Spring 2009 **Vol. 28, No. 1**

NEWSLETTER OF THE BIOLOGICAL SURVEY OF CANADA (TERRESTRIAL ARTHROPODS)

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Canadian Museum of Nature
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General Information

The Newsletter of the Biological Survey of Canada (Terrestrial Arthropods) appears twice yearly. All material without other accreditation is prepared by the Secretariat for the Biological Survey.

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Queries, comments, and contributions to the Newsletter are welcomed by the editor. Deadline for material for the Fall 2009 issue is 31 July 2009.

Donna Giberson will assume the editorial duties for the Fall issue of this newsletter. Please contact her at Giberson@upei.ca.

Editorial Notes

The Biological Survey of Canada (Terrestrial Arthropods) develops and coordinates national initiatives in taxonomic and ecological entomology on behalf of the Canadian Museum of Nature and the Entomological Society of Canada. The Newsletter communicates information about systematic and faunistic entomology that may be of interest in Canada, and reports especially on activities relevant to the Biological Survey.

This newsletter is available on the Survey's website at:
http://www.biology.ualberta.ca/bsc/bschome.htm

To receive this newsletter via email (as a pdf file) instead of a paper copy please send an email message to bsc@mus-nature.ca.

News and Notes

The Biological Survey of Canada Second Annual Symposium

The BSC has begun preparations for the second annual symposium at the Entomological Society of Canada and Entomological Society of Manitoba Joint Annual Meeting in Winnipeg from 18–22 October 2009. The working title of the symposium is: Terrestrial Arthropod Surveys in Canada: Purpose, Progress, and Plans and the co-organisers are Andrew Smith <asmith@mus-nature.ca> and Doug Currie <dc.currie@utoronto.ca>.

Here is a tentative list of speakers with the topics they will cover:

Andy Hamilton, Canadian National Collection of Insects – border conflicts: how leafhoppers can help resolve ecoregional viewpoints in Canada and the USA.

Cory Sheffield, York University – the bees of Canada.

Rob Roughley, University of Manitoba – beetles of Churchill: comparison and contrast.

Joseph Shorthouse, Laurentian University – an overview of research on the biodiversity of cynipid galls and their inhabitants on the wild roses of Canada.

David Langor, Natural Resources Canada – the arthropods of Newfoundland and Labrador or Invasions/reductions research.

Terry Galloway, University of Manitoba – establishing biodiversity of lice on birds and mammals in Manitoba.

Terry Wheeler and Chris Buddle, McGill University – faunistic / ecological research going on at McGill University.

Dale Parker, AquaTax Consulting and Iain Phillips, Saskatchewan Watershed Authority – Saskatchewan aquatic macroinvertebrate biodiversity surveys and database: past, present, and plans.

Leland Humble, Natural Resources Canada – barcoding as a tool for species identification of woodborers.

Virginia Anne Kowal, University of Calgary – terrestrial arthropod assemblages at the edges of anthropogenic forest disturbances in Kananaskis Country in southwestern Alberta.

Jim Herbers, Alberta Biodiversity Monitoring Institute – Alberta Biodiversity Monitoring Institute overview.

David Walter, Royal Alberta Museum – Alberta Biodiversity Monitoring Institute Soil arthropod protocols / oribatid results.

Rob Hinchliffe, Royal Alberta Museum – Alberta Biodiversity Monitoring Institute aquatic arthropod protocols / EPT results.

Tyler Cobb and Bert Finnamore, Royal Alberta Museum – terrestrial arthropod protocols / beetle and pollinator progress and results.

News from the Biological Survey of Canada Secretariat

BSC Incorporation. The Biological Survey of Canada was incorporated as a not-for-profit corporation effective 10 February 2009. This corporation was created to oversee finances and the management of the organization. The provisional board of directors of the BSC corporation are:

Robert Anderson <randerson@mus-nature.ca>
Patrice Bouchard <bouchardpb@agr.gc.ca>
Doug Currie <dc.currie@utoronto.ca>
Donna Giberson <Giberson@upei.ca>
David Langor <dlangor@nrcan.gc.ca>
Joe Shorthouse <jshorthouse@laurentian.ca>

More details of the structure of the new BSC corporation will be worked out over the coming months and an update will be given in the fall newsletter.

Arthropods of Canadian Forests Newsletter. The latest (and final) issue of the Arthropods of Canadian Forests Newsletter was released in January 2009. The newsletter can be found on the BSC web site.

Canadian Journal of Arthropod Identification Editor's Notebook. This new feature was added to the journal website with the first entry from Editor-in-chief Steve Marshall on The *Canadian Journal of Arthropod Identification* and cost-effective identification of North American arthropods.

Canadian Arthropods Electronic Mailing List. To stay up-to-date on BSC activities and discussions, please consider joining the Canadian Arthropods Electronic Mailing List. This is an electronic discussion group initiated and maintained by the Biological Survey of Canada. The purpose of this list is

1) to facilitate communication between researchers who are interested in the Canadian arthropod fauna;

2) to be a forum for discussion about issues facing Canadian arthropod researchers and arthropod collections; and

3) to disseminate information for and about the Biological Survey of Canada.

See the BSC web site for subscription instructions.

Biological Survey of Canada Scholarship awarded

Congratulations to Marla Schwarzfeld for winning the 2008 Biological Survey of Canada scholarship! Marla was selected by the Entomological Society of Canada Student Awards Committee for her research on ichneumonid boreal forest diversity patterns. She is currently examining the impact of forest harvesting techniques on ichneumonid biodiversity in northwestern Alberta. As well, she is doing a systematic analysis of *Ophion*, a genus of large nocturnal ichneumonids. Marla is a PhD student at the University of Alberta. Her website is: http://www.biology.ualberta.ca/faculty/felix_sperling/?Page=5115

The Biological Survey of Canada Scholarship is awarded by the Entomological Society of Canada every second year to assist a student studying insect or terrestrial arthropod biodiversity in Canada. The next BSC Scholarship will be awarded in 2010 and the deadline for application is 16 February 2010. For more information and eligibility, see: http://www.esc-sec.ca/bscschol.html.

Marla Schwarzfeld receiving the Biological Survey of Canada Scholarship from Andrew Smith at the 2008 Joint Annual Meeting of the Entomological Society of Canada and Entomological Society of Ontario in Ottawa. (Photograph by Rick West)

Biological Survey of Canada sponsored Curation Blitz at the Canadian Museum of Nature

The second annual BSC Curation Blitz took place at the Canadian Museum of Nature's Natural Heritage Building in Gatineau, Quebec on 20 October 2008. The purpose of the event was to give people the chance to see the insect collection at the Canadian Museum of Nature, to bring entomologists together for a collegial exchange of ideas in a museum setting, and to improve the curation and identification of insect specimens in this collection.

The Canadian Museum of Nature houses a world-class Coleoptera collection with particular strengths in scarabs and weevils. This collection is strong in Neotropical and Nearctic material with reasonable coverage from other parts of the world.

Twenty entomologists attended the event, including people from as far away as Norway and Saudi Arabia. Participants were interested in a wide range of insects including bees, moths and butterflies, bark beetles, rove beetles, ladybird beetles, scarab beetles, weevils, metallic wood-boring beetles, and several others. Although the overwhelming majority of specimens in the Canadian Museum of Nature collection are beetles, all participants found specimens of interest and many were pleasantly surprised at the size and breadth of the holdings in this collection.

David McCorquodale (Cape Breton University) and Bob Anderson (Canadian Museum of Nature) discuss the beetle holding with Sheila Colla (York University) in the foreground. (Photograph by Clayton D'Orsay)

Sheila Colla, a PhD student from York University, databases the Canadian Museum of Nature bumblebees while Meghan Marriott, a MSc student from Cape Breton University and the University of Prince Edward Island, examines the ladybird beetles. (Photograph by Clayton D'Orsay)

Announcement for the 2009 BSC Curation Blitz

The next BSC Curation Blitz will take place in Winnipeg in conjunction with the Entomological Society of Canada and Entomological Society of Manitoba Joint Annual Meeting from 18-22 October 2009. Insect collections in Winnipeg include those at the J.B. Wallis Museum of Entomology at the University of Manitoba, and the Manitoba Museum. If you are interested in participating, please contact David McCorquodale <David_McCorquodale@cbu.ca>.

New issue of the *Canadian Journal of Arthropod Identification* published on mayflies

CJAI 7: Heptageniidae of the World: Part II, by J.M. Webb and W.P. McCafferty
doi: 10.3752/cjai.2008.07

http://www.biology.ualberta.ca/bsc/ejournal/wm_07/wm_07.html

Abstract. Keys and diagnoses illustrated with line drawings and colour photographs for the identification of larvae and adult males of the genera of Heptageniidae of the world and female adults of North American Heptageniidae genera are provided. *Siberionurus* McCafferty is recognized as a junior objective synonym of *Ecdyogymnurus* Kluge. *Epeiron* Demoulin is shown to be congeneric with *Rhithrogena* Eaton. All subgenera that have been proposed for *Rhithrogena*, *Compsoneuria* Eaton, and *Epeorus* Eaton are treated as junior synonyms (*Rhithrogena* = *Himalogena* Kluge, N.SYN.; = *Sibirigena* Kluge, N.SYN.; = *Tumungula* Zhou & Peters, N.SYN.; *Epeorus* = *Alpiron* Braasch, N.SYN.; = *Albertiron* Kluge, N.SYN.; = *Belovius* Tshernova; = *Caucasiron* Kluge, N.SYN.; = *Iron* Eaton; = *Ironopsis* Traver; = *Proepeorus* Kluge, N.SYN.; *Compsoneuria* = *Siamoneuria* Braasch, N.SYN.).

Specimens and information sought

The list of *Specimens and information sought* on the Survey's website is intended to facilitate cooperation among entomologists through the exchange of specimens. If you have collected material or can collect material that is superfluous to your research, check the list to see who might benefit from those specimens. If you have residues for offer or if you have a request for material that might be obtained in Canada please submit the relevant data for posting on the BSC web site. Minimum data requested with all specimens are, of course, locality, date, collector, and habitat.

See www.biology.ualberta.ca/bsc/english/listofrequests.htm

Material requested	Cynipidae: galls on oak
Area of interest	Anywhere
Collecting methods/notes	Collect mature galls (spring gen: most in June; autumn gen: late August – Oct) into plastic bags, separating gall species. Preserve emergents in 70% ethanol. Please note oak species (at least a guess at oak section – red or white oaks; leaf, bud and acorn samples also useful).
Name of requester	Scott Digweed
Address	3761 – 20 Street, Edmonton, AB, Canada T6T 1R8

Material requested	Dermaptera: *Forficula auricularia* (perce-oreille européen / European earwig)
Area of interest	Amérique du Nord et autres régions si possible
Collecting methods/notes	A sec ou dans l'alcool.
Name of requester	J.C. Tourneur
Address	Département des Sciences biologiques, Université du Québec à Montréal, C.P. 8888, Montréal, Québec H3C 3P8

Summary of the Meeting of the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods), October 2008

The Scientific Committee met in Ottawa on 22–23 October 2008.

Future of the BSC

The Canadian Museum Nature has committed enough funds to pay Dr. Andrew Smith's salary through the summer of 2009 as well as provide a small operating budget for 2009/2010. There is no commitment for funding from the CMN beyond 31 March 2010.

Dr. Smith and Dr. Shorthouse made a presentation to the Federal Biodiversity Information Partnership (FBIP) management board in September. The FBIP board is in agreement that the BSC is a relevant and critical player in Canadian biodiversity that could be funded as part of the FBIP strategy. A letter of agreement between the BSC and FBIP has been drafted. FBIP's intention is to act as a funding agency and therefore would not be involved with the operations of the BSC. However, they are very interested in seeing the BSC expand into a biological survey that encompasses all taxonomic groups. They are also very interested in specimen databases. The BSC will continue to think strategically about products and services it might offer that would assist FBIP in achieving its goals.[1]

An interim plan will be put in place to keep certain activities going if the Secretariat ceases to exist or is significantly reduced. Some duties may fall to the Chair of the Scientific Committee, while other Committee members may be recruited for more specific tasks such as producing the newsletter. The possibility of appointing a Vice-Chair was considered.

In response to the interest in seeing the BSC expand into a more comprehensive biological survey that encompasses all taxonomic groups, the Committee discussed the potential structure of an expanded BSC. For now the BSC will focus on and promote selected key projects, such as the Northern Insect Survey and the *Canadian Journal of Arthropod Identification*.

Alternative funding strategies were considered such as approaching individual government departments and/or foundations. Another suggested approach is to exist on funding on a project by project basis, that would also help pay for the BSC administration in addition to the specific project.

BSC Incorporation

The BSC will be forming a not-for-profit corporation to facilitate fundraising and other activities. The Committee discussed some of the outstanding issues required to formulate the bylaws such as membership, quorum, and so on. How this new BSC not-for-profit corporation will affect the relationship with the Entomological Society of Canada was also discussed. Dr. Fields will discuss this issue with the Entomological Society's executive committee.

Scientific projects and priorities

Northern Insect Survey project

The subcommittee is working on a detailed formal proposal that will be submitted to granting agencies such as NSERC. The main objective of this project is to inventory arthropod diversity in numerous arctic and subarctic localities and to curate and database relevant specimens from collections. Some of the main themes that will be highlighted in the proposal, depending on the recipient, will be global climate change, arctic sovereignty, and employment and training for First Nations people. Expressions of interest for participation from others will be sought more broadly after the initial planning stages.

[1]Editor's note: The viability of FBIP has become more uncertain since the fall meeting due to the federal election call and the economic recession. FBIP is currently reformulating their strategy and goals.

Grasslands project

The first grasslands publication (*Arthropods of Canadian Grasslands: Ecology and Interactions in Grassland Habitats*) has been submitted to NRC Press for publication consideration as part of their monograph series.[2] Some chapters for the second volume on Arthropods and Altered Grassland Ecosystems have been submitted. The editor, Dr. Kevin Floate, estimates that there will be 12 to 15 chapters in the second volume.

Canadian Journal of Arthropod Identification (CJAI)

The CJAI continues to be well received and many submissions have been promised. A key to Heptageniidae of the World was published in October. Discussions for linkages with the Encylopedia of Life and Discover Life are ongoing. Dr. Steve Marshall is also discussing the possibility of a network of journals of arthropod identification from other countries.

Terrestrial arthropods of Newfoundland and Labrador

The Newfoundland and Labrador Department of Environment and Conservation has continued to support this project and proposals have been submitted for continued funding in 2009.

A key to the Curculionoidea of Newfoundland should be submitted to the *Canadian Journal of Arthropod Identification* in 2009. All specimens of Carabidae in the Memorial University of Newfoundland collection and Canadian National Collection of Insects have been databased along with many literature records. Production of distribution maps is planned. Work on the Staphylinidae continues with a full key expected by late 2009. Work on compiling a checklist and identifying Lepidoptera from several collections is ongoing. A contractor was hired to database all of the Lepidoptera at the Canadian National Collection of Insects from Newfoundland and Labrador.

Several manuscripts have been submitted or published, which include treatments of NL fauna for several beetle families. Work on a comprehensive bibliography of works dealing with Newfoundland entomology continues at a good pace.

Plans for a major collecting expedition throughout Newfoundland in 2010 or 2011, to repeat the Lindroth's 1948 and 1951 expeditions, is proceeding. This project is an open initiative and any/all participation is welcome. Please contact Dave Langor <dlangor@nrcan.gc.ca> for more information.

Forest arthropods

Volume 4 of the *Arthropods of Canadian Forests* newsletter was issued in January and will be the last issue. The seven synthesis papers stemming from a BSC-sponsored symposium, entitled "Maintaining Arthropods in Northern Forest Ecosystems," were published in the July/August issue of *The Canadian Entomologist*. Good progress continues on a handbook to the Cerambycidae (Coleoptera) of Canada and Alaska. Colour habitus photos of each species will be proved by Klaus Bolte.

Invasions and reductions

The proceedings of the symposium on Ecological Impacts of Non-Native Insects and Fungi on Terrestrial Ecosystems held at the 2006 Joint Annual Meeting have been published online in the journal *Biological Invasions*. The hard copy was published in January 2009.

Coccinellid data from a variety of collections are being databased because of the interest of the potential affect of non-native on native species. COSEWIC has expressed interest in compiling the available information and have it posted on a web site.

Work on developing a comprehensive list of the non-native terrestrial arthropods of Canada continues at a good pace and a publication is planned for 2009. Another related activity is the capture of label data associated with archived specimens of non-native arthropod

[2]Editor's note: Due to changes at NRC Press, it will no longer be possible for them to publish this volume. The editors have decided that the grassland books will be published electronically by the BSC.

fauna and fungal flora on trees. This activity is complete for collections at the Canadian Forest Service and the Canadian National Collection of Insects. Collections at the Lyman Entomological Museum and at the University of Guelph will also be databased. These data will be used to develop distribution maps and for analysis of rates and patterns of range expansion.

BioBlitzes

The 2008 BioBlitz was held at Bruce Peninsula National Park. A report can be found in the fall *Newsletter of the Biological Survey of Canada (Terrestrial Arthropods)*. The BioBlitz resulted in some important contributions to the Bruce Peninsula database. The Committee discussed some possible locations for a 2009 BioBlitz. However, for various reasons it is unlikely that such an event will be held in 2009.

Anybody who participated in the 2001 Bioblitz at Onefour, Alberta is urged to send information on the species collected to Kevin Floate: <FloateK@agr.gc.ca>.

Curation Blitzes

A good number of people gathered at the Canadian Museum of Nature for the 2008 Curation Blitz. There are plans to hold another Curation Blitz in Winnipeg at the JB Wallis Museum during the 2009 ESC/ESM Joint Annual Meeting.

Databasing

The BSC plans to start compiling a list of databases initiated because of a BSC project or interest. Initially, the goal will be to show a track record to groups such as FBIP.

The database of common and historical collecting localities that is on the BSC web site has generated positive response. A file with some corrections will be posted in the future.

BSC Symposia

The BSC Symposium held at the 2008 ESC/ESO JAM went well and there are plans to hold another symposium in Winnipeg in 2009 (see also p. 1). Committee members were in favour of continuing to invite students to make presentations.

Survey publicity

The BSC had arranged for Dr. Steve Marshall to give a well-received public lecture (The Web we weave - Discovering insects in this digital age) at the Canadian Museum of Nature in Ottawa to coincide with the ESC/ESO Joint Annual Meeting and the meeting of the Scientific Committee. Publicity is of critical importance and this role needs to be fostered in the future.

Liaison and exchange of information

Canadian Museum of Nature

Mr. Roger Baird, Director, Collection Services reported that the Canadian Museum of Nature (CMN) and eight other institutions from around world have been approached to form a global task force for the mobilization of natural history collections. Though the GBIF web site they have been able to make accessible 160 million records, 40% of which are specimen based. The task force over the next 12-15 months will be looking at what would be needed to make 1 billion records.

Renovations are still on track for a grand reopening of the Victoria Memorial Museum Building in May 2010. The opening will feature a new water gallery including a blue whale specimen, and a renewed mineral gallery. Additional funding is required for the planned gallery of the nature of humans.

The Museum will have a reduction of $1.4 million appropriations for the next fiscal year as a result of the federal strategic review process. In addition, the increased cost of running two buildings is creating tremendous economic pressures. The CMN remains committed to a sound and strong program of scientific research.

Entomological Society of Canada

Dr. Paul Fields, President of the Entomological Society of Canada, reported that the Board of the Entomological Society of Canada continues be ready to provide whatever non-

monetary support that they can to the Biological Survey during this difficult period.

Agriculture and Agri-Food Canada

Dr. Jean-François Landry reported that Mr. Jim Troubridge, the former collection manager has retired. Mr. Eric Rickey, who manages the national identification service, will act as a temporary replacement.

Barcode of Life

Dr. Alex Smith, Research Scientist, Canadian Centre for DNA Barcoding, provided an overview of the Canadian DNA Centre for Barcoding which is located in the new Biodiversity Institute of Ontario building at the University of Guelph and answered a number of questions about their processes and procedures.

Canadian University Biodiversity Consortium

Dr. Anne Bruneau, Université de Montréal, provided an overview of the Canadian University Biodiversity Consortium which was funded by the Canadian Foundation for Innovation in 2007 to set up a database infrastructure across the country. Currently 11 universities, 6 botanical gardens, and 2 collections from the Royal Ontario Museum are participating. She advised contacting participating universities with entomology collections for collaboration possibilities or for suggestions on which groups to focus.

Encyclopedia of Life

Mr. David Shorthouse, WorkBench Project Leader – Encyclopedia of Life, shared some information about activities at the Encyclopedia of Life (EOL) project. It is hoped that there might be some sort of collaboration with EOL and the *Canadian Journal of Arthropod Identification*

Other items

Regional developments

Reports on regional developments were curtailed because of the shorter time period for the Committee meeting. However, among other items it was reported that in the Maritimes Dr. Reggie Webster continues his prolific collecting in New Brunswick and Mr. Chris Majka and many others continue much work on beetles. In Alberta, a curator has been hired by the University of Calgary to curate their invertebrate collections. The University of Alberta and Olds College will offer entomology courses in a new Bachelor of Science agricultural program. The Entomological Society of Alberta prepared a submission regarding the Joint Panel Review of EnCana Corporation's proposal to drill an additional 1275 natural gas well in the Suffield National Wildlife area. In Quebec, at McGill University, a program with an entomological specialization will start in the fall of 2009.

Other matters

The Committee briefly discussed other matters such as the BSC web site, the BSC newsletter, the BSC scholarship, a brief on the importance of insect collecting, the faunal analysis project, endangered species, and Scientific Committee membership.

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New Guide to Northern Grasshoppers and their Relatives

A new guide to Orthoptera in northwestern North America was published recently by the Government of the Northwest Territories. "Grasshoppers and related insects of the Northwest Territories and adjacent regions" is 77 pages in length and includes chapters on biology, habitats, geography, and identification. Copies may be obtained (free) from: Terrianne Berens <nwtbugs@gov.nt.ca>, Government of the Northwest Territories, Box 1320, Yellowknife NT X1A 2L9, Canada.

CITATION: Catling, P.M. 2008. *Grasshoppers and related insects (Ulonata) of the Northwest Territories and adjacent regions*. Environment and Natural Resources, Government of the Northwest Territories, Yellowknife, NT. 77 pp.

ISBN 978-0-7708-0172-4

Scientific Committee Members

The Biological Survey of Canada is pleased to announce that Dr. Chris Buddle (McGill University) has agreed to serve as the newly created Vice-Chair of the BSC Scientific Committee. Dr. Buddle has consistently brought fresh ideas to our discussions and we all look forward to his continuing involvement as we plot the future of the BSC. The Vice-Chair position was created, in part, to prepare for a reallocation of responsibilities within the BSC with the impending reductions to the BSC Secretariat at the Canadian Museum of Nature.

We are equally pleased to announce that Dr. Robert Anderson (Canadian Museum of Nature) and Dr. Andrew Bennett (Agriculture and Agri-Food Canada) were recently appointed by the President of the Entomological Society of Canada to the BSC Scientific Committee. Welcome aboard!

Members of the Scientific Committee for 2009:

Robert Anderson, Canadian Museum of Nature, Ottawa, ON

Roger Baird (Canadian Museum of Nature representative), Canadian Museum of Nature, Ottawa, ON

Andrew Bennett, Agriculture and Agri-Food Canada, Ottawa, ON

Patrice Bouchard, Agriculture and Agri-Food Canada, Ottawa, ON

Chris Buddle (Vice-Chair), McGill University, Anne de Bellevue, QC

Doug Currie, Royal Ontario Museum, Toronto, ON

Joanne DiCosimo (Canadian Museum of Nature representative), Canadian Museum of Nature, Ottawa, ON

Lianne Dwyer (Agriculture and Agri-Food representative), Agriculture and Agri-Food Canada, Ottawa, ON

Chris Buddle (photograph by Torsten Bittner)

Paul Fields (Entomological Society of Canada representative), Agriculture and Agri-Food Canada, Winnipeg, MB

Donna Giberson, University of Prince Edward Island, Charlottetown, PE

Jan Klimaszewski, Canadian Forest Service, Québec, QC

Jean-François Landry (Agriculture and Agri-Food representative), Agriculture and Agri-Food Canada, Ottawa, ON

David Langor, Canadian Forest Service, Edmonton, AB

Steve Marshall, University of Guelph, Guelph, ON

David McCorquodale, Cape Breton University, Sydney, NS

Geoffrey Scudder, University of British Columbia, Vancouver, BC

Joe Shorthouse (Chair), Laurentian University, Sudbury, ON

Derek Sikes (International member), University of Alaska Museum, Fairbanks, AK

Felix Sperling, University of Alberta, Edmonton, AB

Jon Sweeney, Canadian Forest Service, Fredericton, NB

Honorary / Founding Member:
George Ball , University of Alberta, Edmonton, AB

Why We Kill Bugs – The Case for Collecting Insects

Greg R. Pohl
Canadian Forest Service, 5320-122nd Street, Edmonton, AB T6H 3S5
Greg.Pohl@NRCan-RNCan.gc.ca

Introduction

As I go about my work doing biodiversity research, I kill thousands of insects every year. I am not proud of that particular fact, but I am proud of the work that it contributes to. Despite terminating so many insect lives, I have a deep connection to these fascinating beings of tergites and tarsi, and I know that the knowledge our research team reveals is helping to protect their habitats. It must seem incongruous to some folks that I will go to great lengths to release a wayward spider unharmed out of my house, yet kill hundreds of moths in a black-light trap in the same evening. Most entomologists have no trouble understanding this apparent contradiction, because they understand the nature of insect populations and the techniques required to study them. This is not so obvious to members of the general public.

It pains me when, in my entomological pursuits, I receive a comment along the lines of; "great, kill them all!" These are typically from people who only notice insects when they are a nuisance, and who will stomp on them whenever possible. Theirs are very simple reactions, and the solution is basically education. Depending on the situation, I often try to open their eyes just a little to the wonders of the miniature world around them. More complex is the occasional expression of horror at the carnage of my nets and traps. These responses usually come from people who are concerned about the environment, but do not have much ecological knowledge. Generally they are familiar with vertebrates, and assume that other organisms operate in similar ways. The solution in these situations is also education, but the approach we take is critical. We can either engage in a mutually destructive fight that distracts us all from the real threat of habitat loss, or recognise that we share the same concerns, and try to work together to protect wild places and wild species. As someone who also cares deeply about these creatures, I would much rather have these people as allies than enemies in the struggle for environmental preservation.

I have recently dealt with a concerted campaign against "bug collecting" by a well-meaning but misguided naturalist group. I approached it as an opportunity to educate them, and took considerable time and energy to explain how insects are not the same as vertebrates, and why entomologists do what we do. In this article I present the arguments I used in that case; I hope this will serve as a resource for entomologists who may find themselves in a similar situation where they are obliged to defend what they do.

Opposition to insect collecting generally comes from people familiar with birds and mammals. However, insects are vastly different creatures. As I will detail below they are incredibly numerous and prolific, so the effects of collecting on their populations are minimal. Because we know little or nothing about most insect species, and they are very difficult to identify, it is necessary to kill and collect them to study them. I will detail how collecting insects is a vital part of most entomology research, including taxonomic, diagnostic, biodiversity, and pest management work. Much of this work is carried out by amateurs, who have become world-class experts through collecting insects. Finally, I will argue that the conservation of insects and other organisms will benefit from MORE, rather than less, collecting of insects.

Why are insect populations resilient to collecting?

Insects are very different from birds and other vertebrates in that they have short generation spans, they have a phenomenal capacity for reproduction, and their populations regularly number in the billions. Insects are so abundant that their numbers simply cannot be considered in the same terms as those of vertebrates. Think of the thousands of insects that a single songbird eats during its lifetime; while each species is important in the ecosystem, a given individual of each species do not have equal ecological importance.

Because of their population size and their ability to reproduce, it is very difficult to affect insect populations by collecting. While it is true that over-collecting may pose a threat to species that are already endangered, those species did not become endangered as a result of collecting (New *et al.* 1995). Pyle (2002) states "while it is extremely difficult to make a dent in most insect populations with a net, the bulldozer, the cow, and the plow eradicate whole butterfly colonies in no time." Habitat loss is by far the most significant threat to insects in Canada and elsewhere.

The special challenges of entomology

Insects are incredibly diverse: Before delving into why entomologists must collect specimens, we must first discuss the enormous diversity of insects, and the special challenge this presents to entomologists. Insects comprise over 2/3 of the approximately 2 million known species of living things on the planet, and scientists estimate there are millions more species of insects remaining to be discovered. Danks (1979) estimated that approximately 66 000 species of insects and related terrestrial arthropods live in Canada, slightly more than half of which had been discovered and described at that time. Compared to birds and other vertebrates, the number of insect species is staggering. There are over ten times as many known kinds of beetles in the world (approximately 357 000 known species; Bouchard et al. 2009)

Biologist Derrick Kanashiro sweeps for insects, as part of an inventory of insect species in native prairie near Purple Springs, Alberta.
(photograph by G.R. Pohl)

as all terrestrial vertebrates – birds, mammals, reptiles, and amphibians – combined (20 000 species; Tree of Life 2009). There are more species of butterflies and moths in one small area of Boreal forest in Alberta (500+; Pohl *et al.* 2006), than there are resident bird species in all of Canada (470; Avibase 2009). This is the special challenge that entomologists deal with every day – identifying, recognizing, describing, and cataloguing the millions of species of insects is almost overwhelming.

Insects are tiny: Another challenge in entomology is that insects are so small. With the exception of a few large and distinctive species like some butterflies and moths, the majority of insects need to be examined under a microscope to make an accurate species identification. Often specimens need to be dissected and their internal reproductive organs examined in order to accurately identify them. Needless to say, this precludes identification of living specimens in all but a slim minority of insect groups. Thus, killing and collecting insects is a necessary part of almost all entomological research that requires species identifications.

Insects are poorly known: Because of the enormity of the task, and the lack of resources and people to carry it out, entomologists are still in the exploratory stage of discovering and naming species. At last count, approximately 1.2 million insect species have been described, out of a total estimated at between five and ten mil-

lion (Marshall 2006). Except for a few species that have economic or health impacts on people, just about nothing is known about them. Many species are known only from a very brief description, often unaccompanied by illustrations, in an obscure journal article over 100 years old. Some species cannot be identified at all with our present state of knowledge. We simply do not possess the knowledge required to put together comprehensive identification guides to most insect groups. General insect guides cover only a few representative species, and omit the myriad of lesser-known but very similar-looking ones. A few relatively well-known groups such as butterflies and odonates have been the subjects of some excellent field guides published in recent years (Layberry *et al.* 1998; Acorn 2001, 2004, 2007; Cannings 2002; Jones *et al.* 2008). Even among these groups, many species-level taxonomic problems remain (for example in the butterfly genera *Boloria* and *Polygonia* and the ladybeetle genus *Scymnus*).

The comfortable position ornithologists and birders are in today, where comprehensive field guides exist and accurate field identifications can be made without killing specimens, is built on a strong taxonomic foundation. That exists now because, at one time, people collected birds and studied their skins and skeletons to arrive at a stable nomenclature and classification. For entomologists, that level of knowledge is a dream that is still decades or even centuries away. In entomology we are still building that foundation, and are highly dependent on insect collecting to do so.

Why is it necessary to collect insects?

Taxonomy: Insect collections are a critical building block to almost all other aspects of entomology (Danks 1991, Wiggins *et al.* 1991). A basic field of entomological research that is heavily dependent on collections is taxonomy – the discovery and description of new species. To describe and name a new species, a "type specimen," and ideally a "type series," must be designated and safeguarded so that future workers can re-examine the organism in detail. These types are the basis of our nomenclature and are required for a stable system of names. Insect collections are the repository for existing type material, as well as the source for future types. It is not an exaggeration to say that taxonomists make just as many exciting discoveries among historical specimens in collections as they make in the field. The accumulation of unidentified specimens, as long as they are properly labeled, is exactly the substrate from which crucial new discoveries are made. The existence of a whole new insect order, the Mantophasmatodea, was discovered recently among old museum specimens obtained years earlier in the course of general collecting (Klass *et al.* 2002). It may not seem valuable to an observer or even a collector at the time, but well labeled and curated specimens of all but the most common species are a useful addition to any collection.

Diagnostics: Getting a correct identification on a sample is important in scientific research and in pest management. An incorrect species determination can result in spurious research results, in costly and needless application of pesticides being applied in error to a non-pest species, or in failing to detect a new outbreak in the early stages.

Because of the aforementioned challenges of diversity, small size, and lack of published identification guides, insects are difficult to identify. Thus synoptic insect collections are an essential tool for making identifications. Where comprehensive guidebooks do not exist, entomologists examine specimens that have been authoritatively identified in the past, and exchange information and specimens with researchers in other collections. As entomologists encounter new species, they add these to the collection, which becomes an ever-expanding "identification guide" to the insects of a given region.

Vouchers: Because nomenclature changes over time as we discover new species and refine our understanding of existing species, it is very important, in all entomological research, to collect and save vouchers of the species being studied (Huber 1998, Wheeler 2003). Over time, if

our understanding and definition of a particular species changes, we can go back and re-examine the vouchers from past research and determine the current identity of the organisms being studied, and thus ensure the ongoing scientific value of the work. For example, the symbiotic relationship between yuccas and yucca moths has been the subject of many studies over the past century. Before Pellmyr (1999), all these pollinator moths were thought to be a single widespread species, *Tegeticula yuccasella*. It is now recognised that yucca moths are in fact a complex of 13 very similar species with different natural history, identifiable only via microscopical examination. Any previous research on yucca moths is of questionable value, unless voucher specimens were kept so it can now be determined which species was really the subject of the research.

A voucher collection is also very important in the legal realm, to stand as proof that a particular species existed at a particular time and place. This can be very important information when a corporation fights against environmental restriction on resource development. Vouchers are also important when legal action or trade sanctions are pursued over exotic pest issues; they can prove what was intercepted in a shipment, and whether or not a species occurred in an area at a given time.

Inventory and biodiversity work: Insects are also collected to do inventory work – to fully understand which species live in a given area, and what the range and habitat associations of a given species are. Such information on many species forms the basis of biodiversity information. By sampling and identifying the insects that live at a given location, researchers measure the composition and diversity of the insect community there. They can then use the insect community as a tool to assess the relative "ecological health" of the area, and compare it to other areas – this allows us to identify biodiversity hotspots, to determine which areas should be set aside for protection, and to assess whether existing areas adequately protect biodiversity. Researchers also use this biodiversity information to measure the environmental effects of human activities such as agriculture, mining, forestry, and urbanization on the environment.

To carry out biodiversity work, researchers choose an appropriate target group (for example moths, ground beetles, or aquatic larvae) and then deploy traps that catch these particular insects in a standardised, repeatable manner. By its very nature, this work requires broad sampling of many individuals of an insect community, to generate the data that will lead us to more sustainable land use decisions and, ultimately, to more protection for all wildlife.

Existing insect collections can also be a useful source of baseline environmental data in biodiversity research. Each specimen represents proof of the historical occurrence of a species at a particular place and time. This information allows us to retroactively track the arrival and extinction of various species, and forms a baseline for the study of the effects of human disturbance and climate change.

Pest management: Pest control in agriculture, forestry, and human health obviously accounts for the deaths of billions of harmful insects, but many beneficial insects are killed in pest control operations as well. Some pest monitoring work, which is vital to the protection of our agricultural and forest products and our health, involves the unavoidable collection of beneficial insects. Monitoring programs for exotic forest pests depend on traps that broadly sample insects, and collect beneficial as well as harmful species. Likewise, mosquito traps for monitoring West Nile Virus carriers inevitably collect non-pest species as well. However, this supposed "bycatch" does not have to be wasted; when examined it often yields new species records, including unexpected introduced pests. For example, the first detection in Alberta of the exotic shot-hole borer (*Scolytus rugulosus*; a pest of fruit trees) came from the "bycatch" in traps deployed to monitor elm bark beetles (Pohl *et al.* 2007).

Education and training: An insect collection is a wonderful tool to open people's eyes to the beauty and wonder of the natural world before them. Entomologists who regularly bring col-

The author, Greg Pohl, gives a presentation about insects to high school students in Fort McMurray, AB. (photograph by R. Walters, Timberlea Public School)

lections to schools will attest to the sense of excitement and wonder they bring to the students. The building of an insect collection is a valuable training tool as well – there is no better way to get to know the species in an area than to make an insect collection. Every expert identifier of insects that I know in western Canada developed and continues to develop his/her expertise by building and maintaining an insect collection.

DNA: Another use of old specimens that may not have been imagined by the original collectors is the extraction and analysis of DNA from them. With modern techniques, it is now possible to take a single leg from a specimen up to several decades old, and extract and sequence DNA from it (Meusnier *et al.* 2008). This is an incredibly powerful tool that allows researchers to check identifications, discern species relationships, and study changes in the genetic make-up of populations over time. Old specimens can also yield parasites and phoretic mites, and plant and fungus spores, helping us make ecological associations. Thus, specimens from inventory and biodiversity work, voucher collections and "bycatch" from pest monitoring programs, all continue to provide valuable information. Who knows what uses we will find for insect collections in the future?

Amateurs versus professionals

The argument for allowing professional researchers to collect insects is clear, but collecting by amateurs is at least as important (Miller 1986). The distinction between "amateur" and "professional" is largely artificial. Just about everyone involved in entomology was drawn to the field by a love of the subject. We are all passionate about what we do, but some of us are lucky enough to get paid for it, while others do it on their own time at their own expense. The quality of the resulting information often has nothing to do with whether or not the researcher got paid to do the work. Some of the most knowledgeable people in entomology are folks who are self-taught, and carry out their avocation in their spare time. This is especially true in taxonomy, where all one needs to do excellent work is a microscope, access to specimens, and an aptitude for the subject. In this era of "fiscal restraint," governments provide little support for basic taxonomic research. Thus the discovery and inventory of non-pest species is largely left to those who do it for the love of it. The majority of the data points on our species distribution maps have likely been obtained by amateurs.

Another role of amateurs is that they are often our future experts, as noted above. The young people who might be casual hobby collectors today are the world-class experts of tomorrow. Not every "hobby collector" becomes a world-class taxonomist, but there is no doubt that virtually every world-class taxonomist started out as a "hobby collector." If we discourage the casual collectors, we will have no experts in the future. I am especially concerned that undue restrictions placed on insect collecting would effectively relegate it to the "paid professionals" only. I cannot overstate the importance of amateurs to entomological

science and conservation – if we limit collecting to ill-defined "serious researchers" only, we will lose a huge resource of valuable specimens, information, and expertise.

Insect Conservation

Resource managers are beginning to recognise the importance of insect conservation (New *et al*. 1995; New 2004), but we cannot protect species that we do not know well. Many entomologists (including myself) sit on conservation boards such as the Arthropod Specialists Subcommittee of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Alberta's Endangered Species Conservation Committee. These are the bodies that assess species and make recommendations for protective legislation for them. The kind of information required to get protection for a species is derived from data from specimens in insect collections, most of which were collected by amateurs. Other than perhaps for the Monarch butterfly, there would be no formal protection of any insect species in Canada, if it were not for the work of amateur insect collectors.

Insects are also making a major contribution to the conservation of vertebrates and their habitats. An example of this is the yucca habitat in southeastern Alberta. The plant is already listed as Threatened federally and endangered provincially. However, three moths and one skipper butterfly, all obligate yucca associates, have also been or are in the process of being evaluated (Committee on the Status of Endangered Wildlife in Canada 2009). The addition of these four insects to the endangered species list will lend much greater voice to the protection of this unique community in southeastern Alberta. The same is true for dune habitats – several moths that are restricted to dunes (*Copablepharon grandis*, *Melaporphyria immortua*, *Schinia avemensis*, and *S. verna*) are in the process of being assessed nationally and provincially, based on work carried out by several amateurs (Committee on the Status of Endangered Wildlife in Canada 2009, Alberta's Endangered Species Conservation Committee 2009). Listing of these species as threatened or endangered will help provide protection for all the animals and plants living in dune habitats. These insects can only be assessed if they are well known taxonomically, and their range and population levels are well enough known. All that information can only be gathered accurately by killing and collecting insect specimens, so it remains necessary to kill some insects, in order to protect the rest.

Collecting and Endangered Species: As detailed by Pyle (1992), insect collectors are a very minor mortality factor for insects, and their efforts generally do far more good than harm. The Lepidopterists' Society has developed a well-considered position on insect collecting (The Lepidopterists' Society 1996). Of all the insects listed as threatened or endangered in Canada by COSEWIC, not one of the species assessments lists insect collecting as a significant threat (Committee on the Status of Endangered Wildlife in Canada 2009). In fact, without the work of collectors, we would not have had the background information required to measure their populations accurately enough to make such assessments in the first place. Once these species are recognized as threatened or endangered and protected by legislation, it becomes illegal to collect them on crown lands, and it is illegal to collect them or any other spe-

A boy hunts for bugs in the badlands of Alberta. (photograph by G.R. Pohl)

cies in provincial or national parks and protected areas without a research permit. This is adequate protection for these threatened species from overzealous collectors. For the vast majority of insects that are not yet well enough known to make accurate assessments of their rarity, we need MORE collecting, not less, in order to gather that information.

Conclusion

In the recent campaign against "bug collecting" that I mentioned earlier, a society of local entomologists (The Alberta Lepidopterists' Guild) decided to engage with naturalist groups in a constructive way, by joining the Federation of Alberta Naturalists (FAN), an umbrella group of local naturalists' groups, including the group that had launched the anti-collecting campaign. I think that we have effectively communicated what entomologists do, and we are working with FAN to draw up a specimen collecting policy. The Alberta Lepidopterists' Guild has also been drawn into a local fight over proposed gas well drilling in the Suffield National Wildlife Area in southern Alberta and we have been providing well-documented scientific information on rare and little-known insects there, which appears to have been instrumental in putting a halt to the proposed drilling. Time will tell, but so far this has been a mutually beneficial collaboration, resulting in a much greater understanding of "bug collecting" and entomology among the local naturalist community, and a greater contribution by scientists to specific habitat protection initiatives.

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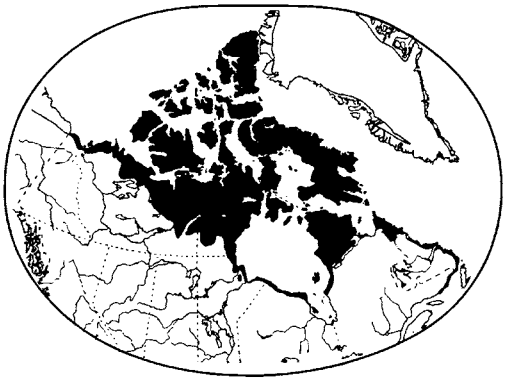
The COSEWIC Arthropod Specialist Subcommittee visits Norman Criddle's historic entomology laboratory at Aweme, MB.
(L-R): Gloria Goulet, Gary Anweiler, Ron Hooper, Donna Hurlburt, Laurence Packer, Rob Roughley, Jean-Francois Landry (with net), Ross Layberry, Herni Goulet, Greg Pohl, Donna Giberson, Rob Cannings, Colin Jones, Paul Catling (kneeling), Robb Bennett, and Dan Johnson. (Photograph by Brenda Kostiuk)



ARCTIC CORNER

News about studies of arctic insects

Introduction

Arctic Corner provides a forum for news and updates on research involving arctic arthropods. Contributions to *Arctic Corner* are welcomed by the Editor (see inside front cover).

Klondike spider rush

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There are spiders in them hills – and gold too, apparently! Despite a common belief that the arctic is a barren wasteland, especially with respect to arthropod fauna, the Yukon Territory is host to a wealth of spider and other arthropod species. Over the past four years it has become my personal gold (spider) rush. There are more than 300 species of spiders recorded from north of 60°C globally (Marusik and Koponen 2002) and a similar number represented in the Yukon Territory (Dondale *et al*. 1996).

The arctic for arthropods may be defined as the "region north of the transition from the boreal forest zone to the tundra" (Strathdee and Bale 1998). As with plants, this definition may have to be augmented sooner than one might expect. Global changes in climate are projected to have disproportionately dramatic effects on the arctic environment and arctic arthropods are projected to be some of the most rapidly affected organisms in the north (Callaghan *et al*. 2004). Although the number of models that attempt to predict future changes to the arctic is growing, large-scale temporal and spatial climatic effects on northern biota will be difficult to model, especially due to the substantial lack of quantitative data from the arctic currently available. There is evidence that vegetation is shifting northward in some regions of the arctic (e.g. Stow *et al*. 2004), yet we lack quantitative data for any mobile species in the north. Addressing how animals will be affected by future changes in climate will not be possible without an existing baseline of data. As such, areas where there are sudden changes in the landscape relative to the adjacent matrices (ecotones) likely serve as limits to ranges for many arthropod species and should serve as a good focus for monitoring temporal changes of arthropod species (Danks 1992). A baseline of data for arthropod biodiversity across the boreal forest-tundra transition zone (FTT) (Payette *et al.* 2001) will better serve future projections of the effects of climate changes in the north. The boreal forest-tundra transition zone is one of the largest transition zones globally and is unsurprisingly well represented in Canada's north.

The Dempster highway, North America's most northern highway, serves well as an envi-

ronmental gradient across the boreal forest-tundra transition zone and is an excellent place to address questions regarding present limits of species and changes in biodiversity along a north-south gradient. Not only does the Dempster highway cross the boreal FTT, but it also serves as a latitudinal transect with which to address regional biogeographic patterns. This northern region of the Yukon Territory was also unglaciated during the last (Wisconsinan) glaciation and served as a refugium for many arthropod species. This refugium may have allowed for the allopatric diversification of species from more southern refugia, thus providing the relatively high northern endemism in this region (e.g. ~ 8% spider species) (Marusik and Koponen 2002).

I have chosen to focus my studies on spiders while collecting numerous other arthropod taxa for future analyses. Collecting began in the summer 2005 and continued in 2006 and 2008. Spiders are easily collected via pitfall trapping and by hand or sweep nets in a repeatable fashion and are found in relatively high densities in the north ($\geq$ 1 per m^2 on the tundra). They are relatively identifiable (albeit many new records for these taxa are only otherwise represented in northeastern Siberia) and are ecologically meaningful, representing the top of the food chain for arthropods and others (e.g. oligochaetes etc.). With the exception of sanguinivorous Diptera, spider abundances are among the highest for arthropod groups in the arctic and probably contribute highly to the greater food chain in the north as food for birds and mammals.

Over the three years of sampling in the Yukon Territory, I have collected over 10 000 individuals representing more than 200 species. This work includes all three years of sampling alongside the Dempster highway (from Dawson City to the border with the Northwest Territories) and one year of collections from mountain transects (accessible from the Dempster highway). These collections give me the capability of analysing a powerful arthropod dataset in order to answer questions about how biodiversity changes across spatial (latitude and altitude) and environmental (FTT) gradients in the north. Along the 3.25+ degrees of latitudinal covered, spider species richness does not change significantly, but tundra habitats do yield more species and more individuals captured as opposed to forested sites. I have also shown significant effects of elevation on spider species richness and abundance. Furthermore, the boreal forest-tundra transition zone functions as a sledge hammer on species composition moving north. There are significant differences in species composition between boreal and tundra sites. Elevation and latitude also significantly affect species composition. This drastic change in composition is likely due to the fact that historical refugia existed in this region. Not surprisingly, the current faunal composition of the tundra is similar to that of northeastern Siberia. Current 'boreal forest species' likely belonged to historically more southern refugia during the last glaciation (~28-14 tya).

The most dominant spider species represented across the boreal FTT in the Yukon Territory is *Pardosa lapponica* (Thorell), which is a holarctic species that consistently comprises approximately 25% of trap captures. This species appears to be a tundra-adapted species but is found in lesser abundance in forested areas. *Pardosa uintana* Gertsch dominates forested

Female *Pardosa sodalis* with egg sac.
(photograph by J.F. Aublet)

areas and is ubiquitous throughout boreal forests of North America. *Pardosa sodalis* Holm is a strictly 'Beringian' species (represented in northwestern North America and northeastern Siberia) adapted to tundra sites and coexists with, but seems to out-compete, the significantly smaller *P. lapponica*. *Pardosa moesta* Banks is ubiquitously abundant throughout North American boreal forests and although relatively abundant, is likely near its range margin in my most northern areas sampled. These four species cumulatively represent over half of total individuals collected and will be the focal species examined for the effects of spatial and habitat gradients on life history characters.

My research has also revealed many new records (~10 spp.) for the Yukon Territory and one new record for the continent of North America (*Mughiphantes marusiki* Tanasevitch). My collections have also yielded numerous morphospecies, which may be new, undescribed species. It will become increasingly important to monitor biodiversity of the north given future climate projections and the first stage of this will require the accumulation of robust baseline data; this will require knowledge of not only the species present in the arctic but also patterns of abundance and richness as well as species ranges that encroach or span the north.

From my data thus far a few things are clear: the arctic of Canada and Alaska is a very understudied ecosystem that sustains many unique and potentially rare arthropod species. There is great potential for new species records and even descriptions of novel species, which need to be obtained for accurate predictions of changes in the north. It is also apparent (at least for spiders) that species richness does not change abruptly from the northern boreal forest to the tundra in northwestern North America, but there are significant differences in the kinds of species found in either biome type.

Being bent over collecting spiders all day is backbreaking work (similar to blueberry picking for those who have done it), but worth the powerful dataset that will result, a dataset that will hopefully serve as a benchmark for biodiversity in the north and a 'barometer' of future climate changes for arthropods and alike in the north. There are long days (≥ 24 hours) of light to work on a portable microscope (pro or con depending on degree of fatigue), but the scenery and relatively untouched land is inspiring, one might say golden, and there are plenty of tourists to chat with.

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Revisiting the Northern Insect Survey: Preliminary Results for Microgastrinae Wasps (Hymenoptera: Braconidae)

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Organized entomological research in northern Canada began in 1947 with the inauguration of the Northern Insect Survey (NIS) and the collection of thousand of specimens (Freeman 1952, Freeman and Twinn 1955). This unprecedented initiative sampled the insect diversity at 58 arctic and subarctic localities at a time when climate change was not yet a global concern (Buddle *et al*. 2008). Many scientific papers have been produced through the years – a compilation covering up to 1980 was published by the Biological Survey of Canada (BSC) (Danks 1981b), as well as a comprehensive book about arctic arthropods in general (Danks 1981a).

The BSC has maintained a research focus on arctic insects throughout its existence and a large-scale effort is planned to survey insects across Canada's far north (Buddle *et al.* 2008). The newly envisioned Northern Insect Survey project will document changes in Canada's arthropod fauna. Previous BSC arctic research activities have been scattered and/or directed to particular geographical regions; however, the current scope and intensity of biotic changes demand a more coordinated effort (Buddle *et al.* 2008). With this in mind, the present note discusses the preliminary results of ongoing research on microgastrine wasps from arctic and subarctic North America.

Microgastrinae (Hymenoptera: Braconidae) is one of the largest and most diverse groups of parasitoid wasps (Mason 1981, Whitfield 1997). They are key regulators of Lepidoptera larvae and play an important role in biological control efforts for both agriculture and forestry (Shaw and Huddleston 1991; Whitfield 1995, 1997).

We have studied over 7 000 specimens (Table 1) housed in the Canadian National Collection of Insects (CNC). Most of that material was collected as part of the NIS efforts, but we also incorporate substantial data from recent collecting and a few specimens from expeditions that predated the NIS itself. Altogether we have compiled data for over 120 localities covering most of the arctic and subarctic regions of North America; ranging from Alaska to the west, to Greenland to the east, and from 82.3° N in the north (Alert, Ellesmere) to 60° N in the south. Additionally, some more southern localities were included (usually 55–59° N; but in the case of Newfoundland, as far south as 47° N), in order to represent the full set of localities worked during the original NIS (Fig. 1).

In all cases, the sites sampled represented either tundra or boreal forest ecosystems – according to the ecozones classification and description by Environment Canada (2008). We subdivided the studied region in four major areas:

1- Canadian Arctic Archipelago, also including Greenland. This area represents most of the Arctic Cordillera and the Northern Arctic ecozones.

2- West of the Mackenzie River, covering Alaska and Yukon Territory, plus some localities in northern British Columbia and a few localities from Northwestern Territories west of the Mackenzie River. This area represents the Taiga Plains, Taiga Cordillera, and Boreal Cordillera ecozones.

3- East of the Mackenzie River and west of Hudson Bay, encompassing the continental parts of the Northwestern Territories, Nunavut, northern Manitoba and Alberta, and a small portion of northern Ontario near James Bay. This area covers the ecozones of the southern Arctic and the Taiga Shield west of Hudson Bay, as well as most of the Hudson Plains ecozone.

4- East of Hudson Bay, covering northern Quebec, Labrador, and Newfoundland. This area encompasses the southern tips of the Arctic Cordillera, Northern Arctic, and Southern Arctic ecozones, as well as the portion of the Taiga Shield east of Hudson Bay and a small portion of the Boreal Shield (Newfoundland).

Because the specimens came from diverse sources and years, the sampling coverage is far from uniform (Table 1); with collecting techniques, dates, and sites sampled varying considerably. Significant sampling efforts have been carried out in the Yukon Territory (close to a thousand specimens from the northern half of the territory made mostly during the NIS period; plus about the same number of specimens collected in the southern half during 2006); Churchill, Manitoba (over 700 specimens, about one third collected during the NIS efforts, the rest between 2005-2007); King Salmon, Naknek River, Alaska (more than 450 specimens, NIS); Tuktoyaktuk and surroundings, Northwestern Territories (400, NIS); Payne Bay, Quebec (more than 350 specimens, NIS); and Newfoundland (around a thousand specimens, half of them collected during the NIS period and the rest during 2007). Within the Arctic Archipelago, Ellesmere Island had the largest number with around 500 specimens (NIS and some recent efforts).

As for species diversity of Microgastrinae, the results, though incomplete yet, are nonetheless impressive (Table 2 and 3). Thus far we have identified close to 100 species and we estimated that there will be twice as many when the research has been completed. This represents more than the total currently known in Canada (135 species, Fernandez 2007) and two thirds of the Nearctic figure (around 300

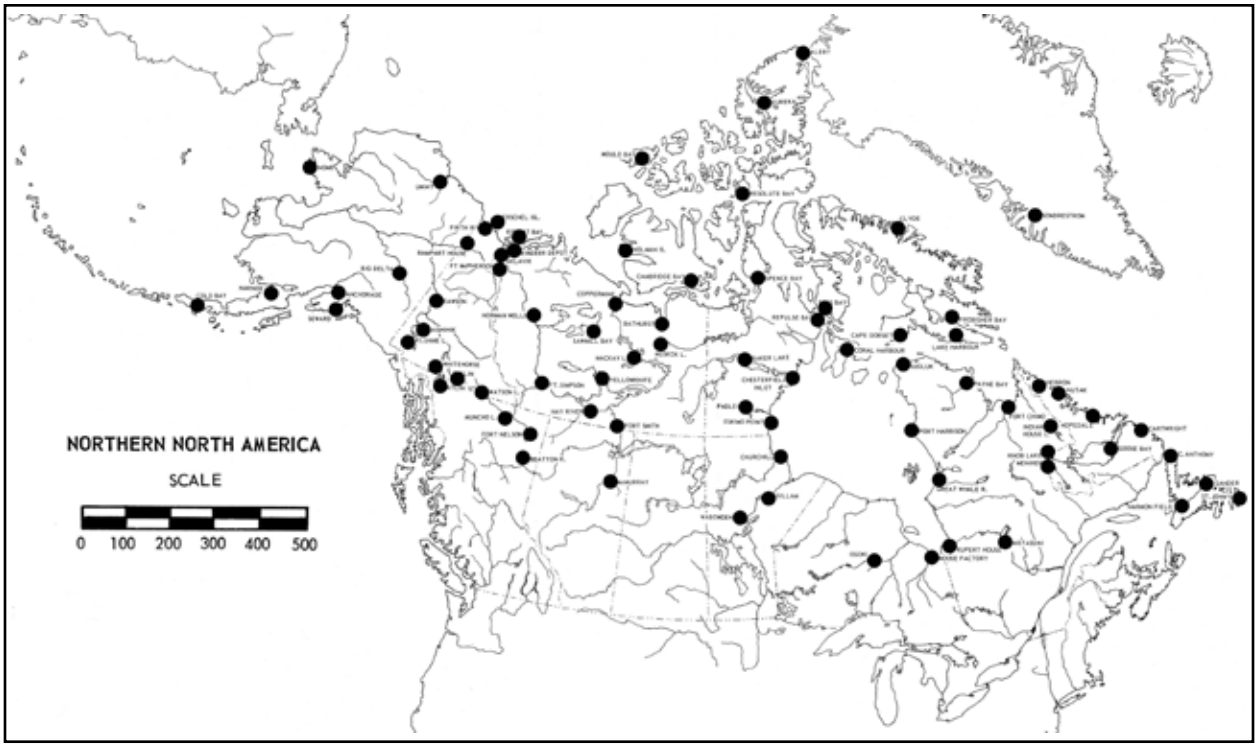

Figure 1. Localities surveyed from the Northern Insect Survey 1947–1958

Table 1. Localities best represented (in specimen numbers) from each major area. AA: Arctic Archipelago; WMR: West of the Mackenzie River; EMWH: east of the Mackenzie River and west of the Hudson Bay; EHB: east of Hudson Bay. Figures in parentheses after acronyms show the approximate number of localities studied in each area. All figures are rounded to the nearest tens.

AA (17)	WMR (55)	EMWH (25)	EHB (25)
Ellesmere Is., Hazen Camp (>200) Baffin Is., Clyde Inlet (150) Banks Is., Masik River (>100) Victoria Is. (100)	King Salmon, Naknek River (>450) Herschel Is. (>200) Old Crow (200) Pelly Crossing (200) Unalakleet (>100) Whitehorse (100) Champgane (100) Summit Lake (100)	Churchill (>700) Tuktoyaktuk (400) Norman Wells (150) McMurray (100) Yellowknife (50)	Payne Bay (>300) Corner Brook (200) South Branch (200) St John's (>100) Deer Lake (65) Plum Point (50)

species, Whitfield 1995, 2006; Yu *et al.* 2005). Previous information of Microgastrinae within the arctic and subarctic North America tallied only 30 species (Table 2).

Altogether, the evidence gathered strongly suggests that the actual diversity of this wasp group (both within the Arctic and elsewhere) is much higher than previously expected. For example, a preliminary comparison of the fauna of Churchill (Manitoba) with that of southern Yukon revealed that less than 20 % of the species were shared among the two areas – both samples had roughly the same number of specimens (700-800) and species (>70) available for study.

Even for the Arctic Archipelago, with its impoverished fauna, the number of known species has significantly increased as a result of our studies; and the diversity for other northern areas has similarly increased (see Table 2). We expect that more collecting will increase those figures further. For example, some recent efforts made in the Canadian Arctic (Bolduc 2008) have the potential to add valuable information. We will take this opportunity to solicit those who have conducted field work in northern North America to make any samples that may contain Microgastrinae specimens available for study. We would greatly appreciate the opportunity to borrow samples and specimens housed in institutions other than the CNC.

Besides of using traditional taxonomy, we also incorporated molecular data in our study. At present, we have obtained over 1 000 DNA barcodes, roughly half from Churchill specimens, 45% from southern Yukon, and the rest from several arctic localities. Barcoding has been advantageous through speeding up the identification process; associating males and females; revealing cryptic, morphologically similar species; and it has also helped with specimens in poor condition (missing body parts) that would otherwise be difficult – if not impossible – to identify. The latter is critical when dealing with old specimens, which are often damaged. The combination of approaches has proven to be very useful in our studies thus far.

With global warming, insect diversity will increase in the Arctic, bringing invasive species to the region with considerable impacts to ecosystem productivity and function. Therefore, a better understanding of the beneficial fauna to deal with potential new pests should be a priority. Microgastrinae is the single most important group parasitizing Lepidoptera larvae (Whitfield 1997). The fact that we have consolidated a relatively rich data source (+7 000 specimens, +100 species, +1 000 barcodes, +120 localities from arctic and subarctic North America) makes these wasps an ideal candidate for future projects such as the new Northern Insect Survey initiative.

Table 2. Approximate number of specimens studied and species found in arctic and subarctic North America. AA: Arctic Archipelago; WMR: west of the Mackenzie River; EMWH: east of the Mackenzie River and west of the Hudson Bay; EHB: east of Hudson Bay. Specimens studied - Figures rounded to the nearest hundreds. Previously known species - data compiled from Yu *et al*. (2005), van Achterberg (2006), and Whitfield (2006). Preliminary estimates - figures represent rounded numbers and are based on work done up until February 2009, with further research still in progress.

	AA	WMR	EMWH	EHB	All areas combined
Specimens studied	1000	3000	1700	1500	7200
Previously known species	14	14	7	9	30
Preliminary estimates	>20	~100	~100	>40	~200

Table 3. Genera of Microgastrinae found thus far in arctic and subarctic North America. Genera with > 15 species (***), > 10 species (**), and > 5 species (*) are highlighted. Data based on work done until February 2009, with further research still in progress.

1. *Apanteles* (***)	6. *Glyptapanteles* (**)	11. *Paroplitis*
2. *Choeras*	7. *Illidops*	12. *Pholetesor* (*)
3. *Cotesia* (***)	8. *Lathrapanteles*	13. *Protapanteles* (*)
4. *Diolcogaster* (*)	9. *Microgaster* (**)	14. *Sathon*
5. *Dolichogenidea* (*)	10. *Microplitis* (***)	15. *Venanus*

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Invertebrate samples from Arctic Wildlife Observatories Linking Vulnerable Ecosystems (ArcticWOLVES)

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As part of the International Polar Year (IPY), the ArcticWOLVES project has established in 2007 a network of circumpolar wildlife observatories in order to assess the current state of the arctic terrestrial food webs over a large geographical range. See http://www.cen.ulaval.ca/arcticwolves/.

Through Arctic WOLVES, a large number of invertebrate samples have been collected across the Arctic in the last four summers using pitfall and intercept traps. Traps were generally emptied every two days from early/mid June to early/mid August.

Some of these samples have been sorted to insect family and to other groups (except for the spiders and Collembola) and could be available for further study to those interested in one or several specific groups. The carabids and staphylinids of Herschel Island have already been spoken for, but others have not. In order to get additional information, please contact the people in charge for the different field sites:

Herschel Island: Don Reid at dreid@wcs.org or 867-456-7556

Bylot Island: Elise Bolduc at elise.bolduc@gmail.com or 418-723-1986 ext. 1909 or Joël Bêty at joel_bety@uqar.qc.ca or 418-723-1986 ext. 1701

Alert: Guy Morrison at guy.morrison@ec.gc.ca or 613-998-7296

Southampton Island and Coats Island: Grant Gilchrist at Grant.Gilchrist@ec.gc.ca or 613-998-7364 or Paul Smith at psmith@ncf.ca or 613-990-2384

Spitsbergen, Ellesmere Island (Eureka), Akimiski, Coats Island: Samples from these sites have not been sorted yet. These may be available for taxonomic work in the spring. For information on these samples, contact:

Spitsbergen: Maarten Loonen at m.j.j.e.loonen@rug.nl

Ellesmere Island (Eureka): Josée Lefebvre at josee.lefebvre@ec.gc.ca

Akimiski Island: Ken Abraham at ken.abraham@ontario.ca

Coats Island: Grant Gilchrist at Grant.Gilchrist@ec.gc.ca or 613-998-7364 or Paul Smith at psmith@ncf.ca or 613-990-2384

Selected Future Conferences

Organization	Date	Place	Contact
ENTOMOLOGICAL CONFERENCES			
Entomological Society of Canada	**2009,** 18–21 Oct..	Winnipeg, MB	with the Entomological Society of Manitoba http://www.esc-sec.ca/annmeet.html
	2010, 31 Oct. –3 Nov.	Vancouver, BC	with the Entomological Society of British Columbia
Entomological Society of America	**2009**, 13–16 Dec.	Indianapolis, IN	http://www.entsoc.org/am/fm/2009/index.htm
	2010, 13–16 Dec.	San Diego, CA	http://www.entsoc.org/am/fm/index.htm
Entomological Collections Network	**2009,** 12–13 Dec.	Reno, NV	http://ecnweb.org/
6th WDA International Congress of Odonatology	**2009**, 7–12 June	Xalapa, Mexico	http://www.odonatology2009.org/
13th International Symposium on Trichoptera	**2009**, 22–27 June	Białowieża, Poland	http://www.biol.uni.lodz.pl/trichoptera2009/
11th International Symposium on Tardigrada	**2009**, 2–7 August	Tübingen, Germany	http://www.tardigrada-symposium-2009.org
2010 International Congress of Dipterology	**2010**, 8–13 August	San Jose, Costa Rica	http://www.nadsdiptera.org/ICD/ICD-home.htm
XX1V International Congress of Entomology	**2012**	Daegu, Korea	http://www.ice2012.org/
OTHER SUBJECTS (especially those relevant to Survey projects)			
Canadian Society of Zoologists	**2009**, 12–16 May	Scarborough, ON	http://www.utsc.utoronto.ca/~csz2009/
North American Benthological Society	**2009**, 17–22 May	Grand Rapids, MI	http://www.benthos.org/Meeting/
Society for the Preservation of Natural History Collections	**2010**, 6–11 July	Leiden, The Netherlands	http://www.spnhc2009.org/
REGIONAL SOCIETIES			
Entomological Society of Ontario	**2009**, 2–4 October	Dorset, ON	http://www.entsocont.com/annual_meeting.htm