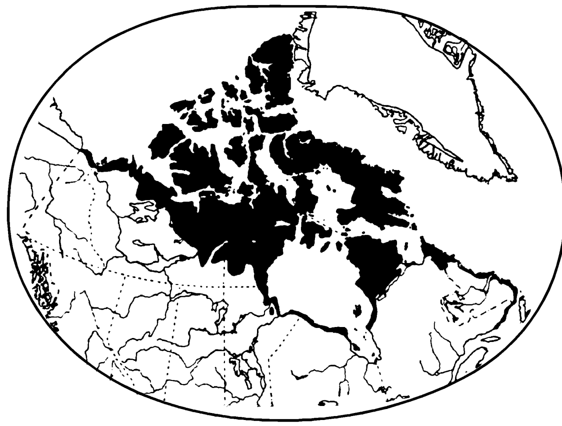
ARCTIC INSECT NEWS



NO. 9 1998

IN THIS ISSUE

EDITOR'S COMMENTS

This issue of the newsletter has profited from a number of contributions from Scandinavia as well as from North America. These articles supplement regular features such as *Feature Locality*, *Feature Species*, and *History Corner*. Contributions for the newsletter on any aspect of arctic insects and their relatives continue to be warmly welcomed by the editor.

Also included here is a copy of the *Arctic Insect News* mailing list. Anyone not yet on that list who wishes to receive this annual newsletter can do so simply by notifying the Biological Survey (see box below).

H.V.D.

Arctic Insect News, distributed free of charge, is available upon request from the Secretariat, Biological Survey of Canada (Terrestrial Arthropods), Canadian Museum of Nature, P.O. Box 3443, Station "D" Ottawa, Ontario, Canada K1P 6P4

NEWS BRIEFS

Arctic Information on Web

The Arctic Council has recently established a web site (http://www.nrc.ca/arctic) for the dissemination of information about the Arctic. As well as information about the Council, its members and programs, the site has a section of Arctic Links on the following topics: Economic Development, Social Development, Cultural Development, The Human Dimension, Environment, Scientific/Academic/Traditional Knowledge and General. The Scientific/Academic/Traditional section is further divided into Research Institutions, Academic Institutions, Polar Libraries and Traditional Knowledge.

The Arctic Council was established in 1996 to provide a mechanism to address the common concerns and challenges faced by the Arctic governments and the people of the Arctic. The main activities of the Council focus on the protection of the Arctic environment and sustainable development as a means of improving the economic, social and cultural well-being of the north. The members of the council are Canada, Denmark, Finland, Iceland, Norway, the Russian Federation, Sweden and the U.S. The web site is maintained by the Canada Institute for Scientific and Technical Information (CISTI), a division of the National Research Council of Canada.

The Third European Workshop of Invertebrate Ecophysiology

The Third European Workshop of Invertebrate Ecophysiology (EWIE) took place 6-10 September 1998 at the University of Birmingham, Edgbaston, Birmingham, UK, and like the previous workshops (Station biologique de Paimpont, France, 1992; „eské Bud•jovice, Czech Republic, 1995) was a great success. Professor Jeff Bale was the local organizer for the 3rd EWIE. The more than 50 participants came chiefly from European countries (including the Czech Republic, Denmark, France, Germany, Greece, Hungary, Norway, Russia and U.K.) but scientists from Canada, Japan, New Zealand and the United States also participated.

The papers were organized into four sessions:

¤ Life cycles and phenology: 17 papers, including keynote papers on “Species at the edge of their range: the significance of the thermal environment for the distribution of congeneric *Craspedolepta* species (Homoptera: Psylloidea) living on *Epilobium angustifolium*” by I.D. Hodkinson, and “Shutting down for the winter”, by D.L. Denlinger.

¤ Insects and responses to climatic change: 2 papers including a keynote paper on “Impacts and responses at the population level to elevated CO_2” by J.B. Whittaker.

¤ Thermal biology: 16 papers including a keynote paper on “Insect cold hardiness and ice nucleating active microorganisms”, by R.E. Lee.
Water relations and respiration: 5 papers.

A further 6 papers were the focus of a poster session on a range of topics. All of the presentations in each section fostered lively questions.

Most of the presentations at the workshop dealt with insects, but arthropods in general, collembolans, mites, spiders, enchytraeids, earthworms, nematodes, millipedes, and crustaceans were also treated. About 20 papers from the workshop have been submitted for a special issue of the *European Journal of Entomology*, with guest editors J.S. Bale, W. Block and L. Sømme, who played the same role successfully for the second workshop (see *European Journal of Entomology* 93(3), 1996).

The workshop was extremely well organized and much appreciated by all the participants. Accommodation and meeting facilities at the University of Birmingham were convenient for a group of this size, the food was excellent, and the layout of the dining and coffee facilities further enhanced interaction among participants. A welcoming reception and a workshop dinner also helped to foster interaction.

One day of the workshop was devoted to an outing providing a glimpse of nearby points of interest, as well as further opportunity for informal discussions among participants, and a change from the full days of papers. This outing allowed visits to the village of Hagley, with the estate of Hagley Hall, to the town of Stratford-upon-Avon, birthplace of William Shakespeare, and to Warwick Castle, the finest mediaeval castle in England. It ended at a restaurant specializing in one of the foods characteristic of the Birmingham area, Balti Indian cuisine.

At the end of the workshop, an open discussion considered the future and timing of the EWIE, and it was agreed that such focussed and rewarding meetings should continue as events separate from other congresses or meetings. The next (fourth) workshop will be held in St. Petersburg, Russia, in 2001, organized by Professor V.E. Kipyatkov and E.B. Lopatina (St. Petersburg State University).

Hugh Danks

Spiders from Svalbard

A total of 16 species of spiders are known from the archipelago of Svalbard, and 15 of them have been recorded from Spitsbergen, which is the largest island. During an expedition in 1996 *Erigone arctica palaearctica* Braendegaard, 1934 and *Lephyphantes sobrius* (Thorell, 1872) were collected for the first time from the island of Nordaustlandet. *Collinsia spetsbergensis* (Thorell, 1872) is the first record of spiders from the small northernmost islands of Sjuøyane, collected at Phippsøya (80°40′N, 20°50′E). The species has a circumpolar distribution, while *Collinsia holmgreni* (Thorell, 1872) collected around the volcanic hot springs at Bockfjorden, Spitsbergen, is holarctic.

Reference

Hauge, E. and L. Sømme. 1997. Records of spiders (Aranea) from Nordaustlandet and Sjuøyane, Svalbard. *Fauna norv. Ser. A*, 18:17-20.

Lauritz Sømme

Cold Hardiness Symposium 2000 Announced

The 7th Triennial International Symposium on insect/invertebrate and plant cold hardiness will be held at the University of Victoria, Victoria, B.C., Canada, Sunday, 28 May - Friday, 2 June, 2000.

The scientific program is intended to cover the following general areas at the theoretical, molecular, biochemical, genetic, ecophysiological, organismic, ecological and/or applied levels.

¤ Cold hardiness in insects/invertebrates

¤ Cold hardiness in plants

¤ “Freezing frogs”

¤ Climate change and cold hardiness

¤ Polar and alpine insects

The Symposium will consist of oral presentations, a poster session and perhaps workshops. Time will also be set aside for informal discussions and for determining the future of this Symposium.

For suggestions and information contact the organizer:

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FEATURE LOCALITY: TRUELOVE LOWLAND, DEVON ISLAND, CANADA

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Truelove Lowland, north coast of Devon Island, N.W.T., Canada 75°33′N, 84°40′W

Temperature (1970-73): 278 degree days above 0°C, 75 days above 0°C, July mean temperature 6.3° C.

Habitats: Mosaic of sedge-moss meadows, cushion plant communities, dwarf shrub heath; beach ridges; hummocky tundra; lakes, ponds, streams; rocky coast; Precambrian shield.

Vegetation: 96 perennial vascular plant species, 182+ lichen species, 126 diatom taxa, 132 moss species, 30 hepatic species.

Vertebrates: 7 mammal and 35 bird species (17-19 species actually nesting), one fish species.

Invertebrates, known species: protozoans 61, platyhelminths 1, cestodes 4, nematodes many, rotifers 66, annelids 7, tardigrades 13, crustaceans 13, spiders 10, mites 22,

Truelove Lowland is the most thoroughly studied biological research site in the Canadian Arctic. The International Biological Programme (IBP) studies conducted there from 1970-74, led by Lawrence C. Bliss, generated a great range of ecological information. Centred on the concept of energy flow through this ecosystem, IBP investigations ranged from permafrost, soils and climate through plants, animals and decomposers, and human impacts. The synthesis of four field seasons of research was thorough, comprehensive and compactly presented by all participating investigators in the project summary (Bliss 1977). Previous and subsequent studies, many by former IBP participants, have added significantly to the knowledge of this site and of arctic science.

The Truelove Lowland (Fig. 1) is a 43 km^2 coastal plain, one of a series of five lowlands on the northeast coast of Devon Island. The site is biologically diverse compared with the surrounding lands, most of which are high plateau. The Lowland may be called an oasis of diversity as it is representative of the especially rich sites that form about 1% of the Queen Elizabeth Islands land area. The tallest vegetation rarely reaches 5 cm above dry soils—15 cm in meadows—and consists mostly of sedges, mosses, cushion plants, prone woody shrubs and lichens. A variety of meadows dominates the land, separated by more than 20 steps of relict beach ridges created as the Lowland uplifted from the sea 9700-7500 years B.P. Devon Island, 54,100 km^2, has no permanent human residents.

Biota

The biota of Truelove, summarized in appendices of the project book (Bliss 1977), bears review and updating.

The flora includes 96 species of perennial vascular plants. Of these, 7 species were considered dominant, 30 common, 44 moderately abundant, and 15 were rare. Diatoms were not included in the appendices, but Wolfe and King (1990) report 126 taxa from 29 genera and 7 orders of freshwater diatoms at Truelove. There were 132 species of mosses and 30 of hepatics. Lichens include 182 listed species, with subsequent additions. Altogether 92 species of fungi were identified from soils, dung, and other sources. The age distribution of freshwater arctic char was studied by James Trask. Thirty-five species of birds were sighted on the Lowland, of which 17-19 species actually nested during 1970-74. Mammal inhabitants consisted of musk oxen and fluctuating low populations of arctic hare, groenland lemming and short-tailed weasel, with sporadic visits by arctic wolf, fox, and polar bear. Ringed and bearded seals were common, and walrus occasionally visited. Bones of walrus and whale were found on land.

The invertebrate fauna is depauperate. The IBP fauna list is discussed in detail in my thesis (Ryan 1977). Protozoa were understood to be the most significant invertebrate energy releasers, but only 11 species were cited in the IBP list. Beyens (1990) reported finding 57 taxa in 17 genera of testate rhizopods. This indicates a great but undocumented diversity of more typical protozoa. A single species of a 1 mm flatworm was found. Nematodes, studied in detail by Procter (who also measured respiration rates of Truelove invertebrates) (in Bliss 1977), were known to be diverse but the taxa remain largely undocumented. Seven species of rotifers were recognized in the IBP tally, but knowledge of this fauna has been expanded to 4 bdelloid and 62 monogonont species (DeSmet and Beyens 1995). Enchytraeids, represented by seven identified species, were the only segmented annelid worms. Two tardigrade species were identified from their characteristic eggs. The known diversity of this group has subsequently been increased to 13 species, dominated by *Isohypsibius granulifer*, *I. palpillifer* and *Hypsibius dujardini* (vanRompu *et al.* 1992). The crustacean fauna in ponds seemed to represent miniatures from an early Cambrian sea. Activities of these species were attractive to Inuit students of polar ecology, who found experimentally that the top carnivore among them was the tadpole shrimp *Lepidurus arcticus*. Copepod and ostracod species were abundant in meadows.

There were 10 species of spiders. Web spinners included 8 linyphiids and one dictynid. These, and especially the large lycosid hunter *Tarentula exasperans*, were important food items for small bird migrants arriv-

Fig. 1. View of Truelove Lowland in summer showing meadows, raised beaches, lakes, and ice covered Truelove Inlet extending into Jones Sound. Insert map indicates location of study area.

ing to the snow-covered Lowland. Mites were ubiquitous and the fauna should encompass more than the 22 identified species, 7 of which are parasitic.

Eight orders of insects were represented by 156 identified species on the Lowland. These included several species of lice from birds, and one from a walrus. The true diversity of lice will be greater, but is inherently difficult to assess as it requires killing and combing vertebrate hosts. One homopteran species, a male scale, was collected on a single occasion. Aphids were sought, but not found. Such seasonal aerial plankton migrants might colonize in the future. One caddisfly species was collected annually from the shores of several lakes. Of the three beetle species, the pond dwelling dytiscid *Hydroporus polaris* and the carabid *Amara alpina* were frequently encountered, while the 2.5 mm staphylinid *Gynpeta* sp. was rare. Four orders, Collembola, Lepidoptera, Diptera and Hymenoptera, dominated the insect fauna.

Collembola populations and their effects on soil metabolism were studied intensively by Addison (in Bliss 1977). Moulting by adults, and long adult lives, compounded population analyses, but specific focus on abundant *Hypogastura tullbergi* produced clearer understanding of the significance of these insects. Thirty species were cited in the IBP list. Fjellberg (1986) made eight revisions to this list, including the significant change of *H. tullbergi* to *H. concolor* (Carpenter 1900). Other studies are reported by Babenko (1994).

Lepidoptera taxa included two butterfly species and 12 moths. Both *Boloria* butterflies were melanized, a condition that has been noted to aid solar basking by arctic insects. Because butterflies are attractive to collectors, the diversity of butterflies offers a simple scale to compare diversity of insect faunas at other locations. *Gynaephora* moths, investigated in detail as models for the study of polar adaptation and energy flow (Ryan and Hergert, in Bliss 1977), remain a focus of continued study by Olga Kukal and others. Larvae of the two *Olethreutes* moth species have subsequently received attention from Sharron Meier as miners within hollow *Pedicularis* stems.

Flies comprised the most visibly abundant group of insects at Truelove. The soviet IBP entomologist Yuri Chernov visited the site in 1989 and estimated that he collected 8 species of tipulid flies, versus 4 cited in the appendix. He thought that the single syrphid species probably belongs in the genus *Platycheirus*, and is not *Melanostoma* n. sp. Chironomid flies, the species diversity of which is expected to be greater than the 21 species indicated in the appendix, emerge from lakes in great abundance. They were noted to be a source of nitrogen enrichment to meadows adjacent to lakes. Don Pattie observed two arctic foxes eating windrows of lake-edge chironomids, and their scats revealed distinct evidence of gnat consumption. The two *Aedes* sp. mosquitoes were uncommon during the 1970-74 period. Their pestiferous times, when perhaps 20 mosquitoes annoyed each researcher even at 320 m a.s.l. on the plateau, lasted about 10 days. Individuals frequently flew away without feeding. As another anecdote about Truelove conditions, a carcass of a winter-killed musk ox calf was colonized by calliphorid fly larvae in the summer of 1971. Most of these larvae were unable to complete development that summer, and were eaten by arctic foxes before the next spring.

The Hymenoptera species list remains unchanged from the 1977 appendix, although *Bombus hyperboreus* is expected to be found. Kukal and Pattie (1988) witnessed two events of snow bunting nests being usurped by *B. polaris*, forcing these birds to abandon their eggs.

The fauna was found to include no molluscs (except marine molluscs), nor any orthopteroids, aphids, thrips and neuropteroid insects. The largest insects were lymantriid and noctuid moths, bumble bees and tipulid flies.

When the IBP list was compiled I felt that the fauna would remain relatively as constant and predictable as the vascular plant flora. Isolation here is extreme. This does not mean annual stability. Some taxa may be prone to explosive dominance by certain species, and disappearance of others, over short periods of time. Natural fluctuations in abundance are well known for vertebrates such as lemmings. Pattie (1990) observed Truelove bird populations over 16 years, and found that old squaw duck populations fluctuated from a peak of 166 to a low of 4 individuals. Invertebrate populations will undergo similar natural fluctuations. Such fluctuations obscure the recognition of colonizations by invader species. In the future, evidence of climatic change may be sought through a comparison of faunal elements from then with the present. It would be useful to continue studies of the Truelove biota to develop baselines for such comparison.

Climatic change would be expected to affect productivity directly. A direct measure of insect production is emergence of winged insects from soil. Data from 35 m^2 emergence traps at Truelove remain unpublished except in my thesis (Ryan 1977). Diptera made up almost 100% of the numbers, and 95% of the biomass, of insects collected in these traps. Chironomids, which dominated collections, emerged in the first weeks after thaw, sciarids over a longer period, and muscoids throughout the season. Truelove meadows averaged 449 insects/m^2/year, weighing (oven dried) 33.2 mg, while raised beaches yielded 68 insects weighing 7.6 mg. Char Lake on Cornwallis Island (315 km west of Truelove) produced 143 mg/m^2/yr of aquatic winged insects, while a pond at Pt. Barrow yielded 300 mg/m^2/yr. Low seasonal production of generally small insects characterizes arctic environments.

Post IBP Research

The IBP study exposed some problems at Truelove that were pursued in subsequent studies. The paleohistory of a site is usually explored through examination of pollen layers in soil cores, but arctic plants produce little pollen to permit this technique. As an alternative, the succession of diatom species in lake bottom cores was used to create a record of the transition from marine to brackish and then freshwater beginning 9700-7500 years B.P. (Wolfe and King 1990). The pattern of terrestrial plant communities provided further evidence for this isostatic rebound succession (Bliss and Gold 1994). Soil development has been a topic of study (Kelly and King 1995). Nitrogen availability is a critical limiting factor in arctic ecosystems, and aspects of its production and distribution have been examined (Chapin 1996, Lennihan *et al.* 1994, Nosko *et al.* 1994, Chapin *et al.* 1991). Pattie reported on musk ox populations (1986). A series of archeological excavations has led to the recognition of 6 discrete occupations of Truelove by paleo-eskimos (Helmer 1991).

Climate is critical to arctic life. Areas close to the 300 m sea cliffs, which act as solar concentrators, were the most biologically diverse places on the Lowland. The Devon ice cap, which covers 1/4 of the island, has been monitored annually since 1961 (Fritz Koerner, Geol. Survey of Canada). Annual measurements of Truelove's climatic conditions were resumed by Claude Labine in 1990. The 1998 season appears to have been extraordinarily warm there, and throughout the Arctic.

Site Access

The Truelove camp is leased from the federal government by the Arctic Institute of North America (AINA), located at the University of Calgary. An Arctic Institute pamphlet describes the camp kitchen, laboratory and living structures, and terms of access. It can be obtained by request from Mike Robinson, head, AINA. Transport and supply are separately arranged through the Polar Continental Shelf Project, Ottawa, directed by Bonnie Hrycyk. The camp is most suited for summer activities, but was occupied for one winter to allow studies of musk ox and climate.

Although intended to be a research site, the camp has recently hosted successive groups of archeology and polar ecology students under the direction of James Helmer and Paul Hebert, University of Guelph. In 1998 25 persons, including 16 students, studied at the camp. The use of tuition-paying students is a limited means of site access.

At present the Truelove site receives minimal scientific use. With its baseline biological data and secure camp it is an ideal location for arctic research. There is general Canadian government underfunding of northern studies, with the net result that the U.S. spends more money on arctic science than Canada (Robinson, AINA). The IBP study may stand as a monument to successful arctic research and fund procurement, thanks to the singularly successful efforts of L.C. Bliss. Truelove remains available for research studies for at least another ten years. The Arctic Institute of North America is receptive to research proposals.

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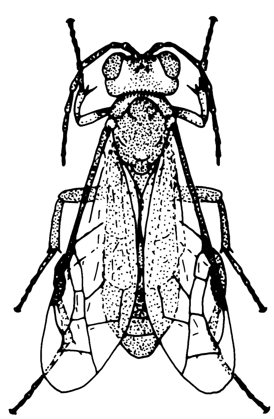

The Tenthredinidae (northern sawflies) includes many arctic species, some of which occur in the high arctic. Among the species known from these regions are numerous widely distributed, even holarctic, ones. The arctic species comprise leaf-feeders as well as gall makers on leaves or stems, especially on species of willows.

THE ITEX PROGRAM AND INSECTS AT ALEXANDRA FIORD, ELLESMERE ISLAND, NUNAVUT, CANADA (78°53′N, 75°55′W)

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The ITEX programme

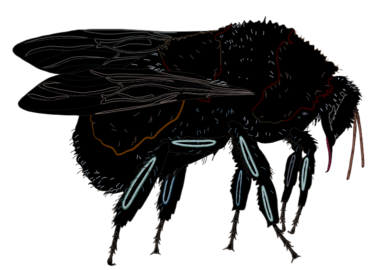
A large-scale field experiment underway in the arctic is the International Tundra Experiment (ITEX), a long-term collaborative research effort by scientists from 9 countries working at 26 research sites to examine the effects of enhanced summer warming on tundra vegetation. Investigators use a common experimental design, study a common set of species, and monitor common parameters of the ecosystem and physical environment. Small, translucent fibreglass open-top chambers (OTCs) are used to passively increase summer temperature, and these have proved efficacious in stimulating predicted climatic warming in arctic environments. However, investigators have observed that seed production for some species appears to be more limited in OTCs than in designated control plots.

An insect component

At a recent meeting of ITEX in Copenhagen, it was decided that a subcommittee be struck to implement an insect component within ITEX. My laboratory at the University of Victoria and some Danish entomologists are the only entomologists working in this area at the moment. At the meeting, Dean Morewood and Richard Ring (Canada) and Jens Böcher (Denmark) successfully highlighted the importance of invertebrates both as vectors for pollen and as potentially significant herbivores (although the intensity may vary dramatically from year to year). This working group recognised the value of including some incisive work on plant/animal interactions and intends to establish a formal group entitled the Trophic Level Interaction Committee (TROLINC) to explore future initiatives. At present the working group has identified the need to quantify "patterns" (e.g. identification of the major herbivores/pollinators at any particular site, and quantification of the impacts) and "processes" (e.g. the potential longer-term impacts at all scales ranging from individual plants, through populations and communities to the whole landscape).

Recent fieldwork

In order to meet the first objective, insect specimens were collected from six ecologically distinct plant communities at Alexandra Fiord, a polar oasis on Ellesmere Island in Nunavut, Canada. Differences among insect pollinator taxa both within and without (control) the OTCs have been compared and contrasted. Lepidoptera and Diptera are present in almost equal overall abundance, but significant differences have been found between insect pollinators collected in OTC plots versus control plots for some taxa. Mean numbers of Lepidoptera per site suggest a 32-fold overall decrease within the OTCs. OTCs do not significantly affect the abundance of the majority of Diptera families, but bumble bees (*Bombus*) (Hymenoptera) are found only in control plots. Significant exclusion of some of the larger insect pollinators occurs within OTCs, resulting in serious implications for experimental work on global change scenarios using OTCs. These results will have confounding effects on reported ITEX data, particularly with respect to plant reproductive success.



FURTHER DATA ON ARCTIC ANTHOMYIIDS (DIPTERA)

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Students of arctic insects may be interested in the revision of Nearctic species of *Zaphne* (part of *Hydrophoria* s.l.) contained in issue number 12 of my Flies of the Nearctic Region: Anthomyiidae (Griffiths 1982-98). Fifty-two species of this genus are known worldwide, of which 44 occur in the Nearctic Region. Most species are found in the low arctic and alpine to boreal and boreomontane zones of the Northern Hemisphere. Particularly diverse in the low arctic are species of the *Zaphne frontata* section. These are densely setose, rather large, black flies which are one of the most diverse and abundant groups of flies in moist tundra and tundra marshes.

Two new Beringian endemics are described in my revision, *Zaphne arctopolita* Griffiths from the Northern Yukon and Mackenzie Delta and *Z. manuata* Griffiths from Herschel Island, the Alaskan coastal plain and the Tanana Valley. Two species have Palaearctic - East Beringian distributions (not penetrating North America beyond unglaciated areas of Beringia), namely *Z. nuda* (Schnabl) and *Z. fasciculata* (Schnabl).

In view of the interest in the insects of Beringia generated by the recently published book "Insects of the Yukon" (Danks and Downes 1997), it may be useful if I update the table of biogeographic data given on page 720 of that book (Griffiths 1997). That table was based on data from the first ten issues of my Flies of the Nearctic Region: Anthomyiidae. Inclusion of data for the additional species treated in issues 11 and 12, together with correction for the two species mentioned in the footnote on page 720, gives the updated summary shown in Table 1.

Differences in percentage values in the table from those previously published are insignificant, in no case exceeding 2% in the totals for any given category. While certain genera of Anthomyiidae remain unrevised and excluded from consideration, it appears safe to assume that a very high proportion of species Holarctic in a wide sense (69.6% for East Beringia, if we combine categories 2 and 5 in the table) is characteristic of the family as a whole.

Description of the genitalia has confirmed the validity of *Zaphne diffinis* (Huckett), still known only from Southampton Island and the shore of Hudson Strait. The genitalia of this species are so distinctive morphologically that it is inconceivable that the species can be of postglacial origin. The distribution suggests survival through glacial periods in Eastern Arctic refugia, probably in Baffin Island or Labrador.

Despite the abundance of *Zaphne* species in moist tundra, virtually nothing is known of their immature stages and biology. Elucidation of their ecological role is a task for some future arctic ecologist. How, for instance, does *Z. frontata* (Zetterstedt) survive at Cape Seddon north of the outfall of the Steenstrup Glacier in Greenland, where there is hardly any unglaciated land? And what are the adults of *Z. nigerrima* (Malloch) doing on glaciers and snowfields in the mountains of Washington and California, where they have been collected repeatedly?

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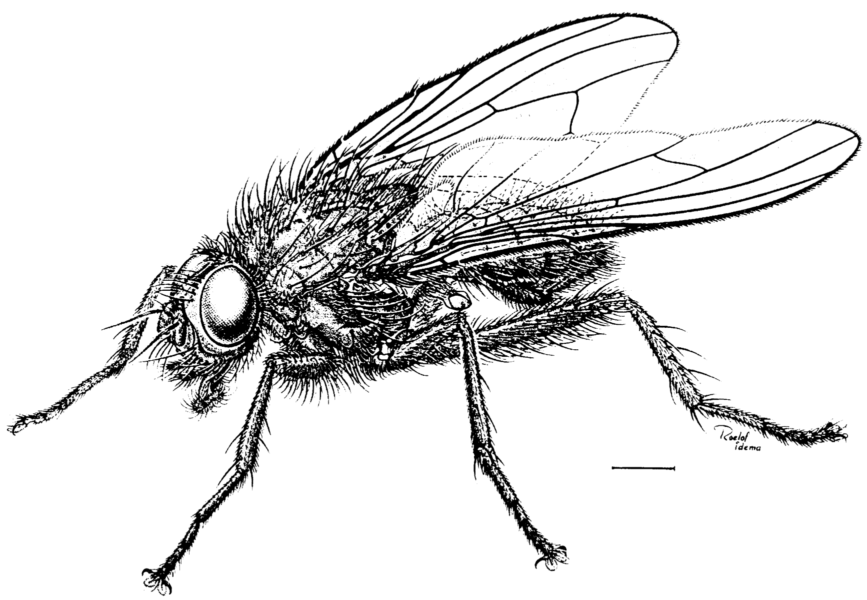
Table 1. Numbers of species (or subspecies) of Anthomyiidae in the fauna of the Yukon and Alaska (exclusive of the Panhandle)

Biogeographic Category	**Confirmed in Yukon**	**Expected in Yukon**	**Total for Yukon**	**Confirmed in East Beringia**	**Expected in East Beringia**	**Total for East Beringia**
1. Beringian	10 (5.7%)	3	13 (6.6%)	13 (6.8%)	–	13 (6.7%)
2. Palaearctic-East Beringian	15 (8.6%)	3	18 (9.2%)	17 (8.9%)	2	19 (9.8%)
3. Nearctic including East Beringian	41 (23.6%)	4	45 (23.0%)	44 (23.2%)	1	45 (23.2%)
4. Nearctic excluding East Beringia	5 (2.9%)	1	6 (3.1%)			
5. Holarctic including Beringian	102 (58.6%)	11	113 (57.7%)	115 (60.5%)	1	116 (59.8%)
6. Holarctic excluding Beringia	1 (0.6%)	–	1 (0.5%)			
Other (introduced from South America)	–	–	–	1 (0.5%)	–	1 (0.5%)
Totals	174 (100%)	22	196 (100%)	190 (100%)	4	194 (100%)

Alaskan species not expected in Yukon: 18 (of which 5 included in above numbers for East Beringia)

Total for Yukon + Alaska (excluding Panhandle): 214 species or subspecies (210 confirmed + 4 expected)



Eutrichota woodi Griffiths, male, an anthomyiid recorded only from the Yukon on open slopes above treeline.

FEATURE SPECIES: THE ARCTIC WEEVIL *ISOCHNUS ARCTICUS* AND ITS CHALCIDOID PARASITOID

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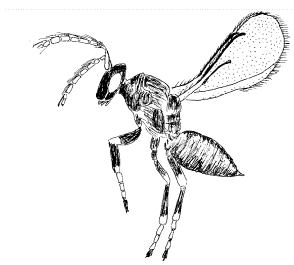
***Isochnus arcticus* (Korotyaev) (Coleoptera: Curculionidae) and *Pnigalio* sp. (Hymenoptera: Eulophidae)**

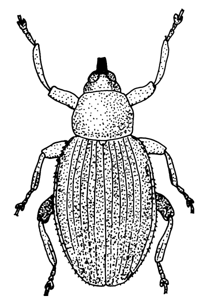
Range: Known from a scattering of localities in Canada (Ellesmere Island, Axel Heiberg Island, Boothia Penninsula, Melville Island); in USA: Alaska (Cape Thompson, Quoinhagak, St. Paul Island, St. Matthew Island); and in Russia (Wrangel Island). The fossil record indicates that this species has had essentially the same distribution since at least the Pleistocene. The range of *Pnigalio* sp. presumably tracks that of *I. arcticus*. Nothing is known of its fossil record.

Habitat and larval food: The weevil larvae mine leaves of the prostrate Arctic Willow (*Salix arctica*) growing on warmer, well-exposed sites. *Pnigalio* sp. is a primary, solitary, external parasitoid of the weevil.

Features of special interest: The most northerly willow is host to the most northerly weevil, a leaf miner, which is itself host to an undescribed parasitoid.



Male of *Pnigalio* sp.



Isochnus arcticus

Isochnus arcticus is a high arctic species of particular interest. Leaf mining is a habit that has been exploited by comparatively few weevils. Downes (1964) first discovered this weevil (as *Rhynchaenus* sp.; revised by Anderson 1989) at Hazen Camp, Ellesmere Island. He noted that the larvae make blotch mines in willow leaves, pupate within the leaf and that adults emerge in the fall at which time they may feed but do not mate. Adults overwinter in the leaf litter and the ovarioles in the female remain undifferentiated until the spring.

At Hot Weather Creek, in early June, 1990, I first noticed small, circular holes, about 1 mm in diameter, appearing just as new arctic willow leaves were more or less expanded. These holes presumably had been eaten out by adult weevils although I never actually saw a weevil on a leaf. A few days later, similar-sized but yellowed areas appeared on willow leaves. The epidermis, top and bottom, were intact, and in between one could distinguish a whitish blob, the newly hatched larva. As the weevil larva fed and continued to grow within the confines of the leaf, it ate out an increasingly broader area which became discoloured by this weevil activity and by the accumulation of dark granules of frass within the leaf (Brodo in press).

In 1990 weevil damage to *Salix arctica* was evident on most plants and both adult beetles and the immature stages within the leaves were easily collected. Random checking of the developmental progress of the immature weevils, as the season progressed, revealed a surprise. About half the blotch mines which I opened up contained not one, but two larvae within. They were both about the same size and were firmly attached at their head ends.

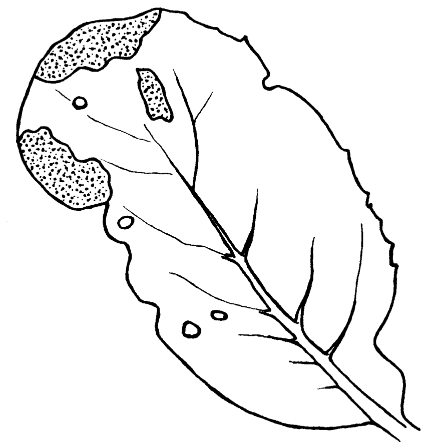
At this point I collected a shoe box full of leaves having blotch mines and stored many single leaves in separate containers. Within a few days several wasps emerged, and then a few beetles. Meanwhile the various traps, especially the yellow bowls, were pulling in a few more weevils as well as some of the same tiny wasps.

All the wasps were female except for a solitary male specimen which emerged later in Ottawa. That male (and subsequently others) confirmed this to be an undescribed species of *Pnigalio* (Dr. John Huber, personal communication). Another leaf-mining weevil in the same subfamily as *Isochnus* is parasitized by three different species of *Pnigalio* which also parasitize a variety of insects from several orders (Yoshimoto 1983). It is quite likely, therefore, that *Isochnus arcticus* is not the only host for this particular *Pnigalio* in the high arctic.

The egg of *Pnigalio* sp. is deposited within the leaf but externally on the weevil larva. The hatched parasitoid attaches itself by its mouthparts to the soft-bodied beetle larva near its head end, and sucks out the body contents of its host. It pupates within the leaf to emerge the same season.

In contrast to the previous year, in 1991 weevil holes in willow leaves were almost nonexistent, and I found no developing larvae. Dead adult weevils, however, were plentiful in the previous years' leaf litter and a few weevils and the *Pnigalio* parasite turned up in my traps. There had been severe spring wind storms in February and March of 1991 which blew away most of the snow cover at Hot Weather Creek. (A planned research project on snow cover at the Hot Weather Creek Research Station for 1991 had to be abandoned.) It is possible that the weevils sustained lethal abrasive damage by being buffetted around while still in winter diapause and this might have initiated rapid ice growth through the cuticle, so killing the beetles (see Danks et al. 1994).

Both the weevil and its parasitoid undergo complete development rapidly within a single growing season, and apparently only one stage, the adult in both cases, overwinters. This situation is in contrast to many other arctic insects which have evolved physiological processes to extend their life cycles for one or more years when conditions are less favourable (Danks 1987, and references therein). The small size of these insects, less than 1 mm for *Pnigalio* and about 2 mm for *Isochnus*, may have something to do with this.



Salix arctica leaf showing 3 blotch mines of *Isochnus arcticus* and 4 feeding holes made by adult weevils

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BIOLOGICAL FIELDWORK AT 78°N ON ELLESMERE ISLAND: THE OTTO SVERDRUP CENTENNIAL EXPEDITION 1999-2000

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On June 24 1999 the yacht *Northanger* leaves Norway with a joint Canadian-Norwegian crew flying the flags of both countries and of the newly proclaimed Canadian Nunavut territory, heading for arctic Canada and Ellesmere Island. The expedition aims to retrace the voyage of the Norwegian polar explorer Otto Sverdrup who left Norway in the famous vessel *Fram* one hundred years earlier. For four years Otto Sverdrup and his crew explored vast areas of northern Canada. The present-day expedition will, however, last only one year. The plan is to sail north along the west coast of Greenland and then cross over to the Canadian side of the Nares Strait to the wintering harbour Herschel Bay, just a little south of where Sverdrup over-wintered in Fram.

This expedition hopes to achieve several goals. First, we want to strengthen the ties between Canada and Norway. As northern friends and neighbours we share common interests, and should be working towards common goals. Second, we hope, through technology unimagined by Sverdrup only 100 years ago, to bring the arctic, its beauty and its importance into homes and schools across Norway and Canada. We have already started enrolling schools in both countries in an education programme on arctic issues, where we also hope to twin schools in the two countries for cultural exchange. In this connection we will focus on the newly established Nunavut territory in arctic Canada, both because our expedition will for the most part take place within this territory, but also, and more importantly, because we believe people in both countries should be aware of the historical returning of land to the aboriginal people of northern Canada. And last but not least we want scientific investigations to be a major part of our expedition, like they were an important part of Otto Sverdrup's expedition a century ago.

The planned field work on Ellesmere Island will consist of a biological and a geophysical part. As the party will be on the site throughout the winter season it will be able to carry out measurements and collect data normally not obtainable by scientists at these latitudes. In addition to the planned field work we may be of assistance to other scientists.

Standard meteorological parameters such as wind, air temperature, air pressure and humidity will be measured continuously during the winter, handled statistically, compared with Otto Sverdrup's historical observations and presented on the expedition website. Water column measurements, profiles of salinity (S) and temperature (T) below the sea ice, will be carried out with a portable CTD (conductivity-temperature-density) during the wintering. We also plan to bring with us a so-called *All-Sky-Camera* for observations of auroral activity at the wintering site, which is located close to the magnetic north pole.

The biological work will focus on soil arthropods, especially mites, thermophilous plant species and phytoplankton/ice algae. The author is doing her doctorate work on arctic oribatid mites from Svalbard. The project focuses on mites in a patchy habitat, where the effects of patchiness on the dynamics and distribution of species assemblages is studied. Furthermore, the question of interactions between variation in space and time and effects on natural systems is investigated through experimental field studies where episodic ice-crust formation (freezing rain) and the uneven distribution of the vegetation cover in the Arctic are emphasised. Scenarios of global climate change not only predict a rise in annual mean temperature, but also an increased inter- and intra-annual variance in climatic conditions. Mild periods during winter may lead to precipitation falling as rain causing a thick ice lens to be created on the tundra (freezing rain). Earlier studies have shown that such a thick ice cover during winter caused considerable mortality in assemblages of species of Collembola. On Ellesmere Island we want to estimate and compare winter survival rates of Collembola and oribatid mites in soil experimentally covered by no snow, by a thick snow layer and by a thick ice lens. Samples for extraction will be taken on a selected site in August upon arrival (before treatment), in mid-winter and when the snow has melted in spring/summer (after treatment).

We will be carrying out extensive sampling of soil mites (Mesostigmata and Oribatida, Acari) for Dr. Valerie Behan-Pelletier and Dr. Evert Lindquist at Agriculture and Agri-Food Canada, and Dr. Josef Stary at the Institute of Soil Biology, Academy of the Czech Republic. The field work will for the most part take place in Alexandra Fiord, an arctic oasis a little farther north than our wintering site. Our collections hopefully will provide data that can be used in many different studies. Dr. Behan-Pelletier is involved in the Biological Survey of Canada's project on the arthropod fauna of Canadian grasslands. Obviously, arctic grassland is as important a habitat to know about as the more southern prairies, for instance. Arctic areas support grassland at temperature and nutrient extremes. It is important to know and understand the biodiversity of these arctic grasslands to understand "biodiversity and ecosystem functioning" in grasslands along climatic gradients. Also, Dr. Behan-Pelltier hopes to extend the Canadian National Collection databases on distribution and ecology of arctic mites. These databases will be fundamental for many studies, for instance assessing climate change, and shifts in distribution due to environmental perturbation.

The oribatid fauna of the extreme high Canadian Arctic is poorly known. The comparison of the oribatid and mesostigmatid fauna of Ellesmere Island with the well-known fauna of Svalbard and Greenland will improve our knowledge of the biodiversity and biogeography of soil mites in arctic areas.

Dr. Josef Stary is interested in the ecology, taxonomy and biogeography of oribatids, and has asked us to look for bird nests and driftwood. Oribatids have very limited possibilities for active dispersal, so the study of possible passive spreading of these mites is important. The composition of oribatid mite populations in feathers of living birds and in material of their nests, as well as in decaying timber on the sea shore are extremely significant from a biogeographical point of view. Most seabirds will probably have left when we arrive in late August. However, we hope to find some abandoned nests on bird cliffs and sample small parts of them. Driftwood is rare in the Canadian Arctic, but we will be searching for it and sample what we find. The arthropod fauna from both nests and driftwood will be extracted for future analyses.

In co-operation with Dr. Cecilie Hellum von Quillfeldt, who is doing her postdoctoral studies at the University Courses on Svalbard (UNIS), Norway, we will be sampling phytoplankton and ice algae both on the sailing journey north along the west coast of Greenland and during our over-wintering in Herschel Bay. When the sea is frozen in winter the sampling will be done through a hole drilled in the sea ice. These regular samplings will be co-ordinated with the CTD-measurements. Slightly coloured parts of the ice cores will be melted, and the water (hopefully) containing ice algae conserved. Ice algae/phytoplankton have been regularly sampled in the North Water polynya in both 1997 and 1998. The planned field work will increase the value of these already existing data, as it will be possible to say something about the inter-annual variation in the species assemblages. Furthermore, the sampling season from previous years will be extended. This is important in trying to understand the dynamics between ice algae and phytoplankton. For instance, where do the species found in the spring bloom of algae in the water masses originate from? If they do originate from the ice, this would emphasise the importance of the ice algae in the biological production in the area.

Part of our planned field work will be botanical, and carried out in co-operation with PhD. student Inger Greve Alsos at the University of Tromsø, Norway. She is working with thermophilous arctic plant species, and her main field sites are on Svalbard. The most thermophilous plant species in this archipelago are extremely rare. Their few, small, and disjunct present-day populations may be fragments of more continuous populations originating from immigrants to this arctic archipelago in a warmer climatic period. Knowledge of the biology, history, and origin of the present northern outposts of such species is important because northward expansion of southern species is expected as a result of global warming. Greve Alsos studies the Svalbard populations and reference populations from other areas (Scandinavia, Greenland, Northern Canada, Alaska and Siberia) of three model species (*Betula nana* s. lat., *Vaccinium uliginosum* s. lat., and *Campanula rotundifolia* s. lat.) for molecular genetic variation (AFLPs, CAPs, RAPDs, isozymes), population dynamics, morphology, and taxonomic relationships. The data will be used to test if the present Svalbard populations are fragmented relics or founded after recent dispersal, and to analyse the relationships between these populations and populations from possible source areas to estimate divergence times and immigration routes. The project is a co-operation between the Universities of Oslo and Tromsø, Norway, and forms part of a larger research effort to strengthen international collaboration on arctic biodiversity and conservation. We will be collecting plant material for Inger Greve Alsos along the west coast of Greenland and from Ellesmere Island (Herschel Bay and Alexandra Fiord) based on site descriptions given to us by her.

More information on the expedition can be found on our website:
http://www.sverdrup2000.org/.

Questions can be addressed to the author at guldborg.sovik@bio.uio.no

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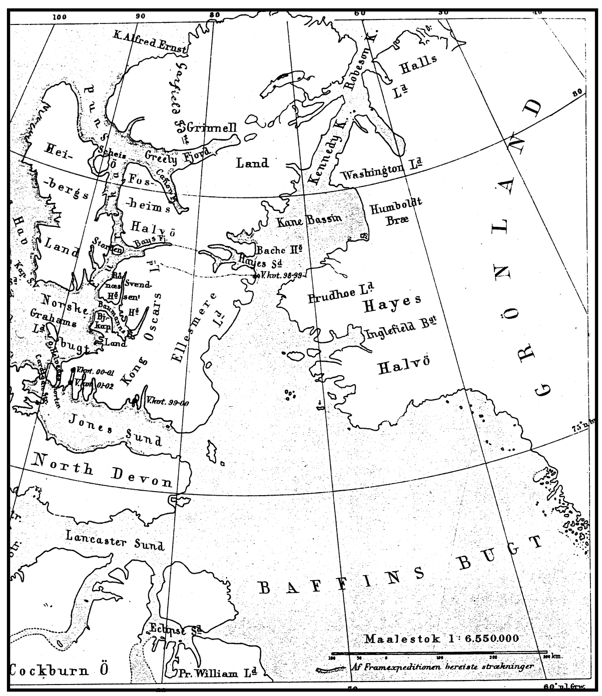

Map taken from “Nyt Land” (New Land) by Otto Sverdrup, 1903. The expedition will overwinter approximately at ‘V.kvt.98-99’, just south of Hayes Sound, where Sverdrup overwintered with the vessel ‘Fram’ the first winter.

DEHYDRATION AND COLD HARDINESS IN THE COLLEMBOLAN *ONYCHIURUS ARCTICUS*

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and
Martin Holmstrup
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Onychiurus arcticus represents the first record of a terrestrial arthropod that literally has to dry out to tolerate freezing temperatures (Holmstrup and Sømme 1998). Such a "protective dehydration strategy" has previously been demonstrated in earthworm cocoons from temperate areas (Holmstrup and Zachariassen 1996) and in several species of Enchytraeidae from Svalbard (Sømme and Birkemoe 1997).

O. arcticus is widely distributed in northern areas of the Palaearctic region where it is abundant along sea shores (Fjellberg 1994). In bird cliffs at Spitsbergen, Svalbard, the species tolerates –20 °C or lower temperatures during the winter (Coulson et al. 1995).

Unlike other polar and alpine Collembola, *O. arcticus* does not respond to the onset of winter by increased supercooling capacity. During acclimation at 3, 0 or –3°C in the laboratory, supercooling points remained at approximately –7°C, and all specimens were killed by freezing. This makes it difficult to understand how the collembolans can survive in their natural habitat.

Due to the low water vapour pressure above ice, unfrozen invertebrates are likely to lose water. When specimens of *O. arcticus* were placed in closed containers over ice at –3°C, their water content fell from 3.0 to 1.5 g g^{-1}dry weight in two weeks. At the same time the melting point of their body fluids fell from –0.7 to –3°C. Similar periods at lower experimental temperatures resulted in even lower water contents, e.g. 0.25 g g^{-1} dry weight at -19.5°C. Following slow warming to above-zero temperatures, 80 to 90% survival was recorded in all groups.

Following considerable water loss in a group of specimens kept at –8°C, a mean supercooling point of –22°C was recorded. In individuals acclimated over ice at –12°C or lower, no supercooling points could be recorded, probably because all freezable water had been lost.

In conclusion, this experimental study shows that *O. arcticus* will undergo dehydration when exposed to subzero temperatures in its natural frozen habitat. Consequently, the melting points and supercooling points are lowered and in this way freezing is avoided. It is not unlikely that this protective dehydration strategy may be found in other soil invertebrates in polar regions.

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HISTORY CORNER: POLLEN ON BUMBLE BEES COLLECTED BY THE "FRAM"

Hugh V. Danks

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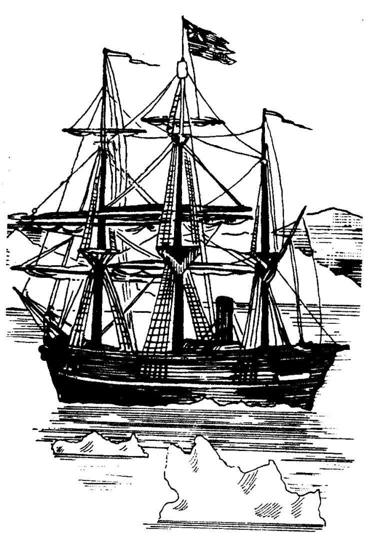
Most of the published results of the second voyage of the Fram (1898 - 1902) to Ellesmere Island and Greenland were lists or annotated lists (chiefly in German) prepared by the senior entomologists of the day such as Alexander (1923), Braendegaard (1936), Kieffer (1926), Munster (1923), Natvig (1930), Strand (1905), and Wahlgren (1907).

One very different treatment (Høeg 1929) dealt with pollen found by later examination of the bumble bees collected by the expedition. Høeg's paper reads as follows:

"Some years ago I had an opportunity to examine the pollen on the humble-bees collected in Novaya Semlya by F. Økland, the zoologist of the Norwegian Expedition in the year 1921 under the leadership of Professor O. Holtedahl; the determinations were published in a small paper in the 'Results' of the expedition (Oslo 1924). Soon afterwards through the kindness of L.R. Natvig, Curator of the Zoological Museum, Oslo, I was enabled to make preparations of the pollen still found on the *Bombi* brought home from Ellesmere Land and adjacent islands by the Second 'Fram' Expedition. The results of the examination have been kept til now;



but they may perhaps be worth printing as a contribution, however trifling, to the biology of humble-bees and flowers in these regions.

The insects have been determined by Embr. Strand; in his report (in the Report of the Second Norwegian Arctic Expedition in the 'Fram') are found details as to the localities; for information as to the vegetation of the regions in question may be referred to the papers by H.G. Simmons in the same series.

Altogether, I have seen 21 specimens, which I have numbered in succession. They belonged to the following species:

1—5	*Bombus balteatus*	Dahlb	%
6—12	—	—	D
13—18	—	—	&
19—21	*Bombus hyperboreus*	Schönh	&

Some of them had large lumps of pollen in the 'pockets' of their hind legs; on others were only scattered pollen grains on the head. Some did not carry any pollen at all, the corresponding numbers remaining vacant in the sequel. The pollen masses were often attacked by fungi; this made the determination difficult in some cases, especially when the lumps were closely united by the hyphae.

5. *B. balteatus* %, Cape Rutherford, June 27th, 1989. A fragment of an anthera on the head, containing pollen and many fungus spores. The pollen grains 15—20 µ across, smooth, often with 3 pores; they have not been detached from each other during the preparation and cannot be determined with certainty. A few *Salix* pollen.
6. *B. balteatus* D, Godhavn, July 30th, 1898. Large lumps of *Salix* pollen in the pockets.
7. *B. balteatus* D, Cape Rutherford, June 27th, 1899. Large lumps in the pockets, consisting of a mixture of *Salix* and *cfr. Cassipe tetragona* (see below).

8. *B. balteatus* D, Cape Rutherford, June 27th, 1899. Small lumps of *Salix*, *Saxifraga*, *cfr. Cassiope*.
10. *B. balteatus* D, Fort Juliane, July 6th, 1899 (?). In the pockets were found compact aggregates of smooth pollen grains; in some of them the characteristic striation could be discovered, and these, together with several others, may consequently be determined as *Saxifraga*. Further: one *Salix*, one *Silene*, and some indeterminable ones.
12. *B. balteatus* D, the Harbour, Rice Strait, June 29th, 1899. Remain of pollen lumps, especially on the right leg: *Salix*.
13. *B. balteatus* &, Fort Juliane, July 7th, 1899. Among the numerous pollen grains there are some *Saxifraga*, further globular grains resembling the cruciferons and *Salix* type, but only 20 (—23) μ in diameter; I have not been able to identify them with certainty.
14. *B. balteatus* &, the Harbour, Jones Sound, July 24th, 1900. Small quantities of pollen on right hind tarsus: *Saxifraga*.
17. *B. balteatus* &, Goose Bay, Jones Sound, July 3rd, 1902. Large brown lump in left pocket, remains in the right one. Chiefly *Salix*, also *Dryas* and *Saxifraga*, at least partly *S*.(?) *aizoides.*
18. As No. 17. Remains in the right pocket: *Salix, Saxifraga,* and (?) *Dryas*.
20. *B. hyperboreus*&, Galgeodden (Gallow Point), Jones Sound, July 22nd, 1901. *Saxifraga (oppositifolia*), a few *Salix* and *Silene*, and some not identified.

As to the reliability of the determination of *Saxifraga* and *Dryas*, I beg to refer to my remarks in the Novaya Semlya paper. I take this opportunity to mention that some of the pollen grains from Novaya Semlya determined as crucifers had perhaps better been referred to *Salix*. The *Salix* pollen has wider limits of variation that it had impressed me to have then. The preparations contain several tetrads of the *Ericacea* type. The heath family is represented in these regions only by two species, *Vaccinium uliginosum* var. *microphyllum*, and *Cassiope tetragona*. I have not yet succeeded in grasping the difference between their pollen. The tetrads from the humble-bees seem to have most in common with that of *Cassiope*, and this is the more acceptable as *Cassiope* is by far the most dominating arctic heath; on the other hand, *Vaccinium* is certainly much better adapted to pollination by hymenoptera. As, however, the conformity is not quite convincing, I dare not but cite it as *cfr. Cassipe tetragona*.

There are several interesting differences between the 'pollen flora' of Ellesmere Land and that of Novaya Semlya. This is, of course, partly due to the much greater number of plant species in the latter. The vegetation of Ellesmere Land has, upon the whole, a much more Arctic character; *Leguminosae* do not occur. On the humble-bees, *Salix* was found to be the most common species, together with *Saxifraga. Dryas* is probably also represented, even in more instances, and (cfr.) *Cassiope* is rather abundant on some insects. However, it is curious that *Silene* is but very scanty, and that *Pedicularis* has not been found with certainty at all."

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PUBLICATIONS AVAILABLE

This list indicates publications associated with the Biological Survey of Canada (Terrestrial Arthropods) that may be of interest to readers of *Arctic Insect News*.

Unless otherwise noted, publications can be requested from the Survey (see back cover for address details).

*Prices for publications available from the Entomological Society of Canada include shipping costs. *Orders from Canada should pay in Canadian dollars and add 7% GST; orders from other countries should pay in U.S. dollars.*

Arthropods of Polar Bear Pass, Bathurst Island, Arctic Canada.	1980. Danks, H.V. Syllogeus 25. 68 pp.	Available upon request
Arctic Arthropods. A review of systematics and ecology with particular reference to the North American fauna.	1981. Danks, H.V. Entomological Society of Canada, Ottawa. 608 pp.	$30.00* from the Entomological Society of Canada, 393 Winston Avenue, Ottawa, Ontario, K2A 1Y8
Bibliography of the Arctic Arthropods of the Nearctic Region.	1981. Danks, H.V. Entomological Society of Canada, Ottawa. 125 pp.	$7.00* from the Entomological Society of Canada, address above
Arctic insects; Adaptations of arctic insects.	1986. Kevan, P.G. and H.V. Danks. pp. 72-77 and 55-57 in B. Sage, The arctic and its wildlife. Croom Helm, Beckenham. 190 pp.	Book available from booksellers
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QUESTIONNAIRE: PEOPLE INTERESTED IN ARCTIC INSECTS

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____

Telephone (______) ____________________ **Fax** (_____) ____________________

Interest Areas (circle category, or write in details desired)

General interest in arctic

____

Biological subjects (taxonomy, ecology, etc.)

____

Taxon/Taxa (order, family, etc., if applicable)

____

____

Ecological interests (populations, behaviour, etc.)

____

____

Other subjects (meteorology, etc.)

____

Geographical area(s) (high arctic, etc.)

____

Current projects

____

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Please return this completed form to: Secretariat, Biological Survey of Canada, (Terrestrial Arthropods), Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, K1P 6P4

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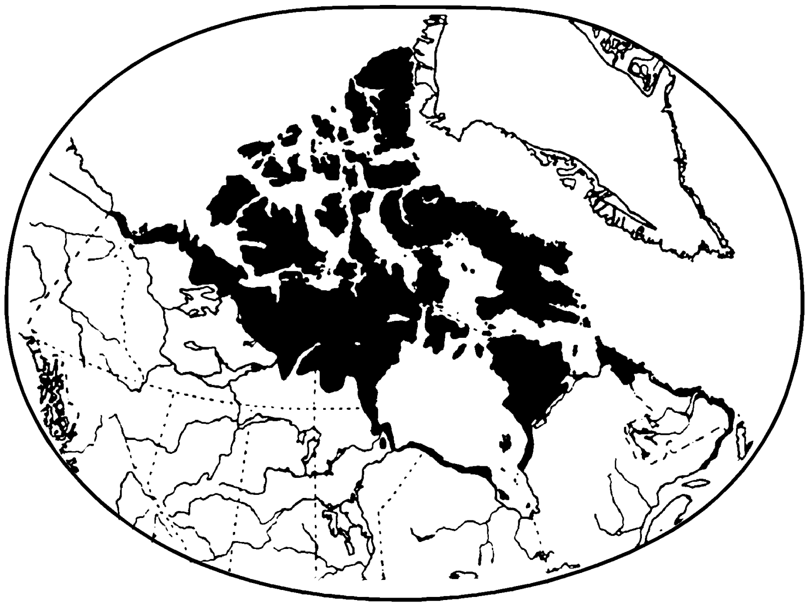

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