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Patterned-Ground Plant Communities along a bioclimate gradient in the High Arctic, Canada

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with 16 figures, 14 tables and 1 appendix

Abstract: Non-sorted circles, non-sorted polygons, and earth hummocks are common ground-surface features in arctic regions. They are caused by a variety of physical processes that occur in permafrost regions including contraction cracking and frost heave. Here we describe the vegetation of patterned-ground forms on zonal sites at three locations along an N-S transect through the High Arctic of Canada. We made 75 relevés on patterned-ground features (circles, polygons, earth hummocks) and adjacent tundra (interpolygon, intercircle, interhummock areas) and identified and classified the vegetation according to the Braun-Blanquet method. Environmental factors were correlated with the vegetation data using a nonmetric multidimensional scaling ordination (NMDS). We identified eleven communities: (1) *Puccinellia angustata–Papaver radicatum* community in xeromesic non-sorted polygons of subzone A of the Circumpolar Arctic Vegetation Map; (2) *Saxifraga–Parmelia omphalodes* ssp. *glacialis* community in hydromesic interpolygon areas of subzone A; (3) *Hypogymnia subobscura–Lecanora epibryon* community in xeromesic non-sorted polygons of subzone B; (4) *Orthotrichum speciosum-Salix arctica* community in xeromesic interpolygon areas of subzone B; (5) *Cochlearia groenlandica-Luzula nivalis* community in hydromesic earth hummocks of subzone B; (6) *Salix arctica–Eriophorum angustifolium* ssp. *triste* community in hygric earth hummocks of subzone B; (7) *Puccinellia angustata–Potentilla vahliana* community in xeromesic non-sorted circles and bare patches of subzone C; (8) *Dryas integrifolia–Carex rupestris* community in xeromesic intercircle areas and vegetated patches of subzone C; (9) *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community in hydromesic non-sorted circles of subzone C; (10) *Dryas integrifolia–Carex aquatilis* community in hydromesic intercircle areas of subzone C; and (11) *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community in hygric intercircle areas of subzone C. The NMDS ordination displayed the vegetation types with respect to complex environmental gradients. The first axis of the ordination corresponds to a complex soil moisture gradient and the second axis corresponds to a complex geology/elevation/climate gradient. The tundra plots have a greater moss and graminoid cover than the adjacent frost-heave communities. In general, frost-heave features have greater thaw depths, more bare ground, thinner organic horizons, and lower soil moisture than the surrounding tundra. The morphology of the investigated patterned ground forms changes along the climatic gradient, with non-sorted polygons dominating in the northernmost sites and non-sorted circles dominating in the southern sites.

Keywords: biocomplexity, Braun-Blanquet classification, Nonmetric Multidimensional Scaling, earth hummocks, non-sorted circles, non-sorted polygons.

1 Introduction

Small patterned-ground features, such as circles, polygons, nets, and hummocks, are products of freezing processes in soils (the patterned-ground terminology used here follows Washburn (1980). The presence of these features influences the microscale patterns of tundra vegetation (e.g. Bliss & Svoboda 1984, Matveyeva 1998) and strongly affects numerous key arctic ecosystem properties and processes (Walker et al. 1998, 2004). Previous investigations dealing with patterned ground have mainly focused on geomorphology (e.g. Washburn 1980), self-organization of patterned ground (e.g. Peterson et al. 2003, Kessler et al. 2001), and soil relationships (e.g. Ping et al. 2004). A few studies have addressed the vegetation of patterned ground (e.g. Wiggins 1951, Walker 1985, Chernov & Matveyeva 1997, Matveyeva 1998). This study is part of a multidisciplinary analysis of the complex interactions between climate, soils, and vegetation in the formation of these landforms along an 1800-km transect in Alaska and Canada that passes through all five bioclimate subzones of the Arctic Tundra Zone (CAVM Team 2003) (Fig. 1). Kade et al. (2005) described the vegetation along the Low-Arctic Alaskan portion of the transect while this papers describes and analyzes the vegetation along the High Arctic portion in Canada.

The High Arctic of Canada is characterized mainly by dry sparsely-vegetated landscapes with mineral soils, in contrast to the mainly moister well-vegetated landscapes with peaty soils in the Low Arctic (Bliss & Matveyeva 1992). Patterned ground occurs abundantly on nearly all landscapes in the High Arctic. Here we focus on the vegetation of the smaller patterned-ground features that are dominant on flat, primarily zonal sites, although we also include some patterned-ground plant communities in

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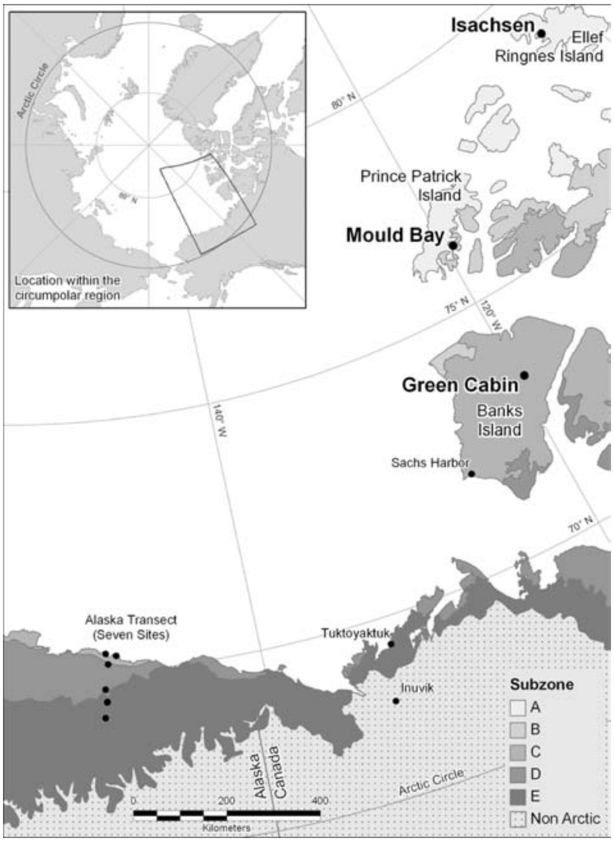

Fig. 1. Location of study sites in the Canadian Arctic Archipelago and their position within the arctic bioclimate subzones (CAVM Team 2003). Plant communities at Alaskan sites have been described by Kade et al. 2005.

some adjacent project-relevant wet and dry sites. The features described here include non-sorted circles, earth hummocks, and small non-sorted polygons. Non-sorted circles are more or less flat, barren to sparsely vegetated patches 0.5 to 3 m across and lack a border of stones (Washburn 1980). Earth hummocks are well-vegetated, dome shaped, about 40–50 cm high and 1–2 m across, with a core of silty and clayey mineral soil that may show evidence of cryoturbation (Zoltai et al. 1978). Non-sorted circles and earth hummocks are both circular in planar view and caused by differential frost heave, a process that has been described and modeled by Peterson & Krantz (2003). Non-sorted polygons are caused by contraction cracking due to either desiccation and/or freezing processes. These are much smaller than the circles, generally about 10 to 30 cm in diameter, and are, as their name suggests, angular polygonal forms with 4 to 6 sides (Washburn 1980).

2 Study area

The study sites in Canada were chosen within the mapped bioclimate subzones A, B, and C of the Arctic Tundra Zone as described by the Pan-Arctic Flora initiative and the Circumpolar Arctic Vegetation Map (Elvebakk 1999, CAVM Team 2003). These three subzones compose the High Arctic of Bliss & Matveyeva (1992). The emphasis here is on mesic zonal sites where the vegetation develops mainly in response to the regional climate, i. e. sites that are not influenced by extreme soil moisture, snow, disturbance, or unusual soil conditions. These sites are normally old, stable, well-drained, and with fine-grained sediments. Our study examines mainly zonal undisturbed sites paired with adjacent sites on the patterned-ground features, although in some project-relevant cases we include patterned ground of hygromesic or xeromesic sites. The study sites at Isachsen on Ellef Ringnes Island and Mould Bay on Prince Patrick Island are located near existing weather stations. Both stations were part of a joint Canadian-USA military weather collaboration that started in 1948. After abandonment of the facilities in 1978 and 1997, respectively, automated weather stations started recording at Isachsen in 1989 and at Mould Bay in 2002. The third site at Green Cabin on Banks Island has an automated weather station since 1998. Comparing the climates of Isachsen, Mould Bay, and Green Cabin is difficult because the stations have been moved and changed during the period of operation. Consistent data are therefore only available for Isachsen and Mould Bay for the period 1967–1977. Comparable data of all three sites is restricted to 2003–2005 (Table 1).

2.1 Isachsen: Subzone A

Isachsen is located at 78° 47′ N latitude and 103° 35′ W longitude on Ellef Ringnes Island, a small (11,295 km^2) low-lying island in the Sverdrup group of the Queen Elizabeth Islands. The substrate of El-

Table 1. Mean July temperatures and summer warmth indices (SWI) for the study sites. (Source: Environment Canada, August 20th 2006, www.weatheroffice.ec.gc.ca/canada_e.html).

Time period	Study site	Subzone	July ø T (°C)	SWI (°C mo)
1967-1977	Isachsen	A	2.77	3.58
	Mould Bay	B	3.96	6.22
	Green Cabin	C/D	–	–
2003-2005	Isachsen	A	2.20	2.53
	Mould Bay	B	2.43	3.57
	Green Cabin	C/D	7.13	14.67

lef Ringnes Island consists predominantly of eroded marine sediments of Jurassic to early Tertiary age (Heywood 1957, Stott 1969). In the vicinity of Isachsen, the topography is somewhat more varied than most of the island because of numerous rocky, volcanic, predominantly diabase hills about 100 m high. Scattered diabase glacial erratics from the nearby hills are common over much of the study area. These apparently were deposited during the late Wisconsin (Atkinson & England 2004). Most of the soils at our study sites consist of clays derived from the Christopher Formation marine shales (Everett 1968). The mean annual temperature for Isachsen (1967–1977) is −19.6 °C, the mean July temperature is 2.8 °C, and the summer warmth index (SWI, sum of the monthly mean temperatures greater than 0 °C) is 3.6 °C mo. The mean measured precipitation at Isachsen is 129 mm. Snow depths were measured May 12, 2006. Barren exposed areas had shallow snow less than 10 cm deep, and somewhat less exposed zonal sites had 22–30 cm of snow. Cloudy and foggy conditions are most common during the summer.

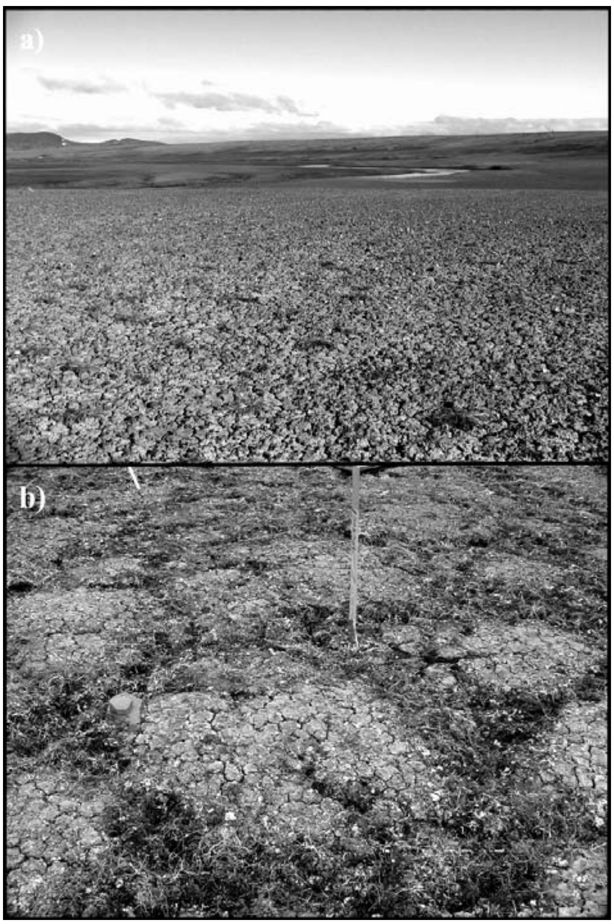

Fig. 2. Non-sorted polygons at Isachsen, Ellef Ringnes Island, Canada (subzone A);. a) Small non-sorted polygons (average diameter 10–20 cm) on dry plain near Isachsen Creek, b) larger non-sorted polygons (average diameter 50–60 cm).

The patterned-ground features in the region are predominantly small non-sorted polygons that are formed by contraction of the soils and subsequent cracking. On drier plains, which cover a large portion of the local landscape, the small polygons are 10–20 cm in diameter and poorly vegetated (Fig. 2a). Our main study site was on a gentle south-facing hillside near the landing strip at Isachsen. This site had a somewhat more favorable microclimate than much of the island. Larger non-sorted polygons, 30 to 50 cm in diameter were dominant on the better-vegetated surfaces. These appear to be an agglomeration of smaller polygons (see Fig. 2b). These larger polygons have well-developed vegetation mats in the cracks between the polygons. This situation was considered to be the zonal one. Non-sorted circles, which are formed by differential frost heave, are rare near Isachsen. Such features appear to require more continuous cover of vegetation. We observed non-sorted circles in only one small well-irrigated area at the base of a large snow bank where there was shallow peat development in a *Dupontia fisheri* plant community. The relevé data reported here are from either small non-sorted polygons on the dry plains or the larger non-sorted polygons in zonal sites.

A previous botanical survey by Savile (1961) reported a local flora of 49 vascular plants. Isachsen is placed within subzone A on the Circumpolar Arctic Vegetation Map (CAVM Team 2003). This subzone is characterized by a mean July temperature of < 3 °C, a very small flora (< 50 vascular species), generally open vegetation on zonal sites, a lack of all woody shrub species, the lack of all members of the family Cyperaceae, and the lack of peat development in wetlands. The prostrate dwarf shrub *Salix arctica* and the sedge *Eriophorum scheuchzeri* do occur at Isachsen, but only rarely in very favorable microhabitats, suggesting that Isachsen is at the southern limit of subzone A. There have been no previous vegetation-classification studies in the region.

2.2 Mould Bay: Subzone B

The research site near the Mould Bay weather station is located on the southern coast of Prince Patrick Island (15,848 km^2) at 76° 15′ N latitude and 199° 15′ W longitude in a somewhat sheltered position on the east side of Mould Bay. The local surface geologic units are mostly folded Paleozoic and Mesozoic sedimentary rocks, many of which are carbonate bearing (Tozer 1955, Tozer & Thorsteinsson 1964). The soils around the Mould Bay airstrip formed mainly from the Jurassic Wilke Point Formation, which consists of light gray, very-fine-grained sands, sandstones and siltstones, and the Devonian Griper Bay Formation, which has light-colored, fine to medium grained sandstones (Everett 1968). Tedrow et al. (1968) mapped the dominant soils in the immediate vicinity of the Mould Bay weather station as silt loam upland tundra soil. In contrast, large

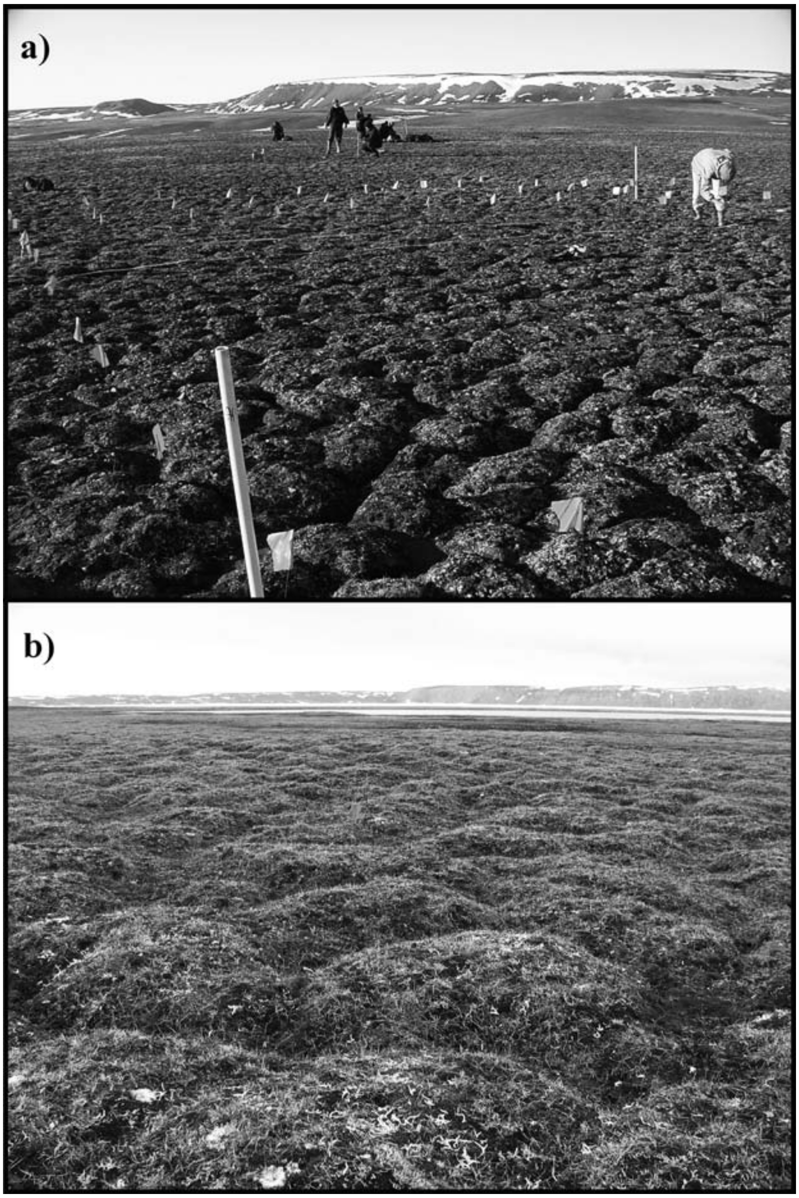

Fig. 3. Non-sorted polygons and earth hummocks at Mould Bay, Prince Patrick Island, Canada (subzone B); a) non-sorted polygons found at the drier sites, b) earth hummocks found at the wetter sites.

parts of the western plains of the island consist of gravels and dry sands without soil development or polar desert soils on acidic sands. The lack of glacial features in the area indicates that this area was not glaciated during the late-Wisconsin (Tedrow et al. 1968).

The mean annual temperature for Mould Bay (1967–1977) is −17.9 °C, the mean July temperature is 4.0 °C, and the SWI is 6.2 °C mo. The mean measured annual precipitation at Mould Bay is 104 mm. A snow cover of 7–25 cm had accumulated on zonal surfaces by early May 2006. Cloudy and foggy conditions are most common during the summer.

The fine-grained soils on the lower hills and valleys near the camp at Mould Bay are covered mainly by small non-sorted polygons and turf hummocks (Fig. 3a), similar to the dominant forms at Isachsen but more vegetated. The polygons are about 10–50 cm in diameter and formed by cracking. On slopes these often develop into turf hummocks where the cracks between the polygons become eroded to a depth of 10–20 cm. In snowbed situations the turf hummocks often are larger because the troughs between the hummocks are further eroded and enhanced by the deposition of windblown sand and silt on the tops of the hummocks (Broll & Tarnocai 2002). Our study also included earth mounds on a south-facing hill slope and in a hygromesic saline site at the coast adjacent to Mould Bay (Fig. 3b). Descriptions of the vegetation on these features are included here for comparison with earth mounds that are much more common at lower lati-

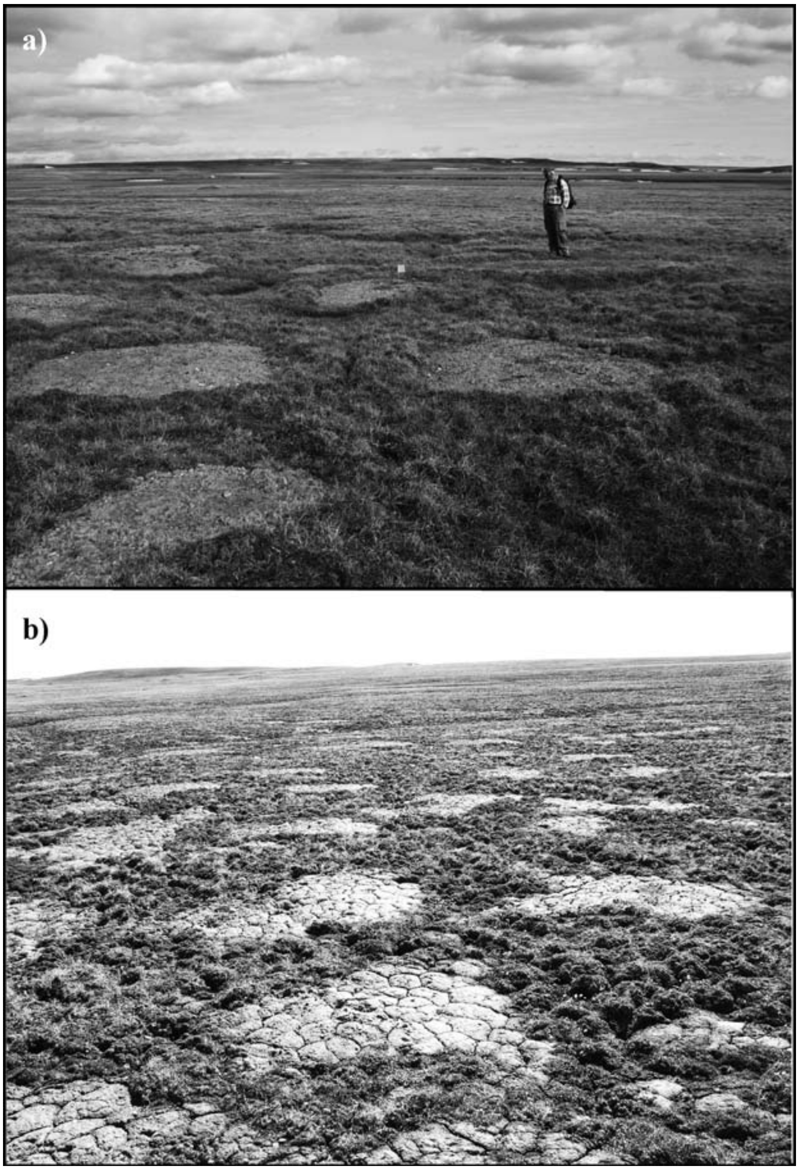

Fig. 4. Non-sorted circles at Green Cabin, Banks Island, Canada (subzone C);. a) Large non-sorted circles in a relatively wet site, b) xeromesic site with non-sorted circle in fine-grained sediments in a saddle near Green Cabin.

tudes (subzone E and the northern boreal forest). Sparsely vegetated coarse talus and gravel cover the nearby hills and ridges. These areas have some spectacular sorted polygons, nets, and stripes but the vegetation on these features is not included here because of the focus on non-sorted periglacial features on fine-grained sediments.

The relatively favorable microclimate with coastal fog and cool temperatures keep the soils moist all summer and promote the growth of a continuous cover of tundra on zonal surfaces. Vegetation studies in the region have been limited to floristic surveys (Porsild 1957, Savile 1961, Bird 1975). The flora of the Mould Bay vicinity consists of 84 species (Tedrow et al. 1968). In southeastern portions of Prince Patrick Island around Walker Inlet, Mould Bay, and Intrepid Inlet, lowlands and small hills to about 60 m are covered with tundra vegetation and fit the concept of bioclimate subzone B of the Circumpolar Arctic Vegetation Map (CAVM Team 2003). The zonal vegetation on well-drained upland surfaces consists of a rich assemblage of rushes (*Luzula nivalis* and *L. confusa*), grasses (e.g. *Alopecurus borealis, Arctagrostis latifolia, Festuca brachyphylla*), forbs (e.g. *Cerastium* spp., *Draba* spp., *Oxyria digyna, Papaver radicatum, Saxifraga* spp., *Stellaria* spp.), prostrate dwarf shrubs (*Dryas integrifolia* and *Salix arctica*), and many species of mosses and lichens. The nearby plateaus above 100 m and northwestern two thirds of the island are very sparsely vegetated and fit the concept of elevation belt A of the CAVM.

2.3 Green Cabin: Subzone C

Green Cabin is located at 73° 13′ N latitude and 119° 32′ W longitude in Aulavik National Park on northeastern Banks Island (70,028 km^2). The cabin and airstrip are situated on a sandy gravel terrace of the Thomsen River and the study sites are in the nearby low hills southwest of the cabin (Munger et al. 2004). These hills are composed of well-weathered glacial till deposited during the middle-Pleistocene (Vincent 1990).

The summer climate of Green Cabin is more continental than that at Isachsen or Mould Bay. Sunny, warm conditions often occur when the coast has fog and drizzle. For the period 2003–2005, the mean July temperature at Green Cabin was 7.1 °C and the SWI was 14.7 °C mo. The short-term climate data suggest that this location may be near the southern boundary of subzone C or actually within subzone D (see below). No precipitation data are available from the site.

The most common patterned-ground forms at Green Cabin are small non-sorted polygons on flat areas. Turf hummocks and stripes are common on nearly all hill slopes. Non-sorted circles occur locally where there is good cover of vegetation, especially in wet peaty lowland areas (Fig. 4a) and in broad saddles between hills where fine soil particle accumulate (Fig. 4b). The latter situation is uncommon at Green Cabin, but it was considered to be the zonal one. Our analysis included non-sorted circles and irregular patterned ground features on xeromesic sites, and large very well-developed non-sorted circles in a hygromesic meadow.

No previous vegetation classification has been done at Green Cabin, but relevant nearby work was done by Schweingruber (1977) at Umingmak on Banks Island and Thannheiser (1988) on Victoria Island. Zoltai et al. (1980) prepared a general map of soils, the relief classes, surface deposits, soil texture, petrography, vegetation types, and percent ground cover for the proposed Aulavik Park including Green Cabin at 1 : 250,000 scale. This same report lists 154 plant taxa for the Thomsen River region.

Green Cabin is shown as within subzone C on the CAVM. Subzone C is broadly similar to subzone B with generally prostrate dwarf-shrub vegetation, but with mean July temperatures in the range of 5–7 °C, vascular flora in the range of 75–150 species, and an abundance of the hemiprostrate shrub *Cassiope tetragona* particularly in snowbed sites. It is distinguished from subzone D by a lack of erect dwarf shrubs greater than 10 cm tall. The general physiognomy of the vegetation at Green Cabin is predominantly that of subzone C and very similar to sites on Howe Island in northern Alaska (Kade et al. 2005). However, after sampling this location, several factors suggest that Green Cabin is near the southern boundary of bioclimate subzone C or may actually be in subzone D, including the large flora, warm summer climate, and the presence of erect dwarf shrubs (*Salix richardsonii*) in favorable habitats.

3 Methods

3.1 Field and laboratory methods

We established 21 plots at Isachsen, 24 at Mould Bay, and 30 at Green Cabin. Vegetation sampling was conducted during the summer periods of 2003 through 2005 using the centralized replicate sampling procedure (Mueller-Dombois & Ellenberg 1974). Relevés were selected within homogeneous stands of vegetation. The plots, however, did not have discrete boundaries and no frame was used to define the limits of the plots. Patterned ground has very complex horizontal structure, consisting of many small areas that are difficult to draw boundaries around. Often it is difficult to find single areas that contain all the species that are typical of the communities. If the sample was in a large area of homogeneous tundra we started with a small area of search and expanded the area of search until all of the species in the community were noted, we then estimated the size of the area that we searched after the relevé was finished. In complex situations with very small micro-communities, such as in areas of small non-sorted polygons, we would divide the plot into microhabitats (e. g., polygon centers and polygon troughs) and confine one relevé to the troughs and one to the centers, and then search each small habitat until we had a complete species list for that habitat. We then estimated the area searched after completing our species list. Generally, we searched at least a square meter of similar habitat to get sufficient area for the relevé. Cover-abundance of each species was recorded according to the scale in Westhoff & Van der Maarel (1973).

In addition, we recorded the cover of plant groups and the average vegetation height. Vascular plant nomenclature followed the Panarctic Flora Checklist draft (Elven et al. 2006). Nomenclature of mosses followed Ignatov & Afonina (1992), Konstantinova et al. (1992) for liverworts, and Esslinger (1997) for lichens. All cryptogamic collections were identified or verified at the Komarov Botanical Institute in St. Petersburg, Russia, where voucher specimens are housed. Vascular plants were collected from most study plots and are at the Alaska Geobotany Center, University of Alaska, Fairbanks.

At each relevé, we recorded the following site information: percent bare soil, percent salt crust, cover of standing water, exposure, and elevation. Moreover, the sites were briefly described using subjective rating scales for a variety of environmental factors including snow duration, glacial history, topography, site stability, and site moisture.

We measured maximum snow depths in mid May 2006 at Mould Bay and Isachsen. We were not able to measure snow depths at Green Cabin, because we were unable to land there during the snow survey. Maximum thaw depths were measured in late July (years varied with site) using a metal probe.

We measured the depth of the organic horizon and collected soil samples of the upper 10 cm of the mineral horizon, which represents the rooting zone for most tundra species. 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 °C for 72 hours and determining percentage weight loss. All other analyses were completed on air-dried samples. Particle size, pH-values, total carbon, total nitrogen, and availability of cations (K^+, Na^+, Ca^{2+}, Mg^{2+}) were determined using standard methods described in Kade et al. (2005).

We correlated the vegetation information with the summer warmth index (SWI) calculated for all study sites (Table 1). We also mapped the patterned ground at selected study sites in 1 × 1-m plots.

3.2 Typification of vegetation, syntaxonomic classification and ordination

We distinguished vegetation types according to the Braun-Blanquet sorted-table method (Westhoff & Van der Maarel 1973, Mueller-Dombois & Ellenberg 1974) and the protocol suggested by Dierschke (1994). Vegetation types are characterized by character and differential species of local value. Differential species and degree of fidelity of species were distinguished following the criteria proposed by Dierschke (1994). We refrained from distinguishing associations; however, we assigned the community types when possible to higher syntaxa.

The relationship between vegetation frequency data and environmental data were explored through ordination analysis, using detrended correspondence analysis (DCA) and nonmetric multidimensional scaling (NMDS) (Legendre & Legendre 1988, Kent & Coker 1992, Ter Braak 1995). We used both methods because there is currently no consensus on the most appropriate indirect ordination method (Kent & Coker 1992, Ter Braak 1995); DCA assumes a unimodal species response curve, whereas NMDS makes no such assumption, deriving configuration scores only from the rank order of the dissimilarities between samples or species (Faith et al. 1987); and where both methods produced similar results, we felt more confident that the patterns represented an inherent structure in the data.

Thus, for the analysis a NMDS as implemented in PC-ORD 4.10 (McCune & Mefford 1999) was used. To reduce the noise of rare species, species in fewer than three plots were deleted prior to analysis. The appropriate dimensionality for the ordination was determined by first running NMDS in autopilot mode with 50 runs for each of six dimensionalities; the lowest dimensionality was chosen that (i) showed substantial stress reduction compared to the next lowest dimensionality and (ii) captured new information in all dimensions. In this dataset, ordinations were best described by two axes (instability < 0.00005). To ensure that the ordination avoided a local stress minimum, the analysis was then run 50 times using random starting configurations, 50 runs of the real data, 100 runs with the randomized data for a Monte Carlo test of significance. Biplot diagrams were used to show the direction and strength of correlation in the ordination diagram for metric environmental variables having correlation $r^2 > 0.35$.

3.3 Plant groups and phytogeographic spectra

We analyzed growth form distributions (prostrate dwarf-shrubs, forbs, graminoids, mosses, liverworts, and lichens) and the phytogeographic spectra of the communities using the methods described in Kade et al. (2005). Each vascular species was assigned to a class according to three categories: major regional units (coastal, arctic, arctic-alpine, arctic-boreal), northern limits of plant distribution within the four climatic zones developed by Young (1971, slightly modified), and geographic range (North America, North America-Asia, North America-Asia-Europe, circumpolar). Young (1971) differentiated four climatic zones based on the SWI criteria (zone 1 = 0–6 °C, zone 2 = 6–12 °C, zone 3 = 12–20 °C, zone 4 = 20–35 °C).

4 Results and discussion

4.1 Classification overview

The typological analysis of cryoturbated tundra in the High Arctic of Canada resulted in 11 community types that have been tentatively placed into four classes (Table 2, Appendix 1). Five plant communities are placed in the class Carici rupestris-Kobresietea bellardii Ohba 1974. This class includes mostly meso- to xerophytic, minerotrophic dwarf-shrub and grass heath communities comprised of circumpolar arctic and alpine species (Kade et al. 2005). The communities belong to the order Kobresio-Dryadetalia (Br.-Bl. 1948) Ohba 1974 and the North American alliance Dryadion integrifoliae Ohba ex Daniëls 1982. The *Dryas integrifolia–Carex rupestris* community, the *Hypogymnia subobscura–Lecanora epibryon* community, and the *Orthotrichum speciosum–Salix arctica* community belong to the typical suballiance of the Dryadion integrifoliae, Dryadenion integrifoliae Sieg, Drees et Daniëls 2006 (Sieg et al. 2006). The *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community and the *Dryas integrifolia–Carex aquatilis* community belong to the Dryadion integrifoliae suball. Rhododendrenion lapponici Lünterbusch et Daniëls 2004, a meso-hygrophytic sub-

Table 2. Class, order, alliance of the cryoturbated tundra in the Canadian High Arctic.

Undescribed unit
Puccinellia angustata -Potentilla vahliana comm.
nonsorted circles and bare patches, xeromesic nonacidic tundra, subzone C
Carici rupestris-Kobresietea bellardii Ohba 1974
Kobresio-Dryadetalia (Br.-Bl. 1948) Ohba 1974
Dryadion integrifoliae Ohba ex Daniëls 1982
Hypogymnia subobscura -Lecanora epibryon comm.
nonsorted polygons, xeromesic nonacidic tundra, subzone B
Orthotrichum speciosum -Salix arctica comm.
interpolygon areas, xeromesic nonacidic tundra, subzone B
Dryas integrifolia -Carex rupestris comm.
intercircle areas and vegetated patches, xeromesic nonacidic tundra, subzone C
Braya glabella ssp. *purpurascens -Dryas integrifolia* comm.
nonsorted circles, hydromesic nonacidic tundra, subzone C
Dryas integrifolia -Carex aquatilis comm.
intercircle areas, hydromesic nonacidic tundra, subzone C
Scheuchzerio-Caricetea nigrae (Nordh. 1936) Tx. 1937
Scheuchzerietalia palustris Nordh. 1936
Caricion lasiocarpae Vanden Berghen ap. Lebrun et al. 1949
Salix arctica -Eriophorum angustifolium ssp. *triste* comm.
earth hummocks, hygric nonacidic tundra, subzone B
Eriophorum angustifolium ssp. *triste -Carex aquatilis* comm.
intercircle areas, hygric nonacidic tundra, subzone C
Salicetea herbaceae Br.-Bl. 1947
Salicetalia herbaceae Br.-Bl. 1926
Saxifrago-Ranunculion nivalis Nordh. 1943 emend. Dierβ. 1984
Saxifraga-Parmelia omphalodes ssp. *glacialis* comm.
interpolygon areas, hydromesic nonacidic tundra, subzone A
Cochlearia groenlandica -Luzula nivalis comm.
earth hummocks, hydromesic nonacidic tundra, subzone B
Thlaspietea rotundifolii Br.-Bl. 1948
Thlaspietalia rotundifolii Br.-Bl. in Br.-Bl. et Jenny 1926
Arenarion norvegicae Nordh. 1935
Puccinellia angustata -Papaver radicatum comm.
nonsorted polygons, xeromesic tundra, subzone A

alliance described from Greenland by Lünterbusch & Daniëls (2004).

The *Salix arctica–Eriophorum angustifolium* ssp. *triste* community (subzone B) and the *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* (subzone C) are placed in the mire class Scheuchzerio-Caricetea nigrae (Nordh. 1936) Tx. 1937, order Scheuchzerietalia palustris Nordh. 1936, alliance Caricion lasiocarpae Vanden Berghen ap. Lebrun et al. 1949. This alliance includes wet basiphytic sedge beds on calcareous, poorly drained soils and occurs in the northern boreal zone and the Arctic (Kade et al. 2005).

The *Cochlearia groenlandica–Luzula nivalis* community of subzone B and the *Saxifraga–Parmelia omphalodes* ssp. *glacialis* community of subzone A are provisionally placed within the snow patch class Salicetea herbaceae Br.-Bl. 1947, order Salicetalia herbaceae Br.-Bl. 1926, alliance Saxifrago-Ranunculion nivalis Nordh. 1943 emend. Dierß. 1984, suballiance Luzulenion arcticae (Nordh. 1936) Gjærevoll 1950. The class comprises alpine and arctic snow-patch communities, which often exhibit solifluction and cryoturbation features, and the alliance is tied to arctic regions with relatively wet permafrost soils. The Luzulenion

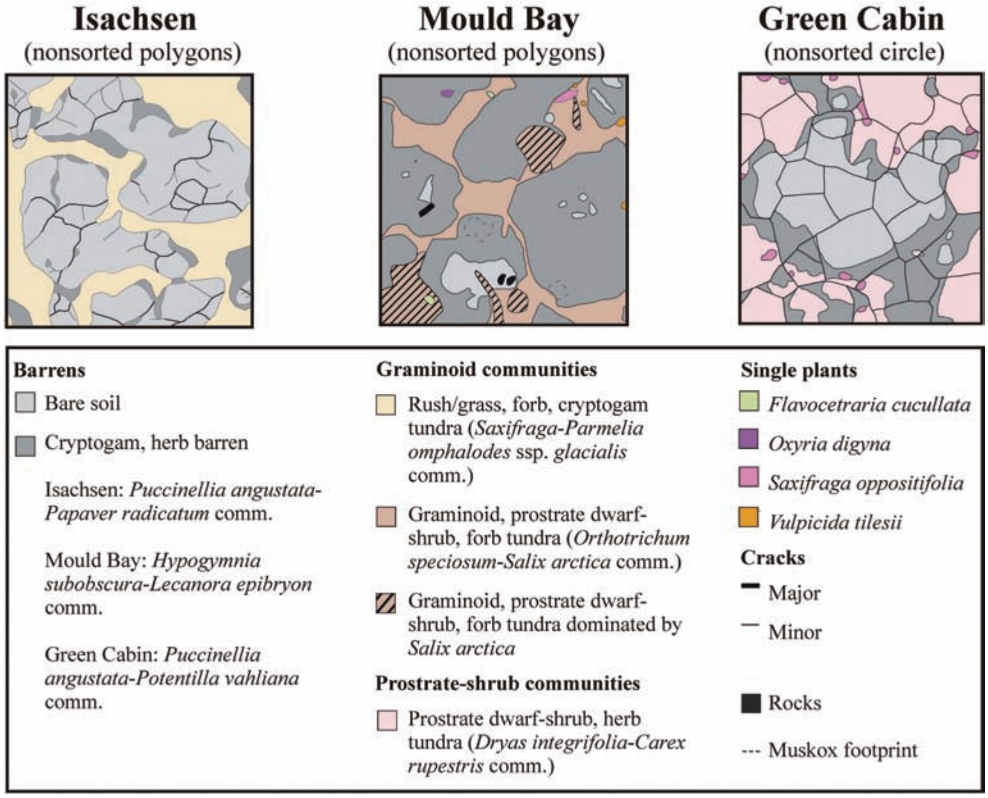

Fig. 5. Vegetation maps of typical 1 × 1 m plots of the patterned ground forms occurring in representative xeromesic habitats at Isachsen, Mould Bay, and Green Cabin.

arcticae includes communities with arctic species on slightly drier soils (Kade et al. 2005).

The xeromesic non-sorted polygons of subzone A (*Puccinellia angustata–Papaver radicatum* community) are placed within the scree slope class Thlaspietea rotundifolii Br.-Bl. 1948, order Thlaspietalia rotundifolii Br.-Bl. in Br.-Bl. et Jenny 1926, and alliance Arenarion norvegicae Nordh. 1935. This class includes arctic and alpine scree slope communities and the alliance is tied to boreo-arctic scree slope communities occurring on calcareous bedrock. The xeromesic, nonacidic bare non-sorted circles and bare patches of subzone C (*Puccinellia angustata–Potentilla vahliana* community) could not be properly assigned to a described class.

4.2 Maps of typical zonal features in each subzone

The morphological changes of the investigated patterned ground forms on zonal sites of subzones A, B, and C are shown in representative 1 × 1-m maps in Fig. 5. The non-sorted polygons at Isachsen exhibit a high cover of bare ground and contained smaller non-sorted polygons. The outer parts of the non-sorted polygons are covered with cryptogams. Interpolygon areas have mainly rushes, forbs, lichens, and mosses. At Mould Bay the non-sorted polygons (Fig. 5) have only small patches of bare ground. Polygons are almost completely overgrown with cryptogams and herbs. Prostrate dwarf-shrubs, graminoids, and forbs dominate in interpolygon areas. The middle of the non-sorted circles at Green Cabin at the dry southern end of the gradient is almost bare and the outer parts of the circles are covered with cryptogamic crust. Several contraction cracks dissect the non-sorted circles and form small contraction crack polygons. Prostrate dwarf-shrubs and herbs dominate in intercircle areas.

4.3 Description of the plant communities

The following descriptions of the vegetation types are arranged according to climatic subzones, starting with the sites farthest north. Within each subzone, the vegetation types are sorted by soil moisture. Drier sites are mentioned first. Table 3 summarizes the environmental information and plant growth-form characteristics for each of the eleven plant communities.

4.3.1 Isachsen (subzone A)

***Puccinellia angustata–Papaver radicatum* community** (Table 4; Fig. 6)

This community occurs on barren non-sorted polygons of subzone A. Two common variations are de-

Table 3. Environmental variables and plant groups for the plant communities of the cryoturbated tundra. Mean with standard error in parentheses for the environmental variables and total species number for the plant groups.

	Puccinellia angustata–Papaver radicatum	*Saxifraga–Parmelia omphalodes* ssp. *glacialis*	*Hypogymnia subobscura–Lecanora epibryon*	*Orthotrichum speciosum–Salix arctica*	*Cochlearia groenlandica–Luzula nivalis*	*Salix arctica–Eriophorum angustifolium* ssp. *triste*	*Puccinellia angustata–Potentilla vahliana*	*Dryas integrifolia–Carex rupestris*	*Braya glabella* ssp. *purpurascens–Dryas integrifolia*	*Dryas integrifolia–Carex aquatilis*	*Eriophorum angustifolium ssp. triste–Carex aquatilis*
Thaw depth (cm)	38.0 (1.1)	30.9 (1.1)	31.4 (0.9)	24.2 (0.8)	20.7 (2.0)	31.3 (3.0)	53.5 (3.1)	40.5 (7.0)	56.1 (1.7)	23.8 (1.7)	22.3 (0.7)
Snow depth (cm)	13.36 (2.9)	20.4 (2.9)	17.3 (1.5)	23.2 (1.4)	49.0 (4.9)	NA	NA	NA	NA	NA	NA
O-horiz. depth (cm)	0.0 (0.0)	9.3 (4.7)	0.0 (0.0)	3.0 (0.9)	3.3 (1.0)	3.1 (1.1)	0.0 (0.0)	0.8 (0.3)	0.2 (0.1)	14.8 (5.0)	9.3 (6.4)
Bare soil (%)	89.1 (2.3)	0.0 (0.0)	12.0 (4.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	87.5 (2.5)	27.3 (10.6)	50.3 (13.4)	0.0 (0.0)	14.2 (12.9)
Soil moist. (vol.-%)	22.9 (1.2)	36.7 (2.0)	29.4 (1.3)	30.0 (2.5)	35.0 (1.7)	41.8 (2.9)	11.8 (1.6)	16.1 (1.9)	34.3 (7.0)	66.1 (2.8)	66.3 (2.5)
Bulk density (g/cm^3)	1.3 (0.0)	1.1 (0.1)	1.3 (0.1)	1.1 (0.1)	1.3 (0.1)	1.1 (0.1)	1.2 (0.1)	1.0 (0.1)	1.1 (0.1)	0.5 (0.1)	0.5 (0.1)
Sand content (%)	14.1 (1.3)	14.3 (2.8)	42.6 (4.4)	47.0 (3.5)	33.1 (2.0)	40.8 (2.4)	40.4 (1.2)	67.2 (2.1)	75.3 (1.1)	81.1 (3.6)	80.7 (2.6)
Silt content (%)	31.8 (1.1)	34.5 (0.8)	46.4 (2.8)	44.0 (2.3)	41.6 (1.1)	41.0 (2.7)	33.8 (1.0)	18.8 (1.2)	16.4 (1.2)	16.1 (3.2)	16.9 (2.6)
Clay content (%)	54.1 (1.1)	51.2 (2.1)	11.0 (2.4)	9.1 (1.5)	25.3 (1.2)	18.2 (1.5)	25.8 (0.2)	14.0 (1.7)	8.4 (0.8)	2.9 (0.9)	2.4 (0.8)
Soil pH	6.3 (0.1)	6.4 (0.2)	7.4 (0.2)	7.1 (0.2)	5.5 (0.1)	5.8 (0.2)	8.4 (0.1)	8.1 (0.1)	8.3 (0.1)	7.3 (0.1)	7.5 (0.0)
Total C (%)	2.69 (0.04)	3.23 (0.26)	1.89 (0.30)	3.04 (0.51)	1.66 (0.17)	2.58 (0.60)	4.53 (0.21)	6.80 (0.28)	7.3 (0.4)	9.73 (1.06)	9.66 (1.20)
Total N (%)	0.20 (0.00)	0.24 (0.02)	0.13 (0.02)	0.20 (0.02)	0.09 (0.01)	0.14 (0.04)	0.08 (0.02)	0.26 (0.02)	0.14 (0.04)	0.66 (0.07)	0.46 (0.11)
Ca^{2+} (me/100g)	9.5 (0.2)	10.9 (0.5)	10.8 (1.2)	14.5 (2.4)	4.6 (0.4)	9.1 (2.3)	28.1 (2.8)	30.4 (1.7)	34.0 (2.7)	35.8 (4.3)	23.0 (4.6)
Mg^{2+} (me/100g)	6.01 (0.30)	7.57 (0.43)	3.89 (0.29)	3.87 (0.29)	3.69 (0.23)	2.88 (0.48)	14.22 (0.80)	9.19 (0.52)	7.92 (0.96)	10.53 (1.07)	8.46 (1.60)
K^+ (me/100g)	0.59 (0.02)	0.63 (0.03)	0.13 (0.02)	0.17 (0.02)	0.27 (0.01)	0.19 (0.02)	0.35 (0.04)	0.33 (0.01)	0.10 (0.01)	0.16 (0.03)	0.16 (0.06)
Na^+ (me/100g)	0.15 (0.03)	0.23 (0.03)	0.11 (0.03)	0.10 (0.02)	0.52 (0.05)	0.13 (0.04)	0.23 (0.00)	0.13 (0.04)	0.08 (0.01)	0.08 (0.02)	0.05 (0.02)
Prostrate dwarf shrubs (species)	0	0	2	2	0	2	1	2	2	2	1
Forbs (species)	13	14	13	13	14	11	10	18	9	15	4
Graminoids (species)	5	6	5	4	5	6	2	3	11	9	10
Vascular (species)	18	20	20	19	19	19	13	23	22	26	15
Mosses (species)	42	37	29	34	25	45	0	22	15	23	18
Lichens (species)	66	59	36	7	17	27	0	25	10	11	0
Liverworts (species)	4	12	0	0	2	1	0	1	2	1	3

scribed: the first occurs in very barrens situation on small non-sorted polygons; the second occurs in xeromesic situations on larger more-vegetated non-sorted polygons with an average diameter of 50–60 cm.

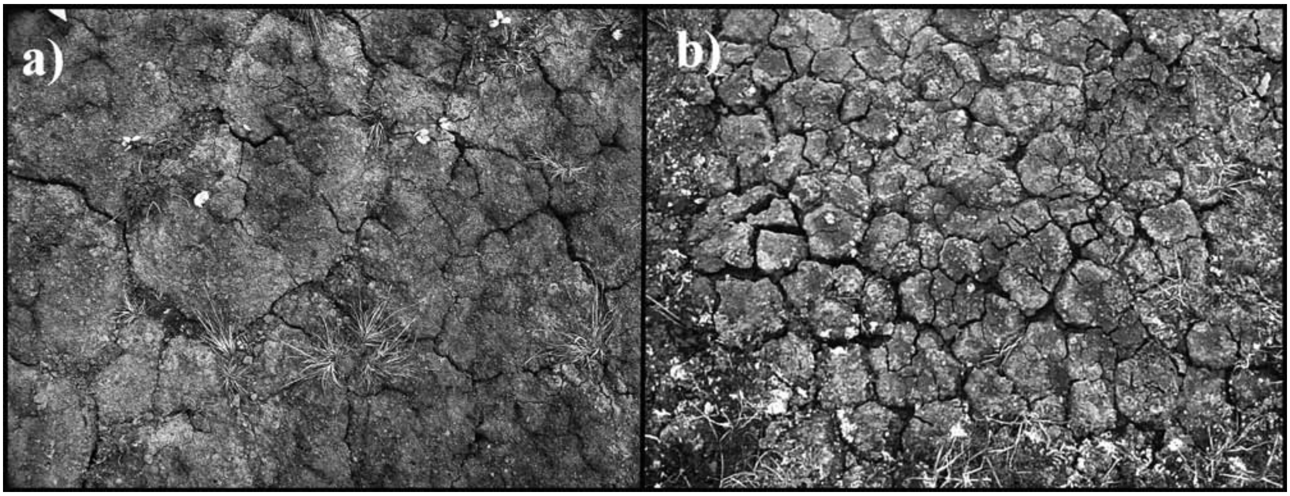

Fig. 6. *Puccinellia angustata – Papaver radicatum* community occurring on xeromesic non-sorted polygons at Isachsen: a) *Poa abbreviata* variant, b) *Poa alpigena* variant.

The community is characterized by barren surfaces – bare soil covers up to 96 % of the community. Vegetated parts of the community are mainly covered by crustose lichens. Only a few scattered vascular plants occur, including *Papaver radicatum, Puccinellia angustata/andersonii, Draba oblongata, Alopecurus borealis* and *Saxifraga cernua*. (Note: we were unable to consistently distinguish *Puccinellia angustata* from *P. andersonii* in the field; both these species were present in this community. However, due to the fact that *Puccinellia angustata* is common in other subzone areas, we named this community *Puccinellia angustata – Papaver radicatum* community.Future studies should be able to clarify which Puccinellia species is dominant in this community and therefore it might be that this community has to be renamed afterwards).

Character/differential taxa of this community are mainly crustose lichen species, including *Rinodina terrestris, Fuscopannaria praetermissa, Lecidella wulfenii, Megaspora verrucosa, Megalaria jemtlandica* etc., along with *Puccinellia* spp..

This community is divided into two variants. The *Poa abbreviata* variant is the more barren, occurring on ridge crests and wind-swept sites. The community establishes itself mainly in the narrow contraction cracks. The *Poa alpigena* variant occurs on the more vegetated polygons with up to 18 % cover. This variant occurs in complexes with the *Saxifraga – Parmelia omphalodes* ssp. *glacialis* community, which occurs in the interpolygon areas. In the *Poa alpigena* (zonal) variant more vascular taxa are found than in the *Poa abbreviata* variant. Main differential taxa for the *Poa abbreviata* variant are *Ochrolechia* cf. *inaequatula* and *Poa abbreviata*. The *Poa alpigena* variant is mainly differentiated by *Thamnolia vermicularis, Poa alpigena, Cerastium arcticum, Stellaria longipes*, and *Polytrichastrum alpinum*. Being situated within complexes with the more mesic *Saxifraga – Parmelia omphalodes* ssp. *glacialis* community, this variant shares several of its taxa, including *Cardamine bellidifolia, Cladonia pyxidata, Festuca brachyphylla, Poa alpigena, Ranunculus sabinei, Rinodina turfacea, Schistidium frigidum* etc.

The soil types of this community vary with site moisture conditions and the amount of bare soil. Typic Haplorthels are found on the drier, less vegetated sites and Glacic Aquiturbels (Ping & Michaelson in Vonlanthen et al. 2006) on the moister, zonal sites. Organic horizons are absent; and the exposed mineral soils show signs of contraction cracking (Washburn 1980). The mineral soil is brown to dark grayish brown and has high clay content (> 50 %). Soil moisture is low (20 % bare sites, 26 % more vegetated sites), and the soil pH averages 6. 3. Average thaw depth is greater at the bare sites (41 cm) than at the zonal sites (35 cm). More snow is accumulated at the zonal sites (21 cm) than at the bare sites (7 cm).

The *Puccinellia angustata – Papaver radicatum* community shows some similarities with the Papaveretum radicati (e.g. Dierssen 1992) and the Papaveretum dahliani (Hofmann 1968) described from Arctic regions, even though this community is more species rich and *Papaver radicatum* is not as abundant (Möller 2000) as in most Papaveretum associations described in High Arctic regions. We placed this community in the class Thlaspietea rotundifolii (alliance Arenarion norvegicae).

Saxifraga – Parmelia omphalodes ssp. _glacialis_ community (Table 5; Fig. 2b)

The *Saxifraga – Parmelia omphalodes* ssp. *glacialis* community occurs in mesic interpolygon areas in subzone A in association with the *Poa alpigena* variant of the *Puccinellia angustata – Papaver radicatum* community described above. The community has nearly 100 % cover of vegetation, dense moss cover, and is species rich. The interpolygon areas are 5 to

Table 4. *Puccinellia angustata – Papaver radicatum* community in xeromesic non-sorted polygons at Isachsen (subzone A).

	Poa abbreviata var.							Poa alpigena var.						
Relevé No.	501	502	503	507	505	504	506	519	517	521	515	511	509	513
Altitude (m.a.s.l.)	41	40	45	38	35	35	42	45	30	40	32	39	29	47
Plot size (m^2)	25	16	16	25	16	16	25	25	25	25	25	25	25	25
Vegetation cover (%)	5	5	4	5	5	4	5	25	30	15	5	20	15	10
Number of vascular taxa	12	9	5	7	4	4	5	14	15	15	14	8	12	13
Number of nonvascular taxa	59	42	45	23	20	20	17	37	29	35	34	43	38	22
Total number of taxa	71	51	50	30	24	24	22	51	44	50	48	51	50	35
Ch/D: Community														
Rinodina terrestris	1	2	+	2	2	1	1	2	1	.	+	1	+	+
Fuscopannaria praetermissa	+	+	+	+	.	+	+	+	+	+	r	+	+	+
Lecidella wulfenii	+	+	+	+	+	+	+	+	+	+	.	+	+	+
Puccinellia andersonii/angustata	1	1	+	1	1	1	1	+	+	+	+	.	+	.
Megaspora verrucosa	+	+	+	+	+	+	+	+	+	+	+	r	.	.
Megalaria jemtlandica	+	+	+	+	.	.	+	.	+	+	+	+	+	+
Tetramelas insignis	+	+	.	.	.	+	.	+	+	+	+	+	+	+
Lecanora hagenii var. fallax	+	+	+	.	.	.	+	+	+	+	.	.	.	.
Collema ceraniscum	r	.	+	.	.	.	.	.	+	+	+	+	.	.
Leptogium gelatinosum	+	.	+	.	.	.	.	+	.	.	+	+	+	.
Leptogium lichenoides	.	.	+	.	+	.	+	+	.	.	+	+	.	.
D: Poa abbreviata var.														
Ochrolechia cf. inaequatula	+	+	+	+	+	+	+	.	.	+	.	.	.	.
Poa abbreviata	1	+	r	+	r	+	r	r	.	r	.	.	.	.
Racomitrium panschii	+	+	+	+	+	+	.	+	.	+	.	.	.	.
Cladonia pocillum	+	+	+	+	+	+	.	.	.	.	.	.	+	.
Caloplaca ammiospila	+	+	+	+	+	+	.	.	.	.	.	.	.	.
Candelariella terrigena	+	+	+	+	.	+	+	.	.	.	.	.	.	.
Caloplaca tiroliensis	+	+	+	+	.	+	+	.	.	.	.	.	.	.
Caloplaca cerina	+	+	+	+	+	.	+	.	.	.	.	.	.	.
Stereocaulon rivulorum	+	+	+	+	.	+	.	.	.	.	.	.	.	.
Didymodon icmadophilus	+	+	+	+	.	.	.	.	.	.	.	.	.	.
Stereocaulon glareosum	.	.	+	+	.	+	+	.	.	.	.	.	.	.
Cephaloziella arctica	+	+	+	.	+	.	.	.	.	.	.	.	.	.
Ceratodon purpureus	+	+	+	.	.	.	.	.	.	.	.	.	+	.
Peltigera rufescens	+	+	+	.	.	.	.	.	+	.	.	.	.	.
Sanionia uncinata	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Rinodina olivaceobrunnea	+	+	.	.	+	.	.	.	.	.	.	.	.	.
Schistidium papillosum	+	+	.	.	+	.	.	+	.	.	.	.	.	.
Cetraria aculeata	+	.	.	r	+	.	.	.	.	.	.	.	.	.
D: Poa alpigena var.														
Thamnolia vermicularis	.	+	+	.	.	.	.	+	+	+	+	1	+	+
Poa alpigena	.	.	.	.	.	.	.	+	+	+	+	+	+	+
Cerastium arcticum	+	+	.	.	.	.	.	+	+	+	+	+	+	+
Stellaria longipes	+	+	.	.	.	.	.	+	+	+	+	+	+	+
Polytrichastrum alpinum	+	+	.	.	.	.	.	+	+	+	+	+	+	+
Ranunculus sabinei	r	.	.	.	.	.	.	+	+	+	r	r	+	.
Saxifraga nivalis	.	+	.	.	.	.	.	+	+	+	+	.	+	+
Cladonia pyxidata	.	.	.	.	.	.	.	+	+	+	.	+	+	+
Protopannaria pezizoides	.	.	+	.	.	.	.	+	+	+	+	+	.	.
Festuca brachyphylla	.	.	.	.	.	.	.	+	+	+	+	.	.	+
Encalypta rhaptocarpa	.	.	.	.	.	.	.	+	+	r	r	.	+	.
Minuartia rossii/rubella	.	.	.	.	.	.	.	r	+	.	.	+	+	+
Schistidium frigidum	+	.	.	.	.	.	.	+	.	+	+	+	.	+
Cardamine bellidifolia	r	.	.	r	.	.	.	.	+	+	+	.	+	+
Tetramelas papillata	.	.	.	.	.	.	.	.	+	+	+	+	.	.
Peltigera venosa	.	.	.	.	.	.	.	r	.	.	r	r	.	.

Table 4 (cont.)

d: more wind-exposed, more disturbed plots														
Cetraria islandica ssp. islandica	+	.	.	.	.	.	.	+	+	+	.	.	+	.
Distichium capillaceum	.	.	.	.	.	.	.	+	+	+	.	.	+	.
Potentilla hyparctica	r	.	.	.	.	.	.	+	+	+	.	.	.	r
Cirriphyllum cirrosum	.	.	.	.	.	.	.	+	+	+	.	.	.	.
d: less wind-exposed, less disturbed plots														
Lepraria cf. vouauxii	.	.	+	.	.	.	.	.	.	.	+	+	+	+
Japewia tornoënsis	.	.	.	.	.	.	.	.	.	.	+	+	+	+
Stereocaulon alpinum	.	.	.	.	.	.	.	.	.	+	+	+	+	+
Candelariella placodizans	.	.	.	.	.	.	.	.	.	+	+	+	.	+
Arctomia delicatula	+	.	.	.	.	.	.	+	.	.	+	+	+	.
Myxobilimbia lobulata	.	.	.	.	.	.	.	.	.	.	r	r	+	.
Solorina bispora var. subspongiosa	+	.	.	.	.	.	.	.	.	.	r	+	+	.
Ch: Class, order, and alliance														
Papaver radicatum	1	1	+	+	1	1	1	+	+	+	+	+	+	+
Others														
Hypnum revolutum	+	+	+	+	+	+	.	1	1	1	1	1	1	+
Pertusaria octomela	+	+	+	+	r	+	.	1	2	+	+	+	1	+
Draba oblongata	+	+	+	+	r	+	r	.	+	+	+	+	+	+
Alopecurus borealis	+	+	.	+	1	1	.	1	1	+	+	1	+	1
Ochrolechia inaequatula	+	+	+	.	.	+	+	+	+	+	+	+	+	+
Syntrichia ruralis	+	+	+	+	r	.	r	+	+	+	+	+	+	.
Psoroma hypnorum	+	+	+	+	+	+	+	+	+	+	.	+	.	.
Rinodina turfacea	+	+	+	+	.	.	.	+	+	+	+	+	+	+
Parmelia omphalodes ssp. glacialis	+	+	.	+	.	.	.	+	1	+	+	2	1	+
Peltigera didactyla	+	+	+	.	.	r	+	.	+	+	+	+	.	.
Draba subcapitata	+	+	.	+	.	.	.	+	+	+	r	.	+	+
Saxifraga cernua	+	.	.	r	.	.	r	+	+	+	+	.	+	+
Ditrichum flexicaule	+	+	+	.	.	.	.	+	+	+	+	.	+	.
Pohlia cruda	r	+	+	.	.	.	.	.	+	+	.	+	.	.
Timmia austriaca	+	+	.	.	.	.	.	.	+	+	.	.	+	.
Tortula mucronifolia	+	.	+	.	.	.	.	+	.	.	+	.	+	.
Aulacomnium turgidum	+	+	.	.	.	.	.	+	.	.	.	.	.	.
Polytrichum piliferum	+	.	.	.	.	.	.	.	.	.	.	+	.	+

Additional taxa wih two or less occurrences: Caloplaca phaeocarpella (rel. 501:+, 502:+), Distichium inclinatum (501:+, 502:+), Grimmia sp. (501:+, 503:+), Hypogymnia subobscura (501:+, 506:r), Peltigera canina (502:+, 503:r), Catapyrenium sp. (503:+, 521:+), Saxifraga caespitosa (519:+, 515:+), Candelariella sp. (519:+, 509:+), Eurhynchium pulchellum (519:+, 509:+), Pertusaria glomerata (521:+, 511:+), Racomitrium lanuginosum (521:+, 509:+), Catapyrenium cinereum (515:+, 511:+), Saxifraga flagellaris (515:r, 513:+), Gymnomitrion corallioides (511:+, 509:r), Bartramia ithyphylla (501:+), Ceratodon heterophyllus (501:+), Hypnum subimponens (501:+), Hypnum vaucheri (501:+), Lecanora epibryon (501:+), Lophozia polaris (501:+), Myurella julacea (501:r), Physconia muscigena (501:+), Pohlia drummondii (501:+), Tomentypnum nitens (501:+), Tritomaria quinquedentata (501:+), Brachythecium mildeanum (502:+), Lepraria sp. (502:+), Rinodina mniaraea (502:+), Bryum argenteum (503:+), Bryum teres (503:+), Campylium arcticum (503:+), Endocarpon pusillum (503:+), Placopsis gelida (503:+), Pohlia nutans (503:+), Rinodina roscida (503:+), Schistidium holmenianum (505:+), Stereocaulon depressum (505:+), Lecanora geophila (504:+), Bryocaulon divergens (519:+), Collema sp. (519:+), Dicranum acutifolium (519:+), Pertusaria atra (515:+), Campylium stellatum (511:+), Conostomum tetragonum (511:+), Isopterygiopsis pulchella (511:+), Micarea incrassata (511:+), Mycoblastus sanguinarius (511:+), Ochrolechia sp. (511:+), Pogonatum urnigerum (511:r), Arctoa anderssonii (509:+), Fissidens arcticus (509:+), Lepraria neglecta (509:+), Sticta arctica (509:1), Biatora subduplex (513:r), Peltigera frippii (513:r).

30 cm wide and are found between the slightly more elevated polygons described above.

Character/differential taxa of this community are *Racomitrium panschii, Racomitrium lanuginosum, Pohlia cruda, Sticta arctica, Festuca brachyphylla*, etc. Other common taxa include *Parmelia omphalodes* ssp. *glacialis, Aulacomnium turgidum, Timmia austriaca, Polytrichastrum alpinum, Alopecurus borealis,*

Table 5. *Saxifraga – Parmelia omphalodes* ssp. *glacialis* community in hydromesic interpolygon areas at Isachsen (subzone A).

Relevé No.	510	512	508	520	514	518	516
Altitude (m.a.s.l.)	39	47	29	40	32	45	30
Plot size (m^2)	25	25	25	25	25	25	25
Vegetation cover (%)	100	100	100	100	100	100	100
Number of vascular taxa	17	17	19	17	16	17	18
Number of nonvascular taxa	78	58	65	52	53	50	54
Total number of taxa	95	75	84	69	69	67	72
Ch/D: Community							
Racomitrium panschii	+	1	+	2	1	2	+
Racomitrium lanuginosum	2	2	1	+	+	+	+
Pohlia cruda	1	1	2	+	+	+	1
Sticta arctica	r	+	2	r	+	+	+
Festuca brachyphylla	+	1	+	+	+	1	1
Poa alpigena	1	+	1	+	+	+	+
Schistidium papillosum	+	+	+	+	+	+	+
Peltigera canina	+	+	+	+	+	+	+
Ranunculus sabinei	+	+	+	+	+	+	+
Cladonia pyxidata	+	+	+	+	+	+	+
Caloplaca ammiospila	+	+	+	+	+	+	+
Cardamine bellidifolia	r	+	+	+	+	+	+
Protopannaria pezizoides	.	+	+	+	+	+	+
Cephaloziella arctica	.	+	+	+	+	+	+
Schistidium frigidum	+	2	.	2	2	2	+
Cladonia coccifera	+	+	+	.	+	+	+
Bryocaulon divergens	+	+	+	+	.	r	+
Peltigera leucophlebia	+	+	+	+	+	.	+
Stereocaulon alpinum	+	1	+	1	1	1	.
Alectoria nigricans	+	+	+	+	+	+	.
Peltigera rufescens	+	+	+	+	+	+	.
Caloplaca tetraspora	+	+	+	+	+	+	.
Hypnum subimponens	+	+	+	+	+	+	.
Tritomaria quinquedentata	+	+	+	+	+	+	.
Alectoria ochroleuca	+	+	+	.	+	.	r
Lophozia polaris	+	.	+	+	+	.	+
Hypnum vaucheri	+	.	+	.	+	+	+
Luzula confusa	r	.	r	+	.	r	1
Rinodina olivaceobrunnea	+	+	.	+	.	+	+
Sphaerophorus globosus	+	+	r	.	.	+	r
Stereocaulon rivulorum	.	+	.	+	+	+	+
Candelariella sp.	.	r	.	+	r	.	+
Bryonora castanea	+	+	+	.	.	.	.
Cladonia chlorophaea	+	.	+	+	.	.	.
Anastrophyllum minutum	+	.	1	.	+	.	.
Rinodina mniaraea	+	.	+	.	+	.	.
Hylocomium splendens	+	+	.	+	.	.	.
Barbilophozia hyperborea	+	+	.	.	.	.	+
Cladonia trassii	+	+	.	.	.	.	+
Peltigera scabrosa	.	+	+	.	.	r	.
Ch: Class, order, and alliance							
Alopecurus borealis	1	1	1	1	1	1	1
Saxifraga nivalis	1	1	+	+	+	+	+
Cerastium arcticum	1	+	+	+	1	+	+
Luzula nivalis	+	+	1	+	+	+	+
Pohlia drummondii	+	+	+	+	.	+	+
Saxifraga flagellaris	+	+	r	+	+	.	.

Table 5 (cont.)

Others							
Parmelia omphalodes ssp. glacialis	2	2	2	2	2	1	2
Aulacomnium turgidum	2	1	2	1	2	2	2
Timmia austriaca	1	1	2	1	+	1	2
Polytrichastrum alpinum	1	1	+	+	+	2	1
Hypnum revolutum	1	+	1	1	+	1	1
Saxifraga caespitosa	1	1	1	+	1	1	+
Syntrichia ruralis	+	+	+	1	1	2	1
Ditrichum flexicaule	1	+	1	1	+	+	1
Potentilla hyparctica	1	+	1	+	+	+	+
Distichium capillaceum	+	+	+	+	+	+	1
Saxifraga cernua	+	+	+	+	+	+	+
Cetraria islandica ssp. islandica	+	+	+	+	+	+	+
Papaver radicatum	+	+	+	+	+	+	+
Draba oblongata	+	+	+	+	+	+	+
Psoroma hypnorum	+	+	+	+	+	+	+
Rinodina turfacea	+	+	+	+	+	+	+
Thamnolia vermicularis	+	+	+	+	+	+	+
Cladonia pocillum	+	+	+	+	+	+	+
Caloplaca tiroliensis	+	+	+	+	+	+	+
Stellaria longipes	+	+	+	+	+	+	+
Peltigera didactyla	+	+	+	+	+	+	.
Pertusaria octomela	.	1	1	1	+	1	+
Draba subcapitata	.	+	+	+	r	+	+
Sanionia uncinata	+	+	.	+	+	+	+
Didymodon icmadophilus	+	.	+	.	+	+	+
Bartramia ithyphylla	+	.	+	+	.	+	+
Caloplaca cerina	.	+	+	+	+	+	.
Minuartia rossii/rubella	+	+	+	.	.	.	+
Bryum pseudotriquetrum	+	+	+	.	.	.	+
Myurella julacea	+	.	r	.	+	.	+
Tomentypnum nitens	+	+	.	+	+	.	.
Bryoerythrophyllum recurvirostrum	+	+	+	.	.	.	.
Hypogymnia subobscura	r	.	r	.	.	.	r
Physconia muscigena	+	.	+	.	.	.	+
Rinodina terrestris	+	+	.	+	.	.	.
Candelariella terrigena	.	.	.	+	.	+	+

Additional taxa wih two or less occurrences: Peltigera frippii (rel. 510:r, 512:r), Anaptychia bryorum (510:+, 508:+), Dactylina ramulosa (510:r, 508:r), Lecanora epibryon (510:+, 508:+), Orthothecium chryseon (510:r, 514:r), Polychidium muscicola (510:+, 518:+), Cladonia gracilis (510:+, 516:+), Mnium marginatum (510:+, 516:+), Plagiochila asplenioides (510:+, 516:+), Gymnomitrion concinnatum (512:+, 508:+), Gymnomitrion corallioides (512:+, 508:+), Stereocaulon glareosum (512:+, 514:+), Saxifraga rivularis (508:r, 516:r), Sphaerophorus fragilis (508:+, 516:+), Placopsis gelida (520:+, 514:+), Megaspora verrucosa (520:+, 516:+), Lecanora geophila (518:+, 514:+), Arctocetraria nigricascens (510:+), Brachythecium mildeanum (510:+), Bryum arcticum (510:r), Cephaloziella grimsulana (510:+), Cladonia scabriuscula (510:+), Flavocetraria cucullata (510:+), Lopadium pezizoideum (510:+), Lophozia latifolia (510:+), Orthothecium strictum (510:+), Orthotrichum speciosum (510:+), Philonotis tomentella (510:+), Racomitrium canescens (510:+), Solorina crocea (510:+), Lophozia excisa (512:+), Bryodina rhypariza (508:+), Kiaeria cf. blyttii (508:+), Myxobilimbia lobulata (508:+), Peltigera venosa (508:r), Polytrichum piliferum (508:r), Stereocaulon groenlandicum (508:+), Callialaria curvicaulis (520:+), Campylium arcticum (520:+), Caloplaca tornoënsis (514:+), Schadonia fecunda (514:+), Bryum teres (518: +), Pterygoneurum ovatum (518: +), Puccinellia andersonii/angustata (518: +), Scapania obcordata (516: +), Solorina bispora var. subspongiosa (516: +).

Hypnum revolutum, Saxifraga caespitosa, S. cernua, and S. nivalis. This community has a high presence of mosses (e.g. *Aulacomnium turgidum, Distichium capillaceum, Ditrichum flexicaule, Hypnum revolutum, Pohlia cruda, Polytrichastrum alpinum, Racomitrium* spp., *Schistidium* spp., *Syntrichia ruralis*, and *Timmia austriaca*) and soil lichens (e.g. *Caloplaca* spp., *Cladonia pocillum, Parmelia omphalodes, Peltigera* spp., *Sticta arctica*).

The soil organic horizons consist of undecomposed moss bases and range in thickness from 1 to 30 cm. Mean soil moisture is 37 % and soil pH averages 6. 4. The dense vegetation cover acts as good insulator and allows for less thaw (31 cm) than in the *Puccinellia angustata – Papaver radicatum* community described above.

The *Saxifraga – Parmelia omphalodes* ssp. *glacialis* community shows floristic affinities with the moss-graminoid meadows described by Bliss & Svoboda (1984) from King Christian and Ellef Ringnes Islands, which are dominated by either one of *Alopecurus borealis, Luzula nivalis* or *Luzula confusa* as well as *Aulacomnium turgidum, Ditrichum flexicaule, Racomitrium lanuginosum* etc. This community shares also some floristic elements with the *Luzula confusa-Racomitrium lanuginosum* community described from Spitzbergen (Eberle et al. 1993), although the *Saxifraga – Parmelia omphalodes* ssp.

glacialis community does not exhibit a discontinuous vegetation cover.

4.3.2 Mould Bay (subzone B)

***Hypogymnia subobscura–Lecanora epibryon* community** (Table 6; Fig. 7)

The *Hypogymnia subobscura–Lecanora epibryon* community occurs on top of the xeromesic, wind-blown non-sorted polygons in subzone B and is characterized by high lichen cover. The non-sorted polygons are 10 cm high and have a diameter up to 50 cm.

Taxa faithful/differential of this community are cryptogamic species, including *Hypogymnia subobscura*, *Vulpicida tilesii*, *Pertusaria dactylina*, *Ochrolechia frigida*, *Encalypta alpina*, and *Lecanora luteovernalis*. Other common taxa are *Lecanora epibryon*, *Lecidea ramulosa*, *Luzula nivalis*, and *Saxifraga oppositifolia*. This community is separated into two variants. The typical variant of the *Hypogymnia subobscura–Lecanora epibryon* community is not as species rich as the *Distichium capillaceum* variant and grows on non-sorted polygons found on hill crests. The *Distichium capillaceum* variant is found on non-sorted polygons occurring more on side slopes and has more bryophytes. The *Distichium capillaceum* variant is mainly differentiated by *Tetramelas* sp., *Distichium capillaceum*, *Bryum rutilans*, *Draba alpina*, and *Hypnum revolutum*.

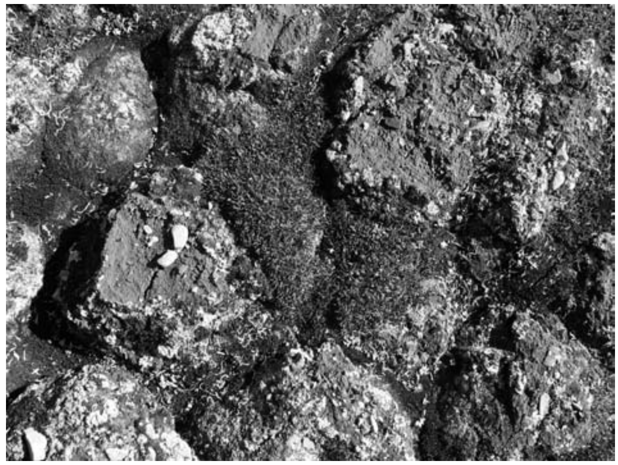

Fig. 7. *Hypogymnia subobscura–Lecanora epibryon* community occurring on xeromesic non-sorted polygons at Mould Bay. Some of the non-sorted polygons have been eroded by wind, exposing bare soil.

Table 6: *Hypogymnia subobscura–Lecanora epibryon* community in xeromesic non-sorted polygons at Mould Bay (subzone B).

	typicum		Distichium capillaceum var.		
Relevé No.	403	408	414	410	412
Altitude (m.a.s.l.)	40	40	38	37	40
Plot size (m^2)	4	10	10	10	10
Vegetation cover (%)	85	95	80	80	100
Number of vascular taxa	14	14	18	12	17
Number of nonvascular taxa	30	30	36	36	36
Total number of taxa	44	44	54	48	53
Ch/D: Community					
Hypogymnia subobscura	3	1	2	2	2
sterile black crust	2	2	2	1	2
Vulpicida tilesii	+	1	1	1	1
Pertusaria dactylina	1	1	2	.	2
Ochrolechia frigida	+	+	+	.	+
Encalypta alpina	.	1	1	+	+
Lecanora luteovernalis	+	.	.	+	1
D: Distichium capillaceum var.					
Tetramelas sp.	.	.	2	+	+
Distichium capillaceum	.	.	1	+	+
Bryum rutilans	.	.	+	+	+
Draba alpina	.	.	+	+	+
Hypnum revolutum	.	.	+	+	+
Bryoerythrophyllum recurvirostrum	.	.	+	+	.
Cirriphyllum cirrosum	.	.	+	+	.
Distichium inclinatum	.	.	+	+	.
Orthotrichum speciosum	.	.	+	+	.
Mnium thomsonii	.	.	.	+	+
Myurella julacea	.	.	+	.	+
Orthothecium chryseon	.	.	+	.	+
Ranunculus sulphureus	.	.	+	.	r
Ch: Class, order, and alliance					
Saxifraga oppositifolia	+	1	1	1	+
Dryas integrifolia	+	+	+	1	+

Table 6 (cont.)

Others					
Lecanora epibryon	3	3	1	3	2
Lecidea ramulosa	1	1	2	2	1
Luzula nivalis	1	1	1	+	1
Thamnolia vermicularis	1	2	+	+	+
Potentilla hyparctica	+	1	1	+	+
Cetraria islandica ssp. islandica	+	+	+	1	1
Parmelia omphalodes ssp. glacialis	+	+	+	+	2
Fulgensia bracteata	+	1	+	+	+
Papaver radicatum	+	+	1	+	+
Oxyria digyna	+	+	1	+	+
Juncus biglumis	+	+	+	+	1
Draba sp.	+	+	+	r	+
Parrya arctica	+	+	+	+	+
Flavocetraria cucullata	+	+	+	+	+
Caloplaca tiroliensis	+	+	+	+	+
Rinodina roscida	+	+	+	+	.
Alopecurus borealis	+	+	+	.	1
Stellaria longipes	+	r	+	.	+
Salix arctica	+	1	.	+	+
Timmia austriaca	+	+	.	+	+
Physconia muscigena	+	.	+	+	+
Ctenidium procerrimum	.	+	+	+	+
Didymodon icmadophilus	.	+	+	+	+
Megaspora verrucosa	+	.	2	.	1
Festuca hyperborea	+	.	1	.	+
Minuartia rossii/rubella	+	.	+	.	+
Cladonia pocillum	r	.	.	+	+
Alectoria nigricans	+	+	.	+	.
Lepraria cf. vouauxii	+	+	+	.	.
Polytrichastrum alpinum	.	+	+	+	.
Ditrichum flexicaule	.	1	.	+	1
Sanionia uncinata	.	+	+	.	1
Saxifraga caespitosa	.	+	+	.	+
Rinodina turfacea	+	+	.	.	.
Phaeorrhiza nimbosa	+	.	+	.	.
Caloplaca cerina	+	.	.	+	.
Saxifraga nivalis	.	+	.	+	.
Pohlia cruda	.	+	.	.	+

Single occurrences: Caloplaca ammiospila (rel. 403:+), Caloplaca tetraspora (403:+), Dactylina ramulosa (403:r), Encalypta sp. (403:+), Evernia perfragilis (403:+), Leptogium sp. (403:+), Bryum pseudotriquetrum (408:+), Campylium arcticum (408:+), Myurella tenerrima (408:+), Ochrolechia inaequatula (408:+), Orthothecium strictum (408:+), Baeomyces rufus (414:+), Flavocetraria nivalis (414:+), Poa abbreviata (414:1), Saxifraga flagellaris (414:+), Tomentypnum nitens (414:1), Caloplaca xanthostigmoidea (410:+), Didymodon asperifolius (410:+), Schistidium papillosum (410:+), Stereocaulon alpinum (410:+), Alectoria ochroleuca (412:+), Catapyrenium sp. (412:+), Racomitrium lanuginosum (412:+), Racomitrium panschii (412:+), Tortula leucostoma (412:+).

The soils are classified as Typic Aquiturbels (Ping & Michaelson in Munger et al. 2005). No organic horizons were present. The mineral horizons have a dark brown to dark grey/black color and a sandy to sandy loam texture. Soil moisture content is 29 % and soil pH averages 7. 4. Mean thaw depth is 31 cm, and average snow depth is 17 cm.

We place this community in the class Carici rupestris-Kobresietea bellardii; however, this community is transitional to the plant communities of the Salicetea herbaceae with regards to species composition. The *Hypogymnia subobscura–Lecanora epibryon* community shows some similarities with the dry *Dryas integrifolia–Saxifraga oppositifolia–Lecanora epibryon* dwarf-shrub, crustose lichen tundra (Type B2) described from the Prudhoe Bay region (Walker 1985). This community also shares some floristic elements with the hummock communities described from Bathurst Island, which are dominated by *Encalypta alpina*, *Cladonia pyxidata*, *Ochrolechia frigida*, *Oxyria digyna*, *Juncus biglumis* etc. (cluster 4; Sheard & Geale 1983).

Orthotrichum speciosum–Salix arctica community (Table 7; Fig. 8)

The *Orthotrichum speciosum–Salix arctica* community occurs in the xeromesic interpolygon areas in complex with the *Hypogymnia subobscura–Lecanora epibryon* community described above. The interpolygon areas are completely covered with vegetation; bryophytes and prostrate dwarf-shrubs have a much higher cover than in the adjacent *Hypogymnia subobscura–Lecanora epibryon* communities (Fig. 15).

Table 7. *Orthotrichum speciosum–Salix arctica* community in xeromesic interpolygon areas at Mould Bay (subzone B).

Relevé No.	415	404	409	413	411
Altitude (m.a.s.l.)	38	40	40	40	37
Plot size (m^2)	3	1	2	3	3
Vegetation cover (%)	100	100	100	100	100
Number of vascular taxa	14	15	14	12	11
Number of nonvascular taxa	23	21	24	22	22
Total number of taxa	37	36	38	34	33
Ch/D: Community					
Orthotrichum speciosum	3	2	3	2	3
Ch: Class, order, and alliance					
Dryas integrifolia	+	1	+	2	3
Saxifraga oppositifolia	3	1	1	1	1
Others					
Syntrichia ruralis	3	4	2	2	2
Salix arctica	+	2	2	3	2
Sanionia uncinata	2	1	1	2	1
Thamnolia vermicularis	1	2	+	1	1
Ditrichum flexicaule	1	+	2	+	1
Flavocetraria cucullata	1	1	+	1	1
Alopecurus borealis	+	+	+	1	+
Distichium capillaceum	+	+	1	+	+
Cetraria islandica ssp. islandica	+	+	+	+	+
Potentilla hyparctica	+	+	+	+	+
Hypnum revolutum	+	+	+	+	+
Poa abbreviata	+	+	+	+	+
Tomentypnum nitens	.	1	1	1	1
Stellaria longipes	.	+	+	+	+
Didymodon icmadophilus	+	.	+	+	+
Ctenidium procerrimum	+	.	+	+	+
Distichium inclinatum	+	1	+	.	+
Oxyria digyna	+	+	+	.	+
Saxifraga caespitosa	+	r	+	.	r
Luzula nivalis	+	1	+	+	.
Saxifraga nivalis	+	+	+	+	.
Polytrichastrum alpinum	1	.	1	.	+
Saxifraga cernua	+	.	.	+	+
Festuca hyperborea	+	.	.	+	+
Cerastium arcticum	+	+	.	+	.
Racomitrium lanuginosum	+	1	.	+	.
Cirriphyllum cirrosum	+	+	.	.	+
Parrya arctica	+	+	+	.	.
Papaver radicatum	+	+	+	.	.
Pohlia cruda	.	+	+	+	.
Timmia austriaca	.	+	+	.	+
Didymodon asperifolius	.	+	+	.	+
Encalypta alpina	+	.	1	.	.
Bryoerythrophyllum recurvirostrum	+	.	.	.	+
Bryum rutilans	+	.	.	+	.
Myurella julacea	+	.	.	+	.
Orthothecium chryseon	+	.	.	+	.
Draba sp.	.	+	+	.	.
Alectoria nigricans	.	+	.	+	.
Tortula leucostoma	.	+	.	+	.
Mnium thomsonii	.	.	.	+	+

Single occurrences: Dactylina ramulosa (rel. 415:+), Stereocaulon alpinum (415:+), Bryum sp. (404:+), Draba alpina (404:+), Hennediella heimii (404:+), Abietinella abietina (409:r), Bryum pseudotriquetrum (409:+), Campylium arcticum (409:+), Cinclidium latifolium (409:+), Myurella tenerrima (409:+), Tetraplodon mnioides (409:+), Hylocomium splendens (411:+), Racomitrium panschii (413:+), Saxifraga flagellaris (413:+), Schistidium papillosum (411:+), Vulpicida tilesii (411:+).

The soils are classified as Mollic Aquiturbels (Ping & Michaelson in Munger et al. 2005). Organic horizons are shallow (mean 3 cm). The mineral horizons have a dark brown to dark grey/black color and a sandy to sandy loam texture. Mean soil moisture is 30 % and soil pH averages 7. 1. Average thaw depth is 24 cm, and mean snow depth is 23 cm.

Orthotrichum speciosum is the only faithful/differential taxon. Common taxa are *Dryas integrifolia, Saxifraga oppositifolia, Syntrichia ruralis, Salix arctica, Sanionia uncinata, Flavocetraria cucullata, Thamnolia vermicularis, Tomentypnum nitens* etc. We place this community in the class Carici rupestris-Kobresietea bellardii; however, this community is transitional to the plant communities of the Salicetea herbaceae with regards to species composition.

The *Orthotrichum speciosum–Salix arctica* community shows some floristic affinities with the *Dryas integrifolia–Salix arctica* community described from cracks and depressions between the large frost-heave features on Howe Island (Kade et al. 2005). Both communities share *Dryas integrifolia*, *Salix arctica*, *Saxifraga oppositifolia, Sanionia uncinata* and many other species. However, these two communities have different faithful taxa. Thus, it seems that the *Orthotrichum speciosum–Salix arctica* community is the "subzone B counterpart" of the *Dryas integrifolia–Salix arctica* community (Kade et al. 2005) described from dry nonacidic tundra in subzone C. The *Orthotrichum speciosum–Salix arctica* community also shares some floristic elements with the cushion plant communities described from the Canadian High Arctic polar semi-deserts by Bliss et al. (1984), which are dominated by *Salix arctica*, *Dryas integrifolia,* and *Saxifraga oppositifolia* which, unlike the community described here, are poor in bryophytes.

Cochlearia groenlandica–Luzula nivalis community (Table 8; Fig. 9)

The *Cochlearia groenlandica–Luzula nivalis* community is associated with the hydromesic, saline earth hummocks found near the coast at Mould Bay. Although it does not occur in zonal situations, this community is included here because of its occurrence on well-developed earth hummocks that are formed by differential frost-heave.

Taxa faithful/differential of this community are *Tortella arctica*, *Stellaria* sp., *Cochlearia groenlandica*, and *Saxifraga foliolosa*. Other common taxa are *Luzula nivalis, Alopecurus borealis, Bartramia ithyphylla*, *Distichium inclinatum*, *Poa abbreviata*, and *Polytrichastrum alpinum.*

The soils are classified as Typic Aquiturbels (Ping & Michaelson in Munger et al. 2005). Or-

Fig. 8. *Orthotrichum speciosum–Salix arctica* community occurring on xeromesic interpolygon areas at Mould Bay.

Fig. 9. *Cochlearia groenlandica–Luzula nivalis* community at Mould Bay with the *Cladonia pocillum* variant occurring on top of hydromesic earth hummocks and the *Orthothecium chryseon* variant occurring in interhummock space.

ganic horizons range from 1.5 to 7 cm. They overlay dark brown to dark grey mineral horizons with a silty loam texture. Soil moisture is similar for hummock and interhummock areas (35 %), and pH averages 5. 5. Average thaw depth is greater at the hummock sites (25 cm) than at the interhummock sites (17 cm). The snow depth is anomalously high (49 cm). This community has a high moss cover (Fig. 15). The average diameter of the earth hummocks is between 0.9–2 m. Many of the earth hummocks contained small non-sorted polygons that had formed by contraction cracking. Some of the small non-sorted polygons contained an even finer cracking pattern. Soils are well saturated and standing water was observed in interhummock areas during summer.

This community shares some floristic elements with the moss seepage community found in snowbeds at Bathurst Island (cluster 15; Sheard & Geale 1983), which is dominated by *Cochlearia groenlandica*, *Saxifraga nivalis,* and *Ditrichum flexicaule* and has a high moss cover. This community is divided into two variants. The variant with *Cladonia pocillum* occurs on hummock tops, while the *Orthothecium chryseon* variant occurs on interhummock areas. Lichens, notably *Lecidea ramulosa,* an additional unidentified species of *Lecidea*, *Cladonia pocillum,* and *Ochrolechia inaequatula,* dominate in the *Cla-*

Table 8. *Cochlearia groenlandica–Luzula nivalis* community hydromesic earth hummocks at Mould Bay (subzone B).

	Cladonia pocillum var.			Orthothecium chryseon var.		
Relevé No.	436	434	438	439	437	435
Altitude (m.a.s.l.)	3	3	3	3	3	3
Plot size (m^2)	7	-	8	2	3	-
Vegetation cover (%)	100	100	100	100	100	100
Number of vascular taxa	15	12	17	14	12	12
Number of nonvascular taxa	22	20	28	20	18	20
Total number of taxa	37	32	45	34	30	32
Ch/D: Community						
Tortella arctica	2	1	2	3	4	4
Stellaria sp.	3	3	2	1	1	1
Cochlearia groenlandica	+	+	+	+	+	+
Saxifraga foliolosa	+	+	+	+	.	+
D: Cladonia pocillum var.						
Lecidea sp.	1	1	2	.	.	2
Cladonia pocillum	1	+	1	.	.	.
Lecidea ramulosa	1	1	+	.	.	1
Ochrolechia inaequatula	2	+	+	.	.	.
Juncus biglumis	+	+	+	.	.	+
Cetrariella delisei	+	+	+	.	.	+
Cetraria islandica ssp. islandica	+	+	+	.	.	.
Cladonia macroceras	+	+	+	.	.	.
Ranunculus nivalis	+	+	+	+	.	.
sterile black crust	2	1	.	.	.	.
Solorina sp.	+	+	.	.	.	.
Potentilla hyparctica	+	.	+	.	.	.
Encalypta alpina	.	+	+	.	.	.
D: Orthothecium chryseon var.						
Orthothecium chryseon	.	.	.	1	1	1
Nostoc commune	.	.	+	3	+	+
Carex heleonastes	.	+	.	+	+	+
Oncophorus wahlenbergii	.	.	+	+	+	+
Limprichtia revolvens	.	.	.	1	1	.
Campylium arcticum	.	.	.	1	+	.
Cirriphyllum cirrosum	.	.	.	+	+	.
Ch: Class, order, and alliance						
Luzula nivalis	1	2	2	2	1	1
Alopecurus borealis	1	2	1	+	+	+
Saxifraga nivalis	+	+	+	+	+	+
Cerastium regelii	1	.	1	+	1	+
Cerastium arcticum	.	.	+	.	+	.
Others						
Bartramia ithyphylla	3	3	3	1	2	2
Distichium inclinatum	3	1	3	1	3	+
Poa abbreviata	2	2	1	1	1	+
Polytrichastrum alpinum	2	1	1	+	1	+
Saxifraga cernua	+	+	+	+	+	+
Draba sp.	+	+	+	+	+	+
Thamnolia vermicularis	+	+	1	+	+	+
Pseudocalliergon brevifolium	.	1	2	3	3	2
Papaver radicatum	+	+	+	.	+	+
Bryum pseudotriquetrum	+	.	+	+	+	+
Distichium capillaceum	+	.	+	+	+	.
Saxifraga caespitosa	+	.	+	+	.	.
Oxyria digyna	+	.	+	+	.	.
Ditrichum flexicaule	+	.	+	.	+	.
Peltigera leucophlebia	.	+	+	.	+	.
Bryoerythrophyllum recurvirostrum	.	.	+	+	.	+
Cinclidium latifolium	.	.	+	+	.	+
Warnstorfia sarmentosa	.	.	+	+	.	+
Myurella julacea	.	.	+	.	+	+

Single occurrences: Aneura pinguis (rel. 436:+), Caloplaca cerina (436:+), Flavocetraria cucullata (436:+), Psoroma hypnorum (436:+), Cetrariella fastigiata (434:+), Parmelia omphalodes ssp. glacialis (434:+), Anthelia juratzkana (438:+), Aulacomnium acuminatum (438:+), Lepraria cf. vouauxii (438:+), Saxifraga flagellaris (438:r), Bryum cryophilum (439:+), Calliergon giganteum (439:+), Cinclidium arcticum (439:+), Schistidium andreaeopsis (437:+), Fissidens arcticus (435:+), Pohlia sp. (435:+).

Table 9. *Salix arctica–Eriophorum angustifolium* ssp. *triste* community in hygric earth hummocks at Mould Bay (subzone B).

	Cetraria islandica ssp. islandica var.				Oncophorus wahlenbergii var.			
Relevé No.	428	440	430	432	431	433	429	441
Altitude (m.a.s.l.)	16	5	18	19	18	19	16	5
Plot size (m2)	4	6	5	5	3	3	3	3
Vegetation cover (%)	100	100	100	100	100	100	100	100
Number of vascular taxa	6	8	10	6	11	8	6	10
Number of nonvascular taxa	26	33	25	26	33	30	36	30
Total number of taxa	32	41	35	32	44	38	42	40
Ch/D: Community								
Aulacomnium acuminatum	2	1	.	2	1	1	2	+
Bistorta vivipara	1	1	2	+	+	.	+	+
Aneura pinguis	+	+	+	+	.	+	+	.
Petasites frigidus	.	+	+	.	+	.	.	+
D: Cetraria islandica ssp. islandica var.								
black crust with apothecia	2	2	2	2	.	.	.	.
Cetraria islandica ssp. islandica	+	+	+	+	.	.	+	.
Flavocetraria cucullata	+	+	+	+	.	.	+	.
Lecanora epibryon	1	.	2	1	+	.	.	.
Rinodina turfacea	+	+	.	+	.	.	.	.
Caloplaca tiroliensis	+	+	.	+	.	.	.	.
Carex aquatilis	+	3	+	.	.	.	.	2
Peltigera leucophlebia	+	+	+	.	.	+	.	.
Ochrolechia frigida	.	+	.	2	.	.	.	.
Encalypta alpina	+	.	+	.	.	.	.	.
D: Oncophorus wahlenbergii var.								
Oncophorus wahlenbergii	.	.	.	.	+	+	1	2
Limprichtia revolvens	.	.	+	.	1	+	+	1
Philonotis fontana	.	.	.	.	+	+	+	+
Cyrtomnium hymenophyllum	.	.	.	.	+	+	+	+
Calliergon giganteum	.	.	.	.	+	+	+	+
Myurella julacea	.	.	.	.	+	+	+	+
Catoscopium nigritum	.	.	.	.	1	1	2	.
Nostoc commune	.	.	.	.	1	1	1	.
Cinclidium arcticum	.	.	.	.	+	+	+	.
Didymodon sp.	.	.	+	.	+	+	+	.
Carex heleonastes	.	.	.	.	+	+	+	.
Tortella arctica	.	.	.	.	+	+	+	.
Campylium arcticum	.	.	.	.	+	+	.	+
Timmia austriaca	.	.	.	+	+	+	.	+
Ranunculus sulphureus	.	r	.	.	+	+	.	+
Myurella tenerrima	.	.	.	.	+	.	+	+
Pseudocalliergon brevifolium	.	.	.	.	.	+	+	+
Mnium thomsonii	.	.	.	.	.	.	+	+
Saxifraga hirculus	.	.	.	.	r	+	.	.
Draba sp.	.	.	.	.	r	+	.	.
Ch: Class, order, and alliance								
Eriophorum angustifolium ssp. triste	2	+	2	3	3	2	2	+
Bryum pseudotriquetrum	+	+	+	1	1	1	+	+

donia pocillum variant; and bryophytes, notably *Orthothecium chryseon* and *Oncophorus wahlenbergii*, dominate the *Orthothecium chryseon* variant.

Salix arctica–Eriophorum angustifolium ssp. *triste* community (Table 9; Fig. 10)

The *Salix arctica–Eriophorum angustifolium* ssp. *triste* community occurs on the mesic to hygromesic earth hummocks within subzone B. Generally, this community is found on south facing slopes with considerable water seepage. The earth hummocks (average diameter 1.4 m across, 2–4 m long) are completely overgrown with vegetation dominated by sedges, prostrate dwarf shrubs, and mosses. The soils usually are well saturated and some standing water was observed in interhummock areas during summer.

Taxa faithful/differential of this community are *Aulacomnium acuminatum*, *Bistorta vivipara*, *Aneura pinguis*, and *Petasites frigidus*. Other common taxa are *Eriophorum angustifolium* ssp. *triste*, *Salix*

Table 9 (cont.)

Others								
Salix arctica	2	2	2	2	2	2	2	2
Arctagrostis latifolia	2	2	2	2	1	2	1	1
Tomentypnum nitens	2	+	2	2	+	1	1	3
Distichium inclinatum	1	1	3	1	2	2	2	1
Ditrichum flexicaule	2	+	2	2	3	1	2	+
Aulacomnium turgidum	1	+	1	1	1	2	1	1
Thamnolia vermicularis	+	1	+	+	+	+	+	+
Polytrichastrum alpinum	+	.	+	+	+	+	+	+
Orthothecium chryseon	+	+	+	.	2	2	2	2
Luzula nivalis	+	+	+	+	.	+	+	+
Cladonia pocillum	1	1	1	1	+	+	.	.
Distichium capillaceum	.	.	+	+	+	+	+	+
Bryoerythrophyllum recurvirostrum	.	.	+	+	+	+	+	+
Ochrolechia inaequatula	+	2	2	.	.	.	+	+
Solorina sp.	+	.	.	+	.	+	+	.
Bryum rutilans	.	+	+	.	+	.	.	+
Platydictya jungermannioides	+	.	.	.	+	.	+	.
Poa sp.	+	.	.	+	.	.	.	+
Syntrichia ruralis	.	.	.	1	.	.	2	+
Dicranum spadiceum	.	+	+	.	+	.	.	.
Dicranum acutifolium	.	+	+	.	+	.	.	.
Orthothecium strictum	+	.	.	.	.	.	+	.
Lecidea sp.	+	.	.	.	1	.	.	.
Stellaria longipes	.	.	+	.	.	.	.	+

Single occurrences: Peltigera rufescens (rel. 428:+), Alectoria nigricans (440:r), Arctocetraria nigricascens (440:+), Cladonia macroceras (440:+), Dactylina ramulosa (440:+), Dicranum sp. (440:+), Hylocomium splendens (440:+), Micarea sp. (440:+), Nephroma expallidum (440:+), Parmelia omphalodes ssp. glacialis (440:+), Pohlia beringiensis (440:+), Psoroma hypnorum (440:+), Stereocaulon alpinum (440:r), Dryas integrifolia (430:+), Flavocetraria nivalis (430:+), Papaver radicatum (430:+), Dacampia hookeri (432:+), Minuartia rossii/rubella (432:r), Protopannaria pezizoides (432:+), Vulpicida tilesii (432:+), Philonotis tomentella (431:+), Saxifraga cernua (431:r), Saxifraga foliolosa (431:r), Meesia triquetra (433:+), Aplodon wormskjoldii (429:+), Campylium stellatum (429:+), Tetraplodon mnioides (429:+), Cirriphyllum cirrosum (441:+), Draba alpina (441:r), Hypnum bambergeri (441:+), Loeskypnum badium (441:+), Oncophorum virens (441:+), Schistidium andreaeopsis (441:+).

Fig. 10. *Salix arctica–Eriophorum angustifolium* ssp. *triste* community at Mould Bay with the *Cetraria islandica* ssp. *islandica* variant occurring on top of hygric earth hummocks and the *Oncophorus wahlenbergii* variant occurring in interhummock space.

arctica, *Arctagrostis latifolia*, *Tomentypnum nitens*, *Distichium inclinatum*, *Ditrichum flexicaule*, *Aulacomnium turgidum*, and *Thamnolia vermicularis*. The community is split into two variants: the first occurs on hummock tops (*Cetraria islandica* ssp. *islandica* variant) and the second occurs on interhummock areas (*Oncophorus wahlenbergii* variant). Lichens, including an unidentified black crust, *Cetraria islandica, Flavocetraria cucullata, Lecanora epibryon,* and *Cladonia pocillum* are common in the *Cetraria islandica* ssp. *islandica* variant and bryophytes, including *Oncophorus wahlenbergii, Limprichtia revolvens, Philonotis fontana, Cyrtomnium hymenophyllum,* and *Orthothecium chryseon* are common in the *Oncophorus wahlenbergii* variant. Main differential taxa for the *Cetraria islandica* ssp. *islandica* variant are *Cetraria islandica* ssp. *islandica* and *Flavocetraria cucullata.* The *Oncophorus wahlenbergii* variant is mainly differentiated by *Oncophorus wahlenbergii* and *Limprichtia revolvens.*

Many taxa occurring on top of these hummocks are also able to survive in interhummock areas. Some species such as *Carex heleonastes*, *Limprichtia revolvens*, *Oncophorus wahlenbergii* were found in the interhummock areas of both the *Cochlearia groenlandica – Luzula nivalis* community and the *Salix arctica – Eriophorum angustifolium* ssp. *triste* community (see above). Other species such as *Cyrtomnium hymenophyllum* were just found in the interhummock areas of the *Salix arctica – Eriophorum angustifolium* ssp. *triste* community.

The soils are classified as Typic Aquiturbels (Ping & Michaelson in Munger et al. 2005). The mineral soils have dark grey horizons and a silty loam texture. Organic horizons range from 0.5 to 8 cm. Mean soil moisture content is higher in interhummock areas (46 %) than in hummock areas (38 %). Soil pH averages 5. 8. Average thaw depth is greater at hummock sites (38 cm) than at interhummock sites (25 cm).

The *Salix arctica – Eriophorum angustifolium* ssp. *triste* community shows some floristic affinities with the Eriophoro-Salico-Arctagrostidetum latifoliae association described from Devon Island (Barrett 1972), although the present community does have a higher lichen and moss cover and is more species-rich than the Eriophoro-Salico-Arctagrostidetum latifoliae. The *Salix arctica – Eriophorum angustifolium* ssp. *triste* community is also somewhat similar to the mesic grass meadows described from Bathurst Island (cluster 10; Sheard & Geale 1983). Like in the Arctagrostio-Eriophoretum tristis described in Greenland (Fredskild 1998) *Eriophorum angustifolium* ssp. *triste* and *Arctagrostis latifolia* are highly abundant in the *Salix arctica – Eriophorum angustifolium* ssp. *triste* community, however, this community occurs on wetter soils and is not as heavily grazed as the Arctagrostio-Eriophoretum.

4.3.3 Green Cabin (subzone C)

***Puccinellia angustata – Potentilla vahliana* community** (Table 10, Fig. 11 a and b)

The *Puccinellia angustata – Potentilla vahliana* community occurs on the xeric non-sorted circles within subzone C. Most of the non-sorted circles have an average diameter of 0.9 m and contained small non-

Table 10. *Puccinellia angustata – Potentilla vahliana* community in xeromesic non-sorted circles and bare patches at Green Cabin (subzone C).

Relevé No.	304	301	307	310
Altitude (m.a.s.l.)	72	63	75	65
Plot size (m^2)	55	30	60	40
Vegetation cover (%)	10	20	10	10
Number of vascular taxa	7	6	7	8
Number of nonvascular taxa	0	0	0	0
Total number of taxa	7	6	7	8
Ch/D: Community				
Potentilla vahliana	+	+	1	+
Puccinellia angustata	+	+	1	+
Elymus alaskanus ssp. hyperboreus	+	.	+	+
Artemisia borealis	+	+	.	.
Others				
Draba oblongata	+	+	.	+
Salix arctica	+	+	.	+
Taraxacum sp.	.	.	+	r
Parrya arctica	+	.	+	.

Single occurrences: Oxytropis arctobia (rel. 301:+), Lesquerella arctica (307:+), Potentilla nivea (307:+), Oxytropis arctica (310:+), Oxytropis borealis (310:+).

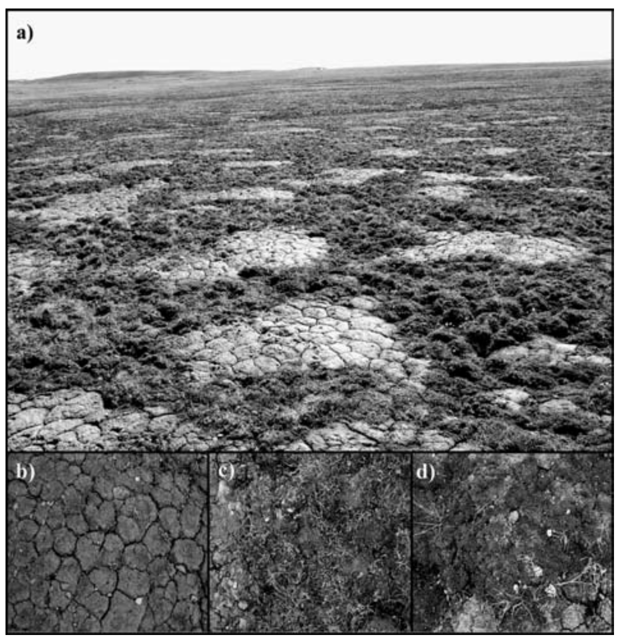

Fig. 11. Xeromesic non-sorted circles at Green Cabin: a) non-sorted circles, b) *Puccinellia angustata – Potentilla vahliana* community occurring on the non-sorted circles and bare patches, c) *Dryas integrifolia – Carex rupestris* community (*Psora decipiens* variant) occurring on the borders of the non-sorted circles and bare patches, d) *Dryas integrifolia – Carex rupestris* community (*Dryas integrifolia* variant) occurring on intercircle areas and more vegetated patches.

sorted polygons that had formed by contraction cracking. This community is also found on the xeromesic, almost vegetation free patches – up to 90 % of the non-sorted circles and patches are barren.

Taxa faithful/differential of this community are *Potentilla vahliana*, *Puccinellia angustata*, *Elymus alaskanus* ssp. *hyperarcticus*, and *Artemisia borealis.* Only vascular plants were found in this community. This community shares several taxa with the nearby *Dryas integrifolia–Carex rupestris* community (*Psora decipiens* variant).

The soils are classified as Typic Haploturbels (Ping & Michaelson in Munger et al. 2004). An organic horizon is absent, and the exposed mineral soil shows signs of contraction cracking (Washburn 1980). The mineral soil is brown to dark grey and has a silty loam texture. Soil moisture is very low (12 %), and soil pH is high (mean 8.4). The sparse vegetation cover acts as poor insulator and allows for deep thaw (54 cm).

This community has some similarities to the *Braya purpurascens–Puccinellia angustata* community described from dry, nonacidic frost-heave features on Howe Island (Kade et al. 2005) and the Puccinellietum angustatae described from Spitzbergen (Möller 2000). The *Puccinellia angustata–Potentilla vahliana* community also shares some floristic elements with the *Puccinellia* stands of arctic coastal salt meadows described by Thannheiser (1991). The community is quite barren and physiognomically similar to the *Braya purpurascens–Puccinellia angustata* community; however, other than *Puccinellia angustata,* there are few other species in common between these other communities. We could not place this community into existing syntaxa.

Dryas integrifolia–Carex rupestris community (Table 11, Fig. 11 c and d)

The *Dryas integrifolia–Carex rupestris* community is associated with xeromesic intercircle areas and more vegetated patches between the barren circles described above with the *Puccinellia angustata–Potentilla vahliana* community. The *Dryas integrifolia–Carex rupestris* community often contains many small non-sorted polygons; we did not distinguish the vegetation growing on the polygon tops from that growing between the polygons. A variant of the community is found on the margins of the nonsorted circles intermediate between the *Puccinellia angustata–Potentilla vahliana* and the *Dryas integrifolia–Carex rupestris* communities (Fig. 11c).

Taxa faithful/differential of this community are *Oxytropis borealis, Toninia sedifolia,* and *Lesquerella arctica.* Other common taxa include *Carex rupestris*, *Saxifraga oppositifolia*, *Dryas integrifolia*, *Salix arctica, Lecanora epibryon, Parrya arctica, Thamnolia vermicularis, Rinodina roscida,* and *Fulgensia bracteata*. The community has two variants. The *Dryas integrifolia* variant is associated with intercircle and more vegetated areas, and the *Psora decipiens* variant grows on the margins of the patches and circles. Compared with the *Psora decipiens* variant, the *Dryas integrifolia* variant is richer in bryophytes and is dominated by *Dryas integrifolia.* The main differential taxa are the mosses *Syntrichia ruralis*, *Ctenidium procerrimum*, *Ditrichum flexicaule*, and *Distichium capillaceum*. The *Psora decipiens* variant is mainly differentiated by *Psora decipiens* and *Potentilla vahliana*.

The soils are classified as Typic Molliturbels (Ping & Michaelson in Munger et al. 2004). They have a sandy to sandy loam to silty loam texture, and the mineral soil is olive brown to dark brown. These soils have a shallow (0.8 cm) organic horizon. Soil moisture is low (20 % *Dryas integrifolia* variant, 12 % *Psora decipiens* variant), and the soil pH is high (8.1). Average thaw depth is greater in the *Psora decipiens* variant (42 cm) than in the *Dryas integrifolia* variant (39 cm).

A similar community type has been described by Schweingruber (1977) from Banks Island (*Dryas integrifolia* community *Carex rupestris* development). Also, strong affinities exist to the *Dryas integrifolia–Carex rupestris* community described by Thannheiser (1988) and Thannheiser & Geesink (1990) from the Canadian Arctic Archipelago. The community might be considered a geographical variant of the Carici-Dryadetum integrifoliae described from Greenland (Daniëls 1982).

Braya glabella ssp. *purpurascens–Dryas integrifolia* community (Table 12, Fig. 12)

The *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community occurs on hydromesic non-sorted circles (average diameter 1.8 m) within subzone C, i. e. wetter sites than those of the *Puccinellia angustata–Potentilla vahliana* community described above. Large well-developed non-sorted circles occur in similar situations marginal to wetlands all across Banks Island.

Faithful/differential taxa are *Braya glabella* ssp. *purpurascens* and *Hymenostylium recurvirostre*. This community can be split into three variants: The *Eriophorum angustifolium* variant occurs on the centers of almost barren non-sorted circles and is species poor (Fig. 12b); *Eriophorum angustifolium* is the sole differential taxon. The *Placidiopsis pseudocinerea* variant occurs on somewhat wetter and more vegetated parts of the non-sorted circles (Fig. 12c), usually along the margins of the circles; the main differential taxa are *Placidiopsis pseudocinerea* and *Nostoc commune*. The *Dryas integrifolia* variant occurs on more well-vegetated parts of non-sorted circles (Fig. 12d). The *Dryas integrifolia* variant is the most distinctive subtype; it occurs on the best drained circles and is characterized by high cover of *Dryas integrifolia* and *Saxifraga oppositifolia* and is differentiated by *Carex rupestris*, *Thamnolia vermicularis*, and *Orthotheciella varia.*

Table 11. *Dryas integrifolia–Carex rupestris* community xeromesic intercircle areas and vegetated patches at Green Cabin (subzone C)

	Dryas integrifolia var.					Psora decipiens var.				
Relevé No.	306	309	303	312	315	311	314	302	308	305
Altitude (m.a.s.l.)	72	75	63	68	63	65	63	63	75	72
Plot size (m^2)	20	25	100	30	-	-	30	100	15	25
Vegetation cover (%)	95	98	99	95	99	85	30	25	80	20
Number of vascular taxa	10	11	9	8	7	15	10	9	18	8
Number of nonvascular taxa	19	18	21	17	13	18	7	11	13	11
Total number of taxa	29	29	30	25	20	33	17	20	31	19
Ch/D: Community										
Oxytropis borealis	+	1	+	+	+	+	1	+	+	+
Toninia sedifolia	+	+	+	.	.	1	+	+	+	+
Lesquerella arctica	+	+	+	.	.	+	+	+	+	+
D: Dryas integrifolia var.										
Syntrichia ruralis	2	1	+	2	2	1	.	.	.	.
Ctenidium procerrimum	2	2	2	1	+	+	.	.	.	.
Ditrichum flexicaule	1	2	1	1	1	+	.	.	+	.
Distichium capillaceum	+	1	+	+	+	+	.	.	.	.
Hypnum revolutum	+	+	+	.	.	+	.	.	.	.
Flavocetraria cucullata	+	+	.	r	.	.	.	.	.	.
Didymodon asperifolius	+	.	+	.	+	.	.	.	.	.
Abietinella abietina	.	+	.	+	+	.	.	.	.	.
D: Psora decipiens var.										
Psora decipiens	.	.	.	.	.	3	2	2	3	2
Potentilla vahliana	.	+	.	.	.	1	r	+	1	+
Elymus alaskanus ssp. alaskanus	.	.	.	.	.	+	r	+	+	.
Megaspora verrucosa	.	.	+	.	.	+	r	+	.	.
Collema tenax	.	+	.	.	.	+	+	.	+	.
Caloplaca sp.	.	.	.	.	.	+	+	.	.	+
Draba oblongata	.	.	+	.	.	+	.	+	.	+
Ch: Class, order, and alliance										
Carex rupestris	2	1	2	1	2	2	1	1	2	1
Saxifraga oppositifolia	1	1	1	+	1	+	+	1	1	+
Dryas integrifolia	4	4	4	4	4	r	+	.	.	+
Others										
Salix arctica	2	1	+	1	2	2	+	+	1	+
Lecanora epibryon	1	+	+	+	+	1	+	1	1	+
Parrya arctica	+	+	r	+	+	+	+	+	1	+
Thamnolia vermicularis	1	1	+	2	+	1	1	.	1	+
Rinodina roscida	+	+	+	+	+	+	.	+	+	.
Fulgensia bracteata	+	+	+	.	.	+	.	r	+	+
Catapyrenium cinereum	.	.	+	+	.	.	.	.	+	+
Draba alpina	.	+	.	r	.	+	.	.	r	.
Solorina bispora var. subspongiosa	.	.	+	+	.	.	.	+	.	+
Oxytropis arctobia	+	.	+	.	.	+	.	.	+	.
Caloplaca tiroliensis	+	.	.	+	.	.	.	+	.	.
Catapyrenium sp.	+	.	.	.	.	+	.	+	.	.
Didymodon icmadophilus	.	+	.	+	.	+	.	.	.	.
Draba nivalis	.	1	.	.	.	+	.	.	+	.
Taraxacum sp.	.	+	.	.	.	+	.	.	+	.
Hypnum cupressiforme	.	.	.	+	1	+	.	.	.	.

Additional taxa with two or less occurrences: Alectoria ochroleuca (rel. 306:+, 312:r), Oxytropis arctica (306:+, 312:r), Astragalus alpinus (306:r, 314:r), Toninia arctica (306:+, 308:+), Orthothecium strictum (309:+, 303:+), Puccinellia angustata (309:+, 308:+), Bryoerythrophyllum recurvirostrum (303:+, 312:+), Hypnum bambergeri (303:+, 315:+), Tomentypnum nitens (303:+, 315:+), Artemisia borealis (311:+, 308:+), Protoblastenia terricola (302:+, 308:+), Cladonia pocillum (308:+, 305:+), Bryum wrightii (306:+), Cephaloziella arctica (306:+), Evernia perfragilis (306:+), Timmia austriaca (306:+), Cratoneuron sp. (309:+), Dactylina arctica (309:+), Phaeorrhiza nimbosa (309:+), Amblystegium longicuspis (303:+), Bryum sp. (303:+), Pseudocalliergon brevifolium (303:+), Encalypta sp. (312:+), Astragalus richardsonii (315:r), Myurella julacea (315:+), Encalypta vulgaris (311:+), Placynthium nigrum (302:+), Braya glabella ssp. purpurascens (308:+), Cerastium beeringianum (308:r), Minuartia rossii/rubella (308:r), Physconia muscigena (308:+), Potentilla nivea (308:+), Candelariella sp. (305:+), Psora vallesiaca (305:+).

Table 12. *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community in hydromesic non-sorted circles at Green Cabin (subzone C).

	Eriophorum angustifolium var.			Placidiopsis pseudocinerea var.			Dryas integrifolia var.		
Relevé No.	316	320	319	321	322	323	324	326	325
Altitude (m.a.s.l.)	45	45	50	53	53	53	50	50	50
Plot size (m^2)	30	4	6	3	4	2	2	2	1.5
Vegetation cover (%)	10	5	5	55	50	30	95	99	98
Number of vascular taxa	9	5	6	12	13	8	9	8	9
Number of nonvascular taxa	5	3	1	3	3	3	15	13	6
Total number of taxa	14	8	7	15	16	11	24	21	15
Ch/D: Community									
Braya glabella ssp. purpurascy	+	+	+	r	+	+	+	+	+
Hymenostylium recurvirostre	+	+	.	1	+	+	.	.	.
D: Eriophorum angustifolium var.									
Eriophorum angustifolium	+	+	+	.	.	.	.	.	.
D: Placidiopsis pseudocinerea var.									
Placidiopsis pseudocinerea	.	.	.	2	2	1	.	.	.
Nostoc commune	.	+	.	+	+	+	.	.	.
Pedicularis sudetica	.	.	.	+	+	.	.	.	.
Juncus biglumis	.	.	.	+	+	.	.	.	.
Tephroseris atropurpurea ssp. atropurpurea	.	.	.	r	r	.	.	.	.
D: Dryas integrifolia var.									
Carex rupestris	.	.	.	.	.	.	1	2	+
Thamnolia vermicularis	.	.	.	.	.	.	+	2	+
Orthotheciella varia	.	.	.	.	.	.	+	+	+
Bryum sp.	.	.	+	.	.	.	+	.	+
Lecanora epibryon	.	.	.	.	.	.	+	2	.
Ditrichum flexicaule	.	.	.	.	.	.	+	1	.
Carex scirpoidea	.	.	.	.	.	.	+	+	.
Platydictya jungermannioides	.	.	.	.	.	.	+	+	.
Lophozia collaris	+	.	.	.	.	.	.	+	+
Ch: Class, order, and alliance									
Dryas integrifolia	+	r	+	+	+	+	4	4	4
Carex misandra	.	.	.	2	2	1	1	2	2
Saxifraga oppositifolia	+	.	.	.	+	+	3	3	3
Others									
Salix arctica	+	.	+	+	+	+	1	+	1
Carex aquatilis	+	+	+	+	1	2	.	.	.
Carex membranacea	+	+	.	1	1	.	+	+	.
Distichium inclinatum	+	+	.	.	.	.	+	+	+
Eriophorum angustifolium ssp. triste	.	.	.	2	+	2	+	.	+
Equisetum variegatum	+	.	.	+	.	.	.	.	.
Hulteniella integrifolia	+	.	.	.	.	.	.	.	+

Single occurrences: Catapyrenium cinereum (rel. 316:+), Cephaloziella arctica (316:+), Puccinellia sp. (319:r), Carex lachenalii (321:1), Eriophorum vaginatum (322:r), Stellaria humifusa (322:r), Draba oblongata (323:r), Amblystegium longicuspis (324:+), Bryoerythrophyllum recurvirostrum (324:+), Didymodon icmadophilus (324:+), Encalypta sp. (324:+), Hypnum bambergeri (324:+), Leptobryum pyriforme (324:+), Myxobilimbia lobulata (324:1), Rinodina roscida (324:+), Agonimia gelatinosa (326:1), Flavocetraria cucullata (326:+), Meesia sp. (326:+), Sanionia uncinata (326:+), Solorina bispora var. subspongiosa (326:r), Vulpicida tilesii (326:+), Pedicularis langsdorfii (325:+), Tortula mucronifolia (325:+).

The soils are classified as Psammentic Aquiturbels (Ping & Michaelson in Munger et al. 2004). Organic horizons are shallow (mean 0.2), and overlay gray to brown mineral horizons with a sandy to loamy sand texture. Soil moisture ranges from 21 % (*Eriophorum angustifolium* variant) to 29 % (*Dryas integrifolia* variant) to 49 % (*Placidiopsis pseudocinerea* variant). Average pH is quite high (8.3). These sites are often covered by water, especially in early summer, and deposits of marl (calcium carbonate precipitated in ponds) are common on the soil surface. The sparse vegetation cover acts as a poor insulator and allows for deep thaw depth (53 cm in *Eriophorum angustifolium* variant, 59 cm in *Placidiopsis pseudocinerea* variant, 57 cm in *Dryas integrifolia* variant).

The *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community shares some floristic elements with the *Braya purpurascens–Puccinellia angustata* community (*Mycobilimbia lobulata* var.) described

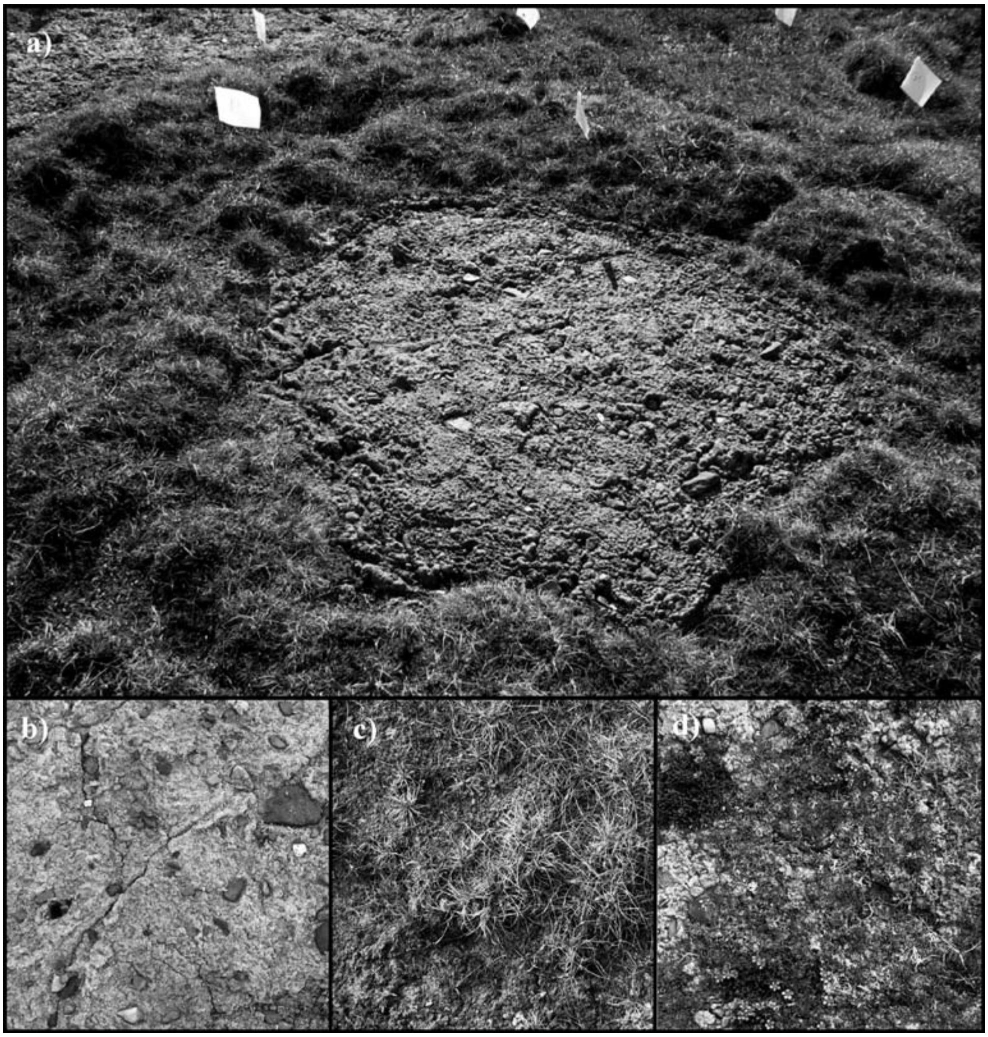

Fig. 12. *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community occurring on the hydromesic non-sorted circles at Green Cabin: a) non-sorted circle, b) *Eriophorum angustifolium* variant occurring on the almost bare center of the non-sorted circles, c) the *Placidiopsis pseudocinerea* variant occurring on the slightly more vegetated parts of the non-sorted circles, d) *Dryas integrifolia* variant occurring on the more vegetated parts of the non-sorted circles. *Dryas integrifolia–Carex aquatilis* community occurring on hydromesic intercircle areas at Green Cabin. *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community occurring on hygric intercircle areas at Green Cabin.

from dry, nonacidic frost-heave features on Howe Island (Kade et al. 2005). The *Dryas integrifolia* variant is floristically and physiognomically similar to the Junco–Dryadetum integrifoliae typicum on the poorly vegetated non-sorted circles of subzone D (Kade et al. 2005), and *Saxifraga oppositifolia–Juncus biglumis* community from Prudhoe Bay (Type B3 Dry; Walker 1985).

Dryas integrifolia–Carex aquatilis community
(Table 13, Fig. 12)

The *Dryas integrifolia–Carex aquatilis* community occurs in hydromesic intercircle areas of subzone C in association with the *Braya glabella* ssp. *purpurascens–Dryas integrifolia* community described above. The intercircle areas are completely overgrown with vegetation that is dominated by prostrate dwarf shrubs, sedges, and mosses.

Character/differential taxa of this community are *Tephroseris atropurpurea* ssp. *atropurpurea*, *Pedicularis langsdorffii*, *Polyblastia sendtneri*, and *Dactylina arctica*. Other common taxa are *Dryas integrifolia*, *Hypnum bambergeri*, *Saxifraga oppositifolia, Carex membranacea*, *Tomentypnum nitens, Salix arctica*, *Eriophorum angustifolium* ssp. *triste, Ditrichum flexicaule, Arctagrostis latifolia, Carex aquatilis* etc.

The soils are classified as Ruptic-Histic Aquiturbels (Ping & Michaelson in Munger et al. 2004). The mineral soils have a brown to grayish color and a loamy sand texture. Organic horizons range in thickness from 2 to 25 cm. Soil moisture is very high (66 %), and the pH averages 7. 3. Mean thaw depth is 24 cm.

Table 13: *Dryas integrifolia–Carex aquatilis* community in hydromesic intercircle areas at Green Cabin (subzone C)

Relevé No.	331	317	329	330
Altitude (m.a.s.l.)	55	45	50	50
Plot size (m^2)	-	40	3	4
Vegetation cover (%)	100	100	100	100
Number of vascular taxa	18	12	20	13
Number of nonvascular taxa	25	16	16	11
Total number of taxa	43	28	36	24
Ch/D: Community				
Tephroseris atropurpurea ssp. atropurpurea	+	+	+	+
Pedicularis langsdorffii	+	+	+	.
Polyblastia sendtneri	+	1	.	.
Dactylina arctica	+	+	.	.
Ch: Class, order, and alliance				
Dryas integrifolia	3	3	3	3
Hypnum bambergeri	1	2	2	2
Saxifraga oppositifolia	1	1	+	+
Carex rupestris	2	.	+	1
Carex misandra	1	1	.	1
Carex scirpoidea	+	.	+	.
Others				
Carex membranacea	3	2	2	2
Tomentypnum nitens	2	2	2	3
Salix arctica	2	2	2	2
Eriophorum angustifolium ssp. triste	+	2	2	2
Ditrichum flexicaule	1	1	1	3
Arctagrostis latifolia	+	+	1	1
Carex aquatilis	+	+	1	1
Equisetum variegatum	+	+	+	+
Thamnolia vermicularis	+	+	+	+
Lecanora epibryon	+	+	+	+
Orthothecium chryseon	+	+	+	+
Pseudocalliergon brevifolium	+	+	+	+
Distichium capillaceum	1	+	+	.
Flavocetraria cucullata	+	+	r	.
Bryum pseudotriquetrum	+	.	+	+
Campylium stellatum	+	.	+	+
Bistorta vivpara	+	.	+	.
Cardamine digitata	+	.	+	.
Carex lachenalii	.	+	.	+
Syntrichia ruralis	.	+	+	.
Aulacomnium acuminatum	.	.	1	1

Single occurrences: Amblystegium longicuspis (rel. 331:+), Bryoerythrophyllum recurvirostrum (331:+), Bryum subneodamense (331:+), Caloplaca tiroliensis (331:+), Cinclidium arcticum (331:+), Cladonia pocillum (331:+), Cladonia pyxidata (331:r), Draba alpina (331:r), Juncus biglumis (331:+), Pedicularis sudetica (331:+), Pseudocalliergon turgescens (331:+), Rinodina roscida (331:+), Solorina bispora var. subspongiosa (331:+), Timmia austriaca (331:+), Tortula norvegica (331:+), Campylium polygamum (317:+), Collema tenax (317:+), Didymodon asperifolius (317:+), Scorpidium scorpioides (317:+), Cratoneuron sp. (329:+), Ctenidium procerrimum (329:+), Draba sp. (329:r), Eutrema edwardsii (329:+), Parrya arctica (329:r), Pedicularis capitata (329:+), Pedicularis sp. (329:r), Stellaria longipes (329:+), Tetraplodon sp. (329:+), Scapania gymnostomophila (330:+), Silene uralensis ssp. uralensis (330:r).

We place this community in the class Carici rupestris-Kobresietea bellardii. However, the *Dryas integrifolia–Carex aquatilis* community is somewhat intermediate with plant communities of the Scheuchzerio-Caricetea nigrae. This community is similar to the *Dryas-Carex stans* community described from ice-wedge crests on Banks Island (Schweingruber 1977) and the *Dryas integrifolia-Carex membranacea* community in the Canadian Arctic Archipelago (Thannheiser 1988, Thannheiser & Geesink 1990). It appears to be somewhat in between these two communities because both *Carex aquatilis* and *Carex membranacea* are highly abundant. This, however, is a common situation in wet coastal environments of subzone C and D (e.g. Type U4, moist *Eriophorum angustifolium, Dryas integrifolia, Tomentypnum nitens, Thamnolia subuliformis* community at Prudhoe Bay, Alaska; Walker 1985). Moreover, it seems that the *Dryas integrifolia–Carex aquatilis* community is the "less species rich subzone C counterpart" of the Dryado integrifoliae-Caricetum bigelowii (Walker et al. 1994) described from moist, nonacidic tundra in subzone D, as they have many species in common and occur in the same kind of habitat.

***Eriophorum angustifolium*, ssp. *triste–Carex aquatilis* community** (Table 14, Fig. 12)

The *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community occurs in somewhat wetter intercircle areas than the *Dryas integrifolia–Carex aquatilis* community described above. This community is dominated by graminoids and mosses. Character/differential taxa are *Pseudocalliergon turgescens*, *Pedicularis sudetica*, *Meesia longiseta*, *Amblystegium longicuspis*, *Limprichtia cossonii*, and *Bryum subneodamense*. Other common taxa are *Carex aquatilis*, *Eriophorum angustifolium* ssp. *triste*, *Campylium stellatum*, *Hypnum bambergeri*, *Carex membranacea*, *Salix arctica, Nostoc commune, Pseudocalliergon brevifolium,* and *Arctagrostis latifolia.*

Soil moisture is high (66 %), and the average pH is 7. 5. Organic horizons range from 1 to 22 cm. The dense vegetation and organic soil horizons acts as an insulator and prevents deep thaw depth (22 cm). Standing water is often present, especially the early summer, and like the *Braya glabella–Dryas integrifolia* community described above, it often has deposits of marl on the soil surface.

The *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community shows some affinities with the *Eriophorum angustifolium–Carex aquatilis* ssp. *aquatilis* community described from wet meadows and basins of low-centered polygons with saturated soils at Point Barrow and on Barter Island, Alaska (Elias et al. 1996) and the *Carex aquatilis–Eriophorum triste* community described from valley bottoms and slopes on Ellesmere Island (Bergeron & Svoboda 1989).

Table 14. *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community in hygric intercircle areas at Green Cabin (subzone C).

Relevé No.	327	328	318
Altitude (m.a.s.l.)	50	50	45
Plot size (m^2)	4	4	30
Vegetation cover (%)	99	98	60
Number of vascular taxa	8	7	14
Number of nonvascular taxa	14	15	13
Total number of taxa	22	22	27
Ch/D: Community			
Pseudocalliergon turgescens	+	+	+
Pedicularis sudetica	+	.	+
Meesia longiseta	+	+	.
Amblystegium longicuspis	+	+	.
Limprichtia cossonii	+	+	.
Bryum subneodamense	+	+	.
Ch: Class, order, and alliance			
Carex aquatilis	2	2	+
Eriophorum angustifolium ssp. triste	2	2	+
Campylium stellatum	2	1	+
Bryum pseudotriquetrum	+	+	1
Equisetum variegatum	+	+	+
Meesia triquetra	+	+	.
Others			
Hypnum bambergeri	3	3	2
Carex membranacea	2	1	2
Salix arctica	+	2	1
Nostoc commune	+	+	+
Pseudocalliergon brevifolium	+	+	+
Arctagrostis latifolia	+	+	+
Cinclidium latifolium	1	+	.
Distichium capillaceum	+	1	.
Ditrichum flexicaule	+	+	.
Orthothecium chryseon	+	+	.

Single occurrences: Ctenidium procerrimum (rel. 328:1), Aneura pinguis (318:+), Braya glabella ssp. purpurascens (318:+), Cardamine digitata (318:+), Carex atrofusca (318:+), Carex heleonastes (318:+), Carex lachenalii (318:+), Carex misandra (318:1), Carex scirpoidea (318:+), Cephaloziella arctica (318:+), Distichium inclinatum (318:1), Encalypta alpina (318:+), Juncus biglumis (318:+), Lophozia collaris (318:+), Meesia sp. (318:+).

4.4 Ordination

A two dimensional NMDS ordination was used for examining patterns of community composition with respect to sites and environmental characters, (Fig. 13 and 14). A third dimension did not provide substantial stress reduction, and did not add information on environmental correlations. The NMDS ordination had a final stress value of 15.01 (p = 0.0099) and the two axes accounted for 68.8 % of the original variation in the dataset. Other ordinations methods were also tested, but the NMDS showed the best spread of the plots and accounted for most of the variation on the first two axes. The next best type of ordination, DCA, accounted for only 27.3 % of the variation with the first two axes.

The arrows within the biplot diagram display the principal direction of variation and strength of correlation for major environmental variables (Fig. 14). Only metric environmental variables with $r^2 > 0.35$ are shown.

Axis 1 is interpreted as a "complex soil moisture gradient", because there is a complex of factors, in-

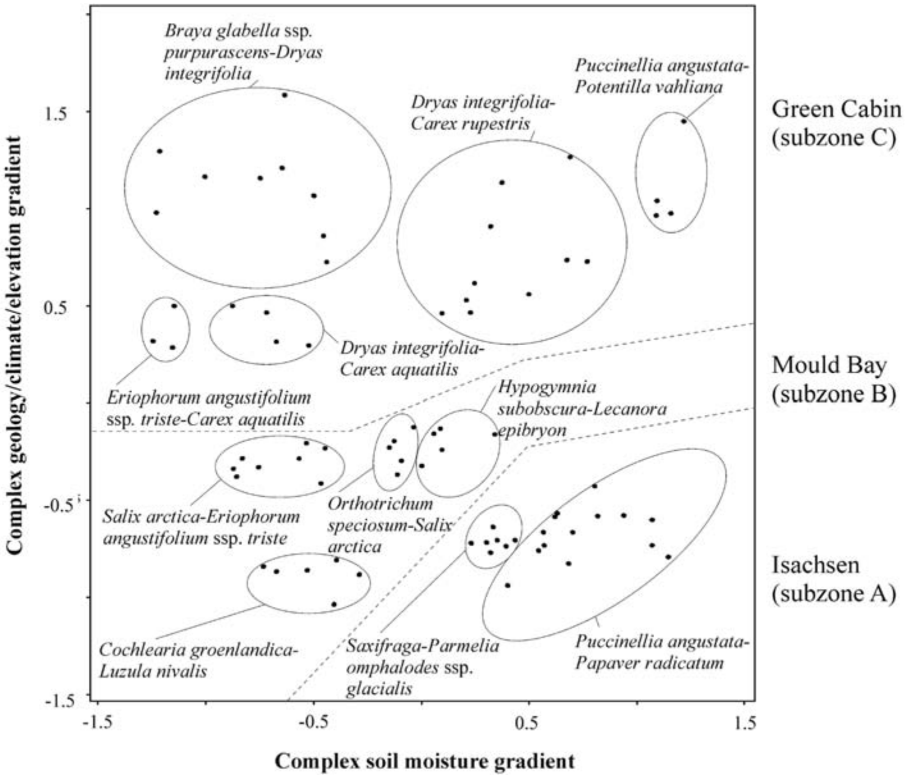

Fig. 13. NMDS ordination of all relevés. The sample plots are grouped according to communities.

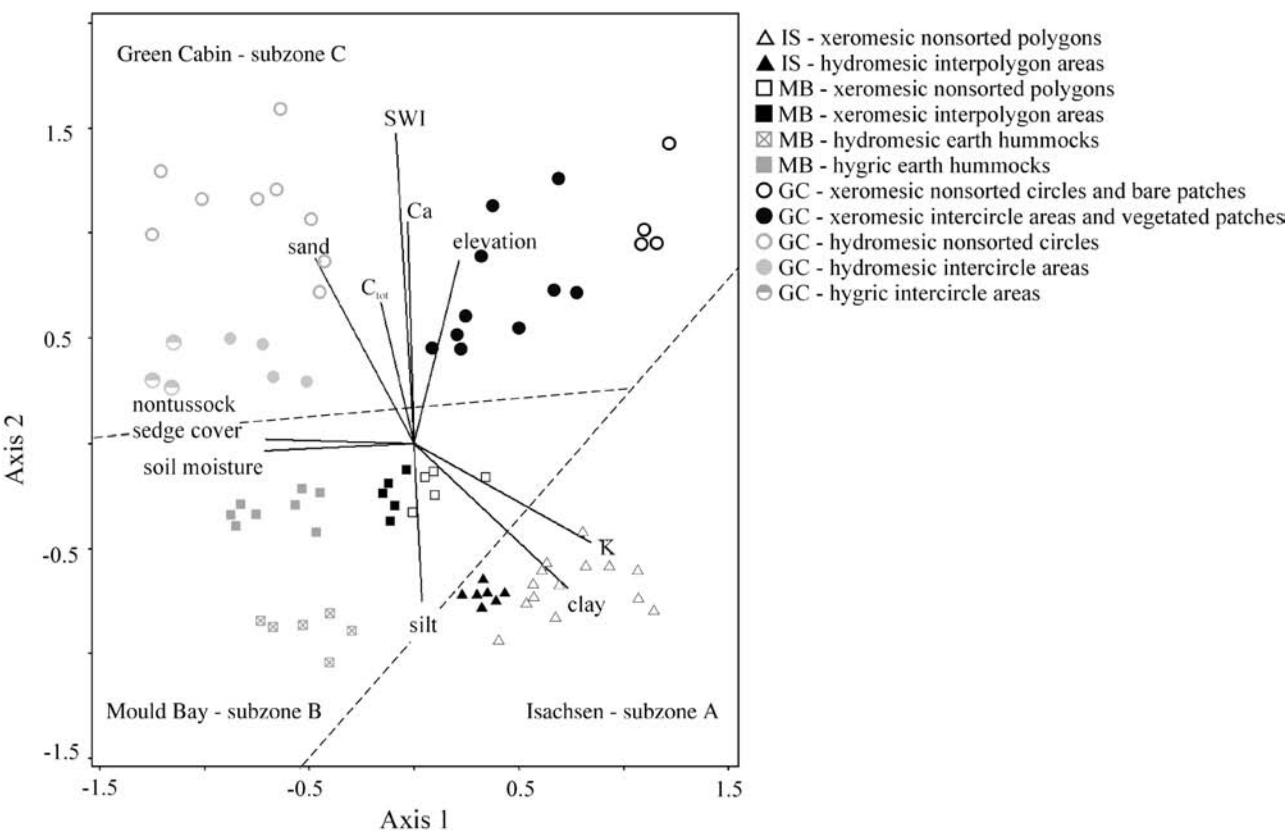

Fig. 14. NMDS ordination of all relevés. The biplot diagram displays variables correlated with the plot distribution and indicates the direction and strength of correlation of metric variables with $r^2 > 0.35$. The sample plots are coded according to the location of the study sites: IS = Isachsen, MB = Mould Bay, GC = Green Cabin.

cluding volumetric soil moisture, percent clay, non-tussock sedge cover, all related to soil moisture that vary along the first axis. Soil moisture and sedge cover decrease along axis 1 while clay and K increase. Axis 2 is interpreted as a complex climate/elevation/geology gradient. Summer air temperature as measured by the SWI increases along axis 2, which corresponds to the south to north negative trend in temperature. Furthermore, sand, Ca, and C_{tot} contents as well as elevation increase and silt content decreases along axis 2.

The community types obtained by the classification are clearly separated in the ordination analysis with no overlap between the communities (Fig. 13 and 14). The xeric and xeromesic communities in subzone C at Green Cabin (*Puccinellia angustata–Potentilla vahliana* and *Dryas integrifolia–Carex rupestris* communities) are clustered in the upper-right part of the ordination space, which is correlated with warm air temperatures, slightly higher elevations, and dry soils. The more mesic and hygromesic communities at Green Cabin (*Eriophorum angustifolium* ssp. *triste–Carex aquatilis, Braya glabella–Dryas integrifolia* and *Dryas integrifolia–Carex aquatilis*) are in the upper-left part of the ordination space. The communities of subzone B occupy the middle to lower-left portion of the ordination space, which is correlated with high soil moisture and high sedge cover. The *Cochlearia groenlandica–Luzula nivalis* community is found in the lower left corner of the diagram, which corresponds to high silt contents. The *Orthotrichum speciosum–Salix arctica* community and the *Hypogymnia subobscura–Lecanora epibryon* community occur in the middle of the ordination diagram. The communities of subzone A, i.e. *Saxifraga–Parmelia omphalodes* ssp. *glacialis* and *Puccinellia angustata–Papaver radicatum* community, are located in the lower right corner of the diagram, which corresponds to high clay, K, and silt contents. Moreover, the diagram shows also that the plant communities are arranged along the bioclimate gradient, as all communities of subzone C are found in the upper part of the diagram, communities of subzone A occur in the lower right corner of the diagram, and communities of subzone B are mainly situated in the middle of the diagram.

4.5 Plant groups and phytogeographic spectra

The analyses of plant groups and phytogeographic spectra (Fig. 15 and 16) show some differences between frost-heave feature communities and adjacent tundra plots as well as changes along the bioclimate gradient. Species richness at the plot level (α-diversity) peaks in Isachsen (subzone A) and is lower at Mould Bay (subzone B) and Green Cabin (subzone C). The high species richness at Isachsen is mainly due to the great diversity of lichens and mosses. The high species richness of lichens in the northernmost sites in small sample plots might be due to several causes. Competition for light and space by vascular plants is strongly reduced in the polar desert with poor vascular plant floras. This benefits the small, slowly growing photophytic lichens and mosses which are better physiologically adapted to disturbance and stress situations than most vascular plants. Moreover they easily propagate vegetatively and thus are able to colonize and persist in open places (cf. Bültmann & Daniëls 2001, Lünterbusch & Daniëls 2004). Lichens tend to disappear as soon as graminoids and shrubs increase in cover (Fig. 15). Shrub and graminoid cover increases towards the south. Similar trends have been shown by warming experiments in the Arctic (e.g. Epstein et al. 2004, Hollister et al. 2005, see also Daniëls 1988). Lichens and mosses tend to be more abundant in coastal areas where it is foggier (more moisture) than in drier interior island areas. Isachsen and Mould Bay are situated near the coast and have therefore more lichens (and mosses) than Green Cabin, which is located in the drier interior of the island. The floristic richness is greatest in the *Puccinellia angustata–Papaver radicatum* community with 130 species (the community with the highest cover of bare soil of 89 %) and the *Saxifraga–Parmelia omphalodes* ssp. *glacialis* with 128 species. The *Puccinellia angustata–Potentilla vahliana* community has the poorest floristic diversity with 13 species. With the exception of the *Puccinellia angustata–Potentilla vahliana* community, species numbers in the investigated communities are driven by nonvascular species, which make more than 50 % of the total species. In general, the species richness of lichens and mosses increases along the bioclimate gradient from south to north. Shrubs and sedges are not present in subzone A. High diversity has also been noted in other Arctic associations such as the *Dryado integrifoliae-Caricetum bigelowii* in Alaska with an average of 55 species per plot (Walker et al. 1994), the Greenlandic Rhododendro-Vaccinietum with 70 species per plot (Lünterbusch & Daniëls 2004), and the Carici arctisibiricae-Hylocomietum alaskani in the Russian Taimyr Peninsula with 81 species per plot (Matveyeva 1994). However, it should be noted that Matveyeva sampled 100 m^2 relevés that included the rims, centers, and troughs of patterned-ground complexes. The rich *Saxifraga–Parmelia omphalodes* ssp. *glacialis* community at Isachsen may contain the most species of any homogeneous community sampled in the Arctic.

Total plant cover is greater in the tundra plots than in the adjacent frost-heave communities (Fig. 15). In general, tundra plots have greater moss and graminoid cover than the adjacent frost-heave communities. The cover of graminoids plays an important role especially in the *Dryas integrifolia – Carex aquatilis* community, the *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* community, and the *Salix arctica–Eriophorum angustifolium* ssp. *triste* community. Highest shrub covers occurred in

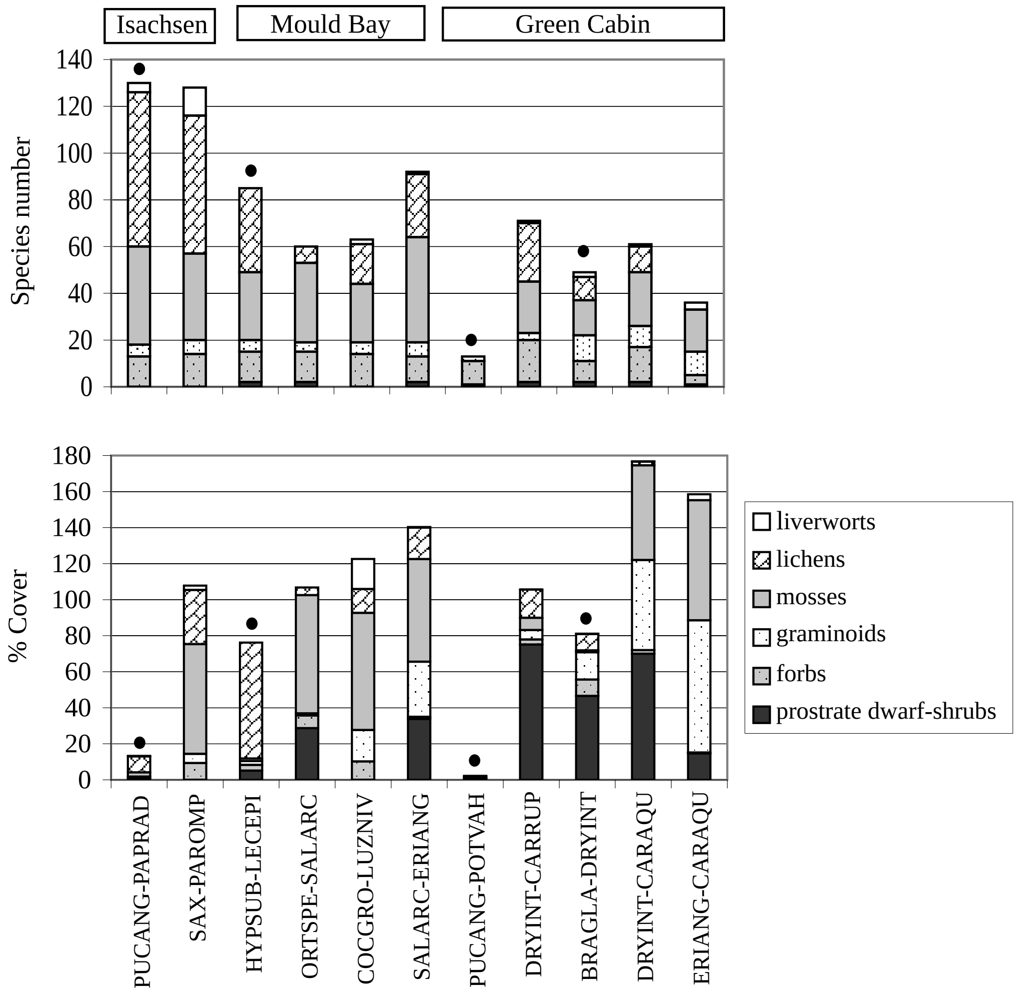

Fig. 15. Analysis of the species richness and plant groups of the cryoturbated tundra communities. Plant groups are shown as species numbers and percent cover values. Key to plant communities: PUCANG–PAPRAD = *Puccinellia angustata–Papaver radicatum* comm., SAX–PAROMP = *Saxifraga–Parmelia omphalodes* ssp. *glacialis* comm., HYPSUB–LECEPI = *Hypogymnia subobscura–Lecanora epibryon* comm., ORTSPE–SALARC = *Orthotrichum speciosum–Salix arctica* comm., COCGRO–LUZNIV = *Cochlearia groenlandica–Luzula nivalis* comm., SALARC–ERIANG = *Salix arctica–Eriophorum angustifolium* ssp. *triste* comm., PUCANG–POTVAH = *Puccinellia angustata–Potentilla vahliana* comm., DRYINT–CARRUP = *Dryas integrifolia–Carex rupestris* comm., BRAGLA–DRYINT = *Braya glabella* ssp. *purpurascens–Dryas integrifolia* comm., DRYINT–CARAQU = *Dryas integrifolia–Carex aquatilis* comm., ERIANG–CARAQU = *Eriophorum angustifolium* ssp. *triste–Carex aquatilis* comm. Plant communities associated with cryoturbation activity are marked with ●.

the warmest subzone included in this study, subzone C. Lichen covers increases toward the north. The cover of forbs is low in all community types (0.5–10 %), but is highest in the *Cochlearia groenlandica–Luzula nivalis* community. Along the bioclimate gradient, total plant cover of the tundra plots decreases from south to north.

Fig. 16 presents an analysis of the phytogeographic spectra of the vascular plant within each plant community. The analysis considers the flora in three ways modified from the criteria by Walker (1985): major regional units, northern limits of species distribution, and geographic range. Differences between frost-heave features and adjacent tundra are slight. With the exception of the *Puccinellia angustata–Potentilla vahliana* community arctic-alpine species usually make up more than 40 % of the total vascular species. The proportion of the arctic-boreal species decreases from south to north.

All the species in the northernmost communities have their distribution limit in Young's Zone 1. Notably, the plant communities at the southern end of the bioclimate gradient have up to 23 % of their species with northern distribution limits in Zone 3, which in Young's (1971) approach is more or less equivalent to bioclimate subzone D. This is further indication that Green Cabin may actually be in the northern part of subzone D.

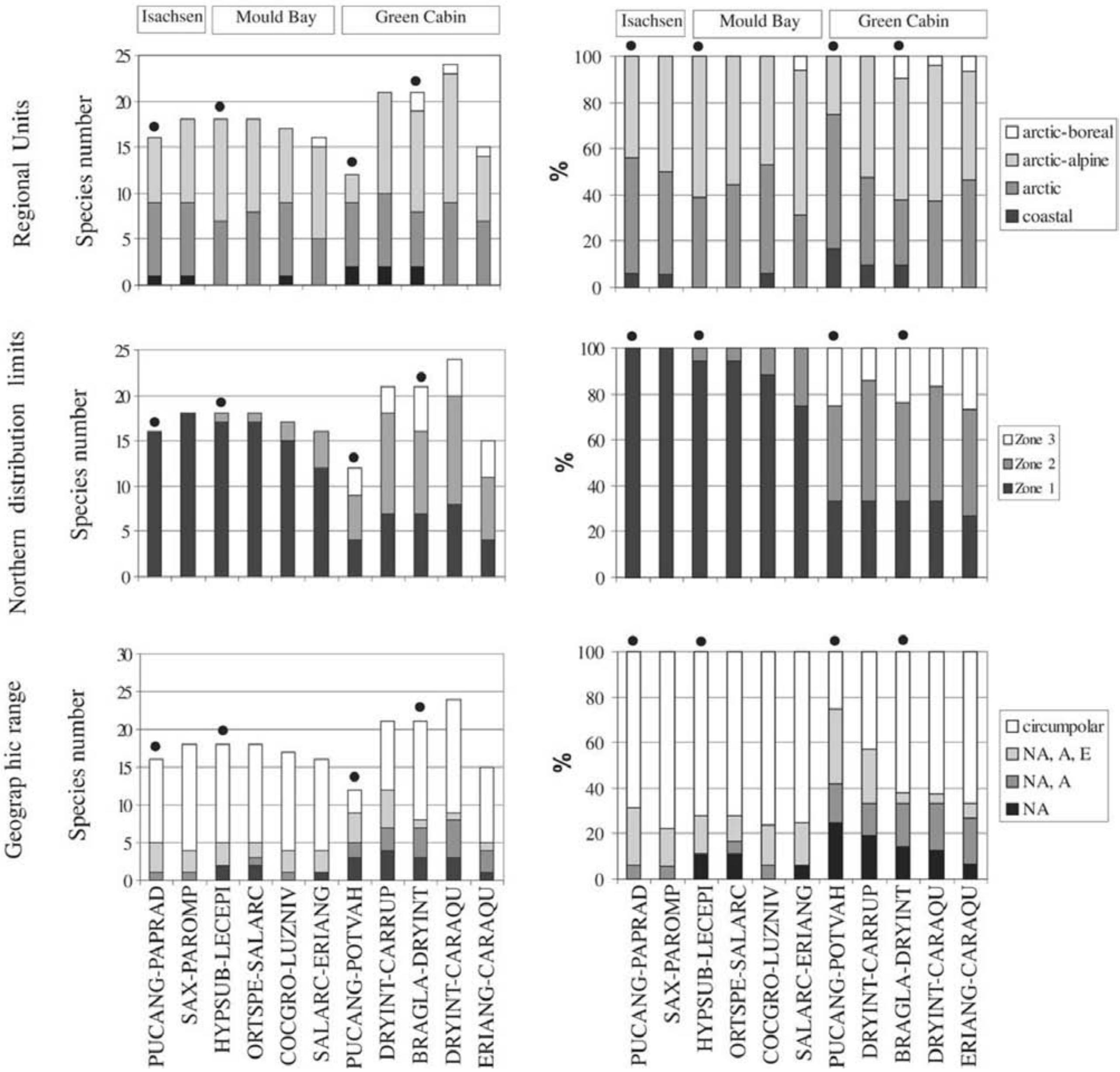

Fig. 16. Phytogeographic spectra for vascular species of the cryoturbated tundra communities. The major regional units, northern distribution limits, and geographic ranges are shown as total species numbers and percent values. See Fig. 15 for key to plant communities. Key to geographic units: NA = North America, A = Asia, E = Europe.

With the exception of the *Puccinellia angustata–Potentilla vahliana* community the investigated communities are dominated by species with circumpolar ranges. Species with their geographical range limited in Northern America and Asia (Beringian species) are more frequent at Green Cabin than further north.

5 Conclusions

Based on 75 relevés we have classified, described and analyzed eleven plant communities associated with small patterned-ground features at three locations along the High Arctic bioclimate gradient in the northwestern part of the Canadian Archipelago. Within six of the described communities we have recognized 12 variants. All except one plant community are placed within existing Braun-Blanquet classes, orders and alliances. We refrain from assigning the plant communities at this time to associations or subassociation because this should be done after a more thorough treatment of the total vegetation of the localities studied, which is planned for the future. A few general conclusions regarding the nature of the patterned ground features and their associated plant communities can be drawn from this study:

1. The dominant patterned-ground features in the High Arctic are distinct from those in the Low Arctic in several respects: (a) The dominant genetic process in the High Arctic is cracking due to either desiccation or thermal contraction, which results in small non-sorted and sorted polygons and turf hummocks. In the Low Arctic, differential frost-heave is the dominant process, which results in non-sorted circles and earth mounds. (b) The size of the High Arctic polygonal features is generally much smaller (10–50 cm diameter) than the mounds and circles in the Low Arctic (1–2 m diameter). (c) The centers of the small polygonal features generally are not strongly influenced by frost-heave. They often, however, are affected by other forms of disturbance such as wind erosion. They may or may not be well vegetated depending on the level of disturbance and the availability of water. Often the cracks are much more vegetated than the centers of the polygons because of slightly protected microsites and availability of soil water. (d) As in the Low Arctic, differential frost-heave, non-sorted circles, and earth mounds occur in areas with good vegetation cover, and especially in wet areas. Such conditions are, however, much less common in the High Arctic.

2. The low stature of the High Arctic vegetation, thinner moss mats, and lack of soil organic horizons do not create the strong differences in active layer and heave that were noted in adjacent microsites in the Low Arctic. Generally, there was about a 7–11 cm difference in the active layer between centers of the features and the surrounding tundra. The contrast was most marked in the wet sites at Green Cabin, where the average thaw within the *Braya glabella–Dryas integrifolia* community on barren non-sorted circles was 56 cm vs. 23 cm on the adjacent *Dryas integrifolia–Carex aquatilis tundra*. This is similar to the situation in subzone D in the Low Arctic (Kade et al. 2005) and is the result of the strong contrast in the thickness of the moss and vegetation layers.

3. Ordination analysis indicated that most of the variation within the data set appears to be due to differences in soil moisture and climate differences, but geological differences also play a role. For example, the very clayey soils at Isachsen are due to the local Christopher Shale deposits, and the high sand percentages at Green Cabin reflect sandy glacial till at that site. The coastal sites at Isachsen and Mould Bay show higher Na^+ concentrations than Green Cabin. The NMDS ordination shows clear separation of all the described plant communities and the groups of plant communities associated with each locality (Isachsen, Mould Bay, and Green Cabin). The first axis of the ordination corresponds to a complex soil-moisture gradient, and the second axis corresponds to a complex geology/climate/elevation gradient.

4. Despite differences in geology, the plant communities at each location show the floristic site characteristics expected within the respective bioclimate subzones as described by Elvebakk (1999), with the exception of Green Cabin. For example: (a) within the Isachsen relevés (subzone A), there is a total absence of sedges and woody plants, very shallow to absent organic soil horizons, and high presence of grasses, rushes, small forbs, mosses, and especially soil lichens, (b) At Mould Bay (subzone B), there are high presence and cover of prostrate dwarf shrubs (*Salix arctica* and *Dryas integrifolia*), sedges (*Eriophorum angustifolium* ssp. *triste, Carex aquatilis, C. heleonastes*); organic soil horizons occur in mesic to wet areas; and there is much higher total species diversity than at Isachsen. (c) At Green Cabin (subzone C), there is much greater diversity of species and plant communities in the landscape. In fact, the common presence of erect dwarf shrubs (*Salix richardsonii*) in some landscapes at Green Cabin (however not represented in any of the relevés sampled here) and numerous plant species which normally have their northern distribution limits in Young's Zone 3 suggest that this site is probably within subzone D.

5. The phytogeographic spectra of the plants change along the gradient. At Isachsen only plants with their northern limit in Young's (1971, slightly modified) Zone 1 are present. At Mould Bay, some Zone 2 plants are also present in each of the plant communities, and there is a reduction in the number of Zone 1 plants. At Green Cabin Zone 2 plants are dominant in all of the plant communities, but there is also a large number of Zone 3 plants (again suggesting that this location should actually be in bioclimate subzone D), and the number of Zone 1 species is farther reduced. Circumpolar species are dominant at all three sites, but the number of North American and Beringian species increases toward the south.

6. Total within-plot (alpha) diversity declines along the climate gradient from north to south. Very high alpha diversity occurs in the *Saxifraga–Parmelia omphalodes* ssp. *glacialis* community at Isachsen, where 95 species were recorded in one relevé, and the average species richness is 76 species per plot caused mainly by the large number of soil lichens. The high lichen abundance at Isachsen is likely due to a combination of factors, including more open vascular plant canopies, constantly cool moist conditions ideal for lichens due to the coastal locality, and low competition from vascular plants. Moss within-plot richness also decreases from north to south from 42 species at Isachsen to 15 species at Green Cabin. Total vascular within-plot richness does not vary markedly along the gradient. However, the total number of vascular species within the set of relevés at each location increases considerably toward the south from 21 at Isachsen to 35 at Mould Bay to 51 at Green Cabin, while the total number of mosses and lichens declines.

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Appendix

Synoptic table of all plant communities. Species occurring in only one community type with constancy < III are omitted. Key to reference number: 1 *Puccinellia angustata – Papaver radicatum* comm., 2 *Saxifraga – Parmelia omphalodes* ssp. *glacialis* comm., 3 *Hypogymnia subobscura – Lecanora epibryon* comm., 4 *Orthotrichum speciosum – Salix arctica* comm., 5 *Cochlearia groenlandica – Luzula nivalis* comm., 6 *Salix arctica – Eriophorum angustifolium* ssp. *triste* comm., 7 *Puccinellia angustata – Potentilla vahliana* comm., 8 *Dryas integrifolia – Carex rupestris* comm., 9 *Braya glabella* ssp. *purpurascens – Dryas integrifolia* comm., 10 *Dryas integrifolia – Carex aquatilis* comm., 11 *Eriophorum angustifolium* ssp. *triste – Carex aquatilis* comm.

Reference No.	1	2	3	4	5	6	7	8	9	10	11
Number of relevés	14	7	5	5	6	8	4	10	9	4	3
Ch/D Puccinellia angustata-Papaver radicatum comm.											
Rinodina terrestris	V^{2}	III^{+}	.	.	.	.	.	.	.	.	.
Puccinellia andersonii/angustata	V^{1}	I^{+}	.	.	.	.	.	.	.	.	.
Fuscopannaria praetermissa	V^{+}	.	.	.	.	.	.	.	.	.	.
Lecidella wulfenii	V^{+}	.	.	.	.	.	.	.	.	.	.
Megaspora verrucosa	V^{+}	II^{+}	III^{2}	.	.	.	.	II^{+}	.	.	.
Megalaria jemtlandica	IV^{+}	.	.	.	.	.	.	.	.	.	.
Tetramelas insignis	IV^{+}	.	.	.	.	.	.	.	.	.	.
Collema ceraniscum	III^{+}	.	.	.	.	.	.	.	.	.	.
Lecanora hagenii var. fallax	III^{+}	.	.	.	.	.	.	.	.	.	.
Leptogium lichenoides	III^{+}	.	.	.	.	.	.	.	.	.	.
Ochrolechia cf. inaequatula	III^{+}	.	.	.	.	.	.	.	.	.	.
Leptogium gelatinosum	III^{+}	.	.	.	.	.	.	.	.	.	.
Ch/D Saxifraga-Parmelia omphalodes ssp. glacialis comm.											
Sticta arctica	$+^{1}$	V^{2}	.	.	.	.	.	.	.	.	.
Pohlia cruda	III^{+}	V^{2}	II^{+}	III^{+}	.	.	.	.	.	.	.
Racomitrium lanuginosum	I^{+}	V^{2}	I^{+}	III^{1}	.	.	.	.	.	.	.
Racomitrium panschii	III^{+}	V^{2}	I^{+}	I^{+}	.	.	.	.	.	.	.
Schistidium frigidum	III^{+}	V^{2}	.	.	.	.	.	.	.	.	.
Poa alpigena	III^{+}	V^{1}	.	.	.	.	.	.	.	.	.
Festuca brachyphylla	II^{+}	V^{1}	.	.	.	.	.	.	.	.	.
Stereocaulon alpinum	II^{+}	V^{1}	I^{+}	I^{+}	.	I^{r}	.	.	.	.	.
Cardamine bellidifolia	III^{+}	V^{+}	.	.	.	.	.	.	.	.	.
Cephaloziella arctica	II^{+}	V^{+}	.	.	.	.	.	$+^{+}$	I^{+}	.	2^{+}
Cladonia pyxidata	III^{+}	V^{+}	.	.	.	.	.	.	.	2^{r}	.
Ranunculus sabinei	III^{+}	V^{+}	.	.	.	.	.	.	.	.	.
Protopannaria pezizoides	III^{+}	V^{+}	.	.	.	I^{+}	.	.	.	.	.
Peltigera rufescens	II^{+}	V^{+}	.	.	.	I^{+}	.	.	.	.	.
Peltigera canina	I^{+}	V^{+}	.	.	.	.	.	.	.	.	.
Hypnum subimponens	$+^{+}$	V^{+}	.	.	.	.	.	.	.	.	.
Tritomaria quinquedentata	$+^{+}$	V^{+}	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	$+^{+}$	V^{+}	.	.	.	.	.	.	.	.	.
Pohlia drummondii	$+^{+}$	V^{+}	.	.	.	.	.	.	.	.	.
Caloplaca ammiospila	III^{+}	V^{+}	I^{+}	.	.	.	.	.	.	.	.
Schistidium papillosum	II^{+}	V^{+}	I^{+}	I^{+}	.	.	.	.	.	.	.
Saxifraga flagellaris	I^{+}	IV^{+}	I^{+}	I^{+}	I^{r}	.	.	.	.	.	.
Caloplaca tetraspora	.	V^{+}	I^{+}	.	.	.	.	.	.	.	.
Alectoria nigricans	.	V^{+}	III^{+}	II^{+}	.	I^{r}	.	.	.	.	.
Peltigera leucophlebia	.	V^{+}	.	.	III^{+}	III^{+}	.	.	.	.	.
Cladonia coccifera	.	V^{+}	.	.	.	.	.	.	.	.	.
Luzula confusa	.	IV^{1}	.	.	.	.	.	.	.	.	.
Rinodina olivaceobrunnea	II^{+}	IV^{+}	.	.	.	.	.	.	.	.	.
Stereocaulon rivulorum	II^{+}	IV^{+}	.	.	.	.	.	.	.	.	.
Hypnum vaucheri	$+^{+}$	IV^{+}	.	.	.	.	.	.	.	.	.
Lophozia polaris	$+^{+}$	IV^{+}	.	.	.	.	.	.	.	.	.
Alectoria ochroleuca	.	IV^{+}	I^{+}	.	.	.	.	I^{+}	.	.	.
Sphaerophorus globosus	.	IV^{+}	.	.	.	.	.	.	.	.	.
Anastrophyllum minutum	.	III^{1}	.	.	.	.	.	.	.	.	.
Candelariella sp.	I^{+}	III^{+}	.	.	.	.	.	$+^{+}$	.	.	.
Hylocomium splendens	.	III^{+}	.	I^{+}	.	I^{+}	.	.	.	.	.
Rinodina mniaraea	$+^{+}$	III^{+}	.	.	.	.	.	.	.	.	.
Barbilophozia hyperborea	.	III^{+}	.	.	.	.	.	.	.	.	.
Bryonora castanea	.	III^{+}	.	.	.	.	.	.	.	.	.
Cladonia chlorophaea	.	III^{+}	.	.	.	.	.	.	.	.	.
Cladonia trassii	.	III^{+}	.	.	.	.	.	.	.	.	.
Peltigera scabrosa	.	III^{+}	.	.	.	.	.	.	.	.	.

Ch/D Hypogymnia subobscura - Lecanora epibryon											
Hypogymnia subobscura	I^{+}	III^{r}	V^{3}	.	.	.	.	.	.	.	.
Sterile black crust	.	.	V^{2}	.	II^{2}	.	.	.	.	.	.
Vulpicida tilesii	.	.	V^{1}	I^{+}	.	I^{+}	.	.	I^{+}	.	.
Pertusaria dactylina	.	.	IV^{2}	.	.	.	.	.	.	.	.
Encalypta alpina	.	.	IV^{1}	II^{1}	II^{+}	II^{+}	.	.	.	.	2^{+}
Ochrolechia frigida	.	.	IV^{+}	.	.	II^{2}	.	.	.	.	.
Tetramelas sp.	.	.	III^{2}	.	.	.	.	.	.	.	.
Lecanora luteovernalis	.	.	III^{1}	.	.	.	.	.	.	.	.
Ch/D Orthotrichum speciosum-Salix arctica comm.											
Orthotrichum speciosum	.	I^{+}	II^{+}	V^{3}	.	.	.	.	.	.	.
Ch/D Cochlearia groenlandica-Luzula nivalis comm.											
Tortella arctica	.	.	.	.	V^{4}	II^{+}	.	.	.	.	.
Saxifraga foliolosa	.	.	.	.	V^{+}	I^{r}	.	.	.	.	.
Cochlearia groenlandica	.	.	.	.	V^{+}	.	.	.	.	.	.
Cerastium regelii	.	.	.	.	V^{1}	.	.	.	.	.	.
Ranunculus nivalis	.	.	.	.	IV^{+}	.	.	.	.	.	.
Cetrariella delisei	.	.	.	.	IV^{+}	.	.	.	.	.	.
Stellaria sp.	.	.	.	.	V^{3}	.	.	.	.	.	.
Lecidea sp.	.	.	.	.	IV^{2}	II^{1}	.	.	.	.	.
Warnstorfia sarmentosa	.	.	.	.	III^{+}	.	.	.	.	.	.
Cladonia macroceras	.	.	.	.	III^{+}	I^{+}	.	.	.	.	.
Ch/D Salix arctica-Eriophorum angustifolium ssp. triste comm.											
Bistorta vivipara	.	.	.	.	.	V^{2}	.	.	.	3^{+}	.
Aulacomnium acuminatum	.	.	.	.	I^{+}	V^{2}	.	.	.	3^{1}	.
Aneura pinguis	.	.	.	.	I^{+}	IV^{+}	.	.	.	.	2^{+}
Black crust with apothecia	.	.	.	.	.	III^{2}	.	.	.	.	.
Calliergon giganteum	.	.	.	.	I^{+}	III^{+}	.	.	.	.	.
Cyrtomnium hymenophyllum	.	.	.	.	.	III^{+}	.	.	.	.	.
Didymodon sp.	.	.	.	.	.	III^{+}	.	.	.	.	.
Petasites frigidus	.	.	.	.	.	III^{+}	.	.	.	.	.
Philonotis fontana	.	.	.	.	.	III^{+}	.	.	.	.	.
Ch/D Puccinellia angustata-Potentilla vahliana comm.											
Potentilla vahliana	.	.	.	.	.	.	5^{1}	III^{1}	.	.	.
Puccinellia angustata	.	.	.	.	.	.	5^{1}	I^{+}	.	.	.
Elymus alaskanus spp. hyperarcticus	.	.	.	.	.	.	2^{+}	.	.	.	.
Artemisia borealis	.	.	.	.	.	.	3^{+}	I^{+}	.	.	.
Potentilla nivea	.	.	.	.	.	.	2^{+}	$+^{+}$	.	.	.
Ch/D Dryas integrifolia-Carex rupestris comm.											
Oxytropis borealis	.	.	.	.	.	.	2^{+}	V^{1}	.	.	.
Toninia sedifolia	.	.	.	.	.	.	.	IV^{1}	.	.	.
Lesquerella arctica	.	.	.	.	.	.	2^{+}	IV^{+}	.	.	.
Psora decipiens	.	.	.	.	.	.	.	III^{3}	.	.	.
Ch/D Braya glabella ssp. purpurascens-Dryas integrifolia comm.											
Braya glabella ssp. purpurascens	.	.	.	.	.	.	.	$+^{+}$	V^{+}	.	2^{+}
Hymenostylium recurvirostre	.	.	.	.	.	.	.	.	III^{1}	.	.

Ch/D Dryas integrifolia-Carex aquatilis comm.											
Tephroseris atropurpurea ssp. atropurpurea	.	.	.	.	.	.	.	.	II^{r}	5^{+}	.
Pedicularis langsdorffii	.	.	.	.	.	.	.	.	I^{+}	4^{+}	.
Polyblastia sendtneri	.	.	.	.	.	.	.	.	.	3^{1}	.
Dactylina arctica	.	.	.	.	.	.	.	+$^{+}$	.	3^{+}	.
Cratoneuron sp.	.	.	.	.	.	.	.	+$^{+}$	.	2^{+}	.
Campylium polygamum	.	.	.	.	.	.	.	.	.	2^{+}	.
Eutrema edwardsii	.	.	.	.	.	.	.	.	.	2^{+}	.
Pedicularis capitata	.	.	.	.	.	.	.	.	.	2^{+}	.
Scapania gymnostomophila	.	.	.	.	.	.	.	.	.	2^{+}	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	2^{+}	.
Tetraplodon sp.	.	.	.	.	.	.	.	.	.	2^{+}	.
Tortula norvegica	.	.	.	.	.	.	.	.	.	2^{+}	.
Pedicularis sp.	.	.	.	.	.	.	.	.	.	2^{r}	.
Silene uralensis ssp. uralensis	.	.	.	.	.	.	.	.	.	2^{r}	.
Ch/D Eriophorum angustifolium ssp. triste-Carex aquatilis comm.											
Pseudocalliergon turgescens	.	.	.	.	.	.	.	.	.	2^{+}	5^{+}
Amblystegium longicuspis	.	.	.	.	.	.	.	+$^{+}$	I^{+}	2^{+}	4^{+}
Pedicularis sudetica	.	.	.	.	.	.	.	.	II^{+}	2^{+}	4^{+}
Bryum subneodamense	.	.	.	.	.	.	.	.	.	2^{+}	4^{+}
Limprichtia cossonii	.	.	.	.	.	.	.	.	.	.	4^{+}
Meesia longiseta	.	.	.	.	.	.	.	.	.	.	4^{+}
Carex atrofusca	.	.	.	.	.	.	.	.	.	.	2^{+}
Ch/D Salicetea herbaceae: Saxifrago-Ranunculion nivalis											
Alopecurus borealis	V^{1}	V^{1}	IV^{1}	V^{1}	V^{2}	.	.	.	.	.	.
Saxifraga nivalis	III^{+}	V^{1}	II^{+}	IV^{+}	V^{+}	.	.	.	.	.	.
Luzula nivalis	.	V^{1}	V^{1}	IV^{1}	V^{2}	V^{+}	.	.	.	.	.
Cerastium arcticum	IV^{+}	V^{1}	.	III^{+}	II^{+}	.	.	.	.	.	.
Ch/D Carici rupestris-Kobresietea bellardii: Dryadion integrifoliae											
Dryas integrifolia	.	.	V^{1}	V^{3}	.	I^{+}	.	IV^{4}	V^{4}	5^{3}	.
Saxifraga oppositifolia	.	.	V^{1}	V^{3}	.	.	.	V^{1}	IV^{3}	5^{1}	.
Hypnum bambergeri	.	.	.	.	.	I^{+}	.	I^{+}	I^{+}	5^{2}	5^{3}
Carex rupestris	.	.	.	.	.	.	.	V^{2}	II^{2}	4^{2}	.
Carex misandra	.	.	.	.	.	.	.	.	IV^{2}	4^{1}	2^{1}
Carex scirpoidea	.	.	.	.	.	.	.	.	II^{+}	3^{+}	2^{+}
Platydictya jungermannioides	.	.	.	.	.	II^{+}	.	.	II^{+}	.	.
Ch/D Scheuchzerio-Caricetea nigrae: Caricion lasiocarpae											
Bryum pseudotriquetrum	.	III^{+}	I^{+}	I^{+}	V^{+}	V^{1}	.	.	.	4^{+}	5^{1}
Eriophorum angustifolium ssp. triste	.	.	.	.	.	V^{3}	.	.	III^{2}	5^{2}	5^{2}
Carex aquatilis	.	.	.	.	.	III^{3}	.	.	IV^{2}	5^{1}	5^{2}
Campylium stellatum	+$^{+}$	.	.	.	.	I^{+}	.	.	.	4^{+}	5^{2}
Equisetum variegatum	.	.	.	.	.	.	.	.	II^{+}	5^{+}	5^{+}
Limprichtia revolvens	.	.	.	.	II^{1}	IV^{1}	.	.	.	.	.
Meesia triquetra	.	.	.	.	.	I^{+}	.	.	.	.	4^{+}
Carex heleonastes	.	.	.	.	IV^{+}	II^{+}	.	.	.	.	2^{+}
Only Isachsen											
Pertusaria octomela	V^{2}	V^{1}	.	.	.	.	.	.	.	.	.
Draba subcapitata	IV^{+}	V^{+}	.	.	.	.	.	.	.	.	.
Peltigera didactyla	IV^{+}	V^{+}	.	.	.	.	.	.	.	.	.
Candelariella terrigena	III^{+}	III^{+}	.	.	.	.	.	.	.	.	.
Stereocaulon glareosum	II^{+}	II^{+}	.	.	.	.	.	.	.	.	.
Polytrichum piliferum	II^{+}	I^{r}	.	.	.	.	.	.	.	.	.
Peltigera venosa	II^{r}	I^{r}	.	.	.	.	.	.	.	.	.

Only Isachsen and Mould Bay											
Polytrichastrum alpinum	IV^{+}	V^{2}	III^{+}	III^{1}	V^{2}	V^{+}	.	.	.	.	.
Papaver radicatum	V^{1}	V^{+}	V^{1}	III^{+}	V^{+}	I^{+}	.	.	.	.	.
Cetraria islandica ssp. islandica	II^{+}	V^{+}	V^{1}	V^{+}	III^{+}	IV^{+}	.	.	.	.	.
Campylium arcticum	+$^{+}$	I^{+}	I^{+}	I^{+}	II^{1}	II^{+}	.	.	.	.	.
Parmelia omphalodes ssp. glacialis	IV^{2}	V^{2}	V^{2}	.	I^{+}	I^{+}	.	.	.	.	.
Saxifraga cernua	IV^{+}	V^{+}	.	III^{+}	V^{+}	I^{r}	.	.	.	.	.
Potentilla hyparctica	II^{+}	V^{1}	V^{1}	V^{+}	II^{+}	.	.	.	.	.	.
Saxifraga caespitosa	I^{+}	V^{1}	III^{+}	IV^{+}	III^{+}	.	.	.	.	.	.
Cirriphyllum cirrosum	II^{+}	.	II^{+}	III^{+}	II^{+}	I^{+}	.	.	.	.	.
Psoroma hypnorum	IV^{+}	V^{+}	.	.	I^{+}	I^{+}	.	.	.	.	.
Rinodina turfacea	IV^{+}	V^{+}	II^{+}	.	.	II^{+}	.	.	.	.	.
Caloplaca cerina	III^{+}	IV^{+}	II^{+}	.	I^{+}	.	.	.	.	.	.
Poa abbreviata	IV^{1}	.	I^{1}	V^{+}	V^{2}	.	.	.	.	.	.
Ochrolechia inaequatula	V^{+}	.	I^{+}	.	III^{2}	IV^{2}	.	.	.	.	.
Dactylina ramulosa	.	II^{r}	I^{r}	I^{+}	.	I^{+}	.	.	.	.	.
Aulacomnium turgidum	II^{+}	V^{2}	.	.	.	V^{2}	.	.	.	.	.
Bartramia ithyphylla	+$^{+}$	IV^{+}	.	.	V^{3}	.	.	.	.	.	.
Lepraria cf. vouauxii	II^{+}	.	III^{+}	.	I^{+}	.	.	.	.	.	.
Only Mould Bay											
Oxyria digyna	.	.	V^{1}	IV^{+}	III^{+}	.	.	.	.	.	.
Bryum rutilans	.	.	III^{+}	II^{+}	.	III^{+}	.	.	.	.	.
Mnium thomsonii	.	.	II^{+}	II^{+}	.	II^{+}	.	.	.	.	.
Myurella tenerrima	.	.	I^{+}	I^{+}	.	II^{+}	.	.	.	.	.
Lecidea ramulosa	.	.	V^{2}	.	IV^{1}	.	.	.	.	.	.
Festuca hyperborea	.	.	III^{1}	III^{+}	.	.	.	.	.	.	.
Tortula leucostoma	.	.	I^{+}	II^{+}	.	.	.	.	.	.	.
Ranunculus sulphureus	.	.	II^{+}	.	.	III^{+}	.	.	.	.	.
Oncophorus wahlenbergii	.	.	.	.	IV^{+}	III^{2}	.	.	.	.	.
Solorina sp.	.	.	.	.	II^{+}	III^{+}	.	.	.	.	.
Only Mould Bay and Green Cabin											
Salix arctica	.	.	IV^{1}	V^{3}	.	V^{2}	4^{+}	V^{2}	V^{1}	5^{2}	5^{2}
Juncus biglumis	.	.	V^{1}	.	IV^{+}	.	.	.	II^{+}	2^{+}	2^{+}
Parrya arctica	.	.	V^{+}	III^{+}	.	.	3^{+}	V^{1}	.	2^{r}	.
Draba sp.	.	.	V^{+}	II^{+}	V^{+}	II^{+}	.	.	.	2^{r}	.
Ctenidium procerrimum	.	.	IV^{+}	IV^{+}	.	.	.	III^{2}	.	2^{+}	2^{1}
Draba alpina	.	.	III^{+}	I^{+}	.	I^{r}	.	II^{+}	.	2^{r}	.
Pseudocalliergon brevifolium	.	.	.	.	V^{3}	II^{+}	.	+$^{+}$	.	5^{+}	5^{+}
Didymodon asperifolius	.	.	I^{+}	III^{+}	.	.	.	II^{+}	.	2^{+}	.
Nostoc commune	.	.	.	.	IV^{3}	II^{1}	.	.	III^{+}	.	5^{+}
Encalypta sp.	.	.	I^{+}	.	.	.	.	+$^{+}$	I^{+}	.	.
Cinclidium latifolium	.	.	.	I^{+}	III^{+}	.	.	.	.	.	4^{1}
Bryum sp.	.	.	.	I^{+}	.	.	.	+$^{+}$	II^{+}	.	.
Cinclidium arcticum	.	.	.	.	I^{+}	II^{+}	.	.	.	2^{+}	.
Arctagrostis latifolia	.	.	.	.	.	V^{2}	.	.	.	5^{1}	5^{+}
Fulgensia bracteata	.	.	V^{1}	.	.	.	.	IV^{+}	.	.	.
Evernia perfragilis	.	.	I^{+}	.	.	.	.	+$^{+}$	.	.	.
Abietinella abietina	.	.	.	I^{r}	.	.	.	II^{+}	.	.	.

Only Green Cabin											
Carex membranacea	.	.	.	.	.	.	.	.	IV^{1}	5^{3}	5^{2}
Carex lachenalii	.	.	.	.	.	.	.	.	I^{1}	3^{+}	2^{+}
Taraxacum sp.	.	.	.	.	.	.	3^{+}	II^{+}	.	.	.
Oxytropis arctobia	.	.	.	.	.	.	2^{+}	II^{+}	.	.	.
Oxytropis arctica	.	.	.	.	.	.	2^{+}	I^{+}	.	.	.
Collema tenax	.	.	.	.	.	.	.	II^{+}	.	2^{+}	.
Lophozia collaris	.	.	.	.	.	.	.	.	II^{+}	.	2^{+}
Meesia sp.	.	.	.	.	.	.	.	.	I^{+}	.	2^{+}
Cardamine digitata	.	.	.	.	.	.	.	.	.	3^{+}	2^{+}
Only Isachsen and Green Cabin											
Draba oblongata	V^{+}	V^{+}	.	.	.	.	4^{+}	II^{+}	I^{r}	.	.
Solorina bispora var. subspongiosa	II^{+}	I^{+}	.	.	.	.	.	II^{+}	I^{r}	2^{+}	.
Myxobilimbia lobulata	II^{+}	I^{+}	.	.	.	.	.	.	I^{1}	.	.
Catapyrenium cinereum	I^{+}	.	.	.	.	.	.	II^{+}	I^{+}	.	.
Gymnomitrion corallioides	I^{+}	II^{+}	.	.	.	.	.	.	.	.	.
Tortula mucronifolia	II^{+}	.	.	.	.	.	.	.	I^{+}	.	.
Others											
Ditrichum flexicaule	III^{+}	V^{1}	III^{1}	V^{2}	III^{+}	V^{3}	.	IV^{2}	II^{1}	5^{3}	4^{+}
Thamnolia vermicularis	IV^{1}	V^{+}	V^{2}	V^{2}	V^{1}	V^{1}	.	V^{2}	II^{2}	5^{+}	.
Distichium capillaceum	II^{+}	V^{1}	III^{1}	V^{1}	IV^{+}	IV^{+}	.	III^{1}	.	4^{1}	4^{1}
Flavocetraria cucullata	.	I^{+}	V^{+}	V^{1}	I^{+}	IV^{+}	.	II^{+}	I^{+}	4^{+}	.
Bryoerythrophyllum recurvirostrum	.	III^{+}	II^{+}	II^{+}	III^{+}	IV^{+}	.	I^{+}	I^{+}	2^{+}	.
Lecanora epibryon	+$^{+}$	II^{+}	V^{3}	.	.	III^{2}	.	V^{1}	II^{2}	5^{+}	.
Cladonia pocillum	III^{+}	V^{+}	III^{+}	.	III^{1}	IV^{1}	.	I^{+}	.	2^{+}	.
Tomentypnum nitens	+$^{+}$	III^{+}	I^{1}	IV^{1}	.	V^{3}	.	I^{+}	.	5^{3}	.
Timmia austriaca	II^{+}	V^{2}	IV^{+}	III^{+}	.	III^{+}	.	+$^{+}$	.	2^{+}	.
Myurella julacea	+^{r}	III^{+}	II^{+}	II^{+}	III^{+}	III^{+}	.	+$^{+}$	.	.	.
Distichium inclinatum	I^{+}	.	II^{+}	IV^{1}	V^{3}	V^{3}	.	.	III^{+}	.	2^{1}
Orthothecium chryseon	.	II^{r}	II^{+}	II^{+}	III^{1}	V^{2}	.	.	.	5^{+}	4^{+}
Didymodon icmadophilus	II^{+}	IV^{+}	IV^{+}	IV^{+}	.	.	.	II^{+}	I^{+}	.	.
Stellaria longipes	IV^{+}	V^{+}	IV^{+}	IV^{+}	.	II^{+}	.	.	.	2^{+}	.
Syntrichia ruralis	V^{+}	V^{2}	.	V^{4}	.	II^{2}	.	III^{2}	.	3^{+}	.
Caloplaca tiroliensis	III^{+}	V^{+}	V^{+}	.	.	II^{+}	.	II^{+}	.	2^{+}	.
Hypnum revolutum	V^{1}	V^{1}	III^{+}	V^{+}	.	.	.	II^{+}	.	.	.
Sanionia uncinata	II^{+}	V^{+}	III^{1}	V^{2}	.	.	.	.	I^{+}	.	.
Minuartia rossii/rubella	II^{+}	III^{+}	III^{+}	.	.	I^{r}	.	+^{r}	.	.	.
Rinodina roscida	+$^{+}$	.	IV^{+}	.	.	.	.	IV^{+}	I^{+}	2^{+}	.
Physconia muscigena	+$^{+}$	III^{+}	IV^{+}	.	.	.	.	+$^{+}$	.	.	.
Orthothecium strictum	.	I^{+}	I^{+}	.	.	II^{+}	.	I^{+}	.	.	.
Catapyrenium sp.	I^{+}	.	I^{+}	.	.	.	.	II^{+}	.	.	.