Biological Survey of Canada Newsletter

Vol. 29(1)
Spring 2010

In this issue

The Newsletter of the BSC is published twice a year by the Biological Survey of Canada, an incorporated not-for-profit group devoted to promoting biodiversity science in Canada, particularly with respect to the Arthropoda.

Species diversity of Tabanidae on Akimiski Island

This cloth trap on Akimiski Island in James Bay seems be attracting more than Tabanidae. See David Beresford's article for more on his study of Tabanidae in the James Bay region.

The E.H. Strickland Entomolgoical Museum

A species page from the Virtual Musuem of the Strickland Museum. See the first in a new series on Canadian insect collections on page 13.

Entomology Collection

A new look for the Newsletter of the Biological Survey of Canada

Starting with this issue, the BSC newsletter is taking on a new format to make it easier to read it as an on-line version (cont'd on p. 2)

Visit Our website | Contact us | Previous issues

P.O. Box 3443, Station D, Ottawa, ON K1P 6P4
bsc@mus-nature.ca

Editorial: A new look for the *Newsletter of the Biological Survey of Canada*

Donna J. Giberson

Starting with this issue, the BSC newsletter is taking on a new format, to make it easier to read it as an on-line version. The newsletter will continue to be published twice a year, in spring and fall, but cutbacks in the support for a BSC secretariat have prompted the switch to an on-line newsletter. We hope to reach even more people with this format, and to continue bringing news about Canada's arthropod biodiversity to our broad audience.

This issue also introduces a new series on Canadian insect collections for the newsletter. This was inspired by the terrific article by Derek Sikes in our last issue on the U of Alaska insect collection, and I hope to highlight a different insect collection in our subsequent issues.

We welcome submissions from anyone working in biodiversity science who would like to provide an article about their projects or on-going biodiversity work. We also welcome photos, and would love to publish pictures of researchers and students collecting in interesting Canadian localities. Please remember to identify the photographer, everyone in your photo, as well as the location where it is taken, and provide a brief caption explaining what is happening in the picture.

The Newsletter of the Biological Survey of Canada is published twice a year by the Biological Survey of Canada, an incorporated not-for-profit group devoted to promoting biodiversity science in Canada, particularly with respect to the Arthropoda.

Send submissions to:
Dr. Donna Giberson, Editor
Newsletter of the Biological Survey of Canada
Department of Biology, University of Prince Edward Island
550 University Ave., Charlottetown, PE C1A 4P3
giberson@upei.ca

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 Board of Directors of the Biological Survey of Canada continues to meet monthly by conference call to discuss the activities of the Survey.

One important activity of the board over the past few months has been to negotiate a new Memorandum of Understanding with the Canadian Museum of Nature. Although the funding for the Secretariat and most activities of the Survey are no longer covered by the Canadian Museum of Nature, we have been able to maintain an address and some infrastructure support at the museum, and hope that that will continue.

In January, we submitted a report on the Biological Survey of Canada to the Council of Canadian Academies' Expert Panel on the State and Trends of Biodiversity Science in Canada. This report clearly illustrated the synergy created by the association between the Canadian Musuem of Nature and the Biological Survey of Canada as we study and report on Canada's biodiversity.

The first Volume of the BSC grasslands project entitled '*Arthropods of Canadian Grasslands. Volume 1: Ecology and Interactions in Grassland Habitats*' edited by J. D. Shorthouse and K. D. Floate has been completed. The entire 15 chapter project has been posted on the web site of the Biological Survey of Canada, where it is available on line for free downloading (see the end of this report for the table of contents for this first volume). We are currently negotiating with NRCPress to print the volume in hard copy. Volume II of the project is nearly ready for copy editing and it will also be posted on the BSC website.

Plans are being made for the first field season of the Northern Biodiversity Program project which was initiated by members of the Biological Survey of Canada. The BSC is a partner in this project, which will see a group of BSC members and their students assessing arthropod biodiversity over two summers at 12 sites originally sampled for the Northern Insect Survey (NIS) in the 1950s and 60s. The goal is to compare current arthropod biodiversity to information from the NIS, and to assess present day ecological and distributional patterns. This summer, teams will sample sites in the northern boreal forest (Moosonee and Moose Factory, ON, and Goose Bay, NL), in the southern arctic (Shefferville, QC and Churchill, MB), and the high arctic (Lake Hazen, Ellesmere Island, NU, and Iqaluit NU).

The 8th BioBlitz organized by the BSC will be held in Sudbury, Ontario this year from June 14 – 20 (see article on page 6). This will be a special BioBlitz as we will be celebrating the United Nations International Year of

Biodiversity. The City of Sudbury and Laurentian University contributed sufficient funds to hire two summer students to sample local biodiversity from May to August, along with sampling and curatory supplies.

In February, we signed a funding agreement between the BSC and Natural Resources Canada to have one of our Directors undertake a project assessing the Terrestrial Arthropods of Newfoundland and Labrador.

The *Canadian Journal of Arthropod Identification* has published two new issues so far in 2010 (see http://www.biology.ualberta.ca/bsc/ejournal/ejournal.html) and several more are at the review stage. As reported in the fall issue, CJAI has been discussing a partnership with the Encyclopedia of Life to enable data sharing and an agreement for this is imminent.

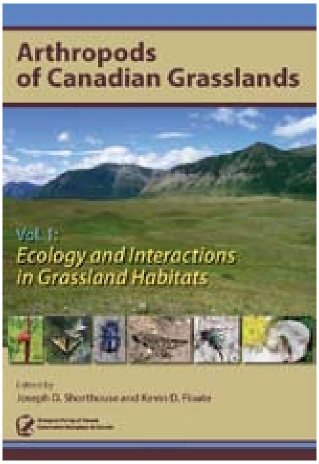
The Annual General Meeting for the BSC will be held November 3, 2010 in Vancouver at the Joint Annual Meeting of the Entomological Societies of British Columbia and the Entomological Society of Canada. The meeting will commence directly after the BSC Symposium. All are welcome to attend the AGM.

2010 research crew for the Northern Biodiversity Program project.
Back row, from left: Patrick Schaefer, Terry Wheeler, Chris Buddle, Anna Solecki, Sarah Loboda, Crystal Ernst, Angut Pedersen.
Front row: Doug Currie, Donna Giberson, Karine Duffy, Meagan Blair, Christine Roussel, and Jana Aker.

Photo by Sarah Adamowicz.

Back to Index

Arthropods of Canadian Grasslands (Volume 1): Ecology and Interactions in Grassland Habitats



Introduction to the grasslands and grassland arthropods of Canada
J. D. Shorthouse and D. J. Larson

Canada’s grasslands as habitat for arthropods
J. D. Shorthouse

Ecoregions of Canada’s prairie grasslands
J. D. Shorthouse

Ecoregions with grasslands in British Columbia, the Yukon, and southern Ontario
J. D. Shorthouse

Weather and climate patterns in Canada’s prairie grasslands
S. M. McGinn

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

Acari in grassland soils of Canada
V. M. Behan-Pelletier and D. Kanashiro

Leafhoppers (Homoptera: Cicadellidae): a major family adapted to grassland habitats
K. G. A. Hamilton and R. F. Whitcomb

Insects of Ojibway Prairie, a southern Ontario tallgrass prairie
S. M. Paiero, S. A. Marshall, P. D. Pratt and M. Buck

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

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

Galls induced by cynipid wasps of the genus Diplolepis (Hymenoptera: Cynipidae) on the roses of Canada’s grasslands
J. D. Shorthouse

Gall-inducing aphids and mites associated with the hybrid complex of cottonwoods, Populus spp. (Salicaceae) on Canada’s grasslands
K. D. Floate

Aquatic Hemiptera of the prairie grasslands and parkland
G. G. E. Scudder, M. A. Alperyn and R. E. Roughley

Arthropods in Canada’s grasslands: synthesis and future directions
J. D. Shorthouse and D. J. Larson

Biological Survey of Canada Symposium

The Biological Survey of Canada will present a symposium on Wednesday morning, November 3, in conjunction with the Joint Annual Meeting of the Entomological Societies of British Columbia and Canada, being held 21 October – 3 November, at Vancouver, BC.

Talks will cover diverse aspects of grassland arthropods to celebrate progress on the BSC's 'Arthropods of Canadian Grasslands' book series. Publication of Volume I (Ecology and Interactions in Grassland Habitats) is anticipated this summer. Publication of Volume II (Arthropods in Altered Grassland Ecosystems) is anticipated early in 2011.

More information on this series in available at: http://www.biology.ualberta.ca/bsc/english/grasslands.htm

Back to Index

Biological Survey of Canada BioBlitz in Sudbury, Ontario

Celebrate the United Nations International Year of Biodiversity by studying the biota colonizing revegetated smelter-damaged lands near Sudbury

Joe Shorthouse,
Department of Biology, Laurentian University

The 2010 BioBlitz of the Biological Survey of Canada will be held in Sudbury, Ontario June 14-20 to help celebrate the United Nations International Year of Biodiversity. For those unfamiliar with BioBlitzes, they are a special type of field study where a group of scientists and volunteers conduct an intensive biological inventory, attempting to identify and record all species of living organism in an area. The term "BioBlitz" was coined by U.S. National Park Service naturalist Susan Rudy while assisting with the first BioBlitz at Kenilworth Aquatic Gardens, Washington D.C. in 1996. Besides establishing the degree of biodiversity in an area, BioBlitzes help popularize science. The 2010 BSC BioBlitz will be different from those in the past as it will be more general. That is, besides entomologists, there will be botanists, mycologists, and vertebrate zoologists, along with the general public.

The BSC has held 7 BioBlitzes; the first was at Onefour in southeastern Alberta (see the BSC website http://www.biology.ualberta.ca/bsc/bschome.htm). Four of the BioBlitzes were held in National Parks (Waterton Lakes, Gros Morne, Riding Mountain and Bruce Peninsula) where ecosystems are relatively untouched by human activity. A BioBlitz at Aweme, Manitoba in 2004, at the site of the Criddle/Vane homestead, was the first to be held at a site modified by past agricultural activities. The 2010 BioBlitz is novel because it is the first to be held at a site that has been damaged by past mining and smelting activities, but is in the process of being restored. Entomologists interested in participating in the 2010 BioBlitz have a unique opportunity to join the citizens of Sudbury in conducting an inventory and assessment of the insects that have colonized these recovering ecosystems.

The lands that received damage in the past surround three copper-nickel smelters near the towns of Copper Cliff, Falconbridge, and Coniston, all on the outskirts of Sudbury (Fig. 1). The Coniston smelter was decommissioned in 1972. However, initial damage to the environment around Sudbury was caused by roast yards, an old smeltering technique whereby ore was placed on top of huge piles of logs and burned to drive off the sulphur. Fumigating clouds of sulphur swept over the surrounding country side killing vegetation, and as a result, soils were eroded from the hills. By the 1970s, environmental damage, caused primarily by the local mining industry, had stripped the vegetation from over 100,000 hectares of the land near Greater Sudbury. Furthermore, forested areas on the edge of the industrial barrens had their majestic white pines (*Pinus strobus*) removed to feed the roast yards or shipped to the United States for use in buildings. Stumps of these trees remain to this day (Fig. 2), though some near the former roast yards were almost 'fossilized' by the sulphur emissions.

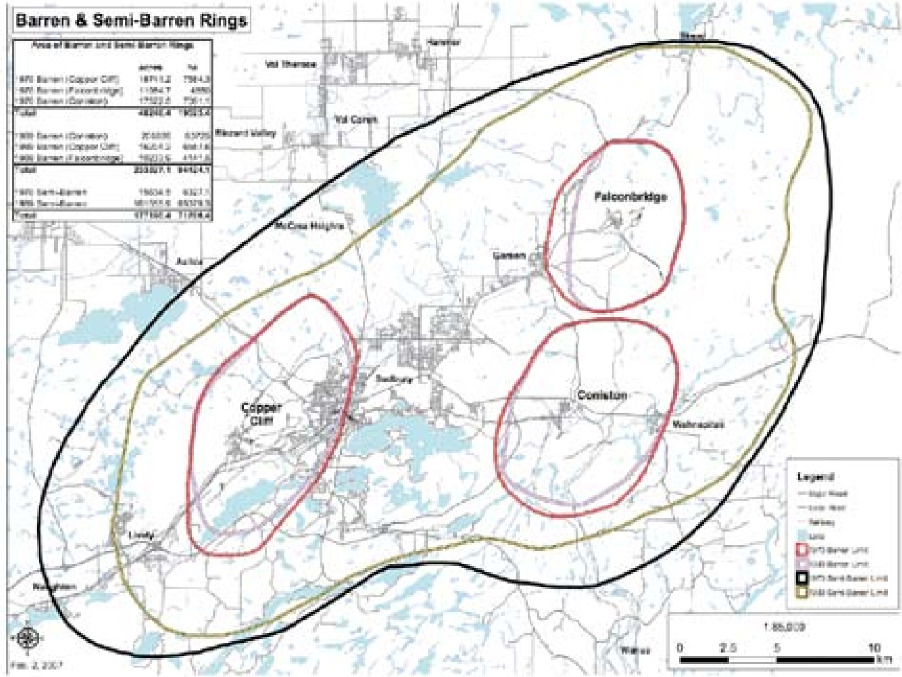


Fig. 1. Map of Sudbury area showing location of the three smelters, barren lands, restored lands and the location of areas where trees have been planted by VETAC. Map courtesy of VETAC.

Much has been written on the environmental damage around Sudbury and the unique ecosystems that resulted from over 150 years of lumbering, mining, smelting, and forest fires (see Gunn 1995 and Winterhalder 1996 for references). Apparently, the early citizens of Sudbury paid little attention to the fumigations and damage caused to area hillsides, but things changed in the early 1970s when local citizens demanded a change in smeltering practices and an end to pollution. The famous superstack (which raised the emissions higher in the air, so that impacts were spread further away) was built in 1972 and new technologies resulted in S02 reductions of about 90% between 1970 and 2000. So little S02 comes from the Copper Cliff and Falconbridge smelters today that damaging fumigations no longer occur.

Most early attempts to re-establish trees on the damaged hillsides were unsuccessful, but then in the early 1970s, researchers in the Department of Biology at Laurentian University began researching the use of limestone to buffer the acidity and fertilizers to provide missing nutrients. One finding from these studies was that it was necessary to establish grasses and legumes as nurse plants before attempts were made to plant trees. The grasses and legumes thrived and provided habitat for successful establishment of both the planted trees and the seeds of surrounding trees (mainly birch and poplars) that blew in and became established in the developing leaf litter and soil.

Restoration of damaged ecosystems intensified in 1973 with the launch of an organization called VETAC, the Vegetation Enhancement Technical Advisory Committee, with a mandate to coordinate the restoration process. In 1978, the severely damaged lands near highways running east, west and north of Sudbury were the first to receive the amelioration treatment and subsequently planted with trees such as

Fig. 2. Ancient white pine stump at the edge of the barrens that was likely cut down over 100 years ago.

jack pine, red pine and white pine on the grass-covered lands. Streets bordering the barrens within the city (Figs. 3 and 4) were also restored early in the process. To date > 3400 ha have received the amelioration treatment and over 9 million trees have been planted.

The restoration process has been so successful that the region has been the recipient of many international awards, including the United Nations Local Government Honors Award presented at the Rio de Janiero Earth Summit in 1992. Restored sites, which are likely similar to those following the retreat of glaciers about 12,000 years ago, have become fascinating places to study the compliment of flora and fauna that colonize these unique ecosystems.

A unique forest called the birch transition zone (Figs. 5 and 6) developed around the once barren areas. This zone is inhabited by coppiced white birch (*Betula papyrifera*), a species well adapted to harsh conditions, but there is evidence that without human intervention, it will take many years until a more normal forest returns. It is thought that coppiced birch grow in this stunted, multi-stemmed form because of their roots being damaged by acidity, heavy metals, and frost heaving that occurs in areas without thick leaf litter and a closed canopy (Courtin 1995). Of interest, the tops of many hills in this zone are still blackened and have sparse vegetation. However, in a manner likely similar to events following glaciation, hardy lichens and mosses are slowly spreading across the rock faces (Fig. 7).

Lowbush blueberry, an acid-loving species, grows profusely beneath the birches on the side of birch transition zone hills (Shorthouse and Bagatto 1995). Blueberry shrubs tend to accumulate leaf litter from the birch which prolongs moisture following snow melt. Blueberries here are often heavily galled by a small chalcid wasp (West and Shorthouse 1989). However, when limestone and fertilizer is applied to birch transition hills, and planted with jack, red and white pine, leaf litter accumulates, soils begin to form, and a somewhat normal boreal forest begins to appear (Fig. 8). Forests that develop in this manner have been considered examples of ‘anthropogenic succession’ (Bagatto and Shorthouse 1999), but unfortunately, they have received little entomological attention. However, pitfall trapping in 1995 at a typical birch transition site revealed 24 species of carabids, 20 species of scelionids, 32 species of wandering spiders, and 7 species of sawflies. However, the short, coppiced trees make it easy to sample insects in the canopy compared to normal forests. One study used transition zone birch to study the accumulation of metals in the larvae of gypsy moths (Bagatto and Shorthouse 1996). Maturing larvae were easily removed from the upper canopy without the use of ladders or ropes!

Other forest types surround the birch transition zone (Amiro and Courtin 1981) and the flora and fauna gradually becomes more diverse

Fig. 3. End of a street in 1975 with a rocky hill denuded of vegetation and soil by years of fumigation and deposition of sulphuric acid and heavy metals.
Photo by Keith Winterhalder.

Fig. 4. The same street in 1990 after liming and fertilizer showing a developing forest of white birch and conifers. Such forests are considered early successional and may be similar to those that developed after glaciers left the area about 10,000 years ago.
Photo by Keith Winterhalder.

Fig. 5. Birch transition zone photographed in early spring showing coppiced growth form of white birch.
Photo by Joe Shorthouse.

Fig. 6. Birch transition zone in June showing showing coppiced birch, lowbush blueberry and metal tolerant mosses.
Photo by Joe Shorthouse.

Fig. 7. Metal tolerant moss, Pohlia nutans, spreading on rock face on a hill top in the birch transition zone.
Photo by Joe Shorthouse.

and natural as one moves away from the smelters. Clines from stressed to natural forests can be observed and studied in all directions from Sudbury (Amiro and Courtin 1981; Bagatto and Shorthouse, 1991) with highways and side roads providing easy access.

The June BioBlitz will concentrate on the flora and fauna of the birch transition zone, although maps and directions to all forest types in the Sudbury area will be provided. The Laurentian University campus is within the birch transition zone and will be the focal point of the BioBlitz. Rooms have been reserved in a campus residence at a cost of $50.00 per night. Participants can literally walk out the doors of all campus buildings into birch transition forest. Free parking and access to an Olympic pool, recreation facilities and food services are available on campus.

Space to sort specimens and meet with the public will be available in teaching laboratories in the Department of Biology. Two students have been hired to sample the campus forests by pitfall and pan traps, sweeping, malaise, light trapping, etc. from May to August and will provide specimens for all participants and those interested in the survey, but unable to join us.

Sudbury was chosen for the 2010 BSC BioBlitz because of its leadership in recognizing the importance of biodiversity, the City's award-win-

Fig. 8. Birch transition zone in the early spring on the campus of Laurentian University that has been limed and fertilized and planted with red pine.
Photo by Joe Shorthouse.

ning efforts at restoring once smelter-impacted lands, and the opportunity to learn about the fauna and flora that is colonizing once barren and polluted sites. The City has developed a Biodiversity Action Plan to be overseen by VETAC and the plan can be accessed at www.greatersudbury.ca/biodiversity). The 2010 BioBlitz is sponsored by the City of Greater Sudbury, Vale Inco, Xstrata Nickel and Laurentian University, as well as the Biological Survey of Canada.

For further information, to register, or book rooms, contact:
Joe Shorthouse,
Department of Biology, Laurentian University,
Sudbury, Ontario, P3E 2C6.
jshorthouse@laurentian.ca, Telephone: 705-675-1151 Ext. 2285.

References

Amiro, B. D., and Courtin, G. M. 1981. Patterns of vegetation in the vicinity of an industrially disturbed ecosystem, Sudbury, Ontario. Canadian Journal of Botany. 59: 1623-1639.

Bagatto, G., and Shorthouse, J. D. 1991. Accumulation of copper and nickel in plant tissues and an insect gall of lowbush blueberry, *Vaccinium angustifolium*, near an ore smelter at Sudbury, Ontario, Canada. Canadian Journal of Botany, 69:1483-1490.

Bagatto, G.., and Shorthouse, J. D. 1996. Accumulation of Cu and Ni in successive stages of *Lymantria dispar* L. (Lymantriidae), Lepidoptera) near ore smelters at Sudbury, Ontario, Canada. Environmental Pollution. 92: 7-12.

Bagatto, G., and Shorthouse, J. D. 1999. Biotic and abiotic characteristics of ecosystems on acid metalliferous mine tailings near Sudbury, Ontario. Canadian Journal of Botany. 77: 410-425.

Courtin, G. M. 1995. Birch coppice woodlands near the Sudbury smelters: dynamics of a forest monoculture. In Restoration and Recovery of an Industrial Region. *Edited by* J. M. Gunn. Springer-Verlag, New York. pp. 233-245.

Gunn, J. M. (editor). 1995. Restoration and Recovery of an Industrial Region. Springer-Verlag, New York.

Shorthouse, J. D., and Bagatto, G. 1995. Potential role of lowbush blueberry (*Vaccinium angustifolium*) in colonizing metal-contaminated ecosystems. In Restoration and Recovery of an Industrial Region. *Edited by* J. M. Gunn. Springer-Verlag, New York. pp. 247-255.

West, A., and Shorthouse, J. D. 1989. Initiation and development of the stem gall induced by *Hemadas nubilipennis* (Hymenoptera: Pteromalidae) on lowbush blueberry, *Vaccinium angustifolium* (Ericaceae). Canadian Journal of Botany. 67: 2187-2198.

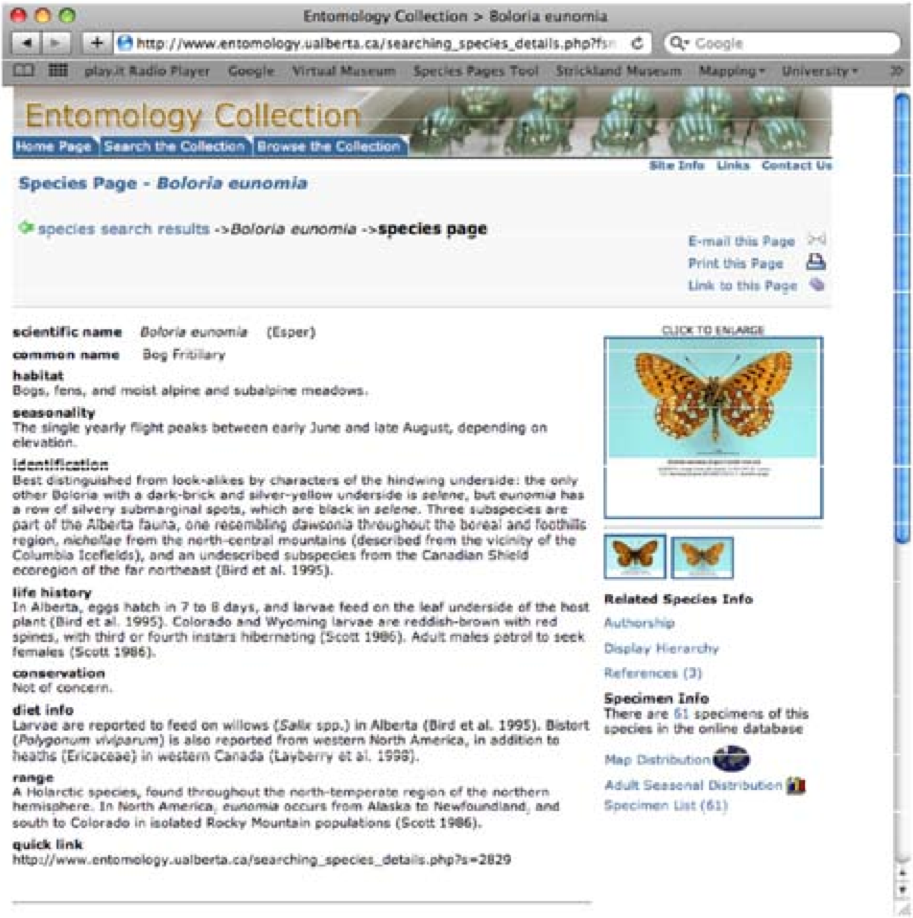
Winterhalder, K. 1996. Environmental degradation and rehabilitation of the landscape around Sudbury, a major mining and smelting area. Environmental Reviews. 4: 185-224.

Back to Index

Insect Collections in Canada Series: E.H. Strickland Entomological Museum, University of Alberta

Danny Shpeley, Assistant Curator

The E. H. Strickland Entomological Museum was named in honour and in memory of Dr. Edgar Harold Strickland, who founded the University of Alberta Department of Entomology in 1922, and a few years thereafter established the insect collection. In 1994 the Departments of Botany, Genetics, Entomology, Microbiology and Zoology were merged to form the current Department of Biological Sciences. The Strickland Museum is one of nine different museums/collections in the Department of Biological Sciences. The Strickland Museum's holdings are in two rooms in the Earth Sciences Building: 2-18 and 2-27 on the north end of the University of Alberta campus.



Species Page - *Boloria eunomia*

species search results ->*Boloria eunomia* ->**species page**

scientific name *Boloria eunomia* (Esper)

common name Bog Fritillary

habitat
Bogs, fens, and moist alpine and subalpine meadows.

seasonality
The single yearly flight peaks between early June and late August, depending on elevation.

identification
Best distinguished from look-alikes by characters of the hindwing underside: the only other Boloria with a dark-brick and silver-yellow underside is selene, but eunomia has a row of silvery submarginal spots, which are black in selene. Three subspecies are part of the Alberta fauna, one resembling dawsonia throughout the boreal and foothills region, *nichollae* from the north-central mountains (described from the vicinity of the Columbia Icefields), and an undescribed subspecies from the Canadian Shield ecoregion of the far northeast (Bird et al. 1995).

life history
In Alberta, eggs hatch in 7 to 8 days, and larvae feed on the leaf underside of the host plant (Bird et al. 1995). Colorado and Wyoming larvae are reddish-brown with red spines, with third or fourth instars hibernating (Scott 1986). Adult males patrol to seek females (Scott 1986).

conservation
Not of concern.

diet info
Larvae are reported to feed on willows (*Salix* spp.) in Alberta (Bird et al. 1995). Bistort (*Polygonum viviparum*) is also reported from western North America, in addition to heaths (Ericaceae) in western Canada (Layberry et al. 1998).

range
A Holarctic species, found throughout the north-temperate region of the northern hemisphere. In North America, *eunomia* occurs from Alaska to Newfoundland, and south to Colorado in isolated Rocky Mountain populations (Scott 1986).

quick link
http://www.entomology.ualberta.ca/searching_species_details.php?s=2829

Related Species Info
Authorship
Display Hierarchy
References (3)

Specimen Info
There are 61 specimens of this species in the online database

Map Distribution
Adult Seasonal Distribution
Specimen List (61)

Figure 1. Example of a species page found on the Strickland Virtual Museum.

Scope of the Collection

Over one million specimens are included, preserved dry on pins; in vials, in alcohol; or in Canada balsam, on microscope slides. The pinned specimens are in cardboard trays, housed in about 2,400 wooden drawers with glass tops. The drawers are in wooden or steel cabinets, each of which is labeled as to contents. The collection compactor has seven carriages, each with six double wide steel cabinets, and each of these can hold a maximum of 54 drawers.

Three collections comprise the Strickland Museum: the Research Collection, the Alberta Reference Collection and the Fossil Insect Collection. Also included is a cabinet containing 20 drawers of 3” X 5” ruled index cards, containing distributional and phenological information about the insect species known from Alberta. An extensive collection of reprints, filed by taxonomic group treated, is available in the Museum for ready reference.

The Research Collection includes principally Nearctic insects, representing most orders and the major families thereof. The beetle family Carabidae, housed in about 500 drawers, is especially well represented: included are about 400,000 specimens principally from the Nearctic region, but with an important Neotropical component, and fewer taxa from the remaining biogeographical regions. The Kenneth Bowman Collection of Lepidoptera, housed in about 600 drawers, contains pinned specimens representing most of the species of butterflies and moths known from Alberta. Approximately half of the Lepidoptera are from localities other than Alberta. The F.S. Carr Collection of Coleoptera is housed in approximately 300 drawers.

Except for the carabids, the collections are arranged in systematic order, according to recent textbooks, catalogues and checklists, as appropriate. The Carabidae are organized by zoogeographical region, and then systematically, within each region. The arrangement of the Lepidoptera collection is currently being updated by Gary Anweiler, a long-term volunteer, based on the recently published Annotated List of Lepidoptera of Alberta (Pohl et al., 2010).

Most of the specimens in the Strickland Museum were field-collected by staff and graduate students. Over the years, they have collected in Canada, United States, Mexico, Guatemala, Guyana, Venezuela, Colombia, Peru, Ecuador, Bolivia, Brazil, Australia, Thailand and Russia. Trips to the West Indies have included the Cayman Islands, Jamaica and Dominica. Recently we have accepted two donations of Lepidoptera, one for about 44,800 specimens (Troubridge collection), and the other for about 5,700 specimens (Shigematsu collection), which have substantially increased our Lepidoptera holdings.

Graduate students are generally required to deposit voucher specimens of species studied in their thesis project. These may be pinned specimens, or they may be parts of specimens that were used for molecular studies. DNA vouchers are stored in -80°C freezers.

The Alberta Reference Collection includes one or two representatives of many of the species known to occur in this province. The collection is used primarily as an aid in identifying local species, but its nomenclature is in need of updating and some specimens are in need of replacement. In some respects, internet-available species pages developed for the Strickland Museum (see below for more on the species pages, and an example of how they are used) now serve the same purpose as the original Alberta Reference Collection.

The Fossil Insect Collection, with just over 2,800 fossils, is housed in two metal cabinets and one wooden cabinet. All of the sedimentary fossils have accession numbers and are databased, but not loaded to the Virtual Museum. These fossils are from Alberta and British Columbia in Canada, and from Colorado, Montana, Nevada, Oregon, Utah, Washington and Wyoming in the United States. Also included are about 200 pieces of amber with insect inclusions that were donated by E.M. Pike. Most are either Dominican or Baltic, with a fewer number of Burmese origin. None of the amber specimens have been databased.

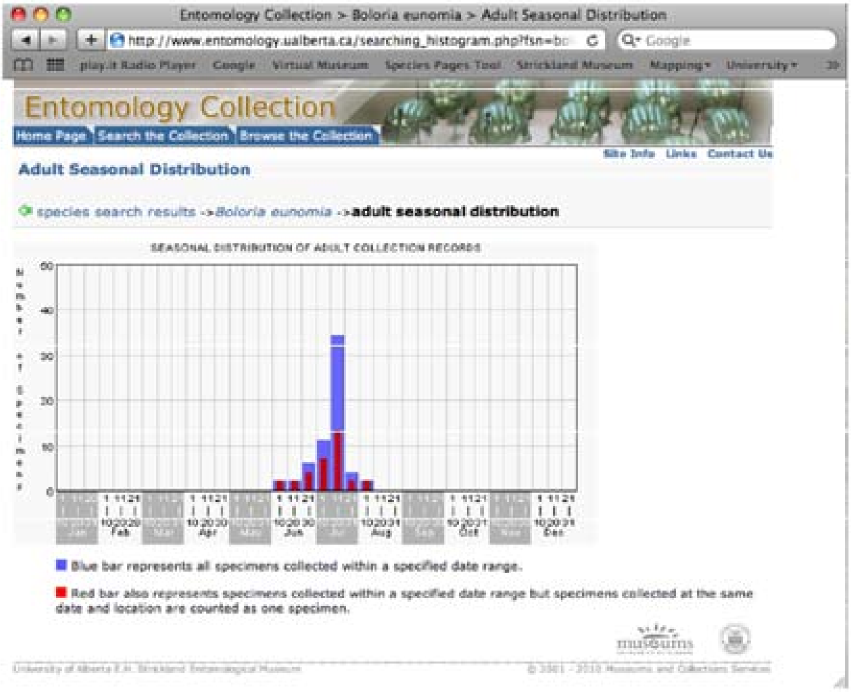
The Virtual Museum

One of the mandates of the Strickland Museum is to make our collections available to the public, in essence unlocking the legacy of our collections. We are making our collection available both as basic specimen information and knowledge summaries in the form of species pages through our Virtual Museum (VM), which can be viewed at http://www.entomology.ualberta.ca/ . Many of our VM's Lepidoptera species pages are also available through the Encyclopedia of Life web page [http://www.eol.org/]. All of the VM specimen records are available through the Global Biodiversity Information Facility (GBIF) portal [http://data.gbif.org/welcome.htm]. See Sperling et al. (2003), for more detailed information about digital outreach aspects of the Strickland Museum.

Databasing of the Strickland Museum collections is a continuing process. Specimen records are first entered into Excel spreadsheets, which are Darwin Core compliant, prior to loading into MIMSY XG, an Oracle based software. All of the VM data is stored on servers maintained by Museums and Collections Services (MACS), a separate service unit of the University of Alberta. MACS supports web interface, data management, policy development and coordination for all 35 of the U of Alberta collections.

Currently we have just over 200,000 databased specimens on our VM, with a backlog of about 6,000 databased specimens still to load onto the server. In 2008, the VM experienced an average of 316 unique visitors per month, and in 2009 the average number of unique visitors per month was somewhat higher at 390.

The VM now has just over 2,100 species pages with about 2,450 associated images. Each of the species pages (e.g. Figure 1) has the following headings: common name, habitat, seasonality, identification, life history, conservation, diet, range/distribution and notes. Some species pages do not have an image, and some species pages may only have an image. Specimen record data can be used to generate an adult seasonal histogram (Figure 2) and distribution maps (Figure 3) through Google Earth.



Adult Seasonal Distribution

species search results -> *Boloria eunomia* -> **adult seasonal distribution**

🟦 Blue bar represents all specimens collected within a specified date range.

🟥 Red bar also represents specimens collected within a specified date range but specimens collected at the same date and location are counted as one specimen.

Figure 2. Example of adult seasonal distribution generated from specimen records on the Strickland Virtual Museum

The number of specimens loaded to the VM has varied through the years, but shows a marked increase in 2009, when four students worked during the four summer months. Most of the 2010 specimens shown in the following bar graph (Figure 4) were actually databased in 2009, but were not loaded until 2010.

Services provided by the Strickland Museum

Material from both the Research and Reference Collections is available for loan and study by those who are preparing taxonomic revisions. Records of loans and of all incoming and outgoing shipments of speci-

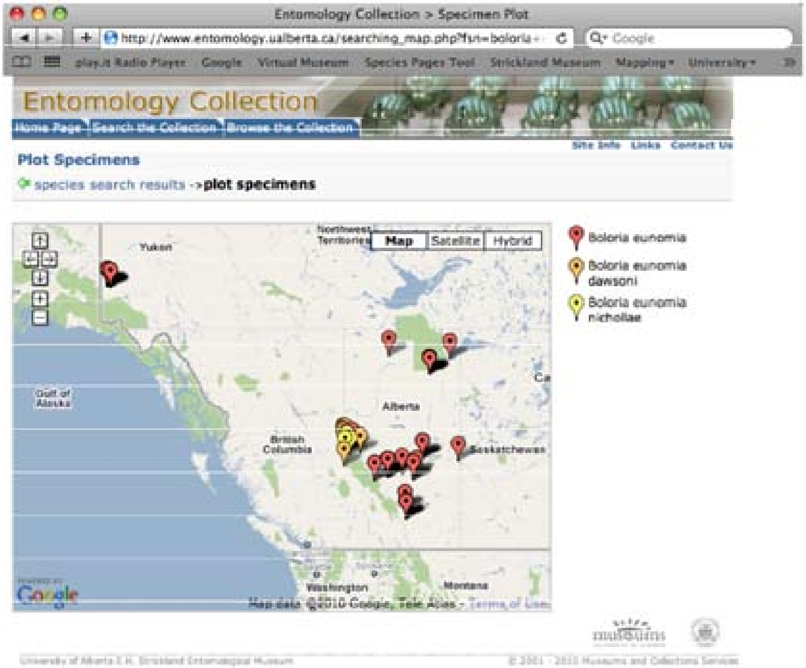


Figure 3. Example of specimen locality data plotted from specimen records on the Strickland Virtual Museum, illustrating the ability to plot subspecies.

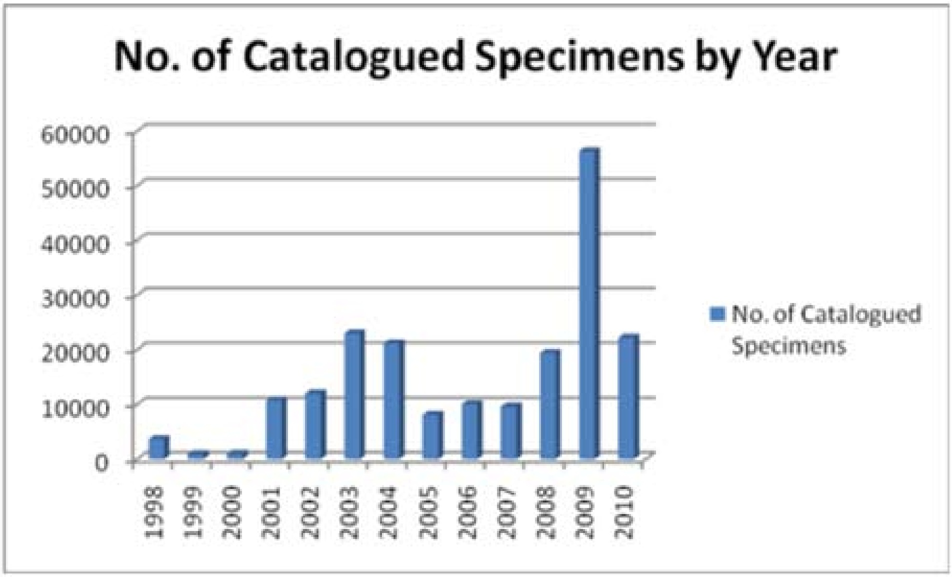


Figure 4. Bar graph produced by MACS illustrating the number of specimen records loaded to the Strickland Virtual Museum for the period 1998-2010.

mens are maintained. For the ten-year period 2000-2009, the museum sent out 49 loans comprising 18,173 specimens. Primary type material (holotypes, lectotypes and neotypes) based on Strickland Museum specimens has not been retained here, but has instead been deposited in appropriate larger museums.

Identification of carabids is one of the main services provided, on the basis of written requests, in aid of research or collection development. Submitted specimens must be labeled as to locality and must be prepared properly for ease of examination.

As well, insect specimens are identified for the general public locally, Agriculture and Agri-food Canada, Alberta Department of Agriculture, public health units in Alberta and the Northwest Territories, medical laboratories, Provincial Laboratory of Public Health, the University of Alberta Hospital, and police forces in Alberta and British Columbia. Methods of control of household insect pests are recommended, on request. During the ten-year period 2000-2009, I fielded an average of 131 extension identifications or other information requests per year.

Curatorial staff consists of three personnel and volunteers. The curator is Felix A.H. Sperling, assistant curator is Danny Shpeley, and the emeritus curator is George E. Ball. Gary G. Anweiler is our main volunteer. As assistant curator, I look after the day to day operations of the museum, as well as providing support for a number of courses in the Department of Biological Sciences.

References Cited

Pohl, G.R. et al. 2010. An annotated list of the Lepidoptera of Alberta, Canada. ZooKeys, 38:1-549 (doi: 10.3897/zookeys.38.383)

Sperling, F. et al. 2003. Unlocking the Legacy of Alberta's Natural Science Collections. Paper presented at: UMAC 2003 Conference Sept. 21-26, 2003, Sam Noble Oklahoma Museum of Natural History, Norman, Oklahoma. Available at: http://publicus.culture.hu-berlin.de/umac/2003/sperling.html

Back to Index

Insect Collections in the Maritime provinces

David B. McCorquodale, Meghan Marriott and Donna Giberson

Department of Biology, Cape Breton University, Sydney, NS B1P 6L2, and Department of Biology, University of Prince Edward Island, Charlottetown, PE

Small regional collections abound in Canada, and the Maritimes are particularly rich in small insect collections with a primarily regional focus. These collections are often overlooked when studying insect distributions, partly because they are not well known to the broader entomological community. Yet they frequently have specimens and cover time periods not covered in the larger "national" collections. For example, our understanding of the distribution of beetles in the Maritimes has improved in the past 10 years, primarily because of attention to small regional collections. Majka (2008) summarized the progress in a previous issue of this newsletter (27(1):15-21).

One reason that these small collections are rarely consulted is that they are not well known, particularly outside the region. Our work on beetles has shown that they are of value for studies such as status assessments and analysis of geographic distributions. Another difficulty with using these collections is that specimen material is rarely digitized, and specimens in many groups need to be identified or have their identities verified. Most of these collections would benefit from the taxonomic expertise of specialists in most insect groups.

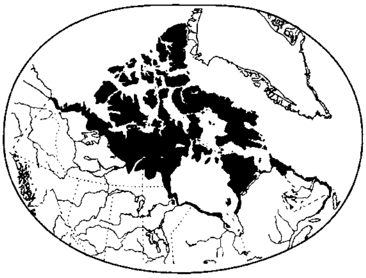
The following list aims to make the existence of several small collections more widely known so that the data associated with valuable specimens can be more widely used and so that the collections can benefit from the systematic expertise of entomologists across Canada. We would like to hear from anyone that knows of other collections in the region to add to this list. Lists of collections for other regions of the country will be covered in a subsequent edition of this newsletter.

Table 1: Insect collections in the Maritime provinces of Canada with the Bishop Museum coden, mailing address and contact person as of May 2010.

Collection	Coden	Contact
Agriculture & Agri-Food Canada Kentville, NS	ACNS*	Agriculture and Agri-Food Canada 32 Main Street Kentville, NS B4N 1J5
Atlantic Forestry Centre Fredericton, NB	AFC*	P.O. Box 4000 1350 Regent Street South Fredericton, New Brunswick, Canada E3C 2G6 Jon Sweeney

Collection	Coden	Contact
Nova Scotia Department of Natural Resources Shubenacadie, NS	NSNR*	P.O. Box 130 Shubenacadie, NS B0N 2H0 Jeff Ogden
New Brunswick Museum St. John, NB	NBMC*	277 Douglas Ave. Saint John, NB E2K 1E5 Donald McAlpine
Nova Scotia Museum, Halifax, NS	NSMC*	1747 Summer St., Halifax, NS B3H 3A6 Andrew Hebda
Acadia University Wolfville, NS	Acadia	Department of Biology, Acadia University, Wolfville, NS B4P 2R6 Kirk Hiller
Cape Breton University Grand Lake Rd., NS	CBU*	Department of Biology, Cape Breton University, Box 5300 Sydney, NS B1P 6L2 David McCorquodale
Nova Scotia Agricultural College, AD Pickett Collection Bible Hill, NS	NSAC*	Department of Environmental Sciences Nova Scotia Agricultural College, Bible Hill, NS B2N 5E3 Chris Cutler
St. Francis Xavier University Antigonish, NS	STFX*	Department of Biology, Saint Francis Xavier University, Antigonish, NS B2G 2W5 Randy Lauff
Université du Moncton Moncton, NB	UMNB*	Départmente de Biologie, Université de Moncton, Moncton, NB Gaetan Moreau
University of New Brunswick Fredericton, NB	DFRU*	Faculty of Forestry and Environmental Management University of New Brunswick, Fredericton, NB E3B 5A3 Dan Quiring
University of Prince Edward Island Charlottetown, PE	UPEI*	Department of Biology University of Prince Edward Island, Charlottetown, PE C1A 4P3 Donna Giberson

Back to Index



ARCTIC CORNER

News about studies of arctic insects

Species diversity of Tabanidae (Diptera) on Akimiski Island, Nunavut, Canada

D. V. Beresford[1], S. Gan[1], and K. F. Abraham[2]

[1]Department of Biology, Trent University
1600 West Bank Drive, Peterborough ON, Canada K9J 7B8

[2]Wildlife Research & Development Section,
Ontario Ministry of Natural Resources
c/o Trent University,
2140 East Bank Drive, DNA Building
Peterborough, ON K9J 7B8

Abstract

We sampled the Tabanidae of Akimiski Island in James Bay, Canada by several methods during the summer of 2008: small Malaise traps, blue and black Coroplast^{R} sticky traps, cloth and Coroplast^{R} Vavoua traps, aerial netting; and adhesive patches (Tred-Not^{TM}) worn on the hat and trouser legs. Catches were compared based on species richness, diversity, and similarity of species caught. A total of 757 tabanids were caught, 24 species from three genera: *Hybomitra*, *Tabanus*, and *Chrysops*. Malaise traps collected the most individuals with followed by; hat and leg adhesive traps, Vavoua traps, aerial netting, and coloured Coroplast^{R} sticky traps. Human-baited hat and leg traps caught the fewest species and Malaise traps caught the most species when corrected for sample size.

Introduction

The Tabanidae are an important group of biting fly species in northern regions whose immature stages occupy a diverse range of habitats. While maggots can be difficult to find, adults are usually easy to collect, often being attracted to researchers as potential hosts. This combination of qualities make them potentially useful for diversity surveys.

To sample biting flies, current trap technology commonly uses cloth (Mihok 2002), painted plywood (Mihok and Carlson 2007) or plastic (Cilek 2003, Beresford and Sutcliffe 2006). Traps are designed to maximize catch based on the apparent attractiveness of color, texture, and shape of these materials: e.g. a black target on a blue background (Schofield 1998), a combination used in Nzi (Mihok 2002) and Vavoua (Laveissière and Grébaut 1990) cloth traps. Baits are often incorporated to increase the catch, with an implicit assumption that higher catches necessarily gives greater insight into species richness and/or abundance. Therein lies the difficulty. Community descriptors such as richness, evenness, and diversity are based on abundance data. These are a function of sampling method, and incorporate the associated trap biases.

In this paper, we compare richness, evenness, and diversity estimates based on our tabanid surveys on Akimiski Island, Nunavut, Canada. Data were collected using modified Malaise traps, plastic sticky traps; blue and black cloth traps, aerial netting, and adhesive patches worn on the hat and trouser legs. This report is an early part of a larger study of Tabanidae in the James Bay region.

Materials and Methods

Study Site. Akimiski Island (Nunavut) is a large (3,800 km^2) island located in western James Bay, about 200 km north of Moosonee, Ontario, Canada (53° 06'N, 80° 57'W). It is within the Hudson Bay Lowlands region, and is an important breeding ground for Canada geese (Leafloor et al. 2000). The study area that we used is a 30 metre by 30 metre fenced enclosure operated by the Ontario Ministry of Natural Resources and is used as a base for monitoring goose nesting ecology, banding geese, and studying shore birds (Hudson Bay Project 2007). Akimiski Island also has polar bears in the latter half of the summer. Because the bears damaged many of the traps used in this study (e.g. the Malaise traps), this resulted in irregular sample dates.

Trapping methods. Tabanidae were sampled using modified Malaise traps, sticky traps, cloth traps, a hand held aerial net, and adhesive strips placed on clothing worn by a human host.

*Malaise traps***.** Tabanids were collected as part of a larger Arthropod Sampling Protocol undertaken at Akimiski Island (ArcticWOLVES Project and Ontario Far North Terrestrial Biodiversity Project). Each trap consisted of a 40 cm wide and 50 cm high black nylon screening held between two wooden posts, placed at ground level. Over this was a white ABS plastic funnel 50 cm diameter by 50 cm high, leading to a clear plastic collecting bottle which contained water and a soap surfactant. Five traps were placed in two shoreline habitats which were dominated by one of two species of grass, *Festuca rubra* in supratidal areas, and *Puccinellia phyrganodes* in intertidal areas. Insects caught were collected every two days from June to the end of August, when possible, and stored in 80% ethanol.

Sticky traps. Sticky traps were made of Coroplast^R (twinwalled corrugated plastic material commonly used for signs and packaging, Coroplast, Great Pacific Enterprises Inc. 700 Vadnais, Granby, Que. J2J1A7, and 4501 Spring Valley Rd., Dallas, TX 75244). Different coloured panels (19 cm wide by 22.5 cm tall) were installed along a wooden bar, 30 cm apart, with their bottom edge 60 cm above the ground, and coated on both sides with Tangle-Trap^{R} insect adhesive (Tangle Foot Co., Chicago, IL). Panel colours were blue, red, black, yellow, white, and green, and placed followed a 6x6 Latin squares design. Each trapping session lasting one day. When there were zero catches due to cool temperatures or damage by polar bears, the configuration was repeated the following day.

Cloth traps. From 7 Aug. 2008 to 23 Aug. 2008, two Vavoua traps were deployed (Laveissière and Grébaut 1990) (Fig 1a), one made of blue and black cloth (Mihok et al., 2006) and one made from blue and black Coroplast^{R} panels. Each trap presented a 42 cm high target of three 40 cm wide blue wings (0.50 m^2 total surface area). The centre area was a 7 cm wide black strip visible from each side. Trapped flies were directed by a white fabric netting toward a collector bottle (a plastic water bottle). Traps were baited with an octenol bait stick (French and Kline 1989, Leprince et al. 1994) (Mega-Catch™ Octenol Fragrance Strip, 3.74 g 1-Octen-3-ol per strip) and placed 20 metres apart, with trap location switched each day. From Aug. 15 to Aug. 23 we deployed a third cloth trap (Figs. 1b, c), constructed to present a larger coloured surface area. This trap had a 30 cm wide by 42 cm tall black Coroplast^{R} central region flanked by a 61 cm wide by 42 cm tall piece of blue cloth on each side (1.3 m^2 total surface area), and surmounted with a funnel of white netting leading to a collecting bottle (Fig. 1b). The assembly was held in place using guy wires attached to ground stakes. Catches were collected at 20:00 h each day, and samples stored in 80% ethanol. These three traps are referred to collectively as “cloth” traps.

Aerial net. Tabanids were sampled using an aerial net within the research station fenced area amidst the buildings at midday on 15 Aug.

Adhesive strips. We sampled Tabanidae attracted to human hosts using 5 cm by 12.5 cm adhesive strips (Tred-Not™ DeerFly Patches, Leroy Michigan) (Cilek 2000) placed on the front of DB’s trouser legs and hat (Tilley^{R} Hat, white canvas bucket-style). A single patch was placed on the back of the hat, and on both trouser legs 40 cm high, facing the front. There were five 40 minute collections: 3 Aug. (1) 4 Aug. (2), and 11 Aug. (1). Sampling consisted of walking slowly along the shore in front of the research station. Flies attached to adhesive patches were killed by being placed in killing jars with ethyl acetate. Flies were kept attached to patches and stored for later identification, at which time they were removed from the patches using naphtha gas (Ronsonol^{R} lighter fluid) to dissolve the adhesive.

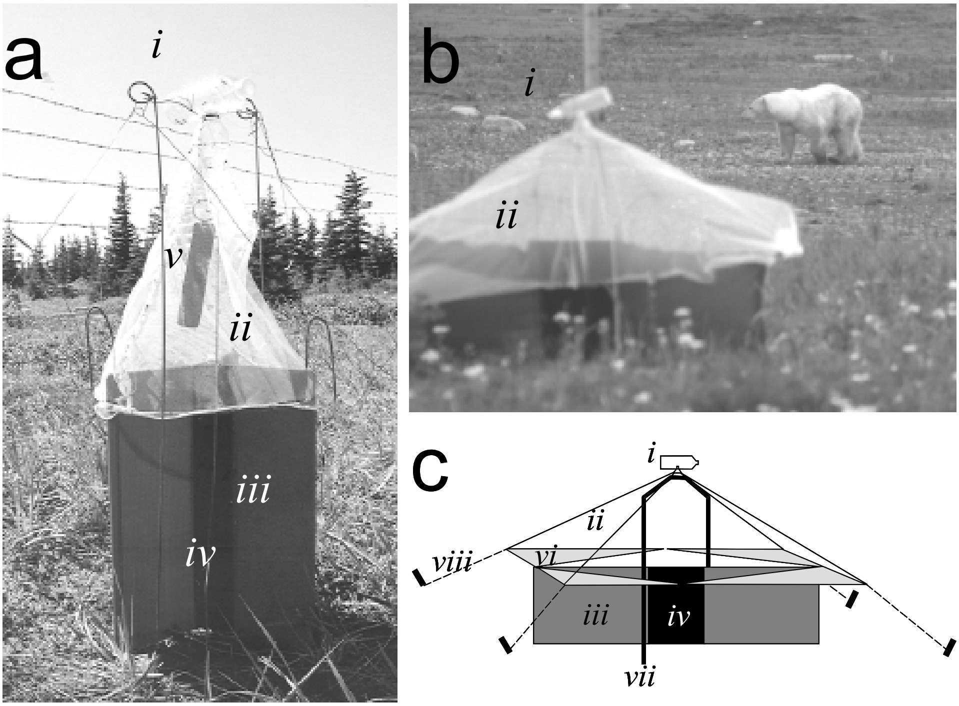


Fig. 1. Vavoua (a. left) and Akimiski trap (b. right, and c. below), showing the collecting bottle i, netting over trap ii, blue sides iii, black target area iv, and octenol bait stick v (Vavoua traps only), netting side shelves vi, metal wire frame vii, staked guy wires viii. (Photograph in b by Lisa Pollock, 2008).

Analysis. The species caught were identified using the keys in Teskey (1990). Trapping methods were compared based on species composition using percent similarity, calculated as $P = 100*\Sigma \text{ minimum } (p_{1i}, p_{2j})$, where P = percent similarity between sampling methods, p_{1i} = proportion of species *i* in sampling method 1, and p_{2j} = proportion of species j in sampling method 2 (Krebs 1989).

Species diversity was determined using the Shannon's index (the Shannon-Wiener function), calculated as $H' = - \Sigma\, p_i \ln p_i$, where p_i is the proportion of the *i*th species in each sampling method. H' is sensitive to rare species, and indicates the level of uncertainty about what species a random individual from the sampled area belongs to. The number of species of equal abundance that produces the observed value for H' is N_1, and is calculated as $N_1 = \exp H'$ (Krebs 1989).

Species richness was examined using a Whittaker plot of the number (ln) of each species vs the species rank (Ludwig and Reynolds 1988), and rarefraction analysis for estimating the number of species that would be caught with various sample sizes (Ludwig and Reynolds 1988, Krebs 1989).

An estimate of the total number of species in the region was calculated by fitting the pooled trap catches to a lognormal distribution based on the method outlined in Ludwig and Reynolds (1988):

$$S(R) = S_0 e^{(-a^2 R^2)}$$

where $S(R)$ is the number of species in a class or category based on a base 2 log scale (e.g. 0-1, 1-2, 2-4, 4-8, 8-16, etc. individuals per species), S_0 is the estimated number of species in the class with the most species (modal class), and a is half of the standard deviation, and governs the width of the distribution. The total number of expected species, S^*, is calculated as $S^* = 1.77\ (S_0/a)$. The parameters of the lognormal distribution were determined iteratively, minimizing the χ^2 value obtained by fitting the expected lognormal frequencies to the observed frequencies (Ludwig and Reynolds 1988).

Calculations were carried out using either a spreadsheet (Microsoft^R Excel 2003) or STATISTICA 4.5 (StatSoft^R, Tulsa, OK).

Results

Trap comparison. Catches by trap method and species are summarized in Table 1. Hat and leg traps caught a large proportion of *Hybomitra. frontalis* and *H. pechumani*. Cloth and sticky trap collections had large numbers of *H. liorhina* and *H. illota* but few *H. frontalis* or *H. pechumani*. The sticky traps caught only 33 individual tabanids. Catches differed by colour (Kruskal-Wallis ANOVA test of ranks (Sokal and Rohlf 1995): $H_{(5, 35)} = 11.50$, p =.042) with most tabanids caught on blue traps (18), followed by black (6), red (5), yellow (2), green (2) and white (0).

About the same number of tabanids were caught on the Coroplast Vavoua trap (42) compared to the cloth Vavoua trap (31) (17 trapping days, $F_{(1, 32)} = 0.37$, $p = 0.55$).

The percent similarity index indicated that the greatest similarity was between the total Malaise and August Malaise catches (89.4 and 73.5 % with and without deer flies, Table 2). Hat and leg and netted collections were least similar (2.5%, deer flies excluded). Excluding deer flies from the analyses had the greatest impact on cloth, hat and leg, and sticky % similarities.

Species abundance. The Whittaker plot in Fig. 2 shows the relationship between relative abundance and species rank (ranked in ascending order with 1 as most abundant based on pooled catch data ($y = 21.91^* e^{-0.234x}$, $R^2 = 0.97$, $p < 0.001$). *Crysops furcatus* was the most abundant species, followed by *H. pechumani* and *H. frontalis*. Rarest species were *C. ater*, *H. affinis*, *H. microcephala*, and *H. trepida*.

The number of species caught increased with trap success measured as abundance. Excluding the hat and leg collections from the analysis produced a strong relationship between abundance and species observed (number of species = 5.59 * *ln*abundance - 13.63, $R^2 = 0.99$, $p < 0.0001$, Fig. 3). The Malaise trap catches from August fell close to this line (not included in the model). Hat and leg traps caught proportionately fewer species than the other trapping methods based on this model.

From the rarefraction curves (Fig. 4), two sampling methods had distinct sampling sampling patterns: using an aerial net produced new species most rapidly, whereas the hat and leg traps produced new species at the slowest rate. Malaise and cloth traps produced similar abundance to species curves (Fig. 4).

Species abundances were described by the lognormal distribution (Fig. 5) for the Malaise trap catches ($\chi^2 = 4.07$, $p = 0.77$, d.f. = 7, 9 classes) and the combined catches from all trapping methods ($\chi^2 = 3.17$, $p = 0.92$, d.f. = 8, 10 classes). Parameter values and total species estimates were $S_0 = 3.56$, $a = 0.1925$, $S^* = 32.73$; and $S_0 = 3.55$, $a = 0.17$, $S^* = 36.96$ for Malaise catches and combined catches respectively.

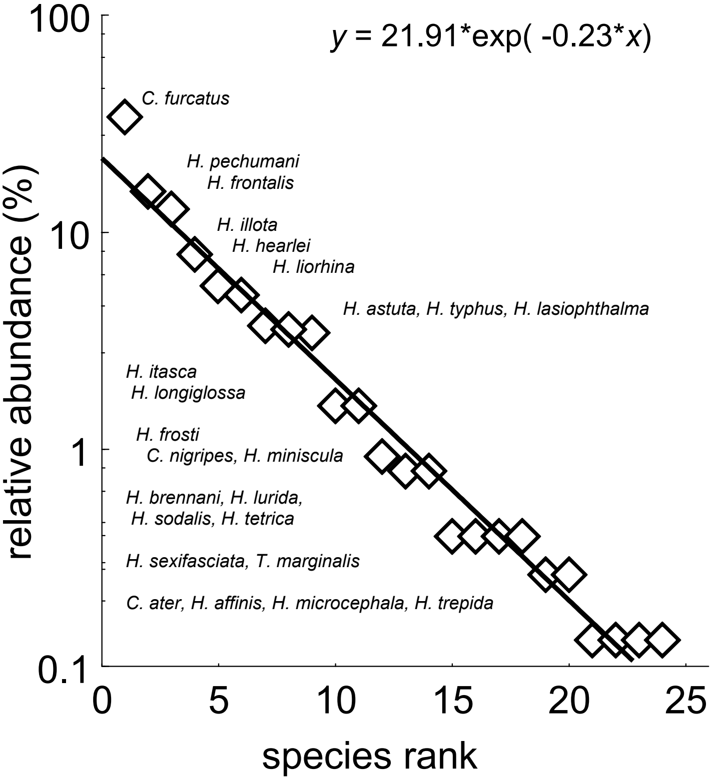


Fig. 2. Tabanidae species ranked according to relative abundance (%), based on the sum of all Tabanidae collections from Akimiski Island, Nunavut, in summer 2008.

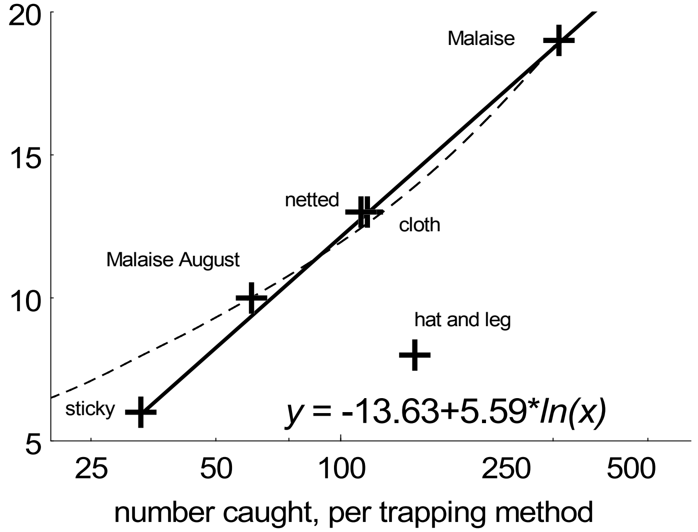


Fig. 3. Tabanidae abundance vs number of species caught, totals of various method used in the Akimiski Island, Nunavut, collections. The August Malaise totals were not used for line fitting, but were included because the other trapping methods were obtained during this month. The hat and leg collections were excluded from the regression. The broken line is the rarefraction curve (Fig. 4) on a log scale for the total catch using the modified Malaise traps.

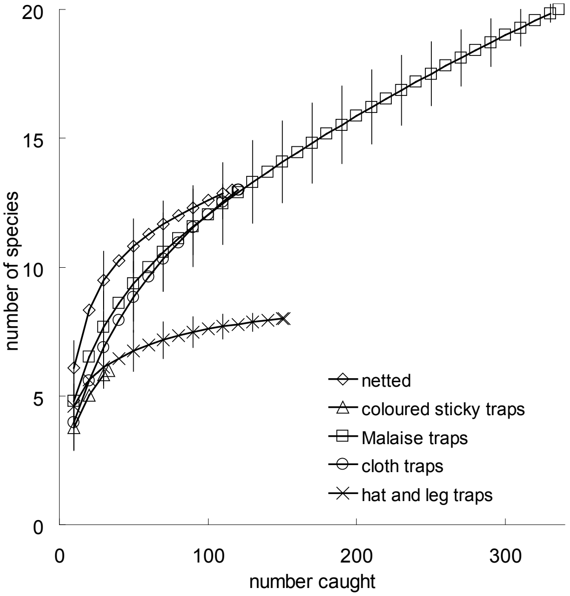


Fig. 4. Expected number of species for each sampling method, Akimiski Island, Nunavut, for different abundances determined by rarefraction analysis. Bars are standard deviations

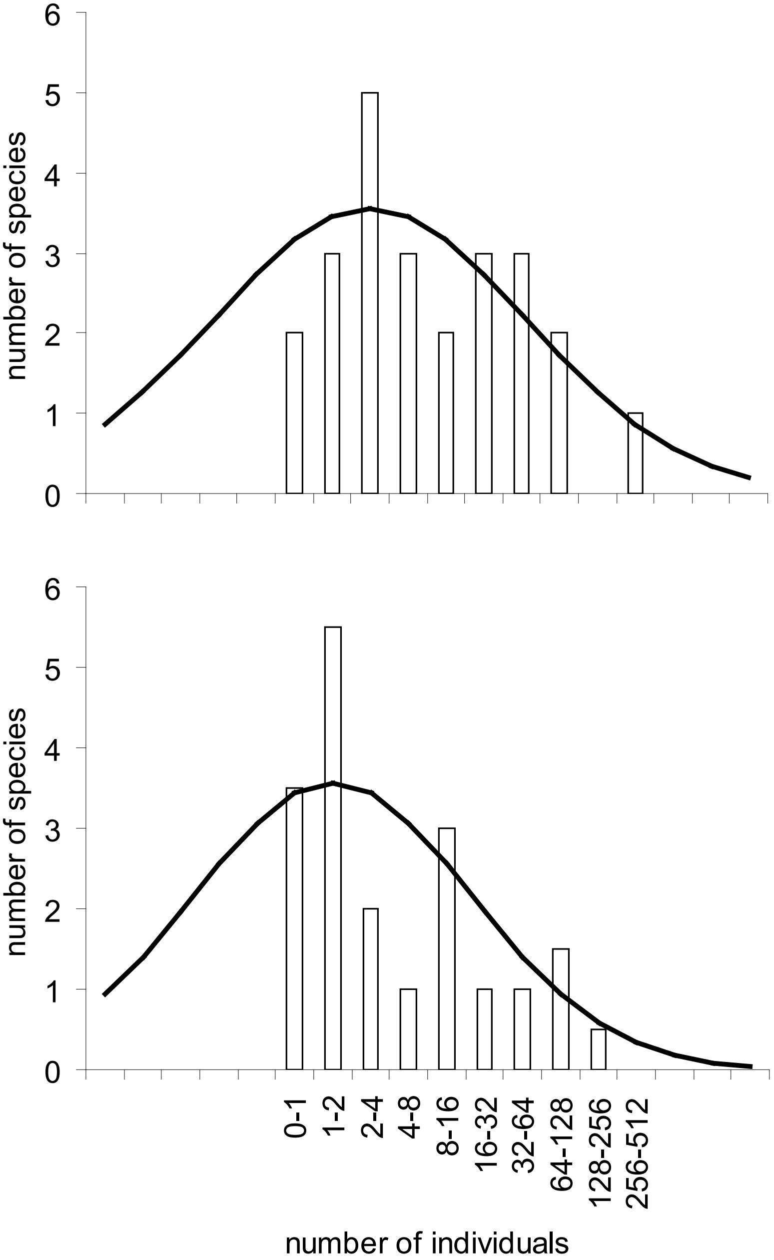


Fig. 5. Lognormal plot of Tabanidae caught on Akimiski Island, based on Malaise trap catches (upper) and total trap catches (lower). Species are apportioned into categories, and ties are split. For example, the number of species in which only one individual was caught are divided between the 0-1 and 1-2 categories

Discussion

Diversity was highest in the netted sample, H′ = 2.19 (Table 1), based on a relatively even distribution of the catch across 13 species. The Malaise traps had the highest species count, 19, yet low diversity, H′ = 1.85, due to the number of species represented by single catches. The hat and leg traps had a similar diversity, H′ = 1.68, reflecting catches spread more of less evenly across 8 species. For biodiversity studies of habitat, species richness provides a more useful index than diversity.

So what is the best sampling method? It depends upon the research question. Direct sampling using sticky patches attached to the researcher as bait can provide data on host-seeking tabanids that would affect human activities. While simple and productive in terms of numbers, our results suggest that this method is less effective for surveying extant species in a region by missing less abundant species compared to the other methods.

From our results, estimates of species richness based on rarefraction methods that equate abundance to species collected are methodologically specific. For example, Butt et al. (2008) reported catching 480 tabanids from 14 species in a collection in Gros Morne National Park in Newfoundland using unbaited Malaise traps. They contrasted this to an earlier collection of 4912 from only 15 species taken from a different region of Newfoundland using CO_2 baited traps (Graham 1992, reported in Butt et al. 2008). Butt et al. (2008) pointed out that the difference could be due to sampling method. We agree, and would state this more strongly. From our analysis comparing species richness based on different trapping methods can be misleading, and we caution against comparing species richness or abundance in two regions using data collected with unbaited and host-baited sampling methods.

Such trap biases may offer a potential tool for comparing regions, allowing insights into changes of species composition. For example, from Fig. 4, almost twice as many species are expected in netted samples of 100 compared to hat and leg catches of 100. Any site differences or changes in land use could be reflected by changes in the netted/hat-leg trap ratio.

We caught 24 species of Tabanidae. Based on fitting abundance data to a lognormal distribution, there are possibly between 33 and 37 species in the same region. The smaller value is based on the Malaise trap catches only, while inclusion of the all trapping data produced the larger value. Given our comments on trap bias, we expect that the estimate derived from the Malaise catches will prove to be the better estimate.

Table 1. Number of each Tabanidae species caught by various trapping methods deployed on Akimiski Island, Nunavut in August 2008. All flies were female except for a single *Hybomitra lurida*.

Species	Collecting method				
	netted	sticky traps	Malaise	cloth	hat and leg
*Chrysops ate*r Macquart		1			
Chrysops furcatus Osten Sacken	1	17	128	60	51
Chrysops nigripes Zetterstedt		2	1		3
Hybomitra affinis (Kirby			1		
Hybomitra astuta (Osten Sacken)	4		24		
Hybomitra brennani (Stone)	3				
Hybomitra frontalis (Walker)	15		49	2	31
Hybomitra frosti Pechuman			6	1	
Hybomitra hearlei (Philip)	11		2	7	23
Hybomitra illota (Osten Sacken)	23	9	14	2	12
Hybomitra itasca Philip			11	1	
Hybomitra lasiophthalma (Macquart)	24		1	1	
Hybomitra liorhina (Philip)	3	1	1	34	
Hybomitra longiglossa Philip	9			2	1
Hybomitra lurida (Fallén)			1	1	
Hybomitra lurida male			1		
Hybomitra microcephala Osten Sacken			1		
Hybomitra miniscula (Hine)	1			5	
Hybomitra pechumani Teskey and Thomas	12		78		27
Hybomitra sexifasciata (Hine)	1		1		
Hybomitra sodalis (Williston)			2	1	

Species	Collecting method				
	netted	sticky traps	Malaise	cloth	hat and leg
Hybomitra tetrica (Marten)					3
Hybomitra trepida (McDunnough)			1		
Hybomitra typhus (Whitney)	9	3	11	4	
Tabanus marginalis Fabricius			2		
	indices				
total horese flies	115	13	207	61	97
total deer flies	1	20	129	60	54
total tabanids	116	33	336	121	151
number of species	13	6	19	13	8
H’ with deer flies	2.19	1.30	1.85	1.52	1.68
N_1 with deer flies	8.97	3.65	6.37	4.55	5.35

Table 2. Percent similarity based on the minimum proportions of each species in each trap (Krebs, 1989) with deer flies included [excluded].

	sticky traps	total Malaise	cloth	hat and leg	Malaise Aug.
netted	31.0 [30.2]	8.6 [7.7]	6.1 [5.2]	2.5 [1.7]	42.3 [44.6]
sticky traps		46.1 [7.7]	45.3 [5.2]	35.0 [1.7]	27.9 [13.7]
total Malaise			48.4 [10.3]	37.2 [3.9]	73.5 [89.4]
cloth				43.1 [9.8]	28.8 [21.3]
hat and leg					63.8 [63.1]

Acknowledgements

The Ontario Ministry of Natural Resources Far North program (Terrestrial Biodiversity Project), the OMNR waterfowl program. We thank Elise Bolduc and Joel Bety for supplying the modified Malaise traps as part of the IPY ArcticWOLVES project. We also are indebted to Rod Brooke, Sarah Hagey, Lisa Pollock, Danica Hogan, and Andrée-Michelle D’Aoust-Messier for their invaluable help in this project.

References

Beresford, D. V., and J. Sutcliffe. 2006. Studies on the effectiveness of Coroplast^{R} sticky traps for sampling stable flies, *Stomoxys calcitrans* (Diptera: Muscidae), including a comparison to Alsynite. J. Econ. Entomol. 99: 1025–1035.

Butt, C., B. Hicks, and C. Campbell. 2008. The diversity and abundance of Tabanidae in black spruce forests and sphagnum bogs in Gros Morne National Park, Newfoundland, Canada. J. Acad. Entomol. Soc. 4: 7-13.

Cilek, J. E. 2000. Evaluation of “Tred-Not™ Deer Fly Patches” against host-seeking deer flies (Diptera: Tabanidae) in north Florida. Fla. Entomol. 83: 476-480.

Cilek, J. E. 2003. Attraction of colored plasticized corrugated boards to adult stable flies, *Stomoxys calcitrans* (Diptera: Muscidae). Fla. Entomol. 86: 420-423.

French, F. E., and D. L. Kline. 1989. l-Octen-3-ol, an effective attractant for Tabanidae (Diptera). J. Med. Entomol. 26: 459-461.

Hudson Bay Project. 2007. The Hudson Bay Project: 2007 Annual Progress Report. 31 pp.

Krebs, C. 1989. Ecological Methodology. Harper and Row, Publishers, Inc. New York. N. Y.

Laveissière, C. & Grébaut, P. 1990. Recherches sur les pièges a *glossines* (Diptera: Glossinidae). Mise au point d’un modele economique: Le piège «Vavoua». Trop Med Parasitol 41: 185-192.

Leafloor, J. O., M. R. J. Hill, D. H. Rusch, K. F. Abraham and R. K. Ross. 2000. Nesting ecology and gosling survival of Canada geese on Akimiski Island, Nunavut, Canada, pp. 109-116. In K. Dickson (ed.), Towards conservation of the diversity of Canada geese (*Branta canadensis*). Canadian Wildlife Service Occasional Paper 103.

Leprince, D. J., L. J. Hribar, and L. D. Foil. 1994. Responses of horse flies (Diptera: Tabanidae) to Jersey bullocks and canopy traps baited with ammonia, octenol, and carbon dioxide. J. Med. Entomol. 31: 729-731.

Ludwig, J. A., and J. F. Reynolds. 1988. Statistical Ecology. John Wiley and Sons Ltd. New York.

Mihok, S. 2002. The development of a multipurpose trap (the Nzi) for tsetse and other biting flies. Bull. Ent. Res. 92: 385-403.

Mihok, S., and D. A. Carlson. 2007. Performance of painted plywood and cloth Nzi traps relative to Manitoba and greenhead traps for tabanids and stable flies. J. Econ. Entomol. 100: 13-618.

Mihok, S., D. A. Carlson, E. S. Krafsur, and L. D. Foil. 2006. Performance of the Nzi and other traps for biting flies in North America. Bull. Entomol. Res. 96: 387-397.

Schofield, S. 1998. Responses to electrified targets and daily activity of *Stomoxys* spp. (Diptera: Muscidae) in Zimbabwe. Bull. Entomol. Res. 88, 627-632.

Sokal, R. R., and F. J. Rohlf. 1995. Biometry, 3rd ed. W. H. Freeman and Co. New York.

Teskey, H. J. 1990. The horse flies and deer flies of Canada and Alaska (Diptera: Tabanidae). The Insects and Arachnids of Canada Part 16. Agri. Canada Publ. No. 1838, Ottawa.

Back to Index

Biological Survey of Canada Curation Blitz at the Spencer Entomological Collection, Beaty Biodiversity Museum

The fourth annual BSC Curation Blitz will be held the evening of Monday 01 November 2010 at the Spencer Entomological Collection, Beaty Biodiversity Museum, 2212 Main Mall, UBC in Vancouver during the Entomological Society of Canada meetings. These gatherings encourage awareness of holdings of the collection, provide assistance with curation and networking for entomologists interested in faunistics and systematics.

An attraction this year will be the venue, the recently established Beaty Biodiversity Museum (www.biodiversity.ubc.ca/museum), at the University of British Columbia.

If you are interested in attending please contact:

David McCorquodale (david_mccorquodale@cbu.ca) or

Karen Needham (needham@zoology.ubc.ca).

Details about time and transportation will be available at the ESC meeting.

Back to Index