Data Report of the

2007 Expedition to Nadym, Laborovaya and Vaskiny Dachi, Yamal Peninsula Region, Russia

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ABSTRACT

This data report is a summary of information collected during the 2007 expedition to the Yamal Peninsula region of West Siberia, Russia as part of the Greening of the Arctic (GOA) project. The overarching goal of the Yamal portion of the GOA 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 affect traditional herding of the indigenous people of the region. The purpose of the expedition was to collect ground-observations in support of remote sensing studies at three locations along the southern part of a transect that traverses all the major bioclimate subzones in the Yamal region. Another expedition is planned for summer 2008 to the northern locations along the transect. The locations visited in 2007 were Nadym (northern taiga subzone), Laborovaya (southern tundra = subzone E of the Circumpolar Arctic Vegetation Map (CAVM), and Vaskiny Dachi (typical tundra = subzone D of the CAVM). Data are reported from 7 study sites – 2 at Nadym, 2 at Laborovaya, and 3 at Vaskiny Dachi. The sites are representative of the zonal soils and vegetation, but also included variation related to substrate (clayey vs. sandy soils). Most of the information was collected along 5 transects at each sample site, 5 permanent vegetation study plots, and 1-2 soil pits at each site. The expedition also established soil and permafrost monitoring sites at each location. This data report includes: (1) background for the project, (2) general descriptions and photographs of each locality and sample site, (3) maps of the sites, study plots, and transects at each location, (4) summary of sampling methods used, (5) tabular summaries of the vegetation data (species lists, estimates of cover abundance for each species within vegetation plots, measured percent ground cover of species along transects, site factors for each study plot), (6) summaries of the Normalized Difference Vegetation Index (NDVI) and leaf area index (LAI) along each transect, (7) soil descriptions and photos of the soil pits at each study site, (8) summaries of thaw measurements along each transect, and (9) contact information for each of the participants. One of the primary objectives was to provide the Russian partners with full documentation of the methods so that Russian observers in future years could repeat the observations independently.

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. 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). It addresses the NEESPI science 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

Project overview

The terrain and vegetation of the Yamal Peninsula in northern Russia is experiencing rapid change due to a variety of natural and anthropogenic factors including unusual permafrost conditions, gas and oil development, grazing and trampling by the native Nenets' reindeer herds, and climate change (**Figure 1**).

Figure 1. A Nenets reindeer herder drives her sled by an oil derrick on heavily disturbed terrain in the Bovanenkova oil field, Yamal Peninsula, Russia. (Photo copyright and courtesy of Don and Cherry Alexander.)

The Yamal Land Cover/Land-Use Change project examines 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 by the indigenous people of the region. One goal is to collect ground-based observations of the vegetation, soils, and spectral properties of vegetation along the climate gradient on the Yamal Peninsula to help interpret the information from space-based sensors.

This data report provides a record of the methods used and the data collected in the summer of 2007 at three sites along a transect in the Yamal region: Nadym, Laborovaya, and Vaskiny Dachi (**Figure 2**).

A second expedition is scheduled for summer 2008 and will visit Marresale, Kharasavey, and Ostrov Belyy. Scientists from Finland, Switzerland, Russia, and the United States participated in the 2007 expedition (see list of participants, **Appendix A**).

Figure 2. The 2007 study locations at Nadym, Laborovaya, and Vaskiny Dachi, and other proposed study locations.

The sites chosen for the studies were selected because they are representative of the bioclimate subzones described on the Circumpolar Arctic Vegetation Map (CAVM Team 2003) and because they have histories of previous research. Nadym has been studied since the early 1970s by Dr. Nataliya Moskalenko and scientists at the Earth Cryosphere Institute. Vaskiny Dachi has been studied since the late 1980s by Dr. Marina Leibman. Dr. Moskalenko and Leibman are chief research scientists at the Moscow unit of the Earth Cryosphere Institute, Siberia Branch of the Russian Academy of Science. Laborovaya is a research site of the Environmental and Social Impacts of Industrial Development in Northern Russia (ENSINOR) project, directed by Dr. Bruce Forbes of the Arctic Centre, University of Lapland, Rovaniemi, Finland.

Description of the study sites

Nadym (Nataliya Moskalenko)

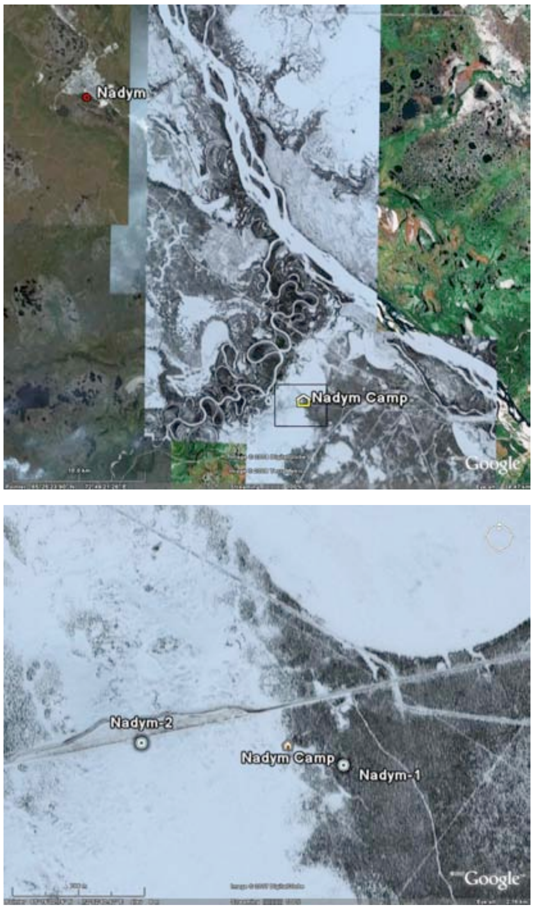

Figure 3. Location of study sites near Nadym. Upper image shows the region southeast of Nadym and the study location (black rectangle). The large river in the upper image is the Nadym River. Lower image shows the location of the field camp and the two study sites. The river in the upper left of the lower image is the Hejgi-Jakha River. The extensive road network is associated with oil development in the region. Images by Google Earth, copyright Digital Earth.

The expedition established the Nadym study sites during the period 3-10 Aug 2007. The sites are situated about 30 km south-southeast of the city of Nadym at 65˚ 18.87' N, and 72˚ 52.84' E. (**Figure 3**). Researchers at the Earth Cryosphere Institute have studied this location since 1970. It is a monitoring site for the Circumpolar Active Layer Monitoring (CALM) project, and there are long-term climate and permafrost records from numerous nearby localities, as well as detailed information regarding the geology, vegetation, permafrost, and anthropogenic disturbances (Melnikov et al. 2004; Moskalenko 1984, 1995, 1999, 2000, 2003, 2005a, b; Pavlov and Moskalenko 2002; Ponomareva 2005, 2007) plus ongoing studies of animals and insects.

Physiography and geology

The study sites are situated on a flat fluvial-lacustrine plain that is dissected by the Nadym and Hejgi-Jakha rivers. Two major terraces of the Nadym River cover much of the local area in the vicinity of the research sites. The Terrace II deposits (Karga age, 20-40 kya) have elevations between 14 and 20 m and are covered largely by better drained sandy soils and forests. The Terrace III fluvial-lacustrine plain (Zyranski age, 60-80 kya) is 25 to 30 m in elevation and is covered with many lakes and mires, peat up to 5 m thick, and a mix of tundra and open woodlands. Numerous large well-drained palsas rise above the boggy landscapes.

Climate

The climate of West Siberia is influenced by maritime air masses from the Atlantic Ocean and continental air masses from the Asia. Interaction of these opposing air masses causes highly variable weather. Winter (November-March) is characterized by low temperatures interspersed with periods of sharp warming accompanied by continuous overcast and snowfalls. In April the transition season begins with consolidation and destruction of the snow cover. In May sharp cold snaps accompanied by spring blizzards (*burans*) are possible. Spring is the driest, clearest, and windiest season. In summer (June-July), cloudy weather is typical with occasional intensive rains. Autumn (August-September) has long periods of continuous overcast conditions and precipitation. The climate of the Nadym site is summarized in Table 1.

Table 1. Climate conditions of the Nadym site.

Average air temperature (°C):
Annual -5.9
Summer 10.8
Winter -14.2
Annual amplitude (meteorological), °C 40.5
Mean-annual ground-surface temp. (°C) +1 to -3

Date of transition of air temp through 0 °C
In the spring 27 May
In the autumn 20 Oct

Precipitation (mm):
Annual 483
Liquid 237

Snow cover:
Date of formation 15 Oct
Date of melting 27 May
Maximum depth (April) (cm) 76
Average density (in April), kg m^{-3} 290

Soils

The Nadym research sites are situated in the northern taiga bioclimate subzone. A wide variety of ecosystems are present due to Nadym's position within this transitional region. The parent materials for the soils are derived from fluvial-lacustrine deposits. Mainly sandy materials interbedded with loamy and clay deposits were repeatedly spread by the river systems. The heterogeneous soil textures complicates the permafrost distribution patterns. Key soil processes are peat accumulation, gleying and podzolization. In well-drained forested ecosystems on Terrace II, podzolic soils are common with evidence of previous cryogenic attributes, such as networks of former ice wedges (pseudomorphs) that are filled with loamy and/or clayey materials. On Terrace III, superimposed on these sandy soils, are the effects of various bog-forming and metamorphic cryogenic processes (including paludification, thermokarst, frost heave, and thermoabrasion) that create a heterogeneous complex of soils with permafrost landforms and peatlands with peat-gley soils.

Vegetation

Figure 4. Nadym-1 (forest site). The trees are mainly Scots pine (**Pinus sylvestris*****), and mountain birch (*****Betula tortuosa*****) mixed with Siberian larch (*****Larix sibirica*****). The understory consists of dwarf shrubs (*****Ledum palustre, Betula nana, Empetrum nigrum, Vaccinium uliginosum, V. vitis-idaea*****), lichens (mainly *****Cladonia stellaris*****) and mosses (mainly *****Pleurozium schreberi*****). Photo no. DSC_0325, 8/09/07, P. Kuss.***

Figure 5. Nadym-2 (CALM-grid site). Hummocky tundra consists of a complex of vegetation with a *****Ledum palustre-Betula nana-Cladonia** spp. dwarf-shrub community on the hummocks and a *****Cladonia stellaris-Carex glomerata***** lichen community in the inter-hummock areas. Photo no. DSC_0101 8/03/07, D.A. Walker.***

Zonal northern taiga covers large areas of Terrace II. Here there are birch-larch (*Betula tortuosa-Larix sibirica*) and birch-pine shrub-lichen (*Betula tortuosa-Pinus sylvestris/Betula nana-Cladonia stellaris*) open woodlands.

Terrace III is characterized by peatlands occupied by *Rubus chamaemorus-Ledum palustre-Sphagnum*-lichen tundra on raised palsas and elevated microsites and *Eriophorum-Carex-Sphagnum* mires in the lower microsites. Large frost mounds also occur in these peatlands and are characterized by *Pinus sibirica-Ledum palustre-Cladonia* open woodlands.

Our Nadym-1 study site (forest site) is located on Terrace II in a lichen woodland (**Figure 4**), and the Nadym-2 study site (CALM Grid site) is located on Terrace III at the 100 x 100-m CALM grid in hummocky tundra (**Figure 5**). The study areas are currently not used by the Nenets for reindeer forage lands, so the lichen areas are well preserved at both sites.

Laborovaya (Bruce Forbes)

Figure 6. Location of the Laborovaya field camp and study sites. The Obskay-Paijuta railway/road corridor is evident, and a quarry used for construction of the railroad just north of the field camp is on a sandstone ridge. Another sandstone ridge is about 2 km west of camp. Several large thaw lakes are to the south of camp. Google Earth image, copyright Digital Globe.

The Laborovaya study sites were sampled during the period 13-21 Aug 2007. The expedition traveled to the site via rented truck from Labytnangi. The Laborovaya region has been studied since 1997 by Dr. Bruce Forbes and colleagues researching anthropogenic disturbances in the region and more recently in conjunction with the ENSINOR studies. No detailed climate or geological information is available for the Laborovaya location. The following information is modified from Forbes (1997).

Figure 7. Base camp at the Laborovaya location. The Obskaya-Paijuta railway/road corridor is in the background, and the access road to a nearby quarry is in the foreground. Photo no. DSC_0597, 8/14/07, D.A. Walker.

Location and physiography

The study sites are situated in the foothills at the northern end of the Polar Urals. Our base camp was at lat. 67° 42.21' N, long. 68° 01.08 E, about 21 km northeast of the small settlement of Laborovaya and at km 147 of the Obskaya-Paijuta railway/road corridor (**Figure 6**). The base camp was located near a small oxbow lake adjacent to an access road that leads to a gravel quarry used for construction of the road and railroad (**Figure 7**).

This section of the transport corridor was constructed in 1989, and the quarries have been essentially abandoned since that time. The road and railroad are in active use throughout the year, largely for the transport of construction materials and workers along the corridor, although a few small personal vehicles also use the road.

The local physiography consists of flat plains with thaw lakes to the east and north and hills with sandstone bedrock outcrops to the west and south. Surficial materials on the plains consist primarily of Pleistocene sands underlain by saline clays.

Climate

The nearest year-round meteorological station is at Salekhard, 150 km to the south, near the mouth of the Ob River (Fig. 1), which is not comparable because Salekhard is in the forest and is warmer and calmer than the Laborovaya region. The location lies within the continuous permafrost zone.

Vegetation

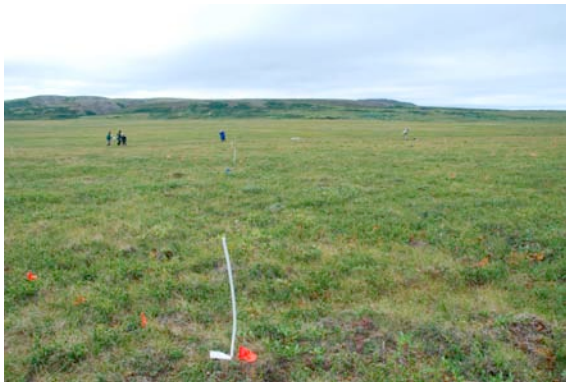

Figure 8. Laborovaya-1 study site (clay site). The vegetation is a moist dwarf-shrub, sedge moss tundra dominated by* Carex bigelowii, Eriophorum vaginatum, Betula nana, Vaccinium vitis-idaea, V. uliginosum, Aulacomnium palustre, Hylocomium splendens, *and* Dicranum *spp. Photo no. DSC_0188, 8/16/07, D.A. Walker.

Phytogeographically, the study site lies about 100 km north of the latitudinal treeline within the southern southern tundra subzone (= Subzone E of the Circumpolar Arctic Vegetation Map, (CAVM Team, D.A.Walker et al. 2003)). According to Yurtsev (1994), the Yamal-Gydan West Siberian subprovince is characterized by a low floristic richness due to gaps in the ranges of species with predominantly montane, east Siberian distributions and western (amphi-Atlantic) distributions. The region's vegetation has been mapped at small scale (Ilyina et al., 1976) and its community types described by Meltzer (1984).

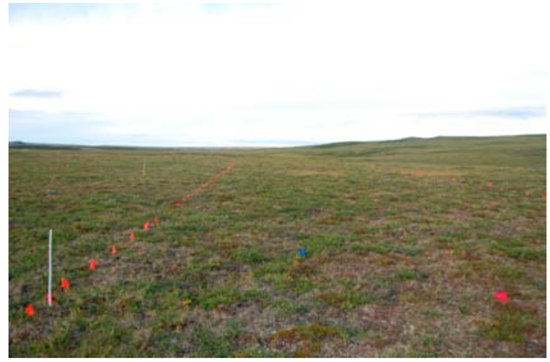

Figure 9. Laborovaya-2 study site (sand site). The vegetation is moist/dry dwarf-shrub, lichen tundra dominated by* Betula nana, Vaccinium vitis-idaea, V. uliginosum, Carex bigelowii, Cladonia arbuscula, Sphaerophorus globosus, *and* Polytrichum strictum. *Photo no. DSC_0596, 8/17/07, D.A. Walker.

Ridge tops on the sandstone hills are dry. Well-developed stands of alder (*Alnus fruticosa*) are common on slopes in the vicinity of the study site and especially in riparian zones. Shrub willows (*Salix* spp.) are generally <30 cm in height, although individuals >2 m occur in riparian zones and on hillslopes. The areas between hills are a mix of wetlands and more mesic vegetation. Much of the tundra is overgrazed, with the ruderal lichens. The study area is extensively grazed in summer by reindeer herds belonging to the Nenets, a group of aboriginal nomadic pastoralists. Vilchek & Bykova (1992) estimated that the number of reindeer on Yamal is already 1.5 to 2 times greater than the optimum for the region.

We had two study sites at Laborovaya – one was moist dwarf-shrub, sedge tundra on wet clayey soils located about 1.1 km west-northwest of basecamp in a valley between two sandstone ridges (**Figure 8**), and the other was relatively dry dwarf-shrub, lichen tundra on a sandy site located about 1.2 km southeast of the basecamp near a small stream (**Figure 9**).

Vaskini Dachi (Marina Leibman)

Figure 10. Location of the camp and study sites at Vaskiny Dachi. The eastern end of the road network in the Bovanenkova gas field is in the upper left. Google Earth image, copyright Digital Earth.

Figure 11. Vaskiny Dachi Camp at the far end of the small lake. Photo no. MG_9350, 8/28/07, D.A. Walker.

The Vaskiny Dachi location was visited and sampled during the period 21-30 Aug 2007. The location is southeast of the main Bovanenkova gas field in the central part of the Yamal Peninsula (70˚ 17.21' N, 68˚ 53.65' E) (**Figure 10** and **Figure 11**). Travel to and from the location was by helicopter. Vaskiny Dachi is the name of a field camp established by Dr. Marina Leibman, who leads a team of scientists in the study of cryogenic processes at Vaskiny Dachi (Leibman 1994, 1995, 1998, 2001; Leibman et al. 1991, 1993 a, 1993 b, 1997; Leibman and Stretskaya 1996, 1997; Romanovskii et al. 1996; Stretletskii et al. 2003). The site is visited annually and has been a CALM monitoring site since 1993. Much of the work has focused on landslides and considerable information is available for vegetation response to landslide disturbances (Ukraintseva 1997, 1998; Ukraintseva and Leibman 2000, 2007; Ukraintseva et al. 2000, 2002, 2003).

Topography and geology

The research sites are located in the watersheds of the Se-Yakha and Mordy-Ykha rivers (**Figure 10**). The study sites are located in a region with a number of highly-dissected alluvial-lacustrine-marine plains and terraces. The deposits are sandy to clayey, most are saline within the permafrost, and some are saline in the active layer. Hilltops in sandy areas are often windblown with sand hollows, some covering large areas. Saddles between the hilltops are often occupied by polygonal peatlands. The topography of the region is defined by a series of marine terraces and plains.

The highest plain is the *Salekhardskaya* marine plain (Terrace V) with maximum heights (up to 58 m). Depths of dissection at this level are 20-50 m. The geological section is composed of clay with clastic inclusions of marine and glacio-marine origin. The top several centimeters to several decimeters of soil consist of silty sand enriched with clasts through wind erosion. Lowered surfaces are often occupied by peatlands. This terrace covers a relatively small portion of the landscape.

The *Kazantsevskaya* coastal-marine plain (Terrace IV) is 40-45 m high built of interbedding of clayey and sandy deposits with a considerable amount of organic matter dispersed in the section. The surfaces sometimes have windblown sands, but are mainly tussocky, hummocky or frost-boil tundras and peatlands in the lower areas. Our Vaskiny Dachi-1 study site was on a gentle terrace hill-top (

Figure ***12***).

Figure 12. Vaskiny Dachi-1 study site on Terrace IV. The soils are clay and the vegetation is heavily grazed sedge, dwarf-shrub-moss tundra dominated by **Carex bigelowii, Vaccinium vitis-idaea, Salix glauca, Hylocomium splendens,** *and* **Aulacomnium turgidum.** *Photo DSC_0146, 8/23/07, D.A. Walker.*

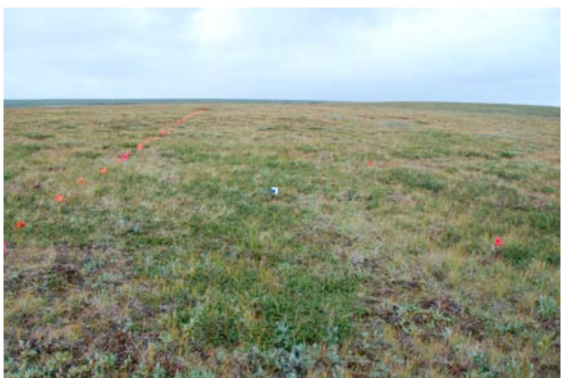

Figure 13. Vaskiny Dachi-2 study site on Terrace III. The soils are a mix of sand and clay. The vegetation is heterogeneous, but dominated by **Betula nana, Calamagrostis holmii, Carex bigelowii, Vaccinium vitis-idaea, Aulacomnium turgidum, Hylocomium splendens,** *and* **Ptilidium ciliare.** *Photo DSC_0344, 8/25/07, P. Kuss.*

The third fluvial-marine or fluvial lacustrine terrace (Terrace III) is up to 26 m high, built of fine interbedding of sandy, silty, loamy, and organic layers of several milimeters to several centimeters thick. Flat hilltops are often occupied by polygonal sandy landscapes with windblown sand hollows on the tops of high-centered polygons. Lowered surfaces are hummocky tundras.

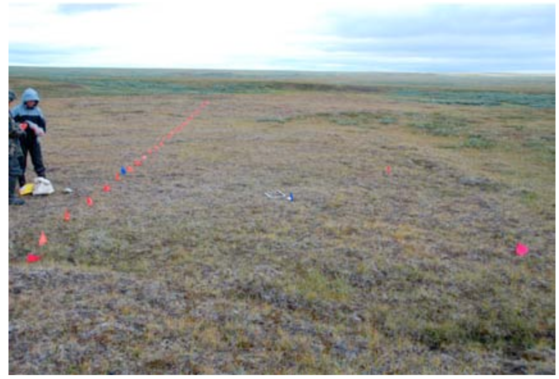

Figure 14. Vaskiny Dachi-3 study site on Terrace II. The soils are sandy and the vegetation is a dry dwarf-shrub-lichen tundra dominated by **Carex bigelowii, Vaccinium vitis-idaea, Cladonia arbuscula, Sphaerophorus globosus, Racomitrium lanuginosum,** *and* **Polytrichum strictum.** *Photo DSC_0112, 8/27/07, D.A. Walker.*

Our Vaskiny-Dachi-2 study site was on a broad hill top of terrace III (**Figure 13**).

Lower terraces (such as our terrace II site, **Figure 14**) are of fluvial origin, probably ancient river terraces of the Mordy-Yakha and Se-Yakha rivers.

Up to 60% of the study area is represented by gentle slopes (less than 7˚), steep slopes (7-50˚) occupy about 10% of the area, and the remaining 30% of the landscape is composed of flat hilltops, valleys and lake depressions.

Climate

The closest climate station is Marresale, which about 100 km southeast and located at the coast, where summer temperatures are somewhat cooler than at Vaskiny Dachi. The average annual air temperature for the last 15 years at Marresale is -7.5˚C. The average January temperature over the same period is -21.5˚C, and the July mean temperature is 7.5˚C. There has been a 1.3˚C warming trend of over the past 45 years. In 1962-1976 the mean annuaul temperature was -8.8˚C, and in 1992-1997 it was -8.2˚C.

The total precipitation is around 300 mm per year – half of this is snow (8.5-9 months), and half is rain (3-3.5 months), which falls mainly in August-September. The end-of-winter-snow depth on flat surfaces is about 30 cm, snow drifts on leeward slopes may be up to 6 m deep. The average period with positive air temperatures at Marresale weather station is 59 days, and the transition to above freezing daily mean temperatures is usually in late June and early October.

Active layer and permafrost

Active-layer dynamics depend upon surfacial deposits, gravimetric moisture content in the fall, organic and vegetative covers, and air temperature in summer. Maximum active-layer depths (1-1.2 m) are found in sands on bare surfaces or with sparse vegetation and low moisture content (up to 20%). Minimum active layer depths (50-60 cm) are found in peat or clay deposits covered by thick moss and with moisture contents more than 40%. The region has continuous permafrost. Open taliks are possible only below the great lakes 30-50 m deep and big river channels (such as Mordy-Yakha and Se-Yakha). Smaller lakes several meters deep have closed taliks 5-7 m deep under the lake bottoms. The older surfaces have the thickest permafrost. Permafrost thickness ranges from 270 to 400 m and more on the marine and coastal-marine plains, and is 100-150 m at the younger river terraces and 50 m at the modern sea level. The average annual ground temperatures at the depth of zero annual amplitude ranges between 0 and -9°C. The lowest permafrost temperatures are characteristic of the hilltops with sparse vegetation where snow is blown away. The warmest permafrost temperatures are in areas with tall willows due to retention of snow in depressions.

Cryogenic processes

The region has very dynamic erosional processes that are important with respect to the vegetation ecology. Highly erodable sands and the presence of massive ground ice near the surface contributes to the unstable landscapes. Cryogenic processes observed in the area are connected to tabular ground ice found in geological sections at the depths of 1 to 25 m practically everywhere. The most widespread processes observed in the study area are landslides of various types and thermoerosion of slopes. Aeolian erosion is common on convex hilltops. Thermokarst and frost heave are less common. In August 1989, 400 new landslides occurred within an area of 10 km^2, where previously there were only three modern landslides (but hundreds of ancient landslides). The age of five of the older landslide events was determined by radiocarbon dating to be 300 to 2000 years old. Dendrochronology was used to determine the reaction of willows to land sliding. During the last two warm summers (2006-2007) several new areas of tabular ground ice were exposed by landslide activity (retrogressive thaw slumps).

Geoecology

Figure 15. Willow communities (**Salix lanata*** ***and*** **S. glauca*****) cover large areas of the landscapes near Vaskiny Dachi. Most of these are on old landslides and in valley bottoms. A more barren recent landslide surface is visible on the upper left side of the photo. Photo no. DSC_0488, 8/21/07, D.A. Walker.***

A striking aspect of the regional vegetation is the abundance of willow thickets (*Salix lanata* and *S. glauca*) covering many hill slopes and valley bottoms (**Figure 15**). Studies of the willow communities in relationship to landslides have included: (a) vegetation succession, (b) ash chemistry of each vegetation group, (c) ground water chemistry, and (d) plant and soil chemistry using water extraction and X-ray–fluorescent analyses of air-dry and homogenized plants (Ukraintseva 1997, 1998; Ukraintseva and Leibman 2000, 2007; Ukraintseva et al. 2000, 2002, 2003). Phytomass was measured in layers: shrubs from a 5 x 5-m area and herb and moss layers from 0.5 x 0.5-m plots.

The study concluded that there is a strong correlation between disturbance age soil fertility, and willow growth. Desalination of old marine sediments after the landslide event leads to active layer enrichment with water-soluble salts, which supply plants with nutrition, provide active revegetation of herbs, and re-formation of soils, followed by willow-shrub expansion. Willows are the main reason for increased biodiversity and biological productivity. They provide more nutrition than typical tundra vegetation due to leaf litter.

Striking differences in soil chemistry were observed between stable undisturbed surfaces and landslide-affected slopes of various ages. The soil of stable hilltops is characterized by relatively low pH (pH 5.5-5.8), very low base saturation (4.5%), low nitrogen content (0.08-0.18%), and rather high organic carbon (1.5-2.3%); whereas recent landslide surfaces have high soil pH (7.5-8.0), much higher base saturation (50-100%), and low organic carbon content (0.2-0.7%).

Tall willow thickets occupy old landslide surfaces due to additional nutrients, especially where there is deep winter snow cover. On 1000-2000 year old landslides, soils show gradual reduction both in pH (down to 6.5) and in base saturation (down to 24.5 %) that indicates continuing desalination of the active layer deposits towards the background conditions. Organic carbon and nitrogen concentration in the older soils was double that of recent landslide surfaces, thus improving soil fertility. In summary, landslides that started more than 2000 years ago result in increased soil fertility and biomass in the modern typical tundra subzone of Yamal Peninsula.

METHODS AND TYPES OF DATA COLLECTED

Study sites

Criteria for site selection

Study sites were selected at each location (Nadym, Laborovaya, and Vaskiny Dachi) in large areas of more or less homogeneous vegetation. The objective was to select large areas of zonal vegetation that could be recognized by their homogeneous spectral signatures on aerial photographs and satellite images. At all three locations there were surfaces with different parent materials that affected the character of the vegetation (**Table 2** and **Table 3**).

Table 2. Study locations, site numbers, site names, and geological settings.

Location and site no.	Site name	Microsite	Geological setting, parent material
Nadym-1	Forest site		Fluvial terrace II, Karga-age, (about 20-40 kya), alluvial sands
Nadym-2a	CALM-grid site	Hummocks	Fluvial terrace III, Zyranski-age, (about 60-80 kya), alluvial sands
Nadym-2b		Inter-hummocks	
Laborovaya-1	Clay-site		__________ (?), clay
Laborovaya-2	Sand site		____________ (?), alluvial sand
Vaskiny Dachi-1	Terrace IV site		Coastal marine plain, Kazantsevskaya-age (Eamian-age 130-117 kya), marine clays
Vaskiny Dachi-2	Terrace III site		Fluvial-marine terrace, (middle-Wiechselian, 75-25 kya), mixed alluvial sands and marine clays
Vaskiny Dachi-3	Terrace II site		Fluvial terrace, (late-Wiechselian, 25-10 kya), alluvial and eolian reworked sands

Table 3. Dominant vegetation at each study site.

Location and site no.	Dominant vegetation
Nadym-1	*Pinus sylvestris-Ledum palustre-Cladonia stellaris* lichen-woodland
Nadym-2a	*Ledum palustre-Betula nana-Cladonia stellaris* dwarf-shrub, lichen tundra
Nadym-2b	*Cladonia stellaris-Carex glomerata* lichen tundra
Laborovaya-1	*Carex bigelowii-Betula nana-Aulacomnium palustre* sedge, dwarf-shrub, moss tundra
Laborovaya-2	*Betula nana-Vaccinium vitis-idaea-Sphaerophorus globosus-Polygrichum stirctum* dwarf-shrub, lic
Vaskiny Dachi-1	*Carex bigelowii-Vaccinium vitis idaea-Hylocomium splendens* sedge, dwarf-shrub, moss tundra
Vaskiny Dachi-2	*Betula nana-Calamagrostis holmii-Aulacomnium turgidu* dwarf-shrub, graminoid, moss tundra
Vaskiny Dachi-3	*Vaccinium vitis idaea-Cladonia arbuscula-Racomitrium lanuginosum* dwarf-shrub, sedge, lichen, t

Size, arrangement, and marking of transects and study plots

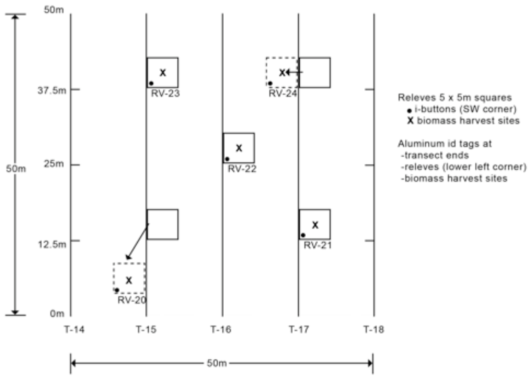

Figure 16. Typical transect and plot layout.

At most study sites the transects and study plots were arranged similarly to the pattern shown in **Figure 16**. Transects were laid out parallel to each other. Most transects were 50 m long and spaced 12.5 m apart. The study plots (relevés) were generally 5 x 5 m and arranged along the transects as shown, with the following exceptions.

Nadym-1: 100-m transects, spaced 25 m apart.

Nadym-2: Transects arranged around perimeter of the CALM grid, and plots were 1 x 1 m to adjust to size of the hummocks.

Vaskiny Dachi-3: 50-m transects arranged to conform to areas of homogeneous vegetation.

The transects were temporarily marked with pin flags spaced at 1-m intervals.

The plots were temporarily marked with pin flags at each corner and one in the middle (the biomass harvest site).

After sampling all flags were removed except for the following which were left so that the transects and plots could be resampled in the future:

1. Transects: pin flags at the ends of each transect and labeled with an aluminum tag that designated the location name, transect number, and distance along the transect, e.g. LA_T15_00m (Laborovaya, transect 15, 0 m).
2. Relevés: pin flags at the southwest corner of each plot labeled with the location name, and relevé number, e.g., LA_RV21.
3. Biomass harvest sites: pin flag in the southwest corner of the harvest site, labeled with location, relevé number, and biomass harvest number, e.g. LA_RV21_BM.

Photographs were taken of each transect from both ends of the transect.

Sampling along the transects

Species cover using the Buckner point-intercept sampling device

Species cover was sampled using the Buckner point-intercept sampling device

Figure 17) (Buckner 1985) and the data form in **Appendix B**. Sampling was done at 0.5-m intervals along each transect (100 points per transect, 500 points per study site), except on the Nadym-1 forest site where sampling was done at 1-m intervals along 100-m transects.

Figure 17. Buckner point-intercept sampling device. The box on the end piece of the device contains a mirror that can be pointed down to the ground cover or up to the forest canopy. The tube is a telescope that magnifies the image in the mirror. Cross hairs in the sighting device identify a point that intercepts a plant species which is recorded as a "hit". The percentage cover of an individual species or cover type is the number of hits for that type divided by the total number of hits. Photo no. DSC_0151, 8/06/07, D.A. Walker.

For the ground cover, at points where there were more than one layer in the plant canopy, two hits were recorded: the species at the top of the ground canopy, and the species, litter or soil at the base of the canopy. "Foliage" or "wood" was recorded for trees and shrubs, and "live" or "dead" for leaves and stems of herbaceous species. At each sample point at the Nadaym-1 site, the mirror on the device was also flipped to face upward, and the intercepted tree species or "sky" were recorded at each point.

Normalized Difference Vegetation Index (NDVI) and Leaf area index (LAI)

***Figure 18**. Howie Epstein sampling NDVI using the PSII Spectrometer. Photo no. DSC_0175, 8/23/07, D.A. Walker.*

At each site, five 50-m (100-m at Nadym-1) transects were run parallel to each other. NDVI was measured every meter using a PSII Portable Spectroradiometer from Analytical Spectral Devices. NDVI measurements were take 0.5 m off the transect in the direction of the sun to ensure well-lit conditions when available. The sensor was held 0.9 m from the ground surface; with a 25° field of view, this produces a circular footprint with an approximate diameter of 0.4 m. White and dark references were taken after every 10 samples and more frequently under cloudy or variable sun conditions. For relevés, NDVI samples were taken in the center of the relevé, and then at the midpoint of the distance between the center and each of the four corners, for a total of five NDVI measurements for each relevé.

LAI measurements were taken every meter along each of the 50-m transects at each site, using a LICOR LAI-2000 Plant Canopy Analyzer. Measurements of LAI were taken at the same locations as the NDVI measurements, however the person doing the sampling would stand with his/her back to the sun, to keep the sensor shaded. A mask of 270° was placed on the sensor, so that the sensor would only measure the incoming radiation within a 90° angle pointing away from the user (so the user is not included as part of the LAI). At each measurement point, an initial reading was taken either above or outside of the plant canopy. Then four readings were taken below the canopy, each at 20 cm from a central point (0.5 off the transect) in the cardinal directions (N,S,E,W). These five readings were used by the instrument to calculate a single LAI value (with standard error) for each point along the transects. LAI measurements were also taken for each relevé at the center point and then at the midpoint of the distance between the center and each of the four corners, for a total of five LAI measurements for each relevé. **Note:** LAI and NDVI were also measured at each grid point in the Vaskiny Dachi CALM grid, and at two additional transects at Vaskiny Dachi (a wet transect and a shrubby transect).

Active layer depth

Figure 19. Anatoly Gubarkov with active-layer probe used for measuring depth to the permafrost table. Photo no. DSC_0180, 8/27/07, D.A. Walker.

The active layer summer thaw depth was measured at 1-m intervals along each transect using a 2-m long steel probe (**Figure 19**).

Sampling within the study plots (relevés)

Site factors and species cover-abundance

Each study plot was described using the data forms shown in **Appendix C**. Site factors included estimates of cover for all plant growth forms, bare soil, water, and total dead plant cover. We also recorded vegetation canopy height; thickness of the moss, the organic soil horizon, and the soil horizon; height of microrelief; mean thaw depth; landform, surficial geology/parent material; microsite description; site moisture (scalar estimate); topographic position; estimated snow duration (scalar estimate); disturbance degree (scalar estimate); disturbance type; stability (scalar estimate); and exposure to wind (scalar estimate).

Each vascular plant, moss and lichen species within the plot was noted and a sample taken as a voucher. The cover-abundance of each species was recorded using the Bruan-Blanquet cover-abundance scale (see data form **Appendix C).** The voucher samples were sent to the Komarov Botanical Institute (KBI) for identification.

A small soil pit was dug next to the study plot, and plug of soil was removed. A sample of the soil was collected from the top of the uppermost mineral horizon using a 190 cm^3 soil can. The soils will be analyzed for physiochemical properties at the University of Alaska Palmer Soils Laboratory.

Photographs were taken of each study plot and each soil plug.

Placement of iButton temperature loggers for determining n*-factors*

The *n*-factor is an integrator of the total insulative effect of the vegetation, soil organic, and snow layers (Kade, Romanovsky et al. 2006). The *n*-factor is defined here as ratio of the seasonal degree-day sum at the ground surface to that of the air at standard screen height. To determine the n-factor, temperatures at the surface of the soil are compared to temperatures at the base of the soil organic horizons.

We used small iButton temperature loggers (Maxim Integrated Products, Inc.) to measure the temperatures. Each iButton was wrapped in duct tape and numbered with a consecutive logger number. A purple ribbon was attached to each logger so it could be located at a later date (**Figure 20**).

Figure 20. An iButton logger wrapped in duct tape with the logger number.

Each logger can record approximately 11 mo of temperature data with 4 daily readings. One iButton was placed just below the surface of the soil, and one was placed at the boundary between the bottom organic soil horizon and the mineral soil horizon **(**Error! Reference source not found. shows the serial number of the iButtons and corresponding logger number (label on the duct tape). **Table 5** gives the logger numbers for each relevé. The loggers were placed about 1 m from the SW corner of each plot.

We defined two different *n*-factors, a summer *n*-factor (n_s) and a winter *n*-factor (n_w): $n_s = TDD_m/TDD_a$ and $n_w = FDD_m/FDD_a$ where TDD_m is the annual sum of thawing degree-days (TDD or mean daily temperatures above 0 ˚C) at the top of the mineral horizon, and TDD_a is the annual sum of the thawing degree-days of the soil surface. Similarly, FDD_w is annual sum of the freezing degree-days (mean daily temperatures below 0˚C) at the top of the mineral soil, and FDD_a is the freezing degree-days at the soil surface.

Table 4. Logger numbers (on outside of duct tape) and iButton serial numbers.

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

Table 5. Locations of iButton loggers in relevés and depths.

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
Vaskiny Dachi-3, Terrace II		
VD-RV-35	47	0
	50	3
VD-RV-36	24	0
	15	2
VD-RV-37	57	0
	48	1
VD-RV-38	7	0
	20	3
VD-RV-39	23	0
	52	2

Tundra biomass

Aboveground biomass was harvested in a 20 x 50-cm plot, generally located in the center of each relevé. The method of harvest followed the procedures outlined in the tundra biomass procedures guidelines (**Appendix D**).

Forest structure methods (Nadym-1 site only)

Point-centered quarter method

The forest trees at Nadym-1 were sampled using the point–centered quarter method for determining frequency, density, and basal area for each tree species (Cottam and Curtis 1956). The sampling and calculation methods are described in several textbooks (Shimwell 1971; Mueller-Dombois and Ellenberg 1974; Barbour, Burk et al. 1996), and are summarized in **Appendix E**.

Sample points were established at 10-m intervals along the five 100-m transects (10 points per transect, 50 points total for the study site).

At each point four quadrants were defined using the transect line and a meter stick placed at right angles to the transect. In each quadrant, the nearest tree to the sample point was defined in each quadrant, and the species of the tree, diameter at breast height (dbh), the distance from the sample point to the tree, and the height of the tree were recorded. Thus 40 trees were sampled along each transect (200 total trees for the study site). Using these data, the frequency, density and basal area of each tree species were calculated.

The *frequency* was the occurrence of each tree species within a sample of 4 trees at each point along the five 100-m transects. So if a given tree species occurred at half of the points, it had a frequency of 50%. If it occurred at only one point in the total of 50 points, it had a frequency of 2%.

The *density* is the number of trees per hectare. This calculation uses the average distances recorded. The calculation is too long to describe here, but intuitively, the density of trees increases as the total distances decrease. The average distance squared is the area occupied by a single tree, and the density is the area occupied by one tree divided into one unit of area measurement (i.e. 1 hectare).

The *basal area* is the area of the tree stems at breast height per hectare. This calculation uses the density of each tree species and areas of the measured stems.

Plot-count method:

In each 10 x 10-m plot, the location of each tree was recorded using coordinates in meters. The position of each tree was estimated to nearest 0.25 m by running a 10-m tape along each border of the plot, using the SW corner of the plot as the origin. For each tree the species, diameter at breast height, and the height of the tree was recorded. The number of samplings (dbh < 5 cm) and number of seedlings of each species was also recorded.

Using these data the density and basal area of each tree species within each plot was determined.

Tree biomass

Tree biomass was determined for the forest using both the data from the point-centered quarter method and the plot-count method. Aboveground tree biomasses were calculated using following equations (Zianis et al. 2005):

Betula pubescens (equation no. 40, Zianis et al. 2005):

Biomass [kg] = $a * D^b$, where

a = 0.00029, b = 2.50038, D = diameter at breast height [mm]

Pinus sylvestris (equation no. 388, Zianis et al. 2005):

Biomass [kg] = $a + b*D + c*D^2$, where

a = 18,779; b = (-4,328); c = 0.506; D = diameter at breast height [cm]

Larix sibirica (equation no. 136, Zianis et al. 2005):

Biomass [kg] = $a * D^b * H^c$, where

a = 0.1081; b = 1.53; c = 0.9482; D = diameter at breast height [cm]; H = height [m].

Pinus sibirica (equation no. 733. Muukkonen et al. 2006):

Biomass [kg] = $a + b*D^2*H + c*D^2$, where

a = (-3.4268); b = 0.010356; c = 0.14144; D = diameter at breast height [cm]; H = height [m].

Biomass for both *Pinus sylvestris* and *P. sibirica* saplings (dbh < 5 cm) (equation no. 327 (Zianis et al. 2005). Note: Because there are few equations available for estimating biomass of young trees, the following equation was used.

Biomass [kg] = a * exp(D*b), where

a = 0.2304; b = 0.6536; D = diameter at breast height [cm].

Tree cover, density, and basal area using the plot-count method (Nadym-1 forest site only)

For each of the five 10 x 10 m relevés at the forest site at Nadym, each individual tree was mapped, with diameter at breast height measured and height visually estimated. In addition the number of seedlings for each species was counted for each relevé.

Soils

Two types of soils data were collected: (1) A sample of soil was collected from each of the 39 study plots (relevés) as described above. These soil samples are being analyzed at the University of Alaska for physical and chemical properties. (2) One or two soil pits were dug at each site, in a representative site, usually near the southwest corner of the site. These pits were described by Dr. Georgy Matyshak according the Russian approach and translated into descriptions corresponding to the US Soil Taxonomy approach of soil description.

Results

Maps and locations of study sites

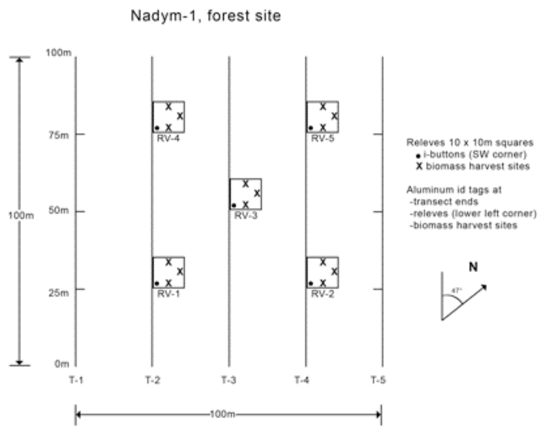

Figure 21. Map of transects and vegetation study plots at Nadym-1.

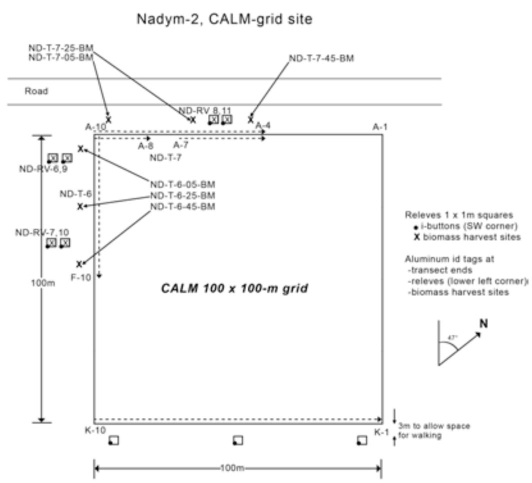

Figure 22. Map of transects and vegetation study plots at Nadym-2.

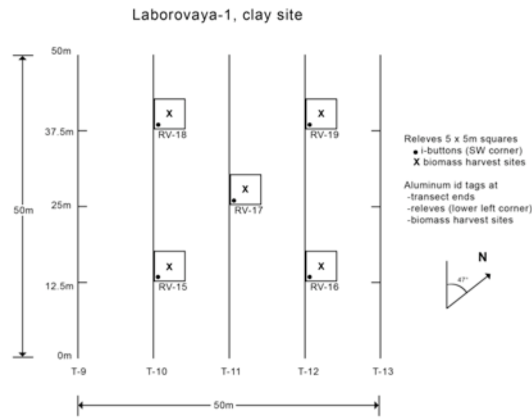

Figure 23. Map of transects and vegetation study plots at Laborovaya-1.

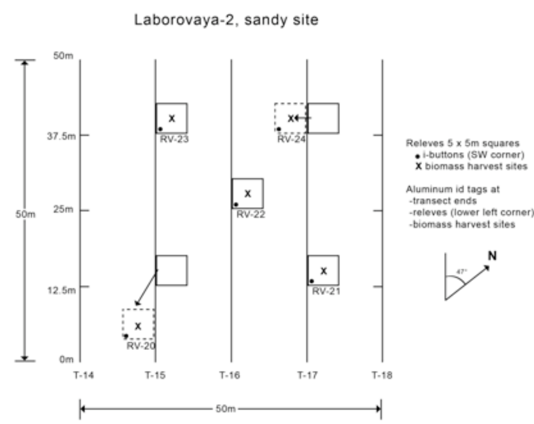

Figure 24. Map of transects and vegetation study plots at Laborovaya-2.

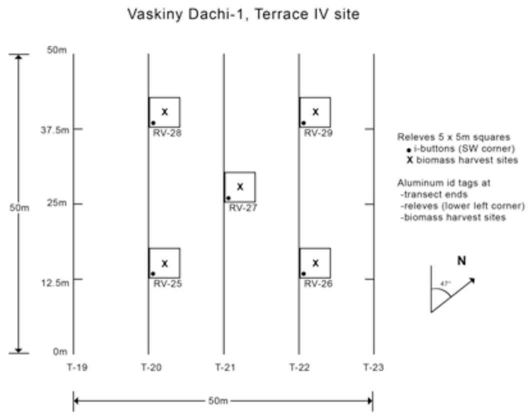

Figure 25. Map of transects and vegetation study plots at Vaskiny Dachi-1.

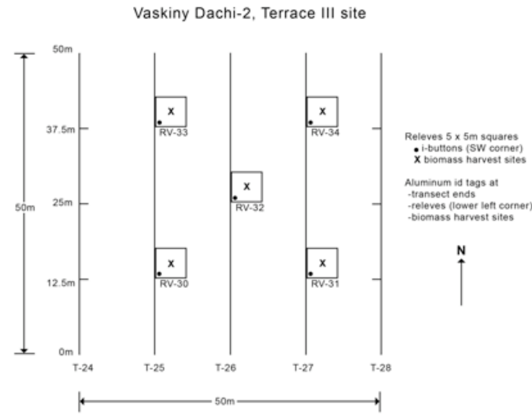

Figure 26. Map of transects and vegetation study plots at Vaskiny Dachi-2.

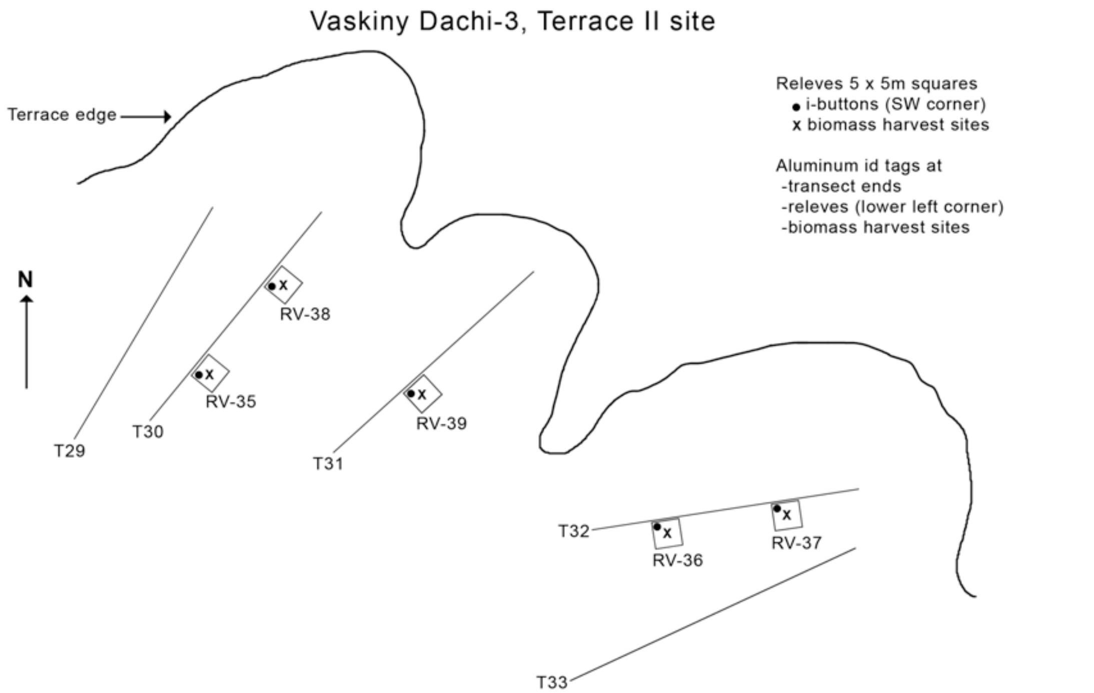

Figure 27. Map of transects and vegetation study plots at Vaskiny Dachi-3.

Table 6. GPS coordinates and elevations of vegetation study plots and transects. LA = Laborovaya, ND = Nadym, VD = Vaskiny Dachi. 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	Descriptior	North	East	Altitude	Site
LA Camp	67 42.210	068 01.089	72	NA	ND T05 10	65 18.817	072 53.35	31	1
LA RV 15	67 42.397	067 59.946	79	1	ND T06 00	65 18.828	072 51.73	17	2
LA RV 16	67 42.387	067 59.970	79	1	ND T07 00	65 18.885	072 51.71	23	2
LA RV 17	67 42.396	067 59.971	79	1	ND T08 10	65 18.833	072 51.86	18	2
LA RV 18	67 42.406	067 59.969	77	1	VD Camp	70 17.214	068 53.65	29	NA
LA RV 19	67 42.397	067 59.995	78	1	VD RV 25	70 16.540	068 53.44	38	1
LA RV 20	67 41.691	068.02.244	63	2	VD RV 26	70 16.528	068 53.46	40	1
LA RV 21	67 41.684	068 02.283	59	2	VD RV 27	70 16.538	068 53.46	40	1
LA RV 22	67 41.694	068 02.270	64	2	VD RV 28	70 16.547	068 53.47	41	1
LA RV 23	67 41.703	068 02.277	62	2	VD RV 29	70 16.536	068 53.49	41	1
LA RV 24	67 41.696	068 02.301	63	2	VD RV 30	70 17.734	068 53.02	27	2
LA T09 00m	67 42.396	067 59.920	79	1	VD RV 31	70 17.731	068 53.06	29	2
LA T09 50m	67 42.416	067 59.970	79	1	VD RV 32	70 17.739	068 53.05	29	2
LA T10 00m	67 42.391	067 59.934	79	1	VD RV 33	70 17.747	068 53.03	30	2
LA T10 50m	67 42.411	067 59.984	79	1	VD RV 34	70 17.744	068 53.07	31	2
LA T11 00m	67 42.387	067 59.946	80	1	VD RV 35	70 18.088	068 50.51	15	3
LA T11 50m	67 42.406	067 59.995	79	1	VD RV 36	70 18.031	068 50.58	14	3
LA T12 00m	67 42.383	067 59.959	80	1	VD RV 37	70 18.060	068 50.58	13	3
LA T12 50m	67 42.402	068 00.008	80	1	VD RV 38	70 18.097	068 50.55	15	3
LA T13 00m	67 42.378	067 59.971	81	1	VD RV 39	70 18.031	068.50.62	10	3
LA T13 50m	67 42.398	068 00.019	81	1	VD T19 00	70 16.542	068 53.41	45	1
LA T14 00m	67 41.692	068 02.230	60	2	VD T19 50	70 16.557	068 53.48	41	1
LA T14 50m	67 41.712	068 02.273	62	2	VD T20 00	70 16.537	068 53.42	46	1
LA T15 00m	67 41.689	068 02.243	61	2	VD T20 50	70 16.551	068 53.49	41	1
LA T15 50m	67 41.709	068 02.287	64	2	VD T21 00	70 16.529	068 53.44	42	1
LA T16 00m	67 41.684	068 02.255	61	2	VD T21 50	70 16.545	068 53.50	41	1
LA T16 50m	67 41.705	068 02.301	64	2	VD T22 00	70 16.524	068 53.45	39	1
LA T17 00m	67 41.679	068 02.269	58	2	VD T22 50	70 16.540	068 53.51	40	1
LA T17 50m	67 41.700	068 02.315	61	2	VD T23 00	70 16.519	068 53.46	39	1
LA T18 00m	67 41.675	068 02.286	60	2	VD T23 50	70 16.535	068 53.52	41	1
LA T18 50m	67 41.696	068 02.330	63	2	VD T24 00	70 17.729	068 53.00	30	2
ND Camp	65 18.873	072 52.841	24	NA	VD T24 50	70 17.756	068 53.02	29	2
ND RV 01	65 18.810	072 53.226	32	1	VD T25 00	70 17.728	068 53.02	32	2
ND RV 02	65 18.794	072 53.277	28	1	VD T25 50	70 17.754	068 53.04	28	2
ND RV 03	65 18.811	072 53.274	18	1	VD T26 00	70 17.726	068 53.04	32	2
ND RV 04	65 18.831	072 53.261	27	1	VD T26 50	70 17.752	068 53.06	30	2
ND RV 05	65 18.814	072 53.314	26	1	VD T27 00	70 17.725	068 53.06	28	2
ND RV 06	65 18.883	072 51.703	23	2	VD T27 50	70 17.751	068 53.08	28	2
ND RV 07	65 18.863	072 51.695	22	2	VD T28 00	70 17.723	068 53.08	28	2
ND RV 08	65 18.888	072 51.785	23	2	VD T28 50	70 17.750	068 53.09	32	2
ND RV 09	65 18.884	072 51.702	21	2	VD T29 00	70 18.076	068 50.47	4	3
ND RV 10	65 18.867	072 51.703	21	2	VD T29 50	70 18.100	068 50.51	4	3
ND RV 11	65 18.887	072 51.785	21	2	VD T30 00	70 18.083	068 50.50	15	3
ND RV 12	65 18.825	072 51,737	22	2	VD T30 50	70 18.099	068 50.56	9	3
ND RV 13	65 18.824	072 51.803	16	2	VD T31 00	70 18.047	068 50.56	14	3
ND RV 14	65 18.828	072 51.831	23	2	VD T31 50	70 18.072	068 50.59	13	3
ND T01 000m	65 18.810	072 53.186	27	1	VD T32 00	70 18.031	068 50.56	14	3
ND T01 100m	65 18.855	072 53.272	36	1	VD T32 50	70 18.031	068 50.64	11	3
ND T02 000m	65 18.799	072 53.208	18	1	VD T33 00	70 18.019	068 50.54	14	3
ND T02 100m	65 18.843	072 53.288	31	1	VD T33 50	70 18.024	068 50.62	12	3
ND T03 000m	65 18.793	072 53.232	28	1	VD T34 00	70 17.470	068 52.43	14	4
ND T03 100m	65 18.834	072 53.307	28	1	VD T34 50	70 17.488	068 52.37	16	4
ND T04 000m	65 18.783	072 53.258	28	1	VD T35 00	70 17.422	068 51.82	13	5
ND T04 100m	65 18.824	072 53.331	27	1	VD T35 50	70 17.402	068 51.76	17	5
ND T05 000m	65 18.775	072 53.281	31	1					

Factors measured along transects

Species cover along transects using the Buckner point sampler.

Table 7. Nadym-1 (forest site) cover along transects. 6 Aug 2007. Skip Walker, Elena Kaerkjärvi, Natalya Moskalenko*, Pinus Sylvestris-Cladina stellaris *forest. Five 100-m transects, observations at 1-m intervals. Record top species in tree layer, shrub layer, and moss layer at each point. 505 total points.

	TRANSECT 1 (A)			TRANSECT 2 (B)			TRANSECT 3 (C)			TRANSECT 4 (D)			TRANSECT 5 (E)			Total tally	% Cover	s.d.	
Layer	Tree	Dwarf-shrub	Moss	Tree	Dwarf-shrub	Moss	Tree	Dwarf-shrub	Moss	Tree	Dwarf-shrub	Moss	Tree	Dwarf-shrub	Moss				TOTAL (FOLIAGE + DEAD
Species																			
Trees																			
Larix sibirica (foliage)	1			3			1			1			4			10	1.98	0.28	2.98
Larix sibirica (stem or dead)				1			1			1			2			5	0.99	0.10	
Pinus sibirica (foliage)				1			1			7			3			12	2.38	0.56	2.58
Pinus sibirica (stem or dead)										1						1	0.20		
Pinus sylvestris (foliage)	14			13			14			12			7			60	11.90	0.58	22.22
Pinus sylvestris (stem or dead)	11			6			13			7			15			52	10.32	0.76	
Betula toruosa (foliage)	5			10			16	1		19			5			56	11.11	1.39	11.31
Betula toruosa (stem or dead)													1			1	0.20		
																0			
Shrubs																0			
Betula nana (foliage)		3			6			1			2			5		17	3.37	0.41	4.96
Betula nana (stem or dead)		2			2			2						2		8	1.59	0.00	
Empetrum nigrum (foliage)		3						1			5			3		12	2.38	0.32	3.97
Empetrum nigrum (stem or dead)					7			1								8	1.59	0.84	
Juniperis sibirica (foliage)								1						2		3	0.60	0.14	0.60
Ledum palustre (foliage)		14			11			15			10			7		57	11.31	0.64	17.06
Ledum palustre (stem or dead)		8			8			3			5			5		29	5.75	0.43	
Vaccinium myrtellis		2			1			4			4			4		15	2.98	0.28	2.98
Vacciinium uliginosum (foliage)		10			5			5			6			4		30	5.95	0.47	7.34
Vacciinium uliginosum (stem or dead)		1						3			3					7	1.39	0.23	
Vaccinium vitis-idaea (foliage)		6			2			7			11			5		31	6.15	0.65	6.35
Vaccinium vitis-idaea (stem or dead)								1								1	0.20		
																0			
Graminoids, forbs																0			
Carex globularis					2											2	0.40		0.40
																0			
Mosses and lichens																0			
Cetraria islandica						1									5	6	1.19		1.19
Cladina rangiferina						1			1							2	0.40	0.00	0.40
Cladina stellaris			56			35			23			31			42	187	37.10	2.79	37.10
Cladina stygia						5			4			3			3	15	2.98	0.20	2.98
Peltigera aphthosa									1			2			1	4	0.79	0.14	0.79
Pleurozium schreberi			12			29			35			20			23	119	23.61	2.00	23.61
Polytrichastrum commune ?			1			2			2							5	0.99	0.11	0.99
																0			
Litter			26			29			39			45			27	166	32.94	1.75	32.94
																0			
TOTAL	31	49	95	34	44	102	46	45	105	48	46	101	37	37	101	921	182.74	5.61	182.74
TOTAL POINTS	504																		
TOTAL TREE COVER (%)	39																		
TOTAL DWARF-SHRUB LAYER COVER	44																		
TOTAL MOSS LAYER COVER	100																		

Table 8. Nadym-2 (CALM-grid site) cover along transect. "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; (l) - live green plant part, (d) – dead or senescent plant part. Species use six letter abbreviations. Only two transects were sampled at Nadym-2 because of the limited area available for sampling. Sample points were identified as one of three microsites: hummocks, inter-hummocks, and wet inter-hummocks.

Percent Cover

	Transect 6		Transect 7		
	Overstory	Understory	Overstory	Understory	
Hummocks:					**Average**
Andpol	1.9		6.7		**4.3**
Betnan (l)	11.1		13.3		**12.2**
Betnan (s)	1.9		0.0		**0.9**
Carglo (d)	3.7		6.7		**5.2**
Carglo (l)	5.6		10.0		**7.8**
Empnig (l)	1.9		0.0		**0.9**
Ledpal (l)	29.6		1.7		**15.6**
Ledpal (s)	0.0		18.3		**9.2**
None	35.2		6.7		**20.9**
Vacvit (l)	9.3		20.0		**14.6**
Vacvit (d)	0.0		3.3		**1.7**
Cetcuc		0.0		11.7	**5.8**
Cetisl		0.0		1.7	**0.8**
Claama		1.9		1.7	**1.8**
Claarb		5.6		1.7	**3.6**
Claste		31.5		5.0	**18.2**
Clasty		25.9		28.3	**27.1**
Flacuc		5.6		23.3	**14.4**
Litter		29.6		26.7	**28.1**
Polstr		0.0		1.7	**0.8**
Sphang		0.0		1.7	**0.8**
Sphfus		0.0		5.0	**2.5**
Sphwar		0.0		5.0	**2.5**
Total		200		200.0	

Note: total is the total of top and bottom hits=200%

	Transect 6		Transect 7		
	Overstory	Understory	Overstory	Understory	
Interhummocks					**Average**
Andpol (l)	0.0		5.3		**2.7**
Betnan (l)	4.9		0.0		**2.4**
Betnan (d)	2.4		0.0		**1.2**
Carglo (l)	19.5		2.6		**11.1**
Carglo (d)	0.0		13.6		**6.8**
Erivag (l)	2.4		2.6		**2.5**
Ledpal (l)	2.4		2.6		**2.5**
None	58.5		68.4		**63.5**
Rubcha (l)	4.9		2.6		**3.7**
Vaculi (l)	2.4		0.0		**1.2**
Vacvit (l)	2.4		2.6		**2.5**
Cetisl		4.9		0.0	**2.4**
Claarb		2.4		2.6	**2.5**
Claste		53.7		57.9	**55.8**
Clasty		24.4		10.5	**17.4**
Flacuc		2.4		0.0	**1.2**
Litter		12.2		23.7	**17.9**
Polstr		0.0		5.3	**2.7**
Total		200.0		200.3	

		Transect 6	Transect 7	
Wet interhummocks:				
	Carglo (l)	1		25
	None	3		75
	Claste		1	25
	Sphcom		2	50
	Sphmag(?)		1	25
	Litter	4	4	
	Total	8	8	200

		Transect 6	Transect 7	
Wet interhummocks:				
	Clasty		1	50
	Litter		1	50
	none	2		100
	Total	2	2	200

Table 9. Laborovaya-1 (clayey site) 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, sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY												
Species	**T09 count**	**T09 %**	**T10 count**	**T10 %**	**T11 count**	**T11 %**	**T12 count**	**T12 %**	**T13 count**	**T13 %**	**Total count**	**Total %**
Arclat	1	**1.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.2**
BetnanL	24	**24.2**	28	**28.3**	18	**18.2**	26	**26.3**	24	**24.2**	120	**24.2**
BetnanS	1	**1.0**	2	**2.0**	1	**1.0**		**0.0**	6	**6.1**	10	**2.0**
Calstr	2	**2.0**		**0.0**		**0.0**		**0.0**		**0.0**	2	**0.4**
Calstr D									4	**4.0**	4	**0.8**
Calstr L			2	**2.0**	2	**2.0**	3	**3.0**	8	**8.1**	15	**3.0**
CarbigD	9	**9.1**	4	**4.0**	7	**7.1**	5	**5.1**	3	**3.0**	28	**5.7**
CarbigL	12	**12.1**	15	**15.2**	17	**17.2**	10	**10.1**	3	**3.0**	57	**11.5**
Empnig L					1	**1.0**		**0.0**		**0.0**	1	**0.2**
Eriang L			2	**2.0**		**0.0**		**0.0**		**0.0**	2	**0.4**
Erivag D					3	**3.0**		**0.0**	4	**4.0**	7	**1.4**
ErivagL	3	**3.0**	6	**6.1**	7	**7.1**	3	**3.0**	1	**1.0**	20	**4.0**
Fesovi L					1	**1.0**				**0.0**	1	**0.2**
Ledpal L			1	**1.0**		**0.0**				**0.0**	1	**0.2**
None	28	**28.3**	25	**25.3**	22	**22.2**	34	**34.3**	31	**31.3**	140	**28.3**
Petfri					2	**2.0**				**0.0**	2	**0.4**
Poaalp					1	**1.0**				**0.0**	1	**0.2**
Rubcha	2	**2.0**	1	**1.0**		**0.0**			1	**1.0**	4	**0.8**
Salgla S	1	**1.0**		**0.0**		**0.0**				**0.0**	1	**0.2**
Salphy	2	**2.0**		**0.0**		**0.0**				**0.0**	2	**0.4**
Salphy L					3	**3.0**	3	**3.0**	2	**2.0**	8	**1.6**
Salphy S			1	**1.0**							1	**0.2**
Vaculi L	2	**2.0**	1	**1.0**	3	**3.0**	3	**3.0**	1	**1.0**	10	**2.0**
VacvitD	1	**1.0**	1	**1.0**	2	**2.0**	1	**1.0**	5	**5.1**	10	**2.0**
VacvitL	11	**11.1**	10	**10.1**	9	**9.1**	11	**11.1**	6	**6.1**	47	**9.5**
(total)	99	**100.0**	99	**100.0**	99	**100.0**	99	**100.0**	99	**100.0**	495	**100.0**

UNDERSTORY												
Species	**T09 count**	**T09 %**	**T10 count**	**T10 %**	**T11 count**	**T11 %**	**T12 count**	**T12 %**	**T13 count**	**T13 %**	**Total count**	**Total %**
Aulpal					12	**12.1**		**0.0**		**0.0**	12	**2.4**
Aultur	3	**3.0**	5	**5.1**	4	**4.0**	10	**10.1**	3	**3.0**	25	**5.1**
Carbig D	1	**1.0**									1	**0.2**
Cetisl		**0.0**	2	**2.0**		**0.0**	1	**1.0**		**0.0**	3	**0.6**
Chaset		**0.0**	1	**1.0**	1	**1.0**		**0.0**		**0.0**	2	**0.4**
Claarb	1	**1.0**	7	**7.1**		**0.0**	2	**2.0**		**0.0**	10	**2.0**
Claama									2	**2.0**	2	**0.4**
Cladsp		**0.0**		**0.0**		**0.0**	2	**2.0**		**0.0**	2	**0.4**
Clagra		**0.0**		**0.0**		**0.0**	1	**1.0**	2	**2.0**	3	**0.6**
Clasty		**0.0**		**0.0**		**0.0**	1	**1.0**		**0.0**	1	**0.2**
Dicang	5	**5.1**	18	**18.2**	5	**5.1**	13	**13.1**	8	**8.1**	49	**9.9**
Dicelo	21	**21.2**	2	**2.0**	3	**3.0**	5	**5.1**	12	**12.1**	43	**8.7**
Dicfus		**0.0**	1	**1.0**		**0.0**		**0.0**	3	**3.0**	4	**0.8**
Dicrsp		**0.0**	1	**1.0**		**0.0**		**0.0**		**0.0**	1	**0.2**
Dicsco		**0.0**	6	**6.1**		**0.0**		**0.0**		**0.0**	6	**1.2**
Flacuc	1	**1.0**		**0.0**		**0.0**	2	**2.0**		**0.0**	3	**0.6**
Hepaticae	1	**1.0**		**0.0**		**0.0**	4	**4.0**	1	**1.0**	6	**1.2**
Hylspl	1	**1.0**	8	**8.1**	7	**7.1**	4	**4.0**	2	**2.0**	22	**4.4**
Litter	47	**47.5**	30	**30.3**	37	**37.4**	20	**20.2**	39	**39.4**	173	**34.9**
Pelaph					1	**1.0**		**0.0**		**0.0**	1	**0.2**
Pelmal		**0.0**		**0.0**		**0.0**	1	**1.0**		**0.0**	1	**0.2**
Plesch		**0.0**		**0.0**		**0.0**	6	**6.1**		**0.0**	6	**1.2**
Polstr	5	**5.1**	4	**4.0**	12	**12.1**	6	**6.1**	6	**6.1**	33	**6.7**
Pticil	1	**1.0**	7	**7.1**	11	**11.1**	15	**15.2**	12	**12.1**	46	**9.3**
Sphang	9	**9.1**	4	**4.0**	1	**1.0**	3	**3.0**		**0.0**	17	**3.4**
Sphfus							1	**1.0**	1	**1.0**	2	**0.4**
Sphgir	2	**2.0**		**0.0**	2	**2.0**		**0.0**	2	**2.0**	6	**1.2**
Sphwar	1	**1.0**	2	**2.0**	2	**2.0**	2	**2.0**	5	**5.1**	12	**2.4**
Tomnit			1	**1.0**	1	**1.0**		**0.0**	1	**1.0**	3	**0.6**
(total)	99	**100.0**	99	**100.0**	99	**100.0**	99	**100.0**	99	**100.0**	495	**100.0**

Table 10. Laborovaya-2 (sandy site) 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, sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY

Species	T14 count	T14 %	T15 count	T15%	T16 count	T16 %	T17 count	T17 %	T18 count	T18 %	Total count	Total %
AndpolL			3	**3**		**0**		**0**		**0.0**	3	**0.7**
AndpolD			1	**1**		**0**		**0**		**0.0**	1	**0.2**
BetnanD	**1**	**1.5**		**0**	1	**1**		**0**		**0.0**	2	**0.4**
BetnanL	10	**15.2**	9	**9**	10	**10**	11	**11**	6	**6.9**	46	**10.2**
BetnanS	2	**3.0**	2	**2**		**0**		**0**	3	**3.4**	7	**1.5**
Calhol					1	**1**	1	**1**		**0.0**	2	**0.4**
CarbigD	2	**3.0**	4	**4**	6	**6**	4	**4**	5	**5.7**	21	**4.6**
CarbigL		**0.0**	4	**4**	5	**5**	1	**1**	3	**3.4**	13	**2.9**
CarrotD		**0.0**	1	**1**		**0**		**0**		**0.0**	1	**0.2**
EmpnigD	1	**1.5**		**0**		**0**		**0**		**0.0**	1	**0.2**
EmpnigL	1	**1.5**	2	**2**	3	**3**	1	**1**	1	**1.1**	8	**1.8**
EmpnigS	1	**1.5**	1	**1**		**0**		**0**		**0.0**	2	**0.4**
EriangD	2	**3.0**	1	**1**		**0**	1	**1**	1	**1.1**	5	**1.1**
EriangL					1	**1**		**0**	1	**1.1**	2	**0.4**
ErivagL					2	**2**		**0**		**0.0**	2	**0.4**
LedpalL		**0.0**	3	**3**	4	**4**	8	**8**	4	**4.6**	19	**4.2**
LedpalS		**0.0**	1	**1**		**0**		**0**		**0.0**	1	**0.2**
None	39	**59.1**	53	**53**	58	**58**	66	**66**	47	**54.0**	263	**58.1**
Salphy							2	**2**		**0.0**	2	**0.4**
VaculiL	1	**1.5**	9	**9**		**0**	2	**2**	10	**11.5**	22	**4.9**
VaculiD	1	**1.5**		**0**		**0**		**0**		**0.0**	1	**0.2**
VaculiS		**0.0**	1	**1**		**0**		**0**	2	**2.3**	3	**0.7**
VacvitD	1	**1.5**		**0**		**0**	1	**1**		**0.0**	2	**0.4**
VacvitL	4	**6.1**	5	**5**	9	**9**	2	**2**	3	**3.4**	23	**5.1**
VacvitS									1	**1.1**	1	**0.2**
Wet (exclude from total)	35			**0**		**0**		**0**	12		47	
(total)	101	**100.0**	100	**100**	100	**100**	100	**100**	99	**100.0**	500	**100.0**

UNDERSTORY

Species	T14 count	T14 %	T15 count	T15%	T16 count	T16 %	T17 count	T17 %	T18 count	T18 %	Total count	Total %
Asachr			1	**1**		**0**		**0**	1	**1.1**	2	**0.4**
Aultur	1	**1.5**	3	**3**		**0**	2	**2**	2	**2.3**	8	**1.8**
BlackCrust	2	**3.1**	12	**12**	3	**3**	7	**7**		**0.0**	24	**5.3**
BlkCrstLiver					1	**1**		**0**		**0.0**	1	**0.2**
Brydiv							3	**3**	3	**3.4**	6	**1.3**
Cetdel					1	**1**		**0**		**0.0**	1	**0.2**
Cetisl			1	**1**	2	**2**	1	**1**	1	**1.1**	5	**1.1**
Claarb	7	**10.8**	13	**13**	9	**9**	14	**14**	8	**9.2**	51	**11.3**
Clabrnholes					2	**2**		**0**	1	**1.1**	3	**0.7**
Cladsp					2	**2**	2	**2**	1	**1.1**	5	**1.1**
Clagra					2	**2**	1	**1**	1	**1.1**	4	**0.9**
Claran	4	**6.2**	3	**3**		**0**	4	**4**		**0.0**	11	**2.4**
Clasty			1	**1**	10	**10**	2	**2**	6	**6.9**	19	**4.2**
Claunc	2	**3.1**	10	**10**	5	**5**	7	**7**	6	**6.9**	30	**6.6**
Dialap			1	**1**		**0**	1	**1**		**0.0**	2	**0.4**
Dicelo	5	**7.7**	2	**2**	7	**7**	4	**4**	3	**3.4**	21	**4.6**
Dicfus	1	**1.5**		**0**		**0**		**0**		**0.0**	1	**0.2**
Drepsp									1	**1.1**	1	**0.2**
Flacuc	1	**1.5**		**0**		**0**	2	**2**	2	**2.3**	5	**1.1**
Flaniv			1	**1**	1	**1**		**0**	3	**3.4**	5	**1.1**
Hepaticae	1	**1.5**		**0**	1	**1**	1	**1**	2	**2.3**	5	**1.1**
Litter	12	**18.5**	22	**22**	9	**9**	16	**16**	9	**10.3**	68	**15.0**
Ochfri					1	**1**	1	**1**	3	**3.4**	5	**1.1**
Oikstr?					1	**1**		**0**		**0.0**	1	**0.2**
Pelmal					1	**1**		**0**		**0.0**	1	**0.2**
Pertsp					1	**1**		**0**		**0.0**	1	**0.2**
Plesch									1	**1.1**	1	**0.2**
Polcom			1	**1**		**0**	2	**2**		**0.0**	3	**0.7**
Polhyp	2	**3.1**		**0**	6	**6**		**0**	3	**3.4**	11	**2.4**
Polstr	11	**16.9**	12	**12**	14	**14**	3	**3**	10	**11.5**	50	**11.1**
Ptarmigan poop	1	**1.5**		**0**		**0**		**0**		**0.0**	1	**0.2**
Pticil	4	**6.2**	4	**4**	9	**9**	9	**9**	10	**11.5**	36	**8.0**
Raclan			2	**2**	3	**3**	2	**2**	2	**2.3**	9	**2.0**
ReindeerPoop							1	**1**		**0.0**	1	**0.2**
Sphglo	11	**16.9**	9	**9**	7	**7**	13	**13**	7	**8.0**	47	**10.4**
Stersp			1	**1**	2	**2**	1	**1**	1	**1.1**	5	**1.1**
Vacvit							1	**1**			1	**0.2**
white crust			1	**1**							1	**0.2**
wet	35								12		47	
(total)	100	**100.0**	100	**100**	100	**100**	100	**100**	99	**100.0**	499	**100.0**

Table 11. Vaskiny Dachi-1 (Terrace-IV) 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, sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY

Species	T19 count	T19 %	T20 count	T20 %	T21 count	T21 %	T22 count	T22 %	T23 count	T23 %	Total count	Total %
Betnan L	5	**5.0**	5	**5.0**	4	**4.0**	4	**4.0**	3	**3.0**	21	**4.2**
Betnan S	1	**1.0**		**0.0**	1	**1.0**	1	**1.0**		**0.0**	3	**0.6**
Bisviv			1	**1.0**	1	**1.0**	2	**2.0**			4	**0.8**
Carbig D	8	**8.0**	12	**12.0**	6	**6.0**	12	**12.0**	4	**4.0**	42	**8.4**
Carbig L	15	**15.0**	22	**22.0**	21	**21.0**	12	**12.0**	19	**19.0**	89	**17.8**
Dryoct L			1	**1.0**	3	**3.0**	2	**2.0**			6	**1.2**
Empnig L					1	**1.0**	1	**1.0**			2	**0.4**
Eriang D									1	**1.0**	1	**0.2**
Eriang L							1	**1.0**	5	**5.0**	6	**1.2**
Fesrub L							1	**1.0**			1	**0.2**
Festsp							1	**1.0**	1	**1.0**	2	**0.4**
None	55	**55.0**	42	**42.0**	47	**47.0**	38	**38.0**	45	**45.0**	227	**45.4**
Poaalp									5	**5.0**	5	**1.0**
Salgla L	2	**2.0**	6	**6.0**	3	**3.0**	7	**7.0**	2	**2.0**	20	**4.0**
Salgla S									1	**1.0**	1	**0.2**
Sallan L			2	**2.0**	5	**5.0**			1	**1.0**	8	**1.6**
Salpol L	8	**8.0**	6	**6.0**	1	**1.0**	10	**10.0**	8	**8.0**	33	**6.6**
Vacvit L	6	**6.0**	3	**3.0**	7	**7.0**	8	**8.0**	5	**5.0**	29	**5.8**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	500	**100.0**

UNDERSTORY

Species	T19 count	T19 %	T20 count	T20 %	T21 count	T21 %	T22 count	T22 %	T23 count	T23 %	Total count	Total %
Aultur	14	**14.0**	19	**19.0**	18	**18.0**	14	**14.0**	6	**6.0**	71	**14.2**
Aultur Trail									1	**1.0**	1	**0.2**
Bisviv					1	**1.0**					1	**0.2**
Carbig D			1	**1.0**					1	**1.0**	2	**0.4**
Carbig D Trail									2	**2.0**	2	**0.4**
Carbig L	2	**2.0**		**0.0**		**0.0**		**0.0**		**0.0**	2	**0.4**
Cetisl	**1.0**	1	**2.0**	2	**2.0**	2		0		0	5	**1.0**
Claama							2	**2.0**			2	**0.4**
Cladsp							1	**1.0**			1	**0.2**
Clagra					1	**1.0**	1	**1.0**			2	**0.4**
Dicelo					2	**2.0**	5	**5.0**	2	**2.0**	9	**1.8**
Dicelo = Dic small					1	**1.0**					1	**0.2**
Dryoct L	2	**2.0**	4	**4.0**		**0.0**	2	**2.0**	1	**1.0**	9	**1.8**
Flacuc									1	**1.0**	1	**0.2**
Hepatic							1	**1.0**			1	**0.2**
Hylspl	37	**37.0**	43	**43.0**	22	**22.0**	22	**22.0**	13	**13.0**	137	**27.4**
Hylspl Trail							3	**3.0**	2	**2.0**	5	**1.0**
Litter	23	**23.0**	16	**16.0**	38	**38.0**	12	**12.0**	27	**27.0**	116	**23.2**
Litter Trail							1	**1.0**	21	**21.0**	22	**4.4**
Ochfri							1	**1.0**	1	**1.0**	2	**0.4**
Pelaph	1	**1.0**	1	**1.0**		**0.0**		**0.0**		**0.0**	2	**0.4**
Pelmal							2	**2.0**	1	**1.0**	3	**0.6**
Pelmal = Pelgreen					1	**1.0**					1	**0.2**
Polstr	12	**12.0**	8	**8.0**	5	**5.0**	23	**23.0**	6	**6.0**	54	**10.8**
Polstr Trail							2	**2.0**	3	**3.0**	5	**1.0**
Pticil			2	**2.0**			3	**3.0**	2	**2.0**	7	**1.4**
Reinpoop							1	**1.0**			1	**0.2**
Salpol L	1	**1.0**		**0.0**		**0.0**		**0.0**		**0.0**	1	**0.2**
Salpol L Trail									2	**2.0**	2	**0.4**
Sphglo	2	**2.0**		**0.0**		**0.0**		**0.0**		**0.0**	2	**0.4**
Thaver			1	**1.0**			1	**1.0**	1	**1.0**	3	**0.6**
Tomnit			3	**3.0**	6	**6.0**	3	**3.0**	5	**5.0**	17	**3.4**
Vacvit L	5	**5.0**		**0.0**	3	**3.0**		**0.0**	2	**2.0**	10	**2.0**
(total)	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	100	**100.0**	500	**100.0**

Table 12. Vaskiny Dachi-2 (Terrace-III) 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. L - live green plant part; D – dead or senescent plant part. Species use six letter abbreviations.

OVERSTORY (Zonal)												
Species	**T24 count**	**T24 %**	**T25 count**	**T25 %**	**T26 count**	**T26 %**	**T27 count**	**T27 %**	**T28 count**	**T28 %**	**Total count**	**Total %**
Arclat L							1	**1.1**	2	**3.9**	3	**0.9**
Betnan D	1	**1.9**						**0.0**		**0.0**	1	**0.3**
Betnan L	7	**13.5**	2	**2.5**	12	**16.0**	11	**12.5**	7	**13.7**	39	**11.2**
Betnan S	2	**3.8**			1	**1.3**		**0.0**		**0.0**	3	**0.9**
Bisviv											0	**0.0**
Calhol D	3	**5.8**	2	**2.5**	7	**9.3**	4	**4.5**	3	**5.9**	19	**5.5**
Calhol L					7	**9.3**	2	**2.3**	2	**3.9**	11	**3.2**
Carbig D	7	**13.5**	12	**14.8**	2	**2.7**	10	**11.4**	4	**7.8**	35	**10.1**
Carbig L	7	**13.5**	14	**17.3**	3	**4.0**	7	**8.0**	3	**5.9**	34	**9.8**
Eriang D			1	**1.2**				**0.0**		**0.0**	1	**0.3**
Eriang L			1	**1.2**			2	**2.3**			3	**0.9**
Erivag D											0	**0.0**
None	19	**36.5**	31	**38.3**	32	**42.7**	29	**33.0**	24	**47.1**	135	**38.9**
Pedlap							1	**1.1**			1	**0.3**
Rubcha								**0.0**		**0.0**	0	**0.0**
Salgla L			1	**1.2**			4	**4.5**	1	**2.0**	6	**1.7**
Sallan D								**0.0**		**0.0**	0	**0.0**
Sallan L								**0.0**		**0.0**	0	**0.0**
Salnum L	1	**1.9**			1	**1.3**		**0.0**	1	**2.0**	3	**0.9**
Salpol L	1	**1.9**	2	**2.5**	1	**1.3**	4	**4.5**		**0.0**	8	**2.3**
Vacvit L	4	**7.7**	15	**18.5**	9	**12.0**	13	**14.8**	4	**7.8**	45	**13.0**
(total)	52	**100.0**	81	**100.0**	75	**100.0**	88	**100.0**	51	**100.0**	347	**100.0**

UNDERSTORY (Zonal)												
Species	**T24 count**	**T24 %**	**T25 count**	**T25 %**	**T26 count**	**T26 %**	**T27 count**	**T27 %**	**T28 count**	**T28 %**	**Total count**	**Total %**
Aultur	3	**5.8**	6	**7.4**	5	**7.1**	11	**12.5**	2	**3.9**	27	**7.8**
Betnan S					1	**1.4**					1	**0.3**
Black crust	3	**5.8**	2	**2.5**	2	**2.9**					7	**2.0**
Carbig D					1	**1.4**					1	**0.3**
Cetisl	1	**1.9**					2	**2.3**			3	**0.9**
Claama									2	**3.9**	2	**0.6**
Claarb	2	**3.8**	2	**2.5**	3	**4.3**	4	**4.5**			11	**3.2**
Clasty			3	**3.7**	3	**4.3**					6	**1.7**
Claunc	1	**1.9**	1	**1.2**	1	**1.4**			2	**3.9**	5	**1.4**
Dacarc							2	**2.3**			2	**0.6**
Dicang			3	**3.7**							3	**0.9**
Dicang is Dic big			1	**1.2**							1	**0.3**
Dicelo	7	**13.5**	3	**3.7**	5	**7.1**	2	**2.3**	3	**5.9**	20	**5.8**
Eriang L									1	**2.0**	1	**0.3**
Flacuc	1	**1.9**									1	**0.3**
Gymcor							1	**1.1**			1	**0.3**
Hepatic			5	**6.2**			2	**2.3**	2	**3.9**	9	**2.6**
Hylspl	12	**23.1**	17	**21.0**	8	**11.4**	13	**14.8**	8	**15.7**	58	**16.7**
Litter	4	**7.7**	5	**6.2**	13	**18.6**	7	**8.0**	10	**19.6**	39	**11.2**
Ochfri			1	**1.2**	2	**2.9**	2	**2.3**			5	**1.4**
Pelaph			1	**1.2**					1	**2.0**	2	**0.6**
Pelmal					3	**4.3**	2	**2.3**	2	**3.9**	7	**2.0**
Pertsp							1	**1.1**			1	**0.3**
Polstr	7	**13.5**	19	**23.5**	9	**12.9**	18	**20.5**	11	**21.6**	64	**18.4**
Poop			1	**1.2**							1	**0.3**
Pticil	3	**5.8**	4	**4.9**	11	**15.7**	17	**19.3**	3	**5.9**	38	**11.0**
Raclan			6	**7.4**			3	**3.4**			9	**2.6**
Salnum L	2	**3.8**									2	**0.6**
Salpol L					1	**1.4**					1	**0.3**
Sphglo	2	**3.8**	1	**1.2**	4	**5.7**	1	**1.1**			8	**2.3**
Thaver									1	**2.0**	1	**0.3**
Tomnit	1	**1.9**									1	**0.3**
Vacvit L	3	**5.8**			3	**4.0**			3	**5.9**	9	**2.6**
(total)	52	**100.0**	81	**100.0**	75	**106.9**	88	**100.0**	51	**100.0**	347	**100.0**

Table 12 (cont') Vaskiny Dachi-2 (Terrace-III) 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, sometimes followed by L (live green plant part) or D (dead or senescent plant part).

OVERSTORY (Moist)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Betnan L	5	**11.4**	5	**13.5**					7	**30.4**	17	**14.7**
Betnan S	1	**2.3**	1	**2.7**					2	**8.7**	4	**3.4**
Calhol L	1	**2.3**	1	**2.7**					1	**4.3**	3	**2.6**
Carbig D	1	**2.3**	1	**2.7**							2	**1.7**
Carbig L	2	**4.5**	2	**5.4**			2	**16.7**	1	**4.3**	7	**6.0**
Eriang D	4	**9.1**	4	**10.8**			2	**16.7**			10	**8.6**
Eriang L	2	**4.5**	2	**5.4**							4	**3.4**
None	17	**38.6**	11	**29.7**			5	**41.7**	9	**39.1**	42	**36.2**
Rubcha	2	**4.5**	2	**5.4**							4	**3.4**
Salgla L							1	**8.3**			1	**0.9**
Sallan D	1	**2.3**	1	**2.7**							2	**1.7**
Sallan L	1	**2.3**									1	**0.9**
Vacvit L	7	**15.9**	7	**18.9**			2	**16.7**	3	**13.0**	19	**16.4**
(total)	44	**100.0**	37	**100.0**			12	**100.0**	23	**100.0**	116	**100.0**

UNDERSTORY (Moist)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Aulpal	1	**2.3**	1	**2.7**							2	**1.7**
Aultur	1	**2.3**	1	**2.7**			2	**16.7**			4	**3.4**
Black crust	3	**6.8**	2	**5.4**							5	**4.3**
Clagra									2	**8.7**	2	**1.7**
Dicang	4	**9.1**	4	**10.8**			1	**8.3**			9	**7.8**
Dicelo	1	**2.3**	1	**2.7**							2	**1.7**
Dicfus									1	**4.3**	1	**0.9**
Hylspl	15	**34.1**	9	**24.3**			3	**25.0**	4	**17.4**	31	**26.7**
Litter	8	**18.2**	8	**21.6**					6	**26.1**	22	**19.0**
Pelmal	1	**2.3**	1	**2.7**							2	**1.7**
Polstr	4	**9.1**	4	**10.8**			5	**41.7**			13	**11.2**
Pticil	3	**6.8**	3	**8.1**			1	**8.3**	7	**30.4**	14	**12.1**
Salnum L									1	**4.3**	1	**0.9**
Sphglo	1	**2.3**	1	**2.7**							2	**1.7**
Thaver									2	**8.7**	2	**1.7**
Vacvit L	2	**4.5**	2	**5.4**							4	**3.4**
(total)	44	**100.0**	37	**100.0**			12	**100.0**	23	**100.0**	116	**100.0**

OVERSTORY (Dry)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Betnan L									3	**11.1**	3	**11.1**
Calhol D									1	**3.7**	1	**3.7**
Carbig D									1	**3.7**	1	**3.7**
Carbig L									1	**3.7**	1	**3.7**
None									16	**59.3**	16	**59.3**
Salgla L									2	**7.4**	2	**7.4**
Salnum L									1	**3.7**	1	**3.7**
Vacvit L									2	**7.4**	2	**7.4**
(total	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**	27	**100.0**	27	**100.0**

UNDERSTORY (Dry)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Aultur									2	**7.4**	2	**7.4**
Black crust									1	**3.7**	1	**3.7**
Claarb									2	**7.4**	2	**7.4**
Dicelo									1	**3.7**	1	**3.7**
Hylspl									1	**3.7**	1	**3.7**
Litter									10	**37.0**	10	**37.0**
Ochfri									3	**11.1**	3	**11.1**
Polstr									1	**3.7**	1	**3.7**
Pticil									2	**7.4**	2	**7.4**
Raclan									1	**3.7**	1	**3.7**
Sphglo									3	**11.1**	3	**11.1**
(total)	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**	27	**100.0**	27	**100.0**

OVERSTORY (Wet)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Betnan L									1	**4.0**	1	**4.0**
Calhol D									1	**4.0**	1	**4.0**
Calhol L									2	**8.0**	2	**8.0**
Carbig D									1	**4.0**	1	**4.0**
Eriang D									4	**16.0**	4	**16.0**
Eriang L									2	**8.0**	2	**8.0**
None									9	**36.0**	9	**36.0**
Salgla L									2	**8.0**	2	**8.0**
Salnum L									1	**4.0**	1	**4.0**
Vacvit L									2	**8.0**	2	**8.0**
(total)	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**	25	**100.0**	25	**100.0**

UNDERSTORY (Wet)

Species	T24 count	T24 %	T25 count	T25 %	T26 count	T26 %	T27 count	T27 %	T28 count	T28 %	Total count	Total %
Aultur									1	**4.0**	1	**4.0**
Dicelo									1	**4.0**	1	**4.0**
Eriang D									1	**4.0**	1	**4.0**
Eriang L									1	**4.0**	1	**4.0**
Hepatic									2	**8.0**	2	**8.0**
Hylspl									5	**20.0**	5	**20.0**
Litter									9	**36.0**	9	**36.0**
Pelmal									2	**8.0**	2	**8.0**
Polstr									3	**12.0**	3	**12.0**
(total)	0	**0.0**	0	**0.0**	0	**0.0**	0	**0.0**	25	**100.0**	25	**100.0**

Table 13. Vaskiny Dachi-3 (Terrace-II) cover along transects.

OVERSTORY

Species	T29 count	T29 %	T30 count	T30 %	T31 count	T31 %	T32 count	T32 %	T33 count	T33 %	Total count	Total %
Arclat		0.0		0.0		0.0		0.0		0.0	0	0.0
BetnanL		0.0		0.0	8	8.2	1	1.0		0.0	9	1.8
BetnanS		0.0		0.0		0.0	3	3.1		0.0	3	0.6
Calhol L	3	3.1		0.0	1	1.0		0.0		0.0	4	0.8
Calstr		0.0		0.0		0.0		0.0		0.0	0	0.0
Calstr D		0.0		0.0		0.0		0.0		0.0	0	0.0
Calstr L		0.0		0.0		0.0		0.0		0.0	0	0.0
CarbigD	9	9.2	11	11.2	1	1.0	1	1.0	1	1.0	23	4.7
CarbigL	9	9.2	4	4.1		0.0	1	1.0	3	3.1	17	3.5
Empnig					1	1.0			1	1.0	2	0.4
Empnig L		0.0		0.0		0.0		0.0		0.0	0	0.0
Eriang L		0.0		0.0		0.0		0.0		0.0	0	0.0
Erivag D		0.0		0.0		0.0		0.0		0.0	0	0.0
ErivagL		0.0		0.0		0.0		0.0		0.0	0	0.0
Festuca			1	1.0							1	0.2
Fesovi L		0.0		0.0		0.0		0.0		0.0	0	0.0
Hiealp							1	1.0			1	0.2
Ledpal L		0.0		0.0	7	7.1	12	12.2	2	2.0	21	4.3
Ledpal S					2	2.0	4	4.1	6	6.1	12	2.4
Luzmul					1	1.0					1	0.2
Luzmul D					1	1.0					1	0.2
None	67	68.4	63	64.3	61	62.2	67	68.4	77	78.6	335	68.4
Petfri		0.0		0.0		0.0		0.0		0.0	0	0.0
Poaalp		0.0		0.0		0.0		0.0		0.0	0	0.0
Rubcha		0.0		0.0		0.0		0.0		0.0	0	0.0
Salgla S		0.0		0.0		0.0		0.0		0.0	0	0.0
Salnum L					4	4.1	1	1.0	2	2.0	7	1.4
Salphy		0.0		0.0		0.0		0.0		0.0	0	0.0
Salphy L		0.0		0.0		0.0		0.0		0.0	0	0.0
Vaculi L		0.0		0.0		0.0		0.0		0.0	0	0.0
VacvitD		0.0		0.0		0.0		0.0		0.0	0	0.0
VacvitL	10	10.2	19	19.4	10	10.2	7	7.1	6	6.1	52	10.6
Vacvit S					1	1.0					1	0.2
(total)	98	100.0	98	100.0	98	100.0	98	100.0	98	100.0	490	100.0

UNDERSTORY

Species	T29 count	T29 %	T30 count	T30 %	T31 count	T31 %	T32 count	T32 %	T33 count	T33 %	Total count	Total %
Aleoch							2	2.0		0.0	2	0.4
Aultur					1	1.0					1	0.2
Black crust	1	1.0	3	3.1	7	7.1	6	6.1	9	9.2	26	5.3
Brydiv	1	1.0		0.0	1	1.0	4	4.1	1	1.0	7	1.4
Carbig L	1	1.0		0.0		0.0		0.0		0.0	1	0.2
Cetdel							2	2.0	1	1.0	3	0.6
Cetisl	3	3.1	2	2.0	2	2.0	4	4.1		0.0	11	2.2
Claarb	6	6.1	8	8.2	2	2.0	2	2.0	3	3.1	21	4.3
Clabel							1	1.0			1	0.2
Cladsp	1	1.0		0.0	2	2.0		0.0	1	1.0	4	0.8
Cladw/brwnholes							1	1.0			1	0.2
Clagreenw/brwn					2	2.0					2	0.4
Clasty	5	5.1	5	5.1		0.0		0.0	4	4.1	14	2.9
Claunc	2	2.0	5	5.1		0.0	3	3.1		0.0	10	2.0
Dacarc	1	1.0	2	2.0	1	1.0		0.0		0.0	4	0.8
Dicelo	1	1.0	4	4.1	1	1.0		0.0	1	1.0	7	1.4
Flacuc			1	1.0	3	3.1		0.0		0.0	4	0.8
Flaniv	2	2.0		0.0		0.0	4	4.1	7	7.1	13	2.7
Gymcor					2	2.0			7	7.1	9	1.8
Hylspl					2	2.0			1	1.0	3	0.6
Ledpal D									2	2.0	2	0.4
Ledpal L									1	1.0	1	0.2
Ledpal S					1	1.0					1	0.2
Litter	21	21.4	5	5.1	26	26.5	6	6.1	27	27.6	85	17.3
Ochfri	1	1.0	2	2.0	2	2.0	3	3.1	2	2.0	10	2.0
Polstr	16	16.3	19	19.4	6	6.1	5	5.1	3	3.1	49	10.0
Pticil	7	7.1	4	4.1	1	1.0	3	3.1		0.0	15	3.1
Raclan	18	18.4	24	24.5	7	7.1	29	29.6	9	9.2	87	17.8
Salnum L					3	3.1					3	0.6
Sand					2	2.0					2	0.4
Sphglo	7	7.1	14	14.3	21	21.4	20	20.4	17	17.3	79	16.1
Stespp							1	1.0			1	0.2
Thaver					2	2.0	2				4	0.8
Vacvit L	4	4.1		0.0	1	1.0		0.0	2	2.0	7	1.4
(total)	98	100.0	98	100.0	98	100.0	98	98.0	98	100.0	490	100.0

Leaf-area index (LAI)

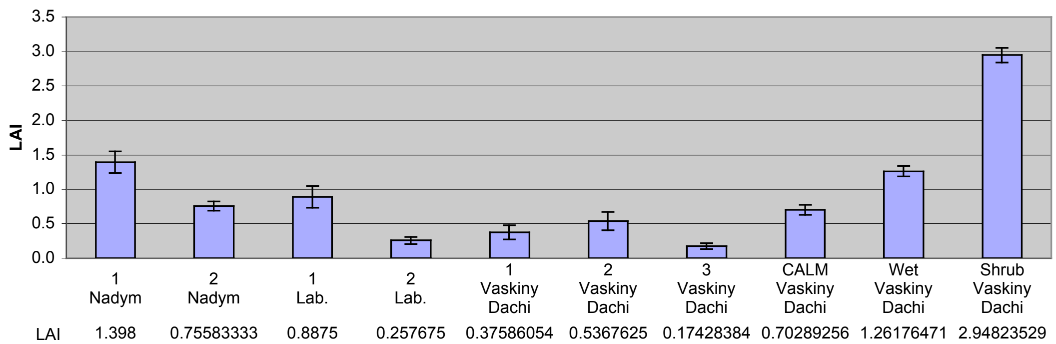

Figure 28. Mean leaf-area index of transects.

Normalized Difference Vegetation Index (NDVI)

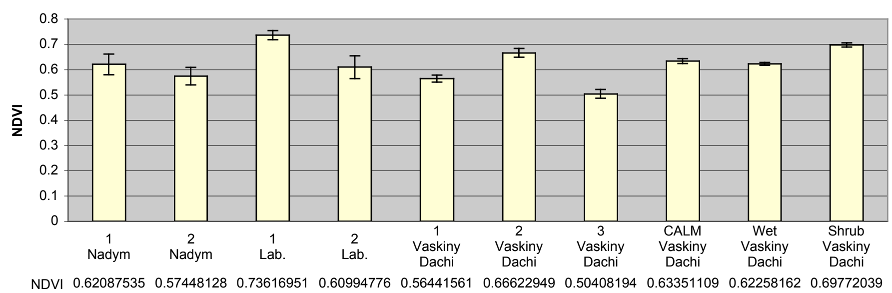

Figure 29. Mean NDVI of sample transects.

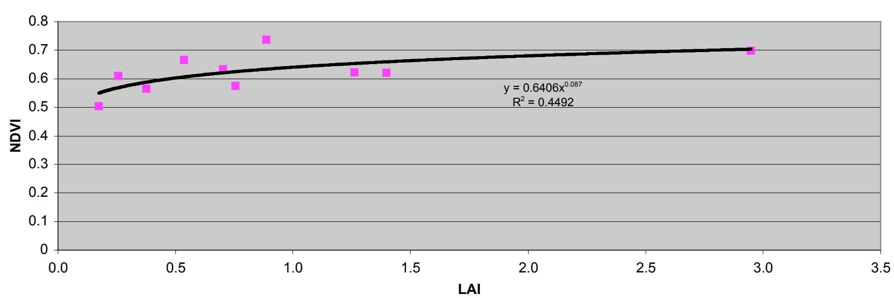

Figure 30. NDVI vs. LAI for all transects.

Point-centered quarter data for Nadym-1 (tree species density, frequency, basal area, biomass)

Table 14. Point-centered quarter data for Nadym-1 with species arranged alphabetically within each transect. 10 points (40 trees) were sampled along each transect (200 trees total). Abbreviations: Betpub= **Betula pubescens,** ***Larsib*=Larix sibirica,** ***Pinsib*=Pinus cembra** ***ssp.*** **sibirica** ***Pinsyl*=Pinus sylvestris.** ***(See Appendix B for explanation of method and data sheets).***

Species	Dbh /cm	Basal area /cm2	Height /m	Above-ground biomass /kg/tree	Above-ground biomass /g/tree	Species	Dbh /cm	Basal area /cm2	Height /m	Above-ground biomass /kg/tree	Above-ground biomass /g/tree	Species	Dbh /cm	Basal area /cm2	Height /m	Above-ground biomass /kg/tree	Above-ground biomass /g/tree	Species	Dbh /cm	Basal area /cm2	Height /m	Above-ground biomass /kg/tree	Above-ground biomass /g/tree	Species	Dbh /cm	Basal area /cm2	Height /m	Above-ground biomass /kg/tree	Above-ground biomass /g/tree
Transect 1						*Transect 2*						*Transect 3*						*Transect 4*						*Transect 5*					
Betpub	7	38.48	6	11.9	11908.1	Betpub	8	50.27	5	16.6	16628.2	Betpub	5	19.63	3	5.1	5134.2	Betpub	7	38.48	3	11.9	11908.1	Betpub	6	28.27	6	8.1	8099.4
Betpub	7	38.48	8	11.9	11908.1	Betpub	10	78.54	8	29.1	29050.8	Betpub	4	12.57	4	2.9	2938.7	Betpub	8	50.27	7	16.6	16628.2	Betpub	7	38.48	6	11.9	11908.1
Betpub	8	50.27	9	16.6	16628.2	Betpub	8	50.27	5	16.6	16628.2	Betpub	5	19.63	6	5.1	5134.2	Betpub	8	50.27	7	16.6	16628.2	Betpub	6	28.27	6	8.1	8099.4
Betpub	2	3.14	3	0.5	519.4	Betpub	9	63.62	9	22.3	22322.7	Betpub	4	12.57	5	2.9	2938.7	Betpub	6	28.27	5	8.1	8099.4	Betpub	9	63.62	6	22.3	22322.7
Betpub	3	7.07	5	1.4	1431.4	Betpub	9	63.62	7	22.3	22322.7	Betpub	7	38.48	6	11.9	11908.1	Betpub	5	19.63	5	5.1	5134.2	Betpub	9	63.62	7	22.3	22322.7
Larsib	2	3.14	3	0.9	884.7	Betpub	7	38.48	5	11.9	11908.1	Betpub	6	28.27	6	8.1	8099.4	Betpub	10	78.54	9	29.1	29050.8	Betpub	7	38.48	7	11.9	11908.1
Pinsyl	4	12.57	7	9.6	9563.0	Betpub	8	50.27	4	16.6	16628.2	Betpub	17	226.98	1	109.5	109488.3	Betpub	3	7.07	5	1.4	1431.4	Betpub	7	38.48	6	11.9	11908.1
Pinsyl	5	19.63	5	6.1	6050.0	Larsib	9	63.62	8	22.4	22393.7	Betpub	5	19.63	3	5.1	5134.2	Betpub	7	38.48	9	11.9	11908.1	Larsib	2	3.14	3	0.9	884.7
Pinsyl	6	28.27	7	11.0	11027.0	Larsib	3	7.07	13	6.6	6607.9	Larsib	9	63.62	8	22.4	22393.7	Betpub	3	7.07	3	1.4	1431.4	Pinsib	4	12.57	5	3.1	3147.0
Pinsyl	2	3.14	3	0.9	851.5	Larsib	3	7.07	3	1.6	1645.2	Larsib	6	28.27	5	7.7	7711.9	Pinsyl	15	176.71	10	67.7	67709.0	Pinsib	5	19.63	5	6.1	6050.0
Pinsyl	2	3.14	2	0.9	851.5	Larsib	6	28.27	6	9.2	9167.3	Larsib	6	28.27	6	9.2	9167.3	Pinsyl	6	28.27	6	11.0	11027.0	Pinsib	11	95.03	5	19.9	19892.3
Pinsyl	3	7.07	4	1.6	1637.0	Pinsib	10	78.54	9	19.9	19947.6	Pinsib	5	19.63	7	1.9	1904.0	Pinsyl	6	28.27	7	11.0	11027.0	Pinsyl	6	28.27	6	11.0	11027.0
Pinsyl	5	19.63	5	6.1	6050.0	Pinsib	13	132.73	10	37.8	37809.2	Pinsib	3	7.07	3	1.6	1637.0	Pinsyl	15	176.71	9	67.7	67709.0	Pinsyl	5	19.63	3	6.1	6050.0
Pinsyl	4	12.57	5	3.1	3147.0	Pinsib	8	50.27	8	10.9	10876.4	Pinsib	3	7.07	4	1.6	1637.0	Pinsyl	11	95.03	7	32.4	32397.0	Pinsyl	5	19.63	6	9.8	9789.0
Pinsyl	2	3.14	3	0.9	851.5	Pinsib	2	3.14	2	0.9	851.5	Pinsyl	14	153.94	4	57.4	57363.0	Pinsyl	9	63.62	8	20.8	20813.0	Pinsyl	13	132.73	8	48.0	48029.0
Pinsyl	3	7.07	4	1.6	1637.0	Pinsib	3	7.07	4	1.6	1637.0	Pinsyl	5	19.63	6	9.8	9789.0	Pinsyl	10	78.54	7	26.1	26099.0	Pinsyl	3	7.07	3	1.6	1637.0
Pinsyl	2	3.14	3	0.9	851.5	Pinsib	4	12.57	4	3.1	3147.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	2	3.14	2	0.9	851.5	Pinsyl	4	12.57	4	3.1	3147.0
Pinsyl	10	78.54	11	26.1	26099.0	Pinsyl	14	153.94	9	57.4	57363.0	Pinsyl	9	63.62	7	20.8	20813.0	Pinsyl	2	3.14	2	0.9	851.5	Pinsyl	2	3.14	2	0.9	851.5
Pinsyl	6	28.27	9	11.0	11027.0	Pinsyl	8	50.27	8	16.5	16539.0	Pinsyl	13	132.73	9	48.0	48029.0	Pinsyl	13	132.73	11	48.0	48029.0	Pinsyl	11	95.03	8	32.4	32397.0
Pinsyl	10	78.54	10	26.1	26099.0	Pinsyl	14	153.94	8	57.4	57363.0	Pinsyl	14	153.94	9	57.4	57363.0	Pinsyl	10	78.54	10	26.1	26099.0	Pinsyl	7	38.48	6	13.3	13277.0
Pinsyl	13	132.73	10	48.0	48029.0	Pinsyl	2	3.14	4	0.9	851.5	Pinsyl	2	3.14	3	0.9	851.5	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	10	78.54	8	26.1	26099.0
Pinsyl	11	95.03	7	32.4	32397.0	Pinsyl	7	38.48	6	13.3	13277.0	Pinsyl	6	28.27	3	11.0	11027.0	Pinsyl	8	50.27	7	16.5	16539.0	Pinsyl	13	132.73	9	48.0	48029.0
Pinsyl	6	28.27	5	11.0	11027.0	Pinsyl	11	95.03	8	32.4	32397.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	15	176.71	15	67.7	67709.0	Pinsyl	4	12.57	5	3.1	3147.0
Pinsyl	5	19.63	7	9.8	9789.0	Pinsyl	14	153.94	9	57.4	57363.0	Pinsyl	2	3.14	3	0.9	851.5	Pinsyl	17	226.98	14	91.4	91437.0	Pinsyl	4	12.57	4	3.1	3147.0
Pinsyl	6	28.27	10	11.0	11027.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	6	28.27	5	11.0	11027.0	Pinsyl	4	12.57	5	3.1	3147.0	Pinsyl	6	28.27	6	11.0	11027.0
Pinsyl	13	132.73	4	48.0	48029.0	Pinsyl	7	38.48	6	13.3	13277.0	Pinsyl	10	78.54	8	26.1	26099.0	Pinsyl	3	7.07	5	1.6	1637.0	Pinsyl	2	3.14	3	0.9	851.5
Pinsyl	3	7.07	4	1.6	1637.0	Pinsyl	12	113.10	7	39.7	39707.0	Pinsyl	15	176.71	9	67.7	67709.0	Pinsyl	3	7.07	3	1.6	1637.0	Pinsyl	20	314.16	10	134.6	134619.0
Pinsyl	3	7.07	4	1.6	1637.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	5	19.63	4	6.1	6050.0	Pinsyl	2	3.14	4	0.9	851.5	Pinsyl	6	28.27	5	11.0	11027.0
Pinsyl	3	7.07	4	1.6	1637.0	Pinsyl	11	95.03	8	32.4	32397.0	Pinsyl	16	201.06	9	79.1	79067.0	Pinsyl	5	19.63	8	9.8	9789.0	Pinsyl	11	95.03	7	32.4	32397.0
Pinsyl	7	38.48	8	13.3	13277.0	Pinsyl	12	113.10	10	39.7	39707.0	Pinsyl	4	12.57	4	3.1	3147.0	Pinsyl	14	153.94	8	57.4	57363.0	Pinsyl	7	38.48	6	13.3	13277.0
Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	17	226.98	8	91.4	91437.0	Pinsyl	7	38.48	6	13.3	13277.0	Pinsyl	13	132.73	13	48.0	48029.0	Pinsyl	2	3.14	2	0.9	851.5
Pinsyl	6	28.27	8	11.0	11027.0	Pinsyl	11	95.03	10	32.4	32397.0	Pinsyl	3	7.07	4	1.6	1637.0	Pinsyl	10	78.54	11	26.1	26099.0	Pinsyl	3	7.07	3	1.6	1637.0
Pinsyl	6	28.27	8	11.0	11027.0	Pinsyl	20	314.16	14	134.6	134619.0	Pinsyl	6	28.27	6	11.0	11027.0	Pinsyl	3	7.07	4	1.6	1637.0	Pinsyl	10	78.54	7	26.1	26099.0
Pinsyl	6	28.27	5	11.0	11027.0	Pinsyl	4	12.57	5	3.1	3147.0	Pinsyl	13	132.73	9	48.0	48029.0	Pinsyl	3	7.07	5	1.6	1637.0	Pinsyl	15	176.71	8	67.7	67709.0
Pinsyl	5	19.63	7	9.8	9789.0	Pinsyl	15	176.71	13	67.7	67709.0	Pinsyl	4	12.57	4	3.1	3147.0	Pinsyl	12	113.10	8	39.7	39707.0	Pinsyl	9	63.62	6	20.8	20813.0
Pinsyl	9	63.62	9	20.8	20813.0	Pinsyl	5	19.63	6	9.8	9789.0	Pinsyl	14	153.94	10	57.4	57363.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	2	3.14	3	0.9	851.5
Pinsyl	11	95.03	10	32.4	32397.0	Pinsyl	5	19.63	7	9.8	9789.0	Pinsyl	7	38.48	5	13.3	13277.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	12	113.10	8	39.7	39707.0
Pinsyl	13	132.73	11	48.0	48029.0	Pinsyl	4	12.57	6	9.6	9563.0	Pinsyl	4	12.57	3	3.1	3147.0	Pinsyl	14	153.94	10	57.4	57363.0	Pinsyl	17	226.98	10	91.4	91437.0
Pinsyl	9	63.62	10	20.8	20813.0	Pinsyl	15	176.71	13	67.7	67709.0	Pinsyl	12	113.10	9	39.7	39707.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	9	63.62	7	20.8	20813.0
Pinsyl	4	12.57	5	3.1	3147.0	Pinsyl	5	19.63	5	6.1	6050.0	Pinsyl	12	113.10	9	39.7	39707.0	Pinsyl	2	3.14	4	0.9	851.5	Pinsyl	3	7.07	4	1.6	1637.0

Table 15. Summary of point-centered quarter data: Density, basal area, height, and biomass for each tree species and all tree species for each transect and average for all transects.

Density (trees/ha)

Transect	1	2	3	4	5	Average	s.d.	s.e.
Species								
Betula pubescens ssp. tortuosa	202.83	183.88	340.80	565.32	534.17	365.40	179.19	80.14
Larix sibirica	40.57	105.07	127.80	0.00	76.31	69.95	50.93	22.78
Pinus cembra ssp. sibirica	0.00	157.61	127.80	0.00	228.93	102.87	100.84	45.10
Pinus sylvestris	1379.24	604.17	1107.61	1947.23	2213.00	1450.25	645.58	288.71
Total	1622.64	1050.73	1704.01	2512.55	3052.41	1988.47	790.69	353.61

Basal area (m^2/ha)

Transect	1	2	3	4	5	Average	s.d.	s.e.
Species								
Betula pubescens ssp. tortuosa	0.56	1.04	0.37	0.66	2.28	0.98	0.77	0.34
Larix sibirica	0.01	0.28	0.17	0.00	0.02	0.10	0.12	0.06
Pinus cembra ssp. sibirica	0.00	0.86	0.24	0.00	0.97	0.41	0.47	0.21
Pinus sylvestris	5.24	0.21	1.65	2.44	14.07	4.72	5.54	2.48
Total	5.81	2.38	2.44	3.10	17.34	6.22	6.38	2.85

Height (m)

Transect	1	2	3	4	5	Average	s.d.	s.e.
Species								
Betula pubescens ssp. tortuosa	6.20	6.71	7.50	5.44	7.71	6.71	0.93	0.42
Larix sibirica	12.57	4.50	8.67		5.00	7.68	3.75	1.87
Pinus cembra ssp. sibirica		4.83	8.33		6.33	6.50	1.76	1.01
Pinus sylvestris	5.76	5.78	7.50	6.90	5.76	6.34	0.81	0.36
Average	5.80	5.68	7.65	6.58	6.13	6.37	0.80	0.00

Biomass (g/m^2)

Transect	1	2	3	4	5	Average	s.d.	s.e.
Species								
Betula pubescens ssp. tortuosa	171.98	355.90	642.31	642.08	736.92	509.84	236.88	105.94
Larix sibirica	3.59	104.58	167.30	0.00	6.75	56.45	75.92	33.95
Pinus cembra ssp. sibirica	0.00	195.09	22.06	0.00	221.98	87.83	110.97	49.63
Pinus sylvestris	1859.33	2113.41	2733.25	5430.03	5199.63	3467.13	1718.33	768.46
Total	2034.90	2768.99	3564.92	6072.11	6165.28	4121.24	1902.29	850.73

Thaw depth

Table 16. Active layer at Laborovaya and Vaskiny Dachi 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	115,18	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					

Factors measured in study plots

Relevé data

Table 17. 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.

General relevé descriptions

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	all photos in folder:
02	Nadym	Forest	Pinsyl, Betpub, Betnan, Ledpal, Vacmyr, Claste, Plesch	6-Aug-07	PK	10x10	65 18.794	72 53.277	25	0	0	/data/ru_yamal/photos/
03	Nadym	Forest	Pinsyl, Ledpal, Vacmyr, Claste	6-Aug-07	PK	10x10	65 18.811	72 53.274	25	0	0	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	all photos in folder:
07	Nadym	CALM-grid, hummock	Ledpal, Rubcha, Sphfus	8-Aug-07	PK,NM	1x1	65 18.863	72 51.695	23	0	0	data/ru_yamal/photos/
08	Nadym	CALM-grid, hummock	Betnan, Ledpal, Carglo, Clasty	8-Aug-07	PK,NM	1x1	65 18.888	72 51.785	23	0	0	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	all photos in folder:
16	Laborovaya	Clay-site	Betnan, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.387	67 59.970	80	2	SW	data/ru_yamal/photos/
17	Laborovaya	Clay-site	Betnan, Vacvit, Carbig, Dicelo	15-Aug-07	EK,NM,PK	5x5	67 42.396	67 59.971	80	2	SW	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	all photos in folder:
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	data/ru_yamal/photos/
22	Laborovaya	Sand-site	Vaculi, Sphglo, Dicelo	17-Aug-07	NM,PK	5x5	67 41.694	68 02.270	60	1	S	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	all photos in folder:
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	data/ru_yamal/photos/
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	SubzoneD_VD_VaskinyDachi/VD_Site1_
28	Vaskiny Dachi	Terrace IV	Salnum, Carbig, Aultur, Hylspl	23-Aug-07	PK,NM	5x5	70 16.547	68 53.475	40	2	S	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	all photos in folder:
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	data/ru_yamal/photos/
32	Vaskiny Dachi	Terrace III	Betnan, Vacvit, Calhol, Diclae	26-Aug-07	PK,NM	5x5	70 17.739	68 53.052	30	2	SW	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	all photos in folder:
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	data/ru_yamal/photos/
37	Vaskiny Dachi	Terrace II	Ledpal, Salnum, BlackCrust	28-Aug-07	PK,NM	5x5	70 18.060	68 50.580	15	1	NW	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

Table 18. Relevé site characteristics. See data forms (Appendix C).

Relevé site characteristics. See also Relevé site characteristics form												
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**
	height / cm											
01	800	50	10	0	0	4	0	40	NA	fluvial terraces	stabilized alluvium	featureless
02	1000	50	10	0	0	4	0	50	NA	fluvial terraces	stabilized alluvium	featureless
03	900	60	12	0	0	2	0	20	NA	fluvial terraces	stabilized alluvium	featureless
04	1100	50	10	0	0	3	0	20	NA	fluvial terraces	stabilized alluvium	featureless
05	1100	45	10	0	0.5	4	0	30	NA	fluvial terraces	stabilized alluvium	featureless
06	0	15	0	0	1	>40	?	30	40	fluvial terraces	stabilized alluvium	turf hummocks
07	0	15	0	1	27	>40	?	20	36	fluvial terraces	stabilized alluvium	turf hummocks
08	0	15	0	0	1	2	1	30	?	fluvial terraces	stabilized alluvium	turf hummocks
09	0	10	10	0	0	25	1	5	50	fluvial terraces	stabilized alluvium	flat centered polyons
10	0	10	15	0	20	>20	?	10	60	fluvial terraces	stabilized alluvium	flat centered polyons
11	0	10	15	0	0	2	0.5	10	?	fluvial terraces	stabilized alluvium	flat centered polyons
12	0	0	25	0	0	?	?	0	?	fluvial terraces	NA	wetland
13	0	0	25	0	0	?	?	0	?	fluvial terraces	NA	wetland
14	0	0	25	0	0	?	?	0	?	fluvial terraces	NA	wetland
15	0	30	10	5	3	5	6	30	89	fluvial terraces	?	with <20 % frost scars
16	0	20	35	2	2	10	3	15	70	fluvial terraces	?	with <20 % frost scars
17	0	15	25	2	2	6	0.5	30	91	fluvial terraces	?	with <20 % frost scars
18	0	30	35	2	2	4	0.5	20	74	fluvial terraces	?	with <20 % frost scars
19	0	25	30	2	2	3	2	20	82	fluvial terraces	?	with <20 % frost scars
20	0	5	15	2	0	1	3	10	118	fluvial terraces	stabilized alluvium	small hummock
21	0	5	5	1	0	3	2	10	114	fluvial terraces	stabilized alluvium	flat centered polyons, small hummock
22	0	8	5	1	0	4	1	5	128	fluvial terraces	stabilized alluvium	flat centered polyons, small hummock
23	0	10	10	1	0	4	2	10	109	fluvial terraces	stabilized alluvium	flat centered polyons, small hummock
24	0	20	3	2	1	5	3	10	106	fluvial terraces	stabilized alluvium	flat centered polyons, small hummock
25	0	10	10	1	1	3	1	5	70	hills, marine terrace	marine sands	with <20 % frost scars
26	0	10	15	1	1	4	1	5	66	hills, marine terrace	marine sands	with <20 % frost scars
27	0	8	10	1	4	3.5	1	5	76	hills, marine terrace	marine sands	with <20 % frost scars
28	0	10	10	1	2	4	1	5	66	hills, marine terrace	marine sands	with <20 % frost scars
29	0	2	10	1	3	2	1	5	79	hills, marine terrace	marine sands	with <20 % frost scars
30	0	5	7	1	3.5	2.5	2	5	71	marine terrace	marine glay	with <20 % frost scars
31	0	5	7	1	4	4.5	1	5	71	marine terrace	marine glay	with <20 % frost scars
32	0	5	7	1	2	2	0	5	76	marine terrace	marine glay	with <20 % frost scars
33	0	5	7	1	3	4	9	5	61	marine terrace	marine glay	with <20 % frost scars
34	0	5	7	1	3	3.5	0	5	61	marine terrace	marine glay	with <20 % frost scars
35	0	1	4	0.5	2	3	2	5	0	marine terrace	marine sands	with <20 % frost scars
36	0	3	4	1	1	1	1	5	0	marine terrace	marine sands	with <20 % frost scars
37	0	2	2	1	1	2	2	5	0	marine terrace	marine sands	with <20 % frost scars
38	0	2	2	1	0	0.5	5	5	0	marine terrace	marine sands	with <20 % frost scars
39	0	3	4	1	1	0	1	5	0	marine terrace	marine sands	with <20 % frost scars

Table 18 (cont') Relevé site characteristics.

Relevé site characteristics. See also Relevé site characteristics form (cont.).

Releve #	Micro-site	Site moisture	Soil moisture	Topographic position	Snow bank persistance after melt out	Disturbance degree	Disturbance type	Stability	Exposure
01	0	subxeric	damp	flat	1-2 weeks	no sign present	none	stable	protected from winds
02	0	subxeric	damp	flat	1-2 weeks	no sign present	none	stable	protected from winds
03	0	subxeric	damp	flat	1-2 weeks	no sign present	none	stable	protected from winds
04	0	subxeric	damp	flat	1-2 weeks	no sign present	none	stable	protected from winds
05	0	subxeric	damp	flat	1-2 weeks	no sign present	none	stable	protected from winds
06	hummock	mesic	moist	flat	snow free prior to melt out	no sign present	none	subject to solifluction	exposed to winds
07	hummock	mesic	moist	flat	snow free prior to melt out	no sign present	none	subject to solifluction	exposed to winds
08	hummock	mesic	moist	flat	snow free prior to melt out	no sign present	none	subject to solifluction	exposed to winds
09	interhummock	mesic	moist	flat	1-2 weeks	no sign present	none	subject to solifluction	exposed to winds
10	interhummock	mesic	moist	flat	1-2 weeks	no sign present	none	subject to solifluction	exposed to winds
11	interhummock	mesic	moist	flat	1-2 weeks	no sign present	none	subject to solifluction	exposed to winds
12	0	hydric	very saturated	flat	1-2 weeks	no sign present	none	stable	exposed to winds
13	0	hydric	very saturated	flat	1-2 weeks	no sign present	none	stable	exposed to winds
14	0	hydric	very saturated	flat	1-2 weeks	no sign present	none	stable	exposed to winds
15	0	subxeric to mesic	moist to wet	flat	0 weeks	minor	reindeer tracks & scat	stable	exposed to winds
16	0	subxeric to mesic	moist to wet	flat	0 weeks	minor	reindeer tracks & scat	stable	exposed to winds
17	0	subxeric to mesic	moist to wet	flat	0 weeks	minor	reindeer tracks & scat	stable	exposed to winds
18	0	subxeric to mesic	moist to wet	flat	0 weeks	minor	reindeer tracks & scat	stable	exposed to winds
19	0	subxeric to mesic	moist to wet	flat	0 weeks	minor	reindeer tracks & scat	stable	exposed to winds
20	NA	subxeric to mesic	moist	flat	0 weeks	minor	reindeer scat	stable	exposed to winds
21	NA	subxeric to mesic	moist	flat	0 weeks	minor	reindeer scat	stable	exposed to winds
22	NA	subxeric to mesic	moist	flat	0 weeks	minor	reindeer scat	stable	exposed to winds
23	NA	subxeric to mesic	moist	flat	0 weeks	minor	reindeer scat	stable	exposed to winds
24	NA	subxeric to mesic	moist	flat	0 weeks	minor	reindeer scat	stable	exposed to winds
25	0	mesic	moist to wet	hill crest	snow free prior to melt out	moderate	ptarmigan scat & reindeer tracks	stable	exposed to winds
26	0	mesic	moist to wet	hill crest	snow free prior to melt out	moderate	ptarmigan scat & reindeer tracks	stable	exposed to winds
27	0	mesic	moist to wet	hill crest	snow free prior to melt out	moderate	ptarmigan scat & reindeer tracks	stable	exposed to winds
28	0	mesic	moist to wet	hill crest	snow free prior to melt out	moderate	ptarmigan scat & reindeer tracks	stable	exposed to winds
29	0	mesic	moist to wet	hill crest	snow free prior to melt out	moderate	ptarmigan scat & reindeer tracks	stable	exposed to winds
30	0	subxeric to mesic	moist to wet	hill crest	0 weeks	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
31	0	subxeric to mesic	moist to wet	hill crest	0 weeks	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
32	0	subxeric to mesic	moist to wet	hill crest	0 weeks	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
33	0	subxeric to mesic	moist to wet	hill crest	0 weeks	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
34	0	subxeric to mesic	moist to wet	hill crest	0 weeks	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
35	0	xeric	dry	flat	snow free prior to melt out	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
36	0	xeric	dry	flat	snow free prior to melt out	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
37	0	xeric	dry	flat	snow free prior to melt out	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
38	0	xeric	dry	flat	snow free prior to melt out	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds
39	0	xeric	dry	flat	snow free prior to melt out	minor	ptarmigan scat, reindeer tracks&scat	stable	exposed to winds

Table 19. Species percentage cover in vegetation study plots (relevés).

Relevé species percentual cover.

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	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39
Alopecurus alpinus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	1	0.1	2	0.1	.	0.1	.	.	.	.	.	.	.
Andromeda polifolia	.	.	.	.	.	1	0.5	.	0.01	0.01	4	0.01	0.1	0.1	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arctagrostis latifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.01	.	.	.	.	.	.	.	.	0.01	0.01	0.01	0.1	0.1	0.1	3	2	0.1	2	0.5	.	.	.	.
Arctous alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Betula nana	10	10	7	10	1	.	5	20	.	.	0.1	.	.	.	25	45	40	50	25	10	15	7	10	25	5	5	10	10	.	20	30	30	2	15	.	.	1	.	1
Betula pubescens	8	10	2	1	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bistorta vivipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	0.1	0.1	.	.	.	.	.	.	.	.	.
Calamagrostis neglecta agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	0.1	2	2	2	0.1	0.1	.	0.1	0.1	0.1	.	0.1	0.1	0.1	20	40	20	20	20	0.1	0.1	0.1	0.1	.
Carex bigelowii subsp. *arctisibirica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	25	20	20	20	7	5	7	35	20	60	50	40	50	20	10	5	5	10	10	15	10	0.1	15	2
Carex chordorhiza	.	.	.	.	.	.	.	.	.	.	.	30	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex globularis	.	.	.	.	.	0.2	0.1	10	0.1	8	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex limosa	.	.	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex rotundata	.	.	.	.	.	.	.	.	.	.	.	30	30	30	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.5	.	.	.
Chamaedaphne calyculata	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diapensia lapponica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diphasiastrum aplinum	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Drosera rotundifolia	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dryas octopetala subsp. *subincisa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	10	5	5	5	.	.	.	.	.	.	.	.	.	.
Empetrum nigrum	5	5	3	5	5	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Empetrum subholarcticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	1	5	1	0.1	5	3	1	10	.	.	.	0.5	.	.	.	1	.	.	.	.	0.5	0.1	0.1
Eriophorum angustifolium	.	.	.	.	.	.	.	.	.	.	.	3	0.1	.	2	.	.	.	.	0.1	0.1	.	.	0.1	.	.	.	0.01	.	0.1	0.1	.	1	1	.	.	.	.	.
Eriophorum russeolum	.	.	.	.	.	.	.	.	.	.	.	1	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Eriophorum vaginatum	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	25	0.1	2	0.1	2	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	.	.	.	.	2	1	.	.	0.1	0.1	0.1
Festuca cf. *ovina*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	0.01	0.01	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca sp.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.01	0.01	0.1	0.1	.	.	.	.	.	.	.	.	.	.
Hierochloe alpina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	0.01	0.01	0.01	.	0.01	.	.	.	.	.	.	.	2	.	2
Huperzia selago	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.
Juniperus communis	.	2	4	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Larix sibirica	1	5	5	3	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ledum palustre	15	15	10	20	15	65	40	60	0.1	0.01	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ledum palustre subsp. *decumbens*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	2	0.1	2	3	1	2	.	.	.	.	.	.	.	.	.	.	.	15	15	3	10
Luzula cf. *confusa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula cf. *wahlenbergii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Luzula sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.5	0.1	0.1
cf. *Minuartia arctica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oxycoccus microcarpus	.	.	.	.	.	.	5	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	0.1	.	.	.	.	0.1	0.1	0.1	.	.	.	.	.	.
Pedicularis labradorica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pedicularis cf. *lapponica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	0.01	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites frigidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.5	0.5	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus sibirica	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pinus sylvestris	25	10	10	10	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Poa arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	0.01	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.
Rubus chamaemorus	.	.	.	.	.	10	15	3	2	1	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix glauca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	0.1	.	5	5	5	7	1	3	2	1	2	2	.	.	.	.	.
Salix hastata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	5	1	1	1	.	.	.	.	.	.	.	.	.	.	.
Salix lanata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.
Salix myrtilloides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix nummularia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	10	15	.	.	.	.	.	.	.	.	.	.	.
Salix polaris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	30	15	10	5	20	8	5	3	1	1	.	0.1	5	.	7
Salix phylicifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	5	2	1	15	2	0.5	0.1	4	1	.	0.1	.	.	.	0.1	.	.	.	.	.	.	.	.	.
cf. *Senecio*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.
Stellaria sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.
Vaccinium myrtillus	20	15	15	4	15	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaccinium uliginosum	6	10	8	5	8	.	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaccinium uliginosum subsp. *microphyllum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	2	7	3	5	15	20	10	10	10	5	.	1	0.1	.	.	.	.	.	.	.	.	.	.	.
Vaccinium vitis-ideae	5	5	5	5	5	5	2	2	1	0.1	5	.	.	.	10	7	15	5	10	0.1	0.5	.	0.5	.	2	1	5	5	7	30	15	15	20	10	35	15	2	20	2
Valeriana capitata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	0.1	0.1	.	.	0.1	.	.	.	.	.	.	.	.	.	.
Alectoria nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.	0.1	.	0.1	.	0.1	0.1	.	0.1	.	0.1	0.1	0.1	0.1	0.1	.
Alectoria ochroleuca	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	.	.	.	.	.	.	0.1	.	.	.	0.1	0.1	0.1	0.5	0.1	0.1
Arctocetraria andrejewii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.
Asahinea chrysantha	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	0.1	1	0.5	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Baeomyces rufus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.
Bryocaulon divergens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.01	.	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.5	0.1	0.1	0.1
Bryoria nitidula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	0.1	.	0.1	.	.	.	.	0.1	.	.	.	.	.	0.1	.	.	.	0.1

Table 19 (cont'). Species percentage cover in vegetation study plots _(relevés)._

Relevé species percentual cover.

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	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39
Cetraria delisei	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.
Cetraria islandica	2	1	1	1	1	.	.	0.1	2	.	.	.	.	.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1
Cetraria laevigata	.	.	.	.	.	1	0.01	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	.	0.1	.	.	.	.	.	.	.	0.1	.	.	.	.
Cetraria nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1
Cetrariella fastigiata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.
Cladonia amaurocraea	.	.	.	.	.	0.1	5	0.01	0.1	0.01	0.01	.	.	.	0.01	0.01	0.1	0.1	0.1	3	0.1	0.1	.	0.1	0.1	0.1	.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	.
Cladonia arbuscula subsp. *arbuscula*	.	4	.	4	5	.	.	5	.	.	.	.	.	.	0.1	0.01	.	0.01	0.1	20	10	7	20	15	.	.	.	.	.	0.5	0.5	0.1	0.1	0.1	5	.	1	2	1
Cladonia arbuscula subsp. *mitis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.
Cladonia bellidiflora	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	0.1	.	.	.	0.1	0.1	.	.	0.1	.	.	0.1	0.1	.	0.1	0.1
Cladonia cenotea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia cf. *cenotea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.
Cladonia cf. *decortiata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	0.1	.	.	.	.	.
Cladonia cf. *grayi*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	0.1	.	.	.	.	0.1	0.1	.	0.1	0.1
Cladonia cf. *scabriuscula*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.
Cladonia chlorophaea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	0.1	.	.	.	0.1	0.1	.	0.1	.	.	0.1	.	.
Cladonia chlorophaea s. l.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.
Cladonia coccifera	.	.	.	.	.	.	0.1	.	0.1	0.01	.	.	.	.	0.01	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	.	0.1	0.1
Cladonia cornuta subsp. *cornuta*	.	.	.	0.01	.	.	.	0.01	.	.	.	.	.	.	.	0.01	.	.	.	0.01	0.1	0.1	.	.	.	.	.	0.1	.	.	.	.	0.1	0.1	.	.	.	.	.
Cladonia cornuta subsp. *groenlandica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.1	.	.	.	.	.	.
Cladonia crispata	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia cyanipes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia deformis	.	.	.	.	.	1	.	.	.	.	0.1	.	.	.	0.01	0.01	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	.	.	0.1	.	.	.	.	.
Cladonia furcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.01	.	.	.	.	0.1	0.1	0.1	0.1	0.1	.	0.1	.	.	.	.	.	.	.	.	.
Cladonia gracilis	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	0.01	1	0.1	0.1	.	0.1	0.1	0.1	0.1	.	0.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	.
Cladonia grayi	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cladonia macrophylla	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.
Cladonia pleurota	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.1	.	.	.	.	.	.
Cladonia pyxidata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.1	.	.	.	0.1	.	0.1	0.1	0.1	.	.	.	.	.	0.01	.	.
Cladonia rangiferina	5	.	7	1	.	.	.	.	0.1	.	.	.	.	.	.	1	0.1	0.1	.	5	0.5	2	2	1	.	.	.	0.1	0.1	0.1	.	.	.	.	.	.	1	.	.
Cladonia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.
Cladonia sqamosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.1	0.1	0.01	.	.	.	.	.	.	0.1	.	0.1	0.1	.	.	.	.	.	.
Cladonia stellaris	50	45	80	85	50	30	0.1	.	90	40	75	.	.	.	.	.	.	0.5	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.
Cladonia stricta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	0.01	.	.	.	.	0.1	0.1	0.1	.	.	.
Cladonia stygia	.	1	1	.	4	25	10	15	10	50	20	.	.	.	0.1	0.1	0.1	0.01	0.01	10	1	1	1	1	.	.	.	.	0.1	0.5	0.5	0.1	0.1	0.1	5	2	.	1	1
Cladonia subfurcata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.1	0.1	0.1	0.1	0.1	.	.	.	.	.	0.1	0.1	.	.	0.1	0.1	0.1	.	0.1	0.1
Cladonia sulphurina	.	.	.	.	.	.	.	.	0.01	.	0.1	.	.	.	0.01	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.
Cladonia uncialis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.01	0.01	0.01	2	10	10	5	10	.	.	0.1	0.1	0.1	0.1	0.1	0.1	1	0.1	10	5	.	1	1
Dactylina arctica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.01	0.01	.	0.01	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Flavocetraria cucullata	.	.	.	.	.	1	0.1	2	.	.	.	.	.	.	0.1	0.1	0.5	0.1	0.1	1	7	5	1	1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.1	0.1	0.1
Flavocetraria nivalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.1	0.1	.	0.01	0.1	7	7	3	1	.	.	.	.	.	.	.	.	.	.	1	2	0.5	1	0.5
Hypogymnia physodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.
Icmadophila ericetorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	0.5	1	0.5
Lichenomphalia hudsoniana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.
Mycoblastus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ochrolechia androgyna	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.
Ochrolechia frigida	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	0.1	0.01	1	1	0.01	0.1	0.1	0.1	0.1	.	.	.	.	0.1	.	.	.	.	.	1	2	2	1	0.01
Ochrolechia inequatula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.1	0.1	.	1	1	1	0.5	2	0.1	.	.	.	.
Peltigera canina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera cf. *frippii*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.	.	.	.
Peltigera cf. *neckeri*	.	1	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.1	.	0.01	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.
Peltigera leucophlebia	1	1	1	1	2	.	.	.	.	.	.	.	.	.	0.01	.	0.01	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	.	.	.	.	.
Peltigera malacea	.	1	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera polydactylon-group	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Peltigera scabrosa	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	0.01	0.01	0.01	.	0.1	.	.	.	0.1	.	.	0.1	0.1	0.1	0.1	0.1	.	.	.	.	.	.	.	.
Peltigera sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pertusaria dactylina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	0.1	0.1	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	0.5	.	.	.	1
Pertusaria geminipara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	5	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	0.5	.
Pertusaria panyrga	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.5	.
Protopannaria pezizoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.
Protothelenella leucothelia	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Psoroma hypnorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.	.	.	.	.	.	0.1	.	0.1
Rhexophiale rhexoblephara	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.
Sphaerophorus globosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	.	15	40	50	15	10	0.1	0.1	0.1	0.1	0.1	1	1	1	1	2	10	15	10	15	15
Stereocaulon alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.5	1	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	0.1
Stereocaulon paschale	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Table 19 (cont').* Species percentage cover in vegetation study plots *(relevés).

Relevé species percentual cover.

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	VD_RV_36	VD_RV_37	VD_RV_38	VD_RV_39
Thamnolia vermicularis var. *subuliformis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	0.1	.	0.1	0.1	0.1	0.1	.	.	0.1	.	0.5	.	.	.	.	.	.
Thamnolia vermicularis var. *vermicularis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.01	0.01	0.01	1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	0.1	0.1	0.1	.	0.1	0.1	0.1	0.1	0.1	0.1
Varicellaria rhodocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	0.1
Aulacomnium palustre	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	0.5	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aulacomnium turgidum	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	5	5	3	2	5	0.01	1	0.1	0.5	2	50	40	60	40	40	20	15	10	10	5	0.01	.	0.1	.	0.1
Blepharostoma trichophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.
Calypogeia sphagnicola	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Cephaloziella sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	0.01	.	.	.	.	.
Ceratodon purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Conostomum tetragonum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.01	0.1	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.
Cynodontium strumiferum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum acutifolium	.	0.5	.	.	.	.	.	0.01	.	.	.	.	.	.	5	5	.	.	.	.	.	.	.	.	.	.	1	1	1	.	0.1	.	20	15	.	.	2	.	.
Dicranum elongatum	.	.	.	.	.	.	.	0.1	.	.	0.1	.	.	.	20	20	15	15	15	20	20	15	15	30	2	1	1	1	5	0.1	0.1	0.1	0.1	.	3	.	.	2	1
Dicranum flexicaule	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	0.01	0.1	.	.	.	0.1	.	.	.	.	20	30	.	.	.	.	.	.	.	.
Dicranum fuscescens	.	.	.	.	0.5	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum groenlandicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum laevidens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	15	15	15	15	.	.	.	.	.	.	.	.	.	.	.	.	40	0.1	15	.	.	.	.	.
Dicranum majus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dicranum spadiceum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	6	4	.	.	2
Ditrichum flexicaule	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Gymnocolea inflata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.
Gymnomitrion corallioides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.01	0.01	0.01
Hylocomium splendens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.5	2	2	1	5	.	0.01	0.01	.	.	40	40	30	30	10	20	10	10	10	10	.	.	0.1	0.1	0.1
Kiaeria cf. *blyttii*	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lophozia ventricosa s.l.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	0.1	0.1	.	0.01	0.1	.	0.1	0.1	0.1	.	.	0.1	.	.	.	0.1	0.1
Mylia anomala	.	.	.	.	.	0.01	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Oncophorus wahlenbergii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.5	.	.	0.01	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Orthocaulis binsteadii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	0.1	0.1	.	0.1	0.1	.	.	.	.	.
Orthocaulis kunzeanus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	5	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.
Plagiomnium ellipticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.
Pleurozium schreberi	30	30	15	15	15	.	.	0.5	.	.	.	.	.	.	0.01	0.5	2	.	0.01	.	0.1	0.1	.	0.1	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.
Pogonatum dentatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.01
Pogonatum urnigerum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.
Pohlia cruoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.
Pohlia nutans	.	.	.	.	.	0.01	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	0.01	0.01	0.01	.	.	.	.	.	.	0.1	.	0.1	0.01	.	.	.	0.01	0.01	0.01
Pohlia sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.
Polytrichastrum alpinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	10	10	10	.	.	.	.	.	.	.
Polytrichastrum longisetum	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polytrichum commune	0.01	.	0.01	.	0.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	2	2	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.
Polytrichum hyperboreum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	3	1	2	2
Polytrichum jensenii	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	2	.	.	.
Polytrichum piliferum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.
Polytrichum strictum	.	.	.	.	0.1	.	.	.	0.01	0.01	0.01	.	.	.	0.1	0.1	0.1	0.1	0.1	10	0.1	1	15	10	1	1	1	10	30	10	1	10	5	10	1	.	.	.	.
Ptilidium ciliare	.	0.01	.	.	.	.	.	0.01	.	.	.	.	.	.	1	5	3	2	5	5	2	0.1	5	5	0.1	0.1	0.1	0.1	0.1	5	5	5	3	5	5	3	0.1	2	1
Ptilidium crista-cristensis	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Racomitrium lanuginosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	1	1	0.1	0.1	0.1	.	.	0.1	.	.	0.1	1	1	0.1	1	10	10	2	5	5
Sanionia uncinata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	0.01	0.1	.	0.1	.	0.1	0.1	.	.	0.01	0.1	.	.	.	.	.	.	.	.	.
Sphagnum balticum	.	.	.	.	.	.	.	.	.	.	.	30	.	.	0.1	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum compactum												30																											
Sphagnum fuscum	.	.	.	.	.	0.01	75	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum girgensohnii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum lenense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum lindbergii													80																										
Sphagnum majus	.	.	.	.	.	.	.	.	.	.	.	30	20	100	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum rubellum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	0.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum squarrosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum teres	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.5	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphagnum warnstorfii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sphenolobus minutus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	0.1	0.1	0.01	.	1	1	0.5	0.1	.	.	.	0.01	0.01	0.1	0.01	0.01	0.1	.	2	0.1	0.01	.	.
Splacnum sphaericum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.1	.	.	.	.	.	.
Stereodon holmenii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.
Stereodon subimponens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.
Straminergon stramineum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tetralophozia setiformis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	.	.
Tomentypnum nitens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.01	.	0.5	.	.	.	.	.	1	10	1	1	.	.	.	.	.	.	.	.	.	.	.
Tritomaria quinquedentata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0.5	.	.	.	.	.	0.1	.	.	0.1	.	.	.	0.1	0.1	.	.	.	.	.	.

Plot-count data for tree cover, density, and basal area (at Nadym only)

Table 20. Raw plot-count data from the Nadym-1 relevés. All trees in each 10 x 10-m plot were recorded, including diameter at breast height (dbh), basal area of the stem at breast height, height of the tree, and above-ground mass of the tree. Mass was determined using the equations presented in the methods (from Zianis et al. 2005). The location of the tree is given by the x and y coordinates measured in meters from the southwest corner of the plot.

n	Species	dbh (cm)	dbh (mm)	basal area (cm^2)	ht (m)	x.coor	y.coor	mass (kg)	mass (g)
ND_RV_01									
23	Bet.pub	1	10	0.8	3	5.7	1	0.1	91.8
24	Bet.pub	6	60	28.3	7	5.3	2.2	8.1	8099.4
26	Bet.pub	9	90	63.6	8	8.2	4.2	22.3	22322.7
17	Lar.sib	1	10	0.8	2	4.8	1.5	0.2	208.6
21	Lar.sib	4	40	12.6	6	5.8	0.7	4.9	4929.7
1	Pin.syl	16	160	201.1	9	0.9	8.3	79.1	79067.0
2	Pin.syl	16	160	201.1	9	0.5	9.8	79.1	79067.0
3	Pin.syl	3.5	35	9.6	4	2.8	1.3	2.3	2269.7
4	Pin.syl	3	30	7.1	4	1.8	3.3	1.6	1637.0
5	Pin.syl	14	140	153.9	9	1.8	3.8	57.4	57363.0
6	Pin.syl	12	120	113.1	8	1.2	1.2	39.7	39707.0
7	Pin.syl	3	30	7.1	2	1.8	4.5	1.6	1637.0
8	Pin.syl	7	70	38.5	8	1.2	5.6	13.3	13277.0
9	Pin.syl	12	120	113.1	9	1.8	6.3	39.7	39707.0
10	Pin.syl	3.5	35	9.6	5	1.8	7.5	2.3	2269.7
11	Pin.syl	12	120	113.1	9	2.8	4.8	39.7	39707.0
12	Pin.syl	6.5	65	33.2	6	2.5	2.8	12.0	12025.5
13	Pin.syl	0.5	5	0.2	1.5	2.8	1.8	0.3	319.5
14	Pin.syl	6	60	28.3	6.5	3.6	7.7	11.0	11027.0
15	Pin.syl	14	140	153.9	9	3.2	8.5	57.4	57363.0
16	Pin.syl	13	130	132.7	8	4.5	5.8	48.0	48029.0
18	Pin.syl	11	110	95.0	8	4.5	0.8	32.4	32397.0
19	Pin.syl	4	40	12.6	5.5	5.5	1	3.1	3147.0
20	Pin.syl	5	50	19.6	7.5	5.2	0.7	9.8	9789.0
22	Pin.syl	7	70	38.5	7	5.7	0.6	13.3	13277.0
25	Pin.syl	20	200	314.2	11	7.2	2.8	134.6	134619.0
ND_RV_02									
15	Bet.pub	6	60	28.3	7.5	4.6	7	8.1	8099.4
32	Bet.pub	0.6	6	0.3	2	7.2	9.2	0.0	25.6
33	Bet.pub	1	10	0.8	4	7.5	6.5	0.1	91.8
34	Bet.pub	7.5	75	44.2	7	7.6	5.8	14.2	14150.2
37	Lar.sib	20	200	314.2	12	7.5	3.6	111.6	111604.4
45	Lar.sib	21	210	346.4	13	9	8.2	129.7	129736.5
44	Pin.sib	4	40	12.6	5	8.2	7.6	3.1	3147.0
1	Pin.syl	3	30	7.1	3.5	0.2	3.3	1.6	1637.0
2	Pin.syl	0.5	5	0.2	1.5	0.4	3.4	0.3	319.5
3	Pin.syl	16	160	201.1	10	1.7	3.2	79.1	79067.0
4	Pin.syl	10	100	78.5	8.5	1.2	3	26.1	26099.0
5	Pin.syl	3	30	7.1	1.5	1.2	1.8	1.6	1637.0
6	Pin.syl	2.5	25	4.9	3.5	2.3	0.5	1.2	1180.6
7	Pin.syl	2	20	3.1	2.2	2.5	0.5	0.9	851.5
8	Pin.syl	5	50	19.6	5.5	3.3	2	9.8	9789.0
9	Pin.syl	10	100	78.5	8	2.5	8.8	26.1	26099.0
10	Pin.syl	0.7	7	0.4	2	2.5	9.2	0.4	364.1
11	Pin.syl	4.5	45	15.9	6.5	2.2	10	4.4	4363.4
12	Pin.syl	2	20	3.1	4	3.6	9.5	0.9	851.5
13	Pin.syl	0.5	5	0.2	2	3.7	9.2	0.3	319.5
14	Pin.syl	0.4	4	0.1	1	3.3	8.3	0.3	299.2
16	Pin.syl	3	30	7.1	4.5	4.3	9.5	1.6	1637.0
17	Pin.syl	2	20	3.1	4	4.7	9.6	0.9	851.5
18	Pin.syl	0.5	5	0.2	1	4.3	9.7	0.3	319.5
19	Pin.syl	0.6	6	0.3	2	5.5	9.8	0.3	341.0
20	Pin.syl	7	70	38.5	8.5	5.5	9.5	13.3	13277.0
21	Pin.syl	6	60	28.3	8	5.7	9.2	11.0	11027.0
22	Pin.syl	2	20	3.1	3.5	5.5	1	0.9	851.5
23	Pin.syl	2	20	3.1	3	6.3	0	0.9	851.5
24	Pin.syl	10	100	78.5	8.5	6.2	2.5	26.1	26099.0
25	Pin.syl	3.5	35	9.6	6	6.5	3.5	2.3	2269.7
26	Pin.syl	4	40	12.6	6	6.7	4	3.1	3147.0
27	Pin.syl	7	70	38.5	7	6.9	4.5	13.3	13277.0
28	Pin.syl	1	10	0.8	2	6.9	4.7	0.4	442.9
29	Pin.syl	3.5	35	9.6	4	6.2	5.5	2.3	2269.7
30	Pin.syl	3	30	7.1	5	7.5	9.5	1.6	1637.0
31	Pin.syl	1	10	0.8	2.2	7.6	9.2	0.4	442.9
35	Pin.syl	0.5	5	0.2	1.8	7.6	4.2	0.3	319.5
36	Pin.syl	3.5	35	9.6	6	7.4	4	2.3	2269.7
38	Pin.syl	3	30	7.1	5	7.4	2.7	1.6	1637.0
39	Pin.syl	8	80	50.3	7	8	1.5	16.5	16539.0
40	Pin.syl	2	20	3.1	3	7.5	1.2	0.9	851.5
41	Pin.syl	1.5	15	1.8	3	4.8	0.8	0.6	614.1
42	Pin.syl	7	70	38.5	7	9	1.6	13.3	13277.0
43	Pin.syl	3	30	7.1	6.5	8.2	1.8	1.6	1637.0
46	Pin.syl	7	70	38.5	7.5	8.2	9.7	13.3	13277.0
47	Pin.syl	2	20	3.1	3	10	9.7	0.9	851.5
48	Pin.syl	5	50	19.6	6.5	9.2	9.5	9.8	9789.0
49	Pin.syl	2	20	3.1	3	10	9.4	0.9	851.5
50	Pin.syl	4.5	45	15.9	5.5	9.2	3	4.4	4363.4
51	Pin.syl	8	80	50.3	7.5	9.7	1.3	16.5	16539.0

n	Species	dbh (cm)	dbh (mm)	basal area (cm^2)	ht (m)	x.coor	y.coor	mass (kg)	mass (g)
ND_RV_03									
1	Bet.pub	0.3	3	0.1	1.5	0.2	0.2	0.0	4.5
2	Bet.pub	0.2	2	0.0	1.8	0.3	1.2	0.0	1.6
3	Bet.pub	1	10	0.8	2.3	0.3	2.3	0.1	91.8
6	Bet.pub	0.2	2	0.0	1	1	2	0.0	1.6
4	Lar.sib	5	50	19.6	4.5	0.3	2.7	5.3	5279.9
8	Lar.sib	5	50	19.6	6	2.9	6.7	6.9	6935.7
13	Lar.sib	7	70	38.5	6.5	5.8	9.2	12.5	12520.7
5	Pin.syl	17	170	227.0	9	0.1	9.7	91.4	91437.0
7	Pin.syl	6	60	28.3	7	3	6.5	11.0	11027.0
9	Pin.syl	11	110	95.0	9	4	9.7	32.4	32397.0
10	Pin.syl	8	80	50.3	6	4.5	6.7	16.5	16539.0
11	Pin.syl	9	90	63.6	6.5	4.5	0.1	20.8	20813.0
12	Pin.syl	4	40	12.6	2.3	6	2.4	3.1	3147.0
14	Pin.syl	2	20	3.1	1.7	6.2	5.8	0.9	851.5
15	Pin.syl	12	120	113.1	7	6.7	0.2	39.7	39707.0
16	Pin.syl	8	80	50.3	7	7.4	7.4	16.5	16539.0
17	Pin.syl	16	160	201.1	9	8.5	2.5	79.1	79067.0
18	Pin.syl	9	90	63.6	7	8	0.8	20.8	20813.0
19	Pin.syl	8	80	50.3	6	9.8	1.6	16.5	16539.0
20	Pin.syl	13	130	132.7	8.5	9.3	6.3	48.0	48029.0
ND_RV_04									
8	Bet.pub	1	10	0.8	2.5	4.1	2.3	0.1	91.8
21	Bet.pub	11	110	95.0	8	9.7	1	36.9	36868.5
5	Lar.sib	6	60	28.3	4.5	3.5	3.5	7.0	6978.7
14	Lar.sib	1.5	15	1.8	2.2	8.5	1.6	0.4	424.6
1	Pin.syl	11	110	95.0	8	0.2	4.2	32.4	32397.0
2	Pin.syl	5	50	19.6	2.2	1.2	6.7	6.1	6050.0
3	Pin.syl	21	210	346.4	9.5	1.5	6.2	151.0	151037.0
4	Pin.syl	2	20	3.1	2.5	2.5	8.7	0.9	851.5
6	Pin.syl	2	20	3.1	3	3.6	3.4	0.9	851.5
7	Pin.syl	15	150	176.7	8.5	4.5	0.4	67.7	67709.0
9	Pin.syl	4	40	12.6	4	4.5	2.5	3.1	3147.0
10	Pin.syl	0.5	5	0.2	1.2	4.6	2.4	0.3	319.5
11	Pin.syl	5	50	19.6	4.5	4.5	3.1	6.1	6050.0
12	Pin.syl	15	150	176.7	9	6.5	5.7	67.7	67709.0
13	Pin.syl	1.5	15	1.8	2.2	6.2	6.8	0.6	614.1
15	Pin.syl	7	70	38.5	6	8.5	2.6	13.3	13277.0
16	Pin.syl	0.5	5	0.2	1	8	8.8	0.3	319.5
17	Pin.syl	4	40	12.6	4.5	9.7	8.6	3.1	3147.0
18	Pin.syl	0.4	4	0.1	1	9	3.5	0.3	299.2
19	Pin.syl	16	160	201.1	9	9	3.1	79.1	79067.0
20	Pin.syl	8	80	50.3	6.5	9.5	1.5	16.5	16539.0
ND_RV_05									
1	Bet.pub	0.7	7	0.4	2.5	0.4	0.5	0.0	37.6
5	Bet.pub	1	10	0.8	3	0.7	9.7	0.1	91.8
8	Bet.pub	11	110	95.0	7	1.8	4	36.9	36868.5
24	Bet.pub	0.8	8	0.5	2	9.7	4.7	0.1	52.5
25	Bet.pub	7.5	75	44.2	7.5	9	4.2	14.2	14150.2
4	Lar.sib	7	70	38.5	6	0.7	9.2	11.6	11605.6
11	Lar.sib	2	20	3.1	2.5	3.5	3.5	0.7	744.3
13	Lar.sib	12	120	113.1	8	4	7	34.8	34776.3
6	Pin.sib	0.7	7	0.4	2.5	0.7	10	0.4	364.1
9	Pin.sib	8	80	50.3	6	1.5	3.5	9.6	9563.7
26	Pin.sib	0.7	7	0.4	1	9.5	4	0.4	364.1
2	Pin.syl	2.5	25	4.9	3.2	0.8	1.8	1.2	1180.6
3	Pin.syl	6	60	28.3	7	1	7.8	11.0	11027.0
7	Pin.syl	4.8	48	18.1	6	2	5	5.3	5308.7
10	Pin.syl	18	180	254.5	8.5	3	3.4	104.8	104819.0
12	Pin.syl	15	150	176.7	8.5	3.8	6	67.7	67709.0
14	Pin.syl	14	140	153.9	8	5	0.2	57.4	57363.0
15	Pin.syl	14	140	153.9	8	6	6.9	57.4	57363.0
16	Pin.syl	2	20	3.1	3	7.5	6.2	0.9	851.5
17	Pin.syl	7	70	38.5	6.5	8.7	5.3	13.3	13277.0
18	Pin.syl	4	40	12.6	5	8.5	5.5	3.1	3147.0
19	Pin.syl	0.4	4	0.1	1.5	8.5	6.5	0.3	299.2
20	Pin.syl	0.4	4	0.1	1.2	8	7	0.3	299.2
21	Pin.syl	3.5	35	9.6	6.5	8.7	7.2	2.3	2269.7
22	Pin.syl	6.5	65	33.2	7.5	9.1	8.1	12.0	12025.5
23	Pin.syl	7	70	38.5	7.5	9.2	5.8	13.3	13277.0
27	Pin.syl	0.3	3	0.1	0.8	9.5	1.8	0.3	280.3

Table 21. Summary of tree data from the plot-count method (biomass, basal area, density, and tree height) at Nadym-1.

Biomass (g/m2)

Transect	1	2	3	4	5	Average	s.d.	s.e
Species								
Bettor	305.14	223.67	1.00	369.60	512.01	282.28	189.39	84.70
Larsib	51.38	2413.41	247.36	74.03	471.26	651.49	999.22	446.86
Pinsib	0.00	31.47	0.00	0.00	102.92	26.88	44.64	19.96
Pinsyl	6777.01	3144.35	3969.06	4493.84	3504.97	4377.85	1433.53	641.09
Total	**7133.54**	**5812.90**	**4217.42**	**4937.48**	**4591.16**	**5338.50**	**1164.41**	**520.74**

Biomass (g/tree)

Transect	1	2	3	4	5	Average	s.d.	s.e
Species								
Bettor	10171.29	5591.75	24.90	18480.14	10240.14	8901.64	6798.96	3040.59
Larsib	2569.14	120670.46	8245.46	3701.62	15708.72	30179.08	50849.11	22740.42
Pinsib	0.00	3147.04	0.00	0.00	3430.60	1315.53	1804.15	1275.73
Pinsyl	32271.50	7146.25	30531.20	26434.38	21906.06	23657.88	10060.43	4499.16
Total	**45011.93**	**136555.50**	**38801.56**	**48616.14**	**51285.51**	**64054.13**	**40798.64**	**18245.71**

Basal area (m^2/ha)

Transect	1	2	3	4	5	Average	s.d.	s.e
Species								
Bettor	0.93	0.74	0.01	0.96	1.41	0.81	0.51	0.23
Larsib	0.13	6.61	0.78	0.30	1.55	1.87	2.70	1.21
Pinsib	0.00	0.13	0.00	0.00	0.51	0.13	0.22	0.10
Pinsyl	17.95	9.09	10.91	0.83	9.26	9.61	6.10	2.73
Total	**19.01**	**16.56**	**11.70**	**2.08**	**12.73**	**12.42**	**6.48**	**2.90**

Height (m)

Transect	1	2	3	4	5	Average	s.d.	s.e
Species								
Bettor	6.00	5.13	1.65	5.25	4.40	4.49	1.68	0.75
Larsib	4.00	12.50	5.67	3.35	5.50	6.20	3.65	1.63
Pinsib		5.00			3.17	4.08	1.30	0.92
Pinsyl	6.95	4.71	6.62	4.86	5.54	5.74	1.01	0.45
Average	**5.65**	**6.83**	**4.64**	**4.49**	**4.65**	**5.25**	**1.00**	**0.45**

Density (trees/ha)

Transect	1	2	3	4	5	Average	s.d.	s.e
Species								
Bet.pub	300.00	400.00	400.00	200.00	500.00	360.00	114.02	50.99
Lar.sib	200.00	200.00	300.00	200.00	0.00	180.00	109.54	48.99
Pin.sib	0.00	100.00	0.00	0.00	0.00	20.00	44.72	20.00
Pin.syl	2100.00	4400.00	1300.00	1700.00	0.00	1900.00	1604.68	717.64
Total	**2600.00**	**5100.00**	**2000.00**	**2100.00**	**500.00**	**2460.00**	**1671.23**	**747.40**

Table 22. Summary of number of trees and seedlings from each relevé at Nadym-1.

SPECIES	Bet.pub	Lar.sib	Pin.sib	Pin.syl
Releve 1				
Number Individuals	3	2		21
Mean dbh (cm)	5.3	2.5		9.0
Mean height (m)	6.0	4.0		7.0
Number Seedlings	1			5
Releve 2				
Number Individuals	4	2	1	44
Mean dbh (cm)	3.8	20.5	4.0	3.9
Mean height (m)	5.1	12.5	5.0	4.7
Number Seedlings	2			2
Releve 3				
Number Individuals	4	3		13
Mean dbh (cm)	0.4	5.7		9.5
Mean height (m)	1.7	5.7		6.6
Number Seedlings	1			14
Releve 4				
Number Individuals	2	2		17
Mean dbh (cm)	6.0	3.8		6.9
Mean height (m)	5.3	3.4		4.9
Number Seedlings				10
Releve 5				
Number Individuals	5	3	3	16
Mean dbh (cm)	4.2	7.0	3.1	6.6
Mean height (m)	4.4	5.5	3.2	5.5
Number Seedlings			1	4

Table 23. Comparison of tree biomass as determined by the plot-count method and the point-centered quarter method.

10 x 10-m plot count method, biomass (g/m²)								
Relevé	**1**	**2**	**3**	**4**	**5**	**Average**	**s.d.**	**s.e.**
Species								
Betula pubescens ssp. tortuosa	305.14	223.67	1.00	369.60	512.01	282.28	189.39	84.70
Larix sibirica	51.38	2413.41	247.36	74.03	471.26	651.49	999.22	446.86
Pinus cembra ssp. sibirica	0.00	31.47	0.00	0.00	102.92	26.88	44.64	19.96
Pinus sylvestris	6777.01	3144.35	3969.06	4493.84	3504.97	4377.85	1433.53	641.09
Total	7133.54	5812.90	4217.42	4937.48	4591.16	5338.50	1164.41	520.74

Point-centered quadrat method, biomass (g/m²)								
Transect	**1**	**2**	**3**	**4**	**5**	**Average**	**s.d.**	**s.e.**
Species								
Betula pubescens ssp. tortuosa	171.98	355.90	642.31	642.08	736.92	509.84	236.88	105.94
Larix sibirica	3.59	104.58	167.30	0.00	6.75	56.45	75.92	33.95
Pinus cembra ssp. sibirica	0.00	195.09	22.06	0.00	221.98	87.83	110.97	49.63
Pinus sylvestris	1859.33	2113.41	2733.25	5430.03	5199.63	3467.13	1718.33	768.46
Total	2034.90	2768.99	3564.92	6072.11	6165.28	4121.24	1902.29	850.73

Plant biomass

Table 24. 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 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 Shrubs				Evergreen Shrubs				Graminoid										Trees		
Site& sample number	Stem	Live foliar	Att. dead foliar	Repro-ductive	Stem	Live foliar	Att. dead foliar	Repro-ductive	Live foliar	Att. dead foliar	Forb	Live lichen	Live bryophyte	Total excluding dead moss & lichen & litter	Dead moss	Dead lichen	Litter	Total including dead moss & lichen & litter, excluding trees	Broadleaf deciduous trees	Needleleaf deciduous trees	Ever-green trees
Nadym-1*																					
ND_RV_01_BM_01	46.88	11.08	0.00	1.48	76.88	49.28	1.68	1.16	0.10	2.18	0.00	0.00	161.32	352.00	1123.00	22.08	333.02	1830.09	305.14	51.38	6777.01
ND_RV_02_BM_01	141.83	22.36	0.50	1.40	98.63	70.78	2.96	0.10	0.00	0.00	0.20	150.73	251.83	741.29	773.00	75.58	413.53	2003.39	223.67	2413.41	3175.82
ND_RV_03_BM_01	82.63	14.36	0.00	0.50	16.66	20.86	1.90	0.00	0.00	0.00	0.00	1720.20	2.56	1859.66	1.86	341.83	662.83	2866.17	1.00	247.36	3969.06
ND_RV_04_BM_01	9.46	3.36	0.10	0.20	7.36	4.76	1.70	0.00	0.00	0.00	0.00	1450.40	0.50	1477.83	0.00	559.92	603.43	2641.18	369.60	74.03	4493.84
ND_RV_05_BM_01	46.08	4.06	0.00	0.10	109.03	68.06	7.46	0.10	0.00	0.00	0.00	702.60	34.38	971.85	21.88	469.23	844.30	2307.25	512.01	471.26	3607.89
Average	65.37	11.04	0.12	0.74	61.71	42.75	3.14	0.27	0.02	0.44	0.04	804.79	90.12	1080.53	383.95	293.72	571.42	2329.62	282.28	651.49	4404.72
s.d.	49.96	7.86	0.22	0.66	46.94	29.12	2.47	0.50	0.04	0.97	0.09	764.97	111.83	596.35	529.64	237.36	203.48	430.52	189.39	999.22	1411.62
s.e.	22.34	3.51	0.10	0.29	20.99	13.02	1.11	0.22	0.02	0.44	0.04	342.11	50.01	266.70	236.86	106.15	91.00	192.54	84.70	446.86	631.29
Nadym-2																					
Hummocks																					
ND_RV_06	0.00	0.00	0.00	0.00	681.62	196.63	3.46	0.86	2.58	11.58	18.46	342.58	16.78	1274.52	97.13	142.38	681.98	2195.99			
ND_RV_07	13.08	1.08	0.00	0.00	109.98	67.28	0.10	0.10	0.00	1.36	28.48	2.78	1112.50	1114.21	883.00	0.00	5.78	1826.38			
ND_RV_08	74.36	30.76	0.00	0.76	419.73	182.06	11.16	4.36	8.58	56.43	9.56	340.03	20.96	1158.72	36.46	169.73	264.66	1629.56			
Average	29.14	10.61	0.00	0.25	403.77	148.65	4.91	1.77	3.72	23.12	18.83	228.46	383.41	1182.48	338.86	104.03	317.47	1883.98			
s.d.	39.70	17.46	0.00	0.44	286.15	70.85	5.67	2.27	4.40	29.29	9.46	195.45	631.41	82.75	472.21	91.13	341.18	287.58			
s.e.	22.92	10.08	0.00	0.25	165.21	40.91	3.27	1.31	2.54	16.91	5.46	112.84	364.55	47.78	272.63	52.61	196.98	166.03			
Inter-hummocks																					
ND_RV_09	0.18	0.18	0.00	0.00	3.46	2.76	0.00	0.00	0.00	0.00	2.78	1007.90	1.26	1018.50	0.00	877.03	50.96	1946.48			
ND_RV_10	22.06	1.36	0.00	0.00	11.66	0.56	0.00	0.00	2.66	7.46	4.06	1029.80	0.00	1079.61	0.00	594.42	47.26	1721.28			
ND_RV_11	8.56	0.96	0.00	0.00	422.82	96.38	2.26	2.16	39.28	132.03	1.36	753.60	1.56	1460.94	3.66	0.00	548.33	2012.93			
Average	10.26	0.83	0.00	0.00	145.98	33.23	0.75	0.72	13.98	46.49	2.73	930.43	0.94	1186.35	1.22	490.48	215.51	1893.56			
s.d.	11.04	0.60	0.00	0.00	239.78	54.70	1.30	1.25	21.95	74.17	1.35	153.53	0.83	239.76	2.11	447.66	288.23	152.85			
s.e.	6.37	0.35	0.00	0.00	138.44	31.58	0.75	0.72	12.67	42.82	0.78	88.64	0.48	138.42	1.22	258.45	166.41	88.25			
Laborovaya-1																					
LA_RV_15	259.43	42.66	0.00	2.96	44.18	25.16	3.36	0.00	36.48	83.46	3.76	59.68	271.32	832.42	612.52	0.00	182.53	1627.46			
LA_RV_16	248.43	52.78	0.00	0.00	37.96	44.36	6.16	0.00	35.48	47.68	1.36	102.78	395.02	971.98	312.53	0.00	336.53	1621.03			
LA_RV_17	302.98	27.28	0.00	5.08	10.58	20.68	4.68	0.38	42.68	119.96	6.36	42.36	202.66	785.63	1059.80	0.00	169.68	2015.11			
LA_RV_18	299.42	86.08	0.00	1.46	17.26	24.96	0.00	0.00	15.28	82.88	4.56	31.48	264.82	828.17	595.50	0.00	72.78	1496.44			
LA_RV_19	77.93	24.16	0.00	0.00	19.98	33.06	3.66	0.00	6.86	23.46	0.47	92.38	375.13	657.07	683.52	0.00	103.58	1444.16			
Average	237.63	46.59	0.00	1.90	25.99	29.64	3.57	0.08	27.35	71.49	3.30	65.73	301.79	815.05	652.77	0.00	173.02	1640.84			
s.d.	92.45	24.95	0.00	2.16	14.35	9.36	2.28	0.17	15.41	37.07	2.39	30.98	80.92	112.83	268.00	0.00	102.11	223.71			
s.e.	41.34	11.16	0.00	0.96	6.42	4.19	1.02	0.08	6.89	16.58	1.07	13.85	36.19	50.46	119.85	0.00	45.67	100.05			
Laborovaya-2																					
LA_RV_20	123.73	12.96	0.00	0.00	21.06	29.36	0.00	0.00	13.36	62.38	0.00	285.43	110.36	658.62	315.93	0.00	595.53	1570.07			
LA_RV_21	285.33	112.98	0.00	3.06	9.26	16.76	0.00	0.00	8.78	18.88	0.00	201.13	77.78	733.93	280.53	0.00	532.03	1546.48			
LA_RV_22	13.76	2.86	0.00	0.00	10.86	18.56	0.86	0.00	2.66	17.56	0.00	232.58	8.56	308.24	28.66	0.00	502.33	839.23			
LA_RV_23	99.86	5.56	0.00	0.00	1.40	4.56	0.00	0.00	32.48	82.83	0.00	342.53	94.73	663.93	506.52	9.96	301.43	1481.83			
LA_RV_24	81.08	6.66	0.00	0.00	4.76	15.56	0.76	0.00	9.58	32.78	0.00	243.68	119.28	514.11	466.83	0.00	332.73	1313.66			
Average	120.75	28.20	0.00	0.61	9.47	16.96	0.32	0.00	13.37	42.88	0.00	261.07	82.14	575.76	319.69	1.99	452.81	1350.25			
s.d.	100.69	47.53	0.00	1.37	7.48	8.83	0.44	0.00	11.35	28.70	0.00	54.63	44.07	169.57	188.94	4.45	128.87	302.75			
s.e.	45.03	21.26	0.00	0.61	3.34	3.95	0.20	0.00	5.08	12.84	0.00	24.43	19.71	75.84	84.50	1.99	57.63	135.39			
Vaskiny Dachi-1																					
VD_RV_25	32.16	42.96	0.00	0.46	2.66	5.46	2.06	0.00	23.78	69.38	2.56	27.18	169.23	377.86	687.80	0.00	167.23	1232.88			
VD_RV_26	32.18	19.56	0.00	0.00	47.48	56.48	21.46	0.56	44.88	71.38	13.88	32.98	286.83	627.63	586.90	0.00	234.63	1449.15			
VD_RV_27	171.88	43.56	0.00	0.00	12.96	40.36	0.00	1.26	23.56	72.86	0.00	21.18	150.93	538.53	449.62	0.00	318.02	1306.16			
VD_RV_28	9.86	10.56	0.00	1.36	7.16	22.86	0.00	0.56	38.28	64.08	2.06	24.88	268.33	449.96	516.10	0.00	149.93	1115.98			
VD_RV_29	24.66	32.26	0.00	1.16	0.00	0.00	0.00	0.00	9.36	24.78	1.36	53.68	317.33	464.57	834.10	0.00	91.68	1390.34			
Average	54.15	29.78	0.00	0.59	14.05	25.03	4.70	0.47	27.97	60.49	3.97	31.98	238.53	491.71	614.90	0.00	192.29	1298.90			
s.d.	66.44	14.52	0.00	0.64	19.32	23.65	9.41	0.52	13.92	20.24	5.62	12.86	74.00	95.01	151.02	0.00	86.81	131.15			
s.e.	29.71	6.49	0.00	0.29	8.64	10.58	4.21	0.23	6.23	9.05	2.51	5.75	33.10	42.49	67.54	0.00	38.82	58.65			
Vaskiny Dachi-2																					
VD_RV_30	7.26	5.56	0.00	0.00	14.76	28.86	2.06	0.10	17.48	33.48	0.00	72.78	210.73	393.04	514.02	0.00	112.28	1019.33			
VD_RV_31	113.73	36.58	0.00	0.00	11.46	32.66	1.66	0.00	19.18	29.28	0.00	89.28	210.33	544.13	456.02	0.00	171.38	1171.52			
VD_RV_32	39.88	8.06	0.00	0.00	15.56	45.56	1.30	0.10	6.38	28.68	0.00	53.88	253.73	453.10	602.62	0.00	146.58	1202.29			
VD_RV_33	13.06	5.16	0.00	0.00	18.36	49.56	3.06	1.86	19.36	63.58	0.00	68.38	278.23	520.58	666.70	0.00	90.48	1277.76			
VD_RV_34	120.13	21.36	0.00	1.06	9.16	31.46	0.00	0.56	15.28	26.78	0.00	59.68	366.93	652.37	1258.30	0.00	132.48	2043.14			
Average	58.81	15.34	0.00	0.21	13.86	37.62	1.62	0.52	15.53	36.36	0.00	68.80	263.99	512.64	699.53	0.00	130.64	1342.81			
s.d.	54.51	13.60	0.00	0.47	3.60	9.29	1.12	0.78	5.38	15.41	0.00	13.61	64.46	98.01	322.65	0.00	31.09	402.62			
s.e.	24.38	6.08	0.00	0.21	1.61	4.15	0.50	0.35	2.40	6.89	0.00	6.09	28.83	43.83	144.29	0.00	13.91	180.06			
Vaskiny Dachi-3																					
VD_RV_35	0.00	0.00	0.00	0.00	15.86	42.56	0.00	0.10	7.88	27.28	0.00	174.33	115.18	383.17	399.53	0.00	238.58	1021.27			
VD_RV_36	0.00	0.00	0.00	0.00	7.06	11.06	0.00	0.00	3.36	15.06	0.00	183.43	230.53	450.48	460.43	0.00	104.66	1015.57			
VD_RV_37	3.86	5.16	0.00	0.86	9.26	6.46	0.00	0.66	0.76	2.26	0.00	191.23	43.28	263.77	164.38	0.00	278.08	706.22			
VD_RV_38	0.00	0.00	0.00	0.00	9.06	20.66	1.66	1.86	7.58	25.78	0.00	256.73	116.33	439.63	284.13	0.00	134.98	858.73			
VD_RV_39	0.00	0.00	0.00	0.00	93.03	33.56	0.00	2.46	0.66	2.16	0.00	255.93	402.73	790.51	165.68	0.00	398.23	1354.41			
Average	0.77	1.03	0.00	0.17	26.85	22.86	0.33	1.02	4.05	14.51	0.00	212.33	181.61	465.51	294.83	0.00	230.90	991.24			
s.d.	1.73	2.31	0.00	0.38	37.14	15.13	0.74	1.09	3.53	12.17	0.00	40.61	140.62	196.21	134.35	0.00	117.71	240.93			
s.e.	0.77	1.03	0.00	0.17	16.61	6.77	0.33	0.49	1.58	5.44	0.00	18.16	62.89	87.75	60.08	0.00	52.64	107.75			

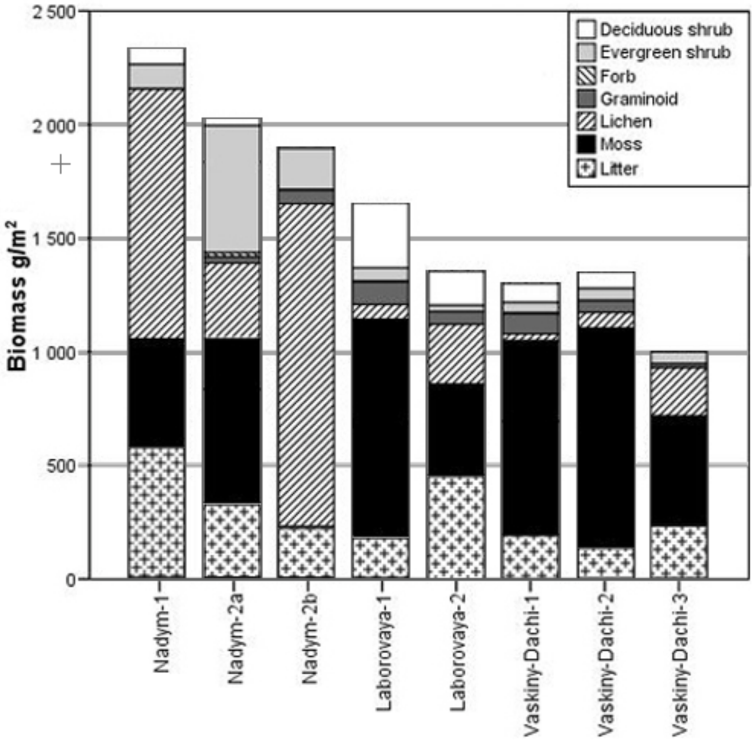

Figure 31. Average total biomass for each of the study sites excluding tree biomass at Nadym-1 and including dead moss and dead lichen components.

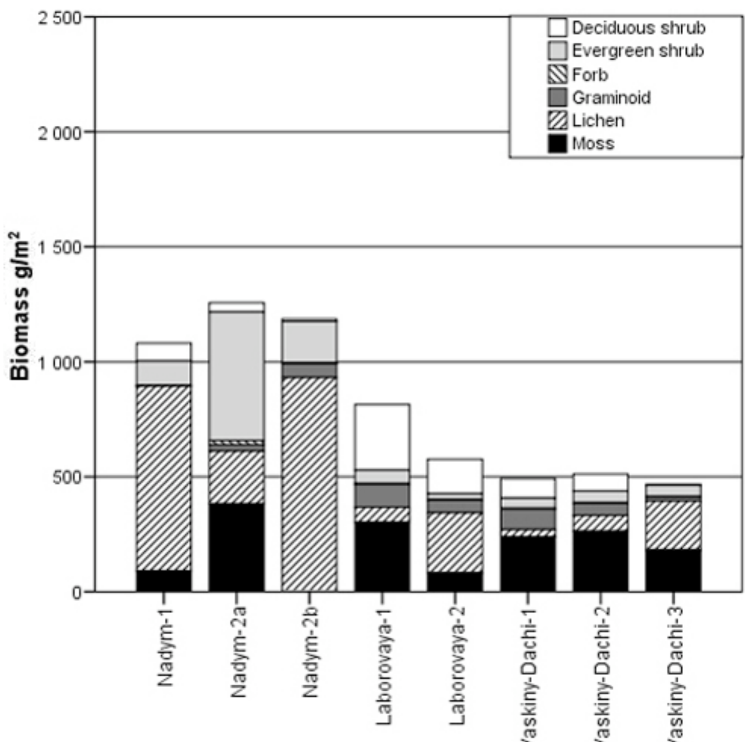

Figure 32. Average live biomass for each of the study sites excluding tree biomass, litter, dead moss, and dead lichen.

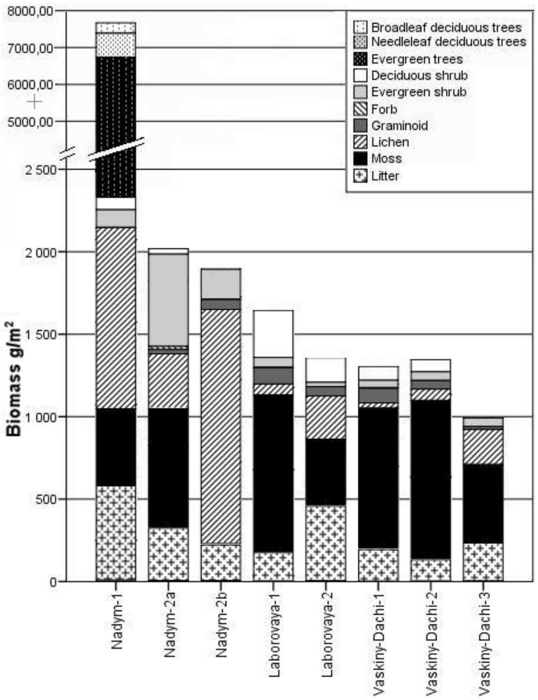

Figure 33. Average total biomass for each of the study sites including tree biomass at Nadym-1.

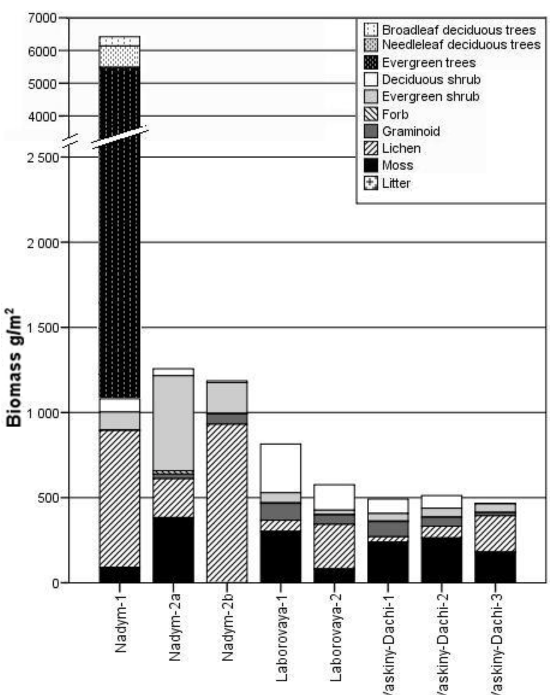

Figure 34. Average live biomass for each of the study sites including tree biomass at Nadym-1.

Soil Descriptions of Study Sites: G. Matyshak

Nadym – 1

Location:
GPS position: 65º18'48.2"N, 72 º53'16.6"E
Elevation: 49 m
Parent material: alluvial-lacustrine sediments
Classification: Typic Haplocryods, (Podzols in Russia)

(a)

(b)

Figure 35. (a) Soil pit at Nadym – 1 (pit №1), higher microsite. (b) Close up of pit wall.

0-2cm; Oi; fibric material, loose, (slightly decomposed lichen and moss, a few slightly decomposed twigs, needles and leaves).

2-6 cm; Oa; dark reddish brown (2.5YR2.5/4) sapric material (lichen), (H8, F0, R1,V3), very friable, 20% fine coal in horizon; moderately few medium roots; abrupt wavy boundary.

6-14 cm; E; gray (10YR6/1) sandy with slightly and moderately decomposed organics (10YR3/2); structureless; loose, non-sticky, non-plastic, common medium roots; abrupt irregular boundary.

14-20 cm; EB; yellowish brown (5YR5/6) sandy loam; moderate fine angular structure; friable, non-sticky, non-plastic, clear wavy boundary, common medium roots.

20-44 cm; Bw; grayish brown (10YR3/2) sandy clay loam with moderately decomposed organics (10YR2/2); weak medium subangular blocky structure; firm, non-sticky, slightly plastic; many medium roots, abrupt wavy boundary.

44-75 cm; BC; yellowish gray (7.5YR8/3) loamy sand; structureless; very friable, non-sticky, non-plastic, common dark brown (7.5YR3/2) streaks of 5-10 mm thickness of Fe-Mn concentrations; 5% medium pebbles in horizon; very few fine roots; gradual wavy boundary.

75-140 cm; C; gray (10YR7/1) sandy; structureless; loose, non-sticky, non-plastic, many dark brown (7.5YR3/2) streaks of 5-10 mm thickness of Fe-Mn concentrations; water below 140 cm.

(a) (b)

Figure 36. (a) Soil pit at Nadym – 1 (pit №2), lower microsite. (b) Close up of pit wall.

0-2 cm; Oi; 10YR5/2; fibric material, loose (slightly decomposed lichen and moss, a few slightly decomposed twigs, needles and leaves).

2-11 cm; Oe; dark brown (7.5YR3/2) hemic material (lichen and moss), (H6, F3, R1, V2), very friable, moderately decomposed lichen, twigs and leaves, few coarse roots; abrupt wavy boundary.

11-12 cm; Oa; black (10YR2/1) sapric material (H8, F1, R2, V0), loose; 40% fine coal in horizon; common medium roots; abrupt wavy boundary.

12-64 cm; E; light gray (10YR7/1) sandy, structureless; loose, non-sticky, non-plastic, very few coarse roots; 3% medium pebbles in horizon; clear irregular boundary.

64-90 cm; Btjj; yellowish-brown (5YR5/6) loamy sand; non-sticky, non-plastic, weak medium subangular structure; very friable, 10% medium pebbles; common dark brown (7.5YR3/2) streaks of 5-10mm. thickness of Fe-Mn concentrations; few medium roots; clear irregular boundary.

90-140 cm; BC; gray (10YR7/1) sandy; structureless; friable, non-sticky, non-plastic, many yellowish-brown (10YR4/6) streaks of 5-10mm. thickness of Fe-Mn concentrations; water below 140cm; very few fine roots.

Nadym – 2

Location: CALM Grid
GPS position: 65 º 18'51.9"N, 072 º 51'42.8"E
Elevation: 35 m
Parent material: alluvial-lacustrine sediments
Classification: Typic Histoturbels, (Peat Cryozems in Russia)

(a) (b)

Figure 37. (a) Soil pit at Nadym - 2 (pit №3), higher hummock microsite. (b) Close up of pit wall.

0-2 cm; Oi; fibric material, loose, slightly decomposed lichen, a few slightly decomposed twigs and leafs of shrubs.

2-26 cm; Oi; dark reddish brown (2.5YR2.5/4) fibric material (moss), (H4, F3, R2, V0); friable, common medium roots; abrupt wavy boundary.

26-33 cm; Oa; black (10YR2/1) sapric material (H8, F0, R2, V1); very friable, abrupt irregular boundary.

33-37 cm; Bhjjf; light gray (10YR8/1, 40%) and grayish brown (10YR3/2, 60%) loamy sand; structureless; loose, non-sticky, non-plastic, common vertical frozen cracks with dark brown (7.5YR3/2) of mucky peat of 10 mm to 50 mm; moderately few medium roots (inside of frozen cracks); 5% coarse pebbles in horizon; frozen below 37 cm.

(a)

Figure 38. (a) Soil pit at Nadym – 2 (pit №4), lower inter-hummock microsite.

0-5 cm; Oi; fibric material, loose, slightly decomposed lichen, a few slightly decomposed twigs and leaves of shrubs.

5-15 cm; Oi; reddish brown (5YR3/4), fibric material (moss), (H3, F3, R2, V1); very friable, common medium roots; abrupt wavy boundary.

15-28 cm; Oa; dark brown (7.5YR3/2) sapric material, (H8, F1, R1, V0); friable, moderately few fine roots; abrupt wavy boundary.

28-38 cm; Bhjj; yellowish gray (7.5YR8/3) loamy sand; structureless; very friable, non-sticky, non-plastic, few fine roots; abrupt wavy boundary.

38-40 cm; Cf; (Gley 2, 7/5BG) silty clay; weak very coarse platy structure; friable, slightly sticky, moderately plastic, water below 40 cm; frozen below 42 cm; many Fe concentrations around root channels, cracks.

Laborovaya-1

Location:
GPS position: 67º42'22.8"N, 067º59'57.7"E
Elevation: 84 m
Parent material: Pleistocene saline clays
Classification: Typic Historthels, (Peat Gleyzems in Russia)

(a) (b)

Figure 39. (a) Soil pit at Laborovaya-1 (pit №5). (b) Close up of pit wall.

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

2-7 cm; Oe; brown (7.5YR4/4) hemic material, (H6, F3, R2, V0); very friable, common medium roots, gradual wavy boundary.

7-10 cm; Oa; dark brown (7.5YR3/3) sapric material (moss), (H8, F2, R2, V0); very friable, common medium roots, abrupt wavy boundary.

10-11 cm; Bw1; dark brown (7.5YR3/2) loam; moderate fine granular structure; friable, moderately sticky, moderately plastic, many fine and medium roots, gradual wavy boundary.

11-75 cm; Bw2; grayish brown (10YR5/2, 70%) and (Gley 1, 5/5GY, 20%) and yellowish red (5YR5/8, 10%) clay; weak very coarse platy structure; friable, moderately sticky, moderately plastic; common medium roots (inside of frozen cracks); common vertical and horizontal frozen cracks with dark brown (7.5YR3/2) of mucky peat of 10-100 mm; 10% coarse gravel and medium pebbles in horizon; clear wavy boundary.

75-78 cm; Cgf; (Gley 2, 6/10G); Clay with cryoturbated organics (10YR3/2); moderate very coarse platy structure; firm, moderately sticky, very plastic, frozen below 78 cm; 10% coarse gravel and medium pebbles in horizon; 20-30% ice by volume, ice lenses and ice veins of 3-5 mm thickness.

Laborovaya-2

Location:
GPS position: 67 º 41'41.1"N, 068 º 02'15.3"E
Elevation: 55 m
Parent material: alluvial sands underlain by pleistocene saline clays?
Classification: Typic Haploturbels, (Podburs in Russia)

(a) (b)

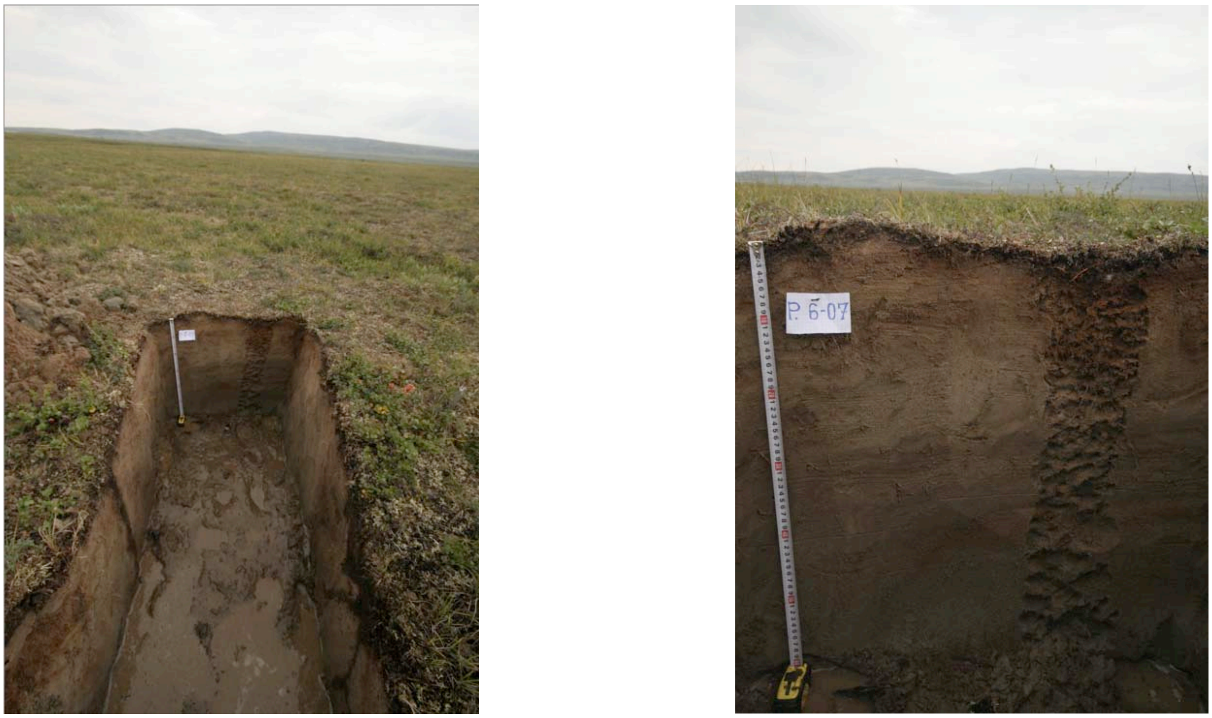

Figure 40. (a) Soil pit at Laborovaya-2 (pit №6), higher polygon microsite. (b) Close up of pit wall.

0-1 cm; Oi; fibric material, loose, slightly decomposed lichen and moss.

1-3 cm; Oa; dark brown (7.5YR3/3) sapric material, (H7, F1, R3, V0); friable, abrupt irregular boundary; common fine and medium roots.

3-12 cm; Bw; reddish brown (5YR4/4) and dark brown (7.5YR3/3) on top of horizon loamy sand, moderate medium subangular blocky structure; friable, non-sticky, non-plastic, few fine roots; 5% medium pebbles in horizon; gradual irregular boundary.

12-60 cm; BC light gray (5YR6/1) reddish brown (5YR4/4) on bottom of horizon loamy sand; weak medium subangular blocky structure; very friable, non-sticky, non-plastic; common 5-20 mm of organic streaks (10YR 4/1), few fine roots; abrupt wavy boundary.

60-62 cm; Cf; gray (5YR5/1) sand; structureless; loose, non-sticky, non-plastic; water below 62 cm; frozen below 100 cm.

(a)

Figure 41. (a) Close up of soil pit wall at Laborovaya-2b (pit №7).

0-1 cm; Oi; fibric material, loose, slightly decomposed lichen and moss.

1-7 cm; Oa; dark brown (7.5YR3/3) sapric material, (H7, F2, R2, V1); very friable, clear wavy boundary; common fine and medium roots.

7-19 cm; Oa; yellowish-brown (10YR4/6) sapric material, (H8, F1, R2, V0); friable, abrupt wavy boundary; common fine and medium roots.

19-50 cm; Bhjj; grayish brown (10YR5/2) sandy loam; moderate medium subangular blocky structure; very friable, non-sticky, non-plastic; few vertical frozen cracks with dark brown (7.5YR3/2) of mucky peat of 10-50 mm; many fine and medium roots (inside of frozen cracks); gradual irregular boundary.

54-50 cm; BCf; gray (5YR5/1) sand; structureless; loose, non-sticky, non-plastic, water below 50 cm; frozen below 90 cm.

Vaskiny Dachi-1

Location:
GPS position: 70 º 16'32.4"N, 068 º 53'24.8"E
Elevation: 30 m
Parent material: marine sediments
Classification: Typic Histoturbels, (Peat Gleyzems in Russia)

(a)

(b)

Figure 42. (a) Soil pit at Vaskiny Dachi-1 (pit №8), higher microsite. (b) Close up of pit wall.

0-1 cm; Oi; fibric material, loose, slightly decomposed moss, twigs and leafs of shrubs and sedge.

1-2 cm; Oi; brown (7.5YR4/4) fibric material, (H4, F3, R2, V0); friable, common fine roots; gradual wavy boundary.

2-5 cm; Ah; reddish brown (2.5YR4/6) sandy loam; moderate fine subangular blocky structure; friable, slightly sticky, slightly plastic, many fine roots; abrupt wavy boundary.

5-28 cm; Bgjj; (Gley 1, 6/10GY) loam; moderate coarse angular structure; firm, slightly sticky, slightly plastic, many Fe concentrations around root channels, cracks and on top of horizon (2.5YR5/8); many 5-10 mm of organic streaks and lenses (10YR 4/1); common medium roots; gradual irregular boundary.

28-70 cm; BCjj**;** grayish brown (10YR5/2) clay loam; moderate coarse platy structure; firm, moderately sticky, moderately plastic, few 10-30 mm of organic streaks (10YR 4/1) (Ab?), with oxidized zone around boundary (5YR6/8); few medium roots;

70-72 cm; Cf; gray (5YR5/1) clay loam; massive, frozen; extremely firm; sticky, plastic; 10-20% ice by volume, ice lenses and ice veins of 1-3 mm. thickness.

(a)

(b)

Figure 43. (a) Soil pit at Vaskiny Dachi-1 (pit №9), lower microsite. (b) Close up of pit wall.

0-3 cm; Oi; fibric material, loose, slightly decomposed moss and sedge.

3-8 cm; Oe; dark reddish brown (2.5YR2.5/4) hemic material, (H5, F2, R2, V0); friable, common fine and medium roots; gradual wavy boundary.

8-21 cm; Ah; brown (7.5YR4/3) clay loam; moderate fine subangular blocky structure; firm, non-sticky, slightly plastic; common fine roots; clear irregular boundary.

21-34 cm; Bwjj1; grayish brown (10YR5/2) clay loam with oxidized zone around boundary (5YR6/8), moderate medium subangular blocky structure; firm, slightly sticky, slightly plastic, few 5-10 mm of organic streaks (Ab?) and lenses (10YR 4/1); strongly cryoturbated, common medium roots; gradual irregular boundary.

34-62 cm; 2Cjjf; gray (7.5YR5/1) silty clay loam; strong coarse platy structure; firm, moderately sticky, moderately plastic, many 5-10 mm of organic streaks and lenses (10YR 4/1); strongly cryoturbated; few fine roots; frozen below 62 cm, 10-20% ice by volume, ice lenses and ice veins of 1-3 mm thickness.

Vaskiny Dachi-2

Location:
GPS position: 70 º 17'43.7"N, 068 º 53'00.8"E
Elevation: 36 m
Parent material: Aeolian sand over marine clays
Classification: Glacic Haploturbels (Cryozems in Russia)

(a) (b)

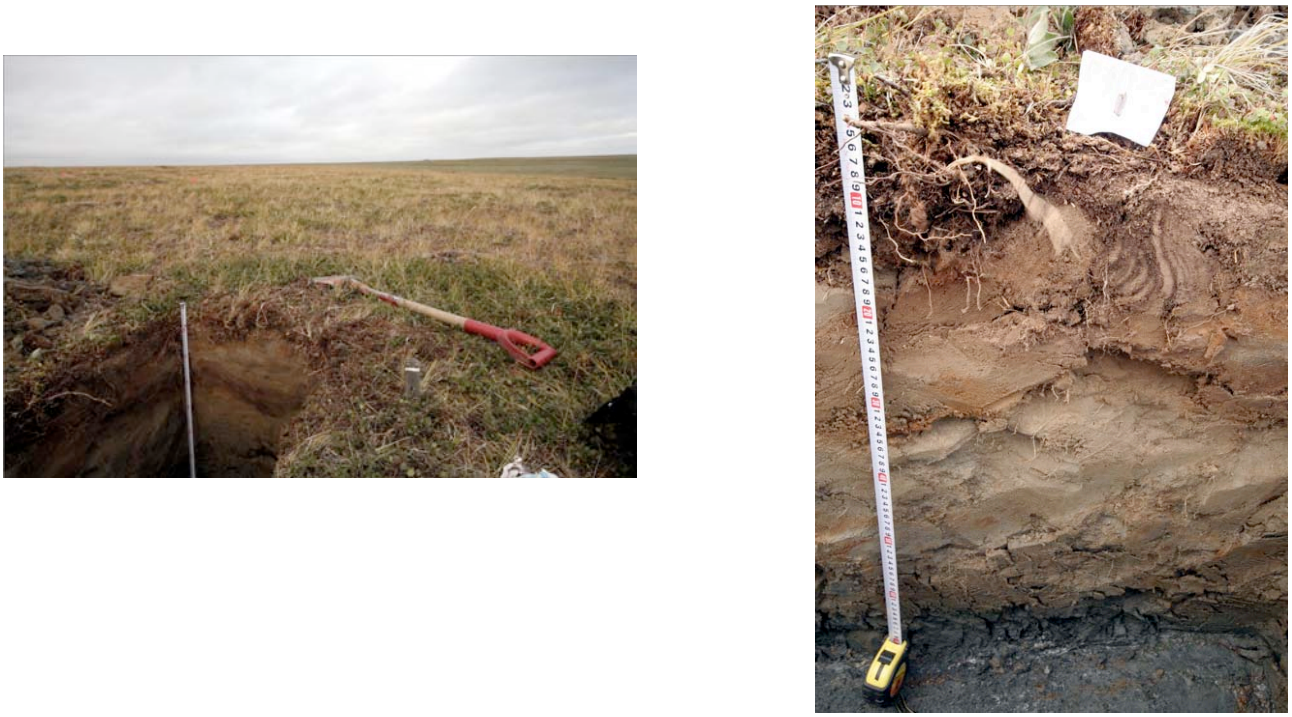

Figure 44. (a) Soil pit at Vaskiny Dachi-2 (pit №10), lower microsite. (b) Close up of pit wall.

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

2-11 cm; Oe; brown (7.5YR4/4) hemic material (moss), (H5, F2, R2, V0); friable, common fine and medium roots; abrupt wavy boundary.

11-20 cm; Bwjj; reddish brown (5YR4/4, 70%) and (5YR6/8, 30%) sandy loam, moderate fine subangular blocky structure; friable, non-sticky, slightly plastic, strongly cryoturbated, many vertical frozen cracks with brown (7.5YR4/3) of mucky peat of 10-20 mm; few fine roots; gradual irregular boundary.

20-60 cm; Bw; gray (7.5YR5/1, 80%) and (2.5YR4/6, 20%) silty clay loam; weak coarse platy structure; very friable, slightly sticky, slightly plastic; few fine roots; abrupt wavy boundary.

60-62 cm; 2Cgzf; dark gray (7.5YR4/1) silty clay; moderate coarse platy structure; firm, moderately sticky, very plastic, many fine vesicular pores; frozen below 62 cm, 30% ice by volume, ice lenses of 5-10 mm thickness.

(a) (b)

Figure 45. (a) Soil pit at Vaskiny Dachi-2 (pit №11), higher microsite. (b) Close up of pit wall.

0-1 cm; Oi; fibric material, loose, slightly decomposed moss, twigs and leaves of shrubs, sedge.

1-3 cm; Oi; brown (7.5YR4/4) fibric material (moss), (H4, F3, R2, V0); loose; common fine roots; abrupt wavy boundary.

3-4 cm; Ah; light brown (7.5YR6/4) clay loam; moderate fine subangular blocky structure; friable, slightly sticky, moderately plastic; common fine and medium roots; clear irregular boundary.

4-21 cm; Bwgjj; (Gley 1, 6/10GY) silty loam; weak medium angular structure; firm, slightly sticky, slightly plastic, common Fe concentrations (2.5YR5/8); few fine roots; clear wavy boundary.

21-26 cm; Ab**;** brown (7.5YR4/4) clay loam; moderate fine subangular blocky structure; friable, slightly sticky, slightly plastic, few fine roots; clear wavy boundary.

26-62 cm; Bw; gray (7.5YR5/1, 80%) and yellowish red (5YR5/8, 20%) silty clay loam, weak coarse platy structure; friable, slightly sticky, slightly plastic, few medium roots; abrupt wavy boundary.

62-67 cm; 2Cgzf; dark gray (7.5YR4/1) silty clay; moderate coarse platy structure; firm, moderately sticky, very plastic, many fine vesicular pores; frozen below 67cm, 30% ice by volume, ice lenses of 5-10 mm thickness.

Vaskiny Dachi-3

Location:
GPS position: 70 º 18'01.7"N, 068 º 50'33.5"E
Elevation: 18 m
Parent material: Aeolian sand over marine sediments?
Classification: Typic Haploturbels, (Podburs in Russia)

(a) (b)

Figure 46. (a) Soil pit at Vaskiny Dachi-3 (pit №12). (b) Closeup of pit wall.

0-0.5 cm; Oi; fibric material (black crast), firm; very abrupt smooth boundary.

0.5-1.5 cm; Ah; dark brown (7.5YR3/3) silty loam, moderate fine subangular blocky structure; very friable, slightly sticky, slightly plastic, common fine and medium roots; abrupt irregular boundary.

1.5-5 cm; Bw; light brown (7.5YR6/4) sand; weak medium subangular blocky structure; loose, non-sticky, non-plastic, few vertical frozen cracks with brown (7.5YR4/3) of mucky peat of 10-20 mm few medium roots; gradual irregular boundary.

5-24 cm; Bwjj; reddish brown (2.5YR4/6, 80%) and light brown (7.5YR6/3, 20%) sand; structureless; very friable, non-sticky, non-plastic, few lenses gray (7.5YR5/1) silty loam; few medium roots; gradual irregular boundary.

24-71 cm; BC; light gray (5YR7/1, 60%) and reddish yellow (5YR7/8, 40%) loamy sand; structureless; loose, non-sticky, non-plastic, water below 71 cm; frozen below 124 cm;

(a) (b)

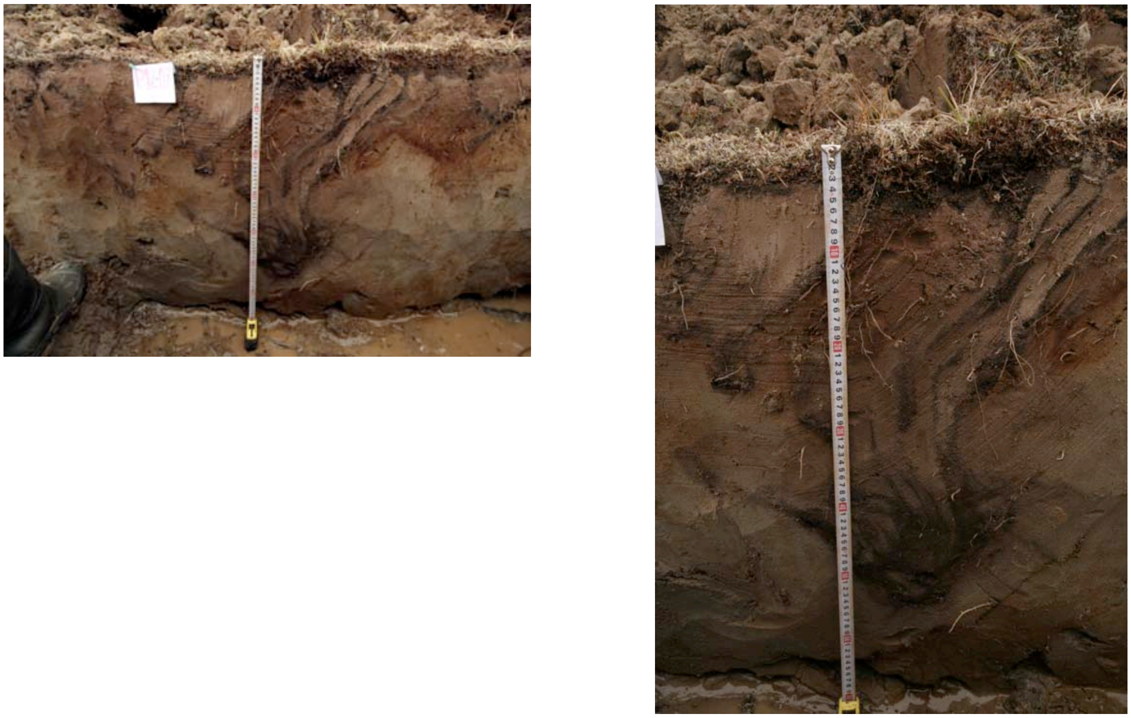

Figure 47. (a) Soil pit at Vaskiny Dachi-3 (pit № 13), inter-polygon lower microsite. (b) Close up of pit wall.

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

2-5 cm; Oe; dark brown (7.5YR3/3) hemic material (moss), (H6, F1, R2, V0); very friable, common fine roots; abrupt irregular boundary.

5-30 cm; Bwjj1**;** reddish brown (2.5YR4/6) sand; weak medium subangular blocky structure; friable, non-sticky, non-plastic, many vertical frozen cracks with black (10YR2/1) of mucky peat of 10 mm to 20 mm; common fine and medium roots (inside of frozen cracks); gradual broken boundary.

30-40 cm; Bwjj2**;** grayish brown (10YR5/2) sand with cryoturbated organics (10YR3/2); structureless; friable, non-sticky, non-plastic, common medium roots; clear broken boundary.

40-50 cm; Oajj; dark brown (7.5YR3/3) mucky peat; very friable, common fine and medium roots; clear broken boundary.

50-75 cm; Bw; gray (5YR6/1, 50%) and reddish yellow (5YR7/8, 50%) loamy sand; structureless; very friable, non-sticky, non-plastic; common Fe concentrations around frozen cracks, few medium roots; clear broken boundary.

75-77 cm; Cf; gray (5YR6/1) clay loam; moderate coarse platy structure; firm, moderately sticky, moderately plastic, water below 75 cm; frozen below 130 cm.

Table 25. Summary of mean chemical properties for the Nadym-2 Histoturbels. Smallest N for any variable is 66.

Horizon			
	pH 1:2.5	TC (%)	TN (%)
Oi	4.26	40.2	0.05
Oe	4.63	43.1	0.5
Oa	4.48	41.8	0.9
B1	5.75	0.8	-

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APPENDIX B: DATA FORM FOR SAMPLING SPECIES COVER ALONG TRANSECTS USING THE BUCKNER SAMPLE

Yamal Expedition 2007

Method: 50m transect - 0.5m spacing - 1 point at each 0.5 meter - 100 points total - Species at top and bottom of plant canopy

Location: ____________________ Date: ____________________

Vegetation Type: ____________________ Observers: ____________________

Species	Transect __		Transect __		Transect __		Transect __		Transect __		Mean	
	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
0.5												
1												
1.5												
2												
2.5												
3												
3.5												
4												
4.5												
5												
5.5												
6												
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22.5												
23												
23.5												
24												
24.5												
25												

Appendix C: Data forms for relevé data (site description and species cover/abundance)

Relevé data form: Site description, and growth form cover values

Yamal Expedition 2007

Grid Releves

Location: ____________________ Grid Number: ____________________

GPS Location of SW corner of Grid: ____________________

Grid photo from N: ____________________

Observer: ____________________ Slope: ____________________ Grid photo from E: ____________________

Date: ____________________ Aspect: ____________________ Grid photo from W: ____________________

Community: Elevation: ____________________ Grid photo from S: ____________________

		Releve number					Notes
	(grid point at SW corner)						
Live & standing dead cover %	Low shrubs						
	Erect dwarf shrubs						
	Prostrate dwarf shrubs						
	Evergeen shrubs						
	Deciduous shrubs						
	Erect forbs						
	Mat & cushion forbs						
	Non-tussock graminoids						
	Tussock graminoids						
	Foliose lichen						
	Fruticose lichen						
	Crustose lichen						
	Pleurocarpous bryophytes						
	Acrocarpous bryo./Liverworts						
	Horsetails/Algae						
Cover %	Rocks						
	Bare soil/Salt crust						
	Water						
	Total dead						
(cm)	Vegetation canopy height						
	Moss/Organic/A horizon						
	Microrelief						
	Mean thaw depth						
Site information	Landform						
	Surficial geol./parent material						
	Surficial geomorphology						
	Microsite						
	Site moisture						
	Soil moisture						
	Glacial geology						
	Topographic position						
	Estimated snow duration						
	Disturbance degree						
	Disturbance type						
	Stability						
	Exposure						
	Soil grab sample taken						
Photo	Plot (from south side)						
	Soil						

species cover data on back side

Site Description Codes

SITE DESCRIPTION CODES

Landforms

1 Hills (including kames and morair
2 Talus slope
3 Colluvial basin
4 Glaciofluvial and other fluvial terr
5 Marine terrace
6 Floodplains
7 Drained lakes and flat lake margin
8 Abandoned point bars and slough
9 Estuary
10 Lake or pond
11 Stream
12 Sea bluff
13 Lake bluff
14 Stream bluff
15 Sand dunes
16 Beach
17 Disturbed
18 Alluvial plain/abandoned
19 Island
20 Plain - residual surface
21 ________

Surficial Geology (Parent Material)

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

Surficial Geomorphology

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

Microsites

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

Site Moisture (modified from Komárková 1983)

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

Soil Moisture (from Komárková 1983)

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

Glacial Geology

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

Topographic Position

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

Soil Units

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

Estimated Snow Duration

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

Animal and Human Disturbance (degree)

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

Animal and Human Disturbance (type)

1 Ptarmigan scat
2 Caribou tracks
3 Caribout scat
4 Goose tracks & scat
5 Squirrel mounds
6 Vole tracks & scat
7 Vehicle tracks

Stability

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

Exposure Scale

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

Species cover/abundance:

Vascular plant species						

Non-vascular plant species						

r = rare; **+** = common, but < 1%; **1** = 1-5%; = 6-25%; **3** = 26-50%; **4** = 51-75%; **5** = 76-100%

APPENDIX D: BIOMASS SAMPLING PROCEDURES FOR TUNDRA VEGETATION

Skip Walker, Martha Raynolds, Elina Kaarlejärvi

August 2007

PURPOSE

The goal of biomass sampling of vegetation is to quantify the amount of plant material in a given vegetation type, thus we sample all phytomass from a specified amount of surface area, so the values can be extrapolated over larger areas.

Phytomass is sorted into categories that were relevant to the research questions. Phytomass included above-ground live phytomass, above-ground dead phytomass. Below-ground phytomass was not determined. Phytomass was sorted by plant functional type (trees, deciduous shrub, evergreen shrub, graminoid, forb, horsetail, lichen, moss) . Finally, plant functional types were sorted into plant parts, such as live leaves, dead leaves, stems, and reproductive parts.

Most of the difficulties in obtaining good phytomass data come from inconsistencies in the clip harvest methods and the sorting methods. This document is intended to make these methods as consistent as possible. Please read through the whole document, so as to understand and be able to minimize problems associated with getting consistent biomass data. The methods are based primarily with some modification on the methods used to collect biomass along the North American Arctic Transect (Walker et al. 2007 submitted; Epstein et al. 2007 submitted).

COLLECTING ABOVEGROUND BIOMASS

Equipment needed: Metal frame(s), pegs, serrated knife, clippers, scissors, gallon zip-lock plastic bags, indelible "Sharpie" markers, "write-in-the-rain" paper or Post-its

1. **Establish sample strategy.** At each location biomass sample sites should be chosen randomly within areas of homogeneous vegetation. For the 2007 Yamal Expedition, the biomass harvest locations are shown in Figures 16 to 22 in the main body of this data report.
2. **Discuss clipping strategy.** Before beginning the harvest, the group of samplers should sample one plot as a team and define just how this particular vegetation type will be treated. One topic that should be discussed is the definition of the distinction between the aboveground and belowground portions of the plant canopy. This transition will be at the bottom of the dead moss layer, and at the top of the soil. Usually, the dead moss will extend down to a dark compressed layer of moss that is no longer loose. For our purposes, the light colored loose moss is part of the aboveground material, and the dark compressed layer is the top of the soil layer. See discussion of live vs. dead mosses on page 7 below. Our harvest will be a slice of tundra that extends 2 cm down into the dark belowground portion. Take notes regarding the sampling strategy.
3. **The clip harvest frame.** Tundra biomass is collected using a 20 x 50-cm frame (0.1 m^2). 25 of these 0.1 m^2 frames provide an adequate sample of a tundra vegetation type (Walker et al. 2003). If the shrubs are over 50 cm tall, it becomes difficult to determine if

the shrubs are within the frame or not. In that case, a 1 x 1 m frame on 1.5 m legs is used to sample the shrubs, and the 20 x 50 cm frame is used to sample the understory.

4. **Anchor the frame** to the tundra, using metal pegs or pins in the corners.
5. **Trim the margins of the frame.** Cut all plants than hang over the frame. Anything above the inside of the frame is included in the sample, everything above the outside is excluded. Be sure the pieces you cut end up on the right side. Throwing the excluded pieces far away from the frame helps prevent future confusion.
6. **Remove slices of tundra.** Use a serrated knife to cut down along the inside edge of the frame. You will want to cut deep enough that you are below the dead moss layer and into the belowground layer. Cut the sample in half, creating two 20 x 25-cm pieces of tundra. If the sample is very thick, it may need to be divided into thirds. Cut horizontally across the bottom of each piece with the knife, below the dead moss layer, 1-2 cm into the belowground layer. Remove each slice of tundra so that the entire plant mat and top layer of soil comes out in 2-3 slices of turf about 5-10 cm thick.
7. **Bag each sample.** Put each slice of tundra into a gallon zip-lock bag. Label the bag with the date, location, plot number, and which bag this is out of the total for this plot, and your initials (e.g. "5 Aug 2007, Nadym, Plot 2, 1 of 2, SW"). Also place a paper label inside the bag with the same information in case the label on the outside of the bag rubs off. Large garbage bags will be needed for 1 m^2 shrub samples.
8. **Put the samples into cardboard boxes.** Keep the samples from each location in separate boxes. Each box should hold about 8-10 sample bags (4-5 plots). Label each box with "Aboveground Biomass" Date, Location, which box this is out of the total for that location, and the plot numbers included in the box. (e.g. "Aboveground biomass, 5 Aug 2007, Nadym, 1 of 5 boxes, Plots 1-5"). The samples should be kept cool in the field, and frozen as soon as possible. They should remain frozen until they are sorted.

SAMPLING ISSUES FOR PARTICULAR TYPES OF SITES

Barren areas, **such as frost boil centers -** Bare soil should be sampled, even if it has nothing growing on it. That way there is a record that it was sampled, and any tiny crumbs of vegetation can be sorted and dried in the lab.

Crustose lichen areas – These should be sampled, though sorting is difficult

Very wet areas - It is difficult to extract a good sample from very wet areas. You need to disturb the site as little as possible and keep the knife vertical in order to get a deep, straight cut along the sides. Extracting the sample without collapsing the sides or washing away much of the sample takes a lot of care.

Tussocks – Tussocks should be included in the sample, cutting below them into the belowground (usually mineral) layer.

SORTING ABOVEGROUND BIOMASS

Equipment needed: scissors, tweezers, aluminum pans, bags, scale, drying oven, markers.

1. **Log the samples through each step of the sorting process.** Use the attached log (Table 1) to keep track of the samples from each location by filling in the appropriate box for each step with your name and date each step is completed.
2. **Remove the sample from the freezer and allow it to thaw in the bag.**

3. **Define above vs. belowground biomass in your sample.** Dead unattached organic matter is considered aboveground litter if the plant parts are loose, easily separated,

distinct and identifiable. Litter that has decomposed beyond this point is considered belowground biomass. Consult any field notes regarding the distinction between above and below ground biomass at this particular location. Remove the belowground biomass from your sample. It should be dried, labeled as "soil and roots" and saved along with the rest of the sample, but there is no need to weigh it.

4. **Sorting categories**. The sample will be sorted into the following categories:
    - **evergreen shru**b
        - stem
        - live foliar
        - attached dead foliar
        - reproductive
    - **deciduous shrub**
        - stem
        - live foliar
        - attached dead foliar
        - reproductive
    - **graminoid**
        - live
        - attached dead
    - **forb**
    - **equisetum**
    - **bryophyte** (mosses & liverworts):
        - live
        - dead
    - **lichen**
        - live
        - dead
    - **algae**
    - **litter** (all unattached dead plant parts)
    - **soil and roots** (belowground)
5. **Put labels in the sorting tins with the plot number and the above plant categories.**
6. **Clip with scissors and sort the vascular plants into their specific categories.** Cut off vascular plants above the roots or base of green stems in herbaceous species. This is generally the same location as the above/belowground definition as above, but some plants may have roots in the dead moss layer. Include all attached dead. See below for issues associated with particular species.
7. **Sort the lichens, equisetum and algae into their categories.** These are usually loose and can be immediately separated. Keep your sample moist or the plants will crumble. If it has dried out, you can always wet it again. If you have a relatively intact moss mat, you may be able to separate litter from moss by turning it upside-down and brushing it gently.
8. **Separate the live moss from the dead moss and sort into subcategories if needed.** Be aware that many mosses are brown, so the live/dead distinction cannot be done solely on color (see details below)!
9. **Sort the crumbs.** At this stage, you will be left with a mix of plant pieces and litter. Remove the recognizable pieces of moss and lichen to their proper containers. There may be some live vascular leaves that were missed in the first sorting that should go in their respective containers. All the rest - the dead leaves and the crumbs - go into the litter category. If there is noticeable soil in your sample, you may need to sieve it or wash it to remove the soil.

10. **Clayey samples.** Samples from clayey soils, or prostrate shrub samples, may need to be washed after sorting to remove soil.
11. **Dry the sorted samples.** Once you have completely sorted a sample, put the containers into the drying oven until they are dry (1 day for small samples, 2 days for larger, wetter samples).
12. **Weigh the samples**. Once the samples are dry, weigh them and record the weights (Table 2).
13. **Store the samples**. Put the weighed material in bags labeled with the location, plot number, growth-form category, and the weight. Store all the individual sorted samples from a plot into the original large plastic sample bag for that plot. Place all the sorted aboveground biomass samples for each location in a single box for storage. Label the box "Aboveground biomass, Yamal expedition 2007, Nadym." If more than one box is needed, label each box with the number of the box and the total number of the boxes (for example "Box 1 of 3").
14. **Time estimate:** For a well-trained sorter, the average is 4-5 hours/sample though some samples can take twice that time.

Sorting considerations for each growth form:

Evergreen Shrubs: Separating *Dryas* leaves into live, dead, and litter is difficult. You will probably end up with some live leaves in the dead pile and vice-versa. Try to minimize this, but the differences will probably balance out. Many of the dead leaves fall off when the plants are handled. These should go into dead leaves, not litter, as they were on the plants when sampled. The *Dryas* leaves that are part of the litter are often hidden in the moss and lichen layer. Turning samples upside-down and brushing them can remove a lot of this litter. *Dryas* leaf stipules (leaf stems) go along with their leaves. Dead *Dryas* plants that have no live leaves go into litter.

Vaccinium vitis-idaea leaves lose their color when they freeze, so even the live leaves will look brownish; the leaves that are lighter brown and brittle go in the dead pile

Cassiope tetragona has leaves that are very hard to get off the stem when wet. Separate this species, dry the plants, and then take off the dead and live leaves.

Ledum - be sure to put the flower buds into the reproductive category.

Deciduous Shrubs: Deciduous leaves often lose their green color from being frozen and thawed. Most attached leaves on deciduous shrubs are live. There may be a few dead ones, especially on *Salix pulchra* or *Salix phlebophylla.*

Rubus chamaemorus is very low growing, but it is a deciduous shrub.

Graminoids: Any blade that has any green on it goes in the live pile. Make sure you dissect the ramets that look completely dead, because there are often live blades hidden in the center. Any blade that has no green on it goes in the dead pile. Graminoid reproductive parts go in with the "live graminoid"; there is no special reproductive category.

Differentiating between dead graminoid (still attached to the plant), and litter (unattached, but not decomposed) from very wet areas is difficult because leaves get separated from the plants as you scoop them up from the water.

Eriophorum vaginatum tussocks are formed from an assemblage of shoots growing off to all sides. The aboveground portion is the shoot, with its live and attached dead leaves. The belowground portion is composed of roots below the base of the shoot. In some tussocks, old shoots may have decomposed to the point where they are no longer recognizable and distinct, in which case they are part of the underground peat category.

Forbs: All forb stems, leaves, flowers, etc. go into the "forb" pile.

Saxifraga oppositifolia – this forb often has large quantities of dead stem below the live. This issue is rare enough that the dead stem is just included in the single "forb" category. If there is no live part to the stem, it goes into the "litter" pile.

Lichens: Foliose lichens that are growing on mineral soil need to carefully cleaned of soil, either by brushing them off or washing them, otherwise the soil will outweigh the lichen.

It is not possible to separate crustose lichens from rhizinae (the little root-like hairs under the lichen), mycelium and mineral soil. Separate any plants that you can. All the rest of the crustose lichen should go in the belowground pile, as the non-lichen parts of the crumbs far outweigh the actual lichen. Compared to well vegetated areas, their weight is minimal.

Bryophytes: The most important sorting decision for mosses and liverworts is the distinction between live mosses, dead mosses and peat (belowground biomass). Live mosses are greenish, pliable when moist, the leaves are translucent and distinct. There are many brown mosses, but even these have leaves that look greenish under magnification. Dead mosses are darker, the stems more brittle, and the leaves no longer distinct and entire. For example, the live portions of the common feather-moss, *Hylocomium splendens*, can range from bright lime green to golden brown. Its branches often grow horizontally in the moss layer, with a live upper portion growing from a dead lower portion. The peat portion of mosses consists of densely packed dead stem bases. For unbranching (acrocarpous) mosses that form tight cushions, this may be everything below the green, live moss (i.e. there may be only live moss and peat, with no dead moss portion). For *Sphagnum*, there is a greenish live portion on top, then a loose dead portion, and often a packed peat portion at the base. Thin moss layers on soil sometimes cannot be separated from the soil, and have to be left with the belowground portion of the sample. When they can be separated, thin moss layers may need to be sifted or washed to remove clinging mineral soil.

References

Epstein, H. E., et al. 2007 submitted. Phytomass patterns across the full temperature gradient of the arctic tundra, *Journal of Geophysical Research - Biogeosciences.*

Walker, D.A., H.E. Epstein, J.G. Jia, A. Balsar, C. Copass, E.J. Edwards, W.A. Gould, J. Holllingsworth, J. Knudson, H. Meier, A. Moody, and M.K. Raynolds. 2003. Phytomass, LAI, and NDVI in northern Alaska: relationships to summer warmth, soil pH, plant functional types and extrapolation to the circumpolar Arctic. *Journal of Geophysical Research*, 108 (D2):8169, doi:10.1029/2001JD000986.

Walker, D. A., H. E. Epstein, W. A. Gould, C. L. Ping, V. E. Romanovsky, Y. Shur, C. T. Tarnocai, R. P. Daanen, G. Gonzalez, A. N. Kade, A. M. Kelley, W. B. Drantz, P. Kuss, N. V. Matveyeva, G. J. Miochaelson, C. A. Munger, D. J. Nickolsky, R. A. Peterson, M. K. Raynolds, and C. M. Vonlanthen. 2007 submitted. Biocomplexity of small patterned-ground features along the North American Arctic Transect. *Journal of Geophysical Research – Biogeosciences*.

Table 1. Data sheet for recording aboveground biomass sample sorting procedures.

Yamal Expedition 2007

ABOVE GROUND BIOMASS SORTING

write date and your initials when each step is done

Location & number	Thawed	Sorted	Into drier	Out of drier, weighed, recorded	Boxed

Table 2 (page 1 of 2). Data sheet for recording aboveground biomass weights.

Yamal Expedition 2007 **ABOVEGROUND BIOMASS weights**

20x50cm = 0.1 m2			Deciduous					Evergreen				Graminoid			
Location & number		Stem	Live leaves	Dead leaves	Flowers/ berries		Stem	Live leaves	Dead leaves	Flowers/ berries		Live	Dead		Forb

Table 2 (page 2 of 2). Data sheet for recording aboveground biomass weights.

Equisetum	Lichen	Bryo-phyte	Algae		Total above-ground biomass (excluding dead moss & litter)		dead moss	litter	Total above-ground biomass (INCLUDING dead moss & litter)	Notes

APPENDIX E: POINT-CENTERED QUARTER METHOD: CALCULATION OF FREQUENCY, DENSITY, AND BASAL AREA IN FORESTS

Materials:

100-m tape	Meter stick	Pencil
Biltmore stick or diameter tape	Data sheets (this handout)	Hand calculator

Methods: Stretch the 100-m tape the length of a transect. Sample points at 10-m intervals along the tape (10 points total). At each sample point, lay a meter stick perpendicular to the transect and make an imaginary "X" that defines four quadrants. Record the following for the nearest tree to the sample point in each quadrant: (1) tree species, (2) distance from the sample point to the tree, and (3) diameter at breast height of the tree. Sample a total of 10 points (40 trees). Count dead trees greater than breast height. Note next to species code if the tree is dead.

Table 1. Field Data Sheets:

1. Transect No. ____________________

(1) Sample Point	(2) Quadrant No.	(3) Species code	(4) Distance (m)	(5) dbh (cm)	(6) Basal area (cm^2)	(7) Height (m)
1	1					
	2					
	3					
	4					
2	1					
	2					
	3					
	4					
3	1					
	2					
	3					
	4					
4	1					
	2					
	3					
	4					
5	1					
	2					
	3					
	4					
6	1					
	2					
	3					
	4					
7	1					
	2					
	3					
	4					
8	1					
	2					
	3					
	4					
9	1					
	2					
	3					
	4					
10	1					
	2					
	3					
	4					

m=10	n=40		d_t=			

Table 2. Summary data sheet, Transect No. ______________

A. Species code	B. Absolute frequency (Fa_j)	C. Relative Frequency (Fr_j)	D. Absolute Density (Da_j)	E. Relative density (Dr_j)	F. Absolute Dominance (Ba_j)	G. Relative Dominance (Br_j)	H. Importance Value (IV_j)

Fill in the above table using the calculations described below.

Calculate the absolute density of all trees (Da):

Step 1. Calculate the **total distance, d_t**:

$$d_t = \sum_{i=1}^{n} d_i = \_\_\_\_\_\_\_\_ \text{ meters}$$

where d_t is the total distance, d_i is the distance to tree number i, and n is the total number of trees.

Step 2. Calculate the **average distance between trees, $\bar{d}$**:

$$\bar{d} = d_t \div n = \_\_\_\_\_ \text{ meters}$$

Step 3. Calculate the **average area occupied per tree, A**:

$$A = \bar{d}^2 = \_\_\_\_\_ \text{ meters}^2$$

Step 4. Calculate the **absolute density for all trees, Da**, in trees per hectare (ha):

$$Da = (10^4 \text{ m}^2) \div A = \_\_\_\_\_ \text{ trees/ha}$$

Note: One hectar is 100 x 100 meters, or 10^4 meters^2.

Step 5. Fill in Table 2 (note that capital letters match column headings and in certain cases are not in order they are calculated!):

A. Species code. Record the names of all species encountered. Use a six letter code for each species (first three letters of the genus name and first three letters of the species name). Then calculate each of the following values for *each species.*

B. Absolute frequency of species j, Fa_j:

$$Fa_j = M_j \div m$$

where M_j is the number of points where species j occurs, and m is the total number of points (10 for each transect).

C. **Relative frequency of species j, Fr_j,** is the absolute frequency of species j divided by the sum of the absolute frequencies for all species:

$$Fr_j = Fa_j \div \sum_{k=1}^{p} Fa_k \cdot 100\%$$

where the denominator is the sum of the absolute frequencies (i.e., the sum of column B in Table 3) for all species, k is the species number, and p is the total number of species.

E. **Relative density of species j, Dr_j,** is the number of occurrences of species j divided by the total number of trees:

$$Dr_j = N_j \div n \cdot 100\%$$

where N_j is the number of occurrences of species j and n is the total number of trees.

D. **Absolute density of species j, Da_j,** is the relative density of species j times the absolute density of all trees:

$$Da_j = Dr_j \cdot Da$$

where Da is the absolute density for all trees (calculated in Step 4).

F. **Absolute dominance for species j, Ba_j**, is the mean basal area for species j times the absolute density of species j:

$$Ba_j = \bar{Ba}_j \cdot Da_j$$

where k is an individual of species j, and t is the number of occurrences of species j.

G. **Relative dominance of species j, Br_j,** is the absolute dominance of species j divided by the sum of dominance for all species:

$$Br_j = \frac{Ba_j}{\sum_{i=1}^{p} Ba_i} \cdot 100\%$$

where the denominator is the sum of the absolute dominance (i.e., the sum of column F in Table 3) for all species, and p is the total number of species.

H. **Importance value for species j, IV_j,** is the sum of the relative frequency, relative density, and relative dominance for the species:

$$IV_j = Fr_j + Dr_j + Br_j$$

Appendix F: Lists of vascular plants, lichens, and bryophytes recorded in the Yamal-region study plots

Vascular plants

Nomenclature followed Elven et al. 2007: Checklist of the Panarctic Flora (PAF). Vascular plants. -Draft. University of Oslo.

Alopecurus alpinus
Andromeda polifolia
Arctagrostis latifolia
Arctous alpina
Betula nana
Betula pubescens
Bistorta vivipara
Calamagrostis neglecta agg.
Carex bigelowii subsp. arctisibirica
Carex chordorhiza
Carex globularis
Carex limosa
Carex rotundata
Chamaedaphne calyculata
Diapensia lapponica
Diphasiastrum aplinum
Drosera rotundifolia
Dryas octopetala subsp. subincisa
Empetrum nigrum
Empetrum subholarcticum
Eriophorum angustifolium
Eriophorum russeolum
Eriophorum vaginatum
Festuca cf. *ovina*
Festuca sp.
Hierochloe alpina
Huperzia selago
Juniperus communis
Larix sibirica
Ledum palustre
Ledum palustre subsp. decumbens
Luzula cf. *confusa*
Luzula cf. *wahlenbergii*
Luzula sp.
cf. *Minuartia arctica*
Oxycoccus microcarpus
Pedicularis hirsuta
Pedicularis labradorica
Pedicularis cf. *lapponica*
Petasites frigidus
Pinus sibirica
Pinus sylvestris
Poa arctica
Rubus chamaemorus
Salix glauca
Salix hastata
Salix lanata
Salix myrtilloides
Salix nummularia
Salix polaris
Salix phylicifolia
cf. *Senecio*
Stellaria sp.
Vaccinium myrtillus
Vaccinium uliginosum
Vaccinium uliginosum subsp. microphyllum
Vaccinium vitis-ideae
Valeriana capitata

Lichens

Nomenclature followed H. Kristinsson & M. Zhurbenko 2006: Panarctic lichen checklist (http://archive.arcticportal.org/276/01/Panarctic_lichen_checklist.pdf)

Alectoria nigricans

Alectoria ochroleuca

Arctocetraria andrejewii

Asahinea chrysantha

Baeomyces rufus

Bryocaulon divergens

Bryoria nitidula

Cetraria delisei

Cetraria islandica

Cetraria laevigata

Cetraria nigricans

Cetrariella fastigiata

Cladonia arbuscula ssp. *arbuscula*

Cladonia arbuscula ssp. *mitis*

Cladonia amaurocraea

Cladonia bellidiflora

Cladonia cenotea

Cladonia chlorophaea

Cladonia chlorophaea s. l.

Cladonia coccifera

Cladonia cornuta ssp. *cornuta*

Cladonia cornuta ssp. *groenlandica*

Cladonia crispata

Cladonia cyanipes

Cladonia cf. *decortiata*

Cladonia deformis

Cladonia furcata

Cladonia gracilis

Cladonia grayi

Cladonia macrophylla

Cladonia pleurota

Cladonia pyxidata

Cladonia rangiferina

Cladonia cf. *scabriuscula*

Cladonia sqamosa

Cladonia stellaris

Cladonia stricta

Cladonia stygia

Cladonia subfurcata

Cladonia sulphurina

Cladonia uncialis

Cladonia sp.

Dactylina arctica

Flavocetraria cucullata

Flavocetraria nivalis

Hypogymnia physodes

Icmadophila ericetorum

Lichenomphalia hudsoniana

Mycoblastus sp.

Nephroma arcticum, found outside of relevés in Nadym Forest site

Ochrolechia androgyna

Ochrolechia frigida

Ochrolechia inequatula

Peltigera canina

Peltigera cf. *frippii*

Peltigera malacea

Peltigera polydactylon-group

Peltigera leucophlebia

Peltigera cf. *neckeri*

Peltigera scabrosa

Peltigera sp.
Pertusaria dactylina
Pertusaria geminipara
Pertusaria panyrga
Protopannaria pezizoides
Protothelenella leucothelia
Psoroma hypnorum
Rhexophiale rhexoblephara
Sphaerophorus globosus
Stereocaulon alpinum
Stereocaulon paschale
Thamnolia vermicularis var. *subuliformis*
Thamnolia vermicularis var. *vermicularis*
Varicellaria rhodocarpa

Bryophytes

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 and for liverworts N.A. Konstantinova & A.D. Potemkin 1996: Liverworts of Russian Arctic: an annotated check-list and bibliography. *Arctoa* 6: 125-150.

Aulacomnium palustre
Aulacomnium turgidum
Blepharostoma trichophyllum
Calypogeia sphagnicola
Cephaloziella sp.
Ceratodon purpureus
Conostomum tetragonum
Cynodontium strumiferum
Dicranum acutifolium
Dicranum elongatum
Dicranum flexicaule
Dicranum fuscescens
Dicranum groenlandicum
Dicranum laevidens
Dicranum majus
Dicranum spadiceum
Ditrichum flexicaule
Gymnocolea inflata
Gymnomitrion corallioides
Hylocomnium splendens
Kiaeria cf. *blyttii*
Lophozia ventricosa s.l.
Mylia anomala
Oncophorus wahlenbergii
Orthocaulis binsteadii
Orthocaulis kunzeanus
Plagiomnium ellipticum
Pleurozium schreberi
Pogonatum dentatum
Pogonatum urnigerum
Pohlia cruoides
Pohlia nutans
Polytrichastrum alpinum
Polytrichastrum longisetum
Polytrichum commune
Polytrichum hyperboreum
Polytrichum jensenii
Polytrichum piliferum
Polytrichum strictum
Ptilidium ciliare
Ptilidium crista-cristensis
Racomitrium lanuginosum
Sanionia uncinata
Sphagnum balticum

Sphagnum capillifolium, found outside of relevés in Nadym CALM site

Sphagnum compactum

Sphagnum fuscum

Sphagnum girgensohnii

Sphagnum lenense

Sphagnum lindbergii

Sphagnum majus

Sphagnum rubellum

Sphagnum squarrosum

Sphagnum teres

Sphagnum warnstorfii

Sphenolobus minutus

Splacnum sphaericum

Stereodon holmenii

Stereodon subimponens

Straminergon stramineum

Tetralophozia setiformis

Tomentypnum nitens

Tritomaria quinquedentata

APPENDIX G: PLOT PHOTOS

Key:

ND Nadym

LA Laboravaya

VD Vaskiny Dachi

RV Relevé

Soils – Nadym 1

ND RV 01

ND RV 03

ND RV 05

ND RV 02

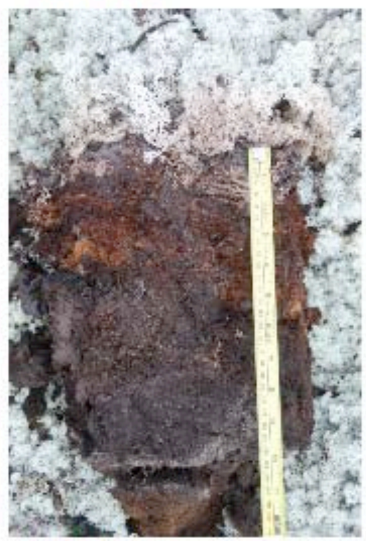
ND RV 04

Soils - Nadym 2

ND RV 06

ND RV 07

ND RV 08



ND RV 09

ND RV 10

ND RV 11 - no photo available
ND RV 12 - no photo available
ND RV 13 - no photo available
ND RV 14 - no photo available

Soils - Laborovaya 1

LA RV 15

LA RV 17

LA RV 19

LA RV 16

LA RV 18

Soils - Laborovaya 2

LA RV 20

LA RV 22

LA RV 24

LA RV 21

LA RV 23

Soils - Vaskiny Dachi 1


VD RV 25


VD RV 27


VD RV 29


VD RV 26


VD RV 28

Soils - Vaskiny Dachi 2

VD RV 30

VD RV 32

VD RV 34

VD RV 31

VD RV 33

Soils - Vaskiny Dachi 3

VD RV 35

VD RV 37

VD RV 39

VD RV 36

VD RV 38

Vegetation – Nadym 1

ND RV 01

ND RV 02

ND RV 03

ND RV 04

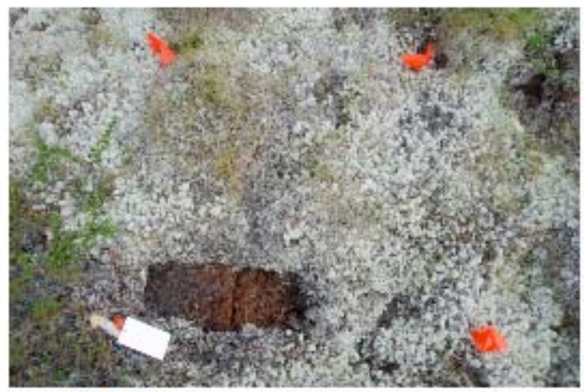
ND RV 05

Vegetation - Nadym 2

ND RV 06

ND RV 09

ND RV 07



ND RV 10

ND RV 08

ND RV 11


ND RV 12


ND RV 14


ND RV 13

Vegetation – Laborovaya 1

LA RV 15

LA RV 18

LA RV 16

LA RV 19

LA RV 17

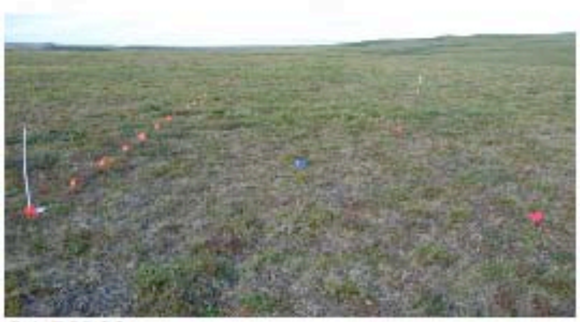
Vegetation – Laborovaya 2


LA RV 20

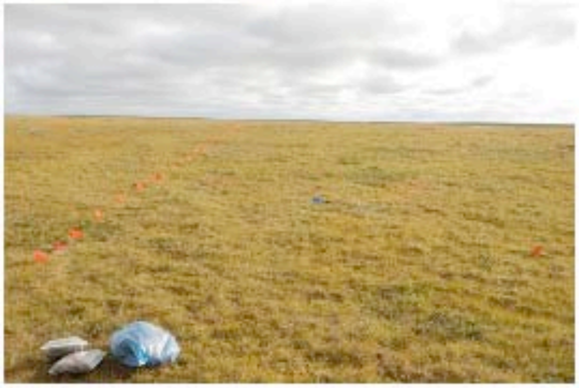

LA RV 23


LA RV 21

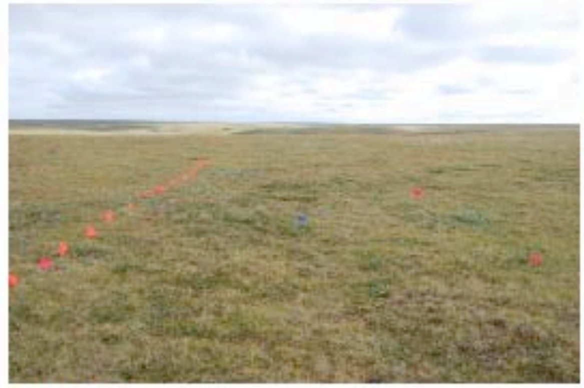

LA RV 24


LA RV 22

Vegetation – Vaskiny Dachi 1



VD RV 25



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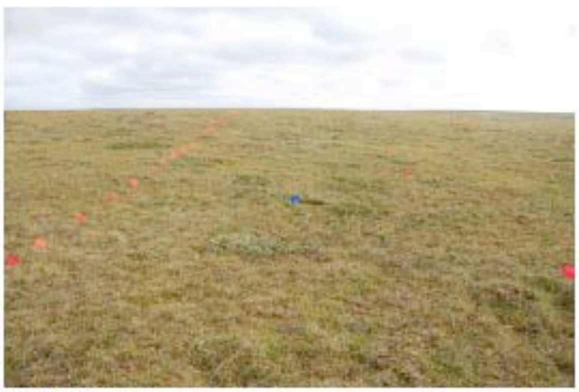

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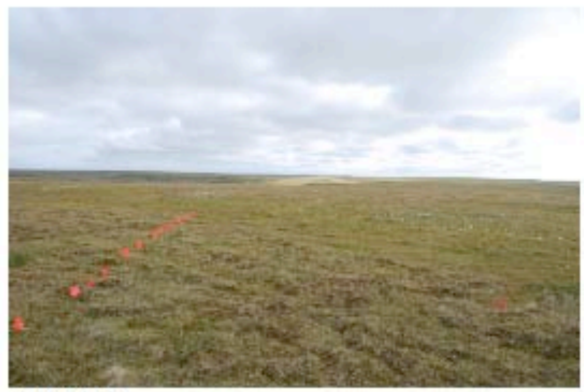

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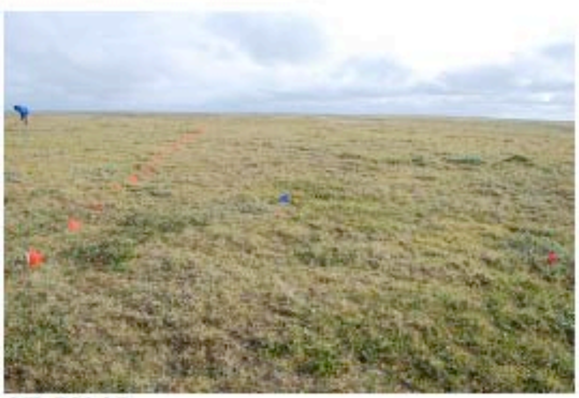
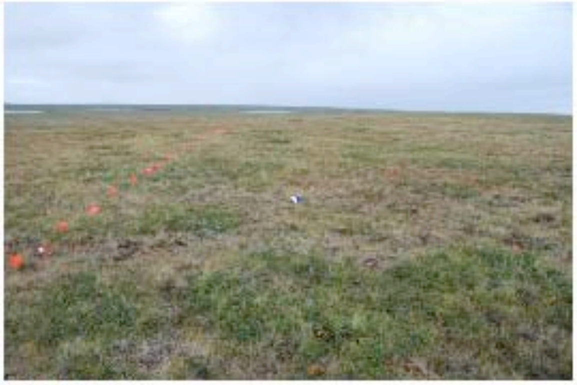


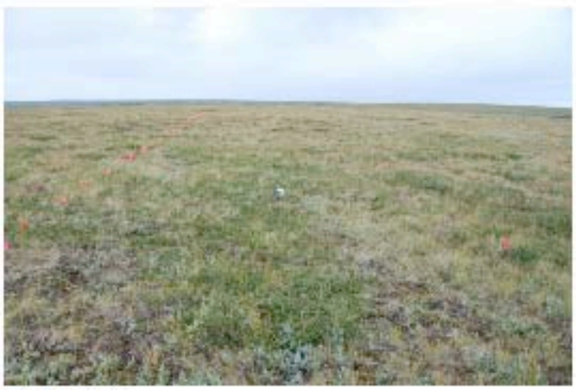
VD RV 27

Vegetation - Vaskiny Dachi 2



VD RV 30

VD RV 33



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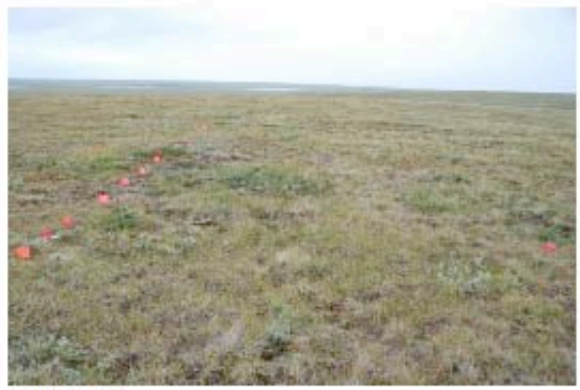

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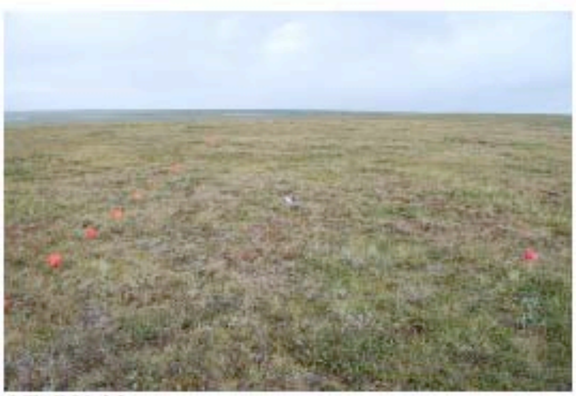
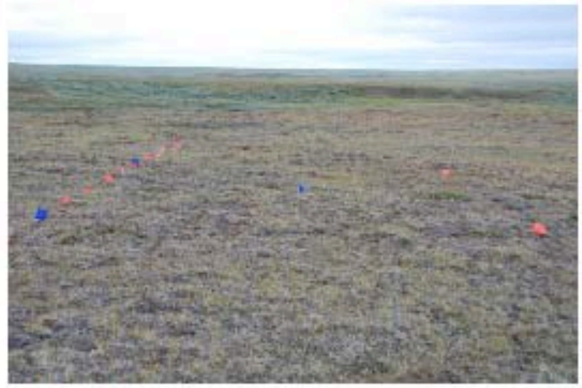


VD RV 32

Vegetation - Vaskiny Dachi 3

VD RV 35



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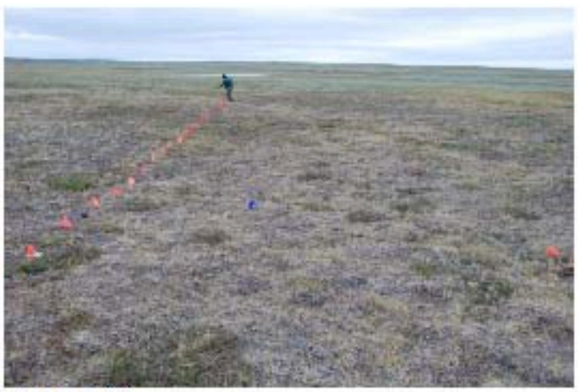

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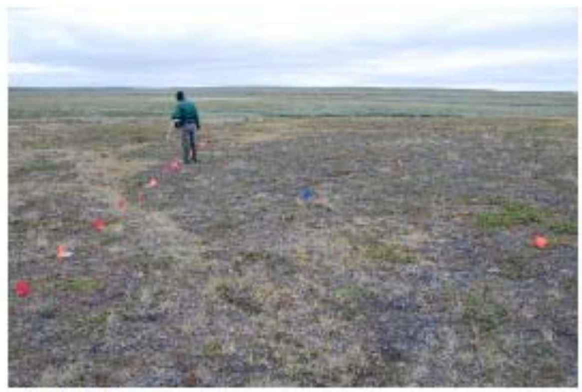

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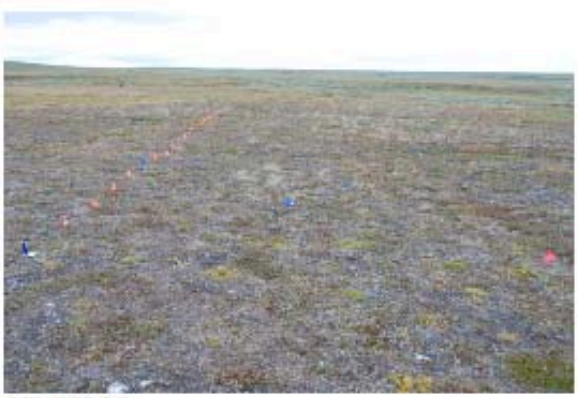

VD RV 37