

NEWSLETTER OF THE BIOLOGICAL SURVEY OF CANADA (TERRESTRIAL ARTHROPODS)

Table of Contents

General Information and Editorial Notes	(inside front cover)
News and Notes	
Handbook series rejuvenated	1
Activities at the Entomological Societies' meeting	2
Summary of the Scientific Committee meeting	5
Arthropods of Canadian Grasslands – News	11
The Quiz Page	12
Project Update: Terrestrial Arthropods of Newfoundland and Labrador	13
New Project: Arthropods of Canadian Forests	15
Forest arthropod project inventory	17
Web Site Notes	19
Opinion Page: Bioinformatics and Misinformatics	20
Resources for the Study of Odonata in Canada	25
Arctic Corner	
Arctic and Boreal Entomology: what's new about 2003 & 2004	34
Selected Future Conferences	37
Answers to Faunal Quiz	38
Quips and Quotes	39
List of Requests for Material or Information	40
Cooperation Offered	46
List of Addresses	46
Index to Taxa	49

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.

Editor: H.V. Danks

Head, Biological Survey of Canada
(Terrestrial Arthropods)
Canadian Museum of Nature
P.O. Box 3443, Station "D"
Ottawa, ON K1P 6P4
Tel. 613-566-4787
Fax. 613-364-4022
Email: hdanks@mus-nature.ca

Queries, comments, and contributions to the Newsletter are welcomed by the editor. Deadline for material for the Fall 2004 issue is July 16, 2004.

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>

News and Notes

Handbook series rejuvenated

A valuable series of handbooks on the fauna "*The Insects and Arachnids of Canada*" was published from 1976 (part 2; part 1 appeared in 1977) until 1993 by the Research Branch of Agriculture Canada. However, various subsequent developments, especially the loss of Agriculture Canada's in-house publishing unit, conspired to suspend the series despite attempts to maintain it.

The Insects and Arachnids of Canada has now been rejuvenated through an agreement with the National Research Council Research Press, which already had produced an English version of part 7 on genera of the Trichoptera in 1998. The new arrangement will see the continuation of the series as NRC monographs, with several volumes over the next few years, beginning with a volume recently published on orb-weaving spiders. The general concept of the series continues unchanged, providing an accessible means to know and identify the Canadian arthropod fauna, although some modifications of design and of editorial policy under the guidance of an editorial committee are to be expected.

The maiden volume of the rejuvenated series in 2003, part 23 (part 22 was published in 1993) is a highly credible representative of the series. Treating the four families of orb-weaving spiders for which relatively recent revisions exist (Uloboridae, Araneidae, Tetragnathidae and Theridiosomatidae), the book provides taxonomic accounts (including familial, generic and specific diagnoses), range maps and keys, and known information on biology including habitats and webs. It also contains a very useful introductory section that deals not only with the necessary details of methods and anatomy as would be expected, but also has useful reviews of biological features such as habitats, reproduction, venoms, and silk production including a detailed account of web construction.

NRC Research Press will also continue to produce other occasional entomological publications in its monograph series. All of the monographs are book-length treatises prepared with high standards of scholarship and written by specialists for the benefit of other specialists. Examples of such monographs recently published on the Canadian insect fauna are Annotated keys to the genera of nearctic Chalcidoidea (1997), The Caddisfly family Phryganeidae (1998), The Butterflies of Canada (1999), Catalogue of the tiger beetles of Canada and United States (1999), Predaceous diving beetles of the nearctic region (2000) and Checklist of Hemiptera of Canada and Alaska (2000).

Further details of these publications are available at <http://pubs.nrc-cnrc.gc.ca>

Gibson, G.A.P., J.T. Huber and J.B. Woolley. 1997. Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera). NRC Research Press, Ottawa. 794 pp.

Wiggins, G.B. 1998. The Caddisfly Family Phryganeidae (Trichoptera). University of Toronto Press in association with NRC Research Press. Toronto. 353 pp.

Layberry, R.A., P.W. Hall and J.D. Lafontaine. 1998. The Butterflies of Canada. University of Toronto Press in association with NRC Research Press. Toronto. 280 pp.

Freitag, R. 1999. Catalogue of the Tiger Beetles of Canada and the United States. NRC Research Press, Ottawa. 195 pp.

Larson, D.J., Y. Alarie and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region. NRC Research Press, Ottawa. 982 pp.

Maw, H.E.L., R.G. Footitt, K.G.A. Hamilton and G.G.E. Scudder. 2000. Checklist of Hemiptera of Canada and Alaska. NRC Research Press, Ottawa. 220 pp.

Dondale, C.D., J.H. Redner, P. Paquin and H.W. Levi. 2003. The Orb-Weaving Spiders of Canada and Alaska. Araneae: Uloboridae, Tetragnathidae, Araneidae, Theridiosomatidae. *The Insects and Arachnids of Canada: Part 23*. NRC Research Press, Ottawa. 371 pp.

Activities at the Entomological Societies' meeting

The 2003 joint annual meeting of the Entomological Society of Canada and the Entomological Society of British Columbia took place in Kelowna 1-5 November 2003. The meeting was attended by about 300 people. One third of these were student members and there were 66 entrants for the student presentations competition. Items in the program or associated with it included:

A plenary session in accordance with the meeting theme on Insects and shifting environments.

Symposia on "Adaptations and constraints: a symposium in honour of Richard Ring", "Insects in a changing climate", "Introduced species: Friends and foes and those we do not know", and "Biodiversity".

Workshops on "Temperate fruit flies: ecology, behaviour, and management", "Resistance of two kinds: insecticides and host plants", and "Ecology and structure of aphid populations".

Submitted papers in several sessions.

A student presentation competition, in several sessions, (biodiversity and systematics, management, behaviour, population ecology and evolution), for prizes of the Entomological Society of Canada and the Entomological Society of British Columbia.

An extensive poster session.

The ESC Heritage Lecture given by Dr. Richard Ring, entitled "Insect adaptations: a personal perspective".

The ESC Gold Medal Address given by Dr. Hugh Danks, entitled "Knowledge and synthesis in entomology".

Associated meetings of the "Mountain Pine Beetle Symposium", "Canadian Forum for Biological Control", "Western Forum and Western Committees on Crop Pests and Plant Diseases" and the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods).

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.

Symposium on Adaptations and constraints

The symposium: "Adaptations and Constraints: A symposium in honour of Richard Ring", was organized to recognize Richard Ring's retirement during 2004 from the Biology Department at the University of Victoria. Opening and closing remarks were made by symposium organizers N. Winchester and R. Bennett. The first formal presentation began with an introduction to Richard Ring and his achievements in teaching, research and other areas. Papers from the symposium are being submitted for publication as a set in the Canadian Entomologist.

Insect adaptations to cold and changing environments. **H.V. Danks**

Alien true bugs (Heteroptera) in Canada: composition and adaptations. **G.G.E. Scudder, R.G. Footitt**

Melanism in arctic and alpine *Colias* butterflies. **J. Roland**

Overwintering adaptations in arctic sawfly communities: cold tolerance and desiccation resistance. **L. Humble, R.A. Ring**

The sky is the limit: patterns in the distribution and abundance of invertebrates inhabiting suspended soils in ancient northern temperate coniferous rainforests. **N.N. Winchester, R.A. Ring**

Symposium on Biodiversity

The symposium "Biodiversity", introduced by organizer G.G.E. Scudder, exposed a variety of detailed information about insect and mite diversity in several important Canadian habitats.

Diversity of boreal forests of western Quebec: a beetle's point of view. **P. Paquin**

Insect surveys and southern Ontario's biodiversity hotspots. **S. Marshall**

Rarity and richness hotspots in British Columbia. **G. Scudder**

Why forest canopies of the Pacific Northwest are hotspots for oribatid mite diversity. **V. Behan-Pelletier, M. St. John, N.N. Winchester.**

The potentially rare and endangered terrestrial arthropods in British Columbia: revisiting British Columbia's biodiversity. **N.N. Winchester, R.A. Ring, L. Humble**

Papers on systematics and related themes

Many presentations were made in contributed sessions on biodiversity. 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.)

Factors affecting the community ecology of predaceous water beetles (Coleoptera: Dytiscidae) in ponds across Manitoba. **M. Alperyn**

Arthropods associated with downed woody material in Forillon National Park, Québec. **H. Varady-Szabo, C.M. Buddle**

Bee community composition change over a 35-year period. **J. Grixti, L. Packer**

Fly pollination and the dioecious breeding system in plants: A relationship of cause or consequence? **C.J. Borkent, L.D. Harder**

Effect of habitat loss and invasion by scotch broom (*Cytisus scoparius*) on rare butterflies of garry oak meadows. **W. Hallstrom**

The precipitous decline and uncertain future of Taylor's checkerspot butterfly (*Euphydryas editha taylori*). **J. Miskelly, D.S. Eastman**

Effects of habitat fragmentation and loss of scolytid and its predators at various spatial scales. **K. Ryall, L. Fahrig**

Effectiveness of Nordlander pitfall traps for ants, with comparison to standard sampling methods. **R. Higgins, B.S. Lindgren**

Salmon-derived nitrogen and carbon in terrestrial invertebrates from coniferous forests of coastal British Columbia. **M.D. Hocking, T.E. Reimchen, R.A. Ring**

Adaptive radiation of gall-inducing insects within a single host plant species. **J. Joy, B.J. Crespi**

Genetic lineages and morphological characters: important partners for coneworm (Pyalidae: Dioryctria) identification. **A. Roe, G. Grant, L. Stein, N. Gillette, F. Sperling**

Revision of the Nearctic species of *Brychius* Thomson (Coleoptera: Haliplidae). **T. Mousseau, R.E. Roughley**

The parasitoid community structure of a bark-feeding lepidopteran, *Enarmonia formosana* (Lepidoptera: Tortricidae). **W. Jenner, U. Kuhlmann, J. Cossentine, B. Roitberg**

Differences in leafhopper (Homoptera: Cicadellidae) species composition, distribution, and feeding preferences between severe and mild drought years in Saskatchewan. **T. Saretski, C. Gillott, J. Soroka**

Diploid male production and the population size paradox in "common" orchid bees: implications for detecting pollinator declines. **A. Zayed, D.W. Roubik, L. Packer**

Life history strategy of the stem galler *Aulacidea hieracii* (Hymenoptera: Cynipidae) on hawkweed (Asteraceae). **M. Sliva**

Host specificity of *Lygus* parasitoids: understanding mirid-parasitoid associations in different habitats. **T. Haye, U. Kuhlmann, P.G. Mason, H. Goulet**

Hyperparasitism in *Lygus* spp. (Hemiptera: Miridae) by a parasitoid *Peristenus* near *mellipes* (Hymenoptera: Braconidae) in alfalfa. **M. Ashfaq, L. Braun, M. Erlandson**

Genetic analysis of some coniferophagous "*Choristoneura*" populations using amplified fragment length polymorphisms (AFLPs) as molecular markers. **P. Dale, F. Sperling**

Spiders of the genus *Cicurina* (Dictynidae): application of molecular techniques to conservation and systematics. **P. Paquin, M.C. Hedin**

Molecular barcoding – mixed results for Pipunculidae (Diptera). **J. Skevington**

New Milichiidae (Diptera) taxa, same old phylogenetic problems? **J. Swann**

Parsimony analysis of endemism, the best of a bad lot? **J. Swann**

New species, new records and importance of taxonomic research in the leaf-miner flies (Diptera: Agromyzidae). **S. Boucher**

Redescription of *Haliplus dorsomaculatus* with comments on distribution, habitat and a new synonymy. **R. Kenner**

- Ride a pale horse: diversity and host associations of *Pseudogaurax* (Diptera: Chloropidae), predators of arachnids. **T. Wheeler**
- Interactive, illustrated keys to the Ichneumonidae (Hymenoptera) parasitizing North American *Choristoneura* spp. (Lepidoptera: Tortricidae): a practical example of the advantages of Lucid over standard keys. **A. Bennett**
- A virtual museum for real world entomologists. **F. Sperling**
- Landscape characteristics affect patch colonization in a host-parasitoid community. **B. Van Hezewijk**
- Climatic adaptations in some prairie aphid species: local overwintering versus annual immigration. **P. MacKay, M. Smith**
- Life history and behavior of the blueberry aphid, *Ericaphis fimbriata*, in relation to the spread of Blueberry Scorch Virus. **D. Raworth**
- Distribution and ecology of *Pemphigus* aphids in a trispecific swarm of hybridizing cottonwood (*Populus*). **K. Floate**
- Molecular analyses of aphid populations. **R. Footitt**
- Aquatic insect studies in the Canadian Central Barrens (NWT and NU). **D. Giberson**
- A quest for mites: the search for oribatid soil mites from western Canadian grasslands. **D. Kanashiro, M.J. Clapperton, V. Behan-Pelletier, G.H.O. Osler**
- Sampling for diversity – Is 4 weeks enough? **S. Carson**
- Surprises in the boreal: experiments with dead wood and ground-dwelling spider assemblages. **C. Buddle**
- Beetle diversity in man-maintained and wild ecosystems in the Whangamata area of New Zealand. **J. McLean, D. Jones**
- Effects of forest fragmentation on carabid beetles in coastal western hemlock forests. **I. Pearsall**
- Diversity and abundance of Staphylinidae in Acadian red spruce stands under different silvicultural regimes. **J. Sweeney, J. Klimaszewski, G. Gesner, J. Price**
- Assessing success of rainforest restoration using arthropod assemblages. **H. Proctor, J. Kanowski, C. Catterall, G. Wardell-Johnson, T. Reis, S. Piper**
- Hymenopteran parasitoids of the cabbage seedpod weevil (*Ceutorhynchus obstrictus*: Curculionidae) in Alberta. **B. Ulmer, L. Dossdall, G. Gibson, J. Huber**
- Entomological research in Haida Gwaii: from studies of deer-insect interaction to a fauna inventory. **S. Allombert, R. Cannings, J-L. Martin**
- An approach to site selection using GIS for management and monitoring of mason bees in Digby/Smith's Cove, Nova Scotia. **S. Carbyn, S. Javorek, K. MacKenzie**
- Molecular phylogenetic reconstructions of Far Eastern Asia species of the genus *Sitobion* and the genus *Macrosiphum*. **H.J. Choe, S. Lee, H.J. Kim**
- Orchard releases of native parasitoids of the oblique-banded leafroller. **J. Cossentine, K. Deglow, L. Jensen**
- Occurrence of *Rhagoletis* spp. (Diptera: Tephritidae) on the island of Newfoundland. **P. Dixon, S. Berlocher**
- Use of molecular markers in host range and non-target risk assessment studies of *Lygus* parasitoids. **T.D. Gariépy, M. Erlandson, U. Kuhlmann, C. Gillott**
- Black flies in salt: *Simulium vittatum* (Zett.) in beach streams affected by tidal incursions on Prince Edward Island. **D. Giberson, L. Purcell**
- The effects of landscape fragmentation and prey density on the regulation of forest tent caterpillars (*Malacosoma disstria*) by generalist predators. **M. Glasgow**
- Three spatial nesting patterns within managed hives of local solitary bees and wasps. **P.E. Hallett**
- Biosystematics in forestry: Invasive species and native biodiversity. **J.T. Huber, P.T. Dang**
- Effects of two insecticide application methods on soil Collembola and mite populations in commercial potato fields on Prince Edward Island. **C. Noronha, M. Carter**
- Biodiversity of aquatic insects and macroinvertebrates from a boreal lake in Saskatchewan. **D. Parker**
- Emergence phenologies of mayflies (Ephemeroptera) and caddisflies (Trichoptera) in a shallow bay at Candle Lake, SK. **D. Parker, J. Webb**

The effects of forest fragmentation on forest tent caterpillar (*Malacosoma disstria*) parasitoid communities. **D. Roth**

Arboreal arthropod community composition in lichens and branches of *Abies amabilis* in montane variable retention stands. **S. Wilkerson, N. Winchester**

Biodiversity of saproxylic beetles in old-growth and mature-managed forest in south-eastern Ontario. **R. Zeran**

Summary of the Meeting of the Scientific Committee for the Biological Survey of Canada, November 2003

The Scientific Committee met in Kelowna on November 5-6.

Scientific Projects

1. Grasslands

Authors have been identified for each chapter of the grasslands volume on ecology and interactions in grasslands habitats. There are 16 confirmed chapters and one chapter has already gone out for informal review. A list of potential authors for the second and third volumes on grasslands is under development, dealing with arthropods and altered grassland ecosystems, and with biodiversity of arthropods in grasslands. The Committee will seek an update about the EMAN prairie project.

The grasslands focus trip held in Dunvegan last summer was well attended although the weather for collecting was less than optimal. Some other collecting was done in other areas before and after the organized collecting period. Next year's focus site will be Aweme, Manitoba.

2. Family keys

The apterygote and exopterygote keys are progressing slowly, and a subcommittee was established to take forward the project for the endopterygote orders.

3. Insects of Newfoundland and Labrador

Much work has been done on this project recently by Dr. David Larson especially on aquatic orders, Orthopteroids, Hemiptera and Coleoptera. Many keys and other drafts have been produced. There are various possibilities for future products but no decision has yet been

reached on which product(s) will be pursued. There remains much work to do and help is needed from others especially for some groups. Dr. David Langor reviewed other elements and possibilities for the project. The Survey encouraged the project to move ahead broadly. In consultation with Dr. Larson, the BSC will investigate publication outlets (including the possibility of funding for a Survey-published series), and encourage wider participation. An article will be produced for the Survey newsletter to publicize it (see p. 13).

4. Forest arthropods

Dr. Langor reported that he had consulted about this topic with a number of people across Canada. Information exchange among various people and organizations is especially poor, with virtually no synthetic activity, cohesion or long-term products. This would be a good opportunity for the BSC to fulfill its role as clearing house and coordinator and as a voice for matters of concern. Instead of focusing on a particular subject, therefore, it might be better to embrace all topics and foster better communication including an update of the 1997 BSC list of what is going on in forest biodiversity studies and investigating the possibility of starting a forest arthropod newsletter in partnership with the Canadian Forest Service. These initiatives were agreed to (see p. 15). A symposium discussed at earlier meetings on carabids (and probably including comparisons with other groups) would also be moved forward, provisionally for 2005. This symposium will be coordinated as necessary with the Survey symposium on arthropods and

fire. Other proposals, for a prospectus, web page, etc. would be reconsidered after progress has been made on these items.

5. *Insects of the Arctic*

Dr. Currie reported a fourth year of field activity on this project, with visits to Rankin Inlet, Arviat and Baker Lake. In previous expeditions 30 spp. of blackflies had been collected in the Thelon River area and the Horton River area, of which half of the species were shared, but so far only one species different from the Thelon collection has been identified from those more eastern areas. The process of sorting and analyzing the data is ongoing. Given the extraordinary expense of arctic field work, instead of another field trip next year to the Mackenzie/Keewatin region a start will be made on writing up the findings of the work so far. However, future visits are planned to the Seward Peninsula of Alaska, and perhaps to the Anadyr region of Russia. Dr. Giberson continues to work on the mayflies and stoneflies from these expeditions, and is exploring alternate ways of obtaining data from various co-operators, given the great expense of arctic fieldwork. Dr. Giberson and Dr. Currie plan a symposium for the 2004 ESC meeting to summarize what the project has achieved.

6. *Seasonal adaptations*

Dr. Danks reported upon several papers and conference presentations on mitochondrial status, insect photoperiodism and rhythmicity, seasonal adaptations of arctic insects, insect cocoons in cold conditions and insect adaptations to cold and changing environments. The latter, given in the Richard Ring symposium at the recent ESC/ ESBC meeting, has been submitted for publication as part of the symposium package. Dr. Danks also hopes to go to Japan for several months in 2004-2005 to further these studies as an invited visiting professor at Okayama University, at a time between the fall and spring meetings of the Scientific Committee.

Other scientific priorities

1. *Invasions and reductions*

The project on coccinellids is assembling, on a regional basis across Canada, overviews of the coccinellid fauna, history of introductions and evidence for reductions. About 10-15 regional articles and 2-3 synthetic articles are planned. The subcommittee is considering what the final product should be and its time frame. It is also hoped that in due course this project might be able to spin off a public component in conjunction with the Canadian Museum of Nature.

A broader idea about invasions and reductions is to examine basic principles by means of a synthesis through a symposium and publication. This would include issues such as an early warning system for the detection of invasive species that might be developed from collections and regional faunal surveys. A subcommittee will take forward ideas for a symposium and synthesis.

2. *Endangered species*

The Committee agreed to re-address a potential Biological Survey project that was put forward some years ago to develop a list of rare or potentially rare species of insects of Canada. At that time a project was organized but serious resistance was received from a few members of the systematics community. However, since then a list has been produced for British Columbia, demonstrating that such a publication does not seem to have the feared detrimental effects such as restriction of permits. Indeed such a list generates an incredible profile and brings in money for surveys.

The Committee also commented on the fact that COSEWIC now intends to deal with other insect orders, not just Lepidoptera as at present. The current Lepidoptera group works well, with good expertise. In this context, a Canadian list could be accompanied by a preamble and associated documents pointing out that it would have been impossible to call attention to the status of the species without good solid field work. As well, as soon as a list is avail-

able the community is placed in the position of having to do more work to discover where the endangered species are, a task that the Survey should be involved in. However, some potential negative consequences were identified. For example, in B.C. collecting is no longer possible in Indian reserves where it once was feasible. Butterflies and dragonflies are easy to identify in the field, an estimate of populations can often be made, it is known that they can be wiped out by collecting, and collecting techniques are specialized. As soon as other insect groups are involved and different collecting techniques come into play, permits become more difficult to obtain, for example, and expertise may be limited. Some members noted that a species-by-species approach will not work for most insects. Alternative approaches can be proposed (e.g. taxon reports), as recently accepted by the Committee on the Status of Species at Risk in Ontario (COSSARO). An action plan for the project will be developed for discussion at the spring meeting.

3. *Survey website*

A number of updates have been made to the website such as posting the voucher brief and the Survey newsletters, and revising the Scientific Projects page to reflect the review of scientific priorities in April. A few problems occurred as a result of server updates but these have been rectified. The idea of a permanent web site subcommittee was considered but deemed unnecessary given the current operation by the Secretariat.

4. *Survey poster*

A poster about the BSC had been drafted, and comments were provided by the Committee. After revision, the poster will be made available for downloading by members of the Committee for various uses.

5. *Databasing*

Information was received about topics of interest, including attempts to create an international butterfly network by databasing specimens and making information available on the internet, and other large networks of databases. The virtual museum hosted by the University

of Alberta is a prototype for an Alberta-wide application that will involve all the natural science collections across Alberta. The Geolocate program was described, a georeferencing program for all natural history specimens available at <http://www.museum.tulane.edu/geolocate/default.aspx>. Other software available for this purpose was noted (e.g. OziExplorer, SoftMap). Topographic maps can be downloaded from the Natural Resources Canada website [<http://maps.nrcan.gc.ca/topographic.html>].

6. *Monitoring of continuing priorities*

Information on ongoing interests in the Canadian fauna was reported, including arthropods of the Queen Charlotte Islands (Haida Gwaii), arthropod ectoparasites of vertebrates, arthropods of the Yukon, arthropods of special habitats, small regional projects, and agroecosystems, including mention of some specific studies and a discussion of the need for proper pre-release surveys before biological control agents are brought in. Some members noted that it is easier to get money to bring in and release foreign parasitoids than to do a proper study ahead of time, because it is difficult to receive grants to study insects that are not pests. The Committee will consider inviting a representative of the regulatory agency for importation of biocontrol agents to explain the process.

Information about arthropods of aquatic habitats included a discussion about "rapid biodiversity assessments". Many of the people driving studies of aquatic habitats seem to believe more and more strongly that genus-level identification is not necessary. The North American Benthological Society meetings have been dominated in recent years by papers that espouse this notion, and most government-sponsored studies will only fund studies that identify to a family level. Those shortcuts stem partly from the fact that the time and money available is inadequate to do the proper work. Journals continue to accept papers based on inadequate taxonomy, including even a belief in the validity for detailed impact assessment of identification only to order (and as taught at a recent workshop) and some people are mak-

ing a career out of doing these sorts of rapid assessments. A brief pointing out these matters was published by the Survey years ago, but non-scientists are especially pleased to hear the erroneous but time-saving message that species identification is never necessary.

Discussion about interests in arthropods of Les Îles de la Madeleine led to the decision to pursue a project in this area, broadened to include arthropods of islands in the Gulf of St. Lawrence. A short concept document will be developed for discussion at the next meeting.

7. *Other priorities*

The Committee also discussed actions and information about a recently published brief on voucher specimens and its wider distribution, arthropods and fire (a symposium is planned for 2005), the insect common names list (including expertise to validate scientific names in the list), naturalists' publications, a potential Canadian "Encyclopedia of Life", the potential for memoranda of understanding with certain government departments, potential website links from natural history sites, and other topics.

Liaison and exchange of information

1. *Canadian Museum of Nature*

Mr. Roger Baird, Director, Collection Services, noted that the Biological Survey's coordination and collaboration work is characteristic of the way in which the Museum wants to expand its national service role. The BSC demonstrates how the Museum is relevant as an organization and how it partners with others beyond the National Capital region.

Mr. Baird reported that a steering group for the management and coordination of biodiversity information as it is collected in federal organizations has been set up through the Federal Biodiversity Information Partnership (FBIP). A modest number of model projects have been identified to demonstrate the value of working on a larger scale in collecting biodiversity information. Five projects have been funded and are underway. In September the CMN in conjunction with the Canadian Heri-

tage Information Network (CHIN) was the organizer and host for the North American training session for the Species Analyst – DiGIR (Distributed Generic Information Retrieval) protocol for sharing species data. The goal of databasing the CNC collections is to have the material verified, georeferenced and made available electronically.

Mr. Baird announced that the CMN has now received authorization from Treasury Board to proceed with a complete rehabilitation of the Victoria Memorial Museum Building, the Museum's main exhibit facility in Ottawa. The CMN remains responsible for the costs of developing new content for the galleries whereas the Treasury Board funding will cover the rehabilitation of the infrastructure of the building over a five-year period. Four new major galleries, scheduled to be opened in phases from 2006 to 2009, will be funded through the \$16 million Natural Partnerships fundraising campaign. The first new gallery will be a new fossil gallery.

2. *Agriculture and Agri-Food Canada*

Dr. Jeff Cumming reported that the reorganization at Agriculture and Agri-Food Canada continues to evolve with the development of national themes and programs. Many of the entomologists in Ottawa work under the Biodiversity theme. With the reorganization has come recognition of the importance of the national collections housed in the Neatby and the Saunders buildings. A proposal is underway to upgrade these facilities or perhaps to construct a new building on the Central Experimental Farm. Dr. Kevin Floate commented that at a recent Agriculture and Agri-Food workshop biocontrol and biodiversity were identified as major departmental priorities. There is also an emphasis on memoranda of understanding and linkages with other institutions.

3. *Entomological Society of Canada*

Dr. Sandy Smith, Past President, reported that the annual ESC meeting was successful and the Society continues to generate revenue. The new editor-in-chief for the Canadian Entomologist in 2004 will be Dr. Richard Ring.

The Publications and Finance committees are looking at more cost-effective ways of publishing the Bulletin and the Canadian Entomologist. The Canadian Entomologist is the only journal published by NRC that does not follow NRC's standard format. Dr. Smith noted that recommendations for changes to the journal and bulletin will be reviewed at the April 2004 Executive Council meeting; comments can be sent to Dr. Ring.

The ESC Governing Board had welcomed the Survey's report and also was pleased to have the BSC meeting held in conjunction with the ESC annual meeting. The ESC had reacted positively to the Survey's proposal for a BSC award (and see below). The Committee expressed appreciation for Dr. Smith's support of the Biological Survey.

Secretariat activities

Ongoing operations of the Biological Survey secretariat were reviewed including clearing house and coordination roles, research and other items, and Dr. Danks' travels to entomological centres on behalf of the Survey to exchange information about relevant work. In 2003, visits were made to Kelowna, Victoria, Edmonton, Vegreville and Winnipeg. Seminars and lectures presented in addition to more or less informal treatments of the Biological Survey included Insect adaptations to cold and changing environments, Dehydration in dormant insects, How to assess insect biodiversity, The insect fauna of the Yukon, Knowledge of the insect fauna in relation to pest management, and Ranges of Yukon insects and their Beringian history.

Other items

1. Summary of actions from Survey review

Several revised or new documents resulting from the major review at the April 2003 meeting had been circulated. The content of two more general documents, "The Biological Survey of Canada (Terrestrial Arthropods): the first 25 years" and "Scientific priorities of the Biological Survey of Canada (Terrestrial Arthropods)" were deemed appropriate

for broader use. The Committee discussed potential uses for these documents other than distribution to new Committee members. It was decided that wider distribution of the '25 years' document would help future BSC continuity, indicate what are the lessons for other biological surveys in other countries, demonstrate a successful model more widely, confirm that good science can be done from the bottom up, and so on. Every incoming ESC President should also receive the document. Given the need to educate the Survey's stakeholders and clientele more widely, it was agreed to find a way to publish a version of the document. A subcommittee was charged with determining the best way to do this.

2. Survey succession

A succession document drafted by a subcommittee and distributed prior to the meeting was approved for submission to the Canadian Museum of Nature. Among other elements, the succession plan points out the need, when the head of Secretariat eventually retires, for continuity and staffing overlap and gives details about the need for a well motivated scientist rather than simply an administrator to steer the Survey.

3. ESC liaison and BSC award

A regular BSC report to the ESC Governing Board had been instituted and well received. Such a report provides the opportunity to highlight future action items. The Board is happy to recognize BSC symposia and put appropriate instructions in the meeting guidelines and requested that proposals make the Survey's involvement clear.

The idea of a BSC award was thought to be a good one by the Board but potential problems are created for a travel award by recent developments with the ESC Scholarship fund and Canada Customs and Revenue Agency (CCRA) rules. Therefore, Dr. Giberson will prepare a modified proposal for a research award, in consultation with the Committee, for further consideration by the ESC. Fundraisers will also be sought.

4. *Regional developments of potential interest*

Information of potential interest was reported from different regions of Canada. In British Columbia, various projects in the Okanagan are underway including attention to potentially endangered invertebrates and ecoregional planning. The text of a handbook on mirids is finished and drawings are in progress. Publications on the Montane Cordillera and Pacific Maritime ecozones are in progress. Other work focuses on alien species, and on temperate canopy arthropods. Dr. Richard Ring, who gave the heritage lecture at the ESC meeting, retires officially in June, but there are no plans at present to replace his position with an entomologist. The Royal BC Museum has a new exhibit on giant robotic insects which includes some information panels on entomological work in British Columbia. Dr. John McLean has returned from sabbatical to the University of British Columbia. At Simon Fraser University the Masters of Pest Management program is back on track. Dr. Peter Belton has been brought out of retirement to deal with the mosquito aspects of the West Nile virus problem. Other projects in B.C. were also noted.

In the Prairies, Dr. Dan Johnson has accepted a Canada Foundation for Innovation chair at the University of Lethbridge. There is a new entomologist at Agriculture and Agri-Food in Saskatoon, Dr. Chrystel Olivier. Employment of some recent graduates was noted. The 7th Prairie Conservation and Endangered Species Conference and Workshop will be held in Calgary on February 26-29, 2004. The theme title is 'Keeping the Wild in the West'. In Manitoba and Saskatchewan West Nile virus has dominated the local news and has brought resources to some entomologists. The forestry program at the University of Winnipeg continues to be active. Initiatives by the Canadian and U.S. Nature Conservancies to purchase and preserve tall grass prairie continue. For example, sections in Canada have been approved for purchase but only if the pig manure easement can be removed from those lands. Databasing of the University of Manitoba collections con-

tinues. The Criddle homestead site at Aweme is now a provincial park and has been nominated as a national historic site. The University of Alberta has a new entomologist on faculty, Dr. Maya Evenden, who is studying pheromones of Lepidoptera.

The Alberta Department of Environment has again funded members of the Alberta Lepidopterists Guild to go to far northern sites, leading to a survey of the Caribou mountains. The International Lepidopterists Society meeting was hosted in Olds last summer. A number of forest biodiversity projects centred in Edmonton through partnerships between the Northern Forestry Centre and the University of Alberta were reviewed, including work on beetles and fire impacts and ecological land classification systems. Synthetic publications in progress include treatments of the importance of biosystematics in addressing key forest research and policy issues and arthropods as ecological indicators for sustainable forest management.

In Ontario there are several current or recently completed graduate students in entomology in Toronto, Sudbury, Guelph and elsewhere. Major efforts at the Royal Ontario Museum recently have been concentrated on gallery redevelopment. Current work is on the life sciences components of the new galleries. Odonates at the ROM from the old historical Ministry of Environment collections will be properly identified and curated. The Ivey Foundation is putting funds towards the study of biodiversity of forests in the context of conservation, but the Foundation will not fund graduate students, long-term research or studies of individual species! The Entomological Society of Ontario meeting is in Guelph, November 28-30, 2003. Three new research scientists have now started work at Agriculture and Agri-Food Canada, Drs. Patrice Bouchard, Jeff Skevington and Andrew Bennett. Dr. Don Bright has retired. Two large North American catalogues are in press on Dolichopodidae and Tachinidae.

In Quebec the annual meeting of the Société d'entomologie du Québec is in Quebec

City in November with the topic of Insectes sans frontières (insects without borders). The provincial diagnostic laboratory is now on the internet, and a lot of applied information will be posted for extension personnel. Many graduate students are now working at McGill University in Dr. Wheeler's laboratory and also Dr. Chris Buddle's laboratory with work on forest biodiversity projects. The current databasing focus at the Lyman Museum is on the Diptera collection. No replacement for Dr. Peter Harper at the Université de Montréal has yet been hired after advertising for the last two years.

In Newfoundland and Labrador and the Maritimes the work of graduate students and others in the region was noted. Hurricane Juan caused considerable damage in Prince Edward Island including blowing the roof off the Biology building at the University of PEI. The joint

annual ESC / Acadian Entomological Society meeting will be in Charlottetown in 2004, from 15–18 October. The collection of Odonata from PEI National Park is now at the New Brunswick Museum, and has just been databased.

For the arctic, a two-week course on boreal and arctic entomology was held in Churchill last summer under the auspices of the University of the Arctic (see p. 34). The course will be repeated next year. Some groups have high diversity there, perhaps because Churchill represents the southernmost extent of many arctic species and northernmost extent of many boreal species.

5. *Other matters*

The Committee considered information about international liaisons, membership of the Scientific Committee, the location of meetings, and other subjects.

Arthropods of Canadian Grasslands — News

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

1. T. A. Wheeler and H. V. Danks – Introduction to the Grasslands Project
2. J. D. Shorthouse – Attributes of Canada's grasslands
3. S. McGinn – Weather in grasslands
4. V. Behan-Pelletier – Mite fauna in grassland soils
5. D. Wade – Diversity of spiders in tallgrass prairies
6. R. E. Roughley and G.G.E. Scudder – Aquatic Hemiptera in grasslands
7. S. Boucher and T. A. Wheeler – Trophic guilds of Brachycera (Diptera) in xeric Yukon grasslands
8. K. D. Floate – Gall-forming arthropods and their distributions in overlap and hybrid zones of cottonwoods on the Canadian prairie

9. J. D. Shorthouse – The component community of arthropods associated with cynipid galls on wild roses
10. R. E. Roughley et al. – Use of fire as a conservation and management tool in tallgrass prairie
11. G. G. E. Scudder – Arthropods in identifying hot-spots for conservation
12. K. G. A. Hamilton - Leafhoppers as indicators of grassland habitat types
13. M. Alperyn – Dytiscids in prairie ponds
14. D. Johnson – Grassland insects as food for birds
15. D. Johnson – Temporal changes in grasshoppers
16. T. A. Wheeler, H. V. Danks, R. E. Roughley – Ecology and interactions: Summary and synthesis

Focus site 2004

The annual grassland field trip will be held June 5-6, 2004 in Aweme, Manitoba in conjunction with a larger BioBlitz. For more information please see the Aweme BioBlitz website: <http://www.brandonu.ca/zoology/aweme%20bioblitz/>

The Quiz Page

—test your knowledge of Canada and its fauna—

1. What kind of insect is most commonly characterized in Canada by a strikingly disjunct range?
2. Name five species of insects that in recent years have obtained a high public profile in Canada.
3. Name five families of flies that are characteristic of the northern parts of North America.
4. Concentration corner
Ants discover a rich food source 10 metres away from the nest. An average ant can carry a 50 mg load and walk at 0.1 km / hr along a trail marked by nest mates. To gather a full load from the food source and to discharge it into the nest takes an ant 20 seconds at each end. How much of the food source can 500 ants bring into the nest by working continuously for three hours?
5. Name 20 families of insects that occur in Canada and begin with the letter A.

[Answers on p. 38]

Project Update: Terrestrial Arthropods of Newfoundland and Labrador

David W. Langor

Canadian Forest Service, Northern Forestry Centre, 5320 - 122 Street, Edmonton, AB T6H 3S5
dlangor@nrcan.gc.ca

The terrestrial arthropod fauna of Newfoundland (NF) is interesting because it reflects mainly postglacial immigration from the mainland with 'enrichment' by numerous European introductions. In fact, NF is the most 'Europeanized' part of North America in terms of the proportion of its fauna represented by Palaearctic introductions. The fauna of Labrador (LB) is likewise of great interest, as it represents the easternmost limits of the arctic, sub-arctic and mainland boreal regions of North America. Interest in the arthropod fauna of NF & LB has been evident since 1766 when Joseph Banks made, over a 6-month period, the first extensive and documented natural history collections from the area, including some arthropods. From 1832-35, Philip Henry Gosse collected and observed insects in NF and made hand paintings of nearly 250 species, included in his unpublished treatise *Entomologia Terrae Novae*. Over the last 75 years, knowledge of the terrestrial arthropods of NF & LB has benefited from formal surveys (e.g. from the Northern Insect Survey, Forest Insect and Disease Survey, Fenno-Scandinavian expeditions of 1949 and 1951, surveys by the British Schools Exploring Society), and collecting trips by numerous specialists. Unfortunately, few of the results of these efforts have been reported and the existing published records of the NF & LB fauna are widely scattered through the entomological literature.

Since its inception, the Biological Survey of Canada (BSC) has been interested in the terrestrial arthropod fauna of this province, especially that of NF, and recognized that a comprehensive survey, based on new collecting and study of existing collections and literature,

was warranted. The interests of the BSC were boosted in 1977 upon the arrival of David J. Larson at the Memorial University of NF, and since then, faunistic activity on NF & LB arthropods was sustained by Larson, students and colleagues. This activity has been embraced by the BSC as one of its projects since 1977.

Until 1998, most effort focused on surveying the fauna of NF & LB, especially aquatic and semi-aquatic groups, resulting in numerous and sundry publications. Since 1998, a larger synthetic effort was undertaken to develop comprehensive lists, databases and analyses to describe the terrestrial arthropod fauna of NF & LB and, where feasible, to produce illustrated keys to all known species. It is



Collecting *Petrobius* in Newfoundland
(photo by D. Larson)

expected that over the next 5-8 years a series of 5-6 monographs will be published on the provincial fauna, including keys, distribution, biological notes, illustrations and references. Eventually a complete faunal analysis will be completed. Other activities include an overview of entomological work in NF & LB, a bibliography of the entomological literature of the province and a database of species, collection localities and habitus photographs.

The number of participants in the Project has been few to date and includes David Larson (Project Leader, all insect Orders); David Langor, Barry Hicks and Jan Klimasewski (Coleoptera); Geoff Scudder (Heteroptera); and Roger Pickavance (spiders). The current database of NF & LB insects includes over 4700 species, based on literature records and museum speci-

mens. Preliminary keys have been constructed for: Archaeognatha, Thysanura, Ephemeroptera, Odonata, Orthoptera sensu lato, Dermaptera, Plecoptera, Heteroptera, Megaloptera, Neuroptera, Coleoptera, Trichoptera, and Siphonaptera; species of some of the families of Lepidoptera, Diptera, and Hymenoptera. No keys have been prepared for Homoptera, Phthiraptera, Thysanoptera, and Psocoptera. A list of current keys is available on the BSC website [<http://www.biology.ualberta.ca/bsc/english/nfldfamilies.htm>]. The Project would benefit from the involvement of other faunal specialists insofar as to build on current checklists and to test and improve existing keys. If you are interested in participating please contact David Larson (dlarson@mun.ca) or David Langor (dlangor@nrca.gc.ca).



Long Range Mountains, Gros Morne National Park, Newfoundland
(photo by D. Larson)

New Project: Arthropods of Canadian Forests

David W. Langor

Canadian Forest Service, Northern Forestry Centre, 5320 - 122 Street, Edmonton, AB T6H 3S5
dlangor@nrca.gc.ca

The BSC has decided to initiate a new Forests Project to address arthropod faunistics and systematics work related to forested ecosystems. The primary goal of the new Project is to coordinate research on the diversity, ecology and impacts of the arthropods of Canadian forests.

Arthropods represent 60-70% of all species in Canadian forests, but are relatively little known despite their great importance (see overleaf). The current situation in Canada concerning research on diversity of arthropods in Canadian forests can be characterized as follows:

- There is much research activity across the country focusing on a wide variety of biodiversity issues, but most work is tightly focused on restricted faunistic inventories or localized testing of specific hypotheses.
- Information exchange is abysmal. Most groups work in isolated pockets and there is relatively little interchange of results or true collaboration.
- There is little synthetic activity to ascertain what is known and where important gaps are.
- Work is often criticized, poorly funded and non-influential because there is no cohesive overall plan.

The BSC is well placed to offset some of these difficulties. It can play strong roles as a clearing house for information, a coordinator and catalyst to foster research and synthesis on arthropod biodiversity, and a unifying voice to express matters of national concern and need. No other organization is currently filling these roles. The Survey proposes to take this op-

portunity to build better communication, collaboration and cohesion among those working on forest arthropod biodiversity issues, and to build on and integrate existing BSC activities related to forests.

To fulfill these general roles the BSC is undertaking a number of activities:

- Develop an updated list of ongoing forest biodiversity projects. The last survey was completed in 1997 and is outdated. The database will be available on the BSC web site, and will be continually updated. This activity will highlight current activity in Canada and help to facilitate contact between researchers with complementary interests. The survey form is available in this issue of the Newsletter (p. 17) and on the BSC web site (<http://www.biology.ualberta.ca/bsc/english/forests.htm>).
 - Publish a newsletter, *Arthropods of Canadian Forests*, commencing in the spring of 2004. The newsletter will serve as a communication tool for encouraging information exchange and collaboration among those in Canada who work on forest arthropod biodiversity issues, including faunistics, systematics, conservation, disturbance ecology and adaptive forest management. Content will include: brief news articles concerning meetings, symposia, opportunities, collecting trips, etc.; project updates (short articles that introduce ongoing relevant projects in Canada); feature articles (overviews, summaries, commentaries or syntheses); a listing and brief review of featured publications and websites; and opportunities for graduate student programs, employment, collaboration, funding, etc.
-

- Sponsor and organize symposia and workshops on relevant topics. The BSC will start by hosting a symposium at the 2005 ESC/ESA meeting (Edmonton) to focus on epigaeic arthropods in forests. This symposium will review progress to date and highlight important gaps and opportunities.
- Construct new pages on the BSC web site to facilitate exchange of information.

In its broader scientific roles, the project as it develops will involve a large number of specialists with expertise on different taxa, in different geographic regions, and with different research interests, embracing three general objectives on the nature of arthropods associated with Canadian forests:

- Description of the diversity (alpha, beta, gamma) of arthropods associated with Canadian forests.
- Determination of the ecological roles of arthropods in Canadian forests and of the drivers that determine species distributions and assemblage structure.

- Measurement of the impacts of natural and anthropogenic disturbances on forest arthropod communities, and identification of mitigation measures to improve conservation.

To these ends, faunistic and taxonomic research on selected groups of forest arthropods will be pursued.

- Currently, G.G.E. Scudder and R.G. Footitt are assessing the guild of sucking insects on *Pinus banksiana* (Jack pine) and *P. contorta* (Lodgepole pine) by extracting data from collections and by field collecting.
- Other specific activities are anticipated in the near future.

Stay tuned as this project matures and consider becoming involved. **If you are interested in participating please contact**

David Langor (dlangor@nrca.gc.ca) *or*

Neville Winchester (tundrast@uvvm.uvic.ca).

The economic context

About 45% of Canada's land area is forested and 25% of the land area is represented by commercial forests. Fifteen terrestrial ecozones in Canada contain forest types, and two-thirds of Canada's estimated 140,000 species of plants, animals and micro-organisms live in forests. Clearly, forests dominate life zones in the country to the extent that a study of their associated fauna is basic to a full understanding of the arthropod fauna of Canada. Forests also underpin a pillar of the Canadian economy, worth about \$75 billion annually and contributing over 360,000 jobs directly, resulting in increased forest development activity. The search for a sustainable balance between ecological, economic and social values of forests drives the national forest policy agenda. The ecological values and services provided by forests are not fully understood or appreciated, a critical information gap that impedes optimal decision-making. In the absence of detailed knowledge of the full range of forest ecosystem functions, biological diversity represents a generally-accepted surrogate of functional ecosystem integration and, as such, is increasingly being included in the suite of forest management objectives for the Canadian forest industry. However, there is the realization that little is known about the vast majority of species, including arthropods, in forests and that improved knowledge (composition, variation, impacts of disturbances) of these groups is necessary to establish meaningful, operational biodiversity objectives as an essential component of sustainable forest management.

Forest Arthropod Project Inventory in Canada

Rationale: The Biological Survey of Canada (Terrestrial Arthropods) is undertaking a survey of active forest arthropod biodiversity projects in Canada to update a database that is now 10 years old. The intention is to build a comprehensive searchable on-line database that will be regularly updated. Improving awareness of ongoing forest biodiversity research/survey projects in Canada is expected to lead to: increased opportunities for data sharing and syntheses; exchange of experiences, expertise and information; broader collaboration; and better visibility for our activities. We ask you to please take a few minutes to complete the following survey and return it (preferably in an electronic form, e.g., Word document).

Scope: We wish to include current projects focusing on: faunal surveys requiring bulk sampling and assessment of assemblage structure; impact of natural (e.g., wildfire) and anthropogenic (e.g., forestry) impacts on species abundance and genetic diversity; development of ecological indicators; conservation of forest arthropods. Projects in rural or urban forests are of interest. The term 'current' refers to projects in which sampling is ongoing, those in which sampling is completed but identifications and analyses are ongoing; and those for which collaborative opportunities exist for those who wish to look at unprocessed and archived specimens. We are not including projects that are oriented towards pest management, population ecology, physiology, behaviour, systematics. If you have some uncertainty concerning whether your project should be included, please contact David Langor (dlangor@nrca.gc.ca; 780-435-7330).

Survey: For **each** project the following information is requested, although some categories may not be relevant to particular types of projects. At the end a completed example is provided.

- 1. Province/Location/Name:** Province(s) may be sufficient for projects of broad geographic scope. A more specific location should be given for projects of smaller scope, e.g. Southern Ontario, Fundy National Park, City of Edmonton. In some cases an experiment may have a name.
 - 2. Contact:** Name(s) of main contact (try to limit to 1 or 2), affiliation, email address, phone number.
 - 3. Forest type (tree species):** e.g., boreal spruce, Carolinian, Garry oak, spruce mires
 - 4. Trapping methods:** e.g., pitfall traps, light traps, flight intercept, sweeping, soil cores, pans.
 - 5. Sampling duration:** include years in which sampling took place, and the time of year in which sampling occurred, e.g., 1992-98 – snow-free season; 1996 – July; 1998-2002 – early May, mid-July, late Sept.
 - 6. Focal taxa:** Class, Order, Family, Genus, trophic group, ecological assemblage, e.g., spiders, Lepidoptera, Carabidae, defoliators, saproxylic beetles. Also note if other taxa (plants, vertebrates, worms) were sampled in the same experiment.
 - 7. Design:** very brief overview of experimental design, number of replicates, number of sites/samples, e.g. 1: 2 harvest treatments and control, 4 replicates, 60 traps, 600 samples; e.g. 2: 14 trees, 300 branch samples, 2500 specimens.
 - 8. Goal/Objectives:** very succinct (<50 words) description of the goal/objectives of the project.
-

9. **Opportunities:** succinct description of opportunities for collaboration, data exchange, specimens, etc., e.g., graduate student opportunity, looking for other carabids datasets for meta-analyses, spiders unidentified and available to interested parties.
10. **Products:** an indication of whether some products are available and the type, e.g., journal papers, URL, species list, photographs, databases. If publications are available, please provide one or two examples for inclusion in the database. PDFs especially welcome as these could be attached to the database.
11. **Vouchers:** Location of voucher specimens.

Example:

1. **Province/Location/Name:** Alberta, Northwest, Zama Experiment
2. **Contact:** David Langor, Canadian Forest Service – Edmonton, dlangor@nrcan.gc.ca, phone (780) 435-7330
3. **Forest type (tree species):** Boreal Highlands – white spruce dominated
4. **Trapping methods:** pitfall traps, flight intercept (FI) traps on snags, UV light traps, Lindgren funnel traps
5. **Sampling duration:** 1997 (pre-treatment), 1998, 1999, 2002 – April to Sept.; continuous sampling except for UV traps which were run 1 night each week.
6. **Focal taxa:** Lepidoptera; epigaeic Carabidae, Staphylinidae and spiders; saproxylic beetles.
7. **Design:** 7 harvesting treatments and controls; 4 replicates; 32 UV traps, 96 pitfall traps, 96 FI traps; 4 Lindgren traps; many thousands of samples.
8. **Goals/objectives:** To assess responses of arthropods to alternate harvesting practices.
9. **Opportunities:** Staphylinidae, spiders and saproxylic beetles yet unidentified and may be available to interested parties.
10. **Products:** species list of Carabidae; journal papers Volney, W.J.A et al. 1999. A silvicultural experiment to mitigate pest damage. Forestry Chronicle 75:461-465.
11. **Vouchers:** Northern Forestry Centre, Edmonton

Please return entries to David Langor, preferably by email (dlangor@nrcan.gc.ca).

Please pass this on to colleagues involved in forest biodiversity studies.

Thank you.

This article is available on line at <http://www.biology.ualberta.ca/bsc/english/forests.htm>

Biological Survey of Canada
Terrestrial Arthropods français

Web Site Notes

What's new?

Roles and responsibilities

Structure and personnel

Publications

Scientific projects

Arthropods of Canadian Grasslands

Forest arthropods

Terrestrial arthropods of Newfoundland and Labrador

Canada's insect fauna

List of workers (database)

Faunal analysis project

Requests for Material or Information

Biological Survey Foundation

Other sites of interest

Site map

In April 2003 the Survey's Scientific Committee reviewed all Survey projects (see Review of scientific priorities, Newsletter of the Biological Survey 2003, 22(2): 53-54). Based on that review, the web page on Scientific Projects has been updated to reflect the current scientific priorities. See <http://www.biology.ualberta.ca/bsc/english/scientificprojects.htm> for an introduction to:

- Arthropods of Canadian grasslands,
- Insects of the Arctic,
- Illustrated keys to the families of terrestrial arthropods in Canada,
- Forest arthropods,
- Seasonal adaptations of insects, and
- Insect fauna of Newfoundland and Labrador

Two projects have become more active recently and each now has its own section on the website.

Insects of Newfoundland and Labrador has a description of the project as well as a list of the number of known species from each insect family in Newfoundland and Labrador. In the future we hope to enlarge this section with more content which may include keys for testing, a biogeography of NF/LB entomology, a database of known species from the province, and historical information.

See <http://www.biology.ualberta.ca/bsc/english/nfld.htm>

The *Forest arthropods* page also has a description of the project's goals and objectives. A new survey of active forest arthropod biodiversity projects in Canada has been initiated and a questionnaire is available here.

See <http://www.biology.ualberta.ca/bsc/english/forests.htm>

Opinion Page

—The Opinion Page is a forum for views and ideas of potential interest to readers—
Contributions should be sent to the editor.

Bioinformatics and misinformatics: the missing links between taxonomic data and taxonomic databases

Terry A. Wheeler

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

The Importance of Systematic Data

The systematist has two fundamental responsibilities to the scientific community: assemble, analyse and synthesize the data necessary to describe the diversity of life on earth; and ensure that other scientists and users have access to the data. For 250 years, the primary tool used to disseminate systematic information has been the published revision, containing species descriptions, keys, distribution maps, ecological notes, etc. The rise of the World Wide Web and more powerful desktop computers in the last decade has led to a tremendous increase in the range of media and products that may be used to disseminate the results of systematic research. The opportunity to connect researchers and data almost instantaneously led to the realization that massive amounts of data could now be synthesized, organized and made accessible to a community of users limited only by access to a computer network. I contend that organized Canadian efforts to synthesize biodiversity data have not taken advantage of this opportunity; in fact, ongoing initiatives have obscured an increasing gap between basic research in systematics and dissemination of “products”.

It has long been recognized that Canada is losing specialists trained in systematics and that our collective research output in the field has suffered as a result. A variety of solutions has been proposed to address this lack of basic

research. The systematics community has repeatedly proposed a bold plan based on training and hiring more systematists. This innovative solution has unleashed a storm of apathy in most circles, with a few notable exceptions; the most encouraging has been the recent hiring of three systematic entomologists by Agriculture and Agri-Food Canada. Other scientists (Canadian and otherwise) have proposed grand but naïve plans to replace primary taxonomic research with so-called “DNA barcodes” based on sequencing a minute portion of the genome (e.g., Hebert et al. 2003, Tautz et al. 2003) or doing away with the tedious (at least to non-systematists) necessity of observing rules of nomenclatural priority and hard copy publications and transferring taxonomy *in toto* to the Web (e.g., Godfray 2002). Such sweeping and technology-driven proposals have been effective in getting systematics into the pages of *Nature*, *Science* and other prominent journals, and I suppose that is a good thing. However, these are, in the end, simplistic and flawed “solutions” that ignore the need for trained systematists to actually recognize new species in the first place, to describe taxa accurately in such a way that they are recognizable to other scientists, and to propose and test hypotheses on phylogenetic relationships. Technological advances have obviously revolutionized the way we conduct and disseminate systematic research, but such advances should be tools, not crutches, that serve as an adjunct to good work

done by well-trained systematists (Mallet and Willmott 2003, Scotland et al. 2003, Wilson 2003).

Some countries have adopted a balanced view of the importance of research at all levels of the systematic process and have responded accordingly. In the United States, for example, the National Science Foundation has multiple discrete funding programs for systematic research (see www.nsf.gov/bio/deb/start.htm). There are programs to discover and describe new taxa (*Partnerships for Enhancing Expertise in Taxonomy*), to conduct large-scale faunal inventories (*Biodiversity Surveys and Inventories*), to reconstruct phylogenetic history and place species within an evolutionary context (*Assembling the Tree of Life*), to support curation and access to collections (*Biological Research Collections*), and to establish bioinformatics frameworks (*Biological Databases and Informatics*). This is a logical and scientifically valid approach that increases the likelihood that the taxonomic databases will be built on accurate data. The current picture is very different in Canada; other than the traditional sources of (limited) support to individual researchers from agencies like the Natural Sciences and Engineering Research Council and the employment of an ever-shrinking cohort of government systematists, Canadian government agencies have largely ignored the need for research on the identity and relationships of species. Instead, they have opted for presentation over content. No new funds have been allocated across the systematics community and support for systematic research continues to erode. In contrast, bioinformatics is a current hot topic and agencies involved in disseminating and using biodiversity information have embraced packaging and marketing with the zeal of a new recruit at an advertising agency. The result is that Canada can now hold her own with any other scientific power in the production and proliferation of acronyms and websites.

“Initial” Efforts

The Federal Biosystematics Group (FBG), a consortium made up of the five federal Natural Resources departments with a stake in biodiversity knowledge, released a report (Federal Biosystematics Group 1995) on the state of systematics in Canada. The report identified two important areas most in need of financial support: new scientists (namely, 15 systematists, additional support staff, and support for students); and better facilities (namely, a National Collections Strategy, cost sharing to support collections, and computerised access to holdings). Subsequent actions on this front by FBG included changing their name to the Federal Biosystematics Partnership (FBP) followed by the launch in early 2003 of the Federal Biodiversity Information Partnership (FBIP) (www.cbif.gc.ca/fbip/fbip_e.php). No funding programs for systematic research have been established other than a single three-year postgraduate fellowship in systematics, which was awarded only once. Current FBIP projects include scattered “proof of concept” (to commandeer a reprehensible management cliché) projects such as databasing the mosquito collections in a small subset of selected museums across the country, which, it is hoped, will provide more accurate distributional data for monitoring West Nile virus. There is no indication on the FBIP website as to whether species identifications will be confirmed by one of our very few qualified specialists prior to the taxonomic information appearing on the Web.

While FBG/FBP/FBIP coordinated activities within the federal government departments, a broader initiative led to the formation of the Canadian Biodiversity Information Initiative (CANBII), based on the American NBII program. CANBII quickly became CBIN (The Canadian Biodiversity Information Network), which, in turn, became BCIN (Biota of Canada Information Network), which, in the fullness of time, became BKIN (Biodiversity Knowledge Information Network). Some workshops were held and optimistic plans were made.

The major “proof of concept” project resulting from the CANBII/CBIN/BCIN exercise is the Butterflies of Canada (www.cbif.gc.ca/spp_pages/butterflies/index_e.php). That project assembled specimen data from many (but not all) major insect collections across Canada on a single, well-known, group of insects for which taxonomic data and curation are in good shape and, thus, used repeatedly in databasing and analysis projects. The butterflies represent a small group of insects in Canada (293 species) and are unusual in that they have been so well studied by systematists that available identification tools like field guides and regional catalogs make specimen identification a simple process for competent entomologists. There have been, apparently, no other concrete products combining data from a large number of collections arising from CBIN/BCIN/BKIN, though there has been limited distribution of the reports of the workshops and identification of some vague objectives. It appears that BKIN has been subsumed within CBIF (see below).

The Global Biodiversity Information Facility (GBIF, www.gbif.org) is an international program that will coordinate national and regional efforts to compile interconnected databases of biodiversity information. Canada, one of the member countries of GBIF, has responded to its commitment to GBIF by establishing CBIF, the Canadian Biodiversity Information Facility (www.cbif.gc.ca), coordinated by FBP (or perhaps FBIP), which has assumed responsibility for the objectives previously held by CBIN, BCIN and BKIN.

Under the Canadian programs, the databases of taxonomic names will be built upon, and linked to, the framework of the Integrated Taxonomic Information System (ITIS) (about which more below).

One of the main weakness in this whole system, aside from the necessity to learn new acronyms every few months, is that the FBIP/BKIN/CBIF initiatives in Canada are overwhelmingly top-down, with federal agencies driving all decisions, meetings, workshops and

consultations, as well as dispensing all budgets, much of which seems to be allocated to the aforementioned meetings, workshops and consultations. Information transfer to members of the systematics community is sporadic at best. The university community is notably absent from any substantive input into the programs. On the other hand, the actual data collection and verification is primarily bottom-up, built on the efforts of individual systematists, frequently in the university system. Between the top-down “planning” and the bottom-up execution, there is a broad no-man’s land, and the working systematists grow increasingly disillusioned and cynical with the glowing visions of a computerized utopia coming from above.

Most databasing that has been done at the level of natural history collections has involved individual researchers finding small sums of money for support staff or setting aside some of their own valuable time to organize data on a portion of their own collection, often as part of a larger systematic study. The FBIP/BKIN/CBIF vision of a community of data generators and data users sitting at the computer peering virtually into the drawers of other museums is certainly an appealing vision, but it is, at best, a little farther in the future than we are led to believe, and, at worst, an indication of how out of touch these initiatives are with the current state of raw biodiversity information for nearly all groups of arthropods.

The quality and quantity of information

There seems to be an assumption at some levels that compiling taxonomic databases is a management problem, not a science problem (i.e., we don’t need particular expertise, just some bodies to connect the data). This assumption has led to the generation and proliferation of errors in the few existing databases. I searched ITIS (our “flagship” for taxonomic names), for my own family of expertise - the fly family Chloropidae (for those who wonder if this may be a particularly obscure or arcane choice, the family contains over 2000

described species worldwide, major pests of wheat, oats and rice on most continents, and vectors of conjunctivitis, yaws and Brazilian Purpuric Fever). The ITIS search generated a list of 368 chloropid names (subfamilies, genera and species); most are Nearctic, but there is a strange and woefully incomplete smattering of names from other biogeographic realms. One entire subfamily is missing (although an older, preoccupied name for one of the genera in that subfamily is included, albeit in the wrong subfamily). Some names are recent and valid, described in 1980; others are synonyms that have not been used in 40-50 years. Clearly, the anonymous person who did the data entry did not know anything about these organisms. I say “anonymous” not to spare their reputation, but simply because the database does not identify individuals responsible for the data. I fared no better with a search on Sphaeroceridae, one of the few acalyptrate Diptera families in North America with an authoritative and recent set of revisions, keys and species lists. Some genera were completely omitted; some species turned up in multiple genera. Admittedly, I had better luck when I searched for some major agricultural crops and pests.

The ITIS website identifies the source of its taxonomic data as the NODC Taxonomic Code, database version 8.0; The acronym “NODC” is not, unfortunately, defined on the ITIS website. However, a Google search revealed that NODC is the National Oceanographic Data Center (www.nodc.noaa.gov), which, in turn, gives no indication as to the source of *its* information on terrestrial organisms. These data, evidently used as the basis for launching the initiative, have simply been incorporated wholesale, with all their errors, into ITIS. Some may assume that bad data (“unverified” sensu ITIS) are better than no data (this is an erroneous assumption); some may assume that seeing such errors would encourage the appropriate specialists to volunteer their time and effort to fix them (this is also an erroneous assumption). Perhaps there was simply a desire to get as many records as possible incorporated

into ITIS during the early “proof of concept” stages.

There are multiple problems here. First, given the small number of specialists and the current nature of our workloads, it is unlikely that we (the working systematists) will be lining up to clean up ITIS anytime soon. Second, and in the meantime, the error-filled lists are available on the Web in databases like ITIS or *Nomina Insecta Nearctica* (www.nearctica.com/nomina/main.htm), another widely used, incompletely verified compilation that is rife with errors, at least in Diptera. People who are unaware of the errors incorporated in those resources use them, in turn, as their source for taxonomic names. And so the misinformation radiates out across the Web. So too does the mistaken assumption that as long as we have a name we don’t really need a systematist just to confirm what we already “know”.

The dangers of misinformatics

The term *bioinformatics* has become entrenched in the biological lexicon (Sugden and Pennisi 2000). Some people restrict its use to the compilation and large-scale analysis of genetic data in centralized databases such as Genbank; others, including most of the agencies and initiatives discussed here, use a broader concept encompassing genetic, taxonomic, nomenclatural, phylogenetic and ecological data on organisms. Unfortunately, in its present incarnation, ITIS and similar entities are dispensing as much *misinformatics* as bioinformatics and until the focus changes from “proof of concept” to “ground-truthing” (to commandeer another reprehensible management cliché) they will continue to do so. There is a fine line between bioinformatics and misinformatics and unless the systematics community is encouraged to become a major player in these initiatives and there is tangible (i.e. financial) support for generating and verifying the data that these databases are built upon, Canada will be standing on the wrong side of that fine line. The proliferation of misinformatics websites

has the potential to do more damage to the study of biodiversity than having no databases at all.

Where do we click now?

Progress on two fronts is necessary: the accumulation and verification of accurate primary data to build the databases; and the construction and coordination of databases to build a synthesis of information across collections. Data generation and data organization are tied together as securely as two people in a three-legged race. If we do not move forward together, neither of us will get where we want to go.

I have been assured, on more than one occasion and by more than one web database promoter, that increased funding for their products cannot help but generate additional support for basic systematic research. After many years, and especially since the adoption of the Rio Convention more than a decade ago, I have seen no evidence for this assertion whatsoever, at least in Canada. Too much money from limited departmental budgets has already been spent on ineffectual workshops and consultation reports, all of which state, repeatedly, the painfully obvious. There is little money left over to support meaningful progress toward the long-term goals.

Current federal initiatives in biodiversity databasing must acknowledge the weaknesses in their existing data and organizational structure and increase support for, and involvement of, the working systematics community. The continuing absence of involvement from academia and even of many systematists within the government system is a critical oversight that seriously weakens Canadian initiatives compared to ongoing American, European and Latin American programs. If this unification of purpose does not happen soon, future developments are obvious. Systematists will continue to lose valuable time trying to convince the bioinformatics committees and working groups of the value of our expertise and research, and of

the necessity to train and employ more systematists to build the foundation that our database administrators seem to think is already in place. The systematists will also waste too much time trying to correct the damage done by the growing body of taxonomic misinformation that litters the information superhighway. Meanwhile, the biodiversity database designers will surround themselves in pretty paper and ribbons as they gift-wrap the same empty boxes, over and over again.

References

- Federal Biosystematics Group. 1995. Systematics: an impending crisis. A statement at the time of the Federal Science and Technology Review. Publishing Division, Canadian Museum of Nature, Ottawa. 18 pp.
- Godfray, H.C.J. 2002. Challenges for taxonomy. *Nature* 417: 17-19.
- Hebert, P.D.N., A. Cywinska, S.L. Ball and J.R. de Ward. 2003. Biological identifications through DNA barcodes. *Proceedings of the Royal Society of London, Series B* 270: 313-322.
- Mallet, J. and K. Willmott. 2003. Taxonomy: renaissance or Tower of Babel? *Trends in Ecology and Evolution* 18: 57-59.
- Scotland, R., C. Hughes, D. Bailey and A. Wortley. 2003. The Big Machine and the much-maligned taxonomist. *Systematics and Biodiversity* 1: 139-143.
- Sugden, A. and E. Pennisi. 2000. Diversity digitized. *Science* 289: 2305.
- Tautz, D., P. Arctander, A. Minelli, R.H. Thomas and A.P. Vogler. 2003. A plea for DNA taxonomy. *Trends in Ecology and Evolution* 18: 70-74.
- Wilson, E.O. 2003. The encyclopedia of life. *Trends in Ecology and Evolution* 18: 77-80.

Resources for the study of the Odonata in Canada

Rob Cannings

Royal British Columbia Museum, 675 Belleville Street, Victoria, BC V8W 9W2
rcannings@royalbcmuseum.bc.ca

Introduction

When I began studying the Odonata in the early 1970s, only six or seven people across Canada shared my interest. Since then, and especially during the last decade, dozens and dozens of enthusiasts have taken up the challenge of studying and watching dragonflies. Biologists research the ecology, behaviour, biogeography and phylogeny of these endlessly fascinating insects; conservationists study the status and abundance of populations; naturalists watch and record the comings and goings of adults and larvae. The popularity of dragonfly study is on the rise. New and useful books and internet sites have multiplied. This brief report lists only the most important of these resources for the study of the Odonata in Canada.

The English term “dragonflies” here refers to the whole order Odonata, which, in Canada, includes the suborders Zygoptera (damselflies) and Anisoptera (dragonflies proper).

There are two international odonatological societies that publish journals and newsletters; belonging to one or both of these organizations brings the student into contact with the international odonatological community and the benefits that this conveys:

Foundation Societas Internationale Odonatologica (FSIO): four issues of the journal *Odonatologica* and two of the smaller *Notulae odonatologicae*. See <http://www.afn.org/~iori/siointro.html> for membership information.

The Worldwide Dragonfly Association (WDA) publishes *The International Journal of Odonatology* and the twice-yearly newsletter

Agrion. Information: <http://powell.colgate.edu/wda/dragonfly.htm>.

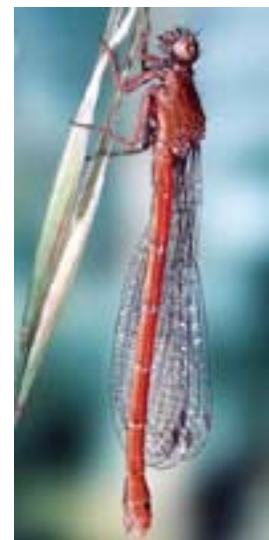
Perhaps even more useful is membership in the Dragonfly Society of the Americas, with its *Bulletin of American Odonatology* and newsletter, *Argia*, where all sorts of information on Odonata, publications and regional field meetings is published. See <http://www.afn.org/~iori/dsaintro.html>. Also invaluable is a connection to the international Odonata list-serve where e-mail discussions on innumerable dragonfly topics occur. Information on joining this discussion group can be found at <http://orion.ups.edu/mailman/listinfo/odonata-1>.

Basic Literature

Corbet, P.S. 1999. *Dragonflies: behavior and ecology of Odonata*. Cornell University Press, Ithaca, New York. 829 pp.

(A superb and comprehensive treatment of the biology of Odonata worldwide by the dean of odonatologists.)

Amphiagrion abbreviatum female. The genus *Amphiagrion* contains two recognized species, one eastern, one western. *A. abbreviatum* is the western species. There is some uncertainty over species limits in the genus; taxonomic studies are still needed to solve many questions in the Odonata.
Photo: Rob Cannings, Royal BC Museum



Dunkle, S.W. 1989. Dragonflies of the Florida Peninsula, Bermuda and the Bahamas. Scientific Publishers, Gainesville, Florida. 154 pp.

(Colour photos and descriptions of many Canadian species; good general treatment of Odonata biology and study.)

Dunkle, S.W. 1990. Damselflies of Florida, Bermuda and the Bahamas. Scientific Publishers, Gainesville, Florida. 148 pp.

(Colour photos and descriptions of many Canadian species; good general treatment of Odonata biology and study.)

Dunkle, S.W. 2000. Dragonflies through binoculars: a field guide to dragonflies of North America. Oxford University Press, Oxford. 266 pp.

(Useful field guide to all North American Anisoptera; diagnostic field information, photos and distribution maps; useful for putting Canadian species in the continental context.)

Miller, P.L. 1987. Dragonflies. Naturalists' handbooks 7. Cambridge University Press, Cambridge. 84 pp.

(A small British book with an excellent summary of the biology of Odonata.)

Needham, J.G., M.J. Westfall, Jr. and M.L. May. 2000. Dragonflies of North America. Scientific Publishers, Gainesville, Florida. 939 pp.

(The most up-to-date treatment for the identification of all Nearctic Anisoptera; heavy on description, light on distribution, biology and ecology.)



Argia vivida male. An uncommon damselfly of the western mountains, this species inhabits the pools and streams associated with springs, especially warm ones. Hot springs are frequently developed for bathing, and *Argia vivida* habitat is threatened in several localities. Dragonflies are the subject of many species at risk studies. Photo: George Doerksen, Royal BC Museum.

Nikula, B. and J. Sones. 2002. Stokes beginners guide to dragonflies and damselflies. Little Brown and Co. 160 pp.

(An excellent treatment of the subject for the beginner.)

Silsby, J. 2001. Dragonflies of the world. Smithsonian Institution Press, Washington DC. 216 pp.

(A colourful and wide-ranging overview of the biology and systematics of the world's Odonata.)

Walker, E.M. 1912. The North American dragonflies of the genus *Aeshna*. University of Toronto. 213 pp.

(Out of date but a classic treatment of a large and important Canadian genus.)

Walker, E.M. 1925. The North American dragonflies of the genus *Somatochlora*. University of Toronto Studies (Biology) 26: 1-202.

(Out of date but a classic treatment of a large and important Canadian genus.)

Walker, E.M. 1953. The Odonata of Canada and Alaska. Volume 1. Univ. Toronto Press, Toronto. 292 pp.

(Contains introduction and Zygoptera. This and the following two volumes comprise the classic treatment of Canadian species – identification, description, distribution and biology. Although out of date, they are still indispensable for Canadian work.)

Walker, E.M. 1958. The Odonata of Canada and Alaska. Volume 2. Univ. Toronto Press, Toronto. 318 pp.

(Contains the non-libelluloid Anisoptera.)

Walker, E.M. and P.S. Corbet. 1975. The Odonata of Canada and Alaska. Volume 3. Univ. Toronto Press, Toronto. 307 pp.

(Contains the libelluloid Anisoptera.)

Westfall, M.J., Jr. and M.L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville. 649 pp.

(Companion to Needham et al. above; the most up-to-date treatment for the identification of all Nearctic Zygoptera; heavy on description, light on distribution, biology and ecology.)

Basic Regional Literature

Yukon:

Cannings, R.A. 2002. *Introducing the Dragonflies of British Columbia and the Yukon*. Royal British Columbia Museum. 96 pp.

(Field guide with colour photos; general distribution of Yukon species put in context of the Cordillera as a whole.)

Cannings, S.G. and R.A. Cannings. 1997. Dragonflies (Odonata) of the Yukon. Pp. 169-200 in H.V. Danks and J.A. Downes (Eds.), *Insects of the Yukon*. Biological Survey of Canada (Terrestrial Arthropods). Ottawa. 1034 pp.

(Yukon fauna in a biogeographical light.)

Cannings, S.G., R.A. Cannings and R.J. Cannings. 1991. Distribution of the dragonflies (Insecta: Odonata) of the Yukon Territory, Canada, with notes on ecology and behaviour. *Contributions to Natural Science*, Royal British Columbia Museum 13: 1-27.

(Detailed distribution, including maps for each species).

British Columbia:

Cannings, R.A. 2002. *Introducing the Dragonflies of British Columbia and the Yukon*. Royal British Columbia Museum. 96 pp.

(Field guide with colour photos; general distribution of BC species put in context of Cordillera as a whole.)

Cannings, R.A. and K.M. Stuart. 1977. The dragonflies of British Columbia. *British Columbia Provincial Museum Handbook No. 35*. 254 pp.

(Somewhat out of date with respect to distribution and status, but useful still; detailed descriptions and identification keys to adults and larvae.)

Walker, E.M. 1927. The Odonata of the Canadian Cordillera. *British Columbia Museum of Natural History*. 16 pp.

(Early treatment of western odonatology by the master.)

Whitehouse, F.C. 1941. British Columbia dragonflies (Odonata), with notes on distribution and habits. *American Midland Naturalist* 26: 488-557.

(Classic biological writing of strong historical interest.)



Yoho National Park, BC. In the western mountains, small peatland pools are good places to look for boreal species of dragonflies. Photo: Rob Cannings, Royal BC Museum.

Alberta:

John Acorn has a manuscript on the damselflies of Alberta that is awaiting publication. Look for it before long, we hope!

Whitehouse, F.C. 1918. *Dragonflies (Odonata) of Alberta*. Alberta Natural History Society, Red Deer. 18 pp.

Manitoba:

Duncan, J.R. 1999. *Manitoba dragonfly survey citizen's monitoring guide*. Wildlife Branch, Department of Natural Resources, Winnipeg, Manitoba. 34 pp.

Ontario:

Carmichael, I., A. MacKenzie and B. Steinberg. 2002. *Photo Field Guide to the Dragonflies and damselflies of southwestern Ontario*. The Friends of Pinery Park, Grand Bend, Ontario. 72 pp.

(Effective little guide to the Odonata of the richly diverse southwestern corner of Ontario).

Catling, P.M. and V.R. Brownell. 1997. Damselflies (Zygoptera) in Ontario from 1900 to 1952: an atlas of E.M. Walker's distributional data for monitoring, and biodiversity and biogeography studies. Metcalfe, Ontario, Canada. 53 pp.

(Distributional maps of E.M. Walker's extensive damselfly records)

Catling, P.M. and V.R. Brownell. 2000. Damselflies and dragonflies (Odonata) of Ontario: resource guide and annotated list. ProResources, 2326 Scrivens Drive, Metcalfe, Ontario, Canada. 200 pp.

(Extremely useful compendium of information on Ontario Odonata and its study, including distribution maps, habitat preferences and status of the 168 species recorded to 1999.)

Catling, P.M., C.D. Jones and P.D. Pratt (eds.). 2000. Ontario Odonata Volume 1 (including 1999 observations). Toronto Entomologists' Association, Toronto, Ontario. 153 pp.

(Ontario Odonata publishes observations and the results of dragonfly projects throughout the province. The three issues noted here, along with future ones, are invaluable aids to the study of dragonflies in Ontario).

Catling, P.M., C.D. Jones and P.D. Pratt (eds.). 2001. Ontario Odonata Volume 2 (including observations for the year 2000). Toronto Entomologists' Association, Toronto, Ontario. 186 pp.

Catling, P.M., C.D. Jones and P.D. Pratt (eds.). 2002. Ontario Odonata Volume 3 (including observations for the year 2001). Toronto Entomologists' Association, Toronto, Ontario. 208 pp.

Holder, M. 1996. The dragonflies and damselflies of Algonquin Park. Algonquin Park Technical Bulletin No. 11. Friends of Algonquin Park, Whitney, Ontario. 40 pp.

(A fine booklet on some of the odonate fauna of this famous northern park).

(Holder, along with Colin Jones, Peter Burke and Andrea Kingsley are working on a full field guide to the dragonflies and damselflies of Algonquin Park. Watch for it soon!)

Quebec:

Ménard, B. 1996. Liste annotée des Odonates de la vallée de l'Outaouais. Fabriques 21(2): 29-64.

Pilon, J.-G. and D. Laglace. 1998. Les Odonates du Québec. Entomofaune du Québec Inc. Chicoutimi, Québec. 367 pp. (Identification and distribution.)

Robert, A. 1963. Les Libellules du Québec. Service de la Faune du Québec, Bulletin No. 1. 223 pp.

Two journals provide much information on Quebec odonatology:

Cordulia: Jan 1975 - Dec 1980 (plus 11 supplements 1976 - 1979). Privately published by A. Larochelle and R. Hutchinson at College Bourget, Rigaud.

Fabriques: Jan 1975 – present. Association for Amateur Entomologists of Quebec: AEAQ Inc., 302 Gabrielle Roy, Varennes, Quebec J3X 1L8.

Atlantic Provinces:

Brunelle, P.M. 1997. Distribution of dragonflies and damselflies (Odonata) of the Atlantic Provinces, Canada. *Northeastern Naturalist* 4: 61-82.

Brunelle, P.M. 1999. Additions to the lists of dragonflies (Odonata: Anisoptera) of the Atlantic Provinces, Canada. *Northeastern Naturalist* 6: 35-38.

Brunelle, P.M. 2000. Distribution of damselflies and dragonflies (Odonata) of Cape Breton Island, Nova Scotia, Canada. Parks Canada – Technical reports in ecosystem science; no. 24. Iv + 52 pp.

Nearby United States:

Brunelle, P.M. 1999. Distribution of damselflies and dragonflies (Odonata) of Maine, United States. *Northeastern Naturalist* 6: 95-118.

Carpenter, V. 1991. Dragonflies and damselflies of Cape Cod. Cape Cod Museum of Natural History, Natural History Series No. 4. 79 pp.

Curry, J.R. 2001. Dragonflies of Indiana. Indiana Academy of Sciences, Indianapolis, Indiana. 303 pp.

(Guide to the adult Anisoptera of Indiana, with colour photographs and distribution maps.)



Larva of *Aeshna interrupta*. Studies on the detailed habitat requirements of larvae are high on the list of the most needed odonatological research. Photo: Rob Cannings, Royal BC Museum

- Donnelly, T.W. 1992. The Odonata of New York State. *Bulletin of American Odonatology* 1 (1): 1-27.
- Glotzhober, R.C. and D. McShaffrey (editors). 2002. *The dragonflies and damselflies of Ohio*. Ohio Biological Survey Bulletin, new series 14(2).
- Legler, K, Legler, D and D. Westover. 1998. *A color guide to common dragonflies of Wisconsin*. 64 pp.
- Manolis, T. 2003. *Dragonflies and damselflies of California*. University of California Press, Berkeley, CA. 201 pp.
- Mead, K. 2003. *Dragonflies of the north woods*. Kollath-Stensaaas Publishing. 203 pp.
- O'Brien, M. (ed.) 1997. *Michigan Odonata Survey Collector's Handbook*. Ann Arbor, MI. 78 pp.
- Paulson, D.R. 1997. The dragonflies of Washington. *Bulletin of American Odonatology* 4(4): 75-90.
- Paulson, D.R. 1999. *Dragonflies of Washington*. Seattle Audubon Society, Seattle, WA. 32 pp.
- Nikula, B., J.L. Loose and M.R. Burne. 2003. *A field guide to the dragonflies and damselflies of Massachusetts*. Massachusetts Natural Heritage Program, Westborough, MA. 196 pp.
- Rosche, L. 2002. *Dragonflies and damselflies of Northeast Ohio*. Cleveland Museum of Natural History, Cleveland, OH. 94 pp.

Literature relating to faunas of particular habitats

- Cannings, S.G. and R.A. Cannings 1994. The Odonata of the northern cordilleran peatlands of North America. *Memoirs of the Entomological Society of Canada* 169: 89-110.
- Hilton, D.F.J. 1987. Aquatic insects of peatlands and marshes in Canada. *Memoirs of the Entomological Society of Canada* 140: 57-63.

Some Catalogues and Lists

- Bridges, C.A. 1991. *Catalogue of the family-group, genus-group and species-group names of the Odonata of the world*. C.A. Bridges, Urbana, Illinois. 479 pp.
- Davies, D.A.L. and P. Tobin. 1984. *The dragonflies of the world: a systematic list of the extant species of Odonata*. Volume 1 Zygoptera, Anisozygoptera. *Societas Internationalis Odonatologica Rapid Communications (Supplements)* 3. 127 pp.
- Garrison, R.W. 1991. A synonymic list of the New World Odonata. *Argia* 3(2): 1-30.
- Paulson, D.R. and S.W. Dunkle. 1999. A checklist of North American Odonata, including English name, etymology, type locality and distribution. *Slater Museum of Natural History Occasional Paper No. 56*. University of Puget Sound, Tacoma, WA.

Internet

General Internet Sites

There is a huge amount of information available on the Internet. The best site to locate most of this is: Oregon Dragonfly and Damselfly Survey

http://www.ent.orst.edu/ore_dfly/links.html.

(The site is invaluable — it gives links to more odonatological sites than any other single web page. Use this site to search for any topic. A few other useful sites are listed below in various categories. Note this is only a small selection.)

International Odonata Research Institute.

<http://www.afn.org/~iori/>

(The site of the International Odonata Research Institute, Gainesville, FL. A comprehensive compendium of news, events, information requests, e-mail directories, books, odonatological supplies and links to many other sites.)



Columbia River marshes, Invermere, BC. The rich marshes and ponds of southern Canada support some of the most diverse dragonfly communities in the country. Photo: Rob Cannings, Royal BC Museum

Tillyard, R.J. 1917. The biology of dragonflies.

This Cambridge University Press classic is still essential reading for serious students. A preliminary web version is at <http://www.jcu.edu.au/school/tbiol/zoology/auxilry/odonata/tillyar1.htm>

Regional Sites

British Columbia:

Cannings, R.A., S.G. Cannings and L. Ramsay. 2000. The dragonflies (Insecta: Odonata) of the Columbia Basin, British Columbia: field surveys, collections development and public education. Royal B.C. Museum and British Columbia Conservation Data Centre, Victoria.

http://www.livingbasin.com/cbasin/www_dragon/toc.html

Robert A. Cannings and Sydney G. 1998. Odonata (Damsel­flies and Dragonflies) in Smith, I.M., and G.G.E. Scudder, eds. Assessment of species diversity in the Montane Cordillera Ecozone. Burlington: Ecological Monitoring and Assessment Network, 1998.

http://www.naturewatch.ca/eman/reports/publications/99_montane/odonata/intro.html

Cannings, Robert A. The Blue Darners: dragonflies of the genus *Aeshna* in British Columbia.

http://www.royalbcmuseum.bc.ca/nh_papers/aeshna.html

Ontario:

Pratt, P.D. 1999. Regional lists of Ontario Odonata (Grey, Bruce, Huron, Middlesex, Elgin, Lambton, Kent, Essex counties).

<http://www.netcore.ca/~prairie/odonata.html>

Ojibway Nature Centre, Windsor. Damsel­flies and dragonflies of the Ojibway Prairie complex.

<http://www.ojibway.ca/odonata.htm>

(Paul Pratt's fine outline of the Odonata of this rich site in SW Ontario.)

Sankey, J. 1999. A guide to the adult damsel­flies and dragonflies of the Ottawa district.

On the Internet at <http://www.ncf.carleton.ca/~bf250/odonata.html>

Atlantic Provinces:

Nova Scotia

Dragonflies of Nova Scotia, by Paul-Michael Brunelle

<http://www.gov.ns.ca/natr/WILDLIFE/conserva/16-01-10.htm>

<http://lakes.chebucto.org/ZOOBENTH/BENTHOS/iv.html>

EMAN Ecozones

Robert A. Cannings and Sydney G. 1998. Odonata (Damsel­flies and Dragonflies) in Smith, I.M., and G.G.E. Scudder, eds. Assessment of species diversity in the Montane Cordillera Ecozone. Burlington: Ecological Monitoring and Assessment Network, 1998.

http://www.naturewatch.ca/eman/reports/publications/99_montane/odonata/intro.html

Catling, P.M., R. Hutchinson and B. Ménard. 1998. Assessment of species diversity in the Mixed Plains ecozone. Dragonflies and damsel­flies.

On Internet at <http://www.naturewatch.ca/Mixedwood/odonata/intro.html>

Nearby United States**Alaska**

<http://www.ups.edu/biology/museum/AlaskaOD.html> (*species list*)

<http://www.ups.edu/biology/museum/AKdragonkey.html> (*field key*)

California

<http://www.sonic.net/dragonfly/>

Idaho

<http://imnh.isu.edu/digitalatlas/bio/insects/insefr.htm>

Illinois

http://www.museum.state.il.us/research/entomology/od_db.html

http://www.museum.state.il.us/research/entomology/od_outofstate.html

Maine

<http://MDDS.umf.maine.edu/~odonata/index.html>

Massachusetts

<http://www.odenews.net>

(Odenews is an excellent newsletter (also available in paper) about Odonata in southern New England. The site also has links to other important material.)

Michigan

http://groups.yahoo.com/group/gl_odonata

(sharing information on the Odonata of the Great Lakes region; sponsored by the Michigan Odonata Survey.)



Aeshna canadensis male. Odonata are excellent subjects for scientific study. Recently the order has caught the interest of more and more naturalists, students and the general public. Photo: George Doerksen, Royal BC Museum.

<http://insects.ummz.lsa.umich.edu/michodo/mos.html> (*The Michigan Odonata Survey*)

<http://insects.ummz.lsa.umich.edu/fauna/MIODONAT.HTML> (*A Checklist of Odonata found in Michigan.*)

Minnesota

<http://www.chaparraltree.com/mn/dragonflies.shtml>

Ohio

<http://www.ohiodonata.com/>

<http://mcnet.marietta.edu/~odonata/> (*The Ohio Odonata Society*)

Oregon

http://www.ent.orst.edu/ore_dfly/

Washington

<http://www.ups.edu/biology/museum/WashOD.html>

Bibliography

<http://www.windsofkansas.com/odbib.html>

Conservation

Check the web sites of the various provincial Conservation Data Centres or Natural Heritage Information Centres. Go to these via the home page at <http://www.natureserve.org/visitLocal/index.jsp>. Provinces post conservation ranking lists. Some Centres, such as Alberta, Manitoba, Ontario and the Atlantic Provinces, have databases for Odonata records (see Collections and Databases below).

Ideas on how to build and maintain dragonfly ponds and other habitats are found at

<http://www.dragonflysoc.org.uk/mhd4.htm>

and

<http://www.dragonflysoc.org.uk/dap3.htm>

Collecting and preserving

Equipment and supplies

<http://insects.ummz.lsa.umich.edu/entostuff.html>

Collecting and preservation techniques

<http://www.afn.org/~iori/morse2.html>

<http://www.ups.edu/biology/museum/ODcollecting.html>

Collecting policy

<http://www.afn.org/~iori/oincolgl.html>

Distribution

There are many sources of distributional information. Check with provincial Natural Heritage Information Centres (Conservation Data Centres) and museums.

Distribution maps of western North American species by US county.

<http://www.ups.edu/biology/museum/westernOD.html>

Distribution of North American Zygoptera by state and province.

<http://www.afn.org/~iori/zyglist.html>.
(Based on Westfall and May (1996) with additions linked to sources.)

Distribution of North American Anisoptera by state and province.

<http://www.afn.org/~iori/nalist.html>.
(Based on Needham, Westfall and May (2000) with additions linked to sources.)

Dragonflies and damselflies (Odonata) of the United States. United States Geological Survey, Northern Prairie Wildlife Research Center.

<http://www.npwrc.usgs.gov/resource/2000/dfly/DFLYUSA.htm>.
(US distribution maps, but not complete or current.)

Glossary

<http://www.ups.edu/biology/museum/ODglossary.html>

Images

Photographs and scanned images are everywhere on the Internet; here are a few:

<http://www.ups.edu/biology/museum/WAODphotos.html>
(Live scans of western North American species.)

<http://www.ups.edu/biology/museum/ODphotos.html>

<http://www.sonic.net/dragonfly/>

http://insects.ummz.lsa.umich.edu/Images/Odonata/Odo_picts.html

<http://www.odenews.net/images.htm>

List-serves and discussion groups

<http://www.afn.org/~iori/oinforum.html>

Phylogeny

Bechly, G.H.P. 1998. Phylogenetic systematics of Odonata: phylogenetic classification of fossil and extant Odonata.

<http://www.bechly.de/phylosys.htm>

Societies and People

<http://www.afn.org/~iori/oinemail.html>
(Email addresses of odonatologists by country.)

Species Lists

<http://www.ups.edu/biology/museum/NAdragons.html>
(North American list with common names sponsored by Dragonfly Society of the Americas.)

<http://www.ups.edu/biology/museum/NWOLAUG2000.html>
(R. Garrison. New World list.)

<http://www.ups.edu/biology/museum/worldodonates.html>
(Schorr, M., M. Lindeboom and D.R. Paulson. List of Odonata of the world.)

<http://www.afn.org/~iori/oinlist.html>
(Links to many lists – world species, continents, regional.)

Collections and Databases

Specimen collections are valuable for confirming identifications and occurrence data and for supplying material for systematic studies. Some collections have their material databased. The main Canadian collections containing Odonata are listed below. Private collections are not included. The main databases residing outside collections are also included.

British Columbia:

Royal British Columbia Museum, 675 Belleville Street, Victoria, BC V8W 9W2.

Spencer Entomological Museum, Department of Zoology, University of BC, Vancouver, BC V6T 1Z4.

Alberta:

Strickland Entomological Museum, Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E3.

Alberta Natural Heritage Information Centre, 2nd Floor, Oxbridge Place, 9820-106 Street, Edmonton, Alberta T5K 2J6 (database of species considered to be of conservation concern).

Saskatchewan:

Royal Saskatchewan Museum, Wascana Park, Regina, SK S4P 3A2

Manitoba:

Entomology Department, University of Manitoba, Winnipeg, MB R3T 2N2.

Manitoba Conservation Data Centre, Box 24, 200 Saulteaux Crescent, Winnipeg, MB R3J 3W3 (database)

Ontario:

Canadian National Collection of Insects, Agriculture and Agri-food Canada, Ottawa, ON K1A 0C6

Department of Entomology, Royal Ontario Museum, 100 Queen's Park, Toronto, ON M5S 2C6.

Department of Environmental Biology, University of Guelph, Guelph, ON N1G 2W1.

Natural Heritage Information Centre, Ontario Ministry of Natural Resources, Box 7000, 300 Water St., Peterborough, ON K9J 8M5.

Department of Zoology Collection, University of Western Ontario, London, ON N6A 5B7

Algonquin Provincial Park Visitor Centre, Ontario Ministry of Natural Resources, Box 219, Whitney, ON K0J 2M0

The Ontario Odonata database is housed and maintained at the Natural Heritage Information Centre (Ontario Ministry of Natural Resources, Box 7000, 300 Water St., Peterborough, ON K9J 8M5). It currently contains over 35,000 georeferenced records. It is not a fully public database. Access is currently limited to major contributors and partners, as well as on a project-to-project, need-to-know basis for conservation related work.

Quebec:

Département des sciences biologiques, Université de Montréal, CP 6128, Succ. A, Montréal, QC H3C 3J7.

Natural History Museum, Bishop's University, Lennoxville, QC J1M 1Z7.

Prince Edward Island:

The largest PEI collection is in the New Brunswick Museum (see below).

New Brunswick:

New Brunswick Museum, 277 Douglas Ave, St. John, NB E2K 2E5.

Nova Scotia:

Nova Scotia Museum, 1747 Summer St., Halifax, NS B3H 3J5.

Newfoundland and Labrador:

Biology Department, Memorial University of Newfoundland, St. John's NF A1C 5S7.

Atlantic Provinces Database:

The Atlantic Dragonfly Inventory Program (ADIP) database currently holds more than 16,000 records from the Atlantic Provinces and an additional 25,000 records from northern New England (principally Maine). Contact Paul-Michael Brunelle, 6044-1 Compton Ave., Halifax NS B3K 1E7.

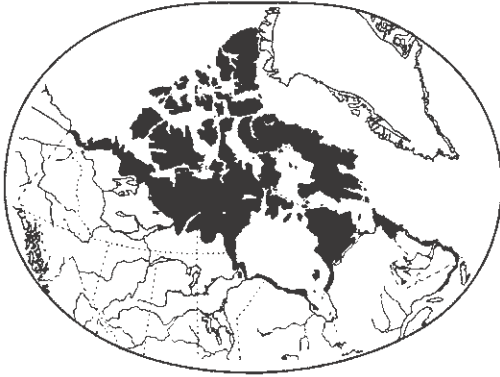
The Atlantic Canada Conservation Data Centre (17 Waterfowl Lane, PO Box 6227 Sackville, NB, E4L 1G6) holds all data from the Atlantic Provinces as of 2001.

Acknowledgements

I thank Colin Jones and Paul Brunelle for their constructive comments.



Sympetrum pallipes, mating pair.
Behavioural research on the Odonata is popular.
Photo: George Doerksen, Royal BC Museum



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).

Arctic and Boreal Entomology: What's New about 2003 & 2004

Peter Kevan¹, Robyn Underwood² and Rob Roughley²

¹University of Guelph, Department of Environmental Biology, Guelph, ON N1G 2W1

²University of Manitoba, Department of Entomology, Winnipeg, MB R3T 2N7

It has been a long time since entomologists have been present in force in the Canadian Arctic; the last concerted efforts were represented by the series of about 45 papers noted as "Studies in Arctic Insects" that came to an end in about 1970. Although a number of us have been able to keep our antennae waving sporadically in the north over the intervening years, issues of research and educational funding, priorities, and policies have discouraged northern activities. However, recent developments place entomology back under the northern lights: The Insects of Keewatin and Mackenzie project (see BSC Newsletter Vol. 22, No. 2); the Arctic and Boreal Entomology Course; the NSERC Major Facilities 3-year Grant for the Churchill Northern Studies Centre (CNSC) (awarded 2003); and the recent reinstatement of the NSERC Discovery Grant Northern Research Supplements.

After about a year of planning, the first Arctic and Boreal Entomology Course ran through the University of the Arctic in Finland at the Churchill Northern Studies Centre (CNSC) from August 9 – 23, 2003. The instructors, Dr. Peter Kevan, Environmental Biology, University of Guelph, Dr. Rob Roughley and Ms. Robyn Underwood (teaching assistant), Department of Entomology, University of Manitoba had an enthusiastic group of neophytes from 4 countries: Moe Vidotto, Guelph, ON, Canada; Eric Chapman, Kent State University, OH, USA; Fabiana Oliviera da Silva and



A view from spruce forest on esker ridge of extensive fen complex south of Churchill Northern Studies Centre.

(photo by R. Underwood)



Blandina Felipe Viana, Universidade Federal de Bahia, Ondina, Bahia, Brazil; Michael Adjaloo, Kumasi National University of Science and Technology, Kumasi, Ghana; Ronald Silvers and Vivian Darroch-Lozowski, University of Toronto, ON, Canada and Ann Millett, Bramalea, ON, Canada. The students had a wide range of knowledge and background and were eager to learn about the arctic boreal transition zone and its diverse and abundant insect life.

The course is slated to be given again at CNSC July 31 – August 14, 2004 with instructors Dr. Rob Roughley and Dr. Peter Kevan. It will be in conjunction with the Arctic Ecology course from the University of Guelph which is co-taught by Dr. Paul Hebert (Zoology) and Peter Kevan. Information on the course can be found on the web site of the University of the Arctic and (under “courses”). Student fees for the course are payable to CNSC at Canadian \$1,500 and that includes all room, board, use of facilities and materials (but not travel to Churchill) for the two-week period. One or two scholarships of \$500 will be available for worthy applicants.

The facilities at the CNSC are highly appropriate for this kind of course. The centre includes laboratory space, classrooms, and extensive dormitory and kitchen facilities (cook included!). Station employees provide excellent support; notably, in 2003, David Wright, who acted as bus driver, bear guard, and tour guide. Between the facilities and the people, the CNSC provides a highly enjoyable and safe environment, and a splendid atmosphere for learning. The NSERC Major Facilities Grant will improve the infrastructure of the station, and allow for the establishment of a small insect museum for general reference with storage cabinets from the University of Manitoba designated for transport to the CNSC. The collection is expected to grow through the efforts of the students on the course. Biological diversity is the hall-mark of the course and it is hoped that genetic and molecular diversity can be incorporated as facilities are upgraded.



Krumholz-modified spruce tree on shore of Hudson Bay east of Churchill, with characteristic shortened branches on windward side and normal branches on leeward side. Note the luxuriant growth that would be below the snow cover. (photo by R. Underwood)

Evening lectures and discussions address various topics of entomology with emphasis on the northern boreal and arctic habitats. These include the arctic as a habitat for insects, classification of insects and spiders, insect cold hardiness, thermoregulatory behavior, aquatic habitats, insect-floral relations, diversity, biology and classification. Course participants design, implement and report on projects of their choice. Among the topics chosen in 2003 were species richness and abundance of aquatic beetles (Dytiscidae) in rock-pool ponds, aquatic invertebrates of the Churchill area, Collembola of burned and unburned forests, snail predators (Sciomyzidae), and phenomenology of insect collecting (a study of how field entomologists recognize their quarries). During 2003, many interesting insects were collected, some that seem to represent large range extensions. Most of the specimens are or will be deposited in the J.B. Wallis Museum of Entomology at the University of Manitoba.

The course, at present, comprises a day-time schedule of visiting the wide array of habitats, ranging from the shores of Hudson Bay and the Churchill River and its estuary to tundra and the boreal forest. All are close at hand. Insect collection involves the kelp strand, saline shoreline and saline ponds, an as-

sortment of fens, bogs, ponds and streams, salt marshes along the edge of the Churchill River, the northern boreal forest, the forest margin, the treeline, the krumholz, the willow scrub, boreal forest-tundra transition zones, and tundra zones. Gall insects and pollinators can be sampled easily in various habitats to illustrate insect/plant symbioses, and the community of soil insects compared between habitats. Among the collecting techniques used in the course were Malaise traps, fan traps, pitfall traps, Berlese funnels, bottle traps for aquatic insects, sweep and dip nets, aspirators (pooters), and killing vials. Through demonstrations, pinning, preserving, and proper labeling are also stressed. Among the collecting highlights for 2003 were:

Fan Trap – Because the CNSC had electricity, we were able to use a fan trap in the vicinity of the station. These traps, equipped with a low speed fan, sample the aerial plankton. Within minutes of being set up, this trap was collecting specimens. It was a particularly good method for sampling very small beetles, true bugs, psyllids and aphids.

Malaise Trap – A standard malaise trap was used with a trough under the centre panel.



Malaise trap in bed of crustose lichens in spruce forest, ca. 20 km south of Churchill Northern Studies Centre. (photo by R. Underwood)

It yielded a staggering richness of biting flies (not all mosquitoes!). We were able to run traps both in the boreal forest about 20 km south of the CNSC as well as at CNSC itself. One very interesting specimen was an apterous trichopteran within the trough under the trap at CNSC.

Aquatic collecting – Rob Roughley and Eric Chapman ran bottle traps (recycled 2 L pop bottle design) in almost every kind of aquatic habitat during the duration of the course. They were also used in one of the student projects. The water beetle fauna was sampled extensively with bottle traps and net collecting. This will add significantly to the known fauna of water beetles with at least 10 new records for species from Churchill and one new family (Elmidae) which may well represent the most northern record of the family in North America. Interestingly, the known fauna of Dytiscidae for Churchill was increased by five species over the 73 species recorded by Larson et al. (2000) [Larson, D. J., Y. Alarie, and R. E. Roughley. 2000. *Predaceous diving beetles (Coleoptera: Dytiscidae) of the Nearctic region, with emphasis on the fauna of Canada and Alaska*. NRC Research Press, Ottawa, Ontario, Canada. 982 pp.].



Rock pools on bluffs east of Churchill. These pools contained a high species richness of water beetles. (photo by R. Underwood)

As this essay is being written, two of the authors are preparing applications for NSERC Discovery Grant Northern Research Supplements. These supplements have been re-instated in recognition of the additional costs of doing northern research, and in recognition of the difficulty that Universities have in supporting the advancement of knowledge through research and teaching in the North. The supplements are a small step towards Canada's dues to Arctic research: Canada's contribution to Arctic research is about 10% per capita of the per capita investment of the USA or Australia in Polar research. These supplements are a great incentive for those of us who love the North, with all its bugs, to resurrect our national excellence in hyperboreal entomology.



Selected Future Conferences

Organization	Date	Place	Contact
ENTOMOLOGICAL CONFERENCES			
Entomological Society of Canada	2004, 15–18 Oct.	Charlottetown, PEI	with the Acadian Entomological Society
	2005	Alberta	with the Entomological Society of Alberta
	2006	Québec	with la Société d'entomologie du Québec
Entomological Society of America	2004, 14–18 Nov.	Salt Lake City, UT	ESA, 9301 Annapolis Rd., Lanham, MD 20706-3115; meet@entsoc.org
	2005, 6–10 Nov.	Fort Lauderdale, FL	ESA, see above
	2006, 10–14, Dec.	San Diego, CA	ESA, see above
16th International Congress of Arachnology	2004, 2–7 Aug.	Gent, Belgium	http://allserv.rug.ac.be/%7ejpmaelfa/index.htm
XXII International Congress of Entomology	2004, 15–20 Aug.	Brisbane, Australia	http://www.ccm.com.au/icoe/index.html Myron Zalucki, Chair ICE Executive M.Zalucki@zen.uq.edu.au
COLLECTIONS / MUSEUMS / SYSTEMATICS			
Society for the Preservation of Natural History Collections Annual Meeting	2004, 11–16 May	New York, NY	http://www.peabody.yale.edu/other/spnhc
OTHER SUBJECTS (ESPECIALLY THOSE RELEVANT TO SURVEY PROJECTS)			
Canadian Society of Zoologists Annual Meeting	2004, 11–15 May	Wolfville, NS	http://events.acadiau.ca/msc-csz-2004/
North American Benthological Society	2004, 6–10 June	Vancouver, BC	http://www.benthos.org/meeting/index.htm , John S. Richardson (Chair), jrichard@interchange.ubc.ca

Answers to Faunal Quiz

[see page 12]

1. Many introduced insects arrived at both west-coast and east-coast ports and still are not widespread. Also, arctic-alpine and some other historical disjuncts, and mesic species absent from the drier centre of the continent, have disjunct ranges.
2. Insect species that have obtained a high public profile in Canada in recent years include:
Multicoloured Asian ladybeetle, *Harmonia axyridis*
Mountain pine beetle, *Dendroctonus ponderosae*
Asian tiger mosquito, *Aedes albopictus*
Emerald Ash borer, *Agrilus planipennis*
Cabbage seedpod weevil, *Ceutorhynchus assimilis*
3. Families of flies characteristic of northern parts of North America include:
Chironomidae, Muscidae, Tipulidae, Mycetophilidae, Sciaridae, Anthomyiidae
(see 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.)
4. In this simplified scenario, the ants can deliver about 225 g of food into the nest.
5. Families of insects that occur in Canada and begin with the letter A include the following 50 families:
Acanthosomatidae, Acartophthalmidae, Achilidae, Acrididae, Acroceridae, Acrolepiidae, Acrolophidae, Adelgidae, Aeolothripidae, Aeshnidae, Aetalionidae, Agonoxenidae, Agromyzidae, Aleyrodidae, Alleculidae, Alloxystidae, Alucitidae, Alydidae, Ametropodidae, Amphipsocidae, Amphizoidae, Andrenidae, Anisopodidae, Anobiidae, Anthicidae, Anthocoridae, Anthomyiidae, Anthomyzidae, Anthophoridae, Anthribidae, Apatelodidae, Aphalaridae, Aphelinidae, Aphididae, Apidae, Apioceridae, Aradidae, Arctiidae, Argidae, Argyresthiidae, Artematopidae, Arthezidae, Ascalaphidae, Asilidae, Asteiidae, Asterolecaniidae, Athericidae, Aulacidae, Aulacigastridae, Axymyiidae

Quips and Quotes

Is that clear?

When I came home I expected a surprise and there was no surprise for me, so of course I was surprised.
(Ludwig Wittgenstein)

Probable impossibilities are to be preferred to improbable possibilities.
(Aristotle)

Things are not what they seem; or, to be more accurate, they are not only what they seem, but very much else besides.
(Aldous Huxley)

Think before you think.
(Stanislaw Lec)

How can I tell what I think till I see what I say?
(E.M. Forster)

No one means all he says, yet very few say all they mean, for words are slippery and thought is viscous.
(Henry Adams)

If the phone doesn't ring, you'll know it's me.
(Anon)

Bug lines

It was so quiet here, I was jolted by the sound of a caterpillar backing into a globule of dew.
(Fred Allen)

I'm fuller than a tick.

He's as crazy as a sprayed 'roach.

The National Bird of Canada is the mosquito.

List of Requests for Material or Information Required for Studies of the Canadian Fauna 2004

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 cooperators 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. 46)

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	**
1	Acari (free living and parasitic terrestrial and aquatic mites)	Anywhere, but especially sub-arctic 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	Adelgidae (conifer woolly aphids)	Anywhere	Preserve insects and bark, needles or galls in 70% ethanol. Specimen records and host plant records	R. Foottit	1
3	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	**
4	Anthomyiidae	North America	Specimens with biological data (especially reared specimens) in the genera <i>Strobilomyia</i> (conifer cone maggots), <i>Lasiomma</i> (larvae mainly in dung or bird nests), <i>Egle</i> (larvae in willow and poplar catkins), <i>Chirosia</i> (incl. <i>Pycnoglossa</i>) (larvae phytophagous in ferns), and <i>Acrostilpna</i> (biology unknown).	G.C.D. Griffiths	2
5	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	3
6	Aphididae (aphids)	Anywhere	Preserve in 70% ethanol. Specimen records and host plant records.	R. Footitt	1
7	Asilidae (robber flies)	North America	Pinned adults	R.A. Cannings	4
8	Braconidae	Anywhere	Pointed or in ethanol.	M. Sharkey	5
9	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	6
10	Butterflies (see also 32, 33, 34)	Arctic	Preserve papered or pinned (collecting / preserving information supplied on request) [for Alaska Lepidoptera Survey]	K.W. Philip	7
11	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	8
12	Cercopidae (frog-hoppers, 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	**
13 Chalcidoids, especially Eupelmidae	Holarctic	Incl. sweep-net samples (see also 40) (collect into ethanol). Reared material is especially useful.	G.A.P. Gibson	1
14 Chironomidae: <i>Lar-sia</i> (Tanypodinae)	Nearctic and Palearctic fresh waters	Reared material preferred but will accept all stages in ethanol or on slides.	B. Bilyj	9
15 Chironomidae: <i>Eukiefferiella</i> , <i>Tvetenia</i> (Orthocla-diinae)	All areas, especially Ontario	Include sampling method, habitat information	W.B. Morton	10
16 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
17 Cicadellidae (leaf-hoppers)	Canada and Alaska	Specimens (preferably not in ethanol), records and host records.	K.G.A. Hamilton	1
18 Coccoidea (scale insects)	North America	Preserve insect and host plant material in 70% ethanol. Specimen records and host plant records.	R. Footit	1
19 Coleoptera (adults or immatures)	Canada	For teaching. Material from mass collections accepted. (Kill larvae in boiling water removed from the heating element, let cool and transfer to 70% ethanol.)	Y.H. Prévost	11
20 Curculionidae (weevils)	Anywhere, but especially northern Canada	Adults can be pinned, pointed, or preserved in ethanol. Record host plant information if possible.	D.E. Bright	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	12
22 Dermaptera: <i>Forficula auricularia</i> (perce-oreille européen / European earwig)	Amérique du Nord et autres régions si possible	A sec ou dans l'alcool	J.C. Tourneur	13

	Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	**
23	Diprionidae (diprionid sawflies)	North America	Living diprionid sawflies of any species, identified or unidentified. Record foodplant. Contact in advance about shipping.	L. Packer	14
24	Eupelmidae: <i>Anastatus</i>	North America	Reared materials with associated sexes are particularly important, regardless how few in number.	G.A.P. Gibson	1
25	Formicidae (ants)	Anywhere	Record type of habitat and nest site. Include brood if possible (preserve in ethanol).	A. Francoeur	15
26	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	16
27	Halictidae (sweat bees) brown and black spp. only	North America	Particularly from blueberries. Pinned or preserved. Include flower record if available.	L. Packer	14
28	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	17
29	Insects on snow	Especially western mountains	<i>Chionea</i> (Tipulidae), <i>Boreus</i> (Mecoptera), Capniidae (Plecoptera): preserve in 70% ethanol.	S. Cannings	18
30	Isoptera (termites)	N. America incl. Mexico	Preserve in 75% ethanol; try to collect as many soldiers as possible.	T.G. Myles	19
31	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	20
32	Lepidoptera (see also 10)	Arctic	For revisionary work on the holarctic fauna	J.D. Lafontaine	1
33	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	21
34	Lepidoptera	Areas not previously sampled in western Canada	Standard collecting methods	N. Kondla	22

Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	**
35 Lygaeidae	Anywhere	Material can be collected in ethanol.	G.G.E. Scudder	17
36 Mallophaga	Anywhere	Preserve specimens in 70% ethanol; host species is extremely important.	T.D. Galloway	23
37 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
38 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	4
39 Opiliones (harvestmen)	Canada and adjacent states	Preserve in 75% ethanol, especially adults with notes on habitats.	R. Holmberg	24
40 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
41 Phoridae	Anywhere; especially boreal	Collect into 70% ethanol: especially interested in Malaise trap samples from boreal forest.	B.V. Brown	25
42 Pipunculidae (big-headed flies)	Anywhere; especially boreal	Adults can be pinned, pointed or preserved in ethanol.	E. Georgeson	26
43 Pseudoscorpions	Canada	Preserved in 90% ethanol is preferred, please include collection information (method, habitat)	C. Buddle	27
44 Psyllidae	North America	Preferably preserve in glycerine or dried. Specimen records and host plant records	R. Footitt	1
45 Pteromalidae: <i>Pachyneuron</i>	North America	Rearred materials with associated sexes are particularly important, regardless how few in number.	G.A.P. Gibson	1

Material Requested	Areas of Interest	Collecting Methods, Notes	Name of Requester	**
46 Salticidae (jumping spiders)	Canada	Adult specimens preserved in 70% ethanol. Include habitat information, specific location of collection, collecting method.	D. Shorthouse C. Buddle	28 27
47 Scelionid egg parasites of Orthoptera	Anywhere	Especially from Grylloidea; preserve in ethanol.	L. Masner	1
48 Sciomyzidae	Anywhere	Preferably pinned	L. Knutson	29
49 Silphidae	Canada	Include habitat and trapping method. Malaise trap material welcome.	R. Lauff	30
50 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	31
51 Siphonaptera (fleas)	Anywhere	Preserve specimens in 70% ethanol; host species is extremely important	T. D. Galloway	23
52 Solpugida (sun spiders)	Canada	Preserve in 75% ethanol, especially adults with notes on habitat.	R. Holmberg	24
53 Sphaeroceridae	Anywhere, esp. arctic or high elevations	Collect into ethanol. Acalyprate fraction of trap samples welcomed.	S.A. Marshall	32
54 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
55 Tabanidae	Canada	Include habitat and trapping method. Malaise trap material welcome.	R. Lauff	30
56 Thysanoptera (thrips)	North America	(Preserve in 70% ethanol). Specimen records, habitat, host plant records where applicable.	R. Footitt	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 5, 13, 19, 40, 49, 53, 55 above |
| c | Field kits or instructions available on request | See especially entries 37, 40, 50 above |
| d | Exchange of specimens | Several requesters, including entries 7, 38, 51 above. |
| e | Limited collecting in Coppermine area, N.W.T., if particular material required. | A. Gunn (address 33 below). |
| f | Caterpillars, larval sawflies, aphids and mites available on request from trapnets for solitary bees and wasps [and see <i>Am. Bee. J.</i> 2001, pp. 133–136, 441–444]. | P. Hallett (address 34 below) |
| g | Insect material from grassland and adjacent habitats at Onefour, Alberta, is available for examination. | D.L. Johnson (address 35 below) |

List of Addresses

1. Eastern Cereal and Oilseed Research Centre, 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
G.A.P. Gibson gibsong@agr.gc.ca
L. LeSage lesagel@agr.gc.ca
D.E. Bright brightd@agr.gc.ca
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. 117 Collingwood Cove, 51551 Range Road 212A, Sherwood Park, AB T8G 1B2;
gcdgriff@telusplanet.net
3. Canadian Forest Service, 1219 Queen St. E., Sault Ste. Marie, ON P6A 5M7;
kbarber@nrca.gc.ca

-
4. Royal British Columbia Museum, P.O. Box 9815, Stn. Prov. Govt., Victoria, BC V8W 9W2; rcannings@royalbcmuseum.bc.ca
 5. Department of Entomology, University of Kentucky, 5 - 225 Agricultural Science Center North, Lexington, KY 40546-0091, U.S.A.; msharkey@uky.edu
 6. 482 Montée de la Source, Cantley, QC J8V 3H9
 7. University of Alaska, Institute of Arctic Biology, P.O. Box 757000, Fairbanks, AK 99775-7000 U.S.A.; finkwp@uaf.edu
 8. 1171 Mallory Road, R1-S20-C43, Enderby, BC V0E 1V0; aborkent@jetstream.net
 9. 12 Westroyal Road, Etobicoke, ON M9P 2C3; biotax@interlog.com
 10. 3 Woodridge Drive, Guelph, ON N1E 3M2; jkmorton@sciborg.uwaterloo.ca
 11. Faculty of Forestry and the Forest Environment, 955 Oliver Rd. Lakehead University, Thunder Bay, ON P7B 5E1; yves.prevost@lakeheadu.ca
 12. Department of Biology, Laurentian University, Sudbury, ON P3E 2C6; jshortho@nickel.laurentian.ca
 13. Département des Sciences biologiques, Université du Québec à Montréal, C.P. 8888, Montréal, QC H3C 3P8; tourneur.jean-claude@uqam.ca
 14. Department of Biology, York University, 4700 Keele Street, Downsview, ON M3J 1P3; bugsrus@yorku.ca
 15. Département des Sciences fondamentales, Université du Québec à Chicoutimi, 9555 boul. de l'Université, Chicoutimi, QC G7H 2B1; andre_francoeur@uqac.ca
 16. Department of Biology, St. Mary's University, 923 Robie St., Halifax, NS B3H 3C3; doug.strongman@smu.ca
 17. Department of Zoology, University of British Columbia, Vancouver, BC V6T 1W5; scudder@zoology.ubc.ca
 18. NatureServe Yukon, Yukon Territorial Government, Box 2703, Whitehorse, YT Y1A 2C6; syd.cannings@gov.yk.ca
 19. Faculty of Forestry, University of Toronto, 33 Willcocks, Toronto, ON M5S 3B3; t.myles@utoronto.ca
 20. Department of Biology, Carleton University, Ottawa, ON K1S 5B6; stewart_peck@carleton.ca
-

21. Department of Biology, University of Waterloo, Waterloo, ON N2L 3G1; jkmorton@sciborg.uwaterloo.ca
 22. P.O. Box 244, Genelle, BC V0G 1G0; colias@shaw.ca
 23. Department of Entomology, University of Manitoba, Winnipeg, MB R3T 2N2; terry_galloway@umanitoba.ca
 24. Athabasca University, Centre for Science, Athabasca, AB T9S 3A3; robert@athabascau.ca
 25. Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Blvd., Los Angeles, CA 90007 U.S.A.; bbrown@nhm.org
 26. N.S. Department of Natural Resources, P.O. Box 130, Shubenacadie, NS B0N 2H0
 27. Department of Natural Resource Sciences, McGill University, Macdonald Campus, 21,111 Lakeshore Road, Ste. Anne-de-Bellevue, QC H9X 3V9; chris.buddle@mcgill.ca
 28. Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9; dps1@gpu.srv.ualberta.ca
 29. Paluzzo Gioia Piazza Traniello, 8-Int. 26, 04024 Gaeta (LT), Italy; lvknutson@tiseali.it
 30. Department of Biology, St. Francis Xavier University, PO Box 5000 Antigonish, NS B2G 2W5; rlauff@stfx.ca
 31. Centre for Biodiversity and Conservation Biology, Royal Ontario Museum, 100 Queen's Park, Toronto, ON M5S 2C6; dcurrie@zoo.utoronto.ca
 32. Department of Environmental Biology, University of Guelph, Guelph, Ontario N1G 2W1; smarshal@evb.uoguelph.ca
 33. 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
 34. Department of Physiology and Zoology, University of Toronto, 144 Hendon Avenue, Willowdale, ON M2M 1A7; peter.hallett@utoronto.ca
 35. Department of Geography, University of Lethbridge, 4401 University Drive West, Lethbridge, AB, T1K 3M4; dan.johnson@uleth.ca
-

Index to Taxa (entry nos.)

Arachnida

Solpugida.....	52
Araneae	
Salticidae.....	46
Opiliones.....	39
Pseudoscorpionida.....	43
Acari.....	1, f
Hydracarina.....	1

Insecta.....26, 29, g

Odonata.....	38
Plecoptera.....	29
Isoptera.....	30
Dermaptera.....	22
Orthoptera.....	47
Mallophaga.....	36
Hemiptera.....	28
Adelgidae.....	2
Aleyrodidae.....	3
Aphididae.....	6, f
Cercopidae.....	12
Cicadellidae.....	17
Coccoidea.....	18
Lygaeidae.....	35
Psyllidae.....	44
Thysanoptera.....	56
Coleoptera.....	19
immatures.....	19
Chrysomelidae.....	16
Curculionidae.....	20
Leiodidae.....	31
Silphidae.....	49
Mecoptera.....	29

Diptera

Anthomyiidae.....	4
Anthomyzidae.....	5
Asilidae.....	7
Ceratopogonidae.....	11
Chironomidae.....	14, 15
Phoridae.....	41
Pipunculidae.....	42
Sciomyzidae.....	48
Simuliidae.....	50
Sphaeroceridae.....	53
Tabanidae.....	55
Tipulidae.....	29
Siphonaptera.....	51
Lepidoptera.....	10, 32, 33, 34, 37, f
Hymenoptera	
parasitic Hymenoptera.....	8, 13, 24, 40, 45, 47
Aculeata.....	9, 27
Apidae.....	9
Braconidae.....	8
Chalcidoidea.....	13, 45
Cynipidae.....	21
Diprionidae.....	23
Eupelmidae.....	13, 24
Formicidae.....	25
Halictidae.....	27
Pteromalidae.....	45
Scelionidae.....	47
Symphyta.....	23, 54, f

Fungi.....26

