



Arthropods of Canadian Grasslands

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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.

The Ghost Tiger Beetle, *Cicindela lepida* Dejean (shown here) may be threatened with local extinction if dune areas shrink. Read about this and other grassland tiger beetles on page 6.





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, 2005.

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Articles without other accreditation are prepared by the Editor.

The website of the Biological Survey is at <http://www.biology.ualberta.ca/bsc/bschome.htm>



Grasslands project action

Ecology and Interactions in Grasslands Habitats

Chapters for *Ecology and Interactions in Grassland Habitats*, the first publication to stem from the current phase of the Survey's Arthropods of Canadian Grasslands project, are in progress. Confirmed chapters are listed below with authors and tentative titles. (The order of chapters is not finalized.)

Introduction to the Grasslands Project –
T. A. Wheeler and H. V. Danks

Attributes of Canada's grasslands –
J. D. Shorthouse

Weather in grasslands –
S. McGinn

Mite fauna in grassland soils –
V. M. Behan-Pelletier

Diversity of spiders in tallgrass prairies –
D. Wade

Aquatic Hemiptera in grasslands –
R. E. Roughley and G.G.E. Scudder

Trophic guilds of Brachycera (Diptera) in xeric
Yukon grasslands –
S. Boucher and T. A. Wheeler

Gall-forming arthropods and their distributions
in overlap and hybrid zones of cottonwoods
on the Canadian prairie –
K. D. Floate

The component community of arthropods as-
sociated with cynipid galls on wild roses –
J. D. Shorthouse

Use of fire as a conservation and management
tool in tallgrass prairie –
R. E. Roughley et al.

Arthropods in identifying hotspots for
conservation –
G. G. E. Scudder

Leafhoppers as indicators of grassland habitat
types –
K. G. A. Hamilton

Dytiscids in prairie ponds –
M. Alperyn

Grassland insects as food for birds –
D. L. Johnson

Temporal changes in grasshoppers –
D. L. Johnson

Ecology and interactions: Summary and
synthesis –
T. A. Wheeler, H. V. Danks, R. E. Roughley

For further information on this volume please
contact Terry A. Wheeler (McGill University)
(wheeler@nrs.mcgill.ca, 514-398-7937).

Plans for the second volume – *Arthropods
and Altered Grassland Ecosystems* – are under-
way. The tentative publication date is 2006. For
more information on the second volume please
contact Kevin Floate (Agriculture and Agri-Food
Canada) floatek@agr.gc.ca.

Focus sites

The annual group field trip in 2003 was held
in the Peace River grasslands. See p. 2 for Felix
Sperling's and Margot Hervieux's report of this
gathering.

The 2004 project key site will be at Aweme,
Manitoba. Details can be found on p. 5.



Sandra Kinsey, Laird Law, Margot Hervieux, Cris Guppy
at the 2003 field trip. (photo by G. Pohl)



Grande Grasslands Gathering: Dunvegan, July 2003

Felix Sperling

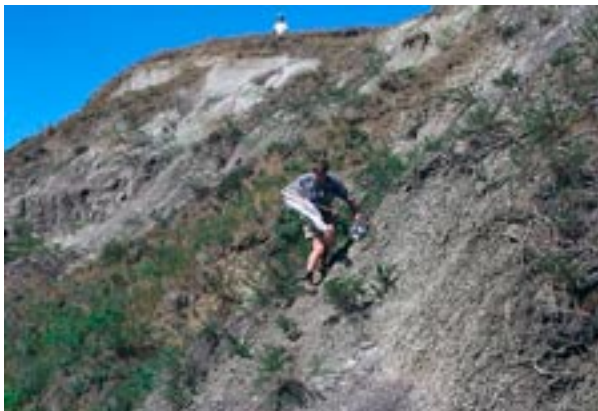
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A great group of grassland gurus (and entomologists) gravitated to the Grande Prairie during July 18-21 last year. Participants from Denmark, the USA, and across Canada met at Dunvegan Provincial Park in northwestern Alberta to explore remnant native grasslands in the Peace Region. Co-organized by local naturalist Margot Hervieux and Survey member Felix Sperling, the trip was timed to take in the late summer peak of endemic butterflies, as well as to draw in Lepidopterists winging their way to the Lepidopterists' Society Annual Meeting and the COSEWIC Lepidoptera Species Specialist Group meeting held in central Alberta the following week.

At the turn of the 20th century, between 435,000 and 1.1 million hectares of upland grassland covered the area around Grande Prairie, Spirit River and Fairview/Peace River. Most of the south-facing slopes of the Peace, from B.C down-



Felix Sperling on a Kleskun Hill badlands slope, with *Artemisia dracunculoides* (Wild Tarragon) plants in the exposed areas. (photo by T. Simonsen)

stream to as far north as Ft. Vermillion, also supported grassland vegetation. According to recent research by the Alberta Conservation Association (ACA), however, less than half of one percent of the upland prairie has survived human settlement. Large stretches of the river slopes are still intact although often heavily grazed.

Over the past three years, the ACA (a provincial conservation organization funded by revenue from hunting and fishing licenses) has conducted a detailed inventory of remnant upland prairie in the Peace region and initiated a landowner stewardship and education program. The survey found that most of the remaining grassland parcels are in private hands. The largest area of protected upland prairie lies within Kleskun Hill Natural Area (just northeast of Grande Prairie). Some native grassland is also contained in the newly established Dunvegan and Peace River Wildland Provincial Parks and Green Valley Provincial Park but most of the river slope areas remain within crown grazing leases. It is hoped that the additional biodiversity information collected during this survey (and by others in the future) will help strengthen support for additional protection of native grassland sites within the Peace region, including the upgrading of significant locations like Kleskun Hill.

The prairie areas of the Peace Region are thought to be remnants of the grasslands that covered much of central and northern Canada prior to the last ice age. These grasslands were pushed south by the ice and then expanded back into the Peace during the hot, dry Hypsithermal period 6000-9000 years ago. Over 400 km of boreal for-



est now separate the remaining grasslands from the prairie to the south. Previous work on butterflies in the area has identified at least eight prairie species with disjunct populations in the Peace region and there are also two known disjunct tiger beetles. Virtually nothing is known, however, about the distribution of other arthropod species. Participants on this trip collected moths (macro and micro), flies, diving beetles and earthworms and soil mites.

The primary goal of the July 2003 field trip was to sample for arthropods in these remnant native grassland sites. Most of the collecting was focused at three sites – two river-slope (Dunvegan Provincial Park and Highland Park Natural Area) and one upland (Kleskun Hill Natural Area). All three sites were explored during the day and lights were set up after dark at Dunvegan and Kleskun. Highlights of the survey included: finding excellent bugs and friendly entomologists (and vice versa), a ferocious thunderstorm, and much-appreciated showers and spaghetti at the Hervieux family home in Grande Prairie near the end of the trip.

Lepidopterists were well represented among Peace participants. Jean-François Landry, from the Canadian National Collection in Ottawa, found that Dunvegan and area prairie sites produced excellent collecting as far as Microlepidoptera were concerned. Three days collecting by Landry and Sperling at 10 different sites yielded a total of 328 micros, both at mercury-lights at night and sweeping during the day. All specimens were field pinned and spread, representing an initial count of 85 species, primarily in the Gelechioidea, Tineoidea, Yponomeutoidea and Tortricoidea. For micros, this is a very good catch, especially considering that we got a day of rainy weather and traversing some of the prairie sites was rather difficult due to the very steep terrain and slippery ground. Among the *Coleophora* that Landry currently studies, at least one Dunvegan species is undescribed.

Greg Pohl, from the Canadian Forest Service in Edmonton, and Landry found several microlepidoptera species that represent substantial range



Jean-François Landry sweeping for microlepidoptera at Highland Park, with Peace River canyon in the background. (photo by G. Pohl)

extensions to northern Alberta. In particular one species of Epermeniidae found at the Kleskun Hill site, *Ochromolopis ramapoella* Kearfott, was previously recorded only from the southern half of Alberta. Other records of interest are no doubt contained in the material collected. Dissections will be necessary to identify species in several groups, particularly the Gelechioidea for Landry and the poorly known tortricid tribe Cochylini for Pohl.

Reed Watkins, retired engineer and peripatetic plume moth taxonomist from New Jersey, was pleased to find five different Peace prairie pterophorids at Dunvegan. The two most common at that time have a wide distribution, but among experts there remains uncertainty as to the correct names due to geographic variation and the fact that the few North American workers have generally not examined the types in the British Museum. One very interesting specimen, of another species entirely unknown to Reed, requires further detailed study.

For Thomas Simonsen and Marie Olsen, entomology graduate students at the University of Copenhagen, the Peace River trip was the beginning of a month long jaunt across North America that included Florida, Las Vegas and Mexico. Their rental car got a good workout on Alberta's gravel roads, but they saw plenty of wildlife and Thomas was able to pick up material en route for



his PhD on *Boloria* butterflies. They are both keen to return to Alberta.

Cris Guppy had already spent most of the summer inventorying the butterflies of the “South” Peace River District in British Columbia, along with fellow environmental consultants Sandra Kindsey and Laird Law (Guppy et al. 2003). His day with the Biological Survey in Alberta provided an interesting comparison to the grassland habitats in the BC Peace River. It emphasized to him how much more dependent the BC grasslands are on fire, rather than lack of moisture, for maintaining the open shrub/grassland habitats.

Dipterists also joined the survey in goodly number, including Terry Wheeler, Stephanie Boucher, and Vincent Dion from the Lyman Museum, McGill University, Quebec. For Boucher, this was familiar territory, as she had been to the Fairview area in 1995 and 1997. Although she has not yet had time to identify all the material collected at Dunvegan, and the weather was rainy while they were there, she feels that the diversity of Diptera was good. The Agromyzidae were well represented, with some species showing interesting geographical range extensions. For example *Pseudonapomyza atra* (Meigen), previously known in Alberta from Onefour, was collected in Dunvegan for the first time in 2003, and this represents the northern geographic limit for this species. They also collected additional specimens of a new species of *Cerodontha*. Although the species is not restricted to Dunvegan, this is the northernmost record for the new species. The most exciting find was Boucher’s first specimen of Acroceridae (small headed flies – internal parasitoids of spiders), and was collected on a south-facing slope of the Peace River.

Derrick Kanashiro, with Agriculture and Agri-Food Canada in Lethbridge, Alberta, made good use of the Peace River foray to collect soil mites and earthworms. For these groups, almost every sample is sure to represent something new and interesting. So far he has identified about 78 species of soil oribatid mites from the Peace River trip. He collected 65 species from the Kleskun

Hills site and this represents the highest number of oribatid mite species recorded from a Canadian grassland area so far. There were several new species and new records for Canada. Kanashiro was also able to document new distribution areas for 3 species of earthworms.

For Rob Roughley, stalwart coleopterist from the University of Manitoba, the Peace River grassland trip has generated a lot of questions. With topographic relief and exposure to light as the primary factor distinguishing grassland from wooded sites, the area represents a series of nicely controlled ecological experiments. Linear distributions along rivers can also be compared to broken patches higher on the upland areas. Although the dytiscid beetles that Roughley collected did not yield new records, due largely to the prior work of Dave Larson, they did illustrate the pervasive importance of habitat structure to the Peace River fauna.

Rob Roughley will be the host of the 2004 Biological Survey grassland trip at Aweme Manitoba. He has been busy accumulating records for species at Aweme, Onah and Treesbank, with about 2,000 species from the greater Aweme area and with no real effort yet to look for museum records. Diptera and Coleoptera and to some extent Lepidoptera are not well represented in the historical database. Entomologists are sure to find plenty of worthwhile material. Stay tuned!

References:

- Guppy, C.S., S.J. Kinsey, and L.L. Law. 2003. Reconnaissance Inventory of the Butterflies of the South Peace. Submitted to Louisiana-Pacific Canada Ltd., Dawson Creek, BC. 104 pp. [and see p. 26]



Photo by T. Simonsen



Grassland Project Key Site 2004: Collecting grassland arthropods in Manitoba

What:	Prairie Insect Collecting at Aweme, MB, summer, 2004
When:	June 4-5, 2004
Where:	Criddle-Vane Historic Site, Aweme, MB and Yellow Quill Prairie site of the Nature Conservancy Canada. This latter site is featured on The Nature Conservancy of Canada's website http://www.natureconservancy.ca under Manitoba
How:	Contact person: Bill Gallaway, Department of Zoology, Brandon University, Brandon, MB R7A 6A9, gallaway@brandonu.ca (204) 727-9655. You should register for this trip at www.brandonu.ca/zoology/aweme%20bioblitz Camping is available in nearby Wawanesa, MB

This locality is now an official Province of Manitoba Historic site. It is situated near the confluence of the Assiniboine and Souris Rivers about 20 km SE Brandon, MB. The historical importance of this site is well known to most entomologists. It was discussed in *Newsletter, Arthropods of Canadian Grasslands* 6 (2000): 6-12 (which includes references). On the Aweme website, listed

above, are other interesting observations about the site. This will be a bioblitz occasion involving a wide variety of scientists from a variety of disciplines, educators and students and is sponsored by the Criddle/Vane Homestead Heritage Committee and the Nature Conservancy Canada.

Every field entomologist needs to make a pilgrimage to Aweme, MB. Let yours be 2004!



Tallgrass, Aweme, MB, Criddle homestead
(photo by J.D. Shorthouse)



Grassland Tiger Beetles in Canada

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Cicindela decemnotata Say (see also p. 12)



Cicindela formosa Say (see also p. 9)

Introduction

Tiger Beetles— one author recently referred to them as the “butterflies of the beetle world,” whatever that might mean. Whatever their appeal, tiger beetles have been favourites of collectors in the past, and now the naturalist and conservationist crowd as well. The following brief summary presents the common species in the Canadian grasslands, exclusive of those that are entirely riparian.

Most of the information for this article is included in my book on the Alberta fauna (Acorn, 2001), and I strongly recommend it as well, if only to please my publisher. I have used the English names from my book here, as well as a set of names that may well become standard in the near future (Pearson, in press).

For each species, I provide brief notes on identification, habitat, seasonality, and general notes on status and biology.

I have assumed that most people with an interest in this group will show at least some conservationist leanings, so that is where I have placed my emphasis in the space allowed. I hope, however, that insect conservationists will also read the section in my book on this topic, in which I express an opinion that is perhaps not the majority

view, but which I hope will encourage greater rationality nonetheless.

For identification, please note that the light elytral markings are the ones that have names, and that the humeral lunule is the mark that originates on the humerus, or shoulder of the elytron. The middle band is the vaguely leg-shaped mark that extends onto the elytral disc.

Key References:

- Acorn, John. 2001. Tiger Beetles of Alberta: Killers on the Clay, Stalkers on the Sand. University of Alberta Press. 120 pp.
- Freitag, Richard. 1999. Catalog of the Tiger Beetles of Canada and the United States. NRC Research Press. 195 pp.
- Pearson, David L. in press. A list of suggested common English names for species of tiger beetles (Coleoptera: Cicindelidae) occurring in Canada and the US. *Cicindela*.
- Wallis, J. B. 1961. The Cicindelidae of Canada. University of Toronto Press. 72 pp.

All photographs by J. Acorn



The Sand Dune Species

Cicindela lepida Dejean

Identification: a smallish tiger beetle, generally pale, with pale legs.

Habitat and Seasonality: a summer species, found on the open, blowing portions of large sand dunes.

Notes: this species is found on the larger dune fields, such as the Middle Sand Hills in Alberta, the Great Sand Hills in Saskatchewan, and the Spirit Sand Hills in Manitoba. Where it occurs, it can form huge populations, but the species does not persist where dunes have become stabilized by vegetation, nor does it inhabit small sandy blowouts or road cuts. Thus, if dune areas shrink (as most appear to be doing), the Ghost Tiger Beetle may be threatened with local extinction.

Ghost Tiger Beetle



Cicindela limbata nympha Casey



Identification: a smallish tiger beetle, mostly with mostly pale elytra, and dark legs.

Habitat and Seasonality: found on almost any open sandy area, overwintering as an adult and persisting into early July, with new adults emerging in August.

Sandy Tiger Beetle

Notes: Sandy Tiger Beetles are apparently quite vagile, and quickly colonize new open sand habitats along road cuts and where blowouts form. They are also extremely common on the large dune fields. Of all the sand-dune species of *Cicindela* in Canada, this is the most common and widespread. By contrast, in southern Utah, the subspecies *C. l. albissima* Rumpff is restricted to only some parts of the Coral Pink Sand Dunes, and is at the centre of a legal battle between conservationists and dune-buggy riders.



Cicindela lengi versuta Casey

Identification: note the long, finger-like humeral lunule, that is not noticeably constricted behind the humeral angle. The ground colour of the elytra is red on most individuals, but may also be green, blue, or dark purple (the latter appearing black at a distance).

Habitat and Seasonality: a spring-fall species, found on the margins of large dunes, as well as on blowouts and semi-open sand areas.

Notes: if the Sandy Tiger Beetle is the first species to colonize new open sand habitat, the Blowout Tiger Beetle is usually the last to leave, as vegetation slowly stabilizes the blowing sand. As such, Blowout Tigers are also found on a variety of sand habitats, and are both common and widespread.

Blowout Tiger Beetle



Cicindela scutellaris scutellaris Say



Identification: a bright, iridescent red and green tiger beetle with no light markings whatsoever, or, a somewhat greenish or purplish beetle with light lateral borders to the elytra.

Habitat and Seasonality: a spring-fall species, found mainly around the margins of dunes in the

Festive Tiger Beetle

large dune fields, but occasionally on sandy roadcuts or blowouts as well.

Notes: the subspecies *C. s. scutellaris* appears to mimic the distasteful blister beetle *Lytta nutalli* Say, and is common in the large dune fields, but rare in most other sandy habitats. In recent years, we have seen it reappear in the northern portions of its historical range, presumably as a result of a series of mild winters. It is unclear, however, whether this is the result of recent dispersal, or increases in populations that were undetectably small until quite recently. On the Spirit Sand Hills of Manitoba, the subspecies *C. s. criddlei* is found – a lighter version of *C. s. lecontei* to the south.



***Cicindela formosa* Say**

Identification: our largest tiger beetle. In Alberta, it is bright red with purple legs and thick light markings. In Manitoba, it looks much the same but with a brownish ground colour instead of red. In Saskatchewan, it is very pale on the elytra, and purplish elsewhere.

Habitat and Seasonality: a spring-fall species, found mainly on the margins of dunes in the large dune fields, as well as in a limited number of smaller open sand habitats.



Cicindela formosa gibsoni Brown

Notes: Beautiful Tiger Beetles appear to be poor dispersers. Unlike Sandy and Blowout Tigers, they do not readily colonize new open sand habitat. As well, the three main dunefields in western Canada each appear to be home to an endemic subspecies of this beetle. The most obvious of these is the big, white and purple *C. formosa gibsoni* Brown, of the Great Sand Hills of Saskatchewan. In Alberta, since the publication of my book, it has become clear that we have an endemic subspecies as well, *C. f. fletcheri* Criddle. Cindy Sheppard, a student of mine, showed convincingly in an unpublished study that these beetles are larger, with more exten-

**Beautiful Tiger Beetle,
Big Sand Tiger Beetle**



Cicindela formosa fletcheri Criddle

sive light markings, than *C. f. formosa* Say to the south, and that there is no cline linking the two subspecies. Likewise, I have long argued that the Manitoba subspecies *C. f. manitoba* Leng (the emblem of the Manitoba Entomological Society, no less!) is clearly separate from *C. f. generosa* Dejean to the south. This interesting pattern suggests that all three taxa originated in situ, since the end of the Wisconsinan glaciation. For the most part, their habitats are secure, but shrinking dunes may threaten all three in the long run. I hate to say it, but I'm hoping for a really good drought...



Cicindela formosa manitoba Leng



The Salt Flat Species

Cicindela fulgida Say



Shiny Tiger Beetle, Crimson Salt Flat Tiger Beetle

Identification: another species with a long, finger-like humeral lunule. The ground colour of the elytra is red on most individuals, but may also be green, blue, reddish-green, or purple. These beetles are smaller and shinier than Blowout Tiger Beetles, and live in different places.

Habitat and Seasonality: a spring-fall species, found on moist salt flats, mainly near rivers and streams. Often associated with springs and seeps, but not as fond of the wet mud as the next species.

Notes: Shiny Tiger Beetles are found in salty places, but not salt lake beds, or the salty low-lying areas of fields and pastures. Look for them beside rivers and streams that cut through ancient marine sediments.

Cicindela nevadica knausi Leng

Identification: a slim, brownish tiger beetle with very fine markings, and a coat-hanger-shaped humeral lunule.

Habitat and Seasonality: a summer species that is found only on wet saline mud, usually associated with springs and seeps along river courses.

Notes: populations of this species can persist for decades in habitats half the size of a typical entomologist's office. Our subspecies appears to be doing well, albeit in a diffuse and localized way, but the Nebraska subspecies *C. nevadica lincolniiana* Casey seems destined for extinction, as a victim of development.

Salt Creek Tiger Beetle, Nevada Tiger Beetle





The Clay and Loam Species

Cicindela punctulata Olivier



Backroad Tiger Beetle, Punctured Tiger Beetle

Identification: a slim, black tiger beetle with very narrow white borders to the elytral apices, and a row of tiny green pits along the inner margin of each elytron.

Habitat and Seasonality: a summer species, found on sparse prairie, especially dirt roads and tracks.

Notes: the Backroad Tiger Beetle is one of the most abundant North American members of the group, and in some places it is found even on sidewalks and driveways, at least as an adult. In the Canadian grasslands, it is a moderately common beetle of loamy, open prairie.

Cicindela nebraskana Casey

Identification: an all-black tiger beetle that may or may not have a few small white markings on the elytra, but never has white elytral apices.

Habitat and Seasonality: a spring-fall species, found on sparse prairie, dry mudflats, and loamy areas.

Notes: this tiger beetle is never abundant, but if you spend time in the grasslands you will encounter it often. As a bit of a habitat generalist, it can turn up almost anywhere, but usually not on sand dunes or salt flats. The closest relative to this species is *Cicindela longilabris* (the Long-lipped or Boreal Long-lipped Tiger Beetle), which generally lives farther north and west, and has a blue-green, not black, underside.

Black-bellied Tiger Beetle, Prairie Long-lipped Tiger Beetle





***Cicindela limbalis* Klug**

Identification: a green or reddish tiger beetle with the humeral lunule reduced to spots on most individuals.

Habitat and Seasonality: a spring-fall species, associated with clay soils, and slopes. Generally not as common in the grasslands as the following two species, to which it is closely related.

Notes: Claybank Tigers are more often encountered in the aspen parkland and boreal forest ecoregions, but they do stray into the grasslands along rivers and streams, where they are replaced by the following two species. Along with their close relatives, they seem to appear earlier in the spring, and later in the fall than most other spring-fall tiger beetles.

Claybank Tiger Beetle, Common Claybank Tiger Beetle



***Cicindela decemnotata* Say**



Badlands Tiger Beetle

Identification: a green tiger beetle with a characteristically shaped middle band, something like a sock.

Habitat and Seasonality: a spring-fall species, found on clay slopes, badlands, the tops of river valleys, and on gravelly, sparsely-vegetated prairie.

Notes: the Badlands Tiger Beetle is a species that one could easily miss simply by getting out too late in the season, and quitting too early in the fall. It is abundant once you find it, but it took me years to figure out the secret to this beetle.

***Cicindela purpurea auduboni* LeConte**

Identification: a dimorphic beetle, either iridescent green or black-purple, with white elytral apices and very sparse light markings overall.

Habitat and Seasonality: a spring-fall species, found on the same sorts of habitats as the Badlands Tiger, but also sometimes on loamy soils, or sand.

Cowpath Tiger Beetle, Cow Path Tiger Beetle

Notes: this is another early spring/late fall species, and it holds my personal record for the earliest tiger of the season, on March 12. It is easy to confuse with both the Black-bellied and the Backroad Tiger, but only in the dark morph, and only until you clue in to the “look” of the elytral apices.



The Generalist Species

Cicindela tanquebarica kirbyi LeConte

Identification: note the long, finger-like humeral lunule, that is noticeably constricted behind the humeral angle. The ground colour of the elytra is brown. As well, this is a reasonably large tiger beetle, exceeded in size only by the Beautiful Tiger.

Habitat and Seasonality: a spring-fall species, that lives in just about every habitat where tiger beetles can be found.

Notes: most tiger beetlers agree that this is the most abundant and widespread tiger in all of the US and Canada. As such, it is often overlooked, or ignored. I personally wonder how such an adaptable, eurytopic species has failed to out-compete all of its stenotopic congeners, but I doubt we'll ever know the answer to this question.

Oblique Tiger Beetle, Oblique-lined Tiger Beetle



Cicindela terricola Say



Grass-runner Tiger Beetle, Variable Tiger Beetle

Identification: our smallest tiger beetle, with very fine light markings and a greenish or black ground colour.

Habitat and Seasonality: a summer species, found on sparsely-vegetated prairie, as well as on salt flats, and even in gardens.

Notes: this is an easy species to overlook, since it is so small, and often runs rather than flying when disturbed. In Alberta and western Saskatchewan, the subspecies *C. t. cinctipennis* LeConte is found, while the nominate *C. t. terricola* is found in eastern Saskatchewan and Manitoba. This is an abundant beetle, although rarely common in any one locality.



The Northern Scorpion, *Paruroctonus boreus*, in southern Alberta, 1983-2003

Dan L. Johnson

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The Northern scorpion (*Paruroctonus boreus*; Class Arachnida, Order Scorpiones, Family Vaejovidae) is the only species of true scorpion found in Canada. It is found in 12 U.S. states, from northern Arizona (K. McWest, pers. comm.) to southwestern Canada (Gertsch and Soleglad, 1966, 1972; Hjelle, 1972; Johnson and Allred, 1972; Tourtlotte, 1974). In southern Alberta, it is found in dry, eroded riverbank slopes (usually not north-facing), where it inhabits rock fissures in sandstone or shale, or narrow cavities under surface stones.

Distribution:

In Alberta, this species occurs in the valleys of the Oldman River, St. Mary River, Milk River and South Saskatchewan River. Specimens have been recorded from near Drumheller to Jenner, along the Red Deer River (G. Hilchie, D. Johnson, C. Wershler, others), east to Empress, and in southwestern Saskatchewan near the Alberta border (museum records, Estuary and Leader; K. Roney, pers. comm.; Buckle, 1972; collected near Acadia and Suffield, D. Johnson; others). Populations near Medicine Hat and Milk River are usually reported as being the most numerous and active (e.g., Seven Persons Coulee, G. Duke, and others; D. Johnson, and others, such as collections by S. Schultz, pers. comm.). Numerous sitings at Onefour and Manyberries are known mainly from drier years. In addition, this species has been collected in the southern Okanagan Valley of British Columbia (museum records, R. Cannings, pers. comm.; Kurata, 1930).

Feeding:

P. boreus confined individually in containers in the field or lab readily consumed soft-bodied prey in the approximate size range 4-20 mm (D. Johnson, 1986-2003, unpubl.). Prey accepted in the cages included immatures (3rd to 5th instar) of grasshoppers of moderate size (such



Photo by D.L. Johnson

as *Melanoplus* species), adults of smaller grasshopper species (such as *Aeropedellus clavatus* and *Psoloessa delicatula*), crickets, ground spiders (Gnaphosidae), and Lepidoptera (Arctiidae and Noctuidae). Robust adult grasshoppers (*Dissosteira carolina*) were avoided. *P. boreus* often completely consumed the prey, including appendages, by chewing and ingesting. This is unlike the Sun scorpion (Arachnida, Solifugae: *Eremobates* spp.) found in Alberta and B.C., which in similar arenas was observed to pierce grasshoppers and crickets with the chelicerae, and shift them back and forth alternately, and vertically (like bicycle pedals), sucking the liquid contents from the prey.

Field observations:

Personal observations during 1983-2003 were based on annual sampling of approximately 20 to 40 trips per year, mostly daytime sampling but also after dark, with search periods of approximately 1-2 hours per trip, but not regularly scheduled on the same dates or stratified across the region. Pitfall trapping was found to be an inefficient method of collecting or sampling the Northern scorpion. The Northern scorpion is adept at walking around the rim of a container. Directed searches during the day, involving turning over stones, or at night with the assistance of portable UV lights,



generally yield more specimens (typical of collecting methods for other scorpion species).

Observations from searches, and observations contributed by others, indicated that population densities were low throughout this 21-year period, but relatively higher during dry, warm years, especially 1983-88 and 2000-2001. During intervening moister, cooler periods, Northern scorpions were found at lower densities in southern Alberta, requiring longer search times, if found at all. Heavy rain in southern Alberta in mid-June, 2002, may be the cause of reduced populations in that area in 2002 and 2003.

Change over time:

The Northern scorpion has been reported from Alberta in entomological collections and literature since the 1920's. Anecdotal information (numerous; e.g., K. White, S. Lapp, pers. comm.) suggests greater populations were found in Alberta, especially near Medicine Hat, during the dry years. Recollections of finding larger numbers of scorpions in former times usually come from people who describe seeing them during one of the dry periods, for example, 1960-62, 1972-74 and 1983-88, when scorpions may have been more common and more active, and collecting conditions were more inviting. The changes in density may reflect the direct effects of weather on survival and reproduction, or the availability of prey (often grasshoppers, which are more common following a series of dry years). There is not sufficient evidence to conclude that a general decline in abundance of the Northern scorpion has occurred in Canada; a sampling program is planned to clarify this question.

Warmer weather expected under climate change scenarios might result in more frequent and more northern observations, if *P. boreus* increases in population density and moves along the river valleys. Construction of unbroken river bank barriers related to urban and suburban development is likely to obstruct the slow movement of scorpion migrants and result in more frequent contacts with humans as scorpions collect in nearby habitat or enter homes. This would not represent a significant risk to human health, but could affect scorpion numbers through mortality of encoun-

tered migrants, increased levels of pest collecting, and ill-advised pest control actions. In some cases, the Northern scorpion has invaded homes in Lethbridge and Medicine Hat, including during relatively moist years, possibly as a means of avoiding cool or moist weather conditions.

Population estimation:

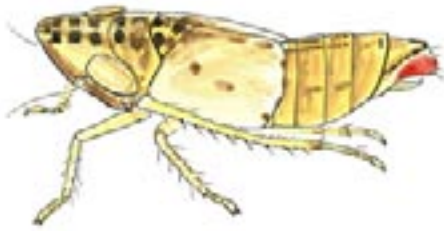
A map of the distribution of *P. boreus* in Alberta was compiled by Johnson (2004). The Canadian distribution map will be updated by field surveys planned for 2004-2007, augmented by volunteer mail-in and web-based recording. Development of a likelihood-of-encounter GIS model based on habitat suitability and the scorpion survey database is in progress. An on-line survey is in place at the following website:

<http://people.uleth.ca/~dan.johnson/scorpions/>

See address above for contributing observations by mail.

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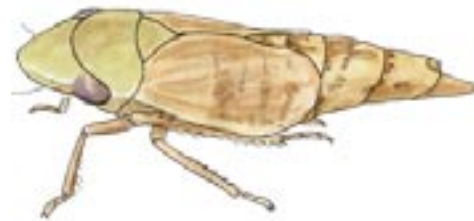
Aflexia rubranura is a specialist on prairie dropseed; but despite being completely flightless it is found on alvars on islands in Lake Huron as well as in eastern prairies from Manitoba to northern Illinois.



Erythroneura carbonata is a specialist on sea-milkwort, a primrose relative that carpets saline depressions.



Memnonia consobrina, found in arid grasslands in western Canada, has subterranean nymphs.



Memnonia consobrina
female



Neohecalus magnificus, found in Canada only in the Red River valley and at Ojibway Prairie in Windsor, Ontario, has very different males and females.



Neohecalus magnificus
female



Stirellus bicolor – in the United States this species has two forms: in spring it is brown and in high summer it is iridescent; but in Canada the two forms may be taken together.



Stirellus bicolor
(spring form)

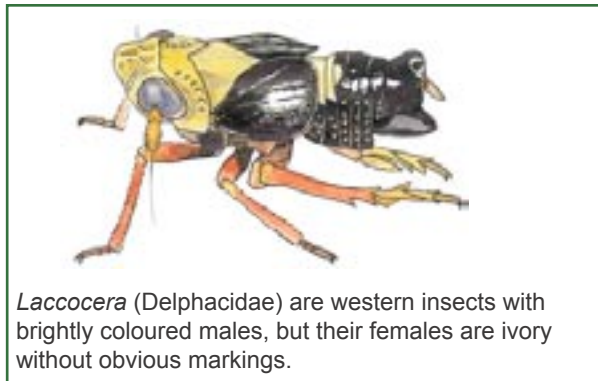


Leafhoppers and their relatives (Homoptera, Auchenorrhyncha) from the Canadian Great Plains

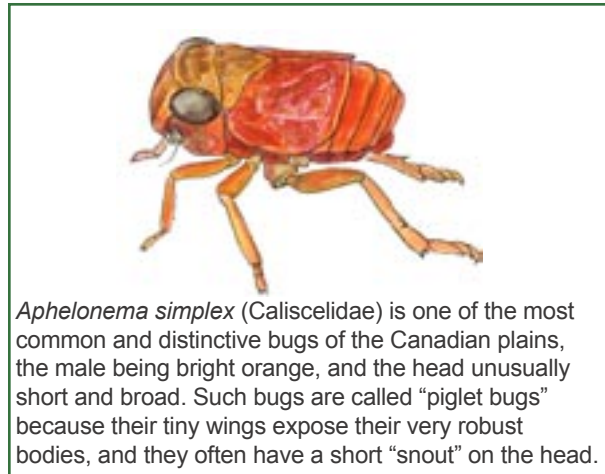
K.G. Andrew Hamilton

Biodiversity, Agriculture & Agri-Food Canada, CEF Ottawa Ont. K1A 0C6, hamiltona@agr.gc.ca

The Canadian Great Plains are often referred to as “prairies”. This term is French for “meadows” and properly describes only the eastern plains grasslands, particularly those around the southern end of Lake Manitoba or “Lac des Prairies.” There, prairie grasses are lush even in the driest part of the summer, yet seldom if ever attain the height of “tall-grass” prairies farther south. The Auchenorrhyncha fauna or “short-horned bugs” of this region of Manitoba is unique (Hamilton 1999). Just how unique, and how extensive this fauna is, has never been elucidated. Recent sampling suggests that it extends all the way into eastern Saskatchewan! A preliminary analysis of this fauna generates other surprising results. For example, the biodiversity “hot spot” on the Canadian Great Plains appears to be Elbow, Saskatchewan which is at the head of Lake Diefenbaker behind the Gardiner and Qu-Appelle dams.



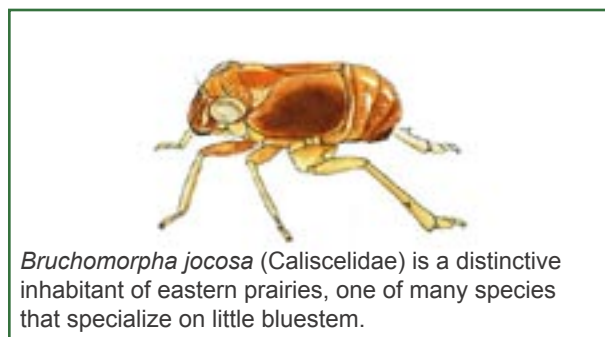
Short-horned bugs include a large number of species endemic to the Great Plains. The following account of the Canadian fauna is presented as a species list. An ongoing analysis of detailed biogeographic patterns and their implications for understanding the ecology of the Great Plains requires a great deal of analysis and will be published as separate papers. The listing presented here gives an overview by grouping the sites by latitude and longitude so that the most obvious distribution patterns



(east vs. west, north vs. south, regional endemism vs. migration from southern localities) can be determined easily.

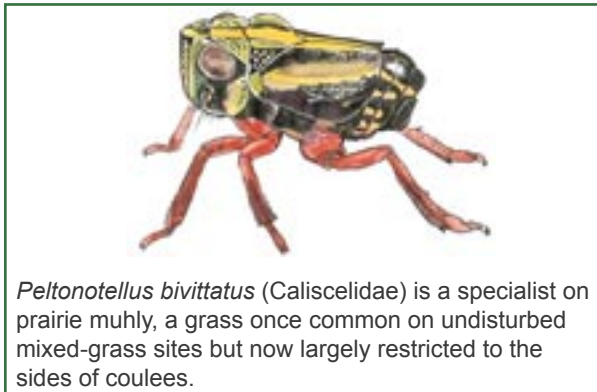
This synthesis is based on nine surveys across the Canadian Great Plains that were made since I was a student and began collecting leafhoppers at Winnipeg in 1965. The initial work was greatly assisted by the catches from mosquito traps maintained at the University of Manitoba and at Glenlea Research Station (Hamilton 1972). This work has been supplemented by studies on other northern grasslands since I first found a “prairie” leafhopper on a heathland near Manitoulin Island, Ontario in 1975.

What, exactly, is an endemic “prairie” bug? It is one that feeds only on a grassland-associated plant



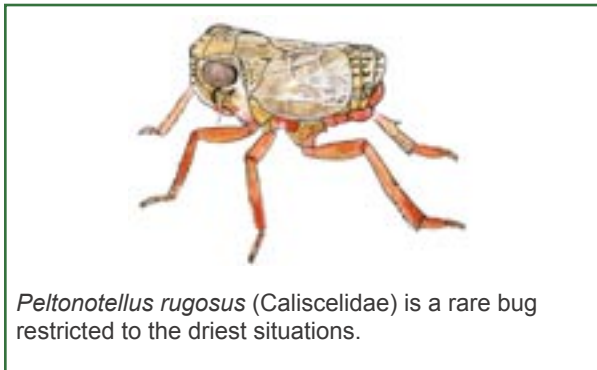


or is rarely, if ever, taken far from a native prairie. The definition must be expanded somewhat to include the insects feeding on plants that are largely associated with the prairies, but by virtue of their preference for moist habitats, find their way along water courses a considerable distance from the Great Plains (sandbar or “wolf” willow and certain diminutive spike-rushes are good examples).



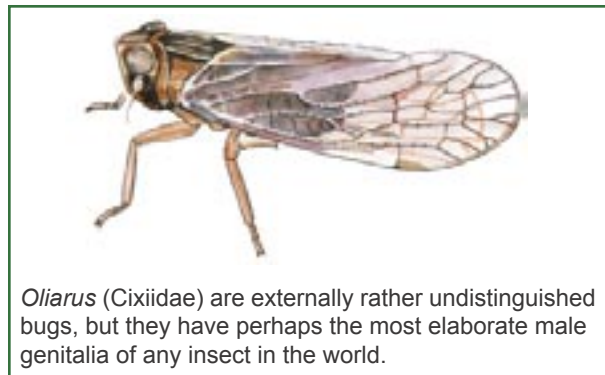
Peltonotellus bivittatus (Caliscelidae) is a specialist on prairie muhly, a grass once common on undisturbed mixed-grass sites but now largely restricted to the sides of coulees.

Others that are not confined to the Great Plains are found in areas that were probably once connected to the prairies, but as world temperatures declined over the last 7000 years have become isolated in forested regions. They now inhabit sheltered valleys in the mountains as far north as the Yukon, or patches of sandy soils in boreal forest, or limestone plains (alvars) in the vicinity of the Great Lakes, and even on saline or sandy areas of the Atlantic coast.



Peltonotellus rugosus (Caliscelidae) is a rare bug restricted to the driest situations.

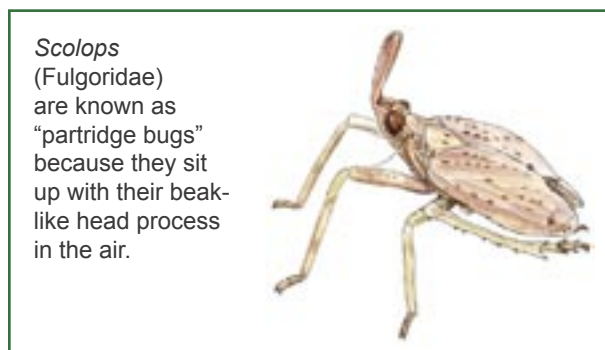
This summary of what we now know about the Auchenorrhynch fauna of the Canadian prairies is based on more than 340 sites (Table 1). Samples taken within a 5 km radius of each other are “lumped” to make data presentation simpler. These sites are then grouped according to one-degree quadrats (Fig. 1). In Alberta (AB) and Saskatchewan (SK) there are an average of 4-5 sites per quadrat; in Manitoba



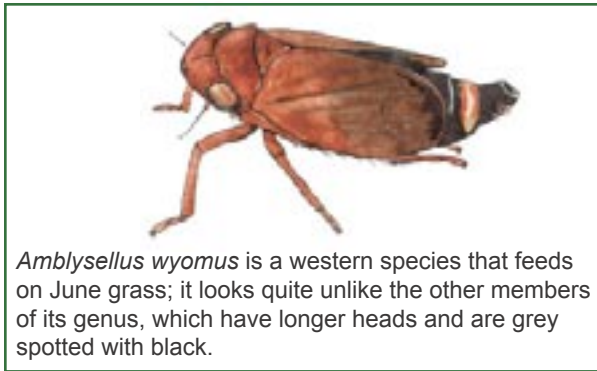
Oliarus (Cixiidae) are externally rather undistinguished bugs, but they have perhaps the most elaborate male genitalia of any insect in the world.

(MB), where the prairie is much more localized and fragmented, there are 6.7 sites per quadrat. The maximum number is 17 sites in quadrat 2 of southwestern Manitoba (between 49°N 100°W and 50°N 101°W) which has been a favourite collecting area for many entomologists.

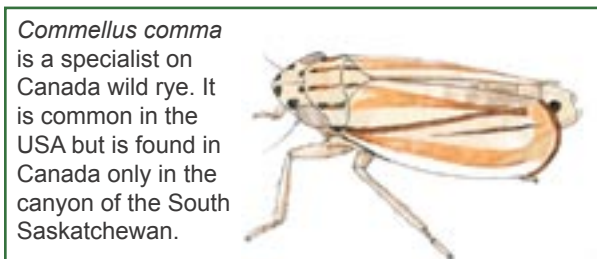
This information is taken largely from material in the Canadian National Collection of insects, supplemented by data from DeLong (1931), Doering (1940), Strickland (1953), Medler (1958), Nielson (1965), Kramer (1967), and Hamilton (1972). The results of this compilation indicate that there are at least 226 prairie-endemic Auchenorrhyncha, of which 168 are leafhoppers (Cicadellidae), 47 are planthoppers (Fulgoroidea), 7 are treehoppers (Membracidae), 3 are cicadas (Cicadidae) and 1 is a spittlebug (Cercopidae). Almost all the planthoppers are Delphacidae, but these are rare compared to the Caliscelidae or “piglet bugs,” with 6 species of *Bruchomorpha* plus one of *Aphelonema* and two of *Peltonotellus*, most of which are common and widespread on the plains. The remaining families of Fulgoroidea represented in the endemic fauna are Fulgoridae (or Dictyopharidae) with one species of “partridge-bug” *Scolops*, and Cixiidae with one species each in the genera *Myndus* and *Oliarus*.



Scolops (Fulgoridae) are known as “partridge bugs” because they sit up with their beak-like head process in the air.



The species are grouped roughly by overall distribution. Fifty-five species are found widely across the Great Plains; 32 of these also occur in other Canadian grasslands, either along the Atlantic coast, or in alvars and relict grasslands of Ontario (ON), intermontane grasslands of British Columbia (BC) and the Yukon Territories (YT), or in the Peace River District of Alberta (Table 2). These widespread insects are therefore characteristic of the Northern Grasslands Biome. When these are known only (or primarily) from the Canadian Great Plains, they are indicated as “endemic.”



Species characteristic of only parts of the Great Plains can be divided into two biotic provinces, 34 species characteristic of eastern grasslands or “true prairie” and 39 that are widespread on the western plains or “Canadian steppe” (Table 3), with the remaining species divided between 40 on moist steppe or “aspen parkland” and 58 on dry steppe or “short-grass prairie” (Table 4). The intervening area or “mixed grass prairie” appears to have no characteristic bugs.

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Acknowledgments

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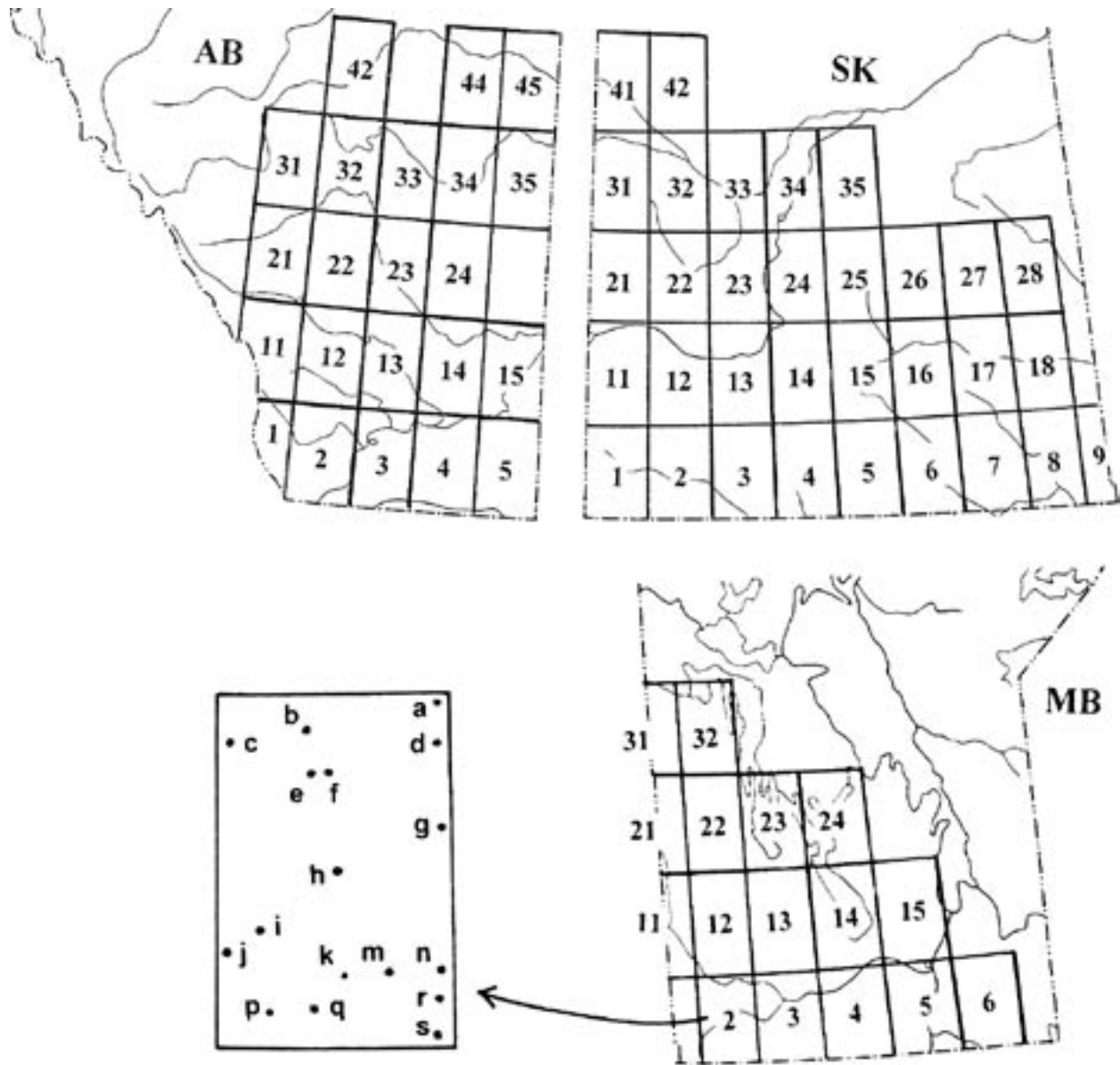


Figure 1. Distribution of sampled sites on the Canadian Great Plains by one-degree quadrats, with quadrats for each province numbered from west to east, beginning with southern row. Individual sites are listed north to south and west to east within each quadrat, as shown in enlarged view of quadrat 2 of Manitoba (lower left).



Table 1. Sites sampled on the Great Plains of Canada (conserved sites in boldface), numbered and lettered as in Fig. 1.

Alberta (AB)

1a Porcupine Hills (44 km N Lundbreck), *b* Frank, *c* Bellevue
2a Granum, *b* **Smashed-in-Head Buffalo Jump**, *c* Fort McLeod, *d* Cowley, *e* Pincher Ck, *f* Brocket, *g* Glenwood, *h* **Waterton**
3a Iron Springs, *b* Taber 15 km N, *c* Taber, *d* Chin, *e* Diamond City, *f* Lethbridge, *g* Welling, *h* Stirling, *i* Magrath, *j* Raymond, *k* New Dayton, *m* Del Bonito 10 km NW (**Ross Lake**), *n* Milk River, *p* Kimball, *q* Del Bonito 9 km E
4a Purple Spgs 5 km W, *b* Burdett, *c* Whitla, *d* Foremost, *e* Clarinda, *f* Milk River 10 km E, *g* Coutts, *h* **Writing-on-Stone**, *i* Aden
5a Irvine, *b* Walsh, *c* **Elkwater**, *d* Orion, *e* Manyberries, *f* Orion 8-10 km S, *g* Onefour, *h* **Orion 40 km S**, *i* Manyberries 45 km S
11a Hartell, *b* Pekisko 5 km W, *c* Longview 22 km S, *d* Longview 30 km S
12a Gleichen, *b* Nanton
13a Bassano, *b* Scandia, *c* Vauxhall
14a Steveville, *b* Duchess 13 mi N, *c* Brooks, *d* Tilley, *e* Tilley 5 mi E
15a Empress, *b* Suffield CFB (**Amiens**), *c* Medicine Hat
21a Olds, *b* Didsbury, *c* Ghost Dam, *d* Calgary 9 mi W (Chestermere Lake), *e* Calgary
22a Beiseker 5 mi E
23a Morrin, *b* Delia, *c* Michichi 4 mi N, *d* Drummheller, *e* Rosedale, *f* Rosebud, *g* Hussar
24a Sheerness 10 mi NW, *b* Sunnynook 12 mi SW
31a Spruce View
32a Wetaskiwin, *b* Battle River 1st- 3rd crossing, *c* Lacombe, *d* Red Deer
33a Nevis, *b* Stettler
34a Castor
35a Wainwright, *b* Czar, *c* Provost
42a Edmonton, *b* Devon
44a Ranfurly, *b* Mannville
45a Vermilion, *b* Islay 4 mi S, *c* Blackfoot

Saskatchewan (SK)
1a **Cypress Hills**
2a Gull Lk 14 mi S, *b* Illerbrun 2 mi S, *c* Simmie 6-7 mi SW, *d* Scotsguard 3 mi N, *e* Dollard, *f* Eastend
3a Cadillac 9-11 mi S, *b* Val Marie (**Grasslands N Pk**)
4a Assiniboia, *b* Limerick, *c* Wood Mountain, *d* Lisieux, *e* Killdeer
5a Mossbank, *b* Ardill, *c* Willows, *d* Readlyn 5 mi W, *e* Verwood, *f* St. Victor, *g* Willow Bunch, *h* Rockglen, *i* Fife Lake
6a Pangman, *b* Minton

7a Weyburn, *b* Stoughton 5 km W, *c* Torquay
8a Kenosee, *b* Kisbey 8 km W, *c* Kisbey 5 km E, *d* Arcola, *e* Glen Ewen, *f* Estevan, *g* Roch Percée, *h* North Portal
9a Maryfield, *b* Redvers 15 km N, *c* Wauchope 4 km E
11a Gascoign, *b* Fox Valley, *c* Cliftonville, *d* Maple Creek 10 mi NW, *e* Piapot and 2 mi NW
12a Lacedena, *b* **Great Sand Hills** (Hazlet), *c* Hazlet 6 mi E, *d* Swift Current 10 mi W, *e* Webb, *f* Gull Lk 8 mi N, *g* Tompkins, *h* Gull Lake
13a **Matador Prairie**, *b* **Saskatchewan Ldg** (Stewart Valley 9 mi W), *c* Waldeck, *d* Swift Current, *e* Simmie 5 mi NE
14a Riverhurst, *b* Tugaskie, *c* Eyebrow 3 mi SE, *d* Chaplin, *e* Bateman
15a Aylesbury, *b* Brownlee, *c* Moose Jaw 5 mi S, *d* Crestwynd 4 mi N
16a Craven 2 km NW, *b* Lumsden, *c* Regina, *d* Davin
17a Duff 2 km E, *b* Fort Qu'appelle (Lebret), *c* Katepwa Bch, *d* Qu'Appelle, *e* Indian Head, *f* Qu'Appelle 7 mi S
18a Melville, *b* Duff 8 km E, *c* Stockholm and 5 km W, *d* Esterhazy, *e* Round Lake 6 km E Birds Point, *f* B roadview, *g* Pipestone Creek, *h* Pipestone Creek 6 km SE St. Hubert, *i* Peebles, *j* Kennedy
21a Marengo, *b* Kindersley 13 km W
22a Plato
23a Harris, *b* Rosetown, *c* Dinsmore
24a Saskatoon 14 km SE, *b* Beaver Creek, *c* **Pike Lake**, *d* Dundurn, *e* Dundurn 5 mi S (Rudy), *f* Hanley 3 mi SE, *g* Bladworth, *h* Davidson 11 mi W, *i* Elbow, *j* Elbow 8 mi SE (**Douglas Prov. Park**)
25a Viscount 11 km E, *b* Imperial, *c* Imperial 11-18 km E (**Last Mountain WMA**), *d* Davidson
26a Dafoe, *b* Kandahar
27a Foam Lake, *b* Ituna 3 km N
28a Canora, *b* Willowbrook 12 km E, *c* Yorkton, *d* Rokeby, *e* Crescent Lake
31a Neilburg, *b* Cut Knife, *c* Rutland
32a Battleford, *b* Denholm
33a Redberry, *b* Radisson, *c* Borden, *d* Ceepee, *e* Asquith, *f* Biggar 16 mi N
34a Blaine Lake, *b* Duck Lake, *c* Rosthern, *d* Fish Creek, *e* Hepburn, *f* Vonda, *g* Martensville, *h* Saskatoon 3 mi NW, *i* Saskatoon 4 mi NE, *j* Saskatoon
35a Dana
41a Tangleflags, *b* Lloydminster 4 mi SE, *c* Marshall 3 mi NW, *d* Lashburn 3.5 mi E, *e* Maidstone

42a Cochin**Manitoba (MB)**

2a Brandon 5-7 mi N, *b* Oak Lake 11 km N, *c* Virden, *d* Brandon, *e* Oak Lake, *f* Griswold 4 km W, *g* Brandon 15 mi S (Carroll), *h* Hartney, *i* Napinka, *j* Melita, *k* Deloraine, *m* Whitewater Lk, *n* Boissevain, *p* Waskada, *q* Horton, *r* Goodlands, *s* **Turtle Mountain Prov. Park**
3a Onah, *b* Carberry, *c* Melbourne, *d* Shilo 5 mi SW, *e* Carberry 7 mi S, *f* Glenboro 13 mi N (**Bald Head Hills**), *g* Glenboro 14-18 km N, *h* Rounthwaite, *i* Treesbank (Aweme), *j* Stockton MB 2 mi W, *k* Glenboro MB and 5 km N, *m* Ninette, *n* Baldur, *p* Ninga, *q* Rock Lake
4a MacGregor 3 mi E, *b* Austin MB 16 km S, *c* La Riviere, *d* Pilot Mound, *e* Crystal City, *f* Morden, *g* Morden 5 km W, *h* Morden 6 km S, *i* Snowflake
5a St. Fr-Xavier, *b* Winnipeg (St. Charles Rifle Range), *c* Winnipeg (airport, **Living Prairie Museum**), *d* Transcona, *e* Winnipeg (S), *f* Ft Whyte, *g* Glenlea, *h* Niverville, *i* Myrtle, *j* Morris, *k* Arnaud, *m* Altona (Neuenburg 2 km W), *n* Dominion City, *p* Emerson
6a Steinbach 9 km S, *b* Marchand 2 mi W, *c* **Marchand 6 mi E**, *d* **Stuartburn 8 km ENE**, *e* **Tolstoi 2-6 km E**, *f* **Gardenton and 3-5 km W**
11a Russell, *b* Binscarth, *c* Birtle
12a Rossburn, *b* Solsgrith, *c* Kellogg, *d* Shoal Lake, *e* Strathclair, *f* Rapid City 6 mi E, *g* Oakner
13a St. Amelie, *b* McCreary 3 km E, *c* Minnedosa and 5 mi N, *d* Forrest Station 9 mi N
14a Mulvihill 4 km N, *b* Oak Point 3 mi S, *c* Gladstone, *d* Woodside 5 km E, *e* Westbourne, *f* High Bluff 3 mi S
15a Fraserwood, *b* Komarno, *c* St. Laurent 13 km E, *d* St. Laurent 8 km S, *e* Lake Francis 3 mi NW, *f* **St. Ambrose 7-9 km E**, *g* Woodlands and 3 mi SE, *h* **Stony Mountain 12 km N**, *i* Grosse Isle
21a Roblin
22a Pulp River 13 km E, *b* Ethelbert, *c* Ashville 16 km N (**Crocus Hill**), *d* **Ashville 11 km N**, *e* Ashville, *f* Dauphin, *g* Keld
23a Winnipegosis 1 km NW, *b* Toutes Aides, *c* Rorketon 6 km SE, *d* Ochre River 4 km N
24a Moosehorn, *b* Wapah 7-10 km E, *c* Camper 2.5 km SSE
31a Mafeking
32a Cowan



Table 2. "Short-horned" bug fauna characteristic of the Northern Grasslands biome including much of the Great Plains of Canada, with distribution (codes as in Table 1).

Leafhoppers

Amblysellus acuerus DeLong & Hamilton: SK 3a, 5f; MB 15d, 24b.	Flexamia serrata Beamer & Tuthill: BC; AB 35a, 44a; SK 8abf, 18a, 24fi, 25c, 27b, 28de, 31a, 34gi; MB 4g, 6ef, 12c, 14b-d, 15cdghi, 22a, 23c.	Mesamia nigradorsum (Ball): AB 21e, 45c; SK 4cd, 24d, 34i; MB 3ip, 5hp, 6e, 15di; ON.
Athysanella attenuata Baker: BC; AB 3f, 5ce-h, 13c, 14b, 15a-c, 22a, 23ae, 32a, 42b; SK 2a, 3ab, 5d, 8h, 11bd, 12be, 13ad, 14a, 15b-d, 16b, 17d, 18b, 21b, 24hi, 25d, 28d, 33bf, 34i-km; MB 3km, 5c, 14d.	Gypona contana DeLong: AB 2b, 3fn, 5cg, 14b, 15c, 21e, 22a, 23dg, 33b; SK 2f, 3b, 6b, 8f, 9a, 11e, 12bg, 13d, 17c, 24bcdi, 28b, 32b, 33e, 34g-j; MB 2a, 3in, 4gi, 5bdehp, 15dfi.	Mocuellus americanus Emeljanov: AB Peace R District, 45a; SK 3b, 5b, 8b, 17e, 18ch, 25c, 28b, 34bij, 42a; MB 2df, 3k, 4b, 12c, 14a, 15cg-i, 22f, 23cd, 24bc; ON.
Athysanella kadokana Knull: AB 5g, 15a; SK 5bd, 24fi, 25c, 26ab; MB 3j, 12c, 14d, 15gh.	Hebecephalus occidentalis Beamer & Tuthill: AB 3fq, 14ce, 15a-c, 21e, 22a, 23f, 24ab, 42b, 44b; SK 5de, 8bch, 11e, 13d, 15cd, 17bde, 21b, 24h-j, 25ad, 28bde, 32b, 33c, 34gj, 42a; MB 2bf, 3c, 4a, 5e, 12c, 14d, 15i, 23d, 24c.	Paraphlepsius continuus (DeLong): AB 33b, 42a; SK 31b; MB 15e; ON.
Athysanella secunda Blocker & Wesley: SK 24f, 25c, 34gi; MB 14b, 15d. Endemic sp.	Hebecephalus truncatus Beamer & Tuthill: YT; BC; AB 3m, 15b, 23a; SK 24c, 34j; MB 2dr; 5e.	Paraphlepsius lascivius (Ball): YT; BC; AB Peace R District, 3c, 14c, 15b, 23d, 33b; SK 3b, 4b-d, 5gh, 15a, 21a, 23b, 24cd, 26b, 33b, 34cj; MB 4af, 5ef, 15i.
Athysanella terebrans Gillette & Baker: AB 5fhi, 15ab, 35a; SK 3b, 8f, 11e, 18e, 24c, 33c; MB 3cij, 5e.	Hecalus viridis (Uhler): AB 2b, 3bcfmq, 4adf, 5abe-h, 13b, 14a, 15a-c, 23df, 35a; SK 1a, 3ab, 4a, 5g, 11e, 12h, 15c, 21b, 24i, 25c, 34j; MB 3bhim, 5cip, 6e, 13d, 14d; ON.	Paraphlepsius solidaginis (Walker): AB 3f, 5e, 15c, 33b, 35a; SK 4d, 5gh, 6b, 13d, 28d, 31ac, 34i; MB 3im, 5n, 6e, 12dg, 14d, 15di; Atlantic coast.
Attenuipyga minor (Osborn): AB 3b, 4abf, 5afh, 13b, 15bc, 21ce, 23a; SK 2bc, 3ab, 12bf, 13e, 18bce, 22a, 24aci, 25c, 33a, 34j; MB 3bin, 4af, 5dimp, 12f, 13b, 14bcd.	Idiocerus freytagi Hamilton: BC; AB Peace R District, 3f, 5ce, 15c; SK 13b, 16b, 17bd, 24j, 32a, 33d, 34ij; MB 2a, 4eg, 5e, 12bd; ON.	Paraphlepsius turpiculus (Ball): AB 35a; SK 4c, 24i; MB 2deh, 3i, 4f, 11a, 22a; ON.
Auridius sandaraca Hamilton: YT; AB 42b; MB 3c, 6a; ON.	Idiocerus raphus Freytag: BC; AB 3f, 5ce, 15c, 23d; SK 5a, 13b, 17b, 24j, 32a, 33d, 34j; MB 2ar, 3di, 4e-g, 5eg, 12b, 14f, 31a; ON.	Pendarus magnus (Osborn & Ball): AB 15b; SK 9c, 12b, 18bc, 24i, 28d, 34j; MB 4g, 6e, 14b, 15di.
Ceratagallia viator Hamilton: AB 1a, 2h, 3f, 5c, 11a-c, 13b, 14a, 15bc, 22a, 23d, 24a, 33b, 34a, 35a, 42a; SK 2a-d, 3ab, 5bd, 7a, 8bf, 9bc, 13e, 15c, 17a, 18cehi, 24ci, 27b, 28e, 31b, 34j; MB 2d, 3bcimn, 4eg, 5bcdjp, 6ef, 12c, 13b, 14c, 22cf, 23a-d, 31a, 32a.	Laevicephalus poudris Tuthill: AB 2h, 34a, 35a, 44a; SK 2b, 18a, 24fi, 31ac, 34gi, 35a; MB 6ef, 13d, 14b-d, 15cdf-i, 22f.	Prairiana cinerea (Uhler): YT; AB 1b, 2h, 3fq, 4i, 5ace-h, 15bc, 21e, 23acde, 33b; SK 2b, 3ab, 4c, 5acd, 8a, 13e, 15c, 18f, 24ai, 25c, 33a, 34gi; MB 2c, 3beim, 4f, 5abe, 6e, 14b, 21a.
Cicadula longiseta (Van Duzee): YT; BC; AB Peace R District, 12b, 21b, 22a, 33b, 44a; SK 8b, 21c, 31a, 33b, 34ag, 41b; MB 2a, 22a.	Laevicephalus saskatchewanensis Hamilton & Ross: SK 5b, 12e, 18b, 24h, 28d, 33b, 35a, 41b; MB 5c, 12c, 14bd. Endemic sp.	Prairiana kansana (Ball): AB 15b; SK 2c, 3b; MB 3i, 4g, 5b, 6e, 15b, 24c; ON.
Commellus sexvittatus (Van Duzee): YT; BC; AB Peace R District, 5begh, 12a, 14a, 15a-c, 21e, 23de, 42b; SK 2b-d, 3b, 5c, 6a, 7a, 8h, 12beh, 13ae, 15c, 24i, 28d, 34j; MB 2hj, 4d, 5c, 11a, 15b, 32a.	Limotettix symphoricarpae (Ball): MB 2h, 5e.	Psammotettix knullae Greene: YT; BC; AB 5e, 14c, 15bc, 22a, 44a; SK 2e, 4a, 8b, 13d, 24di, 32b, 33b, 34acj, 41e; MB 2d, 4b, 13b, 14c, 22a, 23acd, 24b, 31a.
Deltocephalus serpentinus Hamilton & Ross: AB 21d, 23d, 33b; SK 3b, 5d, 8b, 11d, 17bd, 18b, 24fhi, 28de, 34f, 41c; MB 12d, 14d, 24b, 31a; coast of James Bay, ON.	Limotettix utahns (Lawson): BC; AB 42a; SK 15d, 17f, 24i, 31b, 34j; MB 4f, 5efg.	Texananus marmor (Sanders & DeLong): AB 23d, 33b, 34a, 44b, 45a; SK 18b, 23a, 24bi, 34bj; MB 3abeij, 11a; ON.
Destria crocea (Beirne): SK 8g, 14e, 24fi, 31a, 34i; MB 3i, 4f-h, 5bce, 15dhi; Atlantic coast.	Lonatura salsura (Ball): BC; AB 3c, 14a, 15ab, 33b, 45bc; SK 5bdg, 8b, 18bc, 24fhi, 25c, 33b, 34a, 41b; MB 2m, 6e, 14d, 15di, 23ab, 31a.	Xerophloea zionis Lawson: BC; AB 15c; SK 2b-d, 3a, 13e; MB 2p, 3i, 5e.
Driotura robusta Osborn & Ball: AB 5h, 15b; SK 3ab, 8f, 18e, 26b, 28d; MB 2jkr, 3beg.	Lonatura teretis Beamer: AB 32c; SK 18eh, 24fi, 27b, 34i; MB 15di.	Other bugs
Erythroneura carbonata McAtee: AB 45b; SK 8c, 34j; MB 13b, 23a.	Macropsis feminis Hamilton: AB 2c, 23d; SK 18d, 33d, 34j; MB 2e, 3bi, 4g, 5e, 6b, 12bf, 13c.	Aphelonema simplex Uhler: AB 3c, 5g, 35a; SK 5g, 8c, 14e, 18ac, 24i, 26b, 28de, 31c, 34ij; MB 2nq, 4d, 5bdi, 6e, 12c, 13b, 14b-e, 15dghi, 22af.
Euscelis maculipennis DeLong & Davidson: BC; AB 3f, 5cg, 15b, 35a; SK 3b, 5g, 16b; MB 4f, 5e.	Macropsis rufescens Hamilton: AB 5e, 15c, 23d; SK 4c, 16b, 33d, 34j; MB 2d, 3b, 5e.	Bruchomorpha beameri Doering: BC; AB Peace R District, 2bh, 5ceg, 14b, 22a, 23cdf, 24ab, 33b, 35ac, 44b; SK 1a, 2b, 3ab, 5bdeg, 8cf, 11ae, 12b, 13bde, 15b-d, 17bf, 18a-c, 24bci, 25c, 28bd, 31ab, 32ab, 33bcf, 34bgj; MB 2gn, 3bdei, 4b, 5b.
Extrusanus oryssus Hamilton: AB Peace R District, 3f, 5cgh, 11b, 15a-c, 23d, 32d, 35a, 42b; SK 1a, 2bc, 3ab, 4c, 5cg, 6a, 8a, 13e, 16b, 18g, 21b, 24ai, 25c, 28ac, 31ac, 33a, 34j; MB 2iqs, 3bimnq, 4g, 5b-ep, 6aef, 14bd, 15cdhi, 21a, 22e, 24b, 31a.	Macropsis rufocephala Osborn: AB 21b, 23d, 17b, 24i, 27a, 32a, 33d, 34ij; MB 2s, 3i, 4ag, 5e, 12b, 13c; ON.	Caenodelphax nigriscutellata Beamer: AB 5fi, 13b, 15b; MB 3g, 5b; ON.
Flexamia decora Beamer & Tuthill: AB Peace R District, 2h, 12a, 15b, 21e, 35a; SK 2bc, 3b, 5h, 8a, 11d, 13a, 18a, 24fi, 28d, 31ac, 34gij, 41a; MB 6e, 14bd, 15cdfhi, 24bc.	Memnonia anthalopus Hamilton: AB 35a; SK 3b, 24i, 25c, 31a, 34j; MB 6ef, 14bd, 15cdhi, 24b.	Cixius cultus (Ball): AB Peace R District, 3cf-jn, 5ceg, 14cd, 15a-c, 23g; SK 1a, 3b, 5i, 8a, 13d, 24i, 34j.
	Mesamia ludoviciana Ball: AB Peace R District, 2b, 3cf, 15b, 23d, 34a; SK 2c, 3b, 8f, 13d, 18c, 24bi, 25c, 34gj; MB 15i.	Delphacodes sp.nov. A: AB Peace R District, 4f; SK 24i, 26b, 34j; MB 14b.
		Pissonotus delicatus Van Duzee: BC; AB 3cf, 14acd, 15ac, 23d; SK 5g, 8b, 11a, 13d, 16bc, 24i, 31a, 32b, 34gi; MB 2jm, 5i, 11ab, 14d, 23ab.
		Publilia brunnea (Ball): AB 3f, 4a, 5acde, 13b, 15abc; SK 11a, 12bh, 13bd, 14d, 16a, 18ce, 24bci, 25b, 28ab, 33e; MB 2b, 4g, 5bi, 15a, 22cd, 23c, 24a; ON.



Table 3. "Short-horned" bug fauna characteristic of two major subdivisions (biotic provinces) of the Great Plains of Canada, with distribution (codes as in Table 1).

BIOTIC PROVINCE: PRAIRIES**Leafhoppers**

Aflexia rubranura (DeLong): MB 5b, 14b, 15d/hi, 24b; ON.
Athysanella incongrua Baker: MB 3g, 15g.
Attenuipyga joyceae Hamilton: MB 14b, 15di. Endemic sp.
Commellus colon (Osborn & Ball): SK 18eh; MB 3di, 5bc, 11a, 15di.
Commellus comma (Van Duzee): AB 15b; SK 24i.
Cuerna fenestella Hamilton: MB 3im, 5b, 15i, 24c; ON.
Flexamia atlantica (DeLong): SK 18e; MB 15g.
Flexamia delongi Ross & Cooley: SK 18e; MB 3i, 14bd, 15bcdghi, 24c; ON.
Flexamia graminea (DeLong): SK 9c, 18ch; MB 2f, 4g, 13b, 23c.
Flexamia inflata (Osborn & Ball): BC; MB 5d, 6ef, 13b, 14d, 15h, 22f, 23a, 32a; ON.
Flexamia prairiana DeLong: MB 4g, 5b-d, 6ef, 14c, 15dgi, 22bc, 24b; ON.
Flexamia reflexa (Osborn & Ball): MB 14d, 22f; ON.
Flexamia sp.nov.: MB 14c. Endemic sp.
Graminella ampla (Beamer): SK 8g; MB 5c.
Laevicephalus unicoloratus (Gillette & Baker): SK 18ceh, 28b; MB 2f, 3k, 4g, 5dp, 6ad-f, 13b, 14b-d, 15cdf-i, 23cd, 24c; ON.
Laevicephalus vannus Knull: MB 6b, 23a?
Latalus latidens (Sanders & DeLong): MB 2d.
Limotettix urmura Hamilton: SK 5g; MB 5eg, 6e, 15i; ON.
Macrosteles flavalis Hamilton: 5 MB 2d, 3d, 4f, 5eg. Endemic sp.
Macrosteles sp.nov.: MB 24b. Endemic sp.
Memmonia panzeri Hamilton: MB 5bp, 6ef, 14b, 15dhi; ON.
Neohecalus magnificus Hamilton: MB 5b-eik, 6e, 14b, 15di; ON.
Paraphlepsius hemicolor (Sanders & DeLong): MB 4f, 5ej.
Paraphlepsius lobatus (Osborn): SK 9b, 17a, 18ceh; MB 4g, 12c, 15i, 22cd; ON.
Paraphlepsius umbrosus (Sanders & DeLong): SK 18ce; MB 3b, 4g, 5e; ON.
Polyamia caperata Ball: SK 18ceh; MB 4gh, 5bc, 13b, 14c, 15di, 22d; ON.
Stirellus bicolor (Van D): SK 18c, 28b; MB 2f, 4g, 5bp, 6e, 14bd, 15cdghi, 23c, 24c.

Other bugs

Bruchomorpha dorsata Fitch: SK 18eh; MB 4g, 5bc, 6ef, 15cdf; ON.
Bruchomorpha jocosa Stål: SK 8cf, 18ceh, 28ab; MB 3c, 5p, 6e, 13b, 15d/hi, 22c, 23c.
Bruchomorpha keidensia Doering: AB Peace R District; MB 6e, 15bd, 22dfg, 31a. Endemic sp.
Bruchomorpha pallidipes Stål: SK 18c; MB 3a, 23c.
Delphacodes angulata Beamer: MB 4g.
Delphacodes parvula (Ball): MB 5b-dp, 6ae,

14bd, 15dghi, 22cd, 24c, 32a; ON.
Delphacodes sp.nov. B: MB 5c.
Megamelus metzaria Crawford: MB 2g, 5b, 6e, 15h, 23a; ON; Atlantic coast.
Megamelanus sp.nov.: MB 14d.
Prokelisia crocea (Van Duzee): SK 16a, 17d; MB 4gh, 5bcd/fim, 6e, 13a, 14a, 15f, 23a; Atlantic coast.
Lepyronia gibbosa Ball: 7 SK 8g; MB 3abd/hi, 4b; Atlantic coast [MA].
Tortistilus minutus Cald.: 3 MB 3b, 4g, 14b.

BIOTIC PROVINCE: STEPPE**Leafhoppers**

Acinopterus viridis Van Duzee: BC; AB 14be, 23d, 24b, 33b, 34a; SK 3b, 5e, 13a, 23bc, 24ej, 34g.
Amblysellus valens (Bm. & Tut.): AB 5c, 23f, 24a, Peace R District; SK 2b, 3ab, 34j.
Athysanella bifida Ball & Beamer: AB 3bfq, 5cegh, 13b, 14a-ce, 15c, 22a, 23de, 35a, 45c; SK 2a-d, 3ab, 4c, 8ab/hi, 11b, 12h, 13ae, 15bcd, 18g, 24ci, 25c, 34gj; MB 2q, 3bj.
Athysanella occidentalis Baker: AB 3fq, 4a, 5ce, 12a, 15ab; SK 2a, 3b, 11b 12h, 15c, 24ci, 25d, 34j.
Athysanella robusta Baker: YT; BC; AB Peace R District, 3mq, 4a, 5aceghi, 14a, 15a-c, 21e, 23e, 32a; SK 1a, 2a-d, 3ab, 6a, 7a, 8h, 11a, 12h, 13ae, 24acdi, 25c, 33a, 34ff; MB 3i.
Auridius auratus (Gillette & Baker): BC; AB Peace R District, 1c, 4ai, 5e, 12a, 14c, 15ab, 21de, 23c, 31a, 33b, 35a; SK 3ab, 11d, 12e, 13a, 24fi, 32a, 33a, 34j.
Auridius ordinatus (Ball): YT; BC; AB Peace R District, 2b, 3j, 12a, 15b, 21e, 23f, 32b, 42a; SK 2bd, 3b, 5h, 8ah, 11d, 12de, 13ae, 15c, 17e, 18g, 24i, 25c, 31c, 33f, 34j; MB 2q, 6c.
Ceratagallia semiarida Hamilton: AB 3f, 5c, 13b, 14c, 15c, 23bd, 35b; SK 3b, 11a, 12a, 15c, 24bfi, 34j; MB 3i.
Deltoccephalus lineatifrons Oman: BC; AB 13c, 15b; MB 2h.
Empoasca medora DeLong: AB 3e, 5ab, 14c, 15a-c, 34a, 35a; SK 3b, 24i; MB 11a.
Flexamia abbreviata (Osborn & Ball): AB 2b, 3f, 12a, 14ab, 15bc, 21e, 23df, 24b, 35a; SK 2b, 3b, 5cf, 8f, 11d, 13ae, 15cd, 18eh, 24i, 25c, 34j; MB 2j, 3cd/egi, 13c.
Flexamia flexulosa (Ball): AB 2b, 3f, 5ceg, 14a-c, 15bc, 22a, 24b; SK 2b, 3ab, 8fh, 11d, 13ae, 24i, 34j; MB 2q, 22c.
Flexamia grammica (Ball): AB 2b, 5ei, 15a, 23d, 35a; SK 11e, 12b, 13b, 24di, 34j.
Flexamia stylata (Ball): AB 2b, 5a, 15b, 21e; SK 3b, 5g, 13a, 18ehj, 24i; MB 2jq.
Frigartus frigidus (Ball): AB 15b, 22a, 34a, 35a; SK 2bc, 3b, 8c, 13e, 23b, 24i, 34ij; MB 3i.
Hardya dentata (Osborn & Ball): BC; AB 1a, 3mq, 5acehi, 11ad, 15b, 23d, 34a; SK 2a-c,

3ab, 11a, 13e, 24ai, 25c, 34j.
Hebecephalus rostratus Beamer & Tuthill: AB 2b, 3cf, 5ceg, 14be, 15c, 22a, 23a-d, 34a; SK 2d, 3b, 5bd, 8ae, 11d, 12f, 13ade, 14bc, 15bd, 17be, 18b, 24e-j, 25d, 33c, 34gij; MB 2a, 4g, 14d.
Idiocerus ramentosus Uhler: BC; AB Peace R District, 3fnp, 5ade, 15c, 23d, 44b; SK 5a, 7c, 12b, 17b, 24cj, 32a, 33e, 34j; MB 2ak, 4ceg, 12a, 13c; ON.
Memmonia brunnea (Ball): AB 3g, 5a; SK 8b, 24i, 34j; MB 14d.
Mocuellus caprillus Ross & Hamilton: AB 1c, 2bh, 3bf, 4ai, 5afg, 12a, 13b, 14bc, 15a-c, 21e, 22a, 23d-f, 24b, 33b, 34a, 35a, 44b; SK 2b-d, 3ab, 4a, 5g, 8h, 11d, 12beh, 13ae, 15cd, 16b, 17bd, 23b, 24ci, 25cd, 33f, 34ij; MB 2j.
Oncopsis marilynnae Hamilton: BC; SK 8f, 34j; MB 2ns, 3b.
Orocastus labecculus (DeLong): BC; AB 5c, 12a, 13b, 14ace, 15a-c, 21e, 24ab, 34a, 35a; SK 2bc, 3ab, 11d, 12h, 13e, 14a, 15cd, 24i, 34j.
Orocastus perpusillus (Ball & DeL.): YT; BC; AB Peace R District, 3bf, 4a, 12a, 13b, 14a-c, 15a-c, 21e, 23df, 34a, 35a, 44b; SK 2b-d, 3ab, 8a, 11d, 12h, 13ae, 17b, 18a, 22a, 24i, 33cf, 34gj; MB 2q, 3cdik, 22c.
Rosenus cruciatus (Osborn & Ball): YT; BC; AB 3bfq, 4adg, 5ce-i, 15b, 23ac-e, 32b, 44b, 45c; SK 2bc, 3ab, 6a, 11b, 13e, 15d, 18eh, 24aci, 25c, 32a, 34j; MB 3deijk, 22c.
Stenometopiellus cookei (Gillette): AB 3q, 5ei, 13c, 15b; SK 2a, 3ab, 13e, 24ai, 34j.

Other bugs

Delphacodes paransera Beamer: AB Peace R District, 35a; SK 5f, 8a, 24j; MB 2c, 3i.
Elachodelphax indistincta (Crawford): AB 3f, 5c, 15c; SK 3b, 24di, 34j; MB 3i.
Eurybregma magnifrons (Crawford): YT; BC; AB Peace R District, 13b, 15ab, 23d; SK 3b, 23a, 34j.
Laccocera obesa Van Duzee: BC; AB 2b, 3f, 5adegh, 14b, 15a-c; SK 3b, 5g, 11ab, 13ae, 21b, 24i, 34j.
Nothodelphax gillettei (Van Duzee): BC; AB 3fnq, 5c/fg, 11c, 21e, 23d; SK 3b, 24i, 28a, 33a.
Peltonotellus bivittatus Ball: BC; AB Peace R District, 2b, 5g, 14b, 15c, 23d; SK 3b, 5g, 8af, 18eh, 24i, 34j.
Pentagramma vittatifrons (Uhler): AB 3ef, 5g, 15ac, 23g, 35a; SK 4c, 8f, 11e, 17b, 24di, 26b, 31b, 33a, 34j; MB 2g, 4d, 12e.
Prokelisia salina (Ball): BC; AB 2bg, 15b; SK 11e, 12b, 17d, 21b, 25a, 26b, 34i; MB 3cdfj; ON.
Campylenchia rugosa (Fowler): BC; AB 1c, 2dh, 3ef, 4i, 5ce, 13b, 15abc, 21e, 33b, 35a; SK 3b, 4e, 5gh, 12bc, 13bd, 17c, 18c, 24ci, 31bc, 34j; MB 2eq, 3bin, 11b, 22d.



Table 4. "Short-horned" bug fauna characteristic of two biotic regions of the steppe of Canada, with distribution (codes as in Table 1).

BIOTIC REGION: ASPEN PARKLAND Leafhoppers

Amblysellus dorsti Oman: AB 33b, 35a, SK 24i, 34j.
 Ceratagallia cerea Hamilton: AB 5c.
 Colladonus olus Nielson: SK 34j.
 Cuerna nielsoni Hamilton: SK 17e; MB 3cm. Endemic sp.
 Deltocephalus castoreus Ball: BC; AB 33b, 35a; SK 16b, 24i, 34a.
 Deltocephalus sp.nov. A: SK 31a.
 Elymana circius Hamilton: BC; AB *Peace R District*, 2d, 21ae, 22a, 23cd, 33b, 34a, 35a; SK 5d, 24fi, 31a, 33bf, 34gij.
 Empoasca digita DeLong: BC; SK 24i; MB 11c.
 Empoasca exiguae Ross: BC; AB 3f, 13c; SK 34j; MB 3i.
 Empoasca mexicana Gillette: SK 34j.
 Empoasca nigroscuta Gillette. & Baker: BC; AB *Peace R District*, 3f, 5g; SK 24bi.
 Erythroneura calva Beamer: 3 AB 13b; SK 25c; MB 3i.
 Flexamia dakota Young & Beirne: SK 24i.
 Flexamia sp. SK 3b.
 Gyponana vincula DeLong: AB 2b, 3f, 4c, 15b, 23f, 24a; SK 18d, 32ab, 34gij; MB 3m, 15i.
 Idiocerus moniliferae Osborn & Ball: SK 16b, 33d; MB 2a.
 Limotettix bisoni Knull: AB 35a; SK 17b, 31a; MB 2m; On.
 Limotettix brooksi Hamilton: AB 45c. Endemic sp.
 Limotettix conservatus Hamilton: AB 33b; SK 31b.
 Limotettix myralis (Medler): AB 23d; SK 34j.
 Limotettix shastus (Ball): BC; SK 35a.
 Limotettix taramus (Medler): SK 34j.
 Macrosteles snowi (Dorst): AB 32d, 35a; SK 24i, 34j; MB 3bf.
 Oncopsis incidens Hamilton: BC; SK 8d, 34j.
 Oncopsis junco Hamilton: BC; SK 24i.
 Pinumius sexmaculatus (Gillette & Baker): BC; AB *Peace R District*, 1c, 21e, 32b, 42b; SK 12e, 34dj.
 Stragania rufoscutellata (Baker): BC; AB *Peace R District*, 2h, 3ef, 4eg, 5a-eh, 15bc, 21e, 23d, 32d, 33ab, 35a; SK 2f, 8a, 11c, 13e, 16d, 17b, 18af, 24ei, 31c, 33a, 34dgj, 41d; MB 2cdkn, 3bdijmn, 13c.

Other bugs

Caenodelphax sp.nov.: SK 25c. Endemic sp.
 Criomorphus inconspicuus (Uhler): MB 2c.
 Delphacodes anufrievi Wilson: YT; BC; SK 24i, 34j.
 Delphacodes lutulentoides (Beamer): BC; SK 8a, 34j; MB 2s.
 Delphacodes stricklandi Metcalf: AB *Peace R District*, 13a, 21d; SK 6a, 7b, 8a, 28e, 34j; MB 2m, 3m, 4d, 31a.
 Elachodelphax hochae (Wilson): YT; BC; AB *Peace R District*, 5c; SK 8a.

Elachodelphax pediforma (Beamer): BC; AB 2h, 5c; SK 8a; MB 2q.
 Elachodelphax sp.nov. A: 5 BC; AB 4f, 5c, 23d, 32d; SK 34f.
 Elachodelphax sp.nov. B: MB 2c.
 Laccocera canadensis Beirne: AB 3m, 5c, 23d; SK 1a, 2b, 3a, 24ai, 33a, 34j.
 Myndus collinus Ball: SK 34j.
 Scolopygos pallidus Bartlett: 4 AB 23d, 33b, 35a; SK 31a; Atlantic coast.
 Vanduzea triguttata (Burmeister): SK 18c; MB 2d, 3i.

BIOTIC REGION: SHORT-GRASS STEPPE

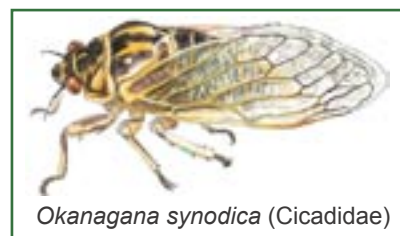
Leafhoppers

Amblysellus punctatus Osborn & Ball: BC; AB 14b, 15b, 24b, SK 2bc, 3ab, 13e.
 Amblysellus wyomus Kramer: BC; AB 1c, 2b, 3m, 5f, 15b; SK 2b, 3b, 6a, 13e, 25c.
 Aplanus albidus (Ball): AB 23d.
 Athysanella obesa Ball & Beamer: AB 3mq, 5acg, 15b; SK 2b-d, 3ab, 4c, 5f, 13e, 24i.
 Athysan ella sinuata Osborn: AB 3f, 4b, 5ceg, 14a, 15a; SK 11b, 24i.
 Attenuipyga balli Oman: SK: 3b.
 Auridius helvus (DeLong): BC; AB *Peace R District*, 2b, 12a, 14be, 15bc; SK 2b-d, 3b, 13e; MB 3k.
 Ballana ortha DeLong: BC; 2 AB 34a; SK 5g.
 Ceratagallia califa Oman: AB 15b.
 Ceratagallia cinerea (Osborn & Ball): AB 5ag, 14b, 15c, 23de, 34a; SK 3b, 5c, 24i.
 Ceratagallia nanella (Oman): SK 3b.
 Cuerna alpina Oman & Beamer: AB 2b, 3dfghjkn, 5dgi, 14ab, 15a-c; SK 2f, 3b, 11e, 13b, 17b, 18e, 24i.
 Cuerna sayi Nielson: AB 3n, 5de, 15c.
 Deltocephalus artemisiae (Gillette & Baker): AB 3f, 14c, 15b; SK 2b, 8b, 13e, 16b, 24i.
 Deltocephalus gnarus Ball: AB 3f, 15b; SK 3b; MB 3di.
 Deltocephalus sp.nov. B: SK 3b.
 Dicyphonina ornata (Baker): AB 15b.
 Empoasca angustifoliae Ross: AB 2f.
 Empoasca typhlocyboides Gillette & Baker: BC; AB *Peace R District*, 15b; SK 2bc, 3ab, 24i.
 Erythroneura sp.nov.: AB 15b; SK 3b.
 Hecalus finnamorei Hamilton: SK 3b. Endemic sp.
 Idiocerus canae Hamilton: AB 15c. Endemic sp.
 Idiocerus interruptus Gillette & Baker: AB 3f.
 Laevicephalus exiguus Knull: AB 3e; SK 3b, 13b, 24i; MB 3f; ON.
 Limotettix cacheolus (Ball): AB 2a.
 Lonatura megalopa (Osborn & Ball): SK 3b, 24i.
 Lonatura melina (DeLong): AB 15a; SK 5g, 24fhi.
 Memnonia consobrina Ball: AB 15b; SK 2c, 3ab.
 Memnonia grandis (Shaw): AB 15b.

Memnonia maia Hamilton: AB 3mq, 5ce, 15b; SK 2acd, 3ab. Endemic sp.
 Mesamia straminea (Osborn): AB 3f; SK 13e.
 Neokolla surcula (DeLong & Currie): AB 3f.
 Norvellina clarivida (Van Duzee): AB *Peace R District*, 5a, 14c; SK 24i.
 Norvellina columbiana (Ball): BC; AB 23d.
 Stragania atra (Baker): BC; AB 3e, 5e, 15c; SK 3b.
 Telusius sp.nov.: AB 15ab; SK 3b, 24i. Endemic sp.
 Texananus cumulatus (Ball): AB 15c; SK 3a; MB 2p, 3a.
 Texananus dolus DeLong: MB 4de.
 Texananus extremus (Ball): AB 15c.
 Unoka gillettei Metcalf: AB 4a.
 Xerophloea peltata (Uhler): AB 2bc, 3f, 4h; SK 3b, 4a, 5b, 8f, 15d; MB 2s.

Other bugs

Okanagana fratercula Davis: AB 2eh, 5a, 21e.
 Okanagana luteobasalis Davis: AB 3f, 5c, 15c.
 Okanagana synodica (Say): AB 3f.
 Bruchomorpha sp.nov.: SK 8f.
 Delphacodes emeljanovi Wilson: YT; BC; AB 11bc.
 Delphacodes munda (Beamer): AB 3n, 5g.
 Eurybregma montana (Beamer): AB 5g, 13b, 14c; SK 12e.
 Laccocera flava Crawford: AB 3n, 4d, 5eg, 14a, 15a-c; SK 23e, 24i.
 Laccocera lineata Scudder: BC; AB 5ch, 15b; SK 2c, 3a, 13e.
 Ollarius dondonius Ball: 8 AB *Peace R District*, 5aeg; SK 3b, 4c, 5g, 6b, 24i.
 Parkana alata Beamer: BC; AB 21d.
 Peltonotellus rugosus (Ball): AB *Peace R District*, 2b, 3acfn, 14be, 15ab, 24b; SK 3b, 6b, 8f, 24ci.
 Scolops hesperius Uhler: AB 3ch, 14b, 15ac; SK 13b; MB 3ef.
 Yukonodelphax kendallae Wilson: YT; BC; AB 13c, 14d, 15c; SK 2b, 3a, 24i.
 Ceresa wickhami Van Duzee: BC; AB 1a, 2h, 5e, 15b.
 Leioscyta ferruginipennis (Goding): AB 5eg; SK 5g, 6b.
 Telamona viridia Ball: AB 3f, 5e, 15c; SK 16c, 18d; MB 3i.



Okanagana synodica (Cicadidae)

All illustrations by K.G.A. Hamilton; Cicadellidae unless otherwise noted.



Web Watch: Build a prairie in the comfort of your own home

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“Build-A-Prairie” is an interactive web-site game designed to teach users about the basics of prairie ecology. Which prairie? You get a choice - ‘tall grass’ or ‘short grass’. Each includes a very general description with a map of its North American extent.

The game challenges the user in a series of stages to select the most appropriate species for prairie restoration. Each stage is accompanied with six choices of which only four are suitable. In sequence, the stages are for the selection of grasses, forbs, birds, mammals, and insects.

Users picking an inappropriate species are gently admonished and encouraged to try again. Each species is accompanied by an image and is linked to text to aid in making an informed choice. Users selecting the four correct species are rewarded with animations - e.g., growing plants, soaring birds, slithering snakes - that are overlapped on an ever more complex prairie vista.

Not all choices will be obvious to the layperson. Prairie dogs are inappropriate for tall grass prairie, because “*They would find the grasses too tall to see over, making them an easy catch for predators*”. *Fire ants are a definite no-no; i.e., “... you would be very unhappy to find the fire ant in your prairie! Fire ants were imported accidentally from Brazil in the late 1930s and have become a scourge of ecosystems both natural and agricultural. Their sting is also dangerous to humans.”*

Just when you think the job is done, encroaching weeds threaten to crowd out the native species. Fortunately, you can implement a

‘controlled’ fire burn to restore your ‘native’ prairie back to its original state.

If you only have limited time for ecosystem reconstruction, I suggest you restore the shortgrass prairie. The ferocious attack of the tiger beetle on what appears to be a pierid butterfly will make it worthwhile!

The site is cleverly done and informative with only the occasional error: i.e., ‘... *you should reconsider your choice of the cabbage butterfly. This beetle was imported from Europe in the 1800s and cause serious damage to prairie grasses and plant.*’ It is part of a larger website titled “On the Prairie” with links to resources designed to help the user discover the plants and animals that compose the prairie ecosystem.

“Build-A-Prairie” is part of the Bell LIVE! 1999 “On the Prairie” program.

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<http://www.bellmuseum.org/mnideals/prairie/build/index.html>





Butterfly Inventory of the South Peace River, BC

Cris Guppy spent most of the summer of 2003 inventorying the butterflies of the “South” Peace River District in British Columbia. He was able to participate for one day of the Biological Survey group trip (see p. 2) in the grassland habitats of the Alberta Peace River country. These habitats provided an informative comparison to the corresponding B.C. habitats, and emphasized to him how much more dependent the BC grasslands are on fire, rather than lack of moisture, to maintain the open shrub/grassland habitats. A large proportion of the BC grasslands are being severely affected by shrub and tree encroachment in the absence of wildfires. The executive summary of the BC report submitted to Louisiana-Pacific Canada Ltd. is reproduced below.

Guppy, C.S., S.J. Kinsey, and L.L. Law. 2003. Reconnaissance Inventory of the Butterflies of the South Peace. Submitted to Louisiana-Pacific Canada Ltd., Dawson Creek, BC. 104 pp.

Executive Summary

The butterflies of the south Peace River area, which is the portion of the Dawson Creek Forest District south of the Peace River, were inventoried with emphasis on the blue-listed species. This is consistent with the objective of the Dawson Creek Land and Resource Management Plan (Province of BC 1999) to “*sustain and manage wildlife habitat for red, blue and yellow-listed species*”. The distribution, abundance and habitats of the blue-listed butterflies are poorly known prior to this study. There was no information regarding the effects of industrial development, including forest development, on the habitats and populations of the blue-listed butterflies.

Louisiana-Pacific Canada Ltd. initiated this project to determine the effects of aspen harvesting activities on the conservation status of the blue-listed butterflies. The project was designed to provide basic information on the effects of forest harvesting on the rare butterfly component of biodiversity. This project provides the *only* information specifically focused on the effects of forest management in British Columbia on the habitats and populations of butterflies of conservation concern.

The objectives of this project were to:

1. Complete a reconnaissance inventory of the butterflies and their habitats, with emphasis on the aspen

forest associated species, in the south Peace River district.

2. Re-assess the conservation status of the rare (blue-listed) butterflies in the area.
3. Assess the effects of forest harvesting on the populations and habitats of the blue-listed butterflies.

Eighty-one butterfly species occur in the South Peace River, of which fifteen are blue-listed. Two new species were recorded for the South Peace River, and one “species” with two “subspecies” was determined to actually be two distinct species. Four of the blue-listed butterflies clearly benefit from land clearing due to industrial development; ten are strongly associated with the montane shrub/grassland (MS) broad ecosystem unit which tends to be avoided by industry, and one is restricted to subalpine and alpine habitats with some impact by the energy industry. Harvesting and road building provides open, grassy habitats that are used by the four species that benefit from forest development.

The Red-disked Alpine should be considered for removal from the red/blue list, because it is quite common and widespread in northern BC. The conservation status of five of the blue-listed butterflies is recommended to remain unchanged, because they have a restricted range but are well distributed within that range: the Arctic Skipper (subspecies *mandan*), Great Spangled Fritillary (subspecies *pseudocarpenteri*), Common Ringlet



(subspecies *benjamini*), Common Woodnymph (subspecies *ino*), and Uhler's Arctic. Mead's Sulphur should also be left on the blue-list because it is known from few sites, but inhabits relatively stable alpine/subalpine habitats. Eight species (none of which are adversely affected by the forest industry) should be considered for moving from the blue list to the red list, because they are clearly very restricted in distribution and dependent on a single habitat type (MS): the Common Branded Skipper (subspecies *assiniboia*), Baird's Swallowtail (subspecies *pikai*), Coral Hairstreak,

Striped Hairstreak, Arctic Blue (subspecies *lacustris*), Aphrodite Fritillary (subspecies *manitoba*), Tawny Crescent, and Alberta Arctic. One additional species, the Northern Checkerspot, should have the Peace River populations considered for red-listing once they have been named as a new subspecies.

Forest harvesting activities are either beneficial (4 species) or have no effect (11 species) on the populations and habitats of the blue-listed butterflies.

Update your research projects

For the 2000 issue of this newsletter (Vol. 6, pp. 13-14) Kevin Floate prepared a synopsis of some past and ongoing research projects on grassland arthropods. We invite everyone to submit details of their current projects in this area in order to update and extend this list.

The list of projects from 2000 is reproduced below and is also on the Survey website at <http://www.biology.ualberta.ca/bsc/english/grassprojects.htm>

- Bouchard, P. and T.A. Wheeler. Arthropods associated with alvar habitats in southern Ontario
- Boucher, S. and T.A. Wheeler. Diversity and zoogeography of Diptera (Brachycera) associated with relic grasslands in the southern Yukon
- Cannings, R.A. Diversity of robber flies (Diptera: Asilidae) in grasslands of the Canadian Great Plains
- Cannings, R.A. Diversity of robber flies (Diptera: Asilidae) in grasslands of British Columbia
- Cannings, R.A. The genus *Efferia* (Diptera: Asilidae) in Canadian grasslands
- Clapperton, M.J., W.D. Willms, D.A. Kanashiro and V. Behan-Pelletier. Soil mite communities of fescue grassland in Alberta.
- Crecco, V. Diversity of Agromyzidae (Diptera) in tallgrass prairie habitats in Canada
- Entomological Society of Saskatchewan, Arthropod survey of Grasslands National Park
- Finnamore, A.T. Arthropod survey of Grasslands National Park
- Finnamore, A.T. Stinging wasps and spiders at CFB Suffield
- Floate, K. Arthropods associated with cattle dung in southern Alberta
- Floate, K. Galling arthropods on cottonwoods of prairie rivers
- Hamilton, K.G.A. Evaluation of leafhoppers and their relatives (Insecta: Homoptera: Auchenorrhyncha) as indicators of prairie preserve quality
- Hamilton, K.G.A. Leafhopper and planthopper endemism in Pacific Northwest grasslands (Rhynchocha: Homoptera: Cicadellidae and Delphacidae)
- Hamilton, K.G.A. Leafhopper evidence for origins of northeastern relict prairies (Insecta: Homoptera: Cicadellidae)
- Hamilton, K.G.A. Leafhoppers (Homoptera: Cicadellidae) of the Yukon: dispersal and endemism [1997. In Danks, H.V. and J.A. Downes (Eds.), *Insects of the Yukon. Biological Survey of Canada Monograph 2*, pp. 337-375]
- Hamilton, K.G.A. Leafhoppers (Insecta: Homoptera: Cicadellidae) as indicators of endangered ecosystems
- Hamilton, K.G.A. Short-horned bugs (Homoptera-Auchenorrhyncha) [In preparation for: I.M. Smith (Ed.), *Assessment of Species Diversity in the Prairies Ecozone* - electronic publication on CD-ROM].
- Hamilton, K.G.A., S.F. MacLean, Jr. and Y.J. Kwon. Of leafhoppers and mammoths: Holocene and Pleistocene life in Alaska



- Johnson, D.L. Recovery of arthropod assemblages after grassland fires [Porcupine Hills and CFB Suffield]
- Larson, D.J. Coleoptera of prairie ponds
- Longair, R. Arthropod survey of Waterton Lakes National Park with an emphasis on Vespidae (Hymenoptera)
- Parker, D. Invertebrates of prairie ponds and rivers
- Pollock, D. and Xie Weiping. Ground beetles of tallgrass prairie pastures at Gardenton, MB
- Pollock, D. and R.E. Roughley. Ground beetles of Aweme, Manitoba; A comparison of historical records to the modern assemblage
- Roughley, R.E., D. Pollock and B. Ford. Biodiversity of tallgrass prairie: the use of fire as a biodiversity and conservation management tool for insects and plants, St. Charles Rifle Range, Winnipeg
- Scudder, G.G.E. Comparative studies of the Heteroptera diversity in grassland ecosystems in Canada
- Scudder, G.G.E. True bugs (Heteroptera) of the Yukon -. [1997. In Danks, H.V. and J.A. Downes (Eds.), *Insects of the Yukon*. Biological Survey of Canada Monograph 2, pp. 241–336]
- Scudder, G.G.E. Effect of livestock grazing on ground-dwelling arthropods in a bunchgrass ecosystem in southern BC
- Scudder, G.G.E. Habitat restoration and change in ground-dwelling arthropod diversity in a bunchgrass ecosystem in southern BC
- Scudder, G.G.E. Recovery of ground-dwelling arthropods following fire in a bunchgrass ecosystem in southern BC
- Shorthouse, J.D. Cynipid galls on the wild roses of Canada's grassland: distribution and habitats of host roses, biology of each gall, host specificity, and composition of component communities of inquiline and parasitoids. [includes sites in AB, SK and MB]
- Wheeler, T.A. Diversity and zoogeography of Chloropidae in Canadian grasslands
- Wheeler, T.A. Diversity of the phytophagous Diptera community in Canadian grasslands
- White, K. and R. Cartar. Post-fire recovery of arthropod assemblages in the Porcupine Hills

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