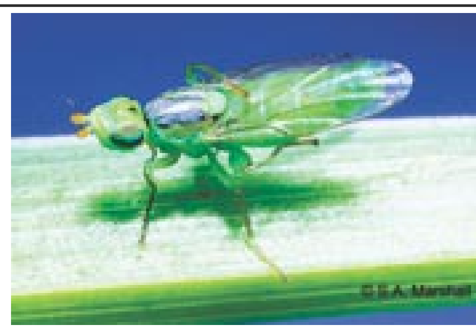
Arthropods of Canadian Grasslands

Number 11 **2005**

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.

Chloropid flies are common in grasslands, and historical records from early in the 20th century, available because of careful recording and preservation of specimens and documents, allow interesting present-day comparisons in the same places, as explained on page 5.



Contributions welcome

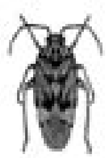
Please consider submitting items to *Arthropods of Canadian Grasslands*

Grassland site descriptions

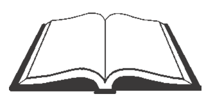
Current research – project reports

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, 2006.

Editor:
H.V. Danks
Biological Survey of Canada (Terrestrial Arthropods)
Canadian Museum of Nature
P.O. Box 3443, Station "D"
Ottawa, ON K1P 6P4
613-566-4787 (tel.)
613-364-4022 (fax)
hdanks@mus-nature.ca

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
This newsletter and all back issues are available there in the Publications section.

Grasslands project action

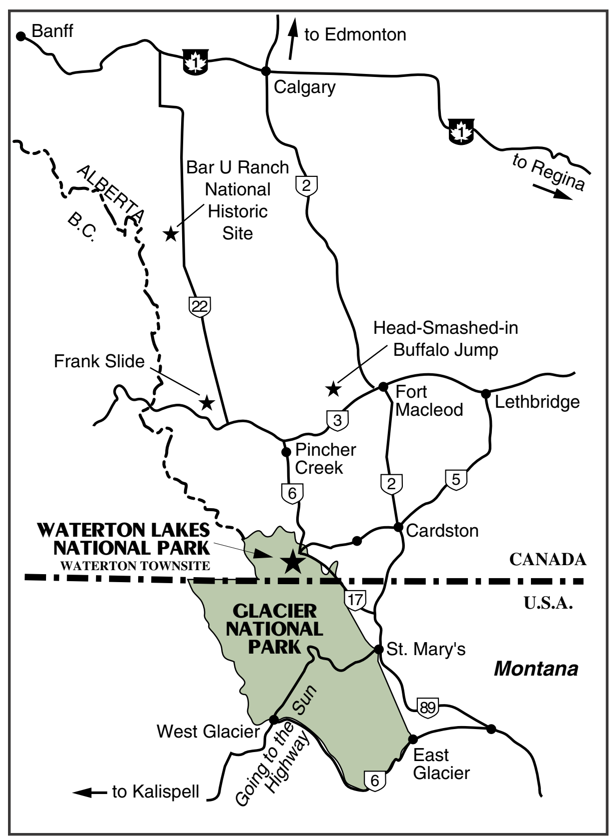
Grassland Project Key Site 2005: Waterton Lakes National Park

What:	BioBlitz, summer, 2005
When:	July 7–12, 2005
Where:	Waterton Lakes National Park, Alberta
How:	Contact person: David Langor, Canadian Forest Service, Northern Forestry Centre, 5320 - 122 Street, Edmonton, AB T6H 3S5; dlangor@nrcan.gc.ca

The 2005 Biological Survey of Canada Bio-Blitz will occur in Waterton Lakes National Park (WLNP), Alberta from 7–12 July. This BioBlitz provides an exciting opportunity to collect in one of Canada's most scenic and biologically-interesting natural areas, which is also a UNESCO Biosphere Reserve.

The park's name derives from the Waterton Lakes, a chain of lakes named in honour of a British naturalist, Squire Charles Waterton (1782-1865). The 525 km^2 WLNP represents the southern Rocky Mountains Natural Region, where some of the most ancient mountains in the Rockies abruptly meet the prairie. It is a landscape shaped by wind, fire, and flooding; with a rich variety of plants and wildlife. The town site sits at 1280 m above sea level and the park's highest peak, Mt. Blakiston, is 2940 m above sea level. WLNP is located in the southwest corner of Alberta. It is bordered: on the west by the province of British Columbia (Akamina-Kishinena Provincial Park and Flathead Provincial Forest); on the south by Glacier National Park, Montana; on the north and east by the Bow-Crow Forest, and private lands in the Municipal Districts of Cardston and Pincher Creek; and includes a large timber reserve belonging to the Kainaiwa (Blood Tribe).

Several different ecological regions meet in WLNP – with biota of the Great Plains, northern Rocky Mountain and Pacific Northwest all overlapping. The park's four natural subregions – foothills parkland, montane, subalpine and alpine – embrace 45 different vegetation types, including grasslands, shrublands, wetlands, lakes, spruce-fir, pine and aspen forests, and alpine areas. Sixteen of the vegetation types are considered rare or fragile and threatened. WLNP is the only Canadian national park that preserves foothills fescue grasslands. This rich collection of vegetation types in a small geographic area means that WLNP has an unusually rich and varied number of plants for its size, with more than 970 vascular plant species,



(map courtesy Parks Canada)

Aerial view of Lower Waterton Lake and the fescue grassland / aspen parkland area of the park (photograph by Cyndi Smith, Parks Canada)

182 bryophytes and 218 lichen species (this represents more than half of Alberta's plant species, and more species than Banff and Jasper National Parks combined). About 179 of the vascular plant species in WLNP are rare in Alberta, and 22 of these are not found anywhere else in Alberta.

The park's variety of vegetation communities provides homes for many animals, including more than 60 species of mammals, over 250 species of birds, 24 species of fish, 10 species of reptiles and amphibians, and thousands of species of terrestrial arthropods. Large predators include wolf, coyote, cougar, grizzly bear, and American black bear. The grasslands are important winter range for ungulates such as elk, mule deer, and white-tailed deer. In the fall, the marsh and lake areas of the park are used extensively by migrating ducks, swans, and geese. Some animals found here are considered rare or unusual, e.g., Trumpeter Swans, Vaux's Swifts, and vagrant shrews.

Historically, collection of arthropods in WLNP has been sporadic and usually focused on a few taxonomic or functional groups. Recent collecting by Rob Longair and students (University of Calgary) has contributed greatly to our knowledge of some groups. Many arthropod species found in WLNP are found nowhere else in Canada; some of these may be endemic and, for others, WLNP represents the northernmost limit of their distribution in North America. WLNP has a small collection of insects, much of which originates from the efforts of David and Margaret Larson collected during their honeymoon in WLNP. This collection, and other material (pinned and wet residuals) collected by the University of Calgary, are available for examination during Bio-Blitz 2005

Thus, Bio-Blitz 2005 offers a unique opportunity to collect in the varied habitats of one of Canada's biologically rich areas. The Parks Canada staff is enthusiastic about and highly supportive of this event. They have offered the use of their research house, which has sleeping facilities for 8 and space for sorting and examination of samples and specimens. As well, group camping facilities will be provided. For those who prefer hotels, these are in abundant supply at the Waterton town site.

If you are interested in participating in Bio-Blitz 2005, or would like more details, please contact David Langor (dlangor@nrcan.gc.ca).

Middle and upper Waterton lakes looking south (photograph by Cyndi Smith, Parks Canada)

Aweme Bioblitz 2004

R.E. Roughley
Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2
Rob_Roughley@umanitoba.ca

(with notes from P.A. MacKay, 2004. The Aweme Bioblitz, 5–6 June 2004. *The Entomological Society of Manitoba Newsletter*: 31(3): 3-5)

The Aweme Bioblitz was held on the Criddle-Vane homestead at Aweme, MB on June 5 and 6, 2004. Somewhere near 60 people attended this Bioblitz. People attended this gathering from Alberta, Manitoba, Saskatchewan, North Dakota and South Dakota and even as far east as Nova Scotia. There were tours, conducted by members of the Criddle-Vane Heritage Committee, of the Criddle and Vane homes, the entomological laboratories and the homestead grounds; Gene Fortney of the Nature Conservancy of Canada toured us around the Yellow Quill Prairie and the adjoining Assiniboine River Wildlife Management Area explaining the history and significance of these protected areas.

The idea of a Bioblitz is to record and collect organisms associated with a locality or habitat. Mixed grass prairie such as that found at Aweme and the Yellow Quill is an ecotonal zone from the shortgrass grassland further west and tallgrass prairie further east. Ecotones often have a richer fauna than the areas they are derived from – this may be one of the reasons that this area is renowned for the number of species collected there.

Collecting was a lot of fun and highly varied. Anyone who has had the pleasure to be in the field with Robert Gordon (retired, USDA Scientist), from North Dakota, with his knowledge and desire to seek out unique scarabs will know whereof I speak – the collecting stories, anecdotes and natural history did not stop. Beetles and moths were the groups sought particularly among insects but is was quite nice to mingle with a variety of collectors using a variety of sampling techniques, from soil coring, bait trapping, night lighting, ripping bark, and picking insects off fungi, to traditional sweep netting. Isn't it interesting how sitting around a black light at night is analogous to sitting around the campfire? Most of the same activities are incorporated. But the collecting was not limited to insects. Excursions to search for rare molluscs were led by Joe Carney (Brandon University) and Jim Duncan (Manitoba Conservation) and while the river was too high and limited the sampling time it was still a unique and profitable experience to learn more about endangered clams within the river system and their natural history. Botanists from the University of Manitoba were examining plant communities and collecting plants for the Herbarium. Michele Piercey-Normore, a lichenologist in the Department of Botany at the University of Manitoba, was collecting lichens and bryophytes – her enthusiasm for lichens is infectious. There are many things to be said for studying organisms that do not move! Of course, there was the usual complement of bird watchers. The Aweme homestead was made an official heritage

The Yellow Quill Prairie and the Assiniboine River. (Photograph by Anita Stjernberg).

area on July 17, 2004 and it is now the Criddle-Vane Heritage Provincial Park. It is very good news to know that this area has been conserved!

The Criddle-Vane Homestead Heritage Committee arranged for refreshments on both days of the Bioblitz. This group has done an outstanding job of promoting the awareness and significance of the Aweme area. The CVHHC is in the process of restoring and rebuilding Norman Criddle's First Entomological Laboratory. See box below.

Norman Criddle's first entomological laboratory. The first entomological laboratory in western Canada. (Photograph by Anita Stjernberg).

Restoration project for the Criddle Laboratory

Thanks to all those who made generous donations to the restoration project for Norman Criddle's first entomology laboratory on Prairies. We have reached our goal of $5000, or will when the Province makes their donation as promised. The materials have all been bought. When doing a restoration project such as this you can't just walk into the local lumber store and purchase the materials. To match the original cedar siding we had to have it specially milled. Other materials had to be ordered from across the country.

We began actually working on the lab last fall. Taking off the pieces of siding - saving what we could and numbering those pieces to be returned to the same spot on the wall. A job requiring a gentle hand when working with 90-year old cedar. Some interesting artifacts were found in the earth around the building, ink bottles, three pair of strap on ice skates and a few odds and ends we aren't sure of.

The restoration was begun and the building stabilized for the winter. With the help of the soldiers at CFB Shilo we hope to be back at it this spring under the guidance of the restoration carpenter from Parks Canada. Both these groups have been very generous with their time and expertise.

Do you have photographs of the lab? Now that the building is underway we are trying to find photographs of the inside of Norman's lab so the inside can be restored too. We would also like to put some interpretive signs up inside the lab when it is finished, showing Norman working and telling more of the story of the importance of the site. Please contact the committee at the address below if you have any photographs you could share.

If you are still interested in make a donation to the project it would go to either the restoration of the building or to putting up some signs inside the lab telling the public about Norman Criddle and his importance as a scientist on the Prairies. (Please make cheques payable to the "Friends of Spruce Woods" who will supply the tax receipt.)

Thanks again for your support, hope to see you at the homestead this summer.

Sherry Dangerfield
3 - 733 McMillan Avenue
Winnipeg, MB R3M 0S8
204-452-2949; sherryd@mts.net

Long term research: Norman Criddle, John Merton Aldrich and the grass flies of Aweme

Terry A. Wheeler
Department of Natural Resource Sciences, Macdonald Campus, McGill University,
Ste-Anne-de-Bellevue, QC H9X 3V9; wheeler@nrs.mcgill.ca

Your energy is furnishing me with a lot of valuable data on the wheat and grain insects of the Northwest, much of which no doubt will be applicable on the south side of the imaginary line.
J.M. Aldrich to N. Criddle, 30 July 1915

Why are you hanging on to all this old stuff?
Unnamed colleague, McGill University, 2005

Introduction

One of the few causes for regret among field entomologists – generally a fairly contented lot – is that more of us did not start long-term, standardized sampling of particular taxa and habitats years earlier, when we all started collecting insects. The main reason for this collective regret is the increasing realization in recent years that ecosystems are changing quickly, and that we do not have the baseline data in most habitats to allow us to monitor and assess those changes in a meaningful way. There are few examples of research groups or forward-thinking individuals who have established long-term sampling protocols to monitor arthropod biodiversity in a particular place over time. Because of the rarity of long-term data sets, it is satisfying on those rare occasions when we find verifiable, quantitative data from the past that may allow us to assess species turnover over time scales longer than a few years. This paper describes the first few chapters in such a story dealing with my own taxon of interest, the grass flies (Diptera: Chloropidae).

Criddle, Aldrich and the packrats of science

The life of Norman Criddle (1875-1933) (Fig. 1) is well-known to most Canadian entomologists and has been summarized by others (e.g., Criddle 1973, Roughley 2000). Partly as a result of his development of the “Criddle Mixture”, an effective grasshopper poison (see reference to the mixture in Fig. 3), Criddle was employed by the Government of Canada in a series of entomological appointments from 1902 onwards. By 1915, Criddle was employed as entomological field officer for Manitoba and, in the same year, had begun construction of his entomological laboratory at Aweme (Criddle 1973).

By 1915 John Merton Aldrich (1866-1934) (Fig. 1) was already well-established as a dipterist, partly on the strength of his *Catalogue of North American Diptera* (Aldrich 1905) and was employed from 1913-1919 by the United States Bureau of Entomology at West Lafayette, Indiana. In 1919, shortly after the collaboration with Criddle outlined below, he moved to the Smithsonian Institution’s Department of Entomology in Washington where he continued to work on Diptera until his death in 1934.

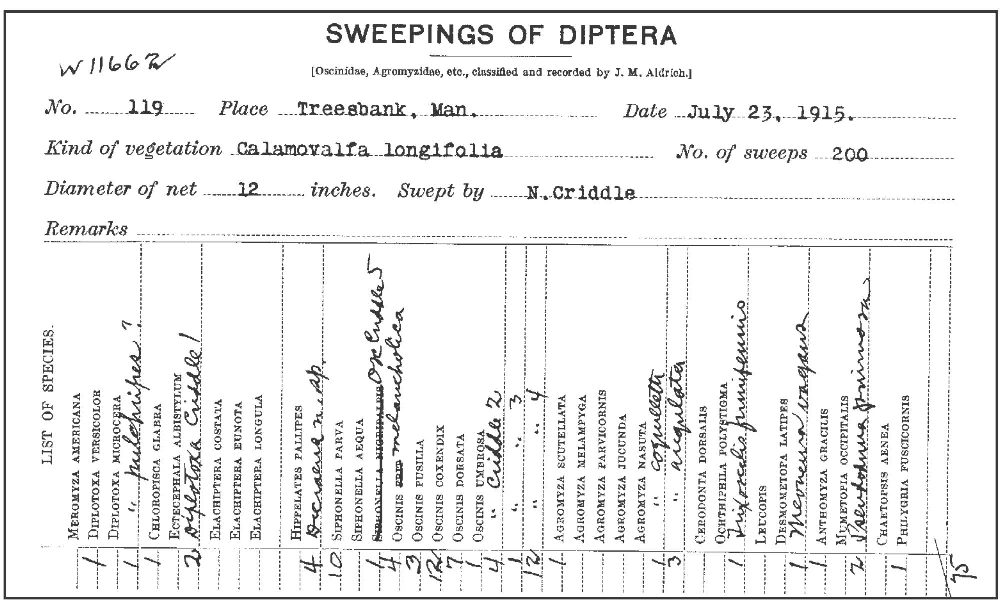
Fig. 1. Norman Criddle (left, with crows) and John Merton Aldrich (right, without crows)

During 1915 and 1916 Aldrich established a network of collaborators at a number of sites in the midwest, who collected Diptera in a range of grassland habitats and sent him the samples for sorting and identification. Aldrich compiled the species and specimen information from each sample lot on index cards (Fig. 2) that he had printed for the project. Aldrich took these cards with him when he moved to the Smithsonian Institution and they were subsequently passed on to Curtis Sabrosky, another dipterist, and chloropid specialist, who joined the museum staff in the late 1930s. Many of Aldrich's pinned flies from the samples also went to the Smithsonian.

Criddle was one of the more prolific collectors in Aldrich's network, so much so that Aldrich's work schedule was occasionally disrupted by the arrival of another large shipment of specimens from Aweme, as seen in a 1915 letter from Aldrich to Criddle (Aldrich 1915, Fig. 3). Apparently because there were so many specimens of chloropid flies in the samples, Aldrich sent Criddle, probably in 1916, a copy of an unpublished key to the North American species of Chloropidae so that Criddle could do his own sorting, for later verification by Aldrich (Aldrich ?1916, 1917).

Despite the enormous quantity of material exchanged by these two entomologists there is little published evidence of that exchange, with the exception of one paper describing four of the species as new (Aldrich 1918). Most of the other evidence has been scattered in various forms in a number of places; and this is where the oft-criticized tendency of many entomologists to hoard things has borne fruit.

My first introduction to this material, although I did not realize it at the time, was during my postdoctoral fellowship in Ottawa in the early 1990s when I realized just how many chloropid specimens collected by Criddle and identified by Aldrich were housed in the Canadian National Collection (CNC) and the US National Museum of Natural History (USNM). While museums all over the world contain large numbers of specimens and species from Aweme (Roughley 2000), they tend to be larger things than chloropids. Most collectors in the early part of the 20th Century did not tend to collect or mount quite so many tiny flies, especially in long series from a single locality or date. The second line of evidence was the presence of lot numbers on the labels of some of the specimens identified by Aldrich. These lot numbers may allow us to match voucher specimens of


SWEEPINGS OF DIPTERA

[Oscinidae, Agromyzidae, etc., classified and recorded by J. M. Aldrich.]

W11662

No. 119 *Place* Treesbank, Man. *Date* July 23, 1915.

Kind of vegetation Calamovalfa longifolia *No. of sweeps* 200

Diameter of net 12 *inches.* *Swept by* N. Criddle

Remarks

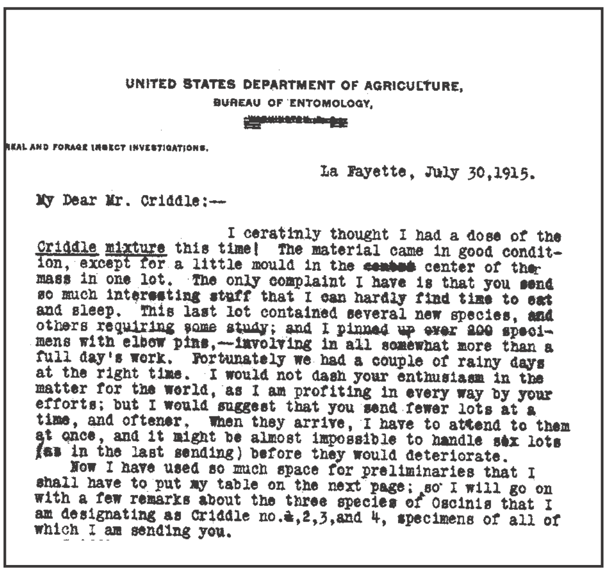
LIST OF SPECIES.

Meromyza americana
Diplotoxa versicolor
Diplotoxa microcera
Chloropisca glabra
Ectecephala albistylum
Elachiptera costata
Elachiptera eunota
Elachiptera longula
Hippelates pallipes
Siphonella parva
Siphonella aequa
Siphonella nigripalpis
Oscinis pusilla
Oscinis coxendix
Oscinis dorsata
Oscinis umbrosa
Agromyza scutellata
Agromyza melampyga
Agromyza parvicornis
Agromyza jucunda
Agromyza nasuta
Cerodonta dorsalis
Ochthiphila polystigma
Leucopis
Desmometopa latipes
Anthomyza gracilis
Mumetopia occipitalis
Chaetopsis aenea
Phlygria fuscicornis

Fig. 2. One of Aldrich's Diptera data cards showing a good day for chloropid species at Treesbank, July 1915. Note undescribed species "Criddle 1" to "Criddle 5".

undetermined species on Aldrich's numbered data cards on the Criddle material.

In 2000 I visited the USNM in order to go through a large collection of unpublished notes on Chloropidae assembled over 60 years by the late C.W. Sabrosky. Among the many invaluable notes in that collection, I found Aldrich's data cards from the 1915-1916 study, presumably passed on to Sabrosky after Aldrich's death because of the large amount of chloropid data. Those unpublished documents are now deposited in the Lyman Entomological Museum. In 2002, Rob Roughley from the University of Manitoba sent me some correspondence between Aldrich and Criddle, which finally allowed me to put the pieces together and match Criddle's collections to the file cards to the lot numbers to the specimens in the CNC and USNM.



UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
[illegible]

…EAL AND FORAGE INSECT INVESTIGATIONS.

La Fayette, July 30,1915.

My Dear Mr. Criddle:—

I ceratinly thought I had a dose of the <u>Criddle mixture</u> this time! The material came in good condition, except for a little mould in the [illegible] center of the mass in one lot. The only complaint I have is that you send so much interesting stuff that I can hardly find time to eat and sleep. This last lot contained several new species, and others requiring some study; and I pinned up over 200 specimens with elbow pins,—involving in all somewhat more than a full day's work. Fortunately we had a couple of rainy days at the right time. I would not dash your enthusiasm in the matter for the world, as I am profiting in every way by your efforts; but I would suggest that you send fewer lots at a time, and oftener. When they arrive, I have to attend to them at once, and it might be almost impossible to handle six lots (as in the last sending) before they would deteriorate.

Now I have used so much space for preliminaries that I shall have to put my table on the next page; so I will go on with a few remarks about the three species of Oscinis that I am designating as Criddle no.1,2,3,and 4, specimens of all of which I am sending you.

Fig. 3. Excerpt of a letter from Aldrich to Criddle (Aldrich 1915)

Grassland Chloropidae

The Chloropidae (grass flies, frit flies, eye gnats) are one of the most species-rich and abundant families of acalyptrate Diptera in most open terrestrial habitats. They are especially dominant in grasslands. According to the most recent comprehensive estimate (Danks 1979) approximately 100 species of Chloropidae have been recorded in Canada. Another few dozen species have been recorded in Canada since then (e.g., Wheeler 1994a, 1994b, Savage and Wheeler 1999, Beaulieu and Wheeler 2001, 2002, Fast and Wheeler 2004) although this is apparently just a fraction of the true number of species present.

Chloropid flies occupy a variety of ecological roles in grassland ecosystems. Larvae of the majority of species are saprophagous, feeding on dead and damaged plant tissues, invertebrate and vertebrate carrion, insect frass and other substrates rich in bacteria (Ferrar 1987). Larvae of other species are phytophagous stem-borers, seed feeders or gall-inducers in grasses or sedges, predators of root aphids, predators of spider egg masses or Lepidoptera cocoons, or kleptoparasites of the prey of spiders and other arthropod predators (Ferrar 1987). Most adults are relatively innocuous and appear to feed primarily on nectar or other fluid sources, although the eye gnats of the genera *Hippelates* Loew and *Liohippelates* Duda feed, sometimes in high numbers, on sweat and other secretions on exposed skin or around the eyes (Sabrosky 1987). Because of this range of habits chloropids can build up enormous populations in grassland ecosystems and our collecting in recent years in grasslands across Canada has confirmed the dominance of Chloropidae in grasslands, especially in the southern prairies. A few sweeps with an aerial net in native prairie can yield several hundred specimens representing at least a dozen species.

Most of the North American chloropid genera are represented in Canadian grasslands, and genera such as *Apallates* Sabrosky, *Chlorops* Meigen, *Conioscinella* Duda, *Incertella* Sabrosky, *Rhopalopterum* Duda, *Olcella* Enderlein, *Oscinella* Becker, and *Thaumatomyia* Zenker are especially abundant, although not necessarily species-rich.

Aldrich had obviously anticipated that Chloropidae would be a species-rich component of the Diptera fauna from his grassland samples; 17 of the 30 species names pre-printed on his data cards were Chloropidae (Fig. 2). Six species were Agromyzidae, and the remaining seven species were divided up among five families:

Chamaemyiidae; Milichiidae; Anthomyzidae; Otitidae; and Ephydridae.

The grass flies of Aweme

Criddle sent Aldrich 65 lots of Diptera between 12 June and 05 November 1915, and 37 lots between 05 May and 11 October 1916. These samples were swept from a range of grassland types, including several cereal crops as well as native species of grasses and sedges. Data recorded for each lot included date, locality, plant species swept, diameter of net and number of sweeps (see Fig. 2).

The 102 lots collected by Criddle totalled well over 10,000 specimens in several families of higher Diptera, but Chloropidae was by far the most abundant and species-rich family. In the two years of sampling Criddle collected a total of 9,728 specimens of Chloropidae representing 54 taxa (Appendix 1). Over half of all specimens (5,179 of 9,728, 53%) belonged to a single species, *Apallates coxendix* (Fitch) (Table 1), and the 11 most abundant species collected over the two years made up 96% (9,355 of 9,728) of all Chloropidae (Table 1, Fig. 4).

Although many of the species identified by Aldrich were previously described, there was a significant number of undescribed species, including the dominant species *Oscinis* sp. criddle 2, *Oscinis* sp. criddle 3, *Oscinis* sp. criddle 4 and *Dicraeus* n. sp. Aldrich (1918) described four of the most abundant species from Criddle's Treesbank and Aweme material as new species: *Lasiosina canadensis*, *Dicraeus incongruus*, *Oscinis criddlei* (now *Rhopalopterum criddlei*) and *Oscinis scabra* (now *Aphanotrigonum scabrum*). *Lasiosina canadensis* is one of two species of Chloropidae in southern Manitoba grasslands that is polymorphic for wing length; the other is *Conioscinella zetterstedti* Andersson (Wheeler 1994a). Because Criddle collected his 1915-1916 chloropid lots only by sweeping vegetation, he would have likely missed most specimens of the brachypterous and apterous forms of these species, which are best collected in pitfall traps. There is, however, a brachypterous specimen of *L. canadensis* in the USNM collection that was collected by Criddle at Aweme in 1917 and apparently examined by Aldrich.

Given the enormous quantity of material, Aldrich's workload at the time and the great species diversity of North American Chloropidae, it is not surprising that several of the species collected by Criddle remained undescribed for many years; some are still undescribed. However, the presence of pinned vouchers of many of those species in the USNM and CNC collections facilitates identification and eventual description of this material.

Table 1. Dominant species of Chloropidae collected by N. Criddle at Treesbank in 1915-1916. Current status of most species is tentative pending examination of museum specimens. See text for comments on undetermined species 1-4.

Rank	Species sensu Aldrich	Current status (tentative)	Specimens
1	*Oscinis coxendix*	*Apallates coxendix* (Fitch)	5179
2	*Siphonella parva*	*Olcella parva* (Adams)	751
3	*Chloropisca glabra*	*Thaumatomyia glabra* (Meigen)	679
4	*Oscinis dorsata*	undetermined species 1	594
5	*Oscinis* sp. criddle 2	undetermined species 2	569
6	*Oscinis* sp. criddle 3	*Incertella* ?*incerta* (Becker)	388
7	*Oscinis pusilla*	undetermined species 3	352
8	*Oscinis misera*	undetermined species 4	303
9	*Meromyza americana*	*Meromyza americana* Fitch	225
10	*Oscinis* sp. criddle 4	*Rhopalopterum criddlei* (Aldrich)	190
11	*Dicraeus* n. sp.	*Dicraeus incongruus* Aldrich	125

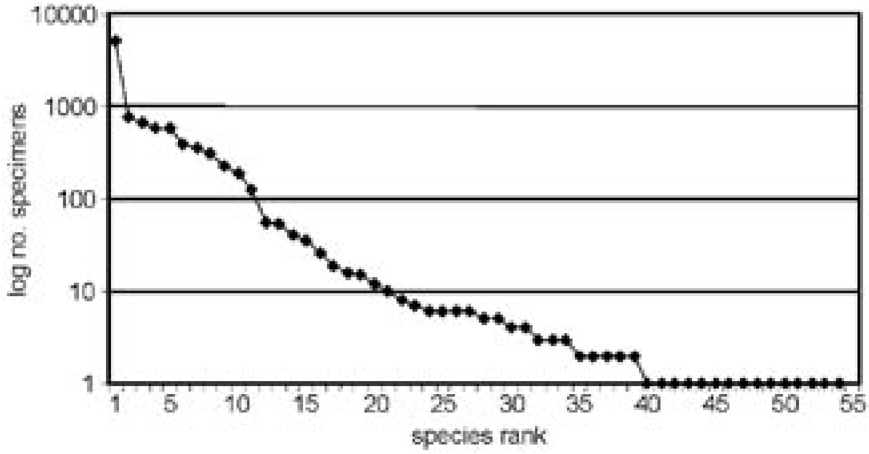


Fig. 4. Rank abundance curve of Chloropidae collected by Criddle, 1915-1916. Note that Y-axis is logarithmic.

Updating the data

One of the challenges in comparing old species lists to new data is the uncertain status of the old names. Several lines of evidence may be used in updating and verifying Aldrich's species concepts: direct evidence from published catalogs of species names; indirect evidence from Aldrich's notes and correspondence; and direct evidence from museum specimens.

Catalogued names - Many of the species identified by Aldrich (Appendix 1) were already described at the time and the names have been applied consistently, either in the combinations used by Aldrich, or under subsequent generic combinations or senior synonyms that can be easily traced in the chloropid literature. Examples of such simple cases include: *Meromyza americana* Fitch; *Chloropisca glabra* (Meigen) (now *Thaumatomyia glabra*); and *Siphonella aequa* Becker (now *Malloewia aequa*).

Indirect written evidence - The identity of some questionable species can be traced through Aldrich's published work (e.g., Aldrich 1918), or from his notes and correspondence with Criddle (Aldrich 1915, ?1916, 1917). Examples of this group of species include: *Dicraeus* n. sp., later described as *Dicraeus incongruus* Aldrich (Aldrich 1918); *Elachiptera* n. sp., later identified as *Elachiptera planicollis* (Becker) (Aldrich 1917, 1918), a junior synonym of *Eribolus nana* (Zetterstedt); *Oscinis* sp. criddle 4, later identified tentatively, in an annotation to his key, as *Oscinis incerta* Becker, now *Incertella incerta* (Aldrich ?1916).

Direct evidence from museum specimens - The identity of some of Aldrich's species is more problematic. Four of the dominant species in Table 1 fall into this category. They cannot be identified confidently from Aldrich's notes and examination of specimens will be required in all cases before their identity can be confirmed.

Undetermined species 1 - Aldrich identified these specimens as *Oscinis dorsata* Loew, now in the genus *Incertella* Sabrosky. However, Aldrich's key suggests that he may have combined, two species under this name: true *I. dorsata* and *Incertella minor* (Adams), another abundant grassland species.

Undetermined species 2 - This was one of several undescribed species identified by Aldrich from Criddle's material. Although Aldrich included *Oscinis* sp. criddle 2 in his manuscript key there are not enough definitive characters to assign these specimens unequivocally to a described species.

Undetermined species 3 - *Oscinis pusilla* (Meigen), is a valid species now placed in the genus *Oscinella* Becker; however, it is Palearctic and there are no confirmed North American records. Identification of the Nearctic species of *Oscinella* is difficult because of a number of apparently undescribed species, and Aldrich's "*Oscinis pusilla*" may be among them.

Undetermined species 4 - Aldrich (1917) noted in correspondence to Criddle that his "*Oscinis misera*" from the 1915 records was actually *Oscinis sulfurihalterata* Enderlein (now *Lioscinella sulfurihalterata*), but in his key (Aldrich ?1916) he apparently treated his *Oscinis misera* as closer to *Oscinis pleuralis* Becker (now *Olcella pleuralis*), and keyed out *sulfurihalterata* as a separate species. Both *O. pleuralis* and *L. sulfurihalterata* are exclusively Neotropical species, so the identity of "*Oscinis misera"* from Treesbank remains a mystery.

In addition to these four dominant species, others in Appendix 1, such as four species of *Chlorops*, remain undescribed, pending generic revisions.

Long-term research

Given the current interest in long-term monitoring, especially in altered habitats, the logical question arising from all these grassland Diptera data is how we could repeat the sampling and analysis almost a century later.

All of Aldrich's data cards from Criddle's collecting record the locality simply as "Treesbank". Criddle included a rather broad area under the locality names "Aweme" and "Treesbank" which makes it difficult to pinpoint collecting sites (Roughley 2000). However, it may be possible to match the collecting dates to other notes by Criddle, with a little more searching. The data cards also document the type of plants swept for each sample. The sampling method itself is easily replicated; we know from the data cards that each lot was taken entirely by sweeping vegetation. Based on the species composition in the samples, I am reasonably confident that the sweeps were probably not taken extremely close to ground level, nor would they have just skimmed the tops of the vegetation. The net size and number of sweeps is known, but not terribly critical, because rarefaction techniques would allow us to compare relative species-richness, abundance and dominance between Criddle's sampling and a repeated study.

As part of our ongoing studies on grassland Diptera diversity, Lyman Entomological Museum staff and students have collected sporadically at Aweme in recent years (Fig. 5). Two to four collectors from the Lyman group swept vegetation at the homestead and some surrounding areas on multiple visits during June and August 1999 and July 2000. The Chloropidae have been prepared and sorted to the generic level and deposited in the Lyman Museum collection. As time has permitted, we have sorted some material to the species level, although there are several thousand specimens to process so the work will continue. Because of the high numbers of Chloropidae collected, and because we were, at that time, unaware of the Aldrich-Criddle collaboration, we did not sample quantitatively. We did not standardize the number of sweeps per transect or site, and the most abundant chloropid morphospecies were later subsampled for processing and mounting. As a result we can make only qualitative comparisons between our 1999-2000 data and the 1915-1916 data. Even so, there are some interesting (at least to us) patterns.

The relative ranking of dominant species was not the same. *Apallates coxendix* and some closely related species described by later authors were abundant in our samples, but certainly not seven or more times more abundant than the next dominant species, as in 1915-1916 (Table 1). *Thaumatomyia glabra* and *Olcella parva* were also among the top three dominant species in 1915-1916, but the former was not particularly abundant in our samples. On the other hand, multiple species of *Incertella* and *Conioscinella* were extremely abundant in our 1999-2000 samples. Both of these genera contain undescribed species in Canadian grasslands so work remains to be done to sort out their species diversity. Some of the fourth to eighth-ranked species in 1915-1916 (Table 1) may apparently belong in *Incertella* or *Conioscinella*. "Undetermined

Fig. 5. Stéphanie Boucher (left) and Joëlle Pérusse preparing to assess faunal change in grassland Diptera, Criddle-Vane homestead, June 1999.

species 3" from 1915-1916 is potentially an *Oscinella*, and the *Oscinella frit* (L.) species complex was reasonably abundant in our 1999-2000 samples. *Meromyza americana*, *Rhopalopterum criddlei* and *Dicraeus incongruus* rounded out the dominant species from 1915-1916. The first and third of those were abundant in our samples, but *Rhopalopterum criddlei* is a relatively rarely collected species. There are several problems with species limits in Nearctic *Rhopalopterum* and some changes in species status may be required.

Despite the limited duration and design of the 1999-2000 sampling, we can treat it as a pilot study for a more structured sampling program in the future to compare long term changes in the chloropid assemblage at Aweme. The new material will facilitate identification of the species at the site and will allow us to sort out some remaining systematic problems prior to starting any quantitative sampling. Comparison of the new material with older museum specimens may also help to resolve the identity of some of Aldrich's mystery species.

Conclusion

The Criddle-Aldrich collaboration makes an interesting story, but what general conclusions can be drawn from it? We already know the value of collaboration between scientists, especially those working in different regions, with different kinds of expertise. The dedication, motivation and expertise of Norman Criddle and John Aldrich are also undeniable but already well-documented elsewhere. The diversity of grassland Chloropidae is not news to anyone who has swept Diptera in Canadian grasslands. Chloropids are one of the most species rich and abundant families of Diptera in those habitats, so there are no revelations there. Perhaps the most important message in this tale is this: when you are cleaning out the lab someday and you find that box of old papers or file cards or hand-scribbled notes buried deep in a corner, don't throw it out before you find out what it is.

Acknowledgments

Thanks to Chris Thompson and Al Norrbom (U.S. National Museum) who had the foresight to save Curtis Sabrosky's unpublished notes, which contained Aldrich's chloropid data, and to Rob Roughley (University of Manitoba) who sent me some of the correspondence between Aldrich and Criddle, the missing pieces that allowed me to put this story together. Thanks also to Rob for introducing me and my students to the Criddle-Vane homestead.

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Appendix 1. Chloropidae collected by N. Criddle at Treesbank in 1915-1916. Current status of most species is tentative pending examination of museum specimens.

Species (sensu Aldrich)	Current status (tentative)	Specimens collected		
		1915	1916	total
Chloropisca glabra	*Thaumatomyia glabra* (Meigen)	288	391	679
Chloropisca grata	*Thaumatomyia grata* (Loew)		1	1
Chloropisca integra	*Thaumatomyia pulla* (Adams)	2		2
Chloropisca pulla	*Thaumatomyia pulla* (Adams)		6	6
Chloropisca variceps	*Thaumatomyia annulata* (Walker)		1	1
Chlorops graminea	*Homaluroides gramineus* (Coquillett)		1	1
Chlorops obscuricornis	*Chlorops obscuricornis* Loew	1		1
Chlorops producta	*Chlorops productus* Loew		2	2
Chlorops sp. 5	undetermined		1	1
Chlorops sp. 16	undetermined	3	2	5
Chlorops sp. 18	undetermined		1	1
Chlorops sp. 23	undetermined	1		1
Chlorops? n. sp.	*Lasiosina canadensis* Aldrich	3	16	19

Dicraeus n. sp.	*Dicraeus incongruus* Aldrich	124	1	125
Diplotoxa microcera	*Diplotoxa approximatonervis* (Zetterstedt)	1	1	2
Diplotoxa pulchripes	*Neodiplotoxa pulchripes* (Loew)	1		1
Diplotoxa versicolor	*Diplotoxa versicolor* (Loew)	24	31	55
Diplotoxa sp. criddle 1	undetermined	2		2
Elachiptera costata	*Elachiptera costata* (Loew)		7	7
Elachiptera decipiens	*Elachiptera decipiens* (Loew)		3	3
Elachiptera eunota	*Melanochaeta eunota* (Loew)		1	1
Elachiptera longula	*Eribolus longulus* (Loew)	1		1
Elachiptera nigriceps	*Elachiptera nigriceps* (Loew)	8		8
Elachiptera n. sp.	*Eribolus nana* (Zetterstedt)	28	7	35
Hippelates flavipes	*Liohippelates pallipes* (Loew)	3	12	15
Hippelates flavipes (dark)	*Liohippelates pallipes* (Loew)		6	6
Hippelates pallipes	*Liohippelates pallipes* (Loew)	4		4
Meromyza americana	*Meromyza americana* Fitch	133	92	225
Meromyza flavipalpis	*Meromyza flavipalpis* Malloch	1		1
Oscinis coxendix	*Apallates coxendix* (Fitch)	2647	2532	5179
Oscinis dorsata	*Incertella* sp. undetermined	257	337	594
Oscinis marginalis	*Incertella ovalis* (Adams)	7	9	16
Oscinis melancholica	*Tricimba melancholica* (Becker)	46	7	53
Oscinis misera	undetermined	44	259	303
Oscinis pusilla	undetermined	49	303	352
Oscinis trigramma	*Olcella trigramma* (Loew)	3	7	10
Oscinis umbrosa	*Rhopalopterum umbrosum* (Loew)	3	38	41
Oscinis sp. criddle 2	undetermined	153	416	569
Oscinis sp. criddle 3	*Incertella ?incerta* (Becker)	138	250	388
Oscinis sp. criddle 4	*Rhopalopterum criddlei* (Aldrich)	128	62	190
Oscinis sp. criddle 5	undetermined	1		1
Oscinis sp. criddle 6	undetermined		3	3
Oscinis sp. nr. *trigramma*	*Aphanotrigonum scabrum* (Aldrich)		12	12
Oscinis sp. nr. *umbrosa*	undetermined		4	4
Oscinis sp.	undetermined	26		26
Siphonella aequa	*Malloewia aequa* (Becker)		6	6
Siphonella finalis	*Olcella finalis* (Becker)		1	1
Siphonella neglecta	*Malloewia neglecta* (Becker)		3	3
Siphonella oscinina	*Siphonella oscinina* (Fallén)	1		1
Siphonella parva	*Olcella parva* (Adams)	580	171	751
Siphonella pumilionis	undetermined		2	2
Siphonella sp. criddle 1	undetermined	4	1	5
Siphonella sp.	undetermined	1		1
Tricimba cincta	*Tricimba cincta* (Meigen)		6	6
Total specimens		4716	5012	9728
Total taxa		35	41	54

Immigrant Insects Help Restore Canada's Grassland Communities

Rose De Clerck-Floate (floate@agr.gc.ca) and Rob Bourchier (bourchierr@agr.gc.ca)
Agriculture and Agri-Food Canada, Lethbridge Research Centre,
5403 - 1st Avenue S., Lethbridge, AB T1J 4B1

Invasive alien plants are recognized as a serious threat to ecosystem integrity and biodiversity around the world. Millions of hectares of native North American grasslands are currently under siege by introduced plants such as leafy spurge, spotted and diffuse knapweed and Dalmatian toadflax. These aggressive plants occur in high densities and displace native plants and the organisms that rely on them; including indigenous insect species. Whether introduced accidentally or intentionally from other parts of the globe, weedy alien invaders are a problem partly because they arrived at our shores without the natural enemies that normally keep them in check in their places of origin.

'Classical' weed biological control is an attempt to reunite host-specific natural enemies – usually insects – with the plants with which they closely evolved, thereby reducing densities of the targeted weed to levels that are not environmentally or economically damaging. The aim of biological control is not to eradicate the host weed, nor is this achievable anyhow once the weed becomes well-established. As per predator-prey principles, both weed and released insect biocontrol agents will stabilize at low densities, but remain within the grassland community once the weed is brought under control by the agent. In this way, the biocontrol agent becomes part of the diversity that it helped to restore.

Biocontrol is an attractive option for weed control on native grasslands when compared to the use of either chemicals or mechanical methods. In situations where the weed is widespread or in ecologically-sensitive habitats, often biocontrol is the only economic or environmentally-feasible option available. The method is not only self-sustaining once the insects are established, but typically self-spreading over the large areas requiring treatment. Furthermore, biocontrol is seen as having a minimal environmental impact compared to other control methods, or to the option of not attempting weed control whatsoever. Prior to release, potential biocontrol agents undergo extensive and rigorous host-range testing to ensure specificity to the target weed. Current testing incorporates the study of potential direct non-target impacts on plant species that are taxonomically-related to the weed. It also includes consideration of potential indirect ecological impacts. Ultimately, the benefits, risks (which are never zero) and economic realities must be carefully weighed when making weed control decisions.

Additions to the grassland faunal lists

Biological weed control has had a long, successful history in Canada; starting in 1951, with the release of two species of leaf beetles for the control of St John's Wort. Since then, 21 alien weed species have been targeted for biocontrol and at least 75 insect species have been purposely introduced to Canada as biocontrol agents, mostly from Europe and Eurasia. The majority of these insects have been released to control weeds of native grasslands where chances for successful establishment, population increase and impact on target weeds are better than on cropland, where detrimental disruptions of host and insects are more frequent. About 2/3 of the introduced species have become successfully established, and thus, are additions to the Canadian insect faunal lists for grasslands. A few of these species have gone on to become locally abundant providing effective suppression of an invasive weed and contributing to the restoration of native grasslands. Two of the more recent successful biological control agents have been released against Dalmatian toadflax and leafy spurge

Mecinus janthinus on Dalmatian toadflax

The European stem-boring weevil, *Mecinus janthinus* Germar, was first released in Canada in 1991 to control Dalmatian and yellow toadflax (*Linaria dalmatica* and *L. vulgaris*). Both European in origin, Dalmatian toadflax is a serious weed of grasslands in western North America, and yellow toadflax is a weed mostly of perennial and annual crops, but also occurs on grasslands in Canada. Weevils initially released in Canada were collected from yellow toadflax in the French Rhine Valley and used against Dalmatian toadflax in southern British Columbia (B.C.) and Alberta. Establishment on Dalmatian toadflax in B.C. has been highly successful, with populations reaching outbreak densities within 3-5 years after release. Large numbers of adult weevils, emerging from these sites in May to early June, feed on the growing shoot tips of toadflax, thereby preventing flowering and causing severe stunting of shoots. It appears that repeated, annual attack by both adults and larvae of the univoltine *M. janthinus* eventually causes local reductions in the density of its perennial host. In contrast, establishment and increase of the weevil on yellow toadflax in western and eastern Canada has not been as successful for unknown reasons.

Mecinus janthinus on Dalmatian toadflax
(photograph by F. Brouwers)

Mecinus janthinus adults are easily observed in the field as elongate, bluish-black weevils (ca. 5 mm long) that stand out against the new, green foliage of its hosts in the spring. In warmer locations of B.C., emergence of adults can occur as early as April, but typically the peak of emergence occurs in May. Oviposition lasts from early May to late June, during which females chew holes into toadflax shoots and insert their white, oval eggs singly. Numerous eggs can be laid per shoot, resulting in weevil densities of up to 100 per Dalmatian toadflax shoot. Eggs take 6-7 days to hatch, and the cream-coloured larvae then proceed to mine within toadflax shoots. Mines can reach a maximum of 3 cm in length. Development through the three larval instars takes 4-5 weeks, and pupation occurs within the oval chamber formed by the last instar larvae within the mined shoot. Adults emerge by late summer-early fall, but remain within the toadflax shoots to overwinter, during which time, the shoots die and become dried. The adults then chew their way out of the dried stalks during spring emergence.

Aphthona spp. on Leafy spurge

Leafy spurge, *Euphorbia esula* L., was introduced into North America from Eurasia in the early 1800s. It has spread rapidly in rangeland, roadsides, and non-crop riparian areas. The weed now occurs in all Canadian provinces except Newfoundland, with the most heavily infested areas being in the prairie provinces.

The plant is a deep-rooted perennial that reproduces by seed and vegetative root buds, and its stems can be >1 m tall. Monocultures of leafy spurge on rangeland and riparian habitats threaten biodiversity and populations of native species. The plants' white latex sap causes direct toxicity to cattle, while displacement of rangeland forage plants due to competition from *E. esula* leads to reduced livestock production.

Leafy spurge was one of the early targets for weed biological control in Canada. There have been 14 foreign insects released against leafy spurge with the most successful being 5 flea-beetle species in the genus *Aphthona.* Each flea beetle has slightly different habitat preferences; the larvae of these insects feed on the roots of leafy spurge, and at high densities, the adult beetles defoliate the weed prior to seed set. The most recent introduction to Canada is *Aphthona lacertosa.* The beetle was first released in small numbers in Alberta in 1991 and then more widely, in all western provinces by 1997. Since 2001, in collaboration with Agricultural Fieldmen, there has been an operational program to redistribute the beetle throughout Southern Alberta. Recent surveys in Alberta indicate that the beetle has successfully reduced leafy spurge densities at a release-patch scale at multiple release sites.

Adults of *A. lacertosa* are a shiny metallic black, 2.5-3.4 mm long (about twice the size of an alfalfa seed), equally tapered front and rear with light coloured (light brown to reddish) hind legs. Adults are very active and climb, fly and jump readily. Larvae are approx 1-5cm long, creamy-white, except for a brown head capsule, and often in a comma shape.

Adult emergence is staggered and starts on the prairies about the third week in June and the beetles disappear by beginning-to-mid August. The adults aggregate strongly, often on certain plants in a stand. They mate shortly after emergence, and females lay between 200-300 pale yellow eggs (0.7 x 0.4 mm) throughout the summer, in small batches underground, near the stems of spurge plants. Eggs hatch in 2-3 weeks, and newly emerged larvae burrow into roots. Larvae pass through 3 moults before they pupate. Young larvae bore into and feed on small, filamentous roots (these roots have much less milky latex than larger roots). Older larvae feed from the outside on larger roots and root buds to weaken and kill their host. Larvae will feed throughout the summer, and spend the winter as mature larvae in small chambers they construct in the soil. In late spring, when soil temperatures are warm enough, larvae will pupate in soil chambers, and then emerge from the soil as adult beetles. There is one generation of beetles per year.

A second species, *Aphthona nigriscutis* was the first flea beetle released in Canada in the late 1980s. This species is of similar size and shape to *A. lacertosa.* However, adults are red-brown with a darkened scutellum. This species has been effective in very dry, exposed spurge sites with sandy soil and high degree-day accumulations.

Aphthona spp. and *M. janthinus* are successfully controlling their target weeds at specific release sites. Most invasive weeds have at least a

Aphthona lacertosa on spurge
(photograph by R. Bourchier)

100 year head start spreading on Canadian grasslands, prior to the recent release of biological control agents. Thus wide-scale population suppression will take time because of the scale of the problem. Current research is now focused on understanding population growth and dispersal rates of biological control agents, and the development of novel mass-rearing methods so that it does not take another 100 years to bring the weeds under control.

For additional information on Weed Biological Control in Canada please see:

http://res2.agr.gc.ca/lethbridge/weedbio/index_e.htm#toc.

Ants of the South Okanagan Grasslands, British Columbia

Jennifer Heron
Department of Zoology, University of British Columbia, 6270 University Blvd., Vancouver, BC V6T 1Z4

The South Okanagan grasslands are an extension of the intermontane grasslands of the Great Basin that extends from northern Mexico through the mid-western United States to the southern edge of the temperate forests in British Columbia (Pitt and Hooper 1994). Within the South Okanagan grasslands, the ecosystem of greatest importance to biodiversity conservation is the Antelope-brush (*Purshia tridentata*) shrub-steppe, 60% of which has been lost to agriculture and urban development (Schluter et al. 1995), and 9% remains in good natural condition (Redpath, 1990). This ecosystem occurs from valley bottoms to 700 m elevations, from Osoyoos in the south to Penticton in the north. The dominant plant in the ecosystem's natural state is blue-bunch wheatgrass (*Elymus spicatus* [*Agropyron spicatum*]), followed by big sagebrush (*Artemisia tridentata*), both characteristic plants of bunchgrass ecosystems (Miedinger and Pojar 1991). Occurring on sandy soils, the main bunchgrasses are three-awn (*Aristida longisita*), needle-and-thread (*Stipa coratea*) and sand dropseed (*Spirobolus cryptandrus*). Douglas-fir and Ponderosa pine are sparse and wetlands are common in valley bottoms.

Invertebrates dominate grassland environments, have the ability to withstand desiccation, and thus exploit the subterranean environment. Since most surface species are inconspicuous and others live underground, the diversity of these animals in grassland environments is often overlooked. Ants make up a significant component of the arthropod diversity in grassland ecosystems, and form a unique subgroup within the ground and soil surface population. The scarcity of precipitation results in very little soil leaching and consequently, temperate grasslands have an abundance of organic matter that contributes to the microhabitat available to these sub-surface soil dwellers. Ants contribute to the functioning of an ecosystem in their biomass and species richness, and also as soil engineers, seed dispersers, foragers and scavengers (Hölldobler and Wilson 1990; Folgarait 1998). The social nature of the ant gives it an advantage over solitary insects. Ants are not mobile or transient in the manner of most insects; they have a colony and nest that functions as a unit. Nests can persist in one location for months, seasons and years, growing or diminishing in response to the microhabitat and available resources (Wagner and Medler 1970). Ants are entirely dependent on temperature for their daily activities, both inside and outside the nest. With daily summer temperatures in the South Okanagan reaching over 35°C for weeks at a time, ants thrive.

Desert near Osoyoos in the Okanagan
(photograph by J.D. Shorthouse)

The information in this article is a brief summary of the ant species identified for my master's degree thesis, brief notes on their behavioural and nesting characteristics, as well as some observations made from my thesis data. Ecological information was taken from Bolton (1994); Creighton (1950); Gregg (1963); Hölldobler and Wilson (1990); Wheeler and Wheeler (1963; 1986); Buckell 1932; Brown 1949; Blacker 1992; Naumann et al. 1999; Preston, pers. comm.; Francour, pers. comm. and personal observations.

The main objective of my thesis was to assess the effects of domestic livestock grazing on ant diversity in the South Okanagan grasslands, and this will be reported on elsewhere. The ants were collected (using pitfall traps) from ten sites located throughout the Antelope-brush shrub-steppe ecosystem in 1994 and 1995. These sites were categorized as ungrazed, moderately grazed or heavily grazed based on the known grazing history of the site. This study was part of a larger study that assessed the impacts of grazing on biodiversity in the South Okanagan.

In Canada, the average ant colony has 3000 workers although nests can range from 10 to millions of adults (Masner et. al. 1979). Often, it seemed the whole nest would fall into the closest pitfall trap, blindly following their sisters to a pit of propylene glycol! Nonetheless, they all were identified.

A total of 2397 of the 2500 pitfall trap samples had ant specimens present. All of the 93 515 ants collected in the traps were identified and represent 31 species from 13 genera (Table 1). All ants were identified to species using taxonomic keys in Bolton (1994); Creighton (1950); Gregg (1963); Hölldobler and Wilson (1990); and Wheeler and Wheeler (1963; 1986). Synoptic collection identifications were confirmed by Andre Francoeur (University of Chicoutimi, Quebec) and Bill Preston (Manitoba Museum of Man and Nature).

When the species list was checked with provincial data (Buckell 1932; Brown 1949; Blacker 1992; Blades and Maier 1996; Naumann et al. 1999; Royal British Columbia Museum;

Table 1 Checklist of ant species captured in pitfall trapping in the South Okanagan

- Family Formicidae
- Subfamily Myrmicinae
    - Tribe Myrmicini
    - Genus *Pogonomyrmex* Mayr
        - *owyheei* Cole
    - Genus *Aphaenogaster* Mayr
        - *subterranea* Emery
    - Genus *Pheidole* Westwood
        - *californica* Mayr
    - Genus *Solonopsis* Westwood
        - *molesta* Say
    - Tribe Leptothoracini
    - Genus *Leptothorax* Mayr
        - *nevadensis* W.M.Wheeler
        - *nitens* Emery
        - *rugatulus* Emery
    - Tribe Myrmicini
    - Genus *Myrmica* Latreille
        - *nearctica* Weber
        - *crassirugus* undescribed
- Subfamily Dolichoderinae
    - Tribe Tapinomini
    - Genus *Liometopum* Mayr
        - *luctuosum* W.M. Wheeler
    - Genus *Tapinoma* Foerster
        - *sessile* (Say)
- Subfamily Formicinae
    - Tribe Formicini
    - Genus *Camponotus* Mayr
        - *nearcticus* Emery
        - *vicinus* Mayr
    - Genus *Lasius* Fabricius
        - *crypticus* Wilson
        - *neoniger* Emery
    - Genus *Myrmecocystus* Wesmael
        - *testaceus* Emery
    - Genus *Formica* Linnaeus
        - *argentea* W.M.Wheeler
        - *curiosa* Creighton
        - *haemorrhoidalis* Emery
        - *integroides* Emery
        - *lasioides* Emery
        - *microgyna* W.M.Wheeler
        - *neoclara* Emery
        - *neogagates* Emery
        - *near nepticula* Wheeler
        - *obscuripes* Forel
        - *planipilis* Creighton
        - *propinqua* W.M.Wheeler
        - *subpolita* Mayr
        - *viculans* W.M.Wheeler
    - Genus *Polygerus* Latreille
        - *breviceps* Emery

University of British Columbia Spencer Entomological Museum), there were five new records for British Columbia (*Formica nr. nepticula*, *Formica planipilis*, *Formica propinqua*, *Myrmica crassirugus* and *Myrmica nearctica*).

Ants are often grouped according to the niche they occupy, the nest they build or the habits they exhibit. Ant functional group profiles have been used in Australia (Andersen 1995) and later in North America (Andersen 1997) to form a basis from which to draw patterns of community structure along an environmental gradient. Research has shown that in ant communities the patterns of distribution and abundance are results of interspecific competition (Savolainen and Vepsäläinen 1988). Differences in exploitation behaviour, interference behaviour and interspecific predation can cause changes in the community structure of ants (Pontin 1997). Nest spacing allows for the coexistence of other less dominant species and coexistence could depend on chemical and behavioural differences, or on competition for food (Pontin 1997). Intraspecific competition can also contribute to nest dynamics. Based on food, nesting, microhabitat and behavioural tendencies, ants are grouped and discussed accordingly.

The aggressive and dominant thatch ants of the *Formica rufa* group are prominent in grassland ecosystems. In this study they comprised approximately 19% of the total ants collected, although often pitfall traps were situated in close proximity to a nest. *Formica haemorrhoidalis*, *Formica integroides*, *Formica microgyna*, *Formica obscuripes*, *Formica planipilis*, *F. propinqua* and *Pogonomyrmex owheeyi* are known to be opportunistic ant species that make (sometimes) large thatch mound-like nests out of sticks and needles, vegetative debris, gravel, sand and any other readily available materials. Each of these species, aside from *Formica microgyna*, can also be characterized as aggressive, tends to form multicolonial populations and displays hostility towards ants that compete for similar resources through similar habits, i.e. ants of the same species or same subgenera. Alternatively, if the species forms unicolonial populations, then the ant remains aggressive towards a broad range of species.

Formica haemorrhoidalis, *Formica integroides*, *Formica obscuripes*, *Formica planipilis* and *Formica propinqua* are all known to live in various environments other than grasslands, including wooded coniferous forests at variable elevations.

Formica haemorrhoidalis was recorded at each of the ten sites, although at very low numbers in moderately grazed sites and comprised approximately 6% of trap catch. *Pogonomyrmex owyheei*, on the other hand, was recorded at 3 sites and comprised less than 0.2% of trap catch; thus aggressive behaviour may not always lead to dominance or abundance. Ants in this genus are also referred to as harvester ants, and are represented by this species alone in British Columbia. Harvester ants gather and store seeds within their nests and are generally non-selective in seed preference, thus a specific food source is likely not the cause of low numbers. They are also known for a very painful sting. This species is at the northern limit of its range as the genus is fairly abundant in the southern United States and Mexico (Wheeler and Wheeler 1986). The pygmy short-horned lizard (*Phrynosoma douglasii*) is known to feed on harvester ants and is listed as Extirpated from Canada by the Committee on the Status of Endangered Wildlife in Canada. *Pogonomyrmex owyheei* has only been found south of Penticton in grassland and desert environments. The rarity of this ant may partially explain the absence of the lizard, and habitats with known records of harvester ants could provide potential recovery habitat and should be prioritized for surveys.

While aggressive behaviour allows some species to dominate an ecosystem, other ants are ubiquitous by different means. *Solonopsis molesta* and *Tapinoma sessile* are both lestobiotic; small species of ants that nest in the walls of colonies built by a different ant species. Lestobiotic ants steal food, prey on inhabitants including the brood of the host nest, and utilize the resources of the host nest to survive. These ant species can also live independently and may be abundant, but usually do not behave aggressively (Hölldobler and Wilson 1990) in soil or vegetation mounds, under stones or wood. *Tapinoma sessile* has a wider nesting preference and will also live under dung, a substrate that is found abundantly in grazed ecosystems. Both *Solonopsis molesta* and *Tapinoma sessile* are very small, and their size coupled with their lestobiotic ability allows these ants to live throughout all ecosystems of North America. Thus it was not surprising these ants were found in all sites surveyed, *Solonopsis molesta* comprising 42% of all the ants identified!

Solonopsis molesta can also be categorized as a dulotic or slave-making ant species. These parasitic ants have a separate nest, with workers raiding other species' nests and capturing the brood, usually the pupae, for rearing in the host nest (Holldöbler and Wilson 1990). A dulotic ant species utilizes enslaved workers for reproduction, foraging and nest building. *Formica curiosa*, *Formica microgyna*, *Leptothorax nevadensis* and *Polygerus breviceps* also exhibit dulotic abilities.

Polygerus breviceps is a true slave making species and is known to use a variety of hosts including *Formica subpolita*, *Formica argentea* and *Formica neoclara*, each have been trapped in this study. *F. subpolita* is known as a timid species, and tends to nest under stones or sometimes creates a crater nest in open spaces. The species is also known to tend other insects for honeydew. Elsewhere nests have been located at the base of Artemesia tridentata, a shrub commonly known as big sagebrush that occurs widely throughout the South Okanagan grassland ecosystems. *Formica argentea* is found throughout North America, and is common in urban, rural and disturbed environments including those throughout the South Okanagan and elsewhere in BC. *Formica neoclara* is also relatively widespread throughout the southern part of the province and is recorded from open areas, grasslands and disturbed areas.

Only one specimen of *Formica curiosa* was caught, at a moderately grazed site. The species' known host is *Formica lasioides*, which comprised less than 0.2% of trap catches and was found in total numbers less than 50 at any one site over the course of the two year study. This species has been reported from British Columbia in the past, although there is little reported about the habitat in which it was found. Elsewhere the species has been recorded from dry desert and grassland type environments.

The most abundant slave-making ant after *Solonopsis molesta* was *Leptothorax nevadensis*, also known to form a soil or vegetative mound or nest in and under decaying wood. This species is known to live in a wide range of habitats, including coniferous and mixed forests, open woodlands and grasslands and was found in all grazing categories and at nine of the ten sites.

Additional ants trapped during this study that can be enslaved to work by a dulotic species include *Formica neogagates*. This species is known to form a soil or vegetation mound, or nest under stones, under dung or create crater nests in a variety of environments, including grasslands, forests and open woodlands. In British Columbia it has been recorded in areas other than the South Okanagan and in this study it was one of seven species recorded at all sites. *Formica neogagates* has also been characterized as a timid species, an ant that tends to hide or run away fast when disturbed, does not defend its brood when the nest is disturbed, and is out-competed or readily displaced by more aggressive ant species.

Other species characterized as having timid behaviour include *Aphaenogaster occidentalis* (*subterranea*), *Camponotus nearcticus*, *Lasius crypticus*, *Lasius neoniger* and *Leptothorax rugatulus*. *Aphaenogaster occidentalis* is known to have nests in both extreme cover and in open spaces, in open and forested landscapes. The species is known to range from southern Vancouver Island through the southern interior of British Columbia, and although it was not trapped from all sites it was the second most abundant species, comprising 12% of the total trap catch.

Camponotus nearcticus, a carpenter ant, is known to live under the bark of dead trees and other forms of dry wood, in pine cones, galls and rotting logs and under dung. The species has previously been recorded from the South Okanagan and although occurring at seven of the ten sites, the species comprised less than 0.2% of ants identified. Both *Lasius crypticus* and *Lasius neoniger* nest under stones, decaying wood and dung, may form crater nests and are known to tend other species of insects such as aphids for honeydew. Both species have previous records in the South Okanagan and are known to inhabit grassland environments and occurred in all grazing categories. Another ant known to tend insects and have similar nesting habits is *Leptothorax rugatulus*.

Camponotus vicinus is a widespread species in British Columbia and like most carpenter ants it is known to build nests in rotten wood, although this species has also been observed to build nests under stones and other forms of cover. The species is also known to feed on and tend insects as well as scavenge on dead insects and decaying material. The aggressive behaviour of the species enables it to readily compete for resources and thus it was not surprising that it was found in all ten sites of this study, comprising approximately 3% of the total trap catch.

Some ants can also be categorized as tolerant: they do not appear to be disturbed easily, do not display aggressive tactics when disturbed, and able to live within close proximity (nest territories overlap) with other more aggressive ant species. Stratification of foraging activities permits the coexistence of dominant and subordinate species in greater diversity and abundance (Cerdá et. al. 1998). Tolerant ants include *Myrmecocystus testaceus*, *Myrmica crassirugus*, *Myrmica nearcticus* and *Pheidole californica*, and all four of these species are known only from South Okanagan records. Both *Myrmica crassirugus* and *Myrmica nearctica* are new records for British Columbia. *Myrmica crassirugus* is a species new to science (A. Francoeur pers. comm.) yet has been documented elsewhere in Canada. These species are known to nest in rotten wood, under stones or form soil and vegetation mounds in addition to tending insects.

The ant fauna of British Columbia is little studied and thus it is difficult to assess whether species occurring solely in the South Okanagan are truly specific to the ecosystems of this region. Based on the provincial records and scanning the literature it would appear that *Pogonomyrmex owheeyi*, *Camponotus nearcticus*, *Lasius neoniger*, *Lasius cryptigus*, *Myrmecocystus testaceus*, *Myrmica crassirugus*, *Myrmica nearcticus* and *Pheidole californica* are associated with the grassland environments of the South Okanagan. Of these species, *Pogonomyrmex owheeyi*, *Myrmica crassirugus* and *Myrmica nearcticus* were extremely rare in the trapping done in this study.

Ants may be considered resilient to habitat alterations due to innate defence mechanisms as a direct result of their sociality. Grassland ant species typically nest in microhabitats that protect and conceal their nests: under rocks, stones or boulders, under the bark of a dead tree, or piece of wood or at the base of a plant or under thatch. If the nest is an exposed crater or thatch mound, it may be just outside of the fray of herbage, which would attract grazers or browsers; therefore the probability of periodic and repeated disturbance (e.g. from trampling) is considerably lessened, although ants can be quite resilient to livestock trampling (Heske and Campbell 1991). Although apparently ubiquitous and considered somewhat resilient, ants should not be overlooked in conservation planning, specifically in the rapidly changing South Okanagan grasslands.

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Web Watch: Ants of the tallgrass prairie

K.D. Floate
Agriculture and Agri-Food Canada, Lethbridge Research Centre, Lethbridge, AB T1J 4B1
floatek@agr.gc.ca

Ants (Hymenoptera: Formicidae) are a ubiquitous component of prairie ecosystems, frequently dominating arthropod assemblages in both species and biomass. Prairie remnants may support 25 to 35 co-occurring species with the combined weight of ants capable of exceeding that of grasshoppers.

All ants are predacious and feed on naturally-occurring sugary substances, but different feeding guilds of prairie species can be distinguished. Predatory ants forage on soil and plant surfaces for suitable prey, with a preference for soft-bodied adult or immature insects. Tending ants (e.g., *Acanthomyops* and some *Lasius* spp.) protect sap-feeding insects in return for sugary secretions. Raiding species (e.g., *Neivamyrmex*, *Polyergus* and some *Formica* spp.) attack the nests of other ants to obtain slaves or food. A fourth guild specializes in opportunistic scavenging (species of Myrmicinae and Dolichoderinae).

Studies of tallgrass prairie show that there is no 'endemic' ant fauna, but rather an assemblage of species derived from the fauna of eastern deciduous forests. The prairie assemblage virtually lacks the plant-dwelling and leaf-litter inhabiting (*i.e.*, fire-sensitive) species common in woodlands, but has a preponderance of ground-nesting species (e.g., *Formica* spp.). The tunnelling activity of these ground-nesting ants is important in moving and aerating soil, particularly in northern prairie regions where past glaciation has eliminated native species of earthworms. The soil around ant mounds is enriched with minerals and minerals in the form of waste products, dead ants and fragments of unconsumed prey. These pockets of enriched and loose soil often are preferentially colonized by prairie plant species.

The genus *Formica* has the highest biomass and species richness of all ants in the tallgrass region. *Formica* ants frequently are observed because of their abundance, relatively large size, numerous species, and often-conspicuous mounds. Worldwide, *Formica* is restricted to the temperate northern hemisphere, and is also dominant in the grasslands of the northern Great Plains and of the Eurasian steppes. *Formica* becomes far less abundant and less species-rich southward. *Lasius, Myrmica* and *Leptothorax* are other genera best developed in the temperate northern hemisphere.

This information on ants of the tallgrass prairie has been abstracted from:

Trager, James C. 1998. An introduction to ants (Formicidae) of the tallgrass prairie. Missouri Prairie Journal. Vol. 18:4-8. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/1999/ants/ants.htm (Version 17MAY99).

Northern Prairie Wildlife Research Center
http://www.npwrc.usgs.gov

The Northern Prairie Wildlife Research Center (NPWRC) is one of 18 science and technology centers in the Biological Resources Discipline of the U.S. Geological Survey. The mission of Northern Prairie Wildlife Research Center is to provide the scientific information needed to conserve and manage the nation's biological resources, with an emphasis on the species and ecosystems of the nation's interior. Because of their research emphasis, many of the resources listed here stress information about resources in North Dakota and the Great Plains. However, many of the resources also pertain to the entire United States, as well as to Canada, Mexico, and occasionally other countries.

The insects/invertebrate section lists links to Identification Tools, Checklists, Distributions, Species Accounts/Descriptions, Literature Review and Bibliographies, Regional Overviews, Resource management Techniques, Software products and Non-technical resources.

Some recent publications

Peterson Field Guides: The North American Prairie.

This new field guide provides detailed profiles of 48 major North American prairie preserves and capsule descriptions of 120 smaller preserves. Each preserve profile includes practical information on what times of year to visit, how to get there, where to go hiking and camping – and even boating. Each profile also covers weather conditions and wildlife of special interest, in addition to the flora, fauna, and natural history of the preserve.

Part I describes the ecology of the North American prairie region. Part II – Where to see the prairie – is arranged by state or province. Canadian provinces featured include Alberta (Head-Smashed-In-Buffalo Jump, Writing-on-Stone Provincial Park and other Alberta sites), Manitoba (Birds Hill Provincial Park, Manitoba Tallgrass Prairie Preserve and other Manitoba sites) and Saskatchewan (Cypress Hills Interprovincial Park, Grasslands National Park, Last Mountain Lake National Wildlife Area and other Saskatchewan sites). Each area includes a map showing locations of selected features, site description and history, and a description of a characteristic plant and animal. There is an appendix of prairie preserves in Indiana, Michigan, Ohio and Ontario and another appendix of common and scientific names of plants mentioned in the text. For people interested in prairie sites this work would be a good starting place.

S.R. Jones and R.C. Cushman. 2004. Peterson Field Guides: The North American Prairie. Houghton Mifflin 528 pp.

R. Roughley

Bugs of the tallgrass prairie

Abstract:

Only tiny remnants of unploughed natural meadows remain in the eastern part of the state of North Dakota, and in Canada from eastern Saskatchewan to Manitoba. Those west of Lake Manitoba and the Red River Valley are characterized by their distinctive fauna of insects, principally leafhoppers and planthoppers (Homoptera: Auchenorrhyncha). These true bugs include hundreds of species invariably associated with North American grasslands. The distributions of those with the most limited dispersal abilities reflect long-term patterns of dominance and contiguity of native grass stands in prairies. These bug distributions indicate that bluestem-dominated grasslands in Canada, which usually are under 0.5 meter (20 inches) in height, are equivalent to tallgrass prairie from Illinois. This prairie once extended as much as 400 kilometers (250 miles) northwest of its previously known distribution. These bugs help differentiate tallgrass prairie from sites in southwestern Manitoba and adjacent North Dakota, which are more arid, and from sites east of Lake Manitoba and southward in the Red River Valley, which were formerly oak savanna.

Hamilton, K. G. A. 2004. Bugs reveal an extensive, long-lost northern tallgrass prairie. *BioScience* 55(1): 49-59

Mailing list for the grasslands newsletter

John Acorn
Department of Renewable Resources
University of Alberta
Edmonton, AB T6G 2H1
janature@compusmart.ab.ca

Barry Adams
Alberta Agriculture, Food and Rural Development
#100, 5401 1st Ave. S.
Lethbridge, AB T1J 4V6
barry.adams@gov.ab.ca

Michael Alperyn
Department of Entomology
University of Manitoba
214 Animal Science Building
Winnipeg, MB R3T 2N2

Robert Anderson
Canadian Museum of Nature
P.O. Box 3443, Station "D"
Ottawa, ON K1P 6P4
randerson@mus-nature.ca

Wasyl Bakowsky
Natural Heritage Information Centre
Ministry of Natural Resources
P.O. Box 7000
Peterborough, ON K9J 8M5

George Ball
Department of Biological Sciences
University of Alberta
Edmonton, AB T6G 2E9
gball@ualberta.ca

George Balogh
6275 Liteolier
Portage, Michigan 49024
bugdr@net-link.net

Valerie Behan-Pelletier
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
behanpv@agr.gc.ca

Robb Bennett
Seed Pest Management
B.C. Ministry of Forests
7380 Puckle Rd.
Saanichton, BC V8M 1W4
Robb.Bennett@gems6.gov.bc.ca

Guy Boivin
Centre de Recherche et de Développement en Horticulture
Agriculture et Agro-alimentaire Canada
430 Boul. Gouin
St.-Jean-sur-Richelieu, QC J3B 3E6
boiving@agr.gc.ca

Christie Borkowsky
Centre for Interdisciplinary Forest Research, University of Winnipeg
515 Portage Ave.
Winnipeg, MB R3B 2E9
umborko2@cc.umanitoba.ca

Patrice Bouchard
Agriculture and Agri-Food Canada
960 Carling Ave.
Ottawa, ON K1A 0C6
bouchardpb@agr.gc.ca

Stephanie Boucher
Lyman Entomological Museum
McGill University
21111 Lakeshore Drive
Ste.-Anne-de-Bellevue, QC H9X 3V9
sboucher@nrs.mcgill.ca

Rob Bourchier
Lethbridge Research Centre
Agriculture and Agri-Food Canada
Lethbridge, AB T1J 4B1
bourchierR@agr.gc.ca

Yves Bousquet
Agriculture et Agroalimentaire Canada
Ottawa, ON K1A 0C6
bousquety@agr.gc.ca

Eleanor Bowie
The Great Sand Hills Planning District Commission, c/o R.M. of Piapot
Box 100
Piapot, SK S0N 1Y0

Jim Broatch
8 Maple Bay
Lacombe, AB T4L 1V5
jim.broatch@gov.ab.ca

Brian Brown
Entomology Section
Natural History Museum of Los Angeles County
900 Exposition Blvd.
Los Angeles, California 90007
bbrown@nhm.org

Don Buckle
620 Albert Ave.
Saskatoon, SK S7N 1G7
djbuckle@shaw.ca

Bob Byers
Lethbridge Research Centre
Agriculture and Agri-Food Canada
Lethbridge, AB T1J 4B1
byers@agr.gc.ca

James Cahill
Department of Biological Sciences
University of Alberta
Edmonton, AB T6G 2E9
jc.cahill@ualberta.ca

Sydney Cannings
Yukon Territorial Government
Box 2703
Whitehorse, Yukon Y1A 2C6
syd.cannings@gov.yk.ca

Robert Cannings
Natural History Section
Royal British Columbia Museum
P.O. Box 9815, Stn. Prov. Govt.
Victoria, BC V8W 9W2
rcannings@royalbcmuseum.bc.ca

Héctor Cárcamo
Lethbridge Research Centre
Agriculture and Agri-Food Canada
P.O. Box 3000
Lethbridge, AB T1J 4B1
carcamoh@agr.gc.ca

Ralph Cartar
Department of Biological Sciences
University of Lethbridge
4401 University Drive
Lethbridge, AB T1K 3M4
cartar@uleth.ca

M. Jill Clapperton
Lethbridge Research Centre
Agriculture and Agri-Food Canada
PO Box 3000
Lethbridge, AB T1J 4B1
clapperton@agr.gc.ca

Daniel Coderre
Département des sciences biologiques
Université du Québec à Montréal
C.P. 8888, Succ. Centre Ville
Montréal, QC H3C 3P8
coderre.d@uqam.ca

Murray Colbo
Department of Biology
Memorial University of Newfoundland
St. John's, NL A1B 3X9
mcolbo@mun.ca

Malcolm Coupe
Department of Biological Sciences
University of Alberta
Edmonton, AB T6G 2E9

Jeffrey Cumming
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
cummingjm@agr.gc.ca

Douglas Currie
Department of Natural History
Royal Ontario Museum
100 Queen's Park
Toronto, ON M5S 2C6
dcurrie@zoo.utoronto.ca

Brenda Dale
Canadian Wildlife Service
Environment Canada
200 - 4999 98th Ave,
Edmonton, AB T6B 2X3

Diane Debinski
Department of Animal Ecology
Iowa State University
124 Science II
Ames, IA 50011
debinski@iastate.edu

Rosemarie DeClerck-Floate
Lethbridge Research Centre
Agriculture and Agri-Food Canada
P.O. Box 3000
Lethbridge, AB T1J 4B1
floate@agr.gc.ca

Andy Didiuk
Prairie and Northern Wildlife Research Centre
115 Perimeter Road
Saskatoon, SK S7N 0X4

Lloyd Dosdall
Department of Agricultural / Food and Nutritional Science
University of Alberta
4 - 10 Agriculture / Forestry Centre
Edmonton, AB T6G 2P5
lloyd.dosdall@ualberta.ca

John Dunlop
Last Mountain Lake National Wildlife Area, Canadian Wildlife Service
Box 280
Simpson, SK S0G 4M0
john.dunlop@ec.gc.ca

Ian Dyson
Prairie Region
Alberta Environmental Protection
200 5th Ave. South
Lethbridge, AB T1J 4L1
ian.dyson@gov.ab.ca

W.G. Evans
Department of Biological Sciences
University of Alberta
Edmonton, AB T6G 2E3
wevans@gpu.srv.ualberta.ca

Pat Fargey
Grasslands National Park
P.O. Box 150
Val Marie, SK S0N 2T0
Grasslands_Info@pch.gc.ca

Todd Farrell
Nature Conservancy of Canada
Ontario Region
R.R. #5, 5420 Highway 6 North
Guelph, ON N1H 6J2
todd.farrell@natureconservancy.ca

Albert Finnamore
Provincial Museum of Alberta
12845 - 102nd Ave.
Edmonton, AB T5N 0M6
Albert.Finnamore@gov.ab.ca

Kevin Floate
Lethbridge Research Centre
Agriculture and Agri-Food Canada
Box 3000
Lethbridge, AB T1J 4B1
floatek@agr.gc.ca

Robert Foottit
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
foottitrg@agr.gc.ca

Bruce Ford
Department of Botany
University of Manitoba
Winnipeg, MB R3T 2N2
bford@ms.umanitoba.ca

Gene Fortney
Manitoba Branch
The Nature Conservancy Canada
611 Corydon Avenue, Suite 200
Winnipeg, MB R3L 0P3
genef@natureconservancy.ca

Ken Fry
Olds College
School of Horticulture
Olds, AB T4H 1R6
kfry@oldscollege.ca

Terry Galloway
Department of Entomology
University of Manitoba
Winnipeg, MB R3T 2N2
Terry_Galloway@UManitoba.ca

Gary Gibson
Agriculture and Agri-Food Canada
960 Carling Avenue
Ottawa, ON K1A 0C6
gibsong@agr.gc.ca

Bruce Gill
Entomology Unit, Centre for Plant Quarantine Pests
Canadian Food Inspection Agency
4125 - 960 Carling Ave.
Ottawa, ON K1A 0C6
gillbd@inspection.gc.ca

Robert Gordon
P.O. Box 65
Willow City, ND 58384

Henri Goulet
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
gouleth@agr.gc.ca

Larry Grenkow
Agriculture & Agri-Food Canada
107 Science Place
Saskatoon, SK S7N 0X7
grenkowl@agr.gc.ca

Graham Griffiths
Box 1380
Athabasca, AB T9S 2B2
gcdgriff@telusplanet.net

K.G. Andrew Hamilton
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
hamiltona@agr.gc.ca

Rudolf Harmsen
Department of Biology
Queen's University
Kingston, ON K7L 3N6
Dolf@harmsen.net

Peter Harper
Département des Sciences biologiques
Université de Montréal
C.P. 6128, Succ «Centre-Ville»
Montréal, QC H3C 3J7
harperp@biol.umontreal.ca

Wayne Harris
The Great Sand Hills Planning District Commission
c/o R.M. of Piapot, Box 100
Piapot, SK S0N 1Y0

Kerry Hecker
Last Mountain Lake NWA
Canadian Wildlife Service
Box 280
Simpson, SK S0G 4M0

Richard Henderson
WI DNR Research Center
1350 Femrite Drive
Monona, WI 53717
HendeR@mail01.dnr.state.wi.us

Margot Hervieux
6410 - 99 A Street
Grande Prairie, AB T8W 2K7
hervieux@telusplanet.net

Neil Holliday
Department of Entomology
University of Manitoba
Winnipeg, MB R3T 2N2
Neil_Holliday@UManitoba.CA

Robert Holmberg
Centre for Science
Athabasca University
Athabasca, AB T9S 3A3
robert@athabascau.ca

Lee Humble
Canadian Forest Service
Natural Resources Canada
507 West Burnside Road
Victoria, BC V8Z 1M5
lhumble@pfc.cfs.nrcan.gc.ca

Dan Johnson
Department of Geography,
University of Lethbridge
4401 University Drive West,
Lethbridge, AB, T1K 3M4
dan.johnson@uleth.ca

Derrick Kanashiro
Lethbridge Research Centre
Agriculture and Agri-Food Canada
PO Box 3000
Lethbridge, AB T1J 4B1
kanashirod@agr.gc.ca

Andrew Keddie
Department of Biological Sciences
University of Alberta
CW 405 Biological Sciences
Edmonton, AB T6G 2E9
andrew.keddie@ualberta.ca

Peter Kevan
Department of Environmental Biology
University of Guelph
Guelph, ON N1G 2W1
pkevan@uoguelph.ca

Bob Lalonde
Department of Biology
Okanagan University College
3333 College Way
Kelowna, BC V1V 1V7
bglalonde@ouc.bc.ca

Robert Lamb
Agriculture and Agri-Food Canada
195 Dafoe Road
Winnipeg, MB R3T 2M9
rlamb@agr.gc.ca

Jean-François Landry
Agriculture et Agroalimentaire Canada
960, ave Carling
Ottawa, ON K1A 0C6
landryjf@agr.gc.ca

Bernard Landry
Muséum d'histoire naturelle
C.P. 6434
Genève, 6 Suisse
bernard.landry@mhn.ville-ge.ch

David Larson
Box 56
Maple Creek, SK S-N 1N0
dmlarson@sasktel.net

Dennis Lemkuhl
Department of Biology
University of Saskatchewan
Saskatoon, SK S7N 0W0
dennis.lehmkuhl@usask.ca

Laurent LeSage
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
lesagel@agr.gc.ca

David Lewis
Department of Natural Resource Sciences
McGill University,
21,111 Lakeshore Rd
Ste.-Anne-de-Bellevue, QC H9X 3V9
lewisd@nrs.mcgill.ca

Evert Lindquist
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
lindquiste@agr.gc.ca

Robert Longair
Department of Biological Sciences
University of Calgary
2500 University Dr. N.W.
Calgary, AB T2N 1N4
longair@ucalgary.ca

Patricia MacKay
Department of Entomology
University of Manitoba
Winnipeg, MB R3T 2N2
pa_mackay@umanitoba.ca

Stephen MacLean, Jr.
1925 Lynx Lane
Fairbanks, AK 99709
ffsfm@uaf.edu

Dug Major
Alberta Prairie Conservation Forum
P.O. Box 820
Hanna, AB T0J 1P0
dug.major@ma.gov.ab.ca

Steve Marshall
Department of Environmental Biology
University of Guelph
Guelph, ON N1G 2W1
smarshal@evb.uoguelph.ca

Malcolm Martin
9194 Binns Rd.
Vernon, BC V1B 3B7

Lubomir Masner
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6

Peter Mason
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
masonp@agr.gc.ca

Ernest Mengersen
Horticulture
Olds College
4500 - 50 Street
Olds, AB T4H 1R6
emengersen@admin.oldscollege.ab.ca

James Miskelly
Department of Biology
University of Victoria
P.O. Box 3020, Stn CSC
Victoria, BC V8W 2Y2
j_miskelly@hotmail.com

Vincent Nealis
Canadian Forest Service, Pasific Forestry Centre
Natural Resources Canada
506 W. Burnside Road
Victoria, BC V8Z 1M5
vnealis@nrcan.gc.ca

Wayne Nordstrom
Alberta Natural Heritage Information Centre
9820 - 106 Street
Edmonton, AB T5K 2J6
Wayne.Nordstrom@gov.ab.ca

James O'Hara
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
oharaj@agr.gc.ca

Owen Olfert
Agriculture and Agri-Food Canada
Saskatoon Research Centre
Saskaton, SK S7N 0X2
olferto@agr.gc.ca

Donald Ostaff
Canadian Forest Service
Natural Resources Canada
P.O. Box 4000
Fredericton, New Brunswick E3B 5P7
dostaff@nrcan.gc.ca

Jennifer Otani
Beaverlodge Research Farm
Agriculture and Agri-Food Canada
Box 29
Beaverlodge, AB T0H 0C0
otanij@agr.gc.ca

Laurence Packer
Department of Biology
York University
4700 Keele Street
North York, ON M3J 1P3
bugsrus@yorku.ca

Steve Paiero
Department of Environmental Biology
University of Guelph
Guelph, ON N1G 2W1
spaiero@uoguelph.ca

Ron Panzer
Biology Department
Northeastern Illinois University
16248 S. Grove Ave.
Oak Forest, Illinois 60452

Douglas Parker
Entomology Unit
Canadian Food Inspection Agency
960 Carling Ave
Ottawa, ON K1A 0C6
parkerd@inspection.gc.ca

Stewart Peck
Department of Biology
Carleton University
1125 Colonel By Drive
Ottawa, ON K1S 5B6
stewart_peck@carleton.ca

Rod Penner
Living Prairie Museum
2795 Ness Avenue
Winnipeg, MB R3J 3S4

Greg Pohl
Canadian Forest Service
5320 - 122 Street
Edmonton, AB T6H 3S5
gpohl@nrcan.gc.ca

Darren Pollock
Department of Biology
Eastern New Mexico University
Station #33
Portales, NM 88130
Darren.Pollock@enmu.edu

Bradford Rence
Lawrence University
P.O. Box 599
Appleton, WI 54912-0599

David Rider
Department of Entomology
North Dakota State University
Hultz Hall, Box 5346
Fargo, ND 58105
David_Rider@ndsu.nodak.edu.

Richard Ring
Department of Biology
University of Victoria
Victoria, BC V8W 2Y2
raring@uvic.ca

Keith Roney
Royal Saskatchewan Museum
2340 Albert St.
Regina, SK S4P 3V7
kroney@royalsaskmuseum.ca

Robert Roughley
Department of Entomology
University of Manitoba
214 Animal Science / Entomology Building
Winnipeg, MB R3T 2NT
Rob_Roughley@umanitoba.ca

Colin Schmidt
Grasslands National Park
P.O. Box 150
Val Marie, SK S0N 1Y0

Michael Schwartz
Systematic Entomology
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6

Geoffrey Scudder
Department of Zoology
University of British Columbia
Vancouver, BC V6T 1Z4
scudder@zoology.ubc.ca

Michael Sharkey
Department of Entomology
University of Kentucky
5 - 225 Agricultural Science Center North
Lexington, KY 40546-0091
msharkey@uky.edu

Joseph Shorthouse
Department of Biology
Laurentian University
Sudbury, ON P3E 2C6
jshortho@nickel.laurentian.ca

Ian Smith
Eastern Cereal and Oilseed Research Centre
Agriculture and Agri-Food Canada
Ottawa, ON K1A 0C6
smithi@agr.gc.ca

Cyndi Smith
Waterton Lakes National Park
Parks Canada
Waterton Park, AB T0K 0M0
Cyndi.Smith@pc.gc.ca

Rob Smith
Atlantic Food and Horticulture Research Centre
Agriculture and Agri-Food Canada
32 Main Street
Kentville, Nova Scotia B4N 1J5
smithr@agr.gc.ca

John Spence
Renewable Resources
University of Alberta
Edmonton, AB T6G 2E9
john.spence@ualberta.ca

Felix Sperling
Department of Biological Sciences
University of Alberta
CW405 Biological Sciences Centre
Edmonton, AB T6G 2E9
felix.sperling@ualberta.ca

Anita Stjernberg
University of Manitoba
Department of Entomology
Winnipeg, MB R37 2N2
umstjera@cc.umanitoba.ca

Philip Taylor
Prairie and Northern Wildlife Research Centre
Canadian Wildlife Service
115 Perimeter Road
Saskatoon, SK S7N 0X4

Paul Tinerella
Department of Entomology
North Dakota State University
202 Hultz Hall, University Station
Fargo, ND 58105
Paul_Tinerella@ndsu.nodak.edu.

Alan Tomlin
Southern Crop Protection and Food Research Centre
Agriculture and Agri-Food Canada
1391 Sandford Street
London, ON N5V 4T3
tomlina@agr.gc.ca

W.J. Turnock
28 Vassar Road
Winnipeg, MB R3T 3M9
wturnock@agr.gc.ca

Mary Vetter
Luther College, Biology
University of Regina
3737 Wascana Parkway
Regina, SK S4S 0A2
Mary.Vetter@uregina.ca

David Voegtlin
Center for Biodiversity
Illinois Natural History Survey
Champaign, IL 61820-6970

David Wade
374 Beliveau Road
Winnipeg, MB R2M 1T4
dwade@mb.sympatico.ca

Richard Westwood
Biology Department
University of Winnipeg
515 Portage Ave.
Winnipeg, MB R3B 2E9
r.westwood@uwinnipeg.ca

Terry Wheeler
Department of Natural Resource Sciences
McGill University
Macdonald Campus
21,111 Lakeshore Road
Ste.-Anne-de-Bellevue, QC H9X 3V9
wheeler@nrs.mcgill.ca

Walter Willms
Lethbridge Research Centre
Agriculture and Agri-Food Canada
5403 - 1 Ave. S.
PO Box: PO BOX 3000
Lethbridge, AB T1J 4B1
willms@agr.gc.ca

Barry Wright
791 Herman's Island
RR #1
Mahone Bay, NS B0J 2E0
barrywright@ns.sympatico.ca

Dale Wrubleski
Institute for Wetland and Waterfowl Research
Ducks Unlimited Canada
P.O. Box 1160
Stonewall, MB R0C 2Z0
d_wruble@ducks.ca

Daniel Young
Department of Entomology
University of Wisconsin
1630 Linden Drive
Madison, WI 53706
young@entomology.wisc.edu