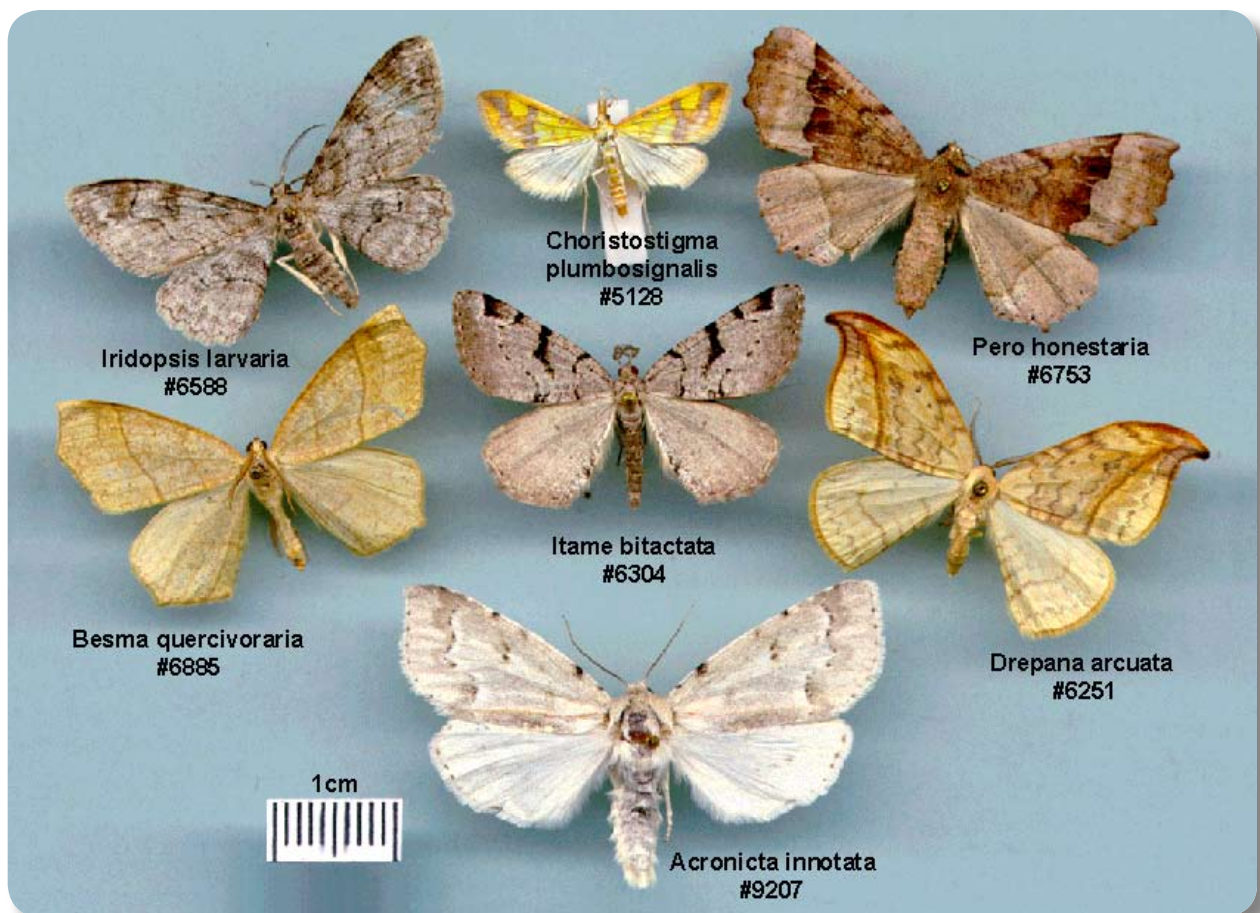




Arthropods of Canadian Forests

Number 3

April 2007

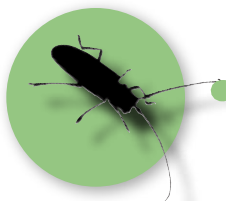


A selection of beautiful Alberta moths (photo by G. Pohl).



Contents

Welcome	3
Contributions	3
Biological Survey of Canada Forest Arthropods Project—Progress Report	4
Report on Bio-Blitz 2006	4
Project Updates	6
Green Tree Retention: A Tool to Maintain Ecosystem Health and Function in Second-Growth Coastal Forests	6
Lepidoptera Faunistics Research in Alberta	10
Diversity and Abundance of Beetles and Other Invertebrates in Three Forests in Eastern Newfoundland	15
Lepidoptera of Holmes Crossing Ecological Reserve	18
Graduate Student Focus	20
The Effect of Ants on Carabid Communities Relative to Vegetation Characteristics at Different Successional Stages after Clearcutting	20
Hierarchical Diversity of Canopy Arthropods in Hardwood Forests of Southern Québec	21
Carabid and Staphylinid Communities as Indicators for the Development of Clumped Retention Applications In Managed Forests	23
News and Events	24
Graduate Student Opportunity	24
Bio-Blitz 2007—Riding Mountain National Park	24
Meeting Announcement	24
New Publications	25



Welcome

Welcome to the third issue of *Arthropods of Canadian Forests*. This newsletter is a product of a collaboration between Natural Resources Canada—Canadian Forest Service and the Biological Survey of Canada (BSC)—Terrestrial Arthropods. The goal of the newsletter is to serve as a communication tool for encouraging information exchange and collaboration among those in Canada who work on forest arthropod biodiversity issues, including faunistics, systematics, conservation, disturbance ecology, and adaptive forest management. As well, the newsletter supports the Forest Arthropods Project of the BSC. This annual newsletter will be distributed electronically (as a pdf file) in early April. If you wish to be placed on the distribution list, please contact David Langor (see below for contact information).

Newsletter content will include project updates (short articles that introduce relevant Canadian projects); feature articles (overviews, summaries, commentaries, or syntheses); a graduate student section featuring brief summaries of thesis research, funding opportunities, employment notices, and other items of interest; brief news articles concerning meetings, symposia, collaboration opportunities, collecting trips, and other activities; and new publications and websites. Please consider submitting items to the *Arthropods of Canadian Forests* newsletter—articles in either official language are welcome. We also welcome comments on how we can improve the content and delivery of this newsletter.

Contributions

Contributions of articles and other items of interest to students of forests and forest arthropods are welcomed by the editor. Submission in electronic format by email or CD is preferred. The copy deadline for the next issue is 31 January 2008.

Editor:

David W. Langor
Natural Resources Canada
Canadian Forest Service
5320-122 Street
Edmonton, AB T6H 3S5
780-435-7330 (tel.)
780-435-7359 (fax)
dlangor@nrcan.gc.ca

Copy Editor: Brenda Laishley

Design and layout: Sue Mayer

Articles appearing in this newsletter without attribution have been prepared by the Editor.

Publisher websites:

Canadian Forest Service: <http://cfs.nrcan.gc.ca>

Biological Survey of Canada: <http://www.biology.ualberta.ca/bsc/bschome.htm>

Cette publication est également disponible en français sous le titre *Arthropodes des forêts canadiennes*.



Biological Survey of Canada Forest Arthropods Project—Progress Report

In 2003, the Biological Survey of Canada (BSC) initiated a new project on arthropod faunistics and systematics related to forested ecosystems. The primary goal of this project is to coordinate research on the diversity, ecology, and impacts of the arthropods of Canadian forests. There has been notable progress with all current activities organized through this project.

Project Database

The BSC continues to maintain and update a list of forest arthropod biodiversity projects in Canada and adjacent parts of the United States (see www.biology.ualberta.ca/bsc/english/forestprojectsummary.htm). This product highlights current activity in Canada and the northern United States and facilitates contact between researchers with complementary interests. As of early 2007, 68 projects were listed. Researchers are encouraged to regularly update their project descriptions and progress and add new projects as they arise. This is a particularly good forum for graduate students to advertise their new work.

Communications

Volume 2 of the *Arthropods of Canadian Forests* newsletter, published in April 2006, was distributed electronically in English and French to almost 200 recipients in 9 countries. The mailing list for the newsletter continues to grow rapidly. In addition, the project web pages (www.biology.ualberta.ca/bsc/english/forests.htm) continue to be maintained and updated.

ualberta.ca/bsc/english/forests.htm) continue to be maintained and updated.

Symposium proceedings

Seven synthesis papers stemming from a BSC-sponsored symposium, entitled "Maintaining Arthropods in Northern Forest Ecosystems," held in 2005, are near completion and will be published in *The Canadian Entomologist* later this year.

Report on Bio-Blitz 2005 (Gros Morne National Park)

The sixth annual BSC Bio-Blitz occurred in Gros Morne National Park, Newfoundland, from 5 to 10 July 2006. A report on this event appears elsewhere in this newsletter.

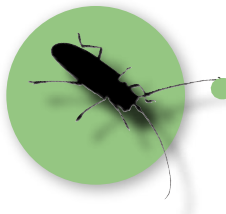
Cerambycidae of Canada and Alaska

A collaboration between the Canadian Forest Service, the US Department of Agriculture Forest Service, Agriculture and Agri-Food Canada, the University of Cape Breton, and the BSC has the goal of producing a handbook to the Cerambycidae (Coleoptera) of Canada and Alaska. All large collections in Canada and Alaska have now been examined, and specimens identified and entered into a database. Revisionary work is near completion for several genera, and other taxonomic work is under way. Many keys have already been developed and some photographs prepared.

Report on Bio-Blitz 2006

The 2006 BSC Bio-Blitz took place in Gros Morne National Park (GMNP) in northwestern Newfoundland from 5 to 10 July. This sixth annual Bio-Blitz was the first to be held in eastern Canada. The eight enthusiastic participants from Alberta, Ontario, and Newfoundland enjoyed the cooperative weather, spectacular scenery, and famous Newfoundland hospitality to collect in many of the interesting habitats in the park (e.g., aquatic systems, wetlands, forest, tuckamore, high elevation subarctic barrens, and the fascinating Tablelands). Most participants were accompanied

by their families who also eagerly joined in the collecting and social activities. Parks Canada (PC) personnel were very generous in providing complimentary park permits, camping sites, maps, helicopter transportation to high elevations, and a wealth of information about the habitats and ecology of the park. Occasionally, several PC employees also eagerly participated in collecting activities. The Newfoundland Department of Environment and Conservation, a co-organizer of the event, was very helpful with local logistics and in providing equipment, supplies and assistance



with deploying traps. The event attracted some positive attention and several radio interviews were conducted. The social highlight of the Bio-Blitz was a reception at the Newfoundland Insectarium, hosted by Lloyd and Sandy Hollett, owners of this magnificent facility (a must-see for anyone visiting Newfoundland) (Figure 1).

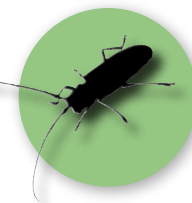
Over the next months participants will be preparing and identifying the many thousands of specimens collected. Entomologists who may be interested in examining specimens should contact David Langor. Data will be contributed to a central database that will be provided to GMNP. Already we are aware of two new mosquito records for the island, and undoubtedly many other exciting discoveries will be made. The

specimens and data collected are contributing to several research programs at universities and colleges and to the BSC project on the terrestrial arthropods of Newfoundland and Labrador. There is much interest from PC employees at GMNP in facilitating continued arthropod surveys in the park. Overall, the 2006 Bio-Blitz was a success in terms of specimen collection, creating public awareness, and forging new partnerships, which bodes well for future arthropod biodiversity work on the island. Special thanks to Shelley Pardy Moores, Bruce Rodriguesa, and Tom Knight.

The 2007 Bio-Blitz will be held in Riding Mountain National Park, Manitoba. See the advertisement in this newsletter.



Figure 1. Enthusiastic participants of Bio-Blitz 2006 gathered in the Newfoundland Insectarium. They are holding the flag of the Biological Survey of Canada. (photo by J. Shorthouse).



Project Updates

Green Tree Retention: A Tool to Maintain Ecosystem Health and Function in Second-Growth Coastal Forests

Jan Addison

School of Environment and Sustainability, Royal Roads University
Victoria, BC V9B 5Y2

Introduction

Clearcutting has been the primary harvesting system applied on the Canadian west coast over the last century, but increasing public demand for forests with multiple uses, including timber, recreation, and nontimber forest products, as well as biodiversity and spiritual values has put pressure on the forest industry to consider alternative harvesting and silviculture practices. Although the use of some form of green tree retention (GTR) harvesting is intuitively appealing, there is currently a lack of reliable scientific data to support decision-making regarding the use of different forms of GTR. This study looks at the biological implications of GTR for the soil system.

Soil organisms play vital roles in decomposition and nutrient cycling and so are critical components of long-term forest sustainability. Green tree retention patches are thought to act as “biological lifeboats” to preserve aspects of the biological communities, foster recolonization, and return to preharvest conditions. Retention of green-tree patches on harvested sites may be of particular benefit to soil organisms, continually replenishing their sources of energy and nutrients from roots and litter. Yet as anyone who has struggled across a clearcut can attest, harvesting leaves behind a mosaic of soil disturbance patterns, ranging from areas that are almost undisturbed, to those consisting of exposed mineral soil. In this study there were four main questions of interest:

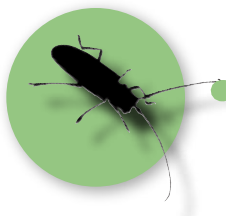
1. Do patches of GTR retain the structure and function of soil biota of the uncut forest?
2. Is there a minimum patch size of GTR necessary to do this?
3. How far does the effect of a GTR patch extend into the harvested area, and does the ‘shadow’ vary with GTR patch size?

4. How does the severity of soil disturbance in cutover areas affect soil faunal communities, and how do soil disturbance and distance from a GTR patch interact?

The study utilizes two replicates of the Silviculture Treatments for Ecosystem Management in the Sayward (STEMS) project, a large-scale, multidisciplinary, replicated experiment that compares forest productivity, economics, and public perception of seven treatments in the Sayward Forest west and north of Campbell River on Vancouver Island, BC. The treatments include five different silvicultural systems: clearcut, patch cut, group selection, aggregate retention, and uniform dispersed retention, which are compared against two extended rotation options (nonharvested controls), with and without commercial thinning. Before harvest the sites were covered with even-aged (60–70 yr) stands of western hemlock (*Tsuga heterophylla* [Raf.] Sarg.) and Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco var. *menziesii*). A full description of the experimental design of the STEMS project is given by de Montigny (2004).

The soil project involves a multidisciplinary group of researchers applying both whole organism studies and a broad range of novel molecular and biochemical analyses to quantify the diversity and interactions of a wide range of soil fauna and microbes. The study involves researchers from UBC (microbes, macrofungi, and mites), the BC Ministry of Forests (macrofungi), and Royal Roads University (nematodes, Collembola and other soil-dwelling arthropods). This update focuses on the Collembola and other arthropods.

Our soil study is being carried out at two sites: STEMS 1 (harvested in 2001) and STEMS 2 (harvested in 2004) and involves a subset of the available treatments. Since we always sampled



in late October when it was always rainy, we were surprised to find that both sites are located in the Very Dry Maritime Subzone of the Coastal Western Hemlock Biogeoclimatic Zone (Green and Klinka 1994). The soil project is funded by the BC-FIA Forest Science Program. International Forest Products, Ltd. provided the field site and has covered the design, road construction, and logging costs at STEMS 2.

Methods

STEMS 2 was sampled before harvest, with samples taken from the areas designated to be unharvested controls, clearcuts, or 'aggregated retention' (AR) harvested areas. The AR treatments were to be harvested leaving circular GTR patches of 5, 10, 20 and 40-m diameter, with four replicates of each patch size. Preharvest soil samples were collected at what was designed to be the center of the patch, the northern edge of the patch, and at 30 m north of the edge of the patch. The sampling was repeated postharvest, but in addition, samples were also taken at 10, and 20 m from the edge of each retention patch. The 5-year postharvest samples (STEMS 1) were taken as described above from uncut controls, clearcut, and AR (20-m diameter patch size only). In addition 4 trees were selected in an area of dispersed retention (DR), and samples were taken immediately beside the tree and at distances of 10, 20 and 30 m north of the tree.

The soil mesofauna (mites, collembolans, and pauropods) were obtained using high-gradient extraction from soil cores (Figure 2) that included



Figure 2. Soil cores placed in a High Gradient extractor (photo by J. Addison).

the entire depth of the forest floor (LFH layers) and the upper 3 cm of mineral soil. Larger elements of the soil fauna (large oligochaete worms, millipedes, symphylans, centipedes, and soil-dwelling beetles, and fly larvae) were obtained from soil blocks (15 × 15 × 6 cm) that were first hand-sorted, and then half of the material was extracted using large Tullgren funnels. Prior to being processed in the laboratory, the degree of disturbance of each core or soil block was assessed.

Extracted specimens were sorted and categorized into taxonomic groupings using a dissection microscope. Collembola and pauropods were cleared and examined under high power phase contrast microscopy (Figure 3). A series of reference slides were prepared, and additional reference material has been stored in 95% alcohol.



Figure 3. *Friesea millsii*, a predaceous collembolan, cleared and mounted on a slide for identification. Actual size ~0.75 mm (photo by S. Berch).

Preliminary Results

Preharvest fauna (STEMS 2)

Vancouver Island is one of the few areas in Canada where native earthworms occur, and in addition, coastal rainforests are also known to contain a very large species of enchytraeid worm (~10 cm in length). The main purpose of the soil blocks was to investigate whether these unique oligochaetes were present at the site. Although a single individual of a native earthworm species (*Toutellus* sp.) was found in a riparian zone beside the study site, no earthworms (either native



or exotic) were found at STEMS 2. However, a combination of data from the soil blocks and cores allowed us to determine preharvest densities of several groups of larger, more mobile arthropods in addition to the collembolan and mites that were the main focus of the study.

The myriapods were very well represented at the site with an average of 82 millipedes, 372 centipedes, and 1 300 symphylans per square metre of forest floor. By far the most abundant millipede at the site was a relatively small species of the family Parajulidae. Only a single (immature) individual of a large polydesmid millipede and 3 immature polyxenid millipedes were collected. Pauropods, which are small, fragile relatives of the centipedes and millipedes, were especially abundant at this site, giving a mean abundance of 3 637 individuals per square metre. Very little is known about the taxonomy or ecology of pauropods in Canada. In fact until 1982, it was assumed that pauropods did not even occur in Canada (Tomlin 1982). The mean population density of this group in the LFH layer was higher than values reported by Petersen (1982) for this group in a variety of temperate and tropical ecosystems, where usual values ranged from between a few hundred to about 2 000 individuals per square metre. More recently Hågvær and Scheller (1998) reported a mean density of 1 780 individuals per square metre for a coniferous forest site in Norway, where only a single species of Pauropoda occurred. At STEMS 2 there are at least 3 different species in 3 different genera (*Stylopauropus*, *Allopauropus*, and *Aletopauropus*). The occurrence of large numbers of this group in preharvest samples is significant because pauropods are considered to be extremely sensitive to environmental change (Scheller 1990) and, therefore, may prove to be valuable bioindicators of soil conditions. Another unusual group of invertebrates encountered in the soil were the copepods, which are usually considered to be aquatic crustaceans.

Forty-two species of Collembola were identified from the LFH layer. Of these, 18 were also present in the mineral horizon. No species was exclusive to the mineral soil, which contained <5 % of the total collembolan population. Three species, *Agraporhura eisi* (Rusek), *Tetracanthella pacifica* Rusek and Marshall, and *Tullbergia vancouverica* (Rusek),

may be endemic to Vancouver Island. The effect of harvesting on these three putatively endemic species, as well as on a species of *Cryptopygus* restricted to the lowest depths in the LFH layer, is of particular concern.

One-year postharvest (STEMS 2)

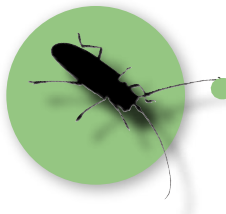
Preliminary analyses of fauna collected from the soil cores (Collembola and pauropods) and the larger arthropods from the Tullgren samples indicated there was no clear relationship between the abundance of most of the faunal groups and either the size of the patch, or the location along the sampling transect. The degree of disturbance of the soil from which the fauna was extracted was a significant determinant of abundance for almost all the groups tested. As almost all the soil samples taken from the center or edge of a leaf patch were minimally disturbed, these areas also tended to have the highest populations of fauna. However, with few exceptions, there were no significant differences in population density between areas of undisturbed forest floor in harvested sites and unharvested retention patches.

Of all the groups tested, the Symphyla appeared to have the most stringent requirements for undisturbed soil. Some groups (symphylans, diplurans, and parajulid millipedes) did not occur in the most disturbed samples. On the other hand, fly larvae were abundant in disturbed soil—indeed significantly more abundant than in samples with an undisturbed organic layer.

It, therefore, appears that, at least immediately following harvesting, populations of most of the soil Collembola and other soil-dwelling mesofauna are influenced more by the amount of disturbance of the forest floor, than by the influence of living trees.

5-years postharvest (STEMS 1)

High numbers of the exotic earthworm species *Aporrectodea trapezoides* (Dugès) (~120 individuals per square metre) were found in highly disturbed areas of clearcuts. Although no earthworms were found in the cores or the soil blocks taken from the nearby unharvested controls, some earthworm casts were found, and a 5-minute search yielded several individuals of *A. trapezoides* and *Lumbricus rubellus* Hoffmeister at the two control sites nearest



the road. Two immature earthworms (*Aporrectodea* sp.) were extracted from soil blocks taken in the DR treatment. No earthworms were found in the AG treatments; nor were there signs of earthworm casts at this site.

The presence of exotic earthworms at STEMS 1 will complicate the analysis and interpretation of the impacts of the harvesting treatments on the soil system. Other studies have shown that the invasion of exotic earthworms into forested sites greatly impacts the soil's physical, chemical, and biological properties (e.g., Groffman et al. 2004; Bohlen et al. 2004).

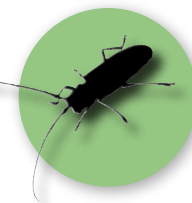
Of the 39 Collembola species found at this site, 29 also occurred at STEMS 2. Of the 4 species initially considered to be of concern, *Agraphorura eisi* and *Tullbergia vancouverica* (with the exception of a single individual) were found only in the unharvested control site at STEMS 1. Neither species was present in the GTR patches. No individuals of *Tetracanthella pacifica* were found at STEMS 1. The *Cryptopygus* sp. is common and prefers some mineral soil mixed with the organic matter (as occurs in the deepest layer of the LFH in unharvested sites), a condition that is ubiquitous following harvesting.

Future Plans

Counting and identification of the fauna collected in the first 2 years of the study is more or less complete. We are now working on samples from the third (and final) year. Data analyses are in progress, and we hope to have several papers submitted for publication within the next year.

Literature Cited

- Bohlen, P.J.; Scheu, S.; Hale, C.M.; McLean, M.A.; Migge, S.; Groffman, P.M.; Parkinson, D. 2004. Non-native invasive earthworms as agents of change in northern temperate forests. *Front. Ecol. Environ.* 2: 427–435.
- De Montigny, L.E. 2004. Silvicultural treatments for ecosystem management in the Sayward (STEMS): establishment repost for STEMS 1, Snowden Demonstration Forest. BC Minist. For., Res. Branch, Victoria BC, Tech. Rep. 017.
- Green, R.N.; Klinka, K. 1994. A field guide to site identification and interpretation for the Vancouver Forest Region. BC Minist. For., Victoria, BC, Land Manag. Handb. 28.
- Groffman, P.M.; Bohlen, P.J.; Fisk, M.C.; Fahey, T.J. 2004. Exotic earthworm invasion and microbial biomass in temperate forest soils. *Ecosystems* 7: 45–54.
- Hågvar, S.; Scheller, U. 1998. Species composition, developmental stages and abundance of Pauropoda in coniferous forests soil of southeast Norway. *Pedobiologia* 42: 278–282.
- Petersen, H. 1982. Structure and size of soil animal populations. In Petersen, H.; Luxton, M. (eds.), *Quantitative ecology of microfungi and animals in soil and litter*. *Oikos* 39: 306–329.
- Scheller, U. 1990. Pauropoda. Pages 861–890 in Dindal, D.L. (ed.), *Soil biology guide*. John Wiley and Sons, New York.
- Tomlin, A. 1982. Pauropoda (Arthropoda: Myriapoda) do occur in Canada. *Can. Entomol.* 114: 655–656.



Lepidoptera Faunistics Research in Alberta

Greg R. Pohl

Natural Resources Canada, Canadian Forest Service
5320 – 122 Street, Edmonton, AB T6H 3S5

Introduction

Alberta is one of the best-known provinces of Canada in terms of its Lepidoptera fauna, thanks to a long tradition of faunistics research on the group. Here I review the history of Lepidoptera faunistics research in Alberta, and discuss the current state of knowledge, with particular emphasis on the forested regions of the province. Much of this information will be published in an annotated checklist of the Lepidoptera of Alberta, currently in the final stages of preparation by the author, G.G. Anweiler, B.C. Schmidt, and N.G. Kondla. In that forthcoming checklist, we will include a list of all the species of butterflies and moths known to occur in the province of Alberta, along with unconfirmed records, species that are likely to occur here, and those that have been reported in error. It will also include a general indication of the natural areas in which each species has been found, the peak adult flight times, and additional taxonomic, nomenclatural, distributional and biological notes. That information has been gathered from publications and from local and national collections. The checklist will also provide references to the taxonomic literature as an aid to identifying specimens and obtaining further information. We hope that the list will serve as a baseline measure of the province's Lepidoptera diversity before the effects of resource development, habitat loss and degradation, and other human impacts such as climate change become more pronounced.

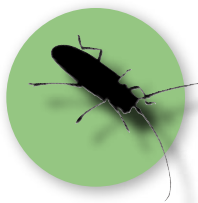
Historical Research on Lepidoptera in Alberta

The first documented collection of Lepidoptera made in present day Alberta was a series of butterfly specimens collected in the Jasper area by Edward Burke in 1844. Six specimens ended up as type specimens for species described by Edward Doubleday. In 1883, J. Gamble Geddes published the first list of Alberta Lepidoptera (Geddes 1883), based on butterflies he had collected that year while traveling through Alberta (then part of the Northwest Territories). He returned the next

year and published two papers with additional information (Geddes 1884a, b). Several other travelers are known to have collected Lepidoptera in the late 1800s, but Thomas E. Bean (1844–1931), a telegrapher with the Canadian Pacific Railway, was probably the first resident Lepidopterist in Alberta. He lived at Laggan (now Lake Louise) for several years.

The first major resident Lepidopterist in Alberta was Wolley Dod (1871–1919), an independently wealthy Englishman who emigrated to the Calgary area in 1893. He was a bona fide amateur, largely self-trained and self-motivated in entomology. He lived for 2 years on his brother's homestead at the head of Fish Creek, southwest of Calgary, before setting up his own homestead at the head of Pine Creek. He collected extensively around his home and published a checklist of the macrolepidoptera of Alberta, as a series of papers in *The Canadian Entomologist*, between 1901 and 1906 (Dod 1901a, b, 1904, 1905a, b, c, d, e, f, 1906a, b, c). This was followed by further notes and updates published between 1908 and 1915 (Dod 1908, 1914, 1915a, 1915b, 1915c; see Harper 1979 for a complete bibliography). He was acquainted with several other local collectors, and was a founding member of the short-lived North-West Entomological Society (founded in Lacombe in 1898), which evolved into the Red Deer River Naturalists. In 1912, Dod hired W.H.T. Tams (later to be employed by the British Museum) as a personal entomological assistant. In 1917, Dod joined the army, fought in World War I, and died of dysentery in Macedonia in 1919.

The first professional entomologist in Alberta was Edgar H. Strickland, who came to the Agriculture Research Station in Lethbridge in 1912. He was originally hired to deal with an outbreak of Pale Western Cutworm (*Agrotis orthogonia*) but went on to deal with various other agricultural insect problems before becoming the founding professor of the Department of Entomology at the University of Alberta, in Edmonton, in 1922. He taught there until his retirement in 1954.



The second major resident lepidopterist in Alberta was Kenneth Bowman (Figure 4; 1875–1955), a chartered accountant who lived in Edmonton and collected throughout the province. Born in England, Bowman came to Alberta in 1904, and collected Lepidoptera in Alberta from the time of his arrival in the province until shortly before his death 50 years later. He collected extensively at his home on a wooded ravine in Edmonton, as well as other places around Alberta. Initially, he focused on butterflies, but by about 1920 he turned his attention to the macromoths, and later (about 1925) he began collecting micromoths as well. He published an update to Dod's checklist in 1919 (Bowman 1919), and further updates over the next 25 years. These initially dealt with butterflies, macromoths, and only the largest micromoths. However, he amassed a large collection of micromoths over many years, sending them off to specialists for identification. In 1951 he compiled all this information in a comprehensive checklist of Alberta Lepidoptera (Bowman 1951). It was among the most comprehensive regional North American checklists of the time. After his death, his widow sold his collection to the University of Alberta, where it resides today.



Figure 4. Kenneth Bowman and friend (photo courtesy of J. Acorn)

Another early resident entomologist was W. Clayton McGuffin. He worked at the Calgary laboratory of the Canadian Forest Service (CFS) from the time it opened in 1948 until 1962. He then moved to Ottawa to work in the Canadian National Collection (CNC). He published many papers on Lepidoptera larvae and adults, particularly in the family Geometridae. While in Calgary, McGuffin was the head of the Forest Insect and Disease Survey (FIDS), a project of the CFS that had several forest rangers collecting and rearing forest insects all over Canada each year from 1948 to 1962. This resulted in many host records, and thousands of Alberta specimens, which are deposited in the CFS collection (now in Edmonton) and the CNC. The forest Lepidoptera of Canada recorded by FIDS are summarized by McGugan (1958) and Prentice (1962, 1963, 1965). They include host plant information and range maps for many tree-feeding species.

Between the time of Bowman and about 1990, most Lepidoptera research consisted of applied work. Since then, aided by major improvements to trapping equipment (Figure 5) and the road network, there has been a resurgence in taxonomic and faunistics work. In 1993, Edmonton naturalist John Acorn published *Butterflies of Alberta*, a field guide featuring about 80 of the more common Alberta butterfly species. In 1995, Charles Bird, Gerald Hilchie, Norbert Kondla, Ted Pike, and Felix Sperling published *Alberta Butterflies*, a comprehensive guide treating 177 species in detail. In 1999, Felix Sperling joined the University of Alberta; he oversaw the rejuvenation of the Lepidoptera collection in the Strickland Museum there and launched the Virtual Museum (<http://www.entomology.ualberta.ca/index.html>) a website with species-level information and images. Also in 1999, a number of amateur and professional entomologists with an interest in Lepidoptera formed the Alberta Lepidopterists' Guild (ALG). The group has a website (http://www.biology.ualberta.ca/old_site/uasm//alg/index.html) and maintains a list-server for its members. ALG organizes local events and gatherings, and offers small annual bursaries intended to support amateur Lepidoptera research.



Figure 5. A primitive light trap (image courtesy of Agriculture and Agri-Food Canada, Lethbridge Research Station).

(Christensen 2006; Macaulay 2006; Macaulay and Pohl 2002, 2003, 2005; (Downing and Pettapiece 2006) Pohl et al. 2004, 2006; Schmidt 2001; Schmidt and Pohl 2001; Schmidt et al. 2004). The Grasslands Ecoregion is moderately well-known, because of historical work by researchers at Agriculture and Agri-Food Canada's Lethbridge Research Station, and more recently by G.G. Anweiler (2006). The Rocky Mountain Ecoregion, with its diverse range of habitats, remains the most poorly known ecoregion. Thanks to the collecting efforts of so many avid Lepidopterists, the fauna of Alberta is among the best surveyed in Canada. This rich history of faunistics work provides a solid foundation on which to develop a detailed understanding of the biology of Lepidoptera in our province.

Current State of Knowledge

The numbers of species known to occur in Alberta has increased dramatically over the past century (Table 1). At present, 2283 Lepidoptera species, in 59 families, are known to occur in Alberta. Overall, this is 17.4% of the known North American Lepidoptera fauna of approximately 14 000 species, and 1.35% of the known global fauna of approximately 140 000 species.

Alberta is a diverse landscape, divided into six ecoregions (Figure 6). Our knowledge of Alberta Lepidoptera varies from region to region and among taxonomic groups. Butterflies occurring in Alberta have been more thoroughly documented, although new species continue to be found, with 16 species added in the past decade. In recent years, about 15 moth species have been discovered annually in Alberta. Many specimens remain unidentified in collections, particularly among the Microlepidoptera, where many represent undescribed species. The most poorly known groups are micromoths in the superfamily Gelechioidea.

Overall the Parkland Ecoregion is the best known, thanks to the historical collecting of Dod and Bowman, and recent inventory work, particularly by Dr. Charles Bird (unpublished reports available on the ALG website). The Boreal Ecoregion and Canadian Shield Ecoregion are relatively well-known owing to FIDS work and recent biodiversity and inventory projects

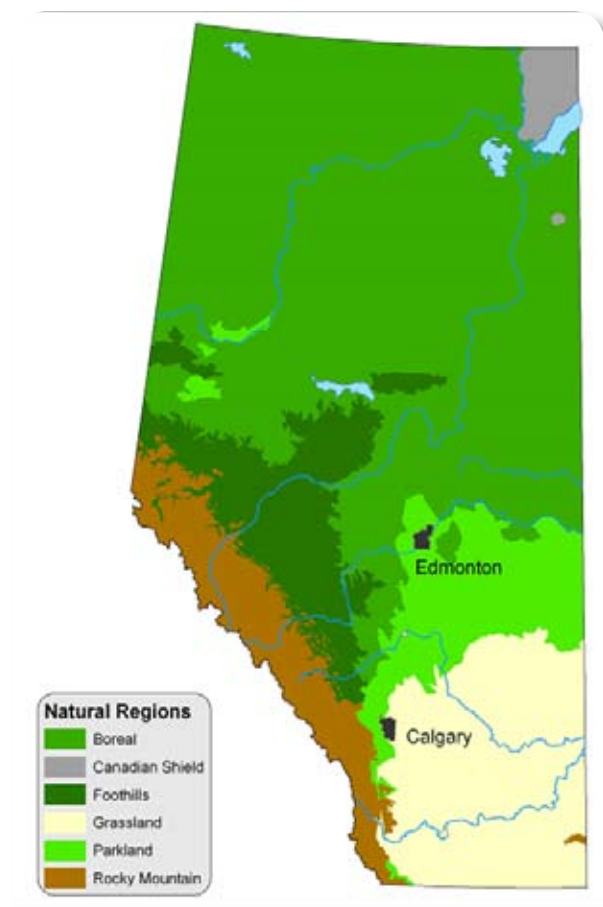
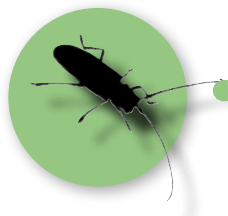


Figure 6. Natural regions and subregions of Alberta, modified from Natural Regions Committee (2006).


Table 1. Comparison of historical lists of Alberta Lepidoptera to the current list of valid species

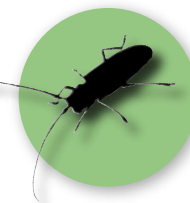
Alberta Lepidoptera	Dod (1901–1915)	Bowman (1951)	Bird et al. (1995)	Current list
Micromoths	9	645	-- ^a	1003
Butterflies	108	145	160	180
Macromoths	567	880	--	1101
Total	684	1670	160	2284

^aDashes indicate not reported.

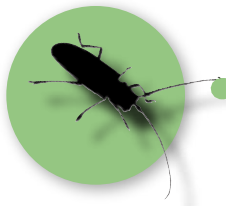
Note: Dod's list takes into account the original list (1901–1906) as well as species added in a number of updates (1908–1915). Numbers of species in the Dod and Bowman lists include species considered valid at the time of publication but are currently junior synonyms.

Literature Cited

- Acorn, J. 1993. *Butterflies of Alberta*. Lone Pine Publishing, Edmonton, AB. 141 p.
- Anweiler, G.G. 2006. Summary results of the Alberta grasslands moth surveys. Prepared for the Alberta Lepidopterists Guild. Edmonton, AB. Add place of publ., Unpubl. Rep. 30 p. Accessed 30 May 2007. http://www.biology.ualberta.ca/old_site/uasm//alg/projects/inventory_faunal.html.
- Bird, C.D.; Hilchie, G.J.; Kondla, N.G.; Pike, E.M.; Sperling, F.A.H. 1995. *Alberta butterflies*. Prov. Mus. Alta. Edmonton, AB. 349 p.
- Bowman, K. 1919. Annotated checklist of the macrolepidoptera of Alberta. *Alta. Nat. Hist. Soc., Red Deer, AB.* 16 p.
- Bowman, K. 1951. An annotated list of the Lepidoptera of Alberta. *Can. J. Zool.* 29:121–65.
- Christensen, B.C. 2006. Collection of Lepidoptera at Moose Lake Provincial Park in 2005. Prepared for the Alberta Lepidopterists' Guild, Vegreville, AB. Unpubl. Rep. 10 p. Accessed 24 April 2007. http://www.biology.ualberta.ca/old_site/uasm//alg/projects/inventory_faunal.html.
- Dod, F.H. 1901a. Preliminary list of macro-lepidoptera of Alberta, N.W.T. *Can. Entomol.* 33: 40–42.
- Dod, F.H. 1901b. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 33: 157–172.
- Dod, F.H. 1904. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 36: 345–355.
- Dod, F.H. 1905a. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 17–28.
- Dod, F.H. 1905b. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 49–60.
- Dod, F.H. 1905c. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 145–156.
- Dod, F.H. 1905d. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 173–184.
- Dod, F.H. 1905e. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 221–230.
- Dod, F.H. 1905f. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 37: 241–252.
- Dod, F.H. 1906a. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 38: 45–54.
- Dod, F.H. 1906b. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [continued]. *Can. Entomol.* 38: 89–94.
- Dod, F.H. 1906c. Preliminary list of macro-lepidoptera of Alberta, N.W.T. [concluded]. *Can. Entomol.* 38: 253–267.
- Dod, F.H. 1908. Further notes on Alberta Lepidoptera. *Can. Entomol.* 40:181–193.
- Dod, F.H. 1914. Further notes on Alberta Lepidoptera. *Can. Entomol.* 46:393–403.
- Dod, F.H. 1915a. Further notes on Alberta Lepidoptera. *Can. Entomol.* 47:1–8.
- Dod, F.H. 1915b. Further notes on Alberta Lepidoptera, with description of a new species. *Can. Entomol.* 47: 33–42.
- Dod, F.H. 1915c. Further notes on Alberta Lepidoptera. *Can. Entomol.* 47:122–134.



- Downing, D.J.; Pettapiece, W.W., compilers. 2006. Natural Regions and Subregions of Alberta. Natural Regions Committee. Edmonton, AB. Publ. No. T/852. 264 p.
- Geddes, J.G. 1883. List of diurnal Lepidoptera collected in the North-West Territory and the Rocky Mountains. *Can. Entomol.* 15: 221–223.
- Geddes, J.G. 1884a. List of diurnal Lepidoptera collected in the North-West Territory and the Rocky Mountains, during the season of 1883, with localities. *Can. Entomol.* 16: 56–57.
- Geddes, J.G. 1884b. List of diurnal Lepidoptera collected in the North-West Territory and the Rocky Mountains, season of 1884, with localities. *Can. Entomol.* 16: 224.
- Harper, A.M. 1979. A bibliography of Alberta Entomology 1883–1977. *Alta. Agric., Lethbridge, AB.* 101 p.
- Macaulay, A.D. 2006. Survey of the Lepidoptera fauna from the Holmes Crossing Sandhills Ecological Reserve, the Fort Assiniboine Sandhills Wildland Park, and nearby areas. Unpubl. Rep. 26 p. Accessed 25 April 2007. http://www.biology.ualberta.ca/old_site/uasm//alg/projects/inventory_faunal.html.
- Macaulay, A.D.; Pohl, G.R. 2002. Survey of Lepidoptera in the Canadian shield ecoregion of northeastern Alberta II, 2001 survey of La Butte Creek and Fidler/Greywillow Wildland Parks. Prepared for the Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development. Unpubl. Rep. 61 p.
- Macaulay, A.D.; Pohl, G.R. 2003. Survey of Lepidoptera in the Canadian Shield Ecoregion of northeastern Alberta III, 2002 Survey of Colin-Cornwall Lakes Wildland Park. Prepared for the Alberta Natural Resources Service and Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development. Unpubl. Rep. 44 p.
- Macaulay, A.D.; Pohl, G.R. 2005. Survey of the Lepidoptera fauna in Birch Mountains Wildland Provincial Park. Prepared for Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development. Unpubl. Rep. 13 p. + Appendixes.
- McGugan, B.M. 1958. Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Volume 1: Papilionidae to Arctiidae. *Can. Dep. Agric., For. Biol. Div. Ottawa, ON. Publ.* 1034. 76 p.
- Pohl, G.R.; Langor, D.W.; Landry, J.-F.; Spence, J.R. 2004. Lepidoptera from the boreal mixedwood forest in east-central Alberta: comparison of assemblages from a mature and an old stand. *Nat. Resour. Can., Can. For. Serv., North. For. Cent., Edmonton, AB. Inf. Rep. NOR-X-396.* 21 p.
- Pohl, G.R.; Langor, D.W.; Landry, J.-F.; Spence, J.R. 2006. Lepidoptera of the Boreal Mixedwood Forest near Lac La Biche, Alberta, including new provincial records. *Can. Field-Nat.* 118: 530–549.
- Prentice, R.M. 1962. Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Volume 2: Nycteolidae, Notodontidae, Noctuidae, Liparidae. *Can. Dep. For., For. Entomol. Pathol. Branch, Ottawa, ON. Bull.* 128. P. 77–281.
- Prentice, R.M. 1963. Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Volume 3: Lasiocampidae, Drepanidae, Thyatiridae, Geometridae. *Can. Dep. For., For. Entomol. Pathol. Branch, Ottawa, ON. Publ.* 1013, P. 282–543.
- Prentice, R.M. 1965. Forest Lepidoptera of Canada recorded by the Forest Insect Survey, Volume 4: Microlepidoptera. *Can. Dep. For., Ottawa, ON. Publ.* 1142. P. 544–840.
- Schmidt, B.C. 2001. Biology of the forest tent caterpillar at low population densities. M.Sc. thesis. Univ. Alberta, Edmonton, AB. 171 p.
- Schmidt, B.C.; Pohl, G.R. 2001. Butterflies and moths (Lepidoptera) of the Canadian Shield Ecoregion of Alberta I, Preliminary survey of the Richardson Dunes, Maybelle River, and Marguerite Crag and Tail Wildland Parks. Report prepared for Natural Resource Service, Alberta Environment. 24 p.
- Schmidt, B.C.; Macaulay, A.D.; Pohl, G.R. 2004. Survey of Lepidoptera in the Sub-arctic Ecoregion of northeastern Alberta. I. 2003 Survey of Caribou Mountains Wildland Park. Prepared for the Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development. Edmonton, AB. Unpubl. Rep. 18 p. + appendixes. Accessed 25 April 2007. http://www.biology.ualberta.ca/old_site/uasm//alg/projects/inventory_faunal.html.



Diversity and Abundance of Beetles and Other Invertebrates in Three Forests in Eastern Newfoundland

Barry Hicks
College of the North Atlantic
4 Pike's Lane, Carbonear, NL A1Y 1A7

Introduction

Arthropods, especially beetles, are often used as bioindicators of environmental change in various terrestrial habitats (Rainio and Niemelä 2003). Within boreal habitats, the impact of forest management on diversity and abundance of arthropods (especially carabid beetles) has received increasing attention (e.g., Saint-Germain et al. 2005; Jukes et al. 2001). Relatively little is known about the Coleoptera assemblage structure of boreal forests in Newfoundland, nor about the impacts of forest practices on the fauna. To help build a knowledge base, I undertook a study to compare the diversity and abundance of Coleoptera in three different forest cover types in eastern Newfoundland.

Methods

The three forest cover types (pine, larch, and spruce) were located in the Conception Bay North area of the Avalon Peninsula in eastern Newfoundland. The three forest types (one stand of each) were located in close proximity to each other. The pine stand was dominated with jack pine (*Pinus banksiana* Lamb.), which is not native to Newfoundland. The site is located near the town of Tilton. The site was initiated in 1949 with the planting of 150 000 Scots pine (*Pinus sylvestris* L.), red pine (*Pinus resinosa* Ait.), and jack pine seedlings. The poor growth form of the stems resulted in no merchantable trees, so the trees were made available for firewood. Today, only jack pine remains on the site. The larch forest was located 2 km to the southwest of the pine forest and was dominated by eastern larch (*Larix laricina* [Du Roi] K. Koch). The spruce forest was situated 4 km north-east of the pine forest and was dominated by black spruce (*Picea mariana* [Mill.] BSP).

In each forest stand, two 100-m transects were randomly established in the middle of the forest stand, forming an "L" shape. In each transect, pitfall traps (Figure 7) were placed at 10-m intervals along the transect with the first 5 traps along a north-south line and five pitfall traps along an east-west

line. Each forest had a total of 20 pitfall traps. The traps consisted of plastic cups (8-cm diameter at the rim) containing soapy water, shielded with a Styrofoam rain cover. Traps were emptied weekly from 6 June to 8 August 2003. In each stand, air temperature, soil temperature, relative humidity, and soil moisture were measured weekly. Stands were also assessed for percentage canopy cover, understory vegetation, stand age, litter depth, and tree density.



Figure 7. Barry Hicks attending a pitfall trap in the jack pine forest near Tilton, Newfoundland (photo by B. Hicks).

Results and Discussion

There were no significant differences among sites for air temperature, soil temperature, and relative humidity. The pine forest had the lowest density of trees (1164 trees per hectare), the youngest average age (21 yr), and the highest diversity and abundance of understory vegetation. The larch forest had a tree density of 3045 trees per hectare, an average age of 25 years, and a high diversity and abundance of understory vegetation. The spruce forest was 39 years old and had 8862 trees per hectare, the lowest plant diversity (with a typical carpet of bryophytes), the wettest soil, and the thickest litter layer.

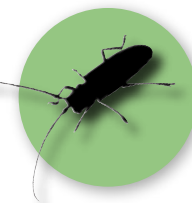
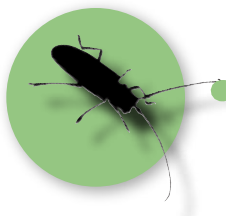


Table 2. Abundance of Coleoptera collected in pitfall traps from three forest types in eastern Newfoundland

Species	Family	Pine	Larch	Spruce
<i>Sphaeroderus lecontei</i>	Carabidae	3		
<i>Syntomus americanus</i>	Carabidae	2		
<i>Bembidon lampros</i> *	Carabidae		2	
<i>Bembidon wingatei</i>	Carabidae			3
<i>Carabus nemoralis</i> *	Carabidae	5	34	
<i>Notiophilus biguttatus</i> *	Carabidae		4	5
<i>Pterostichus coracinus</i>	Carabidae	54	132	38
<i>Pterostichus punctatissimus</i>	Carabidae			8
<i>Pterostichus strenuus</i> *	Carabidae			1
<i>Clivina fossor</i> *	Carabidae		2	
<i>Harpalus rufipes</i> *	Carabidae		1	
<i>Hylobius congener</i>	Curculonidae	18	6	1
<i>Hylobius pinicola</i>	Curculonidae			2
<i>Otiorhynchus singularis</i> *	Curculonidae	12	27	
<i>Otiorhynchus porcatus</i> *	Curculonidae	1		1
<i>Otiorhynchus sulcatus</i> *	Curculonidae		2	
<i>Otiorhynchus ovatus</i> *	Curculonidae		1	
<i>Pissodes nemorensis</i>	Curculonidae	1		
<i>Strophosoma melanogrammum</i> *	Curculonidae	4	44	3
<i>Nemocestes horni</i>	Curculonidae		1	3
<i>Barypeithes pellucidus</i> *	Curculonidae			2
<i>Agriotes limosus</i>	Elateridae	1	1	
<i>Agriotes fucosus</i>	Elateridae		2	
<i>Ctenocera falsifica</i>	Elateridae			1
<i>Ctenocera nitidula</i>	Elateridae		1	
<i>Sericus brunneus</i>	Elateridae			1
<i>Hypnoides bicolor</i>	Elateridae		2	
<i>Nicrophorus defodiens</i>	Siphidae	24	15	17
<i>Nicrophorus vespilloides</i>	Siphidae	4	6	
<i>Nicrophorus sayi</i>	Silphidae	2		1
<i>Syneta ferruginea</i>	Chysomelidae		2	
<i>Chrysolina staphylea</i> *	Chysomelidae			1
<i>Neoscutopterus horni</i>	Dytiscidae			1
<i>Catops basilaris</i>	Leiodidae	4	2	1
<i>Cicindela longilabris</i>	Ciccindellidae		1	
<i>Dryocoetes affaber</i>	Scolytidae			2
<i>Xestoleptura tibialis</i>	Cerambycidae			1
<i>Ontholestes cingulatus</i>	Staphylinidae		1	
<i>Podabrus</i> sp.	Cantharidae		1	1
Abundance		135	290	94
Number of species		14	23	21
Number of restricted		3	11	11

Note: Species marked with * represent introduced species from Europe.



The greatest abundance and number of species of beetles occurred in the larch forest, followed by the spruce forest and then the pine forest (Table 2). I was surprised to find that the pine forest had the lowest number of species of Coleoptera (14 species). Much of the literature suggests that open forested areas normally have higher abundance and species richness than dense stands (for example see Jukes et al. 2001); however, the pine site had the lowest density of trees of the three stands studied. The pine site had significantly more chilopods than the other stand types (Table 3), and they may have competed with or preyed upon the beetles in the forest. More carrion beetles (Silphidae) were collected from the pine site than from other sites, and this may reflect the higher abundance of slugs in traps in the pine stand (Table 3), as rotting slugs are attractive to these beetles.

Table 3. Mean weekly abundance of selected invertebrates sampled by pitfall traps in pine, larch, and spruce forests of eastern Newfoundland

Taxon	Pine	Larch	Spruce
Slugs	59.4a	28.1b	33.1b
Isopoda	35.3a	37.3a	10.7b
Arachnida (spider)	97.7a	108.9a	79.0a
Chilopoda	7.2a	1.7b	2.2b
Diplopoda	1.7a	2.8a	47.4b

Note: For each taxon, means followed by the same letter are statistically nonsignificant at $\alpha = 0.05$.

The larch forest had the greatest abundance of beetles and highest species richness (23 species) (Table 2). This site had the greatest diversity of vegetation and thus a greater diversity of microhabitats, habitats, and food items. The larch forest also had the lowest abundance of slugs and chilopods.

I predicted that the spruce forest would have the lowest number of species because of the high tree density, high percentage canopy cover, and low diversity of understory vegetation. Instead, it had the second highest species richness (21 species) of Coleoptera, but it had the lowest abundance among the three forests studied. This site also supported the greatest number of millipedes, which may be related to the deep litter layer.

Finally, the number of carabid species (11) collected in the three forests was very much lower than expected. As well, six of the 11 species are known to be introduced species from Europe. The Conception Bay North area has a long association with European settlers going back some 400 years. The introduction of carabid species to the area and their establishment in local habitats is shown in this study. It is important to further investigate the diversity of carabid beetles in this area to see what impact they have had on the native beetle fauna.

Literature Cited

- Jukes, M.R.; Peace, A.J.; Ferris, R. 2001. Carabid beetle communities associated with coniferous plantations in Britain: the influence of site, ground vegetation and stand structure. *For. Ecol. Manag.* 148: 271–286.
- Rainio, J.; Niemelä, J. 2003. Ground beetles (Coleoptera; Carabidae) as bioindicators. *Biodivers. Conserv.* 12: 487–506.
- Saint-Germain, M.; Larrivée, M.; Drapeau, P.; Fahrig, L.; Buddle, C.M. 2005. Short-term response of ground beetles (Coleoptera: Carabidae) to fire and logging in a spruce-dominated boreal landscape. *For. Ecol. Manag.* 212: 118–126.



Lepidoptera of Holmes Crossing Ecological Reserve

Doug Macaulay, P.Ag. P.Biol., Woodlot Specialist
Main Floor, Provincial Building
9621 – 96 Avenue, Peace River, AB T8S 1T4

One of my favorite collecting sites in Alberta is the Holmes Crossing Sandhills Ecological Reserve, located just south of the Athabasca River near Fort Assiniboine, Alberta. My father introduced me to this area when I was just a young lad, and I immediately fell in love with it. The reserve boasts some of the most intact transverse dune systems in the province and is home to a variety of rare plant and animal communities.

In the mid-1980s, I started collecting in this area and since then have discovered many unique species. Recently I compiled and published all of my Lepidoptera data from this reserve (Macaulay 2006).

The reserve's habitat varies widely. The south-facing dune slopes are dominated by kinnikinnick and other herbaceous plants. Dune ridges and northern slopes are populated by jack pine and aspen (Figure 8), while the dune saddles feature low mats of blueberry and alder. The wetlands range from extensive larch and sedge fens to black spruce bogs.



Figure 8. South facing dune slope surrounded by jack pine forest (photo by D. Macaulay).

Lepidoptera specimens were collected by means of handnetting during daylight hours and at dusk. At night, specimens were collected using

a sheet illuminated with a 175-Watt mercury vapor (MV) light powered by a portable generator and in two 25-Watt 12V DC battery-powered ultraviolet (UV) light traps. Baiting was also conducted on occasion using a mixture of beer and molasses.

A total of 444 species in 33 families were collected in the Holmes Crossing Sandhills Ecological Reserve, the Fort Assiniboine Sandhills Wildland Park and surrounding area. Of these, 49 were species of butterfly, 320 macromoths, and 75 micromoths. Of all the species collected, 15 represented rare species and 19 uncommon species (Table 4).

A few species are particularly notable:

- The skipper, *Poanes hobomok*, was first discovered at this site in 2006, and marks the westernmost record for the species.
- Only one specimen of the elusive *Hemaris gracilis* was collected here in June 1993. Since then, despite returning on several occasions, I have never again observed this species. In Alberta there are only two other records for this species.
- *Dodia* sp. nr. *albertae* (Figure 9) was collected at the base of a stabilized dune amongst a stand of pine and alder. This species was also collected in Alberta from the Caribou Mountains (three specimens) and from Harlan, Saskatchewan near Lloydminster (one specimen). The species has yet to be described.
- Two specimens of *Feralia major* were collected one warm night in April at an MV sheet trap. This rare species is known only at two other localities in Alberta: Redwater and Gainford.
- *Trichordestra rugosa*, a rare species in fens, was rumored to have been collected in the Wagner Fen Natural Area, west of Edmonton. Unfortunately, we were not able to locate any such specimens from that site. The six specimens from Holmes Crossing Ecological Reserve were collected using UV traps in a larch fen.

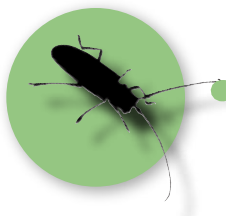


Table 4. Rare and uncommon Lepidoptera species collected at the Holmes Crossing Sandhills Ecological Reserve

Species	Family
<i>Polites themistocles</i>	Hesperiidae
<i>Poanes hobomok</i>	Hesperiidae
<i>Lycaeides idas scudderii</i>	Lycaenidae
<i>Euptoieta claudia</i>	Nymphalidae
<i>Macaria andersoni</i>	Geometridae
<i>Aspitates taylorae</i>	Geometridae
<i>Hemaris gracilis</i>	Sphingidae
<i>Gluphisia avimacula</i>	Notodontidae
<i>Dodia</i> sp. nr. <i>albertae</i>	Noctuidae: Arctiinae
<i>Grammia speciosa</i>	Noctuidae: Arctiinae
<i>Syngrapha microgamma</i>	Noctuidae
<i>Baileya ophthalmica</i>	Noctuidae
<i>Feralia major</i>	Noctuidae
<i>Brachionycha borealis</i>	Noctuidae
<i>Trichordestra rugosa</i>	Noctuidae
<i>Trichordestra tacoma</i>	Noctuidae
<i>Lasionycta taigata</i>	Noctuidae
<i>Euxoa sinelinea</i>	Noctuidae
<i>Hemipachnobia monochromatea</i>	Noctuidae
<i>Xestia atrata</i>	Noctuidae
<i>Lycophotia phyllophora</i>	Noctuidae
<i>Abagrotis brunneipennis</i>	Noctuidae
<i>Schinia florida</i>	Noctuidae
<i>Korscheltellus gracilis</i>	Hepialidae
<i>Xenolechia aethiops</i>	Gelechiidae
<i>Swammerdamia caesiella</i>	Yponomeutidae
<i>Ancylis mediofasciana</i>	Tortricidae
<i>Sparganothis reticulatana</i>	Tortricidae
<i>Parapoynx maculalis</i>	Crambidae
<i>Nealgedonia extricalis</i>	Crambidae
<i>Crambus ainsliellus</i>	Crambidae
<i>Catoptria trichostoma</i>	Crambidae
<i>Pediasia truncatella</i>	Crambidae
<i>Geina tenuidactyla</i>	Pterophoridae



Figure 9. Undescribed *Dodia* species taken from the Holmes Crossing Ecological Reserve (photo by D. Macaulay).

- *Lasionycta taigata*, a boreal species found in peatlands, occurs in bogs throughout the boreal region and is known only at other Alberta localities – Calling Lake and Birch Mountains Wildland Park.
- *Pediasia truncatella*, rare in Alberta, represents a localized species found only in bogs harboring sphagnum, its host plant. Two specimens were collected in a larch fen.

Although I have collected all over Alberta, the selection of species collected in this reserve continues to amaze me. Whenever I sample a new location in the reserve it usually results in collection of another new species. I discover 5–10 new species, especially micromoths, every year in this reserve. Species in the open dune and pine forest habitats seem to be well collected; those in the peatlands and other wetlands are less well-collected and should be the focus of further surveys. I estimate that there are 200–300 more species awaiting discovery in the Holmes Crossing Sandhills Ecological Reserve.

Literature Cited

Macaulay, D. 2006. Survey of the Lepidoptera fauna of the Holmes Crossing Sandhills Ecological Reserve, the Fort Assiniboine Sandhills Wildland Park, and nearby areas. Prepared for the Alberta Natural Heritage Information Centre, Parks and Protected Areas Division, Alberta Community Development. Unpubl. Rep. 26 p. (URL: Accessed 25 April 2007. <http://www.cd.gov.ab.ca/preserving/parks/anhic/docs/HolmesLep06DEC06.pdf>)



Graduate Student Focus

The Effect of Ants on Carabid Communities Relative to Vegetation Characteristics at Different Successional Stages after Clearcutting

Duncan McColl, M.Sc candidate

(Supervisor: Staffan Lindgren), Natural Resources and Environmental Studies, University of Northern British Columbia, 3333 University Way, Prince George, BC V2N 4Z9

Forest invertebrate communities respond to changes in their environments by shifts in species composition and abundance. These responses are variable depending on the disturbance, ecosystem, and the species or species group. In forested ecosystems the loss of forest cover and the subsequent regeneration of that cover over time has been hypothesized as a possible driver of change in carabid beetle community composition. Correlations between carabid communities and changing forest structure have been observed in numerous studies conducted in boreal forests. While relatively few in number, some studies have demonstrated an influence of ants on carabid behavior, abundant activity, and distribution. The purpose of my research is to gain an understanding of carabid community responses in regenerating forests, and how ants influence these communities.

As there is inadequate knowledge of carabid communities in cool wet sub-boreal spruce (SBS) forests in various stages of succession, the first goal of my research is to identify carabid communities in several stands within the SBS forests in west-central British Columbia. In 2005, I sampled carabids and ants (using modified Nordlander pitfall traps) in 10 stands of age classes that represent different stages of forest succession. Data pertaining to canopy cover, ground cover, vegetation species composition, and coarse woody debris (CWD) were also collected.

Initial impressions obtained from field observations and pitfall catches from the 2005 sampling period suggest that ants, in particular *Formica aserva*, may be exerting an influence on carabids in regenerating stands. *Formica aserva* is a sanguine ant that, in the northern portion of its range, uses CWD as a nesting substrate. Where colonies of *F. aserva* are present, the abundant activity and diversity of carabids appear to be reduced. From these initial observations I hypothesized that *F. aserva* colonies reduce the abundant activity and diversity of carabids in the

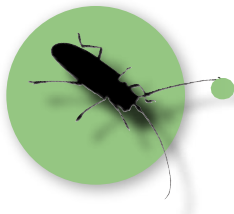
proximity of their nests, and that this influence decreases with greater distance from the nest. In the spring and summer of 2006, I tested these hypotheses by transplanting 19 *F. aserva* colonies, nesting in logs, into a cutblock where *F. aserva* were not previously detected (Figure 10).



Figure 10. A relocated *Formica aserva* colony nesting in coarse woody debris (photo by D. McColl).

Of the 19 colonies relocated, eight abandoned their nests within the first 3 weeks of relocation. Three other colonies abandoned the transplanted CWD and relocated to different pieces of CWD, and one colony was consumed by a bear in the last sampling period. Preliminary analyses indicate that colonies of *F. aserva* negatively influence the abundant activity of carabids, and that this influence decreases with increasing distance from the colonies.

Currently 30 species of carabids have been identified from the 2005 sampling period as well as 9 species of ants. Analysis of carabid communities, further species identification, and species confirmations are ongoing. Numeric responses of the entire carabid community to introduction of *F. aserva* colonies have provided an early indication of an effect. Further examination of the data and analyses at the species level should provide greater insight into the effects of *F. aserva* on carabid abundant activity, as well as effects on carabid diversity.



Hierarchical Diversity of Canopy Arthropods in Hardwood Forests of Southern Québec

Maxim Larrivée, Ph.D candidate

(Supervisor: Chris Buddle) Department of Natural Resource Sciences
McGill University, Macdonald Campus, 21,111 Lakeshore Road
Ste Anne de Bellevue, QC H9X 3V9

Deciduous hardwood forests in southern Québec have changed dramatically over the last 200 years due to harvesting, agriculture, urbanization, and introduced pathogens. It is, therefore, imperative to benchmark biodiversity and understand arthropods communities associated with the dominant trees species found in these ecosystems. There is a dearth of rigorous multiscale ecological investigations of arthropod diversity in the understory and canopy of forests in eastern Canada. As a result, the relevant scales of intervention required to maintain the regional biodiversity are unknown. Knowledge about how canopy arthropods contribute to overall forest biodiversity is critical as ecological signals detected at the ground level may not reflect ecological changes in the canopy. Additionally, rare and potentially endangered arthropod species associated with these forest types should be identified. To address these knowledge gaps, canopy and understory arthropods were sampled extensively in sugar maple forests of southern Québec in 2005 and 2006. The main objective was to assess the species diversity of selected arthropod groups associated with trees of *Acer saccharum* Marsh. and *Fagus grandifolia* Ehrh. at multiple spatial scales.

Following a hierarchically nested spatial design, the canopy and the understory of 90 trees was sampled: three sugar maple trees and three American beech trees were sampled in each of three stands in each of three protected areas (Mont-St-Hilaire Biosphere Reserve, Oka Provincial

Park, and Mont-St-Bruno Provincial Park). Three collecting methods (beating, Lindgren funnel traps, and sticky traps on trunks) were used. Sampling in the canopies was conducted with a DINO 260xt® mobile aerial lift platform, towed from site to site with a 4WD vehicle. This allowed us to reach heights of 27 m in the study forests.

Fifty-one species from 2341 individuals resulted from the 2005 beating samples of sugar maples, 46 species from 1299 individuals were collected in the understory, and 23 species from 1042 individuals were collected in the canopy. Five species were collected only in the canopy of sugar maple, and of these *Araneus guttulatus* and *Philodromus keyserlingi* were collected for the first time in Québec. A non-metric multidimensional scaling ordination (Figure 11) of the samples shows a clear separation between the spider assemblages found in the canopy and the understory.

Over the next year, data on spider catches from 2006 and beetle catches from 2005 and 2006 will be analyzed, and should allow us to have a clear idea of the contribution of spiders and beetles to overall sugar maple forest biodiversity. Canopy arthropod research is now testing ecological hypotheses in addition to inventorial and descriptive research, and this should lead a better understanding of the diversity patterns of the arthropods of our hardwood forests. As a final note, fractions from our samples (all arthropods collected apart from spiders and beetles) are available to researchers with an interest in fostering collaborations.

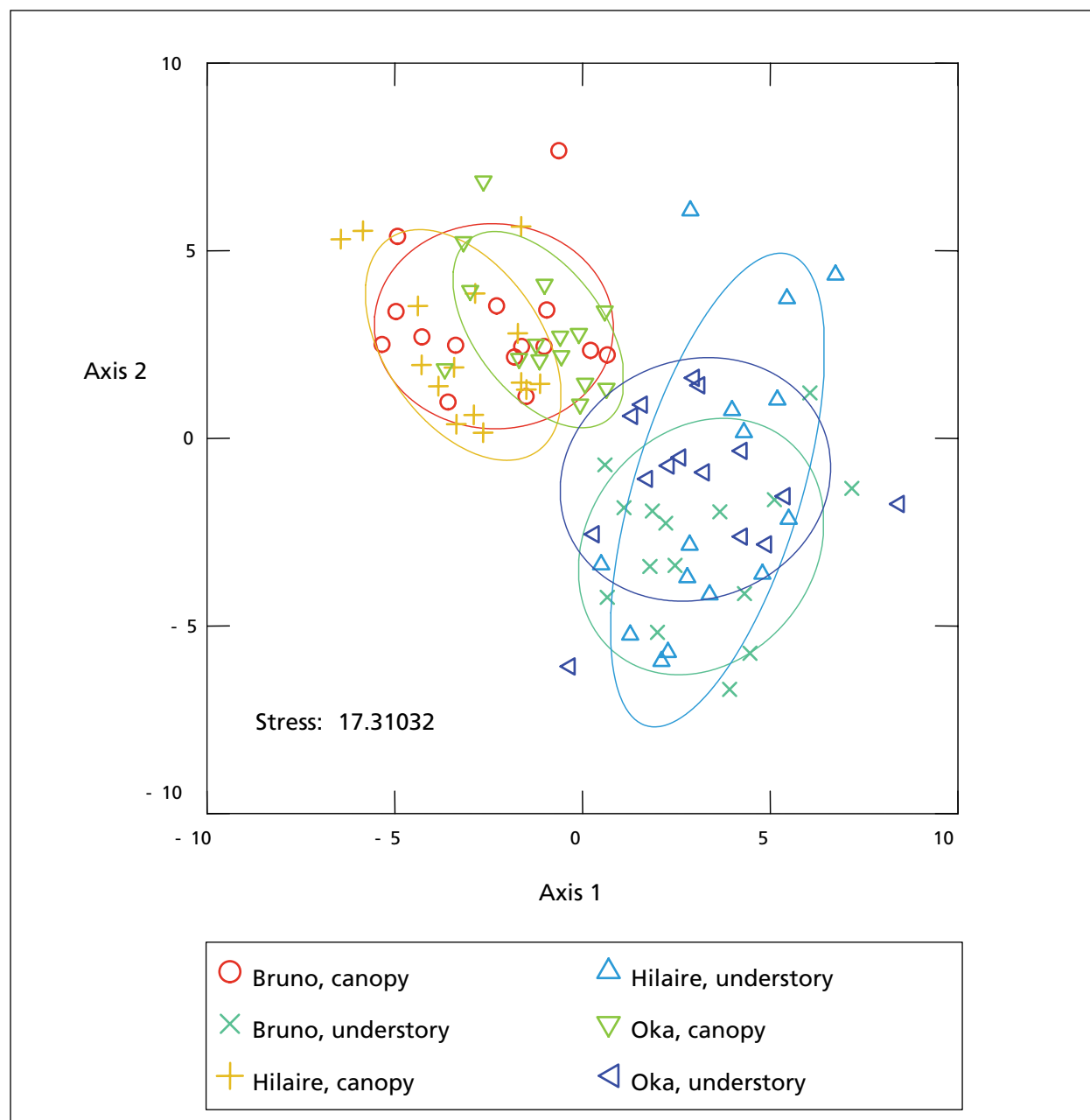
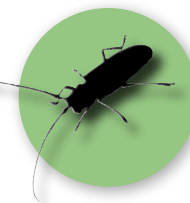
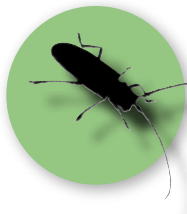


Figure 11. Non-metric multidimensional scaling scatter plot of spider assemblages sampled in the canopy and the understory of sugar maple trees. Each replicate is coded according to canopy or understory as well as site. Confidence ellipses cover one standard deviation from the centroid of each group.



Carabid and Staphylinid Communities as Indicators for the Development of Clumped Retention Applications In Managed Forests

Matthew Pyper, M.Sc candidate

(Supervisors: John Spence and David Langor)) Department of Renewable Resources,
University of Alberta, Edmonton, AB T6G 2H1

With the emulation of natural disturbances (e.g., wildfire) now a central tenet in most sustainable forest management strategies, there is enhanced opportunity for efficient conservation of biodiversity resources. The central assumption is that biodiversity will be conserved throughout managed landscapes if industrial practices emulate the patterns and structural features of natural disturbances. This strategy has defined modern management at the landscape scale; however, information for the development of accurate fine-scale management strategies is lacking, even though this finer scale is known to be more relevant to the persistence of most biodiversity, especially arthropods.

My research focuses on the use of clumped retention (i.e., isolated patches of live trees within a harvested area) to provide beneficial fine-scale management strategies for arthropod conservation (Figure 12). Clumped retention can play a critical role in the conservation of arthropod communities within managed forests by acting as 'lifeboats' for species with an affinity for mature forests, promoting connectivity between forest patches, and acting as source populations for recovering harvest sites. However, knowledge of the criteria that make clumped retention applications effective is still lacking.

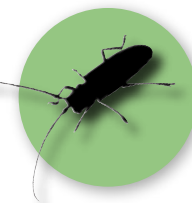
I used pitfall traps to sample ground beetle and rove beetle communities

for use as indicators of biodiversity patterns. Deciduous dominated (>70% of canopy trees are deciduous) clumped retention sites ranging from 1 to 14 ha were surveyed as well as mature forest and harvest sites in the boreal forest near Peace River, Alberta. My project aims to advance current knowledge of efficient clumped retention applications within managed forests by using beta-diversity models to determine 1) area thresholds that maintain mature forest arthropod communities within patches, 2) shape metrics that maximize the quality of patches, and 3) proximity metrics that permit species dispersal between patches.

Initial results following the first field season suggest that beetle communities within clumped retention sites of 3–5 ha begin to resemble mature forest sites. Field work planned for 2007 will serve to increase sample sizes of deciduous dominated sites, sample conifer dominated sites (>70% of canopy trees are conifer), and test the effect of proximity and shape variables on beetle communities within clumped retention sites. Within each cover type, five replicates of both mature forest and harvest sites as well as 25 replicates of clumped retention sites will be sampled. The completed project will further demonstrate the strength of arthropods as indicators for biodiversity assessment and promote methods for conserving communities within the boreal forest.



Figure 12. Example of clumped retention within conifer dominated harvest block (photo by J. Spence).



News and Events

Graduate Student Opportunity

We are looking for a PhD candidate to study insect diversity and abundance in relation to disturbances caused by deer overbrowsing on Anticosti Island (Gulf of St-Lawrence). The overall objective is to characterize the recovery of forest communities from deer overbrowsing using experimental control of deer abundance. Major guilds of insects (herbivores, pollinators, ground and foliage hunting predators, and insect decomposers) will be characterized over a range of controlled experimental levels of deer abundance in large enclosures. The study provides the opportunity to elucidate links between insect diversity, ecosystem integrity, and forest productivity in boreal forests through post-disturbance experimental manipulation of deer abundance. From a practical viewpoint, knowing how insect diversity and abundance react to vegetation recovery with deer control should help to predict which deer densities are compatible with ecological stability. This could also provide an opportunity to examine the potential for ecological restoration of this large forested island ecosystem. The project will be part of the research program of the NSERC Industrial Research Chair-Produits Forestiers Anticosti, with a stipend available as financial support to the candidate, depending on merit. Please contact: Conrad Cloutier, Department of Biology, University of Laval, Québec, QC, G1K 7P4; phone: 418-656-3183; email: Conrad.Cloutier@bio.ulaval.ca or Christian Hébert, Laurentian Forestry Centre, Natural Resources Canada, Canadian Forest Service, Québec, QC, G1V 4C7; phone: 418-648-5896; email: chhebert@rncan.gc.ca.

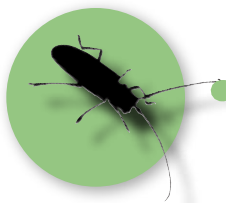
Bio-Blitz 2007—Riding Mountain National Park

The seventh annual BSC-organized Bio-Blitz will be held at Riding Mountain National Park, Manitoba, on July 16–20, 2007. More details about this event are found in the Spring 2007 (Volume 26, No. 1) issue of the Newsletter of the Biological Survey of Canada.

For more information or to register please contact: Rob Roughley, Department of Entomology, University of Manitoba, Winnipeg; email: Rob_Roughley@umanitoba.ca; phone: 204-474-6023 or Bob Lamb, Agriculture and Agri-Food Canada, Winnipeg; email: rlamb@agr.ca; phone: 204-983-1458.

Meeting Announcement

The XV International Colloquium on Soil Zoology will take place, August 25–29, 2008, in Curitiba, Brazil. The meeting theme is Biodiversity, Conservation and Sustainable Management of Soil Animals. For further information please check the following website: www.unicenp.edu.br/icsz.



New Publications

- Gouix, N.; Klimaszewski, J. 2007. Catalogue of aleocharine rove beetles of Canada and Alaska (Coleoptera, Staphylinidae, Aleocharinae). Pensoft Publishers, Sofia-Moscow. 163 p.
- Jacobs, J.M.; Spence, J.R.; Langor, D.W. 2007. Influence of forest succession and dead wood qualities on boreal saproxylic beetles. *Agric. For. Entomol.* 9: 3–16.
- Klimaszewski, J.; Pelletier, G.; Germain, C.; Work, T.; Hébert, C. 2006. Review of Oxypoda species in Canada and Alaska (Coleoptera, Staphylinidae, Aleocharinae): systematics, bionomics, and distribution. *Can. Entomol.* 138: 737–852.
- Klimaszewski, J.; Assing, V.; Majka, C.G.; Pelletier, G.; Webster, R.P.; Langor, D.W. 2007. New records of adventive aleocharine beetles from Canada (Coleoptera, Staphylinidae, Aleocharinae). *Can. Entomol.* 139: 54–79.
- Klimaszewski, J.; Majka, C.G. 2007. Two new Atheta species (Coleoptera: Staphylinidae: Aleocharinae) from eastern Canada: taxonomy, bionomics and distribution. *Can. Entomol.* 139: 45–53.
- Klimaszewski, J.; Majka, C.G. 2007. Euvira micmac, a new species (Coleoptera: Staphylinidae: Aleocharinae), and first record of the genus in Canada. *Can. Entomol.* 139: 147–153.
- Koivula, M.J.; Cobb, T.P.; Dechene, A.D.; Jacobs, J.; Spence, J.R. 2006. Two *Sericoda* Kirby, 1837 (Coleoptera: Carabidae) species in the boreal mixed-wood post-fire environment. *Entomol. Fenn.* 17: 315–324.
- Langor, D.W.; Spence, J.R. 2006. Arthropods as ecological indicators of sustainability in Canadian forests. *For. Chron.* 82:344–350.
- Langor, D.W.; Spence, J.R.; Hammond, H.E.J.; Jacobs, J.; Cobb, T. 2006. Maintaining saproxylic insects in extensively managed boreal forests: the Canadian experience. Pages 83–97 in S.J. Grove, and J.L. Hanula (eds.). *Insect biodiversity and dead wood: proceedings of a symposium for the 22nd International Congress of Entomology*. USDA For. Serv., South. Res. Stn., Asheville, NC, Gen. Tech. Rep. SRS-93, 109 p.
- Majka, C.G. 2006. The checkered beetles (Coleoptera: Cleridae) of the Maritime provinces of Canada. *Zootaxa* 1385: 31–46.
- Majka, C.G. 2006. The Mycteridae, Boridae, Pythidae, Pyrochroidae, and Salpingidae (Coleoptera: Tenebrionoidea) of the Maritime provinces of Canada. *Zootaxa* 1250: 37–51.
- Majka, C.G.; Bondrup-Nielsen, S. 2006. Parataxonomy: a test case using beetles. *Anim. Biodivers. Conserv.* 29: 149–156.
- Majka, C.G.; Chandler, D.S.; Sheffield, C.S.; Webster, R.P. 2006. New records of Rhipiphoridae (Coleoptera) from the Maritime provinces of Canada. *Coleopt. Bull.* 60: 299–303.
- Majka, C.G.; Cline, A.R. 2006. Nitidulidae and Kateretidae of the Maritime provinces of Canada 1: new records from Nova Scotia and Prince Edward Island (Coleoptera: Cucujoidea). *Can. Entomol.* 138: 314–332.
- Majka, C.G.; Cline, A.R. 2006. New records of Corylophidae (Coleoptera) from the Maritime provinces of Canada. *Coleopt. Bull.* 60: 106–111.
- Majka, C.G.; Cook, J.; Ogden, J. 2006. Colydiidae (Coleoptera) in the Maritime provinces of Canada. *Coleopt. Bull.* 60: 225–229.
- Majka, C.G.; Cook, J.; Westby, S. 2006. Introduced Carabidae (Coleoptera) from Nova Scotia and Prince Edward Island: new records and ecological perspectives. *Can. Entomol.* 138: 602–609.
- Majka, C.G.; Jackman, J.A. 2006. The Mordellidae (Coleoptera) of the Maritime provinces of Canada. *Can. Entomol.* 138: 292–304.
- Majka, C.G.; Klimaszewski, J.; Lauff, R.F. 2006. New Coleoptera records from owl nests in Nova Scotia, Canada. *Zootaxa* 1194: 33–47.
- Majka, C.G.; McCorquodale, D.B. 2006. The Coccinellidae (Coleoptera) of the Maritime provinces of Canada: new records, biogeographic notes, and conservation concerns. *Zootaxa* 1154: 49–68.
- Majka, C.G.; Moseley, M.; Klimaszewski, J. 2006. *Gennadota canadensis* (Casey) (Staphylinidae: Aleocharinae): new records, a range extension, and bionomic notes. *Coleopt. Bull.* 60: 231–234.
- Majka, C.G.; Noronha, C.; Smith, M. 2006. Adventive and native Byrrhidae (Coleoptera) newly recorded from Prince Edward Island. *Zootaxa* 1168: 21–30.
- Majka, C.G.; Pollock, D.A. 2006. Understanding saproxylic beetles: new records of Tetratomidae, Melandryidae, Synchronidae, and Scaptiidae from the Maritime provinces of Canada (Coleoptera: Tenebrionoidea). *Zootaxa* 1248: 45–68.
- Majka, C.G.; Selig, G. 2006. *Laccotus punctatus* and the family Mycteridae (Coleoptera) newly recorded in Atlantic Canada. *Can. Entomol.* 138(4): 636–637.
- Majka, C.G.; McCorquodale, D.B.; Smith, M.E. 2007. The Cerambycidae (Coleoptera) of Prince Edward Island: new records and further lessons in biodiversity. *Can. Entomol.* 139: 258–268.



- Pearce, J.L.; Venier, L.A. 2006. The use of ground beetles (Coleoptera: Carabidae) and spider (Araneae) as bioindicators of sustainable forest management: a review. *Ecol. Indic.* 6(4): 780–793.
- Phillips, I.D.; Cobb, T.P.; Spence, J.R.; Brigham, R.M. 2006. Salvage logging, edge effects and carabid beetles: connections to conservation and sustainable forest management. *Environ. Entomol.* 35: 950–957.
- Roughley, R.E.; Pollock, D.A.; Wade, D.J. 2006. Biodiversity of ground beetles (Coleoptera: Carabidae) and spiders (Araneae) across a tallgrass prairie – aspen forest ecotone in southern Manitoba. *Can. Entomol.* 138: 545–567.
- Saint-Germain, M.; Buddle, C.M.; Drapeau, P. 2006. Sampling saproxylic Coleoptera: scale issues and the importance of behaviour. *Environ. Entomol.* 35: 478–487.
- Saint-Germain, M.; Buddle, C.M.; Larrivée, M.; Mercado, A.; Motchula, T.; Reichert, E.; Sackett, T.E.; Sylvain, Z.; Webb, A. 2007. Should biomass be considered more frequently as a currency in terrestrial arthropod community analyses? *J. Appl. Ecol.* 44: 330–339.
- Zeran, R.M.; Anderson, R.S.; Wheeler, T.A. 2006. Sap beetles (Coleoptera: Nitidulidae) in managed and old-growth forests in southeastern Ontario, Canada. *Can. Entomol.* 138: 123–237.
- Zeran, R.M.; Anderson, R.S.; Wheeler, T.A. 2007. Effect of small-scale forest management on fungivorous Coleoptera in old-growth forest fragments in southeastern Ontario, Canada. *Can. Entomol.* 139: 118–130.