Arthropods of Canadian Grasslands

Number 8 **2002**

Contents

Arthropods of Canadian Grasslands supports the grasslands project of the Biological Survey of Canada (Terrestrial Arthropods) by providing information relevant to the study of grassland arthropods in Canada.

356 species of spiders, including this salticid, are known from the prairie ecozone of Alberta and Saskatchewan. Read about this fauna on page 11

Contributions welcome

Please consider submitting items to *Arthropods of Canadian Grasslands*

Grassland site descriptions

Current research - project reports

Short news items

Feature articles

Grassland species accounts

Selected publications

Contributions such as these, as well as other items of interest to students of grasslands and their arthropods, are welcomed by the editor. This publication (formerly *Newsletter, Arthropods of Canadian Grasslands*) appears annually in March; final copy deadline for the next issue is January 31, 2003.

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Articles without other accreditation are prepared by the Editor.

The web site of the Biological Survey is at: http://www.biology.ualberta.ca/bsc/bschome.htm

Grasslands news

Prospectus available

The prospectus for the Arthropods of Canadian Grasslands is the framework for ongoing development of the Grasslands Project. This document describes the scope, objectives, rationale and anticipated products of the project. The prospectus also contains an overview of grassland habitats in Canada and a brief review of research to date on the arthropods of Canadian grasslands. Read the Executive Summary on page 5 of this newsletter and look for the complete text in the Grasslands section of the website of the Biological Survey of Canada (see inside front cover).

Second focus site

A series of annual group field trips in key grassland habitats began last year with a successful trip to Onefour (see report on p. 7). The site for 2002 will be the Tall Grass Praire Preserve in southeastern Manitoba. This is a geographically restricted, threatened and perhaps the most species-rich of Canada's grassland types. For more information on the July expedition please see p. 2.

BC Grasslands Mapping Project

The goal of the BC Grasslands Mapping Project is to produce a comprehensive inventory of BC grasslands. This project endeavours to map not only the well known, abundant grasslands of the Kamloops, Cariboo, and Nelson regions, but also the lesser known and smaller grassland ecosystems of the province.

The BC Grasslands Mapping Project is a three-year joint project of the Grasslands Conservation Council of British Columbia, government, and non-government organizations and is due to be completed in 2003. For further information see the website of the Grasslands Conservation Council of British Columbia: http://www.bcgrasslands.org.

Grasslands project action

Grasslands Publication in Planning Stages

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Unlike many previous initiatives of the Biological Survey of Canada, the scope of the grasslands project lends itself to multiple products, including three planned major volumes dealing with different aspects of the diversity, ecology and interactions of Canadian grassland arthropods. The first major volume will be entitled *Arthropods of Canadian grasslands: ecology and interactions in grassland habitats*. The focus of the chapters in this volume will be the ecological relationships and interactions of arthropods in selected grassland habitats. Many recent and ongoing studies of grassland arthropods have been designed to address ecological questions beyond strict species inventories. Such questions include analyses of community structure, changes in species assemblages, and effects of extrinsic factors, both abiotic and biotic, on diversity and abundance of species. This ecological approach is intended as a complement to the taxonomic

inventory-based approach such as that taken in the Biological Survey of Canada's *Insects of the Yukon*. Taxonomic inventories and species-level analyses will be the focus of a planned subsequent volume arising from this project. A final list of chapters and authors for the ecological volume is currently being compiled. Those wishing to propose a contribution to this volume, or those seeking more information on the volume, should contact Terry Wheeler, McGill University (wheeler@nrs.mcgill.ca).

Symposium 2002: Ecology of Arthropods in Canadian Grasslands

Terry A. Wheeler

Some of the chapters to be published in the above volume will be presented as invited papers at a formal symposium on Ecology of Arthropods in Canadian Grasslands at the Joint Annual Meeting of the Entomological Societies of Canada and Manitoba, to be held in Winnipeg, Manitoba on 08 October 2002. As for the volume described above, the focus of the symposium will be ecological and habitat-based studies on selected grasslands or taxa. Although some symposium contributors have already been confirmed, final organization continues. For more information contact the symposium organizer, Terry Wheeler (address above).

Grasslands project key site 2002: Collecting grassland arthropods in Manitoba

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What:	Prairie Insect Collecting at Gardenton, Manitoba, summer, 2002
Where:	Tall Grass Prairie Preserve, Gardenton, Manitoba
When:	July 11-17, 2002
How:	Contact Rob Roughley (see above), bring your camping and collecting gear and get busy!

The Tall Grass Prairie Preserve (TGPP), located in southeastern Manitoba, was established in 1989. It was discovered following an extensive search for remnant tall grass prairie habitat in the province. Located an hour from Winnipeg, TGPP is situated along the eastern edge of the historical range of tall grass prairie habitat in Manitoba. In places the tall grass prairie habitat exists as pure stands, blends with the adjacent aspen parkland, or blends into oak savanah habitat. The TGPP is home to a diverse floral and faunal community with more than 36 species of mammals, 130 species of birds, 5 species of amphibians, 5 species of reptiles, and 250 species of plants including three endangered, and three threatened plant species. The insect community has been under-sampled: only the Lepidoptera have been examined in detail and includes 50 species of butterflies and skippers and 270 species of moths.

(Photo by C. Borkowsky)

The TGPP topography slopes gently to create contrasting upland and wetland areas that merge seamlessly into one another. Upland areas are dominated by big blue stem (*Andropogon gerardi*) and Indian grass (*Sorghastrum nutans*) and decades of fire suppression have allowed oak (*Quercus macrocarpa*) and aspen (*Populus tremuloides*) trees to mature. Low lying portions of the TGPP are dominated by sedges (*Carex* spp.) with prairie cord grass (*Spartina pectinata*) and willow shrubs (*Salix* spp.) filling in the intermediate areas. During the time of the collecting trip, nearly 30 species of plants will be in full flower including the endangered western prairie fringed orchid (*Platanthera praeclara*), an event that has drawn visitors from across Canada and around the world. While several smaller populations are known from the United States, the population in southeastern Manitoba is the only one in Canada and is by far the largest on the continent. This species stands nearly 45 cm tall and produces two to 15 creamy white flowers, each of which measures approximately 4 cm in diameter. The evening air is filled with its vanilla-like fragrance that serves to attract its hawkmoth pollinators.

The TGPP has grown from the initial 130 ha purchase in 1989 to 2 500 ha, and is arranged into three distinct areas, the north, central and south blocks. A self-guided hiking trail, located in the south block, was designed in the late-1990s to provide visitors with the opportunity to learn more about the habitat as well as the cultural history of region. English settlers were the first to arrive in this area more than 100 years ago; however, after barely surviving their first Manitoba winter and attempts to farm the rocky soil, most left the area and moved farther west. The Bukovinian settlers from western Ukraine were the next to arrive and while it was a struggle, they were able to carve out a living off the rugged land. The Ukrainian Museum, located in Gardenton, hosts an annual festival to celebrate the cultural history of the area, complete with traditional music, costumes,

(Photo by C. Borkowsky)

and food. St. Michael's Church, located 2.5 km west of Gardenton, was the first permanent Ukrainian Greek Orthodox church built in Canada and continues to serve the community.

All lands within the Preserve are open to the public; however, access does not include motorized vehicles. On-site, seasonal staff includes the manager, an ecologist, and a botanist; all will be on hand during the time of the collecting trip. The headquarters for the Preserve is located on a former homestead and provides accommodations and office space for staff. Space will be available for sorting and processing insect samples and for other equipment. Visitors may choose to camp at the headquarters or stay in either Tolstoi or Vita.

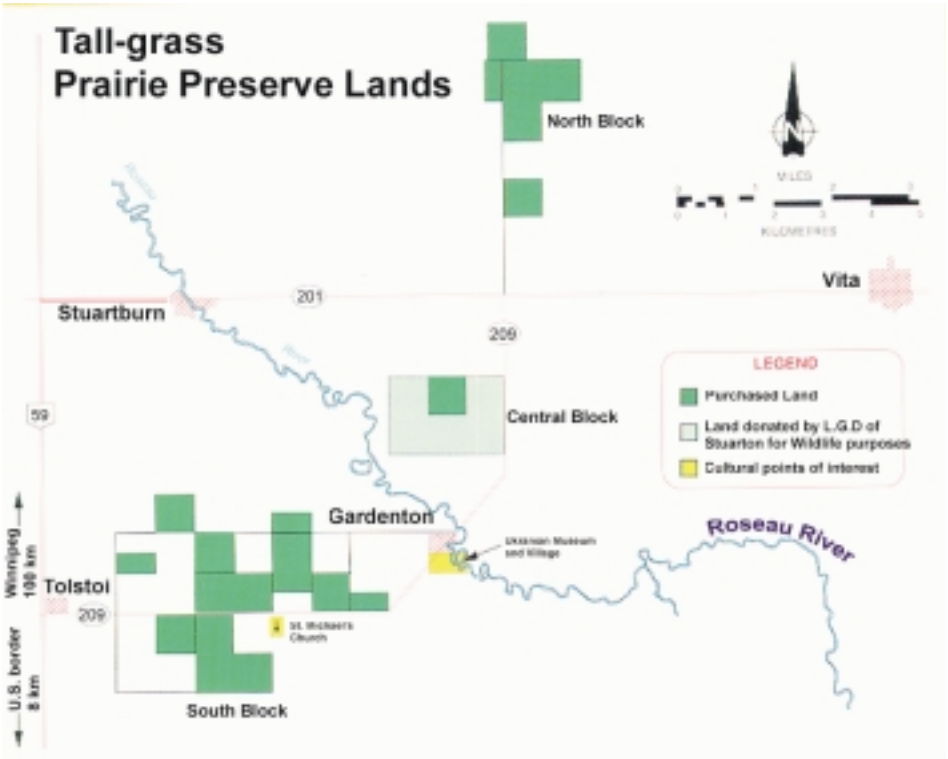
The following links have more information on the Manitoba Tall Grass Prairie Preserve:

Environment Canada (includes a map of the area):
http://www.mb.ec.gc.ca/nature/whp/df00s08.en.html

Manitoba Naturalists Society:
http://www.manitobanature.ca/mbtgprbr.html

Nature Conservancy of Canada – Manitoba Branch :
http://www.natureconservancy.ca/files/frame.asp?lang=e_&region=5&sec=ma_welcome

Manitoba Conservation – Wildlife Branch :
http://www.gov.mb.ca/natres/wildlife/managing/cwhp_tallgrass.html



(Map courtesy of Environment Canada)

Prospectus
Arthropods of Canadian Grasslands
An Initiative of the Biological Survey of Canada
(Terrestrial Arthropods)

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Executive Summary

Grasslands are one of Canada's major biomes. The largest expanse of grassland spans the southern portion of the prairie provinces, but similar grasslands are found from the Yukon to eastern Ontario. Canada's grasslands have been heavily exploited for agriculture and, as a result, these ecosystems are now threatened. Despite their intensive use by humans, we know very little about the biodiversity, ecology and responses to habitat change in grassland communities. This lack of knowledge is especially acute in the insects and other arthropods, which are the most diverse, abundant and ecologically important group of animals in grassland habitats. The Grasslands Project of the Biological Survey of Canada (Terrestrial Arthropods) is a major national effort to address this lack of knowledge.

The long-term objectives of the Grasslands Project are to address three major questions:

- What is the biodiversity of arthropods associated with Canadian grasslands?
- What are the ecological interactions between arthropods and other species in Canadian grasslands?
- What is the impact of human activity and climate change on grassland arthropods and, conversely, what are the impacts of grassland arthropods on human activities?

(Photo by J.D. Shorthouse)

Answering these questions will involve many collaborators conducting systematic and ecological research in Canadian grasslands. Fieldwork and collecting in a range of grassland habitats will facilitate taxonomic studies of grassland-associated arthropods. Systematic research provides the necessary framework into which ecological and other applied studies must be placed. Standardized sampling programs in selected habitats will provide quantitative data on arthropod populations for analyses of similarities and differences among the arthropod communities of different localities and grassland types. Given their intimate connection with the development of agriculture in western Canada, grasslands provide an excellent system to study impacts of human activities on relatively simple ecosystems, as well as the potential effects of long-term factors such as climate change.

The products and applications of the Grasslands Project will be diverse. Core knowledge on arthropod diversity and ecology will provide a long-term source of specimens and data for future studies in grassland arthropod biology. Major volumes on the biodiversity of grassland arthropods, the ecology of arthropods in selected habitats, and the interaction between human activities and arthropods will provide a visible means of disseminating the knowledge gained from this project. Once this systematic and ecological framework is in place, there will be many opportunities for the future use of arthropod data in applied studies such as habitat conservation, and monitoring the effects of agriculture, fire, climate change and other habitat alterations.

With growing public awareness of the Biodiversity Crisis, the scientific community is under pressure to understand and preserve ecosystems. At the same time, Canada's international obligations dictate that we catalogue, monitor and protect the flora and fauna within our borders. Thus, there is an urgent need to survey the biodiversity of grassland arthropods, the majority of which play as yet undiscovered roles in these important ecosystems. The Biological Survey of Canada is the organization best suited to coordinate this major project.

(Photo by J.D. Shorthouse)

Entomologists swarm to Onefour in 2001

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Onefour, Alberta was the scene of last summer's first Survey-sponsored field trip to promote the collection and identification of Canada's grassland arthropods. Co-organized by Survey members Rob Roughley and Kevin Floate, entomologists swarmed to the site from British Columbia, Alberta, Manitoba, Ontario and North Dakota.

Onefour (49° 07 00" N; 110° 28 00" W) is a substation of the federal government's Lethbridge Research Centre. Established in 1927, the substation is located in the far southeast corner of the province; one township north of the United States border and four townships west of the Saskatchewan border. The nearest grocery store and gas station are in Elkwater in Cypress Hills Provincial Park, about an hour's drive to the north. Foremost, about 1.2 hours to the northwest, is the nearest sizable population centre with about 600 occupants.

The Onefour substation, encompassing some 17,000 hectares, is the largest ranch operated by the Canadian government. A herd of several hundred animals is maintained primarily for research on beef genetics and range management. A core staff of federal employees live at the ranch headquarters. The headquarters is surrounded by shelterbelts and consists of a main office building, several houses, a maintenance shop, cattle-handling facilities, and a community hall for use with permission of the Onefour ranch manager.

Much of the Onefour property is comprised of native grassland, with lesser areas of badlands associated with the Lost River valley, which joins with the Milk River valley just south of the U.S. border. Because of its relatively pristine state, portions of the property combined with the neighouring Pinhorn and Sage Creek Provincial Grazing Reserves were designated in December 2001 as the Onefour Heritage Rangeland (111.65 km^2) by the Alberta government (see inset).

The Onefour Heritage Rangeland is representative of Alberta's Dry Mixedgrass Subregion, which is the warmest and driest part of the province. Its continental climate has cold winters, warm summers and low precipitation. Warm temperatures and a high average wind speed promote a high rate of evaporation during summer months. Mean maximum summer temperatures average 24 °C with mean minimum winter temperatures of -13 °C. This pattern explains why Onefour occasionally appears in the national spotlight as Canada's daily hot or cold spot. Total precipitation averages 272 mm for the year.

Habitat can best be described as extensive grassland and ephemeral wetlands with minor badlands and riparian shrublands along streams. Numerous species of rare plants have been reported with some of the only populations of yucca in Canada growing on the Onefour property. Rare

What is a "Heritage Rangeland"? Heritage Rangelands are a class of protected area under Alberta's 'Special Places' program. This program preserves areas representative of the province's natural regions and subregions.

The classification permits grazing by local ranchers and public access with the permission of leaseholders. Use of motorized vehicles and bicycles is generally banned, as is commercial tourism and the establishment of recreation and camping facilities. Existing infrastructure associated with surface access to mineral deposits is phased out and no new surface access is granted. Existing pipeline right-of-ways are honoured, and may be expanded if no other reasonable alternatives can be identified.

species of birds reported for the area include the mountain plover, bobolinks, Baird's sparrow, ferruginous hawks, burrowing owls, loggerhead shrikes, and sage grouse. Swift fox have been released in the vicinity and deer are common.

With part of the property now designated as a "Heritage Rangeland", the federal government has an increased responsibility to ensure that its activities at Onefour do not adversely affect rare or endangered species of arthropods. However, management practices to ensure this outcome cannot be implemented until a comprehensive survey of arthropods has been completed. This survey is currently being performed under the direction of Dr. Dan Johnson of the Lethbridge Research Centre (see inset). Selection of Onefour as the Survey's first location for a grassland arthropod survey was partially to assist in this endeavour.

The expedition!

To accommodate diverse schedules, entomologists were invited to Onefour during the last week of June and the first week of July. Several folks stayed at Elkwater and travelled to Onefour during the day. Hardier souls tented at the ranch headquarters, making good use of the community hall for meal preparation and insect sorting. Ian Walker, the Onefour ranch manager, and his staff were the perfect hosts. Not only did they provide directions and maps to 'prime' collecting habitat, several people were given guided tours of the property and Ian even greeted new arrivals with a large windscorpion (Arachnida: Solifugae). Several other specimens of these critters, absent in most of Canada, were later collected.

Upon arrival, participants checked in at the main office building and signed the guest book. With this administrative duty out of the way, folks had considerable freedom to collect with only a few restrictions. Visitors were asked to drive only on roads, to stay out of pastures with

Grassland insects at Onefour (short grass), Stavely (fescue), and Suffield (National Wildlife Area), AB

Dan Johnson has collections of arthropods from Onefour obtained using pitfall traps, yellow pan traps and sweep netting. The most recent collections were made weekly during summer months in 2000 and 2001. He also has periodic collections from fescue grassland at Stavely, in the foothills of the Rocky Mountains, and Suffield (1993-94, and current).

Identifications of a few arthropod groups are complete, but many remain. Dan is interested in communicating with others collecting in grassland, and especially with people interested in collaborating on detailing the biodiversity at these and other grassland sites. If you are interested in particular groups, arrangements could be made for collections or sorting. Phone (403) 317-2214, fax 382-3156, or e-mail at: JohnsonDL@em.agr.ca

cattle, and to close all gates. After three years of drought and several previous fires on the property, everyone also was asked to take extreme precautions to avoid starting grass fires. In 2001, precipitation at Onefour was 50% of the long-term average with mean daily temperatures 2 °C above normal.

Despite the dry conditions, there was much to see. Yucca moths were observed on their host plants, and long-horned milkweed beetles (Cerambycidae: *Tetraopes* sp.) were abundant on common milkweed in the Milk River valley. Several species of mites were recovered, including a first report for Canada (see inset). Observations of macrofauna included antelope and rattlesnakes, and even a few dinosaur fossils.

Depending upon individual objectives, efforts were made to collect arthropods with yellow pan traps, sweep nets, soil cores, black lights and even aquatic dip nets in the few places where water could be found. A thunderstorm early one evening provided a spectacular light show, much needed moisture, and a local power outage. Undaunted by muddy roads and further showers, the more avid collectors set out black light traps later in the evening with considerable success.

Unexpected mite at Onefour

Graham Osler, Derrick Kanashiro and Linda Hamilton came in search of soil mites, but they weren't expecting to recover a species of *Alycosmesis* (Terpnacaridae). The first report of this genus in North America was from New Mexico early in 2001. Its recovery at Onefour is the first report for Canada.

The species seems to be unique to sand dunes or dry sandy areas. Its recovery at Onefour was from an area of active sand dunes.

The following day, a small troop of people drove 25 kilometers west of Onefour to the Pinhorn Provincial Grazing Reserve. There, in the span of about an hour, the previous night's storm had started a grass fire, hailed, and then extinguished the fire with rain of almost biblical proportions. Whereas a respectable 13 mm of rain fell at Onefour, an impressive 50+ mm fell on the Pinhorn reserve. Individuals skeptical of this total quickly were convinced by wading through pools of water on previously arid pasture.

Badlands near Onefour.

At the request of Manitoba visitors, a "Restricted Research and Collection" permit was obtained in advance to allow participants of the Onefour expedition to collect arthropods in Cypress Hills Interprovincial Park. The park straddles the Alberta/Saskatchewan borders and contains areas of fescue grassland and mixedgrass prairie. However, it is most renowned as a montane oasis characterized with lodgepole pine forest and a vegetation understory more normally associated with the Rocky Mountains 300+ km to the west.

All in all, the expedition was a great success. Many specimens were recovered to aid in developing a comprehensive inventory of Canada's prairie arthropods. Attendees were able to exchange ideas and form new contacts. Perhaps the best outcome, however, was a renewed appreciation for Canada's grasslands as expressed by T. Mousseau's first impressions of Onefour.

"Miles and miles of dry, barren grassland nothingness enclosed the lonely agricultural sub-station of Onefour. Above this thirsty, echoing landscape, a blue sky stretched with no ending. This perceived emptiness, however, was nothing more than a mirage, as the surrounding area was filled with exceptional beauty of both scenery and life, nothing like I had ever seen before. As someone who grew up on the coast of BC, Onefour offered me a unique experience over and above the opportunity to collect insects.

Unfamiliar flora and fauna were discovered as the Onefour area was explored. The last trickling droplets of the Lost River had seen its time of carving the fossil-filled valley slopes above. Along these mild cliffs were Yucca plants, with the last of their petals falling at the end of bloom. With careful observation and to much pleasure, the true Yucca moth, Tegeticula yuccasella and the cheater moth, Prodoxus were seen. Squishing fingers around in sodden, soppy cattle dung gratefully produced both adults and larvae of many different species of dung beetles. These are just a few of the interesting memories I have of Onefour."

T. Mousseau

Participants on the Onefour experience included: Greg Pohl, Jason Machney and Doug Macaulay (Canadian Forest Service, Edmonton), Ernest Mengersen (Olds College, Olds, AB), Steve Marshall (University of Guelph, Guelph, ON), Robert Gordon (Smithsonian Institute, retired), Derrick Kanashiro, Linda Harrison, Graham Olson and Kevin Floate (AAFC, Lethbridge), Rob Roughley, Keegan Roughley, David Wade and Tonya Mousseau (University of Manitoba, Winnipeg, MB), Joe Shorthouse (Laurentian University, Sudbury, ON) and Robb Bennett (B.C. Ministry of Forests, Saanichton, BC).

Related links:

Alberta's Special Places program: http://www.cd.gov.ab.ca/preserving/parks/sp_places/index.asp

Alberta's Dry Mixedgrass Subregion: http://www.cd.gov.ab.ca/preserving/parks/anhic/drymxgrs.asp

Cypress Hills Provincial Park: http://www.cypresshills.com/

Prairie Spiders of Alberta and Saskatchewan

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Abstract

In the prairie ecozone of Alberta and Saskatchewan, 356 species of spiders in 21 families have been collected. The 10 families with the most species were Linyphiidae (30%), Gnaphosidae (13%), Salticidae (8%), Theridiidae (8%), Lycosidae (8%), Dictynidae (6%), Thomisidae (6%), Araneidae (5%), Philodromidae (5%) and Clubionidae (3%). These 10 families constituted 91% of the spider biodiversity. In the grassland region of the prairie ecozone, there were relatively more species of Gnaphosidae, Lycosidae, Theridiidae, Thomisidae, Dictynidae and Philodomidae and fewer Linyphiidae and Clubionidae than for all provincial ecozones combined. The percentages in the parkland region of the prairie ecozone tended to be intermediate.

Introduction

Spiders (Araneae) are important predators of insects and similar-sized invertebrates in nearly every terrestrial ecosystem. They are the sixth most diverse Order (after Coleoptera, Hymenoptera, Diptera, Hemiptera and Acari) with 37,596 described species in 109 families (Platnick 2002).

In Canada, the prairie ecozone encompasses the southern regions of Alberta, Saskatchewan and Manitoba. The ecozone occupies 23.8% and 37.2% of Alberta and Saskatchewan; a total of 30.5% for both provinces combined. (Data derived from the map produced by Ecological Stratification Working Group 1995.) Currently, there is little published information on spiders specifically from the Canadian prairie ecozone (Doane and Dondale 1979, Finnamore and Buckle 1999, Pepper 1999). However there is relevant information in works dealing with larger areas (Benell-Aitchison and Dondale 1990, Dondale and Redner 1978, 1982, 1990, Leech 1972, Platnick and Dondale 1992). There is also minor information scattered in various other publications (not listed here).

This paper summarizes what is known about the spider biodiversity in the prairie ecozone of Alberta and Saskatchewan and compares it for the entire spider fauna of these two provinces.

Spider Collections

This work is based on collections done by others and us, as well as the publications mentioned above. Nearly all of the identifications of the unpublished specimens were done or checked by DJB. The major collection sites are shown in Figure 1. These sites had at least one month of pit trapping usually supplemented with sweeping and hand searching. Data from many other miscellaneous collection sites were used also. Table 1 lists the major sites but divides them into two groups - grassland (southern prairie, dominated by grasses with trees only in river valleys) and parkland (northern prairie, grassland with scattered clumps of trees). Table 1 also lists the principal collectors.

Table 1. Major collection sites in the grassland and parkand regions of the prairie ecozone as well as the principal collectors. See also Fig. 1.

Collection sites	Collectors
Grassland	
Lethbridge, AB	RGH
Suffield, AB	A. (Bert) L. Finnamore; see Finnamore and Buckle (1999)
Writing-on-stone, AB	David B. McCorquodale
Cadillac, SK	Jeanette Pepper; see Pepper (1999)
Grasslands National Park, SK	A. (Bert) L. Finnamore (paper in preparation)
Hodgeville, SK	Ken Pivnick
Matador, SK	Paul Riegert
Shaunavon, SK	Jeanette Pepper; see Pepper (1999)
Simmie, SK	Jeanette Pepper; see Pepper (1999)
Parkland	
Edmonton, AB	RGH
Hanley, SK	Ken Pivnick
North Battleford, SK	Ken Pivnic
Saint Denis, SK	Ken Pivnick
Saskatoon (Clavet), SK	J.F. Doane; see Doane and Dondale (1979)
Saskatoon (Kernen's Prairie), SK	Ross Lein

Fig. 1. Map of major spider collection localities in the prairie ecozone of Alberta and Saskatchewan.

Results

We have documented 247 species in 19 families from the grassland region of the prairie ecozone and 356 species in 21 families from the combined grassland and parkland regions of Alberta and Saskatchewan. This compares with 662 species in 23 families for all six ecozones of the provinces (Table 2). In other words, the prairie ecozone has 54% of the species and 91% of the families present in the two provinces.

Ten families represented over 90% of the species diversity in all three tabulations (grassland, grassland + parkland, all province ecozones). In all cases, the Linyphiidae was the most diverse family. The Clubionidae held the 10th place consistently. The other eight Families changed positions relative to one another. Salticidae, Gnaphosidae and Lycosidae always ranked in the top five. Theridiidae, Thomisidae and Dictynidae always ranked between 4th and 7th. Araneidae and Philodomidae always ranked 8th or 9th. There were relatively more species of Gnaphosidae, Lycosidae, Theridiidae, Thomisidae, Dictynidae and Philodomidae and fewer Linyphiidae and Clubionidae in the grassland than in the provincial percentages. The parkland percentages were intermediate or similar to the provincial data. The exception was the Theridiidae, which were highest in the parkland percentages and lowest in the provincial.

Discussion

Figures 2, 3 and 4 show the species percentages of the dominant spider families in grassland, prairie, and all Alberta and Saskatchewan ecozones combined. For clarity, only the top seven families are shown. The remaining 12 to 16 families are lumped into "Other".

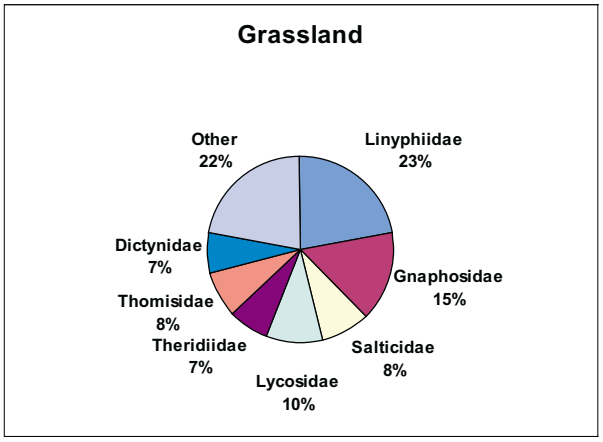

Fig. 2. Relative percentages of the seven families of spiders with the most species in the grassland region of the prairie ecozone.

The following is a very brief overview of habits of the 10 families containing the most species.

Linyphiidae (dwarf spiders, sheet web spiders) primarily are small and live in leaf litter and amongst low vegetation. They spin small webs to catch their equally small prey. It is surprising to find that, although there often is relatively little leaf litter in grasslands and vegetation is very short, this family still dominated the spider biodiversity at 23% of species. However by including moister ecozones to the north and west, this percentage of the spider species increased to 39%.

Gnaphosids (ground spiders) spend the day in silken retreats under stones, bark and debris. At night they wander out to catch their prey. Their diversity peaked at 15% of species in the grassland but was only 9% when all ecozones were considered.

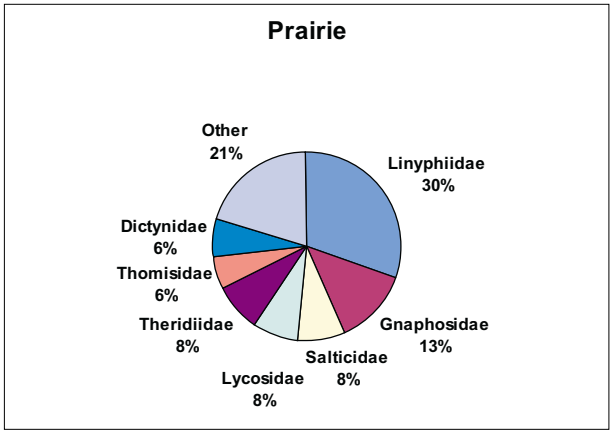

Fig. 3. Relative percentages of the seven families of spiders with the most species in the prairie ecozone (grassland + parkland).

Salticidae (jumping spiders) are diurnal hunters with good eyesight. They are less frequently caught in pit traps and so the true numbers of species in the various ecozones are probably considerably higher than our figure of 8% suggests.

Lycosidae (wolf spiders) are ground dwellers that are active during the day and, if warm enough, at night. They favour open areas and so were more diverse in grasslands than in other regions. For the casual observer, these spiders are more often encountered than most other families. They attained 10% of species in the grassland but were only 8% in the provincial totals.

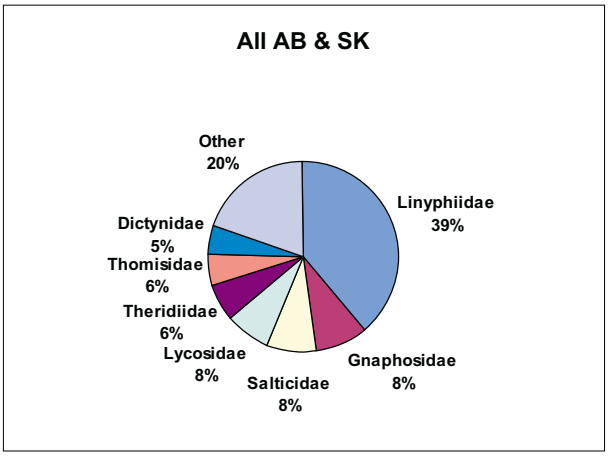

Fig. 4. Relative percentages of the seven families of spiders with the most species in Alberta and Sasakatchewan.

Theridiidae (comb footed spiders) tend to make small, irregular cobwebs amongst vegetation, stones or bark. They constituted 8% of the fauna in both the grassland and prairie data and 6% in all ecozones.

Thomisidae (crab spiders) are ambush predators. Most inhabit the leaf litter, but some inhabit flower heads and await pollinating insects. This family reached 8% of species in the grasslands but only 6% in the other areas.

Dictynids are small, cribellate spiders that form irregular webs at the tips of leaves or flowers or in crevices. They peaked in the grassland at 7% of species but were only 5% when all ecozones were considered.

Araneidae (orb weavers) tend to be large, by Canadian standards, and spin flat, circular webs on shrubs and lower vegetation. Their webs are very obvious to humans and so they are often overly represented in sweep and hand collections. They attained about 5% of the biodiversity in all three areas under consideration.

Philodromids (also called crab spiders) are closely related to the thomisids. Their flattened bodies and laterigrade legs allow them to move easily through tight spaces in the vegetation and on the ground. They were most abundant in the grassland, about 7% of species, but were only about 4% in the provincial totals.

Clubionidae (sac spiders) make silken tubular retreats in curled leaves or among stones and bark. Most are nocturnal but some are diurnal. They contributed only 2 or 3% of the biodiversity.

Of these ten families, six can be grouped as wandering spiders that catch prey without using a web. The Linyphiidae, Theridiidae, Dictynidae and Araneidae are more sedentary and use webs for prey capture. In the grassland, wandering species outnumbered web spinners about 1.2 to 1 (cf. 1.6 to 1 web-spinner species to wanderers in all ecozones). Note that, because they are on the ground most of the time and move about, wandering spiders are more easily collected in pit traps than the web spinners and so the numbers of *individuals* collected, by this very common collecting method, are biased towards the wanderers. However the relative number of *species* is probably close to reality. This is because 1) even with pit traps alone, web spinners are caught, especially adult males that are searching for females, and 2) most collectors also do sweeping and hand collections.

Table 2. Families and species of spiders in the grassland, prairie (= grassland + parkland) and all of Alberta and Saskatchewan.

Family	Grass-land species	Prairie species	Total for AB & SK
Linyphiidae	55	109	258
Salticidae	20	29	56
Gnaphosidae	38	45	56
Lycosidae	24	27	50
Theridiidae	18	29	41
Thomisidae	19	21	37
Dictynidae	18	23	33
Araneidae	12	16	30
Philodromidae	16	16	24
Clubionidae	6	10	2
Tetragnathidae	3	6	13
Agelenidae	3	3	11
Hahniidae	3	6	8
Liocranidae	4	5	5
Amaurobidae	0	0	5
Corinnidae	3	3	3
Titanoecidae	2	2	2
Mimetidae	1	2	2
Pisauridae	1	1	2
Uloboridae	0	0	2
Oxyopidae*	1	1	1
Anyphaenidae	0	1	1
Pholcidae**	0	1	1
Totals	247	356	662

*present in Alberta but absent from Saskatchewan

**introduced

When people think of the prairies, they usually think only of dry grasslands devoid of trees. However even the driest grasslands do have occasional wetlands, such as temporary ponds and streams and wooded areas in ravines and along watercourses. Such areas increase biodiversity substantially by promoting species that are typical of other ecozones. On the other hand, many typical prairie species can be found in dry, sparsely vegetated habitats of wetter, forested ecozones such as sandy areas along rivers, open areas of boreal forests, and rocky south-facing slopes of mountains. Thus only a few species are truly endemic to the prairie ecozone.

Not all spiders could be associated with current species names. As most spider taxonomy of North America has been done farther east or south, about 14% of the prairie species are undescribed or uncertain. Most of these are in the Linyphiidae and Salticidae.

Of the six ecozones of Alberta and Saskatchewan, the spiders of the prairie ecozone are the most thoroughly sampled. Thus the number of species reported here for the prairie ecozone should not increase as much as current estimates for such ecozones as the montane cordillera (all in Alberta) and the boreal shield (nearly all in Saskatchewan).

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Spur-throated grasshoppers of the Canadian Prairies and Northern Great Plains

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The spur-throated grasshoppers have become the most prominent grasshoppers of North American grasslands, not by calling attention to themselves by singing in the vegetation (stridulating) like the slant-faced grasshoppers, or by crackling on the wing (crepitating) like the band-winged grasshoppers, but by virtue of their sheer numbers, activities and diversity. Almost all of the spur-throated grasshoppers in North America are members of the subfamily Melanoplinae. The status of Melanoplinae is somewhat similar in South America, where the melanopline *Dichroplus* takes the dominant role that the genus *Melanoplus* holds in North America (Cigliano et al. 2000). The biogeographic relationships are analysed by Chapco et al. (2001). The grasshoppers are characterized by a spiny bump on the prosternum between the front legs, which would be the position of the throat if they had one. This characteristic is easy to use; I know elementary school children who can catch a grasshopper, turn it over for a look and say "melanopline" before grabbing the next.

The subfamily Melanoplinae is represented by the most commonly known grasshopper in North America, *Melanoplus sanguinipes*, the lesser migratory grasshopper. This subfamily is also the most diverse grasshopper group, with hundreds of species adapted to living in many grassland and forested ecoregions, from arctic to tropics, and from alpine to desert. Most of the melanopline grasshoppers have a one-year life cycle and eggs that overwinter in soil, but the diversity in habitat and food preferences can be extreme. The group contains flightless species that inhabit meadows and mountaintops, as well as excellent long-distance fliers like the lesser migratory grasshopper and *M. spretus*, the Rocky Mountain locust, the now extinct (or merely extirpated, and hiding in the valleys?) scourge that wiped out so much of mid-western agriculture in the 1870's.

Approximately 40 species of grasshoppers in the subfamily Melanoplinae (mainly Tribe Melanoplini) can be found on the Canadian grasslands, depending on weather and other factors affecting movement and abundance. The following notes provide a brief look at representative spur-throated grasshoppers that I have collected and observed during more than 20 years of frequent collecting on grassland mainly in Alberta and Saskatchewan, with emphasis on species that are significant in agroecosystems or unique in some way. I focus in this article on lower grassland ecozones, but I include a few grasshoppers that represent higher elevation grassland faunas (which could form a separate article in a montane survey newsletter). I also include some species whose distributions overlap the boundaries of grassland, parkland, boreal and montane ecoregions.

The descriptions, in alphabetical order, give a few details on the lives of these grasshoppers and how to recognize them. The accompanying

photos show examples of how they appear in western Canadian grassland and regions immediately south of the border (color, size and appearance vary with geography to some extent). Actual species identification for the purposes of diversity studies must be based on detailed examination of anatomy (for example male furculae, genital plates and cerci), but for the purpose of this article I have tried to rely only on characters observable with the unaided eye.

***Aeoloplides turnbulli* (Thomas)**

Russian thistle grasshopper (also called thistle grasshopper or Turnbull's grasshopper)

I once proposed (1995 Annual Meeting of the Entomological Society of Canada) that *Psoloessa delicatula*, a slant-faced grasshopper (this subfamily is the subject of a future article) be classified as a beneficial species because of its dominance in the diet of grassland songbirds early in the spring. There are other beneficial grasshoppers that deserve beneficial status, not for being food items, but rather for feeding on weeds. *A. turnbulli* is known to feed mainly on tumbleweed (also known as Russian thistle), Kochia and other plants in the family Chenopodiaceae, some of which are considered to be weeds. This choice of food plant is interesting, because I have seen plenty of evidence since 1983 that melanopline pest species, such as the lesser migratory grasshopper, will starve in the presence of kochia, and eat every other plant except this weed, which sometimes results in a pure stand of young kochia plants in drought-stricken pastures.

You can recognize the Russian thistle grasshopper by the robust pronotum (shield covering the thorax), three bands on the hind femur, and general greenish color, often with nicely contrasting orange antennae. Some keys refer to tegmina (hindwings) being shorter than the abdomen, but often this is not the case.

***Buckellacris nuda* (E.M.Walker)**

Buckell's timberline grasshopper

When considering grassland biomes, we might forget how widespread and distinct the montane and alpine grasslands are in the world. In Canada, the montane and alpine grass meadows are limited to narrow and fractured zones that nonetheless harbor their special grasshoppers. Buckell's timberline grasshopper is so adapted to alpine living, among the avens (dryas), alpine bluegrass, and heather, that it cannot come down to the lower levels and survive. I have collected grasshoppers in transects from the lower grasslands to the tops of mountains, from the US border north to Kananaskis, Banff, Lake Louise, Jasper and Yoho, and, if present at

A male at Waterton Lakes National Park, where grassland meets the mountains.

A pair at the top of Mt. Norquay, Banff, AB, on a south-facing grass-sedge meadow.

all, this species is always at the top of the vegetation zone, after the lesser migratory, Dawson's, boreal, huckleberry, montane and alpine grasshoppers have dropped out, usually in that order. *B. nuda* represents the tenacity of life under harsh and fluctuating conditions, and it is well worth a trip to the mountains just to see it. You can recognize this species by the dark eyes, snakeskin pattern on the back, complete lack of any vestige of wings (apterous), and the fact that you are probably standing 1500 to 2600 m above sea level.

All of the grasshopper species mentioned in this report are in the family Acrididae, subfamily Melanoplinae, and tribe Melanoplini, except *B. nuda*, which is in tribe Podismini.

Hesperotettix viridis pratensis Scudder

Meadow purple-striped grasshopper

The meadow purple-striped grasshopper (in the US, also called the snakeweed grasshopper and the green-striped grasshopper) is never abundant, but when found it is usually near its preferred food plants, including some classed as weeds by ranchers: ragweed (*Ambrosia*), snakeweed (*Xanthocephalum*), goldenrod (*Solidago*), and sage (*Artemisia*).

H. viridis pratensis can be recognized by colour. It is striped with bright green, white and pink on all femora, and often with pink antennae and a fine black chevron on the hind femora (the part shaped like a drumstick in grasshoppers).

Melanoplus alpinus Scudder

Alpine grasshopper

This species lives in the upper reaches of the foothills fescue grassland and in montane and sub-alpine grassland meadows, where it eats a mixture of grass and forbs. In some lists you will see it reported as common in Canadian foothills, but during the past 20 years it has been almost absent, except in periods with several years of warm, dry summers and mild winters.

This grasshopper is usually yellowish in color, with gray-green coloration on the head and pronotum. The wings are long, extending past the end of the abdomen, but it rarely flies as readily or as far as other species found in the same middle elevation zone (for example, the clear-winged grasshopper discussed in the previ-

ous article in this series, Johnson 2001). The species is easily distinguished from other *Melanoplus* species by the unique male cerci shaped like an antler (staghorn). Most melanopline cerci are shaped more like a fingernail or flattened thorn. The only other species with a staghorn-shaped cercus is *M. infantilis*, a much smaller grasshopper which in Canada tends to occur on lower, drier grassland sites (although the species may occur together in US grasslands).

***Melanoplus bivittatus* (Say)**

Adult female of *M. bivittatus.*

This species feeds on a wide range of plants, unlike many grasshoppers which avoid plant defences by feeding mainly on grasses (Johnson et al. 2001). This natural readiness to eat broad-leafed plants has resulted in pest status on a wide range of new crops (Johnson and Mündel 1987). It was recently discovered that this grasshopper has unique mechanisms that allow it to feed on toxic plants such as timber milkvetch (Johnson et al. 2001). It is one of the heavier species, with high rate of consumption of green plant tissue and a high rate of reproduction. Because of these attributes, the appearance of Europeans and farming transformed this species from one that was probably restricted to small trampled or lush spots on the grassland, into one of the most damaging insect pests of cereal crops, forages and even oilseed crops. Among the melanopline grasshoppers, it is the first to hatch and often does so in large numbers.

Two-striped grasshopper

In 1984-86, it caused losses of tens of millions of dollars worth of cereal crops in Alberta and Saskatchewan, and was reduced in numbers somewhat by an isolate of the fungus *Entomophaga grylli* that mainly attacks this species (Erlandson et al. 1988).

It is a favorite food of larger birds; the hind femora are commonly found in the regurgitated pellets of Burrowing Owls, and during a research study on bird diets we once collected a

5th instar of *M. bivattatus.*

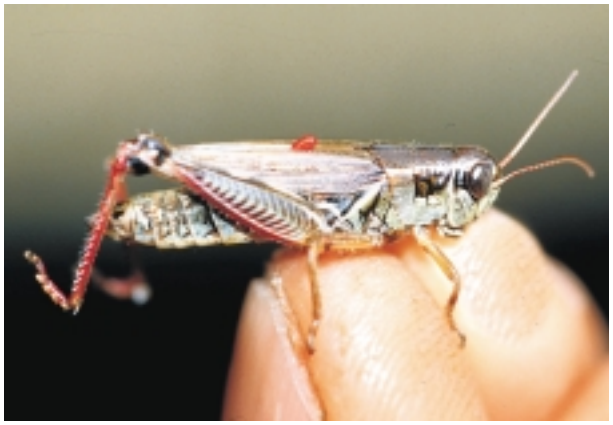
ring-billed gull with 585 5th instars and adults of this species, plus a ham sandwich (Johnson and Dore, unpublished). This species can be recognized by the prominent longitudinal stripes on the dorsal surface, solid black stripes on the hind legs, and green and yellow color (but note that nymphs can be brown, tan, lime green, or yellow-orange, like the fifth-instar in the photograph).

Melanoplus borealis (Fieber)

Northern grasshopper

This species feeds on grass and sedge, with occasional forbs. Unlike many of the melanopline grasshoppers found on the lower elevation grasslands, it is capable of thriving in cool and moist habitats. It is one of a small number of grasshoppers near the northern treeline (I have collected it at Porter Lake, NE of Great Slave Lake). It rarely flies, and can be collected by flushing and watching for short jumps which it expertly directs into

Male *M. borealis* from the interface of grassland and forest at Kananaskis, AB.



Female *M. borealis* with an attached red mite (*Eutrombidium locustarum*).

nearby vegetation. The life cycle of this and some other grasshoppers living at higher elevation or latitude requires two years for completion, and numbers tend to fluctuate in odd and even years at some sites, perhaps indicating part mortality events. When collecting in northern foothills or lower montane grassy sites, you can spot this species by the blood-red hind tibiae and lower ridge of the hind femora, which is quite striking when seen from below, and the lack of bands on the hind femora.

Melanoplus dawsoni (Scudder)

Dawson's grasshopper

This is one of the smaller melanopline grasshoppers on Canadian grasslands, similar in size to *M. infantilis* discussed below. Dawson's grasshopper is a short-winged, flightless grasshopper that is usually restricted to open ground in otherwise dense grassland. Fescue grassland that has been opened up by overgrazing or erosion seems to favor higher numbers. Dawson's grasshopper occurs in low numbers throughout southern Alberta, Saskatchewan and Manitoba in the short grass, mixed grass, fescue grass and aspen parkland ecoregions, but it reaches its highest densities in fescue grassland. Rarely it will appear with long wings (I have seen this only in 1984 and 1996, during regular sampling in Alberta from 1983-2002), and move more into the shortgrass transition, although it flies only a little better with wings than it does without.

The species is easily recognized by the short wings, which look like bracts on a tiny spruce cone, and the bright yellow underside. The hind femora usually have a chevron of fine black lines on a yellow and reddish background.

Melanoplus fasciatus (F.Walker)

Huckleberry grasshopper

This species can sometimes be found in significant numbers on grassy, south-facing high-elevation slopes at the transition from lower grasslands to montane grassland and forest. They probably eat forbs. The legs are reddish below, but banded, unlike *M. borealis*. This grasshopper has a prominent dark band on the side, more so than other species, a generally slim outline, and a "perky" stance (as opposed to some sluggish grasshoppers).

Melanoplus femurrubrum (DeGeer)

Red-legged grasshopper

M. femurrubrum has an unfortunate name, because although femurrubrum does actually mean red leg, the part of the leg that is red is the tibia, not the femur. It feeds on forbs and grasses, and has even made itself a pest of corn in the US. It is common in eastern Canada and in the US, but rare in Alberta until recent warm, dry years, although numbers are still low. The numbers of this species in general collections have gone from less than one in 10,000 to more than 1 per 1,000.

M. femurrubrum appears similar to *M. sanguinipes*, discussed below, but it can be distinguished by its bright yellow underside. (It also has long and pointed male cerci, but to see that requires a hand lens.)

Melanoplus infantilis Scudder

Little spur-throated grasshopper

The little spur-throated grasshopper is often the most numerically abundant grasshopper on Canadian grassland in Alberta and Saskatchewan, not in terms of biomass, but because of its small size. This small size makes the species an important food for grassland songbirds (Martin et al. 2000).

This species can be distinguished by the tiny staghorn-shaped cerci (claspers) on the end of the male abdomen. Once a male is identified, the females of the species can be recognized and separated from other *Melanoplus* species based on comparative size and markings. The photograph shows the relative size of *M. infantilis* and *M. sanguinipes*.

With aggressive posture and actions, a male *M. sanguinipes* causes a smaller male *M. infantilis* to move along.

Melanoplus packardii Scudder

Packard grasshopper

The Packard grasshopper is a common grasshopper of pastures, alfalfa fields and roadsides, often sharing habitat with *M. bivittatus*, *M. sanguinipes* and *Camnula pellucida* (discussed in Johnson 2001). During years with warm, dry summers, the Packard grasshopper increases in numbers in regions with sandy soil.

This species is somewhat similar in appearance to the two-striped grasshopper, in that as an adult it has two stripes on the back, but the stripes of the Packard grasshopper are diffuse and usually slightly salmon-colored, or maybe even blue. The nymphs of both species may be lime green or brown. You can easily tell them apart by looking for the peppery black spots on the back of the immature Packard, where the two-striped immature already has two stripes. *M. foedus* Scudder is a rare but similar species that is not easily recognized as being separate from *M. packardii*, without microscopic examination of male genital anatomy, preferably using grasshoppers collected from the same site.

Melanoplus sanguinipes (Fabricius)

Lesser migratory grasshopper

This is a very successful species in North America, and certainly the most widely distributed species in the subfamily. The grasshopper faunas of the Canadian Prairies and Florida have about the same number of species of *Melanoplus* (26 listed by Capinera et al.1999), and *M. sanguinipes* is the only one in common (other than *M. keeleri*, which has been rarely found in Alberta and Saskatchewan). On the Canadian grasslands, *M. sanguinipes* occurs in every ecoregion, and exhibits remarkable variability in color and proportions, such as length of the wings. It is polyphagous (omnivorous), eating most green plants. In grassland community studies (e.g., Johnson 1989) it is typically the most common species of grasshopper. *M. sanguinipes* (formerly called *M. mexicanus* and *M. bilituratus*) is probably the closest living relative of *M. spretus*, the Rocky Mountain locust, which is found now only in centuries-old deposits of glaciers of Montana.

It is good practice to separate melanopline grasshoppers on the basis of details of adult anatomy, but *M. sanguinipes* can be recognized in the immature stages and adult by the strong

A rare magenta *M. sanguinipes*, which is normally gray. I have seen and photographed the magenta characteristic in this species, and also in *M. bivitattus*, *M. packardii* and *C. pellucida*.

stripe on the side of the head and thorax. The adult strongly displays the fenestrated tegmina (hindwings look like they have tiny windows or a grid) that are also found on some other *Melanoplus* species. It can be distinguished from *M. gladstoni*, a common grassland species that hatches later in the summer, by the more robust and ashen appearance of the latter species. The hind tibiae of *M. sanguinipes* are usually bright red (but may be orange, blue, white, gray, yellow...). At higher elevations it is often found to be darker in color, to almost black, which is in keeping with our models of how grasshoppers bask to attain optimum high body temperature (Lactin and Johnson 1998).

The male subgenital plate (spoon-shaped rounded tip of the abdomen) is clearly notched on *M. sanguinipes*, and not on any other melanopline (but it is also notched on the easily distinguishable males of *Schistocerca emarginata* (Scudder) a member of a related spur-throated grasshopper subfamily, Cyrtacanthacridinae, represented on Canadian grasslands by this rare species: Vickery and Kevan 1986).

***Phoetaliotes nebrascensis* (Thomas)**

Large-headed grasshopper

This species was rare on the Canadian grasslands until a period of above-average rainfall in 1992-93 resulted in great increase in growth of grasses and forbs. Within two years, *P. nebrascensis* became one of the top three species at many grassland sites in southern Alberta. For example, of 4,333 individuals collected from *Stipa-Boutelloua* grass pasture near Barnwell, AB, in 1994, we found that 37% were this species (Martin et al. 1998). Typically it is from 5% to 15% of the grasshopper community in southern Alberta (Johnson 1994).

After examining the other melanopline species, this one will seem as though it has a head that is too big for its body. The female of this species is flightless, while the male may have either long or short wings. Even the short-winged male disperses better than the short-winged female, because it is smaller. In 1994-95, I observed a case on the Suffield Canadian Armed Forces base in which grass fires killed thousands of these grasshoppers. Examination of the crisp cadavers left behind, and sweeping surrounding grassland, indicated that mostly females of the species had died, shifting the normal grasshopper sex ratio of 1:1 to a more male population.

Collections were made during work for Agriculture and Agri-Food Canada, for the University of Lethbridge, personal collecting, or under research permits provided by Parks Canada. All photos were taken by the author.

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The Voyages to the Vortek

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"So tell me," I asked my long-time beetle collecting friend Kate Shaw, "where did you get all those Canthon scarabs in the early 70's?"

"At the Vortek" she answered, as if I had any clue what she meant. "You know, the thing on the prairies near Empress. The one that is either a giant milk bottle or a giant bowling pin—weren't you there?"

I wasn't, but armed with this less-than-perfect locality data, I struck out to find this legendary site. *Canthon* are actually quite difficult to find in Alberta, and I needed some for my television show, Acorn the Nature Nut. It was 1996, and I travelled in the company of three undergraduate students with time to kill between their last exams and the beginning of their summer jobs. We found the Vortek (it's actually a "Vortac" airplane beacon, as if that matters), but not the beetles, and had such a good time that we decided to do it every year, if not twice every year.

Thus began the tradition of the "Voyages to the Vortek." These natural history/biodiversity appreciation tours are held twice a year on the Alberta plains. Participants (we have had as few as four and as many as 80) pay no fees other than their own expenses. We spend our time watching birds, herping for herpetiles, blacklighting for moths, stalking tiger beetles, netting butterflies and odonates, combing the beaches for washed-up ladybugs, and investigating just about any creature we can find.

Most of the "vortekians" are students at the University of Alberta. Some are faculty, some come from other institutions, some are govern-

ment biologists, technicians, interpretive naturalists, and amateurs of all sorts. The atmosphere is one of enthusiastic naturalizing, and low-key sharing of knowledge and expertise. Some folks bring their children, some bring their pets, and some (well, one really) bring liquid Nitrogen, liquid Oxygen, and other supplies for evening physics demonstrations. These, along with a strong tradition of campfire music, and the frequent addition of "local colour" all combine to make the Vortek trips memorable for everyone from first-timer Vorto-virgins to Vorto-veterans like myself.

For the most part, the value of these trips lies in the fact that they help young biologists develop a strong appreciation for basic natural history, and familiarity with organisms in nature. Many first timers on the trips have never seen a Pronghorn, a Prairie Rattlesnake, a Black Widow Spider, or a live tiger beetle.

We have, however, also generated some valuable data, including quite a few range extensions for things as varied as Woodland Skippers (*Ochlodes sylvanoides*) at Dinosaur Provincial Park, and Burrowing Wolf Spiders (*Geolycosa missouriensis*) at Purple Springs. We also collected what will likely become a paratype for a new species of solifuge, now in the care of Robert Holmberg of Athabasca University. Moths have been especially well-documented on the Vortek trips, thanks to the participation of numerous active members of the Alberta Lepidopterists' Guild.

The spring trip is held each year over the last weekend in April, and the fall trip is held the weekend after the Labour Day long weekend. To receive the twice-yearly Vortek announcements and field notes, please feel free to contact me <janature@compusmart.ab.ca> or Chris Fisher <ccfisher@telusplanet.net>. We welcome entomologists on these trips, and our hope is that they will become increasingly sophisticated and increasingly well attended as time goes on.

John Acorn greeting the Vortek on a June morning that fairly overflowed with entomological potential.

Distributional notes on Agromyzidae (Diptera) from alvars on Manitoulin Island, Ontario

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Abstract

Agromyzid flies were collected in two different alvar habitats (alvar grassland, alvar savanna grassland) on Manitoulin Island, Ontario. Of 23 species identified, six (26%) were new Ontario records and two (9%) were new Canadian records. These range extensions, primarily of western species, indicate that documenting species diversity in outliers of the prairie ecozone is a key component in establishing the true distribution of grassland arthropod species.

Introduction

Alvars have received much attention recently because of their restricted global distribution and susceptibility to anthropogenic disturbance. These factors contribute to the need for baseline studies of alvar biodiversity for use in conservation and management (Reschke et al. 1999). Among the best known alvar habitats are the alvar pavements characterized by an exposed limestone or dolostone substrate with sparse woody or herbaceous vegetation. However, other alvar types are similar to "typical" grassland habitats. Alvar grasslands and alvar savanna grasslands have a soil layer up to 30cm deep overlying the bedrock; this supports a ground cover of grasses, sedges and other herbaceous plants, many of which are shared with tall grass prairies (Catling and Brownell 1995). The thin soil and seasonal cycles of flooding and drought discourage the establishment of trees. Alvar grasslands have less than 10% tree cover; alvar savanna grasslands have 10-50% cover, usually bur oak (*Quercus macrocarpa* Michx.) (Catling and Brownell 1995).

Studies of alvar arthropods have lagged far behind those of the flora. Although most Canadian alvars are in the Great Lakes region of southern Ontario, they are relevant to studies of

Alvar pavement at Misery Bay, Manitoulin Island, Ontario.
(Photo by V. Crecco)

grassland arthropods because they support eastern or northern populations of many species of grassland plants (Catling and Brownell 1995). As a result, alvars might be expected to support eastern or northern populations of arthropods associated with those plants. One such group is the Agromyzidae, a family of phytophagous Diptera that is abundant and diverse in grasslands.

A faunal inventory of alvar arthropods on Manitoulin Island, Ontario yielded several species of Agromyzidae, including new Ontario and Canadian records. We document those records here as part of an ongoing effort to fill the gaps in the known distribution of Canadian grassland Agromyzidae.

Material and Methods

Specimens were collected using Malaise traps and sweeping in two alvar sites on Manitoulin Island: an alvar savanna grassland (10 km SW Gore Bay, 45°52 N, 82°31 W); and an alvar grassland (10 km W Gore Bay, 45°53 N, 82°34 W). *Schizachyrium scoparium* (Michx.) Nash., *Poa compressa* L. and *Sporobolus heterolepis* A. Gray were the dominant grasses at both sites; dominant shrubs were *Juniperus communis* L., *Shepherdia canadensis* (L.) Nutt. and *Potentilla fruticosa* L. (see Morton and Venn (1984) for a detailed vegetation list). Sampling was carried out from 20 May - 2 September 1996 and from 17-19 July 2000. Complete specimen data are available in Crecco (2001). All specimens are deposited in the Lyman Entomological Museum, McGill University (LEM). Geographic distributions of species were established using published records (e.g., Spencer 1969, Sehgal 1971, Spencer and Steyskal 1986, Boucher and Wheeler 2001).

Results and Discussion

Over 180 specimens, representing 23 species, were identified (Table 1). Six species (26%) were new Ontario records and two of those (9%) were new Canadian records of species previously known from the United States (Table 1). Thirteen species (57%) were also collected in tallgrass prairies in southern Manitoba (Crecco and Wheeler, unpublished data) (Table 1).

Over half of the species identified are widespread in North America. Many of these are associated with widespread host plant species (e.g., *Ophiomyia nasuta* on *Taraxacum officinale* Weber ex Wiggers), or have multiple host plants (e.g., *Cerodontha dorsalis* on many genera of grasses). However, there were major range extensions of species with more restricted distributions.

Of the new Canadian records, *Cerodontha impercepta* was a major northward extension of the known range, but *Calycomyza michiganensis* was known from Michigan and its presence in Ontario was predictable. *Cerodontha impercepta* was the dominant species in the alvar samples (Table 1). The host is unknown but is probably a species of *Carex* (Spencer and Steyskal 1986), a genus that is dominant and diverse in alvars and mesic grasslands such as tallgrass prairies.

The other new Ontario records were major eastward extensions of the known range: *Phytoliriomyza triangulata* was previously known only from the Yukon Territory; *Melanagromyza shewelli* and *Chromatomyia caprifoliae* had not previously been recorded east of Alberta; and *Paraphytomyza orbitalis* was known from as far east as Manitoba and Kansas. Some of these species may be grassland associates; *C. caprifoliae* and *P. orbitalis* feed on *Symphoricarpos* spp., which are often dominant in grasslands (*P. orbitalis* also feeds on *Lonicera* spp.). *Phytoliriomyza triangulata* is known only from grassland sites, although the host plants are unknown.

The number of alvar species shared with tallgrass prairies in Manitoba was not surprising given the number of plant species common to both habitats. Many of the shared species may be associated with grasslands, although this is difficult to determine at present given that host plants and actual distributions are unknown for many species. A similar pattern, with outliers of phytophagous prairie species in alvars was also

documented in the leafhoppers (Hemiptera: Auchenorrhyncha) (Bouchard et al. 2002).

The sampling program was restricted in scope and not focussed primarily on Diptera, but the agromyzid diversity recorded supports results from other studies (e.g., Boucher and Wheeler 2001, Crecco 2001) that it is one of the more diverse families of Diptera in grasslands. It is also obvious that large gaps remain in the documented Diptera diversity in alvars. Genera like *Liriomyza*, for example, that were diverse and abundant in other grassland studies (Boucher and Wheeler 2001, Crecco 2001) were almost absent in our samples.

Although the Agromyzidae is one of the more intensively studied families of acalyptrate Diptera in Canada, many species are still known only from the type locality and others show major disjunctions in their known distributions. Incomplete knowledge of species distribution is one of the impediments to documenting patterns of diversity of Canadian grassland arthropods. Continued collecting in outliers of the main prairie ecozone is essential to establish the distribution of grassland-associated Agromyzidae and other Diptera. Other eastern sites such as Ontario's tall grass prairie remnants, alvars and oak savannas undoubtedly harbour a rich fauna of undocumented species.

Table 1. Agromyzidae identified from Manitoulin Island alvars. Distribution: known Nearctic range prior to the present study; (ws) - widespread in USA; [HOL] - Holarctic species. No: number of specimens collected. TGP: species shared with Manitoba tall grass prairies. Status: OR - new Ontario record; CR - new Canadian and Ontario record.

Species	Distribution	No	TGP	Status
Agromyza albipennis Meigen	CAN: BC to LB; USA: AK, (ws) [HOL]	5	X	
Agromyza aristata Malloch	CAN: AB, ON; USA: (ws)	3		
Melanagromyza shewelli Spencer	CAN: BC, AB	10	X	OR
Melanagromyza virens (Loew)	CAN: BC, ON, QC; USA: (ws)	16		
Ophiomyia coniceps (Malloch)	CAN: BC to QC; USA: CA, UT, IN, LA	28	X	
Ophiomyia nasuta (Melander)	CAN: YT to QC; USA: CA to NY [HOL]	2	X	
Calycomyza menthae Spencer	CAN: AB, ON; USA: CA, FL	4	X	
Calycomyza michiganensis Steyskal	USA: MI	4		CR
Calycomyza promissa (Frick)	CAN: MB, ON; USA: CA, LA, FL, NY	5	X	
Calycomyza solidaginis (Kaltenbach)	CAN: YT, ON, QC, NS; USA: (ws) [HOL]	4	X	
Cerodontha dorsalis (Loew)	CAN: BC to NF; USA: CA to FL	26	X	
Cerodontha impercepta Spencer	USA: NC	40		CR
Cerodontha inconspicua (Malloch)[1]	CAN: YT; USA: CA, CO, UT, NC	1	X	
Cerodontha magnicornis (Loew)	CAN: ON, QC; USA: (ws)	2	X	
Cerodontha pygmaea (Meigen)	CAN: ON, QC, LB; USA: AK, NY [HOL]	1		
Chromatomyia caprifoliae (Spencer)	CAN: AB	4	X	OR
Chromatomyia fuscula (Zetterstedt)	CAN: BC, AB, NT, ON, QC, NB [HOL]	9		
Liriomyza eupatorii (Kaltenbach)	CAN: AB, ON, QC; USA: (ws) [HOL]	7		
Paraphytomyza orbitalis (Melander)	CAN: AB, MB; USA: CA, WA, ID, KS	1	X	OR
Phytobia betulivora Spencer	CAN: ON; USA: IL, KS, DC, NY	3		
Phytoliriomyza conspicua (Sehgal)	CAN: AB, SK, MB, ON; USA: MI	1	X	
Phytoliriomyza dorsata (Siebke)	CAN: ON; USA: (ws) [HOL]	1		
Phytoliriomyza triangulata Boucher & Wheeler	CAN: YT	1		OR

[1] - Published records of this species are questionable; it may be a species complex (Boucher and Wheeler 2001)

Acknowledgments

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Albertans vote rough fescue as their official native prairie grass

During February through April 2001, over 2000 Albertans voted for their preferred provincial grass by internet or mail-in ballot, responding to the Prairie Conservation Forum "Get A Grass" initiative. Rough fescue, *Festuca scabrella*, emerged as the clear winner from a list of five candidates. Second place went to June grass, *Koeleria macrantha*, and third place to blue grama grass, *Bouteloua gracilis*.

The "Get A Grass" initiative is intended to remind Albertans of their prairie heritage, and to increase their appreciation for the cultural, environmental, and economic importance of native grasslands.

Rough fescue, variously considered to be one or a group of three species, grows in the southern two-thirds of Alberta. Reasons given by voters for its selection include:

- its value as winter forage for bighorn sheep, deer, elk and bison
- its use as an indicator species of well-managed rangeland
- it is not designated elsewhere as a provincial or state grass
- the world's largest rough fescue grassland is in Alberta
- its official designation as the province's native grass would represent a commitment by Albertans to protect this valuable natural resource

The winning grass was announced on May 25th (see www.albertapcf.ab.ca/rfwins.htm). The Prairie Conservation Forum will now take steps to have the candidate provincial grass introduced in the Alberta Legislature as a potential new emblem representing Alberta's prairie heritage. This will require review and approval by the Provincial Museum, followed by an amendment to the Emblems of Alberta Act.

The Manitoba Tall Grass Prairie Preserve

The Discovery of the Century and the Evolution of a Prairie Partnership

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Tall grass prairie once covered 6,000 square kilometers (1.5 million acres) in Manitoba. Conversion by agriculture and other human developments has all but eliminated this rare natural system. The very rich soils that developed under this diverse wild grassland had led to its demise. Until the late 1980s and except for a few, small, scattered remnants, tall grass prairie was believed to have been eliminated from Manitoba. Following clues from satellite imagery, a small group of botanists and prairie enthusiasts from the Manitoba Naturalists Society surveyed the southeastern part of the province and were successful in locating several high quality tall grass prairie sites. A significant find! The establishment of the Tall Grass Prairie Conservation Initiative by the Manitoba Naturalists Society followed. A prairie technician was hired to conduct inventories in the region of the discovery to develop a priority list of sites according to quality. Endangered species such as the western prairie fringed orchid (*Platanthera praeclara*), the small white lady's slipper (*Cypripedium candidum*), Great Plains ladies'-tresses (*Spiranthes magnicamporum*) as well as the threatened Dakota skipper (*Hesperia dacotae*) were all found on the prairie sites. The goal at this point was to identify the extent of this discovery of the century.

Interest in this initiative continued to grow and a larger partnership was formed within the Critical Wildlife Habitat Program that was administered and housed in the offices of the Manitoba Department of Natural Resources. Members of this partnership included the Manitoba Naturalists Society, Manitoba Department of Natural Resources, and Manitoba Habitat Heritage Corporation, World Wildlife Fund and Wildlife Habitat Canada. This partnership enabled the group to expand its efforts to include more intensive survey, additional securement as well as the development of signage and promotional materials. Long-term securement of high quality sites became a priority and the establishment of a tall grass prairie preserve had begun.

Inventories had identified the properties that would be suitable for inclusion into the Preserve.

(Photo by C. Borkowsky)

The partnership was enlarged to include the Canadian Wildlife Service and the Nature Conservancy of Canada. The Nature Conservancy became the securement arm of the partnership and the Preserve rapidly grew in size. A local advisory committee was established and its membership included local farmers, merchants and other members of the local community. The advisory committee provided important input to the initiative concerning both management and securement issues.

The local advisory committee also began an annual community event on the Preserve, now known as the Manitoba Tall Grass Prairie Preserve 'Prairie Day', held every second Saturday of August. This event provides an opportunity for the community and all interested parties to meet the technicians and learn about the incredible diversity of the prairie. Techniques for inventorying mainly bird and mammal species were showcased. Malaise and blacklight traps together with sweep net collections are techniques used for insect collection. These mechanisms and portions of the collections have been displayed during public events.

The partnership has evolved over time on the Preserve with some changes in responsibilities, and management of the existing holdings soon became a normal part of business. All of the original partners are still present on the membership list. Management on the Preserve has now become a key element within the mandate of the Manitoba Tall Grass Prairie Preserve partnership. Conducting safe and effective prescribed burns had become one of the principal tools for the enhancement of the existing prairie and for the control of the invasion of both native and exotic species.

Partnerships have been established with both the agricultural and academic communities to conduct research and establish evaluation techniques of ongoing and proposed management systems. Graduate students have performed research on the insect communities of the Preserve as well as interrelationships between the insect and plant communities. Current and proposed studies include a project concerning pollinators of the western prairie fringed orchid, as well as monitoring the effects of livestock grazing on species diversity, particularly endangered species.

Inventories of plants, birds and small mammals have continued and even expanded to include certain insect groups. Preliminary inventories continue on the Coleoptera, Lepidoptera, Odonata, Diptera and Hymenoptera. The Lepidoptera have received the greatest attention with the identification of 50 species of butterflies and skippers and approximately 270 species of moths from 22 families. Recent research has suggested that hawkmoths (Sphingidae) may be key pollinators of the endangered western prairie fringed orchid.

Management of this prairie ecosystem is very complex and costly. Managed grazing, together with mowing and prescribed burning, are the main activities undertaken to maintain biodiversity within this complex ecosystem. Photostations and research plots have been established to determine the effects of the various management techniques on the flora and fauna. Additional research is needed to determine habitat needs of less motile species. It is understood that the development of refugia will be a basic part of the management plan when using large-scale disturbances as management techniques. There is great opportunity for study as the serious research has only just begun.

In the future it is expected that the partnership will continue to evolve as new challenges are addressed. New discoveries will uncover new species as well as a better understanding of this dynamic and productive ecosystem. The main ingredient that will continue to cement the partnership and lead to its long-term success is the common goal of all the partners - the survival of one of Canada's most endangered ecosystems for future generations.

Web Watch: Prairie restoration at Last Mountain Lake National Wildlife Area

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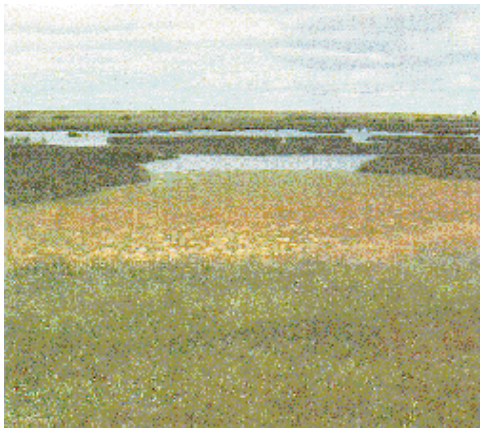
The Last Mountain Lake National Wildlife Area (NWA) is a protected area of 15,600 hectares in south-central Saskatchewan. The landbase is comprised of 21 percent wetlands, 50 percent native grasslands, and 25 percent of grasslands altered by agricultural practices.

Created by government decree in 1887, the NWA was the first federal bird sanctuary in North America and was identified as a "Wetland of International Importance" in 1982. Over 280 species of birds have been recorded on-site during migration and the area provides important breeding habitat for at least 100 species of birds, including the Western Grebe, the American White Pelican, the American Avocet and the Wilson's Phalarope.

Wildlife and habitat conservation is the primary mandate of the NWA, which is managed by the Canadian Wildlife Service.

To reconnect fragments of the natural prairie community, Environment Canada initiated the Mixed Grass Prairie Habitat Restoration Project



Wetland and upland habitat at the Last Mountain Lake NWA (Photo by Philip Taylor)

Location of Last Mountain Lake NWA

in 1992. In less than 10 years, the project has developed effective techniques for wild harvesting, handling, processing, cleaning, storing and planting over 70 species of native grasses and wildflowers. Since 1994, some 50 hectares of diverse native prairie have been planted from wild-harvested seed at Last Mountain Lake, the largest restoration project of its kind in Canada. Valuable information also have been obtained on the longevity, germination, flowering and seed production of various plant species.

Ducks Unlimited Canada has been a partner in developing improved water control structures to retain spring melt water for longer periods, particularly important in drought years.

Prescribed burning is used to encourage seed set by native grasses and to control the spread of shrubs and exotic species of plants. Because of the frequency of grass fires prior to European settlement, prairie plants and animals are naturally

adapted to fire. Burned areas provide feeding and roosting sites for many species of birds and will improve the quality of nesting habitat once regrowth occurs.

Dr. Andy Hamilton (Agriculture and Agri-Food Canada, Eastern Cereal and Oilseed Research Centre, Ottawa, ON) visited the NWA during the first week of June, 1995. In a survey of grassland leafhoppers, he found a rich fauna of 16 species (see inset) and speculated that additional species might occur elsewhere on the property. His findings also suggested that grassland fires at the site help maintain leafhopper and plant diversity, and benefit populations of planthoppers (*Laccocera* spp.) through the rapid regrowth of forbs after burning. At one site, a fire two years previously apparently had no effect on species of leafhoppers overwintering as late instar nymphs or adults, but few nymphs of summer species were recovered. Additional information on the species of leafhoppers recovered at the NWA is provided in Hamilton, KGA. 2000. Five genera of new-world "shovel-headed" and "spoon-bill" leafhoppers (Hemiptera: Cicadellidae: Dorycephalini and Hecalini) Canadian Entomologist 132: 429-503.

With the exception of the leafhopper survey, site managers currently have a dearth of information on the arthropod biodiversity at the Last Mountain Lake NWA. In keeping with the NWA mandate of wildlife and habitat conservation, site managers are very interested in having a comprehensive survey of arthropods performed.

Leafhoppers at the Last Mountain Lake NWA

Species (host plant)

Athysanella acuticauda (*Festuca* spp.)
Athysanella bifida (*Bouteloua gracilis*)
Athysanella kadokana (*Muhlenbergia richardsonis*)
Athysanella robusta (*Koeleria macrantha*)
Athysanella secunda (*Muhlenbergia richardsonis*)
Attenuipyga minor[1] (*Agropyron* spp.)
Erythroneura calva (forb?)
Extrusanus oryssus (grasses)
Hardya dentata[2] (grasses)
Hecalus viridis (*Agropyron* spp., *Elymus* sp.)
Memnonia anthalopus[3] (*Muhlenbergia richardsonis*)
Orocastus perpusillus (*Stipa comata*)
Prairiana cinerea (*Artemisia frigida*)
Rosenus cruciatus (*Koeleria macrantha*, *Stipa comata*)
Stenometopiellus cookei (*Carex filifolia*)
Stragania rufoscutellata (*Artemisia frigida*)

identified in correspondence to the Last Mountain Lake NWA dated June 14, 1995 as: [1] *Dorycara minor*, [2] *Hardya* n. sp., [3] *Memnonia* n. sp. B

Acknowledgements

The above images are from the Last Mountain Lake NWA website and are used here with permission of Environment Canada. I thank John Dunlop and Kerry Hecker of Environment Canada, and Andy Hamilton for their valued input in the preparation of this article.

Web links:

General information on Last Mountain Lake NWA:
http://www.mb.ec.gc.ca/nature/whp/lml/df09s00.en.html

Mixed Grass Prairie Habitat Restoration Project:
http://www.mb.ec.gc.ca/nature/whp/lml/df09s12.en.html

Recent publications

Tallgrass prairie and the use of fire as a biodiversity and conservation management tool

Roughley, R.E. 2001. Tallgrass prairie and the use of fire as a biodiversity and conservation and management tool on the St. Charles Rifle Range, Department of National Defence, Winnipeg, Manitoba. 81 pp.

Executive Summary

"For four years, 1997-2000, a research project was funded principally by the Department of National Defence to investigate the impact of fire management on the flora and fauna of the tallgrass prairie portion of the St. Charles Rifle Range. For this research, Dr. R.E. Roughley, Department of Entomology, University of Manitoba, Winnipeg, MB was the principal investigator. Dr. Darren Pollock was appointed as a post-doctoral fellow associated with the project from 1997 to 2000 and there was extensive collaboration with Dr. Bruce Ford, Liz Punter and Julie Sveinson, Department of Botany, University of Manitoba. Additional funding was supplied by the Department of Natural Resources, State of Wisconsin, USA and a research grant from the Natural Sciences and Engineering Research Council of Canada to R.E. Roughley.

In this project we studied the impact of fire as a disturbance in a seasonal burn regime (spring, summer, fall and "no burn" or refuge) on small plots on tallgrass prairie at the St. Charles Rifle Range. The principal question was to determine the most appropriate time of burn for the integrity and health of this endangered ecosystem. This study concentrated on the impact of the timing of burns on species richness and abundance of plants and selected groups of insects. Suppression of fire leads to degradation of tallgrass prairie. Interpretation of the available data suggests that there is no single best time of year to burn. Rather, the development of a management plan should include all three burn regimes (spring, summer and fall) along with a refuge which is not burned. A mosaic pattern of burns will increase and maintain habitat heterogeneity resulting in a healthy and dynamic tallgrass prairie ecosystem. Our arthropod and plant data suggest that four years is required in this locality for a full cycle of succession from climax community through disturbance and succession back to climax community."

The references from this report are posted on the Biological Survey's website at: http://www.biology.ualberta.ca/bsc/english/grassrefs.htm.

Finding publications on northern prairie biological resources

The Northern Prairie Wildlife Research Center is striving to make information on the biotic resources of the Great Plains more widely available to decision-makers, resource managers, scientists, and the public as part of the Northern Prairie's Grasslands Ecosystem Initiative, through a webpage at http://www.npwrc.usgs.gov/resource/resource.htm#RES. Because of the research emphasis of the Center, many listings emphasize information about resources in North Dakota and the Great Plains. However, many also pertain to the entire United States, as well as to Canada, Mexico, and occasionally other countries. Some information on invertebrates is included.

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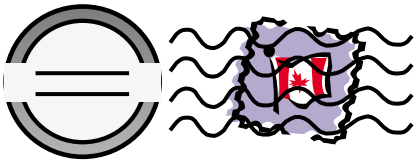

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