FINAL REPORT:

HISTORICAL BIODIVERSITY AT REMOTE AIR FORCE SITES IN ALASKA

Department of Defense, Air Force
Legacy Resource Management Program Project #0742
Point Barrow and Barter Island Long Range Radar Sites, Alaska

Scott A. Elias, Susan K. Short, Donald A. Walker, Nancy A. Auerbach

Legacy Research Site, Point Barrow LRRS

Institute of Arctic and Alpine Research
University of Colorado
Boulder, Colorado 80309-0450

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LEGACY RESOURCE MANAGEMENT PROGRAM

The Legacy Resource Management Program was established by the Congress of the United States in 1991 to provide the Department of Defense with an opportunity to enhance the stewardship of natural and cultural resources on more than 25 million acres of land under Department of Defense jurisdiction. The Legacy Program allows the Department of Defense to determine how to incorporate better the stewardship of irreplaceable natural and cultural resources into the military mission. To achieve this goal, the Department of Defense gives high priority to inventorying, protecting, and restoring its natural and cultural resources in a comprehensive, cost-effective manner, in partnership with federal, state, and local agencies and private groups. Legacy activities emphasize the protection and conservation of natural and cultural resources by fully incorporating these activities into Department of Defense mission requirements. Through the combined efforts of the various Department of Defense components, the Legacy Program seeks to achieve its legislative purposes with cooperation, creativity, and vigor and to make the Department of Defense the federal environmental leader.

The primary objective of the FY 1994 Legacy Program was to give priority to projects that demonstrated the following applications: (1) Management techniques and strategies that defined appropriate uses of a site or ecosystem, develop or test a conservation strategy, or otherwise address management of sensitive resources; (2) conservation training for installation personnel; (3) integration of natural, cultural, and earth resources stewardship; or (4) demonstration of innovative technology that benefited the management of natural, cultural, and earth resources. Additional objectives of particular interest included identification of significant and sensitive resources, including: (1) federal or state listed or candidate threatened or endangered species; (2) resources eligible for listing in the National Register of Historic Places; (3) species identified as category G 1 to G4 or S 1 to S4 in the Nature Conservancy's Natural Heritage System; or (4) unique resources such as those on the list of National Natural Landmarks and other rare or sensitive species.

Regional biodiversity themes of the FY 1994 Legacy Program included: threatened and endangered species; ecosystem protection, restoration, and management; and neotropical migratory birds. Cultural Resources initiatives were associated with: Native Americans, Native Hawaiians, and Alaska Natives; settler communities on land now under Department of Defense jurisdiction; Cold War properties and history; historic family housing; and the use of the Cultural Resource Inventory System (CRIS) in support of Integrated Training Areas Management (ITAM). Earth Resources focused on the interactions of land, air, and water resources and their relationships with biological and cultural resources. Integrated Resources emphasized integration of biological, earth. and cultural resource practices.

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COASTAL AMERICA

Coastal America sets forth an innovative approach to work in partnership with other Federal programs and integrate Federal actions with state, local, and nongovernmental efforts. This partnership ensures that stewardship of coastal living resources is coordinated, efficient, and successful. Coastal America complements other actions taken to protect America's coastal resources.

1. Executive Summary

Our study reveals that there are significant differences in both ancient and modern environments between eastern and western regions along the arctic coast of Alaska. These differences are most likely caused by varying substrates and different climatic conditions; they are expressed in the plant communities and ancient insect communities by greater species diversity in the east. Acidic tundra covers the Barrow landscape; whereas nonacidic tundra is dominant at Barter Island. Species lists from the two Long Range Radar Sites (LRRS) include: vascular plants, 71 at Point Barrow, 119 at Barter Island. Fifty-five species of vascular plants at Barter Island were not found at Point Barrow, whereas only seven species showed the opposite pattern. Numerous basiphilous species occur at Barter Island that do not occur at Point Barrow.

A suite of plant species that may be suitable for revegetation efforts at arctic coastal sites has been identified from species lists at a variety of disturbed localities. A larger group was identified for nonacidic sites than for acidic sites.

The modern vegetation physiognomy at the two sites is very similar and is typical of coastal areas across northern Alaska. Compared to inland areas the vegetation is species poor, and is dominated by grasses and sedges. Seven broad community types and four subtypes are described. Ordination analysis shows that the dissimilarity between acidic and nonacidic vegetation is greatest in the dry vegetation types and least in the aquatic types. Vegetation composition is strongly related to the soil moisture and pH gradients. The long period of natural vegetation recovery at both sites and their relatively protected status makes these sites very valuable for disturbance-and-recovery studies. Several disturbed sites should be set aside for permanent monitoring of vegetation recovery.

From 10,200 - 5,600 years before present (yr B.P.) the vegetation at Barrow was dominated by grasses and heaths; conditions were probably moister and warmer than the latter part of the Holocene (10,500 yr B.P. to present) and species richness is poorer. These large grass values are not recorded at Barter Island; however, that basal zone appears to represent a poorer vegetation community than subsequently occupied the island. Holocene insect assemblages all reflect mesic tundra environments such as those of today at both LRRS sites. The oldest sample from Barter Island LRRS (ca. 10,500 yr B.P.) yielded a significantly different insect assemblage, with species that are indicative of substantially warmer climatic conditions. The fossil taxa here and elsewhere in arctic Alaska and the Yukon indicate that climatic conditions could have supported coniferous forest, if only for a brief interval of time, probably about 11,000-10,000 yr B.P.

Pollen evidence from Point Barrow and Barter Island LRRS indicates the establishment of modern vegetation conditions, dominated by sedges, with alder and spruce reaching their present-day northern limits by 5.6 ka. A larger number of taxa were recovered in the modern pollen study at Barter Island LRRS than at Point Barrow LRRS.

2. INTRODUCTION

The Long Range Radar Sites (LRRS) at Point Barrow and Barter Island, Alaska (Fig. 1) are military reservations built by the U. S. Air Force in the 1950s as part of the Defense Early Warning (DEW Line) system of radar sites across the high latitudes of North America. They were converted to LRRS in the 1980s and presently function as remote Air Force sites in the Alaska Radar System. Two other LRRS, Point Lay LRRS and Oliktok LRRS, as well as three unattended Short Range Radar Sites (SRRS), Bullen Point SRRS, Lonely SRRS, and Wainwright SRRS, are also former DEW Line stations. All seven Air Force sites are located on the North Slope of Alaska and contain coastal tundra biological communities. Point Barrow and Barter Island LRRS were built on the Alaskan North Slope and contain coastal tundra biological communities.

The aim of this project was to build inventories of present and past biotic communities at the two sites as a basis for the establishment of guidelines for mitigation and restoration. These inventories included modern plant communities, modern insects, Holocene plant communities, and Holocene insects. Our goal was to link these data sets together, to arrive at a synthetic view of the history of biological communities and their responses to environmental change over the last 10,000 years.

2.1 Goals and objectives of the study

The vegetation portion of the study had two objectives. First we wanted to characterize the modern natural vegetation and compare it with information in the paleo record. Although there has been considerable vegetation research at Barrow and Prudhoe Bay areas as part of the International Biological Programme (IBP) Tundra Biome (Tieszen, 1978; Brown et al., 1980; Walker et al., 1980; Walker, 1985; Walker and Everett, 1991), there has been only one study at Prudhoe Bay that attempted to relate the present day vegetation to the pollen record (Walker et al., 1979). Although there has been extensive sampling of vegetation in the Arctic National Wildlife Refuge as part of the 1002 studies (Walker et al., 1982; Jorgenson et al,. 1994) the vegetation of Barter Island itself was poorly known. The general impression from previous studies is that the Arctic-coastal-margin vegetation is not particularly varied or rich in species. Previous studies have noted a rich calcareous flora in the Prudhoe Bay region (Murray, 1978; Walker, 1985), but these studies covered a large region that extended well inland along the major river drainages. There has not been a vegetation analysis to determine if there are major differences in the plant communities immediately adjacent to the coast and if these differences are reflected in the paleo record.

Secondly, we wanted to examine the vegetation on a suite of disturbed sites. If there are major differences in the flora and vegetation of the two sites, this could have important implications regarding the pool of native species available for recolonizing disturbed coastal habitats. The Point Barrow and Barter Island LRRS were constructed in 1953, and recovery has proceeded on many locations without subsequent disturbance. A wide variety of disturbances occur at both sites. These include vehicle trails, sewage lagoons, bulldozed ditches and channels, areas impacted by snowfences, tundra covered by gravel, and roadside areas. We focused on some of the more prominent disturbances, including gravely substrates, such as road embankments and gravel pads, and peaty substrates, such as the bulldozed tundra of the new Point Barrow LRRS sewage lagoon. We also examined in some detail the bulldozed drainage ditch at Point Barrow LRRS, which was constructed in 1960 to improve the drainage around the station. The original ditch was bulldozed to the top of the permafrost table (about 40 cm). Subsequent thermal erosion has deepened the channel to over 1.7 m and caused extensive thermal erosion along ice-wedge polygon troughs, particularly on the southern side of the ditch. One of the peat sections sampled by Elias and Short is from the side of an eroded polygon trough adjacent to the ditch. Additionally, we made brief observations at the large snow fences at Barter Island LRRS.

The specific aims of paleontological portion of the study were to reconstruct the history of biotic response to environmental change in the two study regions during the postglacial period.

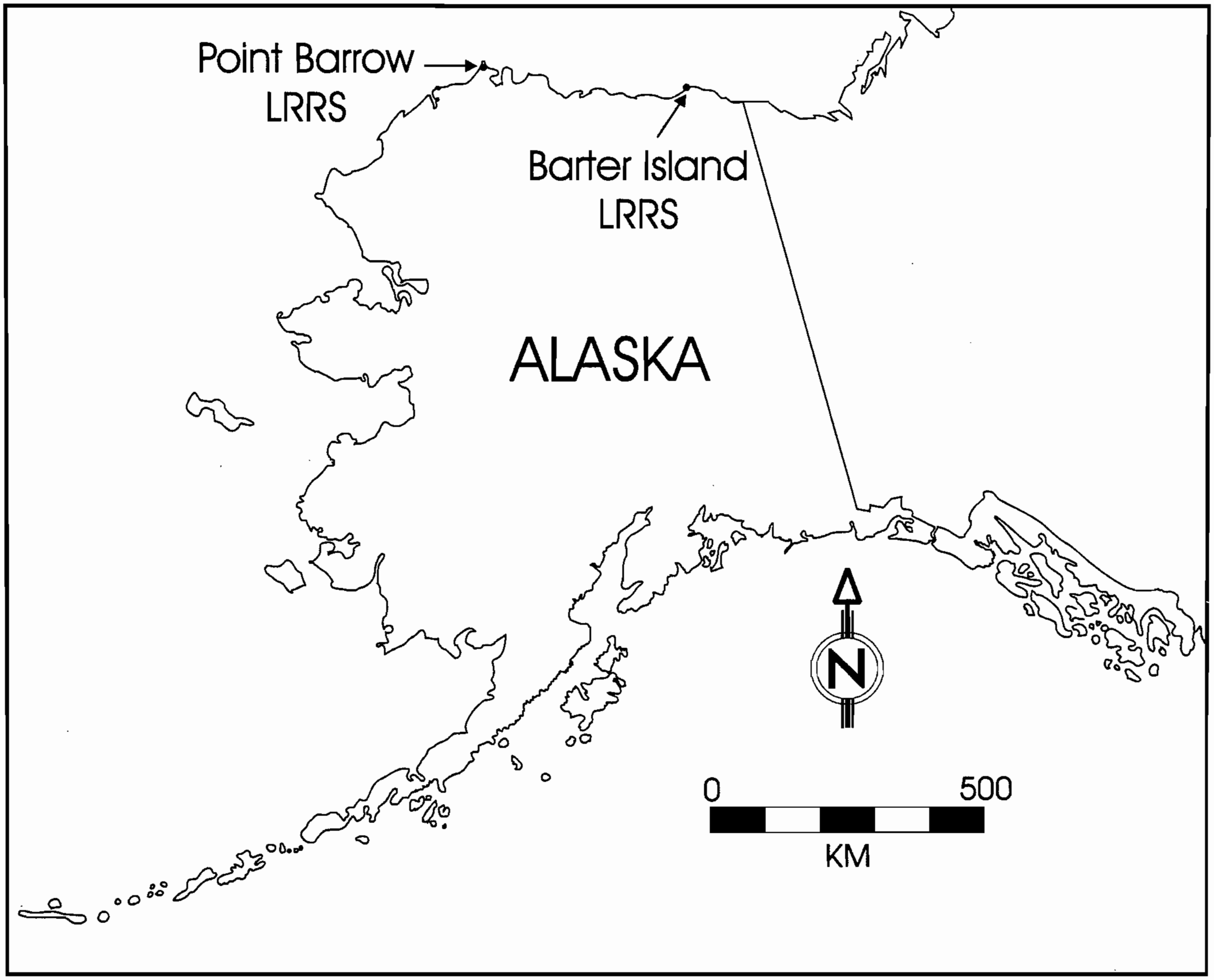

Figure 1. Map of Alaska, showing location of the Point Barrow and Barter Island LRRS facilities.

This was achieved through studies of fossil pollen and insects from peat profiles at Point Barrow LRRS and from organic-rich sediments exposed on coastal bluffs at Barter Island LRRS. In addition, modern pollen and insects were collected, to provide modern baseline data for the interpretation of the fossil assemblages.

2.2 Relevance of study to the Legacy Program

The species inventories are a vital contribution to the Legacy Program as it concerns LRRS sites in arctic Alaska. Past human activities at these stations have disturbed local biota, but the degree of disturbance cannot be fully documented without species inventories, especially botanical species. Our project has documented vegetation regimes before and after human impacts brought on by the building and operating of the LRRS facilities. Should these facilities be closed, our data will provide valuable information for mitigation and restoration of the sites.

Mitigation of disturbed sites can only take place after a thorough knowledge of the potential vegetation has been accessed. In addition, our studies have identified several species of plants that have the potential to colonize (i.e., revegetate) disturbed sites in a variety of types of habitats, ranging from wetlands to drier upland locations.

3. BACKGROUND

We present here a brief summary of the history of the Point Barrow and Barter Island LRRS facilities, and a broader historical context of the postglacial development of North Slope ecosystems. It is necessary to place these sites in a broader historical context, because the forces that have shaped the tundra ecosystems of this region have worked on century and millennial time scales to produce the modern biotic communities. In addition, human activities began in this region with the arrival of Inuit peoples, several thousand years ago. The impacts of these hunter/gatherers were probably minimal, at least in prehistoric times (i.e., before contact with Europeans).

3.1 Physiography, climate, and soils of the Arctic Coastal Plain

The North Slope region was not glaciated during the last (Wisconsin) glaciation, but mountain glaciers in the Brooks Range brought large volumes of sediment to the region, as they melted back at the beginning of the postglacial period. These sediments choked the rivers and smaller streams with sediments ranging from silts and clays to coarse gravels and cobbles; this glacial sediment eventually mantled the Foothills region, forming the parent materials for Holocene soils in this zone.

Northern Alaska can be divided into three physiographic provinces (Wahrhaftig, 1965): a mountainous region in the south, the Arctic Coastal Plain bordering the Arctic Ocean to the north and the Arctic Foothills forming a zone between the two. The Arctic Coastal Plain is an area of low relief formed by Quaternary and Tertiary marine deposits overlying the nearly flat Cretaceous bedrock. Permafrost underlies most of the area and the development of ice-wedge polygons and their associated thaw-lake features is pronounced.

The North Slope is a region of extreme cold winter temperatures, cool summer temperatures and relatively little precipitation. A steep temperature gradient from the coast towards the interior exists during the summer (Walker, 1980). The mean July temperature, from 1975 to 1978, for the West Dock at Prudhoe Bay is 5°C while 15 km inland it is 6.9°C and at Franklin Bluffs, 83 km inland, it is 8.9°C (Haugen, 1980). The mean July temperature for the same record period at Toolik River in the Southern Foothills is 11.9°C. The mean January temperature, from 1970 to 1978, for Prudhoe Bay is -24°C (Haugen, 1980).

Rainfall and snowfall are highest on the North Slope during the periods of open water; the ice cover between November and June removes the primary moisture source.

Soils of the Arctic Coastal Plain region are formed under low temperature, and high moisture conditions. Mean annual precipitation is low, but relatively high humidity and poor drainage lead to high soil moisture content. This, in turn, leads to the accumulation of organic matter. Soil profile differentiation is retarded by the restriction of downward leaching and associated chemical transformations. The soils of Barrow are more acidic than those farther east along the coastal plain (from Prudhoe to Barter Island), where calcareous parent materials and lower organic matter raise soil pH. Soil properties in all of these regions are the products of both cold climate and the regional geologic history (Gersper et al., 1980).

3.2 Holocene (postglacial) history of the North Slope Region

The climatic history of the North Slope region during postglacial times is poorly known. Wilson and Elias (1986) studied pollen, plant macrofossils, and insects from postglacial peat deposits at Barter Island. The fossil insects from this study indicated that summer temperatures have changed little throughout the last 10,000 years. The most recent interval that experienced substantially different climate took place between 11,000 and 10,000 yr. B. P. (radiocarbon years before present). During this interval, North Slope summer temperatures apparently rose to warmer-than-modern levels, as evidenced by the invasion of *Populus* (poplar) trees onto the North Slope, and of boreal insect species. These events are recorded at Clarence Lagoon, near the Yukon-Alaska border on the arctic coast (Matthews, 1975); they are also recorded from fossil assemblages at sites on the Ikpikpuk and Titaluk Rivers on the North Slope (Nelson and Carter, 1987).

3.3 Construction Impacts of Point Barrow and Barter Island LRRS facilities

Construction of these two facilities began in 1953, as part of the network of Defense Early Warning (DEW Line) sites that stretched across arctic Alaska, Canada, and Greenland. The majority of buildings were prefabricated elsewhere and shipped to Alaska, where they were placed above ground on concrete, wood and/or steel supports over gravel pads. This construction method minimized thermokarst problems, such as frost heaving or the melting of permafrost beneath the buildings. In addition, the road systems developed for the sites (Figs. 2 and 3) were laid on gravel pads over the tundra, minimizing these same thermokarst problems. The raised design also allows snow to be blown away, rather than accumulate in drifts, blocking entries.

Disturbance of vegetation was particularly evident at Point Barrow LRRS. Where the vegetation cover has been removed, large-scale thermal erosion has taken place. For instance, in the early 1960s, a drainage ditch was constructed. As of 1994, the permafrost table had melted down to a depth of up to 2 m along this ditch, forming a steep-walled trench that partially fills with standing water in the summer months. Numerous other types of disturbances occur at both sites, but environmental damage is more in evidence at Point Barrow LRRS than at Barter Island LRRS.

3.4 Setting of the Point Barrow LRRS facility

Point Barrow is the northernmost point in the United States, and its climate is colder year-round than any other North Slope locality for which we have measurements. At Barrow, mean July temperature is 3.7°C; mean January temperature is -25.9°C. However, mean annual precipitation totals only 169.8 mm, far less than other North Slope regions (Brown et al., 1980).

Point Barrow is situated on the Beaufort Sea coast, in the Arctic Coastal Plain zone of the Alaskan North Slope. The regional topography is one of low relief. Thaw lakes and salt-water

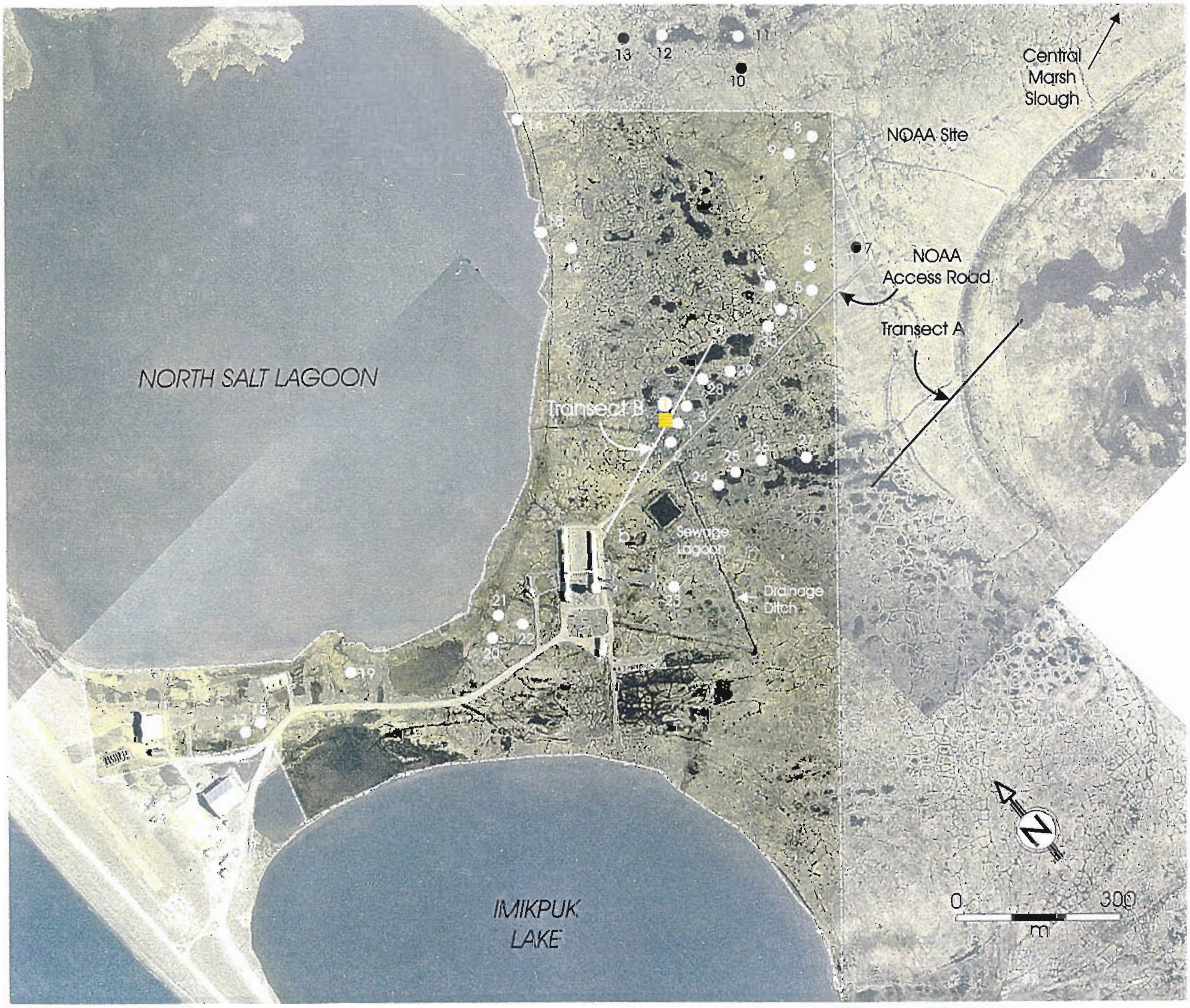

Figure 2. Composite aerial photograph of the Point Barrow LRRS and vicinity, showing location of modern vegetation transects (black and white lines), modern vegetation study sites (white and black dots), fossil study site (yellow square), and other features mentioned in the text.

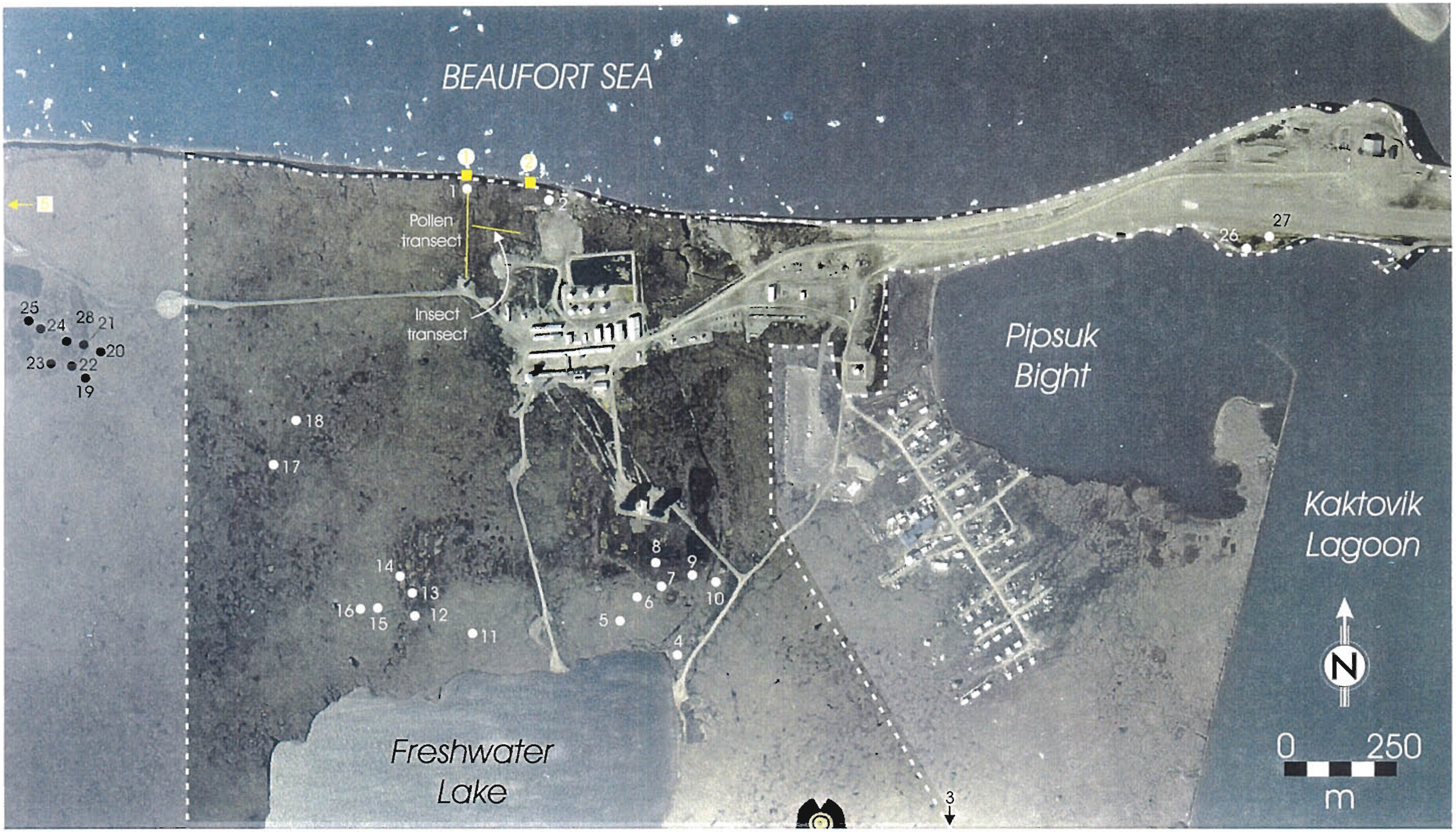

Figure 3. Aerial photograph of the Barter Island LRRS and vicinity, showing location of modern vegetation study sites (white and black dots), fossil study sites (yellow squares), pollen and insect transects (yellow lines), and other features mentioned in the text.

lagoons dominate the landscape; these features have migrated across the landscape on a century- to millennial-time scale, generally in the direction of prevailing winds. The active layer is shallow, rarely exceeding 50 cm even in late summer. Accordingly, drainage is poor, and much of the soil is damp to saturated through the summer months.

Point Barrow and Barter Island LRRS are both on flat coastal terrain. The overall appearance of the vegetation is very similar, i.e. wet tundra consisting of sedges and grasses (mainly *Carex aquatilis, Eriophorum angustifolium* and *Dupontia fisheri*). Cantlon (1961) characterized this coastal area as littoral tundra zone, lying north of the 7°C July mean temperature isotherm, with a dominance of sedges and grasses, low vascular-plant species diversity, few cottongrass tussocks, few shrubs, and little *Sphagnum* moss. Yurtsev (1994) considers this to be part of the true Arctic tundra subzone, which is dominated by eutrophic tundra, and where dwarf birches and boreal species do not occur.

3.5 Setting of the Barter Island LRRS facility

At Barter Island, temperatures are slightly warmer and precipitation substantially greater than at Point Barrow. Mean July temperature at Barter Island is 4.4°C; mean January temperature is -26.2°C, and mean annual precipitation totals 247.5 mm (Brown et al., 1980). Both regions experience many days of fog, especially during the summer months. Mean summer precipitation (June through August) at Barter Island is about 80 mm; this increases inland reaching 150 mm in the Foothills (Haugen, 1980; Brown et al., 1980).

Like Point Barrow, Barter Island is situated in a low-relief landscape with poor drainage and relatively shallow active layer in the soils. However, calcareous parent materials and less organic matter in the soils at Barter Island combine to create less acidic soils than at Barrow. This is reflected in differences in vegetation between the two regions.

4. METHODS

4.1 Modern vegetation

Vegetation sampling was conducted at Point Barrow LRRS in August 1993 and 1994. During 1993 a detailed transect of vegetation plots was laid out across the beach ridge south of the LRRS site boundary to characterize the range of vegetation and thaw along a topographic gradient (Transect A in Fig. 2). The results of this study were reported in a data report summarizing the first year's activities (Auerbach et al., 1994; Appendix A). The 1993 reconnaissance study and previous information collected during the International Biological Programme Tundra Biome Studies (Walker 1977; Brown et al., 1980) provided an adequate background for classification of the Point Barrow LRRS vegetation. At Barter Island, some previous information was collected during mapping of the Arctic National Wildlife Refuge (Walker et al., 1982).

During the period, July 29 to August 12, 1994, we collected vegetation data for a vegetation classification at Point Barrow and Barter Island LRRS. Species lists were made of the vascular plants along transects covering the sites. Voucher collections of unknown species were sent to the Herbarium at the University of Alaska. To sample the vegetation communities, we used the Braun-Blanquet approach with a centralized replicate sampling procedure in representative stands of homogeneous vegetation (relevés) (Mueller-Dombois and Ellenberg, 1974, Westhoff and Van der Maarel, 1978). Most relevés were about 80 m^2, but no formal boundaries were established, the objective being to obtain a complete species list from each sample site. A total of 59 relevés (31 at Point Barrow LRRS and 28 at Barter Island LRRS) were sampled.

4.1.1 Classification

Classification was done using the specific protocols of Daniëls (1982) to distinguish the vegetation types. All vascular plants, bryophytes, and lichen species were scored using the Braun-Blanquet cover-abundance scale (Mueller-Dombois and Ellenberg, 1974). A small sample of each species was collected and returned to the laboratory for final identification. Bryophytes were identified by Dr. Olga Afonina; liverworts were identified by Dr. Alexey Potemkin, and lichens were identified by Dr. Mikhail Zhurbenko at the Komarov Botanical Institute, St. Petersburg, Russia.

A brief site description of each relevé included landform, surficial geomorphology (periglacial features), microsite description, site moisture rating, soil moisture at 10 cm depth, topographic position, soil unit, exposure, estimated snow duration, slope, aspect, and thaw depth. A sample of soil at 10 cm depth was collected and returned to the lab where gravimetric soil moisture, bulk density, and soil pH (saturated paste method) were determined.

4.1.2 Gradient analysis

Detrended correspondence analysis (DCA) ordination was used to examine the relationship of the relevé data to environmental gradients. The ordination displays relevés in a two dimensional space according to their species similarity to each other. DCA is based on a model of unimodal species response along gradients. The DCA produces first axes showing major directions of variation in the data and the relationship of the classification to major environmental gradients. The computer program CONOCO (ter Braak, 1987) was used to ordinate the relevés according to species composition; species were weighted equally and detrended by segments. Two ordinations were done; the first used the entire data set and the second used a partial data set that did not contain 14 aquatic and saline plots; these extreme plots with low floristic similarity with the other communities tended to clump most of the relevés in the center of the ordination space. Environmental variables were related to the ordination axes with biplot diagrams, which indicate the direction in the ordination diagram that has the maximum correlation with a particular environmental variable (Dargie, 1984; Jongman et al., 1987).

4.1.3 Disturbance studies

Species lists were made of taxa occurring on some of the most extensive disturbance types at both sites, including gravel roads and pads, a bulldozed berm surrounding the Point Barrow LRRS sewage lagoon, the old sewage lagoon at Point Barrow LRRS, and a bulldozed peat pile.

In addition, a 360-m transect was surveyed across the Point Barrow LRRS drainage ditch to record changes in vegetation, microtopography, and thaw depth (Transect B in Figure 2). Depth of thaw was measured at 2-m intervals, and species and relative elevation were recorded at 1-m intervals.

4.2 *Vegetation history*

4.2.1 Sample sites and sampling methods

The goals of this part of the project were twofold: 1) to analyze the vegetation history of the area through pollen analysis of peat sections; and 2) to establish a modern pollen "rain" signature though the analysis of polsters (clumps of mosses and lichens which serve as pollen traps). For the latter, samples are either collected from vegetation plots (relevés) or along a transect which is set up to sample a number of vegetation communities. Two or three polsters are collected at each site to provide a summary pollen signature for that site. Polsters are believed to average the pollen "rain" over a ten to twenty-five year period. During the 1993 field season at Point Barrow LRRS, pollen traps designed to sample the pollen fallout during a single growing season were set out; these, however, were removed by foxes. The modern polster samples for Point Barrow and Barter Island LRRS are listed below in Tables 1 and 2.

4.2.2 Point Barrow LRRS modern samples

Two modern transects were established at the Point Barrow LRRS. Transect A was collected along the vegetation transect study of 1993 (Appendix A). The transect begins in a drained-lake basin, crosses a beach ridge, and ends on an area with high and low-centered polygons and thaw lake features (Fig. 2). Fig. 4 in Appendix A illustrates the vegetation types described along the transect. Pollen samples were collected at 10 m, 100 m, 200 m, 300 m, and 400 m (Table 1). In 1994 a second transect (B) was established from the LRRS peat section-raised polygons east through a moist meadow region into a dry beach ridge area near the NOAA buildings (Fig. 2). In addition, three polsters were collected at the two peat sections described below.

Table 1. Paleoenvironmental study sample inventory, Point Barrow LRRS

Site	Modern Polster Samples	Fossil Pollen Samples	Fossil Insect Samples	^{14}C Samples
Barrow Peat #1	3	19	14	4
Barrow Transect A	15			
Barrow Transect B	11			
Central Marsh Slough	3	28	11	2

4.2.3 Barter Island LRRS modern samples

Forty-one moss and lichen polsters were collected at several localities at the Barter Island LRRS, including a transect from the SSR Station north to the ocean and Walker's vegetation plots (Fig. 3, Table 2). In addition, three polsters were collected from the lowland marsh region along the western margin of the island.

The second class of sample collected in this study is the fossil peat sections sampled at both sites for both pollen and insect analyses.

Table 2. Paleoenvironmental study sample inventory, Barter Island LRRS

Site	Modern Polster Samples	Fossil Pollen Samples	Fossil Insect Samples	^{14}C Samples
Western Marsh (Site 5)	3	-	-	-
Ravine	3	-	-	-
Pollen Transect (Sites 1-4)	12	-	-	-
Barter Island Peat #1	-	26	12	2
Barter Island Peat #2	-	-	-	2

4.2.4 Point Barrow LRRS fossil samples

The Point Barrow Peat #1 section is located ca. 150 m ESE of the Point Barrow LRRS buildings (71°19'N, 156° 38'W), 7 km northeast of town of Barrow, Alaska (Fig. 1). The site is located adjacent to the Point Barrow LRRS drainage ditch (Fig. 2) in an area of high-centered polygons with a relief of approximately 1-1.5 m. In 1993, a face was cleared and pollen samples were taken at 5 cm intervals from the surface to 91 cm; permafrost was encountered at 55 cm (Fig. 4). At that time, samples for fossil insect analyses were taken at 10-cm intervals to the 55-cm level. In 1994 we successfully collected additional samples from the frozen peat using a chain saw.

A second peat section was collected in 1994 along the Central Marsh Slough (71°18'N, 156°34'W, 2 m asl). This site consisted of 140 cm of sandy peat grading into clay. Pollen samples were collected at 5-cm intervals and samples for fossil insect analyses were taken at 10-cm intervals.

4.2.5 Barter Island LRRS fossil samples

The northern margin of the island is characterized by massive frozen cliffs of peat, clay, and sand; these are often twisted by permafrost action, with ice wedges and slumping evident. We searched these cliffs to find a peat section that was not deformed. Barter Island Peat #1 (70°08'N, 143°39'W, 6 m asl) is located ca. 100 m west of the landfill cut at the LRRS station. We did not observe any evidence of disturbance in the field. The section consisted of 190-cm of peat with clay and sand lenses resting on sand and gravel (Fig. 5); plant macrofossils were abundant in the section. Pollen samples were taken at 5-cm intervals in the upper 82-cm section; below a thick sand and gravel lens from 82-125 cm, pollen samples were collected at irregular intervals in peat lenses. Samples for radiocarbon analyses were collected at the base of the section and at the 82-cm level.

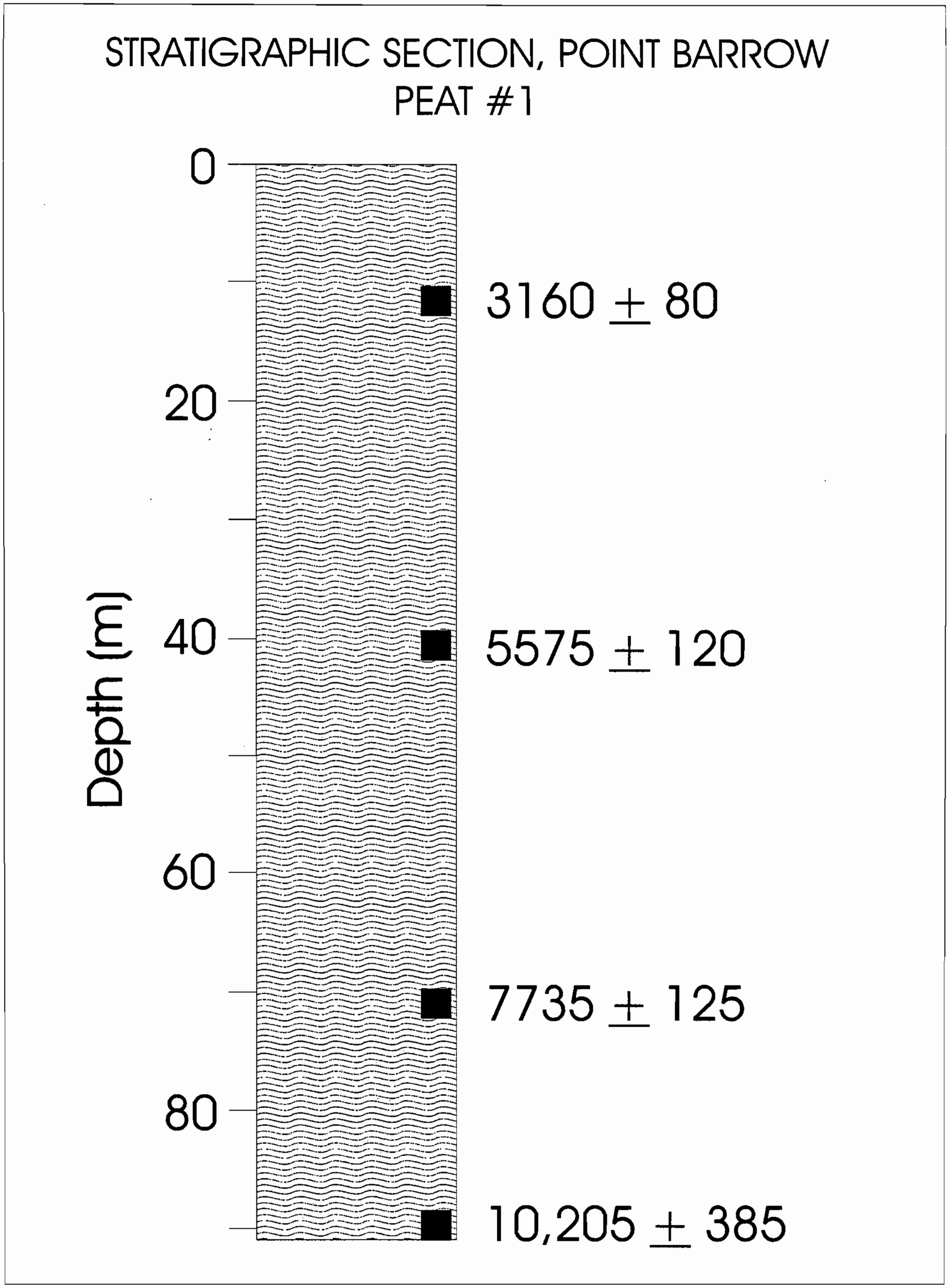

Figure 4. Stratigraphic section, Point Barrow Peat #1, showing radiocarbon ages in years before present.

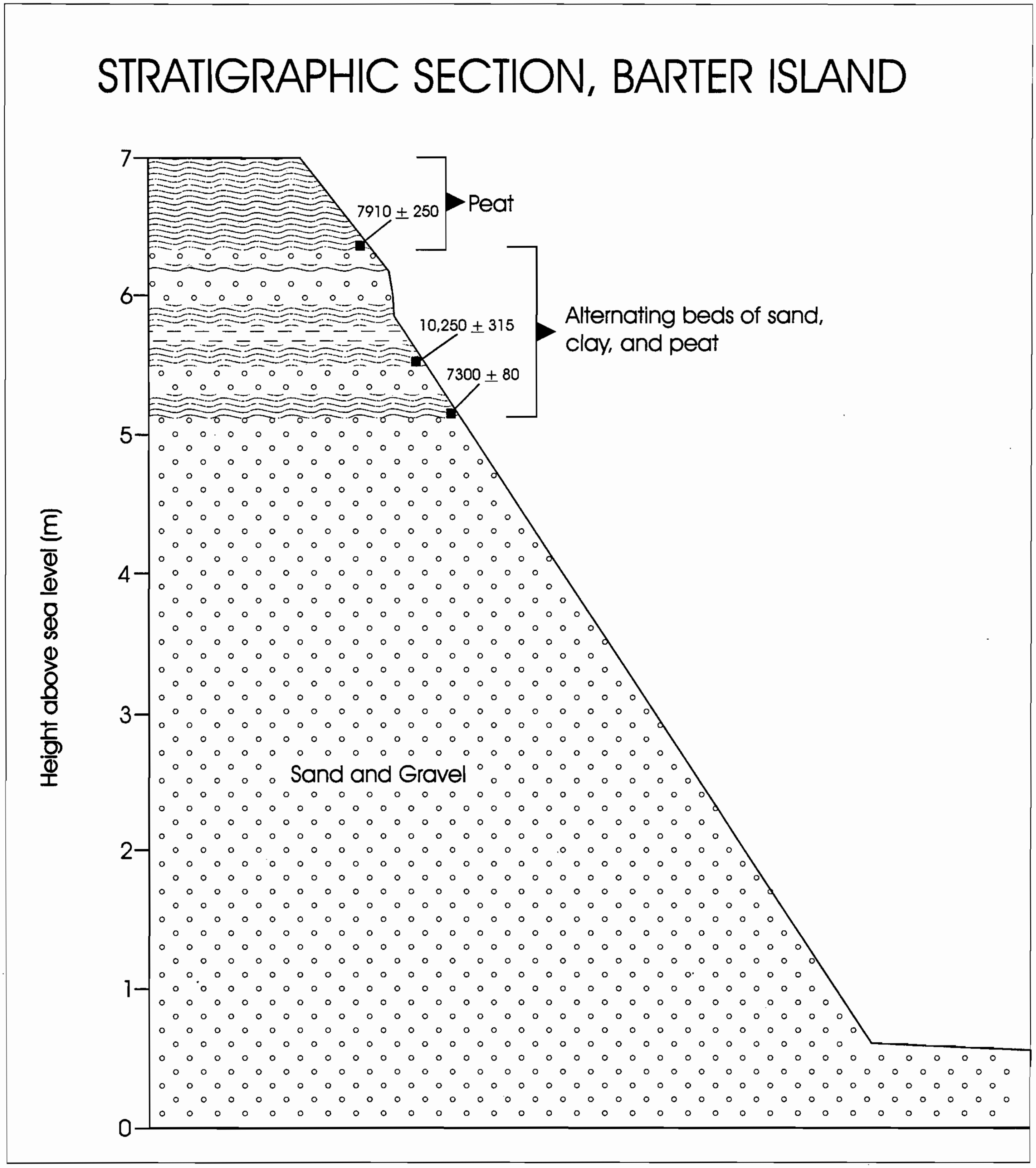

Figure 5. Stratigraphic section, Barter Island Peat #1 site, showing radiocarbon ages in years before present.

Basal peat was also collected from a second section (70°08'N, 143°38'W, 5 m asl) east of the landfill cut.

4.2.6 Laboratory methods: palynology

Pollen samples include peats, organic silts, and moss and lichen polsters. Laboratory processing consisted of sieving to remove coarse organics (>0.25 mm), caustic soda, acetolysis, and hydrofluoric acid (Faegri and Iversen, 1975; Nichols, 1975), with extended boiling times because of the elevation of the laboratory. A tablet containing a known number of exotic tracer grains (*Eucalyptus*) was added to a weighed sample prior to chemical concentration, allowing calculation of pollen concentrations as number of grains per gram dry weight (g/gdw) of sample (Jørgensen, 1967; Stockmarr, 1971).

4.2.7 Pollen data analysis and interpretation

Pollen counts ranged from 100 to 350 grains (pollen + spores) per sample. Pollen identifications were made using the INSTAAR Palynology Laboratory reference collection plus keys and floras (Hultén, 1968; McAndrews et al., 1973; Moriya, 1976). The modern and fossil pollen data are presented in the form of pollen diagrams which illustrate major taxa only.

4.3 Insect History

4.3.1 Sample sites and sampling methods

Fossil insects were sampled from the same sites as fossil pollen: one site at Point Barrow LRRS yielded insect fossils, as did the Barter Island Peat #1 site. We also sampled the Central Marsh Slough site for insects, but peat samples from this site were devoid of insect remains. In general, insect remains were extracted from 5-10 cm intervals. Blocks of peat were removed for insect analysis. These blocks averaged 1-2 liters in volume for each sampled horizon.

4.3.2 Laboratory methods: paleoentomology and modern entomology

Insect fossils were extracted from the blocks of peat representing from 5-10 cm depths in the stratigraphic profiles. Each block was rehydrated by soaking in water from one to several days. The wetted peat was then screened, using a 300 m sieve, to remove fine inorganic particles. Insect fossils were extracted from the screened residue by the kerosene flotation method (Elias, 1994). The flotant was washed in detergent and sorted in alcohol under low power binocular microscope. Insect fossil sclerites were stored in vials of alcohol. Insect fossil identifications were made chiefly through comparison with both modern and fossil identified specimens at INSTAAR.

Modern specimens were collected from both Point Barrow and Barter Island LRRS, chiefly by pit-fall trapping along a transect from wet to dry habitats. Pitfall traps were placed about every 5 m, and checked each morning for insects. At Point Barrow LRRS, pitfall trapping was rendered nearly useless by arctic foxes. Each night, foxes would come and overturn the traps, spilling their contents onto the ground. After several nights of this, pitfall traping was abandoned at Point Barrow LRRS.

4.3.3 Insect data analysis and interpretation

Fossil insect data was analyzed using the presence-absence method for all species identified. Data were presented in terms of minimum numbers of individuals identified from a given horizon. Paleoenvironmental interpretations of insect data were made on the basis of the species' modern ecological requirements and distribution (Elias, 1994).

5. RESULTS

5.1 Modern vegetation

Appendix B contains a checklist of the vascular plants for Point Barrow and Barter Island LRRS. Appendix C contains the lists of cryptogams collected from the relevé sites. A total of 126 vascular plants, 86 mosses, 14 liverworts, 73 lichens, and 11 lichenicolus fungi were recorded at the two sites. Barter Island LRRS has a relatively rich vascular plant and moss flora (119 vascular plants, 66 mosses compared to 71 and 56 respectively at Point Barrow LRRS). On the other hand, Point Barrow LRRS had relatively more liverworts (12 vs. 5 at Barter Island LRRS). Both sites had about the same number of lichens (51 at Point Barrow LRRS vs. 52 at Barter Island LRRS); however, Point Barrow LRRS had a larger number of *Cladonia* species (13 vs. 9 at Barter Island LRRS). Six lichenicolous fungi, *Arthonia* cf. *nephromiaria, A. peltigerina, Cerdidospora decolorella, Geltingia associate, Lichenodiplis lichenicola,* and *Zwackhiomyces berengerianum,* and the lichen *Lecanora leptacinella* are new to North America (Zhurbenko et al., 1995).

The 119 vascular plant species collected at Barter Island LRRS is somewhat surprising given the short amount of time for collecting and the small size of the LRRS site. The initial expectations were that both sites were maritime arctic coastal sites with similar temperatures and topography, and we expected a similar species list from both sites. The list from Barter Island LRRS, however, contains 55 species that were not recorded at Point Barrow LRRS, many of which are basiphilous or calciphilous (e.g. *Artemisia comata, Astragulus alpinus, A. umbellatus, Cardamine digitata, Carex glareosa, C. misandra, C. saxatilis, Chrysanthemum integrifolium, Dryas integrifolia, Equisetum variegatum, Lagotis glauca, Oxytropis bryophila, Papaver lapponicum, Salix arctica, S. glauca, S. lanata, S. reticulata, Saxifraga oppositifolia*). Only seven species were recorded from Point Barrow LRRS that were not collected at Barter Island LRRS, and most of these probably also occur on Barter Island, but were just not found during the short sampling period.

5.1.1 Classification

Appendix D contains the raw data from 59 relevés at Point Barrow and Barter Island LRRS. The diversity of vascular plants, brophytes, and lichens are shown in Table 3. Summary floristic information is presented in a synoptic table (Table 4). Table 5 contains the average values for key environmental variables. The synoptic table presents important plant species and their Braun-Blanquet constancy class and mean cover-abundance score for each of the vegetation unit. The classification resulted in seven community types and four subtypes. The community types described below are generally somewhat broader than units previously described by Webber (1978) and Walker (1977) at Barrow, and Walker (1985; Walker and Everett, 1991) at Prudhoe Bay. More extensive sampling at both sites is required to define finer units.

Table 3. Number of taxa occurring in each vegetation type.

Vegetation types, subtypes	Vascular Plants	Mosses	Liver-worts	Lichens	Total
Sphglo-Luzcon, Salfol	18	12	1	28	59
Sphglo-Luzcon, Salrot	25	21	3	33	82
Ochfri-Dryint	43	32	1	43	119
Dryint-Caraqu	34	36	1	29	100
Saxcer-Caraqu	42	40	10	32	124
Eriang-Caraqu, Sarsar	12	17	1	0	30
Eriang-Caraqu, Drebre	28	19	3	1	51
Arcful	6	0	0	0	6
Other saline	36	8	0	0	44
Stehum-Pucphr	4	1	0	0	5

5.1.1.1 Dry habitats

At Point Barrow LRRS, most well-drained vegetation types were grouped into Community Type *Sphaerophorus globosus-Luzula confusa* with two subtypes: *Saxifraga foliolosa* and *Salix rotundifolia*. Both subtypes are lichen rich (*Cladonia amaurocraea, C. gracilis, C. bellidiflora, C. coccifera, Sphaerophorus globosus, Bryocaulon divergens, Alectoria nigricans, Dactylina arctica, Cetraria islandica, C. cucullata, Ochrolechia* spp., and *Thamnolia subuliformis*).

Subtype *Saxifraga foliolosa* occurs mainly on organic-rich high-centered polygons, low-centered polygon rims, and somewhat elevated microsites (Fig. 6a, b). Compared to subtype *Salix rotundifolia,* it has relatively high cover of graminoids (*Calamagrostis stricta, Dupontia fisheri, Luzula confusa, L. arctica, Poa arctica*) and the forb *Saxifraga foliolosa.* The abundant cushion moss *Dicranum elongatum* is often covered with white crustose lichens (*Ochrolechia inequatula*) that give the subtype a lumpy appearance (Fig. 6b). This subtype corresponds to Type 5 in Walker (1977) and is included in Nodum III of Webber (1978).

Subtype *Salix rotundifolia* occurs mainly on well-drained gravely beach ridges (Fig. 7). This type has sparser but more diverse vascular-plant cover than Subtype *Saxifraga foliolosa.* Common vascular plant species include *Luzula arctica, L. confusa, Pedicularis lanata, Poa arctica, Salix rotundifolia, Stellaria laeta).* It is recognized by the sparse vascular-plant cover and usually high cover of *Salix rotundifolia.* It has the highest species diversity at Point Barrow LRRS (25 species; Table 3), mostly due to the abundance of lichen species. This subtype also has several vascular plant species not found in the *Saxifraga foliolosa* subtype (e.g. *Papaver hultenii, Potentilla hyparctica, Rumex arcticus, Saxifraga nelsoniana, Vaccinium vitis-idaea.*). This subtype corresponds to Type 4 in Walker (1977) and is approximately equivalent to Nodum II of Webber (1978).

Most dry sites at Barter Island LRRS have Community Type *Ochrolechia frigida-Dryas integrifolia* (Fig. 6c). This type occurs on base-rich mineral soils that are cryoturbated. The vegetation is dominated by *Dryas integrifolia* and a suite of fruticose lichens (e.g. *Thamnolia subuliformis, Cetraria islandica, C. cucullata, C. nivalis, Dactylina arctica, Ochrolechia frigida*). Other common taxa include *Artemisia comata, Cardamine digitata, Carex bigelowii, Eriophorum triste, Lecanora epibryon, Luzula multiflora, Minuartia arctica, Papaver macounii, Pedicularis lanata, Physconia muscigena, Rhytidium rugosum, Salix arctica, S. phlebophylla, S. reticulata, Senecio atropurpureus,* and *Saxifraga oppositifolia.* This type is closely related to the dry *Dryas*

Table 4. Synoptic table of Point Barrow and Barter Island LRRS vegetation types. Constancy classes: r, present in < 5% of records; +, 5-10%; I, 11-20%; II, 21-40%; III, 41-60%; IV, 61-80%; V>80%. Taxa that had only one occurrence were omitted. For communities of four or fewer releves, the actual number of occurrences is shown rather than the constancy class. Following the constancy average Braun-Blanquet cover-abundance class value is shown. For the purpose of computing the average, class "r" was converted to 0.4 and "+" to 0.7.

Community types: (1 and 2) Sphglo-Luzcon, *Sphaerophorus globosus-Luzula confusa*, subtypes Saxfol, *Saxifraga foliosa* and Salrot, *Salix rotundifolia* ssp. *rotundifolia*; (3) Ochfri-Dryint, *Ochrolechia frigida-Dryas integrifolia*; (4) Dryint-Caraqu, *Dryas integrifolia-Carex aquatilis* ssp. *aquatilis*; (5) Saxcer-Caraqu, *Saxifraga cernua-Carex aquatilis* ssp. *aquatilis*; (6 and 7) Eriang-Caraqu, *Eriophorum angustifolium-Carex aquatilis* ssp. *aquatilis*, subtypes Sarsar, *Sarmenthypnum sarmentosum* and Drebre, *Drepanocladus brevifolius*; (8) Arcful, *Arctophila fulva*; (9) Other saline; (10) Stehum-Pucphr, *Stellaria humifusa-Puccinellia phryganodes*.

Community Type	**Sphglo-Luzcon**		**Och fri-Dry int**	**Dry int-Car aqu**	**Sax cer-Car aqu**	**Eriang-Caraqu**		**Arc ful**	**other saline**	**Ste hum-Puc phr**
Subtype	**Sal fol**	**Sal rot**				**Sar sar**	**Dre bre**			
Number of Releves	**6**	**4**	**7**	**5**	**10**	**4**	**10**	**7**	**4**	**4**
Dry, Moist, Wet and Aquatic: Point Barrow and Barter Island										
Carex aquatilis ssp. *aquatilis*	V/1	1/+	II/1	V/3	V/3	4/2	V/3	IV/2	.	.
Dry, Moist and Wet: Point Barrow and Barter Island										
Salix planifolia var. *pulchra*	I/+	1/+	II/+	III/2	+/1	1/+	I/+	.	.	.
Oncophorus wahlenbergii	II/+	1/3	III/+	II/+	III/2	2/1	V/1	.	.	.
Juncus biglumis	I/+	1/+	.	I/+	II/1	.	III/+	.	.	.
Cladonia pyxidata	II/1	.	III/+	II/+	II/+	.	.	.	.	.
Polytrichum commune var. *jensenii*	I/1	.	.	.	+/2	1/+	II/+	.	.	.
Lecidea ramulosa	I/1	.	I/+	.	+/2	.	+/+	.	.	.
Dry, Moist, and Wet: Barter Island										
Salix arctica	.	.	III/+	I/+	.	.	I/+	.	1/2	.
Carex misandra	.	.	II/2	I/1	.	.	I/+	.	.	.
Dry and Moist: Point Barrow and Barter Island										
Sphaerophorus globosus	V/+	4/1	III/+	I/r	+/+	.	.	.	.	.
Luzula arctica	V/1	4/1	III/+	V/+	II/+	.	.	.	.	.
Luzula confusa	V/2	4/1	V/1	II/+	II/+	.	.	.	.	.
Polytrichastrum alpinum	V/1	4/1	V/1	II/1	IV/1	1/+	+/+	.	2/1	.
Dactylina arctica	V/1	4/1	V/2	V/2	III/1	.	.	.	.	.
Thamnolia subuliformis s.l.	IV/1	4/1	V/2	V/1	IV/1	.	.	.	.	.
Poa arctica s.l.	III/2	4/1	III/1	V/+	IV/1	.	.	.	2/1	.
Arctagrostis latifolia var. *latifolia*	I/1	3/2	III/1	II/+	II/+	.	.	.	.	.
Cetraria islandica	I/+	4/1	V/1	.	III/+	.	.	.	.	.
Ochrolechia frigida	.	4/2	V/2	II/1	.	.	.	.	.	.
Cetraria cucullata	I/+	4/+	V/1	V/1	I/+	.	.	.	.	.
Salix rotundifolia ssp. *rotundifolia*	II/+	4/2	V/2	V/2	III/2	.	.	.	.	.
Cetraria laevigata	IV/+	.	I/2	V/2	II/+	.	.	.	.	.
Stellaria laeta	III/+	3/+	III/+	II/1	V/+	.	.	.	.	.
Alectoria nigricans	V/1	4/1	V/1	III/1	.	.	.	.	.	.
Pohlia nutans	III/+	2/+	I/+	.	I/+	.	.	.	.	.
Cladonia stricta	II/1	2/1	I/+	I/+	I/+	.	.	.	.	.
Dicranum spadiceum	I/+	1/+	II/2	II/1	+/+	.	.	.	.	.
Cladonia pocillum	II/1	1/+	III/1	II/1	.	.	.	.	.	.
Saxifraga nelsoniana ssp. *nelsoniana*	.	2/1	II/1	III/+	+/+	.	.	.	.	.
Lobaria linita	.	1/1	III/+	III/+	II/1	.	.	.	.	.
Psoroma hypnorum	.	1/+	II/1	III/+	I/+	.	.	.	.	.
Ditrichum flexicaule	.	1/+	III/+	II/+	I/+	.	.	.	.	.
Potentilla hyparctica s.l.	.	2/1	I/+	.	I/+	.	.	.	1/1	.
Dicranum angustum	I/+	1/+	.	I/+	I/1	.	.	.	.	.
Aulacomnium palustre	I/+	1/+	.	II/1	.	.	.	.	.	.
Dicranum majus	.	1/1	III/2	I/1	.	.	.	.	.	.
Eriophorum vaginatum s.l.	.	1/+	.	II/1	.	.	.	.	.	.
Cetraria fastigiata	II/1	.	.	I/+	+/+	.	.	.	.	.
Peltigera canina	I/+	.	.	III/+	+/+	.	.	.	.	.
Ceratodon purpureus	I/1	.	.	.	+/+	.	.	.	1/+	.
Masonhalea richardsohnii	.	2/1	.	I/+	+/+	.	.	.	.	.
Cetraria delisei	.	1/1	I/2	.	II/+	.	.	.	.	.
Blepharostoma trichophyllum	.	1/+	I/+	.	I/+	.	.	.	.	.
Pohlia cruda	.	.	I/+	I/+	+/+	.	.	.	.	.
Bryum caespiticium	.	.	I/+	II/1	+/+	.	.	.	1/1	.

Table 4. Continued.

Community Type	Sphglo-Luzcon		Och fri-Dry int	Dry int-Car aqu	Sax cer-Car aqu	Eriang-Caraqu		Arc ful	other saline	Ste hum-Puc phr
Subtype	Sal fol	Sal rot				Sar sar	Dre bre			
Number of Releves	6	4	7	5	10	4	10	7	4	4
Dry: Point Barrow and Barter Island										
Hypogymnia subobscura	.	2/1	III/1	.	.	.	.	.	.	.
Papaver hultenii	.	2/+	I/+	.	.	.	.	.	.	.
Pertusaria glomerata	.	1/+	I/+	.	.	.	.	.	.	.
Vaccinium vitis-idaea ssp. *minus*	.	1/1	I/+	.	.	.	.	.	.	.
Racomitrium lanuginosum	.	1/+	I/+	.	.	.	.	.	.	.
Caloplaca ammiospila	I/+	.	I/+	.	.	.	.	.	.	.
Festuca brachyphylla	I/+	.	I/+	.	.	.	.	.	2/1	.
Sphglo-Luzcon: Point Barrow										
Bryocaulon divergens	V/+	4/2	II/1	.	+/+	.	.	.	.	.
Cladonia coccifera s.l.	V/1	3/+	I/+	.	II/+	.	.	.	.	.
Cladonia bellidiflora	IV/1	3/+	.	.	+/+	.	.	.	.	.
Calmagrostis stricta ssp. *groenlandica*	III/1	1/2	.	.	.	.	.	.	.	.
Sphglo-Luzcon, Saxfol: Point Barrow										
Ochrolechia inaequatula	V/3	.	.	.	+/+	.	.	.	.	.
Cladonia uncialis	V/+	.	I/+	.	II/+	.	.	.	.	.
Dicranum elongatum	IV/3	2/1	I/2	I/1	II/1	.	.	.	.	.
Siphula ceratites	III/+	.	.	.	.	.	.	.	.	.
Cladonia amaurocraea	V/2	2/+	III/+	I/+	II/+	.	.	.	.	.
Cladonia gracilis s.l.	IV/2	2/1	III/+	II/1	II/+	.	.	.	.	.
Sphglo-Luzcon, Salrot: Point Barrow										
Gymnomitrion corallioides	.	2/3	.	.	.	.	.	.	.	.
Pertusaria dactylina	.	2/+	.	.	.	.	.	.	.	.
Pogonatum dentatum	.	2/1	.	.	.	.	.	.	.	.
Pohlia crudoides	.	2/+	.	.	.	.	.	.	.	.
Dry and Moist: Point Barrow										
Saxifraga foliolosa s.l.	IV/+	1/+	II/1	.	IV/+	1/+	II/+	.	.	.
Dupontia fisheri ssp. *fisheri*	V/r	.	.	.	V/3	3/2	II/+	.	2/1	.
Cetraria andrejevii	II/1	1/+	.	.	+/+	.	.	.	.	.
Anastrophyllum minutum	III/+	.	.	.	I/+	.	.	.	.	.
Peltigera malacea	II/+	.	.	.	+/+	.	.	.	.	.
Plagiothecium berggrenianum	II/+	.	.	.	+/+	.	.	.	.	.
Polytrichum strictum	II/+	.	.	.	+/+	.	.	.	.	.
Cladonia subfurcata	I/+	.	.	.	+/1	.	.	.	.	.
Conostomum tetragonum	.	2/1	.	.	+/+	.	.	.	.	.
Bartramia ithyphylla	.	1/r	.	.	+/2	.	.	.	.	.
Plagiomnium ellipticum	.	1/+	.	.	I/+	.	.	.	.	.
Bryum rutilans	.	1/+	.	.	I/+	.	.	.	.	.
Rumex arcticus	.	1/+	.	.	I/1	.	.	.	.	.
Dry and Moist: Barter Island										
Cetraria nivalis	.	2/+	V/1	V/1	.	.	.	.	.	.
Dryas integrifolia	.	.	V/2	V/2	.	.	.	.	.	.
Bistorta vivipara	.	1/+	V/+	V/+	II/1	.	III/+	.	1/+	.
Pedicularis lanata	.	1/+	V/1	V/1	.	.	.	.	.	.
Tomentypnum nitens	.	1/+	IV/1	V/3	I/1	.	.	.	1/2	.
Timmia austriaca	.	.	III/+	III/+	.	.	.	.	.	.
Parmelia omphalodes ssp. *glacialis*	.	1/2	III/1	II/+	.	.	.	.	.	.
Carex bigelowii	.	.	III/1	I/1	.	.	.	.	.	.
Ramalina almquistii	.	.	III/1	I/+	.	.	.	.	.	.
Rinodina turfacea	.	.	III/1	I/+	.	.	.	.	.	.
Cladonia macroceras	.	.	II/+	II/+	.	.	.	.	.	.
Hypnum subimponens	.	.	II/+	I/+	.	.	.	.	.	.
Bryoerythrophyllum recurvirostre	.	.	I/+	II/+	.	.	.	.	.	.
Brachythecium velutinum	.	.	I/+	I/+	.	.	.	.	.	.
Dicranum bonjeanii	.	.	I/+	I/+	.	.	.	.	.	.
Didymodon rigidus var. *icmadophilus*	.	.	I/+	I/+	.	.	.	.	.	.
Ochfri-Dryint: Barter Island										
Saxifraga oppositifolia	.	.	IV/2	.	.	.	.	.	.	.
Senecio atropurpureus ssp. *frigidus*	.	1/1	IV/1	II/2	I/1	.	.	.	.	.
Eriophorum triste	I/r	.	IV/+	II/2	+/+	.	.	.	.	.
Luzula multiflora	.	.	V/1	II/+	.	.	.	.	.	.
Cardamine digitata	.	.	III/+	.	.	.	.	.	.	.
Salix phlebophylla	.	.	III/2	.	.	.	.	.	.	.
Lecanora epibryon	.	.	III/1	.	.	.	.	.	.	.
Papaver macounii	.	.	III/+	.	.	.	.	.	.	.
Physconia muscigena	.	.	III/1	.	.	.	.	.	.	.
Rhytidium rugosum	.	.	III/+	.	.	.	.	.	.	.
Pedicularis sudetica (undesc. ssp.)	.	.	V/+	III/+	+/+	.	+/1	.	.	.

Table 4. Continued.

Community Type	Sphglo-Luzcon		Och fri-Dry int	Dry int-Car aqu	Sax cer-Car aqu	Eriang-Caraqu		Arc ful	other saline	Ste hum-Puc phr
Subtype	Sal fol	Sal rot				Sar sar	Dre bre			
Number of Releves	6	4	7	5	10	4	10	7	4	4
Minuartia arctica	.	.	II/1	.	.	.	.	.	.	.
Phaeophyscia constipata	.	.	II/+	.	.	.	.	.	.	.
Saussurea angustifolia	.	.	II/1	.	.	.	.	.	.	.
Silene acaulis	.	.	II/1	.	.	.	.	.	.	.
Stereocaulon alpinum	.	.	II/1	.	.	.	.	.	.	.
Sticta arctica	.	.	II/1	.	.	.	.	.	.	.
Moist: Point Barrow and Barter Island										
Saxifraga hieracifolia	.	.	.	I/+	III/+	.	.	.	.	.
Tritomaria quinquedentata	.	.	.	I/+	II/+	.	.	.	.	.
Brachythecium salebrosum	.	.	.	I/2	I/1	.	.	.	.	.
Cladonia squamosa var. *subsquamosa*	.	.	.	I/+	+/+	.	.	.	.	.
Myurella julacea	.	.	.	I/+	+/+	.	.	.	.	.
Orthothecium chryseum	.	.	.	I/+	+/+	.	.	.	.	.
Rhizomnium andrewsianum	.	.	.	I/+	+/+	.	.	.	.	.
Sphagnum fimbriatum	.	.	.	I/+	+/+	.	.	.	.	.
Eutrema edwardsii	.	.	.	I/+	+/+	.	.	.	.	.
Sphagnum girgensohnii	.	.	.	I/+	+/+	.	.	.	.	.
Dryint-Caraqu: Barter Island										
Sanionia uncinata	.	1/1	I/+	V/1	I/1	.	.	.	.	.
Aulacomnium turgidum	.	1/1	III/1	V/1	+/+	.	.	.	.	.
Distichium capillaceum	.	.	IV/+	V/2	III/1	.	II/2	.	.	.
Salix reticulata ssp. *reticulata*	.	.	III/2	V/1	.	.	.	.	.	.
Hylocomium splendens	.	1/1	III/1	V/1	I/2	.	.	.	.	.
Stellaria edwardsii	.	2/1	III/+	V/+	III/2	.	.	.	1/+	.
Peltigera aphthosa	.	1/1	III/+	V/+	III/+	.	.	.	.	.
Myurella tenerrima	.	.	.	II/+	.	.	.	.	.	.
Saxcer-Caraqu: Point Barrow										
Saxifraga cernua	.	1/1	.	I/2	V/1	1/+	II/+	.	.	.
Petasites frigidus	.	1/1	.	II/2	III/1	.	.	.	.	.
Alopecurus alpinus ssp. *alpinus*	.	.	.	.	IV/1	.	.	.	2/2	.
Oncophorus virens	.	.	.	.	I/2	.	.	.	.	.
Cladonia thomsonii	.	.	.	.	I/+	.	.	.	.	.
Dicranum scoparium	.	.	.	.	I/+	.	.	.	.	.
Ptilidium ciliare	.	.	.	.	I/1	.	.	.	.	.
Chrysosplenium tetrandrum	.	.	.	.	I/1	.	.	.	.	.
Ranunculus nivalis	.	1/+	.	I/1	III/+	.	.	.	.	.
Moist and Wet: Point Barrow and Barter Island										
Saxifraga hirculus var. *propinqua*	.	.	I/+	I/+	+/+	1/r	III/+	.	1/r	.
Calliergon giganteum	.	.	.	II/+	+/+	1/+	II/+	.	.	.
Eriophorum russeolum s.l.	.	.	.	I/+	II/2	2/2	II/+	I/+	.	.
Bryum cyclophyllum	.	.	.	.	I/+	1/+	.	.	1/2	.
Dupontia fisherii ssp. *psilosantha*	.	.	.	.	+/+	1/1	+/+	.	.	.
Carex rariflora	.	.	.	I/1	.	.	III/2	.	.	.
Pseudobryum cinclidioides	.	.	.	.	II/1	1/+	.	.	.	.
Cerastium jenisejense	.	.	.	.	III/+	.	+/r	.	.	.
Cardamine pratensis ssp. *angustifolia*	.	.	.	.	II/+	.	+/r	.	.	.
Hierochloe pauciflora	.	.	.	.	+/+	.	II/1	.	.	.
Calliergon richardsonii	.	.	.	.	+/+	.	+/5	.	.	.
Eriang-Caraqu: Point Barrow and Barter Island										
Limprichtia revolvens	.	.	.	.	II/+	4/3	V/2	.	.	.
Eriophorum angustifolium s.l.	II/+	1/2	.	II/2	IV/2	4/1	V/1	I/1	.	.
Eriophorum scheuchzeri var. *scheuchzeri*	.	.	.	.	.	2/2	II/1	.	.	.
Meesia triquetra	.	.	.	.	.	2/2	II/+	.	.	.
Scorpidium scorpioides	.	.	.	.	.	1/+	II/1	.	.	.
Aplodon wormskjoldii	.	.	.	.	.	1/+	I/+	.	.	.
Eriang-Caraqu, Sarsar: Point Barrow										
Sarmenthypnum sarmentosum	.	.	.	II/+	III/+	4/3	V/+	.	.	.
Pseudocalliergon (turgescens?)	.	.	.	.	.	4/+	.	.	.	.
Bryum pseudotriquetrum	.	.	.	.	+/+	4/+	I/+	.	1/2	.
Cinclidium subrotundum	.	.	.	.	.	4/+	II/+	.	.	.
Eriang-Caraqu, Drebre: Barter Island										
Drepanocladus brevifolius	.	.	.	.	.	.	V/2	.	.	.
Pedicularis albolabiata	.	.	.	.	+/+	.	V/1	.	.	.
Meesia uliginosa	.	.	.	.	.	.	IV/+	.	.	.
Bryum subneodamense	.	.	.	.	.	.	III/+	.	.	.
Cinclidium latifolium	.	.	.	.	.	.	III/1	.	.	.
Campylium stellatum	.	.	.	III/2	II/2	.	IV/1	.	.	.
Aneura pinguis	.	.	.	.	+/+	2/1	IV/1	.	.	.

Table 4. Concluded.

Community Type	Sphglo-Luzcon		Och fri-Dry int	Dry int-Car aqu	Sax cer-Car aqu	Eriang-Caraqu		Arc ful	other saline	Ste hum-Puc phr
Subtype	**Sal fol**	**Sal rot**				**Sar sar**	**Dre bre**			
Number of Releves	**6**	**4**	**7**	**5**	**10**	**4**	**10**	**7**	**4**	**4**
Carex rotundata	.	.	.	.	.	.	II/1	.	.	.
Salix ovalifolia s.l.	.	.	.	.	.	.	II/+	.	1/+	.
Gastrolychnis apetala	.	.	.	.	.	.	I/+	.	1/r	.
Nostoc commune	.	.	.	.	.	.	III/1	I/1	.	.
Arcful: Point Barrow and Barter Island										
Arctophila fulva	.	.	.	.	+/r	.	.	V/3	.	.
Ranunculus pallasii	.	.	.	.	.	1/+	.	III/2	.	.
Hippuris tetraphylla	.	.	.	.	.	.	+/r	I/1	.	.
Other Saline: Point Barrow and Barter Island										
Puccinellia langeana s.l.	.	.	.	.	.	.	.	.	4/2	.
Potentilla pulchella	.	.	.	.	.	.	.	.	2/1	.
Saxifraga rivularis s.l.	.	.	.	.	.	.	.	.	2/+	.
Sagina nivalis	.	.	.	.	.	.	.	.	2/+	.
Cochlearia officinalis ssp. *arctica*	II/1	.	.	.	III/+	1/r	+/+	.	4/+	.
Artemisia comata	.	.	III/1	.	.	.	.	.	2/2	.
Cerastium beeringianum	.	.	II/+	.	.	.	.	.	2/2	.
Papaver lapponicum ssp. *occidentale*	.	.	I/+	.	.	.	.	.	2/1	.
Oxyria digyna	.	.	I/+	.	.	.	.	.	1/2	.
Oxytropis bryophila	.	.	I/+	.	.	.	.	.	1/2	.
Poa alpigena					+/+				1/+	
Senecio yukonensis	.	.	.	.	+/+	.	.	.	1/r	.
Stehum-Pucphr: Point Barrow and Barter Island										
Puccinellia phryganodes	.	.	.	.	.	.	.	.	.	4/4
Carex subspathacea	.	.	.	.	.	.	.	.	.	2/3
Stellaria humifusa	.	.	.	.	.	.	.	.	2/2	4/2
Carex ursina	.	.	.	.	.	.	.	.	1/1	4/1
Other: Point Barrow and Barter Island										
Caloplaca sp.	.	.	II/+	.	.	.	.	.	.	.
Draba sp.	.	.	III/+	I/+	I/+	.	I/1	.	.	.
Ochrolechia sp.	.	1/1	.	.	+/1	.	.	.	.	.
Stellaria sp.	.	.	.	.	I/+	.	+/r	.	.	.
Stereocaulon sp.	.	.	.	II/1	.	.	.	.	.	.

Table 5. Summary of plots and environmental information for the Point Barrow and Barter Island LRRS vegetation types. Soil information is from samples collected at 10-cm depth at each releve.

Vegetation types, subtypes	Plots	Soil moisture (%)	Bulk density (g/cm3)	Soil pH	Thaw depth (cm)
Sphglo-Luzcon, Salfol	B-1,2,4,13,28,30	144 ± 34.4	0.4 ± 0.11	4.3 ± 0.10	22 ± 0.9
Sphglo-Luzcon, Salrot	B-6,7,8,21	36 ± 4.1	0.9 ± 0.19	4.4 ± 0.18	76 ± 24.3
Ochfri-Dryint	BI-1,3,5A,11,16,17A,17B	140 ± 29.7	0.5 ± 0.10	5.8 ± 0.25	48 ± 11.4
Dryint-Caraqu	BI-4,5B,10,15,19	143 ± 49.1	0.7 ± 0.24	5.4 ± 0.16	35 ± 2.6
Saxcer-Caraqu	B-3,5,9,10,16,20,22,23,29; BI-6	117 ± 36.0	1.1 ± 0.20	4.7 ± 0.15	33 ± 2.2
Eriang-Caraqu, Sarsar	B-11,25,26,31	428 ± 105.3	0.3 ± 0.07	4.5 ± 0.17	29 ± 0.4
Eriang-Caraqu, Drebre	BI-7,9,12,13,14,18,20,22,23,24	285 ± 27.5	0.3 ± 0.03	5.3 ± 0.05	37 ± 1.4
Arcful	B-12,24,27; BI-8,21,25,28	295 ± 29.6	0.5 ± 0.19	5.0 ± 0.23	34 ± 2.3
Other saline	B-17,18; BI-2,27	23 ± 9.4	1.1 ± 0.26	6.5 ± 0.38	83 ± 14.8
Stehum-Pucphr	B-14,15,19; BI-26	79 ± 21.7	1.0 ± 0.23	5.8 ± 0.16	72 ± 14.0

a

b

c

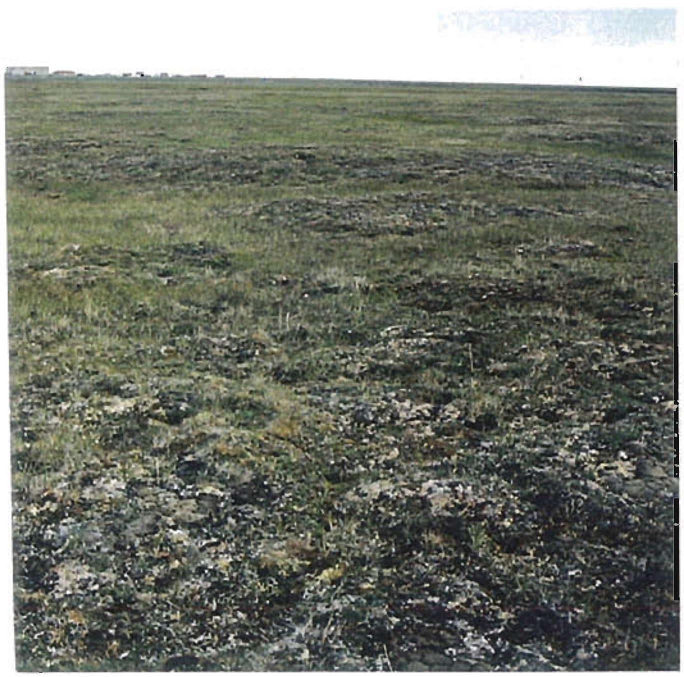

Figure 6. (a) Community Type *Sphaerophorus globosus-Luzula confusa* subtype *Saxifrage foliolosa* on a high-centered ice-wedge polygon at Point Barrow LRRS. (b) Close up showing the *Luzula confusa* and hummocks of *Dicranum elongatum* moss covered with the white lichen *Ochrolechia inequatula.* (c) Figure Community Type *Ochrolechia frigida-Dryas integrifolia* at Barter Island.

a

b

Figure 7. (a) Community Type *Sphaerophorus globosus-Luzula confusa* subtype *Salix rotundifolia* on a gravely marine terrace at Point Barrow LRRS. (b) Close up showing the lichen covered surface and forbs, including *Papaver hultenii* and *Potentilla hyparctica.*

integrifolia, Saxifraga oppositifolia dwarf-shrub, crustose-lichen tundra (Type B2) described from Prudhoe Bay (Walker, 1985; Walker and Everett, 1991).

5.1.1.2 Moist habitats

At Point Barrow LRRS, Community Type *Saxifraga cernua-Carex aquatilis* (Fig. 8a, b) occurs on flat-centered polygons, moist meadows, and areas with moderate drainage. It is dominated by graminoids (*Alopecurus alpinus, Carex aquatilis, Dupontia fisheri, Eriophorum angustifolium, Poa arctica,*), forbs (*Cardamine pratensis, Cerastium jenisejense, Chrysosplenium tetrandrum, Petasites frigidus, Saxifraga cernua, S. hirculis, S. hieracifolia, S. nelsoniana, Stellaria laeta*) and mosses (*Oncophorus wahlenbergii, Polytrichastrum alpinum, Polytrichum strictum* and *Sarmentypnum sarmentosum*). Prostrate shrubs (*Salix rotundifolia, S. planifolia* ssp. pulchra) are common in some areas. This unit includes Types 6 and 7 of Walker (1977) and Noda III and IV of Webber (1978). This unit has the highest species diversity of any unit in the study, 124 (Table 3).

At Barter Island LRRS, the most common vegetation on moist sites is Community Type *Dryas integrifolia-Carex aquatilis* (Fig. 8c). This unit is dominated by graminoids (*Carex aquatilis, Eriophorum angustifolium,* and *Dupontia fisheri*), and dwarf shrubs (*Dryas integrifolia, Salix reticulata, S. rotundifolia*). Common forbs include *Bistorta vivipara, Pedicularis lanata, Stellaria edwardsii.* Common mosses are *Aulocomnium turgidum, Distichium capillaceum, Hylocomium splendens, Sanionia uncinatus* and *Tomentypnum nitens.* Fruticose lichens include *Dactylina arctica, Cetraria* spp., *Peltigera aphthosa,* and *Thamnolia subuliformis.* This unit is closely related to Types U3, U4, and U12 at Prudhoe Bay (Walker, 1985, Walker and Everett, 1991).

5.1.1.3 Wet habitats

Wet sites at Point Barrow and Barter Island LRRS have a variety of communities that have been grouped into one community type, *Eriophorum angustifolium-Carex aquatilis* with two subtypes: *Sarmenthypnum sarmentosum* at Point Barrow LRRS (Fig. 9a)and *Drepanocladus brevifolius* at Barter Island LRRS (Fig. 9c). Both subtypes occur in wet meadows and the basins of low-centered polygons with saturated soils or shallow standing water. Both subtypes are dominated by graminoids (*Carex aquatilis, Dupontia fisheri, Eriophorum angustifolium*) and mosses (*Limprichtia revolvens, Sarmenthypnum sarmentosum,* and *Sarmentypnum sarmentosum* at Point Barrow LRRS; *Drepanocladus brevifolius, Meesia uliginosa* and *Campylium stellatum* at Barter Island LRRS). Subtype *Sarmenthypnum sarmentosum* includes Types 9, 10, 12, and 13 in Walker (1977), and Noda V and VI in Webber (1978), and M8 and M10 at Prudhoe Bay (Walker, 1985). Subtype *Drepanocladus brevifolius* subtype is closely related to the Types M1, M2, M3, M4, at Prudhoe Bay (Walker, 1985). This unit will require much more sampling before useful subtypes can be defined. The subtypes here correspond approximately to vegetation occurring on acidic ($pH<5.0$) and nonacidic soils ($p>5.0$).

5.1.1.4 Aquatic habitats

Shallow ponds at both sites have Community Type *Arctophila fulva* (Fig. 10). This is sometimes a monospecific unit, but it may also may include *Carex aquatilis, Ranunculus pallasii,* and *Hippuris tetraphylla.* It generally occurs in ponds less than 1-m deep at Barter Island LRRS and in shallower ponds at Point Barrow LRRS. This corresponds to Type 14 in Walker (1977), Noda VII in Webber (1978) and Type E2 at Prudhoe Bay (Walker, 1985).

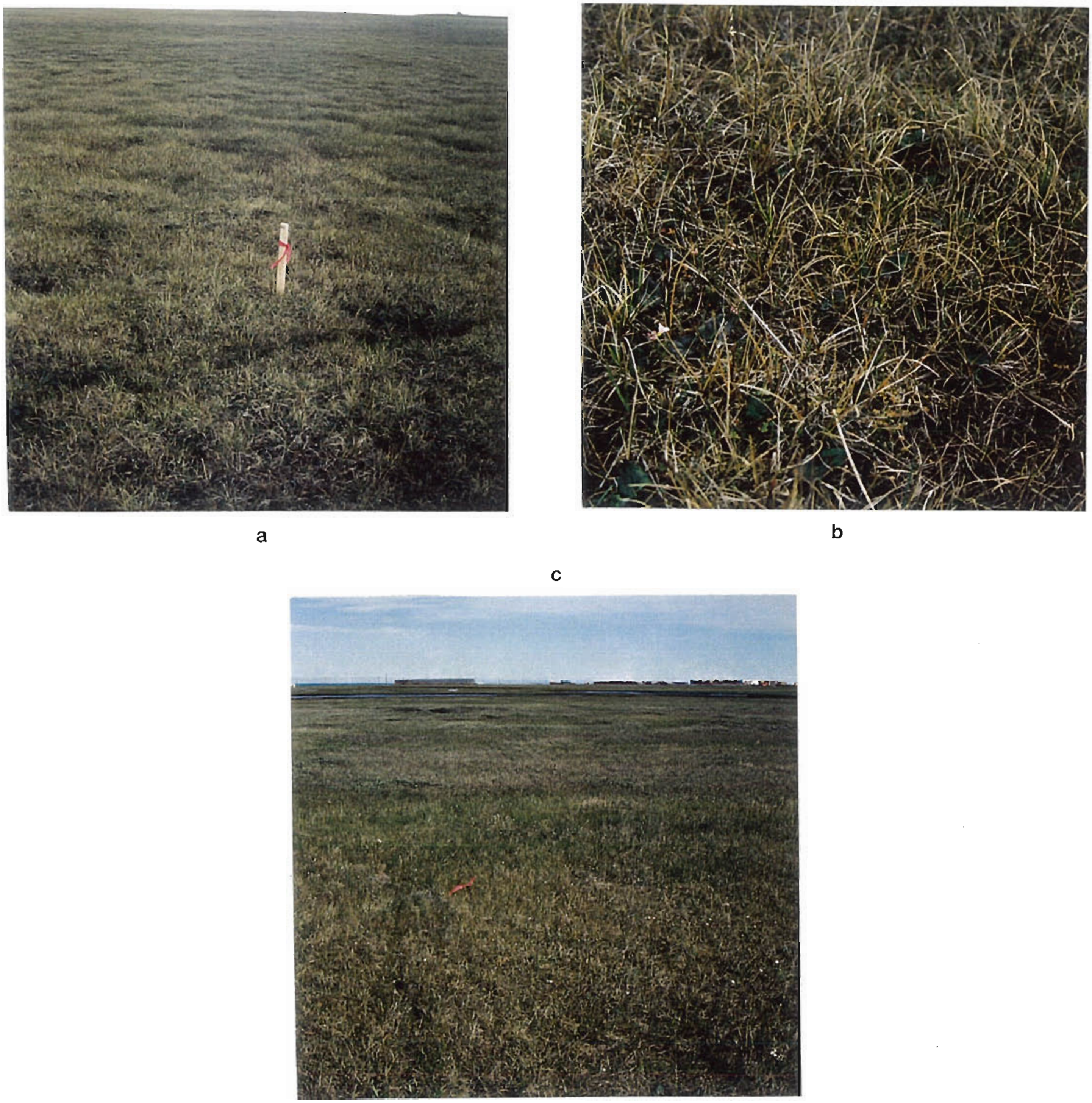

Figure 8. (a) Community Type *Saxifraga cernua-Carex aquatilis* in a moist meadow at Point Barrow LRRS. (b) Close up showing the sedge *Carex aquatilis* and scattered forbs. The larger green leaves are *Petasites frigidus*. (c) Community Type *Dryas integrifolia-Carex aquatilis* on a flat-centered ice-wedge polygon at Barter Island LRRS.

a

b

c

Figure 9. (a) Community Type *Eriophorum angustifolium-Carex aquatilis* subtype *Sarmenthypnum sarmentosum* in a shallow pond at Point Barrow LRRS. (b) Close up of *Carex aquatilis* in about 5 cm of water with the submerged moss *Limprichtia revolvens*. (c) Community Type *Eriophorum angustifolium-Carex aquatilis* subtype *Drepanocladus brevifolius* in a wet meadow at Barter Island LRRS.

Figure 10. Community Type *Arctophila fulva* at Barter Island LRRS.

a

b

Figure 11. (a) Community Type *Stellaria humifusa-Puccinellia phryganodes* along North Salt Lagoon at Point Barrow LRRS. (b) Rich forb community that occurs on the Barter Island LRRS gravel spit, which consists of *Alopecurus alpina, Artemisia comata, Cerastium beeringianum, Epilobium latifolium, Oxytropis bryophila, Papaver lapponicum, Polemonium boreale, Potentilla pulchella,* and *Puccinellia lageana,* (Relevé BI-27).

5.1.1.5 Saline habitats

Saline habitats are not extensive within either LRRS site, but a wide variety of saline community types were recognized. One unit was adequately sampled to define a community type (Community Type *Stellaria humifusa-Puccinellia phryganodes,* Fig. 11a, b). This unit occurs in quiet lagoons and estuarine sites. The vegetation is a reddish-brown color and consists mostly of *Carex subspathacea, C. ursina, Puccinellia phryganodes,* and *Stellaria humifusa.* This unit has also been described from Prudhoe Bay (Stand Type M9, Walker, 1985) and at numerous other sites in the circumpolar arctic. It corresponds to the Association *Caricetum suspathaceae* Hadac 1946 (Thannheiser and Willer, 1988).

More active coastal beaches are devoid of vegetation. Somewhat stable beaches contain open communities of *Puccinellia phryganodes, P. langeana, Stellaria humifusa and Cochlearia officinalis.* At Barter Island LRRS, beach areas on the southern side of the Barter Island spit near the runway had *Mertensia maritima* and *Honckenya peploides.* The most stable portions of the Barter Island spit contain a rich forb strand community consisting of *Alopecurus alpina, Artemisia comata, Cerastium beeringianum, Epilobium latifolium, Oxytropis bryophila, Papaver lapponicum, Polemonium boreale, Potentilla pulchella,* and *Puccinellia lageana,* (Relevé BI-27, Fig. 12). Areas between the beaches and the upper strand line are frequently inundated with saltwater and contain Community Type *Stellaria humifusa-Puccinellia phryganodes.* Strand line vegetation varies considerably but often includes *Poa arctica, Dupontia fisheri, Carex aquatilis, Saxifraga cernua, Petasites frigidus, Potentilla pulchella* and *Cerastium beeringianum.*

5.1.2 Gradient analysis

The ordination diagram of the total data set (59 relevés) separated the aquatic and saline communities along Axis 1 leaving the remainder of the relevés in a long vertical cluster in the center of the diagram where it was difficult to discern any environmental relationships (Fig.13a). Removal of the aquatic and saline communities from the ordination resulted in a better spread of the relevés and clearly captured two primary complex environmental gradients, soil moisture and soil pH (Fig. 13b). The terms acidic and nonacidic correspond to similar terminology in the US soil taxonomy, where the terms are used at the Family level to distinguish acidic (pH<5.0) and nonacidic soils (pH 5.0). The relative distance between plots and vegetation types in the ordination diagram is an indication of their floristic similarity; the low degree of overlap between the clusters is an indication that the vegetation types are distinct recognizable units, with little confusion between units. Within clusters, the dry and moist acidic types have the most floristic variability. The recognition of two dry acidic subtypes in the classification (A and B dashed ellipses in Fig. 13b) is supported by the ordination diagram. Clearly more sampling in the moist acidic sites is required to reduce the amount of variability within Community Type *Saxifraga cernua-Carex aquatilis.* Earlier vegetation studies (Walker, 1977; Webber, 1978) recognized several more moist meadow types than in this study.

The diagram also illustrates that the degree of dissimilarity between acidic and nonacidic types decreases with increasing site moisture. There is no overlap between the acidic and nonacidic communities; whereas the wet acidic and nonacidic communities are relatively similar. This appears to support the decision to place all the wet communities in a single community type with acidic and nonacidic subtypes.

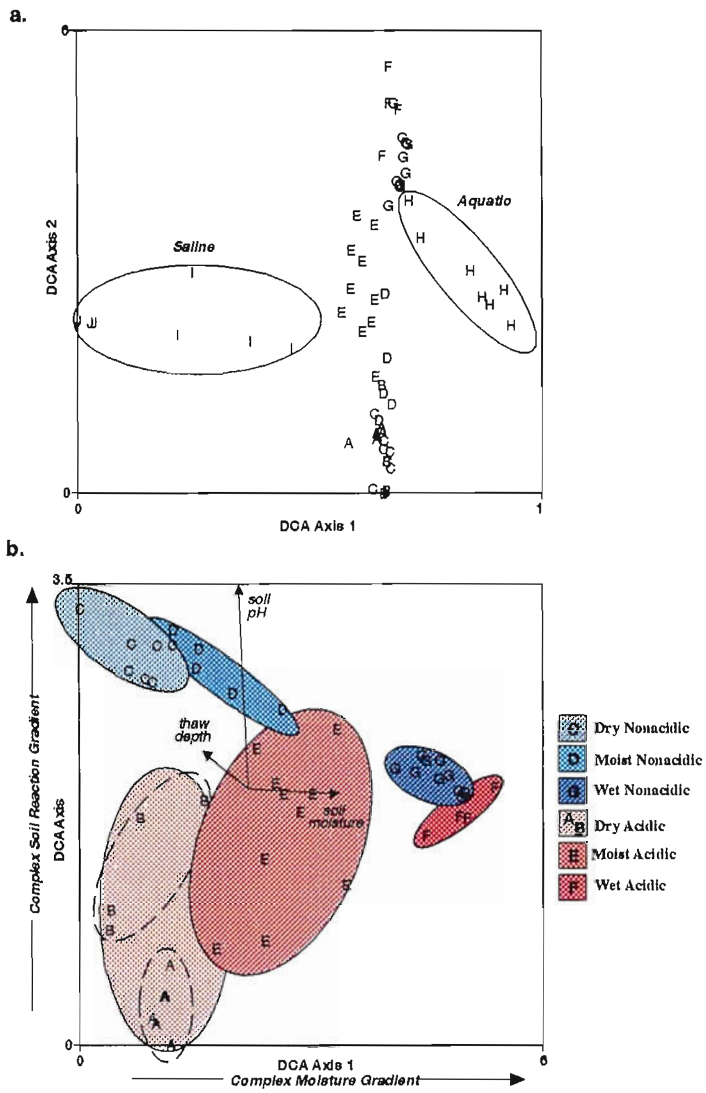

Figure 12. Ordination of Point Barrow and Barter Island LRRS relevés (a) Samples-environment biplot, with samples coded by community types. A, *Sphaerophorus globosus-Luzula confusa* subtype *Saxifrage foliolosa*; B, *Sphaerophorus globosus-Luzula confusa* subtype *Salix rotundifolia;* C, *Ochrolechia frigida-Dryas integrifolia*; D, *Saxifraga cernua-Carex aquatilis*; E, *Dryas integrifolia-Carex aquatilis;* F, *Eriophorum angustifolium-Carex aquatilis* subtype *Sarmenthypnum sarmentosum;* G, *Eriophorum angustifolium-Carex aquatilis* subtype *Drepanocladus brevifolius;* H, *Arctophila fulva;* I, saline communities. (b) Ordination after removal of 7 aquatic and 7 saline samples. Ellipses enclose samples of acidic and nonacidic dry, moist and wet vegetation types. Arrows indicate directions of principal environmental gradients. Units along the axes are standard deviation (SD) units. One SD unit represents approximately a 50% turnover of species, and 4 SD units corresponds to about a 100% turnover. The terms acidic (pH<5.0) and nonacidic (pH ≥5.0) correspond to similar terminology used in the US soil taxonomy (Soil Survey Staff 1975).

Figure 13. Old sewage lagoon at Point Barrow LRRS. The dominant grass in the bright green areas is *Dupontia fisheri*. Other important vascular species in areas affected by sewage effluent include *Alopecurus alpinus, Arctophila fulva, Carex aquatilis, Petasites frigidus,* and *Phippsia algida.* Important mosses include *Bryum rutilans, B. pseudotriquetrum, Campylium stellatum,* and *Splachnum vasculosum.*

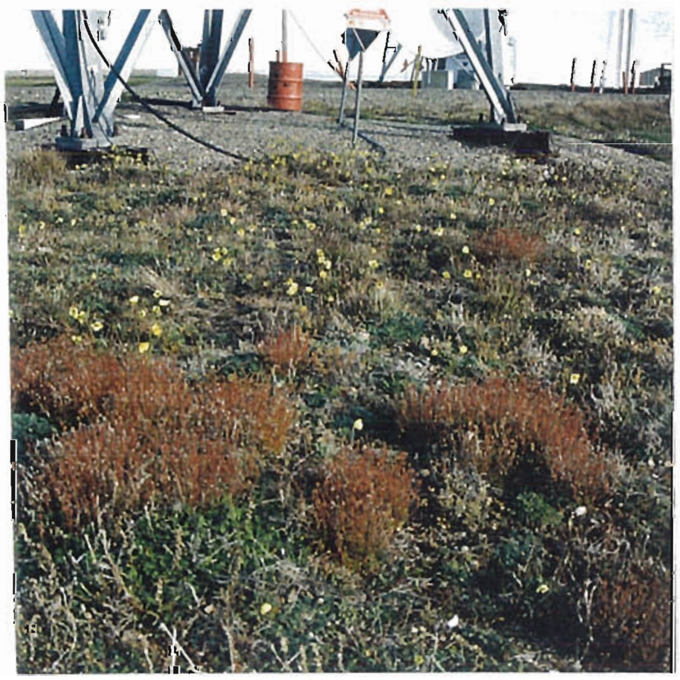

Figure 14. Natural revegetation of gravel pad at Barter Island LRRS radar site. Dominant species include *Artemisia comata, Astragalus alpinus, Calamagrostis stricta, Cerastium beeringianmum, Epilobium latifolium, Eutrema edwardsii, Festuca brachyphylla, Luzula confusa, Oxytropis bryophila, Polemonium boreale, Saxifraga cernua, S. hieracifolia,* and *Stellaria laeta.* This community is very similar to a rich forb community that occurs on the Barter Island gravel spit (Fig. 11b), which consists of *Alopecurus alpina, Artemisia comata, Cerastium beeringianum, Epilobium latifolium, Oxytropis bryophila, Papaver lapponicum, Polemonium boreale, Potentilla hyparctica,* and *Puccinellia lageana,* (Relevé BI-27).

5.1.3 Disturbance studies

Species lists were made for four disturbance types at Point Barrow LRRS: gravel pads and road areas, an organic berm of the new sewage lagoon, a margin of stream draining the old sewage lagoon, and a bulldozed mound bordering a drainage channel (Table 6). Forty-one species were recorded on stable portions of the pads and in gravely roadside areas. In some areas *Alopecurus alpinus* and *Stellaria edwardsii* formed a closed turf on the tops of gravel berms. Twenty species were recorded on the peat berm of the sewage lagoon, 16 of which also occurred along the roads. Important species included *Arctophila fulva* (in wet sites), *Calamagrostis stricta, Cochlearia officinalis, Dupontia fisheri, Luzula arctic, Poa arctica,* and *Stellaria edwardsii.* Common species along the stream draining out of the old sewage lagoon included *Alopecurus alpinus, Arctophila fulva, Bryum rutilans, B. pseudotriquetrum, Campylium stellatum, Carex aquatilis, Dupontia fisheri, Petasites frigidus, Phippsia algida,* and *Splachnum vasculosum* (Fig 14). Thirteen species were recorded on a bulldozed mound that was formed by a channel that drains Central Marsh south of the LRRS boundary.

Species that may be good native candidates for revegetation efforts at acidic coastal sites include: *Alopecurus alpinus, Arctagrostis latifolia, Arctophila fulva* (wet sites), *Cochlearia officinalis, Dupontia fisheri* ssp. *fisheri, Luzula confusa, Petasites frigidus, Poa alpigina, Poa arctica Potentilla hyparctica, Ranunculus nivalis, Saxifraga cernua, Stellaria edwardsii, S. laeta* , and *S. humifusa* (Table 6).

The Barter Island LRRS is not as impacted as the Point Barrow LRRS. At the Barter Island LRRS, we noted species along the relatively untraveled road west of the station, and at the base of an old radar tower. Most of the common species were the same as those found along roads at Point Barrow LRRS with exception of *Artemisia comata, Astragalus alpinus, Epilobium latifolium, Eutrema edwardsii, Oxytropis bryophila, Papaver lapponicum,* and *Saxifraga oppositifolia,* most of which are colonizers of gravel riparian habitats in the eastern portion of the Arctic Coastal Plain. One of the most well-vegetated gravel pads was at the base of an old radar tower, where a rich forb community very similar to that found along the Barter Island spit covered 90% of the site (Fig. 15).

Fig. 15 portrays the topography and thaw depths along the ditch transect. Relatively high elevations adjacent to both sides of the ditch are due to organic spoil piles bulldozed from the ditch. The mean thaw depth in unimpacted areas is 28.1 cm. Thaw depth is about 20 cm deeper in the bottom of the ditch than in nonimpacted areas. About 1.5 m of erosion has occurred in the ditch and in the ice-wedge polygon troughs leading into the ditch, creating a ditch that is now over 5 m wide. The ditch is most extensively eroded on the southeast side of the ditch due to the general SE-NW drainage gradient. Severe erosion has occurred along ice-wedges to about 60 m from the ditch on the SE side and to about 10 m on the NW side. Some erosion is evident to distances of about 130 m in some other areas on the SE side. Irregular topography at distances beyond -60 and +10 in Fig. 15 is due to natural microrelief associated with ice-wedge polygons.

The vegetation marginal to the ditch has changed considerably. The spoil piles from the ditch are for the most part completely barren. Drainage of the adjacent ice-wedge polygons has created an area of organic-rich high-centered polygons that are very sparsely vegetated with *Luzula confusa, Saxifraga foliolosa, Stellaria laeta, Cochlearia officinalis, Carex aquatilis,* and white

Table 6. Species occurring on disturbances at Point Barrow and Barter Island LRRS. (Key: blank, does not occur; 1, occurs; 2, abundant; 3, very abundant.)

SPECIES	Point Barrow				Barter	
	bulldozed mound	gravel pads/ roadsides	old sewage lagoon margin	berm of new sewage lagoon	old gravel pad	roadside areas
Alopecurus alpinus ssp. *alpinus*	3	3	2		2	3
Arctagrostis latifolia var. *latifolia*	2	2			2	1
Arctophila fulva		2	2	3		
Artemisia comata					3	2
Astragalus alpinus					2	
Calamagrostis stricta ssp. *groenlandica*				2		
Carex aquatilis ssp. *aquatilis*		2	2	1	2	1
Cerastium beeringianum		2		1	3	
Cerastium jenisejense		1				
Ceratodon purpureus					3	
Chrysosplenium tetrandrum		1				
Cochlearia officinalis ssp.*arctica*	1	2		2		1
Distichium capillaceum					3	
Draba spp. (3 spp.*Draba micropetala)*		2				1
Dupontia fisheri		2	3	3		1
Epilobium latifolium					3	2
Equisetum arvense						3
Eriophorum angustifolium				1		1
Eriophorum russeolum		1		1		
Eriophorum scheuchzeri var. *scheuchzeri*		1		1		2
Eutrema edwardsii					2	1
Festuca brachyphylla					3	2
Gastrolychnis apetala						1
Honckenya peploides ssp. *peploides*		1				
Leymus mollis ssp. *villosissimus*		1				
Luzula arctica		1		1		
Luzula confusa	1	2		2	2	
Oxyria digyna		1				
Oxytropis bryophila					3	
Papaver hultenii	2	1				
Papaver lapponicum					3	1
Pedicularis lanata	1	1				1
Pedicularis sudetica					1	1
Petasites frigidus	2	3	2	1		3
Phippsia algida		1	2			
Poa alpigena	2	3				
Poa arctica		1		3	3	1
Polemonium boreale					1	
Polytrichum juniperinum				1		
Potentilla hyparctica		2		1	3	

Table 6 Continued.

SPECIES	Point Barrow				Barter	
	bulldozed mound	gravel pads/ roadsides	old sewage lagoon margin	berm of new sewage lagoon	old gravel pad	roadside areas
Puccinellia langeana		1			1	1
Ranunculus nivalis	2	2				
Ranunculus pygmaeus	1	1				
Rumex arcticus		1				
Sagina nivalis		1				
Salix arctica						1
Salix glauca		1				
Salix ovalifolia						1
Salix phlebophylla		1				
Salix reticulata						1
Saxifraga caespitosa		2			1	
Saxifraga cernua	1	2		1	2	
Saxifraga hieracifolia	1	1			2	
Saxifraga hirculus var. *propinqua*		1				1
Saxifraga foliolosa				1		
Saxifraga oppositifolia						1
Saxifraga rivularis		2				
Senecio congestus		1				
Stellaria edwardsii	2	2		3		
Stellaria humifusa		2		1		
Stellaria laeta		1		1	2	1
Taraxacum ceratophorum		1				
Utricularia vulgaris						1

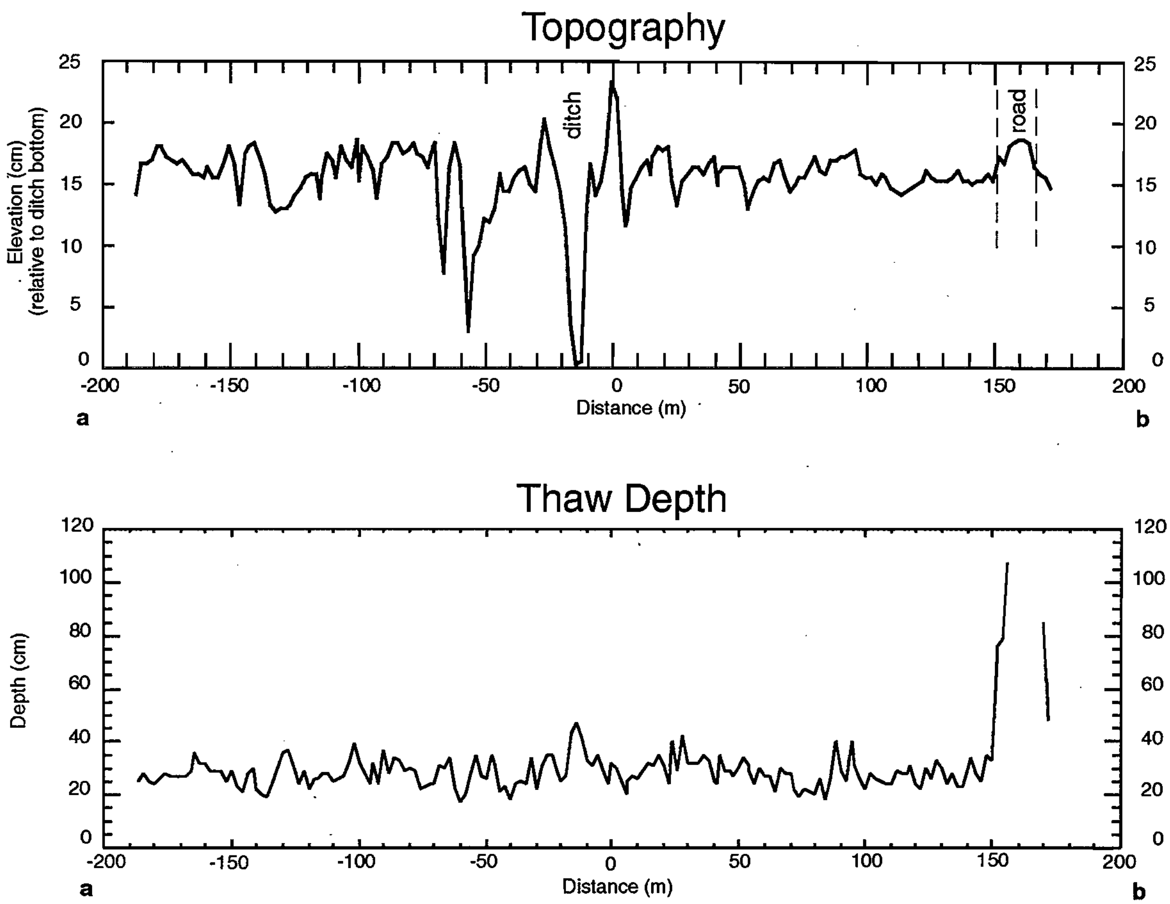

Figure 15. Transect across the Point Barrow LRRS drainage ditch (see Figure 2). (a) Topography. The ditch is located at -15 m on the transect. (b) Thaw depth. Thaw in the drainage ditch is about 20 cm greater than that in nonimpacted areas. Note the very deep thaw associated with the NOAA access road. See text for more detailed discussion.

crustose lichens. The ditch itself, and the bottoms of ice-wedge polygons leading into the ditch are vegetated with *Dupontia fisheri.*

5.2 Vegetation history

Modern pollen data, Point Barrow and Barter Island LRRS

The mean percentage values for the two or three polsters analyzed at each site are presented in Figs. 16 (Point Barrow LRRS) and 17 (Barter Island LRRS). Only the major pollen taxa are presented in these diagrams. The minor pollen taxa for both sites are listed in Table 7. Nineteen taxa were recovered in the Point Barrow LRRS modern study and 24 taxa were registered in the Barter Island LRRS polsters.

5.2.1.1 Transect A, Point Barrow LRRS

10 m samples

The pollen spectra are dominated by the grass family (Poaceae) (78.6-83.8%). These data correlate strongly with the wet grass-dominated (*Dupontia*) landscape (Fig 9a).

100 m samples

The modern habitat is a wet meadow, dominated by sedges and grasses. The pollen spectra in this suite of samples are also dominated by grass family percentages, and sedge family (Cyperaceae) values are still low (< 7%), despite importance of cotton grass (*Eriophorum* spp.) in the vegetation. However, two species of saxifrage (*Saxifraga*) are also important in the vegetation complex (Appendix A:Table 5), and this taxon was recovered in moderate to large percentages (3-24%) (Fig. 16) in these polsters.

200 m samples

The 200-m point falls on the beach ridge, a topographic high along the transect (Appendix A:Fig. 3). The vegetation along this ridge, whether on a high-centered polygon or in a snowbed trough, is dominated by willow (*Salix rotundifolia*). The pollen spectra from the three polsters correlate well with the vegetation data, recording maximum willow values for the transect (15-77%). Poaceae percentages continue to be important also, while Cyperaceae values remain low. On this topographic high for the area, percentages of the exotic taxa, alder (*Alnus*) and birch (*Betula*), reach maximum percentages.

300 m samples

The 300 m sampling grid occurred at the base of the beach ridge in a shallow snowbed community dominated by least willow (*Salix rotundifolia*). Again there is a good correlation with the pollen data (18-24% willow). In one moss polster, we begin to see the rise in sedge values that continues in the next suite of samples.

400 m samples

This point lies on the rim of a polygon and the vegetation is characterized by grass and sedges. The pollen spectra record maximum sedge values along the Transect A with 18-25%; grass percentages remain moderate to large at this site. In summary it appears that maximum sedge and

Table 7. Minor pollen taxa list, Point Barrow and Barter Island sites

TAXON	Common Name	Point Barrow-Modern	Point Barrow-Fossil	Barter Island-Modern	Barter Island-Fossil
Ambrosia type	Ragweed	✓			
Campanula	Harebell			✓	
Chenopodiaceae	Goosefoot family		✓	✓	✓
Cruciferae	Mustard family	✓	✓	✓	✓
Equisetum	Horsetail			✓	✓
Juglans	Walnut				✓
Koenigia	Koenigia		✓		
Leguminosae	Pea family		✓	✓	✓
Liliaceae	Lily family				✓
Orchidaceae	Orchid family				✓
Oxyria	Mountain Sorrel		✓	✓	✓
Pedicularis	Lousewort	✓	✓	✓	✓
Plantago	Plantain		✓		
Polemonium	Jacobs-ladder		✓		
Polygonum viviparum	Alpine bistort			✓	✓
Potentilla	Cinquefoil	✓			
Ranunculaceae	Buttercup family	✓		✓	✓
Rosaceae	Rose family		✓		
Rubus chamaemorus	Bakeapple		✓		
Selaginella	Selaginella				✓
Thalictrum	Meadow-rue		✓		
Tilia	Linden		✓		

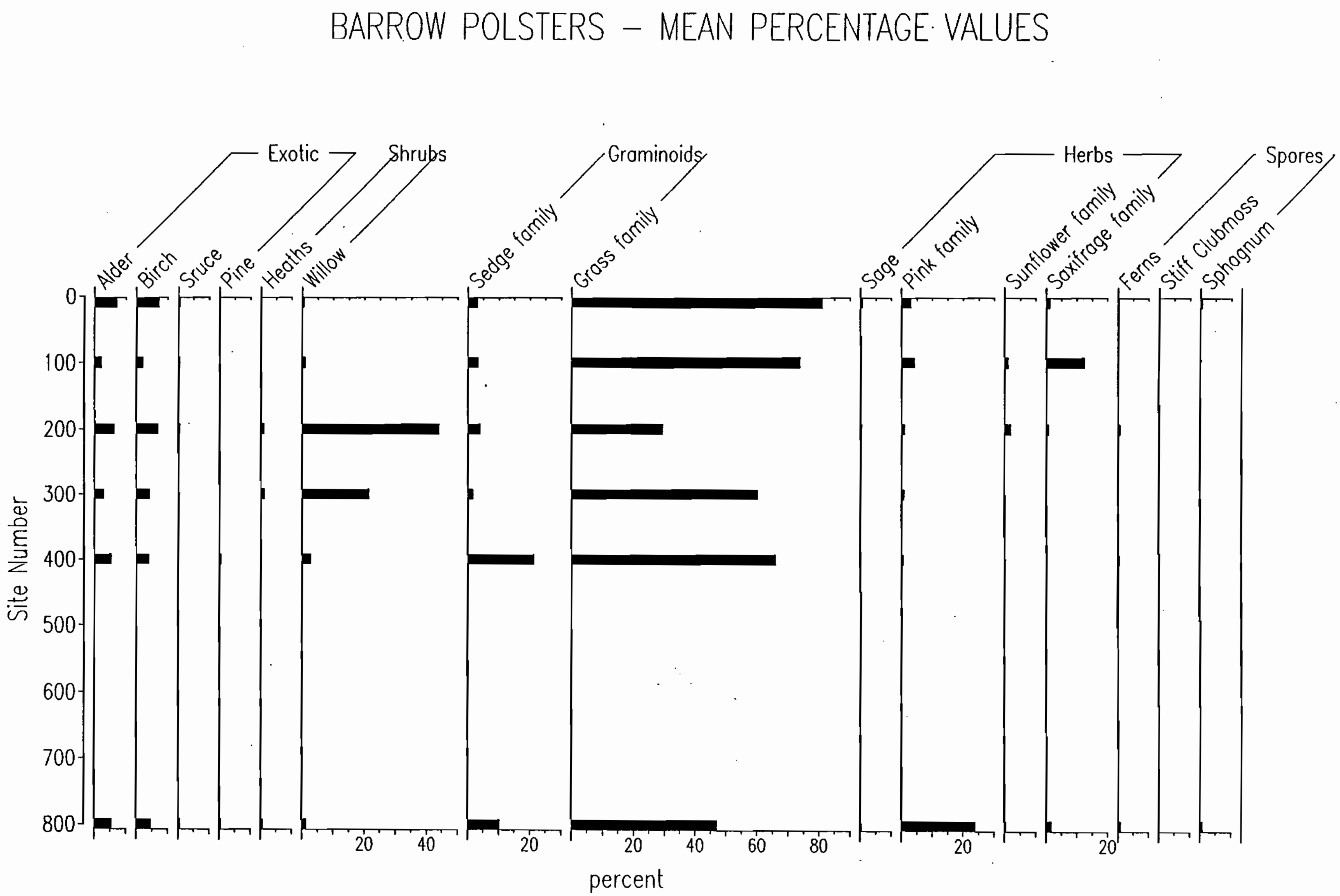

Figure 16. Percentage pollen diagram (reduced data set), Point Barrow LRRS site. Bars represent mean values of three polsters per site. Sites 0 - 400 are located along Transect A. Site 800 represents the Central Marsh Slough locality.

BARTER ISLAND POLSTERS – MEAN PERCENTAGE VALUES

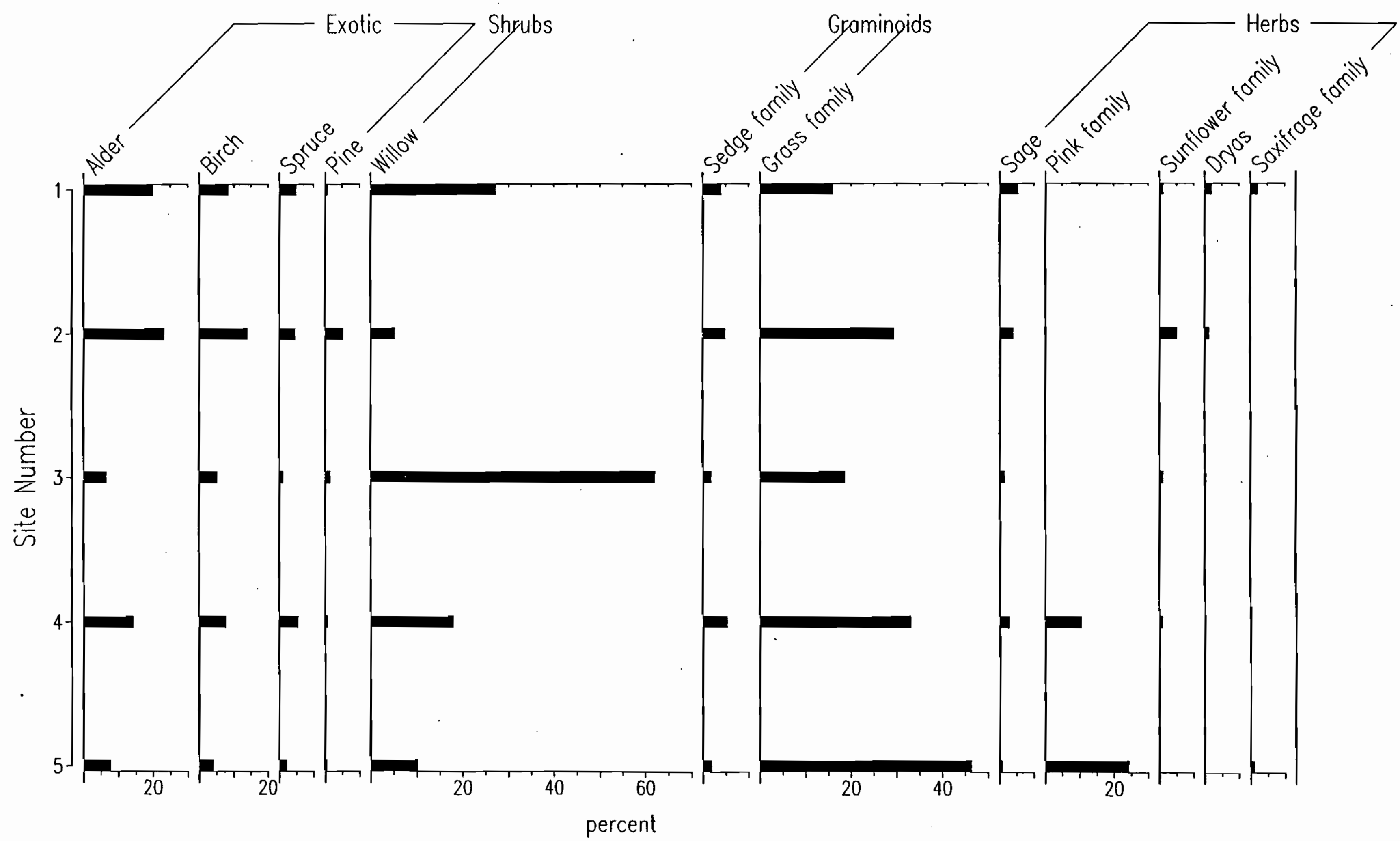

Figure 17. Percentage pollen diagram (reduced data set), Barter Island LRRS site. Bars represent mean values of three polsters per site. Sites 1 - 4 are located along the Pollen Transect. Site 5 represents the Western Marsh locality.

willow values are characteristic of drier sites along this transect, while wet and moist sites are dominated by grass species.

5.2.1.2 Central Marsh Slough samples, Point Barrow LRRS

These pollen spectra (800 m on Fig. 16) register values much like 400 m samples with moderate sedge and moderate to large grass percentages. One polster recorded very high percentages (67%) of the pink family (Caryophyllaceae). In the Arctic, a region of generally low pollen productivity, it is not uncommon for an herb taxon to occasionally register very large percentages, overwhelming the other taxa.

5.2.2 Barter Island LRRS samples

At the Barter Island site (Fig. 3), pollen analyses were done for the LRRS transect (Sites 1-4) and also for the Western Marsh polsters (Site 5) (15 polsters total) (Fig. 17). Site 1 ties the transect down at the northern (coastal) end (above the sampled peat section) while site 4 lies close to the road. In general, the pollen spectra are dominated by grass and willow.

However, the two coastal sites (#1,2) are characterized by large exotic percentages: alder (15-26%), birch (6-15%), and spruce (*Picea*) (2-8%). In the eastern portions of the North Slope of Alaska and in the Canadian Mackenzie Delta region, the northern limits of these taxa extend close to the coast, in contrast to central and western Alaska. Pollen of these taxa are easily transported by wind over long distances due to either small size (alder, birch) or the presence of large bladders on the pollen grain (spruce). In addition, the percentages of these exotic taxa decline rapidly inland, suggesting that the wind source is from the east and north.. Maximum willow percentages are recorded in site 3 (38-89.5%); there was an increased density of willow shrubs at this site. The wet marsh environment of the Western Marsh site is correlated with maximum grass values in this study. The correlation of large grass percentages with wet or moist conditions was also found at Point Barrow LRRS.

5.2.3 Fossil pollen data, Point Barrow and Barter Island LRRS

5.2.3.1 Barrow Peat #1

Pollen analyses are complete at 5-cm intervals. The peat stratigraphy is illustrated in Fig. 4. A reduced taxa percentage pollen diagram for the site is illustrated in Fig. 18. Twenty-eight taxa were recovered in the analyses. Four radiocarbon dates provide chronological control for this section (Table 8). There is a date of 10,205±385 yrs BP at the base of the section, and the other dates indicate that the peat accumulated at a fairly constant rate (80-120 yrs/cm) through ca. 3000 yrs BP. In the late Holocene, peat accumulation slowed to ca. 200 yrs/cm. Based on the pollen stratigraphy, the pollen diagram has been divided into two pollen zones.

Zone I, dating from 10.2 - 5.6 ka, is characterized by maximum grass (39-80%) and heaths and heath allies (Ericales) (1-23%) percentages. The former suggests moister conditions than at present in the Point Barrow region. Birch percentages range from 4.5-21%; values in the lower half of the zone represent a diagram maxima for this taxon. The present-day birch limit is located ca. 50 km south of Point Barrow, and modern values for this taxon range from 2 - 7 % at this site (Fig. 16). This history of birch on the North Slope is discussed below, but the values recorded here, plus the large heath percentages, suggest warmer conditions, especially in the early Holocene. The other exotic taxa, alder, spruce, and pine (*Pinus*) [not shown], record small values here, although the alder curve rises in the upper half of the zone.

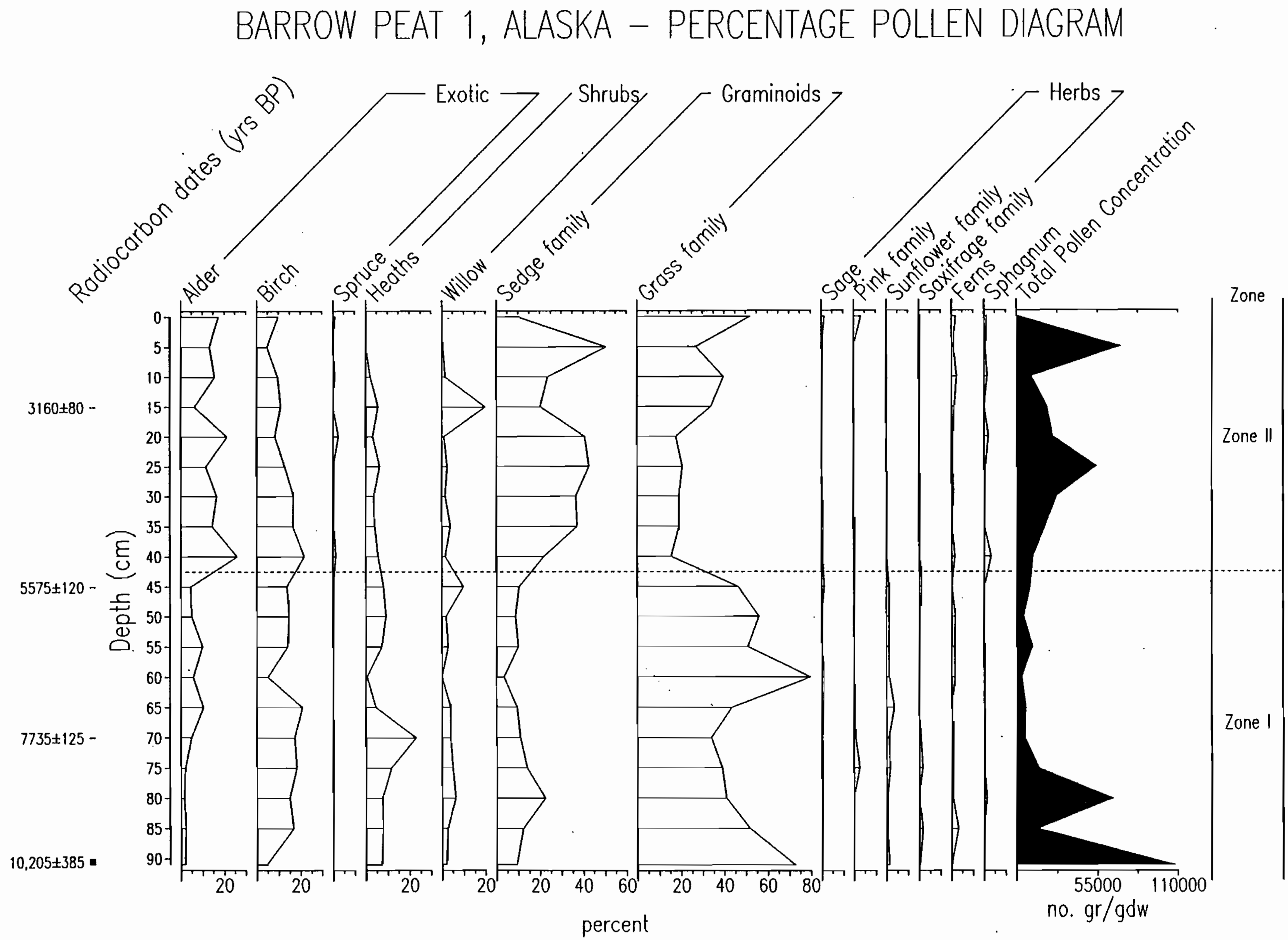

Figure 18. Percentage pollen diagram (reduced data set) and pollen concentration summary (g/gdw), Barrow Peat #1.

Table 8. Radiocarbon dates, Legacy Peoject, Point Barrow and Barter Island LRRS sites, Alaska

SITE	INSTAAR NO.	DEPTH	AGE	LAB NO.
Barrow Peat #1	DEW 1-4	15 cm	3160±80	GX-20046
	DEW 1-3	45 cm	5575±120	GX-20045
	DEW 1-2	70 cm	7735±125	GX-20044
	DEW 1-1	90-91 cm	10,205±385	GX-19653
Central Marsh Slough	CMS - 1	50 cm	7660±235	GX-20436
	CMS - 2	100-110 cm	8340±245	GX-20437
Barter Is. #1	BI 1-1	82 cm	7910±250	GX-20438
	BI 1-2	190 cm	7300±80	GX-20439
Barter Is. #2	BI 2-1	150 cm	10,250±315	GX-20440

Zone II, 5.6 - 0 ka, is characterized by decreased grass (15-52%) and maximum sedge (10-50%) values. Heath percentages decline to < 6.5 % in this zone. Sphagnum percentages are consistently recorded here in contrast to Zone I. This pollen spectrum suggests the establishment of modern vegetation conditions at Barrow. The increase in sedge and the decrease in grass implies drier conditions. Alder values rise to 6-26%; the present-day alder limit is located 150 km south of Barrow. The sudden increase in alder values at the base of the zone suggest the the northern limit of this taxon was reached shortly after 5.6 ka. Spruce percentages, though small, are consistently recorded in this zone, suggesting that it too had reached its maximum northern/western extent at this time.

5.2.3.2 Central Marsh Slough peat

Two radiocarbon dates (Table 8) have been received. A date of 8.3 ka at 100-110 cm fits into the regional chronology. However, the date of 7.7 ka at the 50-cm level appears too old by several thousand years. The peat samples proved barren of insect remains; consequently, the section was not analyzed for pollen at this time.

5.2.4 Barter Island LRRS

Pollen analyses are complete at roughly 10-cm intervals from those levels of the exposure in which organic content was high enough to ensure pollen preservation (see Fig. 5). As the stratigraphic column indicates, there is a large gap in the center of the section where sand and gravel lenses interrupt organic deposition. Two radiocarbon dates (Table 8) have been received. They suggest that the section was disturbed and that younger material has been redeposited at the base by permafrost and slumping action. Nor do we accept the mid-section date as accurate; consequently, dating control is lacking for this site. Note that the basal date from Peat #2 - 10,250±315 yrs BP - is similar to the basal date from Barrow Peat #1. We believe that this date represents a more accurate date for the initiation of peat growth in the early postglacial on the island, and indeed suggests a regional pattern.

Fig. 19 records the reduced taxa percentage pollen diagram for the site. Twenty-nine taxa were recovered in this study; the minor taxa are listed in Table 7. Although the dating results suggest redeposition, two pollen zones can be determined in Fig. 19. We believe this indicates internal cohesion in the section.

Zone I of the basal pollen zone is dominated by large birch (38-52%) and heath (3.7-15%) percentages. Sedge percentages are relatively low (generally 15%) and grass values are moderate

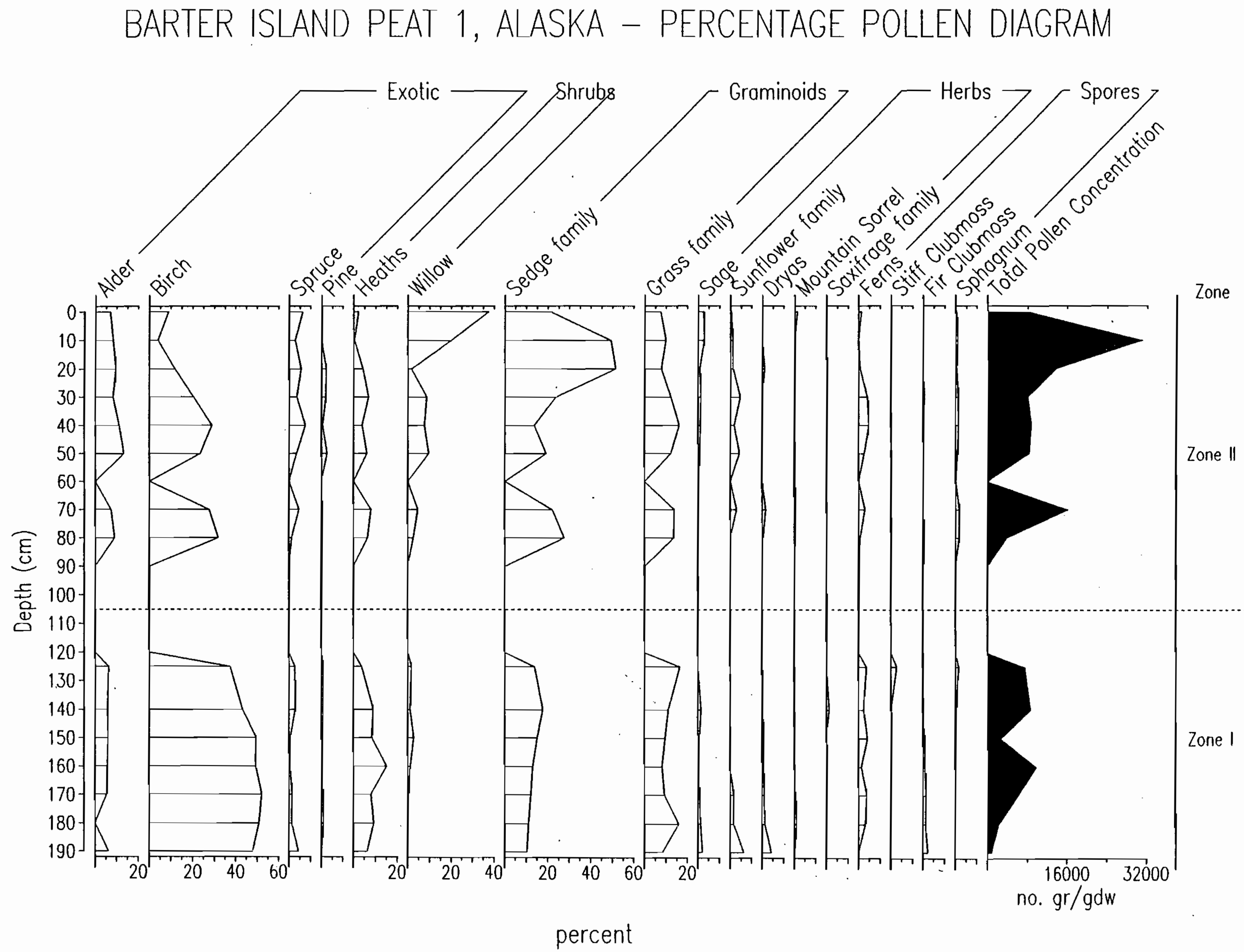

Figure 19. Percentage pollen diagram (reduced data set) and pollen concentration summary (g/gdw), Barter Island Peat #1.

(8-16.5%). Pollen influx values range from ca. 800 to 9800 g/gdw. The local vegetation was probably a fairly sparse sedge-heath community. The northern limit of continuous growth for birch is approximately 40 km south of Barter Island. Note that significantly lower percentages (mean values = 3.8-14%) are recovered in the modern polster samples from Barter Island (Fig. 17). The history of birch on the North Slope is discussed in greater detail below. However, the values for birch and heath recorded here suggest warmer climatic conditions, presumably in the early Holocene.

In Zone II, after the hiatus represented by the sand and gravel lenses (Fig. 5), birch percentages decline, although moderate values (12-29%) are maintained to the 40-cm level; subsequently, the birch curve declines rapidly. Sedge percentages increase in this zone and reach maximum values (ca. 50%) at 10 and 20 cm. Heath values decline and willow becomes more important, reaching a peak of 37.4% in the surface sample. Pollen concentration values are generally larger than in Zone I, with peaks of >10,000 g/gdw at several levels. This pollen spectrum records the establishment of the modern sedge-willow vegetation community. The exotic taxa, alder, spruce and pine, register maximum percentages here, recording the establishment of the northernmost extension of these taxa in Alaska and the Northwest Territories..

5.3 *Insect history*

5.3.1 Modern insect collections, Point Barrow and Barter Island LRRS

The modern collections from the study regions were dominated by ground beetles (family Carabidae) and rove beetles (family Staphylinidae). In addition, flies (Diptera), spiders (Arachnida), and mites (Acarina) were collected. The flies, spiders, and mites were not identified beyond the family level, because they are unimportant in the fossil record, which is dominated by beetles (Coleoptera). The flies included species of crane fly (Tipulidae), mosquitoes (Culcidae); midges (Ceratopogonidae) and blowflies (Calliphoridae). The spiders were mostly in the dwarf spider family (Erigonidae). The mites were all in the oribatid group (Oribatei), the dominant soil mites in the Arctic. A list of the modern beetles collected in the study is found in Table 9.

5.3.2 Fossil insect assemblages, Point Barrow and Barter Island LRRS

The Point Barrow LRRS yielded a very consistent, almost homogeneous series of insect faunal assemblages, spanning the interval from 0-8500 yr B.P.. Older samples were analyzed, but lacked insect remains. The fossil insect assemblages include 17 taxa from eight families of beetles, caddisflies (Trichoptera), wasps (Hymenoptera), spiders, and mites. A minimum of 333 individuals were identified (Table 10).

The Point Barrow LRRS insect faunas reflect mesic tundra environments, essentially like those found there today. No significant changes in faunal diversity were found. This is a surprising result, because a great deal of environmental change took place elsewhere in Alaska during the Holocene period (Elias, 1995), and suggests a relatively constant climate, moderated by the effects of the Arctic Ocean. Shrub tundra-dwellers include the ground beetle, *Pterostichus nivalis*, the rove beetles *Holoboreaphilus nordenskioeldi, Micralymma brevilingue*, and *Tachinus brevipennis,* and the leaf beetle, *Chrysomela.* All of these beetles are found on the Arctic Coastal Plain of Alaska today. *H. nordenskioeldi* is found in arctic willow leaf litter, in damp mosses, grasses, and sedges (Campbell, 1978). *M. brevilingue* is a coastal inhabitant, frequently found in damp beach sand and gravel (Wilson and Elias, 1986). *Tachinus brevipennis* is another arctic coastal species, ranging across the North Slope and along the west coast of Alaska to the Seward Peninsula. It has also recently been found in alpine tundra in the Brooks Range (Campbell, 1988).

Table 9. Modern Insect List, Point Barrow and Barter Island LRRS sites

Taxon	Barter Island	Point Barrow
COLEOPTERA (Beetles)		
Carabidae (Ground Beetles)		
Pterostichus caribou Ball	-	2
Pterostichus pinguedineus Eschz.	13	-
Pterostichus costatus Men.	1	-
Amara alpina Zett.	4	-
Staphylinidae (Rove Beetles)		
Holoboreaphilus nordenskioeldi Mäkl.	5	3
Tachinus brevipennis Sahlb.	1	1
Micralymma brevilingue Schiödt.	4	2
DIPTERA (Flies)		
Tipulidae (Crane Flies)	12	5
Culcidae (Mosqitoes)	57	15
Ceratopogonidae (Midges)	3	-
Calliphoridae (Blow Flies)	12	3
ARANEIDA (Spiders)		
Erigonidae (Dwarf Spiders)	3	2
ACARI (Mites)		
Oribatei (Oribatid Mites)	4	2

Table 10. Fossil Arthropod List, Point Barrow Peat #1

TAXON	Depth (cm) 0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-59	59-69	69-80	80-85
COLEOPTERA (Beetles)														
Carabidae (Ground Beetles)														
Pterostichus nivalis Sahlb.	0	0	0	2	0	0	0	0	0	0	1	0	0	0
Pterostichus (Cryobius) sp.	0	0	0	1	2	1	1	0	0	0	0	0	0	0
Dytiscidae (Predaceous Diving Beetles)														
Agabus arcticus Payk.	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Staphylinidae (Rove Beetles)														
Acidota quadrata (Zett.)	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gymnusa atra Csy.	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Holoboreaphilus nordenskioeldi (Mäkl.)	0	0	0	5	2	4	2	1	2	0	2	1	0	1
Micralymma brevilingue Shiödt.	8	0	2	0	0	3	0	0	0	0	0	0	0	0
Stenus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tachinus brevipennis (Sahlb)	11	1	3	1	0	1	0	0	1	0	0	0	0	0
Chrysomelidae (Leaf Beetles)														
Chrysomela sp.	0	1	2	2	0	1	1	0	2	1	0	1	0	1
TRICHOPTERA (Caddisflies)														
Limnephilidae														
Genus and spp. indet.	0	0	0	0	0	1	7	0	3	0	0	0	0	0
HYMENOPTERA (Wasps, Bees, and Ants)														
Chalcidoidea (Chalcid Wasps)														
Genus and sp. indet.	0	0	0	0	1	0	0	0	0	0	0	0	1	0
ARACHNIDA (Spiders, Ticks, and Mites)														
ARANEIDA (Spiders)														
Erigonidae (Dwarf Spiders)														
Genus and sp. indet.	1	0	0	0	0	0	0	0	0	0	0	0	0	0
ORIBATEI (Oribatid Mites)														
Genera and spp. indet.	42	65	39	45	37	10	0	2	3	0	0	1	1	1

Standing water habitats are indicated by the presence of the predaceous diving beetle (Dytiscidae), *Agabus arcticus*, and by the caddisfly larvae in the family Limnephilidae. *Agabus arcticus* inhabits sheltered margins of large, clear lakes (Larson, 1975).

The Barter Island LRRS yielded a more diverse set of insect assemblages (Table 11). A minimum of 166 individuals were identified The fossil assemblages included 38 identified taxa in twelve families of insects, arachnids, and crustaceans. Among these are several species that are useful environmental indicators.

The ground beetles in the genus *Bembidion* are generally indicative of riparian habitats. *B. concolor* lives on the banks of running water, on substrates of bare gravel or coarse sand. The modern distribution of this species falls mostly within the boreo-montane zone of Canada and Alaska (Lindroth, 1963). It is not found north of treeline today, so its presence at Barter Island indicates warmer-than-modern summer temperatures at the beginning of the Holocene. *B. sulcipenne* also lives on the gravel banks of running waters. There are two subspecies of this beetle; one ranges onto the arctic tundra in Alaska today; the other is a boreal zone form (Lindroth, 1963). Unfortunately, the fossil specimen lacked the diagnostic features used to separate the subspecies. Another ground beetle found in the fossil assemblages, *Notiophilus borealis,*ranges today across the boreal and arctic regions of North America. In both regions it lives in open country with sparse vegetation (Lindroth, 1961).

Another insect indicative of warmer-than-modern summer temperatures was found in the basal sample (190-195 cm) from Barter Island. This is the ant, *Myrmica alaskensis*. Like other species of ants in Alaska, this is a resident of the boreal forest zone that does not range north of treeline today (Nielsen, 1987).

Other ground beetles identified from the Barter Island LRRS assemblages are indicative of arctic tundra habitats. Among these is *Elaphrus parviceps*. This beetle ranges today from the west coast of Hudson Bay westward to the North Slope of Alaska. It is often found on the shores of lakes and ponds (Goulet, 1983). Two species of the *Cryobius* group of the genus *Pterostichus* were identified from the Barter Island assemblages. *P. arcticola* is found today across the high latitude regions of North America, frequently in coastal tundra regions (Lindroth, 1966). *P. nivalis* is found today only in Alaska and eastern Siberia. It lives on the arctic and alpine tundra, across the North Slope and southwest along the Bering Sea coast, as well as high elevations in the Alaska Range. It has been collected from rather dry tundra habitat (Lindroth, 1966).

The predaceous diving beetles found in the Barter Island LRRS assemblages are all indicative of arctic tundra ponds and lakes. These include *Agabus arcticus and Colymbetes dolobratus*. *C. dolobratus* ranges north onto pack ice in the Arctic Ocean, where it breeds in ponds of meltwater that accumulate in summer (Zimmerman, 1981).

The rove beetles found in these samples are indicative of mesic tundra environments. In addition to *Holoboreaphilus nordenskioeldi* and *Micralymma brevilingue* (habitats and distribution described above), the Barter Island samples also contained *Eucnecosum brachypterum.* This species ranges across the boreal and arctic regions of Alaska and Canada; it lives in a variety of mesic and damp habitats, in patches of open ground (Campbell, 1984).

Table 11. Fossil Arthropod List, Barter Island Peat #1

TAXON	Depth (cm) 0-10	10-20	20-30	30-40	40-70	70-82	125	130-140	140-150	150-160	160-170	190-195
COLEOPTERA (Beetles)												
Carabidae (Ground Beetles)												
Amara sp.	0	0	0	0	0	0	1	0	0	0	0	0
Bembidion spp.	0	0	0	0	0	0	0	1	0	1	0	1
Bembidion (Striola) sp.	0	0	0	0	0	0	1	0	0	0	0	0
Bembidion concolor Kby.	0	0	0	0	0	0	0	0	0	0	0	1
Bembidion sulcipenne Sahlb.	0	0	0	0	0	0	0	0	0	0	3	1
Dyschirius sp.	0	0	0	0	0	0	0	1	0	0	0	1
Elaphrus parviceps Van Dyke	0	0	0	0	0	2	0	0	0	0	0	0
Notiophilus borealis Harr.	0	0	0	0	0	0	0	0	0	1	0	0
Pterostichus arcticola Chd.	0	0	0	0	0	0	0	0	0	1	0	0
Pterostichus nivalis Sahlb.	0	0	0	0	0	0	0	0	0	1	0	0
Pterostichus (Cryobius) sp.	0	1	0	0	0	0	0	1	1	2	1	0
Dytiscidae (Predaceous Diving Beetles)												
Agabus arcticus Payk.	0	0	1	1	0	1	1	2	0	2	0	0
Colymbetes dolobratus (Payk.)	0	0	0	0	0	0	0	0	0	0	1	0
Hydroporus morio Aube	0	0	0	0	0	1	2	2	3	4	5	0
Hydroporus sp.	0	0	0	0	0	0	0	0	0	0	0	1
Ilybius angustior Gyll.	0	0	0	0	0	0	0	1	0	0	0	0
Hydrophilidae (Water Scavenger Beetles)												
Enochrus sp.	0	0	0	0	0	0	0	1	1	0	1	0
Helophorus spp.	0	0	0	0	0	0	0	0	1	0	1	1
Ochthebius sp.	0	0	0	0	0	0	0	0	2	0	1	0
Staphylinidae (Rove Beetles)												
Eucnecosum brachypterum (Grav.)	0	1	0	0	0	0	0	0	1	0	0	0
Gymnusa atra Csy.	0	0	0	0	0	0	0	0	0	0	0	2
Holoboreaphilus nordenskioeldi (Mäkl.)	2	3	1	0	1	0	0	2	1	0	1	1
Lathrobium sp.	0	0	0	0	0	0	2	1	2	0	1	1
Micralymma brevilingue Shiödt.	0	1	0	0	0	0	0	0	1	0	0	0
Quedius sp.	0	0	0	0	0	0	1	1	0	1	0	1
Olophrum latum Mäkl.	0	0	0	0	0	0	0	0	0	2	1	2
Stenus sp.	0	0	1	2	1	0	3	2	1	3	9	9

Fossil Arthropod List, Barter Island Peat #1, continued

TAXON	Depth (cm) 0-10	10-20	20-30	30-40	40-70	70-82	125	130-140	140-150	150-160	160-170	190-195
CURCULIONIDAE (Weevils)												
Apion sp.	0	0	0	0	0	0	0	0	0	0	0	1
Genus and sp. indet	0	0	0	0	0	0	0	0	0	1	0	0
TRICHOPTERA (Caddisflies)												
Limnephilidae												
Genus and spp. indet.	0	0	0	1	2	4	3	2	0	2	0	3
Molannidae												
Molanna sp.	0	0	0	0	0	0	0	0	1	0	0	0
HYMENOPTERA (Wasps, Bees, and Ants)												
Chalcidoidea (Chalcid wasps)												
Genus and sp. indet.	0	0	0	0	0	0	1	0	0	0	0	0
Formicidae (Ants)												
Myrmica alaskensis Whlr.	0	0	0	0	0	0	0	0	0	0	0	1
ARACHNIDA(Spiders, Ticks, and Mites)												
ARANEIDA (Spiders)												
Erigonidae (Dwarf Spiders)												
Genus and sp. indet.	0	0	0	0	0	0	0	0	0	0	1	0
ORIBATEI (Oribatid Mites)												
Genera and spp. indet.	0	0	1	4	2	2	0	0	1	0	0	3
CRUSTACEA												
CLADOCERA (Water Fleas)												
Daphnia sp.	0	0	0	0	2	2	1	0	0	0	0	1

6. Discussion

6.1 Modern vegetation at Barrow and Barter Island LRRS

Point Barrow and Barter Island LRRS are both on flat coastal terrain dominated by wet tundra consisting of sedges and grasses (mainly *Carex aquatilis, Eriophorum angustifolium* and *Dupontia fisheri*). Although the overall physiognomy of the vegetation is very similar at the two sites (compare Figs. 6a and 6c, 8a and 8c, and 9a and 9c, the species lists document their floristic dissimilarity, and the ordination analysis confirms that the dissimilarity is strongest in the dry portion of the moisture gradient.

The relatively large vascular flora at the Barter Island LRRS appears to be partially due to a combination of somewhat warmer summer temperatures, and the close proximity of large rivers flowing out of the Brooks Range at Barter Island. Barter Island is further south (N70° 07' vs. N71° 17' at Barrow) and the mean July temperature is 4.4° C compared to 3.7° C at Point Barrow (Brown et al., 1980). Several authors have noted the strong relationship between summer temperature and the size of arctic floras (Cantlon, 1961; Young, 1971; D.A. Walker, 1985; Rannie 1986). For example, in Arctic Canada, Rannie (1986) showed that July mean temperature (T) explained 94-95% of the variance in species diversity (N) based on data from 38 mainly coastal localities. Using Rannie's regression equation (N = 24.2T - 29.1) we might expect to find 60 species at Point Barrow and 77 species at Barter Island. At first glance, the 71 species we found at Point Barrow LRRS is close to this predicted number; however, the total flora for the Point Barrow region is much larger than that of the LRRS site – over 125 species (Murray, 1978). This total flora list for the Point Barrow region reflects the long history of research and the generally richer Beringian flora of western North America (Yurtsev, 1994). There is no comparable total flora list for Barter Island. However, if we use the slope in Rannie's equation as a predictor of the effect of temperature and use the Point Barrow species number (125) to adjust the equation's constant to account for the richer Beringian flora, we might expect about 142 species in the total Barter Island flora.

The different vegetation at Point Barrow and Barter Island are also partially due to the different substrates. The Point Barrow LRRS is situated between the present-day active beach and a gravely marine terrace that has been variously dated at between 8,500 to 18,500 yr BP (Brown et al., 1980). Most of the site is covered with ice-wedge polygons formed in acidic marine sands of the Barrow Unit, which is overlain with up to 50 cm of peat. Average soil pH at 10-cm depth over most of the site, excluding the saline areas, is 4.5.

In contrast, Barter Island is composed of Pleistocene alluvial gravels overlain by peat. The gravels have been deposited by the nearby Jago and Okpilak rivers which flow out of the Brooks Range. These gravels create soils with relatively high soil pH. Barter Island soil pH at 10-cm depth averaged 5.5, and samples collected from the C horizon averaged 7.7. Numerous basiphilous species occur at Barter Island, including *Artemisia comata, Astragalus umbellatus, Cardamine digitata, Carex saxatilis, Chrysanthemum integrifolium, Dryas integrifolia, Eutrema edwardsii, Gastrolychnis apetala, Lagotis glauca, Salix lanata, S. reticulata, S. glauca, Saussurea angustifolia,* and *Valeriana capitata.* In most respects the flora is similar to that at Prudhoe Bay, where the soil pH is even higher due to continuous input of windblown silt from the Sagavanirktok River (Walker, 1985). The only species recorded at Barter Island LRRS that has not been found at Prudhoe Bay is the Alaska-Yukon Territory endemic *Senecio yukonensis.*

In this study, we have based the vegetation units on floristic differences that correspond closely to substrate differences along the soil moisture and pH gradients. The importance of the moisture gradient is supported by the earlier work of Webber (1978) at Point Barrow and Walker (1985) at Prudhoe Bay. The distinction between acidic and nonacidic tundra types is also well supported by earlier studies. For example, Murray (1978) noted the low floristic similarity between Point Barrow and Prudhoe Bay during the studies of the International Biological Programme, and a recent Braun-Blanquet classification of the vegetation of the Toolik Lake region has defined moist and dry tundra associations that correspond closely to landscape-scale topographic gradients and regional-scale landscape-age gradients (M.D. Walker, 1994). In the Arctic Foothills, older (>15,000 yr?) landscapes have acidic soils that support the dominant tussock tundra vegetation; whereas younger landscapes tend to have nonacidic vegetation types that are floristically similar to those found on moist sites at Barter Island.

6.2 Disturbed vegetation at Barrow and Barter Island

The lists of species on disturbed coastal sites at Point Barrow and Barter Island LRRS complement similar lists from other North Slope, mainly inland, sites (Ebersole, 1985; Everett et al., 1985; McKendrick, 1991; Jorgenson and Joyce, 1994) and recent collections in western Alaska at Point Hope and Port Clarence (Wright 1996 personal communication). Species that should be considered for revegetation efforts on abandoned gravel pads at the coast include *Alopecurus alpinus, Arctagrostis latifolia, Arctophila fulva* (wet sites), *Cochlearia officinalis, Dupontia fisheri* ssp. *fisheri, Luzula confusa, Petasites frigidus, Poa alpigina, Poa arctica Potentilla hyparctica, Ranunculus nivalis, Saxifraga cernua, Stellaria edwardsii, S. laeta* , and *S. humifusa.* In areas with higher soil pH, *Artemisia comata, Astragalus alpinus, Epilobium latifolium, Eutrema edwardsii, Oxytropis bryophila, Papaver lapponicum,* and *Saxifraga oppositifolia* are also good colonizers. Hardy cultivars presently exist and are commercially available for *Arctagrostis latifolia, Poa glauca, Deschampsia caespitosa,* and *Festuca rubra.* Plants that have potential for revegetation that were noted in our study and in western Alaska collection efforts include *Alopecurus alpinus, Artemisia comata, Astragalus alpinus, Dupontia fisheri, Epilobium latifolium, Oxytropis bryophila, Petasites frigidus, Poa alpigina,* and *Poa arctica.* Several naturally occurring species identified as having potential for revegetation in the western Alaska coastal areas and which are either known to occur on the Barter Island spit or with strong likelihood of occurring in the Barter Island area include: *Leymus mollis, Poa alpina, Juncus arcticus, Honckenya peploides, Oxytropis viscida, O. campestris, and O. maydelliana.* Some of the above species my be available commercially in limited quantities as soon as 1998 (Wright 1996 personal communication).

Thermokarst of the drainage ditch at Point Barrow LRRS well illustrates the consequences of removing the surface organic mat. Over 1.5 m of organic material and sediment has been eroded out of the ditch and adjacent ice-wedge-polygon troughs. The thermal regimes of the soils have been altered and active layer thickness in the some areas of the ditch are greater than those of the adjacent undisturbed sites. Drainage has also changed the vegetation of polygonal areas adjacent to the ditch, which have become relatively well-drained and no longer support the moist meadow vegetation that formally occurred. Most of the resulting raised center polygons are now dry and sparsely vegetated.

An important impact at Barter Island LRRS that was only examined briefly is that associated with the large snow fences that were erected in the winter of 1993-94 to minimize snow accumulation around the buildings. These fences are 5-m tall and create large drifts that last into August. This greatly reduces the growing season for the vegetation in the deeper parts of the drifts. For example, *Pedicularis lanata* is one of the earliest blooming plants, normally blooming in early

June in most areas along the coast, but in deep snow areas downwind of the snowfences it was just beginning to flower on August 7! Extensive subnivian lemming activity was also evident in the drift areas. In total these fences affect a large area of tundra, and it would be advisable to erect a series of permanent plots to monitor changes to the vegetation.

6.3 Paleoenvironmental history of the Point Barrow and Barter Island LRRS

Because of reversed dates at the Barter Island section, dating control is provided only by the Point Barrow LRRS site. Trends observed in the former site can be compared to the latter.

From 10.2 - 5.6 ka, the vegetation at Point Barrow was dominated by grasses and heaths; conditions were probably moister and warmer than the latter part of the Holocene and species richness is poorer. These large grass values are not recorded at Barter Island; however, that basal zone appears to represent a poorer vegetation community than subsequently occupied the island. Both sites record maximum birch values in the basal zones; as noted above, these percentages are very large in the Barter Island LRRS site. The history of birch on the North Slope is discussed in greater detail below, but the large birch and heath percentages recorded at both sites probably registers warmer climatic conditions on the North Slope in the early Holocene.

Insect assemblages ranging in age from modern to approximately 10,000 yr BP all reflect mesic tundra environments such as those of today at both Point Barrow and Barter Island. Small thaw lakes were present throughout this interval, as indicated by the water beetles. Upland vegetation was mesic shrub tundra; climatic conditions were essentially like modern ones. The oldest sample from Barter Island LRRS (190-195 cm depth interval) yielded a significantly different insect assemblage. This assemblage contained the ant, *Myrmica alaskensis*, and other species such as the ground beetle, *Bembidion concolor,* and the rove beetle, *Gymnusa atra*, that are indicative of substantially warmer climatic conditions. In particular, the presence of the ant species indicates that mean summer temperatures were like those found today only south of the Brooks Range, in the boreal forest zone. While there is no indication of trees or tree-associated insects (bark beetles, carpenter ants, etc.) in the assemblage, the fossil taxa indicate that climatic conditions could have supported coniferous forest, if only for a brief interval of time, probably about 11,000-10,000 yr B.P (Matthews, 1975; Nelson and Carter, 1985).

Insect assemblages that date to younger (mid- to late Holocene) intervals from Barter Island LRRS are all indicative of conditions very similar to those found there today. There are indications of both dry and mesic tundra environments with thaw lakes and streams with gravel or sandy banks. Since the brief but remarkable warming interval recorded in the lowest sample, there appears to have been little change in local environments during most of the Holocene. This supports the interpretations of the Point Barrow LRRS insect fossil assemblages.

Pollen Zone II at Point Barrow represents the establishment of the modern vegetation communities, dominated by sedges. Similarly, zone II appears to record the establishment of the modern sedge-willow vegetation on Barter Island also. We suggest that alder and spruce reached their present-day northern limits around 5.6 ka. The similarity of the alder and spruce percentage rise in the Barter Island section provides further evidence that the date of 7.9 ka at 82 cm is in error.

M. Wilson analyzed a peat exposure at Barter Island as part of her master's thesis (1984) on the modern pollen fallout and the paleoenvironmental history of the Arctic National Wildlife Refuge. Because of erosion of the coastal cliffs, it was not possible to exactly locate her site, but we believe it was located within 100 m of the section described here. The first section was extremely convoluted, probably due to ice wedge growth and active bankside erosion by thaw lakes, and it was believed that the material forming the section was, for the most part, reworked. Therefore, it was not surprising that the three radiocarbon dates reported by Wilson were not in order and ranged from 6.7 ka at the base to 7.8 ka at the top of the section (Wilson, 1984:Fig. 4-1). Wilson cautioned that the age of 7000-8000 yrs BP used for the pollen assemblage must be accepted with caution. The same caveat must be used with the Barter Island Peat # 1 reported on here.

Both the pollen and fossil insect data from Wilson's section suggest that the vegetation surrounding the lake was probably damp sedge marsh, similar to that of thaw lake edges today. Wilson also recovered high percentages of birch pollen (generally >50%) (1984:Fig. 4-6) in her study. In an analysis of modern pollen data for birch, Wilson concluded that the northern limit of birch on the North Slope coincided with the 20% isopoll line (1984:Fig. 3-9). It is probable that there are no modern analogues to the high birch percentage assemblages recorded in both studies. However, Wilson concluded that the northern limit of birch was probably further north during the period of record, 8000-7000 yrs BP.

In this study, the period of maximum birch percentages coincides with lower pollen concentration values. Thus, the large birch values may be partly an artifact of low, local pollen production. However, we agree with Wilson that a northern extension of the birch limit, reflecting warmer climatic conditions in the early Holocene, is likely. The greater importance of heaths in the basal zones of both sites supports this conclusion.

6.4 Links between modern and fossil data

Comparison of the modern vegetation with the modern and fossil insect and pollen records indicates several interesting patterns. The correlations along topographic gradients are particularly interesting. For example, the high correlation of grasses with wetter vegetation types at Barrow makes sense in view of the high percentage of the grasses *Arctophila fulva* and *Dupontia fisheri* in these types. Similarly, higher percentages of willow pollen were found on the relatively dry sites is probably due to the abundance of *Salix rotundifolia* in dry habitats. This pattern, however, is somewhat at odds with past interpretations of the North Slope pollen record that has attributed high grass concentrations to dry conditions, possibly associated with steppe tundra (references in Hopkins, 1982). Also willow pollen is often interpreted as indicative of more mesic conditions that followed the last glacial interval. We are not suggesting that the entire interpretation of a drier interval during the late Pleistocene needs to be revisited, but we are suggesting that caution be used in broadly ascribing high grass concentrations to drier conditions and willows to more mesic conditions because these taxa occur across the full range of site moisture conditions. This is particularly important at coastal sites where *Dupontia fisheri* is so abundant in wet sites and prostrate willows are so abundant on dry sites. More studies relating modern vegetation assemblages to pollen spectra along topographic gradients in a variety of climate, substrate, and physiographic settings would likely prove very enlightening for interpreting the pollen record.

There are also interesting patterns suggested by comparison of the paleo and modern patterns on acidic and nonacidic substrates. The greater diversity of insects and pollen at Barter Island reflects the greater diversity of present-day plant species and suggests that nonacidic substrates may have generally higher biodiversity across a wide range of biological groups. A more comprehensive study relating pollen and insect faunas to habitat pH would be very useful for interpreting the paleohistory of the Arctic. Currently, the timing and processes involved in conversion of northern Alaska from a nutrient-rich eutrophic environment to the present-day oligotrophic environments are poorly understood partially because a clear signal in the pollen record has not been identified. The greater abundance of Alpine Aven (*Dryas*) pollen, and wider occurrence of pollen from several taxa associated with minerotrophic environments (e.g. *Chenopodiaceae, Asteracea, Equisetum, Lililiaceae, Leguminosae, Lycopodium, Orchidaceae*) suggests that the minor taxa in the pollen record could contain a good acidic/nonacidic signal. Some of the broad taxonomic units could be examined in more detail. For example, the Saxifrage family (*Saxifragaceae*) has numerous species that can be identified from their pollen. Purple Mountain Saxifrage (*Saxifraga oppositifolia*) is one such taxon that is limited to and moderately abundant on calcareous substrates, and may be present in the pollen record. Horsetails (*e.g. Equisetum arvense* and *Equisetum variegatum*) are also abundant on nonacidic substrates and nearly absent in acidic areas. On the other hand, Cloudberry (*Rubus chamaemorus*) is a readily identifiable member of the Rose family (Rosaceae) that is restricted to acidic habitats. It would also be useful to do more detailed analysis of the range of insect taxa occurring on acidic vs. nonacidic substrates.

6.5 Suggestions for mitigation of disturbed sites at Point Barrow and Barter Island LRRS

The LRRS sites are particularly valuable to arctic disturbance-and-recovery studies because there appears to have been no attempt to revegetate the sites. These were among the first areas disturbed by placement of gravel roads and pads and other types of construction impacts now associated with oil-field development. Natural recolonization has been operating for over 40 years at both sites and allows us to see the differences in recolonization on acidic vs. nonacidic substrates at extreme coastal sites. The most extensive studies of long-term recovery in northern Alaska were conducted as part of the USGS cleanup operation at drill sites from the 1943-53 oil exploration of the Naval Petroleum Reserve-4 (renamed the National Petroleum Reserve in Alaska, NPRA; Lawson et al., 1978; 1982; Ebersole, 1985; Gryc, 1985). Most of the NPRA drill sites have been revegetated, and there are now few remaining disturbed sites along the coast where the history of disturbance is well known and which have been allowed to recover naturally.

It would be desirable to maintain a few areas of representative disturbances and establish permanent plots to record natural revegetation. A series of permanent photo plots (Mckendrick, 1976) on different substrates should be established and protected from future disturbance at both sites. Total species lists and selected soil properties should also be periodically monitored. Candidate areas for permanent disturbance plots at Barrow include the areas marginal to the drainage ditch and sewage lagoons, and representative areas of gravel pads that are not impacted. At Barter Island, roadside areas, the base of the old radar tower and several habitats impacted by the snow-fences should be monitored.

7. Conclusions

The modern and ancient vegetation of the North Slope coastal region is not a homogeneous band of coastal tundra. As our study reveals, there are some significant differences between eastern and western regions along the coast. These differences are most likely caused by varying substrates and different climatic conditions; they are expressed in the plant communities and ancient insect communities by greater species diversity in the east. We hypothesize that modern insect community diversity is also greater at Barter Island than at Point Barrow, but our modern insect collections were incomplete, so this will have to be tested later. Our specific conclusions from the various components of the study are as follows.

7.1 Modern vegetation study

1. Species lists from the two LRRS sites include vascular plants: 71 at Point Barrow, 119 at Barter Island; bryophytes: 56 at Point Barrow, 66 at Barter Island; lichens: 51 at Point Barrow and 52 at Barter Island. Additionally, 13 species of lichenicolous fungi were noted (Zhurbenko et al., 1995). Six lichenicolous fungi and one lichen are new to North America. The dissimilar species lists for the two sites reflect the substrate differences, acidic marine sands at Point Barrow and nonacidic alluvial gravels at Barter Island. The somewhat warmer summer climate at Barter Island also contributes to the larger flora at Barter Island. Fifty-five species of vascular plants at Barter Island were not found at Point Barrow, whereas only seven species showed the opposite pattern. Numerous basiphilous species occur at Barter Island that do not occur at Point Barrow.

2. The vegetation physiognomy at the two sites is very similar and is typical of coastal areas across northern Alaska. Compared to inland areas the vegetation is species poor, and is dominated by grasses and sedges; *Dupontia fisheri* is especially abundant near the coast, but relatively rare inland There are few cottongrass tussocks, low shrubs, or *Sphagnum* all of which are common at more southerly tundra sites. Although physiognomically similar, the compositions of the plant communities are dissimilar and reflect the different substrates at the two sites. Seven broad community types and four subtypes are described. Ordination analysis shows that the dissimilarity between acidic and nonacidic vegetation is greatest in the dry vegetation types and least in the aquatic types. Vegetation composition is strongly related to the soil moisture and pH gradients. Vegetation in saline habitats belongs to the Association *Caricetum suspathaceae* Hadac 1946 (Thannheiser and Willer, 1988).

3. The long period of natural vegetation recovery at both sites and their relatively protected status makes these sites very valuable for disturbance-and-recovery studies in northern Alaska. Studies of the species occurring on disturbed sites can be used to select plants for revegetation efforts at disturbed extreme coastal localities. Several sites in representative disturbances should be set aside for permanent monitoring of vegetation recovery.

4. A suite of plant species that may be suitable for revegetation efforts at arctic coastal sites has been identified from species lists at a variety of disturbed localities. A larger group was identified for nonacidic sites than for acidic sites. Suitable species at acidic sites (pH<5.0) include *Alopecurus alpinus, Arctagrostis latifolia, Arctophila fulva* (wet sites), *Cochlearia officinalis, Dupontia fisheri, Luzula confusa, Petaistes frigidus, Poa alpigina, Poa arctica, Potentilla hyparctica, Ranunculus nivalis, Saxifraga cernua, Stellaria edwardsii, S. laeta,* and *S. humifusa.* At nonacidic sites (pH>5.0), suitable species include all the above species plus *Artemisia comata, Astragalus alpinus, Epilobium latifolium, Eutrema edwardsii, Oxytropis bryophila, Papaver lapponicum,* and *Saxifraga oppositifolia.* Some of these species have already been used for recultivation (e.g. *Arctagrostis latifolia, Arctophila fulva*). Only a few of the others may have large and abundant enough seeds to be appropriate for further consideration in recultivation studies.

5. Comparison of the modern vegetation with the modern and fossil insect and pollen records indicates several interesting patterns. The correlations along topographic gradients are particularly interesting. For example, the high correlation of grasses with wetter vegetation types at Point Barrow makes sense in view of the high percentage of the grasses *Arctophila fulva* and *Dupontia fisheri* in these types. Similarly, higher percentages of willow pollen were found on the relatively

dry sites is probably due to the abundance of *Salix rotundifolia* in dry habitats. This pattern, however, is somewhat at odds with past interpretations of the North Slope pollen record that has attributed high grass concentrations to dry conditions, possibly associated with steppe tundra. More studies relating modern vegetation assemblages to pollen spectra along topographic gradients in a variety of climate, substrate, and physiographic settings would likely prove very enlightening for interpreting the pollen record.

6. The greater diversity of insects and pollen at Barter Island LRRS reflects the greater diversity of present-day plant species and suggests that nonacidic substrates may have generally higher biodiversity across a wide range of biological groups. A more comprehensive study relating pollen and insect faunas to habitat pH would be very useful for interpreting the paleohistory of the Arctic. Some of the broad taxonomic units could be examined in more detail, for example, the Saxifrage family.

7.2 Fossil study

1. A larger number of taxa were recovered in the modern pollen study at Barter Island LRRS than at Point Barrow LRRS (24 versus 19, respectively). This accurately reflects the larger flora recovered in the modern vegetation analyses. There was little difference in the number of taxa recovered in the two fossil analyses (29 and 28 taxa, respectively). However, the minor taxa occurred more frequently (i.e., in more levels) at Barter Island LRRS than at Point Barrow LRRS, supporting the interpretation of increasing species richness at the former location.

2. There is a strong association between large grass percentages with wet substrates in the modern pollen study at both locations.

3. From 10.2 - 5.6 ka, the vegetation at Point Barrow was dominated by grasses and heaths; conditions were probably moister and warmer than the latter part of the Holocene and species richness is poorer. These large grass values are not recorded at Barter Island; however, that basal zone appears to represent a poorer vegetation community than subsequently occupied the island. Both sites record maximum birch values in the early Holocene, as did Wilson (1984) from an earlier study on Barter Island. The large birch and heath percentages indicate warmer climatic conditions on the North Slope in the early Holocene.

4. Insect assemblages ranging in age from modern to approximately 10,000 yr BP all reflect mesic tundra environments such as those of today at both Point Barrow and Barter Island. Small thaw lakes were present throughout this interval, as indicated by the water beetles. Upland vegetation was mesic shrub tundra; climatic conditions were essentially like modern ones. The oldest sample from Barter Island (190-195 cm depth interval) yielded a significantly different insect assemblage. This assemblage contained species that are indicative of substantially warmer climatic conditions. The fossil taxa here and elsewhere in arctic Alaska and the Yukon indicate that climatic conditions could have supported coniferous forest, if only for a brief interval of time, probably about 11,000-10,000 yr B.P.

5. Insect assemblages that date to younger (mid- to late Holocene) intervals from Barter Island are all indicative of conditions very similar to those found there today. Since the brief but remarkable warming interval recorded in the lowest sample, there appears to have been little change in local environments during most of the Holocene. This supports the interpretations of the Point Barrow insect fossil assemblages.

6. Pollen Zone II at Point Barrow and Barter Island represents the establishment of modern vegetation conditions, dominated by sedges. Alder and spruce reached their present-day northern limits by 5.6 ka. The similarity of the alder and spruce percentage rise in the Barter Island section provides further evidence that the date of 7.9 ka at 82 cm is in error.

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BARROW DEW-LINE STATION, ALASKA

VEGETATION TRANSECT STUDY, 1993

Objectives

This project was implemented to satisfy objectives put forth in the Air Force Legacy Resource Management Program project: "Historical Biodiversity, DEW-Line Stations, Alaska" proposal. The approach of the project was to inventory modern and ancient vegetation and insect communities in the area of the United States Air Force (U.S.A.F.) Point Barrow, Alaska, DEW-Line Station, and to investigate changes between past and present biotic composition and diversity. A benefit of this study includes the documentation of biota in disturbed and undisturbed communities as a basis for the establishment of guidelines for possible future mitigation and restoration.

Introduction

This data report summarizes field activities during the summer of 1993 to describe modern plant communities in the area of the U.S.A.F. Pt. Barrow DEW-Line Station, referred to in this report as the Legacy Site. Field activities investigating modern and historic insect assemblages, as well as historic vegetation communities are described in other reports. The first-year focus of the modern vegetation study was to describe as much variation in undisturbed communities in the area as possible. Vegetation near the DEW-Line Station has been heavily impacted by disturbance, and so it was necessary to select a study site in an area with at least minor disturbance.

Previous vegetation studies of the Barrow area tundra include Wiggins (1951), Koranda (1954), Spetzman (1959), Britton (1966), Webber (1978) and Webber et al. (1980). Drew (1958) analyzed thaw as it related to soil types at a site very near the current study site. Moreover, ecology of the tundra near Barrow was intensively examined during the United States/International Biological Program (US/IBP) tundra biome study (Tieszen, 1978; Brown et. al., 1980).

Study Area

The Legacy Site study area described in this data report is located near the U.S.A.F. Pt. Barrow DEW-Line Station, about 7 km northeast of town of Barrow, Alaska, on the Arctic Coastal Plain (Wahrhaftig, 1965) (Figure 1). The sampling site, a 400 m-long transect, is located approximately 0.5 km south of DEW-Line Station operations buildings at about 71°19'N latitude, 156°38'W longitude. The transect is southeast to northwest-trending, originating at the northern edge of the Central Marsh drained-lake basin (Figure 1). The transect begins in a drained-lake basin, crosses a beach ridge and ends on an area with high and low-centered polygon and thaw lake features (Figure 2). Minimum elevation of the transect (1.70 m a.s.l.) is in a pond in the drained lake basin (0 m on the transect), maximum elevation (5.40 m a.s.l.) is on the beach ridge (230 m along the transect) (Figure 3). Minimum seasonal thaw (20 cm) was measured in the drained lake basin where thick mats of moss insulated the soil; maximum thaw (83 cm) was measured on the beach ridge at 220 m (thaw may have been deeper at the top of the beach ridge (230 m), but it was impossible to measure due to the presence of large amounts of gravel) (Figure

3). The study area encompasses a gradient in vegetation communities (Figure 4, Table 1).

Methods

Flags were used to mark each 10 m interval along the 400 m-long transect. Topography was surveyed using a stadia rod and a level; sitings were taken every 10 m. Absolute elevation of the transect was estimated by adding a value of 170 cm (elevation of the lowest point on the transect) to relative elevations measured on the transect. Transect topographic elevations then corresponded to absolute elevations on Barrow area maps surveyed by the Cold Regions Research Laboratory (CRREL, 1965). Active layer thaw depth was measured at every 10 m along the transect, with five replicates at each point, where feasible (Appendix A). Some of the areas on the beach ridge proved too difficult to measure thaw, due to the presence of large amounts of marine gravels.

Eight major vegetation communities represented along the transect were visually selected, and two sampling sites for all but one vegetation type were selected. (One vegetation community covered too small of an area to be sampled twice; only one sample site was selected in this case). Sample transects perpendicular to the long transect were placed in the selected locations, and five sample plots were staggered along this transect (Figure 5). Site factors were described for each transect; descriptions include landform, surficial geology, surficial geomorphology, microsite, site moisture, soil moisture, topographic position, slope, aspect, exposure scale, estimated snow duration, animal or human disturbance, and site stability. Thaw depth was also measured along transects of vegetation community sampling areas at three points (each end of the transect and in the middle); thaw was measured with five replicates at each point (Appendix B). Photographs were taken of each transect with a far-away and a close-up view (Appendix C). Species cover in each plot was then estimated using the point-quadrat method (Mueller-Dombois and Ellenberg, 1974). A 50 cm x 100 cm point-quadrat was strung with fishing-line in two layers of grids for cross-sighting points. Recordings were made of species encountered at 50 points, 10 cm apart, for each sample plot (Appendix D). Total number of hits recorded for a species was tallied for each community type and percent cover was calculated. Species names follow Murray and Murray (1978) and an electronic database of current nomenclature by Murray (unpubl.). Bryophytes and lichens not identified in the field were collected and were identified by M.S. Ignatov, Botanical Gardens, Russian Academy of Sciences.

Results

The eight major plant communities (Table 2), site factors for each community transect (Tables 3 and 4), and community vegetation cover by species were described (Table 5). Overall, 110 different species were recorded in the sample transects: 2 shrub species, 12 graminoids, 21 forbs, 40 mosses, 5 liverworts, and 30 lichens (Table 6). Growth form cover by community type was also estimated (Table 7).

Discussion

In this report, we have described variation in vegetation along a 400 m transect near the U.S.A.F. Pt. Barrow DEW-Line Station, a Legacy research site. Eight relatively undisturbed community types were sampled using the point-quadrat vegetation sampling method. The strength of the point-quadrat sampling method is in describing the most common species, but it may miss documentation of rare species--particularly bryophytes. In the 1994 field season, we plan to describe vegetation at the Legacy Site using the releve method. With this method, we will record all species present in the vegetation communities sampled. In addition, we plan to make a complete list of all the vegetation species present at the Legacy Site to document the modern vegetation biotic composition. To determine total diversity we can then compare the Legacy Site species list to the Barrow area published species list (Murray and Murray, 1978).

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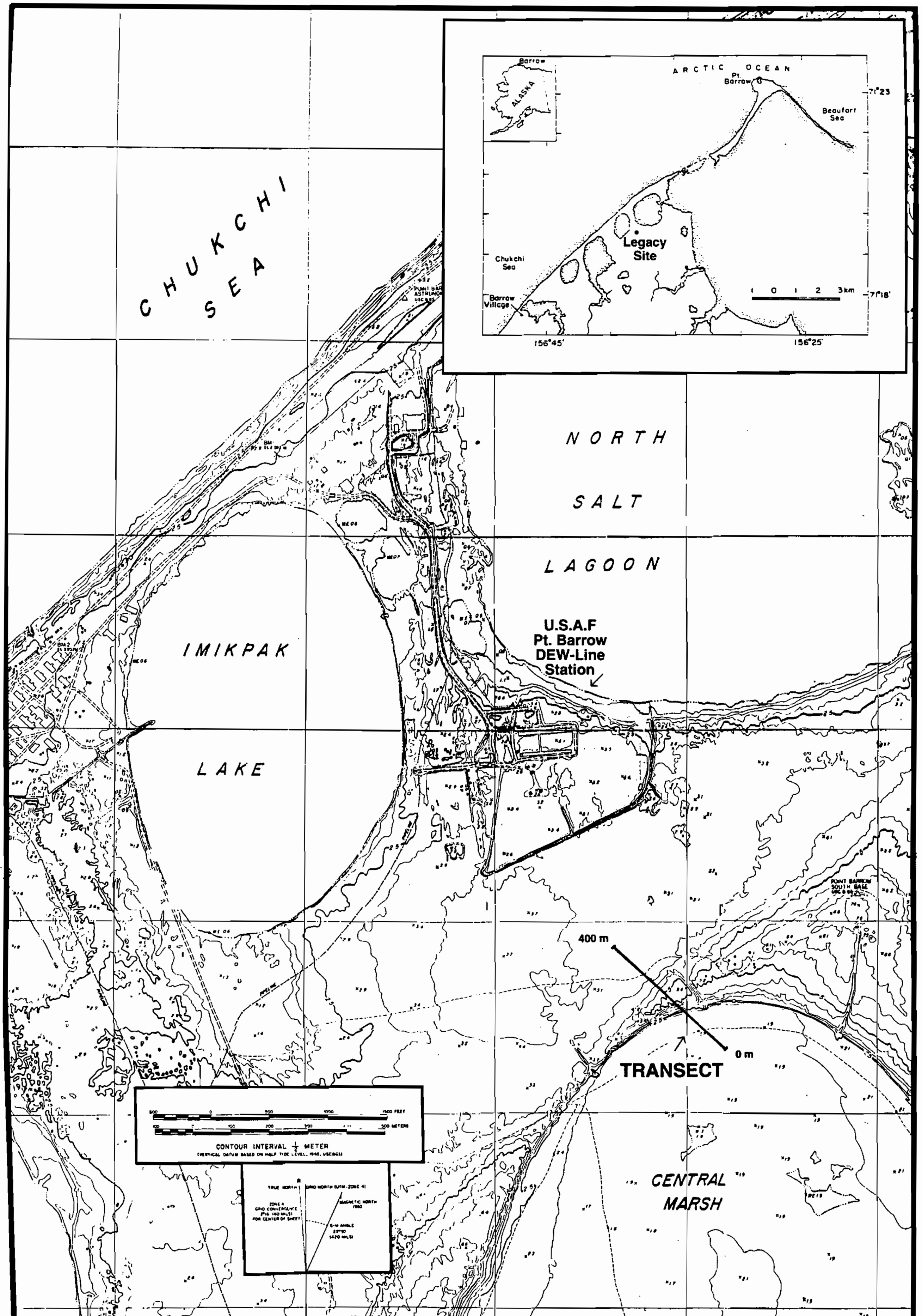


Figure 1. The location of the Legacy Site research study area in northern Alaska, located near the U.S.A.F. Pt. Barrow DEW-Line Station. The sampling site is labelled as "Transect." (Inset map modified from Bunnell et al., 1975).

Figure 2 (a)

Figure 2. View of the vegetation transect facing southeast (a) and northwest (b-next page) from the beach ridge at the middle of the transect (200 m) in late August of 1993. The vegetation transect originates (0 m) and terminates (400 m) in *Arctophila fulva* marshes, appearing in the photographs as reddish-colored vegetation. Yellow flags mark 10 m intervals along the transect, orange flags mark vegetation sampling transects.

Figure 2 (b)

Figure 2. View of the vegetation transect facing southeast (a-previous page) and northwest (b) from the beach ridge at the middle of the transect (200 m) in late August of 1993. The vegetation transect originates (0 m) and terminates (400 m) in *Arctophila fulva* marshes, appearing in the photographs as reddish-colored vegetation. Yellow flags mark 10 m intervals along the transect, orange flags mark vegetation sampling transects.

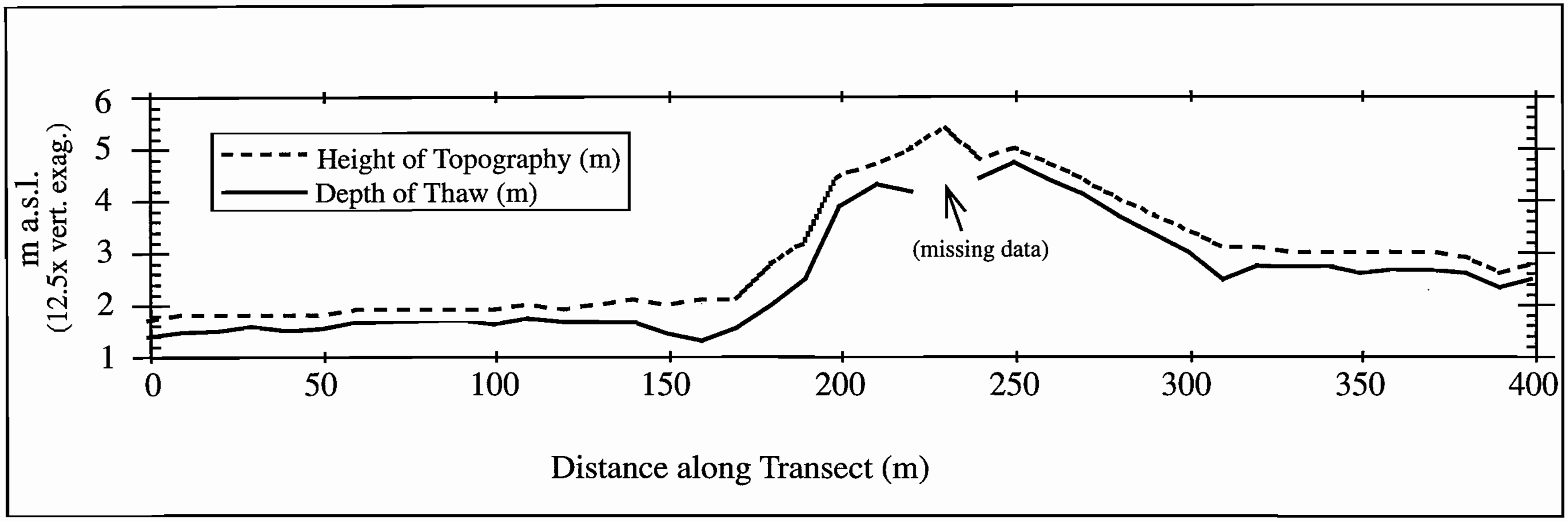


Figure 3. Height of topography and depth of thaw (m a.s.l.) along the vegetation transect, from 0 m to 400 m. Topography and thaw were measured every 10 m (see methods section). Due to presence of large amounts of marine gravels, it was not possible to measure thaw at 230 m.

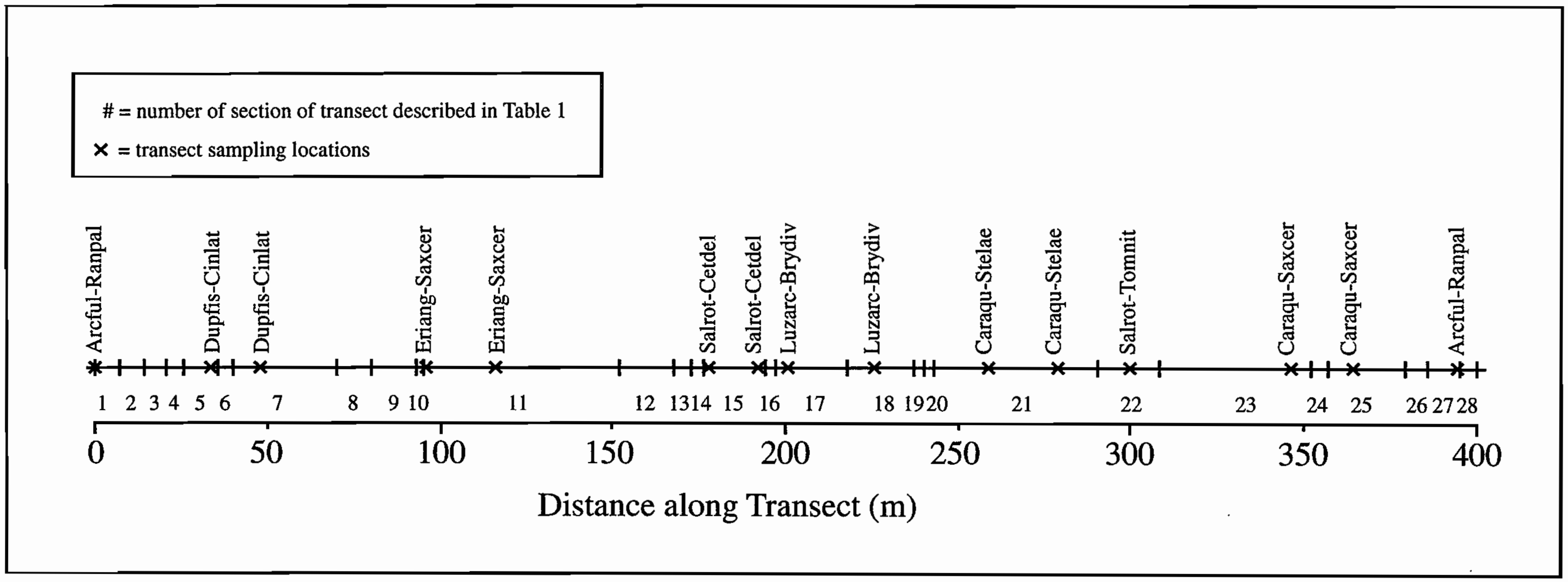


Figure 4. Diagram of vegetation transect. Vertical lines along the transect delineate transitions in vegetation types and numbers indicate sections of the transect with general vegetation type descriptions, found in Table 1. Sampling locations are marked with an "x" and are labeled with sampled vegetation community name.

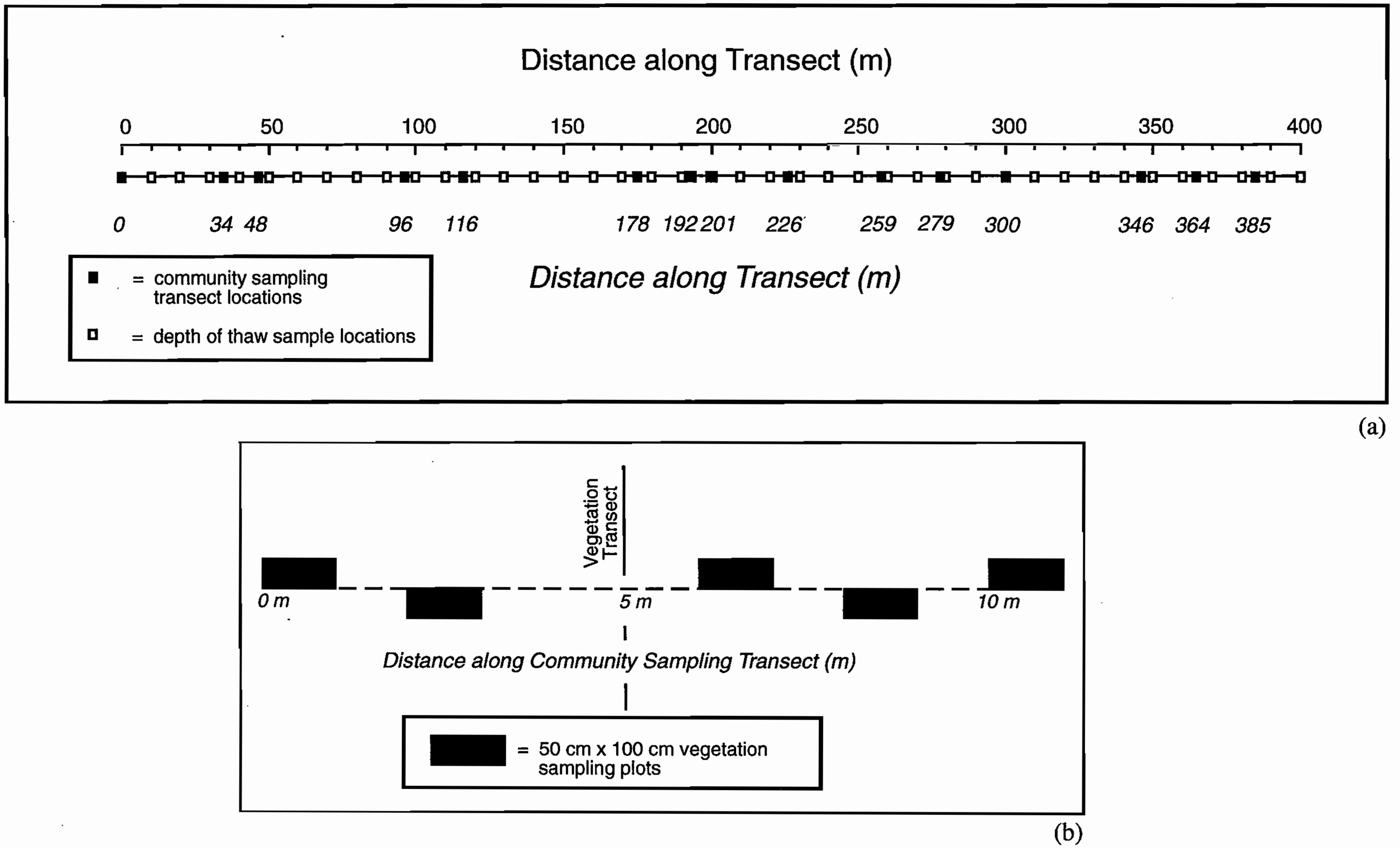


Figure 5. Diagram of sampling locations for vegetation communities and depth of thaw along the transect (a) and enlargement of community sample plot location procedure (b). Eight vegetation communities were described using two sampling transects per vegetation community (with the exception of one community, where only one sampling transect was selected). Five sample plots per sampling transect were described.

Table 1. Description of general vegetation types along the transect.

Sect.	Distance	Vegetation type description	Habitat
1	0-7	Aquatic *Arctophila fulva, Ranunculus pallasii, Sphagnum* sp. marsh	Pond
2	7-14	Wet *Dupontia fisheri, Eriophorum scheuchzeri* var. *scheuchzeri, Sphagnum* sp., *Sarmenthypnum sarmentosum, Drepanocladus* sp. tundra	Wet meadow
3	14-21	Vehicle trail	Disturbed
4	21-26	Wet *Dupontia fisheri, Eriophorum scheuchzeri* var. *scheuchzeri, Saxifraga cernua, Sarmenthypnum sarmentosum, Drepanocladus* sp. tundra	Wet meadow
5	26-36	Wet *Dupontia fisheri, Cardamine pratensis* ssp. *angustifolia, Saxifraga cernua, Saxifraga foliolosa, Cerastium jenisejense, Stellaria laeta, Drepanocladus* sp., *Calliergon* sp. tundra	Wet meadow
6	36-40	Wet *Dupontia fisheri, Eriophorum scheuchzeri* var. *scheuchzeri, Caltha palustris, Drepanocladus* sp., *Calliergon* sp. tundra	Wet meadow
7	40-70	Wet *Dupontia fisheri, Saxifraga cernua, Cardamine pratensis* ssp. *angustifolia, Sarmenthypnum sarmentosum* tundra	Wet meadow
8	70-80	Wet *Dupontia fisheri, Eriophorum angustifolium, Saxifraga cernua, Cardamine pratensis* ssp. *angustifolia, Sarmenthypnum sarmentosum* tundra	Wet meadow
9	80-93	Wet *Eriophorum angustifolium, Dupontia fisheri, Saxifraga cernua, Stellaria laeta, Mnium* sp., *Drepanocladus* sp., *Campylium stellatum* tundra	Wet meadow
10	93-95	Wet *Eriophorum angustifolium, Dupontia fisheri* tundra	Wet meadow
11	95-152	Complex of wet *Eriophorum angustifolium, Dupontia fisheri, Saxifraga hieracifolia, Saxifraga hirculus, Chrysosplenium tetrandrum* tundra, and wet *Dupontia fisheri, Eriophorum scheuchzeri var. scheuchzeri, Calliergon* sp. tundra	Wet meadow
12	152-168	Thermokarsted vehicle trail with patches of *Arctophila fulva,* some barren, mostly wet *Dupontia fisheri, Saxifraga cernua, Cochlearia officinalis, Campylium stellatum* tundra	Disturbed
13	168-173	Wet *Dupontia fisheri, Saxifraga cernua, Ranunculus pallasii, Cerastium beeringianum* tundra	Disturbed
14	173-176	Transition to *Salix rotundifolia* ssp. *rotundifolia, Cetraria delisei* tundra	Moist meadow
15	176-194	Dry *Salix rotundifolia* ssp. *rotundifolia, Luzula arctica, Saxifraga oppositifolia* ssp. *oppositifolia Pedicularis lanata, Cetraria delisei* snowbed	Snowbed

Table 1. concluded.

Ref.	Distance	Vegetation type description	Habitat
16	194-197	Dry *Salix rotundifolia* ssp. *rotundifolia, Alectoria nigricans, Ochrolechia frigida* tundra	High-centered polygon
17	197-218	Moist *Salix rotundifolia ssp. rotundifolia, Arctagrostis latifolia, Carex aquatilis, Stereocaulon* sp.tundra	Snowbed trough
18	218-237	Dry *Luzula arctica, Luzula confusa, Calamagrostis holmii, Potentilla hyparctica, Petasites frigidus, Polytrichum juniperinum, Alectoria nigricans* tundra	Marine terrace
19	237-240	Moist *Salix rotundifolia* ssp. *rotundifolia, Carex aquatilis, Petasites frigidus* tundra	Transition
20	240-243	Wet *Dupontia fisheri, Carex aquatilis* tundra	Trough
21	243-290	Moist *Salix rotundifolia* ssp. *rotundifolia, Carex aquatilis, Luzula arctica, Saxifraga hieracifolia, Petasites frigidus, S.axifraga punctata, Tomenthypnum nitens, Hylocomium splendens* tundra	Gentle west-facing slope
22	290-308	Moist *Salix rotundifolia* ssp. *rotundifolia, Carex aquatilis, Hierochloe pauciflora, Saxifraga cernua, Tomenthypnum nitens, Thamnolia subuliformis* tundra	Base of slope, shallow snowbed
23	308-352	Wet *Carex aquatilis, Dupontia fisheri, Poa arctica, Saxifraga hirculis, Petasites frigidus, Saxifraga cernua, Stellaria laeta, Cerastium beeringianum* tundra	Low-centered polygon, raised sites
24	352-357	Aquatic *Arctophila fulva, Dupontia fisheri* marsh	Thermokarst pond
25	357-379	Wet *Carex aquatilis, Dupontia fisheri, Poa arctica, Saxifraga hirculis, Petasites frigidus, Saxifraga cernua, Stellaria laeta, Cerastium beeringianum* tundra	Low-centered polygon, raised sites
26	379-386	Wet *Dupontia fisheri, Eriophorum scheuchzeri* var. *scheuchzeri, Carex aquatilis* tundra	Rim
27	386-395	Aquatic *Arctophila fulva, Ranunculus pallasii* marsh	Basin
28	395-400	Moist *Arctophila fulva, Eriophorum scheuchzeri* var. *scheuchzeri, Carex aquatilis* tundra	Rim

Table 2. Community types occurring along the transect.

Community Type	Community Type Description *(moisture status, dominant species in each layer, dominant growth forms)*	Principal habitat	Distance along Transect (m)
Salrot-Cetdel	Dry *Salix rotundifolia* ssp. *rotundifolia,Cetraria delisii*, *Physconia muscigena,* dwarf-shrub, lichen, tundra	Dry snowbed	178 and 192
Luzarc-Brydiv	Dry *Salix rotundifolia* ssp. *rotundifolia, Luzula arctica, Alectoria nigricans, Bryocaulon divergens*, dwarf-shrub, graminoid, fruticose-lichen, tundra	High-centered polygon	201 and 226
Caraqu-Stelae	Moist *Carex aquatilis, Stellaria laeta, Dactylina arctica,* graminoid, forb, fruticose-lichen, tundra	Moist tundra	259 and 279
Salrot-Tomnit	Moist *Salix rotundifolia* ssp. *rotundifolia, Alopecurus alpinus* ssp. *alpinus, Tomentypnum nitens,* dwarf-shrub, graminoid, moss, tundra	Moist snowbed	300
Caraqu-Saxcer	Wet *Carex aquatilis, Saxifraga cernua*, *Oncophorus wahlenbergii*, graminoid, forb, moss, tundra	Wet meadow	346 and 364
Eriang-Saxcer	Wet *Eriophorum angustifolium, Dupontia fisheri, Saxifraga cernua, Stellaria laeta*, graminoid, forb tundra	Wet meadow	96 and 116
Dupfis-Cinlat	Wet *Dupontia fisheri, Eriophorum scheuchzeri* var. *scheuchzeri, Cinclidium latifolia, Sarmenthypnum sarmentosum,* graminoid, moss, tundra	Wet meadow	34 and 48
Arcful-Ranpal	Wet *Arctophila fulva, Ranunculus pallasii*, graminoid, forb marsh	Aquatic marsh	0 and 385

Table 3. Example data sheet and key to environmental site factors.

Location: ______________ Releve No: ______________ Date: ______________ Photo No: ______________
Recording personnel: ______________ Weather: ______________
Study area description: ______________
Slope (deg): ______________ Aspect: ______________ Thaw depth: ______________
Vegetation (describe moisture status, dominant species in each layer, dominant growth forms, and physiognomic unit):

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

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

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

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

Site Moisture (modified from Komárková 1983)
1 Extremely xeric - almost no moisture; no plant growth
2 Very xeric - very little moisture; dry sand dunes
3 Xeric - little moisture; stabilized sand dunes, dry ridge tops
4 Subxeric - noticeable moisture; well-drained slopes, ridges
5 Subxeric to mesic - very noticeable moisture; flat to gently sloping
6 Mesic-moderate moisture; flat or shallow depressions
7 Mesic to subhygric - considerable moisture; depressions
8 Subhygric - very considerable moisture; saturated but with < 5% standing water < 10 cm deep
9 Hygric - much moisture; up to 100% of surface under water 10 to 50 cm deep; lake margins, shallow ponds, streams
10 Hydric - very much moisture; 100% of surface under water 50 to 150 cm deep; lakes, streams

Soil Moisture (from Komárková 1983)
1 Very dry - very little moisture; soil does not stick together
2 Dry - little moisture; soil somewhat sticks together
3 Damp - noticeable moisture; soil sticks together but crumbles
4 Damp to moist - very noticeable moisture; soil clumps
5 Moist - moderate moisture; soil binds but can be broken apart
6 Moist to wet - considerable moisture; soil binds and sticks to fingers
7 Wet - very considerable moisture; water drops can be squeezed out of soil
8 Very wet - much moisture can be squeezed out of soil
9 Saturated - very much moisture; water drips out of soil
10 Very saturated - extreme moisture; soil is more liquid than solid

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

Aspect
0 North-facing
45 Northwest-facing
90 West-facing
135 Southwest-facing
180 South-facing
225 Southeast-facing
270 East-facing
315 Northeast-facing

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

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

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

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

Table 4. Environmental site factors, see Table 3 for key.

Transect Distance (m)	Thaw Depth (cm)	Land-form	Surficial Geology	Surficial Geomor-phology	Micro-site	Site Moisture	Soil Moisture	Topo-graphic Position	Slope (deg.)	Aspect	Exposure Scale	Estimated Snow Duration	Animal/ Human Disturbance	Stability
0	30.7	7	8	16	n/a	9	10	7	0	--	2	4	0	1
34	26.8	7	8	11	14	8	9	4	0	--	2	4	3[a]	1
48	27.1	7	8	11	14	8	9	4	0	--	2	4	2[b]	1
96	26.0	7	8	11	13	8	8	4	0	--	2	4	4[c]	2
116	26.4	7	8	11	13	8	8	4	0	--	2	4	4[d]	2
178	75.3	7	8/13	11	n/a	4	3	3	< 2	135	2	5	2[e]	1
192	57.8	7	6/13	1/11/14*	n/a	4	3	2	2	135	2	5	2[f]	1
201	63.2	5	14	1/6*	5	4	3	1	0	--	3	2	2[g]	1/4***
226		5	14	1/6*	5	4	3	1	0	--	3	2	2[h]	1/4***
259	25.9	5	6	6	5	6	5	2	3	315	2	4	2[i]	1
279	35.3	5	6	11	n/a	6	5	2	3	315	2	5	3[j]	1
300	44.9	5	6	1/11**	n/a	6	5	3	0	--	2	5	1[k]	2
346	30.5	18	15	7	5	7	7	4	0	--	2	4	3+[l]	1
364	33.9	18	15	7	5	7+	7	4	0	--	2	4	2[m]	1
385	37.8	18	9	7	12	9	10	7	0	--	2	4	0	1

*frost scars on surface
**stabilized frost scars
***frost scar areas disturbed annually

[a]lemming runways
[b]lemming runways and scat
[c]lemming runways, tunnels, scat
[d]lemming runways, tunnels, scat
[e]ptarmigan scat; caribou scat and grazing; owl feathers
[f]lemming scat, caribou scat
[g]caribou scat
[h]caribou scat; lemming dens; human disturbance - old stakes, markers
[i]caribou scat
[j]lemming runways and scat; caribou scat; owl feathers
[k]lemming tunnels and scat; caribou scat
[l]lemming runways
[m]lemming runways

Table 5. Species cover (%) by community type.

Species	Salrot-Cetdel (178 and 192 m)	Luzarc-Brydiv (201 and 226 m)	Caraqu-Stelae (259 and 279 m)	Salrot-Tomnit (300 m)	Caraqu-Saxcer (346 and 364 m)	Eriang-Saxcer (96 and 116 m)	Dupfis-Cinlat (34 and 48 m)	Arcful-Ranpal (0 and 385 m)
Shrubs (2)								
Salix rotundifolia ssp. *rotundifolia*	27.0	18.8	4.4	35.6	-	-	-	-
Salix rotundifolia ssp. *rotundifolia*, dead	2.2	-	0.2	0.4	-	-	-	-
Vaccinium vitis-idaea ssp. *minus*	-	1.0	-	-	-	-	-	-
Graminoids (12)								
Alopecurus alpinus ssp. *alpinus*	0.8	-	1.2	3.6	-	0.2	-	-
Alopecurus alpinus ssp. *alpinus*, dead	-	-	-	0.8	-	-	-	-
Arctagrostis latifolia	0.2	0.2	0.4	0.8	-	-	-	-
Arctophila fulva	-	-	-	-	-	-	0.4	32.8
Arctophila fulva, dead	-	-	-	-	-	-	0.2	3.0
Calamagrostis holmii	-	2.2	0.6	-	-	-	-	-
Carex aquatilis	-	-	24.6	2.8	24.8	-	-	-
Carex aquatilis, dead	-	-	6.0	-	5.0	-	-	-
Dupontia fisheri	-	-	0.6	2.4	6.6	12.8	29.2	0.2
Dupontia fisheri, dead	-	-	-	0.4	0.6	1.4	27.2	-
Dupontia fisheri, viviparous	-	-	-	-	-	1.6	-	-
Dupontia fisheri, viviparous, dead	-	-	-	-	-	0.6	-	-
Eriophorum angustifolium	-	-	-	1.6	11.8	42.0	-	-
Eriophorum angustifolium, dead	-	-	-	-	1.6	8.6	-	-
Eriophorum scheuchzeri var. *scheuchzeri*	-	-	-	-	10.2	-	8.0	0.8
Eriophorum scheuchzeri var. *scheuchzeri*, dead	-	-	-	-	1.2	-	0.2	-
Eriophorum triste	-	-	-	-	-	-	-	0.4
Luzula arctica	0.6	4.4	0.6	-	-	-	-	-
Luzula arctica, dead	0.2	0.6	0.4	-	-	-	-	-
Luzula confusa	3.4	3.8	3.2	-	-	-	-	-
Luzula confusa, dead	0.2	1.2	-	-	-	-	-	-
Poa arctica	-	0.2	0.4	1.2	-	-	-	-
Forbs (21)								
Cardamine pratensis ssp. *angustifolia*	-	-	-	-	-	0.6	0.2	-
Cerastium beeringianum	-	-	-	-	-	0.2	-	-
Cerastium jenisejense	-	-	-	-	-	-	0.2	-
Chrysosplenium tetrandrum	-	-	-	-	-	0.2	-	-
Cochlearia officinalis ssp. *arctica*	-	-	-	-	-	-	0.2	-
Pedicularis lanata	0.4	-	-	-	-	-	-	-
Petasites frigidus	-	0.2	1.2	0.4	-	-	-	-
Polygonum viviparum	-	-	-	1.2	-	-	-	-
Potentilla hyparctica	0.2	1.6	0.6	0.4	-	-	-	-
Ranunculus nivalis	-	-	0.8	0.4	-	-	-	-
Ranunculus pallasii	-	-	-	-	-	-	-	6.8
Saxifraga cernua	-	-	0.6	1.2	0.6	4.2	1.2	-
Saxifraga flagelleris	0.2	-	-	-	-	-	-	-
Saxifraga foliolosa	-	-	-	-	-	-	0.2	-
Saxifraga hieracifolia	-	-	-	-	0.4	-	-	-
Saxifraga hirculus	-	-	-	-	0.2	-	0.2	-
Saxifraga nelsoniana	0.8	0.2	1.8	0.4	-	-	-	-
Saxifraga oppositifolia ssp. *oppositifolia*	1.0	-	-	-	-	-	-	-

Table 5. Continued.

	Salrot-Cetdel (178 and 192 m)	Luzarc-Brydiv (201 and 226 m)	Caraqu-Stelae (259 and 279 m)	Salrot-Tomnit (300 m)	Caraqu-Saxcer (346 and 364 m)	Eriang-Saxcer (96 and 116 m	Dupfis-Cinlat (34 and 48 m)	Arcful-Ranpal (0 and 385 m)
Forbs (cont.)								
Saxifraga oppositifolia ssp. *oppositifolia*, dead	0.8	-	-	-	-	-	-	-
Senecio atropurpureus ssp. *frigidus*	-	-	0.2	1.6	-	-	-	-
Stellaria humifusa	-	-	-	-	-	0.4	-	-
Stellaria laeta	0.4	0.6	3.4	2.0	-	4.2	-	-
Stellaria laeta, dead	0.2	-	0.4	1.2	-	-	-	-
Mosses (40)								
Aulacomnium palustre	-	-	0.4	-	-	-	-	-
*Brachythecium coruscum**	-	-	-	-	-	0.2	-	-
Brachythecium turgidum	-	-	-	-	-	0.2	-	-
*Brachythecium velutinum**	-	0.4	-	-	-	-	-	-
Bryum pseudotriquetrum	-	-	-	-	0.2	-	0.8	-
Calliergon richardsonii	-	-	-	-	-	0.2	0.6	-
Calliergon stramineum	-	-	-	-	-	0.2	0.6	-
Campylium stellatum	-	-	-	-	-	2.6	-	-
Cinclidium latifolium	-	-	-	-	-	-	2.6	-
Dicranum elongatum	-	-	3.4	-	-	-	-	-
Dicranum spadiceum	1.0	0.2	-	-	-	-	-	-
Distichium capillaceum	0.8	-	0.4	0.4	0.2	-	-	-
Ditrichum flexicaule	0.8	-	-	1.6	-	-	-	-
*Drepanocladus sendtneri**	-	-	-	-	-	-	0.8	-
Encalypta alpina	0.6	-	-	-	-	-	-	-
*Hamatocaulis vernicosus** = *Drepanocladus vernicosus*	-	-	-	2.4	-	-	-	-
Hylocomium splendens	-	-	0.2	-	-	-	-	-
Limprichtia revolvens = *Drepanocladus revolvens*	-	-	-	-	0.2	-	1.4	-
Meesia triquetra	-	-	-	-	-	-	0.2	-
Oncophorus wahlenbergii	-	-	-	-	0.4	-	-	-
Orthothecium chryseum	-	-	-	0.4	-	-	-	-
Plagiomnium ellipticum	-	-	-	-	-	1.2	-	-
Plagiomnium medium ssp. *curvatulum*	-	-	-	-	-	0.6	-	-
Pohlia cruda	0.2	-	-	-	-	-	-	-
Pohlia crudoides	-	0.4	-	-	-	-	-	-
Polytrichastrum alpinum	-	0.8	-	-	-	-	-	-
Polytrichum commune var. jensenii = *Polytrichum jensenii*	-	-	-	-	0.2	-	-	-
Polytrichum juniperinum	-	-	0.4	-	-	-	-	-
Polytrichum piliferum	-	2.2	0.8	-	-	-	-	-
Pseudobryum cinclidioides	-	-	-	-	-	0.6	0.8	-
Racomitrium lanuginosum	-	0.4	-	-	-	-	-	-
Sanionia uncinata	-	-	0.4	-	-	-	-	-
Sarmenthypnum sarmentosum = *Calliergon sarmentosum*	-	-	-	-	-	-	2.6	-
Sphagnum squarrosum	-	-	-	-	-	-	-	0.2
Sphagnum subsecundum	-	-	-	-	-	-	0.6	-
Timmia austriaca	0.2	0.2	-	-	-	-	-	-
Tomentypnum nitens	-	-	0.6	6.4	-	-	-	-
Tortella tortuosa	-	-	-	1.2	-	-	-	-
Warnstorfia exannulata = *Drepanocladus exannulatus*	-	-	-	-	-	-	0.6	-
Warnstorfia fluitans = *Drepanocladus fluitans*	-	-	-	-	-	-	0.2	-

Table 5. Concluded.

	Salrot-Cetdel (178 and 192 m)	Luzarc-Brydiv (201 and 226 m)	Caraqu-Stelae (259 and 279 m)	Salrot-Tomnit (300 m)	Caraqu-Saxcer (346 and 364 m)	Eriang-Saxcer (96 and 116 m	Dupfis-Cinlat (34 and 48 m)	Arcful-Ranpal (0 and 385 m)
Liverworts (5)								
Aneura pinguis	-	-	-	-	-	-	0.2	-
Chiloscyphus pallescens var. fragilis = Chiloscyphus fragilis	-	-	-	-	-	-	0.8	-
Lophozia rutheana	-	-	-	-	-	-	0.4	-
Ptilidium ciliare	-	-	0.2	-	-	-	-	-
Tritomaria quinquedentata	0.4	-	-	-	-	-	-	-
Lichens (30)								
Alectoria nigricans	2.2	10.2	-	-	-	-	-	-
Bacidia microcarpa	1.0	-	-	-	-	-	-	-
Bryocaulon divergens	1.4	10.4	-	-	-	-	-	-
Bryoria chalybeiformis = Alectoria chalybeiformis	0.4	-	-	-	-	-	-	-
Cetraria cucullata	1.2	0.6	1.2	-	-	-	-	-
Cetraria delisei	9.4	-	-	-	-	-	-	-
Cetraria ericetorum	4.0	0.4	0.4	-	-	-	-	-
Cetraria islandica	0.4	-	-	-	-	-	-	-
Cetraria nivalis	1.8	0.4	-	-	-	-	-	-
Cetraria simmonsii	-	-	-	0.4	-	-	-	-
Cladonia bellidiflora	-	0.2	-	-	-	-	-	-
Cladonia gracilis	0.2	-	0.6	-	-	-	-	-
Cladonia pocillum	0.2	-	-	0.4	-	-	-	-
Cladonia subfurcata	0.2	-	-	-	-	-	-	-
Collema ceraniscum	0.6	1.2	-	-	-	-	-	-
Dactylina arctica	0.4	0.2	2.4	-	-	-	-	-
Hypogymnia subobscura	-	0.2	-	-	-	-	-	-
Nephroma expallidum	1.4	0.4	-	0.4	-	-	-	-
Ochrolechia frigida	0.8	7.6	-	-	-	-	-	-
Peltigera aphthosa	-	-	1.4	-	-	-	-	-
Peltigera canina	-	-	0.6	-	-	-	-	-
Pertusaria glomerata	0.8	-	-	-	-	-	-	-
Physconia muscigena	6.8	-	-	-	-	-	-	-
Psoroma hypnorum	1.4	-	-	-	-	-	-	-
Rhizocarpon geographicum	0.2	1.0	-	-	-	-	-	-
Sphaerophorus globosus	-	2.2	-	-	-	-	-	-
Stereocaulon paschale	-	0.2	-	-	-	-	-	-
Stereocaulon tomentosum	3.6	-	-	-	-	-	-	-
Thamnolia vermicularis	3.6	5.6	1.2	0.8	-	-	-	-
White crust lichen	5.6	-	-	-	-	-	-	-
Non-Living	9.8	19.6	33.8	27.2	35.8	17.2	19.4	55.8
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

*Species occurrence at Barrow previously undocumented (Murray and Murray, 1978). Specimen identified by M.S. Ignatov, Botanical Gardens, Russian Academy of Sciences.

Table 6. Species richness (separated by growth form) by community type

Growth Form	Salrot-Cetdel (178 and 192 m)	Luzarc-Brydiv (201 and 226 m)	Caraqu-Stelae (259 and 279 m)	Salrot-Tomnit (300 m)	Caraqu-Saxcer (346 and 364 m)	Eriang-Saxcer (96 and 116 m	Dupfis-Cinlat (34 and 48 m)	Arcful-Ranpal (0 and 385 m)
Shrubs	1	2	1	1	0	0	0	0
Graminoids	4	5	8	6	4	3	3	4
Forbs	6	4	7	8	3	6	6	1
Mosses	6	7	8	6	5	8	12	1
Hepatics	1	0	1	0	0	0	3	0
Lichens	23	15	7	4	0	0	0	0
Total	41	33	32	25	12	17	24	6

Table 7. Growth form cover (%) by community type

Growth Form	Salrot-Cetdel (178 and 192 m)	Luzarc-Brydiv (201 and 226 m)	Caraqu-Stelae (259 and 279 m)	Salrot-Tomnit (300 m)	Caraqu-Saxcer (346 and 364 m)	Eriang-Saxcer (96 and 116 m	Dupfis-Cinlat (34 and 48 m)	Arcful-Ranpal (0 and 385 m)
Shrubs	29.2	19.8	4.6	36.0	0.0	0.0	0.0	0.0
Graminoids	5.4	12.6	38.0	13.6	61.8	67.2	65.2	37.2
Forbs	4.0	2.6	9.0	8.8	1.2	9.8	2.2	6.8
Mosses	3.6	4.6	6.6	12.4	1.2	5.8	11.8	0.2
Hepatics	0.4	0.0	0.2	0.0	0.0	0.0	1.4	0.0
Lichens	47.6	40.8	7.8	2.0	0.0	0.0	0.0	0.0
Non-living	9.8	19.6	33.8	27.2	35.8	17.2	19.4	55.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix A. Transect depth of thaw data.

Distance along Transect (m)	Thaw Depth (cm)					Number of Samples	Mean Thaw Depth (cm)	Standard Error (cm)	Notes
	A	B	C	D	E				
0	35	28	30	30	32	5	31.0	0.73	a
10	35	35	31	34	33	5	33.6	0.58	
20	33	35	30	31	33	5	32.4	0.62	
30	20	21	23	25	20	5	21.8	0.66	
40	31	31	30	32	30	5	30.8	0.41	
50	26	25	30	27	24	5	26.4	0.68	
60	21	24	25	24	24	5	23.6	0.55	
70	24	23	21	23	25	5	23.2	0.54	
80	23	21	21	22	20	5	21.4	0.48	
90	21	21	19	20	19	5	20.0	0.45	
100	29	26	29	33	25	5	28.4	0.79	
110	26	28	28	27	26	5	27.0	0.45	
120	23	26	24	24	24	5	24.2	0.47	
130	37	31	32	35	35	5	34.0	0.70	
140	45	44	45	45	44	5	44.6	0.33	
150	57	55	56	60	51	5	55.8	0.81	
160	80	74	85	84	75	5	79.6	1.00	
170	59	55	55	55	54	5	55.6	0.62	
180	83	80	81	79	80	5	80.6	0.55	
190	72	74	69	69		4	71.0	0.78	
200	60	64	60	63	61	5	61.6	0.60	
210	40	39	40	39	39	5	39.4	0.33	
220	80	86				2	83.0	1.46	b
230						0			c
240	37	38	34	38	37	5	36.8	0.57	
250	26	26	25	31	29	5	27.4	0.71	
260	28	34	31	30	29	5	30.4	0.68	
270	26	31	24	28	31	5	28.0	0.79	
280	34	33	34	28	34	5	32.6	0.72	
290	36	36	38	35	32	5	35.4	0.66	
300	39	38	41	40	38	5	39.2	0.51	
310	65	49	65	67	66	5	62.4	1.23	
320	38	35	37	34	34	5	35.6	0.60	
330	29	28	30	29	30	5	29.2	0.41	
340	25	24	27	25	25	5	25.2	0.47	
350	41	40	38	40	40	5	39.8	0.47	
360	34	34	32	33	31	5	32.8	0.51	
370	34	33	35	34	34	5	34.0	0.38	
380	27	29	30	30	29	5	29.0	0.49	
390	28	27	26	28	29	5	27.6	0.48	d
400	34	32	30	29	30	5	31.0	0.63	

a measured under 11 cm of water
b too much gravel to measure more samples
c too much gravel to measure
d measured under 11 cm of water

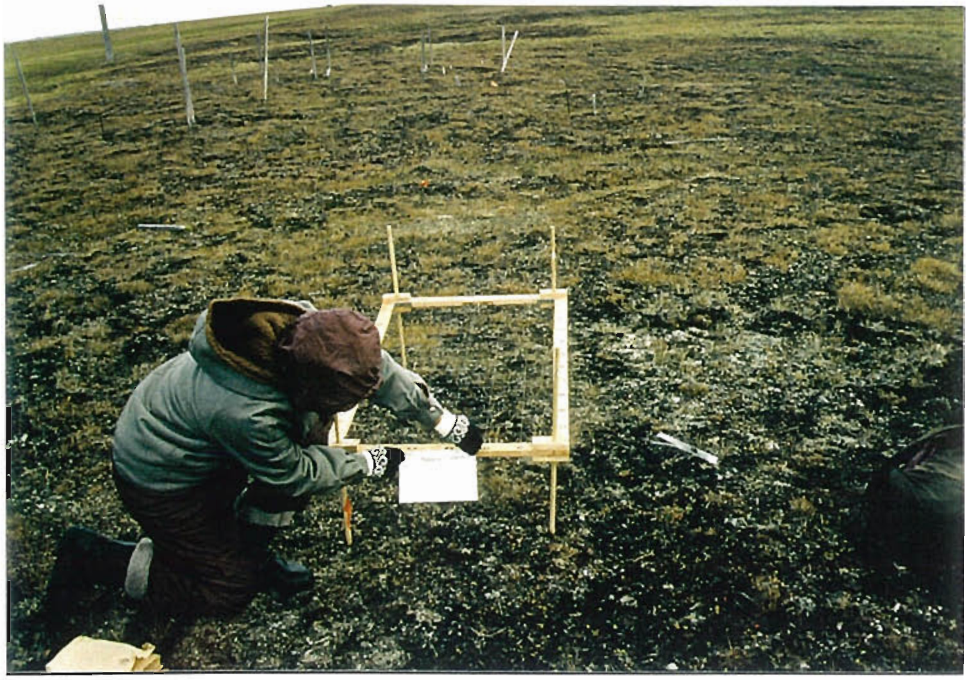
Appendix B. Community transect depth of thaw data

Distance along transect (m)	Thaw Depth (cm) at Distance along Sampling Transects: 0 m A	0 m B	0 m C	0 m D	0 m E	5 m A	5 m B	5 m C	5 m D	5 m E	10 m A	10 m B	10 m C	10 m D	10 m E	Number of Samples	Mean Thaw Depth (cm)	Standard Error (cm)	Notes
0	34	33	35	29	31	35	28	30	30	32	31	30	29	25	28	15	30.7	0.4	a
34	28	28	27	27	29	28	27	26	24	26	25	24	29	28	26	15	26.8	0.3	
48	25	25	24	31	26	26	27	25	24	26	29	29	30	30	29	15	27.1	0.4	
96	20	23	25	24	23	26	25	29	33	29	26	27	26	28	26	15	26.0	0.5	
116	25	28	24	25	26	26	26	26	31	27	28	27	25	26	26	15	26.4	0.3	
178	92					83					60	74	77	69	72	7	75.3	1.2	
192	41	43	39	43	47	72	74	85	69	69	56	57	56	57	59	15	57.8	1.0	
201											65	64	60	63	64	5	63.2	0.6	b
226																0			c
259	21	23	22	19	18	28	34	31	30	29	29	23	25	30	27	15	25.9	0.6	
279	39	36	39	41	39	34	33	34	28	34	35	37	34	36	31	15	35.3	0.5	
300	50	49	52	54	49	39	38	41	40	38	46	47	44	43	44	15	44.9	0.6	
346	38	35	34	33	35	33	27	30	31	31	24	26	28	26	27	15	30.5	0.5	
364	36	37	37	37	36	26	25	24	26	26	40	40	40	39	39	15	33.9	0.7	
385	30	35	34	34	33	42	38	40	40	39	41	41	42	39	39	15	37.8	0.5	d

a 7 cm water at 0 m, 11 cm at 5 m, 15 cm at 10 m
b measurements at 20 m along transect
c too much gravel to measure thaw
d 10 cm water at 0 m, 16 cm at 5 m, 8 cm at 10 m

Appendix C. Photographs of vegetation community types along transect.

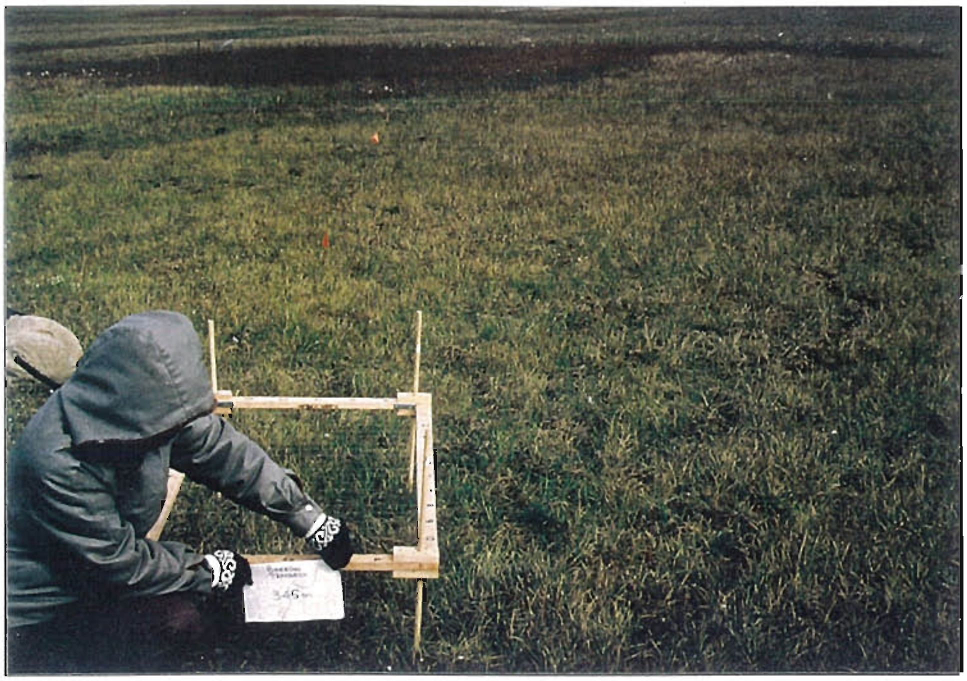
(a) Salrot-Cetdel community type, 178 and 192 m.



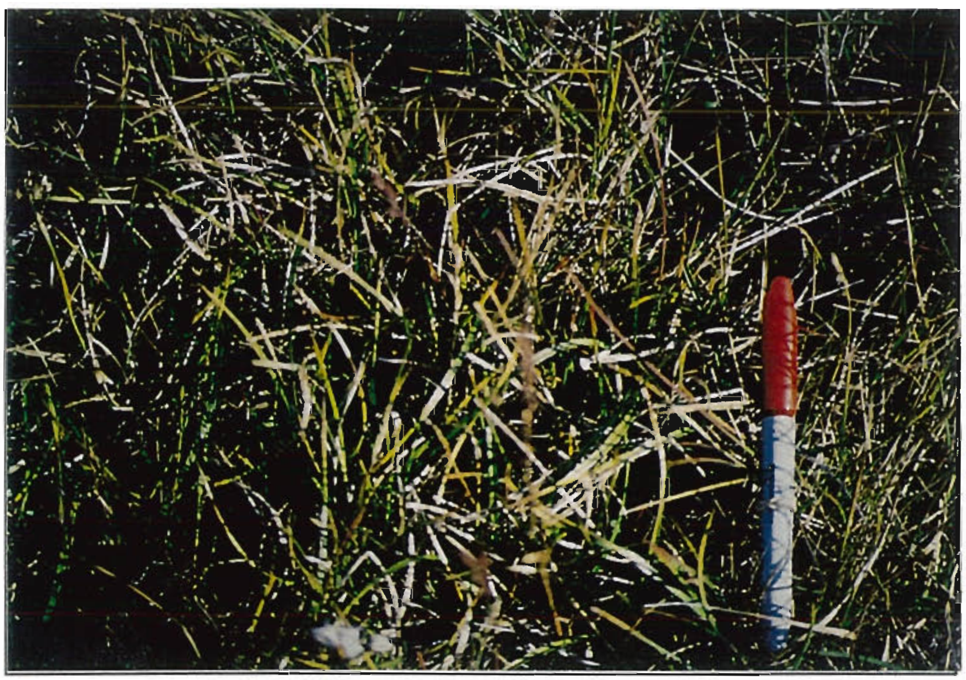
(b) Luzarc-Brydiv community type, 201 and 226 m.

(c) Caraqu-Stelae community type, 259 and 279 m.

(d) Salrot-Tomnit community type, 300 m.

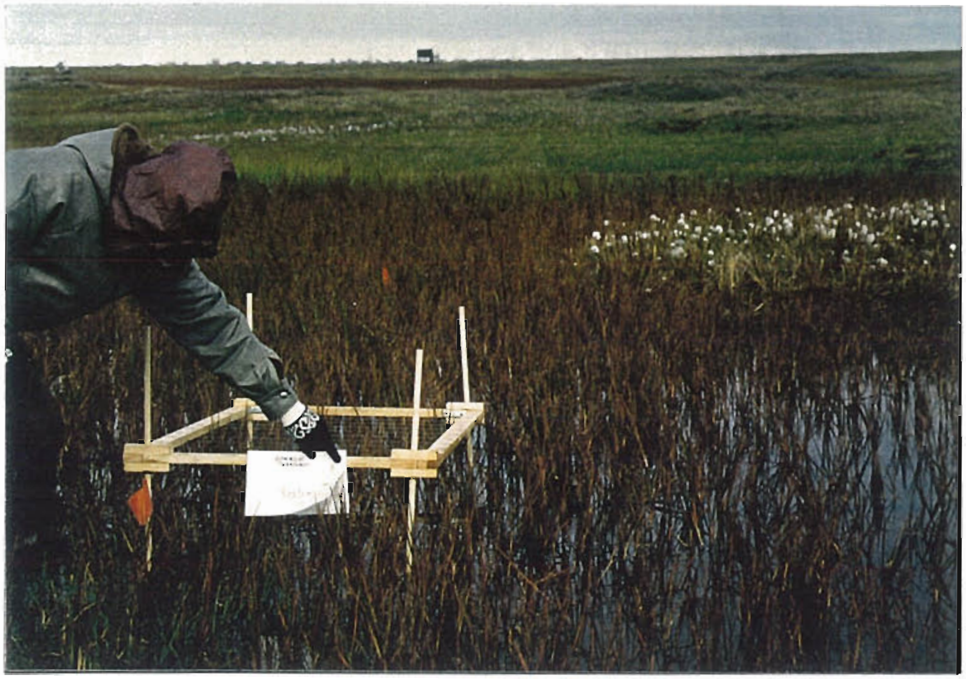


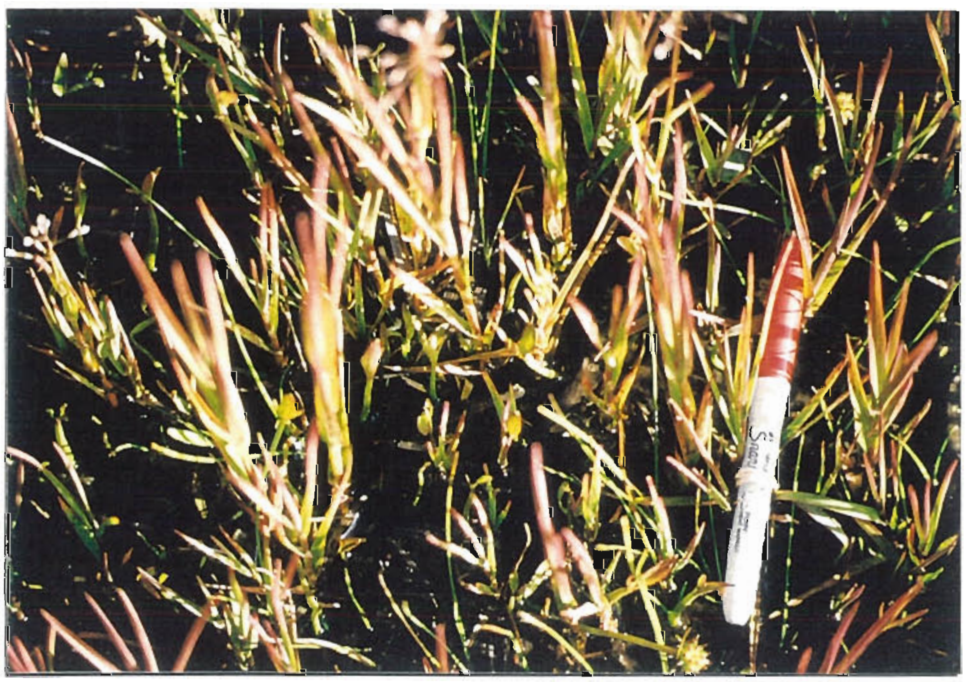
(e) Caraqu-Saxcer community type, 346 and 364 m.



(f) Eriang-Saxcer community type, 96 and 116m.

(g) Dupfis-Cinlat community type, 34 and 48 m.





(h) Arcful-Ranpal community type, 0 and 385 m.

Appendix D. Species cover by transect and sample plot.

	Arcful-Rampal 0 m					Dupfis-Cinlat 34 m					Dupfis-Cinlat 48 m					Eriang-Saxcer 96 m					Eriang-Saxcer 116 m					Salrot-Cetdel 178					Salrot-Cetdel 192 m					Luzarc-Brydiv 201 m				
Species	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Shrubs																																								
Salix rotundifolia ssp. rotundifolia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10	9	17	4	5	23	19	15	20	13	13	24	15	23	18
Salix rotundifolia ssp. rotundifolia, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	5	1	--	--	1	--	--	1	--	--	--	--	--
Vaccinium vitis-idaea ssp. minus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Graminoids																																								
Alopecurus alpinus ssp. alpinus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	2	1	--	--	--	--	--
Alopecurus alpinus ssp. alpinus, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctagrostis latifolia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1
Arctophila fulva	13	23	19	26	13	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Arctophila fulva, dead	--	3	4	--	1	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calamagrostis holmii	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
Carex aquatilis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Carex aquatilis, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia fisheri	--	--	--	--	--	19	12	15	15	12	21	13	15	8	16	5	--	11	15	6	9	4	1	4	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia fisheri, dead	--	--	--	--	--	22	18	9	6	4	10	9	19	15	24	--	--	--	1	--	--	3	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia fisheri, viviparous	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	1	--	1	--	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dupontia fisheri, viviparous, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eriophorum angustifolium	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	29	14	17	23	18	26	21	24	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eriophorum angustifolium, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	7	3	2	8	3	7	2	3	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eriophorum scheuchzeri var. scheuchzeri	4	--	--	--	--	2	3	8	9	7	1	3	4	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eriophorum scheuchzeri var. scheuchzeri, dead	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Eriophorum triste	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Luzula arctica	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	1	--	1	--	1	--
Luzula arctica, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	--	--	--
Luzula confusa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	0	1	2	4	6	--	--	2	--	1	1	2	2	2
Luzula confusa, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--
Poa arctica	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Forbs																																								
Cardamine pratensis ssp. angustifolia	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	1	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cerastium beeringianum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cerastium jenisejense	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chrysosplenium tetrandrum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cochlearia offinialis ssp. arctica	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pedicularis lanata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--
Petasites frigidus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polygonum viviparum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Potentilla hyparctica	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1	2	1	--
Ranunculus nivalis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ranunculus pallasii	2	5	9	7	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga cernua	--	--	--	--	--	2	--	--	1	--	2	--	1	--	--	3	4	1	1	2	4	2	1	1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga flagelleris	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
Saxifraga foliolosa	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga hieracifolia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga hirculus	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Saxifraga nelsoniana	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	2	1	--	--	--	1	--
Saxifraga oppositifolia ssp. oppositifolia	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	2	1	1	--	--	--	--	--	--	--	--	--
Saxifraga oppositifolia ssp. oppositifolia, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	2	--	--	--	--	--	--	--	--	--	--
Senecio atropurpureus ssp. frigidus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stellaria humifusa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stellaria laeta	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	--	10	--	--	1	--	1	--	1	--	--	--	--	--	--	--	1	--	1	--	--	1	1	1
Stellaria laeta, dead	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
Mosses																																								
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Appendix D. Continued.

Species	Arcful-Ranpal 0 m					Dupfis-Cinlat 34 m					Dupfis-Cinlat 48 m					Eriang-Saxcer 96 m					Eriang-Saxcer 116 m					Salrot-Cetdel 178					Salrot-Cetdel 192 m					Luzarc-Brydiv 201 m				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Mosses (cont.)																																								
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Pohlia crudoides	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
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Cetraria simmonsii	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Dactylina arctica	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--

Appendix D. Continued.

Species	Arcful-Ranpal 0 m 1	2	3	4	5	Dupfis-Cinlat 34 m 1	2	3	4	5	Dupfis-Cinlat 48 m 1	2	3	4	5	Erlang-Saxcer 96 m 1	2	3	4	5
Lichens (cont.)																				
Hypogymnia subobscura	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nephroma expallidum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ochrolechia frigida	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltigera aphthosa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltigera canina	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pertusaria glomerata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Physconia muscigena	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Psoroma hypnorum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rhizocarpon geographicum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sphaerophorus globosus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stereocaulon paschale	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Thamnolia vermicularis	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
White crust lichen	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Living	29	19	18	16	29	0	0	8	17	19	12	12	8	13	8	10	6	5	10	10
Total	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Species	Erlang-Saxcer 116 m 1	2	3	4	5	Salrot-Cetdel 178 1	2	3	4	5	Salrot-Cetdel 192 m 1	2	3	4	5	Luzarc-Brydiv 201 m 1	2	3	4	5
Lichens (cont.)																				
Hypogymnia subobscura	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nephroma expallidum	--	--	--	--	--	--	2	1	--	--	1	--	--	--	3	1	--	1	--	--
Ochrolechia frigida	--	--	--	--	--	--	--	--	1	--	--	2	1	--	--	3	3	3	2	1
Peltigera aphthosa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltigera canina	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pertusaria glomerata	--	--	--	--	--	--	--	--	1	2	--	--	--	1	--	--	--	--	--	--
Physconia muscigena	--	--	--	--	--	10	6	6	7	5	--	--	--	--	--	--	--	--	--	--
Psoroma hypnorum	--	--	--	--	--	3	1	--	1	--	1	--	--	--	1	--	--	--	--	--
Rhizocarpon geographicum	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	1	--	--	1
Sphaerophorus globosus	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	--	--	--
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Stereocaulon tomentosum	--	--	--	--	--	--	--	--	--	--	9	4	--	3	2	--	--	--	--	--
Thamnolia vermicularis	--	--	--	--	--	2	1	--	1	3	--	2	3	5	1	5	2	3	--	4
White crust lichen	--	--	--	--	--	2	8	3	6	8	--	1	--	--	--	--	--	--	--	--
Non-Living	6	6	13	10	10	1	7	7	9	3	1	4	5	4	8	8	7	7	7	13
Total	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

*Species occurrence at Barrow currently undocumented (Murray and Murray, 1978).
Specimen identified by M.S. Ignatov, Botanical Gardens, Russian Academy of Sciences.

Appendix D. Continued.

Species	Luzarc-Brydiv 226 m					Caraqu-Stelae 259 m					Caraqu-Stelae 279 m					Salrot-Tomnit 300 m					Caraqu-Saxcer 346 m					Caraqu-Saxcer 364 m					Arcful-Ranpal 385 m				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5`	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Shrubs																																			
Salix rotundifolia ssp. rotundifolia	--	--	--	--	1	--	9	--	--	--	--	9	4	--	--	22	11	18	19	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Salix rotundifolia ssp. rotundifolia, dead	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vaccinium vitis-idaea ssp. minus	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Appendix D. Continued.

Species	Luzarc-Brydiv 226 m					Caraqu-Stelac 259 m					Caraqu-Stelac 279 m					Salrot-Tomnit 300 m					Caraqu-Saxcer 346 m					Caraqu-Saxcer 364 m					Arcful-Ranpal 385 m				
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Cetraria ericetorum	--	--	--	--	--	--	--	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cetraria islandica	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cetraria nivalis	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cetraria simmonsii	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia bellidiflora	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia gracilis	--	--	--	--	--	--	--	2	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia pocillum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cladonia subfurcata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Collema ceraniscum	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Dactylina arctica	--	1	--	--	--	1	--	2	3	--	1	1	2	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Appendix D. Concluded.

Species	Luzarc-Brydiv 226 m					Caraqu-Stelae 259 m					Caraqu-Stelae 279 m					Salrot-Tomnit 300 m					Caraqu-Saxcer 346 m					Caraqu-Saxcer 364 m					Arcful-Ranpal 385 m				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Lichens (cont.)																																			
Hypogymnia subobscura	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nephroma expallidum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ochrolechia frigida	5	5	7	5	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltigera aphthosa	--	--	--	--	--	--	--	--	--	--	--	4	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Peltigera canina	--	--	--	--	--	--	1	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pertusaria glomerata	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Physconia muscigena	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Psoroma hypnorum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rhizocarpon geographicum	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Sphaerophorus globosus	3	2	1	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stereocaulon paschale	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stereocaulon tomentosum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Thamnolia vermicularis	3	1	2	3	5	--	--	--	2	--	--	--	1	2	1	1	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
White crust lichen	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Living	9	15	12	14	6	17	14	21	20	18	19	8	15	16	21	10	17	20	8	13	22	20	22	14	10	16	21	21	15	18	34	30	28	36	40
Total	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

*Species occurrence at Barrow currently undocumented (Murray and Murray, 1978).
Specimen identified by M.S. Ignatov, Botanical Gardens, Russian Academy of Sciences.

Appendix B. Vascular plants collected from the Point Barrow and Barter Island LRRS. Nomenclature according to D.F. Murray, Electronic authority file, Herbarium, University of Alaska, Fairbanks, AK, USA. Voucher specimens were collected only in instances of uncertain identification and were sent to the University of Alaska Herbarium for identification. Common names are from Hultén (1968) or Polunin (1959).

	Botanical Name	Common Name	Point Barrow	Barter Island
	Vascular Plants			
1.	*Alopecurus alpinus* Smith ssp. *alpinus*	Alpine Foxtail	x	x
2.	*Androsace chamaejasme* Host ssp. *lehmanniana* (Sprengel)	Rock Jasmine		x
3.	*Arctagrostis latifolia* (R. Br.) Griseb. var. *latifolia*	Polar Grass	x	x
4.	*Arctophila fulva* (Trin.) Andersson	Pendent Grass	x	x
5.	*Artemisia comata* Rydb.	Arctic Wormwood		x
6.	*Astragalus alpinus* L. s.l.	Alpine Milkvetch		x
7.	*Astragalus umbellatus* Bunge	Milkvetch		x
8.	*Bistorta plumosa* (Small) E. Greene (=*Polygonum bistorta*)	Mountain Meadow Bistort		x
9.	*Bistorta vivipara* (L.) Gray (=*Polygonum viviparum*)	Alpine Bistort	x	x
10.	*Braya purpurascens* (R. Br.)	Purplish Braya		x
11.	*Calamagrostis stricta* (Timm) Koeler ssp. *groenlandica* (Shrank) A. Love (=*Calamagrostis holmii*)	Reed Bent Grass	x	
12.	*Caltha palustris* L. ssp. *arctica* (R. Br.)	Marsh Marigold		x
13.	*Cardamine digitata* Richardson (=*Cardamine hyperborea*)	Bittercress		x
14.	*Cardamine pratensis* L. ssp. *angustifolia* (Hook.) O.E. Shultz	Cuckoo Flower	x	x
15.	*Carex aquatilis* Wahlenb. ssp. *aquatilis* (=*Carex aquatilis*)	sedge	x	x
16.	*Carex bigelowii* Torrey	sedge		x
17.	*Carex capillaris* L.	sedge		x
18.	*Carex glareosa* Wahlenb. s.l.	sedge		x
19.	*Carex maritima* Gunnerus	sedge		x
20.	*Carex membranacea* Hook.	sedge		x
21.	*Carex misandra* R. Br.	sedge		x
22.	*Carex rariflora* (Wahlenb.) Smith	sedge		x
23.	*Carex rotundata* Wahlenb.	sedge		x
24.	*Carex saxatilis* L. ssp. *laxa* (Trautv.) Kalela	sedge		x
25.	*Carex subspathacea* Wormsk.	sedge	x	x
26.	*Carex ursina* Dewey	sedge	x	x
27.	*Cassiope tetragona* (L.) D. Don ssp. *tetragona*	Lapland Cassiope	x	x
28.	*Cerastium beeringianum* Cham. & Schldl. s.l.	Beringian Chickweed	x	x
29.	*Cerastium jenisejense* Hultén	chickweed	x	x
30.	*Chrysanthemum integrifolium* Richardson	Entire-Leaved Chrysanthemum		x
31.	*Chrysosplenium tetrandrum* (N. Lund) E. Fries	Northern Water Carpet	x	x
32.	*Chrysosplenium wrightii* Franchet & P.A.L. Savat.	Bering Sea Water Carpet		x
33.	*Cochlearia officinalis* L. ssp. *arctica* (Schldl.) Hultén	Scurvy Grass	x	x
34.	*Draba alpina* L.	Draba		x
35.	*Draba lactea* J. Adams	Draba	x	x
36.	*Dryas integrifolia* M. Vahl.	Arctic Avens		x
37.	*Dupontia fisheri* R. Br. ssp. *fisheri*	Tundra Grass	x	x
38.	*Dupontia fisheri* R. Br. ssp. *psilosantha* (Rupr.) Hultén	Tundra Grass	x	x
39.	*Empetrum hermaphroditum* (Lange) Hagerup	Crowberry		x
40.	*Epilobium latifolium* L.	River Beauty		x
41.	*Equisetum arvense* L.	Common Horsetail		x
42.	*Equisetum variegatum* Schleicher	Variegated Horsetail		x
43.	*Erigeron eriocephalus* Vahl	Dwarf Fleabane		x
44.	*Eriophorum angustifolium* Honck. s.l.	Narrow-Leafed Cottongrass	x	x
45.	*Eriophorum russeolum* Fries s.l.	Russet Cottongrass	x	x
46.	*Eriophorum scheuchzeri* Hoppe var. *scheuchzeri*	Arctic Cottongrass	x	x

Appendix B Continued.

	Botanical Name	Common Name	Point Barrow	Barter Island
47.	*Eriophorum triste* (Th. Fries) Hadac & A. Löve	Cottongrass	x	x
48.	*Eriophorum vaginatum L.*	Sheathed Cotton - grass	x	x
49.	*Eutrema edwardsii* R. Br.	Edward's Eutrema		x
50.	*Festuca brachyphylla* Schultes & Schultes F.	Alpine Fescue	x	x
51.	Festuca rubra L. s.l.	Red Fescue		x
52.	*Gastrolychnis apetala* (L.) Tolm. & Kozhanch. (=*Silene uralensis*)	Catchfly		x
53.	*Hierochloe alpina* (Sw.) Roemer & Schultes	Alpine Holy Grass	x	x
54.	*Hierochloe pauciflora* R. Br.	Arctic Holy Grass	x	x
55.	*Hippuris tetraphylla* L.F.	Mare's Tail		x
56.	*Honckenya peploides* (L.) Ehrh. ssp. *peploides*	Seabeach Sandwort	x	x
57.	*Juncus biglumis* L.	rush	x	x
58.	*Lagotis glauca* P. Gaertner s.l.	Glaucous Weaselsnout		x
59.	*Leymus mollis* (Trin.) Hara *ssp. villosissimus* (Scribner) A. Löve & D. Löve (= *Elymus arenarius* ssp. *villosissimus*)	Lyme Grass	x	x
60.	*Luzula arctica* Blytt	Arctic Woodrush	x	x
61.	*Luzula confusa* Lindeb.	Northern Woodrush	x	x
62.	*Luzula multiflora* (Retz.) Lej. s.l.	Many-Flowered Woodrush		x
63.	*Mertensia maritima* (L.) A. Gray ssp. *maritima*	Oysterleaf		x
64.	*Minuartia arctica* (Steven) Asch. & Graebner	Arctic Sandwort		x
65.	*Oxyria digyna* (L.) Hill	Mountain Sorrel	x	x
66.	*Oxytropis bryophila* (E. Greene) (= *O. nigrescens* ssp. *bryophila*)	Blackish Oxytrope		x
67.	*Papaver hultenii* Knaben	Arctic Poppy	x	
68.	*Papaver lapponicum* (Tolm.) Nordh. ssp. *occidentale* (C. Lundstrom) Knaben	Lapland Poppy		x
69.	*Papaver macounii* E. Greene	Macoun's Poppy	x	x
70.	*Pedicularis albolabiata* (Hultén) Kozhanch. (=*Pediculas sudetica* ssp. *albolabiata*)	Lousewort	x	x
71.	71. Pedicularis *capitata* J. Adams	Lousewort		x
72.	72. *Pedicularis lanata* Cham. & Schldl. (=*Pedicularis kanei* ssp. *kanei*)	Lousewort	x	x
73.	*Pedicularis langsdorffii* (Fisch.) ssp. *arctica* (Br.) Pennell	Lousewort	x	
74.	*Pedicularis sudetica* Willd.	Lousewort	x	x
75.	*Petasites frigidus* (L.) Franchet	Sweet Coltsfoot	x	x
76.	*Phippsia algida* (Sol.) R.	Snow Grass	x	x
77.	*Poa alpigena* (Fries) Lindman	Common Bluegrass	x	x
78.	*Poa arctica* R. Br. s.l.	Arctic Bluegrass	x	x
79.	*Polemonium boreale* J. Adams s.l.	Boreal Jacob's Ladder		x
80.	*Potentilla hyparctica* Malte s.l.	Arctic Cinquefoil	x	x
81.	*Potentilla pulchella* R. Br. s.l.	Bright Cinquefoil		x
82.	*Primula borealis* Duby	Northern Primrose		x
83.	*Puccinellia langeana* (Berlin) T. Sorenson s.l.	Dwarf Alkali Grass	x	x
84.	*Puccinellia phryganodes* (Trin.) Scribner &Merr.	Creeping Alkali Grass	x	x
85.	*Ranunculus gmelinii* DC. ssp. *gmelinii*	Gmelin's Buttercup		x
86.	*Ranunculus hyperboreus* Rottb. ssp. *hyperboreus*	Arctic Buttercup	x	x
87.	*Ranunculus nivalis* (Lindblom) Fries	Snow Buttercup	x	x
88.	*Ranunculus pallasii* Schldl.	Pallas's Buttercup	x	x
89.	*Ranunculus pygmaeus* Wahlenb. s.l.	Pygmy Buttercup	x	x
90.	*Rhodiola integrifolia* Raf. (= *Sedum rosea*)	Roseroot		x
91.	*Rubus chamaemorus* L.	Cloudberry		x
92.	*Rumex arcticus* Trautv.	Arctic Dock	x	

Appendix B Concluded.

	Botanical Name	Common Name	Point Barrow	Barter Island
93.	*Sagina nivalis* (Lindblom) Fries	Snow Pearlwort	x	x
94.	*Salix arctica* Pallas	Arctic Willow		x
95.	*Salix glauca* L. s.l.	Northern Willow	x	
96.	*Salix lanata* L. ssp. *richardsonii* (Hook.) Skvortsov	Woolly Willow		x
97.	*Salix ovalifolia* Trautv. s.l.	Oval-Leafed Willow	x	x
98.	*Salix phlebophylla* Andersson	Veiny-Leafed Willow	x	x
99.	*Salix pulchra* Pursh.	Diamond-Leaf Willow	x	x
100.	*Salix reticulata* L. ssp. *reticulata*	Net-Veined Willow		x
101.	*Salix rotundifolia* Trautv. ssp. *rotundifolia*	Round-Leaf Willow	x	x
102.	*Saussurea angustifolia* (Willd.) DC.	Narrow-Leafed Saussurea		x
103.	*Saxifraga caespitosa* L. s.l.	Tufted Saxifrage	x	x
104.	*Saxifraga cernua* L.	Bulbous Saxifrage	x	x
105.	*Saxifraga foliolosa* R. Br.	Foliolose Saxifrage	x	x
106.	*Saxifraga hieracifolia* Waldst. & Kit. s.l.	Hawkweed-Leafed Saxifrage	x	x
107.	*Saxifraga hirculus* L. var. *propinqua* (R. Br.) Simmons	Yellow Marsh Saxifrage	x	x
108.	*Saxifraga nelsoniana* D. Don ssp. *nelsoniana* (=*S. punctata* ssp. *nelsoniana)*	Brook Saxifrage	x	x
109.	*Saxifraga nivalis* L. s.l.	Alpine Saxifrage	x	
110.	*Saxifraga oppositifolia* L.	Purple Saxifrage	x	x
111.	*Saxifraga rivularis* L. s.l.	Alpine Brook Saxifrage	x	x
112.	*Senecio atropurpureus* (Ledeb.) B. Fedtsch. ssp. *frigidus* (Richardson) Hultén	Arctic Senecio	x	x
113.	*Senecio congestus* (R. Br.) DC. s.l.	Marsh Fleawort	x	x
114.	*Senecio yukonensis* A. Pors.	Alaska-Yukon Senecio		x
115.	*Silene acaulis* L. s.l.	Moss Campion		x
116.	*Stellaria crassifolia* Ehrh. s.l.	Fleshy Stitchwort		x
117.	*Stellaria edwardsii* R. Br.	Long-Stalked Stitchwort	x	x
118.	*Stellaria humifusa* Rottb.	Low Chickweed	x	x
119.	*Stellaria laeta* Richardson	Long-Stalked Stitchwort	x	x
120.	*Taraxacum alaskanum* Rydb.	Lyrate Dandelion		x
121.	*Taraxacum ceratophorum* (Ledeb.) DC.	Horned Dandelion	x	
122.	*Tripleurospermum phaeocephalum* (Rupr.) Pobed.	Wild Chamomile		x
123.	*Trisetum spicatum* (L.) K. Richter s.l.	Spiked Trisetum		x
124.	*Utricularia vulgaris* L.	Common Butterwort		x
125.	*Vaccinium vitis-idaea* L. ssp. *minus (Lodd.)* Hultén	Mountain Cranberry	x	x
126.	*Valeriana capitata* Pallas	Capitate Valerian		x
	Total vascular plants at each site		**71**	**119**
	Number of vascular plant species not shared with other site		**7**	**55**

Appendix C. Bryophytes and lichens at the Point Barrow and Barter Island LRRS. Nomenclature is according to Anderson et al. (1990) for mosses, Stotler and Crandall-Stotler (1977) for liverworts, Egan (1987) for lichens and Zhurbenko et al. (1995) for lichenicolous fungi.

	Botanical Name	Point Barrow	Barter Island
	Mosses		
1.	*Aloina brevirostris* (Hook. & Grev.) Kindb.		x
2.	*Aplodon wormskjoldii* (Hornem.) Kindb.	x	x
3.	*Aulacomnium palustre* (Hedw.) Schwaegr.	x	x
4.	*Aulacomnium turgidum* (Wahlenb.) Schwaegr.	x	x
5.	*Bartramia ithyphylla* Brid.	x	
6.	*Brachythecium salebrosum* (Web. & Mohr) Schimp. *in* B.S.G.	x	x
7.	*Brachythecium velutinum* (Hedw.) Schimp. *in* B.S.G.		x
8.	*Bryoerythrophyllum recurvirostre* (Hedw.) Chen		x
9.	*Bryum caespiticium* Hedw.	x	x
10.	*Bryum cyclophyllum* (Schwaegr.) Bruch & Schimp. *in* B.S.G.	x	
11.	*Bryum pseudotriquetrum* (Hedw.) Gaertn. et al.	x	x
12.	*Bryum rutilans* Brid.	x	
13.	*Bryum subneodamense* Kindb.		x
14.	*Bryum teres* Lindb.	x	
15.	*Calliergon giganteum* (Schimp.) Kindb.	x	x
16.	*Calliergon richardsonii* (Mitt.) Kindb. *in* Warnst.	x	x
17.	*Campylium polygamum* (Schimp. *in* B.S.G.) C. Jens.		x
18.	*Campylium stellatum* (Hedw.) C. Jens.	x	x
19.	*Ceratodon purpureus* (Hedw.) Brid.	x	
20.	*Cinclidium latifolium* Lindb.		x
21.	*Cinclidium subrotundum* Lindb.	x	x
22.	*Cirriphyllum cirrosum* (Schwaegr. *in* Schultes) Grout	x	
23.	*Conostomum tetragonum* (Hedw.) Lindb.	x	
24.	*Desmatodon heimii* (Hedw.) Mitt.		x
25.	*Desmatodon leucostoma* (R. Br.) Berggr.		x
26.	*Dicranum angustum* Lindb.	x	x
27.	*Dicranum bonjeanii* De Not *in* Lisa		x
28.	*Dicranum elongatum* Schleich. *ex* Schwaegr.	x	x
29.	*Dicranum fuscescens* Turn.		x
30.	*Dicranum majus* Sm.	x	x
31.	*Dicranum scoparium* Hedw.	x	
32.	*Dicranum* sp. Hedw.		x
33.	*Dicranum spadiceum* Zett.	x	x
34.	*Didymodon rigidus* Hedw. var. *icmadophilus* (Schimp. *ex* C. Müll.) Zand.		x
35.	*Distichium capillaceum* Hedw.	x	x
36.	*Ditrichum flexicaule* (Schwaegr.) Hampe	x	x
37.	*Drepanocladus brevifolius* (Lindb.) Warnst.		x
38.	*Drepanocladus sendtneri* (Schimp.) Warnst.	x	
39.	*Encalypta* sp. Hedw.		x
40.	*Hylocomium splendens* (Hedw.) Schimp. *in* B.S.G.	x	x
41.	*Hypnum cupressiforme* Hedw.		x
42.	*Hypnum revolutum* (Mitt.) Lindb.		x
43.	*Hypnum subimponens* Lesq.		x
44.	*Hypnum vaucheri* (Lesq.)		x
45.	*Kiaeria glacialis* (Berggr.) Hag.		x
46.	*Leptobryum pyriforme* (Hedw.) Wils.	x	
47.	*Limprichtia revolvens* (Sw.) Loeske. [=*Drepanocladus revolvens* (Sw.)Warnst.]	x	x
48.	*Meesia triquetra* (Richt.) Angstr.	x	x
49.	*Meesia uliginosa* Hedw.		x
50.	*Myurella julacea* (Schwaegr.) Schimp. *in* B.S.G.	x	x
51.	*Myurella tenerrima* (Brid.) Lindb.		x
52.	*Oncophorus virens* (Hedw.) Brid.	x	
53.	*Oncophorus wahlenbergii* Brid.	x	x
54.	*Orthothecium chryseum* (Schwaegr. *in* Schultes) Schimp. *in* B.S.G.	x	x

Appendix C. Continued.

	Botanical Name	Point Barrow	Barter Island
	<u>**Mosses continued.**</u>		
55.	*Plagiobryum demissum* (Hook.) Lindb.		x
56.	*Plagiomnium ellipticum* (Brid.) T. Kop.	x	x
57.	*Plagiothecium berggrenianum* Frisv.	x	
58.	*Plagiothecium cavifolium* (Brid.) Iwats.		x
59.	*Pogonatum dentatum* (Brid.) Brid.	x	
60.	*Pohlia cruda* (Hedw.) Lindb.	x	x
61.	*Pohlia crudoides* (Sull. & Lesq.) Broth.	x	
62.	*Pohlia nutans* (Hedw.) Lindb.	x	x
63.	*Polytrichastrum alpinum* (Hedw.) G. L.	x	x
64.	*Polytrichum commune* Hedw. var. *jensenii* (Hag.) Mönk. *in* Warnst.	x	x
65.	*Polytrichum hyperboreum* R. Br.	x	
66.	*Polytrichum strictum* Brid.	x	
67.	*Pseudobryum cinclidioides* (Hüb.) T. Kop.	x	x
68.	*Pseudocalliergon (turgescens?)* (T. Jens.) Loeske	x	
69.	*Racomitrium lanuginosum* (Hedw.) Brid.	x	x
70.	*Rhizomnium andrewsianum* Steere) T. Kop.	x	x
71.	*Rhytidium rugosum* (Hedw.) Kindb.		x
72.	*Saelania glaucescens* (Hedw.) Broth. *in* Bomanss. & Broth.	x	
73.	*Sanionia uncinata* (Hedw.) Loeske	x	x
74.	*Sarmenthypnum sarmentosum* (Wahlenb.) Tuom. & T. Kop.	x	x
75.	*Scorpidium scorpioides* (Hedw.) Limpr.	x	x
76.	*Sphagnum fimbriatum* Wils. *in* Wils. & Hook.	x	x
77.	*Sphagnum girgensohnii* Russ.	x	x
78.	*Sphagnum squarrosum* Crome	x	
79.	*Sphagnum subsecundum* Nees *in* Sturm		x
80.	*Tetraplodon mnioides* (Hedw.) Bruch & Schimp. *in* B.S.G.		x
81.	*Tetraplodon urceolatus* (Hedw.) Bruch & Schimp. *in* B.S.G.		x
82.	*Timmia austriaca* Hedw.		x
83.	*Tomentypnum nitens* (Hedw.) Loeske	x	x
84.	*Tortella tortuosa* (Hedw.) Limpr.		x
85.	*Tortula ruralis* (Hedw.) Gaertn. et al.		x
86.	*Warnstorfia exannulata* (Schimp. *in* B.S.G.) Loeske	x	
	Total mosses at each site	**56**	**66**
	Number of moss species not shared with other site	**20**	**30**
	<u>**Liverworts**</u>		
1.	*Anastrophyllum minutum* (Schreb.) Schust.	x	
2.	*Aneura pinguis* (L.) Dum.	x	x
3.	*Anthelia juratzkana* (Limpr.) Trev.	x	
4.	*Blepharostoma trichophyllum* (L.) Dum.	x	x
5.	*Gymnomitrion corallioides* Nees	x	
6.	*Jungermannia hyalina* Lyell	x	
7.	*Jungermannia obovata* Nees	x	
8.	*Lophozia rutheana* (Limpr.) M.A. Howe		x
9.	*Nardia geoscyphus* (De Not.) Lindb.	x	
10.	*Odontoschisma macounii* (Aust.) Underw.		x
11.	*Ptilidium ciliare* (L.) Hampe	x	
12.	*Scapania irrigua* (Nees) Gott. et al.	x	
13.	*Scapania* sp. (Dum.) Dum.	x	
14.	*Tritomaria quinquedentata* (Huds.) Buch	x	x
	Total liverworts at each site	**12**	**5**
	Number of liverwort species not shared with other site	**9**	**2**
	<u>**Lichens**</u>		
1.	*Alectoria nigricans* (Ach.) Nyl.	x	x
2.	*Bryocaulon divergens* (Ach.) Kärnef.	x	x

Appendix C. Continued.

	Botanical Name	Point Barrow	Barter Island
	Lichens continued.		
3.	*Caloplaca ammiospila* (Wahlenb. *in* Ach.) H. Olivier	x	x
4.	*Caloplaca* sp. Th. Fr.		x
5.	*Cetraria andrejevii* Oxner	x	
6.	*Cetraria cucullata* (Bellardi) Ach.	x	x
7.	*Cetraria delisei* (Bory *ex* Schaerer) Nyl.	x	x
8.	*Cetraria fastigiata* (Del. *ex* Nyl. *in* Norrl*in*) Kärnef.	x	x
9.	*Cetraria inermis* (Nyl.) Krog		x
10.	*Cetraria islandica* (L.) Ach.	x	x
11.	*Cetraria laevigata* Rass.	x	x
12.	*Cetraria nivalis* (L.) Ach.	x	x
13.	*Cladonia amaurocraea* (Flörke) Schaerer	x	x
14.	*Cladonia bellidiflora* (Ach.) Schaerer	x	
15.	*Cladonia coccifera* s.l. (L.) Willd.	x	x
16.	*Cladonia gracilis* s.l. (L.) Willd.	x	x
17.	*Cladonia macroceras* (Delise) Ahti		x
18.	*Cladonia pocillum*(Ach.) O. Rich	x	x
19.	*Cladonia pyxidata* (L.) Hoffm.	x	x
20.	*Cladonia scabriuscula* (Delise *in* Duby) Leighton	x	
21.	*Cladonia* sp. Hill *ex* Browne	x	
22.	*Cladonia squamosa* (Nyl. *ex* Leighton) Va*in*io var. *subsquamosa* (Scop.) Hoffm.	x	x
23.	*Cladonia stricta* (Nyl.) Nyl.	x	x
24.	*Cladonia subfurcata* (Nyl.) Arnold	x	
25.	*Cladonia thomsonii* Ahti	x	
26.	*Cladonia uncialis* (L.) Weber *ex* Wigg.	x	x
27.	*Coelocaulon aculeatum* (Schreber) L*in*k		x
28.	*Dactylina arctica* (Richardson) Nyl.	x	x
29.	*Dactylina ramulosa* (Hook.) Tuck.		x
30.	*Fulgensia bracteata* (Hoffm.) Rasanen		x
31.	*Hypogymnia subobscura* (Va*in*io) Poelt	x	x
32.	*Lecanora epibryon* (Ach.) Ach.		x
33.	*Lecidea ramulosa* Th. Fr.	x	x
34.	*Lecidea* sp. Ach.	x	
35.	*Lecidella* sp. Körber	x	
36.	*Lobaria linita* (Ach.) Rabenh.	x	x
37.	*Lopadium coralloideum* (Hyl.) Lynge	x	
38.	*Masonhalea richardsohnii* (Hook.) Kärnef.	x	x
39.	*Nephroma arcticum* (L.) Torss.		x
40.	*Nephroma expallidum* (Nyl.) Nyl.		x
41.	*Ochrolechia androgyna* (Hoffm.) Arnold	x	
42.	*Ochrolechia frigida* (Swartz) Lynge	x	x
43.	*Ochrolechia inaequatula* (Nyl.) Zahlbr.	x	
44.	*Ochrolechia* sp. Massal.	x	
45.	*Pannaria pezizoides* (Weber) Trevisan		x
46.	*Parmelia omphalodes* (L.) Ach. ssp. *glacialis* Skult	x	x
47.	*Peltigera aphthosa* (L.) Willd.	x	x
48.	*Peltigera canina* (L.) Willd.	x	x
49.	*Peltigera leucophlebia* (Nyl.) Gylnik	x	
50.	*Peltigera malacea* (Ach.) Funck	x	
51.	*Peltigera membranacea* (Ach.) Nyl.		x
52.	*Peltigera rufescens* (Weis) Humb.		x
53.	*Peltigera scabrosa* Th. Fr.	x	
54.	*Peltigera* sp. Willd.	x	
55.	*Pertusaria bryontha* (Ach.) Nyl.		x
56.	*Pertusaria dactylina* (Ach.) Nyl.	x	
57.	*Pertusaria glomerata* (Ach.) Schaerer	x	x
58.	*Pertusaria oculata* (Dickson) Th. Fr.	x	

Appendix C. Concluded.

	Botanical Name	Point Barrow	Barter Island
	Lichens continued.		
59.	*Pertusaria panyrga* (Ach.) Massal.	x	
60.	*Phaeophyscia constipata* (Norrlin & Nyl.) Moberg		x
61.	*Physcia* sp. (Schreber) Michaux		x
62.	*Physconia muscigena* (Ach.) Poelt		x
63.	*Psoroma hypnorum* (Vahl) Gray	x	x
64.	*Ramalina almquistii* Vainio		x
65.	*Rinodina turfacea* (Wahlenb.) Körber		x
66.	*Siphula ceratites* (Wahlenb.) Fr.	x	
67.	*Solorina bispora* Nyl.		x
68.	*Sphaerophorus globosus* (Huds.) Vainio	x	x
69.	*Stereocaulon alpinum* Laurer *ex* Funck		x
70.	*Stereocaulon rivulorum* Magnusson	x	
71.	*Stereocaulon* sp. Hoffm.		x
72.	*Sticta arctica* Degel.		x
73.	*Thamnolia subuliformis* s.l. (Ehrh.) Culb.	x	x
	Total lichens at each site	**51**	**52**
	Number of lichen species not shared with other site	**21**	**22**
	Lichenicolous Fungi		
1.	*Arthonia* cf. *nephromiaria* (Nyl.) Nyl. *ex* H. Oliver		x
2.	*Arthonia peltigerina* (Almq.) H. Olivier	x	
3.	*Cercidospora decolorella* (Nyl.) O.E. Erikss. & J.Z. Yue	x	
4.	*Dactylospora deminuta* (Th. Fr.) Triebel		x
5.	*Geltingia associata* (Th. Fr.) Alstrup & D. Hawksw.	x	
6.	*Lichenoconium lecanora* (Jaap) D. Hawksw.	x	
7.	*Lichenodiplis lichenicola* Dyko & D. Hawksw.		x
8.	*Phaeosporobolus alpinus* R. Sant., Alstrup & D. Hawksw.	x	x
9.	*Sphaerellothecium araneosum* (Rehm *ex* Arnold) Zopf	x	x
10.	*Sphinctrina turbinata* (Pers.) de Not.		x
11.	*Zwackhiomyces berengerianus* (Arnold) Grube & Triebel		x
	Total lichenicolous fungi at each site	**6**	**7**
	Number of lichenicolous fungus species not shared with other site	**4**	**5**
	Algae		
1.	*Nostoc commune*		x

New and interesting lichenicolous fungi and lichens from Alaska

Mikhail Zhurbenko[1], Rolf Santesson[2], Donald A. Walker[3], Nancy A. Auerbach[3], and Brad Lewis[3]

Abstract. *A list of 13 species of lichenicolous fungi and four new or rarely reported lichen species from Alaska is presented. The following lichenicolous fungi* - Arthonia *cf.* nephromiaria, A. peltigerina, Cercidospora decolorella, Geltingia associata, Lichenodiplis lichenicola, *and* Zwackhiomyces berengerianus; *as well as the lichen* Lecanora leptacinella *are new to North America.*

Introduction

In the course of identification of lichen specimens collected during ecological studies in Alaska, a number of lichenicolous fungi as well as some interesting lichens have been detected. These specimens are housed at the herbaria of the Komarov Botanical Institute in St.Petersburg, Russia; the Botanical Museum, Uppsala University, Sweden; and the University of Helsinki, Finland.

Study site description

All of the study sites where specimens were collected are located in the state of Alaska (Figure 1). Three of the study sites, Barrow, Barter Island, and Happy Valley, are located on the Arctic Slope, in northern Alaska. Barrow and Barter Island lie within the Arctic Coastal Plain Physiographic Province, Happy Valley lies within the Arctic Foothills Province, and Fort Richardson lies within the Pacific Border Ranges Province (Wahrhaftig, 1965).

The Barrow area is a former U.S. International Biological Program (IBP) study site, and is described thoroughly in Brown et al., 1980. Situated on the coast at the northern extremity of Alaska (71°20'N, 156°30'W; 5 m a.s.l.), Barrow is bounded by the Chuckchi Sea on the west and the Beaufort Sea on the east. The coastal tundra is characterized by low relief, patterned ground, ice wedge polygons, shallow oriented lakes, drained lake basins, and small ponds.

[1]Laboratory of Systematics and Geography of Fungi, Komarov Botanical Institute, Prof. Popov 2, St. Petersburg 197376, Russia; email: binran@glas.apc.org
[2]Botanical Museum, Uppsala University, Villavagen 6, S-752 36 Uppsala, Sweden
[3]Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO 80309-0450, USA

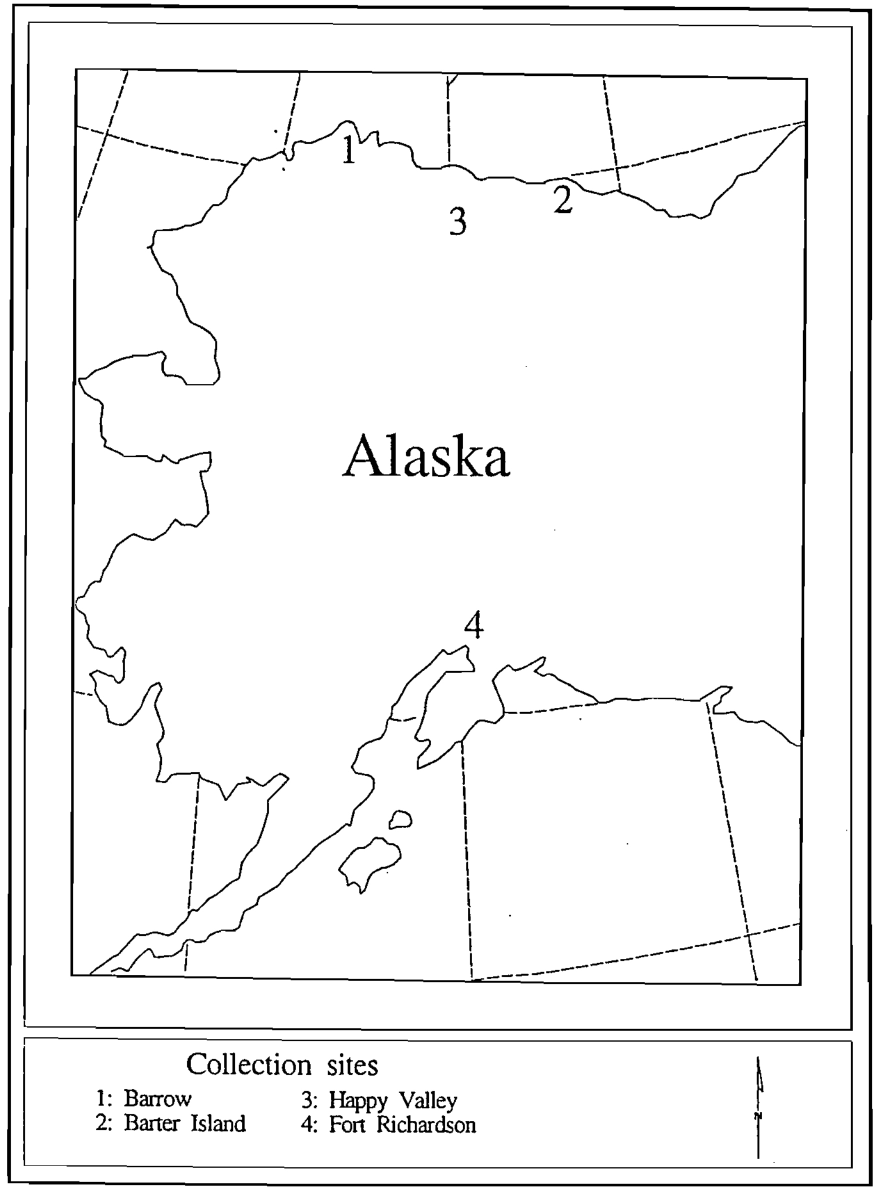

Figure 1. Localities of study sites in the state of Alaska where lichenicolous fungi and lichens were collected.

Another feature present at the Barrow site is a gravelly paleo-beach ridge, formed by a retreating sea during mid-Wisconsianan time. The Barrow peninsula is dominated by wet, acidic (pH < 5.0) soils and sedge meadows, but variations in soil and vegetation across microtopographic features are typical. Lichenicolous fungi collected at Barrow tended to occur in dry to moist vegetation types, on well-drained sites either on centers of high-centered polygons, or on the paleo beach ridge.

Barter Island is located on the coast of the Beaufort Sea (70°8'N, 143°38'W; 12 m a.s.l.) and is situated at the northern edge of the Arctic National Wildlife Refuge (ANWR), an area mapped on a broad scale by Walker et al. (1982). Barter Island and Barrow have similar geomorphic features, but vegetation and soils are more typical of nonacidic (pH > 5.0) tundra as is found at Prudhoe Bay, Alaska. The Prudhoe Bay area, a coastal tundra site lying west of Barter Island, has been described by Walker (1981) and Walker and Everett (1991). Lichenicolous fungi collected at Barter Island tended again to occur in dry to moist vegetation types, on well-drained sites.

The inland Happy Valley site (69°9'N, 147°51'W; 312 m a.s.l.) is characterized by rolling foothills with acidic tussock tundra vegetation similar to that described at Imnavait Creek and Toolik Lake (Walker et al., 1994). The Happy Valley site is situated further north, but is warmer in climate than Imnavait Creek and Toolik Lake. Lichenicolous fungi at Happy Valley was found on a hill crest.

The Fort Richardson study site is located at the western end of the Chugach Mountains in south-central Alaska (61°15'N, 149°37'W; 762-1067 m a.s.l.). Habitats at Fort Richardson are representative of types found in the mountains of south-central Alaska (e.g. Marvin, 1986). Lichenicolous fungi at Fort Richardson were found in a subalpine meadow community, a snowbed community, and in rock crevice alpine communities.

List of Species

Comments: Collection site, date, collector(s), substrate, ecology (for lichens only), and herbaria where specimens are deposited. Herbaria abbreviations: Komarov Botanical Institute in St. Petersburg, Russia (LE)i; Botanical Museum, Uppsala University, Sweden (UPS); University of Helsinki, Finland (H). Substrate abbreviations: apothecia (ap.), thallus (th.). Specimen significance: # - new to North America, $ - new to Alaska, * - lichenicolous fungus.

* *Arthonia* cf. *nephromiaria* (Nyl.) Nyl. ex H. Olivier - Barter Island, 9 VIII 1994, D.A. Walker & N.A. Auerbach, on *Nephroma expallidum* (th.), (LE).

*# *A. peltigerina* (Almq.) H. Olivier - Barrow, 2 VIII 1994, D.A. Walker & N.A. Auerbach, on *Peltigera canina* (th.), (LE).

(*)# *Cercidospora decolorella* (Nyl.) O. E. Erikss. & J. Z. Yue - Barrow, 1 VIII 1994, D.A. Walker & N.A. Auerbach, on algal crust, (LE, UPS).

Cetraria inermis (Nyl.) Krog - , Barter Island, 9 VIII 1994, D.A. Walker & N.A. Auerbach, on soil in dry dwarf-shrub fruticose lichen tundra, (LE).

Cladonia thomsonii Ahti - Barrow, 2 VIII 1994, D.A. Walker & N.A. Auerbach, on soil in moist graminoid forb meadow; 3 VIII 1994, D.A. Walker & N.A. Auerbach, on soil in dry barren; rev. T. Ahti, 1995, (H, LE).

*$ *Dactylospora deminuta* (Th. Fr.) Triebel - Barter Island, 9 VIII 1994, on *Pannaria pezizoides* (th.); 10 VIII 1994, on *Ochrolechia* sp. (th.), *Rinodina turfacea* (th.), *Rinodina turfacea* (th. + ap.); 11 VIII 1994, on *Psoroma hypnorum* (ap.). All specimens: coll. D.A. Walker & N.A. Auerbach, (LE).

* *Everniicola flexispora* D. Hawksw. - Fort Richardson, 13 VII 1994, B.E. Lewis & L. Colemeda, on *Nephroma arcticum* (th.), (LE).

*# *Geltingia associata* (Th. Fr.) Alstrup & D. Hawksw. - Barrow, 1 VIII 1994, 2 VIII 1994. All specimens: coll. D.A. Walker & N.A. Auerbach, on *Ochrolechia inaequatula* (th.), (LE).

* *Illosporium carneum* Fr. - Fort Richardson, 11 VII 1994, B.E. Lewis & L. Colemeda, on *Peltigera leucophlebia* (th.), (LE).

Lecanora leptacinella Nyl in Norrl. - Barrow, 1 VIII 1994, D.A. Walker & N.A. Auerbach, on bryophyte in dry moss lichen meadow, (UPS).

* *Lichenoconium lecanorae* (Jaap) D. Hawksw. - Barrow, 3 VIII 1994, D.A. Walker & N.A. Auerbach, on *Psoroma hypnorum* (ap.), (LE).

*# *Lichenodiplis lichenicola* Dyko & D. Hawksw. - Barter Island, 10 VIII 1994, D.A. Walker & N.A. Auerbach, on *Rinodina turfacea* (th. + ap.), (LE).

* *Phaeosporobolus alpinus* R. Sant., Alstrup & D. Hawksw. - Barrow; 2 VIII 1994, 3 VIII 1994; D.A. Walker & N.A. Auerbach. Barter Island; 9 VIII 1994, 10 VIII 1994, 10 VIII 1994; D.A. Walker & N.A. Auerbach. Fort Richardson, 13 VII 1994, B. E. Lewis & L. Colemeda. All specimens: on *Ochrolechia frigida* (th. + ap.). Happy Valley, 24 VII 1994, D.A. Walker, N.A. Auerbach & A. Gallant, on *Pertusaria dactylina* (th.). All specimens: (LE).

Ramalina almquistii Vain. - Barter Island, 9 VIII 1994, on soil in dry prostrate shrub, forb tundra; 9 VIII 1994, 10 VIII 1994, on soil in dry dwarf-shrub, fruticose lichen tundra. All specimens: coll. D.A. Walker & N.A. Auerbach, (LE, UPS).

* *Sphaerellothecium araneosum* (Rehm ex Arnold) Zopf - Barrow; 3 VIII 1994, 3 VIII 1994; on *Ochrolechia frigida* (th.); 2 VIII 1994, on *Pertusaria dactylina* (th.). All specimens: coll. D. A. Walker & N. A. Auerbach. Barter Island, 10 VIII 1994; D.A. Walker & N.A. Auerbach, on *Ochrolechia frigida* (th.). Fort Richardson, 13 VII 1994, B.E. Lewis & L. Colemeda, on *Ochrolechia frigida* (th.). All specimens: (LE).

* *Sphinctrina turbinata* (Pers.:Fr.) De Not. - Barter Island, 9 VIII 1994, D.A. Walker & N.A. Auerbach, on *Pertusaria* sp. (th. + ap.), (LE).

*# *Zwackhiomyces berengerianus* (Arnold) Grube & Triebel - Barter Island, 10 VIII 1994, D.A. Walker & N.A. Auerbach, on *Mycobilimbia lobulata* (th.), (LE).

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Appendix E. Raw relevé data from 61 sites at Point Barrow and Barter Island LRRS.

Point Barrow LRRS

	Total occur.	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
Soil moisture (% at10 cm)		189	221	68	62	19	35	43	--	17	18	195	183	246	93	79	36	18	18	20	125	29	178	348	342	659	542	361	88	104	58	317
Bulk density (g/cm3 at 10 cm)		0.3	0.2	0.8	0.8	1.7	1.2	0.8	--	1.8	1.7	0.4	0.5	0.2	1.3	0.7	0.8	1.2	1.6	1.4	1.4	0.5	1.3	0.4	1.6	0.2	0.2	0.1	0.2	0.2	0.6	0.5
Soil pH (at 10 cm)		4.3	4.2	4.8	4.1	4.5	4.7	4.0	4.4	4.6	4.6	4.9	4.5	3.9	6.0	5.3	5.3	5.9	5.9	6.0	5.2	4.8	4.6	3.9	4.3	4.2	4.2	4.2	4.6	4.4	4.4	4.5
Thaw depth (mean of 5 samples)		26	21	29	21	38	31	118	118	40	26	30	31	20	62	62	38	108	93	52	38	37	42	28	34	29	28	27	23	22	21	29
Number of species in plot		27	30	28	29	52	52	35	30	47	32	8	2	26	3	3	26	10	11	5	31	29	32	15	3	16	21	2	23	34	27	13
Alectoria nigricans	19	+	1	.	1	.	+	2	1	.	.	.	.	2	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	+	.
Aloina brevirostris	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alopecurus alpinus ssp. alpinus	9	.	.	.	.	1	.	.	.	1	1	.	.	.	.	.	+	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.
Anastrophyllum minutum	5	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.
Aneura pinguis	10	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.
Anthelia juratzkana	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Aplodon wormskjoldii	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Arctagrostis latifolia var. latifolia	13	.	.	.	1	+	3	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctophila fulva	7	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	r	.	.	.	3	.	.	3	.	.	.	.
Artemisia comata	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus alpinus	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus umbellatus	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aulacomnium palustre	4	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Aulacomnium turgidum	10	.	.	.	.	.	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bartramia ithyphylla	2	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bistorta vivipara	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.
black crust	1	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharostoma trichophyllum	4	.	.	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium salebrosum	3	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium velutinum	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	13	1	+	.	+	.	1	3	3	+	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	+	.
Bryoerythrophyllum recurvirostre	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum caespiticium	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.
Bryum cyclophyllum	4	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	2	.	.	.	.	+	.	.	.	+	.	.	.	.	.
Bryum pseudotriquetrum	8	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	2	.	.	.	.	.	.	.	+	+	.	.	.	.	+
Bryum rutilans	3	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Bryum subneodamense	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum teres	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Calliergon giganteum	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Calliergon richardsonii	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calmagrostis stricta ssp. groenlandica	4	.	+	.	2	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
Caloplaca ammiospila	2	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca sp.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium polygamum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium stellatum	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Cardamine digitata	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cardamine pratensis ssp. angustifolia	5	.	.	.	.	1	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex aquatilis ssp. aquatilis	41	1	+	2	1	3	.	.	.	4	2	3	+	+	.	.	+	.	.	.	3	+	.	3	2	+	3	+	1	3	+	2
Carex bigelowii	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex misandra	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Total occur.	Point Barrow LRRS B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
Carex rariflora	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex rotundata	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex saxatilis ssp. laxa	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex subspathacea	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Carex ursina	5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Cassiope tetragona ssp. tetragona	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium beeringianum	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium jenisejense	6	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.
Ceratodon purpureus	3	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria andrejevii	4	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Cetraria cucullata	19	.	.	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Cetraria delisei	5	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.
Cetraria fastigiata	4	.	.	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Cetraria inermis	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria islandica	17	.	+	+	.	+	2	+	+	+	.	.	.	.	.	.	+	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.
Cetraria laevigata	13	.	.	+	1	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Cetraria nivalis	13	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Chrysanthemum integrifolium	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chrysosplenium tetrandrum	2	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cinclidium latifolium	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cinclidium subrotundum	7	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	+
Cirriphyllum cirrosum	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia amaurocraea	16	2	+	+	2	+	+	+	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	3	.
Cladonia bellidiflora	8	2	.	.	+	.	+	+	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Cladonia coccifera s.l.	13	1	2	+			+		1	+	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	1	+	+	.
Cladonia gracilis s.l.	14	.	1	.	2	+	1	.	.	+	.	.	.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	2	.
Cladonia macroceras	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia pocillum	9		1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Cladonia pyxidata	10	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.
Cladonia scabriuscula	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Cladonia squamosa var. subsquamosa	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia stricta	8	2	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	.	.	.
Cladonia subfurcata	2	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Cladonia thomsonii	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia uncialis	9	+	+	+	+	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Cochlearia officinalis ssp. arctica	14	+	2	+	.	r	.	.	.	.	.	.	.	.	.	.	+	1	+	.	+	.	+	.	.	.	r	.	.	+	.	.
Coelocaulon aculeatum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conostomum tetragonum	3	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Dactylina arctica	27	2	+	.	2	+	2	+	1	+	.	.	.	1	.	.	+	.	.	.	+	1	.	.	.	.	.	.	+	2	2	.
Dactylina ramulosa	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmatodon heimii	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmatodon leucostoma	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum angustum	5	.	.	.	.	.	+	.	.		1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Dicranum bonjeanii	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum elongatum	12	2	.	.	3	+	2	+		1	.	.	.	4	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	3	3	.
Dicranum fuscescens	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

Point Barrow LRRS

	Total occur.	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
Dicranum majus	5	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum scoparium	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Dicranum sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum spadiceum	7	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Didymodon rigidus var. icmadophilus	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Distichium capillaceum	19	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Ditrichum flexicaule	8	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba sp.	8	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drepanocladus brevifolius	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drepanocladus sendtneri	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Dryas integrifolia	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dupontia fisheri ssp. fisheri	22	r	r	.	r	2	.	.	.	2	4	.	.	+	.	.	4	2	+	.	3	.	4	3	.	2	1	.	+	r	.	2
Dupontia fisherii ssp. psilosantha	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.
Encalypta sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium latifolium	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum angustifolium s.l.	27	.	.	.	+	2	2	.	.	.	2	1	.	+	.	.	+	.	.	.	2	.	3	2	.	3	1	.	.	.	.	+
Eriophorum russeolum s.l.	10	.	.	1	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	2	2	.	.	2	.	.	.	.	.
Eriophorum scheuchzeri var. scheuchzeri	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	2
Eriophorum sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum triste	9	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.
Eriophorum vaginatum s.l.	3	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eutrema edwardsii	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca brachyphylla	4	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fulgensia bracteata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrolychnis apetala	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnomitrion corallioides	2	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hierochloe alpina	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hierochloe pauciflora	5	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hippuris tetraphylla	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Honckenya peploides. ssp. peploides	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hylocomium splendens	11	.	.	.	.	2	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum cupressiforme	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum revolutum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum subimponens	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum vaucheri	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypogymnia subobscura	5	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus biglumis	11	.	.	2	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.
Jungermannia hyalina	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jungermannia obovata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Kiaeria glacialis	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora epibryon	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecidea ramulosa	4	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.
Lecidea sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.
Lecidella sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Leptobryum pyriforme	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limprichtia revolvens	18	.	.	.	.	+	.	.	.	1	+	4	.	.	.	.	.	.	.	.	.	.	+	.	.	3	3	.	.	.	.	3
Lobaria linita	11	.	.	.	.	2	1	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Lopadium coralloideum	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Total occur.	Point Barrow LRRS B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
Lophozia rutheana	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula arctica	21	2	1	1	1	r	1	1	1	.	+	.	.	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	1	.
Luzula confusa	22	3	2	1	.	.	+	2	2	.	+	.	.	2	.	.	.	.	.	.	r	1	.	.	.	.	.	.	1	1	1	.
Luzula multiflora	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Masonhalea richardsohnii	4	.	.	.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Meesia triquetra	6	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	.	.	.	.
Meesia uliginosa	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Minuartia arctica	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myurella julacea	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Myurella tenerrima	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nardia geoscyphus	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.
Nephroma arcticum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nephroma expallidum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nostoc commune	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia androgyna	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia frigida	12	.	.	.	.	.	+	2	3	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
Ochrolechia inaequatula	7	2	3	.	4	.	.	.	.	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	2	.
Ochrolechia sp.	2	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Odontoschisma macounii	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus virens	2	.	.	.	.	.	.	.	.	3	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus wahlenbergii	24	+	.	+	.	3	3	.	.	+	2	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	1	.	.	2	+	.
Orthothecium chryseum	2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxyria digyna	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxytropis bryophila	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pannaria pezizoides	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver hultenii	3	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver lapponicum ssp. occidentale	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver macounii	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parmelia omphalodes ssp. glacialis	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.
Pedicularis albolabiata	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis lanata	13	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis sudetica (undesc. ssp.)	12	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera aphthosa	13	.	.	.	.	1	1	.	.	1	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Peltigera canina	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Peltigera leucophlebia	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Peltigera malacea	3	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Peltigera membranacea	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera rufescens	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera scabrosa	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera sp.	1	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria bryontha	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria dactylina	2	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria glomerata	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Pertusaria oculata	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria panyrga	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites frigidus	9	.	.	.	.	1	.	.	1	1	2	.	.	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.
Phaeophyscia constipata	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Total occur.	Point Barrow LRRS B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
Phippsia algida	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physconia muscigena	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physcia sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiobryum demissum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiomnium ellipticum	3	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiothecium berggrenianum	3	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Plagiothecium cavifolium	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa alpigena	2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa arctica s.l.	25	.	1	.	2	1	1	1	1	1	1	.	.	.	.	.	+	.	.	.	.	1	1	.	.	.	.	.		2	2	.
Pogonatum dentatum	2	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia cruda	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Pohlia crudoides	2	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia nutans	8	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Polemonium boreale	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichastrum alpinum	29	1	1	2	+	.	2	2	1	1	+	.	.	2	.	.	2	.	1	.	+	+	.	2	.	.	+	.	+	1	+	.
Polytrichum commune var. jensenii	6	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Polytrichum hyperboreum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Polytrichum strictum	3	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Potentilla hyparctica s.l.	6	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Potentilla pulcheila	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Primula borealis	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudobryum cinclidioides	4	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+
Pseudocalliergon (turgescens?)	4	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+
Psoroma hypnorum	8	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Ptilidium ciliare	2	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia langeana s.l.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	3	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia phryganodes	4	.	.	.	.	.	.	.	.	.	.	.	.	.	3	4	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.
Racomitrium lanuginosum	2	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ramalina almquistii	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus hyperboreus ssp. hyperboreus	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus nivalis	8	.	.	.	.	+	+	.	.	1	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Ranunculus pallasii	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	+	.	.	.	.	.
Ranunculus pygmaeus s.l.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Rhizomnium andrewsianum	2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhytidium rugosum	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rinodina turfacea	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex arcticus	3	.	.	.	.	1	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saelania glaucescens	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sagina nivalis	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix arctica	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix ovalifolia s.l.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix phlebophylla	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix planifolia var. pulchra	11	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.
Salix reticulata ssp. reticulata	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix rotundifolia ssp. rotundifolia	23	+	.	.	.	3	3	2	1	2	1	.	.	.	.	.	+	.	.	.	.	3	1	.	.	.	.	.	.	.	+	.
Salix rotundifolia x pulchra	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Sanionia uncinata	9	.	.	.	.	1	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sarmenthypnum sarmentosum	21	.	.	+	.	+	.	.	.	+	+	4	.	.	.	.	.	.	.	.	.	.	+	+	.	2	2	.	.	.	.	3

Appendix E. Continued.

	Total occur.	B-1	B-2	B-3	B-4	B-5	B-6	B-7	B-8	B-9	B-10	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19	B-20	B-21	B-22	B-23	B-24	B-25	B-26	B-27	B-28	B-29	B-30	B-31
		Point Barrow LRRS																														
Saussurea angustifolia	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga caespitosa	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga cernua	17	.	.	+	.	1	1	.	.	1	1	.	.	.	.	.	1	.	.	.	2	.	2	2	.	.	+	.	.	+	.	.
Saxifraga foliolosa s.l.	19	.	+	+	+	+	.	.	+	+	1	.	.	+	.	.	+	.	.	.	.	.	.	1	.	.	+	.	.	+	+	.
Saxifraga hieracifolia	6	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Saxifraga hirculus var. propinqua	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.
Saxifraga nelsoniana ssp. nelsoniana	8	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga oppositifolia	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga rivularis s.l.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania irrigua	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Scapania sp.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Scorpidium scorpioides	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Senecio atropurpureus ssp. frigidus	10	.	.	.	.	+	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Senecio yukonensis	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Silene acaulis	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siphula ceratites	3	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Solorina bispora	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	14	1	+	.	+	.	+	1	2	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	+	.
Sphagnum fimbriatum	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Sphagnum girgensohnii	2	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum squarrosum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Sphagnum subsecundum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria edwardsii	16	.	.	.	.	.	1	+	.	.	1	.	.	.	.	.	2	.	.	.	2	.	2	.	.	.	.	.	.	1	.	.
Stellaria humifusa	6	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	+	3	2	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria laeta	20	1	+	+	+	1	1		+	+	+	.	.	.	.	.	.	.	.	.	1	+	+	1	.	.	.	.	.	1	.	.
Stellaria sp.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.
Stereocaulon alpinum	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon rivulorum	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon sp.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sticta arctica	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetraplodon mnioides	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetraplodon urceolatus	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thamnolia subuliformis s.l.	28	+	+	+	1	+	1	1	1	+	.	.	.	1	.	.	+	.	.	.	+	1	+	.	.	.	.	.	1	2	.	.
Timmia austriaca	7	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tomentypnum nitens	13	.	.	.	.	.	+	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortella tortuosa	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortula ruralis	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tripleurospermum phaeocephalum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trisetum spicatum	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tritomaria quinquedentata	5	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Vaccinium vitis-idaea ssp. minus	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warnstorfia exannulata	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3

Appendix E. Continued.

	Barter Island LRRS																													
	BI-1	BI-2	BI-3	BI-4	BI-5a	BI-5b	BI-6	BI-7	BI-8	BI-9	BI-10	BI-11	BI-12	BI-13	BI-14	BI-15	BI-16	BI-17a	BI-17b	BI-18	BI-19	BI-20	BI-21	BI-22	BI-23	BI-24	BI-25	BI-26	BI-27	BI-28
Soil moisture (% at10 cm)	99	54	32	16	--	35	262	286	199	82	192	188	322	261	260	258	213	--	169	248	213	404	275	334	285	365	325	124	3	379
Bulk density (g/cm3 at 10 cm)	0.8	0.3	0.8	1.5	--	1.1	0.3	0.3	0.3	0.6	0.3	0.3	0.2	0.3	0.3	0.3	0.3	--	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.3	0.5	1.5	0.2
Soil pH (at 10 cm)	5.3	6.8	6.1	5.1	--	6.0	5.6	5.3	5.4	5.1	5.4	5.2	5.5	5.0	5.3	5.3	6.7	--	5.5	5.7	5.3	5.2	5.6	5.4	5.3	5.3	5.4	6.0	7.7	5.4
Thaw depth (mean of 5 samples)	32	47	99	40	--	39	28	41	30	45	34	32	32	41	35	35	40	--	38	37	25	31	45	34	36	34	37	114	--	36
Number of species in plot	32	18	55	50	48	41	28	25	3	27	47	39	9	12	17	32	56	53	40	19	44	14	1	31	22	25	2	4	23	5
Alectoria nigricans	.	.	+	+	2	1	.	.	.	.	1	1	.	.	.	.	2	2	+	.	.	.	.	.	.	.	.	.	.	.
Aloina brevirostris	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alopecurus alpinus ssp. alpinus	.	3	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Anastrophyllum minutum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aneura pinguis	.	.	.	.	.	.	.	1	.	1	.	.	.	.	+	.	.	.	.	+	.	.	.	1	1	1	.	.	.	.
Anthelia juratzkana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aplodon wormskjoldii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctagrostis latifolia var. latifolia	.	.	.	+	2	+	+	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.
Arctophila fulva	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	+	.	.	.
Artemisia comata	1	1	2	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	.
Astragalus alpinus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Astragalus umbellatus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aulacomnium palustre	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Aulacomnium turgidum	.	.	.	1	1	2	.	.	.	.	1	1	.	.	.	.	.	1	2	.	+	.	.	.	.	.	.	.	.	.
Bartramia ithyphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bistorta vivipara	+	+	1	+	+	+	1	+	.	+	+	+	.	.	.	+	+	1	+	.	1	r	.	+	.	1	.	.	.	.
black crust	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharostoma trichophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium salebrosum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium velutinum	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryoerythrophyllum recurvirostre	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum caespiticium	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum cyclophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum pseudotriquetrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.
Bryum rutilans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum subneodamense	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	+	.	+	.	1	.	.	.	.	.	.
Bryum teres	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calliergon giganteum	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.
Calliergon richardsonii	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calmagrostis stricta ssp. groenlandica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca ammiospila	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Caloplaca sp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium polygamum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Campylium stellatum	.	.	.	+	.	.	4	1	.	2	.	.	.	.	.	2	.	.	.	1	2	2	.	1	+	2	.	.	.	.
Cardamine digitata	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Cardamine pratensis ssp. angustifolia	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.
Carex aquatilis ssp. aquatilis	2	.	.	3	.	.	3	4	.	4	3	+	3	3	3	3	.	.	.	3	3	4	.	2	3	2	3	.	.	5
Carex bigelowii	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	1	1	2	.	.	.	.	.	.	.	.	.	.	.
Carex misandra	2	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.

Appendix E. Continued.

Barter Island LRRS

	BI-1	BI-2	BI-3	BI-4	BI-5a	BI-5b	BI-6	BI-7	BI-8	BI-9	BI-10	BI-11	BI-12	BI-13	BI-14	BI-15	BI-16	BI-17a	BI-17b	BI-18	BI-19	BI-20	BI-21	BI-22	BI-23	BI-24	BI-25	BI-26	BI-27	BI-28
Carex rariflora	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	.	.	.	.	+	.	+	.	3	+	3	.	.	.	.
Carex rotundata	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Carex saxatilis ssp. laxa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Carex sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Carex subspathacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.
Carex ursina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.
Cassiope tetragona ssp. tetragona	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium beeringianum	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Cerastium jenisejense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria andrejevii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria cucullata	1	.	+	1	1	2	.	.	.	.	1	1	.	.	.	+	2	+	1	.	1	.	.	.	.	.	.	.	.	.
Cetraria delisei	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria inermis	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria islandica	+	.	+	.	.	.	.	.	.	.	.	2	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Cetraria laevigata	.	.	.	1	2	2	.	.	.	.	2	.	.	.	.	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.
Cetraria nivalis	2	.	1	1	1	2	.	.	.	.	2	1	.	.	.	.	1	+	1	.	+	.	.	.	.	.	.	.	.	.
Chrysanthemum integrifolium	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chrysosplenium tetrandrum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cinclidium latifolium	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	2	+	+	.	.	.	.
Cinclidium subrotundum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.
Cirriphyllum cirrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia amaurocraea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	+	.	.	.	.	.	.	.	.	.
Cladonia bellidiflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia coccifera s.l.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia gracilis s.l.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	.	1	.	.	.	.	.	.	.	.	.
Cladonia macroceras	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia pocillum	+	.	1	1	1	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia pyxidata	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.
Cladonia scabriuscula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia squamosa var. subsquamosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia stricta	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Cladonia subfurcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia thomsonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia uncialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Cochlearia officinalis ssp. arctica	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Coelocaulon aculeatum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dactylina arctica	1	.	+	1	2	2	.	.	.	.	2	2	.	.	.	+	2	1	2	.	2	.	.	.	.	.	.	.	.	.
Dactylina ramulosa	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmatodon heimii	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Desmatodon leucostoma	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum angustum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Dicranum bonjeanii	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum elongatum	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum fuscescens	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Barter Island LRRS																													
	BI-1	**BI-2**	**BI-3**	**BI-4**	**BI-5a**	**BI-5b**	**BI-6**	**BI-7**	**BI-8**	**BI-9**	**BI-10**	**BI-11**	**BI-12**	**BI-13**	**BI-14**	**BI-15**	**BI-16**	**BI-17a**	**BI-17b**	**BI-18**	**BI-19**	**BI-20**	**BI-21**	**BI-22**	**BI-23**	**BI-24**	**BI-25**	**BI-26**	**BI-27**	**BI-28**
Dicranum majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	3	.	1	.	.	.	.	.	.	.	.	.
Dicranum scoparium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum sp.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum spadiceum	.	.	.	.	1	1	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Didymodon rigidus var. icmadophilus	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Distichium capillaceum	+	.	1	2	1	2	2	2	.	2	2	.	.	.	.	+	.	+	+	.	+	.	.	+	.	.	.	.	.	.
Ditrichum flexicaule	+	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Draba sp.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	r	.	.	.	.	.	.
Drepanocladus brevifolius	.	.	.	.	.	.	.	4	.	4	.	.	.	+	1	.	.	.	.	2	.	1	.	+	1	+	.	.	.	.
Drepanocladus sendtneri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dryas integrifolia	2	.	3	2	1	2	.	.	.	.	3	1	.	.	.	.	3	2	3	.	1	.	.	.	.	.	.	.	.	.
Dupontia fisheri ssp. fisheri	.	.	.	.	.	.	2	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Dupontia fisherii ssp. psilosantha	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Encalypta sp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium latifolium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Eriophorum angustifolium s.l.	.	.	.	.	.	.	2	1	.	2	.	.	1	1	1	2	.	.	.	2	2	2	.	1	1	+	.	.	.	1
Eriophorum russeolum s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	+	+	.	.	.	+
Eriophorum scheuchzeri var. scheuchzeri	.	.	.	.	.	.	.	1	.	1	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum triste	.	.	.	1	+	.	.	.	.	.	2	+	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.
Eriophorum vaginatum s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Eutrema edwardsii	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca brachyphylla	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Fulgensia bracteata	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Gastrolychnis apetala	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	r	.
Gymnomitrion corallioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hierochloe alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hierochloe pauciflora	.	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.
Hippuris tetraphylla	.	.	.	.	.	.	.	.	1	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Honckenya peploides. ssp. peploides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Hylocomium splendens	.	.	.	+	+	+	.	.	.	.	.	+	.	.	.	1	1	.	1	.	2	.	.	.	.	.	.	.	.	.
Hypnum cupressiforme	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum revolutum	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum subimponens	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypnum vaucheri	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypogymnia subobscura	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Juncus biglumis	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	+	.	.	.	1	+	+	.	.	.	.
Jungermannia hyalina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Jungermannia obovata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kiaeria glacialis	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecanora epibryon	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Lecidea ramulosa	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Lecidea sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecidella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Leptobryum pyriforme	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Limprichtia revolvens	.	.	.	.	.	.	.	+	.	+	.	.	1	1	4	.	.	.	.	3	.	3	.	2	5	3	.	.	.	.
Lobaria linita	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	+	1	.	.	+	.	.	.	.	.	.	.	.	.
Lopadium coralloideum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Barter Island LRRS																													
	BI-1	BI-2	BI-3	BI-4	BI-5a	BI-5b	BI-6	BI-7	BI-8	BI-9	BI-10	BI-11	BI-12	BI-13	BI-14	BI-15	BI-16	BI-17a	BI-17b	BI-18	BI-19	BI-20	BI-21	BI-22	BI-23	BI-24	BI-25	BI-26	BI-27	BI-28
Lophozia rutheana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Luzula arctica	.	.	+	+	1	+	.	.	.	.	+	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.
Luzula confusa	2	.	+	+	+	+	.	.	.	.	.	1	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.
Luzula multiflora	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	2	+	.	.	.	.	.	.	.	.	.	.	.
Masonhalea richardsohnii	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Meesia triquetra	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.
Meesia uliginosa	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	+	.	.	.	+	+	+	.	.	.	.
Minuartia arctica	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Myurella julacea	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myurella tenerrima	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Nardia geoscyphus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nephroma arcticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nephroma expallidum	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Nostoc commune	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	2	.	.	.	1	2	r	.	.	.	1
Ochrolechia androgyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia frigida	1	.	.	1	3	.	.	.	.	.	1	3	.	.	.	.	3	3	+	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia inaequatula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Odontoschisma macounii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus virens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus wahlenbergii	.	.	.		.	+	.	+	.	+	.	+	.	+	1	.	.	+	+	+	+	.	.	2	+	2	.	.	.	.
Orthothecium chryseum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxyria digyna	+	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxytropis bryophila	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.
Pannaria pezizoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Papaver hultenii	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Papaver lapponicum ssp. occidentale	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Papaver macounii	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
Parmelia omphalodes ssp. glacialis	.	.	.	+	1	+	.	.	.	.	.	+	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis albolabiata	.	.	.	.	.	.	+	1	.	1	.	.	.	+	2	.	.	.	.	.	.	1	.	1	1	1	.	.	.	.
Pedicularis lanata	+	.	2	+	1	1	.	.	.	.	1	+	.	.	.	+	1	1	+	.	1	.	.	.	.	.	.	.	.	.
Pedicularis sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Pedicularis sudetica (undesc. ssp.)	+	.	+	+	+	.	.	.	.	.	+	+	.	.	.	.	+	+	+	1	+	.	.	.	.	.	.	.	.	.
Peltigera aphthosa	.	.	.	+	+	+	+	.	.	.	+	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.
Peltigera canina	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera leucophlebia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera malacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera membranacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera rufescens	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera scabrosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria bryontha	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria dactylina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria glomerata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria oculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria panyrga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites frigidus	.	.	.	1	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Phaeophyscia constipata	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.

Appendix E. Continued.

	Barter Island LRRS																													
	BI-1	BI-2	BI-3	BI-4	BI-5a	BI-5b	BI-6	BI-7	BI-8	BI-9	BI-10	BI-11	BI-12	BI-13	BI-14	BI-15	BI-16	BI-17a	BI-17b	BI-18	BI-19	BI-20	BI-21	BI-22	BI-23	BI-24	BI-25	BI-26	BI-27	BI-28
Phippsia algida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physconia muscigena	+	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Physcia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.
Plagiobryum demissum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiomnium ellipticum	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiothecium berggrenianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiothecium cavifolium	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa alpigena	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Poa arctica s.l.	.	2	+	1	1	+	1	.	.	.	+	.	.	.	.	1	1	+	.	.	+	.	.	.	.	.	.	.	+	.
Pogonatum dentatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia cruda	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia crudoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia nutans	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polemonium boreale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Polytrichastrum alpinum	+	1	.	.	+	+	.	+	.	.	.	1	.	.	.	.	+	+	2	.	1	.	.	.	.	.	.	.	.	.
Polytrichum commune var. jensenii	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.
Polytrichum hyperboreum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla hyparctica s.l.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla pulchella	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Primula borealis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudobryum cinclidioides	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pseudocalliergon (turgescens?)	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoroma hypnorum	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	1	+	.	.	+	.	.	.	.	.	.	.	.	.
Ptilidium ciliare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Puccinellia langeana s.l.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Puccinellia phryganodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.
Racomitrium lanuginosum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ramalina almquistii	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus hyperboreus ssp. hyperboreus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus nivalis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ranunculus pallasii	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Ranunculus pygmaeus s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhizomnium andrewsianum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rhytidium rugosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.
Rinodina turfacea	.	.	.	.	1	.	.	.	.	.	+	1	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.
Rumex arcticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saelania glaucescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sagina nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Salix arctica	+	2	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.
Salix ovalifolia s.l.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.
Salix phlebophylla	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	2	2	.	.	.	.	.	.	.	.	.	.	.
Salix planifolia var. pulchra	+	.	.	1	.	.	.	+	.	+	2	.	.	.	.	.	+	.	.	.	3	.	.	.	.	.	.	.	.	.
Salix reticulata ssp. reticulata	.	.	2	1	.	.	.	.	.	.	2	2	.	.	.	+	2	.	.	.	2	.	.	.	.	.	.	.	.	.
Salix rotundifolia ssp. rotundifolia	2	.	2	3	2	3	.	.	.	.	2	3	.	.	.	3	2	2	3	.	1	.	.	.	.	.	.	.	.	.
Salix rotundifolia x pulchra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sanionia uncinata	.	.	.	1	.	2	.	.	.	.	+	.	.	.	.	1	+	.	.	.	1	.	.	.	.	.	.	.	.	.
Sarmenthypnum sarmentosum	.	.	.	.	.	.	.	+	.	+	.	.	+	+	+	+	.	.	.	+	+	2	.	+	+	.	.	.	.	.

Appendix E. Concluded.

Barter Island LRRS

	BI-1	BI-2	BI-3	BI-4	BI-5a	BI-5b	BI-6	BI-7	BI-8	BI-9	BI-10	BI-11	BI-12	BI-13	BI-14	BI-15	BI-16	BI-17a	BI-17b	BI-18	BI-19	BI-20	BI-21	BI-22	BI-23	BI-24	BI-25	BI-26	BI-27	BI-28
Saussurea angustifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
Saxifraga caespitosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Saxifraga cernua	.	.	.	.	.	.	2	1	.	+	.	.	.	.	.	2	.	.	.	.	.	.	.	+	.	+	.	.	.	.
Saxifraga foliolosa s.l.	.	.	.	.	.	.	.	+	.	+	.	r	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	.	.	.
Saxifraga hieracifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga hirculus var. propinqua	+	.	.	.	.	.	+	1	.	+	.	.	.	.	.	+	.	.	.	+	.	+	.	+	.	+	.	.	r	.
Saxifraga nelsoniana ssp. nelsoniana	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	1	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga oppositifolia	.	.	2	.	+	.	.	.	.	.	.	.	.	.	.	.	2	2	+	.	.	.	.	.	.	.	.	.	.	.
Saxifraga rivularis s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania irrigua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scapania sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scorpidium scorpioides	.	.	.	.	.	.	.	.	.	+	.	.	.	2	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Senecio atropurpureus ssp. frigidus	.	.	+	1	1	2	.	.	.	.	.	.	.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.
Senecio yukonensis	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Silene acaulis	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Siphula ceratites	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solorina bispora	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	.	.	.	.	+	.	.	.	.	.	r	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum fimbriatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Sphagnum girgensohnii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum squarrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum subsecurdum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Stellaria edwardsii	.	.	.	+	+	+	.	.	.	.	+	+	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	+	.
Stellaria humifusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.
Stellaria laeta	+	.	+	1	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.
Stereocaulon alpinum	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon rivulorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon sp.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sticta arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.
Tetraplodon mnioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetraplodon urceolatus	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thamnolia subuliformis s.l.	1	.	1	1	2	2	.	.	.	.	2	2	.	.	.	+	2	2	2	.	1	.	.	.	.	.	.	.	.	.
Timmia austriaca	.	.	.	+	+	.	.	.	.	.	+	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.
Tomentypnum nitens	.	2	.	3	+	4	+	.	.	.	2	+	.	.	.	.	1	+	2	.	3	.	.	.	.	.	.	.	.	.
Tortella tortuosa	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tortula ruralis	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tripleurospermum phaeocephalum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Trisetum spicatum	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tritomaria quinquedentata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Vaccinium vitis-idaea ssp. minus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Warnstorfia exannulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.