

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 2001 issue is January 29, 2001.

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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 (formerly the National Museum of Natural Sciences) and the Entomological Society of Canada. This 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 web site at:
<http://www.biology.ualberta.ca/esc.hp/bschome.htm>*

News and Notes

Grasslands conference at 2000 meeting

The joint annual meeting of the ESC / ESA / SEQ (Montreal, 2-7 December 2000) includes an informal conference about grassland arthropods in support of the Biological Survey's active project on this subject. The program of the conference as currently constituted is listed below.

Introduction. **T.A. Wheeler**, McGill University, Ste-Anne-de-Bellevue, QC

From pasture to pens: the role of cattle in structuring agroecosystems on the modern prairie. **K.D. Floate**, Agriculture and Agri-Food Canada, Lethbridge, AB

The use of fire as a biodiversity and conservation management tool in tallgrass prairies. **R.E. Roughley and D.A. Pollock**, University of Manitoba, Winnipeg, MB

What, if anything, is a wheat stem maggot? Diversity of *Meromyza* (Diptera: Chloropidae) in Canadian native grasslands. **T.A. Wheeler**, McGill University, Ste-Anne-de-Bellevue, QC

Endemism and dispersal of short-horned bugs (Homoptera: Auchenorrhyncha) in Pacific Northwest intermontane grasslands. **K.G.A. Hamilton**, Agriculture and Agri-Food Canada, Ottawa, ON

Project Update: ongoing studies on North American grassland arthropods

Round Table Discussion: progress and priorities for research on North American grassland arthropods.

Survey website expanding

The website of the Biological Survey of Canada (Terrestrial Arthropods) is being modified and greatly expanded to include many publications and other materials in electronic form. There may be some disruptions in the site during this expansion. For further details, see page 52.

Biodiversity brief published

The Biological Survey has just published a brief entitled "Terrestrial arthropod biodiversity projects - building a factual foundation", intended to reinforce appropriate guidelines for the study of arthropod biodiversity, and including consideration of costs.

The abstract from the brief reads as follows:

"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."

The brief is available in electronic format on the Survey's web site at <http://www.biology.ualberta.ca/esc.hp/bschome.htm>. Paper copies are available from the Survey Secretariat (see address on inside front cover).

[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.]

Spider Newsletter Published

A new annual newsletter about Canadian spiders and students of the group has been launched by editors David Shorthouse and Chris Buddle of the University of Alberta (dps1@ualberta.ca; cbuddle@ualberta.ca).

The inaugural issue of the *Canadian Arachnologist* (May 2000) contains an account of current arachnologists in Canada as well as a variety of information about spiders. The aim of this freely distributed newsletter is “to promote communication, initiate collaborative efforts, announce meetings of interest, and other arachnological activities among professional and amateur Canadian arachnologists.”



New cone and seed insect web site launched (<http://www.for.gov.bc.ca/TIP/IIG/>)



Staff at the Seed Pest Management section of the BC Ministry of Forests recently launched a new website related to insects affecting conifer and seed production in British

Columbia. Currently the site provides a listing, by tree species, of insects and other organisms of concern to conifer cone and seed production in British Columbia, general information on the conifer cone and seed industry and tree breeding in British Columbia, a section containing important information about cone and seed insect ecology and a search engine. The search engine yields relevant documents on the site that provide basic information about the species in question.

The authors of the site are eager for feedback. Contact: Robb Bennett, Seed Pest Management Officer, BC Ministry of Forests, 7380 Puckle Road, Saanichton, BC, V8M 1W4. Email: Robb.Bennett@GEMS6.gov.bc.ca

Nature Discovery Fund Makes First Award

The Nature Discovery Fund of the Canadian Museum of Nature, a fund developed to promote taxonomy in Canada and facilitate the discovery and naming of Canada's biodiversity, has made its first award. NDF is pleased to announce that Ms. Stephanie Boucher of the Department of Natural Resource Sciences, McGill University, Ste-Anne-de-Bellevue, is the first recipient of funding in support of her work “Di-

versity of Agromyzidae (Diptera) in disjunct grasslands of the southern Yukon”. Ms. Boucher has just completed an MSc. in Entomology at McGill University. Funding from NDF will go towards the publication of her thesis results. For further information about the fund and for instructions on application procedures, please visit http://nature.ca/research/ndfund/ndfund_e.cfm

Summary of the meeting of the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods), April 2000

The Scientific Committee met in Ottawa on 13-14 April 2000.

Scientific Projects

The various scientific projects of the Survey were discussed, including the following progress.

1. Grasslands

Dr. Joe Shorthouse reminded the Committee that Arthropods of Canadian Grasslands is the Survey's next major project and that a subcommittee chaired by Drs. Kevin Floate and Terry Wheeler is steering the project. The grasslands project can look at the role of insects in both natural areas and those influenced by human activities. A draft prospectus prepared by Dr. Shorthouse and Dr. Wheeler was distributed before the meeting, designed to be used in a variety of ways.

Dr. Shorthouse described preliminary attempts by him, Dr. Floate and Dr. Wheeler to identify subjects for the next three products from the grasslands project. He hoped that this attempt would encourage Committee members to identify other potential products and people who might play a role in them. The Grasslands subcommittee planned to meet after the Scientific Committee meeting and Dr. Shorthouse invited other participants to join. Dr. Shorthouse reviewed various grassland types in habitats across the country, as background for the project.

The nature of the prospectus and possibilities of specific funding for the project were discussed at length. An initial prospectus would develop in detail the scientific purpose of the grasslands project, to characterize grassland arthropods from various scientific perspectives. A separate prospectus to seek specific funding is also needed, and funding options would also be considered by a working group of the grasslands subcommittee.

An informal conference on "Arthropods of grasslands - current status and future directions" organized by Dr. Wheeler will be held at

the joint ESC/ESA/SEQ meeting this year. This conference will expose the project and solicit ideas. Plans will also be made for a more formal symposium at the ESC meeting in 2001.

2. Seasonal adaptations

Dr. Hugh Danks reported on papers on seasonal adaptations (Diversity and evolution of insect life cycles; Dehydration in dormant insects) published or in press. A section symposium is planned by Dr. Danks and Dr. Rick Lee (Ohio) at the joint ESC/ESA/SEQ meeting in Montreal in December, entitled "Water relations and winter survival in insects". The international insect and plant cold hardiness symposium will take place in Victoria during May-June, including a treatment of "Insect cold hardiness in northern Canada". Dr. Danks reported that specific cooperative work at the University of Victoria is now proceeding in earnest.

3. Insects of Keewatin and Mackenzie

Dr. Doug Currie confirmed that an expedition, which leaves on July 16, 2000, includes five participants who will paddle 620 km down the Horton River from Horton Lake to the Beaufort Sea, collecting both aquatic and terrestrial insects along the way from this relatively unsampled area. If the project is successful an expedition farther east will be considered next season (e.g. Coppermine) and potentially still farther east after that. A report of the expedition will be submitted for the Survey's newsletter.

Other scientific priorities

1. Arthropod fauna of soils

Dr. Valerie Behan-Pelletier announced that the 50th annual acarology summer program will be held this summer at Ohio State University [see www.biosci.ohio-state.edu/~acarolog/summer.htm]. Dr. Behan-Pelletier provided citations or circulated various books, publications and other documents relevant to soil arthropod

biodiversity. She outlined activities of various relevant societies. The Soil Ecology Society, a North American Society, has a new web site [<http://www.wcsu.ctstateu.edu/ses/ses.html>]. The XII International Colloquium on Soil Zoology will be held 14-18 August 2000 in the Czech Republic (see: <http://www.jcu.cz/~upb/icsz.htm>). The Acarological Society met last fall during the ESA annual meeting. A symposium at the joint 2000 meeting, organized by Dr. Behan-Pelletier and Dr. Hans Klompen, is entitled "Soil mites: systematics, diversity and ecology in four dimensions".

Dr. Behan-Pelletier continues to collaborate in a number of projects studying mite diversity and ecosystem function, e.g. the Montane Alternative Silvicultural System (MASS) project in British Columbia, the tall-grass prairie in Konza, and the La Selva project in Costa Rica.

2. *Old-growth forests*

Discussions about organizing a symposium on old-growth forests to amalgamate the various work being done throughout the country and determine if something original can be produced are continuing. Dr. Geoff Scudder reported on some of his work in old-growth forests.

Dr. David Larson described a unique forest in Newfoundland that abuts on to Gros Morne National Park. It consists of old fir trees of a variety of ages, apparently without records of past fire or insect kills. The forest seems to be replacing itself through individual tree senescence. A pulp company's plan to log this area has been challenged, apparently the first time that this has happened in Newfoundland.

3. *Invasions and reductions*

Dr. Scudder and Dr. Bob Foottit are considering a book of edited contributions on arthropod bioinvasions, to look not only at science issues but also at societal issues, such as data handling, quarantine legislation and procedure. There is wide interest in this topic in a number of agencies.

Dr. Steve Marshall emphasized his view that the invasive species issue is a good way to attract support for collections because the first line of detection is through collections and their continued addition to and care. Although a monitoring program can be effective for a relatively narrow target group, the more general approach of developing insect collections is the best way to detect unexpected new invaders.

4. *Endangered species*

Dr. Marshall had recently joined the Committee on Status of Species at Risk in Ontario, where there appears to be much interest at the provincial level.

The Committee discussed the desirability of adding invertebrates to endangered species lists. For example, if invertebrates are considered for listing, funds should be available for study, but once insects are put on endangered species lists entomologists may not be allowed to collect them for study. There is concern about this issue in Quebec, Ontario and elsewhere. Moreover, the likelihood of being wrong that a species is endangered is relatively high because knowledge is limited and some species of insects come and go in cycles. Nonetheless, listing species that are rare or have restricted ranges provides a means to obtain protection for their habitats, such as headwaters and springs.

5. *Survey web site*

Dr. Danks reported that despite some difficulties, work on the Survey's revised website has continued, and the new draft site is substantially changed and expanded from the older one. For example, English and French are now entirely separate, the layout and lettering have been redesigned and there are additional images. The site will include a home page, a site map, links to selected relevant web sites, and a variety of general information about the Survey including more information about Scientific Committee members. An internal search capability is being added. Newsletters will be available in electronic form, as will all the Survey briefs. Selected scientific publications, notably the books *Insect Dormancy* and *Insects of the*

Yukon will be posted. Another new feature will be an interactive searchable database of personnel, based on updated records for the Survey's *Annotated List of Workers*. The grasslands project will be highlighted as a scientific project. Finally, information about the Survey's project on faunal analysis and availability of expertise will be provided.

Dr. Danks added that the site will continue to reside on the University of Alberta server through cooperation with the Entomological Society of Canada. It had been hoped that the Survey's site could be organized as a smaller hub on the CMN's web site with larger amounts of data remaining on the University of Alberta server, but the Museum is not yet in a position to provide this service.

6. *Funding for biodiversity projects*

Dr. Wheeler reported that the first section of this brief, consisting of tips on preparing grant applications, has been revised. Additional entries as to sources of funding are also available. The core data will be on the McGill University site, with the introductory material and a link on the revised Survey website.

7. *Error rates in identifications*

Dr. Marshall reminded the Committee that there is a lack of quantitative data about this issue. He had drafted an article which takes a general approach to looking at factors affecting error rates, such as the availability of reference collections, intrinsic difficulties of different keys, availability of regional works, experience and innate ability of identifiers. The article also makes a few recommendations which should be useful to people planning projects. The article will be submitted to the Biological Survey Newsletter.

8. *Brief on geographic data standards for specimen labels*

Dr. Wheeler reported that a draft of this brief is almost complete. The brief will include both general guidelines and standards, and specific information of practical use, such as suppliers, source numbers, and printer settings. A

final draft of the brief will be prepared before the October meeting of the Committee.

9. *Brief on the value of proper biodiversity studies*

The late draft of a brief entitled "Terrestrial arthropod biodiversity projects – building a factual foundation" was well received by the Committee, and with a few adjustments will go forward for publication by the Survey [see p. 35].

10. *Monitoring of continuing priorities for work on Canadian faunas*

Updated information on earlier or currently less active Survey projects was reviewed, including arthropods of peatlands, aquatic insects of freshwater wetlands, arthropod fauna of springs, arthropod ectoparasites of vertebrates, arthropods of the Yukon, mountain faunas, arthropods of the Queen Charlotte Islands (Haida Gwaii), climatic change, and agroecosystems.

Specific work on the insects of Newfoundland is also in progress. Dr. Larson reported that he is assembling literature records for all insect species that have been recorded in Newfoundland, as well as a survey of what is held in local collections. Some identification keys are being developed. In due course, it is hoped to document the fauna and to have keys to all the taxa on the islands by developing the study further.

11. *Other priorities*

The Committee also discussed other scientific priorities such as damaged ecosystems, faunal analysis, and Survey publicity.

Liaison and exchange of information

1. *Canadian Museum of Nature*

Dr. Joanne DiCosimo, President, Canadian Museum of Nature, reported that much of the Museum's energy is now being focussed on the refit and renewal of the Museum's public display building, the Victoria Memorial Museum Building in Ottawa. This will be a \$54-million program of which \$43 million will

be spent on necessary infrastructure repairs. Provided Treasury Board funding is committed, the Museum will launch a private-sector campaign focussed on gallery development and visitor amenities. The private sector campaign will include a fund to support the automation of the collections records, support for the Canadian Centre for Biodiversity and three gallery projects on fossils, oceans and human biology and physiology.

The next major exhibition, to be opened on June 14, is an exhibit of Dr. Roberta Bondar's photographs of Canada's 41 national parks. In September an exhibit called Animal Athletes coincides with the Olympics and highlights the remarkable physical achievements and attributes of animals.

The Museum's web site (www.nature.ca) is undergoing a redesign and the revised site will be launched on May 10; traffic has increased about 800% on the CMN web site over the last five months. The national museums, including the CMN, will be hosting a meeting of the Parliamentary Standing Committee on Canadian Heritage on International Museums Day, May 18, with a theme of the role of the national museums of Canada.

Ms. DiCosimo concluded by noting that the Museum is reviewing its strategic plan established three years ago, and a collections development plan is also being formulated over the next 8-12 months. Consultations are planned with other museums, universities and government agencies.

Dr. Mark Graham, Director, Research Services, reported that NSERC has agreed to lead a workshop (June 2-3 in Ottawa) to identify issues and consider best practices for granting agencies with respect to issues surrounding collections that go into museums.

Dr. Graham described how, with the Canadian Museums Association, the Museum is trying to find a way to emphasize the importance of museums in doing natural history research. Currently there is no easy way to use the information for various purposes (lobbying, student research, general public, etc.). With the Canadian Heritage Information Network

(CHIN) the Museum is putting together a survey to solicit information from all natural history museums about what research they do or support in Canada.

The Federal Biosystematics Partnership is developing a position for Canada relating to the Global Biodiversity Information Facility (GBIF). This new international initiative aims to coordinate systematics and informatics activities around the world.

Dr. Graham also noted the Macmillan Coastal Biodiversity Workshop (Bamfield Marine Station), a report on Building Excellence in Science and Technology: The Federal Roles in Performing Science and Technology (http://csta-cest.gc.ca/csta/website/publications_e.html), Environment Canada's effort to prioritize biodiversity issues under their Canadian northern ecosystems initiative, and the Biota of Canada information network workshop.

2. *Biological Resources Program, ECORC*

Dr. Ian Smith reported on behalf of Dr. Jean-Marc Deschênes, Director, ECORC. The core of a proposal to renovate and retrofit the Neatby Building, to become a first-class collection facility for entomology, botany and mycology, should be completed soon for submission to Treasury Board.

Dr. Smith reported that he and Dr. Deschênes have attended the meetings of the interim steering committee for the Global Biodiversity Information Facility on behalf of the Federal Biosystematics Partnership. Important decisions have to be made regarding financial commitments at the government level. At the next meeting of the interim steering committee, probably near the end of this year, it should be clear whether GBIF will have enough committed members to become operational and whether or not Canada would join.

Dr. Smith and Mr. Larry Speers are involved in the steering committee for the North American Biodiversity Information Network, a group set up under the Commission for Environmental Cooperation (CEC) under NAFTA. Canada might become more involved in this

North American bioinformatics initiative. Within that context the base for the Integrated Taxonomic Information System (ITIS) is being broadened with Mexico as a full partner.

Dr. Smith and Mr. Speers have been leading a working group to form a Biota of Canada information network. A report of the March workshop referred to by Dr. Graham will include a costed workplan, involving a variety of partnerships, to improve the Canadian content of ITIS and to demonstrate the applications of digitized collections data.

Dr. Smith and Mr. Speers have also been promoting the idea of a national conference on biodiversity science and bioinformatics in order to develop an action plan for Canada. A broadly based steering committee is being formed to promote a national conference early in 2001; Dr. Peter Hall (former executive director of the Canadian Environmental Network) has been appointed as conference manager. A potential biodiversity strategy document would be circulated in draft before the conference. Dr. Scudder circulated a document from the Biodiversity Science Board, released at the EMAN national science meeting in January. It is a commentary entitled "The Biodiversity Science Problem in Canada: An Unrecognized Crisis". It has been widely circulated to societies and politicians and the information used to promote the national conference.

Dr. Footitt reported that discussions will soon begin about renewal of the scientific workforce at ECORC. A number of current staff are approaching retirement age and there is also a concern about lack of resources to curate the collections. Dr. John Huber pointed out that the average age of the scientists at ECORC is 53; the average age of the technical staff is 48.

Dr. Smith reported that a server is being set up at ECORC to provide digital information on the Canadian National Collection and other digital information such as the butterflies of Canada project.

3. *Entomological Society of Canada*

Dr. Dan Johnson, President, Entomological Society of Canada, reminded the Commit-

tee about the joint meeting of the ESC/SEQ/ESA in Montreal in December. Dr. Johnson reported that he had attended a meeting of the American Institute of Biological Sciences (AIBS) in November. The Entomological Society of Canada has joined as the 60th society member, the only Canadian organization to do so. Dr. Johnson mentioned another meeting he had attended last week (a tribute to Ernst Mayr) that included many notable speakers. Dr. Johnson also noted the Diversitas International Biodiversity Observation Year 2001-2002 (<http://www.nrel.colostate.edu/IBOY/>), a review of how Agriculture and Agri-Food Canada programs in Lethbridge link to the recently introduced Species at Risk legislation, and the forthcoming Executive Council meeting of the ESC.

4. *Canadian Forest Service*

Dr. John Huber, on behalf of Dr. Ben Moody, reported from the Canadian Forest Service. As part of the Federal Biosystematics Partnership, Forestry was asked to produce a document on biosystematics and bioinformatics needs in Forestry. This draft was released in January to the FBP: a portion of the report deals with problems of informatics, such as databasing collections. The document also itemized the kinds of taxonomists that the Service needs. The document is intended to be one part of a larger document to be published by the FBP. Dr. Huber reported that Dr. Ole Hendrickson has been seconded from the Canadian Forest Service to Environment Canada for two years.

5. *Canadian Wildlife Service / COSEWIC*

Dr. Theresa Fowler, CWS, reminded the Committee that Bill C33, the Species at Risk Act, has been tabled. Copies of the Act and accompanying kits were made available. Dr. Fowler pointed out that this legislation is one component of the national program to deal with endangered species; the others are the national accord signed by all the provinces and territories except Quebec, and the stewardship program. The stewardship program is intended to save habitat through voluntary cooperation.

The endangered species bill is being criticized as being too tough by some and as too weak by others.

Dr. Fowler reported that none of the species listed by COSEWIC to date will be officially considered for listing under the bill until they have been reassessed by COSEWIC using new criteria. The COSEWIC Secretariat, housed at Environment Canada, now has more human resources. A meeting of COSEWIC in May will concentrate on reassessments using the new criteria, which are based largely on the IUCN criteria. Under the new legislation COSEWIC produces a list of assessments, which are made public, and the species at risk and recovery plans are then determined by politicians. Dr. Fowler said that 34 new or updated status reports are available but these will be considered at the May meeting only if all the reassessments are completed. Unfinished business will be postponed to a second meeting in the fall.

6. *Ecological Monitoring and Assessment Network (EMAN)*

Dr. Peter Hall, Partnerships Coordinator, Environment Canada, reported that EMAN has re-established the interdepartmental committee on monitoring and assessment. EMAN is continuing to develop its core variables for ecosystem monitoring. This spring a collaborative pollution gradient study with the Canadian Forest Service will look at forest conditions to determine the applicability of the core variables in a field setting. The vegetation monitoring protocols are being distributed to a variety of groups. A strategy document about the EMAN early warning system is being written.

7. *Parks Canada*

Mr. Stéphane Greffard, Ecological Assessment Officer, highlighted the recent release of the report from the panel on ecological integrity, which analyzed the capacity of Parks Canada to conserve ecological integrity in Canada's national parks (see http://www.parkscanada.gc.ca/EI-IE/index_e.html). Several commitments were made as a result. For example, ecological integrity should be the centre-piece of future decisions, there should be more part-

nerships with aboriginal people, and wilderness areas should be set aside this year in Yoho, Kootenay and Jasper national parks. Other initiatives include the development of a national science strategy with more connections with universities and other science-based agencies, national staff training and orientation on ecological integrity, and the prohibition of new ski hills and golf courses in national parks. A national advisory committee will be established to monitor the implementation of the report.

Members of the Committee discussed extensively the Survey's initiatives a few years ago concerning studies of insect diversity in national parks and concerning permit procedures for insect collecting in national parks. Also, a number of parks with grasslands are now especially relevant for the Survey's grasslands project. Mr. Greffard had not heard of these initiatives, but confirmed that he would be willing to initiate discussions, and as a first step information about the earlier initiatives would be sent to Mr. Greffard by the Survey Secretariat.

8. *Parasitology module, Canadian Society of Zoologists*

Dr. David Marcogliese, Parasitology module, reported that work on the EMAN protocols for the inventory and survey of parasites continues (see www.cciw.ca/eman-temp/research/protocols/99_frespara/). The national stickleback parasite survey is an official IBOY project.

The Canadian Society of Zoologists annual meeting is May 2-6 in St. Andrews, New Brunswick. The meeting includes a symposium organized by Dr. Marcogliese called "Life in the middle of the food web - larval parasites in small fish". The CSZ meeting in 2001 will be held in Sudbury.

Dr. Marcogliese circulated a number of publications on parasites, and other information relevant to the diversity of invertebrates and its study. He noted that Fisheries and Oceans Canada is hiring a parasitologist in Nanaimo, replacing Dr. Mike Kent.

Secretariat activities

Ongoing operations of the Biological Survey Secretariat were reviewed, including clearing-house and coordination roles, research and other items, and Dr. Danks' travels to entomological centres on behalf of the Survey to exchange information about relevant work. In 1999, visits were made to Victoria BC; Edmonton and Lethbridge AB, Saskatoon SK, Winnipeg MB, Hull QC, Fredericton NB, Halifax NS and Charlottetown PEI. Seminars and lectures presented, in addition to more-or-less informal treatments of the Biological Survey, included: Winter habitats and ecological adaptations for winter survival; Diversity and evolution of insect life cycles; Are the life cycles of polar arthropods flexible or programmed?; Arctic insects as indicators of environmental change; Intrinsic elements of insect diapause; and Insect biodiversity: some current themes and requirements. Lectures were also presented in Japan on the fauna and flora of Canada, Canada and its insect fauna, the control of insect dormancy, and the diversity of dormancy responses in insects.

Other items

1. Regional developments

Members of the Committee summarized information from different regions of the country. For example, in British Columbia, Dr. Scudder reported that the Hemiptera catalogue is now in press (NRC Press). He is in the last year of a five-year grant to work on databasing and documenting sensitive species. The B.C. identified wildlife strategy may be of use to have habitat protected. Restoration research and study in Osoyoos continues. A meeting of the Grasslands Conservation Council is scheduled in the Okanagan Valley in May to highlight the idea of biodiversity ranching. At the same time, the Environment Minister will announce a new project for conservation planning in the south Okanagan. The University of British Columbia collections still have no support but a fundraising initiative is being developed for the biodiversity centre which will include support for the collection including post-doctoral fellows, curators, and relocation

of the collection into a new building. Proposals for two millennium chairs at UBC (in biosystematics and conservation biology) from the Biodiversity Centre are advancing. Forest Renewal British Columbia (FRBC) funding is becoming difficult to obtain and tight deadlines are being imposed.

For the prairies, Dr. Floate reported that the planned expansion of the research centre at Lethbridge is now officially set to go ahead and work should begin in June or July 2000. An outbreak of the cabbage seed pod weevil is anticipated this year. Dr. Rob Roughley is considering the feasibility of building an insect record catalogue from Aweme, MB. A study is in progress on the impacts of grazing intensity on vegetation structure and insect communities in the Onefour area of southeast Alberta. Other studies on birds and insects, and grasshopper and spider species sampling, were noted. Several studies dealing with the effects of fire, including spiders of Manitoba tall-grass prairie, and other studies in Alberta and B.C. (as well as Ontario) were noted.

In Ontario, Dr. Currie reported that the Royal Ontario Museum is going through a master planning process, at the same time as a search for a new director. Student work on various systematics projects is ongoing there. Dr. Marshall reported survey work on the Bruce Peninsula, and a long-term inventory continues in Point Pelee. He also continues work in the Ojibway prairie. As of last November the Guelph collection has a full-time professional curator, and as a result the level of curation of the Guelph collection has improved greatly. A project on handbooks to easily identifiable Ontario insects was briefly discussed and will be considered in more detail at the next meeting. Dr. Bob Anderson reported on the CMN's Nature Discovery Fund which has made its first award [see p. 36].

In Quebec, Dr. Wheeler reported that Dr. Mike Sanborne, formerly of the Lyman Museum and a former member of the Committee, died last summer. Planning for the joint ESA/ESC/SEQ meeting continues. The SEQ had its annual meeting in Hull last October; the

theme was biodiversity. Dr. Wheeler described various large-scale diversity projects in Quebec, including forest survey work (especially post-ice-storm) and insect and plant diversity along highway margins. A Canada Foundation for Innovation grant has resulted in renovations and additions to McGill field stations, a new GIS server, software and workstations, new insect cabinets and drawers. Databasing of the Orthoptera holdings continues for the Biota of Canada project. Several students are working on the systematics of Diptera. Dr. George Hsiung, the Lyman Museum curator, is retiring after 30 years, and will be replaced by someone at the Msc. level.

For Newfoundland and the Maritimes, Dr. Larson reported that at Memorial University, Dr. Murray Colbo is doing a mosquito survey as part of a West Nile encephalitis study and Dr. Roger Pickervance continues his study on the spiders of Newfoundland. Only a few graduate students are doing insect-related work. The Newfoundland insectarium has been open for over a year and has been well received by the public and the media. A paper was published recently about the beetles of Brunette Island. Dr. Donna Giberson reported that the At-

lantic Dragonfly inventory group is meeting in August in southern Nova Scotia. Dr. Giberson is completing her 10-year project on the benthos of Cataran Brook, in central New Brunswick. As of January 1, 2000 the University of Prince Edward Island has a graduate program and there are now four graduate students in biology with the hope of more starting in September. There is a shortage of honey bees in parts of the Maritimes, especially on PEI, with implications particularly for blueberry producers. The Acadian Entomological Society meets in Charlottetown this summer.

2. Other matters

The Committee also considered recent Survey publications, especially the revived Grasslands newsletter, the annual report to the Canadian Museum of Nature, a letter sent after the last meeting to the Editor of The Canadian Entomologist concerning systematics papers, liaisons with organizations outside Canada and information on further publications of various sorts. The Annual General Meeting of members of the Biological Survey Foundation also took place.

Members of the Scientific Committee

Dr. R.S. Anderson
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Comments on error rates in insect identifications

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In recent years there has been growing appreciation of the pressing need to document Canada's biodiversity. Surveys of terrestrial arthropods have been launched by national and provincial parks, federal and provincial departments concerned with ecosystem integrity (e.g. Canadian Forest Service, Fisheries and Oceans, Agriculture and Agri-Food Canada, Environment Canada, provincial resource ministries etc.), non-governmental organisations, and individual researchers. Inventory work is generally carried out over the short term, with results closely tied to lists of species collected and identified during the project. Identifications might be done by a single individual, a group, or by a network of cooperating systematists; surveys might cover one or a few taxa (butterflies or ground beetles, for example), or might try to do the most complete stock-taking possible in a given protected area.

Previous briefs by the Biological Survey of Canada have addressed general issues of sampling and sample processing, but have not examined the problem of error rates in identification. It is widely appreciated that misidentifications of potential pests can have serious economic implications, as demonstrated by recent, widely publicized incidents in which long-horned wood boring beetles were misidentified. In one case, a collector misidentified a native species as an exotic species that is not established in Canada but represents a serious threat to the forest industry. The misidentification was perpetuated by the electronic media, and only after considerable effort was the error corrected. In another case, a recently introduced long-horned beetle was misidentified as a native species, an error that was not recognised until the new introduction emerged as a

pest a decade later. These misidentifications of relatively large, economically important insects in well-known groups are important in themselves, but they also point to the probability of large numbers of misidentifications going unrecognized in the long lists of species which are at the heart of ongoing biodiversity studies.

The proliferation of species lists based on identifications by non-specialists is an inevitable result of the taxonomic impediment imposed by Canada's shrunken pool of professional systematists. It is important that agencies involved with the planning of biodiversity work be aware of the magnitude of error rates under different sets of circumstances, and make long-term plans to mitigate the effect of identification errors.

Ideally, specimens collected during regional surveys would be carefully prepared (using the guidelines in earlier briefs from the Biological Survey of Canada), competently sorted to family, then sent to taxonomic specialists with ready access to a national insect collection. Determinations would be assembled into an authoritative species list followed by collaborative efforts to database the records, interpret patterns from the accumulated determinations, and to curate the material for future study and reference. This rosy scenario is being played out to some degree thanks to the willingness of a few key systematists to identify good material in their areas of interest, but the onus is increasingly on the individuals doing the survey work to handle their own identifications. We can assume that identifications of sawflies done by a taxonomist specialising in sawflies will be correct, but what about the growing majority of identifications that now must be done by non-specialists? What is the error rate?

Assessing Error Rates

Some idea of the general error rate in identifications by experienced undergraduate biology students can be garnered by looking at the performance of students in advanced entomology courses with a collection/identification requirement, such as the fourth year insect systematics course at University of Guelph. Students in this course make insect collections during the summer, then spend their laboratory periods during the fall semester identifying the specimens in their collections plus supplemental material. Students have to identify all insects to at least the family level, and they are expected to develop a practical efficiency in using the excellent family keys in a standard textbook. Open book tests early in the course show that students inexperienced in keying have an error rate of over 50%, and even at the end of the course there is a significant error rate in keying to the family level.

This illustrates an obvious, but often overlooked, point of importance when considering the problem of error rates in survey work. Keys are tools that require training and experience for proficient use; the first time someone uses an unfamiliar tool the results are likely to be poor. Identification of insects usually depends on key use, and error rates will depend on the quality of the key, the intrinsic difficulty of the key, the experience of the user, and the key user's opportunity to check and confirm the results. These are all difficult things to quantify, but it is still worthwhile to consider how each factor might influence error rates and how this information should affect studies of biodiversity.

1) Availability of, and differences between, keys

Many taxa are virtually unidentifiable because of the complete lack of keys; in other cases the keys are scattered throughout the literature and are of varying quality. In many cases there are no keys because the taxa involved still require revision and species, or even genera, remain undescribed or at least ill-defined.

The quality of published keys varies from almost foolproof to almost useless. Some keys are badly written or just don't work, but in most cases differences between keys reflect intrinsic differences in the taxonomy of different groups. For example, good keys to fly genera of North America are readily available in the Manual of Nearctic Diptera (McAlpine, 1981, 1987) and keys to all beetle species of northeastern North America are available in Downie and Arnett (1996). Each book has "easy" keys (quick to use, low error rate) and "difficult" keys (very time-consuming, high error rate). For example, the key to Coccinellidae in The Beetles of Northeastern North America is within the reach of a beginning student, but I find the key to Cerambycidae to be considerably more difficult. The Cerambycidae of northeastern North America, however, are easily identified to species using a recent photographic identification guide (Yanega, 1996).

Error rates go down, and identification efficiency goes up, when richly illustrated regional guides are available. This applies even to relatively easily identified groups such as tiger beetles. For example, it takes considerable experience to correctly identify Ontario tiger beetles using a key written for the entire country, but it is easy to identify an Ontario tiger beetle from a set of photographs and notes restricted to the relatively small provincial fauna. Even those groups that lend themselves to richly illustrated guides, however, are prone to significant error rates if the guides are used without appropriate skills. A well-known case in point is provided by the recent CNF (Canadian Nature Federation) survey of Lady Beetles of Canada, in which the number of obvious misidentifications submitted by amateurs (combined with the absence of voucher specimens or photographs) compromised the results of the survey.

It must be remembered, then, that even for those taxa for which keys are available (and species-level keys are not available for many taxa), keys differ widely in intrinsic difficulty, quality, and scope. These differences alone make it impossible to quantify an overall error rate in general insect survey work.

2) Differences in skill level and level of experience

A certain level of training and experience is necessary to develop skills in identification and, all other things being equal, a university student who has had a fourth-year course in insect classification, as well as other entomology courses, will be better qualified to undertake inventory work than a student lacking such training. Of course, all other things are never equal, and individuals vary widely in their taxonomic abilities. Of the hundreds of students (with similar experience and training) who have worked with the University of Guelph Insect Collection, dozens have been “gifted” taxonomists who made few identification errors, whereas others developed only limited identification skills.

Academic qualifications are not the only predictor of an individual’s ability to correctly identify insects. An individual with the right combination of experience, enthusiasm, energy and innate ability, can make considerable progress on a regional inventory in a single season, while an otherwise highly qualified individual without good identification abilities can waste a lot of time (and precious resources) making very little progress. Agencies and organisations who hire personnel lacking the requisite qualifications to undertake inventory work would be well advised to treat the expenditure on salaries as money invested in training, not in the generation of useful results.

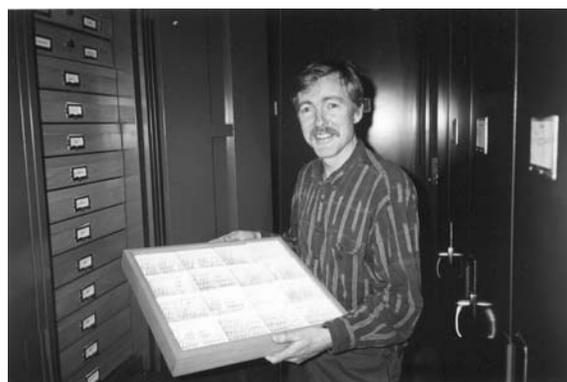
3) Availability of reference collections

The most important factor influencing error rate is the availability of well-identified reference collections. Although photographic guides and well-illustrated regional keys are available for increasing numbers of insect groups, in the vast majority of instances the only available identification tools are keys of varying levels of quality. Most keys have ambiguous or difficult couplets, and the diagnosis of the terminal taxon is rarely explicit enough for the user to confidently confirm the determination. Well-identified regional reference collections are essential for this purpose, and can greatly reduce identification error. A common

approach is to key out a specimen, compare it to a reference collection, re-key the specimen if it does not match up, and repeat the process until a good match is made between a reference specimen and the specimen in hand. Error rates on the first pass (identification attempts made without recourse to a reference collection) often are very high. Of course, the same need to confirm identifications can be met in some groups by reference to good collections of photographs, and in some groups experts are available and willing to check over determinations by colleagues and students. In general, however, a well-identified regional reference collection is needed to reduce error rates in generic or specific keying to an acceptable level.

Conclusions

While the many variables discussed above preclude general statements like “error-rate in species identifications by non specialists exceed 50%”, it is worthwhile to emphasize that a very high error rate is likely to result when either good reference collections or collaborating specialists are absent. Errors are not necessarily a serious problem in a survey in which all specimens are databased and housed in a permanent insect collection, because they can be checked and corrected at a later date. In considering the interim results of survey and inventory work, the abilities and experience of the identifier must be considered along with the level of difficulty and quality of available keys and associated resources for each individual taxon for the area under study.



Insects of Keewatin and Mackenzie

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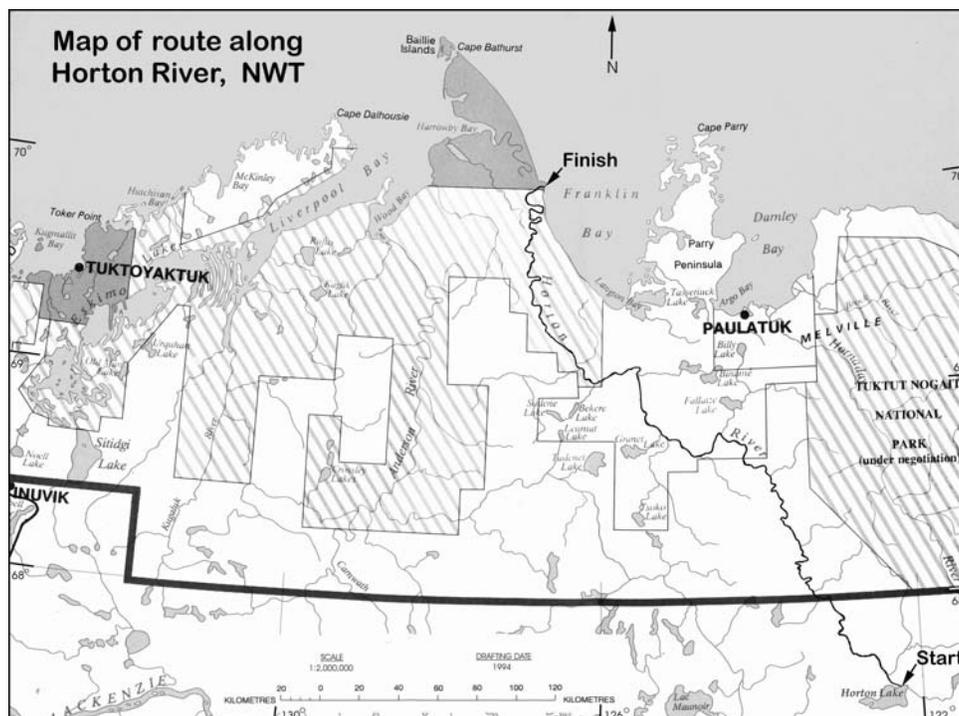
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Introduction

The Canadian north remains among the most inadequately surveyed areas in North America in terms of its insect fauna. During the late 1940's and early 1950's the Departments of Agriculture and National Defence collaborated on a project called The Northern Insect Survey. Although the resulting collections provided valuable insights about insect diversity in the far north, relatively few sites were sampled and material collected is unsuitable for modern analysis (e.g., cytology, DNA sequence data). Problems associated with lack of access and infrastructure continue to hinder efforts to document insect diversity in much of northern Canada.

With completion of the Insects of the Yukon book, it seems appropriate to direct attention towards the inadequately surveyed territory between the Mackenzie River and Hudson Bay. This area, which constitutes mainland Northwest Territories and Nunavut, corresponds with the Districts of Mackenzie and Keewatin. Scientific Committee members Doug Currie (Royal Ontario Museum and University of Toronto) and Donna Giberson (University of Prince Edward Island) are leading a multiyear initiative to survey representative areas throughout the region. Given the short collecting season and logistical constraints, the focus of the survey reflects the interests of partici-



pating scientists. However, mass collecting techniques (e.g., Malaise traps, sweep netting, aquatic kick sampling) provide representatives of many 'non-target' organisms. The survey is expected to generate valuable new insights about the diversity and biogeography of northern insects, as well as to provide information about energetics and food web dynamics.

The Horton River

The Horton River was selected as the venue for the first year of the project because of its close proximity to the eastern boundary of Beringia. It is situated mainly within the Northern Interior Plain region of the Mackenzie Lowlands and is characterized by hilly topography marked with numerous lakes and small streams. Originating north of Great Bear Lake, the river flows in a northwesterly direction for approximately 700 km before emptying into Franklin Bay on the Beaufort Sea. There are no settlements along the Horton River and even the Inuit of Paulatuk (situated some 100 km east on the arctic coast) rarely travel that far. The water is clear in the upper reaches and flows over limestone-dominated sedimentary rock through a series of cobble riffles and long deep pools. The water here is characterised by generally high pH (8.0-8.5) and low conductivity (160-200 $\mu\text{S}/\text{cm}$). The surrounding vegetation consists of sedge- and shrub tundra with scattered black spruce. Spruce, willow and alder are confined mainly to the valley and south-facing slopes. Approximately 180 km downstream of Horton Lake the river enters an area with sheer limestone cliffs; and over the next 150 km it flows through a series of three canyons, each characterised by deep bedrock pools and whitewater rapids. Following the canyon section the geology changes and the surrounding landscape is characterised by eroding hillsides and muddy tributaries, which significantly increase the turbidity of the river. The final 100 km of the Horton River passes through sparsely vegetated badlands dominated by vast deposits of lignite and sulphur. Lignite spontaneously combusts when exposed to oxygen and the area is aptly named the Smoking Hills. Tributaries in the Smoking Hills are muddy and typically highly

acidic, reducing the pH of the Horton River to 6.5-7.5.

The 2000 Horton River Expedition

The process of obtaining a Scientific Research Licence proved to be exceedingly cumbersome and time consuming. Because our proposal involved two different first nations settlement regions, approval was needed from both Sahtu and Inuvialuit authorities (i.e., various Hunters and Trappers Associations and Renewable Resources Councils within the two regions). The NWT Environmental Impact Screening Committee then reviewed our proposal, taking into consideration the views and comments of various stakeholders. Finally, a Land Use Permit from the Inuvialuit Land Administration was needed before a licence could be issued. It arrived in the mail less than a week before departure.

Our team of 5 entomologists convened in Norman Wells on July 17. Doug Currie and Donna Giberson were joined by Peter Adler (Clemson University), Brian Brown (Natural History Museum of Los Angeles), and Malcolm Butler (North Dakota State University). The five of us, along with our guide Tim Gfeller (Wilderness Adventure Company), boarded a chartered Twin Otter for the hour and a half flight to Horton Lake. We carried all our gear and enough food to support our expedition for one month. Given the absence of roads and the high cost of air transportation, our plan was to travel 620 km by canoe from Horton Lake to the Beaufort Sea. Although strenuous, this approach gave us access to a wide variety of microhabitats along the way. The route also provided a south-to-north transect from the High Subarctic Ecoclimatic Region to the Low Arctic Ecoclimatic Region.

Although insects were the focus of our expedition the Horton River proved equally favourable for viewing wildlife. Numerous species of birds were observed including Arctic loon, ptarmigan, peregrine and gyrfalcons, bald and golden eagles, mergansers, scoters, plovers, and jaegers, to name a few. Hundreds of caribou were also seen throughout the journey,

along with occasional sightings of muskoxen, moose, fox, wolf, and grizzly bear. Arctic grayling, lake trout and burbot 'collected' from the Horton River were welcome additions to our larder.

Twenty four days were needed to travel the entire length of the river with only 2 days of respite from paddling. The weather ranged from stifling heat (30°C+) during the first part of the trip to uncomfortably cool (4°C) towards the end. On August 9 a chartered Twin Otter retrieved us from a gravel bar near Franklin Bay and flew us to Inuvik.

Preliminary results

Black Flies (Diptera: Simuliidae)

Doug Currie and Peter Adler made collections at 52 sites along the Horton River and its tributaries. Immature stages were collected from watercourses that ranged in width from a few centimetres to more than 100 metres. Larvae were collected mainly into Carnoy's fixative to facilitate cytological study; selected larvae and adults were fixed in 95% ethanol to facilitate molecular analysis. Adults were collected through a combination of Malaise trapping, aspirating from team members and the insides of tents, and rearing of pupae. Identification at the morphospecies level revealed a total of 18 taxa in 3 genera: *Simulium*, *Metacnephia*, and *Cnephia*. Although the actual number of species will undoubtedly be higher following cytological screening, it is clear that the simuliid fauna is depauperate relative to that of similar drainages in Alaska and the Yukon Territory. This probably reflects, in part, the short period that the Horton River and its valley has been deglaciated. Interestingly, the Horton drainage includes species that are sparsely represented or absent from Beringia. The biogeographical implications of this pattern are a focus of study. Larvae are currently being studied chromosomally by Peter Adler. Doug Currie is curating the adults and his University of Toronto graduate student, Miranda Smith, is analysing molecular sequence data from selected species.

Chironomus (Diptera: Chironomidae)

Mac Butler focused on lentic Chironomidae, especially *Chironomus*. This genus is well-studied cytogenetically, and karyotypes are necessary to confirm identification of most species. In collaboration with an international group of colleagues, he has recently been investigating biogeographic patterns of genetic variation of *Chironomus* from Europe, Siberia, and North America. Twenty lentic habitats were sampled along the 620 km route: ten pools or ponds (<1m depth), and a like number of small lakes. *Chironomus* larvae were found in eight of these sites, and pupal exuviae only were collected from an additional lake. A number of other lentic Chironomidae larvae were collected as well, primarily Tanyptodinae and Tanytarsini. *Chironomus* was quite rare in shallow habitats south of the coastal tundra, but larvae were found in all three ponds sampled in the Smoking Hills. All *Chironomus* larvae were fixed for karyotype analysis, but the material has not yet been examined. It is estimated that at least half a dozen species will be present, perhaps more. In many cases only a few larvae were collected at each site, and not all specimens are likely to provide good-quality karyotypes. Material collected at three sites may be sufficient for characterizing populations in terms of prevailing inversion frequencies, and hopefully to make comparisons with populations from other parts of the Holarctic Region. Nonetheless, the simple knowledge of what cytologically-defined species live in this part of the Arctic is a sufficient outcome from the expedition.

Phorid flies (Diptera: Phoridae)

Phorid flies were collected using mostly Malaise traps. A total of 28 Malaise trap samples were collected, most of which were overnight samples; a few traps were left up for two days worth of collecting. The samples vary widely in the number of insects they contain, due mostly to variation in the weather: warm sunny days produced large diverse catches whereas cold overcast days led to sparse collections. The higher flies (Brachycera) are being removed from the Malaise samples by Brian



Brown, after which the residues will be forwarded to Doug Currie to extract lower flies and Donna Giberson will look at the mayflies, stoneflies and caddisflies. The phorid fauna has not yet been analyzed in detail, but it is much more diverse than the literature on northern insects indicates. At least two genera, *Megaselia* and *Triphleba*, were collected, with the former predominating in numbers and species richness. It was interesting to see that phorid flies were abundant in samples collected on the tundra. Malaise traps were set on tundra sites using canoe paddles as poles, when the already sparse black spruce stands along the river disappeared.

Energetics and Food Web Ecology of the Horton System

Donna Giberson took samples representing different aquatic insect feeding guilds at approximately 20-30 km intervals along the river. Stable isotope (carbon and nitrogen) analysis of the insect samples, along with potential food sources (e.g., detritus, fine particulate organic matter, biofilms) should provide information about food sources and feeding patterns of the dominant taxa. Stable isotope analysis is a chemical analysis of food sources that takes advantage of the fact that different isotopes of common elements are sequestered by the body in different, but predictable ways, allowing researchers to trace food sources and trophic levels by analysing the ratios of the isotopes in the body tissues. Donna also collected water sam-

ples along the river to determine basic water chemistry variables (DO, pH, conductivity) and primary productivity, in collaboration with Joseph Culp at the National Hydrology Research Institute. Donna will also be identifying the Ephemeroptera, Plecoptera, and Trichoptera collected during the trip.

Plans for 2001

Discussions concerning 2001 field season are now underway. We plan to undertake a similar expedition in Nunavut or northern Manitoba, although a specific destination has yet to be identified. The Thelon, Kazan, and Seal Rivers have been discussed as possible venues, but further information is needed about logistical problems associated with each river. Regardless of the destination chosen, the resulting collections will provide a basis for comparison with collections made along the Horton River in 2000. A number of western species attain their eastern limit before Hudson Bay; and other species (e.g., *Simulium giganteum*) are known in the Nearctic Region only from the vicinity of Hudson Bay. A west-to-east transect along any of the three rivers should provide more detailed information about the distribution and composition of northern insects. Such data are fundamental to developing sound biogeographical hypotheses. Anyone interested in participating in this project is encouraged to contact us at the addresses given above.

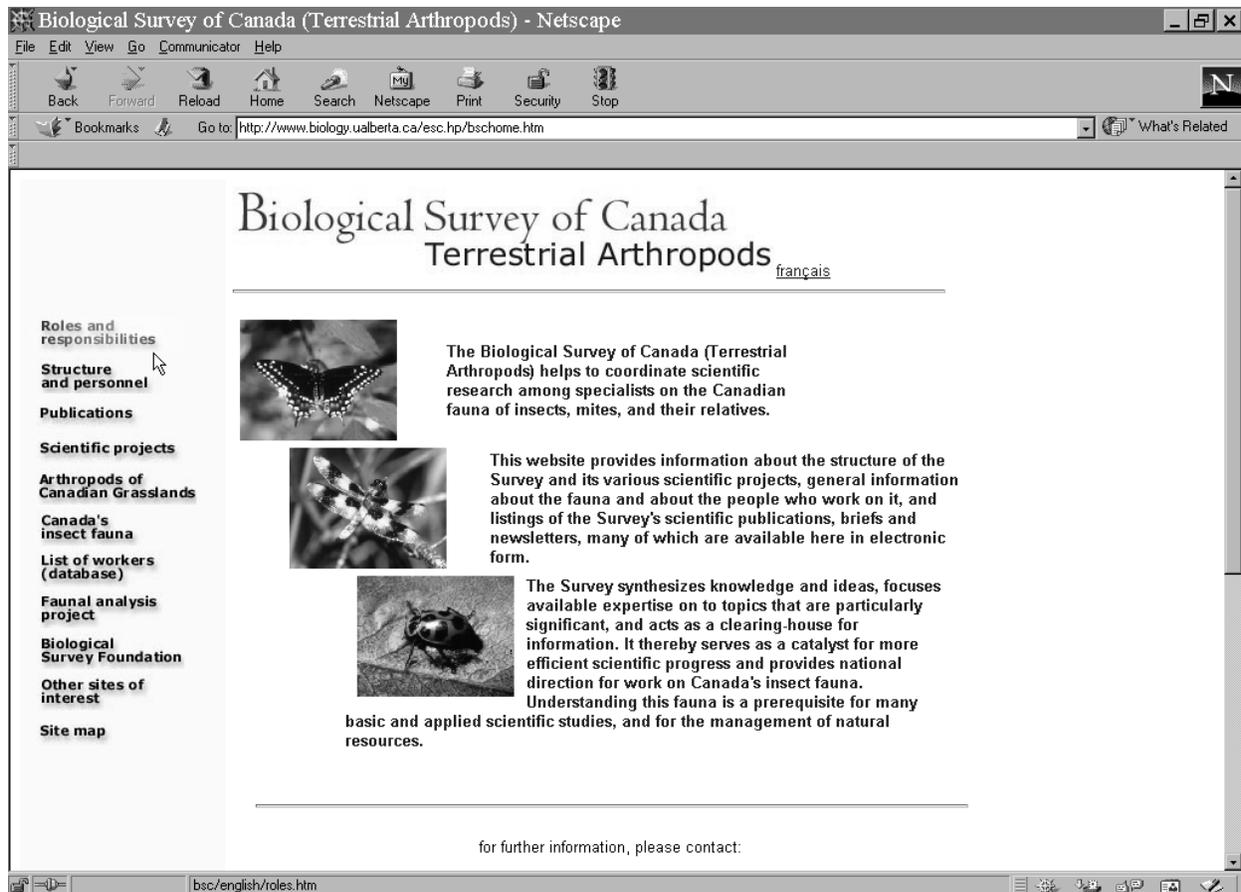
The Website of the Biological Survey of Canada (Terrestrial Arthropods)

<http://www.biology.ualberta.ca/esc.hp/bschome.htm>

The Biological Survey's main roles (to act as a coordinating office for information, coordinate scientific work to foster active research projects and produce synthetic publications, and to address matters of general concern to biologists) are being enhanced with expansion of the Survey's website, an expansion which will soon be fully implemented.

The Biological Survey has had a presence on the web since 1997. Last year a sub-

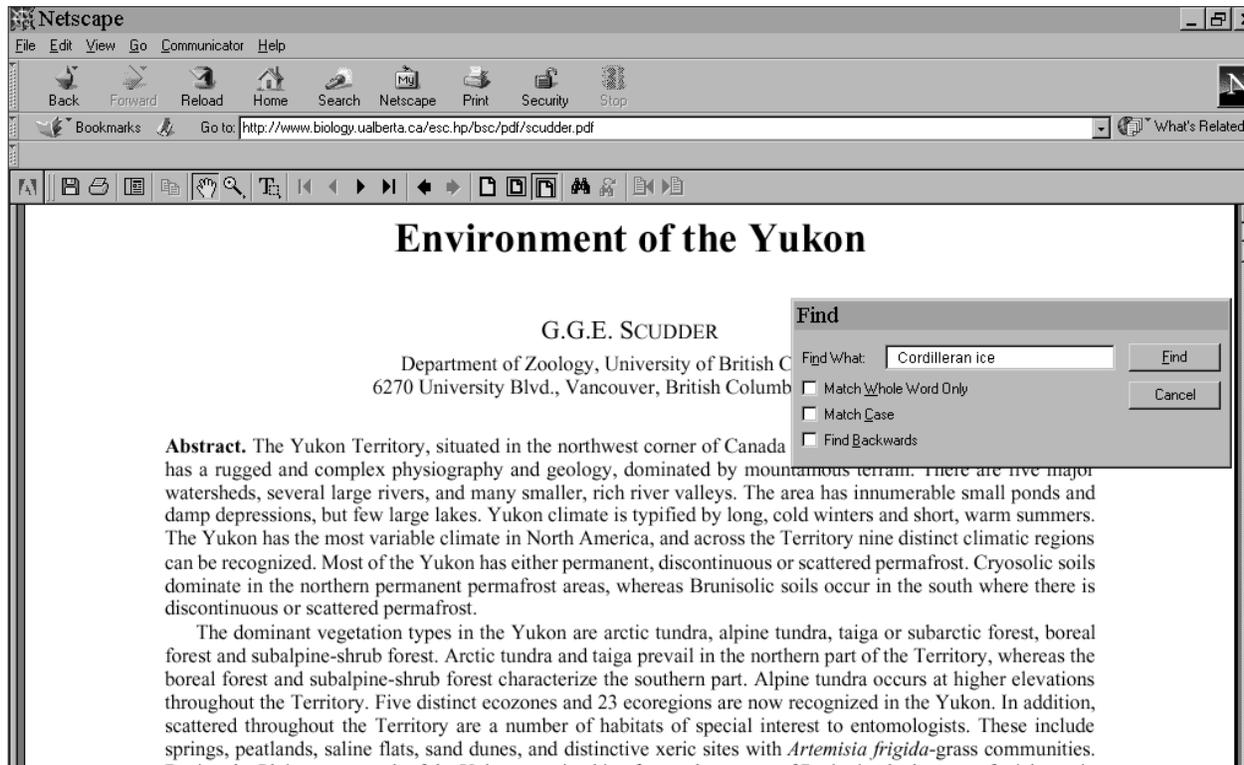
committee of the Survey's advisory Scientific Committee recommended that the site be expanded to make more faunal content available and to increase the profile of the Survey and its projects. With the assistance of Agnes Bonk, an intern hired through the Youth International Internship Program, a redesign and expansion was undertaken late in 1999. The Survey is pleased to announce the launch of our new and improved website.



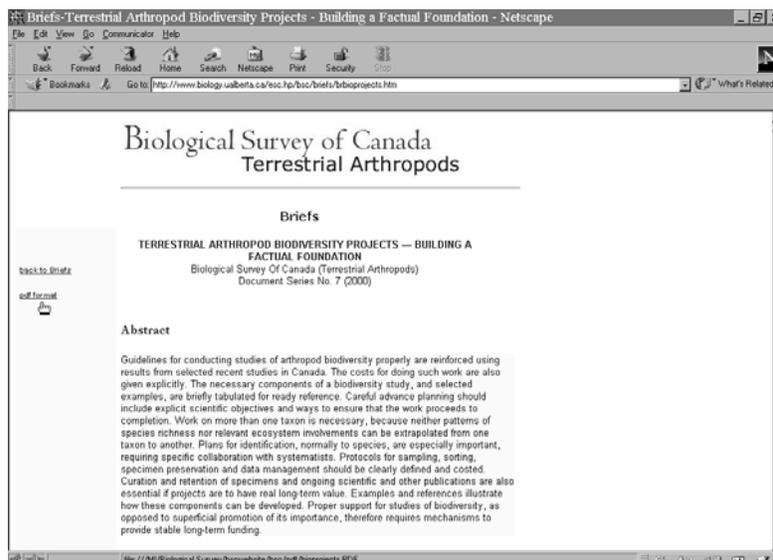
Home page of the new website for the Biological Survey of Canada

In addition to a new look the site now contains more specific content. For example most of the Survey's briefs are now available online in both Adobe Acrobat (PDF) and web page formats. Some larger publications are also available electronically. *Insect Dormancy: An Ecological Perspective* (H.V. Danks, 1987) has

been out of print for some time but the full text is available now on the website. *Insects of the Yukon* has also been posted. Users can view or download the complete text or individual chapters. Most of the publications that are available as Acrobat files have the added benefit of being searchable.



Most Acrobat files (such as *Insects of the Yukon* above) are searchable



Briefs are available as html files that can be viewed with a web browser (left) or as Adobe Acrobat files

An objective of the site is to promote key projects of the Survey. The Survey's currently developing major project on the arthropods of Canadian grasslands is featured in a section of the site that has a description of the project, in-

formation on the upcoming informal conference, and the text for all of the grasslands newsletters. More information will be added as the project progresses.

Grasslands Project - Netscape

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Bookmarks Go to: <http://www.biology.ualberta.ca/esc.hp/bcc/english/grasslands.htm> What's Related

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Arthropods of Canadian Grasslands

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An initiative of the Biological Survey of Canada (Terrestrial Arthropods)

The Arthropods of Canadian Grasslands Project will be the largest and most ambitious scientific project undertaken by the Biological Survey of Canada. Native grasslands are one of the most recognizable biomes in Canada, one of the most altered by human activity, and one of the most endangered. Grasslands are also among the most incompletely studied biomes in terms of their animal biodiversity. Other than a few pest species, the arthropods of Canada's grasslands have been virtually ignored, despite the crucial role they play in maintaining the ecological balance of these ecosystems. The primary goal of the Grasslands Project is to coordinate research on the diversity, ecology and impacts of the arthropods of Canadian grasslands. The project will involve a large number of specialists with expertise on different taxa, in different geographic regions, and with different research interests.

Given the high diversity of grassland arthropod taxa, the wide range of ecological conditions, and the breadth of human impacts and ecological change in grasslands, the focus and products of the Grasslands Project will be equally diverse. As with any comprehensive biological study, the project will require basic research on the diversity and distribution of selected taxa of grassland arthropods. More comprehensive ecological studies on selected grassland habitats or regions are also feasible. Finally, grassland ecosystems provide an excellent opportunity to study the effects of human activity on the native flora and fauna, as well as the effects of arthropods on human activities.

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Site map

Synopsis of some past and ongoing research projects on grassland arthropods
 [compiled by K.D. Floate]

Alaska

- Of leafhoppers and mammoths: Holocene and Pleistocene life in Alaska - K.G.A. Hamilton (Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, Ottawa, ON), S.F. MacLean, Jr. and Y.J. Kwon [in prep.]

British Columbia

- Effect of livestock grazing on ground-dwelling arthropods in a bunchgrass ecosystem in southern BC
 - G.G.E. Scudder (Department of Zoology, University of British Columbia, Vancouver, BC)

Document: Done

A fledgling project on faunal analysis aims to compile accurate and authoritative, up-to-date, information on the diversity of Canada's terrestrial arthropod fauna. Such data will allow the Biological Survey of Canada and oth-

ers to demonstrate needs related to faunal studies, especially the need for more positions in systematics. It is hoped that posting of existing data will be an incentive for experts to update the older estimates of Canadian diversity.

For authors and additional information see [Notes and comments on the Hymenoptera](#)
For explanation of column headings, see [Protocol](#)

C	D	E1	E2	F	G	H	I	J	K	L
Family name	Described species	Unreported or new spp.	Unreported species	Total species	Reliability of estimate	Information	Difficulty of sp. ident.	Date, and name	Personnel	Status of active identifiers
Ampulicidae	2	-	-	2	1				1	
Anaxyelidae	1	0	0	1	1				1	
Andrenidae	250	-	-	250	1				2	
Aphelinidae	23	10	10	43	1				3	
Apidae (incl. Anthophoridae)	147	-	-	147	1				2	
Argidae	25	15	0	40	1				1	
Astatidae	9	-	1	10	1				2	
Aulacidae	19	1	1	21	1				1	
Bethylidae	22	30	-	52	3				4	
Braconidae	684	278	1117	2052	2				3	

The Hymenoptera (above) were chosen as a test case for applying the protocol for the Faunal Analysis project.

To promote coordination and cooperation among Canadian entomologists the Survey has long published an *Annotated List of Workers on Systematics and Faunistics of Canadian Insects and Certain Related Groups*. In the near future this information will be part of the site in the form of a searchable database. Users will be able to search by name (of people), taxon, ecological group or city of interest. Search results will show name and contact in-

formation of relevant entomologists as well as their detailed interests and current projects. An online form is available for additions and updates. This database is kept up to date by the Survey Secretariat and it is hoped that having the information on the web will facilitate access to the database as well as encourage entomologists to submit revised information.

Annotated List of Workers on Systematics and Faunistics of Canadian Insects and Certain Related Groups

Search Results

Here are the results of your search:

Alarie, Yves
 Associate Professor
 Laurentian University
 Department of Biology
 Sudbury, Ontario P3E 2C6
 phone: 705-675-1151, ext 2346
 fax: 705-675-4859
 email: yalarie@nickel.laurentian.ca

General interests: MORPHOL., TAX., Ecol., Environt.

Taxa: DYTISCIDAE: Autoecol., Biogeog., Correl.ad.-larv., Evol., Ident., Invent., Phenol.-cycles, Pop. dynam., Synecol., Tax. GYRINIDAE: Autoecol., Biogeog., Correl.ad.-larv., Evol., Ident., Invent., Phenol.-cycles, Synecol., Tax. HALIPLIDAE: Autoecol., Biogeog., Correl.ad.-larv., Evol., Ident., Invent., Phenol.-cycles., Synecol., Tax.

Ecological groups: AQUATIC INSECTS: Autoecol., Biogeog., Correl.ad.-larv., Evol., Ident., Invent., Phenol.-cycles., Synecol., Tax.

Navigation of the Survey's new site has been made easier with the addition of a site map and a search feature.

The website is at <http://www.biology.ualberta.ca/esc.hp/bschome.htm>. Sugges-

tions for improvements or additions are always welcome. Thanks go to the Entomological Society of Canada (and webmaster Barry Lyons) and the University of Alberta for hosting our site.

ARTHROPODS OF CANADIAN GRASSLANDS

- [Overview](#)
- [Prospectus](#)
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CANADA'S INSECT FAUNA

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ANNOTATED LIST OF WORKERS ON SYSTEMATICS AND FAUNISTICS OF CANADIAN INSECTS AND CERTAIN RELATED GROUPS (DATABASE)

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The Quiz Page

— test your knowledge of Canada and its fauna —

1. Which province extends through the greatest number of degrees of longitude?
2. Which is the deepest lake in Canada?
3. What proportion of earwig species (Dermaptera) in Canada is introduced and which of the introduced species has recently been spreading most rapidly?
4. Name three species of moths that live during the larval stage in tents made of or held together by silk?
5. Give the approximate ranges of the following characteristic Canadian insects.
 - a) *Aedes communis* (Culicidae)
 - b) *Aphrophora gelida* (Cercopidae)
 - c) *Aeshna septentrionalis* (Aeshnidae)
 - d) *Chrysops frigidus* (Tabanidae)
 - e) *Grylloblatta campodeiformis* (Grylloblattidae)
 - f) *Hylurgopinus rufipes* (Scolytidae)

[Answers on page 62]

Selected Publications Associated with the Biological Survey

Arthropod ectoparasites of vertebrates in Canada. A brief	1991. T.D. Galloway and H.V. Danks. <i>Bull. ent. Soc. Can.</i> 23(1), Suppl. 11 pp.	Free of charge on request
Arthropods of springs, with particular reference to Canada	1991. D.D. Williams and H.V. Danks (Eds.). <i>Mem. ent. Soc. Can.</i> 155. 217 pp.	\$21 (includes shipping) from Entomological Society of Canada*
The importance of research collections of terrestrial arthropods. A brief	1991. G.B. Wiggins <i>et al.</i> <i>Bull. ent. Soc. Can.</i> 23(2), Suppl. 16 p.	Free of charge on request
Winter habitats and ecological adaptations for winter survival	1991. H.V. Danks. pp. 231-259 <i>in</i> R.E. Lee and D.L. Denlinger (Eds.), <i>Insects at Low Temperature</i> . Chapman and Hall, New York. 513 pp.	Book available through booksellers
Life cycle pathways and the analysis of complex life cycles in insects	1991. H.V. Danks. <i>Can. Ent.</i> 123(1-2): 23-40.	Copies available on request
Museum collections: fundamental values and modern problems	1991. H.V. Danks. <i>Collection Forum</i> 7(2): 95-111.	Reprints available on request
Long life cycles in insects	1992. H.V. Danks. <i>Can. Ent.</i> 124(1): 167-187.	Reprints available on request
Biodiversity and insect collections	1992. S.A. Marshall. <i>Canadian Biodiversity</i> 2(2): 16-22.	Available from author
Arctic insects as indicators of environmental change	1992. H.V. Danks. <i>Arctic</i> 45(2): 159-166.	Reprints available on request
Biodiversity of nearctic soil arthropods	1992. V.M. Behan-Pelletier and B. Bissett. <i>Canadian Biodiversity</i> 2(3): 5-14.	Available from author
The biodiversity crisis, a national initiative: the Biological Survey of Canada (Terrestrial Arthropods)	1993. H.V. Danks. <i>Association of Systematics Collections Newsletter</i> 21(2): 17-23.	

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| Systematics and entomology: diversity, distribution, adaptation and application | 1993. G.E. Ball and H.V. Danks (Eds.). <i>Mem. ent. Soc. Can.</i> 165. 272 pp. | \$25 (includes shipping) from Entomological Society of Canada |
| Environmental lip-synching in Canada | 1993. G.E. Ball. <i>Alternatives</i> 20(1): 21. | |
| Seasonal adaptations in insects from the high arctic | 1993. H.V. Danks. pp. 54-66 in M. Takeda and S. Tanaka (Eds.), [Seasonal adaptation and diapause in insects]. Bun-ichi-Sogo Publ., Ltd., Tokyo. (In Japanese). | Copies of English version available on request |
| La diversité des espèces d'insectes du Québec, vues dans une perspective nord-américaine | 1994. H.V. Danks. <i>Revue d'entomologie du Québec</i> 37 [1992]: 46-51. | Tirés-à-part disponibles sur demande. |
| Regional diversity of insects in North America | 1994. H.V. Danks. <i>American Entomologist</i> 40(1): 50-55. | Reprints available on request |
| Terrestrial arthropod biodiversity: planning a study and recommended sampling techniques. A brief | 1994. S.A. Marshall, R.S. Anderson, R.E. Roughley, V. Behan-Pelletier and H.V. Danks. <i>Bull. ent. Soc. Can.</i> 26(1), Suppl. 33 pp. | Copies available on request |
| Terrestrial arthropods of peatlands, with particular reference to Canada | 1994. A.T. Finnamore and S.A. Marshall (Eds.). <i>Mem. ent. Soc. Can.</i> 169. 289 pp. | \$32 (includes shipping) from Entomological Society of Canada |
| Insect Life-cycle Polymorphism: Theory, Evolution and Ecological Consequences for Seasonality and Diapause Control | 1994. H.V. Danks (Ed.). Series Entomologica 52. Kluwer Academic Publishers, Dordrecht, Netherlands. 376 pp. | \$195 U.S. Available from Kluwer Academic Publ. Group, P.O. Box 358, Accord Station, Hingham, MS 02018-0358 |
| Insect cold-hardiness: insights from the Arctic. | 1994. H.V. Danks, O. Kukul and R.A. Ring. <i>Arctic</i> 47(4): 391-404. | Reprints available on request |
| Regional diversity of insects in the Pacific Northwest | 1995. H.V. Danks. <i>J. ent. Soc. Br. Columb.</i> 92: 57-71. | Reprints available on request |
| The advantages of using arthropods in ecosystem management. A brief from the Biological Survey of Canada (Terrestrial Arthropods) | 1996. A.T. Finnamore. 11 pp. | Limited number of copies available upon request |
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- The SAGE Project. A workshop report on terrestrial arthropod sampling protocols for graminoid ecosystems 1996. A.T. Finnamore (Ed.) Available on the Internet at <http://www.cciw.ca/eman-temp/reports/publications/sage/intro.html>
- How to assess insect biodiversity without wasting your time. A brief. 1996. H.V. Danks. Biological Survey of Canada Document Series No. 5, ISBN 0-9692727-6-6. 20 pp. Copies available on request (Abridged version in *Global Biodiversity* (1997) (version française dans *La biodiversité mondiale* (1997))
- The wider integration of studies on insect cold-hardiness 1996. H.V. Danks. *European Journal of Entomology* 93(3): 383-403. Reprints available on request
- Annotated List of Workers on Systematics and Faunistics of Canadian Insects and Certain Related Groups 1997. H.V. Danks and S. Goods. Third edition, 1996. Biological Survey of Canada Document series No. 6. 119 pp. Free of charge on request
- Insects of the Yukon 1997. H.V. Danks and J.A. Downes (Eds.). Biological Survey of Canada (Terrestrial Arthropods), Ottawa. 1034 pp. \$95 (includes shipping) from Entomological Society of Canada
- Arctic Insect News 1999. H.V. Danks (Ed.). No. 10. 29 pp. Free of charge on request (Annual issues 1-9 also available)
- La dormance et les cycles biologiques 1999. H.V. Danks. *Antennae* 6(2): 5-8. See: <http://www.seq.qc.ca>
- Life cycles in polar arthropods – flexible or programmed? 1999. H.V. Danks. *European Journal of Entomology* 96(2): 83-102. Reprints available on request
- Terrestrial arthropod biodiversity projects - building a factual foundation. A brief from the Biological Survey of Canada (Terrestrial Arthropods). 2000. H.V. Danks and N.N. Winchester. Biological Survey of Canada Document Series No. 7, ISBN 0-9692727-9-0. 38 pp. Copies available on request

[*To order publications from the Entomological Society of Canada contact the Society at 393 Winston Ave. Ottawa, Ontario K2A 1Y8; tel.: 613-725-2619, fax: 613-725-9349; email: entsoc.can@sympatico.ca; [Orders from Canada pay the above-noted price in Canadian dollars; orders from other countries pay the above-noted price in U.S. dollars. Add 7% GST on all orders for Canada.]

Selected Future Conferences

Organization	Date	Place	Contact
Entomological Conferences			
Entomological Society of Canada	2000, 2-7 Dec.	Montréal, QC	(with Société d'entomologie du Québec and the Entomological Society of America) see: http://www.entsoc.org
	2001	Niagara Falls, ON	(with the Entomological Society of Ontario)
Entomological Society of America	2000, 2-7 Dec	Montréal, QC	(joint meeting with ESC, see above)
	2001, 9-13 Dec.	San Diego, CA	ESA, 9301 Annapolis Road, Lanham, MD 20706-3115, e-mail esa@entsoc.org
	2002, 10-15 Dec.	Philadelphia, PA	ESA, see above
Coleopterists Society Annual Meeting	2000, 5 Dec.	Montréal, QC	(Held in conjunction with the joint ESA/ESC/SEQ meeting) http://www.coleopsoc.org/
Collections / Museums / Systematics			
Association of Systematics Collections Annual Meeting	2001, 8-9 June	Chicago, IL	Association of Systematics Collections, 1725 K Street NW, Suite 601; Washington, DC 20006-1401; asc@ascoll.org
Society for the Preservation of Natural History Collections Annual Meeting	2001, Summer	San Francisco, CA	Jean Demouth, California Academy of Sciences, Golden Gate Park, San Francisco, CA. jdemouthe@calacademy.org
Other subjects (especially those relevant to Survey projects)			
First International Conference on Entomology Libraries and Information Networks (ELIN)	2000, 25-27 Oct.	London, England	ELIN Conference Administrator, c/o The Royal Entomological Society, 41 Queens Gate, London, SW7 5HR, UK, reg@royensoc.demon.co.uk

Answers to Faunal Quiz

[see page 57]

1. The province extending through the greatest number of degrees of longitude is British Columbia, nearly 25° of longitude.
2. The deepest lake in Canada, much deeper than other Canadian lakes, is Great Slave Lake, reaching a maximum depth of 614 metres.
3. Four or five of the five species of Canadian earwigs are introduced (*Doru aculeatum* in southern Ontario may be native). The European earwig *Forficula auricularia* has been spreading rapidly in recent years especially in eastern North America.
4. The larvae of many species of moths form tents, but the most conspicuous and best known in Canada are tent caterpillars, species of *Malacosoma* (Lasiocampidae), the fall webworm *Hyphantria cunea* (Arctiidae), and species of *Archips* (Tortricidae), such as the ugly nest caterpillar *A. cerasivorana*.
5.
 - a) The mosquito *Aedes communis* ranges across the northern Holarctic, including Canada from B.C. to Newfoundland north to treeline and slightly beyond.
 - b) The boreal spittlebug *Aphrophora gelida* is locally common in the boreal zone across Canada (central B.C. to Newfoundland), south in the Appalachians to North Carolina.
 - c) The dragonfly *Aeshna septentrionalis* ranges from coast to coast in northern boreal habitats (Yukon, B.C. and Alaska to Newfoundland), north to treeline and south in the Rocky Mountains to 51°N.
 - d) The horse fly *Chrysops frigidus* occurs across the continent, south along the Rocky Mountains to Colorado, and in all Canadian provinces and territories north to treeline.
 - e) The rock crawler *Grylloblatta campodeiformis* lives in the western mountains of Canada (B.C., Alberta) south to Montana and northern Idaho.
 - f) The native elm bark beetle *Hylurgopinus rufipes* is eastern, ranging from New Brunswick west to Manitoba in Canada, and west in the United States to Kansas.

Quips and Quotes

“Human activities . . . entail significant . . . consequences for one or more biodiversity components, primarily by redirecting matter and energy flows. This cumulative redirection is enormous at the planetary scale (Vitousek et al. 1997), as the following three examples illustrate: (1) Vitousek et al. (1986) calculated that 40% of the Earth’s terrestrial primary productivity was being appropriated by humans; (2) Roberts (1997) estimates that 25-35% of the primary productivity of continental shelf marine ecosystems is consumed by humans; and (3) Postel et al. (1996) report that humans now appropriate 26% of total evapo-transpiration and use 54% of all runoff in rivers, lakes, and other accessible sources of water.”

(Excerpt from K.H. Redford and B.D. Richter. 1999. *Conservation Biology* 13: 1246-1256)

It is the way of the world that some people put errors into circulation while others try then to eradicate these same errors. This keeps everyone busy . . .
(Arni Magnusson)

Critical Quips

He can compress the most words into the smallest idea of any man I ever met (Abraham Lincoln)

After all is said and done, more is said than done (Anon.)

His absence is good company (Scottish saying)

The covers of this book are too far apart (Ambrose Bierce)

We had seen the light at the end of the tunnel, and it was out (John C. Clancy)

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).

Requests should be made by the middle of January; the list of requests will appear in the Spring 2001 newsletter.

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 subarctic and arctic Canada, Canadian grasslands	Berlese-Tullgren funnel extraction from subaquatic substrates, from grasses and sedges, and from bird and mammal nests, would be especially fruitful (preserve in 75% ethanol +5% glycerine).	V.M. Behan-Pelletie; E.E. Lindquist; I.M. Smith
2	Adelgidae (conifer woolly aphids)	Anywhere	Preserve insects and bark, needles or galls in 70% ethanol. Specimen records and host plant records.	R. Foottit
3	Aleyrodidae (whiteflies)	North America	Preserve insects and host plant material in 70% ethanol. Adults may be dried. Specimen records and host plant records. (Canadian National Collection deficient in all species, including pest species)	R. Foottit
4	Anthomyzidae	New World	Adults from any habitat, but often associated with graminoids. Preservation in 70% ethanol preferred. Malaise and especially pan trap residues are acceptable and valuable. General description of herbaceous cover and soil moisture advantageous.	K.N. Barber
5	Aphididae (aphids)	Anywhere	Preserve in 70% ethanol. Specimen records and host plant records.	R. Foottit
6	Asilidae (robber flies)	North America	Pinned adults	R.A. Cannings
7	Braconidae	Anywhere	Pointed or in ethanol	M. Sharkey
8	Bumble bees	Anywhere in Canada	Include floral host if any. Collect and preserve dry (but specimens that have already been put into ethanol are acceptable)	R.C. Plowright

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. Number _____

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:
