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Authors: Bomar, Charles R., and Secrist, Eric

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Grasshoppers (Orthoptera: Acrididae) associated with prairie remnants in the Lower Chippewa River State Natural Area (LCRSNA) of Western Wisconsin

Charles R. Bomar and Eric Secrist

(CRB, ES) Department of Biology University of Wisconsin – Stout Menomonie, WI 54751. Email: BOMARC@UWSTOUT.EDU

Abstract

The Wisconsin Department of Natural Resources has identified a new State Natural Area in the Lower Chippewa River region of western Wisconsin. This 100,000-ha+ area contains 800 ha of prairie remnants—25% of Wisconsin's remaining remnant prairie. Diversity of grasshopper populations (Orthoptera: Acrididae) was assessed in these remnant prairies. Remnants ranged in size from <1 ha to > 60 ha, and contained from 6 to 15 species from four subfamilies. Half of the remnants contained 10 or more species. Data from this survey provides the Wisconsin Department of Natural Resources with a tool to evaluate remnant prairies, and a snapshot of what grasshopper communities may have looked like in Wisconsin prior to settlement. This research also updates the Orthopteran literature database for acridid distribution records for this region of the USA.

Introduction

The Lower Chippewa River State Natural Area (LCRSNA) is a 100,000-ha+ floodplain forest in the western portion of the state of Wisconsin (Fig. 1); it drains into the Mississippi River. This area is the largest contiguous floodplain forest in the upper midwest and is readily considered one of the most biologically diverse areas in the state of Wisconsin (Ries & Hoffman 1998).

Within this floodplain forest are found approximately 25% of the remaining remnant prairies (approximately 800 ha) in Wisconsin. Wisconsin's prairies have been greatly decimated since settlement by European immigrants in the mid to late 1800's, as has much of the Great Plains ecosystem (Sampson & Knopf 1996, Packard & Mutel 1997). Most of the original 6 million ha of prairie and oak savannah in Wisconsin has been either converted to agriculture or left to the natural forces of ecological succession. Removal from the landscape of fire, the primary regulating force for maintaining prairie (Leach & Givnish 1996), has resulted in succession to predominantly hardwood forests scattered across much of the southern half of the state, with remaining prairies represented as small islands.

Since European settlement, much of western Wisconsin has remained relatively rural and undeveloped, with the local economy dependent upon agriculture for its mainstay. In recent years, urban sprawl has extended into western Wisconsin with a specific emphasis on the development of river and lakefront acreage. Much of this land contains relicts of ecologically significant remnant prairie, of which many new landowners are either unaware or unconcerned.

The Acrididae, as well as many other taxa, have been poorly surveyed (if at all) in western Wisconsin, with very few published records. A review of distribution maps from Otte (1981, 1984), Vickery & Kevan (1985) and Pfadt (1994), quickly illustrate that Wisconsin has been essentially ignored in the taxonomic literature. The Wisconsin Department of Natural Resources (1999) maintains a list of organisms that are considered endangered, threatened or of special concern in the state, including sixteen grasshopper species. This list considers the status of these species at state and global levels.

Few previous manuscripts directly address Wisconsin Acrididae. Valek & Coppel (1972a,b) discuss only one species, the oak-defoliating grasshopper *Dendrotettix quercus* Packard, and more recently Bomar (2001) compared populations of grasshoppers on restored and remnant communities in western Wisconsin. The objective of the research reported here was to survey remnant prairies associated with the LCRSNA and identify sites with the greatest potential for protecting the greatest biological diversity, based on surveys of grasshopper communities.

Methods

Working in collaboration with the Wisconsin Department of Natural Resources—Bureau of Endangered Resources (WDNR—BER), ten remnant prairie sites were preselected by the WDNR as areas of special interest. Four other sites, Colfax-North, Colfax West, Colfax-Town, and NSP-ECNHS were selected by the authors and are proximal to the LCRSNA (Fig. 1). All four sites were both railroad and power line right-of-ways. All sites were considered high quality, mesic to dry, remnant prairies, based on the presence of prairie indicator plants identified by Curtis (1959). The plant species include little blue stem (*Andropogon scoparus*), needle grass (*Stipa spartea*), blazing star (*Liatris aspersa*) and gray-headed coneflower (*Ratibida pinnata)*. Each site has a minimal history of management. One site, Rock Falls RW, was previously surveyed by Bomar (2001), and is within the LCRSNA. This site was resurveyed in 1999, and served as a reference point for the remainder of the study.

Grasshopper specimens were collected during the summer of 1999 using a sweep net (diameter 38 cm) and by individual collection using a "flush and capture" method as described by Pfadt (1994). Each site was sampled a minimum of five times throughout the field season (May to September), except for Happy and Brush Islands. These latter sites were surveyed only twice (June and August) due to the difficult nature of accessing these island remnants. Species were pooled from each site and analyzed using the diversity analysis described by Bomar (2001). This analysis provides a diversity index

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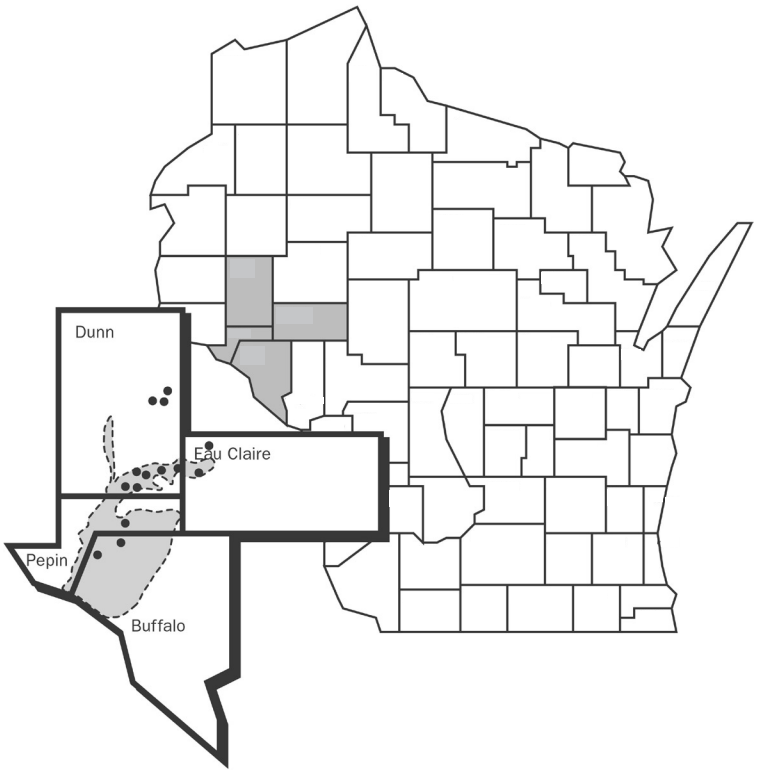


Fig. 1. Localities of fourteen prairie remnants surveyed for grasshoppers (Orthoptera: Acrididae) within or near the boundaries of Lower Chippewa River State Natural Area (LCRSNA) of western Wisconsin.

based on presence/absence of a species at any site. The analysis favored less common species and minimized the importance of more common species, producing a relative value of diversity for each site. All samples were stored in a laboratory freezer (-10°C) until specimens were pinned and labeled. Insects were collected under a Wisconsin Department of Natural Resources permit (#SCP-WD-86-C-98). Grasshoppers were identified to species using the keys of Vickery & Kevan (1985), Otte (1981, 1984), Capinera and Sechrist (1982) and Pfadt (1994). Voucher specimens from each collection are maintained in the University of Wisconsin-Stout research collection.

Results

On the 14 prairie remnants surveyed, 35 species were collected from four subfamilies (Table 1). The two most abundant subfamilies were the Melanoplinae with 15 species and the Oedipodinae with 12. The most commonly collected species were *Melanoplus femur-rubrum* (12 sites), *M. angustipennis* (10 sites), *Dissosteira carolina* (8 sites) *and Spharagemon bolli* (8 sites). The remaining 31 species were collected at 1 to 6 sites. Six species, including *Melanoplus borealis*, *M. differentialis*, *M. flavidus*, *M. gladstoni*, *M. viripides*, and *Trimerotropis maritima* were collected at only one site; of these only *M. flavidus* and *M. gladstoni* represent individuals associated with prairie habitat.

Of all surveyed sites, 50% (n = 7, Table 2) had at least 10 species of grasshoppers present. The greatest number of grasshopper species, 15, occurred at the NSP-Sandblows site. Three other sites (NSP-Dushame Creek, NSP-ECNHS and Rock Falls RW) contained 12 species of grasshoppers. The site with the fewest species was DNR- Happy Island, which contained only five locally common species: this site is a highly disturbed flood plain prairie and endures annual seasonal flood disturbances. One site, NSP-Cobble Flats, contained two species that were collected only once, *Melanoplus viripides* and *M. gladstoni*. Three other sites (Rock Falls RW, Larrabee 2, and Brush Island) contained species that were collected only once. Two species, *Melanoplus foedus* and *M. punctulatas*, were not collected during the 1999 survey, but were present in a 1998 survey (completed by the WDNR) of the NSP-Sandblows site, increasing the total to 17 species at this site. (These also represent species not observed at any other site in this survey, increasing the value of the Sandblows site.) Using Rock Falls RW from Bomar (2001) as a reference site, provided the addition of one species at Rock Falls RW, *Arphia pseudonietana* (Thomas). This site ranked the highest in diversity in this survey, as well as in the survey completed by Bomar (2001).

Sites varied in size from <1 ha to over 100 ha. There was no correlation between the number of species present and the site size, but the four highest-ranking sites (Table 2) were between 12 to 30 ha. The largest site, Brush Island (64 ha), ranked 9th of 14 sites with seven species present. Colfax West, a very small site, ranked in the middle (6th), and contained 11 species of grasshoppers. Site size may not play an important role in the number of species present, but it does play an important role in which species are present (Table 1). Of those species that were considered "special concern" species by the State of Wisconsin, only one of the eight species, *P. nebrascensis*, was collected at a small site (Colfax West). Five sites contained no species of special concern, five sites contained one, three sites contained two species, and one site, NSP-Sandblows, contained three species. Six of the eight 'concerned' species can be accounted for in the four top-ranking sites.

Eight other species from the State of Wisconsin's list of special concern were not collected and in most cases represent species that would not be found in the dry prairie habitat surveyed in this study (*e.g.*, *Stethophyma lineata* (Scudder) is found in association with wet meadows [Otte 1981]). Four new state records were collected in this survey (based on distribution maps from Otte 1981, 1984 and Vickery & Kevan 1985, Pfadt 1994), including *S.marmorata*, *D. viridis, O. obscura* and *P. brachyptera*. The first two are currently on the WDNR list, the last two are not, and represent additional candidates for consideration.

Discussion

This research provides the WDNR a tool to evaluate remnant prairies, as well as a snapshot of what grasshopper populations on remnant prairies in Wisconsin may have looked like prior to settlement. This research also updates the Orthopteran literature database for acridid distribution records for this region of the United States.

While little understanding exists of Wisconsin grasshopper community dynamics, sites such as NSP-Sandblows and Rock Falls RW are logical areas for protection under the LCRSNA and represent

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Table 1. Collection records of 35 grasshopper species (Orthoptera: Acrididae) from 14 remnant prairies in the Lower Chippewa River State Natural Area (LCRSNA), Wisconsin, USA.

Species	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Melanoplinae														
Melanoplus angustipennis (Dodge)	-	-	-	-	x	x	x	x	x	x	x	x	x	x
M. bivittatus (Say)	x	-	-	-	x	-	-	-	-	x	-	-	-	-
M. borealis (Fieber)	-	-	-	-	-	-	-	x	-	-	-	-	-	-
M. confusus Scudder	-	x	-	-	-	-	-	-	x	-	-	-	-	-
M. dawsoni (Scudder)	-	x	-	-	-	-	x	-	-	-	-	-	-	-
M. differentialis Thomas	-	-	-	-	-	-	x	-	-	-	-	-	-	-
M. femurrubrum (DeGeer)	x	-	x	x	-	x	x	x	x	x	x	x	x	x
M. flavidus Scudder*	-	-	-	-	-	-	-	-	-	-	-	x	-	-
M.gladstoni Scudder	-	-	-	-	-	-	-	-	x	-	-	-	-	-
M. keeleri (DeGeer)	-	x	x	x	x	-	-	-	-	-	x	x	-	-
M. sanguinipes (F.)	-	x	-	x	x	-	-	-	x	-	x	-	-	-
M. viripides Scudder	-	-	-	-	-	-	-	-	x	-	-	-	-	-
M.walshi Scudder	x	x	-	-	x	-	-	-	-	-	-	-	-	-
Phoetaloites nebraescensis (Thomas)*	-	-	-	-	x	-	-	-	-	-	-	-	x	-
Certacanthacridinae														
Schistocerca emarginata (Scudder)	-	-	x	x	x	-	-	-	-	-	x	-	x	-

*species of special concern in Wisconsin

A= DNR-Tiffany, B= Golden Valley, C= Colfax-North, D= Colfax-Town, E= Colfax-West, F= DNR-Brush Is., G= DNR-Happy Is., H= DNR-Larrabee 2, I= NSP-Cobble Flats, J= NSP-Dushame Cr., K= NSP-Sandblows, L= Rock Falls RW, M= NSP-ECNHS, N= Round Hill

good models for future acquisitions. It is already recognized that the LCRSNA is one of the most biologically diverse regions of Wisconsin (Ries & Hoffman 1998), containing representatives of 70% of all fish species, 66% of all bird species and 50% of all plant species found in the state.

While a wide array of species inhabit the LCRSNA, many of them are considered endangered, threatened or of special concern in Wisconsin. One common characteristic of many of the LCRSNA prairie remnants is that they are part of a greatly fragmented landscape. Size of these remnants represents an important constraint on what species may be present. Certainly many small sites (*e.g.*, < 2- 3 ha) are present, but it is evident from this research that some grasshoppers are unable to occupy and persist in the reduced environments. Between the competitive forces of other species present (both acridid and nonacridid), the reduced number of microhabitats available, and the impact of management practices (*e.g.*, suppression of fire), these species seem generally unable to occupy enough space to maintain a viable population (National Academy Press 1993).

The long–term goal of the WDNR is to acquire lands through purchase or easement to increase the amount of prairie habitat in the LCRSNA. This research would suggest that unless remnants are relatively larger, perhaps greater than 10 ha, those less common species might not be present. As such, one criterion of these land acquisitions should be to create corridors that connect areas of high diversity (National Academy Press 1993). Bomar (2001) showed that most species of grasshopper do not migrate or invade restored habitats, so the creation of these corridors would increase the potential for localized movement in these habitat extensions. Once the restoration process begins, long-term monitoring (Noss *et. al* 1997) will be essential to ensure that species such as grasshoppers are occupying the new habitat.

Acknowledgments

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Table 1. continued

Species	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Gomphocerinae														
Ageneotettix deorum (Scudder)	-	-	-	-	x	-	-	-	-	-	-	x	-	-
Choleatis conspersa (Harris)	x	-	-	-	-	-	-	x	-	x	-	-	-	-
Chorthippus curtipennis (Harris)	-	-	x	x	-	x	-	-	-	-	-	x	x	-
Dichromorpha viridis (Scudder)	x	-	-	-	-	-	-	-	-	x	-	-	-	-
Mermira bivittata (Serville)*	-	-	-	-	-	-	-	-	-	x	x	-	-	-
Opeia obscura (Thomas)	-	x	-	-	-	-	-	-	-	-	-	x	x	-
Orphellula pelidna (Burmeister)*	-	x	-	-	-	-	-	-	-	-	x	-	-	-
Pseudopomala brachyptera (Scudder)	-	-	-	-	-	-	-	-	-	x	-	-	x	-
Oedipodinae														
Arphia conspersa Scudder*	-	-	-	-	-	-	-	-	-	-	x	x	-	-
A. pseudonietana (Thomas)	-	-	x	x	-	-	-	-	-	-	x	x	x	-
A. sulphurea (F.)	-	-	-	-	-	x	-	x	-	x	-	-	x	-
Chortophaga viridifasciata (DeGeer)	-	-	-	x	-	-	-	-	x	x	x	-	x	-
Dissosteira Carolina (L.)	x	x	-	x	-	x	x	-	-	-	x	-	x	x
Encoptolophus sordidus (Burmeister)	-	-	x	-	x	x	-	-	-	-	-	-	-	-
Pardalophora apiculata (Harris)	-	-	-	-	-	-	-	-	-	x	x	x	x	-
Psinidia fenestralis (Serville)*	-	-	-	-	-	-	-	x	-	-	-	-	-	x
Spharagemon bolli Scudder	x	-	-	x	x	-	x	-	x	x	x	-	-	x
S. collare (Scudder)	-	-	-	-	-	-	-	x	-	-	x	x	x	x
S. marmarota (Harris)	-	-	-	x	x	-	-	-	-	x	x	x	x	-
Trimerotropis maritima (Harris)*	-	-	-	-	-	x	-	-	-	-	-	-	-	-

*species of special concern in Wisconsin

A= DNR-Tiffany, B= Golden Valley, C= Colfax-North, D= Colfax-Town, E= Colfax-West, F= DNR-Brush Is., G= DNR-Happy Is., H= DNR-Larrabee 2, I= NSP-Cobble Flats, J= NSP-Dushame Cr., K= NSP-Sandblows, L= Rock Falls RW, M= NSP-ECNHS, N= Round Hill

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Table 2. Ranked diversity indices (scores), number of grasshopper species and site size for fourteen remnant praires in the Lower Chippewa River State Natural Area, Wisconsin, U.S.A.

Site	Rank	score	# of species	ha
Rock Falls RW[1]	1	51.8	12	16
NSP-Sandblows	2	49.2	15	30
NSP-Dushame Cr.	3	46.8	12	12
NSP-ECNHS	4	46.3	14	16
NSP-Cobble Flats	5	44.9	8	20
Colfax-West	6	41.4	11	<1
Golden Valley	7	37.2	8	8
DNR-Larrabee 2	8	34.5	7	16
DNR-Brush Is	9	29.3	7	64
DNR-Happy Is.	10	27.1	6	19
DNR-Tiffany	11	25.7	7	20
Colfax-Town	12	23.3	10	<1
Colfax-North	13	16.6	6	<1
Round Hill	14	15.9	6	2

[1] Updated since Bomar 2001

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