Biological Survey of Canada Newsletter

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Editorial: What should a Biological Survey of Canada look like?

Donna Giberson

Here's your opportunity to design a Biological Survey!

This November, the BSC is sponsoring a symposium to pose ideas and provoke feedback on what a "Biological Survey of Canada" should actually look like. This will be the topic of the annual BSC symposium at the Halifax meetings of the Acadian Entomological Society and the Entomological Society of Canada, to take place November 6-9. 2011 (http://www.acadianes.ca/2011jam/). Canada is a big country, and we work on a large percentage of the country's biota. The challenge is to establish a Biological Survey that best meets the needs of the people that use and contribute to biodiversity data. How can we partner with other groups to assess Canada's biodiversity? The BSC has been receiving feedback through the new blog (http://biologicalsurvey.wordpress.com/), as well as the Canadian-arthropods listserve*, on this subject, and we're pursuing partnerships with some other groups interested in biodiversity. The Halifax symposium will let you hear from some of these groups, as well as give a chance to contribute your own ideas. For example, there is an exciting new proposal from David Shorthouse for a peer-reviewed checklists journal, which would allow people to contribute their biodiversity information from different regions and jurisdictions of Canada. I hope you will attend and participate!

*To subscribe to the listserve or to view the archives go to http://www.mailman.srv.ualberta.ca/mailman/listinfo/canadian-arthropods

Become a Director of the Biological Survey of Canada!

The BSC has operated for the past two years as a not-for-profit organization under the directorship of a group of people drawn largely from the former advisory "Scientific Committee" of the BSC. The two-year terms of the first Directors are coming to an end, and although some of the current Directors may stand for re-election, you have an opportunity to shape the future of the BSC by becoming a Director of the BSC (see p. 6 for details). Duties are typical of what is required to manage the affairs of a not-for-profit corporation but need not be onerous. Directors typically meet by teleconference once a month or so, and discuss issues relating to our publications, projects and new partnerships in biodiversity work.

Please consider nominating someone, or allowing yourself to be nominated to the board of the BSC. It looks great on the CV, and gives you a voice as well!

Questions? Please contact us at bsc@mus-nature.ca

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Masthead image:Incurvate Emerald, *Somatochlora incurvata* courtesy of Denis A. Doucet

Update on the Biological Survey of Canada/ Commission biologique du Canada activities

Joe Shorthouse,
Department of Biology, Laurentian University

The Biological Survey of Canada (BSC) incorporated as a not-for-profit organization in 2009 and will be holding its third AGM at the ESC/ESBC JAM in Halifax in fall 2011. The BSC operated as a partnership between the Canadian Museum of Nature (CMN) and the ESC from 1981-2010, with a Secretariat funded through CMN, and a scientific committee chosen in cooperation with the ESC. The BSC continues to have strong links with the ESC, including organizing an annual symposium at the ESC meeting, and fundraising for an ESC scholarship supporting insect biodiversity in Canada. The BSC and ESC have also entered into a new partnership with the Canadian Journal of Arthropod Identification (see CJAI report on p. 7).

The Directors of the BSC continue to meet monthly by teleconference, and have discussed issues such as our partnerships with ESC and groups such as Canadensys and the Northern Biodiversity Project, topics for, and organization of, symposia at the ESC and book projects. We are approaching a milestone in our group, however, with two full years as an incorporated, not-for-profit organization. At this time, some directors will be rotating off the board as their two year terms come to an end, so there is an opportunity for new people to get involved. Please consider nominating someone (or accepting a nomination) for election to the board to help move issues on Canadian biodiversity to the forefront (see p. 6 for details).

Last issue, I reported that the first volume **(Ecology and Interactions in Grassland Habitats)** of the projected 3-volume series on Arthropods of Canadian Grasslands had been published, and was available on-line (as a chapter-by-chapter download on the BSC website (http://www.biology.ualberta.ca/bsc/english/grasslandsbook.htm) as well as a hard-copy book from http://www.volumesdirect.com/detail.aspx?ID=4598. I am now pleased to report that the second volume, **Arthropods of Canadian Grasslands: Inhabitants of a Changing Landscape** has also been published, and is similarly available (download: http://www.biology.ualberta.ca/bsc/english/grasslandsbook2.htm and purchase at: http://www.volumesdirect.com/detail.aspx?ID=4764). Volume 3 is currently in preparation, and we will provide an update when more details are available. The BSC foundation has donated a copy of each book to the student auction at the upcoming annual meeting of the Entomological Society of Canada, so I urge you to have a look at the two books, as well as supporting the student scholarship funds.

Other Survey publications continue to get our message out to biodiversity workers, including this Newsletter (http://www.biology.ualberta.ca/bsc/english/newsletters.htm) and the Canadian Journal of Arthropod Identification (CJAI) (http://www.biology.ualberta.ca/bsc/ejournal/ejournal.html). Seven stunning new papers have been published by CJAI this year under the capable editorship of Steve Marshall: V.11: The Blowflies of Eastern Canada; V.12: Staphylinidae of Eastern Canada and adjacent United States; V.13: Tabanidae of Eastern Canada, keys to Tabaninae; V. 14: World Genera and North American Species of Clusiidae; V. 15: Fruitflies (Tephritidae) of Ontario; V.16: Fireflies of Ontario, and V.17: A Matrix Key to Families, Subfamilies and Tribes of Lepidoptera of Canada. Several more papers are under review, and the journal has new stability with a partnership with the Entomological Society of Canada (see p. 7).

Annual Biological Survey of Canada Symposium at the Entomological Society of Canada Meeting: Tuesday Nov. 8, 2011

How to complete a Biological Survey of Canada

This year's BSC symposium is being organized by Felix Sperling (U of Alberta) and Dave McCorquodale (Cape Breton University), and will feature the following speakers:

Donald Baird, Canadian Rivers Institute, U. of New Brunswick and Envir. Canada

Robert Branton - Ocean Tracking Network, Dalhousie Univ.

Peter Desmet, Canadensys, U. of Montreal

Dezene Huber, U. of Northern British Columbia

John Klymko, Atlantic Canada Conservation Data Centre

Laurence Packer and Cory Sheffield, York University

Barb Sharanowski, U. of Manitoba, Dept. of Entomology

David Shorthouse, Encyclopedia of Life

Annual Curation Blitz at the Entomological Society of Canada Meeting:

Monday 07 November 1700:-20:00 at Nova Scotia Museum, 1747 Summer St. Halifax. Within walking distance or short taxi ride.

Contact:
Andrew Hebda, Nova Scotia Museum, hebdaaj@gov.ns.ca
or
David McCorquodale, david_mccorquodale@cbu.ca

Notice: Volume II of the Arthropods of Canadian Grasslands series Published:

Arthropods of Canadian Grasslands, Volume 2: **Inhabitants of a Changing Landscape** is now available for chapter by chapter download, or purchase of the complete book.

To download chapters: http://www.biology.ualberta.ca/bsc/english/grasslandsbook2.htm
To purchase a copy, go to: http://www.volumesdirect.com/detail.aspx?ID=4764).

Arthropods of Canadian Grasslands, Volume 2:
Inhabitants of a Changing Landscape

Call for Nominations: Board of Directors - 2 year term

We are seeking motivated biodiversity workers who are interested in becoming Directors of the BSC (to serve a 2-year term).

Directors meet monthly by teleconference, and discuss issues relating to Survey projects and publications, and present and future biodiversity partnerships. Directors will be elected at the Annual General Meeting of the Biological Survey, this year to be held at the ESC/AES joint meeting in Halifax in November. People with fresh ideas for the future of the BSC are particularly welcome. You need not be present at the meeting to stand for election.

To put forward your name as a Director please send an email to bsc@mus-nature. Please be sure to include all of your contact information and your current occupation, and include a summary of your current entomological interests.

The by-laws of the BSC indicate the following about the Board of Directors:

BOARD OF DIRECTORS

6.1. Number and Qualification

The property and business of the Corporation shall be managed by the Board which shall be composed of not less than three (3) and not more than nine (9) Directors. The number of Directors shall be fixed by the Members from time to time. Directors shall be individuals, at least eighteen (18) years of age and have power under law to contract. A Director need not be a Member of the Corporation.

6.3 Term of Directors

The Directors shall be elected at an annual meeting for a term of two (2) years, as determined by the Members, or until their successors are elected by the Members. All Directors shall be eligible for re-election.

Notice of Annual General Meeting

The annual general meeting of the BSC will be held in conjunction with the joint annual meeting of the Entomological Society of Canada and the Acadian Entomological Society, in Halifax, Nova Scotia. The AGM will start immediately after the BSC Symposium (see above). All are welcome to attend but only members may vote.

Canadian Journal of ARTHROPOD IDENTIFICATION

A product of the Biological Survey of Canada

The Canadian Journal of Arthropod Identification

- now a "core journal" of the Entomological Society of Canada

Steve Marshall, Editor, CJAI

If you have not done so recently, please take a few minutes to look over The Canadian Journal of Arthropod Identification (CJAI) at http://www.biology.ualberta.ca/bsc/ejournal/ejournal.html. The CJAI is moving steadily towards the objective of documenting the Canadian arthropod fauna in the context of freely accessible, thorough reviews incorporating richly illustrated keys. Recent issues deal with the rove beetles of eastern Canada, the horse flies of eastern Canada, the Clusiidae of the World, fruit flies of Ontario, the fireflies of eastern Canada, and new keys to the Canadian families of Lepidoptera. Soon to be published (reviewed and accepted) is a key to the leafcutter bees of Canada; many other submissions are in various stages of review or preparation. If you have special expertise on a group of arthropods occurring in Canada please think about contributing to this exciting new journal!

The CJAI was initiated as a product of the Biological Survey of Canada and as such has always been associated with the Entomological Society of Canada. That association has recently been formalized through a MOU between the BSC and the ESC that explicitly recognizes the CJAI as a core journal of the ESC ("The Entomological Society of Canada will consider the Canadian Journal of Arthropod Identification one of its core publications, along with the ESC Bulletin and The Canadian Entomologist, and as such will take reasonable actions as deemed necessary to ensure continuity of the Canadian Journal of Arthropod Identification"). This is a very important step for CJAI, as it firmly and formally says that CJAI is here to stay, and that it will gradually grow to become a modular, authoritative and tremendously useful guide to the arthropod fauna of Canada.

Our move to a core journal of the ESC coincides with the Canadian Museum of Nature's decision to withdraw support from the BSC, and thus from the CJAI. That support formerly took the form of able assistance from Susan Goods at the CMN, and this is a good opportunity to publicly thank Susan for her help with many aspects of CJAI, including the production and distribution of hard copies. We will miss Susan's watchful eye, tremendous organization and ever positive contribution to the Journal! One aspect of our new agreement with ESC is the transfer of tasks previously handled by Susan to the ESC office, and we look forward to working with Derna Lisa in that office as CJAI grows and improves.

One other very important bit of news about CJAI is the looming loss of our technical editor, Dave Cheung, who has been at the heart of CJAI from day one and deserves much of the credit for the success of the journal. Dave is planning to move to Denmark in the fall, a move for which we wish him every success. Between now and then he is committed to streamlining the CJAI so it will continue to run smoothly as we seek a new technical editor.

Lastly, let me take this opportunity to thank our associate editors and reviewers for their generous contributions of time to CJAI. Although large reviews and keys take significant effort to review, our associate editors have been tremendously diligent in ensuring the quality of every issue. Reviewers have, for the most part, kindly taken significant chunks of time out of their busy schedules to provide timely and insightful comments. Reviewing is an almost thankless task but critical to the integrity of CJAI, so please help us out by accepting review requests if they come your way.

Insect Collections of Canada Series
New Brunswick Museum, Saint John, NB.

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History

The provincial New Brunswick Museum (NBM; Fig. 1), located in Saint John, houses some of the largest and most comprehensive natural history research collections in Atlantic Canada and is an important source of biodiversity data for various government and non-government agencies. The institution (established as a provincial museum in 1929) is one of Canada's oldest continuing public museums, tracing its history back to 1844 through institutional predecessors. Currently, the NBM's Department of Natural Science employees three research curators (all with PhDs and each cross-appointed at one or more universities) in each of geology, botany and mycology, and zoology, two technical support staff (both with MScs), and a part-time zoological preparator. Annually, 2-3 long-term casual or contract staff are also generally working in the Department on various projects, along with a fluctuating number of summer student assistants, co-op students, and volunteers. The NBM has a long history of supporting field and museum research in the areas of faunistics and floristics, systematics, biodiversity, and conservation, especially with respect to non-game species (see McAlpine and Smith 2010). In 2009 the NBM established the Centre for Biodiversity Research (CBR) to further study on the biodiversity of the Atlantic region. Although the NBM insect collection is still very modest in size (conservatively, ~100,000+ specimens), growth over the past two decades has been rapid and the collection is playing an increasing role in entomological activity in the region.

Fig 1. The New Brunswick Museum, St. John New Brunswick. It was constructed in 1930-32, and opened officially to the public in 1934 (NBM photo).

The Natural History Society of New Brunswick (NHSNB) insect collection, amassed mainly between 1897 and 1910, forms the nucleus for the current NBM insect holdings. The NHSNB was a leading scientific organization of its time with international ties (Buhay and Miller 2010). As with institutions and like-minded Societies in the United States

(Sorensen 1995), the NHSNB provided some of the initial support and encouragement needed for the early growth of entomological research in the Maritimes. Fairweather and McAlpine (2011) discuss the history and status of the NHSNB insect collections and the varied connections that William McIntosh, the principal collector, developed with entomologists outside the region. In particular, McIntosh drew on the expertise of entomologists associated with the United States Department of Agriculture - United States National Museum (USDA-USNM) insect collection, including William Beutenmuller, D.W.Coquillet, Harrison G.Dyar, S.H.Rohwer, and John B.Smith, but Canadian entomologists James Fletcher, Rev. F.W.L.Sladen, G.W.Taylor, and W.H.Harrington were also consulted [not H.H.Harrington, as reported in Fairweather and McAlpine (2011); a mistake originating with a typographical error in an unpublished manuscript by McIntosh was brought to our attention by Chris Majka]. McIntosh published papers in the Society bulletin on the butterflies, noctuid and sphingid moths, and Diptera of New Brunswick (McIntosh 1899a,b,c, 1901, 1903, 1904), ultimately serving as part-time provincial entomologist for the New Brunswick Department of Agriculture from 1907-1932 (McTavish and Dickison 2007).

The NHSNB was established in 1862 in Saint John. The Society amassed significant natural history, archaeological, and historical collections, although it was apparently not until about 1884 that the Society received any donations of insects to its collections. Among the early donors was Mrs. C.E.Huestis, certainly one of Canada's earliest female entomologists and a contributor of observations to the journal The Canadian Entomologist during the late 1870s (e.g. Huestis 1879). Unfortunately, these early collections have not survived. It was not until 1897, when William McIntosh (Fig. 2) was reported to have curated the then existing insect collection and donations of 700 specimens were received (mainly collected by McIntosh), that the collection now extant had its origins. By about 1914, almost entirely through the efforts of McIntosh and his colleague, A. Gordon Leavitt (Fig. 3), there were over 24,000 specimens in the NHSNB insect holdings, of which 19,467 had been incorporated into the collection, with Lepidoptera dominant. Leavitt's contributions, which focused on Hymenoptera, included several new sawfly species later described by others, including the namesake *Phyllocolpa leavitti* (Rohwer 1910). Although insect specimens were collected by McIntosh and perhaps Leavitt and others after 1914, growth in the permanent NHSNB insect collection seems to have been minimal after this date. Much of the material acquired after 1914 seems to have been used to support educational programs presented by McIntosh, or was dispersed to school teachers and those in the agricultural community.

Fig. 2. William McIntosh assembled the specimens that now form the nucleus of the NBM entomology collection (Acc. X10721 NBM).

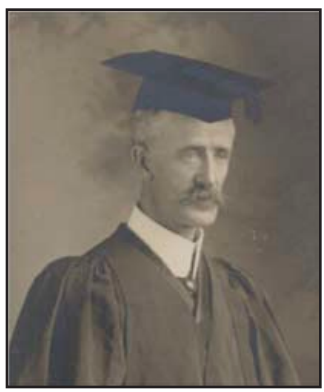

Fig. 3. A. Gordon Leavitt, early New Brunswick collector of Hymenoptera (Acc. X10278 NBM).

Shortly before the NBM first opened its doors in 1932, the NHSNB transferred its collections to the Museum. How many insects this included is not clear, but 7,248 NHSNB specimens survive today (Fairweather and McAlpine 2011). In spite of losses, specimen records of scientific significance remain. Odonates collected in 1898-1900 provide the earliest documentation for 30% of the 142 species currently know from the Maritimes and southeastern Quebec (Brunelle 2010). A specimen of *Eumorpha labruscae* (Linnaeus), a southern sphinx moth, was noted by McIntosh in his Annual Report to the NHSNB Council for 1906 and this specimen remains the only one

from Canada (J.D. Lafontaine, Canadian National Collection of Insects, pers comm. to DFM). Included among the beetles are specimens that document the first occurrence of adventives and therefore help to establish timelines for the introduction of non-native Coleoptera to the Maritimes, including *Quedius mesomelinus* (Marsham) (Staphylinidae), *Attagenus unicolor japonicas* Reitter (Dermestidae), *Ernobius mollis* (Linnaeus) (Anobiidae), *Gymnetron tetrum* (Fabricius)(Curculionidae), *Hypera zoilus* (Scopoli) (Curculionidae) and others. Many of these, and other first beetle records for the region in the NHSNB collection, have been reported on in the various recent papers of Majka and co-workers (e.g. Majka 2007, Majka and Smetana 2007, Majka et al. 2007, Majka and Johnson 2008, Majka 2011, and others). McCorquodale et al. (2010) have noted the importance of regional insect collections in the Maritimes; undoubtedly, as the historic NBM collection is more fully databased and more closely examined by specialists, further specimens of significance will emerge.

From the outset, the NBM encountered financial difficulties (Squires 1945). Although McIntosh became the first Director of the NBM, it was not until 1939 that a curator devoted solely to the natural sciences, W. Austin Squires, was in place. Not surprisingly, since Squires was operating alone as a general naturalist (as well as overseeing the NBM School Services Section and serving as Secretary to the NBM Board), and had a special interest in the birds of the province (Pearce 1980), the insect collection received little attention. How the NHSNB insect collections were handled upon receipt at the NBM is unknown; however, in the five decades that followed, there were few additions to the collection. At some point, the insect specimens in their original glass-topped wooden drawers were relegated to make-shift open cabinetry (rising up in several tiers, such that a step ladder was required to access the upper drawers) in a poorly lit, unfinished, storage room adjacent to the projection room behind the Museum's King George VI Hall auditorium.

In 1970 when teenage entomologist Chris Majka was employed to organize, clean and sort the collection over the summer months, he found the glass-topped drawers so heavily coated with coal dust from the museum's furnaces that their contents were scarcely visible (C. Majka, Nova Scotia Museum, pers. comm. to DFM). Surprisingly though, he found very little dermestid damage. Majka spent the summers of 1970 and 1971 working over the collection, revising the nomenclature for some of the Lepidoptera, and transcribing data from about 70% of the specimen labels to a card file system catalogue (Christie 1971). Probably the highlight of the summers (at least for Majka, laboring over his catalogue before the days of microcomputers) was an excursion made to the Bathurst region to collect specimens of *Coenonypha inornata* and *Lycaena dorcas dospoassosi* with then Natural Science Curator, David Christie (Christie 1970).

In 1977, no doubt prompted in part by this organizational work on the collection, and with an agreement between the NBM Administration and Christie that the latter's salary during a 6 month leave would be used to improve lab and storage conditions (D. Christie pers. comm. to DFM), five steel Lane entomology cabinets (each able to accommodate 25 Cornell insect drawers) were purchased. With this, the insects were moved from their coal-dusted storage room into the main natural science collections area. Insufficient funds were available to permit the purchase of Cornell drawers, so plywood inserts were added and the undersized NHSNB cases laid on the supports. Nonetheless, the collection was now secure from pests and easily accessible. It had been 45 years since the NBM had first taken procession of the NHSNB insect collections.

By 1983 a large-scale reorganization of the NBM natural science collections was underway, with initial funding provided through the federal Museums Assistance Program (McAlpine 1986a). Several entomologists who examined the collection about this time estimated, perhaps over-generously, that 13,000 specimens were present (McAlpine 1986b). Donations in 1987and 1991 of ~3000 pinned Lepidoptera by local collectors Jim Edsall and Dick (R.H.) Peterson justified the purchase of additional cabinetry. Since then, regular donations of specimens as well as insects collected during NBM-supported field programs, have promoted significant growth in the collection. The appointment

of NBM Research Associates in entomology, Mr. Paul Brunelle (Odonata; Fig. 4) and Dr. Reginald Webster (Coleoptera, Lepidoptera; Fig. 5) in 2001 and 2004 respectively, has helped to broaden the expertise associated with the collection.

Fig. 4. Paul Brunelle, NBM Research Associate in entomology, about to set off for Taylor Meadow pond in the Jacquet River Gorge Protected Natural Area in his "odemobile" (NBM/D.F. McAlpine photo).

Fig. 5. Reginald Webster, NBM Research Associate in entomology, instructs student Aaron Fairweather in some of the finer points of insect identification during the Jacaquet River Gorge Bioblitz (NBM/D.F.McAlpine photo).

In 2003 the NBM entomology collection was moved into a separate "insect" room of dimensions 4.6 m x 8.5 m off the bird/mammal range. This provides room for some expansion, as well as the option to isolate the collection for better routine pest control. Internet access to the NBM science collections through the NBM website was first provided in 2002, and since 2003 concerted efforts have been made to digitize the NBM insect collections and make associated information internet accessible. Although much work remains in completing the databasing of the NBM insects, some significant blocks of the collection (Odonata, most Coleoptera, Culicidae, Saturnidae, Sphingidae, some Siphonaptera) are now fully on-line. Most databasing of the entomology collection has been carried out with external funds, usually by long-term casual employees (frequently recent BSc graduates in biology).

Scope of the Collection

The NBM insect collection currently consists of 30 steel cabinets (25 glass-toped drawers each) organized with Cornell foam-bottomed pinning trays. Four sections of Spacesaver steel shelving also hold wet collections of larval odonates, Culicidae, Trichoptera and slide mounted Siphonaptera. Slide mounts are stored 100/box in vertically orientated slide boxes (meaning the slides are resting in a horizontal position, thus preventing drift of the specimen through the mounting media to the edge of the cover-slip). Wet collections, in 70% ETOH, are generally stored in vials organized by genus or species and placed in larger ETOH-filled jars on shelves. Most odonates, and increasingly butterflies, are stored unspread in mylar envelopes. Drawers of enveloped insects are integrated into cabinets with collection trays of pinned insects. Collections are organized phylogenetically to family and arranged alphabetically by genus and species; specimens have been assigned catalogue numbers and databased by lots (same catalogue number for a series of specimens of the same species collected at the same place on the same date) using the software package InMagic.

Currently 27,349 specimen records representing an estimated 80,000 specimens are fully databased and internet accessible through the NBM website (http://www.nbm-mnb.ca/). Public access through the website provides information in a subset of the data fields (i.e. locations to county only), but researchers can request a temporary password for access to the full data on each specimen. Some specimen records, mostly Lepidoptera,

have been uploaded to GBIF (Global Biodiversity Information Facility). The NBM also has a data-sharing agreement with the Atlantic Canada Conservation Data Centre, which has an interest in the growing number of conservation-listed species in particular.

Recent growth of the collection got underway in 1987 with the donation of about 4,000 slide mounted Siphonaptera from N.R.Brown (Brown 1955, 1968), including the holotype material for *Ceratophyllus sternacuminatus* Brown 1968, along with the aforementioned Lepidoptera from the Edsall collection. The flea collection was further expanded with the 2005 acquisition of ~11,000 Siphonaptera slides and some thousands of samples in ETOH from D.A.Smith (formerly of Carleton University). Additional significant donations have included odonates (P.Brunelle, D.A.Doucet, J.Edsall, J.Clifford, K.Dexter, D.J.Giberson, R.W.Harding, A.W.Thomas, D.L.Sabine), Coleoptera (J.Cook, R.F.Miller, M.Turgeon, R.P.Webster), tabanids (A.W.Thomas), and Lepidoptera (J.Edsall, D.Gaskin, R.H.Peterson A.W.Thomas, R.P.Webster,). Large series of wet collections of aquatic insects (mostly Ephemeroptera and Trichoptera), as yet uncatalogued but mostly identified, were also received from the NB Department of the Environment as a result of river classification surveys during the early 1990s. Material collected 1915-1999 by Forestry Canada has on several occasions been moved to the NBM due to space constraints and the feeling that the specimens were surplus to Forestry Canada needs. A large collection of identified mosquitoes, including most species known from the province (Edsall et al. 2010), was offered (frozen in gelatin capsules) to the NBM in 2004-05. The NBM located funds to database representative specimens and contracted Jim Edsall to point these. Most insects in the NBM are from the Maritimes, particularly New Brunswick and Prince Edward Island (from the latter, mainly odonata, collected by the remarkably energetic Robert W. Harding), but there are small numbers of specimens, particularly among the Lepidoptera and Coleoptera, from outside Canada, particularly the US and Central and South America. In addition to insects the NBM also houses the Herbert Habeeb water mite collection, currently on long-term loan to Dr. Ian Smith, Agriculture Canada, which includes 100+ holotypes, 2500 slides and some 4000 specimen lots in vials.

Although a significant part of the collection (perhaps 50%) consists of macro-Lepidoptera, this is not considered one of its strengths, nor is it the area under most active development (but see reference below to the Maritimes Butterfly Atlas). Regional strengths include adult and larval Odonata, mosquitoes, and some groups of Coleoptera (Carabidae, Staphlinidae). About 8% of the estimated 40,000 odonates (11,660 records) in the collection are identified larvae or exuviae. While regionally strong in Siphonaptera, the Smith material is mainly from Ontario. The mosquito specimens (~18,000 specimens in 2568 records) were mainly collected in 1999-2000 during NB West Nile investigations sponsored by the NB Department of Health. There is a very small, as yet only partially unorganized, spider collection. Active areas of collections growth through NBM-supported field work currently focus on Odonata, Coleoptera and Orthoptera, but donations of other insect groups are actively encouraged and welcome.

Additional to the recent insect collections, the NBM houses insect fossils from the Devonian fern ledges site near Saint John, including *Xenoneura antiquorum*, referenced in Charles Darwin's Descent of Man (1873; see Miller and Buhay 1988), fossil arachnids (Miller and Forbes 2001, Dunlop and Miller 2007), and late-glacial Quaternary beetle material from the work of R. F. Miller, the NBMs current Research Curator of Geology and Paleontology (Miller and Elias 2000). The collection is supported by one of the best natural history libraries in the Atlantic region (although perhaps not yet as strong in entomology as some other areas), including some 6,000 book titles in the sciences and over 350 scientific periodical titles. A growing collection of entomological reprints is housed and maintained in the Department.

Services and Current Programs

Like any public museum supporting a research collection, the NBM offers loans of specimens from its entomological holdings to individuals associated with other institutions. Graduate students are asked to have their supervisor sign-off on loans and take responsibility for loaned material. Loans are processed and tracked by Mary Sollows (mary.sollows@nbm-mnb.ca), Curatorial Assistant in Zoology. Over the past 5 years (2006-2010) the NBM has averaged 3.8 research loans from the entomology collection annually (range 2-6) totaling 8,112 specimens. While the NBM does not employ a dedicated Curator of Entomology, its current Curator of Zoology nonetheless fields numerous questions from the public and the media dealing with entomological topics and routinely identifies or arranges for the identification of insects for the public, as well as municipal, provincial and federal agencies, particularly in southern New Brunswick. Without a university program in entomology or an entomologist at the nearby UNB Saint John (UNBSJ) campus or direct access to NSERC funding, curatorial staff at the NBM have become adept at sourcing external support for both the curatorial and research functions of the Museum. Over the past 3 years ~ $40-$50 k has been raised annually that has directly supported NBM programs (mainly databasing) in entomology. The hope is that continued growth of the collection will eventually lead to the filling of a full-time NBM position in entomology, although current financial constraints make that unlikely in the short-term.

Nonetheless, the NBM is increasingly active in conducting or sponsoring field projects that include an entomological component. The NBM Florence M. Christie Research Grants were established in 1988 and have provided small sums annually ($1000) to one or two established researchers or graduate students. Several projects in entomology have been supported, most notably work by Paul Brunelle (Brunelle 2000) that led to the description of *Neurocordulia michaeli* Brunelle, and a project examining mayfly diversity by UNB Ph.D. candidate Alexa Alexander. A small contract issued in 2004 to Henry Hensel, a noted amateur lepidopterist resident in Edmunston, N.B., produced a useful synoptic collection of the moths of that region.

A 2005-2007 Social Sciences and Humanities funded CURA (Community-University Research Alliance) project with UNBSJ saw 3 years of intensive inventory and monitoring of odonates by students in Rockwood Park (including a series of transects on lakes from which exuviae were removed weekly), with support from Brunelle. At ~870ha this is one of the largest urban wildlands in North America. The resulting database of 55 odonate species led to a 1-day trial "citizen science" monitoring project ("Dragons in the Park") in 2007 with a group of students from Korean National University, engaged in a UNBSJ ESL program (Fig. 6). The project was successful and is scheduled to run again for the general public over a week-end in July 2011.

Fig 6. Student participants in the "Dragons in the Park" odonate monitoring program organized by the NBM (NBM/ D.F.McAlpine photo).

Through 2006 - 2008, Dr. Stephen Clayden, NBM Research Curator of Botany, in partnership with Dr. Reginald Webster, examined the lichen and beetle communities of old-growth NB cedar stands. The work revealed numerous species among both groups new to the region, and some new to science and as yet undescribed. The work also led directly to the protection of several sites under the provincial Protected Natural Areas Act. In late 2010 the NBM CBR (Centre for Biodiversity Research), in partnership with NRC Research Press, Agriculture and Agri-Food Canada, and Environment Canada, released the 785 page volume, "Assessment of Species Diversity in the Atlantic Maritime Ecozone" (McAlpine and Smith 2010). Among the books 31 comprehensive chapters are 13 contributions from specialists dealing with various groups of insects and mites in the region. The advent of the Atlantic Canada Conservation Data Centre-organized Maritimes Butterfly Atlas in 2009, with NBM representation on the Steering Committee, has also focused attention on the NBM archival role in maintaining a regional insect collection and supporting entomological research.

Concurrent with the establishment of the CBR, and in an effort to address deficiencies in knowledge of the biodiversity of New Brunswick's 61 Protected Natural Areas (PNAs), the NBM initiated an intensive program of long-term, broad-based, volunteer-supported, biological inventory of the 10 largest PNAs (McAlpine 2009). The first of what will be a series of programs in each PNA, was conducted in the 23,000 ha Jacquet River Gorge (JRG) PNA in 2009-10 near Dalhousie, in northern NB (Fig 7). In 2011 a similar program will start in the much smaller (~3000 ha) Caledonia Gorge (CG) PNA in southeastern NB. The program has brought together 25-35 experts and students, in a collegial atmosphere (Fig. 8), from Canada and the US. Two weeks are spent engaged in intensive biological inventory at each site in each of 2 consecutive years. All of the NB PNA sites are poorly known

Fig 7. Participants in the 2009 Jacquet River Gorge Bioblitz (NBM photo).

entomologically. Although data from the JRG PNA is still being compiled, several thousand new species records for the site (including one or more undescribed species) have been collected. Vouchers for all specimens are being housed in the NBM, with data eventually placed on-line. Emphasis in the JRG was placed on Odonata, Coleoptera, butterflies, Syrphid flies, and Orthoptera. Work in 2011 in CG will include most of the same taxa, as well as tabanids, moths, and ants.

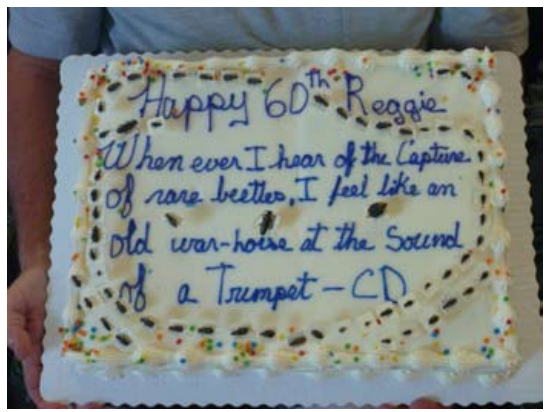

Fig. 8. Reginald Webster celebrated a birthday at the Jacquet River field camp with a coleopteran-decorated cake (NBM/DF McAlpine photo).

Acknowledgements

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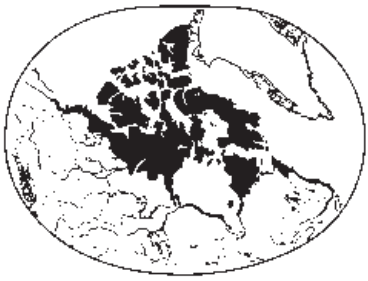

Arctic Corner

News about studies of arctic insects

Fifty years of High Arctic Entomology: Hazen Camp on Ellesmere Island

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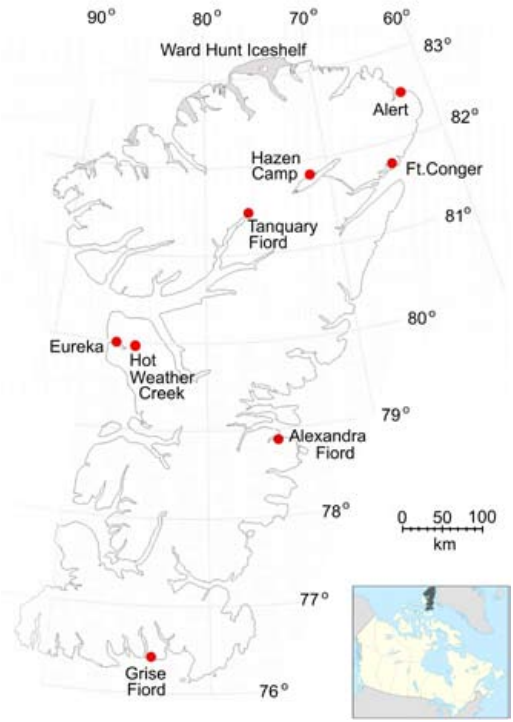

Lake Hazen (Fig. 1) has been described as one of the best-studied high arctic locations in the world (Hattersley-Smith 1974, Dick 1991), and it has a unique entomological history that continues to this day. It had its start as a glaciology field camp during the International Geophysical Year (1957-58), and entomologists associated with the Northern Insect Survey (NIS; 1947-62) began working at the site in 1961 (Hattersley-Smith 1974). The Northern Insect Survey was succeeded by a program called "Studies in Arctic Insects", which maintained a presence at Hazen Camp until 1968 (Riegert 1999). In 2010, an ambitious project (Buddle et al. 2008) was launched to compare present-day distribution and ecology of insects and arachnids in northern Canada to data from the Northern Insect Survey (NIS) a half century earlier. Most of the NIS sites were sampled for only one or two seasons, in keeping with its "survey" mission, but Hazen insects were studied for eight consecutive summers (1961-68). Therefore, Hazen was high on the "hit list" to revisit and resample for the new northern survey. One of us (DJG) was on the 2010 team to Hazen, and couldn't help but drink in the entomological history of the place. The other (JDS) was part of the 1967 team that spent a full summer at Hazen.

Fig. 1. View of Hazen Camp and Lake Hazen from the hills above Camp in 1967 (left; J.D.Shorthouse photo) and 2010 (right; D.J.Giberson photo). The map at upper left shows the main sites of scientific interest on Ellesmere Island, detailed below and in tables 1 and 2.

In early 2011, we had a chance to compare notes about our respective trips, resulting in this article. Initially, we had thought to present a simple comparison of our experiences in the same locality more than 40 years apart, but it is difficult to think of Hazen camp in isolation from its history. Therefore, we present a brief account and a selection of photos of Hazen Camp from our own trips, and we also include some historical information to put Hazen into the perspective of the early days of high arctic exploration, the establishment of the Northern Insect Survey, its connection to the Canadian military, and other high arctic entomological studies.

Lake Hazen is the largest lake in the world entirely above 74°N (Parks Canada 2011; International Lake Environment Committee 2011), covering approximately 540 km^2 and measuring ~70 km long and ~260 m deep. It is located in the Hazen basin in northern Ellesmere Island, ~900 km south of the North Pole, in what is now Quttinirpaaq National Park (Quttinirpaaq means "top of the world" in Inuktituk; Parks Canada 2011). Glaciers cover about 1/3 of the National Park area (Parks Canada 2011), and the lake is fed by glacial melt streams from the south and west, and drains northeast towards the arctic ocean through the Ruggles River. The area is a polar desert with less than 150 mm/yr water equivalent. It is uniquely situated within a valley shaped so that solar radiation is reflected off the mountains and lake ice, resulting in the area becoming a "thermal oasis" in summer (Thompson 1994, cited from Smith 2000), with temperatures that are much warmer than expected for the latitude. Plant and animal diversity is surprisingly high, one of the reasons for the long-running scientific interest in the area.

The 1967 Centennial Operation Hazen Expedition (Joe D. Shorthouse)

By 1967, entomologists from the federal Department of Agriculture and several Canadian universities had been travelling to Lake Hazen for 6 years, collecting data on distribution and ecology of insects and arachnids in this high arctic locality. (Some of the Lake Hazen insect projects are listed in the Bibliography at the end of this article.)

Fig. 2. Entomology researchers at Camp Hazen in 1967. From left: Ken Richards, Joe Shorthouse, Peter Kevan, and Royce Longton Photo: J.D.Shorthouse

The 1967 team (Fig. 2) consisted of University of Alberta entomologist Brian Hocking and three University of Alberta students (Peter Kevan, Ken Richards, and Joe Shorthouse), all of whom went on to long careers in entomology or agriculture. Peter G. Kevan, the project leader, was a Ph. D. candidate studying insect-flower relationships. He went on to become university professor at University of Guelph and currently leads a major NSERC-funded project on pollination. Kenneth W. Richards was an M. Sc. candidate studying ecology of two species of bumblebees and later became a research scientist with Agriculture and Agri-Food Canada, based in Lethbridge and then Saskatoon. Joseph D. Shorthouse was the youngest member, at age 20 (below the drinking age of the time!) and was a 2nd year undergraduate student at University of Alberta. His role on the expedition was to spend 1/3 of his time as a research assistant for Peter Kevan, 1/3 of his time as camp assistant and the remainder studying thermoregulation of arctic Lepidoptera. He finished his degree and went on to do graduate studies, eventually becoming a university professor at Laurentian University. Dr. Brian Hocking (Head of Department of Entomology at the U of A) accompanied the team to Hazen for two weeks to open the camp and get the projects started, then left in early June. A fifth and unexpected team member was Royce Longton, a bryologist, then of the University of Birmingham (UK). He joined the camp for the latter part of summer, arriving on July 20. After 10 years at the University of in Manitoba, he moved to Reading University where he became Head of the Department of Botany. After retirement, he entered British politics.

The University of Alberta team left Edmonton on May 23, 1967 on an Armed Forces Hercules bound for Resolute Bay on Cornwallis Island. The next day, they left Resolute for Eureka on northwest Ellesmere Island on an Atlas Aviation twin otter WWP (first twin otter

made by Bombardier). Then from Eureka, they flew to Lake Hazen and landed on the ice of Lake Hazen near the camp (Fig. 3). They spent the next couple days opening the camp which consisted of two Attwell huts (constructed of insulated canvas stretched over wooden frames; Fig. 4) – one for eating and one for a laboratory (some of the structures present in 1967 were later removed by Parks Canada after the area became a National Park). A pit dug into the permafrost was also covered by a shelter and insulated, serving as a cold room to keep food from spoiling (See Fig. 13 on p.22).

Fig.3. Twin Otter landing on the ice of Lake Hazen (Photo: J.D.Shorthouse)

Fig. 4 Attwell Shelter at Hazen Camp in 1967 (Photo: J.D. Shorthouse)

Each person had his own tent for accommodation (Fig. 5) and eating was a communal activity. Food consisted of canned or freeze-dried meats, vegetables, fruits, dried eggs, canned fish, crackers and other dried goods. All cooking was done on a stove heated with oil. Each team member shared in kitchen activities and a typical day consisted of getting cleaned up with water from the icy lake, preparing breakfast, packing lunches for field trips to collect data, and returning at a designated time for supper. The meals were supplemented with arctic char caught in the narrow areas of open water along the shoreline (Fig. 6). Since the sun revolved around the horizon at about a 40° angle resulting in 24 hours of daylight, a decision was made at the beginning of the season as to the times when the team would sleep and work. A highlight each evening was the scheduled radio call (the "sked") with Tanquary Fiord, the only contact with the outside world (Fig.7). Messages could be relayed between team members and their families in the south, but the messages were passed through several stations and sent to an amateur ham operator in Edmonton for distribution. Such a system, which usually required spelling each word with internationally recognized words for each letter, often resulted in amusing and incomprehensible messages. On a few occasions, aircraft from other arctic camps landed at Hazen bringing mail, more film, and once, two highly appreciated fresh chickens.

Fig. 5. Joe Shorthouse beside tent in 1967 (Photo: K.W.Richards)

Fig. 6. Joe Shorthouse fishing for arctic char in Lake Hazen in 1967 (Photo: K.W.Richards)

Fig. 7. Peter Kevan on the regular "sked" radio call to Tanquary Fiord. (Photo: J.D. Shorthouse)

It was cold and snowy in the spring when the team first arrived, but soon the days became warmer as the short arctic summer began. The long summer days meant long hours of working, but there was also time for exploring and climbing nearby mountains. The lake never did completely open up that year, and remained ice-covered the entire summer except for some open leads and melting along the shore. The lake ice allowed team members to walk to John's Island (a large island just off shore from Hazen Camp; Fig.8A), where they examined interesting geological features along large cliffs and massive spheres of sandstone rock (Fig. 8C). A popular hike was to climb Blister hill just behind camp, and walk up Skeleton Creek, so named because of the number of muskox skeletons in the valley (Fig. 8D). The hummocky ground, formed from erosion between mats of White Mountain Avens (*Dryas octapetala*), made for challenging walking, but other mountains they "conquered" included Mount Omingmak and Mount McGill. Since it was Canada's centennial year, the team mounted a centennial flag on the radio tower and also took flags to the tops of nearby mountains for display (Fig. 8A & B).

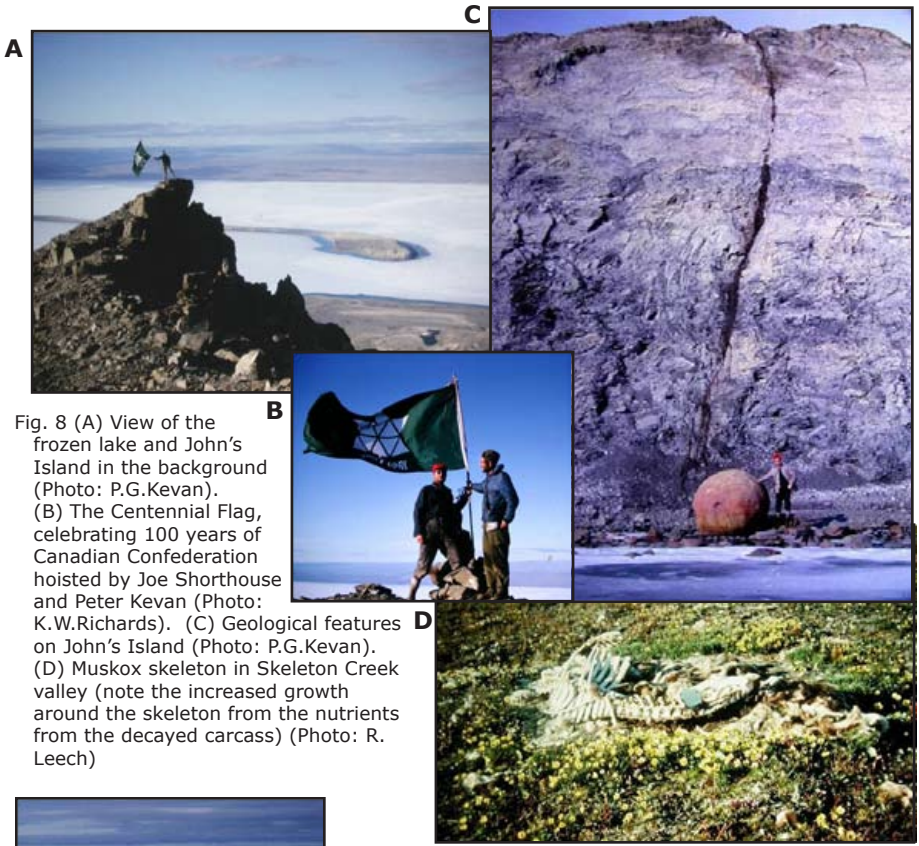

Fig. 8 (A) View of the frozen lake and John's Island in the background (Photo: P.G.Kevan). (B) The Centennial Flag, celebrating 100 years of Canadian Confederation hoisted by Joe Shorthouse and Peter Kevan (Photo: K.W.Richards). (C) Geological features on John's Island (Photo: P.G.Kevan). (D) Muskox skeleton in Skeleton Creek valley (note the increased growth around the skeleton from the nutrients from the decayed carcass) (Photo: R. Leech)

Fig. 9. Author Joe Shorthouse, during his summer at Camp Hazen in 1967 (Photo: P.G.Kevan)

Despite the hard work, it was a life-changing experience for the young undergraduate student, Joe Shorthouse, and even resulted in a publication for the neophyte entomologist, a paper coauthored with Peter Kevan on thermoregulation of high arctic butterflies which appeared in the journal 'Arctic' (Kevan and Shorthouse 1970). Upon returning to Edmonton, Shorthouse discovered the joy of making illustrated presentations on his Hazen experience, wrote semi-popular articles on Hazen, and decided he was going to enter graduate school and become a university professor where he could travel to other regions of Canada and the

world and return to explain his discoveries to others. At the end of the season, the team closed the camp, and flew out of Lake Hazen on August 20 to Resolute, via Tanquary Fiord (just south of Lake Hazen) and Thule Airbase on Greenland. They then flew from Resolute to Edmonton on August 23.

Fig. 9. Hazen Camp: Left: the Camp in 1967 with white canvas tents (Photo: J.D.Shorthouse); Right: a somewhat more colourful camp in 2010 with bright nylon tents (Photo: D.J.Giberson)

The 2010 Northern Biodiversity Program (NBP) Hazen Expedition (D.J. Giberson)

Two NBP teams of four people each, headed north in 2010, each to sample three arctic localities sampled during the original Northern Insect Survey. The team heading to Lake Hazen in July consisted of University of Prince Edward Island Professor Donna Giberson, and three students: Sarah Loboda and Meagan Blair, MSc students from McGill University, working on spiders and flies respectively, and Christine Rousell, a Biology undergraduate student from the University of PEI. The team had already spent time collecting near Goose Bay, Labrador, and Schefferville, Quebec, before heading north to Hazen, via Ottawa, Iqaluit, and Resolute. The Hazen part of the summer collecting took place during the last two weeks of July.

Fig. 11. The 2010 Camp Hazen team: Left: Author Donna Giberson (Photo: C.Roussel); Right: Meagan Blair, Christine Roussel, and Sarah Loboda (Photo D.J.Giberson)

There were some strong differences, but also some eerie similarities between these two Hazen expeditions, more than 40 years apart. One of the biggest differences was that the 2010 expedition team was an all-woman team; a sharp contrast to the all male teams of the 1960s. This, coupled with the new status of the area as a National Park, led to very different bathroom arrangements in camp (there are no trees to hide behind on the tundra,

Fig. 12. "Outhouse" arrangements in 1967 (left; photo J.Shorthouse) and 2010 (right; photo D.Giberson).

even if Parks Canada was willing to let researchers use them) (Fig. 12).

Another difference was that things were more high-tech in 2010 compared to 1967 (Fig. 13); Hazen camp is now a Parks Canada station in the summer, complete with one or two staff members, solar panels for electricity, a propane fridge and stove for cooking, and satellite telephones that supplement (though not replace) the daily radio check-in (the "sked") with Resolute. Accommodation was still in individual tents, though they didn't look much like the 1960s variety, and cooking and eating was still done in the original Attwell Kitchen Shelter, now refurbished and restored by Parks Canada (along with another original shelter which serves as the radio room and warden's quarters and the "cold room" dug into the permafrost). The old Attwell Lab shelter of 1967 was replaced by a high tech laboratory supporting a variety of research projects (part of a grant supporting climate change research to Dr. Vince St. Louis, of the University of Alberta). Also new for 2010 was infrastructure funding relating to the International Polar Year to Parks Canada to upgrade solar panels and construct two new sleeping shelters to provide housing for researchers and park staff while at Hazen. Like the 1967 team, though, food for the 2010 team was mainly dried or canned food that could be prepared easily and quickly, so that we could be in and out of the kitchen quickly to make room for other researchers and camp staff.

Fig. 13. Clockwise from top left: Christine Roussel making the regular satellite phone check-in call to fellow NBP team members in Iqaluit; Tents used in 2010; Pauline Scott (Parks Canada) preparing a meal in the refurbished Attwell Shelter; Installation of new sun-tracking solar panel as part of 2010 construction work; Stowing the biweekly food order in the "cold room" - a covered pit dug into permafrost (all photos: D.Giberson); The cold room shelter in 1967 (photo: J.Shorthouse)

Although research in arctic localities is easier than it once was (an understatement!), there are still some challenges involved in northern travel. An added job for today's northern researchers is the bundle of permits that must be applied for and received before any travel can occur. For Hazen Camp, permits are handled through Parks Canada (in our

year, we were shepherded through the process by Parks Canada staff member, Jane Chisholm), but for other northern sampling, combinations of territorial wildlife and traditional knowledge permits and Fisheries and Oceans permits may also be necessary. The actual travel to Hazen Camp now involves flights to Resolute Bay via commercial carrier, rather than a military Hercules, though the final leg is still by Twin Otter. Logistics are now handled through Natural Resources Canada's Polar Continental Shelf Program (PCSP; based in Resolute). Unfortunately, the same sort of difficulties plague current air travel as were common in the `60s; we enjoyed a 3-day layover at Resolute due to fog and high winds which kept the Otters grounded. One major difference was that the layover in Resolute came with posh accommodation in the new PCSP facility, where the chief crisis among the students appeared to be the slow internet connection.

Fig. 14. Twin Otter arriving in camp in July 2010.

The 2010 project involved sampling ground and aerial insects through a variety of techniques, including pan and pitfall traps, Malaise Traps, sweeping, aquatic kick/dip net sampling, and hand searching, all in a variety of wet and dry habitats (Fig. 15). The methods were standardized to be comparable for all Northern Biodiversity Program sites, to provide information on species diversity as well as ecological patterns. Traps were set up mainly in Skeleton Creek valley, a few km behind the camp, and were checked regularly through our two week visit, along with sampling forays to all accessible aquatic habitats. A highlight was a trip across the lake by helicopter, arranged by the Park Manager (Ross Glenfield), and made possible by all the construction going on in the camp that summer. This allowed the team to sample aquatic habitat well out of the range of our foot travel, especially the Ruggles River outlet to the lake. Ross and Alex Stubbings (another Parks Canada staffer) provided important advice on sampling sites and how to get to them, making it possible to be productive, despite our short trip.

Fig. 15. Insect sampling around Hazen Camp in 2010; Sarah Loboda, Meagan Blair and Christine Roussel-setting up Malaise trap (left) and sweeping vegetation (middle) in Skeleton Creel valley; Rght: Christine taking kick sample in Ruggles River, the outflow to Lake Hazen (photos: D.Giberson)

"Off" days allowed for opportunistic collecting when the weather cooperated and exploring around camp. The students especially took advantage of this, and climbed Blister Hill and nearby Mount McGill, though unlike the 1967 students, they didn't have flags to display at the top. Our visit coincided with one of the rainiest summers in the memory of the local Park staff, so it was an uncharacteristically damp "polar desert". It was also uncharacteristically windy, resulting in flights that were often shut down or delayed. Winds caused the ice to break up on the lake near the end of July, providing team members with the relatively rare sight of a completely open Lake Hazen. Students on the 2010 trip were sometimes stressed, especially on cold, windy and wet days, by not being unable to contact their friends in the south through internet and cell phones, though they could while away the bad weather watching DVDs on their laptop computers. In contrast, at the time of the 1967 expedition, no one had heard of the internet, cell phones, computers, digital cameras or even hand-held calculators!

Fig. 16. View of camp with new sleeping shelters constructed in 2010.

Although the 2010 entomology team was small (only 4 people), the camp was a hive of activity (Fig. 16). Parks Canada was in the midst of a major clean-up of toxic wastes left behind by early explorers and researchers at Ward Hunt Island and Ice shelf (to the north) and Fort Conger (best known as Peary's staging site for his attempts at the North Pole), and had received funds for remediation of the historic sites (see map, Fig. 1). Before the remediation could occur at Fort Conger, a team of Parks Canada archaeologists and historians had to ensure that the historical buildings and artifacts were preserved. The two weeks of entomological collecting in 2010 overlapped with other researchers studying arctic char and climate change effects on wetland carbon fluxes, construction workers enlarging the camp, remediation specialists working at the outlying sites, and a suite of Parks Canada staff members preserving the historical sites. At one point, the population of the camp was near 20, producing a colourful panorama of yellow, blue, and orange tents in front of the backdrop of the northern lake.

You don't have to be a young undergraduate entomology student to find a trip to Lake Hazen a life-changing experience. Everyone who spends time at this site comes away with a different view of life. Over the next two pages, we present a sampling of some photographs from our respective trips, then review some of the scientific and entomological history of the Lake Hazen area.

Fig. 17. Some of the insects seen around Camp Hazen in 1967 (top row; photos: J.Shorthouse and R.Leech) and 2010 (bottom row; photos: D.Giberson). Clockwise from upper left: butterfly visiting *Dryas octapetala* (White Mountain Avens) flower; moth visiting the same type of flower; Arctic woolly bear caterpiller and moth(*Gynaephora groenlandica)*; Caddislfy (*Apatania zonella*) adult perching on tent; mating midges perched on tent; grey moth on ground; recently captured butterfly posing for camera.

Fig. 18. Left: Joe Shorthouse holding muskox skull in 1967 (photo: P.G.Kevan) Right: Muskox skull found near Skeleton Creek in 2010 (photo: D.J.Giberson)

Fig. 19. Some of the wildflowers seen around Hazen Camp; top two rows: 1967 (photos: J.D.Shorthouse); bottom two rows 2010 (photos: D.J.Giberson)

Fig. 20. Photos from the 2010 expedition: Above: Meagan Blair and Sarah Laboda sweeping terrain around Ruggles River; Right: view of Lake Hazen from Skeleton Valley (Photos: D.J.Giberson)

Fig. 21. Transportation in the north is half the fun: top row: loading Twin Otter at Tanquary Fiord in 1967 (photo J.Shorthouse) and Joe Shorthouse driving Bombardier used for camp chores at Lake Hazen (Photo: P.G.Kevan); bottom row: Otter landing and being unloaded in 2010 (photos: D.Giberson)

Fig. 22. The camp today: Left: A National Park sign welcomes visitors to Hazen Camp today. Right: aerial view of camp in July 2010 (Photos: D.J.Giberson)

Fig. 23. Some of the wildlife seen in 2010. Left: Arctic hares feeding on airstrip in Eureka (note flat tire on Twin Otter); Centre: Longtailed Jaeger feeding on Red Poll chick at the edge of camp; Right: Red Knot posing on rock above camp (Photos: D.J.Giberson)

The historical notes that follow give a brief summary of some of the history of Lake Hazen and its environs, much of which has been gleaned from publications relating to the DRB by Geoffrey Hattersley-Smith (1974) and Lyle Dick (1991), and to the Northern Insect Survey by Reigert (1999) and Danks (1981).

The Northern Insect Survey (1947-62) & the "Studies in Arctic Insects" project

In the period immediately following World War II, the Department of Defense created an organization with a mandate to undertake research into areas of interest to the Canadian military (Hattersley-Smith 1974). Not surprisingly, encounters with biting flies near the warning stations in the early days of the Cold War led to these insects being considered as part of the military mandate. This resulted in a collaboration between the newly created Defense Research Board (DRB) and entomologists in the Canadian and American federal Departments of Agriculture, to study the ecology and management of biting flies in the arctic, and the Northern Biting Fly Survey was created in 1947 (Reigert 1999). An expert panel set up to review projects for the DRB included entomologists from the Department of Agriculture, and eventually from Canadian Universities, and led the way for an even more ambitious project, the Northern Insect Survey.

For entomologists, the DRB was notable in that it funded and provided logistics for 16 years of insect study in the Canadian north through these two survey projects. It is easy to see how the Northern Biting Fly Survey fit into the DRB mandate, addressing questions relating to management and ecology of the mosquitoes, black flies, and tabanids, all of which were a summer scourge in the Arctic. The military context for the decision to fund and support more general biological studies (including vertebrates such as birds, mammals and fish, and botanical studies in addition to broader insect studies, is less easy to understand. Hattersley-Smith (1974) referred to the broad approach to northern science by the DRB as "enlightened", but also pointed out that setting up and supporting field stations and workers was a valid goal in terms of establishing Canadian sovereignty over its arctic territories. He concluded his retrospective chapter on Ellesmere Island studies by saying, "it would be well to invest strongly in scientific exploration as the cheapest and most effective means of demonstrating Canadian sovereignty there" (p. 99). He further noted that baseline data on climate, oceanography, geology and biology was critical for any future planning of military and civilian operations.

In the end, 72 sites across the boreal, arctic, and high arctic were sampled for insects with varying degrees of intensity (though generally only for one summer each), and hundreds of thousands of specimens were deposited with the Entomology Research Branch of Agriculture Canada (Reigert 1999). The work was carried out by students and staff associated with the Department of Agriculture and a few universities, most of whom had their salaries paid by the DRB, but were recruited through university entomology departments. At most sites, two men were transported to the locality by military planes and ships (usually a combination of Canadian and American Air Force planes), and they stayed in military or Hudson Bay Company housing or canvas tents, from which they spent the entire summer collecting insects. Reigert (1999) commented that "Young men with an interest in entomology and biology were recruited from the ranks of undergraduate and graduate students at Canadian Universities. They not only had to be physically capable of withstanding the rigours of climate and the austerity of the terrain in northern Canada, but hopefully they would also be capable of bearing the stress of isolation" (p.19). The "all-male" make-up of the teams was likely a DRB requirement, because of military regulations at the time. Probably one of the biggest changes in high arctic research in the past 50 years is the increasing role of women in the research teams.

But even with this broad support for entomological research across Canada, Lake Hazen was a special case. At the point that entomological studies were just getting started at Hazen, DRB stopped funding northern insect work and the Northern Insect Survey wound down in 1962 (Reigert 1999). The new Entomology Research Branch at the Department of Agriculture was ready to step in and keep northern studies going, with new funding, and a new mandate. The "Studies in Arctic Insects" project moved beyond the survey work to address questions on insect ecology and behaviour, and the ecological work initiated at Camp Hazen was encouraged and supported through this project. Today, we know much

about life cycles of high arctic woolybear caterpillars, thermoregulation in butterflies, pollination of high arctic flowers, and many other ecological questions because of the insight of research scientists at the Department of Agriculture (now, Agriculture and Agri-Food Canada) during the early 1960s. To appreciate the uniqueness of Hazen Camp to the history of Canadian northern science, it is important to understand how the camp started, and what other research has occurred there. In the next sections, we summarize the history of Hazen research camp, provide tables giving the dates of many research and exploration milestones relating to Lake Hazen and the high arctic islands, and provide a partial bibliography of published research relating to the area.

History of Hazen Camp, Ellesmere Island

Hazen Camp was established in 1957 by the Defense Research Board (DRB) of Canada, as part of Canada's contribution to the International Geophysical Year (IGY; 1957-58), with a primary focus (at least at first) on geophysics and glaciology (Hattersley-Smith 1974). The logistics of setting up a major research program in a place as isolated as Lake Hazen were daunting, but were made easier by the creation of the DRB a decade earlier (Hattersley-Smith 1974, Reigert 1999). Thanks mainly to the developing "Cold War" between the USA and Soviet Union, research activities quickly developed a focus on the north. Not only did Canada find itself positioned between two major superpowers, but the Canadian military was also looking for peacetime training exercises to challenge its troops. Developing expertise in moving around the Canadian north was important for both roles (Hattersley-Smith 1974, Dick 1991). The DRB expert panel established priorities for scientific research (including studies on geophysics, glaciology, meteorology, wildlife biology, botany, and soils), and provided logistics for getting scientists into the field (Hattersley-Smith 1974).

Research at Lake Hazen for the IGY was a continuation of DRB glaciological and meteorological work begun on the ice-shelves and ice islands off northern Ellesmere in 1953 and 54, with a focus on the ice-caps on the northern part of the Island. Lake Hazen was chosen for the site since it gave good access to freshwater, glaciers were nearby, and it had a good landing field on the frozen lake for most of the year. Reports from early exploration teams indicated that the weather was better there than most places at that latitude, and it was virtually unexplored scientifically (Hattersley-Smith 1974). Since DRB had coordinated the expeditions to the Ward Hunt Ice Shelf (1953-1954), it seemed natural for them to also coordinate the logistics of the Hazen International Geophysical Year project at Hazen (Dick 1991). This was a period of major transition in arctic research; prior to the war, most access to the high arctic was by ship and then overland by human-power or dog-sleds (Hattersley-Smith 1974). After the war, aircraft and pilots were available to provide access to the north. The DRB ice-shelf team (consisting of G. Hattersley-Smith and R.D. Blackadar) still travelled overland on foot and by dogsled during 1953-54, but they started their journey at Alert (a weather station on northern Ellesmere Island established in 1950; see map, Fig. 1) after flying there via the Thule Air base on the west coast of Greenland (Hattersley-Smith 1974). By the 1957 opening of Hazen Camp, planes were used extensively to transport supplies, equipment, and people to the base-camp site, and even to move among study sites; a major change from expeditions even just a few years earlier.

The camp at Hazen Lake was continuously occupied from spring 1957 to late summer 1958 for geophysical and meteorological measurements (Hattersley-Smith 1974). That first summer (1957) saw spring airlifts by the RCAF and helicopters from US Navy and coastguard icebreakers. A C-119 (flying boxcar) made 10 landings on the frozen lake bringing in 8 men, 2 dog teams, 35 tons of stores, fuel, and equipment, and heavy machinery such as tractors, bull dozers, and snow machines from the staging area at Fort Churchill (Hattersley-Smith 1974). Attwell and Jamesway shelters (consisting of insulated canvas stretched over wooden frames) were used for accommodation and lab space, and some of these are still in place at the camp (Dick 1991, and DG, personal observation).

Only a few of these men stayed at Hazen camp, as most were at a second camp on Gillman Glacier, above the lake. The "summer crew" left in mid-August, and were replaced by a team of four from McGill University who wintered at Hazen Camp. This winter was notable as it provided the first record in northern Canada of weather conditions at an inland high arctic locality. The temperatures turned out to be colder than those reported at Alert, to the north, but lack of wind and snow prompted the team to report that the winter was not too difficult, even though radio contact was lost for most of the winter (Hattersley-Smith 1974). The winter crew were replaced by a group of 19 men in the spring of 1958, and this time most of the workers were based at Hazen Camp, and carried out a variety of field studies into botany, plant ecology, microclimates, limnology and fisheries, wildlife biology and archaeology, as well as the geophysical work (Hattersley-Smith 1974, Dick 1991). Dick (1991) visited the camp in 1989 as part of a Parks Canada team assessing the historical resources remaining at the site, and reported that shelters, oil drums, and discarded equipment still remained (he was also a member of the 2010 team that travelled to Fort Conger to ensure that remediation efforts did not damage the historical resources still remaining there).

Research continued at Lake Hazen between 1959 and 1961 as part of the Canadian program of International Geophysical Co-operation (IGC). Field work was supported by DRB and the Arctic Institute of North America during this period, and consisted of glaciological, meteorological, soil and biological studies. Hattersley-Smith (1974) reported that at the end of the 1959 season (mid-August) the ice was too thick near camp to allow the float plane to land, so the team was forced to walk around the lake to the lake outflow, Ruggles River (a distance of 100 km) where there was open water. The float plane was able to take them to Alert, where they travelled south via Thule Air Base (Greenland) and Resolute Bay. 1961 was notable as it marked the first year of directed entomological studies. Since DRB was involved in funding the Northern Insect Survey at the time, it was natural for the DRB to extend an invitation to the Entomology Research Branch in Ottawa for a participant in the on-going Hazen Lake project. A young Don Oliver, newly granted his PhD from McGill University (Reigert 1999), arrived at the lake in mid-July, and set out surveying insects. Previous NIS sampling on Ellesmere Island by Paul Bruggemann at Alert (1951) and Eureka (1953, 1954) resulted in relatively few insects, but the Lake Hazen collecting showed a surprisingly high diversity of insects and arachnids for this latitude (Reigert 1999). Oliver collected about 140 species that summer, increasing the known species on Ellesmere from the 90 previously known (Hattersley-Smith 1974). The number of species has climbed to over 250 today.

Fifty years of Entomology at Hazen Camp, Ellesmere Island

Don Oliver's summer at Lake Hazen marked the start of 7 continuous summers of entomological study at the site, by teams of young men, many of whom went on to become well known entomologists and mentors to a new generation of entomologists. A list of participants between 1961 and 1966 (from Reigert 1999) includes P.S.Corbet, J.A.Downes, W.H.Forrest, J.A.H.Grey, B.Hocking, P. B.Kevan, R.E.Leech, I.C.Lindsay, R.B.Madge, R.H.Mulvey, D.R.Oliver, J.Parkes, T.L.Pickett, H.K.Rutz, D.B.Saville, D.Sharplin, and W.J.Williams. Since then, several other entomologists (including the authors) have had the opportunity to visit the site, as 50 years later, we can build on the work of these early arctic pioneers.

Table 1. Exploration and early science on Ellesmere Island and nearby arctic islands (key: (1): Riegert 1999; (2) Hattersley-Smith 1974; (3) Danks 1981; (4) Canadian Encyclopedia, Ellesmere Island entry. See Fig. 1 for locations.

Date	Activity
1818	John Ross discovered parts of the coastline during a survey of Baffin Bay (4)
1861	I.Hayes (surgeon from a Franklin search team) may have reached Lady Franklin Bay on NE Ellesmere Island (by dogsled from Greenland) (2)
1852	Inglefield expedition: Island named for the Earl of Ellesmere (4)
1871	American C.F. Hall reached 82º11' (north end of Robeson Channel) in Polaris, and was first explorer to see north coast of Ellesmere (2)
1875	British Arctic Expedition: seeking the North Pole (Capt G.S. Nares, RN: HMS Alert, H.F Stephenson RN: HMS Discovery) (2) - HMS Alert wintered at Floeberg Beach (82º27'N), a few km east of the modern station named for it (furthest north reached by a ship under her own power in NA waters until US icebreaker operations in 1948 (equalled in 1905 and 08 by R.E.Peary in Roosevelt). - HMS Discovery overwintered in Lady Franklin Bay (at Discovery harbour). - some scientific work was carried out, with some flora and fauna collections, some geological data, and meteorological data
1881-1882	1st International Polar Year (IPY): Greely expedition to northern Ellesmere island (through US army); orders to estab a scientific station north of latitude 81ºN(2) - landed at Discovery Harbour Sept. 1881, built Fort Conger (decision to build there based on geophysical observations and information on nearby coal deposits from British Arctic Expedition) - collected scientific data (magnetic observations, climate, pendulum, tidal and exploration, including a new furthest north record of 83º24' on Greenland coast; did some exploration of Ellesmere, and made extensive collections of flora and fauna and archaeology. Most of specimens were lost, however, due to their relief ship not reaching them, so having to retreat by foot in 1883. - 1882 (spring) - Greely led team up Chandler Fiord and up Ruggles River valley: discovered Lake Hazen, and visited terminus of Henrietta Nesmith glacier on southwestern side. -Trip notable for first real use of dogsleds, departure from early northern expeditions
1898-1902	Peary Expedition: Peary and his crew were the first (non-Inuit) to travel to northernmost part of Greenland and first to travel along whole north coast of Ellesmere as part of their bid to reach the north pole (1902). They made it to 84º17'N. Peary used Fort Conger as forward base and exploited game in the Lake Hazen area (2)
1901	2nd Norwegian Expedition (in the Fram: Capt. O.Sverdrup) was in 4th season in Queen Elizabeth Islands, and moved to NW Ellesmere Island (2). Explored and mapped Eureka Sound and environs by dog team including site of current Eureka Weather Stn. (These surveys advanced geographical knowledge of Queen Elizabeth Islands more than any other single expedition) His maps were purchased by Canada when the territory was claimed (4).
1905-1906 & 1908-1909	Peary expeditions: Peary returned to N. Ellesmere in 1905, this time wintering on Floeberg Beach; reached 87º06'N the next spring and traversed the north coast of Ellesmere and over to Axel Heiberg Island, linking to the Norwegian surveys. He returned to the same place in 1908, and this time reached the north pole. He predicted that some day, these areas would be reached by airplane; Aircraft flew over Ellesmere Island in 1925, 1928, and 1938, and the first air photos were taken in 1947, but no plane landed until 1952 when a US Airforce reconnaissance aircraft made first landing). (2)
1913-1919	D.B.MacMillan's Crocker land Expedition to northern Ellesmere island; MacMillan followed already established route to Arctic Ocean in search of the mythical "Crocker Land". (2)
1915	W.E.Ekblaw and 2 inuit explored Greely Fiord area (still only partially explored), and discovered Tanquary Fiord. He predicted that there would be a relatively easy route from head of Tanquary Fiord to Lake Hazen, though he didn't travel it. (2)
1919-1920	3rd Thule expedition: Roald Amundsen, in preparation for attempt to sail across Arctic Ocean in the Maud, arranged for emergency depots (in case of land retreat if trapped in the ice) to be laid for him in northern Ellesmere by Inuit & Cpt Godfred Hansen RDN from Thule Station (Greenland). This departed in mid-March 1920, and left supplies at Ft Conger, Cape Columbia & Cape Richardson (east of Cape Columbia). Amundsen ended by traveling far to the south, so didn't use the depots; however, Fort Conger visited by Dr. L. Koch in spring 1921 as part of trip from Thule on the Danish Jubilee Expedition to N. Greenland. (2)

Date	Activity
1925	Central Ellesmere Island overflown by Commander R.E. Byrd (USN) (2)
1928	Northern Ellesmere Island overflown by Sir Hubert Wilkins, during flight from Alaska to Spitsbergen (2)
1930-1932	German Arctic Expedition (part of second IPY): Dr. H.K.E.Krueger (geologist) and companions traveled north from Greenland across central Ellesmere Island, before becoming lost. In 1932, H.W.Stallworthy (RCMP) led search party for Krueger around Axel Heiberg Island. (2)
1935	Oxford University Ellesmere Land Expedition (Late April): organized by Edward Shackleton and under leadership of Dr. G.N. Humphreys (also including Stallworthy, A.W.Moore, + 2 Thule Inuit) reached Lake Hazen by dog team from expedition's base in northern Greenland. Some of team went up the ice cap via he Gilman glacier, and climbed Mt. Oxford; rest of team had base on Lake Hazen where fish were caught for feeding the dogs. (2)
1938	Northern Ellesmere Island overflown by Commander I.Schlossbach, USN (2)
1939-1940	Danish Thule and Ellesmere Land expedition of 1939-40 (underway when war broke out). Northern sled party under James van Hauen (incl Dr. J.C. Troelsen, geologist, and eskimo dog drivers) travelled north to Greely fiord from north Greenland, and did circuit of Hare and Otto fiords and much of Ellesmere before returning to Greenland (2)
1947	- First aerial photos of northern Ellesmere Island, by RCAF (2) - Weather stations established at Eureka at at Resolute on Cornwallis Island. (2) - Formation of the Defence Research Board (DRB) to oversee Canadian scientific activities related to the Department of Defence. Arctic research a priority due to the Cold war, to establish Canadian sovereignty in the arctic, and to provide peacetime training opportunities for the troops (1, 2)
1948	US icebreakers investigated part of the north coast of Ellesmere, and provided a cache of supplies for the later establishment of the weather station at Alert.
1950	Weather station established at Alert (2) (it became a military base in 1958).
1951	P.F. Bruggermann and S.D.Mac Donald studied biology around Alert, including insects as part of Northern Insect Survey (3) (Bruggemann & Calder, 1953; MacDonald 1953). (3)
1952	P.Gadbois and C. Laverdiere carried out geological survey within 10-15 km radius of Alert (3)
1953	Research program on northern Ellesmere Island Ice shelf started by DRB (G.F.Hattersley-Smith and R.G.Blackadar); flew to Alert from Ottawa in late April (via Thule air base in Greenland) for reconnaissance of coastal geology and snow and ice conditions. They traveled to the ice shelf by dog team, spending 9 hrs/day in travel then did their geological field work and ice and snow cover measurements in the evening after camping. In July, they went on a backpacking trip to within 50 km of Lake Hazen (noting that arctic flowers were in full bloom). They returned to Alert and flew to Thule and the south in mid-August. This was the 1st Cdn party to travel a part of the long northern Ellesmere coastline (known only from British and American expeditions previously). (2,3) -Northern Insect Survey collections by Bruggermann at Eureka (1)
1953-1963	Royal Canadian Mounted Police station at Alexandra Fiord, on Johan Peninsula on Ellesmere Island; the most northerly RCMP station and the most northerly police station in the world when established.(4)

Date	Activity
1954	(Apr.-Sept.) G.F. Hattersley-Smith returned to the ice shelf at Ward Hunt Island (83°05' N, 75°W), with E.W.Marshall, A.P.Crary, and R.L.Christie; trips were made east to Cape Albert Edward and Cape Columbia, and west to Kruger Island on the edge of Nansen Sound, completing glaciological and geological reconnaissance of the north coast of Ellesmere. (2,3)
1957-1958	International Geophysical Year; Canadians mount "operation Hazen" - primarily a geophysical, climate, and glaciological expedition to Lake Hazen area (2) - considered to be a good area due to its abundant freshwater, a natural landing field (on lake ice) for 8 months/year, ready access to the ice caps. Previous reports had indicated that it had unusually fine weather for its high arctic location, and it was previously unexplored scientifically. DRB given responsibility for organizing Operation Hazen, and they extended invitations to other government agencies to participate. -1957: established camp in May with spring airlifts by RCAF and US Navy (10 landings on Lake Hazen in April by C-119 (flying boxcar) dropped 8 men, 2 tractors, 2 dog teams, 35 tons of stores, fuel and equipment; came from Fort Churchill via Resolute and Thule air base (bulldozer tractor on first flight then cleared the airstrip for subsequent landings); These 8 men departed for the winter, but were replaced by a winter team of 4 men (from McGill) who overwintered 1957/58 (out of radio contact between October and March), for the first weather record of an Canadian Arctic inland station. Camp consisted of shelters made from insulated canvas spread over wooden frames (Attwell and Jamesway shelters); used for kitchen, lab, and sleeping. Hattersley reported that lake was completely ice-free in 1957. -1958: similar logistics, but for 20 men, 3 dogteams, and 30 tons of supplies and equipment; a C-130A Hercules brought in 9 tons of fuel on separate flight. In August 1958, a Maine doctor (Terris Moore) flew solo to the area in a piper Super-Cub, and landed on pontoons on the lake, staying around to ferry some parties back and forth from sites, making it the 1st time that a light aircraft was used to support scientific work in Northern Ellesmere. Lake retained about 40% ice cover by end of 1958. Work in 1958 showed lake Hazen to be about 260 m deep (we now know it to be 266 m) -besides geophysical studies, other studies included studies of local botany and plant ecology (J.H. Soper of U of Toronto), the limnology and fisheries of the lake (I.A.McLaren), wildlife (J.S.Tener of CWS), and archaeology (showing Thule culture dating to 10th Century).
1959-61	Post-IGY research: Canada continued a program of "International Geophysical Co-operation" (IGC), consisting of field work at Hazen from May to August 1959 (R.B.Sagar and J.M.Powell), supported by DRB and the Arctic Institute of North America (2). They continued glaciological and meteorological studies on the glacier, and started soil studies at Hazen in 1960, then added geomagnetic and entomological studies in 1961. -This trip notable as when Hattersley-Smith arrived to close out the camp with Sagar and Powell, they couldn't be picked up by the scheduled float plane, since the lake had too much ice. They had to walk around the lake to the outflow (Ruggles River) where there was still open water, to be picked up and returned to Alert.
1961	Don Oliver arrives in early July by Piper Super-Cub aircraft from Alert, to begin entomological studies at Lake Hazen (others had arrived in Mid-May, on the lake ice). He collected about 140 spp of insects that summer, increasing the taxa list from about 90 species for Ellesmere Island. (2)
1962-1970	DRB shifted their focus from Lake Hazen to Tanquary Fiord, where marine biology and botanical work was done (2). Other biological work, particularly in entomology, carried on at Hazen until 1968, through scientists from the entomology branch of Agriculture Canada and from the university of Alberta (led by Don Oliver and Brian Hocking. Ultimately, about 250 species of terrestrial insects and related arthropods were collected, along with much information on life history and ecology. In 1965, U.Roen of University of Copenhagen also did a taxonomic study of the freshwater crustacea.
1973	Coordination for high arctic research taken over by the Polar Continental Shelf Project of Natural Resources Canada (2)
1988	Ellesmere Island National Park Reserve established in northeastern Ellesmere Island, encompassing Lake Hazen, Tanquary Fiord, and Fort Conger. It covers 37,775 km2, and is the second most northerly park on earth and the second largest park in Canada. (Parks Canada Website)

Table 2. Some important milestones in Canadian High Arctic Entomology (from Reigert 1999 (1) and Danks 1981 (2)); See Fig. 1 for locations on Ellesmere I.

Date	Activity
1800s	Several expeditions searching for the Northwest passage or John Franklin collected insects as well as other types of specimens during overland trips. For example, Dr. J. Richardson, surgeon and naturalist to the 2nd Franklin Expedition collected insect specimens belonging 447 species in 152 families and 10 orders through the northern Boreal zone to Great Bear Lake and the Arctic coast. Others included Parry (1819-20, 1825-25), Ross (1829-33), Black (1833-35), Richardson (147-49), Collinson (1850-55), McClintock (1857-1859), Nares 1875-76. Other collections were made by missionaries to the north, or as part of expeditions from the Smithsonian Institute, and specimens were returned to the British or Smithsonian museums. (1,2))
1879-1902	Geological Survey of Canada Expeditions: while conducting geological surveys across western and northern Canada, many Geological Survey field teams also collected insects and plants (e.g. Robert Bell, 1879-1881; J.B. and J.W. Tyrell, 1884-1893; D.T. Hanbury, 1899-1902) in localities that included the northern prairie provinces, central Nunavut, and west to Great Slave Lake. (1)
1898-1902	Insects were collected on the second voyage of the 'Fram' (Otto Sverdrup) to Greenland and Ellesmere Island (1)
1913-1918	Canadian Arctic Expedition (led by Vilhjalmur Stephansson): included an entomologist (Frits Johannsen) and resulted in collections primarily from the western coastal regions of the Northwest Territories. (1,2)
1921-1924	Danish 5th Thule Expedition to Arctic North America (Knut Rasmussen); collecting was mainly incidental collections, focussed on the area to the east of the CAE, around Baker lake and the Kazan River to Hudson Bay and some of the islands to the north. (1,2)
1931 & 1934-1935	British Oxford University Expedition to Ungava Bay and then Greenland and Ellesmere Island resulted in collections of insects and spiders (2)
1930s	Sporadic collections in the arctic, including Wordie (Baffin Island and Greenland, 1934), Sutton (Southampton Island, 1929-30) and others (2). Personnel from the Systematic Unit of the Dept. Of Agriculture carried out collecting trips to northern sites (W.S. Walley, Moosonee ON 1934; W.J.Brown, Baffin Island, 1934 and Churchill, 1937; T.N.Freeman, Great Bear Lake, 1937) (1)
1944	Founding of the Arctic Institute of North America by "senior men from government, academic, scientific, and business life" (p. 11, 1)
1947	Establishment of Defence Research Board, to study science and technology pertinent to the military. They appointed panels of experts in 1947 to review research programs, one of which was the Entomological Research Panel, with senior entomologists from the dept. of Agriculture and Universities (e.g. H.G. Crawford, R. Glen, C.R. Twinn, A.W.,A. Brown, F.P. Ide, B. Hocking, J.G. Rempel, and others). (1)
1947	Establishment (through the DRB) of a research lab at Churchill to study behaviour and rearing of northern mosquitoes, and the Northern Biting Fly Project. Many students hired to carry out field work for this project became well known entomologists (e.g. D.G. Peterson, W.O. Haufe, L. Burgess, J. Shemanchuk (1)
1947-1966	Expansion of the Biting Fly project to a broad Northern Insect Survey, collecting insects in 72 north boreal and arctic localities over 16 years. The project was financed by the DRB, including military transport to sites, and the Division of Entomology provided staffing. T.N. Freeman coordinated the project and directed the staff. Most teams consisted of two men, and they were expected to sample well enough so that the areas would not be re-visited. In 1947, Freeman started the project with a collecting trip to Baker Lake (1)
1948	NIS: Crews were sent to the Alaska Highway (Dawson Creek to Snag); Nunavut sites: Frobisher Bay (Iqaluit), Coral Harbour, Cambridge Bay; NWT sites: Sawmill Bay on Great Bear Lake, Reindeer Depot, Norman Wells, Kidluit Bay (Richards Island); NL: Goose Bay, PQ: Fort Chimo, Schefferville; MB: Fort Churchill. (1)

Date	Activity
1949	NIS: Crews were sent to Yukon: Dawson City, Whitehorse; NWT: Norman Wells, Yellowknife, NU: Resolute Bay; Foxe Basin; NL: Stephenville, Gander, PQ: Rupert House, Great Whale River, Port Harrison; MB: Churchill, The Pas to Churchill (rail line); ON: Moose Factory, Moosenee (1)
1950	NIS: Crews sent to NWT: Fort Simpson, Fort Smith; NU: Cambridge Bay, Repulse Bay, Chesterfield, Padlei, Eskimo Point (Arviat); MB: Gillam (1)
1951	NIS: Crews sent to Alaska: Anchorage, Big Delta, Nome, Seyward; NWT: Hay River; NU: Alert, Bathurst Inlet, Coppermine (Kugluktuk), Spence Bay (Taloyoak); NL: St. Anthony (1)
1952	NIS: Crews sent to Alaska: Naknek Island, Cold Bay; Greenland: Sondre Stromfjord, NWT: Holman, Mould Bay; NU: Coral Harbour; MB: Fort Churchill; ON: Ogoki River Post (1)
1953	NIS: Crews sent to YK: Herschel Island; NWT: Muskox Lake; NU: Eureka; AB: Fort McMurray (1)
1954	NIS: Crews sent to NU: Eureka; PQ: Indian House Lake, Payne Bay, Sugluk, Manik; NL: Hebron (1)
1955	NIS: Crews sent to BC: Atlin Lake; NL: Carwright (1)
1956	NIS: Crews sent to PQ: Mistassini Post; YK: Firth River (1)
1957	NIS: Crews sent to BC: Queen Charlotte Islands; NWT: Fort McPherson (1)
1958	NIS: Crews sent to NU: Clyde, Clyde Inlet; PQ: Payne Bay (1)
1959	NIS: Crews sent to Alaska: Umiat; Alaska Highway: Fort St. John (BC) to Chicken (AK); BC: Summit Lake (1)
1960	NIS: Crews sent to BC: Telegraph Creek, Terrace; YK: Ross River; NU: Isachsen (Ellef Ringnes Island) (1)
1961	NIS: Crews sent to Alaska: Unalakleet, Cape Thompson; NU: Hazen Camp (1)
1962	Last year of DRB funding for NIS; Entomology Research Branch replaced NIS (with its focus on finding out what insects were present) with its "studies on arctic insects" project with a stronger focus on insect ecology and behaviour; Crews sent to the Alaska Hwy, including Summit Lake and Dawson (BC), Canol Road (YK), and into Alaska; NU: Hazen Camp (1)
1963	Entomology Research Branch "studies on arctic insects" project: Crews sent to NU: Hazen Camp, McGill Base camp on Axel Heiberg Island (1)
1964	Entomology Research Branch "studies on arctic insects" project: Crew sent to NU: Hazen Camp (1)
1965	Entomology Research Branch "studies on arctic insects" project: Crews sent to NU: Hazen Camp and NWT: Bailey Point, Melville Island (1)
1966	Entomology Research Branch "studies on arctic insects" project: Crews sent to Greenland: Nedre Midsommerso; NU: Hazen Camp, Woldaia Lake along Dubawnt R. to Aberdeen Lake; NWT: Yellowknife and surroundings (1)
1967	Entomology Research Branch "studies on arctic insects" project: Crew sent to Hazen Camp (1)
1969	National Museum of Canada collecting trip to Bathurst Island (H. Danks and ohers) (2)
1970-1974	International Biological Program studies on terrestrial productivity at Truelove Lowland on Devon Island, included insect studies (J.K. Ryan and others) (2)
1983-1985	Studies on *Gynaephora groenlandica* (arctic woolly-bear moth) at Alexandra Fiord, Ellesmere Island (O. Kukal, R. Ring)
1989-1994	High Arctic Integrated Research and Monitoring Area (IRMA) of the GSC was established at Hot Weather Creek (east of Eureka) on Fosheim Peninsula to support interdisciplinary studies related to environmental change. Included insect studies by F. Brodo (as part of ITEX project, see below).

Date	Activity
1990	ITEX (International Tundra Experiment) created as a MAB (Man and the Biosphere) initiative, affiliated with the Global Change and Terrestrial Ecology program within the International Geosphere-Biosphere program. This included two sites on Ellesmere Island: Hot Weather Creek (near Eureka) and Alexandra Fiord. (R.Ring, D.Morewood)
1995	Studies on *Gynaephora groenlandica* (arctic woolly bear moth) at Hazen camp, Ellesmere Island (O. Kukal, R. Lee)
2010	Northern Biodiversity Project to compare current insect distributions to those recorded from NIS (C. Buddle and others); team sent to Hazen camp to collect.

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Other articles from "Arctic Corner"

Long-time readers of this newsletter will recall that the Arctic Corner was created to replace Arctic Insect News, a newsletter published by the BSC from 1990 to 2000 to encourage work on arctic invertebrates. If you found "Fifty years of High Arctic Entomology: Hazen Camp on Ellesmere Island" interesting you might also want to look at the back issues of Arctic Insect News which are available on the BSC website in pdf format. Most issues included an article on a featured species, a featured locality, current research and a short historical article.

The newsletters can be found at:

http://www.biology.ualberta.ca/bsc/english/newsletters.htm#arctic

Call for Proposals for the 2012 Biological Survey of Canada BioBlitz

A Bioblitz is a great way to start or implement a faunal inventory of a region, as can be seen by reading the report of the 2010 bioBlitz on p. 7 of our previous issue (Vol. 29(2)), or other issues of the newsletter. If you are interested in organizing a BioBlitz for the summer of 2012, please contact Dr. Joe Shorthouse, Laurentian University (jshorthouse@laurentian.ca)

Add Your Voice: Biological Survey of Canada Blog

The BSC is looking for input into the the future and role of the BSC. The discussions from the the AGM in Vancouver in 2010 continue on the BSC blog, set up to provide a forum to facilitate wider community discussion. Whether or not you are a member of the BSC we would like to encourage you to visit this site and add your ideas and opinions as the BSC moves ahead in redefining itself.

See http://biologicalsurvey.wordpress.com/

... and Don't forget: The BSC has a listserve that acts as a convenient bulletin board for items related to surveying arthropods in Canada. If you are not already a member, think about joining it and using it.

http://www.mailman.srv.ualberta.ca/mailman/listinfo/canadian-arthropods

Who we are:

The Biological Survey of Canada is a Not-for-Profit Corporation dedicated to promoting biodiversity science in Canada

- The BSC consists of an elected board of directors and a membership representing all areas of biodiversity science
- Membership is free, and includes an email subscription to this newsletter and a chance to comment and participate in a range of biodiversity issues. (A nominal membership fee may be charged in future to cover infrastructure costs).
- The Annual General Meeting is held each fall at the annual meeting of the Entomological Society of Canada, with the option of participating electronically as well as in person.

To Join the BSC:

Send an email to Dr. D. Giberson, Vice President, BSC.
giberson@upei.ca

- In the subject line, write "BSC Membership"
- in the body of the message, give your full name and contact information, and a valid email address. Remember to update the BSC if you change email addresses.