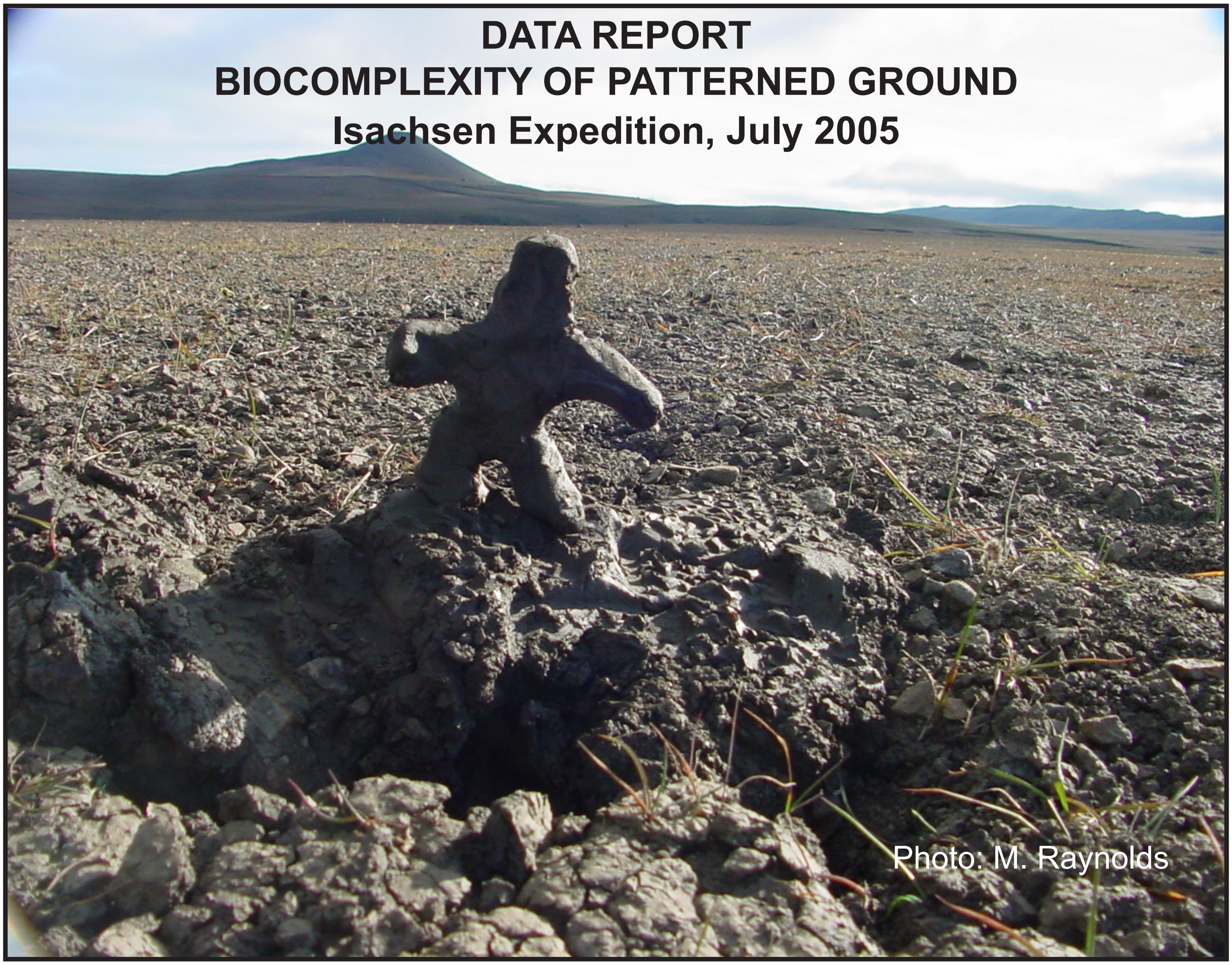
DATA REPORT
BIOCOMPLEXITY OF PATTERNED GROUND
Isachsen Expedition, July 2005



Corinne Vonlanthen, Martha K. Raynolds, Corinne Munger
Anja Kade, Donald A. Walker
Alaska Geobotany Center
Institute of Arctic Biology, University of Alaska
Fairbanks Alaska 99775

March 2006

funded by the U.S. National Science Foundation, grant OPP-0120736

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

A team of 25 people from the University of Alaska Fairbanks and other organizations worked at Isachsen, Ellef Ringnes Island during July 2005, as part of the “Biocomplexity associated with biogeochemical cycles in arctic frost-boil ecosystems” project. The field party consisted of 14 research scientists, 4 graduate students, 4 students in an Arctic Field Ecology course, 2 native hunters from the village of Sachs Harbor, and a cook (see Participant List and Contact Information).

This year’s work was the fourth in a 5-year project. The main objective of the research is to investigate the properties of small-patterned-ground ecosystems along a climate gradient from the coldest parts of the Arctic to the northern boreal forest (Fig. 1). We are studying earth hummocks, non-sorted circles, small non-sorted polygons, and turf hummocks – how they form, how they vary with climate and substrate, and their role in total ecosystem functions. The project is examining five subzones of the circumpolar Arctic (Subzone A is the coldest, and Subzone E is the warmest). In 2002, the project examined non-sorted circles and earth hummocks along the Dalton Highway in Northern Alaska (Subzones C-E). The second year focused on Green Cabin on Banks Island (Subzone C); the third year focused on Mould Bay on Prince Patrick Island (Subzone B); in this year the team worked at Isachsen (Subzone A). In subzone A, B, and C, turf hummocks, and small non-sorted polygons are dominant on zonal sites.

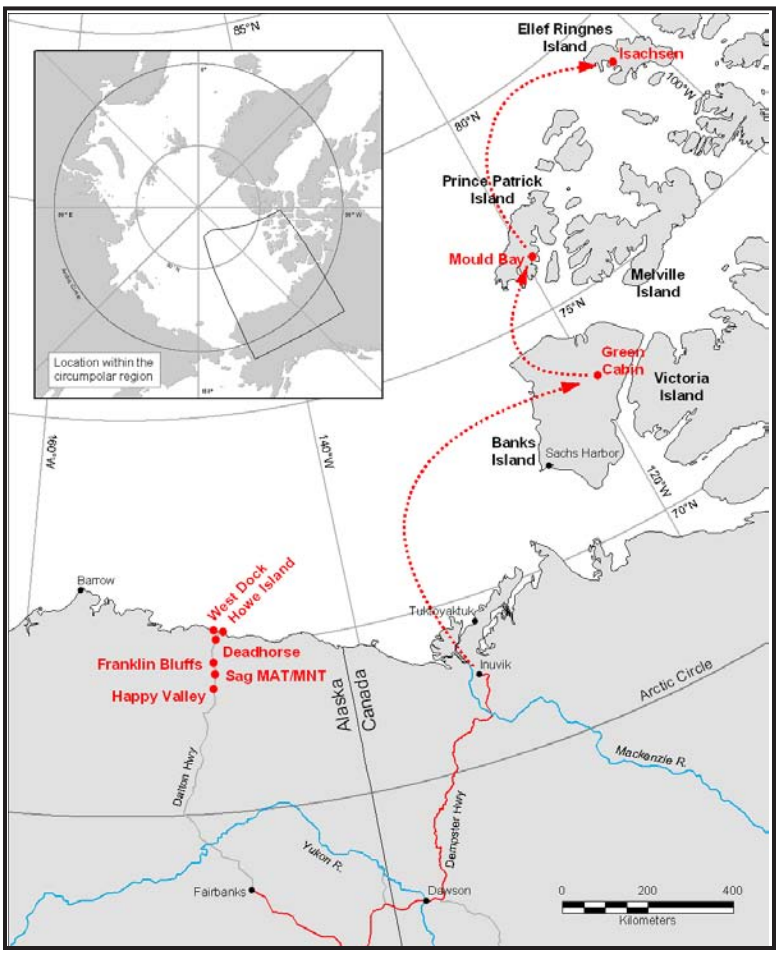


Fig. 1: Map of patterned-ground study sites along climate gradient.

The team is investigating the complex interactions between climate, permafrost, geomorphology, soils, vegetation, and soil invertebrates within these unique ecosystems. One goal is to examine how these systems might change in different parts of the Arctic as the climate warms. This year the project established three new 10 x 10-m grids at Isachsen. We mapped the vegetation and thaw-layer depth within the grids, and characterized the vegetation of the patterned ground by collecting vegetation, site, and soil information from 52 relevé sites in the vicinity of the grids. We also established a climate station near one of the grids and heave instruments.

Students are a major part of the project. Four graduate students participated in the project this summer, and four undergraduate students were involved from the Arctic Field Ecology course organized by Dr. Bill Gould. The first two weeks of the course were mainly spent at Isachsen. The second two weeks were spent at Bathurst. A report of the student research is at the end of this document.

DESCRIPTION OF ISACHSEN

Ellef Ringnes Island (situated in the Canadian Arctic Archipelago) is north of Banks Island and Prince Patrick Island (Figs. 1 -3), and is 12,940 km^2 (Foscolos & Kodama, 1981) in size. Isachsen is the site of a Canadian weather station on the northwestern coast of Ellef Ringnes Island, at 78° 47' N latitude, 103° 35' W longitude.

Ellef Ringnes Island is a low relief island. The northwestern fifth of the island is a nearly flat plain. South of this lies a belt of highly dissected plateau. South of the plateau, the remaining part of the island - about two thirds - is lowland, except for distinct clusters of hills and ridges that rise with locally rugged topography, above the general level to form local uplands. The most distinctive of these uplands are developed on dome structure associated with gypsum intrusions (Fortier,1963). The preponderance of exposed bedrock consists of a conformable succession of nine, marine and nonmarine, clastic formations ranging in age from early Jurassic to early Tertiary. Jurassic rocks are represented by four marine formations which, in ascending order, are the Borden Island, Savik, Jaeger, and Deer Bay. The cretaceous beds are subdivided into five formations which, in ascending order, are Isachsen, Christopher, Hassel, Kanguk, and Eureka Sound. Finally, the Beaufort Formation is the youngest formation consisting of non-marine sands and gravel of late Tertiary to Pleistocene age. (Foscolos & Kodama, 1981). Diapirs occur in major anticlines. A system of northeasterly trending normal faults is best developed in the northern part of the island. In this region also, the Deer Bay Formation is intruded extensively by dykes and sills of diabase, basalt, and gabbro. Similar rocks intrude the Isachsen, Christopher, and Hassel Formations but on a smaller scale (Stott, 1969).

In the plains of the Isachsen research area shale, is the dominant rock with minor amounts of limestone and poorly consolidated sandstone (Heywood, 1957). According to Everett (1968) a single soil association (polar desert soils, see Tedrow, 1966 and Tedrow & Cantlon, 1958) occurs in the Isachsen area, composed of four drainage categories: category I (wet), category II (very poorly drained), category III (poorly drained to somewhat poorly drained), category IV (well drained).

Isachsen is in the Tundra Bioclimate Zone, in Subzone A (CAVM Team, 2003). Mean July temperature for 2005 was 2.7 °C and the SWI for 2005 was 3.7 °C (www.climate.weatheroffice.ec.gc.ca). For further climate information visit the web sites www.weatherbase.com and www.climate.weatheroffice.ec.gc.ca/Welcome_e.html.

Continuous vegetation in the Isachsen area occurs in moist to wet areas. Even under the best of local conditions, the height of the vegetation is approximately 10 cm. The only woody shrub is the prostrate dwarf shrub, *Salix arctica*, which is rare.

Fig. 2: Isachsen camp and crew. Crew from left to right: Bill Gould, Greta Lewanski, Jordan Okie, Corinne Vonlanthen, Gary Michaelson, Corinne Munger, Vlad Romanovsky, Alexia Kelley, Maria Rivera (kneeling), Ina Timling, Manny Kudlak, Nadya Matveyeva, Skip Walker (kneeling), Fred Daniels, Rae Spain (kneeling), Charles Tarnocai, Tako Raynolds, Olga Makarova, Trevor Lucas. Missing: Howie Epstein, Grizelle Gonzalez, Anja Kade, Chien-Lu Ping, Constance Laureau, Robin Austin.

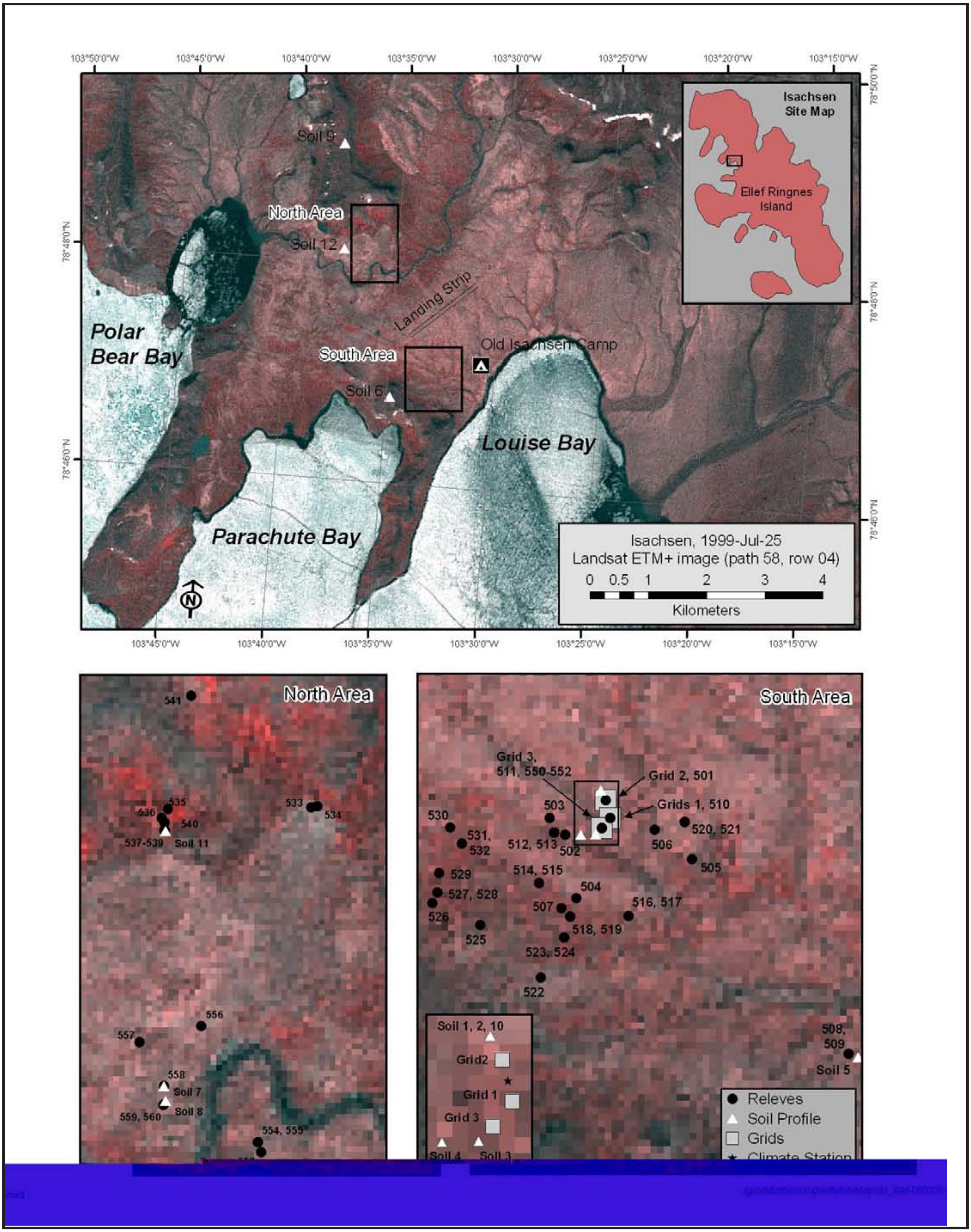


Fig. 3: Landsat false color infrared picture of Isachsen: showing the sampling sites.

METHODS & TYPES OF DATA COLLECTED

CLIMATE AND PERMAFROST

Instruments were installed near Grid 1 (Figs. 3 and 4) to measure air temperature, ground surface temperature and ground temperature. Standard Campbell Scientific L107 thermistors were used for air and ground surface temperature, and MRC thermistor rods for ground temperature. Two sets of ground temperature sensors were installed six meters apart, one in a hummock and another in an inter-hummock area. After pre-installment calibration, the precision of the sensors is better than 0.02 °C. Ground temperatures are collected at ten different depths down to 106 cm (roughly every 10 cm), measured every 5 minutes, and averaged and saved every hour.

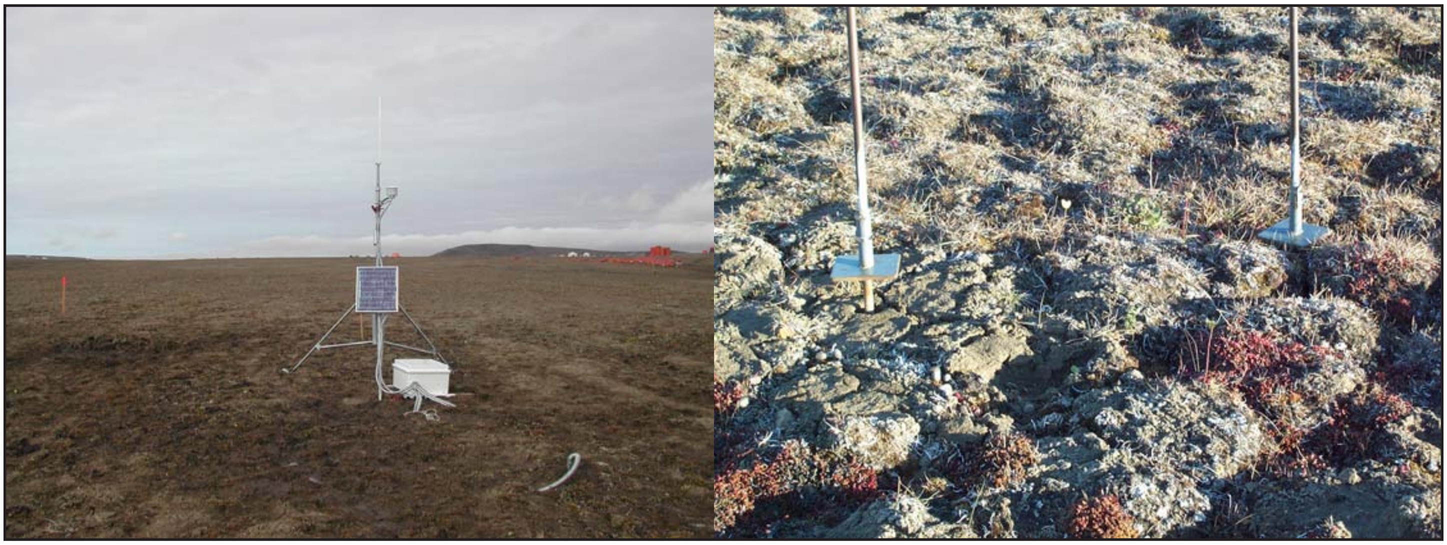


Fig. 4: Climate station and heave scribers.

Ground moisture (including the unfrozen water content in winter) is measured at two different depths within the hummock and at two different depths in the inter-hummock area. VITEL volumetric water content sensors (based on TDR technique) were used. Each of the VITEL sensors was paired with an additional L107 temperature probe. Moisture content is recorded hourly during the entire year. Two Campbell Scientific heat flux probes were also installed at 8 cm depth, one within the hummock and another in the inter-hummock area.

Snow depth is continuously recorded at the site (at hourly intervals) using a CSC Ultrasonic Distance Sensor. A Campbell Scientific CR10-X logger operates the station and saves the data. A 20-watt regulated solar panel coupled with a 12 v battery is used for power supply. The air temperature sensor, the ultrasonic snow sensor and the solar panel are mounted on a 3 m tripod.

Three heave scribers were set up near Grid 1 (zonal Grid). Two more heave scribers were installed at the Grid 3. The heave scribers consist of a 2 m-long 1.5 cm-diameter solid copper grounding rod, with a steel scriber. The copper rod was driven 1.5 m into the ground, anchoring it in the permafrost. The steel plate and sleeve were placed on the rod, with the plate resting on the ground. The steel plate slides freely on the rod, rising with the frost heave in the fall, and falling back down with the spring thaw. A sharp spring steel scriber is attached to the sleeve by hose clamps. Its tip scratches the copper rod. The steel plate was rotated to make a complete circular scratch around the copper rod, marking the initial position. Any heaving of the ground during the winter raises the plate, causing the scribe to scratch the rod. The length of this vertical scratch is measured in following years to determine the amount of heave.

GRIDS

Grids

Three 10 x 10-m grids were marked by 1-m rebar and 1.5-m PVC pipe at the four corners, and labeled with aluminum tags (Fig. 5). Labeled pin-flags were placed every meter within the grid. Grid 1 (zonal vegetation) was located on a gentle slope, and was composed of small non-sorted polygons. The top of the polygons was covered with lichens (such as *Rinodina terrestris, Ochrolechia inaequatula, Megalaria jemtlandica*, and *Fuscopannaria praetermissa*) and *Puccinellia cf. andersonii.* The interpolygon areas had more mosses (especially *Aulacomnium turgidum, Hypnum subimponens, Pohlia cruda, Pohlia drummondii, Racomitrium lanuginosum, Tomentypnum nitens*), *Saxifraga caespitosa* and *Luzula nivalis*. Grid 2 (dry site) was located at the top of a saddle, and had small non-sorted polygons, with little micro-relief. The polygons were sparsely vegetated (*Rinodina terrestris, Ochrolechia inaequatula, Megalaria jemtlandica*, and *Fuscopannaria praetermissa, Puccinellia cf. andersonii, Poa abbreviata)*. Grid 3 (mesic site) was located on the toeslope, and was composed of small turf hummocks. The hummocks were covered with lichens, such as *Pertusaria octomela, Rinodina turfacea*, and *Stereocaulon alpinum.* The interhummock areas had more mosses (especially *Aulacomnium turgidum, Pohlia cruda, Racomitrium lanuginosum, Tomentypnum nitens), Saxifraga caespitosa* and *Luzula nivalis.*

Vegetation mapping

Maps were made of the vegetation types within the three grids. First the different vegetation communities were identified, then their location within the marked grid was mapped by hand on a 15-cm paper grid (Grid 1 and 2: 1:66.7 scale, Grid 3: 1:33.3 scale). The vegetation patterns in Grid 1 and 3 were at such a fine scale that only 1/4 of the grid was mapped. In addition, maps were made of 1 m^2 within each grid, using the same forms, but at larger scale (1:6.7), to show the cracking patterns and polygons which occur on the centimeter scale. The maps were hand-digitized as ARC/INFO polygon coverages.

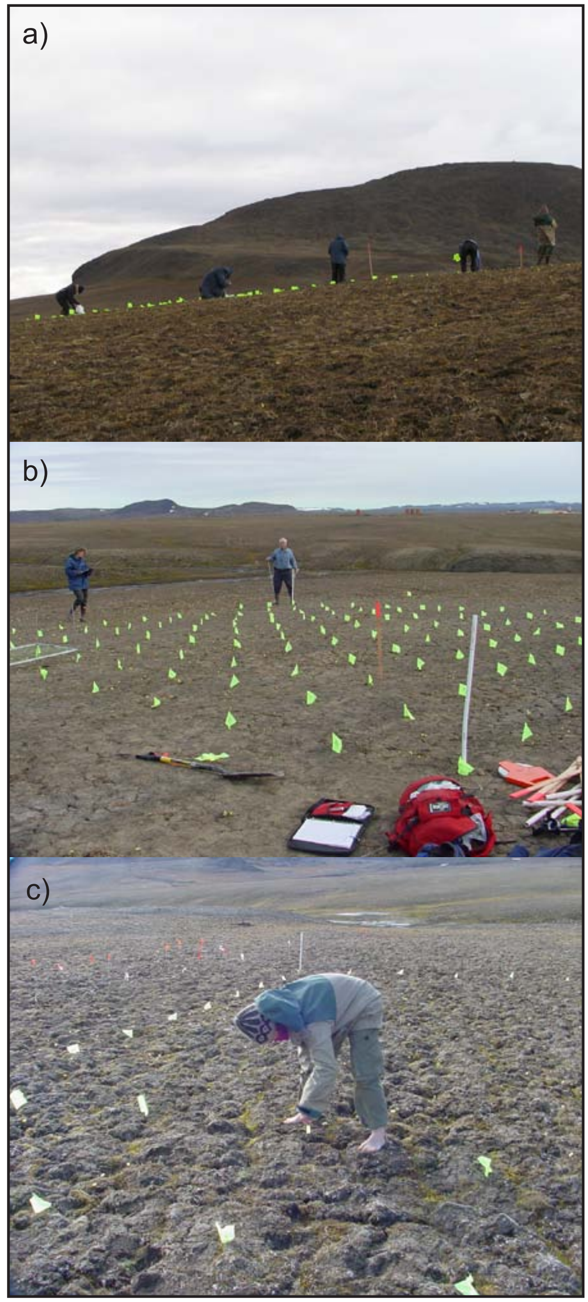


Fig. 5: Grids. a) Grid 1 (zonal), b) Grid 2 (dry), c) Grid 3 (hummocky).

Thaw depth

Thaw depths were sampled every half-meter (every meter Grid 2) within the grids with a metal probe. Vegetation community was noted at each point. The data were summarized by vegetation type. The data were also used to create maps of thaw depth on the grids, using Transform software. Ten thaw depth measurements were also taken at each relevé site.

VEGETATION

Vegetation relevés

52 relevés were sampled at Isachsen, from the grids and other sites (Fig. 3). Sites were chosen to represent the zonal vegetation and other major plant community types in the Isachsen area. Up to seven replicates were collected for each plant community described in the Isachsen vicinity. Relevé location and environmental site descriptions were collected, as well as cover data for all growth forms and species.

Nonvascular plant identification was verified by Mikhail Zhurbenko,Olga Afonina, and Alexei Potemkin at the Komarov Botanical Institute, St. Petersburg, Russia. Nomenclature followed Porsild (1955) and Porsild & Cody (1980) for vascular plants. A complete plant species list was compiled for the relevés. Soil samples were collected at each relevé, at the top of the mineral horizon. These were analyzed for chemical and physical properties.

Plant Biomass

Biomass was collected at each of the relevés. All above-ground vegetation within a 20 x 50-cm frame was clipped. Mosses were clipped at the base of the green portion. The samples were frozen for storage and then sorted by major plant functional type (moss, lichen, forb, horsetail, graminoid) and into live and dead categories. Dry weights of each component biomass sample are reported. Biomass was also collected along two 50-m transects adjacent to each grid, with three randomly placed 20 x 50-cm samples collected for each transect.

NDVI

The Normalized Difference Vegetation Index (NDVI) was measured using an Analytical Spectral Devices FieldSpec spectro-radiometer every meter along the two 50-m transects adjacent to each grid; grids are indicated as being in either dry (D), mesic (M), or wet (W) topographic positions. The sensor was held 0.9 m above the ground to include a ground footprint of ~0.125 m^2. Ground cover at each point was noted as vegetated (V), bare (B), or mixed (M). In addition NDVI measurements were taken for ~35 relevés identified at Isachsen. For each of these relevés, five NDVI measurements were taken at a height of 0.5 m (footprint of ~0.04 m^2). Last, spectra were taken from five replicates of seven individual species; measurements were taken with the sensor just a few cm above the plant so as to avoid spectral contamination from surrounding vegetation. Since the sky was not always clear at Isachsen, a test of NDVI sensitivity to cloud conditions was performed on a day with mixed sun and clouds, where direct sun was highly variable over the time scale of minutes. Measurements were taken of incoming Red and Near Infrared, and NDVI every 5 minutes for 1 hour; prior to each measurement a “white reference” was taken to provide the baseline reflectance conditions. The simple test suggested that NDVI was not sensitive to variable incoming radiation conditions, provided that a white reference is taken before each measurement.

N-factor

At each relevė, we buried one temperature logger (iButton, Maxim Integrated Products) at 1 cm depth in the mineral soil to represent the mineral soil surface. In addition, we installed one temperature logger at the interface of the live moss mat and the soil organic horizon at well-vegetated relevės of the stable tundra. The data loggers will record soil temperatures every 4 hours during September 2005 until August 2006. For each relevė, we recorded the depth of the live moss and, if present, the soil organic layer, and we took thaw depth and soil moisture measurements. We will calculate the modified n-factor, which is a quantitative index of the energy balance at the ground surface, by calculating the ratio of seasonal thawing degree-day sums at the soil surface to that in the air (Carlson 1952). We will compare the modified n-factor between frost-heave features and adjacent stable tundra and examine changes along the climate gradient.

SOILS

Soil pits

A 1.5 x 1-m soil pit was dug at the three grid sites to 1 m depth. Furthermore, nine other soil pits were dug in the Isachsen research area. A jackhammer was used to dig the frozen portion of the soil pit. Cross-sections of the pits were drawn and the soil profiles described. Samples taken from these pits were analyzed for pH, bulk density, P, C, and N. Soils were described according to U.S. soil Taxonomy.

All soil samples were shipped to the University of Alaska Fairbanks Palmer Soil and Plant Analysis Laboratory for analysis. Bulk density and volumetric soil moisture were calculated by drying field samples at 105 ºC for 72 hours and determining percentage weight loss. All other analyses were completed on air-dried samples. Particle size was determined using the hydrometer method, taking readings at 40 seconds and 2 hours (Gee & Bauder, 1986). Soil pH values were measured using the saturated paste method with a glass electrode pH meter (Jackson, 1958). Total carbon and nitrogen were determined by dry combustion using a LECO CNS 2000 analyzer at 1350˚ C (Robertson et al., 1999). The availability of cations (K^+, Na^+, Ca^{2+}, Mg^{2+}) was determined with Mehlich-3 extractions (Mehlich, 1984).

Biogeochemistry

Three representative patterned-ground features were selected at the zonal site. At each sample site, several soil samples were collected within the feature and also between the features to determine the nitrogen and carbon content of the first 5 cm of soil in each area. The samples were then analyzed for percent carbon and nitrogen using a Carlo Erba elemental analyzer.

In order to determine the differences in nitrogen cycling, several processes were measured, including net nitrogen mineralization and nitrogen fixation. Nitrogen mineralization was measured using the buried bag method (Eno 1960) over a period of 7 days. At four locations within each frost feature and between the features, a soil core (2 cm in diameter and 5 cm in depth) was taken, and 10 g of the soil were extracted in 50 mL of 0.5 M K_2SO_4. Another soil core was taken as close as possible to the original core. This soil core was placed into a polyurethane plastic bag and incubated in the soil for seven days. A 10 g sub-sample of the core was then extracted in 50 mL of 0.5 M K_2SO_4. The samples were then mixed on a shaking table for 2 hours. The extracts were filtered and then analyzed for NO_3^- and NH_4^+ with a Lachat/Hach autoanalyzer.

Nitrogen fixation was assessed via the acetylene reduction assay (Knowles, 1980). A small core (approximately 2 cm in diameter and 0.5 cm deep) was removed from the surface of two locations within each frost feature: bare soil, crust, and between the features. The soil was placed in an incubation chamber and 10% of the gas volume was replaced with acetylene (generated from calcium carbide and water). The incubation vials were incubated for 48 hours and then a sample of gas was removed from the incubation vial and placed in a sample vial. The samples were then analyzed for ethylene with a gas chromatograph. Calculations of nitrogen fixation were made based on a standard conversion from acetylene reduction to nitrogen reduction.

Measurements of NDVI were made at three points within each frost feature and between the frost features at each site, following the methods described above. Above ground biomass clippings were also taken, at each sample location. These samples were sorted by plant functional type, dried at 50 °C and the dry weight was taken of each sample.

Physical properties of these areas were measured, including gravimetric soil moisture and thaw depth. These measurements were made at four points within sample site.

Mycorrhizae

Soil samples, fungal fruiting bodies, and roots of vascular plants present in frost feature ecosystems and surroundings, were collected in order to assess their mycorrhizal status. The assessment will include ectomycorrhizal, arbuscular mycorrhizal fungi and dark septate fungi.

Plants were chosen with respect to their presence in the 10 x 10-m grids. For each plant species, six individuals were chosen randomly in the area surrounding the grids. Plants were dug up and their root systems washed in water. Foreign roots were removed with tweezers to assure the identity of the root. Roots from each individual plant were divided into two sample sets, one for microscopy and the other for molecular analysis. All root samples were frozen in liquid nitrogen. Woody species and species which were known to be ectomycorrhizal were transported back alive to the lab. Here three individuals of each species were sampled per site. Root systems were washed and all fine roots were sampled for morphotyping under a dissection scope (Agerer, 1987- 2002). After morphotyping, root tips from each morphotype were frozen at -80 °C for further molecular analysis and also stored in ethanol for morphological description.

Turf hummocks in the Isachsen area

Turf hummocks represent a unique ecosystem, providing a nutritious and warm soil environment for plant growth, and a habitat and readily available food source for small mammals and insects.

Turf hummocks are small, 11–20 cm high, 18–50 cm diameter mounds. They commonly occur on gently to steeply sloping Arctic terrain (Table 1, Fig. 6). The purpose of the turf hummock project is to study characteristics and genesis of turf hummocks in Arctic Bioclimate subzones A, B, and C.

The objectives of this turf hummock sub-study are:

1. To examine the internal and external characteristics of turf hummocks on the basis of soil analytical data and of moisture and temperature measurements.
2. To determine their age and genesis.
3. To establish the role they play in the Arctic ecosystems.

During this fieldwork turf hummocks were studied at 14 locations in the Isachsen area of Ellef Ringnes Island in Arctic Bioclimate Subzone A (Table 1).

Table 1: Locations of turf hummock study sites in the Isachsen area of Ellef Ringnes Island.

Site no.	Lat. (N)	Long. (W)	Slope (%)	Dominant vegetation
ER–1	78° 47' 17"	103° 32' 07"	8	Moss–lichen
ER –2	78° 47' 42"	103° 31' 26"	10	Moss–lichen
ER–3	78° 47' 16"	103° 31' 57"	8	Mosses
ER–4	78° 47' 16"	103° 31' 56"	5	Moss (60% unvegetated)
ER–5	78° 47' 12"	103° 31' 47"	5	Mosses (80% unvegetated)
ER–6	78° 47' 11"	103° 31' 47"	5	Mosses (60% unvegetated)
ER–7	78° 47' 29"	103° 37' 10"	4	Mosses-grasses (80% unvegetated)
ER–8	78° 47' 29"	103° 37' 10"	4	Mosses-grasses (80% unvegetated)
ER–9	78° 48' 25"	103° 28' 38"	2	Lichen–moss
ER–10	78° 48' 25"	103° 28' 39"	3	Lichen–moss
ER–11	78° 48' 25"	103° 28' 48"	3	Lichens (70% unvegetated)
ER–12	78° 48' 25"	103° 28' 49"	3	Lichens
ER–13	78° 48' 24"	103° 28' 48"	4	Moss–lichen
ER–14	78° 48' 25"	103° 28' 55"	3	Mosses-grasses

Methods:

Pits were dug diagonally across the hummock to the adjacent inter-hummock troughs to expose the internal morphology. Detailed cross section diagrams were prepared and the various soil horizons and layers were identified. Soil samples were collected for laboratory analysis to determine their chemical and physical properties. Additional samples were collected for bulk density determinations.

At each site, the heights and diameters of five hummocks were measured. In addition, soil temperature measurements were taken at depths of 2.5 and 5 cm on the tops of three hummocks and under the adjacent inter-hummock troughs. Soil and bulk density samples are being analyzed in Agriculture and Agri-Food Canada's soil laboratory.

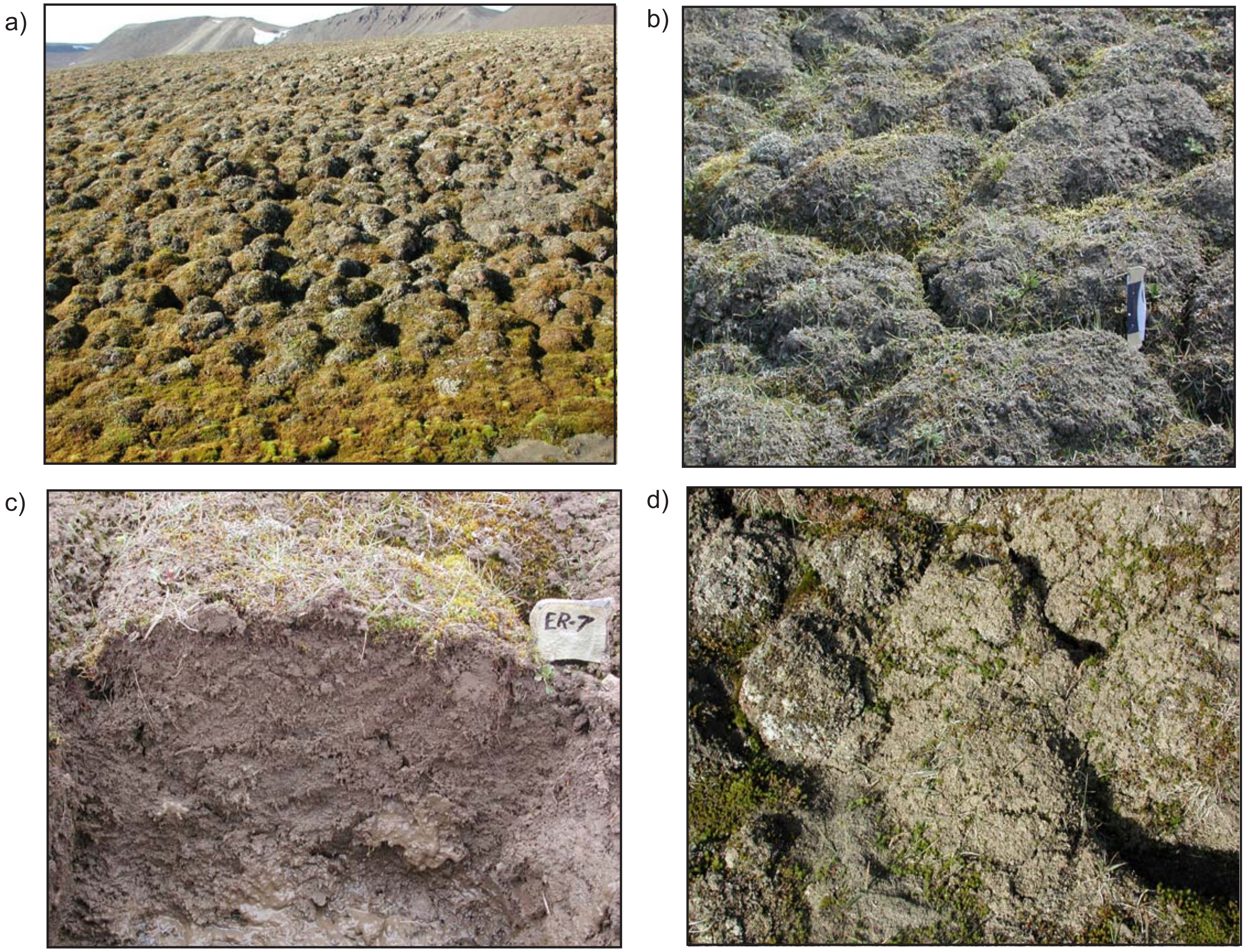


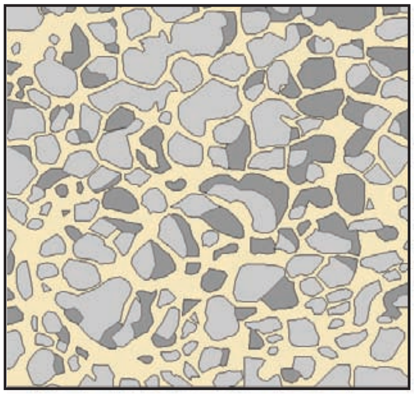
Fig. 6: Turf hummocks at Isachsen. a) turf hummocks on slope, b) close-up of turf hummocks, c) cross section of a turf hummock at site ER-7, d) newly-deposited mineral materials on the top of the hummocks. Note the mosses rapidly breaking through this new layer and incorporating the material into the hummocks.

RESULTS

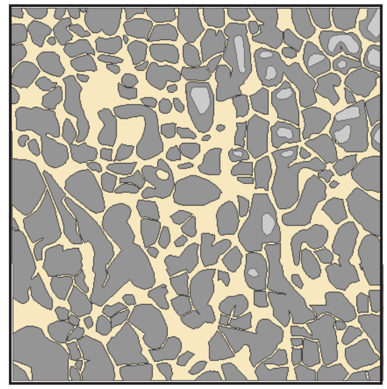
GRIDS

Vegetation maps

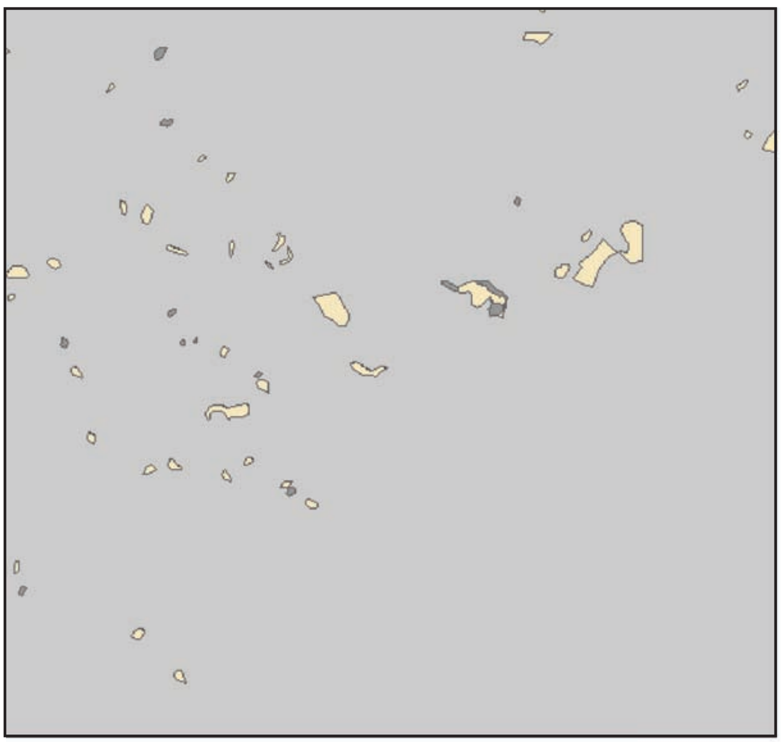
a)

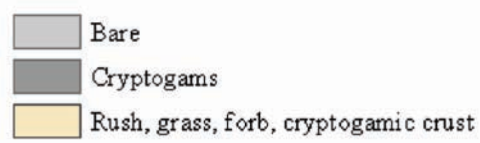


c)



b)





d)

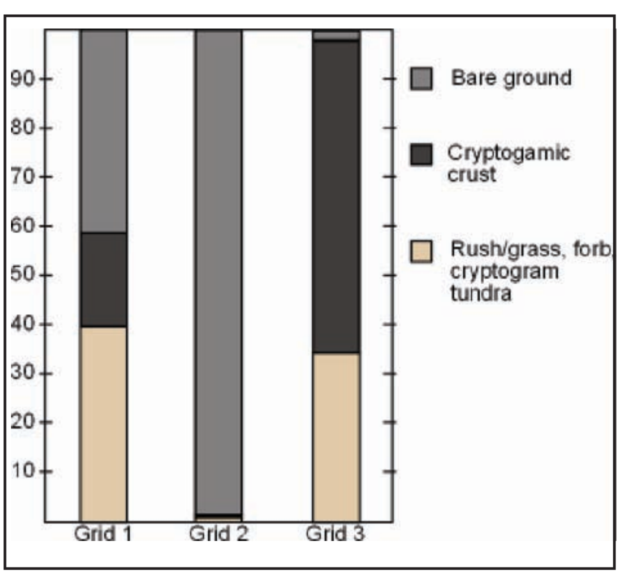


Figure 7: Vegetation maps at Isachsen.
a) grid 1 (zonal site, 5x5m), b) grid 2 (dry site, 10x10m) c) grid 3 (hummocky site, 5x5m), d) chart of percent area of each vegetation unit.

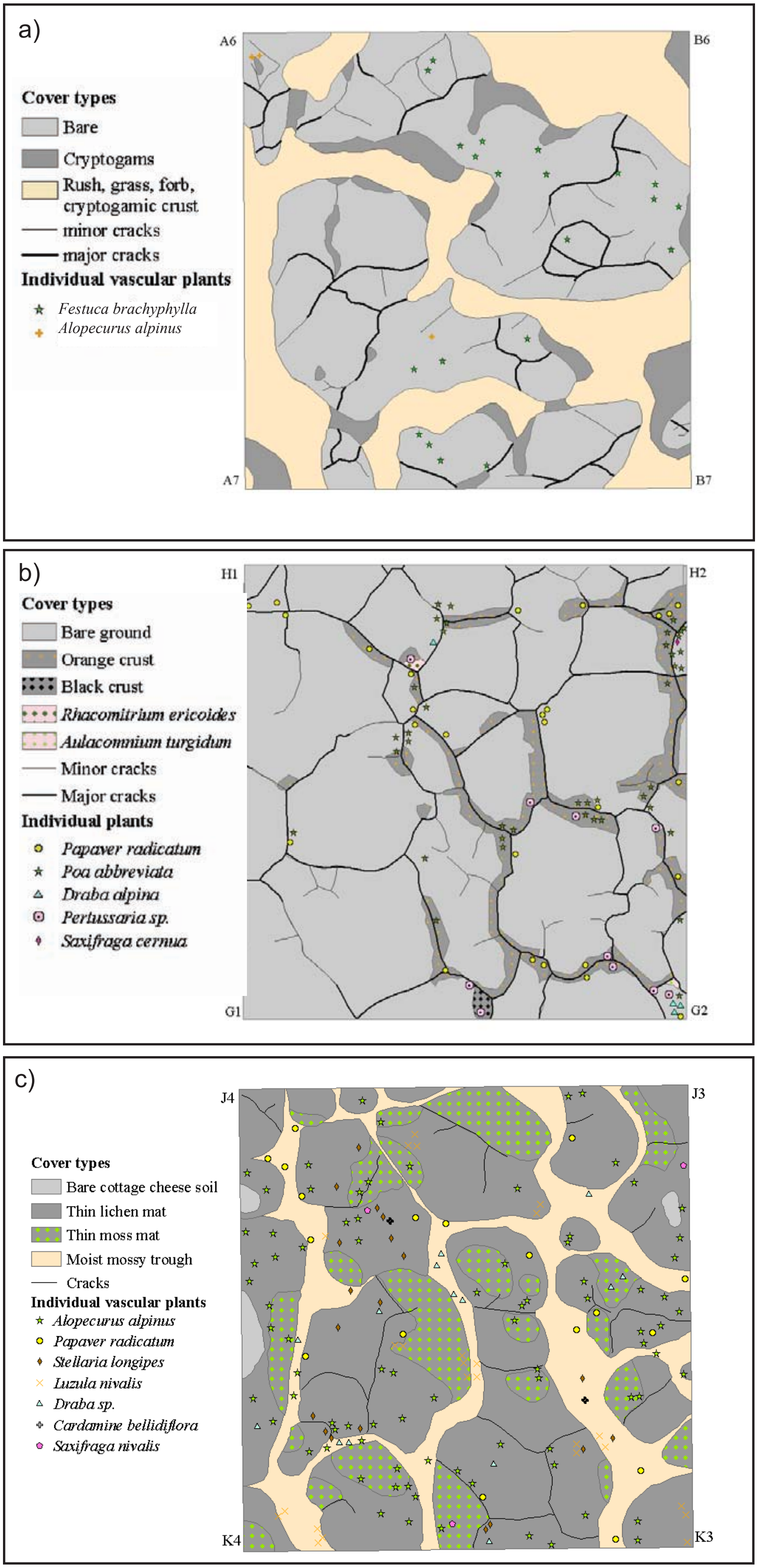
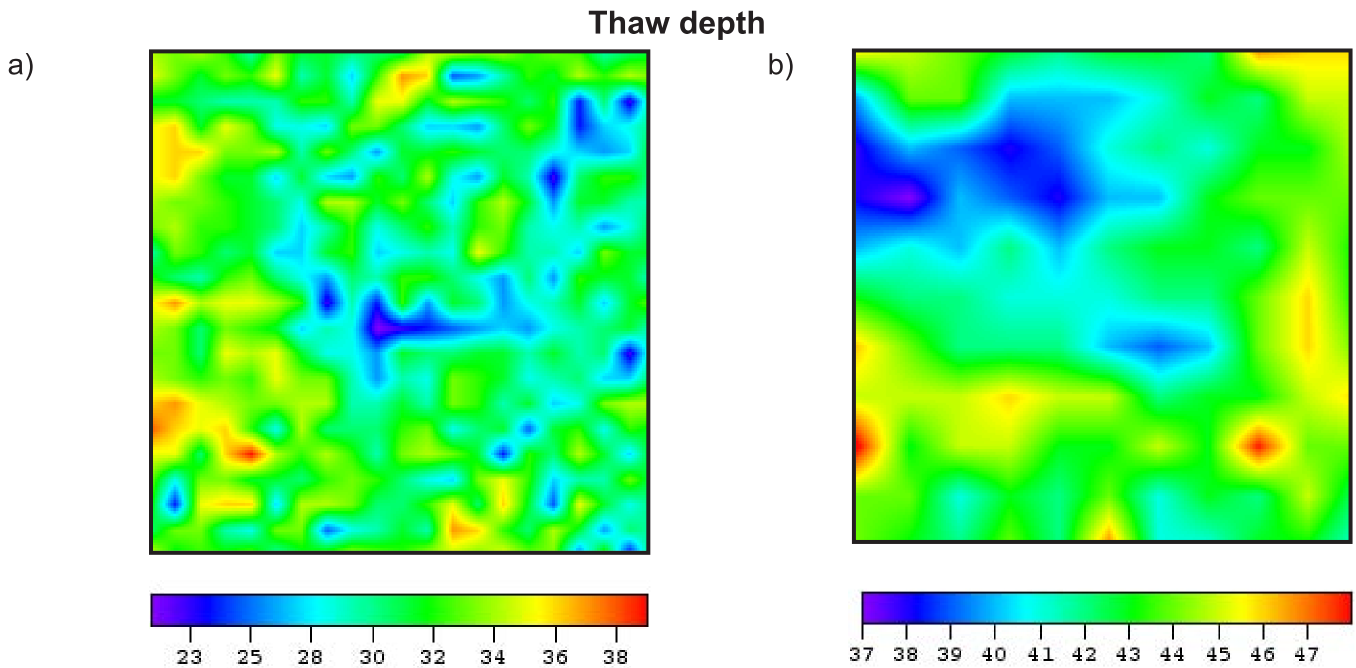


Fig. 8: Maps of 1x 1 m plots, showing polygonal cracking and vegetation: a) $1m^2$ within Isachsen Grid 1, b) $1m^2$ within Isachsen Grid 2, c) $1m^2$ within Isachsen Grid 3.



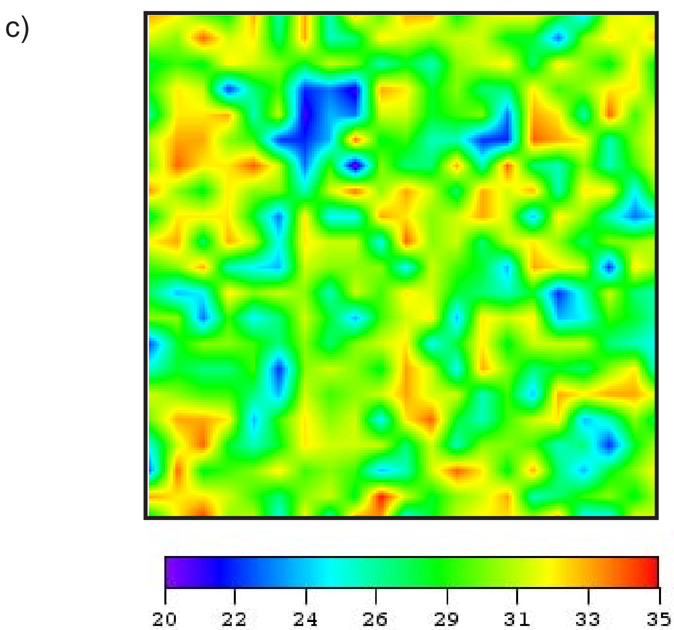


Fig. 9: Thaw depth maps for 10 x 10-m grids (note different scales for the thaw depths). a) grid 1 (zonal site), b) grid 2 (dry site), c) grid 3 (hummocky site).

Table 2: Grid thaw depth data.

Isachsen (Grid 1 - zonal)			Isachsen (Grid 2 - dry)			Isachsen (Grid 3 - hummocky site)		
bare (b)	Mean =	32.75	bare (b)	Mean =	42.70	bare mound top (b)	Mean =	32.08
	S.D. =	2.25		S.D. =	2.26		S.D. =	1.37
	n =	104.00		n =	120.00		n =	40.00
	s.e. =	0.22		s.e. =	0.21		s.e. =	0.22
cryptogamic (c)	Mean =	31.42	vegetated crack (v)	one	43.00	cryptogamic on mounds (c)	Mean =	30.93
	S.D. =	2.49					S.D. =	1.84
	n =	142.00					n =	222.00
	s.e. =	0.21					s.e. =	0.12
vegetated crack (v)	Mean =	29.41	Total	Mean =	42.70	vegetation between mounds (v)	Mean =	26.43
	S.D. =	2.97		S.D. =	2.25		S.D. =	2.39
	n =	195.00		n =	121.00		n =	179.00
	s.e. =	0.21		s.e. =	0.20		s.e. =	0.18
bare & cryptogamic crust	Mean =	31.98				Total	Mean =	29.21
	S.D. =	2.47					S.D. =	3.09
	n =	246.00					n =	441.00
	s.e. =	0.16					s.e. =	0.15
Total	Mean =	30.85						
	S.D. =	2.99						
	n =	441.00						
	s.e. =	0.14						

VEGETATION

Relevés

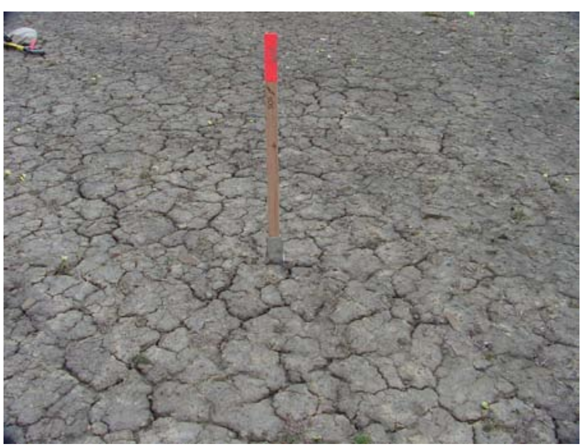
501)

502)

503)

504)

505)

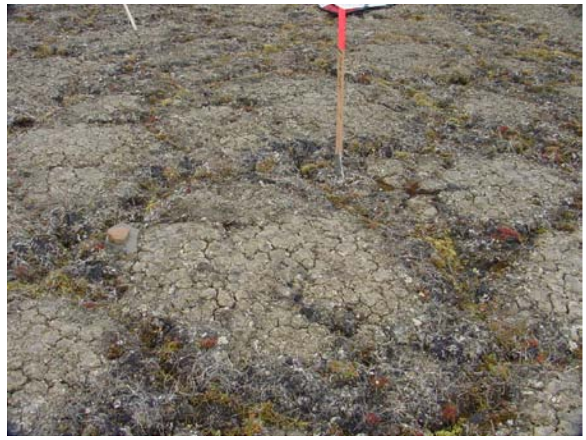


506)

Fig. 10: Relevé pictures.

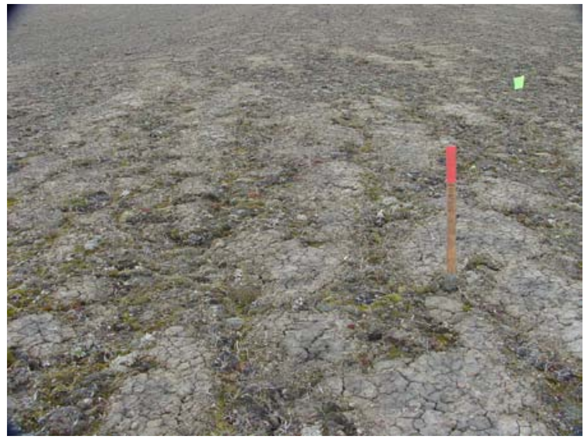
507)

508, 509)

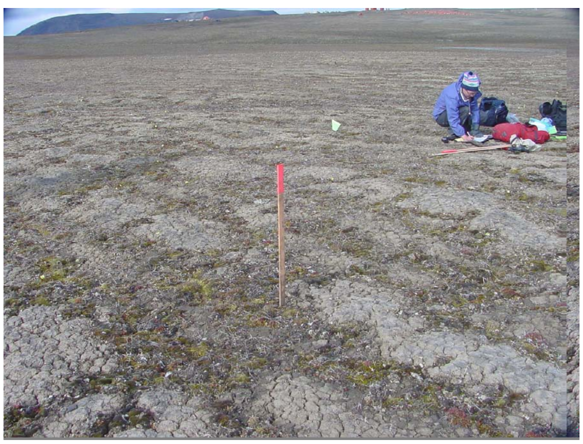


510, 511)

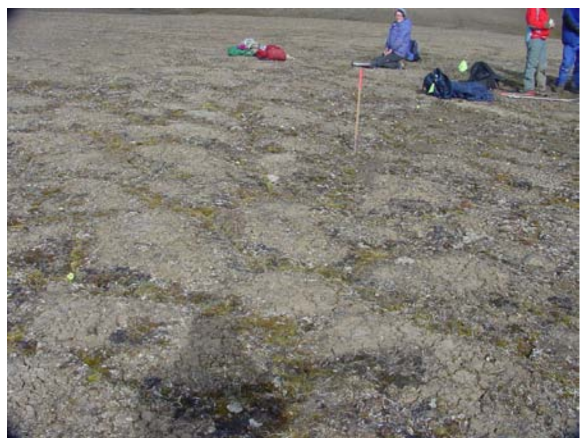
512, 513)



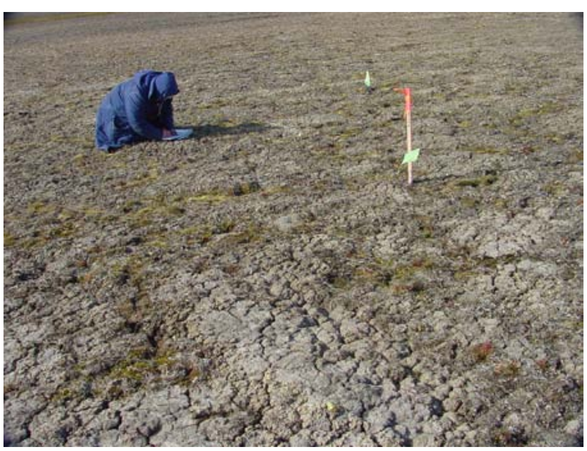
514, 515)



516, 517)



518, 519)



520, 521)

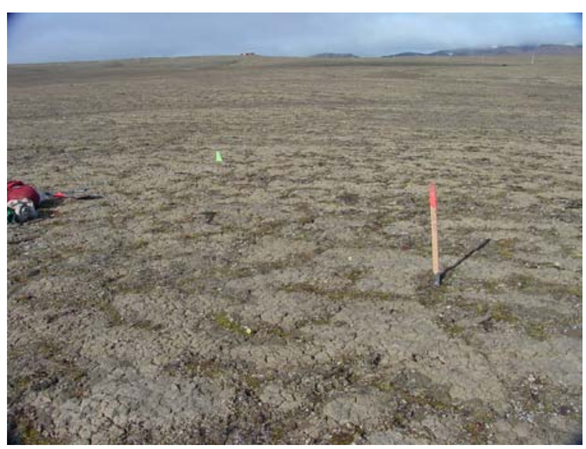
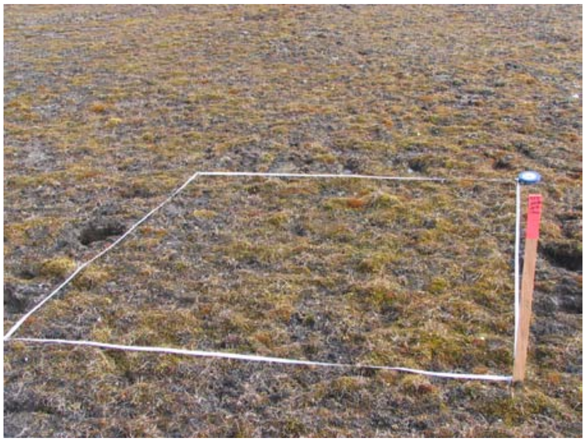
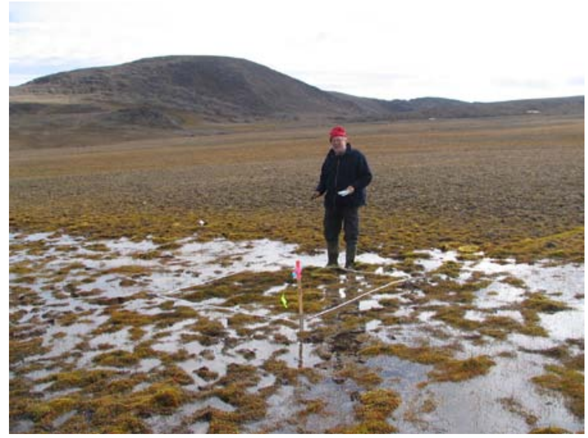


Fig. 10 - continued. 508-521: even numbers = interpolygon areas, uneven numbers = bare top of polygons.

522)

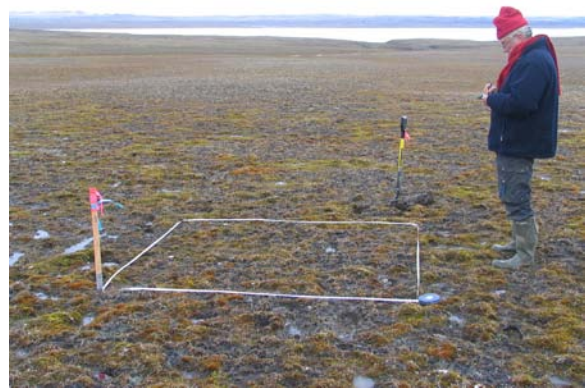


523)

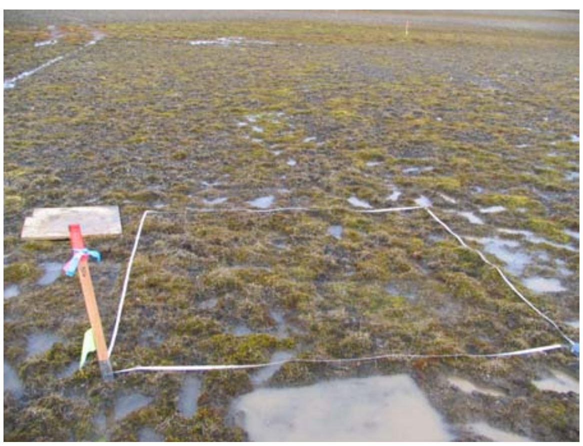


524)

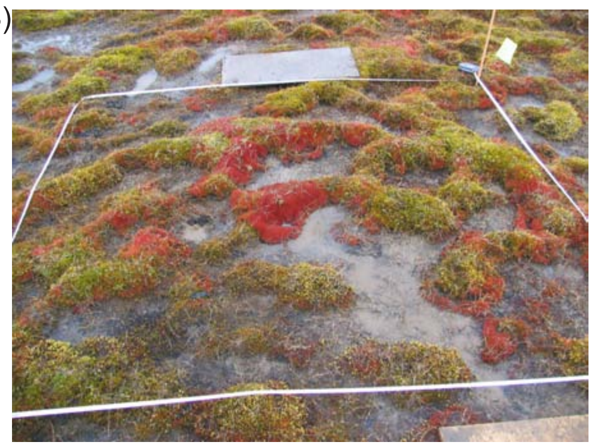
525)



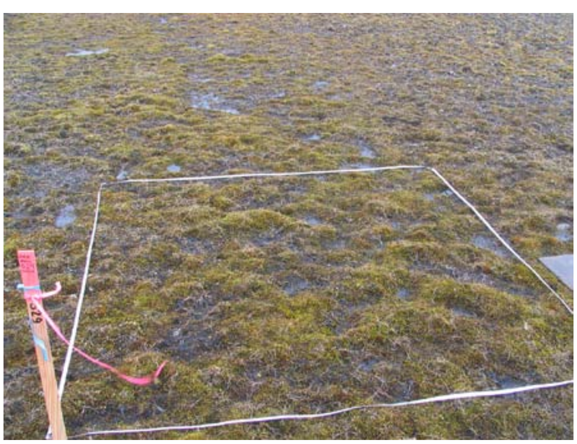
526)



527, 528)



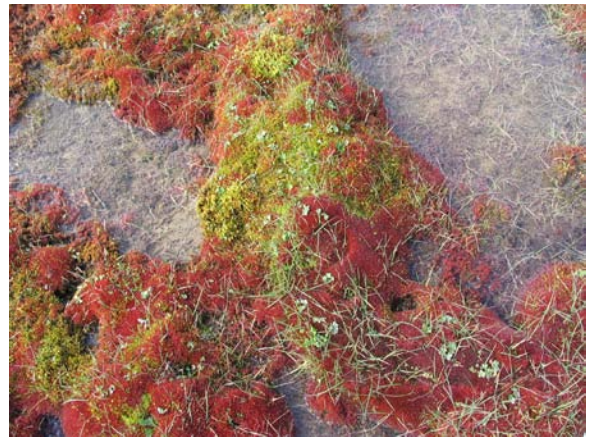
529)



530)

Fig. 10 - continued. Relevé 527 hummocks, 528 inter-hummocks.

531)

532)

538)

539)

540)

550)

551)

552)


Fig. 10 - continued. (photos for relevés 533 - 537 and 541 are missing).

553)

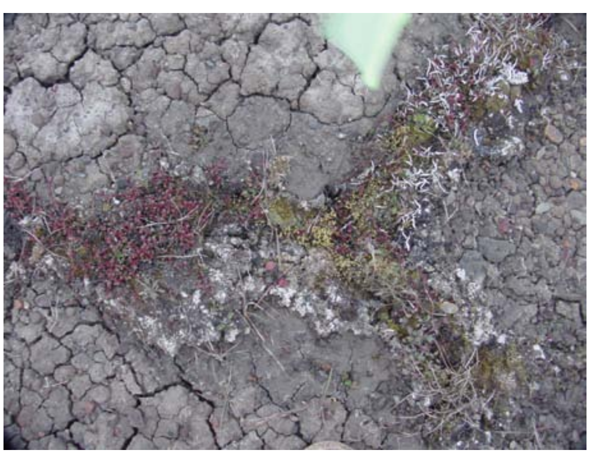

554)


555)


556)


557)


558)


559)


560)


Fig. 10 - continued.

Table 3: Relevé site characteristics form.

Study Site: ***Site Description***

Relevé No.: ________ Date: ____________ Recording personnel: ________________________ Weather: ______________________________

Study area description: ____

Slope (deg): _____________ Thaw depth (cm): A: ____ ____ ____ ____ ____ ____ ____ ____ ____ ___

Aspect: _________________ B: ____ ____ ____ ____ ____ ____ ____ ____ ____ ___

Elevation: _______________ C: ____ ____ ____ ____ ____ ____ ____ ____ ____ ___

Record numbers for all microsites.

Landforms

1 Hills (including kames and moraines)
2 Talus slope
3 Colluvial basin
4 Glaciofluvial and other fluvial terraces
5 Marine terrace
6 Floodplains
7 Drained lakes and flat lake margins
8 Abandoned point bars and sloughs
9 Estuary
10 Lake or pond
11 Stream
12 Sea bluff
13 Lake bluff
14 Stream bluff
15 Sand dunes
16 Beach
17 Disturbed
18 ____________________________
19 ____________________________
20 ____________________________
21 ____________________________

Surficial Geology (Parent Material)

1 Glacial tills
2 Glaciofluvial deposits
3 Active alluvial sands
4 Active alluvial gravels
5 Stabilized alluvium (sands & gravels)
6 Undifferentiated hill slope colluvium
7 Basin colluvium and organic deposits
8 Drained lake or lacustrine organic deposits
9 Lake or pond organic, sand, or silt
10 Undifferentiated sands
11 Undifferentiated clay
12 Roads and gravel pads
13 ____________________________
14 ____________________________
15 ____________________________
16 ____________________________

Surficial Geomorphology

1 Frost scars
2 Wetland hummocks
3 Turf hummocks
4 Gelifluction features
5 Strangmoor or aligned hummocks
6 High- or flat-centered polygons
7 Mixed high- and low-centered polygons
8 Sorted and non-sorted stripes
9 Palsas
10 Thermokarst pits
11 Featureless or with less 20% frost scars
12 Well-developed hillslope water tracks and small streams > 50 cm deep
13 Poorly developed hillslope water tracks, < 50 cm deep
14 Gently rolling or irregular microrelief
15 Stoney surface
16 Lakes and ponds
17 Disturbed
18 ____________________________
19 ____________________________
20 ____________________________
21 ____________________________

Microsites

1 Frost-scar element
2 Inter-frost scar element
3 Strang or hummock
4 Flark, interstrang, or interhummock area
5 Polygon center
6 Polygon trough
7 Polygon rim
8 Stripe element
9 Inter-stripe element
10 Point bar (raised element)
11 Slough (wet element)
12 ____________________________
13 ____________________________
14 ____________________________
15 ____________________________

Site Moisture (modified from Komárková 1983)

1 Extremely xeric - almost no moisture; no plant growth
2 Very xeric - very little moisture; dry sand dunes
3 Xeric - little moisture; stabilized sand dunes, dry ridge tops
4 Subxeric - noticeable moisture; well-drained slopes, ridges
5 Subxeric to mesic - very noticeable moisture; flat to gently sloping
6 Mesic-moderate moisture; flat or shallow depressions
7 Mesic to subhygric - considerable moisture; depressions
8 Subhygric - very considerable moisture; saturated but with < 5% standing water < 10 cm deep
9 Hygric - much moisture; up to 100% of surface under water 10 to 50 cm deep; lake margins, shallow ponds, streams
10 Hydric - very much moisture; 100% of surface under water 50 to 150 cm deep; lakes, streams

Soil Moisture (from Komárková 1983)

1 Very dry - very little moisture; soil does not stick together
2 Dry - little moisture; soil somewhat sticks together
3 Damp - noticeable moisture; soil sticks together but crumbles
4 Damp to moist - very noticeable moisture; soil clumps
5 Moist - moderate moisture; soil binds but can be broken apart
6 Moist to wet - considerable moisture; soil binds and sticks to fingers
7 Wet - very considerable moisture; water drops can be squeezed out of soil
8 Very wet - much moisture can be squeezed out of soil
9 Saturated - very much moisture; water drips out of soil
10 Very saturated - extreme moisture; soil is more liquid than solid

Glacial Geology

1	Till	4	____________________
2	Outwash	5	____________________
3	Bedrock	6	____________________
		7	____________________

Topographic Position

1	Hill crest or shoulder	5	Drainage channel
2	Side slope	6	Depression
3	Footslope or toeslope	7	Lake or pond
4	Flat		

Soil Units

1 Pergelic Cryorthent, acid
2 Pergelic Cryopsamment
3 Pergelic Cryohemist, euic
4 Pergelic Cryosaprist, euic
5 Lithic Pergelic Cryosaprist
6 Pergelic Cryofibrist, euic
7 Histic Pergelic Cryaquept, acid
8 Histic Pergelic Cryaquept, nonacid
9 Pergelic Cryaquept, acid
10 Pergelic Cryaquept, nonacid
11 Pergelic Cryochrept
12 Pergelic Cryumbrept
13 Ruptic-Lithic Cryumbrept
14 Pergelic Cryaquoll
15 Histic Pergelic Cryaquoll
16 Pergelic Cryoboroll
17 ____________________________
18 ____________________________
19 ____________________________
20 ____________________________

Exposure Scale

1 Protected from winds
2 Moderate exposure to winds
3 Exposed to winds
4 Very exposed to winds

Estimated Snow Duration

1 Snow free all year
2 Snow free most of winter; some snow cover persistsafter storm but is blown free soon afterward
3 Snow free prior to melt out but with snow most of winter
4 Snow free immediately after melt out
5 Snow bank persists 1-2 weeks after melt out
6 Snow bank persists 3-4 weeks after melt out
7 Snow bank persists 4-8 weeks after melt out
8 Snow bank persists 8-12 weeks after melt out
9 Very short snow free period
10 Deep snow all year

Animal and Human Disturbance

0 No sign present
1 Some sign present; no disturbance
2 Minor disturbance or extensive sign
3 Moderate disturbance; small dens or light grazing
4 Major disturbance; multiple dens or noticeable trampling
5 Very major disturbance; very extensive tunneling or large pit

Stability

1 Stable
2 Subject to occasional disturbance
3 Subject to prolonged but slow disturbance such as solifluction
4 Annually disturbed
5 Disturbed more than once annually

Other notes: ____

Table 4: Relevé type and location.

Releve #	Location	Type	Characteristic species	Study site	Date species data collected	Observer	Photo (site,soil)	Plot size (m2)	GPS north	GPS west	Elev. (m)	Slope (°)	Aspect
501	Isachsen	dry barren	Pucang, Poaabr, Papdah	Grid 2	22. Jul. 05	NM, CV, MR, DW	47, 48/49	5x5	78 47.139	103 33.081	41	5	E
502	Isachsen	dry barren	Pucang, Poaabr, Papdah	SW Grid 2	22. Jul. 05	NM, CV, MR,DW	51,52/50	4x4	78 47.095	103 33.308	40	10	E
503	Isachsen	dry barren	Pucang, Poaabr, Papdah	SW Grid 2	22. Jul. 05	NM, CV, MR, DW	53,54/56	4x4	78 47.113	103 33.412	45	8	E
504	Isachsen	dry barren	Pucang, Poaabr, Papdah	SW Grid 2	22. Jul. 05	NM, CV, MR,DW	57,59/58	4x4	78 47.022	103 33.214	35	2	SE
505	Isachsen	dry barren	Pucang, Poaabr, Papdah	E Grid 2	22. Jul. 05	NM, CV, MR, DW	60,62/61	4x4	78 47.078	103 32.536	35	2	E
506	Isachsen	dry barren	Pucang, Poaabr, Papdah	E Grid 2	22. Jul. 05	NM, CV, MR,DW	64,65/66	5x5	78 47.109	103 32.774	42	5	SE
507	Isachsen	dry barren	Pucang, Poaabr, Papdah	SW Grid 2	23. Jul. 05	NM, CV, MR, DW	89,90/95	5x5	78 47.009	103 33.300	38	2	SE
508	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	500 m NW of ocean	23. Jul. 05	NM, CV, MR	79-83/88	5x5	78 46.865	103 31.503	29	1	-
509	Isachsen	mesic -polygon	Rinter, Tetins,	500 m NW of ocean	23. Jul. 05	NM, CV, MR	80-82/86, 87	5x5	78 46.865	103 31.503	29	1	-
510	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	Grid 1	24. Jul. 05	NM, CV, MR	112,114/116	5x5	78 47.119	103 33.047	39	1	-
511	Isachsen	mesic -polygon	Rinter, Tetins,	Grid 1	24. Jul. 05	NM, CV, MR	112,113/115	5x5	78 47.119	103 33.047	39	1	-
512	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	W Grid 1	24. Jul. 05	NM, CV, MR	117,118/121	5x5	78 47.097	103 33.376	47	3	E
513	Isachsen	mesic -polygon	Rinter, Tetins,	W Grid 1	24. Jul. 05	NM, CV, MR	117,119/120	5x5	78 47.097	103 33.376	47	3	E
514	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	W Grid 1	24. Jul. 05	NM, CV, MR	122,123/126	5x5	78 47.036	103 33.444	32	1	-
515	Isachsen	mesic -polygon	Rinter, Tetins,	W Grid 1	24. Jul. 05	NM, CV, MR	122,124/125	5x5	78 47.036	103 33.444	32	1	-
516	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	S Grid 2	26. Jul. 05	NM, CV, MR	4,5/8	5x5	78 47.006	103 32.891	30	5	SE

Table 4 - continued.

Releve #	Location	Type	Characteristic species	Study site	Date species data collected	Observer	Photo (site,soil)	Plot size (m2)	GPS north	GPS west	Elev. (m)	Slope (°)	Aspect
517	Isachsen	mesic - top of polygon	Rinter, Tetins,	S Grid 2	26. Jul. 05	NM, CV, MR	4,6/7	5x5	78 47.006	103 32.891	30	5	SE
518	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	S Grid 2	26. Jul. 05	NM, CV, MR	10,11/13	5x5	78 47.000	103 33.241	45	2	S
519	Isachsen	mesic -polygon	Rinter, Tetins,	S Grid 2	26. Jul. 05	NM, CV, MR	10,12/9	5x5	78 47.000	103 33.241	45	2	S
520	Isachsen	mesic - area between polygons	Luzniv, Saxcae, Aloalp	E Grid 2	26. Jul. 05	NM, CV, MR	15,16/14	5x5	78 47.121	103 32.596	40	4	E
521	Isachsen	mesic -polygon	Rinter, Tetins,	E Grid 2	26. Jul. 05	NM, CV, MR	15,17/18	5x5	78 47.121	103 32.596	40	4	E
522	Isachsen	wet	Luzniv, Saxten, mosses	SW of camp	24. Jul. 05	DW, FD	525-527/528	2x2	78 46.926	103 33.390	40	1	-
523	Isachsen	wet - interhummock	Drerev, Calgig	SW of camp	24. Jul. 05	DW, FD	529,532,533/535	1x2	78 46.975	103 33.269	40	1	-
524	Isachsen	wet - hummock	Aultur, Brycry	SW of camp	24. Jul. 05	DW, FD	530,531,534/535	1x2	78 46.975	103 33.269	40	1	-
525	Isachsen	wet	Luzniv, Saxten, mosses	SW of camp	24. Jul. 05	DW, FD	536-538/539	2x2	78 46.982	103 33.780	40	1	-
526	Isachsen	wet	Luzniv, Saxten, mosses	SW of camp	25. Jul. 05	DW, FD	545-548/544	2x2	78 47.003	103 34.075	40	2	N
527	Isachsen	wet - interhummock	Drerev, Calgig	SW of camp	25. Jul. 05	DW, FD	549-551,553/554	1x2	78 47.016	103 34.052	40	1	-
528	Isachsen	wet - hummock	Aultur, Brycry	SW of camp	25. Jul. 05	DW, FD	549-551,552/554	1x2	78 47.016	103 34.052	40	1	-
529	Isachsen	wet	Luzniv, Saxten, mosses	SW of camp	25. Jul. 05	DW, FD	555-557/558	2x2	78 47.039	103 34.051	45	1	-
530	Isachsen	wet	Luzniv, Saxten, mosses	SW of camp	25. Jul. 05	DW, FD	560-562/559	2x2	78 47.093	103 34.004	45	1	-
531	Isachsen	wet - interhummock	Drerev, Calgig	SW of camp	26. Jul. 05	DW, FD	563,565/566	1x2	78 47.075	103 33.926	40	2	E
532	Isachsen	wet - hummock	Aultur, Brycry	SW of camp	26. Jul. 05	DW, FD	563,564/566	1x2	78 47.075	103 33.926	40	2	E
533	Isachsen	snowbed	Antjur, Racspe	NW of camp	26. Jul. 05	DW, FD		1.5x1.5	78 48.374	103 35.622	50	10	S
534	Isachsen	snowbed	Raclan, Stealp	NW of camp	26. Jul. 05	DW, FD		2x2	78 48.376	103 35.575	50	20	S

Table 4 - continued.

Releve #	Location	Type	Characteristic species	Study site	Date species data collected	Observer	Photo (site,soil)	Plot size (m2)	GPS north	GPS west	Elev. (m)	Slope (°)	Aspect
535	Isachsen	snowbed	Raceri	NW of camp	27. Jul. 05	DW, FD		2x2	78 48.355	103 36.664	35	20	S
536	Isachsen	snowbed	Phialg, Calsar	NW of camp	27. Jul. 05	DW, FD		1.5x1.5	78 48.342	103 36.700	35	2	S
537	Isachsen	snowbed	Dupfis, Aultur	NW of camp	27. Jul. 05	DW, FD		2x2	78 48.326	103 36.674	35	1	-
538	Isachsen	snowbed	Junbig, Antjur	NW of camp	28. Jul. 05	DW, FD	708-710/713	1x0.3	78 48.324	103 36.673	35	1	-
539	Isachsen	snowbed	Drerev	NW of camp	28. Jul. 05	DW, FD	711-712/713	1x0.04	78 48.324	103 36.673	35	1	-
540	Isachsen	snowbed	Poaalp, Luzniv	NW of camp	28. Jul. 05	DW, FD	715-717/714	1.5x1.5	78 48.336	103 36.681	35	1	-
541	Isachsen	snowbed	Luzniv, mosses	NW of camp	28. Jul. 05	DW, FD		1.5x1.5	78 48.518	103 36.559	100	15	SE
550	Isachsen	interhummock	Aloalp, Raceri, Aultur	Grid 3	28. Jul. 05	CV, MR, NM	34,37/38	1x5	78 47.106	103 33.091	39	2	SE
551	Isachsen	vegetated hummock	Aloalp, Polpil, Perspe	Grid 3	28. Jul. 05	CV, MR, NM	35,37/39	1x5	78 47.106	103 33.091	39	2	SE
552	Isachsen	bare hummock	Aloalp, Papdah, Perspe	Grid 3	28. Jul. 05	CV, MR, NM	36,37/40	1x5	78 47.106	103 33.091	39	2	SE
553	Isachsen	bare cracks	Papdah, Pucang	W of camp (river)	28. Jul. 05	CV, MR, NM	61,62/60	5x5	78 47.881	103 35.785	25	6	NW
554	Isachsen	stripes (vegetated)	Saxopp, Grimspe	W of camp (river)	28. Jul. 05	CV, MR, NM	57,59/55	5x5	78 47.895	103 35.818	25	8	NW
555	Isachsen	bare ground between stripes	Papdah, Pucang	W of camp (river)	28. Jul. 05	CV, MR, NM	58,59/56	5x5	78 47.895	103 35.818	25	8	NW
556	Isachsen	bare cracks	Papdah, Pucang	W of camp (river)	28. Jul. 05	CV, MR, NM	49,50/51	5x5	78 48.053	103 36.295	30	0	-
557	Isachsen	bare cracks	Papdah, Pucang	W of camp (river)	28. Jul. 05	CV, MR, NM	46,47/48	5x5	78 48.023	103 36.733	30	0	-
558	Isachsen	bare cracks	Papdah, Pucang	W of camp (river)	29. Jul. 05	DW, MR	63, 64	2x2	78 47.964	103 36.530	35	1	-
559	Isachsen	stripes (vegetated)	Saxopp, Grimspe	W of camp (river)	29. Jul. 05	DW, MR	65,66	4	78 47.937	103 36.526	35	4	SE
560	Isachsen	bare ground between stripes	Papdah, Pucang	W of camp (river)	29. Jul. 05	DW, MR	65,67	12	78 47.937	103 36.526	35	4	SE

Table 5: Relevé life form percent cover.

Releve #	Erect forbs	Mat & cushion forbs	Non-tussock graminoids	Tussock graminoids	Foliose lichen	Fruticose lichen	Crustose lichen	Pleuro-carpous bryophytes	Acro-carpous bryo./Liverworts	Horsetails/ Algae	Rocks	Bare soil/marl crust/algal crust	Water/ depth (cm)	Total dead
501	+	0	1	0	0	+	4	+	+/0	0/0	0	95/0	0	+
502	1	0	1	0	0	r	5	+	+/0	0/0	5	95/0	0	+
503	+	0	1	0	r	r	3	+	+/0	0/0	1	96/0	0	+
504	+	0	1	0	+	r	2	+	1/0	0/0	1	96/0	0	+
505	+	0	1	0	0	0	2	+	1/0	0/0	2	95/0	0	+
506	1	0	1	0	0	0	1	0	0/0	0/0	3	95/0	0	+
507	+	0	1	0	+	r	5	+	0/0	0/0	2	95/0	0	+
508	15	4	7	0	30	5	25	20	40/0	0/0	+	0/0	0	2
509	+	0	+	0	+	+	15	2	+/0	0/0	+	85/0	0	+
510	15	2	5	0	20	3	+	10	40/0	0/0	0	0/0	0	+
511	+	0	1	0	5	2	10	0	3/0	0/0	+	80/0	0	+
512	5	5	5	0	15	3	10	5	45/0	0/0	0	0/0	0	+
513	+	+	+	0	+	+	10	0	2/0	0/0	2	90/0	0	+
514	5	3	5	0	20	2	10	5	45/0	0/0	+	0/0	0	+
515	+	+	1	0	+	+	10	+	5/0	0/0	0	95/0	0	+
516	+	1	5	0	10	5	5	15	55/0	0/0	0	0/0	0	2
517	+	+	2	0	10	3	10	+	3/0	0/0	5	70/0	0	1
518	+	3	4	0	15	2	5	4	60/0	0/0	0	0/0	0	1
519	1	+	1	0	+	+	10	+	5/0	0/0	0	75/0	0	1
520	2	4	5	0	10	5	10	2	80/0	0/0	0	0/0	0	2
521	+	+	+	0	+	1	10	0	5/0	0/0	3	85/0	0	+
522	7	7	7	0	+	+	25	25	30/5	0/5	+	2/0	0	3
523	+	0	2	0	0	0	0	50	5/1	0/1	0	40/0	100/4	3
524	5	2	7	0	0	0	0	65	35/2	0/1	0	0/0	0	5
525	4	+	10	0	2	+	5	25	30/10	0/1	0	2/0	1 /2	3
526	4	2	20	0	+	+	10	35	35/20	0/ +	0	+/0	15 /1	5
527	+	0	7	0	0	0	0	50	1/0	0/3	0	10/0	80 /2	3
528	5	2	10	0	+	0	0	20	80/ +	0/0	0	0/0	0	7
529	3	1	7	0	+	+	2	20	80/5	0/3	0	0/0	3 /1	5
530	1	+	4	0	1	1	2	20	60/20	0/0	0	0/0	3 /1	2
531	0	0	8	0	0	0	0	65	5/0	0/+	0	+/0	85 /5	5
532	7	6	12	0	0	0	0	25	75/0	0/1	0	0/0	0	2
533	1	+	1	0	+	3	15	20	7/25	0/0	30	0/0	0	+
534	1	0	+	0	+	3	1	93	2/ +	0/0	4	0/0	0	0
535	+	+	+	0	+	1	+	75	+/+	0/0	20	5/0	0	0
536	+	0	1	0	0	+	0	65	+/+	0/0	2	30/0	2 /1	+
537	+	0	20	0	0	0	0	65	20/25	0/0	0	0/0	0	25
538	+	0	1	0	0	0	0	+	1/+	0/0	3	97/0	0	+
539	0	0	7	0	0	0	0	75	3/2	0/0	0	20/0	0	+
540	1	+	6	0	+	+	0	80	10/10	0/+	0	0/0	+ /1	+
541	+	+	25	0	+	+	0	35	50/15	0/0	1	1/0	3 /1	20
550	+	+	1	0	+	+	2	10	50/20	0/0	0	0/0	0	+
551	+	+	1	0	+	+	25	+	40/10	0/0	0	10/0	0	+
552	+	0	1	0	0	+	10	0	5/+	0/0	0	90/0	0	0
553	1	+	+	0	0	0	+	0	0/0	0/0	60	39/0	0	+
554	1	5	2	0	5	+	3	20	60/0	0/0	5	0/0	0	+
555	r	r	r	0	+	+	+	+	+/0	0/0	50	50/0	0	+
556	+	+	+	0	+	+	+	+	+/0	0/0	30	70/0	0	+
557	+	0	+	0	0	0	+	0	0/0	0/0	60	40/0	0	+
558	2	0	3	0	+	0	2	+	+/0	0/0	45	50/0	0	1
559	5	25	10	0	15	5	15	5	30/0	0/0	+	0/0	0	5
560	+	+	5	0	+	+	1	+	+/0	0/0	30	65/0	0	1

Table 6: Relevé site characteristics.

	Height (cm)						Site Information													
Rel. #	Veg. can-opy	Moss	Or-ganic	A hori-zon	Micro-relief	Mean thaw depth	Land-form	Sur-ficial geo-logy	Surficial geomor-phology	Micro-site	Site moist.	Soil moist.	Gla-cial geo-logy	Topo-graphic position	Soil unit	Estim. snow dur-ation	Distur-bance degree	Distur-bance type	Stab-ility	Expo-sure
501	1	0	0	0	3	44	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
502	1	0	0	0	3	41	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
503	1	0	0	0	3	41	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
504	1	0	0	0	3	41	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
505	1	0	0	0	3	39	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
506	1	0	0	0	3	40	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
507	1	0	0	0	3	40	1	15	18	-	3	3	3	1	hypergelic Typic Haplorthel	2	0	-	1	3
508	1	4	30f	1	5	32	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	2	0	-	1	2
509	1	0	0	0	2	39	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	2	0	-	4	2
510	1	8	25	1	5	27	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	2	0	-	1	2
511	1	0	0	0	2	34	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	2	0	-	4	2
512	1	1	2	3	5	27	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	2	0	-	1	2
513	1	0	0	0	3	30	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	2	0	-	4	2
514	1	3	1	1	5	30	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	2	0	-	1	2

Table 6 - continued.

	Height (cm)						Site Information													
Rel. #	Veg. can-opy	Moss	Or-ganic	A hori-zon	Micro-relief	Mean thaw depth	Land-form	Sur-ficial geo-logy	Surficial geomor-phology	Micro-site	Site moist.	Soil moist.	Gla-cial geo-logy	Topo-graphic position	Soil unit	Estim. snow dur-ation	Distur-bance degree	Distur-bance type	Stab-ility	Expo-sure
515	1	0	0	0	2	37	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	2	0	-	4	2
516	1	1	2	1	3	33	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	3	1	3	1	3
517	1	0	0	0	5	38	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	3	1	3	2	3
518	1	1	3	6	5	32	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	3	0	-	1	3
519	1	0	0	0	5	38	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	3	0	-	2	3
520	1	2	2	6	2	35	1	15	1	2	7	8	3	1	hypergelic Glacic Aquiturbel	3	1	3	1	3
521	1	0	0	0	5	30	1	15	1	1	3	4	3	1	hypergelic Glacic Aquiturbel	3	1	3	2	3
522	2	2	0	0	5	34	1	15	11	-	8	9	?	2,4	-	5	0	-	1	2
523	2	2	0	0	2	32	11	15	5	4	9	10	?	5	-	5	0	-	5	2
524	2	12	5	0	5	37	11	15	5	3	8	10	?	5	-	5	0	-	5	2
525	4	2	0	0	3	34	1	15	11	-	8	9	?	2,4	-	5	0	-	1	2
526	5	4	0	0	5	34	1	15	11	-	8	9	?	2,4	-	5	0	-	1	2
527	2	2	0	0	2	30	11	15	5	4	9	10	?	5	-	5	0	-	4	2
528	2	8	4	0	5	35	11	15	5	3	8	10	?	5	-	5	0	-	4	2
529	2	2	0	0	5	33	1	15	11	-	8	9	?	2,4	-	5	0	-	1	2
530	1	2	0	0	3	33	1	15	11	-	8	9	?	2,4	-	6 ?	0	-	1	2
531	2	2	0	0	3	32	11	15	20	4	9	9	?	5	-	5	0	-	4	1.5
532	3	5	2	0	10	35	11	15	5	3	8	9	?	5	-	5	0	-	4	1.5
533	1	2	0	0	5	?	1	16	19	-	5	5	?	3	hypergelic Typic Aquorthel	7	0	-	3	1
534	1	2	5	4	10	?	1	16	19	-	5	5	?	1	hypergelic Typic Aquorthel	5	0	-	1	2

Table 6 - continued.

	Height (cm)						Site Information													
Rel. #	Veg. canopy	Moss	Organic	A horizon	Microrelief	Mean thaw depth	Landform	Surficial geology	Surficial geomorphology	Microsite	Site moist.	Soil moist.	Glacial geology	Topographic position	Soil unit	Estim. snow duration	Disturbance degree	Disturbance type	Stability	Exposure
535	1	1	5	2	5	?	1	16	19	-	5	5	?	2	hypergelic Typic Aquorthel	6	0	-	1	1
536	1	1	1	0	3	?	1	16	19	-	8	9	?	3	hypergelic Typic Aquorthel	7	0	-	5	1
537	1	3	12	0	4	25	1	16	11	-	7	8	?	3	hypergelic Typic Aquiturbel, hypergelic Typic Historthel	6	6	-	1	2
538	1	0	0	0	3	34	1	16	1	1	7	7	?	3	hypergelic Typic Aquorthel	4	0	-	5	2
539	1	1	0	0	3	?	1	16	1	1	7.5	7	?	3	hypergelic Typic Aquorthel	4	0	-	5	2
540	1	3	7	0	3	36	1	16	19	1	8	9	?	?	hypergelic Typic Aquorthel	6.5	0	-	3	2
541	5	2	5	0	5	?	1	16	11	-	9	9	?	5	hypergelic Typic Aquorthel	7	0	-	3	2
550	1	1	2	1	5	24	1	15	3	4	8	8	3	2	hypergelic Glacic Aquiturbel	4	1	3	2	2
551	1	1	1	1	5	33	1	15	3	4	6	4	3	2	hypergelic Glacic Aquiturbel	4	1	3	2	2
552	1	0	0	0	1	33	1	15	3	3	4	3	3	2	hypergelic Glacic Aquiturbel	3	1	3	2	2
553	1	0	0	0	2	38	1	6	11	13	3	3	-	1	hypergelic Typic Haplorthel	2	0	-	1	3
554	1	1	0	0	5	32	1	6	8	8	4	4	3	2	hypergelic Typic Haploturbel	3	0	-	2	2.5
555	1	0	0	0	3	35	1	6	8	9	3	3	3	2	hypergelic Typic Haploturbel	3	0	-	2	2.5

Table 6 - continued.

	Height (cm)						Site Information														
Rel. #	Veg. can-opy	Moss	Or-ganic	A hori-zon	Micro-relief	Mean thaw depth	Land-form	Sur-ficial geo-logy	Surficial geomor-phology	Micro-site	Site moist.	Soil moist.	Gla-cial geo-logy	Topo-graphic position	Soil unit	Estim. snow dur-ation	Distur-bance degree	Distur-bance type	Stab-ility	Expo-sure
556	1	0	0	0	3	39	1	6	11	13	3	3	-	4	hypergelic Typic Haplorthel	3	0	-	1	3
557	1	0	0	0	2	43	1	6	11	13	3	3	-	1	hypergelic Typic Haplorthel	2	0	-	1	3
558	1	0	0	0	1	40	1	6	11	13	3	3	?	1	hypergelic Typic Haplorthel	2	0	-	1	3
559	2	2	2	0	5	35	1	6	8	8	4	4	?	1	hypergelic Typic Haploturbel	3	0	-	1	2.5
560	1	0	0	0	2	40	1	6	8	9	3	3	?	1	hypergelic Typic Haploturbel	3	0	-	1	2.5

Table 7: Relevé soil moisture and soil nutrients.

		meq/100					%									
Releve #	pH	CEC	K	Ca	Mg	Na	> 2mm	Sand	Silt	Clay	C	N	Inorganic Carbon	volu-metric moisture	gravi-metric moisture	bulk density (g/cm3)
501	6.32	17.02	0.61	11.17	4.42	0.07	8.40	19.20	28.00	52.80	2.68	0.18	<.01	17.78	12.70	1.41
502	5.92	17.08	0.55	8.73	5.15	0.06	1.93	15.20	34.00	50.80	2.71	0.21	na	20.94	14.90	1.42
503	6.34	17.80	0.70	10.77	5.67	0.11	1.10	19.20	26.00	54.80	2.60	0.18	<.01	22.78	16.41	1.40
504	6.01	17.70	0.56	10.16	4.67	0.11	4.95	22.40	26.80	50.80	2.80	0.20	<.01	17.72	14.59	1.22
505	5.49	18.47	0.51	8.07	5.50	0.05	1.31	11.40	33.80	54.80	2.46	0.18	na	18.78	15.28	1.24
506	5.75	18.64	0.67	9.35	5.14	0.11	6.17	15.40	27.80	56.80	2.73	0.19	na	19.50	14.64	1.34
507	6.00	17.79	0.66	9.65	6.06	0.06	2.87	7.40	29.80	62.80	2.52	0.19	<.01	20.33	15.95	1.29
508	6.54	21.41	0.71	11.67	8.62	0.28	<.01	21.40	33.80	44.80	4.11	0.29	<.01	41.67	47.02	0.90
509	7.02	18.31	0.72	9.12	8.33	0.44	5.79	18.40	28.80	52.80	2.57	0.20	<.01	27.50	20.45	1.35
510	6.06	20.95	0.56	10.05	6.42	0.11	<.01	16.40	33.80	49.80	2.87	0.22	<.01	36.78	30.33	1.23
511	6.09	18.70	0.55	9.22	6.27	0.17	1.98	11.40	35.80	52.80	2.68	0.21	<.01	25.39	20.12	1.27
512	5.50	19.92	0.61	9.40	6.48	0.15	5.37	11.40	33.80	54.80	2.83	0.23	na	33.67	33.41	1.02
513	5.70	19.08	0.57	8.55	6.26	0.13	1.81	8.40	30.80	60.80	2.54	0.20	na	26.72	22.32	1.21
514	6.59	19.16	0.57	10.60	6.91	0.16	0.87	16.40	32.80	50.80	2.86	0.22	<.01	36.28	27.23	1.34
515	6.54	17.93	0.57	9.29	6.50	0.16	1.79	8.40	37.80	53.80	2.75	0.16	<.01	19.28	14.77	1.32
516	7.26	18.89	0.67	9.95	9.45	0.30	0.53	0.40	38.80	60.80	2.55	0.17	<.01	26.50	23.59	1.13
517	6.98	18.89	0.53	10.39	7.86	0.16	0.36	16.40	36.80	46.80	3.08	0.23	<.01	33.22	30.57	1.09
518	5.86	22.78	0.55	12.01	7.28	0.32	<.01	22.40	32.80	44.80	4.31	0.32	na	41.17	49.83	0.84
519	6.95	15.71	0.53	9.14	6.03	0.23	1.82	15.40	34.80	49.80	2.89	0.20	0.01	28.06	19.64	1.44
520	6.98	20.97	0.70	12.94	7.88	0.28	<.01	11.40	35.80	52.80	3.05	0.24	<.01	40.94	36.94	1.13
521	6.46	17.49	0.56	8.81	6.28	0.18	8.71	8.40	34.80	56.80	2.70	0.21	<.01	23.33	17.46	1.35
522	5.72	19.48	0.38	9.92	5.55	0.25	20.18	16.40	34.80	48.80	2.75	0.25	na	41.83	27.78	1.54
523	5.29	18.68	0.34	7.39	5.35	0.08	1.50	20.40	36.80	42.80	2.51	0.20	na	41.50	30.75	1.40
524	5.31	25.45	0.45	11.73	7.12	0.12	3.99	19.40	27.80	52.80	5.41	0.31	na	66.56	87.96	0.79
525	5.19	18.51	0.29	7.38	4.89	0.04	0.40	8.40	61.40	30.20	2.55	0.19	na	48.44	34.25	1.46
526	5.25	19.90	0.40	8.65	5.75	0.13	0.25	18.40	36.40	45.20	2.80	0.24	na	47.00	36.56	1.32
527	5.15	18.96	0.37	8.21	5.42	0.13	1.84	16.40	37.40	46.20	3.10	0.24	na	53.00	47.75	1.15
528	5.33	17.50	0.33	7.76	5.21	0.09	2.97	31.40	25.40	43.20	2.77	0.21	na	39.22	38.92	1.08
529	5.62	18.88	0.43	8.50	6.16	0.13	0.31	22.40	32.40	45.20	2.91	0.22	na	47.28	44.37	1.12
530	5.03	20.33	0.46	8.19	6.21	0.18	<.01	14.40	34.40	51.20	2.98	0.24	na	50.17	51.05	1.02
531	5.39	18.09	0.43	7.58	5.83	0.19	1.82	14.40	39.40	46.20	2.71	0.20	na	51.11	43.79	1.20
532	5.32	17.49	0.37	7.50	5.40	0.17	<.01	16.00	40.80	43.20	2.68	0.21	na	46.78	45.22	1.09
533	5.43	22.82	0.23	11.87	5.17	0.06	6.47	45.00	13.80	41.20	3.18	0.24	na		41.53	

Table 7 - continued.

		meq/100					%									
Releve #	pH	CEC	K	Ca	Mg	Na	> 2mm	Sand	Silt	Clay	C	N	Inorganic Carbon	volu-metric moisture	gravi-metric moisture	bulk density (g/cm3)
534	5.58	33.94	0.40	18.03	8.45	0.05	<.01	53.40	33.40	13.20	10.95	0.51	na		89.76	
535	5.42	18.15	0.16	9.25	4.00	0.08	24.24	54.00	24.80	21.20	2.39	0.19	na		23.84	
536	5.29	23.51	0.40	11.51	6.53	0.09	<.01	28.40	25.40	46.20	2.78	0.24	na		77.19	
537	4.61	33.61	0.17	7.86	3.79	0.07	0.21	34.30	55.40	10.30	8.41	0.70	na	62.78	118.82	0.53
538	4.59	23.65	0.17	4.96	2.44	0.04	3.48	35.60	33.20	31.20	2.44	0.23	na	36.89	32.23	1.18
540	5.10	18.46	0.15	9.11	3.93	0.05	32.30	49.00	29.80	21.20	2.52	0.20	na	35.50	29.26	1.23
541	4.83	23.43	0.32	10.78	4.58	0.03	8.66	35.60	29.20	35.20	4.60	0.29	na	57.11	90.10	0.64
550	4.87	20.64	0.45	7.56	5.64	0.07	3.49	22.60	28.80	48.60	2.81	0.22	na	36.56	33.25	1.12
551	4.80	20.74	0.45	7.71	5.71	0.08	1.61	21.60	30.80	47.60	3.41	0.23	na	33.61	37.39	0.91
552	4.80	20.99	0.50	6.56	5.41	0.09	0.79	13.60	30.80	55.60	2.44	0.19	na	33.94	28.09	1.22
553	7.00	25.75	1.12	16.77	8.68	0.16	6.24	4.60	17.80	77.60	0.90	0.14	0.01	31.89	25.79	1.24
554	6.44	21.90	0.77	14.66	5.97	0.18	20.51	17.60	24.80	57.60	2.31	0.17	<.01	33.17	33.73	0.99
555	6.34	25.00	0.99	14.12	7.54	0.14	6.83	5.60	28.80	65.60	0.98	0.11	<.01	34.72	33.07	1.06
556	6.87	26.79	1.57	13.42	10.38	0.36	10.09	0.80	9.40	89.80	1.28	0.15	<.01	38.28	38.26	1.02
557	7.24	22.46	1.26	9.94	9.96	0.15	5.30	5.60	16.80	77.60	1.12	0.13	<.01	38.39	30.44	1.26
salix site	6.47	24.61	0.22	14.01	6.71	0.15	32.96	58.60	21.80	19.60	2.40	0.16	<.01	28.28	17.72	1.60

na=not applicable

Table 8: Isachsen plant species list.

Vascular species	**Bryophyte species**
Alopecurus alpinus	*Anastrophyllum minutus*
Cardamine bellidifolia	*Aneura pinguis*
Cerastium arcticum	*Anthelia juratzkana*
Cerastium regelii	*Apomarsupella revoluta*
Draba oblongata	*Arctoa anderssonii*
Draba sp.	*Arctoa* sp.
Draba subcapitata	*Aulacomnium turgidum*
Dupontia fisheri	*Barbilophozia atlantica*
Festuca brachyphylla	*Barbilophozia hyperborea*
Juncus biglumis	*Barbilophozia quadriloba*
Luzula confusa	*Bartramia ithyphylla*
Luzula nivalis	*Blepharostoma trichophyllum*
Minuartia sp.	*Brachythecium* sp.
Minuartia rubella	*Bryoerythrophyllum recurvirostrum*
Papaver radicatum	*Bryum arcticum*
Phippsia algida	*Bryum argenteum*
Poa abbreviata	*Bryum cryophilum*
Poa alpigena	*Bryum pseudotriquetrum*
Potentilla hyparctica	*Bryum* sp.
Puccinellia cf. *andersonii*	*Bryum teres*
Ranunculus nivalis	*Callialaria curvicaulis*
Ranunculus sabinei	*Campylium arcticum*
Ranunculus sulphureus	*Campylium stellatum*
Sagina intermedia	*Cephaloziella bicuspidata*
Saxifraga caespitosa	*Cephaloziella grimsulana*
Saxifraga cernua	*Cephaloziella varians*
Saxifraga flagellaris	*Ceratodon heterophyllus*
Saxifraga foliolosa	*Ceratodon purpureus*
Saxifraga nivalis	*Cinclidium* cf. *subrotundum*
Saxifraga oppositifolia	*Cirriphyllum cirrosum*
Saxifraga rivularis	*Conostomum tetragonum*
Saxifraga tenuis	*Cryptocolea imbricata*
Stellaria longipes	*Dichodontium pellucidum*
	Dicranella sp.
	Dicranum acutifolium
	Dicranum elongatum
	Dicranum laevidens
	Didymodon icmadophyllus
	Dicranoweisia crispula
	Distichium capillaceum
	Distichium inclinatum
	Ditrichum flexicaule
	Drepanocladus brevifolius
	Encalypta alpina
	Encalypta rhaptocarpa
	Eurhynchium pulchellum
	Fissidens arcticus
	Grimmia sp.
	Gymnomitrion concinnatum
	Gymnomitrion corallioides
	Hygrohypnum polare
	Hylocomium splendens
	Hymenostylium recurvirostre
	Hypnum cupressiforme

Table 8 - continued.

Bryophyte species (continued)
Hypnum hamulosum
Hypnum holmenii
Hypnum revolutum
Hypnum subimponens
Hypnum vaucheri
Isopterygiopsis pulchella
Jungermannia obovata
Jungermannia polaris
Kiaeria cf. *blyttii*
Leiocolea heterocolpos var. *harpanthoides*
Leiocolea heterocolpos var. *heterocolpos*
Limprichtia revolvens
Loeskypnum badium
Lophozia excisa
Lophozia jurensis
Lophozia polaris
Lophozia ventricosa
Marsupella arctica
Meesia longiseta
Mnium marginatum
Myurella julacea
Myurella tenerrima
Nostoc commune
Odontoschisma macounii
Oncophorus virens
Oncophorus wahlenbergii
Orthocaulis sp.
Orthothecium chryseon
Orthothecium strictum
Orthotrichum speciosum
Philonotis caespitosa
Philonotis sp.
Philonotis tomentella
Plagiochila asplenioides ssp. *porelloides*
Plagiothecium berggrenianum
Pogonatum urnigerum
Pohlia cruda
Pohlia drummondii
Pohlia nutans
Polytrichastrum alpinum
Polytrichum piliferum
Polytrichum juniperinum
Pseudocalliergon brevifolium
Psilopilum cavifolium
Pterygoneurum ovatum
Ptilidium cilare
Racomitrium canescens
Racomitrium ericoides/panshii
Racomitrium lanuginosum
Saelania glaucescens
Sanionia uncinata
Scapania cf. *zemliae*
Scapania crassiretis
Scapania kaurinii
Scapania mucronata ssp. *praetervisa*
Scapania obcordata
Scapania perssonii
Schistidium andreaeopsis
Schistidium frigidum
Schistidium holmenianum
Schistidium papillosum
Syntrichia ruralis
Timmia austriaca
Tomentypnum nitens
Tortula mucronifolia
Tritomaria quinquedentata
Warnstorfia exannulata
Warnstorfia sarmentosa

Lichen species
Agonimia gelatinosa
Alectoria nigricans
Alectoria ochroleuca
Anaptychia bryorum
Arctocetraria nigricascens
Arctomia delicatula
Bacidia bagliettoana
Biatora subduplex
Bryocaulon divergens
Bryodina rhypariza
Bryonora castanea
Bryoria nitidula
Caloplaca ammiospila
Caloplaca cerina
Caloplaca jungermanniae
Caloplaca phaeocarpella
Caloplaca tetraspora
Caloplaca tiroliensis
Caloplaca tornoënsis
Candelariella placodizans
Candelariella sp.
Candelariella terrigena
Catapyrenium cinereum
Catapyrenium sp.
Cetraria aculeata
Cetraria islandica
Cetrariella delisei
Cetrariella fastigiata
Cladonia amaurocraea
Cladonia chlorophaea
Cladonia coccifera
Cladonia gracilis
Cladonia pocillum
Cladonia pyxidata
*Cladonia pyxidata (*cf. *libifera)*
Cladonia scabriuscula
Cladonia trassii
Collema ceraniscum
Collema sp.

Table 8 - continued.

Lichen species (continued)
Collema tenax
Collema undulatum
Dactylina ramulosa
Dermatocarpon arnoldianum
Endocarpon pusillum
Flavocetraria cucullata
Fuscopannaria praetermissa
Hypogymnia subobscura
Japewia tornoënsis
Lecanora cf. *geophila*
Lecanora epibryon
Lecanora hagenii
Lecidea ramulosa
Lecidella wulfenii
Lepraria cf. *vouauxii*
Lepraria neglecta
Lepraria sp.
Leptogium gelatinosum
Leptogium lichenoides
Leptogium sp.
Lopadium pezizoideum
Megalaria jemtlandica
Megaspora verrucosa
Micarea incrassata
Mycoblastus sanguinarius
Myxobilimbia lobulata
Ochrolechia cf. *inaequatula*
Ochrolechia inaequatula
Ochrolechia species
Parmelia omphalodes ssp. *glacialis*
Peltigera canina
Peltigera didactyla
Peltigera frippii
Peltigera leucophlebia
Peltigera malacea
Peltigera rufescens
Peltigera scabrosa
Peltigera venosa
Pertusaria atra
Pertusaria geminipara
Pertusaria glomerata
Pertusaria octomela
Pertusaria oculata
Phaeorrhiza nimbosa
Physconia muscigena
Placopsis gelida
Polychidium muscicola
Protopannaria pezizoides
Psoroma hypnorum
Rinodina mniaraea var. *mniaraea*
Rinodina mniaraea var. *mniaraeiza*
Rinodina olivaceobrunnea
Rinodina roscida
Rinodina terrestris
Rinodina turfacea
Shadonia fecunda
Solorina cf. *bispora*
Solorina crocea
Sphaerophorus fragilis
Sphaerophorus globosus
Stereocaulon groenlandicum
Stereocaulon alpinum
Stereocaulon depressum
Stereocaulon glareosum
Stereocaulon rivulorum
Sticta arctica
Tetramelas insignis
Tetramelas papillata
Thamnolia vermicularis var. *subuliformis*
Thamnolia vermicularis var. *vermicularis*

Species found outside of our relevés

Bryophyte species (outside of our relevés)
Andreaea rupestris
Blindia acuta
Dicranoweisia crispa
Didymodon asperifolius
Leicolea heterocolpos var. *arctica*
Polytrichum cf. *hyperborean*
Scapania sp.

Lichen species (outside of our relevés)
Arthrorhaphis sp.
Cetraria cucculata
Cetraria nivalis
Cladina arbuscula ssp. *arbuscula*
Cladonia arbuscula
Cladonia cf. *stygia*
Cladonia squamosa
Cystocoleus ebeneus
Flavocetraria nivalis
Lecanora leptacinella
Lopadium corallioides
Ochrolechia grimmiae
Pertusaria panyrga
Physcia dubia
Pseudephebe pubescens
Stereocaulon botryosum
Tetramelas (Buellia) sp.
Umbilicaria lyngei
Umbilicaria proboscidea
Xanthoria sp.

Table 9: Relevé species cover .

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Agonimia gelatinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Alectoria nigricans	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.
Alectoria ochroleuca	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	r	.	.	.	.	.	.	.	.	.	.
Alopecurus alpinus	+	+	.	1	1	.	+	1	+	1	1	1	1	1	+	1	1	1	1	1	+	1	1	1	1	1
Anaptychia bryorum	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anastrophyllum minutus	.	.	.	.	.	.	.	1	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+
Aneura pinguis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthelia juratzkana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Apomarsupella revoluta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Arctoa anderssonii	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctoa sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctocetraria nigricascens	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctomia delicatula	+	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Aulacomnium turgidum	+	+	.	.	.	.	.	2	.	2	.	1	.	2	.	2	.	2	+	1	.	2	+	2	1	1
Bacidia bagliettoana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barbilophozia atlantica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barbilophozia hyperborea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+
Barbilophozia quadriloba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+
Bartramia ithyphylla	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	+	.	+	.	+	+	+	.	.
Biatora subduplex	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharostoma trichophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Brachythecium sp.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	+	.	r	+	+	.	.	.	.	.	.
Bryodina rhypariza	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryoerythrophyllum recurvirostrum	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	1
Bryonora castanea	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryoria nitidula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum arcticum	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Bryum argenteum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum cryophilum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.
Bryum pseudotriquetrum	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	+	.	.	.	.	.	+	.	+	+	.
Bryum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Bryum teres	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.
Callialaria curvicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.
Caloplaca ammiospila	+	+	+	+	+	.	+	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.
Caloplaca cerina	+	+	+	.	+	+	+	+	.	.	.	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.
Caloplaca jungermanniae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca phaeocarpella	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca tetraspora	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.
Caloplaca tiroliensis	+	+	+	+	.	+	+	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Caloplaca tornoënsis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Campylium arcticum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	1	+	+
Campylium stellatum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Candelariella placodizans	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.
Candelariella sp.	.	.	.	.	.	.	.	.	+	.	.	r	.	r	.	+	.	.	+	+	.	.	.	.	+	.
Candelariella terrigena	+	+	+	+	.	+	+	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.
Cardamine bellidifolia	r	.	.	.	.	.	r	+	+	r	.	+	+	+	+	+	+	+	.	+	+	+	.	+	+	+
Catapyrenium cinereum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Catapyrenium sp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Cephaloziella bicuspidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephaloziella grimsulana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Cephaloziella varians	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+
Cerastium arcticum	+	+	.	.	.	.	.	+	+	1	+	+	+	1	+	+	+	+	+	+	+	+	.	.	+	+
Cerastium regelii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	+	1
Ceratodon heterophyllus	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ceratodon purpureus	+	+	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria aculeata	+	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria islandica	+	.	.	.	.	.	.	+	+	+	.	+	.	+	.	+	+	+	+	+	+	r	.	.	+	.
Cetrariella delisei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetrariella fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cinclidium cf. *subrotundum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirriphyllum cirrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	+	.	+	.	.
Cladonia amaurocraea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia chlorophaea	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	r	+
Cladonia coccifera	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.
Cladonia gracilis	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	+
Cladonia pocillum	+	+	+	+	+	.	+	+	+	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	+	+
Cladonia pyxidata	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	+	+	+	+	+	+	.	.	.	.	.
Cladonia pyxidata (cf. *libifera*)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia scabriuscula	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia trassii	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Collema ceraniscum	r	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	+	2	.	.	1	1
Collema sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Collema tenax	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Collema undulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cryptocolea imbricata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylina ramulosa	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dermatocarpon arnoldianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dichodontium pellucidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Dicranella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranoweisia crispula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum acutifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Dicranum elongatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum laevidens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Didymodon icmadophyllus	+	+	+	.	.	.	+	+	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.
Distichium capillaceum	.	.	.	.	.	.	.	+	+	+	.	+	.	+	.	1	+	+	+	+	+	+	.	+	+	+
Distichium inclinatum	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ditrichum flexicaule	+	+	+	.	.	.	.	1	+	1	.	+	.	+	+	1	+	+	+	1	+	2	.	+	+	+
Draba oblongata	+	+	+	+	r	r	+	+	+	+	+	+	+	+	+	+	+	+	.	+	+	.	.	.	.	.
Draba sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba subcapitata	+	+	.	.	.	.	+	+	+	.	.	+	+	r	r	+	+	+	+	+	+	.	.	.	.	.
Drepanocladus brevifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.
Dupontia fisheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Encalypta alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Encalypta rhaptocarpa	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	.	+	.	+	.	r	.	.	.	.	.
Endocarpon pusillum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eurhynchium pulchellum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Festuca brachyphylla	.	.	.	.	.	.	.	+	.	+	.	1	+	+	+	1	+	1	+	+	+	+	.	.	.	.
Fissidens arcticus	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flavocetraria cucullata	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fuscopannaria praetermissa	+	+	+	+	.	+	+	.	+	.	+	.	+	.	r	.	+	.	+	.	+	.	.	.	.	.
Grimmia sp.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnomitrion concinnatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1
Gymnomitrion corallioides	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hygrohypnum polare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hylocomium splendens	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.
Hymenostylium recurvirostre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Hypnum cupressiforme	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum hamulosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Hypnum holmenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum revolutum	+	+	+	+	+	.	+	1	1	1	1	+	+	+	1	1	1	1	1	1	1	.	.	.	.	.
Hypnum subimponens	+	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	+	.	+	.	.	.	.	.	.
Hypnum vaucheri	+	.	.	.	.	.	.	+	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.
Hypogymnia subobscura	+	.	.	.	.	r	.	r	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Isopterygiopsis pulchella	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Japewia tornoënsis	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Juncus biglumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	+
Jungermannia obovata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Jungermannia polaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Kiaeria cf. *blyttii*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora cf. *geophila*	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.
Lecanora epibryon	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora hagenii	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.
Lecidea ramulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	+
Lecidella wulfenii	+	+	+	+	+	+	+	.	+	.	+	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.
Leiocolea heterocolpos var. *harpanthoides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leiocolea heterocolpos var. *heterocolpos*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Lepraria cf. *vouauxii*	.	.	+	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Lepraria neglecta	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepraria sp.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leptogium gelatinosum	+	.	+	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Leptogium lichenoides	.	.	+	.	+	+	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Leptogium sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limprichtia revolvens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	3	1	+	1
Loeskypnum badium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lopadium pezizoideum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia excisa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia jurensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Lophozia polaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	1
Lophozia ventricosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula confusa	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	1	.	r	.	+	.	.	.	.	.	.
Luzula nivalis	.	.	.	.	.	.	.	1	.	+	.	+	.	+	.	+	.	+	.	+	.	1	.	1	2	3
Marsupella arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Meesia longiseta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Megalaria jemtlandica	+	+	+	.	.	+	+	.	+	.	+	.	+	.	+	.	+	.	.	.	+	.	.	.	.	.
Megaspora verrucosa	+	+	+	+	+	+	+	.	.	.	r	.	.	.	+	+	+	.	+	+	+	.	.	.	.	.
Micarea incrassata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Minuartia rubella	.	.	.	.	.	.	.	+	+	+	+	+	+	.	.	+	+	.	r	.	.	.	.	.	.	.
Minuartia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mnium marginatum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Mycoblastus sanguinarius	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myurella julacea	r	.	.	.	.	.	.	r	.	+	.	.	.	+	.	+	.	.	.	.	.	+	.	.	+	+
Myurella tenerrima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Myxobilimbia lobulata	.	.	.	.	.	.	.	+	+	.	r	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.
Nostoc (film)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nostoc commune (algae)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	+	+	+
Ochrolechia cf. *inaequatula*	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Ochrolechia inaequatula	+	+	+	+	.	+	.	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Ochrolechia species	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontoschisma macounii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Oncophorus virens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
Oncophorus wahlenbergii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2	+
Orthocaulis sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthothecium chryseon	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	.	.	.	.	1	+	1	+	1
Orthothecium strictum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthotrichum speciosum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver radicatum	1	1	+	1	1	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1	.	.	+	+
Parmelia omphalodes ssp. *glacialis*	+	+	.	.	.	.	+	2	1	2	2	2	+	2	+	2	1	1	+	2	+	.	.	.	.	.
Peltigera canina	.	+	r	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.
Peltigera didactyla	+	+	+	r	.	+	.	+	.	+	+	+	.	+	+	.	+	+	.	+	+	.	.	.	.	.
Peltigera frippii	.	.	.	.	.	.	.	.	.	r	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera leucophlebia	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	.	.	+	.	r	.	.	.	+
Peltigera malacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera rufescens	+	+	+	.	.	.	.	+	.	+	.	+	.	+	.	.	+	+	.	+	.	.	.	.	.	+
Peltigera scabrosa	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.
Peltigera venosa	.	.	.	.	.	.	.	r	.	.	r	.	.	.	r	.	.	.	r	.	.	.	.	.	.	.
Pertusaria atra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pertusaria geminipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria glomerata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Pertusaria octomela	+	+	+	+	r	.	+	1	1	.	+	1	+	+	+	+	2	1	1	1	+	.	.	.	.	.
Pertusaria oculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phaeorrhiza nimbosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Philonotis caespitosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Philonotis sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Philonotis tomentella	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Phippsia algida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physconia muscigena	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Placopsis gelida	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Plagiochila asplenioides ssp. *porelloides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Plagiothecium berggrenianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa abbreviata	1	+	r	+	r	r	+	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.
Poa alpigena	.	.	.	.	.	.	.	1	+	1	+	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Pogonatum urnigerum	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia cruda	r	+	+	.	.	.	.	2	.	1	+	1	.	+	.	1	+	+	.	+	+	+	.	2	+	1
Pohlia drummondii	+	.	.	.	.	.	.	+	.	+	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	+
Pohlia nutans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polychidium muscicola	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Polytrichastrum alpinum	+	+	.	.	.	.	.	+	+	1	+	1	+	+	+	1	+	2	+	+	+	1	1	2	2	2

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Polytrichum juniperinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	2
Polytrichum piliferum	+	.	.	.	.	.	.	r	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla hyparctica	r	.	.	.	.	.	.	1	.	1	.	+	r	+	.	+	+	+	+	+	+	.	.	.	+	.
Protopannaria pezizoides	.	.	+	.	.	.	.	+	.	.	+	+	.	+	+	+	+	+	+	+	+	.	.	.	+	1
Pseudocalliergon brevifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Psilopilum cavifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoroma hypnorum	+	+	+	+	+	+	+	+	.	+	+	+	.	+	.	+	+	+	+	+	+	.	.	.	.	.
Pterygoneurum ovatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Ptilidium cilare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia cf. *andersonii*	1	1	+	1	1	1	1	.	+	.	.	.	.	.	+	.	+	+	+	.	+	.	.	.	.	.
Racomitrium canescens	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Racomitrium ericoides/panshii	+	+	+	+	+	.	+	+	.	+	.	1	.	1	.	+	.	2	+	2	+	+	.	.	+	.
Racomitrium lanuginosum	.	.	.	.	.	.	.	1	+	2	.	2	.	+	.	+	.	+	.	+	+	+	.	.	+	.
Ranunculus nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus sabinei	r	.	.	.	.	.	.	+	+	+	r	+	.	+	r	+	+	+	+	+	+	.	.	+	.	+
Ranunculus sulphureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Rinodina mniaraea var. *mniaraea*	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina mniaraea var. *mniaraeiza*	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina olivaceobrunnea	+	+	.	.	+	.	.	.	.	+	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.
Rinodina roscida	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina terrestris	1	2	+	1	2	1	2	.	+	+	1	+	+	.	+	.	1	.	2	+	.	.	.	.	.	.
Rinodina turfacea	+	+	+	.	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	.	.
Saelania glaucescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sagina intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Sanionia uncinata	+	+	+	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	+	+	+	.	+
Saxifraga caespitosa	.	.	.	.	.	.	.	1	.	1	.	1	.	1	+	+	.	1	+	+	.	+	.	.	+	+
Saxifraga cernua	+	.	.	.	.	r	r	+	+	+	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Saxifraga flagellaris	.	.	.	.	.	.	.	r	.	+	.	+	+	+	r	.	.	.	.	+	.	+	.	.	.	.
Saxifraga foliolosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	+	+
Saxifraga nivalis	.	+	.	.	.	.	.	+	+	1	.	1	+	+	+	+	+	+	+	+	+	+	.	.	+	+
Saxifraga oppositifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga rivularis	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Saxifraga tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Scapania cf. *zemliae*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania crassiretis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Scapania kaurinii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania mucronata ssp. *praetervisa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Scapania obcordata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Scapania perssonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 9 - continued.

	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526
Schistidium andreaeopsis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Schistidium frigidum	+	.	.	.	.	.	.	.	.	+	+	2	+	2	+	+	.	2	+	2	+	.	.	.	+	+
Schistidium holmenianum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	3	+
Schistidium papillosum	+	+	.	.	+	.	.	+	.	+	.	+	.	+	.	+	.	+	+	+	.	.	+	.	.	+
Shadonia fecunda	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Solorina cf. *bispora*	+	.	.	.	.	.	.	.	+	.	+	.	.	.	r	+	.	.	.	.	.	.	.	.	.	+
Solorina crocea	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerophorus fragilis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	.	.	.	.	.	.	.	r	.	+	.	+	.	.	.	r	.	+	.	.	.	.	.	.	.	.
Stellaria longipes	+	+	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1	.	+	+	+
Stereocaulon groenlandicum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon alpinum	.	.	.	.	.	.	.	+	+	+	+	1	+	1	+	.	.	1	.	1	+	.	.	.	.	.
Stereocaulon depressum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon glareosum	.	.	+	+	.	+	+	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon rivulorum	+	+	+	+	.	.	+	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	.	+	+
Sticta arctica	.	.	.	.	.	.	.	2	1	r	.	+	.	+	.	+	.	+	.	r	.	.	.	.	.	.
Syntrichia ruralis	+	+	+	.	r	r	+	+	+	+	+	+	.	1	+	1	+	2	+	1	+	.	.	.	.	.
Tetramelas insignis	+	+	.	+	.	.	.	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.
Tetramelas papillata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.
Thamnolia vermicularis var. *subuliformis*	.	+	+	.	.	.	.	+	+	+	1	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.
Thamnolia vermicularis var. *vermicularis*	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Timmia austriaca	+	+	.	.	.	.	.	2	+	1	.	1	.	+	.	2	+	1	.	1	+	+	.	+	.	+
Tomentypnum nitens	+	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	+	.	1	+	2	+	1
Tortula mucronifolia	+	.	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Tritomaria quinquedentata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Warnstorfia exannulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warnstorfia sarmentosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	3	2	+	+

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Agonimia gelatinosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alectoria nigricans	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Alectoria ochroleuca	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	+	+
Alopecurus alpinus	2	1	1	1	2	2	.	.	.	.	1	1	2	1	1	1	1	1	+	+	+	+	.	.	1	1
Anaptychia bryorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anastrophyllum minutus	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Aneura pinguis	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Anthelia juratzkana	.	+	+	2	.	.	4	.	1	+	+	1	+	2	1	.	.	.	.	.	.	.	.	.	.	.
Apomarsupella revoluta	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctoa anderssonii	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctoa sp.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctocetraria nigricascens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctomia delicatula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.
Aulacomnium turgidum	.	2	1	3	+	2	+	+	.	+	4	.	+	1	3	1	+	.	.	+	.	.	.	.	+	.
Bacidia bagliettoana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Barbilophozia atlantica	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Barbilophozia hyperborea	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+
Barbilophozia quadriloba	.	+	+	+	.	.	.	+	.	.	3	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
Bartramia ithyphylla	.	.	+	+	.	+	+	.	+	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.
Biatora subduplex	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Blepharostoma trichophyllum	.	.	+	.	.	.	+	.	.	.	1	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Brachythecium sp.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	+	+
Bryodina rhypariza	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryoerythrophyllum recurvirostrum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Bryonora castanea	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Bryoria nitidula	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum arcticum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum argenteum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum cryophilum	+	4	.	+	+	5	.	.	.	+	.	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.
Bryum pseudotriquetrum	.	.	+	.	.	1	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.
Bryum sp.	.	.	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum teres	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Callialaria curvicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca ammiospila	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	+	+
Caloplaca cerina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	+	+
Caloplaca jungermanniae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Caloplaca phaeocarpella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca tetraspora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Caloplaca tiroliensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	+	+	+

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Caloplaca tornoënsis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium arcticum	+	3	+	1	1	1	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Campylium stellatum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Candelariella placodizans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Candelariella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	r	.	r	.	.	.	+	+
Candelariella terrigena	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.
Cardamine bellidifolia	.	.	+	+	.	.	+	.	+	.	.	.	.	+	1	+	+	.	.	+	+	.	.	.	+	+
Catapyrenium cinereum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Catapyrenium sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Cephaloziella bicuspidata	.	.	.	.	.	.	+	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Cephaloziella grimsulana	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephaloziella varians	+	+	+	2	.	.	+	+	.	+	+	+	+	+	+	.	.	.	.	+	.	.	.	.	+	+
Cerastium arcticum	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	r	.	.	.	+	+	.	.	.	+	.
Cerastium regelii	.	1	1	+	.	2	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Ceratodon heterophyllus	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Cetraria aculeata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria islandica	.	.	.	.	.	.	+	+	r	.	.	.	.	+	+	+	+	.	.	+	+	.	.	.	+	+
Cetrariella delisei	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetrariella fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Cinclidium cf. *subrotundum*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cirriphyllum cirrosum	.	.	+	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.
Cladonia amaurocraea	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia chlorophaea	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia coccifera	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia gracilis	.	.	.	+	.	.	1	+	+	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	+	.
Cladonia pocillum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	.	.	+	+
Cladonia pyxidata	.	.	r	+	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	+	.	.	.	+	.
Cladonia pyxidata (cf. *libifera)*	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia scabriuscula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia trassii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Collema ceraniscum	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+
Collema sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Collema tenax	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Collema undulatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	+	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
Cryptocolea imbricata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylina ramulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dermatocarpon arnoldianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Dichodontium pellucidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Dicranella sp.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.
Dicranoweisia crispula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Dicranum acutifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum elongatum	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum laevidens	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Didymodon icmadophyllus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.
Distichium capillaceum	.	.	3	+	.	+	+	.	+	.	.	.	+	.	.	1	1	+	.	+	r	.	.	.	+	+
Distichium inclinatum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	+	+
Ditrichum flexicaule	.	.	+	+	.	+	+	.	.	.	.	.	.	+	+	1	1	.	.	+	r	+	+	.	+	+
Draba oblongata	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	.	+	r	r	.	+	r	+	+
Draba sp.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba subcapitata	.	.	.	.	.	.	+	.	+	.	.	.	.	.	+	r	.	.	+	r	r	r	r	.	+	.
Drepanocladus brevifolius	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dupontia fisheri	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Encalypta alpina	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Encalypta rhaptocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	.
Endocarpon pusillum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eurhynchium pulchellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca brachyphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	+	.
Fissidens arcticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Flavocetraria cucullata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fuscopannaria praetermissa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+
Grimmia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnomitrion concinnatum	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnomitrion corallioides	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Hygrohypnum polare	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hylocomium splendens	.	.	.	.	.	.	.	+	.	.	1	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.
Hymenostylium recurvirostre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum cupressiforme	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Hypnum hamulosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum holmenii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum revolutum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	+	+
Hypnum subimponens	.	.	+	.	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.
Hypnum vaucheri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+
Hypogymnia subobscura	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+
Isopterygiopsis pulchella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Japewia tornoënsis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Juncus biglumis	+	+	+	+	.	+	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.
Jungermannia obovata	.	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Jungermannia polaris	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kiaeria cf. *blyttii*	.	.	.	.	.	.	+	.	.	.	2	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora cf. *geophila*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora epibryon	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora hagenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.
Lecidea ramulosa	.	.	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Lecidella wulfenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	+	+
Leiocolea heterocolpos var. *harpanthoides*	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Leiocolea heterocolpos var. *heterocolpos*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepraria cf. *vouauxii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+
Lepraria neglecta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lepraria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leptogium gelatinosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+
Leptogium lichenoides	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.
Leptogium sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Limprichtia revolvens	3	1	+	+	+	+	+	.	.	1	1	.	5	+	1	.	.	.	.	.	.	.	.	.	.	.
Loeskypnum badium	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Lopadium pezizoideum	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia excisa	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia jurensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia polaris	.	+	+	1	.	.	+	+	.	.	+	.	.	1	+	.	.	.	.	.	.	.	.	.	+	+
Lophozia ventricosa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula confusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Luzula nivalis	.	1	1	1	r	1	+	+	+	.	1	.	.	2	3	+	+	.	.	.	.	.	.	.	1	.
Marsupella arctica	.	.	.	.	.	.	.	.	.	.	+	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Meesia longiseta	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Megalaria jemtlandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	+	+	+
Megaspora verrucosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	r	.	+	+	+
Micarea incrassata	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Minuartia rubella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	+	+
Minuartia sp.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mnium marginatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycoblastus sanguinarius	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myurella julacea	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	.	+	.
Myurella tenerrima	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myxobilimbia lobulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nostoc (film)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Nostoc commune (algae)	1	1	1	1	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia cf. *inaequatula*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+
Ochrolechia inaequatula	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	+	+

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Ochrolechia species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontoschisma macounii	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus virens	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Oncophorus wahlenbergii	.	.	.	.	.	.	+	.	.	.	+	.	+	1	.	r	.	.	.	.	.	.	.	.	.	.
Orthocaulis sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.	.	.	.	.
Orthothecium chryseon	.	1	1	.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Orthothecium strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthotrichum speciosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver radicatum	.	.	+	.	.	.	+	+	+	.	.	.	.	.	+	+	+	+	+	+	r	+	+	1	+	+
Parmelia omphalodes ssp. *glacialis*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	+	r	.	+	2	1
Peltigera canina	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	+	+
Peltigera didactyla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	r	.	.	.	.
Peltigera frippii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Peltigera leucophlebia	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.
Peltigera malacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.
Peltigera rufescens	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	+	+	.	.	+	.
Peltigera scabrosa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Peltigera venosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Pertusaria atra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria geminipara	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria glomerata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria octomela	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	+	+	r	.	+	1	+
Pertusaria oculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Phaeorrhiza nimbosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Philonotis caespitosa	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Philonotis sp.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Philonotis tomentella	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Phippsia algida	.	.	.	.	.	.	+	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Physconia muscigena	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Placopsis gelida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiochila asplenioides ssp. *porelloides*	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+
Plagiothecium berggrenianum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa abbreviata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	+	+	.	.
Poa alpigena	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Pogonatum urnigerum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Pohlia cruda	.	1	+	1	+	1	.	+	+	.	+	.	.	+	+	+	+	.	.	.	.	.	.	.	+	.
Pohlia drummondii	.	.	+	+	.	+	+	.	+	+	+	+	1	.	1	.	.	.	.	.	.	.	.	.	.	.
Pohlia nutans	.	.	.	.	.	.	.	+	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Polychidium muscicola	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichastrum alpinum	+	1	2	4	.	2	+	+	+	+	1	+	+	5	4	1	+	.	.	1	.	.	.	.	+	+

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Polytrichum juniperinum	.	1	3	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum piliferum	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	2	+	.	.	.	.	.	.	.	.
Potentilla hyparctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.
Protopannaria pezizoides	.	.	.	+	.	.	+	+	+	.	.	+	.	.	+	+	1	+	.	+	+	.	.	.	+	+
Pseudocalliergon brevifolium	.	.	+	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Psilopilum cavifolium	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Psoroma hypnorum	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	+	.	+	+	.	.	.	+	+
Pterygoneurum ovatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ptilidium cilare	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia cf. *andersonii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	1	.	+
Racomitrium canescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Racomitrium ericoides/panshii	.	.	+	.	.	.	2	.	4	+	.	+	.	+	.	2	+	.	.	1	r	.	.	.	1	.
Racomitrium lanuginosum	.	.	+	+	.	.	+	5	.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	1	.
Ranunculus nivalis	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus sabinei	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	r	.	+	+
Ranunculus sulphureus	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina mniaraea var. *mniaraea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.	.	.
Rinodina mniaraea var. *mniaraeiza*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina olivaceobrunnea	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+	+
Rinodina roscida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.
Rinodina terrestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina turfacea	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	+	+	.	+	+	r	.	+	+	+
Saelania glaucescens	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Sagina intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sanionia uncinata	+	+	+	+	.	1	+	+	2	+	+	.	.	+	+	+	.	.	.	1	.	.	.	.	+	.
Saxifraga caespitosa	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	r	+	.	.	.	.	.
Saxifraga cernua	+	1	+	+	.	2	+	+	+	+	+	+	.	.	+	r	.	.	.	+	+	r	r	.	+	+
Saxifraga flagellaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.
Saxifraga foliolosa	.	+	.	.	.	1	.	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Saxifraga nivalis	.	.	+	+	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	r	+	.	.	.	+	.
Saxifraga oppositifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	+
Saxifraga rivularis	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga tenuis	.	.	1	+	.	.	+	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Scapania cf. *zemliae*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Scapania crassiretis	.	.	.	+	.	.	.	.	.	.	1	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.
Scapania kaurinii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Scapania mucronata ssp. *praetervisa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania obcordata	+	+	+	+	.	.	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Scapania perssonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.

Table 9 - continued.

	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	550	551	552	553	554	555	556	557	558	559	560
Schistidium andreaeopsis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schistidium frigidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2	+
Schistidium holmenianum	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Schistidium papillosum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	+	.	.	.	.	1	.
Shadonia fecunda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solorina cf. *bispora*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Solorina crocea	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Sphaerophorus fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria longipes	.	1	+	+	.	1	+	.	.	.	.	.	.	+	.	+	+	+	.	r	.	.	.	.	+	.
Stereocaulon groenlandicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon alpinum	.	.	.	.	.	.	.	1	.	+	.	.	.	+	.	+	+	+	.	+	+	.	.	.	1	+
Stereocaulon depressum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon glareosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Stereocaulon rivulorum	.	.	+	+	.	.	1	.	1	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	+	+
Sticta arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	+
Syntrichia ruralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	+	.	+	.
Tetramelas insignis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+
Tetramelas papillata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Thamnolia vermicularis var. *subuliformis*	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	1	+
Thamnolia vermicularis var. *vermicularis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Timmia austriaca	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	1	+	.	.	1	.	.	.	.	1	.
Tomentypnum nitens	.	2	1	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Tortula mucronifolia	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.
Tritomaria quinquedentata	.	+	+	+	.	+	+	+	.	.	+	.	.	+	+	.	.	.	.	+	.	.	.	.	+	+
Warnstorfia exannulata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warnstorfia sarmentosa	2	2	+	+	3	+	.	.	.	4	+	+	1	1	1	.	.	.	.	.	.	.	.	.	.	.

Plant biomass

Table 10: Relevé biomass (g/0.1 m^2). Note: Moss and lichen values are high and are being corrected - numbers are going to be checked again.

Releve #	live graminoid	dead graminoid	forb	moss	lichen	algae	total (g/0.1m2)
501	0.3	0.5	0.5	0.0	0.0	0.0	1.3
502	0.1	0.1	0.5	0.0	0.2	0.0	1.0
503	0.2	0.3	1.0	0.0	0.0	0.0	1.5
504	0.2	0.0	0.2	0.0	0.0	0.0	0.4
505	0.2	0.2	0.2	0.0	0.0	0.0	0.6
506	0.1	0.3	0.0	0.0	0.0	0.0	0.4
507	0.3	0.9	0.0	0.0	0.0	0.0	1.2
508	3.1	14.6	4.4	37.9	11.9	0.0	71.9
509	0.3	0.2	0.2	0.0	0.0	0.0	0.7
510	0.8	1.8	1.5	141.5	11.0	0.0	156.6
511	0.2	0.3	1.4	0.3	0.3	0.0	2.5
512	0.6	6.5	2.8	39.2	4.2	0.0	53.3
513	0.3	0.3	1.6	0.0	0.0	0.0	2.1
514	0.9	0.3	8.9	72.4	14.4	0.0	96.9
515	0.1	0.1	0.9	0.0	0.0	0.0	1.1
516	2.2	0.7	8.5	147.7	20.9	0.0	180.0
517	0.2	0.1	0.1	1.6	0.0	0.0	2.0
518	2.2	2.2	7.2	75.2	17.4	0.0	104.2
519	0.1	0.2	0.5	5.1	10.8	0.0	16.7
520	0.7	0.6	4.8	91.7	8.9	0.0	106.6
521	0.0	0.0	0.2	1.6	3.2	0.0	5.0
522	0.5	0.6	1.2	36.0	0.1	0.1	38.4
523	0.2	0.4	0.0	30.6	0.0	0.1	31.3
524	0.7	0.8	1.3	58.0	0.2	0.7	61.7
525	2.7	1.4	1.3	33.5	1.4	0.1	40.4
526	1.1	1.5	0.7	38.2	0.2	0.1	41.7
527	0.5	0.1	0.0	18.5	0.2	3.5	22.8
528	0.5	0.6	0.5	45.7	0.0	0.0	47.3
529	18.7	0.9	0.1	68.7	3.2	0.2	91.7
530	2.1	0.1	0.1	66.8	2.2	0.0	71.2
531	0.3	0.9	0.0	14.3	0.1	0.0	15.6
532	0.2	0.1	0.1	48.6	0.0	0.3	49.2
550	0.8	1.7	1.3	43.1	24.6	0.0	71.5
551	0.5	0.8	0.6	12.4	2.3	0.0	16.6
552	0.4	0.6	0.4	0.3	0.1	0.0	1.9

NDVI

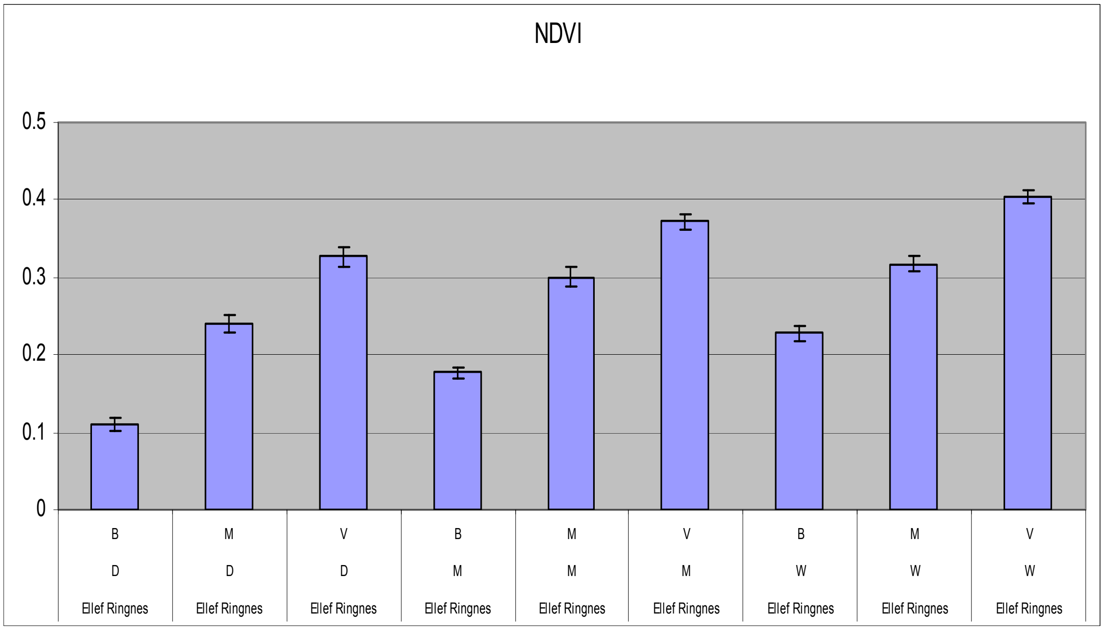


Fig. 11: Mean NDVI of transects. Normalized Difference Vegetation Index (NDVI) every meter along the two 50-m transects adjacent to each grid. Grids: grid 2 - dry (D), grid 1 - mesic (M), or grid 3 - hummocky site (W). Ground cover: vegetated (V), bare (B), or mixed (M).

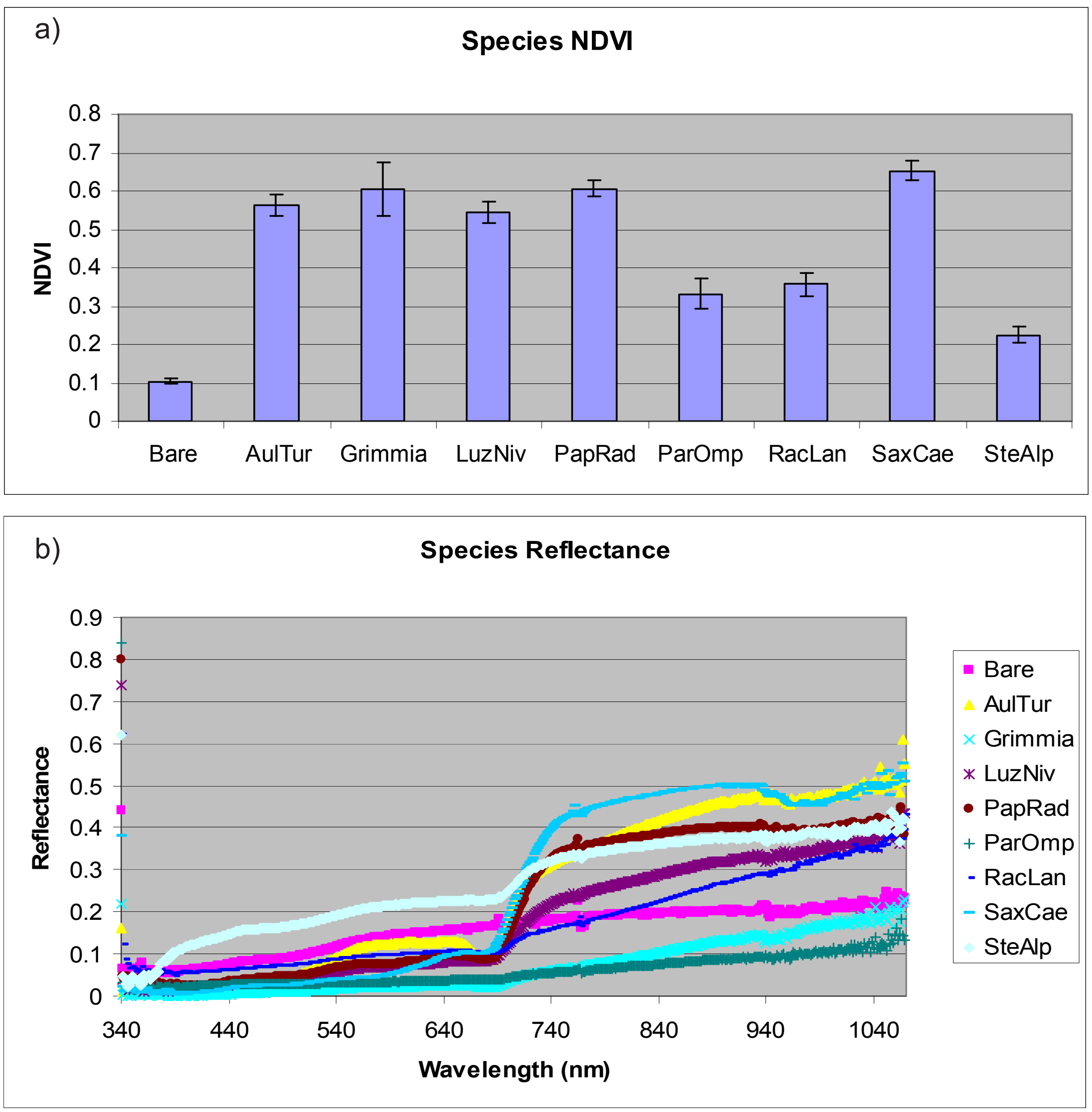


Fig. 12: Species NDVI (a) and reflectance spectra (b). Five NDVI measurements were taken at a height of 0.5 m (footprint of ~0.04 m²) from seven individual species.

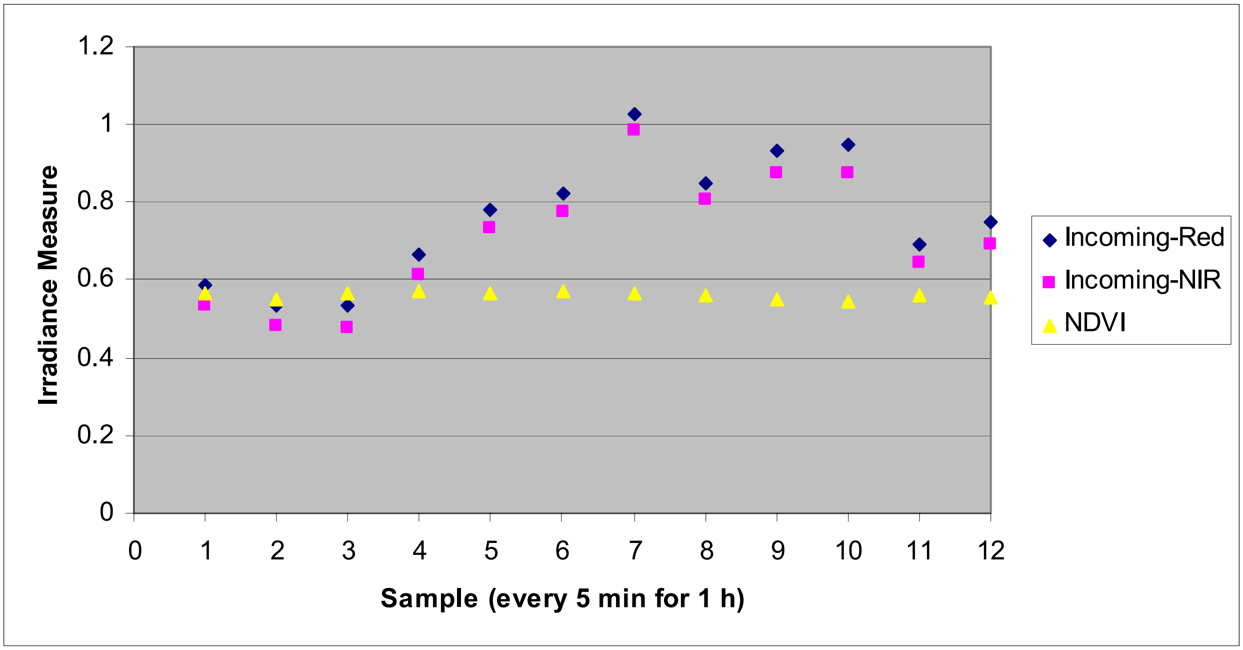


Fig. 13: NDVI sensitivity to cloud conditions.

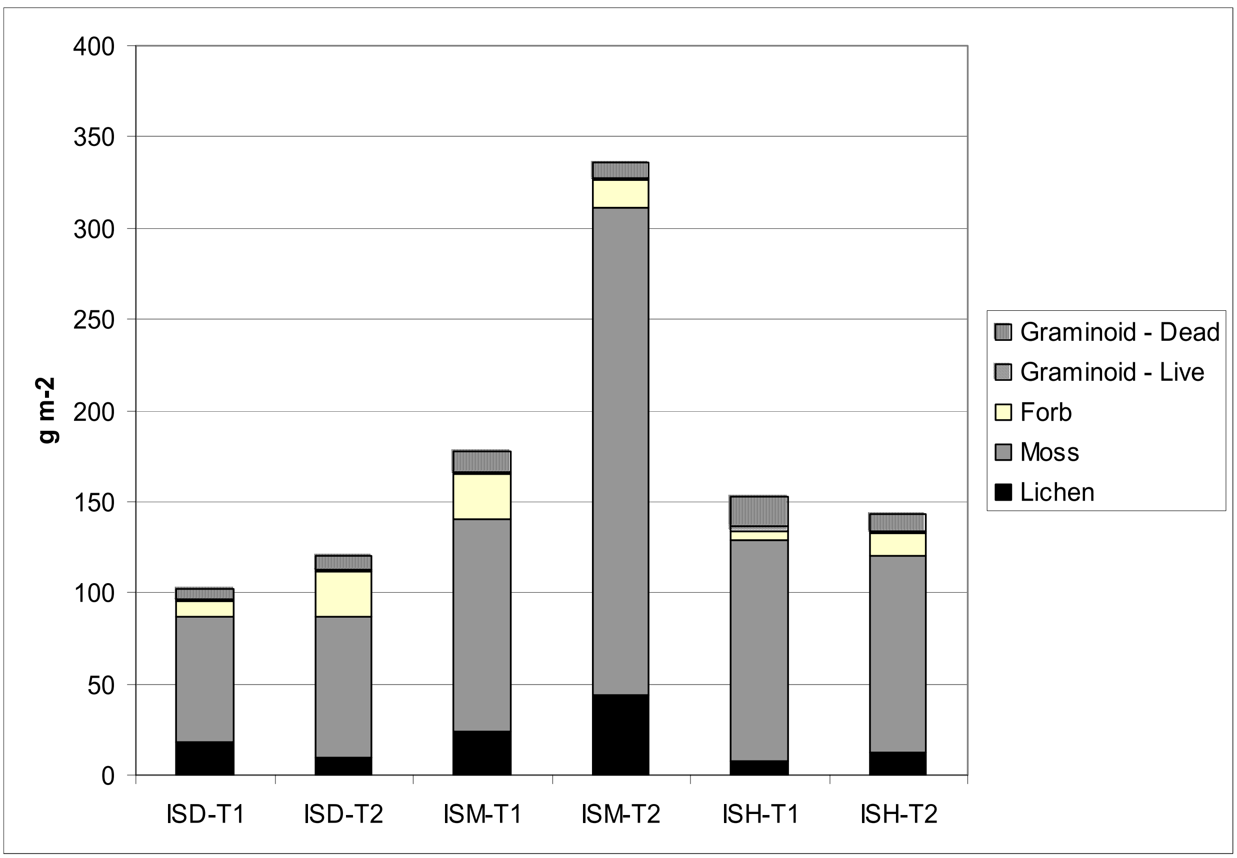


Fig. 14: Aboveground plant biomass for two 50 m transects at the dry (ISD), mesic (ISM), and hummocky (ISH) sites at Isachsen.

SOILS

Soil descriptions

Isachsen 1 – Barren Dry Grid Site
Date: July 21, 2005

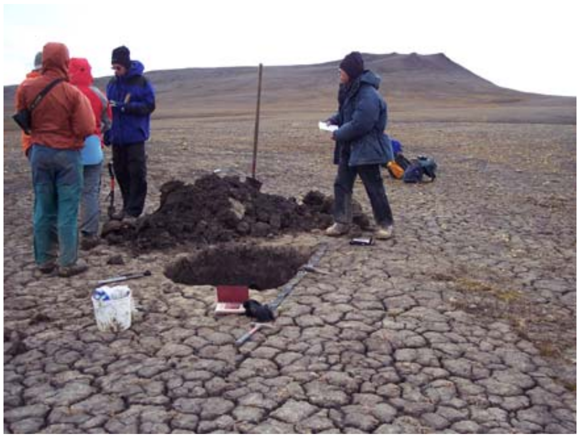


Fig. 15: Soil profile (Isachsen 1)

Location: Ellef Ringnes Island, Queen Elizabeth Islands Nunavut, Canada
GPS position: 78°47.150'N; 103°33.116'W
Elev. 35 m asl
Landform: piedmont, dissected.
Local: head of the saddle
Micro relief: cracked polygon (frost and shrink and swell), dia. 10-20 cm
Slope: 2% SSW
Parent material: glaciomarine deposit over weathered shale
Climate: Arctic, MAAT -19.2C, MSAT 1.2C, MAP 127 mm
Surface stone: none
Landcover: Barren, vegetation coverage: <1%
Vegetation: scattered *Papaver radicatum*
Sampled by: C.L Ping, G. J. Michaelson, Jordan Okie, Robin Austin, Constance Laureau, Greta Lewansky
Classification: Very fine, mixed, active, hypergelic Typic Haplorthel

A1: 0-18 cm; very dark grayish brown (10YR 3/2) clay; strong hard crust with columnar structure-like top breaking into strong coarse angular and subangular block structure; very firm, moderately sticky and moderately plastic; few fine roots; soft thin shale particles on crust surface; abrupt smooth boundary (0- 21 cm) (008)

Bw: 18 – 39 cm; very dark grayish brown (2.5Y 3/2) clay; moderate fine subangular structures; firm, moderately sticky and moderately plastic; 20% volcanic rock fragments and 40% soft thin shale particles disintegrating into fines upon rubbing; few very fine and fine roots; clear smooth boundary (16 – 20 cm) (009)

C: 39 – 50 cm; very dark grayish brown (2.5Y 3/2) clay; strong medium lenticular breaking into moderate fine subangular structure; firm, moderately sticky and moderately plastic; 45% soft thin shale particles; clear smooth boundary (010)

Crf: 50 – 85 cm; very dark grayish brown (10YR3/2) extremely gravelly silt loam; 70% fine (<6 mm long) soft fractured shale; strong medium lenticular structure; 45% ice; extremely firm, moderately sticky and moderately plastic. (11)

Remarks: At edge of ice wedge, est. ice wedge width 5-7 m amid polygon 10-17 m across.
40% of total area not underlain by ice wedge (Romanovsky)

Isachsen 2 - Mesic Site
Date: July 22, 2005

Fig. 16: Soil profile (Isachsen 2)

Location: Ellef Ringnes Island, Queen Elizabeth Islands Nunavut, Canada
GPS position: 78°47.150'N; 103°33.116'W
Elev. 35 m asl
Landform: piedmont, dissected.
Local: backslope
Microrelief: small pattern ground made up of frost polygons (dia. 10-20 cm)
Slope: 5% S slightly convex vertically and horizontally
Parent material: glaciomarine deposit over weathered shale over ice wedge
Climate: Arctic, MAAT -19.2C, MSAT 1.2C, MAP 127 mm
Surface stone: 0.1 % glacial erratics
Landcover: mesic
Vegetation: *Luzula sp., Papaver radicatum; Alopecurus alpinus*
Drainage: poor
Active layer at time of sampling: 55 cm
Classification: Fine, mixed, active, hypergelic Glacic Aquiturbel
Sampled by: C.L Ping, G. J. Michaelson, A. Kade

Bw1: 0 – 7 cm; in cracked nonsorted circle and stripes; brown (10YR4/3) clay; strong very coarse columnar breaking into strong fine crumbs and granular structures; extreme firm as columnar but firm as crumbs and granular, moderately sticky and moderately plastic; surface 3-5 mm as crust, weak thin platy structure; common fine roots; abrupt irregular boundary (0 – 9 cm) (012)
A1: 0-7 cm; under lichen in inter-circles; dark grayish brown (10YR 3.5/2) clay; strong fine granular structure; slightly firm, moderately sticky and moderately plastic; many very fine and fine roots; clear irregular boundary (0 - 8 cm) (013)
A2: 4 -12 cm; under moss in inter-circle; brown (10YR4/3) clay; strong fine granular structure; slightly firm, moderately sticky and moderately plastic; many very fine and fine roots; abrupt irregular boundary (0 – 13 cm) (014)
A3: 7 – 15 cm; under circles and lichen; (sampled as AB); very dark grayish brown (10YR 3/2) clay; moderately medium granular and weak medium subangular structure; firm, moderately sticky and moderately plastic; common very fine and fine roots; clear irregular boundary (0 – 10 cm) (015)
Bw2: 15 – 34 cm; under circles and lichen; very dark grayish brown (10YR 3/1.5) clay; moderately fine lenticular breaking into moderately fine subangular structures; 2% 2-5 cm angular volcanic rock fragment; firm, moderately sticky and moderately plastic; clear irregular boundary (0 - 8 cm) (016)
Bw3: 12 – 30 cm; under moss; dark yellowish brown (10YR4/4) clay; saturated; moderately sticky and moderately plastic; common very fine and fine roots; abrupt irregular boundary (0 – 20 cm) (017)
Bg: 34 – 37 cm; across the cycle; very dark grayish brown (10YR3/2) clay; strong medium lenticular structure; firm, moderately sticky and moderately plastic; weakly reactive to α,α-dipyridyl; abrupt smooth boundary (0 – 11 cm) (018)
Cf: 37 – 56 cm; across the cycle; very dark grayish brown (10YR3/2) clay; 40% fine (<6 mm long) soft fractured shale strong medium lenticular structure; 55% ice; firm, moderately sticky and moderately plastic; abrupt smooth boundary (019)
Wf: 56 – 110 cm; across the whole pedon; ground ice; 3 % scattered shale particles.

Isachsen 3 - Hummocky Wet Grid Site
Date: July 23, 2005

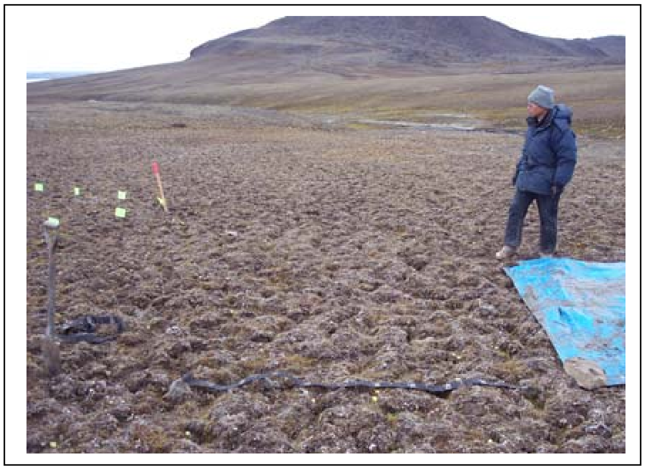


Fig. 17: Soil profile (Isachsen 3)

Location: Isachsen, Ellef Ringnes Island, Inuvut, NWT, Canada
GPS position: 78°47.098'N; 103°33.125'W
Elevation: 32 m.
Landform: piedmont, dissected.
Local: toeslope
Microrelief: small hummocks (dia. 15-22 cm)
Slope: 2% SSE slightly concave vertically and plane horizontally
Parent material: glaciomarine deposit over weathered shale over ice wedge
Landcover type: lichen-moss hummocks
Surface stone: 0.1% angular volcanic rock and 0.5% volcanic cobblestone
Drainage: Poorly drained
Climate: Arctic, MAAT -19.2C, MSAT1.2C, MAP 127 mm
Vegetation: *Saxifraga cernua*; *Papaver radicatum, Alopecurus alpinus* (fox tail), *Luzula nivalis* (rush), *Polytrichum alpinum*; *P. piliferum*; and lichens.
Active layer at time of sampling: 57 cm
Classification: Fine, mixed, active, hypergelic Glacic Aquiturbel
Sampled by: C.L Ping, G. J. Michaelson, A. Kade

Ajj1: 0-10 cm; very dark brown (10YR 3/2) clay; strong fine granular structure; friable, very sticky and very plastic; many very fine and fine roots; clear irregular boundary (0 - 11 cm) (021)
Ajj2: 10-18 cm; brown (10YR4/3) clay; saturated; slightly very sticky and very plastic; many very fine and fine roots; clear smooth boundary (4 – 10 cm) (022)
Bw: 18–34 cm; brown (10YR 4/3) clay; saturated to 30 cm then season frozen to 34 cm; strong medium lenticular structure; 10% angular volcanic rock fragment in cobble and gravel sizes; extremely firm when frozen(40% ice as lens), very sticky and very plastic; few fine roots; 2 pointed rock; abrupt smooth boundary (14 - 18 cm) (023)
Wf /Bgf: 34- 40 cm; dark grayish brown (10YR4/2) clay; ataxitic, strong lenticular structure (3 mm), 60% ice lens (0.5-1.2mm); very firm, very sticky and very plastic; moderate reaction to α,α-dipyridyl; 8% angular volcanic rock fragment; abrupt smooth boundary (024)
Wf: 40-42 cm: continuous ice lens across the pedon; segregated ice; abrupt smooth boundary
Wf/Cf: 42–57 cm; dark grayish brown (10YR4/2) clay; ataxitic, strong medium lenticular and reticulate structures; 60% ice; frozen, extremely firm, moderately sticky and moderately plastic; weakly reactive to α,α-dipyridyl; 8% angular volcanic cobble stones; abrupt smooth boundary (025)
Wf: 57–110 cm; ice wedge across the whole pedon; vertical ice layers of 1-1.2 cm thick separated by brownish color and soils; 3 % scattered shale particles.

Isachsen 4 – Moss-Snow bed below wet grid site
Date: July 25, 2005

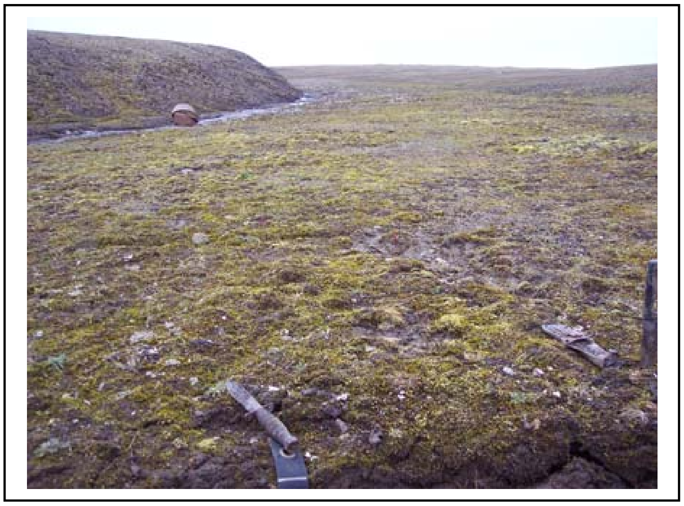


Fig. 18: Soil profile (Isachsen 4)

Location: Ellef Ringnes Island, Queen Elizabeth Islands Nunavut, Canada
GPS position: 78°47.096'N; 103°33.216'W
Elev. 32 m asl
Landform: piedmont, dissected.
Local: river terrace
Slope: 0% S
Parent material: alluvium and colluvium over weathered bedrock
Climate: Arctic, MAAT -19.2C, MSAT 1.2C, MAP 127 mm
Surface stone: 0.5 % glacial erratics (volcanic)
Landcover: moss-snowbed
Vegetation: *Luzula nivalis; Papaver radicatum; Cerastium regelli; Saxifraga nivalis; S. cernua; S. rivularis; Stellaria* sp.; *Polytrichum alpinum; Aulacomnium turgidum; Peltigera* sp.; *Stereocaulon* sp.
Drainage: very poor
Active layer at time of sampling: 37 cm
Classification: Fine, mixed, active, shallow, hypergelic Typic Aquorthel
Sampled by: C.L Ping, G. J. Michaelson

A: 0-8 cm; very dark grayish brown (10YR3/2) cobbly clay loam; 15% angular volcanic cobble stone and 5% channers; strong fine granular structure; friable, moderately sticky and moderately plastic; common very fine and fine roots; clear smooth boundary (026)

Bw: 8-30 cm; very dark grayish brown (10YR3/2) stony clay; 15% angular volcanic stone and 5% channers; strong fine subangular blocky structure; firm, moderately sticky and moderately plastic; few very fine and fine roots; abrupt smooth boundary (027)

Bwf: 30-38 cm: very dark grayish brown (10YR3/2) stony silty clay; 15% angular volcanic stone and 10% angular gravel and shale particles; strong medium lenticular structure, ice lens 2-3mm thick, 30% ice; very firm, moderately sticky and moderately plastic; abrupt smooth boundary (028)

Crf: 38-60+ cm; very dark gray (10YR3/1) extremely gravelly clay loam in fractured shale bedrock; frozen, extremely firm; 65% shale particle; 10% ice. (029)

Isachsen 5 - Releve 508 and 509 (duplicate of No. 2)
Sampling date: July 20, 2005

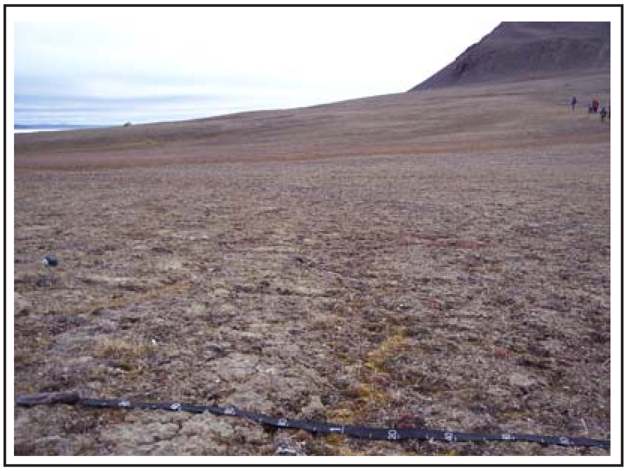



Fig. 19: Soil profile (Isachsen 5)

Physiographic Region: High Arctic Islands
Location: Ellef Ringnes Island, Canada
GPS position: 78°46.861' N; 103°31.445'W
GPS elev. 72ft
Landform: piedmont, dissected.
Local: backslope
Microrelief: stripes and non-sorted circles
Slope: 6% S slightly convex vertically and horizontally
Parent material: glaciomarine deposit over weathered shale over ice wedge
Climate: Arctic, MAAT -19.2C, MSAT 1.2C, MAP 127 mm
Surface stone: 0.1 % glacial erratics
Landcover: mesic
Vegetation: *Luzula* sp.*, Papaver radicatum; Alopecurus alpinus*
Drainage: somewhat poor
Active layer at time of sampling: 40 cm
Classification: Fine, mixed, active, hypergelic Glacic Aquiturbel
Sampled by: C.L Ping, G. J. Michaelson, A. Kade

Bwjj1: 0–15 cm; crust; brown (10YR4/3) clay; strong very coarse angular blocky breaking into strong medium angular blocky structures; very firm, moderately sticky and moderately plastic; no roots; abrupt irregular boundary (0 – 15 cm) (001)
Ajj: 0-32 cm; dark grayish brown (10YR 3.5/2) clay; strong fine granular structure; slightly firm, moderately sticky and moderately plastic; many very fine and fine roots; clear irregular boundary (0 - 25 cm) (0 02)
Bwjj2: 15-30 cm; brown (10YR4/3) clay; moderate fine granular structure; slightly firm, moderately sticky and moderately plastic; common very fine and fine roots; clear irregular boundary (0 – 20 cm) (003)
Bgjj: 30–40 cm; dark olive brown (2.5Y 3/2) clay; moderately medium subangular structure; firm, moderately sticky and moderately plastic; few very fine roots; abrupt smooth boundary (7 – 17 cm) (004)
Bgf: 40–48 cm; dark olive brown (2.5YR3/2) clay loam; strong medium lenticular structure; frozen (60% ice), very firm, moderately sticky and moderately plastic; weakly reactive to α,α-dipyridyl; abrupt smooth boundary (005)
Bg/Ojjf: 48–55 cm; dark grayish brown (10YR3/2) clay loam; strong medium lenticular structure; 45% ice; extremely firm, moderately sticky and moderately plastic; abrupt smooth boundary (006)
Wf: 55–110 cm; ice wedge across the whole pedon; 5 % scattered shale particles in pockets. (007).

Isachsen 6 - Talus Slope Racomitrium Site
Date: July 24, 2005

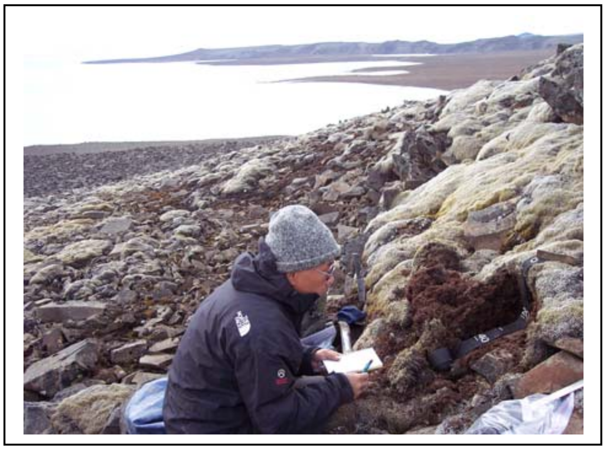



Fig. 20: Soil profile (Isachsen 6)

Location: Ellef Ringnes Island, Queen Elizabeth Islands Nunavut, Canada
GPS position: 78°46.803'N; 103°34.809'W
Elev. 376'
Landform: hills.
Local: talus slope (volcanic, daibase)
Microrelief: steep talus slope with angular boulders
Slope: 55% S undulating
Parent material: organic over aeolian
Climate: Arctic, MAAT -19.2C, MSAT1.2C, MAP 127 mm
Surface stone: 100 % fractured volcanic rock
Landcover: barren, moss cover 2%
Vegetation: *Racomitrium lanuginosum*
Drainage: excessive
Active layer at time of sampling: n/a
Classification: Dysic, pergelic Terric Cryofibrist
Sampled by: C.L Ping, G. J. Michaelson

Oi1: 0-5 cm; live moss roots; clear smooth boundary (30)

Oi2: 5-14 cm; dead moss roots; clear irregular boundary (31)

Oe: 14-21 cm; peaty muck; partially decomposed moss roots; abrupt irregular boundary (32)

Bw: 21-25 cm; loam; (33)

R: 25 cm: fractured volcanic rock.

Remarks: Sorted circles on ridges above and toe slopes below.

Isachsen 7 – Poppy Barrens Relevé 559, 560
Date: July 26, 2005

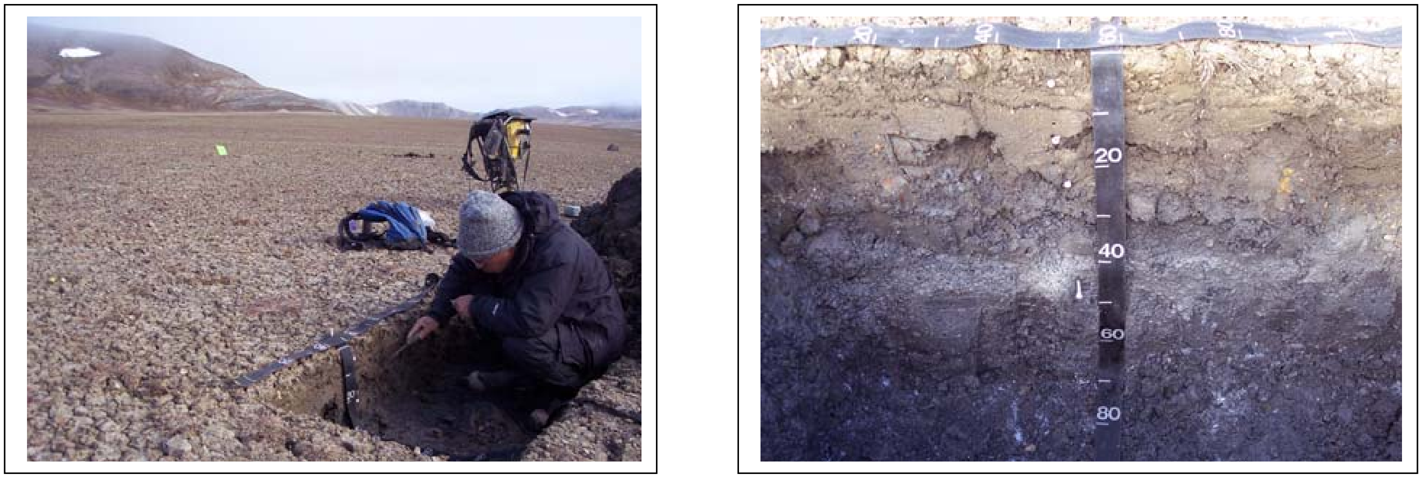


Fig. 21: Soil profile (Isachsen 7)

Location: Ellef Ringnes Island, Nunavut, Canada
GPS Position: 78°47.963'N; 103°36.530'W
Elev. 127'
Landform: Broad valley
Local: Terrace
Micro features: frost polygons (10-20 cm)
Slope: 2% SE; slope shape: slightly convex vertically and horizontally
Parent material: weathered argillite over fractured shale
Surface material contains both angular and rounded gravel
Surface rocks: 0.2% glacial erratics, angular argillite; surface gravel pavement, 35% gravel, sunbaked, highly oxidized argillite and trace of round quartz pebbles.
Land cover type: barren, 2% veg. cover.
Vegetation: *Papaver radicatum, Luzula nivalis*
Sampled by: C.L. Ping, G.J. Michaelson, V.E. Romanovsky
Classification: Clayey, mixed, superactive, hypergelic Typic Haplorthel

A: 0-7 cm; dark grayish brown (2.5Y4/2) gravelly clay; top 2 cm hard crust, strong fine and medium angular blocky and strong medium granular structure 5-7 cm; very firm, very sticky and very plastic; few very fine and fine roots; abrupt broken boundary (6-8 cm) (034)

AB: 7-14 cm; olive brown (2.5Y4/3) clay; strong fine granular structure; firm, very sticky and very plastic; few very fine and fine roots; clear smooth boundary (035)

Bw: 14-24 cm; grayish brown (2.5Y4/2) cobbly clay; weak medium lenticular structure; firm, very sticky and very plastic; few very fine and fine roots along ped surface and cracks; 10% cobbles, 15% shale particle and 5% angular gravel; clear wavy boundary (036)

Bg: 24-45 cm; dark gray (2.5Y 3.5/1) stony clay; 20% stony, angular argillite with sharp edge up, 15% shale particles; saturated, frozen 32-45 cm; very sticky and very plastic; very few very fine roots; clear smooth boundary (037)

Cf1: 45-67 cm; very dark gray (2.5Y3/1) stony clay; 25% fractured argillite; moderate fine and medium lenticular structure; frozen, extremely firm, very sticky and very plastic; 40% ice; clear smooth boundary (038)

Wf/Cf2: 67-84 cm; dark gray (2.5Y 3.5/1) very channery clay; 30% shale particle; moderate medium reticulate and fine lenticular structure; frozen, extremely firm, very sticky and moderately plastic; 60% ice. (039)

Isachsen 8 – Stripes Relevé 554, 555
Date: July 26, 2005

Fig. 22: Soil profile (Isachsen 8)

Location: Ellef Ringnes Island, Nunavut, Canada
GPS Position: 78°47.943'N; 103°36.512'W
Elev. 127'
Landform: Broad valley
Local: terrace
Microrelief: nonsorted stripes and frost cracked polygons
Slope: 2% SE; slope shape: slightly convex vertically and horizontally
Parent material: weathered argillite over fractured shale
Surface mental contains both angular and rounded gravel
Surface rocks: 0.2% glacial erratics, angular argillite; surface gravel pavement, 35% gravel, sunbaked, highly oxidized argillite and trace of round quartz pebble.
Land cover type: barren, 2% veg. cover.
Vegetation: *Papaver radicatum, Luzula nivalis*
Sampled by: C.L. Ping, G.J. Michaelson, V.E. Romanovsky
Classification: Clayey, mixed, supergelic, hypergelic Typic Haploturbel

Ajj1: 0-9 cm; very dark grayish brown (10YR3/2) gravelly clay; top 2 cm hard crust, strong medium angular blocky structure below; very firm, very sticky and very plastic; few very fine and fine roots; 20% gravel and 15% on surface; abrupt broken boundary (0-10 cm) (040)
Ajj2: 0-14 cm; brown (10YR4/3) clay; moderate fine granular structure; firm, very sticky and very plastic; common very fine and fine roots; 12% pebble; clear irregular boundary (041)
Bwjj1: 9-20 cm; grayish brown (2.5Y4/2) clay; strong fine subangular structure; firm, very sticky and very plastic; few very fine and fine roots; 10% angular gravel; clear wavy boundary (042)
Bwjj2: 14-30 cm; dark grayish brown (10YR4/2) clay; moderate very fine granular structure; firm, very sticky and very plastic; common very fine roots; clear irregular boundary (043)
Bgjj: 12-33 cm; very dark gray (2.5Y3/1) clay; saturated; firm, very sticky and very plastic; abrupt smooth boundary (044)
2Cf1: 33-40 cm; very dark grayish brown (2.5Y3/2) extremely gravelly clay; 70% angular and round gravel; frozen, extremely firm, very sticky and very plastic; 40% ice; abrupt smooth boundary (045)
Wf/Cf: 40-60 cm: ataxitic horizon, strong medium reticulate structure, 60% ice
Wf/Cf2: 67-84 cm; dark gray (2.5Y 3.5/1) very channery clay; 30% shale particle; moderate medium reticulate and fine lenticular structures; frozen, extremely firm, very sticky and moderately plastic; 60% ice. (039)

Isachsen 9 - Ridgetop Barren/Lichen Patches
Date: July 27, 2005

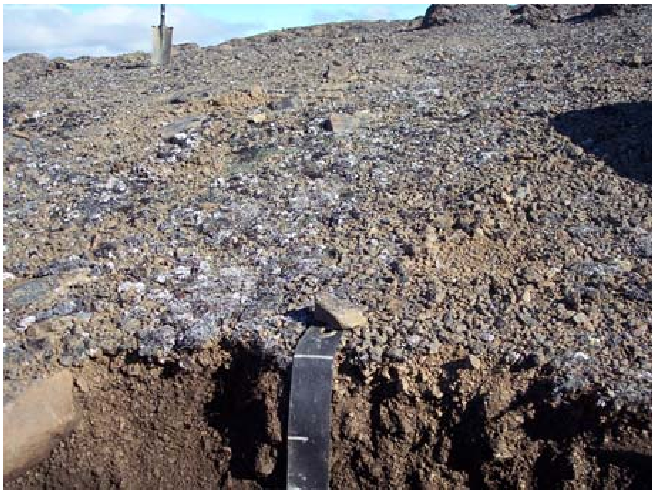



Fig. 23: Soil profile (Isachsen 9)

Location:
GPS position: 78°49.101'N; 103°37.856'W
Elev. 648'
Landform: summit
Microrelief: lichen stripes
Local: rubble land
Surface stone: 60% with pea sized gravel pavement with iron coatings
Parent material: Gruss, weathered granite/granodiorite
Vegetation: lichens and moss
Active layer depth: 42 cm at time of sampling
Classification: Fragmental, mixed, low active, shallow, pergelic Lithic Dystrogelept
Sampled by: C.L. Ping, G.J. Michaelson

A: 0-4 cm; brown (10YR4/3) extremely stony sand; dry; single grained; loose, nonsticky and nonplastic; many very fine and fine roots under lichen mat and few under barren surface; lichen cover 30%; 55% stone, 20% cobble and 15% gravel; clear smooth boundary (046)

AC: 4-8 cm; dark yellowish brown (10YR4/4) extremely stony sand; moist; single grained; loose, nonsticky and nonplastic; few very fine roots; 60% stone, 20% cobble and 10% gravel; gradual smooth boundary (047)

C: 8-42 cm; dark brown (10YR3/3) extremely stony sand; moist; single grained; loose, nonsticky and nonplastic; 55% stone, 10% cobble and 10 % gravel (048)

Rf: 42 cm: frozen fractured bedrock with some sand grains in cracks.

Sampled a moist swivel below a big boulder and the surface soil under the lichen mat is very dark grayish brown (10YR 3/2) with loamy sand texture.

Isachsen 10 – A and Bw Horizon Examination, Hummock Grid Site
Re-examination of Isachsen #3 for A horizon verification
Date: 07/28/05

Fig. 24: Soil profile (Isachsen 10)

Hummocks: lichen-Alopecurus
Interhummocks: *Polytrichum alpinum* (wet site)
Hummock size: 18-20 cm polygon and subrounded
Interhummock: 5-15 cm in irregular shape
Pit excavated to 35cm above seasonal frost table; photographed and horizons delineated in drawing.

A1 0-14 cm: 10YR4/3; clay; strong fine granular structure; very sticky and moderately plastic; many very fine and fine roots (49)
A2 0-16 cm: 10YR3/2.5; clay; strong medium and fine granular and fine crumb structures; very sticky and moderately plastic; many very fine and fine roots (50)
A3 0-16 cm: 10YR3/3; clay; strong fine granular structure; very sticky and moderately plastic; common very fine and few fine roots (51)
A4 0-12 cm: 10YR4/3; silty clay loam saturated; very sticky and moderately plastic; common very fine and few fine roots (52)
A5 0-12 cm: 10YR3/3; clay; strong fine granular structure; very sticky and moderately plastic; many very fine and common fine roots (53)
A6 0-14 cm: 10YR3/2.5; clay; strong medium and fine granular structures; very sticky and moderately plastic; many very fine and fine roots (54)
Bw1 10-30+ cm: 10YR4/3; clay; saturated; very sticky and moderately plastic; many very fine and fine roots (55)
Bw2 10-30 cm: 10YR3/2.5; clay; saturated; very sticky and moderately plastic; few very fine and fine roots (56)
Bw3 10-30 cm: 10YR3/3; clay; saturated; very sticky and moderately plastic; common very fine and few fine roots (57)
Bw4 12-30+ cm: 10YR4/3; clay; saturated; very sticky and moderately plastic; common very fine and few fine roots (58)
Bw5 15-30+ cm: 10YR3/2.5; clay; saturated; very sticky and moderately plastic; many very fine and fine roots (59)
Bw6 12-30+ cm: 10YR3/2.5; clay; saturated; very sticky and moderately plastic; common very fine and fine roots (60)
Bw7 10-30+ cm: 10YR3/2; clay; saturated; very sticky and moderately plastic; few very fine and fine roots (61)
Bw8 15-30+ cm: under A6 dry micro high (62)

Isachsen 11 – Daniels' Snow Bank Relevé 537
Date: 07/28/05

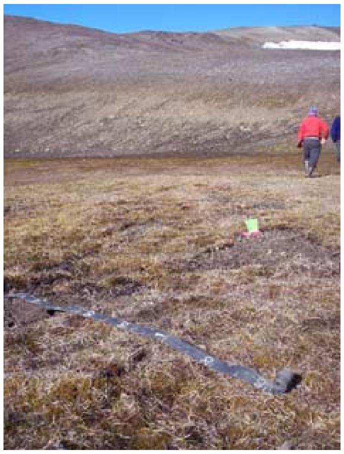



Fig. 25: Soil profile (Isachsen 11)

Location: Ellef Ringnes Island of Queen Elizabeth Islands, Nunavut, Canada
GPS position: 78°48.324'N; 103°36.666'W
Elev.: 87ft
Physiography: broad valley
Local: fan
Micro surface features: nonsorted circle (frost boil)
Slope: 1% S-facing
Parent material: colluvium (volcanic rock) and alluvium (mixed)
Drainage: very poor, standing surface water and runoff, liverwort/moss layer saturated to surface
Surface stone: none but fractured bedrock fragment mixed with subrounded gravel on the surface of frost boil, ca. 35% of the surface area
Landcover type:
Vegetation: *Dupontia fisheri*; *Aulacomnium sp.*; *Hypnum sp.*; liverworts
Active layer depth: 19cm at time of sampling
Classification:
Boil (40%): Fine loamy, mixed, superactive, hypergelic Typic Aquiturbel
Interboil (60%): Fine loamy, mixed, superactive, hypergelic Typic Historthel
Described and sampled by: C.L. Ping and G.J. Michaelson

Interboil
Oi: 0-3 cm; dark brown (7.5YR3/2) peat; many very fine and fine roots; abrupt boundary (2-4 cm) (063)
OA: 3-8 cm: very dark grayish brown (10YR3/2) mucky loam; saturated; moderately sticky and moderately plastic; many very fine and fine roots; pH5.8; clear boundary (064)
A: 8-14 cm; very dark grayish brown (10YR3/2) loam; saturated; moderately sticky and moderately plastic; many very fine and common fine roots; clear boundary (065)
Bg: 14-18 cm; very dark gray (5Y3/1) loam; saturated; moderately sticky and moderately plastic; very few very fine roots; pH6.2; abrupt boundary (066)
Bgf: 18 cm; not sampled

Boil:
A3: 0-2 cm; crust; very dark grayish brown (10YR3/2) loam; moderate fine and medium granular and crumb structures; friable, moderately sticky and moderately plastic; few fine roots; abrupt (broken) smooth boundary (067)
Bw: 2-15 cm; very dark grayish brown (10YR3/2) loam; saturated, moderately sticky and moderately plastic; few fine roots; abrupt wavy boundary (068)
Bg: 15-19 cm; very dark gray (5Y3/1) loam; saturated; moderately sticky and moderately plastic; few very fine roots (069)
Bgf: 19 cm; not sampled

Isachsen 12 - Salt Flat
Date: 07/28/05

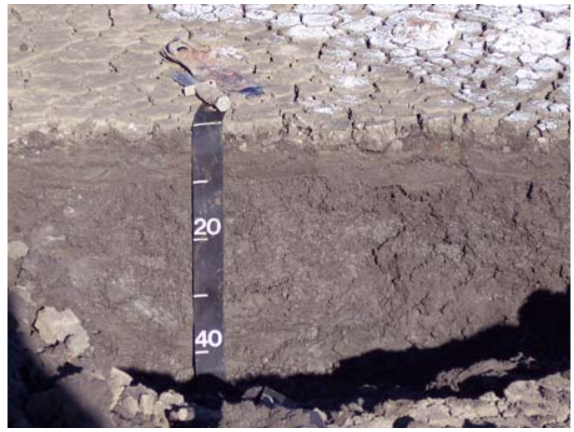



Fig. 26: Soil profile (Isachsen 12)

Location: Ellef Ringnes Island of Queen Elizabeth Islands, Nunavut, Canada
GPS position: 78°48.133'N; 103°37.502'W
Elev.: 99ft
Physiography: broad valley
Local: fan
Micro surface features: frost cracks
Slope: 1% SW-facing
Parent material: alluvium (mixed)
Drainage: somewhat poor
Surface stone: none
Landcover type: Barren, vegetation cover 0.5%
Vegetation:
Active layer depth: 44 cm at time of sampling
Classification: Fine, mixed, active, hypergelic Salic Haplorthel
Described and sampled by: C.L. Ping and G.J. Michaelson

A1: 0-3 cm; black (10YR3/2) clay; strong coarse angular blocky crust breaking to strong fine granular and subangular structures; firm, very sticky and very plastic; common very fine roots; abrupt smooth boundary (070)

A2: 3-10 cm; black (10YR3/2) clay; strong fine granular and subangular structures; firm, very sticky and very plastic; common very fine roots; abrupt smooth boundary (071)

AC: 10-23 cm; black (10YR3/2) clay; strong fine subangular structures; firm, very sticky and very plastic; few very fine roots; abrupt smooth boundary (072)

C: 23-44 cm; black (10YR3/2) clay; strong medium subangular structures; firm, very sticky and very plastic; few very fine roots; abrupt smooth boundary (073)

Wf/Cf: 44+ cm; black (10YR3/2) clay; ataxitic, 55% ice; strong fine reticulate structures; very firm (frozen layer soft, can be easily chipped by knife), very sticky and very plastic (074)

Table 11: Chemical and physical properties of the soil profiles.

Biocomplexity Isachsen 2005 Expedition
Soil Characterization samples

Site ID	Horizon	depth cm	Paste pH	E.C. dS m⁻¹	USDA Texture	< 2mm Fraction Sand %	Silt %	Clay %	< 2mm %	$[H_2O]$wt. %	Total C %	Total N %
Isachsen 1	A1	0-18	6.22	0.26	Clay	18.4	28.8	52.8	2.6	11.3	2.46	0.20
Barren Dry Grid Site	Bw	18-39	6.45	0.23	Clay	18.0	29.2	52.8	0.1	16.0	2.59	0.19
	C	39-50	6.60	0.42	Clay	18.4	32.8	48.8	0.2	16.5	2.60	0.19
	Crf	50-85	3.77	5.82	Silt Loam	25.4	69.8	4.8	1.9	51.3	2.33	0.16
Isachsen 2	Bw1	0-7	5.80	0.28	Clay	11.0	34.2	54.8	0.5	16.6	2.52	0.21
Mesic Site	A1	0-7	5.37	0.21	Clay	20.0	30.8	49.2	0.2	24.3	3.28	0.24
	A2	4-12	5.66	0.22	Clay	20.0	32.8	47.2	0.6	25.3	4.43	0.29
	A3	7-15	5.58	0.13	Clay	12.0	30.8	57.2	0.3	20.7	2.53	0.22
	Bw2	15-34	6.28	0.17	Clay	11.0	32.8	56.2	2.7	21.7	2.50	0.17
	Bw3	12-30	6.10	0.21	Clay	9.0	30.8	60.2	1.1	28.5	2.55	0.20
	Bg	34-37	6.27	0.27	Clay	11.0	32.8	56.2	2.0	25.5	2.56	0.21
	Cf	37-56	6.85	1.29	Clay	25.0	29.8	45.2	9.7	51.4	2.96	0.19
	Wf	56-110	-	-	-	-	-	-	-	-	-	-
Isachsen 3	Ajj1	0-10	4.95	0.27	Clay	18.0	36.8	45.2	<.01	32.1	3.17	0.24
Hummocky Wet Grid Site	Ajj2	10-18	4.88	0.25	Clay	16.0	36.8	47.2	0.1	33.0	2.71	0.25
	Bw	18-34	5.03	0.27	Clay	14.0	38.8	47.2	0.1	33.3	2.70	0.23
	Wf/Bgf	34-40	4.86	0.58	Clay	16.0	38.8	45.2	<.01	78.8	2.69	0.22
	Wf/Cf	42-57	4.89	0.42	Clay	20.0	36.8	43.2	0.9	79.1	2.77	0.21
Isachsen 4	A	0-8	5.32	0.35	Clay Loam	27.6	34.2	38.2	7.5	29.0	2.46	0.15
Moss-Snow bed below wet grid site	Bw	8-30	5.86	0.42	Clay	17.6	37.2	45.2	7.8	18.5	2.24	0.15
	Bwf	30-38	6.51	1.06	Silty Clay	8.0	42.8	49.2	1.8	33.9	2.86	0.19
	Crf	38-60+	7.58	2.36	Clay Loam	41.0	24.8	34.2	43.8	18.4	3.43	0.17
Isachsen 5	Bwjj	0-15	6.60	0.32	Clay	11.6	30.8	57.6	0.6	11.7	2.57	0.20
Releve 508 and 509	Ajj	0-32	6.13	0.35	Clay	15.6	34.8	49.6	0.1	32.5	3.31	0.25
	Bwjj2	15-30	6.68	0.32	Clay	6.4	34.8	58.8	0.2	26.3	2.78	0.23
	Bgjj	30-40	6.54	0.33	Clay	10.4	34.8	54.8	1.2	22.0	2.74	0.19
	Bgf	40-48	6.56	2.96	Clay Loam	36.4	28.8	34.8	1.9	22.7	2.88	0.19
	Bg/Ojjf	48-55	7.08	4.78	Clay Loam	40.4	22.8	36.8	3.4	61.2	3.01	0.19
	Wf(min/ice)	55-110	7.06	6.78	Clay	23.4	29.8	46.8	1.9	458.5	2.70	0.19
	ice	55-110	-	-	-	-	-	-	-	-	-	-
Isachsen 6	Oi1	0-5	4.34	0.09	-	-	-	-	<.1	181.6	34.03	0.40
Talus Slope Racomitrium Site	Oi2	5-14	4.45	0.11	-	-	-	-	<.1	194.1	25.95	0.40
	Oe	14-21	4.55	0.17	-	-	-	-	<.1	187.8	24.74	0.40
	Bw	21-25	4.48	0.11	Loam	50.0	42.8	7.2	<.1	98.1	15.48	0.52
	rock	25+	-	-	-	-	-	-	-	-	-	-
	loess		5.00	0.15	-	-	-	-	9.7	45.2	5.81	0.38

Table 11 - continued.

Site ID	Horizon	depth cm	Paste pH	E.C. $dS\ m^{-1}$	USDA Texture	< 2mm Fraction Sand %	Silt %	Clay %	< 2mm %	$[H_2O]$wt. %	Total C %	Total N %
Isachsen 7	A	0-7	6.38	0.49	Clay	<.1	14.8	85.2	3.0	21.5	0.73	0.14
Poppy Barrens Releve 559, 560	AB	7-14	5.11	0.68	Clay	<.1	25.8	74.2	<.1	26.4	0.86	0.14
	Bw	14-24	4.68	0.91	Clay	1.0	24.8	74.2	0.9	28.0	0.81	0.15
	Bg	24-45	6.76	4.13	Clay	11.0	25.8	63.2	10.2	24.9	1.04	0.13
	Cf1	45-67	7.99	5.04	Clay	9.6	27.2	63.2	4.5	84.9	1.40	0.16
	Wf/Cf2	67-84	8.30	6.57	Clay	3.6	27.2	69.2	10.2	73.5	1.16	0.14
Isachsen 8	Ajj1	0-9	6.11	0.28	Clay	3.6	21.2	75.2	0.9	22.2	1.13	0.18
Stripes Releve 554, 555	Ajj2	0-14	6.14	0.32	Clay	9.6	19.2	71.2	6.6	32.4	1.33	0.17
	Bwjj1	9-20	6.13	0.38	Clay	5.6	19.2	75.2	1.0	32.6	1.33	0.16
	Bwjj2	14-30	6.07	0.45	Clay	16.2	24.6	59.2	5.9	25.1	1.07	0.14
	Bgjj	12-33	6.29	0.58	Clay	13.2	24.6	62.2	1.9	24.4	1.09	0.13
	2Cf1	33-40	6.95	1.26	Clay	19.6	24.8	55.6	54.9	16.6	1.03	0.12
Isachsen 9	A	0-4	5.12	0.15	Sand	92.6	4.2	3.2	28.8	0.8	2.58	0.05
Ridgetop Barren/Lichen Patches	AC	4-8	5.96	0.13	Sand	90.2	6.6	3.2	39.7	2.3	0.15	0.01
	C	8-42	6.01	0.20	Sand	95.2	1.2	3.6	64.2	3.1	0.10	0.01
Isachsen 10	A1	0-14	4.72	0.32	Clay	21.2	35.2	43.6	0.5	34.0	3.48	0.24
A and Bw Horizon Examination, Hummock Grid Site	A2	0-16	4.86	0.32	Clay	18.2	33.2	48.6	0.2	28.6	2.74	0.25
	A3	0-16	4.87	0.30	Clay	21.2	31.2	47.6	1.1	32.0	3.33	0.32
	A4	0-12	4.97	0.40	Clay	20.2	32.2	47.6	0.2	44.1	3.71	0.31
	A5	0-12	4.95	0.30	Clay	18.2	34.2	47.6	0.2	34.2	2.93	0.25
	A6	0-14	5.04	0.28	Clay	15.2	33.2	51.6	0.2	26.4	2.81	0.27
	Bw1	10-30+	4.96	0.38	-	-	-	-	0.5	32.6	2.82	0.24
	Bw2	10-30	4.96	0.43	-	-	-	-	2.9	29.4	2.75	0.24
	Bw3	10-30	5.10	0.40	-	-	-	-	0.4	32.0	2.79	0.25
	Bw4	12-30+	5.05	0.38	-	-	-	-	1.7	30.0	2.71	0.24
	Bw5	15-30+	4.95	0.40	-	-	-	-	2.6	29.5	2.74	0.25
	Bw6	12-30+	5.01	0.34	-	-	-	-	1.2	29.4	2.73	0.24
	Bw7	10-30+	4.99	0.38	-	-	-	-	0.4	36.4	2.81	0.23
	Bw8	15-30+	5.15	0.28	-	-	-	-	0.9	30.2	2.78	0.22
Isachsen 11	Oi intbl	0-3	4.86	0.30	-	-	-	-	1.0	312.1	21.67	1.08
Daniels' Snow Bank Releve 537	OA intbl	3-8	4.78	0.15	-	-	-	-	1.4	126.1	9.28	0.81
	A intbl	8-14	5.12	0.15	-	-	-	-	3.5	33.5	2.81	0.26
	Bg intbl	14-18	4.98	0.28	-	-	-	-	3.5	35.1	2.62	0.24
	A3 boil	0-2	4.80	0.13	-	-	-	-	3.0	39.0	2.78	0.26
	Bw boil	2-15	4.62	0.10	-	-	-	-	3.0	29.1	2.69	0.23
	Bg boil	15-19	-	-	-	-	-	-	-	-	-	-
Isachsen 12	A1	0-3	4.51	9.41	-	-	-	-	0.3	9.3	1.41	0.16
Salt Flat	A2	3-10	4.51	4.19	-	-	-	-	0.0	27.1	1.43	0.16
	AC	10-23	4.57	5.03	-	-	-	-	0.1	15.6	1.44	0.15
	C	23-44	6.16	7.92	-	-	-	-	1.2	25.5	1.35	0.14
	Wf/Cf	44+	7.07	7.58	-	-	-	-	<.1	53.7	1.38	0.15

Table 11 - continued.

Site ID	Inorganic Carbon %	[H2O]vol. %	Field Bulk Den. g cm-3	OC-Stores Active Layer kgOC m-2	OC-Stores Permfrost kgOC m-2	OC-Stores Total 100cm kgOC m-3
Isachsen 1	<.01	20.0	1.70	21.9	9.5	31.5
Barren Dry Grid Site	0.02	27.3	1.72			
	<.01	29.4	1.78			
	<.01	47.6	1.17			
Isachsen 2	<.01	20.9	1.69	14.2	1.0	15.2
Mesic Site	<.01	41.7	1.28			
	<.01	33.4	1.03			
	<.01	32.1	1.67			
	<.01	31.9	1.55			
	<.01	38.4	1.06			
	<.01	29.5	1.37			
	0.14	67.5	1.20			
	-	-	-			
Isachsen 3	<.01	47.0	1.46	14.3	5.6	19.8
Hummocky Wet Grid Site	<.01	60.7	1.80			
	<.01	50.2	1.58			
	<.01	69.3	0.94			
	<.01	69.9	0.95			
Isachsen 4	<.01	27.5	1.35	7.7	6.6	14.3
Moss-Snow bed below wet grid site	<.01	33.1	1.42			
	<.01	35.3	1.08			
	0.27	36.6	1.94			
Isachsen 5	<.01	27.9	1.95	15.8	2.5	18.3
Releve 508 and 509	<.01	43.3	1.42			
	<.01	35.3	1.44			
	<.01	32.3	1.56			
	0.05	51.7	1.32			
	0.15	62.8	1.12			
	0.04	-	-			
	-	-	-			
Isachsen 6	0.01	-	0.22	26.2	0.0	26.2
Talus Slope Racomitrium Site	0.01	-	0.40			
	<.01	-	0.40			
	<.01	-	0.50			
	-	-	-			
	<.01	-	-			
Isachsen 7	<.01	25.3	1.11	4.4	2.4	6.8
Poppy Barrens Releve 559, 560	<.01	36.8	1.45			
	<.01	41.4	1.51			
	0.23	38.4	1.56			
	0.08	77.7	0.67			
	0.05	80.1	0.73			
Isachsen 8	<.01	41.2	1.56	5.6	0.4	6.0
Stripes Releve 554, 555	<.01	48.8	1.24			
	<.01	45.4	1.43			
	<.01	43.6	2.05			
	<.01	41.1	1.66			
	0.01	-	1.66			
Isachsen 9	<.01	-	1.30	0.3	0.0	0.3
Ridgetop Barren/Lichen Patches	<.01	-	1.30			
	<.01	-	1.30			
Isachsen 10	<.01	-	-	-	-	-
A and Bw Horizon Examination, Hummock Grid Site	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
	<.01	-	-			
Isachsen 11	0.01	89.5	0.18	5.2	0.0	5.2
Daniels' Snow Bank Releve 537	0.01	80.3	0.42			
	0.01	50.0	1.28			
	<.01	-	-			
	<.01	43.1	1.10	0.6	0.0	0.6
	<.01	-	-			
	-	-	-			
Isachsen 12	<.01	-	-	7.9	4.9	12.8
Salt Flat	<.01	13.8	1.48			
	<.01	36.1	1.33			
	<.01	21.6	1.38			
	0.01	36.0	1.41			

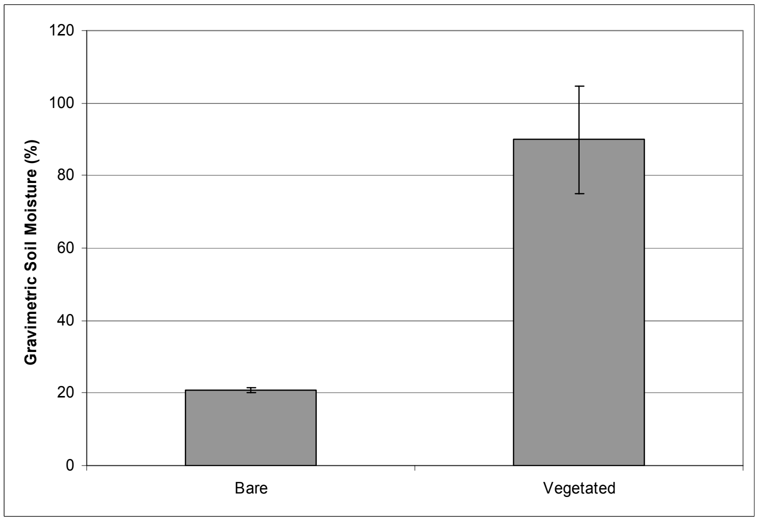


Fig. 27: Soil Moisture (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

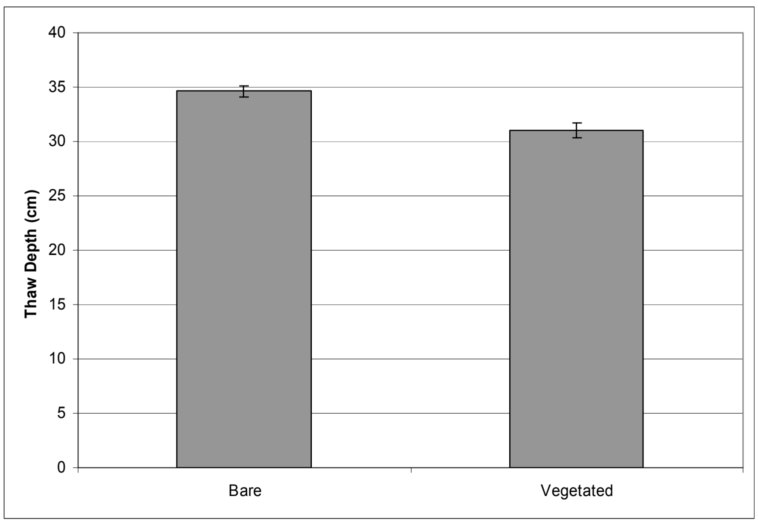


Fig. 28: Thaw depth (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

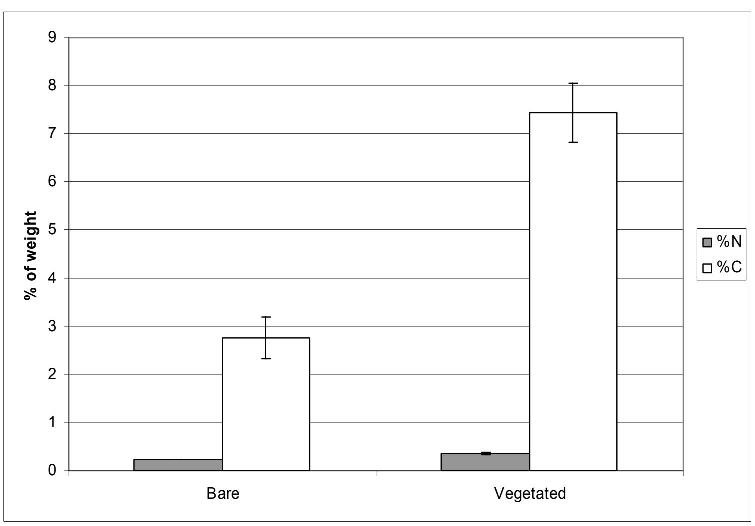


Fig. 29: Percent total carbon (including inorganic and organic carbon) and percent nitrogen of the soil (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

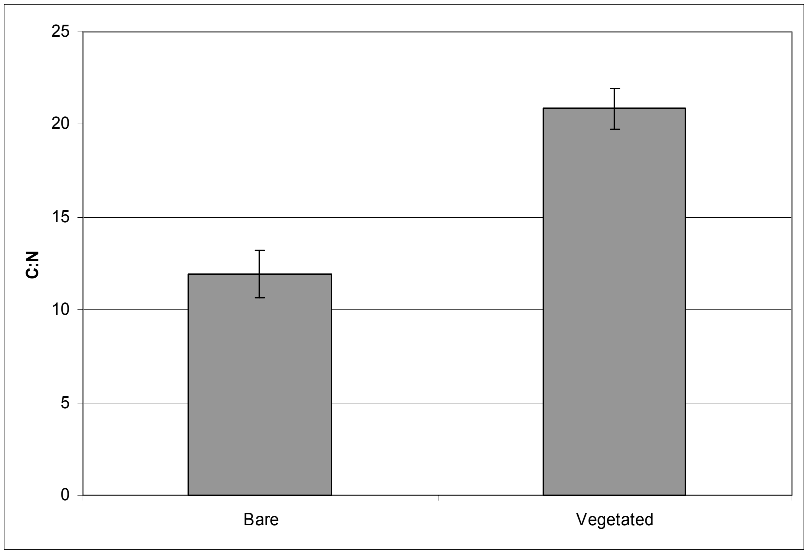


Fig. 30: Carbon to nitrogen ratios (mean ± 1 SE) of the soil from bare and vegetated areas at the Isachsen mesic site.

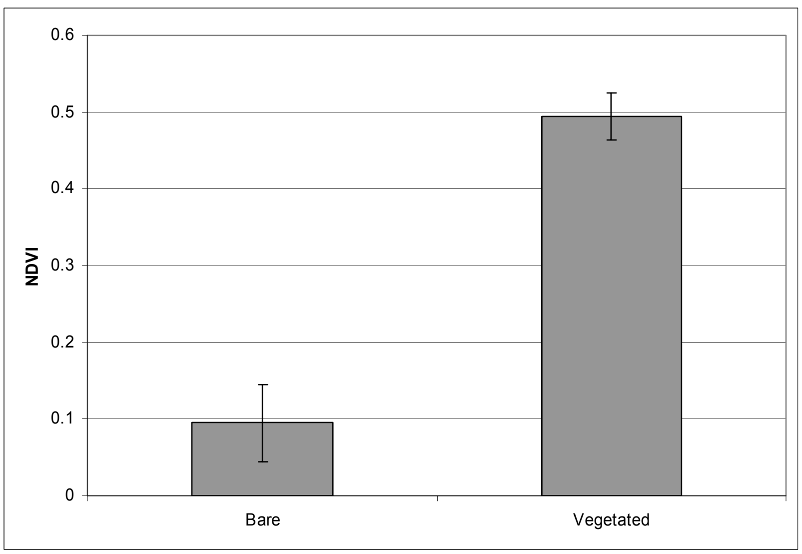


Fig. 31: Normalized Difference Vegetation Index (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

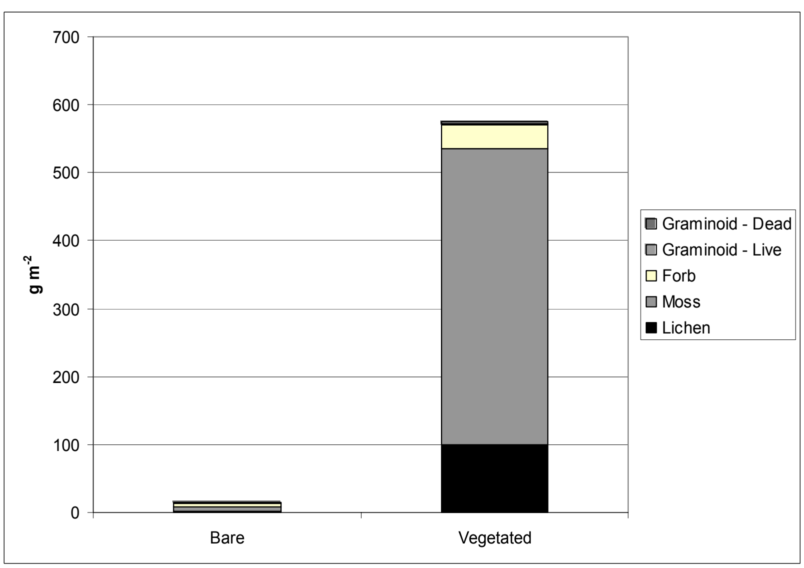


Fig. 32: Aboveground biomass (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

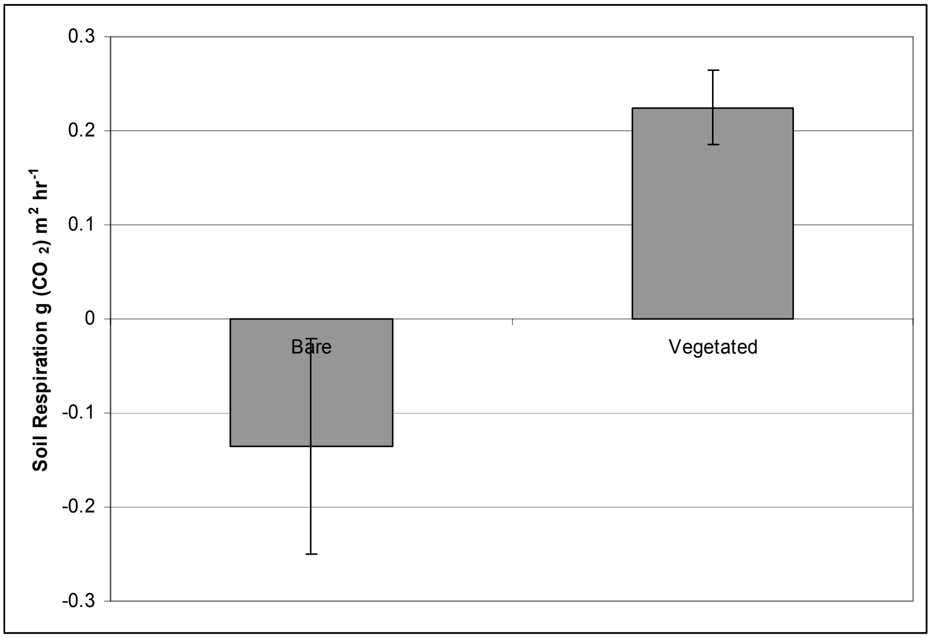


Fig. 33: Soil respiration (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

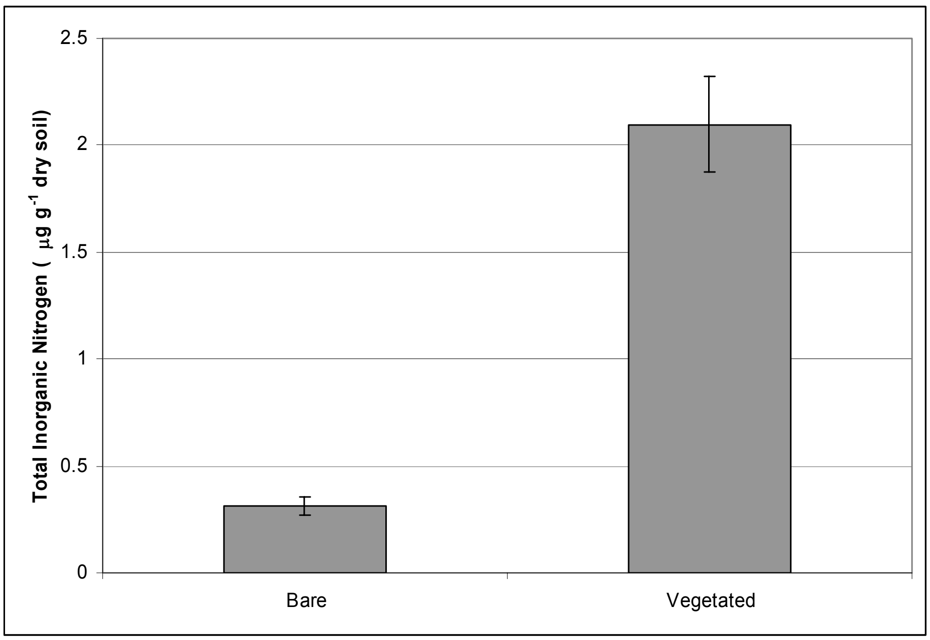


Fig. 34: Total inorganic nitrogen (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site.

Fig. 35: Rate of net nitrogen mineralization (mean ± 1 SE) of bare and vegetated areas at the Isachsen mesic site, as measured over a 7 day period in July of 2005.

Table 12: Soils and bulk density of turf hummock samples collected.

Site no.	Soil	Bulk Density	New deposition*
ER–1	3	2	–
ER –2	4	2	–
ER–3	3	2	–
ER–4	3	1	–
ER–5	3	2	–
ER–6	3	2	2
ER–7	2	–	1
ER–8	2	–	1
ER–9	2	1	–
ER–10	2	1	–
ER–11	3	1	–
ER–12	2	2	1
ER–13	3	1	–
ER–14	4	1	–

– indicates no sample collected
* new deposit on the hummock surface

Acknowledgements

This work was funded by the U.S. National Science Foundation, Grant No. OPP-0120736. Logistics were coordinated by VECO Polar Resources. The Aurora Research Institute and Les Kutny helped with lodging in Inuvik. The Canadian Polar Continental Shelf Program provided daily safety contact. The personnel of Aulavik National Park, Parks Canada facilitated our stop at Green Cabin, Banks Island to re-visit our 2003 sites. Sachs Harbour Hunters and Trappers Committee reviewed our research permit and gave us permission to use Green Cabin.

References

Agerer, R. 1987-2002. Colour Atlas of Ectomycorrhizae. Schwabisch-Gmund: Einhorn Verlag.

Carlson, H. 1952. Calculation of depth of thaw in frozen ground. Frost action in soils: a symposium. Highway Research Board Special Report 2, National Research Council: Washington, D.C., 192-223.

CAVM Team, 2003. Circumpolar Arctic Vegetation Map (Scale 1:7,500,000). Conservation of Arctic Flora and Fauna (CAFF) Map No. 1, U.S. Fish and Wildlife Service, Anchorage, AK.

Eno, C. F. 1960. Nitrate production in the field by incubating the soil in polyethylene bags. Soil Science Society of America Journal 24: 277-279.

Everett, K. R. 1968. Soil Development in the Mould Bay and Isachsen areas, Queen Elizabeth Islands, North west Territories, Canada. 24, Institute of Polar Studies.

Fortier, Y. O. 1963. Cornwall, Lougheed, Amund Ringnes, and Ellef Ringnes Islands (Map 1102A). In Fortier, Y.O., Blackadar, R.G., Greiner, H.R., McLaren, D.J., McMillan, N.F., Norris, A.W., Roots, E.F., Souther, J.G., Thorsteinsson, R. & Tozer, E.T. (eds). Geology of the north-central part of the Arctic Archipelago, Northwest Territories (Operation Franklin). Memoir 320. Ottawa: Geological Survey of Canada. 518-521.

Foscolos, A.E. & Kodama, H. 1981: Mineralogy and chemistry of Arctic desert soils on Ellef Ringnes Island, Arctic Canada. Soil Sci. Soc. Am. J 45: 987-993.

Gee, G.W. & Bauder, J.W. 1986. Particle-size analysis. In: A. Klute (ed.): Methods of soil analysis, part I, physical and mineralogical methods. Wisconsin: Soil Science Society of America, Inc. Madision. 404-408.

Heywood, W. W. 1957. Isachsen area Ellef Ringnes Island district of Franklin Northwest Territories. Geological Survey of Canada, paper 56-8.

Jackson, M.L. 1958. Soil chemical analysis. New Jersey: Prentice Hall.

Knowles, R. 1980. Nitrogen fixation in natural plant communities and soils. In: Bergersen, F. J., editor (ed.). Methods for Evaluating Biological Nitrogen Fixation. New York: John Wiley & Son Ltd. 557-582.

Mehlich, A. 1984. Mehlich No. 3 extractant: a modification of Mehlich No. 2 extractant. Commun. Soil Sci. and Plant Analysis 15: 1409-1416.

Porsild, A.E. 1955. The vascular plants of the western Canadian Arctic Archipelago. Bulletin No. 135, Biological Series No. 45. Ottawa, Ontario: National Museum of Canada.

Porsild, A.E. & Cody, W. J. 1980. Vascular plants of Continental Northwest Territories, Canada. Ottawa, Canada: National Museum of Natural Sciences.

Robertson, G.P., Coleman, D.C., Bledsoe, C.S. & Sollins, P. 1999. Soil carbon and nitrogen. In: Robertson, G.P., Coleman, D.C., Beldsoe, C.S. & Sollins, P. (eds.): Standard soil methods for long-term ecological research. New York:Oxford University Press. 89-105.

Stott, D.F. 1969. Ellef Ringnes Island, Canadian Arctic Archipelago. Geological Survey of Canada, paper 68-16.

Tedrow, J.C.F. 1966. Polar desert soils. Soil Sci. Soc. Am. Proc. 30 (3): 381-387.

Tedrow, J.C.F. & Cantlon, J.E. 1958. Concepts of soil formation and classification in Arctic regions. Arctic 11 (3): 166-179.

Participant List and Contact Information

Fred Daniëls
Institute of Plant Ecology
Hindenburgplatz 55
Muenster 4814 Germany
49 251 8323835
daniels@uni-muenster.de

Howard Epstein
Dept. of Environmental Sciences
University of Virginia
P.O. Box 400123
Charlottesville, VA 22904
434-924-4308
hee2b@virginia.edu

Grizelle Gonzalez
Institute of Tropical Forestry
USDA Forest Service
1201 Calle Ceiba
San Juan, Puerto Rico 00926
787-766-5335
ggonzalez@fs.fed.us

William Gould
Institute of Tropical Forestry
USDA Forest Service
1201 Calle Ceiba
San Juan, Puerto Rico 00926
787-766-5335
wgould@fs.fed.us

Anja Kade
311 Irving, UAF
Fairbanks, AK 99775
907-474-7929
anja_kade@yahoo.com

Alexia Kelley
University of Virginia
Dept. of Environmental Sciences
P.O. Box 400123
Charlottesville, VA 22904
amk5d@virginia.edu

Manny Kudlak
Sachs Harbour, NWT
867-690-3999
Manny.Kudlak@nt.simpatico.ca

Trevor Lucas
Sachs Harbour, NWT

Nadya Matveyeva
Dept. of Vegetation of the Far North
Komarov Botanical Institute
2 Prof. Popov Street
St. Petersburg, 197376 Russia
7 812 234 17 92
NadyaM@NM10185.spb.edu

Olga Makarova
Severtsov Institute of Ecology and Evolution
Russian Academy of Sciences
Leninsky pr., 33
Moscow 119071, Russia
lsdc@genome.eimb.relarn.ru

Gary Michaelson
UAF Ag. & Forestry Exp. Station
533 East Fireweed,
Palmer, AK 99645
907-746-9482
pngjm@uaa.alaska.edu

Corinne Munger
311 Irving, UAF
Fairbanks, AK 99775
907-474-2459
fncam1@uaf.edu

Chien-Lu Ping
UAF Ag. & Forestry Exp. Station
533 East Fireweed,
Palmer, AK 99645
907-746-9462
pfclp@uaa.alaska.edu

Martha Raynolds
311 Irving, UAF
Fairbanks, AK 99775
907-474-6720
fnmkr@uaf.edu

Vladimir Romanovsky
Geophysical Institute
University of Alaska
Fairbanks, AK 99775
907-474-7459
ffver@uaf.edu

Sharon Rae Spain
VECO Polar Resources
Bellingham, WA
(360) 366-5658
larrae2920@yahoo.com

Charles Tarnocai
Ag. and Agri-Food Canada
K.W. Neatby Building, Rm. 1135
960 Carling Avenue
Ottawa, K1A 0C6 CANADA
613-759-1857
tarnocaict@agr.gc.ca

Ina Timling
P.O. Box 750735
Fairbanks AK 99775-0735
Tel: 907-457-1002
timl0003@umn.edu

Corinne Vonlanthen
311 Irving
University of Alaska
Fairbanks, AK 99775
907-474-2459
Corinne.Vonlanthen@giub.unibe.ch

Donald (Skip) Walker
311 Irving
University of Alaska
Fairbanks, AK 99775
907-474-2460
ffdaw@uaf.edu

Arctic Field Ecology participants

Robin Austin
Antioch New England
1033 Delano Road
Irasburg, VT 05845
(802)-755-6873
earthlyjoy@mail.com

Jordan Okie
Carleton College
4627 Lake Avenue North
White Bear Lake, MN 55110
(651) 653-9629
jordanokie@gmail.com

Constance Laureau
130 Avenue de Versailles
7016 Paris, France
leafhoppers@hotmail.com

Greta Lewanski
The Evergreen State College
19500 Villages Scenic Pkwy
Anchorage, AK 99516
(907) 345 5734
cyclingreta@yahoo.com

Maria Rivera
University of PR Mayaguez Campus
Veredas del Monte 3700 carr.176
San Juan, PR 00926
(787) 766-5335
mrivera@fs.fed.us

Report on integration of research and education in the Biocomplexity of Small-Featured Patterned Ground Ecosystems study

W. Gould and G. González

Arctic Field Ecology/Biocomplexity of Small-Featured Patterned Ground Ecosystems, 2005: Integrating research and education in an investigation of climate-permafrost-vegetation interactions in the Arctic (supported by NSF OPP-0120736).

Locations:

Canadian High Arctic

1. Isachsen, Ellef Ringnes Island, NU (bioclimatic subzone A);
2. Mould Bay, Prince Patrick Island, NT (bioclimatic subzone B).
3. Green Cabin, Aulavik National Park, Thomsen River, Banks Island, NT (bioclimatic subzone C).

Canadian Low Arctic

4. Hiukitak River, Bathurst Inlet, NU (bioclimatic subzone D/E).

Canadian Subarctic

5. Inuvik, NT, logistics and laboratory work.
6. Yellowknife, NT, logistics.

Field dates: July 16 to August 12, 2005.

Biocomplexity research and educational project

The goal of this project is to understand the linkages between biogeochemical cycles, vegetation, disturbance, and climate across the full summer temperature gradient in the Arctic in order to better predict ecosystem responses to changing climate. We focus on frost-boils because:

1) The processes involved in the self-organization of these landforms drive biogeochemical cycling and vegetation succession of extensive arctic ecosystems.
2) These ecosystems contain perhaps the most diverse and ecologically important zonal ecosystems in the Arctic and are important to global carbon budgets.
3) The complex ecological relationships between patterned-ground formation, biogeochemical cycles, and vegetation and the significance of these relationships at multiple scales have not been studied.
4) The responses of the system to changes in temperature are likely to be nonlinear, but can be understood and modeled by examining the relative strengths of feedbacks between the components of the system at several sites along the natural arctic temperature gradient.

One of the fundamental goals of our national science policy is to better integrate research and education. There is strong national interest to improve this integration at the graduate and undergraduate levels, with the general public, and (in the Arctic in particular) with indigenous people. The *Biocomplexity of Small-Featured Patterned Ground Ecosystems* project integrates research and education by including the field course Arctic Field Ecology in many aspects of the project. Arctic Field Ecology is offered for credit through the University of Minnesota Itasca Field Biology Program.

Educational goals and overview

The *Arctic Field Ecology* course is designed introduce undergraduate and graduate students to field studies in the Arctic to gain an understanding of the structure and function of arctic ecosystems and the current state of Arctic research. This is accomplished through daily seminars on diverse aspects of arctic ecology, examination and discussion of important publications of Arctic research, integration of student activities with the Biocomplexity of Small-Featured Patterned Ground Ecosystems research team, integration with native elders and wildlife experts, and through active participation in field sampling and analyses for ongoing biodiversity and decomposition studies which are a part of the biocomplexity research.

The course had two components in 2005: Interacting with the full research team investigating small patterned ground features during a two week field season on Ellef Ringnes, Prince Patrick, and Banks Islands in the High Arctic, and integrating the study of patterned ground features with indigenous knowledge during a two week youth-elder-science camp with local Inuit students and elders on Bathurst Inlet. Four North American and European students and nine Inuit students participated in the course. Additionally we had 2 instructors, one staff assistant, and three collaborating scientists working in the high Arctic component with the Biocomplexity team (26 in total). There were nine Inuit elders and an additional 9 Inuit staff and participants involved in the youth-elder-science camp (33 in total). Field class participants were from US, France, Russia, Germany, Canada, and Puerto Rico and conducted research and coursework along the complete climatic gradient of the Arctic.

2005 Participants (53)

Instructors and staff:

Bill Gould, International Institute of Tropical Forestry (wgould@fs.fed.us)
Grizelle González, International Institute of Tropical Forestry (ggonzalez@fs.fed.us)
Maria Rivera, International Institute of Tropical Forestry (mrivera@fs.fed.us)

European and North American students:

Jordan Okie, Carleton College (jordanokie@gmail.com)
Greta Lewanski, Evergreen State College (cyclingreta@yahoo.com)
Robin Austin, Antioch New England College (earthlyjoy@mail.com)
Constance Laureau, Pierre et Marie Curie University, Paris (leafhoppers@hotmail.com)

Inuit staff coordinators:

Jason Tologanak, Kitikmeiot Inuit Association (KIA) youth elder coordinator, Cambridge Bay, NU (jasont@polarnet.ca).
Sandra Eyegetok, Department of Education, Cambridge Bay, NU (seyegetok@gov.nu.ca).

Inuit students and additional youth:

Jason Akoluk, Joseph Jr. Tikhak, Stephanie, Rosemarie, Kyle, Helena, Gilbert, Ivor, Kakak, Nathan, Becky, Michael, Syreena, and Ohak.

Inuit elders:

Mary Kaniak, Ella Panegyuk, Mary Kilaodluk, Tommy Kilaodluk, Jesse, Charlie Klengenberg, Lena Kamoayok, Bernard, and John Paneyuk.

Inuit and KIA staff:

George Paneyuk**,** Eileen Kakolak, Martha Kaniak and Goeff.

Collaborating Scientists

Olga Makarova, Russian Academy of Sciences, Moscow (lsdc@genome.eimb.relarn.ru)
Nadya Matveyeva, Komorov Botanical Institute, St. Petersburg (NadyaM@NM10185.spb.edu)
Fred Daniels, Institute of Plant Ecology, Muenster (daniels@uni-muenster.de)

Biocomplexity Research Team:

Project leader: D.A. Skip Walker, University of Alaska (ffdaw@aurora.uaf.edu)
Howie Epstein, University of Virginia (hee2b@virginia.edu)
Anja Kade, University of Alaska (nja_kade@yahoo.com)
Alexia Kelly, University of Virginia (amk5d@virginia.edu)
Bill Krantz, Cincinnati University (bkrantz@alpha.che.uc.edu)
Gary Michaelson, University of Alaska (pngjm@uaa.alaska.edu)
Chien-Lu Ping, University of Alaska (pfclp@ uaa.alaska.edu)
Martha Raynolds, University of Alaska (fnmkr@uaf.edu)
Vladimir Romanovsky, University of Alaska (ffver@aurora.alaska.edu)
Charles Tarnocai, Agriculture Canada, Ottawa (tarnocaict@em.agr.ca)
Ina Timmerling, University of Alaska
Corinne Vonlanthen, University of Alaska
Corinne Munger, University of Alaska (fncam1@uaf.edu)

Logistic assistance:

Andrew Borner, University of Alaska, (ftp@uaf.edu)
Marin Kuizenga, Veco logistics (Marin.Kuizenga@veco.com)
Sharon Rae Spain, Veco Field support (larrae2920@yahoo.com)
Manny Kudlak, *Sachs Harbour resident(*MannyKudlak@nt.simpatico.ca)
Trevor Lucas, *Sachs Harbour resident*

2005 Activities

Between July 16 and July 30 the class took place on Ellef Ringnes, Banks and Prince Patrick Islands where we set up transects to measure plant and insect diversity patterns associated with frost boil patterning, prepared and placed litterbags for decomposition experiments, held seminars and discussions, and interacted with the biocomplexity team members.

Between August 1 and August 12 the students participated in a Youth-Elder-Science camp at the Hiukitak River near Bathurst Inlet. The students investigated vegetation and soil characteristics in frost boils along a toposequence, set up a climate monitoring station, participated in class with Inuit youth, and learned a variety of traditional information about the region from Inuit elders. This ranged from discussing changes in hunting and climate patterns, to study of traditional uses of plants, skinning a caribou, sewing skills, singing, drumming, and other traditional arts and games.

The class offered seminars on the following topics:

The Arctic landscape: Climate, geochemistry, and topography – hierarchical controls on landscape patterns.
The Arctic ecosystem: The role of temperature, light, nutrients, disturbance, and organisms in above and belowground ecosystems.
Vegetation ecology: Landscape patterns and ecological controls on community composition.
Cryoturbation: The influence of glaciers, permafrost, snow cover, and freeze/thaw cycles on landforms, soils, vegetation, and ecosystem processes.
Soil ecology/biology: Soil development and classification, ecosystem processes and soil organisms.
Traditional Ecological Knowledge: Understanding "Nuna" (the land) from Inuit/Inuvialuit/Inupiaq perspectives.
Global change research: Climate and land-use, detecting environmental change.
Arctic transitions: Extrapolating in space and time – from field measures to modeling.
Biocomplexity: Understanding complex biological systems in the Arctic.
Vertebrate ecology: Behavioral and physiological adaptations to the arctic environment.
Human history and current affairs: Inuit land use, archaeological sites, mining, oil, recreation.

Additional seminars were offered by the participants of the Biocomplexity Research Team each evening on the following topics:

July 19 Skip Walker, Anja Kade – Project Overview and vegetation summary.
July 20 Charles Tarnocai – Geology and soils of Isachsen, hummocks of Mould Bay and Green Cabin.
July 21 Chien-lu Ping – Overview of Frostboil soils and results from Mould Bay and Green Cabin.
July 21 Gary Michaelson – Biogeochemistry of frost boil cryptogamic crusts.
July 22 Vladimir Romanovsky - Climate and permafrost studies: latest results.
July 23 Alexia Kelley and Howie Epstein – Plant community and Nitrogen cycling in frost boil ecosystems with results from Mould Bay and Green Cabin.
July 24 Bill Gould – Educational Component and
July 24 Grizelle Gonzalez - Results from decomposition and invertebrate studies.
July 25 Nadya Matveyeva – Russian High Arctic vegetation.
July 25 Olga Makarova – Russian High Arctic invertebrates.
July 26 Fred Daniels – Greenland arctic plant studies.

These are available as powerpoint presentations at http://geobotany.uaf.edu

Additional Biocomplexity Research Team interaction with the class included:

1. Discussions with Charles Tarnocai about his work on hummocks and his many years of work in the Canadian Arctic.
2. Participation in digging and analyzing soil pits with Chien-lu Ping and Gary Michaelson.
3. Discussions with Vladimir Romanovsky of the equipment, set up, and sampling of snow depths and permafrost, active layer, and air temperatures.
4. Discussions of LAI and NDVI sampling with Howie Epstein.
5. A seminar on identification of mosses and lichens by Fred Daniels.
6. Demonstrations of invertebrate sampling and identification by Olga Makarova.
7. Discussion with local Sachs Harbour Inuvialuit residents and Parks Canada employees Manny Kudlak and Trevor Lucas.
8.

Research activities
The field class has been addressing the question of how biodiversity patterns vary between boil and interboil areas within a given site and along the climatic gradient from the southern to northern arctic (subzones E through A). We have also initiated a series of decomposition experiments, led by Grizelle González, to link ecosystem pattern and process in frost-boil ecosystems. We have conducted the research at nine sites, spanning the complete climatic gradient in the Arctic (Fig. 1).

The class is conducting the following research:
Frost-boil morphology. We are investigating boil and interboil differences in thaw depth and vegetation cover along the arctic climatic gradient.
Litter decomposition experiments: We are investigating the linkage of ecosystem pattern and process in frost-boil ecosystems by studying how litter decay rates vary between boil and interboil areas, above and belowground, and along a toposequence.
Biodiversity transects: We are investigating how plant biodiversity patterns vary between boil and interboil areas within a given site and along the arctic climatic gradient. Beta diversity (plant compositional differences) between boil and interboil areas is greatest in subzone D, where plant diversity is relatively high and barren frost boil surfaces are distinct from vegetated interboil areas.
Phytosociology studies and vegetation mapping. We are investigating variation in plant communities along climatic and topographic gradients. We have investigated vegetation zonation within snow beds on Banks Island and the conducted relevés in dry and zonal vegetation with Nadya Matveyeva and in a set of 7 riparian sites near Isachsen, Ellef Ringnes Island. We are conducting vegetation mapping of field sites using field observations and recent Landsat ETM+ satellite imagery.
Microbial biomass studies. We are investigating variation in microbial biomass related to boil/interboil soils along climatic gradients as well as toposequences.
Soil invertebrate studies. We are investigating invertebrate diversity, functional groups, and biomass variation between boils and interboils and along the climatic gradient in surface-active and subsurface-active soil invertebrates.

Biodiversity and patterned ground feature morphology. Over the last four summers we have established a series of transects at the following Biocomplexity research sites: Subzone E - Happy Valley and Sagwon Moist Acidic Tundra (MAT) sites; subzone D – Sagwon Moist Nonacidic Tundra (MNT), Franklin Bluffs, and Deadhorse sites; subzone C – Banks Island Green Cabin site; subzone B – Mould Bay, Prince Patrick Island;, and subzone A – Isachsen, Ellef Ringnes Island. There are three 20 meter transects at each site, adjacent to the mesic site 10 x 10 meter biocomplexity grid (Fig. 2). Each transect was selected to bisect at least 5 frost boils. Boil/interboil transitions (noted as shifts in vegetation cover) were flagged along the transect and 5 boil and 5 interboil areas were selected for soil sampling, soil invertebrate sampling, and vegetation sampling (Fig 3). Soil samples are being analyzed at the International Institute of Tropical Forestry (IITF) and other laboratories for pH, C:N ratio, percent organic matter, soil chemistry, and microbial biomass (fungal and bacterial estimates). Pitfall traps using funnels and vials with ethanol were set out to sample surface active invertebrates on the boil and interboil areas, and soil samples were taken in order to extract subsurface active insects. Vegetation was sampled within 25 x 25 cm grids and species presence and abundance were recorded. Additionally, we measured thaw depth, micro relief, and vegetation cover type as vascular, moss, cryptogamic crust, or bare soil every 10 centimeters along each transect. These measures will be used to develop profiles of typical frost boils along the climatic gradient, and to look at differences in plant and insect community composition and diversity on boil and interboil areas. We predict that the maximum differences in community composition (*beta* diversity) will be greatest at an intermediate point of high habitat differentiation (bare soil versus vegetated surfaces) and warmer climates (higher regional diversity) (Fig. 4).

Decomposition experiments and soil invertebrate sampling. We established a series of decomposition experiments to look at decay rates of graminoid species on boil and interboil areas along the climatic gradient and along a toposequence at Green Cabin, Mould Bay, and Isachsen.
Experiment 1. In 2002 we collected recently senesced litter of *Luzula nivalis* from Satellite Bay, Prince Patrick Island and created 20 mesh litter bags (2x2 mm) for placement in the field. These were placed in the field in 2003 at Mould Bay, Prince Patrick Island on a series of boil and interboils within a 4 x 4 meter quadrat. A set of controls was retrieved and weighed. These will be analyzed for litter chemistry the IITF chemistry lab. The remaining litterbags were retrieved in 2004 and 2005 to determine boil and interboil variation in percent of mass loss, decay rate, and change in litter chemistry.
Experiment 2. In 2003 we collected freshly senesced litter of *Carex misandra* at the Green Cabin site on Banks Island (subzone C) and created 60 mesh litterbags (2x2 mm). We took field weights and placed these along our biodiversity transects on boil and interboil surfaces and at 4 cm depths. A set of controls was retrieved will be analyzed in the IITF chemistry lab. Bags have been collected for analyses in 2004 and 2005 to determine mass loss, decay rates and changes in litter chemistry. Additional litterbags of *Luzula nivalis* were prepared and placed at the Mould Bay site in 2004, and of *Alopecuris alpinus* in Isachsen in 2005. These will be collected for analyses in 2006.
Experiment 3. We prepared 107 additional litterbags of *Carex misandra* for placement in boil and interboil areas along a toposequence at the Green Cabin site. Three replicate litter bags were placed on the surface and belowground at 4 cm depths within 3 replicate boils and interboils at ridge, slope and valley positions. These are at the same sites being used for nitrogen mineralization experiments by Alexia Kelly and Howie Epstein. Bags have been collected for analyses in 2004 and 2005 to determine mass loss, decay rates and changes in litter chemistry. Additional litterbags of *Luzula nivalis* were prepared and placed at the Mould Bay site in 2004, and of *Alopecuris alpinus* in Isachsen in 2005. These will be collected for analyses in 2006.
Soils were sampling at Green Cabin, Mould Bay, and Isachsen in 2006 in a set of replicated samples of boils and interboils as well as along a toposequence in order to extract soil insects and to measure microbial biomass. Soil insects were extracted in Inuvik and are being identified at the Russian Academy of Sciences.

Phytosociology and mapping. We have conducted relevés at a number of sites along the transect and will utilize this and other information in classification of Landsat satellite imagery for Ellef Ringnes, Prince Patrick, and Banks Island. These datasets will form a hierarchical link between the plot scale investigations of the biocomplexity team and the circumpolar mapping efforts of the CAVM.

Important outcomes and results

Twenty-nine students from the United States, Canada, France, Brazil, Germany, Nunavut Canada, and Puerto Rico have been involved in the research. Two graduate teaching assistants and 40 Inuit people. Village elders from Omingmaktok, Kugluktuk, Cambridge Bay, and Kingaok Canada have participated in the project. The class has visited the Alaskan Inupiaq village of Nuiqsut, established a remote camp with local Inuit in the Bathurst Inlet area of Canada, and a youth-elder-science camp near Bathurst Inlet (Figs. 5-14). Publications regarding the integration of research and education are planned or in progress.

Seven posters have been presented by students or instructors at national and international meetings, three students have been invited to present research results at scientific meetings, three students have been asked to participate with the research team as graduate and postdoctoral students or as field assistants.

Decomposition experiments are finding significant differences in decay of graminoid species over time, and trends but not yet significant differences along the climatic gradient and between boil and interboil positions. These differences may take more than one year to become apparent. Publications are planned or in progress.

Microbial studies have indicated no significant differences in total microbial biomass between Green Cabin and Mould Bay, but significant differences in bacterial counts, indicating a possible shift in functional groups along the climatic gradient. Publications are planned or in progress.

Biodiversity transects indicate higher beta diversity (compositional differences between boils and interboils) in the region where barren boil surfaces are most abundant and vegetation is relatively diverse: Subzone D. Frost boil patterning leads to greater local diversity in some sites by partitioning a significant portion of the landscape into either exposed surfaces (boils) or sheltered hollows (interboils) that collect snow, water, organic material and aeolian deposits. In the southern bioclimatic subzones (E, D) boils create a microsite better suited to those species less well adapted to heavily vegetated surfaces and thick organic mats. In less well vegetated northern subzones (A, B, C), interboils provide environmental microsites that a number of species take advantage of.

Acknowledgements
Thanks to Marin Kuizenga and Rae Spain at Veco, to Alkak Air and Air Tindi for logistics support. Thanks to the Aurora Institute for help with licensing, lab space and logistics. Thanks to Manny Kudlak and Trevor Lucas for meeting with the class. Thanks to Kristen Murphy and David Beisboer of the University of Minnesota, The research has been supported by the University of Minnesota, The USDA Forest Service International Institute of Tropical Forestry, The National Science Foundation (NSF OPP-0120736), and The Kitikmeot Inuit Association. Thanks to all the scientists and students for their enthusiasm and effort.

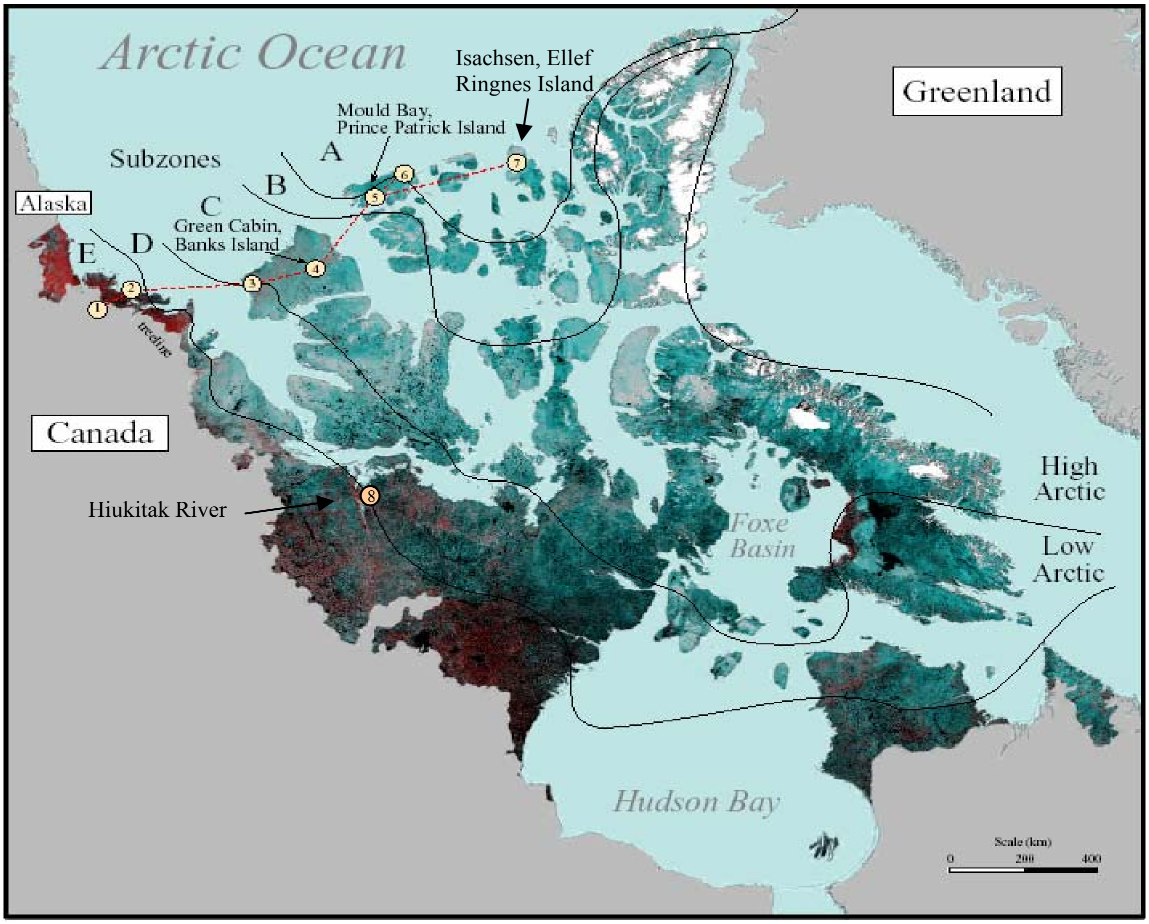


Figure 1. Study sites in Canada include: 1. Inuvik, 2. Tuktuyuktuk, 3. Sachs Harbour, Banks Island 4. Green Cabin. 5. Mould Bay, Prince Patrick Island, 6. Satellite Bay, 7. Isachsen, Ellef Ringnes Island, and 8. Hiukitak River, Bathurst Inlet.

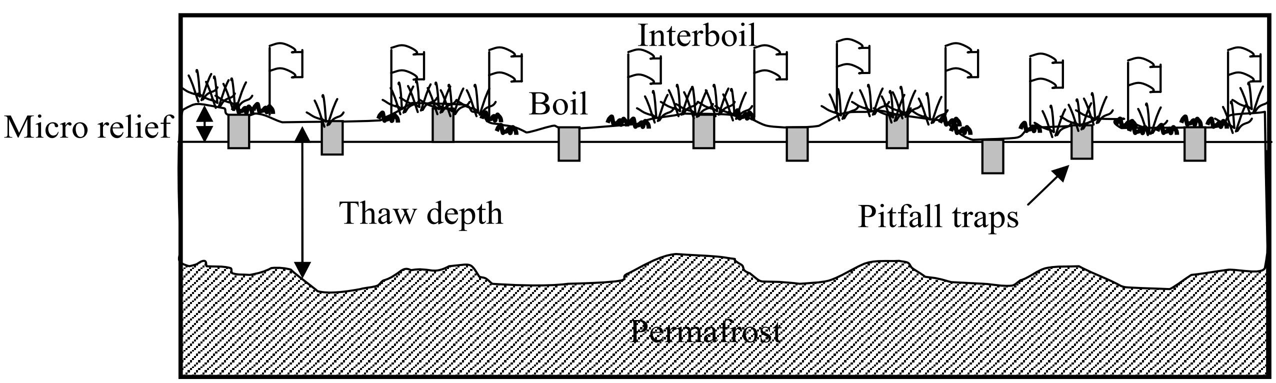


Figure 2. Transect sampling scheme. Thaw depth, micro releif, and vegetation cover were sampled at 10 cm intervals along the 20 meter transect. Ten soil samples were taken to 10 cm depths in boil and interboil areas and invertebrates were sampled using 10 pitfall traps in boil and interboil areas. Three replicate transects were sampled at 9 biocomplexity sites in subzones A, B, C, D, and E representing a climatic gradient with mean July temperatures ranging from 0-12 degrees C.

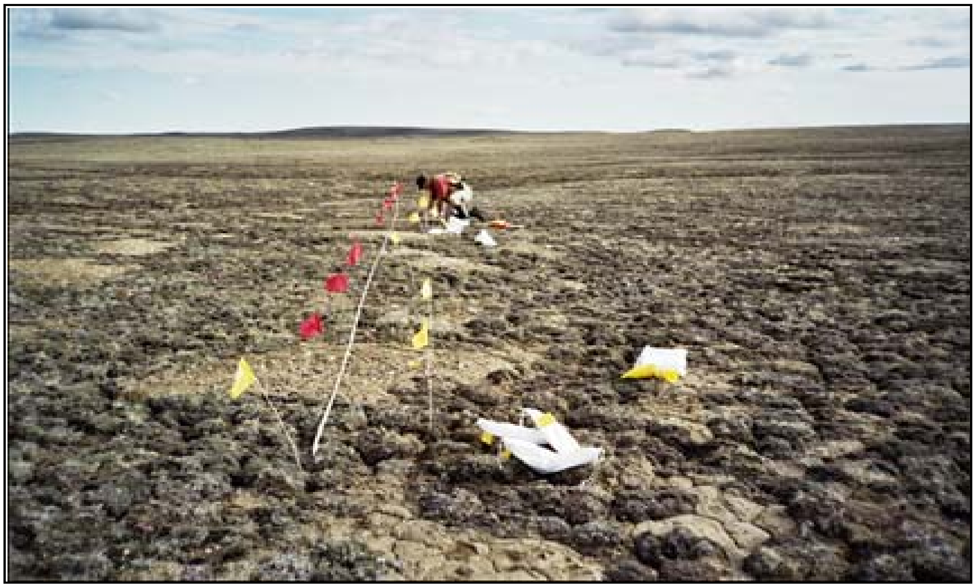


Figure 3. Biodiversity transect boils and interboils flagged in red and pitfall traps in yellow.

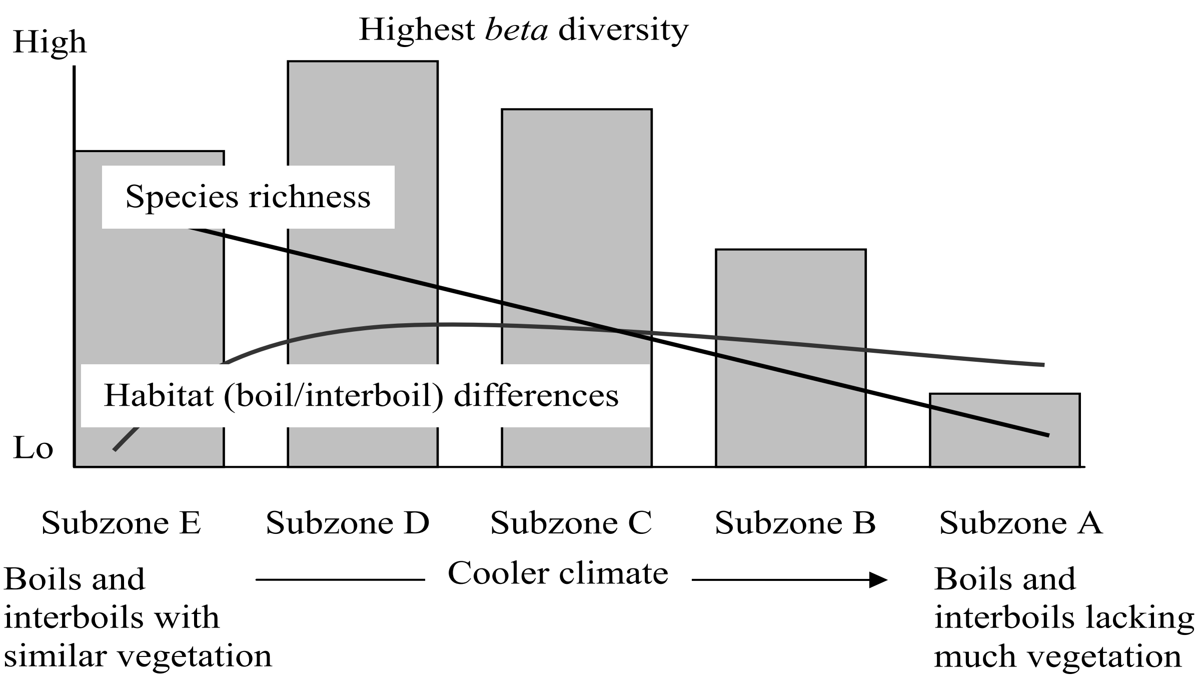


Figure 4. Expected relationships between *alpha* diversity (species richness), climate, habitat heterogeneity, and *beta* diversity (between-habitat compositional differences). The pool of species decreases from subzone E to A due to climatic constraints, and remaining species tend to have broader niches and the ability to colonize both boil and interboil habitats. Interboil habitats become more completely vegetated in subzone E, dampening habitat and compositional differences between boil and interboil areas.

Figure 5. Dr. Gonzalez looking at soil invertebrates with Inuit students Jason and Kyle.

Figure 6. Single small patterned ground feature (frost boil) near Bathurst Inlet.

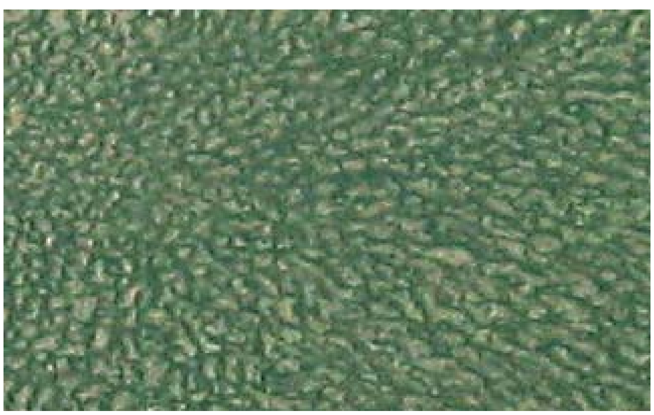


Figure 7. Region of small patterned ground features (frost boils) near Bathurst Inlet.

Figure 8. Bernard (one of the elders) keeping in touch with family by radio.

Figure 9. Student Greta Lewanski digging a soil pit at the Hiukitak site.

Figure 10. Elders demonstrating traditional skills, stretching a caribou hide.

Figure 11. Younger and older members of the youth-elder-science camp.

Figure 12. Elder Tommy Kilaodluk building a drum for drum dancing.

Figure 13. Digging a soil pit at Isachsen.

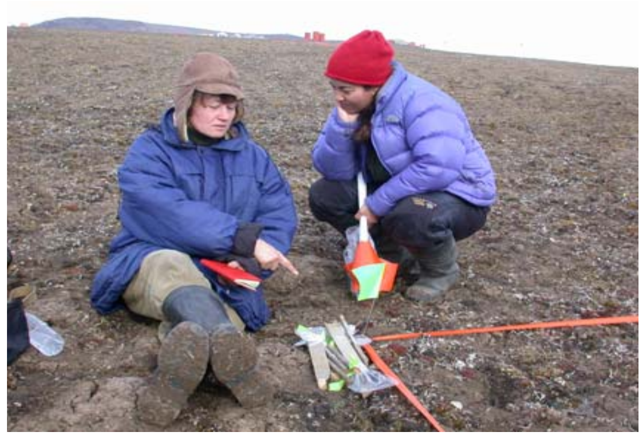


Figure 14. Olga Makarova and Grizelle Gonzalez planning invertebrate sampling at Isachsen.

Appendix

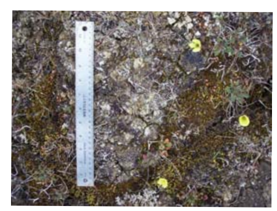
Soil crust sampling by Gary Michaelson

Isachsen-1 Dry Grid Site

	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-1 Dry Grid	0-1	6.9	11.6	1.67
	1-3	9.8	18.8	1.92
	3-5	11.7	25.9	2.23
	5-7	12.6	24.7	1.96
	7-9	13.6	32.4	2.40
	9-11	15.0	27.4	1.82

Isachsen-2 Mesic Grid Site

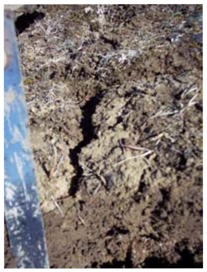
	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-2 Mesic/Bare	0-1	7.3	10.3	1.40
	1-3	10.9	17.3	1.59
	3-5	16.1	24.7	1.53
	5-7	22.4	31.9	1.43
	7-9	23.6	44.8	1.90
	9-11	19.9	39.0	1.96



	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-2 Mesic/Crust	0-1	21.2	19.6	0.93
	1-3	22.4	28.2	1.26
	3-5	21.0	30.0	1.42
	5-7	21.8	37.0	1.70
	7-9	21.0	31.0	1.48
	9-11	25.4	48.4	1.90

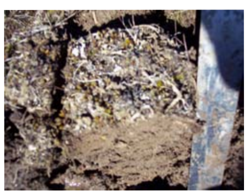
	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-2 Mesic/moss	0-2	25.5	26.4	1.22
	2-4	25.6	34.9	1.39
	4-6	24.6	33.6	1.36
	6-8	24.3	44.7	1.84
	8-10	24.5	39.1	1.63

Isachsen-3 Wet/Hummock Site



	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-3	0-2	24.3	28.4	1.17
bare/hummock	2-5	30.4	48.1	1.58
	5-8	29.1	50.9	1.75

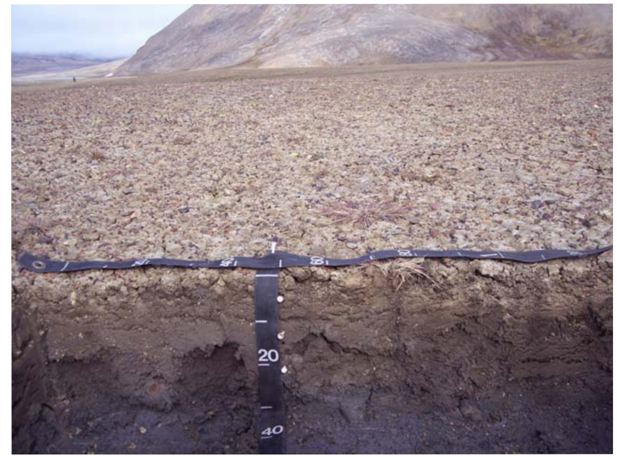
	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-3	0-2	28.2	18.8	0.66
Lichen/hummock	2-5	30.1	37.5	1.25
	5-8	31.9	42.4	1.33



	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-3	0-2	33.9	18.1	0.53
moss/hummock	2-5	32.0	35.8	1.12
	5-8	28.2	60.9	2.16

	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-3	0-2	89.6	28.2	0.31
moss/interhummock	2-5	60.1	54.2	0.90
	5-8	68.0	61.4	0.90

Isachsen-7 Poppy Barren Site



	Depth cm	$[H_2O]_{wt.}$ %	$[H_2O]_{vol.}$ %	Field BD g cm^{-3}
Is-7 Poppy Barren	0-1	7.1	10.6	1.49
	1-3	13.8	18.1	1.31
	3-5	20.4	24.2	1.18
	5-7	25.7	34.1	1.33
	7-9	27.6	50.3	1.82
	9-11	26.7	34.4	1.29