborn)	Cicadellidae	Hamilton 1995; Panzer et al. 1995.	IL IN WI
Paraphlepsius lupalus Hamilton	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Paraphlepsius luxuria Hamilton	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius maculosus (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius nebulosus (Van Duzee)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Paraphlepsius rossi (DeLong)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius solidaginus (Walker)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius turpiculus (Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Paraphlepsius umbrosus	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Pendarus magnus (Osborn and Ball)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Polyamia caperata	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Polyamia compacta (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Polyamia dilata	Cicadellidae	Hamilton 1995 ON, MI, IL, WI, MN, SD, ND, MB	
Polyamia herbida DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Polyamia obtecta (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
Polyamia rossi DeLong	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI
Polyamia saxosa DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
Prairiana cinerea (Uhler)	Cicadellidae	Hamilton 1995; Panzer et al. 1995	IL IN WI

<i>Prairiana kansana</i> Ball	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Psammotettix knullae</i>	Cicadellidae	Hamilton 1995	ON, MI, IL, WI, MN, SD, ND, MB
<i>Remadosus magnus</i>	Cicadellidae	Opler 1981	
<i>Spartina pectinata</i>			
<i>Rosenus cruciatus</i>	Cicadellidae	Hamilton 1995; Ross 1970	ON, MI, IL, WI, MN, SD, ND, MB
<i>Rugosana querci</i> DeLong	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Sanctanus cruciatus</i> (Osborn)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Scaphoideus ochraceus</i> Osborn	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Scaphytopius abbreviatus</i> (DeLong)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Scaphytopius cinereus</i> (Osborn and Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Scaphytopius rubellus</i> (Sanders and DeLong)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Sonronius clavata</i> (DeLong and Davidson)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Stirellus bicolor</i> (Van Duzee)	Cicadellidae	Cwikla and Blocker 1981	KS OK
<i>Stroggylocephala mixtus</i> (Fallen)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Texananus cumulatus</i> (Ball)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Texanus cumulus</i>	Cicadellidae	Hamilton 1995	ON, MI, IL, WI, MN, SD, ND, MB
<i>Unoka gillettei</i>	Cicadellidae	Hamilton 1995	ON, MI, IL, WI, MN, SD, ND, MB
<i>Xerophloea major</i> Baker	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Xerophloea peltata</i> (Uhler)	Cicadellidae	Panzer et al. 1995	IL IN WI
<i>Oecleus chrisjohni</i> Kramer	Fulgoroidea: Cixiidae	Wilson et al. 1993	MO
<i>Delphacodes nigroscutellata</i> Beamer	Fulgoroidea: Delphacidae	Wilson et al. 1993	MO
<i>Megamelus metzaria</i> Crawford	Fulgoroidea: Delphacidae	Wilson et al. 1993	MO
<i>Prokelisia crocea</i> (Van Duzee)	Fulgoroidea: Delphacidae	Wilson et al. 1993	MO
<i>Anotia fitchi</i> (Van Duzee)	Fulgoroidea: Derbidae	Wilson et al. 1993	MO
<i>Phylloscelis pallescens</i> Germar	Fulgoroidea: Dictyopharidae	Wilson et al. 1993	MO
<i>Aphelonema simplex</i> Uhler	Fulgoroidea: Issidae	Ballard 1992; Wilson et al. 1993	MO
<i>Bruchomorpha dorsata</i> Fitch	Fulgoroidea: Issidae	Ballard 1992; Hamilton 1995; Panzer et al. 1995; Wilson et al. 1993	MO ON, MI, IL, WI, MN, SD, ND, MB
<i>Bruchomorpha extensa</i> Ball	Fulgoroidea: Issidae	Panzer et al. 1995; Hamilton 1995	IL IN WI ON, MI, MN, SD, ND, MB
<i>Bruchomorpha tristis</i>	Fulgoroidea: Issidae	Ballard 1992	MI

*Caliscelidae may be classified as a subfamily, Caliscelinae, of the Issidae (Fulgoroidea)

There are 694 species in 5 families of **Thysanoptera** (thrips) in the US and Canada. Thrips are minute insects with rasping-sucking mouthparts; most are plant feeders, some eat fungus spores and some are predators on other insects. They are abundant in flower heads and some are pollinators. Panzer et al. (1995) identified the following 15 species of thrips as prairie remnant-dependent.

Species	Family
<i>Stomatothrips crawfordi</i> Stannard	Aeolothripidae
<i>Eurythrips ampliventralis</i> Hinds	Phlaeothripidae
<i>Eurythrips hindsii</i> Morgan	Phlaeothripidae
<i>Glyptothrips arkansanus</i> Hood	Phlaeothripidae
<i>Haplothrips halophilus</i> Hood	Phlaeothripidae
<i>Haplothrips longiceps</i> (Hood)	Phlaeothripidae
<i>Haplothrips shacklefordae</i> Moulton	Phlaeothripidae
<i>Illinothrips rossi</i> Stannard	Phlaeothripidae
<i>Neothrips dentipes</i> (Reuter)	Phlaeothripidae
<i>Anaphothrips cameroni</i> (Bagnal)	Thripidae
<i>Anaphothrips sandersoni</i> Stannard	Thripidae
<i>Chirothrips texanus</i> Andre	Thripidae
<i>Frankliniella unicolor</i> Morgan	Thripidae

Plesiothrips ayarsi Stannard
 Sericothrips baptisiae Hood

Thripidae
 Thripidae

The order **Neuroptera** contains the alderflies, dobsonflies, fishflies, snakeflies, lacewings, antlions and owlflies. The US and Canada support 350 species in 15 families. Most larvae and many adults are predaceous on other insects. No prairie specialists were identified.

Coleoptera, beetles, is the largest of all insect orders, with 23,701 species in 115 families in the US and Canada. Beetles are found in almost all habitats including water, land, soil, and the nests of social insects, and beetle species include predators, herbivores, scavengers of dung and carrion, parasites and consumers of stored products. Watts et al. (1989) listed these beetle families as important on rangeland: Coccinellidae (ladybird beetles), Scarabaeidae (the white grub larvae of this family), Tenebrionidae (darkling beetles/false wireworms) and Curculionidae (snout beetles). The USFWS cooperators suggested study of the Rhipiphoridae (wedge-shaped beetles), Carabidae (ground beetles), Scarabaeidae subfamily Melolonthinae (June beetles, mostly Phyllophaga species), Meloidae (blister beetles), Languriidae (lizard beetles), Byrrhidae (pill beetles), Elateridae (click beetles) and Cantharidae (soldier beetles). Chrysomelidae (leaf beetles) and Curculionidae were put on the “must do” list.

The literature review revealed only 33 possible prairie specialist species:

Species	Family	References	Location
Agonoderus paratiarius (Say)	Carabidae	Walkden and Wilbur 1944	KS
Anisodactylus sericeus Harr.	Carabidae	Walkden and Wilbur 1944	KS
Carabus meander	Carabidae	Esau and Peters 1975	IA
Dicaelus sculptilis	Carabidae	Esau and Peters 1975	IA
Evarthrus alternans	Carabidae	Esau and Peters 1975	IA
Evarthrus iowensis	Carabidae	Esau and Peters 1975	IA
Harpalus indigens	Carabidae	Esau and Peters 1975	IA
Pasimachus elongatus	Carabidae	Esau and Peters 1975	IA
Pterostichus leconteianus	Carabidae	Esau and Peters 1975	IA
Rembus obtusus Lec.	Carabidae	Walkden and Wilbur 1944	KS
Tachys granarius	Carabidae	Esau and Peters 1975	IA
Typocerus sinuatus	Cerambycidae	Ballard 1992	MI
Cicindela limbata Say	Cicindelidae	Carter 1989	
Cicindela scutellaris lecontei Haldeman	Cicindelidae	Carter 1989	
Cicindela scutellaris scutellaris Say	Cicindelidae	Carter 1989	
Apion commodum Fall	Curculionidae	Bright 1993	
Apion decoloratum Smith	Curculionidae	Bright 1993	
Apion rostrum Say	Curculionidae	Bright 1993	
Bagous obliquus LeConte	Curculionidae	Balsbaugh and Aarhus 1990	ND
Conotrachelus anaglypticus (Say)	Curculionidae	Balsbaugh and Aarhus 1990	ND
Haplorhynchites aeneus (Boheman)	Curculionidae	Bright 1993	
Haplostethops ellipsoidea (Casey)	Curculionidae	Balsbaugh and Aarhus 1990	ND
Rhodobenus tredecimpunctatus (Illiger)	Curculionidae	Balsbaugh and Aarhus 1990	ND
Sitophilus oryzae (L.)	Curculionidae	Balsbaugh and Aarhus 1990	ND
Sphenophorus australis Chittenden	Curculionidae	Balsbaugh and Aarhus 1990	ND
Tychius sordidus LeConte on Baptisia	Curculionidae	Bertwell and Blocker 1975	KS
Phelister subrotundus (Say)	Histeridae	Cervenka and Moon 1991	MN
Cercyon praetextatus (Say)	Hydrophilidae	Cervenka and Moon 1991	MN
Cercyon unipunctatus (Linnaeus)	Hydrophilidae	Cervenka and Moon 1991	MN
Ataenius punctifrons Cartwright	Scarabaeidae	Cervenka and Moon 1991	MN
Copris fricator (Fabricius)	Scarabaeidae	Cervenka and Moon 1991	MN
Ligyris gibbosus (Deg.)	Scarabaeidae	Walkden and Wilbur 1944	KS
Phyllophaga lanceolata Say	Scarabaeidae	Hayes 1927	KS

Nicrophorus obscurus Kirby
 Eleodes suturalis Say

Silphidae
 Tenebrionidae

Anderson and Peck 1985
 Walkden and Wilbur 1944 KS

The order **Strepsiptera**, twisted-wing parasites, has 109 species in four families in the US and Canada. Most species in this order are parasitic on other insect species, including Orthoptera, Hemiptera, Homoptera, Hymenoptera and Thysanura. This order was listed as “possible” by the USFWS cooperators (as the parasitic beetle family Stylopidae, an alternative classification). No prairie specialists were located in the literature search.

The **Mecoptera**, scorpionflies and hangingflies, include 68 species in 5 families in the US and Canada. Some species are predatory and others are scavengers. No prairie specialists were found in the literature surveyed.

Siphonaptera, fleas, feed as adults on bird and mammal blood. There are 320 species in 8 families in the US and Canada. Most flea species are restricted to a single order or family in their host range, and their geographic distributions are also restricted. Conservation of fleas requires conservation of their hosts. The literature search revealed no prairie specialists.

The true flies, **Diptera**, have 18,200 species in 108 families in the US and Canada. Many fly larvae develop in water or decaying matter; the adults of some species feed on liquids such as nectar, sap or blood while other species are predatory. Watts et al. (1989) note the Asilidae (robber flies, the adults prey on grasshoppers and the larvae eat white grubs), Cecidomyiidae (gall midges) and Chloropidae (shoot flies) as families of great importance in grasslands. The USFWS cooperators noted Diptera as important to study but did not specify any particular families. The literature search revealed only 3 possible prairie specialist species:

Species	Family	References	Location
Machimus antimachus (Walker)	Asilidae	Baker and Fischer 1975	MI
Proctacanthus milbertii Macquart	Asilidae	Baker and Fischer 1975	MI
Lispe nasoni Stein	Muscidae	Cervenka and Moon 1991	MN

The order **Trichoptera**, caddisflies, has 1,261 species in 23 families in the US and Canada. The larvae are aquatic and many species construct cases; the adults feed mainly on liquid foods. No prairie specialists were identified.

The **Lepidoptera**, butterflies and moths, have 11,286 species in 75 families in the US and Canada, and are probably the most extensively studied group of insects from a conservation standpoint. In addition, many species are of major economic importance; their families have been well studied. The adults of most species have sucking mouthparts, and the larvae of most species are phytophagous. Watt et al. (1989) noted the Noctuidae (armyworms and cutworms) and the Pyralidae (sod webworms) as important grassland insects. The USFWS cooperators placed moths, especially Noctuidae and leaf-mining micromoths (Gelechiidae), skippers (Hesperiidae), and the regal fritillary Speyeria idalia on their “must do” list. The high level of interest in prairie Lepidoptera is shown by the length of the prairie specialist list (199 species and subspecies) and the number of references to the individual species.

Species	Family	References	Location Ecol
Apantesis williamsii	Arctiidae	Schweitzer 1985	
Cycnia inopinatus (Edwards)	Arctiidae	Panzer et al. 1995	IL IN WI
Pygarctia spraguei (Grote)	Arctiidae	Schweitzer 1985;	

<i>Isophrictis rudbeckiella</i> Bottimer	Gelechiidae	Metzler and Zebold 1995	OH
<i>Apodrepanulatrix liberaria</i> (Walker)	Geometridae	Panzer et al. 1995	IL IN WI
<i>Aspitates aberratus</i>	Geometridae	Schweitzer 1985	
<i>Erastria coloraria</i> (Fabricius)	Geometridae	Panzer et al. 1995	IL IN WI
<i>Itame amboflava</i> Ferguson	Geometridae	Panzer et al. 1995	IL IN WI
<i>Semiothisa eremiata</i> (Guenee)	Geometridae	Panzer et al. 1995	IL IN WI
<i>Semiothisa maculifascia</i> (Hulst)	Geometridae	Panzer et al. 1995	IL IN WI
<i>Semiothisa ordinata</i> (Walker)	Geometridae	Panzer et al. 1995	IL IN WI
<i>Amblyscirtes vialis</i> (Edwards)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Antrytonopsis hianna</i> (Scudder)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Atrytone arogos</i>	Hesperiidae	Baker 1994; Johnson 1992;	
<i>Atrytone arogos iowa</i> (Scudder)	Hesperiidae	Orwig 1990; Schweitzer 1985	IA
<i>Atrytonopsis hianna hianna</i> (Scudder)	Hesperiidae	Orwig 1990	IA
<i>Erynnis baptisiae</i> (Forbes)	Hesperiidae	Orwig 1990; Schweitzer 1985	IA
<i>Erynnis brizo</i> B. & L.	Hesperiidae	Orwig 1990; Panzer et al 1995	IL IN WI
<i>Erynnis horatius</i> (Scudder and Burgess)	Hesperiidae	Orwig 1990	IA
<i>Erynnis icelus</i> (Scudder & Burgess)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Erynnis martialis</i> (Scudder)	Hesperiidae	Orwig 1990; Panzer et al 1995	IL IN WI
<i>Erynnis persius persius</i> (Scudder)	Hesperiidae	Orwig 1990	IA
<i>Erynnis zarucco</i>	Hesperiidae	Johnson 1982	
<i>Euphyes bimaculata</i> (Grote & Robinson)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Euphyes conspicua</i> (Edwards)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Euphyes dion</i> (Edwards)	Hesperiidae	Orwig 1990; Panzer et al 1995	IL IN WI
<i>Heperia leonardus pawnee</i>	Hesperiidae	Schweitzer 1985	
<i>Heperia uncas</i> W. H. Edwards	Hesperiidae	Coffin and Pfannmuller 1988	MN
<i>Hesperia a. attalus</i>	Hesperiidae	Schweitzer 1985	
<i>Hesperia assiniboia</i> (Lyman)	Hesperiidae	Coffin and Pfannmuller 1988	MN
<i>Hesperia comma assiniboia</i>	Hesperiidae	Cuthrell 1991; Schweitzer 1985	MN
<i>Hesperia dacotae</i> (Skinner)	Hesperiidae	Coffin and Pfannmuller 1988; Cuthrell 1991; Dana 1983; Orwig 1990; Schweitzer 1985; Swengel 1996	MN
<i>Hesperia leonardus</i> Harris	Hesperiidae	Baker 1994; Johnson 1982; Panzer et al. 1995; Swengel 1996	MN
<i>Hesperia leonardus leonardus</i> Harris	Hesperiidae	Orwig 1990	IA
<i>Hesperia leonardus pawnee</i> Dodge	Hesperiidae	Orwig 1990	IA
<i>Hesperia metea</i> Scudder	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Hesperia ottoe</i> Edwards	Hesperiidae	Coffin and Pfannmuller 1988; Opler 1981; Orwig 1990; Panzer et al. 1995; Schweitzer 1985; Swengel 1995	IL IN WI
<i>Hesperia sassacus</i> Harris	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Hesperia viridis</i>	Hesperiidae	Schweitzer 1985	
<i>Oarisma garita</i>	Hesperiidae	Baker 1994; Cuthrell 1991	MN
<i>Oarisma powesheik</i>	Hesperiidae	Coffin and Pfannmuller 1988; Cuthrell 1991; Johnson 1982; Opler 1981; Orwig 1990; Schweitzer 1985; Swengel 1995	MN
<i>Poanes byssus</i>	Hesperiidae	Johnson 1982	
<i>Poanes massasoit</i> (Scudder)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Poanes viator</i> (Edwards)	Hesperiidae	Panzer et al. 1995; Johnson 1982	IL IN WI
<i>Polites mystic</i> (Edwards)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Polites mystic dacotah</i> (W. H. Edwards)	Hesperiidae	Orwig 1990	IA
<i>Polites origenes origenes</i> (Fabricius)	Hesperiidae	Orwig 1990	IA
<i>Polites origines</i> (Fabricius)	Hesperiidae	Panzer et al. 1995; Johnson 1982	IL IN WI
<i>Problema byssus</i> (Edwards)	Hesperiidae	Heitzman 1965; Panzer et al. 1995; Schweitzer 1985	IL IN WI
<i>Thorybes bathyllus</i> (J. E. Smith)	Hesperiidae	Panzer et al. 1995	IL IN WI
<i>Thorybes pylades</i> (Scudder)	Hesperiidae	Panzer et al. 1995	IL IN WI

<i>Calephelis muticum</i> McAlpine	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Callophrys irus</i> (Godart)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Callophrys polios</i> (Cook & Watson)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Glaucopsyche lygdamus</i> Grote	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Harkenclenus titus</i> (Fabricius)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Incisalia henrici henrici</i> (Grote and Robinson)	Lycaenidae	Orwig 1990	IA
<i>Lycaeides melissa samuelis</i> Nabokov	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Lycaena helloides</i> (Boisduval)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Lycaena thoe</i> (Guerin-Meneville)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Lycaena xanthoides</i> (Scudder)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Mitoura grynea grynea</i> (Hubner)	Lycaenidae	Orwig 1990	IA
<i>Parrhasius m-album</i> (Boisdual and LeConte)	Lycaenidae	Orwig 1990	IA
<i>Satyrrium acadica</i> (Edwards)	Lycaenidae	Panzer et al. 1995	IL IN WI
<i>Satyrrium acadicum acadicum</i> (W. H. Edwards)	Lycaenidae	Orwig 1990	IA
<i>Satyrrium caryaevorum</i> (McDonnough)	Lycaenidae	Orwig 1990	IA
<i>Satyrrium edwardsii</i> (Saunders)	Lycaenidae	Orwig 1990;	
		Panzer et al. 1995	IL IN WI
<i>Satyrrium liparops strigosum</i> (Harris)	Lycaenidae	Orwig 1990	IA
<i>Agriopodes teratophora</i> (Herrich-Schaffer)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Amphipoea erepta</i>	Noctuidae	Schweitzer 1985	
<i>Anathix aggressa</i>	Noctuidae	Metzler 1994	OH
<i>Calyptra canadensis</i> (Bethune)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Catocala abbreviatella</i> Grote	Noctuidae	Panzer et al. 1995;	
		Schweitzer 1985	IL IN WI
<i>Catocala amestris</i> Strecker	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Catocala antinympha</i> (Hubner)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Catocala gracilis</i> W. H. Edwards	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Catocala nuptialis</i>	Noctuidae	Schweitzer 1985	
<i>Catocala similis</i> Edwards	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Catocala whitneyi</i> Dodge	Noctuidae	Panzer et al. 1995;	
		Schweitzer 1985	IL IN WI
<i>Cirrhophanus triangulifer</i> Grote	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Crymodes burgessii</i>	Noctuidae	Schweitzer 1985	
<i>Faronta rubripennis</i> (Grote & Robinson)	Noctuidae	Metzler 1994;	
		Panzer et al. 1995	IL IN WI
<i>Hadena ectypa</i> (Morrison)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Heliothis phloxiphagus</i>	Noctuidae	Schweitzer 1985	
<i>Hydraecia stramentosa</i> Guenee	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Lemmeria digitalis</i> (Grote)	Noctuidae	Panzer et al. 1995;	
		Schweitzer 1985	IL IN WI
<i>Lithacodia bellicula</i> Hubner	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Loxagrotis grotei</i> Franclemont & Todd	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Mamestra configurata</i>	Noctuidae	Schweitzer 1985	
<i>Meropleon ambifusca</i> (Newman)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Nycterophaeta luna</i>	Noctuidae	Schweitzer 1985	
<i>Oligia obtusa</i> (Smith)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema aerata</i> (Lyman)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema beeriana</i> Bird	Noctuidae	Metzler and Zebold 1992;	
		Panzer et al. 1995;	
		Schweitzer 1985	OH
<i>Papaipema birdi</i> (Dyar)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema cerina</i> (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema cerrusata</i> (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema eryngii</i> Bird	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema eupatorii</i> (Lyman)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema harrissi</i> (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema impecuniosa</i> (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema inquaesita</i> (Grote & Robinson)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema leucostigma</i> (Harris)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema limpida</i> (Guenee)	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema lysimachiae</i> Bird	Noctuidae	Panzer et al. 1995	IL IN WI
<i>Papaipema maritima</i> and/or <i>neocopina</i>	Noctuidae	Schweitzer 1985	

Papaipema maritima Bird	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema nelita (Stecker)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema neocopina (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema nepheleptena (Dyar)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema pterisii Bird	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema rigida (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema rutila (Guenee)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema sciata Bird	Noctuidae	Panzer et al 1995; Schweitzer 1985	IL IN WI
Papaipema silphii Bird	Noctuidae	Metzler 1994; Panzer et al. 1995; Schweitzer 1985	IL IN WI
Papaipema speciosissima (Grote & Robinson)	Noctuidae	Panzer et al. 1995	IL IN WI
Papaipema unimoda (Smith)	Noctuidae	Panzer et al. 1995	IL IN WI
Rhodoecia aurantiago (Guenee)	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia arcigera (Guenee)	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia gloriosa (Strecker)	Noctuidae	Panzer et al 1995; Schweitzer 1985	IL IN WI
Schinia guarae (J. E. Smith)	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia indiana (J. B. Smith)	Noctuidae	Baker 1994; Panzer et al. 1995	IL IN WI
Schinia lucens (Morrison)	Noctuidae	Panzer et al. 1995; Schweitzer 1985	IL IN WI
Schinia meadi	Noctuidae	Schweitzer 1985	
Schinia mortua	Noctuidae	Schweitzer 1985	
Schinia nundina (Drury)	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia oleagina Morrison	Noctuidae	Panzer et al. 1995; Schweitzer 1985	IL IN WI
Schinia septentrionalis (Walker)	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia tertia (Grote)	Noctuidae	Panzer et al. 1995; Schweitzer 1985	IL IN WI
Schinia trifascia Hubner	Noctuidae	Panzer et al. 1995	IL IN WI
Schinia tuberculum (Hubner)	Noctuidae	Panzer et al. 1995	IL IN WI
Spartiniphaga inops (Grote)	Noctuidae	Panzer et al. 1995	IL IN WI
Tarachidia binocula (Grote)	Noctuidae	Metzler and Zebold 1992; Panzer et al. 1995	IL IN WI
Tarachidia tortricina	Noctuidae	Metzler and Zebold 1995	OH
Trichoclea artesta	Noctuidae	Schweitzer 1985	
Tricholita notata Strecker	Noctuidae	Metzler 1994; Panzer et al. 1995	IL IN WI
Hyrarpax aurora (J. E. Smith)	Notodontidae	Panzer et al. 1995	IL IN WI
Boloria bellona (Fabricius)	Nymphalidae	Panzer et al. 1995	IL IN WI
Boloria selene myrina (Cramer)	Nymphalidae	Panzer et al. 1995	IL IN WI
Chlosyne gorgone carlota (Reakirt)	Nymphalidae	Panzer et al. 1995	IL IN WI
Chlosyne nycteis (Doubleday)	Nymphalidae	Panzer et al. 1995	IL IN WI
Clossiana selene myrina (Cramer)	Nymphalidae	Orwig 1990	IA
Euphydryas phaeton phaeton (Drury)	Nymphalidae	Panzer et al. 1995	IL IN WI
Oeneis alberta	Nymphalidae	Schweitzer 1985	
Oeneis uhleri varuna (W. H. Edwards)	Nymphalidae	Coffin and Pfannmuller 1988; Cuthrell 1991; Schweitzer 1985	MN
Satyroides eurydice fumosa Leussler	Nymphalidae	Coffin and Pfannmuller 1988	MN
Satyroides fumosa	Nymphalidae	Schweitzer 1985	
Speyeria aphrodite (Fabricius)	Nymphalidae	Panzer et al. 1995	IL IN WI
Speyeria aphrodite alcestis (W. H. Edwards)	Nymphalidae	Orwig 1990	IA
Speyeria idalia (Drury)	Nymphalidae	Baker 1991; Coffin and Pfannmuller 1988; Nagel et al. 1991; Opler 1981; Panzer et al. 1995; Schweitzer 1985; Shuey et al. 1987; Swengel 1996	
Agonopterix pteleae (Barnes and Busck)	Oecophoridae	Metzler and Zebold 1995	OH
Eurytides marcellus (Cramer)	Papilionidae	Orwig 1990	IA
Euchloe olympia (Edwards)	Pieridae	Orwig 1990; Panzer et al. 1995	IL IN WI

Crambus murellus Dyar	Pyralidae	Panzer et al. 1995	IL IN WI
Nephoterix dammersi Heinrich	Pyralidae	Panzer et al. 1995	IL IN WI
Polygrammodes flavidalis (Guenee)	Pyralidae	Panzer et al. 1995	IL IN WI
Hemileuca maia (Drury)	Saturniidae	Panzer et al. 1995	IL IN WI
Enodia anthedon A. H. Clark	Satyridae	Orwig 1990	IA
Lethe appalachia Chermock	Satyridae	Panzer et al. 1995	IL IN WI
Lethe eurydice (Johansson)	Satyridae	Panzer et al. 1995	IL IN WI
Lethe fumosa	Satyridae	Opler 1981	IA IL
Carmenta anthrasipennis (Boisduval)	Sesiidae	Panzer et al. 1995	IL IN WI
Hemaris gracilis (Grote & Robinson)	Sphingidae	Panzer et al. 1995	IL IN WI
Proserpinus guarae (J. E. Smith)	Sphingidae	Panzer et al. 1995	IL IN WI
Sphinx luscitiosa Clemens	Sphingidae	Panzer et al. 1995	IL IN WI
Epiblema caroliniana (Walshingham)	Tortricidae	Miller 1987	MI WI MN
Rudbeckia, mainly roots*			
Epiblema desertana (Zeller)	Tortricidae	Miller 1987	MI
Solidago, mainly stems			
Epiblema iowana McDunnough	Tortricidae	Miller 1987	MN
Ratibida roots			
Epiblema obfusca (Dyar)	Tortricidae	Miller 1987	MI WI
Solidago stems			
Epiblema scudderiana (Clemens)	Tortricidae	Miller 1987	MI WI MN
Solidago			
Epiblema tandana (Kearfott)	Tortricidae	Miller 1987	MI MN
Rudbeckia roots			
Epiblema tripartita (Zeller)	Tortricidae	Miller 1987	MI WI
Rudbeckia flower heads and stems			
Eucosma bilineana Kearfott	Tortricidae	Miller 1987; Panzer et al. 1995	MI
Helianthus			
Eucosma bipunctella (Walker)	Tortricidae	Metzler 1994; Miller 1987; Panzer et al. 1995	IL IN WI
Eucosma cataclystiana (Walker)	Tortricidae	Miller 1987	MI WI MN
Solidago rootstalks			
Eucosma derelicta Heinrich	Tortricidae	Miller 1987	MI WI MN
Solidago rootstalks			
Eucosma dorsisignatana (Clemens)	Tortricidae	Miller 1987	MI MN
Solidago roots			
Eucosma giganteana (Riley)	Tortricidae	Metzler and Zebold 1992; Miller 1987; Panzer et al. 1995	IL IN WI
Eucosma heathiana Kearfott	Tortricidae	Metzler and Zebold 1995	OH
Eucosma similiana (Clemens)	Tortricidae	Miller 1987	MI WI MN
Solidago rootstalks			
Eucosma sombriana Kearfott	Tortricidae	Miller 1987; Panzer et al. 1995	IL IN WI
Eucosma vagana McDonough	Tortricidae	Miller 1987	MI WI MN
Solidago roots			
Grapholita eclipsana (Zeller)	Tortricidae	Miller 1987	MI WI MN
Amorpha			
Grapholita fana (Kearfott)	Tortricidae	Miller 1987	MI
Desmodium buds and flowers			
Grapholita tristigana (Clemens)	Tortricidae	Miller 1987	MI
seeds and stems of Baptisia, Lupinus			
Olethreutes comandrana	Tortricidae	Miller 1987	MI
Comandra			
Pelochrista scintillana (Clemens)	Tortricidae	Miller 1987	MI WI MN
Helianthus			
Pelochrista womonana (Kearfott)	Tortricidae	Miller 1987	MI MN
Helianthus roots			
Phaneta essexana (Kearfott)	Tortricidae	Miller 1987	MI
Aster stems			
Phaneta formosana (Clemens)	Tortricidae	Miller 1987	MI WI
Solidago terminals			
Phaneta ochroterminana (Kearfott)	Tortricidae	Miller 1987	MI WI MN
Solidago flower heads			

Phaneta olivaceana (Riley)	Tortricidae	Miller 1987	MI
Solidago			
Phaneta parmatana (Clemens)	Tortricidae	Miller 1987	MI WI MN
Aster flower heads			
Phaneta radiatana (Walshingham)	Tortricidae	Miller 1987	MI
Solidago stems			
Phaneta raracana (Kearfott)	Tortricidae	Miller 1987	MI
Solidago			
Phaneta tomonana (Kearfott)	Tortricidae	Miller 1987	MI WI
Aster flower heads			
Sonia canadana McDonnough	Tortricidae	Miller 1987	MI
Aster, Solidago rootstalks			
Suleima cinerodorsana Heinrich	Tortricidae	Miller 1987	MI
Helianthus stems			
Trachysmia cartwrightiana (Kearfott)	Tortricidae	Metzler and Zebold 1995	OH
Trachysmia villana (Busck)	Tortricidae	Metzler and Zebold 1995	OH

*larval foods are listed below species names for tortricids

The **Hymenoptera**, sawflies, parasitic wasps, ants, wasps and bees, have 17,200 species in 78 families in the US and Canada. Watts et al. (1989) list Formicidae (ants) as an important grassland group, and the USFWS cooperators noted native solitary bees (Andrenidae, some Halictidae, Megachilidae and Anthophoridae) on their “must do” list. The literature search generated 182 species and subspecies of Hymenoptera which may be prairie specialists:

Species	Family	References	Location	Pollen Source
Andrena accepta	Andrenidae	Moldenke 1979		Helianthus
Andrena aliciae	Andrenidae	Moldenke 1979		Helianthus
Andrena asteris	Andrenidae	Moldenke 1979		Aster
Andrena beameri	Andrenidae	Arduser 1995	MO	
Andrena bullata	Andrenidae	Moldenke 1979		Heterotheca
Andrena cragini	Andrenidae	Moldenke 1979		Amorpha
Andrena crawfordi	Andrenidae	Moldenke 1979		Pyrrhappus
Andrena gardineri	Andrenidae	Moldenke 1979		Senecio
Andrena geranii	Andrenidae	Moldenke 1979		Hydrophyllum
Andrena Haynesi	Andrenidae	Moldenke 1979		Helianthus
Andrena helianthi	Andrenidae	Moldenke 1979		Helianthus
Andrena helianthiformis	Andrenidae	Arduser 1995; Moldenke 1979		Echinacea
Andrena irrasus	Andrenidae	Moldenke 1979		Amphiachrys
Andrena lamelliterga	Andrenidae	Moldenke 1979		Phacelia
Andrena melliventrifrons	Andrenidae	Moldenke 1979		Gaillardia
Andrena primulifrons	Andrenidae	Moldenke 1979		Lesquerella
Andrena quintilis	Andrenidae	Arduser 1995	MO	
Andrena rudbeckiae	Andrenidae	Moldenke 1979		Rudbeckia/Ratibida
Andrena simplex	Andrenidae	Moldenke 1979		Solidago
Andrena tonkaworum	Andrenidae	Moldenke 1979		Engelmannia
Andrena trapezoidea	Andrenidae	Moldenke 1979		Lesquerella
Andrena verecunda	Andrenidae	Moldenke 1979		Pyrrhappus
Andrena ziziae	Andrenidae	Moldenke 1979		Zizia
Calliopsis coloradensis	Andrenidae	Moldenke 1979		Solidago/Bidens
Calliopsis nebraskensis	Andrenidae	Moldenke 1979		Verbena
Metapsaenythia abdominalis	Andrenidae	Moldenke 1979		Monarda
Nomadopsis australior	Andrenidae	Moldenke 1979		Lepidium
Nomadopsis helianthi	Andrenidae	Moldenke 1979		Euphorbia
Perdita albipennis	Andrenidae	Moldenke 1979		Helianthus
Perdita albipennis palidipennis Graenicher	Andrenidae	Reed 1996	MN	
Perdita alexi	Andrenidae	Moldenke 1979		Helianthus/Heterotheca

<i>Perdita atriventris</i>	Andrenidae	Moldenke 1979		Heterotheca
<i>Perdita bishoppi planorum</i>	Andrenidae	Moldenke 1979		Heterotheca
<i>Perdita bruneri</i>	Andrenidae	Moldenke 1979	Solidago/Grindelia	
<i>Perdita cambarella cambarella</i>	Andrenidae	Moldenke 1979		Heterotheca
<i>Perdita crotonis</i>	Andrenidae	Moldenke 1979		Croton
<i>Perdita dolichocephala</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Perdita fallax</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Perdita gerhardi</i>	Andrenidae	Moldenke 1979		Monarda
<i>Perdita gutierreziae</i>	Andrenidae	Moldenke 1979	Gutierrezia/Haplopappus	
<i>Perdita halictoides</i>	Andrenidae	Moldenke 1979	Physalis/Chamaesaracha	
<i>Perdita ignota crawfordi</i>	Andrenidae	Moldenke 1979		Heterotheca
<i>Perdita labergi</i>	Andrenidae	Moldenke 1979		Euphorbia
<i>Perdita lasiogastra</i>	Andrenidae	Moldenke 1979		Pectis
<i>Perdita laticincta</i>	Andrenidae	Moldenke 1979		Haplopappus
<i>Perdita lepachidis lepachidis</i>	Andrenidae	Moldenke 1979		Gaillardia
<i>Perdita maura</i>	Andrenidae	Moldenke 1979	Physalis/Chamaesaracha	
<i>Perdita melanostoma</i>	Andrenidae	Moldenke 1979		Gutierrezia
<i>Perdita octomaculata terminata</i>	Andrenidae	Moldenke 1979	Solidago/Aster	
<i>Perdita opuntiae</i>	Andrenidae	Moldenke 1979		Opuntia
<i>Perdita perpallida</i>	Andrenidae	Moldenke 1979	Dalea/Amorpha	
<i>Perdita perpallida citrinella</i> Graenicher	Andrenidae	Reed 1996	MN	
<i>Perdita perpulchra punctatissima</i>	Andrenidae	Moldenke 1979		Heterotheca
<i>Perdita pratti</i>	Andrenidae	Moldenke 1979	Helianthus/Heterotheca	
<i>Perdita purpurascens</i>	Andrenidae	Moldenke 1979		Gaillardia
<i>Perdita rhodura</i>	Andrenidae	Moldenke 1979		Haplopappus
<i>Perdita swenki</i>	Andrenidae	Moldenke 1979	Solidago/Grindelia	
<i>Perdita tridentata</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Perdita variegata</i>	Andrenidae	Moldenke 1979		Monarda
<i>Perdita wilmattae wilmattae</i>	Andrenidae	Moldenke 1979		Stanleya
<i>Perdita wootonae</i>	Andrenidae	Moldenke 1979		Mentzelia
<i>Perdita zebrata zebrata</i>	Andrenidae	Moldenke 1979		Cleome
<i>Protandrena bancrofti</i> Dunning	Andrenidae	Reed 1996	MN	
<i>Pseudopanurgus aethiops</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Pseudopanurgus albitarsis</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Pseudopanurgus rugosus</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Pterosarus innuptus</i>	Andrenidae	Moldenke 1979		Helianthus
<i>Ancyloscelis sejunctus</i>	Anthophoridae	Moldenke 1979		Ipomoea
<i>Cemolobus ipomoea</i>	Anthophoridae	Moldenke 1979		Ipomoea
<i>Diadasia afflicta perafflicta</i>	Anthophoridae	Moldenke 1979		Callirhoe
<i>Diadasia diminuta</i>	Anthophoridae	Moldenke 1979		Sphaeralcea
<i>Diadasia enavata</i>	Anthophoridae	Moldenke 1979		Helianthus
<i>Melissodes agilis</i>	Anthophoridae	Moldenke 1979		Helianthus
<i>Melissodes bidentis</i>	Anthophoridae	Moldenke 1979		
<i>Helianthus/Rudbeckia</i>				
<i>Melissodes coloradensis</i>	Anthophoridae	Moldenke 1979		Helianthus
<i>Melissodes denticulata</i>	Anthophoridae	Moldenke 1979		Vernonia
<i>Melissodes desponsa</i>	Anthophoridae	Moldenke 1979		Cirsium
<i>Melissodes fimbriata</i>	Anthophoridae	Moldenke 1979		Oenothera
<i>Melissodes fumosa</i>	Anthophoridae	Moldenke 1979		Solidago
<i>Melissodes gelida</i> LaBerge	Anthophoridae	Moldenke 1979; Reed 1996	MN	Helianthus
<i>Melissodes intorta</i>	Anthophoridae	Moldenke 1979		Callirhoe
<i>Melissodes menuachus</i>	Anthophoridae	Moldenke 1979	Grindelia/Solidago	
<i>Melissodes pallidisignata</i>	Anthophoridae	Moldenke 1979		
			Haplopappus/Chrysothamnus	
<i>Melissodes rustica</i>	Anthophoridae	Moldenke 1979	Aster/Solidago	
<i>Melissodes subagilis</i>	Anthophoridae	Moldenke 1979		Grindelia
<i>Melissodes trinodis</i>	Anthophoridae	Moldenke 1979		Helianthus
<i>Melissodes tuckeri</i>	Anthophoridae	Moldenke 1979	Aster/Heterotheca	
<i>Melissodes vernoniae</i>	Anthophoridae	Moldenke 1979		Vernonia
<i>Melissodes wheeleri</i>	Anthophoridae	Moldenke 1979		Helianthus
<i>Melitoma grisella</i>	Anthophoridae	Moldenke 1979		Ipomoea

Melitoma taurea	Anthophoridae	Moldenke 1979	Ipomoea
Ptilothrix bombiformis	Anthophoridae	Moldenke 1979	Hibiscus
Svastra petulca	Anthophoridae	Moldenke 1979	Helianthus
Bombus fervidus (F.)	Apidae	Hobbs 1966	
Bombus fraternus (Smith)	Apidae	Panzer et al. 1995	IL IN WI
Colletes aberrans Cockerell	Colletidae	Reed 1996	MN
Colletes americanus	Colletidae	Moldenke 1979	Aster/Solidago
Colletes andrewsi	Colletidae	Moldenke 1979	Heuchera
Colletes brevicornis	Colletidae	Moldenke 1979	Specularia
Colletes compactus	Colletidae	Moldenke 1979	Solidago/Aster/Bidens
Colletes laticinctus	Colletidae	Moldenke 1979	Pectis/Gutierrezia
Colletes robertsoni Dalla Torre	Colletidae	Reed 1996	MN
Colletes rufocinctus	Colletidae	Moldenke 1979	Solidago/Aster/Heterotheca
Colletes simulans	Colletidae	Moldenke 1979	Solidago/Aster/Bidens
Colletes susannae Swenk	Colletidae	Reed 1996	MN
Colletes wilmattae Cockerell	Colletidae	Moldenke 1979;	
		Reed 1996	Dalea/Amorpha
Antisrophus silphii Gillette	Cynipidae	Fay and Samenus 1993	KS
Acanthomyops claviger	Formicidae	Wheeler and Wheeler 1963	ND
Acanthomyops interjectus	Formicidae	Wheeler and Wheeler 1963	ND
Acanthomyops latipes	Formicidae	Wheeler and Wheeler 1963	ND
Acanthomyops parvulus	Formicidae	Wheeler and Wheeler 1963	ND
Aphaenogaster traetae	Formicidae	Trager 1989	MO IL
Camponotus (T.) vicinus	Formicidae	Wheeler and Wheeler 1963	ND
Dolichoderus taschenbergi	Formicidae	Trager 1989	MO IL
Dorymyrmex pyramicus	Formicidae	Wheeler and Wheeler 1963	ND
Forelius pruinus	Formicidae	Trager 1989	MO IL
Formica (P.) lasiodes	Formicidae	Wheeler and Wheeler 1963	ND
Formica (P.) limata	Formicidae	Wheeler and Wheeler 1963	ND
Formica (P.) neogagates	Formicidae	Wheeler and Wheeler 1963	ND
Formica (R.) obtusopilosa	Formicidae	Wheeler and Wheeler 1963	ND
Formica (R.) rubicunda	Formicidae	Wheeler and Wheeler 1963	ND
Formica (R.) wheeleri	Formicidae	Wheeler and Wheeler 1963	ND
Formica altipetens	Formicidae	Wheeler and Wheeler 1963	ND
Formica bradleyi	Formicidae	Wheeler and Wheeler 1963	ND
Formica cinerea Mayr	Formicidae	Talbot 1934; Wagner and Medlar 1970;	
		Wheeler and J. Wheeler 1963	ND
Formica criniventris	Formicidae	Wheeler and Wheeler 1963	ND
Formica dakotensis	Formicidae	Wheeler and Wheeler 1963	ND
Formica difficilis	Formicidae	Trager 1989	MO IL
Formica exsectoides	Formicidae	Trager 1989	MO IL
Formica fossiceps	Formicidae	Wheeler and Wheeler 1963	ND
Formica incerta	Formicidae	Trager 1989	MO IL
Formica obscuripes	Formicidae	Wheeler and Wheeler 1963	ND
Formica querquetulana	Formicidae	Trager 1989	MO IL
Formica subnitens	Formicidae	Wheeler and Wheeler 1963	ND
Formica vinculans	Formicidae	Trager 1989	MO IL
Iridomyrmex p. analis	Formicidae	Wheeler and Wheeler 1963	ND
Lasius (C.) flavus	Formicidae	Wheeler and Wheeler 1963	ND
Lasius (Ch.) umbratus	Formicidae	Wheeler and Wheeler 1963	ND
Lasius crypticus	Formicidae	Wheeler and Wheeler 1963	ND
Lasius neoniger	Formicidae	Trager 1989;	
		Wheeler and Wheeler 1963	ND
Leptothorax (M.) hirticornis	Formicidae	Wheeler and Wheeler 1963	ND
Leptothorax (M.) provancheri	Formicidae	Wheeler and Wheeler 1963	ND
Leptothorax ambiguus	Formicidae	Trager 1989	MO IL
Leptothorax pergandei	Formicidae	Trager 1989	MO IL
Leptothorax rugatulus	Formicidae	Wheeler and Wheeler 1963	ND
Manica mutica	Formicidae	Wheeler and Wheeler 1963	ND
Monomorium minimum	Formicidae	Wheeler and Wheeler 1963	ND
Myrmica americana	Formicidae	Trager 1989;	

		Wheeler and Wheeler 1963	ND	
<i>Myrmica brevinodis</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Myrmica brevispinosa</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Paratrechina arenivaga</i>	Formicidae	Trager 1989	MO IL	
<i>Paratrechina terricola</i>	Formicidae	Trager 1989	MO IL	
<i>Pheidole bicarinata</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Pheidole pilifera</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Pogonomyrmex occidentalis</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Polyergus lucidus</i>	Formicidae	Trager 1989	MO IL	
<i>Polyergus rufescens breviceps</i> Emery	Formicidae	Talbot 1934	IL IN MI	
<i>Solenopsis molesta</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Veromessor lobognathus</i>	Formicidae	Wheeler and Wheeler 1963	ND	
<i>Dialictus pictus</i> (Crawford)	Halictidae	Reed 1996	MN	
<i>Dufourea monardae</i>	Halictidae	Moldenke 1979		Monarda
<i>Dufourea oryx</i>	Halictidae	Moldenke 1979		Helianthus
<i>Durfourea maginata</i>	Halictidae	Moldenke 1979		Helianthus
<i>Hemihalictus lustrans</i>	Halictidae	Moldenke 1979		Pyrrhappus
<i>Nomia heteropoda kirbii</i>	Halictidae	Moldenke 1979		Helianthus
<i>Sphecodogastra oenotherae</i>	Halictidae	Moldenke 1979		Oenothera
<i>Sphecodogastra texana</i>	Halictidae	Moldenke 1979		Oenothera
<i>Anthidium psoraleae</i> Robertson	Megachilidae	Arduser 1995; Reed 1996	MO, MN	
<i>Ashmeadiella buconis</i>	Megachilidae	Arduser 1995	MO	
<i>Coelioxys sayi</i> Robertson	Megachilidae	Medler and Lussenhop 1968	WI	
		Par. on <i>Megachile mendica</i>		
<i>Hoplitis micheneri</i>	Megachilidae	Moldenke 1979		Amorpha
<i>Lithurgus apicalis apicalis</i>	Megachilidae	Moldenke 1979		Opuntia
<i>Lithurgus bruesi</i>	Megachilidae	Moldenke 1979		Opuntia
<i>Megachile anograe</i>	Megachilidae	Moldenke 1979		Oenothera
<i>Megachile inimica sayi</i> Cresson	Megachilidae	Medler and Lussenhop 1968	WI	
<i>Megachile mendica</i> Cresson	Megachilidae	Medler and Lussenhop 1968	WI	
<i>Megachile oenotherae</i>	Megachilidae	Moldenke 1979		Oenothera
<i>Osmia distincta</i> Cresson	Megachilidae	Medler and Lussenhop 1968	WI	
		Penstemon		
<i>Paranthidium jugatorium</i>	Megachilidae	Moldenke 1979		Helianthus
<i>Macropis clypeata</i>	Mellitidae	Moldenke 1979		Steironema
<i>Macropis nuda</i>	Mellitidae	Moldenke 1979		Steironema
<i>Macropis patellata</i>	Mellitidae	Moldenke 1979		Steironema
<i>Macropis steironematis</i>	Mellitidae	Moldenke 1979		Steironema

All spiders (**Araneae**) are predatory, mostly on insects. There are about 2500 spider species in 60 families in the US and Canada. Thirty-five species may be prairie specialist.

Species	Family	References	Location
<i>Acacesia hamata</i> (Hentz)	Araneidae	Bruggeman 1981	OH
<i>Acanthepeira stellata</i> (Walckenaer)	Araneidae	Bruggeman 1981	OH
<i>Araneus miniatus</i> (Walckenaer)	Araneidae	Bruggeman 1981	OH
<i>Argiope aurantia</i> (Lucas)	Araneidae	Bruggeman 1981	OH
<i>Mangora gibberosa</i> (Hentz)	Araneidae	Bruggeman 1981	OH
<i>Larinia famulatoria</i> (Keyserling)	Argiopidae	Worley and Pickwell 1927	NE
<i>Castianeira variata</i>	Clubionidae	Wolff 1992	IL
<i>Phrurotimpus dulcineus</i>	Clubionidae	Wolff 1992	IL
<i>Scotinella madisonia</i>	Clubionidae	Wolff 1992	IL
<i>Dictyna volucris</i> Keyserling	Dictynidae	Worley and Pickwell 1927	NE
<i>Drassyllus depressus</i>	Gnaphosidae	Wolff 1992	IL
<i>Sergiolus decoratus</i>	Gnaphosidae	Wolff 1992	IL
<i>Neoantistia agilis</i>	Hahniidae	Wolff 1992	IL
<i>Arctosa rubicunda</i>	Lycosidae	Wolff 1992	IL
<i>Hogna helluo</i>	Lycosidae	Wolff 1992	IL

<i>Pardosa saxatilis</i>	Lycosidae	Wolff 1992	IL
<i>Schizocosa avida</i>	Lycosidae	Wolff 1992	IL
<i>Schizocosa bilineata</i>	Lycosidae	Wolff 1992	IL
<i>Schizocosa retrorsa</i>	Lycosidae	Wolff 1992	IL
<i>Oxyopes scalaris</i> Hentz	Oxyopidae	Bruggeman 1981	OH
<i>Thanatus rubicellus</i>	Philodromidae	Wolff 1992	IL
<i>Sassacus papenhoei</i> Peckham and Peckham	Salticidae	Baker 1994; Coffin and Pfannmuller 1988	MN
<i>Habrocestum pulex</i>	Salticidae	Wolff 1992	IL
<i>Habronattus rutherfordi</i> (Gertsch and Mulaik)	Salticidae	Baker 1994; Coffin and Pfannmuller 1988	MN
<i>Metaphidippus arizonensis</i> (Peckham and Peckham)	Salticidae	Baker 1994; Coffin and Pfannmuller 1988	MN
<i>Phidippus apacheanus</i> Chamberlin and Gertsch	Salticidae	Baker 1994; Coffin and Pfannmuller 1988	MN
<i>Phidippus mccooki</i> (Peckham)	Salticidae	Bruggeman 1981	OH
<i>Phidippus pius</i> Scheffer	Salticidae	Baker 1994; Coffin and Pfannmuller 1988; Wolff 1992	MN IL
<i>Sitticus cursor</i>	Salticidae	Wolff 1992	IL
<i>Tutelina formicaria</i> (Emerton)	Salticidae	Coffin and Pfannmuller 1988	MN
<i>Theridion differens</i> Emerton	Theridiidae	Bruggeman 1981	OH
<i>Theridion glauscescens</i> Becker	Theridiidae	Bruggeman 1981	OH
<i>Misumenoides aleatorius</i> (Hentz)	Thomisidae	Bruggeman 1981	OH
<i>Ozyptila geogiana</i>	Thomisidae	Wolff 1992	IL
<i>Xysticus triguttatus</i>	Thomisidae	Wolff 1992	IL

The **Acari** includes more than 30,000 species, with perhaps 500,000 species still undescribed. Acari are found in practically all habitats and are similar to insects in their wide variety of habits and life histories; both aquatic and terrestrial forms occur, some are parasitic, others predatory, many are plant feeders. I did not survey the literature on this group.

The **Isopods** are mostly marine but some terrestrial forms occur. They are often found under wood, stones or bark. No prairie specialists were identified.

The **Diplopoda** are mainly scavengers on dead plants and are found in moist locations. Many species are holarctic or have been introduced from Europe. No prairie specialists were identified.

The **Chilopoda** are are predatory and are frequently found under bark, stones or in soil. Although they are predominately forest invertebrates due to their requirements for deep litter (Summers et al. 1980), two species may be prairie specialists.

Species	Family	References	Location
<i>Eurymerodaemus mundus</i>	Lithobiidae	Walkden and Wilbur 1944	KS
<i>Tidabius tivius</i> (Chamberlin)	Lithobiidae	Summers et al. 1980	IL

Discussion and Evaluation

Lehmkuhl (1980) noted regarding the prairie: "...entomologists often pass through quickly to reach the more interesting regions on either side of the grasslands...". Despite this gloomy assessment, many books and papers have been published and the present literature search indicates interest in prairie insects is increasing. Among the reports are taxonomic surveys such as Footit and Richards (1993), which list species with their geographic distributions and occasional notes on habitat, to the extent these are known. Other papers such as those of Hendrickson (1930; 1931) list the species found in collections from prairie areas; some studies are limited to collections from one or a few

plant species such as Charlet (1992). Taxonomic changes since publication have made some older literature unreliable. Uncommon, but more helpful in identifying species which are found only on the prairie are detailed studies like that of Ballard and Greenlee (1994), which compare insect species in different habitats in the same geographical area. References vary in the attention given to ecology; our knowledge of insect taxonomy is incomplete, yet far ahead of our knowledge of the biology and ecology of insect species.

The majority of the insect groups have not been studied with prairie specialization in mind. Groups for which the most solid information is available are butterflies, leafhoppers and Orthoptera. Each of these groups has been studied by one person or a small group who have contributed all or most of the information. In general, studies aimed at identifying prairie specialists have succeeded when field work, information from previous studies and museum collections have all be utilized. (Further information and confirmation by different workers on different sites would be valuable.) Several very large insect groups, especially Coleoptera, Hemiptera, Diptera and most of the Hymenoptera have received very little attention from a prairie insect conservation standpoint. Further study of these groups will undoubtedly reveal many more prairie specialist species.

How reliable can a list of specialists be? Literature surveys can be suggestive, but their results must be verified in the field. As noted in the methods, insect species have been included in this list based on assessment of authorities, specialization on prairie plants or animals, collections from presence on the prairie and absence from other habitats, and geographic limitation to prairie states and provinces. Not all the species on this list will be restricted to prairie sites in every part of their ranges: some may be found on host plants off the prairie, and some species are included due to their occurrence in states or parts of states which are partly prairie. Host specialization may vary among geographical areas: a species with a broad host range throughout its geographic range may be specialized to a few hosts or a single host species over a more restricted area. This pattern is common among phytophagous insects (Evans 1990), and has been shown for pollen specialist bees (Cripps and Rust 1989). Species may vary in their degree of prairie remnant dependence among areas (Panzer et al. 1995).

Species which use microhabitats on prairie, eg. tiger beetles which use sandy areas created by disturbances, may not always be considered prairie specialists, but parts of their habitat may lie within prairie areas. Ballard and Greenlee (1996) note that certain Orthopteran species require specific subhabitats such as rock outcroppings in Missouri prairie areas. Many other examples occur.

The UFSWS cooperators at the 1994 Dubuque meeting suggested four criteria for high priority insect species. The species studied should, as a group,

1. Have a high likelihood of being restricted to or highly associated with prairie vegetation or habitat structure.
2. Have a life history that is likely to be sensitive to management practices such as burning or mowing.
3. Have a stable enough taxonomy so that identification to species is possible (i.e., existence of good keys and/or cooperative experts).
4. Have representation across a wide range of ecological functions or niches.

All these criteria deserve consideration in planning further studies. Criterion 1, that species be restricted to or highly associated with the prairie habitat or its vegetation, may shorten the species list (as given here) by removing species which are found in prairie regions but which are able to survive in degraded areas or able to colonize their hosts wherever they may occur. For example, specialist solitary bees seem to have good ability to move to replanted areas (Reed 1995b), while butterflies have much lower mobility (Swengel 1995). Also excluded are widespread generalists which have important ecological functions on the prairie, such as bumblebees which pollinate many prairie plants.

The second criterion, that the selected taxa have life histories which are sensitive to management, is, in my opinion, not at all restrictive. All insect species are sensitive to management, either in the short term following a burn or mowing, or over the long term, following the changes in the plant community which occur due to management or succession. Any management, or lack of it, will definitely influence the insect community (Reed 1995b).

The third criterion, stable taxonomy, is an elusive goal. Some groups are better known than others (some noted below under Recommendations), but most prairie collections of even well-known groups will yield undescribed species. For example, Henderson (1994) identified Homoptera collected from 8 prairie remnants in south central Wisconsin: of 86 species, 22 were new state records and 3 were newly described. Tepedino and Stanton (1981) collected bees for 2 summers on 2 sites on the shortgrass prairie in Wyoming; of over 200 bee species in 43 genera, about a third were new state records and 9% were undescribed. Ballard and Greenlee (1994), collected 132 species of Orthoptera in Missouri, of which 5 species were new to the state and 3 were newly described. Many poorly known groups such as gall wasps and flies, many parasitoids, leaf miners and others can be eliminated from consideration based on this taxonomic requirement.

The species which are undescribed or unusual (hence difficult to identify) may be those of the greatest conservation interest. A good key is more widely available than an overworked expert, however cooperative. More and better keys are needed.

The fourth criterion, that ecological functions or niches be fully represented, indicates a concern for prairie sites as self-sustaining ecosystems. A simplified trophic breakdown of prairie insects includes herbivores, which may feed on leaves, stems, flowers, pollen, seeds or roots; predators which consume other insects including adults, larvae or eggs; parasitoids which complete all or part of their development in other insects' bodies or eggs; parasites on other animals, such as blood-sucking flies; and scavengers which consume dead plant or animal material including litter, carrion and dung. Insects may be found on or within all plant parts, in water or soil, on insect or other animal bodies, or in animal nests including other insect nests; and many of their morphological features and physical characteristics such as sense organs and mobility are directly related to their ecology.

Specialization, size and available information about insect groups are correlated to some extent with their ecological niches, making it difficult to give equal emphasis to all functional groups and suggesting that some groups will contain more prairie specialists than others. Herbivores, especially those which live inside their hosts such

as leaf miners, tend to be more host-restricted than predators, so herbivores may be more likely to be prairie specialists than predators. Less information is available about the diets of predators than of herbivores. Parasitoids also tend to be highly specialized, but since the prairie is defined in terms of plants, the only prairie specialist parasitoids will be those that are limited to other prairie specialists as hosts. Dung and carrion-feeders tend to be highly mobile, (to find their ephemeral and scattered resources) and thus tend to have relatively wide geographical distributions. Very small insects tend to be poorly known compared to larger-bodied groups, and parasitoids are less well known than herbivores or predators.

Some species may already be missing from prairie remnants such as parasites or dung feeders of missing animals (including other insects) . Mohr (1943) notes regarding cattle droppings: "When dropped in a forest, soil insects characteristic of woods invade it; when dropped in a field, soil insects characteristic of fields invade it." Hayes (1927) noted the scavengers as an interesting group of prairie insects formerly dependent on buffalo, now on cattle and horses, but it is not known whether some species have been lost along with their buffalo hosts. Specialized pollinators of rare plants may also be missing.

In summary, the list as presented here overrepresents insect groups which are herbivorous, which are relatively well-known taxonomically, and which have been studied by prairie insect conservationists. The general literature may be used to suggest species for further study, but collections from prairie areas are essential.

Recommendations of Insect Groups for Further Field Study

First, the goals of any study must be carefully defined, and the available resources must be considered. If the collections are done by inexperienced workers, simple collecting methods are important. Aquatic species and parasitoids, stem miners and borers which need to be reared out may be eliminated on this basis. It is desirable to collect several insect groups on the same sites, in view of the different responses of prairie insect groups to management practices.

Any charismatic single species that may be found, and orders where information is available and the interest level high (Orthoptera, Homoptera and Lepidoptera) should be studied.

It is possible to generalize from taxonomic groups, but species which are unique and different from the rest of their groups may be of special interest; use of general guidelines may not include some species of special interest.

The following groups from the major orders may be especially productive of prairie specialist species. Of the Hemiptera: continue with Lygaeidae, Miridae, Pentatomidae, Scutellaridae and add Tingidae (lace bugs; which are plant juice feeders). They are relatively well studied; information is available in the economic entomology literature. These families are common, have many species, and are easy to recognize at the family level.

The Homoptera of the Cicadellidae, Cercopidae, and Fulgoroidea (especially Issidae) families should be further studied. Other families are either unlikely to contain prairie specialists based on their biology (such as the Cicadadae and Membracidae), which are associated with trees and shrubs, or difficult to classify, poorly known and of limited conservation interest, such as the aphids, whiteflies, and scale insects.

Coleoptera: more Chrysomelidae should be studied; much more information is available on this families from economic and taxonomic perspectives, and apparently chrysomelids have not been studied from a prairie conservation perspective. Many species are host specific. Continue with the Cicindelidae due to high interest--though they inhabit sand, not mesic prairie, some of their habitat is on protected prairie sites. The Cerambycidae are wood-boring as larvae, so this family may not yield many prairie specialists. Although most Carabidae are predators, so they may not be specialists, there is a lot of interest in Europe on using this group for studies of woodland age and condition. It would be interesting to see if they have the same function on prairies.

The value of some Coleoptera families for prairie studies is still uncertain. The Silphidae are interesting but do not appear to be obligates; Panzer et al. found all 11 of their remnant-dwelling silphid species to occur outside remnants. Dung beetles (Scarabaeinae or Coprinae in the Scarabaeidae in the Coleoptera) are also of interest, especially from a management perspective. The Curculionidae (weevils) have many specialists but are difficult to identify. Their mobility and fire tolerance are uncertain. Other possible beetles families include the Elateridae (click beetles), which are primarily subterranean, the Cantharidae, whose adults on flowers, the Tenebrionidae, which are "primarily western" (Swann and Papp 1972) and have same niche in drier areas that Carabidae do in damp areas. Cantharidae are found on flowers and may yield specialists.

Beetle families which are unlikely to yield specialists of conservation interest (although information on them would be valuable), include the Languriidae, with adults and larvae on and in common plants, the coccinellids (ladybugs) which are widespread predators. The Rhipiphoridae (wedge-shaped beetles) are rarely seen. The adults are found on flowers, the larvae are internal parasites of wasps in first larval stage. There are 44 species in US and Canada. The Strepsiptera still poorly known, and their parasitic lifestyle makes them relatively inaccessible to the general collector.

The Diptera have not been studied from a prairie conservation perspective, although there is plenty of information on some members of this order in the medical, pest control and economic entomology literature. Families that may include prairie specialists are listed here. The Asilidae (robber flies) have 883 species in the US and Canada, most have restricted ecological requirements and are rather locally distributed. Asilid larvae prey on white grubs (Arnett 1993), and the group is "sun-loving" (Swann and Papp 1972). The Bombyliidae have larvae in the soil, where they prey on other soil insect larvae. They are most common in sandy areas, and are common on prairie flowers. The Syrphidae have a variety of larval life styles (aquatic, in decaying organic matter or predaceous), adults on flowers. The Canadian species don't seem to be habitat restricted (Vockeroth, 1992) but as the group is common on prairie flowers they may repay study. The Sarcophagidae (flesh flies) are an interesting group--most are parasitic (mostly on mammal flesh), some are nest parasites on bees and wasps, others dung feeders. They may be of interest in their roles in the prairie ecosystem.

Other Diptera families seem unlikely to contain many prairie obligates, for the reasons listed below. The Tabanidae (horseflies and deerflies) are generalized bloodsuckers. The Stratiomyidae are "primarily forest species". Of the Therevidae, and Calliphoridae, the US and Canadian species are widespread rather than habitat restricted. The Conopidae have 67 species, most of which are "widely distributed"

(Arnett 1993). Many of the Anthomyiidae are root maggots, others are dung flies. Some may be specialists, but the group is difficult to identify (Arnett 1993).

The Dolichopodidae are common in cold regions, but the larvae are mostly aquatic, both adults and larvae are generalized predators. The Chloropidae are minute. Some species are destructive to grasses and have been studied from a range management perspective, but they do not seem to be of conservation interest.

Among the Lepidoptera, prairie butterflies are well documented, especially the Hesperidae, Lycaenidae, Nymphalidae, and Satyridae, and many noctuid species, especially the stem-boring Papaipema species, have been shown to be prairie specialists. The list of Tortricidae is based on the larval food sources; some species which utilize widespread plant genera such as Helianthus and Aster may not be prairie specialists. No additional groups are suggested for conservation-oriented surveys; host-specific microlepidoptera such as Gelichiidae may be of interest to biogeographers.

Of the hymenopteran orders, the sawflies (Symphyta) are associated with wood and not expected to be prairie specialists in general, although the Cephidae (stem sawflies) and a few species of the Tenthredinidae bore into grass stems (Watts et al. 1989). Gall wasps (Cynipidae), and many of the other parasitoid and hyperparasitoid wasps in the Ichneumonoidea, Chalcidoidea, Cynipoidea, Evanioidea and other Parasitica groups probably include many prairie specialist species, but the small size of many species and their difficult identification make them unlikely candidates for conservation. Wasps (Tiphidae, Pompilidae, Vespidae and Sphecidae) are predatory on other insects to feed their larvae. These groups are probably widespread rather than specialized.

Specialist bees seem to be able to colonize new sites (Panzer et al. 1995; Reed 1995b), thus they are prairie specialist but not remnant-dependent. They are difficult to identify but have an extensive literature. I do not expect to find prairie specialists among bumblebees (Bombus spp.) although many are found on the prairie.

Ants (Formicidae) definitely deserve more study, as individual prairie species and for their influence on prairie soil and on other insect populations. There are probably ant-associated species which are prairie specialists. Holldobler and Wilson (1990) list 16 orders of insects and allied groups which contain ant associates (myrmecophiles). Mites and staphylinid beetle species are especially prominent among species which inhabit ant nests. Many ant species are associated with other insect species which they tend, generally protecting them from predation and collecting secretions from their bodies. For example, Savignano (1994) listed 19 ant species which tend the endangered oak savanna butterfly Lycaeides melissa samuelis (Karner blue).

Of the non-insect arthropod groups, the spiders (Araneae) are definitely worthy of further study due to their high interest level, importance in ecosystem function, and the high level of current knowledge.

Acknowledgements

I thank all the researchers who shared their unpublished data.

References Cited and Additional Bibliography

The references are organized in alphabetical order by insect Order, followed by general references.

Araneae

- Bruggeman, M. J. 1981. Community Ecology of Spiders (Araneae) in Relict Prairies in Adams County, Ohio. M.S. Thesis, University of Cincinnati.
- Bultman, T. L. and G. W. Uetz. 1982. A comparison of cursorial spider communities along a successional gradient. *Journal of Arachnology* 10:23-33
- Cannon, S. S. 1965. Comparison of the spider faunas...*Ohio Journal of Science* 65:97-110
- Chickering, A. M. 1944. The Salticidae of Michigan. *Papers of the Michigan Academy of Science for 1943* 29:139-222
- Doane, J. F. 1979. Seasonal captures of spiders...*Canadian Entomologist* 111: 439-445
- Dondale, C. D. and J. H. Redner. 1978. The Crab Spiders of Canada and Alaska. Canada Department of Agriculture. Ottawa, Ontario. 255 pp
- Dondale, C. D. and J. H. Redner. 1982. The Sac Spiders of Canada and Alaska. Agriculture Canada. Ottawa, Ontario, Canada. 194 pp.
- Dondale, C. D. and J. H. Redner. 1990. The Wolf Spiders, Nurseryweb Spiders, and Lynx Spiders of Canada and Alaska. Agriculture Canada. Ottawa, Ontario, Canada. 383 pp
- Fitch, H. S. 1963. Spiders of the University of Kansas Natural History Reservation and Rockefeller Experimental Tract. Misc. Pub. of the University of Kansas Natural History Museum no.33. 202 pp
- Guarisco, H. and H. S. Fitch. 1995. Spiders of the Kansas Ecological Reserve. *Transactions of the Kansas Academy of Science* 98:118-129
- Levi, H. W. and H. M. Field. 1954. The spiders of Wisconsin. *American Midland Naturalist* 51:440-67
- Lowrie, D. C. 1948. The ecological succession of spiders in the Chicago area dunes. *Ecology* 29:334-351
- Muma, M. H. and K. E. Muma. 1949. Studies on a population of prairie spiders. *Ecology* 30:485-503
- Peck, W. B. 1966. The population composition of a spider community in west central Missouri. *American Midland Naturalist* 76:151-168
- Platnick, N. I. and C. D. Dondale. 1992. The Ground Spiders of Canada and Alaska. Agriculture Canada. Ottawa, Ontario, Canada. 297 pp
- Wolff, R. J. 1992. Diversity of wandering spiders (Araneae) collected by pitfall traps in northern Illinois prairies and woodlands. pp 67-73 in Smith, D. D. and C. A. Jacobs, eds. *Proceedings of the 12th North American Prairie Conference*. Univ. of N. Iowa
- Woodring, J. P. 1957. The Salticidae of Minnesota. M.S. Thesis, University of Minnesota
- Worley, L. G. and G. B. Pickwell. 1927. The spiders of Nebraska. *University Studies* 27, no. 1. Published by the University of Nebraska, Lincoln.

Blattaria

- Vickery, V. R. and D. K. M. Kevan. 1985. The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions. Agriculture Canada, Ottawa, Ontario, Canada.

Chilopoda

- Summers, G., J. A. Beatty and N. Magnuson. 1980. A checklist of Illinois centipedes (Chilopoda). *Great Lakes Entomologist* 13:241-257

Coleoptera

- Allsopp, P. G. 1980. Biology of false wireworms. *Bulletin of Entomological Research* 70:343-379
- Anderson, R. S. and Stewart B. Peck. 1985. The Carrion Beetles of Canada and Alaska. Agriculture Canada. Ottawa, Ontario, Canada. 121 pp.
- Balsbaugh, E. U. Jr. 1987. Reclassification of some Chrysomelini and a new species of *Plagioder* (Coleoptera: Chrysomelidae). *Journal of the Kansas Entomological Society* 60:30-40
- Balsbaugh, E. U. Jr. 1990. Coleoptera of North Dakota. *Proceedings of the North Dakota Academy of Science* 44:10 (abstract)
- Balsbaugh, E. U. Jr. and D. G. Aarhus. 1990. Checklist and new state records of Curculionidae

- (Broad Sense) (Coleoptera) for North Dakota. *Journal of the Kansas Entomological Society* 63:(2) 227-236
- Bertwell, R. L. and H. D. Blocker. 1975. Curculionidae from different grassland treatments near Manhattan, Kansas. *Journal of the Kansas Entomological Society* 48:319-326
- Bright, D. E. 1993. *The Weevils of Canada and Alaska*. Vol. 1. Agriculture Canada. Ottawa, Ontario, Canada. 217 pp
- Carter, M. R. 1989. The biology and ecology of the Tiger Beetles (Coleoptera: Cicindelidae) of Nebraska. *Transactions of the Nebraska Academy of Sciences* 17:1-18
- Center, T. D. and C. D. Johnson. 1964. Coevolution of some seed beetles...*Ecology* 55:1096-1103
- Dahl, R. A. 1991. Light trap records of Phyllophaga (Coleoptera: Scarabeidae) in Wisconsin, 1984-1987. *Great Lakes Entomologist* 24:1-8
- Epstein, M. E. 1982. Habitat and seasonal composition of ground beetles. M.S. Thesis, University of Minnesota
- Epstein, M. E. and H. M. Kulman. 1990. Habitat distribution and seasonal occurrence of carabid beetles in east-central Minnesota. *American Midland Naturalist* 123:209-225
- Esau, K. L. and D. C. Peters. 1975. Carabidae collected in pitfall traps in Iowa cornfields, fencerows and prairies. *Environmental Entomology* 4:509-513
- Evans, E. W. 1990. Dynamics of an aggregation of blister beetles (Coleoptera: Meloidae) attacking a prairie legume. *Journal of the Kansas Entomological Society* 63:616-625
- Evans, W. G. 1983. Habitat selection in the Carabidae. *Coleopterists' Bulletin* 37:164-167
- Harstaad, J. 1985. Ecological relationships among eight species of coexisting burying beetles (Coleoptera--Silphidae; Nicrophous) in east-central Minnesota. Thesis, University of Minnesota
- Hayes, E. P. and J. P. McColloch. 1928. Ecological studies of Kansas Scarabeid larvae (Coleoptera). *Journal of Economic Entomology* 21:249-260
- Johnson, N. E. and R. S. Cameron. 1969. Phytophagous ground beetles. *Annals of the Entomological Society of America* 62:909-914
- Johnson, P. J. 1991. Taxonomic notes, new records, and a key to the adults of North American Byrrhidae (Coleoptera). *Proceedings of the Entomological Society of Washington* 93:322-332
- Jolivet, P., E. Petitpierre and T. H. Hsaio, eds. 1988. *Biology of Chrysomelidae*. Kluwer Academic Publishers, Boston.
- Kirk, V. M. 1971. Ground beetles in cropland in South Dakota. *Annals of the Entomological Society of America* 64:238-241
- Larson, P. R. 1981. The tiger beetles of North Dakota (Coleoptera: Cicindelidae). *Proceedings of the North Dakota Academy of Science* 35:52 (abstract)
- Lawrence, J. F. 1983. *A catalog of the Coleoptera of America north of Mexico: family, Languriidae*. USDA, Washington, DC
- No author given. Leaf beetles of Ohio (Chrysomelidae: Coleoptera). *Bulletin of the Ohio Biological Survey* 43
- Pearson, D. L. 1988. Biology of tiger beetles. *Annual Review of Entomology* 33:123-148
- Refseth, D. 1980. Ecological analysis of Carabid communities...*Biological Conservation* 17:131-141
- Schwert, D. P. 1992. Faunal transitions in response to an ice age...*Coleopterists' Bulletin* 46:68-94
- Schwitzgebel, R. B. and D. A. Wilbur. 1942b. Coleoptera associated with ironweed, *Vernonia interior* Small in Kansas. *Journal of the Kansas Entomological Society* 15:37-44
- Selander, R. B. 1983. An annotated catalog of blister beetles of the tribe Tetraonycini (Coleoptera, Meloidae). *Transactions of the American Entomological Society* 109:277-293
- Selander, R. B. 1988. An annotated catalog and summary of bionomics of blister beetles of the genus *Cylindrothorax* (Coleoptera, Meloidae). *Transactions of the American Entomological Society* 114:15-70
- Whelan, D. B. 1936. Coleoptera of an original prairie area in eastern Nebraska. *Journal of the Kansas Entomological Society* 13:86-100
- Williams, C. E. 1989. *Coreopsis tinctoria*: an unrecorded host plant of adult *Calligraphia californica coreopsivora* (Coleoptera: Chrysomelidae). *Great Lakes Entomologist* 22:99-100

Dermaptera

- Vickery, V. R. and D. K. M. Kevan. 1985. *The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions*. Agriculture Canada, Ottawa, Ontario, Canada

Diplopoda

Jass, J. P. 1994. Presentation to 4th Annual Prairie Invertebrates Conference, Wisconsin

Diptera

Baker, N. T. and R. L. Fischer. 1975. A taxonomic and ecologic study of the Asilidae of Michigan. *Great Lakes Entomologist* 8:31-91

Barr, A. R. 1958. The mosquitoes of Minnesota (Diptera: Culicidae, Culicinae). University of Minnesota Agricultural Experiment Station, St. Paul. 154 pp

Easton, E. R. 1983. The horse flies and deer flies of South Dakota. New state records and an annotated checklist (Diptera: Tabanidae). *Entomological News* 94:196-200

No author given. 1985. Flies of the Nearctic Region: Diopsidae, Anthomyiidae, Dolichopodidae, Bombyliidae, Blepharoceridae

Philip, C. B. 1931. The Tabanidae (horseflies) of Minnesota...Thesis, University of Minnesota.

Skarlato, O. A., ed. 1985. Systematics of Diptera (Insecta): Ecological and Morphological Principles. Oxonian Press, New Delhi.

Teskey, H. J. 1990. The horse flies and deer flies of Canada and Alaska: Diptera: Tabanidae. Agriculture Canada. Ottawa, Ontario, Canada.

Vockeroth, J. R. 1992. The flower flies of the subfamily Syrphinae of Canada, Alaska and Greenland: Diptera, Syrphidae. Agriculture Canada. Ottawa, Ontario, Canada

Wilbur, D. A. and C. W. Sabrosky. 1936. Chloropid populations...*Journal of Economic Entomology* 29:384-389

Hemiptera

Froeschner, R. C. 1949. Contributions to a synopsis of the Hemiptera of Missouri, Pt. IV. *American Midland Naturalist* 42:123-188

Juola, M. C. 1928. A preliminary report on the land Hemiptera of Minnesota, exclusive of the Miridae and Lygaeidae. Thesis, University of Minnesota

Kelton, L. A. 1980. The Plant Bugs of the Prairie Provinces of Canada. Agriculture Canada. Ottawa, Ontario, Canada. 408 pp

McPherson, J. E. 1982. The Pentatomoidea (Hemiptera) of Northeastern North America. Southern Illinois University Press, Carbondale. 241 pp

Schwartz, M. D. 1991. The first nearctic records of two Holarctic species of *Polymerus* Hahn... (Heteroptera: Miridae: Mirinae). *Canadian Entomologist* 124:721-743

Slater, J. A. 1983. On the biology and food plants of *Lygaeus turcicus* (Fabr.) (Hemiptera: Lygaeidae). *New York Entomological Society* 91:48-56

Homoptera

Baldrige, R. S. and H. D. Blocker. 1980. Parasites of leafhoppers from Kansas grasslands. *Journal of the Kansas Entomological Society* 53:441-444

Blocker, H. D. and R. Reed. 1976. Leafhopper populations of a tallgrass prairie. *Journal of the Kansas Entomological Society* 49:145-154

Cwikla, P. S. and H. D. Blocker. 1981. An annotated list of the leafhoppers (Homoptera: Cicadellidae) from tallgrass prairie of Kansas and Oklahoma. *Transactions of the Kansas Academy of Sciences* 84:89-97

Dennis, C. J. 1969. The treehoppers of Wisconsin in relation to the tension zone (Homoptera, Membracidae). *American Midland Naturalist* 81:236-242

Dennis, C. J. 1971. Further notes about Wisconsin treehoppers and the tension zone (Homoptera, Membracidae). *American Midland Naturalist* 86:246-247

Eastop, V. F. 1976. *Survey of the World's Aphids*. Junk, The Hague.

Footit, R. G. and W. R. Richards. 1993. The genera of the aphids of Canada. Agriculture Canada. Ottawa, Ontario, Canada. 766 pp.

Hamilton, K. G. A. 1995. Evaluation of leafhoppers and their relatives (Insecta: Homoptera: Auchenorrhyncha) as indicators of prairie preserve quality. pp 211-226 in Hartnett, D. C., ed. Proc. of the 14th North American Prairie Conf. Kansas State University, Manhattan, KS

Hanna, M. and T. E. Moore. 1966. The spittlebugs of Michigan (Homoptera: Cercopidae). *Papers of*

- the Michigan Academy of Science, Arts and Letters 51:39-73
 Strickland, E. H. 1940. Additional Fulgoroidea taken in Alberta. *Canadian Entomologist* 72:87-88
 Tuthill, L. D. 1943. The Psyllids of America, North of Mexico (Psyllidae, Homoptera). Iowa State College, Ames.
 Voegtlin, E. J. 1988. Catalog of the Cinaria species of North America (Homoptera: Aphididae). Illinois Natural History Survey. Champaign, IL. 55 pp
 Wilson, S. W., J. L. Smith and P. D. Calvert. 1993. Planthoppers of a Missouri tallgrass prairie. *Journal of the Kansas Entomological Society* 66:75-80

Hymenoptera

- Arduser, M. S. 1995. Pers. comm.
 Cripps, C. and R. W. Rust. 1989. Pollen foraging in a community of *Osmia* bees (Hymenoptera: Megachilidae). *Environmental Entomology* 18(4):582-589
 Crosswhite, F. S. and C. D. Crosswhite. 1966. Insect pollinators of *Penstemon*...*American Midland Naturalist* 76:450-467
 Dreisbach, R. R. 1945. The green halictine bees of the genera *Agapostemon*...*Papers of the Michigan Academy of Science, Arts and Letters* 30: 221-227
 Evans, H. E. and C. M. Yoshimoto. 1962. Ecology and nesting behavior of Pompilidae. *Misc. Publications of the Entomological Society of America* 3:67-119
 Frison, T. H. 1926. Bumblebees of Illinois. *Annals of the Entomological Society of America* 19:205-235
 Fye, R. E. 1965. Biology of Apoidea taken in trap nests. *Canadian Entomologist* 97:863-877
 Fye, R. E. and J. T. Medler. 1954. Spring emergence and floral hosts of Wisconsin bumblebees. *Transactions of the Wisconsin Academy of Arts and Letters* 43:75-82
 Goulet, H. 1992. The genera and subgenera of the sawflies of Canada and Alaska: Hymenoptera: Symphyta. Agriculture Canada. Ottawa, Ontario, Canada
 Hayes, W. P. 1924. A preliminary list of the ants of Kansas. *Entomological News* 36:10-12
 Henderson, G. 1992. Population biology and foraging ecology of prairie ants in southern Wisconsin (Hymenoptera: Formicidae). *Journal of the Kansas Entomological Society* 65:16-29
 Hobbs, G. A. 1966. Ecology of species of *Bombus* Latr. (Hymenoptera: Apidae) in southern Alberta. IV. Subgenus *Fervidobombus* Skorikov. *Canadian Entomologist* 98:33-39
 Holldobler, B. and E. O. Wilson. 1990. *The Ants*. Harvard University Press. Cambridge, MA. 732 pp
 Husband, R. W., R. L. Fischer and T. W. Porter. 1980. Description and biology of bumblebees in Michigan. *Great Lakes Entomologist* 13:225-239
 Kurczewski, T. E. and E. J. Kurczewski. 1968. Host records for some North American Pompilidae. *Journal of the Kansas Entomological Society* 41:1-33
 Kurczewski, T. E. and E. J. Kurczewski. 1987. Northern distribution records for some nearctic Pompilidae. *Great Lakes Entomologist* 20:81-84
 LaBerge, W. E. 1973. The bee genus *Proteriades* in South Dakota (Hymenoptera: Megachilidae). *Entomological News* 84:160
 LaBerge, W. E. and M. C. Webb. 1962. The bumblebees of Nebraska. *Research Bulletin* 205, Agriculture Experiment Station, University of Nebraska, Lincoln
 MacDonald, J. F. and M. A. Deyrup. 1989. The social wasps (Hymenoptera: Vespidae) of Indiana. *Great Lakes Entomologist* 22:155-175
 Medler, J. T. and J. F. Lussenhop. 1968. Leafcutter bees of Wisconsin (Hymenoptera: Megachilidae). University of Wisconsin College of Agricultural and Life Sciences. *Research Bulletin* no. 274. 80 pp
 Milliron, H. E. 1949. Taxonomic and biological investigations in the genus *Megastigmus*... (Hymenoptera: Chalcidoidea; Callimonidae). The University Press, Notre Dame, Indiana.
 Moldenke, A. R. 1979. Host-plant coevolution and the diversity of bees in relation to the flora of North America. *Phytologia* 43:357-419
 Morse, D. H. 1982. Behavior and ecology of bumblebees. in Hermann, H. R. ed. *Social Insects*. Vol.3. Academic Press, London
 Reed, C. C. 1996. Unpublished ms
 Small, E. 1976. Insect pollinators...*Canadian Field Naturalist* 90:22-28
 Stephen, W. P. 1957. Bumblebees of western America. Oregon State College Agriculture Experiment

Station Technical Bulletin 40

Talbot, M. 1934. Distribution of ant species in the Chicago region with reference to ecological factors and physiological toleration. *Ecology* 15:416-439

Tepedino, V. J. and N. L. Stanton. 1981. Diversity and competition in bee-plant communities on short-grass prairie. *Oikos* 36:35-44

Thorp, R. W. 1962. Notes on the distribution of some bumblebees of western North America. *Pan-Pacific Entomologist* 38:21-28

Trager, J. C. 1989. Colonization of re-created prairies by native prairie ants (Missouri, Illinois). Unpublished report

Trump, R. F. 1991. Bee watch on the prairie. parts 1 and 2. *American Bee Journal* 131:101-104 and 131:169-173

Wagner, R. O. and J. T. Medlar. 1970. Colony size and longevity as indicated by mounds of a prairie ant. pp 57-58 in J.H. Zimmerman, ed. *Proceedings of the Second Midwest Prairie Conference*. Madison, WI

Weber, N. 1935. Biology of the thatching ant...*Ecological Monographs* 5:165-206

Wheeler, G. C. and J. Wheeler. 1963. *The ants of North Dakota*. Univ. of North Dakota, Grand Forks. 326 pp.

Young, D. K. 1990. Distribution of *Pelecinus polyturator* in Wisconsin (Hymenoptera: Pelecinidae) with speculations regarding geographical pathenogenesis. *Great Lakes Entomologist* 23:1-4

Isopoda

Hatchett, S. P. 1947. Biology of the Isopoda of Michigan. *Ecological Monographs* 17:47-79

Sargent, J. E. 1973. Terrestrial isopods of Minnesota. *Journal of the Minnesota Academy of Science* 38:88-92

Lepidoptera

Catling, P. M. 1977. On the occurrence of *Oarisma garita*. *Great Lakes Entomologist* 10:59-63

Cuthrell, D. L. 1991. The butterflies of Kittson and Roseau Counties, MN. Final report to the Minnesota Nongame Wildlife Program, MN Dept. of Natural Resources.

Dana, R. 1983. The Dakota skipper: a now rare prairie butterfly. *Natural Areas Journal* 3:31-34

Fauske, G. 1985. Moth communities of the North Unit of Theodore Roosevelt National Park. *Proceedings of the North Dakota Academy of Science* 39:31 (abstract)

Hammond, P. C. and D. V. McCorkle. 1983. The decline and extinction of *Speyeria* populations. *Journal of Research in the Lepidoptera* 22:217-224

Heitzman, R. 1965. The life history of *Problema byssus* (Hesperiidae)

Hessell, S. A. 1954. A guide to collecting *Papaipema*. *The Lepidopterists' News* 8:57-63

Hovanitz, W. 1962. The distribution of the species of the genus *Pieris* in North America. *Journal of Research in the Lepidoptera* 1:73-83

Iftner, D. C., J. A. Shuey and J. V. Calhoun. 1992. Butterflies and skippers of Ohio. *Bulletin of the Ohio Biological Survey* n.s. 9:1-212

Johnson, K. 1971. Forest-prairie transitions and the admixture of butterfly faunas. *Journal of the Lepidopterists' Society* 25:216-221

Johnson, K. 1982. Prairie and plains disclimax and disappearing butterflies in the central United States. *Atala* 10:20-30

McCabe, T. L. 1977. Skippers (Hesperoidea) of North Dakota. North Dakota State University, Fargo.

Metzler, E. H. and R. A. Zebold. 1995. Twenty-eight species of moths new to Ohio from Huffman Prairie, Green County (Lepidoptera). *Ohio Journal of Science* 95:240-242

Metzler, E. H. pers. comm. 1994

Miller, S. 1972. Observations and new records of Iowa Rhopalocera. *Journal of the Lepidopterists' Society* 26:229-234

Miller, W. E. 1987. Guide to the Olethreutine moths of midland North America (Tortricidae). *US Forest Service Agriculture Handbook* 660.

Nagel, H. G., T. Nightengale and N. Dankert. 1991. Regal fritillary butterfly population estimation and natural history on Rowe Sanctuary, NE. *Prairie Naturalist* 23:145-152

Orwig, T. T. 1990. Loess Hills prairies as butterfly survival: opportunities and challenges. pp 131-135 in *Proceedings of the 12th North American Prairie Conference*

- Peterson, R. K. D. 1990. Occurrence and relative abundance of *Papaipema* species (Lepidoptera: Noctuidae) in Iowa. *Journal of the Kansas Entomological Society* 63:447-449
- Puckering, D. L. and R. L. Post. 1960. *Butterflies of North Dakota*. North Dakota Agricultural College, Fargo
- Royer, R. A. 1990. The North Dakota butterfly fauna. *Proceedings of the North Dakota Academy of Sciences* 44:9 (abstract)
- Royer, R. A. 1992. Studies of eight rare butterfly species in North Dakota. *Proceedings of the North Dakota Academy of Sciences* 46:60 (abstract)
- Schweitzer, D. 1985. Effects of prescribed burning on rare Lepidoptera. Memo to The Nature Conservancy.
- Shuey, J. A., J. V. Calhoun and D. C. Iftner. 1987. Butterflies that are endangered, threatened, and of special concern in Ohio. *Ohio Journal of Science* 87:98-106
- Swengel, A. B. 1996. Effects of fire and hay management on abundance of prairie butterflies. *Biological Conservation* 76:73-85
- Schwitzgebel, R. B. and D. A. Wilbur. 1942a. Lepidoptera, Hemiptera and Homoptera associated with ironweed, *Vernonia interior* Small in Kansas. *Transactions of the Kansas Academy of Science* 45:195-202

Mantodea

- Vickery, V. R. and D. K. M. Kevan. 1985. *The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions*. Agriculture Canada, Ottawa, Ontario, Canada.

Mecoptera

- Smith, R. C. 1925. The Neuroptera and Mecoptera of Kansas. *Bulletin of the Brooklyn Entomological Society* 20:165-171

Megaloptera

- Parfin, S. L. 1949. *The Megaloptera and Neuroptera of Minnesota*. Thesis, University of Minnesota.

Neuroptera

- Parfin, S. L. 1949. *The Megaloptera and Neuroptera of Minnesota*. Thesis, University of Minnesota.
- Smith, R. C. 1925. The Neuroptera and Mecoptera of Kansas. *Bulletin of the Brooklyn Entomological Society* 20:165-171
- Throne, A. L. 1971. The Neuroptera: suborder Planipennia of Wisconsin. Part I--Introduction and Chrysopidae. *Michigan Entomologist* 4:64-78
- Throne, A. L. 1971. The Neuroptera: suborder Planipennia of Wisconsin. Part II--Hemerobiidae, Polystoechotidae and Sisyridae. *Michigan Entomologist* 4:79-87
- Throne, A. L. 1972. The Neuroptera: suborder Planipennia of Wisconsin. Part III--Mantispidae, Ascalaphidae, Myrmeleontidae and Coniopterygidae. *Great Lakes Entomologist* 5:119-128

Orthoptera

- Ballard, H. E. Jr., and E. S. Greenlee. 1994. Monitoring responses of Orthopteran populations to fire management in Missouri natural area: base-line data and initial analyses. Report to the Missouri Nature Conservancy. 66 pp
- Ballard, H. E. Jr., and E. S. Greenlee. 1996. Field surveys for potentially rare Missouri Orthoptera. Report to the Missouri Department of Conservation. 51 pp + Appendices
- Bragg, J. H. 1939. The geographic distribution of Acrididae in northern Oklahoma. *American Midland Naturalist* 22:660-675
- Cantrall, I. J. and F. N. Young. Contrasts in the Orthoptera faunas of grassland, forest and transitional areas in southern Indiana. *Proceedings of the Indiana Academy of Science****
- Chapman, R. F. and A. Joern. 1990. *Biology of Grasshoppers*. Wiley, N. Y.
- Froeschner, R. C. 1954. The grasshoppers and other Orthoptera of Iowa. *Iowa State College Journal of Science* 29:163-354
- Gangwere, S. K. 1976. Food webs and ecology of Acrididae...*Great Lakes Entomologist* 9:83-123
- Haarstad, J. 1990. The Acrididae of Minnesota. Minnesota Dept. of Natural Resources Pops. and Res. Unit 1990 report. pp 121-123

- Hebard, M. 1934. The Dermaptera and Orthoptera of Illinois. Illinois Natural History Survey Bulletin 20, Article 3. 279 pp
- Joern, A. 1982. Distribution and densities of grasshoppers... Prairie Naturalist 14:37-45
- Joern, A. 1985. Grasshopper dietary (Orthoptera: Acrididae) from a Nebraska Sand Hills prairie. Transactions of the Nebraska Academy of Science 13:21-32
- Joern, A. and L. R. Lawler. 1981. Guild structure in grasshopper assemblages. Oikos 37:93-104
- Mitchell, J. E. and R. E. Pfadt. 1974. Role of grasshoppers...Environmental Entomology 3:358-360
- Mulkern, G. B. et al. 1964. Biology and ecology of North Dakota grasshoppers. II. Food habits. North Dakota Agricultural Experiment Station Research Report 11. 59 pp
- Otte, D. 1981 and 1984. The North American Grasshoppers. Vol. 1, 275 pp. 1981; Vol. 2, 366 pp. 1984. Harvard University Press, Cambridge MA.
- Przybyszewski, J. 1991. Patterns of parasitism among shortgrass prairie grasshopper (Orthoptera: Acrididae) populations. Journal of the Kansas Entomological Society 64:5-17
- Quinn, M. A. 1993. Grasshopper stages of development...Environmental Entomology 22:532-540
- Quinn, M. A. and 7 others. 1991. Habitat characteristics and grasshopper community dynamics on mixed-grass rangeland. Canadian Entomologist 123:89-105
- Quinn, M. A. et al. 1990. Effect of habitat...Environmental Entomology 19:1746-1755
- Somes, M. P. 1914. The Acrididae of Minnesota. Fifteenth Report of the State Entomologist, Minnesota. 98 pp
- Whelan, D. B. 1938. Orthoptera of an eastern Nebraska prairie. Journal of the Kansas Entomological Society 11:3-6
- Wilbur, D. A. and R. F. Fritz. 1940. Grasshopper populations (Orthoptera: Acrididae) of typical pastures in the bluestem region of Kansas. Journal of the Kansas Entomological Society 13:86-100
- Woodruff, L. C. 1937. A grasshopper survey for eastern Kansas, 1936. Journal of the Kansas Entomological Society 10:75-83
- Young, F. N. and I. J. Cantrall. 1955. Orthoptera of relict prairie fragments in Greene County, Indiana. Proceedings of the Indiana Academy of Science 65:111-115
- Panzer, R. 1987. The grasshoppers, katydids and walkingsticks of the prairies and savannas of Illinois. Transactions of the Illinois Academy of Science. Supplement 80:63 (abstract)
- Vickery, V. R. and D. K. M. Kevan. 1985. The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions. Agriculture Canada, Ottawa, Ontario, Canada. 918 pp
- Przybyszewski, J. 1990. Spatial and temporal patterns of grasshopper (Orthoptera: Acrididae) phenology and abundance on shortgrass prairie. Journal of the Kansas Entomological Society 63:405-413

Phasmida

- Panzer, R. 1987. The grasshoppers, katydids and walkingsticks of the prairies and savannas of Illinois. Transactions of the Illinois Academy of Science. Supplement 80:63 (abstract)
- Vickery, V. R. and D. K. M. Kevan. 1985. The Grasshoppers, Crickets, and Related Insects of Canada and Adjacent Regions. Agriculture Canada, Ottawa, Ontario, Canada. 918 pp

Psocoptera

- Mockford, E. L. 1993. North American Psocoptera. Sandhill Crane Press. Gainesville FL. 455 pp

Strepsiptera

- Bohart, R. M. 1941. A revision of the Strepsiptera with special reference to the species of North America. University of California Publications in Entomology 7(6):91-160
- Johnson, V. 1979. New North American distribution records for four species of Strepsiptera. Entomological News 90:251-255
- Kathirithamby, J. 1989. Review of the order Strepsiptera. Systematic Entomology 14:41-92

Thysanoptera

- Huntsinger, D. M., R. L. Post and G. L. Thomasson. 1982. North Dakota Terebrantia (Thysanoptera). North Dakota State University, Fargo
- Stannard, L. J. 1968. Thrips of Illinois. Bulletin of the Illinois Natural History Survey Division 29:215-

General References

- Arnett, R. H. Jr. 1993. American Insects. Sandhill Crane Press, Gainesville FL. 850 pp
- Baker, R. J. 1994. Proposed revisions to the Minnesota Endangered Species list.
- Borror, D. J., C. A. Triplehorn and N. F. Johnson. 1989. An introduction to the study of insects. Saunders, Philadelphia. 875 pp
- Brandhorst, C. T. 1943. A study of the relationship existing between certain insects and some native western Kansas forbs and weedy plants. Kansas Academy of Science Transactions 46:164-175
- Brumfield, D. M. 1919. The animal ecology of Johnson County. University of Iowa Studies in Natural History no 8. 37 pp
- Brusca, R. C. and G. J. Brusca. 1990. Invertebrates. Sinauer Associates, Sunderland MA. 922 pp
- Carpenter, J. R. 1939. Fluctuations in biotic communities. V. Aspection in a mixed-grass prairie in central Oklahoma. American Midland Naturalist 22:420-435
- Carpenter, J. R. 1940. The grassland biome. Ecological Monographs 10:617-684
- Charlet, L. D., D. D. Kopp and C. Y. Oseto. 1987. Sunflowers: their history and associated insect community in the northern great plains. Bulletin of the Entomological Society of America 33:69-75
- Charlet, L.D. 1992. Insect fauna of the heads and stems of native sunflowers (Asterales: Asteraceae) in eastern North Dakota. Environmental Entomology 21:493-500
- Christiansen, T. A. 1988. Winter arthropods in selected habitats of northern mixedgrass prairie. Pan-Pacific Entomologist 64:127-130
- Coffin, B., and L. Pfannmuller. 1988. Minnesota's Endangered Flora and Fauna. University of Minnesota Press, Minneapolis MN. 473 pp
- Cornell, H. 1984. Geographical texture of herbivore species richness patterns on host plants. Bulletin of the Entomological Society of America 30:6-15
- Coupland, R. T. 1950. Ecology of mixed prairie in Canada. Ecological Monographs 20:271-315
- Evans, E. W. 1989. Interspecific interactions among phytophagous insects. Ecology 70: 435-444
- Evans, F. C. and W. W. Murdoch. 1968. Taxonomic composition, trophic structure and seasonal occurrence in a grassland insect community. Journal of Animal Ecology 37:259-273
- Fichter, E. 1954. An ecological study of invertebrates... American Midland Naturalist 51:321-431
- Figg, D. E. 1986. Prairie invertebrate conservation. no 11.04 (no page numbers given) in Proceedings of the 10th North American Prairie Conf. Native Prairie Association of Texas, Dallas TX
- Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence. 1402 pp
- Green, T. W. and I. J. Palmbald. 1975. Effects of insect seed predators...Ecology 56:1435-1440
- Hawkins, B. A. and E. A. Cross. 1982. Patterns of refaunation of reclaimed strip mine spoils by nonterricolous arthropods. Environmental Entomology 11:762-775
- Hayes, W. P. 1927. Prairie insects. Ecology 8:238-250
- Henderson, R. A. 1994. Homoptera from Lisken spider study. pers. comm.
- Hendrickson, G. O. 1930. Studies on the insect fauna of Iowa prairies. Iowa State College Journal of Science 4:49-179
- Hendrickson, G. O. 1931. Further studies on the insect fauna of Iowa prairies. Iowa State College Journal of Science 5:195-209
- Hermann-Parker, S. 1978. Life history of *Psoralea esculenta*. Proceedings of the Fifth Midwest Prairie Conference.
- Husband, R. W. and T. M. Brown. 1976. Insects associated with Michigan bumblebees. Great Lakes Entomologist 9: 57-62
- Kremen, C., R. K. Colwell, T. L. Erwin, D. D. Murphy, R. F. Noss and M. A. Sanjayan. 1993. Terrestrial arthropod assemblages: their use in conservation planning. Conservation Biology 7:796-808
- Lafferty, M. B., ed., 1969. Ohio's Natural Heritage. Ohio Academy of Science, Columbus, Ohio. 324 pp
- Lehmkuhl, D. M. 1980. Temporal and spatial changes in the Canadian insect fauna: patterns and explanations. Canadian Entomologist 112:1145-1159
- Livingston, R. B. 1952. Relict true prairie communities in central Colorado. Ecology 33:72-86
- Merritt, R. W. and J. R. Anderson. 1977. The effects of different pasture and rangeland

ecosystems...Hilgardia 45:31-71

Mohr, C. O. 1943. Cattle droppings as ecological units. *Ecological Monographs* 13:275-298

Nagel, H. G. 1979. Analysis of invertebrate diversity in a mixed prairie ecosystem. *Journal of the Kansas Entomological Society* 52:777-786

Nelson, S. M. and D. C. Anderson. 1994. An assessment of riparian environmental quality by using butterflies and disturbance susceptibility scores. *Southwestern Naturalist* 39:137-142

Opler, P. A. 1981. Management of prairie habitats for insect conservation. *Journal of the Natural Areas Association* 1(4):3-6

Osborn, H. 1939. *Meadow and Pasture Insects*. Educators' Press. Columbus, Ohio. 228 pp

Panzer, R., D. Stillwaugh, R. Gnaedinger and G. Derkovitz. 1995. Prevalence of remnant-dependence among the prairie and savanna-inhabiting insects of the Chicago region. *Natural Areas Journal* 15:101-116

Parmenter, R. P. et al. 1991. Early successional patterns...*Environmental Entomology* 20:135-142

Platt, W. J., G. R. Hill and S. Clark. 1974. Seed production in a prairie legume (*Astragalus canadensis* L.). *Oecologia* 17:55-63

Pool, R. J. et al. 1918. Further studies in the ecotone between prairie and woodland. *University of Nebraska Studies* 18:1-47

Rathcke, B. J. 1976. Competition and coexistence within a guild of herbivorous stem-boring insects (tall-grass prairie). *Ecology* 57:76-87

Rau, P. 1922. Ecological and behavior notes on Missouri insects. *Transactions of the Academy of Science of St. Louis* 24(7):1-71

Reed, C. C. 1995a. Insect responses to prairie management. Final report to USFWS cooperators.

Reed, C. C. 1995b. Insects surveyed on flowers in native and reconstructed prairies (Minnesota). *Restoration and Management Notes* 13:210-213

Ross, H. H. 1970. The ecological history of the Great Plains: evidence from grassland insects. pp 225-240 in W. Dort and D. K. Jones, Jr., eds. *Pleistocene and Recent Environments of the Central Great Plains*. Spec. Pub. of the Univ. of Kansas Dept of Geol. 3

Ruthven, A. G. 1908. The faunal affinities of...*American Naturalist* 42:388-393

Savignano, D. A. 1994. Benefits to Karner blue butterfly larvae from association with ants. pp 37-46 in Andow, D. A., R. J. Baker and C. P. Lane, eds. *Karner Blue Butterfly: a Symbol of a Vanishing Landscape*. Univ. of Minn. Agric Exper Sta. Misc. Publ. 84-1994

Schmidt, N. D. 1975. Arthropod food chain energetics in a Missouri tall grass prairie. pp 143-154 in Wali, M. K., ed. *Prairie: A Multiple View*

Shackleford, M. W. 1929. Animal communities of an Illinois prairie. *Ecology* 10:126-154

Shackleford, M. W. 1939. New methods of reporting ecological collections of prairie arthropods. *American Midland Naturalist* 22:676-683

Shelford, V. E. 1913. *Animal Communities in Temperate America*. University of Chicago Press, Chicago.

Swann, L. A. and C. S. Papp. 1972. *The Common Insects of North America*. Harper and Row, New York. 750 pp.

Van Hook, R. I. Jr. 1971. Energy and dynamics of spider...*Ecological Monographs* 41:1-26

Watts, J. G. and five others. 1989. *Rangeland Entomology*. Society for Range Management, Denver CO. 388 pp

Williams, K. S. 1993. Use of terrestrial arthropods to evaluate restored riparian woodlands. *Restoration Ecology* June 1993: 107-116

Wolcott, G. N. 1937. An animal census of two pastures and a meadow in northern New York. *Ecological Monographs* 7:1-90

Wombacher, J. and R. Garay. 1972. Insect diversity and associations in a restored prairie. pp 77-79 in Hulbert, L. C., ed. *Proceedings of the Third North American Prairie Conference*