

NEWSLETTER OF THE BIOLOGICAL SURVEY OF CANADA (TERRESTRIAL ARTHROPODS)

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General Information

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

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Queries, comments, and contributions to the Newsletter are welcomed by the editor. Deadline for material for the Spring 2007 issue is January 29, 2007.

Editorial Notes

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

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

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

News and Notes

Bio-Blitz 2006

The 2006 BSC Bio-Blitz took place in Gros Morne National Park (GMNP) in north-western Newfoundland from 5-10 July. This sixth annual Bio-Blitz was the first to be held in eastern Canada. The eight enthusiastic participants from Alberta, Ontario and Newfoundland enjoyed the cooperative weather, spectacular scenery and famous Newfoundland hospitality to collect in many of the interesting habitats in the park (e.g., aquatic systems, wetlands, forest, tuckamore, high elevation subarctic barrens and the fascinating Tablelands). Most participants were accompanied by their families who also eagerly joined in the collecting and social activities. Parks Canada (PC) personnel were very generous in providing complimentary park permits, camping sites, maps, helicopter transportation to high elevations, and a wealth of information about the habitats and ecology of the park. Several PC employees also occasionally eagerly participated in collecting activities. The Newfoundland Department of Environment and Conservation, a co-organizer of the event, was very helpful with local logistics and in providing equipment, supplies and assistance with deploying traps. The event at-



Joe Shorthouse sampling at Gros Morne National Park
(photo by J.D. Shorthouse)

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

Over the next months participants will be preparing and identifying the many thousands of specimens collected. Entomologists who may be interested in examining specimens should contact David Langor. Data will be contributed to a central database that will be provided to GMNP. Already we are aware of two new mosquito records for the island, and undoubtedly many other exciting discoveries will be made. The specimens and data collected are contributing to several research programs at universities and colleges and to the BSC project on the terrestrial arthropods of Newfoundland and Labrador. There is much interest from PC employees at GMNP in facilitating continued arthropod surveys in the park. Overall, the 2006 was a success in terms of specimen collection, creating public awareness, and forging new partnerships that



Berry Hill campsite, Gros Morne National Park
(photo by J.D. Shorthouse)

bodes well for future arthropod biodiversity work on the island. Special thanks to Shelley Pardy Moores, Bruce Rodrigues, Tom Knight and Michael Burzynski.

The 2007 Bio-Blitz will be held in Riding Mountain National Park, Manitoba. Stay tuned to the BSC website and newsletter for updates.

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Western Brook Pond, Gros Morne National Park
(photo by J.D. Shorthouse)

Canadian Journal of Arthropod Identification

Last fall's newsletter announced the launch of a new ejournal devoted to the publication of richly illustrated guides to Canadian arthropods (see Project update: The Biological Survey of Canada Journal of Arthropod Identification). The Canadian Journal of Arthropod Identification (CJAI) has now gone live on the Biological Survey's web site.

The first papers to be published are

- Mecoptera of Ontario* (David K. B. Cheung, Stephen A. Marshall, and Don W. Webb)
- Keys to the Families and Genera of Blood and Tissue Feeding Mites Associated with Albertan Birds* (Wayne Knee, and Heather Proctor)

The home page of the CJAI is at <http://www.biology.ualberta.ca/bsc/ejournal/ejournal.html>

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

The Scientific Committee met in Ottawa on April 20–21, 2006.

Scientific Projects

1. *Grasslands*

Additional chapters for the first grasslands volume on "Arthropods of Canadian grasslands: ecology and interactions in grassland habitats" have been received. The introductory chapter is pivotal because it provides the framework for how the grasslands types will be defined and labelled throughout the book. Dr. Wheeler can now begin to standardize terminology for the other chapters. One chapter remains outstanding and the introduction and synthesis chapters will have to be prepared in due course. Dr. Kevin Floate is coordinating volume 2 on arthropods in altered grasslands.

The hard copy version of the Grasslands Newsletter has been discontinued in favour of posting articles electronically, on the BSC web site. Two articles have been posted and further contributions are welcome. There is also space on the grasslands project page to post general information.

2. *Canadian Journal of Arthropod Identification*

It is hoped that the e-journal will become a major vehicle for the publication of image-rich and accessible guides to arthropod identification. The journal will soon be launched with two fully reviewed and edited papers. Those papers represent the breadth of technical formats that can be posted, a traditional-style paper with pictures and a much more complicated html key. Several other papers have been submitted and others are in preparation. The revolution in digital imagery makes the project very timely because it is much easier and cheaper to gather the digital images that make the difference from a traditional key. The instructions to authors have been revised with step-by-step guidelines, which will be included

for the launch. The journal is envisaged as a modular product, whereby regional modules could eventually be expanded to include other regions. The images are of high enough resolution that versions of reasonable quality can be printed.

3. *Terrestrial arthropods of Newfoundland and Labrador*

A key to the Curculionoidea of Newfoundland and Labrador will be completed this year and submitted to the Canadian Journal of Arthropod Identification. Photography is required and some revision to the key in light of new species records. Work by various cooperators continues on Hemiptera, macro moths and Staphylinidae. Work is proceeding to make the AAFC collection in St. John's much more accessible. There is a large amount of activity in extracting species records from the literature. This is contributing to the species database and to the bibliographic database. Work is still needed on major orders such as Diptera and Hymenoptera. The Bio-Blitz 2006 will be held in western Newfoundland and should boost this project, by acquiring specimens and involving other personnel.

4. *Forest arthropods*

Notable progress was reported with all current activities organized through this project, which aims to coordinate research on the diversity, ecology, and impacts of the arthropods of Canadian forests. The BSC continues to maintain and update a list of forest arthropod biodiversity projects in Canada and adjacent parts of the United States. This product highlights current activity in Canada and the northern U.S. and facilitates contact between researchers with complementary interests. As of early 2006, 63 projects were listed.

Volume 2 of the *Arthropods of Canadian Forests* newsletter will be published electronically in late April (English) and mid-May (French) to over 200 recipients in 8 countries. In addition, the forest project web pages con-

tinue to be maintained and updated. Many enquiries have been received as a result of the web page and newsletter, and new contacts have been facilitated.

A BSC-sponsored symposium, entitled "Maintaining Arthropods in Northern Forest Ecosystems," was held during the annual meeting of the Entomological Society of Canada in November 2005. Seven papers synthesized what is known about the structure and dynamics of selected arthropod assemblages (Carabidae, Staphylinidae, spiders, saproxylic arthropods, Lepidoptera, and aquatic arthropods) in managed boreal and north temperate forests. The papers from this symposium will be published in *The Canadian Entomologist*.

Bio-Blitz 2005 in Waterton Lakes National Park (WLNP) was the fifth annual Bio-Blitz sponsored by the Biological Survey of Canada, and the first to include non-grassland ecosystems. Some participants have already identified their collections and have submitted the data to a common database managed by WLNP. Thus far, there are many new records for the park and Alberta and even a few new records for Canada. All data will eventually be accessible to the public, and specimens are being deposited in publicly accessible collections. It is hoped that the 2005 Bio-Blitz experience will give rise to a more long-term arthropod biodiversity survey of WLNP. Bio-Blitz 2006 will be held in Gros Morne National Park (GMNP), Newfoundland, 5–10 July 2006 in collaboration with the Newfoundland and Labrador Department of Environment and Conservation and Parks Canada. There have already been many serious expressions of interest by colleagues in Canada and the USA. Given interest by other National Parks, the Committee considered which Park(s) might be preferable for future BSC Bio-Blitzes, and appropriate contacts will be maintained.

Work on cerambycid beetles continues with the goal of producing three handbooks to the Cerambycidae of Canada and Alaska. Already much material has been examined and revisionary work completed.

5. *Insects of the arctic*

The current phase of the BSC arctic project has been ongoing since 2000. During 2005 two trips were made to Norman Wells including collaborating with the Northwest Territories Department of Environment and Natural Resources. Sampling and ongoing Malaise trap sampling were carried out (and see the Fall 2005 issue of the Newsletter of the Biological Survey of Canada). Visits to areas such as northern Quebec and Labrador would be very useful to resolve some outstanding problems. For example, a number of species of black flies are known currently only from single collections from the northern boreal zone. To conduct this sort of research efficiently, canoe-based travel allows a significant amount of terrain to be covered. Such a venture is expensive and therefore more participants are needed to make it fiscally feasible. Expressions of interest are welcomed by Dr. Doug Currie. Field work was also carried out in 2005 in Chukotka, in far-east Russia, with some rewarding results but with frustrating logistics. Another trip will be made to Chukotka in the summer of 2006.

Work on the dytiscids of Churchill has revealed that of the 74 spp. recorded from Churchill, about 70 spp. are still being found there, and there are additional records of boreal species. Non-biting Diptera from the earlier Horton River and Thelon River trips conducted under the BSC project are still being examined.

6. *Seasonal adaptations*

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

7. *Invasions and reductions*

A 1-day symposium on the ecological impacts of non-native insects and fungi on terrestrial ecosystems will precede the Entomological Societies' Joint Annual Meeting in Montreal on November 18. The proceedings will result in a scientific synthesis volume, including a concluding synthetic chapter. The Committee discussed possible additional speakers and other matters.

A list of the non-native arthropods and fungi of Canada is being developed as an extension of a national CFS project on established alien tree-feeding species. The list has grown to about 1700 species to date, including data on common name, distribution, origin, key references, hosts, notes on date and point of entry, and synonyms. A selected bibliography is also being compiled. The CFS plans to develop a web site that is the first stop for information about exotic tree-inhabiting arthropods and fungi in Canada. The Committee discussed possible outlets for the broader database.

The BSC subproject on lady beetles continues, but the data for BC and Quebec are deficient, making it difficult to coordinate a national project as opposed to separate piecemeal regional publications. The original intention had been to prepare a national synthesis of distributions and historical changes, in the context of invasive species. Coccinellids are a logical group to achieve a single connected national database. These data would then be available for use for addressing various ecological and evolutionary questions, which is the other perspective. Members of the Committee drafted plans to solve the problems holding up the national project.

Other scientific priorities

1. Faunal analysis

The project objectives, including development of a list of the species known and expected to occur in Canada, were reviewed. The emphasis in the past has been on gap analysis to see where systematic expertise is needed. The information now on the web site is also useful to identify future research opportunities. Following discussion especially about the value and reliability of the estimated numbers of species and the difficulty of estimating them, it was agreed that a proposal would be developed for discussion at the next meeting, for example to solicit updates for the known number of species.

2. Arthropods and fire

A plan has been developed to pursue a potential publication, including papers from the recent symposium and added contributions. Potential additional authors and publication routes were discussed.

3. Databasing

In past years, two Canada Foundation for Innovation proposals were put forward to do major databasing of insect collections. Although neither was successful, now they have been amalgamated to produce one application, including money for buildings in Montreal and also databasing for 20% of the major insect collections in Canada. The fact that university collections are excluded from the Alliance of Natural History Museums of Canada means that the universities have to move forward independently with such a proposal, which includes plants, insects and fungi.

A project to list collecting localities for insects is well along. Some problems have to be solved (for example, a single locality might be referred to in four or five different ways, and location names given in the literature with latitude and longitude do not always correspond with the gazetteer), but the data should soon be ready to post on the BSC web site.

4. Survey web site

The BSC web site continues to get good traffic. For example, from November 1 to April 18 there were 26,191 unique visitors, with a daily average of 155. Over the last year there were 64,677 unique visitors with a daily average of 177.

Routine maintenance continues such as posting the new BSC newsletter but most of the work has gone into preparing for launch of the redesigned site. The site is nearly finished, including reorganizing the menu structure into a more logical grouping with all options given to the user at a glance. Since the fall meeting some texts have been revised or finalized, some translations done and technical issues with the database of personnel were resolved. The launch was delayed in the hope that the CJAI

would be ready at the same time. However, the e-journal was recently delayed and so the redesigned site will soon be launched independent of the e-journal.

5. *Endangered species*

There is much interest in endangered insects at the federal and provincial levels because of the Species at Risk Act. The Committee on the Status of Species at Risk in Ontario (COSSARO) meetings were held in April. The deficiency of data on many insects creates difficulties in considering whether they might be endangered, for example. The Arthropod Species Specialist Subcommittee of COSEWIC is now more diverse and the subcommittee will be considering groups other than butterflies. The Committee discussed legislation in some areas of the country. For example, in B.C. much time is being spent on how to define a "residence", a legal requirement with the B.C. legislation on listed species. Ontario considers "breeding range". A potential project of the BSC on endangered insects was discussed. Many years ago a cross-country summary of potentially rare or endangered taxa was proposed, but the project was stopped by the objections of a few people who were concerned that it might interfere with their ability to collect insects. However, a list might highlight species to be considered for COSEWIC or provincial listing, which can result in funding for research. Moreover, the Survey has the expertise to put such a publication on a proper scientific basis, unlike the sort of list that might be put together by somebody else. Therefore, a subcommittee will continue discussion about a possible BSC product on endangered species.

6. *BSC award*

There were many applicants for the BSC scholarship, following attempts to encourage students to apply for the award. Members of the Committee commented on designs for the award certificate, and a final version will be prepared in time for the award presentation later in the year.

7. *Monitoring of continuing priorities*

Several other ongoing interests of the Survey were reviewed. Information about the arthropod fauna of soils included a report on a long-term study in Saskatchewan on the impact of cropping systems, which has finished its 12th year and second cycle. At the end of each 6-year cycle a thorough assessment of arthropods in the soil is done. Some of the insects such as carabids are identified to species. Some for which there is no local identification expertise, such as spiders, collembolans, and nematodes, will be kept. A spider identification manual to genus for all families in North America is now available.

For arthropods of aquatic habitats, new student and other projects include work on bog faunas and bog recolonization in eastern Canada. The Burns Bog near Vancouver is gradually drying out, so as part of the recovery plan the water table is being raised by blocking the drainage channels. In due course, some insect groups such as dragonflies may be monitored.

For arthropod ectoparasites of vertebrates, current programs in Canada were reviewed, including various surveys of ectoparasites, lists of fleas and lice, and the taxonomy of flea larvae and other taxa. A handbook on Ticks of Canada is moving forward, including keys and descriptions for all active stages of ticks known to occur in Canada, maps of known distribution, and information on biology, host associations and medical/veterinary importance. This project began in 1991, and was recently resurrected before electronic data were lost, for example.

Other studies were outlined under arthropods of the Yukon, small regional projects and agroecosystems.

8. *Other priorities*

The Committee also considered work on the arthropods of the Gulf of St. Lawrence Islands, potential future publications, Survey publicity, and other topics.

Liaison and exchange of information

1. *Canadian Museum of Nature*

Mr. Roger Baird reported that the renovation of the Victoria Memorial Museum Building continues within the planned schedule and budget, although steel prices have gone up 70% since the original tenders. The West Wing is scheduled to re-open in October 2006. The CMN continues to be involved with the Global Taxonomy Initiative (GTI). The GTI is an initiative of the U.N.'s Convention on Biological Diversity that recognizes that taxonomy is essential for conservation efforts and that there is a shortage of expertise, facilities and processes.

The CMN is also involved with the Governing Board for the Global Biodiversity Information Facility (GBIF) which is now in its 5th year of operation to help in the documentation and free accessibility of electronic data for the estimated 3 billion curated specimens around the world. GBIF has undertaken an assessment process to set the stage for the next 5 years.

The Alliance of Natural History Museums of Canada, an organization of 12 museums, has been working with the New Brunswick Museum to put forward a call for assessment with the newly established Canadian Academy of Sciences about the state of biodiversity science in Canada. By this means issues can be brought forward such as loss of taxonomic expertise, systemic barriers within current structures, and the fact that digitization of collections is not covered under the existing guidelines for NSERC grants. A decision on whether the Academy wants to explore this subject should be received by June.

A discussion paper to propose increased CMN funding especially for research and collection activities had been sent to cabinet but was overtaken by the January 2006 election. Current CMN resources are largely channelled into renovations, with research and collections support reduced.

Members of the Committee noted that many of the specimens, most of the expertise

and virtually all of the training for natural history collections are housed at universities, and asked if and when the Alliance of Natural History Museums might become a real alliance including university collections. Mr. Baird would communicate that concern to the Alliance. He noted that the Alliance concentrated initially on developing a communication strategy to get the ear of government and establish a profile.

2. *Agriculture and Agri-Food Canada*

Dr. Landry reported that two new scientists have recently been hired. Dr. Frédéric Beaulieu, an acarologist, will be working on the systematics of phytophagous mites. Dr. Qing Yu, a nematologist, will start at the end of May. There are now 17 scientists in Ottawa, an increase of 5 over the last few years. The national theme name has recently been changed from Biodiversity to Bioresources. Mr. Jim Troubridge has been the Collection Manager for the CNC since last year, dealing with logistical issues related to the collection such as equipment, supplies, facilities, and loans. There have been increasing problems with shipping specimens especially across the U.S. border, due to mishandling by couriers. The Centre is trying to raise its profile by preparing posters on the CNC and on the Identification Service. AAFC is working without a budget for the fourth year (although approval for expenditures continues on an ad-hoc basis) making it difficult to plan activities. Reorganization activities continue. Dr. Barry Grace remains the acting Science Director for the national theme.

A number of publications have appeared recently, including monographs and other major publications on Histeridae, Noctuidae, Coleophoridae, and Staphylinoidae.

3. *Entomological Society of Canada*

Dr. Dan Quiring, President of the Entomological Society of Canada, reported that in the last few months the Society has instituted a process whereby all submissions to the Canadian Entomologist will be electronic. NRC Press would like the ESC to adopt a web-based method of submitting papers. An IT committee is looking into software for this purpose.

A candidate to replace Ms. Alexandra Devine as the ESC Office Manager has been chosen. Someone has put his name forward to replace Dr. Paul Fields as the Bulletin Editor. A candidate is also being sought for Editor-in-Chief of the Canadian Entomologist. The Society continues to be in good financial shape.

Dr. Quiring added that the 2006 Joint Annual Meeting in Montreal is on track for November 18 – 22. An invitation was extended to Ms. Devine to attend the meeting. As well, Dr. Peter Harper was invited in order to recognize the translation work he has done for the journal over the years. The theme of the meeting is *Diversité*. Dr. Charles Vincent is the head of the organizing committee and Dr. Wheeler is the program chair. Five symposia have been submitted, including a graduate student symposium, Invasive species, Canopy arthropods, Arachnology (a tribute to Dr. C.D. Dondale) and New developments in potato pest management. Dr. Quiring confirmed that the ESC is looking at implementing on-line membership registration as well as other web issues. Dr. Bouchard noted that on-line registration for the joint annual meeting will be used as a trial.

Dr. Quiring said that the ESC continues to fully support the BSC. It would like to ensure that the Biological Survey continues once Dr. Danks retires, because he has been the driving force behind the organization.

4. *Canadian Forest Service*

Dr. John Huber explained that he is attending the meeting on behalf of Dr. Brenda McAfee who oversees biodiversity and other issues. There is a new assistant deputy minister and therefore more restructuring. There are two new CFS business lines. The first is the Competitiveness of Canada's Forest Products Industry which is aimed at supporting the competitiveness component of the Sustainable Forest activity mandate and includes Integrated Forest Health and Biodiversity. The second business line is the Sustainability of Canada's Forests which responds to the environmental component of the Sustainable Forest activity

mandate. It consists of forest science research aimed at increasing Canada's forest knowledge and at developing and implementing environmentally acceptable forest management strategies, practices and tools to improve forest health and respond to and mitigate threats to Canada's forests. The new ADM wants the CFS to move from being a research organization to being a science-based policy organization; from a regional to a national focus with strong regional delivery; from being capacity driven to demand driven; from being a creator to a creator and synthesizer of knowledge; and from being an 'honest broker' to an opinion provider. The following objectives will be pursued: defining healthy forests and measuring how Canada's forests rate; identifying threats to healthy forests; developing strategies to manage and mitigate these threats; and raising the economic and social value of Canada's forests through enhanced forest resource productivity while maintaining healthy forests.

The CFS is currently in the process of developing two environmental scans to identify the principal players, roles, issues, actions, outcomes, gaps and research needs. The scans will help to determine where biodiversity fits within the CFS business lines. Outputs from this project will assist the CFS to develop its national and international biodiversity agenda for the next 5 or more years. The synthesis of the scans will assist the CFS in formulating a national and international biodiversity agenda to support Canada's commitment to conserve biodiversity and ensure the sustainable use of biological resources. It will assist the CFS to identify science priorities to better inform and support policy development.

Dr. Huber noted two upcoming symposia, Ecological impacts of non-native insects and fungi on terrestrial ecosystems, co-organized and sponsored by the BSC and the CFS, and the 1st Conservation of forest genetic resources forum. Dr. Huber noted that the CFS, like Agriculture, does not currently have a fixed budget.

Members of the Committee thought that as a result of the new CFS approach the depart-

ment will not be doing less research but it will be more focused into one of the four business lines, and there will be a continuing role for biodiversity science in the CFS. It is hoped that some of the substantial funding for invasive alien species received by CFS will be invested into systematics in the near future.

5. *Canadian Society for Ecology and Evolution*

Dr. Wheeler provided an update on this newly formed organization. Its formation grew out of the realization that NSERC Discovery grants in ecology and evolution have been less than sufficient for the needs of the community. There is a chronic problem of underfunding of the Discovery grants program in general and of evolution and ecology in particular. With assistance from NSERC, a meeting was held last year to look at both reorganization of the GSC18 committee and what could be done to organize the ecology and evolution community. NSERC sponsored the recent meeting, the goal of which was to organize a new society to give the ecology and evolution community a single voice.

The Canadian Society for Ecology and Evolution therefore had its first meeting April 3–4 in Montreal. The organizers were expecting 50 to 100 people but over 300 registered. About 500 people are now members of the society. The first meeting was primarily a business meeting to adopt the constitution of the society, to elect the first council, etc. The next meetings of the Society will be in 2007 in Toronto, and in 2008 in Vancouver, with a scientific focus on research.

Systematists and entomologists were under represented at the first meeting, although the Society has potential as a single voice that can be used to lobby various funding agencies such as NSERC to get the message out that ecology and evolution research is critical to Canada's economic, intellectual and cultural health.

6. *Parasitology module, Canadian Society of Zoologists*

Dr. Marcogliese reported that progress with this unfunded module is slow. However, some funding for the international stickleback parasite biodiversity project has been made available and other projects are in progress.

The Science Policy Committee of the Canadian Society of Zoologists utilizes a lobbyist. Current priorities are matching-funds issues, promotion of investment to maintain the climate of creativity, support for post docs, and environmental issues. The annual meeting of the CSZ will be held during the first week of May in Edmonton. The overall thematic symposium will be Biology of the Canadian arctic – integrating across scales. There will be a parasite symposium on emerging pathogens. Next year's meeting will be held in late May in Montreal.

Environment Canada has been reorganized along the theme of projects and results. Research is organized nationally, largely centered in Burlington. Dr. Marcogliese circulated some articles of interest.

Other items

1. *Regional developments*

Information of potential interest from different regions was reported, including work on faunas being carried out by graduate students and others (not noted in detail here), and the following examples. In British Columbia, a group of non-governmental organizations received \$8 million from the province for a biodiversity conservation initiative, including money for land purchase and to develop a biodiversity conservation strategy for British Columbia. A new forest science program has replaced the old Forest Renewal B.C. and the Forest Innovation Initiative; an advisory committee on sustainability deals with biodiversity. The Nature Trust will purchase more than 700 acres of antelope brush habitat in the south Okanagan, home of the endangered Behr's

hairstreak butterfly. British Columbia has several successful biocontrol projects.

In the Prairies, a new containment facility has been built at Lethbridge, to provide as many natural spaces for insect rearing as possible. A retired professor from the Biology Department of the University of Saskatchewan has now expressed interest in curating and databasing the collections at the University and at Agriculture and Agri-Food Canada in Saskatoon.

In Alberta, a recovery plan for the Yucca Moth / Soapweed has just been approved. Weidmeyer's Admiral butterfly has been recommended for designation as a species at risk. The Alberta Conservation Association has funded surveys of moths in southern Alberta. An especially large number of biodiversity projects in forest systems continue at the Canadian Forest Service and the University of Alberta.

In Manitoba, much work is being done on mosquitoes (cf. West Nile Virus) and on projects related to biocontrol.

In Ontario, several fascicles in the handbook series (now published by NRC Press) are being considered for reprinting. On 1 July the Department of Zoology at the University of Toronto will amalgamate with the Department of Botany to form two new departments – the Department of Ecology and Evolution and the Department of Cells and Systems Biology. At the Royal Ontario Museum some new galleries have opened and the 'crystal' addition is progressing. A symposium organized through the Toronto Entomology Association, at which students gave research-based seminars, was very successful. Much activity at the University of Guelph is tied in with the Canadian Journal of Arthropod Identification. Unfortunately, there have been some obstacles to expansion of the insect collection although funds are available from the CFI grant also supporting an active bar coding program.

In Quebec, entomology is in a growth stage with much activity at several universities and at research stations, including work on forest insects and spiders at Université du Québec à

Montréal and McGill University, and taxonomic research at McGill University and elsewhere. Some storage space at the Lyman Museum has been lost and therefore many reprints and memoirs on systematics are available. The editor of *Faberies* (journal of the Association des entomologistes amateurs du Québec) recently resigned and the Society is looking for a new editor.

In Newfoundland and Labrador and the Maritimes, research at universities, museums and government research stations includes work on insects of the Gulf of St. Lawrence, agroecosystems, forests, invasive species in urban systems, and distribution of beetles in the Atlantic region. On PEI community groups are being encouraged to collect and monitor the numbers of Ephemeroptera, Plecoptera and Trichoptera, but no provision has been made to identify further or archive the samples. A mini-Bio-Blitz on Scaterie Island off Cape Breton resulted in interesting finds. The Acadian Entomological Society meets on 11-13 June.

For the arctic, the Boreal and Arctic entomology course in Churchill will take place again this summer, including field work in Wapusk National Park by agreement with the Park. In that park (established because it is a polar bear denning site) there is no road access and fingers of arctic habitat mingle with boreal forest.

2. *Other matters*

The Scientific Committee also discussed other matters arising from the previous meeting, the Annual Report to the Canadian Museum of Nature, planning for the next meeting of the Committee in view of another year with restricted CMN budgets, work of the Secretariat, and other issues. The Annual Meeting of the Biological Survey Foundation was also held.

Project Update: Briefs and Similar Documents prepared by the Biological Survey of Canada

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One role of the BSC is to highlight key themes that are of particular interest in understanding the Canadian arthropod fauna, as well as to advocate proper procedures for such scientific enquiry. Beyond its typical scientific publications, therefore, from time to time the BSC prepares briefs or similar documents that are distributed widely to entomologists and, depending on the subject, to other people such as officials in charge of Provincial programmes studying biodiversity, especially if they can be introduced personally by a Survey representative. Moreover, the contents of many of the briefs, especially those about assessing biodiversity, the value of collections and the appraisal of environmental disturbance, have been explained by the head of the Survey in lectures and seminars at various institutions across the country.

This update outlines the briefs and similar products of the BSC. Most of the publications are available in electronic form on the BSC web site at <http://www.biology.ualberta.ca/bsc/english/briefs.htm> Several briefs, including the more recent ones, are also available in French-language versions.

Many of the briefs deal with general issues in the study of diversity, such as the rationale and care of collections, or methods for assessing biodiversity. Some of them pertain to scientific projects of the BSC, but discuss the relevance and wider context of those subject areas.

Collections and collections policies

Work of the BSC Pilot Study led to some recommendations about collections and notably to the concept of regional centres. A brief was prepared for publication, but following an invitation to present the material at the 1981 meeting of the Society for the Preservation of Natural History Collections, the paper on regional centres was published instead in the proceedings of that meeting.

Danks, H.V. 1983. Regional collections and the concept of regional centres. pp. 1 51-160 in D.J. Faber (ed.), Proceedings of 1981 workshop on care and maintenance of natural history collections. *Syllogeus* 44. Nat. Mus. Nat. Sci. Canada.

The Biological Survey of Canada (Terrestrial Arthropods) was developed as a focus for national discussion and guidance of systematic and faunistic entomology. Therefore, one general concern of the Survey is the status of resources of preserved material in collections. The existing collections of Canadian terrestrial arthropods are discussed. More than half of the estimated 16 million specimens in collections are in the Canadian National Collection, but there are about 50 other collections in Canada that contain more than 10,000 specimens each. Some of these are deteriorating through lack of maintenance. The Biological Survey believes that the support and development of regional centres based on regional collections (in addition to a strong National Collection) are essential to proper study of the fauna. Such regional centres would serve not only as focal points for curation and identification of specimens, but also would underpin research, education and

reference in a broader context. Some preliminary ideas about the development of regional centres are summarised.

During consideration of long-term research activities, the BSC wanted to emphasize the long-term value of collections in this arena, and a document was prepared for discussion and subsequently published.

1987. Danks, H.V., G.B. Wiggins, and D.M. Rosenberg. Ecological collections and long-term monitoring. *Bull. ent. Soc. Can.* 19 (1): 16-18.

Following up a number of concerns about the status of research collections, especially the disposition of materials collected with federal funds, a brief was prepared to point out the importance of collections, as a basis for specific policy suggestions about orphaned collections, collection guidelines within the granting programmes of the Natural Sciences and Engineering Research Council of Canada, and so on. The brief was then widely disseminated. A broader discussion of the subject was also published as a paper in the journal of the Society for the Preservation of Natural History Collections. In addition, more specific briefs emphasizing the need for collection infrastructures were directed to both NSERC and the Biodiversity Convention Office.

Wiggins, G.B., S.A. Marshall, and J.A. Downes. 1991. The importance of research collections of terrestrial arthropods. *Bull. ent. Soc. Can.* 23 (2), Suppl. 16 pp.

Terrestrial and freshwater ecosystems of the world include millions of species of insects and arachnids, most of them still unknown to science. Inability to identify these arthropod species is a severe impediment for scientific investigation of terrestrial and freshwater ecosystems; therefore, some of the most critical gaps in biological science occur in the systematics of terrestrial arthropods. Underlying this deficiency in biological science in Canada is inadequate and declining funding for research collections of terrestrial arthropods and their associated curatorial programs. These collections are an irreplaceable scientific resource. They are the source of much that is known about the systematics of insects and mites of Canada, and the base for what has still to be learned;

and they are part of the ecological database of the country which is essential for detecting and correcting man-made perturbations of natural biological systems. These collections represent a major part of Canada's participation in the task of documenting the biota of the world.

Recommendations are made to address the declining state of research collections of terrestrial arthropods in Canada, culminating in a proposal for a national plan to improve the infrastructure of all biological research collections, administered by the Canadian Museum of Nature and funded through a specified supplement to the annual budget of the Museum.

Danks, H.V. 1991. Museum collections: fundamental values and modern problems. *Collection Forum* 7 (2): 95-111.

Collections support scientific enquiries about the natural world and enhance education. These fundamental values notwithstanding, resources for collections remain limited despite recent increases in material stemming from biodiversity itself, from the development of mass collecting techniques, and from the need to house endangered collections, voucher specimens, collections preserving genetic diversity, and regional collections. The pressure on resources can best be met by obtaining more resources. Knowing biodiversity (and thus understanding the world we inhabit and living there sensibly) requires the steady accumulation of information supported by collections (and by the systematics work they facilitate) must be explained to those who use this support but do not appreciate its true cost. Initial project costs should include the means to identify material and preserve voucher specimens. In addition, existing resources can be used more efficiently by setting priorities to optimize scientific quality and resource use. Increasing operational efficiency (collections management and improved preservation) and division of labour (regional participation, networks, and data standards) also conserve resources. Modern problems can be solved by emphasizing the fundamental scientific value of collections in building knowledge for current and future use.

Langor, D.W., H.V. Danks and G.E. Ball. 1995. Recommendations for support of biological collections infrastructure in Canada, with special reference to terrestrial arthropods. Briefs prepared for submission to the Biodiversity Convention Office and to the Natural Sciences and Engineering Research Council.

Following BSC discussions about geographic standards for data labels, a brief to give standards not only for geographic information but also for label preparation was published.

Wheeler, T.A., J.T. Huber and D.C. Currie. 2001. Label data standards for terrestrial arthropods. A brief. Biological Survey of Canada (Terrestrial Arthropods), Ottawa. ISBN 0-9689321-0-X

The data associated with specimens and recorded on their labels are a permanent record of research that is as important as the specimens themselves. This brief provides recommendations on how to prepare data labels for collections of terrestrial arthropods. Given here are standards for label data, to ensure that the data associated with the collecting event are clearly presented and organized, as well as standards for label preparation, to ensure that the labels are clear, useful and permanent. Labels should provide accurate, unambiguous locality information that includes latitude and longitude. Specific recommendations are also provided on how to format information about the date, collector, collecting method and habitat that should appear on labels, and about unique identifier codes if used. Guidelines for preparing computer-generated specimen labels are given, as well as recommendations on paper and printers for both dry (pinned) specimens and wet specimens (preserved in fluid). Label data should be in a format that maximizes the efficiency with which the data can be extracted into databases, data retrieval systems and geographic information systems.

More recently, the importance of voucher specimens was emphasized, both in general terms and in view of the many studies of biodiversity underway that did not always preserve reference specimens. A detailed brief was produced to point out the advantages of vouchers as well as the disadvantages of neglecting them.

2003. Wheeler, T.A. The role of voucher specimens in validating faunistic and ecological research. A brief prepared by the Biological Survey of Canada (Terrestrial Arthropods). Biological Survey of Canada Document Series No. 9. 21 pp.

Voucher specimens deposited in natural history collections are the only reliable means to verify the identity of species used in biological

studies. However, despite their importance in confirming the results of research, deposition of vouchers is still the exception rather than the rule, especially in non-taxonomic studies. Furthermore, many journals do not require or even recommend deposition of vouchers. This brief reviews the nature of voucher specimens and sample policies on vouchers in systematic, faunistic and ecological research. The advantages of having vouchers available for subsequent study, and the pitfalls of not designating and depositing vouchers, are discussed using examples from the literature. Recommendations as to best practices in voucher policy are given for funding agencies, agencies that issue research permits, university departments, journal editors and natural history collections.

Environmental Appraisal

The Survey considered the appraisal of environmental disturbance as well as the allied topic of formal Environmental Impact Assessments. A brief was prepared to recommend, to those generally concerned with the environment and entomology, procedures by which scientifically effective appraisals could be carried out. A paper was also prepared to point out the value of insects in the more formal process of Environmental Impact Assessment.

Lehmkuhl, D.M., H.V. Danks, V.M. Behan-Pelletier, D.J. Larson, D.M. Rosenberg, and I.M. Smith. 1984. Recommendations for the appraisal of environmental disturbance: some general guidelines, and the value and feasibility of insect studies. *Bull. ent. Soc. Can.* 16 (3), Suppl. 8 pp.

This brief considers the development of proper scientific standards for the monitoring and appraisal of environmental disturbance. Insects are useful in various ways for such evaluations, as demonstrated by examples. The objectives of any such study should be defined by consultation among all interested parties. The complete study should be planned by defining scientific objectives in an ecological context, with the help of peer review of the plans. Data collected should be related to specific questions that have been formulated about the influence of a given disturbance on the system. Scientific answers should be the best attainable at the present state of knowledge; this requires expert personnel for design, analysis and identification of species. Because of their diversity in natural systems, and because they are not well-known, insects usually have not been identified to

species in past studies of this kind. However, problems of identification can now usually be overcome with expert help: species identifications are normally necessary because species are the only taxonomic units by which information on the functioning of natural systems can be organized. Some recommendations summarizing these conclusions are presented.

Rosenberg, D.M., H.V. Danks, and D.M. Lehmkuhl. 1986. The importance of insects in Environmental Impact Assessment. *Environmental Management* 10 (6): 773-783.

Insects are particularly suited for use in environmental impact assessment (e.i.a.) because of their high species diversity, ubiquitous occurrence, and importance in the functioning of natural ecosystems. Examples are given of the use of insects in the predictive phase of e.i.a., in the monitoring and assessment phase, and in the much rarer instance of an e.i.a. that includes both of these phases. The importance of working at the species level to understanding the results of e.i.a. is emphasized.

Study of biodiversity

The BSC recognized that increasing interests in biodiversity were not always matched by knowledge of what is required for proper study, especially for the arthropod components. Therefore, the BSC published a series of briefs. The first emphasized sampling procedures and general planning; a second detailed the steps required to properly plan and execute a biodiversity study; and the third demonstrated the validity of those steps, based on specific studies, and also considered the costs of biodiversity work in more detail. The content of the second brief was also published in popular form elsewhere.

Marshall, S.A., R.S. Anderson, R.E. Roughley, V. Behan-Pelletier and H.V. Danks. 1994. Terrestrial arthropod biodiversity: planning a study and recommended sampling techniques. A brief. *Bull. ent. Soc. Can.* 26 (1), Suppl. 33 pp.

Knowledge of biodiversity is important for wise management and use of the earth's resources. Terrestrial arthropods (insects and their relatives) are by far the most diverse groups of animals and important contributors to biodiversity. However, a synopsis of techniques suitable for

assessing diversity for terrestrial arthropods is not readily available to many of those responsible for general assessments of biodiversity. This brief therefore offers general guidelines for planning a study of arthropod biodiversity, including attention to long-term planning, choice of taxonomic groups, and the resources required for sampling, sorting and identification. The brief recommends in some detail the specific sampling methods appropriate for this purpose. It proposes a standard sampling protocol for the assessment of regional biodiversity, suggesting that any such general inventory should include, at a minimum, Malaise, flight-intercept and pan traps, as well as behavioural extractors such as Berlese funnels, and it presents some estimates of the time required to process samples, for use in planning a budget. The major current impediment to properly planned and executed studies of arthropod diversity is the limited number of systematics experts available to identify species. Resources for systematics support therefore should be included in project budgets.

Danks, H.V. 1996. How to assess insect biodiversity without wasting your time. A brief from the Biological Survey of Canada (Terrestrial Arthropods). Biological Survey of Canada Document Series No. 5, ISBN 0-9692727-6-6. 20 pp.

The diversity and ecological importance of insects makes them very valuable for studies of biodiversity. However, the same overwhelming diversity means that valid and useful results will only be obtained if studies are properly planned. This synopsis outlines the steps required for appropriate biodiversity assessments. Steps that have to be planned from the outset are: definition of objectives, gathering of existing and background information, development of a plan for the project as a whole, definition of level of detail, site selection, selection of taxa, duration of study, selection of sampling methods, quality control of actual sampling, sorting and preparation of samples, identification of material, data management, curation and disposition of specimens, and publication and dissemination of information. The initial definition of objectives is especially important so that studies will answer specific questions, not just generate isolated sets of general information. Planning in advance for identification to species is essential, because using the results requires specific identifications, yet expertise for proper identification is limited. Indeed, project resources may well have to be explicitly devoted to the development of expertise for identification. Finally, it is very important that results are available in the

published scientific literature, and not just in unpublished reports, and that voucher specimens remain available, both to validate progress toward the project objectives, and to add to the fund of knowledge that is required to make real advances in understanding biodiversity.

1997. Danks, H.V. Assessing insect biodiversity - without wasting your time. *Global Biodiversity* 7(3): 17-21.

Danks, H.V. and N.N. Winchester. 2000. Terrestrial arthropod biodiversity projects – building a factual foundation. A brief from the Biological Survey of Canada (Terrestrial Arthropods). Biological Survey of Canada Document Series No. 7, ISBN 0-9692727-9-0. 38 pp.

Guidelines for conducting studies of arthropod biodiversity properly are reinforced using results from selected recent studies in Canada. The costs for doing such work are also given explicitly. The necessary components of a biodiversity study, and selected examples, are briefly tabulated for ready reference. Careful advance planning should include explicit scientific objectives and ways to ensure that the work proceeds to completion. Work on more than one taxon is necessary, because neither patterns of species richness nor relevant ecosystem involvements can be extrapolated from one taxon to another. Plans for identification, normally to species, are especially important, requiring specific collaboration with systematists. Protocols for sampling, sorting, specimen preservation and data management should be clearly defined and costed. Curation and retention of specimens and ongoing scientific and other publications are also essential if projects are to have real long-term value. Examples and references illustrate how these components can be developed. Proper support for studies of biodiversity, as opposed to superficial promotion of its importance, therefore requires mechanisms to provide stable long-term funding.

In addition, during development of the grasslands project a brief was published about the uses in ecosystem management of studies of the biodiversity of grassland arthropods.

Finnamore, A.T. 1996. The advantages of using arthropods in ecosystem management. A brief from the Biological Survey of Canada (Terrestrial Arthropods). 10 pp.

Human society and regional economies are tied to resources produced by ecosystems. Realistic

information on biological diversity must be integrated into policy planning and management practice if ecosystems are to be managed for use by future generations. Arthropods (insects, spiders, mites, & relatives) are the most diverse group of organisms in most ecosystems and many species are well suited to provide ecosystem information. Ecosystem baselines that document arthropod species assemblages in a manner comparable in space and time are key to interpretation of arthropod data. Government departments, agencies, boards, and private sector companies and organizations with interests in ecosystem management should act to support the acquisition of ecosystem baselines of arthropod biodiversity. The acquisition of ecosystem baselines of arthropod biodiversity should be viewed as an integral component in the implementation of Canada's biodiversity strategy.

More recently, given the difficulties experienced by students of biodiversity in securing funding for their projects, a list of relevant sources of funds was prepared and posted on the Survey web site.

Wheeler, T.A. 2000, and updates. Funding sources for graduate students in arthropod biodiversity: Introduction, General advice on preparing applications, Searching for sources of funding, Specific sources of funding. <http://www.biology.ualberta.ca/bsc/english/funding.htm>

One of the greatest obstacles to conducting research in biodiversity is finding a way to pay for it. Because of this, one of the most essential skills for students to develop is the ability to locate and secure funding for graduate and postdoctoral studies, research and travel. This document provides information on some of the available funding sources for graduate study and research in biodiversity, with special reference to terrestrial arthropods.

Even after a source of funding has been located, there is still the matter of getting it. It is surprising and discouraging to see how many students submit poorly prepared applications for funding. One of the reasons for this may be that many students never receive training in grantsmanship. Therefore, this document also gives some general advice on the preparation of grant applications.

Soils

The diversity of the soil fauna and the lack of knowledge about soil arthropods despite their importance in maintaining soil fertility attracted the interest of the Survey even from its inception, but available taxonomic resources were too limited to support an active project. Instead, the Survey prepared a brief to outline the ecological roles of the arthropod fauna of soils and the current state of knowledge.

Marshall, V.G., D.K. McE. Kevan, J.V. Matthews, Jr., and A.D. Tomlin. 1982. Status and Research Needs of Canadian Soil Arthropods. A brief. *Bull. ent. Soc. Can.* 14(1), Suppl. 5 pp.

This brief points out that knowledge of soil arthropods in Canada is strikingly deficient. Although the fauna of the soil is relatively rich, especially in the northern life-zones characteristic of the country, the expertise available in typical soil groups is very limited, especially in taxonomy.

The soil fauna is abundant and ecologically important, particularly in decomposition and nutrient-cycling, and hence of immediate concern in activities such as agriculture and forestry that depend on soil fertility. Some species of soil arthropods are directly important as pests, and others may serve as indicator species, agents of biological control, or aids for teaching.

Deficiencies of information are greatest for immature forms, especially in groups that contain many species, such as mites, spring-tails and flies; however, fewer than half of our estimated 18,000 or more soil species have been described even in the adult stage. These deficiencies reflect a general lack of support for study of soil arthropods at the present time. A basic problem is the lack of taxonomic expertise, which in turn greatly hinders ecological work. This brief is intended to provide a basis for initiatives and representations that can be made as circumstances permit to improve this situation.

Insects of Canada

As part of the preparations for the 1988 International Congress of Entomology held in Canada, a synopsis of the Canadian insect fauna and of entomology in Canada was published in the form of a brief and distributed to each delegate. The content was subsequently

adapted into an abridged form by the Canadian Museum of Nature, with photographs, and posted on the Museum's web site.

Danks, H.V. 1988. Insects of Canada. A synopsis prepared for delegates to the XVIIIth International Congress of Entomology (Vancouver 1988). *Biol. Surv. Can. Doc. Ser. 1.* 18 pp.

This booklet introduces the insect fauna of Canada. It summarizes general features of the country as well as the taxonomic composition and ecological relationships of its insects. The treatment accords with the faunistic interests of the Biological Survey of Canada, and species of economic importance, for example, therefore are treated in a limited way and from general ecological rather than control perspectives.

The booklet also outlines major entomological resources, including Canadian entomological collections and the organizations that support or carry out entomological work. Selected references are provided for readers who wish to explore the subject matter further.

2000 – Abridged version of Insects of Canada [Biological Survey of Canada (Terrestrial Arthropods)]: http://nature.ca/research/bscta_e/

Springs

The BSC recognized that freshwater springs are discrete habitats of great biological interest that can be relatively easily sampled. However, finding these habitats is difficult in many jurisdictions, and the Survey therefore made representations to the Commission of inquiry on federal water policy about the need for an inventory of springs. A brief pointing out the values of springs and making recommendations for future work on arthropods was subsequently published, and together with other efforts helped to launch a project that produced various scientific publications about springs.

1984. Brief submitted to the Pearse Commission of Inquiry on Federal Water Policy (prepared by D.D. Williams and H.V. Danks; presented by I.M. Smith and H.V. Danks).

Williams, D.D., H.V. Danks, I.M. Smith, R.A. Ring, and R.A. Cannings. 1990. Freshwater springs: a national heritage. *Bull. ent. Soc. Can.* 22 (1), Suppl. 9 pp.

Springs are the points of issue of groundwater, an important storage element little studied in Canada. Many springs are very vulnerable because of their potential for recreational development (spas), water-bottling sites and stock watering holes. Some type localities for organisms have already been destroyed. Existing government policy in Canada provides little protection to groundwater despite its increasing use and contamination from a variety of anthropogenic sources. Biomonitoring of spring-dwelling organisms is suggested as a practical method of assessing groundwater quality and the history of individual aquifers.

The Biological Survey of Canada (Terrestrial Arthropods) urges that guidelines be drawn up for the protection of springs from industrial, urban and agricultural pressures. It recommends that an inventory be made to identify rare and regionally characteristic Canadian spring types and their biota which should then be protected as part of our biological heritage.

Arctic

The BSC has had a long-standing interest in arthropods of the arctic, with ongoing scientific programmes, but in addition it produced a brief in 1989 to point out the virtual lack of work on invertebrates in the arctic, in contrast to earlier Canadian efforts. The Survey also wrote letters at that time to relevant agencies about the lack of support for arctic entomological research.

Danks, H.V., and R.A. Ring. 1989. Arctic invertebrate biology: action required. *Bull. ent. Soc. Can.* 21 (3), Suppl. 7 pp.

This brief points out that although invertebrates are the most common and diverse animals in the arctic ecosystems that are characteristic of Canada, no concerted efforts are being made to study their biology in the north. Studies are not integrated despite wide though generally diffuse interest, and despite the existence of valuable general resources for arctic studies, such as field stations and information banks. Arctic invertebrates not only offer instructive cases of adaptations to northern conditions, and lessons about food-chain function and other ecological processes in a tractable but not oversimplified ecosystem, but also they provide information to address broad questions of great

long-term environmental importance, such as climatic change and pollution.

This brief therefore recommends ways in which studies of arctic invertebrate biology can be enhanced: through international cooperative research ventures, to identify and develop key active studies; through scientific workshops associated with professional societies, to address broader themes; and by coordination among individuals and organizations interested in arctic studies. The Biological Survey of Canada (Terrestrial Arthropods) proposes through these recommendations to develop a long-term programme of cooperative studies on arctic invertebrates.

Ectoparasites

Arthropod ectoparasites are a diverse element of the Canadian fauna but are not well known. Recognizing that work on arthropod ectoparasites of vertebrates was inadequate, a brief was prepared to document the situation and recommend ways to improve it.

Galloway, T.D. and H.V. Danks. 1991. Arthropod ectoparasites of vertebrates in Canada. A brief. *Bull. ent. Soc. Can.* 23(1), Suppl. 11 pp.

Arthropod ectoparasites are a diverse element of the Canadian fauna, and frequently impinge upon the performance and well-being of man, domestic animals, and wildlife. The fauna is not well known, with only about 17% of the expected species recorded. The mites and chewing lice in particular need study. There is considerable potential for investigation of the ecological, physiological and systematic relationships of the ectoparasites and their hosts. Unfortunately, there has been no coordinated research effort, and much of the research has been directed only to economically important species or disease vectors. Consequently we are presented with a rather biased view of faunal relationships. The Biological Survey of Canada (Terrestrial Arthropods) therefore recommends ways to improve the state of knowledge of Canadian arthropod ectoparasites: additional resources aimed at long-term objectives, increased awareness among a variety of biological disciplines, and fruitful avenues for future research.

Lost collections – fate or fault

Many arthropod collections have been lost over time though floods, fire and war, through carelessness or neglect (and hence destroyed by dermestids, for example), and for other reasons. Specialized collections built up in a small institution by a single individual who then retires are at particular risk of neglect, but large and well established collections have been destroyed too. Here are a few examples:

Thomas Say collected extensively in North America and described many species of different taxa. Upon his death in 1834 at the age of 47, his collection was given to the Academy of Natural Sciences in Philadelphia. In 1836 it was sent to T.W. Harris in Cambridge, Massachusetts, but most of the material was destroyed by dermestids and by the rough stagecoach ride, and relatively few specimens remain.

Asa Fitch (1803-1879) described many species from galls, but some of the type material is lost. For example, deposited in the United States National Museum is a pin that has no insect but carries only Fitch's original label for the type specimen of the cynipid gall inquiline *Ceroptres quercusarbos*.

B.D. Walsh (1808-1869) collected about 10,000 specimens for the Illinois Natural History Survey starting in about 1860. Most of his collection was sent from Springfield to Chicago in 1871 for safe-keeping, but was destroyed later that year in the Chicago Fire, and only the synoptic collection left in Springfield survived.

J.J. Kieffer assembled an extensive personal collection of Diptera, especially through the early 1900s, but most of it has been destroyed, including all of the neotropical type specimens of Tephritidae described by Kieffer and Jorgenson for example.

The collection of the German lepidopterist G.A.W. Herrich-Schäfer was deposited in the Zoologische Staatssammlung, München, but apparently most of it was destroyed by bombing during the second world war.

The Norwegian taxonomist Sig Thor described many species of mites, but – apparently in anger at criticism by some colleagues – his will specified that his collection including all of the type material should be incinerated, a wish duly carried out by his wife during World War II.



The Quiz Page

—test your knowledge of Canada and its fauna—

1. Considering only New Brunswick, Nova Scotia, and the Island of Newfoundland, which contains the highest point of land?
2. How many species of Mecoptera occur in Ontario, and what is the dominant genus?
3. In a prairie field, an adult grasshopper sits on the same plant as a mymarid parasitoid of moth eggs. How many times heavier than the parasitoid is the grasshopper?
4. Explain the following acronyms related to arthropods, systematics and so on.
 - CRM
 - DEET
 - EPT
 - LBJ
 - PAUP
 - PDB
5. Name at least 6 routes by which micro-organisms affect insects

[Answers on p. 65]

Canadian Perspectives: Life-cycle Types in the Arctic

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It might be expected that the cold temperatures and marked seasonality of polar regions would limit the types of life cycles that are possible in the arthropods living there. One expectation might be that flexibility or opportunism would be prevalent, because it allows growth and development whenever conditions are favourable, so that a species can take advantage of every window of opportunity for development. On the other hand, many insect life cycles involve strict temporal programmes, especially in cold and seasonal environments. There, developmental programmes restrict adult emergence to suitable times of year or enable larval stages to coincide with temporally limited food resources.

Information especially from the Canadian arctic, where many arthropod life cycles are known in general terms, can be used to assess the relative contributions of flexibility or opportunism and of fixity or programming. Depending on taxon, zone, habitat, and food, life cycles in arctic regions take a variety of forms including relatively complex ones, showing that there are many degrees of flexibility. For example, the fact that a life cycle is programmed does not mean that it is precisely controlled every step of the way. In particular, many insect life cycles are more or less flexible in some of their stages, but mechanisms exist to restore seasonal synchrony at or before critical times of year.

Therefore, it is essential to distinguish patterns of the life cycle as a whole from features of individual stages, even though more information exists about single components because it is easier to collect. For example, high arctic

mosquitoes are strictly univoltine and overwinter only as drying- and freezing-resistant eggs in diapause. The position of seasonal emergence nevertheless differs widely from one season to the next, depending on weather, and from one pond to the next, depending on temperatures in a given habitat, because the rates of larval and pupal development are regulated by temperature. Thus, development is flexible locally (at least within a season), but the life cycle as a whole is very closely constrained.

Data for arctic Canada and elsewhere show that several species of springtails and mites, and a few insects, indeed appear to have fully flexible life cycles, as suggested by such things as shorter life cycles where conditions are warmer, winter activity, overlapping generations, lack of seasonal synchrony, winter activity, lack of a fixed overwintering stage and lack of build-up of fat for winter. These species live in relatively well-buffered soil habitats.

Nevertheless, a larger number of species show programmed components. A particularly common pattern is that immature development is flexible (again, typically in habitats that are relatively well buffered, such as the soil or shallow pools), but adult emergence into less stable terrestrial or aerial habitats is very closely controlled, ensuring early emergence and rapid reproduction. For example, high arctic pond chironomids, which spend several years in the larval stage, emerge only if all growth has been completed the previous year, resulting in the earliest possible start in spring and hence the longest possible season for reproduction before winter returns. A few other arthropods develop from egg to adult over a single season but the

adult life span is long and eggs are deposited over a number of seasons.

Other species have life cycles that are relatively closely programmed throughout. For example, the high arctic geometrid moth *Psychophora sabini* appears to moult only once each year, gaining the next instar in spring before beginning to feed. An alternative strategy is to develop extremely rapidly, as in univoltine species that are surprisingly well represented in the arctic. These species complete the whole life cycle in a single season from a fixed overwintering stage. The overwintering stage is characteristic of the taxon, including the egg (e.g. *Aedes* mosquitoes), larva (e.g. the tundra pool caddisfly *Sphagnophylax meioms*) or adult (e.g. bumble bees).

On a longer time frame, a feature of many species is some life-cycle variability among individuals, leading to differences in the numbers of years per generation, for example. Such variability among individuals experiencing similar conditions appears to be “insurance” (which is a programmed response) against the uncertainty of environmental events, rather than “flexibility” to take advantage of possible developmental opportunities. Short-term variability prevents a generation late in the year or in an especially cold year that would be likely to fail (as demonstrated in high arctic chironomids); long-term variability reflects the spreading of risk in uncertain environments (such as prolonged diapause in a variety of arctic flies, sawflies, moths and other species).

Mechanisms by which these arctic life cycles are adjusted seasonally therefore include the occurrence, placement, duration, variability and continuity of both development and reproduction, with various ways to accelerate, delay and adjust the life cycle. Some mechanisms depend on durations that can be altered gradually, as for larval growth rates. Others trigger switches between distinct alternatives such as diapause and non-diapause.

In arctic regions with short, cool summers, many species promote the earliest possible emergence. At least some of these responses

depend on a fixed overwintering resting or diapause stage, typically the prepupa, in which larvae accumulate at the end of the previous season, as in arctic chironomids and crane flies. Several species develop very rapidly on account of low temperature thresholds for growth, high growth rates even at relatively low temperatures, a relatively short pre-moult period, and an abbreviated adult stage, as demonstrated in arctic moths, bugs, mosquitoes, psyllids, leaf beetles, sawflies and so on.

A few species eliminate generations or stages (adult feeding, mating, and even the adult stage itself) that are present in their temperate relatives, and although such traits are also known in certain temperate species they are more common in arctic regions. For example, telescoped development and modified mating in the arctic are known in groups that include aphids, bumble bees, black flies and chironomids, and parthenogenesis is known in mayflies, caddisflies and bugs, and in flies of various families.

Rapid development is possible even in cold regions through relatively rapid metabolism at a given temperature. However, although temperature adaptation has been demonstrated in several species of arctic arthropods it is by no means universal, because many other functions besides the rate of respiration may constrain species in these conditions. Much more commonly, arctic species increase body temperature by choosing specific, relatively warm, microhabitats. Many species — including butterflies and flies and even immature stages such as caterpillars of the moth *Gynaephora* — have closely adapted basking behaviours to increase body temperatures in sunshine.

There are also mechanisms to delay rather than accelerate the life cycle; such delays may be necessary to ensure that feeding stages coincide with habitats or food supplies that are of low quality, unreliable, or seasonally restricted, or to avoid producing a generation or stage so close to winter that it would be certain to fail. These mechanisms include slow development

or reproduction, and interpolation of resting stages.

Diapause, the resting stage characteristic of temperate regions, does occur in arctic species, including some species of chironomid midges, crane flies, mosquitoes, black flies and stoneflies, and this finding is especially significant because the number of studies designed to detect it is so small, given the difficulty of working in the arctic with very limited laboratory facilities.

Both directly controlled and cued development help to adjust arctic life cycles. Many species use temperature cues (as opposed to simple regulation of faster development at higher temperatures) to control development, and one or more key temperature thresholds govern seasonal emergence of adults in various species. In high arctic chironomids, temperature requirements rise steadily for successive components of spring emergence: 1°C for larval activity, 4–5°C for pupation, and 7°C for adult emergence.

Temperature, then, is especially important to arctic arthropods, and is commonly used to regulate the life cycle. Conversely, photoperiod becomes much less relevant than temperature toward the poles: indeed, temperature alone is used by chironomid species in the high arctic to govern adult emergence, including its daily pattern.

In summary, the life cycles of arctic arthropods are diverse, including both flexible development (as in some soil arthropods), and relatively closely governed systems (such as a single moult each spring). However, the life cycles of most species do not show one or the other extreme but instead combine elements of flexibility and programming at different stages, depending on the species. In particular, even species with life cycles that appear to be largely flexible have programmed elements at the season or stage when timing is most significant, such as the emergence of the adult in spring. In addition, some degree of insurance or risk spreading, rather than precise and universal

seasonal or annual coincidence, is achieved through variability.

Moreover, as already noted, arctic life cycles are clearly correlated with the habitats and microhabitats of individual species. For example, forms such as mites and springtails that spend their whole lives in soil tend to have less structured life cycles, because conditions there are buffered. Again, species that live on warm-blooded vertebrate hosts in the winter, such as some fleas and lice, show little life-cycle programming.

On the other hand, most insect species that spend their larval stages in the buffered habitats of soil or water have aerial adults that emerge into more seasonal and rigorous conditions above ground. Their life cycles tend to be seasonally constrained, and adult emergence is closely programmed. Such a finding for species that emerge into aerial habitats re-emphasizes the need to look at whole life cycles and not simply for flexible larval growth, for example.

Evidence from arctic arthropods, then, coincides with the lessons from the more abundant information that is available for temperate regions in confirming that flexibility and opportunism are by no means the only way to cope with highly seasonal or unpredictable environments. Certainly there is room for selective opportunism. However, in most habitats including extreme ones a successful life cycle normally cannot be maintained merely through simple, unstructured, opportunistic responses to the environment. Such a conclusion suggests that life cycles evolve not so much to ensure that growth can be fitted in (or even that adverse conditions can be avoided) but rather so that critical stages of the life cycle, and notably reproduction, coincide with conditions that are favourable. Even in the arctic, specific adaptations for life-cycle timing are generally required, not just flexible opportunism.

[For detailed information and additional references, see especially Danks, H.V. 1999. Life cycles in polar arthropods – flexible or programmed? *European Journal of Entomology* 96: 83-102.]

Web Site Notes

The web site of the Biological Survey has undergone a face lift. Although the site is continuously updated it was time to implement an overall redesign. The former look of our web site was created in 2000 (although the Survey had a simpler web site for a few years prior to that). Over the years we continued to add content to the site to the point where the menu structure had become unwieldy, where the route to sub-pages was not always clear and where the meaning of some titles — as necessarily abbreviated in the original format — were not easily understood. Running the web site is only one of the tasks of the Survey Secretariat and therefore ease of maintenance was a consideration. For example, the former menu was graphical in nature and more difficult to update than the current text-based menu.

Highlights of the changes include:

- The new menu aims for a more logical grouping and most options are given to the user at a glance.
- The page layouts were simplified and made more functional.
- Each page has a similar look (menu and title graphic) which provides a ‘brand’ to the site but also is easier to maintain.
- The titles of some pages have hopefully been made more intuitive. For example:
 - ‘Annotated List of Workers’ becomes ‘Database of Entomologists’
 - ‘The First 25 years’ (originally a document prepared for an operational review) has been edited to become ‘Overview’ (an overview of the BSC)
 - Faunal Analysis Project becomes ‘Numbers of species’
 - Request for Material or Information’ becomes ‘Specimens Sought’
- The home page has less introductory text and space is now devoted to news or other project highlights.
- A section on ‘Information for Students’ has been added to provide a home for information on the BSC postgraduate scholarship and to highlight the BSC brief on funding sources for graduate students in arthropod biodiversity
- Some streamlining was done. For example, the short page about the Biological Survey Foundation was removed and the information included on the ‘Overview’ page; and the seldom-used ‘Site Map’, ‘What’s New’ and ‘Order Form’ pages were removed.
- The publications page has been simplified so that scientific monographs are listed chronologically rather than in the former groupings (Monograph series, Taxonomic series, Other).
- A new search engine provided by the popular Google software was installed.
- ‘Important notices’ (those necessary legal notices) were removed from the home page and put on a separate page.
- Text throughout the site was edited and updated.

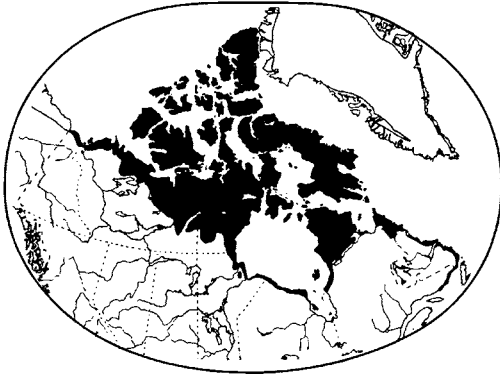
The web site continues to be maintained also in a parallel French version.

The BSC web site is at:

www.biology.ualberta.ca/bsc/bschome.htm
(English)

and

www.biology.ualberta.ca/bsc/cbchome.htm
(français)



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).

Update on Some Insect Biodiversity Activities in the Arctic during 2006

Donna Giberson
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 Prince Edward Island, 550 University Ave.,
 Charlottetown, PE C1A 4P3
 giberson@upei.ca

The COSEWIC Arthropod Specialist Subcommittee met in Whitehorse this July, to discuss arthropod species status reports for COSEWIC and proposals for species to be included for status report preparation. Following the meeting, the various members were given the opportunity to go collecting along a sand dune area in Kluane National Park in southern Yukon. Many of the members also took the opportunity to do some collecting in other parts of the Yukon following the meeting. Many thanks to Syd Cannings of the Yukon Centre for Data Conservation, who organized the meeting with the COSEWIC secretariat and arranged the Kluane trip and the necessary permits.

Following the COSEWIC meeting, I was able to do some incidental mayfly and stonefly collecting along the highways of Yukon, including parts of the Alaska Highway, Klondike Highway, and Dempster Highway. These samples are currently being processed.

My main arctic work this summer has consisted of investigating a number of specimens that were collected for the Mackenzie Valley Pipeline study of the early 1970s. These specimens were archived at the Freshwater Institute and the CNC, but most of the material remains unidentified (at least to species). I am currently relabelling all the material, since most of the vials are identified by code numbers with little or no locality data. Once each vial has a locality label I'll be working (in collaboration with Steve Burian and Ken Stewart) on identifying the mayflies and stoneflies of that region to species. Special thanks are owed to Dave Rosenberg who preserved these samples in the first place, and then arranged for the loan of the material from the Freshwater Institute and provided the "code books".

Interestingly, this work has led to some further collaborations to look at material collected in the Northwest Territories. Aquatic insect samples collected for environmental assessment work in the Canadian north are rarely identified to species (usually to family, or rarely, to genus), so such data are not useful for biodiversity study. However, thanks to the collaboration with Dave Rosenberg on the



initial Mackenzie Valley material, I have found out about recent ongoing studies in region by the Department of Fisheries and Oceans, and also have obtained material collected along Mackenzie Valley tributaries in 2005 and 2006, and along the Nahanni River as well. This has allowed us to increase our “sampling effort” in these areas with very little additional cost.

We would like to highlight insect and arachnid work from the arctic in subsequent issues of this Newsletter, so anyone doing work in the arctic who is interested in getting the word out, should contact Donna Giberson, at giberson@upei.ca

Invertebrate Community Structure in Lakes of the Central Canadian Arctic: Climate-induced Impacts Project

Andrew S. Medeiros

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4700 Keele St, Toronto, ON M3J1P3
fraggle@yorku.ca

Changes in climate are expected to have direct impacts on the arctic ecosystem. A component of arctic ecosystems that can be used to track climate changes are the lakes and ponds, which should be particularly sensitive to long-term changes in climate. In this study, we are investigating lake sediments in two central Arctic areas to provide the basis for paleoecological studies of long-term climate changes. Temperature changes have impacts on algal productivity and can influence the ecological organization of arctic food webs. These climatic impacts can be identified through the examination of indicators, such as lake and pond temperature, dissolved oxygen and compositional change in the paleo-history of the lakes. Family Chironomidae (Insecta: Diptera) community structure and algal sediment pigments are thus used as biomarkers of climate change.

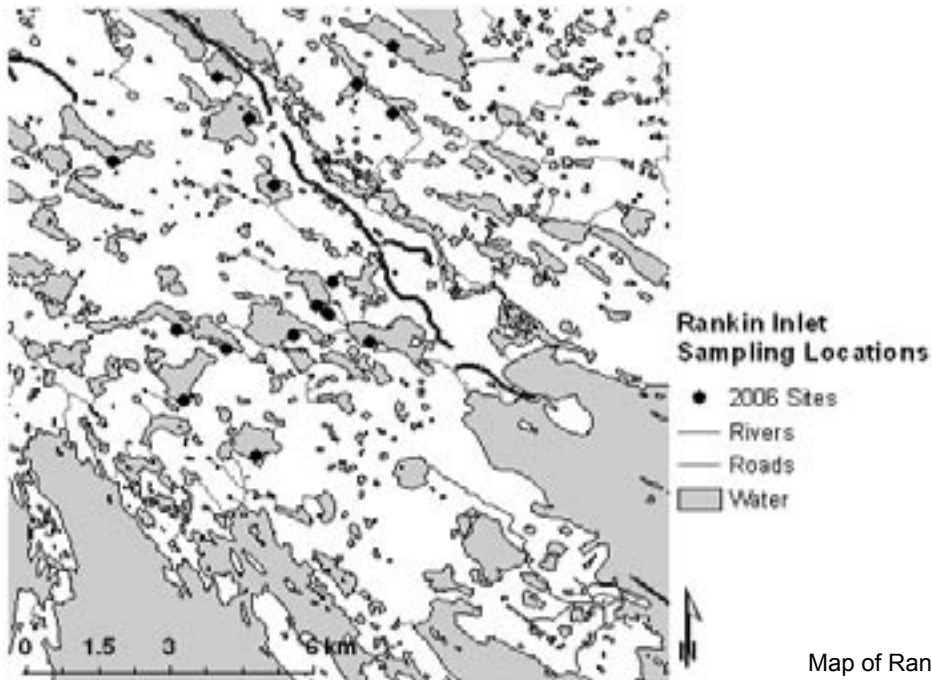
During the July 2006 field-season, we sampled several lakes and ponds in the Rankin

Inlet and Iqaluit (Nunavut) areas. Sediment samples were collected from lakes in areas with differing land-cover and hydrological characteristics. Remote sensing methods were used to assist in locating lakes and ponds in areas that have experienced changes in their moisture regimes during the last two decades. Of particular interest were lakes and ponds in proximity to the Meliadine and Char rivers (Rankin Inlet), which have experienced significant changes in terms of their surrounding land-cover and hydrology.

During our time in Iqaluit (July 1 – July 12) we received logistic support from Mary Ellen Thomas and the staff of the Nunavut Research Institute, who provided us with accommodations, lab space, and field support. They were extremely helpful and gracious in their support of this project. With their direct assistance, sediment core sampling was carried out at five lakes north of Iqaluit. The terrain in Iqaluit was difficult to navigate, since the lakes sampled were not close to any ATV trails or roads. Unfortunately, along the hike to several sampling locations human impacts were readily visible. At one location several HazMat asbestos disposal bags (presumably once filled with asbestos) were found dumped into the lake.



Asbestos bag; Iqaluit July 2, 2006
(photo by A.S. Medeiros)



Map of Rankin sampling sites

The lakes surrounding Iqaluit were characterized by high elevation, rocky surrounding areas, and relatively low surrounding vegetational inputs. Data from these lakes will be used to compare against those collected in the Rankin Inlet area.

While previous studies have examined the sediment core record of lakes south of tree-line, to the west (Yukon, NWT) and across a broad swath of the Arctic Archipelago, regions such as Kivalliq have yet to be sampled. A total of 15 lakes were sampled in the Rankin Inlet area from July 12–August 2, 2006. The terrain surrounding Rankin Inlet is relatively flat and can be accessed by roads and several trails. Many lakes were easily accessed with an ATV. During our stay we were assisted by Dorothy Tootoo of the Nunavut Arctic College and our guide, Andy Aliyak.

We had the opportunity to discuss several issues with the community elders. The weather this July was abnormally cold and extremely windy, and was often referred to by elders as “September weather”. Most days were characterized by calm mornings and windy after-

noons. Whitecaps were common on most lakes, and several days of sampling were cancelled due to a combination of severe winds and rain.

With the assistance of our guide, several sampling locations were found along the Meliadine and Char rivers. With our not-so-trusty collapsible canoe, sediment cores were extruded from the soft lake sediments and water samples were collected from 15 lakes in the Rankin Inlet area.



Andrew Medeiros and Andy Aliyak extruding a sediment core, July 21, 2006.
(photo by A. Namayandeh)



We were very interested in the series of lakes within the Char river system, since these were once well connected by the river, but have become more hydrologically isolated in the past two decades. Four lakes in this system were sampled, each of which were isolated during July 2006, but some of which carry Char River flow at other times of the year. The streams that connect these lakes to the Char River system were completely dry during our time in Rankin. Previous remote-sensing work showed that these lakes were once all connected but that in recent years the connections dry up in most or all summers.

Future work

Stratigraphic examination of these sediment-core samples will provide data to characterize the past invertebrate (mainly Chironomidae) community structure and help to identify any climate-induced impacts on lakes within this region. Future work in different biogeographic regions of the Canadian Arctic is also necessary to attempt to further identify possible climatic impacts to aquatic systems. We also hope to return to the Kivalliq region to sample more lakes if possible during the 2007 field season.



Andrew Medeiros standing at the base of the Char River, August 1, 2006.
(photo by A. Namayandeh)



Iqaluit at Dusk, July 4, 2006
(photo by A.S. Medeiros)

Selected Future Conferences

Organization	Date	Place	Contact
ENTOMOLOGICAL CONFERENCES			
Entomological Society of Canada	2006 , 18-22 Nov.	Montreal, QC	with la Société d'entomologie du Québec; http://www.seq.qc.ca/
	2007 , 30 Sept. - 3 Oct.	Saskatoon, SK	with the Entomological Society of Saskatchewan
	2008	Ottawa, ON	with the Entomological Society of Ontario
Entomological Society of America	2006 , 10-14 Dec.	Indianapolis, IN	ESA, 9301 Annapolis Rd., Lanham, MD 20706-3115; meet@entsoc.org
	2007 , 9-13 Dec.	San Diego, CA	ESA, see above
6th International Congress of Dipterology	2006 , 23-28 Sept	Fukuoka, Japan	http://apollon.nta.co.jp/6icd/perl/jouhou.pl?&mode=other&jouhou_id=1209
3rd International Congress on Phthiraptera	2006 , 16-20 Oct.	Buenos Aires, Argentina	http://icp3.phthiraptera.org/
The Coleopterists Society	2006 , 12 Dec.	Indianapolis, Indiana	http://www.coleopsoc.org/colemeet.shtml#coleopts
International Congress of Entomology	2008 , 6-12 July	Durban, South Africa	http://www.ice2008.org.za/
OTHER SUBJECTS (especially those relevant to Survey projects)			
North American Benthological Society	2007 , 3-8 June	Columbia, SC	http://www.benthos.org/Meeting/index.htm
International Symposium on the Environmental Physiology of Ectotherms and Plants	2007 , 1-6 July	Dunedin, New Zealand	http://www.otago.ac.nz/isepep2/
REGIONAL SOCIETIES			
Entomological Society of British Columbia	2006 , 13-14 Oct.	Richmond, BC	http://esbc.harbour.com/
Entomological Society of Alberta	2006 , 26-28 Oct.	Lethbridge, AB	http://www.biology.ualberta.ca/courses.hp/esa/meet2006.htm
Entomological Society of Manitoba	2006 , 14 Oct.	Winnipeg, MB	http://home.cc.umanitoba.ca/~fieldspg/meet06.html
Soci�t� d'entomologie du Qu�bec	2006 , 18-22 Nov.	Montreal, QC	http://www.seq.qc.ca/ (with ESC, see above)

Answers to Faunal Quiz

[see page 55]

1. New Brunswick's Mount Carleton (817 m; some sources claim 820 m) is slightly higher than Newfoundland's Long Range Mountains (a peak in the Lewis Hills reaches 814 m elevation; some sources claim 815 m). Nova Scotia's highest point in the Cape Breton Highlands is much lower, at 532 m (White Hill, 17 km west of Ingonish).
2. Nineteen species of Mecoptera occur in Ontario, 13 of them in the genus *Panorpa* [see "Mecoptera of Ontario" in the BSC's new electronic Canadian Journal of Arthropod Identification at <http://www.biology.ualberta.ca/bsc/ejournal/ejournal.html>]
3. An approximate figure can be obtained by comparing the adult female of a large acridid (about 2500 mg) with a mymarid parasitoid such as *Caraphractus cinctus* (about 0.005 mg). The grasshopper is about 50,000 times heavier. [but the egg of the parasitoid weighs only 0.0002 mg, more than 12 million times lighter than the locust]
4. In the context of arthropods, systematics, and so on the abbreviations have the following meanings:
 - CRM = Cabbage Root Maggot. Use of such abbreviations made from common names (here in place of *Delia radicum*) should be discouraged even though some publications employ them routinely especially in USA.
 - DEET = Diethyl Toluamide: the active ingredient of many insect repellents.
 - EPT = Ephemeroptera, Plecoptera and Trichoptera: three Orders of aquatic insects commonly studied together as a component of the macrobenthos.
 - LBJ = Little Brown Job: used by some ornithologists for small brown birds such as sparrows that are difficult to distinguish, and adopted by some arachnologists for small brown spiders that are even more difficult.
 - PAUP = Phylogenetic Analysis Using Parsimony: a technique incorporated into computer software that can be used for building consensus phylogenies.
 - PDB = Paradichlorobenzene: a substance once commonly used to protect insect and other collections from attack by pests, but now banned in most jurisdictions because of its potential toxicity and carcinogenicity.

5. Routes by which micro-organisms affect insects include:

- Food supply (fungi and bacteria provide food for microphages in the soil and elsewhere; the fungus cultivated by leaf-cutter ants is eaten).
- Conditioning of food (microorganisms condition food for some saprophages; plant pathogens condition food or overcome host defences, as for ambrosia beetles).
- Digestive symbionts (e.g. gut organisms digest cellulose in termites and some cockroaches).
- Environmental signals (e.g. the oxygen reduction used as a hatching stimulus by some mosquitoes is caused by bacteria – the larval food source – in surrounding water).
- Lethal pathogens (Insects are killed by fungi such as *Beauveria* and *Entomophthora* and bacteria such as *Bacillus thuringiensis*, as well as by various viruses and other pathogens).
- Sublethal pathogens (*Nosema* and other organisms reduce the vitality of field and laboratory populations).
- Inoculative freezing (ice-nucleating bacteria, which are common on plant leaves where their action helps to kill tissues, can also initiate freezing in the guts of insects, for example).
- Sex ratio modification (e.g. some species of *Wolbachia* selectively kill male individuals).
- Vectors (Insects serve as vectors to vertebrate hosts, including humans, for a variety of micro-organisms).

Quips and Quotes

The beginning of wisdom is to call things by their right names. (Chinese proverb)

Anticipatory plagiarism occurs when someone steals your original idea and publishes it a hundred years before you were born. (Robert Merton)

If you aren't confused by quantum physics, then you haven't really understood it. (Niels Bohr)

Words

Good writing is rewriting.
(Truman Capote)

Technique is noticed most markedly in the case of those who have not mastered it.
(Leon Trotsky)

What is written without effort is in general read without pleasure.
(Samuel Johnson)

Writers, like teeth, are divided into incisors and grinders.
(Walter Bagehot)

Backward ran sentences until reeled the mind.
(Wolcott Gibbs)

The moment when the finished book, or, better yet, a tightly packed carton of finished books arrives on my doorstep is the moment of truth, of culmination; its bliss lasts as much as five minutes, until the first typographical error or production flaw is noticed.
(John Updike)

No comment

Long daily meetings will continue until we find out why no work is being done.

Requests for Material or Information Invited

Would you like assistance in studying the fauna?

The Biological Survey of Canada encourages cooperation in taxonomic and ecological studies of the arthropod fauna. Please complete and return the form on the next page if you have a request for material or information that might be obtained elsewhere in Canada (compare the sample entries from a previous list of requests that are shown below). See also the Survey's website (<http://www.biology.ualberta.ca/bsc/english/listofrequests.htm>) for the full list or an electronic version of the Request for Cooperation form.

Requests may be submitted at any time and will be posted on the web periodically. To have your entry included in the Spring 2007 newsletter please submit it by the end of January.

Sample entries (addresses omitted):

	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
2	Acari from family Uropodidae	Anywhere	Free living and parasitic terrestrial, preserve in 75% ethanol	C. Constantinescu
3	Adelgidae (conifer woolly aphids)	Anywhere	Preserve insects and bark, needles or galls in 70% ethanol. Specimen records and host plant records	R. Footitt
4	Aleyrodidae (whiteflies)	North America	Preserve insects and host plant material in 70% ethanol. Adults may be dried. Specimen records and host plant records. (Canadian National Collection deficient in all species, including pest species)	R. Footitt

Request for Cooperation

Please complete and return to:

Biological Survey of Canada
(Terrestrial Arthropods)
Canadian Museum of Nature
P.O. Box 3443, Station "D"
Ottawa, ON K1P 6P4
email: hdanks@mus-nature.ca

Name: _____ Tel. : _____
Email: _____ Fax: _____
Address: _____

Material required (specify taxon, region, habitat, or other details, as appropriate):

Information required (describe in reasonable detail):

Cooperation offered – if there is anything specific you might be able to supply in return (e.g. identifications, material) please indicate it here:
