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NEWSLETTER OF THE BIOLOGICAL SURVEY OF CANADA (TERRESTRIAL ARTHROPODS)

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Canadian Museum of Nature
Musée canadien de la nature

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 2007 issue is July 23, 2007.

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 will also be available soon on the Survey's website at:
http://www.biology.ualberta.ca/bsc/bschome.htm

To receive this newsletter via email (as an Adobe Acrobat file) instead of a paper copy please send an email message to the Editor.

News and Notes

Bio-Blitz 2007

The Biological Survey of Canada will hold its 7th annual Bio-Blitz in Riding Mountain National Park, Manitoba, July 16-20, 2007.

Riding Mountain National Park is in southwestern Manitoba, in a forest-agricultural transition zone approximately 225 km northwest of Winnipeg. It can be accessed by road from south and north on Highway 10, which becomes Riding Mountain Parkway through the park. From east and west, the Trans-Canada Highway and Highway 16 intersect Highway 10.

Riding Mountain National Park protects about 10,000 ha of aspen parkland, an ecotone between boreal forest and grassland. The park is an upland sloping down gently to the west and steeply to the east, surrounded by agricultural lowland. Much of the park is forest of the Mixedwood Section of the Boreal Forest Region dominated by trembling aspen and white spruce, often with a rich understory of shrubs,

Aspen forest of Riding Mountain National Park, with a typical understory of shrubs and forbs (photo by P. MacKay)

A typical stream flowing through a wet meadow and spruce forest in Riding Mountain National Park (photo by P. MacKay)

on a clay-loam soil. Areas of Rough Fescue Grassland and Mixed Grassland occur particularly in the west of the park, but meadows of grasses and forbs are scattered throughout the park. The wildflower display in mid-summer is always colourful and sometimes spectacular. Patches of oak, with ash and elm in moister areas, occur in the east. Isolated dry habitats occur on the south-facing steep slopes of gullies cut into the eastern escarpment. An excellent guide to the park's flora is available, making host associations of insect herbivores. Much of the forest was established after wild fires before the surrounding farmland was settled by Europeans. The park is rich in wetlands, with springs, bogs, streams, many beaver ponds, small rivers, numerous marshes and lakes. Moose, elk, white-tailed deer, black bears and beaver are common; lynx, fisher and wolves are occasionally seen. The bird life is diverse, as is the insect fauna, although the latter is not well studied. One paved highway and a few gravel

roads provide ready access to over 400 km of trails, from which the diverse habitats can be reached on foot, by bicycle or on horseback. An excellent trail guide is available.

Bob Lamb and Pat MacKay have hiked many of the trails and conducted entomological research in many parts of the park over the past decade and will be able to direct entomologists with particular interests to the appropriate habitats.

Colonial planthopper on goldenrod
(photo by P. MacKay)

Mixed grassland in the Grasshopper Valley of
Riding Mountain National Park
(photo by P. MacKay)

Collecting permits and group camping have been arranged. In addition, there are 297 hotel, motel, or cabin units in Wasagaming and 109 units adjacent to the park.

Past BSC Bio-Blitzes have been very successful in collecting a lot of new material from interesting habitats, creating public awareness, and forging new partnerships that will assist in future arthropod biodiversity work.

For more information or to register please contact:

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or

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Updates will be posted on the BSC web site at:
www.biology.ualberta.ca/bsc/english/bioblitz.htm

Activities at the Entomological Societies' meeting

The 2006 joint annual meeting of the Entomological Society of Canada and the Société d'entomologie du Québec took place in Montreal, Quebec, 18-22 November 2006. The meeting was attended by about 350 people. Many of these were student members and there were many entries for the student presentations competition. Items in the program included:

An opening symposium on invasive species organized by the BSC.

A symposium from graduate students, and symposia on "Arachnology", "New trends in potato protection", "Biocontrol in Canada: partners and potential", and "Canopy arthropod ecology".

Numerous contributed papers in several sessions.

A student presentation competition for the President's prizes of the Entomological Society of Canada, in three sessions.

An extensive poster session, including a student competition for the President's Prize.

The ESC Gold Medal Address given by Dr. Richard Ring.

Governing Board and Annual General Meetings also took place, the Gold Medal and other honours were awarded, and there were many opportunities for informal exchange of information, including an opening mixer and a banquet.

The ESC meeting was followed by the meeting of the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods).

Symposium on Ecological impacts of non-native insects and fungi on terrestrial ecosystems

(sponsored by the Canadian Forest Service, Canadian Food Inspection Agency and the Biological Survey of Canada (Terrestrial Arthropods))

This international symposium featured a series of review and case study papers that examined the invasion of Canada and the northern USA by non-native terrestrial invertebrates (insects and earthworms) and fungi. The primary focus was on the impacts on non-native biota on ecological processes and biological diversity.

Implementing an invasive alien species strategy for Canada. **D. Seip**

Diversity of non-native arthropods in Canada. **D. Langor, L. DeHaas**

Ecological impact of invasive insects on forest ecosystems. **S. Liebhold**

Ecological impact of invasive fungi on forest ecosystems. **J. Loo**

Impact of an introduced scolytid, *Tomicus piniperda,* on native scolytids and natural enemy complexes. **S. Smith, N Rudzik**

Ecological impact of invasive insects on agricultural ecosystems – Wheat Midge Case Study. **O. Olfert, B. Elliot**

Ecological and economic impacts of the invasion of western Canada by the cabbage seedpod weevil (Coleoptera: Curculionidae). **L. Dosdall, G.A.P. Gibson, O.O. Olfert, P.G. Mason**

Does the Pandora's Box paradigm apply to parasitoids in classic biological control? **D. Parry**

The legacy of lady beetles (Coleoptera: Coccinellidae): the unintended effects of (un)intentional introductions **D. McCorquodale**

Invasive species under your nose and in your backyard: the secret wars of ground beetles. **J. Spence**

Impacts of invasive earthworms on Canadian forest ecosystems. **J. Addison**

Modeling the potential range and impact of invasive species. **J. Régnière, J. Logan, J. Pitt**

We can eliminate invasions or live with them! – High tech and low tech success stories. **D. Simberloff**

Panel Discussion

Papers on systematics and related themes

Many presentations were made in contributed sessions. The following titles include some of the papers of faunal interest that were

presented in these and various other scientific sessions, including posters. (Interesting treatments on a range of other subjects were presented in the various sessions.)

Deciphering the past: reconstructing the phylogeny of the Clusiidae (Diptera) using multiple (and sometimes conflicting) data sets. **O. Lonsdale, S.A. Marshall**

The impact of rotational seasonal grazing on the invertebrates of mixed-grass prairie, using ground beetles (Carabidae) and spiders (Araneae) as bioindicators. **A. Stjernberg, R.E. Roughley**

The diversity of indirect effects between soil fungi and insects. **R. Laird**

The diversification of the cardiophorine clade of click beetles (Coleoptera: Elateridae). **H. Douglas**

Phylogeography of *Nicrophorus nepalensis* Hope 1831 (Coleoptera: Siliphidae). **T. Mousseau, D.S. Sikes**

Conservation and genetics of the Peace River grassland butterflies. **S. Bromilow, F. Sperling**

Systematics and phylogeny of the subgenus *Sarcophaga* (Neobellieria) Blanchard (Diptera: Sarcophagidae). **M. Giroux, T.A. Wheeler**

Anopheles (Diptera: Culicidae) systematics in Ontario: cytogenetic methods and results. **A. Thielman, F.F. Hunter**

The effects of habitat size and surrounding land-use on selected families of bog-dwelling Schizophora (Diptera: Cyclorrhapha) in the southeastern Quebec and northern Vermont region. **A. Moores, T.A. Wheeler, J. Savage**

Aquatic insects in boreal streams of the Cape Breton Highlands, Nova Scotia: relationships with physical habitat and forest history. **J. Ogden, D. J. Giberson**

Influence of peat mining and restoration on diversity of Brachycera (Diptera) in ombrotophic peatlands in southeastern Quebec, Canada. **A. Grégoire Taillefer, T.A. Wheeler**

Monitoring and modeling terrestrial arthropod biodiversity on the Kenai National Wildlife Refuge, Alaska. **M. Bowser, J. Morton, P. Doak, D. Wagner**

Carabid response to natural disturbance-based silviculture across three boreal forest ecosystems in western Québec. **C. O'Connor, T.T. Work**

Food limitation of ground beetle (Coleoptera: Caraidae) communities in relation to activity, density, and insect mass. **E. Esch, J. Jacobs, J.R. Spence**

Landscape level association between trees and ground dwelling beetles. **C. Bergeron, J.R. Spence, J. Volney**

Species diversity and seasonal abundance of arthropods in turfgrass ecosystems. **S. Rochefort, J. Bordeur**

A comparison of ground beetle assemblages (Coleoptera: Carabidae) in fields grown under sustainable and conventional farming practices. **S. Bourassa, J.R. Spence, H.A. Cárcamo, F.J. Larney**

Ground beetle (Coleoptera: Carabidae) abundance and diversity in canola: wheat intercrops. **J. Hummel, L.M. Dosdall**

Vegetation structure and invertebrate diversity in agriculture: a look at ground beetles (Family Carabidae) in hayfields. **S. LeMoine**

Pollination in the genus *Eulonchus* (Diptera: Acroceridae): Flower visiting behaviour, pollen loads, and mate detection. **C. Borkent, E. Schlinger**

Assessing bee-o-diversity in mixed-grass prairie habitats. **A. Patenaude, R.E. Roughley**

Substrate selection by larvae in highly variable hosts restricts the importance of oviposition site in saprophagous wood-boring beetles (Coleoptera: Cerambycidae). **M. Saint-Germain, C.M. Buddle, P. Drapeau**

Stratégies de dispersion d'une fourmi en forêt boréale. **P. Boucher, L. Sirois, F. Dufresne, C. Hébert**

Mortality factors influencing a newly established invasive species – *Profenusa thomsoni* in Alaska. **C. MacQuarrie, D. Langor, J. Spence**.

The effects of latitude on spider species diversity north of 60. **J. Bowden, C.M. Buddle**

Monitoring spider diversity in SW Quebec forests: field techniques, taxonomy and three years of data. **C. Buddle**

Sexual size dimorphism in spiders: patterns and processes. **M. Foellmer, J. Moya-Laraño**.

Systematics and biogeography of the *Cicurina brevis group* (Araneae: Dictynidae). **P. Paquin**

A phylogeny of the large wolf spiders from North America; are we making progress? **G. Stratton**

Persistence and stability, at four spatial scales, for populations of an aphid on its native host plant. **R. Lamb, P.A. MacKay**

Notes on the life cycle of a fast growing arctic mayfly, *Baetis bundyae*, with an update of the mayflies of Nunavut. **D. Giberson, S. Burian**

Reproduction, feeding, and changing distribution of brachycentrid and hydropsychid caddisflies (Trichoptera) in the Upper St. Lawrence River. **D.B. Conn, D.A. Conn**

Challenges to invertebrate conservation in BC. **J. Heron**

Ecological land classification as a surrogate for arthropod biodiversity. **D. Langor, J. Hammond, G. Pohl**

"The beetles have arrived": Recent case studies on invasive alien insects in our forests. **S.M. Smith, P. de Groot**

Effect of harvesting on rove beetle species diversity in Acadian red spruce stands. **J. Sweeney, J. Klimaszewski, T. Work, J. Price**

Host-use patterns of adults and larvae of saproxylic wood-feeding Coleoptera in black spruce and apsen. **M. Saint-Germain, P. Drapeau, C.M. Buddle**

Recovery of carabid communities to variable retention harvesting. **J. Jacobs, T. Work, J. Spence**

Diversity in a dairy pasture: do Carabidae and Staphylinidae communities respond to different management practices? **K. Aikens, S.M. Townsend, A.A.M. MacDonald, C.G. Majka, D.B. McCorquodale**

Spider colonization of apple orchards. **T. Sackett, C.M. Buddle, C. Vincent**

Blackfly phylogeny through DNA sequencing? A critical study. **B. LaRue, C. Gaudreau, G. Charpentier**

The evolution of some heteropteran true land bugs. **M. Javahery**

Aleocharine rove beetles of Canada and Alaska – rapid progress in our knowledge (Coleoptera, Staphylinidae). **J. Klimaszewski, N. Gouix**

Islands in the sky: The beast, the impediment, and whirlpools in the pattern of arboreal community ecology. **N. Winchester**

Ecological processes shaping the foraging behaviours and associated performance of herbivorous insects within tree crowns. **R. Johns**

Habitat distribution of predatory mites in Australian forests: arboreal specialists, suspended soil generalists, or rainforest floor avoiders? **F. Beaulieu, D.E. Walter, H.C. Proctor, R.L. Kitching**

Canopy research on arthropods in temperate maple-dominated forests: From descriptions to mechanisms in 10 years. **S. Smith**

Diversity patterns at multiple spatial scales of canopy spiders found on sugar maple and American beech in hardwood forests. **M. Larrivée, C.M. Buddle**

Monitoring changes in canopy arthropod populations through time in the western Amazon Basin, Yasuni area, Ecuador. **T. Erwin**

Revision of the Mexican and Central American genus *Trachypholoeomimus* (Coleoptera: Curculionidae, Entiminae). **P. Horsley, R.S. Anderson, T.A. Wheeler**

Systematics of *Goniaspis* and implications for higher classification of Chloropidae (Diptera). **J. Mlynarek, T.A. Wheeler**

A taxonomic revision of the new world fauna of *Mesembrina* Meigen (Diptera: Muscidae) with description of the first Neotropical species. J**. Kuchta, J. Savage**

Phylogenetic analysis of North American *Cybaeus* spp. (Aranea: Cybaeidae) utilizing morphological and molecular characteristics. **C. Copley, R. Bennett, S. Perlman**

Étude moléculaire de la diversité génétique chez le simulies. **C. Gaudreau, V. Charbonneau, B. LaRue, G. Charpentier**

Identification moléculaire des mermithides (nematodes) parasites de mouches noires (Diptera: Simuliidae). **M. St-Onge, B. LaRue, G. Charpentier**

First focused survey of harvestmen (Arachnida: Opiliones) in Québec beech-maple forests. **C. Stephen, C.M. Buddle**

Seven introduced ground beetles (Coleoptera: Carabidae) in Québec: their distribution and potential range expansion since 1975. **A. Mercado, C.M. Buddle**

Beetles, bovines and biodiversity: an inventory of Coleoptera in an eastern Canadian dairy pasture. **S. M. Townsend, K.R. Aikens, A. MacDonald, C.G. Majka, D.B. McCorquodale**

Diversity and abundance of saproxylic Diptera emerging from coarse woody debris in Abitibi-Témiscamingue, Québec. **A. Hibbert, P. Drapeau, T. Work, T.A. Wheeler**

The effect of remnant boreal forest habitats on saproxylic beetle assemblages in landscapes subjected to harvesting. **A. Webb, C.M. Buddle, P. Drapeau**

Effects of alternative silvicultural practices on litter mite assemblages in Quebec's mixed-wood boreal forest. **A. Déchêne, C.M. Buddle**

Effects of stand type on Oribatid mite assemblages in southern Quebec. **Z. Sylvain, C.M. Buddle**.

Ants' colonisation of woody debris after wildfires. **P. Boucher, L. Sirois, C. Hébert**

Does gypsy moth invasion affect the natural mortality of native caterpillars? **L. Timms, S.M. Smith**

Phytophagous mites of Canada. **F. Beaulieu, K.W. Wu**

The Adirondack All-Taxa Biodiversity Inventory: full of possibilities. **C. Milewski, S. McNulty, J. Mihuc**

Biodiversity of parasitic wasps (Hymenoptera: Ichneumonidae) in the highest mountains of a tropical island and its Nearctic relatives: are they related? **J. Fernandez**

Taxonomic tools for paleoentomology in boreal forests. **M-È. André, S. Laberge-Gaudet, T.T. Work**

Insects associated with nests of the American Kestrels, Northern Saw-whet and Boreal owls. **T. Work, A. Hibbert, L. Imbeau**

Molecular identification of West Nile virus vectors and possibility of cross contamination among sorted mosquito samples. **M. Iranpour, R. Lindsay, A. DiBernardo**

An inventory of predacious mites in Quebec commercial apple orchards where IPM programs are implemented. **G. Racette, N.J. Bostanian, J.M. Hardman, J. Franklin, J. Lasnier**

Head of Biological Survey to retire

Hugh Danks, the Head of the Biological Survey of Canada (Terrestrial Arthropods) has announced his plans to retire at the end of August 2007. Hugh was hired on a contract in 1977 as the scientist-in-charge of the Biological Survey Project of the Entomological Society of Canada. In 1980, the Canadian Museum of Nature (then the National Museum of Natural Sciences) became a co-sponsor of the Survey and in 1982 Hugh was hired as the Head of the Survey, a position he holds to this day.

Because the CMN is undergoing strategic planning in 2007-2008, this position will be filled on a temporary (one-year) basis. For further information on this competition please contact the Secretariat or check the BSC website (http://www.biology.ualberta.ca/bsc/bschome.htm) or the Job Opportunities of the CMN web site (http://www.nature.ca/museum/hr/hr_e.cfm).

Summary of the Meeting of the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods), November 2006

The Scientific Committee met in Montréal, QC, on November 22, 2006. Because of budget restrictions this was an abbreviated meeting and some members were not able to attend.

Scientific Projects

1. Grasslands

All chapters have been submitted to editor Terry Wheeler for the first grasslands volume. However, there has been little progress on this volume since April.

2 Canadian Journal of Arthropod Identification

The Canadian Journal of Arthropod Identification (CJAI) was formally launched on June 28, 2006 with the publication of papers on the "Mecoptera of Ontario" and "Keys to the Families and Genera of Blood and Tissue Feeding Mites Associated with Albertan Birds". Several other papers have either been submitted or are in advanced stages. Scientific Committee members were encouraged to ensure that their colleagues are aware of this excellent opportunity for free digital publication of extensively illustrated taxonomic works.

Mr. Dave Cheung, the journal's technical editor, presented a talk on the CJAI at the 2006 Entomological Society of Ontario meetings. His was one of five talks at the meeting that mentioned work published or pending in CJAI.

The University of Alberta Libraries has offered to host the CJAI as part of their Open Access initiative. The Committee responded favourably to this offer and will follow up as appropriate. The CJAI is currently housed on the BSC web site.

3. Terrestrial arthropods of Newfoundland and Labrador

A key to the Curculionoidea is planned for completion this fiscal year and submission to the CJAI. The Newfoundland Department of Environment and Conservation provided a grant to finish this work and is interested in continuing to support arthropod biodiversity work in NL. Work on macromoths and on the Staphylinidae continues. There is a large amount of activity in extracting species records from the literature which will contribute to the species database and to the bibliographic database. Work is still needed on major orders such as Diptera and Hymenoptera. The Bio-Blitz 2006 provided a lot of new material from interesting habitats, including two new mosquito records for the island.

4. Forest arthropods

The BSC continues to maintain and update a list of forest arthropod biodiversity projects in Canada and adjacent parts of the United States This product, which can be found on the BSC web site, highlights current activity in Canada and the northern United States and facilitates contact between researchers with complementary interests. Volume 3 of the Arthropods of Canadian Forests newsletter will be published electronically in late April (English) and mid-May (French) to over 200 recipients in 8 countries.

Most of the 7 papers from the JAM-2005 symposium, "Maintaining Arthropods in Northern Forest Ecosystems," have been finalized and will be published in The Canadian Entomologist.

Work on the Cerambycidae of Canada and Alaska project continues. The goal is to produce and publish a handbook to the Cerambycidae of Canada and Alaska. Most of the large collections in Canada and Alaska have now been examined, and specimens identified and entered into a database. Revisionary work is essentially complete for the genus *Tetropium*, and other taxonomic work is under way.

5. Insects of the arctic

A graduate student, Mr. Julio Rivera did extensive trapping in the western Cordillera in-

cluding Alaska and the Yukon. Other field work is planned for 2007. A proposal to revisit historical arctic insect survey sites in a systematic way (see also Graduate student proposal below) could provide an opportunity to encourage collaborative work. Finding alternate sources of funding might make this costly northern work more feasible.

6. Seasonal adaptations

Several papers published or in press under the auspices of this project were reported on.

7. Invasions and reductions

A well attended 1-day symposium on Ecological Impacts of Non-Native Insects and Fungi on Terrestrial Ecosystems was held on November 18 at the Joint Annual Meeting in Montreal. There were 13 speakers from the USA and Canada. Papers will be published in a special issue of Biological Invasions with the addition of two more papers about fungi.

In 2005, the Canadian Forest Service commenced a new national project on established alien species. As part of a CFS project, Dr. David Langor developed a list (with associated data) of the non-native tree-feeding arthropods and fungi of Canada, and subsequently a list of all non-native terrestrial arthropods. A selected bibliography is also being compiled. An analysis of these data will be published and the data about arthropods on trees will be incorporated into a CFS/CFIA IAS web site currently under development. Another related activity is the capture of label data associated with archived specimens of non-native arthropod fauna and fungal flora on trees. These data will be used to develop distribution maps and for analysis of rates and patterns of range expansion.

Progress on capturing data for the coccinellid project continues and a paper was presented at the aforementioned symposium.

Other scientific priorities

1. Bio-Blitz proposals

The 2005 Bio-Blitz held at Waterton Lakes National Park continues to yield new data as participants complete identifications. Some new collecting occurred in 2006 and the research permit is valid for another year. The 2006 BSC Bio-Blitz took place in Gros Morne National Park, NL, from 5-10 July with the participation of Parks Canada and the Newfoundland Department of Environment and Conservation. There is much interest from Parks Canada employees at Gros Morne National Park 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 that bodes well for future arthropod biodiversity work on the island.

Bio-Blitz 2007 is planned for Riding Mountain National Park, MB. There is some interest in having a 2008 Bio-Blitz in a northern national park.

A proposal to organize a series of Collection Blitzes to assess material and give particular curatorial attention to chosen collections was discussed.

2. Survey web site

An updated web site was launched in the first week of June 2006. A summary of the changes (clearer menu structure, etc.) was published in the Fall 2006 Newsletter.

3. Faunal analysis

Steps needed to revitalize this project were discussed. They included redefining the project objectives, better defining the precise form of the output, updating the higher taxonomic categories, simplifying the existing protocols, renaming the project, striking a new subcommittee, and developing a list of experts. A subcommittee was established to begin the work.

4. Arthropods and fire

The Journal of Insect Conservation has tentatively agreed to publish the papers from the BSC symposium on arthropods and fire held last year. To date 7 authors have confirmed their participation, 2 have given tentative agreements, and 1 has declined.

5. Arthropods of the Gulf of St. Lawrence Islands

Some collecting occurred during the summer of 2006 in this fledgling project.

6. Databasing

A large CFI proposal that will fund databasing at several university entomological and botanical collections across Canada has been funded. The Nearctic Spider Database of The Canadian Arachnologist website at http://canadianarachnology.dyndns.org/, which is constructed and promoted by Mr. David Shorthouse, continues to grow rapidly in size, sophistication and influence. The BSC database of collecting localities should be soon ready for posting on the BSC web site.

7. Biodiversity sampling brief

The proposal to revise and expand the Survey's 1994 biodiversity brief on planning a study and recommended sampling techniques had been put on hold because a planned British Museum publication seemed to cover the same material. However, it has since been learned that the British Museum publication has been cancelled, and so the Survey's initiative could be revived.

8. Monitoring of continuing priorities

Due to the abbreviated meeting only written reports were accepted. For Ectoparasites of vertebrates Dr. Proctor reported that a Lucid interactive key to nasal mites of the family Rhinonyssidae known from birds in Canada has been completed. Dr. Proctor is looking for a new M.Sc. or Ph.D. student interested in the systematics of avian mites to start in Sept 2007.

Liaison and exchange of information

Due to the location and abbreviated nature of this meeting most representatives from other agencies were not able to attend.

1. Alliance of Natural History Museums of Canada

Mr. Roger Baird, Director Collections Services, Canadian Museum of Nature reported that the Alliance of Natural History Museums of Canada is putting together a strategic plan to determine what its current capabilities are, where the gaps are, and the future direction of the Alliance. A collections survey of institutions that are part of the Alliance has been completed. How the organization can grow to be more inclusive is under discussion.

2. Agriculture and Agri-Food Canada

Dr. Jean-François Landry reported that the departmental reorganization is largely completed. Dr. Barry Grace, formerly acting Science Director for the Biodiversity Theme of the Environmental Health Program has been officially appointed to that post. Several publications are in process or have been recently published. The primary types of the CNC will be databased and made available in an online, searchable database.

Other business

1. BSC transition

Following the announced retirement of Dr. Hugh Danks, both the Chair of the Scientific Committee and the President of the Entomological Society of Canada wrote to the President of the Canadian Museum of Nature, Ms. Joanne DiCosimo, to show the support of the scientific community for the BSC operation. In turn, Ms. DiCosimo had written to Dr. Shorthouse and explained that the Museum would not be in a position to make a decision about the long-term relationship between the CMN and the Biological Survey until the Museum's strategic planning process for 2008-13 concludes in the winter of 2007-08. Ms. DiCosimo had outlined options to fill the gap between the time Dr. Danks retires and when this planning is completed. The Committee discussed these and other options and agreed to draft a reply to Ms. DiCosimo.

2. Graduate student proposal

A proposal made by the chair of ESC student affairs committee, Mr. Chris Borkent, to promote graduate student work in northern Canada was considered. Mr. Borkent hoped to build upon the Northern Insect Surveys that were done in the 1950's and 1960's as well as

other programs that have catalogued northern species. A subcommittee agreed to develop a proposal for review at the spring meeting of the Scientific Committee.

3. Other matters

The Committee also considered briefly issues such as endangered species, the BSC award, and the membership of the Scientific Committee.

Project Update: Pending publications

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Most of the scientific projects of the Biological Survey produce publications of various sorts to help develop the projects and to deliver the results of the work. Publications from a number of initiatives are currently in preparation, and these are outlined here.

Arthropods of Canadian Grasslands

The book "Arthropods of Canadian Grasslands: Ecology and Interactions in Grassland Habitats" provides an overview of grassland regions in Canada, with syntheses of arthropod assemblages in select habitats and their ecological roles, and is currently being edited. All component chapters have been received and a synthetic concluding chapter is being prepared. The volume will go to press in 2007.

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Boucher, S. and T.A. Wheeler. Trophic structure of the Brachycera (Diptera) assemblage in xeric grasslands of the southern Yukon Territory.

Floate, K.D. Galling arthropods associated with the hybrid complex of Populus (Salicaceae) on the prairies.

Hamilton, KG.A. and R.F. Whitcomb. Leafhoppers (Insecta: Homoptera: Cicadellidae) as indicators of grassland habitats.

McGinn, S.M. Weather and climate patterns in Canadian grasslands.

Paiero, S.M., S.A. Marshall, P.D. Pratt and M. Buck. The insects of a southern Ontario tallgrass prairie.

Roughley, R.E., D.A. Pollock and D.J. Wade. Tallgrass prairie, ground beetles (Coleoptera: Carabidae) and the use of fire as a biodiversity and conservation management tool.

Scudder, G.G.E. Grasslands: biodiversity hotspots for some arthropods in British Columbia.

Scudder, G.G.E., M.A. Alperyn and R.E. Roughley. The aquatic Hemiptera of prairie grasslands and peatlands.

Shorthouse, J.D. Attributes of the grasslands of Canada.

Shorthouse, J.D. The community of arthropods associated with cynipid galls on wild roses in Canadian grasslands.

Wade, D.J. and R.E. Roughley. The responses of a tallgrass prairie spider (Araneae) community to various burn seasons and its importance to tallgrass prairie management.

Synthesis

The second volume in this series is tentatively entitled "Arthropods of Canadian Grasslands: Arthropods and Altered Grassland Ecosystems" (edited by K.D. Floate; invitations to

authors will be sent this spring). This volume will emphasize arthropods in grassland habitats altered by agricultural activity and livestock production. Chapters will summarize arthropod communities in agroecosystems, and describe the ecological roles of the most significant members in these communities.

"Biodiversity of Arthropods in Canadian Grasslands" (under development led by F.A.H. Sperling and J.M. Cumming) will have a greater taxonomic focus. It will include extensive species' checklists and faunistic analyses of select arthropod groups.

Arthropods of Canadian forests

Chapters derived from invited papers at a BSC symposium on "Maintaining arthropods in northern forest ecosystems" held at the 2005 Annual Meeting of the ESC/ and ESAlberta in Canmore have been edited by D.W. Langor and J.R. Spence and assembled for an issue of the Canadian Entomologist. Most papers have been reviewed and it is hoped that they will be submitted to the journal by the end of April.

List of contents

Langor, D.W., J.R. Spence, J.E.H. Hammond, J. Jacobs, and T. Cobb. Maintaining saproxylic insects in managed forests.

Pohl, G., D.W. Langor, J. Klimaszewski, and T.T. Work. Rove beetles (Coleoptera: Staphylinidae) in northern forests.

Richardson, J. Aquatic arthropods and large-scale land-use effects in temperate North America.

Shorthouse, D.P. and C. Buddle. Deciphering a complex web: the structure and dynamics of spider assemblages in disturbance-driven boreal forests.

Spence, J.R., D.W. Langor, W.J.A. Volney and J. Jacobs. Unthreatening forest arthropods: simultaneous management of 'beezillions' of small and heterogenous risks.

Summerville, K. and T.O. Crist. **S**tructure and conservation of lepidopteran communities **i**n managed forests of northeastern North America: a review.

Work, T. and J.R. Spence, D.W. Langor, M. Koivula and J. Sweeney. Using core species assemblages and rare carabid taxa to evaluate forest change in Canada.

Abstracts of these papers can be seen at http://www.biology.ualberta.ca/bsc/english/forestsymposium.htm

Arthropods and fire

Building on a core of papers based on presentations at a BSC symposium at the 2005 Annual Meeting of the ESC and ESAlberta in Canmore, a set of papers is being developed, edited by C.M. Buddle, for submission to the *Journal of Insect Conservation*.

Provisional list of contents

Cobb, T., D.W. Langor, J.R. Spence and I.D. Phillips Pyrophilous arthropods and post-fire salvage harvesting: the ecological implications of an economic reality.

Hawkes, B. Documenting fire characteristics: what is important in understanding fire and insect interactions?

Roughley, R.E. Beetles, fire and tallgrass prairie.

Saint-Germain, M., C.M. Buddle and P. Drapeau Pyrophily in boreal insects: Do wildfires really contribute at maintaining higher populations?

Scudder, G.G.E. Recovery of the arthropod fauna in an Antelope-brush community following destruction by fire.

Invasive species

A broadly based symposium, sponsored by the CFS and the BSC and organized by D.W. Langor and J. Sweeney, entitled "Ecological Impacts of Non-Native Insects and Fungi on Terrestrial Ecosystems"was held at the 2006 joint Annual Meeting of the ESC and SEQ in Montreal. Invited symposium papers, with a small number of additional titles, are being edited by Dr. Langor and Dr. Sweeney for publication in a special issue of the journal *Biological Invasions*. Submission of peer-reviewed, edited papers is due to the journal 1 October 2007. In addition to the papers listed below a synthesis wrap-up paper will be included. There are also plans to print some copies of the special issue in hardcover.

Provisional list of contents

Addison, J.A. Impacts of invasive earthworms on Canadian forest ecosystems.

Callan, B. and D. Rioux. Ecological impacts of *Phytopthora ramorum* in Canadian forests.

Dosdall**,** L.M. Ecological and economic impacts of the invasion of western Canada by the cabbage seedpod weevil (Coleoptera: Curculionidae).

Langor, D. and L. DeHaas. Diversity of non-native terrestrial arthropods in Canada.

Liebhold, A. Ecological impact of invasive insects on forest ecosystems.

Loo, J. Ecological impact of invasive fungi on forest ecosystems.

McCorquodale, D. The legacy of lady beetles (Coleoptera: Coccinellidae): the unintended effects of (un)intentional introductions.

Rossman, A. Ecological impacts of invasive fungi in agricultural ecosystems.

Olfert, O. and Elliott, R. Ecological of invasive insects on agricultural ecosystems - Wheat Midge Case Study.

Parry, D. Does the Pandora's Box paradigm apply to parasitoids in classic biological control?

Régnière, J. Modeling the spread and ecological impact of invasive species.

Simberloff, D. We can eliminate invasions or live with them! – high tech and low tech success stories.

Smith, S.M. and N. Rudzik. Impact of an introduced scolytid, Tomicus piniperda, on native scolytids and natural enemy complexes.

Spence**,** J.R. Invasive species under your nose and in your backyard: the secret wars of ground beetles.

Web Site Notes

Information for Students

Many sections of the BSC web site include information that is useful for students. For example, an overview of Canada's insect fauna is available (*Canada's insect fauna*), the Survey's *Publications* include substantial amounts of both general and scientific information about the fauna, and an online *database of entomologists* allows searches for others who might be interested in a given thesis topic.

Of particular interest too are the *BSC scholarship*, providing a grant of $1000 as well as scientific recognition in support of students of arthropod biodiversity, and information on *Sources of funding* for work by graduate students on arthropod biodiversity. This latter document provides information on some of the available funding sources for graduate study and research in biodiversity, with special reference to terrestrial arthropods. Advice on preparing applications is also given.

Please see 'Information for Students' (http://www.biology.ualberta.ca/bsc/english/students.htm) or Renseignements à l'intention des étudiants (http://www.biology.ualberta.ca/bsc/french/frstudents.htm) for links to the above.

A general account of the nature of the Canadian insect fauna and of entomology in Canada was prepared by the Survey as a booklet entitled "Insects of Canada", distributed at the International Congress of Entomology held in Vancouver in 1988. The full text of that booklet can be found at http://www.biology.ualberta.ca/bsc/briefs/brinsectsofcane.htm (English version) or http://www.biology.ualberta.ca/bsc/briefs/brinsectsofcanf.htm (French version). Limited numbers of paper copies of this brief are available upon request. The web site of the Canadian Museum of Nature carries the Survey's account of the Canadian insect fauna in a less technical abridged version. See http://nature.ca/research/bscta_e/index.html (English) or http://www.nature.ca/research/bscta_f/index.html (French).

Dubious awards: Sashes and such

Many scientists receive letters from the International Biographical Institute (Cambridge, England), the American Biographical Institute (Raleigh, North Carolina), and other organizations, informing them that they have won an award or recognition for their work. These organizations send letters to large numbers of people, including leaders of science and business, typically promising them inclusion in some prestigious-sounding volume, or promising an award at a meeting convened to provide similar recognition. These letters normally are signed by the "Director" of one of the "Expert Panels" making the awards.

The organisations offer many different categories of recognition, sent out to different mailing lists, to entice gullible people. For example, a small sample of the touted volumes and awards includes such titles as "2000 Leading Scientists of the 21st Century" [and other specialties], "Book of 2000 Intellectuals", "Scholar of the Year", "Man of the Year", "Continental Governor for the United States of America," " International Man of the Year", "International Book of Honour", "500 Leaders of Influence", "1000 World Leaders of World Influence", "International Leaders of Achievement", "5000 personalities of the World", "Community Leaders of America", and so on. More general categories include such things as the "Award for Distinguished Service to Science" and the "World Lifetime Achievement Award". Offered to some other recipients are the "International Diploma of Honour", "Ambassador of Grand Eminence", "American Medal of Honor", "Congressional Medal of Excellence", "Einsteinian Chair of Science", "Genius Laureate of the United States", "Great Minds of the 21st Century Award", "International Peace Prize (United Cultural Convention Award)", "Member of the World Institute of Achievement", "One of the Genius Elite", "Platinum Record for Exceptional Performance", "Register of the World's Most Respected Experts", "World Lifetime Achievement Award", "World Laureate of the American Biographical Institute", "World Medal of Freedom", and even membership in the organization, such as a Diploma of Fellowship "commemorating Magnificent and Distinguished Deeds".

Each recipient is invited to purchase items that can be proudly displayed or worn to showcase his or her high achievement, such as a copy of the volume (perhaps luxuriously bound in leather), a plaque or medal (finely engraved with the recipient's name), or even a sash (splendidly embroidered in gold thread, of course). Each of these items of recognition tend to cost about US $250. The alternative of registration at a meeting might attract a "registration fee" of twice as much. Clearly, promising such "recognition" supports a lucrative business.

Some, chiefly unsuspecting, people in Europe and North America have even claimed the recognition afforded by these "awards" among their lists of qualifications and honours. In some parts of the world, newspaper advertisements are commonly placed by the recipients to advertise the awards, a behaviour reinforced by the fact that no one there laughs at them for having spent money in this way. However, the level of screening to which potential recipients are subjected is suggested by the response when an Indian hotel submitted the name of their cook: he duly received a plaque and citation for his leading role in South Asian Society.

A final category includes various "Who's Who" and similar volumes. Although some such works with wide coverage, such as the original British "Who's Who", are published in large press runs without charge to authors and are held by major libraries for reference, most of the works with similar titles are published by vanity presses and are little used except by the included book purchasers.

The Quiz Page

—test your knowledge of Canada and its fauna—

1. What is the Quaternary Period?

2. What is the lowest winter temperature experienced by profundal chironomid larvae in Canadian lakes?

3. What is the shortest mean minimum generation time (mean interval from oviposition or larviposition to the first progeny of the next generation) for an insect and for a mite?

4. Characteristic suspended soil and litter habitats are associated with the high canopy of the ancient forests that grow in high rainfall areas on the west coast of Canada. What are the two most abundant groups of arthropods in those habitats?

5. What do the following acronyms stand for in an arthropod context?

   a. EABSAP

   b. EAG

   c. FPOM

   d. LPU

   e. SCP

   f. SOG

[Answers on p. 23]

Canadian Perspectives: Climate change impacts on insects in northern Canada

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Canada occupies about 10 million km², and as might be expected different parts have different climates, with considerable differences from south to north and from east to west. Nevertheless, Canada's basic climate is a northern, continental one with hot summers and cold winters. Most major Canadian cities have average annual temperatures only 1 to 5°C above freezing, and winters much colder than that.

The potential social impacts of climate change will be greatest in southern Canada, influencing dominant elements of the Canadian economy including agriculture, forestry, and fisheries, and therefore probably attracting more attention than changes in natural environments. But a focus on change in the north is also appropriate not just because there are huge tracts of uniform habitat like arctic, boreal forest, and transition zones that will be influenced by warming trends, but in particular because the available climate models predict that temperature changes will be much greater in northern Canada than in the south.

Global temperatures have been increasing. The trend in Canada is similar, about 0.4°C in the 50 or 60 years since reliable country-wide records began, compared with 0.5° globally. Nevertheless, there is a great deal of year-to-year variation, so that on relatively short time frames it is difficult to see either the climatic trends or the possible insect responses.

Warming of the country is projected to continue. Nevertheless, there are important geographical and seasonal differences. For example, by 2050 the arctic is expected to have warmed by 5 degrees C or so, while most of the country including the boreal forest will see only about 2 or 3 degrees of increase.

These forecasts are by no means precise. Data about trends are extrapolated by making assumptions about future levels of greenhouse gases such as carbon dioxide and sulphates. Complex models incorporate these and other data (including incoming and outgoing radiation, global circulation patterns, clouds, precipitation, snow and ice, wind, mountains, ocean currents, sea ice, volcanic activity, etc.) to make quantitative predictions, so the process is inexact. Indeed, some models predict up to twice the rise of temperature that is customarily cited.

All models confirm that the effects will vary in location and in degree, and among seasons of the year. In Canada, for example, changes are forecast to be smaller in summer than in winter. Quantitative predictions are also available for Canada about the effects of climatic warming on physical elements such as coastline submergence, permafrost thaw, forest fire impacts, river flows, sensitivity to erosion, degradation of northern soils, and peatland changes. However, there is not much detail about expected responses at the biological level, except for the usual generalizations that the ranges of animals and plants will extend northward, for example, or that grassland will eventually replace forest in the warmer, drier centre of the continent.

Looking at northern insects in this context is instructive because the arctic arthropod fauna is surprisingly numerous with at least a few thousand species north of tree line, although they belong mainly to a limited number of taxa

that do well under these harsh conditions. Insects that eat decaying materials (especially in water and soil) and parasites like lice on the skin of birds and mammals are most common, reflecting the warmest habitats and the availability of food. Because the fauna is taxonomically and ecologically distinctive, climatic warming might be expected to bring some dramatic changes.

Because of the effects of warming by sunshine, uneven distribution of snow driven by the wind, the presence of permafrost, and so on, temperatures in insect habitats are more diverse and variable than the air temperatures used in climate models. Therefore, insects are affected by various patterns of climate, not just by the mean temperatures that are most easily cited and modelled. For example, different degrees of severity, seasonality, unpredictability and variability are associated with different climates, and these will change in different ways as climate changes.

Severity reflects persistent conditions that limit life, such as low summer temperatures and very low winter temperatures, as well as dryness, for example. The severity of conditions for growth can be estimated from the number of day-degrees accumulated in a season as well as from mean temperatures. Coping with severity requires insect resistance, specific microhabitat selection, and so on. The high arctic currently has very few day-degrees for growth; summer temperatures are so low that the predicted summer temperature increase will double the mean July temperature.

Seasonality reflects the fact that conditions are intermittently favourable on an annual time frame. Insects have to time the life cycle to limit development and activity to appropriate times of year, sometimes in a very narrow window when the season is very short, but also if foodplants are suitable for only a short period.

Unpredictability reflects the short-term pattern of conditions, such as the expected range of relevant temperatures in a given month, and hence the need for adaptations to sudden temperature changes. The impact of this range depends also on the mean temperature. For example, in cold High Arctic sites the likelihood of frost in July (the warmest month) may reach 90%.

Variability shows how variable are such features as summer temperature from year to year. Such patterns establish the extent of mortality that might be associated with fixed patterns such as emergence at a given time of year.

Examining these more complex climate patterns still falls far short of allowing us to interpret what will happen to insects when the climate changes, because arthropods live in microhabitats that, especially when warmed by sunshine, can be extremely favourable compared to the air above them. Some arctic soil and plant habitats have temperatures commonly 10°C and up to 30°C or more higher than ambient air temperatures. Shallow ponds stay 10°C or more above ambient during the High Arctic summer when air temperatures are only 4 or 5°C.

Of course, warming trends in climate should permit additional species to survive farther north or augment populations of existing species, because a dramatic effect might be expected from even a modest increase in temperature when current temperatures operate so close to the limits for life for insects and the effective growing season is so short. However, the expectation for insects that there will be more generations per year, more stable and persistent populations, and addition of species currently prohibited by low heat sums is too simple.

For example, diapause may limit development to one generation per year, and even if temperatures rise time may be “wasted” to prevent development that could not be completed before winter. Then there will not be any sort of “linear” increase in development according to temperature, even though much of the literature and oversimplified experimentation makes this assumption. Summers may be longer, but this change will not necessarily improve conditions for insects because the microhabitat temperatures and moisture relationships important

to insects do not all coincide with changes in mean ambient temperature. Winters may be shorter but they will still be very cold, while concomitant changes in insulating snow cover will have other effects on these organisms.

Conditions in the high arctic provide a cautionary example. In the Canadian western high arctic relatively small islands lie in the Arctic Ocean. Climate warming is likely to melt permanent or seasonal sea ice to expose more open ocean. In turn, this open ocean will probably lead to increased cloudiness in summer. The resulting reduction in sunshine would make insect microhabitats cooler and thus almost certainly more than offset any increase in mean air temperature. Indeed, the insect fauna of the northwestern arctic is already much less rich than the east because of the greater summer cloud cover. Such changes are driven by global circulation patterns (cf. climate models) but also by more local effects such as island size, relief and the extent of sea ice in summer.

Moreover, temperature is not the only constraint. The high arctic is a polar desert with extremely limited annual precipitation, where moisture as well as cold constrains life. Changes in moisture regimes that come with climate change affect the suitability of habitats for insects through the amount and seasonal supply of moisture itself, not only by the duration of sunshine controlled by cloudiness. But the effects of climatic warming on moisture regimes are difficult to predict at the local level.

Another complication of understanding climate-change effects on insects is that individual arctic species are engaged in surprisingly complex food webs. Herbivorous insects are much reduced in more severe sites, where insects drop out much faster than the plants on which they could feed. Change would therefore be expected to generate changes in the dynamics of herbivores and pollinators, but we have only general indications of what might happen. Again, most arctic plants are low and clump forming and rely for seasonal growth or seed development on sunshine, and so would be affected in some of the same ways as insects by changes in cloud cover.

In addition, many insects characteristically respond to changed environments not by new adaptations but by movement to or from areas that are newly or no longer suitable. The short life cycles and the potential for aerial dispersal of many insects allows a rapid response to environmental changes, and insects of various kinds disperse into arctic areas from sources many hundreds of kilometers away. Changes will reflect naturally and human-caused introduced species and the dynamics of colonization, not just a change in local climates.

Northern insects could be used to measure climate change Such measurements would have to be relatively simple, because for the arctic fauna in particular it is not possible to sample continuously or even regularly in such remote places.

Some conspicuous species (butterflies, mosquitoes, and bumble bees) that are well known taxonomically would lend themselves to use as markers of abundance or range.

Because many arctic species are linked with other organisms, it may be possible to use interspecific ratios, such as herbivores compared to plants, to indicate ecosystem structure, and hence to reveal correlated or discordant responses of different taxa to environmental change. Aquatic species are better represented in more northern zones compared to terrestrial species, reflecting the fact that shallow waters are especially favourable habitats in the arctic because they warm up rapidly by solar heating of the bottom. Their proportion might decline as climates warm up and support additional terrestrial species.

Detailed assessments of change might also be possible by summarizing the composition of the fauna, because particular taxa increase proportionally and others decrease as climates become more severe or ameliorate. For example, in the arctic, taxa such as the Order Diptera, the family Chironomidae and certain insect genera are well represented whereas many oth-

ers are not. Therefore, the relative representation of selected groups (which can be assessed by a relatively modest local faunal inventory) reflects environmental severity and could be monitored to detect long-term changes.

In summary, thinking about insects in northern Canada in the context of climate change gives a number of clues as to what might happen. First, matters will be much more complex than is suggested by simple proposals such as the invasion of more species into higher latitudes, because the effects will vary widely among species. Insects survive by multiple adaptations throughout the life cycle, involving co-ordinated physiological, structural, ecological and timing features – in the arctic for example especially by cold hardiness, microhabitat choice, life-cycle timing, and energy budgeting. There is no one-to-one relationship with any simple temperature statistic, and by the same token the major constraint for a given insect species may not be the most conspicuous one. Indeed, the need for early spring development and reproduction outweighs the need for additional protection from cold in many arctic species, which therefore overwinter in early thawing but relatively exposed sites. Some predicted effects of reduced winter snow cover would not apply to these species.

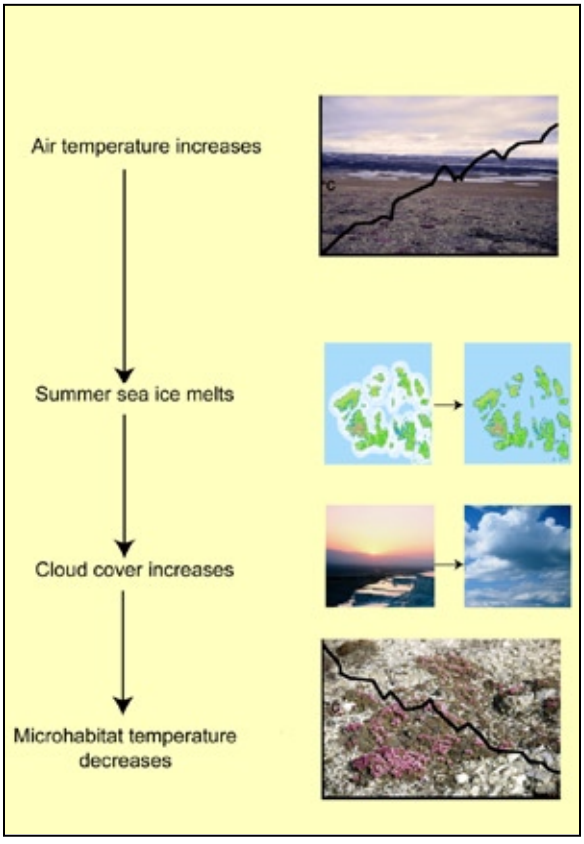
The importance of microhabitats likewise is undervalued by most temperature-change models, because sunshine rather than air temperature is most important in raising the temperature of insect microhabitats at northern latitudes. Increases in air temperature can even have counter-intuitive effects, as when reduction of sea ice reduces solar warming of insect habitats.

Although we see such possibilities in extreme form in parts of northern Canada, the complexity thereby revealed does suggest caution in extrapolating the effects of climate change for insects anywhere in the world.

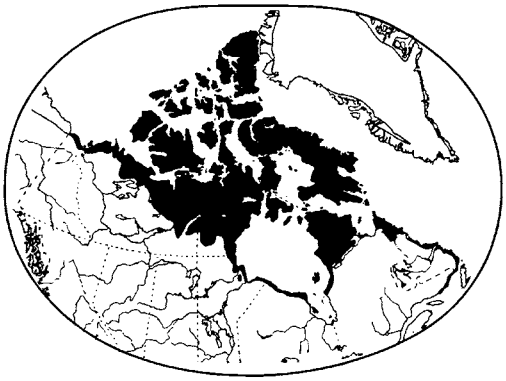
[Selected references for the information on insects here include the following reviews that also cite wider literature:

Danks, H.V. 2006. Insect adaptations to cold and changing environments. *The Canadian Entomologist* 138: 1-23; Danks, H.V. 2004. Seasonal adaptations in arctic insects. *Integrative and Comparative Biology* 44: 85–94; Danks, H.V. 1999. Life cycles in polar arthropods – flexible or programmed? *European Journal of Entomology* 96: 83-102; Danks, H.V. 1993. Patterns of diversity in the Canadian insect fauna. pp. 51-74 *in* Ball, G.E. and H.V. Danks (Eds.). Systematics and entomology: diversity, distribution, adaptation and application. *Mem. ent. Soc. Can.* 165. 272 pp. ; Danks, H.V. 1992. Arctic insects as indicators of environmental change. *Arctic* 45(2): 159-166; Danks, H.V. 1990. Arctic insects: instructive diversity. pp. 444-470, Vol. II *in* C.R. Harington (Ed.), Canada's missing dimension: Science and history in the Canadian arctic islands. Canadian Museum of Nature, Ottawa. 2 vols, 855 pp.

Climate information can be accessed most easily from a variety of web sites, for example under http://www.climatechange.gc.ca, http://www.ec.gc.ca/climate_e.html, and http://adaptation.nrcan.gc.ca]



Hypothetical scheme of adverse effects from climatic warming on insect microclimates in the high arctic, caused by increased summer cloudiness and hence reduced sunshine.



ARCTIC CORNER

News about studies of arctic insects

Introduction

Arctic Corner provides a forum for news of particular arctic interest, replacing the Biological Survey's newsletter *Arctic Insect News* (1990–2000). Contributions to *Arctic Corner* are welcomed by the Editor (see inside front cover).

From the canoe to the microscope: New faunal information on mayflies and stoneflies from Arctic Canada

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Over the past several years, my colleague Doug Currie (ROM) and I have reported on several forays into the central arctic mainland to collect aquatic insects (Currie et al. 2000, 2002; Giberson and Currie 2004; Giberson 2005). This project has moved into the data processing stage, and exciting collecting expeditions to the north have given way to laboratory exploration of the findings.

Mayflies of Nunavut

Eighty-two species have been reported in northern Canada (i.e. north of the line of continuous permafrost). However, most of these are restricted to the northern boreal zone, with only 17 species reported north of tree-line (several of which were found only at Churchill Manitoba), and only 9 species were known from Nunavut (Cobb and Flannagan 1980; Harper and Harper 1981). Our collecting in mainland Nunavut has nearly doubled the known number of species of mayflies from the territory from 9 species in 4 families to 16 species in 7 families (Giberson and Burian in review).

The dominant mayfly family in the north is Baetidae, containing 9 of the 16 Nunavut species. In addition, only 4 species are known from the most northerly collecting localities, and these are all baetids. One baetid species, *Baetis bundyae* Lehmkuhl, was extremely abundant in our recent surveys, especially in

Jade Savage, collecting from the edge of Landing Lake, north of Rankin Inlet, NU, July 2005
(photo by D.J. Giberson)

the coastal zone of northern Hudson Bay, so we were able to study the life cycle more fully than for other taxa. This species showed life-history strategies that are suited to the harsh northern climate, with extremely rapid summer development (2.5-4 weeks) and female-biased sex ratios (suggesting parthenogenesis) (Giberson and Burian in review).

Mayflies of Northwest Territories

The mayflies of the Northwest Territories are better known than the mayflies of Nunavut, largely because of the large Mackenzie Valley Pipeline study of the early 1970s (Brunskill et al. 1973) and subsequent work in the Mackenzie drainage (e.g. Cobb et al. 1995). 54 species were reported from NWT prior to this study, and only 5 additional species were collected along the Horton and Thelon Rivers. Of those, 3 were found only along the Horton River, one was found on the Thelon, and one was found in both rivers. I have recently started a new initiative with Steve Burian to re-examine specimens from the Mackenzie Valley pipeline survey to try to identify a number of specimens that were unidentified, or identified only to genus, for the original study. Specimens from this study were deposited in the CNC in Ottawa and at the Freshwater Institute in Winnipeg, and are in remarkably good shape, considering the length of time they have been in storage. We expect a number of new records and range extensions for the Northwest Territories from this study. We have also been examining some recent collections along the Mackenzie River valley made by workers from Fisheries and Oceans Canada, but these are not expected to yield much additional information due to the small size of the specimens.

Baetis bundyae, partially grown nymph
(photo by D.J. Giberson)

Stoneflies north of 60

According to a stunning new reference book on Plecoptera of the North American north west (Stewart and Oswood 2006), 81 species of stonefly are known from Canada north of the 60th parallel. The numbers of known species in the north declines dramatically as we move east from Alaska (88 species) through the Yukon (75 species) to NWT (29 species) and Nunavut (10 species). Part of this pattern may relate to the intensity of collecting, especially for the Northwest Territories. The authors of the book note the number of new species records reported in this book, and these also show dramatic differences from west to east. Only 15 new records were reported for Alaska (17% of the new total), compared to 6 for Yukon (8%), 15 for NWT (52%) and 8 for NU (80%). The new records for NWT and Nunavut were based on examination of specimens from the CNC (including both Mackenzie Valley Pipeline studies, and specimens from various arctic projects such as the Northern Insect Survey) and collections made during our expeditions to the central mainland barrens. As noted above for the mayflies, many of the NWT records stem from the Mackenzie River Pipeline study material deposited at the CNC (Brunskill et al. 1973). Preliminary examination of additional MacKenzie River study specimens from the Freshwater Institute collection has resulted in 2 more territorial records for NWT (bringing the total to 17), and that number is expected to grow as we continue our work with the large number of unidentified specimens remaining from this project.

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Porcupine drainages in relation to proposed pipeline and highway developments. Canada Task Force, North. Oil Develop. Envir. Comm., Volumes 1 & II. Reports 73-40 (131 pp) & 73-41 (345 pp).

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Cobb, D.G., J.F. Flannagan, P.M.L. Flannagan, and R.D. Wickstrom. 1995. Collections of Ephemeroptera from Kluane National Park, Yukon Territory, and Nahanni National Park, Northwest Territories, Canada. pp. 177-184 in L.D. Corkum and J.J.H. Ciborowski (Eds.), Current Direction in Research on Ephemeroptera. Canadian Scholars' Press, Toronto. 345 pp.

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Steve Burian sorting insects by a pond in Rankin Inlet, and showing the children what is in the pond.
(photo by D.J. Giberson)

Giberson, D.J., S.K. Burian, and M. Shouldice. In review. Life history of the northern mayfly *Baetis bundyae* (Ephemeroptera) in Rankin Inlet, Nunavut Territory, Canada, with updates to the Mayflies of Nunavut list.

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Harper, F., and Harper, P.P. 1981. Northern Canadian mayflies (Insecta: Ephemeroptera), records and descriptions. Canadian Journal of Zoology 59: 1784-1789.

Stewart, K.W. and M.W. Oswood. 2006. The Stoneflies (Plecoptera) of Alaska and Western Canada. The Caddis Press, Columbus, Ohio. 325 pp.

New Book on Arctic Stoneflies

The Stoneflies (Plecoptera) of Alaska and Western Canada, by K.W. Stewart and M.W. Oswood (The Caddis Press, 2006, Columbus Ohio. 325 pp.)

This is an exciting new reference work for anyone working on stoneflies in Northwestern North America, particularly British Columbia, Alberta, Alaska, Yukon, and the western Northwest Territories. The book includes well illustrated keys to the regional Plecoptera fauna, which includes 153 species in 9 families. Species keys are given for adults, and keys to the nymphs are given to the lowest possible taxon. The book also has considerable information on life history and biology (where known), and historical collecting and biogeographical notes. Although the book focusses on the western part of northern North America, it also includes new collection material from eastern NWT and Nunavut. This book should be in the library of everyone doing work on aquatic insects in the northwest!

D.J. Giberson

Selected Future Conferences

Organization	Date	Place	Contact
ENTOMOLOGICAL CONFERENCES			
Entomological Society of Canada	**2007,** 29 Sept. - 3 Oct.	Saskatoon, SK	with the Entomological Society of Saskatchewan; Meeting Chair Dwayne Hegedus - hegedusd@agr.gc.ca
	2008	Ottawa, ON	with the Entomological Society of Ontario
Entomological Society of America	**2007**, 9-12 Dec.	San Diego, CA	ESA: http://www.entsoc.org/annual_meeting/current_meeting/index.htm
	2008, 16-19 Nov.	Reno, NV	http://www.entsoc.org/annual_meeting/Future_meetings/index.htm
International Congress of Entomology	**2008**, 6-12 July	Durban, South Africa	http://www.ice2008.org.za/
OTHER SUBJECTS (especially those relevant to Survey projects)			
North American Benthological Society	**2007**, 3–7 June	Columbia, SC	http://www.benthos.org/Meeting/index.htm
Natural Science Collections Alliance	**2007**, 14-15 May	Washington, D.C.	http://www.nscalliance.org/
Society for the Preservation of Natural History Collections	**2007**, 21-26 May	Saint Paul, MN	http://www.smm.org/spnhc/about.php

Answers to Faunal Quiz

[see page 14]

1. The Quaternary Period, from 1.8 million years ago to the present, is the younger of the two geologic periods in the Cenozoic Era, customarily divided into Pleistocene and Holocene (or recent) Epochs. Fossil insects of this age are of particular relevance for interpreting the impacts of glaciations in Canada. (Some recent classifications, favoured especially by marine geologists, no longer regard the Quaternary as a formal division of the geological time scale and include ongoing geological time in the Neogene. Other geologists, especially Quaternary terrestrial geologists, object to this scheme, insisting that the Quaternary is a separate Period of distinctly different record.)

2. The lowest bottom temperature experienced by profundal chironomid larvae in Canadian lakes is typically 4°C (the temperature at which water is heaviest), but some arctic lakes cool below this temperature, even close to 0°C.

3. The shortest mean minimum generation times are 3.9 days for the aphid *Aphis glycines* at 27°C, and 3.7 days for the histiostomatid mite *Histiostoma polypori* at 26°C [Can. Ent. 138: 407-463 (2006)].

4. The two most abundant groups of arthropods in suspended habitats in the ancient temperate rain forests of western Canada are oribatid mites and collembolans (e.g. N. Winchester, Canadian Entomologist 138: 77, 2006).

5. In an arthropod context the abbreviations have the following meanings:

   a. EABSAP = Emerald Ash Borer Science Advisory Panel: this is a real U.S. entity (suggesting that Every Agency Brings Serious Acronym Proliferation).

   b. EAG = Electroantennogram: preparation using an insect antenna to record sensory (electrical) output upon exposure to molecules potentially eliciting a response.

   c. FPOM = Fine Particulate Organic Matter: the comminuted material in streams that is fed upon by a suite of insects; some other species use CPOM (Coarse Particulate Organic Matter).

   d. LPU = Least Publishable Unit: inclusion of a minimum amount of new information in each paper in order to maximize the number of papers produced; a frustrating tactic for the reader, especially in taxonomy.

   e. SCP = Supercooling point: the temperature at which freezing is initiated in an insect's body as it is slowly cooled below 0°C (the SCP is commonly below -15°C)

   f. SOG = Suboesophageal ganglion: large special ganglion situated beneath the oesophagus of arthropods and involved, for example, in neuroendocrine control of the life cycle.

Quips and Quotes

The loser is always suspicious. (Publilius Syrus)

The know-nothings are, unfortunately, seldom the do-nothings. (Mignon McLaughlin)

The world is divided into people who do things and people who get the credit. Try, if you can, to belong to the first class. There's far less competition. (Dwight Morrow)

There are two kinds of people: those who don't know and those who don't know they don't know. (Robert B. Reich)

Words

Avoid clichés like the plague. (Anon.)

The present age shrinks from precision and 'understands' only soft woolly words which really have no particular meaning, like 'cultural heritage' or 'the exigent dictates of modern traffic needs'. (Flann O'Brien)

The world may be full of fourth-rate writers but it's also full of fourth-rate readers. (Stan Barstow)

I read part of it all the way through. (Sam Goldwyn)

I took a speed-reading course where you run your finger down the middle of the page and was able to read *War and Peace* in twenty minutes. It's about Russia. (Woody Allen)

List of Requests for Material or Information Required for Studies of the Canadian Fauna 2007

This list is intended to facilitate cooperation among entomologists by encouraging those who visit suitable areas while engaged in other studies to collect material of particular interest to workers elsewhere. Similar lists that were circulated in previous years prompted the transmission of several useful sets of material, and the efforts of the various coooperators were much appreciated.

This list can also be found on the Survey's website at http://www.biology.ualberta.ca/bsc/english/listofrequests.htm. It is updated there as information is received.

Minimum data requested with all specimens are, of course, locality, date, collector and habitat.

(**denotes address reference; listed from p. 31)

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
1	Acari (free living and parasitic terrestrial and aquatic mites)	Anywhere, but especially subarctic and arctic Canada, Canadian grasslands	Berlese-Tullgren funnel extraction from subaquatic substrates, from grasses and sedges, and from bird and mammal nests, would be especially fruitful (preserve in 75% ethanol +5% glycerine).	V.M. Behan-Pelletier; E.E. Lindquist; I.M. Smith	1
2	Acari from family Uropodidae	Anywhere	Free living and parasitic terrestrial, preserve in 75% ethanol	C. Constantinescu	2
3	Adelgidae (conifer woolly aphids)	Anywhere	Preserve insects and bark, needles or galls in 70% ethanol. Specimen records and host plant records	R. Foottit	1
4	Aleyrodidae (whiteflies)	North America	Preserve insects and host plant material in 70% ethanol. Adults may be dried. Specimen records and host plant records. (Canadian National Collection deficient in all species, including pest species)	R. Foottit	1

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
5	Anthomyiidae	North America	Specimens with biological data (especially reared specimens) in the genera *Fucellia* (seaweed flies), *Chiastochaeta* (Trollius flies), and *Botanophila* in the wide sense (incl. *Pegohylemyia*) [of diverse life histories, including groups whose larvae are saprophagous, phytophagous (mainly stem-borers or seed-feeders) or fungivorous (especially on *Epichloe* parasites of grasses).	G.C.D. Griffiths	3
6	Anthomyzidae	New World	Adults from any habitat, but often associated with graminoids. Preservation in 70% ethanol preferred. Malaise and especially pan trap residues are acceptable and valuable. General description of herbaceous cover and soil moisture advantageous.	K.N. Barber	4
7	Aphididae (aphids)	Anywhere	Preserve in 70% ethanol. Specimen records and host plant records.	R. Foottit	1
8	Asilidae (robber flies)	North America	Pinned adults	R.A. Cannings	5
9	Braconidae	Anywhere	Pointed or in ethanol.	M. Sharkey	6
10	Bumble bees	Anywhere in Canada	Include floral host if any. Collect and preserve dry (but specimens that have already been put into ethanol are acceptable).	R.C. Plowright	7
11	Butterflies (see also 33, 34, 35)	Arctic	Preserve papered or pinned (collecting / preserving information supplied on request) [for Alaska Lepidoptera Survey]	K.W. Philip	8
12	Cerambycidae	Canada and Alaska	Adults pinned or in ethanol, host plant data if available	D.B. McCorquodale	9
13	Ceratopogonidae	Anywhere in Canada	Send in fully topped-up vials of 70% ethanol. Reared material is especially valuable; provide type of substrate or habitat if material is reared.	A. Borkent	10
14	Cercopidae (froghoppers, spittlebugs)	Canada and Alaska	Specimens (preferably not in ethanol if possible), records and host records.	K.G.A. Hamilton	1

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
15	Chalcidoids, especially Eupelmidae	Holarctic	Incl. sweep-net samples (see also 43) (collect into ethanol). Reared material is especially useful.	G.A.P. Gibson	1
16	Chironomidae: *Larsia* (Tanypodinae)	Nearctic and Palearctic fresh waters	Reared material preferred but will accept all stages in ethanol or on slides.	B. Bilyj	11
17	Chironomidae: *Eukiefferiella*, *Tvetenia* (Orthocladiinae)	All areas, especially Ontario	Include sampling method, habitat information	W.B. Morton	12
18	Chrysomelidae (leaf beetles)	Anywhere, but especially in Canada	Mounted or unmounted and preserved in acetic alcohol (70 ethanol: 25 water: 5 parts glacial acetic acid). Include accurate (species level) host plant information.	L. LeSage	1
19	Cicadellidae (leafhoppers)	Canada and Alaska	Specimens (preferably not in ethanol), records and host records.	K.G.A. Hamilton	1
20	Coccoidea (scale insects)	North America	Preserve insect and host plant material in 70% ethanol. Specimen records and host plant records.	R. Footit	1
21	Cynipidae: insect galls from domestic and wild roses	Anywhere	Maturing to mature galls. Remove galls from plants and place in plastic bags. Try to segregate galls of different species. Preserve any emergents in 70% ethanol.	J.D. Shorthouse	13
22	Cynipidae: galls on oak	Anywhere	Collect mature galls (spring gen: most in June; autumn gen: late August – October) 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).	S. Digweed	14
23	Dermaptera: *Forficula auricularia* (perce-oreille européen / European earwig)	Amérique du Nord et autres régions si possible	A sec ou dans l'alcool	J.C. Tourneur	15

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
24	Diprionidae (diprionid sawflies)	North America	Living diprionid sawflies of any species, identified or unidentified. Record foodplant. Contact in advance about shipping.	L. Packer	16
25	Eupelmidae: *Anastatus*	North America	Reared materials with associated sexes are particularly important, regardless how few in number.	G.A.P. Gibson	1
26	Formicidae (ants)	Anywhere	Record type of habitat and nest site. Include brood if possible (preserve in ethanol).	A. Francoeur	17
27	Fungal pathogens of insects (esp. of deuteromycetes and ascomycetes)	Anywhere	Place any fungus-infected specimens in a vial. (Identification of the fungus available on request.)	D. Strongman	18
28	Halictidae (sweat bees) brown and black spp. only	North America	Particularly from blueberries. Pinned or preserved. Include flower record if available.	L. Packer	16
29	Hemiptera: Heteroptera (bugs)	Anywhere	Aquatic and semi-aquatic Heteroptera from acid waters (an indication of pH would be useful). Terrestrial Heteroptera from bogs. Preserve in ethanol.	G.G.E. Scudder	19
30	Insects on snow	Especially western mountains	*Chionea* (Tipulidae), *Boreus* (Mecoptera), Capniidae (Plecoptera): preserve in 70% ethanol.	S. Cannings	20
31	Isoptera (termites)	N. America incl. Mexico	Preserve in 75% ethanol; try to collect as many soldiers as possible.	T.G. Myles	21
32	Leiodidae (=Leptodiridae)	Northern forest and tundra areas; prairies and grasslands	Most easily collected by window traps or flight intercept traps; and car nets (Can. Ent. 124: 745, 1992) (collect into ethanol).	S.B. Peck	22
33	Lepidoptera (see also 11)	Arctic	For revisionary work on the holarctic fauna	J.D. Lafontaine	1
34	Lepidoptera	Manitoulin and surrounding islands	Records for use in monograph of the region. Information on old records from collections would be particularly welcome.	J.K. Morton	23
35	Lepidoptera	Areas not previously sampled in western Canada	Standard collecting methods	N. Kondla	24

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
36	Lygaeidae	Anywhere	Material can be collected in ethanol.	G.G.E. Scudder	19
37	Mallophaga	Anywhere	Preserve specimens in 70% ethanol; host species is extremely important.	T.D. Galloway	25
38	Microgastrinae (Hymenoptera: Braconidae)	Anywhere in Canada	Stored in alcohol or pinned specimens. Specimens will be returned to sender or duplicates can be deposited in the CNC.	J.L. Fernandez Triana	38
39	Microlepidoptera (excluding Pyralidae and Tortricidae)	North America, esp. west in dry/arid habitats and prairies (CNC deficient in all western species)	Include collecting method and time of day collected. Kill with ammonia fumes. Field-pin; instruction leaflet and field kit available on request.	J.F. Landry	1
40	Odonata (dragonflies)	North America	Include 2-3 word habitat description. Adults preferably in envelopes or papered, prepared by immersing in acetone for 24 hours, then dried; larvae in 70% ethanol.	R.A. Cannings	5
41	Odonata (dragonflies and damselflies)	Ontario, Northwest Territories, Nunavut, Canadian prairies	Dried quickly in paper or glassine envelopes with or without prior immersion of envelope in acetone for one day to retain colour. Include habitat and collection notes and numbers observed in pencil on envelopes. Larvae in 70% ethanol.	P.M. Catling	26
42	Opiliones (harvestmen)	Canada and adjacent states	Preserve in 75% ethanol, especially adults with notes on habitats.	R. Holmberg	27
43	Parasitic Hymenoptera	Anywhere	Including selected unsorted Malaise, suction, pan or pitfall trap collections (pan trap kits and instructions supplied free on request).	L. Masner	1
44	Phoridae	Anwhere; especially boreal	Collect into 70% ethanol: especially interested in Malaise trap samples from boreal forest.	B.V. Brown	28
45	Pipunculidae (bigheaded flies)	Anywhere; especially boreal	Adults can be pinned, pointed or preserved in ethanol.	E. Georgeson	29

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	
46	Pseudoscorpions	Canada	Preserved in 90% ethanol is preferrred, please include collection information (method, habitat)	C. Buddle	30
47	Psyllidae	North America	Preferably preserve in glycerine or dried. Specimen records and host plant records	R. Foottit	1
48	Pteromalidae: *Pachyneuron*	North America	Reared materials with associated sexes are particularly important, regardless how few in number.	G.A.P. Gibson	1
49	Salticidae (jumping spiders)	Canada	Adult specimens preserved in 70% ethanol. Include habitat information, specific location of collection, collecting method.	D. Shorthouse C. Buddle	31 30
50	Scelionid egg parasites of Orthoptera	Anywhere	Especially from Grylloidea; preserve in ethanol.	L. Masner	1
51	Sciomyzidae	Anywhere	Preferably pinned	L. Knutson	32
52	Simuliidae (black flies)	North America, esp. western and northern species	Preserve larvae in Carnoy's solution (1 glacial acetic acid: 3 absolute ethanol). Reared adults with associated pupal exuviae preferred. Instructions available on request.	D.C. Currie	33
53	Siphonaptera (fleas)	Anywhere	Preserve specimens in 70% ethanol; host species is extremely important	T. D. Galloway	25
54	Solpugida (sun spiders)	Canada	Preserve in 75% ethanol, especially adults with notes on habitat.	R. Holmberg	27
55	Sphaeroceridae	Anywhere, esp. arctic or high elevations	Collect into ethanol. Acalyptrate fraction of trap samples welcomed.	S.A. Marshall	34
56	Symphyta (sawflies)	Boreal and arctic Canada	Larvae and adults collected by Malaise trap, sweeping, etc. (collect into 70% ethanol). Identify larval food plant as far as possible.	H. Goulet	1
57	Thysanoptera (thrips)	North America	(Preserve in 70% ethanol). Specimen records, habitat, host plant records where applicable.	R. Foottit	1

Cooperation Offered

a	Identification of groups of interest in return for a sample of duplicate specimens.	Most but not all of entries in list above.
b	Willing to sort material from certain residues, bulk samples, etc.	See entries 6, 15, 43, 56 above
c	Field kits or instructions available on request	See especially entries 39, 43, 52 above
d	Exchange of specimens	Several requesters, including entries 8, 38, 40, 53 above.
e	Limited collecting in Coppermine area, N.W.T., if particular material required.	A. Gunn (address 35 below).
f	Caterpillars, larval sawflies, aphids and mites available on request from trapnests for solitary bees and wasps [and see *Am. Bee. J*. 2001, pp. 133–136, 441–444].	P. Hallett (address 36 below)
g	Insect material from grassland and adjacent habitats at Onefour, Alberta, is available for examination.	D.L. Johnson (address 37 below)

List of Addresses

1. Agriculture and Agri-Food Canada, Central Experimental Farm, KW Neatby Bldg., 960 Carling Ave., Ottawa, ON K1A 0C6
   V.M. Behan-Pelletier . . . . . behanpv@agr.gc.ca
   E.E. Lindquist . . . . . lindquiste@agr.gc.ca
   I.M. Smith . . . . . smithi@agr.gc.ca
   R. Foottit . . . . . foottitrg@agr.gc.ca
   K.G.A. Hamilton . . . . . hamiltona@agr.gc.ca
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   J.D. Lafontaine . . . . . lafontained@agr.gc.ca
   J.F. Landry . . . . . landryjf@agr.gc.ca
   L. Masner. . . . . (email n/a)
   H. Goulet . . . . . gouleth@agr.gc.ca

2. Natural History Museum of District Arges, Armand Calinescu Street, No. 44, Cod: 110047, Arges, Romania; cristinactinescu@yahoo.com

3. P.O. Box 1380, Athabasca, AB T9S 2B2; gcdgriff@telusplanet.net

4. Canadian Forest Service, 1219 Queen St. E., Sault Ste. Marie, ON P6A 5M7; kbarber@nrcan.gc.ca

5. Royal British Columbia Museum, P.O. Box 9815, Stn. Prov. Govt., Victoria, BC V8W 9W2; rcannings@royalbcmuseum.bc.ca

6. Department of Entomology, University of Kentucky, 5 - 225 Agricultural Science Center North, Lexington, KY 40546-0091, U.S.A.; msharkey@uky.edu

7. 482 Montée de la Source, Cantley, QC J8V 3H9

8. University of Alaska, Institute of Arctic Biology, P.O. Box 757000, Fairbanks, AK 99775-7000 U.S.A.; fnkwp@uaf.edu

9. Dept. of Biology, University College of Cape Breton, Box 5300, Sydney, NS B1P 6L2; david_mccorquodale@uccb.ca

10. 691 - 8th Ave., SE, Salmon Arm, BC V1E 2C2; aborkent@jetstream.net

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12. 3 Woodridge Drive, Guelph, ON N1E 3M2;

13. Department of Biology, Laurentian University, Sudbury, ON P3E 2C6; jshorthouse@nickel.laurentian.ca

14. 3761 - 20 Street, Edmonton, AB T6T 1R8; sdigweed@shaw.ca

15. Département des Sciences biologiques, Université du Québec à Montréal, C.P. 8888, Montréal, QC H3C 3P8; tourneur.jean-claude@uqam.ca

16. Department of Biology, York University, 4700 Keele Street, Downsview, ON M3J 1P3; bugsrus@yorku.ca

17. Département des Sciences fondamentales, Université du Québec à Chicoutimi, 9555 boul. de l'Université, Chicoutimi, QC G7H 2B1; andre_francoeur@uqac.ca

18. Department of Biology, St. Mary's University, 923 Robie St., Halifax, NS B3H 3C3; doug.strongman@smu.ca

19. Department of Zoology, University of British Columbia,Vancouver, BC V6T 1W5; scudder@zoology.ubc.ca

20. NatureServe Yukon, Yukon Territorial Government, Box 2703, Whitehorse, YT Y1A 2C6; syd.cannings@gov.yk.ca

21. Faculty of Forestry, University of Toronto, 33 Willcocks, Toronto, ON M5S 3B3; t.myles@utoronto.ca

22. Department of Biology, Carleton University, Ottawa, ON K1S 5B6; stewart_peck@carleton.ca

23. Department of Biology, University of Waterloo, Waterloo, ON N2L 3G1; jkmorton@sciborg.uwaterloo.ca

24. P.O. Box 244, Genelle, BC V0G 1G0; colias@shaw.ca

25. Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2; terry_ galloway@umanitoba.ca

26. Agriculture and Agri-Food Canada, Research Branch, Wm. Saunder Bldg., Central Experimental Farm, Ottawa, ON K1A 0C6; catlingp@agr.gc.ca

27. Athabasca University, Centre for Science, Athabasca, AB T9S 3A3; robert@athabascau.ca

28. Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, CA 90007 U.S.A.; bbrown@nhm.org

29. N.S. Department of Natural Resources, P.O. Box 130, Shubenacadie, NS B0N 2H0

30. Department of Natural Resource Sciences, McGill University, Macdonald Campus, 21,111 Lakeshore Road, Ste.Anne-de-Bellevue, QC H9X 3V9; chris.buddle@mcgill.ca

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

34. Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1; samarsha@uoguelph.ca

35. Wildlife and Fisheries Division, Resources, Wildlife and Economic Development, Government of the Northwest Territories, Box 1320, Yellowknife, NT X1A 3S8; anne_gunn@gov.nt.ca

36. Department of Physiology and Zoology, University of Toronto, 144 Hendon Avenue, Willowdale, ON M2M 1A7; peter.hallett@utoronto.ca

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

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