THE 2009 YAMAL EXPEDITION TO OSTROV BELYY AND KHARP, YAMAL REGION, RUSSIA

DATA REPORT

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ABSTRACT

The overarching goal of the Yamal portion of the Greening of the Arctic project is to examine how the terrain and anthropogenic factors of reindeer herding and resource development combined with the climate variations on the Yamal Peninsula affect the spatial and temporal patterns of vegetation change and how these changes are in turn affecting traditional herding of the indigenous people of the region. Three expeditions to the Yamal region were made in 2007, 2008 and 2009 to conduct vegetation, soil, permafrost and remote sensing studies at locations along a transect that traverses all the major bioclimate subzones of the Yamal Peninsula.

Previous data reports (Walker et al. 2008, 2009a) summarized the data collected during the 2007 and 2008 expeditions to Nadym, Laborovaya, Vaskiny Dachi, and Kharasavey. This report presents the vegetation and soils data collected in 2009 at Ostrov Belyy (bioclimate subzone B) and Kharp (Forest-Tundra transition).

The studies at Ostrov Belyy followed the same basic procedures used at the locations visited in 2007 and 2008. Two study sites were established: one on a mesic loamy (zonal) site and the other on a drier sandy site. Most of the information was collected along 5 transects at each sample site, 5 permanent vegetation study plots (relevés), and 1 soil pit at each site. Most of the methods and data forms for the project are contained in the 2007 and 2008 data reports. The expedition also established permafrost and active-layer monitoring sites at the zonal site. The data from the permafrost studies will be presented in another report.

The data from Ostrov Belyy included: (1) a general description of the location and study sites with photographs, (2) maps of the study sites, study plots, and transects at each location, (3) tabular summaries of the vegetation, site factors, and soils at each relevé, (4) summaries of the Normalized Difference Vegetation Index (NDVI) and leaf area index (LAI) along each transect, (5) detailed soil descriptions and photos of the large soil pits at each study site, (6) contact information for each of the participants.

At Kharp observations were conducted during a one-day reconnaissance visit at the end of the expedition. A short report by Gerald Frost summarizes the observations.

The appendices to the report include: Appendix A — Names and addresses of the participants in the expedition; Appendix B — Vascular-plant species list from Ostrov Belyy; Appendix C — Soil descriptions of study sites; Appendix D — List of birds at Ostrov Belyy; Appendix E — List of mammals at Ostrov Belyy; Appendix F — Transect photos; Appendix G — Relevé vegetation and biomass photos; Appendix H — Relevé soil photos; Log of the 2009 Ostrov Belyy Expedition (attached).

This research is one component of the Greening of the Arctic (GOA) project of the International Polar Year (IPY) and is funded by NASA's Land-Cover Land-Use Change (LCLUC) program (Grant No. NNG6GE00A). It contributes to NASA's global-change observations regarding the consequences of declining Arctic sea ice and the greening of terrestrial vegetation that is occurring in northern latitudes. The work is also part of the Northern Eurasia Earth Science Partnership Initiative (NEESPI), and addresses questions regarding the local and hemispheric effects of anthropogenic changes to land use and climate in northern Eurasia.

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INTRODUCTION AND BACKGROUND

Aerial and ground survey transects

The 2009 Yamal expedition was conducted during the period 8 July to 1 August 2009. Members of the expedition are listed in Appendix A. A log of the expedition by D.A. Walker provides an overview of the daily activities with many photographs including photographs of all the expedition members (Log of the 2009 Ostrov Belyy Expedition). The routes of the helicopter portions of the expedition are shown in Figure 2. The locations of the all the Yamal study locations and other key points are shown in Figure 1.

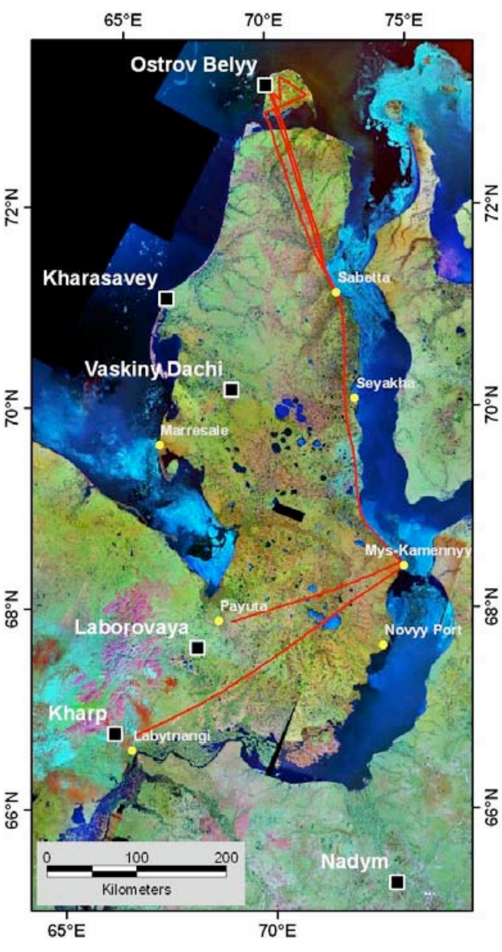

Figure 1. Yamal Peninsula region. The base map is part of a global Landsat TM orthorectified mosaic of Landsat images produced by the USGS using bands 7, 4, and 2. Map by Alaska Geobotany Center.

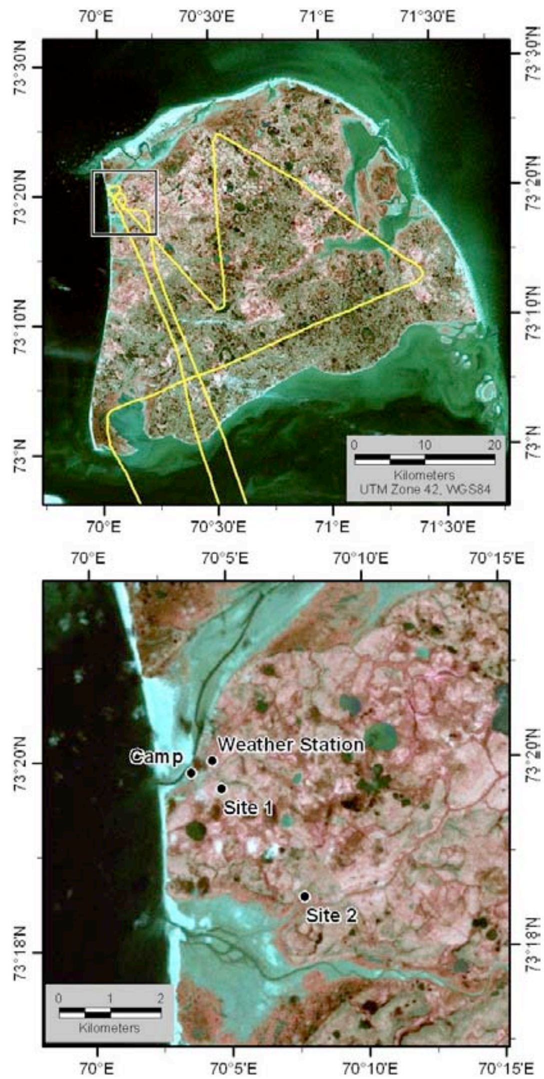

Figure 2. Ostrov Belyy. Top: Entire island with flight paths of the helicopter. See text in vegetation section for interpretation of the colors on the image. The image is a pan-sharpened Landsat ETM+ color composite (bands 4, 3 and 2) acquired Aug 15, 2008. Bottom: Detail of area near the weather station showing locations of study sites and reconnaissance transects. Maps by the Alaska Geobotany Center.

On 17 July, aerial observations of Ostrov Belyy were made from a helicopter along the flight pattern shown in Figure 2, at an altitude of 150 m. Most of the scientific ground observations were conducted during 17-30 July in the vicinity of the weather station on Ostrov Belyy (Figure 3). Reconnaissance observations were made along three transects, and covered a total of 31 km. The main part of the ground

Figure 3. Ostrov Belyy facilities. Top: View of the abandoned portion of the polar meterorological at Ostrov Belyy. The house where the expedition stayed is in the foreground. Middle: Popov Meteorological station built in 2005. Bottom: Building where the expedition was housed. The house was built in 1986. Photos: D.A. Walker, d9009DSC_1256, 1347, 1721,

observations were conducted at study sites 1 and 2 (Figure 2) and are described in the next section, which contains more detailed observations of the Ostrov Belyy location.

The Kharp location (Figure 1) was visited on 1 August, and is described in the section beginning on page 9. It contains more detailed observations of the Kharp location.

Ostrov Belyy (P. Orekhov, D.A. Walker)

Field work was carried out on Ostrov Belyy 17-30 July 2009, near the M.V. Popov polar meteorological station (73°19' N, 70°03' E) (Figure 3). Occupied since 1933, the station has been used as a base for a variety of purposes including meteorological and oceanographic observations, atmospheric studies using rockets, hydrocarbon exploration, and military operations. The older part of the station was temporarily abandoned after a rocket explosion in the 1990's. The new station was erected in 2005. Our expedition was housed in an abandoned building (Figure 3).

Physiography and Geology

Ostrov Belyy is just north of the Yamal Peninsula in the southern part of the Kara Sea (Figure 1). It is separated from the peninsula by the 15-30 km wide Malygin Strait. The island stretches 60 km from southwest to northeast, 58 km from northwest to southeast and is about 2000 km^2 (Figure 2). The island is mostly flat with some areas of very low hills. Relative elevations vary from 1 to 12 meters above sea level. It is mostly marshy with many lakes, particularly in the northeast and southeast parts of the island. The island is divided into two parts from east to southwest by the 34-km long valley complex of the Nabi-Pakha-yakha and the Pakha-yakha rivers, which is the location of a former strait.

The geological framework of the island is presented in several publications (Trofimov et al. 1987; Ershov, 1989; Baulin 1982a, b; Ganeshin, 1973) but still must be considered understudied. The best representation is given in a map of Quaternary deposits of the USSR at a scale of 1:2,500,000 (Ganeshin, 1973) (Figure 4). Marine and river-delta marine sediments cover the island. The age of the sediments varies from modern on the *laydas* (vegetated saline coastal mud flats, mIV in Figure 4) to the upper Pleistocene on the second marine terrace (amIII$_{3\text{-}4}$).

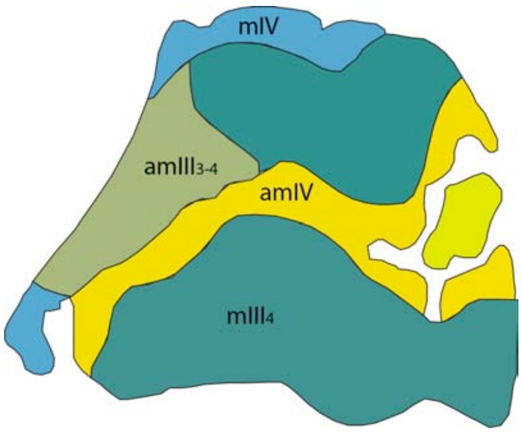

Figure 4. Surface deposits of Ostrov Belyy. Derived from Ganeshin (ed.) 1973.

The laydas (mIV) are composed of syngenetically frozen fine silty sands with interbedded loamy and sandy-loam bands with allochthonous peat lenses.

Holocene alluvial sediments (amIV) have loamy sand composition with organic inclusions and peat lenses. Sediments of this age are not more than 10-15 m thick (Dubikov, 2002).

The upper Pleistocene-Early Holocene marine and alluvial-marine sediments forming most of the island ($amIII_{3-4}$ and $mIII_4$) are up to 10-20 m thick and predominantly sandy, with alternating sandy and loamy layers — analogous to the situation on the northern Yamal Peninsula. Two marine terraces are recognized: The lower is designated marine terrace I and is predominantly sandy, and the upper marine terrace II is mixed sandy and loamy.

Permafrost

Permafrost thickness of the marine sediments of the modern layda is 30 m on the average, varying from 2-10 meters at the coastline to 50-80 m landwards. Permafrost thickness within marine terrace I ($mIII_4$) is from 65 to 165 m thick (average 125 m); within alluvial-marine terrace II ($amIII_{3-4}$), the average is 240 m (Trofimov et al., 1987).

Permafrost rock temperatures derived from well logs vary from -12.2 °C (on elevated areas formed by loamy sand and loamy permafrost with snow 0-10 cm), to -8.7 °C in areas with snow cover 50-60 cm thick (Popov and Trofimov, 1975). Permafrost development trend in this territory is aggradational (Baulin,1982).

Wells made in Holocene marine sediments found inter-permafrost water of the first hydrogeological complex (borehole 148-K, MSU). These waters were found below permafrost 1.5-2.5 m thick, and feature fairly slight head (1-2 m). The temperature of these waters were: within 4-8 m deep – minus 8.5°C; within 9.5 deep – minus 8.4°C. The water's salt content was 111.83 g/l, and the chemical composition of waters was chloride-sodium-magnesium (Ershov, 1989; Popov and Trofimov 1975).

Figure 5. Ice wedge polygons with thermokarst in the troughs between polygons. Photo P. Orekhov.

Ice-wedge polygons and thermokarst features are common over much of the island (Figure 5), and are also observed on lake bottoms, consistent with the observation of similar phenomena northwards of 71°30' (Baulin, 1982b) (Figure 6).

Non-sorted circles and small mounds with diameters of 30-40 cm to 1 m, occur on many surfaces with loamy soils.

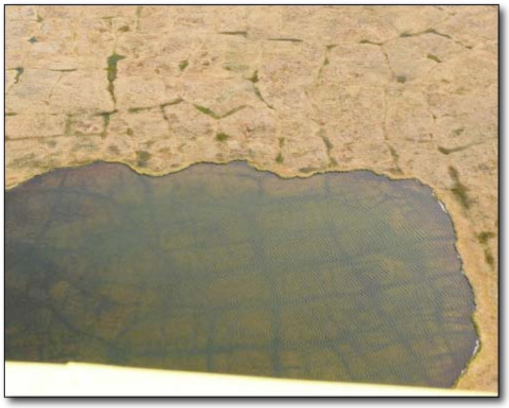

Figure 6. Ice-wedge polygons visible on bottom of lake. Photo P. Orekhov.

Climate

Climate information comes from unpublished data provided by personnel at the polar station. Ostrov Belyy has severe long winters, short cool summers and short transition seasons in the spring and autumn. The average annual air temperature is -10.6 °C. August is the warmest month with a mean temperature of 5.3 °C. In September the mean temperature starts descending rapidly, and on average, turns negative on September 27. The winter climate is unusual for a lack of a pronounced temperature minimum in one of the winter months, i.e. "nucleus-free" winters. This is explained by strong advection of warm air brought by cyclones from the west and heat emission by the Kara Sea. The average monthly temperature in December-March varies from -20.2 to -24.4 °C. The mean temperatures start to rise rapidly in April, and on average become positive in mid June.

Winds are dominantly from the southern quarter from November till February and are associated with cyclonic activity in the Kara Sea. During May-August, the most frequent winds are from the north and northeast. No marked dominance of wind direction is observed during the other months.

Annual precipitation is 258 mm. Precipitation in winter (November-March) averages 87 mm, and during the rest of the year (April-October) the average is 171 mm. The maximum precipitation normally is in August (average of 20 mm) and the driest month is April (14 mm).

Snow depths increase from an average of 11 cm in the second ten-day period of October to 50 cm in the first ten-day period of May, and then rapidly decrease to 20 cm in the second ten-day period of June. Snow starts melting at an average daily air temperature of -1.2 to 1.3 °C. The average transition through the thawing event is June 11.

Flora, landscape and vegetation

The only previous description of the flora on Ostrov Belyy is from Rebristaya (1995), who visited the southeast part and recorded 75 species of vascular plants. The ten leading families of the island flora comprise 69 species (92%). The most diverse families are Poaceae (20 species), Cyperaceae (11 species) and Ranunculaceae (9 species). The families Caryophyllaceae and Brassicaceae comprise 7 species each; Saxifragaceae – 6 species; Juncaceae, Salicaceae and Rosaceae – 3 species each; Polygonaceae – 2 species. The families Equisetaceae, Huperziaceae, Liliaceae, Ericaceae, Scrophulariaceae, and Asteraceae have one representative each.

Ostrov Belyy was the only location along the Yamal transect where we attempted to make a complete list of vascular plants for the location. Olga Khitun noted 65 species in the vicinity of the polar station (Appendix B).

An overview of the landscapes and vegetation of the island is described below with reference to the Landsat image in Figure 2. Three distinct landscapes can be distinguished by their dominant colors on the image:

(1) *Fine-grained loamy sediments with mesic and wet vegetation*. Loamy soils occur in the northwest part of the island (including much of the area near the polar station) and other scattered locations around the island. These areas have light pinkish and reddish tones on the Landsat image, which are caused by the more or less continuous cover of vascular plants and mosses. Much of the

rest of the island is covered by sparser vegetation that grows on the sandy soils (see paragraph 2). The pink tones in the image are associated with moist tundra meadows, and the redder tones are predominantly wetlands.

Zonal vegetation is rare on the island because of the wetness of the island and the sandy substrates, but zonal communities do occur on a few moderately drained sites with loamy soils. Our Ostrov Belyy-1 study site (zonal site; 73°18.564' N 70°07.758' E) is located on a zonal site near the polar station on a low interfluve with abundant non-sorted circles (Figure 7).

We sampled two dominant plant communities within the Ostrov Belyy-1 study site (Figures 7 and 8). One occurred in association with the moist graminoid-dominated areas between non-sorted circles and the other occurred on the more barren and drier centers of the circles. (See Figure 8 caption for common species.) Most areas near the station are wetter than the Ostrov Belyy-1 study site and plant communities are dominated by sedges, grasses, and mosses (*Eriophorum angustifolium, Carex aquatilis, Dupontia fisheri, Arctophila fulva, Drepanocladus* spp., *Sphagnum* spp.).

Figure 7. Ostrov Belyy-1 study site (loamy site) from the southeast corner. The polar station is in the background. Photo DSC_1480, 7/22/2009, D.A. Walker.

Figure 8. Non-sorted circles at Ostrov Belyy-1. Diameter of the circles is about 50 cm. The plant species in the moist graminoid-dominated areas between the circles include* Carex bigelowii, Salix polaris, Calamagrostis holmii, Arctagrostis latifolia, Poa arctica, Hylocomium splendens, Aulacomnium turgidum, Dicranum *spp.,* Ptilidium ciliare, Polytrichum strictum, Sphaerophorus globosus, *and* Cladonia arbuscula*. The centers of circles are more barren and drier, and the dominant species are* Dryas integrifolia, Arctagrostis latifolia, Salix polaris, Racomitrium lanuginosum, Sphaerophorus globosus, Ochrolechia frigida, Bryocaulon divergens *and* Anthelia juratskana*). Photo DSC_1624, 7/22/2009, D.A. Walker.

(2) *Sandy sediments with many lakes and well-drained poorly vegetated margins along streams and lakes.* Much of the island is covered by sandy sediments. Areas with sandy soils along most stream bluffs and lake margins are relatively well-drained and have sparse vascular plant cover. The well-drained surfaces between the lakes appear gray on the Landsat image. Most of the plant cover is provided by crustose liverworts, lichens, and mosses. This describes our Ostrov Belyy-2 study site, located on a low well-drained bluff of a small stream about 2 km southeast of the polar station (Figure 9 and 10).

Figure 9. Ostrov Belyy-2 study site (sandy site). Photo DSC_1480, 7/22/09, D.A. Walker.

Figure 10. Small nonsorted polygons at Ostrov Belyy-2 study site. Diameter of the polygons is about 20-50 cm. The gray crust is composed primarily of the liverwort,* Gymnomitrion corallioides. *The moss in the polygon cracks is* Racomitrium lanuginosum. *Other common species include* Salix nummularia *and* Luzula confusa. *Photo DSC_1561, 7/22/09, D.A. Walker.

(3) *Coastal areas and estuaries.* The coastal areas and estuaries of the larger streams have saline mud flats (laydas) with graminoid-dominated meadows (*Carex subspathacea, C. glareosa, Puccinellia phryganodes, Dupontia fisheri*, *Stellaria humifusa* communities) (Figure 11). Like other wetlands on the island, the laydas have mainly reddish colors on the satellite image.

Barren mud flats are common along the coast, major estuaries, and larger stream channels that are near the coast. Wide sandy beaches are also common, especially along the north and northeast shorelines of the island.

Figure 11. Layda vegetation along the coast northeast of the polar station. Photo P. Orekhov.

Some of the coastal bluffs have more well drained habitats, and communities with sparse *Luzula confusa*, few grasses (*Calamagrostis holmii, Poa arctica, Deschampsia obensis*) and a variety of lichens, including *Cetraria delisei, Cladonia rangiferina, Solarina croces, Ochrolechia frigida,* and *Stereocaulon alpinum*.

Soils

No previous soil surveys have been conducted on the island. Our surveys focused on soils at the two primary study sites.

Figure 12. Horizontal soil pit at Ostrov Belly-1 study site (loamy site), after the vegetation mat was removed. Photo G. Matyshak.

Processes related to frost cracking and differential frost heave play a major role in the fine scale soil patterns at both sites. After the vegetation mat was removed, the polygonal pattern caused by frost cracking was exposed (Figure 12). Thick organic soil horizons occurred in the polygon cracks at both sites and were deepest on the mesic zonal site. Descriptions of the soils are in Appendix C.

Fauna

A total of 8 mammal species have been recorded on the island, of which we observed 5 in 2009 (Appendix E). Additionally, video footage taken by weather station personnel documented the occurrence of polar bears (*Ursus maritima*) in spring 2009.

Figure 13. Siberian brown lemming. Photo Pavel Orekhov.

Characteristic year-round resident mammals on the island include wild reindeer, (*Rangifer tarandus*), Arctic fox (*Alopex lagopus*), Arctic lemming (*Dicrostonyx torquatous*) and Siberian brown lemming (*Lemmus sibiricus*, Figure 13). At present the Department of Biological Resources of Yamal-Nenets Autonomous District is considering the question of introducing musk ox (*Ovibos moschatus*) to the island.

During helicopter reconnaissance over the island on 17 July, one observer (Frost) counted a total of 426 reindeer, including approximately 50 young calves. Thus it is likely that the total reindeer population on the island currently exceeds 1000 animals.

Previous avifaunal studies by Sosin and Paskhal'niy (1995) and Tyulin (1938) documented 51 species of birds on the island. We observed 37 of these species during our field work, as well as an additional 9 species not previously seen on the island (Appendix D). Of the 46 bird species we observed, 11 were confirmed to be breeding and an additional 5 species probably bred in 2009. Regular observations of large numbers of non-breeding Bar-tailed Godwit (*Limosa lapponica*) and Dunlin (*Calidris alpina*), indicate that the island is an important foraging area for migrant shorebirds.

Figure 14. Greater White-fronted Goose. Photo Pavel Orekhov.

Typical summer inhabitants include geese (Figure 14), eiders, loons, shorebirds, gulls, and songbirds. Snowy Owl (*Bubo scandiaca*) and Pomarine Jaeger (*Stercorarius pomarinus*) are common predators, while diurnal raptors such as Rough-legged Hawk (*Buteo lagopus*) and White-tailed Eagle (*Haliaetus albicilla*) occur at low densities. Shorebirds, gulls, and allies (order Charadriiformes) were the most diverse species-group observed in 2009 (22 species), followed by songbirds (Passeriformes; 10 species) and waterfowl (Anseriformes; 9 species).

Social-cultural importance of the island

Ostrov Belyy embodies the traditions and beliefs of Nenets people. The Nenets name of the island is Ser-ngo, which can be translated as "Ice Island". In legends it was inhabited by one of deity-spirits of the Nenets pantheon — Ser Irike or Ser-ngo Irike, which is translated as "Old Man Ice" or "White Old Man" or "Old Man of the Ice Island".

Archeological sites on the island were first described by Yevaldov in his diaries written during his trip to the island in 1928-1929. Several unusual and culturally important religious sites occur along the southern coast of the island. Three of the largest are briefly described below (also see http://bva.wmsite.ru/problemy-vzaimodejstvija/vypusk1/lar/; http://www.ipdn.ru/rics/doc0/DA/a4/3-lar.htm)

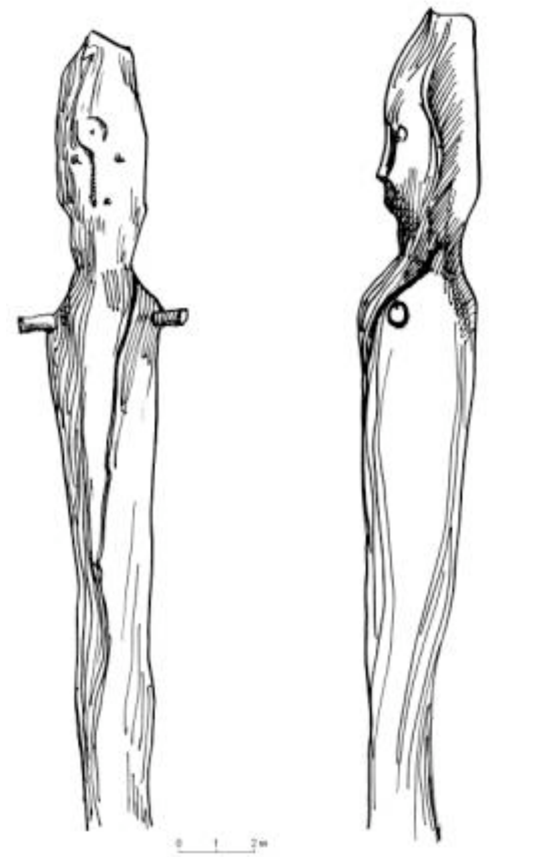

Figure 15. Idol of Ser Irike, principal defender of the Yamalne deity. (http://www.ipdn.ru/rics/doc0/DA/a4/3-lar.htm).

Near Khakhensale, facing the Yamal Peninsula, stands the image of Sero Irike, principal defender of the Yamalne deity (Figure 15). Roughly tooled logs and planks are at his feet. Beside him are the horns and skulls of reindeer and marine animals, and hanging on the horns are shreds of fabric and leather belts with metal pendants. The wooden idol is a long-headed figure about 2.5 m high with an expressive face, with hands shaped like stumps. Ser Irike is the first to face the attack of Ngerma (Deity of North) and mitigates the impact on the people.

At the Tabelovo holy site, hanging on sacred perches of rawhide tents (*sim'sy*) and shoved into the soil, are skulls of polar bears and reindeer. A small pile of reindeer skulls and horns lies on the earth, and shreds of fabric are tied on the horns. Wooden figures of idols are thrust into soil; some of them are leaning against the tent.

At Ilibembertya (Malygin Strait), there is a sacrificial place for the Ilibembertya deity. This name combines two notions – *Ilebts* (life, prosperity, household, wild deer) and *Perts'* (make, hold, call). The principal and primary concern of Ilebembertya was to protect wild deer. However, with the advent of deer farming his concern covers the domestic deer, too.

Therefore Ilebembertya is called "Patron of deer". Nenets legend has it that he goes around the entire earth to give people deer. Nenets also consider him the first reindeer breeder, as well as master and guardian of deer. The skulls found here are mostly of wild reindeer. Shreds hanging on the horns are mostly woolen cloth. Among the offerings are axes, nails, kettle tags and other objects. There are no signs of fresh sacrifices.

Kharp (G.V. Frost)

Comparison of two high-resolution satellite images (Corona, 19 August 1968; and Quickbird, 24 July 2003), indicate dramatic expansion of tall shrublands in uplands near the town of Kharp (Figure 16 and 17), about 30 km northwest of Labytnangi. The Kharp study site is within a broad ecotone of boreal forest and arctic tundra.

G. Frost, D.A. Walker, R. Daanen, and G. Matyshak walked to the Kharp site on 1 August 2009, and made general observations of vegetation, geomorphology, and disturbance history, while returning from Belyy Ostrov as part of the NASA-funded Yamal transect project. It is a primary study area for the doctoral research of Gerald Frost, University of Virginia.

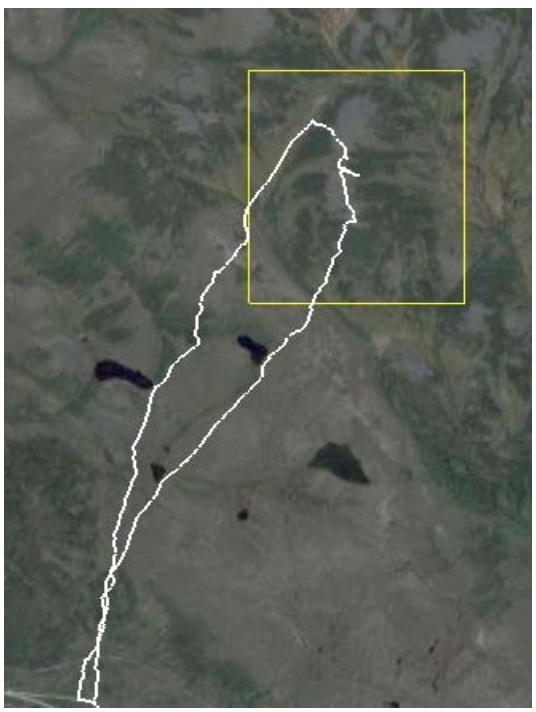

Figure 16. GPS track log of field visit to Kharp study site. The primary observations were made in the area outlined in yellow in the vicinity of 66˚ 48' 12''N, 65˚ 57' 39"W. The start and end of the reconnaissance trip was the road between Kharp and Labytnangi in the lower left corner of the image.

A dramatic increase in shrub cover (dark patches, Figures 16 and 17) is apparent over the 35-year interval. Most of the expansion has occurred in areas that were affected by a wildfire that occurred ~100 years ago.

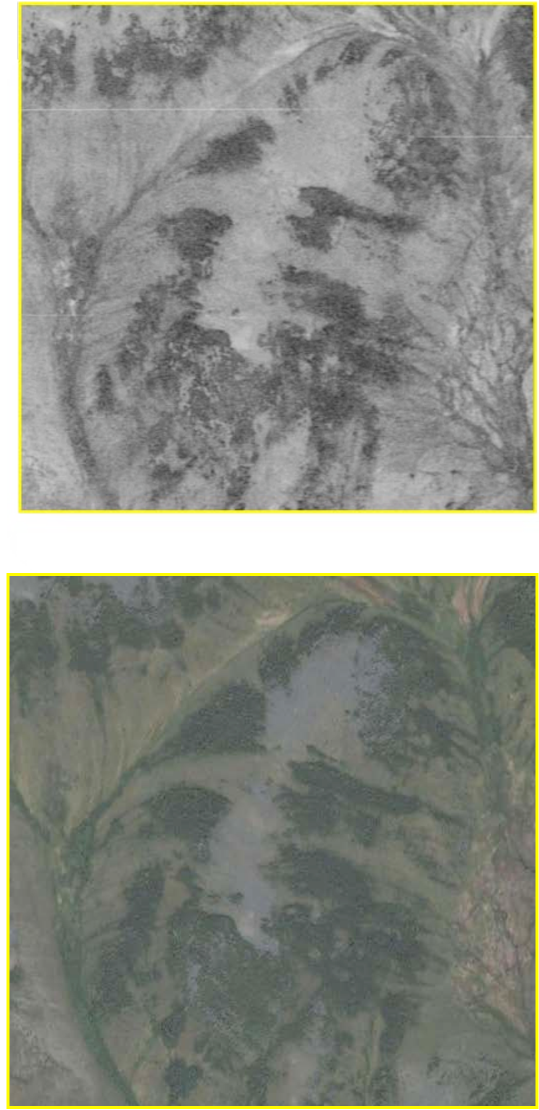

Figure 17. Corona (1968, Top) and Quickbird (2003, bottom) images of a shrubland-tundra ecotone on a gently-sloping ridge near Kharp. The area of the yellow box in Figure 16 is shown in both images and is approximately 1.5 km in the vertical dimension.

The area within the yellow rectangle in Figure 16 was the primary objective for field reconnaissance and was accessed via a moderately easy ~4.8 km hike from the Kharp-Labytnangi road, beginning at a point ~5 km southeast of Kharp.

The surficial geology of the Kharp region is dominated by fluvio-glacial outwash from the nearby polar Ural Mountains. Although soils were not systematically investigated, coarse fragments were conspicuous at or near the surface virtually everywhere, except on frostboils and in lowland areas with thick accumulations of organic material. Coarse fragments consisted of angular and sub-rounded blocks and cobbles, and exhibited diverse lithologies. Cryogenic sorted and nonsorted circles were abundant throughout most of the study area and were particularly conspicuous on sparsely-vegetated ridgetops (Figure 18).

Figure 18 Sorted- and nonsorted circles are abundant in the Kharp study area and are conspicuous in sparsely vegetated areas. Photo: D.A. Walker.

Common vegetation types observed in the area include tall shrublands dominated by alder (*Alnus fruticosa*) with inclusions of Siberian larch (*Larix sibirica*) and willow (*Salix* spp.) (dark photo-signature in Figure 17 and Figure 19). The light green photo-signature in the Corona image (Figure 17 bottom) corresponds to low-growing dwarf birch (*Betula nana*), ericaceous shrubs (e.g., *Ledum palustre*, *Vaccinium* spp.), and sedges, while the gray photo-signatures occur on ridge tops and correspond to sparsely vegetated dwarf shrub tundra with well-developed sorted and nonsorted circles.

Figure 19. Mature larches are only found in association with closed alder thickets (background) . Photo: D.A. Walker.

Numerous larch snags and cut stumps were encountered in the Kharp study area; charring found on some of the snags indicated that the area had been disturbed by wildfire (Figure 20). Soil pits dug among the snags revealed charcoal at the bottom of the surface organic layer, indicating that antecedent organic material was largely consumed (Figure 21).

Figure 20. Fire-killed larches are abundant following a wildfire that occurred ~100 years ago. Photo: D.A. Walker.

Figure 21. Charcoal is evident beneath the surface organic layer, indicating that antecedent organics were removed by fire. Photo: G.V. Frost.

Although the age of the fire is unknown, it is clear that fire occurred prior to the 1968 Corona photography. The weathered condition of fire-killed snags and fallen logs, and the presence of substantial organic material above the charcoal layer in soil pits, suggest that the wildfire occurred on the order of ~100 YBP or more.

On the landscape scale, the spatial distribution of tall shrubs and trees displayed conspicuous patterns in relation to the apparent footprint of intense fire disturbance. First, mature Siberian larches are almost exclusively located within relatively extensive, closed tall alder thickets that were already present in the 1968 Corona photography. This pattern suggests that the alder stands created relatively inflammable firebreaks, which protected trees from wildfire. Additionally, virtually all upland areas in which alder has expanded contain abundant evidence of wildfire (e.g., charred logs, buried charcoal, thin surface organic layers), indicating that alder has aggressively colonized burnt-over areas while undisturbed sites remain little-changed.

On the scale of microtopographic patterned-ground features (~10 m), the distribution of young, post-1968 alders indicates that alder recruitment is highly concentrated on mineral-dominated nonsorted-circle centers, rather than organic-rich inter-circle areas (Figures 22 and 23).

Figure 22. The regular spacing of alders in open shrublands reflect underlying patterned-ground features. Photo: D.A. Walker.

Figure 23 Young alders growing on patterned ground are primarily found in centers nonsorted circles with mineral-dominated soils. Photo: D.A. Walker.

Thus, there are two lines of evidence suggesting that alder expansion in the vicinity of Kharp is localized in areas where soils are mineral-dominated as a result of an active disturbance regime. This relationship may be critical to understanding recent vegetation dynamics in ecotonal areas elsewhere in the Pan-Arctic, particularly for "hotspots" of increased productivity evident in NDVI time-series. For example, field observations on the Yamal Peninsula indicate rapid colonization of landslide features by willows, which are much more productive than the antecedent sedge- and nonvascular-dominated vegetation. In addition, differential shrub recruitment on patterned-ground features constitutes a potential explanation for the open, regular spacing of shrubs commonly found in ecotonal areas of the Arctic.

A two-week field campaign at the Kharp site is currently planned for July 2010 to support testing of hypotheses prompted by this reconnaissance trip.

METHODS

The primary sampling methods used at the Ostrov Belyy study sites were the same as those used in 2007 and 2008 at previously surveyed Yamal transect locations. Readers should refer to the 2008 report (Walker et al. 2009a) for details of the sampling methods:

50-m transects

Criteria for site selection, size, arrangement and marking methods:

Walker et al. 2009a, p. 12-14. GPS coordinates were recorded at the south (00m) and north ends (50m) of each transect. Transect numbers on aluminum-tag markers have a prefix of BO_ (Belyy Ostrov) followed by the transect number and the distance along the transect (e.g. BO_T51_00m to designate the south end of the transect T51.)

Species cover along transects using the Buckner point-intercept sampling device:

Walker et al. 2009a, p. 14.

Normalized Difference Vegetation Index (NDVI) and leaf-area index (LAI) measurements:

Walker et al. 2009a, p. 14-15.

Relevés

Criteria for site selection, size, arrangement and marking methods:

Walker et al. 2009a, p. 12-14. Relevé numbers on aluminum-tag markers have the prefix of BO_ (Belyy Ostrov) followed by the relevé number (e.g. BO_RV49). (Note: the relevé number 49 was also used at Kharasavey so in the data tables KH_RV49* was used to distinguish the relevé at Kharasavey). GPS coordinates were recorded at the southwest corner of all 5 x 5-m relevé plots.

At both sites 1 and 2 (loamy site and clayey site), there were abundant patterned-ground features (nonsorted circles at Site 1 and small nonsorted polygons at Site 2) with distinctively different vegetation and soils on the centers of the features compared to the areas between the features. Therefore, two sub-relevés were sampled within relevés 49 to 58, and given relevé number suffixes *a* (centers of features) and *b* (areas between features). For example at Site 1 Relevé 49, the number BO_RV49a refers to the areas within nonsorted circles and BO_RV49b refers to the areas between the circles. At Site 2, releve BO_RV54a refers to the areas within small nonsorted polygons, and BO_RV54b refers to the cracks between the polygons. The sub-relevé designations are included in the data tables but are not marked in the field.

Relevé site factors and species cover abundance:

Walker et al. 2009a, p. 15-16.

Soil sampling at relevés:

Walker et al. 2009a, p. 18.

Detailed soil descriptions at each site by G. Matyshak:

Walker et al. 2009a, p. 18 and p. 60-76.

Biomass sampling at relevés:

Walker et al. 2009a, p. 17 and Appendix D. Biomass was sampled from a 20 x 50-cm plot in the center of each relevé. Relevé numbers on aluminum-tag markers at biomass sample sites have the prefix of BO_ (Belyy Ostrov) followed by the relevé number and then BM to designate biomass plot (e.g. BO_RV49_BM).

Ground surface temperature measurement, and n-factors, (ibutton placement):

Walker et al. 2009a, p. 16-17.

Active layer measurements along transects:

Active layer thickness was measured at 5-m intervals along the five transects at Site 1 (loamy site), but not along the transects at Site 2 (sandy site). However, at both sites 1 and 2, active layer thickness was measured on each of the relevés and is noted in the site characteristics of each study plot (Table 7).

Other observations

Plant species list

Ostrov Belyy is the only location along the Yamal transect where we attempted to make a complete list of vascular plants for the location. The list by Dr. Olga Khitun is in Appendix B.

Fauna species lists

Lists of bird and mammal species observed during the expedition are in Appendices D and E.

RESULTS

Maps of study sites

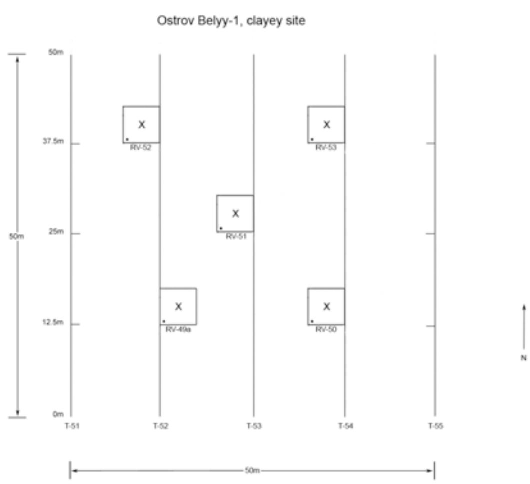

Figure 24. Map of transects and vegetation study plots at Ostrov Belyy-1.

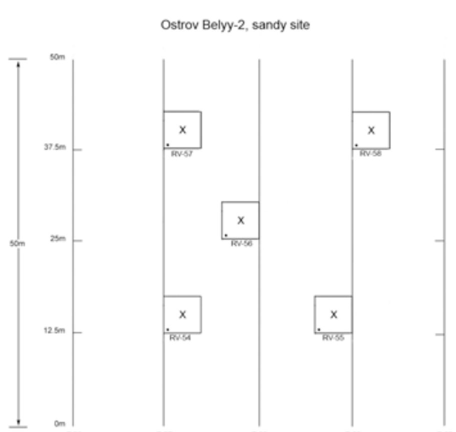

Figure 25. Map of transects and vegetation study plots at Ostrov Belyy-2.

Table 1. GPS coordinates and elevations of vegetation study plots and transects. LA = Laborovaya, ND = Nadym, VD = Vaskiny Dachi. KH = Kharasavey, BO = Belyy Ostrov RV = Relevé, T = Transect. Coordinates are recorded at the southwest corner of each grid, and at both ends of the transects (00 and 50 m).

Description	North	East	Altitude	Site
LA Camp	67 42.210	068 01.089	72	NA
LA RV 15	67 42.397	067 59.946	79	1
LA RV 16	67 42.387	067 59.970	79	1
LA RV 17	67 42.396	067 59.971	79	1
LA RV 18	67 42.406	067 59.969	77	1
LA RV 19	67 42.397	067 59.995	78	1
LA RV 20	67 41.691	068.02.244	63	2
LA RV 21	67 41.684	068 02.283	59	2
LA RV 22	67 41.694	068 02.270	64	2
LA RV 23	67 41.703	068 02.277	62	2
LA RV 24	67 41.696	068 02.301	63	2
LA T09 00m	67 42.396	067 59.920	79	1
LA T09 50m	67 42.416	067 59.970	79	1
LA T10 00m	67 42.391	067 59.934	79	1
LA T10 50m	67 42.411	067 59.984	79	1
LA T11 00m	67 42.387	067 59.946	80	1
LA T11 50m	67 42.406	067 59.995	79	1
LA T12 00m	67 42.383	067 59.959	80	1
LA T12 50m	67 42.402	068 00.008	80	1
LA T13 00m	67 42.378	067 59.971	81	1
LA T13 50m	67 42.398	068 00.019	81	1
LA T14 00m	67 41.692	068 02.230	60	2
LA T14 50m	67 41.712	068 02.273	62	2
LA T15 00m	67 41.689	068 02.243	61	2
LA T15 50m	67 41.709	068 02.287	64	2
LA T16 00m	67 41.684	068 02.255	61	2
LA T16 50m	67 41.705	068 02.301	64	2
LA T17 00m	67 41.679	068 02.269	58	2
LA T17 50m	67 41.700	068 02.315	61	2
LA T18 00m	67 41.675	068 02.286	60	2
LA T18 50m	67 41.696	068 02.330	63	2
ND Camp	65 18.873	072 52.841	24	NA
ND RV 01	65 18.810	072 53.226	32	1
ND RV 02	65 18.794	072 53.277	28	1
ND RV 03	65 18.811	072 53.274	18	1
ND RV 04	65 18.831	072 53.261	27	1
ND RV 05	65 18.814	072 53.314	26	1
ND RV 06	65 18.883	072 51.703	23	2
ND RV 07	65 18.863	072 51.695	22	2
ND RV 08	65 18.888	072 51.785	23	2
ND RV 09	65 18.884	072 51.702	21	2
ND RV 10	65 18.867	072 51.703	21	2
ND RV 11	65 18.887	072 51.785	21	2

Description	North	East	Altitude	Site
ND RV 12	65 18.825	072 51,737	22	2
ND RV 13	65 18.824	072 51.803	16	2
ND RV 14	65 18.828	072 51.831	23	2
ND T01 000r	65 18.810	072 53.186	27	1
ND T01 100r	65 18.855	072 53.272	36	1
ND T02 000r	65 18.799	072 53.208	18	1
ND T02 100r	65 18.843	072 53.288	31	1
ND T03 000r	65 18.793	072 53.232	28	1
ND T03 100r	65 18.834	072 53.307	28	1
ND T04 000r	65 18.783	072 53.258	28	1
ND T04 100r	65 18.824	072 53.331	27	1
ND T05 000r	65 18.775	072 53.281	31	1
ND T05 100r	65 18.817	072 53.356	31	1
ND T06 000r	65 18.828	072 51.730	17	2
ND T07 000r	65 18.885	072 51.716	23	2
ND T08 100r	65 18.833	072 51.861	18	2
VD Camp	70 17.214	068 53.655	29	NA
VD RV 25	70 16.540	068 53.446	38	1
VD RV 26	70 16.528	068 53.465	40	1
VD RV 27	70 16.538	068 53.469	40	1
VD RV 28	70 16.547	068 53.475	41	1
VD RV 29	70 16.536	068 53.498	41	1
VD RV 30	70 17.734	068 53.027	27	2
VD RV 31	70 17.731	068 53.065	29	2
VD RV 32	70 17.739	068 53.052	29	2
VD RV 33	70 17.747	068 53.038	30	2
VD RV 34	70 17.744	068 53.077	31	2
VD RV 35	70 18.088	068 50.519	15	3
VD RV 36	70 18.031	068 50.587	14	3
VD RV 37	70 18.060	068 50.580	13	3
VD RV 38	70 18.097	068 50.554	15	3
VD RV 39	70 18.031	068.50.625	10	3
VD T19 00m	70 16.542	068 53.417	45	1
VD T19 50m	70 16.557	068 53.484	41	1
VD T20 00m	70 16.537	068 53.427	46	1
VD T20 50m	70 16.551	068 53.495	41	1
VD T21 00m	70 16.529	068 53.441	42	1
VD T21 50m	70 16.545	068 53.506	41	1
VD T22 00m	70 16.524	068 53.451	39	1
VD T22 50m	70 16.540	068 53.517	40	1
VD T23 00m	70 16.519	068 53.461	39	1
VD T23 50m	70 16.535	068 53.527	41	1
VD T24 00m	70 17.729	068 53.004	30	2

Description	North	East	Altitude	Site
VD T24 50m	70 17.756	068 53.020	29	2
VD T25 00m	70 17.728	068 53.024	32	2
VD T25 50m	70 17.754	068 53.041	28	2
VD T26 00m	70 17.726	068 53.043	32	2
VD T26 50m	70 17.752	068 53.061	30	2
VD T27 00m	70 17.725	068 53.062	28	2
VD T27 50m	70 17.751	068 53.080	28	2
VD T28 00m	70 17.723	068 53.082	28	2
VD T28 50m	70 17.750	068 53.099	32	2
VD T29 00m	70 18.076	068 50.470	4	3
VD T29 50m	70 18.100	068 50.514	4	3
VD T30 00m	70 18.083	068 50.504	15	3
VD T30 50m	70 18.099	068 50.565	9	3
VD T31 00m	70 18.047	068 50.564	14	3
VD T31 50m	70 18.072	068 50.595	13	3
VD T32 00m	70 18.031	068 50.567	14	3
VD T32 50m	70 18.031	068 50.645	11	3
VD T33 00m	70 18.019	068 50.542	14	3
VD T33 50m	70 18.024	068 50.620	12	3
VD T34 00m	70 17.470	068 52.432	14	4
VD T34 50m	70 17.488	068 52.372	16	4
VD T35 00m	70 17.422	068 51.823	13	5
VD T35 50m	70 17.402	068 51.763	17	5
KH Camp	71 11.075	066 52.166	3	NA
KH RV 40	71 10.723	066 58.778	16	1
KH RV 41	71 10.719	066 58.819	16	1
KH RV 42	71 10.727	066 58.803	16	1
KH RV 43	71 10.738	066 58.778	16	1
KH RV 44	71 10.733	066 58.828	16	1
KH RV 45	71 11.663	066 53.337	8	2a
KH RV 46	71 11.667	066 53.341	8	2a
KH RV 47	71 11.664	066 55.719	13	2b
KH RV 48	71 11.667	066 55.731	13	2b
KH RV 49	71 11.632	066 56.071	13	2b
KH T36 00m	71 10.719	066 58.750	16	1
KH T36 50m	71 10.745	066 58.770	16	1
KH T37 00m	71 10.717	066 58.771	16	1
KH T37 50m	71 10.742	066 58.792	16	1
KH T38 00m	71 10.715	066 58.790	16	1
KH T38 50m	71 10.741	066 58.811	16	1
KH T39 00m	71 10.714	066 58.810	16	1
KH T39 50m	71 10.739	066 58.832	16	1
KH T40 00m	71 10.712	066 58.829	16	1

Description	North	East	Altitude	Site
KH T40 50m	71 10.737	066 58.85	16	1
KH T41 00m	71 11.633	066 53.33	8	2a
KH T41 10m	71 11.668	066 53.33	8	2a
KH T45 00m	71 11.666	066 53.35	8	2a
KH T45 10m	71 11.670	066 53.34	8	2a
KH T46 00m	71 11.664	066 55.71	12	2b
KH T46 10m	71 11.670	066 55.72	12	2b
KH T50 00m	71 11.664	066 55.73	12	2b
KH T50 10m	71 11.669	066 55.73	12	2b
BO Camp	73 33.195	070 61.12	3	NA
BO RV 49	73 19.713	070 04.67	0.3	1
BO RV 50	73 19.713	070 04.71	0.4	1
BO RV 51	73 19.719	070 04.69	0.6	1
BO RV 52	73 19.726	070 04.66	0.4	1
BO RV 53	73 19.726	070 04.71	0.8	1
BO RV 54	73 18.553	070 07.72	0.3	2
BO RV 55	73 18.555	070 07.76	0	2
BO RV 56	73 18.564	070 07.73	0.4	2
BO RV 57	73 18.566	070 07.71	0.8	2
BO RV 58	73 18.568	070 07.76	0.1	2
BO T51 00m	73 19.705	070 4.742	0.8	1
BO T51 50m	73 19.732	070 4.721	2	1
BO T52 00m	73 19.705	070 4.721	0.3	1
BO T52 50m	73 19.732	070 4.675	0.2	1
BO T53 00m	73 19.706	070 4.699	0.2	1
BO T53 50m	73 19.732	070 4.699	0.2	1
BO T54 00m	73 19.706	070 4.674	0.2	1
BO T54 50m	73 19.732	070 4.720	0.2	1
BO T55 00m	73 19.706	070 4.652	0.7	1
BO T55 50m	73 19.732	070 4.743	1.5	1
BO T56 00m	73 18.544	070 7.709	0.5	2
BO T56 50m	73 18.571	070 7.694	0.2	2
BO T57 00m	73 18.546	070 7.730	0.2	2
BO T57 50m	73 18.572	070 7.717	0.3	2
BO T58 00m	73 18.546	070 7.754	0.3	2
BO T58 50m	73 18.573	070 7.740	0.3	2
BO T59 00m	73 18.547	070 7.775	0.9	2
BO T59 50m	73 18.574	070 7.765	0.5	2
BO T60 00m	73 18.549	070 7.799	0.2	2
BO T60 50m	73 18.575	070 7.787	0.6	2

Table 2. Study locations, site numbers, site name, geological settings, and dominant vegetation at each study site.

Location and site no.	Site name	Microsite	Geological setting, parent material	Location and site no.	Dominant vegetation
Nadym-1	Forest site		Fluvial terrace II, Karga-age, (about 20-40 kya), alluvial sands	Nadym-1	*Pinus sylvestris-Ledum palustre-Cladonia stellaris* lichen-woodland
Nadym-2a	CALM-grid site	Hummocks	Fluvial terrace III, Zyranski-age, (about 60-80 kya), alluvial sands	Nadym-2a	*Ledum palustre-Betula nana-Cladonia stellaris*dwarf-shrub, lichen tundra
Nadym-2b		Inter-hummocks		Nadym-2b	*Cladonia stellaris-Carex glomerata* lichen tundra
Laborovaya-1	Clay-site		III glacial terrace, Ermakovsky-age, (about 50-110 kya), clay	Laborovaya-1	*Carex bigelowii-Betula nana-Aulacomnium palustre* sedge, dwarf-shrub, moss tundra
Laborovaya-2	Sand site		Alluvial sand of stream	Laborovaya-2	*Betula nana-Vaccinium vitis-idaea-Sphaerophorus globosus-Polygrichum stirctum* prostrate dwarf-shrub, lichen tundra
Vaskiny Dachi-1	Terrace IV site		Coastal marine plain, Kazantsevskaya-age (Eamian-age 130-117 kya), marine clays	Vaskiny Dachi-1	*Carex bigelowii-Vaccinium vitis idaea-Hylocomium splendens* sedge, dwarf-shrub, moss tundra
Vaskiny Dachi-2	Terrace III site		Fluvial-marine terrace, (middle-Wiechselian, 75-25 kya), mixed alluvial sands and marine clays	Vaskiny Dachi-2	*Betula nana-Calamagrostis holmii-Aulacomnium turgidu* dwarf-shrub, graminoid, moss tundra
Vaskiny Dachi-3	Terrace II site		Fluvial terrace, (late-Wiechselian, 25-10 kya), alluvial and eolian reworked sands	Vaskiny Dachi-3	*Vaccinium vitis idaea-Cladonia arbuscula-Racomitrium lanuginosum* prostrate dwarf-shrub, sedge, lichen, tundra
Kharasavey-1	Clay site		II marine terraces, Karginsky-age, (about 20-40 kya), marine clays	Kharasavey-1	*Carex bigelowii-Calamagrostis holmi-Salix polaris-Dicranum elongatum-Cladonia* spp. graminoid, prostrate dwarf-shrub, moss tundra
Kharasavey-2a	Sand site		Marine terrace I (Sartansky-age, about 10-22 kya) marine clays with eolian reworked sands on surfaces	Kharasavey-2a	*Carex bigeolowii-Salix nummularia-Dicranum*sp., *Cladonia*spp. Graminoid, prostrate dwarf-shrub, moss, lichen tundra
Kharasavey-2b	Sand site		Marine terrace II (Karginsky-age, about 20-40 kya) marine sands and clays	Kharasavey-2b	*Salix nummularia-Luzula confusa-Polytrichum strictum-Sphaerophorus globosus* prostrate dwarf-shrub, gramioid, moss, lichen tundra
Kharasavey-2b	Sand site		II marine terraces(Karginsky-age, about 20-40 kya) marine sands and clays.	Kharasavey-2b	*Salix nummularia-Luzula confusa-Polytrichum strictum-Sphaerophorus globosus* prostrate dwarf-shrub, gramioid, moss, lichen tundra
Ostrov Belyy-1a	Loamy site	Non-sorted circles	Marine terrace II (Upper Pleistocene to Holocene age) , alluvial-marine sediments, loamy facie of mixed sands and clays.	Ostrov Belyy-1a	*Carex bigelowii-Calamagrostic holmii-Salix polaris-Hylocomiuim splendens.* Graminoid, prostrate dwarf-shrub, moss tundra
Ostrov Belyy-1b		Inter-circle areas	Marine terrace II (Upper Pleistocene to Holocene age) , alluvial-marine sediments, loamy facie of mixed sands and clays.	Ostrov Belyy-1b	*Dryas integrifolia-Arctagrostis latifolia-Racomitrium lanuginosum-Ochrolechia frigida.* Prostrate dwarf-shrub, crustose-lichen barren.
Ostrov Belyy-2a	Sand site	Small nonsorted polygon	Marine terrace I (Upper Pleistocene to Holocene age), alluvial-marine sediments, sands.	Ostrov Belyy-2a	*Gymnomitrion corallioides-Salix nummularia-Luzula confusa-Ochrolechia frigida.* Liverwort, dwarf-shrub, gramioid, lichen tundra.
Ostrov Belyy-2b		Polygon crack areas	Marine terrace I (Upper Pleistocene to Holocene age), alluvial-marine sediments, sands.	Ostrov Belyy-2b	*Racomitrium lanuginosum-Salix nummularia.* Moss-prostrate dwarf-shrub tundra

Factors measured along transects

Species cover along transects using the Buckner point sampler

Table 3. Ostrov Belyy-1 cover along transects. "Overstory" species are those recorded at the top of the plant canopy at each point; "understory" species are those recorded at the base of the plant canopy. Species use six letter abbreviations (first three letters of genus name + first three letters of species name), sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY												
Species	**T-51 count**	**T-51%**	**T-52 count**	**T-52%**	**T-53 count**	**T-53%**	**T-54 count**	**T-54%**	**T-55 count**	**T-55%**	**Total count**	**Total %**
Arclat D	1	**1.0**	1	**1.0**			4	**3.9**			6	**1.2**
Arclat L	2	**2.0**	2	**2.0**	2	**2.0**	5	**4.9**	2	**2.0**	13	**2.6**
Calhol D	3	**3.0**	10	**10.0**	13	**13.0**	10	**9.8**	7	**7.0**	43	**8.6**
Calhol L	10	**10.0**	11	**11.0**	14	**14.0**	6	**5.9**	10	**10.0**	51	**10.2**
Carbig D	7	**7.0**	6	**6.0**	7	**7.0**	4	**3.9**	11	**11.0**	35	**7.0**
Carbig L	22	**22.0**	8	**8.0**	9	**9.0**	2	**2.0**	16	**16.0**	57	**11.4**
Eripol L	5	**5.0**	1	**1.0**			2	**2.0**			8	**1.6**
Eripol D	5	**5.0**	1	**1.0**							6	**1.2**
Erisch D			1	**1.0**							1	**0.2**
Erisch L			3	**3.0**							3	**0.6**
None	44	**44.0**	52	**52.0**	55	**55.0**	69	**67.6**	54	**54.0**	274	**54.6**
Poaarc L	1	**1.0**	1	**1.0**							2	**0.4**
Poaarc D			3	**3.0**							3	**0.6**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	102	**100.0**	100	**100.0**	502	**100.0**

UNDERSTORY												
Species	**T-51 count**	**T-51%**	**T-52 count**	**T-52%**	**T-53 count**	**T-53%**	**T-54 count**	**T-54%**	**T-55 count**	**T-55%**	**Total count**	**Total %**
Arclat D	1	**1.0**									1	**0.2**
Arclat L							1				1	**0.2**
Aultur	7	**7.0**	12	**12.0**	3	**3.0**	5	**4.9**	3	**3.0**	30	**6.0**
Bare soil			2	**2.0**			**1**	**1.0**	1	**1.0**	4	**0.8**
Calhol D	1	**1.0**	4	**4.0**	4	**4.0**	**1**	**1.0**	2	**2.0**	12	**2.4**
Calhol L			4	**4.0**	2	**2.0**	**1**	**1.0**			7	**1.4**
Carbig D	3	**3.0**	2	**2.0**	5	**5.0**			3	**3.0**	13	**2.6**
Carbig L			2	**2.0**	1	**1.0**			1	**1.0**	4	**0.8**
Cetisl	1	**1.0**			1	**1.0**	1	**1.0**	2	**2.0**	5	**1.0**
Claama	1	**1.0**	2	**2.0**	1	**1.0**	2	**2.0**			6	**1.2**
Claarb	5	**5.0**			2	**2.0**			3	**3.0**	10	**2.0**
Clagra	1	**1.0**									1	**0.2**
Clagra			1	**1.0**							1	**0.2**
Clamac									1		1	**0.2**
Claran	1	**1.0**	1	**1.0**	2	**2.0**					4	**0.8**
Claunc	1	**1.0**			2	**2.0**					3	**0.6**
Dicrspp	12	**12.0**	18	**18.0**	22	**22.0**	16	**15.7**	17	**17.0**	85	**16.9**
Ditfle	1	**1.0**									1	**0.2**
Drypun D							1				1	**0.2**
Drypun L	1	**1.0**	1	**1.0**	3	**3.0**	1	**1.0**	4	**4.0**	10	**2.0**
Eripol D	2	**2.0**									2	**0.4**
Gymcor					1	**1.0**	1	**1.0**			2	**0.4**
Hepaticae			2	**2.0**							2	**0.4**
Hylspl	24	**24.0**	12	**12.0**	15	**15.0**	19	**18.6**	17	**17.0**	87	**17.3**
Junbig			1	**1.0**							1	**0.2**
Litter	2	**2.0**	2	**2.0**	2	**2.0**	6	**5.9**	1	**1.0**	13	**2.6**
Loblin									1	**1.0**	1	**0.2**
Moss D					1	**1.0**	1	**1.0**	1	**1.0**	3	**0.6**
Nepexp	1	**1.0**									1	**0.2**
Ochfri					1	**1.0**	9	**8.8**	1	**1.0**	11	**2.2**
Paromp					3	**3.0**			**1**	**1.0**	4	**0.8**
Pohlia sp.			1	**1.0**							1	**0.2**
Poljen	1	**1.0**					1	**1.0**			2	**0.4**
Poljun	4	**4.0**			2	**2.0**	1	**1.0**	2	**2.0**	9	**1.8**
Pticil	4	**4.0**	5	**5.0**	4	**4.0**	9	**8.8**	7	**7.0**	29	**5.8**
Raclan									1	**1.0**	1	**0.2**
Salpol	18	**18.0**	17	**17.0**	16	**16.0**	16	**15.7**	20	**20.0**	87	**17.3**
Sanunc									3	**3.0**	3	**0.6**
Sphglo	6	**6.0**	4	**4.0**	1	**1.0**	3	**2.9**	2	**2.0**	16	**3.2**
Stereo sp			1	**1.0**	1	**1.0**	1	**1.0**			3	**0.6**
Thaver	1	**1.0**	3	**3.0**	2	**2.0**	1	**1.0**	1	**1.0**	8	**1.6**
Tomnit	1	**1.0**	3	**3.0**	3	**3.0**	4	**3.9**	5	**5.0**	16	**3.2**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	102	**100.0**	100	**100.0**	502	**100.0**

Table 4. Ostrov Belyy-2 cover along transects. "Overstory" species are those recorded at the top of the plant canopy at each point; "understory" species are those recorded at the base of the plant canopy. Species use six letter abbreviations (first three letters of genus name + first three letters of species name), sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY

Species	T-56 count	T-56%	T-57 count	T-57%	T-58 count	T-58%	T-59 count	T-59%	T-60 count	T-60%	Total count	Total %
Arclat L					1	**1.0**					1	**0.2**
Calhol D	2	**2.0**			1	**1.0**					3	**0.6**
Calhol L	4	**4.0**			4	**4.0**					8	**1.6**
Erisch L					1	**1.0**					1	**0.2**
Luzcon D							1	**1.0**			1	**0.2**
Luzcon L			1	**1.0**							1	**0.2**
None	93	**93.0**	99	**99.0**	92	**92.0**	99	**99.0**	100	**100.0**	483	**96.6**
Poaarc D					1	**1.0**					1	**0.2**
Vacvit	1	**1.0**									1	**0.2**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	500	**100.0**

UNDERSTORY

Species	T-56 count	T-56%	T-57 count	T-57%	T-58 count	T-58%	T-59 count	T-59%	T-60 count	T-60%	Total count	Total %
Aleoch	2	**2.0**			1	**1.0**					3	**0.6**
Bare soil	1	**1.0**	7	**7.0**	4	**4.0**	4	**4.0**	4	**4.0**	20	**4.0**
Brydiv									1	**1.0**	1	**0.2**
Calhol D	1	**1.0**									1	**0.2**
Cetcuc			1	**1.0**					1	**1.0**	2	**0.4**
Claama	1	**1.0**	2	**2.0**	3	**3.0**	1	**1.0**	1	**1.0**	8	**1.6**
Claarb					1	**1.0**			2	**2.0**	3	**0.6**
Clachl	1	**1.0**									1	**0.2**
Clagra									1	**1.0**	1	**0.2**
Claran									1	**1.0**	1	**0.2**
Claunc	1	**1.0**	1	**1.0**	2	**2.0**			2	**2.0**	6	**1.2**
Dacarc					1	**1.0**					1	**0.2**
Dicrspp	1	**1.0**									1	**0.2**
Dryoct L	4	**4.0**							1	**1.0**	5	**1.0**
Equarv	4	**4.0**									4	**0.8**
Erisch D			1	**1.0**							1	**0.2**
Gymcor	26	**26.0**	30	**30.0**	21	**21.0**	40	**40.0**	34	**34.0**	151	**30.2**
Hupsel									1	**1.0**	1	**0.2**
Hylspl	2	**2.0**			1	**1.0**					3	**0.6**
Litter			1	**1.0**	2	**2.0**	1	**1.0**	1	**1.0**	5	**1.0**
Ochfri	13	**13.0**	8	**8.0**	9	**9.0**	6	**6.0**	10	**10.0**	46	**9.2**
Paromp			3	**3.0**	3	**3.0**	4	**4.0**	1	**1.0**	11	**2.2**
Perdac			1	**1.0**	2	**2.0**	10	**10.0**	1	**1.0**	14	**2.8**
Poganatum spp							1	**1.0**			1	**0.2**
Poljun	6	**6.0**	3	**3.0**	5	**5.0**	7	**7.0**	5	**5.0**	26	**5.2**
Polpil	2	**2.0**									2	**0.4**
Polviv	1	**1.0**									1	**0.2**
Pothyp					1	**1.0**					1	**0.2**
Raclan D			1	**1.0**			1	**1.0**	1	**1.0**	3	**0.6**
Raclan L	12	**12.0**	10	**10.0**	12	**12.0**	13	**13.0**	17	**17.0**	64	**12.8**
Reindeer poop			1	**1.0**							1	**0.2**
Salnum D			2	**2.0**	2	**2.0**	1	**1.0**			5	**1.0**
Salnum L	15	**15.0**	19	**19.0**	19	**19.0**	9	**9.0**	12	**12.0**	74	**14.8**
Sanunc	1	**1.0**									1	**0.2**
Sphglo	4	**4.0**	6	**6.0**	8	**8.0**	2	**2.0**	1	**1.0**	21	**4.2**
Stereo sp			2	**2.0**							2	**0.4**
Sphmin					1	**1.0**					1	**0.2**
Thaver			1	**1.0**	1	**1.0**			1	**1.0**	3	**0.6**
Vacvit	2	**2.0**			1	**1.0**			1	**1.0**	4	**0.8**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	500	**100.0**

Leaf-area index (LAI)

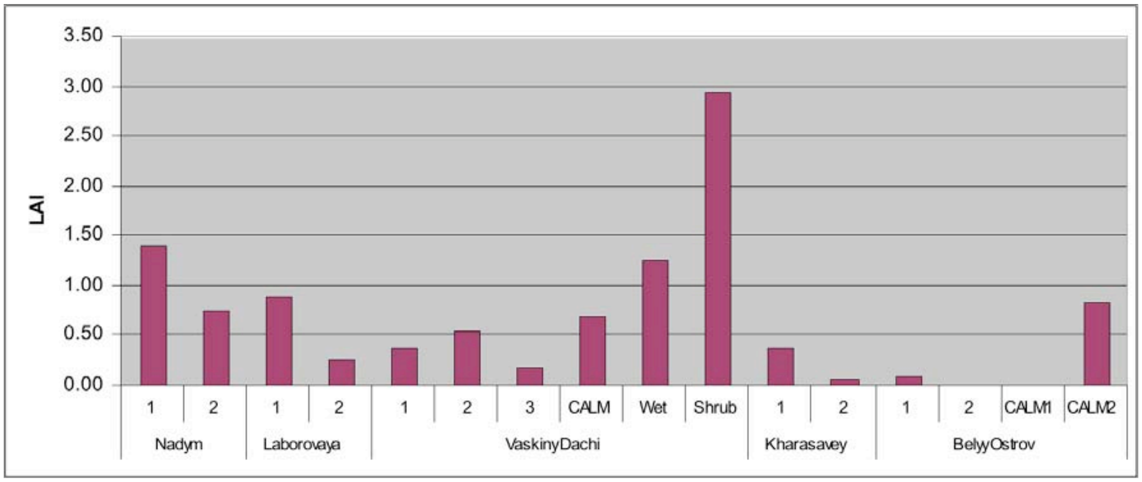

Figure 26. Mean leaf-area index of transects.

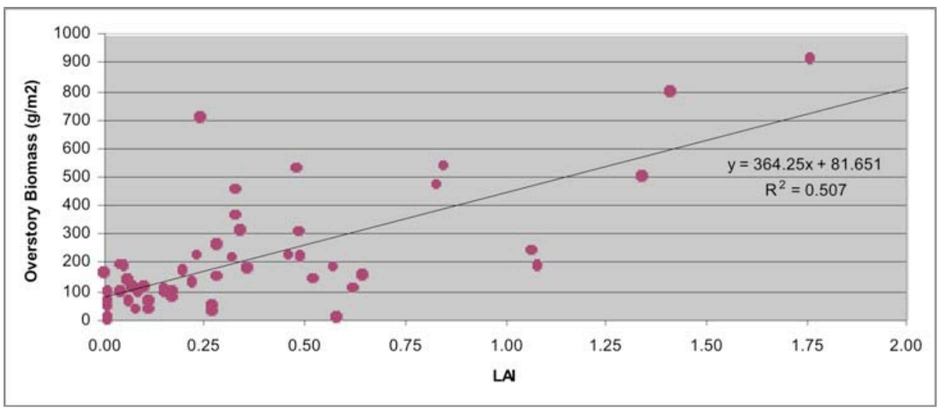

Figure 27. Overstory biomass vs LAI for relevés.

Normalized Difference Vegetation Index (NDVI)

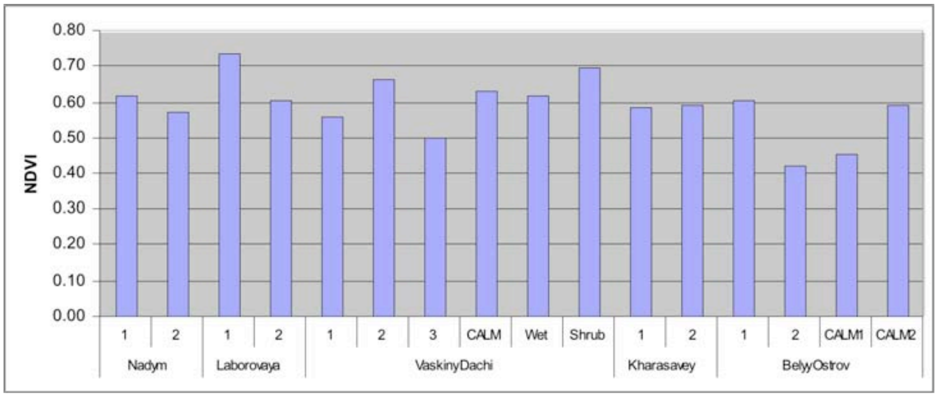

Figure 28. Mean NDVI of sample transects.

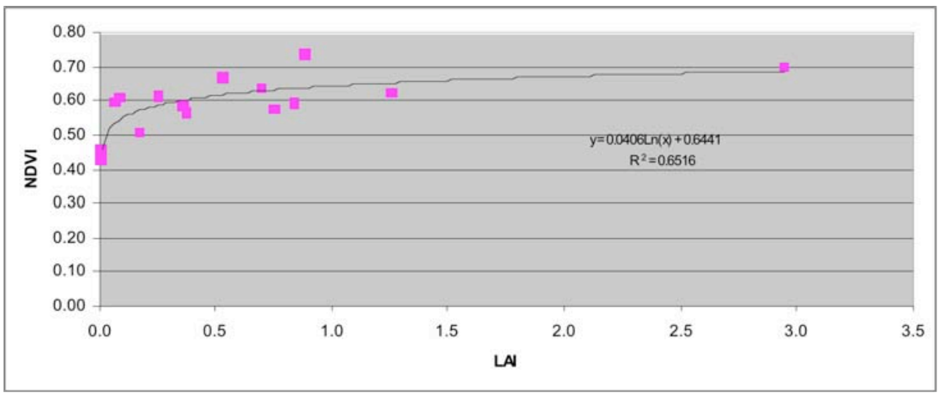

Figure 29. NDVI vs. LAI for all transects.

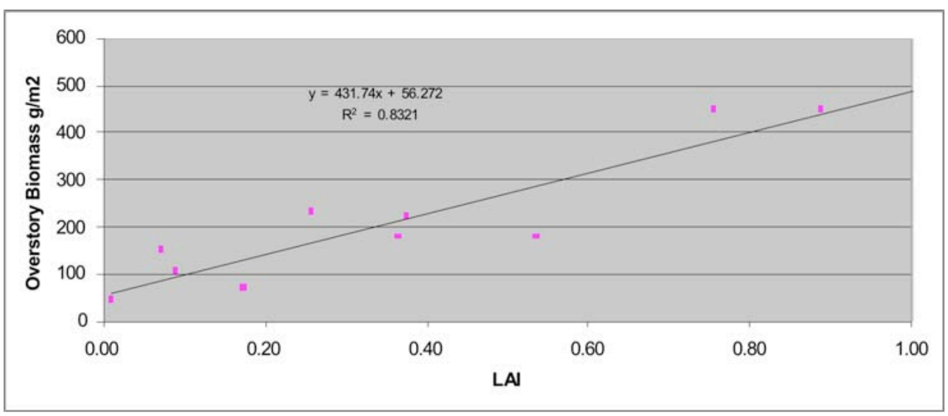

Figure 30. Relationship between LAI and total Overstory Biomass (g m^{-2} – all standing vascular biomass, live and dead) at the grid scale for the Yamal Arctic Transect.

Thaw depth

Table 5. Active layer at transects and relevés. Depths are in centimeters.

Nadym-1 (no permafrost)										
Nadym-2										
See relevé data Table17. No data from transects.										
Laborovaya-1										
Transect/ Relevé #	T09	T10	T11	T12	T13	RV15	RV16	RV17	RV18	RV19
N	31	8	11	8	8	1	1	1	1	1
Max	104	87	95	100	108					
Min	56	66	75	70	66					
Aver	80.1	77.4	83.4	80.0	77.0	89	70	91	74	82
St Dev	10.10	8.05	5.66	10.58	13.88					
Laborovaya-2										
Transect/ Relevé #	T14	T15	T16	T17	T18	RV20	RV21	RV22	RV23	RV24
N	11	5	10	11	5	1	1	1	1	1
Max	119	136	134	133	136					
Min	83	95	87	104	5					
Aver	100.6	117.6	113.8	115.2	73.5	118	114	128	109	106
St Dev	10.21	13.68	14.08	9.35	60.38					
Vaskiny Dachi-1										
Transect/ Relevé #	T19	T20	T21	T22	T23	RV25	RV26	RV27	RV28	RV29
N	11	11	11	11	11	1	1	1	1	1
Max	83	80	76	84	95					
Min	57	55	61	63	74					
Aver	66.9	69.1	68.6	72.9	81.5	71	66	76	66	79
St Dev	7.54	7.40	4.34	7.35	6.22					
Vaskiny Dachi-2										
Transect/ Relevé #	T24	T25	T26	T27	T28	RV-30	RV-31	RV-32	RV-33	RV-34
N	11	11	11	11	11	1	1	1	1	1
Max	93	85	89	91	90					
Min	40	60	50	56	57					
Aver	68.5	70.5	74.2	73.2	71.5	80	77	78	57	51
St Dev	17.41	8.26	12.66	11.12	8.19					
Vaskiny Dachi-3										
Transect/ Relevé #	T29	T30	T31	T32	T33	RV-35	RV-36	RV-37	RV-38	RV-39
N	11	11	11	11	11	1	1	1	1	1
Max	127	115	125	127	127					
Min	91	85	99	104	105					
Aver	102.6	102.7	117.2	117.1	118.9	104	116	128	107	114
St Dev	11.34	9.34	8.29	5.89	7.27					
Kharasavey-1										
Transect/ Relevé #	T-46	T-47	T-48	T-49	T-50	RV-47	RV-48	RV-49		
N	6	6	6	6	6	1	1	1		
Max	84	85	85	93	86					
Min	68	70	78	64	60					
Aver	77.0	77.0	81.7	73.2	73.8	71	60	76.5		
St Dev	8.75	5.47	3.77	3.87	4.53					
Kharasavey-2a										
Transect/ Relevé #	T-41	T-42	T-43	T-44	T-45	RV-45	RV-46			
N	6	6	6	6	6	1	1			
Max	84	83	82	85	84					
Min	69	62	58	68	70					
Aver	74.8	72.7	73.2	78.2	78.5	67	77			
St Dev	5.42	8.50	8.52	6.40	5.28					
Kharasavey-2b										
Transect/ Relevé #	T-46	T-47	T-48	T-49	T-50	RV-47	RV-48	RV-49		
N	6	6	6	6	6	1	1	1		
Max	93	86	91	92	98					
Min	66	64	60	64	64					
Aver	77.7	73.8	76.3	79.2	85.8	71	60	76.5		
St Dev	10.42	8.93	11.00	9.79	12.04					
Ostrov Belyy-1										
Transect/ Relevé #	T-51	T-52	T-53	T-54	T-55	RV-49a boil	RV-50 boil	RV-51 boil	RV-52 boil	RV-53 boil
N						3	3	3	3	3
Max	57	59	68	55	60	56	56	57	51	55
Min	41	41	42	42	43	50	53	55	48	48
Aver	48.8	48.8	52.5	49.8	52.1	53	54.7	55.7	49.7	52.3
St Dev	4.68	4.53	5.56	3.25	4.16	3.00	1.53	1.15	1.53	3.79
Transect/ Relevé #						RV-49a interboil	RV-50 interboil	RV-51 interboil	RV-52 interboil	RV-53 interboil
N						3	3	3	4	3
Max						52	52	49	50	49
Min						50	45	45	40	43
Aver						51.3	49	47.7	44	45.7
St Dev						1.15	3.61	2.31	4.55	3.06
Ostrov Belyy-2										
Transect/ Relevé #	T-56	T-57	T-58	T-59	T-60	RV-54 polygon	RV-55 polygon	RV-56 polygon	RV-57 polygon	RV-58 polygon
N						-	3	3	3	3
Max						-	100	90	84	71
Min						-	97	73	74	57
Aver						89	98	81	79.7	65.3
St Dev						-	1.73	8.54	5.13	7.37
Transect/ Relevé #						RV-54 trough	RV-55 trough	RV-56 trough	RV-57 trough	RV-58 trough
N						-	3	3	3	3
Max						-	97	82	86	77
Min						-	86	55	67	60
Aver						81	92	71.7	75	68.3
St Dev						-	5.57	14.57	9.85	8.50

Factors measured in study plots

Relevé data

Table 6. Relevé Soils Data for relevés 1-58.

			Based on 100 C oven dry																
Clients Description	% of Gravel > 2mm	Paste pH	% Sand	% Silt	% Clay	% C	% N	meq/100g CEC	meq/100g K	meq/100g Ca	meq/100g Mg	meq/100g Na	Wet soil Wt	Air dry soil wt	Weight of H2O	Gravimetric Soil Moisture (%)	Volumetric Soil Moisture (%)	bulk dens. (g cm-3)
ND-1	<.01	3.25	50.4	38.0	11.6	5.06	0.15	17.53	0.12	0.50	0.22	0.04	110.45	90.5	19.95	22	11	0.49
ND-2	<.01	3.71	38.4	48.4	13.2	1.43	0.03	7.29	0.06	0.17	0.08	0.02	185.45	161.86	23.59	15	13	0.88
ND-3	<.01	3.36	56.4	34.4	9.2	4.56	0.13	15.02	0.09	0.37	0.17	0.05	113.75	93.25	20.5	22	11	0.51
ND-4	<.01	3.54	46.4	44.4	9.2	3.47	0.09	12.67	0.07	0.25	0.16	0.03	119.55	103.65	15.9	15	9	0.56
ND-5	<.01	3.39	52.4	36.4	11.2	2.42	0.04	12.93	0.08	0.49	0.15	0.03	138.05	123.33	14.72	12	8	0.67
ND-6																		
ND-7																		
ND-8	<.01	3.43	84.4	12.8	2.8	0.73	<.01	2.69	0.01	0.10	0.02	<.01	234.2	208.89	25.31	12	14	1.13
ND-9																		
ND-10																		
ND-11	<.01	3.66	96.4	0.8	2.8	0.38	<.01	0.78	0.01	0.06	0.01	0.01	237.05	220.78	16.27	7	9	1.20
ND-12																		
ND-13																		
ND-14																		
LA-15	0.49	4.30	14.4	62.4	23.2	2.36	0.09	10.42	0.11	7.02	4.99	0.11	268.25	197.37	70.88	36	38	1.07
LA-16	0.41	4.36	20.4	58.8	20.8	1.86	0.08	17.97	0.14	6.45	4.72	0.09	265.55	200.4	65.15	33	35	1.09
LA-17	0.82	4.83	12.4	63.8	23.8	1.22	0.04	17.88	0.19	7.76	5.66	0.11	295.15	230.99	64.16	28	35	1.25
LA-18	0.94	4.65	14.4	62.8	22.8	1.45	0.04	17.71	0.15	6.71	5.43	0.14	315.95	247.65	68.3	28	37	1.34
LA-19	3.26	5.27	28.4	48.8	22.8	1.73	0.05	14.93	0.12	6.93	5.32	0.09	309.85	239.58	70.27	29	38	1.30
LA-20	<.01	3.76	96.4	0.8	2.8	0.70	0.01	3.56	0.02	0.41	0.35	0.03	250.85	220.64	30.21	14	16	1.20
LA-21	0.37	3.88	96.4	0.8	2.8	0.38	<.01	1.13	0.01	0.09	0.03	0.02	270.25	243.1	27.15	11	15	1.32
LA-22	2.53	4.07	94.4	2.8	2.8	0.56	<.01	2.52	0.01	0.10	0.05	0.02	246.45	222.90	23.55	11	13	1.21
LA-23	1.42	3.81	96.4	0.8	2.8	0.46	<.01	2.34	0.01	0.44	0.30	0.02	290.65	247.75	42.90	17	23	1.34
LA-24	<.01	3.57	84.4	12.8	2.8	0.84	<.01	3.73	0.02	0.36	0.17	0.04	324.35	259.33	65.02	25	35	1.41
VD-25	<.01	4.40	26.4	68.8	4.8	5.98	0.36	21.53	0.17	8.51	3.64	0.12	238.35	155.73	82.62	53	45	0.84
VD-26	0.25	4.97	20.4	62.8	16.8	0.75	0.01	10.94	0.16	5.85	3.28	0.12	326.35	262.04	64.31	25	35	1.42
VD-27	<.01	4.54	28.4	62.8	8.8	1.18	0.03	8.33	0.09	4.56	2.19	0.11	301.75	243.47	58.28	24	32	1.32
VD-28	<.01	4.30	24.4	66.8	8.8	1.00	0.01	7.81	0.07	3.03	1.97	0.09	274.05	252.80	21.25	8	12	1.37
VD-29	<.01	3.83	42.4	50.8	6.8	2.06	0.06	10.24	0.13	2.33	1.22	0.04	287.65	233.60	54.05	23	29	1.27
VD-30	<.01	3.92	39.0	56.6	4.4	1.93	0.04	9.11	0.05	1.79	1.02	0.08	293.75	232.43	61.32	26	33	1.26
VD-31	<.01	3.94	35.6	56.0	8.4	1.19	<.01	8.68	0.07	2.43	1.46	0.10	297.55	249.27	48.28	19	26	1.35
VD-32	<.01	3.98	53.6	38.6	7.8	0.86	<.01	7.03	0.09	2.62	1.66	0.07	310.95	258.00	52.95	21	29	1.40
VD-33	<.01	3.88	35.6	55.6	8.8	2.06	0.04	13.11	0.06	2.42	1.69	0.09	313.75	256.89	56.86	22	31	1.39
VD-34	<.01	4.44	27.6	62.6	9.8	1.28	<.01	8.51	0.05	3.35	2.33	0.13	330.15	270.95	59.20	22	32	1.47
VD-35	<.01	3.52	95.6	1.6	2.8	0.74	<.01	2.69	0.02	0.17	0.11	0.02	283.35	235.85	47.50	20	26	1.28
VD-36	<.01	3.58	95.6	2.0	2.4	0.55	0.01	2.95	0.01	0.11	0.07	0.01	264.45	230.59	33.86	15	18	1.25
VD-37	<.01	3.54	93.6	3.6	2.8	1.75	0.06	5.90	0.05	0.69	0.35	0.05	227.55	186.04	41.51	22	22	1.01
VD-38	<.01	3.87	85.6	12.0	2.4	0.98	0.01	5.29	0.02	0.11	0.07	0.03	267.85	221.05	46.80	21	25	1.20
VD-39	<.01	3.45	93.6	4.0	2.4	2.53	0.10	3.56	0.03	0.29	0.22	0.01	259.55	211.65	47.90	23	26	1.15
KH-40	<.01	4.36	34.8	44.4	20.8	0.67	0.03	9.45	0.08	2.45	2.96	0.12	349.6	298.5	51.1	17	28	1.66
KH-41	<.01	4.68	19.8	55.4	24.8	1.22	0.07	14.24	0.16	4.15	5.48	0.17	298	241.5	56.5	23	31	1.34
KH-42	<.01	4.95	18.8	56.4	24.8	1.41	0.08	13.79	0.26	4.47	5.90	0.15	313.5	253.6	59.9	24	32	1.41
KH-43	<.01	4.50	18.8	57.4	23.8	3.87	0.30	23.22	0.21	5.97	7.14	0.23	273	186.5	86.5	46	47	1.04
KH-44	<.01	4.72	21.2	56.0	22.8	2.67	0.19	17.85	0.23	6.27	6.74	0.22	254.2	182.3	71.9	39	39	1.01
KH-45	<.01	4.18	95.2	2.0	2.8	2.71	0.13	4.37	0.07	0.81	0.74	0.09	183.3	158.3	25	16	14	0.88
KH-46	<.01	3.97	65.6	25.6	8.8	1.06	0.05	5.61	0.06	0.85	1.05	0.14	253.2	219.8	33.4	15	18	1.22
KH-47	<.01	4.21	65.6	27.6	6.8	1.29	0.08	7.18	0.19	1.11	1.24	0.14	254.3	218.1	36.2	17	20	1.21
KH-48	<.01	4.14	70.0	26.2	3.8	4.67	0.26	12.65	0.15	2.73	1.70	0.20	217.7	164.6	53.1	32	29	0.91
KH-49	<.01	4.04	64.0	29.2	6.8	5.87	0.33	13.56	0.14	2.28	2.10	0.17	228	178.3	49.7	28	27	0.99
BO_RV_49Boil	<.01	4.59	34.4	48.0	17.6	1.06	0.04	11.76	0.16	5.08	3.77	0.24	308.3	255.70	52.60	21.26	11.57	1.39
BO_RV_50Boil	<.01	5.49	34.4	49.0	16.6	0.81	0.04	11.42	0.29	5.74	3.94	0.19	291.5	238.70	52.80	22.92	12.48	1.30
BO_RV_51Boil	<.01	5.03	34.4	46.0	19.6	0.71	0.02	6.68	0.29	5.83	3.86	0.19	302.1	250.40	51.70	21.35	11.62	1.36
BO_RV_52Boil	<.01	4.70	42.8	42.0	15.2	0.74	0.03	9.19	0.12	4.25	2.93	0.20	330.1	278.60	51.50	19.05	10.37	1.52
BO_RV_53Boil	<.01	5.31	42.8	35.0	22.2	1.31	0.13	17.47	0.37	9.91	5.18	0.29	284.7	219.50	65.20	30.87	16.81	1.19
BO_RV_49Interboil	<.01	4.29	53.2	42.0	4.8	5.60	2.26	19.90	0.15	6.41	3.86	0.29	250.5	161.40	89.10	58.20	31.68	0.88
BO_RV_50Interboil	<.01	4.55	55.2	40.0	4.8	6.87	3.71	16.71	0.19	9.00	4.83	0.33	284.4	138.10	146.30	112.37	61.17	0.75
BO_RV_51Interboil	<.01	4.39	45.2	45.0	9.8	3.97	1.21	23.24	0.19	9.59	5.84	0.38	246.3	160.00	86.30	56.81	30.93	0.87
BO_RV_52Interboil	<.01	4.29	47.2	44.4	8.4	2.31	0.41	14.93	0.11	5.36	3.65	0.23	278	198.20	79.80	41.89	22.80	1.08
BO_RV_53Interboil	<.01	4.23	52.2	39.4	8.4	1.11	0.04	7.43	0.09	2.75	1.74	0.21	299.2	240.90	58.30	25.08	13.65	1.31
BO_RV_54	<.01	4.03	79.2	16.4	4.4	0.65	0.02	3.57	0.06	0.73	0.80	0.16	262.5	229.90	32.60	14.71	8.01	1.25
BO_RV_55	<.01	3.81	78.4	18.0	3.6	0.78	0.02	4.00	0.05	0.51	0.45	0.14	238.9	212.80	26.10	12.74	6.94	1.16
BO_RV_56	<.01	4.23	93.4	2.6	4.0	0.29	<.01	1.56	0.03	0.51	0.60	0.05	228.1	201.30	26.80	13.89	7.56	1.10
BO_RV_57	<.01	4.00	83.4	12.6	4.0	0.71	0.01	3.83	0.06	0.63	0.45	0.06	314.1	263.60	50.50	19.73	10.74	1.43
BO_RV_58	<.01	3.99	84.4	11.2	4.4	0.66	0.01	3.74	0.03	0.36	0.20	0.07	290.6	252.20	38.40	15.76	8.58	1.37

Table 7. Releve site characteristics. See data forms (Walker et al. 2009a Appendix C).

Releve #	Tree height	Shrub height	Herbs height	Moss height	Soil moss horizon thickness	Soil organic horizon thickness	Soil A-horizon thickness	Micro-relief	Mean thaw depth	Landform	Surficial geology, parent material	Surficial geomorphology	Micro-site	Site moisture	Soil moisture	Topographic position	Snow bank persistence after meltout	Disturbance degree	Disturbance type	Stability	Exposure
	height / cm																				
01	800	50	10	0	0	4	0	40	NA	4	5	11	0	4	3	4	5	0	0	1	1
02	1000	50	10	0	0	4	0	50	NA	4	5	11	0	4	3	4	5	0	0	1	1
03	900	60	12	0	0	2	0	20	NA	4	5	11	0	4	3	4	5	0	0	1	1
04	1100	50	10	0	0	3	0	20	NA	4	5	11	0	4	3	4	5	0	0	1	1
05	1100	45	10	0	0.5	4	0	30	NA	4	5	11	0	4	3	4	5	0	0	1	1
06	0	15	0	0	1	>40	?	30	40	4	5	3	3	6	5	4	3	0	0	3	3
07	0	15	0	1	27	>40	?	20	36	4	5	3	3	6	5	4	3	0	0	3	3
08	0	15	0	0	1	2	1	30	?	4	5	3	3	6	5	4	3	0	0	3	3
09	0	10	10	0	0	25	1	5	50	4	5	6	4	6	5	4	5	0	0	3	3
10	0	10	15	0	20	>20	?	10	60	4	5	6	4	6	5	4	5	0	0	3	3
11	0	10	15	0	0	2	0.5	10	?	4	5	6	4	6	5	4	5	0	0	3	3
12	0	0	25	0	0	?	?	0	?	4	NA	19	0	10	10	4	5	0	0	1	2
13	0	0	25	0	0	?	?	0	?	4	NA	19	0	10	10	4	5	0	0	1	2
14	0	0	25	0	0	?	?	0	?	4	NA	19	0	10	10	4	5	0	0	1	2
15	0	30	10	5	3	5	6	30	89	4	?	11	0	5	6	4	4	2	2,3	1	2
16	0	20	35	2	2	10	3	15	70	4	?	11	0	5	6	4	4	2	2,3	1	2
17	0	15	25	2	2	6	0.5	30	91	4	?	11	0	5	6	4	4	2	2,3	1	2
18	0	30	35	2	2	4	0.5	20	74	4	?	11	0	5	6	4	4	2	2,3	1	2
19	0	25	30	2	2	3	2	20	82	4	?	11	0	5	6	4	4	2	2,3	1	2
20	0	5	15	2	0	1	3	10	118	4	5	18	NA	5	5	4	4	2	3	1	2
21	0	5	5	1	0	3	2	10	114	4	5	6,18	NA	5	5	4	4	2	3	1	2
22	0	8	5	1	0	4	1	5	128	4	5	6,18	NA	5	5	4	4	2	3	1	2
23	0	10	10	1	0	4	2	10	109	4	5	6,18	NA	5	5	4	4	2	3	1	2
24	0	20	3	2	1	5	3	10	106	4	5	6,18	NA	5	5	4	4	2	3	1	2
25	0	10	10	1	1	3	1	5	70	1, 5	15	11	0	6	6	1	3	3	1, 2	1	3
26	0	10	15	1	1	4	1	5	66	1, 5	15	11	0	6	6	1	3	3	1, 2	1	3
27	0	8	10	1	4	3.5	1	5	76	1, 5	15	11	0	6	6	1	3	3	1, 2	1	3
28	0	10	10	1	2	4	1	5	66	1, 5	15	11	0	6	6	1	3	3	1, 2	1	3
29	0	2	10	1	3	2	1	5	79	1, 5	15	11	0	6	6	1	3	3	1, 2	1	3
30	0	5	7	1	3.5	2.5	2	5	71	5	16	11	0	5	6	1	4	2	1, 2, 3	1	3
31	0	5	7	1	4	4.5	1	5	71	5	16	11	0	5	6	1	4	2	1, 2, 3	1	3
32	0	5	7	1	2	2	0	5	76	5	16	11	0	5	6	1	4	2	1, 2, 3	1	3
33	0	5	7	1	3	4	9	5	61	5	16	11	0	5	6	1	4	2	1, 2, 3	1	3
34	0	5	7	1	3	3.5	0	5	61	5	16	11	0	5	6	1	4	2	1, 2, 3	1	3
35	0	1	4	0.5	2	3	2	5	0	5	15	11	0	3	2	4	3	2	1, 2, 3	1	3
36	0	3	4	1	1	1	1	5	0	5	15	11	0	3	2	4	3	2	1, 2, 3	1	3
37	0	2	2	1	1	2	2	5	0	5	15	11	0	3	2	4	3	2	1, 2, 3	1	3
38	0	2	2	1	0	0.5	5	5	0	5	15	11	0	3	2	4	3	2	1, 2, 3	1	3
39	0	3	4	1	1	0	1	5	0	5	15	11	0	3	2	4	3	2	1, 2, 3	1	3
40	0	2	10	2	2	6	4	10	60	5	16	1 (30%)	1,2	6	5	4	9	3.5	1,3	1	2
41	0	2	10	2	2	6	0	13	67/52	5	16	1(30%)	1,2	6	5	4	9	3.5	1,3	1	2
42	0	2	10	2	2	6	0	10	59/50	5	16	1(30%)	1,2	6.5	5	4	9	1	3	1	2
43	0	2	10	2	3	8	2	10	56/52	5	16	1(10%)	1,2	6	6	4	9	2	1,3	1	2
44	0	2	10	2	3	6	0	12	64/46	5	16	1(50%)	1,2	6	6	4	9	2	3	1	2
45	0	1	3	1	3	2	1	5	67	14	15	11	.	5	4	4	3	1	3	1	3
46	0	1	3	1	2	2	1	10	77	14	15	11	.	5	4	4	3	1	2,3	1	3
47	0	1	5	1	1	0.5	1	5	74	14	15	11,3	.	4	4	1	2	1	1,3	1	3
48	0	1	5	1	1	3	4	5	70	14	15	11,3	.	4	4	1	2	2	1,3,8	1	3
49*	0	1	5	1	1	5	2	5	76.5	14	15	1	1,2	4.5	4	1	2	2	1,3,2,7	1	3
49a	0	1	2	1	1	2	0	4	53	20	16	1	1	5	6	4	4	2	3	4	2
49b	0	1	6	2	2	2	3	5	51.3	20	16	1	2	6	7	4	4	2	3	1	2
50a	0	1	3	0.5	0.5	0	2	4	54.7	20	16	1	1	5	6	4	4	2	3	4	2
50b	0	1	7	1	1	3.5	9	5	49	20	16	1	2	6	7	4	4	2	3	1	2
51a	0	1	3	0.5	0.5	1	0	2	55.7	20	16	1	1	5	6	4	4	2	3	4	2
51b	0	1	5	1	1	5	4	5	47.7	20	16	1	2	6	7	4	4	2	3	1	2
52a	0	1	3	0.5	0.5	0	1	2	49.7	20	16	1	1	5	6	4	4	2	3	4	2
52b	0	1	6	4	4	5	1	5	44	20	16	1	2	6	7	4	4	2	3	1	2
53a	0	1	3	0.5	0.5	0	0	2	52.3	20	16	1	1	5	6	2	4	2	3	4	2
53b	0	1	6	2	1.5	1.5	3	5	45.7	20	16	1	2	6	7	2	4	2	3	1	2
54a	0	0.5	1	0	0	0	0	2	89	14	15	20	13	3	3	4	2	2	1,3,8	1	3
54b	0	1	2	1	1	1	0	10	81	14	15	20	14	4	4	4	4	1	1,3,8	1	2
55a	0	0.5	1	0	0	0	0	2	98	14	15	20	13	3	3	4	2	1	1,2,3,8	1	3
55b	0	1	2	1	1	1	2	10	92	14	15	20	14	4	4	4	4	0	1,2,3,8	1	2
56a	0	0.5	1	0	0	0	0	2	81	14	15	20	13	3	3	4	2	1	1,3	1	3
56b	0	1	2	1	1	1	5	15	72	14	15	20	14	4	4	4	4	0	1,3	1	2
57a	0	0.5	1	0	0	0	0	2	79.7	14	15	20	13	3	3	4	2	1	1,3	1	3
57b	0	1	2	1	1	0	1	10	75	14	15	20	14	4	4	4	4	0	1,3	1	2
58a	0	0.5	1	0	0	0	0	2	65.3	14	15	20	13	3	3	4	2	1	1,3	1	3
58b	0	1	2	1	1	1	2	5	68.3	14	15	20	14	4	4	4	4	0	1,3	1	2

Table 8. Species percentage cover in vegetation study plots (relevés). Nomenclature for vascular plants followed Elven et al. 2007: Checklist of the Panarctic Flora (PAF). Vascular plants. -Draft. University of Oslo. Nomenclature for lichens followed H. Kristinsson & M. Zhurbenko 2006: Panarctic lichen checklist (http://archive.arcticportal.org/276/01/Panarctic_lichen_checklist.pdf). Nomenclature for mosses followed M.S. Ignatov, O.M. Afonina & E.A. Ignatova 2006: Check-list of mosses of East Europe and North Asia. Arctoa 15: 1-130. Nomenclature for liverworts followed N.A. Konstantinova & A.D. Potemkin 1996: Liverworts of Russian Arctic: an annotated check-list and bibliography. Arctoa 6: 125-150.

Species	ND_RV_01	ND_RV_02	ND_RV_03	ND_RV_04	ND_RV_05	ND_RV_06	ND_RV_07	ND_RV_08	ND_RV_09	ND_RV_10	ND_RV_11	ND_RV_12	ND_RV_13	ND_RV_14	LA_RV_15	LA_RV_16	LA_RV_17	LA_RV_18	LA_RV_19	LA_RV_20	LA_RV_21	LA_RV_22	LA_RV_23	LA_RV_24	VD_RV_25	VD_RV_26	VD_RV_27	VD_RV_28	VD_RV_29	VD_RV_30	VD_RV_31	VD_RV_32	VD_RV_33	VD_RV_34	VD_RV_35
Vascular plants:																																			
Alopecurus alpinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	+	1	+	.	+	.	.	.
Andromeda polifolia	.	.	.	.	.	1	+	.	r	r	1	r	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctagrostis latifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	r	r	r	+	+	+	1	1	+	1	+
Arctous alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Betula nana	2	2	2	2	2	.	1	2	.	.	+	.	.	.	2	3	3	3	2	2	2	2	2	2	1	1	2	2	.	2	3	3	1	2	.
Betula pubescens	2	2	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bistorta vivipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	.	.	.	.	.
Calamagrostis holmii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	1	1	+	+	.	+	+	+	.	+	+	+	2	3	2	2	2	+
Cardamine bellidifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex aquatilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex bigelowii s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	2	2	2	1	2	3	2	4	3	3	3	2	2	1	1	2	2	2
Carex chordorrhiza	.	.	.	.	.	.	.	.	.	.	.	3	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex globularis	.	.	.	.	.	+	+	2	+	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex limosa	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex rotundata	.	.	.	.	.	.	.	.	.	.	.	3	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cerastium regelii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Chamaedaphne calyculata	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Deschampsia sukatschewii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diapensia lapponica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Diphasiastrum alpinum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba micropetala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Draba sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drosera rotundifolia	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dryas octopetala s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	1	1	.	.	.	.	.	.
Empetrum nigrum	1	1	1	1	1	.	.	1	.	.	.	.	.	.	1	.	1	1	1	+	1	1	1	2	.	.	.	+	.	.	.	1	.	.	.
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	1	+	.	1	.	.	.	.	+	+	.	.	+	.	.	.	r	.	+	+	.	1	1	.
Eriophorum russeolum	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum scheuzeri	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum vaginatum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	2	+	1	+	1	+	+	+	+	+	.	+	+	+	.	.	.	.	1	1	.
Festuca cf. *ovina*	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	r	+	+	r	r	+	+	.	.	.	.	.	.
Hierochloe alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	r	r	r	.	r	.	.	.	.	.	.
Huperzia selago	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Juncus biglumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Juniperus communis	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larix sibirica	1	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ledum palustre	2	2	2	2	2	4	3	4	+	r	r	.	.	.	1	.	.	.	1	+	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Lloydia serotina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula confusa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.
Luzula nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula cf. *wahlenbergii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r
Minuartia cf. *arctica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxycoccus microcarpus	.	.	.	.	.	.	1	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxyria digyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pachypleurum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Parrya nudicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	+	.	.
Pedicularis labradorica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis cf. *lapponica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	r	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Petasites frigidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus sibirica	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus sylvestris	2	2	2	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	ND_RV_01	ND_RV_02	ND_RV_03	ND_RV_04	ND_RV_05	ND_RV_06	ND_RV_07	ND_RV_08	ND_RV_09	ND_RV_10	ND_RV_11	ND_RV_12	ND_RV_13	ND_RV_14	LA_RV_15	LA_RV_16	LA_RV_17	LA_RV_18	LA_RV_19	LA_RV_20	LA_RV_21	LA_RV_22	LA_RV_23	LA_RV_24	VD_RV_25	VD_RV_26	VD_RV_27	VD_RV_28	VD_RV_29	VD_RV_30	VD_RV_31	VD_RV_32	VD_RV_33	VD_RV_34	VD_RV_35
Poa arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	+	.	+	.	.	.	.	.	.
Polemonium acutiflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla hyparctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rubus chamaemorus	.	.	.	.	.	2	2	1	1	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rumex arcticus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sagina intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix cf. *hastata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.
Salix lanata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix cf. *myrtilloides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix nummularia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	1	1	1	1	.
Salix phylicifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	2	1	+	+	1	1	.	+	.	.	.	+	.	.	.	.	.
Salix polaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	2	2	2	2	.	.	.	.	.	.
Salix reptans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	1	1	1	2	1	1	1	.	1	1	.
Saxifraga cernua	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga foliolosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifriga tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stellaria longipes s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Tephroseris atropurpurea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Trisetum spicatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaccinium myrtillus	2	2	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaccinium uliginosum	2	2	2	1	2	.	.	1	.	.	1	.	.	.	+	1	2	1	1	2	2	2	2	2	1	.	1	+	.	.	.	.	.	.	.
Vaccinium vitis-ideae	1	1	1	1	1	1	1	1	1	+	1	.	.	.	2	2	2	2	2	+	+	.	+	.	1	1	1	1	2	3	2	2	2	2	3
Valeriana capitata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	.	.	.	.
Lichens:																																			
Alectoria nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	.	+	.	+	+	.	+	.	+	+
Alectoria ochroleuca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	+	.	.	.	+	+
Arctocetraria andrejevii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Arctocetraria negricascens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Asahinea chrysantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	1	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Bacidia bagliettoana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Baeomyces rufus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryocaulon divergens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	+	+
Bryoria nitidula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.	+
Cetraria aculeata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetraria delisei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Cetraria islandica	1	1	1	1	1	.	.	+	1	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Cetraria laevigata	.	.	.	.	.	1	r	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	.	.	.	.	.	+
Cetraria nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cetrariella fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+
Cladonia amaurocraea	.	.	.	.	.	+	1	r	+	r	r	.	.	.	r	r	+	+	+	1	+	+	.	+	+	+	.	+	+	+	+	+	+	+	+
Cladonia arbuscula s.l.	.	1	.	1	1	.	.	1	.	.	.	.	.	.	+	r	.	r	+	2	1	2	2	2	.	.	.	.	.	+	+	+	+	+	1
Cladonia bellidiflora	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	+	+	+	+	.	.	.	+	+	.	.	+	.	.	+
Cladonia cenotea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Cladonia chlorophaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	+	.	+	.
Cladonia coccifera	.	.	.	.	.	.	+	.	+	r	.	.	.	.	r	r	r	r	r	+	+	+	+	+	.	+	+	+	+	+	+	+	.	+	+
Cladonia cornuta	.	.	.	r	.	.	.	r	.	.	.	.	.	.	r	r	.	.	.	r	+	+	.	.	.	.	.	+	.	+	.	.	+	+	.
Cladonia crispata	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia cyanipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Cladonia cf. *decortiata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.
Cladonia deformis	.	.	.	.	.	1	.	.	.	.	+	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés.

Species	ND_RV_01	ND_RV_02	ND_RV_03	ND_RV_04	ND_RV_05	ND_RV_06	ND_RV_07	ND_RV_08	ND_RV_09	ND_RV_10	ND_RV_11	ND_RV_12	ND_RV_13	ND_RV_14	LA_RV_15	LA_RV_16	LA_RV_17	LA_RV_18	LA_RV_19	LA_RV_20	LA_RV_21	LA_RV_22	LA_RV_23	LA_RV_24	VD_RV_25	VD_RV_26	VD_RV_27	VD_RV_28	VD_RV_29	VD_RV_30	VD_RV_31	VD_RV_32	VD_RV_33	VD_RV_34	VD_RV_35
Cladonia gracilis	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	1	+	+	.	+	+	+	+	.	+	+	+	+	+	+	+
Cladonia cf. *grayi*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	+
Cladonia macrophylla	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.
Cladonia pleurota	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.
Cladonia pocillum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia pyxidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	+	+	.	.	.	.
Cladonia rangiferina	1	.	2	1	.	.	.	.	+	.	.	.	.	.	.	1	+	+	.	1	+	1	1	1	.	.	.	+	+	+	.	.	.	.	.
Cladonia cf. *scabriuscula*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Cladonia squamosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	r	.	.	.	.	.	.	+	.	+	+	.	.
Cladonia stellaris	3	3	5	5	3	3	+	.	5	3	4	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r
Cladonia stricta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	.	+	+
Cladonia stygia	.	1	1	.	1	2	2	2	2	3	2	.	.	.	+	+	+	r	r	2	1	1	1	1	.	.	.	.	+	+	+	+	+	+	1
Cladonia subfurcata/furcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	+	+	+	+	+	+	+	+	+	.	+	+	.	.	+	+
Cladonia sulphurina	.	.	.	.	.	.	.	.	r	.	+	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Cladonia uncialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	r	r	1	1	1	1	1	.	.	+	+	+	+	+	+	1	+	1
Dactylina arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	r	.	r	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dactylina ramulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Flavocetraria cucullata	.	.	.	.	.	1	+	1	.	.	.	.	.	.	+	+	+	+	+	1	2	1	1	1	+	+	+	+	+	+	+	+	+	+	+
Flavocetraria nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	.	r	+	2	2	1	1	.	.	.	.	.	.	.	.	.	.	1
Hypogymnia physodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Hypogymnia subobscura	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Icmadophila ericetorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Japewia toroënsis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lecidea limosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lichenomphalia hudsoniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Lobaria linita	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Micarea incrassata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mycoblastus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Nephroma expallidum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia androgyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia frigida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	r	1	1	r	+	+	+	+	.	.	.	.	+	.	.	.	.	.	1
Ochrolechia inequatula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	1	1	1	+	1	+
Parmelia omphalodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera aphthosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Peltigera cf. *frippii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Peltigera kristinssonii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera leucophlebia	1	1	1	1	1	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	+	+	+	+	+	+	.	+	+	+	.
Peltigera malacea	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera cf. *neckeri*	.	1	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	r	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.
Peltigera polydactylon-group	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera scabrosa	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	+	.	.	.	+	.	.	+	+	+	+	+	.	.	.	.
Peltigera sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria dactylina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+
Pertusaria geminipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	+	.	.	.	.	.
Pertusaria panyrga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Pertusaria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Protopannaria pezizoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Protothelenella leucothelia	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoroma hypnorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Rhexophiale rhexoblephara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Rinodina turfacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	ND_RV_01	ND_RV_02	ND_RV_03	ND_RV_04	ND_RV_05	ND_RV_06	ND_RV_07	ND_RV_08	ND_RV_09	ND_RV_10	ND_RV_11	ND_RV_12	ND_RV_13	ND_RV_14	LA_RV_15	LA_RV_16	LA_RV_17	LA_RV_18	LA_RV_19	LA_RV_20	LA_RV_21	LA_RV_22	LA_RV_23	LA_RV_24	VD_RV_25	VD_RV_26	VD_RV_27	VD_RV_28	VD_RV_29	VD_RV_30	VD_RV_31	VD_RV_32	VD_RV_33	VD_RV_34	VD_RV_35
Siphula ceratides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Solorina crocea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	2	3	3	2	2	+	+	+	+	+	1	1	1	1	1	2
Stereocaulon alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.	.	.	.	.	.	.
Stereocaulon paschale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sticta arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Thamnolia vermicularis s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	r	r	r	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Unknown black crust	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+
Unknown white crust	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Varicellaria rhodocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Bryophytes:																																			
Anthelia juratzkana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aplodon wormskioldii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aulacomnium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aulacomnium turgidum	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	1	1	1	1	r	1	+	+	1	3	3	4	3	3	2	2	2	2	1	r
Barbilophozia binsteadii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.
Barbilophozia kuzeana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Bartramia ithyphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Blepharostoma trichophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Bryoerthrophyllum recurvirostre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum cryophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum pseudotriquetrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calliergon stramineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Calypogeia sphagnicola	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephalozia bicuspidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephalozia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephaloziella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	+	.	.	.	.	.	.	.	.	.	.	.	r
Cynodontium strumiferum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranella subulata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum acutifolium	.	+	.	.	.	.	.	r	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	1	1	1	.	+	.	2	2	.
Dicranum elongatum	.	.	.	.	.	.	.	+	.	.	+	.	.	.	2	2	2	2	2	2	2	2	2	3	1	1	1	1	1	+	+	+	+	.	1
Dicranum flexicaule	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	+	.	.	.	+	.	.	.	.	2	3	.	.	.	.
Dicranum fuscescens	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum groenlandicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.
Dicranum laevidens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	3	+	2	.
Dicranum majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Dicranum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum spadiceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	2
Distichium capillaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ditrichum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Gymnocolea inflata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Gymnomitrion corallioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+
Hylocomium splendens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	1	1	.	r	r	.	.	3	3	3	3	2	2	2	2	2	2	.
Hypnum holmenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Hypnum subimponens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Jungermannia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Kiaeria cf. *blyttii*	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	ND_RV_01	ND_RV_02	ND_RV_03	ND_RV_04	ND_RV_05	ND_RV_06	ND_RV_07	ND_RV_08	ND_RV_09	ND_RV_10	ND_RV_11	ND_RV_12	ND_RV_13	ND_RV_14	LA_RV_15	LA_RV_16	LA_RV_17	LA_RV_18	LA_RV_19	LA_RV_20	LA_RV_21	LA_RV_22	LA_RV_23	LA_RV_24	VD_RV_25	VD_RV_26	VD_RV_27	VD_RV_28	VD_RV_29	VD_RV_30	VD_RV_31	VD_RV_32	VD_RV_33	VD_RV_34	VD_RV_35
Lophozia ventricosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	r	+	.	+	+	+	.	.	+	.
Meesia uliginosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mylia anomala	.	.	.	.	.	r	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Myurella tenerrima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus compactus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus wahlenbergii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	+	.	.	.	.	.	.	.	.	.
Orthothecium chryseum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthothecium strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Plagiomnium ellipticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Plagiothecium berggrenianum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pleurozium schreberi	3	3	2	2	2	.	.	+	.	.	.	.	.	.	r	+	1	.	r	.	+	+	.	+	.	.	.	.	.	.	.	.	+	.	.
Pogonatum dentatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pogonatum urnigerum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia cruda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pohlia crudoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r
Pohlia nutans	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.	r	r	.	+	r	+	r	.	.
Polytrichastrum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	2	2	2	.	.	.
Polytrichastrum longisetum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum commune	r	.	r	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	1	.	.	.	.	.	.	.	.	1	.	.
Polytrichum hyperboreum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Polytrichum jensenii	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Polytrichum piliferum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum strictum	.	.	.	.	+	.	.	.	r	r	r	.	.	.	+	+	+	+	+	2	+	1	2	2	1	1	1	2	3	2	1	2	1	2	1
Ptilidium ciliare	.	r	.	.	.	.	.	r	.	.	.	.	.	.	1	1	1	1	1	1	1	+	1	1	+	+	+	+	+	1	1	1	1	1	1
Ptilidium crista-cristensis	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Racomitrium lanuginosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	1	1	+	+	+	.	.	+	.	.	+	1	1	+	1	2
Sanionia uncinata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	r	+	.	+	.	+	+	.	.	r	+	.	.	.	.	.
Scapania sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum balticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum fuscum	.	.	.	.	.	r	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum girgensohnii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum lenense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Sphagnum majus	.	.	.	.	.	.	.	.	.	.	.	5	5	5	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum rubellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum squarrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum teres	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum warnstorfii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphenolobus minutus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	+	+	r	.	1	1	+	+	.	.	.	r	r	+	r	r	+	.	1
Splachnum sphaericum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Splachnum vasculosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Stereodon holmenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Straminergon stramineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetralophozia setiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetraplodon mnioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tomenthypnum nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	.	.	.	.	.	1	2	1	1	.	.	.	.	.	.	.
Tortella fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tritomaria quinquedentata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.
Warnstorfia pseudostraminea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Warnstorfia sarmentosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sum of occurrences	**16**	**21**	**20**	**18**	**23**	**19**	**18**	**19**	**14**	**11**	**16**	**8**	**7**	**6**	**52**	**35**	**44**	**38**	**43**	**49**	**56**	**58**	**55**	**47**	**41**	**42**	**45**	**47**	**43**	**55**	**41**	**41**	**44**	**43**	**49**

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39	KH_RV_40	KH_RV_41	KH_RV_42	KH_RV_43	KH_RV_44	KH_RV_45	KH_RV_46	KH_RV_47	KH_RV_48	KH_RV_49	BO_RV_49a	BO_RV_49b	BO_RV_50a	BO_RV_50b	BO_RV_51a	BO_RV_51b	BO_RV_52a	BO_RV_52b	BO_RV_53a	BO_RV_53b	BO_RV_54a	BO_RV_54b	BO_RV_55a	BO_RV_55b	BO_RV_56a	BO_RV_56b	BO_RV_57a	BO_RV_57b	BO_RV_58a	BO_RV_58b	Sum of occurrences
Vascular plants:																																			
Alopecurus alpinus	.	.	.	.	.	.	.	.	.	+	+	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12
Andromeda polifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9
Arctagrostis latifolia	.	.	.	.	+	1	+	+	+	+	+	.	+	+	1	+	1	1	+	1	+	+	+	+	.	.	.	.	.	+	.	.	.	.	33
Arctous alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Betula nana	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	29
Betula pubescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Bistorta vivipara	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.	.	.	13
Calamagrostis holmii	+	+	+	.	2	2	2	1	2	2	1	1	1	1	+	+	+	2	+	1	+	1	+	+	+	1	.	.	.	+	.	.	r	.	46
Cardamine bellidifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Carex aquatilis	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Carex bigelowii s.l.	2	+	2	1	2	2	2	1	2	2	2	+	+	2	1	3	1	3	1	3	+	3	1	3	.	.	.	.	.	.	.	.	.	.	45
Carex chordorrhiza	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Carex globularis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
Carex limosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Carex rotundata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Cerastium regelii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Chamaedaphne calyculata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Deschampsia sukatschewii	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Diapensia lapponica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Diphasiastrum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Draba micropetala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	.	.	2
Draba sp.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Drosera rotundifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Dryas octopetala s.l.	.	.	.	.	1	.	.	.	.	+	.	+	.	.	2	+	2	1	1	1	+	+	2	+	+	1	.	2	.	+	.	+	.	.	23
Empetrum nigrum	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	20
Eriophorum angustifolium	.	.	.	.	+	+	1	2	+	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	18
Eriophorum russeolum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Eriophorum scheuzeri	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Eriophorum vaginatum	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	19
Festuca cf. *ovina*	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11
Hierochloe alpina	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
Huperzia selago	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Juncus biglumis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	r	+	.	1	.	+	.	.	.	.	.	r	.	r	.	.	.	8
Juniperus communis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Larix sibirica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Ledum palustre	2	2	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	22
Lloydia serotina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	r	.	.	5
Luzula confusa	.	.	.	.	+	+	+	+	+	+	+	1	1	1	.	.	.	.	.	.	.	.	.	r	+	+	+	1	+	1	+	+	+	+	23
Luzula nivalis	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	4
Luzula cf. *wahlenbergii*	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5
Minuartia cf. *arctica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Oxycoccus microcarpus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Oxyria digyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	.	.	8
Pachypleurum alpinum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Parrya nudicaulis	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Pedicularis hirsuta	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.	+	+	14
Pedicularis labradorica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
Pedicularis cf. *lapponica*	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
Petasites frigidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Pinus sibirica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Pinus sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39	KH_RV_40	KH_RV_41	KH_RV_42	KH_RV_43	KH_RV_44	KH_RV_45	KH_RV_46	KH_RV_47	KH_RV_48	KH_RV_49	BO_RV_49a	BO_RV_49b	BO_RV_50a	BO_RV_50b	BO_RV_51a	BO_RV_51b	BO_RV_52a	BO_RV_52b	BO_RV_53a	BO_RV_53b	BO_RV_54a	BO_RV_54b	BO_RV_55a	BO_RV_55b	BO_RV_56a	BO_RV_56b	BO_RV_57a	BO_RV_57b	BO_RV_58a	BO_RV_58b	Sum of occurrences
Poa arctica	.	.	.	.	.	.	1	1	+	.	.	r	.	r	+	+	+	+	+	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	**17**
Polemonium acutiflorum	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Potentilla hyparctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	**2**
Rubus chamaemorus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**6**
Rumex arcticus	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Sagina intermedia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	**3**
Salix cf. *hastata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Salix lanata	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Salix cf. *myrtilloides*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Salix nummularia	+	1	.	2	.	.	.	.	.	2	2	4	4	3	.	.	.	.	.	.	.	.	.	.	1	3	+	4	1	2	1	3	+	2	**24**
Salix phylicifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**12**
Salix polaris	.	.	.	.	2	2	1	2	2	.	.	.	.	.	1	3	1	3	1	3	+	3	1	3	.	.	.	.	.	.	.	.	.	.	**20**
Salix reptans	.	.	.	.	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**13**
Saxifraga cernua	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Saxifraga foliolosa	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Saxifriga tenuis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	**1**
Stellaria longipes s.l.	.	.	.	.	.	r	.	+	+	.	.	r	.	.	+	.	+	+	+	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	**11**
Tephroseris atropurpurea	.	.	+	.	+	+	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**10**
Trisetum spicatum	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Vaccinium myrtillus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Vaccinium uliginosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**20**
Vaccinium vitis-ideae	2	1	2	1	.	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	**38**
Valeriana capitata	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Lichens:																																			
Alectoria nigricans	+	+	+	.	+	.	.	.	.	+	+	+	+	+	.	.	.	.	+	.	.	.	+	.	+	+	.	+	+	+	+	+	+	+	**29**
Alectoria ochroleuca	+	+	+	+	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	+	.	+	**21**
Arctocetraria andrejevii	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Arctocetraria negricascens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	**1**
Asahinea chrysantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**6**
Bacidia bagliettoana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Baeomyces rufus	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Bryocaulon divergens	+	+	+	+	+	+	r	.	r	1	+	+	+	.	+	.	+	.	+	.	+	.	+	.	+	+	+	+	+	+	+	+	+	+	**44**
Bryoria nitidula	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	**11**
Cetraria aculeata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	**2**
Cetraria delisei	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Cetraria islandica	+	+	+	+	+	+	+	+	+	1	+	+	1	1	+	+	+	+	+	+	+	+	+	+	.	+	.	+	.	+	.	+	+	+	**58**
Cetraria laevigata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	**11**
Cetraria nigricans	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cetrariella fastigiata	.	.	.	.	.	.	.	r	.	.	.	.	r	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	**7**
Cladonia amaurocraea	.	+	+	.	1	1	r	+	.	1	1	1	1	1	+	1	+	+	+	+	+	+	+	+	.	.	.	.	.	.	+	+	.	.	**48**
Cladonia arbuscula s.l.	1	1	1	1	1	1	+	+	+	2	1	+	+	+	+	+	+	3	+	3	+	3	+	3	.	.	.	.	.	r	.	r	.	r	**46**
Cladonia bellidiflora	+	.	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	**20**
Cladonia cenotea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Cladonia chlorophaea	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**7**
Cladonia coccifera	+	.	+	+	+	+	r	+	r	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	+	.	+	.	+	+	+	+	+	**52**
Cladonia cornuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**11**
Cladonia crispata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cladonia cyanipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cladonia cf. *decortiata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Cladonia deformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**8**

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39	KH_RV_40	KH_RV_41	KH_RV_42	KH_RV_43	KH_RV_44	KH_RV_45	KH_RV_46	KH_RV_47	KH_RV_48	KH_RV_49	BO_RV_49a	BO_RV_49b	BO_RV_50a	BO_RV_50b	BO_RV_51a	BO_RV_51b	BO_RV_52a	BO_RV_52b	BO_RV_53a	BO_RV_53b	BO_RV_54a	BO_RV_54b	BO_RV_55a	BO_RV_55b	BO_RV_56a	BO_RV_56b	BO_RV_57a	BO_RV_57b	BO_RV_58a	BO_RV_58b	Sum of occurrences
Cladonia gracilis	+	+	+	.	+	+	+	1	1	1	1	+	1	1	+	+	.	+	+	+	+	+	+	1	+	+	.	+	.	+	.	+	.	+	**45**
Cladonia cf. *grayi*	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**7**
Cladonia macrophylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Cladonia pleurota	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Cladonia pocillum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	**1**
Cladonia pyxidata	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	**11**
Cladonia rangiferina	.	1	.	.	+	+	.	.	+	1	1	+	.	+	+	.	+	+	+	+	+	+	+	+	.	.	.	.	.	+	.	+	.	+	**35**
Cladonia cf. *scabriuscula*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cladonia squamosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**7**
Cladonia stellaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**13**
Cladonia stricta	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	**7**
Cladonia stygia	1	.	1	1	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**35**
Cladonia subfurcata/furcata	+	.	+	+	.	.	.	.	+	r	+	r	r	.	.	+	.	+	.	+		+	.	+	.	.	+	+	.	.	.	+	.	r	**33**
Cladonia sulphurina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Cladonia uncialis	1	.	1	1	1	1	1	.	+	1	1	.	.	1	+	+	+	+	+	1	+	+	+	+	.	+	.	.	.	+	+	1	+	1	**44**
Dactylina arctica	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	+	+	+	+	.	+	+	.	+	.	.	.	+	.	+	.	+	**46**
Dactylina ramulosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	r	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	**3**
Flavocetraria cucullata	+	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	+	+	+	.	+	.	.	.	.	+	.	+	.	.	.	.	.	.	**44**
Flavocetraria nivalis	1	+	1	+	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**19**
Hypogymnia physodes	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Hypogymnia subobscura	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Icmadophila ericetorum	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**4**
Japewia toroënsis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Lecidea limosa	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Lichenomphalia hudsoniana	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**6**
Lobaria linita	.	.	.	.	.	r	r	.	r	.	r	+	.	+	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	**11**
Micarea incrassata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Mycoblastus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Nephroma expallidum	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	**3**
Ochrolechia androgyna	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Ochrolechia frigida	1	1	1	r	1	.	+	+	1	.	.	.	.	.	1	.	2	1	2	+	1	+	2	+	1	+	1	1	1	1	1	+	2	1	**39**
Ochrolechia inequatula	.	.	.	.	.	+	.	.	.	+	+	+	+	1	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**18**
Parmelia omphalodes	.	.	.	.	r	.	.	.	r	r	r	+	+	+	1	.	1	.	1	.	1	.	1	.	+	.	1	+	+	.	+	.	+	.	**18**
Peltigera aphthosa	.	.	.	.	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**9**
Peltigera canina	.	.	.	.	+	+	+	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**7**
Peltigera cf. *frippii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Peltigera kristinssonii	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Peltigera leucophlebia	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	**19**
Peltigera malacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Peltigera cf. *neckeri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**6**
Peltigera polydactylon-group	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Peltigera scabrosa	.	.	.	.	+	+	+	.	+	r	r	.	.	+	.	.	.	+	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	**23**
Peltigera sp.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Pertusaria dactylina	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	**8**
Pertusaria geminipara	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**4**
Pertusaria panyrga	.	.	+	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	**5**
Pertusaria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	**5**
Protopannaria pezizoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Protothelenella leucothelia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Psoroma hypnorum	.	+	.	+	.	r	r	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**10**
Rhexophiale rhexoblephara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Rinodina turfacea	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39	KH_RV_40	KH_RV_41	KH_RV_42	KH_RV_43	KH_RV_44	KH_RV_45	KH_RV_46	KH_RV_47	KH_RV_48	KH_RV_49	BO_RV_49a	BO_RV_49b	BO_RV_50a	BO_RV_50b	BO_RV_51a	BO_RV_51b	BO_RV_52a	BO_RV_52b	BO_RV_53a	BO_RV_53b	BO_RV_54a	BO_RV_54b	BO_RV_55a	BO_RV_55b	BO_RV_56a	BO_RV_56b	BO_RV_57a	BO_RV_57b	BO_RV_58a	BO_RV_58b	Sum of occurrences
Siphula ceratides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	**1**
Solorina crocea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	.	.	.	+	.	**5**
Sphaerophorus globosus	2	2	2	2	+	1	1	.	+	1	1	1	+	1	+	2	2	1	+	2	1	+	2	+	1	2	1	2	+	1	1	2	+	1	**53**
Stereocaulon alpinum	+	.	.	+	+	+	.	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	r	.	.	.	.	**17**
Stereocaulon paschale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Sticta arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Thamnolia vermicularis s.l.	+	+	+	+	+	+	+	+	+	1	1	1	1	1	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	**55**
Unknown black crust	+	2	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**6**
Unknown white crust	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Varicellaria rhodocarpa	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Bryophytes:																																			
Anthelia juratzkana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	**5**
Aplodon wormskioldii	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Aulacomnium palustre	.	.	.	.	.	1	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	**8**
Aulacomnium turgidum	.	+	.	+	2	1	+	1	1	1	1	1	1	2	+	1	+	1	+	1	+	1	+	+	.	.	.	.	.	+	.	+	.	.	**46**
Barbilophozia binsteadii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Barbilophozia kuzeana	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**5**
Bartramia ithyphylla	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	**1**
Blepharostoma trichophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	+	2	+	1	+	2	+	2	+	.	.	.	.	.	.	.	.	.	.	**11**
Bryoerthrophyllum recurvirostre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	**3**
Bryum cryophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	**4**
Bryum pseudotriquetrum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Bryum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	**5**
Calliergon stramineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Calypogeia sphagnicola	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cephalozia bicuspidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cephalozia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Cephaloziella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Ceratodon purpureus	.	.	1	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**3**
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	**8**
Cynodontium strumiferum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Dicranella subulata	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Dicranum acutifolium	.	1	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	1	+	2	.	1	2	2	.	.	.	.	.	+	.	.	.	+	**21**
Dicranum elongatum	.	.	1	1	2	2	3	1	2	1	1	1	1	1	2	+	2	1	2	1	1	1	1	3	.	+	.	+	.	+	.	+	.	+	**49**
Dicranum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**7**
Dicranum fuscescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Dicranum groenlandicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Dicranum laevidens	.	.	.	.	2	1	1	1	1	2	1	1	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**18**
Dicranum majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Dicranum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**0**
Dicranum spadiceum	1	.	.	1	.	.	.	.	.	r	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	**9**
Distichium capillaceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	**3**
Ditrichum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	+	1	.	1	.	.	.	.	.	.	.	.	.	.	**5**
Gymnocolea inflata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Gymnomitrion corallioides	+	2	2	2	.	.	.	.	.	.	+	1	1	1	+	.	.	.	.	.	.	.	.	.	5	+	5	+	4	+	5	+	5	+	**21**
Hylocomium splendens	.	+	+	+	2	1	+	1	1	+	+	1	1	+	+	4	+	3	+	3	+	3	+	1	.	+	.	r	.	r	.	+	.	+	**45**
Hypnum holmenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**2**
Hypnum subimponens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Jungermannia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Kiaeria cf. *blyttii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**
Lophozia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**1**

Table 8 (cont'). Species percentage cover in vegetation study plots (relevés).

Species	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39	KH_RV_40	KH_RV_41	KH_RV_42	KH_RV_43	KH_RV_44	KH_RV_45	KH_RV_46	KH_RV_47	KH_RV_48	KH_RV_49	BO_RV_49a	BO_RV_49b	BO_RV_50a	BO_RV_50b	BO_RV_51a	BO_RV_51b	BO_RV_52a	BO_RV_52b	BO_RV_53a	BO_RV_53b	BO_RV_54a	BO_RV_54b	BO_RV_55a	BO_RV_55b	BO_RV_56a	BO_RV_56b	BO_RV_57a	BO_RV_57b	BO_RV_58a	BO_RV_58b	Sum of occurrences
Lophozia ventricosa	.	.	+	+	+	1	1	+	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	22
Meesia uliginosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Mylia anomala	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Myurella tenerrima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Oncophorus compactus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Oncophorus wahlenbergii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	1	.	1	.	1	.	1	.	.	.	.	.	.	.	.	.	.	9
Orthothecium chryseum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Orthothecium strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Plagiomnium ellipticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Plagiothecium berggrenianum	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Pleurozium schreberi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.									14
Pogonatum dentatum	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	+	+	+	+	+	10
Pogonatum urnigerum	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Pohlia cruda	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Pohlia crudoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	5
Pohlia nutans	.	r	r	r	.	.	+	.	.	.	+	.	.	+	+	.	+	.	.	.	.	.	+	+	+	.	+	.	+	.	.	.	.	.	24
Polytrichastrum alpinum	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	r	.	+	.	+	.	+	13
Polytrichastrum longisetum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Polytrichum commune	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	7
Polytrichum hyperboreum	1	1	1	1	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8
Polytrichum jensenii	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Polytrichum piliferum	.	r	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	7
Polytrichum strictum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	1	+	1	+	1	+	+	+	1	.	1	+	1	+	1	.	.	42
Ptilidium ciliare	1	+	1	1	1	.	.	.	.	.	+	.	.	.	+	1	.	2	+	2	+	2	+	2	.	.	.	.	.	.	.	+	.	.	39
Ptilidium crista-cristensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Racomitrium lanuginosum	2	1	1	1	+	.	r	.	+	r	+	1	+	1	1	.	1	.	1	.	+	.	1	.	1	3	.	2	+	4	+	4	1	4	39
Sanionia uncinata	.	.	.	.	.	r	+	1	r	.	.	.	.	.	+	.	+	+	+	.	+	+	.	+	.	1	.	.	.	.	.	.	.	.	21
Scapania sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Sphagnum balticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sphagnum fuscum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sphagnum girgensohnii	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sphagnum lenense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sphagnum majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Sphagnum rubellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Sphagnum squarrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Sphagnum teres	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Sphagnum warnstorfii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Sphenolobus minutus	+	r	.	.	2	1	+	1	1	1	1	1	1	1	1	1	1	1	1	1	+	1	1	2	.	.	.	+	.	.	.	.	.	+	39
Splachnum sphaericum	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Splachnum vasculosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Stereodon holmenii	.	.	.	.	.	.	.	.	.	+	.	.	.	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	3
Straminergon stramineum	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Tetralophozia setiformis	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Tetraplodon mnioides	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2
Tomenthypnum nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	15
Tortella fragilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Tritomaria quinquedentata	.	.	.	.	.	.	.	.	.	+	+	1	+	+	+	.	+	+	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	16
Warnstorfia pseudostraminea	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Warnstorfia sarmentosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1
Sum of occurrences	39	42	42	44	39	43	47	38	45	48	52	47	38	44	57	29	47	41	45	32	49	36	39	46	26	35	17	30	22	35	22	31	23	30	

Table 9. Relevé descriptions. Characteristic species use six letter abbreviations (first three letters of genus name + first three letters of species name). Observers: PK, Patrick Kuss; NM, Nataliya Moskalenko; EK, Elina Kärlajaarvi, SW, Skip Walker. Photo archives are at UAF.

Relevé #	Location	Study site	Characteristic species	Date	Observer	Plot size (m2)	GPS north	GPS east	Elev. (m)	Slope (°)	Aspect	Photo
01	Nadym	Forest	Pinsyl, Betpub, Betnan, Ledpal, Vacmyr, Claste, Plesch	6-Aug-07	PK	10x10	65 18.810	72 53.226	25	0	0	photos in folder: /geobotany/Nasa_Yamal.
02	Nadym	Forest	Pinsyl, Betpub, Betnan, Ledpal, Vacmyr, Claste, Plesch	6-Aug-07	PK	10x10	65 18.794	72 53.277	25	0	0	Photos_Satellite Images_airphotos_Maps/
03	Nadym	Forest	Pinsyl, Ledpal, Vacmyr, Claste	6-Aug-07	PK	10x10	65 18.811	72 53.274	25	0	0	Photos/SubzoneN_ND_Nadym/
04	Nadym	Forest	Pinsyl, Betnan, Ledpal, Claste	6-Aug-07	PK	10x10	65 18.831	72 53.261	25	0	0	ND_Site1_ForestSite_
05	Nadym	Forest	Betpub, Ledpal, Vacmyr, Claste	6-Aug-07	PK	10x10	65 18.814	72 53.314	25	0	0	Terrasse2
06	Nadym	CALM-grid, hummock	Ledpal, Rubcha, Claste	8-Aug-07	PK,NM	1x1	65 18.883	72 51.703	23	0	0	photos in folder: /geobotany/Nasa_Yamal.
07	Nadym	CALM-grid, hummock	Ledpal, Rubcha, Sphfus	8-Aug-07	PK,NM	1x1	65 18.863	72 51.695	23	0	0	Photos_Satellite Images_airphotos_Maps/
08	Nadym	CALM-grid, hummock	Betnan, Ledpal, Carglo, Clasty	8-Aug-07	PK,NM	1x1	65 18.888	72 51.785	23	0	0	Photos/SubzoneN_ND_Nadym/
09	Nadym	CALM-grid, inter-hummock	Claste, Clasty	8-Aug-07	PK,NM	1x1	65 18.884	72 51.702	21	0	0	ND_Site2_CALMGrid_
10	Nadym	CALM-grid, inter-hummock	Carglo, Claste, Clasty	8-Aug-07	PK,NM	1x1	65 18.867	72 51.703	21	0	0	Terrasse3
11	Nadym	CALM-grid, inter-hummock	Carglo, Claste, Clasty	8-Aug-07	PK,NM	1x1	65 18.887	72 51.785	21	0	0	
12	Nadym	CALM-grid, mire	Carcho, Carrot, Shpmaj	8-Aug-07	PK,NM	1x1	65 18.825	72 51,737	18	0	0	
13	Nadym	CALM-grid, mire	Carrot, Sphmaj	8-Aug-07	PK,NM	1x1	65 18.824	72 51.803	18	0	0	
14	Nadym	CALM-grid, mire	Carrot, Sphmaj	8-Aug-07	PK,NM	1x1	65 18.828	72 51.831	18	0	0	
15	Laborovaya	Clay-site	Betnan, Vacvit, Erivag, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.397	67 59.946	79	2	SW	photos in folder: /geobotany/Nasa_Yamal.
16	Laborovaya	Clay-site	Betnan, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.387	67 59.970	80	2	SW	Photos_Satellite Images_airphotos_Maps/
17	Laborovaya	Clay-site	Betnan, Vacvit, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.396	67 59.971	80	2	SW	Photos/SubzoneE_LA_Laborovaya/
18	Laborovaya	Clay-site	Betnan, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.406	67 59.969	80	2	SW	LA_Site1_
19	Laborovaya	Clay-site	Betnan, Salphy, Vacvit, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.397	67 59.995	80	2	SW	ClayeySite
20	Laborovaya	Sand-site	Betnan, Vaculi, Claarb, Sphglo, Dicelo	17-Aug-07	PK,NM,SW,EK	5x5	67 41.691	68.02.244	60	1	S	photos in folder: /geobotany/Nasa_Yamal.
21	Laborovaya	Sand-site	Betnan, Vaculi, Sphglo, Dicelo	17-Aug-07	PK,NM,SW,EK	5x5	67 41.684	68 02.283	60	1	S	Photos_Satellite Images_airphotos_Maps/
22	Laborovaya	Sand-site	Vaculi, Sphglo, Dicelo	17-Aug-07	NM,PK	5x5	67 41.694	68 02.270	60	1	S	Photos/SubzoneE_LA_Laborovaya/
23	Laborovaya	Sand-site	Betnan, Vaculi, Carbig, Claarb, Dicelo, Polstr	17-Aug-07	NM,PK	5x5	67 41.703	68 02.277	60	1	S	LA_Site2_
24	Laborovaya	Sand-site	Betnan, Empsub, Vaculi, Carbig, Claarb, Dicelo	17-Aug-07	NM,PK	5x5	67 41.696	68 02.301	60	1	S	SandySite
25	Vaskiny Dachi	Terrace IV	Salnum, Carbig, Aultur, Hylspl	23-Aug-07	PK,NM,SW,EK	5x5	70 16.540	68 53.446	40	2	S	photos in folder: /geobotany/Nasa_Yamal.
26	Vaskiny Dachi	Terrace IV	Dryoct, Salpol, Carbig, Aultur, Hylspl, Tomnit	23-Aug-07	PK,NM	5x5	70 16.528	68 53.465	40	2	S	Photos_Satellite Images_airphotos_Maps/
27	Vaskiny Dachi	Terrace IV	Salnum, Salpol, Carbig, Aultur, Hylspl	23-Aug-07	PK,NM	5x5	70 16.538	68 53.469	40	2	S	Photos/SubzoneD_VD_VaskinyDachi/
28	Vaskiny Dachi	Terrace IV	Salnum, Carbig, Aultur, Hylspl	23-Aug-07	PK,NM	5x5	70 16.547	68 53.475	40	2	S	VD_Site1_LoamySite_Terrasse4
29	Vaskiny Dachi	Terrace IV	Salnum, Carbig, Aultur, Polstr	23-Aug-07	PK,NM	5x5	70 16.536	68 53.498	40	2	S	
30	Vaskiny Dachi	Terrace III	Betnan, Vacvit, Calhol, Aultur, Hylspl, Dicfle	26-Aug-07	PK,NM,SW,EK	5x5	70 17.734	68 53.027	30	2	SW	photos in folder: /geobotany/Nasa_Yamal.
31	Vaskiny Dachi	Terrace III	Betnan, Vacvit, Calhol,Dicfle, Aultur	26-Aug-07	PK,NM	5x5	70 17.731	68 53.065	30	2	SW	Photos_Satellite Images_airphotos_Maps/
32	Vaskiny Dachi	Terrace III	Betnan, Vacvit, Calhol, Diclae	26-Aug-07	PK,NM	5x5	70 17.739	68 53.052	30	2	SW	Photos/SubzoneD_VD_VaskinyDachi
33	Vaskiny Dachi	Terrace III	Vacvit, Calhol,Carbig, Dicacu	26-Aug-07	PK,NM	5x5	70 17.747	68 53.038	30	2	SW	/VD_Site2_
34	Vaskiny Dachi	Terrace III	Betnan, Vacvit, Calhol, Diclae, Dicacu	26-Aug-07	PK,NM	5x5	70 17.744	68 53.077	30	2	SW	ClayeySite_Terrasse3
35	Vaskiny Dachi	Terrace II	Vacvit, Carbig, Sphglo, Raclan	28-Aug-07	PK,NM,SW,EK	5x5	70 18.088	68 50.519	15	1	NW	photos in folder: /geobotany/Nasa_Yamal.
36	Vaskiny Dachi	Terrace II	Ledpal, Vacvit, Carbig, Sphglo, Raclan	28-Aug-07	PK,NM	5x5	70 18.031	68 50.587	15	1	NW	Photos_Satellite Images_airphotos_Maps/
37	Vaskiny Dachi	Terrace II	Ledpal, Salnum, BlackCrust	28-Aug-07	PK,NM	5x5	70 18.060	68 50.580	15	1	NW	Photos/SubzoneD_VD_VaskinyDachi
38	Vaskiny Dachi	Terrace II	Vacvit, Carbig, BlackCrust, Raclan	28-Aug-07	PK,NM	5x5	70 18.097	68 50.554	15	1	NW	/VD_Site3_
39	Vaskiny Dachi	Terrace II	Ledpal, Salnum, BlackCrust, Raclan	28-Aug-07	PK,NM	5x5	70 18.031	68.50.625	15	1	NW	SandySite_Terrasse2
40	Kharasavey	Clay-site	Carbig, Salpol, Calhol, Dicspp, Hylspl, Poljun, Claspp	21-Aug-08	SW,NM,JG	5x5	71 10.723	66 58.778	16	0	0	
41	Kharasavey	Clay-site	Carbig, Salpol, Carhol, Dicspp, Claunc, Sphglo	21-Aug-08	SW,NM,JG	5x5	71 10.719	66 58.819	16	0	0	
42	Kharasavey	Clay-site	Carbig, Salpol, Calhol, Dicspp, Poljun	21-Aug-08	SW,NM,JG	5x5	71 10.727	66 58.803	16	0	0	
43	Kharasavey	Clay-site	Eriang, Salpol, Carbig, Calhol, Poljun, Dicspp	21-Aug-08	SW,NM,JG	5x5	71 10.738	66 58.778	16	0	0	
44	Kharasavey	Clay-site	Carbig, Salpol, Calhol, Poljun, Dicspp, Ochfri, Clagra	21-Aug-08	SW,NM,JG	5x5	71 10.733	66 58.828	16	0	0	
45	Kharasavey	Sand-sites	Salnum, Vacvit, Carbig, Calhol, Claspp, Dicelo, Thaver	22-Aug-08	SW,NM,JG,HE	5x5	71 11.663	66 53.337	8	0	0	
46	Kharasavey	Sand-sites	Salnum, Vacvit, Carbig, Claspp, Dicspp, Thaver	22-Aug-08	SW,NM,JG,HE	5x5	71 11.667	66 53.341	8	0	0	
47	Kharasavey	Sand-sites	Salnum, Poljun, Thaver, Claspp	23-Aug-08	SW,NM,JG,HE	5x5	71 11.664	66 55.719	13	0	0	
48	Kharasavey	Sand-sites	Salnum, Poljun, Hylspl, Thaver, Claspp	23-Aug-08	SW,NM,JG,HE	5x5	71 11.667	66 55.731	13	0	0	
49	Kharasavey	Sand-sites	Salnum, Carbig, Aultur, Dicspp, Ochfri, Claspp, Thaver	23-Aug-08	SW,NM,JG,HE	5x5	71 11.632	66 56.071	13	0	0	
49a	Ostrov Belyy	Clayey-site	Carbig, Salpol, Hylspl, sedge, dwarf shrub, moss	24-Jul-09	SW, RD, HE	5x5	73 19.713	70 04.674	0.3	0-2	NE	
50	Ostrov Belyy	Clayey-site	Carbig, Salpol, Hylspl, sedge, dwarf shrub, moss	24-Jul-09	SW, RD, HE	5x5	73 19.713	70 04.713	0.4	0-2	NE	
51	Ostrov Belyy	Clayey-site	Carbig, Salpol, Hylspl, sedge, dwarf shrub, moss	24-Jul-09	SW, RD, HE	5x5	73 19.719	70 04.692	0.6	0-2	NE	
52	Ostrov Belyy	Clayey-site	Carbig, Salpol, Hylspl, sedge, dwarf shrub, moss	24-Jul-09	SW, RD, HE	5x5	73 19.726	70 04.668	0.4	0-2	NE	
53	Ostrov Belyy	Clayey-site	Carbig, Salpol, Hylspl, sedge, dwarf shrub, moss	24-Jul-09	SW, RD, HE	5x5	73 19.726	70 04.712	0.8	0-2	NE	
54	Ostrov Belyy	Sandy-site	dry Gymcor, Salnum, Raclan	22-Jul-09	SW, RD, HE	5x5	73 18.553	70 07.728	0.3	0	0	
55	Ostrov Belyy	Sandy-site	dry Gymcor, Salnum, Raclan	22-Jul-09	SW, RD, HE	5x5	73 18.555	70 07.765	0	0	0	
56	Ostrov Belyy	Sandy-site	dry Gymcor, Salnum, Raclan	22-Jul-09	SW, RD, HE	5x5	73 18.564	70 07.737	0.4	0	0	
57	Ostrov Belyy	Sandy-site	dry Gymcor, Salnum, Raclan	22-Jul-09	SW, RD, HE	5x5	73 18.566	70 07.719	0.8	0	0	
58	Ostrov Belyy	Sandy-site	dry Gymcor, Salnum, Raclan	22-Jul-09	SW, RD, HE	5x5	73 18.568	70 07.768	0.1	0	0	

Plant biomass

Table 10. Summary of above-ground plant biomass for the vegetation study plots (relevés). Tree biomass for each plot was determined from the plot-count method. See Appendix D (Walker 2009a) for biomass sampling and sorting methods for the non-tree species. For the trees, biomass was determined from the plot-count method and expressed in g m^{-2}.

	Deciduous				Evergreen				Graminoid													
Releve #	Stem	Live foliar	Att. dead foliar	Repro-ductive	Stem	Live foliar	Att. dead foliar	Repro-ductive	Live foliar	Att. dead foliar	Forb	Live bryo-phyte	Live lichen	Total excluding dead moss & lichen & litter	Dead bryo-phyte	Dead lichen	Litter	Total including dead moss & lichen & litter, excluding trees	Broadleaf deciduous trees	Needleleaf deciduous trees	Ever-green trees	Total above-ground biomass
Nadym-1*																						
ND_RV_01	47	11	0	1	77	49	2	1	T	2	0	161	0	352	1123	22	333	1830	305	51	6777	8964
ND_RV_02	142	22	1	1	99	71	3	T	0	0	T	252	151	741	773	76	414	2003	224	2413	3176	7816
ND_RV_03	83	14	0	1	17	21	2	0	0	0	0	3	1720	1860	2	342	663	2866	1	247	3969	7084
ND_RV_04	9	3	0	0	7	5	2	0	0	0	0	1	1450	1478	0	560	603	2641	370	74	4494	7579
ND_RV_05	46	4	0	0	109	68	7	T	0	0	0	34	703	972	22	469	844	2307	512	471	3608	6898
Average	65	11	T	1	62	43	3	T	T	T	T	90	805	1081	384	294	571	2330	282	651	4405	7668
s.d.	50	8	0	1	47	29	2	0	0	1	0	112	765	596	530	237	203	431	189	999	1412	813
s.e.	22	4	0	0	21	13	1	0	0	0	0	50	342	267	237	106	91	193	85	447	631	363
Nadym-2																						
Hummocks																						
ND_RV_06	0	0	0	0	682	197	3	1	3	12	18	17	343	1275	97	142	682	2196	0	0	0	2196
ND_RV_07	13	1	0	0	110	67	T	T	0	1	28	160*	3	1114	1437**	0	6	1826	0	0	0	1826
ND_RV_08	74	31	0	1	420	182	11	4	9	56	10	21	340	1159	36	170	265	1630	0	0	0	1630
Average	29	11	0	T	404	149	5	2	4	23	19	66	228	1182	523	104	317	1884	0	0	0	1884
s.d.	40	17	0	0	286	71	6	2	4	29	9	81	195	83	792	91	341	288	0	0	0	288
s.e.	23	10	0	0	165	41	3	1	3	17	5	47	113	48	457	53	197	166	0	0	0	166
Inter-hummocks																						
ND_RV_09	0	0	0	0	3	3	0	0	0	0	3	1	1008	1019	0	877	51	1946	0	0	0	1946
ND_RV_10	22	1	0	0	12	1	0	0	3	7	4	0	1030	1080	0	594	47	1721	0	0	0	1721
ND_RV_11	9	1	0	0	423	96	2	2	39	132	1	2	754	1461	4	0	548	2013	0	0	0	2013
Average	10	1	0	0	146	33	1	1	14	46	3	1	930	1186	1	490	216	1894	0	0	0	1894
s.d.	11	1	0	0	240	55	1	1	22	74	1	1	154	240	2	448	288	153	0	0	0	153
s.e.	6	0	0	0	138	32	1	1	13	43	1	0	89	138	1	258	166	88	0	0	0	88
Laborovaya-1																						
LA_RV_15	259	43	0	3	44	25	3	0	36	83	4	271	60	832	613	0	183	1627	0	0	0	1627
LA_RV_16	248	53	0	0	38	44	6	0	35	48	1	395	103	972	313	0	337	1621	0	0	0	1621
LA_RV_17	303	27	0	5	11	21	5	0	43	120	6	203	42	786	1060	0	170	2015	0	0	0	2015
LA_RV_18	299	86	0	1	17	25	0	0	15	83	5	265	31	828	596	0	73	1496	0	0	0	1496
LA_RV_19	78	24	0	0	20	33	4	0	7	23	T	375	92	657	684	0	104	1444	0	0	0	1444
Average	238	47	0	2	26	30	4	T	27	71	3	302	66	815	653	0	173	1641	0	0	0	1641
s.d.	92	25	0	2	14	9	2	0	15	37	2	81	31	113	268	0	102	224	0	0	0	224
s.e.	41	11	0	1	6	4	1	0	7	17	1	36	14	50	120	0	46	100	0	0	0	100
Laborovaya-2																						
LA_RV_20	124	13	0	0	21	29	0	0	13	62	0	110	285	659	316	0	596	1570	0	0	0	1570
LA_RV_21	285	113	0	3	9	17	0	0	9	19	0	78	201	734	281	0	532	1546	0	0	0	1546
LA_RV_22	14	3	0	0	11	19	1	0	3	18	0	9	233	308	29	0	502	839	0	0	0	839
LA_RV_23	100	6	0	0	1	5	0	0	32	83	0	95	343	664	507	10	301	1482	0	0	0	1482
LA_RV_24	81	7	0	0	5	16	1	0	10	33	0	119	244	514	467	0	333	1314	0	0	0	1314
Average	121	28	0	1	9	17	T	0	13	43	0	82	261	576	320	2	453	1350	0	0	0	1350
s.d.	101	48	0	1	7	9	0	0	11	29	0	44	55	170	189	4	129	303	0	0	0	303
s.e.	45	21	0	1	3	4	0	0	5	13	0	20	24	76	84	2	58	135	0	0	0	135
Vaskiny Dachi-1																						
VD_RV_25	32	43	0	0	3	5	2	0	24	69	3	169	27	378	688	0	167	1233	0	0	0	1233
VD_RV_26	32	20	0	0	47	56	21	1	45	71	14	287	33	628	587	0	235	1449	0	0	0	1449
VD_RV_27	172	44	0	0	13	40	0	1	24	73	0	151	21	539	450	0	318	1306	0	0	0	1306
VD_RV_28	10	11	0	1	7	23	0	1	38	64	2	268	25	450	516	0	150	1116	0	0	0	1116
VD_RV_29	25	32	0	1	0	0	0	0	9	25	1	317	54	465	834	0	92	1390	0	0	0	1390
Average	54	30	0	1	14	25	5	T	28	60	4	239	32	492	615	0	192	1299	0	0	0	1299
s.d.	66	15	0	1	19	24	9	1	14	20	6	74	13	95	151	0	87	131	0	0	0	131
s.e.	30	6	0	0	9	11	4	0	6	9	3	33	6	42	68	0	39	59	0	0	0	59
Vaskiny Dachi-2																						
VD_RV_30	7	6	0	0	15	29	2	T	17	33	0	211	73	393	514	0	112	1019	0	0	0	1019
VD_RV_31	114	37	0	0	11	33	2	0	19	29	0	210	89	544	456	0	171	1172	0	0	0	1172
VD_RV_32	40	8	0	0	16	46	1	T	6	29	0	254	54	453	603	0	147	1202	0	0	0	1202
VD_RV_33	13	5	0	0	18	50	3	2	19	64	0	278	68	521	667	0	90	1278	0	0	0	1278
VD_RV_34	120	21	0	1	9	31	0	1	15	27	0	367	60	652	1258	0	132	2043	0	0	0	2043
Average	59	15	0	T	14	38	2	1	16	36	0	264	69	513	700	0	131	1343	0	0	0	1343
s.d.	55	14	0	0	4	9	1	1	5	15	0	64	14	98	323	0	31	403	0	0	0	403
s.e.	24	6	0	0	2	4	0	0	2	7	0	29	6	44	144	0	14	180	0	0	0	180
Vaskiny Dachi-3																						
VD_RV_35	0	0	0	0	16	43	0	T	8	27	0	115	174	383	400	0	239	1021	0	0	0	1021
VD_RV_36	0	0	0	0	7	11	0	0	3	15	0	231	183	450	460	0	105	1016	0	0	0	1016
VD_RV_37	4	5	0	1	9	6	0	1	1	2	0	43	191	264	164	0	278	706	0	0	0	706
VD_RV_38	0	0	0	0	9	21	2	2	8	26	0	116	257	440	284	0	135	859	0	0	0	859
VD_RV_39	0	0	0	0	93	34	0	2	1	2	0	403	256	791	166	0	398	1354	0	0	0	1354
Average	1	1	0	T	27	23	T	1	4	15	0	182	212	466	295	0	231	991	0	0	0	991
s.d.	2	2	0	0	37	15	1	1	4	12	0	141	41	196	134	0	118	241	0	0	0	241
s.e.	1	1	0	0	17	7	0	0	2	5	0	63	18	88	60	0	53	108	0	0	0	108

Table 10 (cont'). Summary of above-ground plant biomass for the vegetation study plots (relevés).

Kharasavey-1																						
KH_RV_40	18	15	2	1	0	0	0	0	14	29	T	261	184	525	1126	2	212	1865	0	0	0	1865
KH_RV_41	8	8	2	0	0	0	0	0	72	128	T	416	122	755	1613	4	128	2501	0	0	0	2501
KH_RV_42	9	7	0	0	0	0	0	0	93	205	T	285	17	616	687	0	72	1375	0	0	0	1375
KH_RV_43	14	12	2	5	0	0	0	0	58	96	0	320	93	599	653	0	149	1401	0	0	0	1401
KH_RV_44	6	4	0	3	0	0	0	0	32	54	1	202	263	563	905	0	125	1593	0	0	0	1593
Average	11	9	1	2	0	0	0	0	54	102	T	297	136	612	997	1	137	1747	0	0	0	1747
s.d.	5	4	1	2	0	0	0	0	31	69	0	79	93	88	394	2	51	465	0	0	0	465
s.e.	2	2	0	1	0	0	0	0	14	31	0	35	42	39	176	1	23	208	0	0	0	208
Kharasavey-2a																						
KH_RV_45	10	10	1	0	13	43	0	0	14	25	T	292	386	793	901	0	243	1937	0	0	0	1937
KH_RV_46	16	9	7	T	9	35	0	0	12	26	0	406	292	813	1186	0	95	2093	0	0	0	2093
Average	13	9	4	T	11	39	0	0	13	26	T	349	339	803	1044	0	169	2015	0	0	0	2015
s.d.	5	1	5	0	3	5	0	0	1	1	0	81	67	14	201	0	105	111	0	0	0	111
s.e.	3	1	3	0	2	4	0	0	1	1	0	57	47	10	142	0	74	78	0	0	0	78
Kharasavey-2b																						
KH_RV_47	67	27	22	0	0	0	0	0	24	53	2	329	115	638	628	0	534	1800	0	0	0	1800
KH_RV_48	101	39	6	0	0	0	0	0	12	31	T	969	62	1220	1075	0	427	2722	0	0	0	2722
KH_RV_49	58	32	11	1	0	0	0	0	12	26	1	367	325	832	1400	0	345	2577	0	0	0	2577
Average	75	33	13	T	0	0	0	0	16	37	1	555	167	896	1034	0	436	2366	0	0	0	2366
s.d.	23	6	8	0	0	0	0	0	7	15	1	359	139	296	388	0	95	496	0	0	0	496
s.e.	13	4	5	0	0	0	0	0	4	8	1	207	80	171	224	0	55	286	0	0	0	286
Ostrov Belyy-1																						
BO_RV_49a	30	15	0	0	0	0	0	0	23	45	0	256	34	402	254	0	64	720	0	0	0	720
BO_RV_50	20	15	0	0	0	0	0	0	19	67	0	332	55	508	80	0	92	680	0	0	0	680
BO_RV_51	4	2	0	0	38	12	82	0	7	18	0	44	100	308	29	0	19	355	0	0	0	355
BO_RV_52	33	16	2	0	0	0	0	0	15	33	0	294	38	431	506	0	2	938	0	0	0	938
BO_RV_53	14	0	0	0	0	0	0	0	1	22	0	379	145	561	216	0	21	798	0	0	0	798
Average	20	9	0	0	8	2	16	0	13	37	0	261	74	442	217	0	39	698	0	0	0	698
s.d.	12	8	1	0	17	6	36	0	9	20	0	130	47	98	186	0	37	215	0	0	0	215
s.e.	5	3	0	0	8	2	16	0	4	9	0	58	21	44	83	0	17	96	0	0	0	96
Ostrov Belyy-2																						
BO_RV_54	18	9	17	0	0	0	0	0	0	1	5	7	59	116	27	0	21	164	0	0	0	164
BO_RV_55	8	2	0	0	0	0	0	0	0	0	0	4	21	36	0	0	0	36	0	0	0	36
BO_RV_56	82	16	0	0	0	0	0	0	0	0	0	327	268	693	821	0	153	1667	0	0	0	1667
BO_RV_57	50	12	7	0	0	0	0	0	0	0	0	207	103	378	346	0	0	724	0	0	0	724
BO_RV_58	0	0	2	0	0	0	0	0	0	0	0	698	67	767	1671	0	0	2438	0	0	0	2438
Average	32	8	5	0	0	0	0	0	0	0	1	249	104	398	573	0	35	1006	0	0	0	1006
s.d.	34	7	7	0	0	0	0	0	0	0	2	287	96	330	697	0	66	1027	0	0	0	1027
s.e.	15	3	3	0	0	0	0	0	0	0	1	128	43	147	312	0	30	459	0	0	0	459

* Bryophyte biomass consisted purely of Sphagnums. Sphagnum carpet was sampled until 10 cm depth. Live bryophyte biomass was calculated to be 1 cm layer of sampled bryophyte biomass.

** Dead bryophyte biomass was calculated to be 9 cm layer of sampled 10 cm Sphagnum carpet. Total mass of all dead Sphagnum down to the permafrost table was 4582.26g/m², and the total depth was 40cm.

Note added May 22, 2009: The following ash data were obtained by Gosha Matyshak:

samples ash, % (450°C)

RV

KH_RV_49 dead bryophyte **24.25**

KH_RV_ 49 live bryophyte 11.01

KH_RV_ 48 dead bryophyte **31.84**

KH_RV_ 48 live bryophyte 16.91

KH_RV_ 46 dead bryophyte **33.21**

KH_RV_ 46 live bryophyte 20.66

KH-RV-41 Bryophyte live 2.51

KH-RV-44 Lichen 7.65

KH-RV-43 Bryophyte dead 1/2 1.61

KH- RV-48 Litter 25.91

KH- RV-49 Litter 33.98

The high ash weights for live and dead bryophytes and the litter from the sandy plots at Kharasavey (KH_RV_46, 48, 49) indicate that these samples were likely contaminated by sand that was not burned off during the ashing process. The mass of live and dead bryophytes, lichens and litter should be reduced. Reasonable estimates based on these limited data are: Live bryophytes biomass, -13%; dead bryophytes -26%; litter, -28%. Lichens probably should also be reduced about 20%.

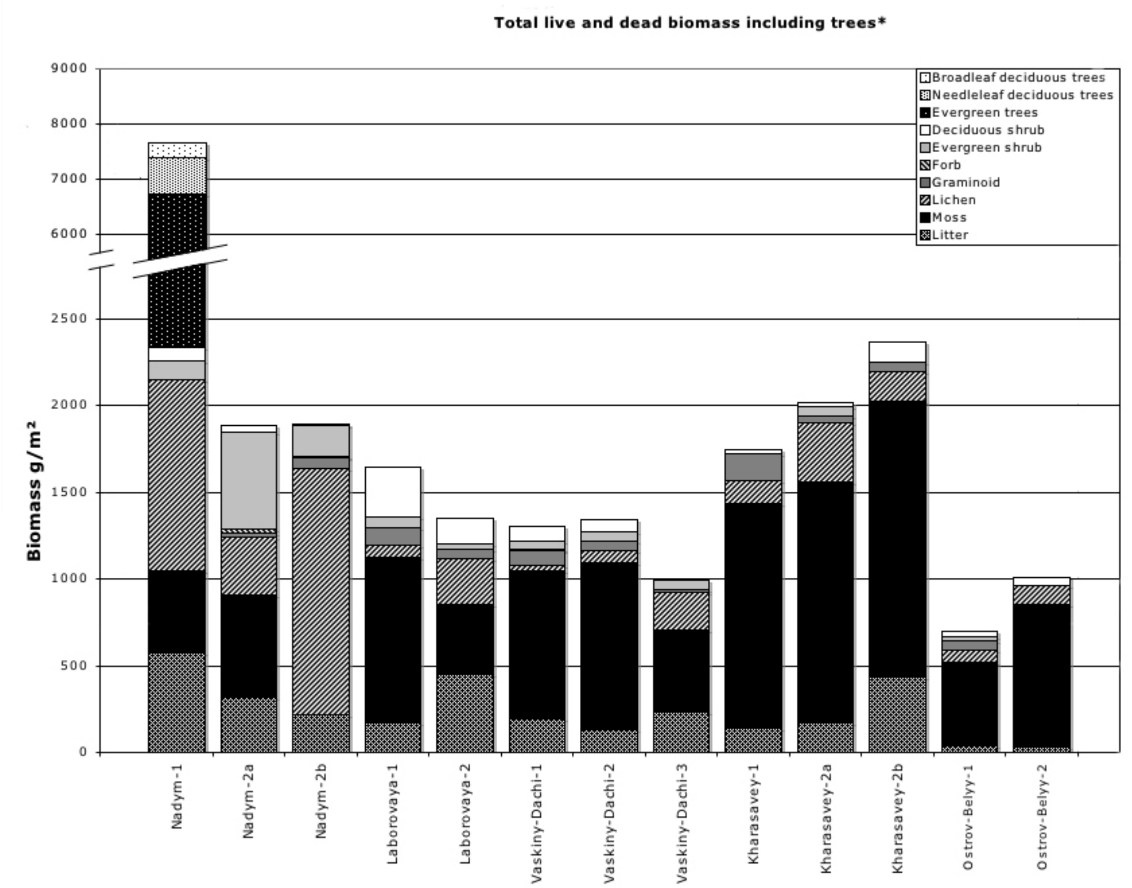

Figure 31. Total live and dead biomass including trees. *Includes all biomass data categories in Table 10.

Table 11. Biomass data for Figure 31 summarized by site (T = Trace amounts).

T=trace amounts	live+dead	live+dead	live+dead		all	all		Broadleaf	Needleleaf	
Site	**Moss**	**Lichen**	**Graminoid**	**Forb**	**Evergreen shrub**	**Deciduous shrub**	**Litter**	**deciduous trees**	**deciduous trees**	**Evergreen trees**
Nadym-1	474	1099	T	T	108	77	571	282	651	4405
Nadym-2a	589	332	27	19	559	40	317	0	0	0
Nadym-2b	2	1421	60	3	181	11	216	0	0	0
Laborovaya-1	955	66	99	3	59	286	173	0	0	0
Laborovaya-2	402	263	56	0	27	150	453	0	0	0
Vaskiny-Dachi-1	853	32	88	4	44	85	192	0	0	0
Vaskiny-Dachi-2	964	69	52	0	54	74	131	0	0	0
Vaskiny-Dachi-3	476	212	19	0	51	2	231	0	0	0
Kharasavey-1	1294	137	156	T	0	23	137	0	0	0
Kharasavey-2a	1393	339	39	T	50	27	169	0	0	0
Kharasavey-2b	1589	167	52	1	0	121	436	0	0	0
Ostrov Belyy-1	478	74	50	0	26	30	39	0	0	0
Ostrov Belyy-2	822	104	T	1	0	45	35	0	0	0

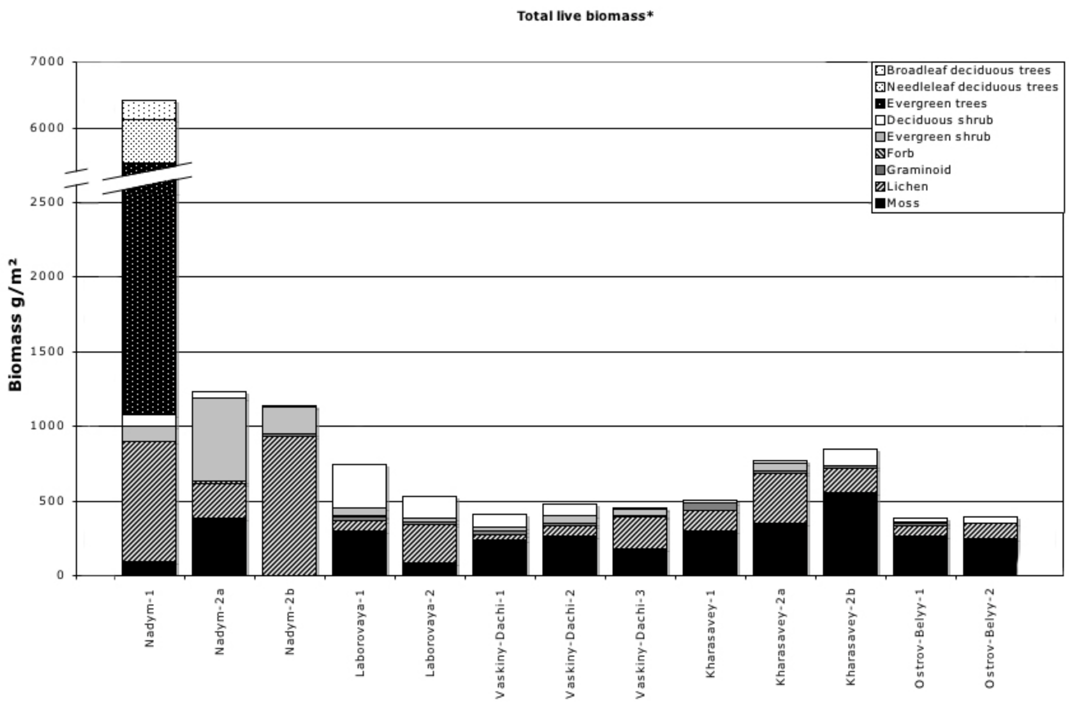

Figure 32. Total live biomass. *Includes all biomass data categories in Table 10 except dead bryophytes, dead lichens, and attached dead foliar.

Table 12. Biomass data for Figure 32 summarized by site.

T=trace amounts	live	live	live		live foliar+repr+stem	live foliar+repr+stem	**Broadleaf**	**Needleleaf**	
Site	**Moss**	**Lichen**	**Graminoid**	**Forb**	**Evergreen shrub**	**Deciduous shrub**	**Deciduous trees**	**Deciduous trees**	**Evergreen trees**
Nadym-1	90	805	T	T	105	77	282	651	4405
Nadym-2a	383	228	4	19	554	40	0	0	0
Nadym-2b	1	930	14	3	180	11	0	0	0
Laborovaya-1	302	66	27	3	56	286	0	0	0
Laborovaya-2	82	261	13	0	26	150	0	0	0
Vaskiny-Dachi-1	239	32	28	4	19	85	0	0	0
Vaskiny-Dachi-2	264	69	16	0	52	74	0	0	0
Vaskiny-Dachi-3	182	212	4	0	51	2	0	0	0
Kharasavey-1	297	136	54	T	0	22	0	0	0
Kharasavey-2a	349	339	13	T	50	23	0	0	0
Kharasavey-2b	555	167	16	1	0	108	0	0	0
Ostrov Belyy-1	261	74	13	0	10	30	0	0	0
Ostrov Belyy-2	249	104	T	1	0	39	0	0	0

Total biomass excluding trees*

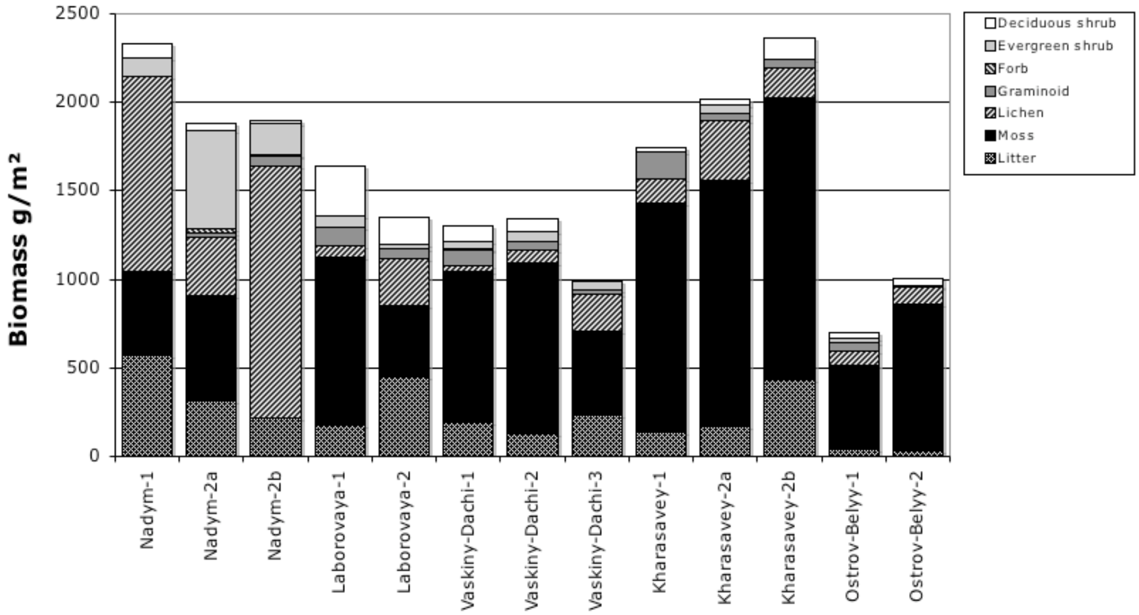

*Figure 33. Total biomass excluding trees. *Includes all biomass data categories in Table 10 except trees.*

Table 13. Biomass data for Figure 33 summarized by site.

T=trace amounts	all	all	all		all	all	
Site	**Moss**	**Lichen**	**Graminoid**	**Forb**	**Evergreen shrub**	**Deciduous shrub**	**Litter**
Nadym-1	474	1099	T	T	108	77	571
Nadym-2a	589	332	27	19	559	40	317
Nadym-2b	2	1421	60	3	181	11	216
Laborovaya-1	955	66	99	3	59	286	173
Laborovaya-2	402	263	56	0	27	150	453
Vaskiny-Dachi-1	853	32	88	4	44	85	192
Vaskiny-Dachi-2	964	69	52	0	54	74	131
Vaskiny-Dachi-3	476	212	19	0	51	2	231
Kharasavey-1	1294	137	156	T	0	23	137
Kharasavey-2a	1393	339	39	T	50	27	169
Kharasavey-2b	1589	167	52	1	0	121	436
Ostrov Belyy-1	478	74	50	0	26	30	39
Ostrov Belyy-2	822	104	T	1	0	45	35

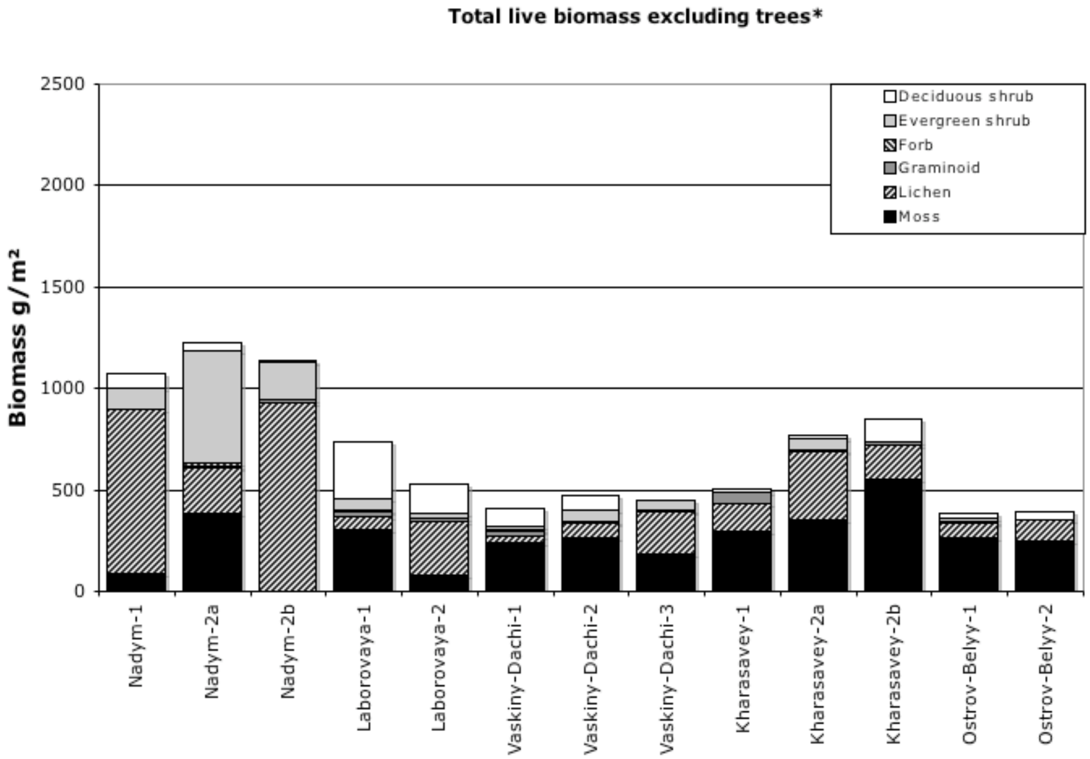

Figure 34. Total live biomass excluding trees. * Includes all biomass data categories in Table 10 except trees, dead bryophytes, dead lichens, and attached dead foliar.

Table 14. Biomass data for Figure 34 summarized by site.

T=trace amounts	live	live	live		live foliar+repr+stem	live foliar+repr+stem
Site	**Moss**	**Lichen**	**Graminoid**	**Forb**	**Evergreen shrub**	**Deciduous shrub**
Nadym-1	90	805	T	T	105	77
Nadym-2a	383	228	4	19	554	40
Nadym-2b	1	930	14	3	180	11
Laborovaya-1	302	66	27	3	56	286
Laborovaya-2	82	261	13	0	26	150
Vaskiny-Dachi-1	239	32	28	4	19	85
Vaskiny-Dachi-2	264	69	16	0	52	74
Vaskiny-Dachi-3	182	212	4	0	51	2
Kharasavey-1	297	136	54	T	0	22
Kharasavey-2a	349	339	13	T	50	23
Kharasavey-2b	555	167	16	1	0	108
Ostrov Belyy-1	261	74	13	0	10	30
Ostrov Belyy-2	249	104	T	1	0	39

iButtons:

Table 15. Logger numbers (on outside of duct tape) and iButton serial numbers.

	2007		
Logger No.	**Serial no.**	**Logger No.**	**Serial no.**
1	12350A	35	125050
2	1252B2	36	123003
3	122D12	37	125256
4	122A9E	38	124A0A
5	1231E8	39	12506D
6	124E85	40	12516B
7	123A83	41	125333
8	124585	42	1250E8
9	12505D	43	12450E
10	122ED0	44	1233E3
11	12339F	45	12534D
12	124EE3	46	12311D
13	122EBF	47	125375
14	123050	48	125389
15	124235	49	123589
16	125073	50	124CC7
17	123163	51	124C87
18	124C01	52	12514D
19	123415	53	123389
20	1236DE	54	1231D8
21	12312A	55	122B9C
22	122EE8	56	1237CE
23	122D44	57	1233BA
24	1233FE	58	122F28
25	125305	59	1251C9
26	1242D8	60	124AA8
27	12333D	61	122A82
28	125086	62	1245A5
29	12379C	63	1230F8
30	1234EE	64	124C68
31	122D4F	65	125204
32	123855	66	124E27
33	124B9E	67	12320C
34	122D94	68	124FD3
	2008		
Logger No.	**Serial no.**	**Logger No.**	**Serial no.**
1	12CD2B	11	12D5EE
2	11CB6E	12	12DFD4
3	12E16A	13	11BC6D
4	11AB6F	14	12D52D
5	12D39B	15	11C23D
6	11D136	16	11B049
7	11C572	17	12CF89
8	12D5BF	18	11A6D2
9	11D57B	19	12E2F8
10	12B58B	20	12CD59
	2009		
Logger No.	**Serial no.**	**Logger No.**	**Serial no.**
1	E4000000 22114721	16	20000000 OD692E41
2	E7000000 22189821	17	B7000000 OD359141
3	A8000000 2201F621	18	CD000000 OD65B241
4	ED000000 22233E21	19	68000000 OD74OC41
5	GG000000 21EF8521	20	93000000 OD641841
6	1A000000 21F39221	T1	880000000 D55C141
7	B5000000 22A6921	T2	CB0000000 D665A41
8	A3000000 21FEFB21	T3	500000000 D5E0041
9	CD000000 21F25521	T4	CE0000000 DBG8841
10	EB000000 21E3D921	T5	670000000 E3CC641
11	20000000 22464721	T6	5D0000000D604641
12	74000000 22172D21	T7	110000000 D5ED741
13	DB000000 0BBBFB41	T8	780000000 D641D41
14	EA000000 0D6CFA41	T9	OB0000000D55F341
15	42000000 OD533E41	T10	A90000000D365B41

In 2009, serial numbers ending in 21 are old iButtons; ending in 41 are high definition capacity iButtons

Table 16. Locations of ibutton loggers in relevés and depths.

2007		
Releve No.	**Logger No.**	**Depth (cm)**
Nadym-1, Forest site:		
ND-RV-1	41	0
	46	19
ND-RV-2	27	0
	26	10
ND-RV-3	62	0
	54	5
ND-RV-4	60	0
	55	13
ND-RV-5	31	0
	67	12
Nadym-2, CALM Grid:		
ND-RV-6	29	60
	49	0
ND-RV-7	39	51
	5	0
ND-RV-9	12	30
	56	0
ND-RV-10	18	10
	59	0
Laborovaya-1, clayey site		
LA-RV-15	16	0
	25	9
LA-RV-16	19	0
	6	10
LA-RV-17	65	0
	13	9
LA-RV-18	63	0
	34	4
LA-RV-19	68	0
	17	9
Laborovaya-2, sandy site		
LA-RV-20	42	0
	44	9
LA-RV-21	30	0
	22	5
LA-RV-22	43	0
	53	4
LA-RV-23	28	0
	37	7
LA-RV-24	32	0
	21	8
Vaskiny Dachi-1, Terrace IV		
VD-RV-25	11	0
	14	6
VD-RV-26	61	0
	8	7
VD-RV-27	38	0
	3	5
VD-RV-28	36	0
	10	8
VD-RV-29	35	0
	9	8
Vaskiny Dachi-2, Terrace III		
VD-RV-30	33	0
	51	8
VD-RV-31	2	0
	1	6
VD-RV-32	4	0
	45	3
VD-RV-33	58	0
	66	7
VD-RV-34	64	0
	40	4

2007		
Releve No.	**Logger No.**	**Depth (cm)**
Vaskiny Dachi-2, Terrace III		
VD-RV-30	33	0
	51	8
VD-RV-31	2	0
	1	6
VD-RV-32	4	0
	45	3
VD-RV-33	58	0
	66	7
VD-RV-34	64	0
	40	4

2008		
Releve No.	**Logger No.**	**Depth (cm)**
Kharasavey-1, clayey site		
KH-RV-40	5	0
	8	12
KH-RV-41	1	0
	10	4
KH-RV-42	9	0
	4	8
KH-RV-43	7	0
	2	7
KH-RV-44	3	0
	6	9
Kharasavey-2a, 2b, sandy sites		
KH-RV-45	20	0
	19	7
KH-RV-46	17	0
	16	5
KH-RV-47	11	0
	18	5
KH-RV-48	13	0
	12	5.5
KH-RV-49	14	0
	15	3

2009			
Releve No.	**Logger No.**	**Depth (cm)**	
Ostrov Belyy-1, loamy site			
BO-RV-49	3	0	interboil
	5	9	interboil
BO-RV-50	6	0	boil
	8	1	boil
BO-RV-51	10	0	interboil
	11	4	interboil
BO-RV-52	14	0	interboil
	17	4	interboil
BO-RV-53	19	0	boil
	20	1	
Ostrov Belyy-2, sandy site			
BO-RV-54	1	0	no organic layer
	4	10	no organic layer
BO-RV-55	2	0	no organic layer
	7	10	no organic layer
BO-RV-56	15	0	
	16	2	
BO-RV-57	9	0	no organic layer
	12	10	no organic layer
BO-RV-58	13	0	
	18	3	

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APPENDIX A. LIST OF EXPEDITION PARTICIPANTS

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APPENDIX B. LIST OF VASCULAR PLANT SPECIES FROM OSTROV BELYY: O. KHITUN

Plants were collected during the period 17-30 July 2009, in the vicinity of the polar station in the northwest corner of Ostrov Belyy. Vouchers were collected for all species (but sometimes not enough for a herbarium sheet) and are deposited at the Komarov Botanical Institute (KBI) in St. Petersburg. Nomenclature follows that used at KBI and is based on Cherepanov (1995) and the *Arctic flora of the USSR,* v. I-X, 1960-1987.

The observations are only the third report of vascular plant species from the island. The first was that of F.R. Kielliing, who noted 17 species on the island during the Vega Expedition of A.E. Nordensköld (1878-79). O. Rebristaya (1995) made more extensive collections in the southwest corner of the island. The list from Ostrov Belyy adds two new species of *Ranunculus* to the island, bringing the total known flora for the island to 75 species. A third new species, *Dryas octopetala* subsp. *subincisa,* was probably misidentified in earlier collections. Plants collected by Rebristaya and not collected during our expedition are noted in brackets []. Starred (*) species are new to Ostrov Belyy. Terminology: *stenotopic* – in limited number of habitat types; *hemi-euritopic* – broadly occurring in numerous habitats; *sparse* – occurring with few other individuals, *copius* – occurring with many other individuals.

Equisetaceae

Equisetum arvense subsp. *boreale* (Bong.) Tolm. - Rare. Frost-boil polygons and cracks on marginal parts of flat sandy hills. Flat tops of coastal bluffs. Slowly revegetating abandoned road.

Lycopodiaceae

Lycopodium selago subsp. *arcticum* Tolm = *Huperzia arctica* (Tolm.) Sipl. – Rare, solitary, stenotopic. Short gentle slopes of sandy hills into creek or lake depressions.

Poaceae

Hierochloë alpina (Sw.) Roem. et Schult. - Rare, sparse, stenotopic. Sandy hill - bank of a creek with polar fox holes.

Hierochloë pauciflora R.Br. - very common, copius, hemi-euritopic. Cotton grass-moss mires and wet tundra on river terraces and sea-shore lowland; flat poorly drained watersheds and their gentle slopes.

Alopecurus alpinus Smith – Very rare. Found only at the territory of the station. On clayey disturbed ground.

Arctagrostis latifolia (R.Br.) Griseb. - Very common, sparse, hemi-euritopic. Widely distributed on better drained sites on slopes, river terraces, and on sand and clayey soils.

[*Calamagrostis deschampsioides* Trin.] – Recorded by O. Rebristaya in SE part of the island on sea marshes. Not found in NW part, probably because it was not developed yet.

Calamagrostis holmii Lange - Very common, sparse, hemi-euritopic. Widely distributed in better drained sites on slopes, river terraces, and on sand, clayey and peaty soils.

Deschampsia borealis (Trautv.) Roshev. - Rare, solitary. Sandy banks of the creeks, sand blow-outs.

?Deschampsia glauca C.Hartm. - Recorded by O. Rebristaya in SE part of the island on slopes and river terraces as relatively common. As it is impossible to distinguish from *D. obensis* until it develops inflorescence, we keep it in the list with question mark. Sandy steep banks of the creeks, eroded slopes, river terraces, abandoned roads.

? *Deschampsia obensis* Roshev. - Recorded by O. Rebristaya in SE part of the island on river terraces as rare. As it is impossible to distinguish from *D. glauca* until it develops inflorescence, we keep it in the list with question mark. Sandy steep banks of the creeks, eroded slopes, river terraces, abandoned roads.

Poa alpigena (Blytt) Lindm. subsp. *alpigena* - Found mainly as last year's stalks on slope and foothills, respectively it is difficult to judge how widespread it is.

Poa alpigena subsp. *colpodea* Jurtz. et Petrovsky – Seems to be more common than subsp. *alpigena.* Often in graminoid communities on the "high" sea coast bluff, sparse to copious.

Poa arctica R.Br. – Common, frequent, scanty, hemi-euritopic. Tops and slopes of watershed hills, foothills, river terraces.

Dupontia fisheri R.Br. – Very common and active grass. Very wide spread, almost euritopic. Very abundant in grass-cotton-sedge-moss mires in lake depressions and along sea coast.

Dupontia psilosantha Rupr. – Common. Stenotopic, sparse to copious. Sea marshes (layda).

Arctophila fulva (Trin.) Anderss. – Relatively common and normally abundant in its habitats. Hemi-stenotopic. Wet bottoms of ravines, along and in shallow creeks, around lakes and in mires in lake depressions, in thermocarst hollows in old tracks.

Phippsia algida (Soland.) R. – Common, hemi-stenotopic, scanty to abundant. Wet bottoms of ravines, sea coast marshes and on river banks and beaches in high tide zone.

Phippsia concinna (Th.Fries) Lindeb. – Occasional. Stenotopic, solitary to sparse. Bottoms of ravines, footslopes.

Puccinellia phryganodes (Trin.) Scri - Common. Stenotopic, copious. On sea coast marshes and on river banks and beaches in high tide zone.

Festuca brachyphylla Schult. et Schult - Found only as last year's straw on south facing sandy slopes. Most probably it is this species as it was recorded by O. Rebristaya in SE part of the island on slopes and tops of the hills.

[*Festuca rubra* subsp. *arctica* (Hack.) Govor.] - Recorded by O. Rebristaya in SE part of the island on slopes and tops of the hills and on river terraces and "high" sea coast slopes. Not found in NW part probably because it was not developed yet.

Cyperaceae

Eriophorum medium Anderss. (= *Eriophorum russeolum* Fr. Ex Hartm. subsp. *leiocarpum* according to Novoselova, 1993) - Relatively rare, sparse. Cotton-grass-moss mires in lake depressions.

Eriophorum polystachion L. (= E. *angustifolium* spp. *polystachion*) - Hemi-euritopic, very common, often copious. One of the most active species in the area. It frequently dominates in tundra communities on the watersheds and their gentle slopes, also in cotton-grass-moss mires in lake depressions and river terraces.

Eriophorum russeolum Fries (According to Novoselova, 1993, this species should be referred to as *Eriophorum russeolum* Fr. ex Hartm. subsp. r*usseolum*) - Stenotopic, common, abundant, sparse to copious. Mires in lake depressions, on river terraces, low sea coast.

Eriophorum scheuchzeri Hoppe - Hemi-stenotopic, very common, sparse. Frost-boils on sandy and clayey flat tops and slopes of watersheds, river sand beaches, wet bottoms of ravines, on disturbed ground around station.

Carex arctisibirica (Jurtz.) Czerep. (= *Carex bigelowii*) – Hemi-stenotopic, common, mostly sparse, rarely dominating compared to mainland tundra.

Carex concolor R.Br. - Hemi-euritopic, common, sparse to copious. Tops and slopes of watershed hills, mires in lake depressions, wet bottoms of ravines, coastal lowland, wet sand beaches of rivers and creeks.

[*Carex concolor* var. *minuscula* Kuvajev] - Recorded by O. Rebristaya in SE part of the island on coastal marshes and river estuaries. Not found in NW part, probably it develops later.

Carex glareosa Wahlenb. - Rarely, Stenotopic, solitary. Coastal marshes and low river banks in high tide zone.

[*Carex lachenalii* Schkuhr.] - Recorded by O. Rebristaya in SE part of the island on wet bottoms of ravines and foothills.

Carex subspathacea Wormsk. ex Hornem. - Stenotopic, common, copious. Sea marshes and low riverbanks in high tide zone.

Carex ursina Dew. - Stenotopic, relatively rare, solitary. Sea marshes and low river banks in high tide zone.

Juncaceae

Juncus biglumis L. - Hemi-euritopic. common, solitary. Tops and slopes of watershed hills, river terraces, marginal part of flat hills with frost-boils, eroded sands, coastal lowland.

Luzula confusa Lindb. - Hemi-euritopic, common, sparse to copious. Tops and slopes of watershed hills, river terraces, marginal part of flat hills with frost-boils, eroded sands, “high” bank of the sea.

Luzula nivalis (Laest.) Spreng. - Hemi-euritopic, common, sparse. Tops and slopes of watershed hills, river terraces, bottoms of ravines, peat hummocks.

Liliaceae

Lloydia serotina (L.) Reichenb. - Hemi-stenotopic, rather rare, solitary. Frost-boiled marginal parts of sandy hills, sandy high coastal bluff.

Salicaceae

Salix nummularia Anderss. - Hemi-euritopic, very common, sparse to copious. Most abundant on dry sandy sites, watersheds in cracks between frost-boils, slopes of hills, river terraces, sea coast bluffs.

Salix polaris Wahlenb. - Hemi-euritopic, very common, sparse to copious. In different tundras on watershed hills, slopes and foothills, river terraces and bottoms of ravines.

Salix reptans Rupr. - Stenotopic, very rare, solely plants (*un*). Sea terrace, around the station 4 shrubs, ca. 10 cm height.

Polygonaceae

Oxyria digyna (L.) Hill. - Hemieuritopic. Common. Sparse. Tops and slopes of the hills, slopes of ravines and riverbanks, coastal bluffs, sand blow-outs.

Polygonum viviparum L. (= *Bistorta vivipara* (L.) S.F.Gray). - Hemi-stenotopic, common, sparse. Tops and slopes of the hills, slopes of ravines and river banks, tops of coastal bluffs, flat margins of sea terrace.

Caryophyllaceae

Stellaria crassifolia Ehrh. - Rare, stenotopic, solitary to sparse. Grass-cotton grass mires in lake depressions.

Stellaria edwardsii R.Br. - Relatively common, hemi-stenotopic, solitary. Flat relatively better drained watersheds with *Salix polaris-Carex arctisibirica* tundra, slopes.

Stellaria humifusa Rottb. – Stenotopic but common and rather abundant in its habitats. Sparse to copious on coastal marshes, creek banks in the high tide zone.

[*Cerastium arvense* L.] – Recorded by O. Rebristaya in SE part of the island on sand blow-outs. No confirmed collection from northwest part of the island.

Cerastium jenisejense Hult. - Rare, solitary, stenotopic. Sand banks of the creek near the station.

Cerastium regelii Ostenf. – Hemi-stenotopic, common, sparse. Slopes and bottoms of ravines and hollows, along creeks, coastal marshes.

Sagina intermedia Fenzl – Common. Stenotopic, solitary. Spots of bare ground (frost-boils) on watersheds, their slopes and foothills. On river terraces and sand blow-outs on creek banks.

Ranunculaceae

**Batrachium trichophyllum* (Chaix) Bosch. subs*p. lutulentum* (Perrier ex Song.) Janch. – Stenotopic, sporadic, sparse. Sparse. Found in a small lake. Not found by O. Rebristaya.

Ranunculus hyperboreus Rottb. – Stenotopic, sporadic, sparse. Shallow creeks, wet banks of the creeks and bottoms of hollows.

[*Ranunculus lapponicus* L.] – Recorded by O. Rebristaya in SE part of the island on peat hummock. Not found in NW part of the island, probably it was at its limit in SE part.

Ranunculus nivalis L. – Rare, solitary, stenotopic? Slope of the sea terrace.

Ranunculus pallasii Schlecht. - Stenotopic. Sporadic. In little amounts, groups. In the lakes in shallow water, in mires with high water level, on sea lowland.

Ranunculus pygmaeus Wahlenb. – Very common. The most wide spread *Ranunculus* species. Hemi-euritopic, mainly sparse. Different types of mesic and wet tundras on watersheds and their slopes, and bottoms of ravines, river terraces, sea coast.

[*Ranunculus spitzbergensis* Hadac.] – Recorded by O. Rebristaya in SE part of the island as rare, stenotopic. Not found in the NW part.

Ranunculus sulphureus C. J. Phipps – Rare, stenotopic, solitary. Found at the sea terrace near the climatic station house. In contrast to SE part, where O. Rebristaya recorded it as common and wide spread.

**Ranunculus tricrenatus* (Rupr.) Jurtz. – Stenotopic, sporadic. In the shallow lake in the tide zone on sea marsh (layda). Not recorded by O. Rebristaya.

Brassicaceae

Cardamine bellidifolia L. – Hemi-euritopic, rather common, solitary. On watersheds and their slopes, on river terraces, in hollows, in mires in lake depressions, on wet banks of the creeks, on sea terrace near station.

Cardamine pratensis L. – Sporadic, solitary, stenotopic. In wet cotton-grass-moss mire, in shallow creek with sedge-cotton-grass vegetation.

[*Draba glacialis* Adams] – Recorded by O. Rebristaya in SE part of the island on the tops of watershed hills. Not found in NW part.

Draba micropetala Hook. (auct. *Draba oblongata* R.Br. ex DC) – Rare, stenotopic, solitary. The only *Draba* species found. On frost boils and in cracks on flat sand tops of the hills.

[*Draba pauciflora* R.Br.] – Recorded by O. Rebristaya in SE part of the island on the tops of watershed hills. Not found in NW part.

[*Cochlearia arctica* Schlecht.] – Recorded by O. Rebristaya in SE part of the island on the sea marshes. Not found in NW part.

Cochlearia groenlandica L. – Hemistenotopic, common, sparse. Slopes and bottoms of ravines, creek hollows, sea marshes, disturbed ground in surroundings of station.

Saxifragaceae

Saxifraga cernua L. – Very common and wide spread species. One of the most active in the area. Usually in solitary to sparse amount. Practically euritopic, except in water. In all kinds of tundra on watersheds, flat tops of coast bluffs, lake depressions, bottoms of ravines, river terraces, marshes, sand beaches.

Saxifraga foliolosa R.Br. – Common, hemi-euritopic, solitary. In different kinds of tundra in watersheds, in mires, in lake depressions.

[*Saxifraga hieracifolia* Waldst. et Kit.] – Recorded by O. Rebristaya in SE part of the island on wet foothills as rare. Not found in NW part of the island.

Saxifraga hyperborea R.Br. – Common, hemi-stenotopic, solitary. Bottoms of ravines, banks of creeks, sea marshes, sea coast bluffs.

Saxifraga nivalis L. – Common, hemistenotopic, solitary. Spots of bare ground in tundras on watersheds and their slopes, banks of creeks, sea-coast bluffs.

Saxifraga tenuis (Wahlenb.) H. Smith ex Lindm. – Rare, stenotopic, solitary. Found once in frost-boils on flat marginal part of sandy hill (dry site).

Rosaceae

Potentilla hyparctica Malte - Rare, stenotopic, solitary. Found once on frost-boils and in cracks on flat marginal part of sandy hill (dry site).

**Dryas octopetala* L. *subsp. subincis*a Jurtz. – Sporadic, sparse to copius, hemi-stenotopic. Both on sandy and clayey watershed hills. Not recorded by O. Rebristaya.

[Dryas punctata Juz.] – Recorded by O. Rebristaya in the SE part of the island. All numerous specimens collected by O. Khitun and American team were *D. octopetala.*

[*Dryas vagans* Juz.] - Recorded by O. Rebristaya in SE part of the island on the clayey watersheds. Not found in NW part.

Ericaceae

Vaccinium vitis-idaea L. subsp. *minus* (Lodd) Hult. - Stenotopic, relatively rare, solitary to sparse. Sandy flat margins of watershed hills (in cracks) and their south-facing slopes.

Scrophulariaceae

Pedicularis hirsuta L. – Hemi-stenotopic. Sporadically, solitary. Tops of watersheds on frost-boil polygons and in cracks, on the flat tops of sea shore bluffs.

Asteraceae

Nardosmia frigida (L.) Hook. – Rare. Stenotopic. Found once, small population (1 clone?) on the foothill of south facing slope of the creek hollow, near the mesic-site.

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APPENDIX C. SOIL DESCRIPTIONS OF STUDY SITES, OSTROV BELYY, RUSSIA: G.V. MATYSHAK

Soil description for Belyy Island - 1

Location: Belyy Island
GPS position: 73º19'42.2"N, 070 º04'40.6"E
Elevation: 2 m.
Parent material: marine sediments
Classification: Boil: Typic Haploturbel?
Interboil: Ruptic-Histic Aquiturbel? (Aquic Molliturbel?)

Figure C - 1. horizontal pit

<u>Boil:</u>

Figure C - 2. Soil pit № 4-09

0-4cm; Bw1; grayish brown (10YR5/2) silty clay; structureless; moderately sticky; moderately plastic; few fine roots and few fine vesicular pores; no reaction to HCl; abrupt broken boundary

4-28cm; Bwjj2; yellowish brown (10YR5/4, 90%) and greenish gray (10BG5/1, 10%) sandy clay loam; structureless; many fine and medium roots and fine vesicular pores with oxidized zone around; slightly sticky; moderately plastic; no reaction to HCl; clear irregular boundary.

28-45cm; Bwjj3; brownish yellow (10YR6/8, 80%) and yellow (10YR7/8, 20%) sandy clay loam; slightly sticky; moderately plastic; many fine roots and fine vesicular pores; common vertical cracks; weak medium platy structure; no reaction to HCl; abrupt wavy boundary.

44-45cm; Cf; gray (10YR4/1) sandy clay loam; moderately sticky; moderately plastic; very few fine roots; no reaction to HCl; frozen below 45cm; 10-20% ice by volume, ice lenses and ice veins of 5-10 mm. thickness.

Boil/Inter Boil:

0-2cm; Oi; fibric material, loose, slightly decomposed moss and sedge.

2-10cm; A; dark brawn (10YR3/3) sandy clay loam; friable; weak medium subangular structure; non-sticky; slightly plastic; many fine and medium roots and pores; no reaction to HCl; abrupt irregular boundary.

10-17cm; Bh; yellowish brown (10YR5/4) sandy clay loam; structureless; many fine and medium roots and fine vesicular pores; slightly sticky; moderately plastic; no reaction to HCl; clear irregular boundary.

17-28cm; Bwgjj; bluish gray (10BG5/1) loam; structureless; few medium roots and few fine vesicular pores with oxidized zone around; moderately sticky; moderately plastic; no reaction to HCl; abrupt wavy boundary.

28-45cm; Bw1; brownish yellow (10YR6/8, 90%) and yellow (10YR7/8, 10%) sandy clay loam; slightly sticky; moderately plastic; many fine roots, fine vesicular pores and; common vertical cracks; weak medium platy structure; no reaction to HCl; abrupt wavy boundary.

45-47cm; Cf; gray (10YR4/1) sandy clay loam; moderately sticky; moderately plastic; very few fine roots; no reaction to HCl; frozen below 47cm; 10-20% ice by volume, ice lenses and ice veins of 5-10 mm. thickness.

Inter Boil:

Figure C - 3. soil pit № 5-09

0-5cm; Oi; fibric material, loose, slightly decomposed moss and sedge.

2-30cm; Ajj; dark brawn (10YR3/3) sandy clay loam; friable; slightly sticky; slightly plastic; many fine and medium roots and pores; weak medium subangular structure; no reaction to HCl; abrupt irregular boundary.

30-41cm; Bwjjf; brownish yellow (10YR6/8, 80%) and yellow (10YR7/8, 20%) sandy clay loam; slightly sticky; moderately plastic; many fine roots and fine vesicular pores; common vertical cracks; weak medium platy structure; no reaction to HCl; abrupt wavy boundary; frozen below 41cm; 10-20% ice by volume, ice lenses and ice veins of 5-10 mm. thickness.

Soil description for Belyy Island - 2

Location: Belyy Island
GPS position: 73º18'32.9''N, 070 º07'41.6''E
Elevation: 7 m.
Parent material: alluvium (aeolian?) sand over marine sediments
Classification: Boil: Typic Haploturbel
Interboil: Typic Molliturbel

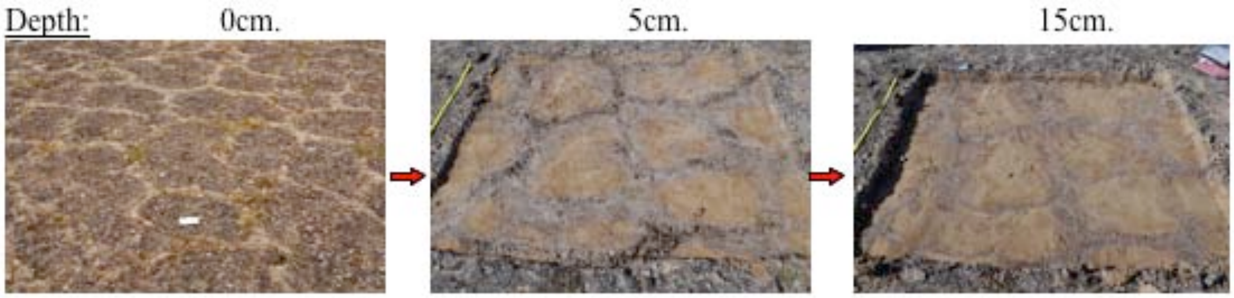

Figure C - 4. Horizontal pit

Boil:

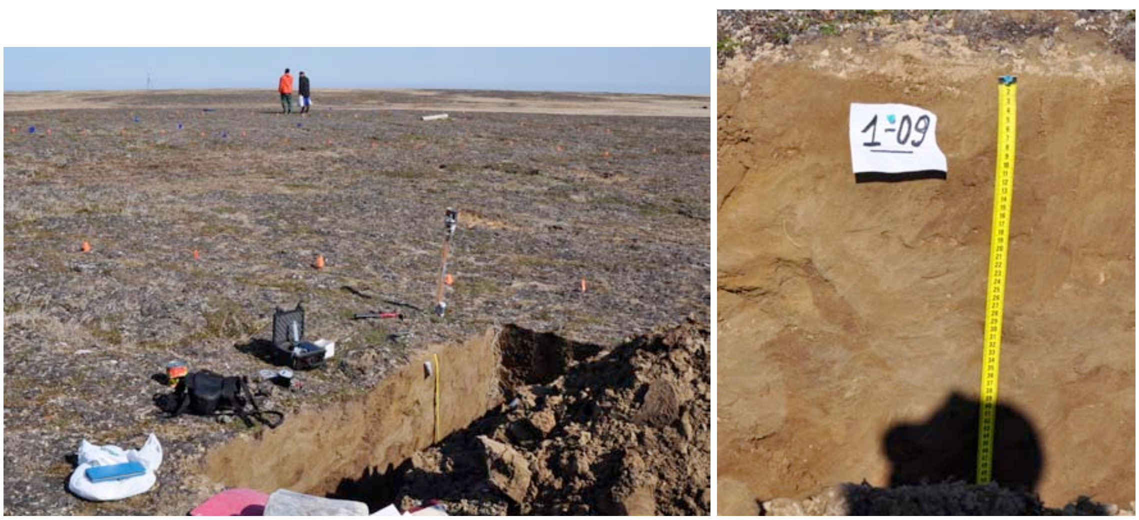

Figure C - 5. soil pit № 1-09

0-0.5cm; Oi; (2,5YR2/1); fibric material (black crust); firm.

0.5-25cm; Bwjj1; yellowish brown (10YR5/4) sand; structureless; friable; non-sticky, non-plastic; very few medium roots; few fine pores; few vertical frozen cracks with brown (7.5YR4/3) sand; no reaction to HCl; clear broken boundary.

25-57cm; Bwjj2; light brownish gray (10YR6/2) sand; structureless; friable, non-sticky, non-plastic; very few fine roots and pores; many horizontal layers (1-2mm.) of yellow (7.5YR7/8) sand on bottom of horizon; no reaction to HCl; clear irregular boundary.

57-74cm; Oejj/Cf; brawn (10YR4/3) sand; structureless; friable, non-sticky, non-plastic; with lenses of gray (10YR6/1) sandy loam (slightly sticky; moderately plastic; medium moderate granular structure) and with cryoturbated organics (10YR3/2, H5); no reaction to HCl; frozen below 74cm.

Inter Boil:

Figure C - 6. Soil pit № 2-09

0-1.5cm; Oi; fibric material, loose, slightly decomposed moss and twigs and leafs of shrubs.

1.5-3.5cm; Oa; brown (7.5YR4/3) sapric material (H9, R2, V0, F0); friable; many fine and medium roots; abrupt irregular boundary.

3.5-5cm; E; gray (10YR5/2) sand, structureless; friable, non-sticky, non-plastic; many medium roots, vesicular pores and cracks; abrupt irregular boundary.

5-10cm; Bhjj; grayish brown (10YR5/2) sand; structureless; friable; very few medium roots; few fine pores; few vertical frozen cracks with brown (7.5YR4/3) sand; no reaction to HCl; clear broken boundary.

10-31cm; Bwjj1; (10YR6/2); light brownish gray (10YR6/2) sand with cryoturbated organics (10YR3/2); structureless; friable; few vertical and horizontal frozen cracks with light gray (10YR7/1) sand of 2 to 5mm.; many horizontal layers (1-2mm.) of yellow (7.5YR7/8) sand on bottom of horizon; no reaction to HCl; clear irregular boundary.

31-70cm; Cf; brown (10YR4/3) sand; structureless; friable, non-sticky, non-plastic; with lenses of gray (10YR6/1) sandy loam (slightly sticky; moderately plastic; medium moderate granular structure); no reaction to HCl; frozen below 70cm.

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APPENDIX D. LIST OF BIRDS AT OSTROV BELYY: G.V. FROST AND S. SIZONENKO

Latin	English	Russian	Source
Anser serrirostris	Tundra Bean-Goose	Гуменник	1, 2
Anser albifrons	Greater White-fronted Goose	Белолобый гусь	1, 2
Branta bernicla	Brant	Черная казарка	1, 2
Anas acuta	Northern Pintail	Шилохвость	1, 2
Polysticta stelleri	Steller's Eider	Гага сибирская	1
Somateria spectabilis	King Eider	Гага-гребенушка	1, 2
Somateria mollissima	Common Eider	Гага обыкновенная	2
Melanitta fusca	White-winged Scoter	Турпан	-
Clangula hyemalis	Long-tailed Duck	Морянка	1, 2
Gavia stellata	Red-throated Loon	Гагара краснозобая	1, 2
Gavia arctica	Arctic Loon	Гагара чернозобая	2
Haliaeetus albicilla	White-tailed Eagle	Орлан-белохвост	1, 2
Buteo lagopus	Rough-legged Hawk	Мохноногий канюк	1, 2
Falco sp.	unidentified falcon	Чеглок?	-
Pluvialus squatarola	Black-bellied Plover	Тулес	1, 2
Pluvialis apricaria	*European Golden-Plover*	*Золотистая ржанка*	*2*
Charadrius hiaticula	Common Ringed Plover	Галстучник	1, 2
Limosa lapponica	Bar-tailed Godwit	Веретенник малый	1, 2
Arenaria interpres	Ruddy Turnstone	Камнешарка	1, 2
Calidris canutus	Red Knot	Исландский песочник	2
Calidris alba	Sanderling	Песчанка	2
Caladris minuta	Little Stint	Куличок-воробей	1, 2
Calidris temminckii	Temminck's Stint	Белохвостый песочник	1
Calidris maritima	Purple Sandpiper	Морской песочник	-
Calidris alpina	Dunlin	Чернозобик	2
Calidris ferruginea	Curlew Sandpiper	Краснозобик	1
Philomachus pugnax	Ruff	Турухтан	1
Phalaropus lobatus	Red-necked Phalarope	Плавунчик круглоносый	1, 2
Phalaropus fulicarius	Red Phalarope	Плавунчик плосконосый	2
Rissa tridactyla	Black-legged Kittiwake	Чайка моевка	2
Larus heuglini	Heuglin's Gull	Клуша восточная	1, 2
Larus glaucus	Glaucous Gull	Бургомистр	1, 2

Appendix D (cont'). List of birds at Ostrov Belyy: G.V. Frost and S. Sizonenko.			
Sterna paradisaea	Arctic Tern	Крачка полярная	1, 2
Stercorarius pomarinus	Pomarine Jaeger	Поморник средний	1, 2
Stercorarius parasiticus	Parasitic Jaeger	Поморник короткохвостый	1
Stercorarius longicaudus	Long-tailed Jaeger	Поморник длиннохвостый	1, 2
Bubo scandiacus	Snowy Owl	Полярная сова	1, 2
Eremophila alpestris	Horned Lark	Жаворонок рогатый	1, 2
Acrocephalus schoenobaenus	Sedge Warbler	Болотная	-
Oenanthe oenanthe	Northern Wheatear	Обыкновенная каменка	-
Sturnus vulgaris	European Starling	Обыкновенный	-
Motacilla citreola	Citrine Wagtail	Желтоголовая	-
Motacilla alba	White Wagtail	Белая трясогузка	-
Anthus cervinus	Red-throated Pipit	Краснозобый конек	-
Calcarius lapponicus	Lapland Longspur	Подорожник лапландский	1, 2
Emberiza pusilla	Little Bunting	Крошка	-
Plectrophenax nivalis	Snow Bunting	Пуночка	1, 2

Sources:

1. Sosin, V.F. and S.P. Paskhal'niy. 1995. Material on the fauna and ecology of ground vertebrates of Belyy Island. Pp. 100-140 *in* Dobrinsky, L.N. (ed.), The modern condition of the vegetation and fauna of the Yamal Peninsula. Ekaterinburg. (In Russian).

2. Tyulin, A.N. 1938. Game fauna of Belyy Island. Pp. 5-39 *in* Proceedings of Research Institute of Polar Agriculture: animal industries and hunting sector. (In Russian).

APPENDIX E. LIST OF MAMMALS AT OSTROV BELYY

Table E -1. List of known mammal species on Ostrov Belyy.

Latin	English	Russian	Species in our observ-ations	Source
Lemmus sibiricus	Siberian brown lemming	Лемминг обский	+	1,2
Dycrostonyx torquatus	Arctic lemming	Лемминг копытный	*	1
Rangifer tarandus	Reindeer	Северный олень	+	1,2
Ursus maritimus	Polar bear	Белый медведь	+	1,2
Canis lupus albus	Gray wolf	Полярный волк	-	1,2
Alopex lagopus	Arctic fox	Песец	+	1,2
Pusa hispida	Ringed seal	Нерпа кольчатая	+	1,2
Erignathus barbatus	Bearded seal	Морской заяц	-	1,2

Sources:

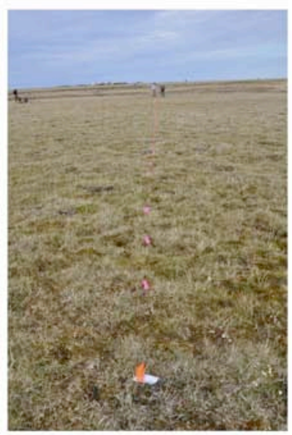
1. Sosin, V.F. and S.P. Paskhal'niy. 1995. Material on the fauna and ecology of ground vertebrates of Belyy Island. Pp. 100-140 *in* Dobrinsky, L.N. (ed.), The modern condition of the vegetation and fauna of the Yamal Peninsula. Ekaterinburg. (In Russian).

2. Tyulin, A.N. 1938. Game fauna of Belyy Island. Pp. 5-39 *in* Proceedings of Research Institute of Polar Agriculture: animal industries and hunting sector. (In Russian).

APPENDIX F. TRANSECT PHOTOS


BO_T51_00m d9009DSC_1583.JPG


BO_T52_00m d9009DSC_1585.JPG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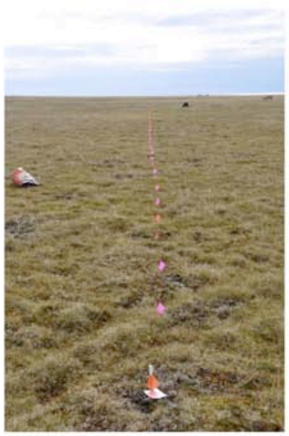
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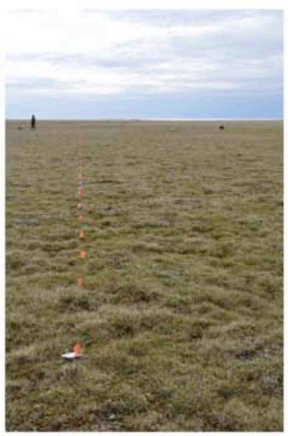
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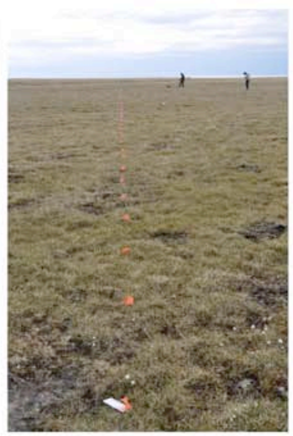
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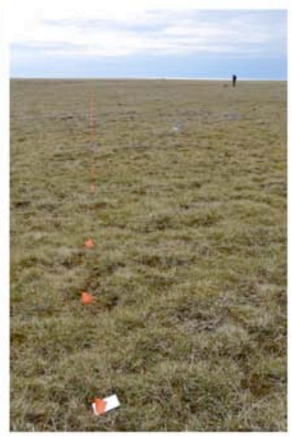
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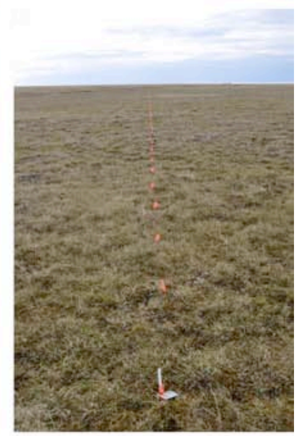
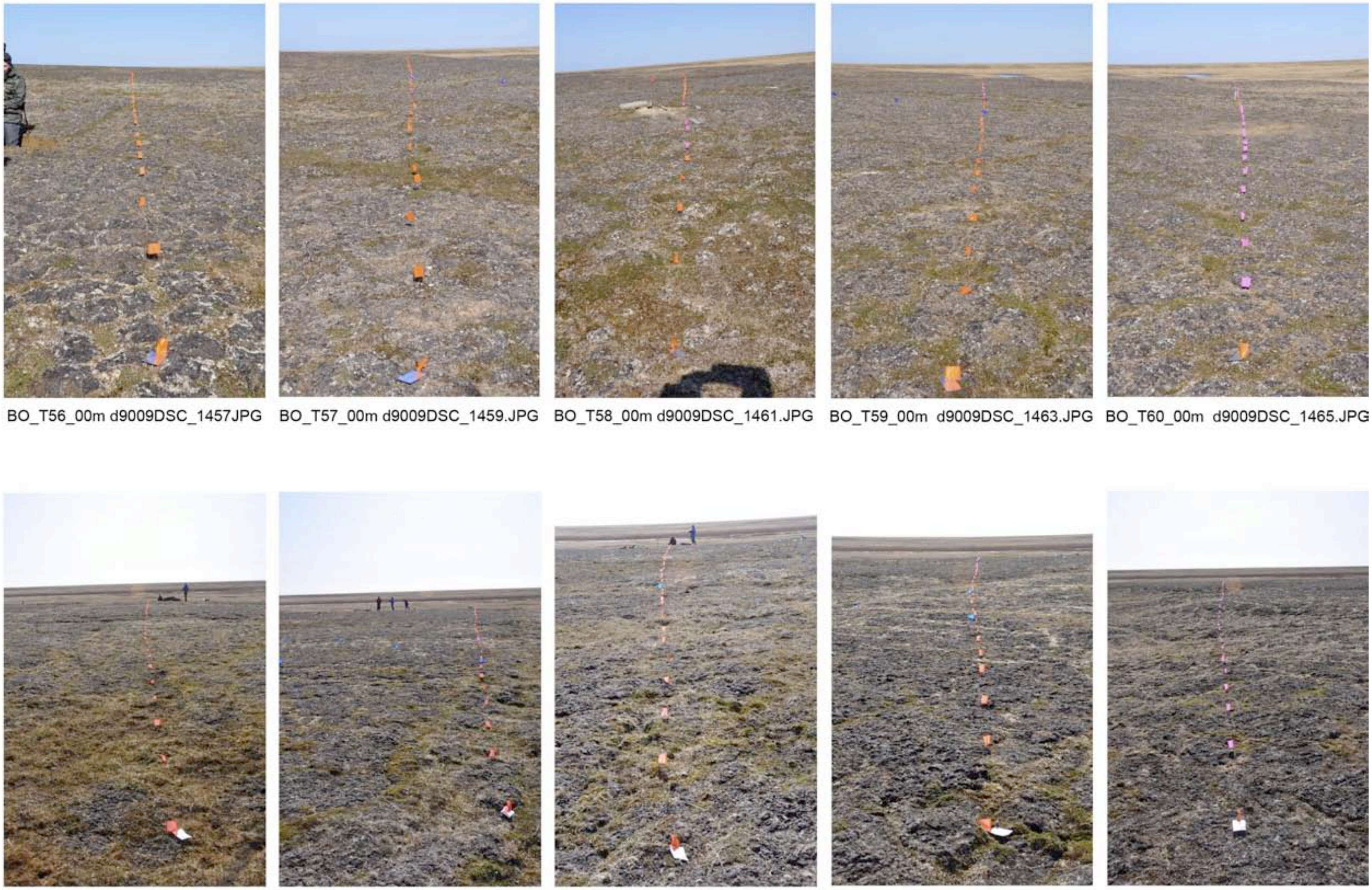

BO_T55_50m d9009DSC_1593.JPG

Figure F - 1. Belyy Ostrov site 1 transects.

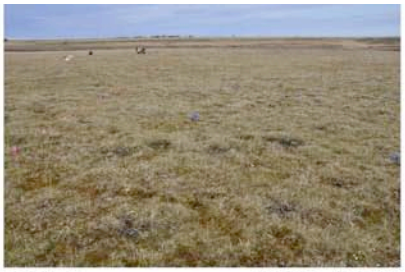


BO_T56_00m d9009DSC_1457JPG BO_T57_00m d9009DSC_1459.JPG BO_T58_00m d9009DSC_1461.JPG BO_T59_00m d9009DSC_1463.JPG BO_T60_00m d9009DSC_1465.JPG

BO_T56_50m d9009DSC_1475.JPG BO_T57_50m d9009DSC_1473.JPG BO_T58_50m d9009DSC_1471.JPG BO_T59_50m d9009DSC_1469.JPG BO_T60_50m d9009DSC_1467.JPG

Figure F - 2. Belyy Ostrov site 2 transects.

APPENDIX G. RELEVÉ VEGETATION AND BIOMASS PLOT PHOTOS



BO_RV_49a d9009DSC_1603.JPG

BO_RV_49a biomass plot d9009DSC_1605.JPG

BO_RV_50 d9009DSC_1606.JPG

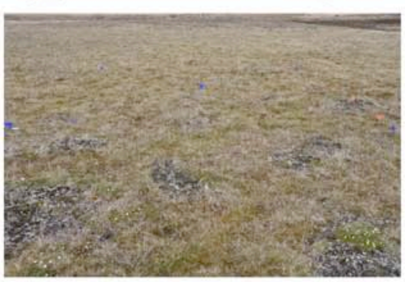
BO_RV_50 biomass plot d9009DSC_1611.JPG

BO_RV_51 d9009DSC_1614.JPG

BO_RV_51 biomass plot d9009DSC_1616.JPG

BO_RV_52 d9009DSC_1623.JPG

BO_RV_52 biomass plot d9009DSC_1627.JPG



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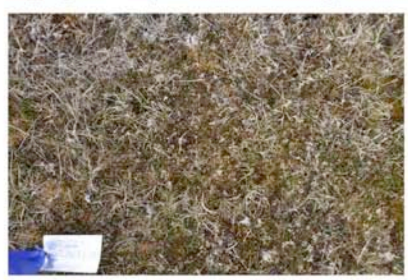
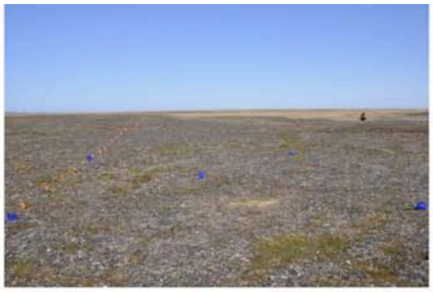


BO_RV_53 biomass plot d9009DSC_1633.JPG

Figure G - 1. Belyy Ostrov site 1 releves.



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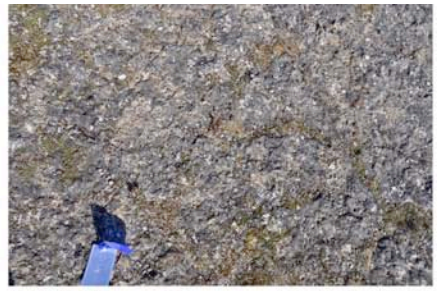

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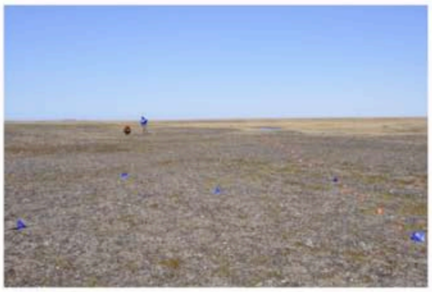
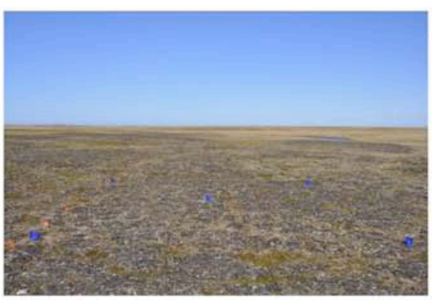


BO_RV_55 d9009DSC_1487.JPG

BO_RV_55 biomass plot d9009DSC_1488.JPG

BO_RV_56 d9009DSC_1491.JPG

BO_RV_56 biomass plot d9009DSC_1492.JPG



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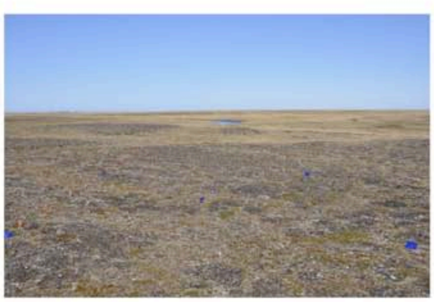
BO_RV_57 biomass plot d9009DSC_1495.JPG



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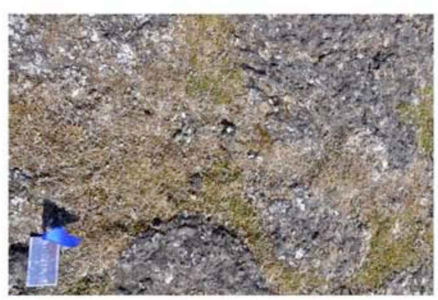


BO_RV_58 biomass plot d9009DSC_1498.JPG

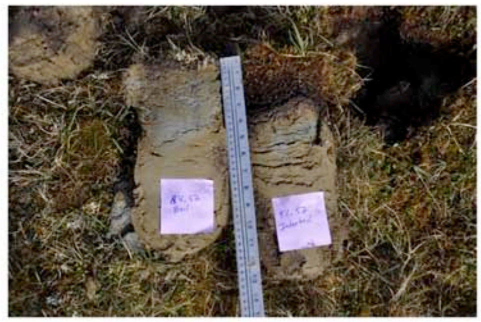
Figure G - 2. Belyy Ostrov site 1 releves.

APPENDIX H. RELEVÉ SOIL PHOTOS

BO_RV_49a d9009DSC_1730.JPG

BO_RV_50 d9009DSC_1732.JPG

BO_RV_51 d9009DSC_1734.JPG



BO_RV_52 d9009DSC_1735.JPG

BO_RV_53 d9009DSC_1744.JPG

BO_RV54
d9009DSC_1537.JPG

BO_RV55
d9009DSC_1540.JPG

BO_RV56 d9009DSC_1542.JPG

BO_RV57
d9009DSC_1543.JPG

BO_RV58
d9009DSC_1544.JPG

Figure H - 1. Ostrov Belyy soils from both sites.

Log of 2009 Belyy Ostrov Expedition

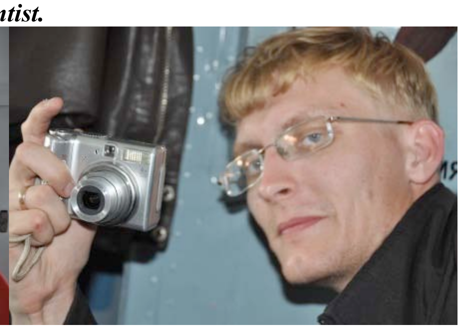
By Skip Walker

Photos and daily notes from the expedition to Belyy Ostrov, Russia, 8 July to 1 Aug 2009

Expedition Members

Russian members:


Left: Pasha Orekhov, Earth Cryosphere Institute, Moscow, expedition organizer, animal ecologist. Right: Marina Leibman, Earth Cryosphere Institute, Moscow, expedition orgaizer, cook, permafrost scientist.

Olga Khitun, Komarov Botanical Institute, St. Petersburg, plant ecologist. Artuom Khomutov, Earth Cryosphere Institute, Tyumen, Russia, Landscape mapping.

From upper left: Gosha Matyshak, Moscow State University, soil scientist. Andrei Tarasov, driller for permafrost borehole. Stanislav Sizonenko, game warden and polar bear protection.

U.S. members:

Ronald (Ronnie) Daanen, University of Alaska, cold climate hydrologist. Gerald (JJ) , University of Virginia, ecology graduate student and ornithologist, Howard (Howie) Epstein, University of Virginia, ecosystem ecologist.


D.A. (Skip) Walker, University of Alaska, peoject leader, geobotanist. (Photo by Howie Epstein.)

July 8-10. Flight to Moscow and preparation for trip. Photos 0003-0015.
Leave Fairbanks Northwest 404, 9:40 pm, Jul 8, on time, Lv Minneapolis NW320 on time, arrive JFK 10 minute early (about 10:30 am, July 9). Moscow Flight not listed on screens. Go to Terminal 3. 5 hour layover. Eat at Chili's in JFK. Exchange $508 = 13,500 Rubles (26.57 Rubles / $). Split cash between JJ ($4000) and Skip ($5492 + 13,500 Rubles). Board JFK at 3:20 pm, Depart 4:20 pm.

Arrive Moscow 10:40 am, Jul 10. Long line to clear immigration. Taxi to Sputnik 5500 rubles. Meet Gosha at Sputnik. Cost of 1 nite at Sputnik for JJ and Skip = 12,390 Rubles (about $400). Arrive at Hotel about 1:15 pm. Check in. Taxi to Gosha's lab to pick up 2 Action Packers, shovel, thaw probe, boxes (732 rubles). Go to ECI to meet Marina, D. Drozdov, Vlad R., Dmitri (Vlad's post doc), Galina, Olga Ponomoreva, Pasha O. Hans Hubberton. Vlad had emergency landing in Iceland on way to Moscow. Pasha has photos of facilities at Belyy Ostrov. Plan is to go up the road from Labytnangi to Laborovaya and rendezvous with a helicopter about 40 km north of Laborovaya. Dinner at Pizza Amore (2000 Rubles for Skip and JJ (2000 rubles) – 2 beers (340 rubles) = (1660 Rubles).

So far everything has gone smoothly. We arrived — with all our baggage! The taxi ride through pouring rain was horrendous — 2 hours of awful traffic, but we understand that that was actually quite quick. We all got good sleep after a brilliant fireworks display at the park near here. Today the sky is bright blue. The rain cleared the smog, so the air is fresh. We are doing some last minute shopping this morning, re-packing and going to the train station to catch the train at 7:30 pm.

I am pretty excited about the expedition. Good team. It is good to have Ronnie along to plug the permafrost hole in the US team, and JJ is really quite good with the species and is eagerly taking to learning Russian and is just generally all-around enthusiastic with broad interests in plants, birds, remote sensing, and ecosystems. Howie will arrive tomorrow and will have time to take care of a last minute detail with his immigration card?

It turns out that neither Dmitri Drozdov nor Nataliya Ukraintseva will go to BO. Olga Khitun will be our botanist, which is great because she has lots of experience on the Yamal and speaks excellent English. Artoum Khomutov will replace Dmitri, and that also might be good because of his remote-sensing and mapping experience. We will be working in a regional park and part of the agreement is that we will make maps of geology, vegetation, etc. This is what we wanted to do at Isachsen and Mould Bay if we got funded. It also turns out that we will first be going to Laborovaya by vehicle from Labytnangi to download the loggers there and then proceeding about 40 km north of there to catch the helicopter to Myc Kameni. This is a great turn of events because it will allow JJ to see tree line. However, the journey might be horrendous. We won't have tents if the weather is bad and helicopter can't come in time to pick us up. 11 of us plus the driver will have to live in the vehicle.

Yesterday we saw a bunch of pictures of the building we are staying in at Belyy Ostrov. Pretty sobering. The pictures were taken in spring and all the walls were covered in about 2-3 inches of frost and there snow everywhere in the rooms. So I imagine that it is going to be pretty damp and almost unlivable. The met station is nearby and really quite nice with sauna and new construction — not at all like Ambarchik. Too bad we won't be living there.

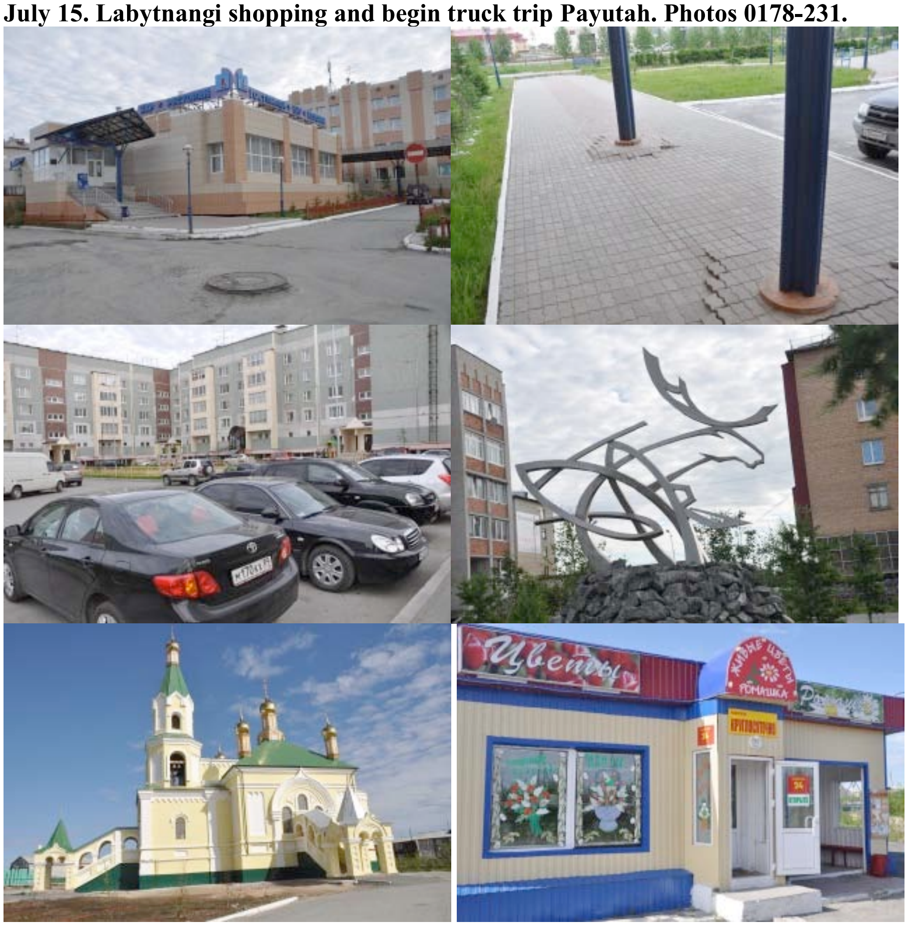
Jul 11-13. Train trip to Labytnangi. Photos 0015-177.

Clockwise from upper left: Checking baggage in Moscow, clusters of dachas near Moscow, Howie Epstein and Ronnie Daanen.

Clockwise from upper left: Countryside between Moscow and Labytnangi. Skip, Ronnie, Howie and JJ in front of our train. Starting into the Ural Mountains. Town of Kharp in the Urals.

Train trip to Labytnangi and town of Labytnangi. 222 photos. Jul 13: Arrive Labytnangi about 2200, go to Seven Larches Hotel. Train trip went pretty smoothly except for heat. No air conditioning in our car. JJ commented that we were having malarial delirium after trying to sleep. Ride is through boreal forest. My new GPS for the camera is quite slow to pick up satellites. I finally got it working on the train near a window. We pass through the town of Kharp in the Urals, which is exciting because this is one of JJ's best remote sensing sites, and he will be able to easily reach this place either by train or car from Labytnangi. Arrive in Labytnangi about 22:30 and we go straight to the hotel (Seven Larches), where we check in and have dinner.

July 15. Labytnangi shopping and begin truck trip Payutah. Photos 0178-231.



Scenes from Labytnangi. From upper left: Our hotel in Labytnangi (Seven Larches). Frost heave of supports at the hotel. Typical old apartment complex with many new cars. Sculpture of reindeer in park near hotel. Russian Orthodox church. Small flower shop.

Marina and JJ and Ronnie shop for food. Howie and I walk around Labytnangi. My main impression is that Labytnangi is showing many more signs of prosperity, proably from the gas development on the Yamal. This is evident by the many new cars and also some of the older sections of town have new tenants that are remodeling their houses. Plus there is quite a bit of new construction. At about 9 pm we load the truck, which turns out to be the vehicle from hell.

In Labytnangi, we also meet our hunter Stanislov Sizonenko, Artoum (who we met at the rail station, Olga Khitun or botanist from the Komarov Institute, and Larisa Markulova who is the young wife of one of the people at the met station.

So there are now 12 of us. Howie Epstein, me, JJ Frost, Ronnie Daanen, Marina Leibman, Pasha Orekhov, Olga Khitun, Andrei Tarazov (the driller for the bore hole at BO, and husband of Nataliya Utkraintseva), Artuom Khomutov, Gosha Matyshak, the hunter Stanislov Sizonenko (who is regional administrator or game warden for the Yamal District in Salekhard), and Larisa Markulova. We are carrying a bunch of stuff for the people at the station including several sacks of potatoes, onions, rice, noodles, and alcohol (cognac, wine, vodka) as gifts for their help. Larisa had a small dog (Fiona, a miniature bulldog?

) that was amazingly well behaved during the entire journey. It stayed in a small box (certainly the most comfortable place in the truck) and came out only to play in her arms and look around and play a bit.

Jul 14-15. Truck from Labytnangi to Pajutah. Photos 232-256

Truck ride from Labytnangi to Pajuta.

Horrible 12.5 hour trip (187 km) from Labytnangi to Pajuta on very bumpy road. Maxium speed was about 20 km/hr, mostly less. No seats, and only one window (with bars to prevent escape in case of an accident). Extremely uncomfortable seating in small space (12 of us and a dog crammed into 7 x 8 ft space on luggage in the back of the container of truck with all of gear packed to ceiling behind us constrained by parachute cord and threatening to avalanche on us the whole way. We are going to Pajuta, a construction camp along the new railroad, with a stop at Laborovaya to download the

Hobo loggers (2 at Site 1 and 1 at Site 2). Markers marking the end points of the transects and all of the releves and biomass plots are still visible. Found one iButton logger (no. 21). We arrive Pajutah thoroughly beat and exhausted from no sleep. The helicopter arrives within 2 minutes of our arrival, and we load the helicopter.

Jul 15. Helicopter, Pajuta-Myc Kameni. (Photos 0257-0500)

Helicopter trip from Pajuta to Myc Kameni. Clockwise from upper left: Loading the ME-8 helicopter. Two scenes of sandy Yamal terrain. Eroded drainage network. Moving the equipment and people to the hotel. Hotel. MK from the air. Myc Kameni street scene.

Too tired to catch up. Many photos of sandy landscapes and drainage networks with small landslides. Myc Kamani is a dump. We arrive in Mys Kameni at about 11: 30, and unload the helcopter and transport the expedition stuff to a storage room in the airport terminal. At about 12:30, we check into our rooms in the barracks. We buy some cake in the small store and go for a nap. In the evening we reload the helicopter, and then have a small meal of noodles (big lunch) and tea.

16 Jul. Aborted trip to Belyy Ostrov. Myc Kameni-Sabetta-Belyy Ostrov-Sabetta. (Photos 0501-1137)

Aerial photos of east coast of Yamal. Many photos are tied to GPS coordinates. Weather was good until the northern part of the peninsula. Low clouds over all Belyy Ostrov. We saw and circled the met station several times, but pilot could not land because of high winds. Stas saw what he thought were to two polar bears, but these were likely the white wild reindeer. Helicopter returned to Sabetta. After two weather checks with B.O. the pilot decided at about 6:30 pm that we would spend the night at Sabetta.

Old Belyy Ostrov weather station thru the fog. Our future home is the large building in the right background of the upper photo.

Scenes from abandoned geophysical camp at Sabetta.

Debris from drilling rigs and associated buildings. Lower photo shows one of 15 piles of reindeer hides scattered about the tundra near the drilling rigs.

While we are waiting for the weather reports, we explore the various parts of Sabetta, including a fleet of old geophysical vehicles. JJ and I walk to 4 large derricks and explore the debris, including an abandoned old radar vehicle, scattered piles of twisted metal, old cables, and abandoned drilling equipment. The place is quite eerie with wind whistling through the cables of the derricks, which must be over 120 feet high. One of the derricks was built in place and the other three somehow dragged to this site because they are on heavy sled runners — one is tilted. How did they manage to keep these things upright while traveling across the tundra?

On the tundra to the southwest of the derricks there are 15 large piles of reindeer hides scattered randomly on the tundra at about 25-50 m intervals between the piles. Each pile consists of what we estimate must be at least 200-300 hides, all are white and with warble-fly holes in the hides. Adjacent to each pile is a killing site with many bones and and a few skulls of reindeer, but no antlers. (We found a large pile of antlers on the other side of the derricks mixed with pieces of concrete and metal.) These must be places where the Nenets brought and slaughtered reindeer to sell to the camp to feed the workers. Each pile must be the hides from one year's supply of meat.

Inside and outside one of the abandoned radio shack of the drill site there are many destroyed pieces of radio equipment. The wall inside are covered with an old issue of *Pravda* dated 14 May 1984, with headlines about a meeting between President Cherenenko and the then-head of China and many stories about Russian athletes.

How did the Nenets feel about the way their land was treated by this development? It is a very dangerous place for their reindeer with all he sharp rusted metal and cables that could cut the animals. The next day while flying to Belyy Ostrov, I put it more in perspective when we see several Nenets camps from the air amidst huge undisturbed landscapes. The developments are relatively small areas and maybe diversions for them and places to sell their reindeer.

Moving to our quarters at Sabetta. Kitchen in our apartment.

How did the Russian people who worked and still work in these camps endure this Gulag-like atmosphere? The winters must be awful. The wind is incessant. There are still snow drifts in the lee of some of the buildings. The streets are puddled and muddy with broken wooden and concrete walks between the buildings and innumerable safety hazards. We joked about what BP and OSHA would say about this. Sand dunes 4-5 feet high are between some of the abandoned portable buildings. It is hard to imagine why this place exists. It is now a refueling site for the many UT-Air helicopters that operate out of here. It must also have some military importance — two military helicopters landed while were refueling yesterday, and an officer warned us to not take any pictures of the helicopters. There are several abandoned radar units nearby. But here again it is a matter of perspective. The living conditions inside the buildings are not terrible. We are housed in the old camp and fed in the canteen. The food is very similar to what we had last year at Kharasavey — soup, chopped-reindeer cutlets, cabbage salad, and kasha — a welcome meal after we thought that we might be living on candy bars and bread tonight. The camp is very run down on the outside with weathered wooden buildings and many abandoned or partially abandoned structures, but our rooms are in 2-room suites with bathrooms and showers and are as comfortable as most apartments in Moscow. Possibly these are rooms reserved for senior administrators. Ronnie and I are in one suite that has a TV that receives several channels. It is apparently lived in most of the year because there is a set of weights and food in the cupboards and lots of personal items.

The residents make their situation as comfortable as possible. The rooms we are in are actually much nicer than the many rooms I've stayed in the camps at Prudhoe Bay. The air control tower had some tomato plants growing in window and many exotic plants in the main office. The little buildings that travel with the geophysical camp look like small homes with TV or radio antennas made out of old truck head gaskets. Some have skis on their porches and windows boarded with stout sticks to prevent entry by polar bears.

Amidst all the debris and history, these places seem to be paradise for birds. JJ is quite the birder. I recognize a few birds from Alaska, such as the snow bunting and Lapland longspur, but there are many species of shorebirds (including a ruff!) Many are Asian counterpart that only an experienced birder like JJ could recognize. (See bird list at the end of the log.)

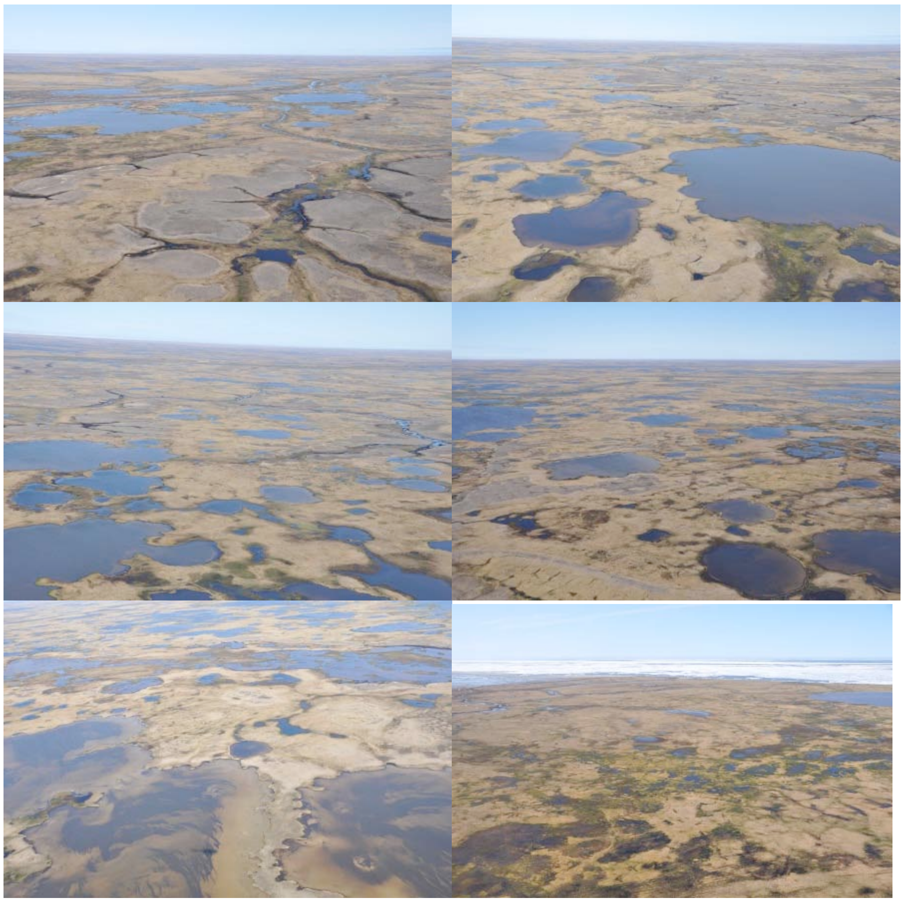
17 Jul, Flight to Belyy Ostrov. Photos 1138-1311.

Belyy Ostrov Expedition group upon departure from Sabetta, from left: Ronnie Daanen, JJ Frost, Andrei Tarazov, Olga Khitun, Gosha Matyshak, Stanislav Sizonenko, Larisa Merkulova, Artuom Khomutov, Howie Epstein, Marina Leibman.

Scenes from flight to Belyy Ostrov along east coast of the Yamal Peninsula north of Sabetta. Bottom two photos show the northern limit of the peninsula and ice in the straight between the Yamal and Belyy Ostrov.

GPS not working during flight, but lighting was excellent along the entire trip for photos. I take many photos, mainly of greening patterns along water tracks and areas with standing water, and the patterns associated with the contrasting dry sandy upland areas and the more well vegetated tundra. There are very few areas of non-sorted circles in the sands. Greening is still confined to the wetter areas; uplands are brown. The transitions between bioclimate subzones are fairly apparent. Streamside shrubs (transition between subzones D and C) are lost south of Sabetta. North of Sabetta there is greater amount of barren tundra on sandy uplands, mainly in association with bluffs of creeks and rivers.

Channel across to Belyy Ostrov has some broken ice. Lots of mud and dirt on the ice. West side of B.O. is packed with ice near shore. East side is open with no ice in sight.



Wetlands of Belyy Ostrov. Lower right photo shows moist tundra in the vicinity of the Belyy Ostrov Station. The other five show the tundra in the southern part of the island with abundant dry tundra between the lakes and streams.

The pilots flew a zig-zag route along the southern and the then northeast sides of the island to the northern tip and then straight south inland to about the center of the island before turning northwest to the met station. The southern part of the island is apparently all sand. There are many lakes and a vast wetland, but the areas between the lakes and along the many small streams have well drained tundra with lichens and most likely *Gymnomitrion-Salix nummularia* communities. These areas appear brown on the false color IR images. The northwest corner of the island is predominantly moist to wet tundra with few large lakes. This area appears to have more fine-grained soils. Several soil plugs dug in moist to wet tundra during the hike on 18 Jul near the met station had mainly loamy soils with some fine sand. The drier areas near small streams had pure sand. Almost all the island is a vast wetland. There are two large estuaries, one in the SW corner of the island that is associated with a sandy hook and large bay, and another much larger one on the northeast side of the island also associated with a large bay that has a large saline island in the center part of the bay. Apparently the *Puccinellia phryganodes-Carex subspathacea* saline wetlands found in these estuaries are relatively uncommon along the Yamal coasts. During the flight we see innumerable flocks of waterfowl and shorebirds.

Wild reindeer of Belyy Ostrov.

JJ counted 426 ± 100 reindeer from the air on left side of aircraft. All are white. (Those on the mainland were mainly brown.) Ronnie estimates about 20 percent of these were this year’s young.

Landing at Belyy Ostrov weather station.

Interior of our house on Belyy Ostrov.

The met station and the abandoned house which will be our camp is on the northwest corner of the island. North of us is a large 15-km long barrier island. The station manager greets us. After unloading the helicopter, we check out the house. It is a large two-story strong log-structure that was the old met station that housed about 30 personnel (coat rack inside has 30 names attached to the hooks). After it was abandoned, the building quickly deteriorated. There are few windows left on the first floor, but only one has been broken on the second floor. The first floor is uninhabitable with wet floors and completely open to the weather. The second floor has been largely demolished. The wall coverings and the top floor layers have been removed in most rooms and there is debris everywhere, but the floors are mainly dry. The main living room has a broken window and the flooring has been completely removed. There are six usable rooms. The south facing side of the building has rooms with large windows. We designate the largest room in the SE corner of the building as the kitchen. The central south room is the science room. And there are four bedrooms. The foreigners are in the NE bedroom), Marina and Olga in the SE bedroom, Stas and Andrei in the NW one, and Gosha, Pasha, and Artuom in the SW one. The rest of the day is spent cleaning, and building doors, and finding, building and moving furniture for the lab and kitchen and hauling water and propane tanks. Dinner is at 7 pm. I am very tired and go immediately to bed after dinner.

18 Jul. Belyy Ostrov, search for study sites east and south east of camp. Photos 1312-1390.
Weather: Clear in early morning but clouded up later in the morning. Frost. Calm in morning but winds picked up in the afternoon. Downloaded 811 photos (501-1311).

In the morning we had late breakfast and discussed what we will do and went over safety protocols, mainly with respect polar bears.

In the afternoon, we looked for study sites to the ENE of camp. We saw no areas large enough for 50-m study sites on either zonal-moist sites nor on dry sites. We visited an old drill site next to a small lake, several small palsa-like mounds, and a fairly large dry tundra area along a small creek, and returned to camp via the coast. Phenology of plants is quite late. The list of sighted flowering plants included: Hiepau, Arclat, Dupfis, Eriang, Erisch, Luzcon, Luzniv, Salpol, Salnum, Salrep, Oxydig, Polviv, Ranniv, Ranpyg, Ransul, Cocarc, Saxcer, Saxfol, Saxhyp, Drypun, Pedhir. A checklist of plants seen is included in the field data. Most of the sedges in the moist tundra are greening but still hidden in the standing dead vegetation. On the way back we checked out more debris, the high tower for the old beacon, and found a Little Stint that allowed us to photograph it closely, and the hip bone of a polar bear!

Sights near our Belyy Ostrov home. Clockwise from upper left: Our house. The new meteorological station. Small non-sorted polygons on sandy dry site. Strand line with abundant trees and station debris. Larisa Merkulova and her husband checking the solar instrument. Beacon tower.

O

Scenes from the Belyy Ostrov House after we settled in. Clockwise from upper left: Kitchen and dinner meal, Science room, Andrei's and Stas' room, ECI men's room and workshop.


Little Stint.

List of potential (according to Arlott 2007, 2009), sighted and nesting birds, Belyy Ostrov, 18-21 July 2009. X = sighted, n = nest or young sighted. List by JJ Frost.


JJ Frost.

Red-throated Loon X, n
Arctic Loon X
Yellow-billed Loon
Northern Fulmar
Bewick's Swan
Barnacle Goose
Greater White-fronted Goose X, n
Lesser White-fronted Goose
Bean Goose
Brant
Common Eider

King Eider X, n
Steller's Eider X
Black Scoter
Long-tailed Duck X
Red-breasted Merganser
White-tailed Eagle
Rough-legged Hawk
Peregrine Falcon
Gyrefalcon
Rock Ptarmigan
Black-bellied Plover X, n
Greater Ringed Plover X, n
Eurasian Dotterel
Red Knot X
Sanderling X
Dunlin X
Little Stint X, n
Temminck's Stint X
Curlew Sandpiper X
Purple Sandpiper X
Bar-tailed Godwit X
Red-necked Phalarope X
Red Phalarope X
Ruff X
Ruddy Turnstone X, n
Long-tailed Jaeger X
Parasitic Jaeger X, n
Pomarine Jaeger X
Ivory Gull
Black-legged Kittiwake
Lesser Black-backed Gull X
Herring Gull X
Glaucous Gull X
Arctic Tern X, n
Black Guillemot
Snowy Owl X
Horned Lark X, n
Red-throated Pipit X, n
Citrine Wagtail X
White Wagtail X, n
Northern Wheatear X
Sedge Warbler X
Lapland Longspur X, n
Snow Bunting X, n
Dead European Starling

19 Jul. Belyy Ostrov: Weather day. Catch up.
Morning: Strong storm last night and all morning with winds from the east changing to the west with a strong storm surge and filled the salt flats in front of our house. Fog prevents us from going out early because of the possible danger of polar bears.

Spent the morning and afternoon catching up on log and photos.

20 Jul. Reconnaissance trip to the south and east of camp. Photos 1393-1433.

Weather AM, clear, frost, calm. Cloudy by early afternoon.

Second day of reconnaissance. Clockwise from upper left: Crossing a small stream near camp. Pedicularis hirsute, Potentilla hyparctica. *Lunch break. Andrei and Boatsman (dog). Nenets fox trap.*

Our goal today is to find sites for two grids, one on loamy soils, and one on drier sandy soils. We walk about 12 km, first southeast to a dry set of bluffs along an estuary of a stream about 2 km south of the station. The terrain is initially very wet and obviously underlain by ice-rich permafrost. There are many small shallow wetlands where the sedges are starting to green. These areas have a complex of plant communities, with most of the variation being in the mosses. The wettest areas have *Arctophila fulva* with *Calliergon* cf. *sarmentosum* and *Drepanocladus* spp. Some areas have *Eriophorum scheuchzeri* and an aquatic *Sphagnum.* Slightly raised microsites have dense mats of *Sphagnum squarrosum* and slightly drier areas yet have *Sphagnum fimbriatum*. Truly mesic areas are pretty uncommon, occurring mainly on gentle slopes along streams. These areas are what we are looking for. They are characterized by abundant *Poa arctica, Eriophorum polystachion (=E. angustifolium?), Dupontia fisheri, Salix polaris*, and scattered lichens, including *Nephroma arcticum, Dactylina arctica,* and *Cladonia* cf. *arbuscula.* Olga is making a list of the plants encountered. We find three "zonal" sites along the small stream, but these are about 2-hour walk from camp. We also locate three sites on dry sandy terraces that are large enough for a 50-m study site. The first of these is slightly south facing and has relatively high (but still very poor) diversity of plants in flower, including *Dryas punctata*, *Potentilla hyparctica, Pedicularis hirsuta* (this species is very small, only about 3-4 cm tall with only 1-2 whorls of 5-6 flowers) *, Oxyria digyna* (also very small with leaves that are only slightly sour)*, Salix nummularia, Hierochloe alpina,* and *Luzula confusa. Draba* sp. is already in fruit! We have lunch along a small protected slope of the stream in an area rich in lichens and *Luzula confusa*. We walk a bit further to another dry bluff. Along the way we notice several areas in moist tundra that have been cratered by reindeer, apparently in search for the starch-rich rhizomes of *Eriophorum subarcticum*. Nearly all the elevated areas have the remains of old Nenets fox traps. Most are boxes with stakes in them. Some have old snap traps still attached. Some are log-fall traps. There are also a few tall pole structures with ladders on them that look possibly like observation sites. There is little other evidence of Nenets use of the landscape.

Our farthest prospective dry site is 5.2 km in a straight line from camp. The tall tower of the beacon at the met station is a good landmark and we walk straight toward it, but the route is *Sphagnum*-wetland hell that sucks at our boots along much of the route, and it takes nearly 2 hours of hard walking and wading to reach camp. Near camp we find several areas of zonal vegetation that are only about 15 minutes from camp, and although not perfect, these areas will be much more convenient for sampling vegetation and we could co-locate a CALM grid and the borehole at the same site.

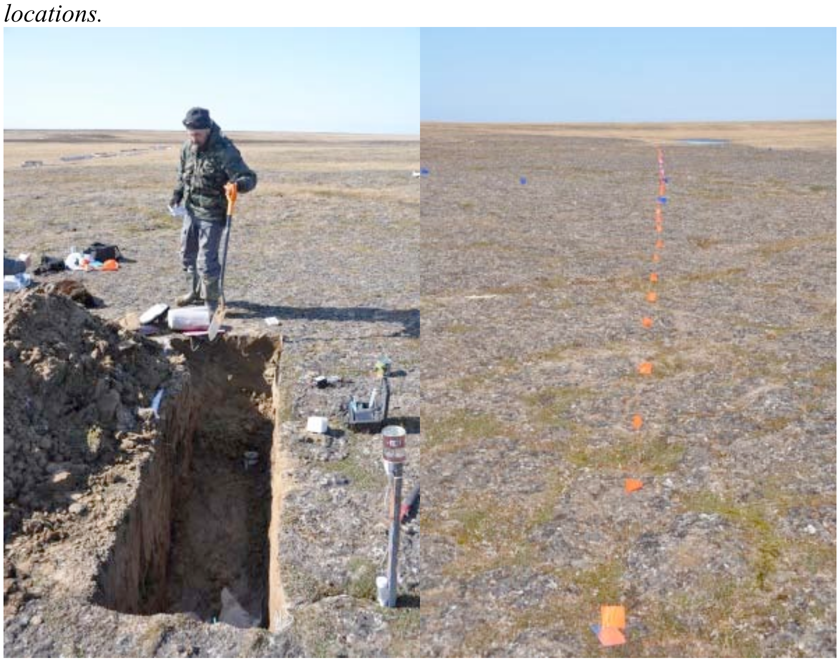
21 Jul Miserable wet morning, clearing in afternoon. Establish first sample site. Weather strong wind from the east, driving rain. Another indoor day. One of the windows blew out and has to be sealed up, and some effort is taken to try to seal the upper floor better. We decide to make the kitchen the one warm room in the house. Today we will make labels for the transects, releve, and biomass plots. Not much else we can do. We will sample the dry site closest to camp at the first opportunity because there are so few vascular plants, and the greenness on these plots is probably close to maximum now, and we will have biomass to sort on days like today.

In the afternoon the rain stops and we decide to put in the zonal grid near camp. This will allow the ECI crew to put in a CALM grid on the same site and also do the borehole nearby.

We first spent quite a bit of time looking for a good location for the site. There is not a perfect site near the camp. The chosen site is wetter than I had hoped for, and is a mosaic of moist and wet tundra, but it seems to be the best that we can hope for without having to walk over 5 km to our zonal site, which would be impractical for the CALM grid and the borehole. The water table on all the iButton sites was less than 5 cm beneath the surface, but this was after the heavy rains of the last few days so we are hoping the site will dry out a bit more by the time we clip. We lay out the transects and relevé plots. The sample site consists of 5 parallel 50-m transects that are oriented north-south and separated by 12.5-m intervals. The transects are numbered using the SW corner as the base point. These are transects BO-T51 to BO-T55 (BO for Belyy Ostrov). The southern end (beginning) of each transect is marked with an aluminum tag (e.g. BO_T51_00m) and the northern (50-m) end is also marked (e.g. BO_T51_50m). The transects will be used for measuring the active-layer depth, plant species, NDVI, and LAI and 1-m intervals. We normally place small pin flags at 1-m intervals along the transects, but today we place flags only at 10-m intervals to save flags for the dry site, which we will sample first. Five 5 x 5-m relevés (study plots for plant-species composition and biomass sampling) are located along the central three transects in homogeneous moist tundra. Ronnie takes the GPS coordinates of all the transects and relevés. We then place ibuttons (small temperature loggers) in the southeast corner of each relevé. One logger is placed at the soil surface and one at the top of the mineral soil horizon beneath the organic layer. The purpose of this will be to determine the insulative value of the soil organic layer to help determine the n-factor, which is useful for calculating the heat flux into and out of the soil. This is valuable for predicting soil temperatures and the thickness of the annually thawed soil layer (the active layer). After we finish with the ibuttons, we returned to camp at about 6 pm. During this whole time Stas has stood silently along the western side of the study site watching for polar bears.

Jul 22. Establish sandy grid.

Upper: Stas, our hunter and wildlife photographer. Lower left, small nonsorted polygons at the sandy site. Lower right: Ronnie and Howie collecting GPS coordinates of transect locations.



Left: Gosha with soil pit. One of the five transects at the sandy site.

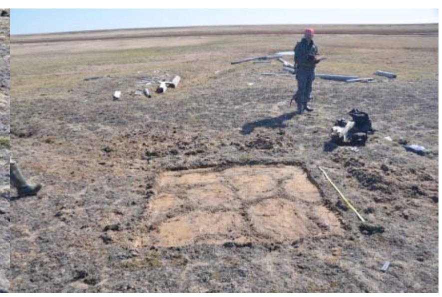
Weather is clear and calm all day, small amount of frost. Great weather. Photos 1441-1522.

We established the grid on the dry sandy site today. This is over a 4 km walk, and we discover a route along the beach that is somewhat longer but much easier to walk. Gosha dug a beautiful soil pit to about 1-2 m depth. The soils are surprisingly deeply thawed in the sands. Ronnie and Howie put in the iButtons. Olga and I collected the biomass samples from each relevé. And Olga, JJ, and I did one relevé. Tomorrow we will return to this site, weather permitting, and do the other 4 relevés and the sampling along the transects. We return to camp via the beach route, but find the crossing near camp difficult because of deep mud in the estuary of a small stream, but finally we get across without losing our boots. Gosha, however, crossed in a different spot and lost his boot and got muddy.

Marina's group put in a 8.1 m borehole near the first site.

23 July 2009, Finish sampling sandy site
Weather: clear gentle breeze warm all day, some mosquitoes, especially in wet areas. Photos 1523-1581.

We returned to the sandy site and finished sampling the relevés (Skip and Ronnie) plant cover along the transects, (JJ and Olga), NDVI and LAI (Howie). Gosha dug a horizontal soil pit that revealed the structure of the small nonsorted polygons.



Horizontal soil pit in area of small nonsorted polygons revealing the pattern of organic matter distribution and cracking pattern. Upper left: pattern of adjacent area of tundra. Upper right and middle left: Pattern after removal of 5 cm of soil. Middle right: Pattern after removal of 10 cm of soil. Bottom photo: Diagonal pattern of organic streaks in the side wall of the pit reveals the slow down-slope movement of the soil from left to right. The cracks and organic-matter redistribution were evident to 15-cm depth.

The polygonal cracking pattern appears to confirm that the common cracking patterns seen in High Arctic soils is due to contraction cracking from extreme cold (frost cracking) and not due to desiccation, since deep desiccation cracking is not known to occur in sandy soils.

24 July. Catch up day, and move plot BO-1.
Weather: Morning warm, calm, some stratus clouds, clearing by mid-morning with some high cirrus. High during day is 16˚C! Photos 1582-1692.

Top: Terrain at new BO-1 site, showing several non-sorted circles (small barren patches). Bottom: Soil pit showed the clear cracking and filling by organic matter in the cracks around the margins of the nonsorted circles.

Morning: Catch up. JJ presses voucher vascular plants. Olga and I put nonvascular plant vouchers in bags and make list of vouchers.

Afternoon: We decide to move the BO-1 to a nearby area that has non-sorted circles and vegetation dominated to by *Carex bigelowii*. The vegetation is probably closer to zonal situation in subzone C and B as described by Nadya Matveyeva, even though this type is very uncommon locally. The first BO-1 area was too wet. The patterned ground will also be more interesting for the soil pit and for Ronnie's sampling of soil fungi.

The site is situated on a well drained pland at the the intersection of two small creeks about 2 km south of the weather station. The site is gently sloping to the east and north, with many small nonsorted circles about 0.5 m in diameter (barren areas) and spaced at about 1.5 m intervals. The vegetation between the circles is a moist *Carex bigelowii, Salix polaris, Hylocomium splendens, Aulacomnium turgidum, Cladonia arbuscula* graminoid, prosrate dwarf-shrub, moss community. The vegetation on the circles consists of a black cryptogamic crust with *Anthelia juratzkana* and fruticose lichens. *Dryas punctata* is the margins of the circles.

At the end of the day we visit the met station and have tea with the station director, Nickolai Ivanovich Nickonov. His assistant, Nadya, speaks very good English and gives us a thorough tour of the facility including the field instruments. The station is almost totally isolated with little communication. Weather reports are sent daily, apparently by a computer connection, but all verbal communication is still via Morse code. There is no TV nor radio. The station personnel had not heard about the world financial crisis until several months after it started. The station is a well equipped and fairly modern. The residents, like most folks in the far North are trying to grow small window gardens, with onions, eggplants, peppers, celery, and tomatoes.

Belyy Ostrov weather station. From upper left clockwise: Station director Nickoloai Ivanovich Nickonov and Nadya. Interior of communication and data room. Window garden, Kitchen where we had tea. Nadya showing field instrument for measuring humidity and periods of direct sunlight. Pet White-fronted Goose gosling.

25-26 Jul. Storm, sorting biomass.
Weather 25 Jul. Fog light rain, wind increasing by late afternoon. Strong winds from the east and rain all day. Photos. 1693-1716.

Weather day keeps us inside all day again. Luckily we have plenty to do. We finish the sorting of the dry sandy biomass samples. The samples are quite heterogeneous with lots of moss on three of the samples, and considerable sand in the samples which will require ashing the samples to determine the mass of the sand. We also make 5 x 5-cm “cookies’ of the *Gymnomitrion* crusts so that they can also be ashed to determine the amount of organic matter per 25 cm^2.

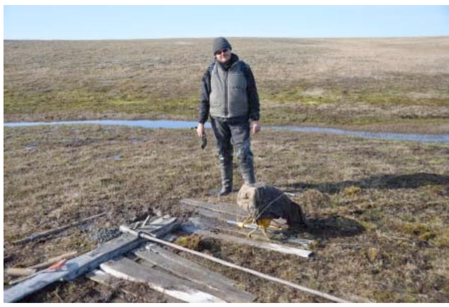
Only three more days to finish.We very much need a good weather tomorrow to finish the sampling on the zonal site.

Sorting biomass.

27 July, Sample zonal site.
Weather breezy, cool, clear. Photos: 1717-1778.

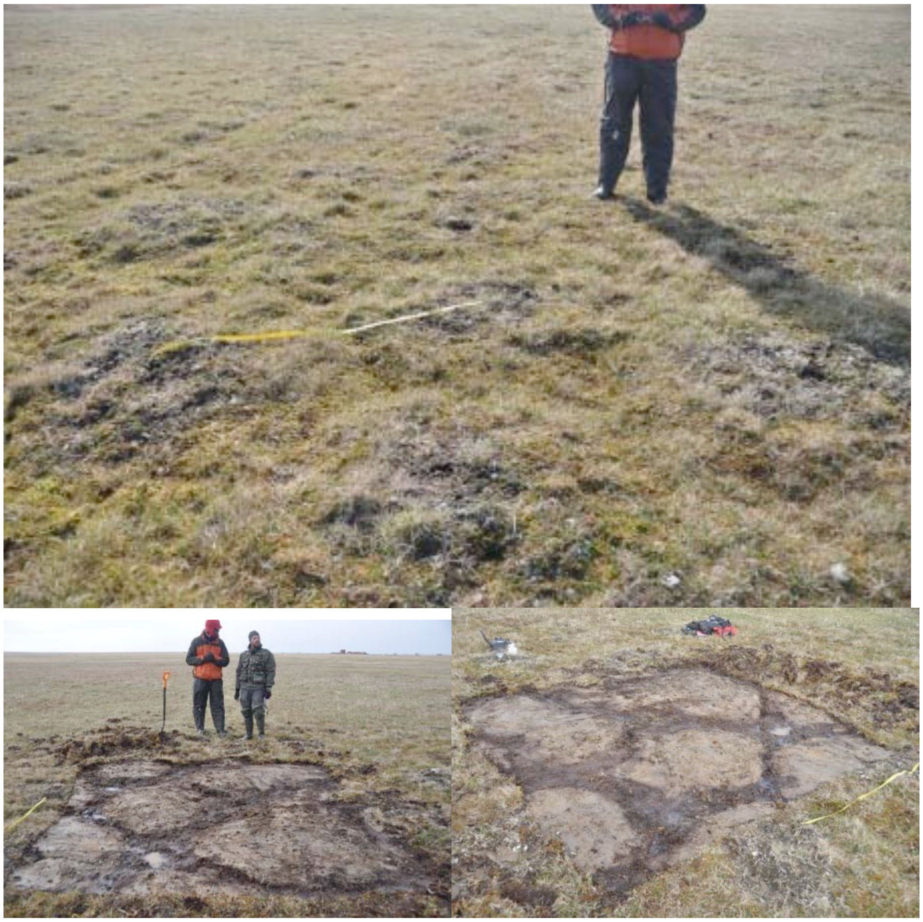
We did all the sampling at the zonal site today, including biomass sampling (JJ and Olga), Relevés (Skip, Ronnie, Howie), Point sampling along transects (JJ and Olga), and NDVI and LAI (Howie).

The Russians are drilling three boreholes along a transect (wet clayey upland site, dry sandy site, and floodplain).



Borehole site in flooplain of small creek. Closeup of borehole.

The most interesting aspect of the day was Gosha's soil pit that revealed the hexagonal pattern of cracks associated with the non-sorted polygons and circles on the zonal site.



Top: Nonsorted circles on zonal site before removal of vegetation mat. Middle: polygonal pattern after removal of tundra mat. Bottom: Soil plugs from center of nonsorted circle (left) and between frost boil, showing depth of organic soil horizon.

Sampling CO_2 emission from cracks and center of polygons.

Lunch near the zonal site.

Debris and buildings from previous meteorological station at Belyy Ostrov. The original station was built in stages starting in 1933. The house we are living in was built in 1986. The station was also a rocket launching facility for atmospheric studies. Rocket explosions in the early 1900s destroyed two of the buildings. The new station was built in 2005.

July 28, Sorting day.
Weather excellent all day. Howie does NDVI and LAI on zonal site and NDVI on dry site and helps with the drilling operation on the floodplain of the small creek. The rest of sort biomass all day.

July 29, Sorting day and catch up on log.
Weather cloudy, light breeze from the east in the morning. Clearing and sunny in the afternoon. Wind swings to the north. Photos 1807-1977

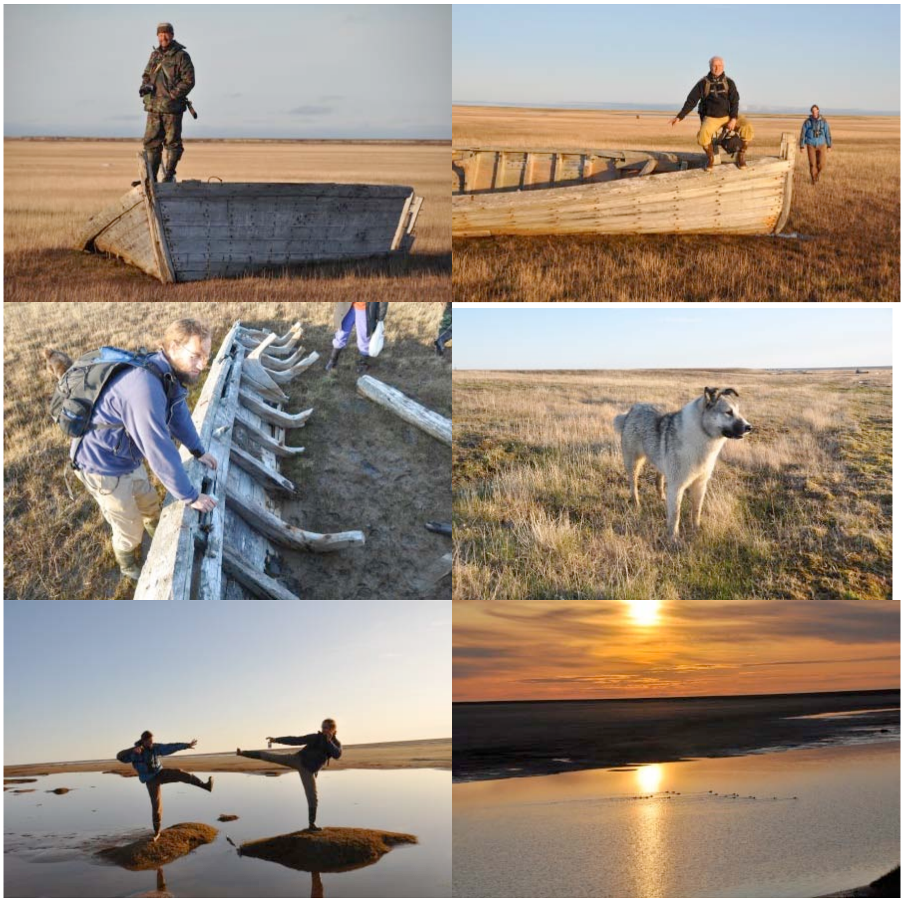
I spend most of the day catching up on the log and paying Olga and Pasha for services and logistics associated with the expedition.

Everyone else sorts the last of the biomass. In the late afternoon we press the voucher collections from the zonal relevés.

Andrei catches four nice fish (Onul) using a net. And I fry these along with potatoes and onions for dinner.

After dinner we walk about 6 km to a salt marsh east of camp.


Andrei with fresh Onul.



Scenes from last night at Belyy Ostrov and walk to local salt marsh.


Group photo on last night at Belyy Ostrov.

Jul 30 Departure from Belyy Ostrov, helicopter flight to Myc Kameni
Weather clear, breeze, and warm, Photos 1978-2163.
Finish sorting moss voucher collections from loamy site. Pack.

The director of the polar station invites us to nail up directional signs to each of our respective states and countries on the station's direction pole, so I nail a sign to UAF (4400 km to the NE), Howie nails a sign to Charlottsville (7405 km to the NW), and Ronnie nails a sign to Groeskbeek, Netherlands (3775 km SW).

From upper left: Ronnie Daanen putting up the direction signs at the Polar Station. Happy face on helicopter landing pad at the Polar Station. Sign at the Polar Station. Helicopter refueling at Sabetta enroute to Myc Kameni.

Myc Kameni.

The helicopter arrives at about 12:45 and we depart at about 1:45. We refuel in Sabetta and arrive in Myc Kameni at about 3:30. Weather enroute is clear to Sabetta, where there are clouds and fog. Weather in Myc Kazmeni is clear and windy, with clouds of small fles. We unload our equipment and check into the hotel. We buy some groceries in the nearby store and have some beer and snacks, and then return to the helicopter to load the equipment on the helicopter we will take to Labytnangi in the morning. We then return to the hotel for some celebration.

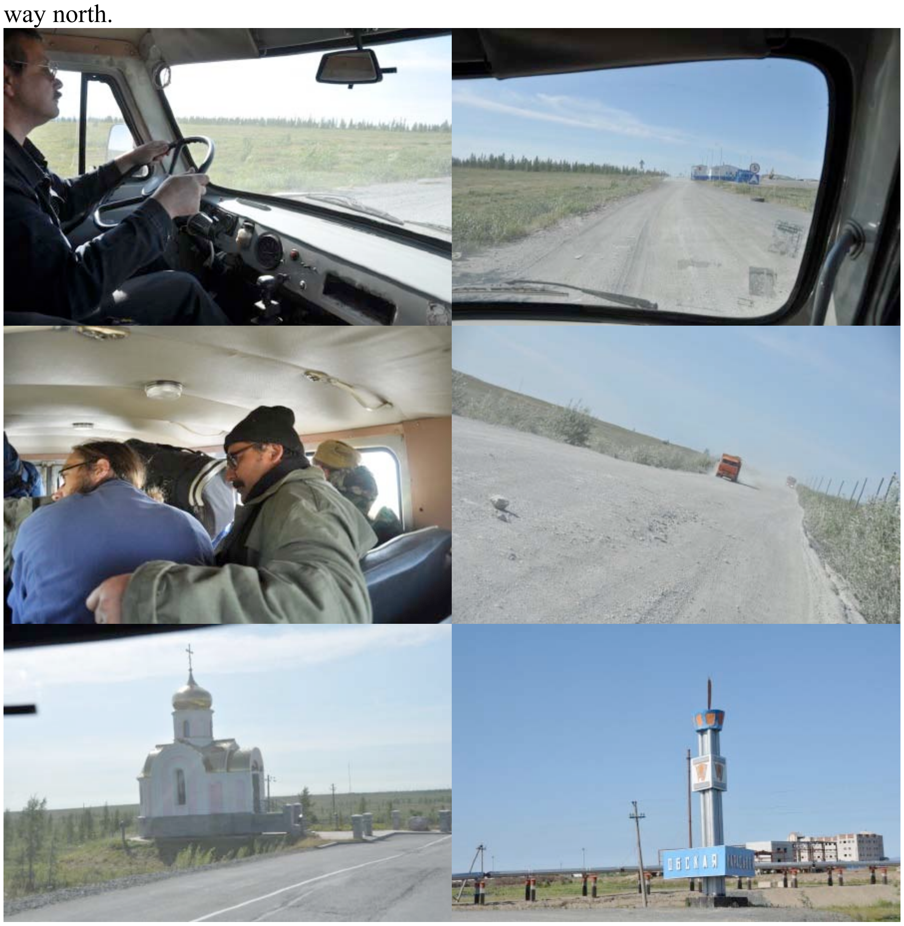
Office 2004 Test Drive…, 7/30/09 4:47 PM
Comment:

31 Jul. Helicopter Myc Kameni to Km 19 north of Obskaya.
Weather: Clear breezy warm at Myc Kameni. The weather is nearly perfect for taking aerial photographs. Photos 2164-2538.

Depart at 9 am. Flight is to a point about 19 km north of Obskaya along the new road and rail route to the Bovanenkova gas field. At this point we are to rendezvous with two truckloads of researchers from the Earth Cryosphere Institute who will then use the helicopter to transport them to Myc Kameni to refuel and pick up Marina Leibman. Then the helicopter will go to Marre Sale to deposit one team of researchers led by Alexander Vasily and then to Vaskini Dachi to deposit Marina Liebman's team. We will use the vehicles to drive our team to Labytnangi.

Left: Aerial view of our rendezvous point and railroad and gravel road to Bovanenkovo; Right: Team of ECI researchers that await us at the rendezvous point.

The drive to Labytnani is pleasant but along the same rough road that we traveled on our way north.



Road to Labytnangi.

Driving back to Labytnangi two days ago after our helicopter flight, I was able to finally relax and just enjoy the day. It was an absolutely beautiful day and we were bouncing along on the rough road that parallels the railway route to Bovanenko in two of the ECI vans packed with us and our field gear. We had just exchanged vehicles (our helicopter for two vans) with another large group from ECI who were all headed out to expeditions to Maare Sale and Vaskiny Dachi. I realized how much fun the summer has been and how it would be nice to spend more time in the field here, but also what an enormous effort was involved in making this happen.

At the rendezvous point there had been a large contingent of students in the group and they were all excited to get into the field. The military-scale logistical operation that was involved was enormous. I was sitting in the helicopter watching the 3-person crew of the ME-8 helicopter and our team off-loading tons of gear and 12 people, and loading tons of other gear for these other expeditions, I realized that this was only part of the overall operation which also involved careful coordination with the crews and camps at Nadym, Maare Sale, and Vaskiny Dachi, and almost impossible logistic nightmares involved with all our invitations, visas, and border passes into the restricted area of the Yamal. Pasha Orekhov and Marina Leibman really performed a miracle in making all this happen.

In Labytnangi we check into the Seven Larches Hotel, and then eat a big meal at the Elta restaurant. The weather in Labytnangi is beautiful and I dry out the field vouchers. There is some indecision about travel arrangements back to Moscow. Howie was planning to fly from Salekhard, and Olga was planning to fly to St. Petersburg, but there are no plane tickets available until Aug 7. So everyone will take the train. However, there are also not enough seats available for us to travel together on the 1 Aug train, so Howie, Olga, and Nadia (from the Polar Station) will travel with the goose to Moscow. We will travel on the day after tomorrow.

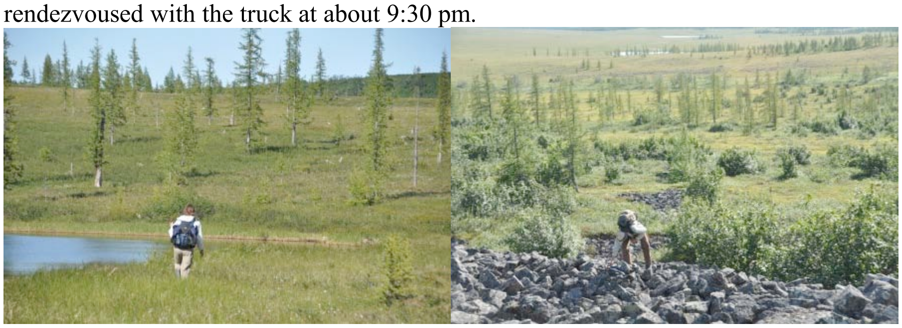
In the evening we have a celebration of Pasha's birthday and the conclusion of the expedition in Olga's room with tequila, sandwiches and fantastic watermelon.

1 Aug: Departure of Howie, Olga and Nadya and visit to the Kharp location
Weather: Perfect, warm calm, no bugs.
Howie Olga and Nadya leave at about 10 am. Olga is to take the voucher plant collections to the Komarov Botanical Institute in St Petersburg.

Pasha pulled off another small miracle by getting JJ, Ronnie and I to a field site that JJ was interested in for his Ph.D. research. One of the most interesting areas that JJ has detected for shrub expansion in all of Russia using Corona and Quickbird imagery turned out to be right along the rail route near the small town of Kharp in the Ural Mountains, which it turns out is really quite close to Labytnangi. However, we figured that it would be almost impossible to get there because of the permissions that were required and the difficulty of renting a vehicle and making arrangements. But it turned out that we had to leave Labytnangi a day later that we intended because of the unavailability of train tickets back to Moscow. Pasha went to Salekhard by ferry and returned by early afternoon with the permissions that were needed and a vehicle and a driver, and by 2:45 pm we were headed to JJ's field site.

The walk proved to be an easier than I had anticipated, although there were moments when crossing some willow choked drainages and were up to our thighs in water and tussocks that we had second thoughts. It turned out to be a terrific experience working the foothills of the Urals and walking through terrain and tundra very much like that in the Finger Moutain and Kanuti Flats area of northern Alaska, except that the trees were nearly all Siberian Larch. It is absolutely amazing to me how similar the plant communities here are to those across much of the North American tundra and boreal forest — except for the trees. The most rewarding part for me was to see first hand the colonization of frost boils by alders, which I relate in the log, and which has eluded me in all my visits to alder savannas in Alaska.

The site was in the in the foothills of the Ural Mountains about 40 west of Labytnangi. We traveled first by a rented 4-wheel drive vehicle, and then walked about 4.7 km to the area that JJ identified on remote sensing images as an area where alder shrub communties have been expanding at a rapid rate. He has identified several such areas on old Corona spy satellite images taken during the 1960s, and he also has recent Quickbird satellite images to compare the area of the alder communities. The topic of shrub expansion in the Arctic has received a lot of recent press. Similar shrub expansion has been seen in northern Alaska and elsewhere, and has been has been attributed to climate change. Once we are at JJ’s field site, it is clear that the area was burned by a forest fire, possibly over a 100 years ago, and that the fire disturbance played a big role in the expansion of alder areas. The fire was so old that at first we did not recognize the dead trees as part of an old fire, but it later became clear that the many dead larch stumps and logs showed charred areas that had not been weathered away. Nearly all of the trees had been blown down and largely decomposed. There was also charcoal in the soils. The site was particularly interesting because the large patches of alders apparently escaped the fire and these areas had numerous large old larch trees that were apparently protected by the alders, which are relatively resistant to fire, as are most deciduous trees and shrubs. The rapid expansion of the alders may have followed the fire because the fire apparently completely burned off the soil surface organic horizon, exposing the underlying mineral soils, which are necessary for the establishment of alders seelings. We saw clear evidence that the shrublands are continuing to expand around the margins of the shrub islands, mainly at sites of nonsorted circles, which have barren soil exposed in their centers. This was a great find for me because it clearly demonstrated that the circles are sites of seedling establishment, and are very likely largely responsible for the regular patterns of shrub distribution that characterize many “alder savannas” near tree line and on the Arctic Slope in Alaska. We visited several stands along a low ridge that had beautiful sorted and nonsorted patterned ground features and then returned to our drop point where we rendezvoused with the truck at about 9:30 pm.



Hike into the JJ's field site near Kharp.

One of the areas where rapid alder shrub expansion has been occurring. Note the large widely spaced large larch trees in the alder shrubland on the hill in the background of the photo on the right.

Dead larch from old fire at JJ's study site.

Alders growing in isolation (left) and part of expanding islands of alders (right).

Left: Large sorted polygons on hill crest at JJ's study site. Right: Nonsorted circles on finer grained soils immediately adjacent to the polygons shown in the left photo.

Alder seedlings establishing on barren soils of nonsorted circles.

Aug 2-4 Train trip Labytnangi to Moscow
We depart Labytnangi at 9:00 am after saying goodby to Pasha and Andrei who were headed to Nadym for another field campaign. Ronnie, JJ and I travel with Gosha, who will help us in Moscow with drying and weighing our biomass samples, and also with retrieving DNA samples for the soil fungal project that have been there since last year. We travel on the “Polar Arrow”, a relatively luxurious train with a dining car.